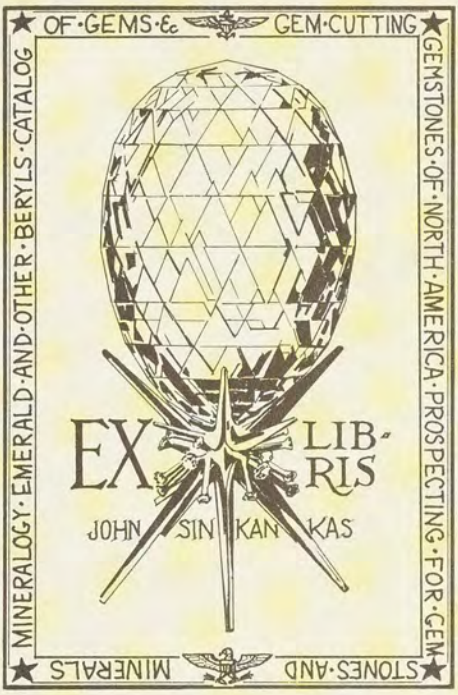
EXERPTS from MINERAL RESOURCES
of the United States-Prec.Stones

1883-1893 incl.

KUNZ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PRECIOUS STONES.

By George F. Kunz.

Introduction.—This paper slightly repeats some of the material of the former one in the 1882 report, but this is scarcely to be avoided. The time allowed for the first paper was scarcely sufficient for consulting the literature to any great extent, and it was prepared from material at hand or from personal observation. The interval of over a year has afforded the time necessary to inquire into and verify the authenticity of this matter. Where the material has been duplicated, it is only in part, and fuller or more authentic facts are added in this report. A number of localities are mentioned where, although no gems have as yet been found, the material at times is very nearly good enough for gems; or else from the small amount of development, the possibility of gems being found in the future may fairly be inferred. A few localities are mentioned where specimens unexampled as such have been found, and have a claim on the gem collector, since they are gem minerals; and also where they have been of financial value to the finders, although little or no gem value may be attached to them, as in the case of the Pike's peak amazonstone and smoky quartz, and the Monroe spinels. Many of these are as beautiful, if not more so, in their native form, than they are after having undergone the cutting process, as for example some of the Utah topazes, beryls from North Carolina, and many others, a fact of which almost any one would be convinced by a visit to some of our finer cabinets. The cutting of such material, therefore, for the higher money value, is really vandalism and should be discouraged by all scientists.

A most important find of gem materials and specimens during the past year was at the Auburn, Maine, locality (*a*), which from July, 1883, to July, 1884, afforded possibly about $1,000 worth of tourmaline specimens, and the other minerals netted about $500 more. These were taken out in one month's work, and since then fully $500 more has been realized on those taken out by the various persons working the locality.

The tourmalines and beryls found in the last work done by the Mount Mica Mining Company during the summer of 1882 were still in the possession of the company, and were offered for sale in the summer of 1884 at Bar Harbor, Mount Desert, Maine. Some were there readily sold as

a See paragraph on tourmaline, page 743.

Maine gems. The cut gems owned by the company in the early part of the summer of 1884 were valued by them as follows:

Tourmalines, from $10 to $500 each	$2,683
Beryls and aquamarines, from $5 to $50 each	1,062

There are about $400 worth of uncut specimens. No work was done here in 1884.

The beryl locality at Stoneham (*a*), Maine, has yielded fully $700 worth of gems and specimens to the different workers, one crystal selling at $75 for gem material. Some very fine blue beryls were found here.

The topaz locality, though it produced no topaz, from other minerals yielded the workers over $500 by the sale of herderite, columbite, and associated minerals.

Work was suspended by the mining company at Stony Point, North Carolina, at the end of August, 1883, and was resumed for about two weeks during July of 1884. Since July, 1883, perhaps $500 has been realized from the work done. The work of 1883 brought to light some of the finest crystals that have yet been found, for color, but of secondary gem value. The largest of these was about 3 inches long and very perfect. The two weeks' work of 1884 discovered a few very fine quartz crystals containing rutile, and some containing asbestus or byssolite (?); also very fine rutile crystals, though no gems. When work will be resumed is not definitely known. The adjoining property is reported to have been purchased with a view to working at some future time. The indications on Mr. John Lackey's property look very well for the class of minerals found in this section.(*b*)

Since October, 1882, the Pike's peak topaz and phenakite locality has been searched to some extent, and the topaz and phenakite taken from it thus far would be valued at fully $1,500, one crystal of topaz being held at $100, and one phenakite also at fully this amount. Two topaz gems cut from the stones found here were worth fully the same each after the cutting.

The Crystal peak locality, near Florissant, Colorado, has yielded perhaps $1,000 worth of topaz, some specimens associated with phenakite and on amazonstone, and a number of fine amazonstone crystals.

A number of stones enumerated here, although below 7 in hardness, and even below 6, may suggest to some that they are too soft for any gem or ornamental uses. Thus apatite and fluorite are too soft for cut gems, yet beautiful cups, vases, etc., can be made of the latter. Serpentine and catlinite could be successfully worked where apatite could not, because they are opaque and do not show scratches, and an even, good color will always appear. It is only by adapting any mineral to its proper use that it can be made a success.

One of the finest displays of gem minerals since 1876 was the North Carolina exhibit in the fall of 1883 at the Mechanics' Fair at Boston.

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a "Mineral Resources of the United States, 1882," page 487.

b See paragraph on beryl, page 738.

In this were some of the finest North Carolina quartzes, from White Plains and other localities; remarkably brilliant rutiles from Mitchell and Alexander counties; beautiful amethysts, some of them rutilated; some remarkable Alexander county emeralds, and blue, green, and yellow beryls, and many others that as a rule were quite new to the general public as gem minerals.

Delusive finds.—During the past year a number of articles have appeared in regard to the finding of valuable gems, which have proved otherwise on investigation; and as newspaper statements are at times copied into the literature, it may be well to give them notice from some reliable source.

The "Blue Ridge sapphire," or the "Georgia marvel," as it was called by the press, was found nearly two years ago in a brook in Georgia, in the Blue Ridge mountains. It was estimated to be worth about $50,000 by the owner, who had been assured of its authenticity as a sapphire by two southern jewelers, and arrived at its valuation by taking into account its weight. Anything scratched by a file is sure to be pronounced glass, whether that or really topaz or some equally hard stone; while, on the other hand, the common fallacy may prevail that anything not touched by a file is to be regarded as a genuine stone, even though it may be only glass. In this instance the gem proved to be a piece of rolled blue bottle glass, and its owner could be convinced of this only when he saw a platinum wire coated with a melted fragment of the material.

Another was a stone plowed up by Mr. James M. Smith, of Gibsonville, Guilford county, North Carolina, pronounced a genuine emerald, weighing 9 ounces, by some local expert, who tested it, and with the microscope showed that it contained various small diamonds. Its value was estimated up in the thousands, and $1,000 was reported to have been refused for it by its owner. As it was believed to be the largest known emerald, it was expected by its owner that it would realize him many thousands. Being therefore too valuable to be intrusted to the express company, he put himself to the expense of a trip to New York, where it proved on examination to be a greenish quartz crystal, filled with long, hairlike crystals of green byssolite or actinolite, on which were series and strings of small liquid cavities that, glistening in the sun, led to the included diamond theory of the local expert. As $5 was the best offer received for the stone, it was returned to North Carolina.

The "Wetumpka ruby," from Elmore county, Alabama, the property of Mr. James W. Thomas, was supposed to be a ruby of 6 ounces' weight "after cutting away all the roughness." Owing to its value, it was deposited in the Wetumpka bank vault, and on no consideration would be sent to any one on approbation. A small fragment sent to Mr. L. P. Gratacap, of New York, and examined by him, led him to believe that it was only a common garnet, and from its stated quality of no value,

even if a ruby. Doubtless it is one of the large rough garnets so often found in the South.

Another is a quartz (?) crystal found by Mr. James Pepper, of Danbury, North Carolina, which was examined and pronounced to be a genuine diamond by the local jewelers, and valued at $7,000.

The diamond discoveries so often reported are not to be wondered at. In one of the southern States one of the late geologists who had much to say as to the "immutability of human events that would eventually lead to the finding of diamonds, rubies, sapphires, and emeralds in his State," knew so little of the diamond that he actually sent a common paste imitation to New York to inquire as to its genuineness as a diamond. Yet his remarks have often been copied, especially a story that a bottle of diamonds that were worth many thousands of dollars was thrown away before they were recognized.

Utilization of precious stones.—During the last ten years taste in furniture and decoration in the United States has reached so high a degree that every conceivable new idea which has been or is applied anywhere on the face of the earth has been resorted to. Minerals, as a rule, have been only slightly utilized, owing principally to the want of familiarity with them and the methods of applying them so as to avoid coldness and inappropriateness. In one of the finest pairs of carved rosewood silver-paneled pedestals in this country the dull effect of the rosewood was very much relieved by the insertion of a number of small round cabochon pieces of a dark red Texas agate, these additions really giving all the necessary brilliancy where polished wood was an effect not desired. Our large list of cheap and beautiful ornamental stones, such as jasper, agate, silicified woods, turquois, rose quartz, and a large number of others, might be introduced with advantage into the inlaid work on clocks, mantels, and fine furniture. The utilization of rock crystal for hand glasses is mentioned on page 750.

One of the new departures in the United States in the uses made of the common stones is the introduction by a leading New York firm of a line of American stone goods, similar to the Scotch jewelry, the designs of which will be so improved and American gem stones used to such an extent in them that they will undoubtedly find a ready sale, and before the year is closed may be universally sold throughout the United States, displacing many of the cheaper varieties of gold and silver pins. Some of the minerals used are agate, moss agate, jasper of all colors, rhodonite, pyrite, labradorite, Chester county moonstone, and other cheap American minerals. The designs are crowns, knots, thistles, shepherds' crooks, nails, horseshoes, crescents, daggers, keys, spears, umbrellas, and a large variety of others suggested by the variations of forms and colors shown in the kaleidoscope.

The following few items may perhaps be of sufficient interest to entitle them to mention in this report: During the last three years a novelty has appeared in the form of a so-called mineral clock, consisting

of a plain wooden case, usually in the form of a house, and completely covered with specimens about an inch square of pyrite, galenite, amazonstone, ores from celebrated mines, and other Colorado minerals. They are glued on, and, as a rule, numbers are pasted on each referring to a list of the minerals on the back of the case. The clock part consists of a Connecticut Yankee clock. They have sold remarkably well since they were introduced, $15,000 worth in 1882, $11,000 in 1883, and $20,000 worth in 1884, to be retailed at an advance of 33 per cent. In addition there are a large number of paperweights, inkstands, and a variety of objects made that have netted several thousand dollars per year more.

Arrow points.—Mr. H. C. Stevens, of Oregon City, Oregon, writes that since 1878 he has personally handled 35,000 fine arrow points, peculiar to Oregon, and that fully 50,000 in all have been found by different persons. Before 1878 perhaps an equal number were found. Fully $3,000 have been realized on these in cash since 1878. At present few are found, except after a heavy freshet and overflow of the river banks, where the greater number have been found. These points at times represent the highest examples of savage stone chipping, and are really so often gem materials that the demand for them as articles of jewelry is not surprising. The prices range from $1 to $2.50 each for the finer ones, which are usually made of rock crystal; flesh-colored, red, yellow-brown or mottled jasper, obsidian, or various colors of chalcedony. They are principally sold in the East, scarcely any being sold in Oregon for jewelry. They are not made by the present Indians of Oregon. Fine suites of Oregon arrow points were exhibited by Mr. M. F. Savage at the Bartholdi Loan Exhibition at the New York Academy of Design, December, 1883.

Trilobite ornaments.—The trilobites found in various parts of the United States are used, when of the proper form, as charms, scarf pins, and other ornaments. Perhaps 99 per cent. of those used for these purposes are found in the vicinity of Cincinnati, especially near Covington, Kentucky. The species is *Calymene senaria*, which, as a rule, are found curled up, evidently in dying, and therefore appear either round or slightly oval in form, making very neat charms, and the smaller ones very pretty scarf pins. They vary in size from one-fourth inch to 2 inches in diameter, and are sold at the locality at from 25 cents to $5 each, according to beauty or perfection. The casts of the *Calymene senaria*, variety *blumenbachii*, if perfectly flattened out and perfect in form, are worn at times as scarf pins. As they are entirely limestone, the surface, as a rule, is covered by thousands of microscopic brilliant crystals of calcite, the glitter of which is very effective. A number of fine trilobites are sold annually at Trenton Falls, especially the *Ceraurus pleurexamthamus* and *Asaphas gigas* from the Trenton limestone. They are sold, however, more as tourists' mementoes than as objects of orna-

ment. Twenty-five dollars is often asked for large fine specimens of the *Asaphas gigas.*

Cat's-eye minerals.—The following minerals found in the United States, when fibrous or cut across the cleavages in cabochon effect, will show the cat's eye ray:

Corundum: At Ellijay creek, Macon county, North Carolina, Mr. E. A. Hutchins cut a dark brown, almost black, crystal of corundum that furnished a long *en cabochon* gem, two-thirds of an inch across, that shows the cat's-eye ray distinctly.

Chrysoberyl: The chrysoberyls of Stow, Peru, and Canton, Maine, would cut into poor cat's-eyes.

Beryl: The beryls of Stoneham, and some of the North Carolina beryls, especially those from Alexander county, would furnish cat's-eyes, although not fine.

Quartz: Quartz filled with actinolite, from Cumberland Hill, Rhode Island, makes a very fine quartz cat's-eye. This is the Thetis hairstone of Dr. Jackson.

Hornblende: A fibrous black hornblende from near Chester, Massachusetts, afforded an imperfect cat's-eye.

Pyroxene: A white compact fibrous pyroxene from Tyringham, Massachusetts, made a curious white cat's-eye.

Labradorite: Some of the Labrador spar, when filled with included minerals and impurities, will show a cat's-eye ray; this is especially applicable to the mineral found in Orange county, New York, and that also in the northern part of the State.

Hypersthene, bronzite, and enstatite, when fibrous and cut across the fiber, produce a cat's-eye effect, and are sold abroad for this purpose to a very limited extent.

Limonite: Limonite from Salisbury (Connecticut), Richmond (Massachusetts), and other American localities, would at times cut into a gem showing the cat's-eye ray.

Aragonite and gypsum satin spars: These both produce the cat's-eye effect.

LOCALITIES OF PRECIOUS STONES IN THE UNITED STATES.

Diamonds.—Referring to the paper on American gems, in "Mineral Resources of the United States, 1882," containing information furnished by Mr. John H. Tyler, sr., about the Manchester diamond, having since been enabled to obtain a more complete history of it, as it is possibly the largest diamond really found in the United States, I herewith present the facts. The first record I have been able to obtain is from the New York *Evening Post* of April 28, 1855, which says: "We were shown yesterday, on board the steamship Jamestown, what is said to be the largest diamond ever discovered in North America. It was found several months ago by a laboring man at Manchester, Virginia, in some earth which he was digging up. It was put in a furnace for melting

iron, at Richmond, where it remained at red heat for two hours and twenty minutes. It was then taken out and found to be uninjured and brighter than ever. It was valued in Richmond at $4,000." This stone was next in the possession of Capt. Samuel W. Dewey, now of Philadelphia, and by him was named the Oninoor or "sun of light," though it has more generally been known as the Dewey or Morrissey diamond. It then passed through many hands. It was cut at an expense of $1,500 by Mr. H. D. Morse, and at one time $6,000 was loaned on it. This diamond was a slightly rounded trigonal trisoctahedron. Its original weight was $23\frac{3}{4}$ carats, and after cutting it weighed $11\frac{11}{16}$ carats. As it is off-color and imperfect it is to-day worth not more than from $300 to $400. Exact copies of it in glass, as it was found, and also as cut, were deposited in the United States mint at Philadelphia, by Capt. S. W. Dewey, and also at the Peabody museum in New Haven. Electrotypes of it may be seen in a number of cabinets.

The first diamond found in North Carolina was at the ford of Brindletown creek, by Dr. F. M. Stephenson. It is an octahedron in form, and is valued at $100. Another, in the possession of Professor Featherstonhough, was found in the same neighborhood by him. A third, observed in Mr. D. J. Twitty's collection by General Clingman, and described by Prof. C. U. Shepard, was found at Twitty's mine, Rutherford county. In form this is a distorted hexoctahedron, yellowish in color. A fourth was found by Dr. C. L. Hunter, near Cottage Home, Lincoln county, in the spring of 1852. It is said to be greenish in color and in form an elongated hexoctahedron. Another, in the possession of Dr. Andrews, of Charlotte, was found at Todd's branch, Mecklenburg county. It was said to be a perfect crystal and of a good white color. Dr. Andrews reports also the finding of a black diamond the size of a chincapin by three persons, who crushed it, believing a diamond could not be broken. He found that the fragments scratch corundum very readily.

Dr. Genth reports two diamonds from the Portis mine, Franklin county, one of them a very beautiful octahedron. A small diamond was found on the headwaters of Muddy creek, in McDowell county, and diamonds have also been reported in weight frequently from one-half carat up to over 2 carats, from J. C. Mills's mines, in Burke county. Some of these, examined by Mr. James B. Mackintosh, proved to be quartz, and another supposed diamond, found in some gravel from this mine, in the State collection at Raleigh, I found not to be a diamond, but zircon. The diamonds in North Carolina are usually found associated with gold, monazite, xenotime, zircon, octahedrite, and other minerals. Dr. Genth(*a*) says this débris is the result of the old gneissoid rocks, such as mica-schist and gneiss, in which graphite is always found.

In a letter to the New York *Sun* Mr. C. Leventhorpe mentions the

a "Mineral Resources of North Carolina," *Journal Franklin Institute*, November and December, 1871.

finding at his placer mine, in Rutherford county, of a diamond of bad color, which was pronounced a diamond and placed in the Amherst College collection by Prof. C. U. Shepard. The same article also mentions a fine white diamond, valued at $400, found in a South Carolina placer by Mr. Twitty, and states that Mr. Twitty has a diamond weighing 3 grains in his possession which was taken in White county, Georgia, from a "long tom."

In the cabinet of Mr. Samuel R. Carter, of Paris, Maine, are two small crystals of diamond weighing less than one-eighth carat, which were found in March, 1866, at the Horshaw placer gold mine, Racoochee valley, White county, Georgia, one by Dr. A. C. Hamlin(*a*), of Bangor, and the other by Mr. H. Ashbury. They are opaque and have no definite form. Several stones of fine quality have been found here.

At the May, 1867, meeting of the California Academy of Sciences Prof. B. Silliman exhibited four diamonds found in California. One, from Forest Hill, El Dorado county, weighing 0.369 gram (= 5.673 grains = 1½ carats), was of good color with a small cavity and a discoloration on one of the solid angles. This crystal, which was not entirely symmetrical, was found at a great depth from the surface, in a tunnel running into the auriferous gravel at Forest Hill. Another was found at French Corral, in Nevada county, weighing 0.3375 gram (= 5.114 grains = 1¼ carats). It was very symmetrical in form, remarkably free from flaws, and slightly yellowish, its color having been altered by having been subjected to a red heat. It had been found in the deep gold washings and was thrown out from the cement. The third was the property of Mr. M. W. Belshaw, weighing 0.2345 gram (= 3.619 grains, little less than 1 carat). This crystal is distorted, and has several reentering angles and cavities. Four others besides this have been found in the search for gold at Fiddletown, Amador county, in the gray cemented gravel underlying a stratum of so-called lava or compact ashes. The other one shown was the property of Mr. George E. Smith, who states that it was found at Cherokee Flat, Butte county, and that he had seen fully fifteen diamonds from this locality; these were all found in the deep gravel washings, and were believed to have come from a stratum 3 feet thick, forming part of a superincumbent mass of material 25 feet thick. Mr. Rèmond (*b*) is quoted as authority for the occurrence of diamonds at Volcano, which may be the same locality as Fiddletown. Professor Whitney at this meeting stated that diamonds had been found at from fifteen to twenty localities in California, the largest that had come to his notice weighing 7¼ carats, having been found at French Corral.

Prof. B. Silliman (*c*) mentions that platinum, almandine garnet, chromite, epidote, gold, iridosmine, limonite, magnetite, pyrite, quartz, rutile,

a "Leisure Hours among the Gems," A. C. Hamlin, page 49, Boston, 1884.
b "Geology of California," Vol. I., page 276.
c *American Journal of Science*, Vol. 6, 1876.

topaz, and zircon are associated with the diamond at Cherokee, Butte county, California.

Mr. W. P. Carpenter (*a*), of Placerville, states that while he was assisting Mr. W. A. Goodyear, assistant State geologist, in 1871, they found several diamonds in the hands of persons who did not know what they were; one of these was purchased as a specimen by Mr. Goodyear, who had found some specimens of itacolumite 3 miles east of Placerville, but had kept them as curiosities. The gravel in the channel is capped by lava from 50 to 450 feet in depth, and of late years is worked by steam cement mills. He says he knows of instances where fragments of broken diamonds have been found in cleaning up the batteries. He gives the following list of the finders of diamonds near Placerville: Charles Reed and Mr. Jeffries, each one; Thomas Ward & Co., three, two white and one yellow (one of these is now in the possession of Mr. Ashcroft, of Oakland, who had it cut in England); Cruson & Olmstead, four, one(*b*) of which, $\frac{9}{32}$ inch in diameter, was sold to Mr. Tucker, of San Francisco, for $300; Thomas Potts, one small flawed stone, which was sold to Mr. Goodyear for $15; Jacob Lyon, one light-straw colored, about the size of a medium pea, and several fragments from the tailings of a cement mill at the Lyon mine; A. Brooks, one, small white; E. Brentfeld, one, small yellow, weighing two grains, which had passed through a cement mill; one was found by Mrs. Henderson in some tailings that were washed for gold, and is most probably the one mentioned in the 1882 report as having been found near San Francisco.

Mr. H. G. Hanks visited Cherokee Flat, with the intention of studying the celebrated diamond localities, and was informed by Mr. A. McDermott, of Oroville, of a diamond the size of a pea and quite round, which had been sent to him in 1862. They are found in cleaning up the sluices and undercurrents. The first notice of a diamond being found here was in 1853. The largest one, now in the possession of Mr. John More, weighs $2\frac{1}{4}$ carats, 9 grains. Fifty to sixty stones in all have been found here, of which some were rose-colored and yellow, and others white, and all were associated with zircon, platinum, iridium, magnetite, gold, etc.

Microscopic diamonds were reported from the platinum sands of the Trinity river by Prof. F. Woehler, of Gottingen, with similar associations as at Cherokee. In all the northern counties of California drained by the Trinity river, in the vicinity of Coos bay in Oregon, and on the banks of Smith river, Del Norte county, diamonds may be looked for in the flumes and sluices.

A fine diamond from the Spring Valley mine at Cherokee, Butte county, was presented to the California State museum by Mr. G. F. Williams, superintendent of the mine. Two diamonds from here, one cut and one uncut, are in the possession of Mr. and Mrs. Harris, of

a Second report of the State mineralogist of California.

b Mentioned in Whitney's "Auriferous Gravels of the Sierra Nevada."

Cherokee. Mrs. W. C. Hendricks, of Morris Ravine, near Oroville, has also a fine Cherokee diamond set in a ring. A diamond found in 1861, weighing 6 grains (= 1½ carats) is now in the possession of Mr. John Bidwell, of Chico. It was from a locality 1½ miles northwest of Yankee Hill, Butte county, and has been cut in Boston.

Mr. C. G. Yale furnishes the following notes on the California occurrences: "For a period of more than thirty years the placer miners of California have occasionally picked up small diamonds. The hydraulic washings at Cherokee, Butte county, have been the most prolific. The diamonds are usually found by the miners when cleaning up their sluices or while washing off the bed rock, though in some few instances they have been picked up on the surface. As a general thing the gravel in which they occur is mixed with lava, ashes, or other volcanic matter; zircon, platinum, iridium, magnetite, etc., being associated with the diamonds. While many of these stones have been of good color, brilliant and perfect, none weighing over 3½ carats have been found in the State. In size they have ranged usually from about half a carat down to stones of microscopic dimensions, the latter being numerous in a few localities. So far as known $500 is the highest price for which any California diamond in the rough has been sold, though large numbers have found purchasers at prices ranging from $10 to $50, and not a few at as much as $100. The stones have been of all colors, white, yellow, straw, and rose, and many of good water. A few small diamonds have been found also in the placer diggings of Idaho, being of about the same quality and occurring under the same conditions as in California. In neither region have diamonds been made the object of special search, those found having been picked up by miners while washing gravel for gold. Fragments of diamonds have been noticed in the tailings from the quartz mills, being the remains of stones which have been broken under the stamps."

Since February, 1884, numerous notices have appeared in the press of the finding of diamonds under very peculiar circumstances. A jeweler of Milwaukee purchased from a lady customer for $1 a stone which he represented as being a topaz. The stone was reported to have been found eight years before at Eagle, Waukesha county, Wisconsin, having been thrown out from a depth of 60 feet while excavating a well. Two small stones are also reported to have been found here, each weighing less than one-half carat, the larger one first found weighng about 15 carats. One of the smaller stones I examined. All three stones are said to resemble those found at the Cape. The 15-carat stone is slightly off-color, and would, therefore, be worth only about $300 at the outside on its merits as a diamond. It has been offered at $1,000, owing to its being the first diamond found in Wisconsin, and it was supposed by the owner that it would be purchased for the State cabinet. Having carefully examined a quantity of the gravel sent to different persons, I have failed to find anything but the regular débris from glacial drift, and,

as remarked by one gentleman, believe if the box were to be filled with the drift material from New York City the owner would not discover the difference.

In the latter part of 1883 a diamond was reported to have been found at Nelson hill, near Blackfoot, Deer Lodge county, Montana. This stone is described as being colorless, and in form dodecahedral, with triangular markings, but is more likely a trigonal trisoctahedron with curved faces. Its specific gravity is said to be about 3.5; its weight about 12 grains. It was pronounced by an old diamond dealer of New York as really a diamond. The person now owning it came into its possession through a Chinaman, who panned it out and handed it to him, and he thinks he has seen many similar stones in the mine.

Mr. J. D. Yerrington, of New York, informs me of a brown diamond weighing 1 carat, and yielding when cut a gem weighing one-half carat, which was found near Philadelphus, Arizona. Two pieces of blue bottle glass that had been rolled so as to lose all form, were naturally supposed by the finder to be sapphires, being in the same locality with the diamond.

To insure the finding of diamonds in a new district one of the best methods is to familiarize the searchers with the luster principally, which can be readily accomplished, as once partly carried out by Mr. Dwight Whiting, of Boston. He suggested selling to the miners small imperfect diamond crystals (bort), mounted in a very inexpensive manner, so as that the entire ring or charm could be sold at from $5 to $10. Several thousand searchers thus prepared would soon ascertain whether diamonds really existed, and the crystal would also serve for testing the hardness of the stone as well as the luster. One of the minerals most likely to be mistaken for the diamond is a form of small quartz crystal found principally at Santa Fé and Gallup, New Mexico; Fort Defiance, Arizona; Deadwood, Dakota; and Shell creek, Nevada. They range in size from 1 to 5 millimeters, and the prism is nearly or entirely obliterated. In addition to this, as a rule, the surface is slightly roughened, and by an inexperienced person is easily mistaken for an octahedron, which is almost universally considered to be the only diamond shape.

The well-known "Arizona diamond swindle" was an adroit one, and the locality could hardly have been better selected; but it should not have received so much credence, since gem minerals are so readily recognized by means of their local characteristics by gem-collecting mineralogists.

SAPPHIRE GEMS.

Corundum.(*a*)—In North Carolina many corundum localities have been opened, and the material found is often of a very fine color even if not of gem quality. It was first found in the State by Gen. T. C. Clingman, who came upon a large dark mass of the cleavable variety, 3 miles be-

a See also page 714 *et seq.*

low Marshall, in Madison county. Later on it was found by Dr. C. L. Hunter in reddish and bluish masses at Crowder's mountain, and also at Chubb's and King's mountains, Gaston county.

The largest deposits of the finest material, however, are those in Macon county, near Franklin (see "Mineral Resources of the United States, 1882," page 485). A very interesting variety from here, in addition to the gems, is a white and blue banded form which would afford curious gem stones. The Culsagee or Corundum Hill vein is from 10 to 14 feet thick. Other Macon county localities are Jacobs & Haskett's mine, on Ellijay creek; Robinson's mine, Sugartown Fork; Houston's mine, and Moore & Higton's mine.

At the Jenks mine, at Franklin, was found probably one of the finest known specimens of emerald-green sapphire (oriental emerald). It is the transparent part of a crystal of corundum 4 by 2 by 1½ inches, from which several gems could be cut that would together furnish from 80 to 100 carats of very fine, almost emerald-green gems (not too dark, as the Siamese), the largest possibly fully 20 carats in weight. As this gem is one of the rarest known, it makes this specimen a very valuable one. It is now in the fine cabinet of Mr. Clarence S. Bement, with a suite of the choicest crystals found at this mine, and its value is over $1,000.

From near Franklin(*a*) a curious brown variety was found which shows a distinct asteria in sunlight or artificial light when the stone is cut *en cabochon*. Similar crystals have recently been found near Franklin by Mr. E. A. Hutchins, and more recently Dr. T. M. Chatard, at a locality 12 miles from Franklin, found a fine dark brown variety with bronze-like reflections.

In the Hogback mine, Jackson county, on the feldspar hanging wall, sapphire is met with in crystals; at the Cullakenee mine at times a deep ruby-red corundum is found, and also at Penland's on Shooting creek, in Clay county. Two miles northeast of Pigeon river, near the crossing of the Ashville road, in Haywood county, and 2 miles north of this on the west fork of Pigeon river, at the Presley mine, are found some of the finest colored specimens of blue and grayish-blue corundum. Twenty miles northeast of this, at the Carter mine, fine white and pink corundum is found in crystals and in a laminated form.

Blue, bluish-white, and reddish corundum is found at Swannanoa Gap, Buncombe county.

Mr. J. A. D. Stephenson found fine hexagonal prisms of a pale brownish corundum at Belt's ridge, and more recently some very fair colors from several new localities near Statesville, North Carolina.

A very fine black corundum crystal is in the Vaux cabinet at the Philadelphia Academy of Natural Sciences, the locality given being Buncombe county, North Carolina. This cabinet has also a fine ruby-

a Transactions New York Academy of Natural Science, March, 1884.

colored corundum from Buck's creek, Clay county, and another from Hogback, Jackson county.

The gravel deposits of Burke, McDowell, and Rutherford counties contain small grains and crystals of corundum usually altered into damourite.

Mr. E. A. Hutchins, who is doing much to develop the corundum properties of North Carolina, has some very fine opalescent and deep indigo-colored corundum from near Franklin and elsewhere in Macon county.

One of the principal Pennsylvania localities is near Black Horse, near Media, Middletown township, Delaware county; the cleavage plains of the crystals show a bronze luster, and the crystals have usually fixed asterias shown by Dr. Isaac C. Lea(*a*) to be produced by included crystals. They are here found in a feldspathic rock. Near here are also crystals, found loose in the soil, at times 4 to 6 inches in length. After sinking a 60-foot shaft fully 50 tons were mined here, but work has been abandoned.

Mineral Hill, near Media, has furnished large brown and altered crystals.

Near Village Green, Ashton township, Delaware county, large brown crystals have often been found with the brown luster. Dr. Genth mentions a small mass of grayish and blue corundum with good cleavage in the vicinity of the chrome mines, Lancaster county, Pennsylvania.

In Chester county, near Fremont, West Nottingham township, and 2 miles south of Oxford, corundum has been observed with albite. Near Unionville, Newlin township, are several localities of interest, also 1½ miles north of this locality loose crystals 3 to 4 inches in length were found in the soil. (*b*)

Mr. W. W. Jefferis described a new locality on the south side of the Serpentine ridge, in Newlin township, Chester county, and fully 500 pounds of massive blue corundum had been taken out.

Mr. Louis Zimmer, of New York, possesses a fine large crystal of corundum of a deep blue color, found by him 40 miles north of Richmond, Louisa county, Virginia.

Professor Wilson, of Chicago, is reported to have found a large deposit of corundum at Lone mountain, Pennsylvania. Good blue corundum has been found on Sequale creek, Georgia.

Prof. C. U. Shepard (*c*) mentions specimens of asteriated sapphire from Litchfield, Connecticut, lacking, however, the transparency requisite to a good gem.

Hoffmann(*d*) mentions impure columnar corundum in fragments nearly 1 inch in diameter from Silver Peak, Nevada.

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a Proceedings Philadelphia Academy of Natural Sciences, May, 1869.

b Proceedings Mineralogical Section Philadelphia Academy of Natural Sciences, 1879.

c "Report on Minerals of Connecticut," 1837, page 64.

d "Mineralogy of Nevada."

In Dr. F. A. Genth's suite of corundums are some that would afford opalescent stones with fixed stars, and other interesting forms from North Carolina and Pennsylvania. Many fine examples of corundums that would afford mineralogical and interesting gems from Pennsylvania are in the cabinets of Mr. W. W. Jefferis, now of Philadelphia, Mr. Lewis Palmer, of Media, and Dr. Cardesa, of Claymont. Specimens from Pennsylvania and North Carolina are to be found in the cabinets of Mr. Clarence S. Bement, Col. Joseph Wilcox, and Dr. Isaac Lea, and in the W. S. Vaux cabinet at the Philadelphia Academy of Natural Sciences. At present, however, the finest of the sapphires for the gem trade really all come from near Helena, Montana, collected there by the miners in the sluice boxes of the placer mines. These are rolled crystals, rarely over one-quarter to one-half inch long, and the colors are pale but brilliant. In the gravels of the upper Missouri river, in Montana, corundum is also found in placer mining.

The largest known crystal of sapphire(*a*) is the one found at the Jenks mine near Franklin, Macon county, North Carolina, about 1872. It weighs 312 pounds and is both red and blue (ruby and sapphire) in color. It is now in the Shepard collection at Amherst College, and escaped the disastrous fire of 1882, which destroyed so many of the fine objects there.

Chrysoberyl has been found at Stow(*b*), Maine, in masses weighing 5 pounds each, and also in single distorted crystals 3 by 5 by 1 inches, of an opaque color; these may in part furnish very poor chrysoberyl cat's-eyes. Large masses have also been found at Canton, Maine, of a somewhat similar character; and recently, perfect, small, and very distinct crystals of no gem value have been found in fibrolite at a new locality in Stow, Maine. Peru, Maine, has also afforded some crystals, though this locality is now exhausted. Mr. N. H. Perry found one small, very perfect crystal at Tubbs' Ledge, Maine, and it has also been observed at Speckled mountain, and at Stoneham, Oxford county, Maine, near the Stow line, by Professor Verrill; also at Norway.

Rev. Frederick Merrick stated that he had collected fifty years ago some crystals that he believed would furnish gems, but perhaps not of the finest quality, at Haddam, Connecticut, an old and well-known locality, now exhausted. The Greenfield locality, 1 mile north of Saratoga Springs, New York, afforded many beautiful crystals, but is now also exhausted. It was also found in New Hampshire in granite, at the deep cut of the Northern railroad at Orange Summit. None of these localities, however, have furnished a fine gem. The most promising localities are those near Stow, Peru, and Canton, Maine, and gems, if found at all, will be likely to be found here. The alexandrite variety of chrysoberyl has not been observed at any American locality.

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a See paper on corundum, *Popular Science Monthly*, Vol. XXII., page 452, February, 1874.

b Transactions New York Academy of Sciences, January 22, 1883.

Spinel.—Mr. Silas C. Young, who has collected minerals in Orange county, New York, for over twenty years, writes that in the past he has collected small ruby spinels, also others of a smoky and purple tint sufficiently clear to cut, and that the locality at Hamburg, New Jersey, was discovered by his father over fifty years ago. The region of granular limestone and serpentine in which spinels abound is from Amity, New York, to Andover, New Jersey, a distance of 30 miles. Monroe, Norwich, and Cornwall (New York), and Vernon, Sparta, Franklin, and Hamburg (New Jersey), are well-known localities. The locality known as Monroe, New York, which furnished the monster spinel crystals so well known to collectors of twenty years ago, is really somewhere between Monroe and Southfield. Its exact location was known only to two persons, Mr. Silas Horton and Mr. John Jenkins, both mineralogists, who worked it for some years by moonlight for secrecy, and from it took crystals that realized over $6,000. The locality furnished many fine crystals that were ruined in blasting and breaking out. Since the death of the former miners the position of this most wonderful locality has been unknown. All this region has afforded an occasional gem stone.

The gahnite from the Deak mine, Mitchell county, North Carolina, is of a very dark green color, translucent on the edges, and appears to be compact enough for cutting. The localities of Franklin and Sterling, New Jersey, have afforded some of the finest known crystals of this mineral, which would cut into mineralogical gems. At the lead mine at Canton, Georgia, some fine ones were found on galenite. Dr. F. A. Genth mentions in his "Contributions to Mineralogy" large, rough crystals 9 centimeters long from the Cotopaxi mine, Chaffee county, Colorado. Mr. William Tatham, of Philadelphia, sent me a specimen of gahnite from some lead mine in New Mexico; the crystals were from one-eighth to three-eighths inch across, bright polished octahedrons embedded in galenite. This most interesting and curious association was accompanied with massive garnet. The crystals were translucent on the edges. This locality may rightfully be regarded one of the most interesting for this variety, and it is to be regretted that more exact information cannot be obtained regarding it. At none of these places has this material been found sufficiently fine to make a good gem.

Topaz.—The Platte mountain topaz locality, near Pike's peak, described by Rev. R. T. Cross(*a*) and by Mr. Whitman Cross(*b*), has been prospected very extensively during the last fourteen months, and many fine crystals of topaz have been found, some of them yielding cut stones from 10 to 193 carats each in weight, and in color ranging from colorless to a rich cinnamon brown, and entirely free from flaws. One of the larger ones, belonging to the cabinet of Mrs. M. J. Chase, weighs 125 carats, and is as fine a gem as America has produced of any

a American Journal of Science, October, 1883.
b American Journal of Science, October, 1882.

kind. These crystals are equal in quality to many of the finest of the same size from Siberia, and one fragment of good color but flawed has been found here which weighed 2 pounds. The crystals found in this locality, over one hundred in all, during fourteen months, have sold for nearly $1,000, at a valuation of from 50 cents to $100 each. At Crystal peak, near Pike's peak, on large amazonstone crystals, topaz is found of a slightly different type, with phenakite, and also different in form, from the Pike's peak variety. Some occur over 1 inch long and quite thick. Prof. J. E. Clayton, of Salt Lake City, visited the locality mentioned, and it was also visited by Lieutenant Simpson in 1847. Here the topaz occurs in some isolated mountains west of the Sevier lake, and 140 miles southwest of Salt Lake City by the road. The rock is an eruptive overflow of trachyte full of amygdaloidal cavities, in which the topaz crystals are found; they are also disseminated through the body of the rock. The crystals are usually small, from 1 to 100 millimeters long, and from 5 to 8 millimeters across. The wine color, yellow, and blue are very uncommon, the general color being limpid white; they are very brilliant and of remarkable transparency, closely resembling the Durango, Mexico, and the Chaffee county, Colorado, varieties, especially the latter, which in the same rock is associated with small fine crystals of garnet. In the scarcity of water the locality presents almost insuperable obstacles, but will no doubt be revisited in the near future. The Stoneham, Maine, locality has furnished scarcely a fair crystal during the year. Genth and Kerr(*a*) mention that the Crowder's mountain topaz is very doubtful, proving on examination to be kyanite. Pycnite occurs in fine columnar aggregations of a yellowish and brownish-yellow color, associated with garnet, near White's Mills, Gaston county, North Carolina.

Diaspore.—Possibly the finest known diaspores are those which were found at the corundum locality near Unionville, in Newlin township, Chester county, Pennsylvania. The crystals were from one-half to 1½ inches in length, and one-quarter of an inch in thickness. The color varies from a white to a fawn color inclining to a topaz, while others are at times of slightly brownish tint. They closely resemble topaz in appearance, and would afford gems as fine as any yet obtained. The finest of these are in the cabinets of Dr. Isaac Lea and Colonel Joseph Wilcox, of Philadelphia.

The emery mines of Chester, Massachusetts, have produced a few small crystals which might be cut into minute cabinet gems.

Mr. John C. Trautwine, of Philadelphia, obtained some minute acicular crystals in a cavity of massive corundum at the Culsagee mine, North Carolina. General T. C. Clingman also observed the mineral associated with blue corundum near Marshall, Madison county, North Carolina.

Beryl and emerald.—Prof. Parker Cleveland(*b*) mentions having seen

a "Minerals and Mineral Localities of North Carolina," page 53.

b "Mineralogy and Geology," by Parker Cleveland, Boston, 1822, page 341.

several emeralds from Topsham, Maine, of a lively beautiful green color, scarcely, if any, inferior to the finest Peruvian emeralds; also two (*a*) rose-colored beryls as having been found at Goshen, Massachusetts. The finding of an emerald at Haddam, Connecticut, of a deep green color, an inch in diameter and several inches in length, is mentioned in Bruce's *Mineralogical Journal*, Vol. V., 1, as belonging to Colonel Gibbs' cabinet.

As no true emeralds are in existence from Haddam or Topsham, these may really refer to very dark green beryls.

Of emerald specimens some of the finest in color, though of little gem value, were found during the summer of 1883 at the Stony Point mine, in North Carolina. The finding of fine beryls and emeralds of pale color collected by Mr. J. A. D. Stephenson on the property of J. O. Lackey, 1 mile southwest of the Stony Point deposit, and a short distance from the Lyons property, on which the same mineral was found by Mr. Smeaton, of New York, shows that the deposit is evidently not accidental, and that there is encouragement for future work in this region. Beryl is found in greenish-yellow and deep green crystals, resembling the Siberian, in the South mountains 9 miles southwest of Morganton, Burke county; in the Sugar mountains at Shoup's ford, Dietz's, Huffman's, and Hildebrand's, and in smaller crystals in Jackson county. One fine blue-green crystal in quartz was found at Mills's gold mine, Burke county, and one fine transparent green crystal from near here is now in the cabinet of Mr. M. T. Lyndé, of Brooklyn. Fine blue-green aquamarine occurs at Ray's mine on Hurricane mountain, Yancey county, North Carolina. Clear green beryls have been found at Balsam Gap, Buncombe county; Carter's mine, Madison county; Thorn mountain, Macon county; E. Balch's, Catawba county; Fort Defiance, Caldwell county, and at Wells, Gaston county. Some crystals 2 feet long and 7 inches in diameter, that would cut into gems with small clear spots, occur 4 miles south of Bakersville creek, and still others, larger, at Grassy creek, North Carolina.

The Stoneham, Maine, beryls have flocculent centers, with fibrous appearance, and some of these may cut into beryl cat's-eyes.

Beautiful transparent beryls have been found at Streaked mountain, Norway, Lovell, Bethel, and Franklin plantation, Maine, and very good ones also at Mount Mica and Grafton, Maine. The best locality, however, is the one at Stoneham, mentioned in the last report.(*b*) Here some perfect gems over 1 inch long were cut from the material, and the work during the last year has yielded aquamarines of a good blue color, the aggregate values of which amount to over $700.

At Albany, Maine, Mr. N. H. Perry has recently found beautiful transparent golden yellow beryls that would cut into perfect gems of over

a "Mineralogy and Geology," by Parker Cleveland, Boston, 1822, page 344.

b "Proceedings American Association for the Advancement of Science," 1883.

2 carats each. One fine-cut light sea-green aquamarine beryl from Sumner, Maine, in Mrs. Merchant's cabinet, weighs about 7 carats.

One remarkably fine deep-blue gem from Royalston, Massachusetts, weighing over 10 carats, is in the United States National Museum, and in the same collection is one weighing 14 carats from Portland, Connecticut, equal to almost any from Brazil for depth of blue color. Both of these localities have at times afforded fine clear material. Some very clear white stones are obtained at Pearl hill, in Fitchburg, Massachusetts, and are sold by the local jewelers. Dr. A. C. Hamlin owns a very fine golden yellow beryl of 4 carats from this locality.

Fine crystals of beryl of almost emerald green color, also beautiful yellowish green and bluish beryls, are found in Deshong's quarry, near Leiperville, Pennsylvania; the crystals are at times 12 inches long, of a yellowish green color. At Shaw & Ezra's quarry, near Chester, at Upper Providence, and in Middletown, Concord, and Marple townships, fine specimens have been found. Fine beryls also have been observed at White Horse, 3 or 4 miles below Darby, Pennsylvania. Bluish green and blue beryls occur in the vicinity of Unionville, Newlin township, and on Brandywine battlefield, in Birmingham township. One crystal, of a dark tourmaline green tint, over one-half inch long, in the cabinet of Mr. Michael Brodley, of Chester, Pennsylvania, is from Middletown, Delaware county, and would afford a fine gem. Some of the gems from here, especially those from the John Smith farm, have much the appearance of bluish emeralds. The finest American golden yellow beryls are found at the Avondale quarries, Delaware county, Pennsylvania. A 20-carat gem is in the cabinet of Mrs. M. J. Chase, and material for another is in the cabinet of Mr. Clarence S. Bement. Mr. B. B. Chamberlain has lately found six fine yellow beryls, 1 to 2 carats each, in Manhattanville, New York City.

The variety of beryl found at Goshen, Massachusetts, and called goshenite, occurs in pieces transparent enough to afford gems.

Phenakite.—About fifty crystals of phenakite have been found during the last year, of which fully one-quarter would aoffrd gems, some over 6 carats in weight and absolutely pellucid; the largest crystal found was 3 inches across; the finer ones are equal in quality to the Siberian. They have been observed at the locality near Pike's peak(*a*), and also near Crystal peak small ones on amazonstone. At the topaz locality at Florissant, El Paso county, Colorado, phenakite(*b*) occurs in small but very interesting crystals implanted on microcline amazonstone. They are rarely over 5 millimeters in size, and are very transparent and colorless, and would afford minute gems.

Euclase.—Only one mention is made of euclase in the United States.(*c*)

a W. Cross, in *American Journal of Science*, October, 1882.

b Identified by Mr. W. Cross in December, 1884.

c "Minerals and Mineral Localities of North Carolina," 1881.

In this case several crystals were reported as found at the residence of Mr. Morrill, Mills's Spring, Polk county, North Carolina, by Gen. T. L. Clingman, in washing the gold sand at this locality, and Dr. F. A. Genth says this mineral was *not* euclase.

Zircon.—At a locality near the Pike's Peak toll road, due west from the Cheyenne mountains (*a*), zircons are found in a soft yellow mineral in a quartz rock. The crystals found here are the most beautiful ever found of this mineral, nearly always brilliant and often transparent; in color generally a rich reddish brown, although at times pink and honey-yellow, some few emerald-green crystals also having been found. They are rarely over one-eighth inch in diameter, as a rule not over one tenth, and yet some of them would furnish very interesting small gems. Opaque zircon is found at several localities in the Pike's Peak district, in one case associated with amazonstone and in another with astrophyllite, also with a flesh-colored microline in the same region, and in a quartz rock. No gems have been found in these localities. Zircon is abundant in the gold sands (*b*) of Polk, Burke, McDowell, Rutherford, Caldwell, Mecklenburg, Nash, Warren, and other counties in North Carolina, in nearly all the colors peculiar to Ceylon; yellowish brown, brownish white, amethystine, pink, and blue. They have many planes, but are too minute to furnish gems of any value. Gen. T. L. Clingman, in 1869, obtained within a few weeks 1,000 pounds of the well-known brownish crystals from Buncombe county, North Carolina. They occur in equal abundance at Anderson, South Carolina. The latter are readily distinguished from the North Carolina crystals, being much larger, often 1 inch across, and the prism is nearly always very small, the crystal being made up often of the two pyramids only.

Fine crystals of this mineral have also been found in Lower Saucon township, Northampton county, Pennsylvania, and three-fourths of a mile north of Bethlehem. The gravels of the Delaware and Schuylkill rivers contain considerable quantities of very minute nearly colorless crystals of zircon. Some fine ones over 1 inch in length have been found at Litchfield, Maine, and all through the cancrinite and sodalite rocks near them. In the Canfield cabinet are some of the finest known black zircons, perfect crystals over 1 inch long, which were found near Franklin, New Jersey.

Andalusite.—The andalusites of Upper Providence, Delaware county, Pennsylvania, described by Prof. E. S. Dana (*c*), are worthy of mention from the fact of their remarkable size, one of the crystals weighing 7 pounds, although not fit for gem purposes.

Andalusites of a fair pink color not entirely perfect, but still of a quality to produce mineralogical gems, were found to some extent at

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a *American Journal of Science*, October, 1882.

b "Minerals and Mineral Localities of North Carolina," 1881, page 44.

c *American Journal of Science*, III., Vol. IV., December, 1872.

Westford, Massachusetts(*a*), some of the crystals being 2 inches long and one-fourth inch across.

No new crystals have been found at the Gorham, Maine, locality(*b*), of which a brief mention was made in the last report.

Andalusite has been found on the slope of Mount Wiley, Standish, Maine, by Mr. Lucien Holmes, of Standish; the crystals are fully one-quarter to three-eighths of an inch in diameter and of a good flesh-pink color; they would cut into very fair mineralogical gems. While collecting on the Dresser farm, back of the Lucien Holmes farm, I found some crystals similar to the above, equally as transparent, associated with crystals of pyrrhotite in a quartz ledge. The locality associations being identical at the three places, although 6 miles apart, would lead to the inference that this mineral must occur in some abundance in this vicinity, and that these are only outcrops of the same rock, which may yield some fine gems if the proper amount of work be expended there.

Prof. W. P. Blake (*c*) first observed that in Mariposa county, California, in the drift of the Chowchilla river, near the old road to Fort Miller, chiastolites are found in great abundance in fine crystals, showing the dark crosses on a white ground in a remarkably perfect and interesting manner. They are also found in the stratum of conglomerate which caps the hills above the streams, and these were doubtless all originally in place in the slates a little higher up the river. Smaller and less perfect "macles" are found in the slates at Hornitos on the road to Bear valley. The Mariposa, California, crystals, are rather the finer.

The interesting and well-known illustrations in Dana's "System of Mineralogy," page 372, well indicate the endless variety of markings that may exist in this mineral and the beautiful ornamental effects that could be produced, serving also purposes of personal adornment.

Lancaster and Westford, Massachusetts, have produced many of the finest "macles" ever found.

Schorlomite.—The schorlomite of Magnet Cove, Arkansas, as a rule is penetrated by white crystals of apatite, but at times is very free from all foreign matters, and very compact, breaking with a very bright conchoidal fracture. Its superior hardness impressed me enough to try and see the effect in gem form. It proved on cutting to yield a dead black stone of not quite as metallic a luster as rutile, but rather a modification between it and black onyx. As it occurs in sufficient quantity we have here material that will form a new and fine mourning gem; stones can be cut of any size to perhaps over 20 carats, as the mineral occurs to fully this size. The first stone cut was over 6 carats in weight. It is the only gem of metallic luster over 7 in hardness.

Staurolite.—The staurolite of Fannin county, Georgia, 12 miles south-

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a School of Mines cabinet, New York.

b "Proceedings American Association for the Advancement of Science," 1883.

c W. P. Blake: "Mineral Localities of California," 1866.

east of Ducktown, Tennessee, first described by Prof. E. S. Dana(*a*), has furnished some of the finest known twinnings of this material. From their beauty these have found a sale abroad as ornaments and charms, and are more highly regarded than those found at Bretagne, France, which the superstitious believe were dropped from Heaven, according to the legend. They occur twinned in single and double crosses, and large quantities were found in decomposed rock, of which perhaps one-tenth were perfect crystals. They usually require a certain amount of scraping and cleaning when found.

Some fine brilliant crystals are found at Windham, Maine, some of the twins forming fine crosses. Occasionally crystals are found here that would afford small mineralogical gems, if cut. Their use for natural ornaments is exceedingly limited abroad, and here they are used scarcely at all.

Staurolite is found also at Franconia and Lisbon, New Hampshire, in mica slate; on the shores of Mill pond, loose in the soil; at Grantham; at Cabot, in Vermont; at Chesterfield, Massachusetts; at Bolton, Litchfield, Stafford, Tolland, and Vernon, Connecticut; on the Wissahickon, 8 miles from Philadelphia, in abundant reddish brown crystals; and at Canton, Georgia, at the lead mine.

It is also found at the Parker mine, Cherokee county, North Carolina, in fine twins; also on Persimmon, Hanging Dog, and Bear creeks, Madison county, and Tusquitee creek, Clay county. At the latter localities it is found in argillaceous and talcose slates.

Some staurolite macles similar to a chiastolite are described by Dr. C. T. Jackson from Charlestown, New Hampshire, which by insensible shades pass into andalusite macles.

Iolite.—The late Dr. Torrey possessed a fine seal made of a cube of iolite from the albite granite of Haddam, Connecticut, that displayed its dichroitic properties to the greatest perfection, the blue being remarkably fine. Though this locality promised well, the supply of gem material was scant. It has been found near the Norwich and Worcester railroad, between the Shetucket and Quinnebaug, where the gneiss has been quarried for the road. At Brimfield, Massachusetts, on the road leading to Warren, it occurs with andalusite in gneiss, and also near Norwich, Connecticut. It is found also at Richmond, New Hampshire, with anthophyllite in a talcose rock. No gems are being found at present.

Tourmaline.—One of the remarkable tourmaline localities(*b*) of the world is Mount Apatite, on the Hatch farm, Auburn, Androscoggin county, Maine, the locality first discovered by Mr. S. R. Carter. It was worked by Mr. N. H. Perry, who first found the true vein in 1882, and obtained probably one thousand five hundred crystals. They are

a American Journal of Science, Vol. XI., May, 1876, page 385.

b American Journal of Science, Vol. XXVII., April, 1884. "Proceedings American Association for the Advancement of Science," 1883.

usually colorless, light pink, light blue, bluish pink, light golden, and sections show the characteristic variety of color, such as blue and pink, green and pink, when viewed through the end of the crystal. Some of the faintly-colored crystals afforded gems that were considerably darker after the cutting.

During the last summer the north side of this locality has been worked by Mr. G. C. Hatch and Mr. T. F. Lamb, and much darker material has been found, especially the green colors, some of which equal anything found at Mount Mica. Rude black crystals were observed here 8 inches in diameter and 12 feet long, and at times inclosing quartzite. Several specimens were almost emerald color, and would afford gems. This promises well to afford fine gems for some time to come, as well as the Mount Mica locality.

Mr. Lucien Holmes, of Standish, Maine, found crystals of green, red, and blue tourmaline on the Hussey farm, but they were not of gem quality, although very good as crystals. As little work has been done, this locality might improve by development. The specimens at Bates College, Lewiston, labelled "Baldwin," are supposed to have been found at this locality.

During the last year Mr. E. G. Bailey and Dr. A. C. Hamlin have opened the Mount Black locality at Rumford and Andover, Maine. The indications here are quite good for gems, and a quantity of rubellite, a great quantity of lepidolite, spodumene 3 feet long, cookite, amblygonite, and other minerals similar to those of the Mount Mica, were taken out, none however of gem quality.

The tourmaline mentioned in Hamlin's "Tourmaline," page 72, was found about 1860, by Augustus Lane, at Welcome's Corner, on the Boutelle farm. This specimen was first recognized by Dr. Hoar. The locality is about half a mile from the Hatch farm, and the indications were found by Dr. Hamlin on working, in 1860 and 1862, to be the same as at the Hatch farm.

The localities in Maine that have furnished fine tourmalines are Mount Mica at Paris, two localities at Auburn, Hebron, Norway, Mount Black in Andover and Rumford, as well as the Standish locality; the two latter have furnished no gems.

Some of the finest of the cut rubellites and green tourmalines are in the possession of Prof. C. U. Shepard and members of his family. One of the most magnificent known green tourmalines is one, the color of which is described by Professor Shepard as of a chrysolite-green, and having a blue tinge, while less yellow and more green than chrysolite. It is 1 inch long, ¾ inch broad, and 1 inch thick, and finer than any of the Hope gems. One fine rubellite of two-thirds this size, and equally fine, one pink topaz one-half this size, and one remarkable rubellite the size of the large green tourmaline, are also in possession of this family.

The Hamlin cabinet (*a*), the first crystal of which was found in 1820,

a See "The Tourmaline," by A. C. Hamlin.

contains many hundred fine rubellites, indicolites, achroites, and fine pink, green, yellow, and other colored tourmalines, mostly from Paris, Maine. It is the finest tourmaline collection in the world, and really would furnish full suites for a dozen cabinets. One wonderful dark gem of 28 carats, 1 inch long, one achroite of 23 carats, and many fine stones of nearly every known shade of color of this gem, are found in this cabinet.

The DeKalb, New York, locality of white tourmalines afforded a few fine crystals. The choicest of these, in the cabinet of Mr. Clarence S. Bement, is over 1 inch long, and would cut into a gem weighing over 10 carats, that for light yellow color would be equal to that from any American locality.

Dr. Genth(*a*) mentions beautiful light yellow, brownish yellow, and at times white crystals, at Bailey's limestone quarry, East Marlborough, Pennsylvania; yellow crystals at Logan's limestone quarry, West Marlborough; brown, light yellow, at times transparent, at John Nivin's limestone quarry, New Garden township; and green tourmaline in talc has been found near Rock Spring, Lancaster county. Very beautiful crystals of black tourmaline are found in Delaware county; near Leiperville, it is found in crystals of 5 inches in length and 1½ inches thick, and well terminated; also in Marple township, terminated with two low rhombohedra. These are about as fine as black crystals are ever found. Bluish and brownish green tourmaline is found in fine crystals, penetrating damourite and diaspore, at Unionville, Newlin township.

The brown tourmaline found near Amity, and called xanthite, Mr. S. C. Young informs me he has observed transparent enough to cut into gems.

A small, well terminated, transparent green tourmaline (*b*) was found by Colonel Mills, on Silver creek, Burke county, North Carolina; also a black crystal 4 inches long, inclosed in a green beryl crystal.

Garnet group.—Although the garnets found in the diamond mines at the Cape of Good Hope, the so-called Cape rubies, are larger in size, and perhaps equal to those of Arizona, New Mexico, etc., by daylight, yet there is undoubtedly no finer garnet found that looks better in the evening than those from the garnet regions of the United States. The dark color in Cape garnets remains by artificial light, whereas with the American garnets nothing but the clear blood color is visible. They are of fine quality and plentiful on the Great Colorado plateau. Hoffmann mentions good though small crystals of garnet from Black Cañon, Colorado river, Nevada. Fine small almandine garnets are also found in the trachyte of White Pine county, Nevada. Some very fine crystals of garnet have been found during the summer at Round mountain, Albany, Maine, by Mr. Edgar D. Andrews. The large dodecahedral and trapezohedral garnets, coated externally with a brown crust of

a "Preliminary report on the Mineralogy of Pennsylvania," page 96.
b "Minerals and Mineral Localities of North Carolina," page 52.

limonite, but usually on breaking showing a bright and very compact material, are often as fine in color as the Bohemian gem material, and should find a ready use for watch jewels and other like purposes. Some of these crystals weigh 20 pounds, and would afford large dishes or cups measuring from 3 to 6 inches across. Some have been cut into very fine gems. They are found in Burke, Caldwell, and Catawba counties, North Carolina. A very large quantity has been found about 8 miles southeast of Morganton, in Burke county, and also near Warlick, in the same county. Another good locality is 4 miles from Marshall. Many of them are very transparent, varying in color from the purple almandine to a pyrope red. Many tons have been crushed to make "emery" and the sandpaper called garnet paper. The peculiar play of color is often due to the inclusions. In these, as well as those from Stony Point and elsewhere, at times nearly one-quarter of the entire crystal is taken up by cavities of fluid, acicular crystals, etc.

Pyrope of good color has been observed in the sands of the gold washings of Burke, McDowell, and Warren counties, North Carolina.

The Avondale, Pennsylvania, quarry has furnished some of the finest known crystals of common garnet as specimens, one of them measuring 2½ inches across (in a piece of quartzite), in color a rich purplish red, with beautiful natural polish and remarkably sharp angles. It is, perhaps, as fine as it is possible for this mineral to occur in crystal form, and is in the cabinet of Mr. C. S. Bement.

Iron-alumina garnet is found in Concord township, at Deshong's quarry, Shaw & Ezra's quarry, and at Upland, near Chester; also in Darby, Acton, Lower Providence, Haverford, and Radnor townships, Pennsylvania. A dark red variety, similar to pyrope in color, is found in the bed of Darby creek, near the Lazaretto, in Delaware county. Some peculiar garnets of a deep blood-red color have been mistaken for pyrope, but an analysis made by Mr. C. A. Kurlbaum proved them to be true garnets. Many garnets have been cut by collectors from both Chester and Delaware counties, and some of these were of very fair quality. At Acworth, Grafton, and Hanover, New Hampshire, garnets of gem value have often been found. At Russell, Massachusetts, a vein of garnet, very dark in color, and called there black garnet (not melanite), was opened during the last two years, and many fine crystals have been taken out, partly by Mr. Daniel Clark, of Tyringham, Massachusetts. These have been sold as specimens only, or exchanged for minerals, and were valued at fully $1,000 in all.

Beautiful transparent essonites one-fourth inch in diameter have been found at the Avondale quarry, Pennsylvania. They are entirely transparent and quite flat, being usually found between plates of mica. A few have been found equal to the Ceylon essonites. Essonite has been found of good quality at Milton plantation, and at the Carter, Perry, and Wild properties, Oxford county, Maine. Very fine essonites, red and fine yellow, were formerly found at Phippsburg, Maine. Mr. George

W. Fiss, of Philadelphia, found some of the most beautiful natural gems of microscopic yellow garnets in the cleaning out of a small cavity at the microlite locality near Amelia Court-House, Virginia. In the cabinet of Dr. Isaac Lea are some crystals of a rich, dark, oily green grossularite, transparent, from 1 to 5 millimeters long, that were found at the Good Hope mine, California. Some very fair crystals of a rich green grossularite, from 1 to 5 millimeters in diameter, are found at Hebron and West Minot, Maine.

The colophonite from Willsborough, New York, although of a beautifully rich, irridescent color, has never been utilized, owing to the small size of the grains and the friability of the large masses. At Franklin, Sussex county, New Jersey, immense crystals of the different varieties, melanite, polyadelphite, colophonite, etc., have been found, but rarely in crystals that would afford a gem.

The beautiful and rare garnet, ouvarovite, was first described as occurring in this country by Prof. C. U. Shepard(*a*), as having been found in minute nearly transparent emerald-green crystals one-tenth inch in diameter at Wood's chrome mine, Lancaster county, Pennsylvania. The ouvarovite from Oxford, Canada, adjoining Newport, Vermont, on Lake Memphremagog, is found in large quantities, at times in masses over 1 foot across. The crystals, however, are very small, being rarely over one-sixteenth inch across, though usually of a good color. The white garnet from here, described by Dr. T. Sterry Hunt(*b*), although not in crystals, is identical with the fine crystals found at Wakefield(*c*), Canada, and has been cut into white gems. The Wakefield ouvarovite is much finer than the Oxford crystals, some one-fourth inch across having been found, one of which is now in the cabinet of the late Mr. John G. Miller, of Ottawa, Canada.

Garnets are found at many localities in California and Arizona. According to Prof. W. P. Blake they have been found at the following places in California: Rodgers mine, in the eastern part of El Dorado county, a green grossular stone in copper ore; near Petaluma, Sonoma county, associated with specular iron, calcspar, and iron and copper pyrites; in the Coso district, Inyo county, in large semi-crystalline masses of a light color, some specimens of which were taken to San Francisco under the impression that they contained tin; 3 miles from Pilot Hill, El Dorado county, in blocks several feet thick; also in Plumas, Mono, Fresno, Los Angeles, and San Diego counties. Garnets occur in great quantities in mica-schist at the mouth of the Stikeen river, near Fort Wrangel, Alaska. Blood-red stones are plentiful on the Nacimiento desert, near Fort Defiance, northeastern Arizona. They are found here in the loose sand, having probably been brought by the action of water from a point 50 miles to the north, where they occur in

a *American Journal of Science*, 2, XLI., page 216.

b "Geology of Canada," 1863, page 496.

c "Proceedings American Association for the Advancement of Science," 1883.

the so-called syenite. This is thought to be the place where the perpetrators of the famous "diamond swindle" procured the garnets with which they salted the bogus diamond field. In the western part of Arizona, on the same parallel with Fort Defiance, garnets have been observed on both sides of the Colorado river.

Kyanite.—The finest American kyanites were possibly those formerly found at Chesterfield, Massachusetts, a fine example of which is in the British Museum cabinet at South Kensington. The crystals in this are all distinct, of a fine dark blue color, and would cut into some small mineralogical gems.

At the locality at Derby creek, Moon's ferry, Delaware county, Pennsylvania, fine deep azure-blue blades 5 and 6 inches long have been found, which would afford gems if they were thicker. Blue, green, and gray specimens are found at East Bradford.

Fine crystals are found, together with lazulite, at Chubb's and Crowder's mountains, Gaston county, North Carolina, on the road to Cooper's gap.

In Maine kyanite is found in fine crystals at Windham.

The old localities are Worthington, Blanford, Westfield, and Lancaster, Massachusetts; Litchfield and Washington, Connecticut; Stratford, Salisbury, and Bellows Falls, Vermont; near Wilmington, Delaware, and at Willis mountain, Buckingham county, also 2 miles north of Chancellorsville, Spottsylvania county, in Virginia.

No really fine gems have as yet been produced from American kyanite.

Danburite is found in considerable quantity at Russell, New York.

Lithia emerald (hiddenite).—Lithia emerald, or hiddenite, has been found in very small quantities at Stony Point, Alexander county, North Carolina, since the spring of 1883; nearly all the gems sold by the company now are, therefore, of old material, usually small stones, or else rather light colored.

SILICA GROUP.

Transparent quartz.—In Herkimer county, New York, quartz crystals have been collected by many for their remarkable brilliancy and perfection, rivaling even those found in the Carrara marble; many collections of them have been made, notably one by Rev. Bogert Walker, of Herkimer. There are a number of others at Middleville, Little Falls, Canajoharie, and other places. Many are sold along the railroads, a two-ounce vial of them usually bringing $2. Crystals with a drop of water bring from $1 to $30; single fine limpid ones, from 10 cents to $25. At times they are brilliant, transparent, and perfect as any known substance, whiter even than any diamond. Curious groupings or inclusions, such as bitumen, pearl spar, etc., also bring fancy prices.

Many fine crystals were obtained where the railroad was opened, at Middleville and Newport, also at Little Falls, on the line of the West

Shore railroad. The old diggings at Little Falls have been worked so extensively that the highway has been encroached upon, thus partly preventing further digging. There crystals are in demand all over the United States, several men being required to dig nearly all the time to supply the demand from all quarters. At Diamond point and Diamond island, Lake George, the same crystals occur as in Herkimer county, and are extensively sold there.

Some of the most magnificent known groups of quartz were formerly obtained at the Ellenville lead mines, Ulster county, New York, some of the finest of which are now at the American Museum of Natural History, New York City. Few, if any, of these were used for gem purposes, although many were sold as souvenirs at the locality over twenty years ago. The Sterling mine at Antwerp, New York, furnishes small, fine, doubly-terminated dodecahedral crystals, and the same forms, slightly different, are also found in the specular iron at Fowler, Herman, and Edwards, Saint Lawrence county; Diamond hill, Lansingburg, is an old but poor locality, and Diamond island, Portland harbor, Maine, is well known for the small but bright crystals found there.

Dr. Genth, in "Preliminary Mineralogy of Pennsylvania," mentions crystals from 1½ to 3 inches across, short and thick, but with clear pyramid, from Nazareth, Northampton county, Pennsylvania; also fine crystals, 1½ inches long and wide, from Crystal springs, on Blue mountain, in Bushkill township.

The highly modified crystals from Diamond Hill and Cumberland Hill, Rhode Island, also the fine ones from White Plains and Stony Point, Alexander county, and from Catawba and Burke counties, North Carolina, are worthy of mention, and lately formed the subject of a crystallographic memoir by Prof. Gerhard vom Rath.

The San Francisco *Bulletin* of July 16, 1884, mentions the finding of a large deposit of crystal or pebble stones on the Santa Margarita rancho, San Diego county, California, special reference being made to one specimen of pure crystal 8 inches in diameter.

Mention is made by Dr. Daniel G. Britton(*a*) in a paper on the folk lore of Yucatan, in quoting the language of Garcia that the natives were converted from Pagan idolaters to Christian idolaters, and speaking of the belief in witchcraft and sorcery among them, that the wise men divine with a rock crystal and that it has great influence over their crops. Their occurrence in the mounds of Arkansas, North Carolina, and elsewhere, and the abrasion of the crystalline edges, would lead to the inference that they were not collected only to bury with the dead, but that they were carried by the natives for a long time to produce certain influences, and having been used for such purposes were probably buried with them as their property. Personal observation in Garland and Montgomery counties, Arkansas, carried on at times 40 miles from the Crystal mountain locality, showed these crystals

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a Folk Lore Journal, August, 1883.

associated with a quantity of some of the finest chipped arrow points of chalcedony anywhere found, and yet no trace of a chipped crystal could be found among them. In a number of the mounds leveled by the farmers in cultivating, and not worked systematically, many single crystals of quartz were revealed, which may, however, have been kept for their beauty and symmetry by the Indians. These masses of transparent quartz, especially from North Carolina, would afford perfectly clear crystal balls, at least 2 to 4 inches in diameter, and a few have been cut over 2 inches.

A large mass weighing 5 kilos was recently brought from Alaska, and was only a part of an original mass which must have weighed 20 kilos. It afforded clear crystal slabs for hand glasses 3 by 5 inches. The superiority of this material over glass lies in the fact that it does not, like glass, by its color detract from the rosiness of the countenance. A fine glass of this kind is in the Dresden "green vaults."

Amethyst.—One of the finest American amethysts was lately shown me by Mr. L. M. Ives, of New York City. The color was nearly equal to the finest Siberian, and the crystal would afford a gem three-eighths inch arcoss. It was found by Mr. Ives, 1½ miles from Roaring brook, near Cheshire, Connecticut.

Amethyst of a light purple and at times pink color is found in crystals 3 inches long and over in large abundance at Clayton, Rabun county, Georgia. At times these have large liquid cavities containing movable bubbles of gas. They are of little gem value, although fine as specimens. Some fine amethysts in the Hamlin cabinet are from Oxford county, Maine. Very fair crystals were formerly found at Mount Crawford, Surray, Waterville, and Westmoreland, New Hampshire. Some very fair crystals have been observed at Bristol, Rhode Island. Dr. F. A. Genth(*a*) mentions magnificent specimens from Delaware and Chester counties, Pennsylvania. Among the principal localities may be mentioned the farms of S. Entrikin, William Gibbon, Mrs. Faulkes, and Dr. Elwayne, in East Bradford township; in Pocopson township, John Entrikin's and Joseph B. Darlington's; Birmingham township, on Davis B. Williams's farm; in Charlestown township about 1 quart of loose crystals were obtained; on Charles Passmore's farm, Newlin township, about 100 pounds have been found. Mr. W. W. Jefferis(*b*) announced that amethysts of a rich purple color had been found in the northern part of Newlin township. Splendid crystals, one weighing 7 pounds, though not gem material, were found at Morgan Hunter's farm in Upper Providence. Other localities are Astor, Concord, Marple, and Middletown townships. Near Twaddle's paper mill, in Birmingham, they are found in clusters, and in isolated crystals near Dutton's mill;

a "Preliminary report on the Mineralogy of Pennsylvania," page 57, B.

b "Proceedings Philadelphia Academy of Natural Science, Mineralogical Section," page 44.

also at Chester and Thornbury, Delaware county, Pennsylvania, where many fine gems have been found, well known among the cabinets.

Hoffmann mentions amethyst on the mesa near the mouth of the Rio Virgen, Nevada. In Llano and Burnett counties, Texas, some very fair amethysts have been found; and at Grand Rapids, Wood county, Wisconsin, also in the amygdaloid on the Lake Superior shore, and in Michigan in trap rock at Keweenaw Point and Point Aux Peaux, Monroe county.

In the Yellowsone National Park and at Holbrook, Arizona, amethysts line the hollow trunks of agatized trees, varying in color from light pink to a dark purple, and forming a beautiful contrast with the chalcedony and banded agate sides of these specimens. They occur also in small crystals at Nevada and neighboring localities on Bear creek, Clear Creek county, on the summit of the range east of the Animas, Colorado. The Lake Superior variety found at Prince Arthur's landing, often of large size, is spotted with the coating of red mosslike markings so well known, giving them a moss-amethyst effect, if cut, though as a rule the coating is so even as to cover the entire surface, and nothing but a brick-red color is visible unless the crystals are broken. Notwithstanding the abundance of this mineral, but few gems could be cut from this locality. The West Shore railroad tunnel at Weehawken, New Jersey, brought to light a few very fair amethyst specimens in the volcanic rock.

The most remarkable amethyst as yet found in the United States has lately been deposited in the National Museum by Dr. H. S. Lucas. It is a turtle-shaped prehistoric chipping, measuring $2\frac{3}{4}$ inches in length, 2 inches in width, and $1\frac{1}{2}$ inches in thickness. The entire piece is transparent, flawless, and would afford a remarkable gem if cut.

Citrine is mentioned by Hoffmann(*a*) as occurring at Tuscarora, Gold Mountain, and in Palmetto cañon, Nevada. At Taylorsville and Stony Point, North Carolina, a number of clear pieces of this material were found that cut fair stones weighing over 1 ounce each. Occasionally at the Herkimer and Lake George localities quartz crystals have a fine citrine tint.

Smoky quartz.—The quartz of Herkimer county, New York, and Diamond island and Diamond point, Lake George, is at times of a variety of beautiful smoky tints and exceptionally pellucid. Some fine smoky quartz has been found at Goshen, Massachusetts, and by Mr. Gideon Bearce at Minot, Maine. A mass of fine clear smoky quartz weighing over 6 pounds, with clear spaces several inches across, was found in the summer of 1884 on Blueberry hill, Stoneham, Maine; and a fine crystal over 4 inches long and 2 across, very clear in parts, was found near Mount Pleasant, Oxford county. Dr. Genth(*b*) mentioned smoky quartz near Philadelphia; on the Schuylkill, near Reading, Berks

a "Mineralogy of Nevada."

b "Preliminary report on the Mineralogy of Pennsylvania," page 58.

county; near Hammerstown, Dauphin county; in Upper Derby, near Garret's road tollgate, and near the Kellyville schoolhouse, all in Delaware county; also at the tunnel near Phœnixville, and in East Nottingham and Birmingham townships, Chester county. In certain parts of Delaware and Chester counties the amethyst and smoky quartz gradually shade into each other, a characteristic peculiar also to many from the North Carolina localities. Alexander, Burke, and Catawba counties and other localities afford fine smoky quartz crystals. Some very fine ones have been found at Iron Mountain, Missouri.

From a region 20 miles west of Hot Springs, for about 60 miles westward, the quartz crystals as a rule are all doubly terminated and detached, and are found loose in the sand between the breaks or veins in the sandstone, which somewhat resembles the calciferous sandstones of Herkimer, New York. At that part of this region called "the gem country," nearest Hot Springs, the crystals are quite white, but gradually shade into a dark smoky color at the other end of the district. As a rule all the quartz is filled with fluid cavities. Some four hundred crystals with liquid inclusions were obtained from two veins of sand within three days.

Most of the cut articles of smoky quartz sold at the tourist localities are of foreign material cut abroad at a very low figure. Smoky quartz pebbles are rarely found in the sands along our coasts. At the watering places, such as Long Branch and Cape May, they are, however, occasionally found and cut as souvenirs.

The Pike's peak region at Bear creek is by far the richest locality for smoky quartz, and many thousands of crystals have been procured from 1 inch to those from 1 foot to over 4 feet long.(*a*) Considerable of this material has been sent abroad for cutting. Crystals are also found on Elk creek and the Upper Platte. Smoky quartz is found near Placerville, El Dorado county, California, in the placers. A fine large crystal 6 inches in diameter was in the cabinet of Dr. White, of Placerville.

A specimen of the rose quartz from Stow, Maine, cut into a long double cabochon from a massive transparent piece of quartz, distinctly shows the asteria effect similar to the star sapphire, if viewed by sunlight or artificial light.

Aventurine(*b*) quartz has not been observed from any American locality in fine specimens, although mentioned by Dr. F. M. Endlich as occurring on Elk creek, Colorado. Prof. John Collett has lately found a few small specimens of white aventurine quartz pebbles in the drift near Indianapolis.

Rose quartz.—At Stow, Albany, Paris, and a number of other localities in Maine, the veins of quartz shade from white, transparent, and opalescent resembling hyaline quartz, often without any imperfections, through faintly tinted pink and slightly salmon colored, into a rich rose

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a Dr. A. E. Foot's cabinet.

b Tenth Annual Report, F. V. Hayden, Geological Survey, 1876, page 150.

color, thus forming a beautiful series of tints of color that have merit for a common gem or for ornamental stone work. Possibly as fine transparent opalescent rose quartzes as have ever been found were recently obtained, in pieces free from all flaws, of a fine rose-red with a beautiful milky opalescence 4 by 5 inches in size, at Round mountain, Albany, Maine. A beautiful opalescent quartz has been found at Daw river, Stokes county, North Carolina. Rose quartz is found at many localities in the granites of Colorado, also in fine specimens at the head of Roaring fork, from near Clear creek, and on Bear creek. It is mentioned by Hoffmann, from Tuscarora, Moray, and Carlin, and Silver Peak, Nevada(*a*); also by Sweet(*b*) in crystals from Grand Rapids, Wood county, Wisconsin.

Prase.—Prase is found always crystallized at the various limonite deposits on Staten Island, New York. As specimens the mineral is very good indeed; groups of crystals are often 8 or 10 inches across, although the crystals are rarely over one-half inch long and one-eighth inch in diameter. The color as a rule is a dark leek green of no gem value.

Prof. W. P. Blake(*c*) mentions a greenish-tinged quartz resembling datolite in color, from the French lode, Eureka district, California.

Hoffmann, in the "Mineralogy of Nevada," mentions prase in crystals at Reese river, San Antonio, and occasionally on the mountain near Silver Peak.

A translucent leek-green variety(*d*) of chalcedony and quartz occurs in the syenitic range of the Lehigh, especially at the allanite locality, 5 miles east of Bethlehem, Pennsylvania. Prase is found at Blue hill, Delaware county, in doubly-terminated crystals, in curious crossings and rosettes several inches across; also in inferior specimens near Dismal run, Delaware county. Very fine quartz(*e*) occurs in its massive variety at George Van Arsdale's quarry, Bucks county; in Delaware county at Radnor; and in East Bradford township, Chester county.

Quartz inclusions.—The quartz inclusions as they occur in some varieties are sometimes of great beauty, and constitute an important part of the American gem minerals. As some of these are quite rare and little known among collectors, mention of a few of the leading American localities may not come amiss.(*f*)

Two of the finest known specimens of rutilated quartz are of American origin; they are massive smoky quartz, evidently parts of one crystal. One of them was originally in the possession of the late Dr. Chilton(*g*) as early as 1847, and is now in the Vaux cabinet at the Philadelphia Academy of Sciences. It is about 7 by 3½ inches, and is

a "Mineralogy of Nevada."

b Sweet's "Minerals of Wisconsin."

c "Catalogue of Minerals of California," 1866, page 20.

d Preliminary report on the Mineralogy of Pennsylvania, page 59.

e Preliminary report on the Mineralogy of Pennsylvania, page 58.

f See also paragraphs on rutile, amethyst, and garnet.

g "Proceedings American Association for the Advancement of Science," 1849.

completely filled with transparent essonite-red crystals of rutile, some of which are over 6 inches long and from the thickness of a knitting needle to that of a thin lead pencil; the larger crystals are slightly flattened. The other belongs to Prof. Oliver P. Hubbard(*a*), of Dartsmouth College, and is 7 inches long by 3 inches across, and of a rich smoky color. The included crystals are a fine essonite-red, but not thicker than a knitting needle. Both were brought from some Vermont locality now unknown; believed, however, not to be Bethel or Rochester, notwithstanding these localities have furnished many fine crystals of similar size filled with beautiful rutile. Beautiful pieces of quartz 3 by 4 inches, and fine crystals of quartz penetrated by beautiful clove-brown and black rutile, were formerly found at Middlesex, Vermont.

Rutilated quartz of unexcelled beauty, the rutile usually brown, red, golden, and black, has been found at many localities in Randolph, Catawba, Burke, Iredell, and Alexander counties, North Carolina; and during the last year, at the emerald mine at Stony Point, crystals of quartz have been found 3 inches in length, and filled with rutile as thick as a knitting needle. Fine pieces of quartz 4 inches square, containing acicular rutile of a rich red color, were found near Amelia Court-House, Virginia. Some fine acicular crystals of rutile in limpid quartz, in the possession of Mr. Joseph Wharton, were found near Knitzer's, Lancaster county, Pennsylvania.

Mr. Samuel R. Carter has in his cabinet cut specimens of pieces of bluish quartz filled with small acicular crystals of indicolite, somewhat resembling rutile in quartz, with the exception of the blue color. These were found in pieces over 1 inch square at the famous tourmaline locality at Mount Mica, Paris, Maine.

The mining operations at Stony Point, North Carolina, brought to light a number of crystals of quartz, some 4 inches long and 3 inches across. Large pieces of quartz 3 inches square, filled with what appears to be asbestus or byssolite, form interesting and pretty specimens. The inclosures of what appears to be göthite in red fan-shape crystals from North Carolina also form very pretty and interesting gem stones.

A fine limpid crystal(*b*) of quartz, 1 inch long and two-thirds of an inch in diameter, penetrated by fine green crystals of actinolite one-half millimeter in diameter, is said to have been found at some Virginia locality. The so-called Gibsonville emerald(*c*), exactly similar to the above, the crystal being 3 by 2 inches, was plowed up in a field at Gibsonville, North Carolina.

Some crystals of limpid quartz have been found in California containing particles of native gold; one of these was said to be 1 inch long, and inclosed a scale of gold about the size of the end of a finger

a "Proceedings American Association for the Advancement of Science," 1849.

b Cabinet of Tiffany & Co.

c See page 725.

nail. Two of these inclusions, not so large, are in the possession of Rev. W. C. Hovey, of Minneapolis, Minnesota.

In Nevada county, California, in the Grass Valley mines, quartz is often found supporting gold between the crystals. Pellucid crystals of quartz, some 1 inch long and three-fourths of an inch across, filled with a very brilliant stibnite projecting in all directions and some of them curiously bent, were found at the Little Dora mine, Animas forks, San Juan, Colorado, Mr. John W. Palmer, of Chicago, owning a very fine one. This material is capable of being made into one of the finest of this class of gems that have been found at any locality.

The beautiful specimens of limpid milky quartz, and also quartz crystals, the latter at times from three-fourths of an inch to 2 inches long, are found penetrated by crystals of black hornblende varying in size from acicular to those one-sixteenth inch in diameter and at times 6 inches long. They interlace and penetrate the quartz in every direction, making a very beautiful gem and ornamental stone. Fine pieces 6 inches square have been found. It occurs at the quarry at Calumet hill, Cumberland, Rhode Island, where the workmen, as a rule, knowing its value, secure the best specimens for disposal to the greatest advantage. Some hundreds of pounds of this material were sent abroad a few years ago to be cut up for jewelry at Idar and Oberstein. As, however, work has been suspended at the locality, the mineral is likely to become somewhat uncommon. Cut specimens sell at from 50 cents to $5, and specimens polished on one side at from 25 cents to $5. This locality is one of the best known for this association.

Among other inclusions that might be utilized for gems may be mentioned the following: Crystals of quartz filled with specular iron found at the Sterling mine, Antwerp, New York; quartz including scales of hematite from King's Mills, Iredell county, North Carolina; dolomite in pellucid quartz of Herkimer county, New York; crystals of quartz containing crystals of the green spodumene (hiddenite) from Stony Point, North Carolina, and fine inclosures of chlorite and mica, green when viewed through the side of the prism, from several North Carolina localities.

The corals and sponges of Tampa bay, Florida, which are so often found there altered to chalcedony by the sileceous waters, are at times filled with fluid that was imprisoned while the regular deposition of silica closed the apertures that admitted the siliceous water. These, as well as the ones found in Uruguay, the so-called hydrolites, or waterstones, are always lined with drusy quartz. If not as beautiful as those from Uruguay, they are even more interesting, and have been sold at from $2 to $20 each.

The crystals of quartz from the Herkimer (New York), North Carolina, and Arkansas localities, containing fluid cavities with moving bubbles, are at times cut into ornaments which are not only interesting but pretty. One of these pure limpid crystals with a crescent-shaped

cavity, from Little Falls, was mounted in a pair of gold ice-tongs to represent a cake of ice. These crystals are valued at from $1 to $25 each. In Rabun county, Georgia, the fine amethysts often contain these cavities nearly 1 inch long, and would afford good gems, as would also those from Stow, Maine.

The quartz pseudomorphs, after calcite cleavages, from the locality 2 or 3 miles northwest from Rutherfordtown, Rutherford county, North Carolina, at times contain liquid in irregular-shaped cavities, and from their breaking out in good shape can be utilized for curious ornaments. This variety of quartz was also found by Mr. J. A. D. Stephenson in Iredell county. Possibly the finest specimen is one belonging to Mr. W. B. Dinsmore, of New York City. It is about 1 inch long and the surface is coated with a beautiful bluish white chalcedony with a curious rough surface, and it is perfect on all sides, with a free movement of the bubble. It is so thin and so filled with liquid that the liquid would weigh fully twice as much as the quartz walls. It is of the proper size and sufficiently beautiful for personal ornament. As nearly as can be ascertained it is from some locality in Georgia.

In the cabinet of Dr. Isaac Lea, of Philadelphia, there are perhaps thousands of remarkably fine and unique inclusions in quartz, as well as in all known gems, probably, in fact, every known form of mineral inclusion, forming undoubtedly the finest cabinet of "included minerals" in the world, the result of scores of years of keen observation and careful microscopic work. In the cabinet there are, of course, many stones which could be cut into fine gem stones, but which possess a higher interest as mineralogical specimens.

Agate and chalcedony.—The "trap" along the Connecticut river, especially at Amherst and Conway, Massachusetts, and Farmington, East Haven, Woodbury, and Guilford, Connecticut, affords agates of considerable beauty, though rarely over 3 inches across. The so-called chalcedonic balls of Torringford are very handsome when polished, and the rich carnelian shades with milky translucency afford a pleasing contrast. Many of these were cut into the form of sealstones as early as 1837(*a*), which were fully equal to any from abroad in the delicate arrangement of the layers and the richness of the colors. At Natural Bridge, Jefferson county, New York, fine agates have been found. The Belmont lead mine, Saint Lawrence county, has afforded some very good chalcedony. White, yellow, and blue chalcedony of good size was found 4 miles east of Warwick, at Bellvale, Orange county, New York, by Dr. W. Horton.(*b*)

Chalcedony is found in Delaware county, Pennsylvania, principally at Middletown and Marple. Brown botryoidal masses occur at the Hopewell mine; also, at Williston, West Nottingham, West Goshen, and London Grove townships, in Chester county; a pale blue variety at

a C. U. Shepard: "Mineralogical Report of Connecticut," 1837.

b "Geological Survey of New York," 1840; Report on Orange county minerals.

Cornwall, Lebanon county; near Rock spring and Wood's mine, in Lancaster county; between Clay and Hamburg; also, at Flint hill, Berks county; in Cherry valley, Munroe county; at Conshohocken, Montgomery county, and at other localities in Pennsylvania. From many of these localities, especially in Delaware and Chester counties, ringstones, sealstones, and other ornaments are worn by the residents who have had them cut from local material.

Agates are found abundantly on the entire Lake Superior shore, and along the Mississippi river, especially in Minnesota, and fine chalcedony occurs 5 miles north of Grand Rapids, Wisconsin. Agate and chalcedony are both found at the Fox river, Illinois. Agate, chalcedony, and carnelian are found near Van Horn's well, Texas, and near Hot Springs, Arkansas.

The agates of the Yellowstone National Park and Holbrook, Arizona, equal any yet found.

A rich fawn and salmon colored chalcedony has been found in Burke county, North Carolina, by E. A. Hutchins. At Caldwell's, Mecklenburg county; near Harrisburg and Concord, Cabarrus county, and Granville, Orange county, and in other localities in North Carolina, fine agates and chalcedony have been found.

In Colorado chalcedony is found 8 miles south of Cheyenne mountain at the Los Pinos agency at Chalk Hills; on the bluffs near Wagon-Wheel Gap and along the upper Rio Grande valley; in Middle and South parks, Buffalo park, Fair Play, Frying Pan, Trout creek, Gunnison river, and frequently in drift accumulations.

Agate is found in fine specimens lined with amethyst on the summit of the range of the Animas, clouded white and gray in the lower trachytic formations of the Uncompahgre group. It occurs in a variety of forms, clouded, banded, laminated, and in a variegated form, at the Los Pinos agency; also in the South park in the drift, in the lower Arkansas valley, on the Frying Pan, and throughout the Middle park in the form of onyx and sardonyx, on the lower Gunnison and adjacent regions.

Prof. W. P. Blake(*a*) mentions large masses of white chalcedony, delicately veined and in mammillary sheets, near the Panoches, in Monterey county, California; on Walker river, Nevada; also of a fine pink color near Aurora, Esmeralda county, Nevada; and in pear-shaped nodules in the eruptive rocks between Williamson's Park and Johnson's river, Los Angeles county, California.

Beautiful pebbles of agate and chalcedony are abundant along the beach of Crescent City, California, and are often cut as souvenirs; they are usually of a light color. In the pebbly drift of the Colorado river they are more highly colored, more abundant, and of larger size; many of the surf-worn pebbles of the Pescadero beach, California, are agate and quartz, of very fine bright colors; occasionally these are

a "Minerals of California," page 9, 1866.

utilized as gem stones. Fine agates and jaspers are found about the Willamette, Columbia, and other rivers in Oregon. Beautiful red and yellow carnelian and sardonyx result from the silicification of the corals and sponges at Tampa bay, Florida, and although the pieces are not large, the colors being natural are very good.

The silicified bones of the atlantasaurus found at Morrison, Colorado, have at times a coarse cellular structure, infiltrated with carnelian, giving a very pleasant effect of a brilliant red striped and mottled appearance.

Chalcedony coats and incloses the crystallized cinnabar of the Redington and other mines of California; and these crusts, if cut with the cinnabar, form very pretty and interesting gem stones.

Silicified coral.—The true silicified corals found at Schoharie, New York, along the Catskills, and at a large number of other American localities, form very pretty gem stones. Some similar to the so-called fossil palm wood from India have been observed at a few localities in New York State. One very interesting black siliceous coral form with large white markings was found at Catskill, New York; when cut across the large white columnar lines the effect was very pleasing and ornamental.

Silicified wood.– In the valley of the east fork of the Yellowstone river, and in the volcanic Tertiary rock, which here attains a thickness of 5,000 feet and is made up of fragmentary volcanic products which have apparently been redistributed by water and now form breccias, conglomerates, and sandstones, Mr. W. H. Holmes(*a*) mentions the occurrence of silicified wood in great abundance, and in some cases the trunks are *in situ* in these strata.

In the valley of the main Yellowstone, in the Gallatin range, and about the sources of Cañon and Boulder creeks, also near the divide at the head of Boulder creek, and at a number of points above this line, may be observed trunks many feet in height and of gigantic proportions, standing in the identical strata in which they grew. In general, these strata are horizontal. Three miles south of Gardiner's river, at an elevation of 6,000 feet above the sea, silicified trunks are found in sandstone belonging to the same strata. On the south side of Third cañon, opposite the mouth of Hell-roaring creek, is a massive promontory, in which many fine trunks are exposed in a conglomerate. At Amethyst or Specimen mountain some of these trunks have been found 10 feet in diameter. Many thousands of silicified trees are found; in some cases the structure is well preserved, and in other cases completely agatized or opalized, and lined with crystals of calcite, quartz, and beautiful amethysts. In this locality many of the finest specimens of American silicified wood are found.

The workmen on the Denver and New Orleans railroad in 1882(*b*),

a "Geology of the Yellowstone National Park," page 48.

b A. E. Foote, *Naturalist's Leisure Hour*, July, 1882, page 32.

while within 20 to 30 miles of Denver, Colorado, between Cherry and Running creeks, were met by an obstacle in the form of a buried forest. The trees are of various sizes, all silicified and agatized, and buried at depths of from 10 to 20 feet; they are very perfect and are met with in a half dozen localities.

Numerous newspaper articles have appeared on the utilizing of the petrified forests near Holbrook, Arizona, by a company which is making large ornaments of the material, and which have gradually driven the so-called California and Mexican onyx out of the market. A company has been formed, however, and a large exhibition of this material was made at New Orleans, and a quantity of the mineral was sold, usually as small paper weights or for small jewelry ornaments. The company has been reorganized, and with its new sawing machinery hopes to be able to cut table-tops, tiles, and for other like purposes. The material is one of the finest known for color and hardness that could be used in this way. A stump, 18 inches across and 3 feet high, was sold to a Russian at New Orleans. Immense quantities of the material exist in Arizona and in magnificent specimens. One in the Peabody museum is fully 24 inches across and very compact; some of the trunks are at times magnificently lined with quartz and amethyst. One tree, fully 100 feet long, spanning a chasm and making a natural bridge, is one of the attractions. Some use may arise for the material if cheap polishing and slitting can be introduced, and no doubt in the near future some developments will be made in this line, since a second company has obtained property adjoining that of the company doing the work. The cutting of some sections of a 12-inch trunk into bottoms for solid silver trays is one of the novelties introduced by a leading jewelry firm.

Moss agate.—Moss agate was formerly found near Hillsborough, Orange county, North Carolina. The agatized trees from Holbrook and Specimen mount show these mosslike markings more like the fine tree-stones from Brazil than our common American agate. One curious stalactite of chalcedony, about 3 inches long and having the appearance of a piece of common sperm candle, had a black core through its entire length about the size of a candle wick, making it at first sight scarcely distinguishable from a half-used candle. It was unfortunately cut into a number of matched stones for cuff-buttons, which were very unique with the beautiful black central dot.

In the southeastern part of Humboldt county, Nevada, are large quantities of moss agate of the dendritic and "fortification" forms, which, however, have been utilized to a very limited extent.

Moss agate has been very sparingly used during the past year, the sales amounting to not over $1,000. Since the recent introduction into cheap jewelry of the Chinese natural green and artificially-colored red and yellow moss agate, the sale of the American has almost entirely fallen off. A so-called moss agate is found at Rock Springs, Lancaster county,

Pennsylvania, and also near Reading, Berks county. A beautiful moss jasper is found in Trego county, Kansas.

Chrysoprase.—Possibly the best American chrysoprase was found within the last year by Mr. F. E. Monteverde, at Nickel mountain, near the town of Riddle, Douglas county, Oregon. The chrysoprase was observed in small veins about one-eighth inch thick, and furnished a number of flat stones of a rich green color, that were over 1 inch square; it occurs in a vein of serpentine associated with the nickel ores.

Traill(*a*) mentions chrysoprase from New Fane, Vermont, which mineral Prof. J. D. Dana refers to green quartz and not chrysoprase, although it was also so-called at the locality where found.

A fine green-colored specimen intermixed with a black hornblende that would afford gems 1 inch across was shown to me by Mr. E. A. Hutchins, of New York, and was found at some locality in Macon county, North Carolina.

Mr. Thomas A. Tabor, in 1839, mentions in a letter to Dr. C. A. Lee the occurrence of chrysoprase in Chester county, Pennsylvania, without any description of its quality, though one would infer that it was of gem quality, since Mr. Tabor was a jeweler. Dr. F. M. Endlich(*b*) mentions chrysoprase as of rare occurrence in Middle park, Colorado.

Opal.—Beautiful fire opal without any opalescence is found in Washington county, Georgia, and was first described by Prof. G. J. Brush, who has the finest piece in his cabinet. It is a vein about one-fourth inch thick and 2 inches square.

Common opal occurs rarely in small masses of a greenish and yellowish white with vitreous luster, at Cornwall, Lebanon county, Pennsylvania. It is found at Aguas Calientes, Gilson gulch, at Idaho Springs, Colorado, in narrow seams in the granite, and most of it is brownish. Mr. J. W. Beath states that he had seen fine opal specimens showing play of colors, said to have come from the Idaho Springs locality. At Colorado Springs it occurs milk white in color.

The following is communicated by Mr. C. G. Yale: "While the precious opal has never been found in the Pacific division, the common kind occurs in numerous localities. Large and very beautiful opalized wood is frequently found in the hydraulic mines of California. Small stones in great number are also taken out of some of the drift mines. A few of these being infiltered with the oxide of manganese, giving them the appearance of being filled with moss or possessing other peculiarites, are enough sought after to give them some little value."

Hoffmann(*c*) mentions opal in magnificent colors (evidently opalized wood) with silicified wood, and states that on breaking some of the large trunks at San Antonio, Nevada, fine specimens were obtained.

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a "Quartz and Opal," page 35.

b "Catalogue of Minerals found in Colorado," 1876; tenth annual report of the Hayden Survey, page 150.

c "Mineralogy of Nevada."

Hyalite occurs with cachalong at several localities in Yavapai county, Arizona; at the Philips ore bed, Putnam county, New York; and cachalong at Bellevale, 4 miles east of Warwick; in Burke and Scriven counties, North Carolina; in yellow fluorescent coatings upon gneiss at Frankford, Pennsylvania, and at Avondale, Delaware county, in bluish-green; also at Megarge's paper mill on the Wissahickon. Hyalite occurs at Concord, Cabarrus county, and the Culsagee mine, Macon county, North Carolina. Associated with semi-opal it is mentioned in the Mount Diablo range about 30 miles south of Mount Diablo.

Prof. W. B. Blake(*a*) mentions that a rich white variety of opal is found at Mokelumne Hill, Calaveras county, California, or on the hill near that place known as Stockton hill, on the west side of Chile gulch. A shaft had been sunk 345 feet, and the opals were found in a thin stratum of red gravel. They varied in size from that of a kernel of corn to a walnut, many of them containing dendritic infiltrations of oxide of manganese resembling moss. In 1866 about a bushel of these stones were raised in a day, and were reported to have a market value. A milky variety similar to the above, and without fire, is found with the magnesite on Mount Diablo, 30 miles south of the mountain; also in the foot hills of the Sierra at the Four creeks.

Beautiful pieces of a moss-marked opal, similar to moss agate, are found in Trego county, Kansas. They are often 3 and 4 inches across.

Semi-opal is found together with the chalcedonies at the Los Pinos agency, and north of Saguache creek, Colorado, in trachyte.

Geyserite.—Some of the geyserite from the geysers in Yellowstone park, especially at Firehole river, occurring in such a variety of concretionary and imitative forms, might be used for small ornaments.

Jasper.—Dr. Genth mentions that cat's-eye has been observed in several localities; a fair hexagonal crystal with the pyramid of greenish color, resulting from very fine fibers of actinolite disseminated through it, came from York county, Pennsylvania; it is found also 5 miles east of Bethlehem at the allanite locality, but not of gem quality.

A curious dark-gray piece of quartz was observed from the West Shore railroad tunnel at Weehawken, New Jersey(*b*), that was filled with what seemed to be byssolite, but really may be an altered pectolite, and would cut a tolerably fair mineralogical cat's-eye.

The so-called Thetis hairstone described by Dr. Jackson(*c*), found at Cumberland, Rhode Island, is really a quartz cat's-eye, and some very fair cat's-eyes have recently been cut from it by Mr. Edwin Passmore, one of them nearly two-thirds of an inch long, and quite equal to many from Hoff, Bavaria.

Little or no novaculite has been used during the last year for ornamental purposes, although it has some use as streakstones for miner-

a "Catalogue of California Minerals," 1866, page 18.

b Cabinet of G. F. Kunz.

c "Geology of Rhode Island," 1839.

alogical work, being better adapted for this purpose than anything else, owing to its hardness and pure white background.

Red jasper is found on Sugar Loaf mountain, Maine, and a fine yellow with chalcedony has been found at Chester, Massachusetts; fine red and yellow also by Dr. Horton 4 miles east of Warwick, at Bellvale, Orange county, New York; pebbles of fine red occur along the Hudson river from Troy to New York, especially at Hoboken, Fort Lee, and Troy, where the jaspery rock outcrops. The so-called green jasper of Norman's Kill from the Hudson river slates was used by the Indians for arrow points.

Jasper agate is found in considerable quantity at Diamond Hill, Cumberland, Rhode Island, in all shades of white, yellow, red, and green; these colors are also all intermixed in one specimen, usually mottled, and at times beautifully banded in irregular seams of white, creamy brown, greenish, and brecciated. It is found in large quantities, and although fully 1,000 pounds is taken away every year by visitors and collectors, not over $100 worth is sold or polished per annum.

Large pieces of fine yellow jasper have been found at Tyringham, Massachusetts, by Mr. Daniel Clark, of that place.

In Pennsylvania(*a*) jaspers more or less impure are abundant in the drift of the Delaware and Schuylkill rivers; also in Berks county, near Reading. Brownish-yellow is found at West Goshen, Chester county, and a reddish brown variety near Texas, Lancaster county, and a brown banded variety at the hydropathic establishment near Bethlehem. The arrow heads found in this vicinity and near Easton are mostly made of jasper. The jaspery sandstone so plenty near Mauch Chunk might be utilized for large ornamental work with advantage.

In North Carolina fine jasper, banded red and black, is found in Granville, Person county; bright brick-red and yellow at Knapp's, Reed's Creek, Madison county; at Warm Springs; at Shut-in Creek in Moore county; also in Wake county, and elsewhere in the State.

In Texas fine jasper has been found near Fort Davis, Bexar county, and at Barilla Springs, where are found the jaspery agates called Texas agate.

The moss jasper of Trego county, Kansas, is equal to any yet found.

Fine yellow, brown, and red jasper is found at the Los Pinos agency; throughout the Middle and South parks; along the Gunnison, in the Dakota group; on the Arkansas, Grand, White, Animas, and other rivers of Colorado, in the drift, and in some of the trachytes, mostly red, green, and brown. A very fine specimen was found at the junction of Lost Trail creek and the Rio Grande. Small but smoothly worn pebbles of jasper and agate are quite plenty on the shores of Lake Tahoe, California. Red and green jasper are very abundant in the

a "Preliminary report on the Mineralogy of Pennsylvania," page 60.

neighborhood of San Francisco, though not of fine quality; some of this stone has been used in building and for sidewalks.

Fine red jasper is found on the Little Colorado river, New Mexico, and also on the Willamette, Oregon. The latter region evidently furnished the material for the fine arrow points of Oregon.

The banded jasper found near Colyer, Graham county, Kansas, red, yellow, and other colors, with even white bands, affords blocks over 1 foot long and 6 to 8 inches wide, and really merits the attention of workers in ornamental stone, as it is unrivaled in the world for banded jasper.

Bloodstones in beautiful specimens with the red markings very fine are found at Chatham county, Georgia. Some fine heliotropes from here are in the cabinet of W. W. Jefferis. Heliotrope was formerly found in veins in slate at Blooming Grove, Orange county, New York. Some very fine pieces have been found near the Willamette river, Oregon, and of fine quality near the South park, Colorado, and below the Uncompahgre, near Grand river.

Basanite was found by Dr. Horton(*a*) at Canterbury and Cornwall, New York. It is also sparingly found in nearly all the drift north of New York City, and in that of the Delaware river from Easton, Pennsylvania, down to the State line.

Gold quartz.—The gold found in California quartz is worth about $16.50 per ounce, but jewelers will give willingly from $20 to $30 for each ounce of gold contained in such material as they can use. The price of specimens varies according to their beauty from $3 to $40 per ounce of quartz. The specific gravity of the mineral is taken, after which the gold value is ascertained by a table called Price's table. The amount of this material in the rough sold for jewelers' purposes is variously estimated at from $40,000 to $50,000 per annum, $1,000 to $2,000 worth being often purchased at one time. One lapidary at Oakland, who employs several assistants, purchased nearly $10,000 worth within one year, and a large jewelry firm in San Francisco, during the same time, purchased nearly $15,000 worth of this material.

Great care must be taken in the selection of the quartz. The stone used must be large enough to bear the rough treatment of the diamond saw and the lap wheel of the polisher; all of the ore is friable, and some of it crumbles to pieces while undergoing these processes. For the same reason all the pieces set in cabinet work are small; the saw hanging in the gold in the slitting prevents the cutting of large pieces, as the wafer like slabs are apt to be broken by this resistance while being separated from the block. Pieces 4 by 2 inches are quite rare, although fine pieces 4 inches square are at times seen.

Rarely more than one-half of the ore purchased finds its way into the mounting owing to this breakage and the trimming into shape. Nearly all the cutting of this material is done at Oakland, California.

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a "Geological Survey of New York," 1840.

The white gold quartz of California is mainly supplied from the following counties: Butte, Calaveras, El Dorado, Mariposa, Nevada, Placer, Sierra, Tuolumne, and Yuba.

The black gold quartz, a quite recent novelty, is found at the Sheep Ranch mine, Calaveras county, and at Sutter creek, Amador county, California.

The so-called rose gold quartz is made by backing a translucent quartz with the desired shade of carmine paste, and forms an effective contrast to the opaque white and black gold quartz with which it is usually mounted in some design.

Single stones for scarf pins, rings, and sets of pin and earrings, sell from $2 to $10 each, and occasionally exceptionally fine or curious pieces bring higher prices.

It is not many years since gold quartz has been utilized to any great extent in jewelry. At first the designs were usually simple and the mountings very modest, but the demand has created a supply of the most elaborate designs, and at present it is used in every conceivable form of jewelry, and in articles of personal or house adornment of almost unlimited variety, such as canes, paper weights, writing cases, perfume bottles, fan sticks, bracelets, watch chains, and lace pins, the latter in such designs as shovels, picks, and other mining emblems.

In certain kinds of furniture it is used as paneling; and here, as in the jewelry, the effect is better brought out by added colors, such as are afforded by agate, moss agate, silver rock, smoky quartz, pyrite, chalcopyrite, cinnabar, malachite, turquois in the matrix, and other bright minerals.

Much of the jewelry made of this material is sold to tourists from the eastern States and from other countries. Eleven hundred dollars' worth was recently purchased by an Asiatic embassy, and scarcely any one visiting California fails to purchase a memento. The sale is increasing.

The best taste as a rule is not exercised in the designs. Many are too large and ungainly for personal adornment, and many others are not as well mounted as most of the other jewelry sold with them. Perhaps not one article in ten sold will have much if any wear. There is much room for improvement in the line of this work.

One of the large designs made of gold quartz, representing the cathedral of Notre Dame, at Paris, is valued at $20,000. It stands about 12 inches high, and is perhaps the finest piece of gold quartz work produced.

A mass of gold quartz(*a*) weighing 160 pounds was hydraulicked out of the bank of the Nevada Hydraulic Company at Gibsonville. The bowlder was smoothly washed and had the appearance of having been ground in a pothole. Its estimated value was $2,500, but its real worth was more, since it was valuable for lapidaries' purposes.

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a Jewelers' Circular, Vol. XIV., page 258, September, 1883.

It is stated that some years since a Mr. Thiery devised a method of fusing quartz and throwing in lumps of heavily alloyed gold, and allowing the material to cool in molds of required shapes. It is said the mingling of the metal and the quartz was complete, but the quartz had a milky, unnatural glasslike appearance entirely unlike the gold quartz it was intended to represent. Messrs. LeDuc, Connor & Laine, on applying for a patent for an imitation gold quartz produced by means of electricity, found that a similar patent had been issued nearly fifty years ago to a New York man. However, notwithstanding they were not able to obtain the monopoly, they started as manufacturers of jewelers' quartz, but abandoned it, as it proved so unsatisfactory.

Actinolite.—The emerald-green glassy actinolite of Concord township, Pennsylvania, is very fine and might be utilized in some form, possibly the compact, as a form of cat's-eye. An inlaid ornament of this mineral taken from an old piece of furniture in London during the early cat's-eye excitement netted the persons who cut it up hundreds of dollars.

Rutile.—The rutile of Middletown, Connecticut, was cut into gems that were almost ruby in color, as early as 1836, by Prof. C. U. Shepard.

The finest small brilliant geniculated crystals are found at Millholland's Mills, White Plains, at John Lackey's farm, near Liberty Church, and at Wilson's near Poplar Springs, in Alexander county, North Carolina. These have furnished some of the finest cut black rutile, which more closely approaches the black diamond in appearance than any other known gem. Some of the lighter colored ones furnished gems closely resembling common garnet.

Beautiful long crystals, at times transparent red, have been found, ranging in thickness from that of a hair to one-quarter and in some few cases nearly two-thirds of an inch across, and from 1 to 6 inches in length, at Taylorsville and vicinity, and at Stony Point, North Carolina. These are very brilliant and at times doubly terminated.

Beautiful crystals are also found in quartz and loose in the soil at Sadsbury township, Pennsylvania, for 7 miles along the valley, especially near Parksburg, where double geniculations and geniculations forming complete circles are found, weighing over 1 pound. This is the "money stone," so called by the inhabitants of the district, as it is often looked for because they can obtain money for it from the collectors; some of the finer small ones are worn as ornaments.

Some of the beautiful geniculated nigrine from Magnet cove would also well serve the purpose of ornament. These and the Alexander county rutiles are possibly the finest in the world.

Axinite has been observed with the essonite and idocrase at Phippsburg and Wales, Maine, and also at Cold Spring, New York. The best American locality is the one near Bethlehem, Pennsylvania, first found by Prof. F. Prime, jr., and Dr. Reopper, and described by Prof. B. W. Frazier.(*a*) These crystals, colorless, pale yellowish, and brown, are

a American Journal of Science, December, 1882.

at times one-fourth inch long, and future finds in this vicinity may bring some gems to light; up to this time no stones suitable for fine cutting have been found, though a few might furnish mineralogical gems.

Jade.—Among the implements collected by the Point Barrow (Alaska) Expedition were a number made of dark green jade. This mineral is supposed to be found in a place somewhere to the east of Point Barrow.

Rhodonite.—Rhodonite has been found in an extensive bed at Blue Hill bay, Maine, on Osgood's farm; also in bowlders at Cummington, Massachusetts, and in the neighboring towns; at Warwick, Massachusetts; in Irasburgh and Coventry, Vermont; near Winchester and Hinsdale, New Hampshire; and at Cumberland, Rhode Island.

The Alice mine, at Butte City, Montana, has produced a large quantity of rhodonite associated with rhodocrosite, and it has here been used to some extent as a gem stone.

It has recently been described by Mr. William North Rice(*a*) as occurring at the White Rocks, Middletown, Connecticut—only in a limited quantity, however.

The variety fowlerite, found at Franklin, Hamburg, and Sterling, New Jersey, is also very fine in color.

Rhodonite has recently been used very effectively in combination with unpolished or stone-finished silver, as handles for very fine ornaments, the rose color streaked with black presenting a very pleasing contrast.

Epidote.—Fine crystals of epidote have been found at Haddam, Connecticut, which might yield small gems. The large crystals in quartz at Warren, New Hampshire, were all too opaque, though fine as cabinet specimens.

At Roseville, in Byram township, Sussex county, New Jersey, epidote was formerly found in good crystals that would afford mineralogical gems.

Dr. F. A. Genth(*b*) mentions a crystal of epidote in the cabinet of the University of Pennsylvania, from the gold washings of Rutherford county, North Carolina. This crystal is strongly pleochroic, like the so-called puschkinite from the auriferous sands of Katherinenburg, in the Ural mountains, and would cut the best American gem yet found.

Some fine highly complex forms have been observed at Hampton's, Yancey county, North Carolina, by Mr. William Earl Hidden.(*c*) The Yancey county crystals would also possibly afford cabinet gems, none of them as fine, however, as the Tyrolese epidote.

In Chester county, Pennsylvania, crystals 3 inches in length have been found. The principal localities are the Smith and McMullin farms, West Bradford township; East Bradford, where dark green specimens

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a Science, Vol. I., No. 21, page 601.

b "Minerals and Mineral Localities of North Carolina," 1881, page 44.

c Ibid., page 86.

occur, and Taylor's mill, West Goshen. In East Marlboro' township it occurs in yellowish-green crystals, and at McCloud's farm and Pearce's old mill, Kennett township. In the limestone quarries of London Grove and Sadsbury townships it occurs in bottle-green crystals.

Idocrase.—Idocrase or vesuvianite that would yield small gems has been found at Phippsburg, Maine.(*a*) A beautiful wine-colored variety(*b*) is mentioned as occurring near New Hope, Bucks county, Pennsylvania.

At the locality 1½ miles from Sanford, Maine, idocrase occurs in unlimited quantities, one ledge being fully 30 feet wide, made up almost entirely of this mineral associated with quartz and occasionally with calcite. Some of the crystals are 7 inches long, and the smaller ones would afford fair gems at times.

Idocrase is mentioned by Endlich as occurring in large crystals on Mount Italia, Colorado, and north of the Arkansas river, in granite.

Cassiterite.—The finer crystals of cassiterite found at Hebron, Norway, and Paris, Maine, would afford mineralogical gems.

The claims in the Temescal range, in San Bernardino county, as well as the locality near San Diego, California, will possibly produce specimens of this mineral equal to that from Durango, Mexico.

The important occurrence at the Broad Arrow mines, 2 miles from Ashland, Clay county, Alabama, may produce both the crystals and the stream tin. The Black Hills of Dakota locality is a fine one for the gem. On Jordan creek, Owyhee county, Idaho, Prof. W. P. Blake mentions very fine specimens of wood tin one-eighth to one-half inch across, of very pure and clean material. Cassiterite has also been found in large quantities in North Carolina, though scarcely any of these localities have produced a single fine gem.

Chondrodite.—The finest known crystals of chondrodite, and the finest known gems of this mineral, have been found at the Tilly Foster mine, Brewster's, New York. The gems are few in number, and one of the finest is a cut stone (*c*) measuring one-half by one-quarter inch, of a transparent garnet color. Another(*d*), an essonite-colored crystal, is one-quarter by one-eighth inch, and another(*e*), of a red essonite color, is one-quarter by one-quarter inch. The two latter, though uncut, would furnish fine gems. The finest of these crystals are in the Allen cabinet, now at the Johns Hopkins University, and in the mineralogical cabinet of the Peabody museum. The gems are so few as only to serve for mineralogical rarities.

Turquois.—Mr. Bernard Moses recently brought to New York a series of finely colored specimens of the American varieties of turquois, obtained at Mineral Park, Mohave county, Arizona. They were from

a Cabinet of Gideon Bearce, West Minot, Maine.

b George Rogers: "Geological Report of Pennsylvania," Vol. II., page 685.

c Cabinet of F. A. Canfield.

d Cabinet of C. Bullman.

e Cabinet of F. A. Canfield.

three veins, varying in width from 1 to 4 inches, about 100 yards apart, running almost parallel and traceable for nearly half a mile. They show evidences of having been worked by the Indians and Spaniards, and a large number of stone hammers were found.

One of the largest masses of the American turquois is in the possession of Prof. W. P. Blake; it is $2\frac{1}{8}$ inches long, $1\frac{3}{4}$ inches wide, and weighs 75.5 grams.

No work is carried on at present at the Los Cerillos mines, the recent investment to work that locality having proved unsuccessful. Some of the specimens sent east showed a fine blue color, which, however, was artificial, as proved by dipping for a moment in ammonia. Along the line of the railroad turquois is sold to some extent by the Indians of the San Domingo pueblo, New Mexico, the men, women, and children coming some distance from the road to sell them. They are ground into round or heart-shaped ornaments, which are drilled with a crude form of bow-drill called by them "malakates." The drilling point is made of either quartz or agate, and the wheel to give it velocity was in one instance made of the bottom of a cup. The selling price of the ornaments is now very low. Rev. R. T. Cross states that one string made up of many hundreds of stones was valued at the price of a pony. Turquois was used by the ancient Mexicans to inlay obsidian ornaments, and also together with pyrite for making mosaic inlays and incrustations, thus forming many rich and curious effects.

Hoffmann (*a*) mentions turquois from the mountains 5 miles north of Columbus, Nevada. The specimens are of a pale blue color, although some fine ones have been obtained.

Very little of the American turquois seems to find sale except as tourists' souvenirs or mineralogical gems; yet for ornamental or inlaying work it might have quite a sale, were it properly introduced, as the green color would contrast favorably with many stones or wood.

Hematite.—See 1882 report.

Ilvaite.—Mr. R. D. Rand (*b*) observed some small black crystals of ilvaite in a narrow calcite vein in gneiss at Flat Rock tunnel on the Philadelphia and Reading railroad, opposite Manayunk.

This mineral forms a curious deep black gem and is one of the few that can be used to represent the initial "I" in jewelry work made up of the initial letters of gems. It would also represent the letter "Y," although the name yenite has been rejected.

It is reported as occurring with hornblende and magnetite, traversing quartz, in slender brown-black or black crystals at Cumberland, Rhode Island, and formerly also at Milk Row quarry, Somerville, Massachusetts. No material for really fair gems has as yet been found in the United States.

Pyrite.—The small groups of brilliant pyrite occurring with the slate

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a "Mineralogy of Nevada."

b "Preliminary report on the Mineralogy of Pennsylvania," page 22.

found through the coal regions, are trimmed and cut into ovals, squares, and other shapes, and sold for mounting as scarf pins, lace pins, ear rings, and ring stones, as well as other ornaments. Fine single crystals are also sold for ornaments, principally at Mauch Chunk and the summit of the Switchback road, and by the local jewelers at Ashland, Shenandoah, and Mahoney City. The finest specimens used here are from the Raven Run mine, 6 miles from Mahoney City.

Many fine single crystals with a very high polish have been found at Black Hawk and other localities in Colorado, which are often sold for ornaments, just as they are found, at Denver, Colorado Springs, and other places in the West. These are compact enough to cut into the faceted gem, known in Europe as "marcasite," which has been almost entirely superseded by bright steel jewelry.

Diopside.—Associated with the garnets from Fort Defiance (Arizona), Gallup (New Mexico), and other localities in that vicinity, small pieces of almost emerald-green diopside are found—evidently a chromium diopside similiar to that found with the South African diamonds. As a rule they are too small to afford gems of any value, but a few pieces have been found that are of sufficient size for very small gems. This would be a very desirable addition to the list of American gem localities, if the specimens were found in any size or quantity.

At the De Kalb (New York) locality, some very large crystals were found in 1884, several over 3 inches long and 1 inch thick, with clear spots of gem material, promising to afford cut stones weighing 20 to 30 carats.

FELDSPAR GROUP.

The greenish variety of orthoclase, called lennilite by Dr. Isaac Lea(*a*), found at Lenni Mills, Delaware county, Pennsylvania; the pearly variety called delawarite by Dr. Lea, and the bluish-green subtransparent of an aventurine character, the bright particles being hexagonal hematite(?), called cassinite by Dr. Lea, found at Blue hill, 2 miles north of Media, are all at times of fine enough color to make a common gem or ornamental stone.

Large bowlders of labradorite are often met with in the towns of Lewis, Moriah, McIntyre, Newcomb, and Westport, also in Green, Lewis, Orange, Schoharie, Saint Lawrence, and Warren counties, New York. Within a few miles of Amity, in Orange county, Mr. Silas C. Young broke up a mass of fine material for specimens, weighing over two tons, that showed the chatoyant play of colors very well.

In Pennsylvania it occurs at Mineral hill, Chester county, and opposite New Hope, Bucks county; and also in the Wichita mountains, Arkansas.

Mention is made by Genth and Kerr(*b*) of a curious white variety as occurring at the Cullakenee mine, Clay county; also, large crystals in

a "Proceedings Philadelphia Academy of Sciences," May, 1866.

b "Minerals and Mineral Localities of North Carolina," page 48.

the trap at Shiloh Church. On the road to Charlotte, Mecklenburg county, and near Bakerville, on Toe river, specimens showing a slight blue chatoyancy are also found.

Rockport, Massachusetts, formerly afforded many finely colored pieces of amazonstone. Some fine green crystals have also been found at Paris, Maine, and at Mount Desert material that will cut into fair gems is occasionally met with.

One large, fine light green crystal, over 6 inches long, was found near Amelia Court House, at the microlite locality.

On the John Smith farm, Middletown, Delaware county, Pennsylvania, many shades of green feldspar, passing into the cassinite and delawarite, are found in the soil in loose bowlders up to 20 inches in diameter.

Elæolite.—The elæolite of Gardiner and Litchfield, Maine, would admit of a very good polish, and at times the color is greenish and would look quite well. Some of the Salem, Massachusetts, variety would also do for this purpose.

Leopardite.—A compact variety of orthoclase, which is spotted with hydrated sesquioxide of manganese, called leopardite(*a*), is abundantly found near Charlotte, Mecklenburg county, and also in Gaston county, North Carolina. It is a variety of porphyry with crystals of disseminated quartz. This material is found in large masses and would furnish a good ornamental stone if polished. It would also furnish material for a cheap gem stone.

Moonstone.—At Van Arsdale's quarry(*b*) near Feisterville, Bucks county, Pennsylvania, orthoclase is found in crystals from one-half to 2 inches in length, usually, however, in cleavage masses of gray or grayish-black colors, which show the blue chatoyancy, as well as many varieties of labrador spar, and make a very fine variety of moonstone.

The albite occurring in such beautiful specimens at Mineral hill, near Media, in Middletown, Delaware county, Pennsylvania, shows the blue chatoyancy remarkably well, and is there called "moonstone." It might well be, and is doubtlessly rightfully classed under this head, since the appearance differs so slightly from an orthoclase moonstone, and it is the effect that really gives it its name.

The greenish-gray granular albite or oligoclase found in the serpentine at the magnesia quarries, West Nottingham township, Chester county, Pennsylvania, shows a faint blue moonstone luster.

The beautiful feldspar found by Mr. W. W. Jefferis, with the sunstone at Pearce's paper mill, shows the blue chatoyancy equal to any labrador spar. It may be the latter or oligoclase (?). The finest examples of this mineral from an American locality, very closely resembling the Ceylon in quality, transparency, and color, have been lately found

a "Minerals and Mineral Localities of North Carolina," Genth and Kerr, page 51.
b "Preliminary report on the Mineralogy of Pennsylvania," page 89.

at Amelia Court House, Virginia, by Mr. George W. Fiss, of Philadelphia, who had two very fine gems over one-fourth of an inch across.

Peristerite has been found in some abundance in the town of McComb, Saint Lawrence county, New York, associated with common orthoclase; it occurs by the ton, and many of the specimens show the beautiful light blue chatoyant effect. Mr. C. D. Nimms has also observed this mineral as far north as Bythurst, Canada, 9 miles north of Perth; also in the towns of Pierrepont, Russell, and in at least a dozen other places in this section of New York State. Some specimens make a very fine gem stone, differing somewhat from labradorite and moonstone. Mr. Charles A. Dana, of New York, has had a number of these flesh-colored pebbles of orthoclase found on Long Island sound, near his home, at Glen Cove, New York, cut *en cabochon*, making thus a very effective salmon-colored stone.

Perthite, found so plenty in Canada, at Perth, Ontario, is likely to be found in the United States as bowlders, and possibly in place. This forms a very curious and rich-colored gem stone, with its bright aventurine reflections.

A very fine oligoclase occurs at Dixon's quarry, Newcastle county, and a fine striated variety at West Chester, Delaware county, Pennsylvania.

Sunstone.—Very good sunstone (oligoclase?), with very fine reflections, has been found near Fairville, Pennsbury township, Pennsylvania. Sunstone (oligoclase?) occurs at Mendenhall's lime quarries, Pennsbury, Chester county; also in Ashton township, some of which is a grayish-white color with coppery reflections; and also a curious variety of sunstone in moonstone (albite) is found, showing double reflections.

A very fine green and red sunstone is found near Media. On John Scofield's farm, in Middletown township, Delaware county, moonstone and sunstone in small nodular lumps are scattered through the soil. About 1 ton has been taken out since the locality was discovered. On John Hibberd's farm, in the same township, moonstone in bowlders is found. A very fine sunstone, the orthoclase of which is a very rich salmon color and quite transparent and streaked with white, showing the aventurine effect beautifully, is found at Glen Riddle, Delaware county.

Another beautiful variety is found in the hornblende at Kennett township, Chester county; this, Dr. Genth thinks, is most probably an oligoclase. The greenish orthoclase, sometimes in bright green pieces, also pale green, and at times much spotted with brownish tints, all showing a very good sunstone effect, is found at Mineral hill, Middletown, and in Upper Providence, Delaware county. The orthoclase of Frankford, Pennsylvania, with the göthite disseminated through it, approaches the sunstone in appearance very closely.

On the Horace Greeley farm, at Chappaqua(*a*), New York, small pieces

a "Proceedings New York Academy of Sciences," Vol. I.

of an orthoclase sunstone were found, almost as fine as any of the Norwegian.

Obsidian.—Smoky, transparent obsidian that would cut well, and form a curious variety somewhat resembling the "Moravian bottle glass" (moldavite), but not so green, has been found in rounded pebbles, over 1 inch across, near Santa Fé, Mew Mexico.

A porphyritic and spherolitic obsidian is found under the trachyte on Gunnison river, and a heavy vein of porphyritic obsidian near the Rio Grande pyramid, continuing from there southward through the trachytic bed. Nodules occur in the lower members of the trachytic veins.

A dike of obsidian, light gray and clear with concentric structure, sets from the Colorado Central lode near Georgetown, north of Saguache creek. Hoffmann mentions obsidian in fine pieces and very abundant as occurring 10 miles southeast of Silver Peak, Nevada. Across the State line, 5 miles in Owen valley, California, it is found in red fragments, and also banded with alternate layers of black and brown. Obsidian occurs in large, fine black pieces, and mottled black and brown, and in small layers, in a moss rock at Obsidian cliffs, Yellowstone park.

Octahedrite.—Octahedrite is reported as occurring in small crystals at Dexter's lime rock at Smithfield, Rhode Island, and in flat tabular glassy crystals of a pale green color and very brilliant in the gold sands of the Brindletown mine(*a*), Burke county, North Carolina. These would possibly afford small gems, nothing, however, to compare with the beautiful blue crystals from Brazil, so splendent at times as to be mistaken for diamonds.

Brookite, arkansite, microlite.—At the Ellenville, Ulster county, New York, lead mines some remarkable flat, ruby-red crystals of brookite have been found, and at Magnet cove, Arkansas, remarkably brilliant crystals of the variety of this mineral known as arkansite occur in great profusion, at times a transparent honey yellow. The mineral does not, however, readily admit of polish. One fine crystal of microlite in the cabinet of Mr. C. S. Bement, is about three-eighths of an inch long, and in part a rich honey-yellow color, having all the color of topazolite, with a higher luster. This might possibly be added to the list of American gem minerals. This crystal was found at Amelia Court House, Virginia. Some few of the microlites found at the Amelia Court House locality are of sufficient transparency to afford gems, the color ranging from an essonite red to that of a rich spinel yellow and remarkably brilliant.

Microlite has the highest specific gravity of any known gem, being about 6.

Ilmenite.—At Magnet cove, Arkansas, the ilmenite is found in such fine bright crystals as to form natural ornaments, and will, besides, admit of a fine brilliant polish.

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a "Minerals and Mineral Localities of North Carolina," 1881 page 84.

Allanite.—The allanite found in large masses and crystals in Amherst county, Virginia, is very compact and bright black in color, and would form a black metallic gem stone.

Sodalite, cancrinite.—At Litchfield and South Litchfield, Maine, sodalite, elæolite, and cancrinite are found in bowlders in size from that of the fist to those weighing many tons. They lie scattered over the surface for a distance of about 4 miles. One mile and a half west of this line, across a pond in West Gardiner, these minerals are found associated with zircon, as in South Litchfield. On some of the West Gardiner farms there are ledges of rocks that are evidently the source of these bowlders. The bowlders occur principally on the farms of Moses True, Capt. Joseph Wharff, and Rufus Smith.

The deep-blue and azure-blue sodalite and cancrinite, a rich yellow, and occasionally in hexagonal crystals, occur sparingly in seams in this tough elæolite and lepidomelane rock. The seams are from 1 millimeter to very nearly 1 inch in thickness; some of the white seams found are evidently altered sodalite; the cancrinite has been found 2 inches thick.

Violet and azure-blue sodalite have been found associated with elæolite, biotite, and zircon in a syenite vein at Salem, Massachusetts. Enough has been found within the last two years at South Litchfield to give it some gem importance. A number of distinct hexagonal crystals of fine waxy yellow cancrinite, as a rule embedded in the deep-blue sodalite, have also been found; also pink and greenish masses, and masses of rich yellow, 2 inches in thickness, which could be used the same as sodalite.

Scapolite.—The pink and purplish scapolite found at Boston, Massachusetts, will polish nicely and form a neat ornamental gem stone.

Lazulite.—Lazulite in dark-blue crystals and crystalline masses is found at Crowder's and Chubb's mountains in Gaston county, North Carolina, and at Coffee Gap, Sauratown mountains, Stokes county. At Graves mountain, Lincoln county, are found the finest sky and dark-blue crystals known. This mineral would make an opaque gem or ornamental stone, as the color, although lighter, is often as rich as lapis-lazuli.

Cobaltite is occasionally cut abroad and resembles a flesh-colored pyrite when cut. It is not found of fair quality at any American locality.

Zincite, franklinite, and willemite(*a*), as found intermixed in the zinc mines at Franklin, New Jersey, are at times ground into charms and paperweights and ornaments of different kinds, principally by the miners. They do not admit of a very fine polish, however, though they present a good appearance. A curious brown serpentine containing zinc, described by Prof. C. U. Shepard, was also cut and polished by the miners here.

Enstatite and bronzite.—Enstatite and bronzite are found half a mile

a See also "Mineral Resources of the United States, 1882," page 496.

west of Texas, Pennsylvania, and in beautiful massive foliated varieties. Bronzite was observed by Dr. Genth (*a*) near Crump's serpentine quarry, near Media, in Middletown township, and also near Henry Hipple's, in Marple township, forming the mass of Castle rock; also in Newton township near the lime kiln, and near Radnor's, Delaware county. Bronzite and enstatite occur in large quantities at Bare Hills, Maryland.

Titanite.—At Bridgewater station, Delaware county, Pennsylvania, some remarkably fine crystals of titanite have been found. Some of them, over 1 inch long and very transparent in parts, are a rich greenish yellow and a vitreous golden, equaling in color the finest from the Tyrol, and some would afford gems weighing from 10 to 20 carats each, that would show a play of colors rather adamantine than opalescent. Some of the fine crystals from this locality are now in the cabinet of Mr. C. S. Bement, the W. S. Vaux cabinet, Academy of Natural Sciences, Philadelphia, and in the Peabody museum, New Haven.

Many yellow crystals(*b*) over 1 inch long have been found in the hornblendic gneiss on the Schuylkill near Philadelphia, and yellow crystals with sunstone at W. Cloud's farm and Pearce's paper mill, in Kennett township, Chester county, Pennsylvania.

Chlorastrolite.—One of the largest known perfect chlorastrolites is in the cabinet of Mr. M. T. Lynde, of Brooklyn, Long Island, a gem measuring $1\frac{1}{2}$ by $1\frac{1}{8}$ inches. A fine pair of chlorastrolites over half an inch across are in the possession of Mr. F. A. Canfield.

Datolite.—The compact, opaque, white, creamy, and flesh-colored varieties of datolite found at the Minnesota, Quincy, Marquette, Ashbed, and other mines in the copper region of Lake Superior, admit of a very high polish, and make an excellent opaque gem or ornamental stone. Notably one especially fine nodule over 4 inches across, with a flesh-colored center shading off into gray and creamy tints, was found at the Delaware mine, and is in the cabinet of Mr. C. S. Bement.

Thompsonite.—Large quantities of thompsonite have been cut into gem stones during the last year, the cutting consisting almost entirely of a rounding off of the pebble so as to show the concentric and other markings to the best perfection. Some of them, over an inch in diameter, have been polished. As a rule the small ones are the finest material. The lintonite is really a variety of the thompsonite and polishes very nicely, either alone or when occurring with the flesh-colored forms of thompsonite.

Natrolite.—Many veins of natrolite, and more particularly one large surface, representing over 300 square feet of the mineral, were met with at shaft No. 2 of the West Shore railroad, at Weehawken, New Jersey. Although this quantity afforded millions of crystals, scarcely any were stout enough to afford gems of this beautiful limpid and white mineral,

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a "Preliminary report on the Mineralogy of Pennsylvania," page 63.
b Ibid., page 27.

so abundantly found here and all along Bergen hill where any tunneling has been carried on.

Fine crystals are found in the Lake Superior copper region. None has been sold for gems in the United States, though it is occasionally used as an initial gem for the letter "N" in initial jewelry.

Pectolite.—Among the Eskimo implements collected by the United States Signal Service at Point Barrow, Alaska, and examined by Prof. F. W. Clarke(*a*), was a supposed jade, which he found on analysis to be a new and interesting variety of compact light-green pectolite; specific gravity, 2.873. This was obtained from some point east of Point Barrow, on the Kowak river, and forms an interesting and unexpected addition to this line of gem stones.

Apophyllite (also called fish-eye stone) is really too soft for gem purposes, though repeated references are made to it by gem writers.

The Erie tunnel, Bergen hill, afforded thousands of fine doubly-terminated detached crystals, less than one-fourth inch in diameter, that were really beautiful as ornaments; this same tunnel afforded a single crystal 4 inches in diameter. Some beautiful ones have also been found at the Cliff mine and other localities in the Lake Superior copper region, at times being perfect specimens of limpidity. The West Shore railroad tunnel at Weehawken, New Jersey, was the first locality in the United States to produce pink and flesh-colored crystals. Many beautiful ones were found here, though not as fine as the Andreasberg or the Mexican varieties. This and the Lake Superior locality would both afford material for cutting.

Apatite.—Apatite was found in such remarkably perfect and fine-colored crystals at the tourmaline locality at Auburn, Maine, by Mr. N. H. Perry, that the hill on which the tourmalines were found has been named Mount Apatite. These crystals were transparent green, pink, and violet, and so much resembled tourmaline as at times to have been mistaken for it. Some of the local collectors attempted cutting some of them, but the hardness is too low for a transparent gem.

Crocidolite.—Crocidolite was observed by Col. Joseph Wilcox(*b*) in long, delicate fibers of a blue color, in one of the western counties of North Carolina.

Mr. Theo. D. Rand found a dark-bluish, fibrous mineral at the Falls of the Schuylkill, and Prof. W. T. Roepper (*c*) found at Coopersburg, associated with white and brownish-white garnet, bluish-white crystalline fibrous coatings, which may belong here.

Crocidolite was also observed near Cumberland, Rhode Island, and at Eland Fountain, Orange river, New Jersey, though none of gem value has yet been found in the United States.

Serpentine.—The many fine varieties of serpentine found in the United

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a American Journal of Science, III., Vol. XXXVIII., page 63.

b "Minerals and Mineral Localities of North Carolina," 1881, page 41.

c "Preliminary report on the Mineralogy of Pennsylvania," page 10.

States would admit of use in some cases as ornaments. The dark-green noble serpentine of Newburyport, Massachusetts, was cut into oak and other leaf-like forms, very effectively indeed, by Mr. F. Osgood, of that place. The handsome yellow serpentine of Montville is also of the precious variety.

The beautiful varieties of serpentine or verd antique from Harford county, Maryland, admit of a fine polish.

The serpentines of Saint Lawrence county, as also those of Cornwall, Monroe, and Warwick townships, Orange county, the ophiolite of New York city and vicinity, the serpentine of New Rochelle, New York, also some of the Hoboken, New Jersey, and the Staten Island varieties are useful for ornamental and occasionally for gem purposes.

At Stoneham, Maine, green and red damourite(*a*), altered from topaz, was cut into different odd forms and charms by local collectors. At Deer Isle, also, serpentine of a very light-green color occurs.

The serpentine of Texas, Mineral Hill, Newtown, Marple, Middletown, and other localities in Delaware county, Pennsylvania, are also very fine.

The serpentine from the neighborhood of Patterson(*b*), Caldwell county, North Carolina, is of a dark greenish-black color, and admits of a fine polish.

The serpentinous substance named pelhamine by Prof. C. U. Shepard(*c*) admits of a very good polish and with a very curious effect.

Dr. F. A. Genth mentions as being found at Easton, Pennsylvania, a bowenite frequently containing a small quantity of tremolite; it is of a greenish and reddish-white color and of great tenacity. This is evidently the so-called jade mentioned in the report for 1882. The easy working of this material, and the effective designs that can be made from it, recommend it as having fully as much merit for tourists' jewelry as the various teeth, beans, and other like things that are sold for this purpose.

Fluorite.—The clear varieties of colored transparent fluorite are designated as false ruby, emerald, sapphire, topaz, amethyst, etc. Many fine specimens of the green have been found at Muscalonge lake, Saint Lawrence county, New York, at times crystals over 1 foot across.

The Hardin county, Illinois, localities are the largest deposits in the United States, and some thousands of tons are annually mined here; crystals of the richest purple, yellow, red, rose-colored, green, and other varieties are very common. It differs from the English in that the crystalline faces in nearly all cases are dull and the colors show only by transmitted light. Some crystals 1 foot across were observed here.

On the Cumberland river, Tennessee, some of the finest American crystals of a blue-green variety have been found; wine and honey-

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a American Journal of Science, May, 1885.

b Genth and Kerr's "Minerals of North Carolina," page 57.

c "Contributions to Mineralogy," 1876.

yellow ones also at Saint Louis, Missouri, in the geodes in the limestone. Fine crystals are found at Pike's peak, Colorado.

One of the most remarkable varieties of this mineral is a chlorophane from the microlite localities(*a*) at Amelia Court House, Virginia. This fluoresces by the heat of the hand, and when a cut stone was placed in a vial of warm water, showed distinctly in a dark room, thus making a new form of gem, *i. e.*, a fluorescent gem stone, though not hard enough for any kind of wear.

Fossil coral.—The Iowa fossil corals have during the last year been sold more largely than heretofore for jewelry, paper weights, and specimens. One Philadelphia lapidary states that he sold over $250 worth in one year. It is sold to some extent at Iowa City and other places in Iowa, as well as at the regular tourists' stopping places all over the United States.

Lepidolite.—Lepidolite has been found in large quantities in the past at Mount Mica, Paris, Maine, which has afforded masses of 50 pounds of very fine color; at Hebron and Norway, and more recently at Auburn, also at Mount Black, Rumford, Maine. As this mineral is used to some extent abroad for ornaments, such as dishes, vases, paper weights, etc., the similar utilization of the American material is suggested.

Aragonite and satin spar.—The aragonite "satin spar," from near Dubuque, Iowa, especially in such fine form as at Rice's cave, and in such remarkably fine forms as the "floss ferri" variety, from near Rapid City, Dakota, would admit of the same uses as common satin spar.

The satin spar (gypsum) ornaments, such as beads, eggs, and a variety of others, sold at Niagara Falls and many of the tourist places, are almost without exception imported from Wales, though some few common white gypsum ornaments are at times cut from gypsum found near Niagara. On Goat island large masses are often found, and occasionally even under the falls, where all the material for all the ornaments sold here is supposed to have been found. Fine selenite occurs here, but no satin spar.

Malachite.—One very fine, compact, fibrous mass of dark green malachite, that would cut a beautiful cube 1 inch square, from the McCulloch mine, Virginia, is in the cabinet of Mr. C. S. Bement.

Hoffmann mentions it in massive concretions in Copper cañon, Galena district, and at Mineral Hill, Nevada. Some of the copper mines of Arizona and New Mexico will undoubtedly furnish fine specimens when they are more developed.

Mr. F. E. Monteverde has some gem specimens of malachite of very good quality, over 1 inch across, from the Copper Queen mine, Bisbee, Arizona. Malachite has been found recently at the Globe and Arizona mines in fibrous and mammillary masses, and in seams from 3 to 4 inches in thickness and of very fine color, in many respects equaling the finest

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a American Journal of Science, July, 1884.

from Russia. A number of fancy articles have been made from it. At Ducktown, Tennessee, some fine radiated masses have been found that would polish well.

At the Jones mine, Berks county, Pennsylvania, very dark green and finely mottled malachite was found that would cut into fine gems over 2 inches across. Some very fine specimens from here are in the cabinet of Mr. W. W. Jefferis. The material from this locality equals any from Russia, but the supply is very limited.

Malachite is found in North Carolina in Guilford, Cabarrus, and Mecklenburg counties. At Silver Hill and Conrad Hill, in Davidson county, the fibrous variety has been observed, and at a number of other localities in the State, but rarely of any gem value. In the United States subtreasury, in New York City, are a few fine gem pieces of malachite from the Copper Knob mine in Ashe county, North Carolina.

Chrysocolla.—A beautiful compact chrysocolla, mixed with quartz, is found at the Allouez mine, Houghton, Lake Superior region. Some of the specimens would furnish fine, rich, bluish-green gems one-half inch square.

Beautiful specimens, botryoidal and massive, greenish blue in color, have been found at the Jones mine, near Morgantown, Berks county, Pennsylvania; and a fine specimen from some Arizona locality, coated with chalcedony, made some beautiful gems when the chalcedony was polished, allowing the botryoidal chrysocolla to show through. In one case these markings resemble a human head.

Anthracite is used to some extent as jewelry, being carved and turned into small trinkets, such as compass cases, boots, hearts, anchors, and other small charms. It could readily be made into beads and round ornaments to be used for scarf pins, lace pins, bracelets, etc., in the same way as jet. It is also turned into cups, saucers, vases, candlesticks, and paper weights, and is carved by hand into a variety of small ornaments. The objects made often have one or more ridges of the rough coal, the other portions being highly polished, thus making a striking contrast. Most of the anthracite is worked at Mountain Top, near Glen Summit, Lucerne county, Pennsylvania. The material used is obtained at the Franklin mine at Ashley, the Spring Tunnel mine at Summit Hill, and at Nanticoke, Pennsylvania. These articles are sold at Scranton, Wilkes Barre, Pittston, Mauch Chunk, and at the Summit Hill station on the Switchback railroad. From $2,500 to $3,000 worth of these anthracite objects are sold annually.

Catlinite or pipestone.—Catlinite, which is found in such large quantities in the Upper Missouri region, and especially in Pipestone county, Minnesota, is worked into a large variety of ornamental pipes, that are sold at from 75 cents or $1 each to as much as $5 and $10; at times as high even as $20 for very large pieces of carving. They are made in a variety of forms, mainly to sell readily, such as tomahawks with the pipe bowl in the back, and often pipes from 10 to 24 inches long have

one or more figures on the stem, which is sometimes made of several pieces, usually, however, of wood. Parts of the pipes are often laid out in designs that are filled in with lead.

This stone is also worked into a variety of ornaments and into small charms of different kinds. These are offered and find a ready sale to persons visiting Minnehaha Falls, Lake Minnetonka, various hotels in Saint Paul and Minneapolis, and other cities in Minnesota and Dakota as far west as Fort Sully. The amount sold annually is perhaps $10,000 to $15,000 worth. This stone should surely find more uses from its compactness, easy working, and the fine polish it admits of. One curious spotted variety is very beautiful, and would make a good contrast with the regular red pipestone.

Catlinite is also found at Rice lake, Barron county, Wisconsin.

Amber.—Before the New York Academy of Sciences, February 5, 1883, I exhibited and described an elongated, twisted mass of amber(*a*) of a rich yellow color, but opaque, weighing 12 ounces, that had been found on the shore at Nantucket, Massachusetts, evidently from the Tertiary deposits there. This mass more closely resembled the true amber than any other American specimen yet seen.

The Rev. Phœbe Hanaford, at the same meeting, mentioned having found a small piece weighing about 1 ounce at the same locality. Amber has also been found at Martha's Vineyard and at Gay Head.

In a paper read before the New York Academy of Sciences, on the same date, I described a mass of amber 20 inches long, 6 inches wide, and 1 inch thick, and weighing 64 ounces, found at Kirby's marl pit, on Old Man's creek, near Harrisonville, Gloucester county, New Jersey. A one-fourth-inch section showed a light grayish-yellow color. A section one-fourth inch thick showed a light, very transparent yellowish-brown color. The entire mass was filled with botryoidal-shaped cavities filled with glauconite or greensand and a trace of vivianite. The hardness is the same as the Baltic amber, only slightly tougher and cutting more like horn, and the cut surface showing a curious pearly luster, differing in this respect from any other amber yet examined by me. This luster is not produced by the impurities, for the clearest parts show it the best. It admitted of a good polish. The specific gravity of a very pure piece of the carefully selected amber is 1.061, which is the lowest density on record, the usual amber range being from 1.065 to 1.081. It ignites in the same way as other ambers. It was found at a depth of 28 feet and under 20 feet of the Cretaceous marl, the amber being found in a 6-foot stratum of fossils.

Dr. N. L. Britton has observed traces of amber near Camden, New Jersey, in the Cretaceous deposits.

Dr. Charles C. Abbott(*b*) mentions having several times found small grains or pebbles of amber in the bed of Crosswick's creek. These he

a Now in the Amherst College cabinet.

b Science, Vol. I., page 594.

gave to Mr. W. S. Vaux, of Philadelphia, and they are now at the Academy of Natural Sciences. He suggests that they are derived from the beds of clay which are exposed in the bluff forming the southern bank of the creek. There are Cretaceous clays nearer Trenton than Crosswick's creek, in which occurs much fossil wood; in and on this grains of amber are not uncommon; they are usually very small and difficult to detect. The wood is soft and very recent in appearance, burning with an uncertain, flickering flame. The amber is evidently derived from the sap of the wood.

The late Professor Kerr(*a*) mentioned the finding of succinite in lumps of several ounces weight in Pitt county and elsewhere, in the Tertiary marl beds of the eastern counties of North Carolina.

Dr. Troost (*b*) mentions that at Cape Sable, on the northern side of Magothy river and western shore of Maryland amber of several varieties occurs. One is entirely opaque in concentric zones of every shade of red, yellow, and brown, thus displaying the most beautiful colors; another is a transparent yellow, and another is an earthy porous variety. It is found here in the lignite beds in some quantity. It also occurs on the Chesapeake and Delaware canal in Kent county, Delaware.

Mr. C. G. Yale, of San Francisco, California, says that amber is common in the lignite deposits on the peninsula of Alaska. It is also obtained in the alluvium in the delta of the Yukon river and in the vicinity of most of the Tertiary coal deposits on the Fox islands, being everywhere an article of ornament with the natives, who carve it into rude beads.

At no American locality is amber found of commercial value, and although the specimens above referred to are all called amber, they are undoubtedly, with the exception of the Nantasket amber, all from different trees from those producing the Baltic amber, and analyses of them would prove of considerable interest.

Jet.—Jet occurs in the Wet Mountain valley, Trinchera mesa, southeast Colorado, and in the coal seams of most coal-bearing rocks of Colorado. The beautiful specimens of El Paso county, although sold largely for specimens, are very little if at all used for ornamental purposes, from the fact mainly that although this perhaps rivals any known jet, black onyx has almost entirely superseded this material in the United States, owing to the greater hardness of the onyx and the cheapness with which it is furnished from Oberstein and Idar.

Meerschaum.—Sepiolite, or meerschaum, has occasionally been met with in compact masses of smooth earthy texture in the magnesia quarries in West Nottingham township, Chester county, Pennsylvania. Only a few small pieces have been found, but they were of good quality. It also occurs in grayish and yellowish-white masses in the serpentine near Stamp's tavern, in Concord township, Delaware county.

a "Minerals and Mineral Localities of North Carolina," page 83.
b Silliman's Journal, page 182, 1832.

Masses weighing 1 pound, of a pure white material, have been found on the John Smith farm, Middletown, in the same county.

It has been observed at the Cheever iron mine, Richmond, Massachusetts, of equally good quality, in pieces over 1 inch across.

It has also been found in the serpentine at New Rochelle, Westchester county, New York.

PRODUCTION OF PRECIOUS STONES IN THE UNITED STATES.

While it is impossible to obtain exact returns of the values of the precious stones found in the United States, it is believed that the estimates given in the following table represent, roughly, the total values and the proportionate values of the several mineralogical species. Gold quartz, the value of which should be more properly perhaps included under the head of gold mining, is added at the close of the list.

Estimated production of precious stones in the United States in 1883 *and* 1884.

Species.	1883.			1884.		
	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
Diamond	.....	.....	.....	.....	$800	$800
Sapphire gems	$200	$2,000	$2,200	$250	1,500	1,750
Chrysoberyl	100	.....	100	25	.....	25
Topaz	1,000	.....	1,000	200	300	500
Beryl	200	300	500	300	400	700
Emeralds	500	.....	500	.....	.....	.....
Hiddenite	100	500	600	.....	.....	.....
Tourmaline	.....	.....	.....	1,500	500	2,000
Smoky quartz	2,500	7,500	10,000	2,000	10,000	12,000
Quartz	10,000	1,500	11,500	10,000	1,500	11,500
Silicified wood	5,000	.....	5,000	10,000	500	10,500
Garnets	1,000	5,000	6,000	1,000	3,000	4,000
Anthracite	.....	2,500	2,500	.....	2,500	2,500
Pyrite	1,500	500	2,000	2,000	1,000	3,000
Amazonstone	3,500	250	3,750	2,500	250	2,750
Catlinite	10,000	.....	10,000	10,000	.....	10,000
Arrow points	1,000	.....	1,000	1,000	.....	1,000
Trilobites	500	.....	500	500	.....	500
Sagenitic rutile	500	500	1,000	500	500	1,000
Hornblende in quartz	500	100	600	500	100	600
Peridot	50	250	300	50	100	150
Thompsonite	250	500	750	250	500	750
Diopside	200	100	300	.....	.....	.....
Agate	1,000	500	1,500	4,000	500	4,500
Chlorastrolite	500	1,000	1,500	500	1,000	1,500
Turquois	1,500	500	2,000	1,500	500	2,000
Moss agate	1,000	20,000	21,000	1,000	2,000	3,000
Amethyst	2,000	250	2,250	2,000	250	2,250
Jasper	2,000	500	2,500	2,000	500	2,500
Sunstone	250	200	450	250	200	450
Fossil coral	500	250	750	500	250	750
Total	47,350	44,700	92,050	54,325	28,650	82,975
Gold quartz	40,000	75,000	115,000	40,000	100,000	140,000

IMPORTS.

Diamonds and other precious stones imported and entered for consumption in the United States, 1867 *to* 1884 *inclusive.*

Fiscal years ending June 30—	Glazier's.	Dust.	Rough or uncut.	Diamonds and other stones not set.	Set in gold or other metal.	Total.
1867	$906	.....	.....	$1,317,420	$291	$1,318,617
1868	484	.....	.....	1,060,544	1,465	1,062,493
1869	445	140	.....	1,997,282	23	1,997,890
1870	9,372	71	.....	1,768,324	1,504	1,779,271
1871	976	17	.....	2,349,482	256	2,350,731
1872	2,386	89,707	.....	2,939,155	2,400	3,033,648
1873	.....	40,424	$176,426	2,917,216	326	3,134,392
1874	.....	68,621	144,629	2,158,172	114	2,371,536
1875	.....	32,518	211,920	3,234,319	.....	3,478,757
1876	.....	20,678	186,404	2,409,516	45	2,616,643
1877	.....	45,264	78,033	2,110,215	1,734	2,235,246
1878	.....	36,409	63,270	2,970,469	1,025	3,071,173
1879	.....	18,889	104,158	3,841,335	538	3,964,920
1880	.....	49,360	129,207	6,690,912	765	6,870,244
1881	.....	51,409	233,596	8,320,315	1,307	8,606,627
1882	.....	92,853	449,313	8,377,200	3,205	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	(*a*)	9,139,460

a Not specified.

Imports of substances not included in the foregoing table, 1868 *to* 1884 *inclusive.*

Fiscal years ending June 30—	Unmanufactured agates.	Bookbinders' and other manufactured agates.	Carnelian.	Brazil pebbles.	Amber.	Amber beads.	Unmanufactured coral.	Manufactured coral.	Unmanufactured meerschaum.	Total.
1868	.....	.....	.....	.....	.....	.....	.....	$62,270	.....	$62,270
1869	.....	$70	$269	.....	$427	.....	.....	22,417	$6,407	29,590
1870	.....	.....	766	.....	1,433	.....	.....	18,975	3,998	25,172
1871	.....	1	661	.....	180	.....	.....	37,877	698	39,417
1872	.....	529	207	.....	2,426	.....	$83	59,598	2,194	65,037
1873	$151	1,310	.....	$1,237	1,534	$595	230	63,805	5,608	74,470
1874	177	1,524	.....	.....	1,448	1,057	527	28,152	270	33,155
1875	520	5,165	.....	57	7,169	715	1,278	33,567	2,902	51,373
1876	293	1,567	.....	.....	15,502	187	109	33,559	21,939	73,156
1877	579	1,904	*b* 69	.....	17,307	329	718	28,650	9,304	58,860
1878	82	404	.....	76	13,215	1,119	1,252	12,667	16,308	45,123
1879	138	364	.....	.....	17,821	203	147	11,327	19,088	49,088
1880	57	2,346	.....	.....	36,860	2,317	62	5,492	30,849	77,983
1881	486	1,700	.....	5	42,400	1,102	89	2,501	72,754	121,037
1882	901	5,084	.....	111	72,479	4,174	1,474	669	56,118	141,010
1883	14	2,895	.....	.....	40,166	3,472	681	1,303	58,885	107,416
1884	.....	6,100	.....	3,496	56,301	4,692	158	(*c*)	43,169	113,916

b Not separately classified since 1877.

c Not specified.

for 1885, publ. in 1886

PRECIOUS STONES.

By George F. Kunz. 1885

In addition to the report on precious stones in the last volume, where the subject was treated in detail, the following pages are intended to show the progress in this field during 1885.

Work was carried on at the Mount Mica tourmaline locality, Paris, Maine, during the months of June, July, and August of the present year, but no crystals of any value were found, all efforts being directed to the removal of the rock above the tourmaline layer. Messrs. N. H. Perry and E. M. Bailey also worked at the Rumford locality for a few weeks, some good specimens were obtained.

For two months during the summer of 1885 work was carried on by the Emerald and Hiddenite Mining Company, at Stony Point, North Carolina, under the direction of the superintendent, Mr. W. E. Hidden, and with flattering success. A remarkably large pocket, containing fine crystals of muscovite with brilliant crystals of rutile implanted on them, was found and sold as cabinet specimens for $750. While they were working in the soil overlying the rock nine crystals of emerald were found all doubly terminated and measuring from 25 millimeters (1 inch) to 77 millimeters ($3\frac{1}{8}$ inches) in length and 42 millimeters ($1\frac{2}{3}$ inches) in width. This latter crystal is very perfect as a specimen; it is of a fine light green color and doubly terminated. It weighs $8\frac{3}{4}$ ounces, only one fourth ounce less than the famous Duke of Devonshire emerald crystal, and is held by the company at $1,500 as a cabinet specimen, the nine crystals together being held at $3,000.

Another of these crystals, which is doubly terminated, measures 63 millimeters ($2\frac{1}{2}$ inches) by 23 millimeters ($\frac{11}{12}$ inch), and is filled with large rhombohedral cavities, formerly containing dolomite. As mineral specimens these crystals are quite unique. The only gem which has been cut from this find was found in a pocket at a depth of over 43 feet. In color it is a pleasing light green, and weighs $4\frac{23}{32}$ carats. No crystal of finer color has yet been found in the United States, and this gem is held by the company at $200.

During the recent mining the largest fine crystal of lithia emerald ever found was also brought to light. It measures 68 millimeters ($2\frac{3}{4}$ inches) by 14 millimeters ($\frac{3}{5}$ inch) by 8 millimeters ($\frac{1}{3}$ inch). One end is of very fine color, and would afford the largest gem yet found of this mineral, weighing perhaps $5\frac{1}{2}$ carats. With this was a number of

superior crystals and some ounces of common pieces of the same mineral. The owners estimate the worth of this entire yield of hiddenite at about $2,500.

A quantity of quartz filled with white byssolite or asbestiform mineral, which makes very attractive specimens, is valued at $250. On the whole this is an encouraging find for this line of minerals.

The locality for emeralds referred to in the last volume of "Mineral Resources of the United States," page 739, is only a duplication of the locality described as J. O. Lackey's in the *American Journal of Science*, III. series, Vol. XXVII., page 153.

Hiddenite has also been found during the past year in working the property known as the Morton tract, formerly known as Smeaton's and Lyon's properties ("Mineral Resources of the United States, 1883 and 1884," page 739).

Among the fictitous reports of the finding of gems may be mentioned that of the finding of three diamonds and about a dozen topazes in the gravel along the Sangamon river, near Springfield, Illinois.

What is perhaps the finest collection of rough diamond crystals in existence was exhibited during the past year by Messrs. Tiffany & Co. in New York. It consisted of 904 crystals, weighing in the aggregate 1,876½½ carats, and was valued at $30,000. This has since been returned to Europe. For description see "Report of the American Association for the Advancement of Science, 1885," page 250.

At the meeting of the British Association, held at Birmingham, September, 1886, Prof. H. Carvil Lewis read a paper on "Diamond-bearing Peridotite," in which he said he had found in Kentucky, peridotite similar to that which occurs in the Kimberley mine, and was convinced that a search would reveal the presence of diamonds in that State. Now, the diamonds in the South African deposits are accompanied by carbonaceous shale which surrounds the mine, and is also scattered through the so called "blue stuff" in sizes varying from microscopic specks to large detached masses, and forming a sort of breccia, so to speak. The theory of the volcanic origin of these pipes was first advanced by Dr. E. Cohen. In the opinion of the writer the peridotite alone is not sufficient to account for the diamonds, but rather its mixture with the shale. Unless this carbonaceous shale is present under similar conditions in Kentucky the outlook for diamonds is not encouraging. In further confirmation of this view may be mentioned Prof. H. E. Roscoe's discovery of an aromatic hydrocarbon on treating diamond earth with hot water. This hydrocarbon, which he separated by digesting the earth with ether and allowing it to evaporate, was crystalline, strongly aromatic, volatile, burned with a smoky flame, and melted at 50° C. It was unfortunate that the quantity of the substance obtained was too small to admit of a full investigation. (Proceedings of Manchester Literary and Philosophical Society, October 17, 1884, page 5.)

A recent London periodical made the statement that any one who found the sapphire and ruby in its original matrix would soon be called the "King of Rubies," and that his fortune would be assured. This recalls the fact that Col. C. W. Jencks, of Boston, was the original finder of the true corundum gems *in situ* at the Jencks mine at Franklin, North Carolina; that he obtained from this locality nearly all of the fine crystals in the best American collections. One of the most interesting of his finds is a piece of a blue crystal with a white band running across it, and a place in the center where a nodule had dropped out.(*a*) This piece was cut and placed back in its original place, and the white band can be seen running across both gem and rock. Nearly all of the fine gems from this locality mentioned in the two previous reports were also brought to light by his mining. The gems were found here in their original matrix, but they were of such rare occurrence that it was not feasible to mine for them more thoroughly. The corundum mining has proved profitable, however, and is still carried on by Dr. Lucas.

A number of beryls of fine blue color, resembling the Mourne mountain beryls, have been found near Mount Antero, in the Arkansas valley, Chaffee county, Colorado. One of these was 4 inches long and three-eighths of an inch across with cutting material in it. The other crystals measured from 1 inch to 1¼ inches in length and one fifth to one third inch in width.

The large beryl mentioned in "Mineral Resources" for 1883 and 1884, has afforded the finest aquamarine of American origin known. It weighs 133¾ carats and measures 35 by 35 by 20 millimeters. It is a brilliant cut gem and with the exception of a few internal hair-like striations it is absolutely perfect. The color is a deep bluish green, equal to that of gems from any known locality.

Mr. George F. Breed, manager of the Valencia Mica Company, has cut from white beryls nearly 100 aquamarines, ranging from one half to 4 carats in weight, and of a light blue color, which were found in their mica mine at North Groton, Grafton county, New Hampshire.

A number of very fine, deep golden yellow, blue, and green beryls, equaling any ever found, were shown to the writer by Mr. M. W. Barse, of Olean, New York, taken from his mica mine between New Milford and Litchfield, Litchfield county, Connecticut. Some fine blood-red garnets from here were cut into gems. Some other parties have sold stones from the same locality which are possibly new gems nearly as hard as the sapphire, and said to come from South America. Since these statements gained currency abroad a correction was deemed necessary. They are undoubtedly American beryls from the above locality.

The finest large phenacite crystal ever found in the United States is the one in the possession of Mr. Whitman Cross. It was found at Crystal Park, Colorado, weighs 59 pennyweights 6 grains, and measures 46.5

a London *Jeweler and Metalworker*, August, 1886.

millimeters in length and 32 millimeters in thickness. Occasional transparent spots are noticeable. Full descriptions of phenacite from Crystal Park and Florissant, Colorado, and of topaz from near Pike's Peak and Devil's Head mountain, Colorado, and also of that found in nevadite at Chaltk mountain, in the same State, are given by Messrs. Cross and W. F. Hillebrand in "Bulletin No. 20 of the United States Geological Survey, Washington, 1885." Phenacite from the Florissant locality was also described by W. E. Hidden in the *American Journal of Science*, III. series, Vol. XXIX., page 249. These crystals at Florissant were first found by Mr. J. G. Heistand, of Manitou, Colorado.

Thousands of garnet crystals found at Ruby mountain, near Salides, Chaffee county, Colorado, have been made into paper weights and sold to tourists. Those weighing a few ounces sell for about 10 cents each, and one weighing 14 pounds was sold. Regular printed lists running up to 4 pounds weight are sent out with scale of prices attached. They have a chlorite coating which can easily be removed.

The finding in the heart of New York City, in Thirty-fifth street, between Broadway and Seventh avenue, of a garnet crystal as perfect as any ever found on this continent, and weighing 9 pounds 10 ounces, is of peculiar interest.

A full account of the wood jasper deposit of Arizona was published in the *Popular Science Monthly* for January, 1886, and in the *Scientific American* for January. Several thousands of dollars' worth of this material has been cut into paper weights, charms, and other articles of jewelry, or polished on one side for cabinet specimens. At the present time numbers of these articles are being cut and sold to tourists along the line of the Atchison, Topeka and Santa Fé railroad. The base of the *World*-fund memorial to be presented to the eminent sculptor, M. Bartholdi, was made out of pieces of this stone.

The compact quartzite of Sioux Falls, Dakota, has been quarried and polished for ornamental purposes. It is known and sold as "Sioux Falls jasper," and is really the stone referred to by Longfellow in his "Hiawatha" as being used for arrow heads. This stone is susceptible of a very high polish and is found in a variety of pleasing tints, such as chocolate, brownish red, brick red, and yellowish. The polished material has been sold to the amount of $15,000 during the last two years, and polishing works run by water power have been erected, and so ingeniously are they contrived that pillars, pilasters, mantels, and table tops can be made here as cheaply as anywhere. The pilasters of the German American Bank in Saint Paul, Minnesota, and the columns in the doorway of the Chamber of Commerce building in the same city are of this beautiful jasper. It is likely to become one of our choicest ornamental stones, especially effective in combination with the Minnesota red granite. Its great tensile strength, its high, almost mirror-like polish, the fact that though so highly polished, the stone is not slippery, the large pieces that can be quarried out, and the pleasing variety of

colors, all combine to render this one of the most desirable building stones. Polishing mills have been built of sufficient capacity to polish $100,000 worth per annum, and in view of the unequaled facility with which it can be prepared for use, it could be made into tablets, blocks, columns, and tiles with advantage, and employed for fine interior and monumental work or in the more artistic branches of stone work. Some good results have been obtained with the sand blast on polished surfaces.

A remarkable mass of rock crystal was recently sent to Messrs. Tiffany & Co. from a place near Cave City, Virginia. Although it weighed 51 pounds this mass was only a fragment of the original crystal, which weighed 300 pounds, but was unfortunately broken in pieces by the ignorant mountain girl who found it. Still this fragment will furnish slabs 8 inches square and ½ to 1 inch thick. The original crystal, if it had remained intact, would have furnished a crystal ball perhaps 4½ to 5 inches in diameter and almost perfect. It is likely that further working in this locality would bring some fine material to light. (Trans. American Assoc. Adv. Science, 1886.)

Mr. F. C. Yeomans, of Washougal, Washington Territory, has found quite a variety of fine agates and moss agates at the above locality.

The menaccanite from Cumberland, Rhode Island, is often spotted with white quartz. Mr. E. Passmore, of Hope, Rhode Island, has cut it into oval stones several inches long, which admitted of a fine polish. This quality, coupled with its hardness, makes it a desirable ornamental gem stone.

It may be worthy of mention that the writer found pieces of peridot, of sufficient transparency to afford *gems* one-fifth inch long, in the largest mass of the Glorieta mountain, Santa Fé county, New Mexico, meteorite. (*American Journal of Science.*, III. series, Vol. XXXII., October, 1886.)

The turquois pseudomorph after apatite from Taylor's ranch on the northeast side of the Chowchilla river, California, has been described by G. E. Moore and V. von Zepharooich (*Zeitsch. fur Kryst. u. Min.*, Vol. X., p. 240). The turquois from Los Cerillos, New Mexico, has been fully analyzed and described by Prof. F. W. Clarke and Mr. J. S. Diller in the *American Journal of Science*, III. series, Vol. XXXII., page 211, September, 1886. Large quantities of this material have been sold, both as specimens and gems. Unfortunately many of those of finest color were found to have been artifically stained. A full series of this mineral has been presented to the National Museum.

Malachite in large masses has been found at the Copper Queen mine at Bisbee, Arizona. One of these masses weighed 15 pounds and others were nearly as large. All were of good enough quality and large enough for tablet tops.

Mr. F. F. Chisolm states that specimens of what appears to be amber were found in one of the Union Pacific coal mines in Wyoming

in 1885, but the tests are not yet completed, so that its genuineness cannot be asserted. He says: "The material which was brought to Denver was hard, highly electric, and of a good clear yellow color. Its fusion point was a little low, and the odor of a burning fragment slightly resembled that of burning india rubber. In places the substance occurs 2 inches thick. The exact place of its occurrence has not yet been ascertained." A few of the choice minerals and gems in the collection of Mr. Clarence S. Bement were well described by Prof. Gerhard vom Rath in the *Jewelers' Circular*, Vol. XVI., No. 12, January, 1886.

Mr. William H. Andrews, of Gouverneur, Saint Lawrence county, New York, has a remarkable collection of 2,200 specimens of polished marbles, serpentines, jaspers, agates, and other ornamental stones, principally from Saint Lawrence, Jefferson, and adjacent counties. A variety of other minerals are also to be found in this collection, which, though the polishing is mainly the work of Mr. Andrews himself, is one of the most complete series of the kind in the United States.

Popular articles have appeared during the year on North Carolina gem stones by Mr. C. D. Smith; on diamonds by William Wareing Habersham (both of these appeared in *Dixie*, published in Atlanta, Georgia, January, 1886), and an article on how hiddenite was formed, by Mr. W. E. Hidden, in *Dixie*, December, 1885.

The National Museum collection of gems, formed by Prof. F. W. Clarke, is now one of the most complete for species in the United States, and as many of the gems are of more than average merit and all can have access to them, this is one of the best opportunities afforded the student in this country. The *Popular Science Monthly* for April, 1886, contains a description of this collection, which, with additions to date, will also appear in the bulletin of the National Museum.

An immense number of small collections of minerals have been sold during the past year, usually consisting of specimens not over ¼ to 2 inches square of a series of some ten to fifty of the principal minerals, or the minerals of a section, or of polished and ornamental stones; sets of fifty; selling for from $1 to $5, are arrayed in cases or pasted to boards. The name which is given to them is generally copyrighted. Thousands of these collections are sold annually.

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While it is impossible to obtain exact returns of the values of the precious stones found in the United States, it is believed that the estimates given in the following table represent, roughly, the total values and the proportionate values of the several mineralogical species. Gold quartz, the value of which should be more properly perhaps included under the head of gold mining, is added at the close of the list.

Estimated production of precious stones in the United States in 1883, 1884, *and* 1885.

Species.	1883.			1884.			1885.		
	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
Diamond	.....	.....	.....	.....	$800	$800	.....	.....	.....
Sapphire gems	$200	$2,000	$2,200	$250	1,500	1,750	.....	$500	$500
Chrysoberyl	100	.....	100	25	.....	25	.....	.....	.....
Topaz	1,000	.....	1,000	200	300	500	$1,000	250	1,250
Beryl	200	300	500	300	400	700	250	500	750
Emerald	500	.....	500	.....	.....	.....	3,000	200	3,200
Hiddenite	100	500	600	.....	.....	.....	500	2,000	2,500
Tourmaline	.....	.....	.....	1,500	500	2,000	500	100	600
Smoky quartz	2,500	7,500	10,000	2,000	10,000	12,000	2,000	5,000	7,000
Quartz	10,000	1,500	11,500	10,000	1,500	11,500	10,000	1,500	11,500
Silicified wood	5,000	.....	5,000	10,000	500	10,500	5,000	1,500	6,500
Garnet	1,000	5,000	6,000	1,000	3,000	4,000	200	2,500	2,700
Anthracite	.....	2,500	2,500	.....	2,500	2,500	.....	2,500	2,500
Pyrite	1,500	500	2,000	2,000	1,000	3,000	1,500	500	2,000
Amazonstone	3,500	250	3,750	2,500	250	2,750	2,500	250	2,750
Catlinite (pipestone)	10,000	.....	10,000	10,000	.....	10,000	10,000	.....	10,000
Arrow points	1,000	.....	1,000	1,000	.....	1,000	.....	2,500	2,500
Trilobites	500	.....	500	500	.....	500	.....	1,000	1,000
Sagenitic rutile	500	500	1,000	500	500	1,000	.....	250	250
Hornblende in quartz	500	100	600	500	100	600	.....	300	300
Peridot	50	250	300	50	100	150	.....	50	50
Thompsonite	250	500	750	250	500	750	250	500	750
Diopside	200	100	300	.....	.....	.....	100	.....	100
Agate	1,000	500	1,500	4,000	500	4,500	1,000	1,000	2,000
Chlorastrolite	500	1,000	1,500	500	1,000	1,500	.....	.....	.....
Turquois	1,500	500	2,000	1,500	500	2,000	1,500	2,000	3,500
Moss agate	1,000	2,000	3,000	1,000	2,000	3,000	500	2,000	2,500
Amethyst	2,000	250	2,250	2,000	250	2,250	2,000	100	2,100
Jasper	2,000	500	2,500	2,000	500	2,500	.....	.....	.....
Sunstone	250	200	450	250	200	450	250	100	350
Fossil coral	500	250	750	500	250	750	.....	.....	.....
Rutile	.....	.....	.....	.....	.....	.....	750	.....	750
Total	47,350	26,700	74,050	54,325	28,650	82,975	42,800	27,100	69,900
Gold quartz	40,000	75,000	115,000	40,000	100,000	140,000	40,000	100,000	140,000

By recalculating from the value of the diamond carat as used in different countries the equivalents in the metric system, the weights in the four places of decimals, according to Mr. Louis D'A. Jackson, in his "Modern Metrology," page 377, will be found in the following table:

Weight of a diamond carat in different countries.

Countries.	Weight.	Countries.	Weight.
	Gram.		*Gram.*
Turin	.2135	Turkey	.2005
Persia	.2095	Spain	.1999
Venice	.2071	Java, Borneo	.1969
Austro-Hungary	.2061	Florence	.1965
France	.2059	Arabia	.1944
Portugal, Brazil	.2058	Egypt	.1917
Germany	.2055	Bologna	.1886
England, British India	.2053	Average weight of diamond carat	.2020
Holland, Russia	.2051		

IMPORTS.

Diamonds and other precious stones imported and entered for consumption in the United States, 1867 to 1885, inclusive.

Fiscal years ending June 30—	Glazier's.	Dust.	Rough or uncut.	Diamonds and other stones not set.	Set in gold or other metal.	Total.
1867	$906	.....	.....	$1,317,420	$291	$1,318,617
1868	484	.....	.....	1,060,544	1,465	1,062,493
1869	445	$140	.....	1,997,282	23	1,997,890
1870	9,372	71	.....	1,768,324	1,504	1,779,271
1871	976	17	.....	2,349,482	256	2,350,731
1872	2,386	89,707	.....	2,939,155	2,400	3,033,648
1873	.....	40,424	$176,426	2,917,216	326	3,134,392
1874	.....	68,621	144,629	2,158,172	114	2,371,536
1875	.....	32,518	211,920	3,234,319	.....	3,478,757
1876	.....	20,678	186,404	2,409,516	45	2,616,643
1877	.....	45,264	78,033	2,110,215	1,734	2,235,246
1878	.....	36,409	63,270	2,970,469	1,025	3,071,173
1879	.....	18,889	104,158	3,841,335	538	3,964,920
1880	.....	49,360	129,207	6,690,912	765	6,870,244
1881	.....	51,409	233,596	8,320,315	1,307	8,606,627
1882	.....	92,853	449,313	8,377,200	3,205	8,922,571
1883	.....	82,628	443,996	7,598,176	2,081	8,126,881
1884	22,208	37,121	367,816	8,712,315	(a)	9,139,460
1885	11,526	30,426	371,679	5,628,916	(a)	6,042,547

a Not specified.

Imports of substances not included in the foregoing table, 1868 to 1885, inclusive.

Fiscal years ending June 30—	Unmanufactured agates.	Bookbinders' and other manufactured agates.	Carnelian.	Brazil pebbles.	Amber.	Amber beads.	Unmanufactured coral.	Manufactured coral.	Unmanufactured meerschaum.	Total.
1868	.....	.....	.....	.....	.....	.....	.....	$62,270	.....	$62,270
1869	.....	$70	$269	.....	$427	.....	.....	22,417	$6,407	29,590
1870	.....	.....	766	.....	1,433	.....	.....	18,975	3,998	25,172
1871	.....	1	661	.....	180	.....	.....	37,877	698	39,417
1872	.....	529	207	.....	2,426	.....	$83	59,598	2,104	65,037
1873	$151	1,310	.....	$1,237	1,534	$595	230	63,805	5,608	74,470
1874	177	1,524	.....	.....	1,448	1,057	527	28,152	270	33,155
1875	520	5,165	.....	57	7,169	715	1,278	33,567	2,902	51,373
1876	293	1,567	.....	.....	15,502	187	109	33,559	21,939	73,156
1877	579	1,904	(a)69	.....	17,307	329	718	28,650	9,304	58,860
1878	82	404	.....	76	13,215	1,119	1,252	12,667	16,308	45,123
1879	138	364	.....	.....	17,821	203	147	11,327	19,088	49,088
1880	57	2,346	.....	.....	36,860	2,317	62	5,492	30,849	77,983
1881	486	1,700	.....	5	42,400	1,102	89	2,501	72,754	121,037
1882	901	5,084	.....	111	72,479	4,174	1,474	669	56,118	141,010
1883	14	2,895	.....	.....	40,166	3,472	681	1,303	58,885	107,416
1884	.....	6,100	.....	3,496	56,301	4,692	158	(b)	43,169	113,916
1885	124	.....	.....	6,541	21,722	3,242	659	(b)	42,590	74,878

a Not separately classified since 1877.

b Not specified.

Publ in 1887

PRECIOUS STONES.

By George F. Kunz. for 1886

Mining during 1886.—As stated in the previous reports of this series, the search for precious stones in the United States is extremely irregular and is generally a side issue in mining other substances. Still, at Stony Point, North Carolina, and at Mount Mica, Paris, Maine, operations involving systematic mining are carried on for obtaining precious stones. At the former locality, which is controlled by the Emerald and Hiddenite Mining Company, nine emeralds were found which were valued at over $2,000. The large crystals, weighing 8¾ ounces, as well as the fine large lithia emerald, are now in the cabinet of Mr. Clarence S. Bement. The total production during 1886 amounted to perhaps $4,000. Particulars concerning this locality were given on page 437 of the last report of this series.

After three months of unsuccessful mining at Mount Mica, Paris, Maine, several pockets were found; one found in October contained cookite, decomposed feldspar, crystals of quartz, and, at the bottom, tourmalines either loose or embedded in the floor of the cavity. Over 100 crystals were obtained, which will furnish more than 200 gems. The entire find was estimated to yield cut tourmalines to the value of about $5,000, and crystals, specimens, and associated minerals to the value of another $1,000. Two of the gems cut from these crystals weighed 34¼ and 27½ carats, respectively. They were of a brilliant, rich grass-green color. Another gem of a deep blue-green color, and weighing 8 carats, one green chrysoberyl of 7½ carats, several yellow and a variety of blue gems, but no red or pink stones, were obtained. Messrs. N. H. Perry and E. M. Bailey found good specimens of tourmaline, but they were of little gem value. Messrs. T. F. Lamb and G. C. Hatch mined for a time at the Mount Apatite locality, near Auburn, Maine, and found tourmaline gems and minerals to the value of $500. This locality will be further worked. Quite a large number of the yellow, green, and white beryls, found in Litchfield county, Connecticut, have been nicely cut and extensively sold. The cut gems sold during the past year are valued at $5,000, but a large part of this sum probably represents the cutting and other necessary expenses.

In connection with mining for substances, other than precious stones, many very considerable contributions have been made to the total output of gems. For example, at the mine of the Marion Bullion Company,

Marion, North Carolina, Colonel Deming has obtained some very good garnets in sufficient quantity to offer them to the trade; also, one fine amethyst of a magnificent purple color and over one inch across, fine aquamarines 1 to 6 carats in weight, and some beautiful chloritic inclusions in quartz, which, when polished, show very fine landscape effects. Among the finds which may be classed in general as accidental are the following:

Garnet.—Of the large garnets from Salida, Colorado, previously referred to, over a ton has been sold during the past year. Quantities of almandite garnet are said to have been found in the gravel of the placer mines near Lewiston, Idaho, in rolled and pitted grains from $\frac{1}{16}$ to $\frac{1}{2}$ inch across. They would cut into gems and jewels for watches.

Quartz.—The large masses of clear quartz referred to in the last report as having been found near Abingdon, Virginia, were in reality found in the mountains of Ashe and Mitchell counties, North Carolina. In addition to these, one large crystal weighing 190 pounds and two smaller ones, weighing 60 and 22 pounds respectively, have been found. Mr. D. A. Jones states that all these masses were found within a distance of 5 miles—the one weighing 22 pounds on the land of Saint Leger Brooks, and the others on the farm of Dr. L. C. Gentry. There was also reported a finding of transparent crystals of quartz, one weighing 642 pounds, another 340 pounds. When these reached New York, however, they proved not to be crystals, but veins of translucent quartzite with crystalline markings of a group rather than of a single crystal, and the clear spaces which were only observed on these crystalline sides would not afford a crystal ball more than one inch in diameter. The larger part was almost white with flaws. Mr. P. A. Hubbard reports finding specimens of rock crystal and rutilated quartz on or near the surface; one mass of the former weighed over 10 pounds and was quite clear, though fractured by frosts. Mr. J. P. M. Butler, of Trinidad, Colorado, reports finding large quantities of crystalline quartz with small doubly terminated crystals of quartz, resembling those from Herkimer county, New York. These may be of value to the dealers selling to Western tourists.

Topaz.—In Bulletin No. 27, United States Geological Survey, Prof. F. W. Clark describes topaz, and its alterations, from Stoneham, Maine, and also publishes an analysis of it. A topaz crystal weighing $18\frac{1}{5}$ ounces (587 grams) was found at Cheyenne Mountain, Colorado, about 7 miles southwest of Colorado Springs. It is very perfect, but of little gem value.

Amethyst.—Among some amethysts found at Deer Hill, Stow, Maine, during the last year, was one remarkable mass which furnished a gem weighing 25 carats, and of the deep purple color of the Siberian amethyst. Very fair amethysts have also been found at Burrville, Rhode Island.

Jasperized wood.—Very little was done during the year 1886 in the development of the jasperized wood deposits of Arizona, but the base of

the New York *World* memorial presented to the eminent sculptor, Bartholdi, was made of it. Preparations have been made to polish this material at Sioux Falls, Dakota, water power and other facilities being found there, and during the present year (1887) important developments are expected in the form of table tops 2 feet across made from a single section.

Hydrophane.—An opaque white hydrophane of great interest has been found in Colorado and the finder has named it "magic stone," because, as usual with this mineral, it possesses the property of becoming absolutely transparent if water is dropped slowly on it from one to three minutes. It is so porous that it will absorb its own weight of water; it quickly recovers its opacity. The finder suggests that the stone be used for seals, rings, and scarf pins, as by reason of its opacity it would completely conceal portraits, mottoes, or mementoes which could be brought to view when desired by the application of a little water. This is the finest hydrophane known.

Chalcedony.—Near Cisco, Utah, a pink chalcedony has been found which admits of a high polish, but which has not yet been introduced in any quantity.

Agate.—The beautiful little agate pebbles from the Pescadero beach, in California, are sold in large quanties and in different forms, polished, and unpolished, and loose, or in vials of water. Occasionally some of them are found inclosing a pebble moving in liquid, like the hydrolites from Uruguay and the chalcedony from Tampa Bay, Florida. They vary in diameter from $\frac{1}{10}$ to $\frac{1}{4}$, rarely 1 inch.

Obsidian.—Mr. J. P. Iddings has contributed a paper to the Seventh Annual Report of the United States Geological Survey, describing the obsidian cliff in the Yellowstone Park, Wyoming, stating that it presents the partial section of a flow of obsidian; the dense glass which forms the lower portion is from 75 to 100 feet thick. A remarkable feature about it is the development of prismatic columns which form its southern extremity, rising 50 or 60 feet, and being only 2 to 4 feet in diameter. The color of the material is for the most part jet black, but some of it is mottled and streaked with bright brownish red and various shades of brown (mountain mahogany), passing into dark or light yellow, purple, and yellowish green. The great quantity and beauty of the material invite attention to its use in the arts.

Azurite and Malachite.—Mr. T. A. Heistand obtained masses of azurite, and malachite resulting from the alteration of azurite, which, being botryoidal in form and showing the two minerals in distinct layers, formed a most beautiful ornamental stone when cut across the tops of the mamillary masses (1 to 3 inches across) and carefully polished. There are from two to four alternate and concentric rings of each color, which produce a very novel and pleasing effect. If this were found in sufficient quantity it would make a very valuable ornamental stone.

As it is, there is barely enough of it to supply the cabinets. The stone is well worthy of attention. Mr. W. A. Woodcock communicates that malachite, which is evidently of value in the arts, has been sent to him from the Yukon country, Alaska.

Amber.—Mr. J. B. Livezey sent the writer a specimen piece of amber found on the southwest branch of Mantua creek, near the town of Sewall, which is 13 miles below Camden, New Jersey. This specimen was taken from the lower marl bed, while the one from Harrisonville, described in a previous report, was from the middle marl bed. Information was also obtained that several other pieces had been found at the former locality, but they have been lost.

Chrysoberyl.—Among some small rolled quartz pebbles sent to Messrs. Tiffany & Co., for examination, a transparent yellow chrysoberyl was observed which would afford a ¼ carat stone.

Diamond.—In the summer of 1886 a diamond was found in the spring on the Alfred Bright farm at Dysortville, McDowell county, North Carolina. While Mr. Grayson Christie's son was drawing a bucket of water, his attention was attracted by the brightness of the stone. It was thought to be a diamond and sent to Messrs. Tiffany & Co., and was so proved to be by the writer. The stone is a distorted hexoctahedron with partial twinning; its length is 10 millimeters and its width 7 millimeters. It is quite perfect and transparent, but having a grayish-yellow tint. Its specific gravity is 3.549+. This stone being more than an average find, the writer thought it would be of interest to visit the locality, and while there, in June, 1887, he fully authenticated all the facts of the finding. No trace of garnet, peridotite, or any of the associations of the diamond was found near the spot. The sediment at the bed of the spring was taken out and carefully examined, as also were the small hollows on the adjacent hillside. This diamond must therefore have been transported in decomposing soil from distant higher ground in the vicinity during a heavy freshet. Its value as a gem, not counting any value its American origin may attach to it, would be from about one hundred to one hundred and fifty dollars. A number of small stones, exhibited as diamonds, have been found at Brackettstown, near by. They are identical with the supposed fine diamonds found by Capt. J. C. Mills at his mine at Brindletown; that is, transparent zircon or smoky-colored quartz, the former of which has a luster that is readily mistaken for the diamond's by an inexperienced person. A number of pieces of bort (rough diamond) exhibited as from the same section, I am informed on good authority, are of South African, and not North Carolina, origin. It is to be hoped that the few legitimate finds which have actually occurred at this locality will not lead to any deceptions, which would greatly retard any natural development.

The stone, 3½ ounces, and said to be a diamond, and which was found by J. S. Keyser in digging for coal near Ponca, Nebraska, proved not to be such, although the excitement it caused was certainly genuine.

Diamond cutting, though now carried on here much more extensively than ever before, has not always proved a profitable industry. The price for rough diamonds in the London market is so close, and they are disposed of so soon after their arrival, that unless purchases are made with the greatest possible judgment, the competition of the foreign cutters, who are convenient to the market, cannot be successfully met. For this reason the trade has in many cases been given up here, yet the standard of merit has been so raised that to-day the finest cutting is done in the United States. A large part of the work done here consists in improving and recutting old stones that have been cut in the East for weight only, or in more modern work that can be improved upon, and these branches are generally profitable. But even with a 10 per cent. duty on cut gems as a protection, it is not likely that we shall soon rival the great foreign cutting centers. Sards, bloodstones, and other cheap agates are often cut to a uniform size for mounting, because it is cheaper to fit the stone to the mounting than the mounting to the stone, and such stones as are from time to time found here are generally cut in this country.

At the time of the publication of the last report the writer had not heard of the occurrence of the shale in the Elliott county peridotite, hence the statement then made in regard to it; but important investigations have since been made in that locality. In his remarks on the "Genesis of the Diamond" (Science, Vol. VIII, p. 345), Prof. Carvill Lewis alluded to the peridotite of Elliott county, Kentucky, and suggested that it is well worth while to examine carefully all localities whose geological composition and history are analogous to those of the South African diamond fields. Mr. J. S. Diller, in the *American Journal of Science*, August, 1886, refers to Prof. A. R. Crandall's having discovered two dikes of eruptive rock in eastern Kentucky, about 7 miles southwest of Willard. Mr. Diller states that he found by microscopic examination that this rock belongs to the peridotites, and occurred in conjunction with a carbonaceous shale; although the exact contact of the two rocks was not exposed, hardened shale was found near the peridotite under such circumstances that the induration is certainly attributable to the influence of the eruptive mass. But this, he thinks, is not the strongest evidence that the peridotite is eruptive, for the peridotite itself includes many fragments of shale which were picked up on its way to the surface. The contact metamorphism has resulted generally in the development of a micaceous mineral, and the production from the shale of a rock such as has been designated spilosite. And in some notes on the trap dikes of Elliott county by A. R. Crandall and J. S. Diller, published in the report on the geology of Elliott county by the Kentucky Geological Survey, Frankfort, Kentucky, 1887—also in *Science*, October 29, 1886—it is stated that although there were few exposures and the excavations made were inconsiderable, nevertheless he reached the conclusion that the shales had been distinctly metamor-

phosed by the peridotite, a fact which was most patent in the enveloped fragments of shale, which in one locality were quite numerous. He says that both forms of peridotite described by Professor Lewis occur in Kentucky, but the brecciated form has not yet been found to contain diamonds. In the advanced stages of metamorphosis little spheroidal bodies were found, pale yellowish to colorless translucent to transparent, and remarkably uniform in size. These generally appeared in a form very suggestive of the diamond, resembling a hexoctahedron with curved faces. Notwithstanding that some of their properties favored the view that they were diamonds more or less perfectly crystallized, their solubility in concentrated hydrochloric acid rendered such a view untenable, and even if they were diamonds their value would be comparatively insignificant because of their small size. In concluding, he says: "The dark shale, which is frequently enveloped by the peridotite, is somewhat carbonaceous, but contains a small proportion of carbon as compared with that of the South African diamond field. H. Carvill Lewis (Science, viii, p. 346) remarks concerning the South African mines, that "recent excavations have shown that large quantities of this shale surround the mines, and that they are so highly carbonaceous as to be combustible, smouldering for long periods when accidentally fired." In the chemical laboratory of the United States Geological Survey Mr. J. Edward Whitfield determined 37.521 per cent. of carbon in the shale from near the Kimberley mine, while the blackest shale adjoining the peridotite near Charles Isom's in Kentucky, he found to contain only 0.681 per cent. of carbon. For this reason it appears to me rather improbable that diamonds will be discovered at the locality in question." Nevertheless, upon the invitation of Prof. J. R. Proctor, State Geologist of Kentucky, Mr. J. S. Diller and the writer were sent by the United States Geological Survey to examine the locality, viz: Isom's creek, Elliott county, Kentucky. The plan was to search by sifting and carefully panning the stream beds receiving the drainage directly from the surface of the peridotite.

The peridotite alters and disintegrates readily; but, from the fact that the declivity of the surface is considerable, the transportation of material almost keeps pace with disintegration, and there is no great accumulation of residuary deposits upon the narrow divides and hillsides. The specific gravity and durability of the gems found in connection with peridotite are generally greater than those of serpentine and other products of its alteration. On this account the gems accumulate upon the surface and in favorable positions along adjacent lines of drainage. We enlisted the services of the people in the neighborhood to scrutinize the steep slopes, where gems weathered out of the peridotite might be exposed. Particular attention was directed also to the examination of the solid rock and residuary deposits, which so closely resemble the material of the South African mines.

During a careful search over a small area for nearly two days, no diamonds were found; but this by no means demonstrates that diamonds may not yet be discovered.

The best time to search for gems in that locality is immediately after a heavy rain, when they are most likely to be well exposed upon the surface. It is proposed by those most interested to keep up the search economically, by furnishing to responsible individuals in the vicinity a number of rough diamonds mounted in rings, for comparison, that they may know what to look for under the most favorable circumstances.

Besides pyrope garnets, a few of which are good enough for cutting, several fairly good specimens of a green pyroxene were found. They resemble the same transparent mineral from Arizona. The South African specimens of this mineral are a little more opaque, but of a richer green color.

Artificial rubies.—The subject of artificial gems is at the present moment of considerable interest. Early this summer the Syndicate des diaments et pierres précieuses was informed that certain stones which had been sold as rubies from a new locality were suspected to be of artificial origin. They were put upon the market by a Geneva firm; and it was surmised that they were obtained by the fusion of large numbers of small rubies, worth at the most a few dollars per carat, into one fine gem worth from $1,000 to $2,500 per carat.

Some of these artificial stones were kindly procured by Messrs. Tiffany & Co. I was not, however, permitted to break them for analysis, to observe the cleavage, or to have them cut so as to observe the optical axes more correctly. It is possible, however, to detect the artificial nature of this production with a mere pocket-lens, as the whole structure is that peculiar to fused masses. Examination elicited the following facts: The principal distinguishing characteristics between these and the genuine stones is the presence in them of large numbers of spherical bubbles, rarely pear-shaped, sometimes containing stringy portions showing how the bubbles had moved. These bubbles all have rounded ends, and present the same appearance as those seen in glass or in other fused mixtures. They are nearly always in wavy groups or cloudy masses. When examined individually they always seem to be filled with gas or air, and often form part of a cloud, the rest having the waviness of a fused mixture. Some few were observed inclosing inner bubbles, apparently a double cavity, but empty. In natural rubies the cavities are always angular or crystalline in outline, and are usually filled with some liquid, or, if they form part of a "feather," as it is called by the jewelers, they are often arranged with the lines of growth. Hence the difference in appearance between the cavities in the natural gem and those in the fused gem is very great, and can readily be detected by the pocket-lens. I have failed to find in any of the artificial stones even a trace of anything like a crystalline or angular cavity. Another distin-

guishing characteristic is that in many genuine rubies we find a silky structure (called "silk" by the jewelers), which, if examined under the microscope, or under a $\frac{4}{10}$ to $\frac{8}{10}$ inch objective, we find to be a series of cuneiform or acicular crystals, often iridescent, and arranged parallel with the hexagonal layers of the crystal. When in sufficient number, these acicular and arrow-shaped crystals produce the asteria or star-effect, if the gem is cut *en cabochon* form with the center of the hexagonal prism on the top of the cabochon. I have failed to find any of them in the stones under consideration, or even any of the markings of the hexagonal crystal which can often be seen when a gem is held in a good light, and the light allowed to strike obliquely across the hexagonal prism. Dr. Isaac Lea has suggested (*a*) that these acicular crystals are rutile, and interesting facts and illustrations have been published by him. From my own observations on many specimens, I believe there is little doubt of the truth of this hypothesis. My explanation is that they were deposited from a solution, either heated or cold, while the corundum was crystallizing, and I doubt very much whether they will ever be found in any substance formed by fusion. The hardness of these stones was found to be about the same as that of the true ruby, 8.8, or a trifle less than 9, the only difference being that the artificial stones were a trifle more brittle. The testing-point used was a Siamese green sapphire, and the scratch made by it was a little broader, but no deeper than on a true ruby, as is usually the case with a brittle material. After several trials it was faintly scratched with chrysoberyl, which will also slightly mark the true ruby.

The specific gravity of these stones was found to be 3.93 and 3.95. The true ruby ranging from 3.93 to 4.01, it will be seen that the difference is very slight and due doubtless to the presence of the included bubbles in the artificial stones, which would slightly decrease the density. As a test, this is too delicate for jewelers' use; for if a true ruby were not entirely clean, or a few of the bubbles that sometimes settle on gems in taking specific gravities were allowed to remain undisturbed, it would have about the same specific gravity as one of these artificial stones.

I found on examination by the dichroscope that the ordinary image was cardinal red, and the extraordinary image a salmon red, as in the true ruby of the same color. Under the polariscope, what I believe to be annular rings were observed. With the spectroscope the red ruby line, somewhat similar to that in the true gem, is distinguishable, although perhaps a little nearer the dark end of the spectrum. The color of all the stones examined was good, but not one was so brilliant as a very fine ruby. The cabochons were all duller than fine, true stones, though better than poor ones. They did not differ much in color, however, and were evidently made by one exact process or at one time. Their dull appearance is evidently due in part to the bubbles. The

a Proc. Philad. Acad. Sc., Feb. 16, 1869, and May, 1876.

optical properties of these stones are such that they are evidently individual or parts of individual crystals, and not agglomerations of crystals or groups fused by heating. In my opinion these artificial rubies were produced by a process similar to that described by Fremy and Feil (*Comptes Rendus*, 1877, p. 1029), by fusing an aluminate of lead in connection with silica in a siliceous crucible, the silica uniting with the lead to form a lead glass and liberating the alumina which crystallizes out in the form of corundum in hexagonal plates, with a specific gravity of 4.0 to 4.1, and the hardness and color of the natural ruby, the latter being produced by the addition of some chromium salt. By this method rubies were formed, which, like the true gem, were decolorized temporarily by heating.

It is not probable that these stones were formed by Gaudin's method (*Comptes Rendus*, XIX., p. 1342), by exposing amorphous alumina to the flame of the oxyhydrogen blowpipe, and thus fusing it to a limpid fluid, which, when cooled, had the hardness of corundum, but only the specific gravity 3.45, much below that of these stones. Nor is it at all likely that they were produced by fusing a large number of natural rubies or corundum of small size, because by this process the specific gravity is lowered to that of Gaudin's product. The same also holds good of quartz, beryl, etc.

The French syndicate referred the matter to M. Friedel, of the Ecole des Mines, Paris, supplying him with samples of the stones for examination. He reported the presence of the round and pear-shaped bubbles, and determined the hardness and specific gravity to be about the same as of the true ruby. On analysis he found them to consist of alumina, with a trace of chromium for the coloring matter. The cleavage was not in all cases distinct, and the rough pieces given to him as examples of the gem in its native state had all been worked, so that nothing could be learned of their crystalline structure. When properly cut according to axes, they showed the annular rings. The extinction by parallel light was not always perfect, which he believed to be due to the presence of the bubbles. He states that he himself has obtained small red globules with these inclusions by fusing alumina by oxyhydrogen light; and, although having no positive evidence, he believes these stones to be artificially obtained by fusion.

On the receipt of M. Friedel's report the syndicate decided that all cabochon or cut stones of this kind shall be sold as *artificial*, and not precious gems. Unless consignments are so marked the sales will be considered fraudulent, and the misdemeanor punishable under the penal code. All sales effected thus far, amounting to some 600,000 or 800,000 francs, shall be canceled, and the money and stones returned to their respective owners.

The action taken by the syndicate has fully settled the position which this production will take among gem dealers, and there is little reason to fear that the ruby will ever lose the place it has occupied for so many centuries.

Estimated production of precious stones in the United States from 1883 *to* 1886.

Species.	1883.		1884.		1885.		Total, 1886.
	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	
Diamond	.....	.....	.....	$800	.....	.....	.....
Sapphire gems	$200	$2,000	$250	1,500	.....	$500	$500
Chrysoberyl	100	.....	25	.....	.....	.....	.....
Topaz	1,000	.....	200	300	$1,000	250	1,000
Beryl	200	300	300	400	250	500	5,550
Emerald	500	.....	.....	.....	.....	.....	3,200
Hiddenite	100	500	.....	.....	.....	.....	4,500
Tourmaline	.....	.....	1,500	500	500	100	6,250
Smoky quartz	2,500	7,500	2,000	10,000	2,000	5,000	7,000
Quartz	10,000	1,500	10,000	1,500	10,000	1,500	11,500
Silicified wood	5,000	.....	10,000	500	5,000	1,500	1,500
Garnet	1,000	5,000	1,000	3,000	200	2,500	3,250
Anthracite	.....	2,500	.....	2,500	.....	2,500	2,500
Pyrite	1,500	500	2,000	1,000	1,500	500	2,000
Amazonstone	3,500	250	2,500	250	2,500	250	2,250
Catlinite (pipestone)	10,000	.....	10,000	.....	10,000	.....	10,000
Arrow points	1,000	.....	1,000	.....	.....	2,500	2,500
Trilobites	500	.....	500	.....	.....	1,000	1,000
Sagenitic rutile	500	500	500	500	.....	250	1,750
Hornblende in quartz	500	100	500	100	.....	300	200
Peridot	50	250	50	100	.....	50	50
Thompsonite	250	500	250	500	250	500	400
Diopside	200	100	.....	.....	100	.....	2,000
Agate	1,000	500	4,000	500	1,000	1,000	1,000
Chlorastrolite	500	1,000	500	1,000	.....	.....	.....
Turquois	1,500	500	1,500	500	1,500	2,000	3,000
Moss agate	1,000	2,000	1,000	2,000	500	2,000	2,000
Amethyst	2,000	250	2,000	250	2,000	100	2,100
Jasper	2,000	500	2,000	500	.....	.....	.....
Sunstone	250	200	250	200	250	100	1,000
Fossil coral	500	250	500	250	.....	.....	.....
Rutile	.....	.....	.....	.....	.....	.....	750
Total	47,350	26,700	54,325	28,650	38,550	24,900	78,750
Gold quartz	40,000	75,000	40,000	100,000	40,000	100,000	.....

IMPORTS.

Diamonds and other precious stones imported and entered for consumption in the United States, 1867 to 1886 inclusive.

Fiscal years ending June 30—	Glazier's.	Dust.	Rough or uncut.	Diamonds and other stones not set.	Set in gold or other metal.	Total.
1867	$906	.....	.....	$1,317,420	$291	$1,318,617
1868	484	.....	.....	1,060,544	1,465	1,062,493
1869	445	$140	.....	1,997,282	23	1,997,890
1870	9,372	71	.....	1,768,324	1,504	1,779,271
1871	976	17	.....	2,349,482	256	2,350,731
1872	2,386	89,707	.....	2,939,155	2,400	3,033,648
1873	.....	40,424	$176,426	2,917,216	326	3,134,392
1874	.....	68,621	144,629	2,158,172	114	2,371,536
1875	.....	32,518	211,920	3,234,319	.....	3,478,757
1876	.....	20,678	186,404	2,409,516	45	2,616,643
1877	.....	45,264	78,033	2,110,215	1,734	2,235,246
1878	.....	36,409	63,270	2,970,469	1,025	3,071,173
1879	.....	18,889	104,158	3,841,335	538	3,964,920
1880	.....	49,360	129,207	6,690,912	765	6,870,244
1881	.....	51,409	233,596	8,320,315	1,307	8,606,627
1882	.....	92,853	449,313	8,377,200	3,205	8,922,571
1883	.....	82,628	443,996	7,598,176	(a)2,081	8,126,881
1884	22,208	37,121	367,816	8,712,315	.....	9,139,460
1885	11,526	30,426	371,679	5,628,916	.....	6,042,547
1886	8,949	32,316	302,822	7,915,660	.....	8,259,747

a Not specified since 1883.

Imports of substances not included in the foregoing table, 1868 to 1886 inclusive.

Fiscal years ending June 30—	Unmanufactured agates.	Bookbinders' and other manufactured agates.	Carnelian.	Brazilian pebbles.	Amber.	Amber beads.	Unmanufactured coral.	Manufactured coral.	Unmanufactured meerschaum.	Total.
1868	.....	.....	.....	.....	.....	.....	.....	$62,270	.....	$62,270
1869	.....	$70	$269	.....	$427	.....	.....	22,417	$6,407	29,590
1870	.....	.....	766	.....	1,433	.....	.....	18,975	3,998	25,172
1871	.....	1	661	.....	180	.....	.....	37,877	698	39,417
1872	.....	529	207	.....	2,426	.....	$83	59,598	2,194	65,037
1873	$151	1,310	.....	$1,237	1,534	$595	230	63,805	5,608	74,470
1874	177	1,524	.....	.....	1,448	1,057	527	28,152	270	33,155
1875	520	5,165	.....	57	7,169	715	1,278	33,567	2,902	51,373
1876	293	1,567	.....	.....	15,502	187	109	33,559	21,939	73,156
1877	579	1,904	(a)69	.....	17,307	329	718	28,650	9,304	58,860
1878	82	404	.....	76	13,215	1,119	1,252	12,667	16,308	45,123
1879	138	364	.....	.....	17,821	203	147	11,327	19,088	49,088
1880	57	2,346	.....	.....	36,860	2,317	62	5,492	30,849	77,983
1881	486	1,700	.....	5	42,400	1,102	89	2,501	72,754	121,037
1882	901	5,084	.....	111	72,479	4,174	1,474	669	56,118	141,010
1883	14	2,895	.....	.....	40,166	3,472	681	(b)1,303	58,885	107,416
1884	.....	6,100	.....	3,496	56,301	4,692	158	.....	43,169	113,916
1885	124	.....	.....	6,541	21,722	3,242	659	.....	42,590	74,878
1886	284	.....	.....	17,379	27,215	5,665	219	.....	23,417	74,179

a Not separately classified since 1877.

b Not specified since 1883.

FERTILIZERS.

Introductory.—The subject of fertilizers is considered here for the purpose of showing what mineral substances find use in this industry, rather than for giving a complete sketch of the subject. It frequently becomes necessary, however, to mention substances not mineral to show their relations to other constituents of manufactured fertilizers.

There are of course very many substances which contain one or another constituent useful in making soil fertile; these are used under varying conditions in such a way as to make an enormous list of substances called fertilizers, and it is a difficult question to decide whether any one shall be ruled out of use as being without any value. But aside from this use, which is chiefly local, of waste products variously named, the fertilizers which are sold commercially are becoming steadily simpler in character and more susceptible of statistical treatment.

The mineral constituents which it is meant to supply to the soil by fertilizers are practically three: phosphoric acid, potassium compounds included generally under the rough term "potash," and lime. The substances from which these are obtained are somewhat more numerous. Thus phosphoric acid is obtained principally from the phosphate rock, essentially tri-calcium phosphate, obtained at Charleston and Beaufort, South Carolina; but it is also obtained from bones, which contain a very large percentage of this same tri-calcium phosphate; from marls, which are principally soft limestone but contain small amounts of phosphoric acid, and from a peculiar form of phosphate rock called apatite, which is the main source of phosphoric acid in Canada, and in Spain and Portugal. Whatever be the source of the phosphoric acid, the substance containing it is usually treated with sulphuric acid to render it soluble; then it is so mixed with other substances that the resulting fertilizer will contain on the average from 10 to 15 per cent. of available phosphoric acid, and henceforth this percentage is the important question, and the original source of the phosphoric acid is a matter of small importance. In special cases, however, the material containing phosphoric acid, especially marl, is applied to the land without chemical treatment, and with valuable results.

"Potash" is contributed to soils principally in the form of "muriate of potash" and kainite (containing potassium sulphate). High grade sulphate of potash is also used, and these three substances, which are imported from Stassfurt, Germany, contribute more than ninety-five

Publ in 1888

PRECIOUS STONES.

By George F. Kunz. for 1887

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

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

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

Estimated production of precious stones

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

in the United States from 1883 *to* 1887.

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

IMPORTS.

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

Fiscal years ending June 30—	Glaziers'.	Dust.	Rough or uncut.	Diamonds and other stones not set.	Set in gold or other metal.	Total.
1867	$906	.....	.....	$1,317,420	$291	$1,318,617
1868	484	.....	.....	1,060,544	1,465	1,062,493
1869	445	$140	.....	1,997,282	23	1,997,890
1870	9,372	71	.....	1,768,324	1,504	1,779,271
1871	976	17	.....	2,349,482	256	2,350,731
1872	2,386	89,707	.....	2,939,155	2,400	3,033,648
1873	.....	40,424	$176,426	2,917,216	326	3,134,392
1874	.....	68,621	144,629	2,158,172	114	2,371,536
1875	.....	32,518	211,920	3,234,319	.....	3,478,757
1876	.....	20,678	186,404	2,409,516	45	2,616,643
1877	.....	45,264	78,033	2,110,215	1,734	2,235,246
1878	.....	36,409	63,270	2,970,469	1,025	3,071,173
1879	.....	18,889	104,158	3,841,335	538	3,964,920
1880	.....	49,360	129,207	6,690,912	765	6,870,244
1881	.....	51,409	233.596	8,320,315	1,307	8,606,627
1882	.....	92,853	449,513	8,377,200	3,205	8,922,571
1883	.....	82,628	443,996	7,598,176	(*a*)2,081	8,126,881
1884	22,208	37,121	367,816	8,712,315	.....	9,139,460
1885	11,526	30,426	371,679	5,628,916	.....	6,042,547
1886	8,949	32,316	302,822	7,915,660	.....	8,259,747
1887	9,027	33,498	262,357	10,526,998	.....	10,831,880

a Not specified since 1883.

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

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

a Not separately classified since 1877. *b* Not specified since 1883.

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

examination. It proved to be an octahedral crystal weighing $4\frac{1}{12}$ carats (828 milligrams), two-fifths of an inch long and one-fourth of an inch wide. It measured 9 by 10 by 7 millimeters, is slightly yellow and has one small black inclusion. The specific gravity was found to be 3.527. Curious long, shallow pittings mark the surface. A stone of from $1\frac{1}{12}$ to 2 carats could be cut from it.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Agate.—At Sioux Falls, Dakota, the company that is cutting and polishing the agatized wood from Arizona and the quartzite found at Sioux Falls has, after a great deal of experimenting, perfected the methods of sawing and polishing hard materials so as greatly to reduce the cost. Among the objects produced were a round column 11¼ inches wide and 21 inches high, cut transversely across the tree, so that the heart was visible on two sides of it, with the radiations in all directions; and sections measuring 25, 24, 17½, and 13 inches in diameter, respectively, so highly polished that when turned with the back to the light they form a perfect mirror. All the specimens were brilliant in color and rivaled any work ever done in hard materials. The company has removed from the forest 180 tons of material, and 20 tons of sections have been ground down to show its characteristic beauties. Perhaps $100,000 worth is now undergoing the cutting and polishing process.

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

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

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

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

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

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

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

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

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

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

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

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

FOREIGN SOURCES.

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

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

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

ing the different companies began. Originally the mines were worked as 3,238 separate claims, each 31 feet square, with a 7½ foot roadway between every two claims; now these are all united in about forty companies. A mine in the early days was a bewildering sight. Miles of wire cables running from individual claims were stretched across it in all directions; to these were attached the buckets for carrying the earth, reef, or wall rock of the mines, and at times water. Some of the claims were almost level with the surface, while others next to them might be cut down 200 feet, and others only 100 feet, yet all being worked independently. At the sides were endless belts with pockets for carrying the earth. One of the results of this independent system of working was that rock was dropped so recklessly that it is said to have been as dangerous as the battlefield to stand around the edges of the claims. Not only was the loss of life great from this source, but also from the falling of immense masses of reef, loosened by the blasting, which sometimes buried a score of men at once. But improved methods were gradually introduced. Steam railroads were run into the mine, and parts of it were leveled down. Millions of tons of reef required removing, and the only way to accomplish this was to assess every company in the mine proportionately. At first many mistakes were made, if mistakes they can be called when the problems offered for solution were entirely new and untried. The yellow or surface soil which overlaid the blue stuff pulverized so readily that it could be taken to the washing machine direct; but as the claims were extended down into the blue rock this proved harder, and dynamite became necessary. Immense quantities of it are now used for blasting. Through careless storing, 30 tons of dynamite, 10 tons of blasting powder, and gelatine, in all worth $80,000, exploded on January 10, 1884, with terrific effect; the smoke column, 1,000 feet high, was visible at the River diggings, 35 miles distant.

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

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

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

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

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

Average value of a carat of South African diamonds.

	s.	*d.*
Kimberley mine	17	6¼
De Beers mine	17	8
Bultfontein	18	2½
Dutoits Pan	24	7½
River digging	47	6

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

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

Yield of South African diamonds during the past ten years.

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

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

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

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

Diamonds weighing 38,000,000 carats, or over 7½ tons, have been found here. In the rough their aggregate value is £50,000,000, and after cutting, £100,000,000, or nearly $500,000,000 more than the world's yield during the two preceding centuries. Of the whole yield not more than 8 per cent. can be said to be of the first water, 12 per cent. of the

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

More diamonds weighing over 75 carats after cutting have been found since the African mines were opened than were known before. The Victoria, the Great White, or the Imperial Diamond, is supposed to be from South Africa. Concerning its early history very little is known; in fact, where the stone was found is only a matter of conjecture—a remarkable circumstance when we consider that it is the largest brilliant in the world. The original weight of the stone was 457½ carats, or 3 1/60 troy ounces; after cutting, 180 carats, valued at £100,000.

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

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

Years.	Carats.	Value.	Average per carat.
			s. *d.*
1882, four months	856, 353⅜	£1, 119, 210	26 1½
1883	2, 312, 234⅛	2, 359, 466	20 4¾
1884	2, 204, 786⅛	2, 562, 623	23 2¾
1885	2, 287, 261	2, 228, 678	19 5¾
1886	3, 047, 639⅜	3, 261, 574	21 5
1887	3, 646, 899¾	4, 033, 582	22 1¼
Total	14, 355, 174½	15, 565, 133	21 8½

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

Years.	Carats.	Declared value.	Average per carat.
		£ *s.* *d.*	*s.* *d.*
1883	2, 413, 953⅜	2, 742, 521 1 0	22 8⅝
1884	2, 263, 686⅝	2, 807, 288 3 4	24 9½
1885	2, 440, 788½	2, 492, 755 13 2	20 5
1886	3, 135, 432¾	3, 507, 210 14 0	22 4
1887	3, 599, 036½	4, 251, 837 14 6	23 7½
Total	13, 852, 897⅛	15, 801, 613 6 0	22 9¾

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

Years.	Carats.	Value.	Average per carat.
			s. *d.*
1882, four months	5,742⅜	£6,010	20 11½
1883	14,800⅝	37,112	50 1⅜
1884	19,710⅝	57,639	58 5¾
1885	27,992	56,123	40 1½
1886	38,673⅞	84,829	43 10½
1887	46,171½	95,433	41 4⅛
Total	153,090½	337,146	44 0½

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

Whence imported.	Carats.	Value.	Average per carat.
			s. *d.*
Colony, England, etc.	130,133½	£127,831	19 7¾
Orange Free State	306,660⅝	505,428	32 11½
River diggings (Barkly West)	153,090½	337,146	44 0½
Total	589,884⅜	970,405	32 10¾

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

Mines.	Carats.	Value.	Average per carat.
		£ *s.* *d.*	*s.* *d.*
Kimberley	1,333,832½	1,410,207 12 1	21 1¾
De Beer's	1,014,048	1,022,878 6 5	20 2
Dutoitspan	696,576¼	987,283 17 8	28 4½
Bultfontein	602,246	612,962 18 6	20 4¼
St. Augustine	197	250 0 0	25 4½
Total	3,646,899¾	4,033,582 14 8	22 1½

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

Years.	Carats.	Value.	Average per carat.
			s. *d.*
1882, four months	380,955½	£456,420	23 11½
1883	947,817⅜	846,705	17 10½
1884	642,438	634,332	19 9
1885	523,774½	458,858	17 6¼
1886	889,864	883,503	19 10½
1887	1,333,832½	1,410,207	21 1¾
Total	4,718,681⅜	4,690,025	19 10½

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

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

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

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

The recent concentration of some of the diamond mining companies in South Africa in their efforts to regulate the production and price has led to an increased interest in mines located in Brazil and India. During the past year the Madras Presidency Diamond Fields Company (limited) has been organized with a capital stock of £190,000. To prove that the Indian mines are not yet exhausted, operations will be commenced at the Wadjra Karur field in the Madras presidency. On this field of 554 acres was found a very fine 67½ diamond crystal which furnished a 25 carat stone called the Gow-do-Norr, valued by the company at £15,000. An English company has recently been formed, under the name of the "Hyderabad Deccan Mining Company," to work the mines in Krishna valley, India, where it is thought that the famous Kohinoor diamond was found.

Diamonds have been found in the Tertiary gravels and recent drift near Bingera in Inverell, Australia; also along the Cudgeon river, 160 miles northwest of Sydney, and in other districts. The colors are white, straw, yellow, light brown, pale green, and black. The largest stones yet found were cut into gems weighing 3½ and 3 carats, respectively. A trial made by the Australian Diamond Mining Company produced 190 diamonds, weighing 197¾ carats, from the washing of 279 loads of earth. These Australian fields can scarcely be called productive as yet, nor from present appearances do they seem likely to become formidable competitors of the South African fields.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

two remarkable carved jadeites, offered some exceedingly interesting suggestions. The Humboldt celt was presented to Humboldt by Del Rio in 1803, and the Leyden plate was given to that museum by A. S. Von Bramm, who found it near St. Felipe, close to the borders of Guatemala, in Honduras. They are both 9 inches in length and 3¼ inches wide; the former 1⅞ inches in thickness, and the latter only one-fifth inch. This similarity of dimensions suggests to me that the two objects were originally part of one and the same celt. Before the same society, in April, 1886, Professor Putnam exhibited his remarkable series of Nicaragua and Costa Rica jadeites, which were all ornaments made by cutting into halves, thirds, or quarters one large celt perforated by one or two drilled holes, in one instance two of them fitting together. The 16-pound adze exhibited by myself at the American Association for the Advancement of Science meeting of 1887, from which fully two pounds had been cut; the breastplate recently found measuring only one-half inch thickness; and the fact that even Burmese jadeite, when burned or exposed to a high temperature, will assume the grayish-green color of the Mexican, all tend to support Professor Fisher's theory that this jadeite originally came from there. Additional evidence is the striking resemblance between the Maya and ancient Burmese styles of carving, although Dr. Meyer, of Dresden, firmly believes that this material will yet be found *in situ* in Mexico. The imperial jade quarries of Burmah, in the Mogung district, 90 miles from Bhamo are leased by two companies, who pay a royalty of $30,000 annually. The trade is entirely in the hands of the Chinese. At the Colonial Exhibition in London in 1886 there were exhibited large rounded and waterworn blocks of jade weighing hundreds of pounds called panaum by the Maories. Much of it is of the finest green color and was worked into charms, knife-handles, etc. Dr. W. Buller exhibited a fine collection of Maori ornaments and clubs, or neeris, heitikas, and other native ornaments made of this stone.

Collections of gems.—A regrettable dispersion of jewels and precious stones took place in May, 1886, when the famous collection formed by the late Henry Philip Hope, and exhibited at the South Kensington Museum for many years, was sold at auction. The Hope collection included the "Saphir Merveilleux" of Madame de Genlis's "Tales of the Castle;" the King of Kandy's cat's-eye, the largest known, having a diameter of 1½ inches; the Mexican Sun opal, carved with the head of the Mexican Sun God, and known since the sixteenth century; an enormous pearl, the largest known, weighing 3 ounces and measuring 2 inches in length; the aqua-marine sword-hilt, made for Murat, King of Naples; and also many curious diamonds, sapphires, emeralds, and several hundred unique and magnificent gems. Such a collection should have been preserved intact as a national possession.

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

should be sold at public auction. These exceptions were made because it was feared that they would fall into the hands of Americans. The sale of this great historic collection took place in May, 1887. The forty-eight parcels were subdivided into one hundred and forty-six lots, and there were sixty-eight buyers; the sales to twelve of them brought over 100,000 francs each. The largest lot, the great corsage, which sold for 811,000 francs, was purchased by a single American firm, the largest buyer at the sale. The purchases of this firm amounted to 2,249,600 francs, or about 34 per cent. of the entire sum realized; while as to quality the same firm obtained more than two-thirds of the finest gems, among them were three Mazarins; a pear-shaped rose brilliant weighing $24\frac{3}{32}$ carats, for 128,000 francs; a pear-shaped white brilliant weighing $22\frac{1}{4}$ carats, for 81,000 francs; a white brilliant weighing $28\frac{7}{16}$ carats, for 155,000 francs; and an oval brilliant weighing $18\frac{1}{32}$ carats, for 71,000 francs; or 435,000 francs for the four. All but one of their purchases were secured by private American customers. The great interest attached to this sale was due not only to the fact that many of the gems were of very fine quality, but also to their historic associations; the history of many of them could be traced back several hundred years.

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

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

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

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

FERTILIZERS.

SOUTH CAROLINA PHOSPHATE ROCK.

The production of phosphate rock increased from 430,549 long tons in 1886 to 480,558 long tons in 1887—a gain of over 50,000 tons. The total value decreased, however, on account of slightly lower prices. The average price of crude land rock in 1887 was $3.75 per long ton, though some sales were made at $3.50 and $4 during the year. The average price of crude river rock was about $4. There is a difficulty in fixing this average on account of the objections shown by the sellers, together with the small amount of river rock sold in this country, as shown by the report; the sources of inquiry are limited. One large seller said that he sold none in this country in 1887, and therefore could not give any price. There were, however, some small sales made at about $3.50 to $3.75, principally to local buyers. Ground rock, whether land or river, or both, which is frequently the case, commanded about the same price, and the average price was $6.50 per ton of 2,000 pounds.

About the same condition of affairs existed in 1887 as in 1886, and efforts were made by the river miners to obtain special rights from the legislature, but were unsuccessful. The depressed condition of the fertilizer trade may also be added as a factor in the change of prices; the desire on the part of the miners to maintain past business relations with their buyers was productive of strong competition, and lower prices were the natural result. The following statistics have been compiled with great care by Mr. Paul C. Trenholm, of Charleston.

Phosphate rock shipped from and consumed in South Carolina during the calendar year 1887.

Destination.	Crude.	Ground.	Total.
From Charleston.			
Domestic—	*Long tons.*	*Long tons.*	*Long tons.*
Baltimore	60,830	.....	60,830
Philadelphia	20,434	.....	20,434
New Town Creek, New Jersey	6,431	.....	6,431
Weymouth, Massachusetts	14,635	.....	14,635
Wilmington, North Carolina	6,204	.....	6,204
Boston *a*	377	.....	377
Richmond, Virginia	3,577	.....	3,577
Barren Island, New York	9,475	.....	9,475
Seaford, Delaware	1,012	.....	1,012
New York	3,268	6,219	9,487
Mantua Creek, New Jersey	2,090	.....	2,090
Wilmington, Delaware	8,169	.....	8,169
Clark's Cove, Massachusetts	600	.....	600

a In part for reshipment to Weymouth.

to, must unquestionably, not only cause a revolution in the existing business in this commodity, but, owing to the great abundance in which the material is found and the trifling price at which it can be put free on board in vessels of any size, are destined to capture the entire trade, hitherto monopolized by Germany. These lakes also afford almost unlimited water power for any purpose to which it can be made available for the mechanical manipulation and manufacture of their product. These earths are so abundant, and the facilities for getting, manufacturing, and shipping are so great, that in conjunction with their peculiarly valuable properties they will no doubt be obtained so cheaply as to enable all kinds of fire-resisting articles—enamel bricks, terra-cotta, fancy tiles and quarries, and glazed ware goods—to be manufactured on the spot at a highly remunerative rate.

Publ. in 1889

PRECIOUS STONES.

By George F. Kunz. for 1888

No systematic mining for precious stones was carried on during 1888, although two small crystals of emerald, valued at about $100, were found at the mines at Stony Point, Alexander county, North Carolina.

Diamonds.—Considerable excitement prevailed during the spring at Morris Station, 13 miles south of Atlanta, Georgia, where the diamond described on page 558 of Mineral Resources for 1887 was found; and much was said at the time as to the resemblance of this locality to that of other diamond-producing districts; but no further discoveries have been reported, although there was every reason to believe, from the statement of the local newspapers, that extensive working would be carried on. During the summer of 1888 a small elongated hexoctahedral crystal of diamond, weighing seven-sixteenths of a carat, was reported to have been found by Mr. C. O. Helm on the farm of Mr. Henry Burris, about 300 yards from the Cabin Fort creek, Russell county, near Adair county, Kentucky. While walking through an old field Mr. Helm observed a small, bright stone in the gravel. On investigation it proved to be a diamond, octahedral in form, with curved faces, lustrous, but slightly off color. The rock in the vicinity is said to be composed of granite dikes, slates and quartz, feldspar, magnetic iron ore, flint, garnets, etc., scattered through hills of clay.

Beryl, phenacite, and topaz.—During the summer of 1888 prospecting was carried on near the top of Mount Antero, Colorado, at an altitude of from 12,000 to 14,000 feet above the level of the sea, and several pockets of crystals of blue beryl and phenacite were found. The blue beryls resembled those from Mourne mountain, Ireland, except that they were very curiously etched and partly eaten out. From the crystals, perhaps a hundred in number, material was obtained which furnished cut gems weighing from 1 to 12 carats. They were of good blue color, although often containing the characteristic beryl striations. The crystals and gems together brought about $600 or $700. The phenacites were found implanted on quartz and beryl, and crystals valued at more than $500 were obtained, although none of them were suitable for cutting. On January 12, 1888, near Little Robinet's store and Little River church, in the vicinity of Russell Gap road, Alexander county, North Carolina, a farmer, while plowing, found a crystal of dark, sea-green beryl, weighing 28 ounces, parts of which would furnish gems weighing from 1 to 20 carats each. This beryl resembles that variety

found at the Stony Point emerald mine, 10 miles distant, and at the Miller farm, 12 miles distant, and also that found in Alexander county. This stone would furnish larger gems than any previously found in North Carolina. During May, 1887, Mr. E. D. Andrews discovered a deposit of crystals of topaz and phenacite on Bald mountain, North Chatham, New Hampshire. The crystals were transparent, light blue, and sherry colored, the larger specimens measuring over 2 inches in length. None of the phenacites were more than half an inch in diameter and all were very primitive in habit. The find was worth about $700.

Garnet.—During the past year considerable attention has been paid to the gathering of the blood-red garnets, the so-called "Arizona and New Mexico rubies." The Navajo Indians have collected and sent from their reservation several hundred pounds of these, among which were some fine gems. Three splendid ones were valued at $75, $50, and $35, respectively. Some of these garnets are believed to have been pounded from what is evidently a peridotite rock. This theory requires verification, as no Government survey has been made of the locality. Of the variety of spessartite garnet found in the Allen mica mines at Amelia Court House, Virginia, mentioned in Mineral Resources for 1887, page 459, a number of irregular masses with a crystalline exterior were obtained, which on cutting furnished fine gems very similar in color and luster to the essonite or hyacinth of Ceylon. The cut stones varied from 1 to 100 carats in weight.

Epidote.—Specimens of epidote in brilliant crystals, 1 inch in length and one-half inch in diameter, apparently dark or black, but perfectly transparent, showing a deep grass green and brownish yellow when viewed in different directions, have been found by Rev. C. D. Smith, 1 mile from Rabun Gap, Rabun county, Georgia. They occur in single simple crystals and twins, identical in habit with those from Unter Sultzbachthal, Tyrol. They were found in veins of pink granite rock on the south slope of the Blue Ridge mountains. The locality promises to afford crystals as fine as the famous Tyrolese gems, although the size may be smaller.

Agatized wood.—Large quantities of the agatized and jasperized wood from Arizona, for which the name "shinarump" (the name used by the Indians) has been suggested as appropriate by Maj. J. W. Powell, have been taken from the locality, and have been cut into sections and polished for table tops, tiles, and for other ornamental purposes. Some of these have been prepared for exhibition at the Paris exposition. One monster stump, weighing $2\frac{1}{10}$ tons, was sent to New York City, and when polished had a surface of $40\frac{1}{2}$ by 36 inches—as large a polished surface of so hard a substance as is known.

Fire opal.—A specimen of fire opal, $1\frac{1}{2}$ by 1 by $\frac{1}{2}$ inch, evidently a water-worn fragment, was found near John Davis river, in Crook county, Oregon. It is transparent, grayish white in color, with red, green, and yellow flames. The play of colors equals in beauty that of any Mexican material, and it is the first opal found in the United States

that exhibits color. Undoubtedly better material exists in the locality where this was found.

Dumortierite.—About the same time that Messrs. Riggs and Diller found that the blue mineral supposed to be indicolite was identical with dumortierite in Harlem, New York, masses of quartz were discovered in Yuma county, Arizona, heavily impregnated with dumortierite and of an indigo-blue color, and which when polished resembled the blue lapis lazuli, and would serve the same purpose in jewelry, as the quartz is harder than lapis lazuli.

Tourmaline.—Among some very interesting minerals found by Messrs. C. E. Beecher and S. A. Robinson, at Newcomb, Essex county, New York, were some remarkable specimens of brown tourmaline. The crystals, although not so fine as those from Gouverneur, New York, were frequently sufficiently transparent to offer material for at least one hundred gems, weighing from 1 to 10 carats. They varied from golden brown to topaz-yellow in color.

Rhodonite.—This mineral, which has been known to occur in bowlders near Cummington, Massachusetts, has been traced to the ledge. Fine masses, weighing several hundred pounds, have been blasted out, and efforts will be made during the coming year to introduce this as an ornamental stone, it being as beautiful as the Siberian variety, which is so extensively used for table tops, mantel pieces, paper weights, etc., in Russia.

Turquois.—Considerable mining of a desultory character has been carried on at the turquois mines near Cerrillos, New Mexico, by the Indians and hunters, who obtained the turquois in a primitive manner by building fires against the wall rock and then cracking off large masses by throwing water on it. This method, however, invariably destroys the color. Some of the material sent from this locality during the past year was in form of thin veins entirely free from rock. In color it was almost equal to the poorer Persian material, and should find a ready use as an ornamental or decorative stone. The recent releasing of the property is likely to prevent the existing method of working the locality. A new deposit of turquois was opened during the year in the Holy Cross mining district, 30 miles from Leadville, Colorado, which is very similar to the variety from Arizona and New Mexico, the color being, if anything, a better blue. At this locality there was no evidence of prehistoric mining. Until recently the impression in the vicinity was that the turquois was an ore of copper.

Gadolinite.—This stone admits of a high polish, and is of a deep velvet-black color. During the last year large quantities of it were obtained near Bluffton, in Llano county, Texas, 22 miles from Burnet. The occurrence of this gadolinite was somewhat similar to that of allanite in Amherst county, Virginia. It has more than ordinary interest from the fact that it contains from 40 to 50 per cent. of yttria. About 1,000 pounds were found in a single pocket, associated with xenotime, fergusonite, and euxenite. One crystal weighed 11 pounds, another 13 pounds, and a single group weighing 40 pounds was obtained. The pro-

ductions of this locality exceeded in quality and size anything yet obtained.

Fluorite.—About four years ago a small vein of fluorite was discovered in the Archaean limestones in the town of Macomb, Saint Lawrence county, New York. It was worked irregularly from time to time until last summer, when the vein suddenly widened, breaking through into an opening or cavity 22 feet in length and varying in width from 8 to 18 feet. The top, bottom, and sides were lined with a magnificent sheet of crystals, varying from 1 to 6 inches in diameter, and each in turn forming part of larger composite crystals. Between the floor and the walls was a layer of partly-decomposed calcite, which was readily removed, so that groups of crystals weighing from 10 to several hundred pounds each, and one of them measuring 2 by 3 feet, were easily detached. The cavity contained at least 15 tons of fluorite. The habit of the crystals is, in nearly every instance, that of the simple cube, but slightly-developed faces of the octahedron are often present. Almost all the crystals have on the surface a small, botryoidal elevation, an even coating of brown hydrodolomite, which is readily removed with diluted hydrochloric acid. The crystals are well colored, but the surfaces are dull. The fluorite is of a uniform light sea-green color, except where it is attached to the gangue, or at the junction of the crystals. Here there are small spots of a rich emerald-green from 1 to 2 inches in diameter. This find is strikingly like that of the famous Muscallonge lake localities of forty years ago, except that the crystals are of a finer color and occur in larger groups. The occurrence of a second deposit in this county leads the hope that fluorite may exist here in commercial quantity available for the arts.

Amber.—For the last fifteen or twenty years travelers have occasionally brought specimens of a remarkable amber from some locality in southern Mexico. The information that has been gained concerning it is brought to the coast by natives, who say that it occurs in the interior so plentifully as to be used by them for making fires. The color of this amber is a rich golden yellow, and when viewed in different positions it exhibits a remarkable fluorescence, similar to that of uranine when dissolved in water, which it also resembles in color. A specimen now in the possession of Mr. M. T. Lynde, of Brooklyn, New York, measures 4 by 3 by 2 inches, is perfectly transparent, and is even more beautiful than the famous so-called opalescent or green amber found in Catania, Sicily. This material would be extremely valuable for use in the arts. It is believed that an expedition has started for the locality in the interior where it is found.

New developments in foreign localities.—The Burmese ruby mines were leased to a powerful London syndicate in November, and machinery was immediately sent to Mandelay, Burmah, for the purpose of prospecting and working the mines. From all appearances active explorations will take place during 1889, and within a short time it will be definitely known whether or not these mines are exhausted.

Estimated production of precious stones

Species.	1884.			1885.		
	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
Diamond	.....	$800	$800	.....	.....	.....
Sapphire gems	$250	1,500	1,750	.....	$500	$500
Chrysoberyl	25	.....	25	.....	.....	.....
Topaz	200	300	500	$1,000	250	1,250
Beryl	300	400	700	250	500	750
Phenacite	.....	.....	.....	.....	.....	.....
Emerald	.....	.....	.....	3,000	200	3,200
Hiddenite	.....	.....	.....	500	2,000	2,500
Tourmaline	1,500	500	2,000	500	100	600
Smoky quartz	2,000	10,000	12,000	2,000	5,000	7,000
Quartz	10,000	1,500	11,500	10,000	1,500	11,500
Silicified wood	10,000	500	10,500	5,000	1,500	6,500
Garnet	1,000	3,000	4,000	200	2,500	2,700
Anthracite	.....	2,500	2,500	.....	2,500	2,500
Pyrite	2,000	1,000	3,000	1,500	500	2,000
Amazonstone	2,500	250	2,750	2,500	250	2,750
Catlinite (pipestone)	10,000	.....	10,000	10,000	.....	10,000
Arrow points	1,000	.....	1,000	.....	2,500	2,500
Trilobites	500	.....	500	.....	1,000	1,000
Sagenitic rutile	500	500	1,000	.....	250	250
Hornblende in quartz	500	100	600	.....	300	300
Thompsonite	250	500	750	250	500	750
Diopside	.....	.....	.....	100	.....	100
Agate	4,000	500	4,500	1,000	1,000	2,000
Chlorastrolite	500	1,000	1,500	.....	.....	.....
Turquois	1,500	500	2,000	1,500	2,000	3,500
Moss agate	1,000	2,000	3,000	500	2,000	2,500
Amethyst	2,000	250	2,250	2,000	100	2,100
Jasper	2,000	500	2,500	.....	.....	.....
Sunstone	250	200	450	250	100	350
Fossil coral	500	250	750	.....	.....	.....
Rutile	.....	.....	.....	750	.....	750
Total	54,275	28,550	82,825	39,300	30,550	69,850
Gold quartz	40,000	100,000	140,000	40,000	100,000	140,000

in the United States from 1884 *to* 1888.

1886.			1887.			1888.		
Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
.....	$60	$60	.....	.....	.....	.....	.....	.....
$250	500	750	.....	$500	$500	.....	$500	$500
.....	.....	.....	.....	.....	.....	.....	.....	.....
1,000	.....	1,000	$1,500	500	2,000	$500	100	600
.....	5,500	5,500	500	3,000	3,500	300	500	800
.....	.....	.....	.....	.....	.....	650	.....	650
3,000	200	3,200	.....	.....	.....	100	.....	100
3,500	1,000	4,500	.....	.....	.....	.....	.....	.....
3,500	2,000	5,500	300	200	500	.....	.....	.....
2,000	5,000	7,000	1,500	3,000	4,500	1,000	3,000	4,000
10,000	1,500	11,500	10,000	1,500	11,500	10,000	1,150	11,150
500	1,000	1,500	35,000	1,000	36,000	1,000	15,000	16,000
1,250	2,000	3,250	2,500	1,000	3,500	2,000	1,500	3,500
.....	2,500	2,500	2,000	.....	2,000	1,500	.....	1,500
1,500	500	2,000	2,000	500	2,500	2,000	500	2,500
2,000	250	2,250	1,500	200	1,700	1,500	200	1,700
10,000	.....	10,000	5,000	.....	5,000	5,000	.....	5,000
.....	2,500	2,500	.....	1,500	1,500	1,500	.....	1,500
1,000	.....	1,000	500	.....	500	500	.....	500
1,750	.....	1,750	.....	.....	.....	.....	.....	.....
200	.....	200	.....	100	100	.....	.....	.....
100	300	400	250	500	750	300	200	500
.....	.....	.....	50	.....	50	.....	.....	.....
1,000	1,000	2,000	3,000	1,000	4,000	3,000	1,000	4,000
500	500	1,000	300	500	800	300	500	800
1,000	2,000	3,000	1,000	1,500	2,500	1,500	1,500	3,000
1,000	1,000	2,000	200	750	950	200	750	950
2,000	100	2,100	2,000	100	2,100	2,200	300	2,500
.....	.....	.....	.....	.....	.....	100	.....	100
200	100	300	50	100	150	.....	.....	.....
1,000	.....	1,000	1,500	500	2,000	2,500	500	3,000
750	.....	750	.....	.....	.....	.....	.....	.....
49,000	29,510	78,510	70,650	17,950	88,600	37,650	27,200	64,850
.....	.....	40,000	.....	.....	75,000	.....	.....	75,000

FERTILIZERS.

SOUTH CAROLINA PHOSPHATE ROCK.

While the vicinity of Charleston and Beaufort has been the steady source for practically all the phosphate used in commercial fertilizers for years, and while the amount of the product has increased annually with only moderate fluctuations, the industry, taken as a whole, has been exceptionally subject to such periods of alternating depression and prosperity as to make it more irregular than many others which are affected by the competition of diverse sources of production. This is in part due to the natural conditions of mining. The deposits are worked by open cuts and only to a moderate depth, making the total cost of production small and inviting the competition of many producers within a small area. Further, the price to be obtained after the phosphate rock is mined and converted into fertilizers depends largely upon the yield of the season's crops, and the consequent purchasing ability of farmers who work without reserves. This last condition and less competition, or rather direct combination among the miners of land rock, resulted favorably during 1888, and a prosperous year was the result. Mr. Paul C. Trenholm has collected the statistics of the phosphate rock produced. It amounted to 448,567 long tons in 1888, against 480,558 long tons in 1887; but the total value of the product in 1888 was $2,018,552, against $1,836,818 in 1887. The average price of land phosphate rock in 1888 was $4.75, and for river rock $4.25, a general gain of about 50 cents per ton over 1887. The distribution of this and previous years is given in the table to follow. The area of the land near Charleston underlaid by phosphate rock at a reasonable depth for mining is tolerably well known. In this area a new opening was made by the Horseshoe Mining Company on the line of the Charleston and Savannah railroad and by Mr. E. J. Hanrahan on Cooper river. The former is quite a large tract. The price of phosphate land has, in general, risen remarkably during the past year. Some land has been sold as high as $250 per acre, and much land favorably located could not be bought for that price. This advance is entirely out of proportion to the increase in phosphate rock, and is the result of efforts to put the known reserve in fewer hands. Further, English capital was freely offered for the purchase of land and mining plants, and it is probable that the active speculation in rock still under ground will be a more important factor in future prices than scarcity of labor, which is com-

Publ. in 1891

PRECIOUS STONES. for

By George F. Kunz. 1889-1890

During 1890 work was carried on at the tourmaline locality at Mount Mica, Paris, Maine. The work was more or less successful and over $2,000 worth of fine gems were obtained. For the first time in the history of America, turquois of fine color, in many respects equal to the Persian, was mined at the Castilian mine between Los Cerrillos and Santa Fé, New Mexico, of which over $10,000 worth was sold in 1890. These stones are well received by the gem trade, as the Persian mines have proved less and less prolific for many years past. Turquois has also been discovered in the Burro mountains, Grant county, New Mexico, and Saguache county, Colorado. Of especial interest among newer discoveries was the finding of a few crystals of diamond on Plum Creek, Pierce county, Wisconsin, where they were found in searching for gold under conditions almost identical with the finding of diamonds in North Carolina. The option was obtained on a tract of 4,000 acres on the Missouri River near Helena, Montana, for the purpose of mining sapphires. A preliminary examination made at the sapphire locality in Montana reveals the fact that sapphires exist in large quantities in the gold glacial gravels that lie immediately on the bed rock, a green slate. From present appearances extensive workings will be carried on for these fancy-colored stones, which are not true ruby red nor true sapphire blue. The success of the enterprise depends very much upon how many of these peculiar-colored gems the markets of the world will absorb.

As in former years, large quantities of garnets have been found in the vicinity of Gallup and Fort Wingate, New Mexico, and Fort Defiance, Arizona, whereas the search that is still being carried on at Ison's Mills, Elliott county, Kentucky, with the hope of finding diamonds there, has brought to light the fact that immense quantities of ruby red garnets—pyrope—exist in that vicinity.

With the exception of a single pebble of fire opal described in a former report, no true gem opal had been found in the United States. During 1890, however, near Whelan, southwest of Colfax, Washington, almost on the Idaho and Washington line, a brilliant fire and noble opal has been found filling the cavities of amygdaloidal basaltic rock, the cavities of which vary in size from that of a pea to a large walnut. Some of these opals have sold for almost the price of fine noble opals from Hungary.

Estimated production of precious stones

Species.	1884.			1885.		
	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
Diamond	.....	$800	$800	.....	.....	.....
Sapphire gems	$250	1,500	1,750	.....	$500	$500
Chrysoberyl	25	.....	25	.....	.....	.....
Topaz	200	300	500	$1,000	250	1,250
Beryl	300	400	700	250	500	750
Phenacite	.....	.....	.....	.....	.....	.....
Emerald	.....	.....	.....	3,000	200	3,200
Hiddenite	.....	.....	.....	500	2,000	2,500
Tourmaline	1,500	500	2,000	500	100	600
Smoky quartz	2,000	10,000	12,000	2,000	5,000	7,000
Quartz	10,000	1,500	11,500	10,000	1,500	11,500
Silicified wood	10,000	500	10,500	5,000	1,500	6,500
Garnet	1,000	3,000	4,000	200	2,500	2,700
Anthracite	.....	2,500	2,500	.....	2,500	2,500
Pyrite	2,000	1,000	3,000	1,500	500	2,000
Amazonstone	2,500	250	2,750	2,500	250	2,750
Catlinite (pipestone)	10,000	.....	10,000	10,000	.....	10,000
Arrow points	1,000	.....	1,000	.....	2,500	2,500
Trilobites	500	.....	500	.....	1,000	1,000
Sagenitic rutile	500	500	1,000	.....	250	250
Hornblende in quartz	500	100	600	.....	300	300
Thomsonite	250	500	750	250	500	750
Diopside	.....	.....	.....	100	.....	100
Agate	4,000	500	4,500	1,000	1,000	2,000
Chlorastrolite	500	1,000	1,500	.....	.....	.....
Turquoise	1,500	500	2,000	1,500	2,000	3,500
Moss agate	1,000	2,000	3,000	500	2,000	2,500
Amethyst	2,000	250	2,250	2,000	100	2,100
Jasper	2,000	500	2,500	.....	.....	.....
Sunstone	250	200	450	250	100	350
Fossil coral	500	250	750	.....	.....	.....
Rutile	.....	.....	.....	750	.....	750
Total	54,275	28,550	82,825	39,300	30,550	69,850
Gold quartz	40,000	100,000	140,000	40,000	100,000	140,000

in the United States from 1884 to 1888.

1886.			1887.			1888.		
Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.	Value of stones found and sold as specimens and curiosities, occasionally polished to beautify or show structure.	Value of stones found and sold to be cut into gems.	Total.
.....	$60	$60	.....	.....	.....	.....	.....	.....
$250	500	750	.....	$500	$500	.....	$500	$500
1,000	.....	1,000	$1,500	500	2,000	$500	100	600
.....	5,500	5,500	500	3,000	3,500	300	500	800
.....	.....	.....	.....	.....	.....	650	.....	650
3,000	200	3,200	.....	.....	.....	100	.....	100
3,500	1,000	4,500	.....	.....	.....	.....	.....	.....
3,500	2,000	5,500	300	200	500	.....	.....	.....
2,000	5,000	7,000	1,500	3,000	4,500	1,000	3,000	4,000
10,000	1,500	11,500	10,000	1,500	11,500	10,000	1,150	11,150
500	1,000	1,500	35,000	1,000	36,000	1,000	15,000	16,000
1,250	2,000	3,250	2,500	1,000	3,500	2,000	1,500	3,500
.....	2,500	2,500	2,000	.....	2,000	1,500	.....	1,500
1,500	500	2,000	2,000	500	2,500	2,000	500	2,500
2,000	250	2,250	1,500	200	1,700	1,500	200	1,700
10,000	.....	10,000	5,000	.....	5,000	5,000	.....	5,000
.....	2,500	2,500	.....	1,500	1,500	1,500	.....	1,500
1,000	.....	1,000	500	.....	500	500	.....	500
1,750	.....	1,750	.....	.....	.....	.....	.....	.....
200	.....	200	.....	100	100	.....	.....	.....
100	300	400	250	500	750	300	200	500
.....	.....	.....	50	.....	50	.....	.....	.....
1,000	1,000	2,000	3,000	1,000	4,000	3,000	1,000	4,000
500	500	1,000	300	500	800	300	500	800
1,000	2,000	3,000	1,000	1,500	2,500	1,500	1,500	3,000
1,000	1,000	2,000	200	750	950	200	750	950
2,000	100	2,100	2,000	100	2,100	2,200	300	2,500
.....	.....	.....	.....	.....	.....	100	.....	100
200	100	300	50	100	150	.....	.....	.....
1,000	.....	1,000	1,500	500	2,000	2,500	500	3,000
750	.....	750	.....	.....	.....	.....	.....	.....
49,000	29,510	78,510	70,650	17,950	88,600	37,650	27,200	64,850
.....	.....	40,000	.....	.....	75,000	.....	.....	75,000

Production of precious stones, ornamental minerals, etc., in 1889 and 1890.

Names of gems or precious stones.	Value of stones before cutting.	Value of stones after cutting into gems for ornamental purposes.	Value of stones sold as specimens and curiosities, occasionally polished to beautify or show the structure.	Total value.
1889.				
Sapphire	$2,600	$6,725	.....	$6,725
Emerald	.....	300	$150	450
Aquamarine	225	597	150	747
Phenacite	.....	.....	200	200
Topaz	100	200	200	400
Turquoise	10,000	23,175	500	23,675
Tourmaline	1,030	2,250	.....	2,250
Garnet	510	1,633	675	2,308
Quartz	510	2,750	11,250	14,000
Amethyst	15	98	.....	98
Rose quartz	200	400	200	600
Smoky quartz	700	4,007	225	4,232
Gold quartz	6,000	9,000	.....	9,000
Rutilated quartz	2	30	.....	30
Dumortierite in quartz	.....	.....	250	250
Quartz coated with chalcedony	1,000	2,000	2,000	4,000
Chrysoprase	50	200	.....	200
Agatized and jasperized wood	42,725	53,000	175	53,175
Banded and moss jasper	.....	80	550	630
Amazon stone	.....	.....	500	500
Pyrite	100	500	1,500	2,000
Chlorastrolite	200	300	200	500
Thomsonite	100	200	200	400
Fluorite	.....	.....	500	500
Fossil coral	100	200	500	700
Azurite and malachite	1,000	.....	2,037	2,037
Catlinite (pipestone)	.....	.....	5,000	5,000
Zircon (*a*)	.....	.....	16,000	16,000
Gadolinite, fergusonite, etc. (*a*)	.....	.....	1,500	1,500
Monazite (*a*)	.....	.....	1,000	1,000
Spodumene (*a*)	.....	.....	200	200
Wooden ornaments decorated with minerals (*b*)	.....	.....	15,500	15,500
Miscellaneous minerals (*c*)	.....	.....	20,000	20,000
Total	.....	107,645	81,162	188,807

Names of gems or precious stones.	Value of stones before cutting.	Value of stones after cutting into gems for ornamental purposes.	Value of stones sold as specimens and curiosities, occasionally polished to beautify or show the structure.	Total value.
1890.				
Sapphire	$2,600	$6,725	.....	$6,725
Emerald	.....	.....	.....	.....
Aquamarine	.....	.....	.....	.....
Phenacite	.....	.....	.....	.....
Topaz	.....	.....	.....	.....
Turquoise	10,000	28,175	$500	28,675
Tourmaline	1,030	2,250	.....	2,250
Garnet	510	1,633	675	2,308
Quartz	510	2,750	11,250	14,000
Amethyst	.....	.....	.....	.....
Rose quartz	.....	.....	200	200
Smoky quartz	700	2,000	225	2,225
Gold quartz	6,000	9,000	.....	9,000
Rutilated quartz	.....	.....	.....	.....
Dumortierite in quartz	.....	.....	250	250
Quartz coated with chalcedony	.....	.....	2,000	2,000
Chrysoprase	.....	.....	200	200
Agatized and jasperized wood	1,000	5,000	1,000	6,000
Banded and moss jasper	.....	.....	.....	.....
Amazon stone	.....	.....	500	500
Pyrite	100	500	1,500	2,000
Chlorastrolite	100	200	200	400
Thomsonite	100	200	200	400
Fluorite	.....	.....	500	500
Fossil coral	100	200	500	700
Azurite and malachite	.....	.....	.....	.....
Catlinite (pipestone)	.....	.....	5,000	5,000
Wooden ornaments decorated with minerals (*b*)	.....	.....	15,500	15,500
Miscellaneous minerals (*c*)	.....	.....	20,000	20,000
Total	.....	58,633	60,200	118,833

a Used to extract the rarer elements for chemical purposes.
b Such as clocks, horseshoes, boxes, etc.
c For cabinets, museums, etc.

Publ. in 1892

PRECIOUS STONES. for 1891

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	.....	a1,000
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

The crystals of crushed steel and steel emery present sharp cutting edges, having about the same angles as quartz when crushed. They are exceedingly hard and are more effective under the saw blades and on the rubbing bed than sand. The effectiveness of crushed steel and steel emery is due to the fact that the crystals do not wear away and become smooth. A grain of crushed steel under the microscope presents a series of crystals, and if sufficient force be applied they are detached, but maintain their crystalline form and abrasive qualities. For this reason the material can be used a great number of times, and in order to effect the greatest economy in its use, the manufacturers of crushed steel have also invented automatic attachments for saw gangs and rubbing beds by which the steel once used is saved and returned. The efficacy of these products—crushed steel, steel emery, and the putty powder and rouge—has been attested by stone workers and manufacturers of lenses.

PRECIOUS STONES.

By George F. Kunz. 1892

This paper is founded on and is a résumé of the nine papers on the precious stones of the United States written since 1882 for the annual reports of the Division of Mining Statistics and Technology of the U. S. Geological Survey, on a report for the Eleventh United States Census, and the following is a condensation of these, together with additional information obtained from studying the collections in the United States and from personal examination of many of the localities where gems are found, and some notes on the gems and precious stones shown at the World's Columbian Exposition. The reader should also consult "Gems and Precious Stones of North America."(*a*)

Systematic mining for gems.—Although nearly all the known varieties of precious stones are found in the United States, there has been very little systematic exploration for them until very recently, as the indications seldom justified the investment of much capital in such search. Whereas mining for precious stones was only carried on in two States in 1889, the following gems were mined in 1893: Tourmaline in Maine, emeralds in North Carolina, turquois in New Mexico, sapphires in Montana, and opal in Washington state, Idaho, and Oregon. Otherwise the gems are found accidentally in connection with other substances that are being mined. They are often gathered on the surface, as is the case with garnet and olivine in Arizona and New Mexico; or in sluicing for gold, as with the sapphires from Montana; or in connection with mica mining, as the beryl from Connecticut and North Carolina; or from the beds of streams and decomposing rocks, as the moss agate from Wyoming; or on the beaches, as the agate, chlorastrolite, and thomsonite from the shores of Lake Superior.

Nearly all of the gems found in these various ways are sent to the large cities in small parcels or are sold in the neighborhood to tourists, or sent to other places to be disposed of as having been found where they are sold.

DIAMONDS.

The occurrence of diamonds in the United States is chiefly confined to two regions, geographically quite remote. The first is a belt of country lying along the eastern base of the southern Alleghenies, from Virginia to Georgia, while the other extends along the western base of the Sierra Nevada and Cascade ranges in northern California and

a New York: 1892. 8vo, 363 pp., 24 pl. Scientific Pub. Co.

southern Oregon. More recently (1891) they have been found in Wisconsin. In all three regions alike, the diamonds are found in loose deposits of gravel and earth, associated with garnets, zircons, iron sands, monazite, anatase, and particularly with gold, in the search for which they have usually been discovered. These loose deposits are merely the débris of the crystalline rocks of the adjacent mountains, and therefore present a general similarity, although the ages of the rocks themselves are widely different. The rocks of the Blue Ridge and eastern Alleghenies are of ancient Archean and Cambrian ages, while in the western belt the Sierra Nevada rocks were not elevated and metamorphosed until the middle or later Mesozoic. From this general resemblance of conditions the details of discovery in the two regions are very similar, and in both occasional diamond crystals are found, accidentally picked up on the surface, or more frequently encountered in the search for gold, sometimes in placer mining and sometimes in the flumes and sluices of hydraulic workings.

There have been various reports of the finding of diamonds in other parts of the country, but little or no positive evidence. A supposed diamond field in central Kentucky has been the subject of much study and discussion on account of the resemblance of the rock to that of the diamond-bearing region of South Africa; but upon closer examination important differences are recognized, and the diamonds are yet to be discovered. The formations in the eastern portions of the United States where diamonds have really been found are entirely different from those of South Africa, and are more like those of the diamond fields of Brazil and of parts of India. The diamonds found in the United States are evidently from much older rocks than those of South Africa, and if they have ever occurred in rock similar to that in Kimberly there is nothing to indicate it now, since the rocks in American diamond-bearing localities are mainly granitic.

North Carolina, so rich and varied in mineral resources, has long been known to yield some gold; and a few diamonds have been found in the same region, either loose in the soil or taken from the washings of auriferous gravel. The portion of the State is that known as the Piedmont region, a belt of country lying, as its name indicates, at the foot of the mountains, along the eastern base of the Blue Ridge. The rocks here are metamorphic and crystalline, with some Cambrian beds a little farther west.

Quite a number of small diamonds have been obtained since 1860 from the various points in this region, and they probably occur sparingly distributed throughout the auriferous belt of the Carolinas and northern Georgia. In the rude and hurried methods of gold-washing employed, they may often have been overlooked in the past, and now lie buried in the piles of sand that stretch for miles along the water courses.

On passing into Georgia the same metamorphic belt, with its localities for gold, itacolumite, and to some extent diamonds, extends across

the State to the Alabama line. In several of the counties lying along this belt diamonds are said to have been found; and it is quite possible that, as in North Carolina, they may occur occasionally in the entire line of country adjacent to the crystalline rocks.

Many notices have from time to time appeared, both in local newspapers and in scientific journals, of the occurrence of diamonds in California. They seem in all cases to have been imbedded in the auriferous gravels and thence washed out in the search for gold. These gold-bearing gravels are of two classes: first, loose material in the valleys and bars of modern streams, and, second, great accumulations, now covered with masses of lava and compact tufa, which occupy the valleys of more ancient streams, trenching the sides of the Sierra Nevada and running down into the valley of California, which lies between the Sierras on the east and the Coast Range on the west. Between these lava streams, which run out as spurs from the Sierras and from the divides between the modern streams, the latter have formed their own gravel deposits, partly from the wear of the old accumulations and partly from that of the mountain sides, as at first. The surface diggings and placers of the early prospective days of California were of course in these modern gravels and bars. The older gravels, equally rich, are worked either by the hydraulic process, or when compacted into what are called "cement beds," by stamp mills. It is in these deposits that the diamonds have been found, picked from the sluices and flumes. In the case of the cement beds, only fragments are obtained, as the diamond crystals have been crushed under the stamps. There is much in the mode of their occurrence that recalls at first sight the diamond mines of Brazil and South Africa. In Brazil the matrix is also a gravel, and is frequently cemented into a conglomerate "cascalho" by oxide of iron. The first recognition of diamonds in the State goes back to the early gold-seeking days of 1850, when Mr. Lyman, a clergyman from New England, was shown a crystal about the size of a small pea, with convex faces, and of a straw-colored tint. He saw it for a moment only, yet its general aspect was enough to identify it as a true diamond, and the interesting fact was published.(*a*)

The first diamond from the Cherokee district, Butte county, was obtained in 1853. This has since proved one of the principal localities in the State. In 1854 Melville Attwood called attention, in a newspaper article, to the similarity of the California deposits to the diamantiferous gravel and conglomerate of Brazil, with which he had become familiar by a residence there. He advised that search be made and care exercised, lest diamonds should pass unheeded in the gold washings. Since then diamonds have been reported from a number of points, and at present, according to Mr. Henry S. Hanks, formerly state mineralogist,

a Am. Jour. Sci., II, Vol. 8, p. 294, Sept., 1849.

five counties, Amador, Butte, El Dorado, Nevada, and Trinity are known to have yielded them. Other localities and larger numbers are yet, in his judgment, to be discovered.

A few small diamonds have been found in the placer diggings of Idaho, of about the same quality, and occurring under the same conditions as those in California. Some excitement has occasionally arisen about these Idaho diamonds. In 1864 to 1866 local and mining papers made many references to reported or anticipated discoveries; but nothing of any importance was found. In the winter of 1892–1893 the matter has again attracted some attention, only small quartz crystals and no diamonds were found, the name Diamond Basin having given color to the reported findings. Diamond Basin lies on the Snake river in Owhyhee county, Idaho. The excitement, intense for a time, subsided before the winter was over.

A few years ago reports were started of the finding of diamonds in central Kentucky. Prof. Edward Orton, the State Geologist of Ohio, visited the district and observed certain resemblances to the diamond-bearing region of South Africa. He found dykes of eruptive rock (peridotite) breaking through fissures in shale, and spreading to some extent over the adjacent country. Garnets and other associated minerals derived from the decomposition of the peridotite were found, suggesting the possibility of a diamond yield from the similarity of the conditions to those of Africa. And the diamonds found at Dlaschkowitz, Bohemia, the writer attributes to similar conditions of occurrence.(*a*)

Similar investigations and results were reported by Prof. A. R. Crandall.(*b*)

It had been previously suggested by Messrs. E. J. Dunn, E. Cohen, H. Huddleston, and Rupert Jones, that the South African diamonds were formed in a sort of volcanic mud (Mr. Huddleston), by a process rather hydrothermal than igneous, resulting from the action of steam in contact with magnesian mud, under pressure upon carbonaceous shales.

In the chemical laboratory of the U. S. Geological Survey, Prof. J. Edward Whitfield found 37.52 per cent. of carbon in the shale from near the Kimberly mine, while in the blackest shale adjoining the peridotite of Kentucky he found only 0.68 per cent. of carbon. The peridotite at the time of its intrusion must have been forced up through a number of coal beds and at a greater depth it penetrated the Devonian black shale, which is considerably richer in carbon than the shale now exposed at the surface.

A small diamond field has lately been found in Pierce County, Wisconsin. Here gold occurs in the gravel and sand along Plum Creek and its smaller tributaries; and some sluicing has been done by private parties. During 1887 and 1888 several small diamonds were found in the

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a Trans. Am. Inst. Min. Engineers, 1892, p. 241.

b Note on the peridotite of Elliott county, Kentucky. Am. Jour. Sci., III Vol. 32, p. 121, Aug., 1886.

auriferous sands a little below the level of the stream; the largest is a rounded hexoctahedron of about three-fourths of a carat and could be cut into a brilliant of about three-sixteenths of a carat. The others are quite small.

SAPPHIRE.

Corundum is found in the United States chiefly in the crystalline rock along the Appalachian mountains from Chester, Massachusetts, to northern Georgia, Colorado, and Montana. At Chester, where the deposits have long been worked, the mineral exists mainly as emery; no gems have ever been found. In the metamorphic rocks of the Highlands of New York and northern New Jersey corundum is somewhat abundant. At Vernon, New Jersey, from 1850 on, crystals of sapphire and ruby corundum have been found, but always opaque; so that among many specimens obtained, some of which have been cut, scarcely any has furnished a transparent gem. It is of interest to note that near Mandalay, in Burmah, rubies occur similarly associated with limestone; hence they are generally found detached and separated from their original matrix.

Mr. C. W. Jenks, in 1870, commenced mining at Corundum Hill, Franklin, North Carolina, and obtained about one hundred gems; but although found here in their original matrix, they were so infrequent that it was found unprofitable to mine for them alone. Several sapphires, true blue and violet blue, weighing over one carat each, were discovered, as well as several fine rubies. The work was discontinued for some years owing to the financial crisis of 1873, but has lately been resumed by the Hampden Emery Company, which now own the mines. It is not easy to learn what success they have had, but certainly few or no gems have appeared in the market of late from that locality. Some very interesting specimens from here are shown in the North Carolina exhibit of the World's Columbian Exposition, Mines and Mining building, and a very remarkable 90-pound mass of red and blue banded sapphire from the lands of the Sapphire Valley Company, near Franklin, North Carolina, in the Tiffany gem collection in the northwest gallery of the Mines and Mining building.

The largest crystal of corundum ever found, five times larger than any other known crystal, is one early discovered by Mr. Jenks and described by Prof. C. U. Shepard. It is now in the cabinet of Amherst College, but it was injured by the disastrous fire of 1882, which destroyed many fine specimens of the Shepard collection. In variety of color the North Carolina corundum excels. It was found gray, green, rose, ruby-red, emerald-green, sapphire-blue, dark-blue, violet, brown, yellow, and of all intervening shades, and colorless. Many specimens have been cut and mounted, especially of the blue and red shades, and make good gems, though not of the choicest quality. Several fair rubies of 1 carat each have been found; a blue sapphire, 1 carat in weight, is in the United States National Museum at Washington, and a series of fine red and blue crystals have been deposited there by Dr. S. F.

Lucas, and a series from a recent find in the Tiffany exhibit, northwest gallery, Mines and Mining building, World's Columbian Exposition.

In Montana, sapphires are found at what are known as Eldorado Bar, Emerald Bar, French Bar, Ruby Bar, and for some 6 miles along the Missouri River; also in Missoula county, 70 miles distant. Stubb's Ferry, 12 miles east of Helena, is about the central point of the Missouri river district. Although these bars had been sluiced for gold, no systematic attempt had been made before 1891 to work them for gems. Occasionally sapphires were sent to the large cities, but owing to the cost of cutting them, and the small demand for any other than the true ruby-red or sapphire-blue stones, they received but little recognition.

The greater part of the region above described passed in 1891 into the hands of an English company bearing the name of the Ruby and Sapphire Mining Company, which has since obtained a large number of stones, some of which have been cut and exhibited in London. They embrace a great variety of the lighter shades—red, yellow, blue, and green. The latter color is quite pronounced and rather a blue green than an emerald green. Nearly all the stones, when finely cut, have a certain metallic luster strikingly beautiful and peculiar to the sapphires from this locality. No true red rubies or true blue sapphires have been found. A fine series of these gems was shown by Mr. Spratt in the Montana exhibit of the Mines and Mining building, World's Columbian Exposition, and mounted in jewelry by an American jeweler in the Manufacturers' building.

At all these bars along the upper Missouri the sapphires occur chiefly in a layer of auriferous glacial gravel, a few inches thick, which lies immediately in a slaty bed rock. Associated in the same layer were topaz in small crystals, garnets of a rich, ruby-red color, often mistaken for and called rubies, cyanite in broken crystals, cassiterite (stream tin), and other commoner minerals. The original source of the sapphires found at these bars is indicated in an eruptive dike, found cutting the slaty rock at Ruby Bar, on which rests the glacial gravel. In this eruptive rock there were found crystals of sapphire, pyrope, garnet, and sanidine feldspar. There seems no doubt that all the sapphire along these bars of the Missouri is derived from the breaking down, by glacial action, of a rock similar to this. The outcrop at Ruby Bar can not, however, account for the deposit of sapphires at Eldorado Bar, 6 miles to the north; and it will be necessary to await further discoveries before attempting to determine the exact source of these gems.

Mr. H. Miers finds the rock at Ruby Bar to be a vesicular mica-augite-andesite, containing an abundance of brown mica and porphyritic crystals of augite. 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 speculitic structure originating in the sides of the cavities.

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

During 1892 excavating and mining have been actively pushed on the property of the Ruby and Sapphire Mining Company, under the superintendence of the well-known mining engineer, Mr. E. G. Wood, who, it is said, lays considerable stress on the placer gold that he hopes to find in connection with the sapphires. During 1892 none or few gems from this property have been placed on the American market, although they have been publicly shown in England, and several minor gems have been cut and their product placed on the New York market. Up to this time it is impossible to state whether the gem market of the world will accept these "fancy-colored" stones in quantity when the demand in the past has only been for the standard ruby and sapphire. A number of minor deposits have been found and considerable interest has been shown in the property adjoining that of the larger company. Various lots of gems have been sent to New York, but the sale for the year, including those sold by the Helena (Montana) jewelers, does not exceed perhaps $5,000, the sales generally being to tourists who are passing through or visiting Montana.

In October, 1892, the Montana Gold and Gem Mining Company was incorporated by some of the best known men in Helena. The property owned by the new company, comprising about 2,000 acres, is situated partly on Emerald Bar, about 15 miles from Helena, and partly at the mouth of Prickly Pear creek, covering 2 miles on both sides of the creek. The company proposes to mine for gold as well as for gems.

During the past year sapphires have also been found in Missoula county, 30 miles west of Phillipsburg, on the west fork of Rock creek, and 70 miles from the Missouri River locality. The sapphires obtained here are of yellow, blue, green, and other colors, associated with garnets, pyropes, etc., occurring in a gravel bed which is 4 feet in depth down to the bed rock, and is overlaid by 3 feet of loam. The sapphires are all found in this bed, and appear to be exceedingly plentiful, from ten to twenty being found in every pan of the gravel. The colors are steely blue, green, yellow, and a few pink or reddish stones.

SPINEL.

Spinel fine enough to be cut into gems has but rarely been found in the United States. A few specimens of a smoky blue or velvety green, and of a dark-tinted claret color, weighing about 2 carats each, have been found near Hamburgh, Sussex county, New Jersey. Some half dozen from San Luis Obispo, California, of very good quality and of nearly 2 carats each, were brought to the notice of the writer by Mr. James W. Beath, of Philadelphia, Pennsylvania. A locality believed to lie between Monroe and Southfield, in Orange county, New York, was known to only two collectors, both now deceased. They secretly

worked the place on moonlight nights from 1862 to 1866, and extracted the monster crystals of black spinel peculiar to Orange county. From the sale of these specimens they realized over $6,000, although many fine crystals were ruined in blasting and breaking out. Since the death of these workers the location has been lost.

TURQUOISE.

This mineral is found near Los Cerrillos, Santa Fé county, and in the Burro Mountains, Grant county, New Mexico; in the Turquois mountains, Cochise county, and in Mineral Park, Mohave county, Arizona; near Columbus, Nevada; in Saguache county, Colorado, and Taylor's Ranch, Fresno county, California. The first-named locality is part of a group of conical mountains situated about 22 miles southeast of Santa Fé, New Mexico, and north of the Placer or Gold mountains, from which they are separated by the valley of the Galisteo river. They are composed of yellow and gray quartzite sandstones with porphyritic dykes.

During the past two years turquoise has been actively mined for by two companies, the American Turquoise Company and the Azure Turquoise Company; a few minor attempts by others have been made. The first of the two above-named companies, engaged in mining 6 miles from Los Cerrillos, New Mexico, reopening some of the mines originally worked by the Indians, and have found turquoise equal in color to the finest Persian material. Its stability in retaining color is equally great, not changing within a short time, as does the Egyptian turquoise, which was so extensively placed on the market about the time when the Persian mines were ceasing to yield. In 1891 the writer had started on a trip to Persia, intending to visit the famous mines of turquoise, when the first specimens from this district were sent to him at Berlin with a fixed price on each gem. Word also reached him of the scarcity of the true turquoise in Persia, and he subsequently had opportunity at Nijni Novgorod, of seeing nearly all the yield of the year. He returned to the United States, giving up the projected trip, and purchasing only the finest gems, as nearly all the material shown, although held at high prices, was not up to the standard of the American turquoise. Stones have been found at these new localities weighing up to 60 carats each, one of which was sold for about $4,000; and it is now possible for the first time in the past half century to match a perfect turquoise necklace.

The Azure turquoise mines are in Grant county, New Mexico. The material is of rather a robin's-egg blue; that is, with a faint greenish tinge. This may be due either to a partial change or metamorphism which has taken place while the turquoise was in the rock, or it may be a local peculiarity. The stones are not the sky-blue of the more northern locality, but it is claimed by the owners of the mine that they are not subject to change of color. Turquoise has always been known as an unstable gem. Even the finest Persian stones are liable to change occa-

sionally with scarcely any warning, the alteration probably being due to the turquoise coming in contact with acid exhalations from the skin or with fatty acids or alkalies in soap, although wearers of turquoise are especially warned to remove the rings while washing their hands. Recent observations also indicate that turquoise is liable to injury from perfumes. The sale of turquoise during the year 1891 from these two localities has probably exceeded $100,000, and, for 1892, $175,000, and a greater amount for 1893 is expected, as quantities of this gem from an American market have been sold abroad for the first time. This gem has given the most substantial evidence of gem mining in the United States.

TOPAZ.

The gem topaz has been found in Huntington and Middletown, Connecticut; Stoneham, Maine; North Chatham, New Hampshire; Deseret, Utah; at Nathrop, Chalk mountain, Crystal Park, Florissant, and Devil's Head mountain, Colorado, and at Ruby mountain, Nevada, and crystals have recently been seen by the author from Palestine, Texas. The first discovery of topaz in the United States was at Trumbull, Connecticut, where it was found in a vein associated with chlorophane. Probably the most brilliant and beautiful crystals of North American topaz are those from Thomas mountain, Deseret, Utah, an isolated and arid elevation about 6 miles long. These crystals are larger than those from Nathrop, California, always white, evidently have been decolorized by heat or exposure to sunlight, and equally as brilliant as those from San Luis Potosi, Mexico, which they closely resemble, and exist in quantity great enough to suggest their use as an abrasive.

Many fine large topaz crystals have been found at Crystal Park, near Pike's Peak, El Paso county, Colorado. The crystals from this locality, remarkable for their color and clearness, have been fully described by Messrs. Whitman Cross and William F. Hillebrand under the title of "Minerals from the neighborhood of Pike's Peak, Colorado." (*a*)

At Devil's Head mountain, in the Colorado range, some 30 miles north of Pike's Peak, the topaz is found in isolated and usually loose crystals surrounded by distorted smoky quartz. The principal color is cherry, although wine-yellow, milky-blue, and colorless crystals were found. (*b*)

Since the discovery of these Colorado localities it is estimated fully $6,000 worth of topaz have been sold as crystals and gems, notably a crystal weighing 18½ ounces (587 grams), found at Cheyenne, Colorado, during 1886, and two sherry-colored gems weighing 125 and 193 carats. During 1882 crystals from Herndon Hall, in the vicinity of Stoneham, Maine, were determined by the writer to be topaz, and further search resulted in the finding of a quantity of crystals.

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a Am. Jour. Sci., III, Vol. 24, p. 282.

b Contributions to the Mineralogy of the Rocky Mountains, p. 70 et seq.; Bulletin No. 20 of the United States Geological Survey, Washington, 1885.

During 1888 nearly 100 crystals, associated with phenacite, were found on Bald mountain, New Hampshire, which is only a few miles from the Stoneham locality. They were colorless, light green or sherry colored on the outer sides, and colorless in the center. The largest one measured 1½ inches in height and the same in thickness. In habit these crystals closely resemble those from Cheyenne mountain, Colorado, and some of them are equal in quality, though not in size, to any found in Colorado.

TOURMALINE.

Tourmalines of gem value were first discovered by Elijah J. Hamlin, at Mount Mica, Paris, Maine, in 1826. He, with several members of his family, among them the person of Dr. A. C. Hamlin, have worked the original locality at Mount Mica, Paris, Oxford county, Maine, finding from time to time remarkable specimens of tourmaline, some single stones of which have been sold for $1,000 apiece. The gem has been found in various shades of green, grass green, olive green, pink, red, blue, yellow, and white. For the past ten years this locality has been worked by the Mount Mica Gem Company.

Enough gems have been found in this locality to realize over $50,000. The finest collection of crystals from this locality is the combined collection of the discoverer and Dr. A. C. Hamlin, and presented by James A. Garland, Esq., of New York city, to the Mineralogical Cabinet of Harvard University. The famous Hamlin tourmaline necklace was exhibited in the Tiffany Pavilion at the 1893 World's Fair.

Some of the fine gems in this locality were in the possession of the late Dr. Charles I. Sheppard, and a fine series of crystals from the Tenny collection are in the Peabody Museum, Yale University.

Tourmalines were discovered at Mount Apatite, Auburn, Maine, in 1893. Several thousand crystals have been found, their value aggregating about $5,000. The work was carried on in a desultory manner, and all the tourmalines from this locality being retained in their original crystalline condition. Tourmaline of gem value have also been found at Hebron and other localities in Oxford county, Maine.

In July, 1893, on the summit of one of the San Jacinto mountains in Riverside county, California, tourmaline was discovered in float crystals, generally green or black. Some good green, rose, red, white, and blue were found. The green crystals, on being broken open, were found to contain red and white centers. One crystal 9 inches and another 6 inches long were found and a number of gems were obtained. Work is now being done on the vein.

BERYL (EMERALD, AQUAMARINE).

The emerald variety of beryl is found in Alexander county, North Carolina. Emeralds and beryls suggesting them have been found at five different points, with quartz, rutile (the latter some of the finest ever found), dolomite, muscovite, garnet, apatite, pyrite, etc., all in

fine crystals. One of these localities, Stony Point, is about 35 miles southeast of the Blue Ridge and 16 miles northeast of Statesville, North Carolina. The country has a rolling surface, and lies about 1,000 feet above the sea. The soil, which is not rich, is generally a red, gravelly clay, resulting from the decomposition of the gneissoid rock, and hence under these circumstances it is easy to find the sources of minerals discovered on the surface. The unaltered rock was found at Stony Point at a depth of 26 feet and is unusually hard, especially the walls of the gem-bearing pockets. The Emerald and Hiddenite Mining Company was organized in 1881 to work the property at Stony Point, and has done so irregularly for periods varying from one week to eight months of each year. The entire output (including specimens of other minerals and other gems) since the organization of the company in 1881 to the present time amounts to about $15,000. Some crystals have been found here measuring 8 inches in length and weighing 10 ounces, but no gem obtained has been sold for over $100. At Stoneham, Maine, many transparent crystals of beryl have been found, and at least $3,000 worth of gems have been sold from this locality; one gem weighed 133¾ carats. At Mount Antero, Colorado, at an altitude of 14,000 feet, many beautiful crystals of beryl were found resembling in color and habit the crystals from Mourne mountain, Ireland; one crystal measured 4 inches in length, many of these afforded small gems, and fully $5,000 worth were cut into gems.

A dark-green beryl, weighing 25.4 ounces, part of which would furnish gems of some size, was found in January, 1888, near Russell Gap road, Alexander county, North Carolina, and fine gems from this crystal were shown in the North Carolina exhibit and in the gem collection in the northwest gallery of the Mines and Mining building, World's Columbian Exposition. Deep golden brown and golden yellow crystals have been discovered in Mitchell county. Yellow and green beryl gems have been found in Alabama, near Coosa, Rockford county. The largest known beryl crystals have been obtained at Alger's Hill, near Grafton, New Hampshire, weighing 2,900 pounds and measuring 4 by 2 by 2½ feet. They were valueless as gems. White and pale gems have been found at Grafton and South Ackworth, New Hampshire, Mount Mica and Hebron, Maine. Very fine golden yellow beryls have been found at the Avondale quarries, Delaware county, Pennsylvania; one weighed 35$\frac{11}{16}$ carats and another 20 carats. Six fine yellow beryls were found at Manhattanville, New York city. At a mica mine between Litchfield and New Milford, Connecticut, many beryls, deep yellow, light yellow, yellow green, light green, and white have been found during the past seven years, which were cut into gems and extensively sold, the former under the name of golden beryl. About $17,000 worth of beryls from this locality were sold within four years by the owner of the mine, S. L. Wilson.

PHENACITE.

Phenacite was first identified in the United States in 1888 in the Pike's Peak range, El Paso county, Colorado, in fine crystals. Since then it has also been found on Mount Antero, where the crystals occur at an altitude of about 14,000 feet in a region of almost perpetual snow, accessible for only a short period in the summer. Some crystals of phenacite were described by the author as occurring on Bald mountain, North Chatham, New Hampshire, near the State line between Maine and New Hampshire, and also in the neighborhood of Stoneham, Maine. From all the localities gems have been cut from the transparent crystals.

GARNET.

The pyrope (precious) garnets are found in the United States, in New Mexico, Arizona, southern Colorado, and Utah, where they are often miscalled rubies. In New Mexico they occur, it is believed, only on the Navajo reservation, where the Indians collect them largely from ant hills and scorpion holes, and are also said to pound them out of rocks. They are associated with olivine and chrome pyroxene. In northeastern Arizona they occur in loose sand, and have probably been brought by the action of water from a point 50 miles to the north, where they occur, as the writer believes, in a peridotite rock. In western Arizona (on the same parallel with Fort Defiance), on both sides of the Colorado river, garnets are similarly associated with grains of peridot, a chrome pyroxene and a hyaline chalcedony. Here also they are found on the ant hills and near the excavations made by scorpions, and are collected by soldiers and Indians, and sold to the Indian traders who send them to the large cities in lots of an ounce and upwards. They vary from an eighth to a quarter of an inch in diameter and a few measure one-half inch across. They have never been found in place by any geologist, and it has been suggested that they are derived from some lower cretaceous sandstone, but it is very evident, from the associated minerals, that they have weathered out of a peridotite rock under an identical mode of occurrence as the pyrope garnets in Bohemia, Elliot county, Kentucky, and Kimberly, South Africa.

Although the garnets found in washing and mining for diamonds in south Africa (the so-called "Cape Rubies") are larger than those of Arizona and New Mexico, and perhaps equal to them in color by daylight, the latter are much superior by artificial light. Only the clear blood-red hue is then visible, while in the "cape rubies" the dark color remains unchanged. They are much used as gems, the annual sales amounting to about $5,000 worth of cut stones. A few remarkably fine ones have brought from $50 to over $100 each, though others equally good have been sold for much less. Fine stones of 1 carat bring from $1 to $3 each, and exceptional ones even $5. They seldom exceed 3 carats. Pyrope garnet of good color that has furnished gems has been found in the sands of some of the gold washings of North

Carolina. The peridotite rock of Elliott county, Kentucky, contains quantities of deep ruby-red grains of pyrope, locally regarded as rubies, having a specific gravity of 3.673 and varying from one-tenth to one-quarter inch in diameter. They are sometimes as fine in color as the Bohemian garnets, which they closely resemble. The lower cost of cutting stones abroad and the smaller size of the Kentucky garnets somewhat precludes the possibility of making them profitable to search for, although it might be possible to encourage the cutting by farmers in their leisure time, on the house industry system of the "Jura," Bohemia, and other European gem-cutting centers.

Large crystals of almandite garnet, some weighing 20 pounds, not fine enough for gems, but which might be cut into dishes or cups, measuring from 3 to 6 inches across, have been found near Morgantown and Warlick's Mills, in Burke county, North Carolina, and in Rabun county, Georgia. Many of them are transparent in part, varying in color from the purple almandine to pyrope red. Tons of these have been crushed to make "emery," and the sandpaper called garnet paper. The peculiar play of color observed in the North Carolina garnets is often due to inclusions. In those of Rabun county, Georgia, sometimes nearly one-quarter of the entire specimen is taken up by fluid cavities and acicular crystals of rutile. Quantities of fine purple almandine garnets are found in the gravel of the placer mines near Lewiston, Idaho, and near Helena, Montana, in rolled and pitted grains, from one-sixteenth to 1 inch across, and would cut into good gems or jewels for watches. Hoffman mentions good small crystals from Black canyon, Colorado river, Nevada. Fine small almandines are also found in the trachyte of White Pine county, Nevada. Tons of almandite garnet, generally opaque, are found in the gold washings near Helena, Montana, suggesting use as an abrasive, as is the garnet found and mined in large quantities in Lewis county, New York.

The Alaska garnets, so well known for their remarkably perfect crystals, which contrast beautifully with their dark gray matrix, occur in quantities near the mouth of the Stikeen river, in the vicinity of Fort Wrangel, Alaska. They are found in a bed of mica schist, and when quarried out are carried about a mile to the river, and thence by boat to Fort Wrangel. Over $1,000 worth are annually sold as specimens.

Spessartite (manganese alumina garnet) is the most interesting garnet yet found in this country, and never found as a gem anywhere else. It was found in Amelia county, Virginia, a few years ago in the working of the Allen mica mines. A cut stone weighing 96 carats is in the Tiffany-Morgan collection in the American Museum of Natural History, New York. Fine examples are shown in the Mines and Mining building and in the Manufactures building, and a remarkable one in the Smithsonian Institution collection, U. S. Government building, of the World's Columbian Exposition. Fully $5,000 worth of this gem

were found, and as the mica mines have since been closed as unprofitable, this gem will undoubtedly become very rare.

Essonite, cinnamon garnet, cinnamon stone, or the hyacinth of the jeweler, has been found of good quality in Oxford county, Maine. Very fine essonites, red and yellow, were formerly found at Phippsburg, Maine, and at Warren, New Hampshire. Beautiful essonite crystals one-fourth of an inch in diameter, entirely transparent and quite flat, have been found between plates of mica at Avondale quarry, Pennsylvania, and near Bakersville, North Carolina. Some of these would cut into fine gems over a carat in weight.

Hiddenite, lithia emerald, spodumene, etc.—In 1881 Mr. J. A. D. Stephenson called the attention of Mr. William E. Hidden to a transparent spodumene and to the locality in which it was found. Mr. Hidden, supposing the mineral to be diopside, sent the specimens for examination to Dr. J. Lawrence Smith, who on investigation found it not to be diopside, but a transparent variety of spodumene, and named it after Mr. Hidden, who sent him the crystals. The crystals were first found loose in the soil with emeralds, but systematic mining revealed them in attached veins of the walls of the rock. The spodumene is generally more or less altered, hence its pitted or eaten-out appearance; but when found in the rock the crystals are quite perfect and unchanged. The crystals are always transparent, and range from colorless (rare) through light yellow and yellowish green into deep yellow emerald green. Sometimes an entire crystal has a uniform color, but generally one end is yellow and the other green. Its hardness is 6.5 on the prism faces. At first considerable difficulty was found in cutting it, owing to its remarkably perfect prismatic cleavage, which is very lustrous. Gems have, however, been cut up to 2½ carats in weight. Its specific gravity varies from 3.18 to 3.194.

The yellow color exhibited by the mineral in even the darkest green gems will prevent its competing with the true emerald. The Siberian demantoids or Uralian emeralds, as the green garnets are variously termed (erroneously olivine), resemble the hiddenite somewhat, but are generally darker, and in addition to their brilliancy have a play of fire or color that has made them highly popular, especially in the very small sizes, the small green garnets selling for a greater price than emeralds of the same size. When lithia emeralds were first introduced they had a considerable sale because of their novelty as a strictly American stone and from the newspaper notoriety which they gained through the controversy as to the true discoverer. Hence for a time the demand exceeded the supply, which, from the desultory working of the mine, was limited. Thus a 2½ carat stone was sold for $500, and a number of stones brought from $40 to over $100 a carat. The total sale of all the gems found from the beginning of operations in August, 1880, to the close of 1892 amounted to about $8,000.

Peridot (olivine chrysolite) is found in the form of small olive-green pitted grains in the sands of Arizona and New Mexico and at Ison's mills, Elliott county, Kentucky. In the two former localities they are called Job's tears (on account of their pitted appearance). These afford smaller gems than those from the Levant. As the demand seems to be for large peridots of the richer olive-green color, which is not possessed by those from the United States, $5,000 would be an outside valuation for the American peridots cut into gems since 1880.

Olivine in meteorites.—There have been found in several instances in the United States—Eagle Station, Carroll county, Kentucky, and Kiowa county, Kansas—meteorites of the type known as pallasites, containing olivine in crystals or masses disseminated through the iron. Some of these olivine grains have been fine enough to furnish good peridot gems. The meteorite found in Kiowa county, Kansas, is a true pallasites with very sharply defined crystals of bright yellow olivine, which break out and leave their casts in the iron; the one from Carroll county, Kentucky, consists largely of olivine with the iron traversing it in irregular meshes and fillings. In the Turner and Liberty mounds in the Little Miami valley, Ohio, some pieces have been found both natural and hammered into articles of use or ornament of a similar pallasite iron, but apparently not identical with either of these other falls, and in the meteorite found in Glorietta mountain, Santa Fe county, New Mexico, olivine grains were found, and from all four of these meteorites the olivine has been cut into what might truly be called a celestial gem.

Quartz (*rock crystal*) has been found near Long Shoal creek, on a spur of Phœnix mountain, in Chestnut Hill township, North Carolina, also at two places 600 feet apart (about 1 mile from the former crystals), one weighing 285 pounds, that was 29 inches long, 18 inches wide, and 13 inches thick, showing one pyramidal termination entirely perfect and the other partly so; also another specimen that weighed 188 pounds, as well as many pieces weighing from 10 to 50 pounds each. A crystal ball over 5 inches in diameter, and a number of art objects made from the rock crystals found, were exhibited at the World's Columbian Exposition; these were all of American work. A rock crystal ball from the summit of Mount Antero, Colorado, was shown in the Mines and Mining building of the World's Columbian Exposition. It measured a trifle less than 6 inches in diameter. It is not perfect, but quite equal to the crystal balls of the eighteenth century.

At Lake George, in Herkimer county, and throughout the adjacent regions in New York, the calciferous sand rock contains single crystals and at times large cavities are found filled with doubly terminated crystals often remarkably perfect and brilliant. These are collected in numbers, and both natural and cut specimens are mounted in jewelry and sold to tourists under the name of "Lake George diamonds." A remarkably choice collection of fine quartz crystals was shown by Mr. A.

B. Crim, of Middleville, New York, in the west gallery of the Mines and Mining building, World's Columbian Exposition.

At Crystal mountain, Arkansas, and in the region around Hot Springs for about 40 miles, large veins of quartz are frequently met with in a red sandstone, the exact geological horizon of which has not yet been accurately defined. They are mined by the farmers, who bring them to Hot Springs in wagons and sell them to local dealers and tourists. At least $10,000 worth are annually sold to be taken away as mementoes. Great quantities of imitation (paste) diamonds are sold to the unwary as cut rock crystals, and quantities of foreign crystals as Arkansas quartz of local cutting.

Many localities in Colorado, notably Mount Antero, yield fine specimens of quartz. All along the Atlantic coast, at Narragansett Pier, Long Branch, Atlantic City, Cape May, Old Point Comfort, and other places, transparent pebbles are found in the sand and are much sought after by visitors, who often have them cut as souvenirs. At many such places the local lapidaries have been known to substitute for pebbles found on the beach foreign-cut quartz, cairngorm, topaz, crocidolite, moonstone from Ceylon, and even glass, obtaining twice the value of the foreign gem for the price of the supposed lapidary work. Many thousands of dollars' worth of such stones are sold annually. At all of these resorts large quantities of the quartz pebbles are cut into gems and seals, and all manner of ornaments are sold as having coming from the vicinity. Sometimes even the stones found by the visitors and intrusted to lapidaries for cutting are exchanged for cut stones brought from Bohemia, Oldenburg and the Jura. Cutting is done abroad on so large a scale and by labor so poorly paid that the cut stones can be delivered in this country at one-tenth of the price of cutting here, as the rock crystal itself has but little value. In the West there are many dealers who sell so-called "Rocky Mountain Gems," the entire stock frequently not containing a genuine stone, all being glass imitations. The same is true of all the blue moonstones and various stones sold in great quantity at the World's Columbian Exposition.

Amethyst is found on Deer hill, at Stow, Maine, where there is a vein of amethystine quartz which has been traced fully one-quarter of a mile and has furnished thousands of crystals during the last twenty years. A few have been of some gem value. Among some found in 1885 was a remarkable mass that yielded a gem weighing 25 carats of the deep purple color of the Siberian amethyst. Fine amethysts have been obtained at Mount Crawford, Surry, Waterville, and Westmoreland, New Hampshire. At Burrillville and at Bristol, on Mount Hope bay, Rhode Island, fine amethysts were found and used as ornaments over sixty years ago. Crystals of fine quality, though not affording gem material, one weighing seven pounds, have been found in Upper Providence township, Delaware county, Pennsylvania. Fine crystals and gems have been found in western North Carolina, and in Rabun county, Georgia. The mode of occurrence of the above gem is identical with

those in the Taljan and other mines in the government of Perm, Ural mountains, Asiatic Russia, which mines have furnished the finest known gems for a century and a half where single stones have sold for $500 each.

Perhaps the most unique gem in the U. S. National Museum at Washington is an amethyst found at Webster, North Carolina, and deposited by Dr. H. S. Lucas. It was originally of a turtle-shaped form, which has unfortunately been lost by chipping; and it is said when found to have borne marks of the handiwork of primitive man. It now measures 3⅖ inches in length, 2⅗ inches in width, 1½ inches in thickness and weighs 4¾ ounces Some very fair amethysts have been found on the Lake Superior shore and in trap rock at Keweenaw point and elsewhere in the upper peninsula of Michigan.

Smoky quartz, also known as smoky topaz, cairngorm, and citrine, is abundant at and near Pike's Peak, Colorado; also to some extent on the summit of Mount Antero, Colorado; Three-Mile Gulch, near Helena, Montana; Magnet Cove, Arkansas; Burke and Alexander counties, North Carolina, Oxford county, Maine, etc. At Pike's Peak it occurs in pockets in a coarse pegmatitic granite, often associated with beautiful crystals of amazon stone and flesh-colored and other feldspars. The largest Pike's Peak crystal found is over 4 feet in length. A beautiful faceted stone measuring 84 millimeters (3⅓ inches) was shown by Messrs. Tiffany & Co. at the World's Columbian Exposition, found in 1891 on Mount Antero, Colorado. The Pike's Peak material is sent abroad in large quantities to be cut, and the larger part is returned to be sold in tourists' jewelry, principally at Denver and Colorado Springs, Colorado; Hot Springs, Arkansas, and in other Western cities and summer resorts. The sum realized from the cut material amounts to about $7,500 annually, and that from the crystals sold to $2,500 more. Most of the cut articles of smoky quartz sold at the tourists' resorts are either from foreign localities or are American material cut abroad. Smoky quartz pebbles are occasionally found along the Atlantic coast at Long Branch, Cape May, etc., and cut as souvenirs.

Rose quartz occurs in large masses at Albany and Paris, Maine, Southbury, Connecticut, and at many other places in the United States; but as yet it has not been used in the arts or as a gem. At Stow, Albany, Paris, and other localities in Maine the quartz veins shade from white-transparent and opalescent—resembling hyaline quartz often without any imperfections—through faintly tinted pink and salmon into a rich rose color, thus forming a beautiful series of tints for gems or for ornamental work. Specimens of this rose quartz, when cut into double cabochons or spherical objects, distinctly show the asteria effect, similar to the star sapphire. Possibly as fine transparent, opalescent, rose quartz as has ever been found was obtained at Round mountain, Albany, Maine, in pieces measuring 4 by 5 inches in size, free from all flaws and of a fine rose red, with a beautiful milky opalescence. A sphere 2½ inches in diameter and various art objects cut from this material are shown at the World's Columbian Exposition.

Gold quartz.—When clear, compact, white quartz contains veins, streaks, or spots of fine gold, it is worked into jewelry and souvenirs on a considerable scale in San Francisco. The mines in California, Oregon, Idaho, and Montana have furnished very fine specimens, especially when the quartz is clear and the gold penetrates in compact stringers. The gold found in California quartz is worth about $16.50 an ounce, but jewelers willingly give $20 to $30 for each ounce of gold contained in material that they can thus use. The price of specimens is governed by their beauty, varying from $3 to $40 per ounce of quartz. The specific gravity of the mineral is first taken, after which the gold value of the quartz is ascertained by Price's table. The amount of this material sold in the rough for jewelers' purposes is variously estimated at from $40,000 to $50,000 a year, $1,000 to $2,000 worth being often purchased at one time. One lapidary at Oakland, California, where most of the cutting of this material is done, bought nearly $10,000 worth within a year; and a large jewelry firm in San Francisco, during the same time, purchased nearly $15,000 worth. A clever imitation of this was patented some years ago by a San Francisco lapidary, who put grains of gold from common gold quartz in a magma of molten white glass the color of a milky quartz.

Novaculite (whetstone or honestone) is a fine grained, compact, sandstone-like substance, found in large pieces at Hot Springs, Arkansas, and employed to a limited extent for cutting into figures such as birds for jewelry. It is extensively used for whetstones, which have a world-wide reputation as Washita whetstones. Its compactness and the purity of its white color make it a very pretty ornamental stone and it should be used for this purpose more than it has been.

Sagenite.—Rutilated quartz of unexcelled beauty (rutile in quartz, Flèche d'amour, or Venus' hairstone), the rutile usually brown, red, golden, and black, has been found in many places in Randolph, Catawba, Burke, Iredell, and Alexander counties, North Carolina. Fine pieces of quartz, 4 inches square, containing acicular rutile of a rich red color, have been found near Amelia Court House, Virginia. Cut specimens command prices ranging from 25 cents to $5 each, and at one time about $500 worth was sold annually. The specimens found here are quite equal to the variety found in Japan, and are even better adapted for use in jewelry than the remarkable transparent masses over a foot across, procured from Madagascar, in which the crystals of hornblende are too large. Quartz crystals with inclusions of goethite have been found in the Tarry-All mountains 40 miles west of Colorado Springs, and cut into beautiful ornaments resembling quartz penetrated by acicular rutile.

The most magnificent specimen known was found in bowlders from the vicinity of Hanover, New Hampshire, during the years 1830 to 1850.

Thetis' hairstone, of Dr. Charles T. Jackson, is found near Sneatch Pond, Cumberland Hill, Rhode Island, is occasionally met with in fair

pieces and is used to a very limited extent in jewelry. It is transparent quartz so completely filled with acicular crystals of green actinolite as to make it quite opaque. Probably $100 worth was at one time sold annually to be cut into seals and charms.

Dumortierite in quartz.—This is a rare species, a nearly pure silicate of alumina, very near staurolite in composition, but without the iron; it exists in small amounts at Harlem, New York, and has of late been found in some quantity at Clip, Yuma county, Arizona. Here it occurs as a dense fibrous inclusion in quartz, to which its deep blue color imparts the appearance of lapis-lazuli in masses one foot square. As the quartz and the dumortierite are about equal in hardness, the mass polishes well and yields a fine dark blue ornamental stone. A locality was discovered in Riverside county, California, in July, 1893.

Agate.—Agate is not produced in sufficient quantity in the United States to admit of exportation. The annual production and sale here does not exceed $2,000. Nearly all the agate jewelry sold in this country, as elsewhere throughout the world, comes from Oberstein and Idar on the river Nahe in the Duchy of Oldenburg, where the manufacture of such articles has flourished for over three centuries.

Agate pebbles, in quantity small and of great beauty, are at Agate Bay, Lake Superior. These are sold to the tourists at all the Lake Superior cities.

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. In Colorado, chalcedony is found 8 miles south of Cheyenne mountain, at the Los Pinos Agency, at Chalk Hills on the bluffs near Wagon Wheel Gap, and along the upper Rio Grande valley, in Middle South Park, Buffalo Park, Fair Play, Frying Pan, along Trout creek and Gunnison river, and frequently in drift accumulations. In Pinal county, Arizona, large quantities of amygdules of beautifully banded agate are found, often coated with opal. They vary from 1 to 8 inches in diameter, and when broken are generally light bluish gray or light gray in color. They would be extremely beautiful if cut and polished. Seven miles south of Cisco, Utah, there are extensive beds of flesh red, pink, and salmon-colored agate, which received considerable press notice under the name of "blood-agate," and a company has been formed to work it.

The beautiful little agates found on Pescadero beach in California are sold in large quantities and in different forms, polished and unpolished, loose or in vials of water. Occasionally some of these are found inclosing a pebble moving in liquid, like the hydrolites from Uruguay and the chalcedony from Tampa bay, Florida. These pebbles, which may well be called sealed flasks, vary from one-tenth to one-fourth of an inch and rarely are one inch in diameter. They are also found on the Oregon coast near Yaquina bay and Astoria, where they average an inch or more in diameter. They are of quite frequent occurrence in pebbles little larger than a pea at Pescadero beach near San Francisco. An-

other locality is Canyon Springs in southern California, as reported by Mr. Orcutt. He also reports beautiful chalcedonies and agates in the drift of the Colorado desert and the neighboring mesas. Fine examples of chalcedony replacing coral and sponges are also found at Tampa bay, Florida, a few holding more than half a gill of water each. The chalcedony coatings on the blue and green chrysocolla occuring in the cavities of the Copper Queen mine, Arizona, are very beautiful if cut with their inclosures and form some of the prettiest and most interesting gem-stones ever found. Fully $10,000 worth of this material has been sold in its natural state for cabinet specimens.

Chrysoprase is found in a vein of serpentine in the nickel mines at Nickel Mount near the town of Riddles, Douglas county, Oregon. It occurs there in veins over an inch thick in the nickel ore, and a few fine rich green stones several inches square have been obtained. Some were shown in the southwest gallery of the Mining building in the World's Columbian Exposition. Some fine stones were also found near Visalia, Tulare county, California, by Mr. M. Braverman.

Jasper Bloodstone or heliotrope in beautiful specimens with very fine red marking is found in Chatham county, Georgia. Heliotrope was formerly obtained in the veins in slate at Blooming Grove, Orange county, New York. Good specimens have been found near the Willamette river, Oregon, near the South Park, Colorado, and below the Uncompahgre near Grand river.

Silicified wood, also known as wood agate and wood opal, is found in great abundance in Colorado, California, Arizona, New Mexico, and other western States and Territories. The agatized wood found at Chalcedony Park and elsewhere in Arizona is one of the most beautiful high-class ornamental stones known. Magnificent collections of polished specimens, some nearly 3 feet in diameter, are shown in the Arizona and South Dakota exhibit and in the Manufactures Building of the World's Columbian Exposition.

On a visit to the locality for the Eleventh Census the writer found that Chalcedony Park, near Holbrook, Arizona, the nearest of the so-called forests in the formation on the Atlantic and Pacific railroad, is about a mile square and is inclosed by table lands from 50 to 100 feet high, composed of several beds of variously colored sandstone, red, white, black, etc. Nearly all the agatized trunks are found lying on the plain below, but they were never in place there. They have been weathered out in the decomposition of the upper layer of sandstone and have rolled down upon the plain. None of those remaining in the upper layer are found in the erect position, nor were any roots visible, and, since none of the trees retain any of the orginal bark, it seems probable that all this deposit was once the bed of an inland sea or lake. Another deposit, 3 miles from Los Cerrillos, New Mexico, very closely resembles that of Chalcedony Park, in Arizona. Two sections from this locality, weighing about a ton each, are in the Historical Society's collection at Santa Fé, New Mexico.

Prof. A. A. Julien, in a communication to the New York Microscopical Society, in January, 1892, announced the discovery of the well-preserved mycelium of a fungus, secreting iron oxide in the jasperized wood from Arizona. To which he attributes the coloration of the agate as detailed in the last report of this series.

Agatized wood in large quantities, consisting of trees from 12 to 35 feet in length and from 18 inches to 2 feet in diameter, has been found near Calistoga, in Napa county, California. True examples of agatized and opalized wood and bluish chalcedony associated with quartz are found in the vicinity of Gallatin, Montana, great quantities of which were collected by Dr. Albert C. Peale and Prof. George P. Merrill, and later by Prof. Frank H. Knowlton, of the United States Geological Survey, for the United States National Museum.

OPAL.

Opal was not observed as a precious stone in the United States until 1889. Since then it has been found in gems equal to the Hungarian in Washington State, Idaho, and Oregon.

In August of 1890 a fine opal was detected in digging a well near Whelan, 20 miles southwest of Colfax, in Washington State. This was in latitude 47 degrees north and longitude 117 degrees west, about midway between the Cœur D'Alene and the Nez Perce Indian reservations, near Moscow, Idaho, almost on the line between Idaho and Washington. It occurred more or less plentifully, and the last 4 feet of the rock contained cavities filled with precious opal. This opal occurs in a basalt, in which most if not all of the feldspar and pyroxene as well as the green mass appears to be altered. Buildings have been erected and the locality named Gem City. The total yield of these mines, during the summer and fall of 1891, amounted to over $5,000; the opal is fine, in many respects equal to the best material from the Hungarian or Australian mines. A gem weighing 3½ carats from this district was held at the extravagant figure of $500, partly perhaps on account of its American origin, and a rough mass of 2 ounces at $1,200. 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, notwithstanding the abundance of fine stones now being found in Queensland and more recently at Wilcannia, New South Wales.

Some remarkable fine fire opals have been found 30 miles from Hepner, Morrow county, Oregon. At this place, immediately overlying a bed of hardened or baked clay or silicified slate, there is a deposit of eruptive ashes about 4 feet in thickness. This, in turn, is overlaid by red lava and other lavas to the top of the mountain. In this bed of ashes are found large nodules or spherical masses from 1 to 40 per cubic yard. These vary in size from one to several feet. On breaking them open, they are found to obtain some kind of opal, of which one in twenty is a fire opal or a noble opal. It is estimated that some $20,000 worth of specimens have been obtained here during 1892; many of these were stolen at the Spokane fair so that the estimate may be exaggerated.

Quite a number of opals of good quality have been found in the Owyhee mountains at Opaline, 20 miles from Silver City, Owyhee county, Idaho, and about 30 miles from Boisé City. In the northwestern part of that county there are extensive lava beds in which are layers of tufa; in this tufa and in the overlying stratum some very fine opals, weighing from 3 to 20 carats, have been found; they are generally associated with hydrophane and some have been sold for from $5 to $40 a carat. Opals have also been discovered in Latah county, Idaho, where they are mined by two companies, and near Moscow in the same State. A fine collection was shown in the Idaho exhibit, Mines and Mining building, World's Columbian Exposition.

A white opaque variety of hydrophane in rounded lumps from 5 to 25 millimeters (one-fifth to 1 inch) in diameter, with a white, chalky, or glazed coating, somewhat resembling the cacholong from Washington county, Georgia, has been found in Colorado. It is remarkable for its power of absorbing liquid. When water is allowed to drop slowly on it it first becomes very white and chalky and then, by degrees, perfectly transparent. This property is so striking that the finder has proposed for it the name "magic stone," and has suggested its use in rings, lockets, charms, etc., to conceal photographs, or other objects which the wearer wishes to reveal only at his pleasure.

MOONSTONE.

Moonstone, albite variety, has been found in fine large masses at the Allen mica mines, Amelia county, Virginia, and in Delaware county, Pennsylvania. Very few moonstones that are transparent have been found in the United States. During 1892 transparent moonstones in very beautiful small crystals (too small to be of value) were found in some quantity by Clement Hightower on the headwaters of the San Francisco river, a tributary of the Gila, 18 miles east of the Arizona line, New Mexico. No moonstones are found on our coast; those so reported are of Ceylonese origin and passed off as of American origin.

SUNSTONE.

Beautiful varieties of orthoclase sunstone are found near Crown Point and Chappaqua, New York. It also occurs at Amelia Court-House, Amelia county, Virginia. A very interesting variety of sunstone was found by Mr. J. A. D. Stephenson at a quarry in Statesville, North Carolina; the reflections are as fine as in that found at Twedde strand, Norway, but the spots of color are very small. Several hundred dollars worth from this locality have been sold as gems.

Labrador spar is found in large quantities in Lewis and Essex counties, New York, and as bowlders in the drift all the way down to Long Island and New Jersey. In Lewis county the bowlders are so plentiful in one of the streams that it has been named Opalescent river. Large quantities of this labradorite rock are quarried at Keesville, Essex

county, New York, for monumental and building work. It is polished there for similar purposes at a cost of about $1 a square foot, and finds a ready sale under the name of Au Sable granite. It somewhat resembles the labradorite from Kief, Russia.

Amazonstone (microcline) is found at Pike's Peak, Colorado, in cavities, in a coarse pegmatite granite with smoky quartz crystals, often of huge size, and with flesh-colored and white feldspars. When associated with smoky quartz it makes a most pleasing and effective combination. Many thousand amazonstone crystals of the most beautiful green color have been obtained, measuring from one-half an inch to over 12 inches in length, and of different shades of green, from the lightest and most delicate to a deep apple green. The crystals are often in groups, the bases of which are covered with white albite. The groups in the New York State Museum at Albany, in the collections of Mr. Clarence S. Bement in Philadelphia, and of Mr. Frederick A. Canfield in Dover, New Jersey, are among the finest known. It is frequently cut into gems or ornamental stones, and large quantities are sold annually to tourists.

Several localities in North Carolina also furnish this mineral. Rockport, Massachusetts, formerly afforded richly colored pieces and some fine green crystals have been found at Paris, Maine; also at Mount Desert, Maine, material that would cut into fair gems is occasionally met with. Several light-green crystals over 6 inches long, and one over 10, were found in the Allen mica mines, Amelia Court-House, Virginia. From the Pike's Peak locality over $10,000 worth have been sold as specimens at prices as high as $200 for a single specimen. Over $1,000 worth from this place is annually cut into tourists' jewelry, In Middletown, Delaware county, Pennsylvania, many shades of green feldspar passing into cassinite and delawarite are found in the soil in loose bowlders up to 20 inches in diameter.

Obsidian in nodules is found in the lower members of the trachytic dike. There is a dike of light gray and clear obsidian with concentric structure near the Colorado Central lode, north of Saguache creek, near Georgetown, Colorado. Obsidian in fine pieces is very abundant 10 miles southeast of Silver Peak, Nevada, and at Obsidian Cliff, in the Yellowstone Park, Wyoming. This locality is described by Mr. Joseph P. Iddings, (*a*) who says: "The cliff presents the partial sections of a floor of obsidian, the dense glass constituting the lower portion, which is from 75 to 100 feet thick. One of its remarkable features is a primitive column forming its southern extremity, which rises 50 or 60 feet and is only 2 to 4 feet in diameter.

Chondrodite that could be cut into gems has been found at the Tilly Foster mine at Brewster's, New York. During 1891 and 1892 some fine transparent garnet-colored crystals were found measuring one-half by one-fourth inch and a few over 4 inches across, some of which would furnish fine gems.

a Seventh Annual Report of the United States Geological Survey, p. 254 *et seq.*

JADE.

As regards origin, some early writers have attributed the Alaskan nephrite native implements to a Siberian source. Native reports pointed to a source known as the Jade mountains north of the Kowak river, about 150 miles above its mouth, and after several attempts the spot was visited in 1882 by Lieut. G. M. Stoney, U. S. Navy. He collected specimens of jade in situ and a number of samples were examined. A magnificent series of archæological objects of Alaskan jade is in the United States National Museum. Lieut. Stoney found that the implements and jade in situ are identical, thus disposing of the theory that their presence in Alaska is to be accounted for upon the basis of trade with Siberia. That theory is also negatived by the discovery announced by Prof. George M. Dawson, of small nephrite bowlders on the upper part of the Lewis river, not far from the eastern boundary of Alaska. But these nephrites are also strikingly like those from many other localities. The most remarkable specimen of jade (nephrite) or pectolite found on this continent is the bowlder (weight 47¼ pounds) from southern Oregon, now in the James Terry collection of the American Museum of Natural History, New York, which museum during 1892 acquired the George F. Kunz collection of 449 specimens of jade and allied minerals, which with the Terry, the "Squier and Davis," the Lieut. Emmons, the Bement, and the objects formerly owned by the Museum, makes this the finest collection of archæological jade known. No American jade has as yet been utilized in the arts. The compact pectolite found in Alaska and in Tehama county, California, is tough, and resembles some white Chinese jade and would make the best known substitute for it. The so-called jade from near Candelaria, Nevada, of which there was quite a mine, proved to be a green agalmatolite, a soft mineral of no little value as an ornamental stone but useful in the arts as a powder.

Rhodonite, so extensively found and cut in Russia, has been little utilized in this country. It has been found in an extensive bed at Blue Hill bay, Maine, and on Osgood's farm near Cummington, Massachusetts, in very fine large masses and in the neighboring towns, in Warwick, Massachusetts, in Irasburg and Coventry, Vermont, near Winchester and Hinsdale, New Hampshire, and at Cumberland Hill, Rhode Island.

ZEOLITIC GEMS.

Among the Zeolitic gems may be mentioned Zonochlorite, referred to prehnite by Hawes. This gem was found at Neepigon bay, Lake Superior, by Dr. A. E. Foote, in 1877, and is generally of a dark-green color, its name being suggested by the bandings which are characteristic of it. A few thousand dollars would represent the commercial value of all the stones found.

Chlorastrolite is found on the beach at Isle Royal in more or less profusions, where they are weathered out from the Amygdaloid rock in which they are found. They vary in size from that of a pea to a few

exceptional stones measuring nearly 2 inches in length, generally selling from 25 cents to $5 each by the jewelers of the Lake Superior region; $25 to $100 have been paid for a few of the remarkable stones. For the past twenty years from $1,000 to $5,000 worth of these stones have been annually sold to be cut into gems or to be taken away as souvenirs.

Thomsonite, generally flesh-colored and beautifully marked with white bands and with green layers (lintonite), is found in great profusion at Grand Marais, Minnesota. This stone is also weathered from Amygdaloid rock, and is generally in grains varying in size from the pea to more than an inch across. Ten dollars is an exceptional price for even the finer specimens; they can generally be bought for from a few cents to several dollars each. In the past ten years from $500 to $1,500 worth have been sold annually.

Fossil coral, generally (Favosites) compact with a grayish-cream color, is found in beautiful masses at Iowa City, Iowa, and in pebbles at the beach at Petosky, Michigan. At the latter place it is known as Petosky marble. The local jewelers in both places cut and polish this material into paper weights, charms, etc., and $1,000 to $2,000 worth are sold annually.

Rutile is found in beautiful, brilliant crystals in Alexander county, North Carolina. In this district the crystals are generally compact enough to admit of the cutting into brilliant stones, with a luster that hey are almost indistinguishable from the cut black diamond.

Pyrite is more or less sold for ornamental purposes in two districts in the United States. First at Wilkesbarre and other parts of the Pluma coal district, where the thin crusts of brilliant crystals are cut nto oval, square, and other forms for scarf pins and other ornaments. In this form several thousand dollars worth are sold annually. In Colorado single crystals or small groups of brilliant crystals in their natural position and to the value of several thousand dollars worth are sold annually. It is not cut into faceted forms as is the same mineral in France, which is known there as marcasite.

TITANITE (SPHENE).

A very remarkable discovery of titanite has been made at the celebrated Tilly Foster iron mine, at Brewster's, Putnam county, New York, where Mr. E. Schernikow obtained several hundred magnificent crystals 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 of them transparent, and a number are large enough to cut into gems of from 1 to 15 carats each. These were found in the summer of 1891, and are among the finest titanites that have been observed in any recent locality, equaling some of the best crystals from Tavetsch or other celebrated places of occurrence abroad. Over $1,000 worth were sold as gems. Some of the finest crystals are shown in the southwest gallery of the Mines and Mining building at the World's Columbian Exposition by Mr. George L. English, and a fine cut gem of ten carats

is in the collection of the United States National Museum. Some fine gems have been obtained at Bridgewater station, Delaware county, Pennsylvania, and small crystals at Magnet Cove, Arkansas.

PRODUCTION.

The following table shows the value of the precious stones produced in the United States from 1885 to 1892, inclusive:

Estimated production of precious stones in the United States from 1885 to 1892.

Species.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.
	Value.	Value.	Value.	Value.	Value.	Value.	Value.	Value.
Diamond	.....	$60	.....	.....	.....	.....	.....	.....
Sapphire gems	$500	750	$500	$500	$6,725	$6,725	$10,000	$20,000
Chrysoberyl	.....	.....	.....	.....	.....	.....	.....	.....
Topaz	1,250	1,000	2,000	600	400	.....	100	1,000
Beryl	750	5,500	3,500	800	.....	.....	.....	1,000
Phenacite	.....	.....	.....	650	200	.....	.....	.....
Emerald	3,200	3,200	.....	100	450	.....	a1,000	.....
Hiddenite	2,500	4,500	.....	.....	.....	.....	.....	.....
Tourmaline	600	5,500	500	.....	2,250	2,250	3,000	3,000
Smoky quartz	7,000	7,000	4,500	4,000	4,232	2,225	5,000	5,000
Quartz	11,500	11,500	11,500	11,150	14,000	14,000	10,000	10,000
Silicified wood	6,500	1,500	36,000	16,000	.....	.....	.....	1,000
Garnet	2,700	3,250	3,500	3,500	2,308	2,308	3,000	5,000
Anthracite	2,500	2,500	2,000	1,500	.....	.....	.....	3,000
Pyrite	2,000	2,000	2,500	2,500	2,000	2,000	1,500	1,500
Amazonstone	2,750	2,250	1,700	1,700	500	500	.....	1,000
Catlinite (pipestone)	10,000	10,000	5,000	5,000	5,000	5,000	5,000	5,000
Arrow points	2,500	2,500	1,500	1,500	.....	.....	.....	1,000
Trilobites	1,000	1,000	500	500	.....	.....	.....	.....
Sagenitic rutile	250	1,750	.....	.....	.....	.....	.....	.....
Hornblende in quartz	300	200	100	.....	.....	.....	.....	.....
Thomsonite	750	400	750	500	400	400	200	500
Diopside	100	.....	50	.....	.....	.....	.....	500
Agate	2,000	2,000	4,000	4,000	.....	.....	.....	2,000
Chlorastrolite	.....	1,009	800	800	500	400	500	500
Turquoise	3,500	3,000	2,500	3,000	23,675	28,675	150,000	175,000
Moss agate	2,500	2,000	950	950	.....	.....	.....	1,500
Amethyst	2,100	2,100	2,100	2,500	98	.....	.....	200
Jasper	.....	.....	.....	100	.....	.....	.....	.....
Sunstone	350	300	150	.....	.....	.....	.....	.....
Fossil coral	.....	1,000	2,000	3,000	700	700	1,000	1,000
Rutile	750	750	.....	.....	.....	.....	.....	.....
Aquamarine	.....	.....	.....	.....	747	.....	1,000	(a)
Rose quartz	.....	.....	.....	.....	600	200	.....	200
Gold quartz	140,000	40,000	75,000	75,000	9,000	9,000	6,000	15,000
Rutilated quartz	.....	.....	.....	.....	30	.....	.....	.....
Dumortierite in quartz	.....	.....	.....	.....	250	250	.....	.....
Quartz coated with chalcedony	.....	.....	.....	.....	4,000	2,000	.....	500
Chrysoprase	.....	.....	.....	.....	200	200	.....	100
Agatized and jasperized wood	.....	.....	.....	.....	53,175	6,000	2,000	10,000
Banded and moss jasper	.....	.....	.....	.....	630	.....	.....	.....
Fluorite	.....	.....	.....	.....	500	500	.....	.....
Azurite and malachite	.....	.....	.....	.....	2,037	.....	.....	.....
Zircon (b)	.....	.....	.....	.....	16,000	.....	.....	.....
Gadolinite, furgusonite, etc. (b)	.....	.....	.....	.....	1,500	.....	.....	.....
Monazite (b)	.....	.....	.....	.....	1,000	.....	.....	.....
Spodumene (b)	.....	.....	.....	.....	200	.....	.....	.....
Wooden ornaments decorated with minerals (c)	.....	.....	.....	.....	15,500	15,500	15,000	15,000
Opal	.....	.....	.....	.....	.....	.....	5,000	10,000
Peridot	.....	.....	.....	.....	.....	.....	1,000	1,000
Miscellaneous minerals (d)	.....	.....	.....	.....	20,000	20,000	15,000	20,000
Total	209,850	118,850	163,600	139,850	188,807	118,833	235,300	299,000

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

PHOSPHATE ROCK.

The statistics of production of phosphate rock in the United States in 1892 are as follows:

Product of phosphate rock in 1891 and 1892.

States.	1891.		1892.	
	Quantity.	Value.	Quantity.	Value.
Florida:	*Long tons.*		*Long tons.*	
Hard rock	57,982	.....	[a]155,908	$859,276
Soft rock			6,710	32,418
Land pebble			21,905	111,271
River pebble	54,500	.....	[b]102,820	415,453
Total	112,482	$703,013	287,343	1,418,418
South Carolina:				
Land rock	344,978	2,187,150	243,653	1,236,447
River rock	130,528	760,978	150,575	641,262
Total	475,506	2,948,138	394,228	1,877,709
Grand total	587,988	3,651,151	681,571	3,296,227

[a] Includes 52,708 tons of land rock carried over in stock from 1891.

[b] Includes 12,120 tons of river pebble carried over in stock from 1891.

SOUTH CAROLINA.

The figures given represent the sales and not that part of the product which went over to be marketed in 1893. This stock increased markedly over the stock carried over from 1891. The average price received by the miners for land rock decreased from $6.33 per long ton in 1891 to $5.07 in 1892, and for river rock from $5.88 in 1891 to $4.26 in 1892. These are for dry rock, free on board, at the point of production.

Phosphate rock (washed product) mined by the land and river mining companies of South Carolina.

Years ending May 31—	Land companies.	River companies.	Total.
	Long tons.	*Long tons.*	*Long tons.*
1867	6	.....	6
1868	12,262	.....	12,262
1869	31,958	.....	31,958
1870	63,252	1,989	65,241
1871	56,533	17,655	74,188
1872	36,258	22,502	58,760
1873	33,426	45,777	79,203
1874	51,624	57,716	109,340
1875	54,821	67,969	122,790
1876	50,566	81,912	132,478
1877	36,431	126,569	163,000
1878	112,622	97,700	210,322
1879	100,779	98,586	199,365
1880	125,601	65,162	190,763
1881	142,193	124,541	266,734
1882	191,305	140,772	332,077
1883	219,202	159,178	378,380
1884	250,297	181,482	431,779
1885	225,913	169,490	395,403
1885 (June 1 to Dec. 31)	149,400	128,389	277,789
1886 (calendar year)	253,484	177,065	430,549
1887	261,658	218,900	480,558
1888	290,689	157,878	448,567
1889	329,543	212,102	541,645
1890	353,757	110,241	463,998
1891	344,978	130,528	475,506
1892	243,652	150,575	394,228

TRIPOLI.

Mention was made in the report for 1892 of the development of a deposit of a siliceous earth in Newton county, Missouri. To this product the term of "tripoli" has been applied, though it is in reality a distinct mineral, being a siliceous lime-stone from which the carbonate of lime has been leached out, leaving the silica in a very porous state. Work was continued on the property in 1893, and the output increased over that of 1892 about 25 per cent. The product is used for water filters in the form of discs, cylinders, tubes, etc.; for ink blotters, either in the shape of rollers or in rectangular blocks about 5½ inches long, 2¾ inches wide, and three-fourths inch thick. It is very porous, absorbs fluids readily, and makes a very convenient as well as enduring desk blotter. When the surface becomes clogged by drying it is easily cleaned by rubbing gently over it a piece of ordinary sandpaper. The material is also ground into a fine powder for polishing metal surfaces and for manufacturing various cleansing preparations.

CARBORUNDUM.

This interesting artificial material continues to attract the attention of scientists, mechanicians and others interested in abrasives. Intelligent study has been given to it during the past year, and its properties and useful fields are becoming more clearly understood. Improvements have been made in the matter of binding, in the manufacture of wheels and discs, and there is no doubt of its continued usefulness in the arts. In glass-cutting and dental work it is particularly useful.

The present capacity of the Carborundum Company is 200 pounds per day, the power consisting of 225 horse power and a battery of 210 horse power, and 112,000 Watt & Westinghouse alternating dynamos. During 1893, 15,200 pounds of carborundum was produced, varying from No. 30, determined by the number of threads in the sieve, down to the finest powder. This is principally made in the form of wheels, which are distributed through the dental, glass, and other trades, 200,000 wheels being used by the dental trade during 1893. The glass trade uses it for the purpose for which Scott stone was formerly used.

The Carborundum Company of Monongahela, Pennsylvania, reports that it has sold in the form of machine wheels, dental wheels, discs and points, powder and hones, $35,933.21; goods manufactured and held in stock, $24,280.75, making a total for the year's business of $60,213.96.

PRECIOUS STONES.

By George F. Kunz.

INTRODUCTORY.

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

In spite of the decline in production above noted, the year 1893 was characterized by a number of interesting gem discoveries, including a diamond weighing $3\frac{14}{16}$ carats, found in a new district, Oregon, Dane county, Wisconsin. An interesting fact was proved, that the supposed diamonds in the Canyon Diablo meteorites are really diamonds, and the first instances are recorded of the polishing of a diamond by means of the diamond dust obtained from meteoric iron. The finding of small rubies of fairly good color in Macon county, North Carolina, gives ground for the belief that larger and better stones may be found there by more extended development.

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

PRODUCTION.

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

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

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

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

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

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

DIAMONDS.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Census of the diamond-cutting industry, 1889.

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

IMPORTS.

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

Imports of rough or uncut diamonds since 1873.

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

IMPORTS.

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

Years ending—	Diamonds.			Diamonds and other stones not set.	Set in gold or other metal.	Total.
	Glaziers'.	Dust.	Rough or uncut.			
June 30, 1867	$906	.....	.....	$1,317,420	$291	$1,318,617
1868	484	.....	.....	1,060,544	1,465	1,062,493
1869	445	$140	.....	1,997,282	23	1,997,890
1870	9,372	71	.....	1,768,324	1,504	1,779,271
1871	976	17	.....	2,349,482	256	2,350,731
1872	2,386	89,707	.....	2,939,155	2,400	3,033,648
1873	.....	40,424	$176,426	2,917,216	326	3,134,392
1874	.....	68,621	144,629	2,158,172	114	2,371,536
1875	.....	32,518	211,920	3,234,319	.....	3,478,757
1876	.....	20,678	186,404	2,409,516	45	2,616,643
1877	.....	45,264	78,033	2,110,215	1,734	2,235,246
1878	.....	36,409	63,270	2,970,469	1,025	3,071,173
1879	.....	18,889	104,158	3,841,335	538	3,964,920
1880	.....	49,360	129,207	6,690,912	765	6,870,244
1881	.....	51,409	233,596	8,320,315	1,307	8,606,627
1882	.....	92,853	449,513	8,377,200	3,205	8,922,571
1883	.....	82,628	443,996	7,598,176	*a* 2,081	8,126,881
1884	22,208	37,121	367,816	8,712,315	.....	9,139,460
1885	11,526	30,426	371,679	5,628,916	.....	6,042,547
Dec. 31, 1886	8,949	32,316	302,822	7,915,660	.....	8,259,747
1887	9,027	33,498	262,357	10,526,998	.....	10,831,880
1888	10,025	29,127	244,876	10,223,630	.....	10,557,658
1889	8,156	68,746	196,294	11,704,808	.....	11,978,004
1890	147,227	179,154	349,915	*b* 12,429,395	.....	13,105,691
1891	565,623	125,688	408,198	11,657,079	.....	12,757,079
1892	532,246	144,487	516,153	13,328,965	.....	14,521,851
1893	357,939	74,255	444,137	9,321,174	.....	10,197,505

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SAPPHIRE.

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

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

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

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

RUBY.

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

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

TURQUOISE.

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

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

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

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

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

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

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

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

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

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

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

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

TOURMALINE.

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

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

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

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

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

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

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

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

BERYL, EMERALD, AQUAMARINE.

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

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

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

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

GARNET.

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

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

MOSS AGATE.

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

HYDROLITE.

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

DUMORTIERITE.

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

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

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

OPAL.

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

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

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

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

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

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

STAUROLITE.

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

JADEITE.

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

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

LAPIS LAZULI.

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

LABRADORITE.

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

GEM EXPLORATION IN CEYLON.

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

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

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

ARTIFICIAL PRECIOUS STONES.

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

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

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

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

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

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

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