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UNITED STATES GEOLOGICAL SURVEY  
• CHARLES D. WALCOTT, DIRECTOR

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# MINERAL RESOURCES

OF THE

# UNITED STATES

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CALENDAR YEAR

1901

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DAVID T. DAY

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# PRECIOUS STONES.

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By GEORGE F. KUNZ.

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## INTRODUCTION.

The chief points of interest concerning precious stones in the United States during the year 1901 are:

(1) The finding of a diamond in Lee County, Ga., which adds a new locality to those previously known; (2) the increased yield of sapphires in Fergus County, Mont., where two companies are now engaged, and further exploration for the fancy-colored sapphires at Rock Creek, Granite County, in the same State; (3) an extensive output of rhodolite garnets in the Cowee Valley, Macon County, N. C., and also considerable mining in other parts of that State for blue, green, and yellow beryls, amethyst, and the new emerald-matrix; (4) continued activity in the remarkable locality for colored tourmalines at Mesa Grande, San Diego County, Cal., and the discovery of a new deposit adjacent to the first; (5) further work at several chrysoprase localities near Visalia, Cal., and the purchase or control of them secured by a company; (6) sustained and enlarged production of turquoises, chiefly in New Mexico, where several important companies are actively engaged in mining them, and the discovery of new turquoise localities in Colorado and Nevada; (7) the finding of epidote crystals, magnificent in size and color, at Prince of Wales Island, Alaska; (8) and the discovery of a beautiful jade-like compact idocrase in Siskiyou County, Cal.

The importation of precious stones for the year 1901 at the port of New York amounted to about \$22,500,000. The importation of diamonds has exceeded that of any previous year, and never have larger or finer stones been brought into the United States. Emeralds have greatly increased in public favor; and coral, long out of fashion, has once more become popular.

Although turquoise is now mined by six different companies, and they all have had fair yields, the popularity of the stone has been such that the entire product was consumed.

The first year of the new century has been the greatest in the history of the precious-stone industry in the United States.

Never has the prosperity and growth of a country been more faithfully indicated, as if by a sensitive barometer, than by the wonderful increase in values and business in the jewelry trade in the United States during the past year. Never were more diamonds, pearls, or emeralds sold, nor did fine gems ever before command better prices, nor were they ever more firmly held; and yet diamonds are likely to advance still further during the present year.

Not since the famous looting of the Chinese Summer Palace in 1862 have so many treasures of jade, rock-crystal, pearls, and other precious-stone objects reached not only this country but every country in Europe. The distressing fact remains that many objects, such as an altar set, or a writing set, or the funeral offering at the tomb of an emperor, an empress, or a noble, and made up of two or three pieces, were divided among several soldiers. Often a superb scepter, or some similar object, will have upon its upper side a thick coating of dirt, the firmly knit dust of ages, and the lower side will be as clean as it was when laid upon the tomb a century or more ago. No class of objects, whether the seal of the imperial post-office, or the tomb ornaments of generations ago, or the name of an emperor in jade, escaped the rapacity of the soldiers, who would secrete them in their baggage with other hard stones, or with metal objects, and then carry them in this crude manner halfway round the globe, thus breaking, scratching, and nicking objects of priceless and historic value. Never has the more open boast of "loot" been made within the memory of man. Frequently the objects offered for sale have a complete history, as having been the jade tablets of some famous altar.

Thus three times has China been sacked of its priceless, precious Yu jade objects—at the looting of the Summer Palace, again during the Japan-China war, and finally in the late international war with China; so that to-day New York, Berlin, London, and Paris hold more such objects than any Chinese city.

## DIAMOND.

### UNITED STATES.

The only authentic instance of the finding of diamonds in the United States during the year 1901 is that in Lee County, Ga. There are reports that several were found along the moraine line near Martinsville, Ind., but these rumors have not yet been verified. Great excitement concerning the supposed discovery of diamonds prevailed for a short time in Montana, but the supposed diamonds proved to be only quartz.

### GEORGIA.

Reports have been made on several occasions in the past as to the finding of diamonds in Georgia, but these rumors have lacked full

confirmation. A reference to this subject was made in the volume of Mineral Resources for 1900. The repeated occurrences in North Carolina, however, and the similarity of conditions in upper Georgia, would afford grounds for expecting occasional diamond finds in the latter region. In November last a peculiar looking little stone was noticed and picked up by a lad on his father's plantation in Lee County, a few miles from Columbus, Ga. When this was shown to a jeweler in that city he advised its being sent to Messrs. Tiffany & Co., of New York, as perhaps valuable. This course was taken, and the stone was pronounced a diamond and of good quality. The stone was a flattened hexoctahedron of  $3.5\frac{1}{4}$  carats; it measured 10 by 8 by 6 mm., and was white, with a tint of green. The owner was Mr. B. F. Hudson, of Columbus, Ga.

#### MONTANA.

Toward the close of the year one or two prospectors in the north-eastern part of Fergus County, Mont., found a number of bright, white pebbles which they supposed to be diamonds. When these facts became known a furore began, and for a short time the excitement ran high over the diamond field in Montana, as it was claimed to be. Reports were widely circulated that New York experts had pronounced the stones to be genuine diamonds of fine quality. Prominent public men became interested, and capital was ready to enter into operations at once if the rumors proved true. The stones were soon found not to be diamonds, and it was then asserted that they must be white sapphires; but the fact was finally recognized that they were rolled crystals of dodecahedral (bipyramidal) quartz. In a few weeks the Montana diamond-field excitement had taken its place with the other similar furores that have from time to time excited the mining world for a brief period.

#### SOUTH AFRICA.

*De Beers Consolidated Mines.*—Considerable space was given in the last report of this division to the diamond mines of South Africa and the effects produced upon them by the war in reducing and partly suspending their operation during the year 1900. The succeeding year has witnessed a resumption of activity, which had, indeed, begun before; and the reports of the directors and of the general manager, presented at the annual meeting of the De Beers Consolidated Mines, December 23, 1901, show very marked advances. There have still, however, been many difficulties and limitations consequent upon the continued war. The natives have become so unsettled that the necessary labor is procured only with great trouble and with constant irregularity and uncertainty. The Government has required so much use of the railway line to Cape Town that the De Beers Company has been restricted in the transport of supplies, and has had to limit

operations correspondingly; and further, the Government has also made such heavy demands on the African coal produced at the Indwe mines that the company has been forced to import English coal in large quantity at greatly increased cost.

On the other hand, the amount of work actually done was a great advance on the year before, the yield of diamonds having doubled, and the proceeds having more than doubled, owing to a continued rise in price. The company has again paid the usual dividend of 40 per cent, omitted in 1900, amounting to £1,579,582; and a balance of £2,887,999 is carried over. During the year the company bought out for £12,000 the last remaining private claims upon the Du Toits pan mine, and proposes soon to operate that mine on an extensive scale. A new contract has been made with the Diamond Syndicate for the sale of the total output at an increased price, and the De Beers Company becomes a partner with the syndicate to share in any profit. Another important change has been effected in that the three "life governors," Messrs. Cecil Rhodes, Alfred Beit, and Julius Wernher, who have heretofore received a fixed share in the company's profits, have commuted that interest and now receive in its place 160,000 shares of deferred stock, par value £2 10s. each, this amount being equally shared between them. The stock of the company is divided into preferred and deferred stock. The previous arrangement gave the life governors, together, one-fourth of all the profits, after 36 per cent had been paid in dividends on the preferred stock. The new agreement obviates various possibilities of complication, and is regarded as a gain to the shareholders in general and a concession on the part of the governors. Mr. Rhodes personally did not favor it, but yielded to the views and wishes of his associates. The life governors are a self-perpetuating body, and upon the death of any one of them his place must be filled by the choice of his colleagues. A large part of the report is taken up with detailed explanations of this new arrangement, its motives, objects, and anticipated results.

Preparations for more extended and more economical working of the mines are being carried on vigorously. The acting general manager, Mr. Alpheus F. Williams, goes largely into these matters in his report. A great deal of new and improved machinery is being installed, which will substitute automatic processes for much of the native labor, now difficult to procure and to regulate. Steam shovels, mechanical haulage lines between floors and crushing mills, devices for tipping and righting trucks, etc., are described among these improvements. The cold-storage plants at Cape Town and Kimberley, referred to in the last year's report, have proved highly successful and profitable; the dynamite factory is progressing, though it has been delayed by the continuance of the war.

*Bultfontein mine.*—Operations have begun at the Bultfontein mine, 148,086 loads having been hauled therefrom; but as they had not yet been washed, that number of loads remained on the floor at the close of the year. Of this, 2,443 loads were “yellow ground.” A great deal of development has been done down to 600 feet, and the “blue ground” in sight is estimated at 13,000,000 loads.

*Premier mine.*—The Premier mine, heretofore a shallow, open mine, though of large area, has been developed to a depth of 500 feet. It is now operated on five levels—at 125, 185, and 240 feet as open workings, and at 460 and 500 feet underground, while the main shaft has been sunk 63 feet deeper. The amount of blue ground in sight was estimated at 12,850,000 loads. Much development has also been done here.

The figures of production, as compared with the three previous years in which this mine has been worked, are as follows:

*Premier mine production from 1898 to 1901, inclusive.*

Year ending June 30—	Carats obtained per load.	Price realized per carat.		Amount realized per load.	Cost of production per load.
	Number.	s.	d.	s. d.	s. d.
1898.....	0.27	20	9.3	5 8.2	2 7.1
1899.....	.30	22	10.1	6 9.8	2 3.3
1900.....	.30	25	0.2	7 5.9	2 7.5
1901.....	.295	27	3.7	8 0.6	3 9.9

The actual number of loads and the yield of diamonds therefrom for the same period were:

*Premier mine operations from 1898 to 1901, inclusive.*

Year ending June 30—	Loads hauled.	Loads washed.	Loads remaining on floors.	Carats of diamonds found.
1898.....	1,146,984	691,722	727,039	189,356
1899.....	2,032,771	1,662,778	1,097,032	496,762
1900.....	980,210	736,929	1,340,313	220,762
1901.....	1,571,631	1,517,981	1,393,963	447,399

The total value of these diamonds was £610,831 4s. 10d., a much greater result than that of any previous year's production from the Premier.

The two great mines, the De Beers and the Kimberley, are for the most part treated together in the reports of the company. The figures for the last year, as given below, in comparison with those of the three years preceding, show a great recovery from the setback produced by the war.

*De Beers and Kimberley production from 1898 to 1901, inclusive.*

Year ending June 30—	Carats obtained per load.		Price realized per carat.		Amount realized per load.		Cost of production per load.	
	Number.	s. d.	s. d.	s. d.	s. d.			
1898.....	0.80	26 6.2	21 2.1	6 7.4				
1899.....	.71	29 7.2	20 11.5	6 7.7				
1900.....	.67	35 10.2	23 6.9	7 6.2				
1901.....	.76	39 7.0	30 3.1	8 5.0				

It will be seen from these data that the yield per load has not only recovered from the diminution referred to in the report of this division for last year,<sup>a</sup> but has improved, and that the price of diamonds has continued to rise, being now higher than ever before in the history of these mines, and just about double what it was in 1889, previous to their consolidation. The increased cost of production, both in these mines and in the Premier, is due to the various unfavorable conditions above noted as results of the war, and to large amounts of development work.

Taking the actual amounts of production and comparing them in like manner, the figures are as follows:

*De Beers and Kimberley operations from 1898 to 1901, inclusive.*

[Fractions of carats and of pounds are omitted.]

Year ending June 30—	Loads hauled.	Loads washed.	Loads remaining on floors	Carats of diamonds found.	Amount realized thereon.
1898.....	3,332,688	3,259,692	2,377,913	2,603,250	£3,451,214
1899.....	3,504,899	3,311,773	2,937,784	2,345,466	3,471,060
1900.....	1,673,664	1,522,108	2,722,595	1,000,964	1,794,222
1901.....	2,120,397	2,616,873	2,216,119	2,000,495	3,959,383

The market value of the year's output is the largest in the history of the company's working, owing to the fact before noted, that the price per carat has been higher than in any previous year. With the opening of the Bultfontein and other mines now controlled by this company, and the improved machinery and appliances constantly introduced, the yield of diamonds would seem certain to be further enlarged. It becomes a curious question whether the price can still continue to advance and the demand for an article of such pure luxury keep pace with the supply. This has been the condition thus far, and of course the company can at any time limit the output in the event of either actual or anticipated fall in price. But with the present general prosperity this seems very remote.

<sup>a</sup> Mineral Resources U. S. 1900, p. 751.



## GUIANA.

The diamond mines on the Upper Mazaruni River, in British Guiana, were described at some length in the last report.<sup>a</sup> The United States consul at Demerara, Mr. George H. Moulton, has again given an account of these workings, under date of January 28, 1902.<sup>b</sup> He states that the prospects are favorable and the local excitement great, only the difficulty and expense of reaching the district with proper facilities for working preventing a rush of explorers. Up to the date of his account the total of diamonds exported was valued at the custom-house at \$50,000. Parties from New York had located claims and kept men at work, and in six weeks they obtained 8,227 small diamonds, weighing about 767 carats and valued at \$9,600. This is about \$12.50 a carat, much the same as the London valuation reported last year.

Mr. Moulton states that there are now a dozen companies organized and new expeditions constantly starting for work. Although no data are given as to the area of diamond-bearing ground, it is clear from these facts that the prediction as to a large increase in the extent of the recognized deposits, made by the Government explorers, Messrs. Harrison and Perkins, and referred to in the last report (p. 752), has been already verified. The great obstacle to free and rapid development is the long journey in small boats from Bartica to the mines, and the necessity of carrying, from the final landing for several miles to the workings, everything on the heads of native laborers. Mr. Moulton suggests the advantage and the profitableness of a steam or electric railway along the Mazaruni Valley as offering a favorable opening for capital. The project has already been broached, and it would be warmly welcomed in the colony

## BORNEO.

The first extended account of the diamond-producing district of Borneo that has been accessible to the general scientific world has been published in the *Annales des Mines* for 1901, by M. Gascuel, a mining engineer.<sup>c</sup> This is not, indeed, a full account of the Bornean diamond beds, as it deals only with one of the most important of several regions; but it possesses very considerable interest, and adds much to our previous imperfect knowledge.

Diamond-bearing deposits have been known and worked for centuries by the Malays, at both the eastern and the western extremities of the northern coast of the island. The latter region is that around

<sup>a</sup> *Mineral Resources U. S. 1900*, pp. 752-753.

<sup>b</sup> *U. S. Consular Reports*, No. 1275.

<sup>c</sup> *Les gisements diamantifères de la région sud-est de l'île de Bornéo (possessions hollandaises)*; par M. Gascuel, Ingénieur civil des Mines; *Annales des Mines, Mémoires*, tome XX, neuvième série, Paris, 1901.

Landak, not far from Pontianak, the capital of the western district. The former is near Banjermassin, on the Martapoera River.

### CORUNDUM GEMS.

#### SAPPHIRE.

##### MONTANA.

Montana is now becoming famous as a region productive of sapphires, not only those gathered from the bars of the Upper Missouri for some years past, but recently and particularly the gems that are mined from the rock in Fergus County, in the now celebrated Yogo district. The rock in which sapphires occur at this point is a basic igneous outflow, the upper portion of which has been eroded away and only the dike left. This dike, nearly vertical, is seen cutting the country rock, which is a hard gray limestone above, underlain by a softer shale. The latter is visible only at the eastern end of the line of workings, where the country falls off to a small basin on the eastern slope of the Little Belt Mountains nearly to the level of the valley of Judith River. This point is about 2 miles north of the river and 10 miles west of the town of Utica. From this eastern end the dike extends to the summit of Yogo Hill, 3 miles west, and thence 2 miles farther, across and beyond Yogo Creek, a total exposure of about 5 miles, its course marked all the way by a line of shafts, drifts, and open cuts.

Two companies are engaged in working this dike or "vein," as it is frequently though not correctly called—the New Mine Sapphire Syndicate, from the eastern extremity to the crest of Yogo Hill, and the American Gem Mining Company, from that point to and across Yogo Creek. All the work of the latter company is done by blasting; that of the former is partly by the hydraulic process. The methods employed are a curious combination of those of the California gold-workings and the South African diamond mines. As in the latter, the gangue of the gems is an igneous rock, hard below, but decomposed above, in varying degrees, to a mere earthy mass at the surface. From this last the gems are separated by washing and sluicing, much in the manner of placer gold; though because of the less density of sapphires more care is necessary, and the sluice boxes must be less inclined, to prevent the gems from being carried over the riffles. Most of the New Mine Syndicate's workings are surface openings and cuts, some of the latter very extensive. Water is carried from Yogo Creek, 10 miles distant, by a ditch and flume, with a parallel hydraulic pipe line, and a system of sluices extends all along the company's workings.

Where the rock is much decomposed the hydraulic process is employed largely; as it becomes harder, powder is necessary to break

it up. Then the rock is thrown out in dumps and allowed to disintegrate by exposure to the weather, as with the African "hard blue." This process requires from a month to a year, according to the condition of the material. Sometimes a stream of water is turned on the dumped rock, and the process thus expedited. When sufficiently decomposed, this material is subjected to the same washing process as the material naturally disintegrated.

Some of the open cuts along the dike are very large. One is 700 feet long and 90 feet deep; another, called the "Blue Diamond cut," is 1,200 feet long and 50 feet deep at its greatest depth. The side of this latter cutting gives a very fine section of the dike, showing the entire gradation from the hard rock below to the soft surface condition. The former is bluish or gray, while the latter becomes brown, reddish, and yellowish, from oxidation of the contained iron. The decomposition has extended to varying depths, in some cases to as much as 50 feet from the surface.

At some points tunnels have been driven several hundred feet into the hard rock, by both of the companies. The dike is fairly uniform in width, and maintains about the same richness in sapphires throughout. In the shale beneath the limestone at the eastern end the rock is somewhat different in character from that elsewhere, more basalt-like than in the limestone.

In the washing the fine earth is carried away with the water, all hard lumps remaining are again thrown out on a dump to decompose further, and the sapphires, after several screenings, are picked out by hand. All are saved, the larger for gems and the smaller for watch jewels, etc. The minute and imperfect ones are crushed and used for polishing powder, sometimes mixed with diamond dust in cutting the larger stones. The Yogo sapphires vary from very small ones up to gems of 4 or 5 carats in their natural state, though a few have been found of larger size—one of 8 carats in the American Gem Company's portion (in the Fourth of July claim), and one of 9 carats in the Syndicate's portion. The latter company sends its product to London for cutting, the former to Helena.

## CORUNDUM.

### UNITED STATES.

A very important publication appeared during the past year in the extended paper of Dr. Joseph Hyde Pratt, State mineralogist of North Carolina, on *The Occurrence and Distribution of Corundum in the United States.*<sup>a</sup> In this pamphlet are brought together and systematically treated all the recent discoveries and studies upon the origin and the distribution of corundum in all its forms at all North American

<sup>a</sup> Bull. U. S. Geol. Survey No. 180, 1901, p. 98.

localities. Many of these have already been referred to by the writer in reports of this survey.

For the last twenty years the fact has been gradually coming into recognition that corundum, formerly regarded as rare, is in reality much less so than was supposed, and that it has been developed in many kinds of rocks and under highly varied conditions. Dr. Pratt discusses the three varieties, as determined by their uses—gem material, corundum proper, and emery—and treats of the localities of each kind in full.

The gem varieties exemplify well some of the differences in the character of the containing rocks just now alluded to. The Montana sapphires, in two of the chief localities—the bars of the Missouri and the more recent mines at Yogo Gulch—have been traced to their source in igneous dikes. In the latter the rock is termed by Dr. Pratt “a basic minette,” an intimate mixture of biotite and pyroxene; in the former it is a mica-augite andesite, apparently altered from an augite-mica syenite. The true rubies of Cowee Valley, Macon County, N. C., have not been fully traced to their parent rock, but the indications are that this is probably an amphibolite or eclogite. The rock underlying the gravels in which they occur is both greatly decomposed and greatly disturbed, but rocks of the types above named are found in and beneath the decomposed portion, and outcrops of similar material occur in the vicinity, which contain corundum, though not the ruby crystals.

The first third of the bulletin discusses the very varied modes of occurrence of corundum in general; the middle third describes the distribution, by important localities, of (1) gems, (2) corundum, and (3) emery; the concluding portion deals with methods of mining, uses, and manufacturing processes, and contains an almost complete list of American localities. The paper is illustrated with numerous views and plates. It forms a most complete and valuable monograph on a subject of both practical and scientific importance, and it is remarkable that this, as well as the classic paper upon corundum by the late Prof. F. A. Genth,<sup>a</sup> were both published by members of the staff of the North Carolina geological survey. It is not mentioned, however, that the supposed first recognized locality of corundum in the United States in reality is Anderson, Laurens County, S. C., where it was noted by John Dickson in 1819.<sup>b</sup>

#### MONTANA.

In my last report<sup>c</sup> mention was made of large quantities of corundum, besides the sapphires, found in the Yogo district and lying on the dumps unused until transportation facilities should improve. It seems that Montana corundum is now beginning to attract attention, and

<sup>a</sup> Corundum, its Alterations and Associated Minerals; Philadelphia, 1873.

<sup>b</sup> Gems and Precious Stones of North America, 1892, p. 42.

<sup>c</sup> Mineral Resources U. S. 1900, p. 756.

may prove important commercially. Thus far the only point where systematic exploration for it is in progress is in the south-central part of Gallatin County, near the headwaters of Elk Creek, among the foothills between Gallatin Valley and Spanish Creek Basin.

Corundum was first found here some years ago by Mr. Harris Kirk, who owned a considerable area of ranch land in these hills, and when it was recognized several claims were located. Only of late, however, has any definite prospecting or surveying been done. The vein has been traced for 2 miles along a ridge south of Elk Creek, and some thirty trial pits have been sunk. The rock is gneiss, principally, and the corundum-bearing veins appear to be conformable to it and in close parallel association with bands of quartz, separated by garnetiferous and hornblende schist. The general mode of occurrence recalls that of the corundum bands in gneiss described by Professor Pratt from two localities in North Carolina and noted in my last report,<sup>a</sup> though to which of his two types of gneiss occurrence that in Montana belongs can not yet be determined. The main vein consists of a white, friable feldspar, with walls and margins of vermiculite, which sometimes increases in proportion until it forms a large part of the vein. Through these minerals the corundum is disseminated in crystals and crystalline grains, varying from a small fraction of an inch to 8 or 10 inches in length, often as beautiful elongated hexagons, and forming from 15 to 75 per cent of the vein mass. The seam averages about 28 inches in thickness along the outcrop, sometimes more, and has been traced downward to half the depth of a canyon formed by Elk Creek cutting through the ridge. This canyon is 800 feet deep, but the lower half is so obscured by a talus of fallen rocks that the vein could not be reached or seen. It appears, however, to dip regularly northward with the surrounding gneiss.

The corundum is found upon trial to be of good quality for vitrifying and to make excellent wheels by the silicate process. A number of claims have been staked out, and a company has been organized. Mr. Leverett S. Ropes has paid much attention to the exploration and development of this mineral.

#### CANADA.

#### ONTARIO.

Operations have begun regularly in the Ontario corundum region, described in the report of this division for 1898.<sup>b</sup> The Canada Corundum Company, Limited, of Toronto, with a branch office at Bridgeport, Conn., has erected works and started operations on the Robillard property, in Renfrew district, township of Raglan, 7 miles south of

<sup>a</sup> Mineral Resources U. S. 1900, p. 756.

<sup>b</sup> Twentieth Ann. Rept. U. S. Geol. Survey, Part VI, 1899.

Combermere. As the corundum-bearing rock forms a large outcrop over a high hill, abundant material is in sight for years to come by simple quarrying, with no under-ground work. The rock averages from 12 to 15 per cent of corundum, and it is found that the best material is produced when the mineral occurs well disseminated in rather small crystals; hence that portion of the deposit which presents this character is being principally exploited at present. The works are already supplied with varied machinery of modern type—crushers, jigs, concentrators, etc.—with a capacity of 20 tons a day; but more machinery is being added which will have double the capacity of that already installed, together with a magnetic separator for magnetite. Water power is the operating force. The present plant is, however, only experimental, and more extensive works are in contemplation. About 45 men are now employed. A road is under construction to a landing on York River, 3 miles from the mine and 4 miles from Combermere.

At the end of 1900 about 60 tons of sized corundum had been produced here, and a large number of wheels manufactured therefrom. These are reported by all who have used them to be of the highest quality for abrasive work.

Other companies are being organized to develop other portions of the Ontario corundum field. Among these, the Crown Corundum Company, Limited, will work the Methuen and Burleigh deposits, in Peterboro district. Like the Canada Company, above noted, this one also combines American and Canadian capital, its president being in Boston and its secretary in Toronto.

Large exhibits of the corundum-bearing rock from this region were shown in the Canadian section of the Mining Building at the Pan-American Exposition at Buffalo.

#### CORUNDUM AND ELÆOLITE-SYENITES IN INDIA.

Mr. Thomas H. Holland<sup>a</sup> has described the occurrence of elæolite-syenites in close association with corundum-bearing syenites in the Coimbatore district of Madras Presidency. These rocks, occurring together as they do, present a remarkable similarity to those of the corundum region in Ontario, Canada, described in the report of this Survey for 1898.<sup>b</sup> The elæolite-syenite appears in several varieties; it is gneissoid in character, conformable to the surrounding and inclosing gneisses. A remarkable feature is the presence of graphite in the rock mass and also in bands and lenses. Mr. Holland, in view of this feature, has sought carefully to determine the origin of the elæolite rock, whether igneous, as has been generally held, or otherwise; but he finds no absolute evidence, though inclining to the former view

<sup>a</sup> *Memoirs Geol. Survey India*, Vol. XXX, Pt. III, 1901, pp. 169-220.

<sup>b</sup> *Twentieth Ann. Rept. U. S. Geol. Survey*, Pt. VI, 1899, pp. 18-21.



and regarding the foliation as imposed before full consolidation. If this be true, it presents the novel and important feature of the occurrence of graphite in a properly igneous rock—a fact which, as Prof. L. V. Pirsson remarks, may be correlated with the occurrence of carbon in meteorites and of diamonds in the South African peridotite, and may lead to important conclusions tending to the solution of vexed problems in geology. The corundum appears in a highly feldspathic syenite associated with the elæolite rock, sometimes containing red garnet and sometimes chrysoberyl. The relations of the two syenites were not clear, but Mr. Holland regards them as differentiated products from the same magma.

### RUBY.

#### NORTH CAROLINA.

*Ruby matrix.*—The well-known occurrence of pink and red ruby corundum in a green amphibole (smaragdite), at Buck Creek, Clay County, N. C., has been utilized for a new semiprecious stone. Pieces are selected in which the bright spots of red or pink ruby are inclosed in the bright-green matrix. The contrast is very pleasing, and the stone is being introduced under the name of ruby matrix and adds one more material of this kind to the opal matrix, turquoise matrix, and emerald matrix, which have become so popular of late.

#### BURMA.

The Burma Ruby Mines Company, Limited, of which an account was given in the last report of this division,<sup>a</sup> has again made a successful showing, after a number of years of difficulty now apparently past. The first favorable results, announced last year, have been exceeded in the year ending February 28, 1902, as shown by the report of the directors' annual meeting in June. A dividend of 17½ per cent was declared (as against 12½ per cent in 1900), amounting to £26,162 10s., leaving a net balance to be carried over of £10,123 17s., as against £8,881 5s. in 1900.

The amount of gemmiferous earth ("byon") washed and the cost involved for the two years are stated as follows:

#### *Operations at the Burma ruby mines.*

Year.	Number of loads.	Cost per load.
1900 .....	818,185	d. 10.39
1901 .....	947,444	10.29

Comparing these data with those given in the table for the previous seven years (on page 758 of the last report of this division, above cited),

<sup>a</sup>Mineral Resources U. S. 1900, pp. 757-758.

it will be seen that the yield continues to increase and the cost to diminish.

The second electrical pumping plant has proved eminently successful, and a third has been ordered and has arrived, intended for a new mine, on which preparatory work was begun in January, 1902, and which was expected soon to be yielding gems.

### EMERALD.

#### NORWAY.

The old and well-known emerald locality at Arendal, Norway, which has long yielded mineralogical specimens, was taken up for exploitation some two years ago, in the hope of obtaining gems, by the Norwegian and General Exploitation Company, Limited, of London, and an exhibit was made of gems and specimens at the Paris Exposition of 1900. Many cut gems, most of them pale in color, but generally free from flaws, were shown. Up to this time, however, the mines have not been profitably worked, and the second annual report of the company, presented on December 21, 1901, is not very promising. Work had been carried on through the year in a manner deemed entirely capable and satisfactory, but with small results in emeralds, though much fine beryl was procured. The uncertainty of emerald mining is referred to, and the statement made that "first-class stones may be met with at any time." The stock of emeralds on hand is valued at £934 19s. 8d., and the balance of the profit and loss account for the year is £2,110 11s. 6d. The stock of gems appears to have come over from the previous year, when it was valued at £1,127 3s. 9d., the diminution being due to sales made during the year.

This occurrence of emerald strikingly resembles that at the Crab Tree Mountain, Mitchell County, N. C., which latter locality has afforded many of the emerald matrix specimens, and was first described by the writer in these pages.<sup>a</sup>

### GOLDEN BERYL.

#### NORTH CAROLINA.

Dr. J. H. Pratt exhibited, in the North Carolina section of mineral products at the Charleston Exposition, a crystal of golden beryl an inch and a half in diameter and over 2 inches long, taken from an Indian mound near Tesanty Creek, Maçon County, N. C. This place, elsewhere referred to in this report as yielding fine amethysts, is not far from the Littlefield beryl mine, and it is supposed that this crystal must have come from that locality. This is the first noted occurrence of a beryl crystal in an Indian grave.

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<sup>a</sup>Sixteenth Ann. Rept. U. S. Geol. Survey, Pt. IV, 1895, p. 600.



## CHRYSOBERYL.

## MANHATTAN ISLAND.

Chrysoberyl is a mineral of such rare occurrence that the recognition of another well-defined American locality for it is of considerable interest, even though the specimens found be very few. The Manhattan gneiss, of which the island on which New York is built is mainly composed, is very rich in the number of mineral species which it has yielded, though few of them are abundant or remarkable for elegance. The late Benjamin B. Chamberlin, an enthusiastic local mineralogist, whose collection was purchased after his death by the New York Mineralogical Club and deposited with the American Museum of Natural History, where it still remains under mutual agreement, published a complete list of the minerals of the island, with bibliographical references to all previous treatment of the subject.<sup>a</sup> In that list, which comprised no less than 76 species and 111 varieties, chrysoberyl is mentioned as having been found by William Niven, near High Bridge, "in small crystals on orthoclase," in May, 1888, and also in the Fort George locality.

During the last year, however, Dr. Wallace G. Levison has published a full account of two very well characterized specimens obtained by him on Manhattan Island, one in 1893 and the other in August last. The first was exhibited at a meeting of the New York Mineralogical Club, November 9, 1894, but was not then publicly noticed. A full description, with enlarged half-tone plate, was published in a pamphlet by Dr. Levison, dated July 15, 1901, and a crystallographic account of it, with enlarged woodcut, by Dr. A. J. Moses.<sup>b</sup> After the discovery of the second and larger specimen, Dr. Levison prepared a second edition of the pamphlet entitled *Crystals of Chrysoberyl from the Borough of Manhattan, New York City*, issued under date of October 15, and including the later specimen. The two crystals were not found in the same locality, but about half a mile apart. The first was from Eighty-eighth street and Amsterdam avenue, the second from Ninety-third street and Riverside Park. Both show that they represent several grouped crystals, part of which have been lost. Both are of good color; the second and larger one is a very fine, delicate light green, while the other is more brownish or olive. In crystallization they are not alike, the first being, in the words of Professor Moses, "of the heart-shaped type, with prominent pyramid, described by Kathrein as occurring at the emerald mines of Takowaia, Siberia, and is composed of two individuals with the usual twinning plane P (031). It is not tabular." The dimensions are 8 by 10 by 14 mm. Professor Moses gives a full list of measurements for all

<sup>a</sup>Trans. New York Acad. Sci., 1888.

<sup>b</sup>Am. Jour. Sci., August, 1901 (4th ser., Vol. XII, No. 68, pp. 104-105).

the faces. The second specimen is a large tabular crystal, or rather several parts of one, some 8 mm. thick, and the larger portions over 20 mm. in diameter. The striated *a* faces are broad and brilliant; no detailed measurements have been made of the others as yet. Both are in quartz, mingled with oligoclase feldspar. The specimens remain in the possession of the finder, Dr. Levison, of Brooklyn.

### GARNET.

#### RHODOLITE.

##### NORTH CAROLINA.

In the report on Mineral Resources for 1898 reference was made at some length to the composition of the peculiar and beautiful gem-garnet from the Cowee Valley in North Carolina, for which the name of rhodolite has been proposed and generally adopted. At that time, as there stated, the mineral had been found only in rolled fragments, not in crystals, and its matrix was unknown. By a recent letter from Mr. W. E. Hidden, who is engaged in working the locality, it appears that these missing data are now to some extent supplied. He reports having found several crystals during the summer of 1901, of considerable size, embedded in a decayed or saprolitic rock, though of what character is not stated. One crystal weighed as much as  $3\frac{1}{4}$  pounds (avoirdupois) and yielded 300 carats of fine pale-red material, flawless and suitable for cutting. The crystal was a trapezohedron, and had developed "parting planes" in all directions, but enough remained to yield the amount of gem material above mentioned. Mr. Hidden also reports having found rhodolites inclosing green and yellow crystals of apatite.

The yield for the year was about 200,000 carats, which may be valued approximately at \$20,000 after cutting. Mr. Hidden estimates that seven-eighths of the total weight must be lost in shaping and cutting, certainly three-fourths, while many of the pieces found—perhaps one-half—are too small to cut profitably at the present rates.

Very fine exhibits of these rhodolites, in the rough and also cut, were displayed in the North Carolina section of minerals and mining at both the Buffalo and Charleston expositions.

### PYROPE.

#### NEW YORK.

A number of small and brilliant garnets, probably of this species, were obtained last summer from a new opening in the peridotite outcrop at Syracuse, N. Y. They were too much shattered to have any value as gems, but are of much geological interest in adding a further point of resemblance in this rock to that of the African diamond mines

and of Isoms Creek, Kentucky. It will be remembered that the late Prof. H. Carvill Lewis emphasized the similarity of the peculiar rock at these three points, and proposed for it the name of kimberlite.<sup>a</sup> The pyrope garnets, or "Cape rubies," of the African mines had their analogue in the pyropes found in the Kentucky rock, but none had before been obtained at Syracuse. Of course the discovery led to some excitement when these facts were made known, and sensational articles appeared, of the usual kind, about rubies and diamonds to be anticipated at great depths in central New York.

#### TOPAZOLITE.

##### CALIFORNIA.

According to Mr. Max Braverman, many fine groups of topazolite garnet were taken out during the year from the locality near Visalia, Cal., before referred to in these reports.<sup>b</sup>

#### SPESSARTITE.

##### CALIFORNIA.

In addition to the interesting tourmalines, rose beryl, and other material that have been found at Mesa Grande, San Diego County, Cal., may be noted spessartite garnet implanted on a garnet rock in brilliant crystals from 5 to 15 millimeters in diameter, with striated faces. The crystals are usually translucent and would only furnish small transparent gems; but they possess great brilliancy.

#### GROSSULARITE, WITH EPIDOTE.

##### ALASKA.

A remarkable discovery has been made during the past year on the property of the Green Monster Copper Mine Company, near Sulzer, Prince of Wales Island, Alaska, of magnificent crystals, large in size and brilliant in color, of epidote and grossularite garnet, associated with twin crystals of quartz of the Japan type. The epidote crystals are implanted on a vein rock of epidote or on crystallized quartz, and are either associated or coated with crystallized quartz. The crystals are generally isolated and distinct, are rather stout in habit, are bright dark green with brilliant luster and pistache-green reflections. This color is more pronounced on the broken and fractured pieces. They are almost invariably twinned, and vary in size from 1 cm. to 15 cm. in length, in one case a single detached crystal weighing 359 grams (10 ounces).

The garnet is true grossularite, and is disseminated throughout the

<sup>a</sup> Eighteenth Ann. Rept. U. S. Geol. Survey, Part V (continued), 1897, p. 1194.

<sup>b</sup> Seventeenth Ann. Rept. U. S. Geol. Survey, Part III (continued), 1896, p. 911.

chalcopyrite of the copper mine, in which it occurs in isolated dodecahedrons ("I") with the trapezohedral faces slightly developed. The more brilliant crystals, however, are found in the limestone contact, where they occur with lustrous faces from 3 mm. to 12 mm. in diameter, varying greatly in color—pale cinnamon, pale brown, rich honey brown, dark brown, pale yellow brown, dark brownish green, smoky brown, and greenish black. All these are in the form of crystalline sheets over a paler mass, and are not detached as when found in the chalcopyrite. The paler-colored garnets are all smaller, the darker larger, some of the latter measuring 12 mm. on the face.

The quartz occurs generally crystallized, associated with, upon, or under the epidote crystals, almost always doubly terminated, transparent, and very often inclosed or coated with green chlorite. Among these are found crossed crystals. In habit the crystals are smaller at one end than at the other. The twin crystals resemble those of Japan, but none measure more than 1 inch in length. They are flat, and generally are coated with chlorite. The chalcopyrite forms a large vein mass, with quartz containing cavities in which are malachite crystals. It also incloses pyrrhotite, as well as the grossularite. The epidote is principally found at a contact with a limestone vein, as is frequently the occurrence. The finer crystals, however, are not found in the vicinity of the main copper mass.

#### ALMANDITE.

##### GERMAN EAST AFRICA.

Another remarkable discovery in 1901 was that of garnet in Luisenfeld, German East Africa. The garnet is a variety of almandite with a color inclining to brown. It is brought to commerce in fractured pieces, probably originally large crystals. Some of these pieces measure over 1 inch in length and more than half an inch in thickness. Immense quantities have been found, and it has made its way extensively into the commerce of Europe in sacks weighing 50 or more pounds each. This garnet is largely transparent, and yields handsome gems of a rich brown-red up to 10 carats in weight.

#### PERIDOT.

##### UPPER EGYPT.

One remarkable development of the year was the great quantity of peridot, olivine, or chrysolite, as the gem is known, fine examples of which at one time or another have existed among almost all well-known church treasures of Europe. The original locality of these gems is unknown, at least in many cases, and, as the writer has suggested, they must date back to the time of the Crusades, having been brought from the East, and, from time to time, having found their way into

commerce from churches and cloisters by changes which time brings about, but which can not be explained except by such processes as those by which the jade and rock crystal objects have reached us from China during the past year.

The new source, which is doubtless the old one rediscovered, is not yet precisely known, or rather made known, but it is somewhere in Upper Egypt, near the Red Sea. Large quantities of the mineral, both in crystals and broken pieces, have been brought to Europe and sold, and some have reached this country. Most of these are small, not over 1 or 2 carats, but very brilliant; some are as large as 20 or 30 carats, but rarely more; a crystal of 90 carats and a mass of 190 carats have also been found. In the earlier times pieces weighing as much as 200 or 300 carats were obtained, such as those to be seen in the Dom Schatz of the Cologne Cathedral, and in the American Museum of Natural History at New York. When the exact locality of the new supply can be reached and scientifically examined the mode of occurrence of such quantities of transparent olivine will be a matter of much interest.

#### VESUVIANITE (IDOCRASE).

##### CALIFORNIA.

In California there has been a very interesting discovery of massive green vesuvianitê, which seems capable of being used as an ornamental stone. It was found by Dr. A. E. Heighway, on land owned by him on the South Fork of Indian Creek, 12 miles from Happy Camp and 90 miles from Yreka, in Siskiyou County. Here a hard and handsome stone, varying from olive to almost grass green, and taking a fine polish, outcrops for some 200 feet along a hillside about 100 feet above the creek, and large masses have fallen into the bed of the creek below. It was at first supposed to be jade (nephrite), but proves to be vesuvianite. The fallen pieces were in some cases as much as 5 feet square and 2 feet thick, of excellent quality for polishing, and of varying shades of light to dark green. The associated rock is precious serpentine.

The mineral acts very feebly between crossed nicols. Its specific gravity, determined from two pieces, is 3.286. It closely resembles the mineral from the south side of the Piz Longhin, in the Bergellthal, also found in rolled pieces in the bed of the stream called the Ordlegna, near Casaccia, in the Upper Engadine. These were at first taken for jadeite,<sup>a</sup> but were positively identified as idocrase by the analyses of Berwerth.<sup>b</sup> It seems remarkable that the same mistake should have been made in both cases as to this massive idocrase, but its whole aspect is so jade-like that it is not surprising. The rich

<sup>a</sup> Fellenberg, Jahrb. Min., Vol. I, 1889, p. 103.

<sup>b</sup> Ann. Mus. Wien, Vol. IV, 1889, p. 87.

translucent green color, fine-grained subplintery fracture, and brilliant luster when polished all strongly suggest jade. The polished surface shows minute pale streaks or flocculi, which still further heighten the resemblance. It is proposed that work be undertaken at once to develop this material, which, if obtained in sufficient quantity, would be an interesting addition to American ornamental stones.

### TOURMALINE.

#### CALIFORNIA.

The remarkable new locality of colored tourmalines at Mesa Grande, San Diego County, Cal., described in my last report<sup>a</sup> has continued to yield exceedingly choice material. It occurs on the same belt as that in which is found the lepidolite of Smith Mountain, and the close association of this lithia mica with the colored lithia tourmalines, familiar elsewhere, leads to a belief that there may prove to be a zone of these valuable and interesting minerals traversing this region. At Mesa Grande the tourmalines occur in a vein of mingled quartz, lepidolite, and feldspar, which is exposed by erosion for a distance of some 300 feet or more on the mountain side. The locality has been known to the Indians, who break up the rock by blasting, and thus get access to the cavities, in which the tourmalines chiefly occur. Many crystals are also found loose in a red clay, resulting from the decomposition of the rock.

The story runs that about twenty-five years ago some Indian children playing around their camp in this vicinity picked up an oddly shaped stone about 3 inches long, six-sided, and as thick as a lead pencil or thicker, which, when cleaned and rubbed, was found to be of a rich blue color, partly clear and very brilliant, like a sapphire. This, although not known or understood at the time by those who saw it, was probably the first tourmaline discovery in San Diego County. Subsequently other crystals were picked up by Indians and cowboys, who prized them for their attractive colors—blue, green, red, etc.—but had no knowledge of their real character or commercial value. Now, as above mentioned, the Indians have learned somewhat how to get them from the rock. The spessartite garnet found at this locality has already been noted under “garnet,” above.

E. A. Wulff, in a recent article,<sup>b</sup> publishes his studies on the optical properties of the Elba and Haddam neck tourmaline, giving a series of comparative optical tables.

<sup>a</sup> Mineral Resources U. S. 1900, pp. 761-762.

<sup>b</sup> Centralblatt für Mineralogie und Geologie, 1901, pp. 299-302.



**JADEITE.****MEXICO.**

Probably one of the most important recent discoveries of jadeite was that made in the excavations of the Escalerillas, immediately back of the cathedral of Mexico, near or upon the site of the great temple. This excavation was carried on during the years 1900 and 1901 and brought to light at least 2,000 beads of jadeite, jadeite tablets, many hundred copper objects, and a large and beautiful obsidian knife measuring 32 inches in length. This Dr. H. M. Saville believes to have been placed there as an offering at the time of the dedication of the temple. A few fine specimens are in the collection of the American Museum of Natural History.

**NEPHRITE.****NEW ZEALAND.**

Reference was made in the last report<sup>a</sup> to the discovery of nephrite in place in Siberia. A recent announcement of its occurrence in serpentine on D'Urville Island, New Zealand, is made in a paper by E. Dieseldorff, referred to in the American Journal of Science for January, 1902.<sup>b</sup> This is the first discovery of nephrite in place in New Zealand, where it has so long been known and used, but heretofore always from bowlders. The mineral was found here both as nodular masses in serpentine and as bowlders, with the interesting difference that while the latter were essentially true actinolite, with no signs of alteration, the former showed uralitization, being in fact uralite-nephrite. This indication bears out a suggestion made years ago by Arzruni that nephrite may in some cases be an alteration from an original pyroxenic mineral.

**MOONSTONE.****NORTH CAROLINA.**

A very interesting new form of moonstone has been found by Mr. D. A. Bowman, near Bakersville, N. C. The moonstone is either white or gray feldspar, oligoclase, at times quite transparent, then translucent, being remarkable because, parallel to the cleavage planes, there are crystals of a red goethite that are unusually brilliant and iridescent by reflected light; so that in one position the stone may have the appearance of a moonstone, and in another that of a sunstone.

This moonstone occurs about 1 mile north of Bakersville, at the base of Medlock Mountain, on the land of W. G. Bowman, in a vein of granite and white feldspar in a hard, bluish-glistening schist, steeply inclined, and with a strike of about 15° north of east. The locality was exposed by a slide or washout in a great freshet in May, 1901, but the mineral was not discovered until some months afterwards. The

<sup>a</sup> Mineral Resources U. S. 1900, p. 767.

<sup>b</sup> Am. Jour. Sci., 4th ser., Vol. XIII.

moonstone itself forms a band or "streak," rather narrow at times, but traceable for 200 or 300 yards across the cove in which it appears. Goethite is present also in small amounts in the adjoining bluish schist.

#### FELDSPAR AS AN ABRASIVE.

Dr. N. H. Winchell reports that efforts have been made at Duluth, Minn., to introduce labradorite as an abrasive material. When ground and properly cemented on a wheel which is revolved with sufficient velocity the application of steel to its surface causes sparks of hot steel to fly in the same way as from a corundum wheel. This labradorite is obtained from the anorthosite masses of Minnesota.

#### QUARTZ.

##### ROCK CRYSTAL.

###### TENNESSEE.

A very interesting occurrence of quartz crystals is reported from near Russellville, Hamblen County, Tenn. They are small but beautiful, and quite as brilliant as those from Herkimer County, N. Y., and interesting as being double pyramids, well developed, with the pyramidal faces elongated. They are found both colorless and smoky, and sometimes present peculiar forms of twinning.

##### SMOKY QUARTZ.

###### ALABAMA.

Prof. Eugene A. Smith, of the University of Alabama, reports the discovery of very handsome crystals of smoky quartz in that State, near Zana, Tallapoosa County. Specimens were sent to New York to be tested as to their fitness for ornamental use, and two fine brilliants were cut, which left nothing to be desired in color or brightness. None of this material has yet been placed on the market.

###### MONTANA.

An immense crystal of smoky quartz weighing  $93\frac{1}{2}$  pounds was found in Montana near Clear Creek, Jefferson County, by Mr. O. P. Chisholm, of Boulder, Jefferson County, Mont. It measured 22 inches long and 13 inches wide, and before the fracture it must have been 25 inches long. The prisms of the crystal were quite perfect, but the terminal planes had been broken.

##### ROSE QUARTZ.

###### SOUTH DAKOTA AND CALIFORNIA.

The old locality for rose quartz in the Black Hills, in Custer County, S. Dak., is still somewhat worked, and there are immense quantities



of the mineral in sight. Mr. L. W. Stillwell, of Deadwood, reports having shipped 400 pounds of select material, during the year past, for jewelry and ornamental work. Some available for similar uses, and almost as good in color, has also been taken out at Yokohol, Tulare County, Cal.

#### RUTILATED QUARTZ.

##### NORTH CAROLINA.

A fine quality of rutilated quartz, well crystalized and perfectly transparent, is found in the monazite mines near Shelby, Cleveland County, N. C., together with handsome garnets.

#### AMETHYST.

##### NORTH CAROLINA.

Mining for amethyst has met with considerable success at Tesanty, on the creek of that name, Smith Bridge Township, Macon County, N. C., where a large vein occurs in an altered pegmatite. The development thus far has been entirely in a kaolinized rock in which the amethyst crystals, from one-half to 3 inches in length, are found loose with the quartz and mica in the kaolin. The entire vein when found had been uncovered to the depth of 20 feet by a landslide. It is evident that further working will show the amethysts in the rock. In color the crystals are light and dark, the dark spots often of the deepest, richest purple; no finer amethysts have been found in the United States. Several thousand dollars' worth of stones were sold from the first development work.

##### ALASKA.

During the past year some specimens of amethyst crystals containing fine material were brought to the United States from Alaska. Further development of the amethyst vein known to exist is expected.

##### BRAZIL.

Brazil, one of the richest countries of the world in minerals, has for more than half a century been in constant communication with Germany in the matter of precious and semiprecious stones, as a leading source of supply to the celebrated polishing works at and near Oberstein, in the valleys of the Nahe and the Idar. The last-named stream, a tributary of the former, has its source in the neighborhood of Erbeskapples, the highest point of the Rhine province, in the elevated forest region of the Hunsrucks. In its descent to the Nahe, near Oberstein, it presents a succession of falls through a distance of about 24 miles, and supplies water power for more than sixty polishing works. The valley has a large population, the principal towns being Oberstein, which is a station on the Nahe-Rhine Railway, and Idar, half an hour

distant by train, on the river of the same name. These two towns receive precious and semiprecious stones for polishing from all parts of the world and export their products in like manner everywhere, manufacturing many special styles of work adapted to the tastes and demands of numerous races and tribes, both civilized and uncivilized. Oberstein, formerly entirely an agate-cutting district, is occupied especially with the watch-chain industry, while the more general work in precious and semiprecious stones is in the hands of the Idar merchants.

As the polishing industry has developed, the usual change has taken place from the water power which originated the industry to the use of steam, and lately to the use of electric motors. Not only is a great increase of power thus obtained, but the danger of lack of water in summer and the interruption by freezing in winter, both of which have been serious embarrassments, are alike obviated.

All kinds of precious and semiprecious stones can be and are polished at these numerous works, among the former being diamonds, rubies, emeralds, sapphires, etc., and among the latter agates, amethysts, opals, topazes, and the quartz gems in general. The polished products find ready sale all over the world. At times when one or another variety is out of fashion, and hence not in demand for jewelry or for decorative work, the stones are put aside and kept in reserve until the public taste or fancy changes and brings them again into favor.

Brazil has long furnished many varieties of the quartz gems, and of late has yielded especially the remarkable "almond agates" in great quantity, as well as the purple amethysts, which have held their place steadily in public esteem, despite the competing attractions of other gems. This enduring favor is largely due to the fact that there is in reality no other precious stone with the beautiful violet color of the amethyst.

German agents and explorers are constantly engaged in the search for new localities and varieties of gem stones in Brazil, and indeed in many parts of the globe, to supply material for the Idar and the Oberstein works. In the course of such exploitations there was found a few years ago an immense hollow "almond," or amygdaloid geode, of amethyst; or, in other words, a single amygdule in an igneous rock, far surpassing in size and elegance anything of the kind previously known.

This wonderful geode or "druse" measured about 10 meters (33 feet) in length, 5 (16.5 feet) in width, and 3 (10 feet) in height, and was estimated to weigh some 70,000 pounds (35 tons). It was lined with quartz, colorless at first, near the outside, but passing gradually, toward the interior, into a lining of richly colored amethyst crystals, many of them as large as a man's fist, and with brilliant, lustrous faces, as though polished by a lapidary.

It is unfortunate for science that a specimen so unique in its magnificence should not have been preserved. But since the first discovery many parts have been broken away, and many lots bought by various gem prospectors for special uses, until there was no possibility of saving it as a whole. It has been partly put together as the "Amethyst Grotto," shown in the Düsseldorf Exhibition of 1902 (class 11).

The mode of occurrence of this great amygdule or geode may be briefly described as follows: The Serra do Mar, the mountain range parallel to the Brazilian coast, on passing into the State of Rio Grande do Sul, turns toward the west and declines in height, but its southern slope is somewhat rugged. Here are situated a number of German settlements, as Santa Cruz, Germania, St. Angelo, Silvina, Martens, New Berlin, Teutonia, New Petropolis, St. Leopold, etc., with a German-speaking population of perhaps 200,000. In Santa Cruz are many immigrants from Idar and its vicinity, who are of course familiar with the nature and occurrence of precious and semiprecious stones. The Serra is largely composed of granitic and igneous rocks, frequently covered by a mantle of red clay, resulting from the decomposition of the rocks by weathering. At an elevation of from 500 to 1,000 feet (150 to 300 meters) above the sea, a red rock is largely present which often passes into melaphyr and amygdaloid, in which agates frequently occur.

The principal district in which the agate amygdules are obtained is along the upper waters of the Garuky and its left-hand tributaries, north of Santa Cruz. They are generally found in the red soil above referred to as produced by the weathering of the igneous rocks. In the case of the great geode, this was true of its upper portion, while the lower part remained embedded in the underlying melaphyr. It was hence very difficult of extraction, especially as blasting could not be employed for fear of injuring or dislodging the elegant crystals. The upper part of the geode had been broken open, and the interior was filled with the red soil, in which, as in a unique flowerpot, had grown a palm  $\frac{1}{4}$  meters (13.5 feet) in height.

The spot where it was found was north of Santa Cruz, and only 20 miles distant in an air line, but the paths down the mountain side are suitable only for transportation on mule back. Hence the large and heavy pieces, into which the great geode, or what remained of it, was finally broken, had to be carried by a much longer and very round-about way to reach a point of shipment. The pieces were ten in number and weighed 1,500 kms. They were carried on two-wheeled carts, each drawn by eight oxen, across several mountain streams to Villa Birra; then, by the Harrara railway to Santa Maria; then, on the Urugaryan railway, for 262 ks., to Targum-Taquary; thence by river steamer to Porto Alegre, and by raft to Rio Grande, where they were at last shipped to Europe. The finest parts of this grotto

have been presented to the Tiffany-Morgan collection in the American Museum of Natural History, at New York, and to the Musée d'Histoire Naturelle, Jardin des Plantes, Paris.

#### CAIRNGORM STONE.

##### SCOTLAND.

At the meeting of the British Association for the Advancement of Science in 1901,<sup>a</sup> Mr. E. H. Cunningham Craig gave an account of the celebrated locality of smoky quartz, Scotch topaz, or cairngorm stone, so called from Cairngorum, near Banff in Scotland. The search was formerly quite profitable, but is now very little prosecuted. At points near the great granite masses, shallow pits or trenches were dug in the decomposed rock that covers many of the flat hill tops and appears in the "corries" or ravines. Pieces of vein quartz, with muscovite and orthoclase crystals, in the decayed rock were regarded as surface indications of cairngorm veins beneath. Sections in the "corries" show vertical or steeply inclined veins (or dikes) of fine granite traversing the coarser surrounding rock. These have a central zone of drusy cavities and coarse crystallization with plates of muscovite, crystals of orthoclase, and more or less smoky quartz, together with occasional beryls. The mode of occurrence seems to be identical with that of the amethyst crystals in this country from Maine to Georgia. Mr. Craig regards these veins as intrusions of a more highly differentiated material from and underlying magma into fissures formed in cooling. To the drusy cavities he attributes a like origin, and a subsequent filling with acidic solutions from which the crystals developed.

#### NONCRYSTALLINE QUARTZ.

Numerous occurrences of the minor varieties of noncrystalline quartz minerals are reported every year. Some of these never prove important, while others may. In many instances, however, they possess interest and serve to develop more or less business in "local" gem stones. Among those lately announced, the following may be referred to:

##### AGATE.

Some fairly good material, of red and other colors, has been obtained in Clarke County, Ala., and has been cut and polished in New York for sets of cuff buttons, etc., and for ornaments and small slabs. Prof. Eugene A. Smith, who reports these facts, states that this agate occurs in veins in the "Buhrstone" division of the Claiborne formation, in the Eocene Tertiary.

Agate pebbles, or rather nodules, occur in and around the city of St. Paul, Minn., in the sand and gravel of the soil. They vary from very small size to that of a hen's egg. Mr. E. C. Mitchell, president

<sup>a</sup>Report Seventy-first Meeting, 1901, p. 664.

of the St. Paul Academy of Sciences, says that while few, especially of the larger ones, are at all choice, yet handsome agates are obtained at times.

Mr. J. T. Jamison, of Mathis, Tex., reports very pretty moss agates from that vicinity, but not in any quantity.

Moss agate from Oregon is described further on under jasper.

It was reported lately from Philadelphia that a large vein of mottled and banded agate had been discovered on Chickies Ridge, Lancaster County, Pa., from which pieces large enough for table tops could be taken.

#### CHALCEDONY.

Beautiful chalcedony pebbles are found among the sand and gravel at low tide, north of the pier at Redondo Beach, California. They are believed to have come from strata of sand extending for a mile in the vicinity. Several of these pebbles have also been found during the past year in an Indian grave north of Redondo.

#### CHRYSOPRASE.

More or less mining has been done at the several chrysoprase localities in Tulare County, Cal.; and a portion of the material taken out is really fine enough to be valued for cutting. At the original locality at Venice Hill, 12 miles northeast of Visalia, some 300 pounds of chrysoprase were obtained. The parties who are working at this point have secured several thousand acres of adjoining land, and also the locality near Lindsay, 18 miles southeast of Visalia. This was first announced in *Mineral Resources for 1898*<sup>a</sup> as a chrysoprase locality; but Mr. Braverman, who has given so much study to these occurrences, now calls it prase-opal. From the workings at Deer Creek<sup>b</sup> some 1,200 pounds were shipped to New York, but work has been suspended for a time.

Mr. J. A. Edman, of Meadow Valley, Plumas County, Cal., reports prase as occurring in lenses in the serpentine belt and as pebbles in adjacent gravel deposits. It varies from light grayish-green to deep green, the latter said to be peculiarly suitable for ornamental uses. In *Mineral Resources for 1899*<sup>c</sup> green jasper was announced in a like occurrence at the same place. Whether both prase and jasper are thus found, or whether both are really a form of chrysoprase, is not yet certain.

#### JASPER.

##### OREGON.

A discovery has been made of true bloodstone or heliotrope, and also of fine moss agate at Hood River, Wasco County, Oreg., by Miss

<sup>a</sup> Twentieth Ann. Rept. U. S. Geol. Survey, Pt. VI (continued), 1899, p. 589.

<sup>b</sup> Eighteenth Ann. Rept. U. S. Geol. Survey, Pt. V (continued), 1897, p. 1207.

<sup>c</sup> Twenty-first Ann. Rept. U. S. Geol. Survey, Pt. VI (continued), 1901, p. 465.

Nettie Hayes. The heliotrope is in fair-sized pieces, of deep green, with the red spots that characterize the variety well marked, making specimens as fine as those of India. The moss agate is not in rolled nodules, like many of the Western specimens, but in fragments, evidently from a vein or deposit. They are somewhat angular and only rounded on the edges. The markings are very fine.

#### CALIFORNIA.

Mr. J. A. Edman, of Meadow Valley, Plumas County, Cal., states that jaspers occur frequently thereabout, chiefly gray, light red, and white and red mixed, some of which would be suitable for ornamental use.

#### MINNESOTA.

Prof. Raphael Pumpelly reports a blood-red jasper and also a blue-gray chalcedony as occurring in the region west of Lake Superior. They are found in great abundance, the former on Hunter's Island, and the latter near Gunflint Lake, both of which are on the boundary line of Minnesota and Ontario.

#### NORTH WALES.

A very remarkable discovery of jasper is announced in the English press as having been made in South Carnarvonshire, at Carreg-y-Plas, North Wales. The deposit appears in very large veins, from 10 to 40 yards in width, exposed at intervals along the shore cliffs for some distance from Porthper Bay. The color is chiefly deep red varied with lighter tints, and the supply of material seems enormous. Specimens cut and polished at Birmingham are of fine quality and much admired. A syndicate is already proposing to undertake active work.

#### PETRIFIED FOREST OF ARIZONA.

In my last report<sup>a</sup> is given a résumé of the report of Dr. Lester F. Ward on the geological relations of the petrified forest of Arizona, made under directions from the National Museum and the General Land Office. The agatized logs were described as all washed out of a bed of coarse sandstone several hundred feet above the areas in which they now lie, and a few points were noted where they may be seen in place in the sandstone. This bed was referred in a general way to the Triassic.

In a subsequent paper,<sup>b</sup> Professor Ward has followed up this subject in a highly interesting manner. He describes the whole succession of Triassic beds in the region traversed by the Little Colorado River, and

<sup>a</sup> Mineral Resources U. S. 1900, pp. 763-766.

<sup>b</sup> Geology of the Little Colorado Valley: Am. Jour. Sci., 4th ser., Vol. XII, No. 72, Dec., 1901.



for the first time distinguishes them into definite series. He has traced three main divisions, which are named in ascending order, the Moencopie, the Shinarump, and the Painted Desert beds. The middle group, the Shinarump (already so named by Powell), is the source of the silicified logs. They occur more or less distributed through its entire thickness of 1,600 feet, and Professor Ward uses the presence of the fossil wood as a criterion to define the limits of the formation in certain cases, so characteristic is its general occurrence. There is a well-marked division of the Shinarump into a lower and an upper portion about equal in thickness (the latter of which he names the Le Roux beds), and there is much lithological variation in both members, but the wood appears throughout. The lower division is largely sandstone and conglomerate, but interstratified with shales and marls, which often present brilliant colors, and all these together form the striking banded bluffs around the eroded areas of the Petrified Forest. The upper division is principally a body of variegated marls, especially conspicuous at the Middle Forest, which lies amid these Le Roux beds, while the other parts are in the lower section of the Shinarump.

These determinations by Professor Ward are of great interest, both as to the general geology of the region and as defining the exact horizon of the remarkable agatized forest.

In further prosecution of the same subject, much interest attaches to discoveries of other localities, where the agatized trees are apparently in place, reported by Mr. James M. Pulver, Territorial geologist of Arizona. He and his party found a fine group of fossil trunks in the foothills 12 miles east of Winslow, Ariz., about 45 miles from Chalcedony Park. Here great trees were standing erect, looking like the pillars of an ancient temple, in the face of a perpendicular sandstone cliff. Some were 20 or 30 feet high and 4 to 6 feet across, and with roots running out below into the inclosing rock. One had fallen, leaving its niche or mold in the face of the cliff; others were precariously exposed; others just appearing, indicating that the rock was full of them. All about through the sandstone were branches, leaves, and fruits, from which it was seen that some of the trees were of a coniferous type, similar to the Sequoia, and others were angiosperms.

Another fine locality, though of limited extent, was found some miles farther west. Here, on a mountain slope, is a small forest, very perfectly preserved, even to the bark and roots. One large stump, on the summit of a little isolated mesa, with roots in position, measured 14 feet in height and  $26\frac{1}{2}$  feet in circumference at its base. The silicified tree, with its roots, had evidently preserved the surrounding material from complete erosion, and thus in a sense formed the little mesa on which it stands.

The precise geological relation of these localities to the Shinarump horizon of Professor Ward is not given, and its determination will be of much interest.

New localities are constantly reported by prospectors and cowboys, and it seems evident that the fossil trees are widely distributed throughout northern New Mexico and Arizona.

It would appear that this material was well known and highly valued among the Indians long before any whites had seen it, as many objects of use and ornament made from it—pestles, arrowheads, charms, etc.—are found from Zacatecas on the south to Wyoming on the north. The first white man who ever saw the locality is believed to have been Col. John W. Stedman, in 1851, who learned of it from some of the Zufis. A year later Prof. Jules Marcou, with a party of United States surveyors, examined the spot and made collections and reports. In the year following Lieutenant Whipple reached and named his “Lithodendron Creek,” which must have been some part of the Chalcedony Park, although Dr. Ward, as above noted, does not think that it was the main arroyo which he describes. From these reports of Government officers it became gradually known, though it was too remote for access by the tourist and the vandal until the opening of the railroad in 1880.

#### OPAL.

##### NEW MEXICO.

A very interesting variety of green semi-opal has been discovered in Taos County, N. Mex., by Mr. A. C. Twining. The particulars of its occurrence are not yet reported.

##### CUBA.

Moss opal, in masses larger than a man's fist, has been found in a bed of white cherty rock on the banks of the Yucatan River at La Cieba, 8 miles north of the city of Puerto Principe, Cuba, by Mr. C. H. Drake, of that place. The moss opal in general appearance closely resembles the large masses of moss agate found near Hartville, Wyo., but is entirely opal and not quartz.

##### AUSTRALIA.

##### NEW SOUTH WALES.

The opal production in New South Wales, especially in the remarkable White Cliffs region in Wilcannia district, is described in the reports of this survey for 1896 and 1898.<sup>a</sup> According to Mr. E. F. Pittman, in his work *The Mineral Resources of New South Wales*, this rich opal field was first discovered by a mere accident, as indeed has often been the case. In 1889 a hunter following a wounded kangaroo noticed a piece of bright-colored opal on the ground and picked it up. Further

<sup>a</sup> Eighteenth Ann. Rept. U. S. Geol. Survey, Part V (continued), 1897, p. 1208. Twentieth Ann. Rept., Part VI (continued), 1899, pp. 589-596.



search revealed other pieces; trenches were then dug, and the mineral was discovered in place. From that time mining has been carried on more or less continuously, though much hindered at times by lack of water. Still, it has become a fixed industry, and a prosperous township has been established at White Cliffs. The total yield since the discovery is estimated at £376,600, but it must really be much larger, as a great deal of the opal found is not reported.

The mineral occurs in seams or layers in Cretaceous deposits, as described in the reports above cited. The variety of color and pattern is very great, and prices range correspondingly, from quite low up to \$100 or even \$125 an ounce, which is the unit of purchase in the rough. The types of pattern and color are described in a previous report.<sup>a</sup> Some other features as to the value of stones for jewelry may be here noted. The shape of a piece of opal may be important, as affecting the disposition of pattern and color, which may be fine on the edge and less so on the face, or vice versa. A thick piece, with a good edge pattern, may be cut up into a number of small fine stones, using that pattern for their main face; a thin piece, equally good in the edge pattern, could not be so treated. It is not easy to obtain separate stones of uniform character for sets of jewelry, and so such sets are usually cut from a single large piece, which is therefore worth much more per ounce than a corresponding number of smaller stones, equally fine, but not quite similar. The ground or body, again, is important; it should neither be too clear nor too opaque; and another difference lies in the matter of toughness or brittleness, in which the stones vary somewhat, greatly affecting their cutting and wear. Some single pieces from these mines have brought very high prices; one of 4½ ounces was sold for £100, and another of 9 ounces was valued at £700. These were local prices and would have been much higher in London.

Dr. George Gurick in an exhaustive article<sup>b</sup> describes fully his studies of these very interesting White Cliffs occurrences of noble opal and opal pseudomorphs. These deposits have been described from time to time by Dun<sup>c</sup> and in many other publications cited by Dr. Gurick in his article.

Dr. Gurick classifies the opal occurrences in the following five classes:

1. As material filling small rents in various rocks, as sandstone, often rich with feldspar.
2. As material filling cracks and wormholes in opalized wood.
3. As the cementing material of a sandstone.
4. As a fossilizing material of wood, of Devonian crinoidal stems and parts, and of brachiopods and saurian bones.

<sup>a</sup> Twentieth Ann. Rept. U. S. Geol. Survey, loc. cit.

<sup>b</sup> Neues Jahrbuch für Mineralogie, Vol. XIV, pt. 3, pp. 472-783.

<sup>c</sup> Records Geol. Survey New South Wales, Vol. IV, Pt. IV, p. 300.

5. As first large pseudomorph after a radial crystalline aggregate.

All these varieties are often opals of great beauty. Dr. Weisbach believed that the crystalline aggregates were originally sulphur. Dr. Pelikan believed them to be gypsum crystals. Dr. Gurick, however, infers that they may be after gaylussite, similar to those from northern Germany. He also believes that where the noble opal shows by transmitted light a network of color slightly different from the mass itself, it may be a pseudomorph after calcite; yet at the same time it may be a minute remnant of the cellular structure of the saurian bones. This locality has produced during the past ten years more opals, and as fine if not finer ones, than have the famous Royal Hungarian mines in the centuries of their production. The stones are often of great size. They occur of the purest white with all the play of color that has been seen in opals from any precious opal locality, and the color reflections often have a great variation. More opals are now sold in a year than were sold in fifty years before the Australian mines were opened.

#### TURQUOISE.

Turquoise mining has been active during the last year. There are at least six companies now engaged in working for American turquoises, and it is a question that only time can decide how much increase of output the market will stand. Thus far, however, as the multiplication of companies shows, there is no sign of oversupply; the gem is in high favor, and novel and varied forms of cutting and setting it have been lately introduced.

Turquoise mines have now been found in at least five States and Territories—Arizona, New Mexico, California, Nevada, and Colorado.

#### COLORADO.

A new and apparently fine locality for turquoise has been discovered in Colorado, at Lajara; a mile and a half west of the Rio Grande and 10 miles north of the New Mexico line. This, which is the first mine in the district, was discovered early in 1901. It is located in a little volcanic hill, and is surrounded with the usual evidences of ancient working—stone hammers, pieces of deerhorn, and the like. A large mass, reported to weigh 1,500 carats, was brought to Denver during the summer and greatly admired. This was not, however, pure blue turquoise, as was claimed in press notices, but was probably a rich piece of matrix. A company has undertaken to develop this mine and has located several claims.

#### NEVADA.

Another locality for turquoise in Nevada has been announced during the year past. Mr. William Petry, of Los Angeles, Cal., has discovered

a new deposit on Cactus Mountain, 50 miles east of Butler, Nye County, Nevada. The turquoise was traced by a large quantity of broken material on the surface. A stone, weighing some 8 carats, was found, but the color is not the finest blue. Considerable work is being carried on in the hope of further developments.

#### ARIZONA.

Mr. C. D. Childers, also, of Whitehills, Mohave County, Ariz., has described what is apparently a new turquoise mine in that Territory near the Colorado River. Like all the rest, it bears evidence of former working, by Indians or earlier prehistoric people, in the form of stone hammers and carvings on adjacent rocks. No other particulars have yet been obtained.

#### NEW MEXICO.

In New Mexico, according to the published report of Governor Otero, there are some 60 or 70 turquoise claims, of which 10 or 12 are being worked with profit. Six important companies, as above stated, are actively at work and are furnishing the bulk of the world's supply.

During the Southwestern tour of President McKinley four beautiful turquoises from the Pofterfield mines in the Burro Mountains were presented to him by Governor Otero. The largest stone was a superb specimen of 20 carats weight.

Turquoise is occasionally liable to fade. Some of the companies claim that their stones never change or lose color; if so, indeed, it is a remarkable fact in the case of a mineral so long regarded as unstable in this respect. Several of the companies give a guaranty that if one of their stones changes color within six months after its purchase from a retail jeweler, they will replace it with a new one. This is a great improvement on the old method of the Persian dealers, who were wont to decamp for parts unknown as soon as their turquoises were sold. In order to protect themselves against false claims the several companies have adopted the system of marking each of their stones by cutting a trade-mark on the back, an A for the American Turquoise Company, a circle for the Azure Company, a cross for the American Turquoise and Copper Company, a T for the Toltec, an arrow for the Himalaya, etc.

#### APATITE.

An unusual occurrence of apatite was made known in the fall of 1900, at Auburn, Me., on the farm of Mr. P. P. Pulsifer. The mineral was found in a matrix of quartz, and appeared in beautiful prismatic crystals, often transparent and richly colored, notably a fine purple in lighter and darker shades. It was first supposed to be tourmaline, and was announced as such. The whole "find" was purchased for the collection of Harvard University.

### CONCHITE.

The new variety of calcium carbonate described under the name of conchite by Miss Kelly,<sup>a</sup> as well as that of Mr. Lacroix, called by him ktypteite, are questioned by Dr. H. Vater<sup>b</sup> and are held to be not really distinct from aragonite.

### AMBER.

Dr. Hapke states in a recent article<sup>c</sup> that as early as 1875 seventy-five localities in northwest Germany where amber had been found had been described in the Journal of the Natural History Society of Bremen. He notes five new occurrences in that region, thus making eighty in all. He mentions a single enormous piece weighing 3.125 kilograms, 6.875 pounds, of mingled straw color and greenish yellow, which had been found in the 70's by some fishermen in Langlutjensand. Other discoveries had also been made in clay and sand in Binnenlande. This amber of the northwest coast rarely shows inclosures, as it is mostly opaque or subtranslucent. Quite recently a rich discovery of amber has been made in the Elbemündung by crab fishers. One beautiful piece from Altenbruch weighs half a pound.

Dr. Goetze mentions<sup>d</sup> the finding of amber in pieces weighing 200 grams—one-half pound—on the left bank of the Weser, at Blexen, opposite Geestemunde, in a brown to black deposit.

### EPIDOTE.

Mr. O. H. Blocker, of Old Fort, N. C., sends for examination some interesting crystals of epidote in brilliant prisms  $1\frac{1}{2}$  inches in length, one-eighth inch in diameter, and dark green, but too dark to have value as gems. They are reported to occur 40 miles from Old Fort. The property may be explored further.

### CHLORASTROLITE.

This mineral, long familiar from Isle Royale, Lake Superior, is announced as obtained also from Green Stone Island, south of the Isle Royale. No particulars are yet forthcoming.

### ZOISITE.

Dr. F. Slavik<sup>e</sup> discusses the occurrence of the well-known Moravian pink zoisite, describing the various localities and occurrences and giv-

<sup>a</sup> Mineral Resources U. S. 1900, p. 776.

<sup>b</sup> Zeitschrift für Krystallographie, Vol. XXXV, p. 149.

<sup>c</sup> Nachtrag zu den Bernsteinfinden: Beiträge zur nordwestdeutschen Volks- und Landeskunde, herausgegeben vom Naturwissensch. Verein zu Bremen, Abhandl. 15, Heft 3, 1901, pp. 307-310.

<sup>d</sup> Bernstein an der Wesermündung: Zeitschrift für Ethnologie, 34, 1900, pp. 428, 429.

<sup>e</sup> Centralblatt für Mineralogie, 1902, p. 686.

ing an analysis made by Prof. Fr. Kovar, of Prag, who has chemically investigated the red zoisite of Borovina with the following results:

*Analysis of zoisite.*

Constituent.	Per cent.
Si O <sub>2</sub> .....	38.91
Al <sub>2</sub> O <sub>3</sub> .....	29.38
Fe <sub>2</sub> O <sub>3</sub> .....	4.46
Mn O.....	0.17
Ca O.....	25.18
Mg O.....	0.44
H <sub>2</sub> O.....	2.06
Total.....	100.60

Zoisite has recently been used to some extent as a gem stone in the form of small round spheres.

#### MISCELLANEOUS.

Mr. Wm. E. Hidden reports a number of interesting minerals that may possibly prove to be of gem value, though as yet undeveloped, from Mason's Branch, Macon County, N. C. Among these are green spinel, translucent and glassy; iolite, clear and chatoyant; sapphire corundum, in promising crystals; and bronzite, pale, transparent, and bronze-tinted.

#### GEM CUTTING IN THE UNITED STATES.

Within the last few years more attention than ever has been paid to the quaint and fanciful cutting of all precious stones, including the diamond. Whereas ten years ago scarcely any other form than the "brilliant" and the "rose" in diamonds were used, of late there has been a great demand for stones that are "pear-shaped," "marquise," "briolette," and for table-cut stones in all forms—triangular, circular, hexagonal—and for stones cut also in the double rose, or "rose-brilliant" form. A modification of the latter, bearing 80 facets, 40 above and 40 below, has been patented under the name "twentieth century cutting." This is not unlike the old-fashioned rose-brilliant, in which some fancy stones have also been cut for some years past, but omits the culet and table entirely.

The inventor claims that by eliminating the table and the culet the brilliancy of the stone is greatly increased. His patent is essentially on a shape formed of two cones, base to base, each cone made up of planes. Eight diamond-shaped planes meet at each apex, taking the place of the table at the top and the culet at the bottom of the present brilliant.

An instance of where a change of fashion or a lower rate of wages affects an industry may be recognized in the fact that from 1866 to 1882 there were employed in the city of Providence, R. I., from 75 to 100 men engaged in the lapidary-business, earning from \$18 to \$30 per week. A large part of the time they were engaged in cutting Wyoming moss agates and what was known as the Montana agate, which commanded a price of from \$4 to \$12 per dozen. But the cutting of these stones abroad at \$4 per gross resulted in an entire collapse of the industry. A similar fact was also instanced when cameos and intaglios were in fashion, a period ranging from 1865 to 1885, when fully 100 men were engaged in cutting intaglios and cameos in the city of New York. To-day there are less than four men so engaged, in consequence of the change of fashion, which has not favored that style of ornaments for some years past, though now there are indications of a return to them.

### GEM CUTTING IN EUROPE.

#### GERMANY.

Although there are only about 120 diamond cutters at Hanover, and not more than twice that number in all Germany, yet the Prussian commission of commerce has had under consideration the placing of a duty of 25 per cent ad valorem on all cut diamonds brought into Germany, which at present represent a value of about \$4,000,000. The United States is the largest consumer of diamonds. The duty on cut diamonds is 10 per cent ad valorem, and rough diamonds are free.

The jewelry industry of Germany is to a considerable extent concentrated at the little towns of Hanau and Pforzheim, near Frankfort on the Main, and at the Oberstein-Idar district elsewhere described. There were in operation last year in Pforzheim more than 400 jewelry manufactories, giving employment to over 18,000 persons and producing an output valued at more than 60,000,000 marks.

#### NETHERLANDS.

The combined diamond-cutting industry of Antwerp and Amsterdam employs about 4,000 men.

A serious strike has recently taken place among the Dutch diamond cutters, which has produced considerable agitation and trouble.

#### FRANCE.

A commission appointed by the minister of commerce to gather statistics as to the industrial position of France has recently examined and reported upon 38 establishments for working in precious metals and gems, most of which are in the Department of the Seine. There are three workshops for the cutting of diamonds and other precious



stones, employing 130 persons, of whom 15 per cent are women and children. The day is of ten hours, and the average daily wage is 8 francs. Four establishments for cutting imitation gems were also visited; these employed 80 persons, 16 of whom (20 per cent) were women. The day in these is eleven hours and the average pay 5 francs.

#### GEM-CUTTING APPLIANCES.

A great number of ingenious and intricate devices have been invented and patented during the last few years for the cutting of diamonds and other precious stones, a fact which bears evident testimony to the growth of interest and of business in this line. Among these, one of the latest is really in principle only an improved adaptation of a simple device that was used in Europe during the last century, and is still employed in Russia and to some extent in France. This is known as the *cadrans*.

One of the new machines combines the features of this apparatus and of that employed in cutting the teeth in clock wheels, but is more complicated than either. It is very neatly constructed and weighs only about half a pound. A standard, adjustable both vertically and horizontally, carries a screw shaft support which is capable of being revolved about the standard and fixed in any position and at any desired angle. Adjustment pins on the side regulate a pointer on a scale or small dial at the top of the machine, showing the exact inclination at which the stone is held by the shaft. It is claimed to be possible so to adjust the position of a stone that a series of facets—four, eight, or more—may be cut on a piece of gem material at any given angle and each angle and facet be mathematically symmetrical.

#### ANCIENT JEWELS.

Among the most remarkable discoveries ever made of ancient Egyptian jewelry are those of Prof. Flinders Petrie, in his recent excavations at Abydos. The date which he assigns is as remote as 5000 B. C., but the workmanship in gold and jewels is marvellous. In exploring the tomb of King Zer, of the earliest of Mr. Petrie's pre-Menean dynasties, it was found that the tomb had been entered for robbery at some unknown period in the past, and the plunderers had broken off the arm of the queen's mummy and hidden it in a crevice of the wall—perhaps on being disturbed or alarmed—and had never returned to remove it. On taking off the wrappings Professor Petrie found four magnificent bracelets of gold with amethyst, turquoise, and lapis-lazuli in varied and elegant adjustments. The gold work was exquisitely fine and delicate, though the metal was pure and soft, apparently with no hardening alloy. The stones were beautiful and very strikingly and peculiarly arranged.

Mr. Edward Ayer, of Chicago, Ill., possesses a number of amethyst

beads, about a quarter of an inch in diameter, of the richest and deepest purple, obtained by him at Dashour, Egypt, from the treasure in the tomb of Princess Meret, daughter of Amenhotep II, of the twelfth dynasty.

#### COLORS OF PRECIOUS STONES.

The colors of gems, and their liability at times to fade or to change, are of much scientific interest and also of considerable practical importance. Much may be learned, undoubtedly, concerning these questions by careful experimentation with glass and like substances. These subjects have been studied with great care for years past, and some valuable publications thereon have been issued by the late Mr. Thomas Gaffield, of Boston, Mass., a scientific glass manufacturer.

As early as 1863 he began experiments as to the action of sunlight in changing the color of glass, which have thrown light to some extent upon similar phenomena in precious stones. Mr. Gaffield, who died December 8, 1901, had made extensive collections of specimens and books illustrating these studies and experiments and the whole subject of glass and porcelain manufacture. These he bequeathed to the Massachusetts Institute of Technology, and his minerals and gems were largely presented to the Boston Society of Natural History.

#### LITERATURE.

##### PRECIOUS STONES ON NEW YORK ISLAND.

The reports of this Survey have contained from time to time notices of gem minerals—though rarely of gem quality—found on the island of New York, or more strictly, Manhattan. To these, chrysoberyl is added in the present report (p. 26) from a new locality. Some of the Manhattan beryls have been cut and mounted, but among the garnets, beryls, tourmalines, zeolites, and smoky quartz of the island few specimens are capable of such use, though many are interesting and sometimes remarkable as minerals. A valuable pamphlet on the geology and mineralogy of "Greater New York," including the five boroughs lately consolidated (Manhattan, Bronx, Queens, Brooklyn, and Richmond), has appeared during the year from the pen of Dr. Louis P. Gratacap, of the American Museum of Natural History.<sup>a</sup> It is a very complete and up-to-date handbook of the geological structure, topographical features, and mineral contents of this interesting area of the great metropolis.

##### PRECIOUS STONES OF MADAGASCAR.

A notable pamphlet has lately appeared on the mineralogy of Madagascar by Prof. Alfred Lacroix, of the Musée d'Histoire Naturelle of

<sup>a</sup> Geology of the city of New York, by L. P. Gratacap, published by the American Museum of Natural History. 82 pp., illustrated, 8°, 1901.



the Jardin des Plantes at Paris.<sup>a</sup> After treating of the general geology and mineralogy of the island, Professor Lacroix gives several pages to the precious stones. Diamonds are unknown, but corundum, spinel, chrysoberyl, topaz, beryl, garnet, tourmaline, and various quartz minerals are found in the auriferous alluviums, gathered by a natural concentration process, due to their density and hardness. Some of these species are also known in crystals, and even in the matrix, especially the fine colored tourmalines. The rolled grains or little pebbles in the alluvium are clear and brilliant, but rarely large enough to be valuable, but few of the crystals have anything like such purity and elegance. This fact, which is general and in no wise peculiar to Madagascar, Professor Lacroix points out as due to the fact that crystals are apt to be fissured, and that thus, as well as by cleavage, they break up in the process of rolling and attrition in stream beds; it is the purest and finest portions that resist longest and so form a large proportion of the pebbles and grains.

The corundum is sometimes colorless, pink, or a pale shade of blue or green, but generally very deep blue—too dark, indeed, for setting unless in very small stones. The rolled crystals show planes of the hexagonal prism, the base, and a very acute pyramid, and closely resemble those of Puy de Velay, in France. Their source is unknown as yet, whether from the volcanic rocks of the central "massif" or, as Professor Lacroix thinks more probable, from the gneisses and granites. Crystals of opaque corundum also occur.

Spinel, green but not of gem quality, are associated with the corundum. They are rolled out of all distinct crystalline form, but a similar spinel in distinct crystals occurs in limestone near the capital, Tananarive.

Cymophane (chrysoberyl) is here announced for the first time from Madagascar. It is abundant at several placer localities in the form of grains, transparent, and of beautiful color, and it would be a fine gem stone if it could be of sufficient size. With it, and closely resembling it, are grains of yellow tourmaline, distinguishable by their lower hardness and density and greater fragility.

Topaz appears in rounded grains resembling quartz. It is similar to that of Brazil, and would be of value if larger sized material could be found. Thus far none have exceeded a diameter of 4 mm.

Beryl (aquamarine) is obtained of green or light blue color and one specimen of a delicate pink;<sup>b</sup> but none have been seen in place. This and the two preceding species are judged to be from disintegrated pegmatite.

Garnets are by far the most abundant species, being found in almost

<sup>a</sup> Madagascar au début du XXme Siècle: (extrait) Minéralogie, par A. Lacroix, Paris, Société d'Éditions Scientifiques et Littéraires, Jan., 1902, 41 pp., 8vo.

<sup>b</sup> A fine pink crystal and a pink gem are in the Tiffany-Morgan collection, American Museum of Natural History, New York.

every stream bed of the gneissic region, and in place in the gneiss and in the pegmatite. These are chiefly almandites, well crystallized in the usual forms. An orange-yellow grossularite, or essonite, appears in some of the gold placers.

Zircon, in small rolled crystals, is found in the same alluvium, but nothing of gem quality.

Triphane (spodumene), transparent and light pink, is known from a single specimen. It might be an attractive gem stone if found in any amount.

Tourmaline is much the most important precious stone of Madagascar. The colored lithia types are found of a size and beauty equaling those of Brazil, Ceylon, or the Urals. The fragments in the streams are generally homogeneous in color, but the crystals exhibit the polychromatic character so frequent in this species, often being, like the Brazilian specimens, red within and green externally. A citron-yellow type is not uncommon, and occasionally a pure ruby red. A fine golden-yellow specimen was shown at the Paris Exposition of 1900.

The crystals are found in place in quartz veins in the pegmatites at several localities mentioned.

Black tourmalines also abound in the pegmatites, often large, very regular in form, and very pure.

Other minerals of the pegmatites that may prove of gem value are a beautiful green microcline (amazon stone), an opalescent orthoclase (moonstone), and klaprothite (lazulite) of a rich Prussian blue.

It is for its masses of hyaline quartz, however, that Madagascar has been noted since the middle of the seventeenth century, when large irregular blocks of this material were first reported by travelers. In 1658 Flacourt, in his history and map of the island, indicated its occurrence at various points along the streams entering the sea opposite and near to Isle Ste. Marie, on the east coast. Since then many specimens have been brought to the museum at Paris, all of similar character. It occurs throughout the central gneissic region, especially in the northeastern part, and along the coast in the neighborhood of Vohémar. It has been obtained principally from this port and carried elsewhere by native boats and other vessels; whence the name of Vohémar has been generally given, in commerce and in collections, as the locality for all Madagascar quartz.

Thus far only rolled masses from stream beds have been used. These are for the most part completely rounded, but sometimes large crystals of good form are found, weighing several hundred kilograms, and for purity, brilliancy, and perfection, unrivaled at any other known locality. Two-thirds of all the crystal balls sold as Japanese are really of Madagascar origin, and are cut either in Germany, France, or the United States. They are frequently over 5 inches in diameter. The writer saw a heap of 50 tons of transparent material

in Paris in 1891. Fine crystals are in the American Museum of Natural History and the Field Columbian Museum. The material is largely limpid and colorless, but is often full of fluid cavities disposed in horizontal or curved planes; and when these become very abundant the quartz is rendered milky, and hence unsuitable for either optical or ornamental uses. Some smoky quartz occurs with it, but in much less abundance.

The quartz with inclusions is also often in large pieces, which when polished form magnificent cabinet specimens. Examples may be seen in the Tiffany-Morgan collection at the American Museum of Natural History, and in the Tiffany-Higginbotham collection at the Field Columbian Museum, Chicago.

The sources of this material are not yet known, and Professor Lacroix speculates somewhat as to whether it comes from quartz veins or from the pegmatites. The latter view is favored by the occasional presence of inclusions of mica scales and needles of tourmaline, the former by other cases where the quartz contains acicular rutile, lamellæ of chlorite, and crystals of epidote and siderite. Besides the large masses and crystals, it occurs also in crystals of ordinary sizes, and presents colored varieties—amethystine, smoky, and yellow (false topaz). Some of the amethysts are very rich in color, and might be available for gem use equally with those of Brazil and Siberia. These occur both in the granites and schists and in the volcanic rocks; and there are also many varieties of chalcedony, onyx, and jasper, some of which may be valuable for ornamental uses.

M R 1901—49

## PRODUCTION.

In the following table is given a statement of the production of precious stones in the United States from 1896 to 1901:

*Production of precious stones in the United States from 1896 to 1901.*

Stone.	1896.	1897.	1898.	1899.	1900.	1901.
Diamond .....	None.	None.	None.	\$300	\$150	\$100
Sapphire .....	\$10,000	\$25,000	\$55,000	68,000	75,000	90,000
Ruby .....	1,000	None.	2,000	3,000	3,000	500
Topaz .....	200	None.	100	None.	None.	None.
Beryl (aquamarine, etc.) .....	700	1,500	2,200	4,000	11,000	5,000
Emerald .....	None.	25	50	50	4,000	1,000
Phenacite .....	None.	None.	None.	None.	None.	None.
Tourmaline .....	3,000	9,125	4,000	2,000	2,500	15,060
Peridot .....	500	500	500	500	500	500
Quartz, crystal .....	7,000	12,000	17,000	12,000	10,000	10,000
Smoky quartz .....	2,500	1,000	1,000	None.	1,000	1,000
Rose quartz .....	500	None.	100	100	100	150
Amethyst .....	500	200	250	250	500	500
Prase .....	100	None.	None.	None.	None.	None.
Gold quartz .....	10,000	5,000	5,000	500	2,000	2,000
Rutilated quartz .....	500	None.	100	50	50	50
Dumortierite in quartz .....	50	None.	None.	None.	None.	None.
Tourmalinated quartz .....	None.	None.	None.	None.	None.	1,000
Agate .....	1,000	1,000	1,000	1,000	1,000	1,000
Moss Agate .....	1,000	1,000	1,000	1,000	1,000	500
Chrysoptase .....	600	None.	100	100	100	1,500
Silicified wood (silicified and opalized) .....	4,000	2,000	2,000	3,000	6,000	7,000
Opal .....	200	200	200	None.	None.	None.
Garnet (almandite) .....	500	7,000	5,000	5,000	500	100
Rhodolite .....	None.	None.	None.	None.	20,000	21,000
Garnet (pyrope) .....	2,000	2,000	2,000	2,000	1,000	1,000
Topazolite .....	100	None.	None.	None.	None.	None.
Amazon stone .....	1,000	500	500	250	250	200
Oligoclase .....	500	25	10	20	20	None.
Moonstone .....	250	None.	None.	None.	None.	None.
Turquoise .....	40,000	55,000	50,000	72,000	82,000	118,000
Utahlite (compact variscite) .....	500	100	100	100	100	250
Chlorastrolite .....	500	500	5,000	3,000	3,000	3,000
Nesolite (thomsonite, so called) .....	500	500	1,000	1,000	1,000	1,000
Prehnite .....	100	100	100	50	50	None.
Diopside .....	200	100	None.	None.	None.	None.
Epidote .....	250	None.	None.	None.	None.	None.
Pyrite .....	1,000	1,000	1,000	1,000	2,000	3,000
Malachite .....	None.	None.	None.	250	200	100
Rutile .....	100	800	110	200	100	None.
Anthracite .....	2,000	1,000	1,000	2,000	2,000	2,000
Catlinite (pipestone) .....	3,000	2,000	2,000	2,000	2,000	2,000
Fossil coral .....	1,000	500	500	50	50	100
Arrow points .....	1,000	1,000	1,000	1,000	1,000	500
Total .....	97,850	130,675	160,920	185,770	233,170	289,050

## IMPORTS.

The following table shows the value of the diamonds and other precious stones imported into the United States from 1867 to 1901:

*Diamonds and other precious stones imported and entered for consumption in the United States, 1867 to 1901, inclusive.*

Year ending—	Diamonds.					Diamonds and other stones not set.	Set in gold or other metal.	Total.
	Glaziers'.	Dust.	Rough or uncut.	Set.	Unset.			
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	2,371,586
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	68,270			2,970,469	1,025	3,071,173
1879.....		18,889	104,158			3,841,335	588	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	3,206	8,922,771
1883.....		82,628	443,996			7,598,176	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		10,831,890
1888.....	10,025	29,127	244,876			10,223,630		10,507,658
1889.....	8,156	68,746	196,294			11,704,808		11,978,004
1890.....	147,227	179,154	349,915			12,429,395		13,105,691
1891.....	a 565,623	125,688	(c)			f 12,065,277		12,756,588
1892.....	532,246	144,487				f 13,845,118		14,521,851
1893.....	357,939	74,255				f 9,765,311		10,197,505
1894.....	82,081	53,691				f 7,291,342		7,427,114
1895.....	107,463	135,558				f 6,330,834		6,573,855
1896.....	78,990	65,690		(d)	(d)	f 4,474,311		4,618,991
1897.....	b 29,576	167,118	1,386,726	\$330	\$2,789,924	1,903,055		6,276,729
1898.....	8,058	240,665	2,513,800	6,622	5,743,026	1,650,770		10,162,941
1899.....	2,428	618,354	4,896,324	13,388	8,795,541	2,882,496		17,208,531
1900.....	8,333	605,495	3,658,645	10,721	7,803,066	1,472,328		13,558,588
1901.....	5,864	831,984	6,592,469	2,654	13,544,326	1,938,055		22,815,352

a Including also engravers', not set, and jewels to be used in the manufacture of watches, from 1891 to 1894; from 1894 to 1896 miners' diamonds are also included.

b Including also miners' and engravers' not set.

c Included with diamonds and other stones from 1891 to 1896.

d Not specified prior to 1897.

e Includes stones set and not specially provided for since 1890.

f Including rough or uncut diamonds.

g Not specified since 1883.