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UNITED STATES GEOLOGICAL SURVEY
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MINERAL RESOURCES

OF THE

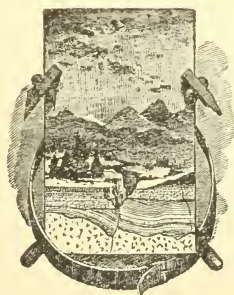
UNITED STATES

CALENDAR YEAR

1904

DAVID T. DAY

CHIEF OF DIVISION OF MINING AND MINERAL RESOURCES



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PRECIOUS STONES.

By GEORGE F. KUNZ.

INTRODUCTION.

The important facts in the history of precious stones in 1904 are in the main as follows:

The output of diamonds was less in quantity than in 1903, and the year was marked by several advances of 5 per cent in the price of the rough-diamond material, which was imported into the United States to the value of \$9,675,742, from which it would appear that diamonds and pearls to a greater value are now cut annually in the United States than were imported, cut or uncut, into the country for the years 1867 to 1871, inclusive, or for any one year until 1887. The value of the total import of precious stones for the year was \$26,086,813.

The cutting strikes in Amsterdam, which were of long duration and threatened to be so disastrous to the diamond trade, are apparently settled for a period of at least three or four years to come.

The greatest diamond known in history (prior to 1905), the "Excelsior" of Jägersfontein, has been cut up and divided into ten stones, weighing from $13\frac{1}{2}$ to 68 carats each, and furnishing a total of $340\frac{1}{2}$ carats of the whitest material of any of the large diamonds, with a total value of about \$400,000.

No great diamond discoveries abroad were chronicled during 1904, but the development of the mines in the Transvaal has been remarkable, the new Premier having produced diamonds to a total of 749,653 carats, valued at \$4,201,000, during the year, and promising to become a still greater factor in production. In the case of this mine, 60 per cent of the output is controlled by the Transvaal Government.

No discoveries of diamonds were recorded in the United States during the year 1904.

In Brazil a number of attempts were made to form new diamond mining companies, but the output has been very small.

In British Guiana the interest is still maintained, and the production was about the same as in the preceding year.

It is a fact of especial interest that in the cutting of gems other than the diamond many foreign lapidaries have entirely discarded emery (corundum) and are substituting for it the artificial carbon silicide, carborundum, which has a hardness of 9.5, between corundum (9) and diamond (10), and is the best-known abrasive next to the diamond. The year 1904 also witnessed the first discovery of this substance as a natural mineral in the Canyon Diablo meteorite by Prof. Henri Moissan, of Paris, France, and the naming of it after him, *moissanite*, as a true mineral, by the writer.

Australian sapphires, from the Anakie district of New South Wales, which are frequently too dark for high-grade stones, were cut in quantities in both faceted and unfaceted forms and en cabochon and used for the medium quality of jewelry.

In the United States one-gem discovery after another has been made in southern California, notably in San Diego County, where there have been found magnificent blue and white topazes, near Ramona, which as crystals quite equal those from Siberia, a single one weighing more than a pound; beryls from 3 to 6 inches in length and 1 or more inches in diameter, pale to dark sea green in color; crystals of rose-colored beryl, until recently one of the rarest varieties of this mineral, at Mesa Grande and Pala (and also at Hemet, in Riverside County); axinite, a gem mineral not previously known in good crystals in this country, though formerly in Switzerland and France, in beautiful crystals, near Bonsall; colored tourmalines, red and green, have been extensively mined at Mesa Grande, Pala, and other localities in the same county; and epidote in crystals only 1 inch in length and one-eighth of an inch in diameter, but transparent, has been found near Hemet, in Riverside County. The old locality at Mount Mica, Paris, Me., has produced fine tourmaline crystals and some good gems; a new locality, also interesting for its crystals of tourmaline, which are large and beautiful, although of little gem value, has been opened near Rumford Falls, Me., and some very fine crystals have been found at the mine at Haddam Neck, Conn. Kunzite, the new gem spodumene, has been mined, but not so extensively. As to sapphires, the entire output and also all previous outputs of those found at Yogo Gulch, Mont., have been disposed of abroad up to the present time by the companies which operate these mines from London. Turquoise has been mined with some success at a number of localities in New Mexico, Arizona, Nevada, and California. The new locality for peridot, olivine, or chrysolite, as it is variously known, at Talklai, Gila County, Ariz., has yielded great quantities of this mineral, immediately associated with or inclosed in the volcanic rocks; thousands of beautiful gems of from 1 to 5 carats have been cut from this material and extensively sold throughout the United States.

Great development has taken place in gem production in Brazil. Continued exploration in the State of Minas Geraes has led to great discoveries of tourmaline, which have furnished magnificent red (rubellites), as well as blue-green, and green gems; and large quantities were found, cut, and sold during 1904. Further discoveries of gem beryls in the same State have furnished magnificent blue and green aquamarines, which have been cut and have reached the gem markets of the world.

In regard to the Brazilian amethyst, a large quantity of gems have come from the great geode, the bulk of which was shown at the Düsseldorf Exposition in 1902. Many of these which were obtained from the points of the myriads of crystals that lined the great grotto were, on account of their rich, dark color, sold as Siberian amethyst.

There has been an extensive demand for many of the semiprecious stones, such as the peridot, of which quantities have been cut from Egyptian material, and the yellow smoky quartz called topaz from Spain and Brazil. The Queensland opal matrix has also been much in favor, both the variety with rich patches of opal, either white or bluish, often of great brilliancy, and the variety that is dark brown, with the entire mass permeated with very thin irregular streaks or veins of highly colored opal, making a perfectly iridescent play of color on a brown field, like the lumachelle marble.

Semiprecious stone beads of every variety of material, in short and long necklaces and of all sizes, either round, India cut, or faceted, made of amethyst, Spanish topaz, rock crystal, rose quartz, aventurine, blue chalcedony, amazon stone, New Zealand jade (nephrite), Burmese (so-called Chinese) jadeite, moonstone, garnet, and other minerals of every kind, have been sold in great profusion.

Coral has been greatly in vogue, especially in the form of beads, often of great size. The market has demanded the richest Mediterranean coral, either deep red or delicate pink; Japanese coral, pink, yellow pink, and red; as well as white coral, either pure white or with a single speck of red or pink on each bead, the beads in the center of a string being often $\frac{3}{4}$ of an inch to 1 inch in diameter. The demand and the high price for the pale-pink coral has led to some imitations, consisting, first, of a decoloration of the darker coral by heating; second, of marble of about the same weight as coral and stained with aniline or other dyes; third, of white coral stained in the same manner; and, fourth, of glass paste imitations imported from the East. Another imitation is made from the mineral substance so much used by the Chinese for their stone carvings and imitations of jade, agalmatolite or Chinese figure stone, which is very cleverly stained to be palmed off as red or deep-pink coral.

DIAMOND.

UNITED STATES.

INDIANA.

No further diamond occurrences of any importance have been reported lately within the United States. Two or three small stones have been found in Morgan County, Ind., in cleaning up the sluices of a gold-washing plant recently installed about 29 miles from Indianapolis. These facts were communicated to the writer by the State geologist, Prof. W. S. Blatchley, who also mentions the finding of a few sapphires and rubies in the same association, some of which have been cut into small gems for directors of the gold-washing company. For previous references to gold and various minerals, including corundum, in the glacial gravels of this region, see report of this Bureau for 1902, page 814.

Professor Blatchley states that he had learned of an offer of \$1,200 having been made for the "Maxwell" diamond, one of the earlier stones from this vicinity and the best that has been yet obtained in the State, the value being mainly a local one, as the gem value only is a small part of the sum.

As to the source or sources of these diamonds, supposed to be drift diamonds transported by ice from Canada, a letter from Dr. H. M. Ami, of the Canadian Geological Survey, states that no diamonds have yet been found within Dominion territory, although much interest has been awakened by the discussion of the subject in the public press, and many persons have been on the lookout for occurrences.

The new National Transcontinental Railway, from Quebec to Winnipeg and the great wheat region of Manitoba, will traverse much of the country whence the drift diamonds have probably come, and Doctor Ami states that the Government is sending out numerous survey parties for exploration along the route. Some of these may make interesting and even important discoveries.

CALIFORNIA.

With regard to diamonds in California, it seems as though the extensive dredging operations now being conducted upon the gold-bearing gravels of that State should bring to light many diamonds, though none have as yet been reported. By this process large areas of auriferous gravel are being exploited on a great scale, the whole deposit down to bed rock being taken out and washed. The process is described in all its aspects and at all the localities in a recent bulletin (No. 36) of the State Mining Bureau of California,^a a publication

^aGold dredging in California, Bull. No. 36, California State Mining Bureau, 1905.

of much interest and value. The dredging process is applicable only to certain portions of the auriferous gravel beds of the State—those which are not much compacted, are not saturated with water, and rest upon a soft bed rock of ash or tufa. Of such deposits there are estimated to be some 2,500 acres in several of the counties in the Sacramento Valley, especially in Butte, Sacramento, and Yuba counties, and there are some deposits in the northern portion of the State. These gravels vary from 25 to 60 feet in thickness, with a mean of about 35 feet, and carry gold, and occasionally platinum, etc., to an average value of some 18 cents per cubic yard.

SOUTH AFRICA.

De Beers consolidated mines.—The sixteenth report of the general manager, Mr. Gardner F. Williams, brings the record of operations down to the close of the company's year on June 30, 1904. In comparison with the report for 1903, reviewed in the last report of this Bureau,^a the most salient points are the extensive developments in progress at the great Dutoitspan mine, the enormous quantities of blue ground in sight at this and the Bultfontein and the Premier mines, and the fact of a continued falling off in the richness of the blue ground in the De Beers and the Kimberley mines. This latter has now become such as to exceed the counteracting advance in the price of diamonds, so that the value per load extracted has begun to decline.

In general the supply of negro labor has been adequate to the needs, though liable to fluctuation from the desire of the natives to go to their homes at planting time and at harvest. The number employed has varied from a little below 10,000 to 13,750. A large amount of development work and construction has been done at all the mines, and great expense has been incurred in the installment of machinery, insomuch that little will be necessary for this purpose for some time to come. Illicit diamond buyers have been active during the year, and a number have been caught and sentenced.

An interesting point is made as to the timber for the mines. For this purpose California redwood (*Sequoia sempervirens*) is found to be the best. Redwood sleepers after ten years in the ground proved to be as sound as at first, while Oregon pine, Puget Sound cedar, African yellow wood, and Baltic deals had decayed and had been replaced.

Large quantities of tailings have been washed during the last three years with good results, and Mr. Williams claims that the company possesses "an enormous asset" in these accumulations of years, which are now being steadily washed and reduced.

^a Mineral Resources U. S. for 1903, U. S. Geol. Survey, 1904, pp. 911-917.

Total production of Kimberley diamond mines since the consolidation of the De Beers Company in 1889, by mines.

	De Beers and Kimberley (15 years).	Premier (7 years).	Bultfontein (4 years).	Total.
Loads of blue hoisted...	38,843,766	11,842,360	1,249,267	51,935,393
Loads of blue washed...	37,304,527	10,486,100	851,764	48,642,291
Carats of diamonds found	30,940,461	3,075,850	229,343	34,245,654
Value of the same	£48,461,973 12s. 9d.	£4,600,792 8s. 7d.	£344,777 8s. 0d.	£53,407,543 9s. 4d.

Averages of yield, value, and cost for the same periods, by mines.

	De Beers and Kimberley (15 years).	Premier (7 years).	Bultfontein (4 years).
Yield of carats per load	0.832½	0.292	0.2466
Value per carat.....	33s. 0.6d.	28s. 4.5d.	33s. 11.6d.
Value per load	26s. 8.8d.	8s. 3.7d.	7s. 6.97d.
Cost per load	7s. 4.4d.	2s. 11.9d.	6s. 0.4d.

From these figures it appears that these mines, since the year 1889, have produced an initial value in the world's commerce of over \$250,000,000; and that the cost of selling the rough diamonds, and of cutting and polishing, and the new advance in the price of diamonds being added, this initial value represents fully \$600,000,000 to \$700,000,000 by the time the jewels reach the wearers.

Transvaal mines.—An account was given in the last report^a of this Bureau of the great new Premier mine in the Pretoria district of the Transvaal. Two articles have recently appeared in the Engineering and Mining Journal relating to this mine, one by Mr. C. A. Troge^b and the other by Mr. T. Lane Carter,^c whose description of the Vaal River diamond workings was also reviewed in the last report.^d These articles fully confirm the remarkable accounts before published as to the extent of this great mine, which covers an area of over 70 acres, and they describe the progress in equipment and development during 1904.

The mine lies about 21 miles east of Pretoria, 6 or 7 miles from a small station, Van der Merwe, on the railroad to Delagoa Bay. Access to it thus far has been only by team over a rough country, but a branch is soon to be built from the railroad which will greatly reduce the cost of supplies and fuel.

Premier (Transvaal).—The annual report of this great new mine was presented to the shareholders at Johannesburg on January 3, 1905. It is only the second report, but it shows the extraordinary development of this mine within the short time in which it has been operated.

^a Mineral Resources U. S. for 1903, U. S. Geol. Survey, 1904, pp. 917-918.

^b Eng. and Min. Jour., July 28, 1904.

^c Ibid., Aug. 25, 1904.

^d Mineral Resources, loc. cit. pp. 918-919.

Production of Transvaal Premier mine for years ending October 31, 1903 and 1904.

	1903.	1904.
Loads of blue washed	76,931	939,265
Carats of diamonds found ^a	99,208	749,653
Value of diamonds found ^a	£137,435 2s. 9d.	£866,030 0s. 5d.
Number carats per load	1.29	0.798
Value per carat ^a	£1 7s. 9d.	£1 3s. 1d.
Value per load ^a	£1 15s. 8d.	18s. 5d.
Cost of production per load ^a	4s. 7d.	2s. 6d.

^a Fractions of carats and pence omitted.

Since the presentation of the report, two immense diamonds have been obtained at this mine, one the unprecedented stone of 3,024½ carats, of oval form and measuring 4½ by 2½ by 1½ inches, found on January 27, 1905, and the other of 334 carats, found on February 15, 1905.

Vaal River mines.—In the last report of this Bureau there was a review of an article by Mr. T. Lane Carter on diamond gravels and pipes in the Vaal River district.^a Another and somewhat different article was read before the Institute of Mining and Metallurgy by Mr. F. Ernest Coe.^b

The region treated of in this paper lies on both sides of the valley of the Vaal, northeast from Kimberley, the portion on the left bank being in Cape Colony and that on the right bank partly in Cape Colony and partly in the Transvaal. Mr. Coe gives a particular account of the mining in the deep placers, or the old river and stream gravels. These represent a period of great erosion, when deep and steep channels were worn through hard diabase rock, and were subsequently filled with sand, pebbles, and bowlders, much rolled and smooth, and then, in some cases at least, were overlain with beds of red sand—the rooi-grond (red ground) of the early Dutch diamond seekers. The floor or bed rock of these deep placers consists of carbonaceous (Karoo) shale, underlain by amygdaloidal diabase. The exact relations of these beds to the period of erosion are not very clear from the account as given, although Mr. Coe goes into considerable geological discussion.

The diamonds are found among the pebbles and bowlders of the deposit filling the channels, and are derived presumably from pipes not yet discovered, save partly, no doubt, from the pipe described by Mr. Carter.

Jägersfontein mines.—Occasional references have been made in former reports to the mining of diamonds at Jägersfontein, in the Orange Free State, now the Orange River-Colony. The Jägersfontein

^a Carter, T. Lane, The Diamond District of the Vaal River: Eng. and Min. Jour., Sept. 5, 1903.

^b Min. Jour., R'way and Com. Gaz., Aug. 6, 1904, p. 136.

mine has been noted not so much for its great production as for the fact that it has yielded an unusual proportion of large diamonds, among them especially the extraordinary stone found in 1893, weighing 971 $\frac{3}{4}$ carats, and named the Excelsior diamond, the largest ever known up to that time.^a

Production of the new Jägersfontein mine for the year ending March 31, 1904.

Loads of blue hauled	2, 076, 408
Loads of blue washed	1, 836, 634
Carats of diamonds found	167, 597 $\frac{3}{4}$
Value of diamonds sold	£555, 695 16s. 7d.
Number of carats per load0968
Value per carat	66s. 3.75d.
Cost of production per load	2s. 10.79d.
Loads remaining on floors	975, 185

Cape Colony Mines.—One or two new diamond mines are now being developed in Cape Colony, in the district of Griqualand West, and considerable interest is taken at Bloemfontein in the success of this venture. The New Kimberley Diamond Developing Company has been formed to acquire full control of two farms, the Witpan and the Bultpan, situated about 15 miles north of Kimberley and 7 miles east of the Vaal River, on the railroad line to Rhodesia. Mr. F. W. Robb, a Kimberley expert, has made a report to the company upon the Phoenix mine on the Witpan farm, and advises careful and extended development. He describes the work of former prospectors who had made openings here—perhaps 100 claims—in a small pipe to a depth of 30 feet. Recent shafts have gone down 60 feet and 80 feet, all in “yellow ground,” after passing through a few feet of capping. Blue ground has not yet been reached, but the yellow ground contains a good deal of olivine, garnet (pyrope), and carbon, and some diamonds, though no recent figures were obtained. Mr. Robb states that the detective department at Kimberley has registered 77 diamonds from this prospect weighing 37 $\frac{1}{2}$ carats. From this it would appear that the stones thus far found are quite small.

Rhodesia mines.—The diamond-bearing pipes and the surface deposits derived from them apparently occur throughout a wide area of country in South Africa; but the few very large mines already in operation so control and overshadow newer enterprises that there is not much encouragement for further exploration. The Kimberley mines, in Cape Colony, the Jägersfontein, in the Orange River Colony, and the new Premier, in the Transvaal, have the field of African diamond production well occupied. Diamonds are known to occur farther north in Rhodesia, but recent accounts indicate that little is likely in the way of discovery until there is more freedom for individual activity and more promise of returns therefrom. In the report

^aSixteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1895, p. 598.

of the Rhodesia Chamber of Mines for September, 1904, this subject is spoken of quite frankly. An agreement exists between the De Beers Consolidated Corporation and the British South African Company with regard to diamond prospecting in Rhodesia that would leave very little for the discoverer of a mine in case the agreement receives legislative sanction. The chamber of mines protests earnestly against such action as discouraging and well nigh prohibitive unless various points are modified and limited and various rights secured, as is the case with gold discoveries under the mines and mineral ordinance of 1903.

BRAZIL.

One or two important articles have appeared during 1904 upon the diamond region of Bagagem and Agua Suja, Brazil. The diamond industry of the State of Minas Geracs was described in 1899 by Mr. T. C. Dawson, of the American legation to Brazil, and his important account was given in abstract in the report of this Bureau for that year. The Bagagem locality is referred to in that article as one long known and worked, but much of the region around it has been but little explored. Agua Suja is about 16 miles distant. An extended article on this locality, by L. F. Gonzaga de Campos, E. M., has been published in the Brazilian Mining Review and the (London) Mining Journal.^a

BRITISH GUIANA.

The diamond industry developed since 1900 in British Guiana has extended and become established. The fact is now recognized that the first stages of exploitation are fast passing, and that more systematic methods on a larger scale must soon be adopted. A detailed review of the whole subject appeared in the (London) Mining Journal for May 28, 1904, in which the history, the present condition, and the future needs and prospects are quite fully treated.^b

DUTCH GUIANA.

The occurrence of diamonds in Dutch Guiana has been noted within the last year, the French consul-general at Amsterdam having called attention to the discovery and to the fact of some stones having been sent to Holland and found to be of excellent quality. This announcement was followed by a letter^c from Mr. Charles Douglas, of Paramaribo, who gave many particulars. The locality is in the Mindreneti district, in central Dutch Guiana, between the Surinam and the Saramaca rivers, and accessible from either.

^a Min. Jour., Rwy. and Com. Gazette, July 9, 1904, pp. 23, 30.

^b Min. Jour., R'way and Com. Gazette, May 28, 1904.

^c Min. Jour., Rwy. and Com. Gazette, Aug. 20, 1904; *ibid.*, Dec. 8, 1904.

CORUNDUM GEMS.**CORUNDUM.****TASMANIA.**

Corundum, occurring in the quartz wash with topaz, zircon, and pleonaste as water-worn nodules and irregular crystals, is fairly abundant at the northeastern tin fields.

SAPPHIRE.**MONTANA.**

During 1904 no extensive stoping has been done by the New Mine Sapphire Syndicate in Montana, which has been occupied rather in driving levels. This fact, in addition to the necessity of working through a small break in the lead containing much hard rock at times, explains the reason of a decrease from the production of former years. The price, however, of all qualities has increased during the last year, and any deficiency in output has thus been compensated. The demand for the stones steadily increases, and difficulty has been experienced in filling orders with promptitude.

The product of the mine for the year 1904 is given as follows: Stones for cutting purposes, 38,529 carats; stones for watch-jewelry purposes, 808,404 carats. These are valued, respectively, at \$30,170 and \$11,570, a total value for the year's output of \$41,740.

QUEENSLAND.

The sapphire deposits of the Anakie district in Queensland, which were described in the report of this Bureau for 1902, have been largely developed within the last two years. An extended report upon them, by Mr. Lionel C. Ball, assistant government geologist, has recently appeared, which contains descriptions of all the workings in the several centers of mining activity and many data as to production and value, up to the close of 1904.^a At that time about 200 men were at work, of whom one-third were at points on Retreat Creek (Sapphire-town, 50, and Middle Camp, 20) and half as many (36) on Policeman Creek, while the remainder were scattered, a few each, at a number of minor workings.

TASMANIA.

Sapphire is quite plentiful at some of the mines. In color it varies to a great extent, being found in almost all shades of blue, dull green, purple, and yellow, and from translucent to opaque. Occasionally it

^a Ball, Lionel C., The Sapphire Fields of Central Queensland: Queensland Gov't Min. Jour., March 15, 1905, pp. 112-117, with illustrations.

is particolored, with shades of blue to yellowish and colorless. The asteriated variety also occurs. Really fine gem sapphire is scarce; but some very good stones have been cut and polished, although too rare to constitute an article of trade. The ruby has not been obtained. Notable localities are Mount Cameron, Thomas Plain, Weld River, Main Creek, and Branxholm. At Shekleton on the northwest coast fragments of fairly good color to colorless have been collected, associated with zircon and quartz.

RUBY.

BURMA.

The English company, known as the Burma Ruby Mines (Limited), which has been carrying on the exploitation of rubies in the celebrated Mogok Valley in Burma, has continued its operations during the past year, as now for several years previous, with good success.

EMERALD.

NEW SOUTH WALES.

Beryl of gem quality, some of it so richly colored as to be called emerald, has been known for as much as fifteen years past in New South Wales, and numerous gems have been cut therefrom. It occurs in pegmatite, with topaz, fluor spar, and cassiterite, at Glen Creek, 7 miles north by east from Emmaville. Several crystals are described and one very elegant one figured by Mr. C. Anderson in the Records of the Australian Museum in December, 1904.^a

BERYL AND CHRYSOBERYL.

NEW HAMPSHIRE.

Some good gem material has been recently obtained at the old beryl locality near Grafton, N. H. The exact locality is in Springfield, Sullivan County, 119 miles from Boston and about 4 miles from the Boston and Maine Railroad. About two-thirds of the way up the mountain at this point the Sullivan County Mica Mining Company have operated a vein of mica about 25 feet distant from the vein carrying beryls, which the company did not observe or work. Little has been done yet in beryl mining, only some surface work; but there is described a remarkable development of crystals of beryl and of garnet in a space 14 feet square and 2 or 3 feet deep. A number of fine beryls that yield material for cutting have been taken out.

^aAnderson, C., Mineralogical Notes, No. 1: Rec. Austral. Museum, vol. 5, pt. 5, December, 1904, p. 301.

UTAH.

Three crystals of beryl have been received from Mr. Maynard Bixby, of Salt Lake City, which because of their color—a rich raspberry red—deserve special notice. The specimens are single crystals, of short prismatic or almost tabular form, 3 millimeters in height and up to 7 millimeters across the basal plane, implanted on imperfect topaz crystals. According to Dr. W. F. Hillebrand and Mr. W. T. Schaller, the only other forms are those of prisms of the first and second order, the habit being the usual one for beryl; the specific gravity is 2.65. The color is presumably due to manganese, of which the crystals contain a very appreciable amount. Approximate chemical determinations leave no doubt as to the identity of the species. The locality of occurrence is that made known by the discovery of bixbyite about 35 miles southwest from Simpson Springs, Utah, in the Dugway Range.

TASMANIA.

A very interesting discovery has been made of chrysoberyl of the rare alexandrite variety in Tasmania. It is found in the tin-bearing drift in the valley of the Weld River, which drains a granite range in the northeastern part of the island. A personal communication from the government geologist, Mr. W. H. Twelvetrees, gives the following statement:

The tin and chrysoberyl are derived from a biotite-granite, usually with large pseudo-porphyrific crystals of orthoclase scattered through it; but wherever it is stanniferous the biotite has been replaced by muscovite or lithia mica. The age of the granite is considered to be Devonian. One gem was found which has been cut; * * * it is a half inch across, pale in color, but very near the variety * * * found in Ceylon. Several smaller fragments have been obtained. * * * The larger specimen had some semblance of crystallization; the smaller ones are rolled fragments, with no crystallization, and of no value as gems.

Mr. Twelvetrees thinks that the mineral may exist in some abundance, but that it has been overlooked. The cut stone has an attractive light-green color and is red by transmitted light. The piece was found in the ordinary process of treating the drift for tin ore.

TOPAZ.

TASMANIA.

Tasmania is noted for its remarkably fine water-clear topaz, which is often cut and polished for ornamental purposes. It also occurs in pale shades of sea green and blue, but the yellow variety is unknown. It is comparatively abundant throughout the northeastern tin fields, and is sometimes obtained in well-developed crystals of unusually large size for the species. Well known localities are Mount Cameron,

Weld River, Thomas Plains, Moorina, and in fact it occurs throughout the whole district in more or less abundance wherever alluvial tin mining is in operation. It is found with quartz, zircon, pleonaste, and occasionally beryl. At Killierankie Bay, Flinders Island, it is in considerable quantity, and sometimes in large sized crystals. At this locality it has been obtained in place in a pegmatite dike composed of enormous crystals of orthoclase, with quartz and muscovite. At Bell Mount, in the Middlesex district, this mineral is often met with in place in a tin-bearing rock at the junction of granite and Silurian slate. At the Stanley River it occurs in granitic detritus with tin and monazite. Much of the stanniferous rock at Mount Bischoff is topaz porphyry, and the radiating cylindrical variety, pycnite, is somewhat abundant in special portions of this celebrated tin mine.

NEW SOUTH WALES.

Topaz from New South Wales has been recognized and described before; but in a recent paper quite detailed accounts have been given by Mr. C. Anderson, in the Records of the Australian Museum, December, 1904.^a

ZIRCON.

TASMANIA.

This mineral is extremely abundant at the northeastern alluvial tin mines, but has not been found in place. It occurs as more or less water-worn particles, which rarely exceed 1 inch in length, and the crystallographic characters are usually obliterated. The common forms are the yellow-brown jargon and the bright-red hyacinth varieties. The former is usually much clouded by darker tints, but when cut and polished it becomes a gem of remarkable attractiveness. The hyacinth variety is sometimes of very good color, and is then a beautiful stone.

GARNET.

ALMANDITE.

NEW YORK.

Garnet of this variety occurs largely in the Adirondack region of New York, and, though not of gem quality, is mined quite extensively as an abrasive. A recently issued bulletin of the New York State Museum^b describes this industry and gives the figures of production; for 1904 these were 3,045 short tons, valued at \$104,325, about the same figures as for 1903. The garnet occurs "associated with hornblende-feldspar rocks in crystals that range from small size up to

^a Anderson, C.: Mineralogical Notes, No. 1; Rec. Austral. Museum, vol. 5, pt. 5, December, 1904; pp. 296-300, and plate 39.

^b Newland, D. H.: The mining and quarry industry of N. Y. State, N. Y. State Museum Bull. No. 93, Albany, 1905.

masses of several feet across;" the proportions vary widely, and only the richest rock is worked, which is done by crushing and washing. The quarries are situated in the Hudson River Valley near the boundaries of Essex and Warren counties, the principal shipping point being the town of North Creek. Several companies are at work.

TOURMALINE.

CONNECTICUT AND MAINE.

The recent remarkable discoveries of colored tourmaline in southern California have somewhat eclipsed the old New England localities, but within the last year some very fine gem material has again been taken out both in Connecticut and Maine. The resemblances between these remote regions, both in the character and in the association of the minerals found, are very remarkable. Lithia minerals of various kinds, notably the gem tourmalines, occur in almost identical ways in veins or dikes of pegmatite in San Diego and Riverside counties, Cal., as at Haddam Neck, Conn., and in Oxford County, Me., although separated by the entire breadth of the continent and with scarcely any occurrences in all the intervening area.

AUSTRALIA.

Tourmaline of gem quality has been recently announced from Kangaroo Island, South Australia. The government geologist, Mr. H. Y. L. Brown, states that the crystals are very large and fine and yield beautiful gems. They are usually green, and some have also the pink center so often seen in Brazilian tourmalines. Six specimens have been described and figured in the records of the Australian Museum, for December, 1904, by Mr. C. Anderson;^a these crystals were from the Mining and Geological Museum at Sydney.

JADEITE AND CHLOROMELANITE.

GUATEMALA.

Dr. Max Bauer, of the University of Marburg, has described a number of prehistoric objects from Guatemala made from jadeite and chloromelanite.^b

QUARTZ.

THERMOELECTRIC PROPERTIES OF QUARTZ.

The thermoelectric properties of quartz crystals have furnished a field of fascinating research in molecular physics which now affords renewed interest in its relation to radio-activity. Sections of smoky quartz, decolorized by heating, regained their color by ten days of

^aAnderson, C., Mineralogical Notes, No. 1; Rec. Austral. Museum, vol. 5, pt. 5, December, 1904, pp. 302-303.

^bCentralbl. neues Jahrbuch für Mineral., 1904, pp. 65-79.

exposure to radium rays. On warming and sprinkling them with flour of sulphur and red lead (the sulphur clinging to the electro-positive and the red lead to the electronegative parts of the quartz twin) the smoky tint was developed in three triangles (segments of one of the twins), which were found to be negatively electrified. This study has been described by M. Egeroff.^a A related question of equal interest concerns the nature of the smokiness that is thus eliminated and redeveloped. It has usually been supposed to be carbon, but it may prove to be something quite different, as it is not easy to see how a carbon compound could thus be affected.

NONCRYSTALLINE QUARTZ.

CHALCEDONY.

A number of occurrences of beautiful varieties of chalcedonic quartz minerals have recently been reported to the writer. Most of these are on the Pacific coast, but several are in other parts of the country.

IOWA.

A beautiful gray and fawn-colored translucent chalcedony, in rolled botryoidal masses, up to 3 inches by 2 by 2 in size, has been found in the vicinity of Ames, Iowa, by Mr. H. B. Jones. These pieces are rich in color, very compact, and would answer for some forms of ornamental work.

OREGON.

Sapphirine chalcedony.—In the vicinity of Eaglepoint, Jackson County, Oreg., a great quantity of beautiful chalcedony, agate, and jasper has been found. Among these are some beautiful white chalcedony, gray, brown, and green jasper, and an endless variety of agate. Of especial interest, however, is a beautiful blue chalcedony (sapphirine), which is quite equal to that found in Hungary or in California.

NEVADA.

Rose chalcedony.—A most beautiful rose and lilac-tinted variety of chalcedony is reported from Aurora, Nev., by Mr. Maynard Bixby, the well-known mineralogist of Salt Lake City, Utah. It occurs in an amygdaloidal rock, and the delicate rose-pink variety, very translucent, rests directly upon a base of almost white chalcedony. Where broken across, the fractured surface shows a peculiar almost stellated structure.

^aComptes Rendus Acad. Sci., Paris, 1905.

JASPER AGATE AND JASP OPAL.

MEXICO.

On the Rancho Guadalupe, a few miles from Ensenada, in Lower California, Mexico, belonging to Mr. T. Morris Flower, there have been found in great quantity—scattered over the surface in the form of boulders measuring from a few inches across to several feet—jasper, red, with a faint salmon tint, beautiful compact jasper agate, and jasp opal, in color generally red, although frequently turning to green and white, all of which would admit of a very high polish and would be of value in the arts and for certain forms of jewelry. The boulders have an outer coating of white and cream-colored jasper, but when they are broken the color within is found to be red or yellow or green.

OPAL.

IDAHO.

About ten years ago considerable interest was aroused as to the occurrence of precious opal at several points in Idaho, especially near Moscow, Owyhee County, as noted in the reports of this Bureau for 1892 and 1893. Not much has been done here for some time past, but it is now announced that the Moscow locality has been reopened and is to be worked for opaline or opal matrix.

OREGON.

A deposit of opal in a rhyolite rock exists in Baker County, Oreg., some of which is very handsome, although it does not appear to have been worked commercially. Remarkable specimens were obtained a few years ago by Prof. William B. Dwight, of Vassar College, Poughkeepsie, N. Y., and are now in the cabinet of that institution. One of these is a large mass of rhyolite, containing nodules of precious opal, 1 or 2 inches in diameter, transparent and glassy, and of brilliant colors. In other specimens the opal varies to a peculiar dense white, like the purest white enamel, and again to a transparent hair brown.

NEW SOUTH WALES.

A new opal field is reported in New South Wales, at Wallangulla, near the Queensland border, about 50 miles north from the town of Walgett. Pieces of opal have been picked up in the vicinity for several years past, but no mining had been undertaken until about two years ago, when a syndicate was formed, and careful prospecting revealed the mineral in place (see reports of this Bureau for 1896, 1898, 1900, and 1902). No specific data are yet given as to production, though several hundred pounds' worth are said to have been sent from the new workings by individual miners.

QUEENSLAND.

The opal production in Queensland, described in the report of this Bureau for 1902, has become an important and established industry; though according to official figures it is not as large as it was a few years ago. Other accounts state that it has greatly increased in recent years.

WEST AUSTRALIA.

Crocidolite opal.—The crocidolite opal referred to in the report of this Bureau for 1903, has been analyzed and shown to be, as supposed, a replacement of crocidolite by hydrous silica, with some ferric oxide.

TURQUOISE.

NEW JERSEY.

Turquoise was obtained some months ago at Somerville, N. J., in the workings of the American Copper Mining Company on Watchung Mountain. The specimens were obtained from Mr. Josiah Bond, now of Wichita, Kans., who was at the time the manager of the mine, and who had a number of pieces, some of them as large as a silver dollar and two or three times as thick. They were found in little veins on the incline shaft, about 1,100 feet from the opening. This occurrence is not likely to be of any commercial importance, but it is highly interesting and worthy of record as the most eastern locality for this interesting gem.

NEW MEXICO.

In the reports of this Bureau for a number of years, notes have been given as to turquoise development in New Mexico and the discovery of new localities. In connection with the St. Louis Exposition, a general sketch has appeared as to the history, geology, and present condition of all the mines now actually yielding turquoise in the Territory, by Mr. Fayette Alexander Jones.^a The account is popularly written and contains interesting facts.

Turquoise is now profitably mined in four different districts of New Mexico. Taken in the order of their modern discovery, these localities are: In the vicinity of Los Cerrillos, north of the Southern Pacific Railway, in Santa Fe County; in the Burro Mountains, southwest of Silver City, in Grant County; at Old Hachita, also in Grant County, and in the Jarilla Mountains, Otero County.

EGYPT.

Prof. Flinders Petrie, the noted archaeologist, has recently visited the ancient turquoise mines at Maghara, in the Sinai district. It has

^aJones, F. A., *New Mexico Mines and Minerals*, 1904, World's Fair Edition: Scientific Publishing Company, 1904, New York, pp. 269, 273-277.

been a question whether the mining here was for turquoise or copper, but Mr. Petrie finds indications that both were sought, though perhaps at different periods. Evidences are found of copper smelting in the fourth and twelfth dynasties; but the mines generally seem to follow the veins of turquoise, and the rubbish heaps abound in turquoise chips. Three kinds of mining also are noted. In the third and twelfth dynasties all the work was done with chisels; at another period, not determined, holes were picked in the rock, 5 inches apart and a foot deep, and blocks were then broken out. Neither of these kinds of workings show any traces of flints. Another class of waste heaps contain numerous flints, and may be of Bedawi origin at many periods and even prehistoric.

WEST AUSTRALIA.

Reports have been published of a turquoise mine in the Murchison district, West Australia. The government geologist, Mr. A. G. Maitland, in his report for 1903, states that he has examined several specimens of the supposed turquoise and found them in every case to be richly colored chrysocolla, and not turquoise at all.

MALACHITE AND AZURITE.

ARIZONA.

The malachite and azurite which have been so noted for their beauty as specimens from the mines at Morenci, Ariz., are no longer found to the same extent that they were a few years ago and may become rare hereafter. Such is the statement of Mr. Waldemar Lindgren, of the United States Geological Survey, in a letter to the writer in December, 1904. The magnificent specimens of these minerals obtained several years ago came chiefly from two of the mines, the Detroit and the Manganese Blue; but these have been practically worked out, and no large masses are now found. Mr. Lindgren doubts whether any more such masses are likely to be met with, unless perhaps at some points in the Shannon mine.

An important paper on the copper minerals of this region was published by Mr. Lindgren in the Transactions of the American Institute of Mining Engineers for 1904.^a In this article the geological conditions and the successive phases of metamorphic action connected with these remarkable deposits are treated of at some length and with considerable detail, and the history of the formation of the various minerals, including malachite, is traced out in a highly interesting manner.

^aLindgren, Waldemar: The Genesis of the Copper Deposits of Clifton-Morenci, Arizona; Trans. Amer. Inst. Min. Eng., Lake Superior meeting, Sept., 1904, vol. 35, 1905, pp. 511-550.

PERIDOT.**ARIZONA.**

Peridot (olivine) has heretofore been found scattered abroad on the surface in the Navaho country, associated with the pale and ruby-red garnets. During 1904, however, a locality was discovered near Talklai, Ariz., where it is found independently of any garnet occurrence. The specimens are of fine color and often of considerable size. A single peridot came to the writer's notice which weighed $1\frac{1}{2}$ ounces and was $1\frac{1}{2}$ inches in length. The stones are found principally in a peridotite rock, associated with obsidian, in a canyon known as Peridot Canyon. They are also obtained at Mesa, 6 miles from Talklai. The former is the most promising locality in the United States, as the gem here occurs in its natural matrix. The rock is at times porous, like a vesicular lava, and it is from the breaking down of this rock and the weathering out of the included harder peridots that the latter are obtained.

OBSIDIAN.**OREGON.**

In the vicinity of Drewsey, Oreg., Mr. E. L. Beede reports finding the mottled brown and black obsidian (marekanite) in pieces more than 1 foot across, similar to that found in the State of Guadalajara, Mexico.

IOLITE.**NORTH DAKOT**

Iolite (dichroite) has been found in grains 5 millimeters square, both translucent and transparent, blue in one direction and almost colorless in the other, associated with almandite garnets 3 millimeters across, in a black micaceous quartzose schist, near Edgeley, N. Dak., by Mr. George H. Quivey. This mineral, when clear and of rich color, has been sometimes employed as a gem, and this discovery may prove to be valuable if specimens of fine quality are at all abundant.

UTAHLITE.**UTAH.**

Uthallite (compact variscite) was first described and named in the report of this Bureau for 1894. Some recent data have been received regarding it under the name of chlorutahlite. The account given in this communication is essentially identical with that in the report above mentioned, although somewhat more detailed. The locality is in Clay Canyon, Camp Floyd mining district, Utah County, Utah, about 2 miles south of the famous Mercur gold mine, and at an altitude of 6,250 feet. It is on a ridge or spur, one of a number that radiate from the Oquirrh

Mountains, and the spot is quite accessible. The rock is a metamorphosed limestone, at times highly ferruginous and siliceous. The utahlite occurs in a vein 12 feet wide, running with the strike of the country rock, and containing about 10 per cent of limonite.

SERPENTINE.

GREECE.

Mr. W. Brindley, F. G. S., has made a communication to the Royal Institute of British Architects, recently published in their Proceedings, concerning the verde antico marble so much used and valued in Rome and Byzantium. He gives interesting accounts of his search through several years for the lost source of this very elegant and highly prized stone, a quest in which he at last succeeded by the discovery of no less than ten adjacent quarries. These are situated at Casambala, 7 miles northeast of Larissa, near the road leading to the celebrated Vale of Tempe. A neighboring village still bears the name of Marmariani, no doubt the ancient marble-workers' town.

AMBER.

NEW YORK.

A very interesting discovery of Cretaceous amber was made by Dr. Arthur Hollick, of the New York Botanical Garden, in November, 1904, at Kreischerville, Staten Island (borough of Richmond, New York City), where it exists in some abundance. Cretaceous amber is somewhat rare, and this occurrence is of much interest. Kreischer-ville is situated on the shore of Staten Island Sound or Arthur Kill, near the extreme southwestern end of the island and distant about $2\frac{1}{2}$ miles from Richmond Valley station on the Staten Island Railway, about 23 miles from New York city hall.

The amber was found in connection with the clays which are mined there for manufacturing purposes (fire and ornamental brick, hollow ware, terra cotta, etc.). They are known to be of middle Cretaceous age, and are approximately the equivalent of the Cenomanian of Europe, of the lower Atane beds of Greenland, and of the Dakota group of the West. They represent the eastward extension of the Raritan or Amboy clay series of New Jersey.

FLUORITE (Chlorophane.)

VIRGINIA.

It is a fact of much interest that the variety of fluorspar^a found at Amelia, Va., has been found extremely sensitive to heat, so that it becomes distinctly luminous by the warmth of the hand, and that it

^a Kunz, G. F., Gems and Precious Stones of North America, 1892 p. 184.

also shows a triboluminescence so marked that the slightest friction will cause it to emit a phosphorescent light. During an examination as to the cause of this phosphorescence, in a series of experiments^a made by Dr. Charles Baskerville and the writer, specimens were sent to Prof. William J. Humphreys, of the University of Virginia, who examined spectroscopically these and more than one hundred other examples of fluorite, obtained from almost every quarter of the globe. His experiments showed that yttrium was present in most of the specimens, and ytterbium also in a few of them.^b These results led the writer to suggest that the chlorophane variety of fluorspar could be distinguished and separated very simply by the fact of its being both triboluminescent and also thermoluminescent even at low temperatures.

FOSSIL CORAL.

IOWA.

For many years beautiful specimens of cut and polished fossil coral from Iowa have been familiar to collectors and geologists; and there has been a constant production and sale of such material but only on a very moderate scale as compared with what it might be if the stone were better known to the public and applied to a greater variety of ornamental uses. The Iowa exhibits at several of the recent expositions have contained beautiful displays of this material; and some very elegant polished balls were shown at the St. Louis fair by Mr. Charles E. Briggs, of Lisbon, Iowa.

GEM MINERALS OF CALIFORNIA.

INTRODUCTION.

The reports of this Bureau for 1902 and 1903 have contained somewhat extended notices of the remarkable discoveries of gem spodumene in southern California, and also of gem tourmaline and of various other interesting minerals. The colored tourmaline and lithia minerals of the same region have also been separately noticed in several former reports of the Bureau. These various occurrences, together with those of other gem minerals, beryl, topaz, essonite, etc., in the same or neighboring localities, are making the whole district one of the most remarkable in the world for these minerals, comparable only to the famous gem region of the Urals. It is therefore fitting that a more general statement of the whole subject should here be presented. In this statement will be included a body of data specially collected during the last year for the writer in connection with the State Mining Bureau of California, and some notes on the geology of the region

^a Kunz, G. F., and Baskerville, Charles, *Science*, 1904.

^b Humphreys, W. J., On the Presence of Yttrium and Ytterbium: *Astrophysical Jour.*, vol. 20, November, 1904, pp. 266-273.

from various sources, the latest being an article just published by Mr. G. A. Waring, of Leland Stanford University.^a

It is worth while to note the fact that there is already more actual mining for gems done in California than in any other State or Territory of the Union, and the indications are that there will be many more gem mines discovered in the southern counties as remote districts are opened and old ones more fully explored.

An extensive report, to appear as a volume, on the gems and jewelers' materials of California is now in press; this was prepared by the writer at the request of the State Mining Bureau, under the direction of the State mineralogist, Mr. L. E. Aubury. A report on the occurrence of lithia minerals in the United States, by Mr. Waldemar T. Schaller, of the United States Geological Survey, is also in preparation. As the lithia minerals are so intimately connected with the gem minerals, the latter will of necessity be more or less treated of in this report. These two publications will describe quite fully the remarkable mineralogical discoveries in southern California and make them known to the world. Heretofore almost all that has appeared, until very recently, has been in the annual reports of this Bureau by the writer. The privilege of using in this present summary the data obtained for the forthcoming volume has been very liberally accorded the writer by the California State Mining Bureau. A large amount of this material has been obtained from personal communications and other unpublished sources, and is now brought together and corrected to date, so as to furnish a general view of the gem resources of the State.

The distribution of gem minerals in California as a whole may be broadly outlined as follows: (1) There is first the gold region of the central and northern counties along the western base of the Sierra Nevada; in this are found the gold quartz used so much for jewelry and ornamental work, and the few but interesting diamonds. These latter occur loose in the gold-bearing gravels, sometimes of the surface placers but generally of the old river beds now covered and compacted by lava flows. In these old river beds also is found much of the agatized and opalized wood, which is sometimes capable of use as an ornamental stone. In the same gravel filling of an ancient stream bed in Calaveras County was encountered the wonderful deposit of transparent quartz crystals (rock crystal) of great size, which yielded some of the finest material for art work ever known anywhere.^b These occurrences, it is true, are adventitious, and not in the nature of mines that can yield any permanent supply. But they have been found, and may be found again at any time. The gold quartz is different in this respect, and a fairly steady production of it in certain of the quartz mines may be relied upon hereafter as before.

^aWaring, G. A., The Pegmatite Veins of Pala: Amer. Geologist, vol. 35, No. 6, June, 1905, pp. 356-369.

^bMineral Resources U. S. for 1898, Ann. Rept. U. S. Geol. Survey, 1899.

The diamonds found in the gravels are neither numerous nor large, but some of them are beautiful and all of them possess much interest. Their occurrence was described in the paper of Mr. H. W. Turner, reviewed in the report of this Bureau for 1899. All have been found incidentally, and no search for them has ever been made. One or two suggestions, however, may be offered here.

As the United States Geological Survey is now carrying on a special study of the occurrence of platinum in the Pacific States, it would seem that if some attention were paid to the occurrence of the diamond it also might be found in the course of this investigation, as the diamond is one of the heavier minerals and would probably be met with in the riffles with the gold and platinum.

The new grease-board separator used by the De Beers Diamond Company in the African mines might prove a valuable adjunct to some of the present gold stamps, or in the sluices, to detect the occurrence of diamonds in California. The concentrates are carried with a stream of water over an inclined board coated with mutton tallow; when such a board is vibrated or "jigged," other minerals pass on, while all diamonds present adhere to the grease and can thus be separated. By this means, diamonds down to the size of a pin-point are now saved in the Kimberley mines, while otherwise they would surely be lost.

(2) There is next the region of Tulare County, centering around Visalia, where the recently developed chrysoprase mines occur at several points. This rare and beautiful stone exists here apparently in some abundance, and associated with it are other forms and varieties of quartz minerals capable of use for ornamental purposes, such as rose quartz, chrysopal, etc., besides several species of garnet, some of which have yielded gem material. Another interesting and rather peculiar stone found in this section, on the borders of Tulare and Fresno counties, is that named by the writer *californite*, a compact green variety of vesuvianite that perfectly resembles the celebrated jade so much prized in the Orient for elegant art work. This mineral is also found in Siskiyou County, at the northern extremity of the State.^a

(3) The desert region of the southwest, bordering on Nevada and Arizona. Here, in an arid and desolate country, consisting largely of volcanic rocks, are found some interesting localities of opal and of turquoise, the latter giving evidence, as in Arizona, of long and extended working by prehistoric tribes, who have left their stone tools and their rock inscriptions around their old places of labor. These will be further referred to under turquoise.

(4) The region specially considered in the present review is the mountainous central and southern portions of San Diego and Riverside counties. Here it is that such remarkable gem discoveries have

^a Mineral Resources U. S. for 1901.

been made in the last ten years. Besides the richly colored tourmalines and spodumenes, other gem minerals have lately been found in various parts of this district, especially topaz, transparent epidote and axinite, pink, green, and blue beryl, and essonite garnet, the whole forming such an assemblage of minerals that is scarcely, if at all, equaled in the world. Many of these mines are as yet only prospects or trial openings, but the indications are that the region is full of possibilities. Lack of water and fuel are the chief obstacles thus far to a much more extended development.

In general it may be said that throughout the schistose and granitic region of San Diego and Riverside counties there is a widespread prevalence of an igneous rock of gray color, generally called a diorite, with a little disseminated quartz and mica (biotite); but some examples have been determined to be gabbro rather than diorite. This rock and the granite appear in a series of ridges or mountains, with a prevailing north and south course, and are traversed by dikes or veins of pegmatite, which have a general direction of northwest-southeast, and dip southward or southwestward at varying angles. It is in these pegmatite veins, which with slight differences yet possess great general similarity, that the gem minerals are found. In the notes given farther on as to the several mines the more special features will be described.

In this region several centers of occurrence of two somewhat distinct types may be recognized, those yielding lithia minerals with gem tourmaline and sometimes gem spodumene and those yielding principally garnet, beryl, and topaz. Of the former, there are especially to be noted in San Diego County first the Mesa Grande mines, which yield crystallized gem tourmaline of splendid quality almost exclusively; second, the Pala district, in which there are three parallel ridges—Pala Mountain on the west, with the great lithia mines and some colored tourmaline; Pala Chief Mountain, in which are found very fine tourmaline and the new and remarkable gem spodumene (kunzite), and Hiriart Mountain on the east, with a number of openings yielding both tourmaline and kunzite; then third, northeast of these, in Riverside County, there is the region near Coahuila, in San Jacinto Mountains. Here was the first discovery of gem tourmaline in California, so far as known to the whites, and kunzite and other lithia minerals have also been found recently in association with the tourmaline. There are also other localities between this latter and Mesa Grande, and probably many others may yet be found. About halfway between Mesa Grande and Pala is a fine beryl mine near Rincon.

The other class of mineral localities appears to lie along a line somewhat southeast of those just noted, extending from near the Mexican boundary, at Jacumba, northwest to Ramona and perhaps beyond, and following the general strike of the pegmatite veins and almost exactly

paralleled to the line from Mesa Grande to Pala. At Ramona are found abundant fine garnet (essonite), with topaz and beryl, notably the rose variety, but not much tourmaline, no kunzite, and, in general, little of the lithia minerals. Around Jacumba are found beryl and essonite garnet (often called hyacinth); the latter is abundant and at one or two points has been worked somewhat for several years. Jacumba, or Jacumba Hot Springs, is close to the Mexican line, some 20 miles east of Campo, and almost on the western edge of the Colorado desert.

NONCRYSTALLINE QUARTZ.

ROSE CHALCEDONY.

A very beautiful pink chalcedony, occurring in rather a peculiar manner, has been found by Mr. W. B. Coombs, of Needles, San Bernardino County. He noticed pieces of pink and also of white chalcedony as float material in washes or gullies about $3\frac{1}{2}$ miles west of Siberia station, a siding on the Santa Fe Railway. Following these up several gulches he traced them to outcroppings of small quartz veins in a granitic rock that had apparently been altered by some volcanic action. The locality is near what is known as Ash Hill, and there are porphyritic rocks and old craters in the vicinity.

HYDROLITE.

Among the interesting specimens of chalcedony found at various points along the Pacific coast of California and Oregon, one of the most remarkable is mentioned as having been found on Pebbly Beach, Crescent City, Del Norte County, Cal. This specimen was a geode $4\frac{1}{2}$ inches in length and $3\frac{1}{2}$ by $3\frac{1}{2}$ in the other dimensions and contained a teaspoonful of water with a moving bubble. It was reported by Mr. Frank Clovenow, of Pebbly Beach. These hollow geodes of chalcedony, containing water, which have been called natural sealed flasks and also hydrolites, have been long known from some of these Pacific beaches, and have been sought with much interest by collectors, but nothing approaching the size of this specimen has ever been found before.

CHRYSOPRASE.

The last reference to the chrysoprase occurrences in California in the reports of the writer to this Bureau was in the report for 1901. The following general summary is derived from recent data gathered in connection with a report to the State mining bureau of California. Chrysoprase was discovered in Tulare County in 1878 by Mr. George W. Smith, a surveyor, of Visalia. He presented specimens to Mr. M. Braverman, of that place, who identified them as chrysoprase from the presence of nickel oxide. Later the State mining bureau con-

firmed this determination. The first specimen was the finest ever found in America, and was sent to the Paris exposition of 1879, but failed to reach its destination. It was about $3\frac{1}{2}$ inches long and $1\frac{1}{2}$ inches thick. The first discovery and thus far the best outcroppings developed are located on the McGinnis property in the NE. $\frac{1}{4}$ sec. 8, T. 18 S., R. 26 E., Mount Diablo meridian, about 10 miles northeast of Visalia, on Venice Hill. These outcroppings extend along the southeastern slope of this hill and through section 8 and the SW. $\frac{1}{4}$ sec. 4. Here it occurs in small, irregular veins, which range from mere seams to a thickness of 2 or 3 inches, in a somewhat altered red jasper rock.

The chrysoprase outcroppings have been traced at different places all along the foothills of the Sierra Nevada across Tulare County, and the following localities have been noted by different authorities: Venice Hill, Stokes Mountain, Tule River, Deer Creek, and 1 mile east of Lindsay. All of these localities have been announced in the annual reports of the writer on the production of precious stones in the United States for 1895 to 1898, inclusive.

OPAL.

A considerable deposit of opal is reported in San Bernardino County at a point about 25 miles northwest of Barstow or north of Hinckley, both of which are stations on the Atchison, Topeka and Santa Fe Railroad. Mr. C. E. Dolbear, of Long Beach, Cal., describes the opal as occurring in a fine-grained, brittle, andesite tufa, in which it forms narrow bands, sometimes widening to a thickness of several inches. Most of it is semiprecious and amber colored; but some 25 specimens of a bright rose pink were obtained, one of them weighing $2\frac{1}{2}$ carats. Other accounts state that the opal is found in an indurated clay overlain by tufa, and that the deposit extends for a length of 2 miles with a breadth of half a mile. Further details of this occurrence are to be desired.

TURQUOISE.

An account was given in the report of this Bureau for 1898 of remarkable discoveries of ancient turquoise mines in southern California. These have been followed up, and a good deal of exploitation has been done, although the region is very barren and inaccessible. Turquoise mines now exist in a considerable area in the northwestern angle of San Bernardino County, and are operated by the Himalaya and the Toltec mining companies. The latter company has three groups of mines, all of them patented, situated on the great desert about 100 miles northwest from Needles Station and about 50 miles northwest of Manvel, which is on a branch of the Santa Fe Railroad. The three mining centers are some 6 miles apart in the old Solo mining district, and are known as East Camp, Middle Camp, and West Camp,

the latter being within 20 miles of Death Valley. The altitude is between 5,000 and 6,000 feet; and as there is no water at either camp, it is necessary to haul it over mountains from 1 to 5 miles. The same company has also operated turquoise mines in Nevada, some 60 miles due east of the California mines. The other company, the Himalaya, has a group of five mines in the same district (the Solo), but some distance from those of the Toltec, being about 60 miles northwest of Manvel, and reached only by teams. These claims are all on one ledge, which is described as a "bird's-eye porphyry" with some granite, striking north and south, with a dip of 75° west.

INDIVIDUAL MINES AND THEIR MINERALS.

The account of the several main openings and their condition in 1904 is as follows:

These data are grouped geographically, and to some extent also in the order of discovery, beginning in Riverside County and proceeding southward and southeastward through San Diego County, by Pala, Mesa Grande, and Ramona, to the Mexican line at Jacumba.

RIVERSIDE COUNTY.

COAHUILA DISTRICT.

The most northern occurrences and the earliest discoveries of gem tourmaline were made here in Riverside County as far back as 1872, but they were not announced to the public, and the facts were little known until twenty years later.

FANO KUNZITE-TOURMALINE MINING COMPANY.

KUNZITE AND TOURMALINE.

This mine consists of four claims about 3 miles north of Coahuila Indian Reservation, and was located in 1902 by Mr. Bert Simmons. The nearest post-office is Hemet, Riverside County. An experimental tunnel has been carried into the ledge to a depth of 176 feet in solid blue granite, but most of the work has been done near the surface. The ledge is about 5 feet wide, striking northwest and southeast, with a dip to the southwest of 17° . The pegmatite is finely crystallized and resembles that of the other tourmaline and kunzite mines in the district.

Three men are at work at an average wage of \$3 per day, and operations will be continued indefinitely. The output so far has been 25 pounds of kunzite, white; 1 pound of kunzite, pink; and 25 pounds of all classes of tourmaline, mostly blue and green; about 250 pounds of beryl have also been taken out, but only about 5 per cent of it is available for gem purposes. Two hundred pounds of very fine quartz crystals have also been sold, and about a ton of lepidolite and 30 or

40 pounds of amblygonite; also, splendid flake mica has been discovered large enough for commercial purposes. There is a spring near the property on land rented by the owners of the mine. There is also plenty of oak timber for mining purposes. Considerable money has been expended without much result, but for the work actually done on gem pockets, this mine has been a splendid producer.

COLUMBIA MINE.

TOURMALINE.

The Columbia, the oldest tourmaline mine in the State, situated at Coahuila, Riverside County, is about one-half mile northwest of the road leading from Coahuila to the Hemet reservoir, at an altitude of about 5,000 feet. Very little has been done here for over five years, but it was the first tourmaline mine discovered in southern California in 1872, and it has produced a great many beautiful gems. The pockets, however, seem to have been worked out, and nothing important has been found recently.

The ledges of pegmatite are of very fine granite, and both sides of the pocket material seem to be of the same character, thus differing from any other mine in the gem district. Considerable work is proposed in the near future, but the mine is in litigation. There is no water or timber available and the region is barren.

SAN DIEGO COUNTY.

Passing southward from the Coahuila district into San Diego County the locality next described lies by itself, about half way to the great Mesa Grande-Pala line of mines. Although not yet an important producer, the occurrence is interesting, as suggesting other possible localities yet to be discovered in the intervening area.

GEM MINE NO. 1.

TOURMALINE.

Practically no work has been done on this mine since its location in June, 1903. Its altitude is higher than that of any other gem mine in San Diego County, being 5,100 feet above the sea; it is on the top of the divide between San Luis Rey River and Temecula Canyon, and about 1 mile east of the summit of Aguanga Mountain. The average width of the vein is apparently about 4 feet, but it is much broken; both foot and hanging walls are of very hard blue diorite. Great pressure has apparently crushed the ledge, and the pocket layer is found on the top, out of place, between the diorite and the pegmatite; it presents fine, broken crystallizations of orthoclase and albite, in which a red clay is mixed. The tourmaline crystals show much indication of dynamic action, being badly broken and twisted, but they

afford nodules of beautiful coloring, deep blues, reds, and an almost emerald green predominating. So little work has been done, however, that it seems better to reserve any report as to quantity and quality until more is ascertained. There is no wood at hand, and it is $3\frac{1}{2}$ miles to the nearest water. Parties are at work at present, however, and will send specimens direct to the State Mining Bureau.

PALA DISTRICT.

As elsewhere described in this report, the mines near Pala are located on 3 hills or ridges, the western being properly called Pala Mountain, on which are the great lepidolite, or Alvarado mine, and the Stewart mine, next described, which yields some gem material. The other mountains, Pala Chief and Hiriart, which are apparently foothills or spurs of Agua Tibia Mountain, are those yielding gem spodumene as well as tourmaline. About 18 miles to the southwest, but probably belonging to the same range of hills, lie the great tourmaline mines of Mesa Grande. These will be given in the order stated.

STEWART MINE.

TOURMALINE.

This mine, said to have first been discovered by an Indian deer hunter named Vensuelada in the early days of California history, was first worked by a miner named Henry Magee, who located the claim as a quicksilver mine, mistaking the pink tourmaline for cinnabar, but upon analysis he abandoned his prospect. It was next located as a rock claim by Don Tomas Alvarado, a Mexican landowner, who believed that the beautiful bluish, pinkish, and gray mineral studded with deep-pink crystals was a peculiar variety of marble. Several years later a German scientist, familiar with lithia mines in Europe, saw a specimen of Pala lepidolite in New York. Obtaining a piece, he made an analysis and found the ore to be as rich in lithia as any in the world. From this time forward gradual development under many ownerships has proved that great deposits of lithia-bearing ores exist in the pegmatites of this district, the largest and most valuable being the Stewart and Alvarado mines. The latter is the great lepidolite and amblygonite mine that has yielded so many beautiful specimens of radiated pink tourmaline, but no gem material.

The workings and surface of the Stewart mine show numerous indications of gem minerals, especially in the lower workings. As in the Alvarado mine, the lepidolite is generally studded with small, fan-shaped crystallizations of rubellite, and with occasional crystals of bluish or greenish tourmaline, but not of gem quality. Near the surface the tourmalines are small and perfectly crystallized, but are more or less fractured, opaque, and unfit for jewelers' use. In the deeper workings and in the extreme western tunnels, however, pink tourma-

lines from one half inch to 1 inch in diameter are found in columnar groups, all more or less altered and not over 3 in hardness, associated with quartz, orthoclase, gray lepidolite, and amblygonite. Triplite and triphylite occur as associated minerals. Large crystallizations of what appears to be an altered spodumene were observed penetrating the quartz. On the surface small green tourmalines are found in the pegmatite, generally more or less flattened between the cleavage planes of muscovite mica. Several years ago a pocket containing about a quart of small tourmaline crystals was found in coarse pegmatite 60 feet south of the present tunnel of the Stewart mine. Some of these crystals were cut into very good gems, but no further work at that spot has been done. With proper development this mine should become a paying producer of tourmaline.

PALA CHIEF MINE.

TOURMALINE AND KUNZITE.

This mine was located in May, 1903, by Messrs. John Giddens, Pedro Teiletch, Bernardo Hiriart, and Frank A. Salmons. The claim covers 1,500 by 600 feet, running northwest and southeast. The main workings are at an altitude of 1,220 feet and consist of open cuts 250 feet wide, extending to a depth of 10 to 30 feet horizontally on the vein; at the deepest working the ledge is 21 feet in height. A tunnel 45 feet long was run to encounter the vein up to about 20 feet in depth, but it was found that the ledge was a blanket vein, and nothing was discovered in the tunnel. In the upper or surface workings the hanging and foot walls were both found to be of bluish and grayish decomposed diorite. The upper part of the vein consists of 3 feet of finely crystallized white pegmatite; beneath this the crystallizations become coarser and more granitoid; the third layer is composed in part of finely crystallized albite and orthoclase, upon the lower edge of which and extending to the pockets is a layer of lithia-bearing micas. Within the pockets, which are generally from 8 to 10 inches wide, pinkish and white talc is found, in which are numerous large and perfect quartz crystals, with pink and white spodumene. As usual in the region, the lower half of the ledge below the pocket line is a very finely crystallized granite without mica, with small crystals of essonite garnet. Giant powder has been used exclusively, and has been found to be the only satisfactory explosive. Two men have been working nearly all the time, but during the last 6 months with no great success. There is no timber on the property, and the nearest water is about 1 mile away. The section and township in which the mine is located were not determined, but it lies 3 miles east of Pala, and the workings can be seen from the town.

The minerals noted were spodumene, pink, lavender, and white; tourmaline, blue, green, and red; orthoclase; albite; graphic granite;

lepidolite, pink, green, and lavender; muscovite; quartz crystals; steatite, and other clays.

The products so far noted are tourmaline, kunzite, and quartz crystals.

TOURMALINE QUEEN MINE.

TOURMALINE.

This mine is near the summit on the northeast slope of Pala Mountain at an altitude of 1,450 feet. It is about $3\frac{1}{2}$ miles north by a little east of the town of Pala. The mine was located as a quartz claim in March, 1903, and is 1,500 by 600 feet and runs north 34° west. The vein is about 14 feet wide and dips to the southwest 15° . Little has been done on this property, save scalping work; an open cut 60 feet wide, entering the vein to a depth of about 10 feet, produced some 80 pounds of gem tourmaline crystals. The colors are yellow, green of different shades, light pink, ruby red, and black. In the ledge 18 inches of material lying between the diorite hanging wall and the coarse pegmatite appears to consist of decomposed feldspar, which passes gradually to pegmatite. Below this are about 3 feet of coarse granular pegmatite, consisting of crystallized quartz, feldspar, and muscovite, with black tourmaline in fan-shaped crystallizations and minute essonite garnets, also occasional crystals of biotite and hornblende. Below this again, and merging with the above, are masses of graphic granite, incrustated at the lower edge with albite, in which the gem tourmaline seems to have a root or extremity. Between the albite and the line rock are large pockets filled with rose and lavender colored muscovite, and decomposed feldspars in the form of a whitish or pink clay; in these pockets the gem tourmalines are found, often broken and more or less altered. Many crystals show an exterior of opaque green, while the interior is a rich pink or ruby red, affording beautiful gems. The ledge has been prospected for about 250 feet, and shows gem indications wherever opened. The hanging wall is a coarse greenish and grayish diorite, like the general formation of the entire belt. The foot wall is the same, though showing more alteration.

Both giant and Judson powders have been used in mining, although from the hardness and toughness of the rock the former was found to be the best. After the pocket material has been extracted, screens are used, by which the earth and fine worthless material are eliminated. The matter left in the screens is then examined for gems and afterwards washed. Two of the owners have performed all the work so far accomplished. Active operations were to be resumed about January 1, 1905, but nothing was done in 1904. The same parties have filed on a spring 350 feet northeast of the present workings, and abundant water for mining and domestic purposes has been developed.

The minerals noted in this claim are tourmaline, albite, orthoclase, muscovite, lepidolite, kaolin, talcose clays, essonite garnets, hornblende, and indications of epidote. The lower part of the ledge is composed of a fine, granular, mica-free granite of a gray color, banded at intervals of from 3 to 6 inches with minute essonite garnets, whence the name line rock. As in all the pegmatite veins in this region, this lower portion has about the same width as that of the formation from the pocket layer or center to the top and lies directly upon the diorite foot wall.

TOURMALINE KING MINE.

TOURMALINE.

This mine is situated on the north slope of Pala Mountain, about 300 yards from the summit, at an altitude of 1,540 feet. It was located in March, 1903, but very little work has been done, so that it is hardly possible to make a definite report. The mine is $\frac{1}{4}$ miles directly north of Pala and is the last mine so far discovered at the western extremity of the Pala mineral belt. The claim runs northeast and southwest and is 1,500 by 600 feet. The vein dips to the southwest at an angle of $16\frac{1}{2}^{\circ}$, with an average breadth of 7 feet, and is essentially coarse pegmatite, but shows evidence of crushing and is badly broken in many places. The hanging wall is a coarse, gray diorite, and at the place where the work was done lies over about 15 inches of coarse, broken feldspar and lepidolite.

It is in this stratum that the gems appear, unlike the general pocket formation of the Pala district. Tourmaline was the only gem stone noted, and occurred in pencils, disseminated through this altered mass of decomposed spar, and apparently out of place. Concretions of albite, coated with beautiful purple muscovite, were found loose in the soil. The ledge here was too badly broken to note the exact character of the pegmatite, and the line rock or lower stratum had not been uncovered, so that its character could not be determined. No work has been done here for several months, and nothing definite could be learned as to when it would be resumed. About 10 pounds of crystals were secured in a cut 12 feet wide, barely scalping off the top layer of earth.

NAYLOR-VANDERBURG MINE.

KUNZITE.

This mine, also near Pala, lies at an altitude of 1,400 feet, on the eastern slope of Mount Hiriart. The location was made by Mr. F. M. Sickler in February, 1903, soon after discovering that the pink and white crystals that he had found on the mountain side were not tourmalines, as had been supposed, or any stone known to local mineralogists. After considerable trouble and expense Mr. Sickler, still believing the stone to be of some value, continued his investigations. He at length sent a piece to New York to the writer, who determined it as

spodumene, and after whom it was subsequently named kunzite by Prof. Charles Baskerville, of North Carolina, as a new gem stone—the first occurrence of transparent pink or lavender spodumene in the world. The ledge in this mine, at the point examined, was 16 feet in width, but badly broken. An open cut about 30 feet wide, entering the vein to a depth of 22 feet, has produced approximately 5 pounds of perfect gem kunzite. Several pieces have also been found in adjacent workings, but this seems to be the best part of the ledge. The hanging wall is gray orbicular diorite. Between this and the ledge itself a layer 18 inches thick of decomposed feldspar and clay was found as a gouge. About 7 feet of coarse granitic pegmatite forms the upper part of the ledge, altering into decomposed layers of albite and orthoclase. In this latter are small pockets, seldom larger than a man's hand, in which one or two crystals of kunzite are found, completely embedded in yellow, pink, or white clay. No metallic stains appear in the upper part of the ledge, but the lower beds of granitic rock interlined with garnet are in many places stained with manganese and show large crystallizations of triplite, from which it is evident the kunzite receives its coloring. The vein dips 10° to the west and extends the full length of the location, 1,500 feet, joining the Katarina mine on the south. There is no water or timber on the property, and neither are available except by buying adjoining land. The claim lies within the boundaries of the Pala Indian Reservation, although it was located before the reservation was declared, and there has hence been some controversy as to the validity of the title.

The minerals noticed are muscovite, pink, green, and lavender, in very large scales; montmorillonite and steatite talcs; pink, green, and white spodumene; and black tourmaline, but no gem tourmaline. Albite and orthoclase, with some potash feldspars, are the mother of crystallization. The output here since the beginning of work has been about 10 pounds of gem kunzite, no other minerals having been disposed of. Some pink and green beryls were noticed, but nothing has been developed in that line.

Other claims and openings on Mount Hiriart are enumerated in the report of this Bureau for 1903, this one being thus far the most important.

MESA GRANDE DISTRICT.

The mines are situated on Mesa Grande Mountain and are the most southern of the gem tourmaline localities in the region, on the ridge stretching down southeastward from the Pala and Agua Tibia mountains, already described. To the west is another locality for tourmalines, at Vista; and northward are, first, the Oak Grove location, and farther on those near Coahuila. Several mines have been opened on the Mesa Grande, the Himalaya Mining Company occupying the west side of the ridge and the San Diego Tourmaline Company the east side.

HIMALAYA MINE.

TOURMALINE.

This mine is situated in the east half of sec. 17, T. 11 S., R. 2 E., San Bernardino meridian, at an altitude of 3,800 feet. The property is about $4\frac{1}{2}$ miles northwest of the Mesa Grande store and on the watershed between San Luis Rey River and Mesa Grande Creek. It had long been known that beautiful colored stones existed on this ridge, but after repeated failures and with no determination of quality or value the locality was brought into notice in 1898 by Mr. Charles Russell Orcutt, who opened it and for a time worked it; afterwards it was operated by Dr. A. E. Heighway. This led to later development by the Himalaya Company, and the present output is the result. During 1904 about 6 tons of rough tourmaline were shipped to the company's lapidary in New York. Of this quantity about 350 pounds were fine nodules and pencils of the very highest grade. Surface or bench digging has been followed exclusively, although a tunnel is being run to tap the ledges at the 150-foot level. Both hanging and foot walls are of hard blue diorite and the ledge is of fine crystallized pegmatite not over 18 inches in width, and dipping from 26° to 33° southwest. In working this ledge pay material has been in sight continuously, and at no time has a barren piece of ground been encountered. The upper pegmatite is usually stained with lithia and manganese, and large masses of lepidolite are associated with tourmalines. The pockets are large and filled with talc and hydrous micas in which the gem crystals occur embedded, many showing peculiar etchings. The ledge has been uncovered for about 700 feet and to an average depth of 15 feet. These open cuts, however, are proving dangerous and will have to be abandoned as soon as the rainy season has soaked the walls on either side. Wood, water, and all natural advantages are of the best, and a good dwelling house, barn, tool houses, and blacksmith shop, a windmill, and water piped to all constitute the improvements. From 4 to 10 men are constantly employed about the mine.

Among the minerals noted were orthoclase, albite, lepidolite, amblygonite, small clear pieces of spodumene, muscovite; tourmaline, black, green, blue, deep red, and rose pink; beryl, pink and aquamarine; hornblende and epidotic rocks, spessartite and essonite garnet, large and very transparent quartz crystals, talc and hydrous micas, and a dark-brownish transparent crystal, very dense (specific gravity, 10), and with a hardness of $5\frac{1}{2}$, not yet identified. This mineral is very rare, and only a few pieces have been found.

SAN DIEGO TOURMALINE MINING COMPANY.

TOURMALINE.

The mines are situated in the east half of sec. 17, T. 11 S., R. 1 E., San Bernardino meridian, and about 4 miles northwest from Mesa Grande post-office. This property was opened by Mr. Gail Lewis at the time of the first discoveries on this mountain. He had but small success at first, but persevered and reached a fine pocket of gem material just before his option expired. The mine has been developed more elaborately than any other of the district and carried much deeper. Fine gem tourmalines are taken out at a depth of nearly 200 feet, the greatest depth at which these gems are obtained anywhere in the world. A tunnel 120 feet long was run, tapping the ledge at 64 feet; from this, drifts were run about 150 feet in both directions, and the ledge matter was stoped to the surface; tourmalines in paying quantities were then extracted. Later a tunnel was run 286 feet in length, tapping the ledges at from 145 to 170 feet, and drifts from 20 to 30 feet long were run on two ledges which were struck. The ledge matter is a fine-grained pegmatite, showing on both top and bottom black tourmalines in fan-shaped crystallizations. Near the center, at intervals, pockets occur in which fine gem tourmalines are found, though not as rich as in the adjoining claim, the Himalaya, just described. This company has employed from 3 to 7 men continuously, and is doing good work, timbering the workings as they are made and doing scientific mining. The company has its own lapidary in San Diego, where most of their product is cut. Wood, water, and all facilities are at hand. Giant powder has been used exclusively, and the blasting has not resulted in the breaking or destroying of any crystals. The ledges are over 18 inches in width and are generally of a character which would not be prospected, looking barren and worthless, but the locality seems to be highly mineralized, and any ledge shows gem crystals.

Other mines are being opened in the vicinity, and probably during 1905 there will be a great development in the Mesa Grande section. One recent opening may be noted in particular.

ESMERALDA MINE.

TOURMALINE.

The Esmeralda mine is situated about 5 miles northwest of the Mesa Grande store and $1\frac{1}{4}$ miles west of the Himalaya mine, on the eastern slope of the Temescal Valley. It was located by Mr. Dougherty late in 1903 or early in 1904, and covers 1,500 by 600 feet. The course of the ledge is northeast and southwest, but the claim lies across a spur running southwest and northeast at right angles with the main ledge at an altitude of about 3,500 feet. The work consists of two open cuts crossing the vein and exposing it to a depth of $7\frac{1}{2}$ feet; a tunnel of 60

feet below the surface workings tapped the ledge at 28 feet; but no further work has been done in the tunnel, and no gems were found in the formation at that place. Both hanging and foot walls are composed of a coarsely crystallized hornblende-diorite of a rich grass-green color, resembling a serpentine. The ledge itself is a coarse granitic pegmatite, and is faulted in several places. The pockets are quite large, and contain quartz crystals, orthoclase, and albite in beautiful transparent crystallizations. Lepidolite in pieces weighing from 50 to 300 pounds also occurs in conjunction with the pocket material. In the ledge $2\frac{1}{2}$ feet of pegmatite overlies the pocket stratum. The pockets themselves are filled with soil and foreign matter, rendering it impossible to say exactly what was the nature of the softer material that once filled them. Some pockets are hollow, containing only quartz crystals, while near them are other pockets absolutely filled with tourmaline pencils. The lower stratum or line rock of these ledges is also pegmatitic, although of much finer crystallization than the top. About 250 feet southwest of the tourmaline workings the ledge is badly broken and shows only in places, in the nature of blow-outs of pegmatite and quartz. In some of these blow-outs golden and aquamarine beryl were found "frozen" in the formation. There is neither wood nor water on the claim, but an abundance of timber can be secured within half a mile, and water can be piped to the mine from springs on the hill.

Tourmaline is the only perfect gem found, and occurs in pink, bright red, azure blue, aquamarine blue, and a peculiar shade of green blue, which cuts to a stone in which one set of facets show a sapphire blue and another set a rich emerald green. Crystals of this kind have not been noticed in any other tourmaline mine in southern California, although fine blues and greens exist in other places. With the lepidolite is a granular blue and lavender mineral which could not be determined, but apparently it is a lithia compound. Many of these were of excellent gem quality, and the owners intend doing considerable development work at these places. About \$300 has been expended, producing about 20 pounds of tourmaline of gem quality. As in many other cases of prospecting and mining for gems in southern California, lack of funds has greatly hindered the proper development and exploiting of this mine.

RINCON DISTRICT.

The mine next described does not furnish either gem tourmaline or kunzite, but is worked as a beryl mine, some fine material having been obtained. It lies on the Pala belt, about halfway between Pala and Mesa Grande, on Palomar Mountain, which is a spur or foothill of the Smith Mountain ridge, with which Pala Mountain is closely related, and hence it is considered here.

MACK MINE.

BERYL.

This mine is located at Rincon, San Diego County, $9\frac{1}{2}$ miles southeast of Pala, in sec. 25, T. 10 S., R. 1 W., San Bernardino meridian. It was discovered in November, 1903, by Mr. J. M. Mack and an Indian named J. Calec, near the Rincon Indian Reservation. The exact locality is $1\frac{1}{4}$ miles northeast of the Rincon store, in the first canyon east of it, at an altitude of 1,960 feet. The ledge dips 45° to the southwest, and is exposed on the hanging wall for about 75 feet; all work has thus far been confined to the surface. Fine gem beryls have been found, and also a peculiar opaque, deep blue variety, different from any elsewhere known in the county. These crystals should be analyzed. Much development work during 1905 is contemplated. The ledge is essentially pegmatite, with an average width of from 5 to 6 feet, with a gray granite footwall. The hanging wall is hard to determine, as much rock had fallen and covered it, but it is apparently a blue and gray diorite. The pockets are very narrow and are confined exclusively to a "bony" crystallization of orthoclase, in which most of the beryls are attached. Wherever a pocket is found in which clays or other soft substances are the matrix, the crystals are exceptionally fine and can be cut into perfect gems. So little work has been done that it is hardly of importance to report this locality if it were not for the peculiarity of the crystals found. There is a small spring of water on the property and some sycamore and oak timber.

RAMONA DISTRICT.

South of all these localities lies a separate group of occurrences of garnet with beryl and in some cases topaz centering around Ramona, and also the garnet country far to the southeastward in the vicinity of Jacumba. These suggest a line or belt of garnet and beryl southeast of the tourmaline-kunzite line and parallel to it; but it is not possible yet to say how far this idea may be correct. The garnets belong mainly to the essonite variety, although many of them are called spessartite (manganese garnet); but the writer is not satisfied that this latter species really occurs. Both varieties are often called hyacinth by jewelers, and at many of these points they present rich orange and fulvous shades between red and yellow.

A B C MINE.

BERYL, TOURMALINE, ESSONITE AND SPESSARTITE GARNET.

This mine was discovered November 1, 1903, and is situated in the SW. $\frac{1}{4}$ NW. $\frac{1}{4}$ sec. 8, T. 13 S., R. 1 E., San Bernardino meridian, and at an altitude of 1,950 feet. It is about 4 miles northeast of Ramona.

The vein has an average width of 7 feet, and runs north 35° west, with a dip of 12° to the southwest. The claim is 1,500 by 600 feet and embraces two promising ledges. Three places have been opened at the eastern extremity of the claim at intervals of about 50 feet. The first two are in open cuts, in which the scalping process was employed and gems were taken from broken-ledge matter and soil. The principal working, however, consists of a tunnel 18 feet long, from which a stope following the pay shoot for 45 feet has been run. Both foot and hanging walls are of a gray decomposed diorite, in which the feldspar has been much altered, with some quartz and biotite. The ledge shows first some 3 feet of coarse, poorly crystallized pegmatite, stained in some places with iron and manganese. Many black tourmaline crystals with terminals pointing directly toward the pockets were observed, somewhat altered to quartz and muscovite. Below the pegmatite is a stratum from 1 to 6 inches thick of a grayish or whitish decomposed orthoclase, with disseminated crystals of muscovite having a pinkish and lavender tinge on the outer edges (probably a lepidolite border, as sometimes noted elsewhere). In this stratum, coated with albite and clay, pink beryls are found, generally solitary in a pocket, with two or three large blackish-green tourmalines. Quartz crystals were observed on both the top and bottom of this stratum, but not in the pockets with the beryls. It was also noticed that the pink-tinged muscovite was not in contact with the beryl crystals. Contrary to what is usual in ledges of this character, the edges of the pockets do not touch between the upper and lower strata, but continue through the entire working without interruption, although widening and narrowing in places. No other minerals were found existing in the same pocket (or rounded mass of clay and decomposed spar).

Underlying this beryl-bearing stratum is about 18 inches of a soft albite, angular in crystallization, and with numerous holes penetrating the mass. In these cavities minute essonite garnets were seen, also spessartite (?) and hundreds of small black tourmalines, penetrating in every direction. No gems, however, were found among these. This stratum of albite lies "frozen" to the line rock, which constitutes the base of the ledge. The line rock is coarse and shows less interlineations than at any other mine observed in this vicinity. In places large portions of graphic granite occur, embedded in the upper stratum of ordinary pegmatite. In this graphic granite are small cavities containing steatite and montmorillonite, with lithia mica occurring at intervals. Minute whitish crystals were found in these tales which appeared to be topaz, although too small for identification. In some places, also, where quartz crystals were found disseminated crystals of pink muscovite occur, embedded and penetrating. Giant powder was used exclusively.

The minerals noted were pink beryl; green, dark green, and black tourmaline crystals; essonite and the so-called spessartite, sparingly; lepidolite, muscovite, and biotite micas; albite and orthoclase feldspars; montmorillonite, steatite, kaolin, and stains of manganese and iron. Altogether several pounds of pink beryl have been produced. Some of these stones have been cut by local lapidaries and show a rose-petal pink. They possess considerable brilliancy and are remarkably free from hairs, flaws, or bubbles. One cut stone, weighing 30 carats and without a flaw, has been on exhibition at the jewelry shop of Mr. John Hetzel in San Diego.

LITTLE THREE MINE.

TOPAZ, TOURMALINE, SPESSARTITE GARNET.

The Little Three Mine was discovered in May, 1903, by Mr. H. W. Robb. It is situated in the NE. $\frac{1}{4}$ SE. $\frac{1}{4}$ sec. 8, T. 13 S., R. 2 E., San Bernardino meridian, at an altitude of 1,940 feet, and is about $4\frac{1}{2}$ miles northeast of Ramona, the nearest base of supplies. The vein runs north 35° west and dips to the south at an angle of 20° , with an average width of $4\frac{1}{2}$ feet. The work so far consists of open cuts. As the vein is naturally exposed for about 60 feet on the hanging wall, it has been possible to commence work where the vein enters the ground and to break open the ledge of the pegmatite to where the pockets occur in the center. About 60 square yards of the vein have been uncovered in this manner, showing some very interesting conditions of formation. At the southeast extremity of the workings spessartite garnet was encountered, associated with small green beryls in pockets of decomposed albite, orthoclase, and muscovite mica. In this portion of the ledge no tourmalines of any color nor any topaz were found in the pockets, but black tourmalines were thickly interspersed in the upper or pegmatite portions of the vein. The line rock forming the base of the ledge has parallel wave-like bands of minute black tourmaline. The associated minerals at this part were only quartz crystals and some beryl. A concentric band of hematite and ferruginous quartz seems to separate this particular pocket from the other pocket material of the ledge.

Northwest from this pocket a gradual change was encountered and a barren condition for about 10 feet. Then coarse, bone-like concretions of albite were first discovered, with large and perfect quartz crystals. The interior of the pockets found with these minerals has either been decomposed completely and washed away or else the pockets were hollow, without any filling, as they are now filled with soil, apparently the same as that of the hillside above the ledge. In this loose soil and "frozen" to the albite and orthoclase are numerous wedge-shaped crystals of topaz, some of which weigh over a pound; they are white, sea green, sky blue, and light yellow in color. Attached

to the roof and floor of these cavities and with a long root extending up into the quartz and pegmatite are gigantic tourmaline crystals, deep green, mostly opaque, some of them 5 inches in diameter and weighing as much as 15 pounds. Some small pencil tourmalines of a deep-green color and gem quality are found loose in the pockets, and many small topaz crystals that have become detached from their matrix of albite. Purple and pinkish muscovite in very large crystallizations and "frozen" into nuggets are also observed loose in the pockets or attached to the albite. Usually these crystals of mica are attached to each other at right angles, and in these angular cavities very perfect topaz crystals have formed.

The ledge proper is a fine-grained pegmatite, with foot and hanging walls of gray decomposed diorite. The underlying line rock in the topaz locality assumes a banded appearance, very straight in its inter-linements. It is coarser than is generally seen in ledges of this kind, and is notable for the absence of either garnet or tourmaline in any quantity, the lines or bands being apparently a stain from manganese. A little biotite was also seen. This is a very persistent ledge, and can be traced without a break for over 3,000 feet, with an average width of 4 feet. No work has been performed other than that described, but the ledge shows indications of garnet for its entire length. This mine is a westerly extension of the Surprise mine, next to be described. There is abundant oak and sycamore timber at hand and a spring of water sufficient for domestic uses, which can probably be developed for mining purposes also. Giant powder has been used exclusively, and no bad results have been reported. Pocket material has been extracted, and the gems taken out by the screening process only, and quite a quantity of small crystals of good quality were found in the tailings. Active operations will be shortly resumed, when it is contemplated to tap the ledge about 30 feet below the present workings.

The output of this work has been approximately 30 pounds of topaz, 50 pounds of all classes of tourmalines, and a small quantity of spessartite garnet. Beryl pseudomorphs after topaz were also noticed, badly checked, but of pinkish and light yellow colors; also quartz pseudomorphs after the topaz, in square and rhombic prisms, are found loose in the topaz pockets.

SURPRISE MINE.

TOPAZ, BERYL, TOURMALINE, SPESSARTITE GARNET.

The Surprise mine, adjoining the last, is situated in the NW. $\frac{1}{4}$ SW. $\frac{1}{4}$ sec. 9, T. 13 S., R. 2 E., San Bernardino meridian. It was discovered on land owned by Mrs. G. M. Stone, November 1, 1903, by Mrs. J. W. Booth, who noticed a few spessartite garnets sticking in the pegmatite. The vein runs nearly east and west, with a slight trend

to the northwest and southeast. It dips southward about 20°, and has an average width of 3½ feet.

Two places have been opened on the ledge at intervals of about 300 feet, each showing an entirely different condition in the formations. The first is about 250 feet north of Mr. Booth's residence, which is the stage station between Fosters and Julian. Here the pegmatite is finely crystallized and about 18 inches thick under a hanging wall of micaceous diorite. The pegmatite contains considerable graphic granite, with greenish stains, crystallized quartz, clear and white, and muscovite of a rich grass green. Beneath this is an average thickness of 1½ feet of decomposed albite and orthoclase and infiltrated sand and earth, with some hydrated muscovite and black tourmalines, many of which are altered to muscovite and quartz. Disseminated through this friable mass are spessartite garnets, varying from deep red to light honey yellow, affording beautiful gems, some of which have been cut and weigh from 3 to 6 carats. About 5 pounds of these were taken out of a cut running along the ledge about 6 feet in depth and 18 feet long, with an average width of 4 feet. Beneath this is the usual "line rock," in which no garnets, but banded lines 2 to 3 inches apart of minute black tourmalines, were observed: this would indicate that a higher crystallization of the ledge forces the lower into the wall or outer rock, as garnets are always found to occur in the lower rock of tourmaline ledges, while the tourmaline is found in this locality as embedded crystals in the lower rock of garnet-bearing ledges. Some broken quartz crystals which appear to have been etched either by fluorides or some other chemical compound, are disseminated with the garnets.

The second working lies east of the first between foot and hanging walls of gray micaceous diorite. The pegmatite here is very compact and finely crystallized, is stained with iron and manganese, and shows serrated black tourmalines. In the center of this ledge, between the gray base rock and the upper pegmatite, are 6 or 8 inches of orthoclase, somewhat altered, and containing small pockets 2 or 3 inches in diameter, filled with fine granular ferruginous quartz. In this sandy filling are found topaz crystals, usually coated with a talcose clay. Those near the surface were mostly white or colorless, while at a depth of 6 feet the color had changed to sky blue and aquamarine blue. About 4 pounds of these crystals have been taken from a cut 20 feet long and extending 8 feet in depth on the incline of the ledge. Several very fine pink beryls were also obtained, one 6 inches long and 1½ inches in diameter, having 3 perfect sides, being the largest crystal yet found. About 2 pounds of pink beryl have been the output so far. The above quantities of spessartite, topaz, and beryl have been extracted at an expense of \$250. Giant powder is used exclusively, but no work is in progress at present: development is contemplated

after January 1, 1905. This mine is an extension of the Little Three mine adjoining it on the northwest. The same persons own several other ledges in the same vicinity, which traverse four quarter sections of land owned by them, and lie in a line extending east from the present workings. Timber and water are both available in sufficient quantities for mining purposes. The stones are extracted in both localities by screening and washing.

In some of the topaz pockets a yellowish, reniform, compact, and extremely heavy substance was noted. The specific gravity of this mineral and its peculiar color have attracted the attention of several people, but it was impossible, with the means at hand, to determine it. From the edge of the pockets containing these nuggets were found radiated black tourmalines, altered to a micaceous substance of emerald and sea-green color, with occasional tinges of purple and rose-pink. This alteration seems to be an allied mineral to the one above noted. Some triplite and magnetic iron occur at the junction of foot wall and pegmatite.

The minerals noticed in these mines were white and blue topaz; pink, green, and white beryl; black, green, and brown tourmaline; spessartite (so called); biotite; magnetite; orthoclase; albite; quartz in fine crystallizations, and the two unknown minerals above referred to.

HERCULES MINE.

BERYL, ESSONITE, AND SPESSARTITE GARNET.

This mine lies about $4\frac{1}{2}$ miles northeast of Ramona and about three-fourths of a mile northwest of the stage station between Fosters and Julian. It was located in August, 1903. Work has been confined to open cuts or scalping, and all the gems have been extracted either from the débris, or from broken pockets in the ledge. This is a coarse pegmatite, decomposed, and with very little perfection in the albite or orthoclase; but where black tourmalines penetrate this crystallization and join the tourmaline embedded in either albite or orthoclase, are essonite garnet and so-called spessartite. The latter is of the finest quality, and has produced flawless gems from 1 to 6 and 8 carats in weight, which retail at \$20 a carat. Both hanging and foot walls are a gray diorite, with some mica. The course of the vein is north 60° west, with a dip of 45° . The location is in the SE. $\frac{1}{4}$ SE. $\frac{1}{4}$ sec. 6, T. 13 S., R. 2 E., San Bernardino meridian. The product has been handled exclusively by screening, and a good many gems have been thrown over on account of the peculiar condition of the clays which cover them; but the output so far has been 15 pounds of garnet and one-half pound of very clear green beryl, which is associated with it. A few green and blue tourmalines, but not of gem quality, have been found higher up on the ledge. There is a spring on this property, which will furnish water for domestic and mining purposes, also sycamore and oak timber in sufficient quantity.

LOOKOUT MINE.

BERYL AND SPESSARTITE GARNET.

This mine was located in July, 1903. It is situated $4\frac{1}{2}$ miles northeast of Ramona, and joins the Hercules mine on the northeast. The vein has a dip of 20° to the southwest, and an average width of $4\frac{1}{2}$ feet. The claim is 600 by 1,000 feet, runs north 55° west, and is located in the SE. $\frac{1}{4}$ sec. 5, T. 13 S., R. 2 E., San Bernardino meridian.

Work in this mine has been confined to open cuts and scalping. Spessartite garnet is the only gem found, although indications of beryl and tourmaline, with several peculiar metallic substances not yet determined, were noticed. Both walls are of gray diorite, containing some biotite mica, although a seam of red clay lies between either wall and the ledge itself. The latter consists of feldspar, with very little quartz. In the pockets, albite and orthoclase are the mother of crystallization, and a very peculiar condition of the quartz appears. The crystals seem to have been broken at some time into splinters and then welded together, forming a brecciated mass of quartz with no distinct crystallization. Adhering to this quartz, and also to the surface of the albite, are perfectly formed garnet crystals, many of which have afforded beautiful gems. Not enough work has been done to make a satisfactory examination, but this mine if properly handled should be a paying producer. About 3 pounds of garnet and perhaps $\frac{1}{4}$ ounces of fine beryl are the total product thus far (1904). Some sycamore and oak timber is available, and water on the Hercules mine can be used in connection with this one.

M'FALL MINE.

ESSONITE GARNET AND EPIDOTE.

This mine is situated $7\frac{1}{2}$ miles southwest of Ramona and on the eastern line of the San Vicente grant; it was located about ten years ago as a zinc mine, and erroneous reports were given of its value as a zinc property. On examination, no evidence of zinc was found, but a large body of essonite garnet and finely crystallized epidote were shown. A shaft 21 feet in depth still remains in solid garnet, with very little impurity of quartz. Very few gems were found, however, although many handsome crystals, more or less transparent, have been taken out. But there is some condition in these crystals which does not produce good refraction of light, and hence they have no value as gems. The epidote, however, is the finest yet seen in San Diego County, and will probably produce gems. Mr. McFall expects to work the garnet for abrasive purposes, as transportation can be secured cheap enough to do this profitably. There are both wood and water adjacent to the property, though not on it. No work has been done for some little time, and specimen hunters have taken the finest accessible material. The general formation is blue and gray diorite, and the masses of garnet appear to be pockets rather than ledges.

PROSPECT MINE.

TOURMALINE AND SPESSARTITE GARNET.

The Prospect mine was located on September 15, 1904, and is about 4 miles northwest of Ramona, crossing the road between Ramona and Mesa Grande, an open cut having been made on the east side of the road in the Hatfield Canyon. Spessartite has been the only product in gems, although greenish tourmalines have also been found. The ledge is about 6 feet thick, of a poorly crystallized pegmatite, and most of the gems are found "frozen" into the ledge, few pockets having been discovered. Work is going on, and probably a better condition will be found in 15 or 20 feet from the present working. The output has been small, and no sales have yet been made. The Prospect is worth mentioning, however, as it is the last mine on the northwest end of the Ramona belt of crystallization, the belt apparently being barren for 14 miles northward of Mesa Grande. The owners expect to continue their work until something definite is known of this property, and a report a few months later will be more satisfactory than can be had at present. There are both wood and water in plenty on the property.

THE JACUMBA DISTRICT.

This region is developing indications of much interest. It lies quite near the Mexican line far south of the districts previously considered and on the eastern border of the gneissic and granitic zone of hills and mountains, where the latter fall off steeply toward the desert. The Jacumba Hot Springs are some 70 miles east of the city of San Diego, on the line of a projected railroad. The region, for a considerable distance around, and even out on the desert to the northeast, is rich in garnets, but most of it is wild, inaccessible, and barren. The following are the points thus far opened and definitely reported:

DOS CABEZOS MINE.

ESSONITE GARNET.

This mine is 17 miles north and east from Jacumba Hot Springs by road, although in a direct line only about 8 miles; it is situated in sec. 2, T. 17 S., R. 8 E. Here many hyacinth garnets have been taken out from a matrix of carbonate of lime, which occurs in quantities sufficient to be used as building marble, etc. There are also indications of phosphate of lime superior to that from the Grapevine district in San Diego County. This locality has been worked from time to time for the last ten years for gem crystals, and several hundred dollars' worth have been taken out, but nothing definite has been done, owing to its inaccessibility and to the lack of wood and water. Other properties are now owned in the same vicinity and development is expected during 1905.

— MINE.

ESSONITE AND SPESSARTITE GARNET.

Nine and one-half miles east of Jacumba and near Mountain Springs, on the road from San Diego to Imperial and on unsurveyed land, is a locality on which several prospects have been located showing excellent essonite and so-called spessartite garnet. A shaft has been sunk and considerable surface work has been done. The gems extracted are of exceptional quality and size. Several thousand dollars will be expended by the owners during 1905. The water supply is about $4\frac{1}{2}$ miles away, and there is no timber whatever or even wood for ordinary purposes. The country is very rough and inaccessible, but bids fair to be one of the best producers of gems yet discovered in California.

CRYSTAL GEM MINE.

BERYL, ESSONITE AND SPESSARTITE GARNET.

This mine is situated about $8\frac{1}{2}$ miles northwest from Jacumba. Pink and green beryls associated with essonite and (so-called) spessartite garnet have been the only output, but general indications are very favorable. The ledge is a coarse pegmatite about 8 feet in width, and extends for nearly a mile. Quartz crystals, albite, orthoclase, and indications of lithia are found associated. The property is not worked at present, but probably will be during 1905. Ten pounds of fine essonite garnet and perhaps 3 or 4 pounds of beryl were taken out during 1904. There is a spring of water on the property and plenty of timber.

MANGANESE DEPOSIT.

GARNET, BERYL, BLACK TOURMALINE.

These deposits lie $1\frac{1}{2}$ miles northwest of Jacumba Hot Springs. A ledge averaging 10 feet in width and extending about 5,000 feet has been located and shows oxides of manganese associated with garnet, beryl, and black tourmaline. No development work has been done, but upon the advent of a railroad this property will be valuable as the manganese is of exceptional quality and can be utilized in many ways.

Farther to the north and east are other localities—in the vicinity of Seventeen Palms, in the Santa Rosa Mountains, on the edge of the desert, and in the direction of Salton Lake, where fine and abundant occurrences of garnet are reported. Much of this is the wild and barren country claimed by an old Indian chief known throughout the region as Fig-tree John.

PRODUCTION.

In the following table is given a statement of the production of precious stones in the United States from 1898 to 1904, inclusive:

Production of precious stones in the United States, 1898-1904.

Stone.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Diamond	None.	\$300	\$150	\$100	None.	\$50	None.
Sapphire	\$55,000	68,000	75,000	90,000	\$115,000	100,000	\$100,000
Ruby	2,000	3,000	3,000	500	None.	None.	None.
Topaz	100	None.	None.	None.	None.	200	None.
Beryl (aquamarine, etc.)	2,200	4,000	11,000	5,000	4,000	4,000	5,000
Beryl (pink)						200	100
Emerald	50	50	1,000	1,000	1,000	250	None.
Phenacite	None.	None.	None.	None.	None.	None.	None.
Tourmaline	4,000	2,000	3,500	15,000	30,000	45,000	40,000
Peridot	500	500	500	500	500	5,000	5,000
Kunzite							10,000
Quartz, crystal	17,000	12,000	10,000	10,000	12,000	10,000	10,000
Smoky quartz	1,000	None.	1,000	1,000	2,000	1,500	2,000
Rose quartz	100	100	100	150	200	1,500	1,000
Amethyst	250	250	500	500	2,000	3,000	3,000
Prase	None.	None.	None.	None.	None.	None.	None.
Gold quartz	5,000	500	2,000	2,000	3,000	3,000	5,000
Rutilated quartz	100	50	50	50	100	100	None.
Dumortierite in quartz	None.	None.	None.	None.	None.	None.	None.
Tourmalinated quartz	None.	None.	None.	1,000	None.	None.	None.
Agate	1,000	1,000	1,000	1,000	1,000	2,000	2,000
Moss agate	1,000	1,000	1,000	500	500	1,400	1,500
Chrysoprase	100	100	100	1,500	5,000	1,500	6,000
Silicified wood (silicified and opalized)	2,000	3,000	6,000	7,000	7,000	5,000	5,000
Opal	200	None.	None.	None.	150	200	None.
Garnet (almandite)	5,000	5,000	500	100	None.	None.	None.
Rhodolite	None.	None.	20,000	21,000	1,500	1,000	None.
Garnet (pyrope)	2,000	2,000	1,000	1,000	1,000	2,000	3,000
Topazolite	None.	None.	None.	None.	None.	None.	None.
Amazon stone	500	250	250	200	500	400	500
Oligoclase	10	20	20	None.	None.	None.	None.
Moonstone	None.	None.	None.	None.	None.	None.	None.
Turquoise	50,000	72,000	82,000	118,000	130,000	110,000	100,000
Utalite (compact variscite) ..	100	100	100	250	None.	100	200
Chlorastrolite	5,000	3,000	3,000	3,000	4,000	3,000	2,000
Mesolite (thomsonite, so called)	1,000	1,000	1,000	1,000	1,000	500	500
Prehnite	100	50	50	None.	None.	None.	None.
Diopside	None.	None.	None.	None.	None.	None.	None.
Epidote	None.	None.	None.	None.	None.	None.	None.
Pyrite	1,000	1,000	2,000	3,000	3,000	3,000	3,000
Malachite	None.	250	200	100	None.	None.	None.
Rutile	110	200	100	None.	None.	None.	None.
Anthracite (ornaments)	1,000	2,000	2,000	2,000	2,000	2,000	2,000
Catlinite (pipestone)	2,000	2,000	2,000	2,000	2,000	2,000	2,500
Fossil coral	500	50	50	100	None.	None.	None.
Arrow points	1,000	1,000	1,000	500	None.	None.	None.
Miscellaneous							15,000
Total	160,920	185,770	233,170	289,050	328,450	321,400	324,300

IMPORTS.

The following table shows the value of the diamonds and other precious stones imported into the United States from 1867 to 1904, inclusive:

Diamonds and other precious stones imported and entered for consumption in the United States, 1867-1904.

Year ending—	Diamonds.					Diamonds and other stones not set.	Set in gold or other metal.	Total.
	Glaziers'.	Dust.	Rough or uncut.	Set.	Unset.			
June 30—								
1867	\$906					\$1,317,420	\$291	\$1,318,617
1868	484					1,060,544	1,465	1,062,493
1869	445	\$140				1,997,282	23	1,997,890
1870	9,372	71				1,768,324	1,504	1,779,271
1871	976	17				2,349,482	256	2,350,731
1872	2,386	89,707				2,939,155	2,400	3,033,648
1873		40,424	\$176,426			2,917,216	326	3,134,392
1874		68,621	144,629			2,158,172	114	2,371,536
1875		32,518	211,920			3,234,319		3,478,757
1876		20,678	186,404			2,409,516	45	2,616,643
1877		45,264	78,033			2,110,215	1,734	2,235,246
1878		36,409	63,270			2,970,469	1,025	3,071,173
1879		18,889	104,158			3,841,335	538	3,964,920
1880		49,360	129,207			6,690,912	765	6,870,244
1881		51,409	233,596			8,320,315	1,307	8,606,627
1882		92,853	449,513			8,377,200	3,205	8,922,771
1883		82,628	443,996			7,598,176	α2,801	8,126,881
1884	22,208	37,121	367,816			8,712,315		9,139,460
1885	11,526	30,426	371,679			5,628,916		6,042,547
December 31—								
1886	8,949	32,316	302,822			7,915,660		8,259,747
1887	9,027	33,498	262,357			10,526,998		10,831,880
1888	10,025	29,127	244,876			10,223,630		10,507,658
1889	8,156	68,746	196,294			11,704,808		11,978,004
1890	147,227	179,154	340,915			b12,429,395		13,105,691
1891	c565,623	125,688	(d)			e12,065,277		12,756,588
1892	532,246	144,487				e13,845,118		14,521,851
1893	357,939	74,255				e9,765,311		10,197,505
1894	82,081	53,691				e7,291,342		7,427,214
1895	107,463	135,558				e6,330,834		6,573,855
1896	78,990	65,690		(f)	(f)	e4,474,311		4,618,991
1897	g29,576	167,118	1,386,726	\$330	\$2,789,924	1,903,055		6,276,729
1898	8,058	240,665	2,513,800	6,622	5,743,026	1,650,770		10,162,941
1899	2,428	618,354	4,896,324	13,388	8,795,541	2,882,496		17,208,531
1900	8,333	605,435	3,658,645	10,721	7,803,066	1,472,328		13,561,588
1901	5,864	831,984	6,592,469	2,654	13,544,326	1,828,055		22,815,352
1902	10,738	798,523	8,221,389	175	13,834,168	1,888,793		24,753,586
1903	10,634	720,150	10,275,800	675	13,022,367	2,494,897		26,524,523
1904	73,054	445,621	10,234,587	559	13,439,023	1,893,969		26,086,813

a Not specified since 1833.

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

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

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

e Including rough or uncut diamonds.

f Not specified prior to 1897.

g Including also miners' and engravers' not set.

