Gem Stones

By Benjamin Petkof [1]

Gem stone production during 1965 was estimated at $2.2 million, an increase of 50 percent over last year. Amateur collectors continued to be the principal collectors of domestic gem material.

DOMESTIC PRODUCTION

Production estimates show that 38 States produced gem material during the year. Oregon, California, Texas, Idaho, Arizona, Wyoming, and Nevada were the leading producing States. The estimated value of production was 50 percent more than in 1964.

During the year the excise tax on gem materials was removed. This appeared likely to promote increased sales of gems and gem materials.

Very well-formed augite crystals were found on the west rim of the Haleakala Crater, Island of Maui, Hawaii. Most of the crystals were single but contact and penetration twins were also found. The largest one found was eleven-sixteenth of an inch long.[2] Wavellite was identified in the King turquoise mine in the San Luis Valley, Colo.[3]

CONSUMPTION

Gem diamond consumption reached $307 million, an increase of almost 19 percent over that of 1964. Value of imported synthetic and imitation gem stones including imitation pearl was $7.1 million, an increase of 16 percent over that of 1964 and value of natural and cultured pearls was $22.2 million, an increase of 13 percent over that of 1964.

Apparent consumption (domestic production plus imports minus exports) was $248 million, an increase of 31 percent over that of 1964.

PRICES

At midyear, prices for cut and polished, unmounted gem diamond were 0.25 carat $75 to $275; 0.50 carat $200 to $725; 1 carat $400 to $1,900; and 2 carats $1,250 to $5,500.

FOREIGN TRADE

Precious and semiprecious gem stone exports were valued at $47.1 million, compared with $46.8 million in 1964. Diamond, both rough and uncut, accounted for the bulk of the exports.

Reexports of all varieties of gem stone were valued at $60.5 million, compared with $64.3 million in 1964. Diamond made up the major portion of total reexports.

India provided 73 percent of the emerald (cut but unset) imported during the

[1] Commodity specialist, Division of Minerals.

[2] Pemberton, Earl H. Augite Crystals at Haleakala Crater, Hawaii. Gems and Minerals, No. 331, April 1965, p. 42.

[3] Rock Products. Rare Wavellite Found in King Mine. V. 68, No. 4, April 1965, p. 122.

Table 1.—U.S. imports for consumption of precious and semiprecious stones, exclusive of industrial diamond

Stones	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Diamond:				
Rough or uncut, suitable for cutting into gem stones, duty-free—carats	1,547,955	$149,729	1,900,936	$175,457
Cut but unset, suitable for jewelry, dutiable—do	1,096,795	108,805	1,258,745	131,828
Emerald: Cut but not set, dutiable—do	180,069	3,218	189,828	5,397
Pearls and parts, not strung or set, dutiable:				
Natural	NA	474	NA	592
Cultured or cultivated	NA	19,204	NA	21,674
Other precious and semiprecious stones:				
Rough or uncut, duty-free	NA	2,514	NA	2,728
Cut but not set, dutiable	NA	r 7,441	NA	8,901
Imitation, except opaque, dutiable:				
Cut or faceted:				
Synthetic—number	1,218,326	623	2,526,418	1,007
Other	NA	5,825	NA	5,429
Imitation, opaque, including imitation pearls, dutiable	NA	337	NA	415
Marcasites: Real and imitation, dutiable	NA	r 2	NA	3
Total	NA	r 298,172	NA	353,431

r Revised. NA Not available.

year. The remainder was supplied by 25 other countries. Indian emerald imports had an average value of $16.20 per carat.

Ruby and sapphire (cut but unset) were imported from 20 countries, with India and Thailand supplying over 50 percent of the total value of almost $4.8 million.

Japan supplied 97 percent of the cultured-pearl imports by value but only 8 percent of the natural pearl imports. India supplied 66 percent by value of the natural pearl imports.

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

Country	1964				1965			
	Rough or uncut		Cut but unset		Rough or uncut		Cut but unset	
	Carats	Value (thousands)	Carats	Value (thousands)	Carats	Value (thousands)	Carats	Value (thousands)
Argentina							15	$18
Australia	24	$10						
Austria			584	$35			255	40
Barbados			81	11	925	$14		
Belgium-Luxembourg	77,728	9,264	583,207	60,155	74,979	7,597	679,614	73,923
Brazil	1,329	196	5	3	4,185	293	1,014	97
British Guiana	10,156	383			19,295	742	40	5
Canada	7,753	1,200	227	28	7,139	1,138	349	44
Central African Republic	102,919	5,451			144,209	8,365		
Ceylon							177	20
Congo (Léopoldville)	236	71			928	63		
Denmark							2	(1)
France	6,066	435	15,781	1,678	1,642	70	15,675	1,665
Germany, West			18,040	1,335			18,507	1,370
Ghana	858	53			2,883	146	183	16
Guinea	2,774	418			2,065	205		
Hong Kong			329	41	15	3	4	1
India			535	111			2,469	342
Iran							23	55
Ireland	3,616	464			4,114	71	47	3
Israel	49,011	3,800	426,052	36,800	56,681	3,310	472,602	42,134
Italy			84	17			13	9
Ivory Coast					188	29		
Jamaica	18	5					178	13
Japan			1,541	95	46	8	1,276	142
Korea, South			61	3				
Lebanon							28	8
Liberia	8,417	806			6,598	674		
Malaysia					67	4		
Malta and Gozo			205	16				
Netherlands	39,265	4,179	14,358	1,896	33,524	4,094	20,772	2,835
Netherlands Antilles			22	18			7	4
New Guinea					349	38		
New Zealand			74	7				
Nigeria					961	108		
Panama							2	1
Peru							55	6
Poland							158	11
Portugal			33	4				
Senegal	128	17						
Sierra Leone	72,153	2,867			44,161	2,818		
South Africa, Republic of	138,015	12,162	23,721	4,918	158,539	15,330	27,223	6,166
Switzerland	33,748	2,192	783	364	104,044	9,879	1,142	633
Trinidad and Tobago			95	13				
U.S.S.R.			5,590	503			11,289	1,410
United Kingdom	894,260	100,928	5,387	754	1,141,833	113,481	5,626	857
Venezuela	78,486	2,960			54,448	1,950		
Western Africa, n.e.c.[2]	20,995	1,868			34,973	4,903		
Western Portuguese Africa, n.e.c.[2]					2,145	124		
Total	1,547,955	149,729	1,096,795	108,805	1,900,936	175,457	1,258,745	131,828

[1] Less than ½ unit.
[2] Not elsewhere classified.

WORLD REVIEW

Angola.—The Angolan Diamond Company produced diamond in excess of 1 million carats during the year. During 1964 the company produced almost 1.15 million carats. Rubble processed in 1964 yielded 0.37 carat per cubic meter. The company intends to contract for additional prospecting teams to mark and map claims for exploitation when its present contract terminates in 1971.

Basutoland.—Two large diamonds, weighing 103 and 527 carats were found at the Letseng-la-Terae native diamond diggings in northeast Basutoland. They

Table 3.—World production of diamond, by countries
(Thousand carats)

Country	1964		1965	
	Gem	Industrial	Gem	Industrial
Africa:				
Angola	804	345	878	277
Central African Republic	221	221	268	268
Congo (Brazzaville) [1 2] e	316	4,949	318	4,982
Congo (Léopoldville)	295	14,457	14	12,490
Ghana	267	2,402	225	2,023
Guinea [1]	r 21	r 51	e 21	e 51
Ivory Coast	120	80	116	77
Liberia [1]	298	272	277	263
Sierra Leone	r 585	r 878	e 658	e 804
Republic of South Africa:				
Pipe mines:				
Premier	556	1,668	e 654	e 1,963
De Beers group [3]	928	759	e 1,119	e 916
Others	18	41	e 18	e 42
Alluvial	288	192	e 188	e 126
South-West Africa	r 1,387	154	1,432	158
Tanzania	r 338	326	e 414	e 414
Total Africa	r 6,442	r 26,795	6,600	24,854
Other countries:				
Brazil e	175	175	175	175
British Guiana	60	49	45	68
India	2	1	4	1
U.S.S.R. e	240	2,760	300	3,200
Venezuela	58	58	46	45
World total [4]	r 6,977	r 29,838	7,170	28,343

e Estimated. r Revised.
[1] Exports.
[2] Probable origin, Republic of the Congo.
[3] Includes some alluvial from De Beers Properties.
[4] Does not include minor world production.

were found by native Africans, using hand methods.[4]

Bechuanaland.—Kimberlite Searches Ltd., a De Beers Consolidated Mines Ltd. subsidiary has found indications of diamond in northern Bamangwato Tribal Territory, west of Francestown.[5]

Belgium.—About 4.93 million carats of rough cuttable diamond was imported during 1964, an increase of about 11 percent over 1963 imports. Polished diamond imports reached 304,000 carats, an increase of 2 percent over 1963 imports. During the first 9 month of 1965 about 3.72 million carats of cuttable and 241,000 carats of polished diamond had been imported.

Exports of cuttable and polished diamond reached 1.02 million and 1.33 million carats, respectively, in 1964. During the first 9 months of 1965, 762,000 carats of cuttable and 1.04 million carats of polished diamond were exported. The major portion of polished diamond went to the United States, the United Kingdom, and Hong Kong.[6]

Chile.—The only producer, Compañia Minera Caren, mined about 36,400 pounds of lapis lazuli during 1964. The company has arranged to sell about 22,000 pounds of material to a New York importing firm. Deliveries are expected to extend into 1966. About 12,000 pounds of lapis lazuli, valued at $15,492, was exported to West Germany, Hong Kong, Italy, and the United States.[7]

Dahomey.—The Government issued the first license for diamond pospecting to De Beers Consolidated Mines Ltd., London. Plans include prospecting in the Dassa-Zoumé foothills and the area to the north.[8]

Indonesia.—A Netherland firm will assist the Indonesian Government in developing the Kalimantan diamond fields. Reports indicated that these deposits contain primarily gem quality diamond.[9]

[4] Bureau of Mines. Mineral Trade Notes. V. 62, No. 1, January 1966, pp. 8–9.
[5] Mining Journal (London). V. 264, No. 6763, Apr. 2, 1965, p. 251.
[6] Bureau of Mines. Mineral Trade Notes. V. 62, No. 3, March 1966, pp. 8–9.
[7] Bureau of Mines. Mineral Trade Notes. V. 61, No. 4, October 1965, p. 29.
[8] Bureau of Mines. Mineral Trade Notes. V. 62, No. 2, February 1966, p. 9.
[9] Bureau of Mines. Mineral Trade Notes. V. 61, No. 3, September 1965, p. 24.

Israel.—Imports of raw diamond material reached about $96.7 million in 1965. Exports of polished diamond were valued at $131.76 million.[10]

Sierra Leone.—The Parliament approved the agreement between the Sierra Leone Government and the New York firm of Leon Tempelsman & Son to establish a diamond cutting and polishing industry. The firm will have a 10-year monopoly of diamond cutting and polishing in the country. Complete details of this agreement have been published.[11]

South Africa, Republic of.—Late in 1964, the Commissioner of Patents awarded four patents to the General Electric Co. relating to the manufacture of synthetic diamond. The Transvaal and Orange Free State Chamber of Mines has requested permission to appeal the patent award.[12]

South-West Africa.—In May 1965, De Beers Consolidated Mines Ltd. announced through its subsidiary, Consolidated Diamond Mines of South-West Africa Ltd. (CDM), that a 29-percent interest in the Marine Diamond Corp. Ltd. (MDC), had been acquired. MDC recovered diamond from shallow water concessions of the South-West African coast. In addition, CDM transferred its coastal strip concession between high and low water mark to MDC.[13]

In October, Orama Holding Ltd. was formed by CDM and other MDC stockholders. Ownership of 58 percent of CDM's stock gave Orama controlling interest.

The exploration vessel "Rockeater" was purchased by De Beers to continue evaluation of offshore mineral concessions. This vessel was previously used to evaluate MDC offshore concessions for De Beers.

During 1964, MDC recovered 286,651 carats of diamond. During 1965 production of almost 219,000 carats of diamond was lower because of bad weather and accidents.[14]

TECHNOLOGY

A method was developed to grow single alumina crystals by vapor-deposition. For constant gas compositions and flow rates, the growth rate varied directly with temperature. Crystal growth rate varied up to 90 milligram per square centimeter per hour. Analysis showed impurities to be less than 30 parts per million. Substrate temperature, total pressure, and reactant gas partial pressures controlled crystal structure.[15]

A new theory has been published about the origin of the diamonds found in the glacial drift in Ohio, Indiana, Michigan, and Wisconsin. The theory proposes that the diamonds had been carried south from an ancient meteorite crater located in an area in southeastern Hudson Bay. When the meteorite impacted, the deep mantle rock breccia, containing diamonds, was brought to the surface in a central uplift as found in lunar craters. After the crater formed, it was filled with sediments which lithified. It is conjectured that these rocks slid by gravity from the crater center as it was uplifted, reexposing the diamond-bearing rocks.[16]

Volume compression measurements were made on sapphire, rutile, and spinel to a maximum pressure of 10,000 atmospheres. The data were reported as the constants of an empirical equation.[17]

Methods were developed to produce gem-quality synthetic emerald. Material was grown by hydrothermal techniques in a high-pressure bomb on seed plates cut parallel to a pyramid face. The techniques used were similar to those used for quartz crystal synthesis.[18] Gem material was crystallized in 2 minutes from beryl powder at pressures in excess of 10,000 atmospheres. Color was controlled by the quan-

[10] Mining Journal (London). V. 266, No. 6805, Jan. 21, 1966, p. 51.

[11] Bureau of Mines. Mineral Trade Notes. V. 61, No. 1, July 1965, p. 13.

[12] Bureau of Mines. Mineral Trade Notes. V. 61, No. 6, December 1965, p. 12.

[13] Bureau of Mines. Mineral Trade Notes. V. 61, No. 2, August 1965, pp. 24–26.

[14] Bureau of Mines. Mineral Trade Notes. V. 62, No. 2, February 1966, pp. 9–12.

[15] Schaffer, Philip S. Vapor-Phase Growth of Alpha Alumina Single Crystals. J. Am. Ceram. Soc., v. 48, No. 10, October 1965, pp. 508–511.

[16] Schwarcz, H. P. The Origin of Diamonds in Drift of the North Central United States—Geological Notes. J. of Geol., v. 73, No. 4, July 1965, pp. 657–663.

[17] Weir, C. E. Compressibility of Eleven Inorganic Materials. NBS J. of Res., v. 69A (Phys. and Crem.), No. 1, January–February 1965, pp. 29–31.

[18] Pough, Frederick H. The New Linde Synthetic Emerald. Jewelers' Circular-Keystone, v. 135, No. 12, August 1965, pp. 126–142.

tity of metallic oxides in the beryl powder.[19]

Ruby crystals have been grown experimentally from solution in molten lead fluoride. The solvent was chosen from a group having preferred properties. Crystals were grown under three sets of experimental conditions in a sealed platinum crucible that was in a high-temperature furnace. The results of the experiments were discussed.[20]

Structure was determined by studying etch patterns on polished diamond surfaces. The surfaces were etched at an elevated temperature with potassium nitrate. Several etch patterns were obtained. Rectilinear structures corresponded to a layered growth. Curved lines indicated growth interference. Additional conclusion concerning growth were derived based on observed patterns.[21]

Various microstructure patterns have been observed concurrently on the surfaces of diamonds obtained from the Panna mines in India. Observations indicate that these diamonds may have been subjected to solution in nature.[22]

A more efficient method to make girdles on precious and semiprecious gem stones has been described. Two rough stones are arranged to work the edges of each other's table while their axes of rotation are at right angles. While working against each other, round girdles are formed on both stones simultaneously.[23]

A method was reported to convert a used garbage disposal unit in an efficient lapping and grinding unit.[24]

Waste has been reduced in cutting cabachons from semiprecious material. A slab of material is faced with gem-defining patches. These patches are sawed off with straight line cuts. The edges are ground off to the patch. The patch is removed, and the cabachon is completed.[25]

A method was developed to produce large synthetic diamond crystals from a diamond seed. The method can be used to grow diamond in a batch or a continuous process at comparatively low temperature and pressure.[26]

A device has been designed to finish and to polish semiprecious gem stones quickly by applying a high-frequency vibration to a plastic-lined container, mixing and tumbling the charge of gem stone and abrasive completely.[27]

A method to synthesize diamond particles by using an electric discharge across a spark gap has been developed. One or both of the electrodes contain elemental carbon and are immersed in a dielectric liquid. Repeated discharges provide an elevated pressure and temperature that converts particles of carbon to diamond.[28]

An apparatus has been built to inspect a mounted or unmounted gem stone. A magnified image is projected which makes any flaw easily visible.[29]

A method was developed to join two brilliant-cut natural diamonds to form a large composite doublet stone in a marquise form.[30]

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[19] Hickman, Bill. Synthetic Emerald Process May Aid Laser, Maser R&D. Electronic News, v. 10, No. 484, Apr. 12, 1965, p. 44.

[20] White, E. A. D., and J. W. Brightwell. The Growth of Ruby Crystals From Solution in Molten Lead Fluoride. (Paper pres. at the Symp. on Inorganic Single Crystals in London, Apr. 12–13, 1965). Chem. and Ind. (London), No. 39, Sept. 25, 1965, pp. 1662–1668.

[21] Seal, Michael. Structure in Diamonds as Revealed by Etching. Am. Mineralog., v. 50, No. 1 and No. 2, January–February 1965, pp. 105–123.

[22] Patel, A. R., and M. K. Agarwal. Microstructures on Panna Diamond Surfaces. Am. Mineralog., v. 50, No. 1 and No. 2, January–February 1965, pp. 124–131.

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[24] Redmond, Gordon. At Your Disposal. Gems and Minerals, September 1965, pp. 16–18.

[25] Drown, C. R. Method of Gem Cutting. U.S. Pat. 3,211,141, Oct. 12, 1965.

[26] Brinkman, J. A., C. J. Meecham, and H. M. Dieckamp (assigned to North American Aviation, Inc.). U.S. Pat. 3,175,885, Mar. 30, 1965.

[27] Smith, E. E. Apparatus for Agitating and Polishing Materials. U.S. Pat. 3,197,922, Aug. 3, 1965.

[28] Inoue, Kiyoshi. Method of Synthesizing Diamond Particles by Utilizing Electric Discharge. U.S. Pat. 3,207,582, Sept. 21, 1965.

[29] Robinson, D. A., L. M. Robinson, and J. Dods. Apparatus for Viewing Gems and Similar Objects. U.S. Pat. 3,225,647, Dec. 28, 1965. Australian Pat. 249,602, Feb. 13, 1964.

[30] Sirakian, C., and Fils. British Pat. 1,005,060, Sept. 22, 1965.