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MINERAL RESOURCES

OF THE

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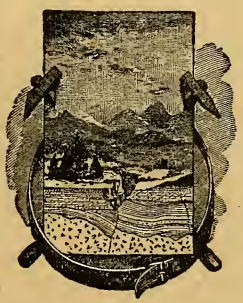
CALENDAR YEAR

1891

DAVID T. DAY
CHIEF OF DIVISION OF MINING STATISTICS AND TECHNOLOGY



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PRECIOUS STONES.

By George Frederick Kunz.

Introduction.—Since the last report on this subject was prepared, definite and systematic mining has been carried on at seven places in the United States, viz: Near Los Cerrillos and in Grant county, New Mexico, for turquoise with much success and profit; extensively for sapphire in connection with gold on the Missouri river, near Helena, Montana, with what commercial success is not known; for opal, with fair success, at Gem City, Washington State; for tourmaline at Mount Apatite and Mount Mica, both in Auburn, Maine, and for emeralds and lithia emerald in Alexander county, North Carolina, during 1891, but with little success.

Production.—The following table gives the output of the various gems and precious stones during 1891:

Product of rough gems before cutting, for the year 1891.

Gems.	Value.	Gems.	Value.
Turquois	$150,000	Agatized and jasperized wood	$2,000
Opal	5,000	Pyrite	1,500
Sapphire	10,000	Chlorastrolite	500
Tourmaline	3,000	Thomsonite	200
Garnet	3,000	Fossil coral	1,000
Peridot	1,000	Catlinite (pipestone)	5,000
Emerald and lithia emerald	1,000	Ornaments	15,000
Aquamarine	1,000	Topaz	100
Quartz	10,000	Miscellaneous	15,000
Smoky quartz	5,000		
Gold quartz	6,000	Total	235,300

Estimated production of precious stones in the United States from 1884 to 1891.

Species.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Value.	Value.	Value.	Value.	Value.	Value.	Value.	Value.
Diamond	$800	.....	$60	.....	.....	.....	.....	.....
Sapphire gems	1,750	$500	750	$500	$500	$6,725	$6,725	$10,000
Chrysoberyl	25	.....	.....	.....	.....	.....	.....	.....
Topaz	500	1,250	1,000	2,000	600	400	.....	100
Beryl	700	750	5,500	3,500	800	.....	.....	.....
Phenacite	.....	.....	.....	.....	650	200	.....	.....
Emerald	.....	3,200	3,200	.....	100	450	.....	*a*1,000
Hiddenite	.....	2,500	4,500	.....	.....	.....	.....	.....
Tourmaline	2,000	600	5,500	500	.....	2,250	2,250	3,000
Smoky quartz	12,000	7,000	7,000	4,500	4,000	4,232	2,225	5,000
Quartz	11,500	11,500	11,500	11,500	11,150	14,000	14,000	10,000
Silicified wood	10,500	6,500	1,500	36,000	16,000	.....	.....	.....
Garnet	4,000	2,700	3,250	3,500	3,500	2,308	2,308	3,000
Anthracite	2,500	2,500	2,500	2,000	1,500	.....	.....	.....

a For cabinets, museums, etc.

Estimated production of precious stones in the United States from 1884 to 1891—Cont'd

Species.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	Value.	Value.	Value.	Value.	Value.	Value.	Value.	Value.
Pyrite	$3,000	$2,000	$2,000	$2,500	$2,500	$2,000	$2,000	$1,500
Amazonstone	2,750	2,750	2,250	1,700	1,700	500	500	.....
Catlinite (pipestone)	10,000	10,000	10,000	5,000	5,000	5,000	5,000	5,000
Arrow points	1,000	2,500	2,500	1,500	1,500	.....	.....	.....
Trilobites	500	1,000	1,000	500	500	.....	.....	.....
Sagenitic rutile	1,000	250	1,750	.....	.....	.....	.....	.....
Hornblende in quartz	600	300	200	100	.....	.....	.....	.....
Thomsonite	750	750	400	750	500	400	400	200
Diopside	.....	100	.....	50	.....	.....	.....	.....
Agate	4,500	2,000	2,000	4,000	4,000	.....	.....	.....
Chlorastrolite	1,500	.....	1,000	800	800	500	400	500
Turquois	2,000	3,500	3,000	2,500	3,000	23,675	28,675	150,000
Moss agate	3,000	2,500	2,000	950	950	.....	.....	.....
Amethyst	2,250	2,100	2,100	2,100	2,500	98	.....	.....
Jasper	2,500	.....	.....	.....	100	.....	.....	.....
Sunstone	450	350	300	150	.....	.....	.....	.....
Fossil coral	750	.....	1,000	2,000	3,000	700	700	1,000
Rutile	.....	750	750	.....	.....	.....	.....	.....
Aquamarine	.....	.....	.....	.....	.....	747	.....	1,000
Rose quartz	.....	.....	.....	.....	.....	600	200	.....
Gold quartz	140,000	140,000	40,000	75,000	75,000	9,000	9,000	6,000
Rutilated quartz	.....	.....	.....	.....	.....	30	.....	.....
Dumortierite in quartz	.....	.....	.....	.....	.....	250	250	.....
Quartz coated with chalcedony	.....	.....	.....	.....	.....	4,000	2,000	.....
Chrysoprase	.....	.....	.....	.....	.....	200	200	.....
Agatized and jasperized wood	.....	.....	.....	.....	.....	53,175	6,000	2,000
Banded and moss jasper	.....	.....	.....	.....	.....	630	.....	.....
Fluorite	.....	.....	.....	.....	.....	500	500	.....
Azurite and malachite	.....	.....	.....	.....	.....	2,037	.....	.....
Zircon(*a*)	.....	.....	.....	.....	.....	16,000	.....	.....
Gadolinite, fergusonite, etc. (*a*)	.....	.....	.....	.....	.....	1,500	.....	.....
Monazite (*a*)	.....	.....	.....	.....	.....	1,000	.....	.....
Spodumene (*a*)	.....	.....	.....	.....	.....	200	.....	.....
Wooden ornaments decorated with minerals (*b*)	.....	.....	.....	.....	.....	15,500	15,500	15,000
Opal	.....	.....	.....	.....	.....	.....	.....	5,000
Peridot	.....	.....	.....	.....	.....	.....	.....	1,000
Miscellaneous minerals (*c*)	.....	.....	.....	.....	.....	20,000	20,000	15,000
Total	222,825	209,850	118,850	163,600	139,850	188,807	118,833	235,300

a Including lithia emerald.
b Used to extract the rarer elements for chemical purposes.
c Such as clocks, horseshoes, boxes, etc.

Diamonds.—In connection with the occurrence of diamonds in the United States, mention should be made of certain recent discoveries in the Northwest. In the Engineering and Mining Journal, December 13, 1890, page 686, a communication appeared from Mr. G. H. Nichols, of Minneapolis, Minnesota, stating that in a review of Gems and Precious Stones of North America, published in that journal, no reference had been made to the occurrence of diamonds in Wisconsin, where he had found several small stones. The writer immediately put himself in communication with Mr. Nichols, and from him obtained the following particulars:

In the summer of 1887 Mr. Nichols was engaged in prospecting for gold on Plum creek, Rock Elm township, Pierce county, Wisconsin, in company with Mr. W. W. Newell and Mr. C. A. Hawn, of Rock Elm. While sluicing for gold one of their workmen detected a bright stone, which proved to be a diamond, in gravel taken from the bank of the

stream at a depth of some few feet below water level. Bad weather interrupted the work at that time, but subsequently they resumed the search, and several more diamonds were found by other members of the party. Nothing more was done in 1887, but in panning three miles farther up the stream Mr. Newell found another diamond, much distorted and off color. In the summer of 1888 actual sluicing for gold was begun, and in three weeks' time in the gravel at the washout four diamonds were found. One came from the surface of the gravel bed and one from a pit some 30 rods distant, at a depth of 5 or 6 feet below water level. The most perfect stone was obtained by a workman, who secreted it. In 1889 prospecting was resumed on the west branch of Plum creek, and here Mr. Nichols found another diamond in gravel taken from the sluice. Two or three small ones were also found in the tailings.

Gold occurs all along the main branches of Plum creek, as well as along the smaller runs of their extreme headwaters from 2 to 5 miles from their junction. From Mr. Nichols the writer received a series of specimens both of the gold-bearing sands in which the diamonds sent to him for examination were reported to have been found, and three of the diamonds weighing, respectively, $\frac{25}{32}$ of a carat (160.5 milligrammes), $\frac{7}{16}$ of a carat (46 milligrammes), and $\frac{3}{32}$ of a carat (19.25 milligrammes). Only the largest of these would cut into a stone of any value. It is a hexoctahedral crystal with rounded faces, white, with a slight tinge of grayish green, and could be cut into a perfect brilliant of about $\frac{3}{16}$ of a carat. On one side is an L-shaped depression with rounded faces in which there are minute grains of sand. The next in size is a slightly yellowish elongated hexoctahedron. The surface is less smooth than that of the larger one and is entirely covered with small crystalline markings. The smallest one is an elliptical hexoctahedral twin, with a dull surface. In color it resembles the second.

The sand sent by Mr. Nichols, when examined by the microscope, was found to contain the following minerals besides the quartz grains: magnetic iron, titanic iron, almandite garnet in grains and in minute perfect dodecahedrons, small transparent brilliant crystals, none more than one-third the size of a pin's head, of what appeared to be spessartite or essonite garnet, numerous grains and rolled crystals of monazite and one small grain reported to the platinum, but this was lost before the writer could examine it. The whole material is thus seen to resemble in many particulars the gold-bearing sands of Burke county, North Carolina, and Hall county, Georgia. This matter is interesting as a new locality for diamonds, but it is very doubtful if these sands will be more prolific or the discovery have any greater commercial value than the gold sands of the southern Alleghenies up to the present time.

Diamonds in meteorites.—A remarkable account has been published by Prof. George A. Koenig, of the University of Pennsylvania, regarding the discovery of what appears to be diamond, or at least the diamond form of carbon, in a meteorite from Cañon Diablo, Arizona, sent

to him for examination by Prof. A. E. Foote, of Philadelphia, who obtained it at the locality in 1891. The following is a summary of this account: (*a*)

The piece examined weighed about 16 pounds; it was one of a number, some of which were very large. On attempting to cut it, remarkable hardness was at once observed, and the edge of the half-inch chisel was repeatedly broken. Presently an intensely hard spot was reached where a black powder was produced instead of chips. This powder carefully collected amounted to about four-tenths of a grain. The spot was found to be a round cavity, about half an inch across, through which the cutting machine had passed, leaving the halves on both sides lined with a black mammillary coating, resembling black diamond. On attempting to polish the sections of the meteorite on an emery wheel, the latter was cut to pieces where it met with this cavity, and corundum was easily cut into grooves by the black coating. The powder dissolves in nitric acid, yielding a red solution resembling iron carbide and leaving a black residue. The latter with sodium hydrate yields an intense amber yellow or gold-colored liquid, from which acids give no further precipitate. The residue, fused with hydrosodium sulphate, left a substance in which the microscope revealed minute particles, some black and others partially transparent, and one white spherical grain. These had no effect on polarized light. Unfortunately, however, they were lost by an accident before further examination could be made.

During 1891 work was carried on for a number of months at Isons Mills, Elliott county, Kentucky, at the periodotite dikes previously examined by Dr. Diller and the writer by direction of the U. S. Geological Survey. It was supposed at that time that as these dikes contained carbonaceous shale under conditions similar to those at the south African fields diamonds might also be found there. Although it was suggested previously (*b*) that the paucity of the carbon in the Kentucky shale precluded the possibility of its containing diamonds, yet a number of gentlemen have carried on operations there during 1890 and 1891 with the hope that diamonds may at some time be obtained. These efforts have not yet met with success.

Sapphire.—The sapphire locality in Montana is being developed. The mineral is found to be somewhat abundant in the gravel bars of the Missouri river for a distance of some 6 miles. The principal points are those known as Ruby bar, French bar, Spokane bar, and Eldorado bar. Of these, the central point is the Spokane bar, at Stubbs ferry on the Missouri, some 12 miles east from the city of Helena. Although these bars had been partially sluiced for gold, no systematic attempt had been made to work them for gems until 1891. Some of the sapphires had occasionally been sent to large cities, but they never

a Am. Jour. Sci., 3d ser., vol. XLII, 1891, p. 413.
b Science, October 29, 1886, and September 16, 1887.

until recently received much recognition, owing to the high price of cutting sapphire gems and the small demand existing for stones other than of deep color, such as true ruby red or sapphire blue. In 1889 an area of about 4,000 acres (6¼ square miles) was purchased, or the option obtained upon it, by a company capitalized at £450,000, which contemplates working Eldorado bar and the other bars for a distance of about 6 miles.

The company has had the property examined by mining engineers, whose estimate is that Eldorado bar will yield some 2,000 ounces of sapphires to the acre. Only a part of these, however, may be of such quality as to warrant cutting for gems. The stones found exhibit a great variety of colors, chiefly the lighter shades of red, yellow, blue, and green. The latter tint is found quite pronounced, being rather a blue green than an emerald green. Nearly all them, when finely cut, have an apparent metallic luster, strikingly peculiar to the stones from this locality. No true red rubies, nor true blue sapphires, the colors demanded by the public, have been found, the other shades having thus far been only sought by the collectors. It is claimed that there is an abundance of gold, and time only can tell whether the enterprise can be a success.

Several minor companies have been formed or are contemplated. One, known as the Spokane Sapphire Company, embraces that part of the river, near Stubbs ferry, and on what is known as Spokane bar, and one is said to have been formed to protect the interest of the Montana Sapphire and Ruby Company. At all these bars the sapphires are principally found in a layer of auriferous glacial gravel a few inches in thickness, which reposes directly on a slaty bed rock. While work was going on at Ruby bar, a mastodon tusk, 3 feet in length, was found in the sapphire layer.

Among some of the associated minerals observed were white topaz in brilliant crystals not over one-fourth of an inch in length, similar to those from Thomas mountain, Utah; rounded grains of garnet, sometimes as large as a pea and rich ruby red in color, often erroneously called rubies; cyanite in broken translucent crystals, which are white with blue patches, one-half an inch in length and one-eighth of an inch in diameter; cassiterite (stream tin) in rolled concentric nodules, none over one-fourth of an inch in diameter; limonite pseudomorph after iron pyrites, in a variety of imitative and concentric shapes, showing a radiated structure when broken; chalcedony in small irregular and imitative pieces, often an inch in length; and white calcite in small rolled masses.

In regard to the original source of the sapphire itself it is worthy of note that during the winter of 1889 and 1890 an eruptive dike was found cutting the slaty rock at Ruby bar, on which rests the glacial gold gravel. In this eruptive rock were found crystals of sapphire, pyrope garnet, and sanidine feldspar. There seems little doubt that all the sapphire along the bars of the Missouri river has come from the

breaking down of a rock similar to this. It is evident that some outcroppings have been eroded by glacial action north of all the bars, but from what precise locality is not yet known. It can not have come from the dike at Ruby bar, as this locality is 6 miles south of Eldorado bar, where a quantity of sapphires were found, but rather from some others now worn away or covered over farther to the north. Mining in this district will probably bring to light other dikes, as did the drifting of a level at Ruby bar some hundreds of feet from the outcrop of the original 4-foot dike. The rock is shown by Mr. H. Miers to be a vesicular mica-augite-andesite, containing an abundance of brown mica and porphyritic crystals of augite.(*a*) The ground mass consists chiefly of feldspar microlites with a considerable amount of glassy interstitial matter and much magnetite. Many of the cavities are occupied by a brown glass which appears yellow in thin sections and displays a spherulitic structure originating in the sides of the cavities.

It is of course difficult to say whether or not the sapphires have been caught up by the augite-andesite from schists or other rocks cut through in coming up, as may have been the case in the occurrences in the Eifel Laacher See, at Unkel, and in Auvergne at Espailly, France.

Owing to the prominence given to the Montana sapphires by the press some thousands of these stones have been sent east and to other centers by the people residing in the vicinity of the district where they are found, for cutting. The result has been that many of them have been cut in the belief that they have a value as gems far beyond their true commercial one. With them many garnets also have been sent frequently exceptionally fine in color.

Emerald.—The mining for emerald and lithia emerald has been carried on for ten years by the Emerald and Hiddenite Mining Company, organized in 1881, with a nominal capital of $100,000. Work was carried on for some time during the summer of 1891, and about 1,500 carats of lithia emerald (hiddenite) and a few small emeralds were obtained, although all were of little value.

Turquois.—During 1890 and 1891 turquois of fine quality and of gem value has been found in the United States. The main locality is the one near Los Cerrillos, New Mexico; the others known are in Grant county, New Mexico.

During the early part of 1890, what is known as the Castilian turquois mine was leased and a number of men put to work by Mr. J. A. Allen, of Chicago, Illinois. This mine is 7 miles from Los Cerrillos, New Mexico, on the road from that place to Santa Fé, and about 1½ miles from Bonanza, with another one adjacent to it. At both these places an immense amount of working was done centuries ago by the Indians, as the hundreds of stone hammers observed by the writer indicate. This property has been opened during the past year, a shaft has been sunk 75 feet, and a lode opened for about 40 feet. The vein or

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a Mineralogical Magazine, vol. 9, No. 44, 1891, p. 396.

lode is nearly due east and west. Although the rock is the same, the color of the turquois is superior to that found at the old mine, and a number of other mines have been opened in this vicinity. Thousands of stones were obtained during the two years' operations. Many of them are of fine blue color, quite equal to the best Persian, and material has been obtained choice enough to insure a sale amounting to fully $200,000. A single stone has been sold for about $4,000. The discoveries have proved especially valuable at a time when the Persian mines have almost ceased to yield.

Two new localities for turquois have been discovered in the Burro mountains, near the old Paschal smelting works, about 15 miles southwest of Silver City, in Grant county, New Mexico. This discovery resulted in the forming of an eastern company, which is finding fine material.

This company, organized in October, 1891, under the name of the Azure Mining Company, under the laws of the State of New York and incorporated, has a number of turquois mines in New Mexico, but up to the present has paid especial attention to but one mine, the Azure. This has been steadily worked and several thousands of dollars' worth of turquois have been sold. The colors range from a deep sky-blue to a blue with a faint tint of green, the fine material being limited in quantity. The stones produced at this mine always have a tint of green, due either to a partial change in the mineral or to a local variation. They are not by any means an ideal turquois blue, but they furnish good merchantable material, and if they continue to keep their color it is believed that they will eventually drive out of the market the Egyptian and the poorer quality of American stones. Up to the present time the output of good turquois has not much more than paid for the expenses of the enterprise. After selling the turquois for seven months the owners claim that thus far they do not know of a single stone that has changed color.

The turquois traverses the rocks in seams and streaks, one mass of which measured 8 inches in diameter and was one-eighth to one-fourth of an inch in thickness. A heap of débris 50 feet in height and quantities of small fragments of weathered turquois show that this locality, like the other New Mexican ones, was extensively worked by the aborigines.

About 12 miles from this deposit is an Indian graveyard. In every grave that has been opened a few polished or irregular-shaped turquois beads have been found.

As to the use of turquois by the aborigines, the writer observed some interesting facts in New Mexico recently while witnessing the annual "festa," which is held on August 4 in honor of the patron saint of the Indians of the pueblo of Santo Domingo, a point lying about three miles west by south from Wallace Station, on the Atchison, Topeka and Santa Fé railroad. This "festa" is attended by many Indians of the

neighborhood, including the San Felipe, Navajo, Isleta, Acoma, and Jicorilla Apache tribes, and a curious custom is maintained. A carved wooden image of the saint, about four feet high, which is said to date from the time of the reconquest in 1692, is carried in procession through the principal streets to a small tent made of the finest Navajo blankets. Here it is placed on an improvised altar and various offerings are presented to it. Among these are strings of turquois beads, both round and flat, of the choicest color, which are suspended from the ears of the figure and from a string which encircles its neck, while on its breast is hung one of the curious turquois-encrusted marine clam-shells, similar to one which Lieut. F. H. Cushing found in the excavations near Tempe, Arizona.(*a*) With the exception of a black band of obsidian running across the center, the entire exterior of the shell is covered with a sort of miniature pavement of little squares of turquois cemented to it with a black shellac-like substance obtained from the "grease-wood" plant common in New Mexico and Arizona.

Tourmaline.—The Mount Apatite Mining Company, organized in 1891, kept a small force of men at work at Mount Apatite, Auburn, Maine, during that summer and obtained a large quantity of material in the form of mineral specimens, but few gems of any value. The operations carried on by private parties yielded during 1890 about $1,000.

In September, 1881, the Mount Mica Tin and Mica Company was organized under the laws of the State of Maine, proposing to explore and mine the deposits in Oxford county, which were believed to be rich in tin, mica, tourmaline, and the minerals of the lithia group. Their principal property was the Bowker farm, situated on the famous Mount Mica, in the town of Paris, Oxford county, Maine, about 4 miles distant from South Paris station, on the Grand Trunk railroad. The company was organized with a nominal capital, the stock being entirely held by the directors and officers. Work has been carried on from time to time at this locality, generally when the farm hands in the vicinity were not otherwise employed. This is true as well of the mine at Hebron, Maine, also secured by the company. Single gems have been obtained valued at over $500 each, and in all at least $15,000 worth have been found since 1881. A number of these have been sold and others retained by the directors, in whose collections they have been placed. The bulk of the crystals—the famous Hamlin collection of tourmalines—has been sold by Dr. A. C. Hamlin and presented by Mr. James A. Garland to the mineralogical cabinet of Harvard University. This collection will be more fully described and figured in colors in a publication which Dr. Hamlin is now preparing. It contains the finest crystals of tourmaline on the matrix found at Mount Apatite, and the finest collection of minerals found associated with tourmalines at this locality, collected by Mr. Thomas F. Lamb, of Port-

a Gems and precious stones of North America, p. 61.

land; also, a series of nearly one hundred crystals from the same place, collected by the late Prof. N. H. Perry, and a number of other crystals from other Maine collections. Harvard University, therefore, now possesses the finest known series of colored tourmalines in the world.

A new locality for pink tourmaline is given by Mr. Orcutt in a report on the minerals of the Colorado desert.(*a*) It is found in the mountains of Lower California, south of the Alamo mines (though whether within the actual limits of the desert or not, he does not specify), in an identical association with that from Rumford, Maine, and from Rozena, Moravia, viz, rose-colored tourmalines in lepidolite.

Quartz.—An interesting discovery has been made at Placerville, Eldorado county, California, by Mr. James Blackiston, in a quartz ledge running north and south and dipping eastward from 45 to 50 degrees. The rock of the ledge, which is partly decomposed and partly compact, is traversed for perhaps 100 feet by a vein of crystallized quartz varying in width from 6 inches to over a foot. This vein is also decomposed, and is filled in with a reddish earth or sand and can be dug into with a stick or board. It was full of quartz crystals of all sizes, from that of a man's finger up to large dimensions, some of the crystals weighing as much as 80 or 90 pounds.

Several of these, over 50 pounds in weight, were pellucid and free from flaws; while others have peculiar interest from remarkable inclusions of chlorite, 3 to 5 millimeters in thickness, at several depths in the crystal, thus marking successive stages of crystal growth and making very striking "phantoms," generally of green chlorite on white quartz layers. Of still greater interest, however, are other quartz crystals, 2 to 4 inches in length and half as much in diameter, containing at or near their centers inclusions resembling groups or clusters of dolomite or siderite crystals cream-white to brown in color, and consisting of many curved rhombohedra from 2 to 4 millimeters in diameter.

Quartz crystals containing inclusions of goethite crystals, have been found in the Tarry All range, 40 miles west of Colorado Springs, and cut into beautiful ornaments resembling quartz penetrated by crystals of black rutile.

Smoky quartz.—Fine crystals of smoky quartz, one of them 3½ inches in length and 1¾ inches in diameter, have been found in Three-Mile gulch, 3 miles southeast of Helena, Montana.

Hydrolites.—Thin shells of chalcedony filled with water and containing a moving bubble, measuring from ½ to 1½ inches in diameter, are frequently found on the Oregon coast near Yaquina bay and Astoria.

In a report on the minerals of the Colorado desert, Mr. C. R. Orcutt mentions "water-agate" (hydrolite) from Canyon Springs, and beautiful agates and chalcedonies in the drift of the desert and scattered over the mesa-like formations that border the depressed plains.

a C. R. Orcutt, Tenth Annual Report of the State Mineralogist of California, 1890.

Agate.—Agate in bowlders from a few inches to a foot across, of rich red, brown, and mottled tints, is found in the vicinity of Austin Bluffs, near Colorado Springs and Colorado City, Colorado.

Agatized wood.—In the eighth annual report of the U. S. Geological Survey for 1886–87, Prof. Lester F. Ward, has contributed the most exhaustive treatise on the geological distribution of fossil plants throughout the world, including silicified and agatized wood, that has appeared up to the present time. He says:

"These remarkable petrifactions are believed to occur in the Shinarump group of Powell, and their mode of occurrence is described by him in his 'Geology of the Uintah mountains,' 1876, p. 69. These great trees of stone are believed by the Indians to be the shafts of their thunder-god, Shinauav, and from this Major Powell named the group, which he regards as of Cretaceous age."

On visiting Chalcedony Park, the nearest of the three so-called forests in this formation on the Atlantic and Pacific railroad, the writer found it to be about a mile square and inclosed by table lands from 50 to 100 feet in height. Nearly all the agatized wood is found on the flat plain below these table lands, and rests on layers of sandstone. The lower layer is chocolate-red, another white, another black, and another a compact sandstone, gray, and on these rests a layer of white sandstone in which all the wood at this locality originally belonged. By the washing and weathering away of this formation, the tree trunks have rolled down to the level plain below, and none of them were ever in place there. In the upper layer, where they belong, no trunks occur in the upright position, nor were any roots visible; and since none of the trees retain any of the original bark, it seems very probable that all this deposit was once the bed of an inland sea or lake.

There exist two more deposits of jasperized wood, distant respectively 8 and 16 miles from Chalcedony Park; and also a number of outcrops of this material are seen along the line of the Atlantic and Pacific railroad, although the quality is not as fine as that of the three original deposits.

Within 3 miles of Los Cerrillos, New Mexico, there is a small fossil forest of agatized and jasperized wood, closely resembling that of the Chalcedony Park in Arizona. Two sections from this locality, weighing about a ton each, are to be seen in the collection of the Historical Society of New Mexico, at Santa Fe.

Dr. Alexis A. Julien, who has made a careful microscopic study of the jasperized wood, made the following communication to the New York Microscopical Society at the January meeting, 1892: "In the jasperized wood from Arizona, many of the wood cells are traversed by the well-preserved mycelium of a fungus, secreting iron oxide, of which the still living species has already been described.—[Jour. of the N. Y. Microscopical Society.] The fine threads are silicified and heavily coated with yellowish to reddish brown ferric oxide, and, by their minute and

close branching, form spongy masses of cylindrical shape, often somewhat curved or spiral, and of a little less diameter than the wood cells along which they lie. It was often noticed in a sliced thin section of the silicified wood that these spongy cylinders of iron oxide adhered mostly to the same side of the wood cells which inclosed them. In other cases, the walls of several wood cells appeared to be broken down in the vicinity of the larger ocherous cylinders, as if by erosion, through the agency of the organism, producing irregular cavities, now filled with clear quartz.

"Another mode of growth of the fungus was well shown in many branching plants which have insinuated themselves within the thin lamellæ, which make up the walls of the wood cells, and so have crossed over several cells through and inside of their walls, but without entering the cells.

"The mode of introduction of the fungus into the wood is clearly shown in many thin veins of agate, which cross the sections and indicate cracks in the trunk of the original tree. In these veins, as well as in the erosion cavities referred to above, many fungus spores were observed sprouting into mycelium, of which some of the branches were noticed penetrating through the walls of the neighboring wood cells. From these, as well as from other facts observed on the plant now living, the following conclusions were drawn:

"1. That the tree fell and was submerged in a shallow sheet of gently running water, such as that which oozes through the cedar swamps of the Atlantic coast down to the sea, at the present day.

"2. The wood tissue of the tree was attacked by the water fungus immediately after its fall, and this growth mainly progressed on the lower side of the cells in the prostrate tree. After the decay and loosening of the bark, the floating spores of the fungus evidently made their entrance into the tree, through the cracks in its trunk.

"3. The slowly moving current under the swamp brought by infiltration into the wood cells a constant supply of water, charged with organic salts of iron, etc. The coloration of the wood has been effected, not by chemical or mechanical agency, but entirely by organic secretion and deposit of ferric oxide, etc., by this interesting species of water fungus.

"4. The complete silicification of the wood finally ensued, with a deposit of the chalcedonic and crystalline quartz, producing varieties of jasper, banded chalcedony, ruin agate, etc.

"In the silicified wood from Barillas Springs, Texas, still more delicate and complex forms of the same fungus were detected in a perfect state of preservation."

Opal.—In August, 1890, Mr. James Allen, a jeweler, of Yonkers, New York, detected what proved to be fire opal in a heap of rocks thrown out in digging a well, from a depth of 22 feet, on the farm of William Leasure, near Whelan, 20 miles southwest of Colfax, in Washington

State, lat. 47 north, long. 117 west. This point is about midway between the Cœur D'Alene and the Nez Perces Indian reservations, near Moscow, Idaho, almost on the line of Idaho and Washington. The material was rather plentiful, as the last 4 feet of the rock contained cavities filled with precious opal. The rock is a basalt in which most or nearly all the feldspar and pyroxene, as well as the green mass, appears to have been altered. Some original constituent may have changed, but whether or not it is olivine it is difficult to determine, because of the crystalline aggregate character of the pseudomorphic mass. The pieces vary from the size of a half pea to that of a hen's egg, and are found in vasicular lava; the smaller nodules are very rich in color, but the larger ones often have little or no play of colors. The quality of some of the specimens examined was very fine, and if the material is as abundant as supposed, and is properly worked, it is likely to be one of the most promising of our precious stones, from a financial point of view. Mine buildings have been erected and the locality has been named Gem City. A company was organized in June, 1891, under the laws of Colorado, with a capital of $250,000, and the operations commenced in July. Up to the first of October about $280 was expended for mining and supplies, and after paying for lapidary work and other expenses, the yield was $3,500 worth of opals, which were sold at from $30 to $55 a carat. Some of these prices were in excess of that of Hungarian material of equal or finer quality. This spring, owing to the unusual weather, about three weeks' time was lost, and work was interrupted by water and snow three times; still, with an expenditure of about $1,200 up to date, the results have more than doubled in both quantity and quality, one very superior stone having been found and sold at an extraordinary figure—much higher than the prices quoted above. The work is carried on by about 20 men, and is much in the nature of an open quarry. As it progresses into the hill the top soil becomes deeper, but the layer of black basaltic rock next to it and overlying the softer opal-bearing rock remains of about the same thickness. Considerable veins of ocher are met with and various kinds of clay; and good opals are often found embedded in so-called "soap holes," in a greasy, fine-grained, and very tenacious clay. Kernels of opal, all of good quality, are found in hollow amygdules in the rock, the cavities being generally larger than the opal.

Hyalite.—Hyalite, transparent and in great quantity, breaking with an apparent starch-like fracture, has been found in Lake county, California, by Mr. H. H. Myer. Very fine hyalite in thick seams was observed in the trap rock at the falls of the Willamette river, at Oregon City, Oregon, and in beautiful botryoidal masses in the Weiser valley lava fields, about 20 miles north of Weiser, Idaho; at both the latter localities it is equal to the hyalite from Waltsch, Bohemia.

Garnet.—Large quantities of purple almandine garnet, in the form of rolled fractured pieces, have been found along the Columbia river in

Washington and Oregon. These vary in weight from one-half a carat to one-half an ounce. Many of them are good for gem purposes or for watch jewels, and their color is often equal to the best Indian "almandine" garnet.

Malachite.—From the Copper Queen mine at Bisbee, Arizona, fully a ton and a half of beautiful specimens of malachite have been obtained, many of which were polished and sold in Colorado for mineral specimens.

Titanite, Sphene.—A very remarkable discovery of titanite has been made by Mr. Ernest Schernikow at the celebrated Tilly Foster iron mine at Brewster's, Putnam county, New York. Several hundred magnificent crystals have been obtained, varying in size from 1 to 2 inches in length; nearly all have highly polished faces, and some are beautifully twinned. They are of fine yellow shades; many are transparent and several are large enough to cut into gems of from 1 to 15 carats each. These were found during the removal of the upper surface in the new excavations at the mine.

Aboriginal lapidary work.—A visit to Oregon City elicited the fact that Mr. H. O. Stevens and others had found about 150,000 small arrow points on the beaches of the Willamette river at Oregon City, Oregon, between the years 1860 and 1890, principally in two places. One is on the east bank of the Willamette, 300 or 400 feet north of the bridge, where the banks are 15 to 30 feet high, and covered with a dense growth of fir and ash trees, some of them 3 feet in diameter. The arrow points are found in a layer from 1½ to 3 feet below the surface. The other locality is what is known as Green Point, half a mile above the bridge, where a small creek enters the Willamette river; there the banks have receded some 250 feet since 1861, and during the freshet of 1890 over 200 feet. As a result, an island 100 feet in length has been formed in the middle of the river. At both these places the arrow points are gathered by boys and local collectors immediately after a freshet. In the débris of the river are to be found large quantities of broken fragments of obsidian, agatized wood, jasper, and other materials from which the arrow points were made; also large diorite hammers, weighing from 2 to 10 pounds each. There is every indication that these arrow points were not made by the modern Indians, or they would not have existed in such quantities, nor at such depth as the large growth of the trees would indicate. Arrow points, equally fine, are found under similar conditions along the Columbia river. The modern Oregon Indians do not know how to make even rude ones, and have never offered arrow points for sale.

ABRASIVE MATERIALS.

By E. W. Parker.

BUHRSTONES.

The production continued to decrease. The number of pairs of buhrstones made from domestic stone in 1891 was 596, with an aggregate value of $16,587. This is a decrease in value from that of 1890 of $7,133. The product in 1891 distributed by States was: New York, esopus stone, 353 pairs, worth $8,806; Pennsylvania, cocalico stone, 94 pairs, worth $3,801, and Virginia, Brush Mountain stone, 149 pairs, worth $3,980. The value of the annual product since 1883 is shown in the following table. It is probable that the figures for 1888 and previous years are in excess of the actual product, the reports having been based on the estimates by operators of the total yield of their respective regions, and not from a compilation of individual returns.

Value of buhrstones produced in the United States since 1883.

Years.	Value.	Years.	Value.
1883	$150,000	1888	$81,000
1884	150,000	1889	35,155
1885	100,000	1890	23,720
1886	140,000	1891	16,587
1887	100,000		

Value of buhrstones and millstones imported into the United States from 1868 to 1891.

Years ended—	Rough.	Made into millstones.	Total.	Years ended—	Rough.	Made into millstones.	Total.
June 30, 1868	$74,224		$74,224	June 30, 1880	$120,441	$4,631	$125,072
1869	57,942	$2,419	60,361	1881	100,417	3,495	103,912
1870	58,601	2,297	60,898	1882	103,287	747	104,034
1871	35,406	3,698	39,104	1883	73,413	272	73,685
1872	69,062	5,967	75,029	1884	45,837	263	46,100
1873	60,463	8,115	68,578	1885	35,022	455	35,477
1874	36,540	43,170	79,710	Dec. 31, 1886	29,273	662	29,935
1875	48,068	66,991	115,059	1887	23,816	191	24,007
1876	37,759	46,328	84,087	1888	36,523	705	37,228
1877	60,857	23,068	83,925	1889	40,432	452	40,884
1878	87,679	1,928	89,607	1890	32,892	1,103	33,995
1879	101,484	5,088	106,572	1891	23,997	42	24,039

GRINDSTONES.

The value of grindstones produced in the United States increased from $450,000 in 1889 to $476,113 in 1891. The quantity represented

by this value in 1891 was about 60,000 tons. Practically all of the product is from Michigan and Ohio, the portion obtained from California and South Dakota, the only other producing States, being insignificant in comparison. The annual production of grindstones since 1880 may be seen by the following table:

Value of grindstones produced in the United States, 1880 to 1891, inclusive.

Years.	Value.	Years.	Value.
1880	$500,000	1886	$250,000
1881	500,000	1887	224,400
1882	700,000	1888	281,800
1883	600,000	1889	439,587
1884	570,000	1890	450,000
1885	500,000	1891	476,113

Grindstones imported and entered for consumption in the United States, 1868 to 1891 inclusive.

Years ended—	Finished.		Unfinished or rough.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Long tons.		*Long tons.*		
June 30, 1868	----------	$25,640	----------	$35,215	$60,855
1869	----------	15,878	----------	99,715	115,593
1870	----------	29,161	----------	96,444	125,605
1871	385	43,781	3,957.15	60,935	104,716
1872	1,202	13,453	10,774.80	100,494	113,947
1873	1,437	17,033	8,376.84	94,900	111,933
1874	1,443	18,485	7,721.44	87,525	106,010
1875	1,373	17,642	7,656.17	90,172	107,814
1876	1,681	20,262	6,079.34	69,927	90,189
1877	1,245	18,546	4,979.75	58,575	77,121
1878	1,463	21,688	3,669.41	46,441	68,129
1879	1,603	24,904	4,584.16	52,343	77,247
1880	1,573	24,375	4,578.59	51,899	76,274
1881	2,064	30,288	5,044.71	56,840	87,128
1882	1,705	30,286	5,945.61	66,939	97,225
1883	1,755	28,055	6,945.63	77,797	105,852
1884	----------	----------	----------	----------	86,286
1885	----------	----------	----------	----------	50,579
Dec. 31, 1886	----------	----------	----------	----------	(*a*)39,149
1887	----------	----------	----------	----------	(*a*)50,312
1888	----------	----------	----------	----------	(*a*)51,755
1889	----------	----------	----------	----------	(*a*)57,726
1890	----------	----------	----------	----------	(*a*)45,115
1891	----------	----------	----------	----------	(*a*)21,028

(*a*) Classed as finished or unfinished.

OILSTONES AND WHETSTONES.

This industry is controlled practically by one firm, the Pike Manufacturing Company, of Pike Station, New Hampshire. Through the courtesy of Mr. E. B. Pike, vice-president, the following report concerning the business for 1891 has been furnished: The novaculite form which oilstones are made is obtained from Garland county, Arkansas, and Orange county, Indiana. Of the former there are two varieties, the Arkansas, which is of bluish-white color, semitransparent, and very finely grained, and the Washita, not so finely grained, more opaque, and of pure white color. The Indiana stone is known as Hindostan or Orange stone, and varies in color from white to a buff or

orange. The total amount of rough stone produced in Arkansas in 1891 was 1,029,840 pounds and in Indiana 514,000 pounds, nearly all of which was shipped to Pike Station, New Hampshire, for manufacture. In addition to this a small amount of Labrador stone from Truxton, New York, and chocolate stone from Lisbon, New Hampshire, was produced. To complete the list must be added sandstone from Indiana made into kitchen and shoemakers' rubstone, and Indian Pond and Lanesville scythestones quarried at Haverhill and Piermont, Grafton county, New Hampshire, and Orleans county, Vermont. Besides the domestic stone, the Pike company handles Water-of-Ayr stone from Scotland, some Turkish oilstone, and Belgian and German razor hones.

The company reports the following domestic product marketed:

	Value.
Washita stone, 460,000 pounds	$55,000
Arkansas stone, 15,000 pounds	20,000
Labrador stone, 2,000 pounds	200
Hindostan stone, 300,000 pounds	11,500
Sandstone, 120,000 pounds	1,800
Chocolate stone, 15,000 pounds	1,500
Sythestones, 14,000 gross	60,000
Total	150,000

Of the above sales the following is furnished as as estimate of the quantity exported. It should also be stated that the foregoing, as well as the following, figures are not taken from the books, but are sufficiently correct to serve all practical purposes.

The exports were about:

Estimated exports of whetstones in 1891.

	Value.
Scythestones, 8,000 gross	$20,000
Washita stone, 160,000 pounds	18,000
Arkansas stone, 7,500 pounds	10,000
Hindostan stone, 100,000 pounds	3,500
Total	51,500

Estimated imports of whetstones in 1891.

	Value.
Turkey stone, 1,500 pounds	$300
Scotch stones (all kinds), 6,000 pounds	600
Razor hones, 800 dozen	1,200
English scythestones, 50 gross	300
Norway Ragg scythestones, 10 gross	50
German emery scythestones, 25,000	500
Total	2,950

Imports of hones and whetstones for the years 1880 to 1890.

Years ended June 30—	Value.	Years ended December 31—	Value.
1880	$14,185	1886	$21,141
1881	16,631	1887	24,093
1882	27,882	1888	30,676
1883	30,178	1889	27,400
1884	26,513	1890	37,454
1885	21,434	1891	35,344

EMERY AND CORUNDUM.

Corundum and emery are distinguished from each other in that the former is oxide of aluminum alone, while the latter is an intimate mixture of oxide of aluminum with oxide of iron. Corundum is by far the more valuable mineral, being harder and of greater durability. Both minerals are used chiefly for the manufacture of abrasive wheels, the production of which is controlled by a few firms.

The product in 1891 consisted of 1,513 tons of emery and 752 tons of corundum, worth together $90,230. The combined tonnage is in excess of the product of 1890, but the value decreases $965, the difference being due to an increased production of emery and a decrease in the output of corundum.

The product is from Rabun county, Georgia; Macon and Jackson counties, North Carolina; Westchester county, New York; Chester county, Pennsylvania, and Hampden county, Massachusetts.

The following table shows the annual product of corundum and emery since 1881:

Annual product of corundum and emery since 1881.

Years.	Quantity.	Value.	Years.	Quantity.	Value.
	Short tons.			*Short tons.*	
1881	500	$80,000	1887	600	108,060
1882	500	80,000	1888	589	91,620
1883	550	100,000	1889	2,245	105,567
1884	600	108,000	1890	1,970	89,395
1885	600	108,000	1891	2,247	90,230
1886	645	116,190			

Emery imported into the United States from 1867 to 1891, inclusive.

Years ended—	Grains.		Ore or rock.		Pulverized or ground.		Other manufactures.	Total.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
	Pounds.		*Tons.*		*Pounds.*			
June 30, 1867	.....	.....	428	$14,373	924,431	$38,131	.....	$52,504
1868	.....	.....	85	4,531	834,286	33,549	.....	38,080
1869	.....	.....	964	35,205	924,161	42,711	.....	77,916
1870	.....	.....	742	25,335	644,080	29,531	.....	54,866
1871	.....	.....	615	15,870	613,624	28,941	.....	44,811
1872	.....	.....	1,641	41,321	804,977	36,103	.....	77,424
1873	610,117	$29,706	755	26,065	343,828	15,041	$107	70,919
1874	331,580	16,216	1,281	43,886	69,890	2,167	97	62,366
1875	487,725	23,345	961	31,972	85,853	2,990	20	58,327
1876	385,246	18,999	1,395	40,027	77,382	2,533	94	61,653
1877	343,697	16,615	852	21,964	96,351	3,603	.....	42,182
1878	334,291	16,359	1,475	38,454	65,068	1,754	34	56,601
1879	496,633	24,456	2,478	58,065	133,556	4,985	.....	87,506
1880	411,340	20,066	3,400	76,481	223,855	9,202	145	105,894
1881	454,790	22,101	2,884	67,781	177,174	7,497	53	97,432
1882	520,214	25,314	2,765	69,432	117,008	3,708	241	98,695
1883	474,105	22,767	2,447	59,282	93,010	3,172	269	85,490
1884	143,267	5,802	4,145	121,719	513,161	21,181	188	148,890
Dec. 31, 1885	228,329	9,886	2,445	55,368	194,314	8,789	757	74,800
1886	161,297	6,910	3,782	88,925	365,947	24,952	851	121,638
1887	367,239	14,290	2,078	45,033	[a]144,380	6,796	2,090	68,209
1888	430,397	16,216	5,175	93,287	.....	.....	8,743	118,246
1889	503,347	18,937	5,234	88,727	.....	.....	111,302	218,966
1890	534,968	20,382	3,867	97,939	.....	.....	5,046	123,367
1891	90,658	3,729	2,530	67,573	.....	.....	.....	71,302

[a] To June 30, only; since classed with grains.