Gem Stones

By Robert G. Clarke [1]

The value of gem stones and mineral specimens produced in the United States during 1975 was estimated to be $8.7 million, an increase of 90% over that of 1974. The domestic commercial mining industry contributed most of the increase, particularly in the production of turquoise. Amateur collectors accounted for much of the activity in many States. Commercial operators sold mainly to wholesale or retail outlets and also to jewelry manufacturers.

DOMESTIC PRODUCTION

Mines and collectors in 39 States produced gem materials estimated at $1,000 or more in value for each State. Ten States supplied 91% of the total value, as follows: Arizona, $5 million; Nevada, $1 million; Oregon, $500,000; Montana, $400,000; California, $220,000; New Mexico, $200,000; Texas, $160,000; Washington, $160,000; Wyoming, $140,000; and Colorado, $135,000.

Park authorities at the Crater of Diamonds Park in Arkansas reported the finding of the second largest diamond ever found in the area.[2] The diamond, 16.37 carats in weight, was flawless and clear white. The rough value was placed at $15,000; when finished, the stone will be worth $80,000 to $100,000.

Several minute diamond crystals were discovered in a rock sample from a diatreme in Wyoming, according to geologists who have been examining pipelike intrusions of igneous rock in the Rocky Mountain area.[3]

In Nevada, the explosion in demand for turquoise jewelry resulted in an increased value of gem stone production of 150% from an estimated $400,000 in 1974 to $1 million in 1975. To help individuals learn more about collecting localities in Nevada, a "map" was published of the State's rocks and minerals.[4]

The quantity and value of emerald, jade, opal, and sapphire were withheld to maintain confidentiality of reporting producers. Peridot was produced by about 200 individuals of the San Carlos Apache Tribe at Peridot, Ariz.; no estimate of quantity and value of the peridot was available.

The production of turquoise of all grades and quantities was nearly 586 tons, valued at $5.2 million, and was principally from Arizona, Colorado, and Nevada. The great interest in American Indian style jewelry continued throughout 1975. Many articles appeared in various publications describing the qualities of genuine turquoise and Indian jewelry.

The discovery of tourmaline in Maine initially occurred in August 1972. The discovery and subsequent development were described in detail.[5] Tourmaline has appeared in jewelry stores occasionally in the past, but the discovery at Newry assured a regular supply. Retail prices in

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[1] Physical scientist, Division of Nonmetallic Minerals.

[2] Arkansas Gazette. Little Rock, Ark. Record Diamond Found in Park. Aug. 21, 1975, sec A, p. 1.

[3] U.S. Geological Survey. Diamond Discovered in Wyoming. News Release, June 10, 1975.

[4] Nevada Bureau of Mines and Geology. Rockhound's Map of Nevada. Spec. Pub. 1, 1975.

[5] Dunn, P. J. Elbaite From Newry, Maine. Miner. Record, v. 6, No. 1, January-February 1975, pp. 22–25.

MacFall, R. P. Gem Tourmaline . . . Rediscovered at Newry. Miner. Record, v. 6, No. 1, January-February 1975, pp. 14-21.

——. The Story Beyond the Story of the Great Tourmaline Discovery. Lapidary J., v. 29, No. 5, August 1975, pp. 994–1001.

1975 ranged from about $8 per carat for small, slightly flawed stones to $100 per carat for large stones of good color weighing about 50 carats.

In addition to emerald, North Carolina is also the source for rhodolite, a garnet varietal. Western North Carolina is invariably associated with rhodolite garnets and probably the world's only supplier. A description of the area where rhodolite is found was published with complete instructions for gem seekers at the dig-for-fee mine.[6]

Accurate and up-to-date information for collecting areas is difficult to maintain. A listing of fee-basis and free digging areas for agate and other gem materials in central Oregon was provided with the cautionary advice to inquire in advance to verify the information.[7]

Custer, S. Dak., has been called the rose quartz capital of the world. In addition, four totally new minerals were discovered in the area: Jahusite, robertsite, segelerite, and wylheite.[8]

Producers of gem stones in the United States, by principal gem stone reported, follow:

[6] Broughton, P. L. North Carolina's Mason Mountain Rhodolites. Gems and Minerals, No. 453, July 1975, pp. 30–31.
[7] Shipp, M. D. Digging in Central Oregon 1975. Lapidary J., v. 29, No. 4, July 1975, pp. 870–871.
[8] Linde, M. South Dakota Mineral News. Gems and Minerals, No. 452, June 1975, pp. 32–33, 61–64.

Mine	Location	Operator
Emerald: Big Crabtree mine	Mitchell County, N.C	PBH Emerald Co. P.O. Box 163 Little Switzerland, N.C. 28749
Jade: Stewart Jewel Jade mine	Kobuk Village, Alaska	Stewart Jewel Jade Co. 531 4th Ave. Anchorage, Alaska 99501
Opal:		
Royal Peacock mine	Humboldt County, Nev	Harry W. Wilson Denio, Nev. 89404
Spencer Opal mine (dig-for-fee mine).	Clark County, Idaho	Mark L. Stetler 1862 Ranier St. Idaho Falls, Idaho 83401
Sapphire:		
Chaussee Sapphire mine (sold unscreened material to tourists in summer and assisted in screening).	Granite County, Mont	Chaussee Sapphire Corp. P.O. Box 706 Philipsburg, Mont. 59858
Sapphire Village mine (Yogo Gulch).	Judith Basin County, Mont.	Sapphire International Corp. P.O. Box 30 Utica, Mont. 59452
Turquoise:		
Aurora mine	Lander County, Nev	Carico Lake Mining Co. P.O. Box 3426 Albuquerque, N. Mex. 87110
Black Spider mine	---- do	Grillos Mining Co. 2221 10th St. Lubbock, Tex. 79401
Blue Eagle mine	Mineral County, Nev	E. Loving and D. Lester P.O. Box 155 Mina, Nev. 89422
Blue Jim mine	Lander County, Nev	James Elquist P.O. Box 255 Battle Mountain, Nev. 89820
Blue Spider mine	---- do	John Lee & Co. 5101 North 40th St., Apt. 119 Phoenix, Ariz. 85018
Boundary mine	Mineral County, Nev	D. Brannon and R. H. Herrington P.O. Box 377 Mina, Nev. 89422
Duval Corp. mine	Mohave County, Ariz	L. W. Hardy Co., Inc. 3809 East Highway 66 Kingman, Ariz. 86401
Morenci mine	Greenlee County, Ariz	W. O. Brown 230 West 66 Avenue Gallup, N. Mex. 87301
Pinto Valley mine	Gila County, Ariz	L. W. Hardy Co., Inc. 3809 East Highway 66 Kingman, Ariz. 86401
Red Mountain mine	Lander County, Nev	J. M. Johnson 102 West 9th Place Mesa, Ariz. 85201 Turquoise Nugget (colessee) P.O. Box 1118 Flagstaff, Ariz. 86001

Mine	Location	Operator
Turquoise—Continued		
Royal Blue mine	Esmeralda County, Nev	R. C. Wilcox P.O. Box 1311 Tonopah, Nev. 89049
Shoshone and Ackerman mines	Churchill County, Nev	Lombardo Turquoise Co., Inc. 1300 East Main St. Austin, Nev. 89310
Turquoise Chief mine	Lake County, Colo	N. F. Reed Albuquerque, N. Mex. 87110
Villa Grove mine	Saguache County, Colo	G. Musick P.O. Box 174 Villa Grove, Colo. 81155

CONSUMPTION

Domestic gem stone output was utilized for amateur and commercial rock, mineral, and gem stone collections, objects of art, and jewelry. Apparent consumption of gem stones (domestic production plus imports minus exports and reexports) was $468 million, about 17% more than in 1974.

PRICES

Typical costs to a retail jeweler in December 1975 for representative better quality gem stones as reported by 15 typical importers follow: [9]

Gem stone	Carat weight	Median price per carat	Price range per carat
Amethyst	10	$12	$8–$20
Aquamarine	8	95	50–250
Black opal	3	450	200–1,500
Cat's eye	5	1,000	700–1,250
Citrine	10	5	4–8
Emerald	1	1,700	750–12,000
Green garnet	1	425	400–500
Man's sky blue star	10	225	85–500
Peridot	10	45	25–70
Ruby	2	2,000	850–15,000
Sapphire	2	650	350–3,500
Tanzanite	5	200	200–260
Tourmaline, green	10	55	30–80
Tourmaline, pink	10	70	25–90
White opal, fiery	5	65	35–120

NOTES.—Ten-carat cat's eyes and 15-carat peridot, both of which were on the 1974 list, became unavailable during 1975, but the median price per carat of the smaller stones held at the levels of the larger stones.

No survey was made of diamond prices; price trends indicated higher prices for cut diamond 1 carat and smaller, but no change in larger cut diamond.

FOREIGN TRADE

Exports of all gem materials amounted to $257.2 million, and reexports to $133.7 million. Diamond accounted for 92% of the value of both exports and reexports. Exports of diamond totaled 264,873 carats valued at $237.0 million. Of this total, diamond cut but unset, suitable for gem stones, not over 0.5 carat, was 50,180 carats valued at $15.2 million; and cut but unset, over 0.5 carat, was 209,427 carats valued at $220.7 million.

Reexports of diamond amounted to 1,178,482 carats, valued at $122.7 million, in categories as follows: Rough or uncut, suitable for gem stones, not classified by weight, 1,049,903 carats valued at $79.4 million; cut but unset, not over 0.5 carat, 44,089 carats valued at $10.1 million; cut but unset, over 0.5 carat, 84,490 carats, valued at $33.1 million.

The eight leading recipients of diamond exports accounted for 84% of the carats

[9] Jewelers' Circular-Keystone. JC-K's Colored Stone Price Index. V. 146, No. 4, January 1976, p. 124.

and 96% of the value and were as follows: Hong Kong, 82,136 carats valued at $94.3 million; Japan, 40,484 carats, $33.5 million; Switzerland, 40,643 carats, $31.8 million; the Netherlands, 21,894 carats, $24.9 million; Belgium, 13,986 carats, $20.5 million; France, 6,598 carats, $9.3 million; West Germany, 3,885 carats, $7.6 million; and the United Kingdom, 12,878 carats, $6.5 million.

The eight leading recipients of diamond reexports accounted for 97% of both carats and value and were as follows: Israel, 506,473 carats valued at $35.0 million; Belgium, 363,304 carats, $33.4 million; the Netherlands, 181,990 carats, $21.7 million; Switzerland, 7,343 carats, $7.1 million; the United Kingdom, 45,784 carats, $6.9 million; Japan, 9,472 carats, $6.2 million; Hong Kong, 8,953 carats, $4.7 million; and France, 18,578 carats, $3.8 million.

Exports of all other gem materials amounted to $20.2 million. Of this total, pearls, natural and cultured, not set or strung, were valued at $0.4 million. Natural precious and semiprecious stones, unset, were valued at $16.7 million; and synthetic or reconstructed stones, unset, were valued at $3.1 million. Reexports of all other gem materials amounted to $19.9 million in categories as follows: Pearls, $10.0 million; natural precious and semiprecious stones, unset, $9.8 million; synthetic or reconstructed stones, unset, $0.1 million.

Imports of gem materials decreased about 4% in value from those of 1974. Diamond accounted for 85% of the total value of gem material imports.

Although rough and uncut diamond imports were reported from 22 countries, over 99% of the value was from 10 areas, as follows: The Republic of South Africa, 926,738 carats, $189.9 million; the United Kingdom, 450,689 carats, $70.0 million; Sierra Leone, 272,331 carats, $32.7 million; the Netherlands, 36,132 carats, $13.6 million; Belgium-Luxembourg, 30,988 carats, $8.3 million; Venezuela, 389,146 carats, $8.2 million; Southwest Africa, 36,206 carats, $6.6 million; Israel, 32,574 carats, $5.5 million; Central African Republic, 134,068 carats, $5.3 million; and Liberia, 3,870 carats, $5.0 million.

Cut but unset diamond, not over ½ carat, was imported from 35 countries; however, the imports of this category from 8 countries amounted to 98% of total carats and value as follows: Israel, 834,875 carats, $125.7 million; Belgium, 729,438 carats, $105.4 million; India, 299,214 carats, $36.9 million; the U.S.S.R., 44,634 carats, $9.1 million; the Netherlands, 48,194 carats, $6.4 million; the Republic of South Africa, 14,254 carats, $4.0 million; the United Kingdom, 15,836 carats, $2.1 million; and France, 17,910 carats, $2.0 million. Cut but unset diamond, over ½ carat, was imported from 32 countries; the imports from 6 countries amounted to 98% of total carats and value as follows: Belgium, 121,122 carats, $48.6 million; Israel, 72,606 carats, $22.6 million; the Republic of South Africa, 7,636 carats, $4.5 million; the Netherlands, 10,183 carats, $3.9 million; the U.S.S.R., 12,831 carats, $3.8 million; and the United Kingdom, 1,094 carats, $0.5 million.

Imports of emeralds decreased 7% in quantity but increased 19% in value. Emeralds were imported from 33 countries of which the 10 leading countries accounted for 94% of the carats and 92% of the value. In order of value these countries were as follows: Colombia, $13.0 million; India, $6.8 million; Switzerland, $4.6 million; Hong Kong, $3.3 million; Brazil, $2.9 million; France, $2.2 million; the United Kingdom, $1.3 million; Sri Lanka, $1.3 million; Israel, $1.0 million; and West Germany, $0.8 million. Imports of rubies and sapphires decreased 9% in value from those of 1974. Ruby and sapphire imports were reported from 36 countries of which the 7 leading countries accounted for 95% of the value as follows: Thailand, $12.3 million; Sri Lanka, $1.9 million; Hong Kong, $1.2 million; India, $1.1 million; Switzerland, $1.0 million; the United Kingdom, $0.4 million; and France, $0.4 million. Natural pearls and parts from 12 countries increased 53% in value of imports; 4 countries accounted for 97% of the value as follows: Canada, $63,000; India, $365,000; Burma, $157,000; and Japan, $67,000. Cultured pearls, on the other hand, decreased 18% in value of imports, which were received from 16 countries, although Japan, at $7.0 million, accounted for 97% of the value. Imports of imitation pearls decreased 49% in value; Japan, at $469,000, accounted for 91% of the value. Coral, cut but unset, along with cameos suitable for use in jewelry, more than doubled in value of imports, which were received from 19 countries; 3 countries accounted for 97% of the value as

follows: Italy, $4.9 million; Japan, $0.8 million; and Taiwan, $0.5 million.

Imports of other precious and semiprecious stones, rough and uncut, increased 37% in value and came from 41 countries of which 6 countries accounted for 75% of the value as follows: Brazil, $1.8 million; Colombia, $1.0 million; Australia, $1.0 million; the Republic of South Africa, $0.5 million; Tanzania, $0.3 million; and Venezuela, $0.2 million. Other precious and semiprecious stones, cut but unset, decreased only 1% in value and were imported from 58 countries, of which 7 countries accounted for 84% of the value as follows: Hong Kong, $10.6 million; Brazil, $3.6 million; West Germany, $3.1 million; Australia, $2.7 million; Taiwan, $1.7 million; India, $1.2 million; and Iran, $1.1 million. Synthetic gem stones, cut but unset, increased 27% in value and came from 19 countries of which 7 accounted for 99% of the value as follows: West Germany, $4.8 million; Switzerland, $0.7 million; Japan, $0.7 million; France, $0.6 million; Hong Kong, $0.6 million; Taiwan, $0.3 million; and Austria, $0.2 million. Imitation gem stones decreased 27% in value from 24 countries; 5 countries accounted for 99% of the value as follows: Austria, $3.3 million; West Germany, $2.8 million; Czechoslovakia, $1.1 million; Japan, $0.7 million; and Hong Kong, $0.3 million.

Table 1.—U.S. imports for consumption of precious and semiprecious gem stones

(Thousand carats and thousand dollars)

Stones	1974		1975	
	Quantity	Value	Quantity	Value
Diamonds:				
Rough or uncut	2,450	412,678	2,341	347,882
Cut but unset	2,083	347,362	2,236	374,237
Emeralds: Cut but unset	871	34,046	806	40,348
Coral, cut but unset, and cameos suitable for use in jewelry	NA	3,082	NA	6,475
Rubies and sapphires: Cut but unset	NA	20,960	NA	19,069
Marcasites	NA	249	NA	23
Pearls:				
Natural	NA	440	NA	673
Cultured	NA	8,874	NA	7,261
Imitation	NA	1,019	NA	515
Other precious and semiprecious stones:				
Rough and uncut	NA	4,646	NA	6,380
Cut but unset	NA	29,083	NA	28,718
Other n.s.p.f	NA	1,851	NA	1,935
Synthetic:				
Cut but unset ---------- number	9,271	6,316	13,682	8,008
Other	NA	362	NA	610
Imitation gem stones	NA	11,352	NA	8,296
Total	NA	882,320	NA	850,430

NA Not available.

Table 2.—U.S. imports for consumption of diamond (exclusive of industrial diamond), by country

(Thousand carats and thousand dollars)

Country	1973				1974				1975			
	Rough or uncut		Cut but unset		Rough or uncut		Cut but unset		Rough or uncut		Cut but unset	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Angola	--	--	--	--	(1)	15	--	--	4	609	--	--
Belgium-Luxembourg	68	16,836	1,159	177,317	43	14,804	953	162,926	31	8,250	849	153,276
Brazil	(1)	6	2	409	1	535	4	642	5	982	3	491
Canada	1	276	1	91	(1)	(1)	(1)	52	--	--	1	156
Central African Republic	191	7,668	--	--	132	6,766	--	--	134	5,298	--	--
France	6	169	24	2,441	31	5,668	20	2,150	7	231	18	2,195
Germany, West	1	301	1	94	1	72	2	207	--	--	1	281
Hong Kong	--	--	6	1,006	(1)	65	5	772	--	--	5	847
India	(1)	21	213	23,099	--	--	221	26,709	--	--	300	37,211
Israel	34	7,838	852	128,204	37	8,052	774	128,856	33	5,523	902	147,114
Japan	1	36	2	286	1	77	4	854	1	77	2	428
Liberia	7	5,192	(1)	406	6	8,683	(1)	5	4	4,981	--	--
Netherlands	55	22,209	18	4,143	51	19,193	32	4,948	36	13,643	58	9,860
Portugal	(1)	40	--	--	1	408	(1)	1	5	570	2	473
Sierra Leone	[2]747	[2]78,919	(1)	40	453	57,577	1	82	272	32,696	(1)	83
South Africa, Republic of	427	83,707	24	12,833	389	68,948	23	9,786	927	189,885	21	7,777
Switzerland	1	181	5	1,429	2	251	8	1,587	(1)	42	4	1,087
U.S.S.R	--	--	30	5,931	--	--	15	3,609	--	--	43	9,215
United Kingdom	979	225,802	20	2,415	911	211,799	19	3,209	451	69,959	17	2,576
Venezuela	296	9,839	(1)	12	383	8,215	(1)	20	389	8,204	(1)	5
Western Africa, n.e.c	--	--	--	--	1	883	--	--	36	6,568	--	--
Zaire	--	--	--	--	2	200	(1)	18	3	152	--	--
Other	7	1,158	3	831	5	467	2	929	3	212	10	1,162
Total	[2]2,821	[2]460,198	2,360	360,987	2,450	412,678	2,083	347,362	2,341	347,882	2,236	374,237

[1] Less than ½ unit.
[2] Adjusted by the Bureau of Mines.

WORLD REVIEW

Angola.—The production of diamond in Angola declined in 1975 owing to the political chaos caused by the collapse of public authority following the exodus of the Portuguese. The principal diamond producing company was the Portuguese firm, Compania de Diamantes de Angola (Diamang), which was reported to be in financial difficulties.[10] Diamang's production was from alluvial diamond-bearing gravels in areas drained by the major river systems of central and southern Angola. Stripping was the mining method used, and was accomplished by mechanical excavators and hydraulic monitors, as well as manual shovels.

Australia.—It was estimated that 95% of the amount of opal used in jewelry in the world comes from six deposits in Australia.[11] More than half of the production is from the area of Coober Pedy. In 1973, the value of opal exported from Australia was officially reported to be $27 million, but unofficial estimates were much higher. It is simple to smuggle out high-quality opal following cash and carry deals. Mining methods have been mostly by hand digging to be gentle with the opal. Lately, however, bulldozers and rippers have been used to strip the surface, and then hand digging is used to remove opal as it is exposed.

The Mining Houses of Australia Ltd., having ceased sapphire mining operations, offered to sell its sapphire stockpile to shareholders to liquidate its inventories.[12] However, a strong recovery in the sapphire market led to Dominion Mining's resumption of full-scale operations at its Frazers Creek property in New South Wales.

Botswana.—The Government of Botswana and De Beers Botswana Mining Co. concluded negotiations relating to the terms governing diamond mining at Orapa and Letlhakine (formerly the DK 1 and DK 2 complex).[13] Production at Orapa will be increased to 4.5 million carats per year by 1979 from the present 2.4 million carats. The Letlhakine mine is expected to produce about 400,000 carats annually by 1979.

At Orapa in 1975, the tonnage treated was 3,359,832 short tons, compared with 2,953,628 tons treated in 1974.[14] The recovery grade was 79.19 carats per 110 short tons, compared with 92.03 carats per 110 tons in 1974. Two X-ray sorting machines were in use, and two additional machines were being installed in a new circuit.

Brazil.—Results of a 4-year aerial infrared photographic survey of the Amazon region indicated areas suitable for prospecting for diamond in the Tumucumaque mountains and in Roraima. This prompted Anglo American Corp. (AAC) to join Income (Bethlehem Steel Corp./Hanna Mining Corp.) to form Sopermi (40% AAC, 60% Income), an exploration firm which is active in Minas Gerais and Mato Grasso.[15]

Canada.—No occurrences of precious gem stones have been found in Canada, but a variety of other gem stone minerals are available. The main geological regions and some important gem stone areas were described in an article which was well illustrated by color photographs.[16]

Central African Republic.—The output of diamond in 1975 in the Central African Republic was 339,000 carats, about the same as in 1974, and the value was $14.7 million compared with $14.4 million in 1974. In spite of lower dollar exchange rates, the income was higher owing to improved gem stone quality and increased prices of diamond.

Diamond in the Central African Republic, to date, has been mined in alluvial fans, basins, water courses, and streambeds. Because these formations are not conducive to large-scale mining operations, most diamond mining has been by individuals and small groups. However, diamond recovery at these small operations has become more difficult, and a shift to large-scale operations was needed, requiring larger capital expenditures. To maintain and expand production, Diamond Distributors International Inc. (United States), Cominco, Ltd. (Canada), and the Government of the Cen-

[10] Mining Journal. Diamang. How Much Longer? V. 286, No. 7330, Feb. 13, 1976, p. 129.
[11] Hartley, W. D. Dreams of Striking It Rich Sustain Men Bitten by Opal Fever. Wall Street Journal, v. 185, No. 9, Jan. 14, 1975, pp. 1, 26.
[12] Mining Journal. Sapphire Dividends? V. 284, No. 7293, May 30, 1975, p. 422.
[13] Bureau of Mines. Diamond: Botswana. Mineral Trade Notes, v. 72, No. 11, November 1975, p. 4.
[14] De Beers Consolidated Mines Limited. 1975 Annual Report. 59 pp.
[15] Mining Journal. AAC: Brazilian Diamond Interest. V. 284, No. 7295, June 13, 1975, p. 463.
[16] Steacy, H. R. Canada's Beautiful, Little Known Gemstones. Canadian Geog. J., December 1974.

tral African Republic established a local firm, Société Centrafricaine d'Exploitation Diamantifére (SCED), in late 1973 to meet these objectives. SCED has had two successful years and has been largely responsible for maintaining the production of diamond in the Republic at the 1974–75 levels.

The quality of diamond is good as 60% to 70% are of gem grade. Most stones are exported uncut to Europe, Israel, or the United States. Skilled Central African artisans in Black Africa's only diamond cutting factory cut about 5% of the gem diamond production. In 1974, diamond exports to the United States were valued at $6.8 million for gem quality and $464,000 for industrial diamond. Diamond exports comprise an important element in the foreign exchange earnings and tax revenues of the Republic. Over the past 10 years about 30% of its foreign exchange earnings have been from diamond exports.

Colombia.—Bids were invited from private companies for mining rights at the three largest emerald deposits in the Department of Boyacá, at Muzo, Coscuez, and Peñas Blancas, which have been closed since Empresa Colombiana de Minas (Econominas) ceased operations in July 1973.[17] The successful companies, which must be at least 51% Colombian owned, would have an initial lease for 5 years with the possibility of an extension for a further 3 years; Econominas will continue to be responsible for overall control of the deposits. The mining district was described as too rich for a poor country, leading to violence.[18]

Ghana.—The total production of diamond in Ghana is probably fifth in the ranking of countries in the world, but nearly 90% of Ghana's production is industrial grade.[19] Gem diamond in the 2- to 4-carat range was recovered in a dredging operation by Dunkwa Goldfields Co. on the Jimi River in the Ashanti region. Small gem stones were also recovered in the Bonsa Valley of Western Ghana. The First International Natura Corp., New York, with substantial U.S. investment, negotiated with the Government of Ghana for mining rights on a 25-square-mile area at the confluence of the Birim and Pra Rivers. The Government will have 55% equity in the project when negotiations are concluded.

Diamond production is marketed exclusively by the Government's Diamond Marketing Corp. (DMC). DMC buys all local diamond production, and grades, values, processes, and sells to end users abroad. The sales of diamond abroad were made with the assistance of Consolidated African Selection Trust in London. The majority of diamond exports were made to the United Kingdom, the Netherlands, and Belgium-Luxembourg.

Israel.—The diamond industry in Israel was said to be the world's largest.[20] Exports of polished diamond in 1975 were 2,701,388 carats, compared with 2,467,008 in 1974, an increase of 9.5% according to statistics of the Diamond Department of the Ministry of Commerce and Industry. The contemporary market demand for smaller stones resulted in a 2.4% decrease in the value of 1975 exports, $548.6 million compared with the record $562.2 million in 1974. The U.S. market accounted for $153 million out of Israel's total 1975 exports. In concentrating on the smaller stones, it was estimated that in 1975 Israel produced 85% of the world's supply of melées (gem diamonds of from 40 stones per carat to 2 stones per carat). The wider application of automated equipment in many plants plus increased individual effort made possible greater output with approximately the same number of workers.

Lesotho.—After nearly 2 years of negotiations, Prime Minister Leabua Jonathan and De Beers Consolidated Chairman Harry Oppenheimer signed an agreement which will open a new diamond mine in Lesotho.[21] Control of the mine will be by a newly formed company, De Beers Lesotho Mining Co., Ltd., in which Lesotho will hold 25% equity. De Beers investment commitment is U.S. $35 million over 2 years.

The agreement permits development of Lesotho's only identified kimberlite diamond pipe at Letseng la Terae in the northeastern district of Mohkotlong. Output of the mine, will be marketed through a second company to be formed by De Beers and registered in Lesotho. Lesotho will charge a sales tax of about 15% on mine production until De Beers recovers its capital costs. Depending on the mine profitability, the taxes may rise to 71.5% of profits on a graduated scale.

[17] Bolsa Review. News Review. April 1975, p. 220.
[18] Omang, J. Emeralds a Way of Life in Colombia. Washington Post, Sept. 2, 1975, p. D10.
[19] Bureau of Mines. Diamond: Ghana. Mineral Trade Notes, v. 72, No. 4, April 1975, p. 14–15.
[20] Israel Industry & Commerce & Export News. Israel's Diamond Industry. V. 27, March 1976, p. 5.
[21] Bureau of Mines, Diamond: Lesotho. Mineral Trade Notes, v. 72, No. 4, April 1975, pp. 15–16.

Malagasy Republic.—The Malagasy Service of Mines reported production and export of a variety of gem and ornamental stones which contributed to the foreign exchange earnings of the Republic. The list included agate, amazonite, amethyst, beryl (gem grade), citrine, garnet (gem grade), opal, tourmaline, jasper, labradorite. rose quartz, and smoky quartz. The exports were mostly to collectors interested in minerals from the Island of Madagascar.

Pakistan.—The Pakistan Mineral Development Corp. recovered about 3,000 carats of rubies at the Hunza ruby mines for testing and evaluation in Karachi.[22]

Sierra Leone.—The 51% Government-owned National Diamond Mining Co. commenced prospecting in new areas of the Southern Province to replace diamond deposits nearing exhaustion. Diamond Distributors, International, Inc., of New York, acquired a prospecting license for diamond and gold.

South Africa, Republic of.—The Central Selling Organization reported diamond sales in 1975 of 793.5 million rands (US $1,066 million), or 6.5% less than in 1974.[23] During 1975, production exceeded sales, and the excess was absorbed into stock. No breakdown of either gem stones or industrial diamond sales was given. During 1975, demand for the smaller size of gem diamond improved, but the demand for larger, more expensive stones remained weak. To meet the demand for smaller stones, production at mines where the average stone size is smaller was increased and that of mines where the average is larger was decreased.

At the dormant Kimberly mine rains have caused severe slope failures in the drainage tunnel which was started in November 1975 and is expected to be completed in 1977. Also in the Kimberly Division, mechanization was accelerated to replace manual operations wherever possible in underground sections and on the surface under a program to phase out migratory labor.

South-West Africa, Territory of.—The Consolidated Diamond Mines of South West Africa (Proprietary) Ltd. reported an increase in ore treated in 1975 to 13,498,048 short tons from 13,047,780 tons in 1974. The average stone size decreased from 0.88 carat in 1974 to 0.73 carat in 1975. Overburden stripped increased from 45,074,540 tons in 1974 to 46,389,670 tons in 1975. Diamond production was higher in 1975 at 1,747,739 carats, compared with 1,569,961 carats in 1974.

The application of a well-point dewatering system together with the use of a bucket wheel excavator enabled mining to proceed up to 492 feet seaward of the high water mark, and extending operations to 656 feet appeared feasible.

U.S.S.R.—Soviet geologists, according to the Novost Information Service of Moscow, have discovered additional reserves of turquoise, other semiprecious stones, and industrial stones in Uzbekistan in Central Asia. The other stones included lazurite, chalcedony, onyx, quartz, and rhodonite. The Ministry of Geology added that a stone processing plant was already under construction to produce 322,920 square feet of ornamental stone tiles per year. Production of these stones in Uzbekistan will increase three or four times by 1980.[24]

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[22] Mining Journal. Industry in Action. Hunza Rubies Encouraging. V. 284, No. 7292, May 23, 1975, p. 403.

[23] De Beers Consolidated Mines Limited. 1975 Annual Report. 59 pp.

[24] Industrial Minerals. Company News & Mineral Notes. No. 93, June 1975, p. 51.

Table 3.—Diamond (natural): World production, by country [1]

(Thousand carats)

Country	1973			1974			1975 [p]		
	Gem	Industrial	Total	Gem	Industrial	Total	Gem	Industrial	Total
Africa:									
Angola	1,594	531	2,125	1,470	490	1,960	345	115	e 460
Botswana	362	2,054	2,416	408	2,310	2,718	362	2,052	2,414
Central African Republic	r 341	r 183	r 524	220	118	338	220	119	339
Ghana	r 231	r 2,076	r 2,307	257	2,315	2,572	233	2,095	2,328
Guinea e	25	55	80	26	55	80	25	55	80
Ivory Coast	120	180	300	112	167	279	84	125	209
Lesotho [2]	1	8	9	2	9	11	1	2	3
Liberia [3]	509	308	817	377	259	636	[4] 241	[4] 165	[4] 406
Sierra Leone	646	758	1,404	670	1,000	e 1,670	600	900	e 1,500
South Africa, Republic of:									
Premier mine	625	1,876	2,501	605	1,817	2,422	509	1,527	2,036
Other De Beers properties [5]	2,368	1,938	4,306	2,397	1,961	4,358	2,518	2,061	4,579
Other	455	303	758	438	292	730	408	272	680
Total	3,448	4,117	7,565	3,440	4,070	7,510	3,435	3,860	7,295
South-West Africa, Territory of	1,520	80	1,600	1,491	79	1,570	1,660	88	1,748
Tanzania	251	250	501	249	249	498	224	224	448
Zaire	r 1,082	11,858	12,940	1,143	12,468	13,611	1,076	11,734	12,810
Other areas:									
Brazil	r 56	r 57	r 113	127	127	254	135	135	e 270
Guyana	31	21	52	12	18	30	8	13	21
India	18	3	21	18	3	21	17	3	20
Indonesia e	12	3	15	12	3	15	12	3	15
U.S.S.R. e	1,900	7,600	9,500	1,900	7,600	9,500	1,950	7,750	9,700
Venezuela	315	463	778	279	970	1,249	239	821	1,060
World total	r 12,462	r 30,605	r 43,067	12,212	32,310	44,522	10,867	30,259	41,126

e Estimate. p Preliminary. r Revised.

[1] Total (gem plus industrial) diamond output for each country is actually reported except where indicated to be an estimate by footnote. In contrast, the detailed separate reporting of gem diamond and industrial diamond represents Bureau of Mines estimates in the case of every country except Central African Republic (1973), Lesotho (1973–75), Liberia (1973–74), Guyana (1973), and Venezuela (all years), where sources give both total output and detail. The estimated distribution of total output between gem and industrial diamond is conjectural in the case of a number of countries, based on unofficial information of varying reliability.

[2] Exports of diamond originating in Lesotho; excludes stone imported for cutting and subsequently reexported.

[3] Exports.

[4] Partial figure, January 1 through December 15 only.

[5] All company output from the Republic of South Africa except that credited to the Premier mine; excludes company output from the Territory of South-West Africa and Botswana.

TECHNOLOGY

Turquoise may be of inferior quality or may be confused with other materials to the disadvantage of the owner of the turquoise. For example, chrysocolla is identified frequently as turquoise. A simple test will help identify the sample correctly.[25] A drop of commercial grade of hydrochloric acid (HCl), commonly called muriatic acid (32% HCl), is placed on the sample. If it is chrysocolla, the acid will turn to a greenish-yellow color which can be easily observed by blotting it with a white tissue. No reaction will take place on fair to excellent quality turquoise. Azurite and malachite will change the acid's color and they will effervesce also.

American Indian turquoise jewelry can also be difficult to assess. Advice to prospective buyers included cautions against fakes, mass-produced or machine-made jewelry labeled "Indian" creation, and even stolen jewelry.[26] The quality of the turquoise in the jewelry was also described for the benefit of prospective buyers.[27] The geographical distribution of turquoise in

[25] O'Haire, R. T. A Simple Test, Chrysocolla or Turquoise? Arizona Bureau of Mines, Fieldnotes, v. 5, No. 2, June 1975, p. 9.

[26] Changing Times, The Kiplinger Magazine. The Big Rip-Off in Indian Jewelry. V. 29, No. 9, September 1975, p. 4.

[27] Albuquerque Journal. Turquoise Cost Up, But Watch Out. 93d Year, No. 3, Apr. 21, 1974, pp. 1–2.

the United States is limited to the margins of the Colorado Plateau of the Southwestern States. With the aid of instrumental neutron activation analysis to detect trace elements, researchers are able to tell which turquoise came from which mine.[28] The information obtained from a study of turquoise artifacts from a pre-Columbian Indian village contributed knowledge to the trading patterns of the inhabitants.

The Job Safety & Health magazine of the U.S. Department of Labor indicated 10,000 lasers were in use by industry, and the boring of holes in diamond was noted.[29] A proposed safety code required protective housings, safety interlocks, visual and audible warning signals to alert operators in case of interlock failure and other steps to eliminate exposure to any radiation or other hazards.

The current process equipment and products of the semiconductor crystal industry were reviewed and predictions were made for the future state-of-the-art.[30] The processes which were described included the Czochvalski, float zone, pedestal growth, and zone leveling and procedures such as edge defined ribbon growth, dendritic web growth, Schmid Viechnicki, and cold crucible melting.

Natural diamond and most manufactured diamond are formed at high pressure. It is possible to synthesize diamond by growing it from existing diamond in a low-pressure gas rich in carbon.[31] It was found advantageous to have the seed diamond in powder form to take advantage of the large surface per unit of weight. Powder having a particle size of up to 1 micrometer has a specific surface of about 10 square meters per grain. It was also found that, if the diamond particles are suspended in the gas, such as methane by applied vibrations, the growth would be improved; the method could also yield threads, whiskers, or fibers of diamond.

Information about the earth's deep interior is scanty, and even inferences drawn from seismic and electrical conductivity measurements include assumptions about the relevant mineral species. Recently geophysical investigations applied improved techniques to suggest major revisions in the accepted hypothesis pertaining to the earth's lower mantle. The key to the new techniques is a device developed at the National Bureau of Standards and is known as a diamond-anvil or diamond-window pressure cell.[32] The device is not new, but its refinements and applications are. In addition to the work at the National Bureau of Standards, groups at the Geophysical Laboratory of the Carnegie Institution of Washington and at the University of Rochester contributed studies of chemical and physical properties.

The most prominent characteristic of minerals and gems is color. The cause of the color in many of these materials is frequently unknown or misunderstood, and many erroneous early guesses as to the causes of specific colors in minerals have been repeatedly copied from one text to the next so that much misinformation is current. Twelve distinct causes of color were described in three articles,[33] and brief outlines of four theories—crystal field, molecular orbital, band, and physical optics—were included.

The tumbling process has been in use about 30 years for polishing gem stones. The technique is more popular now than ever before, and an evaluation of tumbling was presented.[34] The shape of a tumbler may be round, hexagonal, or barrel. The material of construction may be glass, ceramic, plastic, rubber, or steel. The tumbler may have a fixed speed of rotation, or it may be variable. Tumblers may be open or sealed. Tumblers may rotate on a fixed or a variable axis, or may vibrate, usually on a vertical axis. The stones for the tumbler should be of similar grain, density, toughness, hardness, and porosity. The load should be exact, although most tumblers work well when about two-thirds to three-

[28] Science News. Archaeology. Snaketown Turquoise Trading. V. 108, Nos. 8–9, Aug. 23–30, 1975, p. 125.

[29] American Metal Market. Laws for Lasers. V. 82, No. 13, Jan. 20, 1975, p. 26.

[30] Lenzing, J. Survey of Semiconductor Crystal-Growing Processes and Equipment. Solid State Technology, v. 18 No. 2, February 1975, pp. 34–39, 43.

[31] Devjaguin, B. V. and D. B. Fedoseev. The Synthesis of Diamond at Low Pressure. Scientific American, v. 233, No. 5, November 1975, pp. 102–109.

[32] Science. Research News. High-Pressure Geophysics: A Window on the Lower Mantle. V. 190, No. 4218, Dec. 5, 1975, pp. 967, 968.

[33] Nassau, K. The Origins of Color in Minerals and Gems–Part I. Lapidary J., v. 29, No. 5, August 1975, pp. 920, 922, 924, 926, 928.

———. The Origins of Color in Minerals and Gems–Part II. Lapidary J., v. 29, No. 6, September 1975, pp. 1060, 1062, 1064, 1066, 1068, 1070.

———. The Origins of Color in Minerals and Gems–Part III. Lapidary J., v. 29, No. 7, October 1975, pp. 1250, 1252, 1253, 1254, 1256, 1258.

[34] Zertner, J. C. Tumblers, Tumbling and Tumbled Gems–Part I. Lapidary J., v. 29, No. 9, December 1975, pp. 1670–1691.

fourths full. The amounts of fluid or water, abrasive polishing media, and special additives are also variable. Because of all the possible variations, it was recommended that the instructions of the manufacturers be followed explicitly.