

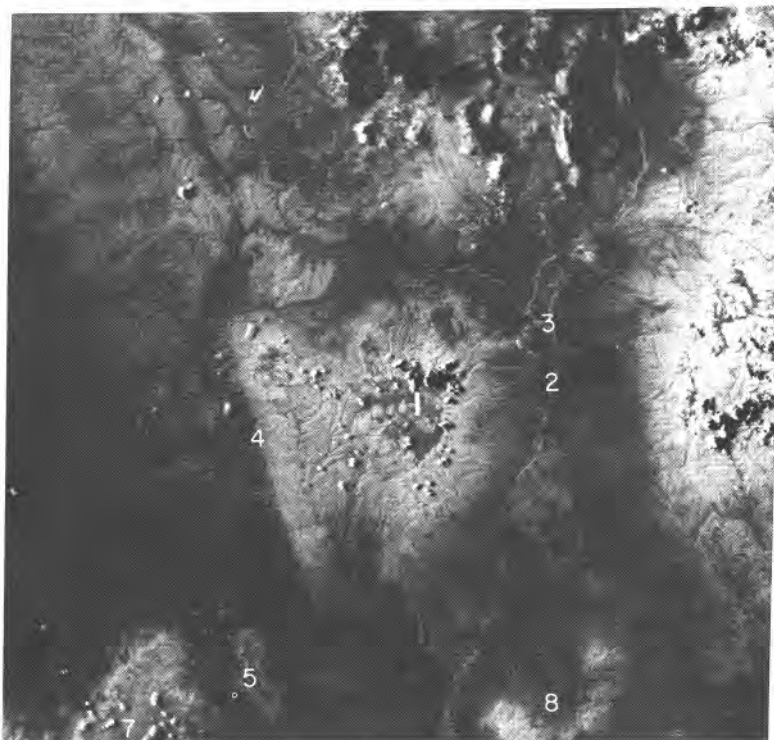


Annual Report

NEW MEXICO STATE BUREAU OF MINES AND MINERAL RESOURCES



ABOUT OUR COVER—Shown is an infrared photograph of northern New Mexico taken at an altitude of 590 miles from ERTS-A (Earth Resources Technology Satellite). The Bureau is the only New Mexico agency participating with the National Aeronautics and Space Administration in interpreting data from the satellite—the first designed specifically for the evaluation of earth resources. Indicated on the index photo below are: 1) the 16-mile wide Valles Caldera of the Jemez Mountains, one of the world's largest volcanic depressions; 2) vegetation clearly outlining the Rio Grande Valley; 3) the fork of the Rio Grande with the Chama north of Española near the San Juan Pueblo; 4) the Nacimiento Fault; 5) Mesa Prieta; 6) Sangre de Cristo Mountains; 7) the San Mateo Mountains north of Mt. Taylor; and 8) the Sandia Mountains.





NEW MEXICO STATE

BUREAU OF MINES AND MINERAL RESOURCES

Annual Report

for the Fiscal Year

July 1, 1971 to June 30, 1972

by

Don H. Baker, Jr.
and Staff

Socorro, New Mexico

December 1972

New Mexico State Bureau of Mines and Mineral Resources

Don H. Baker, Jr., *Director*

A Division of

New Mexico Institute of Mining and Technology

Stirling A. Colgate, *President*

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Leonard DeLayo, *Superintendent of Public Instruction*

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New Mexico State Bureau of Mines and Mineral Resources

Socorro, New Mexico 87801

Business/Publications Office: 505-835-5410

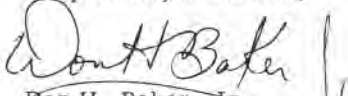
Director's Office: 505-835-5420

November 28, 1972

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

It is with pleasure that I once again review the activities of the New Mexico State Bureau of Mines and Mineral Resources in an annual report. The current report is for the fiscal year 1971-1972 (the 59th year) and is submitted in accordance with Section 3, Chapter 115 of the Eighth State Legislature session laws approved March 4, 1972.

Respectfully submitted,


Don H. Baker, Jr.
Director

DHBjr:jd

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

The New Mexico State Bureau of Mines and Mineral Resources is the State agency responsible for original investigations of mineral resources in New Mexico. The Bureau investigates, evaluates and disseminates information on mineral resources, fuels, metallurgy and geology—with emphasis on finding potential sources, and developing methods of harvesting nonrenewable resources for the benefit and well-being of the citizens of New Mexico.

Although primarily a technical organization providing guidance to the mineral industry and to State officers and departments, the Bureau also serves all interested citizens in advancing the understanding of our natural resources.

The appropriation of State funds to support the Bureau program is less than seven-hundredths of one percent of the total value of mineral production in New Mexico, or about six-tenths of one percent of the total taxes (state, local, school and other) paid by the minerals industry.

The search for new energy and mineral resources has been of prime importance throughout the history of man. Without minerals and fuels, a few technological advancements would be made, and without these advancements, man would still live his life from day to day in a primitive state.

Highlights of the year included Bureau participation with the National Aeronautics and Space Administration in the (see cover picture) 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.

ENVIRONMENTAL GEOLOGY

Environmental geology projects undertaken by the Bureau generally relate to specific problems and to hazards such as earthquakes, landslides and floods. Investigations and studies of a general geologic nature also are performed, however, including mapping of areas or of rock units, the knowledge of which is of immediate or long-range benefit to the State.

Examples include geology of hot springs areas having geothermal power potential; studies of fossils useful for geologic correlation; geologic mapping of areas such as the southern Peloncillo Mountains, Silver City region, Nacimiento Mountains, Sierra de las Uvas, Potrillo Mountains; radioactive dating of various volcanic and intrusive igneous rock units; determination of water resources of the Zuni Indian Pueblo, and of Guadalupe Country; an investigation of the Lake Lucero gypsum beds; and stratigraphic studies of the Ogallala Formation of Llano Estacado and Pennsylvanian rocks near Silver City.

RESOURCES

New Mexico is rich in mineral resources, with the State's major source of income being derived from the large production of oil and gas, coal, metallic ores and industrial rocks and minerals (nonmetallic materials).

Energy Resources

The state is the leading producer of uranium, high on the list of oil and gas production, and is increasing its coal mining. Potential geothermal areas also are plentiful. Bureau projects to aid exploration of energy resources include research on strippable low-sulfur coal, deep coal, and subsurface geologic investigations of possible petroleum reservoir units including reef rocks.

Metals

Major metallic ores produced in New Mexico are uranium (also an energy source), copper and molybdenum. Bureau projects include detailed mapping and petrographic work in the Magdalena and White Oaks Districts, geochemical evaluation of mineralized regions such as Cooke's Peak, and regional resource examinations including Hidalgo and Socorro counties.

Industrial Rocks and Mineral (Nonmetals)

The state is the leading producer of potash and perlite, and yields numerous other industrial rocks and minerals. Bureau projects to help exploration for and development of these nonmetal resources include

statewide evaluations of fluorspar, clays and zeolites, and specific geologic mapping studies including pegmatites near Embudo and the No Agua perlite area. 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.

METALLURGY

Projects in mineral beneficiation and hydro (chemical) metallurgy were directed to improving existing engineering methods and developing new techniques applicable to the mineral values in New Mexico. This research is directed toward finding ways of utilizing vast low-grade mineral deposits that presently are uneconomical to develop. Examples of these projects include testing of different acids and bases for leaching of metallic elements such as copper and molybdenum. Microorganisms that leach sulfide minerals at temperatures of about 60 degrees centigrade also are being examined.

Research on physical concentrations and flotation applied to minerals such as hubernite, fluorspar and barite is continuing.

Several mathematical treatises as well as the modeling of engineering factors for leaching, mill design and mining sequence programs also are being developed for application to conditions in New Mexico.

MINERAL PRODUCTION

New Mexico's mineral production in 1971 (calendar year) dropped slightly to \$1,046,400,000, reflecting a decrease of 1.3 percent less than the record high of \$1,060,358,000 in 1970. New Mexico ranked 7th in the U.S. in total mineral production, according to figures released by the U.S. Department of the Interior, Bureau of Mines, and was first in uranium, perlite and potash.

Copper, molybdenum, natural gas, pumice, crude petroleum and natural gas liquids also were leading commodities.

Uranium, copper and other metals totaled \$254,500,000, or 24 percent; nonmetals totaled \$115,500,000, or 11 percent; coal, natural gas, liquids and crude petroleum production totaled \$676,400,000, or 65 percent. A breakdown of percentages and dollar value of 1971 production, fig. 1, and a county-by-county tabulation of production, table 1, follow.

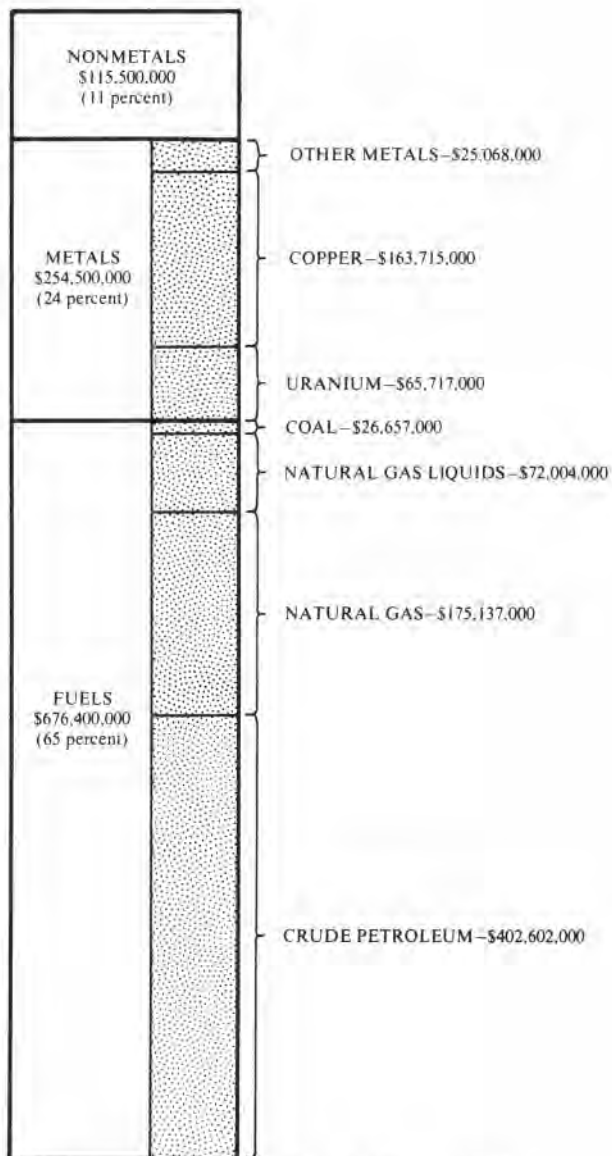


Figure 1—Mineral Production of New Mexico, 1971

Table 1—Value of mineral production in New Mexico, by counties (U. S. Bureau Mines)

County	Production	Chief minerals in order of importance
Bernalillo	\$ 1,802,000	Cement, sand and gravel, stone, clay
Catron	W	Sand and gravel, salt
Chaves	12,326,000	Petroleum, natural gas sand and gravel, stone
Colfax	W	Stone
Curry	W	Stone, sand and gravel
De Baca	W	Sand and gravel
Doña Ana	699,000	Sand and gravel, pumice, clay, stone
Eddy	176,494,000	Potassium salts, petroleum, natural gas, natural gas liquids, salt, stone, sand and gravel
Grant	168,929,000	Copper, zinc, silver, molybdenum, lead, gold, manganese ore, sand and gravel, stone, fluorspar,
Guadalupe	W	Sand and gravel, stone.
Harding	W	Carbon dioxide, sand and gravel.
Hidalgo	1,575,000	Copper, gold, silver, clay, sand and gravel, zinc.
Lea	394,296,000	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Lincoln	W	Stone, sand and gravel
Los Alamos	—	
Luna	W	Sand and gravel, clay, stone.
McKinley	71,304,000	Uranium, natural gas liquids, petroleum, coal, stone, natural gas, molybdenum, sand and gravel.
Mora	W	Sand and gravel, stone.
Otero	W	Stone, sand and gravel.
Quay	W	Sand and gravel, stone.
Rio Arriba	36,499,000	Natural gas, petroleum, natural gas liquids, sand and gravel, stone.
Roosevelt	18,750,000	Petroleum, natural gas, natural gas liquids, sand and gravel, pumice.
Sandoval	2,836,000	Copper, gypsum, petroleum, natural gas, sand and gravel, silver, peat, pumice, clay, stone, zinc.
San Juan	93,571,000	Natural gas, coal, petroleum, natural gas liquids, sand and gravel, helium, stone, pumice, uranium, clay.
San Miguel	W	Sand and gravel, stone.
Santa Fe	2,045,000	Sand and gravel, copper, pumice, gold, silver, stone, zinc.
Sierra	W	Sand and gravel, copper, silver.
Socorro	61,000	Sand and gravel, iron ore.
Taos	21,105,000	Molybdenum, perlite, sand and gravel, mica, stone.
Torrance	W	Sand and gravel.
Union	W	Pumice, sand and gravel.
Valencia	22,477,000	Uranium, perlite, sand and gravel, stone.
Undistributed ¹	11,513,000	
Total ²	1,046,284,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

¹ Includes gemstones and vanadium which cannot be assigned to specific counties; and values indicated by symbol W.

² Data may not add to totals shown because of independent rounding.



ACTIVITIES AND SERVICES

Again this year people of the state called upon their Bureau of Mines for considerable assistance, evidenced, in part, by the 5,321 letters, 6,115 telephone inquiries, and the 2,785 office visitations. The inquiries were to discuss various problems and obtain information on "where to" and "how to."

Mineralogical examinations were requested on 132 prospector samples. The analytical laboratories performed 6,011 analyses on 66 different ores being evaluated metallurgically.

Staff members taught 7 courses in the College Division, gave 21 special lectures in Tech classes, and supervised 33 graduate theses projects. In addition, 21 technical papers and lectures were presented at other universities and national professional meetings.

Throughout New Mexico nearly 15,000 people viewed the Mineralmobile—the Bureau's traveling mineral museum. Samples of state-produced copper and potash ore were provided to 305 students, and 97 mineral kits were supplied to earth science teachers. Many public school and parochial classes visited the Bureau to enjoy our mineralogical museum's rotating exhibits of 9,000-plus specimens. The well cuttings and log library was used by more than 350 persons seeking drilling and subsurface data. This year, data from about 3,000 wells were added to the library, primarily through company donations.

In assisting the people of New Mexico and in carrying out geological, resource, and metallurgical projects, Bureau personnel spent 1,385 days in the field involving 520 man-days of per diem and 103,475 miles of travel.

Besides numerous news and press information releases, the editorial staff reviewed 31 manuscripts, accepting 18 for publication. This year 32 manuscripts and geologic maps were published.

The Bureau business office, in addition to furnishing the staff with secretarial and typing assistance, sold 18,338 publications and maps. Sales increased this year by just over \$7,800.00, reaching \$24,785.00 (see fig. 2, page 17). This section assisted in selecting vendors for specialized material, prepared three equipment bids, 373 requisitions and 339 purchase orders.

PERSONNEL CHANGES

Dr. Roshan B. Bhappu, Bureau senior metallurgist and acting head of the Tech metallurgy department, resigned to enter private industry. Robert L. Price, draftsman, and Mrs. Judy Peralta, staff stenographer, also resigned.

New employees joining the Bureau were Mrs. Shirley Whyte, clerk-typist (April, 1972) and Robert Wood, draftsman I (February, 1972).

FINANCIAL STATEMENT FOR GRANTS AND CONTRACT BUDGET

Receipts

Beginning balance (carried forward July 1, 1971)		\$ 2,694.00
Income		
State and federal	\$26,549.58	
Other	11,805.93	
Accounts receivable federal	<u>9,377.18</u>	<u>47,732.69</u>
Total Funds Available		<u><u>\$50,426.69</u></u>

Expenditures

Salaries	\$19,580.19	
Employee benefits	1,702.06	
Travel	4,231.01	
Supplies and services	5,960.90	
Printing	7,348.65	
Auto use charge	2,590.00	
Overhead	<u>5,068.07</u>	<u>46,480.88</u>
Balance, June 30, 1972		<u><u>\$ 3,945.81</u></u>

FINANCIAL STATEMENT FOR BOARD OF EDUCATIONAL FINANCE—LEGISLATIVE BUDGET

Receipts

Beginning balance		\$ 174.00
State appropriation		636,000.00
Publication sales		24,785.31
Basic geologic and ground-water appropriation		<u>20,000.00</u>
Total Receipts		<u>680,959.31</u>

Disbursements and Commitments

Salaries

Full time	\$353,480.06	
Part time (mostly students)	77,814.70	
Project contract	<u>39,536.75</u>	\$470,831.51

Travel and Automotive

Travel and per diem	\$ 13,307.29	
Gas, repairs, and insurance	<u>5,389.69</u>	\$ 18,696.98

Repairs and Maintenance

	<u>\$ 1,652.74</u>	\$ 1,652.74
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Supplies and Materials

Postage and resale	\$ 7,800.78	
Office	5,257.71	
Laboratory and scientific	<u>13,220.24</u>	\$ 26,278.73

Printing and Publications

	<u>\$ 34,902.48</u>	\$ 34,902.48
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Other Operating Expenses

Telephone and telegraph	\$ 13,967.30	
Professional services	10,259.86	
Retirement	19,858.40	
Old Age and Survivors Insurance	12,080.69	
Overhead—New Mexico Tech	17,500.00	
Building use charge—New Mexico Tech	7,960.00	
Computer service	5,600.00	
Freight, insurance, audit, Board of Educational Finance, subscriptions, etc.	<u>9,151.61</u>	\$ 96,377.86

Capital Outlay

	<u>22,223.83</u>	\$ 22,223.83
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Total Expenditures

	<u>\$670,964.13</u>
--	---------------------

Balance

	\$ 9,995.18
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Budgeted for FY '72-'73

	<u>9,995.18</u>
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Uncommitted balance, June 30, 1972

	<u>\$ 0.00</u>
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PUBLICATIONS

The Bureau issued 32 publications (excluding re-issues) in the form of bulletins, circulars, memoirs, scenic trips, state park brochures, geologic maps, reprints, target explorations, resources maps, bibliographies, and geochronologic bulletins.

New Issues:

Bulletin 97—*Geology of the San Diego Mountain Area, Doña Ana County, New Mexico*, by William R. Seager, John W. Hawley and Russell E. Clemons, 38 pages. \$2.50.

Barite and fluorite deposits provided the earliest impetus for studying San Diego Mountain. Located in north-central Doña Ana County along the east side of the Rio Grande River about 25 miles north of Las Cruces, the mountain is a broad sandstone-capped peak rising about 1,000 feet above the adjacent flood plain.

Circular 116—*Solubility and Enthalpy of the Barium-Strontium Sulfate Solid Solution Series*, by Elise Brower and Jacques Renault, 21 pages. \$0.75

A study of certain physicochemical properties pertinent to the precipitation and dissolution of barium-strontium sulfate to understand the conditions in which hydrothermal sulfates are deposited and recrystallized.

Circular 117—*Batch Grinding Model*, by Ronald J. Roman and George W. Becker, 7 pages. \$0.50.

A grinding model has been developed to predict the product size distribution at any retention time in a batch grinding mill, given the feed size distribution and product size distribution at any other retention time.

Circular 118—*Selected Papers from 1970 Uranium Symposium at Socorro, New Mexico*, compiled by Ronald J. Roman and Don H. Baker, Jr., co-chairmen, 61 pages. \$1.50.

A presentation of six papers from the conference held on the New Mexico Tech campus April 6-8, 1970, in conjunction with Tech's Idea Conference.

Circular 119—*Bibliography of Geophysics for New Mexico through 1970*, by D. J. Cash, 27 pages. \$1.25.

This report is organized into four sections: 1) the bibliography itself consisting of 108 citations, 2) a subject index, 3) an author index, and 4) a map index. Each entry in the bibliography is assigned a reference number.

Circular 120—*Seismicity of the Rio Grande Rift in New Mexico*, by A. R. Sanford, A. J. Budding, J. P. Hoffman, O. S. Alptekin, C. A. Rush, and T. R. Topozada, 10 pages. \$1.25.

Text is written for the non-specialist as well as the seismologist. Engineers who must consider seismic risk in the design of structures, and officials responsible for public safety will find this study informative.

Circular 121—*Geochemical Background Values in Iron-Bearing Rocks of Rio Arriba County, New Mexico*, by Donald F. McLeroy, 11 pages. \$1.25.

A study of the geochemistry of iron-bearing rocks indicate potential for additional mineral deposits in the area.

Circular 124— *Ground-Water Characteristics in a Recharge Area, Magdalena Mountains, Socorro County, New Mexico*, by W.K. Summers, Geraldine E. Schwab and L. A. Brandvold, 26 pages. \$1.50.

Water samples yield new information on chemistry and distribution.

Memoir 24— *Geology of the Pecos Country, Southeastern New Mexico*, by Vincent C. Kelley, 75 pages. \$7.00.

Includes most of the Pecos Valley drainage area from 60 miles north of Roswell to the New Mexico-Texas line. The area, covering more than 12,500 square miles, is dominantly surfaced by Permian carbonate and evaporite rocks of the San Andres Formation and the Artesia Group.

Memoir 25— *Strippable Low-Sulfur Coal Resources of the San Juan Basin in New Mexico and Colorado*, by John W. Shomaker, Edward C. Beaumont, and Frank E. Kottowski, 189 pages. \$9.50.

A study conducted by the New Mexico State Bureau of Mines and Mineral Resources for the Air Pollution Control Office of the Environmental Protection Agency to determine the amount, location, quality and economic potential of low-sulfur strippable coal in the San Juan Basin.

Scenic Trip 10— *Southwestern New Mexico*, by —H. L. James, 80 pages. \$1.50.

The first "tourist" to travel what now is the continental United States crossed Southwestern New Mexico. The wanderings of Alvar Nunez Cabeza de Vaca were responsible for the first descriptions of this area which since has produced mineral wealth and rich farming areas. Includes three side trips.

Scenic Trip 11— *Cumbres and Toltec Scenic Railroad*, by H. L. James, 73 pages. \$2.50.

A historic, geographic and geologic trip on the famed CATS Railroad between Chama, New Mexico and Antonito, Colorado, with milepost-by-milepost rail logs in both directions.

State Park Brochures— *Bottomless Lakes, Bluewater Lake, Valley of Fires, Ft. Selden-Leasburg, Santa Fe River and Hyde Memorial, and Villanueva*. Free leaflets.

Prepared by Bureau staff and others in cooperation with the New Mexico State Park and Recreation Commission, describing the location, facilities, history, flora, fauna and the geology of each park and its environs, with emphasis on geology.

Geologic Map 24— *Geologic Map of the Glorieta Quadrangle, New Mexico*, by A. J. Budding, short text on map. \$1.50.

Geologic Map 25— *Geologic Map and Section of Cuba Quadrangle, New Mexico*, Lee A. Woodward, Douglas McLelland, John B. Anderson, and William H. Kaufman, short text on map. \$1.50.

Fluorspar, by R. E. Van Alstine, 10 pages (reprint from Bulletin 87). Free.

Discussion of the occurrence and production of fluorspar in New Mexico.

Target Exploration Report E-1— *Stratiform Copper Mineralization in the Nacimiento Region, New Mexico*, by William H. Kaufman, Otto L. Schumacher and Lee A. Woodward, 9 pages. \$0.50.

The main purpose of this new series is the immediate release of significant new

exploratory information which otherwise would have to await release at a much later date as part of a comprehensive formal document.

Target Exploration Report E-2— *Leaching of Molybdenite by a Thermophilic Chemoautotrophic Microorganism*, by Corale L. Brierley, 6 pages. \$0.50.

Presents preliminary data which suggests that the organism may be useful as an agent for high temperature biological leaching.

Target Exploration Report E-3— *Winkler Anticline Fluorspar, Hidalgo County, New Mexico*, by W. N. McNulty, Sr., 7 pages. \$0.50.

Recent work in the area of the Winkler anticline in the Animas Mountains has resulted in discovery of potentially commercial deposits of fluorspar. Further prospecting and exploration are recommended for the Winkler anticline as well as the Little Hatchet and Big Hatchet Mountains.

Target Exploration Report E-4— *Zinc-Lead-Copper Trace Contents in Tres Hermanas Stock, Luna County, New Mexico*, by P. Doraibabu and Paul Dean Proctor, 9 pages. \$0.50.

Anomalous values suggest possible nearby sources of metal content.

Resource Map 1— *Geothermal Resources of New Mexico*, compiled by W. K. Summers. \$1.00.

First in a new series. Features wells, springs, known geothermal resource areas and extensive geothermal anomalies.

Annual Report— *New Mexico State Bureau of Mines and Mineral Resources Annual Report for Fiscal Year July 1, 1970 to June 30, 1971*, by Don H. Baker, Jr., and staff, 28 pages, illustrated. Free.

Price List 1 and Price List 2— *Publications Available from New Mexico State Bureau of Mines and Mineral Resources*, 32 pages. Free.

Comprehensive listing of geologic and mineral reports and maps, with colored index map.

Isochron/West No. 2 and Isochron/West No. 3, edited by John H. Schilling, 48 pages and 32 pages. By subscription, back issues available at \$1.00 each.

Serial bulletin of isotopic geochronology.

Annotated and Indexed Bibliography of Geothermal Phenomena, by W. K. Summers, 670 pages, hardbound. \$52.50.

A comprehensive and worldwide reference volume containing 14,000 citations.

Revised Issues:

Scenic Trip 8— *Mosaic of New Mexico's Scenery, Rocks and History*, (reprinted) by Paige W. Christiansen and Frank E. Kottlowski, 164 pages. \$2.50.

A truly representative picture of New Mexico is presented in this guide for visitor and resident.

Re-issues:

Zoological-Botanical Gardens, state park brochure.

New Mexico Energy Resources Map.

Open File Reports:

Lower Permian Stratigraphy of Southern New Mexico and West Texas, by Clifton F. Jordon, Jr.

Chemical Classification of Rocks by Data Processing, by David V. LeMone.

In Press:

(as of June 30, 1972—Available September, 1972)

Bulletin 87 (re-issue)—*Mineral and Water Resources of New Mexico*, \$3.00.

Bulletin 98—*Geology of the Fort Sumner Sheet, New Mexico*, \$3.00.

Circular 122—*Structure of the Glorieta Sandstone, Northwest Chaves County, New Mexico*, \$1.00.

Circular 127—*Determinative Tables of Two-Theta Copper and Two-Theta Iron for Minerals of Southwestern United States*, \$3.00.

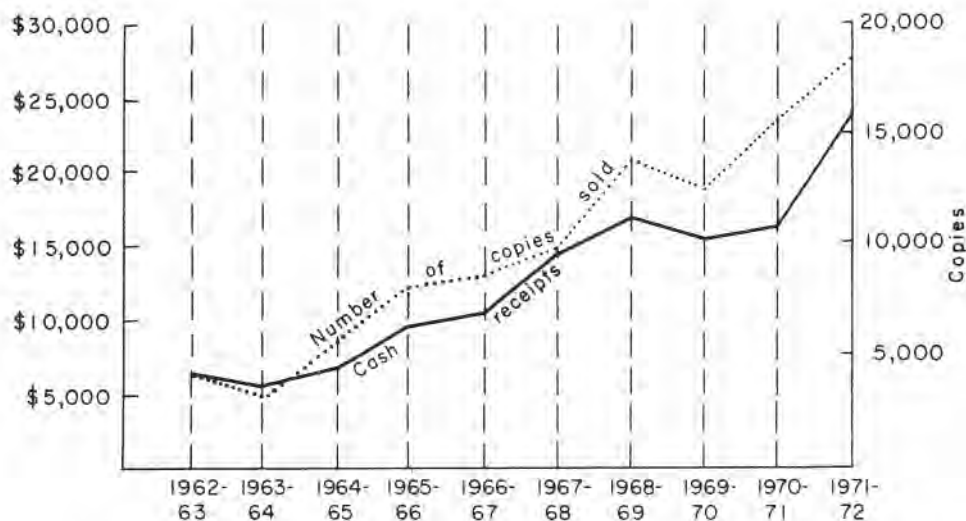


Figure 2—Sales of Bureau publications and maps, 1962-71 (Fiscal Years)

November 1972

NEW MEXICO STATE BUREAU OF MINES AND MINERAL RESOURCES

Don H. Baker, Jr., *Director*

Full-time Staff

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JIM BRUNING, *Geologist*
STUART FAITH, *Geologist*
MICHAEL JAWORSKI, *Geologist*
JAMES JENSEN, *Geologist*

WALTER VERNON KRAMER, *Geologist*
JESUS NAJERA, *Hydrogeologist*
CRAIG OLSON, *Metallurgist*
TERRY SEIMERS, *Geologist*
DON SIMON, *Geologist*

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PAIGE W. CHRISTIANSEN, *Historian-Mining*

ALLAN R. SANFORD, *Geophysics*
FRANK B. TITUS, *Hydrology*



Don H. Baker, Jr., *Director*
July 1, 1969



Frank E. Kottlowski, *Assistant Director,
Senior Geologist* July 2, 1951



Joyce M. Aguilar, *Stenographer*
Sept. 6, 1967

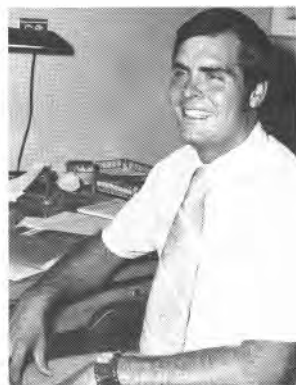


William E. Arnold, *Scientific Illustrator*
Jan. 4, 1954

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Robert A. Bieberman, *Petroleum Geologist*
June 1, 1950



Blair R. Benner, *Junior Metallurgist*
March 1, 1971



Lynn A. Brandvold, *Chemist*
Nov. 10, 1965

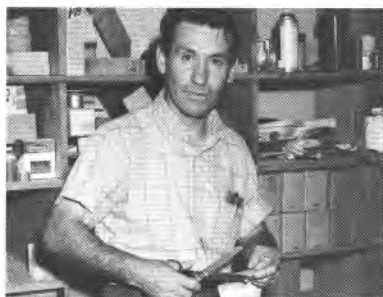
BUREAU STAFF



Corale Brierley, *Assistant Chemist, Biology*
Sept. 1, 1971



Charles E. Chapin, *Geologist*
June 1, 1970



Richard R. Chavez, *Technician*
Feb. 21, 1957



E. Jack Coats, *Bureau Information Coordinator*
Jan. 18, 1971



Jill Collis, *Secretary*
June 28, 1971



Lois M. Devlin, *Office Manager*
Jan. 24, 1962

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Jo Drake, *Administrative Assistant,
Director's Secretary*
Sept. 10, 1968



Rousseau H. Flower, *Senior Paleontologist*
Sept. 1, 1951



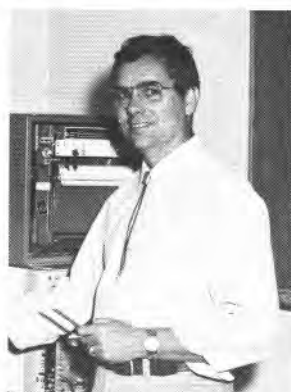
Roy W. Foster, *Petroleum Geologist*
Nov. 19, 1953



William L. Hawks, *Materials Engineer*
Jan. 19, 1970

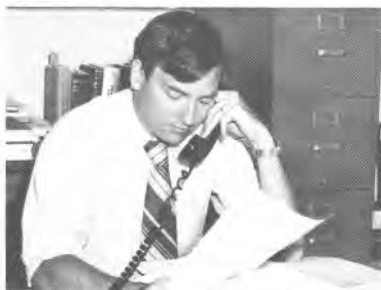


Robert W. Kelley, *Editor, Geologist*
May 15, 1971



Jacques R. Renault, *Geologist*
Sept. 1, 1964

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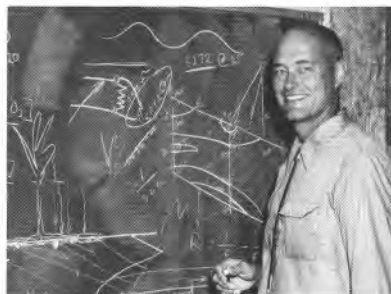
Ronald J. Roman, *Chief Research Metallurgist*
May 5, 1969



John W. Shomaker, *Geologist*
Aug. 18, 1969



Jackie H. Smith, *Laboratory Assistant*
Dec. 16, 1963



Frank B. Titus, *Hydrological Advisor*
Aug. 16, 1965



Karl Vonder Linden, *Mining Engineer,
Environmental Geologist*
Oct. 12, 1970



Charles W. Walker, *Mineralogist*
Oct. 12, 1970

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Robert H. Weber, *Senior Geologist*
May 15, 1950



Shirley Whyte, *Clerk-Typist*
April 26, 1972



Max E. Willard, *Economic Geologist*
Feb. 20, 1952



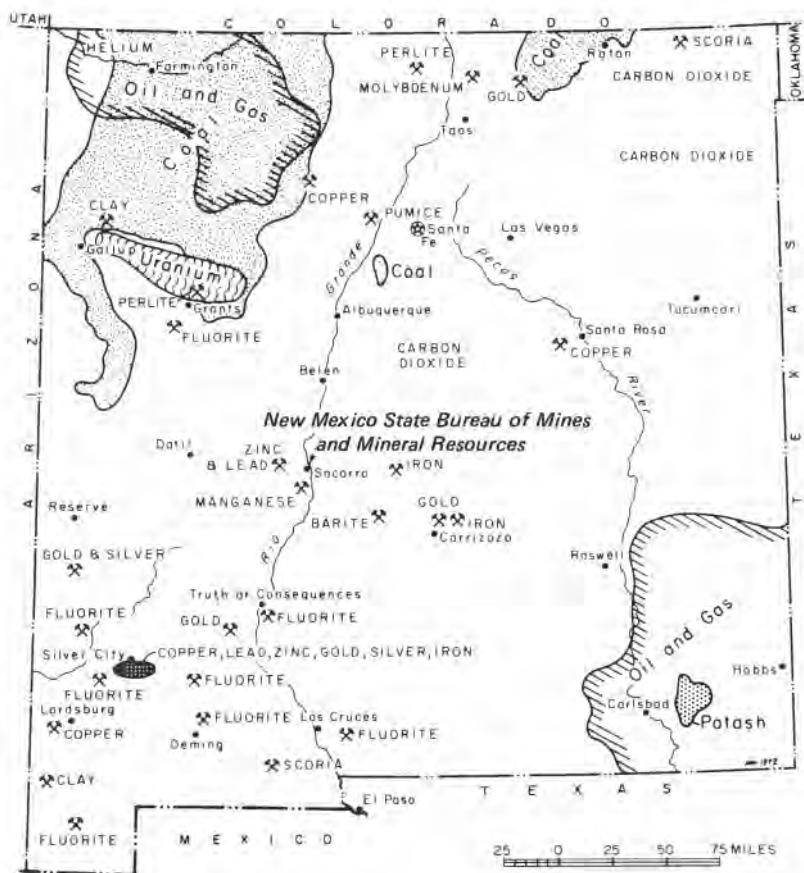
Robert Wood, *Draftsman I*
March 1, 1972



Juarine W. Wooldridge, *Editorial Clerk*
July 22, 1968



Michael W. Wooldridge, *Draftsman*
Jan. 25, 1971



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