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

MINERAL RESOURCES

OF THE

UNITED STATES

CALENDAR YEAR

1913

PART II—NONMETALS

WASHINGTON
GOVERNMENT PRINTING OFFICE
1914

GEMS AND PRECIOUS STONES.

By Douglas B. Sterrett

INTRODUCTION.

The precious and semiprecious stone mining industry of the United States in 1913 was marked by a fairly large output of sapphire, a real advance in the work of testing the Arkansas diamond field, a greater activity in the Nevada opal field, and by a decrease in the output of the majority of the other gem minerals mined. The sapphire came chiefly from Montana and consisted of both blue and varicolored gems and culls for mechanical purposes. In Arkansas one diamond-washing plant was in operation about three months and recovered several hundred diamonds, and the construction of another plant was pratically completed. Many new claims were located in the Nevada opal field, development of which, along with those previously opened, resulted in a fairly large output of beautiful gems.

Prospecting work at the emerald mine near Shelby, N. C., was continued during the first part of 1913, but the last find of emeralds was made in August, 1912. Prospect work was renewed at the Ruby mine in Cowee Valley, Macon County, N. C., and is being continued into 1914. The output of the gem minerals tourmaline, spodumene, etc., in southern California was small, but some good gem material was obtained. The exploitation of the less valuable native semiprecious stones has continued with fair success, but the increasing use of cheap, artificial products is making big inroads on this industry.

ACKNOWLEDGMENTS.

The writer wishes here to express his appreciation of the assistance given by a large number of people in the preparation of this report. It is not possible to name individually all of those who have supplied information, such as statistics of production and names of new producers, but such help is greatly appreciated. Other persons have assisted either by supplying detailed information, loaning specimens, or rendering personal assistance in the examination of mines and prospects, and acknowledgment is here made of the kindness of F. M. Myrick, of Johannesburg, Cal.; Joseph Ward, of Barstow, Cal.; Scott Lewis, of Los Angeles, Cal.; Don Maguire, of Ogden, Utah; A. L. Delkin, of Seattle, Wash.; J. H. Mosher, of Glendive, Mont.; Paul E. Hanson, of Billings, Mont., George Howe, Robert Bickford, and C. B. Hamilton, of Norway, Me.; Perien Dudley, of Buckfield, Me.; F. H. C. Reynolds, of Boston, Mass.; Leon Allen, of Keene, N. H.; F. M. Lynch, of Birmingham, Ala.; A. Q. and H. L.

Millar, of Murfresboro, Ark., and St. Louis, Mo.; the late H. E. Bemis, of Prescott, Ark.; Mr. Warren, Superintendent of the Ozark Diamond Mining Corporation; J. D. Endicott, of Canon City, Colo.; George H. Weed, of Florissant, Colo.; George H. Marcher, of the Pacific Gem Co., of Los Angeles, Cal.; J. J. Kinrade, of San Francisco, Cal.; Gordon Surr, of San Bernardino Cal.; James Shea and Dr. Burt Ogburn, of Phoenix, Ariz.; Maynard Bixby, of Salt Lake City, Utah; George D. Mathewson and Deb Roop, of Denio, Oreg., J. B. Kiernan, of Beatty Nev.; A. A. Turner, of Boston Mass.; A. D. Hudson, of El Paso, Tex.; Frances Holstein, of De Roche, Ark.; N. E. Isbell, of Cincinnati, Ohio; Reginald Fenton, of Coronado, Cal.; L. M. Richard, of Stamford, Tex.; Sam Awalt and Lee McGehee, of Katemcy, Tex.; C. J. Worlie and J. W. Bishop, of Streeter, Tex.; J. W. Ware, of San Diego, Cal.; G. W. Morgan and F. B. Horne, of Crescent, Nev.; Gus Hamstadt, of Niton, Cal.; Allen Culver, and George A. Camphuis, of Brice, N. Mex.; W. C. Hart, of Manitou Springs, Colo.; and Prof. J. P. Rowe, of Missoula, Mont.

AGATE.

CALIFORNIA.

A deposit of fine blue chalcedony or agate was prospected during 1913, by F. M. Myrick, about 37 miles east of Johannesburg and about 2 miles northeast of Lead Pipe Spring, in the Death Valley region, California. The deposit was discovered by Joe L. Foisie and located in January, 1911, as the Sard claim. The title was allowed to lapse and new locations were made by Mr. Myrick, with the approval of Mr. Foisie, in May, 1913, under the names Blue Moonstone and Moonstone claims. The region is desert with rough lava capped hills and washfilled valleys, which drain northward. The chalcedony deposits are about 3,000 feet above sea level.

White to gray ash and conglomeratic tuff beds occupy the lower ground, with a heavy flow of dark-red rhyolite overlying and capping the hills. This rhyolite is vesicular in places and has been badly fractured and crushed. Other lava flows occupy higher hills and mountains to the south. In places a layer of gray perlite is exposed at the base of the rhyolite, but the contact between the rhyolite and the underlying ash beds is generally concealed by loose débris and talus. Blue chalcedony has been found over parts of three claims in the lower portion of the rhyolite or loose in the talus below. The best deposit is on the Blue Moonstone claim on the north side of a small knob. The lower contact of the rhyolite capping this knob is concealed by talus, and, so far, the blue chalcedony from this claim has been picked up from the talus where it occurs in lumps of less than an ounce to several pounds weight associated with the red rhyolite matrix. It is probable that prospecting above the talus bearing the chalcedony would uncover the matrix in place. The occurrence on the other claims is similar, but a little of the chalcedony was found in place in the vesicular rhyolite.

The blue chalcedony occurs as fillings in joints, fractures, and vesicular cavities in the rhyolite forming veins and irregular masses. Much of it is very delicately banded, showing straight, curved, or angularly bent layers as in fortification agate. In some specimens

the agate passes into crystal quartz, lining or filling geode cavities. In others, the cavities are lined with rounded mammillary deposits of chalcedony. Small fragments of red rhyolite are inclosed in some of the deposits of chalcedony.

Various grades of chalcedony are found ranging from dull semi-translucent to highly translucent. The range of colors noted are dull bluish-gray, bluish-gray with a tint of green, blue tinted with lavender, and lavender. The brighter colors are not so common as the dull ones, and a quantity of the chalcedony which appears strongly colored in the hand specimens proves dull and uninteresting when cut. The apparent depth of color of the rough material is due, in many cases, to the bulk of the chalcedony or the shading caused by the inclosing shells of rhyolite.

The cut stones show the various colors mentioned above with or without banding. The dull-colored stones have no special beauty, but the stronger colored gems are very pretty and can be used in various forms of jewelry, such as cuff buttons, scarf pins, brooches, pendants, and bead necklaces. Very pretty bead necklaces have been made up with beads of the lavender-blue chalcedony alternating with rose quartz. The color of the blue chalcedony is not so pleasing under artificial light, but the better gems are not devoid of beauty even there. Some gems have been cut inclosing patches of the red rhyolite matrix with odd effects. Cut gems sold at the California beaches have been hailed as "blue moonstone," the people recognizing the similarity of this chalcedony and the white or gray varieties wrongly sold as "moonstone" along the California coast.

A deposit of cloudy amethyst-colored chalcedony associated with a peculiar leathery-white asbestos-like mineral was opened by Mr. Myrick near his bloodstone deposit described later under jasper. The chalcedony occurs in lenses in a gash vein cutting altered basalt. The vein filling consists chiefly of the chalcedony and a mashed asbestos-like material. The latter is hydrous silicate of magnesium of leathery claylike consistency when moist. It may be an impure hornblendic mineral or possibly allied to meerschaum. This chalcedony has not been tested as a possible ornamental stone, though the color is rather attractive. Lumps of the chalcedony left exposed to the desert sun for several months bleached to a dull gray to a depth of about one-fourth of an inch.

Agate or chalcedony, containing bright-red inclusions, found in the Death Valley region of San Bernardino County, Cal., was mentioned in this report for 1911. It was discovered by F. M. Myrick, after whom it was locally called "myrickite." The deposit is about 45 miles north of east of Johannesburg and about 15 miles northeast of Lead Pipe Spring. According to Mr. Myrick the mineral is obtained from a shallow shaft in a rough lava-capped hill. The chalcedony occurs in bunches and small masses scattered through the lava. The mineral consists of translucent gray chalcedony and a little white chalcedony through which bright red spots and patches of color are irregularly distributed. The majority of the color occurs in irregular mosslike patterns and is exceptionally bright vermilion-red. Robert Masterson, of Johannesburg, suggested that the coloring was due to cinnabar (mercury sulphide) and that was found to be the case on making blowpipe tests on the mineral. The cut gems show

striking contrasts between gray, white, and vermilion-red and should satisfy the desire of the wearer for bright colors.

Mr. Myrick has hesitated placing too much of the "myrickite" on the market since he has discovered that the rich color darkens after long exposure to light. Material left on the dump exposed to the desert sun for a year was discolored, showing a dull purplish red. To what extent the color will deteriorate under conditions of wear in jewelry is not known, but it is not believed the discoloration will be sufficiently rapid to cause the material to be discarded for gem use. The deposit will be tested for its value as a possible source of quicksilver as well as for gem material.

Specimens of chalcedony from the Mohave desert region of California were received from Mr. Scott Lewis, of Los Angeles, Cal. Some of this material was translucent, dimly banded pale lilac or amethystine agate. Specimens cut approximately parallel with the banding show a mottled, cloudlike effect, which is best seen in transmitted light. This lilac-tinted chalcedony has been sold under local name of "Mohave moonstone." Another variety is translucent gray chalcedony with pure white patches or tufts, like snowflakes, scattered through it. The white may be opal occupying pore space in the chalcedony. This variety has been sold as "frost stone" in California. The "Mohave moonstone" and "frost stone" are found on a malpais-capped hill, about 10 miles from Muroc station, on the Santa Fe Railway. Another variety consists of translucent chalcedony mottled with white and dark leek-green streaks, possibly due to inclusions of chloritic material. This comes from near Rosamond, Kern County.

Various types of chalcedony were sent to the Survey by Mr. Joseph Ward, of Barstow, Cal., from deposits he had discovered in the Death Valley region. Among these were gray, blue, red, yellow, and yellowish-green chalcedony. Some of this material was banded like agate, with or without colored layers. Most of the yellowish-green variety contained inclusions of white tufts or patches resembling opal. Several of these varieties of agate were suitable for cutting for the semiprecious stone trade, and the yellowish-green variety, which Mr. Ward calls "amberine," might meet a good sale in the tourist trade.

COLORADO.

Blue chalcedony has been handled by J. D. Endicott, of Canon City, Colo., for several years. Mr. Endicott obtains his supply from his claims on Thirty-one Mile Mountain, about 7 miles west of Guffy, in Park County.

MONTANA.

The fine quality of the Montana moss agate and mocha stone was mentioned in this report for 1911, with a brief description of a collection loaned to the Geological Survey by Mr. J. H. Mosher, of Glendive, Mont. Mr. Mosher has again kindly loaned the Survey another collection of selected cut gems, some of which are mounted in filigree gold settings. Mr. Paul E. Hanson, of Billings, Mont., also kindly loaned a collection of cut stones and furnished rough specimens of the agate, with notes on their occurrence.

All the moss agates cut for jewelry are obtained from pebbles and cobbles gathered along Yellowstone River and its tributaries and

from the mesas and buttes for many miles away from the river. These agates are derived from gravel beds, but their original source is not known. They occur in rounded cobbles, some of which are covered with a chalklike but hard coating of silica. Some of the cobbles are geodes composed of chalcedony or agate containing cavities lined with quartz crystals. Such geodes are found in calcareous formations at some localities. Mr. Hanson states that he has observed many such geodes in place, at the headwaters of Boulder River, in some of which a man could stand upright. Nowhere has he observed in the chalcedony of the geodes in place the mosslike markings which are found in similar geodes and fragments in the gravel beds lower down the rivers. He therefore believes that the dendritic markings have been imparted to the agate after it has been liberated from the original rock matrix in the mountains.

The dendrite stains of the moss agate are due to thin films and deposits of oxides of manganese and iron in the seams and pores of the chalcedony. These stains are introduced into the agate by the solutions which spread by capillary action through every seam from the larger channels into still other channels and finally into the pore spaces of the chalcedony. In this way various markings of black, brown, and red in dendritic shapes are produced. The quality of the gems that a fragment of rough agate will yield depends in a large measure on the skill of the lapidary. The rough agates are broken or sawed into slices and gems are developed from those parts which are favorably marked. The majority of the dendrites are black or dark brown. Red stained agates are less common, but furnish beautiful gems. Much of the agate is of fine quality, with pure translucent light-gray to bluish-gray color. Some of the agate is banded but much of it is not visibly so.

Among the cut stones loaned by Mr. Mosher, of Glendive, are the following:

A flat rectangular stone 7.6 centimeters long and 2 centimeters wide, with beveled edges and corners. This contains about 20 black dendrites ranging from 1 to 8 millimeters high, occupying scattered positions, such as may be seen in a group of wooded isles in a lake or along the coast of a northern country. The agate is slightly banded and shows a hazy effect before distant islands and trees.

An oval stone 2.9 by 2.0 centimeters shows a landscape with or without water, according to the fancy of the viewer, with a group of trees to one side and smaller trees or shrubbery in the middle and to the other side. This agate is delicately banded and of fine, pure translucent gray quality.

Another slightly smaller oval gem portrays a lake with narrows in the distance, wooded shore lines, and islands with perfect reflections of the trees in the water. The dendrites are reddish-brown and there is a slight brownish clouding of the water area.

In two closely matched oval stones about 2 by 1.4 centimeters there are marsh scenes with a dead tree, sedge grass in autumn colors, and water.

A small cabochon gem 1.8 by 1.2 centimeters contains a perfect representation of an Indian tepee under two tall slender trees. Even the poles of the tepee are plainly visible..

Another small cabochon gem 2.0 by 0.9 centimeters shows a perfect grove of small bushy trees with brown foliage and black trunks. The lower part of agate contains a peculiar yellowish stain.

A beautiful pendant, 3.7 centimeters long, 1.5 centimeters wide at the lower end and tapering to 3 millimeters at the top, shows a dendrite-like pine tree in fine translucent gray agate.

A number of gems contain one or more dendrites resembling many varieties of moss, ferns, or seaweeds with delicate spreading branches. Among them is a thin, round cabochon stone 2.3 centimeters in diameter, which shows three branching ferns or seaweeds with extremely delicate structure. In other stones various objects, such as the "Mexican eagle" with spread wings, the Austrian eagle, a battleship with fighting top, etc., are readily recognized.

Among the cut stones loaned by Mr. Hanson, of Billings, are some showing beautiful dendrites resembling trees, patches of moss, or ferns, and a few with good landscapes. Mr. Hanson's collection of rough and cut agates was prepared with a view to showing the mode of occurrence of the moss agate and the method of elaboration.

OREGON.

Mr. Don Maguire, of Ogden, Utah, reports the occurrence of fine brown-stained moss agate on McAllisters Butte, near Ochoco River, in Crook County, Oreg.

WASHINGTON.

Specimens of rough and cut lavender-blue chalcedony were received from Mr. A. L. Delkin, of Seattle, Wash. The rough agate was gathered from the sage-brush country around Ellenburg and is reported to be rare. The material is very similar in appearance to that from Myrick's prospect in California, described above. Mr. Delkin reports a good sale for the cut gems.

AMETHYST.

MAINE.

Of the several localities where amethyst has been found in Maine one was examined in June, 1913. This is on Deer Hill in the town of Stow, $1\frac{3}{4}$ miles N. 30° E. of North Chatham, N. H. Deer Hill was also visited by E. S. Bastin [1] in 1906, but more prospects have been opened since that time. The deposit is on the land of Chester Eastman in the ridge extending south from Deer Hill. One of the new prospects is 20 feet long and 8 feet deep, and other similar pits have been opened within a distance of 150 feet northeast along the west side of the ridge. The old work consisted of numerous small pits in the gravelly soil of the ridge for a distance of about 100 yards northeast of the later work.

The country rock is chiefly granite gneiss, but pegmatite covers much of the ridge at the amethyst locality and is the rock opened by the prospects. A large ledge of quartz is inclosed in the pegmatite having a strike of N. 40° E. and a dip of 35° SE. Geode-like pockets of quartz crystals were opened in the later work along the contact of

[1] Geology of the pegmatites and associated rocks of Maine: U. S. Geol. Survey Bull. 445, p. 102, 1911.

the quartz ledge with the feldspathic part of the pegmatite. No amethysts were left around the new openings, if any were found there, but abundant opaque white and transparent colorless quartz crystals are scattered over the dumps. Numerous pale amethyst-colored quartz crystals were observed around the earlier pits to the northeast. Some of these are quite clear.

An amethyst crystal measuring 2½ by 3 inches was plowed up in a field on the land of Ezra Healds, 1 mile north of North Chatham and about half a mile southwest of the Deer Hill locality. This crystal is irregular in shape and consists of both amethyst and smoky quartz. The colors are not evenly distributed, but are streaked together in parts of the crystal. A portion of the crystal has a rich amethyst color.

Specimens of fine amethyst were seen in the possession of George Howe, of Norway, Me., obtained from a prospect on Pleasant Mountain, in the town of Denmark. These amethysts were rich dark purple and showed a strong garnet-red under artificial light, like the better Siberian amethysts.

NORTH CAROLINA.

A few amethystine quartz crystals and one amethyst of good quality have been found on the R. C. McConnell place, about 3 miles southwest of Mount Ulla, in Iredell County, N. C. The good specimen was found some 20 years ago by the late N. H. Marsh. This was a partly water-worn crystal about 2 inches long and 1¾ inches thick. A large part of it was flawless, with pleasing medium dark purple color. The value of this crystal was not large, but the possibility of a deposit being found should not be overlooked.

SOUTH CAROLINA.

Earle Sloan [1] has mentioned the occurrence of amethyst at several places in the Piedmont counties of South Carolina, especially in Abbeville and Anderson counties. Two localities were visited in 1913 in Greenwood County where amethyst had been reported found. These were on the land of R. M. Haddon, of Abbeville, 1½ miles southeast of Shoals Junction, and of R. W. Dunn, 1 mile southwest of Shoals Junction, both about 3 miles southeast of Donalds.

Amethystine quartz is found at several places on the Haddon plantation, but the best indications are in an area of about 100 feet wide and 250 feet long, north and south, in a field near the road leading to Donalds. The soil in this field is light, sandy, and gravelly, formed by the disintegration of mica gneiss and granite. Numerous crystals of amethystine to nearly colorless quartz were found in the field. Some of these were clear, but none were of sufficient depth of color to warrant cutting for gems. No prospect work has been done at this place and only surface specimens were seen. A trench should easily locate the vein or veins and a little digging would show whether amethysts of value could be expected.

On the R. W. Dunn place amethystine and colorless quartz crystals have been found in the cultivated fields at several places. No regular

[1] Catalogue of the mineral localities of South Carolina: South Carolina Geol. Survey Bull. 2, ser. 4, p. 157, 1908.

prospecting has been done for them and accordingly only surface specimens have been found. The fields have light sandy soil with scattered blocks of hornblende gneiss through it, such as might be derived from the disintegration of granite with hornblende gneiss inclusions.

Amethyst is also reported on the place of J. T. Algary, about 4 miles south of east of Donalds. A good specimen consisting of a cluster of clear pale amethyst crystals from the Algary place was seen at the home of T. F. Drake, of Shoals Junction. This cluster measured 8 inches across and 3 inches thick, and contained some crystals 2 inches thick.

BERYL.

NEW ENGLAND.

Beryl suitable for specimens and gems have been found at many localities in New England. Some of these have been mined for that mineral alone and others have been worked for feldspar and the beryl has been saved as a valuable accessory mineral. In Connecticut fine golden beryl has been obtained from near New Milford, Litchfield County, and during 1913 good aquamarine was found near East Hampton, in Middlesex County. In Maine beryl is widespread in the pegmatites worked for feldspar. Several localities have yielded gem beryl, and among these are prospects in the towns of Buckfield and Stoneham. In Massachusetts Goshen and Royalston have afforded beautiful gem beryl. In New Hampshire beryl is abundant in many of the mica-bearing pegmatites, and some of these have yielded good gems.

A brief examination of several of the New England beryl localities was made in June, 1913. Unfortunately time for this work was so limited that none of the Connecticut localities were visited.

MAINE.

Exceptionally fine beryl gems have been found in the town of Stoneham, Me., at scattered localities. Some of these were visited, but very little local interest was shown in the possibilities of these deposits at that time and only outcrops and old prospects were available for examination. The writer was fortunate in having Mr. Wesley Adams, of North Lovell, guide him to some of the many prospects with which he is familiar. Among these were Sugar Hill, Durgin Mountain, and Chapman Hill or Thousand Acre Hill.

Sugar Hill is about 3 miles northwest of North Lovell. Beryl and associated minerals have been found at several places on the south side of the hill on the land of Edwin McAllister. At one place a prospect pit had been opened in loose talus or drift material a few yards below a rather flat-lying cliff-forming ledge of pegmatite. In this loose drift were found fragments and crystals of beryllonite, a phosphate of beryllium and sodium, beryl, smoky, clear, and transparent gray quartz, mica, and potash feldspar. E. S. Bastin[1] mentions also apatite, cassiterite, columbite, and triplite as having been found here. The pegmatite ledge outcrops about 40 feet higher up on the hillside and, at a distance of about 150 feet northeast of

[1] Geology of the pegmatites and associated rocks of Maine: U. S. Geol. Survey Bull. 445, p. 99, 1911.

the pit, incloses numerous beryl crystals. These crystals are exposed in the bare rock associated with feldspar, opaque and translucent quartz, and a little mica. They range up to 2½ inches in diameter, and one crystal measured about 1½ inches by 10 inches. The pegmatite is exposed for thicknesses of 6 to 12 feet along its outcrop and was followed about 200 feet farther northeast. In places along this outcrop nodules or small masses of translucent quartz are exposed. The pegmatite is in contact with coarse granite above, but the country rock is chiefly mica gneiss intruded by granite and pegmatite in masses of various sizes. About one-third of a mile farther northeast a large pegmatite forms the floor of a bench on the hillside and outcrops as a wall around its lower side. Several prospects have been opened within a distance of 200 feet east and west in the floor of the bench and in these, greenish, yellowish-green, and pale-golden beryl has been found. Most of the crystals are opaque, but some contain translucent and clear portions suitable for gems. The pegmatite is composed of coarse potash feldspar crystals, massive quartz, in part translucent, and muscovite mica. In the wall of the pegmatite below the bench there was an impression in the pegmatite from which a hexagonal crystal, evidently beryl, 3 by 12 inches had been removed. This crystal was larger than those found in the prospects on the bench.

Durgin Mountain is 4 miles N. 30° W. of North Lovell. The prospect visited is on the east side of the mountain on the land of Ernest Bartlett, of East Stoneham. A small prospect had been blasted out of an outcrop of hard pegmatite on the slope of the hill. The pegmatite above the pit is covered with soil and grass. Potash feldspar crystals, 1 to 2 feet thick, are exposed in the pit along with large quartz segregations, some of which are beautifully translucent. Muscovite and biotite mica are both present. Beryl is abundant in crystals ranging up to more than 2 inches thick. They are mostly opaque or only translucent, but some fragments of crystals were seen on the dump having small brilliant transparent portions that were dark golden yellow, yellowish green, bluish green, and nearly colorless. Most of the beryl crystals seen were exposed for a distance of 15 feet in a streak or belt extending north across the pegmatite outcrop.

The beryl locality on Chapman Hill is about 3 miles due north of North Lovell. Two prospects have been opened on the summit of the hill near the east side, one in a field and the other one-fourth mile south in the woods. At both places the openings are small, not over 8 feet deep. The country rock at each place is biotite granite gneiss, but the relations between it and the pegmatite were not exposed. At both prospects rough crystals of orthoclase or microcline, coarse quartz segregations, and crystals of mica, black tourmaline, clevelandite, and beryl were observed. Small pieces of blue and bluish-green beryl of good color were found on the dumps, and these prospects are reported to have yielded blue beryl of fine color.

Fine golden beryl and aquamarine are reported to have been found on the land of Charles Andrews, on Speckled Mountain, in the town of Stoneham, about 5 miles northwest of North Lovell.

George F. Kunz[1] described two fine beryls picked up in pastures in Stoneham in 1881. One of these was cut into a bluish green brilliant gem weighing 133¾ carats of nearly perfect quality and into

[1] Gems and precious stones of North America, pp. 92-93.

smaller gems weighing altogether over 300 carats. The other crystal was smaller, one half having a transparent faint green and the other a translucent green color.

Beryl has been prospected at several places in the town of Buckfield, Me. Besides the more common aquamarine varieties, golden beryl and colorless to bluish caesium beryl are found. Some of the localities which have yielded chiefly cæsium beryl along with a few other minerals of interest were visited.

The Lewis mine, worked by Perien Dudley, is about 2 miles southwest of Buckfield. It is in the eastern side, near the summit of a low but steep-faced hill. The work consists of two connecting open cuts extending up and down the hillside for a distance of about 120 feet. The lower cut has a direction of N. 20° W. and the upper one N. 80° W. up the hill. They range from 5 to 15 feet in depth and 10 to 20 feet in width. The country rock is quartz-biotite gneiss with layers of typical biotite schist. The gem-bearing rock is pegmatite lying approximately conformable with the gneiss which strikes about N. 30° E. and dips 30° SE. Biotite schist overlies the pegmatite on the south side of the cut, but north of this the pegmatite appears to outcrop as a blanket ledge. It had not been cut through in the open cuts and the thickness is therefore not exposed. The pegmatite is rather coarse, but uneven grained. Orthoclase or microcline occurs in rough crystals several inches across and in graphic intergrowth with quartz. Translucent green and bluish-green tourmaline with occasional pink crystals have been found frozen in the pegmatite along with muscovite, biotite, and clevelandite. Pockets ranging from small size to 2 feet in diameter are reported to occur scattered irregularly through the pegmatite. Colorless cæsium beryl was found frozen in the pegmatite and also in pockets. Arsenopyrite, or the related mineral löllingite, is present in the pegmatite associated with various minerals.

Very fine cæsium beryls have been obtained from the mine of J. H. Fletcher, a little over 2 miles southwest of Buckfield, Me., and about one-fourth mile west of the Lewis mine. The Fletcher mine was also worked by Perien Dudley and was opened by a cut extending north into the hillside. The beryls occur in pegmatite inclosed in quartz-biotite gneiss. The feldspar of the pegmatite is grayish othoclase or microcline which occurs in crystals up to 2 feet thick. Dark greenish-black tourmaline and clear light yellowish-green muscovite are abundant. Many small fragments of brilliant transparent colorless and pale greenish beryl were observed in the workings. Similar beryl in larger pieces would yield gems of exceptional brilliance. The largest beryl crystal found is reported to have been nearly 4 inches in diameter with one end composed of clear gem material.

Beryl with other interesting minerals has been found in several prospects on the north slope of a hill 2½ miles southwest of Buckfield, Me., and about half a mile south of the Fletcher cæsium beryl mine. These different prospects have been opened by Perien Dudley and W. S. Robinson. Much of the beryl found in these prospects is nearly colorless or pale greenish, and contains cæsium. At two or more of the prospects, pollucite, a hydrous silicate of cæsium and magnesium, is found along with beryl. In one opening masses of pollucite 8 to 10 inches across were found. A few crystals of opaque or translucent colored tourmaline have also been found in the pegma-

tites in this hill, but most of the tourmaline is dark green or nearly black. Among other minerals associated with the beryl are amblygonite, clevelandite, muscovite, arsenopyrite or löllingite, and cassiterite.

MASSACHUSETTS.

Beryl of especially fine quality has been mined at Beryl Hill, 2½ miles N. 68° E. of Royalston, Mass., by F. H. C. Reynolds, of Boston. Beryl Hill is a low, flat topped hill partly cleared for pasture on the summit and west side. Five openings have been made, four on the summit and one a short distance below, on the west side. The openings are on two approximately parallel outcrops of pegmatite about 80 yards apart extending in a northwest direction across the summit of the hill. A small glacier-made depression lies between the two outcrops. Two pits are located on the pegmatite on the southwest, one at the brow of the hill and the other on the slope about 30 yards northwest. This pegmatite outcrops for about 100 yards southeast to the opposite side of the summit. The northeast pegmatite outcrop extends 100 yards from a pit on the east side of the hill across the summit to a trench on the west side with another pit between these. From the trench the outcrop extends more than 100 yards about N. 20° W. along the edge of the hill. None of the openings are large, the deepest being only 12 feet deep and the largest a shallow trench 60 feet long.

The country rock is chiefly mica gneiss cut by biotite granite. The strike of the gneiss varies from northwest to N. 15° E. and the dip is also variable. The relation between the mica gneiss and granite are not well exposed in the workings, but the granite appears to merge into the pegmatite in places. In one of the openings biotite diorite is in contact with the pegmatite and granite. The texture of the pegmatite ranges from that of coarse granite to rock in which the individual minerals are more than a foot across. Most of the feldspar of the pegmatite is the buff-colored to pink potash variety, but some albite is present. Some of the feldspar occurs in rough crystals and other is graphically intergrown with quartz. Much of the quartz occurs in light smoky gray masses or segregations. Among other minerals of the pegmatite besides beryl are muscovite in crystals up to 3 inches across, a little biotite, black tourmaline, and dark-red garnets.

Beryl has been found in hexagonal crystals ranging from small size up to 2 inches in diameter and of varying length. One fine specimen crystal, of good bluish-green color with some gem material in one end, is 11 inches long and 1½ inches thick, This crystal is a nearly perfect hexagon, but has been broken into three sections. With the exception of a small fragment at the lower end the whole has been preserved and cemented together and appears practically perfect. The crystal is attached to a mass of granular gray quartz with a little mica adhering. Another crystal in a quartz matrix has pyramidal terminations. Many perfect crystals of one-half inch to three-fourths inch in diameter have been obtained, most of them in the granular smoky gray quartz. Another fine gem specimen attached to quartz, feldspar, and mica measures seven-eighths inch by 3¾ inches long. Part of this crystal is flawed, but good blue perfect gems of several carats weight could be cut from the clear portions.

The Beryl Hill gems range in color from light to dark aquamarine, fine blue, yellowish green, to golden. Many very fine bluish-green stones have been cut, and among those seen was a table-cut stone of 13¾ carats. The blue beryls of better quality are rarely excelled by those from other localities in brilliance or beauty of color. Among cut gems of this quality a 12½ carat brilliant cut stone was especially beautiful.

NEW HAMPSHIRE.

A deposit has been worked for gem beryl on Melvin Hill, 2¼ miles S. 25° W. of Grafton, N. H., by F. H. C. Reynolds, of Boston. Two openings were made about 150 feet apart at the east side of the hill and about 400 feet higher than the valley below. The principal working is a quarry with a working face over 80 feet long in a N. 60° W. direction along the hillside and 5 to 15 feet high. The country rock is quartz-biotite gneiss which strikes north with a nearly vertical dip and some folding. The pegmatite cuts across the foliation of the gneiss with a north of west strike and a dip of about 20° N. The contact with the gneiss is not regular but rolling, with a few smaller beds of pegmatite extending out into and parallel with the foliation of the gneiss. The bottom of the pegmatite is not exposed in the workings.

The pegmatite is composed of the usual minerals, potash feldspar, quartz, and mica, with other associated minerals. The feldspar occurs in large pure crystal masses or graphically intergrown with quartz. The quartz is mixed through the pegmatite in grains and massive irregular segregations. It is either white or smoky and some of it is quite translucent. Muscovite mica of good quality occurs rather abundantly and would pay part of the mining cost if saved. Much biotite mica was observed on the dumps, and in many specimens biotite was intergrown with muscovite. Among other minerals in the pegmatite are black tourmaline, red garnets, green apatite, and beryl. Beryl was evidently rather plentiful for there were many fragments of broken crystals on the dumps. Some of the crystals measured several inches across, and most of them were opaque or only translucent. In some of the crystals Mr. Reynolds reports clear gem beryl was found, the golden variety of which was especially finely colored. Light golden beryl gems weighing several carats were cut from some of the crystals, but the dark golden beryl crystals yielded only gems of less than 1 carat weight. The colors observed in the beryl fragments on the dumps were light yellow to rich golden yellow, yellowish-green, and light to dark aquamarine green and greenish-blue.

The other opening of the Reynolds Beryl mine is south of the main working. A pit was made in pegmatite cutting biotite granite and quartz-biotite gneiss. The pit and dump were overgrown with brush and little could be seen.

Another beryl deposit was worked about one-third of a mile west of the Reynolds mine, near the summit of Melvin Hill, by the Columbian Gem Mining Co. The gem beryl found was mostly the aquamarine variety. Another beryl prospect has been worked about 2 miles west of the Reynolds mine and about 1 mile south of Prescott Hill, by Franklin Playter, of Boston.

None of these mines was in operation during 1913.

A new beryl prospect was opened in 1913 on the old Porter K. Filbert farm, 1½ miles S. 75° W. of South Danbury, in the town of Wilmot, N. H. The work was done by J. E. Lovering, of Grafton, N. H., for Charles Murphy, of Detroit, Mich., the present owner. The deposit is on the west end of an elongated rounded hill about 200 feet higher than the road on the west. At the time of examination the pegmatite had been stripped of soil covering for about 200 feet and small prospects had been blasted out. The country rock is chiefly coarse porphyritic biotite gneiss which strikes northeast with a variable but high southeast dip. This gneiss is cut by a medium-grained granite, and the gem-bearing pegmatite cuts both rocks near their contact. The pegmatite strikes about N. 75° E. and has a nearly vertical dip. Through most of the exposed parts the pegmatite varies from 6 inches to 2 feet in thickness, but in one place it bulges to nearly 8 feet in thickness. The texture is fairly coarse, potash feldspar crystals up to 8 inches thick being observed. Much of the quartz is smoky gray, and some occurs crystallized along with small albite crystals in pockets. Black tourmaline and muscovite are other minerals associated with the beryls. The beryl crystals occur unevenly distributed through the pegmatite. They range from small size up to more than 2 inches in diameter. Most of the crystals are opaque or translucent yellowish green, pale green, or good aquamarine in color, but some clear gem crystals are found. Mr. Lovering reported finding a crystal nearly 2 inches in diameter and containing some aquamarine of gem quality.

A small prospect has been opened for feldspar and beryl on Stuart Hill, 3 miles southeast of Grafton, in the town of Wilmot. This hill is called Severance Hill on Hitchcock's Atlas of New Hampshire. The hill is composed chiefly of course porphyritic biotite gneiss which strikes about north with an east dip. A large pegmatite cuts across the north end of the hill forming a small cliff or break in the hill slope. The south contact of the pegmatite with the gneiss approximates east and west, with many minor irregularities. The pegmatite is of very uneven grain which ranges from coarse, with potash feldspar crystals 4 feet thick, down to a texture resembling coarse granite. A dike of medium-grained granite cuts the porphyritic gneiss and the pegmatite into which it appears to merge. Among the minerals observed in the pegmatite, besides feldspar and quartz, were black tourmaline, muscovite and biotite mica, and beryl. The beryl was rather plentiful in crystals ranging up to 4 inches in diameter. They were aquamarine-colored, yellowish-green, and yellow, but mostly opaque or translucent. A few pieces nearly clear enough for cutting into small faceted gems were observed and some of the translucent aquamarine-colored would serve for cabochon gems.

Gem beryl has been found at the Island mica mine, 2 miles N. 20° E. of Gilsum, N. H. During the course of mica mining a large number of beryl crystals and fragments, some of which contained gem material, were thrown on the dumps. The dumps have since been picked over by collectors and the best beryl removed. The mine was worked by three open cuts and a short tunnel. Two of the open cuts were at the east foot of a small knoll (glacial "roche moutonée") standing about 25 feet above the surrounding swampy ground. These open cuts were 20 and 25 feet deep, respectively, but are now filled with water. The third cut was made back into the knoll at a

level a few feet above the lower cuts, but still 18 or 20 feet lower than the summit of the knoll. The country rock is biotite gneiss carrying much black tourmaline near the pegmatite. The gneiss has been strongly folded and crinkled near the pegmatite and accordingly has a variable strike and dip. The pegmatite is very irregular in shape, having a westerly trend across the knoll. It incloses streaks of biotite gneiss, and the surrounding gneiss has been injected by many small lenses and streaks of pegmatite. The pegmatite contains large segregations of gray and smoky quartz, some graphic granite, orthoclase and albite feldspar, pockets or bunches of mica (both muscovite and biotite), black tourmaline, green apatite, a few red garnets, and numerous beryl crystals. A quantity of mica of good quality was obtained during mining. The beryl crystals range up to a foot in diameter and are vari-colored; some are bluish, bluish green, yellowish green, and light and dark golden yellow. Much of the beryl is translucent, and parts of some of the crystals are transparent and flawless so that perfect gems can be cut from them. Small dark golden beryl of exceptional beauty has been cut from clear portions of large crystals. Much of the translucent beryl could be used to advantage for cabochon gems and beads.

Beryl Mountain, in the town of Acworth, N. H., has long been famous for the size and abundance of its beryl crystals. According to Mr. Eugene Crossett [1] owner of the prospect, an attempt was made in 1884 to quarry a large beryl crystal here for use as a tombstone over the grave of Emerson at Concord, Mass. Difficulty was experienced in removing a crystal without fracturing and the attempt was abandoned. Later a bowlder of rose quartz was adopted for this purpose. Mr. Crossett states that some specimen beryl was removed at this time and a quantity of feldspar and quartz were shipped for the manufacture of pottery, glass, and sand paper.

Beryl Mountain is a steep-faced hill or ridge rising about 200 feet above the road around its base. It has a north-northeast trend and is narrow near the summit. Prospects have been opened on the east side of the northern end about 25 feet below the summit and on the summit above. The work on the summit consists of several pits now badly overgrown by vegetation. The principal work is an open cut or small quarry about 25 feet long, 15 feet wide, and 10 to 12 feet high in the hillside. This cut has a cavern-like face 8 to 10 feet high with an overhanging ledge above.

The beryl occurs in a pegmatite mass cutting the mica gneiss country rock. The pegmatite and the inclosing formations appear to strike with the trend of the hill, but no minerals of interest were observed in the outcrop to the south of the prospects. The open cut has been made in a deposit of mixed oligoclase feldspar and quartz through which are scattered numerous beryl crystals and a little muscovite mica. This deposit is capped by a massive bed of granular sugar quartz mostly pure white or tinted with pink. In places this quartz is glassy and translucent, and some has a pale rose color. The contact between the massive quartz and the beryl matrix is not distinct, but the massive quartz grades into that associated with the feldspar and beryl. Several feet below the massive quartz, feldspar is more plentiful than near the quartz. In an exposure of the quarry face measuring about 16 feet long and 8 feet high 35 large beryls

[1] Personal communication, dated South Acworth, N. H., Mar. 2, 1914.

were counted. These ranged from 3 inches to 16 inches in diameter, and sections over 3 feet long were exposed. Each beryl is surrounded by a layer of oligoclase feldspar one-half inch to 3 inches thick. The beryl crystals are variously colored pale bluish green and yellowish green, and light and dark golden yellow. Most of them are opaque, but some contain translucent portions. Many crystals have been broken, either in mining or by collectors looking for gem material, and hundreds of fragments of beryl are scattered over the dump. No transparent gem beryl was observed, but the impression gained by a study of the deposit was that gem beryl might be found by further excavation.

SOUTH CAROLINA.

A prospect opened on the place of J. N. S. McConnell, 3¼ miles east of north of Anderson, is reported to have yielded specimens of green beryl crystals of good color, almost emeralds. When examined in October, 1913, the prospect consisted of a trench 45 feet long in a N. 70° E. direction, 15 feet wide, and 5 feet deep, with a crosscut trench entering at the west end. The country rock is weathered to a dark reddish-brown sandy soil and no outcrops were seen near the prospect. The soil has probably formed by the weathering of a biotite or hornblende granite, and carries small blocks of diorite. The pegmatite is not now exposed, but the dump contains kaolinized feldspar, blocks of massive white quartz, smoky and colorless quartz in rough crystals, weathered plates of mica 8 inches across, large dark red garnets, black tourmaline, limonite pseudomorphs after pyrite, and black manganese oxide stains. No beryl was seen on the dumps.

DIAMOND.

ALABAMA.

A beautiful diamond crystal was sent to the Survey by Mr. F. M. Lynch, of Birmingham, Ala., along with notes on its history, and further information regarding its discovery was furnished by Mr. J. H. Watkins, geologist for the Southern Railway. This diamond is reported to have been found by J. W. Kerr on the property of J. S. Isbell, at Prescott siding, St. Clair County, 1¼ miles east of Brompton on the Southern Railway, about eight years ago. The nature of the stone was not recognized until it came into the hands of Mr. Lynch, who sent it to George F. Kunz,[1] of New York, for identification. This diamond measures a little over 8 millimeters high and 5.5 millimeters in smallest diameter. It weighs 2.41 metric carats and is clear and flawless, with a slight greenish cast. The crystal is so rounded that its form can not be definitely determined. It is slightly flattened parallel with one of the possible octahedral planes.

ARKANSAS.

The Arkansas diamond field received more active development in 1913 than in any previous year. The nature of the work was not such as to definitely prove or disprove the value of the deposits, but

[1] Jewelers' Circular-Weekly, Jan. 7, 1914.

it served to show in what ways improvements could be made in the mills and machinery so far used to treat the peridotite. The companies making the tests have not seen fit to announce the results of their work, but they kindly allowed examination of their mines and mills at the time of the writer's visit in July, 1913. Two washing plants were built, one by the Ozark Diamond Mining Corporation on their holdings at the northeast side of the original peridotite area, and the other by the Kimberlite Diamond Mining & Washing Co., on the west side of Prairie Creek.

The Ozark Co. operated its washing plant about three months during 1913. Mr. Warren, the superintendent, estimated that about 5,000 loads of 16 cubic feet of decomposed peridotite from the original area and about 1,000 loads of gumbo and wash gravel from the west foot of Twin Knobs were washed. The last of this gumbo and gravel were being washed at the time of the writer's visit, but no diamonds had been found in it. Several hundred diamonds were recovered in washing the peridotite from the original area. This peridotite was obtained from an open cut 300 feet long, 15 to 35 feet across, and 8 to 20 feet deep, with tracks leading to the mill. A quantity of surface material was washed in sluice boxes with riffles and yielded a larger per cent of diamonds than the underlying peridotite. Most of the peridotite, even from the bottom of the open cut, was found to be so decomposed as to be ready for washing as mined.

The mill is equipped with a stationary boiler and engine, a trommel separator feeding an elevator to a large storage bin, sizing screens, jigs, and a stationary grease plate table. The oversize is passed through a jaw crusher and then to the storage bin. After necessary changes have been made in the mill further experiments are to be made in washing the peridotite.

The Kimberlite Diamond Mining & Washing Co.'s plant is nearly a mile from its lease holdings on the original peridotite area. A tram has been built from the mine at this place to the mill and another tram will be built to the company's holdings, 3 miles east of Murfreesboro, if success is met with in prospecting and preliminary washing. The mill is substantially constructed with a large storage floor. The earth to be treated will be fed through a revolving screen and into a 10-foot diamond concentrating pan of South African pattern. It is estimated that this pan will treat from 100 to 150 loads of 16 cubic feet per day, reducing 100 tons of earth down to about 1 ton of concentrates. The concentrates will be further screened and then treated on jigs, and the final concentrates examined on metal covered tables in a well-lighted room. Oversize from first screening will be subjected to further weathering. Tailings will be conveyed by flume to Prairie Creek. Final equipment of the mill with automatic handling machinery, grease table, and other improvements will be carried out after the value of the property is proved.

The Arkansas Diamond Co. was idle during 1913, but since the writer last visited the property in 1908 several changes have been made. The peridotite hills have been stripped of timber and a dozen or more new pits and shafts have been made, some of which were of value in showing the depth of decomposition over various parts of the peridotite area. Weathered peridotite has been scraped off of a small area and washed in improvised machinery which proved wasteful in operation. A large area of ground sloping south toward Little

Missouri River could be readily washed by hydraulic methods for which power pumps would be required. Between the peridotite outcrop and Little Missouri River is a large area of bottom land which may prove to be workable placer ground.

Only a small amount of prospecting was done on the property of the American Diamond Mining Co., but Mr. Fuller states that the company reports the finding of one stone.

The best information on the diamond-bearing peridotites of Pike County has been given by Hugh D. Miser.[1] This report contains a carefully prepared map of the known peridotite exposures, with sections and detailed information concerning them. A good résumé of the developments in the diamond field during 1913 has been given by John T. Fuller.[2]

CALIFORNIA.

Mr. M. J. Cooney, of Oroville, Cal., reports the finding of a first quality white diamond by John McGregor on the old placer grounds of the U. S. Diamond Mining Co., at Cherokee, in December, 1913, and of several other smaller stones of inferior quality in the same area. Mr. McGregor states that the stone weighed 1¼ carats and is valued at $75 in the rough state.

Press reports[3] mention a diamond found by Ed. Bryan, a miner at Sawpit Flat, in Plumas County, Cal. In a personal communication Mr. Bryan states that the stone was very similar to a diamond found at the same locality several years ago and known to be authentic. Both stones were found in old hydraulic mining ground similar to the old placers of Butte County, where a number of diamonds have been obtained. Through misplaced confidence the stone was lost to Mr. Bryan before he could be positive of its determination.

IDAHO.

Mr. Frank E. Johnesse, of Boise, Idaho, reports the discovery of three small fragments of diamond in the Rock Flat mine in Adams County, Idaho. The largest of these fragments weighed a little less than one-eighth of a carat. The diamonds were found during placer mining for gold. Other possible gem minerals in the form of sapphire, garnets, and zircon are also found in the clean ups. Robert N. Bell, State mine inspector of Idaho, states that the rock formation of this area is chiefly gneiss with a dike rock of basic composition which has weathered to a soft yellowish earth in places. Mr. Johnesse is installing a hydroelectric plant to treat the concentrates from placer mining for the various minerals of value they may contain, such as monazite, zircon, etc.

INDIANA.

Messrs. Perry Bradford and R. L. Royse, of Centerton, Ind., have furnished information concerning the finding of five diamonds during 1913 on Gold Creek and Highland Creek, in Morgan County. Two of these were found by Hugh Marshall, two by Fred Doyle, and

[1] New areas of diamond-bearing peridotite in Arkansas: U. S. Geol. Survey Bull. 540, pp. 534–546, 1914.
[2] Eng. and Min. Jour., Jan. 10, 1914.
[3] Sacramento Union, Cal., Aug. 17, 1913.

one by R. L. Royse. Mr. Royse describes the one he found as a small green diamond with fine luster, weighing 0.20 metric carat. One of the stones found by Hugh Marshall is described as colorless or white and weighing 0.73 metric carat. Mr. Bradford kindly sent one of the stones found by Fred Doyle to the Survey for examination. It is a yellowish stone, only partly transparent, and weighed 0.69 metric carat. The crystal form is that of a distorted trisoctahedron truncated by the octahedron. A point projecting from one side of the stone indicates that it is probably a twinned crystal.

NEW YORK.

Specimens from two peridotite outcrops in Syracuse, N. Y., were received from Mr. Edwin C. Dinturff, of that city. Some of these were from Green Street and James Street, on the "south crater," and the others from Griffith Street and Highland Street, on the "north crater." Mr. Dinturff states that at the "south crater" exposure peridotite has been found over an area of about 800 feet by 1,200 feet and that at the "north crater" peridotite has been found for about 300 feet in sewer excavations with another exposure, possibly part of the same mass, about 400 yards farther north. The two localities are about three-fourths of a mile apart. In a small hill on Green Street in the "south crater" the peridotite is seen in contact with shale. This is in the peridotite area which has been known for a number of years.

The peridotites of Syracuse bear a marked resemblance to those of South Africa, Arkansas, and Kentucky in composition, texture, inclusions, and weathering. The material from Highland Street was hard when first excavated, but much of it has disintegrated on exposure to the atmosphere. No careful search for diamonds has been made in the peridotite of Syracuse, though the nature of the material would seem to justify such attempts as much as the peridotite of Kentucky, on which considerable work has been expended. Concentrates from panning the altered rock contained garnet, zircon, olivine, diopside, and other minerals. The zircon occurs in minute crystals, which are best separated by treating the peridotite with hydrofluoric acid. In this separation fine particles of ilmenite or rutile are also obtained.

VIRGINIA.

Information on the reported finding of a diamond in Tazewell County, Va., was kindly supplied by Messrs. Charles H. Reynolds, of North Tazewell; H. W. Pobst, a jeweler, of Tazewell; and J. Sanders Gillespie, of Cliffield. This diamond is reported to have been found by Frank Brewster on the farm of Mr. Gillespie, near Pounding Mill, while plowing in a cornfield. The stone was sold to Mr. Pobst, who had it cut by J. R. Wood & Sons, of New York. The cut stone weighs 0.83 metric carat and is considered to be of very fine color and quality by Mr. Pobst. Little has been done toward prospecting for other diamonds.

AFRICA.

UNION OF SOUTH AFRICA.

The production of diamonds during the fiscal year 1913 by the De Beers Consolidated Mines [1] amounted to 2,293,468 carats, as compared with 2,087,392 carats in 1912. Actual sales of diamonds, plus the increase of stocks taken at the cost of production, amounted to £6,297,782. In round numbers, 2,034,000 carats of diamonds were sold. The total production of blue ground in 1913 amounted to 7,382,216 loads, as compared with 7,950,442 loads in 1912. The total quantity of blue ground and tailings washed during 1913 was 8,702,289 loads, as compared with 7,995,953 loads in 1912. The yield in carats of diamonds per load of blue ground washed decreased from 0.31 to 0.29 in the De Beers and Kimberly mines and from 0.29 to 0.27 in the Wesselton mine, and increased from 0.41 to 0.42 in the Bultfontein mine. In the Dutoitspan mine the yield remained the same, at 0.23 carat per load. The De Beers mine remained closed during the year, with the exception of a small amount of development work.

The Premier Diamond Mining Co. (Ltd.) had a successful year during 1913.[2] The company's report for the year closing October 31, 1913, shows 10,434,680 loads of earth washed, yielding 2,107,983 carats of diamonds. The average value per carat was $5.32 and the value of the total production amounted to $11,216,000, as compared with $9,620,000 in 1912.

The output of diamonds from alluvial diggings has increased greatly, and during the first six months of 1913 the value of the diamonds produced amounted to $1,354,882.[3] Some valuable stones have been found in the alluvial workings, and among those registered were a 64½ carat diamond, valued at $2,092, a 32½ carat diamond, valued at $1,897, and a 16 carat stone, valued at $1,094.

A diamond weighing 229 carats [4] was found in the Pniel diggings by F. J. Van Zyl in the latter part of 1913. This stone is a fine octahedron crystal with a slight tinge of yellow. It brought £2,300.

GERMAN SOUTHWEST AFRICA.

According to Consul General Henry W. Diederich,[5] of Antwerp, Belgium, the output of diamonds in German Southwest Africa amounted to about 1,440,000 carats. During the first half of the year the Antwerp Syndicate purchased about 760,000 carats, for which it paid about $8,330,000, or approximately $10.94 per carat. The German imperial chancellor ordered that the output or sales should be limited to less than 1,000,000 carats in 1914 in order not to overstock the market with diamonds of small size and break prices. During the spring of 1914 the output of the German Southwest Africa diamonds for the year was purchased by the London Diamond Syndicate,[6] which therefore practically controls the market of small as well as large diamonds.

---

[1] De Beers Consolidated Mines Twenty-fifth Ann. Rept. for year ending June 30, 1913.
[2] Min. and Sci. Press, Apr. 4, 1914.
[3] Consul Edwin N. Gunsaulus, Johannesburg, Transvaal; Daily Cons. and Trade Repts., Oct. 17, 1913, p. 310.
[4] Jewelers' Circular-Weekly, Feb. 4, 1914.
[5] Daily Cons. and Trade Repts., Mar. 28, 1914, p. 1170.
[6] Jewelers' Circular-Weekly, Apr 8, 1914.

KONGO.

Consul General Henry W. Diederich [1] of Antwerp, Belgium, reports that in January, 1914, 6,795 carats of rough diamonds from Kongo River were sold at auction for $39,372. These diamonds come from the country along Kasai River, a tributary of Kongo River.

FELDSPAR GEMS.

AMAZON STONE.

COLORADO.

The amazon stone and associated minerals of the Pikes Peak region, Colorado, have been a source of interest to mineral collectors and gem dealers for many years. George F. Kunz [2] states that an exhibit of Colorado amazon stone at the World's Fair in Philadelphia, in 1876, occasioned much surprise because of its beauty. There are two general localities where the amazon stone is found, one to the east of Pikes Peak, in the Crystal Park region near Manitou Springs, and the other about 18 miles northwest of Pikes Peak around Crystal Peak, about 4 miles north of Florissant.

In the Crystal Peak region prospects have been opened over an area more than 2 miles square by various prospectors and collectors. The Crystal Peak region is mountainous and timbered, with occasional rocky knobs or domes standing above the ridges and valleys. The prospects examined are situated at elevations ranging from about 9,000 to 9,400 feet above sea level, Crystal Peak having an altitude of 9,668 feet. Crystal Peak is the highest of a range of small knobs along a divide. Other lower knobs are Little Crystal Peak, one-fifth of a mile west of north; Deer Mountain, about one-half of a mile northwest; and Sheeps Head, about two-thirds of a mile northwest of Crystal Peak. Wide ridges and rather gentle slopes extend from the foot of these knobs, but most of these are cut into by valleys within a half mile of the knobs.

The prospects are in both the gentle slopes and in the steeper walled valleys. Among the numerous people who have worked in the Crystal Peak region George Copelen, of Gillette, Colo., was one of the pioneers. Mr. Copelen commenced prospecting here over 35 years ago, but has now abandoned that work. Numerous claims have been filed and some of these are still in force, but others have lapsed. Among the prospects visited in August, 1913, some were on the claims of J. D. Endicott, of Canon City; The Crystal Peak Gem Co., of Cripple Creek; A. Fries, George H. Weed, and Whitmore & Sanders. The claims of J. D. Endicott lie chiefly north of Crystal Peak. One claim is in the gap between Little Crystal Peak and Deer Mountain. A. Fries owns patented ground about one-half of a mile northeast of Crystal Peak and claims other prospects between this and Little Crystal Peak. The claims of the Crystal Peak Gem Co. are scattered, most of them lying north and northwest of Little Crystal Peak with one, the "Pinacoid claim," nearly a mile to the north of Crystal Peak. A claim covering the topaz workings, about 1¼ miles southwest of

[1] Daily Cons. and Trade Repts., Mar. 28, 1914, p. 1170.
[2] Gems and precious stones: Scientific Publishing Co., p. 165, 1890, New York.

Crystal Peak, is held by Whitmore & Sanders, both members of the Crystal Peak Gem Co. G. H. Weed, of the same company, holds a homestead claim at the foot of Crystal Peak on the southeast side, on which some promising amazon stone was found in digging for water.

The best amazon stone was seen in place on the claim of J. D. Endicott, on the northeast side of the gap between Little Crystal Peak and Deer Mountain. In one prospect trench, about 40 feet long on this claim, amazon stone is exposed along the footwall of a pegmatite vein striking N. 20° E. with a dip 30° E. The crystals in this wall range from small size to 4 or 5 inches thick, and the exteriors of some are exceptionally bright bluish green. Good amazon stone has been found on many other claims in the Crystal Peak region, but the exposures were not sufficiently good to determine what prospects are the most promising.

The various workings for amazon stone and other minerals cover considerable ground, but none of them are deep. On some of the claims there are pits every few feet over an area of an acre or more. Practically all of the work has consisted of pits, small open cuts, and occasional tunnels. Most of the workings are less than 12 feet deep, and many have become partly filled with rubbish. In all probably 200 pits were seen, and there are many more in the region that were not visited.

The country rock of the Crystal Peak region is chiefly coarse reddish biotite granite, more or less porphyritic in places. A finer-grained aplitic granite was closely connected with the mineral deposits noted in some of the prospects. Over most of the country the coarse granite has been partly disintegrated and broken down to coarse angular gravelly soil. An accumulation of leaf mold with this has furnished a soil covering for part of the area, so that good outcrops are not abundant. In places the granite outcrops in hard ledges, large bowlders, or gravelly soil without much vegetation, so that that prospecting is easier. Many of the deposits can be mined without blasting because of the disintegrated nature of the granite and the gem-bearing rock, but some of them have to be blasted almost from the outcrop down.

The amazon stone and associated minerals occur in pocket-like deposits more or less irregularly distributed through certain parts of the massive coarse granite of the region. The pockets are miarolitic cavities lined with coarse and often nearly perfectly crystallized microcline and albite feldspar, smoky and colorless quartz, and biotite mica, with occasional crystals of topaz, phenacite, fluorite, columbite, and göthite. Deposits and stains of limonite are abundant. The layer of coarsely crystallized minerals lining the pockets varies from a fraction of an inch to more than a foot in thickness in some places. These pocket linings are typical pegmatite aggregations, which may grade into the surrounding granite or have rather sharp contacts with it. Some of the contacts are plainly banded and the gradation from the pegmatite to the granite is so gradual that it is difficult to determine the actual contact. This is especially true where the pockets are associated with aplitic granite. Some of the gem pockets occur in streaks as in pegmatite veins, but others appear to bear no definite relation to one another.

Amazon stone is widely distributed in the Crystal Peak region, but most of the deposits yield but little material suitable for gem

purposes. This is due to inferior color of the crystals, excessive fracturing, or discoloration by iron rust. The amazon stone and other microline occurs in stout crystals with the characteristic prominent cleavage of that mineral. The crystals range from small size to several inches in diameter and project from the walls of the cavities with crystals of smoky quartz, biotite, and the other minerals of the pockets. In some cases clusters of fine amazon stone crystals, with or without other minerals, can be removed from the prospects for cabinet specimens. Most of the pockets contain grayish microcline crystals as well as those of green color.

The amazon stone occurs in various shades of bluish green, some of which are very bright. Occasional specimens of nearly pure pale blue are found. Most of the crystals show color variations, the best color commonly lying near the outside of the crystals. Such crystals may have bright bluish-green exteriors with successively paler colors toward the middle, either in layers or by gradual change. The middle of these crystals is generally gray or only pale bluish green. The outside shell of good color may range from a small fraction of an inch to an inch in thickness in large crystals. This color variation must be taken into consideration in the choice of cutting material, as it occasions large waste.

The amazon stone can be cut in a variety of shapes for gem purposes, such as stones for brooches, scarfpins, pendants, and beads for necklaces. The bright colors are pleasing and blend well with gold mountings. Some of the cut stones exhibit a silvery sheen in certain lights from partly developed cleavage planes. In considering the class of semiprecious and imitation stones sold to the tourists in Colorado each year, it seems that the possibilities of beautiful amazon stone from the Pikes Peak region are almost neglected. A quantity of amazon stone is sold in the rough in the form of crystals and bright-colored specimens to the tourist trade and many fine crystals are sold by mineral dealers for cabinet specimens elsewhere; but the sale of cut gems could be increased by displaying tastefully cut stones of good color.

SUNSTONE.

CALIFORNIA.

Specimens of sunstone were received from the Pacific Gem Co., of Los Angeles, Cal. The rough material is reported to have come from Modoc County and a quantity has been cut for gem purposes. It consists of labradorite feldspar, rather high in calcium, with many minute inclusions that reflect a bright coppery red light. The inclusions are too minute to be readily recognized. Their arrangement is only partly governed by crystal structure. The body of the feldspar is colorless and clear; in some specimens the particles are almost submicroscopic but sufficiently abundant to impart a red color to the labradorite. The cut gems are very pretty and have been sold under the name of both goldstone and sunstone. Owing to the quantity of artificial goldstone, falsely sold as a natural mineral, it seems better to call this beautiful natural product sunstone.

JADE.

ALASKA.

P. S. Smith [1] has given a few notes on the occurrence of nephrite in Alaska. Bowlders of a hard, green, slightly translucent rock are plentiful in nearly all of the streams of the Shungnak region north of the Kobuk. These are commonly called jade, but the majority are probably serpentine and green quartzite and some may be nephrite. None of the nephrite seen was of gem quality, since it contained many imperfections in the way of cleavage and inclusions, of which magnetite is so abundant as to give the mineral a spotted appearance. Several unsuccessful attempts have been made to work the jade in the Jade Mountains, west of Ambler River; but the inferior quality of the mineral, combined with its inaccessible location, will probably prove too great obstacles for its exploitation for some time to come.

JASPER.

ARKANSAS.

Mr. Francis Holstein reports an occurrence of jasper on sec. 23, Hot Springs County, Ark., near Morrison Springs. This jasper is stated to be beautifully colored and susceptible of receiving a high polish, but the deposit has so far received no development.

CALIFORNIA.

The variously marked and colored jaspers of the San Francisco region, especially the "kinradite" variety, are meeting with increasing appreciation in that city and among tourists. Some of the best of these jaspers have been found on the beaches along the southern part of Marin peninsula, between Point Bonita and Lime Point. Most of the southern end of Marin peninsula terminates abruptly in cliffs at the water's edge, but narrow beaches have formed in a few places below the cliffs and on these the jasper can best be found. Some of the beaches are exposed only at low tide and are difficult to reach.

The rocks along this part of the peninsula belong to the Franciscan group and consist of sandstone and radiolarian chert with intrusive basalt and diabase. The formations strike generally north or northwest chiefly with high dips. The radiolarian chert is a rather thin bedded jaspery rock. The diabase and basalt may have a common origin presenting only variations in texture. Near the water's edge they outcrop in fresh dark greenish-black cliffs which show a large amount of jointing. Fifteen feet above the water and higher up on the hills they have reddish-brown weathered surfaces. These rocks contain jaspery inclusions, some of which may be altered masses of radiolarian chert. Veins and deposits of quartz have formed in joints and fissures in the diabase and basalt. Some of this quartz grades into jaspery material and other is greenish through chloritic or actinolite-like inclusions. It should be possible to find good jasper in the rock, but the greater part is obtained from the beaches where the jasper inclusions have fallen from the cliffs. The force of the waves has ground off much of the adhering matrix and rounded

[1] The Noatak-Kobuk region, Alaska: U. S. Geol. Survey Bull. 536, pp. 154–155, 1913.

the jasper into pebbles and bowlders, which display their color and markings very well when wet.

The jaspers show a wide range of colors, with both dark and light red, yellow, brown, and green. Some of the red and yellow jaspers are very bright colored. A variety of markings or patterns are met with, of which the most interesting is that called "kinradite," after J. J. Kinrade, of San Francisco, who discovered and first used it for gems. This variety shows spherulites, generally of one color, scattered through jasper of another color. The spherulites are composed of radiated aggregates of quartz, with concentric color bands in some specimens. The spherulites resemble chalcedony, but under the microscope, between crossed nicols they have the positive elongation characteristic of quartz. The spherulites range in diameter from microscopic dimensions to over an inch. In cutting kinradite the gem may contain only one large spherulite or there may be several spherulites of various sizes. Some gems may contain 25 or more smaller spherulites. The colors, the variations in texture, and the interesting structure of the spherulites in kinradite render it an attractive gem and ornamental stone.

Some of the other jasper found with kinradite is of good gem quality. Among specimens seen were some showing very bright crimson red in small streaks and patches through yellow and dark dull green. This would yield gems showing the three colors in strong contrast. Almost innumerable other color patterns can be cut from these associated jaspers.

A deposit of bloodstone and jasper was discovered by F. M. Myrick, of Johannesburg, Cal., in the Death Valley region of San Bernardino County, in February, 1908. Considerable prospecting since that time has resulted in promising finds of gem minerals. Many cut gems have been sold in several towns of southern California where they have been favorably received.

The deposit is about 45 miles northeast of Johannesburg and 4 miles S. 20° E. of Brown Mountain in the rough mountains about 12 miles west of Death Valley. Prospects have been opened over an area about 300 yards across among the gulches at the head of three valleys draining west and northwest. The prospects are at elevations of about 3,300 feet above sea level, or 200 feet higher than the camp in the draw to the west. The principal work consists of a cut, 15 feet across and 12 feet deep, and a prospect tunnel in the side of a draw. Over a dozen other pits have been made on outcroppings of bloodstone or associated jasper.

The geology around the bloodstone deposits is complex. Basaltic lava and andesitic rock predominate, but some sedimentary rocks are exposed close to the prospects. The basalt is dark reddish brown, through the oxidation of ferruginous constituents and quite vesicular in places. The andesitic rocks are fine grained and in places they are greenish from the presence of epidote and chloritic alteration products. The sediments consist of gray to white shaly calcareous rock with interbedded sandy and sintery layers. These rocks contain fossil mud cracks, ripple marks, raindrop marks, and a few markings resembling worm tracks. A portion of the sediments contain pebbles and angular inclusions, like a tuff or volcanic ash formation, and such is their general appearance. It is probable that these rocks were formed as ash beds in shallow pools of water. The carbonate of lime may

have been deposited either at the same time from lime-saturated water of the pools or later by solutions penetrating somewhat porous rock. Later action, possibly by hot springs, has apparently leached portions of the tuffaceous rock to porous vesicular masses.

The sedimentary rocks contain a bed of vesicular basalt near their top, and in this basalt the bloodstone occurs. The strata have been tilted and broken by block faulting and contacts are covered with talus slopes in many places, so that it is difficult to trace any horizon far.

The jasper and bloodstone occur in irregular nodular and kidney-shaped masses unevenly distributed through altered phases of the vesicular basalt. The nodules range from about an inch across up to nearly 1 foot in thickness, and most of them are surrounded by shells of dark-green impure opal or soft yellowish-green, rather porous material, which is probably a clayey aggregate. In the largest pit some of the nodular masses occur irregularly distributed in a warped layer having a northwest strike and a northeast dip. The various openings in which bloodstone and jasper have been found, however, do not indicate any definite occurrence in veins or belts of separate deposits.

Red, yellow, and green jasper are the most common, but in places the red and the green are so blended as to yield bloodstone. The bloodstone shows hard, dense, dark-green plasma or jasper with blood-red spots, patches, and streaks. The heliotrope variety of bloodstone, in which the red occurs in small round spots in the green, is rare in the Myrick prospects, but a quantity of bloodstone showing irregular patches and streaks of red in green is found. Jasper of various shades of red, brown, and yellow occurs in nodules several inches across, with or without the green. In some specimens yellow or brownish spots and streaks are scattered through the green, similar to the red in the bloodstone. Some of the larger lumps of jasper show mottlings in various shades of red with or without brown and yellow. Some of the patches of color in the bloodstone are formed by a crushing of the larger pieces and later a cementing by chalcedony or jasper fillings. Such bloodstone shows an abundance of small faults with straight contacts between the red and the green. Occasional seams and veinlets of gray chalcedony cut the jasper and bloodstone, filling fracture lines and joints.

The jasper and bloodstone from this locality take a high polish, and the cut gems show a wide range of patterns and color variations. Stones may be cut showing dark, bright, or dull red, brown, yellow, or green, or pleasing combinations of these colors. The gems are suitable for various forms of jewelry, especially for persons not desiring flashy gems. In cutting, the lapidary should exclude all of the dark-green opal shell surrounding the jasper and bloodstone, for this is brittle and will crack after cutting.

Numerous specimens of jasper with more or less associated chalcedony have been received from Mr. Joseph Ward, of Barstow, Cal. Mr. Ward has collected these from several claims which he has located in the Death Valley region of San Bernardino County, and some of the specimens may have come from Nevada. The jasper shows a wide range of color and markings and would furnish very attractive gems. Some of the jasper shows mosslike patterns of red, brown, or yellow, with patches of gray or blue chalcedony. In other speci-

mens these markings are in nearly pure chalcedony. There were a few pieces of greenish jasper, both with and without red markings. Some of the bluish chalcedony with bright-red jasper inclusions was particularly attractive. Of the several pounds of specimens received, the colors were bright enough for gem purposes in only a small part.

OREGON.

Mr. Don Maguire, of Ogden, Utah, reports the occurrence of a deposit of bloodstone discovered by him in Harvey County, Oreg., about 15 miles east of the town of Burns. The bloodstone occurs in a ledge over 3 feet thick cutting a trap dike. Some of the rough material was shipped for cutting during 1913.

UTAH.

Richly colored jasper, showing various shades of red in laminations or other structures, is reported by Mr Don Maguire, of Ogden, Utah, from the Wasatch Mountains in that State. Some of this jasper has been cut with very pleasing results in Salt Lake City.

JET.

TEXAS.

Prof. J. A. Udden, of Austin, Tex., reports the occurrence of jet in Presidio County, Tex. The jet occurs as compressed and flattened trunks of trees in a thin layer of coal from 100 to 200 feet below the San Carlos coal bed.

LAPIS LAZULI.

CALIFORNIA.

An occurrence of lapis lazuli in California has been described by Gordon Surr,[1] and the following notes are taken from his description. Mr. Surr also kindly sent a specimen to the Survey for examination. The locality is on the north slope of the south fork of Cascade Canyon, 1½ miles south of east of the "Hogback," a well-known landmark in San Antonio Canyon, to which Cascade Canyon is tributary. The deposit is about 12 miles from Upland, a town on the Santa Fe Railway, about 20 miles west of San Bernardino. The "blue rock" was long thought by prospectors to carry silver, and the deposit was opened with this idea. A pit 15 feet deep apparently went through the "blue rock," and work was abandoned.

The mineral was identified by John T. Reed, an assayer in San Bernardino, whose son made an attempt to open the deposit further. The locality was visited by several persons subsequently, and in 1913 by Mr. Surr and his associates. No lapis lazuli was found in place, but probably 150 pounds of loose rock with some of the blue intermixed were found in the talus on the slope and in the drift in the stream bed.

The country rock consists chiefly of quartzites and limestones, which strike east with a high northerly dip near the old workings. At

[1] Lapis-lazuli in southern California: Min. and Eng. World, Dec. 27, 1913.

the latter place there is a layer of light-gray quartzite carrying pyrite and iron oxide stains. Above this is dark quartzite with pyrite, then a few inches of soft shaly rock with limestone overlying. The lapis lazuli was apparently found in the layer of dark quartzite. It is not of good quality, being mixed with a number of other minerals difficult of determination. Under the microscope in thin section two varieties of pyroxene, fine sericite, calcite, pyrite, clinozoisite, and other minerals not identified, were observed besides bright-blue lazurite. The matrix consists of a granular mass of these minerals with blue lazurite as a filling in interstices. The specimen furnished by Mr. Surr is about 2 inches thick, showing alternating bands of dark grayish black, lighter gray, pale to dark bright blue, and yellowish streaks of pyrite crystals. It is probable that the bands containing the most blue could be cut into rather pretty matrix gems.

LAZULITE.

ARIZONA.

Specimens of lazulite (false lapis lazuli) were received from Mr. James Shea and Dr. Burt Ogburn, of Phoenix, Ariz., along with a few notes on its occurrence. The deposit is about 12 miles north of Phoenix, in a small hill near the edge of Paradise Valley. A good wagon road passes near the locality. The lazulite is inclosed in quartzite, in which rock it occurs disseminated in small grains and clusters and in larger crudely shaped crystals. The matrix is white, gray, pinkish, brownish, and greenish from staining. Fine mica or sericite has developed through the quartzitic country rock, and some is associated with the lazulite. Of the specimens seen, only a few could be cut into pure blue gems, but a quantity would yield matrix stones showing dark ultramarine-blue patches of various sizes. The presence of a little pyrite in small crystals heightens the resemblance of this material to lapis lazuli.

OBSIDIAN.

UTAH.

A smiall specimen of obsidian from Millard County, Utah, was received from Mr. Maynard Bixby, of Salt Lake. This is glassy reddish brown with jet-black streaks and patches through it. The black appear as rounded spots in one position and as streaks in a position at right angles showing the direction of flow of the molten volcanic glass. The mottled effects of the brown and black are very pretty, and Mr. Bixby states that this obsidian takes a high polish.

OPAL.

CALIFORNIA.

Two deposits of opal have been prospected by F. M. Myrick, about 35 miles east of Johannesburg, Cal. One of these is in the side of the same knob as Lead Pipe Spring and about 100 yards northwest of the spring; and the other is about a mile and a half to the northeast on the north side of a steep hill slope. Only small prospects have been opened at each locality.

Opal from the Lead Pipe Spring locality has been called "sobrisky" opal. It occurs in nodular masses at the contact of a red rhyolite flow with underlying white tuffaceous beds. The rhyolite is perlitic near the contact and has been partly decomposed. It contains an abundance of nodules and clusters of siliceous balls varying in size to over 2 inches in diameter. When these are broken open they are found to contain cores of red rhyolite, chalcedony, common or white opal, and occasionally precious opal. Mr. Myrick states that it is sometimes necessary to break open hundreds of these nodules to find a few inclosed precious opals. The cores of precious opal are rarely over three-fourths of an inch thick, but some of the specimens seen had very good color showing flashes of red, blue, and green in gray or milky white background. Many of these cores included fragments of chalcedony or rhyolite, so that pure gems could not be cut from them. If larger pieces of the precious opal can be found and in greater abundance than up to the present time, the prospect would prove of value.

The other locality has so far not yielded any precious opal, and the claim has been called the "white opal" claim after the variety first found. The deposit occupies the same relative position with the rock formations as at Lead Pipe Spring; that is, in partly decomposed perlitic rhyolite forming the contact between a rhyolite flow and underlying tuffaceous beds. The decomposed perlitic layer is about 10 feet thick, and in this are numerous nodules or balls of common opal from 1 to 5 inches in diameter. White opal was found first and later greenish, yellow, and red opal without fire. A small spring has been opened by Mr. Myrick, on the "white opal" claim.

These opal deposits are in the same region as the blue chalcedony already described, and are associated with the same reddish rhyolite flow as the chalcedony. The White Opal claim is about two-thirds of a mile southwest of the Blue Moonstone claim.

Very pretty clusters of clear colorless glassy hyalite opal have also been found by F. M. Myrick in the rhyolite flows east of Granite Springs and about 30 miles east of Johannesburg, Cal. These are not only very pretty specimens, but a few have been mounted in their natural state as gems. Many of the specimens consist of cup-shaped aggregates of small globules of clear limpid hyalite.

Mr. Joseph Ward, of Barstow, Cal., furnished specimens of opal he has found in the desert region of San Bernardino County. Among these were white and cherry red common opal, botryoidal incrustations of clear glassy hyalite, and thin layers of precious opal in rhyolite matrix. The hyolite was very pretty as specimens, forming clusters of bright globules in cavities in spherulitic rhyolite. The other specimens consisted of dark reddish-brown flow-banded rhyolite cut by seams of precious opal mostly less than 1 millimeter thick, both parallel with the banding and at angles to it. Some of the seams showed bright green and red fire. Other specimens of the rhyolite contained common bluish opal and translucent chalcedony. If precious opal can not be obtained in larger pieces from this locality, opal matrix showing seams of gem opal in the red rhyolite might prove of sufficient beauty to cut for gems.

NEVADA.

Considerable prospecting and development work was done in 1913 in the opal field in the valley of Virgin Creek, Humboldt County, Nev., about 25 miles southwest of Denio, Oreg. A number of new claims were located, which extended the known opal-bearing area. Precious opal was discovered in this region in 1908, in which year several claims were located. Other claims have been located successively each year since, and some of them have been worked on a small scale. The yield of precious opal from some of the prospects has been very encouraging in regard to both quality and quantity. Other claims are still of doubtful value.

This opal field was visited in August, 1913, but only three days were available for examination of the deposits. Under favorable conditions the region can best be reached from Jungo, Nev., a station on the Western Pacific Railway, by automobile stage to Denio, Oreg. From Denio the trip can be completed by automobile or other conveyance.

Virgin Creek drains northward, joining Beet Creek at the head of a narrow canyon below which place it is called Thousand Creek. The valleys above the canyon form an irregular-shaped basin with outlet into Thousand Creek. The opal deposits are in certain formations exposed in the sides of the valley of Virgin Creek.

The opal claims examined lie at elevations ranging from 5,100 feet to 5,400 above sea level. Some of them are in rather gently sloping ground in the foothills along the sides of the valley and others are in the steep valley walls. The plateau country in which Virgin Valley has been carved has an elevation of over 6,000 feet above sea level. The region is desert, but water supplied by several large springs, some of which are hot springs, flows into Virgin Creek and Beet Creek. The creek waters are used for irrigation and supply several large meadows for the different ranches.

Four groups of claims were visited, the location of which will be given with respect to McGee's ranch, about a mile south of the junction of the creeks. The principal group is that in which the claims of Ivan Dow, George D. Mathewson, Alfred Thompson, and others are located, about 3 miles southwest of McGee's ranch in the west side of the valley. Among these claims are the Cracker Jack, Bonanza, Opal Queen, and Opal Queen Fraction. Most of the opal from this group of claims has been handled by the International Gem Co., of New York. Another group of claims belonging to D. Roop, E. McGee, and George T. Hill is situated about 5 miles south of McGee's ranch. W. B. Seitz and C. A. Howard hold claims to a third group about 5 miles southwest of McGee's ranch. In the fourth group is the Stone Tree claim, owned by several parties, about a mile and a half north of west of McGee's ranch.

Bateman & Boyd have the Big Horn claim nearly half a mile east of the Stone Tree claim. George W. Brown has located a claim about $2\frac{1}{4}$ miles west of W. K. Ebeling's ranch, or $3\frac{1}{2}$ miles north of west of McGee's ranch. A large number of other claims have been located in the opal field, some of which may prove of value.

Developments have not been large, and most of the work is limited to pits, small open cuts, and trenches. Some of the deposits are so situated that practically all of the mining can be done by open cuts,

but in other places continued work would require the driving of tunnels and the sinking of shafts. As a general rule all excavations can be made without the aid of dynamite, but in some places the work of loosening the claylike earth could be facilitated by blasting. Much of the work could be done by pick and shovel aided by horse scrapers to remove overburden.

The general geology of the Virgin Valley region has been described by Prof. J. C. Merriam [1] and the following notes have been abstracted from his description and supplemented by a few personal observations. The rocks of Virgin Valley are in a synclinal basin of older formations consisting largely of tuffs, ashes, and rhyolitic lavas. The "Virgin Valley beds," as Prof. Merriam tentatively calls them, consist chiefly of ash and tuff of variable induration which weather into characteristic badland topography. They may be rather arbitrarily divided into upper, middle, and lower beds. The lower beds are the hardest, and the badland sculpture developed in them is characterized by steep-walled gulches. The strata are white, greenish, and bright red. The middle beds are brownish and gray and weather into rounded hills and knolls. The upper beds are softer cream-colored ash. A dark-gray vesicular lava flow caps the upper beds along the rims of the valley. Various fossil mammals have been found in the upper beds, including a mastodon, a horse, camels, and a cat. The middle beds contain many plant remains and petrified wood is abundant. Fossil evidence points to the Miocene age of the beds.

The formations have been broken by extensive block faulting, some of the blocks having dropped several hundred feet. Tilting of the strata has also produced differences in elevation of parts of the same horizons.

The opal occurs in ash or fine tuff beds associated with petrified wood. The ash beds are grayish and greenish-gray with a hard claylike consistency. The surface material is dry and crumbling, but some of the same material below the surface if moist resembles hard sticky gumbo. The ash contains variable quantities of sand, pebbles, and cobbles. Among these inclusions quartz, a little obsidian, and rhyolite were observed. On the Cracker Jack claim two horizons about 75 feet apart, vertically, have been worked for opal. These were separated by harder ash beds. At most of the horizons carrying opal considerable petrified wood is found in which common opal and silica are the petrifying agents. The ash beds have been somewhat altered by solutions, probably those which were active in depositing the opal.

The opal occurs in a variety of shapes most of which are associated with petrified wood. Petrified wood is abundant in the form of logs, limbs, twigs, bark, and roots, in which the petrifying material is opal and other forms of silica. This wood is in various stages of petrification ranging from partly silicified lignite to material completely replaced by silica or opal. A quantity of wood has been petrified with common opal by a replacement process retaining minutely the texture and grain of the wood. This variety occurs in petrified wood, bark, roots, and other structures, among which Mr. Roop has found spruce or pine cones.

[1] Science, new ser., vol. 26, pp. 380–382, 1907.

The precious opal occurs chiefly as casts of different parts of trees and as coatings and fillings in cracks in ordinary petrified wood. The precious opal casts rarely retain the texture or grain of the wood, but may show such structure as bark and inclosed wood by slight color variations or other lines of demarcation. Mr. Roop has found two very interesting specimens of opalized cones, one measuring about 1 inch long that has been perfectly cast by milky opal and the other, a slightly larger cone of milky color, completely inclosed in a mass of translucent precious opal 2½ inches thick. Twigs and limbs of trees 2 and 3 inches thick have been reproduced in precious opal of beautiful colors. Logs several inches in diameter have been cast with common jet-black or dark-brown opal, parts of which show fire. The black opal gives off water and tarry matter smelling of pyroligneous acid when heated in a closed tube. A quantity of other variously colored common opal occurs with gem variety, as translucent purplish, reddish-brown, gray, and white. Some precious opal has been found as fillings in cavities in the volcanic ash. Among such specimens are small patches of gray or white opal with a beautiful play of green, yellow, blue, and red fire, but exceedingly brittle so that the small pieces can be crushed between the fingers into powder. The minute grains still display their fine color and fire after the opal has been crushed. Opal, both in casts and in veinlets filling cracks in petrified wood, is used for gem purposes, and some of the petrified wood containing seams and veinlets of precious opal would yield very good matrix opal.

The best gem opal from Virgin Valley is unexcelled in variety and brilliance of fire and color by that from other localities. The cut gems exhibit superb flashes of green, blue, yellow, and red of various shades with milky white, gray, bluish, or brownish background which may be opaque, translucent, or nearly transparent. In some the color is uniform over the whole stone or over large areas, changing, as the gem is turned, from green to red, or from red to blue, and so on. Some of the gems show a rich ultramarine blue in one position, and green or red in another. Many gems display various bright colors arranged in patches, and each patch changes color as the stone is turned. The brilliant flashes of peacock-feather colors exhibited by the opal of dark color yield a gem which might be called black opal, but most of it is not like the Australian gem of that name, since it occurs in thick pieces and the colors are less localized. Most of the dark-colored gems, no matter how beautiful in reflected light, become a rich reddish-brown in transmitted light. The more opaque bluish-gray and milky opal with good fire also yields especially beautiful gems.

A quantity of brittle opal which checks and cracks considerably after removal from the mines has been found. Some of this opal has magnificent color and fire, but close inspection shows that it contains fine cracks, some of which are sufficiently pronounced to allow the stone to fall apart. In many cases this tendency to check could be partly overcome by a careful handling of the rough material, that is, by a rather slow seasoning process in which the opal is not immediately exposed to the dry atmosphere and considerable temperature changes of the desert, but is kept in a moderately cool place or in moist wrapping.

At the suggestion of H. D. McCaskey, of the United States Geological Survey, specimens of opal containing cinnabar were cut with a view to determining their suitability for gem purposes. This material came from a quicksilver mine operated by J. B. Kiernan, of Beatty, Nev. Specimens of the rough mineral were kindly supplied by Mr. Kiernan and general information on the deposit was given by A. A. Turner, a mining engineer of Boston, Mass.

The mine is in Bare Mountain in southwestern Nevada, the nearest point being about 10 miles from the California State line. The Amargosa Desert lies west of the mountain and Crater Flat to the east, the highest point being approximately 6,235 feet above sea level, or 3,300 feet above the surrounding plains. The formations around the cinnabar deposit are limestone, quartzite, schist, and a volcanic rock, probably dacite. The deposit lies between two dacite dikes and is apparently a replacement deposit. Opal impregnated with cinnabar was found within a few feet of the surface and extended to a depth of 61 feet, the depth of the workings at the time last examined by Mr. Turner. The opal is an associated mineral but much of it contains sufficient mercury to smelt with the regular ore. The opal bodies are surrounded by a fine white sand resulting from the decomposition of impure opal. The nature of the deposits and the presence of small vent holes in the sand near the ore bodies indicate that they have resulted from past hot spring activity.

Most of the material that can be cut as a semiprecious stone consists of milk-white to slightly translucent gray opal impregnated with bright vermilion-red cinnabar. The cinnabar occurs in minute particles disseminated or grouped in irregular tufts, patches, and streaks through the opal. Specimens were seen in which the cinnabar was in a duller chalcedonic material, probably altered quartzite. The contrast between the red and the white or gray, with the variations of markings displayed by the cut stones, make this an attractive semiprecious stone which could be readily used in the western tourist trade. The possibility of the cinnabar losing some of the brightness of its color, as in the "myrickite" described under agate, will have to be taken into consideration.

OREGON.

Mr. Don Maguire, of Ogden, Utah, reports the occurrence of semiprecious opal along Deschutes River, Crook County, Oreg. This opal is reported to be abundant and very pretty. A limited quantity was shipped to Portland, Oreg., for gem purposes during 1913.

TEXAS.

Specimens of opal found near Alpine, Tex., were received from Mr. A. D. Hudson, of El Paso. They consisted of small patches of white and bluish opal in a dark red rhyolite-like matrix. Some of the opal showed flashes of rich green and bluish fire. The reddish matrix might be cut showing patches of precious opal, if pure gem can not be obtained in larger pieces.

QUARTZ.

ARKANSAS.

Mr. Francis Holstein, of De Roche, Ark., states that a quantity of the quartz crystals from near that place are still sold to visitors and jewelers at Hot Springs. These quartz crystals range in size from small specimens up to fine cabinet specimens. They vary from colorless and limpid to light and very dark smoky brown. Inclosures of phantom crystals and bubbles are present in some specimens. Bright lustrous faces are characteristic of these Hot Spring County quartzes, and occasional crystals show an unusual development of planes. Others are variously etched. Mr. Holstein states that the quartz crystals are obtained chiefly from pockets where they are imbedded in red clay.

MAINE.

Minerals of interest because of their semigem nature are found at the J. A. Hibbs feldspar and mica quarry, a little over a mile northeast of Hebron, in Oxford County, Me. These minerals are translucent quartz and beryl. The quartz varies from colorless to pale rose, light and dark smoky brown, and yellowish. Specimens were seen in which there were rounded patches of dark smoky brown in quartz of lighter color. The beryl is mostly opaque grayish-green. Other associated minerals are potash feldspar, mica, and black tourmaline.

RHODONITE.

COLORADO.

Mr. J. D. Endicott, of Canon City, Colo., reports the discovery of a deposit of rhodonite about 10 miles southeast of that place. He states that the deposit will yield a quantity of mineral with good pink color and of fine texture.

RUBY.

NORTH CAROLINA.

Tests were made on the ruby deposits along Caler Fork of Cowee Creek in Macon County, N. C., during the last part of 1913. Prospecting was under the charge of N. E. Isbell, of Cincinnati, who had charge of the developments here several years before. Mr. Isbell used a churn drill during this work, going to a depth of 65 feet at the "In Situ" Hill locality. Some ruby and sapphire of marketable color were found along with opaque corundum. During the first part of 1914 better equipment in the way of a 3-inch core drill operated by a 10-horsepower gasoline engine was installed, and a number of holes will be sunk at the "In Situ" Hill locality to a depth of about 150 feet.

SPODUMENE.

CALIFORNIA.

Operations of the Pala Chief Gem Mining Co., at the Pala Chief mine and the Tourmaline Queen mine, near Pala, San Diego County, Cal., resulted in a production of more of the lilac-colored spodumene

and tourmaline. Although the spodumene has heretofore been called kunzite, as a compliment to Dr. George F. Kunz, the owners of the mine have given their permission to European jewelry firms to sell it under the name of "California iris" as being appropriately descriptive of its native home and its remarkable coloring. Mr. R. Fenton, secretary of the Pala Chief Gem Mining Co., states that the mineral is being well received under this name in many countries of Europe. Much of this spodumene will be sold as "California iris" in the United States also, especially in the West, where the name is considered especially appropriate.

TOPAZ.

GEORGIA.

Two gems, cut from crystals found in the Williams mica mine near Two Run, Ga., were loaned for examination by Mr. L. M. Richard, of Stamford, Tex. One of these was ordinary quartz with a slight brownish tint. The other was colorless topaz, a crystal of which was found inclosed in a cavity in a large crystal of mica. This is a new locality for topaz and an unusual mode of occurrence.

MAINE.

No new work has been done at the topaz prospects on Harndon Hill, in the southwest corner of the town of Stoneham, Me. This locality has been described by George F. Kunz [1] and E. S. Bastin.[2] At the time of examination by the writer, in June, 1913, there were three pits within about 75 feet of one another on three sides of a projecting point of the hill. These pits were 6 to 10 feet deep and from 10 to 35 feet long. They were made in the edge of a body of pegmatite capping the summit of the hill. The rock outcropping below on the hillside is quartz-mica schist or gneiss injected by pegmatite. The pegmatite exposed in the openings is coarse and of uneven grain. Orthoclase or microcline is the principal feldspar, but some albite is present, especially as clevelandite. Quartz occurs in large white masses and muscovite in greenish crystals and bunches of crystals measuring several inches across were seen. Numerous fragments of pale-green, white, and colorless beryl were left on the dumps and scattered over the hill top. Kunz states that some of the beryl crystals found were about a yard long and over a foot across. The only topaz observed was a fragment of an opaque white crystal, an inch and a half thick, attached to a mass of clevelandite and greenish scaley muscovite. According to Kunz, most of the topaz crystals were found in one pocket with clevelandite. The crystals ranged from those small in size to large rough opaque ones, weighing 10 to 20 kilograms. The better crystals measured 10 to 60 millimeters across and were colorless or faintly tinted with green or blue. Some were transparent only in parts. A few reddish garnets and blocks of bluish-green triplite were observed on the dumps. Among other minerals found during operations on Harndon Hill, Kunz mentions apatite, columbite, fluorite, montmorillonite (a variety of kaolin), herderite, and bertrandite.

[1] Topaz and associated minerals at Stoneham, Me.: Am. Jour. Sci., 3d ser., vol. 27, pp. 212-216, 1884.
[2] Geology of the pegmatites and associated rocks of Maine: U. S. Geol. Survey Bull. 445, pp. 100-102, 1911.

NEW HAMPSHIRE.

The discovery of topaz on Baldface Mountain, N. H., was made, according to George F. Kunz,[1] by E. A. Andrews, in May, 1888. Baldface Mountain is about 4 miles northwest of North Chatham. It rises to an elevation of 3,585 feet above sea level or some 3,000 feet above the valley of Cold River on the east. Only rock is exposed on the steep cliff-like slopes of the upper part of the mountain, but the lower part is heavily timbered. Two knobs or shoulders project from the mass of the mountain half a mile northeast and southeast, respectively, of the main summit and 500 to 600 feet lower down. It is on these knobs or shoulders of the mountain that the topaz has been found.

The bare rock of the upper part of the mountain is composed of biotite granite, partly broken into great loose blocks and partly showing the effects of rounding and erosion by the ice of the glacial epoch. Near the east foot of the mountain outcrops of mica schist and gneiss were observed in the hollows.

No systematic mining has been carried on for the topaz and associated minerals, but most of the crystals have been obtained at various times by prospectors and mineral collectors working only a few days at a time. Considerable prospecting for topaz and associated minerals on Baldface Mountain has been done by John Chandler, of North Chatham. Mr. Chandler acted as guide for the writer, and three prospects were visited. Two of these were on the northeast shoulder of the mountain in the steep cliff-like slope, and the other was on the southeast shoulder of the mountain. The two prospects on the northeast shoulder are a few hundred feet apart in a northeast-southwest direction with a difference of elevation of 200 to 300 feet. At the upper prospect the topaz occurs with crystals of smoky quartz, orthoclase or microcline, biotite, muscovite, and a little phenacite lining the walls of miarolitic cavities or pockets of pegmatite in the granite. These pockets range from small to large size, one measuring 10 feet deep (or high) and 2 by 3 feet across at the top and 4 by 7 feet across near the bottom. The pockets have been worked in a northeast course down the mountain side for a distance of nearly 50 feet. The granite near the pockets is medium to coarse grained, rich in biotite and smoky quartz. The crystals lining the walls of the pockets range from small size to 2 or 3 inches across, in the case of the feldspar. The transition from the ordinary granite to the coarser, more crystallized deposit forming the walls of the pockets is gradual in some places, and in other places there is a layer of fine tufted graphic granite between.

Some of the feldspar crystals have a faint bluish-green color, like pale amazon stone. Others are buff colored, but present well-developed crystal faces. Most of the quartz crystals found in the pockets are smoky brown and many are clear. Some occur in single well-developed crystals and others in aggregates of crystals in parallel growths. In the cavities biotite occurs in sharply developed prismatic crystals with hexagonal outlines. The topaz occurs in crystals of minute size up to those more than an inch thick. The majority of them are translucent, or transparent only in places, but some perfectly transparent crystals are found. Some of the topaz is suitable

[1] Gems and precious stones of North America, p. 70, 1890.

for cutting into gems but the most of it is worth more as specimens, because of the perfection of the crystals. They range from colorless to pale bluish green, and some are yellow from iron stains on the surface. Phenacite was observed in small transparent colorless crystals only, which were attached to or partly imbedded in feldspar, quartz, or topaz. Crystals of phenacite measuring over half an inch across are reported to have been found. The phenacite crystals from Baldface Mountain have been described by O. C. Farrington[1] and W. T. Schaller.[2]

At the lower prospect on the northeast shoulder of Baldface Mountain, topaz occurs in a thin pegmatite vein cutting the granite with a strike of N. 35° W. and a dip of 45° SW. This vein has been exposed for about 75 feet by the dropping away of the northeast side attached to a huge block of granite. Crystals have also been obtained from the vein attached to the loose block about 50 feet lower down the mountain side. The vein contains fine graphic granite in places and small miarolitic cavities with mineral associations similar to those at the first prospect described.

TEXAS.

The occurrence of topaz in Mason County, Tex., has been mentioned in these reports for previous years and some of the deposits have been described by H. Conrad Meyer.[3] Several of the localities were visited in July, 1913, when the notes for the following description were obtained. The discovery of topaz was made in 1904 by R. L. Parker. Other prospects were found and all were developed on a small scale between 1908 and 1910. The owners of the different prospects failed to realize on the topaz found on their property and therefore forbade further work. Since that time a limited amount of prospecting has been done by the property owners, in some places with promising results. Meyer first recorded the occurrence of cassiterite or stream tin associated with the topaz of Mason County.

Mason County is in the broken plateau country of central Texas. Much of the county is a basin-like area with included ridges and hills. The county is drained chiefly by Llano River, on which the lowest elevation is less than 1,200 feet above sea level. The topaz localities examined are at elevations of from 1,600 to 1,800 feet above sea level. Water is scarce and only the larger streams flow the whole year.

The basin-like portion of Mason County is part of the pre-Cambrian basin described by Sidney Paige.[4] The surrounding rim rock or scarp is part of a dissected plateau composed chiefly of Paleozoic rocks, among which limestone is prominent. The pre-Cambrian rocks in the topaz areas consist largely of granite, but a belt of rock composed of mica schist and mica gneiss was observed between the two groups of deposits. The principal granite of the topaz region is a coarse red granite, with porphritic texture locally developed. The feldspar phenocrysts of this granite measure over an inch long in some places. A finer grained granite, also reddish, was observed in the region but not associated with the topaz deposits. Pegmatite is

[1] Notes on various minerals in the Museum collection: Field Columbian Mus. Pub., Geol. Ser., vol. 3, pp. 157–158, 1908.
[2] Notes on crystallography of phenacite: U. S. Geol. Survey Bull. 490, p. 53, 1911.
[3] Topaz and stream tin in Mason County, Tex.: Eng. and Min. Jour., Mar. 8, 1913, pp. 511–512.
[4] U. S. Geol. Survey Geol. Atlas, Llano-Burnet folio (No. 183), 1912.

associated with the coarse granite, chiefly in irregular masses or streaks, with or without miarolitic cavities, and is the source of the topaz. The coarse granite weathers out in rounded bowlders or flat floors. The products of weathering are angular gravelly to coarse sandy soil becoming finer with more extended weathering. Quartz and feldspar grains are the principal constituents of this soil.

Two groups of topaz deposits were examined, one about 8 miles west of Mason, between Streeter and Grit, and the other about 8 miles west of north of Mason or 4 miles west of south of Katemcy. In the first group the topaz prospects of C. J. Worlie, half a mile east of Streeter, and J. W. Bishop, 2 miles northeast of Streeter, were visited. Other prospects were reported on the land of Dan Blickenbach, 2½ miles northeast of Streeter, and on Alexander Smart's place near Grit. In the second group the prospects of Sam Awalt, Lee McGehee, and D. E. Amarine were visited.

The Worlie prospect is about a quarter of a mile east of the house in the wash of a dry stream. All of the work has been done within a distance of 200 feet along stream channel or within 50 feet from it. Several small pits and diggings 1 to 3 feet deep have been made in sand, gravel, and alluvium among large bowlders, and one pit 6 feet deep and 15 feet long was made in rock. The country rock is coarse red granite with porphyritic texture in places. Locally there are pegmatitic phases around miarolitic cavities. Some of the granite is friable and partly decomposed, but much of it has weathered out into large spheroidal bowlders, or is exposed in hard flat ledges or floors. The prospect pits were dug through the drift to the granite floors where all depressions and crevices were carefully cleaned out. The pit in the solid rock opened irregular miarolitic cavities in the granite. The minerals of value lining these cavities had been removed, but some of the matrix was left in contact with the granite. The matrix contained much biotite in thin flat scales ranging from small size to more than 1 inch across, a little graphic granite with red feldspar, some albite in the form of clevelandite, gray microcline and pale amazon stone in stout crystals, muscovite, and colorless and smoky quartz crystals. Topaz is reported to have been found in these pockets also. The best topaz crystals were found loose in the gravel and sand beds. Most of these were partly broken and the edges were rounded by attrition, but beneath the roughened surface most of the crystals were of fine transparent quality. A few crystals were found which had not been badly disfigured by abrasion and would serve as fine cabinet specimens Many of the topaz crystals were tinted pale bluish or bluish green and a few were rather strongly colored.

Several prospects were opened on the land of J. W. Bishop. The one examined is about a quarter of a mile northeast of the house in a low rocky hill. The work consists of a crescent-shaped open cut 40 feet long and 4 to 10 feet deep and of another small pit about 40 yards to the southwest. The country rock is coarse porphyritic red granite which outcrops in large rounded bowlders and ledges The open cut was blasted out of an outcrop of hard granite following a pegmatitic vein. This vein was irregular in shape and carried miarolitic cavities or pockets, in which the topaz was found. A portion of such a pocket was left exposed in one end of the cut. It measured about 2 feet wide and 1½ feet high; the length was not exposed. It is reported

this pocket contained much red clay with some of the crystals loose in the clay. The walls were crumbling and soft with no crystals left attached. A few small colorless topaz crystals were found on the dump at the time of examination. These crystals were long and slender, measuring less than a centimeter in thickness The prospect is reported to have yielded many transparent finely tinted bluish-green crystals. The pit to the southwest was made on a small vein of pegmatite 1 to 3 inches thick, cutting the granite in a N. 70° E. direction, but apparently little topaz was found The pegmatite vein was traced over 100 feet toward the main working. Four other prospects were opened on the Bishop place and good topaz is reported to have been found at some of them.

The topaz prospect of Sam Awalt is in low ground between the forks of a dry wash about 250 yards southeast of the house. About a dozen prospect pits have been made within an area 125 feet wide and 200 feet long east-northeast. The pits are irregular in shape and none of them are more than 25 feet across or 8 feet deep. The presence of water within a few feet of the surface made more difficult the working of the prospects. They are in part in gravel beds, but chiefly in deposits of pegmatite, which, with the coarse granite country rock, form a floor over part of the flat. No definite structure or relation between the pegmatite and the granite was observed, and the impression gained was that the pegmatite occurs as irregular masses developed around miarolitic cavities in the granite. The workings are scattered and it could not be ascertained whether the pegmatite exposed in each is all part of one flat-lying sheet or consists of a number of disconnected masses in a nearly horizontal zone. In the largest pit the pegmatite exposed ranges from a few inches to nearly 4 feet in thickness, and the deposit dips about 10° S. The texture of the pegmatite in this pit is coarse, and pockets were opened which measured over 3 feet across and 1 foot high. Besides massive quartz and microcline feldspar, rough crystals of each measuring as much as 1 foot across were found projecting from the walls of the cavities. Most of the quartz crystals had drusy surfaces but were transparent within. They were colorless to smoky, and some contained inclusions of many small cavities with or without bubbles. Most of the feldspar crystals were red, but some of a gray and pale bluish-green amazon stone variety were observed. A little black tourmaline in long acicular crystals was associated with the quartz, penetrating some of the crystals in many directions. No topaz had been left exposed in the matrix at this prospect.

In another pit 200 feet to the northeast the topaz-bearing rock is peculiar and different from that observed at the other prospects in Mason County. The pit exposed a large mass of fine red felsitic rock through which were scattered red, gray, and greenish microcline, radiated groups or tuffs of clevelandite, colorless and smoky quartz, muscovite, and topaz crystals. The felsitic rock is dense grained and composed chiefly of feldspar, quartz, and fine needles of black tourmaline. It appears to be molded around the larger crystals of quartz and other minerals, in some cases showing a partial banding parallel to their surfaces. The microcline, quartz, muscovite, and topaz are in crystals of varying degrees of perfection. All are frozen in the felsitic rock and are generally badly fractured by attemps to separate them. The radial groups of clevelandite measure several

inches across, and many of them are aggregated around quartz crystals. The felsite has the appearance of growing secondarily around the larger crystals of the different minerals—that is, of filling portions of previously existing miarolitic cavities.

The majority of the topaz from the Awalt prospect is colorless and of beautiful transparency, but a little clear delicately tinted bluish topaz was also found.

The topaz prospect of Lee McGehee is about half a mile northwest of the Awalt prospect in a flat along a dry branch. Shallow pits have been dug over about an acre of ground on the west side of and a few feet higher than the bed of the dry stream. The pits are scattered here and there without any definite arrangement. The country rock is the coarse porphyritic red granite characteristic of the region and outcrops in flat ledges and large rounded bowlders. A coarse angular gravelly soil formed by the decomposition of the granite covers much of the surface. The topaz occurs in a bed of such soil which has been transported a short distance only and deposited in its present position along with coarser gravel and small angular bowlders. The wash material has been deposited on disintegrated granite and because of the sharp edges of its components it is difficult to determine the line of demarcation between wash material and soil in place. So far all the topaz has been found loose in the wash along with other minerals commonly found associated with it. No gem pockets have been found in the granite, though the topaz-bearing wash has not been transported far from its source. Granite outcrops project above the wash within 100 yards to the southwest, and the dry stream has cut into the granite close to the topaz prospects. Among the minerals which have evidently come from the topaz-bearing pockets are quartz crystals, red, gray, and bluish-green microline feldspar, muscovite, and a small quantity of cassiterite. A number of the dark smoky quartz crystals one-half inch to 2 inches in diameter were coated with a thin layer of reddish-gray microcline. Topaz of very good quality, chiefly colorless but some of pale bluish-green tint has been taken from the McGehee prospect. Many of the crystals have been partly fractured or rounded by attrition so that they are not suitable for fine cabinet specimens. Some large, imperfect transparent crystals and fragments of crystals have been obtained, and among them the largest topaz found in the county. This specimen is now in the collection of the United States National Museum. It weighs 1,296 grams, or 45.7 ounces avoirdupois, and is mostly transparent and colorless. Two opposite corners are tinted a faint bluish green. The crystal has a large cleavage plane base, with some of the other faces fairly well developed but partly dulled by etching and attrition by sand and water.

The Amarine prospects are a few hundred yards southwest of the Awalt prospect. Three pits 8 to 15 feet deep were opened at one place, and another pit 12 feet deep was made about 200 yards to the northwest. All of the workings are in hard rock and required blasting to open. In each opening red pegmatite was encountered in coarse porphyritic red granite. In the southeast prospects large red microcline feldspar crystals, massive and crystal quartz, muscovite, black tourmaline, and purple and gray fluorite were observed. In the northwest prospect a pegmatite vein with an east strike and a 10° S. dip was exposed in coarse red granite. This pegmatite inclosed a vein of gray

quartz 5 to 12 inches thick. In other parts of the pegmatite there were coarse crystals of quartz and feldspar. No topaz was observed at the Amarine prospects, but Mr. Amarine reports that some was found.

TOURMALINE.

CALIFORNIA.

Mr. J. W. Ware, of San Diego, Cal., reports the discovery of a deposit of beautiful "Nile green" tourmaline at his "Mountain Lily" mine on Aguanga Mountain, in San Diego County. Many of these tourmaline crystals are of fine gem quality and have yielded beautiful cut stones. The tourmaline has not been found in large deposits and the associated minerals, quartz, lepidolite, orthoclase, and albite are similar to those in other tourmaline mines of San Diego County.

MAINE.

There was but little activity in the mining of tourmaline in Maine during 1913. A few discoveries of crystals were made in the course of feldspar mining on Mount Apatite near Auburn, but none of these were of great value. Brief visits were made to some of the Maine tourmaline deposits in June, 1913, and the information gained has been used along with abstracts from a report by E. S. Bastin.[1]

Developments have been limited at the Mount Mica tourmaline mine, 1½ miles east of Paris, Maine, during the last two years, and the results of these operations have not been very promising. A good description of this mine has been given by Bastin, and the earlier history by A. C. Hamlin.[2]

A large area on the summit of the hill has been worked over by an open quarry, which has progressed from the northwest to the southeast, with an irregular working face over 200 feet long. The early work was close to the surface but the dip of the formation has carried the work to the southeast deeper, until it is now 20 to 30 feet deep along the face of the cut. No work was in progress at the time of examination in June, 1913, and the deeper parts of the cut were filled with water. Waste rock was rolled from the quarry floor to the hillside at the southwest end of the cut. Near the middle it was hoisted by derrick and piled back to the northwest on worked out ground or run on car and track conveniently located for such purpose.

The country rock is mica gneiss composed of layers or bands of schist, with varying texture and composition, injected by numerous layers and sheets of pegmatite. The schists are composed of numerous minerals, among which are quartz, muscovite, biotite, feldspar, garnet, and a finely columnar or fibrous mineral, probably fibrolite. The strikes measured on the schist were quite variable from nearly east and west to west of north, with dips of 10° to 25° to the south and east. The vein rock is pegmatite, the gems occurring in the upper part of a large mass of this rock, the thickness of which is not exposed. The gem-bearing layer of pegmatite is about 7 feet thick in places. It contains numerous cavities or pockets ranging from less than a pint in capacity to several feet across. This gem-bearing layer

[1] Geology of the pegmatites and associated rocks of Maine: U. S. Geol. Survey Bul. 445, 1911.
[2] The history of Mount Mica, Bangor, Maine, 1895.

differs from the ordinary pegmatite below in being slightly coarser grained and in containing pockets and lithia minerals. A thin layer of garnetiferous rock is present at the base of the gem zone in many places, and no pockets are reported to have been found below this layer. The following notes on the mineral associations at Mount Mica are abstracted from Bastin's report:

The principal constituent minerals of the pegmatite are quartz, orthoclase, and microline, muscovite, biotite, and black tourmaline with the clevelandite variety of albite, lepidolite, and colored tourmalines in the gem-bearing zone. Graphic intergrowths of feldspar and quartz, so common in many of the other tourmaline-bearing pegmatites of New England, is comparatively rare here. Quartz is present in small irregular masses of white to slightly smoky color through the pegmatite and in groups of colorless crystals in the pockets. Orthoclase and microcline are the principal feldspars of the pegmatite and have been gathered up from the dumps for use in pottery. Muscovite occurs in graphic intergrowths with quartz, in bunches of "wedge" and "A"-shaped crystals, and in flat crystals a few of which measure more than a foot in diameter. Some of the mica has a clear light rum color and good cleavage and is purchased by mica manufacturing companies.

Lepidolite is plentiful in the gem-bearing zone and occurs in scattered crystals and in large aggregations or masses of crystals. One mass of lepidolite weighing nearly 10 tons was encountered during the work. Among other minerals of the pegmatite are amblygonite, spodumene, apatite, beryl, cassiterite, columbite, arsenopyrite, triphylite, zircon, and kaolin.

Black tourmaline is very plentiful and occurs in elongated crystals, which range from small size up to 5 inches in diameter and over 2 feet in length. They occur only in the solid portions of the pegmatite. The colored tourmalines are found in the pockets and frozen in the solid pegmatite near the pockets. Nearly all of those of gem quality are found in the pockets, either loose in the bottom with kaolin and cookeite or attached to the walls. Some of the crystals are fresh and sound; others have been fractured; and still others have been found which appeared perfect but crumbled to pieces when handled. Some of these contained hard fresh nodules or cores of fine gem tourmaline inside.

The color and quality of the better tourmaline from Mount Mica are excellent. The crystals range in size to over a foot in length and 6 inches in thickness. Green is the predominant color of the gem tourmalines but the mine has yielded some very fine rubellite, indicolite, and achroite gems. The green tourmaline shades in color from olive green through emerald green to blue green. From colorless the achroite crystals grade into delicate pink, green, or blue. The indicolites are greenish blue and nearly sapphire-blue. The rubellite tourmaline from Mount Mica grades from pale to deep pink and nearly ruby-red. The combinations of the various colors mentioned in single crystals, either in shells of one or more colors around a core of another color or in layers across the crystal, have furnished some remarkable specimens now scattered through mineral collections in many parts of the world. A large number of unusually fine gems have been cut from the tourmalines of Mount Mica.

A small amount of work has been done on the land of James E. Bowker adjoining the land of Mount Mica Co. on the east. There is a good outcrop of the pegmatite on this property, and the reported results of the little work done would justify further development. Pockets with fine green gem tourmaline were found with the same association as in the main quarry.

A number of quarries have been opened for feldspar and gems on Mount Apatite, about 3½ miles west of Auburn, Maine. The early work was sporadic and chiefly in the nature of prospecting for gems, but in 1912 the Maine Feldspar Co. reopened some of the old prospects and started new work for feldspar. Other parties have also supplied feldspar to the Maine Feldspar Co. and have handled the gem and specimen minerals themselves. Some of these are E. Y. Turner, J. S. Towne, P. P. Pulsifer, and H. U. Greenlaw. The Maine Feldspar Co. and the Greenlaw quarries are on the east side of Mount Apatite, the Turner and the older workings on the south side, and the Towne and the Pulsifer quarries on the west side.

As far as seen the whole summit of Mount Apatite, where opened by quarries, is composed of pegmatite, but the relations of this rock to the country rock are not exposed. Bastin [1] gives evidence tending to show that the pegmatite is a large flat-lying mass occupying the summit of the hill.

The Maine Feldspar Co. has worked several quarries for feldspar to depths of 5 to 25 feet, and one quarry to nearly 50 feet in depth. Occasional pockets with gem tourmaline have been found in some of the quarries, and in places the surrounding rock carries colored tourmaline. The majority of the gem tourmaline was found in earlier days by N. H. Perry, Thomas F. Lamb, and other people prospecting on the old Hatch farm on Mount Apatite. The discoveries of gems by the Maine Feldspar Co. have not been especially important. The tourmaline crystals found during earlier mining are described by G. F. Kunz [2] as colorless, light pink, light blue, light puce-colored, bluish-pink, and light green, and at times nearly all these colors are found in one crystal. E. S. Bastin [3] states that later work by Thomas F. Lamb yielded tourmalines which cut into gems of nearly emerald-green color. Still later work by the Maine Feldspar Co. on the east side of the top of Mount Apatite developed two gem-bearing pockets from which deep-blue indicolite crystals with a greenish tint were obtained. M. L. Keith, of Auburn, cut some gems of fair quality from them. In another quarry of this company on the east side of the hill, no gem pockets were found, but considerable massive beryl was obtained from the solid pegmatite.

Three quarries have been worked on the land of H. U. Greenlaw on the east side of the top of Mount Apatite, and at one of these, adjoining one of the quarries of the Maine Feldspar Co., a quantity of dark-pink lepidolite, talcose-like altered pink and blue tourmaline, cookeite, and other alteration products of original lithia minerals are found. Small pockets with a few colored tourmaline and a pink beryl crystal are reported to have been opened here during the summer of 1913.

[1] Geology of the pegmatites and associated rocks of Maine: U. S. Geol. Survey Bull. 445, p. 53, 1911.
[2] On the tourmalines and associated minerals of Auburn, Maine: Am. Jour. Sci., 3d ser., vol. 27, pp. 303–305, 1884.
[3] Op. cit., p. 52.

In the J. S. Towne quarry, on the west side of Mount Apatite, pegmatite has been worked for both feldspar and gem tourmaline. The gems occur in a pocket-bearing zone dipping to the east with a low angle. The pegmatite in the gem-bearing layer is stated by Bastin to be slightly coarser grained than the rest of the pegmatite and to contain clevelandite, lepidolite, and semitransparent green tourmaline frozen in the pegmatite near the pockets. The gem pockets yielded dark grass-green tourmaline and light-green crystals tipped with pink. Among other minerals of interest found in this quarry are amblygonite, zinc spinel, columbite, cassiterite, and herderite.

A number of pits have been opened on the Pulsifer place from 100 to 200 yards north of the Towne quarry. One of these was worked by W. R. Wade [1] and has been described by him along with other gem deposits of Maine. Bastin has given a good description of the Pulsifer quarries also. The pegmatite is approximately flat. It consists of graphic intergrowths of quartz with orthoclase and microcline. Near the base of the gem zone is a layer carrying fine garnets. The garnet-bearing layer is nowhere over 1½ inches thick and has been traced continuously for more than 50 feet. Lepidolite is abundant near the pockets and considerable green, bluish-green, and blue indicolite and pink tourmaline are frozen in the pegmatite in places. Some of the pockets carry good crystals of partly transparent tourmaline of the same colors. A number of pockets have been opened, especially toward the south part of the quarry, which yielded transparent purple, bluish, and pink apatite crystals. Besides those found by Mr. Wade some 10 or 12 years ago, other pockets with purple apatite have been opened by Mr. Pulsifer within the last two years. These apatite crystals are best suited for cabinet specimens. They could be cut as gems, but owing to the comparative softness of the apatite, they would not wear well.

Pockets carrying gem tourmaline have been found irregularly distributed through the A. R. Berry quarry, 1½ miles southeast of Minot, in the town of Poland. The quarry is situated in a large outcrop of pegmatite on the north end of a low ridge, a few hundred yards south of Little Androscoggin River. Mr. Berry has opened a number of pockets in this quarry, some of which yielded gem tourmaline, chiefly green and blue, with a little pink. Among other minerals of interest found here are crystals of herderite, lepidolite, greenish-blue and pale-lavender apatite, beryl, and amblygonite.

The best gem discoveries were made in 1910 to 1912 by F. L. Havey, of the Maine Feldspar Co., who worked a part of the Berry quarry on a lease. Several pockets yielding tourmaline of especially fine quality were found. From the last pocket, opened in October, 1912, 11 pounds of crystals were obtained. Sufficient tourmaline was obtained by Mr. Havey to arrange several characteristic collections showing the variations in crystal development and color with gem and semigem material and to supply an abundance of material suitable for cutting into gems of fine quality. The crystals grade from small size to those more than an inch thick and several inches long. Some have nearly hexagonal outlines, but the majority are more triangular with rounded cross section. The terminations are present on the end of the crystals only in most specimens and consist of

[1] The gem-bearing pegmatites of western Maine: Eng. and Min. Jour., vol. 87, pp. 1127–1129, 1909.

scalenohedrons capped by rhombohedrons. Most of the crystal faces do not show a high polish but are slightly etched and pitted. Green is the predominant color of the tourmaline, and many of the crystals are rich bluish to nearly emerald-green. The crystals from the last pocket opened were said to be darker and to have more of an olive-green color than those from pockets found earlier. A few of the crystals are pink; but where pink is present in the tourmalines it occurs for the most part only in the terminations. The crystals from the last pocket opened have less pink than those taken from the earlier pockets and some of them are salmon-pink.

The gems cut from the best tourmalines, found by Mr. Havey, are brilliant and have a fine deep-green color. The lighter colored stones with shades of blue are also beautiful. Most of these tourmalines are cut by lapidaries in the State and are held for local sale at good prices.

At Mount Rubellite, 1½ miles northeast of Hebron, several small openings have been made on the northwest slope of the hill. Most of them are now partly filled with rubbish and nearly concealed by a thick growth of saplings and brush. Mount Rubellite is a low rounded hill, rising about 150 feet above the valley on the northwest. Pegmatite ledges outcrop over large areas on the summit of the hill and along the west side. Streaks of quartz-mica gneiss are included between the layers of pegmatite with a north to northwesterly strike and an indeterminate dip. Pale translucent rose quartz and masses of graphic granite were observed in several outcrops of pegmatite on the summit of the hill. The main working consists of an open cut with a 50-foot face half way up the hillside. Some of the minerals commonly associated with gem tourmaline were seen on the dump, such as white clevelandite, greenish apatite, and altered pink and green tourmaline. Bastin states that most of the tourmaline was found frozen in the pegmatite and was therefore removed with difficulty. Rubellite-colored tourmalines were common, whence the name of the hill.

A small quantity of gem tourmaline was found in the Mills feldspar quarries on Number Four Hill near the line between the towns of Hebron and Paris. Two pits were opened, about a quarter of a mile apart in a northwest-southeast direction. Gem tourmalines appear to have been found only in the northwest opening, the other pit yielding, besides the feldspar, only opaque beryl and bunches of wedge-shaped mica crystals. The northwest pit was operated by the Mount Marie Mining Co., the last operations being in 1911. Most of the feldspar is very light colored orthoclase or microcline, but some albite and clevelandite are found. Graphic granite and masses of quartz occur in large thick bodies. A few colored tourmalines, mostly opaque, are scattered through parts of the pegmatite, the majority being inclosed in or associated with muscovite and lepidolite. Bastin states that pockets were encountered in the earlier workings, and from these transparent tourmaline was obtained. Quartz occurs in transparent to translucent masses of white, gray, smoky-brown, amber, and rose colors. Among other minerals observed were pale-green beryl, columbite, and blue and green apatite.

TURQUOISE.

ARIZONA.

Turquoise Mountain, in Cochise County, Ariz., has been a point of interest for a number of years. W. P. Blake [1] mentions the locality in 1883, describing extensive ancient workings on the south face of the mountain. Large piles of waste had been thrown out from them and on this débris century plants and various desert cacti were growing. Blake was of the opinion that the deposits were worked before the day of the Apaches. He was successful in finding only light apple-green and pea-green specimens of turquoise on the dumps and a very little with a suggestion of blue. From this he believed the deposits were not so rich as at Cerrillos where there were much larger prehistoric excavations. Remains of ancient workings can still be seen, and hammers made of quartzite and some of basic igneous rocks can be found on Turquoise Mountain. Very little has been published regarding the modern operations at this locality.

Turquoise Mountain (now sometimes called Turquoise Hill) is 1 mile northwest of Courtland. It is a ridgelike prominence about half a mile long in a N. 25° W. direction, with steep cliff-like sides. The greatest elevation is nearly 5,400 feet above sea level, or 300 to 400 feet above the surrounding valleys. The highest parts are near the ends, the southern end of the hill being a knob and wider than the northern end. The region is desert, vegetation on Turquoise Mountain consisting chiefly of cacti, grease wood, and sage brush.

The majority of the workings for turquoise are along the west side of the hill, but other openings have been made on the summit and on the east side. All the openings are within an area about 1,200 feet long and 400 feet wide. There are four principal groups of workings, with other scattered prospects. Three of these are on the west side of the ridge, one about 100 yards northwest of the knob at the south end, another near the middle of the ridge about 400 feet to the north, and the third 200 to 300 feet farther north. The fourth group is on the east side of the ridge about 500 feet north of the knob at the south end or nearly 100 yards northeast of the first group. More than 20 openings have been made, consisting of prospects, pits, shafts, open cuts, and tunnels with stopes. Over 1,500 feet of tunnels have been driven in the hill with stopes and winzes.

In the first group of workings there are two open cuts, a shaft 50 feet deep, and about 500 feet of tunnels with large stopes. The shaft connects with drifts from the crosscut tunnel from the hillside below. In the second group there are over 300 feet of tunnels, a shaft 50 feet deep, and an open cut. In the third group there is an open cut about 40 feet long, 15 to 30 feet wide, and 30 feet deep, with over 400 feet of tunnels and a shaft 60 feet deep in the bottom of the cut. In the fourth group on the east side of the hill there are two open cuts and nearly 200 feet of tunnels with stopes from the lower one. Other workings consist of numerous pits, a few small open cuts, and several tunnels, some on the knob south of the workings described and others to the north.

[1] New locality of the green turquoise known as chalchuite: Am. Jour. Sci., 3d ser., vol. 25, p. 197, 1883.

The summit and steep upper slopes of Turquoise Hill are composed of massive quartzite, considered to be of Cambrian age by F. L. Ransome.[1] Some of this quartzite is fairly coarse grained and feldspathic with the feldspar partly decomposed. Along the western slope of the hill, below and close to the turquoise deposits, there is an igneous rock so badly altered that it can not be readily identified. Ransome has called it granite, stating that a similar rock to the southwest is intrusive into the quartzite. The contact exposed in some of the turquoise workings is that of an intrusive rock, but it was not possible to distinguish between this altered granite and altered quartz monzonite outcropping a few hundred yards to the west. In hand specimen the rock consists of numerous gray quartz grains in a soft kaolin-like matrix. Under the microscope the matrix is found to consist almost entirely of fine sericite. Owing to the fracturing in the quartzite and granite along their contact and the abundance of claylike material in the joints it is not easy to distinguish the contact in some places. The contact measured in one of the tunnels had a north strike and a dip of 75° E. The quartzite strikes nearly north and south with a dip of 60° to 70° E. A prominent system of bedding joints with a north strike and a dip about 70° E. with less prominent cross joints has been developed through the whole quartzite. Many of these joints have been filled with veinlets of white claylike material, which the microscope shows consists largely of massive fine sericite. Brown limonite stains are present in some of the joints and veins

The turquoise occurs in seams and veinlets as a filling in the joints and as nodular or concretionary masses in the sericite veins. Most of the material mined is in the quartzite, but some turquoise was found in the decomposed granite. The veinlets of turquoise are rarely as much as an inch thick and but little of the fine gem turquoise occurs in veinlets over one-fourth of an inch thick. The sericite veins are as much as 2 inches thick, and in places carry rough nodular or botryoidal aggregates of turquoise over an inch thick. A study of the deposits shows that the best turquoise occurs in veinlets, most of which are less than one-eighth of an inch thick. The thicker veins and some of the nodular turquoise is commonly greenish-blue or greenish and some is very pale blue and soft.

From a careful examination of the dumps and workings it was evident that turquoise of exceptional quality was found in Turquoise Mountain. The smaller pieces of fine gems found were translucent, pure dark blue with a fine dense texture. Such turquoise would cut into gems of the finest quality. A quantity of good matrix was undoubtedly obtained, for many small fragments of turquoise mottled with limonite were seen around the workings.

CALIFORNIA.

Several large turquoise mines have been operated in the northeastern part of San Bernardino County, Cal., and in adjoining parts of Nevada. Among these mines were West Camp of the Himalaya Mining Co., Middle Camp and East Camp of the Toltec Gem Mining Co., in California, and the Wood's mine, in Nevada. West Camp, of the Himalaya Mining Co., was described in this report for 1911 It is near the head of Riggs Wash, 12 miles N. 60° E. of Silver Lake, a

[1] The Turquoise copper-mining district: U. S. Geol. Survey Bull. 530, pp. 126–127, 1912.

station on the Tonopah & Tidewater Railroad. Middle Camp is 2 or 3 miles east of West Camp, and East Camp is 8 miles due east, or about 12 miles by road, of West Camp. These mines have not been operated for several years and as they are in a desert region, the writer has had difficulty in obtaining guides competent to take him to the camps in the brief time available for such trips. West Camp was reached from Silver Lake in 1911, but the teamster was not acquainted with the location of the other mines or springs, so that search for them had to be abandoned. A trip was made from Nipton, Cal., a station on the San Pedro, Los Angeles & Salt Lake Railway, to East Camp in August, 1913, but again the location of Middle Camp was not known. Nipton is 31 miles N. 85° E. of East Camp. All the camps can best be reached from Silver Lake if proper equipment for the trip and a guide familiar with the location of the few wells and springs afforded by this region can be obtained.

The Ivanpah topographic sheet, issued by the United States Geological Survey, is an excellent map of the region around the turquoise deposits and the country to the east, beyond Nipton. Unfortunately the region west of the mines toward Silver Lake is not included in this map. The turquoise mines are located in a range of rough hills or mountains extending east of south from Shadow Mountains. The crest of the range is near the east side and from it long valleys, the lower parts filled with wash material, drain westward into Silver Lake. Along the western side of the range, the relief between valleys and hills is greater than on the eastern side. The elevation of West Camp is about 3,700 feet and of East Camp about 4,300 feet above sea level.

There is no water supply near the mines of the Toltec Gem Mining Co., and water had to be hauled several miles for camp use. Water was obtained from a well 80 feet deep at the Himalaya Mining Co.'s mine. The vegetation is that typical of the desert, of which coarse branching yucca cacti, almost large enough to be called trees, are plentiful.

According to the information furnished by Mr. Gus Hamstadt, of Nipton, the turquoise deposits were discovered by an Indian named Prospector Johnnie, who located them in 1894 in partnership with G. Washington and Peter Phifer. Mr. Hamstadt carried some of the turquoise to New York in 1896, selling a quantity and getting parties interested in the deposits. The various interests in the claims were purchased by J. R. Wood, of New York, and operations were commenced at East Camp in 1897 under the name of the Toltec Gem Mining Co. Later Middle Camp and West Camp were opened.

East Camp is located in a draw, draining southwest toward Halloran Springs, about three-quarters of a mile west of the point where the road to the old Valley Wells copper smelter crosses the summit. The draw is not deep, and part of the workings are in a low gap between it and the head of another valley on the north, which drains east. Prospects have been opened for a distance of half a mile along both sides of the draw, but the principal workings are within 250 yards of the mine buildings. There were numerous prehistoric workings, but many of them have been obliterated by recent operations, and only a few of the smaller ancient pits can now be seen. A number of broken stone hammers used by the ancients were seen around

some of the workings. The prehistoric workings were widely scattered and served as guides to the modern workings. Mr. Hamstadt states they were chiefly pitlike holes rarely over 15 feet deep and from 10 to 25 feet across.

Probably the most important workings were those 250 yards northwest of the camp, in the hillside near the summit of the low gap. An open cut 100 feet long in a N. 60° W. direction, 30 feet wide, and 15 to 20 feet deep, two shafts about 40 feet deep, at least 300 feet of tunnels, and stopes were made at this place. Tunnels were driven in from the hillside to the south and connected with the bottom of the open cut by shafts or stopes. Other tunnels were made from each end of the open cut. Among other large workings were deep shafts near the camp, open cuts and tunnels north and also west of the camp on both sides of the draw. Some of these openings were large, consisting of open cuts 20 to 40 feet long and 10 to 25 feet deep and tunnels aggregating several hundred feet in length.

Varied types of rock are exposed in the turquoise region. Along the road to Valley Wells coarse porphyritic biotite granite, inclosing masses of diorite outcrops for a distance of several miles. In the hills south of the mine is a metamorphic series containing hard quartzite, biotite schist, mica gneiss, etc. The turquoise-bearing area is bounded by biotite schist on the west also, and this in turn is overlain by a mesa-forming basalt flow. The turquoise deposits are in coarse porphyritic granite and a porphyry which is probably the monzonite type, slightly quartzose, occurring in the form of dikes. One of these dikes about 250 feet wide cuts the granite with a northwest strike on the north and within a few feet of the mine buildings.

Both the coarse granite and the porphyry have been so fractured and decomposed near the turquoise deposits that it is difficult to distinguish between them. Decomposition has resulted in sericitization and kaolinization of the feldspars of the rocks with a deposition of a quantity of limonite iron stains and probably also some secondary silica. Extensive fracturing or jointing opened many channels for the passage of the water or solutions which caused the decomposition. Later solutions carrying the elements of turquoise and passing through the same channels deposited turquoise in seams and veinlets and in nodular masses imbedded in kaolin or sericite in larger veins. Some of the turquoise is in light-colored matrix, but in other places the matrix is heavily stained with limonite. The abundance of limonite stains in the altered rocks, with which the turquoise is associated, indicates that a quantity of pyrite or other iron sulphides have been decomposed during the weathering. Limonite pseudomorphs and rusty cavities left by weathered pyrite were observed in the fracture zones near the turquoise veins. Veins of chrysocolla and limonite stains were found in a prospect nearly 300 yards east of the camp buildings in another small body of porphyry.

The majority of the gem turquoise found at East Camp was in nodules or nuggets. These ranged in size from small specimens to those over an inch across, as a rule the larger pieces being of poorer grade. Some large nuggest of high-grade turquoise are reported to have been found, however. George F. Kunz [1] mentions one specimen

[1] Gems, jewelers' materials, and ornamental stones of California: California State Min. Bur. Bull. 37, p. 153, 1905

mined by the Toltec Gem Mining Co., which cut into a perfect oval gem of rather pale blue, measuring 32 by 45 millimeters and weighing 203 carats. The best turquoise ranged from pale pure blue to fairly dark nearly pure blue. A quantity of off-colored greenish-blue and some soft pale-bluish semiturquoise was observed around the workings The best gem turquoise was hard and had a dense texture. Besides fine pure gems, some very pretty matrix was obtained during mining.

NEVADA.

The Wood turquoise mine, near Crescent, Nev., also called one of the Toltec mines, was opened by J. R. Wood, of New York, about the same time as the other deposits of the Toltec Gem Mining Co. in California. The mining was conducted by Milton Mundy, now of Hart, Cal. The remains of prehistoric workings, with stone hammers scattered about them, served as a guide for modern development. Parts of these ancient workings and a few broken stone hammers can still be seen near the recent excavations. The region is rough, rocky, and desert with the characteristic vegetation consisting chiefly of cacti and sage brush. The mine is 3 miles S. 75° E. of Cresent, in a gulch-broken valley south of Crescent Peak. Openings have been made over an area about a quarter of a mile wide and half of a mile long and extending north up on the side of Crescent Peak. The elevations at the different openings range from 5,100 to 5,400 feet, Crescent Peak being 6,001 feet above sea level. Two principal groups of workings were made, one on the side of Crescent Peak and the other along both sides of a gulch draining southwest about one-third of a mile to the south. A camp had been established on a ridge between the two groups of workings and a few hundred yards southwest.

There were two sets of workings in the south group, one on the southeast side of the gulch and the other about 100 yards northwest across the gulch. On the southeast side of the gulch a tunnel has been driven east into the hillside 150 feet, about 15 feet above the bottom of the gulch and about 75 feet below a small rocky knoll. There were branching tunnels and stopes connecting with an open cut about 50 feet higher. This open cut was 60 feet long and 10 to 20 feet deep, with short tunnels and a shaft feeding a chute into the tunnel below. Other smaller tunnels and pits were made on the hillside and near the summit of the knoll where there were several small ancient workings.

On the northwest side of the gulch 3 principal workings were made within an area of about 200 feet square, the upper one an open cut 20 by 40 feet across and 15 feet deep, another, 50 feet lower down on the hillside, an open cut 50 feet long and 10 feet deep with short tunnels, and the third 25 feet still lower down, a tunnel 240 feet long driven northwest under the other workings.

In the group on the side of Crescent Peak the principal workings consisted of an open cut 50 feet long and 20 feet deep, a tunnel 100 feet long driven into the side of a gulch under and about 20 feet lower than the cut, and an inclined shaft 200 feet deep on a dip of 50° NW. Other workings were a 75-foot tunnel across the gulch to the east, a 25-foot shaft on the ridge about 100 yards to the east, an open cut 30 feet long in the east side of another gulch about 200 yards to

the west, and several smaller prospect pits scattered over the mountain side.

Other prospects were made in the gulch north of the camp and on the hills south of the workings described above. The small developments at these places indicate that no finds of importance were made.

The rock exposed in the turquoise-bearing area is a decomposed porphyry of granitic or quartz monzonitic nature. In some of the less decomposed phases both pink orthoclase or microcline and white plagioclase can be distinguished in hand specimens along with quartz and biotite. In some of the more altered phases there are grains of quartz scattered through chalky white masses of sericite, kaolin, or other alteration products of the original rock. Fracturing and jointing of the rock have been extensive, doubtless rendering more easy the decomposition and the spreading of the alteration products. In places brown and yellowish stains of limonite and jarosite are abundant. The decomposed rock along some of the fracture zones has been hardened by limonite acting as binding material or cement. Secondary quartz is scattered through the rock in veinlets and small irregular masses and in places sericite has developed plentifully. Clay gouge seams and veinlets have formed in many of the joints and fractures.

The occurrence of the turquoise in the different workings is very similar. A large proportion of it occurs in nugget or nodular form in fractured portions of the rock, and some occurs in seams and veinlets. In many places several nodules are grouped together. The nodular turquoise is embedded in the white claylike masses of the gouge veins or in similar material in badly altered parts of the rock along fracture zones. The turquoise nodules removed from this matrix are coated with white chalklike shells, which have to be chipped or ground off before the quality of the gem can be determined. Sericite is an important constituent of much of the white claylike gouge deposits. In places the claylike matrix and associated turquoise have been cemented into hard masses by limonite. Quartz, in rough crystals, is occasionally associated with turquoise in some of the veinlets. A quantity of soft nodular, pale-blue to bluish-green turquoise or semiturquoise, was found in several of the prospects, especially on the steep spur east of the main working on the side of Crescent Peak. Limonite stains were abundant in the surface rock on this spur and indications seemed favorable for the opening of a good deposit of turquoise. The prospect shaft at this place failed to locate any good gem material, however. The nodules of turquoise range in size up to more than an inch across and generally yield pure turquoise and but little matrix. The better turquoise ranges from light to medium dark pure blue of a shade sometimes called "baby blue." The texture is dense and the mineral over 6 in hardness.

Owing to the occurrence of most of the turquoise in nodular masses embedded in claylike matrix, it was difficult to save all the gem material in mining and a quantity of good turquoise passed to the dumps. Some of these dumps might be profitably worked yet, though their surfaces have been picked over many times by visitors to the mine. Evidently turquoise was rather plentiful in the larger workings, as so much was allowed to go over the dumps and it was still found profitable to carry on extensive operations.

Other turquoise prospects are reported to have been opened by Smithson & Phillips about a mile east of the Wood mine on the east side of the divide extending south from Crescent Peak.

A turquoise prospect was opened several years ago, 1 mile south of Crescent near the head of a small valley. This deposit is now owned by G. W. Morgan, of Crescent, Nev. The workings consist of a tunnel 75 feet long driven southward into a hillside and connecting with a shaft 35 feet deep on an incline of about 70° E. with two smaller pits. The country rock is a dark granular igneous rock of granitic or quartz monzonitic nature. It is cut by a finer grained light colored rhyolite. Both rocks have partly altered, and the rhyolite has been hardened by secondary quartz. The turquoise occurs in seams and veinlets, chiefly in the rhyolite. In places the turquoise shows a tendency to nodular development in the veinlets. Fragments of greenish, pale-blue, and some good nearly pure-blue turquoise were observed around the workings. Mr. Morgan states that about 200 pounds of turquoise and matrix were obtained, for some of which offers of $20 a pound were received.

NEW MEXICO.

The turquoise deposits of the Jarilla mining district have been mentioned in several of these reports by George F. Kunz. They have been referred to as near Las Cruces, for many years the nearest railroad point. W. E. Hidden[1] furnished one of the best early descriptions of the locality. He mentions at least 10 prehistoric workings and states that mining was in progress at the time of his visit in 1893.

The following information was furnished by Mr. Allen Culver, of Brice: The mine known as the Tiffany mine was worked by David King about 20 years ago and yielded a quantity of good turquoise. The De Meules mine was worked two years preceding 1898, when De Meules, the owner, was murdered by José Flores as the result of a quarrel over a payment for Flores's services as a witness at Las Cruces. The property is reported to have yielded $60,000 worth of turquoise in the last year of operation by De Meules. Later it was leased by Cy Ryan and Tom Kelly, yielding a large quantity of good turquoise. The claim of Luna, Moreno & Ascarate was worked about 13 years ago and proved fairly productive. For the last several years only assessment work has been done. The Tiffany mine has been patented under the name of the Alabama claims, the only patented turquoise claims in the district.

The turquoise deposits of the Jarilla mining district are in two groups, about 2 and 4 miles, respectively, northwest of Oro Grande, a station on the El Paso & Southwestern Railroad, about 60 miles northeast of El Paso. One group of claims is about one-third of a mile west of Brice, a post office on a spur from the railroad 2 miles from Oro Grande. The other group is 1½ to 2 miles north of Brice. Prominent among the deposits of the northern group are the old De Meules mine and the Laura claim of F. B. Stuart, of El Paso. In the southern group are the Alabama claims (locally called the "Tiffany" mine) and the claim of Luna, Moreno & Ascarate.

[1] Two new localities for turquoise: Am. Jour Sci., 3d ser., vol. 46, pp. 400-401, 1893.

The group of hills in which the Jarilla mining district is situated rises several hundred feet above the plains country on the east. In the region around the turquoise mines the hills are steep, with basin-like valleys among them. The northern group of turquoise deposits is in such a basin with outlet to the east, and the southern group is in a smaller basin with outlet also on the east through a draw draining into the main gulch through Brice. The turquoise deposits lie chiefly around the edges of the basins near the foot of the steeper slopes, at an elevation of approximately 4,600 feet above sea level. The country is arid, and vegetation is slight and typical of the desert.

According to Waldemar Lindgren [1] the Jarilla Hills consist of carboniferous limestone strata domed up by an irregular intrusive mass of fine-grained monzonite porphyry. Interesting deposits of andradite garnet, diopside, quartz, epidote, hematite, and pyrite have been formed along the contacts between the limestone and porphyry. Observations by the writer show sill-like sheets of porphyry interbedded with the limestone with contact mineral zones between each. There has been faulting, so that the outcrops of the strata do not retain symmetrical positions around the sides of the basins. The turquoise deposits are in the lowest sill or possibly in the top of the main part of the laccolith intrusion exposed in the basins.

The De Meules mine consists of two sets of workings near the western part of the basin, one on the north side of a draw and the other about 175 yards to the south across the draw. Both are in gentle sloping ground at the foot of the hills. At the north workings an open cut 40 to 50 feet across and 20 feet deep has been filled up, but some of the branching tunnels extending northeast from it are still open. These tunnels probably aggregate over 300 feet in length and open into irregular rooms and small stopes, some of which extend to the surface. They are probably nowhere more than 25 feet deep. Other prospects were opened around the workings. At the south workings a dozen or more irregular cuts, pits, and shallow shafts with ground-hog tunnels were made. One old shaft was about 40 feet deep. The dumps of waste rock from both sets of workings are large, and it is probable there have been more extended underground workings than could be seen at the time of examination.

The rock at the De Meules mine is decomposed monzonite porphyry. The stage of decomposition varies but is more advanced near the turquoise deposits than at some distance from them. The less altered porphyry is a dark-gray rock, showing white feldspar and biotite phenocrysts. The altered phases are light-gray to light brownish-gray with numerous white spots. In the turquoise-bearing areas the porphyry has been broken into small blocks by numerous joints. The jointing has aided in the decomposition of the rock by furnishing channels for the passage of water. The joints cut the rock in several directions, but in the north workings the tunnels followed two sets of joints carrying turquoise and striking northeast and northwest with high to vertical dips. Here one prominent joint or fissure striking northwest across the end of the tunnels carried both quartz and chrysocolla, with a small amount of turquoise. Prospects to the north and to the west of the underground workings exposed much chrysocolla in seams and veins with but little turquoise. The joints

[1] The ore deposits of New Mexico: U. S. Geol. Survey Prof. Paper 68, p. 185, 1910.

and seams in the rock exposed in the south workings are heavily stained with brown limonite, but those in the north workings are less heavily stained with iron oxides. Numerous small, fresh pyrite crystals were observed in the partly decomposed monzonite wall rock at the north workings.

The turquoise at the De Meules mine occurs as fillings in joints, small fissures, and fracture zones. Some of it forms solid veinlets, and some shows a tendency to nodular development in the veins with limonite-stained sericite or kaolin filling the interstices. Turquoise of various grades was found ranging from pale blue to dark blue, bluish green, and green. Some of the good blue turquoise was dense and hard and yielded gems of good grade. Very pretty matrix was observed, in which the turquoise was mottled with irregular patches of limonite and limonite-stained quartz in the veinlets. A little soft pale-blue "semiturquoise" was observed, especially in seams cutting the decomposed monzonite, in which there was very little limonite stain.

The prospects on the Laura claim, belonging to F. B. Stuart, of El Paso, are about a third of a mile east of south of the De Meules mine. There are two sets of workings, one in the gently sloping ground at the foot of a hill and the other about 200 yards northwest in the hillside. In the south workings three shallow shafts or pits, 15 to 20 feet deep, were made in decomposed spotted grayish monzonite porphyry. The rock has been strongly fractured, and limonite stains filled many of the joints and pore spaces. Turquoise was found rather plentifully in veinlets and nodular masses and some of it was dense and hard with a fairly pure blue color. The best may be designated as "baby-blue." A quantity of pale-blue and soft or semiturquoise had been left on the dumps. There was much turquoise suitable for matrix, which would yield gems of good blue handsomely mottled with brown limonite stains.

At the north prospect there are some pits and a tunnel driven into the hillside near the contact of the porphyry with overlying siliceous slate. Both rocks have been strongly fractured and are heavily stained with limonite. A quantity of rather soft pale-blue and bluish-green turquoise had been thrown out on the dumps, and some was still exposed in the workings. The intimate association of this turquoise with limonite would furnish a quantity of mottled matrix of medium grade. If better turquoise was found during operations, as may have been, it would yield a beautiful matrix. One of the prospect pits a few feet south of the tunnel exposed a vein of gypsum cutting the rock formation. Turquoise occurs in seams, veinlets, and nodules both in the porphyry and in adjacent siliceous slate.

A little turquoise was found in a prospect opened for copper and other minerals by Allen Culver on the southeast side of the basin about two thirds of a mile southeast of the De Meules mine. Several open cuts, a 60-foot tunnel driven southeast into the hillside, and a shaft at least 100 feet deep were made here. The rock formation is quite similar to that at the De Meules mine, consisting of partly decomposed monzonite porphyry. No turquoise was seen in place in the rock, but there were many small pieces scattered around the dumps. Some of the rock was heavily stained with limonite along

fractured zones. A little turquoise of pure light blue was seen, but the majority had a greenish cast and some was very soft. Specimens on the dumps showed that the turquoise occurred in seams and veinlets with nodular development in places.

The Alabama claims are on the southeast side of the smaller basin. There are two principal sets of workings, one in the steep hillside on the south of the draw draining the basin and the other about 250 yards south-southwest in a low walled hollow, forming part of the basin. The latter workings are the most important and occur in three groups about 100 yards apart. The principal ones are in the hollow and consist of an open cut 60 feet long in a northwest direction and 20 feet deep, with several crosscut trenches and pits. Turquoise occurs in seams and veinlets cutting the rock in all directions. Limonite stains are abundant both in the turquoise veinlets and through the rock. A deposit of pale bluish (copper) tinted alum had formed in one part of the open cut. Turquoise of a fine dark-blue color and hard dense texture was obtained from this working, along with some of poorer quality. Beautiful matrix could be cut from some of the veinlets containing intermixed limonite.

Two small open cuts and a shaft were made on the hillside about 100 yards east of south, but turquoise of an inferior grade only was seen around the workings. In another place about 100 yards north of west of the main working two shafts had been sunk in an open cut. Turquoise was found rather plentifully in these openings and a quantity of soft pale-blue semiturquoise had been thrown on the dumps. There was much nugget or nodular turquoise here as well as that in veinlets. The decomposed rock in this prospect is not heavily stained by limonite as at the other openings.

In the other group of workings on the south side of the draw, 5 small open cuts and pits and a shaft over 100 feet deep were made in a height of 75 feet in the hillside. Remnants of prehistoric workings can still be seen but most of them had been obliterated by modern excavations. Evidently numerous veinlets of turquoise had been followed in the open cuts, but apparently little turquoise was obtained from the lower part of the deep shaft.

The claim of Luna, Moreno, and Ascarate is across the draw about 150 yards north of the north workings of the Alabama claims. Several pits and open cuts have been made in the hillside within an area of 75 by 125 feet in a northwest direction. One of the cuts is 50 feet long and 18 feet in greatest depth, with short tunnels driven from it. The joints and fracture zones have been heavily stained with limonite. The turquoise veinlets had been carefully gouged out during the last operations and little of the mineral had been allowed to go on the dumps. Turquoise of good grade is reported to have been found, however. A deposit of limonite or copper gossan 2 feet thick had been opened in a prospect about 75 feet west of the turquoise workings.

The country rock exposed in this smaller basin is dark-gray monzonite porphyry, in some places showing but little decomposition. Around the turquoise deposits it has been fractured and decomposed to varying degrees. In some places it is a rather light gray or white, with or without limonite stains, and as such it is difficult to see any relation to the fresh rock. In other places it is spotted gray or brownish gray and shows in part the texture of the original monzonite porphyry. In the north working of the Alabama claims much of the

surface rock is strained brown with limonite, but the rock from the deep shaft is hard, altered, light-gray porphyry carrying disseminated pyrite.

TEXAS.

Turquoise has been mined intermittently during the last four years in Culberson County, Tex., about 5 miles west of Van Horn, by the Texas Turquoise Co., of El Paso. The mine is in the smaller hills on the northeastern side of the Carrizo Mountains about 1 mile south of the Texas & Pacific Railway. Developments are small and consists of two openings at the south end of a low oval-shaped hill, one near the bottom of a draw and the other about 70 feet N. 15° E. up the hill. Both are open cuts, the upper one about 25 feet long and 6 feet deep and the lower one an irregularly shaped opening about 10 feet deep.

The turquoise occurs in an area of Algonkian (?) rocks, mapped as the Carrizo formation by G. B. Richardson.[1] This formation consists of quartz-mica schists, quartzite, slates, a little chlorite schist, and some igneous rocks. The turquoise occurs in a hard light-gray to pink rock in which feldspar and quartz are prominent constituents. Two phases of this rock were encountered in the workings—one with a rather fine even granular texture resembling a rhyolite porphyry, the other being a dense rhyolite-like rock with flow texture. To all appearances these rocks are of igneous origin, but a possibility exists that the finely granular rock is a metamorphosed feldspathic sandstone. The rhyolite porphyry, with associated rhyolite, is at least 60 feet thick, passing into a grayish rock of indeterminate nature on the northwest and in contact with an apparently altered basic igneous rock, like diorite, a few feet southeast of the turquoise deposits. The strike of the inclosing formations is N. 45° E., with a high southeast dip. The porphyry has been broken by joints in several directions in which different minerals have been deposited. Among these minerals are quartz, sericite, pyrite, turquoise, limonite, and carbonate of lime. Fracturing followed by deposition of minerals occurred in more than one period. The older joints were filled with quartz and probably some sericite. It is probable sulphides were also deposited contemporaneously with this quartz, for pyrite crystals were observed completely embedded in it. Turquoise was deposited in later joints, apparently contemporaneously with limonite. Both of these minerals probably result from the surficial alteration of older minerals in the rock. The carbonate of lime was the last mineral to be deposited and fills cracks and surfaces with seams and dull white incrustations.

The turquoise first mined at this locality was described by Prof. W. B. Phillips,[2] of the University of Texas, as having a slight greenish tinge, but yielding an odd and attractive matrix of "speckled blue, blue-green, and faint green against a light chocolate background." This description serves very well for a large part of the turquoise, but some has been found in which the green is very slight and the turquoise may be classed with that from other localities as nearly pure blue. No real dark-blue turquoise was observed, but some of that from the seams has a very pretty light-blue color. The turquoise has

[1] U. S. Geol. Survey Geol. Atlas, Van Horn folio (No. 194). (In press.)
[2] Jewelers' Circular-Weekly, Nov. 9, 1910 (from Houston Post, Tex.).

a hard dense texture necessary for good gems. Brown stains of limonite coat the faces of some of the veinlets and have permeated cracks and seams in them. Such material furnishes attractive matrix gems with varied markings.

A little turquoise has been found in a prospect at the Maltby silver-copper mine, about 1 mile south of west of the Texas Turquoise Co.'s mine. Hardened black siliceous slate is the principal rock at the Maltby mine, but the turquoise occurs in a small dike or sill of white partly altered porphyry a few feet thick, which is inclosed in the slate. A few pieces of greenish-blue turquoise were seen. These were associated with brecciated porphyry rather heavily stained with limonite. The only work done for turquoise at this locality consisted of a small prospect pit 2 feet deep, and, until further work has been done, the discovery must be considered merely an indication of possible gem material.

MISCELLANEOUS.

ASTERIA QUARTZ.

Asteria quartz of exceptionally good quality has been applied to use in jewelry by Bell & Birknir, of New York. The source of the rough mineral has not been revealed. The gems are cut round cabochon and are sold as asteria or star stone. They show a fine bright 6-ray star in reflected light on a nearly colorless highly translucent background. The cut stones are very pretty and may be mounted simply or in a girdle of small diamonds.

HELIODOR.

A species of beryl has been introduced to the gem world under the name of "heliodor." [1] This material has been very scarce so far and most of it is in the possession of the Emperor of Germany. It comes from Rossing, German Africa. Heliodor differs from most beryl in containing a small percentage of uranium oxide and in being weekly radioactive. The color by day is golden yellow and by artificial light a delicate bluish green.

HETAEROLITE.

A specimen of hetaerolite from Leadville, Colo., was sent in by Mr. W. C. Hart, of Manitou Springs. This mineral, containing zinc and manganese oxides, occurs in botryoidal and mammillary deposits with radiated columnar structure. According to Dana, it has a hardness of 5 and a specific gravity of 4.93. The specimen sent by Mr. Hart was cut cabochon. It is a brilliant black and in certain lights the radiated structure can be seen.

ICELAND SPAR.

Prof. J. P. Rowe, of the University of Montana, at Missoula, reports the occurrence of crystallized calcite, of sufficient transparency to be classed as "Iceland spar," in Sweet Grass County, Mont.

[1] Houdelet, A., Deutsche Goldschmiede Zeitung, abstracted in Jewelers' Circular-Weekly, Apr. 22, 1914. Hauser, Otto, and Herzfeld, H., Chem.-Zeitung, June 2, 1914.

This calcite occurs in a vein cutting igneous rock. Different grades have been found suitable for chemical standardizing, specimens, and optical purposes. The latter variety has been sold in rhombs measuring from 2 to 10 centimeters long for from $2 to $3.50 a pound.

INTERNATIONAL OR METRIC CARAT.

The new international or metric carat of 200 milligrams, adopted by the National Jewelers' Board of Trade for the United States, beginning with July 1, 1913, has been favorably received by the majority of the trade. The difficulties, due to a readjustment of weights and prices of stones already catalogued, have not proved great. Easily applicable tables and conversion formulas have been supplied by many publications, such as the Jewelers' Circular-Weekly, of New York; Manufacturing Jeweler, of Providence, R. I.; and private advertising catalogues. A complete discussion of the steps leading up to the adoption of the international carat by the jewelers of the United States has been given by George F. Kunz.[1] The metric carat has already been adopted by a number of European countries, among which are Germany, France, Holland, Belgium, Switzerland, Italy, and Spain. Beginning with April 1, 1914, the metric carat was adopted by jewelers of Great Britain.[2]

The new international or metric carat of 200 milligrams replaces a carat of about 205.3 milligrams weight in the United States and carats of varying weights in several other countries. The new carat weights used by jewelers are marked 0.01 cm. to 100 cm., etc.

PUBLICATIONS.

CURIOUS LORE OF PRECIOUS STONES.

A recent book[3] by George F. Kunz will prove of interest to all lovers of gems. This work is handsomely published and contains 86 illustrations, 5 in color. A good outline of the contents is contained on the title page: "The curious lore of precious stones, being a description of their sentiments and folk lore, superstitions, symbolisms, mysticism, use in medicine, protection, prevention, religion, and divination, crystal gazing, birthstones, lucky stones and talismans, astral, zodiacal, and planetary."

RUBY.

A 16-page pamphlet on ruby, giving some practical hints on the detection of artificial and imitation stones, has been issued by the Burma Ruby Mines (Ltd.), of London. The pamphlet contains two colored plates comparing the crystal form and structure of the rough and cut natural ruby and of the manufactured ruby. The points emphasized in the natural ruby are that bubble cavities are generally irregular and angular in shape; color variations are common and generally arranged in bands either parallel or irregular; striations are straight or bend in angles; inclusions of foreign particles of various

[1] The new international diamond carat of 200 milligrams: Am. Inst. Min. Eng. Trans., Butte meeting, August. 1913.
[2] Jewelers' Circular-Weekly, Dec. 10, 1913.
[3] The curious lore of precious stones, J. B. Lippincott Co., Philadelphia, Pa., 1913.

sizes are arranged irregularly; and silk caused by numerous minute parallel canals or tubes arranged in three directions giving a silky sheen in reflected light is often present in the natural stones. Corresponding points in the artificial ruby are that the bubble cavities are generally perfectly round or only slightly elongated and are never angular; the color is commonly uniform but when varied is in curved bands; striations consist of a series of concentric curves; inclusions of foreign particles are generally arranged in curves following the lines of striations; and silk is never found. A simple jeweler's microscope and other apparatus useful in distinguishing between the natural and the manufactured ruby are described and hints are given on how to make the tests with them. Much of the same information has also been given on a wall chart showing the same colored plates.

TURQUOISE.

A very comprehensive work on the ethnology of turquoise has been published by Berthold Laufer,[1] associate curator of Asiatic ethnology of the Field Museum, of Chicago, Ill. Dr. Laufer discusses at length the use of turquoise by the early peoples of India, Tibet, and China. The esteem in which turquoise was held by these people and the meanings attached to the wearing of it proves interesting reading.

Another work on turquoise, by J. E. Pogue,[2] of Northwestern University, formerly of the United States National Museum, is in press as this report goes to press. Dr. Pogue's paper deals with the ethnology, mythology, mineralogy, geology, and technology of the turquoise, and will prove very instructive on these subjects.

PRODUCTION.

The total production of gems and precious stones during 1913 reported to the Geological Survey amounted to $319,454, or approximately the same as in 1912. The value of the production has been estimated in part from the quantities of rough mineral reported as produced, but the majority of values have been given by the producers. The production of sapphire in Montana was the largest ever reported to the Survey and the value is conservatively estimated at $238,635, or $43,130 more than in 1912. This increase was offset by decreases in the output of other gem minerals, such as spodumene, tourmaline, peridot, emerald, and many other gems of less importance. The statistics represent as nearly as possible the first values of the rough mineral. The value of the finished gem material may several times greater.

---

[1] Notes on turquois in the East: Field Mus. Nat. Hist. Pub. 169, Anthrop. ser., vol. 13, No. 1, July, 1913.
[2] Turquois: Nat. Acad. Sci., 3d Mem., vol. 12, 1914.

Production of precious stones in the United States, 1907–1913.

	1907	1908	1909	1910	1911	1912	1913
Agates, chalcedony, onyx, etc.	$650	$1,125	$750	$2,268	$8,128	$9,978	$8,895
Amethyst	850	210	190	.....	725	363	389
Benitoite	1,500	3,638	500	.....	.....	150	.....
Beryl, aquamarine, blue, pink, yellow, etc	6,435	7,485	1,660	5,545	2,505	1,765	1,615
Californite	a 25,000	.....	a 18,000	a 8,000	150	275	152
Catlinite	25	.....	.....	.....	.....	.....	.....
Chiastolite	20	.....	.....	.....	25	.....	.....
Chlorastrolite	.....	25	2,400	a 2,000	1,992	350	.....
Copper ore gems, chrysocolla, malachite, etc	400	6,050	2,300	550	800	1,085	2,350
Chrysoprase	a 46,500	a 48,225	a 84,800	a 9,000	a 13,550	220	.....
Cyanite	100	.....	.....	.....	.....	10	.....
Diamond	2,800	a 2,100	2,033	a 1,400	a 2,750	a 1,475	a 6,315
Diopside	.....	120	.....	.....	.....	.....	.....
Emerald	1,320	.....	a 300	a 700	a 9,500	2,375	.....
Epidote	60	.....	15	.....	.....	10	.....
Feldspar, amazonstone, sunstone, etc	1,110	2,850	a 2,700	2,510	175	1,310	1,285
Garnet, almandine, pyrope, hyacynth, etc	6,460	13,100	1,650	3,100	2,065	860	4,285
Gold quart	1,000	1,010	.....	1,000	1,700	1,900	300
Jasper, petrified wood, bloodstone, etc	1,000	.....	100	475	2,240	6,005	5,275
Opal	180	50	200	270	a 1,875	a 10,925	a 15,130
Peridot	1,300	1,300	300	.....	360	8,100	375
Phenacite	25	95	50	50	.....	.....	.....
Prase	.....	.....	.....	100	.....	.....	25
Pyrite	400	.....	.....	.....	.....	265	50
Quartz, rock crystal, smoky quartz, rutilated quartz, etc	2,580	3,595	2,689	1,335	2,140	2,448	1,640
Rose quartz	6,375	568	2,970	2,537	1,744	865	337
Rhodocrosite	150	.....	.....	.....	.....	.....	.....
Rhodonite	.....	1,250	125	a 6,200	1,300	550	165
Ruby	2,000	.....	.....	.....	210	2,260	200
Rutile	200	.....	25	.....	.....	.....	.....
Sapphire	a 229,800	a 58,397	a 44,998	52,983	a 215,313	a 195,505	238,635
Smithsonite	800	a 1,200	300	.....	25	650	50
Spodumene, kunzite, hiddenite	14,500	a 6,000	15,150	33,000	75	18,000	6,520
Thomsonite	.....	35	100	610	1,500	450	.....
Topaz	2,300	4,435	512	884	2,675	375	736
Tourmaline	a 81,120	a 90,000	a 133,192	a 46,500	16,445	a 28,200	7,650
Turquoise and matrix	23,840	a 147,950	a 179,273	a 85,900	a 44,751	10,140	8,075
Variscite, amatrice chloruiahlite, utahlite	7,500	14,250	35,938	a 26,125	a 5,750	a 8,450	a 6,105
Miscellaneous gems	.....	.....	1,060	2,755	3,224	4,408	2,920
Total	471,300	415,063	534,380	295,797	343,692	319,722	319,454

a Estimated or partly so.

IMPORTS.

The imports of precious stones into the United States during the calendar year 1913, as reported by the Bureau of Foreign and Domestic Commerce, were the largest ever recorded, $45,431,998, and exceeded those of 1912 by $4,068,673 and those of 1906, the year of next largest imports, by $1,829,522. The principal increase was in diamonds, the greatest increase being in rough or uncut stones. On the other hand, the imports of precious stones during the fiscal year ending June 30, 1914, decreased over $15,000,000 in value[1] from those of 1913. The large decrease may be explained by heavy importations during the middle of 1912–13 to take advantage of the duty then prevailing, since the increase of duty under the new law was expected.

The following table shows the value of the diamonds and other precious stones imported into the United States from 1906 to 1913, inclusive:

[1] Jewelers' Circular-Weekly, July 8, 1914.

Diamonds and other precious stones imported and entered for consumption in the United States, 1906–1913.

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	9,654,219	.....	25,676,302	3,795,175	1,384,376	40,820,430
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

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

Tariff.—Changes in the duty on precious stones imported into the United States under the tariff act of October 3, 1913, include the following: Under paragraph 357, diamonds and other precious stones, rough or uncut, not advanced in condition, including bort and diamond dust, are removed from the free list and are made dutiable at 10 per cent ad valorem. Pearls, diamonds, and other precious stones, cut but not set, suitable for the manufacture of jewelry, are raised from 10 per cent to 20 per cent ad valorem.

It may be of interest to know that paragraph 333, on beads and spangles of all kinds, imitation pearls, etc., strung for transportation purposes only, dutiable at 35 per cent ad valorem, refers to imitation products and does not include beads cut from semiprecious stones such as agate, rose quartz, amazon stone, etc. These are rated as cut gem stones and are therefore dutiable at 20 per cent ad valorem under paragraph 357.