

History of New Mexico Bureau of Mines and Mineral Resources
as recorded in legislation, annual reports, and notes
1927-1977

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New Mexico Bureau of Mines and Mineral Resources

Socorro, New Mexico

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Introduction

This open-file report is an outgrowth of my articles, published in the Bureau's Annual Report 1976-1977, on the New Mexico statutes relating to the New Mexico Bureau of Mines and Mineral Resources and on the history of the Bureau. I have not attempted to provide a comprehensive view of Bureau history; available records are incomplete, and such an undertaking would require far more time than was available to me.

Problems encountered in compilation included a basic lack of material. In 1931 President Wells prepared a report of Bureau activities for the first three years: 1927-28, 1928-29, and 1929-30; no additional annual reports were issued for the next 16 years. Other difficulties in collecting material were experienced because of inconsistent indexing and style of the New Mexico statutes.

Annual Reports

All Bureau annual reports are represented in this report. Some years are represented by a great deal of material and others by only a short selection. Selections were chosen that provide both representative and one-time information; repetitive and routine material was generally not cited for each year. Neither did I include complete lists of all personnel, projects, and publications. Much material had to be omitted because the manuscript is already lengthy. I tried to convey tone and substance of the Bureau annual reports without including all details.

Capitalization and punctuation are the same as used in the original reports, with a few exceptions for clarity. Ellipses have

been used liberally to denote omitted material. The complete series of annual reports is held in the New Mexico Bureau of Mines and Mineral Resources archives.

Appropriations

The selection of New Mexico legislative appropriations is essentially copied from the New Mexico statutes. As with the Bureau annual reports, some minor modifications have been made for the sake of clarity, but the original has been retained wherever possible. Inconsistencies in style reflect changing style in the New Mexico statutes. Specific appropriations are not available in the statutes for all years; in fact, no specific appropriations are listed for the Bureau's first year, 1927-28.

Acknowledgments

While preparing the legislative material, the librarians of the following institutions were consulted: New Mexico Supreme Court (Santa Fe), University of New Mexico (Albuquerque), New Mexico Institute of Mining and Technology (Socorro), and New Mexico Legislative Council Service (Santa Fe).

Conversations with Robert L. Bates, Robert Bieberman, Marian Burks, and Roy W. Foster were very helpful in preparing notes on Bureau history.

Two big jobs were the typing and proofreading of the manuscript. I wish to thank the following people for their assistance with these tasks: New Mexico Institute of Mining and Technology student assistant Jay S. May, former student assistants Mark C. Blazek and Colleen Bryant, and former editorial clerk Karen Patterson.

The material covered in this report bridges the time period from 1927 to 1977 in the history of the New Mexico Bureau of Mines and Mineral Resources. While no updates have been specifically planned at this time, additional information may be provided through the Bureau's annual report series in the future..

Socorro, New Mexico
June 30, 1979

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and Mineral Resources

Excerpts from Bureau Annual Reports

Circular No. 3

First, Second and Third Annual Reports of the Director
and Preliminary Report for the Fourth Year

by E. H. Wells, President and Director

First Annual Report of the Director
16th fiscal year, July 1, 1927, to June 30, 1928.

Establishment and Objects of the State Bureau of Mines
and Mineral Resources

The New Mexico Bureau of Mines and Mineral Resources was established by the New Mexico legislature of 1927. It was made a department of the New Mexico School of Mines at Socorro, and hence its activities are supervised by the board of regents of that institution.

The Bureau of Mines and Mineral Resources was established for the primary purpose of assisting the development of the mineral resources of New Mexico. The work of the bureau consists mainly of (a) the preparation and publication of reports dealing with New Mexico geology and mineral resources, (b) the collection of a library and the compilation of a bibliography of the literature pertaining to New Mexico geology, mines and minerals, and (c) the compilation and publication of data pertaining to the mineral industry of the state.

Personnel

The staff of the Bureau during the sixteenth fiscal year was as follows:

E. H. Wells, director (part time)

W. D. Johnston, Jr., geologist (part time)

Geo. B. Somers, geologist (part time)

T. P. Wootton, librarian and statistician (part time)

Harriett Herkenhoff, stenographer (part time)

In addition to their Bureau duties, E. H. Wells served as president of the faculty of the School of Mines, W. D. Johnston, Jr. and Geo. B. Somers as assistant professors of geology and mineralogy on the faculty, T. P. Wootton as school librarian, and Harriett Herkenhoff as school stenographer.

Work of the Bureau during the Sixteenth Fiscal Year

The State Bureau of Mines began to function officially on July 1, 1927, the beginning of the sixteenth state fiscal year. In June 1927 the director made reconnaissance examinations of a number of mineral deposits in Taos, Rio Arriba, and Santa Fe counties for the purpose of adopting a program for field investigations during the year.

In December 1927, the director went to Washington, D. C., to attend the annual convention of the American Mining Congress and to confer with officials of the U. S. Geological Survey and the U. S. Bureau of Mines regarding future Bureau work. Partly as a result of these conferences Dr. A. C. Spencer, geologist for the Federal Survey, was assigned to the Santa Rita district to complete the field work for a

report on this district. The director spent about ten days in the field with Dr. Spencer in February and March 1928 in a joint study of some of the geological problems of the Santa Rita district.

As a further result of the director's conferences with the officials of the U. S. Geological Survey in Washington, the State Bureau was given permission to use Dr. G. F. Loughlin's incomplete geologic map and field notes on the Magdalena district, Socorro County, for the preparation of a state report on the geology and ore deposits of the district. Dr. Loughlin spent parts of 1915 and 1916 in this district with the intention of preparing a report to be issued as a professional paper of the Federal Survey. Because of special assignments during the World War and his promotion to the position of geologist in charge, section of metalliferous deposits, of the Geological Survey shortly after, it had been impossible for Dr. Loughlin to complete the report. . . .

The two chief field investigations of the State Bureau of Mines and Mineral Resources during the sixteenth fiscal year consisted of a study of the mica and lithium deposits of New Mexico by Prof. Geo. B. Somers and a study of the fluorspar deposits of the state by Prof. W. D. Johnston, Jr. Prof. Somers spent most of July and August in the field in Taos and Rio Arriba counties and visited all of the known mica and lithium deposits. The preparation of his report occupied a part of his time during the regular 1927-28 school session.

The investigation of the fluorspar deposits of New Mexico by Prof. Johnston occupied the months of July and August, and several additional field trips were made during the school year.....

In the fall of 1927, Mr. T. P. Wootton began the compilation of a bibliography of New Mexico geology. This bibliography was nearly ready to be put in manuscript form by the end of the fiscal year. Mr. Wootton prepared a revision of the New Mexico portions of Bulletin 507 of the U. S. Geological Survey, "The Mining Districts of the Western United States," and Bulletin 624, "Useful Minerals of the United States." The geological library was systematized by Mr. Wootton and many missing bulletins and periodicals were obtained. . . .

Second Annual Report of the Director
17th fiscal year, July 1, 1928, to June 30, 1929

Fire Losses

On July 5, 1928, the old Main Building of the School of Mines was destroyed by fire with the loss of practically all of its contents, including the library, records, and data of the Bureau of Mines which had been accumulated to date. The chief loss to the Bureau was the almost completed manuscript and also the notes, maps, etc. of the report by Prof. Geo. B. Somers on mica and lithium in New Mexico. Following the fire it was necessary to make a new beginning in the accumulation of books, reports, bibliography and statistical information.

During the balance of the fiscal year the work of the Bureau was curtailed by the lack of office space and the extra demands made on the members of the staff by the construction of Brown Hall, the new main building, and installing necessary apparatus and equipment. The Bureau was partially reimbursed for its fire losses from insurance payments on the contents of the old Main Building.

Work of the Bureau during the Seventeenth Fiscal Year

The chief undertaking of the Bureau of Mines and Mineral Resources during the seventeenth fiscal year was a continuation of the study of the geology and ore deposits of the Magdalena district which had been started by Dr. G. F. Loughlin, geologist of the U. S. Geological Survey, in 1915. Both Prof. Koschmann and Prof. Stringfield were assigned to this project, and the months of July and August 1928 were spent in the district by these men. Most of the time was devoted to completing the geological map of the Magdalena special quadrangle prepared by Dr. Loughlin. Frequent short trips were made to the district during the 1928-29 school year. Dr. Loughlin made brief visits to the district in July and October 1928 for the purpose of checking the geological mapping of Professors Koschmann and Stringfield. Some progress was made in the writing of the report on the district during the latter part of the year.

Early in the fiscal year it was decided to enlarge the area to be covered by the report on the Magdalena district. This required the addition of about six square miles to the north and west of the original Magdalena quadrangle. In this area both topographic and geologic mapping

were required. The geologic mapping was assigned to Prof. Koschmann and the topographic mapping was handled by Mr. Black,, working under Prof. Koschmann's direction. In the seventeenth fiscal year this work occupied the latter part of May and the month of June.

Following the fire at the old Main Building, work was resumed on the bibliography of New Mexico geology by Mr. T. P. Wootton. Progress was slow at first, however, due to the limited library facilities of that year. In the spring of 1929 Mr. Wootton spent several weeks in the libraries of the U. S. Geological Survey and of Congress at Washington, D. C., in checking and adding titles on New Mexico geology and in preparing a more complete index in this connection.

In June 1929, the State Bureau of Mines entered into an agreement with the State Tax Commission whereby the Bureau undertook to assemble data and information which would be of service to the State Tax Commission in appraising the mining properties of the state. All appraisals were to be made by the Commission. Professor A. S. Walter, head of the department of mining and metallurgy of the School of Mines faculty, was assigned to this work. He visited a number of mining properties during June 1929. According to the agreement, all salaries and expenses in connection with this undertaking were paid by the State Tax Commission.

Publications

In this fiscal year Bulletin No. 4, entitled "Fluorspar in New Mexico," by W. D. Johnston, Jr. was published. . . .

Third Annual Report of the Director
18th fiscal year, July 1, 1929, to June 30, 1930

Work of the Bureau during the Eighteenth Fiscal Year

The study of the geology and ore deposits of the Magdalena district continued to be the major undertaking of the Bureau of Mines and Mineral Resources. Geologic and topographic mapping by Prof. A. H. Koschmann and Mr. M. W. Black occupied most of July and August 1929, and considerable time was devoted to this work during the 1929-30 school year. Dr. G. F. Loughlin, geologist in charge, section of metalliferous deposits, of the U. S. Geological Survey, visited the district with Professors Koschmann and Stringfield in October for further consideration of some of the geological problems.

Early in the year it was decided to make the study of the Magdalena district a formal cooperative project between the U. S. Geological Survey and the State Bureau of Mines, beginning with the nineteenth fiscal year. Cooperative agreements of this nature provide that the work shall be done by the geologists and other employees of the U. S. Geological Survey, but the expense shall be shared equally by the two organizations. It was decided to issue the Magdalena report as a bulletin of the State Bureau of Mines, the cost of publication to be met by the Bureau.

In view of the cooperative nature of the project, Dr. G. F. Loughlin agreed to write several sections of the report. Mr. Lasky was sent to Washington in December 1929 to work under Dr. Loughlin in the preparation of parts of the report. His time was devoted to the office

and laboratory work and the preparation of a preliminary draft of the manuscript dealing with the economic geology of the district. Mr. Lasky remained on this assignment until the end of the fiscal year.

Cooperative work under the agreement with the State Tax Commission the preceding year was continued. Professor A. S. Walter spent the months of July and August 1929 in inspecting various mining districts and properties and obtaining data regarding them for tax appraisal purposes. During part of this period he was assisted by Professor J. A. Weir of the School of Mines faculty. Prof. Walter's final report was submitted to the Commission in January 1930. All of the expenses of this work were met by the Commission.

During July and August, Professor V. T. Stringfield accompanied Prof. Walter on his inspection trips. He obtained data regarding the geology, ore deposits, etc. of the properties which would be serviceable to the Bureau in its future work and collected typical geological and ore samples from many of the properties. Part of Prof. Stringfield's time during the balance of the fiscal year was devoted to the report on the Magdalena district.

A study of the ore deposits of Socorro County, exclusive of the Magdalena district, was begun by Mr. S. G. Lasky of July 1928 and this study was continued until he left for Washington to assist Dr. Loughlin. Mr. Lasky visited most of the mining districts of the county and made considerable progress on the report for a bulletin on this subject.

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Arrangements were made early in the fiscal year with Mr. C. H. Fowler, special lecturer~~on~~ mining law at the School of Mines and Socorro attorney, to prepare a report on the mining and mineral laws of New Mexico. Part of the manuscript for the bulletin was written during the year.

The manuscript of the bulletin containing a bibliography of New Mexico geology, etc. was completed by Mr. T. P. Wootton just before the end of the fiscal year. Mr. Wootton devoted considerable time during the year in assisting the director in replying to inquiries regarding the geology, ore deposits and mineral industry of the state.

In February 1930 an economic collection of state minerals and ores was prepared and sent to the State Highway Department, Santa Fe, for inclusion in a state exhibit of the department. This collection was augmented from time to time by additional specimens. . . .

Preliminary Report of the Director for the Fourth Year
19th fiscal year, July 1, 1930, to June 30, 1931

Work of the Bureau from July 1, 1930 to December 31, 1930

and Proposed Work for the Balance of the Fiscal Year

Work on the report on the Magdalena district was continued by Professor A. H. Koschmann during the first four months of the fiscal year under a cooperative agreement between the State Bureau of Mines and the U. S. Geological Survey. Dr. Loughlin, geologist in charge, section of metalliferous deposits, of the U. S. Geological Survey made a last visit to the district with Prof. Koschmann in August 1930, at which time the work of the geologists of the State Bureau was finally

approved. The portion of the report remaining to be prepared will be written by Dr. Loughlin. This report undoubtedly will compare very favorably with the best of the professional papers issued by the Geological Survey. It will probably be published by the end of the fiscal year.

Additional tentative plans for cooperative work in New Mexico between the U. S. Geological Survey and the State Bureau of Mines and Mineral Resources were adopted, following a visit to southwestern New Mexico by Dr. Loughlin and the director in August 1930. This cooperative work will consist of a study of the geology and ore deposits of part of the Central district, Grant County, and the Lordsburg district, Hidalgo County. A special topographic map of each of these districts will be made by the Geological Survey in 1931. The geological field work will be performed by Mr. S. G. Lasky and assistants. Mr. Lasky will join the staff of the Federal Survey following the completion of his contract with the Bureau, which will be about April 1, 1931. The field work and preparation of reports on the districts will probably require eighteen months or more. The cost of both the topographic mapping and geological study will be divided equally between the Survey and the Bureau.

In July 1930 the preparation of a bulletin on the metal resources of New Mexico and their economic features was begun by Mr. S. G. Lasky and ^{Mr.} T. P. Wootton. This bulletin will deal only briefly with the geology of the metalliferous ore deposits of the state, and this part of the report will consist largely of summaries of existing

authentic reports. Special attention will be devoted to the economic features of New Mexico metals including history, production, and marketing. Several districts, regarding which little reliable information has appeared in previous reports, were visited by Mr. Lasky, including the Ground Hog mine. A special report on this property was issued as Circular No. 2 of the Bureau. The state report required most of the time of Mr. Lasky and Mr. Wootton during the first half of the fiscal year. . . .

In November 1930, Mr. D. E. Winchester, consulting petroleum geologist of Denver, Colorado, and formerly geologist of the U. S. Geological Survey, was employed by the Bureau to prepare a report on the oil and gas resources and possibilities of New Mexico. This undertaking will require Mr. Winchester to spend several months in field investigations, and the total time required in the preparation of the report will be six to seven months. . . .

Mr. Winchester's time was first given to a study of oil and gas in Lea County, having in mind the issuance of a special report on this subject early in 1931.

The manuscript of Mr. C. H. Fowler's report on mining and mineral laws of New Mexico was completed in October 1930.

The publication program for the current fiscal year includes the issuance from time to time of circulars by the Bureau. These circulars will consist of mimeographed reports too short to justify

printing as bulletins and subjects of timely interest. They will supplement the regular bulletins of the Bureau.

Publications

Publications issued during the first half of the nineteenth fiscal year included Bulletin No. 5, "Geologic Literature of New Mexico" by T. P. Wootton, Bulletin No. 6, "Mining and Mineral Laws of New Mexico" by C. H. Fowler, Circular No. 1, "An Outline of the Mineral Resources of New Mexico" by E. H. Wells, and Circular No. 2, "The Geology and Ore Deposits of the Ground Hog Mine, Central District, Grant County, New Mexico" by S. G. Lasky.

Publications which will probably be issued during the balance of the year include Bulletin No. 7, "The Metal Resources of New Mexico and their Economic Features" by S. G. Lasky and T. P. Wootton, Bulletin No. 8, "The Ore Deposits of Socorro County" by S. G. Lasky, Bulletin No. 9, "The Geology and Ore Deposits of the Magdalena District, Socorro County, New Mexico" by G. F. Loughlin, A. H. Koschmann, S. G. Lasky, and V. T. Stringfield, Circular No. 3, "First, Second and Third Annual Reports of the Director and Preliminary Report for the Fourth Year" by E. H. Wells, and Circular No. 4, "The Oil and Gas Resources and Possibilities of Central and Southern Lea County, New Mexico" by D. E. Winchester. . . .

Annual Report 1945-46

by Eugene C. Anderson, Director

Preface

This is the first detailed annual report of the activities, accomplishments, and disbursements of the New Mexico Bureau of Mines and Mineral Resources since 1931. In that year Dr. E. H. Wells, then President of the School of Mines and Director of the Bureau, prepared a brief report covering the Bureau activities for the years 1928, 1929, and 1930. A limited number of mimeographed copies of this report were released; it has long been out of print and copies are no longer available.

The New Mexico Bureau of Mines and Mineral Resources was established by act of the State Legislature during its 8th regular session, March, 1927. The act establishing the Bureau designated it a "Department of the School of Mines," designed to function under the Board of Regents of the School, the Board to name a Director of the Bureau and to approve the employment of necessary personnel by him. The legislature outlined the duties of the Bureau, cited its responsibilities to the mineral industry, and provided for its

financing by direct legislative appropriations. The monies from which the appropriations are made are derived from the Federal government from collections made under the Federal Minerals Leasing Act.

Until some three years ago the Bureau was staffed on a part-time basis by faculty members of the School of Mines. The President of the School was also the Director of the Bureau. Field work was done during the summer-vacation months, and reports were compiled during the winter. In 1943 permanent full-time personnel was employed for the first time and the then State Geologist, whose office is located in Santa Fe, was made Director. In January 1945 the management of the Bureau was again established at the School of Mines under a part-time Acting Director. In July 1945 the Regents appointed a full-time Director and authorized the employment of personnel necessary for the proper functioning of the Bureau. The Bureau has been organized and expanded to its present staff during the past year.

General Statement

At the beginning of the year, July 1, 1945, the Bureau had four major and two minor projects underway. Included in the major projects were the plans for completing and publishing two reports, as bulletins, that were being prepared jointly by personnel of this

Bureau, the U. S. Geological Survey, and the U. S. Bureau of Mines. These reports were considered of vital importance in furthering the war effort and this Bureau had agreed with the Federal agencies to publish and release them at the earliest possible date. They concern the strategic minerals, mica and fluorspar.

A third report, dealing with the deep prospecting for oil in the southeastern part of the State, was on the editor's desk at the start of the year. The fourth major project was the preparation of a map and report concerning the geology of the Chupadera Mesa-Gran Quivira area. The field work for this report had been done jointly by Bureau personnel and the U. S. Geological Survey during the summer of 1944.

The two minor projects were a general survey and report on the Headstone mining district, Rio Arriba County, and a tabulation of the lands of the State as to control or ownership, i. e., Federal lands, State lands, lands belonging to State institutions, and private lands

In order to be of service to the petroleum industry of the State, an engineer who is familiar with the oil fields of New Mexico was employed and a branch office was established at Artesia. This office is occupied jointly by the Bureau and the State Oil Conservation Commission representatives. The placing of a petroleum engineer

in the oil districts by this Bureau has met with approval by the industry, and the Bureau personnel is receiving hearty cooperation from the operators

Report of the Oil and Gas Division--Introduction

The Oil and Gas Division is concerned with the geology and resources of petroleum, natural gas, and carbon dioxide in New Mexico. Its work is carried on by two geologists, aided by two School of Mines students working part time. Secretarial work is handled by the Bureau's business office.

Subsurface Geology

One of the functions of the Oil and Gas Division is to maintain a collection of cuttings and cores from oil wells and wildcat tests. The cuttings are kept either in glass vials in metal trays or in paper sacks in cardboard boxes. Trays and boxes are labelled, and a card index is kept up to date. The samples (cuttings) and cores are used by geologists of the Bureau and are also available for examination by company or independent geologists. The collection of samples is an extremely valuable source of subsurface geological information.

This collection is kept up to date by the acquisition of cuttings and cores through the New Mexico Sample Cut at Hobbs, which supplies the Bureau monthly with a set of cuttings from every well being drilled in eastern New Mexico. In addition, the Bureau

occasionally receives samples for a well directly from the operator, generally in exchange for technical advice or help. On July 1, 1945, the collection included samples from 315 wells in all parts of the State.

In July 1945 the Bureau acquired from the Cities Service Oil Company a valuable file of cuttings then in storage at Hobbs. The collection includes samples from many wildcat tests, some drilled years ago; a number are believed not to be duplicated in any other file. Cities Service permitted the Bureau to retain the 383 trays and 64 boxes in which the samples were kept. The first of five shipments arrived at Socorro in September 1945 and the last in February 1946. The samples are now indexed, labelled, and filed in wooden cases. Samples from 394 wells are included.

Early in 1946 the office of the U. S. Geological Survey at Roswell offered to transfer to the Bureau an extensive collection of cuttings, and in April and May this material was trucked to Socorro. It was being indexed and filed at the end of the fiscal year. Samples from 533 wells are included

Artesia Office

The Bureau's Artesia office was established April 16, 1946, with N. R. Lamb, field petroleum engineer, in charge. The office was set up in order to assist oil and gas operators of southeastern New Mexico

with petroleum engineering problems. Extended discussions with operators demonstrated that the most important of these problems are corrosion of oil-field equipment and the secondary recovery of crude oil.

The Artesia office is working with the Lea County Engineers' sub-committee on corrosion, in gathering field data for fundamental research on the problem. The timeliness of the work is indicated by the fact that engineering organizations in west Texas have requested permission to participate in this research. The office is working with the engineering committees of the Maljamar and Loco Hills gas-injection projects for secondary recovery; data are also being compiled to determine the possibility of a pilot water-flood project in the Artesia pool.

Through its Artesia office, the Bureau is represented on the following committees: Lea County Operators Committee, Lea County Engineers Committee, Corrosion Committee, New Mexico Gas Committee, New Mexico Nomenclature Committee, and Engineering Committee. . . .

Mining Division--Services

The functions of the Mining Division may be presented by the following outline of services performed.

1. Investigations and reports covering mining districts and areas,

and mineral deposits; reports published as Bulletins and Circulars.

2. Collection and distribution of statistics relating to the mineral industry.

3. Identification and analysis (both qualitative and quantitative) of mineral specimens and samples sent to the Bureau.

4. Preliminary examinations of, and reports on, properties and prospects for small operators.

5. Miscellaneous services, such as the collection of samples of clay, perlite, pumice, and gypsum from deposits of commercial possibilities, field conferences with small operators, and the showing of New Mexico deposits to out-of-state investors.

During the year the Mining Division prepared 36 reports on prospects and small operations located in 10 counties. . . .

Projects

During the year a map of the State was prepared showing the ownership and control of all lands. In addition, a report on the status of School of Mines lands was prepared and submitted to the Board of Regents.

A bulletin on the State's fluor spar deposits was in press at the end of the fiscal year. It is a joint report by this Bureau, the U. S. Geological Survey, and the U. S. Bureau of Mines. A detailed report on the mica deposits of Rio Arriba County, prepared by the U. S.

Geological Survey, was also in press as a bulletin. A reconnaissance survey of the Headstone mining district, Rio Arriba County, was made by the Mining Division and was issued as Circular 11.

The Mining Division prepared and issued a bulletin containing timely information on the fabrication of building blocks from the porous volcanic materials, pumice and scoria. A brief preliminary report appeared as a circular prior to publication of the bulletin.

A report on the contributions of New Mexico's mineral industry to the war effort was activated and was nearing completion at the end of the fiscal year. . . .

Report of the Editor of Publications--Introduction

The Bureau issues two series of publications, bulletins for longer reports and circulars for shorter ones. Reports for one or both of these series are constantly in preparation or in press, and considerable time must be taken to edit manuscripts, read proof, and supervise final printing. During the fiscal year 1945-1946 these duties were carried out by the chief of the Oil and Gas Division, whose time was thus divided between geological and editorial work.

As of July 1, 1945, Bureau publications in print included Bulletins 1-20 and 22, and Circulars 1-9. Two bulletins and three circulars were issued during the fiscal year, and on June 30, 1946, two additional bulletins were in press. . . .

Report of the Business Office--Introduction

The duties of the Business Office consist of answering inquiries; typing general correspondence for both the Oil and Gas and Mining Divisions; filling orders for bulletins, maps, and well logs; typing of reports, manuscripts, and drillers' logs; and keeping oil-well information up to date on file cards and maps. A register of all visitors to the Bureau is kept.

The personnel consists of an office manager and a stenographer, with part-time help when necessary. . . .

Publications for Free Distribution

All circulars published by the Bureau are distributed free of charge. The total number of circulars distributed during the fiscal year was 2,224.

The Bureau maintains a free mailing list, to the names on which a copy of all publications is mailed as soon as published. The list includes State officials and members of the Board of Regents, as well as Chambers of Commerce, college libraries, State geological surveys, public libraries, and U. S. Government agencies. The arrangement with the State geological surveys is reciprocal; they furnish copies of their publications to the School of Mines library in exchange for Bureau publications. There were 290 names on the free mailing list as of June 30. Upon request, publications are

furnished free of charge to additional libraries, public institutions, and government agencies. . . .

Publicity

During the past year the Bureau has attempted to call the natural resources of New Mexico increasingly to the attention of the general public.

At the State Fair at Albuquerque the Bureau maintained an exhibit of ore specimens and minerals, together with explanatory maps showing the location of their occurrence, and a collection of specimens of New Mexico sand fused by the heat of the first atomic bomb explosion.. The exhibit was seen by an estimated 20,000 visitors.

Believing that the youth of New Mexico should be familiar with the resources of the State, the Bureau prepared a portable exhibit of the more important ores of the various metals and minerals mined in New Mexico. This display, accompanied by members of the teaching staff of the New Mexico School of Mines, who presented an explanatory lecture to groups of high-school students and to local adult organizations, was examined by approximately 8,200 individuals in 23 towns throughout the State. The response was so favorable that it is intended to improve the exhibit and the method of presentation during the coming year, and to show it to an even larger audience.

Other methods of imparting information on the natural resources of New Mexico to a greater percent of the people included a monthly column describing Bureau activities, which appeared in the New Mexico Miner and Prospector, and an historical account of the early days of mining in this State, which appeared in monthly installments in the New Mexico Magazine.

Through these various forms of publicity, the Bureau presented one or another aspect of the natural resources of the State to an estimated 42,000 individuals. . . .

Annual Report 1946-47

by Eugene C. Anderson, Director

General Statement

At the beginning of the year the Bureau had five projects underway. These included the Chupadera Mesa-Gran Quivira map and report which was nearing completion; the compilation of statistics showing contributions of New Mexico's mineral industry to the war effort; the South Chupadera Mesa quadrangle geological map and report; the compilation of gas and oil production statistics for the southeastern New Mexico fields, exclusive of Lea County; and the gathering of statistics covering the clay and other nonmetallic resources of the State. These projects, with the exception of the clay investigations, were completed and reports published.

During the year the Bureau continued its services to the prospectors and small operators of the State by examining, sampling, and making reports on properties; assaying and analyzing samples; and identifying rocks and minerals sent in

Appropriations, Budgets, and New Projects

The 18th session of the State Legislature that ended in March 1947 appropriated to the Bureau \$50,000 from the "Minerals Leasing" fund for general services and activities. In addition to this, we were also given two special appropriations of \$10,000 each annually for "Basic Geological Surveys" and "Ground Water Surveys," the money to be spent in cooperative work with the U. S. Geological Survey, provided satisfactory agreements could be arranged with that Federal agency.

The appropriation bill carried the emergency clause making the act effective at once. However, no monies remained in the "Minerals Leasing" fund for the balance of the fiscal year, so actual activating of these projects could not be achieved until after the beginning of the new fiscal year, July 1, 1947.

Plans were made and discussions held with the district geologists of the U. S. Geological Survey, also correspondence was exchanged with Dr. Wrather, the Director in Washington, in anticipation of activating this work early in the new year. . . .

Cooperation with Other State Agencies

During the year the Bureau contributed a section to the New Mexico Magazine in which the natural resources of the State were discussed.

The minerals exhibited at the State Fair were once again a major attraction, and the Bureau received many compliments. . . .

Report of the Oil and Gas Division--Subsurface Geology

Substantial additions were made to the file of well samples, which form the raw material of subsurface geological studies. Samples were received monthly from the New Mexico sample cut at Hobbs, and on May 1, 1947, an arrangement was made through which the Division receives samples for New Mexico wells distributed by the sample cut at Amarillo, Texas. In addition, sample sets from ten wildcat wells were received direct from the operators, in exchange for technical information supplied by the Division; on clearance from the operators, these samples were then taken to Hobbs for cutting and distribution to companies. At the end of the fiscal year, samples from a total of 1,376 wells were on file; this is an increase of 100 over the preceding year. . . .

Microscopic examination of the samples from 47 wells was made during the year, representing a total drilled footage of over 150,000 feet. Written descriptions were made and plotted in graphic form on log strips. At the end of the year 280 of these strips were on file. They are for wells distributed as follows:

<u>State</u>	<u>County</u>	<u>Number of Logs</u>
New Mexico	Chaves	23
	Eddy	21
	Harding	20
	Lea	30
	San Juan	24
	Other	125
	<hr/>	
	Total	243
Arizona		6
Colorado		11
Oklahoma		5
Texas		14
Utah		1
		<hr/>
Grand Total		280

The plotted log strips are in constant demand by Bureau and company geologists, as they form the basis for interpreting sub-surface structure and stratigraphy, which interpretation is vital to the finding of oil.

"Electric logs" are a valuable supplementary source of sub-surface information. They record the electrical resistivity and other properties of the strata penetrated in a well. A collection of

these electrical logs was started during the year and is increasing each month. . . .

Oil and Gas Division--Artesia Office

The engineering branch of the Oil and Gas Division worked with oil operators and engineering committees in compiling data on corrosion, secondary recovery, and oil and gas production. A discussion of corrosion of oil-field equipment in Eddy County is being prepared for inclusion in a progress report of the corrosion subcommittee of the Lea County Operators Committee. Circular 14, on Eddy County production, was compiled in the Artesia office, and another circular, giving similar data for 1946 for the entire state except Lea County is in preparation. These circulars are prepared with the cooperation of the New Mexico Oil Conservation Commission and the Lea County Operators Committee. A statistical report covering production for the entire State in 1947 is to be prepared, in which the Bureau will provide subsurface completion data and the Lea County Operators Committee and the New Mexico Oil Conservation Commission will provide the production data. The Artesia office will also prepare a section on secondary recovery of oil in New Mexico for the report of the secondary recovery study group of the American Petroleum Institute.

The exhibit of the Oil and Gas Division at the 1946 State Fair, prepared by the Artesia office, included displays of rotary bits, well cuttings and cores, electric-logging equipment, rotary fishing tools, samples of crude oil, a typical well hook-up, gun-perforating equipment, and samples of corroded equipment.

Through its engineering branch, the Bureau was able to familiarize the operators in the Caprock and Robinson pools with an improved type of paraffin scraper used in other oil-producing areas.

Installation of the scrapers at pumping wells in these pools has materially decreased the cost of combating paraffin accumulation.

The New Mexico Oil Conservation Commission and Martin Yates of Artesia are planning a long-range program of repressuring and secondary recovery work in the Artesia pool. This program, which should get under way by late 1947, is to be aided by the Bureau's engineering branch which will act in an advisory capacity.

The Bureau is represented, through the Artesia office, on a number of operating and engineering groups, among them the Lea County Operators Committee, the American Petroleum Institute, the Interstate Oil Compact Commission, and the New Mexico Nomenclature, Committee. . . .

Report of the Mining Division--Services

The functions of the Mining Division may be presented by the following outline of services performed.

1. Investigations and reports covering mining districts and areas, and mineral deposits; reports published as bulletins and circulars.
2. Collection and distribution of statistics relating to the mineral industry.
3. Identifications and analyses (qualitative, quantitative, and spectrographic) of mineral specimens and samples sent to the Bureau.
4. Preliminary examinations of, and reports on, properties and prospects for small operators.
5. Miscellaneous services, such as the collection of samples of clay, perlite, pumice, and gypsum from deposits of commercial possibilities; field conferences with small operators; and the showing of New Mexico deposits to out-of-state investors. . . .

Projects

A report on the contribution of New Mexico's mineral industry to the war effort was completed and issued as Bulletin 27.

Compilation of data on pumice aggregate of New Mexico, together

with laboratory tests on pumice-concrete mix designs, was completed. The resulting bulletin on uses and potentialities of New Mexico's pumice aggregate resources was being edited at the end of the fiscal year. This will be released as Bulletin 28.

Clay samples from various deposits in the State are being gathered, analyzed, and classified for the purpose of possible economic value and ultimate exploitation. Arrangements have been made for the cooperation of the U.S. Bureau of Mines in the physical tests to be made of the most promising samples obtained.

A survey of the mineral resources of Colfax County is underway to be published as a bulletin.

During the year two circulars were released for free distribution: a compilation of State tax laws relating to mineral properties in New Mexico, and a set of tables of fluorescent and radioactive minerals.

Mineral exhibits were made up and distributed to 73 high schools in the State. The schools heartily accepted the minerals for study in science classes and for permanent library or hall-way exhibits. Each exhibit consists of 40 specimens of economic minerals and rocks of New Mexico. . . .

Assays and Analyses

A total of 443 samples were received during the year. Identifications, analyses, and assays performed totaled 867 and were classified as follows:

Paid Assays and Analyses

Description	Number
Assay -----	41
Quantitative -----	52
Total -----	93

Free Assays and Analyses

Assay -----	219
Miscellaneous -----	2
Qualitative -----	173
Quantitative -----	354
Spectrographic -----	26
	<hr/>
Total -----	774

Report of the Editor of Publications

Introduction

Issuance of more publications was announced this year than in any previous year since the Bureau was organized. Four bulletins and three circulars were published, making a total of 27 bulletins and 15 circulars printed by the Bureau.

Editorial work was done by the chief of the Oil and Gas Division until February 1, 1947, at which time this work was taken over by the manager of the Business Office.

Annual Report 1947-48

by Eugene C. Anderson, Director

General Statement

The Bureau of Mines and Mineral Resources entered the 36th fiscal year with total appropriations by the legislature amounting to \$70,000, and anticipated an income of \$4,000 from the sale of publications and services during the year.

Of the monies appropriated, \$10,000 was earmarked for ground water investigations and geological surveys, and \$10,000 was for basic geological surveys and mapping in the igneous, intrusive, and volcanic areas of the state. The remaining \$50,000 was for general use by the Bureau in carrying through projects and work already underway and the activating of new work.

The Bureau budgets as approved by the State Board of Finance called for the expenditure of approximately \$40,000 for salaries, and \$30,000 for printing and publishing, office rental and supplies, field expenses, and other miscellaneous items necessary to the operation of the Bureau.

At the beginning of the year there were five projects underway, two projects planned and ready to activate as soon as funds became available, and three projects in the process of being planned.

The projects underway were:

1. The report on pumice in New Mexico and its uses as a lightweight concrete aggregate. This report was completed and released as Bulletin 28 early in October 1947.

2. The so-called "Clay Project" - an examination and study of the clay deposits of the State to determine their suitability and availability for the ceramics industry, the petroleum industry, the building and other industries using clay. This project has developed into a job of unexpected magnitude.

3. The New Mexico oil and gas production report for the entire State, exclusive of Lea County, was being compiled by our Artesia office personnel in cooperation with the Conservation Commission. This report was completed and released as Circular 16 in September.

4. The "Caprock Pool Statistical Report," giving statistical data on well drillings, well completions, and production in the Caprock Pool area of Lea and Chaves counties, was also being prepared in cooperation with the State Oil Conservation Commission. This report was released in January as Circular 17.

5. The corrosion studies which were begun in 1946 were being continued. The Bureau's part in these studies is principally that of a service agency devoted to collecting, compiling, and releasing information regarding corrosion problems and what is being done to overcome them in the oil fields.

The two projects ready for activating were:

(1) The Ground Water Survey -- a cooperative project with the U.S. Geological Survey, and (2) the Basic Geological Survey -- also a cooperative undertaking with the U.S. Geological Survey. . . .

Both these projects were activated last summer as scheduled. The ground water investigations are being carried out under the direct supervision of Dr. C.V. Theis, Regional Geologist, Ground Water Division of the U.S. Geological Survey, and we were fortunate in securing the services of Dr. Charles F. Park, Jr., Professor of Geology at Stanford, and former Chief of the Metals Section, U.S. Geological Survey, in helping plan the basic geological project and in supervising the work in the field the first season. Dr. Park has agreed to continue as consultant on this project and will give us whatever time he can spare in actual field work.

In the ground water survey, field work has been completed in San Miguel County and is nearing completion in Eddy County. A Colfax County report, prepared by the U.S. Geological Survey and the State Engineer's Office, at the request of the City of Raton and the Colfax County Commissioners, will be published by the Bureau. The San Miguel County report is being completed and will be published at an early date.

The first field season in the basic geology work resulted in a brief report on the Red River and Twining districts which has been released as Circular 18. This report is strictly preliminary and will be included in a broader and more detailed report to be released following a second season in the field. . . .

Report of the Oil and Gas Section

Subsurface Geology

The Bureau's files of well cuttings and plotted sample logs were considerably increased during the year. On July 1, 1948, cuttings from 1,539 wells were on hand, representing an increase of 163 wells over the preceding year. On the same date, 423 plotted sample logs were available, as compared to 280 on July 1, 1947, an increase of 143. The cuttings, mostly from wildcat tests, were examined under a binocular microscope and then plotted in graphic form on log strips. They represent a total of more than 370,000 feet in footage drilled. An effort was made to obtain samples from all wildcat tests drilled in New Mexico during the year and, with only two or three minor exceptions, cuttings were received from all. No important tests were missed. . . .

The majority of the samples received reach the Bureau through the Hobbs Sample Cut, which covers all important wells drilled in southwestern New Mexico. In addition, a few wildcats in central and northeastern New Mexico are handled by the Amarillo Sample Cut Service. During the past year, samples from seven wildcats were obtained through this agency.

A few operators forward samples directly from the wells as they are being drilled. In return for this consideration, the Bureau is glad to furnish the operator with a copy of the sample description at no cost. Upon completion of the well, the samples are forwarded to Hobbs for general distribution. Due to the growing interest in the San Juan Basin and the increase in wildcat activity there, a new sample cut for the Four Corners area was started in Farmington in June 1948. At present it is being sponsored by nineteen independent and major oil companies, in addition to the State Bureau of Mines and is affording excellent service as a non-profit organization. . . .

Report of the Mining Section

Services

The functions of the mining section may be presented by the following outline of services performed.

1. Investigations and reports covering mining districts and areas, and mineral deposits; reports published as bulletins and circulars.
2. Collection and distribution of statistics relating to the mineral industry.
3. Identifications and analyses (qualitative, quantitative, and spectrographic) of mineral specimens and samples sent to the Bureau. A laboratory flash-type perlite expanding furnace has been set up and expansion tests on perlites are made. With the cooperation of the petroleum department of the New Mexico School of Mines, rotary drill mud analyses and tests are now performed.
4. Preliminary examinations of, and reports on, properties and prospects for small operators.
5. Miscellaneous services, such as the collection of samples of clay, perlite, pumice, and gypsum from deposits of commercial possibilities; field conferences with small operators; and the showing of New Mexico deposits to out-of-state investors.

Projects

A report on pumice aggregate in New Mexico was completed and issued as Bulletin 28.

Work on clays of the State was continued throughout the year. Samples are being gathered and their physical properties determined. Chemical analyses are being made in order to catalog them for various ceramic and non-ceramic uses. Rotary drill mud analyses and performance tests are being run on bentonitic clays to determine their suitability as drilling muds.

Mineral exhibits were distributed early in the fall to 40 high schools that had not received them during the spring of the previous year. In ad-

dition, 28 small mineral collections were sent to school children requesting such material for science study. Most of these collections were sent to out-of-state students interested in the minerals of New Mexico. . . .

Basic Geology

The first basic geologic project was started on July 27, 1947, in the Red River and Twining districts of the Sangre de Cristo Mountains, Taos County. A total of six men worked on the project at various periods throughout the year. A two-man field party spent three months doing detailed mapping and studying the mineralization around the town of Red River. The geological work included mapping of the various rock units, examination of all prospects and mines encountered, and the giving of general assistance to individuals and corporations interested in development of mineral resources in the Sangre de Cristo Mountains. Over 50 thin sections of rocks from the area were made and examined.

The following tabulation shows the accomplishments of the first season's field work.

Mining corporations contacted -----	2
Interested individuals and prospectors contacted -----	25
Mining properties and claims examined -----	48
Maps made of open prospects and old mines -----	8
Assays made -----	*

During the winter months the Bureau geologist prepared the field data for publication. Descriptions of the mining properties were written and a map prepared showing the location of the prospects. On April 29, 1948, the Bureau released Circular 18, "Geology and Ore Deposits of Red River and Twining Districts, Taos County, New Mexico." This circular is only a preliminary report. Corrections and additions will be included in reports to be issued in subsequent years.

As one of the main purposes of the geological mapping is to outline areas where ore deposits may occur, plans are now in progress for a more detailed examination of the most encouraging locations. . . .

Report of the Editor of Publications

One bulletin and three circulars were published during the year, making a total of 28 bulletins and 18 circulars printed by the Bureau to date.

Annual Report 1948-49

by Eugene C. Anderson, Director

The Report of the Director covering the 37th fiscal year

The Bureau of Mines and Mineral Resources began the 37th fiscal year with the assurance of sufficient money to carry forward all projects underway as of July 1, 1948. Appropriations by the State Legislature totaled \$70,000 and an additional \$4,000 was anticipated from the sale of publications and services for which charges could be made.

Of the monies available, \$20,000 was committed to the Ground Water and Basic Geological Surveys that had been activated the previous year. Of the 50 odd thousand dollars remaining, \$31,900 was approved for salaries of personnel, \$3,000 for publishing and printing, and the remainder for general overall operating expenses, which included travel, office supplies, automobile operation, postage, express, publicity or educational work, service and rental charges of the School of Mines, etc.

Projects underway at the beginning of the year included the ground

water surveys in San Miguel and Eddy counties, the Colfax County water report which was in the final stages of editing and preparation for the printers, the geologic studies and mapping in the Sangre de Cristo Mountains region, the Sacramento Mountains survey, the revision of our Bulletin 7, "The Metall Resources of New Mexico," the clay deposits studies, and the revision of our Bulletin 23, "Stratigraphy and Oil-producing Zones of the Pre-San Andres Formations of Southeastern New Mexico"

Of these projects the Colfax County report has been released as "Ground Water" Bulletin 1, the San Miguel County report has been completed but is being held up in the U.S. Geological Survey offices for final review and approval, the field work for the Eddy County report has been completed and the final draft of the report is being prepared.

Geological mapping of the Sangre de Cristo Mountains region has been carried forward very satisfactorily, and the current field season will see the area north of Arroyo Hondo and the Twining district to the Colorado state line and from the sedimentary contacts on the east to the Rio Grande on the west, an area of some 650 square miles, completely covered. The report and map of the region may be expected for release in 1950. This work was carried on under the supervision of Dr. Charles F. Park, Jr.,

of Stanford University, as a consultant until October 1948.

Field work on the Sacramento Mountains project has been completed, and the report and maps are in the final stages of completion. Work on the revision of Bulletin 7 has been extremely slow, progress has been very unsatisfactory, and the work on this project has been temporarily discontinued.

The clay report is still in the formative stage. Much progress has been made, but many heretofore unreported occurrences of clay deposits have been brought to our attention, some of which have warranted examination and sampling. A great amount of other field work has interrupted and delayed the completion of this project. It is hoped the report will be completed and released in 1950. General work on the revision of Bulletin 23 was completed as of July 1, 1949. However, some minor details remained to be worked out and the final manuscript prepared for the printer. At the time of the compilation of this report, revised Bulletin 23 is at press and will be released about October 15 as a new Bulletin, No. 29, in our series of publications. It is thought this report will be one of the outstanding publications of the Bureau in recent years. . . .

At press are oil and gas production and engineering statistical reports for the calendar year 1948, and a revised total production.

report for the San Juan Basin. These reports were prepared in cooperation with the State Oil Conservation Commission and the Lea County Operators Committee. The assistance of both organizations is gratefully acknowledged and appreciated.

In releasing these reports a definite departure from the previous practice of this Bureau will be made in that a charge will be made for the publications. Heretofore, it has been our practice to compile and release these data as a free service to the petroleum industry. However, the work involved in accumulating and preparing the material included in these reports has increased tremendously, and the cost of printing has practically doubled since this service was first started. The Lea County Operators Committee, the Oil Conservation Commission, and many operators and geologists who use the reports agreed a charge should be made by the Bureau for the services rendered. Another reason for having a price on the reports is that it eliminates the demand on the part of individuals who are always on the alert for something for nothing. The reports will be released as "Oil and Gas Reports 4-A, 4-B, 4-C," the beginning of a new bulletin series. The three previous reports of oil and gas production and statistical data have been issued as circulars. . . .

Cooperation with other State agencies

Cooperation with other State agencies has been close and most cordial. The Bureau has been of service to the State Land Office, the Oil Conservation Commission, the State Planning Board, the Tourist Bureau, the Secretary of State, the Tax Commission, and the Governor's office. All have requested and received information from the Bureau. These agencies and offices have been most cooperative in giving the Bureau information when requested. Several reports and considerable statistical information have been prepared for transmittal by the Governor to our representatives in the national congress.

The State Inspector of Mines Department has continued to be very closely associated with the Bureau. This arrangement, we believe, has been mutually beneficial to the organizations and to the mining industry as a whole.

Federal agencies with which we have worked closely are the Geological Survey, with which we have cooperative agreements on ground water and basic geological surveys, the Bureau of Mines, the Soil Conservation Commission, the Army Engineers, and the Atomic Energy Commission.

In addition to these, we have been called upon by the State National Guard and the U.S. Army for maps and other information. . . .

Miscellaneous Activities

The Bureau continues to be represented on the New Mexico Nomenclature Committee, but the membership on the Interstate Compact Commission Engineering Committee was discontinued after Mr. Lamb's resignation. Bureau personnel attended all Lea County Operators Committee meetings, Oil and Gas Commission hearings and usually Land Office lease auctions. . . .

Artesia Office

The Artesia office was reactivated in January, 1949, with supervisory personnel after several months of inactivity following the resignation of Mr. N. Raymond Lamb.

The engineering branch of the Oil and Gas Section cooperated with the Lea County Operators in preparing the production statistical and engineering report for 1948 covering oil and gas in the entire State. This report is being published in two sections.

A supplemental report covering additional data on the San Juan Basin area is being prepared.

A study of well remedial work is being made with especial emphasis on (a) old wells drilled deeper, (b) old wells plugged back to new pays, and (c) plug-offs to decrease the oil-gas ratio or the water production. At present these data are not kept together in any permanent file. The data are very important for use in ultimate recovery of oil and in determining field limits. The data should

be available to all operators to aid in eliminating duplication of effort.

A file has been set up in the Artesia office of all available duplicate well sample descriptions as an aid to the industry.

The Bureau is represented, through the Artesia office, on the following petroleum industry operating and engineering groups: The Lea County Operators Committee, the American Petroleum Institute, and the New Mexico Nomenclature Committee. In serving with these various groups, the Bureau representative has been able to be of much assistance to the industry.

Report of the Mining Section -- Services

The services of the Mining Section of the Bureau have been in greater demand by prospectors and small operators than ever before. The high price for metals, the search for radioactive ores, and the growing interest in nonmetallics caused more than the usual number of prospectors to take to the hills. Their activities were reflected in the large number of specimens and samples sent in for identification or analysis, and the requests for examinations of prospects.

Personnel

Personnel of this section during the year consisted of only two regular full-time employees. The chief of section functioned as

field engineer, office engineer, and general consultant for prospector visitors. The metallurgist and assayer assisted in the field work when time permitted. Student help was employed on a part time basis.

Projects

During the year the Mining Section continued the examination and sampling of clay deposits, the laboratory testing of clay samples, and made arrangements with the U.S. Bureau of Mines for "cone" tests to be made on clays that showed promise of being of commercial quality.

More than 40 expansion tests were made on perlite samples brought or sent in from deposits in the State, and assistance was given owners of quality deposits in contacting prospective purchasers of the material. Some deposits have been brought into production, and negotiations are in progress for developing others. . . .

Assays and Analyses

The Bureau was handicapped during the first few months of the year by lack of facilities for doing analytical or assay work. This condition was remedied in the late fall, and this service is gradually reaching its former volume. A total of 829 samples was received during the year, and a total of 412 quantitative determinations

was made. In addition, 577 qualitative analyses and specimen identifications were made. This included over 150 tests for uranium and other radioactive minerals. . . .

Report of the Geological Section--Basic Geology

Basic geology mapping and the study of the northern Sangre de Cristo Mountains was continued in the period covered by this report. During the fiscal year, five months were spent in the field by the geologist assigned to the project. A total of 225 square miles was mapped which included the expansion of the previously mapped area to the west and north. The intensely altered zone along the Red River was outlined and in places studied in detail. For the work done in July through October of 1948, a field headquarters was maintained at the town of Red River. In June 1949, a mobile field camp was established and during that month was located near the junctions of the Latir and Costilla creeks. In addition to the Bureau geologist, two field assistants, consisting of one student geologist and one student helper, were employed in 1948, and one student geologist and camp cook were employed in June of 1949.

The student helpers were employed during the winter months, one to grind and prepare rock thin sections, and the other to help with the drafting work. . . .

Report of the Editor of Publications

Only one bulletin was issued during the year, the first report of the Ground-Water series which was released in May. Four circulars were printed, and the Oil and Gas Map of New Mexico was revised. . . .

Annual Report 1949-50

by Eugene Callaghan, Director

Duties and Objectives of the

Duties and Objectives of the Bureau of Mines and Mineral Resources

Basically, the purpose of the Bureau of Mines and Mineral Resources, which was established by the New Mexico Legislature in 1927, is to secure accurate information on all types of mineral resources in the State and on all phases of their utilization, and to make this information available to all interested citizens, companies, organizations, and to State and Federal agencies. In this capacity, the Bureau has an important role to play in national defense because it supplements the defense work of Federal agencies in the mineral field. The Bureau is the only State agency charged with the duty of investigating, studying, and reporting on mineral resources such as oil and gas, coal, ground water, and metallic and nonmetallic minerals. The Bureau has no regulatory or law-enforcement functions. The Bureau never has had sufficient funds to perform fully the duties assigned to it by law.

In general, it may be said that most of the mineral deposits that can be found easily on the surface have been discovered.

It is recognized that all the knowledge and tools which geologic and engineering sciences have developed must be brought to bear upon the problem of finding new or additional deposits. Further, it is realized widely that the development of basic information, such as regional and local geologic maps and mineral studies, is a legitimate function of the State and a duty to its citizens. In New Mexico the mineral industry is of such vital importance to the State that its maintenance through the finding of new and additional deposits to take the place of those that are depleted is absolutely necessary. The continued flow of these mineral resources is also a necessity to the defense and well-being of our nation. As a single instance, the potash of New Mexico, the principal source in the Western Hemisphere, is absolutely necessary to the maintenance of the intensive agriculture that has made America the best-fed nation and a source of foodstuffs for the world.

The Bureau has recognized the duties outlined herewith and is performing them to the limits of its capacities. It is apparent that the very small technical staff and resources now available permit the performance of but a small part of these duties in an adequate manner. The State Bureau of Mines and Mineral Resources should:

1. Prepare a geologic map of New Mexico.
2. Prepare and have for distribution geologic maps of all parts of the State at a scale of one inch to the mile or larger.
3. Prepare detailed maps of individual mineral deposits or of areas recommended for prospecting on appropriate scales.
4. Prepare maps and reports on school or other State lands for administrative use and for guidance in formulating land sales and leasing policy.
5. Prepare maps and reports on a regional inventory of ground-water resources, as well as reports on intensive ground-water studies and techniques of water-finding.
6. Prepare oil, gas, and coal maps and pertinent diagrams and reports that will aid in exploration for these minerals.
7. Compile reports on individual mineral commodities or groups of commodities for the State.
8. With the aid of paleontologic and other techniques establish stratigraphic sequences and correlations throughout the State.
9. Provide assay, chemical, mineralogical, and metallurgical laboratories for testing materials for citizens of the State.
10. Provide information requested by persons or firms contemplating establishment of industries in the State.
11. Prepare basic reports for specific areas of land utilization such as irrigation districts or recreational areas.

12. Cooperate with State and Federal organizations carrying on work having to do with mineral resources of the State.
13. Prepare booklets on State parks or other recreational areas for use by tourists or other citizens.
14. Prepare educational booklets and maps on mineral resources and their conservation for use by the schools.
15. Keep up-to-date files of information and pictures for accurately answering letters and requests.
16. Prepare statistical and economic reports on mineral resources.
17. Prepare bibliographies of geologic and mineral resource literature concerning the State.
18. Investigate the seismicity of New Mexico and other factors affecting engineering structures.
19. Study application of geophysical techniques to geologic and engineering problems.
20. Publicize the mineral industry of New Mexico through talks before engineering and scientific societies and before lay groups.
21. Preserve records such as mine maps, production records, borehole samples and cores from oil well tests and others.
22. Maintain a museum of New Mexico minerals and raw materials that will serve as a basis for exhibits for State and other fairs.
23. Provide adult education for miners, prospectors, and other interested citizens.

24. Provide in-service training for mineral industry students.

Services

. . . For the benefit of those interested in the discovery of more oil and gas, a rapidly growing sample library representing 1,731 oil and gas well tests, as of June 30, is maintained at Socorro. These samples represent more than 400,000 feet of borehole drilled and are largely from wildcat tests drilled outside of established fields. Log strips for 631 wells have been plotted and are available for consultation at Socorro. More than 6,200 drillers' logs are on file. The office at Artesia maintains a duplicate set of drillers' logs, as well as electrical logs, maps, reports and statistics which are immediately available in the most productive area of the State. The petroleum geologist maintains the facilities in Socorro. The petroleum engineer maintains the office at Artesia and represents the Bureau at Lea County Operators Committee meetings, Oil and Gas Conservation Commission hearings, Land Office lease actions, and meetings of the New Mexico Nomenclature Committee. The knowledge thus gained makes the Bureau more useful to all citizens. The petroleum engineer also cooperates with the Lea County Operators Committee in compiling the annual statistics of each producing well in the State. The compilation is published each year by the Bureau and thus made available to the public.

The engineers and geologists of the Bureau are called upon by prospectors and small operators for advice and assistance, as well as by those looking for likely prospects and mines to explore or to operate. These requests are handled by actual visits and examinations in the field, consultations in the office, or by letter or telephone. Brief reports, prepared on field examinations, are filed for public reference. Numerous samples of clay, perlite, and limestone were collected and tested. Prospectors and others make use of the chemical and assay laboratories; more than 550 assays and analyses were made, as well as 1,000 qualitative determinations. Prevailing fees are charged for assays and analyses through qualitative tests, and mineral determinations are free of charge. . . .

Research Activities-- Nonmetallic or Industrial Minerals

. . . Clay Field and laboratory studies of the clay resources of New Mexico were continued, though hampered by lack of laboratory space and equipment.

Raw materials for portland cement: Preliminary field examinations were made and laboratory work was started on limestones and shales for possible use in portland cement.

Perlite: Volcanic glass commercially known as perlite is finding a rapidly growing market, especially in the building trades, ^{and} is the subject of an intensive study of geology of its occurrence, its chemical and microscopic characteristics, and its behavior under thermal or "popping" treat-

ment. Detailed mapping of a deposit near Magdalena in Socorro County was started and mapping and sampling of other properties was planned. Preliminary laboratory studies were made. . . .

Basic Geology

1. Costilla and Latir Peak quadrangles
2. Questa and Eagle Nest quadrangles
3. Manzano Mountains
4. Capitan quadrangle
5. Black Range NW quadrangle
6. Black Range NE and SE quadrangle
7. Geologic section of the Black Range
8. Sherman quadrangle
9. Lake Valley quadrangle
10. Sacramento Mountains
11. El Paso Gap quadrangle

Ground Water

In cooperation with the Ground Water Branch of the U.S. Geological Survey the program of county-wide surveys of ground-water resources has been continued. This work is under the direction of the Federal agency. In addition to this work a number of brief reports were prepared as results of studies of ground-water conditions adjacent to several towns in New Mexico. San Miguel County, Eddy County, Torrance County, and Socorro County. . . .

Special Project in Socorro County: With funds from its regular appropriation the Bureau started a project in cooperation with the Research and Development Division, New Mexico School of Mines, for the study of techniques of water-finding. The Research Division supplied a geophysical party and equipment for study of geophysical procedures while the Bureau supplied a geologist, Mr. John H. Waldron, of Stanford University, to measure and sample wells and ascertain geological conditions of groundwater accumulation to check with the geophysical results. For reasons of economy the area selected was that in the vicinity of Socorro and extending westward to Magdalena.

Personnel

. . . Dr. Eugene Callaghan, for many years geologist with the metals and nonmetals sections of the U.S. Geological Survey, and for three and a half years professor of economic geology at Indiana University and economic geologist for the Division of Geology, Indiana Department of Conservation, was appointed Director, as of September 1949.

Plant

In October 1949 the offices of the Bureau were moved from exceedingly cramped quarters in the basement of Brown Hall to temporary residence in the new Research Laboratory. This move

permitted the establishment of a business office, publications room, petroleum sample library room, drafting and map room, mineralogical laboratory, two geological laboratories and two engineers' offices. A small chemical laboratory has been set up in a temporary building on the campus and to this was added some space for sample preparation and testing of clays and other nonmetallic materials. Assaying is done by the Bureau assayer in the College Division assay laboratory. Other facilities of the College Division and of the Research and Development Division are kindly made available to the Bureau.

Equipment for field surveying and mapping, as well as for laboratory work, was almost wholly lacking earlier in the year. Insofar as funds permitted, alidades, plane tables, a transit, a level, petrographic microscopes, X-ray diffraction equipment, new trucks, and many other items and accessory equipment have been added. Drafting tables and equipment, plotter for aerial photographs, and other map-making aids were secured. The ultimate aim is to be equipped sufficiently well that any problem can be handled.

A design for a new building to house the minimum staff and activities of the Bureau was submitted to the President of the New Mexico School of Mines. The School of Mines has been authorized to issue bonds for this construction. The Bureau is most urgently in need of integrated laboratory facilities that will

not only permit the proper exercise of functions handled currently, but will permit the establishment of a testing laboratory for non-metallic or industrial mineral materials and metallurgical tests.

Biennial Report, 1950-51 and 1951-52

by Eugene Callaghan, Director

. . . . The assaying service for which standard charges were made was discontinued in April 1951 owing to increase of demand. The mineralogist makes identification of rocks and minerals for the public. His effectiveness has been increased by the building up of a well equipped laboratory.

Field and Research Activities

Field and laboratory work is carried on by both the permanent and temporary personnel. Much of the time of the permanent staff must be devoted to service activities such as meetings with visitors, responses to inquiries, determinations of samples and related activities. The temporary staff devotes its entire time to field work. Laboratory work and preparation of reports is done on personal time. This applies also to the field assistance fellows who, for the most part, are candidates for the Ph.D. degree in major universities throughout the country. They receive a salary of only a dollar a month and a per diem allowance while in the field. . . .

Field projects and projects which are concerned with the whole State or with investigations that have a wide range of application are assigned a permanent number and are listed numerically below. . . .

1. Costilla and Latir Peak quadrangles
2. Questa and Eagle Nest quadrangles
3. Big Rock and other kyanite deposits
4. El Rito quadrangle
5. Santa Fe area (in cooperation with Groundwater and Surface Water Branches and the Topographic Division of the U.S. Geological Survey, and with the Research and Development Division of the New Mexico Institute of Mining and Technology)
6. Cerrillos area
7. Thoreau quadrangle
8. South Manzano Mountains
9. Puertecito quadrangle
10. Magdalena perlite deposit
11. Socorro perlite deposit
12. Area east of Socorro
13. Carrizozo quadrangle
14. Capitan quadrangle
15. Sacramento Mountains area, or Alamogordo quadrangle and part of Escondido quadrangle

16. Lookout Mountain quadrangle
17. Winston and Sugarloaf Mountain quadrangles
18. Geologic Section of the Black Range at Kingston
19. Sherman quadrangle
20. Lake Valley quadrangle
21. Big Hatchet Peak quadrangle
22. El Paso Gap quadrangle
23. Gossans as guides to base metal ores
24. Columbus and Hermanas quadrangles
25. Picuris Range
26. Las Cruces quadrangle
27. Three Rivers area
28. La Luz area
29. Datil NE quadrangle
30. Mt. Sedgwick quadrangle
31. Tohatchi NW and Zith-Tusayan NE quadrangles
32. Pelona NE and NW quadrangles
33. Hansonburg mining district
34. Las Tablas quadrangle
35. Foster Canyon quadrangle
36. Bland mining district
37. Socorro manganese district
38. Contact metamorphism in Sierra Rica and other areas

39. Oil and gas map of New Mexico
40. Geologic map of New Mexico
41. Characteristics of petroleum in New Mexico (project inactive)
42. Tertiary volcanic rocks of New Mexico
43. Tertiary intrusive rocks of New Mexico
44. Stratigraphy of New Mexico
45. Stratigraphy and paleontology of the El Paso limestone
46. Coal deposits in the Capitan quadrangle
47. Ojo Caliente
48. Iron Mountain tungsten

Ground Water

In view of the extreme importance of ground water to every citizen and to all phases of the economy of the State, whether it be city-dwelling, manufacturing, mining, stock or crop-raising, petroleum production, or almost any conceivable activity, the Bureau has turned a large part of its effort toward the problems of the location and evaluation of ground-water reservoirs, whether large or small. Administratively, the Bureau shares with other organizations in the investigation of ground-water resources. Of the sum of \$20,000 appropriated annually to the Bureau for cooperative basic geology and ground-water surveys, \$10,000 less anticipated publication costs is turned over to the Ground Water Branch of the U.S. Geological Survey to be matched by Federal

funds. With this sum the Federal organization carries on county-wide inventory studies of ground water resources. Since the inception of this program reports on Eastern Colfax and San Miguel counties have been published by the Bureau and the report on Eddy county is in press. Field work on part of Socorro County is complete and the study of Torrance County is well along.

In view of the serious water shortage at Santa Fe in 1951, the Bureau initiated with the Ground Water Branch of the U.S. Geological Survey a very intensive study of the ground-water conditions and supply in that area. The geology was mapped in great detail by the Bureau staff using funds from its general appropriation. The U.S. Geological Survey, using the cooperative funds, undertook the engineering phases of the ground-water study. The geophysical section of the Research and Development Division of New Mexico Institute on Mining and Technology carried out a detailed geophysical survey using several techniques aimed at outlining ground-water areas. The Topographic Division of the Geological Survey gave special priority to the preparation of a large-scale topographic base. The maps and text are being prepared for publication by the Bureau.

At Tucumcari in Quay County another type of cooperation designed to aid that city is in progress. The city appropriated a sum to be matched by the Federal agency. The hydrologic engineer of the Bureau has cooperated in supplying the engineering direction.

A special project in water-finding in the vicinity of Socorro has been carried out in cooperation with the Research and Development Division. The geologic and engineering phases have largely been carried out by J.F. Waldron, a Ph.D. candidate at Stanford University. The field studies have been completed. . . .

Bureau Cooperation with Arkansas-White-Red River Basins Inter-Agency Committee

The 81st Congress, in 1950, directed certain Federal bureaus and agencies to set up a committee to develop information and prepare a report for the Congress covering the Arkansas-White-Red River drainage basins as had previously been done for the Missouri River drainage area. The northeastern corner of New Mexico lies within this designated basin.

The authorized committee was to be made up of personnel from Federal agencies that have to do with, or are interested in, flood control, water development, mineral and other resources, and the overall economy of the region, together with a representative from each of the states that lie wholly or partly within the drainage basin. Sub-committees at state level were authorized to assemble information and prepare reports for each state.

The sub-committee for New Mexico was organized August 1950, and the Bureau of Mines was invited to send a representative to the organization meeting. The Bureau representative was named

to the State Committee and was also named to several of the sub-committees or "work groups" that were assigned tasks developing information regarding mineral and water resources, industry, and population trends in the region under study.

Bureau personnel has participated continuously in the activities of the assigned work groups, and is currently assisting with the preparation of the overall State report which is to be completed January 1953. The experience and competence of the Bureau staff has enabled this State organization to make a very material contribution to this regional study which may eventually have considerable significance for New Mexico. . . .

Personnel

During the two-year period seven economic geologists, a hydro-logic engineer, a stratigraphic geologist, a mineralogical petrographer, four geological technologists, a draftsman, and a stenographer were added to the Bureau staff. On a temporary basis, the services of two additional geologists were obtained for special projects, and ten additional students were assigned projects under the Student Assistance Fellowship program. . . .

Biennial Report, 1952-53 and 1953-54

by Eugene Callaghan, Director

. . . The Bureau was host to a large group of geologists who contributed their knowledge of the basement or oldest rocks of New Mexico and adjoining regions in a Conference on the Precambrian in June 1954. The Association of American State Geologists voted to have their annual meeting in Socorro in March 1955, a very fine recognition of this Bureau. . . .

Paleontology and Stratigraphy

The last three years have been devoted primarily to the beginning of a collection of paleontological materials of New Mexico. Thus far, work has been concentrated primarily of the older strata, involving stratigraphically made collections, preparation, illustration, and description, for easily two-thirds of the forms are previously undescribed. As a result, detailed correlation is becoming possible, not only among the New Mexico sections, but bringing our knowledge of the New Mexico succession into line with the successions known in other parts of North America. A paper is well advanced describing

the first fossils diagnostic as to age, found in the Bliss sandstone, with implications as to the age of the Bliss sandstone, its depositional history, and interpretation. Similar results are being obtained for the El Paso limestone, though the amount of new forms still being found indicates that the material thus far collected is only a small portion of the complete faunas. The same is true for the Montoya and Devonian. Work on other formations is less advanced, but already a large Permian collection has been accumulated, and illustrations and descriptions of Permian and some younger forms are now completed for publication. . . .

Research Contracts with U.S. Bureau of Indian Affairs

Publication during 1954 of Bulletin 36, "Mineral resources of Fort Defiance and Tohatchi quadrangles, Arizona and New Mexico", by John Eliot Allen and Robert Balk (192 p., 21 figures, 16 plates) completed the contract undertaken by the Bureau with the U.S. Bureau of Indian Affairs in June 1952, for the mapping of 484 square miles in McKinley County, New Mexico, and Apache County, Arizona. This survey located large reserves of coal and bentonitic shales, and assessed the ground-water resources of the area. The geologic maps and detailed stratigraphic data will be of value in search for uranium and oil and gas in this part of the San Juan Basin. Deposits of building stone, sand, ornamental stone, gravel and crushed rock, and semiprecious stones were located and described.

A second contract between the Board of Regents of the New Mexico Institute of Mining and Technology and the Bureau of Indian Affairs, U.S. Department of the Interior, under authority of the Navajo Rehabilitation Act of 1950, requires the Bureau of Mines and Mineral Resources to conduct a mineral survey, exclusive of uranium, gas, oil, coal, and water, of that part of the Navajo reservation within the State of New Mexico, excluding only the area covered by the previous contract; to locate as many deposits of minerals or rocks of present or future value to the Navajo people as is possible to find; to prepare detailed maps of the deposits that appear to have the greatest value, to test the rocks and minerals by latest scientific methods; and to prepare a report, including an economic analysis. . . .

Bureau Cooperation with Arkansas-White-Red River Basins Inter-Agency Committee

Active participation of Bureau personnel in the Arkansas-White-Red River Basins investigations was concluded early 1954.

The task of the "Sub-Work" group to which Bureau personnel devoted its efforts was a study of the mineral resources and the needs for a geologic mapping program in that portion of the basins within New Mexico. This work was nearly completed at the beginning of 1954. A report has been prepared, reviewed, and approved by the New Mexico Committee and presented to the AWRBIA Committee

at Tulsa, Oklahoma, to become the New Mexico section of the overall AWR Basins report, which is scheduled to go to the President and the Congress not later than June 1955. The New Mexico report is comprehensive and will, we believe, be effective in apprising the Congress of the economic possibilities of that portion of the State and the feasibility of developing it.

Uranium

Uranium is fast becoming a major element of the mineral industry in New Mexico and interest in prospecting has increased enormously. During the past eighteen months, no less than 1500 persons have visited the Bureau Offices or have written requesting information regarding this fabulous material. Most of the people have wanted to know where to go to look for it, how to recognize it if they found it, and then what to do with it.

The Bureau Staff has assisted these people in every way possible. Maps of the State showing the location of proven discoveries are available. A free circular has been prepared that gives the actual location of known deposits by sections, township, and range, the geologic formation in which the mineral occurs; the status of the discovery as of a certain date, that is, whether it is a raw prospect, under development, a producing mine, or a mined-out property. Also samples of ore from the various districts are available for inspection and study by the expectant prospector. Our staff also has tried to be of assistance to the

prospector in his relations with the State Land Office, the U. S. Bureau of Land Management, and the owners of blocks of lands-- such as old Spanish and Mexican grants.

In all its efforts to assist in the discovery and production of uranium ore in the State, the Bureau has always had the cordial cooperation of the U. S. Atomic Energy Commission personnel at Albuquerque, Grants, and Grand Junction, and of the established ore producers.

Biennial Report, 1954-55 and 1955-56

by Eugene Callaghan, Director

. . . An event of great importance during the biennium was the completion of a new wing at the south side of the Research Laboratory on the campus of the New Mexico Institute of Mining and Technology, designed functionally for use by the Bureau. This structure provides laboratories adequate for the present staff of the Bureau, although additional space is needed now for the oil-well-sample library which is growing rapidly with the greatly augmented drilling activity in the State. . . .

In order to bring geologic and resource knowledge to students, tourists, members of rockhound and mineral clubs, and other citizens, a series of guidebooks to interesting areas of the State has been initiated. These are designed to keep tourists in the State "that extra day" which the Tourist Bureau points out is so important to the State's economy. Several thousand of these books have been distributed already, and many more are demanded. Notable scientific

and resource studies by the Bureau were requested, and largely or wholly paid for, by outside agencies, so immediate and necessary was the demand for such information. Bulletins 36 and 44, "Mineral Resources of Fort Defiance and Tohatchi Quadrangles, Arizona and New Mexico," and "Mineral Resources of the Navajo Reservation in New Mexico," were prepared under contract with the Bureau of Indian Affairs under the Navajo-Hopi Rehabilitation Act. Memoir 1, "Stratigraphic Studies of the San Andres Mountains, New Mexico," is an unusually fine publication of particular interest to the oil industry, resulting from data acquired by Bureau staff under contract with three major oil companies. The awarding of these contracts was a fine compliment to the competence and reputation of the Bureau staff.

Another fine compliment to the Bureau was its selection as host for the 1955 meeting of the Association of American State Geologists, of which the Director is currently secretary-treasurer. All who attended this meeting, including the directing heads of the Federal Bureau of Mines and the Geological Survey, were warm in their praises of the Bureau of Mines and Mineral Resources.

Still another indication of confidence in the Bureau was the appointment of two members of the staff by the Governor of New Mexico to serve in the Western Governors Mining Advisory Council, along with Mr. Thomas M. Cramer, president of the Board of Regents of the

New Mexico Institute of Mining and Technology, and Mr. James K. Richardson, of the Kennecott Copper Corporation. These Council members were delegates to the Western Governors Mineral Policies Conference in November 1955 in Sacramento, California. The Director also served on the research committee of that conference.

Field and Research Activities

Field and laboratory studies, as well as compilation and filing of pertinent data, cover parts of every county in the State except Los Alamos, which is essentially a Federal area. . . .

Stratigraphy and Paleontology

A primary function of a State Bureau or Geological Survey 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 intelligent correlation of units whose continuity is interrupted by erosion or by cover of other formations. The practical value of this work is axiomatic. Certain formations are more favorable as locations for petroleum or natural gas accumulations, others for uranium, and still others for various metals and nonmetals. Exploration for mineral resources, almost all of which are hidden, must take into account the thickness and succession of rock units

intervening between the unit sought and the surface, as well as the structural discontinuities that affect the situation.

Units of the entire geologic column in New Mexico, from the oldest to the youngest, are embraced in the various field and research projects listed previously. The oldest basement, or Precambrian, rocks are being studied throughout the State. . . .

Samples from the "granite" reached in oil tests also are recorded and studied.

The very difficult Lower Paleozoic section (Cambrian, Ordovician, Silurian, and Devonian) has been given special attention. . . , with the result that almost all the exposures have been studied, and fossil collections made. Already this work has gone far toward unraveling the complexities, and regional correlations can be made accurately. Several reports have been published in appropriate journals or in Bureau publications.

The Upper Paleozoic (Mississippian, Pennsylvanian, and Permian) has been the subject of intensive field studies. . . and some paleontologic work, particularly on the fusulines of the San Andres Mountains. Many fossil collections from this section await paleontologic work.

Mesozoic rocks (Triassic, Jurassic, and Cretaceous) are included in many intensive field studies. . . . Their fossil content, where present, remains to be studied thoroughly, some progress, however, having been made on Lower Cretaceous paleontology.

The Tertiary and Quaternary sections contain no known . . .

marine fossils, and only sparse collections of fossil plants, fresh-water invertebrates, and vertebrates have been made. Nevertheless, the Tertiary and Quaternary, particularly the volcanic succession and the relation of certain units to ore deposition. . . , have been studied in all parts of the State where these rocks occur. The succession of volcanic rocks is for the first time well known. Mapping of the volcanic areas in Catron County has brought to light windows of Paleozoic rocks. This may have a profound effect upon attitudes toward petroleum exploration in this area. . . .

The new paleontology laboratory in the Research Building has permitted proper housing of collections for study and for comparative purposes. The laboratory is well equipped, so that all modern approaches to paleontologic study can be used.

A sedimentary petrology laboratory also has been established, enabling the undertaking of stratigraphic studies based on mineral content. This laboratory is operated in conjunction with the X-ray laboratory, and new approaches to the study of Mesozoic rocks have been devised by the Bureau personnel. . . .

Mining and Metallurgy

The services of the Bureau's mining engineer were directed principally to the many prospectors who were interested in finding uranium. More than 500 persons called at the office

seeking information on prospecting procedure, claim-location requirements, and the status of ownership of lands in all sections of the State. As radioactive materials have been found to be widespread in formations in which no other metals have been found, scarcely any limits can be placed on areas for prospecting. Prospects and mines were examined in many parts of the State, and requested advice was given on the ground. Hundreds of inquiries by letter concerning uranium and thorium were answered. Close cooperation and exchange of information were maintained with Federal and State agencies concerned with uranium prospecting and mining activity, notably the Atomic Energy Commission, Geological Survey, Bureau of Mines, Bureau of Land Management, Forest Service, State Land Office, State Inspector of Mines, and State Economic Development Commission. . . .

State Geologic Map

As a major part of its program of cooperation with the U.S. Geological Survey in studies of basic geology, as provided by law, the Bureau is mapping large areas for the new State geologic map which will be published by the Survey. Four maps, each representing a quarter of the State will be published in preliminary form in black line with symbols for the units represented. The northwest quarter has been compiled, and it is expected that it will be published early in 1957. The southwest quarter is largely compiled. Field

work is nearly completed on the other two quarters, and compilation is under way. . . .

Personnel

The only changes in the professional staff of the Bureau resulted from the tragic death of Dr. Robert Balk in the crash of a commercial airliner on Sandia Mountain, near Albuquerque, in February 1955.

Robert Balk, who was 56 years old at the time of his death, was one of America's most distinguished and highly respected geologists. Not only was he respected for his superior abilities and experiences as a geologist, but for unique qualities of personality that established him among all who knew him as a truly great man. He was dedicated to the profession of geology and was so fully a lover of nature that he was a naturalist in the best sense of the term. With such unusual comprehension of the natural world was combined a love of people that lives on in the hearts of associates who feel they have lost the best and most devoted friend they will ever have. Though his own struggles with adversity were Lincolnesque, he never shrank from personal sacrifices to help others.

When Dr. Balk joined the staff of the Bureau in January 1952, he so enhanced the stature of this organization that it received unusual respect and attention throughout the nation. . . .

Biennial Report, 1956-57 and 1957-58

by A.J. Thompson, Director

Departmental Activities, Petroleum Industry

. . . Probably the most important service performed by the Bureau in the petroleum field is the maintenance of a well-sample library. Representative samples of the various rocks penetrated during the drilling of a test well are stored in this library, providing an extremely valuable source of subsurface geological information. From the microscopic study of sample cuttings, the depth of producing horizons and the type of oil reservoir can be determined. Information from well cuttings is used in correlating geologic formations, constructing cross-sections, and determining subsurface conditions in general. The charting of subsurface information on maps helps to indicate the location of structural and stratigraphic traps which may be future oil and gas pools. With the continued advance of the science of petroleum geology, the sample library will become even more valuable as a source of information on abandoned areas which are and will be

capable of future production under new and improved techniques.

Present storage facilities for the well-sample library are grossly inadequate; samples are stored in two separate rooms of the Research Building and in a temporary warehouse some distance from the Bureau's offices. More than 4,600 test wells are represented by samples in the library, and samples from nearly 300 new tests are added each year. The average oil test costs about \$50,000 to drill, and in most cases the samples are the only tangible result. The Bureau is able to obtain without cost samples of all tests drilled in the State. However, the Bureau requests samples only of wells that are located a mile or more away from wells already represented. Even with this selectivity of 1 well in 8, storage facilities are overtaxed and inconvenient. The ultimate solution should be to store all samples in one room adjacent to a small laboratory in which the staff and visitors can study the material, and adjacent to the offices and files of the Bureau's petroleum department. Such facilities are included in the Minerals Industry Building being proposed by the Bureau. . . .

Metallurgy

The primary need of the New Mexico Bureau of Mines and Mineral Resources is for space and equipment for testing and research on New Mexico ores and mineral products. Currently it is 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, even though New Mexico mineral production is considerably in excess of that of any of the neighboring States of Arizona, Colorado, and Utah, where much of the research and testing on New Mexico ores has been performed.

In addition to providing facilities whereby testing and research on specific areas can be contracted, it is believed that the Bureau of Mines should be actively engaged in studies relating to the general problems of the industry. This would include research on ores that at present are too low grade or too refractory to be considered commercial.

In the fall of 1956, plans were drawn up for a \$400,000 Bureau of Mines building to house a metallurgical laboratory and to provide space for other Bureau activities for which the present accommodations are inadequate. Funds for this building were requested as part of a general school-bond-issue bill which was proposed in the 1957 Legislature but not enacted. The Bureau expects to propose that funds be made available for this urgently needed building by the next Legislature. . . .

In the summer of 1957, the Bureau cooperated with a New Mexico potash company in the treatment of a refractory potash ore. This was the first time that the Bureau has entered into a cooperative program with a mining company in metallurgical testing or research. This

activity was without expense to the State, as all costs, including staff time, were paid by the cooperating company. Considerable information of value both to the mining company and to the Bureau was accumulated.

In the summer of 1958, the Bureau experimented with the use of newly developed organic compounds as flotation collectors on various New Mexico ores. It is hoped that this work will result in improved methods for treating some of the refractory copper, zinc, and manganese ores in the State. . . .

Biennial Report, 1958-59 and 1959-60

by A.J. Thompson, Director

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. . . .

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 local 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 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. . . .

Biennial Report, 1960-62

by A.J. Thompson, Director

. . . Of special significance in the Bureau operation during the biennium has been the greatly increased activity in the metallurgical section. A number of additions to the staff in this section were made, allowing the Bureau to increase the depth and breadth of studies in beneficiation of the State's low-grade and refractory ores. Construction of a large metallurgical laboratory of modern design was completed during the biennium, which will further aid the Bureau's metallurgical work in the coming biennium. Geological studies and mineral surveys, in progress and contemplated, will be correlated with the metallurgical program to provide a better understanding of the State's mineral potential and augment its future development. . . .

Mining

The Bureau's mining engineer has been engaged in a rock-mechanics research program. The basic aim of this project is to

study stresses in mine rock. This is a fundamental research project which, if successful, will promote the design of safer and more efficient underground openings. . . .

In accordance with the provisions of the New Mexico statutes, the Director of the Bureau serves as chairman of the Mine Safety Board established by the State Legislature in 1961. . . .

Metallurgy

. . . . The building program in the fall of 1961 called for a new addition which was completed at the end of the biennium and the metallurgical department made plans to move into its expanded quarters.

The new facilities provide 4000 square feet of working area for the metallurgical section and house the sample preparation, mineral beneficiation, hydrometallurgical, and pyrometallurgical laboratories. Also provided is sufficient space for conducting pilot-plant studies, if required. The vacated laboratory space in the older part of the building now may be used for chemical, analytical, and additional metallurgical laboratories for dry-mineral beneficiation processes, studies on ion-exchange and solvent extraction, and basic research on various phases of extractive metallurgy.

About \$20,000 worth of metallurgical equipment and supplies

were purchased by the Bureau in the two years and put to good use on various projects. This equipment is also available to the College Division, and is being installed permanently in the new metallurgical laboratories. . . .

Paleontology and Stratigraphy

. . . A study of the colonial corals of the Montoya group was completed. This is the first extensive study of fauna of this sort in North America since 1929. Some four hundred thinsections were prepared and comparisons made. Three weeks were required for comparison with the collections of the United States National Museum at Washington. The work is the first on western Ordovician coral faunas based upon specimens of precisely known origin and will serve as a basis of comparison for similar future studies in other regions. Tiny foreign organisms of 18 different kinds, not before noted, were found and described in an accompanying paper. Though the study could not be extended to include the material, related forms previously ignored were found in comparative study of U.S. National Museum specimens on corals in Norway, Anticosti Island, and Utah. . . .

Ground Water

. . . As a special study the Bureau hydrologist is collecting water samples to determine the correlation of change in the amount and

composition of dissolved solids with pumping. This study will require another season or two of data collection, since the primary correlation appears to be one of change versus quantity pumped. Water samples have been obtained from the selected wells at the end of each pumping season and estimates of pumping times were made and discharges measured.

Biennial Report, 1962-63 and 1963-64

by A.J. Thompson, Director

General Statement

. . . Major projects that should be undertaken or expanded in addition to present activities relate to coal, ceramics, mineral economics, and oil and gas exploration.

Most of the coal in New Mexico occurs on Federal lands and in the past most of the coal exploration and research work has been conducted by the Federal agencies, the U.S. Geological Survey and the U.S. Bureau of Mines. The New Mexico Bureau of Mines to date has not engaged in any coal research but it now appears that state support of a general study of fuels, particularly coals, should be forthcoming. With its tremendous reserves of coal and uranium, and its recognized importance as a producer of oil and gas, New Mexico should be active in all phases of fuels research and development and a leader in this field.

Coal research by the Bureau should consist first of studies of the various types of coal in the State to obtain the conventional data

on chemical and physical characteristics. A second phase would consist of an evaluation of the processes of coal conversion which are most suitable for use on the various kinds of coal found in New Mexico. This would take into account the economic factors associated with the State's industrial development, and economic studies in relation to how the fuels found in New Mexico can best be utilized. With the current anticipated development of New Mexico coals for use in power generation to supply New Mexico and surrounding areas, another line of research is indicated. This would consist of engineering evaluations and exploratory research on methods for control of atmospheric contaminants in flue gases and general air pollution studies. . . .

Annual Report, 1964-65

by A.J. Thompson, Director

TO: President Stirling A. Colgate
Members of the Board of Regents
Members of the New Mexico Legislature

I am pleased to transmit to you the annual report of the New Mexico Bureau of Mines and Mineral Resources for the fiscal year ending June 30, 1965. Previous reports by the Director of the Bureau have been for a biennial period to conform with the biennial sessions of the Legislature. Beginning with this report, which is for the first year following the establishment of annual sessions of the Legislature, yearly reports will be made.

For the period June 30, 1964 to June 30, 1965, the Legislature appropriated \$365,000 to the State Bureau of Mines and Mineral Resources, an amount which has been approximately the same for the last few years. During this period the Bureau spent \$389,093, drawing on income from the sale of publications and its reserve fund to offset the deficit. This is a report of how the funds were

used and what was accomplished with them.

For the 1965-1966 fiscal year, in which the Bureau is now operating, the Legislature appropriated \$400,000 which has had to be augmented, again from surplus, to \$428,700 to take care of anticipated needs. This withdrawal^a from the surplus has essentially exhausted the reserve fund. In the forthcoming 1966-1967 fiscal year the Bureau will have to depend upon a substantial increase in State appropriations in order to meet its goal of an annual increase of service in support of mineral industry development. . . .

Respectfully submitted,

Alvin J. Thompson
Director
State Bureau of Mines and
Mineral Resources

Introduction and Summary

. . . Several new or expanded activities during the 1964-1965 period are of special interest. A project was begun on the geology and mineral resources of Rio Arriba County. Preliminary investigations were initiated in the areas of ceramic resources and thermal power development in New Mexico. Research in the field of ore processing was greatly expanded. In connection with these activities, the Bureau began the acquisition of new and mark-

edly improved analytical equipment for determining the components of the extremely wide variety of mineral products with which the State is so unusually endowed. It is confidently expected that these new endeavors will provide an increased return to the State, all out of proportion to the funds invested. . . .

Activities, Basic and Applied Research

Basic and applied investigations of the Bureau of Mines and Mineral Resources are conducted in geology, mining, metallurgy, petroleum, hydrology, and ceramics. . . .

Studies and projects that have been initiated or have received special attention in the past year are:

Geology and Mineral Resources of Rio Arriba County. On December 8, 1964, the Governor's Advisory Committee on Mineral Development submitted a report recommending a special appropriation to carry out an accelerated program of studies of the mineral resources of Rio Arriba County. Although the special funds were not provided by the legislature, the Bureau used its regular staff to take the initial steps in this project.

Clay Resources Survey. A field investigation was pursued during the year to delineate the potentially valuable clay deposits of New Mexico. Initial data were accumulated and adequate space was obtained on New Mexico Institute of Mining and Technology campus. A laboratory was set up with testing equipment to determine the suit-

ability of the clays for use in making bricks, piping, electrical insulators, and other ceramic products. This project, already started at the Bureau, was also one recommended by the Governor's Advisory Committee on Mineral Development on December 8, 1964.

Like the Rio Arriba project, funds have not yet been provided by the legislature for an accelerated program.

Geothermal Studies. Geothermal studies of heat sources were initiated with reference to their possible use for supplying industrial electricity, for changing crop-growing seasons, and for heating of homes.

Ore Processing. Studies were made to determine better ways of extracting metal from ores now being mined in the state, including the possible use of bacteria in mining and the improvement of equipment designs. Pyrometallurgical, hydrometallurgical, and mineral dressing methods were used to an increasing extent in the Bureau's long-range program of research on the recovery of valuable products from New Mexico low-grade and refractory ores.

Mineral Identification. In 1964 and 1965 the Bureau initiated the use of atomic absorption testing equipment. When its utility is fully developed, it is expected that the speed and accuracy of the analytical work will be increased several fold. Mineral identification and analysis is important to almost every field of mineral research. . . .

Annual Report, 1965-66

by A. J. Thompson, Director

. . . Offices of the Bureau of Mines are on the campus of the New Mexico Institute of Mining and Technology. The Bureau is organized as a branch of the Institute and does not maintain sub-offices.

The staff included during the year 19 professional, 15 non-professional, and 74 part-time employees, including 12 graduate student employees, 26 co-op student employees, and 33 other student employees. There were also four geologists and engineers on special projects. . . .

Bureau Activities, Administration

The New Mexico Bureau of Mines and Mineral Resources is charged with investigating, studying, and reporting the technology of the State's mineral resources. It is responsible for conducting research on all types of ore deposits for the purpose of increasing the production and use of the State's minerals resources, with due regard to proper conservation. Immediate and future needs, indus-

try trends, and the probable by-product aspects of mineral production are important factors guiding the Bureau's research.

Activities of the Bureau cover basic and applied investigations in eight major fields: Ceramics, Geology, Hydrology, Metallurgy, Mining, Mineralogy, Paleontology, and Petroleum. . . .

Petroleum

. . . Mr. Robert Bieberman, petroleum geologist, who has charge of the Petroleum section's activities, is responsible for maintaining the sample library and the petroleum maps. . . .

Mr. Bieberman has published Circular 72 (1966), Petroleum Developments in New Mexico during 1960, and Circular 88 (1966), Index to Samples From Oil and Gas Well Tests in Library Tests at Socorro, July 1, 1966. . . .

As a contributor to the Bureau's co-operative projects, Mr. Bieberman also completed the New Mexico section of the directory, Sample and Core Repositories of the United States, Alaska, and Canada, for the Committee on Preservation of Samples and Cores of the American Association of Petroleum Geologists.

Mr. Roy Foster, associate petroleum geologist, has been occupied with research in petroleum geology and nonmetallics and has made significant contributions to the petroleum work of the Bureau. His petroleum projects initiated during the year have been the following:

1. Preliminary investigations of the shale oil potential in New Mexico.
2. Oil and gas exploration in Colfax County.
3. Post Queen stratigraphy of southeastern New Mexico.
4. Analysis of the stratigraphy of the Sun well in the San Agustin Plains... .

Dr. Frank Kottowski, economic geologist and assistant director of the Bureau, contributed to the Bureau's activities in petroleum research. He is the author of an article, entitled "Sedimentary Basins in South-Central and Southwest New Mexico," printed in the Bulletin of the American Association of Petroleum Geologists, November 1965. He also edited articles for publication by the AAPG in co-operation with personnel from the United States Geological Survey, Nevada Bureau of Mines, U.S. Soil Conservation Service, University of New Mexico, and various petroleum companies.

Geology

Geology is a necessary background for development of mineral resources. Reconnaissance geologic maps, detailed geologic maps, stratigraphic studies, investigations of ore minerals--these and other types of geologic research aid in finding and extracting New Mexico's minerals. Most of the reports published during the year were geologic in nature. What may seem to be purely research today may turn out to be economically important in the future. . . .

In the field of technical geology, a wide range of studies was made. Ten studies were completed and published, some of which also have a bearing on ceramics and petroleum. . . .

Seven Bureau staff members contributed the major part of the geologic studies during the current year: Dr. Robert Bieberman, petroleum geologist; Mr. Roy Foster, associate petroleum geologist; Dr. Frank Kottlowski, economic geologist and assistant director of the Bureau; Dr. Jacques Renault, associate geologist; Dr. Edward Bingler, associate geologist; Dr. Robert Weber, economic geologist; and Mr. Kelly Summers, groundwater geologist. . . .

Projects on which Dr. Kottlowski is continuing research and which were started during the year are the geology of the Las Cruces quadrangle, the Pennsylvanian and early Permian rocks of the Joyita Hills, and the dating of igneous rocks of Parajito Peak. . . .

Metallurgy

The metallurgical section conducts studies in various aspects of extractive metallurgy and provides technical assistance to those who request it. A great many prospectors and small-mine operators and most of the major mining companies have availed themselves of this service.

Dr. Roshan Bhappu, senior metallurgist and research professor,

and Dr. Dexter Reynolds, research chemist, initiated or completed numerous projects and work assignments. They are engaged primarily in:

- (1) Base and applied research in extracting metals and minerals from ores;
- (2) Service work in the form of assistance or consultation with individuals and mining companies in solving operating problems and in metallurgical evaluation of ore samples submitted;
- (3) Long-range studies involving surface chemistry of silicate minerals, sorption processes in hydrometallurgy, and studies of in-place and dump-leaching ores; and
- (4) supervising the training of several co-operative students at various levels, providing in the laboratory, a practical application of the students' college training. Dr. Bhappu gives special lectures in chemistry and metallurgy to classes in the College Division and supervises graduate theses work. He supervises the undergraduate work of National Science Foundation students.

Also initiated or completed and of interest to the mining industry at large were the following projects:

Evaluation of potassium permanganate in mining and metallurgical applications

Recovery of beryllium from Winston mine ore

Studies of tungsten-iron complexes

Recovery of valuable by-products from Socorro County manganese ores

Sulfonate flotation of olivine group minerals

Use of chelating compounds as selective flotation reagents for copper and zinc minerals

A geochemical model of ground-water in contact with a solid media.

Ceramics

The Governor's Advisory Committee on Mineral Development on December 8, 1964, recommended a clay resources survey to delineate potentially valuable clay deposits in New Mexico.

Clay uses are numerous and among other applications include the manufacture of tableware, bricks, electrical insulators, and soil and sewer pipes. Mr. William Hawks, ceramic engineer, is in charge of the Bureau's studies in ceramics and directs the work in the clay testing laboratory that was set up last year and is maintained by the Bureau. Clay and shale samples are submitted by individuals and by industry and are collected by Bureau personnel in the field. Mr. Hawks also teaches a course in ceramic engineering in the College Division of New Mexico Tech.

Current projects under his supervision are a study of the feasibility of building additional ceramic plants in New Mexico and possible utilization of New Mexico clays.

Mineralogy

Identification of minerals, rocks, ores, and clays is offered New Mexico residents free of charge. Dr. Edward Bingler, associate geologist; Dr. Robert Weber, economic geologist; Dr. Dexter Reynolds, research chemist; and Dr. Jacques Renault, associate geologist, are the four persons who are called upon for this type of service. To aid in identification, the mineralogy laboratory facilities include X-ray diffraction apparatus, petrographic microscopes, X-ray fluorescence unit, radiometric apparatus, spectrophotometers and an emission spectograph. . . .

Dr. Renault initiated four mineralogy projects this year: statistical analysis of rock textures, crystal perfection studies, lead mineralogy of Questa molybdenum concentrates, and the Ducktownite project, a determination of the nature and treatment of Ducktownite ore, a complex copper-iron bearing ore from Kennecott Company's Chino mine.

Mining

New Mexico hoists more metallic and nonmetallic ore from underground than any other State in the Union. The Bureau's rock physics research, its studies in better ways to extract minerals from refractory ore, and its research in geochemical prospecting continue to be major efforts directed toward aiding the mining industry.

The entire Bureau staff served as consultants to numerous prospectors and exploration personnel of mining and petroleum companies on

problems pertaining to economic mineral deposits during 1965 and 1966.

Mr. George Griswold, mining engineer, whose primary research for the Bureau during the past year has been in rock mechanics, taught engineering drawing, directed study in mining, rock mechanics, and mechanics of materials courses in the College Division.

Mr. Griswold did considerable work on the following projects:

Project Mohole

Explosive Hydrofracing

Lead Wires

Open-Pit Slope Stability

Raise Boring Device

Underground Nuclear Explosions Project

Geothermal Study Within Woods Tunnel in Socorro Peak

Index of Literature on Mining Engineering for the Period 1950-1966

... Dr. Fazlollah Missaghi, mining engineer, has been working on three projects: biogeochemistry and geochemical survey of the Red River quadrangle, a geochemical survey of stream sediments in Philmont country, and a geochemical survey of the Magdalena mining district, New Mexico, the mercury content of stream sediments.

Mining Records

Mr. Lucien File, staff researcher, coauthored a listing of county,

township, and range locations of New Mexico mining districts with Dr. Stuart A. Northrop of the University of New Mexico. The purpose of the study is to clarify mining district locations and to offer a measure of standardization as a guide line for future designation of mining districts. The information was compiled in co-operation with the Bureau of Land Management and the State Inspector of Mines and contains a complete history of mining in New Mexico from 1535 to 1966, as well as a table of dates of establishments of New Mexico counties.

Also published by Mr. File during the year was a compilation of a mining directory listing most of the known mines in the State, along with some historic mining companies names.

Mr. File initiated a program for the exchange of information by microfilm and other methods among the Bureau of Land Management, the State Archives Division, and the State Bureau of Mines. The information, not heretofore available, will provide a source of research information on the history and economic aspects of individual mines, particularly of those no longer in production. . . .

Strip Mining Study

The Federal Appalachian Regional Development Act provides for a study of recommendations for reclaiming and rehabilitating strip and surface mines through the nation. At the request of the Appalachian Regional Commission, the New Mexico Bureau of Mines

assisted in preparing a preliminary report of the extent of strip mining in the State. It also co-ordinates a meeting of all State department heads concerned and a working committee from the Department of the Interior and several national agencies. The meeting was held in Mabry Hall, State Capitol Building, July 27, 1966, with preparatory work completed in the year by this report.

Hydrology

The Bureau as a State agency charged with the responsibility of investigating underground resources maintained its interest in the ground-water resources field. For several years, the activity of the agency in this area was in the location and evaluation of water wells and in studying ground-water problems. These activities have continued.

Recently, however, emphasis shifted to the study of geothermal resources. The economic implications of heat and hot water sources are enormous, with possibilities of use for generating electricity, for furnishing heat for homes, as a source of preheated water for steam energy production, and for crop growing, especially in greenhouses.

Mr. Kelly Summers, ground water geologist, is engaged in the study of thermal waters and the prospects of developing geothermal

power in New Mexico.

Mr. Summers is preparing a bibliography of geothermal phenomena and since September 1965 has been working under a matching fund grant from the U.S. Department of the Interior, Office of Water Resources Research, on a project entitled, "Appraisal of Some of the Factors Adding to or Subtracting From the Socio-Economic Use of New Mexico's Thermal Waters."

Paleontology

Knowledge of the fossil content of rocks serves to fix the age and to permit intelligent correlation of units whose continuity is interrupted by erosion or cover with other formations. Certain formations are more favorable as locations for petroleum and natural gas accumulations; others are more favorable for locations of uranium; and still others for various other metals and nonmetals. . . .

Dr. Rousseau Flower, stratigraphic geologist in charge of this section, is primarily concerned with the fossils of New Mexico, concentrating largely on those of the older formations. However, his services have been in demand from all over the world in consultation for identification and description of cephalopods.

Annual Report, 1966-67

by A.J. Thompson, Director

Objectives and Duties

In 1927 the Eighth State Legislature established the Bureau of Mines as a division (department) of the School of Mines, which was changed by later statute to the New Mexico Institute of Mining and Technology. The objectives and duties of the Bureau were set forth in twelve paragraphs, which are summarized in the following headings. Under these headings some of the Bureau activities, fulfilling these directives during the period covered by this report, are set forth briefly:

(1) "Collect, compile, and publish statistics."

- (a. Statistics on mines and mining companies are kept and directories of mines and mining districts were published.
- b. The contents of the petroleum sample library were indexed and the index published, as a perpetual activity.

(2) "Collect typical geological and mineral specimens."

- a. Samples of well cuttings are stored for public use in the Bureau petroleum section.

b. A museum of geological specimens is maintained for student and public use in the R&D Building by the Bureau.

(3) "Collect a library and bibliography of literature pertain-

ing to the progress of geology, mining, milling, and smelting. . ."

a. Indexes to mining records are maintained.

b. Mining history and bibliography is being researched.

c. A file of geographic place names for cartographic purposes is maintained.

d. Microfilms of Bureau of Land Management mining records are maintained and kept up to date through cooperation with BLM.

e. A project in cooperation with the Archives Division of State Government provides for a copy of all mining data in county courthouses, when furnished to the Archives, to be made in microfilm for Bureau filing and use of the public.

f. Bulletin 90 published, . . . a complete Bibliography of New Mexico Geology and Mineral Technology.

g. The Atomic Energy Commission has furnished the Bureau with microfilms of records of uranium deposits in the state to be used by the industry, scientific workers, and students. Copies of these are furnished on request.

(4) "To study geological formations of the state with special reference to the economy of mineral resources. . ."

a. Memoir 17, Geology of Pennsylvanian, Wolfcambrian, Rocks in Southeastern New Mexico, published.

b. Memoir 18, Geomorphic Surfaces and Surficial Deposits in Southern New Mexico, published.

c. Circular 85, Geochemical Survey of Magdalena District. Mercury Content of Streams, published.

d. Groundwater 8 Bulletin, A Study of Groundwater in Union County, published.

e. Groundwater 9 Bulletin, Study of Groundwater in Quay County, published.

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

a. Topographic mapping assistance has been given the USGS.

b. Memoir 18 by Ruhe, listed under (4) is carrying out this objective as well fulfilling item four above.

c. Bulletin 81, a summary of the Mineral Resources of Bernalillo, Sandoval, and Santa Fe Counties, and the several other area surveys listed in department activities and in abstracts of publications in this report fulfill this directive and directive (4) above.

d. Many of the studies and research projects that are on-going, studying the paleontology, mineralogy, and geology of selected areas of the state are in fulfillment of this directive.

(6) "To study mining, milling, smelting operations . . . with special reference to their improvement."

a. Practically all of the work of the Metallurgy section reported herein is directed toward finding better methods of refining ore or obtaining values from mining, milling, and smelting operations.

b. The following publications, and others, specifically fill this directive: Circular 86, Study of Precipitation of Copper on Iron from Acid Solutions. Circular 89, Chemical Interpretation of Surface Phenomena in Silicate Minerals. Circular 90, Correlation between surface phenomena and flotation silicates.

(7) "To prepare and publish bulletins and reports with the necessary illustrations and maps which shall embrace both general and detailed descriptions of natural resources, geology, and mines, mineral deposits, etc.

a. Practically all publications by the Bureau are carrying out this directive. . . .

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

Dr. Edward C. Bingler, assisted by graduate students, had this phase of the Bureau work assigned as one of his major undertakings. X-ray and spectrographic analysis are run, if necessary, in the various sections concerned. Dr. Bingler resigned to teach geology at South Dakota School on Mines in August 1967; the work is now under the direction of Dr. Robert H. Weber.

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

The old time prospector and miner is rare today. However, the services assigned the Bureau under section 9 have been continuing in the form of assistance to mining companies, professional engineering organizations such as AIME, Exploration Geologists, Consulting Geologists and Mining Engineers. These are served by Bureau personnel. All staff members are available for this purpose and fulfill this directive by letters, consultations, speeches to societies and teaching in classes. . . .

(10) "To consider such other kindred scientific and economic problems and questions as in the judgement of the Board of Regents shall be deemed of value to the people of the State."

The Board of Regents by approval of this annual report, and by directing the Bureau to carry out such activities as they "deem of value," have control over any projects not specifically directed by the legislature in items 1 thru 9 and 11 and 12.

(11) "To communicate special information on New Mexico Geology, Mining, etc. . . and to serve as a bureau of exchange and information in the mineral, oil, and natural gas resources."

Work under this directive is exemplified by such activities as described for the petroleum section, microfilming and copying AEC uranium location records and having them available for the industry: studies of dual nuclear explosives to increase

rock fragmentation and the effects of thunderstorms on detonation of explosives. This information is transmitted to interested companies such as Sandia Corporation for specific application. The Bureau furnishes speakers whenever requested to communicate information on geology, mining, etc. to interested groups.

(12) "To cooperate with the University of New Mexico, State Mine Inspectors and with other departments (of State and Federal Government). . . as may be mutually beneficial." Many studies have been undertaken and reports published in cooperation with State and Federal government agencies. In the area of cooperation with various organizations, the Bureau has furnished speakers, editing service, and research service. These instances of cooperation during the year 1966-67 are listed in the section of this report on Cooperative Activities. . . .

Ceramics

William Hawks, Ceramics Engineer, was in charge of the studies of clay and shale, the ceramics laboratory and the location of possible sites for obtaining ceramic materials in New Mexico, for such products as tableware, bricks, electrical insulators, soil and sewer pipes, etc. Mr. Hawks resigned in

September 1966, to accept a job with industry and has not been replaced. Some work has been done on ceramics by Mr. Roy Foster, Associate Petroleum Geologist. . . .

A Suggested Program to Aid Development of the Mineral Industries in New Mexico, by A.J. Thompson

Mineral resources are a major factor contributing to the economic growth of New Mexico. The State's mineral production in 1966 had a value of 844 million dollars. Of this amount mineral producers paid directly into the state and county treasuries in excess of 70 million dollars. Indirect revenues would add significantly to this total. These funds now provide a large share of the revenue derived for the support of the state's school and governmental activities. . . .

Present Status of State-Supported Mineral Industry Field Activities With Recommendations

The State Bureau of Mines and Mineral Resources is by statute responsible for such studies and programs in the mineral industry field as will serve best to develop the state's mineral potential, as this in turn will best serve the interest of its people. However, the Bureau of Mines also is charged with a wide variety of service work which, under the appropriations normally provided, greatly limits other efforts that should be exerted to extend and

improve the development and utilization of the state's mineral wealth.

The State Bureau of Mines with what funds are available has supported both long range and short term research in mining and metallurgy. Because of the large expenditures that are required the state might not be justified in extensive exploration work. Nevertheless, the state can do things that would encourage others actively and extensively to explore for mineral deposits. The Bureau has endeavored to create interest in mineral development in New Mexico by the publication of geologic reports of potentially mineralized areas and of bulletins covering the known mineral resources of the counties which appear to offer the best prospects for future mineral development. Because of limited funds the coverage to date is far from complete. It is suggested that adequate funds should be provided to accomplish the following activities over the next five-year period.

The Bureau has published bulletins on the mineral resources of seven counties. A survey should be undertaken and reports issued on the remaining twenty-five.

Reports have been prepared on a number of mineral commodities but a great deal more such reports should be forthcoming. Of special interest, as seen in the light of present knowledge; are studies on uranium, silver, gold, rare earths, mica, strippable-coal, and building materials (including clays, silicia, and sand

and gravel).

Geology and groundwater reports have been completed for ten counties. There is an ever increasing need for such reports that cover the whole state. The new studies should be expanded to include information on the geologic underground structure as it relates both to reservoirs and reserves of liquid fuels as well as water. Reports on the petroleum possibilities of each county would be of aid to petroleum exploration.

There have been tremendous advances in the art and science of geophysical prospecting in recent years. Important finds being made with the aid of geophysical methods attest to the increasing effectiveness of the methods. It is proposed that the State support geophysical surveys of the areas in the State that appear to offer the most promise of having subsurface mineral emplacements.

The program should comprise airborne electromagnetic, magnetic, and radiometric surveys. In some cases geochemical ground surveys should be made to supplement the records. It is suggested that the initial work be in areas where the bulk of the land is owned by the State, since the greatest financial gain to the State would be forthcoming from new discoveries made on these lands.

These studies of the water and mineral resources of the counties and of commodities available in the State as a whole, together with the geophysical surveys, would help to satisfy existing demands for mineral information. By providing an account of the quality and

extent of the known and estimated mineral occurrences in the various areas of New Mexico, and by providing scientific and geologic guides to potentially new deposits, these studies would be a great stimulant to further mineral development in this state.

It is anticipated that to complete this program of field studies in the course of a five-year period would require an expenditure in the order of \$500,000 per year. This is an amount equal to only about 0.06 percent of the value of state's annual mineral production. It seems reasonable to believe that appropriations so provided would yield returns far out of proportion to the amount invested.

A relatively short period is proposed for studies to reveal the nature and extent of the state's mineral wealth because much is to be gained by having such information available soon. Because markets are often a determining factor in the exploitation of some commodities, mineral developments in one area often preclude or delay developments in adjoining areas. This is a consideration that can apply on a statewide basis. New Mexico in the past has lost markets which it might have had, both within and without the state, because other areas have been ahead of it in the development of supplies to meet commodity demands as they occur.

Present Status of Laboratory Research

In the past as potentially fruitful areas of research have been uncovered, either as a result of the Bureau's own field studies or as a result of field studies by others, appropriate laboratory investigations have been initiated. The extent and breadth of the research covered, however, has been limited by the staff and funds available. Some of the major areas in which the State Bureau of Mines now is supporting long range and short term studies are as follows.

- (1) the use of conventional beneficiation processes for the recovery of various metallic and nonmetallic minerals found in the State;
- (2) the application of new chemical and metallurgical techniques to mineral recovery processes now in use or under consideration;
- (3) the possibility of economic recovery of rarer metals or minor mineral constituents from undeveloped deposits known to contain them, or from dumps and tailings that have resulted from past mining operations;
- (4) methods and technology that might be applicable to the extraction of metals by chemical-mining of ores in place, including a study of the application of nuclear energy to prepare the ore for in-place leaching; and
- (5) an overall evaluation of the State's potential for ceramic industry development.

Proposal for Expanded Research in the Mineral Industry Field

A major area of research in which work has not been done to date is in the field of fuels. New Mexico ranks among the top states in the nation in fuel resources and should be actively engaged in research relating to their utilization. Various phases of fuel research in which the Bureau should undertake studies are:

- (1) carbonization and decomposition of coal, including a study of the kinds and quantities of products that are formed when New Mexico coals are heated by various means;
- (2) the utilization of low-grade fuels in the mineral processing of New Mexico ores; or in the manufacture of such products as cement, paper pulp, or glass;
- (3) in-place production of gas from coal;
- (4) the upgrading of low-grade coals;
- (5) the upgrading of low-grade uranium ores;
- (6) the low temperature carbonization of sub-bituminous coals in a fluidized bed, to produce useful yields of tars along with a powdered char which could be useful in large-scale furnaces and power plants;
- (7) the synthesis of organic compounds from natural gas;
- (8) the formation of water soluble humic acids by the oxidation of coals and chars;
- (9) the recovery of by-products such as helium and carbon dioxide from natural gas;

(10) the utilization of coals in road construction.

A list of other specific projects which would be deserving of state-supported research are presented below. Some of these are ones which might be in part supported by private capital after enough development work has been done to indicate some commercial possibilities.

Nonmetallic

- (1) production of high purity silica for glass manufacture;
- (2) production of high purity feldspar for glass manufacture;
- (3) the expanding of bloating characteristics of New Mexico clays and shales, for use in the building industry;
- (4) field and laboratory studies in the utilization of natural building block material in New Mexico;
- (5) methods of improving road aggregate material;
- (6) recovery of mica and associated rare pegmatites and granites of northern New Mexico;
- (7) utilization of the State's enormous reserves of gypsum; and
- (8) the occurrence and utilization of roof rock, shingling granules, and landscape rock in New Mexico.

Metallic

- (1) basic study on the genesis of ore deposits;
- (2) the recovery of zinc oxides from complex ores;
- (3) by-product recovery of tungsten from base metal ores;

- (4) upgrading of taconite and other low-grade iron ores;
- (5) beneficiation of low-grade manganese ores;
- (6) the recovery of titanium and columbium from sandstone deposits in northern New Mexico;
- (7) the recovery of copper from low-grade copper silicate ores; and
- (8) the upgrading of submarginal uranium ores to bring them into a commercial range.

Promising Fields of Process Research

- (1) the use of ultrasonic or electrical vibration for jiggling or dispersion;
- (2) the use of bacteria in the concentration of ores;
- (3) application of flotation to problems in other industries;
- (4) electro dialysis as applied to metal recovery;
- (5) the use of dutch cyclone as a means of concentrating fine ores; and
- (6) the application of vacuum magnetic levitation to metal refining.

The successful conclusion of an investigation in any of these lines of laboratory research could make a significant contribution to the State's economy. Other areas of investigation not noted here no doubt will be forthcoming as more becomes known of the State's mineral potential, and as technology advances and the needs of the market changes.

Areas of Joint Field and Laboratory Research

In the field of ore-reserve development the Bureau has contemplated a research program directed towards improving exploration techniques. Although actual field-drilling and exploration work probably could not be justified, some expenditure of State funds on drilling and geophysics research for the purpose of lowering exploration costs would appear to be a worthwhile and proper state-supported activity. The Institute as a whole is eminently qualified to undertake such a study with its staff composed of a wide variety of specialists in physics, geophysics, mathematics, and mineral technology. The theoretical and practical aspects of the problem could be jointly and effectively pursued. The effort would be directed toward the phases of drilling and other exploration techniques that have the greatest bearing on New Mexico's special problems and terrain.

In the field of mining, theoretical studies have been made at the Institute on the application of hydrofracturing and in-place leaching techniques to the treatment of deeply buried mineral deposits.

These studies offer promise of greatly reducing the overall-costs of extracting metals from certain types of ores. The principles and techniques developed should have application also to treatment of worked-out mines, waste dumps, and tailing piles. From the standpoint of mineral conservation alone this line of investigation should be continued, and on an expanding scale. . . .

Appropriations

In the first part of this report it was proposed that a five-year program be initiated to make a survey of the commodity resources of New Mexico and complete county reports on mineral and water resources. An annual appropriation of \$500,000 per year was suggested.

The other phases of state-financed activities in support of mineral development in New Mexico should be on a continued basis, as part of the normal work now being performed by the New Mexico Bureau of Mines and Mineral Resources. The purely informational and service activities would require an expenditure of around \$300,000 annually. It is believed that the augmentation of Bureau appropriations to a level on the order of one million dollars per year to incorporate activities in all the phases mentioned in this report is more than justified. For the five years during which the surveys were being conducted the total appropriations for the Bureau would be around one and one-half million dollars annually.

To aid in the proper expenditure of such funds it is recommended that a committee composed of representatives of the mineral industries and the state government be appointed by the governor. This committee would review and approve all programs proposed by the Bureau and consider any other programs or areas of activity that may be suggested to them. Such a committee should serve the pur-

pose of insuring maximum economy and effectiveness in carrying out this state-supported work.

In conclusion it should be pointed out that the state has a special interest in its mineral resources. One-sixth of the mineral lands in New Mexico are owned by the state. By virtue of this ownership the state receives around 30 million dollars each year in revenue in the form of bonuses, royalties, and rentals from those who lease the state-owned lands. A few percent increase in revenue from this source alone would more than justify the expenditures proposed in this report.

Annual Report, 1967-68

by Fránk E. Kottlowski, Acting Director

Bureau of Mines and Mineral Resources

Although established in 1927, the Bureau was only sprádically active until the late E. Carter Anderson became director in 1945. During his four-year term, Mr. Anderson began building an effective Bureau of Mines. His sucesor in 1949, Eugene Callaghan, continued this expansion, initiating many geological and mineral resources projects and increasing the professional staff to 17 earth scientists.

Alvin J. Thompson was appointed director in 1957. He diversified the activities of the Bureau, instituting a large metallurgical and chemical analysis section, as well as continuing a broad mineral resources and geologic program.

By 1957, the Bureau had published 41 bulletins and 42 circulars, reflecting the results of its first 29 years of scientific work. Mr. Thompson encouraged completion of pending and publication of additional mineral resources, geological, and metallurgical reports. During his term as director, 49 bulletins, 20 memoirs, 5 ground-water reports, 51 circulars, 5 scenic trips guidebooks, and 4 resources and

Brigham Young University

Continued study of the Ordovician cephalopods of the Ibex region of Utah, supported in part by a NSF grant to that institution.

The cephalopods are being described here (Flower).

Carcus Chemical Company

Evaluation of potassium permanganate in flotation of sulfide minerals (Met. section).

Federal Bar Association

Prepared the 1968 Annual Meeting of the Committee on the topic of "160 acre limitation on water use in Federal Land Law", served as National Deputy Chairman, Committee on Mines, Minerals, and Natural Resources. (Bertholf).

Review of various public lands laws.

Review of Commission matters.

Conversion of property data to uniform digitized law descriptions (with W.K. Summers).

Digitization of the geography-geology for New Mexico (Bertholf and graduate students).

Application of the doctrine of waste and the duty of the sovereign to manage resources efficiently and effectively (Bertholf).

National Deputy Chairman (Bertholf). Term completed Nov. 1967.

New Mexico Chapter in co-operation with State Bureau of Mines published Water Law Atlas. (Bertholf).

Geological Society of American

Cochairman coal geology division. Technical sessions at November

land-status reports were issued. These Bureau reports serve as standard reference materials on New Mexico's mineral resources and are widely used by the mineral industry.

During his distinguished career of service to the mining and metallurgical industries, as chairman of New Mexico Tech's department of mining and metallurgy, and as director of the Bureau, Mr. Thompson personally wrote some 17 published reports, including three on silver, lead, and zinc deposits of New Mexico.

Mr. Thompson has served on the Board of Directors of the New Mexico Mining Association for twenty years and was a past president of that organization. He helped establish and is a past chairman of the Central New Mexico Section of AIME. For the past eight years, he has been chairman of the New Mexico Mining Safety Advisory Committee.

Administration

Besides project planning and guidance, the director of the Bureau is responsible for supervising technical work, budgetary management of funds, and supervising personnel. The director also provided information to the public by phone and letter and personal conferences. He acted in an advisory capacity to the metallurgy section in projects involving extractive metallurgy.

Special activities during the report period included a directorship on the Board of Directors of the New Mexico Mining Association and

chairmanship of the New Mexico Mining Safety Advisory Council, Association of the State Geologists, and the Executive Committee of the New Mexico Institute of Mining and Technology.

The assistant director of the Bureau, in addition to his duties as economic geologist, served as adviser for geologic projects, supervised technical editing of publications, and assisted in public relations, answering mail and personal inquiries. . . .

Museum

The Bureau maintains a museum of geological and mineralogical specimens for general use, consisting of more than 10,000 specimens from all over the world. Recent exhibit gifts by Standard Oil Company have allowed us to set up a display of petroleum geology and refining. The museum is in the Bureau wing of the Research Building, is open to the public, and is maintained by Dr. Robert Weber and Dr. Jacques Renault with student help. A travelling display of these minerals was shown at the state meeting of Gem Clubs at Deming in May 1968. The exhibit designed by Lorna Goebel, a graduate student, won third prize in the competition. Ronald Riese, another graduate student, supervises the permanent displays.

Bureau Projects

One half to one third of the Bureau's work consists of service to the various parts of New Mexico's mineral exploration and development

industry. Scientific investigations by the Bureau's professional staff members range from fundamental studies of rocks or of metallurgical and chemical properties of ores through direct applied projects that aid in finding new mineral deposits to contract work for individual development and producing companies.

The projects are divided into three groups according to their major emphases; (1) geology and mineral resources, (2) metallurgy and chemistry, and (3) mining and economics. Bureau funds are divided among these three groups in the appropriate ratio 42:46:12, respectively. The majority of published reports made available to the general public concerns geology and mineral resources. Many of the results of research projects in metallurgy, chemistry, mining, and economics apply only to a specific ore or mine studied; therefore, these reports are submitted only to the company or individual involved. . . .

Co-operative Projects

The Bureau is required by law to co-operate with the University of New Mexico, the State Mine Inspector, and other departments of the state and federal governments, "as may be mutually beneficial."

Following is a [partial] listing, by agency, of the activities of the Bureau in co-operation with other organizations:

American Association for the Advancement of Science

Chairman of the symposium on border stratigraphy in El Paso late

April (Kottlowski).

American Association of Petroleum Geologists

Service on the Highway Geological Map Committee (Foster).

Reviewed papers submitted for bulletin (Foster).

Associate Editor, District Representative for Central New Mexico,

Standard Stratigraphic Computer Coding Committee, Stratigraphic

Correlations Committee (Kottlowski). District Representative,

June 1968-70 (Bieberman).

American Chemical Society

Chairman-elect of the central New Mexico section of the American

Chemical Society (Reynolds).

American Commission on Stratigraphic Nomenclature

Vice-Chairman and Secretary (Kottlowski).

American Institute of Mining Engineers

Chairman, Council of Section Delegates (Bhappu).

Chairman, Waste Disposal Committee (Bhappu).

Program Chairman, Solution Mining Committee (Bhappu).

Vice-Chairman, Hydrometallurgy Committee (Bhappu).

Student paper awards committee (member)(Bhappu).

American Institute of Professional Geologists (New Mexico Section)

Service as president. (Kottlowski).

Atomic Energy Commission

Proposal for control of radon in the underground environment. (Foster).

1967 meeting. Cochairman, preparation for symposium on coal resources of the Americas to be held at GSA 1968 meeting in Mexico City. (Kottlowski).

Geological Survey of Canada

Cephalopod identification and description, with attendance age indication. A large work on cephalopods of the Silurian of the James Bay lowland is finished, and to be published this fall. Another, on the cephalopods of the Cat Head formation L. Winnipeg was completed last November. Similar work on the Ordovician Cephalopods of Lake Timiskaming is in progress. (Flower).

Geological Survey of Indiana

Identification and description of Silurian Cephalopods of Northern Indiana (Flower).

Governor's Office

Member of Governor Cargo's Committee on Economic Development (Kottlowski).

Assisted with the interim report of the Governor's Committee on reorganization of state government. Completed December 1967. (Bertholf).

Idea Conference

On mineral resources and development held at New Mexico Tech, May 2 and 3, 1968. Sponsored by the Bureau and New Mexico Tech Research Foundation (Foster, Kottlowski, File, Willard).

Jemez Valley High School

Worked with high school science class in the collection and interpretation of water chemistry data for hot springs (Summers).

Museum of New Mexico

Identification of minerals in archeological materials and determination of probable sources. (Weber).

Molybdenum Corporation of America

Recovery of barium and strontium from bastnaesite ore.

Determination of molybdenum and rare earths by X-ray fluorescence sponsored by Molycorp. (Renault).

By-products recovery from Questa tailings. (Met. section).

Narodni Museum v Praze

At the request of this institution, cooperative work was initiated on the revision of the Paleozoic cephalopods of the Bohemian basin.

An extensive conference and discussion on this matter was interrupted by the Russian invasion of Czechoslovakia on August 21; it will be resumed unless workers in that country do not dare enter into extensive correspondence with a capitalist.

New Mexico Institute of Mining and Technology

. . . Proposal for study of radon control in the underground environment (AEC)(Foster).

. . . Geological information for geophysical studies in the San Agustin Plains (Foster).

Review of various proposals and papers (Foster).

New Mexico Tech Research Foundation-Shell Project on hydrocarbon oils as flotation reagents and preparation of activated products from asphaltines and carbon blacks. (Bhappu).

Moroccan copper ore project (Bhappu).

Nickel analysis and extraction from lateretic ores from Guatemala (Bhappu).

. . . Supervising three Ph.D. theses and one M.S. thesis (Bhappu),
Chairman, Off-campus Coop Education Committee; graduate council (Bhappu).

. . . Co-chairman of May Idea Conference on Mineral Resources (Kottlowski).

Teaching of electrical engineering and surveying courses. (Misaqi).

Teaching of graduate mining, geology, and ground-water hydrology courses. (Service on doctoral committee; proctoring one master's thesis; ex officio on the doctoral committee of D.F. McLeroy,

Lehigh University; New Mexico Tech Research Foundation, trustee, Corporate Secretary, and on the executive committee; Vice-President for Finance (Bertholf).

Exhibit for State NMEA Convention. Assist public relations department (File).

New Mexico Academy of Science

Editing and publishing the Academy of Science Bulletin, two issues annually (File); Public Relations Committee Chairman (File).

New Mexico Mining Association

Preparation of a handbook for high school counselors on science-oriented jobs in New Mexico in co-operation with the Academy of Science (File).

New Mexico Geological Society

Registration Chairman, Fall Field Trip October, 1967 (Bieberman).

Society-Treasurer, starting May 1968 (Bieberman).

Cochairman of Caravan Committee (Summers).

Fall Field Conference (Summers).

Cochairman of Spring Meeting and San Andres Symposium (Summers).

New Mexico Mapping Advisory Committee

Preparation of annual reports for recommendations for topographic mapping. (Weber).

New Mexico Water Resources Institute

Evaluation project started on the role of the hydrologic cycle in the development of the White Sands and the determination of the origin of the gypsum there. (Summers).

Paleo-Indian Institute, Eastern New Mexico University

Co-operative project on geology and archeology of the Mockingbird Gap Site (Weber). Pleistocene geology of Northern Jornada del Muerto. A field study supported by laboratory investigations of late Pleistocene history of northern Jornada (Weber).

Pima Mining Company

Removal of copper from molybdenite concentrates. (Met. section).

Rocky Mountain Mineral Law Foundation

Editing services (Bertholf).

Sandia Corporation

Pyrometric cone equivalent tests on selected soils (Foster).

Teaching engineering geology course for Tech Research Foundation
(Foster, Kottlowksi, Weber).

Geologic consultation on the Nevada Test Site (Kottlowksi, with Weber
and Foster).

Shell Chemical Company

Preparation of activated products from asphaltenes and carbon black.

State Department of Development

Revision of Ghost Town maps (Arnold, File).

Public meetings and conferences work (Bertholf).

State Engineer's Office

Various water-quality matters, including Steve Reynold's participation
in the FBA National Water Quality Seminar. (Bertholf).

State Department of Finance and Administration

Several working meetings to reorganize the state computer center
and to select the senior staff for same (Bertholf).

State Land Office

Public Hearings to develop rules and regulations for development of
lands under the geothermal act of 1966 (Bertholf).

State Planning Office

Continuing participation in the state-resources development plan (Bertholf).

State Science Fair

Assistance in judging.

Academy of Science arrangements (File) and registration supervision
(Reynolds).

United Nations

Organization of a seminar on hydrometallurgy (Bhappu).

University Council on Water Resources

Delegate to the council, representing New Mexico Institute of Mining and Technology. (Bertholf),

University of New Mexico

Preparation of reference sets and descriptive definition of lithic types for use of students in the department of anthropology (Weber).

University of Texas at El Paso

Review of proposal (Foster). Paper on Precambrian in Franklin Mountains (Foster).

U.S. Forest Service

Assisted in training project for engineers on wells and geology of wells (Summers).

Identification and interpretation and evaluation of minerals, rocks, and ores (Weber).

U.S. Geological Survey

Interpretation of infrared imagery of the Anima's Valley Hot Spot, Hidalgo County, New Mexico (Summers).

Co-operative work with geologists on geologic problems in New Mexico (Weber).

Cephalopod identification, with resulting indications of age. Significant collections in process of study are from several horizons in the Seaward Peninsula of Alaska (two finished), extensive material from

Utah, Nevada, New Mexico, and a large collection from the Ordovician of Kentucky, with numerous minor collections. (Flower).

U.S. Geological Survey and U.S. Bureau of Mines

Consultation services. (Bertholf).

U.S. Department of Health, Education, and Welfare

Public Health Service, Studies in fluoride content of water.

U.S. Bureau of Health, Education, and Welfare (Public Health),

Co-operation on testing methods for water qualities and analysis (Reynolds).

U.S. Department of the Interior

Supervision of work of transferring of mine records from microfilm to cards (File).

U.S. Bureau of Land Management

Continuation of mining records project. Work on mining law compilation (File).

U.S. Bureau of Mines

Identification and interpretation and valuation of minerals, rocks, and ores (Weber).

U.S. National Museum

Identification, study, and description of cephalopods as requested (Flower).

U.S. Regional Solicitor's Office

Requests answered for information on mineral jurisprudence (Bertholf).

Volunteers for International Technical Assistance Inc. (VITA),

Solutions for various technical problems submitted through VITA (Bhappu).

Water Conference

Advisory committee (Bertholf).

Water Resources Institute

New Mexico Water Resources Institute, New Mexico State University,

Univ. of N.M., and NMIMT Research and Development Division. Study

of water resources of the Pecos River Valley. (Summers).

Weather-Control Commission

Chairman (Bertholf).

Annual Report, 1968-69

by Frank E. Kottlowski, Acting Director

TO: Board of Regents 30 June 1969
Honorable Stirling A. Colgate, President
Members of the New Mexico Legislature
Board of Educational Finance
Taxpayers of New Mexico

I have the honor of transmitting to you the annual report of the New Mexico Bureau of Mines and Mineral Resources for the year July 1, 1968 to June 30, 1969 as required by Section 3, Chapter 115, of the Eighth State Legislature session laws, approved March 4, 1927.

During the year, 39 projects were completed, 24 technical reports published including revisions of those in popular demand, 16 projects were initiated, modernization of our field vehicle fleet was begun and additional laboratory equipment was procured, 11 technical talks were presented at scientific meetings, and 10 technical papers were published in outside scientific journals. Information

concerning exploration and development of New Mexico's mineral resources was given during 3235 visits by outside technical personnel, in 4740 letters, and by 2790 phone calls. Sales of our technical publications, priced at only publication costs, totaled about \$16,500. More than 7700 copies were also sent to state officials, libraries, and other scientific agencies.

A search by the President for a new director from outside New Mexico, that lasted from the last half of FY 1967-68 through the first 10 months of FY 1968-69, culminated with the appointment, effective July 1, 1969, of Prof. Don H. Baker, Jr., an eminent metallurgist from Waterloo University and the U.S. Bureau of Mines. Much staff time was spent on Tech Research Foundation projects, teaching courses for the College and Graduate divisions, in supervising student theses, and serving on New Mexico Tech committees. Bureau staff members also served as officers and on numerous committees for many outside scientific and professional organizations.

The Board of Educational Finance recommended a 3.5% increase in appropriation for the Bureau for FY 1969-70; the Legislature approved a 2.3% increase. This contrasts with the national 4.7% increase in costs. Along with the rising cost of employing students, this decrease in available funds precluded filling of 3 professional staff vacancies for a mining engineer, economic geologist, and a ceramist.

Despite some difficulties, we have accomplished much during the

past year. It is my great pleasure to present this annual report to you.

Respectfully submitted,

Frank E. Kottowski
Acting Director

Metallurgy and Chemistry

. . . The metallurgical section, composed of Bhappu, Johnson, and Smith with numerous students, conducts studies in various aspects of extractive metallurgy and provides technical assistance to those who request it. . . .

Much emphasis during the year was on basic research of leaching agents that might be useful in chemical mining, analyses using x-ray florescence and x-ray diffraction, extraction of rhenium, separation of strontium and barium, extraction of nickel, leaching of uranium ores, testing of alcohol frothers, oxide copper leaching, oxidation of ferrous sulfate solutions, and the leaching of copper ore dumps. Many of the projects were partly supported by contracts with individual companies or through the New Mexico Tech Research Foundation. These include use of potassium permanganate in flotation of sulfide minerals, recovery of by-product value from Questa tailings, Hanna Mining Co. copper leach studies, Occidental Minerals leach tests, Kennecott tailings leach studies, Dotson Minerals Corp. slag tests, U.S. Smelting & Refining thiosulfate

dump leach tests, Winston gold-silver tests, Kerr-McGee Corp. uranium dump leach tests, and leaching of oxide copper ores for Copper Range Co. . . .

As Vice-President for Research of the New Mexico Tech Research Foundation, Dr. Bhappu spent much time obtaining contracts for the Foundation. Most of the work desired is basic scientific studies or applied metallurgical problems, to be done in the Bureau's laboratory, utilizing Bureau and College personnel, with a 25% to 100% overhead charge to the Foundation. . . .

Personnel Changes

On the recommendation of the president, the Board of Regents on May 5, 1969, appointed Prof. Don H. Baker, Jr., as Director of the Bureau effective July 1, 1969. For the past two years, he has been director of extractive metallurgy in the chemical engineering department of the University of Waterloo, Ontario, Canada. Prof. Baker received his B.S. and M.S. degrees in Metallurgical Engineering, as well as a Professional Engineering degree, from the University of Arizona, was a research metallurgist for American Smelting & Refining Company at their Hayden operations, and a research metallurgist and physical scientist for the U.S. Bureau of Mines in Boulder City and Reno, Nevada, and Washington D.C.

Our Editor, Miss Teri Ray, resigned in April 1969, moving to Phoenix, Arizona. During her six years with the Bureau, she edited

and guided through the press more than 100 publications. Mrs. Cheryl A. LePlatt, our Business Office secretary in charge of publication sales, and Mrs. Linda L. Lake, secretary for the Petroleum Geology Section, both resigned in May 1969. They were replaced by Mrs. Linda Sue Wilks and Mrs. Donna Mae Peckenpaugh, respectively.

Dr. Roshan B. Bhappu, Senior Metallurgist, began a year's sabbatical leave in June 1969. He will serve UNESCO at Middle East Technical University in Ankara, Turkey, helping to set up programs for their metallurgical department. Dr. Ronald J. Roman, Research Metallurgist, shared with the Bureau by the Tech Research Foundation and the College Division since May 1969, has taken over Roshan's duties.

At the beginning of the year, Mrs. Myrtie M. Edgar, Director's Secretary and valued employee for 15 years, resigned owing to disability. Her experience and knowledge of the Bureau's activities and personnel, and her cheerful attitude were greatly appreciated by the entire Bureau staff. Her competent replacement, Mrs. Jo Drake, began her duties in September 1968. . . .

Annual Report, 1969-70

by Don H. Baker, Jr., Director

Some Public Services Available at the Bureau

1. Mineralogical identification of rock and ore samples from New Mexico.
2. Make available for public use cuttings from oil wells, as well as electric, radioactive, sonic, and other types of well logs.
3. Make available up-to-date county petroleum exploration maps.
4. Assist, through conferences, geologists, mining engineers, prospectors, landowners, rock hounds, and others by providing geologic and mining engineering information necessary for exploration.
5. Provide speakers for technical and nontechnical talks to groups interested in mineral resources, exploration, and rocks and minerals.
6. Maintain sales office for Bureau publications including scenic guidebooks to selected areas, as well as topographic maps and other publications of Federal agencies and scientific organizations that are related to New Mexico's mineral resources and geology.
7. Perform feasibility and amenability metallurgical and beneficiation tests of mineralized samples.

8. Confer on and assist in the development of chemical and metallurgical flow sheets for New Mexico mining properties.
9. Maintain a public mineral museum that has both educational and research functions.
10. Sponsor occasional public and professional meetings to disseminate new information about New Mexico mineral resources and geology.

Annual Report

This year has been one of evaluation, reorientation, and change. The first major reorientation evoked was in the philosophy of our function. The Bureau is a technical organization whose mission is to serve the minerals industry of the State, to advise and assist other State agencies and Federal agencies, and to aid in the education of the minerals and fuels communities and the public by dissemination of technical and semitechnical information and data.

To accomplish this required that the staff travel extensively within the State, attend sectional and subsectional professional meetings of the industry, and meet with directors and staffs of various State agencies. In these activities we have emphasized our willingness and desire to assist, without regard for politics, in any technical field where the Bureau has the expertise. The Bureau has aggressively searched for ways to expand, enhance, and disseminate knowledge about New Mexico and its mineral resources.

Because of the diversity of the Bureau's programs and of its contacts

with numerous industrial and governmental organizations, it was felt that private consulting by staff members--even outside the State--could easily lead to conflicts of interest. Bureau policy now prohibits private consulting by the staff in any form. The legislature agreed with this policy and allowed an extra salary increment for the elimination of private consulting, effective July 1, 1970. The philosophy of the Bureau is that geology, treatment and extraction techniques for mineral and fuel resources, and environmental problems are not constrained by political boundaries and, therefore, a problem and its solution that have possible application within New Mexico will be examined regardless of their geographic location.

The staff has evaluated the Bureau's projects and programs that have been under investigation for some time and has provided for prompt completion of some, redirected others to produce information more rapidly and effectively, and terminated some that lacked a potential for significant results. Also, support for some outside projects has been eliminated because they failed to produce publishable results. These were preliminary steps in the development of a long-range program that will systematically cover the State with geological maps and resource-potential studies.

The Bureau has been expanding its efforts to advise and assist operators, particularly the smaller ones, in the solution of chemical and metallurgical problems. Although there have been, and will continue to be, joint projects with the major companies to develop

new or improved extraction methods with minimal ecological side effects, the small-mine operator is receiving and will continue to receive the most direct metallurgical help. Blended with direct assistance will be a program of engineering and theoretical research.

The restructuring and modification of the Bureau's philosophy has been made possible because of the cooperation and support given the Director by the President of New Mexico Institute of Mining and Technology in presenting a realistic, appropriately justified budget, and by the action of the Board of Regents in establishing a degree of autonomy for the Bureau in its dealings with the industry.

In support of the Bureau's philosophy for the coming decade, the emphasis of the programs in geology, mineral resources, and stratigraphy has focused on resource-oriented geologic mapping, applied research, and cooperative projects with State and Federal agencies and with individuals.

The problems associated with pollution of our environment have received an increasing amount of attention by the staff. The Bureau sponsored a symposium on mill-tailings waste. Staff members attended and participated in several educational programs aimed at better understanding and engineering to offset environmental problems. The services of the Bureau have been made available to local and State government entities for advice concerning geological problems associated with waste disposal. The Director has been made a member of the U.S. Solid Waste Liaison Committee. A bibliography of stabilization techniques is in preparation under our sponsorship.

A major cooperative project initiated this year was the determination of the San Juan Basin's low-sulfur strippable coal deposits in cooperation with the National Air Pollution Control Administration and the Federal Bureau of Mines. Although not a cooperative program, the Bureau contracted with the State Land Office to evaluate the minerals and fuel potential of the trust land in east-central New Mexico. . . .

The building materials-resources group, reestablished in January, has contributed information on potential clay resources to private industry and government, including the Four Corners Development Commission and the U.S. Forest Service. They have evaluated pitchstone (perlite) deposits and limestones from the southwestern section of the State. . . .

Chemical and metallurgical research has continued in the areas of mineral beneficiation, hydrometallurgy, (in-situ leaching and heap or column leaching), and chemistry of mineral reactions with leach solutions. Development of computer programs and models to assist in projection of engineering designs have also been carried forward as exemplified by "Large Flotation Cells-Selection of the Proper Size and Number," published by Roman in June 1970 Mining Congress Journal. . . .

Our laboratories have continued to develop new or improved techniques for more rapid and accurate sample analyses and have cooperated with various company laboratories in developing and establishing analytical techniques and procedures. The laboratories participated in a program

of the Analytical Reference Service to evaluate old and new methods of water and waste analysis. Under the program, more than 100 participants run various assays; the data are then collected and analyzed, and each participant is notified of the results. The Bureau participated in three separate studies during the past year.

Donations of analytical instruments have further expanded our laboratories' capabilities. Chevron Research Company gave a densitometer that greatly enhanced interpretations of emission-spectrograph films. The New Mexico Tech Research Foundation donated an electron probe, which now makes possible precise matrix analyses; the first samples analyzed were historic copper slags from the pre-Roman era. . . .

Annual Report, 1970-71

by Don H. Baker, Jr., Director

Annual Report

Most everyone in New Mexico became aware of environmental problems this year. The Bureau continued--even expanded--its attention to environmental problems in connection with the development of our mineral resources. This activity was exemplified in several ways, ranging from sponsorship of meetings to presenting testimony and publishing information on surface mining procedures. The Bureau sponsored a meeting between legislators and mineral industry representatives to promote better understanding of the problems and the methods industry is using to solve them. Staff members testified at numerous State and Federal agency hearings on various aspects of the environment and the possible effects of suggested controls and regulations.

Technical activities of the Bureau were directed toward increasing our knowledge of the earth's structure and the more efficient extraction of its mineral wealth, with serious concern for economic considerations as well as maximum protection and improvement of the environment.

These efforts are listed in the projects underway and projects completed.

Early in the fiscal year a Director's Advisory Committee was appointed to assist the Bureau in selecting programs best fitting the needs of the State and the mineral industry, yet retaining impartiality in dispensing technical information and advice as may be appropriate and upon request. Those selected to serve are: Henry S. Birdseye (Board of Regents, New Mexico Institute of Mining and Technology), William F. Darmitzel (mining industries), Walter Famariss, Jr. (petroleum industry), William W. Grant (coal industry), Ralph Stucky (Water Resources Research Institute), and Sherman A. Wengerd (American Institute of Petroleum Geologists). This committee has figured importantly in establishing project priorities and in reviewing operating procedures.

The last of the recommendations of the 1968 "Blue Ribbon" committee were implemented. This was the minimization of dual appointments of professional staff between the College Division and the Bureau, and, the employment of college staff for specific summer and off-term projects. Other recommendations, already implemented, were:

- (1) Principal objective of the Bureau is investigating and evaluating the state's mineral resources with emphasis on aid to exploration and economic evaluation.
- (2) Industrial research contracts must increase our knowledge and

benefit all, with the results published. Consulting, even outside the state, by Bureau staff was eliminated because of possible conflict of interest and possible detriment of the minerals industry of New Mexico.

- (3) The direction of graduate research programs by Bureau staff, and the hiring of students to work in the laboratories wherever feasible was continued.

To create an awareness and understanding of New Mexico mineral resources, a "Mineralmobile" was constructed for use in school earth science programs and by various civic organizations in the state. This 3-sided trailer exhibits more than 100 mineral and rock specimens, along with maps, photographs, and brochures illustrating our mining and fuel industries. The Bureau's Mineralogical Museum also aids considerably in establishing knowledge of minerals. Guided tours were conducted for 37 school and special groups. In memory of Tech student Wayne Seagriff, Mr. and Mrs. Seagriff donated their son's mineral collection to the museum.

To provide versatility and to assure permanent documentation and availability, all Bureau publications are now available on microfiche. Diazo prints of the microfiche can be obtained from the Publications Office. By using this system, libraries and companies can now maintain a complete set of Bureau publications in limited space. . . .

Distinguished Visiting Lecturer

The Bureau co-sponsored, with the College Division, a visit by Dr. June Rapson-McGugan of the Canadian Geological Survey, to present a short intensive course in sedimentary petrology and serve as consultant to Bureau staff and graduate students. . . .

Metallurgical and Chemical Research

. . . Tech's Idea Conference this year, "In Place Leaching and Extraction Technology," was attended by 70 representatives of industry and government agencies. . . .

Annual Report, 1971-72

by Don H. Baker, Jr., Director

Rapid economic change imposes upon all institutions, particularly those supported by the taxpayer, new functions and responsibilities, and diminishes or enhances the importance of old ones. Failure to respond to such changing priorities makes an institution less effective or even obsolete. The Bureau's first duty is to perform its mission with maximum effectiveness.

--Alex. Nicholson

Introduction

. . . Highlights of the year included Bureau participation with the National Aeronautics and Space Administration in the ERTS-A (Earth Resources Technology Satellite) program, and a new building to house the New Mexico Library of Subsurface Data.

A mineral collection representing worldwide varieties of tourmaline was donated to the Bureau mineralogical museum by Pala Properties

International, Fallbrook, California. The collection, valued at more than \$2,800, includes specimens from Australia, Mozambique, Rhodesia, California, Baja California, and Brazil.

The 30th State Legislature passed a coal surface mining act which established a seven-man commission to formulate and administer regulations for reclamation of coal strip-mining areas.

Members of the commission are Larry J. Gordon, director, Environmental Improvement Agency, chairman; Don H. Baker, Jr., director, New Mexico State Bureau of Mines and Mineral Resources; Ladd S. Gordon, director, State Dept. of Game and Fish; A. B. Fleming, chairman of the Soil and Water Conservation Committee; Philip Leyendecker, director of the Agricultural Experiment Station, New Mexico State University; S. E. Reynolds, state engineer; and Alex J. Armijo, commissioner of public lands.

A vacuum frame was added in the cartographic laboratory, enabling the saving of about 40 manhours per full-color geologic map, and allowing preparation of color proofs at \$50 instead of the \$300 rate previously paid. . . .

Industrial Rocks and Mineral (Nonmetals)

. . . A cooperative project has been established with the Tuscaloosa, Alabama, Laboratory of the Federal Bureau of Mines to test clays from numerous areas in New Mexico. These tests will provide up-to-date clay evaluations without cost to the State. . . .

Annual Report, 1972-73

by Frank E. Kottlowski, Acting Director

TO: Board of Regents

November 16, 1973

Honorable Stirling A. Colgate, President
Board of Educational Finance

Members of the New Mexico Legislature

I have the honor of transmitting to you the Annual Report of the New Mexico Bureau of Mines and Mineral Resources for the fiscal year July 1, 1972, to June 30, 1973, as required by Section 3, Chapter 115, of the Eighth State Legislature sessions laws, approved March 4, 1927. . . .

Throughout most of the fiscal year, all positions authorized by the Board of Educational Finance were filled. During the latter part of the period and continuing into the first 2 months of fiscal year 1973-74, deaths and resignations reduced the professional staff by 35 percent. The Director, Mr. Don H. Baker, Jr., resigned in late June 1973, effective in July 1973, to become Supervising Metallurgist for the U.S. Bureau of Mines in Boulder City, Nevada. A six-member committee, headed by Dr. Robert H. Weber, is now processing applications for

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this vacancy.

The Board of Educational Finance recommended an increase of 4.65 percent in the Bureau's appropriation for fiscal year 1973-74. This contrasted with the national increase in costs of 7.4 percent. Annual salaries for Bureau professional staff were about \$1,200 below comparative college salaries, and about \$4,000 less than comparative federal salaries.

Overall support of the Bureau by the Board of Regents and the President of Tech, the Legislature, the taxpayers, and the mineral industry is appreciated. In turn, our technical service and research has helped develop the billion-dollar mineral industry of New Mexico.

Respectfully submitted,

Frank E. Kottlowski

Acting Director

Atlas Program

The "Energy Crisis" will be most apparent this winter if there is a long, cold spell, resulting in shortages of natural gas, fuel oil, and other energy materials. But the dwindling reserves of energy resources are merely the visible tip of the iceberg; the present shortage of oil and gas is the forerunner of scarcity of many mineral resources. Highly mechanized society cannot function without the many metals and industrial rocks and minerals, and energy materials. Inasmuch as the

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major statutory duty of the New Mexico Bureau of Mines and Mineral Resources is to aid in finding and wisely developing the state's mineral resources, the Bureau should play a key role in solving anticipated mineral resource problems.

A unified approach suggested to the Legislature last year was the Atlas Program. The main thrust of this program is to provide statewide estimates of reserves of individual mineral resources--including strip-pable coal, fluorspar, and uranium. After examining major mineral commodities, key resource areas will be studied in details. Most of the Bureau's ongoing projects already fit naturally within the scope of the Atlas Program. Speeding up the program with a special 7-year appropriation is deemed urgent. When completed, this program will provide New Mexico with inventory data for properly managing its minerals.

Components of the Atlas Program are:

- I. Energy resources--oil and gas, coal, uranium, geothermal,
- II. Water resources
- III. Metallic ores--gold, silver, copper-lead-zinc, manganese, molybdenum, iron, and vanadium
- IV. Industrial rocks and minerals--gypsum-salt, potash, stone, cement, sand-gravel, clay, pumice-perlite, fluorspar, mica, and gemstones
- V. Geophysical mapping--airborne magnetometer, gravity, and seismic

VI. Mining districts mapping

VII. Geologic-mineral resources mapping of key areas

VIII. Environmental-geologic hazard mapping of urban areas

Most of our present geologic-mineral resources projects, and those planned for fiscal year 1973-74, are designed to fit into the Atlas Program.

Metallurgy

. . . Current metallurgical projects:

Brierley--1) Use of high-temperature, molybdenite-leaching microorganisms, 2) effect of iron oxidant on bacteria, 3) extraction of copper from sulfide ores using thermophilic microorganisms, 4) theoretical study to support practical studies on microbial copper leaching

Plouf--1) Small-scale characterization of leachability of copper oxide ores, 2) small-scale characterization of leachability of copper sulfide ores, 3) sulfide leaching, 4) metal ion extraction, 5) environmental equilibrium study, 6) clay chlorination

Roman--1) Study of physical and chemical variables in heap leaching with emphasis on their economic significance and scale-up, 2) dissolution of copper concentrates, alternatives to conventional copper smelting, 3) open-pit mining sequence (Progress Report 8), 4) use of dynamic programming for determining mine-mill production schedules, 5) computer program for Monte Carlo economic evaluation of a mineral deposit (Circular 137), 6) computer sim-

ulation of fluid flow in a leach dump of heap, 7) optimization of dump and heap leaching

Benner—1) Hydrometallurgical application to New Mexico ores and concentrates.

Analytical Testing

Analytical laboratories at the Bureau are equipped to perform extensive chemical, mineralogical, and petrologic investigations. Chemical analyses, both qualitative and quantitative, are performed by the classical wet chemical and optical spectrographic procedures, as well as by atomic absorption, x-ray, and electron microprobe spectrometry.

Primarily the laboratory serves the Bureau, College, and R&D divisions. Capabilities include analyzing water, ores, concentrates, geological samples, and leach liquids for the common elements or parameters. New methods of analysis and some basic research are conducted as time permits. Mineralogical and petrologic investigations are facilitated by x-ray diffraction facilities and the newly installed Henry Birdseye petrologic laboratory.

The x-ray fluorescence facility features a vacuum spectrograph and is utilized for non-destructive analysis of rock materials, primarily silicates. More than 12,000 analyses were provided in cooperation with New Mexico Tech, University of New Mexico, and University of Texas at El Paso.

Non-destructive microanalyses are provided by an electron micro-

probe. The Bureau's microprobe is capable of securing quantitative chemical analyses on solid materials over areas as small as a few microns in diameter. Compositional profiles also can be obtained for study of inhomogeneities with special resolution of a few microns. . . .

Annual Report, 1973-74

by Frank E. Kottlowski, Director

To: The Governor of New Mexico, and
New Mexico Tech Board of Regents

December 12, 1974

I have the honor of transmitting to you the Annual Report of the New Mexico Bureau of Mines & Mineral Resources for the fiscal year July 1, 1973 to June 30, 1974, as required by Section 3, Chapter 115, of the Eighth State Legislature sessions laws, approved March 4, 1927.

During the fiscal year, 28 new technical reports were published, 15 talks were presented at scientific meetings, and 13 papers by Bureau staff and consultants were published in scientific journals. Information concerning exploration, development, and conservation of New Mexico's mineral resources was disseminated in 5,670 letters, in 4,210 phone calls, and in 3,120 visitor conferences in Bureau offices. Sales of publications, priced at about cost of printing, totaled \$27,453. More than 8,200 publications were distributed to state officials, libraries, and scientific agencies. In addition, about 45,000 brochures describing

the geology and resources of the State's parks were given out in cooperation with the State Park and Recreation Commission.

Resignations and deaths during the last few months of the previous fiscal year and the first 2 months of the present fiscal year reduced the professional staff by 35 percent, but by the end of the year the Bureau was again at authorized strength. Upon the resignation of the Bureau's director, Don H. Baker, Jr., in July 1973, an acting director was appointed, while a six-member committee headed by Dr. Robert H. Weber searched for a new director. On 4 February 1974 the Board of Regents appointed the present Director, who had been serving as acting director.

The Board of Educational Finance recommended an increase of 4.2 percent in the Bureau's appropriation for next fiscal year. Salaries for professional staff were about \$1,200 below comparative college salaries, or about \$4,000 less than comparative federal salaries. However, extra raises granted by the Board of Regents in October brought Bureau salaries even with college salaries. . . .

Respectfully submitted,

Frank E. Kottowski, Director

New Mexico Library of Subsurface Data

During the year 226 sets of drilling samples were added, bringing the total number of sets on hand to more than 9,000. Also acquired were electric and other types of mechanical logs from 1,236 wells, in addition to 1,225 well records from drilling operations during the fiscal year.

A collection of 138,179 scout cards from wells drilled since 1948 in southeastern New Mexico and west Texas was donated by Mr. Howard P. Holmes of Hobbs.

In cooperation with the American Association of Petroleum Geologists Research Committee and the U.S. Geological Survey, the Bureau provided information on New Mexico for a computer project involving extensive compilation of data and preparation of a wall map of North America showing the distribution of all oil and gas fields and related tectonic elements.

Symposium on Base Metals and Fluorspar, by Charles E. Chapin

Base metal districts of New Mexico and fluorspar highlighted a 3-day symposium held May 22-25 on campus, and cosponsored by the Bureau and the New Mexico Geological Society. Twenty-six papers with 46 authors were presented to more than 300 attendees from throughout the United States. Dr. Spencer Titley, University of Arizona, gave the keynote address The nature and significance of pyrometasomatic alteration of some Cordilleran ore deposits. The outstanding response to the symposium was due to the boom in mineral

exploration being experienced by New Mexico. Realization is spreading that New Mexico is a relatively unexplored state with enormous mineral potential and a variety of significant geologic and mineral research projects instituted since 1970 (12 papers represented projects supported by the Bureau).

The conference committee was chaired by Charles Chapin. W.N. McAnulty, University of Texas at El Paso, organized the fluor spar part of the program. The symposium concluded with a day-long field trip to the Magdalena area lead by Chapin. The 180 participants traveled to the crest of the Magdalena range at North Baldy in a caravan of 48 four-wheel-drive vehicles. Two other stops were made to examine the newly recognized Permian section at the northern end of the Magdalena range and the Cat Mountain mining district.

On the day before the symposium, the Bureau released open-file geologic maps covering about 300 square miles of the Magdalena area (prepared by C.E. Chapin, R.B. Blakestad, J.E. Bruning, D.M. Brown, R.M. Chamberlin, D.A. Krewedl, W.T. Siemers, D.B. Simon, and W.H. Wilkinson). A composite stratigraphic column and a generalized structure map of the Magdalena area were included. In addition, open-file geologic and geochemical maps of the Central Peloncillo Mountains in Hidalgo County, prepared by R.B. Carter, M.L. Silberman, and A.K. Armstrong of the U.S. Geological Survey (in a cooperative project with the Bureau), were available for review.

Annual Report, 1974-75

by Frank E. Kottlowski, Director

To: Board of Regents and President of October 1, 1975
New Mexico Institute of Mining and Technology
Governor of New Mexico

I have the honor of transmitting to you the Annual Report of the New Mexico Bureau of Mines & Mineral Resources for the fiscal year July 1, 1974 to June 30, 1975, as required by Section 3, Chapter 115, of the Eighth New Mexico Legislature sessions laws, approved March 4, 1927.

During the fiscal year 21 new technical reports were published by the Bureau, 12 talks were presented at scientific meetings, and 35 papers by Bureau staff and consultants were published in scientific and mineral resources journals. Information concerning exploration, development, and conservation of New Mexico's mineral resources was provided in 6955 letters, in 4560 telephone calls, and in 3520 visitor conferences in Bureau offices. Sales of publications, priced at about cost of printing, totaled \$32,550. More than 8,500 publications were distributed to state

officials, libraries, and scientific agencies.

Resignations and deaths had reduced professional staff by 35 percent during the previous fiscal year; addition of 7 new members during 1974-75, however, restored professional staff to full strength. The Board of Educational Finance and the New Mexico Legislature closely followed the Regents' recommendations for a 6-percent increase in the Bureau's budget for the 1975-76 fiscal year, and allowed salary adjustments to keep competitive with State agencies..

During May 1975, most of the Bureau staff moved into the newly constructed southwest wing of Workman Research Center. Total space in the new facility is more than 10,000 square feet, a net gain of 3,500 square feet as the Bureau gave up 6,500 square feet of its previous floor space.

Respectfully submitted,

Frank E. Kottlowski

Director

Annual Report, 1975-76

by Frank E. Kottowski, Director

New Mexico Library of Subsurface Data

During the year 168 sets of drilling samples were added, bringing the total number of sets on hand to more than 9,400. Also acquired were electric and other types of mechanical logs from 958 wells, in addition to 1,159 well records from drilling operations.

In October 1975 a special collection of records was acquired from Neil Wills. It consists of sample descriptions from 658 wells, plotted strip logs from 2,783 wells, 3,282 mechanical logs, and 19,857 well records--evaluated by the Bureau at \$30,663. Mr. Wills donated this collection to the Bureau upon his retirement from a 50-year career in New Mexico as a geologist and independent oil operator.

Annual Report, 1976-77

by Frank E. Kottowski, Director

TO: Board of Regents, New Mexico Institute of Mining & Technology
Jerry Apodaca, Governor of New Mexico
Secretary, Department of Energy and Minerals

I have the honor of transmitting to you the Annual Report of the New Mexico Bureau of Mines and Mineral Resources for the fiscal year July 1, 1976 to June 30, 1977, as required by Section 3, Chapter 115, of the Eighth New Mexico Legislature sessions laws, approved March 4, 1927.

On that date more than fifty years ago Governor Richard C. Dillon signed House Bill 226, "An Act establishing a Bureau of Mines and Mineral Resources of the State of New Mexico." Since then, mineral production has increased almost a hundredfold to \$2.37 billion in 1976. The Bureau's role in that increased production is suggested by the more than 475 reports and maps issued, 85 percent published in the last 25 years.

In this golden anniversary year of service and applied research the Bureau distributed more than 18,000 technical reports, and provided information concerning exploration, development, and conservation of the state's mineral resources in 7,700 letters, in 4,700 telephone inquiries, and in 4,200 visitor conferences. Sales of publications, priced at cost of printing, totaled \$41,086. More than 8,000 publications were distributed without charge to state officials, libraries, and scientific agencies.

Professional staff was at authorized strength, with a blend of new employees and seasoned veterans. Almost a fourth of the staff has served New Mexico for more than 20 years: William Arnold, Robert Bieberman, Richard Chavez, Rousseau Flower, Roy Foster, Frank Kottlowski, and Robert Weber.

Today, as New Mexico surges forward to the increased extraction of its mineral resources--particularly energy materials--the trend of the past becomes the prologue of the future. Our program is dedicated to aid the State in wisely husbanding those resources.

Respectfully submitted,

Frank E. Kottlowski,
Director

RECOLLECTIONS OF THE 1940'S AT THE NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES

by Robert L. Bates, *Professor of Geology*, Ohio State University

I was hired by C. E. Needham and moved from Midland to Socorro on January 1, 1941. At first I served halftime in the Department of Geology of the School of Mines (as it was then called), but enrollment diminished during the war, and on January 1, 1944, I became a fulltime employee of the Bureau. I served until July 31, 1947, under Needham, J. M. Kelly, R. H. Reece, A. D. Hahn, and E. C. Anderson.

My recollections of the Bureau center first around the job that I was brought there to do, namely build up the files of well logs and other subsurface data, thus making the Bureau of maximum use to the oil industry. This task turned out to be altogether fascinating and rewarding. We established and maintained good relations with all aspects of the industry—oil-company personnel, the State Oil and Gas Conservation Commission, the regulatory branch of the U.S. Geological Survey, and numerous consultants and independent operators. The period was one of intense activity in the industry, and visitors were numerous. My diary says that on one day we had callers from Shell, Pure, and Standard of Texas as well as the American Smelting and Refining Company. Possibly the Standard of Texas man was the late John Emery Adams, who, I remember, used to show up with his file of log strips neatly coiled on edge in an angel-food-cake pan. The exchange of information was reciprocal; we received much cooperation from companies. An expedition that I recall was made to Hobbs, where Cities Service gave us files of cuttings on many Permian Basin wells. Among the more pleasant aspects of this phase of the work were the stimulating discussions and arguments we used to have on all aspects of the regional geology.

Shortly after I arrived, Dr. Needham walked into my office in Brown Hall with a copy of Bulletin 9, *The Oil and Gas Resources of New Mexico* (Winchester, 1933). Placing this before me, he said "This is out of date and out of print. Revise it." This assignment resulted in the second edition of *The Oil and Gas Resources of New Mexico*, Bulletin 18, 1942. Though my name is on the cover as compiler, most of the field reports were written by others, chiefly from the oil industry. It was a great experience to work with these people and to "get it all together" into a 320-page report with a fat envelope of maps and sections. Probably there were hangups and problems, but if so I don't remember them; all 22 contributors came through as scheduled, and I've always been proud of the resulting bulletin. Those were the days, I might point out, when we had a war to win, and the national attitude was expressed in the words "Can do!" (as contrasted with the present day, when the watchword seems to be "No way").

Preparation of Bulletin 18 introduced me to an activity that I recall with pleasure and gratitude: editorial work, which eventually involved Bulletins 18 through 29 and Circulars 8 through 14. In this work I came under the influence of two excellent tutors. Sterling B. Talmage, professor of geology in the School of Mines, had an eagle eye for jargon and lack of clarity in geological writing and made clear to me many of the mysteries of expository prose; in addition, he taught me how to prepare a manuscript for the printer and how to use

proofreaders' marks: Fred Harvey, longtime manager of the University of New Mexico Press, was a patient explainer of the publishing process and how you get a typescript into print and a map into the pocket of a bulletin. Besides working with these gentlemen, I collaborated with many authors and learned much about subjects other than subsurface geology. Though editors and authors are supposed to be natural enemies, I don't remember any hard feelings. Indeed, one grateful author even presented me with a nice lettering set, which I still have.

Of course we also got into the field. Especially I recall working with Claude Needham in trying to locate and describe usable type sections for the Abo, Yeso, Glorieta, and San Andres, and mapping the Gran Quivira quadrangle with Georges Vorbe of the School of Mines and Archie MacAlpin and Ralph Wilpolt of the U.S. Geological Survey. When World War II was over, we organized a 1945 field trip to the Chupadera Mesa country and a 1946 trip to the Barker Dome and Aztec Ruins region. Each of these had about 125 geologists, in more than 40 cars, and required a bit of organization. My memory of the 1946 expedition is vivid. I was in the lead on a gravel road north of Farmington when the battery fell out of my car and disintegrated in the dust. But the show went on and a good time was had by all.

Perhaps most clearly I remember the years 1941-47 in terms of people: my colleagues in the Bureau, especially E. C. Anderson, Donn Clippinger, Marian Burks, and Dick Northup; U.S. Geological Survey personnel, including not only MacAlpin and Wilpolt but also Charles B. Read, Ernest Dobrovolny, John Barnett, and Jack Frost; colleagues from Albuquerque, particularly Parry Reiche, Stuart Northrop, and Vincent Kelley; members of the Oil and Gas Conservation Commission, especially Glenn Staley, Raymond Lamb, and Bill Macey; and the scores of oil-industry geologists that helped make the New Mexico scene, and the Bureau offices in particular, so lively and interesting. It was a great time.

SKETCH OF THE FIRST FIFTY YEARS OF THE NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES

by Candace H. Merillat, *Assistant Editor*

The fiftieth anniversary of the New Mexico Bureau of Mines and Mineral Resources is this year, 1977. Originally designated a department of the New Mexico School of Mines, the Bureau was established by the New Mexico Legislature on March 14, 1927. During the first 17 years, the Bureau's director was the president of the New Mexico School of Mines. In 1927 the first director, E. H. Wells, and four other part-time employees comprised the entire Bureau staff; all were also employees of the School of Mines. The positions they filled in the Bureau were: a director, two geologists, a librarian-statistician, and a stenographer. Projects that first year included: beginning a bibliography of New Mexico geologic literature; starting field investigations in Taos, Rio Arriba, and Santa Fe Counties, and the Magdalena district of Socorro County; and completing field investigations on deposits of mica, lithium, and fluorspar.

In July 1928 most of the Bureau's records and library were destroyed by fire, including the almost-completed report on mica and lithium. All notes and maps for that report were lost, also. While insurance covered some of the property damage, information on the accomplishments for the Bureau's first year was forever lost. Second-year projects included expansion of the Magdalena district field investigation, resuming work on the New Mexico bibliography (published in 1930 as Bulletin 5), and working with the New Mexico State Tax Commission in its appraisal of state mining properties. Bulletin 4 was published in 1928—the first of the Bureau's technical reports (Bulletins 1-3 were published by the School of Mines as part of the New Mexico Mineral Resources Survey, prior to the establishment of the Bureau).

During the Bureau's third year, the first full-time staff member, S. G. Lasky, was employed. Projects of the first two years were continued, and more new ones were initiated. A report of these first three years was made to the Legislature in the Bureau's Circular 3, published in 1931.

For the 1931-46 period, annual reports were not issued. Consequently, our knowledge of these years is limited. In 1939, after the suicide of Mr. Wells, C. E. Needham became president of the School of Mines and director of the Bureau. Dr. Needham resigned in 1942 and was replaced as director by John M. Kelly, then State Geologist (now a member of the Board of Regents governing New Mexico Institute of Mining and Technology). Mr. Kelly's appointment was on a temporary basis. Later that year Richard H. Reece became president and director. In 1943 the first group of permanent full-time staff members was hired. In 1944 President Reece resigned as director of the Bureau, and Mr. Kelly was reappointed director. Because he was also State Geologist, Mr. Kelly maintained an office in Santa Fe, while the rest of the Bureau remained in Socorro—the only time the director lived outside of Socorro. Prior to this time the directorship of the Bureau had always been a part-time duty of the president of the New Mexico School of Mines.

In January 1945 the Bureau was placed under a part-time acting director, A. D. Hafn; in July of that year a full-time director, E. Carter Anderson, was appointed. During fiscal year 1945-46, the staff consisted of eleven full-time employees, and the Bureau was organized into an oil and gas division and a mining division. A field office was established in Artesia on April 16, 1946, with N. R. Lamb, petroleum engineer, in charge. The office aided oil and gas operators

with petroleum engineering problems, particularly equipment corrosion and secondary recovery of oil. The Artesia office represented the Bureau in such groups as the New Mexico Nomenclature Committee, the Interstate Oil Compact Commission, and the Lea County Operators Committee. The Artesia office was closed in 1953.

During the 1940's Bureau projects expanded progressively, and the already-large collection of oil well samples increased. Circulars and Bulletins were published from time to time; Circulars were free of charge. By fiscal year 1947-48, the Ground Water Survey and the Basic Geological Survey were begun in cooperation with the U.S. Geological Survey. The Ground Water Survey was supervised by C. V. Theis, regional geologist, Ground Water Division of the U.S. Geological Survey. The Basic Geological Survey was supervised by Charles F. Park, Jr., Professor of Geology at Stanford and former Chief of the Metals Section, U.S. Geological Survey.

In 1948 R. N. Lamb resigned as supervisor of the Bureau's Artesia office and was replaced by E. E. Kinney, petroleum engineer. Also in 1948, work continued on the Ground Water Survey and the Basic Geological Survey. The first Ground Water Report was published, in addition to a major revision of the Oil and Gas Map of New Mexico (originally published in 1942). For the first time, charges were placed on Circulars.

After the resignation of Mr. Anderson in September 1949, Eugene Callaghan, economic geologist, was appointed director of the Bureau. During October 1949, the Bureau, having long since outgrown its cramped quarters in the basement of Brown Hall (the current administration and humanities building of the New Mexico Institute of Mining and Technology), moved to the building that housed the Research and Development Division (this building was later named the E. J. Workman Center). In 1950 the Bureau participated in the Arkansas-White-Red River Basins Inter-Agency Committee, set up by directive of the 81st Congress to examine and report upon those drainage basins. This 4-year project contributed significantly to knowledge of the area.

During 1950-52 the Bureau staff increased substantially, adding 7 economic geologists, 1 hydrologic engineer, 1 stratigraphic geologist, 1 mineralogical petrographer, 4 geological technologists, 1 draftsman, 1 stenographer, 10 students, and the temporary services of 2 other geologists. Included in this group was Frank E. Kottowski, our present director.

The Bureau's paleontological collections were initiated during the years 1952-54; by 1954 a large Permian collection had already been established. During these years much work was continued on the Ground Water Survey. A severe water shortage in Santa Fe in 1951 made exploration particularly important in that area.

The Bureau established research contracts with the U.S. Bureau of Indian Affairs in 1954. These contracts included geologic mapping of 484 sq mi, a mineral survey, assessing ground-water resources, preparing detailed maps of mineral deposits, mineral testing, and an economic analysis. The area covered included McKinley County, New Mexico, and Apache County, Arizona.

With the intensified interest in uranium resources during the early 1950's, many people wrote or visited the Bureau to find out more about this interesting source of energy. In cooperation with such organizations as the Atomic Energy Commission and the U.S. Bureau of Land Management, Bureau staff members assisted prospectors whenever possible.

During the period of 1954-56 the Bureau moved into a new wing (south side)

of the Research Laboratory that provided much-needed space and laboratory facilities; by this time, additional space was also needed for the oil well sample library. In 1955 the Bureau used the new quarters to host the annual meeting of the Association of American State Geologists.

Projects during this period placed emphasis on the Ground Water Survey, paleontologic and stratigraphic projects, detailed studies of volcanic rocks, gas and petroleum research, and a new state geologic map. The first book in the series Scenic Trips to the Geologic Past was published in 1955. The first of the Memoir series was published in 1956, as was the first Geologic Map.

Dr. Callaghan resigned in January 1957. In February Alvin J. Thompson was appointed the director of the Bureau. He also continued to serve as head of the Department of Mining and Metallurgy at New Mexico Tech, a position he had held for the previous ten years, ^{until} 1959.

Research in metallurgy was begun in 1957 on a limited basis. In 1959 the first full-time metallurgist, Roshan B. Bhappu, was hired, and a metallurgy section was established within the Bureau. About \$22,000 of metallurgical equipment and laboratory supplies was acquired at this time, some through donations. From 1960-62 another \$20,000 of additional equipment and supplies was purchased. Projects were initiated on systematic froth flotation methods, recovery of minerals from pegmatites, copper recovery, and molybdenum leaching. During the mid-1960's the Bureau's metallurgy section increased in size and activities. Students were hired to assist with the projects. Professional metallurgists were also hired on a temporary basis for specific projects.

In 1964-65 Bureau projects initiated included geothermal studies and a clay resources survey. A clay-testing laboratory was also begun at this time.

Following the resignation of Mr. Thompson in July 1968, Frank E. Kottlowski served as acting director. After a 16-month search that began when Mr. Thompson first announced his plans to retire, Don H. Baker, Jr., a metallurgist previously at the University of Waterloo in Ontario, was appointed director in July 1969.

By 1969 the metallurgy section of the Bureau comprised about a third of the Bureau's work. Coal research also began to play an important role in the Bureau's activities at this time, as energy sources other than oil and gas began to be intensively explored.

In 1971 the Hydrologic Report series was initiated. In 1972 the first Progress Report and first Resource Map were published.

In 1972 the new building for housing the New Mexico Library of Subsurface Data was occupied. This collection includes well logs, subsurface maps, and nearly 3 million individual well samples, all valued at over \$1 million. This same year the Bureau also participated with the National Aeronautics and Space Administration in the ERTS-A (Earth Resources Technology Satellite) program.

The director of the Bureau also became the director of the New Mexico Coal Surfacing Commission from its inception in 1972 to 1977. He served as the official liaison with coal company officials, the public, and the Commission. The Reorganization Act of 1977 changes the name of the Commission to the Bureau of Surfacing. The director of the Bureau of Mines and Mineral Resources continues to be a member, although the chief of the Bureau of Surfacing will not necessarily be the director of the Bureau of Mines and Mineral Resources.

Mr. Baker resigned as director in July 1973, and Dr. Kottlowski again served as acting director until February 1974, when the Regents appointed him director.

The Atlas Program was initiated in 1972 to investigate all forms of energy to

cope with the emerging "Energy Crisis." The Bureau's part of this 7-year program was assisting with estimates of state reserves of strippable coal, fluorspar, uranium, water resources, oil and gas, metallic ores, and other mineral resources.

Of the 41 current full-time staff members, 25 arrived between 1973 and 1977. To accommodate the expanded functions and staff, new offices were built in an added wing to Workman Center and were occupied in May 1975 by most of the Bureau staff. In late June 1977 the second floor addition over this south wing of the building was completed.

In December 1976 George S. Austin was appointed the Bureau's first full-time permanent deputy director. Dr. Austin was previously industrial minerals geologist with the Bureau.

The growth of the New Mexico Bureau of Mines and Mineral Resources reflects the growth of the mineral industry in the state. In the Bureau's first year, 1927, the value of New Mexico's mineral production was \$26.4 million. By 1976 mineral production was \$2.37 billion. The Bureau's first field work was carried out by School of Mines faculty during the summers, with reports written during the winters; all personnel were part time, and the Bureau did not have a separate budget. The present organization (including full-time and part-time staff and students) totals more than 80 employees. The Bureau shares some research facilities with other divisions of Tech and also has the cooperation of faculty and staff in the other divisions, thus increasing both the quantity and quality of Bureau projects. Since 1927 more than 475 technical reports have been published, with more than 400 of these published in the past 25 years. The Bureau's annual budget is approximately \$1,041,000 from State funds, with an additional \$200,000 from grants, contracts, and service commissions. All indications are that the second fifty years of service will be even more productive than the first!

ACKNOWLEDGMENTS—Information for this article was obtained primarily from the New Mexico Bureau of Mines and Mineral Resources Annual Report series. Conversations with Mrs. Marian Burks and Robert A. Bieberman were also very helpful, and I wish to thank them for their time.

A Bureau Open-file Report will be made available later this fiscal year containing this article. Bureau statutory authority and relevant legislation, legislative appropriations, excerpts from all Bureau annual reports, and other notes.

Directors of New Mexico Bureau of Mines
and Mineral Resources

Name	Titles	Tenure
E. H. Wells	President, School of Mines Director of Bureau State Geologist President of faculty	July '27-Jan '39
		Mar '34-Jan '39
C. E. Needham	Acting president, School of Mines Acting director of Bureau President, School of Mines Director of Bureau	Jan '39-May '39
		May '39-Apr '42
J. M. Kelly	(full-time State Geologist) Director of Bureau, pro tem	Apr '42-Aug '42
R. H. Reece	President, School of Mines Director of Bureau	Aug '42-June '46
		Aug '42-Mar '44
J. M. Kelly	(full-time State Geologist) Director of Bureau	Mar '44-Jan '45
A. D. Hahn	Acting director of Bureau	Jan '45-July '45
E. C. Anderson	Director of Bureau	July '45-Sept '49
E. Callaghan	Director of Bureau	Sept '49-Jan '57
A. J. Thompson	Director of Bureau Chairman, Dept. of Mining & Metallurgy, School of Mines/New Mexico Tech (To 9/59)	Feb '57-July '68
		1947-July '68
F. E. Kottowski	Assistant director Acting director	July '65-July '68
		July '68-July '69
D. H. Baker, Jr.	Director of Bureau	July '69-July '73
F. E. Kottowski	Assistant director Associate director Acting director Director of Bureau	July '69-Feb '73
		Mar '73-June '73
		July '73-Feb '74
		Feb '74-present
G. S. Austin	Deputy director	Dec '76-present

ACTS OF THE NEW MEXICO LEGISLATURE 1927-77 RELATING TO
NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES

compiled by Candace H. Merillat, *Assistant Editor*

INTRODUCTION

This year, the fiftieth anniversary of the New Mexico Bureau of Mines and Mineral Resources, is an appropriate time for publishing the first compilation of New Mexico statutes relating specifically to the Bureau, its director, or other staff members. The act that created the Bureau is published completely as it originally was approved. I have excerpted most other legislation rather freely, but all omissions are so indicated by ellipses. Compiler's comments, paraphrasing, and additions for clarification are in italics, and, in some cases, are indicated by brackets. Specific references to the Bureau, its director, or other staff members are printed in boldface type, except in organic acts. In a few cases amendments are given without the original laws. This is because only the amendments applied to the Bureau specifically. Difficulties in the research were encountered because indexing to the New Mexico statutes is not consistently adequate.

Additionally, key words vary from year to year. The search for relevant laws was made under many headings, including: Bureau of Mines and Mineral Resources; Director, Bureau of Mines and Mineral Resources; Mines, Mining; New Mexico Bureau of Mines and Mineral Resources; New Mexico Institute of Mining and Technology; New Mexico School of Mines; State Bureau of Mines and Mineral Resources; and others. Some legislation was discovered virtually by accident, because of the inadequacies and the inconsistencies of indexing. In general, the Bureau is not a regulatory agency; consequently, it is not mentioned frequently in New Mexico legislation.

ACKNOWLEDGMENTS—The librarians of the New Mexico Supreme Court (Santa Fe), the University of New Mexico (Albuquerque), and the New Mexico Institute of Mining and Technology (Socorro), and the New Mexico Legislative Council Service (Santa Fe) were consulted.

All or portions of the following laws are included:

Laws of 1927, Chapter 115
Laws of 1935, Chapter 19
Laws of 1947, Chapter 218
Laws of 1961, Chapter 136
Laws of 1967, Chapter 128
Laws of 1967, Chapter 143
Laws of 1967, Chapter 158

Laws of 1967, Chapter 171
Laws of 1967, Chapter 254
Laws of 1972, Chapter 68
Laws of 1973, Chapter 326
Laws of 1975, Chapter 289
Laws of 1977, Chapter 255

LAWS OF NEW MEXICO 1927, Chapter 115, approved March 14, 1927

AN ACT ESTABLISHING A BUREAU OF MINES AND MINERAL RESOURCES OF THE STATE OF NEW MEXICO; PROVIDING FOR THE CONTROL AND MANAGEMENT OF SAID BUREAU OF MINES AND MINERAL RESOURCES; PROVIDING FOR THE APPOINTMENT OF A DIRECTOR OF SAID BUREAU AND FIXING HIS QUALIFICATIONS; PROVIDING FOR THE OBJECTS, DUTIES AND PURPOSES OF SAID BUREAU OF MINES AND MINERAL RESOURCES AND PROVIDING FOR THE MAINTENANCE AND SUPPORT OF SAID BUREAU OF MINES AND MINERAL RESOURCES OF THE STATE OF NEW MEXICO.

Sec. 1. There is hereby established a Bureau of Mines and Mineral Resources of the State of New Mexico which shall be a department of the New Mexico School of

Mines and under the direction of its Board of Regents. The said Board shall appoint as a director a suitable person to be known as the Director of the Bureau of Mines and Mineral Resources and upon his nomination such assistants and employees as the said Board shall deem necessary. Said Board may also determine the compensation of all persons employed by the Bureau of Mines and Mineral Resources including the director and may remove them at will.

Sec. 2. The objects and duties of said Bureau of Mines and Mineral Resources shall be as follows:

(1) To collect, to compile and to publish statistics relative to New Mexico, geology, mining, milling, 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 non-metallic.

(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 non-metallic, oil wells, natural gas wells, reduction plants, smelters, mills, oil refineries and natural gas refineries.

(8) To make qualitative examination 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 non-metallic, 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 co-operate 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 co-operate with the United States Geological Survey and with the United States Bureau of Mines in accordance with the regulations of those institutions.

Note: Two additional duties are specified in Laws of 1977, Chapter 255, Section 17, paragraphs M and N.

Sec. 3. The Board shall cause to be prepared an annual report showing the progress and condition of the Bureau, together with such other information as they may deem necessary or useful, or as the board may require.

Sec. 4. The regular and special reports of the Bureau of Mines and Minerals shall be printed as the Board may direct and the reports may be distributed or sold by the board as the interest of the State or science may demand and the money obtained by the sale of said reports shall be paid into the State's Treasury. *Note: Amended by Laws of 1935, Chapter 19.*

Sec. 5. All materials collected after having served the purpose of the Bureau shall be distributed by the Board to such educational institutions of the State as the Board may direct.

Sec. 6. The Board may use of the funds appropriated for the maintenance of the New Mexico School of Mines such sums as may be necessary for the maintenance

of the Bureau hereby created, not to exceed, however, such sums as may be appropriated for the New Mexico School of Mines from the fund provided by Section 35 of Senate Bill No. 2775 United States Congress. (Public—No. 146—66th Congress.)

Sec. 7. All Acts and parts of Acts in conflict with the provisions of this Act are hereby repealed.

LAWS OF 1935, Chapter 19, approved February 11, 1935

AN ACT AMENDING SECTION 4, CHAPTER 115 OF THE LAWS OF 1927 (SECTION 88-504 OF THE NEW MEXICO STATUTES ANNOTATED, 1929 COMPILATION) RELATING TO THE PRINTING OF REGULAR AND SPECIAL REPORTS OF THE BUREAU OF MINES AND MINERAL RESOURCES AND PROVIDING FOR THE DISPOSAL OF THE MONIES OBTAINED FROM THE SALE THEREOF.

Sec. 1. There is hereby appropriated for the New Mexico Bureau of Mines and Mineral Resources twenty thousand dollars (\$20,000.00) annually of the moneys received to read as follows:

The regular and special reports of the Bureau of Mines and Mineral Resources shall be printed as the Board may direct and the reports may be distributed or sold by the Board as the interests of the State or science may demand. The monies now in the possession of the Bureau, which have been obtained and those which are hereafter obtained from the sale of said reports, shall be used in such manner as the Board of Regents of the New Mexico School of Mines may direct.

LAWS OF 1947, Chapter 218, approved March 21, 1947

AN ACT APPROPRIATING TWENTY THOUSAND DOLLARS OF THE MINERAL LEASING LAND ACT FUND ANNUALLY FOR THE USE OF THE NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES AND DECLARING AN EMERGENCY.

Sec. 1. There is hereby appropriated for the New Mexico Bureau of Mines and Mineral Resources twenty thousand dollars (\$20,000.00) annually of the moneys received by the state from the Mineral Leasing Land Act fund created by section 35 of the Act of Congress approved February 25th, 1920, being Public Act No. 146, 66th Congress (30 U. S. C., section 191). The moneys appropriated hereunder shall be used to pay the expenses incurred in matching federal funds in connection with a co-operative geologic and ground water survey of the state. . . .

LAWS OF 1961, Chapter 136, approved March 29, 1961

AN ACT RELATING TO MINING SAFETY; CREATING A MINING SAFETY ADVISORY BOARD; AND PROVIDING FOR ADOPTION OF RULES AND REGULATIONS PROPOSED BY SUCH BOARD.

. . . Sec. 3. MINING SAFETY ADVISORY BOARD.—

A. There is hereby created a mining safety advisory board, hereinafter referred to as "the board," consisting of seven members of whom three shall represent industry, three shall be non-supervisory production or maintenance employees, and one, who shall serve as chairman and vote on all motions, shall represent the public, and shall be the director of the state Bureau of Mines and Mineral Resources. The members of the board shall be appointed by the governor for a term of six years or until their successors are appointed and qualified; provided, that in the initial appointment of members of the board one member representing industry and one employee member representing the same type of mining activity shall be appointed for a term of two years and another industry and a corresponding employee member shall be appointed for a term of four years. The pairs of appointed members shall be appointed, one pair each, from the three current major types of mining activity in terms of total employment within the state. Vacancies shall be filled by appointment for the unexpired term by the gov-

error in the same manner as the original appointments. The state mine inspector and the director of public health shall be ex officio members of the board but shall have no vote and receive no additional compensation for duties performed in connection therewith.

Note: This act was amended by the Laws of 1971, Chapter 62. The amendment provided for two additional board members, both to be representatives of molybdenum mining.

B. Members of the board shall receive no salary but shall receive compensation of fifteen dollars (\$15.00) for each day or part thereof necessarily spent in the discharge of their official duties and shall in addition be reimbursed for their necessary travel at the rate of eight cents (\$.08) a mile as approved by the state mine inspector. The inspector is hereby authorized and directed to provide the board with such clerical, technical, legal and other assistance as shall be necessary to permit the board to perform its duties as provided in the "Mining Safety Act."

Sec. 4. DUTIES OF THE MINING SAFETY ADVISORY BOARD—ASSISTANCE TO BE GIVEN BOARD.—In addition to such other duties as may be conferred upon it by laws, the board shall meet upon the request of the mine inspector and shall formulate and propose to the inspector of mines such reasonable general rules and regulations, or modifications, amendments or repeals of rules and regulations, for the prevention of accidents in every mining occupation or pursuit or such place of employment, and for reporting of such accidents as the board shall find, upon the basis of substantial evidence presented at a public hearing held in accordance with the provisions of Section 7 of the "Mining Safety Act," to be necessary for the protection of the life and safety of employees.

The board shall refer the proposed rules or regulations, or modifications, amendments or repeals of existing rules and regulations to the inspector of mines for consideration. It shall submit therewith a report, indicating the need for the proposals and summarizing the testimony presented at the public hearing and any other information or technical data available to the board. A quorum for final approval of any such report shall consist of the chairman, two industry members and two employee members.

In the development of such proposed rules and regulations, or of modifications, amendments or repeal of rules and regulations, the board may appoint special committees composed of employees, employers, and experts to make recommendations as to proposed rules and regulations or to assist the board in developing such rules and regulations. It may call upon the inspector for technical assistance and advice. In addition, the board may utilize the advice and assistance of individuals or organizations, or of other agencies having special knowledge of the proposals being considered by it.

The inspector and the director of public health shall make available to the board any information or technical data that will aid the board in determining the need for and in formulating rules and regulations for the protection of the life and safety of employees.

LAWS OF 1967, Chapter 128, approved March 27, 1967

RELATING TO MINING DISCOVERY AND MINE DRILL HOLES; REQUIRING SUBMISSION OF REPORTS; AND AMENDING SECTION 63-2-3.3 NEW MEXICO STATUTES ANNOTATED, 1953 COMPILATION (BEING LAWS 1957, CHAPTER 108, SECTION 1).

Sec. 1. Section 63-2-3.3 New Mexico Statutes Annotated 1953 Compilation (being Laws 1957, Chapter 108, Section 1) is amended to read:

63-2-3.3. PENETRATION OF WATER STRATUM BY MINE DISCOVERY OF DRILL HOLE—PLUGGING—REPORT TO STATE ENGINEER AND TO DIRECTOR OF THE STATE BUREAU OF MINES AND MINERAL RESOURCES.—Any person drilling a mine lode discovery or mine drill hole to a depth of ten feet or more, who shall encounter or whose drill shall cut into a water body or water-bearing stratum shall:

A. plug at a horizon and in the manner provided in the rules and regulations of the state engineer; and

B. within ninety days from the date of the discovery, report in writing the depth, location and manner of plugging the water body or water-bearing stratum to the state engineer at the state capitol and to the director of the state Bureau of Mines and Mineral Resources at Socorro, New Mexico.

LAWS OF 1967, Chapter 143, approved March 28, 1967

AN ACT RELATING TO GEOTHERMAL ENERGY; AND REQUIRING SUBMISSION OF REPORTS RELATING TO GEOTHERMAL ENERGY.

Sec. 1. GEOTHERMAL ENERGY SOURCE—REPORTS.—

A. Any person drilling a hole on state lands to a depth of ten feet or more who encounters, or whose drill cuts into a geothermal energy source of one hundred degrees centigrade or more shall, within ninety days from the date of the penetration, report in writing to the director the depth, location and nature of the geothermal energy source.

B. As used in this section:

(1) "geothermal energy" means the natural heat of the earth, or the energy, in whatever form, below the surface of the earth present in, resulting from, or created by, or which may be extracted from, this natural heat;

(2) "state lands" includes all land owned by the state, all land owned by school districts, beds of navigable rivers and lakes, submerged lands and lands in which mineral rights or geothermal resources have been reserved to the state; and

(3) "director" means the director of the Bureau of Mines and Mineral Resources.

LAWS OF 1967, Chapter 158, approved March 27, 1967

AN ACT RELATING TO GEOTHERMAL RESOURCES; AND PROVIDING FOR THE LEASING OF GEOTHERMAL RESOURCES ON STATE LANDS UNDER CERTAIN CONDITIONS.

Sec. 3. ADMINISTRATION OF ACT.—Administration of the Geothermal Resources Act shall be based on the principle of multiple use of state land and resources, and shall allow coexistence of other leases on the same lands for deposits of other minerals, and the existence of leases issued pursuant to the Geothermal Resources Act shall not preclude other uses of the land covered thereby. However, operations under other leases, or for other uses shall not unreasonably interfere with or endanger operations under any lease issued pursuant to the Geothermal Resources Act, nor shall operations under leases issued pursuant to the Geothermal Resources Act unreasonably interfere with or endanger operations under any lease issued pursuant to any other law. The Geothermal Resources Act shall not be construed to supersede the authority which any state department or agency has with respect to the management, protection, and utilization of the state lands and resources under its jurisdiction.

Sec. 4. GEOTHERMAL RESOURCES OF COMMERCIAL VALUE.—Where it is determined by the commissioner that the production or use of geothermal energy is also susceptible of economically producing other of the geothermal resources in commercially valuable quantities, and a market therefor exists, production of the other geothermal resources may be required by the commissioner. . . .

Sec. 6. KNOWN GEOTHERMAL RESOURCES FIELD.—

A. The commissioner shall after consultation with the director of the Bureau of Mines and Mineral Resources, make a classification of geothermal areas which he has determined may be capable of producing geothermal resources in commercial quantities. These geothermal areas shall be classified as "known geothermal resources fields." . . .

LAWS OF 1967, Chapter 171, approved March 27, 1967

AN ACT RELATING TO MINING; ENACTING A NEW SECTION 63-1-3.1 NEW MEXICO STATUTES ANNOTATED, 1953 COMPILATION; AND AUTHOR-

IZING PUBLICATION OF MINING LAWS AND REGULATIONS OF THE STATE.

Sec. 1. A new Section 63-1-3.1 New Mexico Statutes Annotated, 1953 Compilation, is enacted to read:

63-1-3.1. PUBLICATION OF MINING LAWS AND REGULATIONS.—The board [*New Mexico Institute of Mining and Technology Board of Regents*] may, in its discretion, cause to be prepared and published a compilation of the mining laws and regulations of the state and is authorized to update and reprint the same at such intervals as it deems advisable to reflect any substantial changes in the law or regulations. The book shall be sold at such price as the board may determine.

LAWS OF 1967, Chapter 254, approved April 5, 1967

AN ACT RELATING TO THE ACCELERATING OF NEW MEXICO'S MINERAL RESOURCES.

Sec. 1. SHORT TITLE.—This act may be cited as the Mineral Resources Development Act.

Sec. 2. PUBLIC POLICY.—The legislature finds and declares that:

A. the exploitation of New Mexico's mineral resources provides an opportunity for highly paid jobs for New Mexicans;

B. the successful exploitation of minerals shall be encouraged by the state of New Mexico;

C. New Mexico has been very successful in the past in exploiting minerals with visual observational methods applied to the surface of the ground; and

D. New Mexico has now reached the stage where future exploitation of minerals must proceed on the basis of the intensive application of modern technology. The immediate need is for the assembly of known data on mineral resources by mineral resource economists in order to make it possible to point to the areas offering the highest probability of successful exploitation of these resources.

Sec. 3. TECHNOLOGICAL STUDIES—ECONOMIST.—New Mexico institute of mining and technology is directed to use its [*Bureau of Mines and Mineral Resources*] mineral resource economist to undertake studies aimed at developing technology which will make possible the profitable exploitation of New Mexico's mineral resources. This effort should be aimed initially at those minerals development opportunities which offer the best hope of successful exploitation and the creation of the greatest numbers of jobs. When a profitable opportunity has been developed, the mineral resource economist shall make this information available to the state planning office and to the department of development. . . .

LAWS OF 1972, Chapter 68, approved February 29, 1972

AN ACT RELATING TO THE ENVIRONMENT; PROVIDING FOR THE CONTROL AND REGULATION OF COAL STRIPMINING; PROVIDING FOR THE RECLAMATION AND ENFORCEMENT OF THE COAL SURFACE-MINING ACT; INCLUDING PENALTY PROVISIONS FOR VIOLATIONS; ESTABLISHING FEES AND MAKING AN APPROPRIATION OF THEM; AND DECLARING AN EMERGENCY.

. . . Sec. 2. DEFINITIONS.—As used in the Coal Surfacemining Act:

A. "affected area" means the area from which overburden is removed and on which it is deposited;

B. "stripmining" means mining coal by removing overburden above the coal and removing the natural deposit directly;

C. "commission" means the coal surfacemining commission;

D. "director," when used without further qualification, means the director of the Bureau of Mines and Mineral Resources;

E. "mining year" means the twelve-month period on which an operator's mining plan is based;

F. "operator" means any person engaged in stripmining;

G. "overburden" means earth and other materials above a coal deposit before and after removal; and

H. "person" means any individual, estate, trust, receiver, cooperative association, club, corporation, company, firm, partnership joint venture, syndicate, or other entity or association.

Sec. 3. COAL SURFACEMINING COMMISSION.—

A. The coal surfacemining commission is created. The commission shall consist of:

(1) the director of the Bureau of Mines and Mineral Resources or a member of his staff designated by him;

(2) the director of the department of game and fish or a member of his staff designated by him;

(3) the director of the environmental improvement agency or a member of his staff designated by him;

(4) the chairman of the soil and water conservation committee or a member of his staff designated by him;

(5) the director of the agriculture experimental station of New Mexico state university or a member of his staff designated by him;

(6) the state engineer or a member of his staff designated by him; and

(7) the commissioner of public lands or a member of his staff designated by him. . . .

Sec. 4. DUTIES AND POWERS OF THE COMMISSION.—The commission shall:

A. administer the Coal Surfacing Act;

B. receive and expend funds appropriated or allocated to the commission for purposes consistent with the Coal Surfacing Act;

C. develop facts and make studies on the effects of stripmining in New Mexico;

D. make every reasonable effort to obtain voluntary cooperation for reclaiming stripmined land;

E. approve or disapprove mining plans; and

F. have such other powers as are necessary to carry out the commission's responsibilities.

Sec. 5. DIRECTOR—DUTIES—REVIEW OF DECISIONS OF DIRECTOR—APPEAL OF DECISIONS OF COMMISSION.—

A. The director shall execute and administer the commission's regulations and perform other duties specified in the Coal Surfacing Act. . . .

Sec. 8. RECLAMATION REQUIRED.—

A. Affected areas must be graded and revegetated in the manner provided for by commission regulation.

B. Reclamation shall be an integral part of the mining operation and shall be completed within reasonably prescribed time limits. . . .

Sec. 10. REGULATIONS.—

A. The commission shall adopt reasonable regulations concerning the productive reclamation of stripmined land. These regulations shall govern the requirements for:

(1) grading the affected area;

(2) revegetating the affected area;

(3) revegetation and grading time schedules; and

(4) other mining plan provisions. . . .

C. In approving mining plans and in adopting regulations concerning the reclamation of stripmined land, the commission shall take into account:

(1) the natural condition and vegetation of the land prior to the stripmining operations;

(2) the technical and economical practicability of each particular revegetation and grading requirement;

- (3) the future productivity of the affected area for domestic, commercial, pastoral, agriculture, wildlife, recreation and other uses;
- (4) the aesthetic appearance of the affected area; and
- (5) the peculiar condition of the geographical area in which the stripmine is located. . . .

Sec. 13. INFORMATION REPORTS.—The director may as prescribed by commission regulation require periodic information reports on the progress of an operator's reclamation efforts.

Sec. 14. SUPERVISION.—The director shall investigate the reclamation status of stripmined lands to insure that the grading and revegetation requirements of the mining plan and the commission's regulations are being adhered to. The director or his authorized representatives may enter upon the operator's lands at all reasonable times to determine compliance with the Coal Surfacemining Act. . . .

LAWS OF 1973, Chapter 326, approved April 3, 1973

AN ACT RELATING TO WATER QUALITY; AMENDING SECTIONS 75-39-2, 75-39-3, 75-39-4, 75-39-8 AND 75-39-11 NMSA 1953 (BEING LAWS 1967, CHAPTER 190, SECTIONS 2, 3, 4, 8 AND 11, AS AMENDED); ENACTING A NEW SECTION 75-39-4.1 NMSA 1953; PROVIDING A PENALTY.

Sec. 1. Section 75-39-2 NMSA 1953 (being Laws 1967, Chapter 190, Section 2, as amended) is amended to read:

75-39-2. DEFINITIONS.—As used in the Water Quality Act:

. . . J. "constituent agency" means, as the context may require, any or all of the following agencies of the state:

- (1) the environmental improvement agency;
- (2) the state engineer and the interstate stream commission;
- (3) the New Mexico department of game and fish;
- (4) the oil conservation commission;
- (5) the state park and recreation commission;
- (6) the New Mexico department of agriculture;
- (7) the state natural resource conservation commission; and
- (8) the New Mexico Bureau of Mines; . . .

. . . Sec. 2. Section 75-39-3 NMSA 1953 (being Laws 1967, Chapter 190, Section 3, as amended) is amended to read:

75-39-3. WATER QUALITY CONTROL COMMISSION CREATED.—

A. There is created the "water quality control commission" consisting of:

- (1) the director of the environmental improvement agency or a member of his staff designated by him;
- (2) the director of the New Mexico department of game and fish or a member of his staff designated by him;
- (3) the state engineer or a member of his staff designated by him;
- (4) the secretary of the oil conservation commission or a member of his staff designated by him;
- (5) the director of state park and recreation commission or a member of his staff designated by him;
- (6) the director of the New Mexico department of agriculture or a member of his staff designated by him;
- (7) the executive secretary of the state natural resource conservation commission or a member of his staff designated by him;
- (8) the director of the New Mexico Bureau of Mines or a member of his staff designated by him; and
- (9) a representative of the public to be appointed by the governor for a term of four years and who shall be compensated from the budgeted funds of the environmental improvement agency in accordance with the provisions of the Per Diem and Mileage Act. . . .

Sec. 3. Section 75-39-4 NMSA 1953 (being Laws 1967, Chapter 190, Section 4, as amended) is amended to read:

75-39-4. DUTIES AND POWERS OF COMMISSION.—The commission:

A. may accept and supervise the administration of loans and grants from the federal government and from other sources, public or private, which loans and grants shall not be expended for other than the purposes for which provided;

B. shall adopt a comprehensive water quality program and develop a continuing planning process;

C. shall adopt water quality standards as a guide to water pollution control;

D. shall adopt, promulgate and publish regulations to prevent or abate water pollution in the state or in any specific geographic area or watershed of the state or in any part thereof, or for any class of waters. Regulations shall not specify the method to be used to prevent or abate water pollution, but may specify a standard of performance for new sources which reflects the greatest degree of effluent reduction which the commission determines to be achievable through application of the best available demonstrated control technology, processes, operating methods, or other alternatives, including, where practicable, a standard permitting no discharge of pollutants. In making its regulations, the commission shall give weight it deems appropriate to all facts and circumstances. . . .

E. shall assign responsibility for administering its regulations to constituent agencies so as to assure adequate coverage and prevent duplication of effort. To this end, the commission may make such classification of waters and sources of water contaminants as will facilitate the assignment of administrative responsibilities to constituent agencies. The commission shall also hear and decide disputes between constituent agencies as to jurisdiction concerning any matters within the purpose of the Water Quality Act. In assigning responsibilities to constituent agencies, the commission shall give priority to the primary interests of the constituent agencies. The environmental improvement agency shall provide testing and other technical services; . . .

I. may adopt regulations requiring notice to it or a constituent agency of intent to introduce or allow the introduction of water contaminants into waters of the state; and

J. may adopt regulations establishing pretreatment standards that prohibit or control the introduction into publicly-owned sewerage systems of water contaminants which are not susceptible to treatment by the treatment works or which would interfere with the operation of the treatment works. . . .

Sec. 5. Section 75-39-8 NMSA 1953 (being Laws 1967, Chapter 190, Section 8) is amended to read:

75-39-8. POWERS OF CONSTITUENT AGENCIES.—Each constituent agency may:

A. receive and expend funds appropriated, donated or allocated to the constituent agency for purposes consistent with the Water Quality Act;

B. develop facts and make studies and investigations and require the production of documents necessary to carry out the responsibilities assigned to the constituent agency. The result of any investigation shall be reduced to writing and a copy thereof furnished to the commission and to the owner or occupant of the premises investigated;

C. recommend regulations for adoption by the commission;

D. report to the commission and to other constituent agencies water pollution conditions that are believed to require action where the circumstances are such that the responsibility appears to be outside the responsibility assigned to the agency making the report;

E. make every reasonable effort to obtain voluntary cooperation in the prevention of abatement of water pollution; and

F. upon presentation of proper credentials, enter at reasonable times upon or through any premises in which an effluent source is located or in which are located any records required to be maintained by regulations of the commission; . . .

Sec. 6. Section 75-39-11 NMSA 1953 (being Laws 1967, Chapter 190, Section 11) is amended to read:

75-39-11. LIMITATIONS.—

A. The Water Quality Act does not grant to the commission or to any other entity the power to take away or modify property rights in water, nor is it the intention of the Water Quality Act to take away or modify such rights.

B. Effluent data obtained by the commission or a constituent agency shall be available to the public. Other records, reports or information obtained by the commission or a constituent agency shall be available to the public, except upon a showing satisfactory to the commission or a constituent agency that the records, reports or information or a particular part thereof, if made public, would divulge methods or processes entitled to protection as trade secrets.

C. The Water Quality Act does not authorize the commission to adopt any regulation with respect to any condition or quality of water if the water pollution and its effects are confined entirely within the boundaries of property within which the water pollution occurs when the water does not combine with other waters. . . .

LAWS OF 1975, Chapter 289, approved April 10, 1975

AN ACT RELATING TO ENERGY; CREATING THE ENERGY RESOURCES BOARD; PROVIDING FOR ITS POWERS AND DUTIES; TRANSFERRING THE OIL CONSERVATION COMMISSION, ITS POWERS, DUTIES, EMPLOYEES, RECORDS AND APPROPRIATIONS TO THE ENERGY RESOURCES BOARD; MAKING CERTAIN DECISIONS OF THE OIL CONSERVATION COMMISSION SUBJECT TO REVIEW BY THE ENERGY RESOURCES BOARD; CREATING THE OFFICE OF STATE PETROLEUM ENGINEER; MAKING THE SECRETARY-DIRECTOR OF THE OIL CONSERVATION COMMISSION THE STATE PETROLEUM ENGINEER; CREATING THE OFFICE OF STATE GEOLOGIST; INCREASING THE RATE OF OIL AND GAS CONSERVATION TAX AND EXTENDING ITS APPLICATION TO ALL OTHER FORMS OF ENERGY SEVERED FROM THE SOIL OF NEW MEXICO; AMENDING AND REPEALING CERTAIN SECTIONS OF THE NMSA 1953; PROVIDING A PENALTY; MAKING AN APPROPRIATION.

... Sec. 2. PURPOSE OF ACT.—It is the purpose of the Energy Resources Act:

A. to provide additional regulation of the production, transportation and distribution of energy resources within this state;

B. to guarantee, insofar as is practicable to the citizens of this state that fuel and power produced in this state, sufficient to the needs of its current and prospective citizens, governments and industries, will be available;

C. to provide for the citizens of this state, consistent with their health, welfare and safety, the lowest reasonable utility rates that are consistent with sound growth of the energy resources industry in the state, and to encourage the establishment of a distribution system sufficient to provide utility services not only to large population centers, but those small isolated communities whose continued existence and growth are necessary to this state;

D. to ensure that the state and its political subdivisions receive, from the severance of irreplaceable energy resources from the soil of this state, the maximum economic return, consistent with the good of the entire state;

E. to develop and administer a statewide plan for energy resources, including energy resources research and development; energy facility management program; energy conservation; fuel allocation; and administration of grants;

F. to enact energy resource conservation and control legislation under the police power of the state, the residuum of the state's power not delegated to the federal government by the constitution of the United States and the authority of the legislature under the constitution of New Mexico;

G. to provide for an economic climate in the state to foster the energy resource extractive industry;

H. to provide for an energy resource administration that will work for a

national energy policy which will benefit the energy resource industry and the people in this state; and

I. to provide that these objectives should be accomplished in a way that is primarily in the best interest of the state but also to the benefit of the rest of the nation.

Sec. 4. BOARD CREATED—APPOINTMENT—TERMS.—

A. The "energy resources board" is created.

B. The board shall consist of seven members and shall include:

(1) the New Mexico "energy resource administrator," a position within the staff of the governor, hereby created, who shall be the chief administrative officer of the board;

(2) the commissioner of public lands;

(3) the director of the New Mexico Bureau of Mines;

(4) the state petroleum engineer;

(5) the state geologist;

(6) a resident of the state who by virtue of education and experience has expertise in one of the fields of nuclear, geothermal, solar or coal energy, and is highly knowledgeable in at least two others of said fields; and

(7) a resident of the state who is not directly involved in the production, transportation or regulation of energy fuels.

C. The term of office, as a member of the board, of the energy resources administrator, commissioner of public lands, director of the Bureau of Mines, state petroleum engineer and state geologist, shall be concurrent with the other office held by him.

Sec. 8. POWERS AND DUTIES OF THE BOARD.—

A. The board shall:

(1) insofar as is practicable, maintain complete records of all fuel and power produced in this state and a complete inventory of all reserves and potential sources of fuel and power in this state, and keep a complete record of the wholesale and quantity sales of fuel and power consumed within the state and exported out of the state;

(2) insofar as is practicable, maintain complete records of the prices paid for and taxes paid on fuel and power produced in this state, and maintain a constant comparison with similar prices and taxes paid for and on similar fuel and power in other states;

(3) formulate a general statewide plan for the siting, production and refining of fuel and power in whatever form in this state, and for wholesale and quantity sales of fuel and power where the sale involves fuel or power produced or refined in this state, regardless of the jurisdiction in which the contract for such sale is consummated;

(4) adopt and publish rules to govern its proceedings;

(5) establish by regulation uniform procedures and methods by which matters under its jurisdiction are reported to it;

(6) consider applications for hearing de novo of any matter contravening the board's statewide plan or the public interest, determined by an order of the oil conservation commission;

(7) cooperate with other energy producing states in the furtherance of the statewide plan;

(8) administer any state fuel allocation program;

(9) administer any state energy conservation program;

(10) prepare and administer the state energy management program;

(11) receive and use funds from federal or other government agencies and grants and gifts from any other source; and

(12) administer any state funded energy resources research and development grants program. . . .

Sec. 10. OFFICE OF STATE GEOLOGIST CREATED—APPOINTMENT—QUALIFICATIONS.

—The "office of the state geologist" is hereby created. The governor shall appoint a state geologist who by virtue of education and experience has expertise in the field of geology.

relating to the natural sources of energy which may be found in this state, including fossil fuels, radioactive minerals and geothermal energy. . . .

Sec. 12. DUTIES OF THE STATE GEOLOGIST.—The state geologist shall take care to avoid wasteful duplications of effort of the New Mexico Bureau of Mines and Mineral Resources and,

A. conduct geological studies of known supplies of natural sources of energy in this state, including fossil fuels, radioactive minerals and geothermal energy with the aim of determining reserves and life expectancy thereof;

B. conduct geological studies of probable and potential supplies of natural sources of energy;

C. cooperate with the New Mexico Bureau of Mines and Mineral Resources in the preparation and publication of maps, brochures and pamphlets describing known, probable and potential sources of natural energy in this state;

D. cooperate with private, state and federal agencies in the gathering of geological data concerning energy supplies in this state and immediately offsetting states; and

E. cooperate with the energy resources board in the performance of its duty to maintain an inventory of all reserves and potential sources of fuel and power in this state. . . .

LAWS OF 1977, Chapter 255, approved April 7, 1977

AN ACT RELATING TO THE ESTABLISHMENT OF AN ENERGY AND MINERALS DEPARTMENT; ABOLISHING CERTAIN AGENCIES; AMENDING, REPEALING AND ENACTING CERTAIN SECTIONS OF NMSA 1953.

Sec. 1. SHORT TITLE.—This act may be cited as the "Energy and Minerals Department Act." . . .

Sec. 3. PURPOSE.—The purpose of the Energy and Minerals Department Act is to establish a single, unified department to administer all laws and exercise all functions formerly administered and exercised by the energy resources board, coal surface-mining commission, Bureau of Mining [*Mines*] and Mineral Resources, oil conservation commission, state mine inspector, state geologist, and by doing so:

A. protect and preserve the extractive resources of the state of New Mexico for present and future generations;

B. utilize, promote and develop extractive resources in a manner compatible with ecological considerations;

C. assume responsibility for research, comprehensive long-range planning and conservation of extractive resources;

D. design and implement statewide programs and policies directed toward the best use of limited supplies of non-renewable energy sources;

E. ensure that the consumers within the state of New Mexico receive optimum benefits from extractive resource development through coordinated policy development by state and federal energy-related agencies; . . .

K. develop and administer a statewide plan for energy resources, including energy resources research and development; energy facility management program; energy conservation; fuel allocation; and administration of grants; . . .

Sec. 12. BUREAU OF [*FUEL*] GEOLOGY—CREATION—duties.—

A. There is hereby created a bureau of [*fuel*] geology within the mining and minerals division of the energy and minerals department.

B. The bureau shall:

(1) conduct geological studies of known supplies of natural sources of energy in this state, including fossil fuels, radioactive minerals and geothermal energy with the aim of determining reserves and life expectancy thereof;

(2) conduct geological studies of probable and potential supplies of natural sources of energy;

(3) cooperate with the Bureau of Mines and Mineral Resources in the

preparation and publication of maps, brochures and pamphlets describing known, probable and potential sources of natural energy in this state; . . .

Sec. 17. Section 63-1-2 NMSA 1953 (being Laws 1927, Chapter 115, Section 2) is amended to read:

63-1-2. PURPOSES AND FUNCTIONS.—The objects and duties of said **Bureau of Mines and Mineral Resources** shall be as follows:

A. to collect, to compile and to publish statistics relative to New Mexico, geology, mining, milling, metallurgy and oil and natural gas and the refining thereof;

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

C. 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;

D. to study the geological formations of the state with special reference to their economic mineral resources, both metallic and nonmetallic;

E. to examine the topography and physical features of the state with reference to their practical bearing upon the occupation of the people;

F. 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;

G. 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;

H. to make qualitative examinations of rocks and mineral samples and specimens;

I. to assist in the education of miners and prospectors through lectures and publications;

J. 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;

K. 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;

L. to co-operate 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 co-operate with the United States geological survey and with the United States bureau of mines in accordance with the regulations of those institutions;

M. to coordinate with the mining and minerals division and the secretary of the energy and minerals department in the formulation of overall policy in the area of mining and minerals; and;

N. to assist the secretary of the energy and minerals department with those projects which come within the expertise and jurisdiction of the **Bureau**.

Sec. 18. Section 63-1-3 NMSA 1953 (being Laws 1927, Chapter 115, Section 3) is amended to read:

63-1-3. ANNUAL REPORTS OF PROGRESS AND CONDITION.—

A. The board shall cause to be prepared an annual report showing the progress and condition of the **Bureau**, together with such other information as they may deem necessary or useful, or as the board may require.

B. The board shall provide the secretary of the energy and minerals department with a copy of such annual report. . . .

Sec. 26. A new Section 63-34-1.1 NMSA 1953 is enacted to read:

63-34-1.1. **BUREAU OF SURFACEMINING.**—There is hereby created a "bureau of

surfacing" within the mining and minerals division of the energy and minerals department.

Sec. 27. Section 63-34-2 NMSA 1953 (being Laws 1972, Chapter 68, Section 2) is amended to read:

63-34-2. DEFINITIONS.—As used in the Coal Surfacing Act:

- A. "affected area" means the area from which overburden is removed and on which it is deposited;
- B. "stripmining" means mining coal by removing overburden above the coal and removing the natural deposit directly;
- C. "commission" means the coal surfacing commission;
- D. "chief" means the chief of the bureau of surfacing; . . .

Note: In all cases in the Coal Surfacing Act, the word "chief" replaces "director." The director of the Coal Surfacing Commission was also the director of the Bureau of Mines and Mineral Resources; the chief will not necessarily be the director of the Bureau of Mines and Mineral Resources.

Legislative Appropriations for the
New Mexico Bureau of Mines and Mineral Resources

No specific appropriations from Legislature until 1933.

Laws of 1933, Chap. 186

To apply on salaries and wages	\$6,500.00
To apply on office expense	500.00
To apply on traveling expenses	1,000.00
To apply on operating expenses	500.00
To apply on repairs	250.00
To apply on equipment	250.00
To apply on contingent and other expenses	1,000.00

Provided that the foregoing appropriation shall be in lieu of that stated in Chapter 134, Laws of 1929 and shall be paid from funds derived under the Mineral Leasing Act (Section 35, Senate Bill No. 2775--Public No. 146, 66th Congress.)

Laws of 1935, Chap. 151

(1) To apply on salaries and wages	\$6,500.00
(2) To apply on office expense	500.00
(3) To apply on traveling expenses	1,000.00
(4) To apply on operating expenses	500.00
(5) To apply on repairs	250.00
(6) To apply on equipment	250.00
(7) To apply on contingent and other expenses	1,000.00

Provided, that the foregoing appropriations shall be in lieu of that stated in Chapter 134, Laws of 1929 and shall be paid from funds derived under the Mineral Leasing Act (Section 35, Senate Bill No. 2775--Public No. 146, 66th Congress.

Laws of 1937, Chap. 232

7. To apply on salaries and wages	\$7,500.00
8. To apply on office contingent and other expenses	1,300.00
9. To apply on traveling expense	250.00
10. To apply on repairs, equipment and operating expenses	2,950.00

Provided that the foregoing appropriation for items 7, 8, 9 and 10 shall be in lieu of that stated in Chapter 134, Laws of 1929, and shall be paid from funds derived under the Mineral Leasing Act (Sec. 35, Senate Bill No. 2775--Public No. 146, 66th Congress.)

Laws of 1939, Chap. 238

7. To apply on salaries and wages	\$7,500.00
8. To apply on office contingent and other expenses	1,300.00
9. To apply on traveling expenses	250.00
10. To apply on repairs, equipment and operating expenses	5,950.00

Provided that the foregoing appropriation for items 7, 8, 9 and 10 shall be in lieu of that stated in Chapter 134, Laws of 1929, and shall be paid from funds derived under the Mineral Leasing Act (Sec. 35-Senate Bill No. 2775-Public No. 146, 66th Congress.)

Laws of 1941, Chap. 212

7. To apply on salaries and wages	\$7,500.00
8. To apply on office contingent and other expenses	1,300.00
9. To apply ontraveling expenses	250.00
10. To apply on repairs, equipment and operating expenses	5,950.00

Provided that the foregoing appropriation for items 7, 8, 9 and 10 shall be in lieu of that stated in Chapter 134, Laws of 1929, and shall be paid from funds derived under the Mineral Leasing Act (Sec. 35-Senate Bill No. 2775-Public No. 146, 66th Congress.)

Laws of 1943, Chap. 127

- 7. For salaries and wages \$18,600.00
- 8. Travel expenses 4,000.00
- 9. Contingent expenses 3,100.00

TOTAL 25,700.00

Items 7 to 9 inclusive shall be appropriated in the amount of \$25,000.00 from funds derived under the Mineral Leasing Act in accordance with Senate Bill No. 54 of the Sixteenth Legislature and \$700.00 shall be provided from proceeds of the sale of bulletins.

Laws of 1943, Chap. 12

CHAPTER 12

An act relating to the "state public school equalization fund" and appropriating all funds annually received under the Mineral Leasing Land Act for the support of public schools except the annual appropriation for the "free textbook fund," and except twenty five thousand dollars (\$25,000.00) annually, which is hereby appropriated to the Department of the Bureau of Mines of the New Mexico School of Mines, and declaring an emergency.

S. B. No. 54; Approved April 2, 1943

Be it enacted by the Legislature of the State of New Mexico:

Section 1. That all moneys annually received by the State under the provisions of the Act of Congress approved February 25, 1920, (41 Stat. 437) entitled "An Act to Promote the Mining of Coal, Phosphate, Oil, Oil Shale, Gas and Sodium on the Public Domain," as amended, be, and the same are hereby appropriated for the use

and benefit of the Public Schools of the State of New Mexico for instructional service, except the annual appropriation out of said fund for free textbooks, as provided by Section 3, Chapter 76 of the New Mexico Session Laws of 1941 (55-1705 New Mexico Statutes 1941 Annotated), and Twenty-Five Thousand Dollars (\$25,000.00) which is hereby appropriated annually to the Department of the Bureau of Mines of the New Mexico School of Mines, and the State Treasurer is hereby authorized and directed to place all such funds annually, as received, to the credit of the "State Public School Equalization Fund."

Section 2. That it is necessary for the preservation of the public peace, health and safety of the inhabitants of the state of New Mexico that the provisions of this Act shall become effective at the earliest possible time and, therefore, an emergency is hereby declared to exist, and this Act shall take effect and be in full force and effect from and after its passage and approval.

Laws of 1945, Chap. 139

(7) For salaries and wages	\$40,400.00
(8) For travel expenses	3,500.00
(9) For contingent expenses	7,700.00

Items (7) to (9) inclusive shall be appropriated in the amount of \$50,000.00 from funds derived under the Mineral Leasing Act in accordance with Senate Bill No. 54 of the Sixteenth Legislature, and \$1,600.00 shall be provided from proceeds of the sale of bulletins and well logs.

Laws of 1947, Chap. 221

- (9) For salaries and wages \$40,400.00
- (10) For travel expense 3,500.00
- (11) For contingent expense 7,700.00

Items (9) to (11) inclusive shall be appropriated in the amount of \$50,000.00 from funds derived under the Mineral Leasing Act in accordance with Senate Bill No. 54 of the Sixteenth Legislature, and \$1,600.00 shall be provided from proceeds of the sale of Bulletins and well logs.

Laws of 1949, Chap. 179

- (9) For salaries and wages \$63,000.00
- (10) For travel expense 5,000.00
- (11) For contingent expense 23,600.00

Provided that items (9) to (11) inclusive shall be appropriated in the amount of \$50,000.00 from funds derived under the Mineral Leasing Act in accordance with Senate Bill No. 54 of the Sixteenth Legislature, and \$1,600.00 shall be provided from proceeds of the sale of bulletins and well logs.

Laws of 1951, Chap. 227

	40th Fiscal Year	41st Fiscal Year
(3) For Bureau of Mines and Mineral Resources	\$170,000.00	170,000.00
(4) For water research	75,000.00	75,000.00

Act and that receipts and sale of bulletins and other publications are hereby appropriated annually.

	46th Fiscal Year	47th Fiscal Year
Geophysical water survey and climatological program	\$71,286	\$72,748
Basic geological survey	10,000	10,000
Ground water survey	10,000	10,000

These surveys were conducted by the New Mexico Bureau of Mines and Mineral Resources.

Laws of 1953, Chap. 156

	42nd Fiscal Year	43rd Fiscal Year
2. Bureau of Mines and Mineral Resources	\$200,000	\$200,000

Provided that \$75,000.00 of Item 2 shall be transferred from the Mineral Lands Leasing Act for each fiscal year for the use of the Bureau of Mines and further provided that there is appropriated to Item 2 the proceeds from the sale of books and publications.

Laws of 1955, Chap. 287

	44th Fiscal Year	45th Fiscal Year
2. Bureau of Mines and Mineral Resources	\$224,091.00	224,091.00

Provided that \$75,000.00 of Item 2 shall be transferred from the Mineral Lands Leasing Act for each fiscal year for the use of the Bureau of Mines and further provided that there is appropriated to Item 2 the proceeds from the sale of books and publications.

Laws of 1957, Chap. 235

	46th Fiscal Year	47th Fiscal Year
2. Bureau of Mines and Mineral Resources	\$249,503.00	254,628.00

Provided that \$75,000.00 of Item 2 shall be transferred from the Mineral Lands Leasing Act for each fiscal year for the use of the Bureau of Mines and further provided that there is appropriated to Item 2 the proceeds from the sale of books and publications.

Laws of 1959, Chap. 288

	48th Fiscal	49th Fiscal
	Year	Year
3. Bureau of Mines and Mineral Resources	\$206,000	206,000
4. Basic geological survey	10,000	10,000
5. Ground water survey	10,000	10,000

Provided that in addition to the above one hundred thousand dollars (\$100,00) for each fiscal year is appropriated to the Bureau of Mines and Mineral Resources from funds of the federal Mineral Lands Leasing Act (64 Stat. 402, as amended) and that receipts from sale of bulletins and other publications are hereby appropriated annually.

Laws of 1961, Chap. 254

	50th Fiscal	51st Fiscal
	Year	Year
2. Bureau of Mines and Mineral Resources	\$228,210	\$244,621
3. Basic geological survey	10,000	10,000
4. Ground water survey	10,000	10,000

Provided that in addition to the appropriation to New Mexico Institute of Mining and Technology, one hundred thousand dollars (\$100,000) for each fiscal year is appropriated to the Bureau of Mines and Mineral Resources from funds of the federal Mineral Lands Leasing Act (64 Stat. 402, as amended) and that receipts from sale of bulletins and other publications are hereby appropriated annually.

Laws of 1963, Chap. 287

3. Bureau of Mines and Mineral Resources --	
general	\$265,000
4. Basic geological survey	10,000
5. Ground water survey	10,000
6. State resources development plan	6,125

Provided that in addition to the appropriation to the New Mexico Institute of Mining and Technology, one hundred thousand dollars (\$100,000) is appropriated to the Bureau of Mines and Mineral Resources from funds of the federal Mineral Lands Leasing Act (30 USCA: 181-214) and that receipts from sales of bulletins and other publications are appropriated.

Laws of 1964, Chap. 2

- 3. Bureau of Mines and Mineral Resources --
 - general \$265,000
- 4. Basic geological survey 10,000
- 5. Ground water survey 10,000
- 6. State resources development plan 6,125

Provided that in addition to the appropriation to the New Mexico Institute of Mining and Technology, one hundred thousand dollars (\$100,000) is appropriated to the Bureau of Mines and Mineral Resources from funds of the federal Mineral Lands Leasing Act (30 USCA: 181-214) and that receipts from sales of bulletins and other publications are appropriated.

Laws of 1965, Chap. 313

- 3. Bureau of Mines and Mineral Resources --
 - general \$300,000
- 4. Basic geological survey 10,000
- 5. Ground water survey 10,000

Laws of 1966, Chap. 66

- 3. Bureau of Mines and Mineral Resources --
 - general \$355,000
- 4. Basic geological survey 10,000
- 5. Ground water survey 10,000

Provided that in addition to the appropriation to the New Mexico Institute of Mining and Technology, one hundred thousand dollars (\$100,000) is appropriated to the Bureau of Mines and Mineral Resources from funds of the federal Mineral Lands Leasing Act (30 USCA: 181-214).

Laws of 1967, Chap. 2

Bureau of Mines and Mineral Resources --	56th Fiscal Year	57th Fiscal Year
general	\$373,000	\$383,000

Provided that in addition to the appropriation to the New Mexico Institute of Mining and Technology, one hundred thousand dollars (\$100,000) is appropriated annually to the Bureau of Mines and Mineral Resources from funds of the federal Mineral Lands Leasing Act (30 USCA: 181-214).

Laws of 1968, Chap. 71

- 3. Bureau of Mines and Mineral Resources \$383,000
- 4. Basic geological survey 10,000
- 5. Ground water survey 10,000

Provided that in addition to the appropriations to the New Mexico Institute of Mining and Technology, one hundred thousand dollars (\$100,000) is appropriated annually to the Bureau of Mines and Mineral Resources from funds of the federal Mineral Lands Leasing Act (30 USCA 181-214).

Laws of 1969, Chap. 282

New Mexico Institute of Mining and Technology:

1. Current general purpose	\$1,037,000	1,037,000
	(58th f. y.)	(59th f. y.)
2. Research	274,000	274,000
	(58th f. y.)	(59th f. y.)
3. Mining and geologic activities.	414,000	414,000
	(58th f. y.)	(59th f. y.)
Total	\$1,725,000	\$1,725,000

Provided that in addition to the appropriation to the New Mexico Institute of Mining and Technology, one hundred thousand dollars (\$100,000) is appropriated annually to the Bureau of Mines and Mineral Resources from funds of the Mineral Lands Leasing Act (30 USCA 181-214).

Note: The amount given to the Bureau from the appropriation to the New Mexico Institute of Mining and Technology is not otherwise specified.

Laws of 1970, Chap. 89

New Mexico Institute of Mining and Technology:

(1) Current general purposes	general fund	\$1,160,000
	other state funds	365,000
	federal funds	56,000
(2) Research	general fund	297,000
	other state funds	45,000
	federal funds	1,444,500
(3) Mining and geologic activities--	general fund	626,000
	other state funds	20,746
(4) Other	other state funds	836,010
	federal funds	217,700

Provided that included in the general fund appropriation to the New Mexico Institute of Mining and Technology one hundred thousand dollars (\$100,000) is appropriated annually to the Bureau of Mines and Mineral Resources from funds of the federal Mineral Lands Leasing Act (30 USCA 181-214).

Note: The amount given to the Bureau from the appropriation to the New Mexico Institute of Mining and Technology is not otherwise specified.

Laws of 1971, Chap. 327

New Mexico Institute of Mining and Technology:

(1) Current general purposes	general fund	\$1,205,961
	other state funds	505,000
	federal funds	54,000
(2) Research	general fund	305,000
	other state funds	23,750
	federal funds	1,797,750
(3) Mining and geologic activities--	general fund	656,000
	other state funds	12,000
(4) Other	other state funds	873,370
	federal funds	147,800

Provided that included in the general fund appropriation to the New Mexico Institute of Mining and Technology \$100,000 is appropriated annually to the Bureau of Mines and Mineral Resources from funds of the federal Mineral Lands Leasing Act (30 USCA 181-214).

Note: The amount given to the Bureau from the appropriation to the New Mexico Institute of Mining and Technology is not otherwise specified.

Laws of 1972, Chap. 98

New Mexico Institute of Mining and Technology:

(1) Current general purposes	general fund	\$1,295,000
	other state funds	628,000
	federal funds	20,000
(2) Research	general fund	320,000
	other state funds	23,800
	federal funds	1,847,700
(3) Mining and geologic activities--	general fund	688,000
	other state funds	9,000
(4) New Mexico Academy of Science Project	general fund	25,000
(5) Other	other state funds	964,400
	federal funds	116,400

Provided that included in the general fund appropriation to the New Mexico Institute of Mining and Technology \$100,000 is appropriated annually to the Bureau of Mines and Mineral Resources from funds of the federal Mineral Lands Leasing Act (30 USCA 181-214).

Laws of 1973, Chap. 403

New Mexico Institute of Mining and Technology:

(1) Current general purposes	general fund	\$1,504,500
	other state funds	442,000
	federal funds	17,000
(2) Research	general fund	332,000
	other state funds	131,500
	federal funds	1,780,000
(3) Mining and geologic activities--	general fund	720,000
	other state funds	19,000
(4) College opportunity program--	general fund	21,000
(5) Other	other state funds	1,052,500
	federal funds	123,400

Included in the general fund appropriation to the New Mexico Institute of Mining and Technology is the amount of \$100,000 which is appropriated to the Bureau of Mines and Mineral Resources from funds of the federal Mineral Lands Leasing Act (30 USCA 181-214).

Laws of 1974, Chap. 3

New Mexico Institute of Mining and Technology:

(1) Current general purposes	general funds	\$1,646,000
	other state funds	423,500
	federal funds	21,500
(2) Research	general fund	345,000
	other state funds	130,000
	federal funds	1,736,500
(3) Mining and geologic activities--	general fund	750,000
	other state funds	45,000

(4) College opportunity program	general fund	\$4,000
	other state funds	11,500
(5) Scanning electron microscope--	general fund	60,000
	other state funds	60,000
(6) Other	other state funds	1,008,800
	federal funds	191,900

Included in the general fund appropriation in item (3) is the amount of \$100,000 which is appropriated to the Bureau of Mines and Mineral Resources from funds of the federal Mineral Lands Leasing Act (30 USCA 181-214).

Note: The amount given to the Bureau from the appropriation to the New Mexico Institute of Mining and Technology is not otherwise specified.

Laws of 1975, Chap. 17

New Mexico Institute of Mining and Technology:

(1) Current general purposes	general fund	\$2,006,700
	other state funds	878,000
	federal funds	99,000
(2) Research	general fund	398,000
	other state funds	313,000
	federal funds	1,242,100
(3) Mining and geologic activities--	general fund	885,000
	other state funds	35,000
(4) Other	other state funds	1,296,000
	federal funds	30,000

Included in the general fund appropriation in item (3) is the amount of \$100,000 which is appropriated to the Bureau of Mines and Mineral Resources from funds of the federal Mineral Lands

Leasing Act (30 USCA 181-214).

Note: The amount given to the Bureau from the appropriation to the New Mexico Institute of Mining and Technology is not otherwise specified.

Laws of 1976, Chap. 58

(5) Bureau of Mines	general fund	\$1,006,000
	other state funds,	35,000

Included in the general fund appropriation in item (5) is the amount of one hundred thousand dollars (\$100,000) which is appropriated from federal Mineral Lands Leasing Act (30 USCA 181, et seq.) receipts.

Laws of 1976, Chap. 45

AN ACT--Relating to the issuance of severance tax bonds; providing for the financing of certain buildings at New Mexico Institute of Mining and Technology; declaring an emergency.

Be it enacted by the legislature of the State of New Mexico:

Section 1. Severance tax bonds--New Mexico Institute of Mining and Technology. --In addition to all other severance tax bonds issued prior to the effective date of this act, the state board of finance may issue and sell severance tax bonds in compliance with the Severance Tax Bonding Act in an amount not exceeding two million thirteen thousand dollars (\$2,013,000) when the board of regents of the New Mexico Institute of Mining and Technology certifies that the need exists for the issuance of the bonds in the following amounts and for the following purposes:

A. Construction of a building for a petroleum recovery research center at the New Mexico Institute of Mining and Technology . . . \$1,905,000.

B. Addition to the New Mexico Bureau of Mines building at the New Mexico Institute of Mining and Technology . . . \$108,000.

Section 2. Emergency. --It is necessary for the public peace, health and safety that this act take effect immediately.

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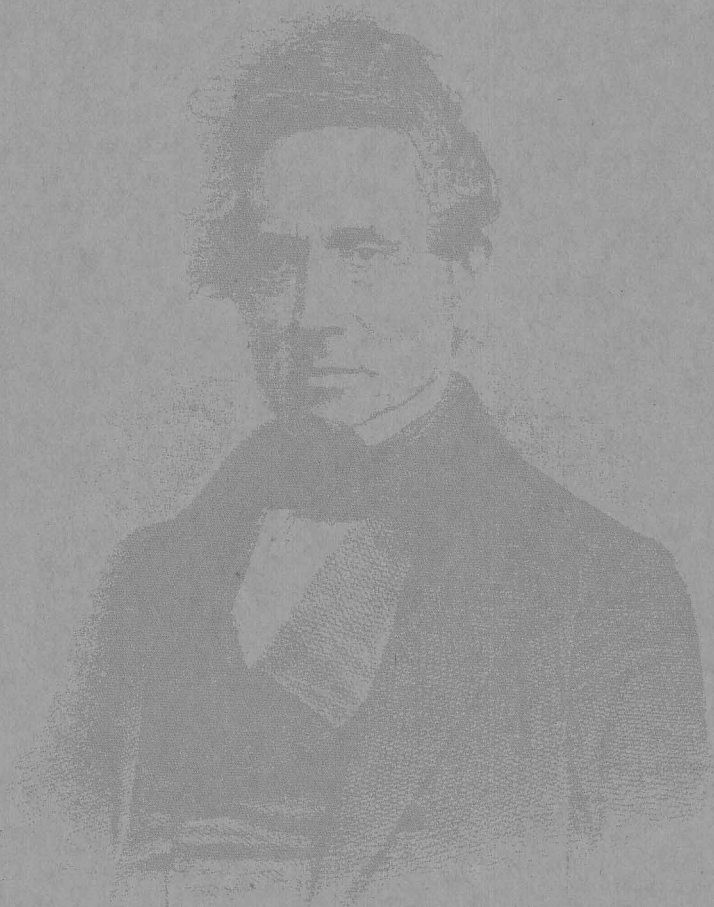
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Don H. Baker

Historical Directory
of
State Geological Surveys



**HISTORICAL DIRECTORY
OF
STATE GEOLOGICAL SURVEYS**

by

George F. Hanson

Historian, Association of American State Geologists

ASSOCIATION OF AMERICAN STATE GEOLOGISTS

E. A. Noble, Editor

University Station, Grand Forks, North Dakota

1972



Professor George F. Hanson
State Geologist and Director
University of Wisconsin-Extension
Geological and Natural History Survey
1953-1972

Historian, Association of American State Geologists
1961-1972

ASSOCIATION OF AMERICAN STATE GEOLOGISTS

E. A. Nelson, Editor

University Station, Grand Forks, North Dakota

1977

PREFACE

As an undergraduate I was blessed with a Professor who had a keen interest in the historical development of geology in the United States, hence soon became acquainted with the outstanding accomplishments of the early state surveys and their directors. Upon becoming a state geologist myself it was apparent that many changes had taken place in state surveys since their beginning years.

The early state surveys were usually formed for a specific task, such as to "complete a study of the geology of the state." Once the task was completed, and indeed often before, the surveys were disbanded. Around the turn of the century the need for continuing geological work became evident and geological surveys became permanent units of state government, but over the years not only their missions changed to reflect the differing resources and needs of the various states, but also so did their affiliation in the governmental framework.

Upon being elected the Historian of the Association of American State Geologists in 1961 I thought it would be of interest to my fellow state geologists to attempt to tabulate the changes in the titles of the organizations over the years, as well as the names, titles and periods of tenure, of their directors; but although much had been written on the history of state surveys, and their contribution to American geology, it soon became apparent that not only was there inadequate published information to make the proposed tabulation, but also some of it was contradictory. Trying to use the publications of the state surveys as a primary source of information only magnified the confusion. I therefore took the easy way out and appealed to my fellow state geologists for help. Much correspondence flowed back and forth as it was found that the task was not as simple as first imagined. In 1962 a report was given to the Association at its annual meeting, and a revised report was presented in 1969. In 1972 a second revision was presented to the Association at which time the members voted that it be printed.

I am therefore entirely indebted to my many colleagues for the information contained herein, and apologize for the inconsistencies in format and for some informational gaps that still persist. I trust that it will nonetheless serve as a useful reference for those interested in the growth and vicissitudes of state surveys.

George A. Hanson
May 5, 1972

ALABAMA**Geological Survey of Alabama**

Michael Tuomey	State Geologist	1848-1857
Eugene Allen Smith	State Geologist	1873-1927
Walter Bryan Jones	State Geologist	1927-1961
Philip E. LaMoreaux	State Geologist	1961-

Note: Although Tuomey was appointed State Geologist in 1848 no funds were appropriated for the Geological Survey until 1854. During this period Prof. Tuomey conducted his work at the expense of the University.

ALASKA**Territorial Department of Mines**

B. D. Stewart	Commissioner of Mines	1935-1950
Leo Saarela	Commissioner of Mines	1950-1952
Phil R. Holdsworth	Commissioner of Mines	1952-1959

Division of Mines and Minerals, Dept. of Natural Resources

James A. Williams	Director	1959-1970
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Division of Geological Survey, Dept. of Natural Resources

James A. Williams	State Geologist	1970-1971
William C. Fackler	State Geologist	1971-

Note: When Alaska attained statehood, Phil R. Holdsworth was appointed Commissioner of the newly created Dept. of Natural Resources.

ARIZONA

John Blandy	Territorial Geologist	? -1891
Theodore Bryant Comstock	Territorial Geologist	1891-1895
William Phipps Blake	Territorial Geologist	1898-1910
Cyrus Fischer Tolman	Territorial Geologist	1910-1912

Arizona Bureau of Mines

Charles Francis Willis	Director	1915-1918
Gurdon Montague Butler	Director	1918-1940
Thomas Garfield Chapman	Director	1940-1956
James Donald Forrester	Director	1956-1970
Richard M. Edwards	Director	1970-1971
William H. Dresher	Director	1971-

Note: J. D. Forrester (pers. comm.) notes "The office of Territorial Geologist appears to have been an honorary one, and funds were seldom appropriated for its operation. With the establishment of the Arizona School of Mines, in 1891, the office, when filled, was held by a member of the faculty of that school. This practice was followed until Arizona attained Statehood in 1912. Between 1912 and 1915 no clear policy is discernable."

ARKANSAS

"First Survey" (Owen Survey)

David Dale Owen	State Geologist	1857-1860
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"Second Survey" (Reconstruction Surveys)

W. F. Roberts, Sr.	State Geologist	1871-1873
George Haddock	State Geologist	1873-1874
William Hazeldine	State Geologist	Jan. 1874-June 1874
Arnold Syberg	State Geologist	June 1874 to end of year

"Branner Survey"

John C. Branner	State Geologist	1887-1893
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Geological Survey of Arkansas

George C. Branner	State Geologist	1923-1942 ?
Richard J. Anderson	Acting State Geologist	1942-1943
Joe W. Kinzey	State Geologist	1943-1945

Division of Geology, Arkansas Resources & Development Comm.

Harold B. Foxhall	Director (& State Geologist?)	1945-1951 ?
Norman F. Williams	Director (& State Geologist?)	1951- ?

Arkansas Geological and Conservation Commission

Norman F. Williams	(State?) Geologist & Director	?
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Note: Roberts was appointed in 1871 but in 1873 Governor Hadley reported to the Assembly that Roberts returned to Pennsylvania "last July and I have not heard from him since."

From 1907-1923 the Professor of Geology, University of Arkansas, acted ex officio as part-time State Geologist. Office holders were A. H. Purdue, N. H. Drake, and G. H. Cady.

Nat. Research Council Bull. 88, 1932, gives name as "The Office of State Geologist" as opposed to Geol. Survey of Arkansas.

CALIFORNIA

"Trask Survey" or "First Geological Survey"

John B. Trask	State Geologist	1853-1856
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State Geological Survey of California

Josiah D. Whitney	State Geologist	1860-1873
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California State Mining Bureau

Henry G. Hanks	State Mineralogist	1880-1886
William Irelan, Jr.	State Mineralogist	1886-1892
J. J. Crawford	State Mineralogist	1892-1896
Augustus S. Cooper	State Mineralogist	1896-1901
Lewis E. Aubury	State Mineralogist	1901-1911
William H. Storms	State Mineralogist	1911-1913
Fletcher Hamilton	State Mineralogist	1913-1923
Lloyd Root	State Mineralogist	1923-1927

Division of Mines & Mining, Dept. of Natural Resources

Lloyd Root	State Mineralogist	1927-1928
Walter H. Bradley	State Mineralogist	1928-1929

Division of Mines, Department of Natural Resources

Walter H. Bradley	State Mineralogist	1929-1946
W. Burling Tucker	Acting State Mineralogist	1946-1947
Olaf P. Jenkins	State Mineralogist & Chief, Division of Mines	1947-1958
Gordon B. Oakeshott	State Mineralogist & Chief	1958-1959
Ian Campbell	State Mineralogist & Chief, Division of Mines	1959-1961

Division of Mines and Geology, Department of Conservation

Ian Campbell	State Geologist & Chief, Division of Mines & Geology	1961-1969
Wesley G. Bruer	State Geologist & Chief, Division of Mines & Geology	1970-

Note: Tucker was last State Mineralogist to be appointed by Governor. Jenkins and successors, appointed from eligible lists of Civil Service determined by competitive examinations.

The tenure dates given for Irelan, Crawford and Cooper are those lettered on their portraits and are used as official dates by the Division of Mines. However, U. S. G. S. Bull. 465 lists their respective tenures as 1886-93, 1893-97, and 1897-1901. (Pers. Comm. Mary Hill 1967).

From 1867-1870 there were no appropriations and Whitney carried on some work at his own expense.

During the period from Campbell's retirement in October, 1969, and Bruer's temporary appointment in December of 1969, the Division operated without a State Geologist. Direction of the Division at this time was assigned to John Mayfield, Deputy Director of the Department of Conservation.

Bruer's permanent appointment as State Geologist was made in Sept., 1970.

COLORADO

J. Alden Smith	State Geologist	1874-1883
Ernest LeNeve Foster	State Geologist	1883-1885
J. Alden Smith	State Geologist	1885-1887
Fred J. Bulkley	State Geologist	1887-1889
George E. Kedzie	State Geologist	1889-1895
Thomas A. Rickard	State Geologist	1895-1901
John W. Finch	State Geologist	1901-1906
B. A. Langridge	State Geologist	1906-1907 ?

State Geological Survey

R. D. George	State Geologist	1907-1929
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Geological Survey Division, Department of Natural Resources

John W. Rold	State Geologist & Director	1969-
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Note: The appointment of a State Geologist was authorized by the Territorial Legislature in 1872 but "No compensation for services, nor for any expense whatever, shall be paid by the state to or for said State Geologist." It was not until the State Geological Survey was organized that funds became available and then not until 1908.

In 1929 the Colorado Geological Survey was reorganized with offices in the State Museum Building at Denver, and under the control of a Board consisting of the Governor, the Commissioner of Mines, the President of the Colorado Mining Association and President of the University of Colorado, the Colorado School of Mines and the College of Agriculture. This board dealt with cooperative U. S. G. S. programs, other geologic matters were handled by free cooperative services of other state organizations. (NRC Bull. 88). In 1968 the Colorado Geological Survey was re-established as a division of the Department of Natural Resources, and in Feb. 1969 John Rold was appointed State Geologist and Director.

CONNECTICUT

"Geological and Mineralogical Survey"

J. G. Percival	Geologist	1835-1841
C. U. Shepard	Mineralogist	1835-1841

State Geological and Natural History Survey

William North Rice	Superintendent	1903-1916
Herbert Ernest Gregory	Superintendent	1916-1921
Henry Hollister Robinson	Superintendent	1921-1925
Wilton Everett Britton	Superintendent	1925-1939
Edward Leffingwell Troxell	Superintendent	1939-1954
John Becker Lucke	Director	1954-1960

In 1959 the G&NHS was placed in new Dept. of Agriculture and Natural Resources

Joe Webb Peoples	Director	1960-1971
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Geological and Natural History Survey, Connecticut Dept. of Environmental Protection

Joe Webb Peoples	Director	1971-
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Note: The survey was located during the various tenures as follows: Rice at Wesleyan University; Gregory and Robinson at Yale; Britton at the Connecticut Agricultural Experiment Station; Troxell at Trinity College; Lucke at University of Connecticut; Peoples at Wesleyan. Percival and Shepard had no titles but were appointed as a committee to carry out the survey.

DELAWARE**Geological and Mineralogical Survey**

James C. Booth	State Geologist	1837-1841
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Delaware Geological Survey

Johan J. Groot	State Geologist	1951-1969
Robert R. Jordan	State Geologist	1969-

Note: On February 18, 1837, the Delaware General Assembly passed a measure to "Procure to make (sic) a Geological and Mineralogical Survey of the State." Three commissioners were appointed to contract with a geologist and on June 1, 1837 they signed articles of agreement with James C. Booth which established him as "State Geologist." No separate autonomous agency was created beyond the commission and its appointee. Booth's appointment was to run "...as long as he is in the service of the State." Presumably, this terminated in January, 1841, when he submitted his report to the commission.

The present organization was established by State law in 1951 as the Delaware Geological Survey. Jordan served as Acting State Geologist from July, 1965 through June, 1966, during a year-long leave of absence taken by Johan J. Groot.

FLORIDA**Florida State Geological Survey**

Elias H. Sellards	State Geologist	1907-1919
Herman Gunter	Director & State Geologist	1919-1958
Robert O. Vernon	Director & State Geologist	1958-1961

Division of Geology, State Board of Conservation

Robert O. Vernon	Director & State Geologist	1961-1969
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Bureau of Geology, Florida Department of Natural Resources

Robert O. Vernon	Chief & State Geologist	1969-1971
Charles W. Hendry, Jr.	Chief & State Geologist	1971-

Note: J. Kost made reports for the state published in 1883 and 1886 but was never designated as State Geologist. With the 1961 reorganization the Florida Geological Survey was subordinated to the Division of Geology, State Board of Conservation. The Division was organized into two sections for administrative purposes, (1) the Geological Survey, and (2) the Oil and Gas Section of which Vernon was Administrator.

In 1969 the Florida State Government was reorganized under a new Constitution. The Division of Geology became the Bureau of Geology under the Department of Natural Resources and the name Florida Geological Survey was no longer used. On December 3, 1971 Hendry was appointed Chief, Bureau of Geology and State Geologist and replaced Dr. Vernon who was appointed the Director, Division of Interior Resources, Department of Natural Resources.

GEORGIA**Geological Survey of Georgia**

John R. Cotting	State Geologist	1836-1840
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Geological, Mineralogical and Physical Survey

George Little	State Geologist	1874-1879
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Geological Survey

J. W. Spencer	State Geologist	1890-1893
W. S. Yeats	State Geologist	1893-1908
S. W. McCallie	State Geologist	1908-1932

Georgia Geological Survey, Department of Forestry & Geological Development

S. W. McCallie	State Geologist	1932-1933
Richard W. Smith	State Geologist	1933-1937

Division of Mines, Mining and Geology, Department of Natural Resources

Richard W. Smith	Director	1937-1938
Garland Peyton	Director	1938-1943

Department of Mines, Mining and Geology, State Division of Conservation

Garland Peyton	Director	1943-1964
A. S. Furcron	Acting Director	1964-1965
A. S. Furcron	Director	1965-1969
Jesse H. Auvil, Jr.	Director	1969-1972

Department of Natural Resources, Earth & Water Division, Geological Section

Sam M. Pickering, Jr.	Division Director & State Geologist	1972-
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HAWAII**NO SURVEY****IDAHO****Idaho Bureau of Mines and Geology**

Francis A. Thomson	Secretary	1919-1928
Ernest W. Ellis	Acting Secretary	1928
A. W. Fahrenwald	Secretary	1929-1930
John W. Finch	Director	1930-1934
A. W. Fahrenwald	Director	1934-1954
J. D. Forrester	Director	1954-1956
E. F. Cook	Director	1956-1964
Rolland R. Reid	Acting Director	1963-1965
Rolland R. Reid	Director	1965-

*Note: Cook was on leave of absence 1963-64.***ILLINOIS****Geological Survey of Illinois**

J. G. Norwood	State Geologist	1851-1858
A. H. Worthen	Director	1858-1875

State Historical Library and Natural History Museum

A. H. Worthen	Curator	1877-1888
Joshua Lindahl	Curator	1888-1893
W. F. E. Gurley	Curator	1893-1897

State Geological Survey, State Geological Commission

H. Foster Bain	Director	1905-1909
Frank W. DeWolf	Director	1909-1917

State Geological Survey, Board of Natural Resources & Conservation

Frank W. DeWolf	Chief	1917-1923
M. M. Leighton	Chief	1923-1954
John C. Frye	Chief	1954-

Note: All provision for Worthen's Survey ended in 1875; however, an Act was passed in 1885 that Volume VIII of the Geological Survey of Illinois be prepared by "the Curator of the State Historical and Natural History Museum, who is required to perform such duties as may be by law required of the State Geologist." Lindahl, who completed this task in 1890 following Worthen's death in 1888, was in fact listed as State Geologist on the title page.

INDIANA

David Dale Owen, M.D.	Appointed Geologist of the State of Indiana	1837-1839
Ryland Thomas Brown	Served as Geological Agent for the State Board of Agriculture	1851-1853
David Dale Owen, M.D.	Recommissioned to make second survey. Died in 1860.	1859-1860
Richard Owen	Brother of D. D. Owen and Principal Asst. with the Survey 1859-1860. State Geologist	1860-1861

Geological Survey of Indiana

Edward Travers Cox	State Geologist	1869-1879
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Indiana Department of Statistics and Geology

John Collett	Chief of Bureau	1879-1881
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Indiana Department of Geology and Natural History

John Collett	State Geologist	1881-1885
James Maurice Thompson	State Geologist	1885-1888
Sylvester Scott Gorby	State Geologist	1888-1889

Indiana Department of Geology and Natural Resources

Sylvester Scott Gorby	State Geologist	1889-1894
Willis Stanley Blatchley	State Geologist	1895-1910
Edward Barrett	State Geologist	1911-1919

Division of Geology, Indiana Department of Conservation

William Newton Logan	State Geologist	1919-1936
Ralph Emerson Esarey	State Geologist	1936-1945
Charles Frederick Deiss	State Geologist	1945-1951

Geological Survey, Indiana Department of Conservation

Charles Frederick Deiss	State Geologist	1951-1959
John Barratt Patton	State Geologist	1959-1965

Geological Survey, Indiana Department of Natural Resources

John Barratt Patton	State Geologist	1965-
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IOWA**The Geological Survey of Iowa**

James Hall	State Geologist	1855-1859
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State Geological Survey

Charles A. White, M.D.	State Geologist	1866-1869
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Iowa Geological Survey

Samuel Calvin	State Geologist & Director	1892-1904
Frank A. Wilder	State Geologist & Director	1904-1906
Samuel Calvin	State Geologist & Director	1906-1911
George F. Kay	State Geologist & Director	1911-1934
Arthur C. Trowbridge	State Geologist & Director	1934-1947
H. Garland Hershey	State Geologist & Director	1947-1969
Samuel J. Tuthill	State Geologist & Director	1969-

KANSAS

(First) State Geological Survey of Kansas

Benjamin F. Mudge	State Geologist	1864-1865
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(Second) State Geological Survey of Kansas

George C. Swallow	State Geologist	1865-1866
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University Geological Survey of Kansas

Erasmus Haworth	State Geologist	1895-1907
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State Geological Survey of Kansas

Erasmus Haworth	State Geologist & Director	1907-1915
William H. Twerhofel	State Geologist & Director	1915-1916
Raymond C. Moore	State Geologist & Director	1916
	State Geologist	1917-1937
	State Geologist & Director	1937-1945
	State Geologist & Director of Research	1945-1954
Kenneth K. Landes	Asst. State Geologist	1927-1937
	Co-State Geologist & Asst. Director	1937-1941
John C. Frye	Asst. State Geologist & Asst. Director, in charge	1941-1945
	Executive Director	1945-1952
	State Geologist & Executive Director	1952-1954
Frank C. Foley	State Geologist & Director	1954-1970
William W. Hambleton	Asst. State Geologist & Asst. Director	1955-1956
	Assoc. State Geologist & Assoc. Director	1956-1970
	State Geologist & Director	1970-
Paul C. Franks	Acting Assoc. State Geologist & Acting Assoc. Director	1959-1960
Paul L. Hilpman	Asst. Director & Asst. State Geologist	1964-1965
Ernest E. Angino	Assoc. State Geologist & Assoc. Director	1970-1972
Charles K. Bayne	Assoc. State Geologist & Assoc. Director	1972-

Note: The third Survey was formally established in 1889 by the State Legislature as the University Geological Survey of Kansas. No appropriation was made and no personnel named until 1895 when the University of Kansas Board of Regents declared the Survey to be organized. Although Haworth is listed as State Geologist of the University Geological Survey from 1895-1907, reflecting his leadership, no formal appointment was made until 1903.

Landes and Frye at times held the title of State Geologist concurrently with Moore. Landes was Co-State Geologist from 1937 to 1941. Moore was on military leave from 1942-45 at which time Frye was in charge of the Survey. After Moore's return, Frye was Executive Director, and Moore was State Geologist and Director of Research. In 1945, Frye gained the additional title of State Geologist.

Franks was Acting Associate State Geologist and Acting Associate Director while Hambleton was on sabbatical leave. Hilpman served as Assistant Director and Assistant State Geologist while Foley was on leave.

KENTUCKY

William W. Mather	State Geologist	1838
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Kentucky Geological Survey

David Dale Owen	State Geologist	1854-1857
Nathaniel S. Shaler	State Geologist & Director	1873-1880

Kentucky Geological Survey and Bureau of Immigration

John R. Proctor	State Geologist & Director	1880-1892
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Kentucky Geological Survey

Charles J. Norwood	Director	1904-1912
Joseph B. Hoeing	State Geologist	1912-1918

Department of Geology and Forestry

J. E. Barton	Commissioner	1918-1919
Willard R. Jillson	Deputy Commissioner and State Geologist	1919-1920

Kentucky Geological Survey

Willard R. Jillson	Director & State Geologist	1920-1932
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Bureau of Mineral & Topographic Survey, University of Kentucky

Arthur C. McFarlan	Director & State Geologist	1932-1934
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Division of Geology, Department of Mines & Minerals

Daniel J. Jones	State Geologist	1934-1948
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Kentucky Geological Survey, University of Kentucky

Arthur C. McFarlan	Director	1948-1958
Daniel J. Jones	State Geologist	1948-1958
Wallace W. Hagan	Director & State Geologist	1958-

Note: D. D. Owen left Kentucky to become State Geologist of Arkansas. Robert Peter, State Chemist, brought manuscripts to completion and saw them through press. This survey was therefore probably active until about 1860.

LOUISIANA**Geological Survey of Louisiana**

Frederick Vincent Hopkins	State Geologist	1869-1872
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Geological and Agricultural Survey of Louisiana

Otto Lerch	Geologist in Charge	1892-1893
W. W. Clendenin	Geologist	1893-1899
Gilbert D. Harris	Geologist in Charge	1899-1909

Louisiana Soil and Geological Survey

Frederick E. Emerson		1914-1919
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Louisiana Geological Survey

Cyril K. Moresi	State Geologist	1934-1941
John Huner	State Geologist	1941-1946
Paul Montgomery	Acting State Geologist	April 1946-Dec. 1946
James M. Cunningham	Acting State Geologist	Dec. 1946-July 1947
G. O. Coignet	Acting Director	July 1947-Oct. 1947
Leo W. Hough	State Geologist	Oct. 1947-

Note: Clendenin was Professor of Mineralogy at Louisiana State University and served half-time as geologist for the survey. Dr. Emerson was Prof. of Geology at Louisiana State University and died in 1919. The University was without a geologist until the arrival of Henry V. Howe in 1922. All geological matters were handled by Dr. Howe until the present survey was established in 1934.

MAINE**Geological Survey, Massachusetts Bay Colony and State of Maine**

Charles T. Jackson, M.D.	Geologist	1837-1839
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Maine Board of Agriculture

C. H. Hitchcock	Geologist	1860-1862
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Geological Survey

Lucius H. Merrill	State Geologist	1929-1930
Joseph Conrad Twinem	State Geologist	1930-1932

Maine Geological Survey, Maine Development Commission

Joseph M. Trefethen	State Geologist	1942-1952
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Maine Geological Survey, Dept. of Development of Industry & Commerce

Joseph M. Trefethen	State Geologist	1953-1956
John R. Rand	State Geologist	1956-1957

Maine Geological Survey, Dept. of Economic Development

John R. Rand	State Geologist	1957-1959
Robert G. Doyle	State Geologist	1959-1971

Maine Geological Survey, Maine Forest Service

Robert G. Doyle	State Geologist	1971-
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MARYLAND

J. T. Ducatel	Geologist	1834-1842
James Higgins	State Agr'l Chemist	1848-1858
Philip T. Tyson	State Agr'l Chemist	1858-1862

Maryland Geological Survey* (Geological and Economic Survey)

William Bullock Clark	State Geologist	1896-1917
Edward Bennett Mathews	State Geologist	1917-1941

Department of Geology, Mines and Water Resources

Edward Bennett Mathews	Director	1941-1943
Joseph T. Singewald, Jr.	Director	1943-1962
Ernst Cloos	Acting Director	1962-1963
Kenneth N. Weaver	Director	1963-1964

Maryland Geological Survey

Kenneth N. Weaver	Director	1964-
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**Note:* The Maryland Geological Survey operated under that name although it was established by the Legislature as the Geological and Economic Survey.

MASSACHUSETTS**“Survey of the Geology and Natural History of Massachusetts”**

Edward Hitchcock	“Geological Surveyor”	1830-1833
Edward Hitchcock	“Geological Surveyor”	1837-1839

Department of Public Works

Joseph Sinnot	State Geologist	1971-
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Note: The dates of Hitchcock’s official tenure are somewhat in doubt.

MICHIGAN**“First Survey”**

Douglass Houghton	State Geologist	1837-1845
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“Second Survey”

Alexander Winchell	State Geologist	1859-1862
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Michigan Geological and Biological Survey

Alexander Winchell	State Geologist	1869-1871
Carl L. Rominger	State Geologist	1871-1885
Charles E. Wright	State Geologist	1885-1888
M. E. Wadsworth	State Geologist	1888-1893
Lucius L. Hubbard	State Geologist	1893-1899
Alfred C. Lane	State Geologist	1899-1909
Rolan C. Allen	State Geologist	1909-1919
Richard A. Smith	State Geologist	1919-1920

Geological Survey Division, Department of Conservation

Richard A. Smith	Division Chief and State Geologist	1920-1946
Gerald E. Eddy	Division Chief and State Geologist	1946-1951
Franklin G. Pardee	Division Chief and State Geologist	1951-1952
William L. Daoust	Acting State Geologist	1952-1954
William L. Daoust	Division Chief and State Geologist	1954-1964

Geological Survey Division and Dept. of Natural Resources

Gerald E. Eddy	State Geologist	1964-1971
Arthur E. Slaughter	State Geologist	1971-

MINNESOTA**Minnesota Geological and Natural History Survey**

Newton Horace Winchell	State Geologist	1872-1900
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Minnesota Geological Survey

William Harvey Emmons	Director	1911-1944
Frank Fitch Grout	Director	1944-1946
George Melvin Schwartz	Director	1946-1961
Paul Kibler Sims	Director	1961-

MISSISSIPPI**Agricultural and Geological Survey of the State**

John N. Millington	Chief Geologist	1850-1853
John C. Keeney	State Geologist	1853-1854
Lewis Harper	State Geologist	1854-1857
Eugene H. Hilgard	State Geologist	1858-1866
George Little	State Geologist	1866-1870
Eugene H. Hilgard	State Geologist	1871-1872

Mississippi Geological Survey

A. F. Crider	State Geologist	1906-1909
E. N. Lowe	State Geologist	1909-1933
W. C. Morse	State Geologist	1934-1958

Mississippi Geological, Economic and Topographical Survey

Tracy W. Lusk	State Geologist	1958-1962
Frederic F. Mellen	Director & State Geologist	1962-1965
William H. Moore	Director & State Geologist	1965-

MISSOURI**Geological Survey of Missouri**

G. C. Swallow	State Geologist	1853-1861
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Missouri Bureau of Geology and Mines

A. D. Hager	State Geologist	1870-1871
J. G. Norwood	Temporary State Geologist	Aug. - Nov. 1871
Raphael Pumpelly	State Geologist	1871-1873
G. C. Broadhead	State Geologist	1873-1875
C. P. Williams	State Geologist	1875-1878

Missouri Bureau of Geology and Mines

Arthur Winslow	State Geologist & Director	1889-1893
C. R. Keyes	State Geologist & Director	1893-1897
J. A. Gallaher	State Geologist & Director	1898-1900
Leo Gallaher	Acting State Geologist & Acting Director	1900-1901
E. R. Buckley	State Geologist & Director	1901-1908
H. A. Buehler	State Geologist & Director	1908-1933

Missouri Geological Survey and Water Resources

H. A. Buehler	State Geologist & Director	1933-1944
E. L. Clark	State Geologist & Director	1944-1945

Missouri Division of Geological Survey & Water Resources, Dept. of Business and Administration

E. L. Clark	State Geologist & Director	1945-1955
T. R. Beveridge	State Geologist & Director	1955-1964
William C. Hayes	State Geologist & Director	1964-1971
Wallace B. Howe	State Geologist & Director	1971-

MONTANA

Montana Bureau of Mines and Metallurgy

Charles H. Clapp (Geol.)	Director	1919-1921
George W. Craven (Math)	Director	1921-1928

Montana Bureau of Mines and Geology

Francis A. Thomson (E.M.)	Director	1928-1950
Arthur E. Adami (E.M.)	Director	1950-1951
J. Robert Van Pelt (E.M.)	Director	1951-1956
Walter S. March, Jr. (P.E. in Min. Engr.)	Associate Director	1956-1962
Edwin G. Koch (Chem.)	Director	1957-1969
Uuno M. Sahinen (P.E. in Min. Engr.)	Associate Director	1962-1969
Uuno M. Sahinen	Director & State Geologist	1969-1971
Sid Groff (Ph.D. Geol.)	Acting Director	1971-1972
	Director & State Geologist	1972-

Note: This Bureau was established as a department in the Montana State School of Mines (Now Montana College of Mineral Science and Technology). Customarily the president of the School of Mines was designated as the director of the Bureau; however, his responsibilities did not necessarily coincide with those of a "State Geologist." Thus, during the period 1957 to 1969 the associate director was in effect the "State Geologist." During the 1969 Legislature, a bill was enacted which made the director of the Bureau the State Geologist and required that said director be either a certified professional geologist or a registered mining engineer.

NEBRASKA

Nebraska Geological Survey

Samuel Aughey	State Geologist	1871-1883
Lewis E. Hicks	State Geologist	1884-1890
Erwin H. Barbour	State Geologist	1891-1918
George E. Condra	State Geologist	1919-1921

Conservation and Survey Division, University of Nebraska

George E. Condra	State Geologist	1921-1953
Eugene C. Reed	State Geologist & Director	1954-1967
V. H. Dreeszen	State Geologist & Director	1968-

Note: Samuel Aughey was Chairman of the Department of Natural Sciences at the University of Nebraska 1871-1885 and acted as unofficial "state geologist."

Byron P. Russell was hired as a "geologist" by the state during the drilling of a well at Lincoln, 1885-1889.

In the National Research Council Bull. 88, 1932, Condra reports Barbour was appointed Acting State Geologist in 1891, that the Survey was created in 1893 and organized into its existing form in 1919.

NEVADA

R. H. Stretch	State Mineralogist	1866
A. F. White	State Mineralogist	1867-1870
H. R. Whitehill	State Mineralogist	1871-1878

Nevada Bureau of Mines

John A. Fulton	Director	1929-1939
Jay A. Carpenter	Director	1939-1951
Vernon E. Scheid	Director	1951-1971

Nevada Bureau of Mines & Geology

Vernon E. Scheid	Director	1971-1972
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NEW HAMPSHIRE**“Geological and Mineralogical Survey of the State”**

Charles T. Jackson	State Geologist	1839-1844
C. H. Hitchcock	State Geologist	1868-1878

**New Hampshire Department of Resources and Economic Development,
Division of Economic Development**

T. R. Meyers	Geologist	1942-1963
Glenn W. Stewart	Geologist	1963-1967
Glenn W. Stewart	State Geologist	1967-

Note: From 1917-1942 Prof. James Walter Goldthwaite of Dartmouth College was consultant and geologist for the N. H. State Highway Dept. and contributed much to the knowledge of the basic geology of the state. The formal Office of State Geologist was created May 9, 1967.

NEW JERSEY**“Rogers Survey”**

Henry D. Rogers	State Geologist	1835-1840
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“Kitchell Survey”

William Kitchell	State Geologist	1854-1856
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Geological Survey of New Jersey

George H. Cook	State Geologist	1864-1889
John C. Smock	State Geologist	1889-1901
H. B. Kummel	State Geologist	1901-1915

Division of Geology and Waters, Department of Conservation & Development

H. B. Kummel	State Geologist	1915-1925
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Division of Geology & Topography, Dept. of Conservation & Development

H. B. Kummel	State Geologist	1925-1937
Meredith E. Johnson	State Geologist and Chief of Division of Geology & Topography	1937-1947

**Bureau of Geology & Topography, Division of Planning & Development,
Dept. of Conservation and Economic Development**

Meredith E. Johnson	State Geologist & Chief, Bureau of Geology & Topography	1947-1958
Kemble Widmer	State Geologist & Chief, Bureau of Geology & Topography	1958-1961

**Bureau of Geology & Topography, Division of Resource Development,
Department of Conservation and Economic Development**

Kemble Widmer	State Geologist & Chief, Bureau of Geology & Topography	1961-1971
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**Bureau of Geology & Topography, Division of Water Resources,
Department of Environmental Protection**

Kemble Widmer	State Geologist & Chief, Bureau of Geology & Topography	1971-
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Note: For the sake of simplicity "New Jersey Geological Survey" is still used on outside cover of some publications.

NEW MEXICO**Bureau of Mines and Mineral Resources, New Mexico School of Mines**

E. H. Wells	President & Director	1927-1939
C. E. Needham	President & Director	1939-1942
R. H. Reece	President & Director	1942-1944

John M. Kelly	Director (part-time)	1944-1945
A. D. Hahn	Director (part-time)	Feb. - July 1945
E. C. Anderson	Director	1945-1949
Eugene Callahan	Director	1949-1951

Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology

Eugene Callahan	Director	1951-1957
Alvin J. Thompson	Director	1957-1968
Frank E. Kottlowski	Acting Director	1968-1969
* Don H. Baker, Jr.	Director	1969-

Note: From 1927-1943 the president of the School of Mines served as director of the Bureau of Mines and Mineral Resources. Staff of the school served as part-time personnel. First full-time director was appointed in 1945. The term "New Mexico School of Mines" was retained for fiscal purposes only until 1960.

* Responsibility established directly to Board of Regents instead of through school President.

NEW YORK

"State Geological and Natural History Survey"

W. W. Mather	Geologist. First District	1836-1843
Ebenezer Emmons	Geologist. Second District	1836-1843
Lardner Vanuxem	Geologist. Third District	1836-1843
Timothy A. Conrad	Geologist. Fourth District	1836-1837
James Hall	Geologist. Fourth District	1837-1843
James Hall	State Geologist	1843-1865

State Cabinet of Natural History

James Hall	Curator	1865-1870
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New York State Museum of Natural History

James Hall	Director	1870-1883
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Office of Geology & Office of Paleontology (in N.Y. State Museum)

James Hall	State Geologist, State Paleontologist & Director	1883-1894
F. J. H. Merrill	State Geologist	1894-1898
(James Hall)	(State Paleontologist & Director)	(1894-1898)
F. J. H. Merrill	State Geologist & Director	1898-1904
John Clarke	State Geologist, State Paleontologist & Director	1904-1926

David H. Newland	State Geologist	1927-1941
C. A. Hartnagel	State Geologist	1941-1944
John G. Broughton	In Charge	1944-1945

New York State Museum and Science Service

John G. Broughton	Acting State Geologist	1945-1949
John G. Broughton	State Geologist	1949-1968
James F. Davis	Acting State Geologist	1968-1970
James F. Davis	State Geologist	1970-

Note: When Hall, who had been an assistant to Emmons, became Geologist of the Fourth District in 1837 Conrad continued as State Paleontologist until 1843. The offices of geology and paleontology were not merged until 1955. State Paleontologists prior to the merger, and not noted above, were: John Clarke 1898 until 1904 when he also became State Geologist; Rudolph Ruedemann, 1926-1937; Winifred Goldring, 1937-1954.

NORTH CAROLINA

Board of Agriculture

Denison Olmsted	Prof. Chemistry & Mineralogy Univ. of North Carolina	1824-1825
Elisha Mitchell	Prof. Chemistry & Mineralogy Univ. of North Carolina	

Geological Survey of North Carolina

Ebenezer Emmons (W. C. Kerr)	State Geologist (State Geologist)	1851-1863 (1864-1866)
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Geological, Mineralogical, Agricultural and Botanical Survey

W. C. Kerr	State Geologist	1866-1885
J. A. Holmes	State Geologist	1891-1905

Geological and Economic Survey of North Carolina

Joseph Hyde Pratt	Acting State Geologist	1905-1906
Joseph Hyde Pratt	State Geologist	1906-1924
Brent S. Drane	State Geologist	1924-1925

Division of Mineral Resources, Department of Conservation & Development

Jasper L. Stuckey	State Geologist	1925-1926
Herman J. Bryson	State Geologist	1926-1940

Jasper L. Stuckey	State Geologist	1940-1964
Stephen Conrad	State Geologist	1964-

Note: Although Kerr was appointed State Geologist in 1864 following the death of Emmons the survey was inactive during the last two years of war.

NORTH DAKOTA

North Dakota Geological Survey

E. J. Babcock	State Geologist	1895-1900
Frank A. Wilder	State Geologist	1901-1902
A. G. Leonard	State Geologist	1903-1932
Howard E. Simpson	State Geologist	1933-1938
Frank C. Foley	State Geologist	1939-1941
Wilson M. Laird	State Geologist	1941-1969
E. A. Noble	State Geologist	1969-

OHIO

“First Geological Survey of Ohio”

W. W. Mather	State Geologist	1837-1838
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“Second Geological Survey of Ohio”

J. S. Newberry	State Geologist	1869-1879
Edward Orton, Sr.	State Geologist	1882-1888

Third Geological Survey of Ohio

Edward Orton, Sr.	State Geologist	1889-1899
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Fourth Geological Survey of Ohio

Edward Orton, Jr.	State Geologist	1900-1906
J. A. Bownocker	State Geologist	1906-1928
Wilbur Stout	State Geologist	1928-1946
George W. White	State Geologist	1946-1947
John H. Melvin	State Geologist	1947-1949

Division of Geological Survey, Ohio Dept. of Natural Resources

John H. Melvin	Division Chief	1949-1957
Ralph J. Bernhagen	Division Chief	1957-1968
Horace R. Collins	Division Chief	1968-

Note: The present survey is considered essentially as a continuation of the "Fourth Survey."

OKLAHOMA**Oklahoma Territory Department of Geology & Natural History Survey**

Albert H. Van Vleet	Director	1898-1907
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Oklahoma Geological Survey

Charles N. Gould	Director & State Geologist	1908-1911
Daniel W. Ohern	Director & State Geologist	1911-1914
Charles W. Shannon	Director & State Geologist	1914-1923
Charles N. Gould	Director & State Geologist	1924-1931
Robert H. Dott	Director & State Geologist	1935-1952
William E. Ham	Acting Director & State Geologist	1952-1954
Carl C. Branson	Director & State Geologist	1954-1967
Charles J. Mankin	Director & State Geologist	1967-

Note: The Survey was inactive from July 1, 1923 to June 30, 1924 and from 1931 to 1935 with Charles E. Decker as Custodian during both periods.

OREGON**Oregon Bureau of Mines and Geology**

Henry M. Parks	Director	1913-1923
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State of Oregon Department of Geology and Mineral Industries

Earl K. Nixon	Director	1937-1944
Fay W. Libbey	Director	1944-1954
Hollis M. Dole	Director & State Geologist	1955-1969
R. E. Corcoran	Director & State Geologist	1969-

Note: Both Libbey and Dole were appointed Acting Director for a short period prior to their appointment as Director. (Hollis Dole was appointed Assistant Secretary of Interior on March 20, 1969).

PENNSYLVANIA

“Geological and Mineralogical Survey of the State”

Henry Darwin Rogers	State Geologist	1836-1842
Henry Darwin Rogers	State Geologist	1851-1858

“Second Geological Survey of Pennsylvania”

J. Peter Lesley	State Geologist	1874-1887
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Topographic and Geologic Survey Commission

Richard R. Hice	State Geologist	1909-1918
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Bureau of Topographic and Geologic Survey, Department of Internal Affairs

George H. Ashley	State Geologist	1919-1946
Ralph W. Stone	State Geologist	Aug. - Dec. 1946
Stanley H. Cathcart	State Geologist	1947-1953
Ralph W. Stone	Acting State Geologist	April - Oct. 1953
Carlyle Gray	Acting State Geologist	1953-1955
Carlyle Gray	State Geologist	1955-1961
Alan R. Geyer	Acting State Geologist	Oct. - Dec. 1961
Arthur A. Socolow	State Geologist	1961-1969

Bureau of Topographic and Geological Survey, State Planning Board

Arthur A. Socolow	State Geologist	1969-1971
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Bureau of Topographic and Geologic Survey, Dept. of Environmental Resources

Arthur A. Socolow	State Geologist	1971-
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Note: The “Third Survey” was established to cooperate with the U. S. Geological Survey. Three citizens of the State were appointed as Commissioners. Supervision of the geologic work was by M. R. Campbell from 1900 to 1904, and by George H. Ashley from 1905-1908. In 1909 the Commission was authorized to appoint a state geologist and Hice was appointed in 1909.

From 1923 to 1927 the Survey was temporarily transferred to the Department of Forests and Waters. During the recent transfers of the state survey, its basic organization has remained unchanged.

PUERTO RICO**Mineralogy and Geology Section of the Department of Industrial Research of the Economic Development Administration of Puerto Rico**

Mort D. Turner	Chief Geologist	1954-1958
John Q. St. Clair	Chief Geologist	1959-1960
Jose F. Cadilla	Chief Geologist	1961-1969
Eduardo Aguilar-Cortes	Director & State Geologist Geology & Mineral Resources	1969-

Note: Prior to 1957 the Section was called the Division of Mineralogy and Geology.

RHODE ISLAND**“Jackson Survey”**

Charles T. Jackson	Geological & Agr'l. Surveyor	1839-1840
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Natural Resources Survey of Rhode Island

Charles Wilson Brown	Superintendent	1909-1913
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SOUTH CAROLINA**“Geological and Mineralogical Survey of South Carolina”**

Lardner Vanuxem	Prof. Geol. & Min. Univ. of S.C.	1824-1826
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“Agricultural Survey of South Carolina”

Edmund Ruffin	Agr'l. Surveyor of the State	1842-1843
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“Geological and Agricultural Survey of the State of South Carolina”

M. Tuomey	State Geological Surveyor	1843-1846
Oscar M. Lieber	Mineralogical, Geological and Agricultural Surveyor	1856-1860

South Carolina Geological Survey

Earle Sloan	State Geologist	1901-1911
M. W. Twitchell	State Geologist	1911-1912
Stephen Taber	State Geologist	1912-1947
L. L. Smith	State Geologist	1947-1961

Division of Geology, State Development Board

Henry S. Johnson, Jr.	Chief, Division of Geology	1957-1961
Henry S. Johnson, Jr.	State Geologist	1961-1969
Norman K. Olson	State Geologist	1969-

Note: From 1912 until the formation of the State Development Board there were no funds appropriated for geological investigations, and the State Geologist served principally in an advisory capacity on a part-time basis. The report of Vanuxem's survey was published in the newspapers of the State in 1826 and was the first geological report issued by any state in America.

SOUTH DAKOTA**South Dakota Geological and Natural History Survey**

J. E. Todd	State Geologist	1893-1907
Elwood C. Perisho	State Geologist	1907-1915
Freeman Ward	State Geologist	1915-1926
E. P. Rothrock	State Geologist	1926-1932

State Geological Survey

E. P. Rothrock	State Geologist	1932-1957
Allen F. Agnew	State Geologist	1957-1963
Duncan J. McGregor	State Geologist	1963-

TENNESSEE

Gerard Troost	State Geologist	1831-1850
James M. Safford	State Geologist	1854-1869

Tennessee State Geological Survey

George H. Ashley	State Geologist	1910-1912
A. H. Purdue	State Geologist	1912-1917
L. C. Glenn	Acting State Geologist	1918
Wilbur Nelson	State Geologist	1918-1923

Division of Geology of the Department of Education

Wilbur Nelson	State Geologist	1923-1925
Hugh D. Miser	State Geologist	1926
Walter F. Pond	State Geologist	1927-1937

Division of Geology, Department of Conservation

Walter F. Pond	State Geologist	1937-1945
H. B. Burwell	State Geologist	1945-1951
Herman W. Ferguson	State Geologist	1951-1952
William D. Hardeman	State Geologist	1952-1959

Division of Geology, Department of Conservation and Commerce

William D. Hardeman	State Geologist	1959-1963
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Division of Geology, Department of Conservation

William D. Hardeman	State Geologist	1963-1969
Robert E. Hershey	Director & State Geologist	1969-

TEXAS**“Geological and Agricultural Survey of Texas” (First Texas Geological Survey--“Shumard Survey”)**

Benjamin F. Shumard	State Geologist	1858-1860
Francis Moore, Jr.	State Geologist	1860-1861
Benjamin F. Shumard	State Geologist	1861 (brief)

Note: Samuel B. Buckley was placed in charge of the above survey when it was briefly reactivated in 1866 following the Civil War.

Geological and Agricultural Survey of Texas (Second Texas Geological Survey--“Buckley Survey”)

John W. Glenn	State Geologist	1873-1874
Samuel B. Buckley	State Geologist	1874-1875

Geological Survey of Texas (of the Dept. of Agriculture, Insurance, Statistics, and History of the State of Texas--Third Texas Geological Survey “Dumble Survey”)

Edwin T. Dumble	State Geologist	1888-1894
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The University of Texas Mineral Survey

William B. Phillips	Director	1901-1905
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Bureau of Economic Geology and Technology, University of Texas
 --name changed in 1925 to:

Bureau of Economic Geology, University of Texas

William B. Phillips	Director	1909-1915
Johan A. Udden	Director	1915-1932
Elias H. Sellards	Director	1932-1945
John T. Lonsdale	Director	1945-1960
Peter T. Flawn	Director	1960-1970
William L. Fisher	Acting Director	1970-1971
William L. Fisher	Director	1971-

UTAH

**Utah Geological and Mineralogical Survey, Department of Publicity
 and Industrial Development**

Arthur L. Crawford	Senior Investigator	1941-1944
Arthur L. Crawford	Director & Commissioner	1946-1949

**Utah Geological and Mineralogical Survey, College of Mines and Mineral
 Industries, University of Utah**

Arthur L. Crawford	Director	1949-1961
William P. Hewitt	Director	1961-

Note: The Geological and Mineralogical Survey was authorized by legislature in 1931 but not formally activated until 1941. During these ten years and indeed prior to this time, several geologists acted as consultants to various state agencies as occasion demanded and were sometimes unofficially referred to as "State Geologist." Among these were J. E. Talmage, F. J. Pack, W. Peterson, E. H. Burdick, F. Gunnell, J. A. March, H. H. Higgs, and A. M. Buranek.

VERMONT

Office of State Geologist (Vermont Geological Survey)

Charles Baker Adams	State Geologist	1844-1847
Zadock Thompson	State Geologist	1849-1856
Judge Augustus Young	State Geologist	1856
Edward Hitchcock	State Geologist	1856-1864
Albert D. Hagar	State Geologist & Curator	1864-1870
H. A. Cutting	State Geologist & Curator	1870-1886
George W. Perry	State Geologist & Curator	1886-1898
George Henry Perkins	State Geologist & Curator	1898-1933
Elbridge C. Jacobs	State Geologist & Curator	1933-1947
Charles G. Doll	State Geologist	1947-

Note: The first reference to the “Vermont Geological Survey” is in the 1913-14 report of Perkins. The term has apparently been in general use since then and appears on recent publications but the “Office of State Geologist” is still the official organizational name. The position of Curator of the Cabinet is still held by the State Geologist but the title is obsolete. The Cabinet is a natural history collection and display at Montpelier, and from 1864-1898 the curatorship was the primary function of the State Geologist.

VIRGINIA

Geological Survey of Virginia, Board of Public Works

William Barton Rogers	Director	1835-1844
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Geological Survey of Virginia, Department of Agriculture and Immigration

Thomas Leonard Watson	Geologist in Charge	1904-1907
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Virginia Geological Survey, University of Virginia

Thomas Leonard Watson	Director	1908-1924
Albert William Giles	Acting Director	1924
Wilbur A. Nelson	State Geologist	1925-1928

Virginia Geological Survey, State Department of Conservation & Development

Linwood H. Warwick	Acting Head	1928-1929
Arthur Bevan	State Geologist	1929-1947
William M. McGill	State Geologist	1947-1954

Division of Geology, Department of Conservation & Development

William M. McGill	State Geologist	1954-1957
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Division of Mineral Resources, Department of Conservation & Development

James L. Calver	Commissioner of Mineral Resources & State Geologist	1957-1958
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Division of Mineral Resources, Dept. of Conservation & Economic Development

James L. Calver	Commissioner of Mineral Resources & State Geologist	1958-
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Note: In 1956 the Division of Mineral Resources was created within the Dept. of Conservation and Development. In 1957 all functions of the Division of Geology were transferred to the Division of Mineral Resources.

WASHINGTON**State Mining Bureau**

George A. Bethune	State Geologist	1890-1892
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State Geological Survey of the State of Washington

Henry Landes	State Geologist	1901-1921
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Division of Geology, Department of Conservation & Development

Solon Shedd	Supervisor	1921-1925
Harold E. Culver	Supervisor	1925-1945

Division of Mines and Geology, Dept. of Conservation & Development

Sheldon Glover	Supervisor	1945-1957
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Division of Mines and Geology, Department of Conservation

Marshall T. Huntting	Supervisor	1957-1967
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Division of Mines and Geology, Dept. of Natural Resources

Marshall T. Huntting	Supervisor	1967-1971
Vaughn E. Livingston, Jr.	Supervisor & State Geologist	1971-

Note: The State Mining Bureau was legally in existence until 1901 but was inactive from 1893 due to lack of appropriations.

WEST VIRGINIA**West Virginia Geological and Economic Survey**

I. C. White	Asst. Geologist	1897-1927
David Reger	Asst. State Geologist (in charge)	1927-1929
James D. Sisler	State Geologist	1930-1934
Paul H. Price	Director & State Geologist	1934-1969
Robert B. Erwin	Director & State Geologist	1969-

WISCONSIN

State Geological Survey

Edward Daniels	State Geologist	1853-1854
J. G. Percival	State Geologist	1854-1856

“Geological and Agricultural Survey”

James Hall) Joint Commissioners	1857-1862
Ezra Carr		
Edward Daniels		

“Survey of the Lead District”

John Murrish	Commissioner	1870-1872
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“Complete Geological Survey”

Increase A. Lapham	State Geologist	1873-1874
O. W. Wight	State Geologist	1875
T. C. Chamberlin	Chief Geologist	1876-1882

Geological and Natural History Survey

E. A. Birge	Superintendent	1897-1900
E. A. Birge	Director & Superintendent	1900-1919
William O. Hotchkiss	State Geologist	1908-1919
William O. Hotchkiss	State Geologist, Director & Superintendent	1919-1925
Ernest F. Bean	Acting State Geologist, Director & Superintendent	1925-1926
Ernest F. Bean	State Geologist, Director & Superintendent	1926-1931
Ernest F. Bean	State Geologist	1931-1953
George F. Hanson	Director & State Geologist	1953-1972
Meredith E. Ostrom	Director & State Geologist	1972-

Note: The Geol. and Nat. History Survey had an *ex officio* governing board until 1931 when it was placed under the Board of Regents of the University of Wisconsin. In 1966 it became a part of the reorganized University Extension.

WYOMING

Y. G. Murphy	Territorial Assayer	1878
Fred J. Stanton	Territorial Geologist	1881-1882

Samuel Aughey	Territorial Geologist	April - Aug. 1882
Gilbert Bailey	Territorial Geologist	1882-1885
Samuel Aughey	Territorial Geologist	1885-1887
Louis D. Ricketts	Territorial Geologist	1887-1890
Henry C. Beeler	State Geologist	1903-1909
Edwin Hall	State Geologist	1909-1911
C. E. Jamison	State Geologist	1911-1913
Loyal W. Trumbull	State Geologist	1913-1919
G. B. Morgan	State Geologist	1919-1923
Albert B. Bartlett	State Geologist	1923-1927
John G. Marzel	State Geologist	1927-1933

Geological Survey of Wyoming

S. H. Knight	State Geologist	1933-1941
Horace D. Thomas	State Geologist & Director	1941-1967
D. L. Blackstone, Jr.	State Geologist & Director	1967-1969
Dan Miller, Jr.	State Geologist & Director	1969-

Note: Prior to 1933 there was simply the office of the Territorial or State Geologist. In 1933 legislation was passed creating the Geological Survey of Wyoming. In 1969 the status of the Wyoming Survey was changed to include a full-time state geologist. (See AASG Journal Oct. 1969.)