

THE  
COPPER  
INDUSTRY

INCLUDING BYPRODUCT MOLYBDENUM

STATISTICS FOR 1972 COMPARED WITH OTHER YEARS  
ARIZONA, THE UNITED STATES AND THE WORLD

COMPILED BY THE ARIZONA DEPARTMENT OF MINERAL RESOURCES

FAIRGROUNDS

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# C O N T E N T S

	<u>Page</u>
Copper (Physical Properties)	1
The Copper Industry in 1972	2-7
Elimination of Statistical Tables	8
 <u>Statistics</u>	
Salient United States Copper Statistics, 1970-72	Table I 9
U.S. Mine Production by States, 1970-72	Table II 10
Mine Production, Arizona, U.S. and World and U.S. Price, 1874-1972	Table III 11-13
World Mine Production by Countries, 1970-72	Table IV 14,15
U.S. New Refined Production, Imports, Exports and Withdrawals, 1967-72	Table V 16
Imports, by Major Sources, 1970-72, Totals only, 1967-69	Table VI 17
Refined Copper Consumed by U.S. Consumer Classes, 1970-72	Table VII 18
U.S. Production and Consumption, 1950-72	Table VIII 19
Employment, Earnings and Hours, U.S. and Arizona; Ore and Copper Production per man Hour, 1947-49 and 1966-72	Table IX 20-22
U.S. Output of Copper ore; Amount and Value of Copper, Gold and Silver Recovered Therefrom, 1962-72	Table X 23
 <u>ARIZONA ONLY</u>	
Arizona's Copper Industry	24-32
Arizona's Copper Mining Output of Copper Ore; Amount and Value of Copper, Gold and Moly Recovered Therefrom, 1962-72	Table XI 33
Mine Production of Copper, Lead, Zinc, Gold and Silver, 1858-1972	Table XII 34
Mine Production of Copper, Gold, Silver, Lead and Zinc in 1972, by classes of Ore	Table XIII 35
Copper and Molybdenum Production of Large Copper Mines in 1971 and 1972	Table XIV 36,37
Covered Employment and Wages, 1947-72	Table XV 38
Employment and Wages in Industries Covered by Social Security, 1970-72	Table XVI 39,40
Mineral Production in Arizona in 1972	Table XVII 41
Arizona Mining Taxation	42
Assessed Valuation of Selected Industries, 1970-73	Table XVIII 42
Assessed Valuations of Selected Industries as a Percent of Total States Assessed Valuations, 1970-73	Table XIX 42
 <u>MOLYBDENUM</u>	
Arizona Molybdenum	1
Molybdenum (Physical Properties)	2
Molybdenum Production	Table I 3
Salient Molybdenum Statistics	Table II 4
Consumption of Moly Material by End Uses, 1972	Table III 5
Free World Production of Molybdenum in Ores and Concentrates	Table IV 6

## C O P P E R

Symbol, Cu. Atomic Weight, 63.54. Specific Gravity, 8.96. Valence, 1 & 2. Melting Point, 1981° F. Boiling Point, 4703° F. Electrical Resistivity, 1.682 Microhms/cm at 20° F. Tensile Strength, H.D. - 60,000 #/sq. in.; annealed - 30,000. Crystallizes in the isometric system.

Copper ranks next to iron as a metal of commercial importance. Its high electrical conductivity, 94 per cent of that of silver, high ductility and availability, make it the most important metal in the electrical field. The conductivity of aluminum is only 61 per cent of that of copper; and that of iron is only 17 per cent. Copper is easily drawn into wires or formed into sheets of desired sizes, including very fine, or thin. It is insoluble in water; soluble in nitric and hot sulphuric acids; slightly soluble in hydrochloric acid and ammonium hydroxide; and has great resistance to weathering. It is widely used in brass, alloyed with zinc; and is alloyed with tin to form bronze. It has excellent thermal conductivity also, and therefore is used extensively in heat exchangers such as car radiators, refrigeration coils and condensers of many types and uses. The long life of copper is illustrated by the large recovery as scrap after it has outlived its original use. In the 5-year period 1965 to 1969, the amounts of secondary copper produced in the United States from scrap copper or copper alloys averaged 99 per cent of the domestic mine output. Copper minerals, more commonly chalcopyrite, chalcocite, bornite, covellite, chrysocolla, malachite, azurite, cuprite and native copper, occur as minor - most frequently very minor - constituents of various kinds of rock in very irregular areas of material which can be economically extracted and processed as "ore". The copper minerals in the ore may be concentrated by hydro-metallurgy and either ore or concentrate may be processed chemically if feasible; or by pyro-metallurgy, or by both, to separate the copper from its minerals. The product may require refining, which may be done by a furnace process but most often is done electrically, thereby producing cathode copper which must be at least 99.9 per cent pure, any silver present being counted as copper. Fire refined copper is used for cast and wrought products and some alloys, and is allowed to be very slightly less pure. The refineries may cast the refined metal into wire bars or other shapes for fabrication or may ship the heavy cathodes without remelting.



## The Copper Industry in 1972

Due to the increased production in countries other than the United States, the world produced more newly mined copper in 1972 than in any previous year. Among the countries abroad where sizeable production increases occurred were Canada, Mexico, Poland, Romania, Spain, Soviet Russia, Yugoslavia, Rhodesia, Republic of South Africa, Zaire (formerly Belgian Congo), Zambia (formerly Northern Rhodesia), the Philippines, Australia and Bougainville. However, copper production in the United States and Arizona was 54,817 tons and 9,306 tons respectively less in 1972 than it was in 1970 due to a combination of smelter pollution controls, built-up concentrate stocks from the 1971 strike, fuel shortages and various equipment failures. World mine production of copper is estimated by the U.S. Bureau of Mines to have been 7,313,536 short tons in 1972, compared to 6,653,048 short tons in 1971 and 6,638,042 short tons in 1970. The 1972 world mine production was 9.9% higher than that of 1971 and 10.2% higher than that of 1970. Arizona mine production of copper in 1972 was 908,612 short tons, 820,171 short tons in 1971 and 917,918 short tons in 1970. The 1972 U.S. mine production was 10.8% higher than that of 1971, but 1.0% lower than the record production of 1970. World, U.S. and Arizona mine production of copper is given in Table III for the years 1874 through 1972.

Due to strikes, equipment breakdowns, construction delays and attempts to comply with Environmental Control regulations, anticipated new, increased and normal production was delayed or curtailed to the extent that important tonnages originally contemplated failed to materialize with the result that the anticipated production surplus did not occur. The U.S. producer delivered price opened the year at 50.32¢ per pound, rose to a high of 52.57¢ per pound by early March, dropped to 50.61¢ in mid-July and remained at that level through year end displaying a maximum change of only 2.25¢ per pound. The London Metal Exchange cash wirebar price, a price that more nearly reflects the supply-demand and political picture of copper economics, remained below the U.S. producer delivered prices, except for brief periods in mid-February and mid-March. LME cash wirebar prices opened the year around 46¢, peaked at nearly 53¢ in March and slid to the 46-47¢ range at year end. However, at year end 1972, LME prices were starting to show signs of recovery because of underproduction as described above, a recovery that was soon to lead to record high copper prices, both home and abroad. At the time of this writing, November 19, 1973, the LME wirebar cash price stands at 109.38¢ a pound, the New York dealer price at 112.5¢ and the U.S. producer delivered price at 60.16¢, the freeze price established by the Cost of Living Council.

Of the estimated 7,313,536 short tons of copper produced in the world in 1972, the U.S. Bureau of Mines estimates that 1,037,850 short tons, or 14.2%, was produced by Sino-Soviet Bloc countries of U.S.S.R., Poland, China, Romania, North Korea, Cuba, East Germany and Hungary. The Sino-Soviet Bloc countries' 1972 estimated production was 12.1% higher than their 1971 production of 925,700 short tons. However, all production data for these countries are estimates based on what little factual information is released to the outside world. The remainder of the world (often referred to as the Free World) produced 6,275,686 short tons in 1972, or 85.8% of the total. The 1972 Free World mine production was 9.6% higher than the 1971 production of 5,727,348 short tons.

The U.S. Bureau of Mines reported copper production for 61 countries in 1972. Of these, the 15 countries that produced 100,000 short tons or more accounted for 92.2% of the new copper produced that year. The fifteen largest world copper producers with their percentage of world production are: United States, 22.76%; Canada, 10.95%; Chile, 10.92%; Zambia, 10.81%; U.S.S.R., 10.02%; Zaire, 6.47%; Peru, 3.39%; Philippines, 3.09%; Australia, 2.79%; Republic of South Africa, 2.44%; Papua-New Guinea (Bougainville), 1.87%; Poland, 1.85%; Japan, 1.71%; Yugoslavia, 1.55% and China, 1.50%. Attention is invited to the production of Zaire and Zambia amounting to 1,263,391 tons of the computed 6,275,686 tons of free world production. This tonnage, about 1/5 of the entire free world's production, was produced in the small "Copperbelt" which is a narrow strip of land extending along the northern boundary of Zambia and along the southern boundary of adjacent Zaire.

World production gains in 1972 reflected several major new mines coming on stream during the year. It was also enhanced by U.S. production recovering from a strike year in 1971, and the Zambians progressing in bringing the Mufulira mine back to normal production levels after a tragic September, 1970, cave-in. Seven new mines, all outside of the U.S., alone added over 500,000 tons per year of new copper production potential in 1972. In Canada there was Placer Development's Gibraltar mine producing at a rate of 55,000 tons per year (tpy) by mid-year; Utah International's Island Copper mine producing at a rate of 56,000 tpy (actually end of 1971); Rio Algom's Lornex mine producing at a rate of 55,000 tpy by mid-year; and Newmont's Similkameen mine producing at a rate of 28,000 tpy in the second half. In Zaire, the Japanese-Zairois Musoshi mine was producing at a rate of 55,000 tpy in the fourth quarter. In Bougainville, the Conzinc Riotinto of Australia's Bougainville mine was producing at a rate of 200,000 tpy in the second quarter. In Indonesia, Freeport's Ertsberg mine was at a production rate of 65,000 tpy by the end of 1972. Although the total combined production potential of the seven above mentioned mines is over 500,000 tpy of copper, only about half of this was realized for the year 1972, meaning that somewhere near 250,000 short tons of additional production can be expected in 1973 from these seven mines alone.

R.H. Lesemann, Vice President of Chender Associates, Inc. writing for the March, 1973, edition of Engineering and Mining Journal, discusses a variety of important production-related developments during 1972. What follows is a brief country-by-country rundown based on his writing:

United States The combined effect of smelter pollution controls, built-up concentrate supplies from the 1971 strike, fuel shortages and equipment problems brought about the much discussed "smelter-bottleneck." Kennecott was forced to cut mine production back to a six-day week while concentrate stocks were gradually reduced. Furnace failure at Hayden, Arizona, forced Asarco to cut concentrate deliveries by up to 50% for a few months. Duval's Esperanza mine was closed all 1972 because Asarco could not handle all of Duval's concentrate commitments. Altogether, U.S. mine production was 1.0% below record 1970 levels, even though installed capacity was higher. Plans and construction of significant mine developments and capacity increases advanced during 1972. By the end of 1978, based on plans of new mines and increases in capacity, U.S. mine production potential will have increased 175,000 tpy.

Canada Noranda's 20,000 tpy Copper Mountain and Sherritt Gordon's 40,000 tpy Ruttan Lake mine will be on stream in 1973, joining the four new Canadian mines mentioned earlier. With a full year's production from those mines starting up in 1972 and the 1973 production from Copper Mountain and Ruttan Lake, Canada's 1973 production might top 1,000,000 short tons. Little progress was made in plans to build new smelting capacity in British Columbia. The new left-wing provincial government is taking a tough stand on subsidies and pollution controls. Noranda is building a 55,000 tpy continuous smelting unit at Horne, Quebec, and is expanding at Gaspé to add a total of 80,000 tpy new capacity over 1973-1974. Noranda's Montreal East refinery will add 100,000 tpy new capacity over the same period to reach 480,000 tpy.

Chile Problems continued to plague the nationalized copper industry. Chile's 1972 mine production of 798,919 short tons fell considerably below the government's programmed production goal of 880,000 short tons. The Big Five properties operated by Codelco were targeted to produce 729,000 short tons in 1972, but it's doubtful they topped 654,000. The small and medium mines fell 10,000 short tons of their goal of 151,000 short tons of copper. Codelco's main problems have been at Chuquibambilla where 1972 production of 259,000 short tons fell 20,000 below its 1971 production. Several major sales contracts were signed with Russia, China and other Communist states. In late October of 1973, the Marxist-Socialist government of Chile was overthrown by a military junta. Within a few weeks there was talk of re-establishing agreements with the U.S. copper companies previously ousted by the socialist government. What effect this sudden turn of events in Chile will have on the international copper picture remains to be seen.

Peru The state mining agency, Minero Peru, took over all marketing of Peru's copper and made contracts with China, Czechoslovakia and India. Minero Peru also made progress on the mining concessions it took away from Cerro, Anaconda and Asarco. European and Japanese companies were actively investigating the possibility of future agreements with Minero Peru to exploit Peru's deposits. A number of contracts were signed and development continued by various foreign countries at the exclusion of the U.S.

Zaire The Japanese-Zairois company, called Sodimico, launched its 55,000 tpy Musoshi mine and has plans for its Tshinsenda mine to start production in 1975 at about 75,000 tpy. Other expansions in the state-owned (Geocomin) properties should increase Zaire's production to nearly 650,000 tpy by 1975.

Zambia Rehabilitation work continued at Mufulira and the Chingola expansion came on stream lifting production by 80,000 short tons. Plans are proceeding to add another 175,000 tpy of capacity by 1975. The government's relations with Anglo American and Roan Selection Trust, the now minority owners and managers, have been running quite smoothly. Continued friction with Rhodesia is the major problem facing Zambia's copper industry. In early 1973, the border between the two countries was closed and Zambia will be hard pressed to get her copper to port via other routes.

Iran Anaconda has agreed to develop and manage the Sar Cheshmeh project for the government. Production of 160,000 tpy of blister copper is due to commence in 1976 and to reach full production in 1977.

Malaysia A Japanese consortium has set plans to bring the 45,000 tpy Mamut mine on stream in 1976.

Philippines Plans are proceeding for a Lepanto-led consortium to build an 88,000 tpy smelter-refinery on Luzon by 1976. Atlas Consolidated is considering a 40,000 tpy smelter of its own. Most Philippine concentrate is currently exported to Japan.

World copper consumption in 1972, as reported by the American Bureau of Metal Statistics, was 7,685,616 short tons, a 6.4% increase over the 7,226,929 short tons consumed in 1971. U.S. copper consumption in 1972 rose to 2,238,867 short tons from 2,019,507 short tons in 1971, an increase of 10.9%. In Japan consumption exceeded one million tons for the first time in history, rising 17.8% above her 1971 total of 888,100 short tons to 1,045,000 short tons in 1972.

Producer stocks, as reported by members of the Copper Institute, rose 92,870 short tons in 1972 to a year end total of 567,655 short tons, an increase of 19.6% over the 1971 year end total of 474,290 short tons.

Attracting more attention in 1972 than rising producer stocks were increases in stocks held in LME warehouses. They rose from 78,000 short tons in the start of 1972 to a peak of 212,000 in November. By mid-January, 1973, stocks were back down to 200,000 and continuing downward. However, these record high values of LME stocks do not necessarily represent an accumulation of unwanted copper. With the market in a supply surplus situation, many fabricators had found they could reduce in plant stocks and the associated capital tied up and carry their "safety margin" in the LME.

Japan, now unquestionably the world's second largest copper consumer; had, despite a record 17.8% jump in consumption, a number of unresolved problems in her copper industry. The 16.88% upward re-evaluation of the yen forced the Japanese to tune down their previous projections of consumption growth, thus leaving the smelters with long term concentrate commitments well in excess of forecasted demand. In general, smelters were able to renegotiate contracts with concentrate



suppliers both from a reduced tonnage and increased smelter charge standpoint. Those companies unable to renegotiate resorted to declaration of force majeure alleging pollution control problems.

Re-evaluation of the Japanese copper position has had some repercussions on the world mining scene. Purchase contracts by Japanese smelters were a vital factor in developing many of the new British Columbia mines, as well as the Philippine expansions and the Bougainville and Ertsberg properties. The Japanese are no longer such eager buyers and several copper deposits are sitting undeveloped as a result. The skyrocketing free market copper price in the second half of 1973 and the later fourth quarter fuel crisis will have a profound effect on Japan's copper position. Normally such high prices (over \$1.00 a pound in November, 1973) would spur increases in mine, smelter and refinery capacity, but the fuel shortage may easily dampen expansion hopes in Japan or elsewhere (especially in fuel importing countries.)

One of the most highly publicized actions in the copper world in 1972 was Kennecott's legal action against Chile. The Chileans seized the properties of Kennecott and Anaconda without compensation charging that "excess profits" realized in previous years by the two companies from the Chilean operations wiped out all compensable value of the properties. Kennecott charged that such appropriation without compensation was a violation of international law and the laws of certain countries which were buying Chilean copper. In September, the French court issued an order blocking payment to Chile by French firms buying copper from the former Kennecott properties. In January, 1973, a similar order was issued by the German courts.

Chile, claiming it was a matter of national sovereignty, refused to put the dispute to the World Court or any other international arbiter. CIPEC partners, Peru, Zambia and Zaire rallied to Chile's side by not allowing their copper to replace any of Chile's blocked by the court action. While the actions did not have any overall effect on supply and demand, a dislocation did occur with a resulting rise in prices especially on the LME where France and Germany had to turn for some of their supply. Again, the future of Chilean copper in the world market will undoubtedly change as a result of the recent overthrow of the Marxist Chilean government.

In the United States, action and debate over smelter pollution controls were the major news-making events on the copper scene. Actions by the Environmental Protection Agency (EPA) to implement pollution control standards for U.S. copper smelters were challenged in several court actions in 1972. The outcome of such actions were so varied that many of the companies involved, although already spending millions of dollars on control equipment, are still in doubt as to what pollution abatement procedures and equipment they will be required to implement.

Contemporaneously with relatively low and static copper prices over the last two years (1971 & 1972), the costs of mining and milling increased sharply, and mining companies who have had to have the completions of the processing done by custom smelters and refineries (who also had their costs of operations increased materially) have had their combined smelting and refining charges moved from the area of 6¢ a pound throughout the 1960's to as high as 12¢ last year, due to greatly increased labor, capital, fuel and pollution control costs, incurred in the smelters and refineries.

There has developed a probable shortage of smelter capacity in the world. In the U.S., Kennecott's six-day work week and Duval's close down of Esperanza caused by smelter strikes and breakdowns resulted in a back-up of concentrates at the supplying mills and tend to stress a probable shortage of smelting capacity in the U.S. Outside the U.S., however, there were no production losses attributable to such factors, although problems in Japan, discussed earlier, did cause some disallocations of concentrate shipments.

The outlook for the world copper industry can only be described as hardly predictable. At the start of 1973, due to loss of production in the United States, Zambia and Chile in 1971 and 1972 due to strikes, cave-ins, accidents to equipment and curtailments caused by government dictation and indecision regarding regulations the copper market was in fairly even balance; economic recovery was in full swing and predictions were for a good chance to match the 1972 consumption gain of 6.4%. However, the world politics of fuel supply may easily change that rosy picture. If price is any indication of supply-demand unbalance, then dollar-a-pound copper certainly reflects an unbalance. The world copper surplus has not occurred, due to the various reasons discussed earlier. The fuel shortages now being experienced in the United States, and the day-to-day changes in what the Federal government proposes as a solution, so cloud the future of the copper industry and other basic industries, except possibly fuel production, that any guess about the future would be a poor one.

### Elimination of Statistical Tables

Due to a combination of responses from users of this report and difficulties in the availability of paper, a number of statistical tables which have in past years been included, have for this 1972 report been eliminated. The eliminated tables, by title, are:

Mine Production of Copper - United States and World - United States  
Production of Secondary (Unalloyed) Copper - World Production and  
Consumption of Refined Copper 1960 - 1971

Exports, by Countries Destination 1969 - 1971

Stocks, Refined and Blister, In and Out of the U.S. 1961 - 1971

Fabricators' Stocks and Sales Position 1961 - 1971

Employment, Earning and Hours, U.S. and Arizona, 1947 - 1971

File copies of these tables are to be kept current at the department. Prints of these file copies, if needed, will be supplied to any user of this report. Send requests to Arizona Department of Mineral Resources, Mineral Building, Fairgrounds, Phoenix, Arizona, 85007.

TABLE I

SALIENT COPPER STATISTICS <sup>1/</sup>

In short tons

	<u>1970</u>	<u>1971</u>	<u>1972</u>
<u>Mine Production</u>			
Arizona	917,918	820,171	908,612
United States	1,719,657	1,522,183	1,664,840
World	6,638,042 <u>r/</u>	6,653,048 <u>r/</u>	7,313,536
<u>Primary Refined Stocks at U.S. Refineries <sup>a/</sup></u>			
Beginning of Year	39,000	130,000	75,000
End of Year	130,000	75,000	57,000
<u>Primary Refined Prod. of U.S. Refineries</u>			
From Domestic Ores	1,521,183	1,410,523	1,680,412
From Foreign Ores, Matte, etc. <sup>a/</sup>	243,911	181,259	192,821
Total	1,765,094	1,591,782	1,873,233
<u>Secondary Copper Produced from Scrap</u>			
Recovered as Unalloyed Copper	521,137	429,095	446,774
Recovered in Alloys <sup>b/</sup>	726,465	771,025	854,199
Total Secondary Copper	1,247,602	1,200,120	1,300,973
<u>Imports:</u>			
Copper in Ores, Concentrates, Matte	33,841	31,288	55,013
Copper in Blister	224,416	156,744	157,432
Refined Copper <sup>a/</sup>	132,143	163,988	192,379
Total Imports	390,400	352,020	404,824
<u>Exports:</u>			
Copper in Ores, Concs., Matte, Blister	69,343	36,824	26,181
Refined Copper <sup>a/</sup>	221,211	187,654	182,743
Total Exports	290,554	224,478	208,924
<u>Excess of Imports Over Exports</u>	99,846	127,542	195,900
<u>Consumption:</u>			
New Refined (Apparent Consumption)	1,585,026	1,623,000 <u>d/</u>	1,901,000 <u>d/</u>
Total Refined (Actual Consumption)	2,043,303	2,019,507	2,238,867
<u>U.S. Mine Production</u>			
Per Cent of Apparent Consumption	108.5	93.8	87.6
<u>Average Price of Copper <sup>c/</sup></u>	57.7¢ <u>e/</u>	51.43¢	50.62¢

r/ Revised1/ U.S. Bureau of Mines; American Bureau Metal Statistics.a/ May include some from scrap.b/ Includes copper in chemicals: 1970 - 2,525; and 1971 - 3,206; 1972 - 3,036c/ "Electrolytic copper, domestic refineries, on Atlantic Seaboard." Source: E/MJ.d/ U.S. Bureau of Mines data rounded to nearest thousand short tons in 1971.e/ Based on known production and selling rates.



TABLE II

MINE PRODUCTION OF RECOVERABLE COPPER IN THE UNITED STATES 1/

(In short tons)

STATE	1970	1971	1972	RANK IN 1972
Arizona	917,918	820,171	908,612	1
California	2,308	515	598	13
Colorado	3,749	3,938	3,944	9
Idaho	3,612	3,776	2,942	10
Maine	2,703	2,510	1,220	12
Michigan	67,543	56,005	67,260	6
Missouri	12,134	8,445	11,509	7
Montana	120,412	88,581	123,110	4
Nevada	106,688	96,928	101,119	5
New Mexico	166,278	157,419	168,034	3
Pennsylvania	2,539	3,349	2,611	11
Tennessee	15,535	13,916	11,310	8
Utah	295,738	263,451	259,507	2
Other States <u>2/</u>	2,500	3,179	3,064	
TOTALS	1,719,657	1,522,183	1,664,840	

1/ Source: U.S. Bureau of Mines.2/ Includes: Alaska, Oklahoma, Oregon, Washington and Wyoming.

TABLE III

## MINE PRODUCTION OF COPPER IN

ARIZONA, THE UNITED STATES AND THE WORLD

DOMESTIC PRICE OF COPPER a/

1874-1911 Total

1912-1972 Annually

Period	ARIZONA			UNITED STATES			WORLD
	Short Tons	% of U.S. Prod.	% of World Prod.	Short Tons	% of World Prod.	Price- ¢ Per Pound	
1874-1911	1,758,000	22.0	9.3	7,989,735 <u>b/</u>	49.1	14.40 <u>c/</u>	16,260,000
1912	182,519	29.2	16.2	624,547	55.5	16.341	1,125,656
1913	203,962	33.0	18.6	617,755	56.2	15.269	1,099,366
1914 <u>1/</u>	196,509	34.2	19.0	574,216	55.5	13.602	1,034,487
1915 <u>1/</u>	229,986	30.9	19.6	744,036	63.4	17.275	1,173,150
1916 <u>1/</u>	360,917	36.0	23.2	1,002,938	64.6	27.202	1,553,498
1917 <u>1/</u>	356,083	37.6	22.2	947,717	59.1	27.180	1,602,914
1918 <u>1/</u>	382,428	40.0	24.2	955,011	60.5	24.628	1,579,246
1919	269,050	44.4	24.6	606,167	55.3	18.691	1,095,697
1920	279,128	45.6	26.4	612,275	58.0	17.456	1,056,014
1921 <u>2/</u>	92,517	39.7	15.1	233,095	38.0	12.502	613,987
1922	200,022	41.5	21.4	482,292	48.2	13.382	935,374
1923	309,464	41.9	22.8	738,870	54.5	14.421	1,355,327
1924	338,876	42.2	23.0	803,083	54.5	13.024	1,472,712
1925	356,678	42.5	22.6	839,059	53.2	14.042	1,576,998
1926	361,648	41.9	22.7	862,638	54.0	13.795	1,596,147
1927	341,095	41.3	20.5	824,980	49.5	12.920	1,666,694
1928	366,138	40.5	19.2	904,898	47.5	14.570	1,903,672
1929	415,314	41.6	19.3	997,555	46.4	18.107	2,150,587
1930 <u>3/</u>	288,095	40.9	16.2	705,074	39.7	12.982	1,775,805
1931 <u>3/</u>	200,672	37.9	13.0	528,875	34.2	8.116	1,545,425

Source: Mineral Resources of the U.S., U.S. Geological Survey (Years 1882-1923), U.S. Bur. Mines (Years 1923-1931); Minerals Yearbooks and other reports, U.S. Bur. Mines (Years 1932-1969); Ariz. Bur. Mines Bull. 140 (1936).

a/ Annual average prices as reported by E/MJ.

b/ Smelter production from domestic ores.

c/ Average price for Arizona copper only, calculated from total of values reported or estimated by sources, amounting to \$506,283,000.

1/, 2/, 3/ See page 13.

(continued next page)

TABLE III (continued)

Period	ARIZONA			UNITED STATES			WORLD
	Short Tons	% of U.S. Prod.	% of World Prod.	Short Tons	% of World Prod.	Price- ¢ Per Pound	Short Tons
1932 <u>3/</u>	91,246	38.3	8.0	238,111	20.9	5.555	1,138,676
1933 <u>3/</u>	57,021	29.9	4.9	190,643	16.4	7.025	1,159,000
1934 <u>3/</u>	89,041	37.5	6.3	237,401	16.8	8.428	1,415,353
1935 <u>3/</u>	139,015	36.0	8.4	386,491	23.5	8.649	1,647,939
1936 <u>3/</u>	211,275	34.4	11.1	614,516	32.4	9.474	1,899,263
1937	288,475	34.3	11.2	841,998	32.8	13.167	2,567,916
1938 <u>4/</u>	210,797	37.8	9.3	557,763	24.5	10.000	2,274,145
1939 <u>5/</u>	262,117	36.0	10.6	728,320	29.4	10.965	2,481,277
1940 <u>5/</u>	281,169	32.0	10.5	878,086	32.7	11.296	2,688,510
1941 <u>5/</u>	326,317	34.1	11.2	958,149	33.0	11.797	2,903,458
1942 <u>5/</u>	393,387	36.4	12.9	1,080,061	35.5	11.775	3,039,041
1943 <u>5/</u>	403,181	37.0	13.2	1,090,818	35.6	11.775	3,064,394
1944 <u>5/</u>	358,303	36.8	12.5	972,549	33.9	11.775	2,866,000
1945	287,203	37.2	12.0	772,894	32.2	11.775	2,400,000
1946	289,223	47.5	14.1	608,737	29.6	13.820	2,056,000
1947	366,218	43.2	14.6	847,563	33.9	20.958	2,500,000
1948 <u>6/</u>	375,121	44.9	14.4	834,813	32.1	22.038	2,600,000
1949 <u>6/</u>	359,010	47.7	14.4	752,750	30.1	19.202	2,500,000
1950 <u>7/</u>	403,301	44.4	14.4	909,343	32.5	21.235	2,760,000
1951 <u>7/</u>	415,870	44.8	14.3	928,330	32.0	24.200	2,900,000
1952 <u>7/</u>	395,719	42.8	13.1	925,359	30.6	24.200	3,020,000
1953 <u>7/</u>	393,525	42.5	12.9	926,448	30.4	28.798	3,050,000
1954 <u>8/</u>	377,927	45.2	12.2	835,472	27.0	29.694	3,100,000
1955	454,105	45.5	13.3	998,570	29.2	37.491	3,420,000
1956	505,908	45.7	13.4	1,104,156	29.1	41.818	3,790,000
1957 <u>9/</u>	515,854	47.5	13.3	1,086,859	27.9	29.576	3,890,000
1958 <u>9/</u>	485,839	49.6	12.9	979,329	25.9	25.764	3,780,000
1959 <u>10/</u>	430,297	52.2	10.7	824,846	20.4	31.182	4,040,000
1960	538,605	49.9	11.6	1,080,169	23.2	32.053	4,650,000
1961	587,053	50.4	12.1	1,165,155	24.0	29.921	4,850,000

3/, 4/, 5/, 6/, 7/, 8/, 9/, 10/ see page 13.

(continued next page)

TABLE III (continued)

Period	ARIZONA			UNITED STATES			WORLD
	Short Tons	% of U.S. Prod.	% of World Prod.	Short Tons	% of World Prod.	Price- ¢ Per Pound	Short Tons
1962	644,242	52.4	12.7	1,228,421	24.2	30.600	5,085,000
1963	660,977	54.5	13.0	1,213,166	23.8	30.600	5,088,000
1964	690,988	55.4	13.0	1,246,780	23.5	31.960	5,297,000
1965	703,377	52.0	12.7	1,351,734	24.4	35.017	5,549,000
1966	739,569	51.7	12.8	1,429,152	24.6	36,170	5,800,000
1967 <u>11/</u>	501,741	52.6	9.0	954,064	17.2	28.226*	5,552,000
1968 <u>11/</u>	627,961	52.1	10.4	1,204,621	20.0	41.847**	6,012,000
1969 <u>12/</u>	801,363	51.9	12.9	1,544,579	24.8	47,534	6,225,000
1970 <u>13/</u>	917,918	53.4	13.8	1,719,657	25.9	57.700	6,638,042 <u>r/</u>
1971 <u>14/</u>	820,171	53.9	12.3	1,522,183	22.9	51.433	6,653,048 <u>r/</u>
1972	908,612	55.2	12.4	1,644,840	22.5	50.617	7,313,536
1874- 1972	25,797,783	41.6	13.3	62,010,023	32.0		193,836,626

r/ Revised

\* Based on first 8 months of 1967. \*\* Based on the last 9 months of 1968.

1/ World War I 1914-1918.

2/ Post World War I Recession (1921). Lasted about one year.

3/ Depression began in 1930; was at its worst in 1933; gradually improved to 1937.

4/ Recession in 1938. Recovery in 1939 caused by War demand.

5/ World War II began in 1939; highest copper consumption in 1944.

6/ In 1948 and early 1949, copper was being produced in the U.S. at the rate of 68,000 short tons per month, imports ran 40,000 tons per month of blister and refined copper, exports ran 12,000 tons per month and the price of copper averaged 22.5 cents.

In March, 1949, Congress suspended the copper import tax, and in the ensuing months domestic demand fell drastically while imports continued at practically the same rate. The price dropped to 16½ cents. Many mines were forced to close. Production dropped to 56,000 tons from a high of 78,000.

7/ Korean War 1950-53.

8/ Curtailment early in the year (1954), and a series of strikes in August and September caused a loss in production of over 100,000 tons. Consumption in the U.S. was reduced but the reduction was offset by an appreciable rise in consumption in other countries, chiefly in Europe. Result: a short supply of copper at the end of the year.

9/ Recession 1957-58. Import tax restored 7/1/58 after 7 year suspension.

10/ First U.S. troops killed in Vietnam in mid-1959. Record copper production rate first half of 1959 but 75% of U.S. output halted in August by strikes which lasted into 1960.

11/ A major Copper Strike started in the U.S. on July 16, 1967, and ended in March, 1968. A loss of 855,000 tons of copper production is estimated as a result of the strike.

12/ 1969, Highest annual production in U.S. history.

13/ 1970, Highest annual production in U.S. history and supply catches up with demand.

14/ A copper strike started in the U.S. on July 1, 1971, and ended in August, 1971. A loss of 250,000 tons of copper production is estimated as a result of the strike.



TABLE IV

WORLD ~~MINE~~ PRODUCTION OF COPPER BY COUNTRIES 1/

Country	1970	1971 (short tons)	1972 <u>p/</u>
North and Central America:			
Canada <u>2/</u>	672,717	721,429	800,619
Cuba <u>e/</u>	3,300	3,300	3,300
Dominican Republic	468	<u>e/500</u>	<u>e/500</u>
Haiti <u>3/</u>	5,344	<u>7,300</u>	<u>e/7,400</u>
Mexico	67,254	69,611	86,774
Nicaragua <u>3/</u>	3,705	4,037	3,970
United States <u>2/</u>	1,719,657	1,522,183	1,664,840
South America:			
Argentina	508	500	<u>c/500</u>
Bolivia <u>4/</u>	9,655	8,281	<u>9,324</u>
Brazil <u>5/</u>	4,233	5,622	4,745
Chile	783,391	790,722	798,919
Colombia	55	62	71
Ecuador	562	622	<u>e/660</u>
Peru	242,756	234,665	248,031
Europe:			
Albania <u>6/</u>	6,160	<u>e/7,000</u>	<u>e/7,200</u>
Austria	2,493	2,920	2,539
Bulgaria	47,500	50,000	53,000
Czechoslovakia	<u>r/4,850</u>	4,960	5,300
Finland	<u>r/34,150</u>	31,317	38,387
France	276	330	550
Germany, East <u>3/ 6/</u>	11,000	2,200	2,650
Germany, West	1,404	1,524	1,456
Hungary <u>e/</u>	1,100	1,300	1,300
Ireland	9,128	12,992	14,200
Italy	<u>r/2,329</u>	<u>7/1,698</u>	<u>7/1,193</u>
Norway <u>7/</u>	21,772	23,889	27,971
Poland <u>e/</u>	79,400	99,200	135,000
Portugal <u>7/</u>	4,103	4,362	5,290
Romania <u>e/ 2/</u>	14,300	15,700	38,600
Spain <u>7/ 8/</u>	10,496	37,514	35,461
Sweden	28,972	33,313	27,300
U.S.S.R. <u>3/ 6/</u>	630,000	680,000	733,000
Yugoslavia	100,099	104,049	113,684
Africa:			
Algeria	633	<u>e/660</u>	<u>e/660</u>
Angola	40	--	--
Congo (Brazzaville) <u>3/</u>	60	456	<u>e/550</u>
Kenya	87	80	79
Morocco <u>3/</u>	3,167	3,472	4,233
Mozambique <u>3/</u>	166	456	778
Rhodesia, Southern <u>9/</u>	29,241	32,338	42,218
South Africa, Republic of	164,470	173,581	178,494
South-West Africa territory of <u>3/ 10/</u>	34,605	35,317	<u>e/35,825</u>

(continued next page)

TABLE IV (continued)

## WORLD MINE PRODUCTION OF COPPER BY COUNTRIES 1/

Country	1970	1971 (short tons)	1972 p/
Africa (continued):			
Uganda	r/21,117	18,810	17,296
Zaire	425,138	447,349	472,891
Zambia	754,100	718,300	790,500
Asia:			
Burma 11/	77	88	88
China, People's Republic of e/	110,000	110,000	110,000
Cyprus 7/	20,019	21,376	12/20,900
India	11,312	11,867	12,856
Iran 13/	r/315	1,106	e/2,200
Israel	9,084	11,161	12,318
Japan 3/	131,740	133,411	125,248
Korea, North e/	14,000	14,000	14,000
Korea, Republic of	1,807	1,955	2,295
Malaysia	336	235	276
Philippines	176,696	217,787	225,970
Taiwan e/	2,700	2,600	2,200
Turkey	30,010	21,429	27,217
Oceania:			
Australia	173,933	192,018	203,930
Fiji	--	--	3
New Zealand	52	94	136
Papua, New Guinea	--	--	136,641
TOTAL	6,638,042 r/	6,653,048 r/	7,313,536

e/ Estimate p/ Preliminary r/ Revised

1/ Source: U.S. Bureau of Mines. In past years world production data by countries was presented for only 20 principle copper producing countries with the remaining countries' production combined under the appropriate continent. The data in the past was derived in part from U.S. Bureau of Mines figures and in part from American Bureau of Metal Statistics figures. Commencing with the 1972 report, copper production of all countries reported by the U.S. Bureau of Mines as producing copper will be given. Data presented represent copper content (recoverable where indicated) of ore mine wherever possible. If such data are not available the nonduplicative total copper content of ores, concentrates, matte, metal and/or other copper bearing products measured at the least stage of processing for which data available has been used.

2/ Recoverable. 3/ Copper content of concentrate produced.

4/ COMIBOL production plus exports by medium and small mines.

5/ Partly estimated, partly calculated on the basis of data furnished by CEBRACO.

6/ Smelter production. 7/ Includes copper content of cupriferous pyrites.

8/ Excludes an unreported quantity of copper in iron pyrites which may or may not be recovered. 9/ Year ending September 30 of that stated.

10/ Output of Tsumeb Corporation Ltd. and Klein Aub Koper Moatskappy Beperk for years ending June 30 of that stated. 11/ Content of matte produced.

12/ Exports. 13/ Year beginning March 21 of that stated.

TABLE V  
NEW (PRIMARY) REFINED COPPER PRODUCED IN, IMPORTED BY AND EXPORTED BY  
THE UNITED STATES AND WITHDRAWN FROM SUPPLY ON DOMESTIC ACCOUNT  
1967 - 1972

	Short Tons					
	1967	1968	1969	1970	1971	1972
Produced from U.S. Ores	846,551	1,160,925	1,468,889	1,521,183	1,410,523	1,680,412
Produced from Foreign Ores	286,431	276,461	273,926	243,911	181,259	192,821
Total New Refined Copper	<u>1,132,982</u>	<u>1,437,386</u>	<u>1,742,815</u>	<u>1,765,094</u>	<u>1,591,782</u>	<u>1,873,233</u>
Imports <u>1/</u>	330,571	400,278	131,171	132,143	163,988	192,379
Stocks at beginning of period <u>1/</u>	43,000	27,000	48,000	39,000	130,000	75,000
Total Available Supply	<u>1,506,553</u>	<u>1,864,664</u>	<u>1,921,986</u>	<u>1,936,237</u>	<u>1,885,770</u>	<u>2,140,612</u>
Exports <u>1/</u>	159,353	240,745	200,269	221,211	187,654	182,743
Stocks at end of period <u>1/</u>	27,000	48,000	39,000	130,000	75,000	57,000
Total	<u>186,353</u>	<u>288,745</u>	<u>239,269</u>	<u>351,211</u>	<u>262,654</u>	<u>239,743</u>
Withdrawn on Domestic Acc. (Apparent) <u>2/</u>	<u>1,320,200</u>	<u>1,575,919</u>	<u>1,682,717</u>	<u>1,585,026</u>	<u>1,623,000</u>	<u>1,901,000</u>
Reported Actual Consumption <u>3/</u>	<u>1,935,592</u>	<u>1,880,300</u>	<u>2,142,218</u>	<u>2,043,303</u>	<u>2,019,507</u>	<u>2,238,867</u>

Source: U.S. Bureau of Mines.

1/ May include some copper refined from scrap.

2/ Includes deliveries to Government stockpiles. Figure is of new copper, insofar as could be determined.

3/ Reported by consumer. Includes refined copper from secondary as well as the primary sources.

TABLE VI

## IMPORTS OF PRIMARY COPPER INTO THE UNITED STATES

By Major Countries, 1970 - 1972  
Totals only, 1967 - 1969

Source	Copper Content (short tons)		
	1970	1971	1972
<u>Ore, Concentrates, Matte</u>			
Canada	4,442	7,325	12,118
Chile	-	-	71
Mexico	135	4	8
Peru	8,949	8,999	9,486
Philippines	18,700	13,616	30,122
Australia	1,336	1,243	2,091
Other Countries	279	101	1,117
Total ore etc.	<u>33,841</u>	<u>31,288</u>	<u>55,013</u>
<u>Blister Copper</u>			
Mexico	2,504	4,926	9,544
Chile	97,952	40,594	33,208
Peru	94,868	89,901	81,559
South Africa, Republic of	28,946	21,247	23,053
Other Countries	146	76	10,068
Total Blister	<u>224,416</u>	<u>156,744</u>	<u>157,432</u>
<u>Refined Cathodes and Shapes</u>			
Canada	91,814	123,028	124,983
Chile	16,928	11,057	26,598
West Germany	(a)	4,387	1
Japan	13,132	(a)	1,125
Peru	6,209	3,510	2,204
United Kingdom	59	5,513	3,938
Zambia	1,102	6,668	-
Other Countries	2,899	9,825	33,530
Total Refined	<u>132,143</u>	<u>163,988</u>	<u>192,379</u>
Total Primary Copper Imports	390,400	352,020	404,824
Less: Primary Copper Exports (Ore, conct's., matte, blister and refined)	<u>290,554</u>	<u>224,478</u>	<u>208,924</u>
<u>Net Primary Imports</u>	<u>99,846</u>	<u>127,542</u>	<u>195,900</u>
	<u>1967</u>	<u>1968</u>	<u>1969</u>
Primary Copper Imports	632,864	698,555	408,168
Less: Primary Copper Exports	<u>219,045</u>	<u>321,484</u>	<u>205,786</u>
<u>Net Primary Imports</u>	<u>413,819</u>	<u>377,071</u>	<u>202,382</u>

Source: U.S. Bureau of Mines  
(a) Not listed separately



TABLE VII  
REFINED COPPER CONSUMED IN THE UNITED STATES 1970 - 1972  
BY CLASS OF CONSUMER <sup>1/</sup>  
(In short tons)

Class of consumer	Cathodes	Wire bars	Ingots and ingot bars	Cakes and slabs	Billets	Other	Total
<b>1970:</b>							
Wire mills	85,925	1,245,470	<sup>2/</sup>	-	-	7,345	1,338,740
Brass mills	154,174	27,862	120,880	156,770	200,785	112	660,583
Chemical plants	-	-	578	-	-	1,663	2,241
2nd'y smelters	3,286	-	3,749	-	-	7	7,042
Foundries	2,127	1,687	11,941	<sup>2/</sup>	<sup>2/</sup>	483	16,238
Miscellaneous <sup>3/</sup>	1,474	744	8,573	282	1,262	6,124	18,459
Total	246,986	1,275,763	145,721	157,052	202,047	15,734	2,043,303
<b>1971:</b>							
Wire mills	108,498	1,206,895	<sup>2/</sup>	<sup>2/</sup>	<sup>2/</sup>	9,501	1,324,894
Brass Mills	192,617	28,042	99,087	154,667	181,259	110	655,782
Chemical plants	-	-	191	-	-	1,320	1,511
2nd'y smelters	4,221	-	2,666	-	-	2	6,889
Foundries	2,183	1,659	8,950	<sup>2/</sup>	<sup>2/</sup>	852	13,644
Miscellaneous <sup>3/</sup>	1,907	332	7,447	170	1,000	5,931	16,787
Total	309,426	1,236,928	118,341	154,837	182,259	17,716	2,019,507
<b>1972:</b>							
Wire mills	222,394	1,295,401	<sup>2/</sup>	<sup>2/</sup>	<sup>2/</sup>	8,001	1,526,296
Brass mills	192,263	34,402	119,710	160,201	160,642	-	667,218
Chemical plants	-	-	35	-	-	819	854
2nd'y smelters	5,602	<sup>2/</sup>	4,129	-	<sup>2/</sup>	222	9,953
Foundries	2,790	1,494	9,705	<sup>2/</sup>	<sup>2/</sup>	1,236	15,225
Miscellaneous <sup>3/</sup>	1,789	632	7,860	312	797	7,931	19,321
Total	425,338	1,331,929	141,439	160,513	161,439	18,209	2,238,867

<sup>1/</sup> Source: U.S. Bureau of Mines.

<sup>2/</sup> Withheld to avoid disclosing individual company confidential data; included in "Other."

<sup>3/</sup> Includes iron and steel plants, primary smelters producing alloys other than copper, consumers of copper powder and copper shot and miscellaneous manufacturers.

TABLE VIII

## UNITED STATES PRODUCTION AND CONSUMPTION OF COPPER

In Short Tons

Year	Mine 1/	Production Secondary 2/	Total	Consumption Total 3/	Total Production As % of Consumption
1950	909,343	260,704	1,170,047	1,424,434	82.2
1951	928,330	186,462	1,114,792	1,416,865	78.7
1952	925,359	173,904	1,099,263	1,479,732	74.3
1953	926,448	242,855	1,169,303	1,494,215	78.3
1954	835,472	212,241	1,047,713	1,254,729	83.5
1955	998,570	246,928	1,245,498	1,502,004	82.9
1956	1,104,156	273,060	1,377,216	1,521,389	90.5
1957	1,086,141	248,015	1,334,156	1,347,815	99.0
1958	979,329	255,121	1,234,450	1,250,677	98.7
1959	824,846	261,588	1,086,434	1,463,031	74.3
Total	9,517,994	2,360,878	11,878,872	14,154,891	
Average 1950-59	951,799	236,088	1,187,887	1,415,489	83.9
1960	1,080,169	300,259	1,380,428	1,349,896	102.3
1961	1,165,155	290,805	1,455,960	1,462,830	99.5
1962	1,228,421	301,374	1,529,795	1,599,676	95.6
1963	1,213,166	314,643	1,527,809	1,744,273	87.6
1964	1,246,780	366,197	1,612,977	1,825,281	88.4
1965	1,351,734	462,811	1,814,545	2,004,623	90.5
1966	1,429,152	509,084	1,938,236	2,359,954	82.1
1967	954,064	423,054	1,377,118	1,935,592	71.1
1968	1,204,621	433,041	1,637,662	1,880,300	87.1
1969	1,544,579	514,593	2,059,172	2,142,218	96.1
Total	12,417,841	3,915,861	16,333,702	18,304,643	
Average 1960-69	1,241,784	391,586	1,633,370	1,830,464	89.2
1970	1,719,657	521,137	2,240,794	2,043,303	109.7
1971	1,522,183	429,095	1,951,278	2,019,507	96.6
1972	1,664,840	446,774	2,111,614	2,238,867	94.3

Source: U.S. Bureau of Mines.

1/ Recoverable copper.

2/ Copper recovered as unalloyed copper.

3/ Refined copper in cathodes, wire bars, etc.; reported by consumers.

TABLE IX

## EMPLOYMENT, EARNINGS AND HOURS IN COPPER MINING

## IN THE UNITED STATES AND ARIZONA

1966-1972 and Base Period 1947-1949

Period	All Employees		Production Workers							
	Ave. No.		Ave. No.		Ave. Weekly		Ave. Weekly		Ave. Hourly	
	(Thousands)		(Thousands)		Earnings		Hours		Earnings	
	1/ Ariz.	2/ U.S.	3/ Ariz.	4/ U.S.	5/ Ariz.	U.S.	6/ Ariz.	U.S.	7/ Ariz.	U.S.
1947-49	10.7	26.9	8.7a/	24.2	\$ 64.06	\$ 62.58	44.8	44.7	\$1.43	\$1.40
1966	15.2	31.9	12.4	26.2	150.06	140.07	45.2	43.5	3.32	3.22
1967	12.2	25.4	9.0	19.1	141.43	140.18	42.6	43.0	3.32	3.26
7 Mos.	15.7	33.2	12.4	27.3	149.41	142.76	44.6	43.5	3.35	3.28
5 Mos.	7.3	14.4	3.8	7.5	130.05	127.95	39.9	40.4	3.27	3.16
1968	13.8	28.1	11.1	21.3	149.21	161.68	43.0	47.0	3.47	3.44
3 Mos.	7.5	14.9	4.3	8.3	118.17	129.06	36.7	40.2	3.22	3.21
9 Mos.	15.8	32.5	13.0	25.6	160.11	165.28	45.1	47.8	3.55	3.46
1969	17.0	33.7	13.9	26.9	166.50	169.00	44.4	46.3	3.75	3.65
1970	18.8	37.0	14.9	29.5	173.01	175.67	43.8	44.7	3.95	3.93
1971	18.9	34.7	14.9	26.8	178.50	178.46	42.4	42.9	4.21	4.16
1972	20.5	38.9	16.1	30.7	194.69	192.19	41.6	41.6	4.68	4.62
Average										
1967-72	16.9	33.0	13.3	25.7	167.22	169.53	43.0	44.2	3.90	3.84

	Production Workers				Copper Ore 10/ Shipped or Treated	
	Ave. Earnings per		Aggregate Man-hours		(Thousand Short Tons)	
	Man per Year 8/		(Thousands) 9/			
	Ariz.	U.S.	Ariz.	U.S.	Ariz.	U.S.
1966	\$ 7,803	\$7,284	29,145	59,264	101,558	186,966
1967	7,354	7,284	19,937	42,708	74,289	127,066
1968	7,759	8,407	24,820	52,057	101,294	170,054
1969	8,658	8,788	32,092	64,764	127,849	223,752
1970	8,997	9,135	33,936	68,570	150,241	257,729
1971	9,282	9,280	32,852	59,785	149,294	242,656
1972	10,124	9,994	34,827	66,410	165,815	266,831
Average						
1947-49	3,331	3,254	20,268	56,250	38,083	82,875
1967-72	8,696	8,815	29,744	59,049	128,130	214,681

(continued next page)

TABLE IX (continued)

	Copper in Copper Ore <u>11/ 12/</u> (Recoverable Content) (Thousand pounds)		Production Workers			
			Copper Ore Mined per Man-hour (Tons)		Recoverable Copper Mined per Man-hour (Pounds)	
	Ariz.	U.S.	Ariz.	U.S.	Ariz.	U.S.
1966	1,474,447	2,805,136	3.485	3.155	50.590	47.333
1967	1,000,572	1,866,037	3.726	2.975	50.187	43.694
1968	1,252,919	2,349,046	4.081	3.267	50.480	45.124
1969	1,593,544	3,021,590	3.984	3.455	49.656	46.655
1970	1,826,734	3,368,957	4.427	3.759	53.829	49.132
1971	1,633,568	2,986,599	4.544	4.059	49.725	49.996
1972	1,816,618	3,264,113	4.761	4.017	52.161	49.151
Average						
1947-49	723,354	1,587,038	1.878	1.473	35.689	28.214
Average						
1967-72	1,520,659	2,809,398	4.253	3.588	51.006	47.292

- 1/ These estimates of "All Employees," made by the Employment Security Commission of Arizona, in cooperation with the U.S. Bureau of Labor Statistics, include all full and part time wage and salary workers who were employed in copper mining in any part of the pay periods which included the 12th of each month of the year. See note 2, Table XV for explanation of differences between numbers of "Covered Employees" in Arizona Copper Mining in that table and those in this Table IX for "All Employees," for the respective years.
- 2/ Estimates of "All Employees" in the United States industry division, "Mining-Copper Ores," which excludes copper smelting. The estimates have been made by the U.S. Bureau of Labor Statistics with the cooperation of the 50 states, and are based upon monthly samplings similar to those in 1/ above, adjusted periodically to census benchmarks.
- 3/ Estimates of production (non-supervisory) workers in Arizona Copper Mining, based upon samplings as in Note 1/.
- 3/a/ Estimate for 1947-49 is based upon assumption of the same ratio of "production" to "all" employees as that for the year 1949. The numbers of "All Employees" for the years 1947 to 1949 varied less than 2 percent from the average of 10,700 for the three years.
- 4/ Estimates of "Production or Non-supervisory Workers" in U.S. "Mining-Copper Ores," made as in 3/ above.
- 5/ Figures for "Average Weekly Earnings" are products of the figures for "Average Weekly Hours" and "Average Hourly Earnings" for the respective years.

(continued next page)

TABLE IX (continued)

- 6/ The gross number of hours worked by production (non-supervisory) and related workers in a monthly sample period divided by the average number of the same workers in the corresponding period, provides the basis for the estimate of "average weekly hours" for the month. Averages for a year or period of months are arithmetical averages of the estimates for the months involved.
- 7/ Gross payroll aggregates, exclusive of irregular bonuses and other pay not earned in a sample pay period, are divided by gross man-hour aggregates of production and related workers for the period in order to determine average hourly earnings. Average hourly earnings for a year or period of months are arithmetical averages of monthly estimates based on the results of the respective sample periods.
- 8/ "Average Weekly Earnings" times 52 weeks.
- 9/ Number of production workers times "Average Weekly Hours" times 52.
- 10/ Copper ore mined and shipped or treated by concentration, smelting or leaching.
- 11/ Recoverable copper from copper ore (Note 10/) and from copper precipitates from dump and in-place leaching.
- 12/ Copper from precipitates is held to be largely a by-product of copper ores, similar to the gold, silver, molybdenum and other metals recovered from copper ores. In previous years, copper from precipitates has not been included in our tables similar to this one. For years prior to 1968, our tables have had added to the recoverable copper from ores a figure for "equivalent copper" computed by dividing the combined value of the by-product gold and silver recovered from the ore, by the average price per pound of copper. The rapid increase in value of the annual recovery of molybdenum has made it rather pointless to continue this somewhat equivocal figure for "equivalent copper" without including the moly. In recent years copper precipitates have yielded value greater than that of the other by-products combined. They require some labor from "Production Workers," and the inclusion of copper from precipitates as reported by the Bureau of Mines has some justification although its labor requirement is minor. The inclusion removes most if not all of the justification for a figure of "equivalent copper" - even with molybdenum added in its calculation.



TABLE X

UNITED STATES COPPER MINING - OUTPUT OF COPPER ORE; AMOUNT AND VALUE OF  
COPPER, GOLD AND SILVER RECOVERED THEREFROM 1/

Year	Copper Ore Tons	Gold Troy Ounces Value	Silver Troy Ounces Value <u>8/</u>	Copper <u>2/</u> Pounds Value	Lbs./Ore Ton Ave. c/lb. <u>3/</u>	Value of Copper, Gold and Silver
1962	150,216,710	483,243 \$16,913,505	10,944,522 \$11,874,806	2,239,326,000 \$ 685,233,756	14.9 30.600	\$ 714,022,067
1963	146,449,540	438,537 \$15,348,795	10,309,897 \$13,187,595	2,178,498,800 \$ 666,620,633	14.9 30.600	\$ 695,157,023
1964	155,200,464	430,630 \$15,072,050	11,470,890 \$14,831,861	2,280,880,781 \$ 688,734,761	14.7 31.960	\$ 718,638,672
1965	173,286,198	567,531 \$19,863,585	12,801,638 \$16,552,518	2,430,879,000 \$ 851,220,899	14.0 35.017	\$ 887,637,002
1966	186,966,042	547,327 \$19,156,445	13,230,411 \$17,106,921	2,499,863,100 \$ 904,200,483	13.37 36.170	\$ 940,463,849
1967	127,066,097	321,398 \$11,248,930	8,351,423 \$12,942,033	1,608,078,200 \$ 614,703,973	12.66 38.226 <u>4/</u>	\$ 638,894,936
1968	170,054,065	405,863 \$15,934,200	9,532,341 \$20,443,000 <u>8/</u>	2,055,156,700 \$ 860,021,400	12.09 41.847 <u>5/</u>	\$ 896,398,600
1969	223,751,510	579,297 <u>6/</u> \$24,440,500 <u>7/</u>	13,581,516 <u>6/</u> \$24,320,000 <u>8/</u>	2,691,376,400 \$1,279,318,900	12.03 47.534	\$1,328,079,400
1970	257,729,000	552,140 <u>6/</u> \$21,080,600 <u>7/</u>	15,728,600 <u>6/</u> \$27,852,500 <u>8/</u>	3,025,021,000 \$1,745,437,000	11.74 57.700	\$1,794,370,000
1971	242,656,000	478,281 <u>6/</u> \$19,518,648 <u>7/</u>	13,142,041 <u>6/</u> \$20,312,339 <u>8/</u>	2,677,569,000 \$1,377,073,737	11.03 51.43	\$1,416,904,724
1972	266,831,000	484,552 <u>6/</u> \$28,297,837 <u>7/</u>	14,655,772 <u>6/</u> \$24,688,381 <u>8/</u>	2,922,127,000 \$1,479,180,687	10.95 50.62	\$1,532,166,905

1/ U.S. Bureau of Mines. 2/ Doesn't include precipitate copper from dump and in-place leaching. 3/ E/MJ average price, domestic, f.o.b. refinery 4/ Based on first 8 months of 1967 5/ Based on last 9 months of 1968 6/ Does not include gold or silver recovered from vat or heap leaching of copper ores. 7/ At average domestic gold prices in "Metal Statistics, 1971": year 1968, \$39.26 per oz.; 1969, \$42.19; 1970, \$36.39; 1971, \$40.81; 1972, \$58.40 8/ At average E/MJ N.Y. market price for silver .999 fine.

## Arizona's Copper Industry

From Arizona's mines 908,612 short tons of recoverable copper in 1972 were obtainable, more than all of the other states combined and more than any other single nation. Her 1972 recoverable content of ores was 10.8% greater than her like 1971 figure of 820,171 short tons, but 1% below her record 1970 production of 917,918 short tons. The value of the 1972 production, \$930,419,000, was 9.1% greater than the 1971 value of \$852,978,000. The value of Arizona's 1972 copper production was still lower than her 1970 value of \$1,059,277,000, caused by the lower than record production and lower than record 1970 copper prices.

The October, 1972, Directory of Active Mines in Arizona, published by the Arizona Department of Mineral Resources, lists the following 19 companies as operating copper producing properties in Arizona. They are: American Smelting and Refining (Asarco), Anaconda, Bagdad Copper, Big Hole Mining, Cities Service, Cyprus Mines, Duval, Duval-Sierrita, El Paso Natural Gas, Hecla, Inspiration, Kennecott, Magma, McAlester Fuel, Phelps Dodge, Pima Mining and Ranchers Exploration and Development. These 17 companies operated 29 mines.

These 29 mines produced 54.6% of the United States recoverable copper production and 12.4% of all the copper produced in the world in 1972. Ranking second after Arizona was Utah, producing 15.6% of the nation's total; New Mexico, third with 10.1%; Montana, fourth with 7.4%; Nevada, fifth with 6.1% and Michigan, sixth with 4.0%.

The average copper content of the 165,915,825 tons of copper, copper-zinc and lead-zinc ores mined in Arizona in 1972 was only 10.95 pounds per ton. Although the value is greater than last year's figure of 9.8 pounds per ton, the two grades are not comparable because of the inclusion of some high grade copper-zinc ore in the total of ore mined. This inclusion was made for 1972 by the U.S. Bureau of Mines to protect confidential data from the producers of the copper-zinc and lead-zinc ore. However, if we use ore grade data from only the ten large copper producing companies, we will then have comparable figures of 11.1 pounds per ton in 1971 and 11.3 pounds per ton in 1972. These compare with 14.1 pounds per ton in 1965 and 15.0 in 1960. Improvement in equipment and technology, plus recovery of byproduct molybdenum, significantly benefited the mining of such low grade ores in the face of rising labor and capital costs. Were it not for the recovery of substantial amounts of molybdenum in a number of the newer mines, it is questionable whether their operation would have been economically feasible.

The gross value of Arizona's copper production in 1972 was 85.3% of the \$1,091,004,000 combined total of all minerals, mineral materials and petroleum products produced in Arizona. Copper mining (including copper-zinc and lead-zinc mining at probably only one Arizona mine) was the source of 93.3% of the copper produced (the remaining 6.9% came from gold-silver and silver mining, gold-silver tailings, copper cleanup from properties not classified as mines and copper precipitates), 99.5% of the gold produced, 99.4% of the silver, all of the molybdenum, all of the zinc and all of the lead, the combined value of which is \$939,089,000, or 86.1% of Arizona's total 1972 mineral production.

The ten larger companies, which produced most of Arizona's production, operated 16 large open-pit mines and 3 large underground mines. Sixteen of the nation's 25 leading copper mines are located in Arizona. They are: Magma's San Manuel Mine, 2nd to the 1st place Utah Copper Mine owned by Kennecott; Phelps Dodge's Morenci Mine, 3rd; Kennecott's Ray Mine, 5th; Pima Mining Company's Pima Mine, 6th; Anaconda's Twin Buttes Mine, 8th; Duval Sierrita's Sierrita Mine, 9th; Phelps Dodge's New Cornelia Mine, 12th; Inspiration Consolidated Copper's Inspiration Mine, 13th; Asarco's Mission, 14th; Phelps Dodge's Copper Queen, 17th; Duval's Mineral Park, 18th; Cities Service's Copper Cities Mine, 19th; Asarco's Silver Bell, 20th; Phelps Dodge's Lavendar Pit, 22nd; Bagdad Copper Corporation's Bagdad Mine, 23rd and Magma Copper Corporation's Magma Mine, 24th. The ore from the 16 open pit mines of the nine larger companies yielded 9.5 pounds of copper per ton; that from the 3 underground mines yielded 15.8 pounds per ton. Ore production, recoverable copper content of ore and recoverable molybdenum content of ore for the major Arizona copper mines in 1971 and 1972 is given in Table XIV of this report.

In spite of difficulties with pollution control regulations, fuel availability and equipment problems, 1972 was an active year for Arizona copper companies with announcements of new facilities, new mines and active exploration programs. The annual reports of the companies mining copper in Arizona contain a summary of each company's important events during the past year. Those annual reports have provided the information for following company-by-company summary.

#### Anaconda - Twin Buttes

American Metal Climax, Inc. (AMAX) announced an agreement in principle with Anaconda for their joint participation in Anaconda's Twin Buttes copper mine near Tucson, Arizona. Anaconda developed the mine and has operated it since 1969 under lease from Banner Mining Company. Amax agreed to purchase Banner's interest and will invest an additional \$93 million in mine development over a three year period. Amax will acquire a one half interest in the mine and will be entitled to one half of the mine production. Anaconda and Amax will jointly expand production, including the construction of a plant for treatment of oxide copper ore from the mine, that will cost \$59 million and will treat 10,000 tons of ore per day.

Concentrates from the Twin Buttes mine are processed at custom smelters in the southwest. One of those smelters curtailed production during the year because of air pollution regulations, and at year end 1972, a substantial inventory of untreated sulphide concentrates had accumulated at the mine.

The mine, in operation since 1969, presently processes sulphide-type ores only. A new plant will be constructed for the treatment of oxide copper ores. The plant, which is scheduled for completion early in 1975, will treat 10,000 tons of ore each day and will produce 30,000,000 pounds of electrolytic copper each year and will cost approximately \$59 million. Under the agreement with Amax, it is intended that the plant will become part of the jointly owned Twin Buttes mine. Twenty million tons of oxide ores have already been mined and are stockpiled for treatment in the new facility.

In the spring of 1973 the merger of Banner Mining Company with Amax became effective. In late June, 1973, Anaconda and Amax signed an agreement creating Anamax Mining Company, a 50-50 partnership to operate and expand the Twin Buttes mine. The agreement includes plans of raising annual production to approximately 240,000,000 pounds of copper. Amax will market its share of the Anamax production independently of Anaconda.

Although not directly related to Anaconda's operations in Arizona, the company did make an announcement in 1972 that may have far-reaching effects on the entire copper industry. In 1972 the company made a decision to proceed with the construction of a new plant at Anaconda, Montana, to convert sulphide copper ore concentrates into electrolytic copper by a new hydrometallurgical process known as the "Arbiter Process." Developed by Anaconda personnel at the company's research department in Arizona, the process is expected to entail a lower initial investment and reduced operating costs compared with conventional smelting and refining processes. The new process is essentially free from air pollution, can be used in connection with existing conventional smelter operations, and is considered a most important development for Anaconda. The new plant will cost an estimated \$25 million and will produce 72,000,000 pounds of electrolytic copper annually.

#### ASARCO

Two new mine projects got underway in Arizona during 1972. Construction of a leach plant to handle 4,000 tons per day of copper oxide from the north mine at San Xavier began early in the year, was 80% completed by year end and dedicated June 14, 1973. San Xavier also continued to produce copper-bearing flux ore for use at Asarco's Hayden smelter.

Asarco's second copper project is the Sacaton Mine near Casa Grande. Construction began in May, 1972, and the open-pit mine and mill are expected to be in operation early in 1974. When both San Xavier and Sacaton are in operation, the combined annual capacity will be 66,000,000 pounds of copper contained in precipitates and concentrates.

Asarco's three copper smelters, two of which process concentrates from Asarco's mines and many other large Arizona mines were not able to operate at full capacity, principally due to the curtailment of production for air quality control purposes, and to a smaller degree, to the shortages of natural gas during severe winter weather. Major breakdowns of air compressor equipment at the Hayden smelter caused an approximately 30% cutback in production for three months. These curtailments caused Asarco to invoke force majeure on shipments of concentrate to the smelters as of June 1, which continued at varying rates through the end of the year.

To comply with pollution control regulations a 1000 ton per day sulfuric plant was constructed at the Hayden smelter and dedicated in January, 1972. The ambient air quality at Hayden will be further improved by the construction in 1973 of a 1000 foot high stack and installation of a new "closed-loop" sulfur dioxide monitoring system.



## Bagdad

Expansion planning was the most significant activity at Bagdad during 1972. In 1971 Bagdad announced a mine expansion program that would allow the mining of an additional 265 million tons of ore over a period of 26 years. The announced program would include an increase in milling capacity from the present 5,600 tons per day to 30,000.

As of July 1, 1972, Bagdad still had considerable copper in concentrate in inventory from 1971. By year-end 1972, much of the excess concentrate had been shipped to White Pine, Michigan, at considerable freight cost. Bagdad ships the majority of their concentrate to the Asarco smelter at Hayden, but the Hayden smelter is unable to take all of Bagdad's concentrate at the present production rate. An increase in production rate of over 5 times would leave the company hard pressed to dispose of their additional concentrate without building their own smelter.

A number of smelting processes were evaluated. Use of a number of smelting processes at Bagdad were ruled out because of risk associated with the use of a process with little commercial history. During the third quarter, a large engineering consulting firm was engaged to evaluate Roast-Leach-Electrowinning (RLE) as a method of treating the increased concentrate production.

On January 16, 1973, it was announced that the management of Cyprus Mines Corporation and Bagdad Copper Corporation had agreed in principle to merge the two companies. The merger was completed on June 25, 1973. Under an expansion plan considered by Bagdad, they estimated that a very large capital investment (in the order of \$100,000,000) would be required.

## Cities Service

Cities Service's mining and leaching production at the Miami Copper Operations was at full capacity throughout 1972.

Development of the 350 million ton, low-grade Pinto Valley copper ore body, located eight miles west of Miami, Arizona, was started in May, 1972. Mill construction and preproduction stripping are on schedule. Ore production and milling are scheduled to start in mid-1974 and to reach the design capacity of 40,000 tons per day early in 1975.

Development is underway at the high grade Miami East ore body located 2,500 to 3,700 feet underground in the Miami area. Extension of an existing Miami shaft will be completed in 1974 with development of the mine to follow immediately. Ore production is expected to start in late 1974.



## Cyprus

The 50.01 percent Cyprus Mines Corporation owned Pima Mine near Tucson saw the completion of a 35 percent expansion of facilities early in 1972. Mill throughput averaged 51,200 tons a day, a 27 percent increase over 1971. The new installation uses large-diameter semiautogenous grinding mills and ball-mill grinding. The new mill section eliminates secondary and tertiary crushing and the rod-mill grinding stages required in the older sections of the concentrator. Studies are under way regarding a possible pit extension to the east and south, which could double the remaining life of the operation.

Cyprus' wholly-owned Bruce Mine near Bagdad operated at near capacity. Although the Bruce mine is primarily a zinc producer, it does produce nearly 7,000,000 pounds of copper annually. The mine is a small high-grade underground operation with a concentrator and supporting facilities. Known reserves are sufficient for at least five years at the present operating rate.

The Company's principal research activity in 1972 was the work performed on a patented new electrochemical process designed to permit the production of copper with no accompanying air or water pollution. This research is being conducted by Cyprus Metallurgical Processes Corporation (Cymet) of which Cyprus owns 90 percent. A demonstration plant is being built in Arizona designed to prove the commercial feasibility of the process. The plant is expected to be in operation late in 1973.

The Cymet process leaves only a small amount of inert solid waste after treating concentrates and does not create pollution. It is expected to be competitive with the cost of conventional pyro-metallurgical processes, and can be applied to other sulfide ores including lead and zinc as well as copper. If it is demonstrated that Cymet will recover all metal values in concentrates more efficiently and economically than present techniques, it will use the nation's diminishing natural resources to better advantage. The Cymet process underwent two years of intensive laboratory research before construction of the demonstration plant was authorized.

## Duval

Duval Corporation witnessed steady market growth for its products in 1972. Sales volumes of copper were up 89,000,000 pounds (46%) and molybdenum up 6,200,000 pounds (60%) over 1971.

The Duval Sierrita Copper/Molybdenum Mine near Tucson, Arizona, is operating at intended capacity. With earlier mechanical problems resolved, Sierrita averaged 84,600 tons of ore milled daily during November and December.

Duval's Esperanza property adjacent to Sierrita resumed operations in January, 1973, at its former capacity of 15,000 tons of ore per day. Esperanza suspended production in December, 1971, due to excess concentrate stockpiled as a result of strikes at non-company smelters.

For two years, Duval Corporation has operated a hydrometallurgical pilot plant under the title Project CLEAR. The CLEAR process creates no solid, liquid or gaseous pollution. Designed to solubilize a variety of copper sulphide minerals in a recycling solution, CLEAR electrolytically deposits metallic copper and discharges sulphur, iron and other metals associated with the copper mineral as solid by-products. In this process electrolytically-produced copper is discharged continuously.

From conclusions drawn in 1972 and three preceding years of laboratory and pilot work, the construction of a CLEAR-process plant has now been authorized. Budgeted at approximately \$22 million, the plant will be designed to produce 32,500 tons of copper per year on a site adjacent to the Duval Sierrita Mine.

### Hecla

Hecla is the 50% owner and operator of the Lakeshore copper deposit on the Papago Indian Reservation with El Paso Natural Gas Company owning the other 50% interest. The total project cost, including start-up cost, working capital and prior expenditures is estimated at \$140,000,000. Production is currently scheduled for early 1975. The deposit will be mined by underground methods.

Surface drilling was continued during the early part of 1972 to fill in the drill pattern and further delineate the northerly portion of the deposit. Drilling was also continued throughout the year to explore lands surrounding the mining claims and mineral leases. Total drilling on the property to the end of 1972 was approximately 363,000 feet.

The concentrator, roast-leach electrowinning and vat leach pilot plants operated successfully during the year and provided the data necessary for design engineering of the commercial plants. Some additional pilot test work in the vat leach-cementation and sponge iron processes will be continued in 1973.

### Inspiration

By the expenditure of some \$50 million, Inspiration will build an entirely new smelter which will include: An electric furnace that will concentrate sulfur gases and make them suitable for conversion into acid; five new siphon-type converters that combine efficiency with maximum capture and minimum dilution of the sulfur oxide gases; an extensive gas cleaning plant including electrostatic precipitators which, along with other devices and design advantages, will capture all sulphur gases from that stage in concentrated form; a double-absorption acid plant which, aided by the concentrated feed gases, will be able to produce about 1330 tons of sulphuric acid a day.

In addition to the \$50 million for the new smelter, capital expenditures will be required to prepare oxide ore deposits for leaching with the newly produced acid; but these investments will result in additional production of copper, whereas the \$50 million investment, brought about solely by the need to comply with air quality standards, won't by itself produce any more copper.

At the company's Sanchez Project, near Safford, Arizona, preliminary mining plans and conceptual metallurgical plant design are complete. As of year-end 1972 no firm date has been set to develop the mine and build the necessary plant facilities.

Inspiration has secured a patent on the di-chromate leaching of copper and other metal, followed by electrowinning extraction of values from solution, a method which eliminates the usual smelting operation. The company believes this new process offers interesting possibilities for use at some of their new mine prospects.

#### Kennecott's Ray Mine

At Kennecott's Ray Mines Division the Mineral Creek flood control dam was completed in April, 1972. The dam prevented severe damage to the mine during the year when heavy and unseasonable rains inundated the area. The more than three mile long Mineral Creek Tunnel is virtually completed. Contracts were awarded for equipment to bring the Division into compliance with Arizona's air pollution standards by the end of 1973. An air surveillance system to monitor ambient air quality in the Hayden, Arizona, area has been arranged in cooperation with the neighboring ASARCO smelter.

A contract was awarded to remodel and enlarge the sulfuric acid plant at the Division's smelter at Hayden. The enlarged facility is expected to have a capacity of about 900 tons of acid per day, more than double the previous capacity of 400 tons of acid per day. The increased acid plant capacity is required to bring the smelter into compliance with current air pollution control regulations.

An in-place leaching experiment was initiated at the Ray Mine. The project involves drilling a deep hole in mineralized rock below the pit level, then attempting to force a leaching solution into the mineralized zone and collecting the solution from another hole. If successful, the method might find economic use at other deposits.

#### Magma Copper

Newmont Mining Corporation's wholly-owned Magma Copper operated their mines at San Manuel and Superior without interruption throughout 1972. New equipment start up difficulties in the San Manuel smelter hampered output of anode copper. As a result, tonnage of copper produced was lower than expected, although higher than in 1971.

The San Manuel mine demonstrated its ability to produce up to 65,000 tons of ore per day. The mine's 1972 production was 271,501,061 pounds of recoverable copper, up 63% from that of 1971 (166,656,905 pounds), and thus establishing the mine as the second largest domestic copper producer. San Manuel's new continuous-cast rod plant (the second one to become operative in Arizona) worked well right from start up.

At Superior the program of doubling mine and mill capacity to 3,300 tons of ore per day is ahead of the original schedule. The new facilities are expected to be in operation in the fall of 1973, which should increase the Superior Division's annual output of copper in concentrates from about 40,000,000 pounds to over 80,000,000 pounds. The cost of the new construction at Superior, which includes sinking a new shaft, driving a haulage tunnel, developing new mining areas, building new surface facilities and expanding the concentrator, is expected to total about \$74.8 million.

At San Manuel, plans to meet air pollution standards are being implemented by installing an acid plant for conversion of the sulfur dioxide in the converter gas to sulfuric acid which is expected to remove up to 70 percent of the smelter's SO<sub>2</sub> emission. The plan includes a revised collection and cooling system for the converter gases. The acid plant is now under construction, and an ambient air monitoring and weather forecasting system has been installed around San Manuel to aid in control of the smelter to meet Arizona and Federal ambient air quality standards. The company has already made arrangements to dispose of up to 500,000 tons of acid annually from the production of the sulfuric acid plant to a major acid consuming company.

#### Phelps Dodge

Phelps Dodge's open pit mines and concentrators at Morenci and Ajo operated on the equivalent of a six day week throughout 1972, the open pit mine and concentrator at Bisbee on a 5½ day week, and the underground mines at Bisbee on a five day week.

It presently appears that the open pit mine at Bisbee will be able to operate through all of 1973 before shutting down due to exhaustion of ore reserves. The Bisbee underground mines will probably continue to operate for a limited time thereafter, although this will depend upon the relationship between production costs and the price of copper.

The company's smelters at Morenci, Ajo and Douglas produced a total of 390,291 tons of copper anodes, an all time record. This quantity includes, in addition to copper from the company's own mines, copper smelted on toll for other mines and copper from purchased scrap.

Major capital outlays were made at both Morenci and Ajo for equipment modification and construction related to air quality control.

At the company's new Metcalf mine near Morenci being developed to produce 100,000,000 pounds of copper annually, the removal of overburden continued throughout the year. The power plant was completed and the site for the concentrator and related facilities was prepared. Construction of the concentrator is now under way.

Development of the Metcalf mine has made necessary the re-routing of a ten mile stretch of U.S. Highway 666. The re-routed part of the highway, constructed at Phelps Dodge's expense, goes along the west rim of the Morenci mine where an observation point has been built that affords a spectacular view of both the Morenci and the developing Metcalf mines.

The company's preliminary development program at Safford, Arizona, where they have a deep orebody containing an estimated 250 million tons of ore with an average grade of 0.92% copper, progressed during 1972. A haulage drift at a depth of 1800 feet was advanced into the orebody, and a test block is being drawn to determine the caving characteristics of the ore. No decision has yet been made as to when the property might be developed for production.

### Ranchers

A major development at Ranchers' Bluebird Mine was the company's announcement in February, 1973, that it had reached a preliminary agreement in principle with Mitsubishi International Corporation on terms of a possible joint venture to expand operations at the mine. The proposed agreement provides that Mitsubishi will initially contribute about \$250,000 to cover costs of research and test work related to changing the leaching system at the mine and enlarging production facilities.

The proposed expansion would include enlargement of the solvent extraction-electrowinning plant and a change in the leaching system so that production could be expanded to about four times the present annual output of 7,500 tons of cathodes. The ore treatment system would involve vat, agitation or acid leaching or some similar method to increase the recovery of copper from the ore.

The in situ leaching operation at the Old Reliable Mine is a joint project of Ranchers and DuPont. The operation involves the in-place leaching of approximately 4 million tons of .74 percent copper ore, which were shattered by explosives in a large blast in March, 1972. Leaching solutions were applied in late August, 1972, and copper-bearing liquors began to return in volume during February, 1973. By the end of June, 1973, production of cement copper was averaging about 17,000 pounds daily.



TABLE XI

## ARIZONA COPPER MINING - OUTPUT OF COPPER ORE; AMOUNT AND VALUE OF

COPPER, GOLD, SILVER AND MOLYBDENUM RECOVERED THEREFROM <sup>1/</sup>

Year	Copper Ore Tons	Gold Troy Ounces Value	Silver Troy Ounces Value	Molybdenum <sup>2/</sup> Lbs. ) Thou- Value) sands	Copper <sup>3/</sup> Pounds Value	Lbs./Ore Ton Ave./c lb. <sup>4/</sup>	Value of Copper, Gold, Silver & Molybdenum
1962	78,868,147	117,362 \$4,107,670	4,571,370 \$ 4,959,936	4,412 \$ 5,864	1,200,945,700 \$ 367,489,384	15.2 30.600	\$ 382,420,990
1963	80,615,132	121,177 \$4,241,195	4,494,239 \$ 5,743,132	5,553 \$ 7,584	1,217,337,700 \$ 372,505,336	15.1 30.600	\$ 390,073,663
1964	86,132,039	133,983 \$4,689,405	4,915,362 \$ 6,355,563	6,296 \$ 9,532	1,279,898,700 \$ 409,055,625	14.9 31.960	\$ 429,632,593
1965	92,859,535	133,830 \$4,684,050	5,352,850 \$ 6,921,235	9,399 \$15,880	1,309,809,700 \$ 458,305,893	14.1 35.017	\$ 485,791,178
1966	101,558,298	127,431 \$4,460,085	5,595,644 \$ 7,235,168	10,161 \$17,812	1,359,481,200 \$ 491,724,350	13.39 36.170	\$ 521,231,603
1967	74,289,203	66,933 \$2,342,655	3,996,587 \$ 6,193,431	9,261 \$15,385	901,853,500 \$ 344,742,519	12.14 38.226	\$ 368,663,605
1968	101,293,963	89,419 \$3,510,600	4,697,394 6/\$10,074,000	12,127 \$19,207	1,146,313,600 \$ 479,697,900	11.32 41.847	\$ 512,489,500
1969	127,848,828	108,718 \$4,586,800	5/ 5,899,843 5/ \$10,564,700	12,699 \$20,947	1,477,520,000 \$ 702,324,400	11.56 47.534	\$ 738,422,900
1970	150,240,842	107,292 \$3,904,400	5/ 7,130,261 5/ 6/\$12,626,700	15,672 \$26,700	1,694,294,000 \$ 977,608,000	11.28 57.700	\$1,020,838,800
1971	149,293,547	93,617 \$3,820,510	5/ 6,106,204 5/ 6/\$ 9,437,749 7/	22,684 \$39,872	1,529,780,500 \$ 786,812,004	9.76 51.433	\$ 830,598,891
1972	165,914,825 <sup>8/</sup>	102,526 \$5,987,518	5/ 6,614,957 5/ 6/\$11,143,226 7/	27,216 \$46,791	1,695,858,000 \$ 858,392,446	10.22 50.617	\$ 922,314,190

<sup>1/</sup> U.S. Bureau of Mines.<sup>2/</sup> Molybdenum content of recovered concentrate.<sup>3/</sup> Does not include precipitate copper from dump and in-place leaching.<sup>4/</sup> E/MJ average prices, domestic, f.o.b. refinery.<sup>5/</sup> Does not include gold or silver recovered from vat or heap leaching of copper ores.<sup>6/</sup> At average gold prices; See note <sup>7/</sup>, Table IX.<sup>7/</sup> At average E/MJ N.Y. market price for .999 fine silver.<sup>8/</sup> Includes some copper-zinc and lead-zinc ore in addition to copper ore, all of which is combined to avoid disclosing individual company confidential data.

TABLE XII

## ARIZONA MINE PRODUCTION OF COPPER, LEAD, ZINC, GOLD AND SILVER

1858 - 1972 Inclusive - In terms of Recoverable Metals

	COPPER		LEAD		ZINC	
	Short Tons	Value (thousands)	Short Tons	Value (thousands)	Short Tons	Value (thousands)
1874 - 1971	24,890,751	12,944,667	654,666	129,419	1,047,213	257,239
1972	908,612	930,419	1,763	530	10,111	3,589
Total 1874 - 1972	25,799,363	13,875,086	654,429	129,949	1,057,324	260,828

  

	GOLD		SILVER		COPPER, LEAD, ZINC, GOLD AND SILVER
	Ounces	Value (thousands)	Ounces	Value (thousands)	Combined Value
1858 - 1971	13,955,181	377,799	422,692,226	449,939	14,079,932,000
1972	102,996	6,036	6,653,000	11,210	951,784,000
Total 1858 - 1972	14,058,177	383,835	429,345,226	461,149	15,031,716,000

  

Est. Value of Other Metals & Non-Metallics Produced thru 1971	1,167,124,000
Value of Other Metals & Non-Metallics Produced in 1972	139,220,000
Est. Value of Other Metals & Non-Metallics Produced thru 1972	1,306,344,000
Grand Total Estimated Value of Arizona Mineral Production thru 1972	16,338,060,000

Source: U.S. Bureau of Mines; U.S. Geological Survey; Arizona Bureau of Mines

TABLE XIII

MINE PRODUCTION OF GOLD, SILVER, COPPER, LEAD AND ZINC IN ARIZONA IN 1972, BY CLASSES OF ORE OR OTHER SOURCE MATERIALS, IN TERMS OF RECOVERABLE METALS

Source	Number of Mines <u>1/</u>	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Gold-silver-----	1	19,500	43	517	93	-	-
Silver-----	2	10,785	1	6,562	1	-	-
Total-----	3	30,285	44	7,079	94	-	-
Copper, copper-zinc, lead-zinc <u>2/</u> -----	32	165,914,825	102,526	6,614,957	847,929	1,763	10,111
Other lode material:							
Gold-silver tailings-----	1	83,493	418	29,890	119	-	-
Copper cleanup-----	(3/)	527	2	874	90	(4/)	-
Copper precipitates-----	11	82,124	-	-	60,380	-	-
Total-----	12 <sup>4</sup>	166,144	420	30,764	60,589	-	-
Placer-----	1	-	6	-	-	-	-
Grand total-----	40	166,111,254	102,996	6,652,800	908,612	1,763	10,111

1/ Detail will not necessarily add to totals because some mines produce more than one class of material.

2/ Combined to avoid disclosing individual company confidential data.

3/ From properties not classed as mines.

4/ Less than  $\frac{1}{2}$  unit.

Source: U.S. Bureau of Mines.

TABLE XIV COPPER AND MOLYBDENUM PRODUCTION OF LARGE ARIZONA COPPER MINES

Company Mine	1971			1972		
	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum
<u>ANACONDA:</u> Twin Buttes	<u>7,676,640</u>	<u>106,661,096</u>	<u>1,208,000</u>	<u>10,137,624</u>	<u>155,719,980</u>	<u>2,119,249</u>
<u>ASARCO:</u> Silver Bell	3,796,000	38,692,504		3,839,600	39,223,598	128,582
Precipitate Copper	-	6,296,544			7,897,007	-
Mission	6,724,900	79,048,691		8,363,800	90,742,767	1,902,029
San Xavier - Si. flux	68,159	1,046,293		75,580	1,229,772	-
Total	<u>10,589,059</u>	<u>125,084,032</u>	<u>1,659,000 2/</u>	<u>12,278,980</u>	<u>139,093,144</u>	<u>2,030,611</u>
<u>BAGDAD:</u> Bagdad	2,000,974	25,039,418		1,982,368	24,558,652	455,380
Precipitate Copper		-			-	
Cathode Copper		14,680,540			13,390,668	
Total	<u>2,000,974</u>	<u>39,719,958</u>	<u>459,000</u>	<u>1,982,368</u>	<u>37,949,320</u>	<u>455,380</u>
<u>CITIES SERVICE -</u>						
<u>MIAMI COPPER OPERATIONS:</u> Copper Cities	4,629,571	44,858,816		5,052,617	42,501,763	213,926
Copper Cities Precipitate		4,375,751			4,577,066	
Miami - Precipitate		12,806,085			12,170,335	
Castle Dome - Precipitate		-			-	
Total	<u>4,629,571</u>	<u>62,040,652</u>	<u>208,000</u>	<u>5,052,617</u>	<u>59,249,164</u>	<u>213,926</u>
<u>DUVAL:</u> Esperanza	5,280,200	36,958,100			194,795	
Precipitate Copper		4,454,106			2,094,329	
Mineral Park	5,645,080	43,495,519		6,975,594	44,181,863	3,503,237
Precipitate Copper		7,315,234			8,935,811	
Sierrita	25,727,175	126,098,171	9,846,000	28,304,333	137,880,330	11,677,246
Total	<u>36,652,455</u>	<u>218,321,130</u>	<u>11,798,000 2/</u>	<u>35,279,927</u>	<u>193,287,128</u>	<u>15,180,483</u>
<u>INSPIRATION:</u> Inspiration	6,862,253	74,229,548		7,792,285	87,407,628	28,138
Copper recovered by dump, in-place and vat leaching	-	16,332,654			20,587,885	
Christmas Division	1,537,883	13,652,047		1,850,122	22,488,926	
Ox Hide Mine	2,630,267	7,962,311		2,400,230	9,672,768	
Total	<u>11,030,403</u>	<u>112,176,560</u>	<u>229,968</u>	<u>12,042,637</u>	<u>140,157,207</u>	<u>28,138</u>

(continued next page)

TABLE XIV COPPER AND MOLYBDENUM PRODUCTION OF LARGE ARIZONA COPPER MINES (continued)

Company Mine	1971			1972		
	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum	Tons Copper Ore Mined	Pounds Recoverable Copper	Pounds Recoverable Molybdenum
<b>KENNECOTT:</b>						
Ray	10,277,916	126,856,249		10,364,150	122,736,684	31,538
Precipitate Copper		31,622,099			31,472,083	
Total	10,277,916	158,478,348	13,353,000 2/	10,364,150	154,208,767	31,538
<b>MAGMA:</b>						
San Manuel	14,975,910	166,656,905		21,844,943	271,501,061	4,953,567
Superior	427,681	35,608,542		450,573	36,337,188	
Total	15,403,591	202,265,447	3,165,000	22,295,516	307,838,249	4,953,567
<b>PHELPS DODGE:</b>						
Morenci	16,589,805	213,008,679		17,214,592	215,031,874	
Precipitate Copper		14,188,039			24,492,649	
New Cornelia	9,243,860	105,995,691		9,792,178	115,749,958	
Lavender Pit	4,574,609	39,689,498		3,760,691	33,263,583	
Precipitate Copper		8,344,567			9,999,890	
Copper Queen	768,389	58,005,882		643,385	53,798,695	
Precipitate Copper		1/			1/	
Total	31,176,663	439,232,356		31,410,846	452,336,649	
<b>PIMA MINING:</b>						
Pima	14,616,949	136,145,699	1,429,000	18,698,023	165,682,532	1,158,513
Total - Large Co's	144,054,221	1,600,125,278	22,684,000 5/	159,542,688	1,805,522,140	26,171,405 7/
Other Copper Ores 4/	5,239,779	33,442,722	-0-	6,373,137	11,701,860	-0- 7/
GRAND TOTAL 3/	149,294,000	1,633,568,000	22,684,000	165,915,825 6/	1,817,224,000	27,216,000 7/

Source: Company Reports.

1/ Included with Lavender Pit precipitate copper.

2/ Includes molybdenum produced by company from operations outside Arizona.

3/ U.S. Bureau of Mines data - used to compute those for "Other Copper Ores."

4/ Determined by difference.

5/ U.S. Bureau of Mines data. Detail will not add to total. See data footnoted 2/ and 3/.

6/ Includes some copper-zinc and lead-zinc ore in addition to copper ore, all of which is combined to avoid disclosing individual company confidential data.

7/ Arizona's entire molybdenum production is a product of the large copper mines. Differences in values are due to time and methods of reporting.



TABLE XV

## "COVERED EMPLOYMENT" AND WAGES IN ARIZONA COPPER MINING AND SMELTING

1947 - 1972 INCLUSIVE

Copper Mining	Average No. Covered Employees <u>1/</u>	Total Wages <u>2/</u>	Average Annual Wage	Average Weekly Wage	Tons Copper Ores <u>3/</u>
1947	11,340	\$ 36,365,277	\$ 3,207	\$ 61.67	37,810,448
1948	11,493	41,318,524	3,595	69.13	39,072,204
1949	11,001	40,612,224	3,692	71.00	37,365,611
1950	10,181	41,994,321	4,125	79.33	41,757,273
1951	10,754	47,825,698	4,447	85.52	42,784,388
1952	11,365	54,950,235	4,835	93.14	44,472,522
1953	12,068	62,742,982	5,199	99.98	45,187,838
1954	12,502	65,518,853	5,241	100.79	43,072,894
1955	12,399	71,293,263	5,750	110.58	52,189,728
1956	14,008	83,568,996	5,966	114.73	60,468,580
1957	14,652	85,125,320	5,809	111.71	59,571,834
1958	14,100	74,726,972	5,300	101.93	56,255,809
1959	11,568	72,095,130	6,232	119.85	53,121,545
1960	13,764	90,312,848	6,562	126.19	66,032,439
1961	14,275	97,271,286	6,814	131.04	71,918,991
1962	14,408	101,920,108	7,074	136.04	78,868,147
1963	14,303	104,291,588	7,292	140.23	80,615,132
1964	14,720	113,792,031	7,730	148.65	86,132,039
1965	15,239	122,163,124	8,016	154.16	92,859,535
1966 <u>1/</u>	17,018	137,187,611	8,061	155.02	101,558,298
1967	13,426	108,427,206	8,076	155.31	74,289,203
1968	15,734	136,089,579	8,649	166.33	101,293,963
1969	19,459	173,183,018	8,900	171.15	127,848,828
1970	21,479	201,665,064	9,389	180.56	150,241,000
1971	21,231	211,978,597	9,984	192.00	149,294,000
1972	23,233	254,717,341	10,964	210.85	165,915,825 <u>4/</u>

1/ "Covered Employment" by law includes all employees of employers of three or more persons. Therefore, the figures for "All Employees" in Table IX should be somewhat higher than those for "Covered Employees" in this table provided the same industries were involved. However, this table includes some smelter workers which the other does not. Prior to 1966 the average numbers in this table included roughly 500 to 1000 Arizona copper smelter workers, the rest of the smelter employees being included under "Manufacturing." Beginning in 1966, all covered smelter workers are included in the average in this column. Figures are from the Unemployment Compensation Division, Employment Security Commission of Arizona.

2/ "Total Wages in Covered Industry," "Mining-copper."

3/ Short tons of "Lode ore: copper" reported by the U.S. Bureau of Mines.

4/ Includes some copper-zinc and lead-zinc ore in addition to copper ore, all of which is combined to avoid disclosing individual company confidential data.

TABLE XVI

## ARIZONA INDUSTRIES COVERED BY SOCIAL SECURITY

AVERAGE NUMBER OF COVERED EMPLOYEES, TOTAL WAGES, AVERAGE ANNUAL WAGE

AND AVERAGE WEEKLY WAGE

Years 1970, 1971 and 1972

<u>Industry</u>	<u>Average No. of 1/ Employees</u>	<u>Total Wages</u>	<u>Average Annual Wage</u>	<u>Average Weekly Wage</u>
<u>YEAR 1970</u>				
Copper Mining 2/	19,340	\$ 182,501,779	\$ 9,436	\$181.47
Copper Smelting 3/	2,139	19,163,285	8,959	172.29
Total Copper Mng. & Smelting	21,479	\$ 201,665,064	\$ 9,389	\$180.55
Other Mining & Quarrying	1,802	16,351,472	9,074	174.50
All Mng., Quarry'g & Smelting	23,281	\$ 218,016,536	\$ 9,364	\$180.08
Mfg., Ex. Copper Smelting	89,040	747,878,179	8,411	161.74
Construction	37,047	361,894,121	9,769	187.86
Transp., Utilities, etc. 4/	27,478	235,905,293	8,585	165.10
Wholesale - Retail Trade	123,139	679,612,363	5,519	106.14
Services, Finance and Misc.	91,411	560,822,791	6,135	117.98
TOTALS AND AVERAGES	391,396	\$2,804,129,283	\$ 7,164	\$137.78
<u>YEAR 1971</u>				
Copper Mining 2/	19,209	\$ 192,278,918	\$10,010	\$192.50
Copper Smelting 3/	2,022	19,699,679	9,742	187.35
Total Copper Mng. & Smelting	21,231	211,978,597	9,984	192.00
Other Mining & Quarrying	1,783	17,574,490	9,857	189.56
All Mng., Quarry'g & Smelting	23,014	229,553,087	9,974	191.81
Mfg., Ex. Copper Smelting	86,398	767,838,982	8,887	170.90
Construction	43,783	478,564,486	10,930	210.19
Transp., Utilities, etc. 4/	28,651	265,094,029	9,252	177.92
Wholesale - Retail Trade	130,669	766,582,732	5,866	112.81
Services, Finance and Misc.	99,957	657,528,823	6,578	126.50
TOTALS AND AVERAGES	412,472	\$3,165,162,139	\$ 7,674	\$147.58

(continued next page)

TABLE XVI (continued)

<u>Industry</u>	<u>Average No. of 1/ Employees</u>	<u>Total Wages</u>	<u>Average Annual Wage</u>	<u>Average Weekly Wage</u>
<u>YEAR 1972</u>				
Copper Mining 2/	20,892	\$ 229,345,846	\$10,978	\$211.12
Copper Smelting 3/	2,341	25,371,495	10,838	208.42
Total Copper Mng. & Smelting	23,233	\$ 254,717,341	\$10,964	\$210.85
Other Mng., Quarry'g & Smelting	1,847	19,938,264	10,795	207.60
All Mng., Quarry'g & Smelting	25,080	274,655,605	\$10,951	210.59
Mfg., Ex. Copper Smelting	96,910	888,392,860	9,167	176.28
Construction	56,033	630,709,787	11,256	216.46
Transp., Utilities, etc. 4/	30,465	307,868,725	10,106	194.35
Wholesale - Retail Trade	150,437	919,886,942	6,115	117.60
Services, Finance and Misc.	167,654	1,145,753,218	6,834	131.42
TOTALS AND AVERAGES	526,579	\$4,167,267,137	\$ 7,914	\$152.19

Source: Arizona Employment Security Commission.

- 1/ Includes all covered employees. Figures relating to copper mining and smelting, and manufacturing, are adjusted as described in the following footnotes.
- 2/ The first number includes all covered employees in copper mining and milling and probably those in one smelter. The figure, therefore, is higher than that for "All Employees" in "Copper Mining" in Arizona in column 1, Table IX.
- 3/ According to correspondence from the Employment Security Commission of Arizona, these figures include all covered smelter employees excepting those included in "Copper Mining." A majority of copper smelting employees customarily are reported under "Manufacturing" and the rest under "Copper Mining."
- 4/ Transportation exclusive of railroads.

TABLE XVII - Mineral production in Arizona <sup>1</sup>

	1971		1972	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays-----Thousand short tons--	119	\$84	2/134	2/\$355
Coal (bituminous)-----	1,146	W	W	W
Copper (recoverable content of ores, etc.)-short tons--	820,171	852,978	908,612	930,419
Gem stones-----	NA	160	NA	168
Gold (recoverable content of ores, etc.)--troy ounces--	94,038	3,879	102,996	6,036
Iron ore (usable)----thousand long tons, gross weight--	15,859	W	W	W
Lead (recoverable content of ores, etc.)---short tons--	859	237	1,763	530
Lime-----thousand short tons--	296	4,474	356	6,024
Molybdenum (content of concentrates)--thousand pounds--	22,684	39,872	27,216	46,791
Natural gas-----million cubic feet--	868	153	W	W
Petroleum (crude)-----thousand 42-gallon barrels--	1,236	3,918	993	3,226
Pumice-----thousand short tons--	949	625	915	722
Sand and gravel-----do-----	19,791	24,391	24,842	32,420
Silver (recoverable content of ores, etc.) thousand troy ounces--	6,170	9,538	6,653	11,210
Stone-----thousand short tons--	2,873	5,848	4,638	8,018
Zinc (recoverable content of ores, etc.)---short tons--	7,761	2,499	10,111	3,589
Value of items that cannot be disclosed: Asbestos, cement, fire clay, diatomite, feldspar, fluorspar, gypsum, helium, mica (scrap), perlite, pyrites and values indicated by the symbol W-----		32,364	XX	41,496
Total-----	XX	981,020	XX	1,091,004
Total 1967 constant dollars-----	XX	834,161	XX	p/907,606

p/ Preliminary. NA Not available. XX Not applicable. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."

1/ Production as measured by mine shipments, sales or marketable production (including consumption by producers). 2/ Excludes fire clay; included with "Value of items that cannot be disclosed."

Source: U.S. Bureau of Mines.

## Arizona Mining Taxation

Arizona's copper mining industry is not only an important source of copper production and employment opportunity, it is an important source of tax revenues for support of schools and other government services. In an effort to determine the characteristics of mining, one of the State's oldest industries, on state tax revenues the Arizona Mining Association has prepared a profile entitled, Arizona Mining Taxation Study. This section is a summary of that Study which was published in the Arizona Legislative Review, November 7, 1973.

Under the property tax program, which became effective in 1968-69, mines are assessed at 60% of their full cash value, while agriculture and manufacturing are taxed at 18 and 25% respectively. Table XVIII gives the assessed valuations of the three industries and Table XIX shows the relative percentages of total state assessed valuation for each of the three industries.

Table XVIII  
Assessed Valuations of Selected Industries

Fiscal Year	Manufacturing	Agriculture	Mining
1970 - 71	\$108,944,529	\$135,817,040	\$427,995,483
1971 - 72	145,632,953	135,645,172	490,862,883
1972 - 73	163,035,634	131,608,245	561,222,180

Table XIX  
Assessed Valuations of Selected Industries  
As a Percent of Total State Assessed Valuations

Fiscal Year	Manufacturing	Agriculture	Mining
1970 - 71	3.77%	4.70%	14.81%
1971 - 72	4.60%	4.28%	15.50%
1972 - 73	4.49%	3.62%	15.44%

The industry's total tax contribution to Arizona was over \$70 million in combined state and local taxes for 1972. These taxes include property taxes, severance taxes (excise), corporate income taxes, payroll taxes and miscellaneous taxes such as taxes of goods and services purchased and motor vehicle licenses and fees. This \$70 million in state and local taxes, still, does not include any Federal corporate income taxes.



### Arizona Molybdenum

Molybdenum is a unique mineral commodity in Arizona. Molybdenum production in Arizona is entirely a byproduct of copper production, so without the copper production there would be no molybdenum production. Therefore, the price of molybdenum, at this time, has little effect on its production in Arizona.

Arizona's 1972 production of molybdenum was 27,216,000 pounds contained in concentrates and was 20% greater than her 1971 production of 22,684,000 pounds, and 24.3% of the U.S. total of 112,138,000 pounds. The value of the 1972 production was \$46,791,000 and ranked second to copper in value. Molybdenum accounted for 4.3% of the total value of Arizona's 1972 mineral production.

In 1972, 0.0149 pounds of molybdenum were reported per pound of recoverable copper, up from 0.0139 pounds per pound of copper in 1971. This increase in molybdenum production per pound of copper reflects both the recovery of molybdenum from copper ores higher in molybdenum and increases in production from some molybdenum producing properties (mainly Duval Sierrita's).

Nearly all of Arizona's large copper mines produce byproduct molybdenum, the exception being those properties operated by Phelps Dodge. One mine, Duval Sierrita's Sierrita Mine, produced 42.9% of Arizona's molybdenum in 1972. Molybdenum accounted for over 20% of the value of production from this mine. Kennecott's molybdenum recovery plant at Ray Mines division was shut down through most of 1972 due to low molybdenum prices. Molybdenum production for the large Arizona copper mines, which account for all of the molybdenum produced in the state, is shown in Table XIV of the preceding Arizona copper section or is attached if this report was obtained separately of the copper report.

M O L Y B D E N U M  
PHYSICAL PROPERTIES 1/

"Molybdenum. A silvery-white, very hard, metallic element in the chromium group or group VI of the periodic system. Its physical properties are similar to those of iron and its chemical properties are similar to those of a nonmetal. Used for electrodes of mercury-vapor lamps, as wire for winding electric-resistance furnaces, and in steel alloys. Symbol, Mo; isometric; valences, 2, 3, 4?, 5?, and 6; atomic number, 42; atomic weight 95.94; specific gravity, 10.22 (at 20°C); melting point,  $2,620^{\circ} \pm 10^{\circ}\text{C}$ ; boiling point,  $5,560^{\circ}\text{C}$  or sublimates at  $4,507^{\circ}\text{C}$  (at 760mm); insoluble in water, in hydrofluoric acid, and in ammonia; soluble in hot concentrated nitric acid, in hot concentrated sulfuric acid, and in aqua regia; and slightly soluble in hydrochloric acid. As an alloying agent, it increases the hardenability and toughness of quenched and tempered steels and it raises the strength of steel at high temperatures. Used in nickel-based alloys that are heat-resistant and corrosion-resistant; in electrodes in electrically heated glass furnaces and fore-hearth; in nuclear-energy applications; for missile and aircraft parts; and as a wire for filaments for metal-evaporation processes and for filaments, grids, and screens in electronic tubes.

(C.T.D.; Handbook of Chemistry and Physics, 45th ed., 1964, pp B2, B-121, B-195)."

1/ U. S. Bureau of Mines; A Dictionary of Mining, Mineral and Related Terms, p 723, (1968).

Molybdenum - TABLE I  
MOLYBDENUM PRODUCTION  
Molybdenum (content of concentrate)

<u>Year</u>	<u>U.S. 1/ lbs.</u> Thousands	<u>Arizona 2/ lbs.</u> Thousands	<u>Arizona's % of U.S.</u> Thousands	<u>Value of Arizona's Production 2/</u> Thousands
1955	61,781	1,497	2.4	\$ 1,511
56	57,462	2,392	4.2	2,670
57	60,753	2,385	3.9	3,071
58	41,069	2,320	5.6	2,827
59	50,956	3,181	6.2	4,019
1960	68,237	4,359	6.4	5,211
61	66,563	4,878	7.3	6,232
62	51,244	4,412	8.6	5,864
63	65,011	5,553	8.5	7,584
64	65,605	6,296	9.6	9,532
1965	77,372	9,399	12.1	15,880
66	90,532	10,161	11.2	17,812
67	90,097	9,261	10.3	15,385
68	93,477	12,127	13.0	19,207
69	99,807	12,699	12.7	20,947
1970	111,352	15,672	14.0	26,700
71	109,592	22,684	20.7	39,872
72	112,138	27,216	24.3	46,791

Source: U.S. Bureau of Mines.

1/ Mine production.

2/ Production as measured by "Mine shipments." U.S. production so measured in thousands of pounds was: 1968 - 93,245; 1969 - 103,009; 1970 - 110,381; 1971 - 97,882; 1972 - 102,197; and for the five years averaged 3.7 percent lower than "Mine production."

Molybdenum - TABLE II  
SALIENT MOLYBDENUM STATISTICS 1/

Molybdenum content, thousands of pounds and thousands of dollars							
	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>
UNITED STATES:							
Moly. Concentrate:							
Production	90,532	90,097	93,447	99,807	111,352	109,592	112,132
Shipments <u>2/</u>	91,670	81,596	93,245	103,009	110,381	97,882	102,197
Value	\$144,327	\$133,604	\$151,000	\$173,819	\$190,077	\$164,917	\$170,580
Consumption	75,476	58,967	75,647	73,275	76,101	66,399	62,560
Imports for Consumption	5	1,179	1	-	25	854	385
Stocks, End of period:							
At Mines and Plants <u>3/</u>	3,433	9,919	12,208	8,398	9,715	29,077	45,243
Primary Moly. Products:							
Production <u>4/</u>	74,392	54,922	69,675	68,526	<u>r/</u> 75,383	67,016	64,841
Shipments <u>2/</u>	78,811	57,231	63,761	77,726	76,095	66,654	75,538
Consumption	52,324	49,506	49,271	51,622	45,337	40,950	45,538
Producers Stocks:							
End of period	5,945	7,156	18,170	17,844	25,904	31,048	28,899
FREE WORLD:							
Production <u>5/</u>	124,988	126,273	128,071	142,639	<u>r/</u> 181,429	170,840	175,250
Consumption <u>6/</u>	111,000	112,000	123,000	132,000	135,000	131,000	144,000

r/ Revised

1/ Sources: U.S. Bureau of Mines. Mining, Annual Review. 2/ Including exports. 3/ Producing molybdenum products. 4/ Comprises total production of all products less quantities of oxide, etc. used to produce other products. 5/ Molybdenum in ores and concentrates. See Table VI. 6/ Molybdenum in concentrates. Estimates in molybdenum chapters of "Mining, Annual Review," issues relating to the above years.

Molybdenum - TABLE III  
Consumption of molybdenum materials by end uses in 1972  
(Thousand pounds, contained molybdenum)

End use	Molybdic oxides	Ferro- molyb- denum <u>1/</u>	Ammonium and sodium Molybdate	Other molybdenum materials <u>2/</u>	Total <u>3/</u>
Steel:					
Carbon	1,024	201	-	11	1,236
Stainless and heat resisting	4,111	1,688	-	63	5,862
Full alloy	15,284	1,529	-	107	16,920
High-strength low- alloy	2,466	481	-	7	2,954
Electric	907	89	-	-	996
Tool	2,097	974	-	31	3,102
Cast irons	734	2,764	-	180	3,678
Superalloys	770	323	-	1,283	2,376
Alloys (exclude steels and superalloys):					
Welding and alloy hard-facing rods and materials	-	317	-	18	335
Other alloys <u>4/</u>	70	486	-	169	725
Mill products made from metal powder	-	-	-	2,467	2,467
Chemical and ceramic uses:					
Pigments	657	-	439	22	1,118
Catalysts	1,442	-	W	-	1,442
Other	412	-	22	786	1,220
Miscellaneous and unspecified	189	125	425	388	1,127
Total <u>3/</u>	30,163	8,977	886	5,532	45,558
Consumer stocks December 31, 1972	2,194	1,586	116	1,000	4,896

W Withheld to avoid disclosing individual company confidential data, included in "Miscellaneous and unspecified." 1/ Includes calcium molybdate. 2/ Includes purified molybdenum disulfide, molybdenite concentrates added directly to steel, molybdenum metal powder, molybdenum metal pellets and other molybdenum materials. 3/ Data may not add to totals shown because of independent rounding. 4/ Includes magnetic and nonferrous alloys.

Source: U.S. Bureau of Mines.



Molybdenum - TABLE IV  
FREE WORLD PRODUCTION OF MOLYBDENUM IN  
ORES AND CONCENTRATES

Thousands of pounds contained molybdenum			
Country	1970	1971	1972 <u>p/</u>
Australia	130	<u>e/</u> 130	<u>e/</u> 130
Canada (shipments)	33,772	22,663	24,844
Chile	<u>r/</u> 12,569	13,935	13,045
China, Peoples Republic of <u>e/</u>	3,300	3,300	3,300
Japan	<u>r/</u> 582	613	825
Korea, Republic of (South)	254	231	110
Mexico	311	174	172
Norway	<u>r/</u> 750	811	<u>e/</u> 880
Peru	1,338	1,782	1,712
Philippines	71	9	-
U.S.S.R. <u>e/</u>	17,000	17,600	18,100
United States	111,352	109,592	112,132
Total	181,429	170,840	175,250

e/ Estimate    p/ Preliminary    r/ Revised

1/ In addition to the countries listed, Argentina, North Korea, Nigeria, Romania, South-West Africa and Spain also may produce molybdenum, but information is inadequate to make reliable estimates of output levels.

Source: U.S. Bureau of Mines.