C O P P E R I N D U S T R Y

STATISTICS FOR 1963 COMPARED WITH OTHER YEARS

ARIZONA, UNITED STATES AND WORLD

COMPILED BY ARIZONA DEPARTMENT OF MINERAL RESOURCES
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Source: United States Bureau of Mines, Copper Institute, American Metal Market, Engineering & Mining Journal, Arizona Bureau of Mines

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C O P P E R

PHYSICAL PROPERTIES *

Symbol - Cu. Atomic Weight - 63.54. Specific Gravity - 8.96

Melting Point - 1981.4°F. Boiling Point - 4700°F

Electrical Resistivity - Microhm-cm. - 1.673

Tensile Strength (H.D. - 60,000 #/sq. in.) (annealed - 30,000)

Crystal Structure - Face-centred cubic. Valence - 1 & 2

Copper ranks next to iron as a metal of commercial importance. It has the best conductivity of any base metal; for example, measured on the ordinary basis of conductivity per unit of cross sectional area, aluminum's conductivity is only 61 per cent of that of copper, but 3.5 times that of iron. Copper is therefore the most important metal in the electrical field. Copper has enough strength for minor structural purposes (such as sheet-metal work, electrical manufactures, etc.), is easily rolled and drawn into wire, has great resistance to weathering, and is of moderate cost compared to competitive materials, In addition to these properties, copper is widely used alloyed with zinc to form brass, which is easily worked, offers good resistance to weathering and most solutions (principal exceptions are certain acids and alkalies), and is fairly strong and elastic; and alloyed with tin to form bronze, of note for its resilience. It has good thermal conductivity, so finds many uses in heat-transfer units, such as cooling fins and water heaters. In addition, a large percentage of copper may be recovered as scrap after it has outlived the usefulness for which it was originally intended. Of the total copper consumed in the United States it has been estimated that about 60 per cent eventually returns to use as copper or copper alloys.

* U.S.B.M.'s "MATERIALS SURVEY" - September, 1952

Arizona Department of Mineral Resources August, 1964

COPPER INDUSTRY IN 1963

The copper industry in the United States in 1963 was marked by a high rate of consumption, a stable price, and a slight decrease in production, according to the Bureau of Mines, U.S. Department of the Interior. Mine output in the United States was 1 per cent less than in 1962, mainly because of continued voluntary production curtailments during the first 9 months of the year. The price of domestic copper remained at 31 cents a pound throughout the year. The return of the United States as a net importing nation began in 1962 and became more pronounced in 1963. Imports were the highest since 1959 and exports of refined copper were the lowest since that year.

Mine production of copper in the United States totaled 1,213,000 tons of which Arizona supplied 54 per cent. Utah continued to rank second among the major copper producing States, but output was 7 per cent below 1962 and its share of the total decreased from 18 to 17 per cent. Production remained virtually unchanged in Nevada and New Mexico and each State contributed about 7 per cent of the Nation's total. Montana was in fifth place in spite of a sharp rise in production in the last 4 months of the year. A slight increase in production was reported in Michigan and the State remained in sixth place.

Demand for refined copper continued strong and consumption of new copper was the largest since 1953. Consumption of refined copper rose 9 per cent to 1,744,300 tons, the highest since compilation of the data was begun in 1945.

December 31 marked the end of more than 30 months during which primary producers' price remained unchanged at 31 cents a pound, delivered. Custom smelter price and primary producers' price for copper remained the same since May 1961 and for this reason American Metal Market discontinued publishing custom-smelter price in July, a service that began in September 1955.

The price of copper on the London Metal Exchange averaged £234 6s. 7d. per long ton in January. Monthly averages varied from a low £234 2s. 6d. for March and August-September. They began to rise in November and attained the year's high in December of £235 13s. 6d. (29.42 cents). The average price for the year was virtually unchanged from 1962.

Imports of unmanufactured copper rose for the third consecutive year and exceeded those of 1962 by 13 per cent. Again Chile was the chief source of foreign copper, supplying 42 per cent of the total, but 1,000 tons less than in 1962. Peru regained second place with 18 per cent of the total and Canada was in third place with 17 per cent. Imports of blister copper increased 11 per cent over those of 1962 and were 68 per cent of the total for 1963. Although receipts of refined copper from Canada were 5 per cent less than in 1962, they remained the chief source. Increased shipments were received from Belgium-Luxembourg, Chile, and Peru.

Exports of refined copper, the principal export class, decreased 7 per cent from 1962. Total exports of copper scrap and brass and bronze scrap remained virtually unchanged.

Because the price of copper remained above 24 cents a pound, the 1.7 cent-a-pound excise tax effective July 1, 1958, was unchanged.

Stocks of refined copper at primary producers dropped 27 per cent, but stocks of unrefined material rose 2 per cent. On December 31, inventories in Government stockpiles totaled 1,121,691 tons. Of this, 1,008,255 tons was in the national (strategic) stockpile, 102,183 tons was in the Defense Production Authority inventory, and 11,253 tons in the supplemental stockpile. These quantities include 31,241 tons of oxygen-free high-conductivity copper in the national stockpile and 5,199 tons in the supplemental stockpile. Also included are copper content of 2,149,758 pounds of beryllium-copper master alloy in the national stockpile and 12,623,973 pounds in the supplemental stockpile.

The pattern of world production of copper was varied. In North America, a decreased production in the United States more than offset a notable increased output in Mexico and a lesser one in Canada. Chile and Peru contributed 21,000 tons to the increase of 30,000 tons in South America. Production in several European countries registered declines which were more than counterbalanced by a marked increase in Yugoslavia. Output in the U.S.S.R. was estimated to have risen about 7 per cent, resulting in adding to the increase in Europe and Asia. Elsewhere in Asia, Japan, and the Republic of the Phillippines recorded increases that more than offset a decline in Turkey. The 3 per cent increase in production in Africa resulted from record outputs in Northern Rhodesia, Republic of South Africa, and South-West Africa. Output from the Republic of the Congo was adversely affected by closure of operations of the Union Miniere du Haut Katanga for three months early in the year. A gain in production of 3 per cent was reported in Australia.

The Copper and Brass Research Association, long known as C.A.B.R.A. ceased operating December 31, 1963. The Copper Development Association, organized in 1963, assumed virtually all activities of C.A.B.R.A. Membership of the new organization included copper mining companies, smelting and refining companies, and foundries.

Prepared August 11, 1964, by F. L. Wideman, Physical Scientist.

O U T L O O K

As reported by Arizona Department of Mineral Resources

(Based on remarks by John M. Boyle, Vice President and General Manager of Phelps Dodge Sales Co., in February, 1964, annual review number of the Mining Congress Journal. Also on remarks by an acknowledged world copper authority, Sir Ronald Prain, head of Rhodesian Selection Trust, in the German publication "Metall" on January 1, 1964.)

Mr. Boyle notes some encouraging signs in the copper industry. Budgets for advertising, market research, and sales promotion are being increased. Several modern laboratories have been completed and are working on the improvement of old products, as well as the development of new ones.

The formation of the "Copper Development Association" in 1962 was indeed a milestone in the history of copper. For the first time, all segments of the copper and brass industry have joined together to promote new products and expand the copper market.

Mr. Boyle says that United States copper mines are competing against foreign mines located in areas where labor costs are lower. "Fortunately, the Government has continued the relatively small tax of 1.7 cents per pound on imported copper, to partially offset the differentials in labor costs. It is imperative that it continue to do so, but the industry must remain vigilant or one day it will awaken to find this protection eliminated by some general political maneuver."

As to the outlook, Mr. Boyle says "The picture is one where ample copper supplies are, and should be, available. With cooperative effort in research and promotion, the market for copper can be maintained and expanded. Therefore, the long range copper outlook is a favorable one and should give a satisfactory return to both investors and employes."

"However, there is no room for complacency. In this jet age, there is no material or industry that is not subject to the most severe competition. To a large extent the destiny of copper will be determined by the time, effort, and money that the miner, in conjunction with the refiner and fabricator, is willing to spend in meeting the challenge ahead."

Sir Ronald Prain, head of Rhodesian Selection Trust, has come up with a reassessment of the long-term growth pattern in the German publication "Metall" on January 1, 1964:

"World Production in 1962 amounted to 4,146,000 tons (copper) which compares with 4,020,000 tons in 1961 and 3,939,000 tons in 1960. All statistics are given in short tons, and refer to the non-Soviet world. There has thus been a steady increase in output despite the fact that voluntary cutbacks of sales and/or production were in force during the past 2-3 years. Free World mine production in 1962 was some 40 per cent higher than in the 1950's. Generally speaking, the proportionate contributions of the main geographical areas, from the developed and under-developed countries, and from the underground and open-pit mines, did not vary greatly. Of the 1962 output, 2,148,000 tons came from developed countries and 1,998,000 tons from under-developed countries. Not without significance, from the standpoint of production costs is a further breakdown which shows that 2,219,000 tons came from underground mines and 1,927,000 tons from open-pit mines.

"Free World costs of producing copper vary widely from country to country, and from mine to mine. In the three years 1960-1962, the median cost has been in the bracket 17½ c. to 20 c. per lb., whereas during the 1950's it was in the bracket 15 c. to 17½ c. per lb."

"Assuming that the purchasing power of money remains unchanged, the median and average cost of producing copper in 1967 should be virtually the same as, or possibly marginally less than, the present median net cost of about £154 per l. ton of refined copper (19¼ c. per lb.)."

Sir Ronald estimates the 1963 demand for Free World primary copper, including allowances for healthy stock growth and Soviet offtake, at 4,100,000 tons. During the fifties and early sixties, Free World refined consumption has shown a growth trend of 4.1 per cent per annum. After taking other factors into account, a continuation of this trend will give a demand for primary copper of between 4,800,000 and 4,900,000 tons in 1967. Assuming normal wastage from strikes and other causes in that year, this corresponds quite closely with the expected primary production of 4,800,000 tons. A 3½ per cent growth rate for refined copper would give a demand of 4,700,000 tons; i.e., a slight surplus. Demand in 1970 is tentatively estimated as being perhaps of the order of about 5,500,000 tons.

The indicators, in Sir Ronald's view, are set fair for copper's continued growth. As the main grounds for confidence in the industry's future he cites the following; First, the responsibility shown by producers in taking charge of the market situation during a period of over-capacity; secondly, the confidence and courage of producers in continuing to expand their capacity at a time of over-production and against a background of declining profit margins; thirdly, the stability of the price which is encouraging consumption; fourthly, the increasing tonnages required by growing populations of the world and by the higher standards demanded; and fifthly, the re-awakening of the copper industry as a whole to the technological and scientific requirements and opportunities of the 20th century.

In the last-mentioned context the article points out that the amounts being spent by the industry on research and promotion are reaching unprecedented levels. It seems inconceiveable that this effort will not be matched by results.

Quote From London Mining Journal, July 24, 1964

"Despite several factors that might have served to increase the London Metal Exchange price of copper, the market has remained fairly stable over the past week with just a small rise recorded. These factors include the fall in L.M.E. stocks, the fall in world stocks as reported by the Copper Institute, and the political difficulties in South America. Against this general background it would now appear that, subject to any sudden change in the American labour situation, the L.M.E. copper price is at, or about, the top. In America the labour negotiations are continuing and although no final agreements have been reached it would seem unlikely that any new phase of militancy on the part of the unions will appear. The Kennecott works are still at a standstill though it is anticipated that this stoppage will draw to a close shortly.

The general feeling across the Atlantic now is that there will be an increase in the American producer price - probably followed by the other producers - early in the autumn. A figure of about 2 cents is suggested. Although this feeling grew initially from thoughts of offsetting the costs of the probable wage awards it has now been further strengthened by the negotiations in Chile where it

is believed that the Copper Dept. is aiming at a price increase of this order.

If a new price in the 34c.-35c. region develops then this will probably be the meeting point between the L.M.E. price and the producers' basis as the former falls during the autumn period."

COMMENTS ON TABLES XII, XIII AND XIV

A study of United States copper production and consumption figures (Table XII), by years from 1946 to 1954 inclusive, and years 1955 to 1963 inclusive, brings out some pertinent statistics. The small increase in domestic consumption of refined copper is especially notable.

The average annual domestic consumption from 1946 to 1954 inclusive (9 years) was 1,363,394 tons and from 1955 to 1963 inclusive (9 years) it was 1,471,288 tons, an increase of only 7.92 per cent for the 9 years, or only 0.88 per cent increase per year, where one might expect a normal growth-rate of at least 2 per cent. The growth-rate in production of refined copper for the two 9-year periods was 2.8 per cent per year.

The other thing of note is that the United States has become self-supporting in copper production. This has been the case for the last six years.

Table XIII indicates a mine production capacity of 1,400,000 tons of copper per year, and with an estimated added production of 315,000 tons of secondary unalloyed copper, this country is now well prepared to produce all of its domestic requirements. Such capacity should permit economical operation for most of the big producers at an 85 to 90 per cent of capacity during a recession or lull in demand.

Meanwhile, a copper tariff high enough to bar out low-cost foreign copper should always be kept in mind, as from now on domestic copper will be mostly high-cost due chiefly to lowering grades of ore and rapidly increasing costs. The new producers, which have brought about this new production capacity, must be kept active, not only for security reasons but for employment stability in a very important industry in our economy.

A study of Table XIV shows that during the last three years it took an annual average of 63,858,045 man-hours of U. S. labor at $2.813 per hour to produce 146,796,016 tons of copper ore, with a recovery of 2,281,193,000 pounds of equivalent copper; a labor cost of $179,580,416 for copper mining, or $0.0787 per pound of copper.

With foreign ores assaying more than twice the grade of U. S. ores and foreign labor averaging less than half the U. S. wage-rate, it is easy to calculate a foreign copper mining labor cost of less than half the U. S. labor cost of producing a pound of copper. As the object of a copper tariff primarily is to equate the difference in wage cost per pound of copper, such a tariff should be at least double the present tariff of 1.7 cents per pound of copper.

In order to insure continuous production of the number one strategic metal, the domestic copper industry must be protected against a flood of low-cost foreign metal. Our foreign aid program has helped the foreign producer to develop his copper production techniques, and he can find a ready market for his product in a rapidly expanding economy throughout the world. The growth-rate of copper consumption throughout Europe has been truly amazing. According to the Copper Institute figures for deliveries of refined copper outside the U.S.A., the average annual consumption of copper for the 9-year period (1946-1954) was 983,000 tons, and for the 9-year period (1955-1963) it was 1,946,000 tons.

TABLE I

SALIENT U. S. COPPER STATISTICS

YEARS 1961, 1962 AND 1963

Compiled By Arizona Department of Mineral Resources from U.S.B.M. Reports

	1961	1962	1963
Arizona Mine Production - Tons Copper . . .	587,053	644,242	660,977
U. S. Mine Production - Tons Copper . . .	1,165,155	1,228,421	1,213,166
World Mine Production - Tons Copper . . .	4,840,000	5,090,000	5,220,000
Refined Stocks - Beginning of Period . . .	98,000	49,000	71,000
Refined Stocks - End of Period . . .	49,000	71,000	52,000
Refinery Production (From Domestic Ores) . .	1,181,015	1,214,146	1,219,342
Refinery Production (From Foreign Ores) . . .	369,124	397,584	377,009
Secondary Copper Recovered from Scrap as Unalloyed Copper . . .	279,511	301,374	314,643
IMPORTS:			
Copper from Ore, Matte, Regulus . . .	47,392	43,552	49,128
Blister Copper . . .	340,312	331,686	368,985
Refined Copper . . .	66,856	98,820	118,447
Total Imports - Crude & Refined . . .	454,460	474,058	536,560
EXPORTS:			
Copper in Ores, etc. . . .	4,478	1,916	1,210
Refined Copper . . .	432,253	336,525	311,477
Total Exports - Crude & Refined . . .	436,731	338,441	312,687
EXCESS IMPORTS OVER EXPORTS . . .	17,729	135,567	223,873
CONSUMPTION:			
New Refined (Apparent Consumption) . . .	1,234,000	1,352,000	1,423,000
Total Refined (Actual) . . .	1,462,830	1,599,676	1,744,273
U. S. Mine Prod. % of Appar. Consumption.	94.4	90.9	85.3
Average E. & M. J. Price of Copper . . .	29.921¢	30.600¢	30.600¢

Arizona Department of Mineral Resources August, 1964

TABLE II

MINE PRODUCTION OF RECOVERABLE COPPER IN THE UNITED STATES
1961-1963, BY STATES, IN SHORT TONS

STATE	1961	1962	1963
Alaska	92	--	--
Arizona	587,053	644,242	660,977
California	1,382	1,162	916
Colorado	4,141	4,534	4,169
Idaho	4,328	3,861	4,172
Michigan	70,245	74,099	75,262
Missouri	1,479	2,752	1,816
Montana	104,000	94,021	79,762
Nevada	78,022	82,602	81,738
New Mexico	79,606	82,683	83,037
Oregon	1/	1/	2/
Pennsylvania 3/	8,934	6,108	4,434
South Dakota	--	--	1
Tennessee	12,272	14,298	13,717
Utah	213,534	218,018	203,095
Washington 4/	66	41	70
Wyoming	1	--	--
Total	1,165,155	1,228,421	1,213,166

1/ Included with Pennsylvania for 1961-62 to avoid disclosing operations of individual companies.
2/ Included with Washington for 1963 to avoid disclosing operations of individual companies.
3/ Includes North Carolina for 1959-62 and Oregon for 1961-62 to avoid disclosing operations of individual companies.
4/ Includes North Carolina and Oregon for 1963 to avoid disclosing operations of individual companies.

TABLE III

ARIZONA, UNITED STATES, AND WORLD MINE PRODUCTION OF COPPER, In Short Tons

E. & M. J. DOMESTIC AND EXPORT PRICE OF COPPER
By Years 1912 - 1963 Incl.

Source: U. S. Geological Survey: Mineral Resources; U.S.B.M. Minerals Yearbooks

	ARIZONA			UNITED STATES		WORLD	E. & M. J.	E.& M. J
Year	Tons	% of U. S. Prod.	% of World Prod.	Tons	% of World Prod.	Tons	Price Per Pound	Export Price Per Pound
1912	182,519	29.2	16.2	624,547	55.5	1,125,656	16.341¢	
1913	203,962	33.0	18.6	617,755	56.2	1,099,366	15.269¢	
1914	196,509	34.2	19.0	574,216	55.5	1,034,487	13.602¢	
1915	229,986	30.9	19.6	744,036	63.4	1,173,150	17.275¢	
1916	360,917	36.0	23.2	1,002,938	64.6	1,553,498	27.202¢	
1917	356,083	37.6	22.2	947,717	59.1	1,602,914	27.180¢	
1918	382,428	40.0	24.2	955,011	60.5	1,579,246	24.628¢	
1919	269,050	44.4	24.6	606,167	55.3	1,095,697	18.691¢	
1920	279,128	45.6	26.4	612,275	58.0	1,056,014	17.456¢	
1921	92,517	39.7	15.1	233,095	38.0	613,987	12.502¢	
1922	200,022	41.5	21.4	482,292	48.2	935,374	13.382¢	
1923	309,464	41.9	22.8	738,870	54.5	1,355,327	14.421¢	
1924	338,876	42.2	23.0	803,083	54.5	1,472,712	13.024¢	
1925	356,678	42.5	22.6	839,059	53.2	1,576,998	14.042¢	
1926	361,648	41.9	22.7	862,638	54.0	1,596,147	13.795¢	
1927	341,095	41.3	20.5	824,980	49.5	1,666,694	12,920¢	
1928	366,138	40.5	19.2	904,898	47.5	1,903,672	14,570¢	
1929	415,314	41.6	19.3	997,555	46.4	2,150,587	18,107¢	
1930	288,095	40.9	16.2	705,074	39.7	1,775,805	12,982¢	
1931	200,672	37.9	13.0	528,875	34.2	1,545,425	8.116¢	
1932	91,246	38.3	8.0	238,111	20.9	1,138,676	5.555¢	
1933	57,021	29.9	4.9	190,643	16.4	1,159,000	7,025¢	6.713¢
1934	89,041	37.5	6.3	237,401	16.8	1,415,353	8.428¢	7.271¢
1935	139,015	36.0	8.4	386,491	23.5	1,647,939	8.649¢	7.538¢
1936	211,275	34.4	11.1	614,516	32.4	1,899,263	9.474¢	9.230¢
1937	288,475	34.3	11.2	841,998	32.8	2,567,916	13.167¢	13.018¢
1938	210,797	37.8	9.3	557,763	24.5	2,274,045	10.000¢	9.695¢
1939	262,117	36.0	10.6	728,320	29.4	2,481,277	10.965¢	10.727¢
1940	281,169	32.0	10.5	878,086	32.7	2,688,510	11.296¢	10.770¢
1941	326,317	34.1	11.2	958,149	33.0	2,903,458	11.797¢	10.901¢
1942	393,387	36.4	12.9	1,080,061	35.5	3,039,041	11.775¢	11.684¢
1943	403,181	37.0	13.2	1,090,818	35.6	3,064,394	11.775¢	11.700¢
1944	358,303	36.8	12.5	972,549	33.9	2,866,000	11.775¢	11.700¢
1912 to 1944	8,842,445	35.3	14.4	23,379,987	41.0	57,057,628		

(Continued)

TABLE III (Continued)

YEAR	ARIZONA			UNITED STATES		WORLD	E & M J	E & M J
	TONS	% of U.S. Prod.	% of World Prod.	TONS	% of World Prod.	TONS	PRICE ¢ per pound	EXPORT PRICE ¢ per pound
1945	287,203	37.2	12.0	772,894	32.2	2,400,000	11.775	11.700
1946	289,223	47.5	14.1	608,737	29.6	2,056,000	13.820	14.791
1947	366,218	43.2	14.6	847,563	33.9	2,500,000	20.958	21.624
1948	375,121	44.9	14.4	834,813	32.1	2.600,000	22.038	22.348
1949	359,010	47.7	14.4	752,750	30.1	2,500,000	19.202	19.421
1950	403,301	44.4	14.4	909,343	32.5	2,760,000	21.235	21.549
1951	415,870	44.8	14.3	928,330	32.0	2,900,000	24.200	26.258
1952	395,719	42.8	13.1	925,359	30.6	3,020,000	24.200	31.746
1953	393,525	42.5	12.9	926,448	30.4	3,050,000	28.798	30.845
1954	377,927	45.2	12.2	835,472	27.0	3,100,000	29.694	29.889
1955	454,105	45.5	13.3	998,570	29.2	3,420,000	37.491	39.115
1956	505,908	45.7	13.4	1,104,156	29.1	3,790,000	41.818	40.434
1957	515,854	47.5	13.3	1,086,141	27.9	3,890,000	29.576	27.157
1958	485,839	49.6	12.9	979,329	25.9	3,780,000	25.764	24.123
1959	430,297	52.2	10.7	824,846	20.5	4,020,000	31.182	28.892
1960	538,605	49.9	11.7	1,080,169	23.5	4,590,000	32.053	29.894
1961	587,053	50.4	12.1	1,165,155	24.0	4,850,000	29.921	27.919
1962	644,242	52.4	12.7	1,228,421 2/	24.1	5,090,000	30.600	28.514
1963	660,977 1/	54.5	12.7	1,213,166	23.2	5,220,000 3/	30.600	28.413
1945 to 1963	8,485,997	47.1	12.9	18,021,662	27.5	65,536,000		

1/ Highest annual production in history of Arizona
2/ Highest annual production in history of United States
3/ Highest annual production in history of the World

Arizona Department of Mineral Resources August, 1964

TABLE IV

MINE PRODUCTION RECOVERABLE COPPER - PRODUCTION SECONDARY UNALLOYED COPPER
REPORTED REFINED COPPER CONSUMPTION IN U.S.A.
ESTIMATED WORLD REFINED COPPER CONSUMPTION

	MINE PRODUCTION RECOVERABLE 1/				SECONDARY COPPER PRODUCTION		
Year	United States	Rest of Free World	Communist Controlled	TOTAL WORLD	United States 1/	Rest of World 2/	TOTAL WORLD 2/
1954	835,472	1,749,000	416,000	3,100,000	212,000	400,000	612,000
1955	998,570	1,955,000	451,000	3,405,000	247,000	595,000	842,000
1956	1,104,156	2,171,000	515,000	3,790,000	273,000	537,000	810,000
1957	1,086,859	2,259,000	544,000	3,890,000	248,000	547,000	795,000
1958	979,329	2,217,000	584,000	3,780,000	255,000	525,000	780,000
1959	824,846	2,590,000	605,000	4,020,000	262,000	520,000	782,000
1960	1,080,169	2,829,000	681,000	4,590,000	300,000	550,000	850,000
1961	1,165,155	2,873,000	812,000	4,850,000	280,000	620,000	900,000
1962	1,228,421	2,888,579	933,000	5,050,000	301,000	900,000	1,200,000
1963	1,213,166	3,015,088	991,746	5,220,000	315,000	1,040,000	1,355,000

	CHANGE IN STOCKS	REPORTED CONSUMPTION	ESTIMATED CONSUMPTION
	Total World	United States 1/	Total World 2/
1954	141,000 D	1,254,000	3,853,000
1955	20,000 I	1,502,000	4,227,000
1956	133,000 I	1,521,000	4,467,000
1957	104,000 I	1,348,000	4,581,000
1958	196,000 D	1,251,000	4,756,000
1959	30,000 I	1,463,000	4,772,000
1960	134,000 I	1,350,000	5,300,000
1961	20,000 D	1,463,000	5,730,000
1962	64,000 I	1,600,000	6,186,000
1963	5,000 D	1,744,000	6,575,000

1/ Source: U.S.B.M. 2/ Estimated. No official records have been published of either secondary unalloyed copper or of world consumption. Estimates are calculated from: "World Mine Production (U.S.B.M.) plus estimated secondary unalloyed copper, plus or minus change in stocks (Decrease or Increase)"

Arizona Department of Mineral Resources August, 1964

TABLE V

WORLD MINE PRODUCTION OF RECOVERABLE COPPER

BY CONTINENTS AND PRINCIPAL COUNTRIES IN THOUSANDS SHORT TONS

Years 1959, 1960, 1961, 1962 and 1963

Source: U.S.B.M.

	1959	1960	1961	1962	1963
NORTH AMERICA:					
U.S.A.	825	1,080	1,165	1,228	1,213
Canada	399	438	450	465	458
Mexico	63	67	54	52	62
Other	10	13	11	14	21
	1,297	1,598	1,680	1,759	1,754
SOUTH AMERICA:					
Chile	602	587	604	646	663
Peru	53	202	218	183	196
Other	4	4	4	4	5
	659	793	826	833	864
EUROPE:					
U.S.S.R.	480	510	600	700	770
Yugoslavia	43	37	55	57	68
Others	141	147	154	162	176
	664	694	809	919	1,014
ASIA:					
China	33	77	110	110	99
Cyprus	40	39	32	28	29
Japan	93	98	106	114	118
Philippines	55	40	57	60	70
Turkey	31	30	32	31	28
Others	10	13	13	19	31
	272	306	350	362	375
AFRICA:					
No. Rhodesia	599	635	633	620	648
Belg. Congo	311	333	325	325	298
U. of So. Africa	56	51	58	51	61
Others	76	59	67	63	75
	1,032	1,078	1,083	1,059	1,082
AUSTRALIA:	104	121	102	118	128
TOTAL WORLD	4,040	4,590	4,850	5,090*	5,220

* Corrected total for 1962.

Arizona Department of Mineral Resources August, 1964

TABLE VI

NEW (PRIMARY) REFINED COPPER WITHDRAWN FROM SUPPLY ON DOMESTIC ACCOUNT

Years 1958-1963 Source: U.S.B.M. Unit: Short Tons

	Year 1958	Year 1959	Year 1960
Ref. Prod. of New Cu from U.S. Ores . . .	1,001,645	796,452	1,121,286
Ref. Prod. of New Cu from Foreign Ores. .	350,875	301,795	397,641
Total Ref. Prod of New Copper	1,352,520	1,098,247	1,518,927
Imports of Refined Copper	127,630	214,056	142,709
Stocks at beginning of period	109,000	48,000	18,000
Total Available Supply	1,589,150	1,360,303	1,679,636
Exports of Refined Copper	384,868	158,938	433,762
Stocks at end of period	48,000	18,000	98,000
TOTAL	432,868	176,938	531,762
Withdrawn on Domes.Acc.(Apparent Cons.).	1,157,000	1,183,000	1,148,000
Reported Actual Consumption	1,250,677	1,463,031	1,349,896

	Year 1961	Year 1962	Year 1963
Ref. Prod. of New Cu from U.S. Ores . . .	1,181,015	1,214,146	1,219,342
Ref. Prod. of New Cu from Foreign Ores. .	369,124	379,584	377,009
Total Ref. Prod. of New Copper . .	1,550,139	1,611,730	1,596,351
Imports of Refined Copper	66,855	98,820	119,165
Stocks at beginning of period	98,000	49,000	71,000
TOTAL AVAILABLE SUPPLY	1,714,994	1,759,550	1,786,516
Exports of Refined Copper	432,253	336,525	311,479
Stocks at end of period	49,000	71,000	52,000
TOTAL	481,253	407,525	363,479
Withdrawn on Domes.Acc.(Apparent Cons.).	1,234,000	1,352,000	1,423,000
Reported Actual Consumption	1,462,830	1,599,676	1,744,273

Arizona Department of Mineral Resources August, 1964

ARIZONA

ARIZONA'S PART IN THE ECONOMY OF THE COPPER INDUSTRY

In the last twelve years, Arizona has increased its copper production from 395,719 tons of recoverable copper in the year 1952 to 660,977 tons in the year 1963, or about 67 per cent. The annual tonnage of copper ore has increased from 44,473,000 tons in 1952 to an estimated 80,615,132 tons in 1963, or over 81 per cent. New producers have come into the picture during that time, such as Phelps Dodge Corporation's Lavender Pit, Magma Copper Company's San Manuel Mine, Asarco's Silver Bell Mine, Pima Copper Company's Pima Mine, Duval Corporation's Esperanza Mine, and Asarco's Mission Unit. In addition, Kennecott Copper Corporation has expanded its Ray Mine by almost 50 per cent, and Bagdad Copper Corporation has expanded its operations by the construction of an acid plant and leaching plant to treat its oxidized ores.

As a result of this new production, Arizona has not only maintained its rank as the Number One copper producing state, but has raised its proportion of United States production from 44.2 per cent in 1952 to over 50 per cent in the last six years. In other words, Arizona is producing more copper than all the other states combined. (See Table III).

CONTENTS OF ARIZONA SUPPLEMENT

* * * * *

MINERAL INDUSTRY SURVEYS

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Stewart L. Udall, Secretary

Marling J. Ankeny, Director

Robert W. Geehan, Area Director, Area V
Mineral Resource Office
224 New Customhouse
Denver, Colorado 80202

Area Report

THE MINERAL INDUSTRY OF ARIZONA, 1963

Mineral production in Arizona in 1963 totaled $481.4 million--an increase of $7.3 million (2 percent) over that of 1962, according to the Bureau of Mines, U.S. Department of the Interior. The value advanced to within 1 percent of the record high established in 1956. A higher output of copper, with substantial increases in other mineral commodities, was the primary reason for the increase. Arizona mines produced an average of 55,081 tons of copper per month, supplying the Nation with 39 percent of domestic copper requirements and 54.5 percent of the total United States production of 1.2 million short tons in 1963. More than 17 percent of the 4 million tons of the copper consumed in the free world was derived from ore mined in Arizona.

The metals group--consisting of copper, gold, lead, mercury, molybdenum, silver, vanadium, zinc, and iron ore and uranium ore--accounted for 91.3 percent of the value of mineral production, followed in order by nonmetals, 8.4 percent, and mineral-fuels group, 0.3 percent. Metals production occurred mainly in Pima, Pinal, Greenlee, and Gila Counties; nonmetals in Pima, Maricopa, and Yavapai Counties; and mineral fuels in Apache County.

Sand and gravel output, ranked second in value of mineral commodities produced in the State, accounted for 36 percent of the value of nonmetals produced and 3 percent of the State total value of mineral output. Used extensively by the construction industry, this commodity declined 3 percent in quantity. Completion of certain phases of construction at the Glen Canyon Dam near Page resulted in a 10-percent drop in the output of cement.

Mineral output was reported from all 14 counties. The combined value of mineral output from Pima and Pinal Counties was $242.9 million, 50 percent of the State total value of mineral production. All but four of the counties--Graham, Mohave, Santa Cruz, and Yuma--had production valued at more than $1 million.

The Federal Bureau of Mines conducted a nationwide survey of water used during 1962 in the mineral industries; from this survey, table 2 depicts specific results for Arizona.

Prepared by L. P. Larson, Physical Scientist, under the supervision of D. H. Mullen, Project Coordinator, Mineral Resource Office, Area V, in cooperation with the Arizona Bureau of Mines, for release August 14, 1964.

TABLE 1.--Mineral production in Arizona[1/]

Mineral	1962		1963	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Beryllium concentrate----short tons, gross weight--	1	(2/)	----------	----------
Clays[3/]----thousand short tons--	139	$184	163	$203
Copper (recoverable content of ores, etc.)----short tons--	644,242	396,853	660,977	407,162
Gem stones----	(4/)	120	(4/)	120
Gold (recoverable content of ores, etc.)----troy ounces--	137,207	4,802	140,030	4,901
Lead (recoverable content of ores, etc.)----short tons--	6,966	1,282	5,815	1,256
Lime----thousand short tons--	174	2,914	181	3,048
Molybdenum (content of concentrate)----thousand pounds--	4,412	5,864	5,553	7,584
Natural gas----million cubic feet--	230	27	1,334	161
Petroleum (crude)----thousand 42-gallon barrels--	39	(5/)	6/55	(5/)
Pumice----thousand short tons--	756	1,640	800	1,877
Sand and gravel----do----	15,579	17,404	15,036	14,466
Silver (recoverable content of ores, etc.)---thousand troy ounces--	5,454	5,917	5,373	6,873
Stone----thousand short tons--	4,333	6,616	3,257	5,069
Tungsten ore and concentrate (60-percent WO_3 basis)----short tons--	15	14	----------	----------
Uranium ore----do----	143,196	3,047	150,584	4,844
Vanadium----do----	632	(5/)	222	(5/)
Zinc (recoverable content of ores, etc.)----do----	32,888	7,564	25,419	5,846
Value of items that cannot be disclosed: Asbestos, cement, clays (bentonite and fire clay), diatomite, feldspar, gypsum, helium, iron ore, mercury, mica (scrap), perlite, pyrites, and values indicated by footnote 5----	----------	7 9/19,883	----------	8/17,982
Total----	----------	9/474,131	----------	481,392

1/ Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
2/ Less than $500.
3/ Excludes bentonite and fire clay; included with "Value of items that cannot be disclosed."
4/ Weight not recorded.
5/ Figure withheld to avoid disclosing individual company confidential data.
6/ Preliminary figure.
7/ Value of metals and mineral fuels, $3,453,000; value of nonmetals, $16,430,000.
8/ Value of metals and mineral fuels, $2,320,000; value of nonmetals, $15,662,000.
9/ Revised figure.

METALS

Arizona retained its position--held since 1910--as the leading copper-producing State, accounting for more than one-half of the Nation's copper output. New developments either planned or underway together with the modernization and expansion of existing plants were expected to provide sufficient additional capacity to assure producers in the State their share of the market.

Domestic prices for copper, stable throughout the year, resulted in a 31-cent-per-pound price for the third year. This stability, combined with assurance of adequate supplies, encouraged and promoted the use of copper, contributed to reduction of stocks, and encouraged producers to increase output. At yearend, Phelps Dodge Corp. and other major producers were considering increasing copper production at their Arizona properties by reinstating certain closedown days in their production schedules. During 1963 Phelps Dodge Corp. operated its properties at Ajo, Bisbee, Douglas, and Morenci at about 90 percent of capacity. Inspiration Division, Inspiration Consolidated Copper Co., mined and treated ore at 90 percent of capacity for the first 9 months of 1963. In the fourth quarter, as demand improved and the Christmas Division production failed to reach expected levels, production at the Inspiration Division was increased 10 percent to capacity level. Lower output at the Ray Pit, operated by Ray Mines Division, Kennecott Copper Corp., reflected the reduction in the operating rate effected on Sept. 16, 1962, to bring production in line with demand. In the fourth quarter of 1963, production at Ray was intensified to meet increased demand.

Arizona mines produced an average of 55,081 tons of copper per month, 54 percent of the Nation's output. More than one-sixth of the free-world output of copper originated at mines in the State.

Eighty-five operators reported production. The 5 leading producers reported output of 412,023 tons or 62 percent of the State total; the first 10 major producers accounted for 575,137 tons or 87 percent; and the first 15 producers 639,629 tons or 97 percent of the total.

Banner Mining Co. signed an agreement with The Anaconda Company granting Anaconda an exclusive option for leasing, exploring, developing, and financing substantially all mining property of Banner Mining Co. located in Pima County. An exception was that area of the Banner property, a part of the Pima pit, which was being mined and milled under contract by Pima Mining Co.

Duval Corp., formerly Duval Sulphur and Potash Co., proceeded with plans to develop and place in operation the company copper-molybdenum deposit in the Mineral Park mining district, 15 miles northwest of Kingman.

TABLE 2.--Water used during 1962 in the mineral industry of Arizona, by type of operations

Type of operation[1/]	New water	Recirculated water	Total water used	Discharged water	Consumed water	New water per $ value of 1962 production
	in million gallons					in gallons
Quarries and mills	27		27	2	25	4.04
Coal mines						
Metal mines and mills	26,214	49,949	76,163	12,890	13,324	61.64
Nonmetal mines and mills	[2/]		[2/]	[2/]		.13
Sand and gravel operations	1,063	253	1,316	919	144	61.06
Natural gas processing plants[3/]						
Total	27,304	50,202	77,506	13,811	13,493	
Oil- and natural gas-well drilling			5			
Secondary-recovery operations[3/]						
Total			5			
Grand total water used			77,511			

1/ Water survey did not include cement plants, lime plants, metal smelters, metal refineries, petroleum refineries, natural-brine operations, sand and gravel operations using suction dredges without preparation plants, stockpile operations, and assessment work operations.
2/ Less than 1 million gallons.
3/ No such operations in Arizona.

Isbell Construction Co. began removing an estimated 18 million tons of waste material overlying the ore deposit in January and by yearend had removed approximately 9 million tons. Stripping the waste from the 5,206-foot elevation to the 4,915-foot level was expected to cost $7 million and require 20 to 24 months on a 24-hour-day schedule. The company was reported to control 7,000 acres in the Mineral Park district. The $21 million 12,000-ton-per-day mill now under construction by Parson-Jurden was to use autogenous grinding for reducing the porphyry-type rock. In March, the company began removing waste material overlying the satellite copper-molybdenum ore body located immediately west of the main Esperanza pit. Six million tons of capping were to have been removed when stripping is completed in 1965. Ore from this deposit, known as the West Esperanza ore body, was to be mined and milled concurrently with ore from the main pit.

Ray Mines Division authorized expenditure of $500,000 for facilities to leach the No. 1 dump adjacent to the Pearl Handle open pit and to install a continuous X-ray system to analyze tailing streams from various units of the Hayden reduction plant. During the year, the Ray Mines Division removed ore and waste material from the Pearl Handle and West pits and from the southeastern extension to the Pearl pit. About midyear, the division began stripping east of Mineral Creek and mining under the Ray business section which had been demolished and made part of the pit. By 1965 the entire community was to be included in the Pearl Handle part of the open pit.

Bear Creek Mining Co., Kennecott Copper Corp. exploration subsidiary, received exclusive right from the Gila River Tribal Council to conduct a mineral-exploration program on 19,200 acres of tribal lands on the Gila River Indian Reservation near Sacaton. The area involved lies in two tracts, one about 10 miles northeast of Sacaton, Pinal County, and the other about 5 miles to the south. The permit, in force for 2 years, excludes oil and gas exploration.

The Phelps Dodge Corp. properties at Ajo, Bisbee, Douglas, and Morenci were operated without interruption throughout 1963 except for the regular 2-week summer shutdowns for vacations. Operating schedules at the various mines were curtailed to about 90-percent capacity. Concentrator capacity was increased about 7 percent with the installation of two new grinding mills. Other major capital expenditures by the company in 1963 included the beginning of construction work on a leach-precipitation-flotation system to recover part of the oxide copper present in the Morenci ore; and partial completion of the Blue Ridge Dam project. Research to increase the continuity of operations at the sponge-iron plant at the Douglas smelter was continued throughout the year.

Phelps Dodge Corp. received a license from the Federal Power Commission to build the $6.7 million Blue Ridge hydroelectric-irrigation project in Coconino and Gila Counties. Construction of the dam for this project on East Clear Creek, a tributary of Little Colorado River in central Arizona, was begun in May.

In August, Pima Mining Co. completed an expansion program at its mill south of Tuscon. The new facility was designed to increase daily mill capacity from 3,800 to 7,000 tons. During the year the company stripped overburden from the west end of the northeast ore body and from the east end of the main pit. Most of the ore came from the west and central part of the pit, including ore mined from across the line on Banner Mining Co. property. In accordance with the agreement between the two companies the ore was milled at the Pima mill.

Shattuck Denn Mining Corp. began production on the 2,000-foot level of a recently discovered copper vein at its Iron King mine near Prescott. The copper vein, near and parallel to the main ore-vein system in the mine, was uncovered during an intensive revaluation and drilling program conducted in the past 2 years. Drilling indicated that the new mineralized ore body contained a higher percentage of copper than that of the normal Iron King ore. The output from the Iron King mine gained impressively near the end of the year following the introduction of a more efficient one-level mining operation employing highly mechanized equipment. The Iron King mine has been a major producer of zinc, lead, silver, and gold for many years; copper was produced only as a byproduct.

Leaching operations were started by Zontelli Western Mining Co. at the Mardun sandstone-copper deposit in the White Mesa district, Coconino County. During the year the company received a loan of $66,500 from the Small Business Administration to develop the property.

Gold production from 48 lode and 4 placer mines in Arizona totaled 140,030 troy ounces, 2 percent (2,823 ounces) more than in 1962. Eighty-seven percent was recovered as a byproduct of copper refining; 12 percent from lead-zinc ores; and the balance from gold-silver, copper-zinc, gold, lead, and silver ores and miscellaneous lode material.

The Omega mine operated by Arkota Steel Corp. and the New Planet mine operated by Pacific Mines, Inc., were idle. Arkota Steel Corp. reported shipping a small quantity of concentrate from stockpile for use in precipitating copper. Magnetite ore produced from the Margaret Howard mine in Gila County was sold for use as a processing agent. Sponge iron was produced from pyrite by Ray Mines Division at Hayden and from iron oxides obtained in the smelting process by Phelps Dodge Corp. at Douglas.

Lead production was 1,151 tons (17 percent) lower in quantity but only 2 percent lower in value compared with that of 1962; it was the lowest production of lead reported in the State since 1934. Most of the production came from lead-zinc ores of the Iron King mine operated by Shattuck Denn Mining Corp. in Yavapai County. The Flux mine in the Harshaw district of Santa Cruz County, operated by Nash & McFarland, was the second largest producer. Yavapai County, with five operations, led the State with 5,383 tons or 93 percent of the production. Santa Cruz County, with four operations, was second, accounting for 6 percent of the output. Eleven operations in four counties--Cochise, Maricopa, Pima, and Pinal cumulatively--furnished 1 percent of the production.

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Mercury production, increasing fivefold compared with that of 1962, came from a mine in the Mazatzal Mountains north of Sunflower in Maricopa County, the State principal mercury-producing area, and from mill cleanup in Gila County.

Ranked third in the Nation behind Colorado and Utah, Arizona accounted for slightly more than 8 percent of the Nation's total output of molybdenum. Production was derived as a byproduct from the processing of copper ores. Molybdenum production from six of the State major copper operations increased 26 percent in quantity and 29 percent in value during the year as a result of new or modernized facilities. Shipments of molybdenum concentrates contained 5.6 million pounds of molybdenum valued at $7.6 million. Listed in decreasing order of production, the mines and operators were San Manuel, San Manuel Division, Magma Copper Co.; Esperanza, Duval Corp.; Silver Bell, American Smelting and Refining Co. (Asarco); Inspiration, Inspiration Division, Inspiration Consolidated Copper Co.; Morenci, Phelps Dodge Corp.; Bagdad, Bagdad Copper Corp.

Silver production increased in value but decreased in quantity. Most of the output was from mines operated primarily for other metals: 84 percent was recovered from copper ores; 14 percent from lead-zinc ores; and the remainder from complex ores of gold, silver, copper, lead, and zinc, and from miscellaneous materials. The five leading producing companies--Phelps Dodge Corp., Asarco, Shattuck Denn Mining Corp., Magma Copper Co., and Pima Mining Co.--accounted for 83 percent of the State total output. Counties in which production occurred--listed in order of descending production--were Pima, Yavapai, Pinal, Cochise, Greenlee, Gila, Santa Cruz, Coconino, Navajo, Maricopa, Mohave, Yuma, and Graham.

Arizona was ranked fourth in the Nation in uranium-ore production. Thirty-eight operations in Apache, Coconino, and Navajo Counties were active in 1963 compared with 31 operations in 1962. Shipments of uranium ore totaled 150,584 short tons valued at $4.8 million, an increase of 5 percent in quantity and 59 percent in value. The value of the ore f.o.b. mine ranged from $1.96 per ton to $47.50, averaging $32.17 per ton during the year. Ore mined in the State came from three northern counties, Apache, Coconino, and Navajo.

Uranium ores from Apache and Navajo Counties were processed at vanadium recovery units at uranium plants operated by Climax Uranium Co., a unit of Climax Division, American Metal Climax, Inc., Grand Junction, Colo.; Union Carbide Corp., Union Carbide Nuclear Co. Division, Rifle and Uravan, Colo.; and Vanadium Corporation of America, Durango, Colo., and Shiprock, N. Mex. (New Mexico plant formerly owned by Kerr-McGee Oil Industries, Inc.). The quantity of fused vanadium oxide recovered was 65 percent below that of 1962.

Zinc production in Arizona was 23 percent lower in quantity and 23 percent lower in value. Following the Iron King mine, the principal producers

of zinc in the State, in order of production, were the Copper Queen and Old Dick mines (Cyprus Mines Corp.), Atlas mine (B S & K Mining Co.), Johnson Camp mine (McFarland & Hullinger), and Flux mine (Nash & McFarland). These six mines supplied 99 percent of the Arizona zinc output.

NONMETALS

Production of asbestos from mines near Globe, Gila County, increased during the year. Jaquays Mining Corp., operator of the Regal and Chrysotile mines in the Salt River canyon district, was the leading producer, and accounted for most of the production. Selectively mined chrysotile asbestos ore was hand-sorted at the property and shipped to the company asbestos mill at Globe. Production was also reported by Asbestos Manufacturing Co. from the Asbestos Peak and Ash Creek mines and by Metate Asbestos Corp. from the Lucky Seven mine.

Arizona Portland Cement Co., a division of California Portland Cement Co., and Phoenix Cement Co., a division of American Cement Corp., produced portland and masonry cements at plants in Pima and Yavapai Counties.

Output of all types of clay sold or used increased 17 percent over that of 1962. A rise in bentonite output and additional production of miscellaneous clays by Phoenix Cement Co. accounted for most of the increased output.

Arizona Gypsum Corp. produced a small quantity of diatomaceous earth from the White Cliffs mine near Mammoth in southeastern Pinal County to be used as filler. The property, formerly operated by American Diatom, Inc., was acquired by Arizona Gypsum Corp. as the result of a merger of the two companies.

Production of feldspar was reported from two mines in the State. The Taylor mine in Mohave County, operated by a contractor of International Minerals & Chemical Corp. (IMC) was the principal producer; the San Antonio Mine Co., Pima County, supplied the balance of production from the San Antonio mica mine. The bulk of the feldspar produced in Arizona was ground at the IMC mill near Kingman.

Production of crude gypsum from mines in Pinal and Yavapai Counties increased 19 percent. Four mines were operated: three in Pinal County and one in Yavapai. Arizona Gypsum Corp. operated two properties, one in Pinal County near Winkelman, and the other in Yavapai County near Camp Verde. Output from the two properties was sold uncalcined for agricultural use and/or as a cement retarder. National Gypsum Co., the largest producer, operated a mine near Winkelman and calcined much of its output for use in manufacturing wallboard and lath at the company-owned plant in Phoenix. Garcia Gypsum Co., Inc., produced crude gypsum for agricultural use.

Lime used in the concentration of copper ores accounted for 85 percent of all lime sold or used. Six limeburning plants were operated during the year, one each in Cochise, Greenlee, Pinal, and Yavapai Counties and two in Gila County. Natural gas was the main fuel used.

Reaching a new high, output of crude perlite, all produced in Pinal County, increased 43 percent over that of 1962. Arizona Perlite Roofs, Inc., the largest producer, accounted for most of this increase: the balance was supplied by Harborlite Corp., the only other producer of crude. Perlite expanding plants were operated at Phoenix by Supreme Perlite, Inc., and in Tucson by Polaris Perlite Co., Inc. The expanded products were used for building plaster, loose-fill insulation, concrete aggregate, and soil conditioner.

Production of pumice was reported by 10 operators--including 3 individuals, 6 companies, and 1 Government agency--from deposits located in Cochise, Coconino, Graham, and Navajo Counties in 1963. Coconino County was the largest producer of pumice or pumicite materials, accounting for 89 percent of the production. Total output in the State, as measured by sales, was 799,869 short tons valued at $1.9 million, an increase of 6 percent in quantity and 14 percent in value over that of 1962. Arizona supplied 31 percent of the United States production, leading all other States in output of this commodity.

Ray Mines Division recovered byproduct pyrite from milling copper ores at Hayden; the pyrite was used to produce sulfuric acid and sponge iron. The sulfuric acid and sponge iron were used in the company copper concentrator for leaching and precipitating the copper occurring in the ore as copper oxide minerals. Pyrite produced during the year contained approximately 44 percent sulfur.

Sand and gravel was again the second most important mineral product of the State; the output was valued at $14.5 million. Consumption declined to 15 million tons, a 3-percent decline from the 15.6 million tons reported in 1962. Commercial production rose 3 percent, because of an increased use of building sand and gravel. Noncommercial output was down 10 percent because of a substantial decrease in the quantity of paving sand consumed.

Production of stone declined from 4.3 million tons valued at $6.6 million in 1962 to 3.3 million tons valued at $5.1 million in 1963. A lower demand for road material and cement was the primary reason for the 25-percent drop in output. Basalt, granite, limestone, marble, sandstone, and other miscellaneous stones were quarried in 13 counties in Arizona. Only Santa Cruz County, in the extreme southern part of the State, did not report production. Crushed stone accounted for more than 99 percent of the total production. Crushed limestone, produced in six counties, accounted for 54 percent of the total quantity of stone produced and 46 percent of the total value. The largest output came from Pima and Yavapai Counties; Cochise, Gila, Greenlee, and Pinal Counties furnished the balance.

At its Glendale exfoliating plant at Glendale in Maricopa County, Ari-Zonolite Co. produced exfoliated vermiculite from crude ores obtained from mines in Montana. Output was 33 percent above that of 1962. The exfoliated product was used as lightweight aggregate in concrete and plaster, insulation, and in agricultural and acoustical products.

MINERAL FUELS

Lawrence Isaac Coal Co. produced less than 1,000 tons of coal from the Black Mesa coal seam of the Cow Springs No. 3 mine near Tona Lea, Coconino County. Production of 1,000 tons or less is not reported in table 1.

The Arizona Oil and Gas Conservation Commission reported that 438.5 million cubic feet of helium-bearing gas was produced from wells in the Pinta Dome field, Apache County, in 1963. The gas contained approximately 8.5 percent helium or 37.3 million cubic feet. Assuming that 97 percent of the contained helium was recovered at the Navajo processing plant in Apache County, the output of Grade A helium was approximately 36.2 million cubic feet. Based on the value of $35 per 1,000 cubic feet of helium, established by the Federal Bureau of Mines for sales of Government-produced helium to Government and industrial consumers, the value of output was $1.3 million.

Output of crude petroleum in Arizona increased 41 percent in quantity over that of the preceding year. All production in the State came from wells in Apache County. Sixteen wells were completed during the year, compared with 54 in 1962. The activity, including 1 development and 15 exploratory wells, resulted in 1 oil and 2 gas discoveries. Exploration by Texaco Inc., in the Paradox-Black Basin area in northern Apache County, resulted in the one oil discovery. In another development, Pan American Petroleum Corp. completed a 1½-mile south extension to Bita Peak field.

TABLE XVII

ARIZONA COPPER MINING - OUTPUT IN TONS COPPER ORE, VALUE OF COPPER, GOLD, SILVER PRODUCED

Source: U. S. Bureau of Mines

	Tons Copper Ore Annual Rate	Gold Ounces & Value	Silver Ounces & Value	Copper Pounds & Value	Lbs. Cu Recov Per Ton & Copper Price	Value of Copper, Gold & Silver	Lbs. Copper Equiv. to Total Val. Cu, Gold & Silver
1947-1949	38,082,754	79,612 $2,786,420	2,603,485 $2,356,154	723,353,767 $ 150,588,843	19.0 Lbs/ton 20.818¢	$155,731,417	748,056,267
1950	41,757,037	79,562 $2,784,670	2,853,375 $2,582,304	765,334,514 $162,250,916	18.3 lbs/ton 21.2¢	$167,617,890	767,000,000
1951	42,784,388	83,521 $2,923,235	3,087,865 $2,794,518	775,609,514 $187,697,501	18.1 lbs/ton 24.2¢	$193,415,254	799,236,600
1956	60,468,580	119,435 $4,180,225	3,963,579 $3,587,039	935,039,400 $390,846,469	15.5 lbs/ton 41.8¢	$398,613,733	953,621,100
1960	66,032,439	115,602 $4,046,070	3,689,622 $3,339,108	993,370,700 $317,878,624	15.0 lbs/ton 32.0¢	$325,263,802	1,016,449,300
1961	71,918,991	129,184 $4,521,440	4,380,458 $4,049,690	1,092,360,900 $326,845,395	14.6 lbs/ton 29.9¢	$335,416,435	1,121,007,000
1962	78,868,147	117,362 $4,107,670	4,571,370 $4,959,936	1,200,945,700 $369,891,276	15.2 lbs/ton 30.8¢	$378,958,882	1,230,386,000
1963	80,615,132	121,177 $4,241,195	4,494,239 $5,748,132	1,217,337,700 $372,505,336	15.1 lbs/ton 30.6¢	$382,494,463	1,249,982,000

TABLE XVIII

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

1858 - 1963 Incl. - In Terms of Recoverable Metals

Source: U. S. B. M.

	COPPER		LEAD		ZINC	
	Short Tons	Value (thousands)	Short Tons	Value (thousands)	Short Tons	Value (thousands)
1874 - 1962	18,426,686	$ 7,470,734	621,744	$ 120,955	913,173	$ 220,167
1963	660,977	407,162	5,815	1,256	25,419	5,846
Total 1874 - 1963	19,087,663	$ 7,877,896	627,559	$ 122,211	938,592	$ 226,013
Avg. Price	$ 0.206361		$ 0.09737		$ 0.12040	

	GOLD		SILVER		
	Ounces	Value (thousands)	Ounces	Value (thousands)	TOTAL VALUE
1858 - 1962	12,876,904	$ 338,187	369,887,241	$ 288,215	$ 8,438,258,000
1963	140,030	4,901	5,373,058	6,873	426,038,000
Total 1858-1963	13,016,934	$ 343,088	375,260,299	$ 295,088	$ 8,864,296,000
Avg. Price	$ 26.3571		$ 0.7864		

Estimated Value of Other Metals and Non-metallics Production in Arizona through 1962	$ 503,126,000
Estimated Value of Other Metals and Non-metallics Production in Arizona in 1963	55,354,000
Estimated Value of Other Metals and Non-metallics Production in Arizona through 1963	$ 558,480,000
GRAND TOTAL ESTIMATED VALUE OF ARIZONA'S MINERAL PRODUCTION THROUGH 1963	$ 9,422,776,000

First Year of reported production: Gold & Silver - 1858, Copper - 1874, Lead - 1894, Zinc - 1905

Arizona Department of Mineral Resources

August, 1964

TABLE XIX

MINE PRODUCTION OF GOLD, SILVER, COPPER, LEAD AND ZINC IN ARIZONA IN THE YEAR 1963
BY CLASS OF ORE IN TERMS OF RECOVERABLE METALS

Source	Number of mines 1/	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold	4	80	50	76	300	----------	----------
Dry gold-silver	8	117,705	383	12,519	1,903,400	----------	----------
Dry silver	22	31,068	5	10,307	272,600	----------	----------
Total	34	148,852	438	22,902	2,176,300	----------	----------
Copper	34	80,615,132	121,177	4,494,239	1,217,337,700	22,200	506,300
Copper-zinc	4	116,251	154	45,560	8,608,000	57,800	15,575,500
Lead	9	2,127	33	10,982	7,400	355,900	22,100
Lead-zinc	2	293,021	17,486	766,898	657,100	11,105,500	32,531,200
Zinc	2	8,454	------	6,299	18,500	84,900	2,197,400
Total	50	81,034,985	138,850	5,323,978	1,226,628,700	11,626,300	50,832,500
Other "lode" material:							
Gold mill cleanup	(2/)	20	43	43	----------	----------	----------
Gold tailings	1	50	26	13	----------	----------	----------
Gold-silver tailings	2	28,891	570	11,835	73,000	----------	----------
Copper cleanup	(2/)	1,715	49	1,220	526,400	----------	100
Copper precipitates	14	67,841	---	------	91,236,600	----------	----------
Lead cleanup	(2/)	4	1	7	----------	3,700	----------
Uranium ore	------	------	---	13,055	1,312,100	---------	5,400
Total	17	98,521	689	26,173	93,149,000	3,700	5,500
Total "lode" material	90	81,282,358	139,977	5,373,053	1,321,954,000	11,630,000	50,838,000
Placer	4	---------	53	5	----------	----------	----------
Total, all sources	94	81,282,358	140,030	5,373,058	1,321,954,000	11,630,000	50,838,000

1/ Detail will not necessarily add to totals because same mines produce more than one class of material.
2/ From properties not classed as mines.

TABLE XX

COPPER PRODUCTION RECORD OF LARGE ARIZONA COPPER MINES

YEARS 1962 and 1963

Source: U.S.B.M. & Company Reports

	1962		1963	
	Tons Copper Ore Mined	Pounds Copper Recovered	Tons Copper Ore Mined	Pounds Copper Recovered
PHELPS DODGE:				
Morenci	16,983,000	242,604,000	17,141,000	242,440,000
New Cornelia	9,648,000	142,016,000	9,370,000	134,412,000
Lavender Pit	5,374,000	83,568,000	5,347,000	76,532,000
Copper Queen	618,000	61,484,000	715,000	66,142,000
Sub-Total	32,623,000	529,672,000	32,573,000	519,526,000
KENNECOTT - Ray	7,695,757	132,950,000	7,123,102	125,860,000
MIAMI:				
Miami		18,077,492		18,195,285
Copper Cities	3,150,952	33,827,784	3,149,260	35,402,918
Copper Cities Dump Leach		175,661		7,039,062
Castle Dome		5,505,398		5,513,538
Sub-Total	3,150,952	57,586,335	3,149,260	66,150,803
INSPIRATION	5,552,219	104,581,211	5,487,483	93,874,294
Christmas Div.			638,755	20,232,893
Sub-Total			6,126,238	114,107,187
MAGMA:				
San Manuel	12,565,545	168,416,024	12,555,000	177,072,298
Superior	337,618	29,825,874	310,039	28,262,686
Sub-Total	12,903,163	198,241,898	12,865,039	205,334,984
A.S. & R. CO:				
Silver Bell	2,760,600	42,932,700	2,954,100	45,764,428
Mission Unit	5,223,500	80,510,800	7,289,100	98,018,489
Sub-Total	7,984,100	123,443,500	10,243,200	143,782,917
PIMA MINING CO: Pima	1,528,556	40,769,270	1,992,725	48,248,471
BAGDAD COPPER CORP.	1,990,910	22,762,100	2,094,670	24,943,200
From Leach				10,326,300
Sub-Total	1,990,910	22,762,100	2,094,670	35,269,500
DUVAL - Esperanza	4,130,149	44,542,483	4,364,029	43,021,755
Precipitate Copper from leaching		1,406,189		3,765,358
Sub-Total	4,130,149	45,948,672	4,364,029	46,787,113
BANNER MINING CO:				
Palo Verde,	243,072	9,039,051	64,298	2,539,896
Mineral Hill & Daisy	256,600	7,366,193	257,195	7,353,021
Sub-Total	499,672	16,375,244	321,493	9,892,917
TOTALS	78,058,478	1,272,330,230	80,852,756	1,314,959,892

Arizona Department of Mineral Resources August, 1964

TABLE XXI

MINERAL PRODUCTION OF LARGE AND SMALL PRODUCERS IN ARIZONA IN 1963 1/

Source: U. S. B. M. Area Report for Arizona, 1963

	PRODUCTION	VALUE
LARGE COPPER PRODUCERS:*		
Copper (lbs.)	1,314,959,892	$ 405,004,569
Gold (ozs.)	121,177	4,241,195
Silver (ozs.)	4,494,239	5,748,941
Molybdenum (lbs.) (content of concentrate)	5,553,000	7,584,000
Total Value of Large Mine Production in 1963		$ 422,578,705
SMALL MINERAL PRODUCERS:		
Clays 3/ thousand short tons	163	$ 203,000
Copper (recoverable content of ores, etc.) lbs.	6,994,108	2,157,431
Gem Stones	(4/)	120,000
Gold (recoverable content of ores, etc.) troy ounces	18,853	659,805
Lead (recoverable content of ores, etc.) short tons	5,815	1,256,000
Lime thousand short tons	181	3,048,000
Natural Gas million cubic feet	1,334	161,000
Petroleum (crude) thousand 42-gal. barrels	6/ 55	(5/)
Pumice thousand short tons	800	1,877,000
Sand and gravel thousand short tons	15,036	14,466,000
Silver (recoverable content of ores, etc) thousand troy ozs.	879	1,124,059
Stone thousand short tons	3,257	5,069,000
Uranium ore short tons	150,584	4,844,000
Vanadium short tons	222	(5/)
Zinc (recoverable content of ores, etc.) short tons	25,419	5,846,000
Values of items that cannot be disclosed; asbestos, cement, clays, (bentonite & fireclay), diatomite, feldspar, gypsum, helium, iron ore, mercury, mica (scrap), perlite, pyrites, and values indicated by footnote 5		8/ 17,982,000
TOTAL		$ 481,392,000
Percentage due to small mines		12.22%

1/ Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
2/ Less than $500.
3/ Excludes bentonite and fire clay; included with "Value of items that cannot be disclosed."
4/ Weight not recorded.
5/ Figure withheld to avoid disclosing individual company confidential data.
6/ Preliminary figure.
7/ Value of metals and mineral fuels, $3,453,000; value of nonmetals $16,430,000.
8/ Value of metals and mineral fuels, $2,320,000; value of nonmetals, $15,662,000.

* Phelps Dodge, Kennecott, Inspiration, Miami, Magma (incl. San Manuel) Asarco's Silver Bell, Pima, Bagdad, Duval's Esperanza, Asarco's Mission Unit, Banner Mining Co.

TABLE XXII

SUMMARY OF TOTAL COVERED EMPLOYMENT & WAGES IN ARIZONA COPPER MINING
1947-1963 INCLUSIVE

Source: Arizona Employment Security Commission
United States Bureau of Mines

COPPER MINING	No. Covered Employees	Covered Wages	Average Annual Wage	Tons Copper Ores	Average Weekly Wage
1947	11,340	$ 36,365,277	$ 3,207	37,810,448	$ 61.67
1948	11,493	41,318,524	3,595	39,072,204	69.13
1949	11,001	40,612,224	3,692	37,365,611	71.00
1950	10,181	41,994,321	4,125	41,757,273	79.33
1951	10,754	47,825,698	4,447	42,784,388	85.52
1952	11,365	54,950.235	4,835	44,472,522	93.14
1953	12,068	62,742,982	5,199	45,187,838	99.98
1954	12,502	65,518,853	5,241	43,072,894	100.79
1955	12,399	71,293,263	5,750	52,189,728	110.58
1956	14,008	83,568,996	5,966	60,468,580	114.73
1957	14,652	85,125,320	5,809	59,571,834	111,71
1958	14,100	74,726,972	5,300	56,255,809	101.93
1959	11,568	72,095,130	6,232	53,121,545	119.85
1960	13,764	90,312,848	6,562	66,032,439	126.19
1961	14,275,	97,271,286	6,814	71,918,991	131.04
1962	14,408	101,920,108	7,074	78,868,147	136.04
1963	14,303	104,291,588	7,292	80,615,132	140.23

TABLE XXIII

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

Base Period 1947-1949 and Period Calendar Year 1963

ARIZONA INDUSTRIES COVERED BY SOCIAL SECURITY

Compiled by Arizona Department of Mineral Resources
Source: Arizona Employment Security Commission

	Average No. of 1/ Employees	Total Wages	Average Annual Wage	Average Weekly Wage
	Base Period 1947-1949			
Copper Mining Only 2/	11,278	$ 39,432,008	$ 3,496	$ 67.23
Copper Smelting 3/	1,500	5,175,000	3,450	66.35
All Copper Mining & Smelting	12,778	44,607,008	3,491	67.13
Other Mining & Quarrying	1,592	4,913,010	3,085	59.33
All Mining, Quarrying & Smelting	14,370	49,520,018	3,446	66.27
Manufacturing (Excl. Smelting)	12,639	36,910,624	2,920	56.15
Construction	10,844	35,424,826	3,267	62.83
Trans. & Utilities (Exlc. R.R.s)	10,530	29,948,944	2,844	54.69
Wholesale - Retail Trade	36,213	91,916,860	2,538	48.81
Services - Misc. (Incl. Agri.)	18,643	43,103,526	2,312	44.46
Totals and Averages	103,239	$ 286,824,898	$ 2,778	$ 53.42
	YEAR 1961			
Copper Mining Only 2/	14,275	$ 97,271,286	$ 6,814	$ 131.04
Copper Smelting 3/	1,578	9,968,163	6,317	121.48
All Copper Mining & Smelting	15,853	107,239,449	6,765	130.10
Other Mining & Quarrying	1,903	10,542,501	5,540	106.54
All Mining, Quarring & Smelting	17,756	$ 117,781,950	$ 6,634	$ 127.57
	YEAR 1962			
Copper Mining Only 2/	14,408	$ 101,920,108	$ 7,074	$ 136.04
Copper Smelting 3/	1,868	12,216,000	6,540	125.76
All Copper Mining & Smelting	16,276	114,136,108	7,013	134.86
Other Mining & Quarrying	1,580	8,727,313	5,524	106.24
All Mining, Quarrying & Smelting	17,856	$ 122,863,421	$ 6,881	$ 132.33
	YEAR 1963			
Copper Mining Only 2/	14,303	$ 104,291,588	$ 7,292	$ 140.23
Copper Smelting 3/	1,817	12,144,000	6,684	128.53
All Copper Mining & Smelting	16,120	116,435,588	7,223	138.90
Other Mining & Quarrying	1,591	9,299,379	5,845	112.40
All Mining, Quarrying & Smelting	17,711	125,734,967	7,099	136.52
Manufacturing (Excl. Smelting)	55,084	348,296,033	6,323	121.60
Construction	28,310	197,866,002	6,954	133.73
Trans. & Utilities (Excl R.R.s)	20,948	125,961,223	6,013	115.63
Wholesale - Retail Trade	85,687	360,110,834	4,203	80.83
Services & Misc. (Incl Agri.)	60,387	262,362,190	4,345	83.56
TOTALS - Averages	268,127	$ 1,420,331,249	$ 5,297	$ 101.87

1/ This number includes all covered employees on payroll, and is not restricted to production workers only, on which the average hourly and weekly earnings are reported. 2/ This number includes all copper mining and milling employees and some copper smelting employees not reported under Manufacturing by the Employment Security Commission. 3/ Smelting Employment has been segregated from Manufacturing as reported by the Employment Security Commission.

August, 1964