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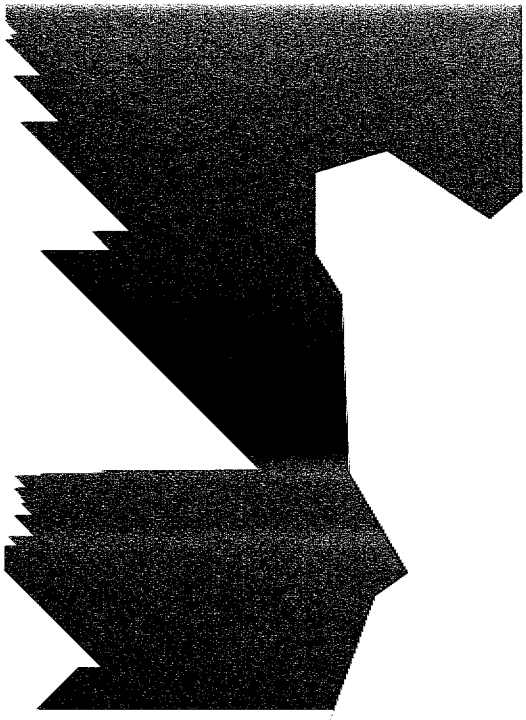
Bill Kurtz

THIS IS COPPER COUNTRY

THIS IS COPPER COUNTRY

Facts about Arizona's copper mining industry.

Prepared by
the Arizona Mining Association
Phoenix, Arizona



This represents 1% of the State's land surface area.

This represents the 0.14% occupied by mining.

	Acres
Arizona total land area	72,688,000
Total devoted to mining (1930-1971)	102,000*

Source: U.S. Bureau of Mines

*Approximately 0.14% (one-seventh of one per cent) of Arizona's land surface is occupied by mines, mills, smelters, waste disposal areas, roads, etc.

Introduction.

We hope, in this booklet, to give you some highlights of the copper industry of Arizona. We want you to have more factual information, as well as pride, in our State's role in supplying over half this nation's newly mined copper. The significance of mineral shortages upon the American "way of life" is seldom appreciated until we face a crisis such as we are experiencing in fuels.

Our national leadership is becoming increasingly concerned with shortages of metals, fuels and industrial minerals. Thanks to Arizona, one of the most critical of these, copper, is not now as serious a problem.

As you read this booklet and appraise copper's impact upon Arizona, we hope you will make your personal evaluation upon facts rather than emotion. Certainly this industry has environmental, economic and social impacts! It has become increasingly controversial as population pressures have grown. A perfect balancing of all these factors is probably impossible, but objective compromise following a thoughtful weighing of facts can afford workable solutions.

We have assembled the information in this booklet from what we believe to be competent sources. Should you have a question or need more specific information, please feel free to write or telephone our office.

Sincerely,

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Producing over half of the nation's newly mined copper.

Arizona is copper country. There are 23 open pit mines and seven underground mines being operated or developed by members of the Arizona Mining Association.

From these operations in 1974 came 842,300 tons or 53% of the nation's newly mined copper, more than all other states in the U.S. combined, and more than any other country in the free world.

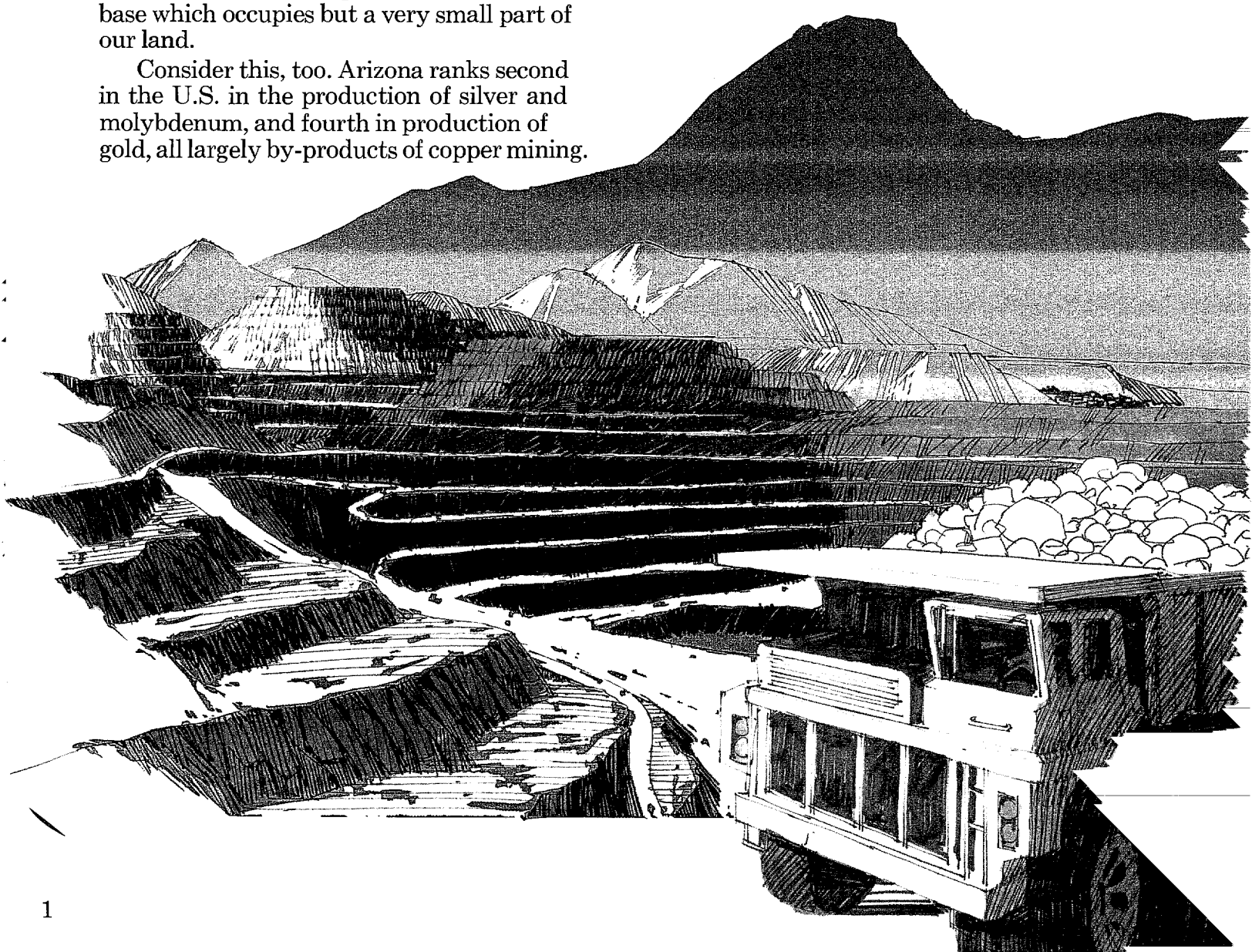
And it all comes from the use of less than 102,000 acres, or about one-seventh of one per cent of Arizona's land surface. What this means to every Arizonan is that much of our whole economy rests upon a small mineral base which occupies but a very small part of our land.

Consider this, too. Arizona ranks second in the U.S. in the production of silver and molybdenum, and fourth in production of gold, all largely by-products of copper mining.

A man-made wonder.

Today's typical large copper mine in Arizona is just as much an engineering marvel as the Golden Gate Bridge, the towering World Trade Center building, a nuclear submarine, or any other man-made wonder.

Developing a modern mine requires the highest degree of technological and engineering skills, vast amounts of manpower and capital — and something else. It takes plain old-fashioned ingenuity to win over half the nation's newly mined copper from Arizona's low grade ores. This is an achievement of which all Arizonans may well be proud.



Moving two tons of rock to get one ton of ore.

Arizona copper mining has come a long way since the early years of this century, when ores containing 5% to 10% copper were not uncommon. Currently, the grade of ore being worked in all Arizona mines averages approximately 0.6% copper.

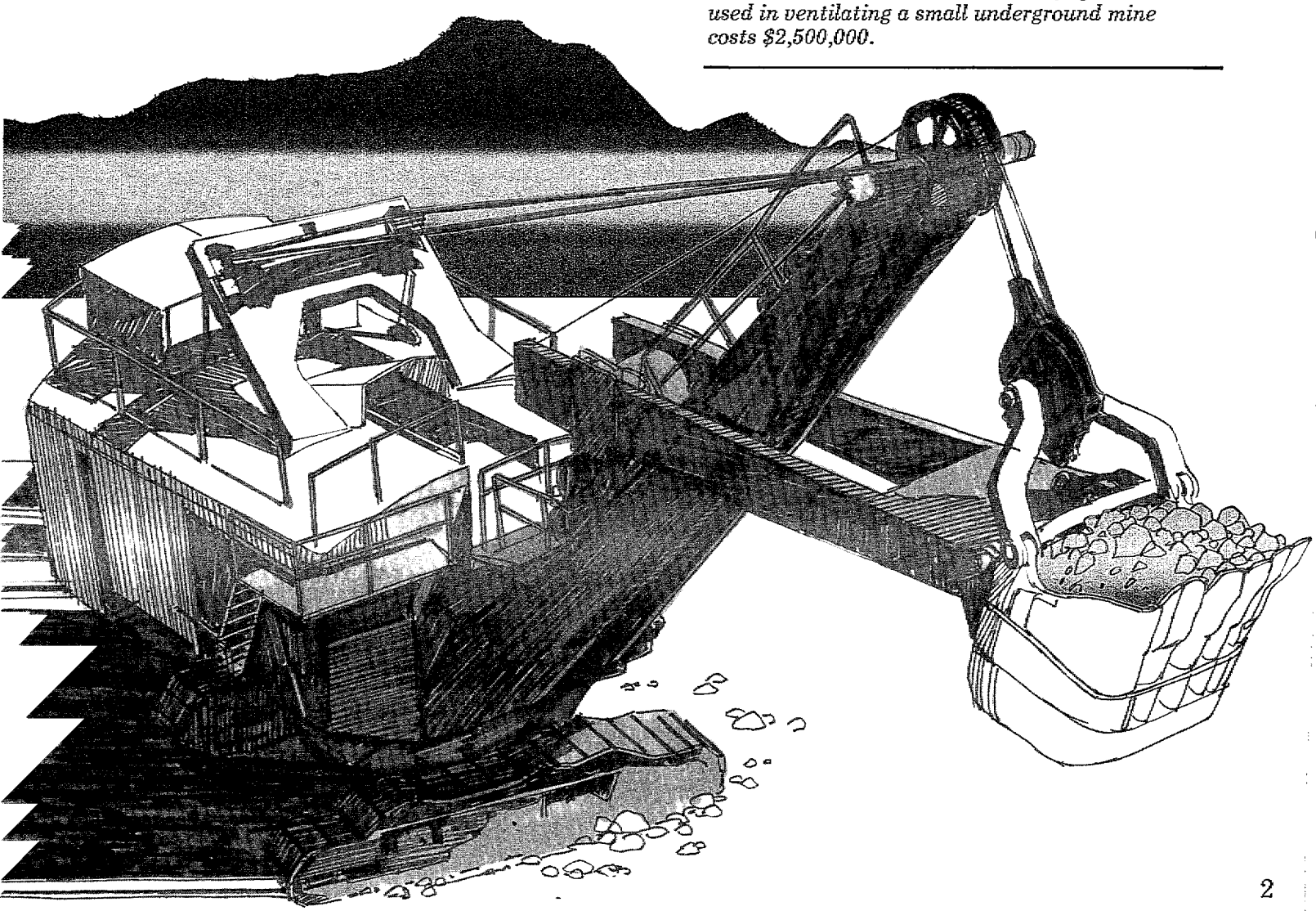
Mining today in Arizona is a high volume operation in terms of tonnages handled, with a low yield in terms of copper content. The average ratio is two tons of waste rock for every ton of ore. This means moving some 6,000 pounds of material to get 10 pounds of copper out of the 12 pounds contained. (100% recovery is not possible.)

Modern technology and equipment make the mining of these lower grade ores feasible.

Underground mining is ordinarily a costlier method. To successfully compete with open pit copper mines, the amount of mineable copper mineral must be significantly greater or the ore body must be of such size and nature to permit block caving, a more economical underground mining method.

Modern equipment carries modern price tags.

Just one huge 20-cubic-yard capacity electric shovel used in an Arizona open pit mine carries a price tag of $1,000,000. A 150-ton capacity ore haulage truck costs about $400,000. A set of tires on these trucks costs around $36,000 and lasts about three months. A 6,000-ton refrigeration unit used in ventilating a small underground mine costs $2,500,000.



The industry's most valuable asset —human resources.

The Arizona copper industry's greatest single asset is its people, the men and women who make it all happen. The truck drivers, stenographers, timbermen. The drill operators, matte tappers, bank spray attendants. The shovel operators, hoistmen, accountants. The converter punchers, slag skimmers, scalers. The geologists, engineers, metallurgists and agronomists.

Safeguarding their health, safety and security is an overriding obligation. Arizona's copper mining firms are successfully meeting that obligation with investments in programs, equipment and benefits beyond wages and salaries paid.

Benefits: Nearly $1,700 a year per employee.

Employee fringe benefits in 1973 amounted to $44,020,043, averaging slightly over $1,667 for every man and woman in Arizona's copper mining industry. This includes group insurance, retirement plan contributions, profit sharing and various other benefits.

Community hospitals in mining areas received over $7,000,000 in 1973 from Arizona copper companies to hold down costs to individual patients — company employees as well as non-mining residents. In most mining communities, recreational facilities also are provided for the benefit of all its residents.

Health and safety go hand in hand. And Arizona's copper mining industry works constantly toward improved working conditions.

Work habits are thoroughly analyzed and evaluated. Measures and methods designed to minimize hazards are adopted. Safety programs emphasize the necessity of rigid adherence to safety rules on the job. Today, every mine worker receives safety training each month and results are encouraging.

For instance, one large Arizona copper mining company reports that its frequency of lost-time accidents has dropped from 40.94 per million man-hours of work in 1952 to an average of only 2.49 in 1973. The national frequency rate at open pit mines averages around 9.24 per million man-hours of work, according to a 1971 National Safety Council report.

Obviously, where safety is concerned, "good" is never good enough. There is always room for improvement. And Arizona's copper producers are dedicated to improving the record through intensified safety programs.

What's being done to protect the environment.

Arizona's copper producers have a responsibility to minimize the effects of their operations on the environment.

They accept that responsibility and are putting environmental protection measures into practice at mine sites all over the State as rapidly as time, money and technology permit.

Commitment to meeting air quality standards.

Long before any laws or regulations were passed in regard to controlling smelter smoke, Arizona's copper producers were working individually and together, trying to develop the missing technology. There still are some gaps. No two smelters are alike and, for some, there just isn't any way known today to solve the whole problem of smoke control.

Today, time limitations of increasingly stringent Federal and State clean air standards are, in some cases, forcing large capital commitments in systems which have not been fully proven.

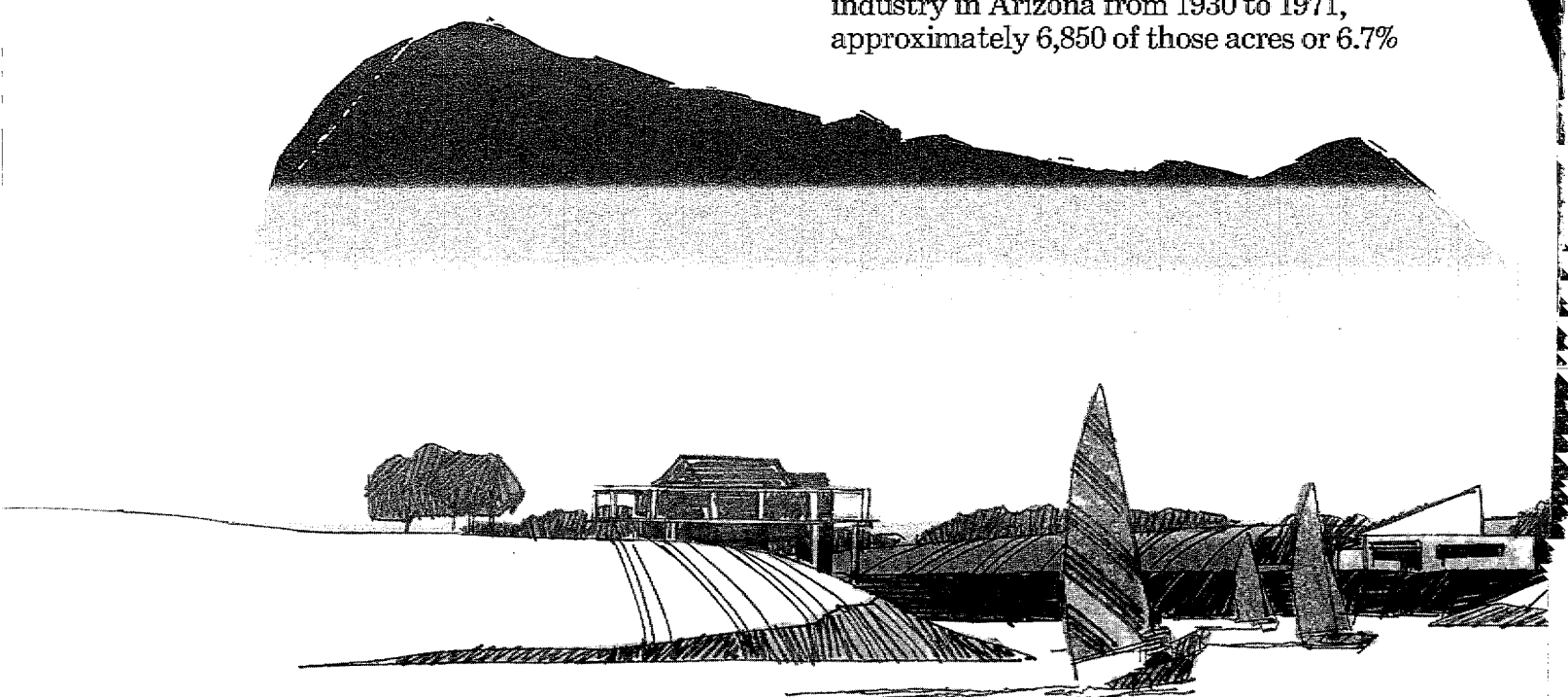
However, much progress has been made. From 1964 to 1974, Arizona copper producers have spent about $400 million on smelter emission controls to meet Federal and State regulations. The copper industry in the past three years has given the University of Arizona over a half million dollars to establish an Atmospheric Analysis Laboratory to study air quality in the State — and another hundred thousand in 1974 to keep the program going. The industry also is contributing to the University of Arizona's College of Agriculture to study possible beneficial uses of sulfuric acid in agriculture.

Overall, a reasonable balance between environmental goals, technical capabilities and economic realities is essential to preserve and improve the quality of air in Arizona. And the copper industry is working to do its full share to achieve that balance.

Water reused; land reclaimed.

Water is essential in the production of copper. It takes about a ton of water to process a ton of ore. And the industry makes the most of that water. Arizona's copper producers reclaim and recycle the water used in their mills. What is meant by recycling? The same water is reused as many as eight and a half times before it finally evaporates!

Of the 102,000 acres used by the minerals industry in Arizona from 1930 to 1971, approximately 6,850 of those acres or 6.7%



of the land has been reclaimed according to U.S. Bureau of Mines statistics. The Bureau also reports that rate of reclamation increased to 10% in 1971 as new practices for reclaimed waste piles have been put in use.

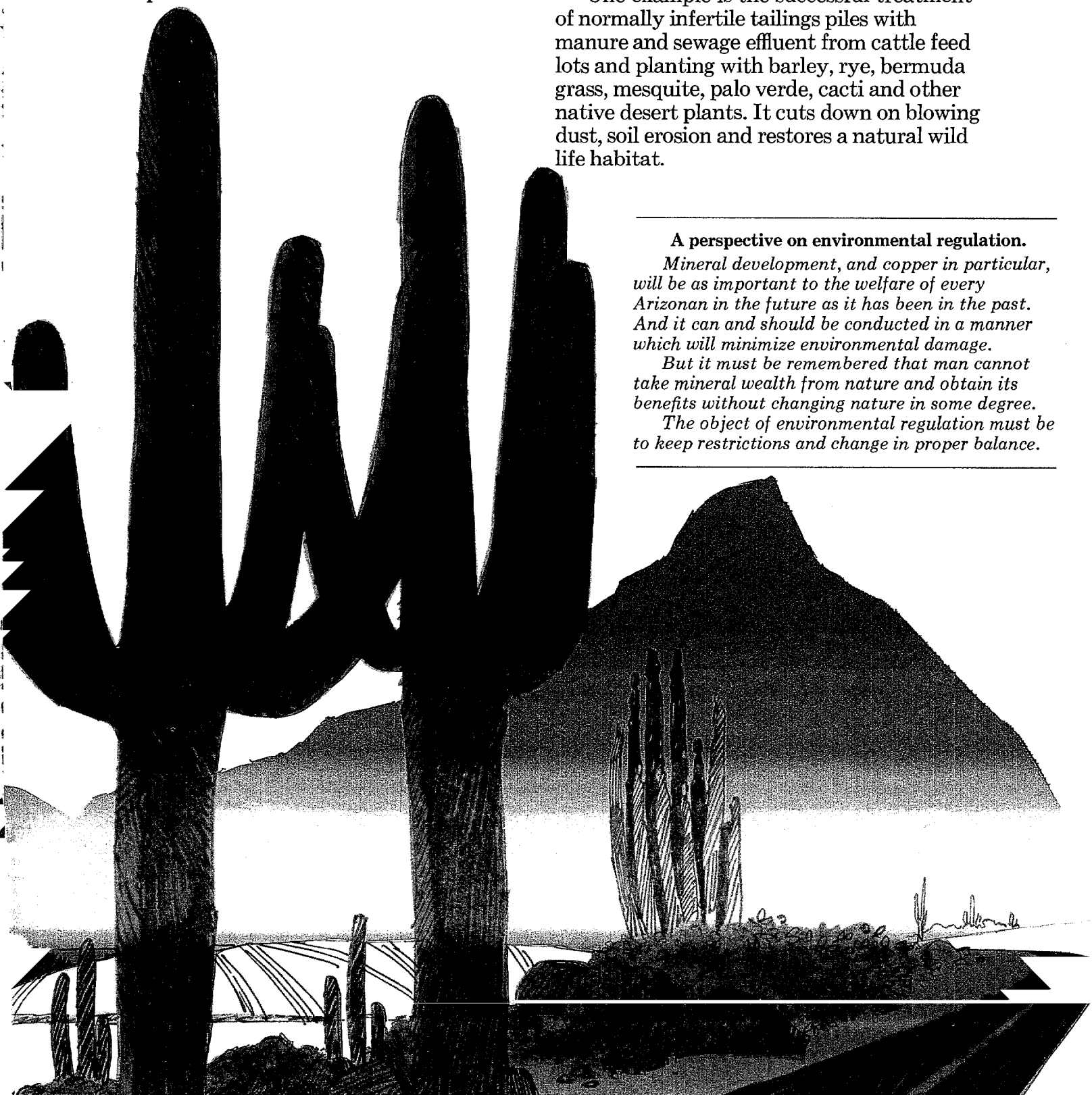
One example is the successful treatment of normally infertile tailings piles with manure and sewage effluent from cattle feed lots and planting with barley, rye, bermuda grass, mesquite, palo verde, cacti and other native desert plants. It cuts down on blowing dust, soil erosion and restores a natural wild life habitat.

A perspective on environmental regulation.

Mineral development, and copper in particular, will be as important to the welfare of every Arizonan in the future as it has been in the past. And it can and should be conducted in a manner which will minimize environmental damage.

But it must be remembered that man cannot take mineral wealth from nature and obtain its benefits without changing nature in some degree.

The object of environmental regulation must be to keep restrictions and change in proper balance.



Why copper is important to every Arizonan.

The earth is the only source of new wealth. It provides those raw materials — minerals, food, fiber — that are the basis for all industry.

Directly and indirectly, the combined impact of Arizona's copper mining industry on the State's economy averaged more than $3.1 billion annually from 1970 to 1972, in the form of personal, business and government income.*

The basic industries making the major contributions to Arizona income are manufacturing, mining, agriculture, tourism and travel.

Major Sources of Arizona Income (Basic Industries) — 1973

Manufacturing Output (value added)	$2,160,000,000
Mining Output	1,304,988,000
Agricultural Income (crops and livestock)	1,097,793,000
Tourism and Travel	690,000,000

Source: Valley National Bank

Statewide: One out of every eight jobs.*

There were more than 26,400 workers employed directly in the search for and production of copper in Arizona in 1973. They comprised about 3% of Arizona's average total employment — and approximately 12% of the State's basic employment. Many thousands of people in other Arizona industries also have their jobs because of copper.

The copper industry thereby accounts directly and indirectly for approximately one out of every eight jobs in the State. About one-third of the State's copper workers live in the Tucson metropolitan area, where approximately one out of every four jobs is directly or indirectly linked to copper.

Personal income: One out of every eight dollars.*

From 1970 to 1972, the copper industry was directly responsible for an annual average of $227.6 million in personal income to Arizonans — and over $301 million in 1973. The more than $300 million represented a 25% increase over 1972.

These payments were in the form of wages, salaries, pensions, other benefits and dividends. And they represented approximately 12%, or one out of every eight dollars, of basic personal income in the State.

In the Tucson area, copper production accounted for one out of every six dollars of personal income.

As those dollars recirculate through the State's economy, the combined direct and indirect impact in personal income is estimated at over $852 million annually to Arizona residents.

Impact on other Arizona businesses.*

Arizona's copper industry purchases more than 70% of all goods and services from business firms within the State. This meant nearly $687 million in income to other Arizona businesses over a three-year period from 1970 to 1972, averaging over $228.9 million annually.

About $88 million a year went to wholesale firms supplying automotive and other equipment and parts. Arizona's manufacturing firms received nearly $34 million a year. Contract construction firms gained more than $44 million yearly, while the State's electric, gas and telephone utilities sold upwards of $41 million worth of energy and service a year to copper producers.

The State's transportation industry received around $14 million annually; retailers picked up around $4 million a year; and service industries benefited by nearly $3 million a year from Arizona's copper mining industry.

Overall, about $85 million annually in purchases went to Pima County businesses, around $82 million a year to firms in Maricopa County, with remaining substantial amounts spread across other

areas of the State.

Again, by the time recirculation takes place, Arizona's copper industry is directly and indirectly responsible for more than $2.0 billion in annual business income.

One out of every four tax dollars from copper.*

State and local government revenues generated by Arizona's copper mining industry go a long way in helping lighten the individual's tax burden.

For example, from 1970 to 1972, the Arizona copper industry paid an average of approximately $65.8 million each year to support State, county, municipal, community college, elementary and high school district, and miscellaneous improvement district governments in the State.

In 1973, the total was in excess of $82 million, paid through property taxes, severance taxes, the corporate income tax, payroll taxes, sales taxes on Arizona purchases and other taxes, royalties and fees.

The combined recirculation effect of direct and indirect tax revenues generated is estimated at more than $254 million annually, or one out of every four dollars in taxes paid to State and local government in Arizona during the period from 1970 to 1972.

Revenues from the copper industry's direct tax payments are applied state-wide. While a major beneficiary is the State government, every county, municipality and school district in the State also benefits from the industry's tax payments.

*Source: Arizona Economic Information Center

Out of every dollar, 62¢ stays in Arizona. **

Arizona is the main beneficiary of its copper mining activities. Out of every dollar's worth of copper mined in Arizona, an estimated 62¢ stays in the State in the form of payrolls, taxes, purchases, dividends and permanent facilities. Historically, dollars from copper have built towns, schools, hospitals, libraries and roads, opening up many areas of the State.

Definitely, copper mining is an Arizona business, of which we can all be proud!

*** In addition to the personal, business, State and local government income figures reported here for 1970-72, another $323.9 million annually went for Federal taxes, out-of-state suppliers of goods and services, out-of-state wages and salaries, debt service and profits.*

Total state and local government revenues provided by the Arizona copper industry, 1970-1973.

Type of Revenue	Amount Paid 1970-1972 Annual Average	Amount Paid 1973
Property Taxes	$31,746,666	$34,998,000
Severance Taxes		
Privilege Sales Tax	8,526,666	10,963,000
Education Excise Tax	4,263,333	5,481,500
Special Excise Tax	4,263,333	5,481,500
Corporate Income Tax	4,469,333	5,901,000
Payroll Taxes		
Unemployment Compensation	1,553,333	1,466,000
Workmen's Compensation	3,431,333	5,041,000
Miscellaneous Taxes[a]	4,819,333	7,596,000
Land Rentals and Royalties	2,704,600	5,100,000
Total	$65,777,930	$82,028,000

[a]Includes sales taxes paid on Arizona purchases as well as motor vehicle licenses and fees.

Source: Arizona Economic Information Center

Arizona state government revenues provided by the copper industry, 1970-1973.

Source of Revenue	Amount of Revenue	
	1970-1972 Annual Average	1973
State Property Tax	$ 8,023,104	$ 4,455,967[a]
Severance Taxes		
Privilege Sales Tax	3,530,040[b]	4,538,682[b]
Education Excise Tax	c	c
Special Excise Tax	c	c
Corporate Income Tax	4,469,333	5,159,925[b]
Payroll Taxes		
Unemployment Compensation	1,553,333	1,466,000
Workmen's Compensation	3,431,333	5,041,000
Sales Taxes on Purchases		
Privilege Excise Tax	645,150	1,023,960
Education Excise Tax	c	c
Special Excise Tax	c	c
Motor Vehicle Taxes and Fees	144,000	176,000
Land Rentals and Royalties	2,704,600	5,100,000
Total	$24,500,893	$26,961,534

[a]The decline in State property tax in 1973 resulted from a decrease in the State property tax rate to 75¢ per $100 of assessed valuation from the $1.55 rate levied in 1972. The rate was raised again in 1974 to $1.50.

[b]Excludes amounts shared with county and municipal governments.

[c]Although paid directly to the State general fund, it is assumed that all educational excise taxes are in fact redistributed to the school districts.

Source: Arizona Economic Information Center

County government revenues provided by the Arizona copper industry, 1970-1973.

County	Amount of Revenue[a]	
	1970-1972 Annual Average	1973
Pima	$ 7,820,808	$ 9,818,421
Pinal	2,092,936	2,357,072
Maricopa	1,782,383	2,363,571
Gila	1,512,685	1,933,721
Cochise	481,711	515,694
Mohave	358,257	273,238
Yavapai	263,131	293,843
Coconino	127,241	164,517
Yuma	100,435	125,710
Graham	69,030	38,585
Navajo	66,314	89,849
Santa Cruz	27,109	33,949
Greenlee	24,736	269,536
Apache	24,432	32,225
Total	$14,751,208	$18,309,931

[a] Contributed directly through the property tax and the automatic apportionment of privilege excise taxes collected by the State.

Source: Arizona Economic Information Center

Municipal government revenues provided by the Arizona copper industry, 1970-1973.

Municipality	Amount of Revenue[a]	
	1970-1972 Annual Average	1973
Phoenix	$1,070,598	$1,741,048
Tucson	501,174	815,027
Mesa	143,615	196,808
Scottsdale	123,454	201,851
Tempe	117,162	190,535
Glendale	66,309	107,834
Yuma	53,072	86,309
Flagstaff	47,803	77,740
Prescott	24,028	39,074
Paradise Valley	13,085	21,279
South Tucson	11,371	18,492
All others	526,679	721,145
Total	$2,698,350	$4,217,142

[a]Contributed directly through the property tax and the automatic apportionment of privilege excise taxes and corporate income taxes collected by the State.

Source: Arizona Economic Information Center

School district revenues provided by the Arizona copper industry, 1970-1973.

School District	Amount of Revenue[a] 1970-1972 Annual Average	1973
Sahuarita Combined[b]	$ 2,092,755	$ 2,455,077
Tucson No. 1 Combined	1,603,333	2,052,188
Morenci Combined	1,240,577	1,273,037
Miami Combined	1,233,991	1,510,189
Mammoth Combined	1,084,185	1,838,539
Ray Combined	934,255	1,100,783
Scottsdale Combined	747,523	957,603
Marana Combined	727,024	881,186
Phoenix Union High School	710,264	885,055
Ajo Combined	621,445	873,261
Bisbee Combined	597,168	753,974
Mesa Combined	576,362	879,486
Washington Elementary	543,749	818,552
Hayden-Winkelman Combined	442,334	762,422
Tempe Combined	401,707	578,316
Bagdad Combined	339,409	468,432
Cartwright Elementary	306,228	417,947
Glendale Union High School	306,198	452,471
Douglas Combined	296,502	266,139
All other school districts	6,618,689	9,844,383
Total	$21,423,698	$29,069,040

[a] Provided directly through the property tax and indirectly through the apportionment of educational excise taxes.

[b] Combined high school and elementary school districts.

Source: Arizona Economic Information Center

Copper supply and demand: A critical need to find more.

There are two sides to our nation's copper supply and demand situation.

On the brighter side, the U.S. approaches self sufficiency insofar as copper requirements are concerned — a position which, given copper's importance to the economy as an essential raw material, warrants maintaining. However, it has been necessary during the past 10 years to import an average of about 9% of our copper to meet national needs.

Looking into the future, projections of increased domestic copper requirements indicate that, if our country is to maintain a high degree of self sufficiency, domestic mine production must increase on the order of 85% by 1985, and nearly 200% by the year 2000. This means our nation should be putting into production one fair to medium size copper mine every year just to keep up with growing needs. It is not being done. One reason it's not being done is the increasing denial of access to public lands which must be prospected to find the ore bodies of tomorrow.

The energy crisis pales by comparison.

Our country is suffering the consequences of its failure to maintain adequate domestic fuel production. Yet, a metals shortage, if permitted to develop, could make the energy crisis seem mild by comparison.

In a 1972 report, the U.S. Secretary of the Interior flatly predicts that our nation will need to import 34% of its domestic copper requirements by 1984 and 56% by the year 2000.

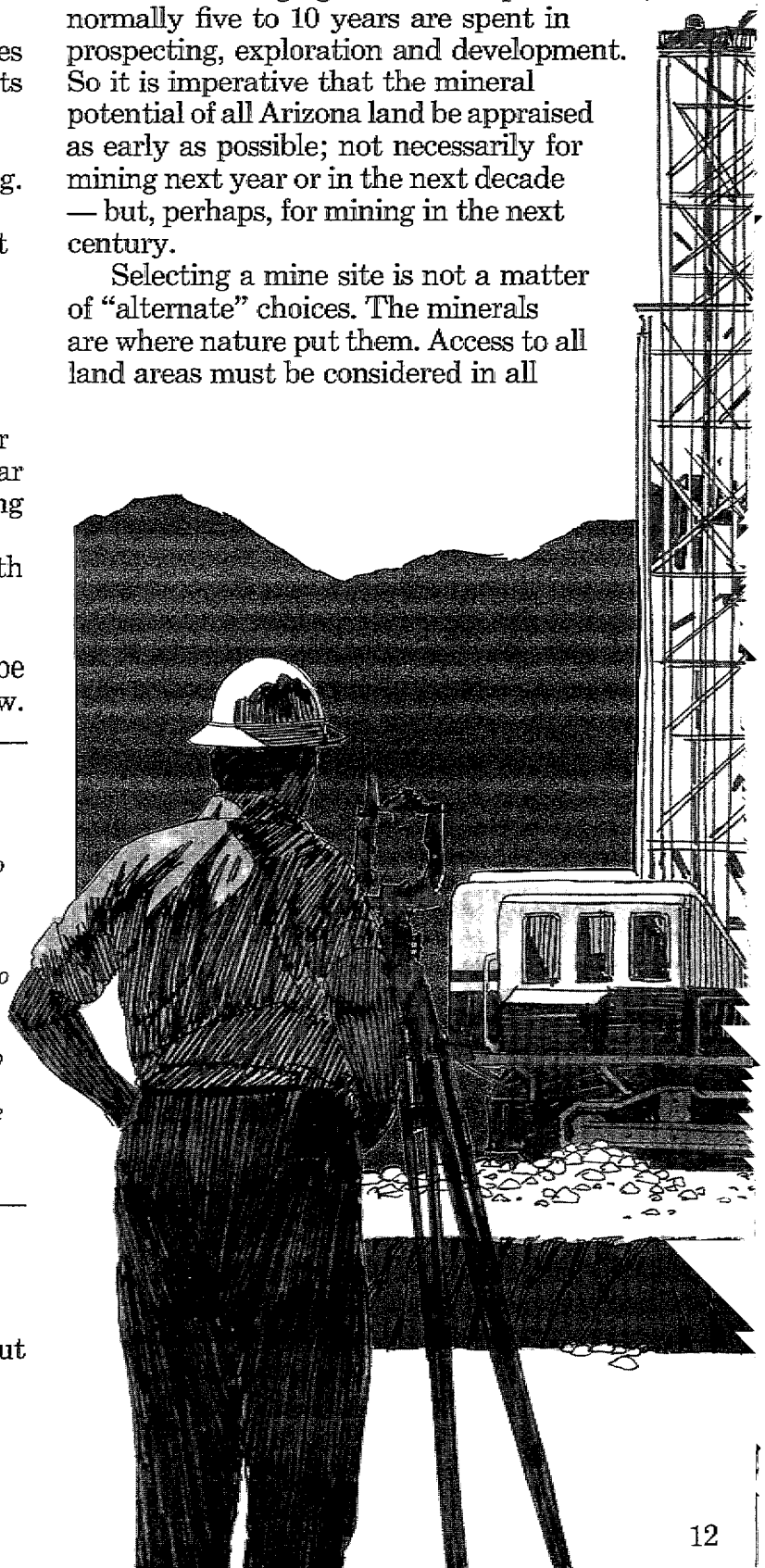
Unless new mine development narrows the gap between domestic copper supply and demand, the long-range effects of such a metals shortage on the economy and national security of a metals-based culture such as ours could be staggering.

There are no quick, easy solutions.

In supplying over half of the nation's newly mined copper, Arizona has a major responsibility in meeting national needs. But bringing in a new copper mine takes mineable ore bodies, money and time.

Prior to bringing a mine into production, normally five to 10 years are spent in prospecting, exploration and development. So it is imperative that the mineral potential of all Arizona land be appraised as early as possible; not necessarily for mining next year or in the next decade — but, perhaps, for mining in the next century.

Selecting a mine site is not a matter of "alternate" choices. The minerals are where nature put them. Access to all land areas must be considered in all



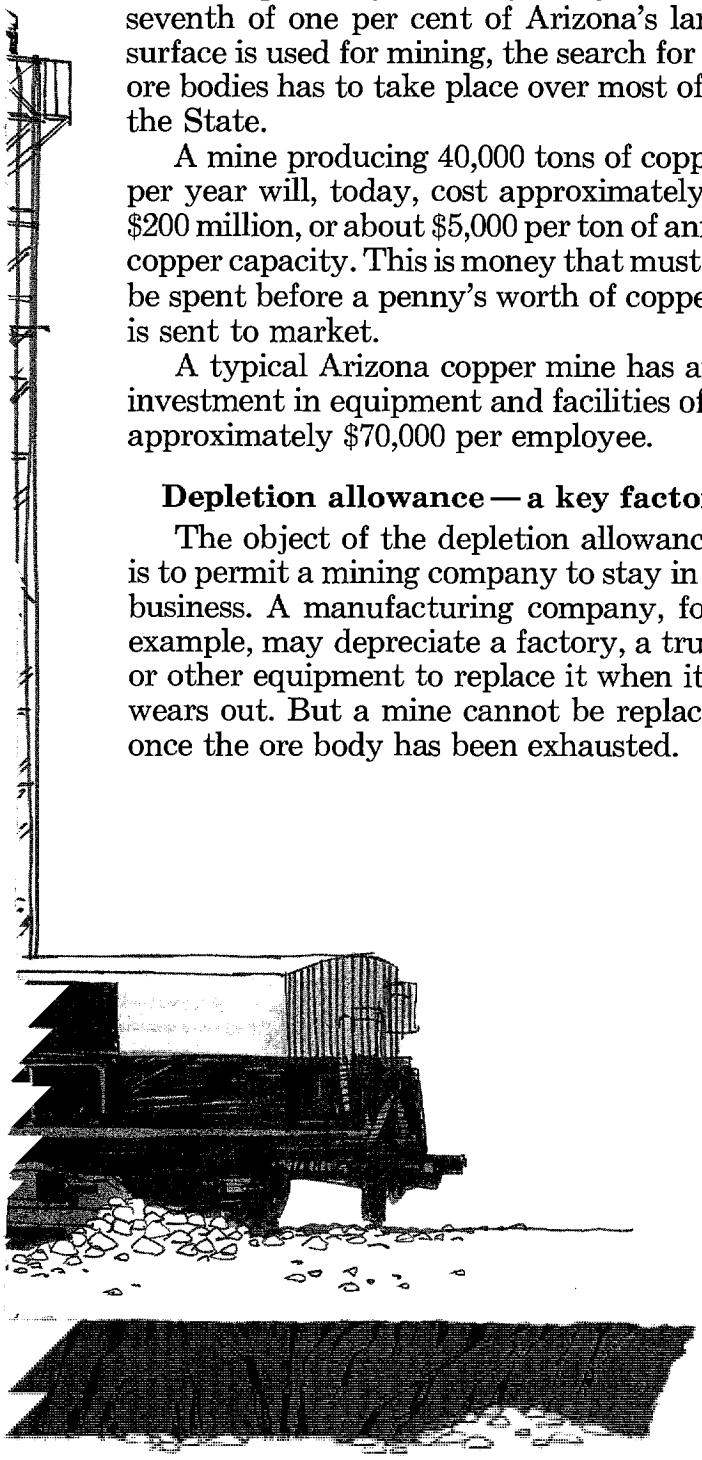
land use planning. Although only one-seventh of one per cent of Arizona's land surface is used for mining, the search for new ore bodies has to take place over most of the State.

A mine producing 40,000 tons of copper per year will, today, cost approximately $200 million, or about $5,000 per ton of annual copper capacity. This is money that must be spent before a penny's worth of copper is sent to market.

A typical Arizona copper mine has an investment in equipment and facilities of approximately $70,000 per employee.

Depletion allowance — a key factor.

The object of the depletion allowance is to permit a mining company to stay in business. A manufacturing company, for example, may depreciate a factory, a truck or other equipment to replace it when it wears out. But a mine cannot be replaced once the ore body has been exhausted.



Therefore, the law allows a certain percentage of the value of that mine's production to be set aside to find a new ore body. In this way, a mining company hopefully finds and develops a new ore body as the old one is being mined, so that it may stay in business.

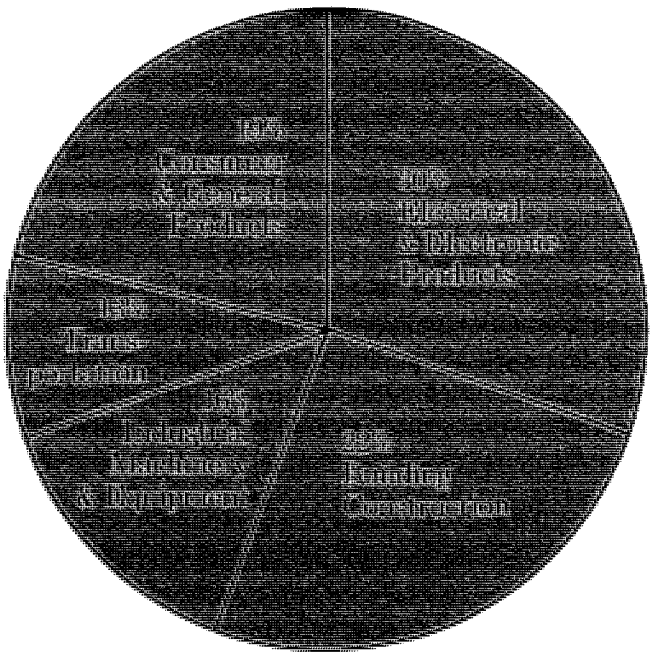
"Present depletion rates provide a proper balance."

The Report of the House Committee on Ways and Means accompanying the Tax Reform Bill of 1969 noted that:

"(Y)our committee's bill provides for substantial reductions in percentage depletion rates for most items. However, some items — namely, gold, silver, oil shale, copper and iron ore — are to remain at the present 15 per cent rate in case of deposits in the United States. For these items, present depletion rates appear to provide a proper balance between the need to encourage exploration and the discovery of new reserves on the one hand and the revenue cost involved on the other hand."

Present and indicated future copper requirements make clear that this conclusion remains sound today.

Where copper is used.



Source: Copper Development Association, Inc.

People use copper. Every man, woman and child in the U.S. uses around 25 pounds of copper every year in essential products, conveniences and services. For instance —

Electrical and electronics industries use the most, turning copper into motors, rectifiers, control panels, solenoids. In areas of high technology, the space age industries, copper is essential to miniaturization of electronic testers, controls, printed circuits, computer components. It is the basic "energy" metal used in electric generators, transmission and distribution lines, and in all forms of communications — telephone, telegraph, radio, TV.

Next biggest user is building construction where copper fills a multitude of needs — in electrical wiring, heating and cooling systems, plumbing, roofing. Building hardware is made of bronze (copper combined with tin) and brass (copper combined with zinc).

Consumer and general products make up the third biggest copper market. Just look around. Copper is an essential part of the electric lamp you may be reading by; your clock on the wall; your refrigerator, freezer, range, automatic washer, dryer, dishwasher and other household appliances.

Industrial machinery and equipment is the next largest market, using copper sheet, tube, rod and wire in ever increasing quantities. The fifth major user is transportation, where automobiles, trucks, buses, planes, trains, ships — and outer space vehicles — all rely on copper.

It's re-used time after time.

About two-thirds of all copper used by industry comes back time after time to be melted and used again. It is practically indestructible and is one of the most recyclable of all metals. In fact, while 49% of the nation's total supply in 1973 came from U.S. newly mined copper, 46% came from recycled domestic scrap. The remaining 5% was imported.

Did you know that:

Over 50 pounds of copper and copper alloys are used in your automobile. Some 2,500 individual insulated copper wires make up a typical large telephone cable, with each wire capable of carrying hundreds of conversations. Wire finer than a human hair is drawn from copper for the electrical industry, which also uses copper bars as thick as a railroad tie. U.S. coins, mostly copper sandwiched between layers of nickel or silver, require some 50,000 tons of copper a year — equalling the total annual output of one medium-sized Arizona mine.

Glossary of mining terms.

acid plant – The plant at the smelter site that recovers sulfur dioxide and manufactures from it sulfuric acid.

anode – Fire-refined copper cast at the smelter into slabs weighing 600 to 1200 pounds of about 99.5% purity; shipped to an electrolytic refinery for final purification process.

ball mill – A rotating horizontal steel cylinder loaded with steel balls which grind the ore to a fine powder consistency.

beneficiation – Concentrating the copper content of the ore; the crushing, screening and grinding of ore and removal of copper-bearing minerals by a flotation process prior to smelting the copper concentrates.

blister copper – Copper 96% to 99% pure, having a blistered surface after casting due to gases generated during solidification; normally is further refined at the smelter into a fire-refined copper and cast into anodes.

block caving – A form of underground mining wherein a block of ore is removed by undercutting it, causing it to fall by gravity through previously driven raises and is loaded through chutes into mine cars, hauled to the shaft and lifted to the surface.

cathode – Refined from anodes in the electrolytic refinery into plates of 99.99% pure copper; these are shipped to factories to be melted and cast into shapes ready for rolling, drawing or extruding into finished products.

concentrate – Copper-bearing material from the flotation process; contains 15% to 30% copper plus various quantities of sulfur, iron and other impurities.

converter – A brick-lined cylindrical vessel in the smelter for processing molten copper matte from the reverberatory furnace; the impurities, principally iron and sulfur, are removed by blowing air through the molten bath; the result is blister copper, about 99% pure.

crusher – Apparatus in which ore is broken into progressively smaller pieces.

development – The process of preparing an ore body for mining; sinking a shaft and driving haulage tunnels for an underground mine, or removing the overburden for an open pit mine; installing crushers, concentrators, transportation, power and water lines, offices, shops, warehouses, etc.

dump – The site for disposal of waste rock from the mine, or slag from the smelter; may be extremely low grade or where dump leaching takes place.

electrolytic refinery – The process in which fire-refined copper anodes are immersed in an acid solution with pure copper cathode starter sheets. An electric current passed between them deposits 99.99% pure copper on the cathodes.

electrowinning – Electrolytic winning process, wherein copper from copper sulfate (leach) solution is electroplated onto cathodes, ready for market.

exploration – The process of locating and proving that a mineral occurrence is indeed an ore body; that is, determining that it is large enough, contains enough copper to be mined profitably.

fire refining – Last step in a smelter wherein molten blister copper from the converter is deposited in the refining (or casting) furnace and gas blown through it to remove more of the impurities, principally oxygen. Also, general term for pyrometallurgical refining or smelting.

flotation – The process of mixing powdered ore with water and chemical reagents to separate the metallic particles from the waste rock; the metallic particles are collected and dried and this concentrate is sent to the smelter for fire refining.

gangue – Undesired minerals associated with ore; that portion of the ore rejected as tailing in the flotation process.

leaching – A process of using a weak sulfuric acid solution to dissolve copper from low-grade oxide ores; may take place in vats, heaps, dumps or in situ (in place).

matte – A mixture of sulfur, iron and copper, containing approximately 20% to 45% copper, tapped from reverberatory furnace in the smelter.

mill – The facility containing rod mills (if used), ball mills and flotation cells where the ore is ground and copper concentrate extracted. Also called the concentrator.

open pit mining –A surface mining method in which overlying rock and soil are removed to expose the ore body, which is then drilled, blasted and loaded into trucks or railroad cars for haulage from the pit.

ore – Rock containing enough mineral value to warrant the expense of mining it.

oxide ore – Ore containing copper minerals which have been altered by oxidation or weathering process.

prospecting – The process of searching for new mineral deposits.

reverberatory furnace – In the smelter, the furnace in which copper concentrates are melted, slag drawn off, and molten copper-bearing matte tapped for further processing.

rod mill – A rotating horizontal steel cylinder in which steel rods initially grind the crushed ore.

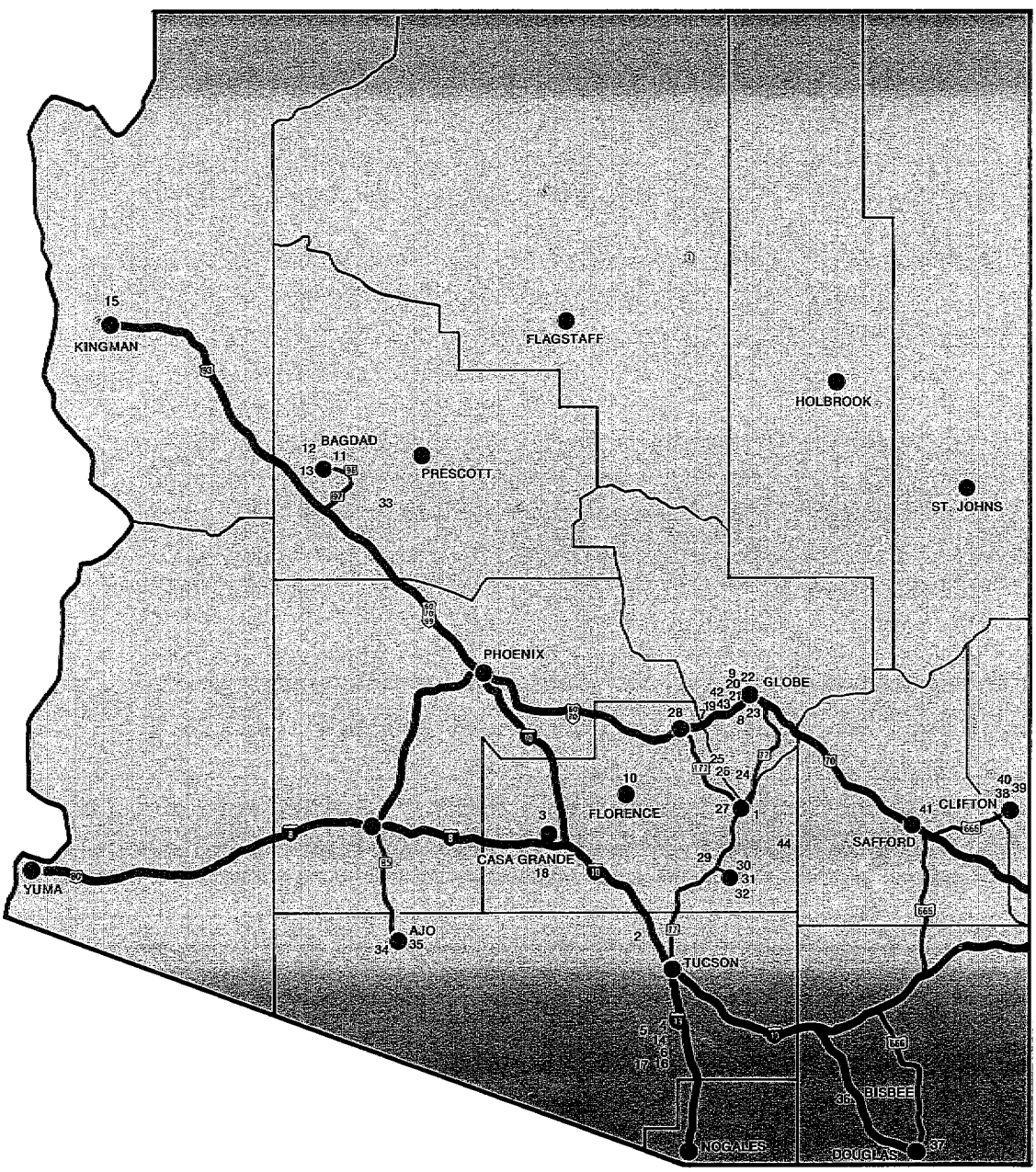
slag – Waste rock from the smelter. The black lava-like material is primarily iron and silica.

smelter – The plant in which fire refining takes place.

sulfide ore – Ore composed of copper, sulfur and usually iron along with the various other minerals making up the host rock.

tailings – The finely-ground residue or waste materials contained in the ore remaining after floating off the copper-bearing concentrate.

underground mining – Extraction of ore through vertical shafts from the surface, or horizontal tunnels, drifts or crosscuts driven into the ore body.



These are Arizona's major copper producers.

These member companies of the Arizona Mining Association and the properties they operate are keyed to the adjacent map.

AMAX ARIZONA, INC.

Partner in Anamax Mining Co., operating Twin Buttes Mine

AMERICAN SMELTING AND REFINING COMPANY

1. Smelter at Hayden
2. Silver Bell Unit, open pit mine northwest of Tucson
3. Sacaton Unit, open pit mine north of Casa Grande
4. Mission Unit, open pit mine south of Tucson
5. San Xavier Unit, open pit mine south of Tucson

THE ANACONDA COMPANY

Partner in Anamax Mining Co., operating Twin Buttes Mine

ANAMAX MINING CO.

6. Twin Buttes Mine, open pit south of Tucson

CITIES SERVICE COMPANY

7. Pinto Valley Mine, open pit west of Miami
8. Miami East, underground mine development
9. Copper Cities Mine, open pit north of Miami

CONTINENTAL OIL COMPANY

10. Mine development project, north of Florence

CYPRUS MINES CORPORATION

11. Bagdad Copper Company Division, open pit mine
12. Bagdad Copper Company Division, electrowinning plant
13. Bruce Mine, underground mine west of Bagdad
14. Cyprus Pima Mining Company, open pit mine south of Tucson

DUVAL CORPORATION

15. Mineral Park Mine, open pit north of Kingman
16. Esperanza Mine, open pit south of Tucson
17. Sierrita Mine, open pit south of Tucson

HECLA MINING COMPANY

18. Lakeshore Mine, underground development south of Casa Grande

INSPIRATION CONSOLIDATED COPPER COMPANY

19. Ox Hide Mine, open pit west of Miami
20. Electrolytic refinery and electrowinning plant
21. Thornton & Live Oak open pit mines, north of Miami
22. Smelter, east of Miami
23. Rod Plant, east of Miami
24. Christmas Mine, open pit south of Miami

KENNECOTT COPPER CORPORATION

25. Ray Mine, open pit north of Hayden
26. Electrowinning plant at Ray
27. Smelter at Hayden

MAGMA COPPER COMPANY

28. Superior Mine, underground
29. San Manuel Mine, underground blockcaving
30. Smelter at San Manuel
31. Electrolytic refinery at San Manuel
32. Rod Plant at San Manuel

McALESTER FUEL COMPANY

33. Zonia Mine, in-place leaching at Kirkland, southwest of Prescott

PHELPS DODGE CORPORATION

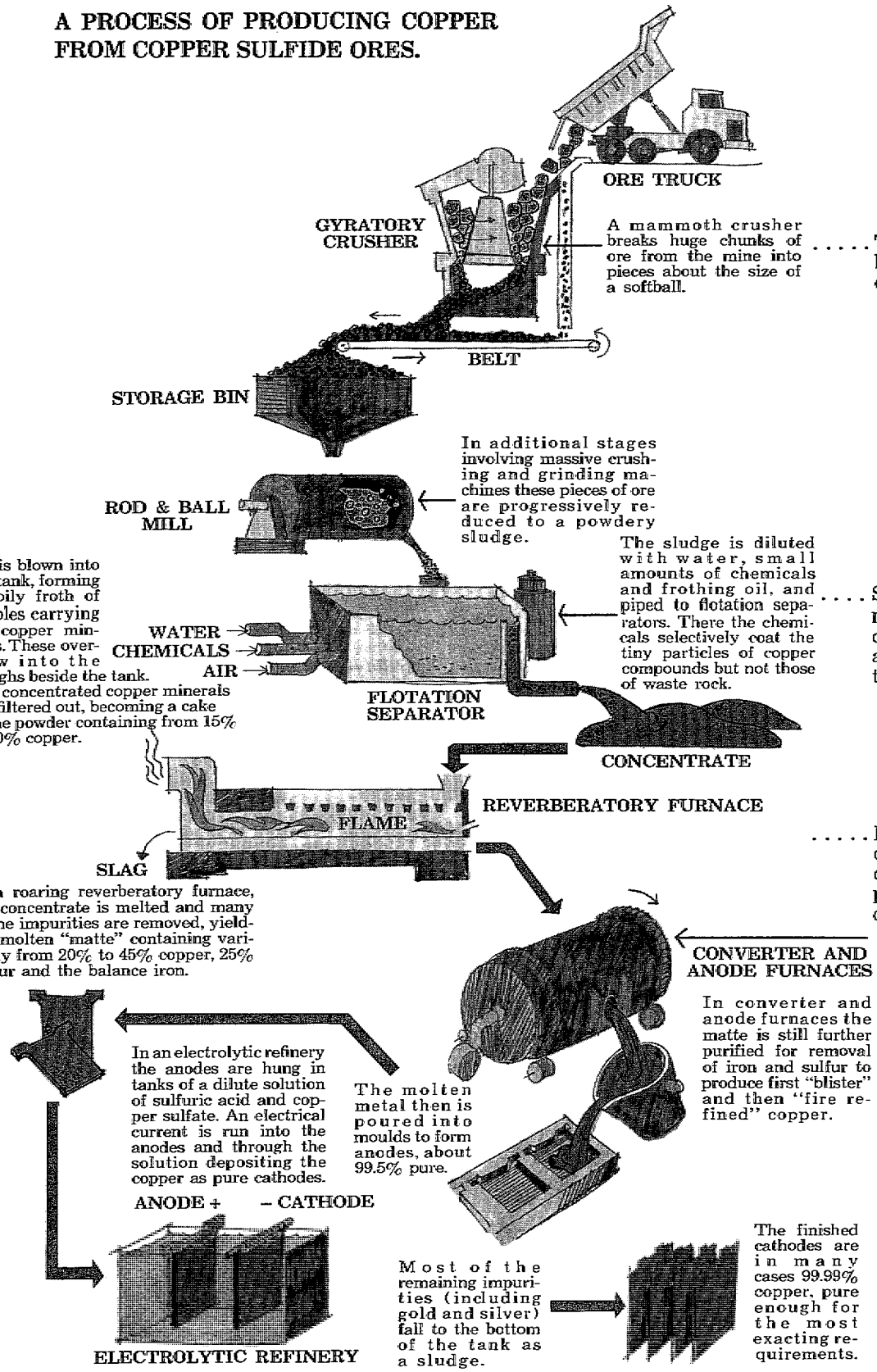
34. New Cornelia Mine, open pit at Ajo
35. Smelter at Ajo
36. Copper Queen Mine, underground at Bisbee
37. Smelter at Douglas
38. Morenci Mine, open pit
39. Metcalf Mine, open pit development near Morenci
40. Smelter at Morenci
41. Safford Project, underground development north of Safford

RANCHERS EXPLORATION & DEVELOPMENT CORPORATION

42. Bluebird Mine, open pit west of Miami
43. Electrowinning plant, at Bluebird Mine
44. Old Reliable Mine, in-place leaching northeast of San Manuel

Processing 0.6% low grade ore into 99.99% pure copper.

A PROCESS OF PRODUCING COPPER FROM COPPER SULFIDE ORES.



. . . . . Two tons of waste rock must be discarded to get one ton of ore at the crusher.

. . . . Separator floats off approximately 45 pounds of copper concentrate, and discards about 1,955 pounds of waste in the form of tailings.

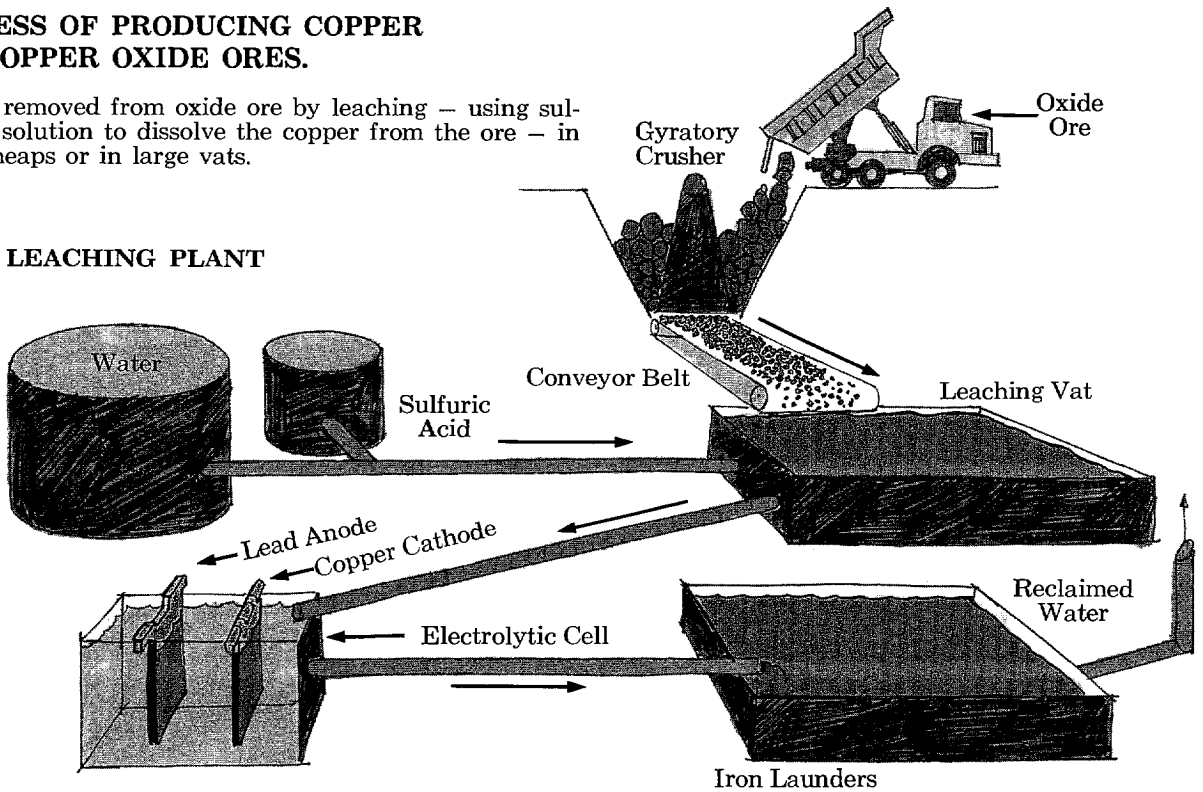
. . . . . In the smelter the 45 pounds of copper concentrate are reduced to approximately 10 pounds of copper. The rest is discarded in the form of slag.

Note: Figures used are state-wide industry averages and will vary at each operation.

A PROCESS OF PRODUCING COPPER FROM COPPER OXIDE ORES.

Copper is removed from oxide ore by leaching – using sulfuric acid solution to dissolve the copper from the ore – in place, in heaps or in large vats.

LEACHING PLANT



In the electrolytic winning plant, the copper from the copper sulfate (leach) solution is electroplated onto a cathode and is ready for market. The remaining, weak copper-bearing solution is washed over scrap iron which removes the last bit of copper. The resulting red-brown "cement" copper (85% copper) is usually sent to a smelter.

The way it all began.

Much of Arizona's history is linked to the search for and development of minerals. Without attempting to document every significant event, here are some historical highlights on the early beginnings of mining in Arizona, down to modern times.

1540 First mineral exploration by Coronado searching for the Seven Cities of Cibola.

1583 Earliest mineral discovery, by Don Antonio de Espejo, an outcrop of silver south of the San Francisco Peaks, probably at the site of what later became the great copper camp of Jerome.

1604 Juan de Onate explores what is now northern and western Arizona but discovers no minerals.

1691 For 25 years Padre Kino explores the Papago country, and mentions the mining of rich silver ores.

1736 Famous Bolas de Plata silver deposit is discovered at Arizonac in northern Sonora.

1750 Some copper is mined at Ajo.

1853 Gadsden Purchase from Mexico acquires that part of Arizona and New Mexico south of the Gila River.

1854 First mining of copper by Americans in Arizona at a site named Ajo. The high-grade ore is packed by mule train across the desert to the Colorado River, then by sea around the Horn to Swansea, Wales for smelting.

1857 Prospectors begin entering Arizona in numbers. Gold ore found in Mohave County near Colorado River.

1863 Castle Dome district near Yuma becomes known. Many placer and lode deposits discovered in Prescott region. Moss Mine, Oatman district, Vulture Mine near Wickenburg, and Planet Mine near Williams River are discovered. Moss and Vulture are lode gold mines; Planet is copper. Many lode deposits discovered in Mohave County. Arizona is made a Territory, chiefly because of gold discoveries, with Prescott as the capital.

1874 Globe becomes a booming silver camp. Railroad built from Clifton to Metcalf, the first in Arizona.

1875 Arizona's first smelter, one-ton capacity, is built at Clifton by the Leszinsky brothers.

1876 Southern Pacific Railway reaches Gila Bend from California. United Verde ore body is discovered at Jerome.

1877 Rich mineralized ledges discovered at Bisbee; silver bonanza makes Tombstone famous boom town.

1878 "Little Emma," a narrow gauge locomotive, is hauled 600 miles by oxen from La Junta, Colorado, to Clifton. Its bell may be seen today in Clifton's Town Hall.

1880 Phelps Dodge Corporation buys half interest in Detroit Copper and builds small smelter at Morenci. Silver-copper ore is mined from Silver Queen at Superior (now the Magma). Leszinsky sells out Clifton smelter operation to Arizona Copper Company, after making $2,000,000.

1881 Railroad reaches Lordsburg. Old Dominion Copper and Smelting Company starts operations at Globe. Phelps Dodge acquires Atlanta claim at Bisbee. Mammoth district opened. A small copper furnace is in operation at the present site of Miami.

1883 Some copper mining is undertaken at Ray. A small smelter is built at Jerome.

1886 Bonanza ores exhausted at Morenci; concentrator built to treat oxidized ore averaging 6.5% copper. Six furnaces in operation at Globe.

1888 Copper replaces gold and silver in economic importance to Arizona.

1898 Twelve-mule teams haul ore from Globe to Bowie before the railroad reached Globe. The 260-mile round trip takes several weeks.

1900 A smelter is built at Douglas by Phelps Dodge. Rich gold ore is found in Oatman and Katherine districts. Cornelia Copper Company is organized to work the Ajo deposit.

1907 Arizona passes Montana in copper production; becomes the No. 1 copper producer in the U.S. Loses its No. 1 position in 1909; regains it in 1910 and retains it thereafter.

1908 Inspiration Copper Company is organized, begins active development work near Miami in 1909.

1910 Magma Copper Company at Superior is formed to work the Silver Queen property.

1911 American Smelting and Refining Company builds smelter at Hayden. Production starts at Miami Copper Company. Ray production starts on large scale. New Cornelia property is drilled. Production starts at Magma.

1915 Metal prices start to boom. Inspiration Consolidated Copper Company introduces the country's first large-scale copper flotation plant.

1921 Postwar depression and shut down of copper properties.

1925 End of high grade ore at Miami in sight; producer plans for working of low grade ores.

1929 Climax of boom and start of the great depression; copper price collapses from 18¢ to under 10¢ a pound, and declines to under 5¢ a pound in 1932.

1933 Kennecott Copper Corporation acquires the Ray Mine property.

1939 World War II begins; mineral industries gear to high production. Copper, lead and zinc prices begin long climb upward.

1943 Arizona's metal output greatest since 1929.

1948 Output of copper ore and zinc-lead ore is the highest of any year in the history of the State.

1950 First significant copper ore body to be discovered by geophysical methods, south of Tucson.

1954 Cyprus Mines Corporation buys Bruce Mine west of Prescott near Bagdad.

1956 Tucson copper district reopened.

1957 Duval Corporation builds concentrator at its Esperanza mine, south of Tucson. Duval had acquired the mine a few years prior to this time.

1958 Arizona supplies over half the nation's newly mined copper, a position which it still holds today.

1963 Cities Service Company acquires the Tennessee Corporation mine near Miami, which originally was owned by the Miami Copper Company.

1964 Ranchers Exploration and Development Corporation buys the Bluebird Mine near Miami from the Stovall Copper Company.

1965 The Anaconda Company begins massive stripping operations at Twin Buttes Mine, south of Tucson.
McAlester Fuel Company explores the Zonia Mine at Kirkland, southwest of Prescott, starts ore leaching production a year later.
First acid plant as part of a smelter is installed by Phelps Dodge at Morenci.

1968 At the Bluebird Mine, near Miami, Ranchers Exploration and Development initiates the industry's, and the world's, first method of copper recovery from cementation to solvent extraction-electrowinning. Other Arizona mines have since begun similar operations.

1969 Continental Oil Company begins exploration near Florence, a year later makes copper ore discovery.
Hecla Mining Company starts new underground development at Lakeshore Mine, south of Casa Grande.
Arizona's first rod plant, built by Inspiration near Miami, starts supplying copper rod to a telephone cable factory in Phoenix. For the first time, the industry manufactures a finished product within the State.

1970 Value of copper produced in Arizona exceeds $1 billion.

1972 Magma's underground mine near San Manuel becomes the State's largest copper producer.

1973 Anamax Mining Company is formed by a partnership of the Anaconda Company and Amax Arizona, Inc., to operate the Twin Buttes Mine.

1974 Inspiration builds the State's first electric smelter, near Miami.

Much has been written about the history of copper mining in Arizona. Many books on the subject are available at public libraries. You will find them interesting, rewarding reading.

An invitation.

Visit an Arizona copper mine. Many copper mining companies offer public tours of their operations. The Arizona Mining Association has a free tour brochure listing the times and dates of tours, safety rules for visitors and whom to contact at the various companies. Just write or call us for it.

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