DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

MINERAL RESOURCES

OF THE

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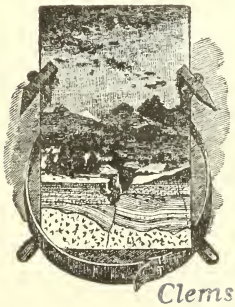
CALENDAR YEAR

1906



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PRECIOUS STONES.

By Douglas B. Sterrett.

INTRODUCTION.

The native gems of southern California, as tourmaline, beryl, kunzite, topaz, essonite, etc., are being mined, cut, and sold in some quantity by jewelers of San Diego and Los Angeles. Good lapidaries are employed at both towns, and the cut stones are retailed in the East and abroad as well as locally. The greater part of the output of California stones, however, is shipped East for cutting.

In Maine, where precious stones of a similar class are mined, the cutting is nearly all done locally and the sale of gems is limited chiefly to the State, good prices being realized by retailing to tourists. The discovery of kunzite, or lilac-colored spodumene, at Andover, Oxford County, Me., will add a new interest to the gem industry of that State if pieces large enough for cutting are found. The material so far found has come from near the surface and was somewhat fractured. It is hoped that better, flawless mineral will be found with depth.

Gem tourmaline and beryl are mined at a new locality near Canyon, Colo., and are cut, at present at least, largely for local sales.

Chrysoprase is known to exist at many places in California and has been mined in considerable quantity. There was a large production in 1906, part of which was high-grade material.

There has been a large decrease in the production of turquoise in the Southwestern States, from Texas to southern California. Several of the companies formerly operating in that region reported good material to be very scarce, and many companies did not attempt mining during the year. If turquoise is to be a popular stone this season, as is reported from London in the Jeweler's Circular Weekly, the scarcity of the native stone should cause a revival of activity in the development of the American turquoise deposits.

The discovery of gem corundum during 1906 in the gold placers of Washington County, Idaho, adds a new locality for the occurrence of blue and other colored sapphires in the United States. Stones of considerable beauty have been found, and it is to be hoped that predictions regarding the finding of sapphires in quantity and in other parts of the State will prove true.

The importation of diamonds for consumption during 1906 again showed a large increase over the preceding year; and this in spite of

a 7 per cent increase in value for rough material. The increase of imports of rough diamonds is the first substantial one in three years, and indicates, it is hoped, an expansion of the cutting industry in this country; but there is room for a larger field of work for the industry, not only in cutting smaller stones, but in cutting a larger portion of the stones imported for consumption.

The demand for domestic fresh-water pearls has been strong, and the production large, but it can not be accurately given. They came chiefly from the Mississippi Valley region. A portion of the production has been exported, and in return there has been an importation of nearly two and a half million dollars' worth.

AMBER.

BURMA.

The production of amber[a] in the Myitkyina district of Burma was considerably greater in 1905 than in 1904, owing, it is said, to the peaceful condition of the country. The value, however, fell from £9 15s. to £7 10s. per hundredweight, owing to the increased output and the inferior quality of the material. The production in 1905 was 126 hundredweight, valued at £945, as against 86 hundredweight, valued at £838, in 1904.

AZURITE SANDSTONE.

UTAH.

A small specimen of rich deep-blue azurite sandstone from La Sal district, Utah, was sent to the Survey by Mr. F. G. Hillman, of New Bedford, Mass. It is thought the stone might be useful for finishing doorways or similar ornamental purposes. The texture as a sandstone would probably prohibit its use in small ornaments, since it would be difficult to give the stone a high polish. The deposit is located 70 miles from a railroad station, and is in a mountainous district. Should it prove attractive and a demand arise for it, it is said that a supply of this stone could be obtained, though as yet it has not been quarried in any quantity.

BERYL.

NORTH CAROLINA.

In North Carolina the American Gem and Pearl Company operated their aquamarine mine at Spruce Pine, Mitchell County, during part of the year. It is said that the gem-bearing portion of the pegmatite is too irregular in direction and contents to pay the cost of mining.

Aquamarine and golden beryl of very fine clear color have been found from time to time in the South Mountains in Burke County. Most of the material has been obtained from near the surface and was, in many cases, somewhat flawed, though stones of fair size have been found.

[a] Records Geol. Survey India, vol. 34, pt. 2, 1906, p. 62.

MASSACHUSETTS.

Blue and yellow beryls of good gem quality were found at Royalston, Mass., during the year. One crystal of blue beryl was estimated by Mr. H. S. Williams, formerly of the American Gem and Pearl Company, as being worth $200.

COLORADO.

Beryl and aquamarine were reported from the tourmaline deposit in the Royal Gorge vicinity, Colorado, operated by Mr. C. A. Beghtol, of Canyon.

EMERALD.

AUSTRIA.

In a letter from Mr. Arthur Thompson to the editor of the Mining Journal,[a] the emerald mines of Austria are briefly described. The mines are located in the Salzburg Mountains at an elevation of over 8,000 feet above the sea and about 7 miles from Habach station, up the Habach Valley, on a narrow-gage railroad. They have been worked in a dilatory, immethodical way. Their value may be judged from the fact that in 1902 about 68,000 carats were mined by six miners in less than four months' time.

The emerald-bearing matrix (a micaceous and steatitic light-gray and copper color formation) is reached by four levels driven into the steep declivity of the mountain, varying in depth of from 600 to 700 feet below the top of the divide or pass of the two mountains constituting the great Legback Valley. The emerald-bearing strata are defined on one side by a highly hornblendic schist and a massive, well-marked gneiss formation on the other, while in some parts between these formations large outcrops of serpentinous and other magnesian rocks are observable; consequently the general geological make-up of this valley is characteristic of the richest emerald-bearing strata of the oldest and most famous emerald mines in various parts of the world, especially the celebrated and ancient Muzo mines of the United States of Colombia.

The greatest depth reached in the workings is only about 200 feet, though it is expected that operations will be carried into the heart of the mountains.

COLOMBIA.

According to Mr. Henry C. Granger,[b] emerald mining in Colombia is a Government monopoly. Short leases only are granted, and 80 per cent royalty is charged.

Conditions at the emerald mines of Muzo, Colombia, are described as follows by an English engineer who examined the mines for the Colombian Government.

The mines are situated in the State of Boyacá, about one and one-half hours' ride from the small town of Muzo. The Muzo district, though hot, is healthy; water and timber are abundant, and the land is fertile. Labor also seems to be easily obtainable.

The emerald deposits vary in height from 3,000 to 4,000 feet above the sea level. Their area extends over many leagues, the Government property alone being estimated at 40,000 hectares.

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[a] Mining Jour. (London), June 30, 1906.
[b] Eng. and Min. Jour., August 4, 1906, p. 194.

There has been for some time a scarcity of water in the mines. There are in the district, however, a number of small streams which could be tapped, and which by means of a ditch, 2 leagues in length, would give a large and constant supply of water to the mines from a high level, thus giving greater pressure for working a monitor or extending the present tank system. Since the report was written, work on this ditch has been begun.

The further improvements recommended to the Government by the writer of the report include a dam to be built across the stream, with sluice to release the water when necessary, so as to sweep away the débris, which now is accumulating to a dangerous extent, a sawmill plant, a monitor and connections, new housing for workmen, storerooms, etc., and new tools and mining appliances, the total cost being estimated at £20,000.

He also advises that the road from Simijaca to Muzo should be put in order, and that a bridge for mule traffic should be built over the river Guaso.

He estimates that if his recommendations are carried out, and the mines properly worked, there should be an annual profit of £200,000. He believes, moreover, that by opening up the old workings on the other side of the valley, opposite the present Muzo mine, another and probably equally productive mine might be worked. He considers, indeed, that the only limit to the production would be the quantity that could be sold without seriously reducing the price of emeralds.[a]

CALIFORNITE (VESUVIANITE).

CALIFORNIA.

About 2 miles east of Exeter, Tulare County, Cal., a vein of compact vesuvianite or californite has been opened on the top of a rounded hill, 500 feet above the valley. Mr. Frank L. Hess, of the United States Geological Survey, who examined the deposit, states that the vein varies from 2 to 4 inches in thickness and lies with small magnesite veins in serpentine. Some material was taken from a prospect hole about 20 feet deep, but none was shipped. In a polished hand specimen the stone appears to have been brecciated and cemented together again by flesh-colored magnesite in small seams, veinlets, and irregular masses. The color of the californite is a nearly clear apple-green, which forms a pleasing contrast with the included portions of the flesh-colored magnesite. This combination would be very attractive in small ornaments and mosaics, while pieces large enough for small table tops and similar decorative purposes might be obtained by cutting some of the gray-green to greenish-black serpentine along with the californite.

CHRYSOPRASE.

CALIFORNIA.

One of the chrysoprase mines in Tulare County, Cal., operated by the Himalaya Mining Company of New York, was visited during the year by Mr. Frank L. Hess, of this Survey, who furnished the notes from which the following information was compiled:

The mine is situated about 8 miles southeast of Porterville, and about one-half mile south of Deer Creek, in a rough serpentine knob. The chrysoprase veins can be traced some distance to the north along the top of the hill. The country rock is a serpentine, covering a large area. In many places this serpentine is badly decayed and weathered away, while in others it forms prominent outcrops. In the latter case the serpentine has been rendered more or less hard by silicification. In some places it has the shining waxy luster of the precious

[a] Mining Jour. (London), February 2, 1907.

varieties. Often, near the chrysoprase veins, the serpentine is badly decomposed and is stained with nickel. The chrysoprase is found in veinlets and veins from one-fourth inch to 8 or 10 inches thick, cutting through the serpentine. The color of the chrysoprase varies considerably in different veins and in different parts of the same vein. In some cases the middle portion has a fine green color of the valuable shade, while in others gem material may occupy any portion in the vein. The greater part of the larger veins is not of good gem quality, and the best material is confined chiefly to the thin veins or the thinner portions of the veins.

The main workings are on the south side of the hill. They consist of two shallow open cuts, extending probably 20 to 25 feet into the hillside, where they meet, and about 15 feet deep in the deepest part, with other smaller openings. Much good chrysoprase is obtained as float by plowing up and harrowing the land lower down on the gentler slopes of the hill. In this way the loose rocks are turned up, and, after exposure to the rain, the good chrysoprase is readily picked out. The operation is then repeated and another crop gathered.

It is reported that from this mine about 3 tons of material have been shipped from which it was said about 300 pounds of gems could be cut. That portion unsuitable for gem purposes is to be shipped to Germany for cutting into slabs for mosaics. Large masses of silicified serpentine, weighing several hundred pounds, with light-colored chrysoprase veins an inch or less thick are to be shipped also. In a fire on the property during the year, nearly 4 tons of chrysoprase ready for shipment were burned and practically destroyed. Much of it lost its color and was so badly cracked by the heat as to be valueless.

On the north side of the hill opal veins have also been found in a decomposed serpentine. The veins are all small, ranging in thickness from an inch down. In some cases the opal has a green color, like that of the chrysoprase, and is called chrysopal.

The same company has operated chrysoprase mines at Venice Hill, about 10 miles east of Visalia and near Exeter. These deposits are about 35 miles and 28 miles respectively north-northwest of the Deer Creek deposit. Small deposits are also reported on White River 25 miles south of Porterville, but their value is, so far, doubtful. Beautiful specimens of chrysopal are found in a serpentine hilltop just east of Plano, about 1½ or 2 miles south of Porterville, but it is not known to have been used commercially.

DIAMOND.

PROSPECTING IN THE UNITED STATES.

Authentic reports of the finding of diamonds in Arkansas during 1906 were received at this office, and there were rumors of diamond discoveries in the localities mentioned in the following paragraphs. A report on the Arkansas discoveries is appended to this paper.

California.—The discovery of what has been called a "diamond pipe" near Oroville, Cal., by Mr. M. J. Cooney, has caused considerable comment in various papers both East and West. The deposit in question was found along the west bank of Feather River, about a mile north of Oroville, in ground from which 20 to 60 feet of alluvium had been washed off during hydraulic gold-mining operations. The

outcrop is being vigorously prospected, and it is expected that a small experimental washing plant will be installed. Mr. Cooney kindly furnished specimens of certain rocks he considered to be typical of the formation near Oroville and to be identical with the kimberlite and associated rocks of South Africa. The specimens marked "blue" were soft, highly serpentinized rocks whose original nature could not be determined. In a thin section under the microscope the rock was found to contain rounded crystals of some mineral, probably olivine, entirely altered to serpentine. The section contained a great deal of serpentine throughout, with some in little streaks and veinlets. There were small fragments, apparently a variety of feldspar, of some larger crystals, mostly lost in grinding. In hand specimens portions of the rock have a brecciated appearance, while other pieces appear to have a more even texture. The color is dull, ranging from greenish to bluish green to bluish black. Slickenside partings are not uncommon in various directions through the small pieces examined. Specimens of two other types of rock were "bull's-eyes," or spherical balls with concentric layer structure, and concretions or nodules of calcium carbonate. The "bull's-eyes" range in size from that of an egg up, and have been formed by the weathering of a fine-grained basic rock, probably of the basalt or diabase family. It has a fine porphyritic texture with a slight development of amygdules.

According to Mr. Cooney, the "bull's-eyes" and lime nodules were found on the surface and to a depth of 20 feet, mixed with earthy material and somewhat cemented together. This gradually gave place to soft yellow ground at 25 feet. The yellow ground held out to a depth of 40 feet, where a semisiliceous stratum, "somewhat like the 'floating reefs' encountered in the diamond chutes or pipes of South Africa," was met. Below this came in the "blue ground" described above. The following minerals are reported by Mr. Cooney in the Oroville serpentine or "blue" and "yellow" earths as similar to those minerals commonly associated with the diamonds in South Africa: Menaccanite, magnetite, olivine, garnets, spinel rubies, topaz, beryl, chrysoprase, agate and other forms of chalcedony, zircons, etc.

The specimens sent to the Survey by Mr. Cooney as typical "blue earth" of the Oroville locality do not bear much resemblance to the genuine kimberlite of South Africa. Points of likeness are the extensive serpentinization in each, a general bluish-green color, and probable brecciation of the California rock compared with the evident extreme brecciation of the kimberlite. On the other hand, the general appearance of the two rocks on close inspection is very unlike. The California serpentine apparently does not contain inclusions of other types of rocks forming the walls, while the kimberlite contains these in quantity, as black shale, conglomerate, quartzite, melaphyre, etc. The numerous plates of biotite common in the true kimberlite were not observed in the California rock. The presence of feldspathic material in the California serpentine indicates a quite different type of rock from the kimberlite. The latter is regarded as a serpentinized volcanic peridotite breccia, with the serpentine probably derived from a less basic rock, possibly of the gabbro or diorite class. As far as can be learned, the presence of "bull's-eyes" is not a prominent feature of the South African diamond mines, while the occurrence of lime concretions is not limited to the outcrop of diamond pipes alone, but

is common to large areas of the country around Kimberley, where rocks other than kimberlite outcrop.

It seems likely that the outcrop of rock near Oroville, designated "kimberlite" by Mr. Cooney, is a portion of one of the belts of serpentinized amphibolite schists running through the country in a northwest direction, as mapped in the geological folios[a] of this Survey by Turner, Lindgren, and Becker. The alluvium has been washed off, exposing a portion of such a belt, which has been mistaken for a pipe formation, since it is exposed over a limited area. The rock formation including the region a mile north of Oroville represents a highly metamorphosed series of basic rocks which have yielded amphibolite schists and serpentine. In this formation are included diabase-porphyrites which would readily furnish such specimens as the "bull's-eyes" described above.

Many authenticated finds of diamonds are on record in Butte County, Cal.[b] Some of these have been along Feather River not very far from Oroville. The majority have come from Cherokee Flats, north of Oroville, where Mr. Cooney and his associates own other land on which they expect to prospect. Since the presence of diamonds is well established for this part of California, it remains for some one to locate them in the matrix. Just what the nature of that matrix will be is not known. It may not be a typical kimberlite rock and in the form of a volcanic neck, but one of the other great varieties of basic igneous rocks so plentiful in the region. It has not been proved that a kimberlite formation is essential to the occurrence of diamonds, nor that where such a rock exists it must carry diamonds. Several rock outcrops are known, as in Elliott County, Ky., and Kakanui, New Zealand, where there are basic rocks almost identical in appearance to kimberlite around which no diamonds have as yet been found. On the other hand, diamonds occur in a matrix of hornblende-diabase near Inverell, Australia. Since the composition of many of the rocks of the Oroville region is not very unlike this, it may be that the diamonds will some day be found in a matrix of similar type in that region.

Kentucky.—The revival of interest in the kimberlite rock formations of Elliott County, Ky., was not abated in 1906. The Kentucky Diamond Mining and Development Company, which owns the outcrop of the kimberlite on Isom and Critches creeks, has arranged for a complete washing plant similar to those used in South Africa. This plant is at present (May, 1907) under construction, and, it is expected, will be ready to make a thorough test of the deposit within a few months. The company disclaims the knowledge of any diamonds having been found on its property. Pyrope garnet, diopside, and olivine, however, all of gem quality, have been found, along with other minerals associated with diamonds in South Africa.

Wisconsin.—The discovery of a diamond field near Plum City, Wis., has been reported.[c] It is said the deposit lies outside of the area of glacial drift. As yet there has been no confirmation of these newspaper reports.

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[a] Geologic Atlas U. S., folio 17 (Marysville), folio 18 (Smartsville), and folio 43 (Bidwell Bar), U. S. Geol. Survey.

[b] Turner, H. W., Diamonds of California: Am. Geol., vol. 23, 1899, p. 182.

[c] Jew. Circ. Weekly, October 3, 1906.

CANADA.

In Canada a large diamond was reported[a] found in the Nipissing district, though the report has not been authenticated. Attempts to trace the diamonds found in the glacial drifts of Ohio, Indiana, Michigan, and Wisconsin back to their original source have not so far been successful. Dr. Robert Bell,[b] of the Canadian geological survey, considers the source of the diamonds found in these States to be just north of Lake Superior, where there is a volcanic area in which igneous rock and shales containing carbonaceous matter are abundant. Débris from this area would have been carried by the ice sheet in the same course as the jasper conglomerate bowlders which are found with the diamonds and have come from the extreme eastern part of the Lake Superior region. In the Muskoka district, east of Georgian Bay, peridotite rocks cut shales carrying carbonaceous matter, thus giving conditions similar to those in South Africa.

SOUTH AFRICA.

De Beers Consolidated Mines.[c]—According to the eighteenth annual report of the De Beers Consolidated Mines operations during the year 1906 were pushed with increased activity. The total production of blue ground at all the mines—De Beers and Kimberley, Wesselton, Bultfontein, and Dutoitspan—was 8,144,979 loads, as against 5,433,357 in 1905; and the total quantity washed was 5,625,592 loads, as against 5,128,015 in 1905. This leaves a remainder of 6,769,126 loads on the floors, an increase of 2,519,387 during the year. The average number of carats recovered per load was slightly less for each of the mines than during the previous year, though this was more than offset by the increased value of the diamonds per carat and the greater number of loads washed. The increase in the number of loads washed came chiefly from the Dutoitspan and the Bultfontein mines, while the others treated less than during 1905. Correspondingly, the increase in the total value of diamonds produced came chiefly from the Dutoitspan and Bultfontein mines, with a smaller increase from the Wesselton. An increased quantity of tailings and débris was treated during the year, with a corresponding increase in the quantity and value of diamonds obtained from such material. The quantity and value of diamonds thus obtained, however, did not equal that from a smaller quantity of tailings treated in 1904.

The total amount of blue ground in sight for all the mines at the close of the year was 64,315,580 loads, as against 59,326,700 loads in 1905. This does not take into consideration the probable great depths to which the mines can be profitably worked below the present lowest levels. At the same rate of washing per year as in 1906 it would take eleven years to exhaust the mines above their present lowest levels, and with the same rate of yield and valuation there would be a product worth £64,000,000.

The five-year contract with the diamond syndicate expired at the close of the year 1906, but was renewed for the same period of time on even more advantageous terms. The market remained strong and the

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[a] Jew. Circ. Weekly, August 1, 1906.
[b] Abstract from Jour. Can. Min. Inst., in Eng. and Min. Jour., November 3, 1906.
[c] Eighteenth Ann. Rept. De Beers Consolidated Mines for year ending June 30, 1906.

demand for diamonds has increased so greatly that the management found it necessary to extend washing operations. The sale of diamonds realized £5,607,718, as against £4,802,844 in 1905. The net profits amounted to £2,937,509, from which the amount distributed in dividends was the same as in 1905, £1,800,000, and £916,057 were carried forward. The company found it necessary to lay aside £500,000 to meet the English income tax, levied since 1901, should it be compelled to pay this second tax in the mother country after paying one to the colony.

Transvaal diamond mines.—According to the annual report of the government mining engineer of Transvaal for the fiscal year 1906 the production of diamonds came principally from volcanic pipes, with some from alluvial deposits. The total output in 1906 was 2,610,084 loads washed (including 104,623 loads from alluvial deposits), which yielded 758,406 carats of diamonds, valued at £968,229, as against 1,568,077 loads washed (including 120,827 loads from alluvial deposits), which yielded 995,002 carats of diamonds, valued at £1,198,530, in 1905.

The Premier Diamond Mining Company (Limited), contributed by far the largest part of the diamond production of Transvaal and earned, during the year ending with October, 1906, a profit of £673,349. Two other companies operating pipes in the Pretoria district that contributed to the diamond production were the Kaalfontein and the Montrose Diamond Mining companies (Limited). The new alluvial deposits along the Vaal River, opened for mining in June, 1906, have not come up to expectations.

One of the promising diamond mines of the Transvaal is the Roberts Victor, which was discovered early in 1905; it made a profit during the last six months of 1906 of £39,045.[a] The average yield per load of ground washed was 0.7 carat.

The Vorspoed is another Transvaal diamond mine of recent (September, 1905) discovery and proved value.

BRAZIL.

The following summary of the diamond-mining conditions in Brazil is given by M. Arrajado R. Lisboa:[b]

The diamantiferous district is very large. It extends from Matto-Grosso to Bahia, crossing the states of Goyaz and Minas-Geraes, which is the principal center of the industry. A French company until recently explored the Boa-Vista mines, near Diamantina, and at present an English company operates the Agua-Suja mines, Bagagem, but operations are still in the installation stage.

Lately several diamond-dredging claims of Brazil, on the river Jequitinhonha, the diamantiferous river, have been examined by American companies. On the river Coxipo, in Matto-Grosso, many diamonds have been gathered with the gold, and with appropriate plant, diamond dredging may offer very satisfactory results when competently directed.

Carbons exist in the diamantiferous district of Bahia, named Chapada Diamantina. There is no systematic exploration, the diamonds being found by the garimpeiros or washers, who employ primitive processes. Carbons being of comparatively high value their presence in the diamantiferous alluvials of Bahia with the diamond has given an added importance to these deposits during the last few years.

New alluvial diamond deposits were reported at Douradinho, district of Coromandel, Estrella do Sul. The stones are perfectly limpid and of very fine quality, and bring good prices.

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[a] Mining Jour. (London), March 30, 1907.
[b] Eng. and Min. Jour., March 2, 1907.

According to Mr. Francis C. Nicholas[a], many of the diamond deposits of Brazil could be worked by dredging.

Nearly all of the diamonds found in Bahia, Brazil, as well as the carbons, are sent to Paris.[b] The yearly exports increased steadily from 1899 to 1902, after which they fell off. The outlook for a larger trade, however, was better during 1906. The yearly production of carbons from Bahia is estimated at 30,000 carats, all of which go to Paris for distribution, about 10,000 carats being taken by New York.

With the increasing price of diamonds and the failure of the large mines to overstock the market, there has been much activity in prospecting and searching for these stones in many parts of the world during 1906. At the same time, according to Consul George L. Anderson[c], of Rio de Janeiro, stock-jobbing companies have chosen the diamond fields of Brazil for the promotion of their wild-cat speculations and have sold much stock in London, New York, and Chicago. In many cases they have had bad titles for their land, or do not even know its location. The diamonds occur in scattered deposits or pockets, often in places difficult to reach with machinery and equipment necessary for mining. Preliminary or hasty examinations do not suffice to prove the richness of a deposit, and often considerable money is necessary to have the properties examined and carefully tested.

Writing at a later date,[d] Consul Anderson states that mining conditions are becoming better and that the bulk of the diamond production from the Diamantina district still goes to Paris and London, though American mining concerns are purchasing larger quantities of stones and increasing the imports into the United States. The production of diamonds can not be given with any degree of accuracy, since the State government imposes a tax on all stones exported, and the producers try to avoid this by keeping no records of their finds or sales. The average production of the Diamantina region is estimated at about 5,000 carats per month, valued at somewhat over $40 per carat in the rough.

INDIA.

The output[e] of diamonds in India is given for 1905 as 172.41 carats, valued at £2,474, as against 286.48 carats, valued at £2,636, in 1904. The industry furnishes employment to 1,890 persons.

The mode of occurrence of the diamonds in the Bundelkhand States, especially in Panna, is fully described by Mr. E. Vredenburg in the Records of the Geological Survey of India for 1096.[f]

NEW SOUTH WALES.

An interesting discovery of diamonds in matrix has been made at Oakey Creek, near Inverell, New South Wales.[g] Two miners were driving a tunnel through a granite hill to penetrate a basalt-capped deep-lead deposit of stream tin and alluvial diamonds. Three intrusive horn-

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[a] Min. World, March 23, 1907.
[b] Jew. Circ. Weekly, February 14, 1906.
[c] U. S. Daily Cons. Repts., July 16, 1906.
[d] Idem, May 15, 1907.
[e] Rec. Geol. Survey India, vol. 34, pt. 2, 1906, p. 53.
[f] Vredenburg, E., Rec. Geol. Survey India, vol. 33, pt. 4, 1906, pp. 273–311; also same volume, pt. 2, pp. 88–90.
[g] David, T. W. Edgeworth, Min. and Sci. Press, January 12, 1907.

blende diabase dikes, standing nearly vertical, were cut through. The first one was about 26 feet thick; the other two were smaller. In the middle of the first dike a diamond of about one-half carat weight was found embedded in solid intrusive rock. Three more small diamonds were later picked out of the more decomposed diabase after it had been exposed to the weather for some time. One of these stones has corrosion hollows on the surface filled with portions of the hornblende diabase matrix.

These specimens, one with the diamond still in the matrix, were exhibited before the geological section of the British Association for the Advancement of Science, and the mode of origin was discussed. Sir William Crookes thought the diamonds had probably formed originally under absolutely nonoxidizing conditions, as would be found in molten iron. Arguments brought against Crookes's theory that the diamonds were originally formed from molten iron were that Doctor Friedlander, of Berlin, had made microscopic diamonds by stirring molten olivine (not very different in composition from the Inverell hornblende diabase) with a graphite rod, and that the diamonds were found in the Novo-Urei meteorite of Russia, which was composed chiefly of silicates. The general opinion seemed to be that the hornblende basalt might well be the original matrix of the diamond, without the necessity of assuming deeply buried masses of metallic iron which were subsequently absorbed by the hornblende basalt.

Consul F. W. Goding reports[a] from New Castle, New South Wales, that rough diamonds have been found lately in Queensland ranging from 1 to 5 carats in weight. The finds have not been numerous, and since European and American merchants have judged them to be of inferior quality exploration has not been pushed vigorously.

Another locality for diamonds in Australia has been reported[b] on the eastern slopes of the Nandewar Range, toward Bingara, where it is said a blue diamond was found and sold locality for £5. At Sydney it brought £32 10s.

TASMANIA.

During 1906 a diamond is reported to have been found on the west coast of Tasmania, at Long Plains. According to Mr. W. H. Twelvetrees, government geologist, the presence of ultra-basic rocks and carbonaceous shale may point to diamond-bearing rock being found in the region. The diamond found weighed about one-eighth carat. It was an octohedral crystal, with a peculiar greenish-yellow tint at the points.

NEW ZEALAND.

Specimens labeled "gem sands" of Kakanui[c] were collected some years ago by the late Professor Ulrich, of the Otago School of Mines, with the idea that gems might be found associated with these sands at some future time. Careful inquiry has failed to discover in the Kakanui region more than a few sapphires of indifferent quality; a jasperoid rock, containing green, yellow, and red bands; and the "gem sands" themselves. The origin of the gem sands has been traced

[a] U. S. Daily Cons. Repts. No. 2819, March 16, 1907.
[b] Mining Jour. (London), May 11, 1907.
[c] Thompson, J. Allen, Gem sands of Kakanui: Trans. and Proc. New Zealand Inst., vol. 38, 1905, pp. 482–495.

back to a volcanic breccia outcropping in several places in that region. This breccia contains all the minerals found in the gem sands, and is similar in appearance and composition to the kimberlite rock of South Africa. In the latter country the kimberlite occurs in necks or pipes of old craters. At Kakanui the breccia is stratified and probably represents a submarine flow. In such a case pipes probably exist in the region, though buried under the flow.

Though diamonds can not be predicted for this region, it will not be surprising if they are found.

BORNEO.

In Netherlands Borneo, according to "Le Diamant,"[a] not only are diamonds found, but there are several cutting establishments where the stones are cut very cheaply. At least 300 polishers and 160 cleavers are at work. The cut stones are bought by native merchants and are shipped to Java, Singapore, and Siam. Not only the stones found in Borneo and Australia are cut, but about 16,000 carats are imported from South Africa. There was much activity in prospecting for diamonds in Netherlands Borneo during 1906, and one report states that stones were found plentifully at Tainam, while extensive digging operations were being carried on near Martapura, in southwest Borneo.

NOTES ON THE DIAMOND INDUSTRY.

Income tax on De Beers Company.—The British Government levied an income tax against the De Beers Consolidated Mines Company, not only for the year 1906, but for several years past. The contention was that the greater part of the company's business was conducted in London, and that it should be taxed there accordingly, regardless of the tax already paid to the Cape Colony government. This new tax amounts to over £100,000 a year, and the total for past years would bring it up to over £600,000. Since this tax is considered unjust, there was some talk of the diamond syndicate moving its offices from London to avoid paying the double tax. America purchases more than one-half of the company's diamond output, while England consumes only about one-sixth. Accordingly, it was suggested that it might be good policy for the company to move its London office to New York. The tax, amounting to something like £600,000, has been paid, however, and it is not probable that this step will be taken at the present time at least.

Diamond cutting.—The question of the establishment of a diamond-cutting industry in South Africa was much agitated by the newspapers of the colonies. It was argued that if an export tax of £1 per carat should be placed on all rough diamonds exported it would cause the mining companies and the diamond syndicate to set up their own cutting establishments in the colonies to escape the tax; and in this way occupation would be supplied for some 15,000 workmen, and a large additional revenue would be earned on the diamond production. It is not likely, however, that the diamond cutters could be attracted from their homes in their native lands unless they were offered greatly increased salaries over what would be required to offset the increased

[a] Jew. Circ. Weekly, May 5, 1907.

cost of living in South Africa. It has been calculated that from the increased revenue for diamonds cut in South Africa wages only about twice those obtained in Holland and Belgium could be paid for cutting, while the cost of living is at least three times as high. No company mining diamonds in South Africa obtains £1 per carat for its stones, and consequently no company could afford to pay such an export tax. Of course the cutting would have to be done chiefly by artisans from abroad for some time to come, since it takes five years in Europe for an apprentice to become anything like an expert cutter, and the wholly uninitiated class in South Africa could not be drilled quickly. A later report[b] announces that an association has formed for the object of establishing a permanent diamond-cutting industry in Cape Colony.

There has been considerable unrest among the diamond cutters in New York and in Europe. The labor unions have demanded increased pay and shorter hours in both countries. An agreement was reached early in the present year (1907) between the diamond manufacturers of America and the Diamond Workers' Protective Union, to last until May 1, 1908. There was about a 10 per cent increase in wages in all departments, affecting the 400 employees in New York. The new scale of wages provides from $30 to $65 per week for polishers, $43 to $90 for cutters, and $35 to $48 for setters. More diamond cutters are coming from Antwerp on account of the higher pay in this country. If wages are raised in Europe to hold the cutters there, the manufacturers in this country will be able to compete with those abroad in cutting still smaller stones instead of those only of one-half carat or more, as at present.

The diamond markets were very strong throughout the year, even with the increase of 7 per cent on the rough material, and the demand seems to have been in excess of the supply. Several large purchasers of diamonds have reported great difficulty in securing all the stones, of the desired quality, needed to meet their requirements. It seems likely that the scarcity of large stones and material in general and the increased pay demanded by the diamond cutters may bring about still another increase in the price of diamonds.

The opinion has been expressed that there would be employment for nearly four times as many diamond workers in New York as at present if the manufacturers would cut stones of smaller size and of less desirable quality. This ought to be possible, since it is said that the 10 per cent duty on cut stones over the rough material gives the American manufacturer a fair margin over the extra cost of labor in New York.

Metric carat.—The use of a carat consisting of 200 milligrams in place of one of about 205 milligrams for weighing diamonds and precious stones was proposed by C. E. Guillaume[c] of Sèvres. This is called the "metric carat" and is intended to simplify the change from an ordinary system of measures to that used in weighing gems. The "metric carat" has been approved by the International Committee of Weights and Measures, and some progress has been made in its use.

[a] "The diamond-cutting industry," by a student of facts: Mining Journal (London), January 19, 1907.
[b] Jew. Circ. Weekly, May 22, 1907.
[c] Idem, November 7, 1906.

The "sun ray."[a]—A new form of cutting for diamonds, called the "sun ray," has been invented by Herbert Cooper. The claims for the new cut are that it gives smaller loss in cutting, with more brilliancy and better color than in the ordinary "brilliant." The general shape of the sun ray is similar to that of the brilliant, with the exception of more weight left above the girdle. There are 49 facets above the girdle, as against 33 in the brilliant; both forms have 25 facets below the girdle. The facets above the girdle are so placed as to give a double-crown effect. The upper crown is the same as in the brilliant, while the lower crown is cut at a different angle, producing a raised point where 7 facets meet midway between the table and girdle, which gives a rose effect. This rose effect is produced eight times around the stone. Since each rose acts as an individual stone, more light enters and is reflected, causing a great improvement in color and brilliancy.

Diamonds in electrical apparatus.—A large number of small diamonds are used in the electrical industry.[b] Attention has been called to this fact by the protest made by a large electrical manufacturing company against a duty being charged on the importation of stones for industrial purposes. The stones in question were brown colored and had been advanced in value by being cut and polished on one side. They were intended for bearings in electric meters, where the least possible friction is desired.

GARNET.

Almandite.—Mr. C. A. Beghtol reports the opening of a prospect for almandite garnets about 2 miles from Canyon, Colo. The stones are said to be of fine quality and in large quantity, though none have been marketed as yet.

Essonite.—Beautiful essonite garnets have been mined in southern California and over the line in Mexico.

Pyrope.—The pyrope garnets brought in from scattered localities in the Navajo Indian Reservation compose the main value of the production of that stone.

JADE.

BURMA.

The production of jade (jadeite) in Upper Burma in 1904 and 1905[c] was 3,778 hundredweight, valued at £50,726, in 1904, and 2,685 hundredweight, valued at £45,474, in 1905. The only mines worked are in the district of Myitkyina, in Upper Burma. The greater part of the output is exported from Rangoon, though some is carried overland to China. It is said that the jade industry of Burma[d] is to be stimulated by a railroad built from Manyasrik to the center of the mining district.

According to Consul-General Amos P. Wilder[e], of Hongkong, it is impossible to secure light-green uncut jade except from the Chinese. Canton is the center of trade for southern China, and buyers must

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[a] Jew. Circ. Weekly, August 1, 1906.
[b] Western Electrician, May 4, 1907.
[c] Rec. Geol. Survey India, vol. 34, pt. 2, 1906, p. 56.
[d] Eng. and Min. Jour., December 1, 1906.
[e] U. S. Daily Cons. Repts., January 21, 1907.

work through the Chinese to secure their supplies. The jade is sometimes obtained in lumps weighing 1 or 2 pounds. One New York firm found jade cheaper in Peking than in southern China. A Chinese merchant in Hongkong reports that he is ready to supply uncut jade, though there might be difficulty in arranging prices unless the buyer has an agent on the ground, or there be some jeweler in China upon whom he could rely to make his purchases.

ONYX MARBLE.

The opening of new onyx marble quarries by E. and C. Traslosheros[a] near Pueblo, Mexico, promises to meet the demands of the manufacturers in the United States. Hitherto it has been difficult to secure all the rough material needed, as the producers preferred to elaborate the stone themselves, and thus realize greater profits. Samples from the new quarries are of varied colors, some being very beautiful. The price of the onyx at the quarries averages about $150 gold per cubic meter. Delivered at the railroad it varies from $175 to $200 gold.

OPAL.

NEW MEXICO.

Maj. E. W. Hubbard, of the United States Artillery Corps, has furnished some notes on an opal prospect opened near Fort Bayard, N. Mex., several years ago. The prospect is located about one-half mile from the station, and is in a very hard volcanic rock. The opal is called "button opal" in the region around, and is white, with little, if any, fire. It makes a beautiful specimen, however, since the opal is invariably outlined by a zone of black chalcedony.

OPALIZED WOOD.

COLORADO.

Opalized wood was obtained in the eastern part of El Paso County, Colo., along with jasperized wood, by Mr. W. C. Hart.

AUSTRALIA.

The White Cliffs opal region of New South Wales, Australia, continued to yield opals of good quality, for which the miners complained they did not receive full value. For this reason it was arranged to have an agent open showrooms nearer foreign markets, where it was expected lapidaries would be employed to elaborate the stone before selling. Chicago was to be the first place to make this trial, and, if successful, similar establishments would be set up in the larger cities of the Continent.

Special Agent H. R. Burrill,[b] at Brisbane, suggests a direct trade between the merchants of the United States and Queensland business houses in opal instead of having the stone imported through other countries, thereby increasing its cost. Such a trade is very much

[a] U. S. Daily Cons. Repts., February 6, 1906.
[b] U. S. Daily Cons. Repts. No. 2870, May 15, 1907.

desired in Queensland, and would doubtless lead to a more extended use of the opal in American jewelry. The opal of Queensland is of particularly fine quality, and the variety called black opal makes a fascinating gem. Its beauty is not at first very apparent, but on closer inspection is better realized when its "hidden fire" and varied colors are observed. According to a report in the Jeweler's Circular Weekly for May 22, 1907, a firm in Los Angeles, Cal., is at present cutting a stock of the Australian black opal.

ROSE QUARTZ.

CALIFORNIA.

The Fano Kunzite-Tourmaline Company owns an undeveloped ledge of rose quartz, reported to be from 4 to 6 feet thick, in the Coahuila Mountains of Riverside County, Cal.

It is reported that at a locality 10 miles northeast of Lemon Cove, Tulare County, rose quartz of beautiful color and quality has been found. There is said to be a vein 3 feet wide whose length has not been determined. Specimens from this locality have attracted considerable attention by reason of their beauty.

NEW YORK.

The quarries operated for feldspar and quartz near Bedford village, Westchester County, N, Y., were visited in 1906 by Mr. Edson S. Bastin,[a] of the United States Geological Survey. The deposits consist of pegmatite in which the quartz is, in part at least, rose colored. In the Kinkle quarry, about three-fourths of a mile southeast of Bedford village, the quartz is mostly white, though here and there it assumes a beautiful rose tint. At the hobby quarry, about 1½ miles southeast of Kinkle's, and in the town of North Castle, the quartz is in part white and in part a beautiful rose color. The proportion of rose-colored quartz to the white was much greater in this quarry than in the Kinkle quarry. None of the rose quartz produced at these quarries has as yet been used for ornamental purposes, though the color is very good and in places the stone is translucent and even transparent.

RUBY.

NORTH CAROLINA.

The company owning gem mines in Cowee Valley, Macon County, N. C., claims to have discovered rubies in the matrix on its property. According to reports, the crystals were found in white chalky limestone pockets, similar to the associations at Burma, and were considered to be very promising by Mr. William Earl Hidden. The discovery was made in October, 1906, and no development work was possible until spring; accordingly, no statement of the probable value of the deposit can be made at this time.

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[a] Contributions to economic geology, 1906: Bull. U. S. Geol. Survey No. 315, pt. 1, 1907, pp. 394–399.

BURMA.

A very primitive system for obtaining rubies is employed by the native miners of Burma.[a] Shafts about 2 feet square are sunk 50 or 60 feet deep, the sides being held up by posts at the corners and branches of small trees, secured by short sticks. The miner squats down in one corner of the shaft and digs in the opposite corner. The ruby-bearing earth, as fast as excavated, is hauled to the surface in buckets and baskets. The latter are attached by bamboo rods and cane to a long bamboo pole pivoted on an upright pole on the surface, about 20 feet high and at such a distance from the hole that one-eighth of its length projects from the pivot away from the mine. Stones on the short arm help to counterbalance the weight.

When sufficient gravel is accumulated it is washed in a stone-paved circular inclosure, where it is shoveled about until the mud and clay are washed away. The clean gravel is then sifted and sorted, the rubies and sapphires being placed in cups of water until the wash is finished. The stones are then placed in calico bags and given to dealers to be sold on bazaar days. The production[b] of rubies in Upper Burma, including small quantities of sapphire and spinel, for the year ending February 28, 1906, amounted to 266,584 carats, valued at £88,340, as against 265,901 carats, valued at £90,612, in 1904. The royalty received by the Ruby Mines Company from native miners amounted to £12,129, as against £17,441 in 1904. The production now comes only from the Mogol area.

According to Consul-General William H. Michael,[c] of Calcutta, the quantity of ruby earth washed during the year 1905–6 was 1,773,129 trucks, or 130,000 trucks less than 1904. The reported decrease was due to the exhaustion of the Choungzone mine, where the material was at the last obtained from corners of crevices in the rocks. Work was to be started on the Myntada mine adjoining, and the same washing machinery was to be used without the necessity of moving it.

The ruby deposits of Burma are controlled by a few persons, who limit the output and thereby hold the price of the ruby 50 per cent higher than it ought to be.

SIAM.[d]

The Navong mine, southeast of Chantobun, about halfway from Krat, produces both rubies and sapphires, the former in the larger quantity. There was much development in mining at this place during 1906, and the year closed with about 3,000 miners at work. The best known gem mine in the south of Siam is the Pailinh sapphire mine, which employs about 4,000 workmen.

TRANSVAAL.

According to Mr. S. M. Tweddill, curator of the museum, in a note in the Annual Report of the Transvaal Geological Survey, a ruby-bearing rock has been discovered at Leydsdorp. The essential con-

[a] New York Commercial, July 25, 1906.
[b] Rec. Geol. Survey India, vol. 34, pt. 2, 1906, p. 60.
[c] U. S. Daily Cons. Repts. No. 2675, October 26, 1906.
[d] Mining Jour. (London), December 22, 1906.

stituents of the rock are a ferromagnesian mineral and granular ruby-colored corundum. The occurrence of this ruby-bearing rock in northern Transvaal, with the discovery of fairly large pebbles of ruby still farther north, points to the probability of this gem being found in the colony in the not distant future.

SAPPHIRE.

IDAHO.

The occurrence of gem sapphire in Idaho has been announced by Dr. Robert N. Bell, State inspector of mines. The sapphire was first found in the concentrates from the Rock Flat placer gold mine, near Meadows post-office, in Washington County. The possible gem value of the stones was first recognized by Doctor Bell, who sent specimens to Dr. George F. Kunz for confirmation. The deposit is located on a high plateau divide between the Salmon and the North Payette rivers. The occurrence is thus described by Doctor Bell:[a]

> The general formation of the district is gneiss, and the corundum crystals, which include some of excellent gem quality, seem to be derived from a wide dike of basaltic clay formation with a peculiar spheroidal structure. The gem stones are found associated with a great array of pyrope garnets in the clean-up boxes of an old placer pit.
>
> Some beautiful gems have been found. They occur in a variety of colors, the oriental amethyst shades predominating. Most of them have an opalescent silky sheen and are not of high value, but would cut into excellent cat's-eyes and star sapphires. Some bronze crystals would also make handsome tiger-eye sets. Some small stones, however, of fine quality have been found, which, when cut, are as large as one-half to 1 carat and have a beautiful clear cornflower blue color. Others make brilliant pink stones as large as 1½ carats in weight after cutting. The crystals also include some of poor red quality, but nothing as yet approaching a true ruby color.

Doctor Bell placed the value of sapphires from this locality sold in 1906 at about $300. The highest price stone was a brilliant pink gem weighing about 1½ carats and valued at $20.

Development work has been started on the dike formation and consists of a drainage tunnel to cut the dike at a depth of 80 feet. Connection will doubtless be made with the surface and the working of the deposit be greatly facilitated.

Since basaltic dikes, similar to the ones at Meadows, are common near the placer deposits found in the eruptive granites of central Idaho, other sapphire discoveries are likely to be made in placer mining, especially in those places where opaque corundum has already been found. For this purpose it would be well for the miners to examine their concentrates for sapphires around Resort, in Idaho County; along the Gold Fork and other tributary streams of the North Payette River, in Boise County; in the Stanley basin, in Custer County; and at Pierce City, in Nez Perce County.

NORTH CAROLINA.

A few sapphire crystals were reported from the western counties of North Carolina during 1906, though just what their value was has not been learned.

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[a] Min. World, April 6, 1907, p. 449.

MONTANA.

The operations of the New Mines Sapphire Syndicate on the sapphire deposit in Yogo Gulch, Montana, have been retarded by an injunction served against the company forbidding the emptying of tailings into the Judith River. The waste from the mill was formerly turned into the river above the intake to the irrigating ditches of the ranches around Utica. Some of the débris was washed out and deposited on the ranches, resulting, it is said, in considerage damage.

The problem of disposing of the waste is being taken up by Mr. Hamilton Walker, a member of the syndicate, who previously managed the mine for the company. Reports state that the mine was worked during the winter with a large force of men, removing vein matter, preparatory to washing in the spring, after the question of the disposition of the tailings is settled.

The latest progress of the American Sapphire Company, operating on another portion of the same vein as the New Mines Sapphire Syndicate, has not been reported to the Survey. It is said there is a mill in operation producing sapphires, though with what success is not known. As late as the first half of 1907 the company seems to have been selling stock, probably to secure capital for improving its plant.

Mr. W. H. Emmons, of the United States Geological Survey, furnishes the following note:

> The American Gem Syndicate continued to work its sapphire placers on Rock Creek, about 20 miles southwest of Philipsburg, Mont. A considerable quantity of sapphires was produced. This company has a factory in Switzerland, where the stones are cut to be used as watch jewels and for other bearings.

INDIA.

Kashmir.—The Kashmir sapphire mines, situated 14,000 feet above sea level, are being reopened after an idleness of sixteen years. The Kashmir Mineral Company (Limited) operated in the district in 1906 from the middle of July to the middle of October, when snows necessitated cessation of work. The plan was to cause a landslide, which it was hoped would expose the deposits. The same scheme was tried in 1887 without much success. The gems occur in hard rock at these mines, and the quality is good, though not the finest. Many of the stones, though beautiful in daylight, are nearly black under artificial light.

AUSTRALIA.[a]

NEW SOUTH WALES AND QUEENSLAND.

Sapphires are found in all the Australian States, though chiefly in Queensland and New South Wales. In the latter State they are associated with alluvial deposits containing gold or tin. Most of the stones have a greenish-blue or bottle-green color, while many—abundant in some localities—that are pure blue by transmitted light are nearly black by reflected light. Stones of indifferent quality are abundant in the Inverell tin-mining district, in the northern part of the State.

[a] Plummer, John, Australian sapphire: Min. World, March 10, 1906.

In Queensland the sapphire is found near the central part of the State, around Anakie. The deposits occur over a wide area, but are confined chiefly to the granite country. A quartzite rock, locally known as "billy," is generally associated with the sapphires. It occurs in large and small bowlders and is sometimes called sapphire gravel, its presence being considered a favorable sign.

The sapphire wash varies from a few inches to several feet in thickness and usually rests on decomposed schists and slates. The bottom of the wash is generally composed of clay, and there is sometimes more than one layer of gravel, with clay interbedded. Sometimes the deposits are extremely thick, but the large size of the bowlders makes it unprofitable to sink through them without hoisting machinery. The sapphires are extracted from the wash by simple methods. The gravel is either washed in sieves or is put through a dry jigger when a dry deposit is being worked. In the wet washing the clean gravel is generally thrown out on a table of bark and the sapphires are picked out; in the dry method the stones are picked by hand out of the sieves.

The output of sapphires for 1904 was estimated at 14,100 ounces, valued at £10,575, or 15s. per ounce. There is much discontent among the miners at the low prices received for their sapphires. Attemps to establish a regular trade with Europe and America failed, as the dealers said there was no market for the Australian stones at the prices demanded. Special agent H. R. Burrill,[a] however, claims that the Queensland sapphires are of fine quality, especially the limpid yellow stones and some of the green ones, which approach the emerald in color.

According to Consul F. W. Goding (New South Wales), also, sapphires of yellow and green color are found in Queensland equal to those of any locality. Recently $1,250 was offered for a rough yellow sapphire, and a large blue one with a yellow center, weighing 2½ ounces, brought $2,500. True rubies of good color, though small, have been found also.

SODALITE.

CANADA.

Sodalite is not only used for ornamental purposes, but is sometimes found in smaller masses with a color rivaling that of the lapis lazuli, and it is then cut as a gem. The deposits near Bancroft, county of Hastings, Ontario, have been developed, and a quantity of material has been taken out for decorative purposes.

SPODUMENE.

MAINE.

Mr. F. G. Hillman, of New Bedford, Mass., has reported the discovery of lilac-colored spodumene, or kunzite, as well as some with a greenish color, called hiddenite by the informant, at Andover, Oxford County, Me. A cleavage specimen sent to the Survey measured 12 by 10 by 3½ millimeters, and had a very pretty clear lilac color. It

[a] U. S. Daily Cons. Repts. No. 2870, May 15, 1907.

was not entirely without cleavage cracks, however. The greenish material had a pale aquamarine color, nearly clear, though rather badly fractured. This spodumene was obtained near the surface, and it is hoped flawless material will be found with depth.

Hiddenite has also been reported from the Pala Chief Mining Company mines near Mesa Grande, San Diego County, Cal. The quality was not described, and, since no specimens were seen, it is not known whether this was the genuine emerald-green material, such as was found in North Carolina, or spodumene of a paler color, similar to that found in other gem mines of San Diego County.

TOURMALINE.

CALIFORNIA AND MAINE.

The tourmaline deposits of California and Maine are described in the notes on the gem stones and industry of these States (pp. 27–33).

COLORADO.

Some of the tourmaline deposits near Canyon, in the vicinity of Royal Gorge, Colorado, have been opened by Mr. C. A. Beghtol, of Canyon. The developments consist chiefly of open cuts, though a shaft is being sunk at one place. Some very fine pink, green, and lavender colored tourmaline crystals are reported to have been found along with other minerals of interest as specimens if not as gems. Among the latter are tourmalinated quartz, beryl, some of aquamarine variety, and amazon stone. The mines only commenced to produce stones of value toward the close of 1906 and during the first part of the present year.

CONNECTICUT.

Dr. S. Ward Loper, of Wesleyan University, reports a new discovery of green tourmaline near the north line of Portland County, Conn. About 50 large crystals of a rich deep-green color, along with about 50 of inferior quality, were obtained from the prospect. The stones were not clear enough for use as gems, and were valued at about $15. Most of the material was secured for the Wesleyan Museum. Some 200 specimens of pink, green, and yellow tourmalines, valued at about $50, were received from the Haddam Neck locality. This represents nearly the whole production of Haddam during the year.

INDIA.

Tourmaline is mined in Upper Burma,[a] south of the ruby mines district. The production in 1905 amounted to 161 pounds, valued at £1,500.

[a] Rec. Geol. Survey India, vol. 34, pt. 2, 1906, p. 66.

PRICES.

Consul McFarland,[a] of Reichenberg, reports the prices of rough tourmaline in Austria, as given early in the year by a reliable manufacturing jeweler, as follows:

Prices per pound of rough tourmaline in Austria in 1906.

Small pink, green, and blue	$32
Green, larger size	160
Very large green and blue	320
Very large pink, extra	640

These values are given as approximate, since the price varies with the demand, especially in America, and was rather low at the time mentioned.

TURQUOISE.

ARIZONA AND NEW MEXICO.

Some of the turquoise deposits near Mineral Park, Ariz., were visited during the year by Mr. F. C. Schrader, of this Survey, who furnished the material for the following notes:

Turquoise was discovered near Mineral Park about 1885 by James Haas. As in New Mexico, the deposits had been worked by the Aztecs, as evidenced by the old tunnels and drifts in which were found stone axes and other tools.

The mines are located on both Ithaca Peak, nearly a mile southeast of Mineral Park, and on Turquoise Mountain, about a mile southwest of the town. The turquoise occurs in an altered quartz porphyry in veins and in solid rock, mostly in kidneys or globular bodies from 1 to 6 or 8 inches in diameter. The lumps are in places connected by mere seams or stringers or are entirely isolated in solid rock.

Two Los Angeles companies and the Aztec Turquoise Company, of New York, are interested in the Mineral Park turquoise deposits. They all own claims on either Ithaca Peak or Turquoise Mountain or on both. The Aztec Company owns nine claims, which it has operated intermittently during the last five years.

Some of the mines are located on the east slope of Ithaca Peak, about 150 feet below the top, at an elevation of about 4,700 feet above sea level, or 800 feet above Mineral Park. They are reached by a burro trail from the camp at the foot of the mountain, and there is a good wagon road from Mineral Park to the camp. The workings consist mostly of open pits and cuts, rarely over 25 feet deep, and a few short tunnels.

The turquoise occurs sporadically in the rock, with a tendency to follow veins, fissures, seams, etc. The country rock is a highly altered feldspathic rock whose nature has not been definitely determined, consisting, in its present condition, chiefly of quartz. The latter mineral occurs in interlacing veinlets and stringers with pea-sized balls, probably original phenocrysts, in a finer matrix. Kaolinization of the original feldspar of the rocks has been extensive, with an accompanying production of sericite or some silvery mica and the liberation of much silica. This has left the rocks porous in places and more compact in others, where much secondary quartz has been deposited.

[a] Jew. Cir. Weekly, April 4, 1906.

Much of the turquoise appears to have been deposited from solutions in crevices and cavities both in quartz and in other matrix, and some seems to be a replacement of another mineral, probably the feldspar or the kaolin formed from the feldspar. The rock is considerably stained with copper, and in places the kaolin takes on the color of turquoise.

The monthly output from the Aztec Company mines is stated to be between 1 and 2 cubic feet. This is shipped to New York, and the bulk of it is sold in the rough, though the company also elaborates some of its own material and works it up into jewelry. The sizes obtained vary from particles too small for use to pieces 2 or 3 inches through. The best color is considered to be the pigeon blue. The dark blue, though very fine, appears greenish under electric light. The greater part of the product is partly off color, and it is very difficult to btain turquoise of the correct shade.

The home production of turquoise reported to the Survey came from New Mexico and Arizona. The large decrease in value was due to the closing down of many mines by some of the hitherto large producers. In New Mexico the Porterfield Turquoise Mines Company operated its deposits in the Burro Mountains, Grant County, about 12 miles southwest of Silver City, opening new ground during the year.

PERSIA.

According to Maj. R. L. Kennion,[a] the turquoise mines near Nishapur (concessions for which are sold annually by the Shah's Government) are the most important mines of the Khorassan. The mines are worked in an unscientific and reckless way, each concessionaire trying to get a maximum production from his mine for the year. If leases of greater duration could be obtained, systematic working would doubtless be undertaken. The present profits are large, but can not be estimated.

UTAHLITE.

The production of utahlite was again entirely from Utah and from the localities already described by Doctor Kunz in these reports.[b] According to Mr. Don Maguire, of Ogden, the value of the output from Clay Canyon, Utah County, and from the Mercur locality, Tooele County, was about the same.

GEM MINERALS OF MAINE.

The following notes on the occurrence of the gem minerals of Maine have been abstracted from a manuscript report by Mr. Edson S. Bastin on the feldspar, quartz, mica, and gem deposits of that State, to be published as a bulletin by this Survey:

The gem minerals described are tourmaline, topaz, quartz, and beryl. They occur as accessory minerals in pegmatite. The latter is composed of feldspar, quartz, and mica in coarse-grained aggregates, and occurs as intrusive masses in closely folded slates and schists. These intrusive masses follow, in general, the bedding planes and schis-

[a] Mining Jour. (London), November 3, 1906.
[b] Mineral Resources U. S. for 1904 and 1905, U. S. Geol. Survey, 1905 and 1906.

tosity of the inclosing rocks. The latter with the interbedded pegmatite dip at high angles in some places, while in others they are but gently inclined. The dip of the formations has much to do with the regularity of the surface outcrop. The latter is more regular and the deposits are more easily followed where the dip is at a high angle than where it is low. Other deposits have no definite direction, but resemble stocks in form.

These pegmatites represent one phase of the granitic intrusions, of late Silurian or Devonian age, so abundant in southern and southeastern Maine. They are intruded into metamorphic slates and schists, with which are associated igneous gneiss, diorite, diabase, etc. Dikes of fine-grained granite are generally associated with the pegmatites and have been found grading into them. The texture of pegmatite varies greatly in different deposits and in different parts of the same deposits. Only those with coarser texture are worked for their valuable minerals, such as feldspar, quartz, mica, and gem minerals. Some of the deposits are worked for more than one of these. The gem tourmalines are usually obtained from pockets in the pegmatite, while the beryl is nearly always embedded in solid pegmatite.

The color and quality of the gem minerals found are often very fine. The tourmaline ranges from white or colorless through various shades of blue, green, and red. One or more of these colors often appear in the same crystal, either in more or less clearly defined layers across the crystal or with one color as a core and others surrounding it. The topaz varies from colorless to amber color, and some specimens from Stoneham, Oxford County, have been described by Doctor Kunz as of beautiful quality, transparent in parts and colorless or faintly tinted with green or blue. Besides clear varieties of quartz, rose and amethystine-colored varieties are found. Beryl in opaque crystals is common, and some of gem quality is encountered, either aquamarine, golden beryl, or rarely emerald. A colorless to bluish or pinkish-white variety containing a small percentage of cæsium is also found. These stones, when not used for museum specimens, are generally cut by Maine lapidaries and sold within the State, where they command a higher price than they would in the open market. Most of the cut tourmalines sold are under 3 carats in size. The Maine stones, like the tourmalines from other localities, generally have to be cut with the table parallel to the longer axis of the crystal, since the absorption of light is so strong in colored stones in the direction of this axis that a stone with a table at right angles to it appears dull and dark. The cæsium beryl makes a stone well adapted for evening wear, rivaling some diamonds in brilliancy.

The following table represents the prices of flawless cut stones as sold in Maine:

Prices, per carat, of Maine gem stones.

Tourmaline:		Beryl:	
Rubellite	$12 to $30	Aquamarine	$4 to $15
Emerald-green	8 to 20	Golden beryl	10 to 25
Indicolite	6 to 18	Cæsium beryl	5 to 20
Olivine-green	6 to 18	Emerald, very rare.	

Tourmaline was first found in Maine at Mount Mica, near Paris in Oxford County, in 1820, by two students, Messrs. E. S. Hamlin and E. Holmes. Exploratory work disclosed a deposit of large size, con-

taining pockets with beautiful stones in them. The deposit was worked in an intermittent way by mining companies and mineral collectors until 1890, when Mr. Loren B. Merrill obtained control; he has since operated it successfully. The present dimensions of the quarry are about 150 feet long by 100 feet wide and 20 feet deep in the deepest part. Work is facilitated by a derrick operated by a horse windlass to remove the waste. Drilling is done by hand, and black powder is used in order not to shatter gem material more than necessary. The pegmatite is in a general way conformable with the schistose country rock, which strikes N. 50° to 60° E., with a dip of 20° to 30° SE., and is overlain by schists on the southern side of the quarry to a depth of about 15 feet. It is probable that tunneling will soon be necessary to avoid the expense of removing a heavy overburden of schist. The thickness of the pegmatite exposed in the quarry is about 20 feet, though the total is probably somewhat greater. The principal constituent minerals of the pegmatite are quartz, orthoclase, and microcline, muscovite, biotite, and black tourmaline. The mode of association of these minerals and the texture of the rock are very irregular. The feldspar crystals attain dimensions of several feet in places, and mica of merchantable size is sometimes found. Other interesting minerals beside tourmaline are granular lepidolite, beryl, and spodumene. The beryl occurs both in pockets and in the solid pegmatite. That in the pockets is the pale-pinkish cæsium gem beryl, and that in the solid rock is generally opaque and pale green, though small clear portions are sometimes found which yield aquamarines.

Gem tourmaline is found almost entirely in pockets in the pegmatite. These pockets seem to be confined to a zone from 6 inches to 7 feet wide, which is not readily distinguished in appearance from the pegmatite above it but is underlain by a narrow garnetiferous layer, beneath which the rock is finer grained and apparently barren of gem minerals. The pockets are sometimes very irregular in shape, and range in size from about a pint in capacity to dimensions of several feet. In all, about 430 pockets have been opened. Out of 350 opened by Mr. Merrill, only 50 were of much value. The walls of these cavities are usually lined with lepidolite, clevelandite, amblygonite, and quartz crystals; and the bottoms of the cavities are generally covered with a sandy or clayey mass, consisting of the decomposition products and fragments of the minerals forming the walls. The tourmalines are embedded in this decomposed matter. Some, whose form and color as they lie thus embedded in the pockets seem to be perfect, crumble away when handled, often leaving a rounded nodule of perfectly fresh mineral, which is generally beautifully transparent. These nodules often yield the finest and most perfect gems.

Most of the gem tourmalines range in color from olivine green through emerald green to blue green and nearly colorless. Beautiful pink tints are also found. One shade usually predominates in a given cavity, though this is not always the case. Single crystals in some cases shade from white at one termination to emerald green, then light green, pink, and finally colorless at the other termination. Green crystals tipped with pink are especially common. Generally these transitions of color are very gradual, but in other specimens the colors are not mingled in the least and the crystals seem to be composed of several distinct sections, though crystallographically they are continuous throughout.

The total value of gems and cabinet specimens obtained from Mount Mica to date is estimated at over $50,000.

The Noyes gem mine is near the summit of a hill about three-fourths of a mile east of Hicks Pond, in the southern part of the town of Greenwood, Oxford County. It has been worked by a small open cut, the southern wall of which consists of schist with a strike of N. 50° W. and a nearly vertical dip. The pegmatite, which can be traced a little way beyond the cut, contains numerous pockets, some measuring several feet in size. Good gem tourmaline, suitable for cutting, was obtained while the mine was worked.

At the Black Mountain mica mine, in the town of Rumford, Oxford County, greenish-black and opaque pink tourmalines have been found. There are no pockets in the pegmatite, however, and no gem material has ever been obtained.

The Dunton mine, in the northeast corner of the town of Newry, Oxford County, was worked a little for gem tourmaline and beryl in 1903 and 1904. The pegmatite, which is extremely coarse grained, has been exposed in the mine in a face about 20 feet high. In a space 5 or 6 feet across, near the center of the pegmatite as exposed in the quarry, much lepidolite, pink and white opaque spodumene, and tourmaline are associated with the feldspar. Some of these minerals are very coarsely crystallized, for spodumene crystals 2½ inches long and 3 inches wide, and tourmaline 2 feet long and 4 or 5 inches in diameter, have been found.

The tourmalines range in color from black to dark indigo blue to grass green, emerald green, red, and pink. They are generally found in solid pegmatite, which makes their extraction without breaking difficult. The blue-green varieties are usually opaque, while the green and pink crystals are transparent. The larger crystals are generally not sufficiently transparent for gems. Beryls are found occasionally, and one seen was of a beautiful grass-green color.

GEM MINERALS OF SOUTH CAROLINA.

In a "Catalogue of the Mineral Localities of South Carolina" (in press), prepared by Earle Sloan, State geologist, the occurrence of several gem minerals is noted. Among these are emerald, aquamarine, beryl, sapphire, amethyst, and rutilated quartz, with some garnet, zircon, green tourmaline, amber, and chalcedony. None of these gem minerals, however, have been worked, nor have commercial deposits been proved as yet.

Beryl, in some cases of gem quality, has been found in a belt running through Anderson and Spartanburg counties and is generally associated with pegmatite. Some beryl, however, also of gem quality, has been obtained during the washing of monazite-bearing gravels. The best specimens have come from Anderson County, among which were green crystals whose color rivaled that of the oriental emerald.

Scattered crystals of corundum, with a few of gem quality, have been found in Cherokee County in monazite deposits. A valuable oriental emerald is said to have been found in the Bowen River section, and a blue sapphire from the same region sold for $75.

Amethyst has been found at several localities in Cherokee, Anderson, and Abbeville counties. Some was of superior quality.

Rutilated quartz has been found in connection with the monazite belt running through Anderson and Spartanburg counties.

The quartz gem stones mentioned above, as well as the crystal and smoky varieties, are found with rutile and other interesting minerals in the continuation of the monazite belt in North Carolina.

GEM MINERALS OF SOUTHERN CALIFORNIA.

The following notes on the gem-mining industry of San Diego and Riverside counties in southern California have been furnished by Mr. Fred M. Sickler, of Pala, San Diego County, Cal.:

SAN DIEGO COUNTY.

The principal gem minerals mined are tourmaline of many colors, pink and lilac colored spodumene, aquamarine and pink beryl, topaz, essonite, epidote, and axinite. These minerals are found in pegmatite veins cutting diorite and gabbro. The latter rocks are inclosed in large areas of granite. The gem-bearing region is bounded on the east and west by sedimentary and eruptive rocks (largely basalt). The sedimentary rocks contain limestone, near the contact of which with the intrusive rocks essonite garnets are found. The gem belt probably nowhere exceeds 40 miles in width, measured in an east-west direction, and extends from the San Jacinto Mountains in Riverside County southward through San Diego County into lower California. The region has been the seat of considerable activity, both in the development of old mines and in the discovery of new prospects, during the year 1906.

PALA.

At Pala work on the tourmaline King mine was pushed energetically for a part of the year, and tourmaline of great beauty and large size was obtained along with some beryl and "water sapphire." On account of litigation with a neighboring claim, however, the work was stopped about the middle of the year. Work on the tourmaline Queen mine was continued, stones of a variety of colors and of unsurpassed quality being produced. Messrs. Gordon and Goodwin have sunk about 50 feet on a new prospect and report the finding of beryl and kunzite. Messrs. Lobaugh & Co. sank an incline shaft to a considerable depth on an extension of the Stewart ledge. Lepidolite, large quartz crystals, and other evidence of a good gem formation were encountered, but no information was given concerning the production. The Pala Chief mine was active during the year and produced a large quantity of kunzite and tourmaline. Messrs. Magee & Co. did a large amount of tunneling on their new property and obtained considerable aquamarine beryl and indicolite. Mr. Ben Hubert reported a good find of gems on a new claim. Messrs. Hiriart and Teilitch mined a quantity of pink kunzite and beryl from their claims. The Caterina mine, which they own in partnership with Mr. M. M. Sickler, has proved to be the equal of any kunzite mine in southern California. They found a very large pocket of gems and have traced the mineralized portion of the ledge several hundred feet beyond its former supposed limit. The Sickler Gem Mining Company produced considerable kunzite, as well as excellent tourmaline and some beryl. The green tourmaline from its properties more nearly rivals the emerald in color than that from any other locality in the State.

RINCON.

At Rincon the Victor Gem Mining Company has been exploiting a new field. In one deposit beryl of fine aquamarine color was obtained in large quantity. In another deposit good kunzite was found for the first time in this district, along with beryl and tourmaline. Some of the tourmaline from this locality has a green core and shell, with a yellowish ring between and has been cut so as to show the combination of colors with pleasing effect.

MESA GRANDE.

The Himalaya Mining Company has directed its energies mainly to deep mining, which involved a large amount of dead work. It is thought, however, that even if the production was small there was a sufficiently large stock on hand from the preceding year to meet requirements, since the mine has been unequaled in the production of tourmaline. The San Diego Tourmaline Mining Company has completed hundreds of feet of tunnels and is in a position to make a large production. The company reports a large sale of gems in Germany at good prices. The Native Gem Mining Company produced principally pink and aquamarine beryl, with tourmaline

of several colors. Its specimens of quartz crystals and beryl from the Esmeralda mine attracted much attention when exhibited in San Diego, and one of the pink beryls sold for $600 toward the close of the year. The Mesa Grande Tourmaline Mining Company drove a tunnel more than 100 feet at a new mine and obtained some pink and green tourmaline. Work had to be suspended, however, as the wet weather caused a cave in.

OTHER DISTRICTS IN SAN DIEGO COUNTY.

Mr. Havis drove a tunnel on a new prospect near Banner and reported the discovery of much lepidolite and some indicolite. Mr. Freeman has developed his property near Vista by tunnels and crosscuts and has obtained some gem tourmaline, chiefly of yellow and green color, with some of a fine pink color. The Ramona gem district did not make much progress, as there have been many lawsuits and much disagreement among the mine owners. The district has, however, produced fine topaz and pink beryl, besides spessartite, essonite, green tourmaline, and aquamarine.

The southern portion of the gem region in San Diego County has been exploited by the San Diego Gem Mining Company and the Mesa Grande Consolidated Gold and Gem Mining Company. Essonite garnet, sold as hyacinth, is the principal stone produced, and the demand for large, clear, yellow stones has exceeded the production.

RIVERSIDE COUNTY.

Mr. Bert Simmons has spent much time developing his claim at Oak Grove, from which he obtained some pink and blue colored tourmalines. At his new and promising claim at Chihuahua fine specimens of beryl and indicolite have been found included in coarse albite. At Coahuila the Mesa Grande Tourmaline Company and the Fano Kunzite-tourmaline Company have been operating on new prospects, and have produced some green beryl and tourmaline. Mr. Robert Magee also has been successful in working several deposits containing beautiful rubellite and beryl of remarkable clearness.

The following notes abstracted from an article on The Pegmatite Veins of Pala, San Diego County, by Mr. G. A. Waring,[a] are added to give further light on this interesting region:

The gem district of San Diego County lies in a region of crystalline rocks between the nearly level Mesa country on the west and the desert on the east. The Palomares and higher mountains included in this area are composed chiefly of mica schists, while the lower-lying hills and mountains are of granite and diorite or gabbro. The relations seem to be "intrusive diorite dikes and later granite intrusions within the main granite mass." The gem minerals are found in pegmatite veins cutting the diorite. The pegmatitic structure is well developed to the northeast of Pala, where there is a gabbro boss about 1½ miles wide and 4 miles long inclosed in granite. The veins in this locality dip rather uniformly to the southwest at an angle of about 30°. They have a uniform banded structure, due to the presence of one band each of graphic granite, coarse pegmatite, pay streak, and garnet quartzite. The latter makes about half of the thickness of the vein. The pay streak, which is composed of lepidolite, albite, muscovite, and black tourmaline, contains pockets lined with crystals and partly filled with clay. The minerals of the pockets are clear and smoky quartz crystals (often showing a development of rare faces), and, in some cases, rose quartz and hyalite; albite in tabular crystals; orthoclase in individual crystals embedded in the clay; greenish muscovite; lepidolite, often containing green tourmaline and kunzite. In some cases the crystals attain large size in these pockets, although one mineral may do so to the exclusion of another. Kunzite and tourmaline are rarely found in the same pocket, though they occur in the same vein. The clay of the pockets is found to consist of quartz,

[a] Am. Geol., June, 1905, pp. 356–369.

feldspar, and muscovite, with spodumene, lepidolite, and tourmaline in smaller quantities. A soft, unctuous-feeling, pink clay, called halloysite, apparently derived from rubellite, occurs in many of the pockets.

At Rincon gem minerals are found in pegmatites of similar structure to those of Pala, though inclosed in badly decomposed granite. The hard pegmatite contains black tourmaline, massive almandine garnet, large beryl, and greenish muscovite; and the pockets contain crystals of quartz, orthoclase, and beryl of gem quality (tourmaline and kunzite have since been found in the pockets also, according to Sickler). The crystals of the pockets have been corroded and partly dissolved by alkaline waters, leaving the faces rough and scarred.

GEMS OF CEYLON.

An interesting article, by Mr. Ralph Stokes,[a] appeared in 1906 on the gems of Ceylon. It seems to be very difficult to obtain reliable information about the gem industry from the natives or elsewhere. The output is handled almost exclusively by a small ring of Mohammedans in Colombo. The merchants obtain their supplies through Moorman dealers from the smaller villages nearest the gemming districts, to which the miners bring their stones for disposal. The Moorman dealers are generally lapidaries and take all the risk incident to the loss of material in cutting. The methods of cutting employed by the lapidaries are primitive, and the tendency is to sacrifice everything for size. The quality of the cutting is otherwise often excellent.

The more common gem stones of Ceylon are sapphire, ruby, star sapphire, chrysoberyl, cat's-eye, and moonstone, with some green, blue, and red spinel, topaz and oriental topaz, green, yellow, and colorless zircon, garnet cinnamon stone, aquamarine, and tourmaline. These stones are obtained almost entirely from alluvial deposits derived from the denudation of crystalline rocks.

According to Dr. A. K. Coomeraswamy,[b] the natives of Ceylon appear to have located nearly all of the deposits valuable for gems. In the gem districts themselves the richer places are pretty well known and generally partly worked out. In some cases only the deeper "illam" or gravels remain. Gem mining probably can never be profitably undertaken by Europeans. Even for the Ceylonese it is usually a lottery. Several unsuccessful attempts have already been made by gemming companies and it is not likely others will succeed, since the gem lands are owned by scattered landowners, who apparently claim all the beds except in the larger rivers, and all operations would require careful supervision. The gemmers fall into three classes: Illicit gemmers; fairly prosperous men who work their own lands, occasionally employing help; and rich men who have their pits worked for them or rent out the land. In the latter case the lessees dig a pit down to the "illam," when the owner or other responsible man attends the work to see that nothing is stolen. The gems are divided, three-fourths to the owner or lessee and one-fourth among the men along with their food, but with no wages.

In the gemming region of Sabaragamuwa the Cingalese employ a crude system of dredging to obtain gems and sometimes gold. A

[a] Min. World, April 28, 1906, pp. 523–524.
[b] Administration Repts., Ceylon Min. Survey, pt. 4, 1905 p. E 11.

convenient place in a river is selected where there is a good current, not too deep, and where, if possible, there are no large bowlders. A low fence or dam is generally built from the sides part way across the stream to increase the flow of water. The men—half a dozen or more are needed—stand in a row facing upstream and rake up the gravel above them with a special long-handled "mamoty" (sort of hoe or rake). They work as far up as their "mamoties" will reach, and eventually scoop a large hole under water in front of them. By this process the overlying layers of sand and clay are removed and the illam exposed. This gravel, along with that underneath, is then worked up and allowed to drop in the water near the men's feet, where the current washes away the lighter material. The gravels thus partly concentrated are washed in the usual way in baskets.

SIMPLE METHOD OF TESTING PRECIOUS STONES.

Mr. Meyer D. Rothschild[a] has suggested a simple test, applicable to a number of stones, that can be made by any jeweler who will exercise care in its execution. Hydrofluoric acid or "white acid" (a mixture of ammonia and hydrofluoric acid) is used. The acid should never be allowed to come in contact with the skin, as it is very poisonous and highly corrosive, producing painful sores and ulcers. The stone to be tested is handled with forceps and immersed one minute in the acid; then it is removed and the acid is washed off. The test is applicable only to diamond, ruby, sapphire, spinel, emerald, aquamarine, precious topaz, tourmaline, garnet, and kunzite, which are unaffected by the hydrofluoric acid. The test is not applicable to turquoise and opal, which are rapidly etched or eaten away by this acid, nor to peridot and the quartz gems, as amethyst, false topaz, crystal, agate, etc., which have their surfaces dimmed and require repolishing. The genuine reconstructed and artificial ruby is also unaffected, while all imitations made of paste, as imitation ruby, sapphire, emerald, etc., are rapidly attacked.

PRODUCTION.

It has been found next to impossible to obtain definite figures showing the production of many varieties of gem minerals in 1906. There has doubtless been a production of several gem minerals not recorded in the table, but since no information could be obtained concerning them, they have not been listed. There are several causes combining to make the collection of statistics for precious stones difficult. In many cases the production is made up of a number of small lots and scattered finds which are brought in at different times and disposed of to different people. Often the persons interested in mining gems do not care to furnish figures showing the production, which has then to be either estimated or omitted entirely. There have been, however, a great many producers and men interested in minerals who have generously assisted in every way possible toward the compilation of statistics of production and have furnished information concerning the progress of the industry.

It has been deemed advisable, for several reasons, to make a change in the form of table showing the production of precious stones. First,

[a] Jew. Circ. Weekly, January 16, 1907.

the list of those gems for which figures were obtained directly from producers or persons closely associated with the production was very much smaller than usual. Furthermore, it is the aim of the Survey to give the value of all material in the rough, and the basis chosen for estimation is therefore, in many cases, not like that previously used, and hence, it has not been found possible for one not closely connected with the trade, as Doctor Kunz has been for many years, to give estimates of production on a basis similar to that formerly used. Though Doctor Kunz has very kindly offered to supply the necessary information and has furnished assistance in many other ways, it has seemed best to rearrange the table of production to fit the information as furnished to this Office. In order that the changes made may be readily understood and a partial comparison be made with the production of precious stones in previous years, the table as printed in the report for 1905 by George F. Kunz is herewith reprinted in part.

In the table for 1906 some large changes from 1905 have been recorded in the production of certain precious stones. These have been caused in part by changes in the basis of estimation and in part by changes in production. The largest changes, where the same minerals appear in both tables, have been in sapphire, turquoise, chrysoprase, tourmaline, and kunzite. In the case of sapphire, turquoise, and chrysoprase, the changes are due in part to the basis of estimation and in part to changes of production; in the case of tourmaline and kunzite, the changes probably result entirely from increased production.

Production of precious stones in the United States in 1906.

Precious stone.	Value.	Remarks.
Amazon stone	$100	Colorado.
Amethyst	700	Scattered lots.
Beryl (aquamarine, etc)	7,800	Mostly gem material; California, Colorado, North Carolina, Massachusetts, New Hampshire, Maine.
Beryl (pink)	1,200	Chiefly from a few large crystals; California.
Chiastolite	25	Massachusetts.
Chrysoprase	32,470	3,250 pounds in the rough; California.
Diopside	5	10 carats in the rough; Kentucky.
Garnet, almandite	100	Few scattered finds; chiefly North Carolina.
Garnet, essonite	400	1,000 carats in the rough; California.
Garnet, pyrope	2,500	Scattered lots; Utah, Arizona, Kentucky.
Moss agate	800	8,000 pounds in the rough; Wyoming.
Peridot	2,400	Scattered lots; Arizona, Kentucky.
Phenacite	250	Gem crystals; Maine.
Prase	50	Colorado.
Quartz, crystal	900	6,000 pounds in the rough; California, North Carolina, New York.
Quartz, rose	4,000	40,000 pounds in the rough; South Dakota, Colorado, Maine.
Quartz, rutilated	50	Scattered finds; North Carolina.
Quartz, smoky	2,000	1,500 pounds in the rough; California, Maine, North Carolina.
Quartz, tourmalinated	100	Colorado.
Ruby	600	Scattered finds; North Carolina, Idaho.
Sapphire	39,100	404,150 carats in the rough; Montana, North Carolina, Idaho.
Spodumene, lilac or kunzite	12,500	75 pounds, rough gem stock; California.
Spodumene, green or hiddenite (?)	1,500	5 pounds, rough gem stock; California.
Topaz	1,550	Maine, Utah, California.
Tourmaline	72,500	1,450 pounds, rough gem stock; California, Maine, Colorado, Connecticut.
Turquoise	22,250	556,500 carats, partly picked; Arizona, New Mexico.
Utahlite	2,000	Utah.
Wood, silicified and opalized	150	3,000 pounds, rough material; Colorado.
Total	208,000	

In the following table is given a statement of the production of precious stones in the United States in 1904 and 1905:

Production of precious stones in the United States, 1904–1905.

Precious stone.	1904.	1905.	Precious stone.	1904.	1905.
Diamond	None.	None.	Garnet (almandite)	None.	None.
Sapphire	$100,000	$125,000	Rhodolite	None.	None.
Ruby	None.	None.	Garnet (pyrope)	$3,000	$5,000
Topaz	None.	500	Topazolite	None.	None.
Beryl (aquamarine, etc.)	5,000	6,000	Amazon stone	500	1,000
Beryl (pink)	100	1,000	Oligoclase	None.	None.
Emerald	None.	None.	Moonstone	None.	None.
Phenacite	None.	None.	Turquoise	100,000	65,000
Tourmaline	40,000	50,000	Utahlite (compact variscite)	200	500
Peridot	5,000	10,000	Chlorastrolite	2,000	3,000
Kunzite	10,000	5,000	Mesolite (thomsonite, so called)	500	500
Quartz, crystal	10,000	10,000	Prehnite	None.	None.
Smoky quartz	2,000	3,000	Diopside	None.	None.
Rose quartz	1,000	1,000	Epidote	None.	None.
Amethyst	3,000	2,000	Pyrite	3,000	2,000
Prase	None.	None.	Malachite	None.	2,000
Gold quartz	5,000	5,000	Rutile	None.	None.
Rutilated quartz	None.	None.	Anthracite (ornaments)	2,000	2,000
Dumortierite in quartz	None.	100	Catlinite (pipestone	2,500	2,000
Tourmalinated quartz	None.	None.	Fossil coral	None.	250
Agate	2,000	2,000	Arrow points	None.	1,000
Moss agate	1,500	1,500	Miscellaneous	15,000	10,000
Chrysoprase	6,000	5,000			
Silicified wood (silicified and opalized)	5,000	5,000	Total	324,300	326,350
Opal	None.	None.			

IMPORTS.

The importation of precious stones into the United States in 1906, as reported by the Bureau of Statistics, again shows a substantial increase over that of the preceding year. This increase was chiefly in unmounted cut diamonds, though there was also a substantial increase in the importation of rough diamonds. The importations of glaziers' points and pearls were also larger than 1905; diamond dust or bort and miscellaneous precious stones showed a slight decrease. Almost the whole imports of precious stones came through the port of New York, the figures obtained for other ports amounting to only $28,988.

The following table shows the value of the diamonds and other precious stones imported into the United States from 1903 to 1906, inclusive:

Diamonds and other precious stones imported and entered for consumption in the United States, 1903–1906.

Year.	Diamonds.					Diamonds and other stones not set.	Pearls.	Total.
	Glaziers'.	Dust or bort.	Rough or uncut.	Set.	Unset.			
1903	$10,634	$720,150	$10,275,800	$675	$13,022,367	$2,494,897	$2,414,524	$28,939,047
1904	73,054	445,621	10,234,587	559	13,439,023	1,893,969	1,142,150	27,228,963
1905	6,851	190,072	10,281,111	741	20,375,304	4,144,434	1,847,006	36,845,519
1906	104,407	150,872	11,676,529	305	25,268,917	3,995,865	2,405,581	43,602,476

PEARL INDUSTRY IN THE UNITED STATES.

Each year there is an unrecorded production of pearls from fresh-water mussels of many of the rivers of the United States. The principal yield comes from the Mississippi Valley region, where beds of pearl-bearing mussels are found in many of the tributary rivers. Along the Atlantic Coast States pearls have been found from Maine to Florida, and in the Gulf States from Florida to Texas.

The season for gathering pearls and mussels is from May to November, when buyers and dealers travel from one locality to another where there are pearl fisheries. Often the mussels are gathered in large quantities and opened simply in search of pearls, and then thrown away with no thought of their value for manufacturing pearl buttons. In other cases the shells are saved for this purpose, but much useful material is wasted at the button factories. With the reckless destruction of millions of mussel shells for pearls and button manufacturing, the beds of these shells are being rapidly depleted, and unless some steps are taken for their preservation it will not be long before the deposits will be exhausted. Laws passed to prohibit the gathering of shells and pearls on certain portions of the rivers for a period of years, after once being fished over, would give the mussel beds a chance to restock themselves, and thus a permanent industry would be established instead of one rapidly working out its own destruction. It is said the Fish Commission will undertake the investigation of the life and history of the pearl mussel shells of the Mississippi Valley in connection with the zoological department of the University of Missouri. This work is to be carried on for the ultimate purpose of devising a method to stop the extermination of the pearl mussels.

Many pearls are desirable for their even qualities and the ease with which they can be matched, while American pearls[a] exhibit the greatest number of variations in color and tint, and it is difficult to match exactly a number of them for necklaces and other jewelry. On the other hand, the exquisite coloring and the fine luster of our pearls more than offset the disadvantages due to such irregularities, and make them much desired in the gem market. A list of publications on American pearls and pearl shells is given in the bibliography at the end of this chapter for the convenience of persons who desire further information on the subject.

Very curious-shaped pearls and baroques are often found. Among those found in 1906 in the Mississippi region are three, which have been described and illustrated in the Jeweler's Circular Weekly. One of these was in the shape of a crowned head which much resembled that of Queen Victoria.[b] Another was rounded, and also looked like a human head.[c] Still another, a baroque, resembled the head of an old man with flowing beard and hair.[d] The color of this pearl was an exquisite pink, shading in places from dark to light tints, which appear to give light and shadow to the face.

The pearl industry is carried on in such a way that it is not possible to collect statistics showing the production. Buyers and dealers, not only from New York and other eastern cities, but even from Paris, visit the Mississippi region in the pearl-gathering season, travel from point

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[a] American Jeweler, October, 1906.
[b] Jew. Circ. Weekly, April 25, 1906.
[c] Idem, October 12, 1906.
[d] Idem, May 1, 1907.

to point, and at the end of the season return to their places of business. Many small dealers sell to larger ones on the spot; others send their product off to be marketed. In many cases parcels of pearls change hands two or three times before appearing in the gem markets. Pearls amounting to many thousands of dollars in value are exported annually, which apparently have not been reported to the Bureau of Statistics of the Department of Commerce and Labor.

Since it has not been possible to collect figures of production it has been thought well to give the estimates of those most familiar with the industry, in order that the size of the latter may be appreciated. In giving these estimates, kindly furnished by the persons named, it must be remembered that each one probably sees the industry in a different aspect, according to his connection with it.

ESTIMATES OF THE PRODUCTION OF PEARLS IN THE UNITED STATES.

Mr. Frank Koeckeritz, one of the largest pearl dealers in the Mississippi Valley region, places the value of pearls and slugs in 1906 at $381,000, with prices ranging from $1 to $2,000 and up each, and slugs from $1.50 to $60 an ounce. The colors are white, cream, pink, purple, blue, and rarely black. The various shapes found are round or ball shape, half round or button shape, pear shape, drop shape, oval, and irregular or baroques, and their occurrence is estimated as follows:

Approximate proportion (percentage) of each shape of pearls found.

Drop	5	Round	15
Pear	5	Button	25
Oval	10	Irregular	40

Mr. Koeckeritz places the production of button shells at 43,500 tons, valued at $348,000 at points of production, or at $556,625 after shipment to the factories.

The value given for pearls and slugs represents the first cost, or prices paid to the pearl fishers. By the time the stones reach the consumer, after passing through the hands of the large dealer, the jobber, the manufacturer, and the jeweler, the value is easily four times that originally paid. The demand for American fresh-water pearls is strong, both in the domestic markets and abroad, especially in Paris, whither many pearls are taken directly from the pearl region.

The production of pearls from the Wabash River alone in 1906 is conservatively estimated at from $100,000 to $150,000 by Mr. W. D. Burd, of St. Louis, a large pearl dealer in the Mississippi region. The Wabash River and its tributaries were probably more actively worked last season than any other rivers in the country.

An estimate of the United States Fish Commission places the value of the production of pearls in the United States in 1906 at about $500,000. The only year statistics were collected by the Commission was 1903,[a] when the value was placed at $213,451, with $316,647 worth of button shells.

[a] Bowers, G. M., Statistical bulletin No. 188, Bur. of Fisheries, Department of Commerce and Labor.

Mr. J. F. Boepple, of Davenport, Iowa, estimates the annual production at about $2,000,000 worth of pearls for the last eight years in the Mississippi region, and states that for the Wabash River alone in 1906 it is reported that about $1,000,000 worth were gathered. Mr. Beopple was the pioneer manufacturer of pearl buttons in the Middle West and was instrumental in establishing both the pearl-button industry and the pearl industry.

OCCURRENCE OF DIAMONDS IN ARKANSAS.

By George F. Kunz and Henry S. Washington.

In Pike County, Ark., there is a small area of peridotite which enjoys the distinction of being the first locality in North America where diamonds have been found in place, and not in river gravels or glacial deposits. In the present paper we purpose to give a brief preliminary account of the locality, of the history of the recent discovery of the diamonds, and of their occurrence, reserving fuller details for a subsequent paper.

The igneous area, which lies about 2½ miles southeast of Murfreesboro, the county seat, just east of the junction of Prairie Creek with Little Missouri River, was first noticed by W. B. Powell as far back as 1842, later by C. U. Shepard in 1846, and was subsequently described in considerable detail by J. C. Branner and R. N. Brackett,[a] from whose description, supplemented by our own observations, the following geological and petrographical data are taken.

The mass of igneous rock forms a small stock, which has cut through massive Carboniferous sandstones and quartzites, somewhat indistinctly bedded at rather steep angles. Unconformably overlying these are horizontally bedded Cretaceous sandstones, themselves overlain by coarse, post-Tertiary conglomerates, the pebbles of which consist of jasper, chert, and flint, and which much resemble some of the Brazilian cascalhos. A small dike of peridotite cuts the Cretaceous sandstone in the bed of Prairie Creek, but does not penetrate the conglomerate above, thus establishing the date of the intrusion as post-Cretaceous but prior to the deposition of the conglomerates.

The igneous area itself is roughly elliptical in shape, with a longer diameter of about 2,400 feet and a shorter of 1,800 feet, the former lying about northeast-southwest, and the latter at right angles to this. The northwest edge of the area is marked by a ridge with three summits, of which the southwestern is composed chiefly of Carboniferous quartzite, as is part of the northeastern one, while the central hill is composed of a dense, dark, rather fresh peridotite, which is split by joints into massive blocks. South and southeast of this ridge, the summits of which lie from 60 to 80 feet above its base, the surface slopes gently down toward the cotton-planted bottom lands on the left bank of Little Missouri River. This portion of the area consists of very much decomposed peridotite, covered in places by a thin stratum of soil and many pebbles derived from the post-Tertiary conglomerate. There is little evidence of alteration of the surrounding sandstones by the igneous intrusion, and, judging from its form and from the petrographic character of the rock, the stock appears to be the neck of a small volcano, the upper part of which has been removed by erosion.

[a] Branner and Brackett, Am. Jour. Sci., vol. 38, 1889, p. 50, and Ann. Rept. Geol. Survey Arkansas or 1890, vol. 2, 1891, p. 377.

The peridotite has been so well described by Branner and Brackett that a few words of description will suffice here. In the hand specimen the freshest peridotite is very dark, brownish or greenish black, and porphyritic with an aphanitic groundmass. The phenocrysts, which make up about one-quarter of the rock, are mostly of olivine, the color of which is commonly black, but in some specimens of the rock is yellow or brown, especially in the less fresh specimens. With these are fewer, small, glistening plates of a bronzy biotite.

In thin section the olivine phenocrysts are seen to be well-formed, from 0.5 to 5.0 mm. long, some of them colorless and fairly fresh in the interior, but most of them largely altered to serpentine. The biotite phenocrysts are seen as irregular brownish-yellow patches, highly pleochroic. The groundmass shows very numerous, small, stout prisms of colorless augite, and many small grains of magnetite and of transparent, yellow, isotropic perofskite, embedded in a vitreous base, which is either colorless or yellow. This is usually isotropic, but may exhibit faint aggregate polarization through decomposition.

The fresh peridotite was analyzed chemically by Brackett, and in its general features it does not differ widely from that found at some other localities, and his figures accord well with the mineral composition shown by the microscope. Ferric oxide predominates over ferrous, which may be ascribed to the somewhat weathered condition of the rock, and potash is rather high, this being connected with the presence of biotite.

As is true of almost all peridotites, the Pike County rock weathers readily, two stages of decomposition being observable here. The first consists of the mechanical disintegration of the mass into an aggregate of small, angular fragments, which still preserve nearly their original hardness, though the olivines are almost wholly altered. This passes into the stage which is of most interest in connection with the occurrence of diamonds, the solid rock being reduced to a soft, friable mass. This is either of a yellowish or, more characteristically, of a yellowish-green or light bluish-green color, the two varieties having been called locally the yellow and green earths. In these the outlines of the original olivines are still well seen, but the mineral is reduced to a soft, yellow substance, while the biotites are comparatively little changed. From the preservation of the form of the olivines it is clear that the decomposition of the rock has gone on in place, and that the yellow and green earths have not been transported from a distance.

These peculiar decomposition products occupy by far the greater portion of the igneous area, occurring just beneath the thin surface soil covering all that portion which lies south of the ridge of three hills mentioned above, while a considerable portion is laid bare and cut into deep gullies by surface erosion. Apparently the yellow earth overlies the green and represents the last stage of decomposition, while both overlie the less decomposed, fragmental, weathered form, though this last reaches the surface in places. The exact depth to which the green earth extends has not yet been ascertained throughout the area, but drill holes sunk to a depth of 30 feet still show the green earth in places, while elsewhere it is less deep and the solid peridotite is struck below it.

The first diamond was discovered on August 1, 1906, by Mr. John M. Huddleston, who had purchased the land lying south of the ridge

and including the greater part of the decomposed portion of the igneous area, largely on account of its peculiar character, as he suspected that it contained some "mineral." Mr. Huddleston was searching, on his hands and knees, for indications of copper or lead ores and his attention was attracted by the luster of the stone, which he recognized immediately as differing widely from the somewhat abundant small quartz crystals which are scattered over the area. The diamond, which is a white stone weighing 4½ carats, was lying among the pebbles on the surface of the thin layer of soil which overlies the green earth near the southern edge of the igneous area where the decomposed peridotite is much cut up by small gullies.

The afternoon of the same day, while riding on horseback into Murfreesboro and carefully scrutinizing the ground, he saw a second diamond lying in the ruts of the road, about 500 feet north of the first and also within the igneous area. This stone is likewise white and weighs 3 carats.

Although he and his family searched the area over very carefully, no more diamonds were found until September 8, when Mr. Huddleston found the third, also lying among the pebbles on the surface of the soil, above the green earth, about 400 feet northeast of the place where the first was found. This stone is yellow, a flattened, triangular hexoctahedron, and weighs one-half carat.

The stones were sent by Mr. Huddleston to persons in Little Rock, who, recognizing the probably great importance of the discovery, immediately secured options on Mr. Huddleston's land and on considerable territory in the vicinity, including the greater part of the igneous area. They then came on to New York and conferred with one of the authors (Mr. Kunz), who was, naturally, deeply interested in the discovery. The junior author (Mr. Washington) was called in and was intrusted with the geologic and petrologic examination of the locality, where he spent some time during the month of October. Pits were sunk in various places over the igneous area, the green and yellow earth was screened and panned, and a careful search was made for more diamonds on the surface, but none were discovered. Various considerations, which need not be discussed here, precluded the possibility of the ground having been "salted." The points of similarity, as well as of dissimilarity, with the South African pipes were recognized, and the conclusion was reached that the diamonds were probably derived from the peridotite; though, in view of the fact that all three had been found among the surface pebbles, which had come from the conglomerate, the possibility that this may have been their source was not excluded from consideration, and further extensive prospecting was recommended. This was subsequently done to some extent, though interfered with by bad weather, and several more diamonds were found by Mr. Huddleston and members of his family, as well as by other persons, all on the surface of the ground but within the igneous area.

In January, 1907, the two authors visited the locality together, and made a careful study of the igneous area and its surroundings. While the resemblance of the conglomerate to the diamond-bearing Brazilian cascalho was recognized, the facts that careful examination and panning of this and of the river gravels led to negative results, and that up to the time of the authors' visit as many as 26 diamonds had been found, all within the igneous area, though all likewise on the surface

of the ground, in addition to the petrographic and other evidence, rendered the presumption in favor of their derivation from the peridotite almost a certainty.

Subsequent to this visit extensive prospecting has been undertaken according to plans suggested by the authors, large amounts of the green earth (which disintegrates in water to a fine, impalpable mud) being washed and screened in Little Missouri River. This work was done under the supervision of Mr. Theodore Hartman, a civil engineer of Little Rock. In the course of these operations two small diamonds were found in the concentrates. This would have settled definitely the question of their source had not some doubt existed through the possible accidental admixture of small amounts of the surface soil with the underlying green earth, as Mr. Hartman's careful precautionary measures to guard against this were not followed by some of the men.

But final and absolutely definite proof that the diamonds occur in the peridotite and that those found have been derived from it was furnished by the discovery, about the middle of March, of a diamond embedded in the green earth, about 3 feet below the surface, while this was being excavated for washing, a careful watch being also kept by the men for just such a discovery. This specimen was brought to New York by one of the parties interested, and was carefully examined by both of the authors. The stone is white, apparently a flattened octahedron, firmly embedded in the decomposed peridotite, so that only a portion of it is visible, this being about 12 mm. long by 2 to 4 mm. wide. The most careful scrutiny failed to reveal any evidence that it had been artificially inserted, and no other conclusion was possible than that it was actually in situ. Taking all the facts into consideration, therefore, the occurrence of diamonds in the peridotite of Murfreesboro may be regarded as unquestionable.

The number of diamonds found up to the date of writing is 130, the weights varying from one thirty-second of a carat up to 6½ carats. The majority are distorted octahedrons, a few being flattened and triangular, and a small number are almost perfect octahedrons. No cubes have been found. Most of the stones are white, a large proportion being of good water and the white of exceptional purity, finer than most African stones. A smaller number are brown; some are yellow, and several small individuals are of bort.

The mass is now being examined with the diamond drill, and fresh and solid peridotite is found beneath varying depths of green earth, the greatest depth yet reached being 186 feet.

As this is the only place outside of South Africa where diamonds have been found in peridotite, a brief comparison of the two localities will be of interest, a more detailed statement being reserved for the future. While, petrographically and chemically, the rocks around Kimberley and near Murfreesboro are much alike, there are some decided differences. The Murfreesboro rock is a true porphyritic lava, although the portion now visible had not reached the surface, and it was evidently ejected through a volcanic vent as a relatively quiet liquid flow, while the peridotite of the South African pipes seems to be uniformly an igneous breccia and to have been ejected by explosive eruptions in a more or less fragmentary condition and probably mingled with a considerable proportion of water. At Murfreesboro inclosed fragments of the rocks traversed by the lava are wholly lack-

ing, not a piece of sandstone, quartzite, shale, or other nonigneous rock having been observed, so far as the authors know, during the extensive diggings. In South Africa, on the other hand, as is well known, such foreign material is abundant in the "blue ground," and includes quartzite, sandstone, shale, diabase, eclogite, and other rocks.

Such fresh peridotite as occurs at the Pike County locality does not seem to have been observed in South Africa, but the green earth of the former much resembles the blue ground of the latter, both in color and in being composed predominantly of highly serpentinized olivine, with smaller amounts of decomposed augite, and a little biotite, perofskite, and magnetite, although the Arkansas material is much softer than is the African. Similarly, at both localities the upper portions of the decomposed rock are yellow, through oxidation and hydration of the ferrous iron.

On the other hand, garnets, which are very abundant at the African pipes, are extremely rare and of very small size at Murfreesboro, though of the same red color, but their chemical composition is unknown as yet. Furthermore, chrome-diopside, hypersthene, zircon, kyanite, chromite, and ilmenite, which are such common ingredients of the African blue ground, are unknown at the Arkansas locality. While the blue ground of Kimberley is compact, and must be exposed for a long time to the weather before it disintegrates sufficiently to permit the extraction of the diamonds, the Arkansas green earth is soft and friable when first excavated, hardens somewhat on drying, but on exposure to the weather soon disintegrates to a fine mud, as it readily does on agitation with water. This, at least, is true of the upper portions, so far as they have been penetrated, but the harder fragmental material of the first stage of decomposition shows much less tendency to disintegrate and remains to be further investigated.

The question of the origin of the diamonds falls outside of the scope of this preliminary paper, but it may be noted here that no carbonaceous shales are known to occur in the vicinity of the igneous mass, nor were they observed as inclusions, as they are at Kimberley. This would indicate that Lewis's view of the derivation of diamonds by the metamorphism of carbonaceous shales does not apply here, and points to the probable truth of the view of Cohen, Hatch, and Corstorphine, that they are original constituents of the igneous rock. At the same time, in view of the occurrence of deposits of asphalt at Pike City, 10 miles northeast of Murfreesboro, and of the occurrence in the post-Tertiary conglomerate immediately north of Murfreesboro of some asphalt which may be supposed to be derived from underlying organic material, the question must, for the present, be left open.

BRIEF BIBLIOGRAPHY OF PRECIOUS STONES.

AMERICAN REFERENCES.

Baskerville, Charles. Kunzite, a new gem: Science, new ser., vol. 18, No. 304, 1903, pp. 303–304.

Claremont, Leopold. Cutting and polishing of precious stones: Mineral Industry, vol. 8, New York, 1900, pp. 229–233.

Dana, E. S. On emerald-green spodumene from Alexander County, N. C.: Am. Jour. Sci., 3d ser., vol. 22, 1881, p. 179.

Ford, W. C. Some interesting beryl crystals and their associations: Am. Jour. Sci., 4th ser., vol. 22, 1906, pp. 217–223.

Johnson, Douglas Wilson. Turquoise; in The Geology of the Cerrillos Hills: School of Mines Quart., vol. 24, 1902–3, pp. 493–499.

JUDD, J. W., HIDDEN, W. C., and PRATT, J. H. On a new mode of occurrence of ruby in North Carolina: Am. Jour. Sci., 4th ser., vol. 8, 1899, pp. 370–381.
KUNZ, GEORGE F. Jewelers' materials and ornamental stones of California: California State Min. Bureau, Bull. 37, 1905.
——— Precious stones: Mineral Resources U. S. for 1882 to 1905, U. S. Geol. Survey, 1882–1905.
——— A new lilac-colored spodumene from Pala, California: Am. Jour. Sci., 4th ser., vol. 16, 1903, pp. 264–267.
——— and BASKERVILLE, CHARLES. The action of radium, actinium, Roentgen rays, and ultra-violet light on minerals and gems: Science, new ser., vol. 18, No. 468, 1903, pp. 769–783.
——— Sapphires in Montana: Am. Jour. Sci., 4th ser., vol. 4, 1897, pp. 417–420.
PIRSSON, L. V. Corundum-bearing rock from Yogo Gulch, Montana: Am. Jour. Sci., 4th ser., vol. 4, 1897, pp. 421–423.
PRATT, JOSEPH HYDE. Crystallography of the Montana sapphires: Am. Jour. Sci., 4th ser., vol. 4, 1897, pp. 424–428.
PRATT, J. H., and HIDDEN, W. E. On rhodolite, a new variety of garnet: Am. Jour. Sci., 4th ser., vol. 5, 1898, pp. 294–296.
——— On associated minerals of rhodolite: Am. Jour. Sci., 4th ser., vol. 6, 1898, pp. 463–468.
SCHALLER, WALDEMAR T. Tourmaline localities of southern California: Science, new ser., No. 476, February 12, 1904, pp. 266–268.
——— Spodumene from San Diego County, California: Publ. Univ. California, vol. 3, No. 13, September, 1903.
SILLIMAN, BENJAMIN. Turquoise of New Mexico: Am. Jour. Sci., 3d ser., vol. 22, 1881, pp. 67–71.
SMITH, J. LAWRENCE, Hiddenite. an emerald green variety of spodumene: Am. Jour. Sci., 3d ser., vol. 21, 1881, p. 128.
STERRETT, DOUGLAS B. Tourmaline from San Diego County, California: Am. Jour. Sci., 4th ser., vol. 17, 1904, pp. 459–465.
TURNER, H. W. Diamonds in California: Am. Geol., vol. 23, 1899, pp. 182–191.
WARING, G. A. The pegmatite veins of Pala, San Diego County, California: Am. Geologist, June, 1905; pp. 356–369.

TEXT AND REFERENCE BOOKS.

BAUER, MAX. Precious stones; trans. by L. J. Spencer, C. Griffin & Co., London, J. B. Lippincott Co. agents, Philadelphia.
CASTELLANI, AUGUSTO. Gems; trans. by Mrs. John Brogden, 1871; Bell & Daldy, London.
CLAREMONT, LEOPOLD. The gem cutter's craft, 1906; George Bell & Sons, London.
EMANUEL, H. Diamonds and other precious stones, 1867; J. C. Hotten, London.
FARRINGTON, OLIVER CUMMINGS. Gems and gem minerals, 1903; A. W. Mumford, Chicago.
KING, C. W. The natural history of precious stones and gems; 1865, Bell & Daldy, London.
KUNZ, GEORGE F. Gems and precious stones of North America, 1890; Scientific Pub. Company, New York.
STREETER, EDWIN W. Precious stones and gems, 1898; George Bell & Sons, London.
TASSIN, WIRT. Catalogue of gems in the United States National Museum: Ann. Rept. U. S. Nat. Mus., 1900, pp. 476–670. Complete bibliography.
WILLIAMS, GARDNER F. The diamond mines of South Africa, 1905; Macmillan Co., New York.

PEARLS.

KUNZ, GEORGE F. Pearls, utilization and application of the shells they are found in, as shown at World's Columbian Exposition: United States Fish Com. Bull. for 1893, pp. 439–457.
——— Fresh-water pearls and pearl fisheries of the United States: United States Fish Com. Bull. for 1897, pp. 373–426.
SIMPSON, CHARLES T. Pearly fresh-water mussels of the United States: United States Fish Com. Bull. for 1898, pp. 279–288.
SMITH, HUGH M. Pearl-button industry and mussel fishery of the Mississippi River: United States Fish Com. Bull. for 1898, pp. 289–314.
TOWNSEND, CHARLES H. Report upon the pearl fishery of the Gulf of California: United States Fish Com. Bull. for 1899, pp. 81–98.