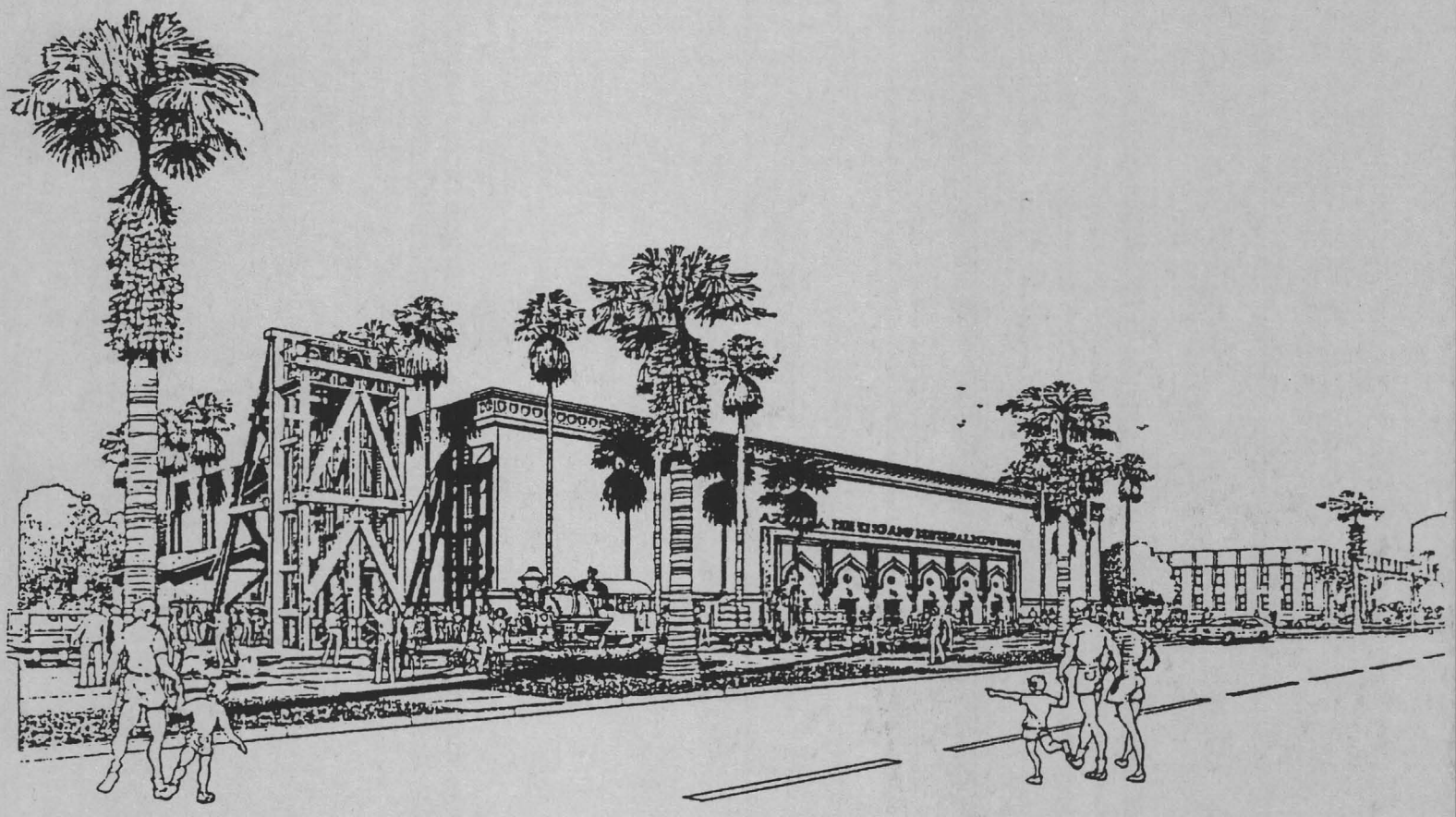
STATE OF ARIZONA

DEPARTMENT OF MINES AND MINERAL RESOURCES



52nd Annual Report
1990 - 91

STATE OF ARIZONA
DEPARTMENT OF MINES AND MINERAL RESOURCES
ARIZONA MINING AND MINERAL MUSEUM
Phone (602) 255-3791 1-800-446-4259 (IN ARIZONA ONLY)
FAX (602) 255-3777 Tucson Field Office (602) 628-6340

August 15, 1991

Fife Symington, Governor
State of Arizona
1700 W. Washington
Phoenix, AZ 85007

Dear Governor Symington:

The Annual Report of the Arizona Department of Mines and Mineral Resources is submitted to you in compliance with A.R.S. Section 27-106.

The Department of Mines and Mineral Resources has the statutory obligation to promote the development of mineral resources in the state. The attached report is a summary of past efforts, especially for the Fiscal Year of 1991, to accomplish that task. The report also establishes realistic goals for the future and provides a plan to reach those goals. In deference to the severe fiscal problems being experienced by government, those plans do not include any requests for additional funding or growth in full-time staff during the next two years. Instead, it is the intent of the Department to rely on volunteers and donations from the private sector to fill the gap between the near skeleton staff of the Department and what we believe is absolutely necessary to fulfill the obligations assigned to us. Much is needed to make a world class institution of which everyone in Arizona will be proud. We have faith that the plan, along with a lot of hard work, will make it so.

The Department and Mining Museum will complete moving to new quarters at 1502 West Washington by September 14, 1991.

Arizona led the nation in 1990 in the production of non-fuel mineral products with $3.1 billion in value. The state benefited directly from this activity with over $100 million in direct taxes, a payroll over $400 million, and, when combined with the support industries, made a $6.5 billion contribution to the economy of Arizona.

Most important of all, Arizona's mining industry produces a significant portion of the copper and other metals and industrial minerals that are absolutely necessary for our civilization to continue to exist.

The Department of Mines and Mineral Resources plays a small but important part in that effort and at a very small cost to the taxpayers of Arizona.

Respectfully yours,

Leroy E. Kissinger
Director
For the Board of Governors

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BOARD OF GOVERNORS

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Glenn A. Miller, Museum Curator
Richard R. Beard, Engineer
Nyal J. Niemuth, Engineer
Ann Turney, Administrative Assistant
Diane Bain, Secretary
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Marcia Wawrzynek, Maintenance
Alice Rosenfeld, Museum Tour Guide
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Les Wagner, Museum Tour Guide
Jeff Scovil, Museum Tour Guide

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FINANCIAL STATEMENT

Appropriation	350,219
Expenditures	347,343
Reverted	76
Disappropriated Funds	2,800

MINES AND MINERAL RESOURCES FUND

Income	
Balance Forward	10,063
Donation Box Receipts	1,092
Donation (Other)	315
Museum Store Sales	21,769
Total Income	**33,339**
Expenses	
Personal Services	15,831
Employee Related Expenses	1,384
Resale Merchandise	5,618
Store Expenses	1,389
Museum Expenses	4,088
Total Expenses	**28,310**
Balance Forward to 7/1/91	**4,929**

PRINTING REVOLVING FUND

Balance Forward	4,383
Publication Sales	9,325
Publication Expenses	10,525
Balance Forward 7/1/91	**3,183**

THE DEPARTMENT OF MINES AND MINERAL RESOURCES

STATUTORY ASSIGNMENT

The Arizona Department of Mines and Mineral Resources is authorized by A.R.S. Section 27-101 to 27-111 to promote the development of the mineral resources of this state through technical and educational processes including field investigations, public seminars, forums, publications, public news media and other functions necessary to achieve its objectives.

IMPLEMENTATION OF ASSIGNMENT

Mineral Museum - The Department operates the State of Arizona Mining and Mineral Museum. The Museum is the official repository for the identification, cataloging and displaying of mineral specimens, ores, gemstones, and lapidary materials found in the state. The Museum also operates a small store to sell mineral specimens and publications relating to minerals.

Education - The Department conducts seminars and training sessions to assist the public in the proper staking of claims and locating and extracting of minerals. Through a series of publications, the Department has accumulated useful guides to mineral law, location of mineral occurrences in the state and technology to mine and extract minerals.

The Museum staff conducts programs on a regular basis to educate teachers and students of Arizona's schools from kindergarten through college about mining and its contribution to the general welfare of Arizona.

Information and Assistance - The Department maintains the most comprehensive records and resource library of mining activity, spanning the period of the earliest settlers to the present day, that is available anywhere. With these files and its library the Department is able to assist prospectors, mining companies, rockhounds and the general public in the efforts to locate and develop mineral resources. The engineering staff is able to provide technical assistance in general mining and processing of minerals for those who need it.

Assistance to Government Agencies - The Department staff spends a great deal of time investigating, sampling, acquiring assays of samples and providing a wide range of information to assist both state and federal agencies in their attempts to prosecute the many fraudulent "mining" promoters who are proliferating in Arizona. Recent national publicity has been given to the many schemes to defraud investors by selling them "ore" containing gold. Our Department staff has been in the forefront in acquiring evidence to build a legal case against the perpetrators. Both the Securities Division of the Corporation Commission and the Federal Trade Commission have been involved.

We provide technical assistance to the Governor's Office, the State Legislature, the State Land Department, the State Department of Environmental Quality, the Department of Revenue, the Attorney General's Office and the Department of Commerce.

The Department has worked with the U.S. Bureau of Mines on many projects over the years. The Department maintains a complete data base listing all the known mineral occurrences in the state for the Bureau's Mineral Industry Location system (MILS). We have all of the data filed both on computer and hard copy.

The Department regularly performs services for, or works cooperatively with, both the U.S. Bureau of Land Management and the U.S. Forest Service. The Department has assisted the World Affairs Council of Arizona in behalf of the U.S. Information Agency.

DEPARTMENT ACTIVITY

Introduction

The following describes in a general way, what the staff of the Department does to accomplish the task of "promoting the development of mineral resources". The projects that are underway mesh with the extensive list of contacts with the mining industry itemized in the "Industry Activity" section of this report.

The return to the state for these efforts must be measured against the results of the exploration and mining activity conducted by individuals and companies that make up the mining industry. Successful projects reap important benefits to the economy in general and in the form of taxes paid directly to state and county treasuries. Even the failures, those exploration projects that don't find viable ore bodies, make a significant contribution to the state's economy. It is estimated that exploration activity alone spends over $18 million a year in Arizona. This in turn generates approximately $1.25 million in sales and payroll taxes.

Activity by the staff makes it possible to maintain an up to date resource center to provide information, technical assistance and support to the industry in its quest for new discoveries.

The Department makes field contacts and mineral deposit evaluations, studies markets and technology to encourage private sector investment in prospecting, exploration, and development and production of mineral deposits. Encouragement and information is supplied through the technology transfer methods of personal contacts, presentations, publications, and operation of the Arizona Mining and Mineral Museum.

The Arizona Department of Mines and Mineral Resources continues to have a positive economic impact on the State of Arizona. The focused orientation of the Department is to aid in the promotion and development of the State's mineral resources. The search for mineral deposits, their development, and production of metals and minerals is a $3.5 billion business in Arizona. It is the largest nonfuel mining industry in the United States. By making contact with thousands of individuals and companies around the world, the staff of the Department collects, analyzes, and disseminates information to foster and expand this business.

Results of the Department's work in the last fiscal year include expenditures and production by the mining and minerals industry and related manufacturing of at least $25 million. Ongoing projects of the Department, if successful, will encourage the expenditure, investment, and production of over $20 billion in future projects.

The ADMMR maintains current files and computer database records on approximately 10,500 mineral occurrences, mines, and prospects in Arizona. These files contain such data as location, bibliographies, mineral content, size, economics, complete feasibility studies, and other data. As new information is developed by ADMMR studies and by industry exploration and mining activity, it is entered into the files. Additional files are also created as new mineral occurrences are discovered and evaluated.

The information contained is made available and used by members of the mining industry. Through the use of this information the industry has been able to make significant discoveries and develop new mining projects that return revenue to the State's economy many times over what it costs to fund the Department.

Even those exploration projects that do not result in producing mines account for a significant financial contribution to the State. Purchase of supplies, food, lodging, gasoline and drilling, earth moving, consulting, and environmental services pay sales and other taxes.

The Arizona Department of Mines and Mineral Resources is dedicated to raising the level of understanding of the public about how important minerals and mineral products are to civilization. Civili-

zation cannot exist without these products, and minerals are available only if they are dug out of the ground.

The museum and engineering staffs have developed audio-visual programs that are regularly presented to clubs, school groups, and teacher workshops around the state. These programs are centered on the use of mineral products in a civilized world.

DEPARTMENT PROJECTS

Metallogenic Project

MM-17, Metallogenic Provinces of Arizona (1-1,000,000) and accompanying text, Metallogenic Map Series - Program Overview were released and published.

Element Zonation of Laramide Veins in the Northern Bradshaw Mountains, Yavapai County, Arizona was presented at a poster session of the Cordilleran Section meeting of the Geological Society of America (GSA) held at San Francisco, California on March 26, 1991. The abstract was published in GSA's Abstracts with Programs, Volume No. 2, March 1991. The paper was coauthored by George E. Ryberg, Patrick F. O'Hara, and Department engineer, Nyal J. Niemuth. Text and illustrations of this paper are being prepared for publication in the new Digest Volume 19 of the Arizona Geological Society.

ADMMR AzMILS Database

In connection with this project significant improvements are being made to the AZMILS database. First, all topographic names were standardized, followed by checking the validity of the each mine's latitude and longitude for the reported quadrangle. Surprisingly, this had never been done by the U. S. Bureau of Mines and over 450 incorrect locations were identified. Those mines had their locations confirmed and re-plotted. A more detailed check of location data correlating legal description location to latitude and longitude is currently underway in cooperation with Dietz and Associates. They are checking all latitudes and longitudes against a high resolution digital version of Arizona's township, range and section grid and supplying us with a listing of properties that do not plot by latitude and longitude within the appropriate township, range and section.

Industrial Mineral Development Project

Arizona, Southern California, and other Southwestern markets are an important key to development of industrial mineral deposits in Arizona

The Arizona Department of Mines and Mineral Resources is compiling data to encourage the development of industrial mineral deposits in Arizona. The manufacturing industries of Arizona and those manufacturing centers within a reasonable shipping distance, especially Southern California, use a large quantity of industrial minerals that are currently shipped to the southwestern states at considerable transportation cost. The development of deposits and processing operations for these minerals in Arizona could have a number of beneficial effects. The State economy would benefit from increased employment and tax base and manufacturers would benefit from increased availability of raw materials, and possible lower prices due to reduced transportation costs, increased competition, and potential substitution.

The series of reports on industrial mineral consumption in a number of Arizona and Southern California industries is continuing. Emphasis is being placed on finely ground minerals used as functional fillers. Although deposits are believed to exist in Arizona, there is currently only one small producer of limited grades of one such mineral for filler applications. The Arizona Department of Mines and Mineral Resources believes that by quantifying consumption, reporting specifications, and explaining uses of minerals in various industries, sufficient demand will be shown to justify new development of nonmetallic mineral deposits in Arizona.

A large variety of industrial minerals as functional fillers are being considered. They include:

alumina compounds	magnesite
asbestos	mica
attapulgite clay	nepheline syenite
barite	perlite
bentonite clay	pumice
brucite	pyrophyllite
diatomaceous earth	rock dust
feldspar	silica
gypsum	talc
kaolin	wollastonite
limestone	zeolites

Three reports in this ongoing project have been completed and released prior to fiscal 1990-91 as open file reports. They are:

OFR 89-1 Industrial Minerals in Arizona's Paint Industry

OFR 89-2 Industrial Minerals in Arizona's Wallboard Joint Cement Industry

OFR 89-3 Industrial Minerals in Southern California's Wallboard Joint Cement Industry: A Potential for Mineral Development in Arizona

Data collection from Arizona's cultured marble and cultured granite industry was completed by the end of 1990 and open file report OFR91-6 entitled Industrial Minerals in Arizona's Cultured Marble Industry was published. Curtailments in travel funding prevented continued survey of consumers after December 1990. With the start of fiscal 1991-92 the surveys are again underway.

Even with interrupted progress on the project, contacts made previously had a beneficial impact on a number of Arizona projects, businesses, and developments.

Oxide Copper Deposit Project

The development of the solvent extraction electrowinning (SX-EW) process has resulted in numerous inquiries about copper properties that may have acid soluble ores. This process eliminates the need for smelting by producing high grade cathode copper directly from leach solution.

The economic benefit to Arizona of attracting exploration money to investigate these properties is sufficient to justify a project to collect and publish information about them. If any of several operations result from these investigations the benefit to the state will be multiplied.

A report is being prepared to present a brief description of the process for leaching and recovering copper from the solutions in addition to a listing of the properties.

The working data base is a list of all the occurrences of acid soluble copper as they appear in the Arizona Mineral Industries Location System (AzMILS). Those properties with inadequate resources or questionable reliability must be winnowed from this database to produce a list of properties that have a reasonable probability of being of commercial size and grade. A much shorter list of properties with known reserves will be produced from this list.

THE ARIZONA MINING AND MINERAL MUSEUM

The Arizona Mining and Mineral Museum can be traced back to the first State Fair in 1894 when mineral displays impressed the crowds. It was not until 1917 that the State Legislature appropriated the funds to construct the original museum building. Additional funds to complete the building and construct display cases were provided by the major mining companies of Arizona.

Since 1919 the Museum's collections have been on public display, except during World War II and a few years during the Great Depression. Originally, the collections were on view only during the State Fair. In 1953 the museum became open on a year round, daily basis. In 1973, the Museum became an integral part of the Arizona Department of Mines and Mineral Resources, an agency of State Government.

The 1989-90 State Legislature appropriated funds to relocate the Department and the Museum into the Capital Mall Area. The new Museum is located in the remodeled El Zaribah Shrine auditorium at 1502 West Washington. The mission of the Arizona Mining and Mineral Museum is to demonstrate that mineral resources are the cornerstone of mankind's existence, that minerals are functional, and that minerals are aesthetic.

From July 2, 1985 until June 30, 1990 more than 175,000 visitors from 41 countries and all 50 states passed through the museum. In that same time frame, over 25,000 Arizona students toured the museum. From July 1, 1990 until July 1, 1991, 41,000 visitors from 24 countries, 50 states, District of Columbia, Puerto Rico, and the Canal Zone toured our facility, The Museum also presented programs to over 5,100 Arizona school children. These visitors come from all walks of life. They were the curious, the professional mineralogists, geologists, rockhounds, and Arizona school children. The Museum's visitors represent a cross section of society.

In February of 1991 a Museum Steering Committee was appointed by the Curator. One purpose of the steering committee is to develop a broad base volunteer group. As a result of this effort over 2,100 hours of volunteer time have been logged at the Museum from February until July 1.

Late in 1990 a person who had visited the Museum during the State Fair approached the Museum Curator to volunteer to help. Her expertise lies in computer systems design and programming. As it turned out she was able to convince her company, Computer Task Group, to volunteer time of up to 4 people, to design and program a digital system for the management of the mineral collection. The system includes complete identification of minerals and artifacts. The value of actual billable time used by this totally volunteer crew amounted to approximately $30,000. This was in response to a simple flyer seeking volunteers that was published and distributed by the Museum.

A second major donation was made as a result of an effort made by the Department Director. The Arizona Conference of the Society of Mining Engineers of AIME made a grant of $10,000 to be used to develop and publish a Portfolio of Museum Plans designed to raise large donations that will bring the Museum up to the level of world class exhibits.

A third major donation of $20,000 was made by the Arizona Mineral and Mining Museum Foundation to plan and construct a special gallery in the new museum building to be used to exhibit several valuable mineral collections owned by the Foundation. These collections are on permanent loan to the Museum.

PUBLIC SERVICE PROGRAMS

During the past year, members of the staff of the Department have presented numerous programs about minerals, mining, and the uses of minerals to make civilization possible. They have conducted educational programs outside the offices and museum. Two major field trips to large copper operations were arranged by the staff for a large group of public school teachers involved in continuing education programs. The Director, Museum Curator, and Chief Engineer prepared and conducted a one-day seminar for a group of middle and high school teachers to better educate them on the use of minerals that make everyday living possible.

The Museum staff prepared and installed exhibits of minerals at such places as Wickenburg, Bisbee, Globe, Tucson, Maricopa County Fair, and at the Arizona State Fair in Phoenix.

The Director conducted fund raising efforts that had a yield of $30,000 to the museum during the fiscal year. Major efforts will be conducted in the immediate future to raise large donations to

support the development of the Arizona Mining and Mineral Museum.

The Director is a participating member of the Minerals and Mining Cluster Group working on Arizona Strategic Planning and Development. He is also a member of the Arizona Rivers Assessment Steering Committee, the Advisory Council for the Arizona Commission on the Environment and serves on the Board of Directors of the Arizona Conference of the Society of Mining Engineers. The Director presented testimony on behalf of Arizona during the hearings on HR-918 "The Mineral Exploration and Development Act of 1991" held by the U.S. House Sub-committee on Mining and Natural Resources. This bill would repeal the mining law system that has evolved from the "Mining Law of 1872" and would do serious damage to the ability of the industry to conduct mining on public lands.

All the staff, particularly the Director and the Museum Curator, were deeply involved in the design, construction, renovation and restoration of the El Zaribah Shrine building into new quarters for the Department at 1502 W. Washington.

PUBLICATIONS OF THE DEPARTMENT DURING THE FISCAL YEAR, 1990

Directory 38, Directory of Active Mines in Arizona.

Mineral Report 7, Gold Panning in Arizona.

Special Report 16, The Primary Copper Industry of Arizona, 1989.

Map 91-1, Active Mines Map

Metallogenic Map MM-17, Metallogenic Provinces of Arizona

Open File Report 90-5, Publications of the Department of Mines and Mineral Resources from 1939 to 1990.

Open File Report 91-6, Industrial Minerals in Arizona's Cultured Marble Industry.

Circular 29, Arizona Mining Update.

Circular 30, Arizona Mining Law Change - 1989.

Circular 31, Earth Science Clubs, 1991.

Circular 32, Arizona Gem Shows, 1991 - 92.

Additionally a number of special purpose flyers, handouts, and program notes were created and distributed. These include:

Lecture Guide for Mohave Prospectors' Meeting

A flyer to solicit volunteers

"Minerals in Unexpected Places in Everyday Life" slide show handout

Position paper for the Arizona Council for Social Studies

Position paper on integrating museum experiences into classroom learning

INDUSTRY ACTIVITY

Descriptions of some of the projects and contacts in which the Arizona Department of Mines and Mineral Resources has been involved in fiscal 1990-91 are described below.

INDUSTRIAL MINERALS

Jerry Hoffer, University of Texas
Jerry Hoffer of the University of Texas Geology Department is authoring a report on pumice deposits in Arizona for our publication. The Arizona Department of Mines and Mineral Resources encourages outside authors to write on mineral deposits and related mine and mineral resource development subjects by providing them a vehicle for publication. The use of pumice in the laundry industry has spurred interest in that mineral resource.

Ralston Purina
Ralston Purina is one of the major employers in Flagstaff. They manufacture pet food from mineral, plant, and animal products. Two important mined raw materials for their products are calcium carbonate and sodium chloride. The company is always seeking the best quality and most reasonably priced materials. Both of these products are currently mined in Arizona and additional undeveloped deposits are known to exist in the state. The ADMMR has worked with Purina in seeking local sources of supply of these important minerals. Their purchases of Arizona minerals could amount to over $100,000 annually.

Dave Bellaire - Chemstone
Chemstone mines pumice as well as purchasing additional pumice from another Arizona producer and foreign sources. Chemstone then processes the pumice for abrasive uses in the garment industry. It is used in the garment industry to produce stone washed and stone dyed clothing. Mr. Bellaire has been assisted greatly by the ADMMR in finding new sources of pumice in Arizona to develop. His production in Arizona reduces his reliance on out of state and foreign imports. Further, his development of Arizona deposits has allowed him to expand his business from under $1 million in annual sales to over $12 million.

Dick Wall
Mr. Wall is an inventor and entrepreneur currently involved in two projects with mineral resources. The first is a safety warning device that would use a large quantity of powdered nontoxic minerals as an inert "smoke signal." He is evaluating sources and deposits of calcium carbonate chalk and mica. His second project is to develop a hobby ceramic clay mining and distribution center. He continues to search for and acquire clay deposits. The economic impact of both projects could be up to $1,000,000 annually.

Sierra Stone
Howard Thomas and Lee Chartland of Snowflake have been encouraged to take advantage of the present demand for architectural building stone and picture rock. By prospecting they have located a sandstone deposit, **Sierra Stone**, in Navajo County. They are exploiting this deposit by selling rough and finished material for the southern Utah tourist industry and sawing the same material for interior and exterior facing stone. Rough material can command a price of up to $200 per ton. The Department has assisted by informing them of other stone deposits and reviewing stone samples for them. Successful to date, they are now planning to produce onyx from an inactive quarry in Gila County.

Don Newman - Sculptor
Don Newman is a stone sculptor in Sedona who has recognized the potential for raw materials for his medium that may be available in Arizona. Initially he was looking for a source of alabaster for his own use to avoid purchasing imported material. After learning from the Department that many other sculptors had also contacted us for possible sources and that there were numerous potential deposits of alabaster, marble, serpentine and other "carving stone" in Arizona, he has embarked on developing a business of prospecting for, developing deposits, mining and marketing special use

stone. He has the potential to develop a cottage industry with sales in the range of $100,000 annually.

Richard Saiz - South East Arizona Electrical Cooperative and **Benson Development Board**
Mr. Saiz, as a utility executive and local public official, is involved with business and industrial development for the Benson area of Cochise County. The ADMMR has provided information on mineral deposits in that area that may become the basis for industrial development. Further, we have provided mineral resource information on the area to possible eastern and California manufacturers considering new plant sites and who will need a supply of minerals as raw materials.

Arizona Silica Sand Company
Arizona Silica Sand Company has been actively producing silica sand for specialty uses for many years. Their mines are located in northeast Arizona near the community of Houck. Their primary product is hydrofrac sand used in the crude oil production industry. They had never given diversification much attention. As part of an Arizona Department of Mines and Mineral Resources project to collect industrial mineral consumption information to encourage development of the minerals in Arizona many other industries have been made aware of Arizona Silica Sand's products. They have been receiving inquiries from possible new customers who have been importing minerals into Arizona. They may be able to expand their operation and employment and Arizona manufacturers may have a closer source of silica sand.

Pfizer Minerals
Pfizer Minerals is part of the multinational Pfizer Corporation which ranks 84th on the Fortune 500 list of major U. S. corporations. They are interested in acquiring industrial mineral deposits and operations as part of expanding their market share of supplying speciality minerals to manufacturers. Pfizer has been supplied with mineral market data developed by the ADMMR project to collect industrial mineral consumption information to encourage development of the minerals in Arizona. Further, they have been provided with information on mineral deposits in the state that may fit their needs. An announcement of their acquisition and development of a major industrial mineral operation in Arizona is expected in early Fall of 1991.

Jimmy Vacek - 49ER Minerals
49ER Minerals is a $300,000 a year cottage business based on the mining, processing, and marketing of mineral specimen and specialty pigments. A major portion of his sales are to export markets. Mr. Vacek obtains mineral deposit occurrence information from the engineers of the ADMMR and the Department's database.

Western States Stone
Western States Stone is one of a half dozen building stone producers in Arizona. This firm, along with their competition, is continually searching for new markets and new deposits to quarry. The ADMMR provides technical information on new occurrences and assists owners of possible stone quarry sites in making contact with producers such as Western States Stone. The Department also serves as a source of information to the architectural industry in finding sources of Arizona stone. Arizona has become the flagstone capital of the world, and with the help of the Department the state's dimension stone business is enjoying a period of quality growth.

Automotive Coatings Manufacturing Research Project
A small business concern has developed a new type of auto body coating requiring mica. They began their search for mica by contacting the ADMMR. They were provided information on the availability of processed samples for their initial test work. Their manufacturing process could begin with mica purchased from out of state sources, but they hope to develop a mine in Arizona.

Georgia Marble Acquisition of Andrada Marble
Georgia Marble Incorporated is a major national miner and supplier of crushed and ground marble products. Based on market, mineral deposit, and mineral rights acquisition data obtained from the ADMMR they purchased the long time, small Arizona producer, Andrada Marble. During 1991 they plan a large scale processing plant modernization project and an increase in production capacity

later in the year.

Non Scents
Non Scents is an odor absorption product made from a zeolite mineral called clinoptilolite that is mined in Arizona. It has been aggressively marketed by a Kansas firm throughout North America. The ADMMR receives about three calls a month from firms looking for a source of similar material. One Arizona firm, GSA Resources, mines a similar material for other industrial uses. Since Non Scents' Arizona source is confidential, GSA Resources has been referred by the ADMMR as a possible alternative source and has thus expanded their business into additional markets. Others desiring a deposit of similar mineral have undertaken exploration projects in Arizona to find their own sources.

D P Enterprises
D P Enterprises owns a large dolomite quarry near Peach Springs, Arizona. They are capable of producing large quantities of construction aggregate from the quarry, but construction aggregate is a very low price per ton mineral commodity. The ADMMR has been instrumental in encouraging them to develop higher price markets. Many possible uses and users have been suggested.

Western Rock Products
The management of Western Rock Products has contacted the ADMMR for verification of the rapidly expanding demand for volcanic cinders. They were provided information on current demand, types of materials mined and available to be mined, locations of deposits, and a realistic explanation of apparent, but fictitious, high demand.

RMC Minerals
RMC Minerals has made extensive use of the ADMMR staff's knowledge and data files to find deposits of the mineral brucite. This mineral has important safety uses in high technology equipment and can replace toxic substances currently used. The company is developing a mine near Kingman and processes to put the mineral on the market. The company's activity has caused an interest by major mining companies in other deposits of the same mineral (see Cyprus Industrial Minerals below). RMC Minerals has spent approximately $500,000 on the project in Arizona to date. When complete, the project may provide $2-3 million in annual economic activity in the state.

Cyprus Industrial Minerals
The ADMMR of Mines and Mineral Resources has been contacted by Cyprus Industrial Minerals, a Division of Cyprus Mines for information and suggestions of how and where to find deposits of brucite. They are interested in developing sources of the mineral to take advantage of an innovation developed by RMC Minerals.

Aquarium Decor
Aquarium Decor produces treated, packaged gravel for aquariums using selected natural and crushed gravels. Prior to being contacted by the ADMMR they were importing all of their raw materials into Arizona to their plant at Kingman. The Department provided Aquarium Decor with suggested Arizona sources of acceptable materials. Some were already in production serving other markets, and others were able to develop their deposits because the cumulative demand is now sufficient.

Joint Cement Manufacturer
A major manufacturer of wall board joint cement is interested in establishing a manufacturing plant in southern Arizona to serve the export market to Mexico. To be cost competitive they must have a source of mineral fillers close to their plant. The ADMMR has gathered and disseminated information on deposits of industrial minerals to encourage prospecting and development of deposits that could serve a new joint cement plant in the area.

COPPER PROPERTIES

Interest in copper properties, especially leachable oxide deposits, remained high with the continued strong copper price. Activities by 2 groups who at present are not producers were of special interest.

Westmont Mining

Westmont Mining leased the privately held Carlotta property in Gila County and was later able to lease the adjacent Cactus deposit from Magma Copper. Drilling by Westmont Mining at the **Carlotta and Cactus** properties has resulted in greatly expanded copper oxide resources. The Department's previous resource information was 14 million tons. New figures announced by Westmont total 50 million tons at .5% Cu which at current copper prices has a value of $500 million.

Orcana Resources

After a visit to our office to review copper properties available for acquisition, Ray Mongeau of Orcana Resources pursued several of the leads. One of them, **Sheep Mountain**, had been dropped by a major company during the 1980's recession as uneconomic. Orcana was able to acquire most of the southern Yavapai County property very reasonably. Review of the data on this property reveals that the resource, estimated to be 350 million tons, although deep, might be economically developed if a sufficiently sized supergene chalcocite body exists. Plans for next year are to interest a major partner and to conduct infill drilling.

Arimetco Johnson Camp Mine

At Johnson Camp cathode production from previously mined ore heaps was started upon completion of the solvent extraction electrowinnig plant.

Arimetco Emerald Isle Mine

The Emerald Isle operation was sold to Solo Petroleum contingent on Arimetco building a solvent extraction electrowinnig plant at the property.

Arimetco Van Dyke Property

The Van Dyke property at Miami was purchased and feasibility studies for a modified in-situ leaching/solvent extraction electrowinning operation are being conducted.

South Atlantic Ventures Oracle Ridge Mine

South Atlantic Ventures commenced production at the Oracle Ridge property. The design capacity of 285,000 tons of ore per year is expected to produce 11.3 million pounds of copper, 151,000 oz of silver and 2,200 oz of gold.

This mine, the newest underground copper mine in Arizona has been developed based on past activity that resulted directly from a ADMMR recommendation to an industry geologist in the early 1970's. Over $25,000,000 has been invested in that mine since then. It will now be producing over $15,000,000 in metal yearly.

ASARCO

Asarco continued its $375 million program to become self-sufficient in concentrates to feed its smelters. The program includes a 42% increase in production at the Mission Complex by utilizing the idle Cyprus Pima mill and a 58% increase in production at Ray by building a new mill at the mine site to supplement the production from the Ray mill at Hayden. Also included in the expansion is the resumption of mining and the construction of an solvent extraction electrowinning plant at Silver Bell.

Asarco - Silver Bell Mine

This copper mine has recently acquired new reserves of ore and announced a $54,000,000 expansion investment. Both Asarco and the owners of the reserve they acquired have been encouraged by the ADMMR to evaluate restarting and expanding the mine. Many independent companies were encouraged to try to purchase or joint venture an operation. Spurred in part by such interest,

Asarco decided to do it on their own. Production at this mine which has been $13,000,000 annually will soon increase to $46,000,000.

ASARCO Santa Cruz Project
The in-situ study at the Santa Cruz property in cooperation with the U.S. Bureau of Mines continued. Injection of saline solution to determine the hydrology of the deposit was accomplished and the results are being evaluated. The ADMMR has actively encouraged the development of leachable oxide copper deposits using new technology.

Cyprus Bagdad Copper Mine
Cyprus accomplished a 20% increase in capacity at its Bagdad mill by adding a fifth grinding line. This mine, one of the largest in Arizona, has had a number of major expansion projects in the last 15 years. The most important was when the original Bagdad Copper Company merged with Cyprus who was subsequently owned by AMOCO Oil Co. David Lincoln, Jr. a principal in Bagdad Copper obtained economic mineral resource and copper industry data from the ADMMR to assemble the merger proposal and to counter possible anti trust concerns. This mine produced approximately $350,000,000 in copper, molybdenum, gold, and silver in 1990 and continues to do so. The ADMMR was recently helpful in limiting expansion of wilderness areas that would have had a significant negative impact on the continuation of this mine.

Cyprus Sierrita Mine
Production continued at the Sierrita and the leased Twin Buttes properties. Sulphide ore from Twin Buttes is conveyed by belt to the Sierrita Mill and the oxide ore is treated in the agitation leach/SX-EW plant built by Anamax at Twin Buttes.

This mine was originally financed by a Federal Government (DMEA) loan. Mineral deposit data, economic operating climate data, and deposit historical data to help justify the loan were supplied by the ADMMR. This mine produces approximately $291,000,000 in copper, molybdenum, gold, and silver yearly. It has been in production for over twenty years and will continue to be so.

Cyprus Miami Mine
At Cyprus Miami a project to make Cyprus independent of outside smelting was announced. An increase in capacity from 450,000 tons to 650,000 tons of concentrate per year is scheduled for completion in 1992 at the Miami Smelter.

Cyprus Lakeshore Mine
The refurbished Hecla Lakeshore RLE (Roast-Leach-Electrowin) plant at Cyprus Casa Grande is treating concentrates from other Cyprus properties. The pregnant solution is fed to the solvent extraction plant with the in-situ solutions prior to electrowinning.

Magma San Manuel Mine
At San Manuel the development of the Kalamazoo ore body continued with some production in late 1990. The recovery of solutions from the in-situ leaching was increased by changes in well to well leaching technology. The smelter at San Manuel attained full design capacity production.

Magma Pinto Valley Mine
At Pinto Valley 14 haulage trucks were replaced with larger units to produce additional feed to the concentrator. Mill capacity was expanded in 1989. Operational difficulties are being experienced by the No.2 Tailings leaching project.

This large open pit copper mine acquired ownership of much of the land on which it operates by a land trade with the US Government. The ADMMR provided data to help assemble the environmental impact statement for that trade. We also provided information for multi agency analysis of the impact statement and public information for the support of the land trade. This mine produced approximately $331,000,000 in copper, molybdenum, gold, and silver in 1989 and continues to do so.

Magma Superior Mine
Production at the Superior underground mine was started with an expected production rate of 1500 tons of ore per day by the end of 1991.

Phelps Dodge Morenci Mine
Phelps Dodge completed the relocation of 2.2 miles of U.S. Highway 666 at Morenci as part of the Northwest Extension project. This project includes the expansion of the solvent extraction electrowinning capacity by 90,000 tons per year to 170,000 tons. The "discovery" of the Coronado ore body adjacent to the Northwest Extension of the Morenci orebody was announced. Additional in-pit crushing capacity is being provided to facilitate re-entry in to the Metcalf mine area. The loading and hauling equipment in the pit were upgraded. An additional ball mill was installed at the Morenci concentrator and the flotation cells at the Metcalf concentrator are being replaced by larger units to increase capacity.

This copper mine complex is the 2nd largest in North America. Its sulfide ore concentrate is processed in New Mexico. Silica is required for that treatment. ADMMR continually steers mines producing or capable of producing silica to them. Their engineers and geologists obtain recommendations of sources from the ADMMR. Independent consultants, aware of this need contact the ADMMR for information on prospects that might be developed for silica and copper, gold, and silver. The Morenci Branch produced $608,000,000 in copper from sulfide ore concentrates in 1989.

Phelps Dodge Copper Queen Mine
Phelps Dodge is considering new mine developments in Bisbee. ADMMR has provided positive mining image information to numerous concerned residents of Bisbee who have moved in to the town because of its perceived retirement and artist community status. The plan is projected to cost $90,000,000 and result in an annual production of $129,000,000.

GOLD PROPERTIES

While exploration activity for gold generally slowed during this period, there were many bright spots.

Malartic Hygrade
Malartic Hygrade constructed a new 350 ton per day CIP mill at the **Congress** mine. Capital costs totaled $3.4 million for the mill which began production in October. Operation of the mill adds 20 employees to Congress's staff. During the year the company changed its name to Republic Gold to reflect the importance of its U.S. operations.

Magma Copper Company's new Gold Division
Magma Copper Company's new Gold Division acquired the **Gladstone McCabe** property in Yavapai County near Humboldt. A raise was bored to improve ventilation and provide a second mine exit. The mining method was changed to shrinkage stopes using drawpoint mucking. This method allows for the wet sticky nature of the ore which contributed to the mine's closure in 1989. The milling circuit was also modified to flotation and will produce a bulk sulfide concentrate that will be processed by the company's smelter at San Manuel. This improves recovery efficiency and also allows copper to be recovered. Following these changes, which required a capital investment of $5.6 million, production resumed in the spring of 1991.

Cyprus Gold
During the year Cyprus Gold was quite active reviewing properties in western Arizona hoping to locate one which could ship ore to the company's Copperstone mill located near Quartzsite. For this reason the **Oakland** mine (BVO) located in northern Yuma County was leased and drilled. Although significant reserves exist, it is likely that higher gold prices will be required before development proceeds.

BEMA
The **Yarnell** property was acquired by BEMA through the acquisition of Norgold's stock. Drilling on the property earlier by junior Norgold and ASARCO had identified over 4 million tons grading .055 oz/ton Au. BEMA plans to develop an open pit heap leach operation next year and will be moving the mining crew and equipment from a completed mine near Arco, Idaho.

Fischer Watt Gold and partner, Mining Drilling and Milling
Fischer Watt Gold found a partner, Mining Drilling and Milling of Salt Lake City, Utah to develop the **Mystic** mine in northern Maricopa County. Driving of a decline began in early 1991 and by summer had intersected the mineralized shear. Bulk sampling and development of the deposit continues while metallurgical testing is being conducted. The company is also negotiating to process the ore on a custom basis at Republic Gold's Congress Mill. Reserves are 50,000 tons grading 0.5 oz/ton Au.

Wounded Bull Resources
Wounded Bull Resources continued their evaluation of the **Newsboy** property located in western Maricopa County. A feasibility study has been completed which included metallurgical testing and reserve and resource calculations. Preliminary mine development plans call for capital costs of $5.5 million for a 600,000 ton per year plant. Initial reserves are 1.5 million tons grading .05 oz/ton Au.

Rod Frisby
Pursuing the idea of less recently exploited placer deposits through literature and department information led small miner Rod Frisby to examine the underground deposits of the **La Cholla district** of La Paz county. Recently acquired engineering reports encouraged sampling of a placer tailings pile and underground examination. Encouraged by the tailing samples, a plant was set up during the winter, a well drilled and 20,000 yards of tailing were reprocessed by Mr. Frisby. Following this success he sampled the underground. Recognizing the potential, but also the capital required to mine underground, he notified ADMMR of his situation. Investor/operator Dan Pawlowski had contacted the Department seeking a small gold property to operate. The individuals were introduced and a partnership has been formed. Plans are to drive a decline and begin production this fall.

Boaz Mine
The Boaz mine, historically known as a gold/silver mine, has been idle for a number of years. The deposit consists of a large, relatively high quality quartz vein containing some precious metals. The current owner is investigating the possibility of producing both the industrial mineral silica and precious metals. The information developed by the Department industrial mineral project was instrumental in encouraging the owner to raise $50,000 for completion of a feasibility study on the deposit.

NON-FUEL MINERAL PRODUCTION FOR 1990

Non-fuel minerals produced in Arizona during the year 19909 had a value of $3.1 billion. The chart below shows the quantities of each commodity produced and their relative value.

MINERAL	QUANTITY	VALUE IN $1000
Clay (Short Tons)	204,000	1,930
Copper (Short Tons)	1,087,000	2,696,000
Gem Stones	NA	2,800
Gold (Troy Ounces)	89,000	34,000
Gypsum (Short Tons)	550,000	3,663
Lime (Short Tons)	800,000	36,800
Moly (Pounds)	29,334,000	82,429
Pumice (Short Tons)	10,000	100
Sand & Gravel (Short Tons)	34,000	133,500
Silver (Troy Ounces)	4,212,000	16,848
Stone (Crushed Short Tons)	3,000,000	13,500
Other	NA	100,030
TOTAL		**3,121,600**

Note: Some production numbers are withheld for proprietary reasons; therefore some totals are estimated.

The statistics above do not include the coal mined on the Navajo and Hopi Reservations. Because of federal policy of assigning fuel mineral such as uranium and coal to the Department of Energy instead of the Bureau of Mines, production data is more difficult to obtain. However, coal production in Arizona was approximately 12 million tons in 1990. All of this is produced from the two mining complexes on the Reservations. Depending on markets, the value of the coal mined is approximately $240 million. It is difficult to measure the actual impact on the Arizona economy, but suppliers to the mines and users of the coal make a significant contribution. Most of the coal is used in the two power plants at Page, Arizona and Laughlin, Nevada. The operator also pays approximately $20 million in taxes each year.

Likewise the production of uranium is not included in the table above. During the calendar year of 1990, Energy Fuels Nuclear produced 1,250,000 pounds of uranium with a spot market value of approximately $11.2 million. EFN suspended mining operations in February, 1991 because of the extremely low prices for the product. It is more economically sound to buy uranium on the spot market at less than $10/pound, and meet contractual commitments at prices in excess of $20. Until there is a clear policy established by the Federal Government, the future for the domestic uranium industry is at best bleak. A change in public opinion and understanding about nuclear power is necessary for any real change. Nuclear power is the safest, cleanest and could be the cheapest (without unending layers upon layers of regulations) way to generate electricity. When the public clearly understands this, the country and the environment will reap great benefits.

GOALS OF THE DEPARTMENT

The Department of Mines and Mineral Resources has several goals that are worthy of attention in this report.

Public Education - The public at large in Arizona has little knowledge about the importance of minerals in everyday life. This strange phenomena for the "Mining State" is especially true in the Phoenix Metropolitan area and to a lesser degree in Tucson. Rural communities near mining activity have at least an insight about how important the economic activity of mining is to their lives.

Far more important is the knowledge that the car they drive, the house they live in, the television set they watch, the computer they program, the telephone they talk on and listen to, and even the food they eat would not be available without the minerals that are dug out of the earth and processed into the products that make these things all possible.

By coincidence, the contribution to the economy of Arizona made by all this mining activity is a major factor in our existence.

The Department believes that it is an important goal to disseminate this knowledge to not only the school children of the state, but also to the adult population as well.

It is our goal to expand the education program used in the past with primarily school groups to include upper levels of formal education and adults. The new facility at 1502 West Washington will serve as the anchor for that program.

Promotion of Mineral Development - The Department and the staff believe that the continued development of mineral resources, even the expansion of that effort, is a vital component in the economic recovery and expansion in the State of Arizona.

Through refinement and expansion of the data base of valuable resource information accumulated over the past 50 years by the Department, we believe that the exploration for and development of minerals in the state can be greatly enhanced by use of this data base. Continued research and ultimate publication of reports on a wide range of mineral commodities will add to that base of information. These studies include broad based geologic and economic information to assist the industry in locating and developing mineral deposits. The studies also include market data that enhance the possibility of successful mining ventures.

It is the success of these projects that benefit the state in the form of direct revenue and economic activity.

Museum Development - While the move of the Mining and Mineral Museum along with the Department headquarters to new quarters at 1502 West Washington on the Government Mall will enhance our ability to reach other state agencies, the legislature, the Governor's office and the general public, this is only the beginning of a long range program.

It is the goal of the Department of Mines and Mineral Resources to make the museum a world class exhibit of mining history, mining technology, and a show of the wide range of minerals that occur in Arizona and elsewhere in the world.

To accomplish this the Department has developed a fund raising program designed to reach private sector donors who have an interest in the improvement of knowledge about the world of mineral resources; i.e. where they come from and how they are used. We have established a fund raising goal of $1,250,000 to be used in the design and construction of galleries, exhibits and educational media for the presentation of minerals as a cornerstone of mankind's existence.

With the severe fiscal problems facing state government in Arizona, reaching these goals is going to be difficult. Aside from the fund raising program for museum development, the program is primarily

people dependent. With the reality that state revenues will not be available to budget for adequate full time paid staff to accomplish these tasks, the Department has developed a program to recruit and train an extensive corps of volunteers to fill the need. The beginning of that effort is already reflected in the more than 2,100 hours of volunteer time contributed by a group of dedicated people who have a sincere conviction that the Department goals are more than important, they are vital, to the continued existence of our way of life. The volunteer staff has been primarily focused on the museum, but it has already been expanded into the department engineering and geologic functions. Volunteers are being utilized to help with the refinement and expansion of the mineral resource data base so important to the promotion of the development of mineral resources.

This volunteer program will be expanded and refined as much and as quickly as is possible in order to make the whole department program functional and productive.

As a final editorial comment, it must be understood that the Department of Mines and Mineral Resources cannot function forever with a major portion of its work load being performed by a volunteer staff. Volunteers can always be used and should be, to fill in on special tasks, but full time positions for necessary work should be handled by appropriations by the Legislature at the earliest possible date. It is expected that with the recovery of fiscal balance in state expenditures and revenues, that the necessary full time positions for the engineering staff and the museum will be funded.

ARIZONA AND MINING

Historical Perspective

"Mining is Basic." The slogan is commonly used by a variety of mining interests to promote the industry and to educate the public on how mining and its products effect everyone. There is nothing that is used by the human race that does not incorporate some product of the mining industry. Agriculture, automobiles, building construction, paint, computers, televisions, radio, paper products, aircraft, communications and everything else used by man has somewhere in its make-up at least one substance that was taken from the earth. This has been true since the beginning of man.

In Arizona, mining has been an important factor from the time of the early miners among the various Indian tribes. The ancient people used clays for pottery, pigments for decoration of their bodies and shelters, chert and flint for their tools and weapons, and turquoise, silver and gold for jewelry. Mining was crude and was done on a small scale, but it is still an example of how even the most primitive cultures were dependent on mining.

The primary reason for exploration of this part of the New World by the Spaniards was to find the treasures of gold and silver the natives had accumulated. As the missionaries established the settlements of Southern Arizona, mining became a part of the developing civilization.

Mining in Arizona lay dormant from the period of the Mexican Revolution for independence from Spain (1810-1812) until after the U.S.-Mexican wars and the Gadsden Purchase. With a slowdown during the Civil War years excluded, mining activity has been an important part of the Territory and State ever since. The first Territorial Governor believed minerals were the most important factor in being able to establish a civilized society in Arizona. Minerals are equally important to the maintenance of civilization.

From the end of the Civil War to the beginning of World War II, as many as several hundred mines operated and produced copper, gold, silver, and other metals. The value of these mines to the new state in terms of jobs, commerce, revenue, and money into the economy are almost incalculable. Without this effort, it is difficult to envision what Arizona would have become.

Following World War II, the copper mining industry was renewed to higher than ever levels by the onset of several large open pit mining operations that now span the State from the southeast to the northwest. With several cycles of boom and bust, improved technology and new efficiencies developed by company-wide restructuring, the copper industry had come full circle by 1987, and is now competitive with the rest of the world. Production and revenue have not yet reached the peak years of 1979-82, but after the low point in 1986 it is on a positive climb. Copper prices have remained strong through the spring of 1991 and are expected to remain that way for the immediate future. World supplies of copper are still not in abundance. A variety of problems, political and technical, continue to impede production from several large projects around the world.

THE FUTURE OF MINING

Predicting the future is a risky endeavor particularly when it comes to mining. This is especially true in those items when the decisions on whether to explore and develop new mines is so heavily influenced by factors not related to mining or marketing of mine products. The boom and bust cycles of the past were largely a result of availability and markets.

Mining in the United States and in Arizona has become a very complex business influenced as much by environmental controls and land use planning as by prices and markets. While the mining industry has solved most of the environmental problems, the availability of new land for the exploration of minerals is questionable. Interference by the "environmental radicals" is still very strong in spite of the excellent record of improved environmental mitigation and remediation by the industry.

With the combined lands encompassed by the National Forests, the National Parks, BLM managed public lands, Wildlife Reserves, Indian Reservations, and land withdrawn for military use, the Federal government controls 69% of all the lands in the State of Arizona. Lands already withdrawn from potential mineral exploration for all intents and purposes include the Military and Indian Reservations, the National Parks, the Wildlife Reserves, and 5,500,000 acres already in the National Wilderness Preservation System.

How much is enough? It is certain that otherwise exploitable, valuable mineral deposits are located within these withdrawn areas. It is equally certain that wilderness advocates will demand more land.

The only sensible solution is to take the time necessary to do a thorough evaluation of mineral potential and carve out those areas that have high potential. These, along with access and other rights, should be excluded from any wilderness designation. Areas already designated as wilderness should be opened up to that evaluation process.

The availability of lands with potential for mineral deposits is under severe threat by the wilderness status. With proper regulation and management of these lands, all interests can be served. The permitting process can require necessary environmental protection of areas that are ultimately developed for their mineral resources. If, in fact there are areas that have unique, natural and pristine values as defined in the 1964 Wilderness Act, they should be set aside and given thorough evaluation on an individual basis. The wholesale designation of large acreages as wilderness without consideration of other resources and uses should not be allowed. It is informative to note that throughout history, approximately 190,000 acres of Arizona land have been affected by mining. This compares to 5.5 million acres removed from public access by wilderness designation.

Legislation to modify or outright repeal and replace the 1872 Mining Law has been introduced in both houses of Congress. Legislation may move forward during the current session. The threat to the mining industry is imminent. Regardless of the attack by various "environmental entities" and their supporters in Congress,the body of law that has evolved over the past 119 years, and is commonly called the "1872 Mining Law" has served the industry and the nation well. It continues to allow a safe, environmentally sound development of mineral resources that are sorely needed to maintain the living standard the country desires and to fill the strategic needs of the Nation. Revision of the law should be done only after careful consideration, and when it can be clearly shown the result will be better for the Nation.

The EPA has been trying for more than three years to develop rules and regulations to manage mined waste under subtitle D of the Resource Conservation and Recovery Act (RCRA). A task force group formed by the Western Governors Association has been working with EPA trying to keep regulations reasonable, and to keep control at the state level. While even the task force proposals would be damaging to the economics of mining projects and would destroy the small miners ability to operate, the "Strawman II" proposals by the EPA are worse. The primary problem is that it would not consider the different parts of the country in the writing of rules and regulations. The

states that have mining interests must resist this federal encroachment if mining is to remain viable.

It would be a tragedy beyond reason if the mining industry of the United States were forced to move to Mexico and other 3rd World countries. Land use planning, environmental regulation, withdrawal of federal lands from mineral entry, and radical changes in mining law are coming together to make America a nation dependent on and at the mercy of imported natural resources.