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

MINERAL RESOURCES

OF THE

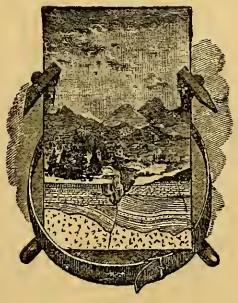
UNITED STATES

CALENDAR YEAR

1893

DAVID T. DAY

CHIEF OF DIVISION OF MINING STATISTICS AND TECHNOLOGY



WASHINGTON
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PRECIOUS STONES.

By George F. Kunz.

INTRODUCTORY.

The value of the rough gems produced in the United States during 1893 decreased, as will be seen by the table on the following page, from $312,050 in 1892, to $264,041. This decrease is principally due to the financial depression. A considerable proportion of the total sales of rough gems found in the United States is to tourists who purchase these as souvenirs of some locality visited, and but for the increase in sales to tourists at the World's Columbian Exposition, it is probable that the decrease in value would have been very much more considerable.

In spite of the decline in production above noted, the year 1893 was characterized by a number of interesting gem discoveries, including a diamond weighing $3\frac{1}{16}$ carats, found in a new district, Oregon, Dane county, Wisconsin. An interesting fact was proved, that the supposed diamonds in the Canyon Diablo meteorites are really diamonds, and the first instances are recorded of the polishing of a diamond by means of the diamond dust obtained from meteoric iron. The finding of small rubies of fairly good color in Macon county, North Carolina, gives ground for the belief that larger and better stones may be found there by more extended development.

It is interesting to note further that, in spite of the financial depression, $143,136 worth of American turquoise was sold—a greater amount probably than has ever been sold from the Persian mines in a single year. The finding of a remarkable 66-carat green tourmaline at Paris, Maine, and the discovery of a new tourmaline locality in the San Jacinto mountains, in California; the development of the opal industry in Idaho, where the gems are quite equal to those of Hungary, and in sufficient quantity to make the United States prominent even compared with Hungary, Queensland and the more recent remarkable find in Wilcannia, New South Wales, and some new moss agate from Hartville, Wyoming, with interesting possibilities for inlaid and ornamental work, are among the notable developments of the year.

PRODUCTION.

The following table shows the value of the precious stones produced in the United States from 1883 to 1893, inclusive:

Estimated production of precious stones in the United States from 1883 to 1893.

Species.	1883.	1884.	1885.	1886.	1887.	1888.
	Value.	Value.	Value.	Value.	Value.	Value.
Diamond	.....	$800	.....	$60	.....	.....
Sapphire	$2,200	1,750	$500	750	$500	$500
Chrysoberyl	100	25	.....	.....	.....	.....
Topaz	1,000	500	1,250	1,000	2,000	600
Beryl (aquamarine, etc.)	500	700	750	5,500	3,500	800
Phenacite	.....	.....	.....	.....	.....	650
Emerald	500	.....	3,200	3,200	.....	100
Hiddenite (Lithia emerald)	600	.....	2,500	4,500	.....	.....
Tourmaline	.....	2,000	600	5,500	500	.....
Smoky quartz	10,000	12,000	7,000	7,000	4,500	4,000
Quartz	11,500	11,500	11,500	11,500	11,500	11,150
Silicified wood	5,000	10,500	6,500	1,500	36,000	16,000
Garnet	6,000	4,000	2,700	3,250	3,500	3,500
Anthracite	2,500	2,500	2,500	2,500	2,000	1,500
Pyrite	2,000	3,000	2,000	2,000	2,500	2,500
Amazonstone	3,750	2,750	2,750	2,250	1,700	1,700
Catlinite (pipestone)	10,000	10,000	10,000	10,000	5,000	5,000
Arrow points	1,000	1,000	2,500	2,500	1,500	1,500
Trilobites	500	500	1,000	1,000	500	500
Hornblende in quartz	600	600	300	200	100	.....
Thomsonite	750	750	750	400	750	500
Diopside	300	.....	100	.....	50	.....
Agate	1,500	4,500	2,000	2,000	4,000	4,000
Chlorastrolite	1,500	1,500	.....	1,009	800	800
Turquoise	2,000	2,000	3,500	3,000	2,500	3,000
Moss agate	21,000	3,000	2,500	2,000	950	950
Amethyst	2,250	2,250	2,100	2,100	2,100	2,500
Jasper	2,500	2,500	.....	.....	.....	100
Sunstone	450	450	350	300	150	.....
Fossil coral	750	750	.....	1,000	2,000	3,000
Rutile	.....	.....	750	750	.....	.....
Gold quartz	115,000	140,000	140,000	40,000	75,000	75,000
Rutilated quartz	.....	.....	250	1,750	.....	.....
Peridot	300	150	.....	.....	.....	.....
Total	206,050	221,975	209,850	118,519	163,600	139,850

Estimated production of precious stones in the United States from 1883 to 1893—Cont'd.

Species.	1889.	1890.	1891.	1892.	1893.
	Value.	Value.	Value.	Value.	Value.
Diamond					$125
Sapphire	$6,725	$6,725	$10,000	$20,000	10,000
Ruby					150
Topaz	400		100	1,000	100
Beryl (aquamarine, etc.)	747		1,000	1,000	500
Phenacite	200				
Emerald	450		1,000		
Tourmaline	2,250	2,250	3,000	3,000	5,000
Opal			5,000	10,000	5,000
Peridot			1,000	1,000	500
Smoky quartz	4,232	2,225	5,000	5,000	5,000
Quartz, rock crystal	14,000	14,000	10,000	10,000	10,000
Silicified wood				1,000	1,250
Garnet (pyrope, almandite and essonite)	2,308	2,308	3,000	5,250	2,000
Anthracite				3,000	3,000
Pyrite	2,000	2,000	1,500	1,500	1,500
Amazon stone	500	500		1,000	1,000
Catlinite (pipestone)	5,000	5,000	5,000	5,000	5,000
Arrow points				1,000	
Thomsonite	400	400	200	500	500
Diopside				500	105
Agate				2,000	1,000
Chlorastrolite	500	400	500	500	500
Turquoise	23,675	28,675	150,000	175,000	143,136
Moss agate				1,500	2,000
Amethyst	98			200	75
Fossil coral	700	700	1,000	1,000	1,000
Rose quartz	600	200		200	100
Gold quartz	9,000	9,000	6,000	15,000	10,000
Rutilated quartz	30				
Dumortierite in quartz	250	250			
Quartz coating chrysocolla	4,000	2,000		500	
Chrysoprase	200	200		100	
Agatized and jasperized wood	53,175	6,000	2,000	10,000	20,000
Banded and moss jasper	630				
Obsidian				100	
Fluorite	500	500			
Azurite and malachite	2,037			1,000	
Prehnite				200	
Zircon (*a*)	16,000				
Gadolinite, fergusonite, etc. (*a*)	1,500				
Monazite (*a*)	1,000				
Spodumene (*a*)	200				
Wooden ornaments decorated with minerals (*b*)	15,500	15,500	15,000	15,000	15,000
Staurolite crystals					500
Miscellaneous minerals (*c*)	20,000	20,000	15,000	20,000	20,000
Total	188,807	118,833	235,300	312,050	264,041

a Used to extract the rarer elements for chemical purposes.
b Such as clocks, horseshoes, boxes, etc.
c Collection and souvenir minerals.

DIAMONDS.

During the year 1893 several interesting discoveries of diamonds were made in the United States, although this is not a regular diamond-producing country. In December my attention was called by Prof. William H. Hobbs, professor of mineralogy and metallurgy in the University of Wisconsin, at Madison, to a diamond that had been found in Oregon township, 2½ miles southwest of Oregon Village, in Dane county, Wisconsin. Through his courtesy the stone was sent to the writer by the finder, Mr. Charles Devine, of the place just named. The diamond was found by him while husking corn, in October, 1893, in a rough, stony field which had been under the plow for forty years. The bank of clayey earth in which it was found contained a

large number of rounded pebbles of quartz, but no other of the associated minerals of the diamond; and as the entire district consists of glacial drift coming from the north, a diamond bed is not likely to exist in the immediate vicinity, but is rather to be looked for in the direction from which the drift came.

The diamond is a rhombic dodecahedron, deeply pitted with circular, elongated, reniform markings. In color it is slightly grayish-green. But it is one of those diamonds in which the color is likely to be superficial, and it would probably cut into a white gem. Its weight is $3\frac{14}{16}$ carats. This is the second authentic occurrence of diamond in Wisconsin, the other occurrence being at Plum Creek, Pearce county, of three small stones, the largest of which weighed $\frac{25}{32}$ carat, see the last report (p. 759). A 16-carat diamond was reported to have been found, also in glacial drift, at Waukesha, Wisconsin, in 1884. Some litigation resulted from its finding, and considerable doubt was expressed at the time as to the genuineness of the discovery.

A small elongated crystal 7 mm. long and 4 mm. in diameter, weighing three-fourths of a carat and of a bright, light canary color, with polished surfaces, was found in the vicinity of Kings Mountain, North Carolina, during the summer of 1893. Mr. H. S. Durden, of the California State Mining Bureau, reports that two small diamonds were obtained in 1892 and 1893; at Cherokee, Butte county, California. One weighed 2 carats.

The London Mining Journal of May 6, 1893, states that important discoveries of diamonds have been made in the Landak district of Borneo. Landak is about three days by steamer from Singapore, and the district has been declared by experts to be not only gem-bearing but auriferous. A large number of diamonds have been taken from the beds of streams. Under ordinary circumstance this would require dredging or diving, but at an interval of every five or six years the streams become so abnormally dry and shallow that the beds can be reached without difficulty.

Diamonds in meteorites.—The discovery of diamonds in the Canyon Diablo meteoric iron was first announced by Dr. A. E. Foote in the American Journal of Science for July, 1891 (Vol. XLII, pp. 413–417). Diamonds have previously been noted in the Novy Urej Russian meteoric stone by Latchinoff and Jerofeieff, and in the Arva, Hungary, meteoric iron by E. Weinschenck. On cutting the Canyon Diablo meteorite it showed extraordinary hardness, a day and a half being consumed and chisels destroyed in the process of removing a section. In the cutting, the chisels had fortunately gone through a group of small cavities, which on examination were found to contain hard particles that cut through polished corundum easily, while the emery wheel used to polish the surface was ruined. The grains exposed were small and black, and Prof. Geo. A. Koenig pronounced them diamonds because of their hardness and their indifference to chemical reagents. The

extreme hardness was subsequently verified by the writer, who carefully examined the type specimen.

Dr. Oliver W. Huntington has contributed much valuable information in regard to this meteoric iron. The results were first announced in *Science*, on April 8, 1892, and were read in detail before the American Academy of Arts and Sciences on May 11, 1892, and afterwards published in the Proceedings, new series, Vol. XXII, p. 252, and in *Science* of July 8, 1892.

He placed 100 grams of iron in a perforated platinum cone suspended in a platinum bowl filled with acid, the cone being made the positive pole and the dish the negative pole of a Bunsen cell. The iron slowly dissolved, leaving on the cone a large amount of black slime. This was carefully collected and digested over a steam bath for many hours first with aqua regia, and afterwards with strong hydrofluoric acid. Most of the residue disappeared, but there remained a small amount of white grains which resisted the acids, and, when carefully separated by hand, resembled fine beach sand. Under the microscope they were found to be transparent and of brilliant luster. One of the grains was then mounted upon a point of metallic lead and drawn across a watch crystal, when it gave the familiar singing noise characteristic of a glass-cutter's tool and with the same result, namely, cutting the glass completely through. It deeply cut glass, topaz, and a polished sapphire.

Subsequently M. C. Friedel says, in the Bulletin de la Sociètè Francaise de Mineralogie (No. 9, p. 258, December, 1892), that he took a fragment of the Canyon Diablo meteorite, weighing 34 grams, with the characteristic Widmannstattian figures, and treated it with hydrochloric acid. He digested the residue in aqua regia and obtained a black powder. After various treatments he thus separated about 0·35 gram of a powder, which he presented to the Academy. No grains were found measuring more than 0·5 mm., the powder being fine and impalpable, capable of scratching corundum, and sinking in a solution of iodide of methyl having a density of 3·3. He also burned some of the black residue, and as a product obtained CO_2.

At the meeting above referred to of the Academy of Arts and Sciences Dr. Huntington showed to the members, under a microscope, the slightly yellow transparent grains he had obtained, and called attention to their adamantine luster. Not enough of the clear material was obtained at the time for a chemical test, and, on account of the association of the diamond grains with amorphous carbon, such a test would not have been conclusive without a perfect mechanical separation. The writer suggested that if enough of the clear grains could be obtained to polish a diamond it would be a conclusive test.

For this purpose about 200 pounds of the meteoric iron was carefully examined, and specimens which appeared to contain diamonds were dissolved. The method used will be published by Dr. Huntington later.

After enough material had been separated by him, on September 11, 1893, Dr. Huntington and the writer were enabled, through the courtesy of Messrs. Tiffany & Company, to try the desired experiment in their diamond-cutting pavilion in the Mining Building of the World's Columbian Exposition. (*a*) They had prepared a new skaif or wheel, 10½ inches in diameter, which was placed in position after having been specially planed down and prepared with the radiating scratches so as to be easily charged with diamond powder. A diamond was then soldered in a metal dop and placed on the clean wheel, which made 2,500 revolutions per minute. This diamond was tried for more than five minutes by itself without the slightest polish resulting, and no markings other than such as would be produced by the minute shattering of the diamond at extreme edges, due to the friction, as when a diamond is placed on an uncharged wheel. A cleavage weighing five thirty-seconds of a carat was set with solder in the metal dop, ready to be placed on the wheel, the diameter of which where the stone was to be placed was 4 inches. The wheel was then charged with the residue from the meteorite (the powder mixed, as usual, with oil).

The moment that the diamond was placed on the wheel a hissing noise was apparent, showing to an expert that the material was really cutting the diamond. In three minutes a flat surface measuring 3 mm. by 1 mm. had been ground down and polished. A small crystal with a natural face up was then set in the metal dop, the crystal being a complex twin, weighing four thirty-seconds of a carat. It was first tried on a projecting angle. The cutting was very slow for about seven minutes as the natural face of a diamond is always exceedingly hard. The position of the stone was then slightly changed, and a face measuring 2 mm. by 1 mm. was ground on the stone and cut. Three minutes later the surface had been cut down somewhat and a decided polish was produced on the triangular face, which was 3 mm. by 1.25 mm. The fragment used was one of the octahedral faces of a crystal. The face ground down was at the angle of 45 degrees with the octahedral face. The entire time of this experiment was fifteen minutes. The two experiments having been made with great care with both of us present, we can not hesitate to pronounce the material diamond, or a substance with the same hardness, color, luster, and brilliancy. (*b*)

The diamond industry.—The great interest manifested in the diamond-cutting industry at the present time makes a statement of the condition of this, and the allied industries abroad, opportune.

At Amsterdam, which is the chief diamond-cutting center at present, there are 52 large factories and about 20 small ones, using steam as a motive power, where the rough diamonds are cut into brilliants and roses. The largest of these is the establishment of Messrs. Boas

a This was announced in the American Journal of Science, Vol. XLVI, December, 1893, pp. 469-472.

b Paper read by G. F. Kunz before Chicago Academy of Science, September 15, 1893.

Brothers, which counts 600 mills, turning as many cylinders or "skaifs." Every one of these is occupied by one polisher; and these, with the number of "setters" (verstellers) and apprentices, bring the total up to at least a thousand persons for this single factory. If we estimate that the 52 large establishments have an average of but 60 mills each, or a total of 3,120 mills, and that the 20 small ones average 20 mills each, making 400 mills, we have in all 3,520 wheels or skaifs. Then counting for each mill or wheel, including polishers, setters, apprentices, scaive-scrapers, and machinists, at least two persons, we have 7,040 employés. To these must be added the diamond cleavers and cutters, about 460 persons, of whom one-quarter are women, giving a total of 7,500 persons for Amsterdam. Now, the large diamond-trading club, composed of diamond merchants and brokers, numbers about 900, and the two smaller ones about 400, with perhaps 100 additional dealers who transact their diamond business in the cafés in the vicinity of the clubs. Adding to these the merchants and brokers who do not frequent any of these places, and the employés of the one steam diamond-cutting shop at Rotterdam, we have about 10,000 persons in all engaged in the diamond industry in Holland.

Antwerp has been rapidly becoming one of the greatest diamond-cutting centers. Whereas in 1870 there were 4 mills and 200 diamond workers, in 1893 there were 78 mills and 4,000 workers, and diamonds are annually cut to the value of 12,000,000 francs. London comes third in importance, where the diamond polishers, brokers, importers, and dealers in rough diamonds must number about 1,000 persons. St. Claude and adjoining cities in the Jura mountains, in France, have several diamond-cutting establishments that employ in various capacities about 1,000 people. Paris comes next with several diamond works, as also a great number of diamond merchants and brokers; these will reach above 500 individuals. Geneva and Berlin each possess a diamond-cutting shop, at each of which perhaps 100 people are employed; and, finally, Hanau, the jewelry center in Hesse, Germany, where much goldsmiths' work is done, and where a few years ago were established two large diamond mills and four or five small ones, all operated by steam power, which on an average employ 500 persons.

In Idar and Oberstein about 1,000 more are similarly engaged, giving a total of above 16,500 persons occupied in the diamond business in Europe; but this does not include the merchants, dealers, and work people who set diamonds in jewelry, or any of the white and colored population engaged in diamond mining at the Cape and in Brazil. If we estimate, therefore, the number of dealers in Europe at about 4,000, and about 200 in the United States and elsewhere, and the workers at the mines, which at present are not carried on with great activity, at between 7,000 and 8,000 persons, we reach a total approximating 28,000 people at the principal diamond centers of the world. When we read, therefore, that in past centuries 60,000 persons were working at

some of the Indian diamond mines at one time, this statement is perhaps not exaggerated, since with the aid of modern machinery more is accomplished by 1,000 persons than formerly by twenty times that number.

Roughly speaking, there probably are in the entire world some 6,500 cutters and about 8,000 dealers in diamonds, who carry in their stock $350,000,000 worth of stones, which is probably one-third of the world's entire possession at the present time; as the total value of all the diamonds known is over $1,000,000,000.

To compare present conditions with those of the past, it is instructive to note the enormous increase in the production of diamonds, and the important industrial changes wrought thereby, which have resulted from the discovery and working of the great South African mines. During the past quarter century, 10 tons of diamonds, selling for more than $300,000,000 uncut and $600,000,000 after cutting, have been added to the world's wealth—an amount more than twice as great as was known to exist before. This vast value is in the most concentrated, portable, and ornamental form, and more convertible than anything except gold and silver. Its accumulation has built up cities like Kimberley, and maintained important industries in Amsterdam and other centers. The De Beers Company, Limited, a single corporation, with stock having a market value quoted at over $90,000,000, controls more than nine-tenths of the entire output, and regulates and maintains the price. As a result, diamond-cutting industries have been established such as were not thought of before, employing thousands of people in immense mills, where the cutters hire only the benches at which they do their work.

Mr. Gardiner F. Williams, superintendent of the De Beers Diamond Mining Company shows that diamonds were mined and sold worth £3,239,389 during the past year. The expenditures amounted to £1,695,293 and the profits to £1,544,096. Through improved mining facilities they have been able to mine the blue stuff for 3 shillings 6 pence per load, formerly 5 shillings and 6 pence, and that they have increased the amount on the floors by 981,557 loads, equaling £2,500,000 on the floors.

In this country diamond cutting has been carried on with some success, and the following statistics and historical notes may properly be appended here. The official census of 1890 reports as follows regarding the diamond-cutting industry in the United States: In New York in 1889 there were sixteen firms engaged in cutting and recutting diamonds, and in Massachusetts three. Cutting has also been carried on at times in Pennsylvania and Illinois, but this has been discontinued.

In 1889 seven of the New York firms ran on full time, but the others were unemployed, respectively, for 14, 50, 61, 120, 125, and 240 days, owing to inability to obtain rough material at a price at which it could be advantageously cut. The firms fully employed were generally the larger ones, whose business consisted chiefly in repairing chipped or imperfectly cut stones or in recutting stones previously cut abroad,

which, owing to the superior workmanship in command here, could be recut at a profit, or else in recutting very valuable diamonds when it was desired, with the certainty that the work could be done under their own supervision, thus guarding against any possible loss or exchange for inferior stones.

It will be seen from the following table that the industry employed 236 persons (69 under age), who received $148,114 in wages. Of the 19 establishments, 16 used steam power, which was usually rented. Foot power was used in but one establishment. Three of the firms were engaged in shaping black diamonds for mechanical purposes, for glass cutters and engravers, or for use in the manufacture of watch jewels. The average weight of the material before and after cutting is also given in the table. The marked difference in the prices of diamonds, as shown, is due to variations in their weight and quality.

Beginning in the latter part of 1888, and lasting through 1889, there was a marked increase in the price of rough diamonds, resulting in rapid advances of from 20 to 25 per cent. at a time, amounting in all to an increase of from 80 to 100 per cent. above the prices of the previous years.

Census of the diamond-cutting industry, 1889.

	Massachusetts.	New York.	Total.
Number of works	3	16	19
Weight of material before cutting...carats..	4,100	50,244	54,344
Weight after cutting into gems, watch jewels, and for mechanical uses .....carats..	1,580	23,425	25,005
Value after cutting into gems	$41,000	$965,716	$1,006,716
Number of men employed	11	156	167
Average wages per day	$4.10	$3.49	$3.53
Average number of days employed	300	229	234
Number of boys employed	4	65	69
Average wages per day	$1.17	$0.62	$0.65
Average number of days employed	300	211	216
Total wages	$14,932	$133,180	$148,114
Value of machinery used in cutting	$3,000	$74,050	$77,050

IMPORTS.

The diamonds used in this industry are all imported, for, as already mentioned, they are but rarely found in the United States. The following table gives the imports of rough diamonds for a series of twenty-one years:

Imports of rough or uncut diamonds since 1873.

Years ending June 30—	Value.	Years ending June 30—	Value.
1873	$176,426	1885	$371,679
1874	144,629	1886	302,822
1875	211,920	1887	262,357
1876	186,404	1888	322,356
1877	78,033	1889	250,187
1878	63,270	1890	513,611
1879	104,158	1891	804,626
1880	129,207	1892	1,032,869
1881	233,596	1893	802,075
1882	449,513		
1883	443,996	Total for 21 years	6,251,550
1884	367,816		

IMPORTS.

Diamonds and other precious stones imported and entered for consumption in the United States, 1867 to 1893, inclusive.

Years ending—	Diamonds.			Diamonds and other stones not set.	Set in gold or other metal.	Total.
	Glaziers'.	Dust.	Rough or uncut.			
June 30, 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	.....	40,424	$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	3,265	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
Dec. 31, 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
1888	10,025	29,127	244,876	10,223,630	.....	10,557,658
1889	8,156	68,746	196,294	11,704,808	.....	11,978,004
1890	147,227	179,154	349,915	*b* 12,429,395	.....	13,105,691
1891	565,623	125,688	408,198	11,657,079	.....	12,757,079
1892	532,246	144,487	516,153	13,328,965	.....	14,521,851
1893	357,939	74,255	444,137	9,321,174	.....	10,197,505

a Not specified since 1883.
b Includes stones set and not specially provided for since 1890.

The importation of rough or uncut diamonds in 1880 amounted to $129,207; in 1889 to $250,187, and the total for the decade was $3,133,529; while in 1883 there was imported $443,996 worth, showing that there was 94 per cent. more cutting done in 1889 than in 1880, but markedly more in the years 1882 and 1883. The large increase in importation is due to the fact that in the years 1882 to 1885 a number of American jewelers opened diamond-cutting establishments, but the cutting has not been profitably carried on in this country on a scale large enough to justify branch houses in London, the great market for rough diamonds, where advantage can be taken of every fluctuation in the market and large parcels purchased which can be cut immediately and converted into cash, for nothing is bought and sold on a closer margin than rough diamonds.

The average wages paid in the United States are $2 per carat less bench expenses. In Boston $3 per carat and higher is paid. In one New York shop, where mathematical accuracy is demanded, $4 per carat is paid. During 1893 diamond cutting was carried on in the United States by 15 firms, employing each from 1 to 20 men, the total number amounting from 130 to 150, consisting of diamond cleavers, cutters, polishers, etc.

The American public demands a much higher quality of cutting than the dealers of the European markets. The result is that more time is consumed, and hence a higher rate of remuneration is demanded. But at present less is often paid for cutting here than in Amsterdam.

Good European workmen receive an equivalent of about $2 per carat in the shops there, while their bench expenses are less than they are in this country. When one considers also the fact that better work is required here for the same wages, it will be seen that there is small inducement for Amsterdam cutters to emigrate.

This subject of diamond-cutting in the United States is worthy of consideration when we remember that there have been imported into the United States since 1868 more than $175,000,000 worth of diamonds, and about $15,000,000 worth in the year between June, 1892, and June, 1893. Of these, the original rough stones could not have cost more than one-half. The difficulty with the diamond-cutting industry in this country is due, as above noted, to the inability of the dealers to obtain the rough stones at first hand, and the fact that diamond-cutting is an old-established industry, and in many ways waste is prevented by a more economic system of working.

The pioneer diamond-cutter in the United States was Mr. Henry D. Morse, of Boston, Massachusetts, who in early life learned the engraver's art and later became a jeweler. In 1869, Mr. Morse had delivered to him the Dewey diamond, weighing $25\frac{11}{32}$ carats, which was found near Richmond, Virginia, and by adroit manipulation and due regard to lights and geometric relations, produced from the rough stone a gem weighing $11\frac{13}{32}$ carats, which permanently established his reputation as a cutter and polisher.

Shortly after the great yields of the South African diamond fields began to attract the attention of the trade in 1871, Mr. B. S. Pray, of Boston, at that time engaged in the African diamond trade, brought to this country a parcel of rough diamonds with the intention of seeing what Mr. Morse could do in the way of cutting. The two men associated themselves in business, and in a short time the industry of diamond cutting was an established fact in this country. The Morse Diamond Cutting Company was the style of the firm, and American dealers watched the result of the undertaking with much interest. Dutch workmen were employed at first, working under Mr. Morse's supervision. Conformably with their long-established custom, the workers maintained secrecy with respect to their art; but Mr. Morse, already familiar with the work, took pains to acquaint himself with all details, which he communicated to apprentices in a shop established in the suburbs of Boston. When the former finally struck, Mr. Morse was ready for them, and his American hands, men and women, took the places of the Amsterdam cutters at once.

The firm of Crosby, Morse & Foss, which succeeded the Morse Diamond Cutting Company, was dissolved in 1875, Mr. Morse going into business on his own account as a cutter and dealer in diamonds. In 1887 he again associated himself with one of his old partners, under the style of Henry D. Morse & Charles D. Foss. Mr. Morse died on January 2, 1888, after having lived to see the art introduced by him extended to about a dozen cutting shops in this country at the time of his death.

In 1870 Mr. Herrmann started the New York Diamond Cutting Company, in New York city. In his attempt to establish this industry in the United States he has sunk three fortunes, but he still has faith in this ultimately becoming a diamond-cutting center.

Both Mr. Morse and Mr. Herrmann taught the art of diamond cutting to girls, which led to the taking up of this industry by women, not only on this side of the Atlantic but to a large extent in France, Switzerland, and other European countries. It was really these pioneer diamond cutters that increased the taste and proficiency of the workers abroad; for cutting diamonds as they did, with mathematical precision, they created a demand for such work here, which the foreign cutters had to acquire the skill to meet; and the result was a style of diamond cutting never before equalled.

Changes in cutting machinery.—In Mr. Morse's shop, in 1872, Mr. C. M. Field invented the first diamond-cutting machine, which has made it possible to do the work faster and with more precision than by the old hand process. It has been adopted in some of the larger establishments in the United States, although abroad its true value has not yet been fully recognized.

Sir Henry Bessemer has devised for the London cutters an endless rope that furnishes the power for as many as ten diamond mills at the

same time, thus doing away with the long belt for each machine. Now, an individual dynamo for each mill is suggested, thus dispensing with the belts entirely, saving power and making it possible to cut diamonds with more cleanliness than with a moving belt. This is also of interest when one realizes that small dynamos could be attached directly to precious-stone polishing wheels, to the gem-cutting lathe, or, better still, to the revolving drill, such as is used for the dentist's work and gem engraving, thus producing, as in the days of ancient Greece and Rome, more artistic finish than would be possible by the horizontal lathe method. This method of gem engraving was fully described by the writer in a paper read before the New York Academy of Sciences, May 25, 1884.

SAPPHIRE.

About $20,000 worth of sapphire was sent abroad in 1892, but during 1893 more Montana sapphires were actually sold than in any previous year, probably on account of the company's endeavor to introduce them into the London market, and also because of the large influx of people into this country and particularly to the World's Columbian Exposition, where a lapidary cut and sold these stones in one of the main aisles of the Mining Building.

At a meeting of the Montana Sapphire and Ruby Company, held in London, December 18, 1893, a deficit of £6,000 was shown, £158 only having been realized from the sale of the gems during the past year. It was also shown that in this company, which was supposed to have been incorporated with a capital of £450,000, apparently not more than one-tenth of that amount had been subscribed; as the underwriters, among whom were the Marquis of Lorne, the Duke of Portland, and the Duke of Leinster, representing £370,000, had withdrawn, so that in reality only £45,000 had been actually paid in.

Among other sapphire deposits in Montana is one of 1,500 acres on the west fork of Rock creek, 25 miles west of Phillipsburg, in Granite county, on the east slope of the Bitter Root range. The specimens obtained here are red, pink, yellow, blue, and amethyst of various shades. The matrix is an argillaceous slate. Another deposit of about 2,500 acres is situated on Dry Cottonwood creek, about 5 miles east of the mining camp of Champion and on the western slope of the main ridge. Within the few days that this was worked, about 25 pounds of sapphires were found. On Rock creek the yield is about 60 stones to the pan of gravel, and about 30 stones to the pan at Bed Rock, on Cottonwood creek. Mr. F. B. Walker mentions a locality for sapphires as occurring about 125 miles northwest of Helena, Montana. The earliest mention of the finding of sapphires in Montana goes back to May 5, 1865, when they were found by Mr. Ed. R. Collins, an earnest and reliable prospector, on claim No. 4, before the discovery of Eldorado Bar. A stone was cut by Messrs. Tiffany & Co., and another by Messrs. M. Fox & Co., New York City. Mr. Collins also sent stones to

an Amsterdam diamond cutter and other parties abroad, endeavoring to find a market for them.

RUBY.

On the Reeves farm, near Franklin, Macon County, North Carolina, in an alluvial deposit, some very interesting crystals of ruby have been found in flat, hexagonal, tabular forms, occasionally 10 to 12 millimeters in diameter and from 2 to 5 millimeters in thickness. Some of these crystals were of fairly good ruby color. One gem weighed when cut three-fourths of a carat; a number of others weighed from one-sixteenth to one-half of a carat, all of good color and quite equal to the medium rubies from Burmah, one gem selling for $50. Some investigation has been made, but as yet they not been found in sufficient quantities to warrant working the ground. Associated with these rubies are some irregular fragments of almandite garnet, very light in color, which, when cut, produced stones of unusually brilliant, rare, and beautiful tints, many of which have found ready sale at from $2 to $10 each. In many respects this was one of the most beautiful varieties of almandite garnet ever found.

It is to be hoped that the Burmah Ruby Mining Company will be more prosperous under its new lease, for which it will now pay the sum of 300,000 rupees instead of 400,000, as formerly, the Government, however, receiving a royalty of 30 per cent. on all rubies found, and the company relinquishing its right to mine for rubies in the whole of Upper Burmah, but securing the exclusive right to mine for rubies in the Mogok district, where the mine is situated and to which rubies have hitherto been confined. Up to 1893 the company has not been fortunate enough to declare a dividend.

TURQUOISE.

In 1893 turquoise has been more actively and more successfully mined than any other gem. The Azure Mining Company reports that material enough was mined to cut about 20,000 carats of turquoise during the year. Half of these were very good material, many of them small stones cut in Europe; and as the average selling price was $5 per carat, the production for the year amounted to $50,000. This company has adopted the system of offering to replace any stones that may change color; and every stone is marked with a small circle engraved on the back, showing it to be from this company's mines. Of the thousands sold, they claim that none have as yet been returned. Many of the stones found are of a paler blue than those formerly mined, and have met with ready sale.

The American Turquoise Company obtained and sold from its various mines $90,136.39 worth of fine blue turquoise during 1893.

The "Persian," situated near the old Castilian, 18 miles from Los Cerrillos, New Mexico, is another turquoise claim recently taken up by

ex-Governor Bradford L. Prince, of New Mexico. It is contemplated to work the claim under the name of the New Mexico Turquoise Company, but since October 6, no developments have been made.

Mr. M. W. Porterfield, of Silver City, New Mexico, has found traces of turquoise on the surface half a mile from the Azure mine, in the Burro mountains, 15 miles south of Silver City, and has made excavations to the depth of about 18 feet. The turquoise has the characteristic green color of that in the Burro mountains. Whether any fine material will be found by further digging is a question.

Two other groups of turquoise mines are described by Mr. William E. Hidden as occurring in New Mexico. (*See* American Journal of Science, November, 1893, vol. 46, pp. 400–402, and the Jewelers' Circular, November 1 and November 8, 1893.) The first group is 15 miles southeast of the Azure Company's mines, in what is known as the Cow Spring district. Some prospecting had been done for turquoise, and 60 miles in a southerly direction the locality showed evidences of prehistoric workings; the matrix containing the trachyte is very similar to that in the Burro mountains. The nearest railroad station, 22 miles north of this locality, was abandoned because of the scarcity of the blue—the only valuable—shades of turquoise, the scarcity of water, and the arid condition of the surroundings.

The most important locality observed by Mr. Hidden is in Doña Ana county, in the Jarilla mountains, 150 miles east of the Burro range The mines are situated here in an arid and desolate region, Las Cruces being 50 miles west, and El Paso 50 miles south. The turquoise is described as occurring in trachyte containing minute crystals of quartz implanted in fine crystals of pyrite, granular jarosite and gypsum coating some of the same. A shaft 70 feet deep has been sunk on the contact with the porphyry, and turquoise was traced all the way down. This is the light green material called "*Shoo-ar-me.*" The writer believes that the phosphoric acid of the turquoise may have been derived from the limestone beds, adjacent to the trachyte, that may have covered this trachyte at no very distant date, and suggests that the oxidation of the pyrite evidently resulted in the decomposition of the kaolin, limonite, gypsum, and jarosite, and that this is a product of a subsequent kaolin, the kaolin being earlier, and the turquoise a secondary formation, basing his opinion upon the fact that the majority of turquoise deposits are semiglobular or reniform in outline, although compact masses are found wholly occupying small cavities.

The tendency of the turquoise is said to be toward the blue, more so than at the two other localities, although green varieties were observed which were attributed to alteration. The turquoise found at a depth of 25 feet or taken from rock was of a rich blue, but it rapidly faded after being detached from the matrix and becoming dry. At all three of the localities described by Mr. Hidden the discoveries were due to the investigation of old turquoise workings which had been considered

merely copper stains. Ancient pottery which was unearthed made it probable that the place had been abandoned for several hundred years.

Messrs. Bell & Barber have opened what they term the Blue Gem mine and Manitou mine, at Village Grove Post-Office, Colorado, 25 miles south of Salida. All the turquoise found there up to the present time has been of a fair blue color, but mostly fissured and veined with small dark streaks. Few have been sold up to 1894.

George M. Bowers, of Los Angeles, California, reports the discovery of turquoise on the side of Turquoise mountain, near Clingman, Arizona, 40 miles from the Colorado river.

Turquoise is reported as occurring twelve miles from Hedi, King River District, Victoria, Australia, where it is found in veins in a gray slaty rock. The color is pale blue shading to dark green. Up to the present no fine gems have reached the gem marts, but it is believed by the miners that they will be obtained by deeper mining.

TOURMALINE.

At the historic Mount Mica locality at Paris, Oxford county, Maine, some work was carried on during the summer of 1893, resulting in the discovery of a number of large green crystals, one of which furnished one of the finest tourmaline gems ever found on this continent, being of a clear grass-green color and weighing 63½ carats. The total find of minerals and gems at Mount Mica for the year 1893 amounted to the value of $3,000. Among the crystals of tourmaline were some fine ones tipped with red, while the shafts were green with a transverse band of indigo blue at the middle portion.

Mr. Charles Russell Orcutt announced a new and remarkable occurrence of pink tourmaline in lepidolite, similar to that of Rumford, Maine, 12 miles south of Temecula, near San Luis Rey river, in San Diego county, the southern county of California, and it has already become celebrated from the abundance and beauty of the specimens yielded, as much as 20 tons having been sent East for sale. Through San Diego county runs the Peninsula range, rising several thousand feet between the coast and the Colorado desert. In these granite mountains are dioritic intrusions and some metamorphic schists, etc. West of the summit lies a parallel belt of granitic rock characterized by dikes of pegmatite, in one of the largest of which occurs this great deposit of lepidolite with tourmaline. In Pala, a little west of Smith's mountain, in the Peninsula range, San Diego county, California, a ledge of lepidolite containing rubellite has been traced for over half a mile. It consists of a coarse granite, penetrating a norite rock, and including masses of pegmatite. Small garnets occur in the granite, and black tourmaline, with a little green tourmaline.

The lepidolite appears in the southern portion, finally forming a definite vein which at one point is 20 yards wide. The rubellite is chiefly in clusters and radiations, several inches in diameter, also occasionally as

single crystals, and the specimens of deep pink tourmaline in the pale lilac mica are remarkably elegant. About 18 tons were mined during 1892. No work has been done since then.

Tourmalines are mined at the California gem mine, the San Jacinto gem mine, and the Columbian gem mine, near Riverside, California. These three mining claims cover the ground on which the tourmaline is found, and are situated in the San Jacinto range of mountains in Riverside township, California, at an altitude of 6,500 feet, overlooking Hemet valley and the Cohuilla valley, and are 27 miles from the railroad. The formation in which the crystals are found is a vein from 40 to 50 feet wide running almost north and south through the old crystalline rocks which make up the mountain range.

The vein in some places consists of pure feldspar, or else feldspar with quartz, in others all mica, and in others rose quartz and smoky quartz. The tourmalines vary in size from almost micrograins to crystals 4 inches in diameter. They are most plentiful in feldspar, but are found in other portions of the vein, sometimes in pockets and sometimes isolated. The larger crystals generally have a green exterior and are red or pink in the center. Some of the crystals contain green, red, pink, black, and intermediate colors: others again are all of uniform tint—red, pink, colorless, or blue.

Associated with the tourmalnies are rose quartz, smoky quartz, asteriated quartz, and fluorite, and some of the quartz was penetrated with fine, hair-like crystals of tourmaline, strikingly like a similar occurrence of rutile. One of the finest specimens found is now in the Harvard College collection at Cambridge, Massachusetts. Another is in the American Museum of Natural History, New York City.

A fuller description is contained in "The Bullion," El Paso, Texas, pp. 3–4, February 13, 1894.

BERYL, EMERALD, AQUAMARINE.

No work was done at the emerald and hiddenite mine in Alexander county, North Carolina, during 1893.

According to the last report of the British minister at Bogota, the celebrated emerald mines of Muzo are situated about 80 miles to the north and northwest of Bogota, on the banks of the river Minero. They are Government property, but are farmed out to a Columbian-French syndicate at a yearly rental of $11,250 (£2,250). The working expenses can be roughly estimated at $50,000 (£10,000) per annum, and the mines yield a fair profit, the production of emeralds being of the value of about $100,000 (£20,000) annually. The rough stones are mostly sent to Paris to be cut, as native work is inferior to foreign. These mines are situated in a very rough, wild country, with nearly impassable roads; at the present time there are about 300 natives employed there. The mode of working is by open cuts, the debris being washed down the river by water collected in a reservoir built above the level of the mine.

The Emerald Mining Company of Colombia was reorganized during the year 1891 in London, and it was believed by the company that emeralds quite as fine as those from the famous Muzo mine would be found. The property was purchased for $1,100,000, all of which, except $10,000, was paid for by the shares of the company, in the expectation that emeralds would be obtained much sooner than they have been.

Mr. A. M. Field, of Asheville, North Carolina, reports that he has sold 89 beryls from Mitchell and Yancey counties, value $311.40. The prices vary from $1 to $20 per carat.

GARNET.

Mr. Field also found 118 garnets, worth $117, in Burke and Macon counties, North Carolina. The value per carat was from $1 to $10.

The essonite locality in Phippsburg, Maine, was worked by Mr. T. P. Lamb in 1893, and specimens valued at $250 were obtained.

MOSS AGATE.

At Hartville, Wyoming, large masses of moss agate, weighing from 40 to 50 pounds each, and covered on the outside with a white calcareous incrustation, have been found in a limestone rock on a 100-acre claim. When they are cut into translucent slabs, they show the magnificent black dendritic or moss-like markings in a most striking manner. Some table tops of this elegant material were exhibited in the Wyoming section of the Mining building at the World's Columbian Exposition. About 4,000 pounds have been found.

HYDROLITE.

Some remarkable specimens of hydrolite from the Cowlitz district, Washington State, were shown the writer by Mr. J. P. H. Morris, consisting of agate replacing fossil marine shells. Some of these silicified shells were nearly 2 inches across and of a beautiful white color, and were replaced by quartz and chalcedony, and filled with water and moving bubbles of air. They were valued from $1 to $15 each.

DUMORTIERITE.

Mr. John Stewart, of Los Angeles, California, informs me that he has found dumortierite in quartz on the land of Mr. Carey, 50 miles north of Yuma, and 11 miles west of the Colorado river on the Colorado desert, and about 25 miles from the Southern Pacific Railroad track. Here it occurs in blocks weighing several hundred pounds and upwards, and varies from dark blue to light blue and a mixture of blue and white, the occurrence being similar to that at Clipp, Yuma county, Arizona.

Mr. Stewart believes that this material can be delivered for $200 per ton on cars, and as the dumortierite thoroughly impregnates the quartz

rock, this ought to find a market as a high-class ornamental stone. It is mistaken here for lapis lazuli. The locality where this dumortierite occurs can be worked only in the winter or in the rainy season, as the water has to be hauled from the Colorado river, and the climate is too hot from June until December for horses or white men in that locality.

OPAL.

Opals were discovered in Idaho during the summer of 1892 by Mr. George Shirley, Mr. F. B. Schermerhorn, and Mr. H. C. Anchor, who kindly furnished me with the following information.

The Owyhee opal mines of Idaho are situated on section 13, township 1 north, range 4 west, Boise meridian, about 3 miles from Snake river in Owyhee county. The work done on the mine amounted to about eight months' work for two men. The opal taken out amounted to about 7,000 carats in the rough, varying from transparent fire opal to the finest white noble opal; but nearly all that they found was given away or poorly marketed. They are found in a dike or vein of dark blue or black andesite rock, 25 feet in thickness, running in a northwest and southeast direction with a nearly perpendicular pitch. This crops out on the surface for a distance of about 750 feet in length by 25 feet wide. In the center of this dike is a stratum of jasper, very hard, 4 to 5 feet wide, on each side of which the opals are found in seams and flat pockets. Opals have been traced for a distance of 250 feet along the surface. The greatest depth reached is about 20 feet, all open cuts.

North of and parallel with this dike is a smaller dike traced for about 50 feet in length, by 8 feet in width. It has produced about 1,000 carats of good stones.

The North America Gem and Opal Mining Company, which works the mines at Moscow, Idaho, did no work during the year 1893, owing to a litigation with a former owner; but it is believed that in 1894 active operations will be carried on.

Opals were announced as having been discovered on a school section in Lincoln county, Washington, and a committee was appointed to investigate and report upon the discovery. It proved not to be a genuine find.

During the past two years opals have been found at Wilcannia, New South Wales, which in quality are quite equal to those from the famous Hungarian mines. It is reported that about 500 men are already on the fields and an immense amount of work and prospecting is going on. The opals found here are generally free from the yellow tint which the Queensland stones show by transmitted light. They are found in a fossiliferous sandstone rock. Many of the fossil univalve and bivalve shells are entirely changed to a beautiful noble opal, as is also the case with wood and branches of trees found in the same district. Some fine stones weighing nearly 50 carats each have been obtained at this place.

STAUROLITE.

During 1893 a large quantity of small crystals of twinned cruciform crystals of staurolite have been found in Patrick county near the Henry county line, Virginia, and they have been drilled at one end, a small eye inserted, and sold as lucky charms. About $500 worth were sold during the past year.

JADEITE.

There are at present two groups of jadeite quarries in Upper Burmah, which the French vice-consul says are situated respectively at the summit of the mountain near the village of Jawmaw and in the valley of the river Uru, the latter commencing near Sanka and extending for some miles below the mountain. The geographical position of Jawmaw is in latitude 25 degrees and 44 minutes north latitude, and 96 degrees and 14 minutes east longitude, while Sanka is about 6 miles from the east coast. According to all accounts, the river mines are the oldest, those on the mountaintop having only been discovered some fifteen years ago. In the valley of the Uru the jade is found in blocks in the alluvial sediment of the river. Where it is imbedded or is found in heavy masses, a primitive method for obtaining the material is adopted, namely, heating by fire on the surface, the reduction of the temperature during the night sufficing to crack the rock, and then by pure force the blocks are broken into transportable pieces. The mines are claimed by a native, who collects a royalty on all the jade produced at a variable revenue. The jadeite, Feitsui or imperial jade, harder than jade (nephrite) but not so tough, is a striking example of the favor that certain persons bestow upon a particular article, whereas others look upon the same article with indifference, and would not give centimes for that which the others have paid gold. The Burmese, but principally the Chinese, appreciate a fine piece of jadeite as much as—if not more than—gold. For example, a piece of jadeite, only sufficient for a bracelet, will fetch 400 to 500 rupees, whereas in Europe it would not fetch a small part of that amount. While China and Burmah are the only markets for the sale of jadeite, it should not be forgotten that the population of these two countries is at least 450,000,000, ready to buy all available jade. However this may be, and whatever the price of jadeite as an article of commerce, the fact is certain that it exists in inexhaustible quantities. If methodical processes of extraction were put in operation, if dynamite replaced the savage methods now employed, if one head in place of a hundred directed the work, the production of jadeite could be made enormous. But will a European company methodically work the deposits, in place of the Kachin savages who exploit them now?" The vice-consul replies: "It is improbable, because the difficulties of the undertaking would be too great."

The revenue for 1892–'93 was 35,000 rupees and for the year 1893–'4, 52,000 rupees.

LAPIS LAZULI.

One of the many remarkable objects in the Montez collection, Anthropological Building, at the World's Fair, was an immense mass of lapis lazuli measuring 26 inches by 14 by 8, and weighing 360 pounds, found in a stone grave in the vicinity of Chankas, Peru. The lapis lazuli was of a fine blue color and this is one of the largest masses known. In the Montez collection there was also a number of small idols and figurines of light green and dark green turquoise, the blue color having been destroyed by burial, if it had ever existed. These were obtained in the same region of Chankas, in a stone grave. With them were some small animals made of sodalite mistaken for lapis lazuli, also found in the vicinity of Chankas, near Cuzco, Peru. The entire collection has been acquired by the Field Columbian Museum at Chicago.

LABRADORITE.

The original locality on the coast of Labrador has been prospected for the past two years, and Lloyd & Taber, of New York, have obtained an extensive Government grant of the only available deposits, from which they have already obtained four tons of good material.

GEM EXPLORATION IN CEYLON.

Mr. Barrington Brown in January, 1893, presented a report on gem-mining to the Ceylon Gem and Mining Syndicate, limited. In this report he says that the rock formations of the island are chiefly gneiss, permeated occasionally by graphite, garnet, and occasional beds of limestone, and suggests that the latter may be the source of the spinels which are occasionally found with the rubies and sapphires.

In the districts visited the gems are generally found in beds of gravel called *illan* by the natives. Usually a number of beds of this *illan* occur, one over the other, separated by strata of alluvial matter in the form of mold or clay. The problem which presents itself to those in the syndicate is to find inexpensive methods of working the lower beds of gravel; as the upper strata have undoubtedly been frequently worked in the search for gems during the many centuries in which gem mining has been carried on by the Singalese, as well as by the natives of India, who have visited the island for this purpose. There is only one instance mentioned of valuable gems being found in the main mass of gneissoid rock. They are always found in the gravel, and hence the rocks have never been searched. Mining is entirely carried on in the beds of streams and rivers, both ancient and modern, where the gems must have either fallen from the overhanging rocks, or come from the wearing down of rocks at some distance from the river by tributary streams.

Rubies, sapphires, cat's-eyes, alexandrites, etc., are the gems sought for, but with these zircon, chrysoberyl, tourmalines, spinels, garnets, and other gems are also obtained. It is proposed to work the streams by means of dredges and other improved mining machinery. The properties mentioned are in Ratnapura, Rakwanne, and Doloswella. In the district acquired by the syndicate are several localities in the province of Sabaragamuwa. The gems occurring here are true sapphires, rubies, and cat's-eyes. Many valuable ones have been found, and the localities have been worked from time immemorial.

ARTIFICIAL PRECIOUS STONES.

Frequent references have been made in the public press during the year 1893 to Mr. Thomas A. Edison's experiments in producing artificial rubies and sapphires. As so much stress is laid commercially on the success of such attempts, inquiry was made of him by the writer as to whether his results had been satisfactory or not. He responded as follows: "The experiments to which you refer were given up because it was found impossible to produce stones free from bubbles, which rendered them useless for cutting edges." This referred to their use as points for the phonograph, but the same objection would render them valueless as gems.

In reference to a statement that the Cowles Electric Smelting and Aluminum Company is suffering an infringement on its patent for making artificial diamonds by means of an electric furnace, Mr. Cowles, the inventor, informs me that the statement is incorrect in so far as it relates to the subject of artificial diamonds, they never having produced any diamonds. Therefore another reputed artificial diamond discovery has been withdrawn. The Cowles brothers claim that they were the first to put on record the direct reduction of silicon from silica in the presence of carbon and in the absence of a base metal to alloy with the product, and they claim that the product they secured is the same as the substance "carborundum" (*a*) lately introduced as a polishing material. In this substance the Carborundum Company has discovered that there is carbon in combination with the silicon, forming a carbide. They now hold a patent secured on the composition of the carbides.

The new composition known as carborundum is essentially a carbide of silicon, containing silicon 69·10 per cent. and carbon 30·20 per cent. Dr. Mulhauser gives the specific gravity of green crystals as 3·22; Mr. J. W. Richards, 3·0123. In form the crystals are hexagonal, either in flat plates or in short, stout rhombohedral plates, varying from one-half to 2½ millimeters in diameter. This material has been used as a high-class abrasive for wheels, dental tools, glass grinders, etc.

In August, 1893, the writer, while examining the hardness of carborundum, found that it readily scratched red, blue, white, pink, and yellow

a "Carborundum" by Acheson. *See* Journal of the Franklin Institute, June 1, 1893; and William P. Blake, Engineering and Mining Journal, September 9, 1893, pp. 270–330, September 23, 1893.

corundum in the form of fine gems. It having been suggested that this material would cut and polish a diamond, an experiment was made on a new wheel in the mining building at the World's Columbian Exposition. After several trials it was found that the carborundum used would not scratch or polish the diamond, but on the other hand it was easily scratched by diamond cleavages and crystal faces.

This experiment is only mentioned as it precludes any possibility of the material which has been found in the Canyon Diablo meteorite being any compound of carbon and silicon, such as the new interesting and valuable abrasive material just mentioned. But it establishes the fact that we have here an artificial substance that exceeds all natural substances except the diamond in hardness, *i. e.*, being harder than 9, but still far distant from 10.