

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
J. W. POWELL, DIRECTOR

MINERAL RESOURCES

OF THE

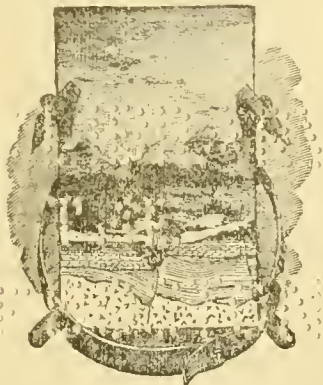
UNITED STATES

CALENDAR YEAR

1887

DAVID T. DAY

CHIEF OF DIVISION OF MINING STATISTICS AND TECHNOLOGY



WASHINGTON
GOVERNMENT PRINTING OFFICE
1888

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PRECIOUS STONES.

BY GEORGE F. KUNZ.

Gem mining.—During 1887 no work was done either at Mount Mica, Paris, Maine, or at Stony Point, North Carolina, which are the two most noted localities where gems are sought for systematically. At Mount Apatite, Auburn, Maine, some work was carried on during the fall of 1887; \$200 worth of tourmalines and \$400 worth of other minerals were found.

Several localities in North and South Carolina and Kentucky have been opened and ordinary mining operations carried on for the purpose of producing zircon, and several other comparatively rare minerals which have been only looked upon as gems heretofore, but are now used for making the oxides of zirconium, lanthanum, cerium, etc. These oxides are needed for manufacturing purposes.

The following table gives an approximation of the value of the gems produced in the United States during the past five years. It does not include about 20 tons of zircon and quite large quantities of allanite, monazite, and samarskite which were mined for use in manufactures as stated above.

Estimated production of precious stones

Species.	1883.			1884.		
	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
Diamond.....					\$800	\$800
Sapphire gems.....	\$200	\$2,000	\$2,200	\$250	1,500	1,750
Chrysoberyl.....	100		100	25		25
Topaz.....	1,000		1,000	200	300	500
Beryl.....	200	300	500	300	400	700
Emerald.....	500		500			
Hiddenite.....	100	500	600			
Tourmaline.....				1,500	500	2,000
Smoky quartz.....	2,500	7,500	10,000	2,000	10,000	12,000
Quartz.....	10,000	1,500	11,500	10,000	1,500	11,500
Silicified wood.....	5,000		5,000	10,000	500	10,500
Garnet.....	1,000	5,000	6,000	1,000	3,000	4,000
Anthracite.....		2,500	2,500		2,500	2,500
Pyrite.....	1,500	500	2,000	2,000	1,000	3,000
Amazonstone.....	3,500	250	3,750	2,500	250	2,750
Catlinite (pipestone).....	10,000		10,000	10,000		10,000
Arrow points.....	1,000		1,000	1,000		1,000
Trilobites.....	500		500	500		500
Sagenitic rutile.....	500	500	1,000	500	500	1,000
Hornblende in quartz.....	500	100	600	500	100	600
Thompsonite.....	250	500	750	250	500	750
Diopside.....	200	100	300			
Agate.....	1,000	500	1,500	4,000	500	4,500
Chlorastrolite.....	500	1,000	1,500	500	1,000	1,500
Turquoise.....	1,500	500	2,000	1,500	500	2,000
Moss agate.....	1,000	2,000	3,000	1,000	2,000	3,000
Amethyst.....	2,000	250	2,250	2,000	250	2,250
Jasper.....	2,000	500	2,500	2,000	500	2,500
Sunstone.....	250	200	450	250	200	450
Fossil coral.....	500	250	750	500	250	750
Rutile.....						
Total.....	47,300	26,450	73,750	54,275	28,550	82,825
Gold quartz.....	40,000	75,000	115,000	40,000	100,000	140,000

in the United States from 1883 to 1887.

1885.			1886.			1887.		
Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
	\$500	\$500	\$250	\$60 500	\$60 750		\$500	\$500
\$1,000	250	1,250	1,000		1,000	\$1,500	500	2,000
250	500	750		5,500	5,500	500	3,000	3,500
		3,200	3,000	200	3,200			
		3,500	3,500	1,000	4,500			
500	100	600	3,500	12,000	5,500	300	200	500
2,000	5,000	7,000	2,000	5,000	7,000	1,500	3,000	4,500
10,000	1,500	11,500	10,000	1,500	11,500	10,000	1,500	11,500
5,000	1,500	6,500	500	1,000	1,500	35,000	1,000	36,000
200	2,500	2,700	1,250	2,000	3,250	2,500	1,000	3,500
	2,500	2,500		2,500	2,500	2,000		2,000
1,500	500	2,000	1,500	500	2,000	2,000	500	2,500
2,500	250	2,750	2,000	250	2,500	1,500	200	1,700
10,000		10,000	10,000		10,000	5,000		5,000
	2,500	2,500		2,500	2,500		1,500	1,500
	1,000	1,000	1,000		1,000	500		500
	250	250	1,750		1,750			
	300	300	200		200		100	100
250	500	750	100	300	400	250	500	750
100		100				50		50
1,000	1,000	2,000	1,000	1,000	2,000	3,000	1,000	4,000
		500	500	500	1,000	300	500	800
1,500	2,000	3,500	1,000	2,000	3,000	1,000	1,500	2,500
500	2,000	2,500	1,000	1,000	2,000	200	750	950
2,000	100	2,100	2,000	100	2,100	2,000	100	2,100
			200	100	300	50	100	150
250	100	350	1,000		1,000	1,500	500	2,000
		750	750		750			
39,300	24,850	69,850	49,000	29,510	78,510	70,650	17,950	88,600
40,000	100,000	140,000			40,000			75,000

IMPORTS.

Diamonds and other precious stones imported and entered for consumption in the United States, 1867 to 1887 inclusive.

Fiscal years ending June 30—	Glaziers'.	Dust.	Rough or ncut.	Diamonds and other stones not set.	Set in gold or other metal.	Total.
1867.....	\$906			\$1,317,420	\$291	\$1,318,617
1868.....	484			1,060,544	1,465	1,062,493
1869.....	445	\$140		1,997,282	23	1,997,890
1870.....	9,372	71		1,768,324	1,504	1,779,271
1871.....	976	17		2,349,482	256	2,350,731
1872.....	2,386	89,707		2,939,155	2,400	3,033,648
1873.....		46,424	\$176,426	2,917,216	326	3,134,392
1874.....		68,621	144,629	2,158,172	114	2,371,536
1875.....		32,518	211,920	3,234,319		3,478,757
1876.....		20,678	186,404	2,409,516	45	2,616,643
1877.....		45,264	78,033	2,110,215	1,734	2,235,246
1878.....		36,409	63,270	2,970,469	1,025	3,071,173
1879.....		18,889	104,158	3,841,335	538	3,964,920
1880.....		49,360	129,207	6,690,912	765	6,870,244
1881.....		51,409	233,596	8,320,315	1,307	8,606,627
1882.....		92,853	449,513	8,377,200	3,205	8,922,571
1883.....		82,628	443,996	7,598,176	(a)2,081	8,126,881
1884.....	22,208	37,121	367,816	8,712,315		9,139,460
1885.....	11,526	30,426	371,679	5,628,916		6,042,547
1886.....	8,949	32,316	302,822	7,915,660		8,259,747
1887.....	9,027	33,498	262,357	10,526,998		10,831,880

a Not specified since 1883.

Imports of substances not included in the foregoing table, 1868 to 1887 inclusive.

Fiscal years ending June 30—	Unmanufactured agates.	Bookbinders' and other manufactured agates.	Carnelian.	Brazilian pebbles.	Amber.	Amber beads.	Unmanufactured coral.	Manufactured coral.	Unmanufactured meerscham.	Total.
1868.....							\$62,270			\$62,270
1869.....		\$70	\$269		\$427		22,417		\$6,407	29,590
1870.....			766		1,433		18,975		3,998	25,172
1871.....		1	661		180		37,877		698	39,417
1872.....		529	207		2,426		\$83	59,598	2,194	65,037
1873.....	\$151	1,310		\$1,237	1,534	\$595	230	63,805	5,608	74,470
1874.....	177	1,524			1,448	1,057	527	28,152	270	33,155
1875.....	520	5,165		57	7,169	715	1,278	33,567	2,902	51,373
1876.....	293	1,567			15,502	187	109	33,559	21,939	73,156
1877.....	579	1,904	(a)69		17,307	329	718	28,650	9,304	58,860
1878.....	82	404		76	13,215	1,119	1,252	12,667	16,308	45,123
1879.....	138	364			17,821	203	147	11,327	19,088	49,088
1880.....	57	2,346			36,860	2,317	62	5,492	30,849	77,983
1881.....	486	1,700		5	42,460	1,102	89	2,501	72,754	121,037
1882.....	901	5,084		111	72,479	4,174	1,474	669	56,118	141,010
1883.....	14	2,895			40,166	3,472	681	(b)1,303	58,885	107,416
1884.....		6,100		3,496	56,301	4,692	158		43,169	113,916
1885.....	124			6,541	21,722	3,242	659		42,590	74,878
1886.....	284			17,379	27,215	5,665	219		23,417	74,179
1887.....	12	1,247		35,291	34,238	10,011	307		35,478	116,584

a Not separately classified since 1877.

b Not specified since 1883.

Exceptional discoveries of gems—Diamond.—In April, 1887, Mr. Lewis M. Parker, a tenant on the farm of Daniel Light, three-fourths of a mile northwest of Morrow Station, and 13 miles south of Atlanta, Georgia, found a diamond on the farm. The stone afterwards came into the possession of Mr. W. W. Scott, of Atlanta, who sent it to the writer for

examination. It proved to be an octahedral crystal weighing $4\frac{1}{2}$ carats (828 milligrams), two-fifths of an inch long and one-fourth of an inch wide. It measured 9 by 10 by 7 millimeters, is slightly yellow and has one small black inclusion. The specific gravity was found to be 3.527. Curious long, shallow pittings mark the surface. A stone of from $1\frac{1}{2}$ to 2 carats could be cut from it.

Mr. L. O. Stevens, of Atlanta, Georgia, has informed the writer that a colored man called on him during the past year with a 2-carat diamond, defective and of poor color, which he stated he had found in his garden within a few miles of Atlanta. He has shown no desire to sell or lend the stone for examination.

Zircon.—Opaque green zircons in crystals 1 inch long and $1\frac{1}{2}$ inches wide, were found by Mr. Nimms in Saint Lawrence county, New York, at the town of Fine. They were curious, but not of gem value. Fully 25 tons of this mineral will be raised during 1888, from Henderson county, Kentucky, for use in a new incandescent gas-burner manufactured in Philadelphia.

Beryl.—Prof. Eugene A. Smith obtained from Coosa county, Alabama, some light golden yellow beryl of sufficient transparency to furnish small gems. Blue green beryl that afforded fair gems was reported by Mr. William E. Hidden, from Mitchell county, near the Yancey county line, North Carolina.

Phenacite.—Dr. S. L. Penfield describes phenacite from Topaz butte, 5 miles north of Florissant and the same distance from Mount Antero, Colorado. Mr. W. B. Smith describes the occurrence of topaz and phenacite at Topaz butte (*American Journal of Science*, February, 1887, III. Series, vol. 34, p. 130). An extensive find of phenacite crystals (few of gem value, however,) associated with aquamarine crystals, was made at Mount Antero, Colorado, in the fall of 1887. The phenacites were almost quartzoids in form. The occurrence is described by the Rev. R. F. Cross, in a note in the *American Journal of Science*, February, 1887, p. 161, vol. 34.

Garnet.—A variety of spessartite garnet was found at Amelia Court House, Virginia, in masses several inches across, and dark brown, dark red, or honey brown in color, which would afford cut gems from 1 to 10 carats in weight. These are the finest specimens of this variety of garnet yet found. Fully $1\frac{1}{2}$ tons of the almandite garnets of Salida, Colorado, were found during the past year and sold as tourists' or mineralogical specimens at from 30 cents to \$1 a pound. One absolutely perfect dodecahedron weighed over 14 pounds. In the proceedings of the "Philadelphia Academy of Natural Sciences," 1886, p. 355, Dr. George Koenig describes a titaniferous garnet from southwestern Colorado, and also analysis of schorlomite from Magnet Cove, Arkansas, which he finds to be titaniferous garnet.

Tourmaline.—A large number of green tourmalines, some quite stout and several inches in length, have been found at Franklin Furnace,

Sussex county, New Jersey, but although they are an important addition to our mineralogical collections and the outer parts of some of the crystals are of a rich almost chrome green, yet not a single one was observed which would cut a transparent gem of even a few carats.

Prof. R. B. Riggs, of the laboratory of the Geological Survey, recently made over 25 analyses of tourmalines of all colors. He found the question of the color of the lithia tourmaline a very interesting one. The color of the iron and magnesian varieties depends on the amount of iron present. It ranges from the colorless De Kalb through all the shades of brown to the Pierrepont black, while the lithia tourmaline, containing more or less manganese, gives the red, green, and blue, as well as the colorless varieties. The shades of color do not depend on the absolute amount of manganese present, but rather on the ratios existing between that element and iron. Thus, when the amount of manganese bears a specific proportion to the iron, we have the colorless, pink, or very pale green tourmaline. An excess of manganese produces the red varieties; and if the iron is in excess the various shades of green and blue result.

Rubellite.—Mr. William Irelan, jr., reports the finding of transparent rubellite in fine crystals 1 to 2 inches long, in San Diego county, California.

Hiddenite.—Rev. Alfred Free, in a report on a placer mine at Bracket Town, McDowell county, North Carolina, mentions the finding of a small crystal of spodumene of the hiddenite variety. He had also observed blue, green, and pink tourmaline at the same locality.

Rock crystal.—In the last report reference was made to the occurrence of rock crystal in what was believed to be a part of Virginia, but which, on visiting the locality, the writer found was really the mountainous part of Ashe county, North Carolina. My attention was first called to this locality by the receipt thence, by Messrs. Tiffany & Co., of a 51-pound fragment of a large crystal, which was said to have been broken from a mass weighing 300 pounds by a twelve-year old mountain girl. This large crystal was found on the Mintor Blevin farm on Long Shoal creek, in Chestnut Hill township, though crystals have also been found at two places 600 feet apart on the L. C. Gentry farm, about one mile from the former locality. All three places are 50 miles from Abingdon, Virginia, and 40 miles from Marion, Virginia. Crystals have also been found close to the north fork of Piny creek, on the Saint Ledger Brooks farm. At the latter place was found a remarkably clear distorted crystal, weighing 20½ pounds, which is absolutely perfect, and is the finest piece of rock crystal ever found in the United States; and on the Gentry farm one crystal was found weighing 188 pounds, and another weighing 285 pounds. The latter was 29 inches long, 18 inches wide, and 13 inches thick, showing one pyramidal termination entirely perfect and another partly so; it sold for over \$500 for use in the arts. A number of others have also been found. All these localities are on a spur of Phoenix mountain, and the crystals have all been found in decomposed crystal-

line rocks, principally coarse felspathic granite, which has all decomposed even to a greater depth than that at which these crystals occur. Most of them are obtained by digging where one crystal has been found or striking and unearthing them with a plow. Altogether several dozen crystals have been found, weighing from 20 to 300 pounds each, and future working will doubtless bring many fine ones to light. Some of these afford larger masses of clear rock crystal than have ever before been found in the United States, and suggest its use for such objects of luxury as crystal balls, clock cases, mirrors, etc., which are now to be seen in the Austrian treasury at Vienna.

From the vicinity of Fairfax county, Virginia, Mr. James W. Beath obtained quartz with alternate green and white veining, the green being produced by chloritic inclusions. When cut it forms an interesting ornamental stone, and several hundred dollars' worth of it have been sold.

Mr. H. L. Hosmer reports that crystals of smoky quartz a foot in length are occasionally found at Sterling, Montana.

Chrysoprase.—Mr. William Irelan, jr., reports from Tulare county, California, beautiful semi-transparent chrysoprase of fine color. This has also been found in Douglas county, Oregon.

Agate.—At Sioux Falls, Dakota, the company that is cutting and polishing the agatized wood from Arizona and the quartzite found at Sioux Falls has, after a great deal of experimenting, perfected the methods of sawing and polishing hard materials so as greatly to reduce the cost. Among the objects produced were a round column $11\frac{1}{4}$ inches wide and 21 inches high, cut transversely across the tree, so that the heart was visible on two sides of it, with the radiations in all directions; and sections measuring 25, 24, $17\frac{1}{2}$, and 13 inches in diameter, respectively, so highly polished that when turned with the back to the light they form a perfect mirror. All the specimens were brilliant in color and rivaled any work ever done in hard materials. The company has removed from the forest 180 tons of material, and 20 tons of sections have been ground down to show its characteristic beauties. Perhaps \$100,000 worth is now undergoing the cutting and polishing process.

Pectolite.—A massive pectolite of unusually dense structure has been announced by Mr. William P. Blake as occurring in Tehama county, California, in masses of considerable size and susceptible of a high polish. In a letter to the writer he gives the following description: "It occurs in a vein, and is broken out in rough tabular masses from 2 to 3 or more inches in thickness, but it is reported that much larger masses can be obtained. It is exceedingly tough and hard to break. The punctured surfaces are irregular, without cleavage, but have a silky luster and crypto-crystalline structure, exhibited in extremely fine inseparable fibers, which are radial, curved, and interlaced, and are perhaps embedded in a siliceous magma, but the fibers constitute the bulk of the mass. The color is white, with a delicate shade of sea green, and trans-

lucent. Exposed or weathered portions lose their porcelain-like translucency, and become white and somewhat earthy in appearance, and exhibit the crypto-fibrous structure with more distinctness. Specimens cut and polished across the end of a slab-like mass show on one side a narrow selvage of breccia, made up of fragments of the pectolite and of dark-colored wall rock mixed and firmly cemented together. On the opposite side or border of the mass there are distinctly formed parallel planes of concentric layering, from the surfaces of which the fibers diverge. These layers and the brecciated border opposite show the vein-like formation of the mass between the walls. The hardness is 6 to 6.5. In the blow-pipe flame it burns to a white enamel and gives off a little water. It may be found useful as an ornamental stone for making small objects—cups, plates, handles, or for carving figures or inlaid work." This is identical with the pectolite from Alaska, described by Prof. F. W. Clarke.

Peristerite.—Large quantities of peristerite are reported by Mr. C. M. Skinner at Cavendish, Vermont., near Cavendish Falls, in the railroad cut 22 miles northwest of Bellows Falls.

Oligoclase.—Of great interest is the transparent oily green oligoclase containing small, white, starlike inclusions, which impart to the mass all the appearance of green glass, and with included white minerals found at a depth of 400 feet in mica near Bakersville, North Carolina. It was found by Mr. Daniel Bowman.

A very interesting variety of sunstone was found by Mr. J. A. D. Stephenson at the quarry in Statesville, North Carolina. Several hundred dollars' worth of it has been sold as gem.

Albite.—In the Allen mica mines at Amelia Court House, Amelia county, Virginia., as a by-product in mica mining, a remarkable series of albite has been found, tabular, but measuring 4 to 7 inches in length and forming large groups; also the same mineral in massive form of the moonstone variety, and tons of amazonstone in bright cleavages.

Rhodonite of the variety known as fowlerite has been found in Franklin Furnace, New Jersey, in groups of rich, flesh colored crystals finer than ever before known. Some of these were 6 or 7 inches in length and several inches thick, forming groups a foot across. Although of value for gem material they possess a higher mineralogical value, and more than \$1,000 worth was sold for specimens. The rhodonite so well known as occurring in boulders at Cunningham, Massachusetts, has recently been traced to the ledge, and we may now hope to see this stone used extensively for decorative and ornamental purposes, as at this locality it is one of the richest pink and flesh colored minerals known.

Turquoise.—Additional evidence of the antiquity of the turquoise workings of New Mexico and Arizona has been gathered by the Hemenway expedition, sent out by Mrs. Hemenway under the direction of Mr. Frank H. Cushing. About 10 miles from Tempe, Arizona, where the excavations are being made, a shell encrusted with turquoise and garnet representing the form of a frog was found.

Cyanite.—Mr. Daniel A. Bowman communicates that the cyanite mentioned in the last report was found near the summit of Yellow mountain, alongside the road to Marion, about 4 miles southeast of Bakersville, North Carolina, at an altitude of 5,500 feet. Some of this is transparent, from one-eighth to one-half inch across and several inches long. So rich is its color that it was sold for sapphire. Its low hardness unfits it to some extent for use as the gem for which it is to be worn. It is a handsome mineralogical gem, however.

Crocidolite.—In the *American Journal of Science*, III Series, volume 34, page 108, Prof. A. A. Chester published analyses of the crocidolite from Beacon Hill Pole, Cumberland, Rhode Island, an interesting occurrence of this mineral, though not in gem form.

Labradorite.—The well-known Labradorite rock in Lewis county, New York, is so plentiful that the reflection of the bowlders has given the river that runs through the locality the name of Opalescent river. This is being extensively cut as an ornamental stone.

Mexican onyx.—The handsomest and lowest priced of our ornamental stones, and one which has been introduced most extensively, is the so-called Mexican onyx or Tecalli, as it was first called, from the town of that name in the state of Pueblo, Mexico, where it is found. The deep colors are richer than those of any marble known, and its wavy stalagmitic structure and the high polish which it can take have made it popular throughout the whole civilized world. With a metal mounting the effect is greatly enhanced. It occurs in almost unlimited quantities, and fully \$500,000 worth has been used in the United States for table tops, mantels vases, etc.

FOREIGN SOURCES.

In this, the fifth of the annual reports on precious stones in the United States, which have done much toward awakening a wide-spread interest in American gems, it was thought well to give a brief sketch of some of the most important changes which are taking place in precious stones at the principal sources, which are usually foreign.

Diamonds.—The author of the "Arabian Nights" undoubtedly thought that he was imagining the wildest and most improbable things when he described the collection of such treasures in the Valley of Diamonds by "Sinbad the Sailor." Yet when compared with the African mines this profusion of wealth has paled into utter insignificance. A glimpse at these new valleys of diamonds will be interesting. The primitive method of washing was carried on for centuries by thousands of slaves, who, like those who built the pyramids, were driven by a master mercilessly goading them on, whip in hand. To-day we have the most ingenious and powerful machinery, which allows fewer diamonds to escape than would the keenest and most disciplined army of washers.

At the Kimberley diamond mines in South Africa wonderful progress has been made in the last decade. About 1877 the work of consolidat-

ing the different companies began. Originally the mines were worked as 3,238 separate claims, each 31 feet square, with a $7\frac{1}{2}$ foot roadway between every two claims; now these are all united in about forty companies. A mine in the early days was a bewildering sight. Miles of wire cables running from individual claims were stretched across it in all directions; to these were attached the buckets for carrying the earth, reef, or wall rock of the mines, and at times water. Some of the claims were almost level with the surface, while others next to them might be cut down 200 feet, and others only 100 feet, yet all being worked independently. At the sides were endless belts with pockets for carrying the earth. One of the results of this independent system of working was that rock was dropped so recklessly that it is said to have been as dangerous as the battlefield to stand around the edges of the claims. Not only was the loss of life great from this source, but also from the falling of immense masses of reef, loosened by the blasting, which sometimes buried a score of men at once. But improved methods were gradually introduced. Steam railroads were run into the mine, and parts of it were leveled down. Millions of tons of reef required removing, and the only way to accomplish this was to assess every company in the mine proportionately. At first many mistakes were made, if mistakes they can be called when the problems offered for solution were entirely new and untried. The yellow or surface soil which overlaid the blue stuff pulverized so readily that it could be taken to the washing machine direct; but as the claims were extended down into the blue rock this proved harder, and dynamite became necessary. Immense quantities of it are now used for blasting. Through careless storing, 30 tons of dynamite, 10 tons of blasting powder, and gelatine, in all worth \$80,000, exploded on January 10, 1884, with terrific effect; the smoke column, 1,000 feet high, was visible at the River diggings, 35 miles distant.

After the earth is raised it is put on the sorting ground, where it is partially disintegrated by water and the action of the atmosphere. It is then further broken up by hand and taken to the "compound" or diamond-sorting machine. After being more finely broken up it is passed down into large vats containing immense centrifugal wheels, by which, as they rapidly revolve, the rock is finely divided. The lighter minerals, such as quartz, mud, and mica, are then floated out, while the diamonds, garnets (some of which are exceedingly rich in color, and of large size and are sold under the name of cape rubies), and other heavy minerals, are concentrated in the lower part of the "compound." So thoroughly does this pulverize the rock and earth that all the diamonds, even those of the size of a pinhead, are saved.

A prize of £5,000 was offered for the best tunnel or shaft system for use at the Kimberley mines, and the prize was awarded to the Jones system, which is sunk on the coffer-dam principle. At present there are seven shafts and inclined planes in the Kimberley mine alone, all sunk at some point in the reef outside of the mine. From 11,000,000

to 13,000,000 gallons of water are annually hoisted from the Kimberley mine at a cost of 6 pence per load of 100 gallons.

In addition to many miles of aerial tramways, there are over 170 miles of tramway around the four Kimberley mines, 2,500 horses, mules, and oxen, and 350 steam engines, representing 4,000 horse power, are employed in the works. For labor, £1,000,000 are annually expended, and over £1,000,000 for fuel and other supplies. The gross capital of the companies is nearly £10,000,000. Over 10,000 natives, each receiving £1 per week, and 1,200 European overseers at an average wage of £5, are employed. It is now proposed to consolidate all the companies into an enormous diamond trust, with a capital of £10,000,000, but at the present quotations of the shares of the company they are valued at over £14,000,000. The supposition long held that this unification would ultimately be accomplished is partly confirmed by the report, this spring, that the house of the Rothschilds, of London, is about to put in operation a project for the consolidation of the diamond mines into one gigantic trust for the regulation of prices and production.

The South African mines yielded during the last ten years 27,878,587 carats, valued at £31,717,341. The yield for 1887 was 3,646,899 carats, worth £4,033,582 at a valuation of £1 2s. 1½*d.* a carat. In December, 1887, a single sale of rough diamonds was recorded of £150,000, and in February, 1888, of £250,000, or \$750,000 and \$1,250,000, respectively. The average value of a carat of diamonds for some years from the respective mines has been as follows:

Average value of a carat of South African diamonds.

	<i>s.</i>	<i>d.</i>
Kimberley mine.....	17	6¼
De Beers mine.....	17	8
Bultfontein.....	18	2½
Dutoits Pan.....	24	7¼
River digging.....	47	6

The product of the latter mine, while only one one hundred and twenty-fifth of the weight in carats, was worth one sixty-second of the entire product, the stones averaging much finer quality.

The approximate annual yields for the last ten years have been as follows:

Yield of South African diamonds during the past ten years.

Years.	Carats.	Value.
1878.....	2,540,000	£2,672,734
1879.....	2,610,000	2,864,631
1880.....	3,030,000	3,168,000
1881.....	3,315,000	4,200,000
1882.....	2,385,000	3,500,000
1883.....	2,312,000	2,359,466
1884.....	2,204,786	2,228,678
1885.....	2,287,263	2,228,680
1886.....	3,047,639	3,261,570
1887.....	3,646,899	4,033,582
River diggings.....	500,000	1,200,000
Total.....	27,878,587	31,717,341

Not only has the yield of the African mines been great, but the diamonds have been of much larger average size than those from any of the old mines. The finding of a 17-carat stone in the Brazilian diggings was sufficient to secure the freedom of the fortunate slave who found it; but stones of this size are found by the hundred here. A 100-carat stone scarcely creates as much excitement as a stone of one-fifth the size did in Brazil.

It is estimated that from one-fifth to one-quarter of all the yield never reached the proper owners, as the native diggers swallow and conceal the diamonds in every possible manner. Hence it became necessary for the companies, in self-defense, to take extraordinary precautions against this great loss, and overseers or special searchers were appointed, who made the most thorough examination of all who left the mines. The natives use most ingenious methods for the concealment of the gems. On one occasion some officers, suspecting that a kafir had stolen diamonds, gave chase and caught up with him just after he had shot one of his oxen. No diamonds were found upon the kafir, it is needless to say, for he had charged his gun with them, and after the disappearance of the officers he dug them out of his dead ox. Diamonds have been fed to chickens, and a post-mortem recently held over the body of a kafir revealed the fact that death had been caused by a 60 carat diamond which he had swallowed. Early in the history of the mines a detective force, consisting of men, women, and children, was formed, and the severest punishment is still inflicted on transgressors of the diamond act. None but those authorized by law, termed patented agents, less than fifty in number, are allowed to purchase or even to possess rough diamonds at Kimberley.

The actual loss of diamonds would not have been so great but for the irregular diamond buyers, or "I. D. B.s," as the "fences" are called, who sent the stones to England and undersold the company in the London market. It was a question at one time whether the mines could be profitably worked under such disadvantages. Within the last two years, however, this pilfering has been in great measure checked by the adoption of what is known as the compound system, by which the "boys" are housed and fed under contract for a certain term, provided with amusements and liquor, and thus kept apart from the influences of the vicious whites. Now the visitors who buy from native diggers what they suppose to be valuable diamonds and secrete them until they have passed beyond the reach of the officials, find to their disgust that they have purchased fac-similes in glass, perfect even to the characteristic yellow tint peculiar to many diamonds from this locality.

Diamonds weighing 38,000,000 carats, or over $7\frac{1}{2}$ tons, have been found here. In the rough their aggregate value is £50,000,000, and after cutting, £100,000,000, or nearly \$500,000,000 more than the world's yield during the two preceding centuries. Of the whole yield not more than 8 per cent. can be said to be of the first water, 12 per cent. of the

second water, 25 per cent. of the third, while the remaining 65 per cent. is called bort, a substance which, when crushed to powder, is of use in the arts for cutting hard substances and engraving. This must not be confounded with the carbon (carbonado) found in Brazil, an uncrystalline form of the diamond, which, from its structure, is adapted for use in drills for boring and tunneling rocks, etc., and has never yet been found in South Africa. It is worth from six to ten times as much as bort.

More diamonds weighing over 75 carats after cutting have been found since the African mines were opened than were known before. The Victoria, the Great White, or the Imperial Diamond, is supposed to be from South Africa. Concerning its early history very little is known; in fact, where the stone was found is only a matter of conjecture—a remarkable circumstance when we consider that it is the largest brilliant in the world. The original weight of the stone was 457½ carats, or 3½¹/₆₀ troy ounces; after cutting, 180 carats, valued at £100,000.

On March 28, 1888, there was found in the De Beers mine an octahedral crystal of diamond weighing 428½ carats; it is not entirely white, having a slight yellow tinge. It was valued at £3,000. From its form it is believed that it will cut into a brilliant of 200 carats, hence it will be the largest known.

Production of diamonds at the Griqualand West mines, Kimberley, De Beer's, Dutoitspan, Bullfontein, and St. Augustine, from September 1, 1882, to December 31, 1887.

Years.	Carats.	Value.	Average per carat.
1882, four months.....	856,353 ³ / ₈	£1,119,210	s. d. 26 1 ¹ / ₂
1883.....	2,312,234 ¹ / ₈	2,359,466	20 4 ³ / ₄
1884.....	2,204,786 ¹ / ₂	2,562,623	23 2 ³ / ₄
1885.....	2,287,261	2,228,678	19 5 ¹ / ₂
1886.....	3,047,639 ³ / ₄	3,261,574	21 5
1887.....	3,646,899 ³ / ₄	4,033,582	22 1 ¹ / ₂
Total.....	14,355,174 ¹ / ₂	15,565,133	21 8 ¹ / ₄

Comparative yearly exports of diamonds from January 1, 1883, to December 31, 1887

Years.	Carats.	Declared value.	Average per carat.
1883.....	2,413,953 ³ / ₈	£ 742,521 1 0	s. d. 22 8 ³ / ₈
1884.....	2,263,686 ³ / ₈	2,807,288 3 4	24 9 ¹ / ₂
1885.....	2,440,788 ¹ / ₂	2,492,755 13 2	20 5
1886.....	3,135,432 ³ / ₄	3,507,210 14 0	22 4
1887.....	3,599,036 ¹ / ₄	4,251,837 14 6	23 7 ¹ / ₂
Total.....	13,852,897 ¹ / ₂	15,801,613 6 0	22 9 ³ / ₈

Imports of diamonds into Kimberley from the River diggings, from September 1, 1882, to December 31, 1887.

Years.	Carats.	Value.	Average per carat.
1882, four months.....	5,742 $\frac{3}{8}$	£6,010	<i>s. d.</i> 20 11 $\frac{1}{8}$
1883.....	14,800 $\frac{3}{8}$	37,112	50 1 $\frac{3}{8}$
1884.....	19,710 $\frac{3}{8}$	57,639	58 5 $\frac{3}{8}$
1885.....	27,992	56,123	40 1 $\frac{1}{8}$
1886.....	38,673 $\frac{7}{8}$	84,829	43 10 $\frac{1}{8}$
1887.....	46,171 $\frac{1}{2}$	95,433	41 4 $\frac{1}{8}$
Total.....	153,090 $\frac{1}{2}$	337,146	44 0 $\frac{1}{2}$

Summary of imports of diamonds into Kimberley from September 1, 1882, to December 31, 1887.

Whence imported.	Carats.	Value.	Average per carat.
Colony, England, etc.....	130,133 $\frac{1}{4}$	£127,831	<i>s. d.</i> 19 7 $\frac{3}{4}$
Orange Free State.....	306,660 $\frac{3}{8}$	505,428	32 11 $\frac{1}{2}$
River diggings (Barkly West).....	153,090 $\frac{1}{2}$	337,146	44 0 $\frac{1}{2}$
Total.....	589,884 $\frac{3}{8}$	970,405	32 10 $\frac{3}{4}$

Summary of production of diamonds at the Griqualand West mines for the year 1887.

Mines.	Carats.	Value.	Average per carat.
Kimberley.....	1,333,832 $\frac{1}{2}$	£ 1,410,207 12 1	<i>s. d.</i> 21 1 $\frac{1}{4}$
De Beer's.....	1,014,048	1,022,878 6 5	20 2
Dutoitspan.....	696,576 $\frac{1}{4}$	987,283 17 8	28 4 $\frac{1}{8}$
Bultfontein.....	602,246	612,962 18 6	20 4 $\frac{1}{4}$
St. Augustine.....	197	250 0 0	25 4 $\frac{1}{2}$
Total.....	3,646,899 $\frac{3}{4}$	4,033,582 14 8	22 1 $\frac{1}{2}$

Production of diamonds, Kimberley mine, from September 1, 1882, to December 31, 1887.

Years.	Carats.	Value.	Average per carat.
1882, four months.....	350,955 $\frac{1}{4}$	£456,420	<i>s. d.</i> 23 11 $\frac{1}{4}$
1883.....	947,817 $\frac{3}{8}$	846,705	17 10 $\frac{1}{4}$
1884.....	642,438	631,332	19 9
1885.....	523,774 $\frac{1}{2}$	458,858	17 6 $\frac{1}{2}$
1886.....	889,864	883,503	19 10 $\frac{1}{4}$
1887.....	1,333,832 $\frac{1}{2}$	1,410,207	21 1 $\frac{1}{4}$
Total.....	4,718,681 $\frac{1}{8}$	4,690,025	19 10 $\frac{1}{2}$

The diamond mines at Salabro, Brazil, known as the Canavieiras, were discovered in 1882 by a poor miner who had worked in the earlier mines, now nearly exhausted. They are situated at a distance of two days' journey from Canavieiras, near the river Pardo, and the gems are found at a depth of about 2 feet in a red gravel. They are very fine in

quality, and are remarkable for their purity and whiteness, the crystals being of such a form that scarcely any cleaving is necessary.

History repeats itself, and as, when the Brazilian mines were first discovered, they sent the stones to India to enter the European markets in European wrappers, so Bultfontein diamonds were sent to Canavieiras to be shipped to Europe as the product of that mine.

So great was the rush for these mines at first that, notwithstanding the rumors of a malarial climate and epidemic diseases, by the end of the first year 3,000 miners were at work where shortly before was a virgin forest. For a time even this number was exceeded. The other Brazilian mines have been only slightly worked of late years.

The recent concentration of some of the diamond mining companies in South Africa in their efforts to regulate the production and price has led to an increased interest in mines located in Brazil and India. During the past year the Madras Presidency Diamond Fields Company (limited) has been organized with a capital stock of £190,000. To prove that the Indian mines are not yet exhausted, operations will be commenced at the Wadjra Karur field in the Madras presidency. On this field of 554 acres was found a very fine $67\frac{1}{2}$ diamond crystal which furnished a 25 carat stone called the Gow-do-Norr, valued by the company at £15,000. An English company has recently been formed, under the name of the "Hyderabad Deccan Mining Company," to work the mines in Krishna valley, India, where it is thought that the famous Kohinoor diamond was found.

Diamonds have been found in the Tertiary gravels and recent drift near Bingera in Inverell, Australia; also along the Cudgeon river, 160 miles northwest of Sydney, and in other districts. The colors are white, straw, yellow, light brown, pale green, and black. The largest stones yet found were cut into gems weighing $3\frac{1}{2}$ and 3 carats, respectively. A trial made by the Australian Diamond Mining Company produced 190 diamonds, weighing $197\frac{3}{4}$ carats, from the washing of 279 loads of earth. These Australian fields can scarcely be called productive as yet, nor from present appearances do they seem likely to become formidable competitors of the South African fields.

India, Borneo, and Australia are now yielding very few diamonds, probably not more than 1 per cent. of the entire product. These three countries, together with Brazil, yield probably less than 10 per cent. of the total output.

Imports of diamonds.—From the custom import lists we find that after deducting the approximate value of cut stones other than the diamond, we find that import duty was paid on about \$90,000,000 worth of cut diamonds in the last twenty-one years; of these \$68,000,000 worth were imported during the last ten years. In 1868 \$1,000,000 worth were imported and \$1,200,000 worth in 1867, but about \$10,000,000 in 1887, or ten times as many as twenty years ago, showing the increase of wealth and the great popularity of the diamond among Americans, the above

being the wholesale import figures. A single firm sells more than the entire imports of twenty years ago.

Diamond dust worth \$464,905 has been imported since 1878, \$289,430 worth from 1868 to 1878, and in 1869 to 1871 only \$228 worth; whereas with the opening of the Kimberley mines \$80,707 worth were imported the first year, showing what great benefit the arts received from the opening of the African diamond mines.

In 1878 the importations of uncut diamonds amounted to \$63,270; in 1887 to \$262,357; the total for the decade was \$2,728,214, while in 1883 there were imported \$443,996 worth, showing that although we are cutting four times as many diamonds as we were in 1878, yet the importations have been falling off. This is partly because in the years from 1882 to 1885 a number of our jewelers opened diamond-cutting establishments, but have either given up the business or sold out to others; for, in spite of the protective duty of 10 per cent. on cut stones, cutting can not be profitably carried on here on a scale large enough to enable one of the partners to reside in London, the great market for rough diamonds, to take advantage of every fluctuation in the market, and purchase large parcels which can be cut immediately and converted into cash; for nothing is bought and sold on a closer margin than rough diamonds.

Diamond cutting.—The recent death of Mr. Henry D. Morse, of Boston, known as the pioneer diamond cutter of the United States, brings to mind many interesting reminiscences. He has scarcely received the credit he deserved for his work. That he was the first in this country to cut diamonds is well known, and the best cutters in the United States to-day received their training under him. But educating young Americans, both men and women, to his art, was not his greatest work. He showed the world that the art which had so long been monopolized by the Hollanders was degenerating in their hands into a mere mechanical trade. His treatment of the diamond has given a great stimulus to the industry both in the United States and abroad. Shops were opened here and in London in consequence of his success. He was one of the few who studied the diamond scientifically, and he taught his pupils that mathematical precision in cutting greatly enhances the beauty and consequently the value of the gem. His artistic eye, sound judgment, and keen perception enabled him to carry the art nearer to perfection than is often attained.

It was in his shop that a machine for cutting diamonds was invented which did away in great measure with the tediousness and inaccuracy of the old manual process. Thanks to his labors, we now have among us the best cutters in the world—men who can treat the diamond as it should be treated to develop its greatest beauty. The fact that so many fine stones were recut here after he started his wheel led to a great improvement abroad in cutting, especially in the French Jura and in Switzerland, where both sexes are now employed at the trade; and, as a result, the diamonds sold to-day are decidedly better than those of

twenty years ago, before Mr. Morse turned his attention to the work. He, above all others, has shown us that diamond-cutting is properly an art and not an industry.

There are at present about 12 cutting establishments in this country, employing from 1 to 50 men each, and in all about 100, at salaries ranging from \$20 to \$50 per week. Most of the cutting done here is of a high class, some shops being almost entirely employed in recutting stones previously cut abroad. Ten years ago nearly all the diamonds used in the United States were purchased through brokers or importers. To-day, owing to the marvelous growth of the diamond business here, and the facilities for transatlantic travel, many of the large retail houses buy their diamonds direct in the European markets; and some have even established branches or agencies abroad.

In 1877 an international syndicate composed of London, Paris, and Amsterdam jewelers, wishing to establish a uniform value for the carat, confirmed 205 milligrams as the standard, and this has been pretty generally used abroad. Recently the discussion of the question has been reopened, and it will probably end in the general adoption of the above standard in place of the twenty or thirty conflicting systems now in use in different parts of the world.

Twenty years ago the wholesale diamond merchants of Amsterdam did not exceed 8 in number; but the development of the African mines has given so great an impetus to the trade, that within the past decade several diamond exchanges or clubs have been established as headquarters for the transaction of business; one of these, the "Handelsbond," has a membership of 800 and owns a fine building, the rooms of which are so arranged with respect to light as to render deception difficult and to facilitate the sale of diamonds. Others known as the "Golconda" and the "Koh-i-noor" are generally thronged with brokers and merchants, as also are the neighboring coffee houses.

At present there are between 50 and 60 large diamond polishing establishments, employing perhaps 3,500 polishers, who, however, no longer receive the princely wages of from \$80 to \$200 a week which they received when the African mines first began to produce so largely, and much higher prices were paid for products of the second and third quality. When fortune smiled on them the cutters lived in luxury; to-day they only receive \$15 to \$40 a week, and some even less than the former figure. To-day every establishment does its own selling. It will doubtless be eventually a question of the survival of the fittest, and the entire cutting will be controlled by a few powerful firms.

Sapphire.—In 1882 a very remarkable discovery of sapphire was made in the Zanskar range of the northwestern Cashmere Himalaya, near the line of perpetual snow, a short distance from the village of Machel and one-half day's journey from the top of Umasi pass. The stones were found at the foot of a precipice, where a land-slide had taken place, the including rocks being gneiss and mica.

At first they were merely collected by the villagers, who were attracted by the beautiful colors; and so little was their value realized that they were used as flints for striking fire with steel. They were so abundant at first that one writer speaks of having seen about a hundred weight of them in the possession of a single native. Traders, however, soon carried them to the distant commercial centers, where their value became known. There was an instant rush of jewelers' agents to the locality of the mine, and the price rose rapidly until about £20 per ounce was paid for good specimens, at which rate they have remained. The Maharajah of Cashmere promptly exercised his authority and sent a regiment of sepoy to take possession of the mines and harry the natives who were suspected of having stones in their possession or any knowledge of new localities where the gems could be found. Any one they laid hands on who had money was suspected either of having sold sapphires or of being about to purchase them, and was despoiled or even imprisoned. This naturally enough had the effect of compelling secrecy. Several crystals were found weighing from 100 to 300 carats each. During the first year of the discovery the Delhi jewelers are said to have bought up more than £20,000 worth of these sapphires. • Exceptionally fine sapphires to-day bring from \$65 per carat to \$125 per carat, which is less than before this great find.

The acquisition of the Burmese ruby mines cost the British Government a vast sum of money. On the wars of 1826 and 1852 England expended \$75,000,000 and \$15,000,000, respectively, and after all this sacrifice of treasure the Burmah and Bombay Trading Company claimed, four years ago, that King Thebaw, of Burmah, had arbitrarily canceled the leases by which the company controlled the output of the ruby mines near Mandalay. A meeting was accordingly held at Rangoon, on October 11, 1884, presided over by Mr. J. Thompson, agent for Messrs. Gillanders, Arbuthnot & Co. The result was the war of 1886, which involved the raising of an army of 30,000 men and an outlay of \$5,000,000, but the British Government gained control of the long coveted ruby mines. The question which next presented itself was, how should they be worked? Several firms were desirous of securing the lease, and after the Indian Government had virtually closed a lease to Messrs. Streeter & Co., the London jewelers, at an annual rental of 4 lakhs of rupees (£40,000), for a term of five and one-half years, with the privilege of collecting 30 per cent. on all stones mined by others, the home Government revoked the lease for some unexplained reason, probably on account of trade jealousies, although Mr. Streeter had apparently every assurance of the acceptance of his proposition and had even made preparations to begin work at the mines.

The ruby mines of Burmah are situated in the valley of the Mogok, 51 miles from the bank of the Irrawaddy river and about 75 miles north of Mandalay, at an altitude of 4,200 feet. Concerning these mines very little has been learned up to the present, as they were always

the monopoly of the Crown and were jealously guarded. It was said that they paid King Thebaw's Government annually 100,000 rupees and one year 150,000 rupees. Mining is carried on there by forty or fifty wealthy natives, who employ the poorer townspeople at liberal wages; but at present only seventy-eight mines or diggings are in operation and the work is done in the most primitive manner. The gravel is carried in baskets. The holes from which they are taken are allowed to fill with water every night. All of the gems are sent to Ruby Hall, Mandalay, to be valued. At present the royalty exacted by the English Government is 30 per cent. A stone was lately sold in Mandalay for 8,000 rupees, but without the knowledge of the officials.

One thing, at least, we learned from the British occupation of Burmah, namely, that King Thebaw did not own the dishes of rubies which were said to outrival anything known. His possessions of this kind proved to be only a few stones of poor quality.

Watch jewels.—About 1,200,000 watches with jeweled works are annually manufactured in the United States, requiring about 12,000,000 jewels, 7 to 21 for each watch; of these 5,000,000 are ruby and sapphire, and 7,000,000 are garnet jewels, valued at over \$300,000. Most of them are imported, but the Waltham Company does its own cutting, employing in this department about 200 hands, under the superintendence of Mr. W. R. Wills. About 15,000 carats of bort, in powdered form, are used annually in slitting and drilling these jewels. Nearly all the ruby, sapphire, and garnet used for jewels are imported, but it is hoped that American materials will soon be used. To be of value for this purpose, the material must be of some decided shade of red or blue, of a hardness greater than quartz, and free from flaws.

During the last decade new stones have come into favor, some neglected ones have regained their popularity, and still others, such as the amethyst and cameos, have been thrown out entirely. The latter, no matter how finely cut, would not find purchasers now at one-fifth of their former value; about ten years ago they were eagerly sought after at from four to twenty times the present prices. Rubies were considered high ten years ago, and a further rise was not looked for, but today they are still higher, a $9\frac{5}{16}$ carat stone having been quoted at \$33,000. There is no demand at present for topaz, yet a syndicate of French capitalists has been organized to control the topaz mines of Spain in the expectation that after twenty years of disfavor this gem will again be popular. Coral has felt the change of fashion, for during the last three years the imports have been less than \$1,000 per annum, and in the last ten years in all \$33,956, whereas in the ten years preceding \$388,570 worth were imported. The popularity of amber, on the other hand, is increasing. The imports of amber beads for the ten years, 1868 to 1878, amounted to less than \$5,000, whereas during the last ten years \$35,897 worth have been introduced. Amber amounting to only \$47,000 was imported from 1868 to 1878, but over \$350,000

worth from 1878 to 1888. Brazilian pebbles worth \$65,000 have been cut or sold ready for regrinding since 1878, and less than \$3,000 in the ten years preceding.

Ten years ago few of our jewelers carried more than the following stones in stock: Diamond, ruby, sapphire, emerald, garnet, and occasionally a topaz or aquamarine. The gem and mineralogical collections contained a large series of beautiful stones, hard, and of rich color, but known here as "fancy stones" and by the French as *pierres de fantaisie*. Since then considerable interest has centered in these fancy stones, and any leading jeweler is not only expected to be familiar with, but to keep almost all of them in stock. This change may be partly referred to the fact that since the Centennial Exhibition art matters have received more attention among us than before.

The Duke of Connaught gave his bride elect a cat's-eye ring as an engagement token; this was enough to make that stone fashionable and to increase its value greatly. The demand soon extended to Ceylon, where the true chrysoberyl cat's-eye is found, and stimulated the search for them there. In the chrysoberyl cat's-eye the effect is the result of a twinning of the crystal, or of a deposit between its crystalline layers of other minerals in microscopic inclusions. If the stone be cut across these layers *en cabochon*, or cabuncle cut, as it is called, a bright line of light will be noticed on the dome-like top of the stone. In price they range from \$20 upwards; exceptional stones have sold at from \$1,000 to \$8,000.

In the search for these chrysoberyl cat's-eyes an endless series of chrysoberyls has been found, of deep golden, light yellow, yellow green, dark green, sage green, yellowish brown, and other tints. They are superb gems, weighing from 1 to 100 carats each, ranking next to the sapphire in hardness. They gave a great surprise to the gem dealers; for it was found that the darker leaf green or olive green stones possessed the wonderful dichroitic property of changing to columbine red by artificial light, the green being entirely subdued and the red predominating. They were in fact alexandrites, a gem which had formerly been found only in Siberia, and even there of poor quality; though found in large crystals, a perfect gem of even 1 carat was a great rarity. Here, however, fine gems but rarely under 4 carats were found and an exceptional one weighed 67 carats. They can be numbered among the most remarkable gems known. Strange to say, among this alexandrite variety a few have been found which combine the characteristics of the cat's-eye and the alexandrite and were accordingly named the alexandrite cat's-eye.

Moonstones also from this same province of Kandy, Ceylon, were brought to light by this search for cat's-eyes. It would not be an overestimate to say that 100,000 of these stones have been mounted here in the last four years. They vary in size from one-eighth of an inch to nearly 2 inches long and 1 inch thick, and many of them surpass anything

hitherto known of their kind in beauty and size, selling from 50 cents to \$100 each, in a few exceptional cases \$150. Those displaying the *chatoyant* white and the opalescent blue color are especially beautiful.

The demand for the cat's-eye also brought into demand the then rare mineral from the Orange river, South Africa, known as erocidolite, more especially that variety that has been altered to a quartz cat's-eye. In this stone an infiltration of siliceous material coated each fiber with quartz or chalcedony, giving it the hardness of 7. This pleasing stone readily sold for \$6 a carat, and at the outset for even more; but owing to the excessive competition of two rival dealers, who sent whole cargoes of it to the London market, the price fell to \$1, or even to 25 cents per pound in large quantity. Even table tops have been made of this material by veneering. Vases, cane heads, paper weights, seals, charms, etc., were made of it and sold in large quantities. Burning it produced a bronze-like luster, and by dissolving out the brown oxide of iron coloring an almost white substance was obtained, which was dyed by allowing it to absorb red, green, and brown colored solutions. These, owing to the delicacy of the fibers, were evenly absorbed. Ten years ago this material was practically unknown, but so extensively has it been sold that to-day it is to be found at every tourist's stand, whether on the Rigi, on Pike's Peak, in Florida, at Los Angeles, or at Nishni Novgorod, showing how thoroughly organized is the system of distribution in the gem market. The green quartz cat's-eye from Hof, Bavaria, has also been brought into use and quite extensively sold, but at present both these varieties are only used in the very cheapest jewelry.

Since it has become generally known that Queen Victoria is partial to the opal, the old and stubborn superstition concerning it, which is said to date from Scott's "Anne of Geierstein," has been slowly yielding, until now the gem has its share of public favor. During the last two years ten times as many opals have been imported as were brought here during the preceding decade, many of these being the fine Hungarian stones. Mexican fire opals are much more common, as those tourists know to their sorrow who buy these stones at exorbitant prices in Mexico, hoping thus to pay the expenses of the trip, until they find on reaching New York that they are worth only about a quarter of what they paid for them.

The opal mines of Mexico are situated on the Hacienda Esperanza, near Queretaro. It is believed that a demand of 50,000 stones per annum could be supplied without raising the price perceptibly.

The opal mines of Dubreck, Hungary, yield the Government a revenue of \$6,000 annually. The output is so carefully regulated that the market is never glutted.

About ten years ago a new and very interesting variety of opal was brought from the Baricoo river, Queensland, Australia, where it was found in a highly ferruginous jasper-like matrix, sometimes apparently as a nodule and then again in brilliant colored patches, or in specks

affording a sharp contrast with the reddish brown matrix, which admits of a high polish and breaks with a conchoidal fracture. Many of these stones are exceedingly brilliant. They are of the variety known as harlequin opals, their color being somewhat yellow as compared with the Hungarian stone, although not less brilliant. The rich ultramarine blue opal is quite peculiar to this locality, and the green variety almost transcends the Hungarian. A company capitalized at £200,000 has been formed, and the gems are extensively mined. Many curious little cameo-like objects, such as faces, dogs' heads, and the like, are made by cutting the matrix and the opal together.

Green beryls, blue and green sapphires, white and bluish topaz, garnets, and zircons have been found at New England in New South Wales, and precious opals are obtained from the Abererombie river.

During the last ten years the taste for collecting jade and other carved hard stone objects has greatly increased, especially among Americans, owing to the stimulus given by the Centennial, Paris and Amsterdam expositions, and the breaking up by sale of many of the large collections. The value of carved jades outside of China and India can not be far from \$2,000,000.

In the United States there are, perhaps, twenty buyers, who have purchased fully \$500,000 worth of this material, many of the pieces being among the finest known, such as the private seal and other objects from the sacking of the Emperor of China's summer palace. The finest pieces, brought over by Tienpau, included some of the best that ever left China, and were intended for the Amsterdam exhibition; the choicest specimens of the Wells, Guthrie, Michael, and Hamilton palace collections are now owned in the United States. Experienced agents have been frequently sent to India and China to secure the finest objects as they presented themselves. One collection alone is worth over \$100,000; single objects sometimes selling for over \$5,000, and one exceptionally fine specimen being valued at over \$10,000. Explorations in Alaska have brought to light the fact that jade was used by the natives for implements, and it is almost proved that it is found not only as boulders but also *in situ*. The National Museum, the Emmons, Everett, Peabody Museum, Canadian Geological Survey, Dresden, and other collections, including the writer's own, contain several hundred objects, at least, that are made of this Alaskan material. A fact of interest in this connection is that Prof. F. W. Clarke found among the objects collected for the National Museum one which, on analysis, proved to resemble pectolite so closely that he referred it to that species. It has the hardness of jade, a specific gravity of 2.873, and is pale green in color. The same discovery was made almost simultaneously by foreign observers.

The theory that jadeite or chalchihuitl was highly prized by the aborigines has been greatly strengthened during the last ten years. Prof. J. J. Valentine, in his paper before the American Antiquarian Society, April 27, 1881, on the Humboldt celt or votive adze and the Leyden plate,

two remarkable carved jadeites, offered some exceedingly interesting suggestions. The Humboldt celt was presented to Humboldt by Del Rio in 1803, and the Leyden plate was given to that museum by A. S. Von Bramm, who found it near St. Felipe, close to the borders of Guatemala, in Honduras. They are both 9 inches in length and $3\frac{1}{4}$ inches wide; the former $1\frac{2}{3}$ inches in thickness, and the latter only one-fifth inch. This similarity of dimensions suggests to me that the two objects were originally part of one and the same celt. Before the same society, in April, 1886, Professor Putnam exhibited his remarkable series of Nicaragua and Costa Rica jadeites, which were all ornaments made by cutting into halves, thirds, or quarters one large celt perforated by one or two drilled holes, in one instance two of them fitting together. The 16-pound adze exhibited by myself at the American Association for the Advancement of Science meeting of 1887, from which fully two pounds had been cut; the breastplate recently found measuring only one-half inch thickness; and the fact that even Burmese jadeite, when burned or exposed to a high temperature, will assume the grayish-green color of the Mexican, all tend to support Professor Fisher's theory that this jadeite originally came from there. Additional evidence is the striking resemblance between the Maya and ancient Burmese styles of carving, although Dr. Meyer, of Dresden, firmly believes that this material will yet be found *in situ* in Mexico. The imperial jade quarries of Burmah, in the Mōgung district, 90 miles from Bhamo are leased by two companies, who pay a royalty of \$30,000 annually. The trade is entirely in the hands of the Chinese. At the Colonial Exhibition in London in 1886 there were exhibited large rounded and waterworn blocks of jade weighing hundreds of pounds called panaum by the Maories. Much of it is of the finest green color and was worked into charms, knife-handles, etc. Dr. W. Buller exhibited a fine collection of Maori ornaments and clubs, or neeris, heitikas, and other native ornaments made of this stone.

Collections of gems.—A regrettable dispersion of jewels and precious stones took place in May, 1886, when the famous collection formed by the late Henry Philip Hope, and exhibited at the South Kensington Museum for many years, was sold at auction. The Hope collection included the "Saphir Merveilleux" of Madame de Genlis's "Tales of the Castle;" the King of Kandy's cat's-eye, the largest known, having a diameter of $1\frac{1}{2}$ inches; the Mexican Sun opal, carved with the head of the Mexican Sun God, and known since the sixteenth century; an enormous pearl, the largest known, weighing 3 ounces and measuring 2 inches in length; the aqua-marine sword-hilt, made for Murat, King of Naples; and also many curious diamonds, sapphires, emeralds, and several hundred unique and magnificent gems. Such a collection should have been preserved intact as a national possession.

In 1886 it was decided by the French Assembly that the Crown jewels, with the exception of the famous "Regent" diamond, two of the Mazarins, and a few historic pieces reserved for the national museums,

should be sold at public auction. These exceptions were made because it was feared that they would fall into the hands of Americans. The sale of this great historic collection took place in May, 1887. The forty-eight parcels were subdivided into one hundred and forty-six lots, and there were sixty-eight buyers; the sales to twelve of them brought over 100,000 francs each. The largest lot, the great corsage, which sold for 811,000 francs, was purchased by a single American firm, the largest buyer at the sale. The purchases of this firm amounted to 2,249,600 francs, or about 34 per cent. of the entire sum realized; while as to quality the same firm obtained more than two-thirds of the finest gems, among them were three Mazarins; a pear-shaped rose brilliant weighing $24\frac{2}{3}\frac{7}{2}$ carats, for 128,000 francs; a pear-shaped white brilliant weighing $22\frac{1}{4}$ carats, for 81,000 francs; a white brilliant weighing $28\frac{7}{8}$ carats, for 155,000 francs; and an oval brilliant weighing $18\frac{1}{2}$ carats, for 71,000 francs; or 435,000 francs for the four. All but one of their purchases were secured by private American customers. The great interest attached to this sale was due not only to the fact that many of the gems were of very fine quality, but also to their historic associations; the history of many of them could be traced back several hundred years.

The collection of antique gems, numbering three hundred and thirty-one pieces, formed by the late Rev. C. W. King, of Trinity College, England, the greatest of all writers on engraved gems, was sent to the United States for sale in 1881. This collection represents the summing up of Mr. King's vast knowledge, and none has ever been more thoroughly studied. His numerous writings mark an epoch in the study of this branch of archæology, and only the loss of his sight led him to part with his treasure. The growing interest and taste in archæological matters in the United States induced him to send it here to be sold intact. In October, 1881, through the friendly mediation of Mr. Feuardent, it was purchased and presented to the Metropolitan Museum of Art by Mr. John Taylor Johnson, the president of the museum, where it now remains. Near it will be placed the Sommerville collection. Mr. Maxville Sommerville, while spending the past thirty-two years of his life in Europe, Asia, and Africa, has collected cameos, intaglios, seals, and other historical gems, and as a result of his liberal expenditure of time and money he is to-day the owner of one of the most unique and valuable collections of engraved gems in the world. It numbers over one thousand five hundred specimens, including Egyptian, Persian, Babylonian, Etruscan, Greek, Roman, Aztec, and Mexican glyptic, or jewel-carving art. All of these are represented by specimens of singular excellence, affording us a panoramic view of the achievements of civilized man in this direction. This remarkable collection, now at his home in Philadelphia, has been loaned to the Metropolitan Museum of Art, New York, where it will soon be placed on exhibition, and the public will be afforded every facility to study the beautiful achievements of the glyptic art.

Of greater antiquity and archæological value, because representing a period before gems were cut in the form of intaglios, is the collection of the Rev. W. Hayes Ward, consisting of 300 Babylonian, Persian, and other cylinders. Two hundred of these he himself collected in Babylon and its vicinity, and sold to the Museum at a nominal figure. Since that time he has collected 100 more cylinders. Many of them date from 2500 B. C. to 300 B. C., and are cut in lapis lazuli, agate, carnelian, hematite, chalcedony, jasper, sard, etc.

The death of Dr. Isaac Lea, of Philadelphia, in his ninety-fifth year, deprived the world of a great investigator in the field of precious stones. During the last twenty years of his exceptionally long and useful life, he devoted almost his entire time to studying the microscopic inclusions in gems and minerals, and the cabinet he left contains thousands of specimens of rubies, sapphires, chrysoberyls, tourmalines, garnets, quartz, etc., all of which he had subjected to the most rigid microscopic scrutiny, noting every interesting fact on the accompanying label. Only a small part of his work on this highly interesting subject has been published by the Philadelphia Academy of Sciences in two papers (in 1869 and 1876), but Dr. Lea made ample provision in his will for the publication of the remainder. His extensive collections of minerals and shells were bequeathed to the National Museum and the gem collection to his daughter. Two months before his death the writer spent two hours with him examining a series of quartz inclusions, over which he worked with all the enthusiasm and brightness of youth.

One of the many benefits traceable to the New Orleans Exposition was the appropriation given to the National Museum for their exhibit. This was wisely expended by Prof. F. W. Clarke in the purchase of a complete series of precious stones, many of which, although not expensive, are still the finest in the United States, from an educational standpoint. Since the exposition, many fine specimens have been added by purchase and donation, especially the diamonds and pearls presented by the Imam of Muscat to President Buchanan, consisting of 138 diamonds and 150 pearls, all of good quality. The collection numbers about 1,000 specimens, and embraces almost every known variety of precious stone, many of them very fine examples.