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GEMS AND PRECIOUS STONES.

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PRODUCTION.

The production of gems and precious stones in the United States in 1918 was smaller than in any previous year since 1881, except in 1896. The value of the output in 1918 was only $106,523. The enlistment of many gem miners in the military service, the general scarcity of labor, and the poor market all had their effect in reducing the quantity and value of the precious stones produced.

Value of precious stones produced in the United States, 1913–1918.

	1913	1914	1915	1916	1917	1918
Beryl	$1,615	$2,395	$1,675	$2,031	$2,178	$1,906
Copper ore gems	2,350	1,280	1,120	1,713	2,857	2,299
Corundum	238,835	61,032	88,214	99,180	54,204	42,414
Diamond	6,315	765	608	2 680	4,175	1,910
Feldspar	1,285	449	368	305	(a)	(a)
Garnet	4,285	1,760	4,523	1,542	624	1,277
Hematite	....	....	126	(a)	(a)	138
Jade	....	300	....	....	....	....
Opal	15,130	1,114	1,850	1,838	805	6,304
Peridot	375	100	(a)	455	(a)	1,018
Pyrite	50	....	1,042	2,075	(a)	(a)
Quartz	16,861	18,838	35,724	25,707	28,273	15,211
Rhodonite	165	1,050	85	(a)	(a)	515
Smithsonite	50	50	(a)	....	(a)	....
Spodumene	6,520	4,000	(a)	(a)	(a)	281
Thomsonite	....	21	(a)	47	(a)	(a)
Topaz	736	1,380	862	1,005	230	907
Tourmaline	7,630	7,980	10,969	50,807	12,452	6,206
Turquoise	8,075	13,370	11,691	21,811	14,171	20,667
Variscite	6,105	5,055	3,867	3,140	2,350	753
Vesuvianite	152	1,425	1,535	(a)	2,765	320
Miscellaneous gems	2,920	2,287	[b] 6,172	[c] 3,457	[d] 5,928	[e] 4,397
	319,454	124,651	170,431	217,793	131,012	106,523

[a] Small production included under "miscellaneous gems."

[b] Includes apatite, calamine, chlorastrolite, crocidolite, datolite, fossil coral, Iceland spar, kyanite, lapis lazuli, obsidian, peridot, phenacite, rutile, smithsonite, spodumene (kunzite), staurolite, thomsonite, titanite, and zircon.

[c] Includes chlorastrolite, datolite, epidote, fossil coral, hematite, kyanite, lazulite, rhodonite, rutile, sepiolite, serpentine, spodumene, staurolite, and vesuvianite.

[d] Includes andalusite, chlorastrolite, datolite, epidote, feldspar, fossil coral, hematite, Iceland spar, lapis lazuli, obsidian, peridot, phenacite, pyrite, rhodonite, rutile, sepiolite, smithsonite, spodumene, staurolite, thomsonite, willemite, and ziosite.

[e] Includes andalusite, calamine, chlorastrolite, datolite, epidote, feldspar, fluorite, Iceland spar, lapis lazuli, mariposite, meerschaum, obsidian, phenacite, pyrite, satin spar (gypsum), staurolite, thomsonite, willemite, and zoisite.

The value given in the table largely represents the value of the rough material; the value of the cut and polished gems is several times greater. The completeness and accuracy of the statistics of

[1] The tables giving statistics of the value of the gems and precious stones produced in the United States in 1918 were compiled by Miss Blanche H. Stoddard, of the United States Geological Survey.

production depend on the assistance rendered by the gem miners and dealers, and their help is greatly appreciated. The Geological Survey carries on a large correspondence concerning precious stones, and the information furnished by the individual producers enables the Survey to put intending purchasers of rough material directly in touch with them.

Corundum, quartz, tourmaline, and turquoise constituted 79 per cent of the total value of the precious stones produced in 1918.

Value of principal precious stones produced in the United States, 1911–1918.

Year.	Corundum.[a]		Quartz.[b]		Tourmaline.		Turquoise.		Total value.	Percentage of total shown by corundum, quartz, tourmaline, and turquoise.
	Value.	Percentage of total.	Value.	Percentage of total.	Value.	Percentage of total.	Value.	Percentage of total.		
1911	$215,523	62	$30,227	9	$16,445	5	$44,751	13	$343,692	89
1912	197,765	62	21,779	7	28,200	9	10,140	3	319,722	81
1913	238,835	75	16,861	5	7,630	2	8,075	3	319,454	85
1914	61,032	49	18,838	15	7,980	6	13,370	11	124,651	81
1915	88,214	52	35,724	21	10,969	6	11,691	7	170,431	86
1916	99,180	46	25,707	12	50,807	23	21,811	10	217,793	91
1917	54,204	41	28,273	22	12,452	10	14,171	11	131,012	84
1918	42,414	40	15,211	14	6,206	6	20,667	19	106,523	79
Average for 1911–1918		58		11		8		8		85

[a] Includes ruby and sapphire.
[b] Includes all varieties of quartz, such as amethyst, rock crystal, chalcedony, agate, jasper, etc.

Reports of actual production were received from 57 persons and companies. A few of these persons are either lapidaries or collectors and not regular producers of precious stones. Thirty-eight distinct mineral species were mined; including all varieties as reported, a total of 75 named precious stones were produced. These came from 27 States (including Hawaii), 8 of which had a production valued at more than $1.000 each.

Value of precious stones produced in 1918, by States.

Montana	$47,753
Nevada	21,674
California	9,572
Arizona	9,206
Maine	7,132
Colorado	3,430
Arkansas and New Mexico	3,089
Other States [1]	4,667
	106,523

Montana continued to lead all the other States in the value of precious stones produced in 1918. The output consisted chiefly of corundum of the variety sapphire, which represented almost half of the total value of all precious stones produced in the United States in 1918. Other gem minerals produced in Montana were agate

[1] Florida, Hawaii, Idaho, Michigan, Minnesota, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Oregon, Pennsylvania, South Dakota, Texas, Utah, Virginia, Washington, and Wyoming. Production of each State less than $1,000.

(chiefly moss agate), Iceland spar, garnet, and topaz; the last two amounted to only a few dollars in value.

Nevada ranked second in the output of precious stones, showing a greater value than for any other year since 1911. The most valuable gem mineral produced in Nevada was turquoise, followed by opal and variscite.

California was third in rank but had an unusually small output. The gem minerals mined were various forms of quartz (such as jasper, chalcedony, bloodstone, and chrysoprase), beryl, diamond, epidote, lapis lazuli, obsidian, rhodonite, spodumene, topaz, tourmaline, and vesuvianite. A three-quarter carat diamond was found in Cherokee Flat, Butte County, Calif.

Arizona had a production whose value was only a few hundred dollars less than that of California. The gem minerals produced include the copper-ore gems (azurite, malachite, azurmalachite, and chrysocolla), garnet, obsidian, peridot, opal, agate, jasper, and turquoise.

Maine produced beryl, garnet, amethyst and rock crystal, topaz, and tourmaline.

Colorado produced calamine, amazonstone, fluorite, garnet, hematite, opal, satin spar, phenacite, pyrite, various forms of quartz, topaz, and turquoise.

From Arkansas several hundred carats of diamonds were reported, including a canary-colored octahedron weighing 17.85 carats, a clear flat stone of 11 carats, and several smaller stones weighing several carats each.

In New York City garnet of gem quality was collected by Gilman S. Stanton and James G. Manchester in November, 1918, on Riverside Drive, north of West One hundred and sixty-fifth Street. The cut stones are deeper red than the spessartites found on the same ridge about half a mile farther north.[1] A number of stones have been cut, the largest about three-fourths of a carat in size. Chemical tests show that the garnet contains both iron and manganese, being intermediate in composition between almandite and spessartite.

In Hawaii an area of decomposed lava contains numerous yellowish-green crystals of peridot, which were cut in Honolulu into gems weighing as much as a carat and a half each. The crystals were separated from the sandy decomposed lava by sifting, and many also were brought to notice by the action of rain. Four workmen are said to have obtained 30,000 fragments of peridot in five days' work.

FOREIGN OCCURRENCES.

DIAMONDS IN SOUTH AFRICA.

A large blue-white diamond, weighing 388¼ carats[2] in its rough state, has been reported as found at the Jagersfontein mine, Orange River Colony, South Africa. Although small in comparison to the Cullinan diamond (3,052 carats), it will rank as one of the world's largest diamonds. The Jagersfontein mine in 1893 yielded the Excelsior, a diamond weighing 969½ carats in the rough. For comparison it may be stated that the largest cut stone obtained from the Cullinan weighs 516½ carats.

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[1] U. S. Geol. Survey Mineral Resources, 1916, pt. 2, p. 894, 1918.
[2] Presumably "English carats." The weights of the older stones are given in English carats. One English carat weighs 205.304 milligrams.

A large diamond, free from flaws, was picked up by a native in September, 1917, on the Dutoitspan mine dump at Kimberley. The stone weighs 442¼ carats and is a record stone for this mine. Although slightly smaller than the large diamond of 503¼ carats discovered in the De Beers mine in 1896, the stone picked up recently is the most valuable diamond ever found at Kimberley in the mines of the De Beers Consolidated Mines Co.

It is said that there are not enough new diamonds in the world to supply the unprecedented increased demand from nearly all countries in the last few months. The shortage is due to the four and a half years of war, during which mining operations were completely suspended for a period of a year and a half and were resumed on a greatly reduced scale. The diamond dealers in the United States have in the meantime been replenishing their stocks from the accumulated surplus that had been mined prior to the war.

The competition which formerly existed in the world's diamond market has completely disappeared because of Germany's loss of German Southwest Africa, the output of which was large enough to be a factor in the market. The former German possession is now held by the British. With this competition eliminated, it is pointed out by leading American diamond dealers, 95 per cent of the world's production of diamonds will be under control of the De Beers Consolidated Mines Co. and its selling agents.

Holland and Belgium did most of the diamond cutting before the war, France and England cutting smaller quantities. The industry has been practically suspended in Belgium, has increased in Holland, and remains about the same in France and England.

It is estimated that about half of the mined diamonds of the world are owned in the United States and that their value exceeds a billion dollars.

AGATE AND AMETHYST IN URUGUAY.

Agates and amethysts are found in the Departments of Tacuarembo, Paysandu, Salto, and Artigas, in the northwestern part of Uruguay. Agate is abundant in many curious and beautiful forms and in a great variety of colors. Amethyst occurs in geodes, which are collected in the fields at a nominal cost, taken on mule-back or in carts to the nearest railway station, shipped from there in barrels to Salto, and thence by river boat to Montevideo. The finest amethysts, of a deep violet color, equal to the best European material, come from Artigas, near the Brazilian border.

Little exact information as to the output of amethyst is available. In 1909, which was a normal year, exports are estimated to have been between 13,000 and 15,000 pounds. Practically the entire output of rough amethyst and agate was formerly exported to Germany to be cut at Idar and Oberstein. The value of rough amethyst varies greatly according to purity and color, ranging from 10 centimos (10.34 cents) to 12 pesos ($12.41) per kilo (2.2 pounds), and exceptionally as high as 40 pesos ($41.36) per kilo has been paid. The output since 1914 has been very small and irregular, owing in part to the depletion of the supply of stones of good quality.

The Morgan Gem Hall of the American Museum of Natural History, New York City, has recently acquired a beautiful statuette, 8 inches high, of a woman dancing, carved out of an unusually perfect block of translucent natural sapphirine (blue quartz) from Uruguay.

IMPORTS AND EXPORTS.

The precious stones (excluding pearls) imported into the United States in 1918, as reported by the Bureau of Foreign and Domestic Commerce, Department of Commerce, were valued at $22,666,839. Pearls are omitted from the total value, as they are lustrous calcareous concretions with animal membrane between successive layers and are not a mineral but an animal product, being deposited in the shells of various mollusks. As pearls owe their beauty and value to the organic part of their composition, they do not come within the scope of this report. They are, however, among the most desired of gems, and their value is therefore given in a separate column in the table of imports.

Including pearls, the value of imported gems in 1918 was the lowest for the last 10 years except that in 1914.

Diamonds and other precious stones imported and entered for consumption in the United States, 1909–1918.

Year.	Diamonds.				Other stones not set.	Total, excluding pearls.	Pearls.
	Glazier's.	Dust and bort.	Rough or uncut.	Cut but not set.			
1909	$758,865	$50,265	$8,033,379	$27,361,799	$4,033,201	$40,237,509	$24,848
1910	213,701	54,701	8,991,890	25,593,641	4,237,232	39,091,165	1,626,083
1911	199,930	110,434	9,654,219	25,676,302	3,820.703	39,461,588	1,384,376
1912	452,810	94,396	9,414,514	22,865,686	3,433,163	36,260,569	5,130,376
1913	471,712	100,704	12,268,543	24,812,604	2,805,963	40,459,526	5,002,624
1914	579,332	77,408	2,851,933	11,976,871	1,649,875	17,135,419	2,090,018
1915	366,793	75,944	7,020,646	13,177,919	1,078,391	21,719,693	4,513,909
1916	836,018	67,290	11,441,328	24,282,140	2,303,351	38,930,127	11,336,971
1917	1,098,102	349,746	13,092,855	18,421,838	1,883,810	34,846,351	4,947,509
1918	718,397	475,870	12,636,024	7,734,150	1,102,398	22,666,839	765,929

Value of diamonds imported into the United States in the fiscal years 1913 to 1918, by countries.

Uncut.

Year.	United Kingdom.	Belgium.	Holland.	British South Africa.	Brazil.	Germany.	All others.	Total.
1913	$8,635,000	$2,130,000	$963,000	$5,000	$70,000	$68,000	$469,000	$12,340,000
1914	6,132,000	974,000	504,000	....	74,000	1,000	422,000	8,107,000
1915	2,879,000	5,000	331,000	59,000	148,000	1,000	191,000	3,614,000
1916	10,718,000	....	210,000	315,000	685,000	....	258,000	12,186,000
1917	10,919,000	....	85,000	445,000	1,000,000	....	207,000	12,656,000
1918	12,285,000	....	130,000	276,000	1,194,000	....	193,000	14,078,000

Cut but not set.

Year.	Holland.	Belgium.	England.	France.	Brazil.	Germany.	All others.	Total.
1913	$10,853,000	$11,997,000	$1,583,000	$2,483,000	....	$254,000	$43,000	$27,213,000
1914	6,998,000	8,555,000	540,000	1,506,000	$4,000	87,000	105,000	17,795,000
1915	5,552,000	972,000	1,169,000	518,000	....	16,000	225,000	8,452,000
1916	16,422,000	68,000	1,817,000	1,679,000	171,000	28,000	382,000	20,567,000
1917	17,856,000	....	2,153,000	1,406,000	13,000	47,000	381,000	21,856,000
1918	11,308,000	....	1,867,000	712,000	6,000	....	39,000	13,930,000

Foreign precious stones reexported, 1913–1918.

Year.	Diamonds.			Other precious stones.		Total, excluding pearls.	Pearls and parts of, not strung or set.
	Uncut.	Cut but not set.	Bort.	Uncut.	Cut but not set.		
1913	$1,870	$57,117	(a)	$1,707	$7,239	$67,933	$24,787
1914	14,809	20,350	(a)	2,573	53,086	90,818	1,066
1915	97,764	5,119	$2,470	661	10,554	116,568	116,809
1916	6,979	9,342	4	9,023	48,352	73,700	894,115
1917	7,757	400	14,962	1,512	16,842	41,473	20,353
1918	[b] 100	....	56	....	57	213	42,908

[a] Not shown for these years. [b] Includes some bort.

SOME INDUSTRIAL USES OF PRECIOUS STONES.

In the following paragraphs are given some industrial uses of minerals of gem quality. In addition to ornamentation, all gem minerals are of value as specimens for collections, for use in standardization (for example, fluorite and quartz as standards of densities and of refractive indices), and as sources of material for investigation, both industrial and scientific. These uses are therefore not always repeated under the different mineral names. Ornamentation itself covers a variety of utilization, such as for jewelry, knife handles, paper weights, and pipes (meerschaum).

Agate. Mechanical bearings and supports, scale bearings, balls for water meters.
Azurite. Ore of copper; pigment for paint.
Azurmalachite. Ore of copper.
Calcite. See Iceland spar.
Chromite. Ore of chromium.
Chrysocolla. Ore of copper.
Cobaltite. Ore of cobalt.
Corundum. See Sapphire.
Diamond. Cutting, grinding, engraving, boring, and polishing material; supports for bearings and pivots; dies for wire drawing; tips for phonograph needles.
Epidote. For coloring artificial slate and roofing material.
Fluorite. See Optical fluorite.
Franklinite. Ore of manganese and zinc.
Garnet. Abrasive; for watch jewels or jeweled bearings; as tared weights.
Garnierite. Ore of nickel.
Gypsum. Used in manufacture of artificial pearls—the so-called "Roman pearls."
Hematite. Ore of iron.
Iceland spar.—Iceland spar is a variety of calcite, clear and transparent and unusually free from imperfections and impurities. Transparent crystals or cleavage pieces of calcite of any appreciable size are very rare, and as Iceland has furnished almost all of such material used, the name Iceland spar has been given it.

Elongated cleavage rhombohedrous of Iceland spar are used in the manufacture of nicol prisms, which are an essential part of optical instruments requiring plane polarized light, as, for example, certain microscopes, dichroscopes, and saccharimeters. The material, on account of its simple chemical composition and purity, finds application in chemical standardization. Iceland spar is also used in the manufacture of some kinds of glass, and some of it is sold as mineral specimens.

Pieces of Iceland spar, either in single untwinned crystals or parts of such crystals, or in homogeneous untwinned cleavage rhombohedra, which are large enough to yield a rectangular prism at least 1 inch long and half an inch thick each way and which possess the properties described below, are suitable for optical purposes. The colorless material must be so clear and transparent that it is limpid and pellucid. It must not be partly opaque on account of numerous cracks or fractures, must not show any internal, iridescent, or rainbow colors due to incipient cracks along fracture lines, nor any cleavage, nor twinning planes. Neither can there be any capillary or larger tubelike cavities, nor cavities or bubbles of any shape, nor inclusions, as isolated particles, veins, or clouds, composed of minute crystals of some other mineral or of any kind of foreign substance. The spar should not be discolored or stained by the presence of any clay, iron oxide, or other material. It should be noted that many of the inclusions and imperfections of Iceland spar are not always scattered irregularly through the mineral or even segregated in distinct masses, but frequently lie in a distinct but very thin plane which can hardly be seen if looked at on edge. In examining a piece of Iceland spar for defects the piece should therefore be turned in all directions while held to the light.

The material suitable for optical uses naturally brings the highest prices, as it has to be at least of the dimensions already given. Specimen material is generally of a larger size. The material used for standardization, chiefly chemical, need be of no special size, and the smaller pieces are as usable as the larger ones.

The optical variety of Iceland spar produced in the United States, sold, per pound, for $3 to $4 in 1914, about $8 in 1915, and as high as $20 in July, 1918. The specimen variety sells for considerably less, and material for standardization sells for from $1 to $2 a pound.

The following firms are buyers of Iceland spar suitable for optical use: Bausch & Lomb Optical Co., Purchasing Department, Rochester, N. Y.; Central Scientific Co., 460 Ohio Street east, Chicago, Ill.; Gilbert S. Dey, Superintendent Optical Department, Eastman Kodak Co., Rochester, N. Y.

The market for specimen spar is irregular, as the demand is usually very light. The best market will probably be found with some of the larger mineral dealers.

Standardization material may be sold to large dealers in general chemicals as well as to mineral dealers.

Although calcite is, next to quartz, the commonest mineral, the only locality outside of Iceland known to produce the variety Iceland spar in commercial quantity is in Montana, about 9 miles from Gray Cliff, Sweet Grass County, on the main line of the Northern Pacific Railway The spar occurs in a nearly vertical fissure vein from 3 to 8 feet thick, which strikes northwest, traversing a gneissic rock for several miles.

Brief mention of the Montana occurrence of Iceland spar is made in the reports on the production of gems and precious stones in Mineral Resources for 1913 (p. 704) and 1914 (p. 335). C. L. Parsons, of the Bureau of Mines, has also described the occurrence and material in Science, vol. 47, No. 1221, pp. 508–509, May 24, 1918.

Jasper. See Agate.

Malachite. Ore of copper, pigment for paint.

Mariposite. Pigment for paint.

Meerschaum. Pipe bowls; cigar and cigarette holders.

Optical fluorite. Fluorite, commonly called fluorspar, is a common mineral but is very seldom found in pieces clear enough and large enough to be of special use in the manufacture of certain optical lenses and prisms. Fluorite of the requisite qualities, as described below, suitable for such use is known as "optical fluorite." Any deposit of fluorite may yield a small quantity of such material, but at present about the only localities known to produce it are southern Illinois; Meiringen, Switzerland; and Obira, Bungo, Japan. Optical fluorite is cut into lenses and placed between glass lenses. It forms the apochromatic objective for microscopes and similar optical instruments, the fluorite lens correcting the spherical and chromatic errors of the glass lens systems. This result is due to the low refractive power, weak color dispersion, and single refraction of fluorite. These apochromatic lenses represent the finest type of microscope objectives made. The use of such a fluorite lens greatly increases the value of a microscope and if optical fluorite were more abundant many more microscope objectives would be equipped with such lenses.

Optical fluorite is also used in the lenses of certain telescopes, in making prisms for spectrographs in ultra-violet work, and in other optical apparatus where transparency in the ultra-violet and infrared parts of the spectrum is necessary.

Optical fluorite must yield or contain pieces at least one-fourth of an inch in diameter, which must be clear and colorless and free from all defects. Defects consist of internal cracks or cleavage planes, bubbles, or inclusions of dirt or mineral matter. The presence of faintly developed or incipient cleavage planes or fracture surfaces usually may be determined, if not readily visible, by moistening the specimen with kerosene. The material must not show any anomalous double refraction. Absolutely water-clear material is of the highest value, but very faint tints of green, yellow, or purple do not render the material useless.

Fluorite suitable for optical use is valued at from $1 to $10 a pound, according to the size of the piece suitable for cutting as well as to its quality. The present yearly requirement is not large—perhaps several hundred pounds—but under proper conditions and with a dependable steady supply this requirement may be increased.

Possible buyers of optical fluorite are: Bausch & Lomb Optical Co., Rochester, N.Y.; Spencer Lens Co., Buffalo, N. Y.; Ward's Natural Science Establishment, Rochester, N. Y.; United States Bureau of Standards, Washington, D. C.

Suitable material has been obtained from several of the fluorite mines in Hardin County, Ill., and may also occur in the extension of this fluorite belt in western Kentucky. Although fluorite is found in many other States, practically none of them is known to contain any "optical fluorite."

Among publications dealing with optical fluorite are the following:

Pogue, J. E., Optical fluorite in southern Illinois: Separate from Bull. 38, Illinois State Geol. Survey, Urbana, Ill., 1918.

Burchard, E. F., Fluorspar and cryolite in 1917: U. S. Geol. Survey, Mineral Resources, 1918, pt. 2, pp. 301–302, 1918.

U. S. Bureau of Standards, Washington, D. C.: Circular letter dated May 8, 1918.

Quartz. See Rock crystal.

Rock crystal.—The perfectly clear and colorless variety of quartz is called rock crystal. It furnishes the material for certain special glasses and fused silica ware; and it is used in wedges for microscopic work, as spectographic prisms for special researches, and as mechanical bearings. A use in connection with certain sounding boxes has recently been developed.

Sepiolite. See Meerschaum.

Sapphire. The variety of gem corundum used for other purposes than jewelry is called sapphire, irrespective of its color. It is used for mechanical bearings and pivot supports, especially in watches and phonograph needles (mostly artificial sapphire).

Topaz. Abrasive.

Tourmaline. In the tourmaline tongs or in polarizing forceps, a very simple form of polariscope.