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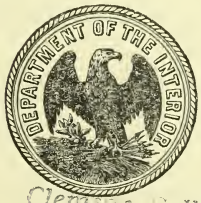

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GEMS AND PRECIOUS STONES.

By Douglas B. Sterrett.

INTRODUCTION.

There was a large decline in the industry of mining precious and semiprecious stones in the United States in 1914. This is in accord with the usual conditions in the gem trade during times of stress. The greatest decrease was in the production of sapphire in Montana, due to the fact that one of the larger placer mines of variegated sapphire was not operated during the year and that the deposits of blue sapphire in matrix, now owned entirely by an English company, were closed in August. The greatly increased demand for native gem minerals that was expected to arise from dealers preparing for the tourist trade at the Panama-Pacific International Exposition at San Francisco and the Panama-California Exposition at San Diego did not materialize. Only small quantities of these gems were mined in the West, and the demand in the East fell off greatly. Among other minerals in which a large decline of production was reported to the Survey was opal, the claims in the northern part of Humboldt County, Nev., not being so actively worked as in 1913. A comparison of the figures in the table of production for 1913 and 1914 shows decreases in 1914 in most of the gem minerals, slight increases in a few, and a decided increase in turquoise.

Acknowledgment is gladly made of assistance rendered by many persons in the preparation of this report by furnishing statistics and information on gem occurrences and by supplying specimens for examination. It is not possible to name individually all who have assisted in this way, but some are mentioned in the following pages.

This report does not deal with the gem-mining industry of the United States during 1914 alone, but follows a plan adopted several years ago by which as many different gem localities as possible are examined and described each year, regardless of whether or not they are worked that year. The aim of this plan is the collection of information for a more complete report on the occurrence of precious stones in the United States at some future date.

AGATE.

ALABAMA.

Mr. J. H. Watkins, geologist for the Southern Railway, presented to the Survey specimens of chalcedonic chert from a small mountain southeast of Gurley, Ala. The material is in lumps measuring as much as 2½ inches across and shows a variety of colors, chiefly in red

and yellow mixed through gray. The color is evenly distributed in some parts and grades from one to the other in other parts. The material has a dense texture very closely resembling the novaculites of Arkansas. Some of it would pass as chalcedony and some has so much impurity in the nature of iron oxide as to resemble jasper. None of it has been cut for ornamental purposes, but the colors would prove attractive.

ARKANSAS.

Mr. F. Holstein, of De Roche, Ark., mentions the occurrence of a bed of brecciated agate-like rock found along the southern border of the Novaculite Mountains, in the northern part of Hot Springs County, Ark., which has many of the qualities desirable in an ornamental stone. When polished the stone shows a brecciated structure with various colors exhibited by the different pebbles and fragments. These fragments are inclosed in a cement of chalcedonic material. It is possible that this bed is a phase of the novaculite, which, as is well known, grades into material indistinguishable from ordinary chalcedony. Some of the novaculites of Arkansas have an exceedingly dense grain, a waxy luster resembling chalcedony, and various bright colors. Prominent among these colors are different shades of pink, red, brown, and yellow scattered in various patterns through gray and white matrix. The color and texture of such novaculites render them quite suitable for ornamental purposes.

COLORADO.

Specimens of agate received from Mr. J. D. Endicott, of Canon City, Colo., were found by him at a new locality in Pueblo County, the exact location of which is not given.

These agates are very delicately banded, showing bright and dull red and brown layers interbanded with gray and white chalcedony. Some of the specimens show a fortification structure and others a concretionary or spherical structure. In some of the translucent gray bands there are small rounded red spots as in the St. Stephen stone variety of agate. The texture is very close-grained and the stones would take a fine polish. The coloring is sufficiently rich without artificial intensifying to make a good grade of agate jewelry.

MONTANA.

Mr. Paul E. Hanson, of Billings, Mont., forwarded to the Survey various specimens of agate, chalcedony, and associated minerals that have been gathered from the gravel deposits lying along Yellowstone River and covering much of the adjacent country. In this report for 1913, specimens of moss agate from the same region, also loaned by Mr. Hanson, were described, and the present notes cover certain associated varieties of agate. Among these is a slice from a cobble $3\frac{3}{4}$ inches long and 2 inches thick which shows a streak of wavy banded agate surrounded by dark-green mottled prase. This streak of wavy agate also contains a large proportion of green intermixed, resulting from the presence of minute particles or scales probably of an iron silicate mineral, such as chlorite. Another specimen consists of banded bluish-gray, brownish, and white agate crusted over with quartz crystals, the tips of which show a pale amethystine color.

Another specimen is a cream-yellow piece of chert which shows black dendritic markings similar to those occurring in moss agate, and still another is a slice of translucent chalcedony with inclusions of tufts or globules of white chalcedony, which, in turn, inclose small spots of green prase.

WYOMING.

The following notes on the occurrence of moss agate in Fremont County, Wyo., along the Sweetwater Valley, have been supplied by C. J. Hares, of the United States Geological Survey. The agate deposits are scattered over several townships, including Tps. 30 and 31 N., Rs. 89, 90, and 91 W., mostly north of Sweetwater River, and among the isolated granitic masses of the Granite Mountains. The locality is about 35 miles west of the Pathfinder Dam and 60 miles west of Casper. Occasionally a few agates are found farther down Sweetwater River, but the best agate beds are limited to from 1 mile to 3 miles north of the McIntosh ranch, located on Sage Hen Creek, in sec. 15, T. 30 N., R. 90 W., and north of the granite in that vicinity.

The agates occur as pebbles scattered over the surface of the ground on terracelike slopes or in valleys. As they are gathered up from the surface a fresh supply is uncovered among the grass, sagebrush, cacti, and soil by hard showers or by the almost daily heavy winds. They apparently represent residual wind-swept gravel from the disintegration of the flat-lying White River formation, of Oligocene age.

The White River formation in this area is composed of a great variety of rocks—very coarse granitic conglomerate, agglomerate containing fragments of Tertiary eruptive rocks, grits, arkosic sandstone, shale, fine volcanic tuffs containing rhyolitic bombs, opalized quartz, opal containing mossy markings in limestone, much unindurated volcanic ash, and clay. In the vicinity of the agate beds the formation lies unconformably on and fills in around the old irregular bald masses of pre-Cambrian granite. The formation is flat lying and, as far as ascertained, has not been materially deformed since its deposition.[1]

The present altitude of the agate beds is about 6,400 feet above sea level, which is approximately 1,000 feet below the highest White River beds in near-by localities—along the northern edge of the Sweetwater escarpment and about 200 feet above Sweetwater River. The crest of the Sweetwater escarpment, composed of the White River formation, about 25 miles to the west of the agate beds, is composed of limestones which, in places, contain opal with mosslike markings. These opalized limestone beds possibly represent the last stages in the deposition of the White River formation. It is probable that the agates are derived from the disintegration of the White River beds and now remain on the surface, from which the finer and softer material has been blown and washed away.

The agate pebbles range in size up to 2 inches or more in diameter, and are usually well rounded and some are partly polished. Many of the agates have the dreikanter shape and the wind-blown facets characteristic of wind action. Some are elongated and others are flattened or lens shaped. The good specimens are uncommon, being

[1] For a fuller description of the geology of this region, see Hares, C. J., The anticlines in central Wyoming. [In preparation.]

associated with a great many worthless pebbles, such as black and red jasper, quartzite, white milky quartz or chalcedony, and waxy gray chalcedony. A quantity of the waxy chalcedony is found in place and loose on the surface between the McIntosh ranch and Lankin Pass.

The agates range from opaque white and gray to highly translucent gray with black, dark brown, reddish to yellowish-brown dendritic markings. Those with the black and dark-brown markings are most common. The dendrites consist of tufts or patches of oxides of manganese and iron. They show great variations in size and in delicacy of pattern. Some are small rounded tufts too dense to show individual lines, and others are as much as 2 or 3 millimeters across, exhibiting very delicate, mosslike or seaweed-like markings. The black dendrites furnish the prettiest gems. Groupings of the dendrites in such manner as to show complex landscapes, as in the Montana moss agate, apparently do not occur, and the gems depend on the perfection of the individual dendrites for their beauty.

The agate beds have not been exploited commercially to the present time. Most of the specimens have been collected by occasional visitors who have not placed the stones in the regular gem market.

AMETHYST.

PENNSYLVANIA.

The occurrence of amethyst at many localities in Chester and Delaware counties, in southeastern Pennsylvania, have been mentioned by Kunz [1] and Dana.[2] The localities given include, in Chester County, several places in east Bradford, Pocopson, Birmingham, and Newlin townships; and in Delaware County, Aston, Birmingham, Chester, upper Chichester, Concord, Edgemont, Marple, Middletown, upper Providence, and lower Providence townships. Most of these discoveries were made before 1890, and since that time only occasional amethysts have been found. The majority of the amethysts have not been of fine quality, but a few specimens of fine crystals capable of yielding beautiful gems have been obtained.

At present very few persons in the region take an interest in these minerals or know of the localities, and since much of the land has grown up in brush or been turned into meadow, there are few opportunities for the further discovery of amethyst. An examination was made of one of the old localities near Village Green, in Aston township, now owned by G. L. Mills. Some pits in a field on this place where good amethyst was obtained, are now filled up. A careful search on the ground near the pits yielded only a few colorless quartz crystals. No rock crops out around these amethyst pits, but the area is mapped as Wissahickon gneiss by F. Bascom.[3]

Mr. John H. Smedley, of Media, who was formerly much interested in the minerals of this region, knows the location of many of the amethyst deposits. He states that few finds of value are now made and that under the present conditions much prospecting and digging will be necessary to uncover gem material at many of the places.

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[1] Kunz, G. F., Gems and precious stones, pp. 112–115, Scientific Publishing Co., New York, 1890.
[2] Dana, J. D., System of mineralogy, 6th ed., pp. 1067–1068, 1909.
[3] U. S. Geol. Survey Geol. Atlas, Philadelphia folio (No. 162), 1909.

VIRGINIA.

A specimen of amethyst from a locality 1 mile west of Minnieville, Prince William County, Va., has recently been acquired by the United States National Museum. This amethyst was found in 1902 in a cultivated field, and was recently brought to the attention of Farnham E. Briggs, of Minnieville. Mr. Briggs has prospected around the locality, but only found a few colorless quartz crystals and failed to find other amethyst. The specimen weighs over 3 pounds, measures 6 inches across the prism zone, and is 5 inches high. The crystal has been split so that a thickness of 3 inches only remains. The whole specimen is not amethyst; the interior consists of colorless to partly fractured quartz crystal nearly 4 inches in diameter, incrusted with groups of amethyst crystals from half an inch to 1¼ inches thick. On one side these groups of crystals have grown into one larger amethyst crystal with a face 3 inches across around the prism zone, but terminated by several pyramidal points. The faces of the amethyst crystals are somewhat dimmed by etching or wear, and part of the crystals are rather badly flawed. Most of the amethyst crystals have a beautiful bright purple color, grading from dark to pale. As usual the color is darkest near the points of the separate crystals. This amethyst is of interest chiefly as a specimen and would yield only small flawless gems. The richness of the color and the size of the crystals, however, are sufficient to justify further efforts to locate the deposit from which the specimen has been obtained.

Amethyst has been found in the region of Trevilians, Louisa County, Va. One of the prospects, on the land of A. J. Rudinger, 4 miles southwest of Trevilians, was visited. Crystals are also reported on the places of Capt. William Overton and J. J. Boxley in the same general region. On the Rudinger land amethyst crystals have been found at two places loose in the soil of cultivated fields about a quarter of a mile north of the house. At one of these places the crystals were found in an area about 40 feet in diameter. The soil at this place is reddish and sandy, resulting from the decomposition of a granitic rock inclosing diorite. An outcrop of quartz has covered the surface with massive quartz débris for a distance of nearly 100 feet in a S. 60° W. direction beginning a few yards southwest of where the amethysts were found. Soapstone borders the granite and diorite on the southeast. About two quarts of crystals have been picked up at this locality, ten or a dozen of which have good color. The others range from paler purple to almost colorless quartz. The crystals are mostly small, not many measuring over an inch thick. The best ones have a fine dark purple color, which is not evenly distributed or clear through the whole crystal.

During July, 1915, Mr. Rudinger dug a trench 12 feet long and 5 feet deep at this prospect. The amethyst vein was located and about half a bushel of crystals are reported to have been taken out. Seven of these crystals were sent to the Survey for examination. They were of about the same size as those found on the surface, but were of better color and quality. Most of them were not perfectly clear or flawless, but would cut into beautiful beads. One or two of the crystals would yield small flawless gems of rich purple color.

The other prospect is about 150 yards N. 15° W. of this place and is less promising. About two dozen crystals have been picked up in an area about 50 feet in diameter. The soil is dark greenish, resulting from disintegrated coarse and medium-grained diorite, and contains many blocks of this rock. Some of these amethysts have fairly good purple color.

BERYL.

ALABAMA.

Golden beryl crystals have been reported from the region of Hissop, Coosa County, Ala., by George F. Kunz.[1] This beryl is described as being light golden yellow and clear enough to cut into small gems.

Two localities were examined, one on the Eliza Goggans place, three-fourths of a mile southwest of Hissop, and the other on John H. Thomas's place, 1 mile northeast of Hissop. The prospects consist of small pits opened by F. M. Dorsey a number of years ago. On the Goggans place the beryl was found in a large outcrop of massive quartz, forming part of a pegmatite ledge. Associated with the quartz is mica in rough fishbone-shaped crystals 3 or 4 inches across, and decomposed feldspar. Most of the beryls were found in the quartz. Two crystals of about 1 inch in diameter were observed at the time of examination. These have a pale yellowish-green to pale aquamarine color. They were so fractured that they would not yield gems over one-third of a carat in weight. Similar outcrops of quartz were observed on the S. Wade place adjoining the Goggans place on the north, and beryl crystals were reported to have been found here also. On the Thomas place the prospect was opened for mica, but a few beryl crystals are reported to have been found. Only yellowish-gray opaque crystals were seen. The country rock around Hissop consists chiefly of biotite granite gneiss, with occasional inclusions of mica schist. Outcrops of massive quartz, similar to those found at the beryl localities, were observed at many places along the road, and Mr. Thomas states that occasional beryl crystals have been found in some of them.

CALIFORNIA.

Mr. Joseph Ward, with headquarters at Barstow and Lone Pine, Cal., who has prospected large areas of the desert between those places for gem and other minerals, has submitted a number of rough beryl crystals to the Survey. These consist of rough, hexagonal crystals ranging from small size to over half an inch in diameter. They are pale to quite dark blue, some of the darkest nearly resembling sapphire in color. All of the specimens found at the time of discovery are opaque, but Mr. Ward expects to prospect the locality more closely for gem varieties. The beryl crystals are associated with such minerals as are found in pegmatite or lining the walls of miarolitic cavities. The associated rock is fine-grained biotite granite, and one specimen contains a vein of the beryl crystals with intermixed quartz and feldspar about half an inch thick. Another

[1] Precious stones: U. S. Geol. Survey Mineral Resources U. S., 1887, p. 59, 1888.

specimen is an inch and a half thick, showing two surfaces which have evidently come from the walls of a vein. The color and association of the beryls are similar to those on Mount Antero, Colo., but so far the California locality has not yielded crystals of gem quality.

CONNECTICUT.

The beryl locality near Merryall, Litchfield County, Conn., has been mentioned by George F. Kunz in these reports for the years 1885, 1892, 1898, and 1899. The beryls were obtained as an important by-product from a quarry worked for feldspar and mica. The deposit has been idle since about 1900, and the workings are now in an overgrown condition. Formerly the mine was owned by two parties, S. L. Wilson and George Roebling, but the whole property is now held by Mr. Roebling, of Northville, Conn. An examination of the deposit was made in October, 1914, at which time the following notes were taken:

The deposit is located 5½ miles N. 12° W. of New Milford, or 3 miles east of Kent, a station on the New York, New Haven & Hartford Railroad. The workings consist of an open cut about 120 yards long driven southwest into a hillside. The cut varies from 10 to 50 feet deep in the deepest part and is 30 to 40 feet wide in the northeast half. The northwest wall overhangs the workings, and the southeast wall dips northwest at varying angles. A little tunnel work has been carried on along the hanging wall. The open cut was originally 65 feet deep toward the northeast end, but this part has been partly filled up by the caving of wall rock. The country rock is biotite gneiss, highly schistose near the vein and has been mapped as Becket gneiss by Rice and Gregory.[1] Immediately around the mine the gneiss has a due northeast strike with a vertical to high northwest dip. The vein rock is pegmatite, which varies from 20 to 40 feet thick. It strikes about parallel with the country rock, but cuts across the schistosity of the latter with a lower dip to the northwest. The pegmatite pinches and swells in different parts and is reported to have been thinner near the bottom of the cut than at the surface. The texture of the pegmatite is extremely coarse grained. Gray quartz occurs in large massive streaks several feet in thickness, lying roughly parallel with the walls of the pegmatite, orthoclase feldspar in crystals and masses several feet across, and mica in bunches and pockets in various parts of the vein. The best mica and feldspar is reported to have come from the northeast half of the open cut and the best beryl from the southwest half. Near the southwest end of the cut there are outcrops of quartz streaks 2 to 3 feet thick and masses of solid mica of even greater thickness, and one 50 feet long. This solid mica is composed of rough "A" and "wedge-shaped" crystals, 1 to 4 inches across, bunched closely together, with a little impurity such as quartz and feldspar mixed with it. One block of solid mica blasted loose from this vein measured 4 feet thick and 8 feet long. Such mica would only be valuable as scrap for grinding, but it is probable there are at least 50 tons in sight. The mica from the northeast end of the cut was suitable for glazing, yielding clear sheets several inches across. Large quantities of

[1] Rice, W. N., and Gregory, H. E., Manual of the geology of Connecticut: Connecticut State Geol. and Nat. Hist. Survey Bull. 6, 1906.

feldspar were shipped for pottery purposes and paid most of the expenses of mining. Among associated minerals are a few dark red opaque garnet crystals, a little biotite mica, and black tourmaline.

Beryl crystals have been found abundantly in some parts of the quarry. These crystals range from small size up to more than a foot in diameter, and one block was seen on the dump which weighed about 50 pounds. The majority of this beryl is opaque or only partly translucent, and is variously colored bluish green, yellowish green, and yellow. In some of the large crystals there are translucent and clear portions from which gems can be cut. In other specimens the gems are obtained from small crystals which are nearly transparent throughout. At one place several fractured crystals are exposed in a streak of granular gray quartz along the southwest wall. These crystals are translucent with a few transparent parts, and are golden yellow to yellowish green in color.

The gem beryls are quite clear and brilliant, with a wide range in colors, from pale to dark golden yellow and almost topaz brown, pale to dark blue and bluish green, and some are yellowish green. Kunz mentions several that were white or colorless.

The production of beryl from this mine has been large, and in four years $17,000 worth of gems are reported to have been sold. Mr. Roebling still has a few specimens showing the quality of the gem material obtained from the mine. This deposit of pegmatite or another in the same lead has been traced for several hundred yards across the hill to the southwest of the mine, and at a few small openings made there showed large pure crystals of orthoclase feldspar. Whether gem beryls would be found by opening this portion of the deposit can not be determined without further excavation.

A number of beryl crystals have been found in the feldspar quarry of Joseph Halberg, 2½ miles S. 25° E., of Middle Haddam. This quarry consists of a cut about 35 feet square and 18 feet deep on the inner side, made in a pegmatite outcrop forming a small steep hill. Besides feldspar the pegmatite contains much quartz, a quantity of biotite mica, some muscovite, large black tourmaline crystals, many beryls, opaque red garnet crystals up to 3 inches in diameter, and columbite in fractured crystals up to several pounds in weight. The beryl occurs in crystals ranging from small ones up to those an inch in diameter and several inches long. In places they are arranged in radial groups in masses of quartz. Most of the crystals are opaque pale yellowish and greenish, but a few contain transparent portions that might yield small gems.

GEORGIA.

Specimens of cut beryl gems found on the farm of T. J. Allen, about 2 miles east of Vaughn, Spaulding County, Ga., were kindly loaned by Mr. John L. Davidson, formerly of Griffin, Ga., now of Chester, S. C. The rough stones from which these gems were cut were found loose in the surface soil several years ago. On the same hill with the beryls black tourmaline, rose quartz, smoky quartz, a few garnets, and mica were found. Mr. Davidson and Mr. Allen sank a shaft nearly 60 feet deep on what appeared to be the beryl vein, but no crystals were found. On the same hill are other deposits of pegmatite and it is possible the beryls were set free by the weathering

of some of these. Among the specimens submitted by Mr. Davidson were two blue beryl gems of fine, light sky-blue color, weighing from 1½ to 2 carats each. These gems contained a few flaws but have the color characteristic of fine gems. A third gem was pale blue with a slight greenish cast, weighed over 1 carat, and was almost flawless; and a fourth was of about the same weight, of yellowish-green color, and slightly flawed. There was one pale translucent rose quartz gem cut in elongated "en cabochon" shape. This gem shows an asterism which would probably be more pronounced in a hemispherical stone cut en cabochon. The fine color of the blue beryl gems and the fact that portions of them are perfectly clear make this locality of interest as a possible source of valuable gem material.

MAINE.

During operations for feldspar in the Mount Apatite region, near Auburn, Me., in 1914, a few finds were made of minerals of value as gems or of interest as specimens. Among these was a beryl crystal 12 inches in diameter and 22 inches long, with a light pink color. Much of this crystal was opaque or only translucent, but in some parts it was clear enough to cut into gems. This beryl was found in a quarry of the Maine Feldspar Co., and a specimen of the cut gem was kindly given to the Survey by Mr. N. G. Smith, of the Maine Feldspar Co., and Mr. M. L. Keith, lapidary, of Auburn, Me. The cut gem weighs 1.2 carats, is perfectly clear and flawless, shows a very light pink color, and has great brilliance. In some lights the pink is not especially noticeable and the beryl resembles the caesium beryl found at many localities in Maine. Larger gems showing deeper color were also cut from the crystal.

MASSACHUSETTS.

In the region of variegated tourmalines around Goshen and Chesterfield, Hampshire County, Mass., many beryls are found. A few occurrences are mentioned in this report under tourmaline. Some of these occurrences have been known for a century, and certain beryls from the Goshen region have been called goshenite. Dana [1] calls the white or colorless variety goshenite, but Kunz [2] describes it as blue beryl. Both varieties occur, and specimens suitable for gems have been obtained. A locality 1½ miles N. 80° W. of Goshen, about 300 yards north of the north end of Lily Pond, was visited. This place is overgrown with heavy brush and showed but little evidence of having been worked. As it was found without the services of a guide, the writer does not know whether it is the usual locality mentioned as near the Lily Pond.

At the locality examined a ledge of mixed granite and pegmatite 30 feet thick standing several feet above the surface outcrops up a hill slope in a due west direction for a distance of about 100 yards. The country rock is fine garnet schist cut by medium-grained gray granite. The pegmatite incloses irregular streaks or veins of white quartz which pinch and swell along their course. A prominent one of these quartz veins is inclosed in the pegmatite at the east end of the outcrop.

[1] Dana, E. S., System of mineralogy, 6th ed., p. 407, 1909.
[2] Kunz, G. F., Gems and precious stones of North America, p. 95, 1890.

Quartz also occurs in smaller masses scattered through the pegmatites. Some of this quartz is highly translucent to almost clear, and some is smoky. Mica occurs in yellowish-green crystals 2 to 3 inches across. Beryl is abundant in crystals ranging from less than an inch to 15 inches in diameter. They occur mostly along the quartz veins, some of the larger ones displacing the quartz. The beryls exposed at the surface are mostly opaque, but some contain translucent portions. They range from nearly white to yellowish, to bluish green and to greenish blue in color.

NEW HAMPSHIRE.

Beryl crystals, some suitable for gems, have been found at several places in the town of Roxbury, a few miles east of Keene, N. H. A number of these have been cut by Leon Allen, a lapidary of Keene, with very good results. Among localities where the crystals occur are Bassett Hill, 5 miles north of east of Keene; Horse Hill, 4½ miles east of Keene; and the Keene granite quarry, on a hill 3 miles south of east of Keene. Still other localities have been found but were not visited. At all of the prospects the beryls have been found in pegmatite.

The surface of Bassett Hill is rolling and stands 200 to 300 feet above the surrounding country or over 1,600 feet above sea level. It is covered with overgrown fields and small pine thickets on the summit and east side and with woods on the west side. The country rock is granite gneiss over most of the hill. Beryl crystals have been found in two ledges of pegmatite on the east side of the hill and in one on the west side. On the east side the outcrop of the lower ledge is exposed for a distance of over 100 yards in a north and south direction. At three places beryl crystals have been found in small openings blasted or cut into the pegmatite outcrop. The vein is about 10 feet thick. It contains smoky and translucent gray quartz, gray orthoclase crystals, plates of greenish muscovite, and beryl crystals. One beryl crystal found at the time of visit was opaque and gray on the outside and pale yellow with clear portions between fractures in the interior. The upper pegmatite ledge on the east side of the hill outcrops with a strike of N. 10° E. and a dip of about 20° W. It is several feet thick, with a zone of coarse-grained rock 2 feet thick next to the hanging wall. There are a few small pockets 1 to 3 inches in diameter at the base of this rock. Among minerals observed in the pegmatite are gray orthoclase crystals, quartz in small masses and graphically intergrown with feldspar and mica, black tourmaline crystals, some arranged in rosettes, and colorless but more or less fractured beryl crystals up to 2 inches in diameter.

Pale-colored beryl crystals have been found in the pegmatite outcrop on the west side of the hill. The pegmatite at this prospect is coarse-grained, containing orthoclase crystals up to 10 inches thick, segregations of quartz over a foot thick, and crude mica crystals 2 to 3 inches across.

Most of the gems that have been cut from beryl crystals from Bassett Hill are colorless or only slightly colored, but quite brilliant, rivaling the cæsium beryl of Maine in luster.

Horse Hill is mostly stripped pasture land with a generous proportion of rock outcrops. Three prospects have been found at the south

end of the hill, one in flat ground to the west and at the foot of the hill slope, another 100 yards northeast on the hill slope, and the third about 200 yards east also on the hillside. Horse Hill is composed of granite gneiss inclosing beds of mica gneiss, both of which are cut by pegmatite. The lower prospect to the west consists of an exposure of pegmatite 75 feet across, outcropping somewhat like a floor. Only the southeast wall is exposed, and this strikes N. 35° E. with a northwest dip. The pegmatite contains irregular quartz segregations, orthoclase crystals 1 foot across, greenish muscovite, and beryl crystals. The beryls range up to 2 inches in diameter and are mostly opaque. Some of the beryl is transparent and rather pale aquamarine green.

At the prospect 100 yards to the northeast a pegmatite vein 18 inches to 3 feet thick crops out in a direction S. 60° E. around the end of the hill for a distance of nearly 100 yards. The vein cuts the bedding of the granite and inclosed gneiss which strike N. 30° E., with a high west dip. Beryl crystals are plentiful in the northwest end of the outcrop.

At the east prospect a pegmatite ledge 2 to 6 feet thick with a low northwest dip outcrops in a northeast direction around the hillside. Many loose blocks of pegmatite and quartz have rolled down the hill slope below. Good beryl crystals have been found at this locality, some being of clear aquamarine color. One rough crystal was found which would cut into a gem weighing possibly 10 carats.

At the Keene granite quarry rock has been quarried over an area about 150 yards long in a northeast direction and about 100 yards wide. The granite is a fine to medium grained gray muscovite-biotite variety. On the southeast side of the quarry a vein of pegmatite cuts the granite with a strike of N. 55° E. and a vertical dip. The pegmatite forks into streaks, which pinch out or enlarge irregularly. The pegmatite contains gray to smoky quartz segregations, crystals of microcline or anorthoclase 2 or 3 inches thick, muscovite crystals 1 to 2 inches across, black tourmaline thickly intergrown with quartz, a little biotite, and beryl crystals. The beryls range from dark to pale golden to greenish yellow to yellowish green in color. Most of them are small, but a large proportion contains parts clear enough to cut. The cut gems are very brilliant, and some of the greenish-yellow stones are unusually pretty.

A deposit was operated for mica and gem beryl several years ago by Franklin Playter, of Boston, in the town of Springfield, Sullivan County, N. H. It is on one of the higher summits of Springfield Mountain (called Melvin Hill on Hitchcock's Atlas of New Hampshire), 3 miles S. 40° W. of Grafton, at an elevation of 2,100 feet above sea level. The workings consist of four open cuts along a small ridge. Three of the openings fall in a line of about N. 55° E., within a distance of 150 feet on the northwest side of the ridge, and the fourth is about 100 feet southeast on the opposite side of the small ridge. Two of the open cuts are 25 feet across and are connected by a passage 6 feet wide. The different openings vary from 8 to 25 feet deep.

The country rock is muscovite-biotite gneiss, which has a general northeast strike and high southeast to vertical dip. The pegmatite cuts the gneiss irregularly with its greatest length corresponding

approximately to the schistosity of the gneiss. By pinching and swelling the deposit cuts the schistosity of the inclosing rock in one place and is conformable with it in another. In the two connected open cuts the pegmatite is over 20 feet wide, but pinches down to 6 feet at the surface in the passage between the two cuts and widens to 10 feet at a depth of about 10 feet below the surface. Where the pegmatite pinches down in this passage it cuts across the bedding of the gneiss in part, and in part the gneiss bends around the bulging shape.

The texture of the "vein" rock is variable, but chiefly rather coarse. The quartz occurs in large segregations of coarse smoky to gray grains. In places it occurs in translucent to nearly clear masses several inches across. Two varieties of feldspar were observed, gray orthoclase or microcline crystals 2 feet thick and smaller masses of albite 3 to 4 inches across. Black tourmaline crystals are plentiful, some with good crystal form. Biotite is present in quantity, and some of it is intergrown with the muscovite. The muscovite is of good quality, splitting well and having a fine clear rum color. Crystals were seen around the workings which would yield perfect plates 2½ by 3 inches and 2 by 4 inches. Beryl occurs rather plentifully, the greater part being opaque, but some is clear with fairly good colors. It is not possible to judge what quantity and quality of beryl were obtained when the mine was in operation, but the following material was found on the dumps and in the pegmatite: Well-formed opaque to translucent pale yellowish-green and bluish-green crystals as much as 2 inches thick, a few crystals with transparent portions showing the same colors that would cut into small gems. The character of this material would indicate that much larger clear beryl may be expected.

Another prospect for gem beryl and mica was opened by the Columbian Gem Mining Co., on one of the summits of the northern part of Springfield Mountain, about half a mile northeast of the Franklin Playter mine, 2½ miles S. 40° W. of Grafton. Over 200 feet of open-cut and trench work with a shaft and considerable stripping of vein outcrop have been made on the summit of the mountain at an elevation of 1,750 feet above sea level. The open cuts range from 10 to 25 feet wide and 5 to 15 feet deep. The shaft is filled with water. No work has been done for a few years, but at the time of examination (October, 1914), four buildings, in good repair, a quantity of material suitable for punch and scrap mica, and a few rough beryl crystals had been left at the mine.

The country rock is quartz-mica gneiss in which the mica consists of both biotite and muscovite. The gneiss is strongly banded and has been much folded and crumpled so that definite strikes and dip could not be measured. It has been cut by pegmatite and associated granite in several directions, some of the pegmatites showing steep to nearly vertical walls and others apparently lying nearly flat or with low dips. The relations seem to be those of the nearly vertical dikes acting as feed channels for the flatter beds. The granite associated with the pegmatite is chiefly fine-grained biotite granite and merges into the pegmatite. The texture of the pegmatite is variable, ranging from a granite-like rock to masses in which there are orthoclase crystals a foot thick, quartz segregations 3 feet across,

and mica crystals 8 to 10 inches in diameter. The arrangement and position of the different minerals in the pegmatite is very irregular.

The quartz of the pegmatite is white, gray, or smoky, mostly opaque, but some is translucent and nearly clear. The muscovite is clear rum-colored and part has a good cleavage. Biotite is plentiful; some of it is intergrown with the muscovite. Black tourmaline is present in some places in crystals up to 2½ inches thick. Opaque dull-red garnet crystals half an inch to 2 inches in diameter are scattered through the pegmatite, and a few small pink garnets were observed in one specimen on the dump. Only a few beryl crystals were seen in the rock. These were yellowish green to pale aquamarine-green and mostly opaque. Little could be learned of the quality of the gem material found during mining.

New prospects for mica and beryl were opened during 1914 by Charles Murphy, of Wilmot, on the old Underhill place, about 1¾ miles N. 75° E. of Springfield in Sullivan County. Only one of these was of interest for its possible gem minerals. This consisted of an open cut 20 feet square and 12 feet deep in a large pegmatite outcrop. Much of the rock exposed in the working is graphic granite of both coarse and fine grain. In places there are small segregations of quartz and orthoclase crystals measuring from a few inches to 1 foot thick. About 4 tons of small mica crystals suitable for cutting into small sheets and for punching were taken from this opening. A great many beryl crystals were found. These range from one-sixteenth of an inch to 1½ inches in diameter. They are well-formed simple hexagonal prisims occurring separately in parallel growths, and in radialg roups. Most of them are opaque or only translucent and have pale-greenish aquamarine color. Up to the time of examination no beryl of gem quality had been found. Among associated minerals are biotite, black tourmaline, opaque red garnet up to 2 inches in diameter, triphyllite in masses up to 8 inches thick, löllingite or arsenopyrite, and apatite.

PENNSYLVANIA.

Beryl crystals occur at many localities in Chester and Delaware counties, Pa., and occasionally one of sufficiently good color and quality for cutting into gems is found. Many of the crystals are obtained from the pegmatite deposits worked for feldspar, but a few have been found in small veins or deposits or pegmatite inclosed in other rocks. One of the best-known localities of this type is in the C. F. Leiper quarry at Avondale, Delaware County. This quarry has been opened by a cut nearly a quarter of a mile long in a north and south direction, 100 to 250 feet wide and 40 to 80 feet deep. The rock quarried is a muscovite-biotite granite gneiss, strongly schistose in some phases. A few streaks or veins of quartz and pegmatite are inclosed approximately conformably with the gneiss, that is, striking north and south with nearly vertical dip. The pegmatite veins examined vary from 1 inch to 2 feet in thickness, pinching and swelling along the strike. They contain flesh-colored potash feldspar, opaque brownish-red garnet up to 2½ inches in diameter, black tourmaline, masses of gray quartz, and muscovite up to 1½ inches in diameter. Fragments of golden beryl crystals were observed at two places in one of these pegmatite veins, but the better

part of the crystals had been broken away by mineral collectors. One of these crystals measured about an inch in diameter but was somewhat flawed. Little attention is paid to such minerals by the quarrymen, and most of the best specimens are found by collectors. Most of the beryls obtained are kept as cabinet specimens, but occasional gems are cut from some of the crystals.

CHRYSOPRASE.

CALIFORNIA.

Two specimens of chrysoprase were received from Messrs. L. H. and H. H. Rhodes, Oakland, Cal., which had been found about 15 miles northwest of Coalinga, in Fresno County. This material was obtained from a prospect being developed for cinnabar, and if mining for that mineral is continued, further prospecting for the chrysoprase will be carried on. The specimens consist of fragments from a vein about half an inch thick. They have a dark-green color, but not so bright as that exhibited by the best chrysoprase.

DIAMONDS.

ARKANSAS.

In the Arkansas diamond field prospecting was continued by the Kimberlite Diamond Mining & Washing Co. whenever funds were available. Very little work was done by the Arkansas Diamond Co., and a few stones reported found by that company were picked up from the surface or from concentrates obtained during previous washing. No work was done by the Ozark Diamond Mining Corporation, and in December, 1914, the mill and property of this company were sold by a receiver to the Kimberlite Co. The property of the American Diamond Mining Co. was idle during the year and also sold by a receiver. The work of the Kimberlite Co. consisted in some mining at its workings on the original peridotite area in which diamonds were found and in washing of blue earth in the mill. Outside reports state that a number of diamonds were found, but the policy of the company at present is to withhold information on this subject. Accordingly, in the table of production giving the output of diamonds the output of this company is not included, but will be given in whatever year the company sees fit to furnish this information.

CALIFORNIA.

Information regarding the diamonds found in Butte County, Cal., during 1914 has been furnished by Messrs. M. J. Cooney and William Fliedner, of Oroville, Cal. Ten to a dozen diamonds were found by different parties operating sluice boxes in the old placer ground at Cherokee Flats. Five of these stones are reported to be white or colorless and flawless, ranging from half a carat to 1¼ carats. The weights of the three larger stones are given as 1.29, 1.25, and 1.11 metric carats, respectively. Some of the diamonds found during 1914 along with others found in previous years have been placed on exhibition at the Panama-Pacific International Exposition by the Sacramento Valley Association.

FELDSPAR GEMS.

AMAZON STONE.

CALIFORNIA.

Mr. Joseph Ward, with headquarters at both Barstow and Lone Pine, Cal., sent to the Survey a number of specimens of amazon stone which he had collected in the deserts of California somewhere between those two places. The material consists of many fragments and crystals which range from small sizes to an inch in thickness. A few of the specimens show especially good shades of bluish green and greenish blue, with fairly smooth, fine texture. The associated rock sent with the amazon stone consists of pegmatitic granite such as is found around the walls of miarolitic cavities in granite. If crystals of larger size and of the same good color can be obtained in quantity, the locality should prove of value.

MAINE.

Specimens of amazon stone were received from Mr. F. H. C. Reynolds, of Boston, Mass., which had been found during 1914 along the coast of Maine. The exact locality from which these were obtained has not yet been made public by Mr. Reynolds. The discovery was made late in the fall, so that little prospecting was possible and only about a pound of crystals was obtained. The material sent to the Survey contains a specimen of biotite granite grading into pegmatitic material, such as is commonly found lining the walls of a miarolitic cavity in granite. The feldspar grades from white or gray where it is attached to the granite into bright bluish-green and greenish-blue amazon stone. The specimens submitted are rather small, but would cut into cabochon gems of pleasing color, and if larger masses of equally good quality are obtained, the deposit will be of interest to the New England semiprecious stone trade.

NEW YORK.

Prof. Freeman F. Burr, of Barnard College, New York City, submitted to the United States Geological Survey several crystals of amazon stone which he had collected in a quarry 2 miles northeast of White Plains, N. Y., along with information regarding the locality. The quarry is worked for materials for use in the construction of Kensico dam for the New York City water supply. Prof. Burr states that about 100 pounds of specimens have been carried away from the quarry and that probably a large quantity of equally good material has been sent through the crushers, along with other rock, for use on the dam. The crystals are described as varying from less than an inch in thickness to one which measured 7 by 7 by 5 inches. This crystal has been placed in the collection of Columbia University. Some of the crystals are fairly well developed; others have but few faces. The quarry is in the Yonkers gneiss, of pre-Cambrian age. This gneiss is a foliated granitic rock which contains pegmatite injections. The amazon stone crystals have evidently come from miarolitic pockets in this gneiss with pegmatite lining their walls. The crystals are microcline, grading from flesh-colored bases or interior

through pale bluish-green to bright bluish-green exteriors. Some of them are associated with smoky quartz in rude crystals and rough tabular albite crystals. Plates of biotite occur with these minerals. Much of the amazon stone is striped with gray to white perthitic markings, but a few specimens do not show more of these markings than is ordinarily present in amazon stone used for gems. The best specimen submitted to the Survey showed a bright translucent bluish-green color. This specimen could not be cut into a pure gem, but would contain some perthitic markings. A few of the amazon stones have been cut as gems, but none have been regularly placed on the market.

SUNSTONE.

ARIZONA.

Specimens of andesine feldspar, some of which showed the characters of sunstone, were received from Dr. H. P. Wightman, of Globe, Ariz. Dr. Wightman states that these were collected by the Apache Indians from their reservation not far from Globe. The specimens resemble the sunstone from Modoc County, Cal., cut by the Pacific Gem Co., of Los Angeles, mentioned in this report for 1913. Microscopic examination shows it to be andesine with a refractive index of 1.550. All of the andesine is clear, one piece showing a pale-yellowish color and the other bright copper-colored reflections from inclusions along certain lines of crystallization parallel to one of the cleavages.

GARNET.

ALASKA.

A deposit of garnet about 7½ miles north of Wrangell, Alaska, from which many fine specimens have been obtained during the last 15 years, is being developed by the Alaska Garnet Mining & Manufacturing Co., of Minneapolis, Minn. The bulk of the garnet taken from this deposit is used for a special foundry powder, but many of the fine crystals, with their associated mica schist matrix, are sold for cabinet specimens, and gems are reported to be cut from occasional fine specimens. A good exhibit of the garnets is being made at the Panama-Pacific International Exposition. The crystals range from small size up to more than an inch in diameter. They show face developments of the rhombic dodecahedron and trapezohedron faces. The small faces are fairly sharp, and where they meet at the dodecahedron points show a dark-red color tinged with violet, characteristic of almandine garnet.

JADE.

ALASKA.

Some of the jade from the Shungnak region north of Kobuk, Alaska, was cut by lapidaries of San Francisco during 1914 in preparation for the expected increase of trade in souvenir gems among visitors to the Exposition. This jade is the dull dark-green variety of nephrite.

JASPER.

CALIFORNIA.

Mr. M. J. Cooney, of Oroville, Cal., states that various types of jasper pebbles and bowlders were found in the old gold placer workings near Oroville when these were prospected for diamonds about four years ago. Among these jaspers was one bowlder of the bloodstone variety.

OREGON.

Mr. Don Maguire mentions a new discovery of a jasper-like mineral found along Crooked River, in Crook County, Oreg., in September, 1914. Only a small quantity was collected, but test specimens cut for gems proved to be unusually pretty for jasper. Mr. Maguire will place the stone on the gem market under the name of "iolanthite."

PERIDOT.

CALIFORNIA.

Mr. Joseph Ward, of Barstow and Lone Pine, Cal., submitted to the Survey specimens of peridot which he has found while prospecting between those places. This peridot resembles very much that found near Rice, Ariz., but among the specimens sent in none was clear or large enough for cutting into gems. The material is in granular masses with grains as coarse as wheat. Mr. Ward reports that the stones were obtained from inclusions in basalt, and a specimen showing this relation was submitted. Further prospecting will be required to learn whether larger peridot suitable for cutting is associated with the deposit.

QUARTZ.

ASTERIATED QUARTZ.

Notes on asteriated quartz have been given by Frank B. Wade.[1] The immediate cause of this investigation is the appearance of the new star stone or asteriated quartz placed on the market by Bell & Birkner, of New York City. No statement has been given of the locality from which this gem is obtained other than that it is an American stone. This quartz has a highly translucent or opalescent appearance, and when cut in hemispherical form in the proper direction with relation to the crystal structure it shows a six-ray star by reflection of sunlight or light derived from a single source. If the same stone is cut into a sphere, the star is seen in the stone by looking toward the source of light. In the better gems these rays are particularly bright and noticeable and move across the surface of the cut stone as the observer's relation to the light is shifted. Microscopic examination was undertaken by Prof. Wade with a view to determining the cause of the rays. The quartz was found to be full of minute needlelike inclusions arranged in three sets, needles of each set lying parallel to each other and at angles of 60 degrees to the other two sets. It was not definitely possible to determine

[1] Jewelers' Circular-Weekly, Jan. 20, 1915.

whether these inclusions are solid needles or very fine tubular cavities, but investigation indicated that they are probably elongated cavities with a diameter of about 0.003 millimeters. It is doubtless the reflection of the light from these different sets of rays which makes the six-ray star visible in the cabochon cut gems. The cause of the inclusions being arranged at angles of 60 degrees may be looked for in the hexagonal structure of quartz.

The gems are cut in round cabochon shapes of standard sizes for the trade and mounted in various articles of gold jewelry. They are sold under the trade name starolite (not to be confused with staurolite), as well as by the mineral name asteriated quartz. Messrs. Bell & Birkner have had on exhibition a rough specimen of the asteriated quartz weighing 10 pounds.

ROSE QUARTZ.

CALIFORNIA.

Mr. M. J. Cooney, of Oroville, Cal., reports the discovery of rose quartz by him near Forbestown, in the eastern part of Butte County, Cal. The rose quartz occurs along the Mammoth gold lode. No information is given regarding the quality.

RHODONITE.

MONTANA.

During 1914 a quantity of rhodonite was collected for ornamental use from the dumps of the old Alice silver mine at Butte, Mont. Rhodonite occurs as a gangue mineral at a number of the mines around Butte, and W. H. Weed [1] states that, next to quartz, it is the most common gangue mineral of the silver veins and is found in some of the fault veins of the copper area. The rhodonite occurs with rhodocrosite and ore minerals in parallel banded veins below the oxidized zone. In places veins composed largely of rhodonite and quartz are 1 to 2 feet thick. Rhodonite is found in other mines along the Rainbow lode and in the Allie Brown and Wappello vein in the Lexington mine. During mining for metal ores a quantity of rhodonite, along with other gangue minerals, has been thrown on the dumps at the different mines, and the supply of this material for ornamental purposes is now obtained by working over these old dumps.

The rhodonite forms fine compact even-grained masses of pale to deep pink color. The best quality is bright rose-pink. Some of the massive mineral is stained by seams of black oxides of manganese, which, by their strong contrast with the pink, add to the beauty of the cut gems. The Butte rhodonite is similar in character to that found at several places in California, notably near Happy Camp, Siskiyou County, and in the Indian Valley, Plumas County. During the last few years a quantity of rhodonite from these different localities has been cut and sold in the west largely to the tourist trade, by which it has been very much appreciated.

[1] Geology and ore deposits of the Butte district, Mont.: U. S. Geol. Survey Prof. Paper 74, p. 84, 1912.

RUBY.

NORTH CAROLINA.

Prospecting at the ruby deposits on Caler Fork of Cowee Creek, in Macon County, N. C., during part of 1914 did not result in a definite determination as to whether or not the property can be profitably worked. Earlier work for rubies a number of years ago in the gravel beds in the bottom land along the creek resulted in the discovery of much red and pink translucent corundum and of some clear stones of value as gems. The best stones had a fine ruby color with silkiness and slight cloudiness in some specimens. Prospecting of the gravel beds carried the work back to a point where the valley narrows below a flat. Here ruby corundum was found in matrix and the hillside was called In Situ Hill. At several different times prospecting has been carried on in this hillside in search of the remaining part of the deposit from which the best rubies of the placer ground have been obtained.

Prospecting work at the In Situ Hill locality was begun in 1913 by the Consolidated Ruby Co., of New York, and was continued in 1914. The new work consisted of a shaft 38 feet deep from the bottom of the open cut at the foot of the hill. From this shaft drifts were run 58 feet west and 80 feet south of east. Several holes were sunk by a churn drill, using chilled-steel shot for cutting edges. One of these holes was 103 feet deep, cutting through all the saprolite or decomposed rock into fresh, unaltered gneiss. The fresh rock from the drill core consists both of garnetiferous diorite and garnetiferous biotite gneiss. The garnetiferous diorite would probably yield yellowish-brown saprolite just like that found in the upper workings of In Situ Hill. No pockets containing ruby corundum were found in the drill holes. In the shaft and the underground workings a vein or seam was followed, in which several small and one large pocket or deposit carrying ruby corundum were found. The largest deposit was a shoot or chimney measuring 6½ feet high by 3½ feet wide, and was nearly 4 feet thick. The material taken from this deposit, when washed, yielded about 20 pounds of translucent pink corundum. These crystals range from small size up to a centimeter in diameter and thickness. None of them has fine red color, and most of them are pink to purplish red. Nearly all of the crystals contained small rust cavities up to 2 millimeters in diameter, formed by the decomposition of minute rhodolite garnets similar to those described by Pratt and Lewis.[1] The corundum crystals are inclosed in whitish kaolin-like deposits, apparently resulting from the decomposition of feldspar or pegmatitic material which originally inclosed the corundum. None of these rubies is of as deep a color or is as clear as those found in the stream gravels below In Situ Hill, but the richness of the pockets adds to the interest of prospecting for stones of better quality.

[1] Pratt, J. H., and Lewis, J. V., Corundum and the peridotites of western North Carolina: North Carolina Geol. Survey, vol. 1, p. 183, 1905.

SAPPHIRE

IOWA.

The discovery of a sapphire on the shore of Lake Okoboji, Dickinson County, Iowa, is described by G. A. Muilenburg.[1] This sapphire was found in the gravel along the lake shore by Mr. Muilenburg in 1912. It is described as resembling a piece of blue bottle glass worn round and smooth by attrition. Examination showed it to be a sapphire of good quality, and the stone was later cut into a gem weighing $1\frac{3}{8}$ carats. It is stated to be the cornflower blue variety, with a good, velvety luster. This gem was probably transported to the Lake Okoboji region by ice during the glacial period along with a large variety of other minerals and rocks. Its original home can only be guessed at, and Mr. Muilenburg suggests possibly either the Yogo region of Fergus County, Mont., or some unknown area to the north in Canada.

MONTANA.

Mining for sapphires was carried on at several localities in Montana, the principal operations being in Fergus County, where the so-called Yogo blue gems are mined. The only mine in operation there was that of the New Mine Sapphire Syndicate, of London, and this company closed down at the beginning of August after the opening of the war in Europe. The mine of the Yogo American Sapphire Co. was purchased by the New Mine Sapphire Syndicate, and for several months preceding this deal the Yogo American mine had been closed.

Operations for the variegated sapphires in Granite and Deerlodge counties consisted of placer work by several smaller producers. The principal yield from these localities is in sapphire suitable for mechanical purposes, such as meter bearings and watch jewels. Large deposits of these sapphires occur along Dry Cottonwood Creek, in Deerlodge County; along the West Fork of Rock Creek, in Granite County; and along Missouri River, to the north and northeast of Helena. These deposits could be made to meet the demands of the American trade arising from the present decreased imports of foreign materials. The small cull sapphires from the Yogo mine are used in the higher grade of watch jewels, and already a shortage of this quality has arisen.

SPODUMENE.

CALIFORNIA.

Mining at the Pala Chief gem mine, near Pala, Cal., resulted in a production of about 20 pounds of fine gem spodumene crystals, along with a quantity of gem tourmaline. The spodumene occurs in magnificent crystals of pink to lilac and violet colors, with beautiful transparency through the whole crystal. Some crystals are colorless in part or throughout. The larger crystals measure several inches in length, 3 or 4 inches in width, and half an inch to 1 inch in thickness. Among the larger crystals that have been found in this mine is one over 11 inches in length and another weighing $47\frac{1}{2}$ ounces.

[1] Iowa Acad. Sci. Proc., vol. 21, p. 203, 1914.

MAINE.

Mr. N. G. Smith, of the Maine Feldspar Co., submitted a specimen of purplish lilac-colored spodumene found during 1914 in the quarry of that company on Mount Apatite, near Auburn, Me. This spodumene is translucent to opaque. The color is as good as that found in much of the California iris or kunzite; the mineral only lacks transparency to make it a valuable gem. Evidently the specimen was broken from a crystal of some size, and Mr. Smith reports the finding of many pounds of the spodumene. It is probable that some of this material cut en cabochon could be used as an ornamental stone.

TOPAZ.

CALIFORNIA.

Mr. J. W. Ware, of San Diego, Cal., has furnished the following information concerning a large topaz crystal found at his mine in San Diego County. The crystal weighs 3¼ pounds, and shows a number of crystal faces, but without a high polish. It has a decided green color. This topaz was found along with other greenish and white topaz crystals in a part of the pegmatite ledge forming the Mountain Lily gem mine on Smith or Aguanga Mountain. Tourmaline is found in pockets in the same ledge, but not in the same pockets as the topaz. A part of this topaz crystal is transparent and will yield good gem material.

WYOMING.

Mr. Paul E. Hanson, of Billings, Mont., kindly gave to the Survey five specimens of topaz, which were obtained from the headwaters of Bighorn River in northern Wyoming. These specimens are all crystals showing a development of a number of faces including prisms, pyramids, domes, pinacoids, and base. They are mostly small, the largest measuring 13 millimeters long, 10 millimeters wide, and 5 millimeters thick. All of the crystals are transparent and colorless, resembling in quality the colorless topaz from the Thomas Range in Utah. The specimens would not have much value as gems, except for the local souvenir trade, but would be of interest as specimens because of their quality and sharp crystal form.

TOURMALINE.

CALIFORNIA.

There was but little increased activity in the tourmaline field of southern California during 1914, to meet the expected demands for this gem at the Panama-Pacific International Exposition and the Panama-California Exposition. The principal output came from the Tourmaline Queen and the Pala Chief mines, near Pala, San Diego County. The Pala Chief mine is worked for both gem spodumene and tourmaline. The tourmaline crystals from these mines show great variations in color and size and have yielded many beautiful gems. Another mine worked for tourmaline was the Mountain Lily mine of J. W. Ware, on Smith or Aguanga Mountain, San Diego County. This mine produced a small quantity of very fine grade

of green, bluish-green, and greenish-blue transparent crystals. Mr. Ware has called some of the more beautiful green and bluish-green gems from his mine emeralite, in allusion to their resemblance to emerald. Among other mines the Esmeralda, 1½ miles north of Mesa Grande, was worked a short time and yielded a few gem tourmaline and good pink beryl crystals. This mine has never been a large producer, but good gems and specimens of aquamarine and pink beryl, along with varicolored tourmalines, have been taken from it.

CONNECTICUT.

Tourmaline of value both as gems and specimens has been found at several places in Middlesex County, Conn. Many of the specimens have been obtained from quarries operated for feldspar for pottery, but in a few quarries the mining has been for tourmaline and associated specimen minerals only. A few of the quarries were visited in October, 1914, and are described below.

The M. P. Gillette feldspar quarry, known as the Haddam Neck quarry, is 1 mile N. 22° E. of Haddam, near the east bank of Connecticut River. It is one of the oldest quarries in Connecticut and, besides many gem tourmalines, has yielded a number of fine specimens of other minerals. The deposit has not been worked for several years and the pits were partly filled with water and overgrown with vegetation at the time of examination. Notes taken at that time have been supplemented from E. S. Bastin's description.[1] The quarry consists of one large irregularly shaped open cut about 100 yards long in a north and south direction and 100 feet wide in the widest part, which joins a smaller open cut on the west about 75 feet long in a north and south direction and 35 feet wide. These quarries range from 20 to 30 feet deep and have crosscuts leading out to two large dumps on the river side. One cut extends west from the west quarry and the other west from the south end of the east quarry. According to Bastin, the west quarry was worked chiefly for tourmalines and specimen minerals. The east quarry was worked chiefly for feldspar, also yielding some mica, gem tourmalines, and specimen minerals.

The country rock is dark-gray muscovite-biotite schist or gneiss, which strikes about north with a vertical dip. The pegmatite is large and has been split into several streaks by large inclusions or horses of schist. In the north end of the quarries there are three beds of pegmatite with a total thickness of about 100 feet in a width of 150 feet. In the middle of the quarry on the south side the schist unconformably overlies a rounded boss of pegmatite. This boss pitches to the south and on the north side of the quarry outcrops as a bed nearly 50 feet thick conformably between schist walls. The pegmatite contains large masses of graphic granite, potash feldspar crystals 1 to 3 feet across, generally with a little intermixed albite, albite, muscovite, black and green tourmaline, and pockets or cavities lined with crystals. Some of the mica crystals measure over 1 foot across and are 6 inches thick, but do not split well because of the presence of "wedge" and "A" structures.

Bastin describes the gem pockets in the east cut as averaging—

8 or 10 inches in diameter, though there are many smaller ones only 2 to 3 inches across. They are distributed with great irregularity through the pegmatite mass.

[1] Feldspar deposits of the United States: U. S. Geol. Survey Bull. 420, pp. 48–49, 1910.

Lepidolite in finely granular masses, pale-green albite, and small green tourmalines are abundant near many of the pockets. Muscovite surrounded by a border of lepidolite, or in parallel growth with lepidolite, is also of common occurrence near the pockets. As in most of the gem-bearing pegmatites the tourmalines are seldom in their original positions on the walls of the cavities, but lie embedded in a sandlike mass of quartz fragments, cookeite, and other decomposition products at the bottom of the pockets. They are mainly grass-green to olive-green in color, becoming nearly colorless toward the tip. The exact apex of some of the crystals is pink and many of them show very perfect terminations. Gem tourmalines are not so abundant that it would pay to work the mine for these alone.

Most of the gems found in the feldspar mining were marketed irregularly through local collectors.

The associated minerals and tourmaline from Haddam Neck have been described by H. L. Bowman,[1] as pinkish muscovite, lepidolite, greenish-white muscovite, tourmaline, apatite, microcline, albite, beryl, quartz, cookeite, fluorspar, microlite, and columbite. The tourmaline occurs in beautiful, transparent, striated, curved triangular prismatic crystals of various colors, the most common being light and dark green and pink. A few crystals are almost perfectly colorless. Color variations in the crystals are generally in transverse bands, either with sharp contacts or hazy gradations. In some crystals the color shades are delimited by planes corresponding to crystal terminations, yielding ghost or phantom crystals. Kunz states that crystals showing marked internal striations have been found which yield gems showing cat's-eye effects when cut cabochon across the prism. This property has also been found highly developed in some of the tourmalines from Mesa Grande, Cal.

The feldspar quarry of F. E. Strickland is about 2½ miles northeast of Portland, in the west side of Collins Hill. It is operated by Mr. Strickland under lease to the Eureka Mining & Operating Co., of Trenton, N. J., all of the spar, quartz, and mica going to the company and gems and other minerals being retained by Mr. Strickland. The quarry consists of two joining open cuts with north and south elongation, parallel, and connected at the north end. The east cut is about 300 feet long, 65 feet wide, and 10 to 40 feet deep. The west cut is about 200 feet long, 50 feet wide, and 25 feet deep. A crosscut leads out to the hillside at the north end of the west cut.

The country rock is muscovite-biotite schist containing much black tourmaline near the pegmatite. The schist has a general north strike and a dip of about 20° W. It has been warped, however, to correspond approximately with the contact of the pegmatite. The pegmatite is a large irregular semibedded deposit both parallel with and cutting the schist in different parts. In the east deposit the outcrop was an elongated dome pitching under the schist at each end. That this body of pegmatite joins the one forming the west deposit under the surface is shown where the two open cuts join at the north end.

The pegmatite is coarse-grained containing large bodies of graphic granite, potash feldspar crystals 2 or 3 feet across, irregular quartz segregations several feet thick, and bunches or streaks of mica crystals. Cavities or pockets with crystal-lined walls are found irregularly distributed in parts of the quarry, especially in the east working. These pockets range from small size up to one reported to be 4 feet long by

[1] Mineralog. Mag. and Jour. Mineralog. Soc. Great Britain, vol. 13, pp. 97–121, 1903. Reviewed by G. F. Kunz, U. S. Geol. Survey, Mineral Resources U. S., 1902, pp. 841–842, 1904.

1½ feet wide and 1½ feet high. Some of them have yielded tourmaline gems of fine quality and specimen minerals of interest. The gem-bearing pockets were found near the middle and in the south half of the east quarry. Work has been abandoned in this part temporarily, but a good working face 20 feet high has been made across the north end of the cut preparatory to removing the spar to that depth southward to the length of the quarry. Mr. Strickland expects to find more gem pockets when this block of pegmatite is quarried.

The tourmalines so far found in the pockets are mostly greenish, showing many variations as olive-green, yellowish green, nearly grass-green, bluish green, and pale greenish blue. They range from small size to large crystals, one of which weighed several pounds. This crystal was badly broken in quarrying, but some beautiful bluish-green and greenish-blue gems were cut from the fragments. Another crystal of transparent green now in the museum of Wesleyan University at Middletown, Conn., is about 7 inches long. Cut gems are of fine quality, show good colors, and are brilliant in the paler varieties. There is little choice between these and the finer gems from Mount Mica and Mount Apatite, Oxford County, Maine. Mr. Berry states that a few pinkish tourmalines have been found along with the green, the pink generally capping a greenish crystal.

Among other minerals adjoining and lining the walls of the pockets are coarse flat albite or clevelandite crystals, granular lepidolite, rough quartz crystals, greenish muscovite crystals, and a little beryl. Much of the beryl is opaque and yellowish green, but in one pocket an irregularly shaped fragment of transparent pale salmon-pink beryl was found. It is 2½ inches long and 1 inch thick, with an exceedingly rough honeycombed and drusy surface. It is evidently the remnant of a much larger crystal, the greater part of which has been dissolved, leaving only a part with a rough etched surface. Parts of this would cut into small gems. In some of the pockets there are mossy tufts or coatings of minute short hairlike tourmaline crystals of dull greenish-gray color. Some of these coatings cover a couple of square inches of the surface of albite crystals and make exceedingly delicate pretty specimens.

Among other minerals found in the quarry are yellowish-green muscovite mica, biotite mica, columbite, and a few garnets. The muscovite occurs in plates up to 12 inches across, but does not have good cleavage. Most of it is injured by "A" lines and tangle sheet structure so as to be suitable only as scrap for grinding.

The Riverside quarry is about 2½ miles east of Middletown on the south side of Connecticut River. It consists of an open cut 30 to 40 feet across made in the steep northwest slope of the river bank above the public road. The country rock is mica schist which strikes north with a variable dip approximating about 20° W. The pegmatite is about 20 feet thick and apparently conformable with the inclosing schist. It contains potash feldspar crystals over 2 feet across, and some albite feldspar, small segregations of gray and smoky quartz, rum-colored mica in crystals up to 2½ inches across, biotite, numerous beryl crystals, garnets, black and colored tourmalines, lepidolite, and, as reported by Bastin,[1] pink to deep salmon-colored fluorite. The

[1] Feldspar deposits of the United States: U. S. Geol. Survey Bull. 420, p. 50, 1910.

beryl crystals range from less than an inch to 6 inches in diameter. Crystals of less than 1½ inches diameter are most plentiful. They are yellowish to aquamarine colored, mostly opaque, with translucent and small transparent portions. Some of the crystals are penetrated by crystals of black tourmaline. Small pockets were observed with pinkish-violet colored lepidolite and variegated tourmaline. The tourmaline occurs in rough triangular-shaped crystals up to an inch in diameter. Some of them have rose-pink exteriors and dull greenish to black cores. Others are solid pink. No transparent tourmalines were observed, but the presence of cavities indicates a possibility of their being found.

MAINE.

At the Mount Mica tourmaline mine, near Paris, Me., work was carried on for nearly 4 months, but Mr. Loren Merrill, the operator, reports that only one small pocket was found, yielding a few green tourmaline crystals. Other products of the quarry are feldspar and a little mica. Work at this locality is becoming more difficult, since there is 25 to 30 feet of overburden to be removed before the gem-bearing portion of the ledge can be quarried, and unless underground mining is adopted it is doubtful whether the deposit can be worked much farther.

On Mount Apatite, near Auburn, Me., a number of achroite, or nearly colorless tourmaline crystals, were obtained from the quarry of P. P. Pulsifer during operations for feldspar.

MASSACHUSETTS.

Colored tourmaline crystals have been found at several localities in the region of Goshen and Chesterfield, Hampshire County, Mass. Some of these localities have been known for many years. An early description of two of the localities was given by George Gibbs [1] in which the minerals and their distinctive characters are discussed. The two localities are probably those called the Clark ledge and the Barrus property below. Shepard [2] speaks of this region as being rich in variegated tourmalines, among which deep indigo-blue crystals were abundant. Other colors, green and rose-red, are also mentioned, and spodumene is reported from the same region. Emerson [3] quotes Alvan Barrus as stating that tests were made by chemists with some of the spodumene with a view to using it as a source of lithia. A number of the spodumene deposits have been located on the geologic atlas of the region by Emerson [4] and colored tourmalines have been found at some of them. So far as known no clear tourmalines suitable for gems have been found in this region, but the deposits are of interest because of mineral associations and the possibility of gem material being found in the future.

A brief visit was made by the writer to the region in October, 1914, and three deposits were examined, one on the George L. Barrus place, 2½ miles northwest of Goshen, another on the summit of a hill 2 miles north of West Chesterfield, and the third, known as the Clark ledge,

[1] Gibbs on tourmaline, etc.: Am. Jour. Sci., 1st ser., vol. 1, pp. 346–351, 1818.
[2] Shepard, C. U., Treatise on mineralogy, 3d ed., p. 220, 1852.
[3] Emerson, B. K., Geology of Hampshire County, Mass.: U. S. Geol. Survey Mon. 19, pp. 760–761, 1898.
[4] Emerson, B. K., U. S. Geol. Survey Geol. Atlas, Holyoke folio (No. 50), 1898.

1½ miles north of West Chesterfield. All of these localities lie in an area mapped as Conway schist by Emerson. The Conway schist is described as dark graphitic mica schist, containing biotite, garnet, staurolite, and zoisite, and beds of impure limestone and quartzite. In each case pegmatite is the matrix for the tourmaline and other minerals found.

At the Barrus prospect a pegmatite ledge has been traced by outcrop and surface bowlders for a distance of over 200 yards. Starting from the south side of the spring the ledge outcrops in a N. 15° W. direction along the hillside, continuing through a small glacial valley at the north end. The thickness of the pegmatite is not plainly exposed but is probably as much as 8 feet in places. The wall rock is garnet-staurolite schist of the typical Conway schist, striking parallel with the pegmatite and dipping east. The pegmatite is only medium coarse to fine grained. No crystal-lined cavities or pockets were observed. The quartz of the pegmatite occurs in small masses thickly scattered through the rock. The feldspar is chiefly albite, some of the rough crystals measuring nearly 6 inches thick. In places the albite has a slightly tabular development, forming small crystals like clevelandite. The mica is mostly greenish muscovite, but a little pale pink lepidolite was observed associated with clevelandite. Gray to pale yellowish-green translucent spodumene is abundant in crystals ranging up to 2 inches long. One translucent aquamarine-colored beryl crystal was found in the pegmatite in close association with the spodumene. Indigo-blue to bluish-black tourmaline crystals are scattered through much of the pegmatite. These crystals range from minute size up to half an inch thick and several inches long. Most of them have dark-blue to black cores with lighter blue shells. A few crystals with bluish-green shells were observed. All of the tourmalines found are opaque to translucent and no transparent ones were seen. No pink or red crystals were observed, but Gibbs states that they occur, but are rare.

Most of the work done here consists of blasting and breaking of surface bowlders and outcrop. Much of the ledge is concealed by deep humus and leaf mold soil which makes careful prospecting difficult. Before thorough prospecting can be carried on, much of the surface would have to be stripped of the soil covering.

Clark's ledge is a large prominent outcrop of pegmatite, outcropping along an east sloping hillside in a N. 10° W. direction for about 150 yards. The lower side forms a small cliff 30 feet high in places. The pegmatite is inclosed nearly conformably with the garnet-staurolite schist wall rock cutting across the schist with offsets to the southeast at intervals. It is split by a horse of schist into two ledges 6 to 10 feet thick at the north end, and has a thickness of 15 feet toward the south end. Some of the feldspar of this ledge is in rough crystals. Quartz occurs in small irregular masses, some of which have a peculiar translucency. Beryl crystals are rather plentiful, some showing translucent aquamarine colors. Emerson marks this ledge as carrying spodumene, but none was observed in the brief examination made. Mica occurs in yellowish-green plates up to 3 inches in diameter. Opaque red garnets and a little biotite occur in the pegmatite. Only black and bluish-black tourmaline crystals were observed, but evidently the vein described by Gibbs was not found. Gibbs mentions a "false" vein, 6 inches to 1½ feet thick, cutting obliquely across the ledge for a distance of about 20 feet.

This vein carried bluish-white transparent quartz, crude feldspar crystals, and green tourmaline crystals, some inclosing red to violet-colored cores. None of the crystals was transparent, but some were translucent.

At the locality 2 miles north of West Chesterfield, a little blasting and excavation work has been done in an outcrop of pegmatite on the nearly flat summit of the hill. The outcrop is about 100 feet long in a west of north direction and nearly 40 feet wide. Part of it stands a few feet above the ground. The country rock is fine dark-colored garnet schist belonging to the Conway schist. It strikes north with a dip of 70° E. The texture of the pegmatite varies from fine to medium coarse. Microcline feldspar occurs in crystals ranging up to 10 inches across. A little spodumene was found in the massive pegmatite. Small veins carrying yellowish-green mica, in crystals 1 to 2 inches in diameter, with quartz, feldspar, beryl, and black tourmaline cut across the pegmatite with a northwest strike. The beryls are rather plentiful and occur in crystals ranging from small size up to 2 inches thick. They are bluish-green in color but opaque or only translucent. A few of the mica crystals inclose opaque greenish-blue crystals of tourmaline of pencil size. Some of the quartz has a translucent milky color.

The pegmatite carries cavities or pockets, and one that has been opened on the east side of the outcrop is 2 feet across and 1 to 8 inches high. It has been stripped of any good specimens it may have contained, but fragments of the lining left in the pocket consisted of crude crystals of clevelandite, opaque bluish-green and indigo-blue tourmaline, bunches of greenish mica, and spodumene. The presence of pockets in this ledge makes it a favorable looking place for further prospecting, since gem tourmalines are usually found in pockets and not frozen in the rock.

TURQUOISE.

NEVADA.

Two new turquoise deposits were developed in Nevada in 1914. One of these, owned by J. F. Campbell, of Colusa, Cal., is located in the Hot Springs mining district on the east side of Reese River valley, about 35 miles south of Battle Mountain, Lander County; and the other, owned by the Cortez Turquoise Co., of Pasadena, Cal., is near the old mining camp of Cortez, along the Lander-Eureka County line, about 35 miles south of Beowawe. Information regarding these deposits and the quality of the turquoise was kindly given by Mr. L. A. Dees, of Los Angeles, and the owners of the properties. Mr. Dees has cut and sold some of the turquoise from both mines. The Campbell mine was discovered in October, 1914, and worked only a short time during the winter. About 300 pounds of matrix, including some pure turquoise of good quality, was taken out during this time. The pure turquoise has been selling at $1 a carat in Los Angeles. It is described as having a good blue color, with but little green, and as being hard with smooth texture. Some of the matrix has also yielded attractive gems.

The mine of the Cortez Turquoise Co. was discovered by Johnny Francis, a Shoshone Indian, several years ago. The assessment work was done by the Indian for several years and in 1914 the claim was leased to a miner who is reported to have taken out 500 pounds

of turquoise and matrix. Later the property was purchased by Messrs. E. C. Smith & McGaw, of Pasadena, under the name of the Cortez Turquoise Co. A quantity of development work has been done, which shows the presence of turquoise in an area 50 feet wide and several hundred feet long.

So far the best turquoise has been found within 15 feet of the surface, but the mineral has been found to persist much deeper. One nugget taken out by the Cortez Turquoise Co. is reported to have weighed about 5 pounds and to be composed of solid turquoise. Another nodule broken in blasting showed a face 5 inches long and 2½ inches wide. These large nuggets are not of the best grade, but are equal to the average output of the mine. One nugget weighing about half a pound is reported to be hard and of good azure-blue color. A large oval cabochon-shaped gem measuring 43 by 67 millimeters, described by S. B. Clem, of the Redondo Gem Co., of Redondo, Cal., as being cut from a nugget weighing 19 ounces, probably came from the Cortez Turquoise Co.'s mine. This gem is reported to be of good azure-blue color, without matrix or other defect. Some matrix gems are cut showing the turquoise and brownish iron-stained matrix, but part of the matrix is somewhat softer than the turquoise and does not polish so well.

NEW MEXICO.

Mr. L. M. Richard, of Silver City, N. Mex., reports the occurrence of turquoise in the White Signal mining district, Grant County, N. Mex. The prospect is about three-fourths of a mile southeast of the Paddyford mine. It is owned by V. F. Mueller and has been tested to a small extent. The turquoise occurs as thin seams or bands along the contact of fine-grained diorite inclusions in granite. The veinlets are hard, with good color, and, with the associated matrix, might prove of value for cutting into cameo gems.

VARISCITE.

UTAH.

The production of variscite in 1914 came chiefly from Utah. There was very little activity at the numerous deposits that have been prospected and worked in Nevada. In Utah the output came from the chlorutahlite mine of Don Maguire, in Clay Canyon, 1½ miles west of Fairfield, in Utah County, and from the amatrice mine of the Occidental Gem Co., 14 miles southwest of Tooele, in Tooele County. In the mining of the chlorutahlite a quantity of yellowish to greenish banded phosphatic mineral was obtained, which forms deposits similar to the variscite, and in some cases incloses the variscite. Recently a quantity of this material has been cut and sold under the name of "sabalite." It has a dull light greenish-yellow color and shows a banded texture very similar to agate. "Sabalite" has been favorably received as a western gem stone for the souvenir trade.

MISCELLANEOUS.

APATITE.

P. P. Pulsifer, of Auburn, Me., reports the finding during 1914 of the finest crystal of purple apatite that has been taken from his feldspar quarry. This quarry has yielded a large number of exception-

ally fine purple and lilac-colored apatite crystals, chiefly suitable for mineral collections but occasionally cut for gems.

BEACH PEBBLES.

An unusual beach pebble found near Redondo, Cal., has been cut as an ornament by the Redondo Gem Co.[1] This stone is shown by photograph to be about 6 inches by 5 inches thick, consisting of a dark-colored matrix, thickly mottled by numerous white to gray flower-like patches. The matrix of the stone is described as brownish-black in color, with a large variety of flower patterns discernible in the white markings, "such as the iris, morning glory, daisy, and lily."

CATLINITE.

Dr. Burt Ogburn, of Prescott, Ariz., submitted a specimen of catlinite or pipestone found near Jerome Junction. This material has a dull dark-red color, with moderately smooth grain. On fractured surfaces the texture looks somewhat gritty, but when carved with a knife it cuts evenly, leaving a smooth surface quite similar to the catlinite of Minnesota. So far the material has only been used locally for ornamental purposes.

ICELAND SPAR.

The occurrence of Iceland spar in Sweet Grass County, Mont., was mentioned in this report for 1913. Prof. J. P. Rowe, of the University of Montana, at Missoula, has furnished further notes on this occurrence. The deposit is located about 9 miles from Gray Cliff and has been traced through the country for several miles. The Iceland spar occurs in a fissure vein from 3 to 8 feet thick, cutting gneiss rock with a northwest strike and almost vertical dip. All of the material mined during 1914 was sold, and large excess orders were received. This Iceland spar may be classed among the best grades of that material, and some of the rhombs obtained measured over 2 inches thick, with perfect transparency and without blemish. This grade is especially suitable for optical work and for specimens. The smaller spar of equally good quality is applied for various uses, and especially for standardizing in chemical work. The present price of the Iceland spar varies from 50 cents to $4 a pound.

PRODUCTION.

The total production of gems and precious stones in the United States in 1914, as reported to the Survey, amounted to $124,651. This is a large decrease from the production reported for 1913, which amounted to $319,454. The principal production of precious stones in the United States consists of the semiprecious and ornamental stones, a large part of which has been cut in Europe, especially in Germany, to which country exports of such minerals have naturally decreased. An important change during the year was the decrease in the production of Montana sapphire, due to the fact that the largest placer mines were not operated and that the mines of matrix deposits, all of which are owned by an English company, were closed

[1] Jewelers' Circular-Weekly, July 15, 1914.

in August. There was a slight increase in the output of turquoise and turquoise matrix, probably to meet the increased demand for souvenir gems in the western tourist trade. The table of production represents only an approximation of the output of gems in the United States. For many gems the values given in 1914 and in previous years have been estimated from figures showing the quantity produced. That is, the tables give as nearly as possible the first values of the rough minerals. The value of the finished gems is several times greater. The preparation of complete statistics of production of precious stones is practically impossible, owing to the attitude assumed by some of the gem miners and dealers, who hesitate to furnish statements of production. The assistance of those who have kindly furnished such figures is greatly appreciated, and it is hoped that those who have not cooperated in this way in the past will do so in the future, on realizing that statistical information furnished by them will be held confidential.

Under miscellaneous gems in the table of production for 1914 are included obsidian, beach pebbles, fossil coral, apatite, kyanite, and Iceland spar. During other years datolite, natrolite, pectolite, apophyllite, iolite, chondrodite, and various gem minerals with trade names have been included.

Production of precious stones in the United States, 1908–1914.

	1908	1909	1910	1911	1912	1913	1914
Agates, chalcedony, onyx, etc.	$1,125	$750	$2,268	$8,128	$9,978	$8,895	$8,312
Amethyst	210	190	.....	725	363	389	255
Benitoite	3,638	500	.....	.....	150	.....	.....
Beryl, aquamarine, blue, pink, yellow, etc.	7,485	1,660	5,545	2,505	1,765	1,615	2,395
Californite	.....	18,000	8,000	150	275	152	1,425
Chiastolite	.....	.....	.....	25	.....	.....	.....
Chlorastrolite	25	2,400	2,000	1,992	350	.....	.....
Chrysoprase	48,225	84,800	9,000	13,550	220	.....	75
Copper ore gems, chrysocolla, malachite, etc.	6,050	2,300	550	800	1,085	2,350	1,280
Cyanite	.....	.....	.....	.....	10	.....	.....
Diamond	2,100	2,033	1,400	2,750	1,475	6,315	765
Diopside	120	.....	.....	.....	.....	.....	.....
Emerald	.....	300	700	9,500	2,375	.....	.....
Epidote	.....	15	.....	.....	10	.....	.....
Feldspar, amazonstone, sunstone, etc.	2,850	2,700	2,510	175	1,310	1,285	449
Garnet, almandine, pyrope, hyacinth, etc.	13,100	1,650	3,100	2,065	860	4,285	1,760
Gold quartz	1,010	.....	1,000	1,700	1,900	300	1,050
Jade	.....	.....	.....	.....	.....	.....	300
Jasper, petrified wood, bloodstone, etc.	.....	100	475	2,240	6,005	5,275	4,700
Opal	50	200	270	1,875	10,925	15,130	1,114
Peridot	1,300	300	.....	360	8,100	375	100
Phenacite	95	50	50	.....	.....	.....	.....
Prase	.....	.....	100	.....	.....	25	.....
Pyrite	.....	.....	.....	.....	265	50	.....
Quartz, rock crystal, smoky quartz, rutilated quartz, etc.	3,595	2,689	1,335	2,140	2,448	1,640	4,046
Rhodonite	1,250	125	6,200	1,300	550	165	1,050
Rose quartz	568	2,970	2,537	1,744	865	337	400
Ruby	.....	.....	.....	210	2,260	200	100
Rutile	.....	25	.....	.....	.....	.....	.....
Sapphire	58,397	44,998	52,983	215,313	195,505	238,635	60,932
Smithsonite	1,200	300	.....	25	650	50	50
Spodumene, kunzite, hiddenite	6,000	15,150	33,000	75	18,000	6,520	4,000
Thomsonite	35	100	610	1,500	450	.....	21
Topaz	4,435	512	884	2,675	375	736	1,380
Tourmaline	90,000	133,192	46,500	16,445	28,200	7,630	7,980
Turquoise and matrix	147,950	179,273	85,900	44,751	10,140	8,075	13,370
Variscite, amatrice chlorutahlite, utahlite	14,250	35,938	26,125	5,750	8,450	6,105	5,055
Miscellaneous gems	.....	1,060	2,755	3,224	4,408	2,920	2,287
Total	415,063	534,280	295,797	343,692	319,722	319,454	124,651

IDENTIFICATION OF GEMS BY THE MICROSPECTROSCOPE.

Attention has again been called to the use of the microspectroscope in the identification of gem minerals in a paper by Edgar T. Wherry.[1] Dr. Wherry mentions the discussions of this subject in textbooks and other publications and supplements them with notes on methods of microspectroscopic examination and tables of results on many minerals examined including gem minerals. Of the other articles cited, one by F. J. Keeley[2] contains interesting data on the color and the coloring agents of several gem minerals.

The apparatus used by Dr. Wherry "consists of a Crouch binocular microscope stand fitted with a 37-millimeter objective, an Abbe-Zeiss 'Spectral Ocular' in the right hand tube, and in the other an ordinary low-power eyepiece, marked on the lower lens at the point where the image of the mineral grain falls when it is visible through the spectroscope slit." White light such as is given by a Welsbach burner surrounded by a dark chimney is found preferable to sunlight. For the examination of gems, either loose or set, it is desirable to concentrate the light from the side by means of a lens or parabolic mirror. A gem must be transparent or at least fairly translucent to respond to the test, since it is necessary for the light to penetrate well into the mineral for absorption of color to take place properly.

Colorless gems show a continuous spectrum, but if the mineral is colored by certain elements or chemical substances, light of some color will be absorbed by it and dark bands will appear in the spectrum at places which are learned to be characteristic of such elements. If the coloring agent in different gems is known, a stone in doubt can be examined for the presence of that coloring agent by the microspectroscope. Dr. Wherry has found this method useful in determining the genuineness of rubies, sapphires, and emeralds, and in picking out corundum, zircon, and garnet from gem gravels.

IMPORTS.

The value of the imports of precious stones into the United States during the calendar year 1914, as reported by the Bureau of Foreign and Domestic Commerce, amounted to $19,211,084, the smallest since 1908, when it was $13,700,404. The imports were less by $26,220,914 in 1914 than in 1913, the greatest proportionate decrease occurring in rough or uncut diamonds. Large decreases were also recorded in pearls and cut diamonds, and the only increase in value of imports was in glazier diamonds.

The following table shows the value of the diamonds, pearls, and other precious stones imported into the United States from 1906 to 1914, inclusive:

[1] The microspectroscope in mineralogy: Smithsonian Misc. Coll., vol. 65, No. 5, Pub. No. 2362, 16 pp., 1915.
[2] Microspectroscopic observations: Acad. Nat. Sci. Philadelphia Proc., pp. 106–116, 1911.

Diamonds and other precious stones imported and entered for consumption in the United States, 1906–1914.

Year.	Diamonds.					Diamonds and other stones not set.	Pearls.	Total.
	Glaziers.	Dust or bort.	Rough or uncut.	Set.	Unset.			
1906	$104,407	$150,872	$11,676,529	$305	$25,268,917	$3,995,865	$2,405,581	$43,602,476
1907	410,524	199,919	8,311,912	.....	18,898,336	3,365,902	680,006	31,866,599
1908	650,713	180,222	1,636,798	.....	9,270,225	[a] 1,051,747	910,699	13,700,404
1909	758,865	50,265	8,471,192	.....	27,361,799	[a] 3,570,540	24,848	40,237,509
1910	213,701	54,701	9,212,378	.....	25,593,641	4,003,976	1,626,083	40,704,487
1911	199,930	110,434	9,651,219	.....	25,676,302	3,795,175	1,384,376	40,820,436
1912	452,810	94,396	9,414,514	.....	22,865,686	3,405,543	5,130,376	41,363,325
1913	471,712	100,704	12,268,543	.....	24,812,604	2,775,811	5,002,624	45,431,998
1914	579,332	77,408	2,851,933	.....	11,976,871	1,635,522	2,090,018	19,211,084

[a] Including agates. Agates in 1906, $20,130; in 1907, $22,644.

FOREIGN LOCALITIES.

DIAMOND.

AFRICA.

UNION OF SOUTH AFRICA.

The production of diamonds during the fiscal year ending June 30, 1914, by the De Beers Consolidated Mines [1] amounted to 2,081,386 carats, as compared with 2,293,468 carats in 1913. Actual sales of diamonds, plus the increase of stocks taken at the cost of production, amounted to £5,123,336, as compared with £6,297,782 in 1913. The total production of blue ground in 1914 amounted to 7,166,829 loads of 16 cubic feet, as compared with 7,382,216 loads in 1913. The total quantity of blue ground and tailings washed during 1914 was 7,406,278 loads, as compared with 8,702,289 loads in 1913. Stocks of blue ground and lumps on the floors increased from 10,803,054 in 1913 to 11,331,022 in 1914. The yield in carats of diamonds per load of blue ground washed remained at 0.36 at the De Beers mine, increased from 0.27 to 0.28 at the Wesselton mine, and decreased from 0.42 to 0.38 and from 0.23 to 0.21 in the Bultfontein and Dutoitspan mines, respectively. The De Beers mine has not been reopened since it was closed in 1908. Developments at the Kimberly mine consisted chiefly in the removal of mixed reef rock and blue ground formed by mud rushes.

The Premier Diamond Mining Co., of the Transvaal, ceased operations on August 10, 1914. The production of diamonds up to that date is reported [2] as amounting to 1,417,755 carats, a decrease of 211,732 carats, as compared with the corresponding period of 1913, and a total decrease of 690,228 carats, as compared with the financial year to October 31, 1913.

Diamond mining practically ceased in South Africa toward the close of 1914. Consul Edwin N. Gunsaulus,[3] of Johannesburg, reported to the State Department in January, 1915, that all diamond mines in the Cape, Transvaal, and Orange Free State Provinces were closed. Later he comments [4] on the effect the closing of practically

[1] De Beers Consolidated Mines Twenty-sixth Ann. Rpt., for the year ending June 30, 1914.
[2] African World, quoted in Jewelers' Circular-Weekly, Feb. 17, 1915.
[3] Jewelers' Circular-Weekly, Jan. 6, 1915.
[4] Daily Cons. and Trade Repts., June 25, 1915.

the entire diamond producing industry of the Union has necessarily had on the industrial conditions of the country. In this statement the output of diamonds in the Transvaal during 1914 is given as 1,101,264 carats, valued at $4,948,704, as compared with 2,156,897 carats, valued at $13,269,305, in 1913.

KONGO.

Vice Counsl General Harry A. McBride, of Boma,[1] Belgian Kongo, gives the following notes on diamonds of that country: The principal mines are in the Kasai district, near Tshikapa, and are operated by the Belgo-American Co., Société Forestière et Minière du Congo. American prospectors are working in the region and have met with some success. Two of the more important shipments of diamonds have been one of nearly 8,000 carats in November, 1913, sold in Antwerp at an average price of $5.79 per carat and another early in 1914 of 4,884 carats, sold to the same firm at an average price of $5.22 per carat.

The diamonds from the Kasai River district are obtained from river beds, but prospecting is in progress on eight matrix deposits or "pipes" in the Kundelunger region. In the Luanza "pipe," 9,315 loads of ground were washed to the end of December, 1913, and yielded 369 small diamonds weighing about 187 carats.

JADE.

NEW ZEALAND.

According to a correspondent of the Mining Journal[2] there was an active demand, before the European war, for the New Zealand jade or nephrite in Germany. A photograph accompanies the article showing a bowlder of nephrite, weighing about 1¾ tons, which had recently been shipped to Germany. Large deposits of the jade have been located, and a company (The New Zealand Greenstone (Ltd.)) has prepared to work them along with the richly colored serpentines in the same region. Both the serpentine and the jade have been called New Zealand greenstone, but the serpentine is used for ornamental building purposes and the jade for smaller ornamental and gem purposes.

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[1] Daily Cons. and Trade Repts., Dec. 7 and 8, 1914. [2] Mining Journal (London), July 25, 1914.

SUMMARY OF THE PRECIOUS-STONES INDUSTRY, 1882–1914.

Mining of precious stones in the United States has been a variable industry since its beginning. Most of the gem minerals have been sporadically mined or found during the course of mining for other minerals and only a few varieties have been systematically mined for periods of years at a time. Among those minerals which have been most persistently produced, and in some quantity at different times, are sapphire, turquoise, tourmaline, spodumene, and chrysoprase. A few other gems such as beryl, garnet, quartz, agate, amazon stone, rose quartz, and variscite, have been produced somewhat regularly, but generally in small quantity.

George F. Kunz,[1] summarizing the production and the localities of the different gem minerals in 1882, mentions the following:

Occasional diamonds had been found in several States. Sapphire was known to occur along Missouri River near Helena, Mont., and both ruby and sapphire at the Jenks corundum mine in Macon County, N. C. Topaz had been found in Maine and Colorado. Emerald and hiddenite had been discovered 16 years before in Alexander County, N. C. Aquamarine and other beryl were obtained from several of the Eastern States. Garnets, called "Arizona ruby," were being collected each year by the Navajo Indians in some quantity. Tourmaline had been mined for many years at Mount Mica, near Paris, Me., and was known to occur at other localities and also in Connecticut. Quartz and rock crystal were obtained from numerous scattered localities, especially fine small crystals coming from Herkimer County, N. Y., and Hot Springs, Ark. Rose quartz was found at several places in New England. Gold quartz from several Western States was made into jewelry. Amethyst had been found in Maine, Pennsylvania, Virginia, and Colorado. Agate was known to occur in many States, and the Wyoming and Montana moss agates were used in large quantities. Jasper and petrified wood were found in many States and used in small quantities. Peridot was gathered by the Navajo Indians of Arizona. Turquoise was known in New Mexico, Arizona, and Nevada. The feldspar gems, labradorite, amazon stone, sunstone, and moonstone were used in small quantities. The amazon stone came from the Pikes Peak region, Colorado. The Lake Superior gem stones, thomsonite and chlorastrolite, were collected for the tourist trade. Numerous lesser gems were known to occur in the United States, but were only sparingly used, such as phenacite, hyacinth garnet, iolite, rutilated quartz, novaculite, rutile, prehnite, obsidian, diopside, chrysoprase, rhodonite, malachite, chiastolite, catlinite, and others.

[1] Precious stones: U. S. Geol. Survey Mineral Resources U. S., 1882, 1883.

The following summary includes only a few of the principal features in the precious stones industry in the United States since 1882:

Diamond.—Only scattered finds were reported in various States, some in river and glacial gravels, and others loose in the soil, until 1906 when diamond was found associated with decomposed peridotite matrix in Arkansas. Since that time 2,000 to 3,000 stones have been found on the surface and by washing the earthy matrix. The value of the Arkansas deposits has yet to be demonstrated.

Sapphire.—A few sapphires were saved from the placer gold mining along Missouri River near Helena, Mont., until about 1890 when active mining for the sapphire was undertaken in connection with mining for gold. In 1891 and for several years following mining was continued successfully. In 1893 placer sapphire deposits were discovered along Rock Creek in Granite County. In 1894 more placer sapphire deposits were found along Dry Cottonwood Creek, in Deerlodge County, and near Yogo Gulch, in Fergus County. The Yogo sapphires are nearly all true sapphire blue and were soon traced to their original matrix, from which they have been mined almost continuously to the present. All of the other placer sapphire deposits produce only varicolored stones, including no pure blue gems. They are used principally for mechanical purposes, such as meter and watch bearings.

Ruby.—Occasional rubies were found in the corundum deposits of North Carolina and Georgia. The best find of ruby was made in 1893 in Cowee Valley of Macon County, N. C., in placer deposits. A few fine gems were found and later the stones were traced to their original matrix, where prospecting has been tried at various times without definite results.

Topaz.—Topaz mining has never reached an important stage in the United States Since 1882 the more important finds have been on Baldface Mountain, near North Chatham, N. H., in 1888; in San Diego County, Cal., about 1903; and in Mason County, Tex., in 1904. These deposits, as well as others in Maine, Colorado, and Utah, are only intermittently worked. The majority of the topaz from the United States is colorless, but some fine blue and bluish-green crystals are found.

Emerald.—The principal emerald localities of the United States are in North Carolina, but a few inferior emeralds have been found in Maine and Connecticut. In North Carolina the emerald-hiddenite mine has already been referred to. After 1891 operations were limited to a little intermittent prospecting, the last of which was in 1907. In 1894 emerald was found on Crabtree Mountain in Mitchell County, N. C., and mining was conducted for a few years. This locality did not produce clear gem emeralds, but a quantity of stones were cut with the white, gray, and black associated matrix and sold under the name of emerald matrix. In the same year, 1894, a stray emerald of good color was found near the North Carolina-South Carolina State line, south of Shelby. This was a forerunner of the discovery of the emerald deposit on the Turner plantation, 5 miles southwest of Shelby, in Cleveland County, N. C., in 1909. This deposit was worked by the Emerald Co. of America and yielded the best colored emeralds so far found in the United States. Work was stopped in 1913.

Aquamarine and other beryl gems.—Beryl gems have been obtained intermittently from many localities, prominent among which are Stoneham and other localities in Maine; Royalston, Mass.; Merryall, Conn.; Alexander, Mitchell, Yancey, and Macon counties, N. C.; Mount Antero, Chaffee County, Colo.; Riverside and San Diego counties, Cal. The localities are scattered and mining and prospecting have been irregular.

Garnet.—The "Arizona ruby" or garnet from the Navajo Indian Reservation has supplied the gem trade with varying quantities of fine garnet to the present time. Mason branch in Macon County, N. C., yielding the rose-pink rhodoite garnet, was an important source of gem garnet from 1897 to 1901. The majority of other gem garnets have been obtained from numerous localities and chiefly during mining for other minerals. Noteworthy among these was the hyacinth or spessartite variety from Amelia, Va., and from San Diego County, Cal.

Tourmaline.—Tourmaline has been obtained intermittently but not in large quantities from several localities in Maine and Connecticut. After 1900 the deposits of southern California became large producers and were actively worked for several years. Since 1911 only a few of these mines have been systematically worked, and the production has not been large. In connection with tourmaline mining in southern California lilac to rose-colored spodumene, called "kunzite" and "California iris," has been obtained in quantity and has taken an important place among American gems.

Chrysoprase.—Chrysoprase was first found near Riddle, Oreg., in 1884. In 1887 deposits were discovered in Tulare County, Cal. There was only a small annual production for a number of years, but between 1901 and 1911 the output was large.

Quartz.—Fine quartz crystals have been obtained from mines worked for tourmaline and other gem minerals in various parts of the country. One of the most important finds was of a lot of large clear crystals on Mokelumne Hill, Calaveras County, Cal., in 1898. One of these crystals yielded a flawless sphere 5½ inches in diameter.

Amethyst.—Amethyst has been mined in some quantity in Georgia, North Carolina, and Virginia, and small outputs have come from numerous other deposits in these and other States.

Agate.—Agate has been obtained from most of the Western States, and in some years the production has been large. The moss agates of Montana and Wyoming continue to be of importance because of their beauty and of the quantity in which they are found.

Jasper.—The varieties of jasper suitable for ornamental purposes known in the United States have increased greatly. Among the promising varieties are bloodstone from the Death Valley region, California, and kinradite or spherulitic quartz and associated jaspers of the San Francisco region.

Peridot.—Peridot has been obtained sporadically and occasionally in some quantities from both the Navajo and the Apache Indian Reservations in Arizona. It is collected chiefly by the Indians.

Turquoise.—Up to 1888 the output of turquoise mining was small, but regular mining was then begun first at Cerrillos, N. Mex., and later in the Burro Mountains, N. Mex., and in Saguache County, Colo. The production rose to $175,000 in 1892. Arizona, California, and Nevada have since entered the list of turquoise-producing States, and have contributed large quantities at different times. The climax in the production of turquoise came in 1909 when more than 17 tons of turquoise and matrix was mined. The value of this rough product was estimated at about $179,000.

Feldspar gems.—Amazon stone is the principal feldspar gem mined in the United States. The Pikes Peak region of Colorado has continued to yield a quantity of this stone nearly every year. Amelia, Va., has been another source of supply of much good grade of amazon stone.

Other semiprecious stones.—The production of numerous other gems has been quite variable. The thomsonite and chlorastrolite beach pebbles of Isle Royale, Lake Superior, have been gathered more or less regularly by tourists each year. Other varieties of beach pebbbles are collected for ornamental purposes along the Pacific coast. Of the numerous other minerals sometimes used for gems or ornaments mentioned as known in 1882, rhodonite, malachite, rose quartz, and catlinite have been used in some quantity.

New gem minerals.—Among new gem minerals may be mentioned californite (massive compact vesuvianite), and benitoite both found in California. Californite has been found in several counties and a quantity has been sold at different times. Benitoite is a barium titanosilicate. It is a new mineral discovered in San Benito County in 1906. Only one deposit, now exhausted, has been found. Benitoite is a blue mineral resembling sapphire in color but much softer. It has a high refractive index and strong dichroism.

Below is given a table of the production of gems and precious stones as recorded in these reports from 1883 to 1914, inclusive. Difficulty was encountered in deciding on the statistics for the earlier years, as there were discrepancies between the tables of production given year by year and those showing the production for periods of years. The figures used are those which seem most reliable.

The tables of production are not given as exact statements, but represent the best estimates that could be made each year. During the last 20 years the statistics include exact figures of production for some minerals and estimates for others. The tables of production for the years 1883 to 1905, inclusive, were prepared by G. F. Kunz. The value of the total production for the years 1883 to 1914 amounts to $7,799,971. Kunz has made an estimate of the total production for the three years preceding 1882 as follows: 1880, $100,000; 1881, $110,000; 1882, $150,000. This makes a grand total of the production of gems and precious stones in the United States from 1880 to 1914 of $8,159,971.

Production of precious stones in the United States, 1883–1914.[a]

	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893
Agate, moss agate, chalcedony, onyx, etc	$4,500	$7,500	$4,500	$3,000	$4,950	$4,950	.....	.....	.....	$3,500	$3,000
Amethyst	2,250	2,250	2,100	2,100	2,100	2,500	$98	.....	.....	200	75
Beryl, aquamarine, blue, pink, golden, etc	500	700	750	5,550	3,500	800	747	.....	$1,000	1,000	500
Catlinite, pipestone	10,000	10,000	10,000	10,000	5,000	5,000	5,000	$5,000	5,000	5,000	5,000
Chlorastrolite	1,500	1,500	.....	.....	800	800	500	400	500	500	500
Chrysoberyl	100	25	.....	.....	.....	.....	.....	.....	.....	.....	.....
Chrysoprase	.....	.....	.....	.....	.....	.....	200	200	.....	100	.....
Copper ore gems, chrysocolla, malachite, azurite, etc	.....	.....	.....	.....	.....	.....	6,037	2,000	.....	1,500	.....
Diamond	.....	800	.....	.....	.....	.....	.....	.....	.....	.....	125
Diopside	300	.....	100	2,000	50	.....	.....	.....	.....	500	105
Emerald	500	.....	3,200	3,200	.....	100	450	.....	1,000	.....	.....
Feldspar, amazon stone, sunstone, moonstone, oligoclase	4,200	3,200	3,100	3,250	1,850	1,700	500	500	.....	1,000	1,000
Garnet, almandine, pyrope, rhodolite, spessartite, hyacinth, topazolite	6,000	4,000	2,700	3,250	3,500	3,500	2,308	2,308	3,000	5,250	2,000
Gold quartz	115,000	140,000	140,000	40,000	75,000	75,000	9,000	9,000	6,000	15,000	10,000
Jasper	2,500	2,500	.....	.....	.....	100	630	.....	.....	.....	.....
Opal	.....	.....	.....	.....	.....	.....	.....	.....	5,000	10,000	5,000
Peridot	.....	150	50	50	.....	.....	.....	.....	1,000	1,000	500
Petrified wood	5,000	10,500	6,500	1,500	36,000	16,000	53,175	6,000	2,000	11,000	21,250
Phenacite	.....	.....	.....	.....	.....	650	200	.....	.....	.....	.....
Prehnite	.....	.....	.....	.....	.....	.....	.....	.....	.....	200	.....
Pyrite	2,000	3,000	2,000	2,000	2,500	2,500	2,000	2,000	1,500	1,500	1,500
Quartz, crystal, smoky; inclosing rutile and other minerals	23,100	25,100	19,050	20,450	16,100	15,150	18,512	16,475	15,000	15,000	15,000
Rose quartz	.....	.....	.....	.....	.....	.....	600	200	.....	200	100
Ruby	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	150
Rutile	.....	.....	750	750	.....	.....	.....	.....	.....	.....	.....
Sapphire	2,200	1,750	500	500	500	500	6,725	6,725	10,000	20,000	10,000
Spodumene, hiddenite, kunzite, California iris	600	.....	2,500	4,500	.....	.....	200	.....	.....	.....	.....
Thomsonite, mesolite	750	750	750	400	750	500	400	400	200	500	500
Topaz	1,000	500	1,250	1,000	2,000	600	400	.....	100	1,000	100
Tourmaline	.....	2,000	600	6,250	500	.....	2,250	2,250	3,000	3,000	5,000
Turquoise and matrix	2,000	2,000	3,500	3,000	2,500	3,000	23,675	28,675	150,000	175,000	143,136
Miscellaneous gems and ornamental stones [b]	4,750	4,750	6,000	6,000	6,000	6,500	55,200	36,700	31,000	40,100	39,500
Total	188,750	222,975	209,900	118,750	163,600	139,850	188,807	118,833	235,300	312,050	264,041

	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904
Agate, moss agate, chalcedony, onyx, etc	$12,500	$3,500	$2,000	$2,000	$2,000	$2,000	$2,000	$1,500	$1,500	$3,400	$3,500
Amethyst	500	200	500	200	250	250	500	500	2,000	3,000	3,000
Beryl, aquamarine, blue, pink, golden, etc	1,050	369	700	1,500	2,200	4,000	11,000	5,000	4,000	4,200	5,100
Catlinite, pipestone	3,000	3,000	3,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,500
Chiastolite, andalusite	.....	1,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
Chlorastrolite	500	500	500	500	5,000	3,000	3,000	3,000	4,000	3,000	2,000
Chrysoprase	100	550	600	.....	100	100	100	1,500	5,000	1,500	6,000
Copper ore gems, chrysocolla, malachite, azurite, etc	1,500	.....	.....	.....	.....	250	200	100	.....	.....	.....
Diamond	200	250	.....	.....	.....	300	150	100	.....	50	.....
Diopside	150	200	200	100	.....	.....	.....	.....	.....	.....	.....
Emerald	250	25	.....	25	50	50	1,000	1,000	1,000	250	.....
Epidote	.....	75	250	.....	.....	.....	.....	.....	.....	.....	.....
Feldspar, amazon stone, sunstone, moonstone, oligoclase	1,600	175	1,750	525	510	270	270	200	500	400	500
Garnet, almandine, pyrope, rhodolite, spessartite, hyacinth, topazolite	4,300	2,350	2,600	9,000	7,000	7,000	21,500	22,100	2,500	3,000	3,000
Gold quartz	10,000	10,000	10,000	5,000	5,000	500	2,000	2,000	3,000	3,000	5,000
Opal	500	300	200	200	200	.....	.....	.....	150	200	.....
Peridot	500	300	500	500	500	500	500	500	500	5,000	5,000
Petrified wood	.....	4,000	4,000	2,000	2,000	3,000	6,000	7,000	7,000	5,000	5,000
Phenacite	.....	1,050	.....	.....	.....	.....	.....	.....	.....	.....	.....
Prase	.....	100	100	.....	.....	.....	.....	.....	.....	.....	.....
Prehnite	300	200	100	100	100	50	50	.....	.....	.....	.....
Pyrite	1,800	1,000	1,000	1,000	1,000	1,000	2,000	3,000	3,000	3,000	3,000
Quartz, crystal, smoky; inclosing rutile and other minerals	7,000	12,660	10,050	13,000	18,100	12,050	11,050	12,050	14,100	11,600	12,000
Rhodonite	100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rose quartz	200	1,000	500	.....	100	100	100	150	200	1,500	1,000
Ruby	2,500	2,000	1,000	.....	2,000	3,000	3,000	500	.....	.....	.....
Rutile	.....	100	100	800	110	200	100	.....	.....	.....	.....
Sapphire	10,000	9,057	10,000	25,000	55,000	68,000	75,000	90,000	115,000	100,000	100,000
Spodumene, hiddenite, kunzite, California iris	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10,000
Thomsonite, mesolite	500	500	500	500	1,000	1,000	1,000	1,000	1,000	500	500
Topaz	1,000	1,000	200	.....	100	.....	.....	.....	.....	200	.....
Tourmaline	2,300	3,160	3,000	9,125	4,000	2,000	3,500	15,000	30,000	45,000	40,000
Turquoise and matrix	30,000	50,000	40,000	55,000	50,000	72,000	82,000	118,000	130,000	110,000	100,000
Variscite, utahlite, chlorutahlite, amatrice	.....	1,000	500	100	100	100	100	250	.....	100	200
Miscellaneous gems and ornamental stones [b]	16,300	4,000	4,000	2,500	2,500	3,500	3,050	2,600	2,000	2,000	17,000
Total	108,650	113,621	97,850	130,675	160,920	186,220	231,170	289,050	328,450	307,900	324,300

[a] Estimated total production: 1880, $100,000; 1881, $110,000; 1882, $150,000.

[b] Includes anthracite ornaments, arrow points, chondrodite, diaspore, fossil coral, fergusonite, fluorite, gadolinite, iolite, jade, monazite, obsidian, staurolite, titanite (sphene), trilobites, willemite, wooden ornaments decorated with gems, zircon, and gems with trade names.

Production of precious stones in the United States, 1883–1914—Continued.

	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Agate, moss agate, chalcedony, onyx, etc	$3,500	$800	$650	$1,125	$750	$2,268	$8,128	$9,978	$8,895	$8,312
Amethyst	2,000	700	850	210	190	.....	725	363	389	255
Benitoite	.....	.....	1,500	3,638	500	.....	.....	150	.....	.....
Beryl, aquamarine, blue, pink, golden, etc	7,000	9,000	6,435	7,485	1,660	5,545	2,505	1,765	1,615	2,395
Californite	.....	.....	25,000	.....	18,000	8,000	150	275	152	1,425
Catlinite, pipestone	2,000	.....	25	.....	.....	.....	.....	.....	.....	.....
Chiastolite, andalusite	.....	25	20	.....	.....	.....	25	.....	.....	.....
Chlorastrolite	3,000	.....	.....	25	2,400	2,000	1,992	350	.....	.....
Chrysoprase	5,000	32,470	46,500	48,225	84,800	9,000	13,550	220	.....	75
Copper ore gems, chrysocolla, malachite, azurite, etc	2,000	.....	400	6,050	2,300	550	800	1,085	2,350	1,280
Cyanite	.....	.....	100	.....	.....	.....	.....	10	.....	.....
Diamond	.....	.....	2,800	2,100	2,033	1,400	2,750	1,475	6,315	765
Diopside	.....	5	.....	120	.....	.....	.....	.....	.....	.....
Emerald	.....	.....	1,320	.....	300	700	9,500	2,375	.....	.....
Epidote	.....	.....	60	.....	15	.....	.....	10	.....	.....
Feldspar, amazon stone, sunstone, moonstone, oligoclase	1,000	100	1,110	2,850	2,700	2,510	175	1,310	1,285	449
Garnet, almandine, pyrope, rhodolite, spessartite, hyacinth, topazolite	5,000	3,000	6,460	13,100	1,650	3,100	2,065	860	4,285	1,760
Gold quartz	5,000	.....	1,000	1,010	.....	1,000	1,700	1,900	300	1,050
Jasper	.....	.....	675	.....	100	475	2,240	6,005	5,275	4,700
Opal	.....	.....	180	50	200	270	1,875	10,925	15,130	1,114
Peridot	10,000	2,400	1,300	1,300	300	.....	360	8,100	375	100
Petrified wood	5,000	150	325	.....	.....	.....	.....	.....	.....	.....
Phenacite	.....	250	25	95	50	50	.....	.....	.....	.....
Prase	.....	50	.....	.....	.....	100	.....	.....	25	.....
Prehnite	.....	.....	.....	.....	.....	.....	.....	20	.....	.....
Pyrite	2,000	.....	400	.....	.....	.....	.....	265	50	.....
Quartz, crystal, smoky; inclosing rutile and other minerals	13,100	3,050	2,580	3,595	2,689	1,335	2,140	2,448	1,640	4,046
Rhodocrosite	.....	.....	150	.....	.....	.....	.....	.....	.....	.....
Rhodonite	.....	.....	.....	1,250	125	6,200	1,300	550	165	1,050
Rose quartz	1,000	4,000	6,375	568	2,970	2,537	1,744	865	337	400
Ruby	.....	600	2,000	.....	.....	.....	210	2,260	200	100
Rutile	.....	.....	200	.....	25	.....	.....	.....	.....	.....
Sapphire	125,000	39,100	229,800	58,397	44,998	52,983	215,313	195,505	238,635	60,932
Smithsonite	.....	.....	800	1,200	300	.....	25	650	50	50
Spodumene, hiddenite, kunzite, California iris	5,000	14,000	14,500	6,000	15,150	33,000	75	18,000	6,520	4,000
Thomsonite, mesolite	500	.....	.....	35	100	610	1,500	450	.....	21
Topaz	500	1,550	2,300	4,435	512	884	2,675	375	736	1,380
Tourmaline	50,000	72,500	84,120	90,000	133,192	46,500	16,445	28,200	7,630	7,980
Turquoise and matrix	65,000	22,250	23,840	147,950	179,273	85,900	44,751	10,140	8,075	13,370
Variscite, utahlite, chlorutahlite, amatrice	500	2,000	7,500	14,250	35,938	26,125	5,750	8,450	6,105	5,055
Miscellaneous gems and ornamental stones [a]	13,250	.....	.....	.....	1,060	2,755	3,224	4,388	2,920	2,587
Total	326,350	208,000	471,300	415,063	534,280	295,797	343,692	319,722	319,454	124,651

[a] Includes anthracite ornaments, arrow points, chondrodite, diaspore, fossil coral, fergusonite, fluorite, gadolinite, iolite, jade, monazite, obsidian, staurolite, titanite (sphene), trilobites, willemite, wooden ornaments decorated with gems, zircon, and gems with trade names.