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

MINERAL RESOURCES

OF THE

UNITED STATES

CALENDAR YEAR

1912

PART II—NONMETALS

WASHINGTON
GOVERNMENT PRINTING OFFICE
1913

GEMS AND PRECIOUS STONES.

By Douglas B. Sterrett.

INTRODUCTION.

The principal gem mineral mined in the United States during 1912 was Montana sapphire, of which there was a large output for use both as gems and in mechanical applications. The greater part of the gem sapphires came from the mines in Fergus County, where they occur in a rock matrix. The majority of these stones have the true sapphire-blue color. The bulk of the sapphire for mechanical use came from the placer deposits in Granite and Deer Lodge counties and consists of varicolored stones.

The development of the opal deposits of Humboldt County, Nev., was attended with much success, and a quantity of magnificent gem material was obtained. The opal is of an unusual type, consisting of dark translucent mineral with a variety of rich colors. The deposits promise to supply a gem equal if not superior in beauty to the opal from Australia.

Prospecting and mining at the emerald mine in North Carolina were attended with only partial success. Two pockets or deposits of emerald were removed during the year; other developments consisted mainly of exploratory work, which has continued into 1913.

The tourmaline output of southern California was small, but some magnificent specimen crystals were obtained. Especially fine gem crystals of kunzite were found and brought good prices. The production of turquoise was very small, compared with some previous years. Beautiful amethyst was found in Warren County, N. C., and some fine gems have been cut from sample crystals. A few fine specimens of golden beryl were obtained from prospects in Alexander County, N. C. Beautiful gems were cut from some of these. The production of agate and associated varieties of chalcedony was again large in several Western States.

ACKNOWLEDGMENTS.

Acknowledgment has been made in many places in the following report for courtesies and assistance rendered by different persons. It is not possible to name all of those who have supplied information, such as statistics of production and names of new producers, but such help is highly appreciated. Other persons have assisted either by supplying or exhibiting specimens and information, and further acknowledgment is here given to the following, who have been especially kind in this way: Maj. W. A. Graham, of Raleigh, N. C.; J. H.

Watkins, of the Southern Railway Co., Washington, D. C.; Thomas B. Wilder, of Louisburg, N. C.; G. W. Alston, of Inez, N. C.; J. T. Cashion, of Statesville, N. C.; A. W. Donald, of Charlotte Court House, Va., and Lacey Rush, of Brookneal, Va., for information concerning amethyst; J. E. Turner, of Hiddenite, N. C.; Lovat Fraser, of New York, N. Y.; George L. English, of Shelby, N. C., and A. C. Land, of Taylorsville, N. C., for information concerning beryl, emerald, and hiddenite; A. H. Rutherfoord, of Amelia, Va., and A. B. Whitmore, of Cripple Creek, Colo., for information concerning amazon stone and associated minerals; International Gem Co., of New York City; J. F. Heeney and Deb Roop, of Reno, Nev., for information concerning opal; A. M. Walker, of New York, N. Y., and Richard Stingle, of Philipsburg, Mont., for information concerning sapphire; L. P. Gratacap, of the Natural History Museum, New York, N. Y., and Frank Salmons, of Pala, Cal., for tourmaline and kunzite; Lee McGehee, of Mason, Tex.; Samuel Awalt, of Katemcy, Tex., and D. E. Amarine, of Parker, Tex., for information concerning topaz; Don Maguire, of Ogden, Utah, for information concerning variscite; and George P. Merrill and J. E. Pogue, of the United States National Museum, Washington, D. C., for information concerning petrified wood.

AMETHYST.

DISTRIBUTION.

Amethyst is widely distributed over the Piedmont and mountain regions of the Southeastern States. Some of the deposits have been prospected or mined, and at others no work has been done. Several localities in North Carolina and Georgia were described in this report for 1910 and 1911. Many other localities in North Carolina and Virginia were visited during 1912 and will be described. A few of these seemed promising. At many of the localities the prospects were not seen under favorable circumstances, for little recent work had been done and the best specimens had at most places been already picked up. Pale-purple crystals are all that have been left around many of the prospects. The crystals found on the immediate surface are generally paler colored than those which have not been exposed to the sun and weather, so that surface specimens should not be used as a definite criterion of the color to be expected in those under ground.

NORTH CAROLINA.

The deposits in North Carolina described below are all in the Piedmont Plateau and are associated with the crystalline rocks of that region. Very little work has been done at any of the localities, and prospecting at some of them might result in the discovery of good gems. Fine gem amethyst has already been obtained from some of the localities.

Warren County.—Amethyst occurs at a number of places in Warren County, at some of which fine gem material has been found. An especially promising prospect is located on the Cherry Hill plantation of George W. Alston, at Inez, about 11 miles southeast of Warrenton. There is another promising prospect on the old John Buxton Williams plantation, about 2 miles south of Inez. This place

now belongs to Fuller & Person, of Louisburg, N. C. A few specimens have been found on Mrs. Jennie Connell's plantation, about 2 miles southeast of Inez. Good specimens and gems are reported to have been found on the surface and in a pit at Folly Springs, about one-third of a mile southwest of Warrenton.

Warren County lies chiefly within the Piedmont Plateau region of North Carolina along the border of the Coastal Plain. Its elevation ranges from less than 200 feet above sea level along the rivers to about 500 feet in the less dissected parts of the plateau, in the western portion of the county. In general the country is nearly flat or gently rolling, with steep hills only along the larger drainage lines. Warrenton is situated on a slightly dissected remnant of the plateau. Inez is located in the fork of one of the elevated ridges, and the country immediately around it has small relief. The Williams and Connell places are on two forks of the same ridge, but are nearer Shocco Creek and accordingly in more broken country.

Amethyst has been found at two places on the Alston plantation, about 200 yards south and about 150 yards southeast of the house. Both prospects are located in a slight hollow, the former in the edge of a small patch of woods and the latter in a cultivated field. At the time of examination the prospect in the woods had been opened by a small pit and a trench about 3 feet deep and 10 feet long on the vein. These openings were about 12 feet apart in a N. 30° W.-S. 30° E. direction from each other. No rock outcrops were seen near the amethyst prospect, but the surface is covered with a light sandy soil containing scattered blocks of granite and pegmatite. The country rock around Inez is chiefly granite, with hornblende schist and mica schist both to the north and to the south for a distance of a few miles. The amethyst occurs in a vein from 1 foot to more than 2 feet thick, striking about with the workings, N. 30° W. This vein consists of irregular seams, streaks, and pockets with or without amethyst crystals, in decomposed fine granite and pegmatitic granite. Black manganese oxide is associated with the crystals and fills most of the seams and veinlets; in places it occurs as small botryoidal and stalactitic masses. Many of the crystals are partly or entirely coated with this manganese oxide, and it is only by breaking them or scraping off the coating that the quality of the stone can be determined.

The crystals are rather stout and range from a fraction of an inch to 3 inches in diameter. The majority have transparent clear portions, suitable for gems when the color is good. The crystals range from practically colorless amethystine to rich dark purple. They have a distinctive reddish-violet tint and yield brilliant gems. Under artificial light these gems lose nothing of their beauty but become an even more beautiful lively reddish purple. In many crystals the color is not evenly distributed but is arranged in layers or streaks parallel to certain crystal faces. One transparent fractured crystal from this locality exhibits a remarkable color variation when viewed in transmitted light. The light transmitted directly through the the crystal is a beautiful reddish purple. That transmitted with an interior reflection is a magnificent bluish purple.

About half a bushel of rough crystals were obtained from the two openings. Of these possibly a quart were suitable for cutting into gems of especially fine quality, 2 quarts could be cut into gems of

ordinary quality, and the remainder would probably be suitable only for specimens or might be cut into cheap gems.

The possible extension of this amethyst vein is concealed by its location in the woods. Three small amethysts were found in the light sandy soil of a field about 50 yards S. 40° E. of the pits. Further prospecting might show the continuation of the vein to this point.

No work had been done at the prospect 150 yards southeast of the house, but a quantity of amethystine quartz crystals have been found in the light sandy soil at that place. The crystals are scattered over a belt about 30 feet wide and nearly 100 feet long in a west of north direction. Some of them are quite clear, but only pale purple. Common vein quartz and quartz inclosing plates of titanic iron also occur with the amethyst. An east-west crosscut trench would probably locate the vein.

Only a few specimens of amethysts were seen on the old John Buxton Williams place, but the quality of these and reports concerning the quantities of fine specimens that had been carried away show that the prospect is a very promising one. No digging has been done, but the crystals have been picked up as specimens by different people during many years, apparently with little thought of their possible value. The amethysts are found on a knoll about a quarter of a mile northwest of the house, outside of the southeast corner of the Williams cemetery. The knoll has been cultivated and is covered with light sandy soil containing angular fragments of fine granite gneiss, quartz, feldspar, and pegmatite composed of smoky quartz, potash feldspar, and mica. Porphyritic hornblende crystals were observed along the bedding planes of some of the fine granite gneiss.

The amethysts are scarce on the surface now, but information furnished by persons who have been visitors at the Williams place shows that they were plentiful some years ago. The specimens found at the time of examination consisted of stout crystals, the largest one measuring 2 inches thick and 2 inches long. The color of the best specimens was very similar to that of the amethyst from the Alston place—that is, characterized by a fine reddish-violet tint. These crystals are clear and brilliant. The color is segregated in patches or layers, and is in evident relation to the crystal structure. The large crystal mentioned is rather pale purple and incloses a few scattered reddish rutile needles. One specimen is partly incrusted with black manganese oxide, like those at the Alston prospect. The occurrence of amethysts on the surface with the depth of color and transparency of a few of those found is considered an especially good indication of a deposit containing good gem material.

As far as could be learned no real gem amethyst has been found on Mrs. Jennie Connell's plantation. A few specimens of amethystine quartz have been found in cultivated land north of the house. In the specimens seen the purple occurred in patches through smoky and gray quartz. Rough fragments of smoky and gray quartz are abundant over the ground in the vicinity. Bluish-green fractured beryl has been found in pegmatite a few hundred yards west of the Connell house in a little stream. The possible occurrence of a better grade of beryl suitable for gems had not been determined.

Lincoln County.—There are many occurrences of amethyst in Lincoln County. Besides the few places described below other

localities have been reported. Two prospects were visited on the land of the Misses Rendleman, 2 miles northeast of Iron Station. One of these is about 200 yards south of the old Rendleman home along the east side and on the spur of a small ridge. A few small pits have been dug, but the best specimens observed were loose in the sandy soil of a cultivated field. The crystals were found through a distance of about 100 yards in a north-south direction. The biotite granite gneiss country rock has mostly decomposed to a friable sandy gray saprolite, but around the amethyst prospects it has been hardened by silicification. This process has developed numerous seams and veinlets of quartz crystals, with comb structure through the rock. Some of the larger veinlets carry amethystine quartz and amethyst. Of the crystals found at the time of examination some were pale purple and others a smoky purple. The latter consisted in part of smoky quartz and in part of amethyst, with the different colors generally arranged in layers or zones parallel to the crystal faces. Such specimens furnish good examples of "ghost" or "phantom" crystals. Clear and smoky quartz crystals are also found loose in the soil about 100 feet west of the amethyst lead.

The other and more promising prospect on the Rendleman place is about a quarter of a mile southeast of the house, on a low rocky knoll in a cultivated field. No digging has been done and only surface specimens were seen. The crystals are scattered over an area about 150 feet across, in which no direction of a lead could be determined. The country rock is decomposed granite, but the knoll on which the amethysts are found is covered with rough blocks of silicified granite. Evidently the occurrence of amethyst is connected with this silicification, as at the other prospect, for in some specimens groupings of amethyst crystals are associated with the seams of smaller quartz crystals in the silicified granite. Amethystine quartz crystals measuring 3 inches across were found and specimens more than 1 inch thick were common. A few amethysts of medium dark purple color were seen, but the majority were pale. Some of the crystals are fairly clear and would be suitable for gems if darker colored.

A small prospect was opened for amethysts several years ago on the land of J. P. Lynch, 1¾ miles northeast of Iron Station. The pit is now filled up, but a few pale amethysts were found in the sandy soil at that place and other specimens were seen in the possession of Mr. Lynch. The amethysts were associated with silicified granite, as at the Rendleman prospects. A slab of this rock covered with pale amethysts and quartz crystals, some of them half an inch thick, in the possession of Mr. Lynch, showed that the mineral occurs here lining the walls of a fissure or other cavity. Groups of much larger crystals were found, also. Some of the amethystine quartz crystals are clear and brilliant.

A quantity of smoky quartz crystals and clusters of crystals measuring 2 inches or less in diameter are found on the place of George W. Goodson, about 5 miles north of east of Iron station. So far as known no amethysts have been found here.

A few amethystine and colorless quartz crystals were seen on the place of Miss Mary Forney, about 1¼ miles southwest of Denver. The crystals were found loose in the soil of a cultivated field about 250 yards north of the old Forney home. No work has been done, and probably most of the surface crystals have been picked up.

Better-colored stones than those seen at the time of examination are reported to have been found. The country rock is granite gneiss, decomposed near the surface, inclosing streaks of mica schist. Hornblende gneiss saprolite outcrops near the house and to the west. No vein has been located, and it is probable that the surface specimens came from more than one deposit.

Amethyst has been found at many localities in Iredell County, N. C. Probably the greatest amount of work has been done and the best specimens obtained from the A. C. Cook place, 9 miles southeast of Statesville. No digging has been done at many of the prospects and the only crystals found were loose in the soil. Such prospects were seen on Mrs. M. G. Martin's place, about half a mile west of the Cook mine; on the Burette Brawley place, about 1½ miles south of Cook's; on the J. S. Fisher place, 4½ miles N. 75° W. of Mooresville and 12½ miles south of Statesville; and on the Joe Cornelius place, 6 miles N. 80° W. of Mooresville. Other occurrences have been reported in Iredell County and in Rowan County adjoining, on the land of J. T. Eudy, at Mount Ulla.

The amethysts on the A. C. Cook place were worked about 12 years ago by H. S. Williams, of New York. The prospect had been located by a large quantity of crystals loose in the light, sandy soil of a field. At the time of examination, in 1903, there was a shaft about 12 feet deep with other workings from it badly caved in. The crystals occurred in veinlets and streaks, cutting decomposed pegmatitic granite. A quantity of crystals were left around the workings and a few of gem quality were found washed out of the dirt by rains. It is reported that only a small quantity of amethysts of fairly good color were found, though many crystals were suitable for cutting into less valuable gems. A large quantity of amethystine quartz crystals suitable for specimens and even for cutting into cheap gems was obtained. Some of the darker-purple crystals contained small rutile needles, penetrating them at various angles. The crystals seen reached a maximum of an inch and a half in thickness.

The occurrences on Mrs. M. G. Martin's plantation and on the Burette Brawley plantation are similar. At both places the crystals have been found in coarse, light, sandy, soil formed by the decomposition of granite probably inclosing pegmatite. At both places amethystine quartz crystals measuring nearly 2 inches thick and fairly clear were observed. Better specimens were reported to have been found.

The amethyst on the J. S. Fisher plantation has been found scattered over the surface on about an acre of ground some 200 yards northeast of the house. The crystals are loose in the light sandy soil of a cultivated field, and no location or direction of vein has been determined. It is probable that there is more than one vein in the granite saprolite underlying the field. Only pale-purple and colorless quartz crystals were seen at the time of examination.

On the J. Cornelius place amethyst crystals have been found on the surface in a cultivated field. The field is on a north slope and has gray sandy soil with blocks of partly weathered biotite granite gneiss scattered through it. A ledge of granite gneiss outcrops above the amethyst prospect with a strike of N. 65° E. and a dip of 30° SE. The position and probable direction of the vein have not been deter-

mined. The best colored crystals are reported to be found associated with shells or veinlets of limonite that have weathered out on the surface. Only pale purple and colorless crystals were found at the time of examination, but some of these were quite transparent.

Davidson County.—Amethysts have been found at two places on the plantation of N. H. Swicegood, about 5 miles northwest of Linwood and 1 mile south of Taro, in Davidson County. These prospects are about one-fifth of a mile west and northeast of the house, respectively. At the former place a trench 15 feet long and 8 feet deep was dug along a vein striking about S. 25° W. and exposed in the bank of a stream. This work was done in 1909, and several pounds of good crystals are said to have been found. At the prospect northeast of the house a trench about 15 feet long had been made on a vein striking northwest. This work was done some 25 or 30 years ago, and about 300 pounds of amethysts are reported to have been taken out in one day. Only a few pale-purple or amethystine quartz crystals were found around the prospects at the time of examination.

The rock in the region around Taro is granite with coarse porphyritic phases. Most of it has weathered at the surface to light sandy soil and saprolite. Decomposed porphyritic phases were encountered in the amethyst prospects. This granite area extends within about 1½ miles of Linwood and from that point to Linwood the country rock is chiefly diorite.

Franklin County.—An investigation was made of the reported occurrence of amethyst near Louisburg, Franklin County, N. C. Amethystine quartz has been found there in two places—on the corner of Nash and Cedar Streets in Louisburg and along the public road about 1 mile northeast of the town in front of the cemetery. At Nash and Cedar Streets a few small, pale, clear amethystine quartz crystals were found in the light sandy granitic soil. A specimen from the other locality seen in a private collection in Louisburg consisted of a slab 7 inches in diameter and 2 inches thick studded with clear quartz and amethystine quartz crystals as much as two-thirds of an inch in thickness. No specimens were found at the time of visit to the locality, but this may have been in part due to improvements on the road covering the original prospect. The rock at this point is evidently granitic, as shown by the light soil and saprolite formed by its decomposition.

A large ledge of pegmatitic quartz extends across Thomas B. Wilder's place on Nash Street in a N. 25°–30° E. direction. This ledge contains many cavities lined with small quartz crystals. It is reported that a few amethysts have been found in some of the cavities.

VIRGINIA.

Nelson County.—Amethysts were mined about 5 years ago by the American Gem & Pearl Co., of New York, on the John Saunders place, 2½ miles northeast of Lowesville and 8½ miles N. 60° W. of Arrington, in Nelson County. A dozen or more pits were dug along the summit of a low flat ridge in a N. 70° W.-S. 70° E. direction. The pits cover an area about 300 feet long, its greatest width being about 125 feet. They range from 2 to 7 feet deep. Little could be learned of the nature of the occurrence of the amethysts from the

pits. The gems were found in pockets, one of which is reported to have yielded about 40 pounds. M. D. Rothschild, president of the American Gem & Pearl Co., states that some of the amethysts obtained were very fine.

Rock outcrops are scarce near the mine and the nature of the country rock could not be definitely ascertained. A reddish, somewhat sandy, saprolite containing scattered fragments of bluish-opalescent quartz and a few small bodies of kaolin were encountered in the pits. The saprolite is suggestive of a granitic rock inclosing pegmatite. On the surface of the ground along the ridge there is a little débris of a pegmatitic rock composed of blue quartz, feldspar, and hornblende, with a little apatite in some specimens. These observations agree with the conditions outlined in the report of Watson and Taber [1] on the rutile deposits in the adjoining region, in which the country rock is described as a complex metamorphosed gneiss of igneous origin corresponding to quartz monzonite. This gneiss is intruded by various later igneous rocks, among which is pegmatite consisting essentially of feldspar and blue quartz with hornblende, apatite, and rutile present in many places. This rock forms the rutile ore in some of the mines operated for that mineral.

Amherst County.—A rather promising occurrence of amethyst is known on the W. P. Sutton place at Fancy Hill, one-third of a mile north of Sandidges post office and 7 miles N. 33° W. of Amherst, in Amherst County. The crystals have been found along a ridge at two places, one about 250 yards and another about 100 yards northeast of C. H. Floyd's house. At the first place amethystine quartz crystals have been picked up in some quantity from an old woods road leading off of the ridge to the northwest. At the second place only a few crystals have been found in the same road along the summit of the ridge. No digging has been done at either place, but it is possible that little work would be required to locate the veins. The country rock of the region surrounding the amethyst deposits is a gneiss of granitic composition, intruded by pegmatite and pegmatitic granite with a porphyritic texture. The pegmatitic rocks contain abundant blue opalescent quartz similar to those of the rutile region in Nelson County already mentioned in the description of the American Gem & Pearl Co.'s amethyst mine.

The amethyst crystals found range from very pale purple to fairly dark purple. In some specimens the purple inclines to a light reddish violet of very pleasing tint. Segregations or patches of color are common in the crystals, their positions generally being influenced by the crystal structure. The majority of the crystals seen were short stout prisms with one or both ends terminated by the rhombohedral faces. Most of the crystals were less than an inch thick. Colorless quartz crystals occur at other points on the Sutton place.

Charlotte County.—Amethyst is found on the A. W. Donald plantation, about 2¼ miles north of west of Charlotte Court House, in Charlotte County. The occurrence of these crystals has been known to members of the Donald family for more than 35 years. Many specimens have been picked up as curiosities, but no use has been made of them as gems. The amethysts have been found rather

[1] Watson, T. L., and Taber, Stephen, The Virginia rutile deposits: Bull. U. S. Geol. Survey No. 430, 1910, pp. 200–213.

plentifully scattered over the fields through a distance of about 200 yards in an east of north and west of south direction. The road from the house to town crosses this lead. A few small test pits have been made, one northeast and others southwest of the road.

The country rock exposed near the amethyst prospects is hornblende gneiss and schistose diorite inclosing granite and pegmatite. The strike of the diorite is N. 10°–45° E. and the dip 40°–60° SE. The lead of amethyst cuts this at a small angle having a more northerly trend. The pit northeast of the road was made some years ago and is now filled up. Many pale amethystine quartz crystals are scattered over the surface here, and Mr. Donald states that amethysts were found equal in color to those from the later pits. In a trench about 4 feet deep and in other small pits on the southwest side of the road several seams and pockets of amethystine quartz and amethyst crystals were found in dark-red clay, probably decomposed hornblendic rock. The seams were irregular in size and direction. In places they opened into pockets of crystals.

A large number of amethysts were plowed up in the field a few yards south of this place, at which point an irregular vein striking N. 15° W. with a vertical dip was exposed by a pit 2½ feet deep. This vein was inclosed in hornblende gneiss saprolite and ranged from 2 inches thick at the surface to 12 inches thick in the bottom of the pit. The thicker part was composed of more than one streak of crystals embedded in red clay. A lump of clay about 12 inches thick removed from the vein apparently contained 4 streaks of amethyst crystals, 1 to 3 inches thick, with red-clay filling between. These four streaks were in reality only two veins lined with a layer of crystals on each wall. The crystals grew with their points turned toward the opposite wall of the vein, but failed to fill the fissure in which they formed. In this way veins with typical comb structure were produced with cavities or vugs in the middle. By weathering the inclosing hornblende gneiss was changed into a red clay saprolite and some of this clay was washed into the cavities in the veins.

A quantity of amethysts were plowed up in the field about 20 yards south of this pit. The groupings of the crystals found here indicate a deposit similar to that exposed in the pit just described.

No fine gem amethysts were seen at the Donald prospect, but the examination was not made under most favorable conditions. The majority of the crystals are rudely developed owing to mutual interference during growth. Most of them have the rhombohedral terminations at one end with only part or none of the prism faces. The rest of such crystals show striated indentations formed by contact with other crystals. Most of the amethysts from the 2½-foot pit described above are coated with a shell of lighter colored or gray quartz less than a millimeter thick. The stones range from practically colorless, to amethystine quartz, to crystals with a fine deep-purple color. As is common in amethysts the color is not evenly distributed through the crystals, but is stronger in one part than another. The patches of color are influenced by crystal structure as shown by their shape and position. The majority of the crystals are not highly transparent, but a few were seen which would cut into small clear gems of rich violet color.

Amethyst has also been reported on the Wingo place, about 4 miles south of Charlotte Court House.

Campbell County.—Amethyst occurs in several places in Campbell County. Crystals have been picked up in a field and a few dug from the roadside on the land of Lacey Rush, about one-third of a mile northeast of Brookneal. Two large crystals have been found here, one measuring nearly 10 inches long and 4 inches thick. The purple color in this crystal is rather pale and occurs chiefly in two layers parallel to two rhombohedral faces at one end. The rest of the crystal is colorless or gray. Colorless quartz crystals are more plentiful than the amethystine-colored ones.

Amethysts and amethystine quartz crystals have been found on the L. H. Clay place, about 10 miles northeast of Brookneal and nearly 3 miles south of west of Red House. They are rather sparingly scattered over the fields 200 to 400 yards northwest of the house. One crystal 2½ inches long and seven-eighths of an inch thick was seen, one end of which was medium dark reddish violet. Amethysts are also reported in the fields of the Shelton Jennings place, three-fourths of a mile southwest of the Clay house.

Practically no work has been done at any of these places. All of the prospects are in areas of light sandy soil formed by the disintegration of granitic rock. The three localities mentioned apparently lie on the same belt of schistose granite extending northeast through Brookneal. In the outcrops this is seen to be schistose biotite-muscovite granite with porphyritic phases.

BERYL.

NORTH CAROLINA.

Alexander County, N. C., is famous for its gem and specimen minerals. Beryl occupies a prominent place among these, and has been found at a number of localities. Emerald and aquamarine varieties have been mined near Hiddenite, associated with green spodumene (hiddenite) and many other minerals of gem or specimen value. Occasional specimens of gem beryl have been reported from the region west and northwest of Taylorsville, and recent finds of valuable yellow and golden beryl have been made by a small amount of prospecting. Most of the gem localities of Alexander County have been idle for a number of years.

The emerald-hiddenite mine has not been operated since 1907, when the last work was done by the late Cary Wright for the American Gem Mining Syndicate. A description of these operations was given in this report for 1907. The workings are filled with water, and the whole mine site has grown up in a thicket of brush and trees. The writer was fortunate in having Mr. J. E. Turner, foreman of the mine when in operation, point out places of interest. The open cut is about 150 feet long, 20 to 50 feet wide, and 15 to 20 feet deep. The cut has a roughly east-west direction, and was made in red clay saprolite formed by the decomposition of a biotite gneiss country rock. Other pits and shafts were made near the open cut. Several veins were followed down into hard rock by two shafts 40 to 50 feet deep.

The gems occur in more or less parallel veins which are not continuous through many feet. Most of these veins have north of east strike and a high northerly dip. In places the veins run out into seams and in other places they open into pockets lined with crystals

of several minerals, such as quartz, calcite, dolomite, muscovite, rutile, black tourmaline, beryl, hiddenite, pyrite, and monazite. A pocket opened in one of the shafts was so large that W. E. Hidden is said to have crawled inside of it. The array of glittering crystals lining this pocket is described as a wonderful sight.

A quantity of fine beryl and hiddenite crystals was obtained from the saprolite removed from the open work. Promising specimens of gem beryl with some hiddenite and many quartz crystals were found in the openings north and west of the mine. Mining operations in the saprolite are easy, but in the fresh biotite gneiss they are difficult. Mr. Turner suggests, and an examination of the locality seems to support his suggestion, that more of the saprolite along the sides of the open cut and at the west end might profitably be removed and washed. If the gently rolling country around the mine were kept under cultivation a good chance would be offered to locate other veins or to determine the trend and possible continuation of the gem formation by a careful search of the fields after rains.

Gem beryl crystals have been found at several places in the region around Hiddenite, and one good hiddenite crystal is reported to have been found about 1 mile east of the mine. These finds, taken into consideration with the widespread occurrence of beautiful crystals of quartz, rutile, and other minerals, such as were found in the veins of the emerald-hiddenite mine, indicate the possible occurrence of other valuable gem deposits in the region.

W. E. Hidden [1] mentions an occurrence of emeralds and hiddenite discovered by W. H. Lackey on the Osborne-Lackey place, one-fifth of a mile northwest of the emerald-hiddenite mine. About 50 emerald crystals, 2 to 7 centimeters long and 2 to 8 millimeters thick, were found. They were transparent but pale colored. One crystal was large and pure enough to cut for gems. The hiddenite crystals were pale colored and of very inferior quality.

Some promising beryl crystals have been found in a prospect on W. H. Warren's place about 1½ miles southeast of Hiddenite. A pit 25 feet long and 15 feet deep was opened in a field where a few surface specimens had been found. A pegmatite vein nearly 8 feet thick with an approximate east and west strike and vertical dip was encountered in a decomposed gneiss formation. The latter is probably biotite gneiss inclosing granite and lies nearly flat. The pegmatite is composed of orthoclase or microcline, gray quartz, and green muscovite, with some biotite, black tourmaline, dark red opaque garnet, and beryl. The beryl occurs in pale greenish or aquamarine, yellow, and nearly golden-colored crystals. The largest crystal seen measured 1 by 1⅓ inches. Most of the specimens remaining in Mr. Warren's possession are somewhat checked and flawed, but some have small clear portions which are very brilliant.

Beryl crystals are reported to have been found at two places in the fields on the land of Alexander Miller adjoining the Warren place. Transparent, slightly smoky quartz crystals were seen at one of these prospects.

Beryl crystals have been found in two places on the estate of the Miller heirs, 1½ miles east of Hiddenite on the ridge between Davis Creek and Little Yadkin River. Good specimens are reported from

[1] Hidden, W. E., Am. Jour. Sci., 3d ser., vol. 29, 1885, pp. 250–251.

this property, and G. F. Kunz,[1] quoting J. A. Stephenson, describes two of them as emeralds "of good color and quite transparent, but very rough on the surface." Since these crystals were found, several prospects have been opened and beryl found in two veins. Quantities of quartz and some fine rutile crystals were obtained from the other openings. In one prospect on a steep hillside above Davis Creek good deep aquamarine-colored beryl crystals are reported to have been found in pegmatite. This pegmatite is composed of orthoclase feldspar, greenish muscovite, smoky quartz, and black tourmaline. The other beryl prospect is about 200 yards northwest of the one mentioned and consists of two sets of openings about 100 feet apart. The beryl occurs in pegmatite cutting a decomposed gneiss, probably biotite gneiss, with an easterly strike. Little could be learned of the results of the prospecting.

Some of the beryl prospects northwest of Taylorsville and to the north of All Healing Springs were examined in November, 1912. All Healing Springs are 5 miles N. 83° W. of Taylorsville, or about 6½ miles by road. No work was in progress at the time of examination, and the prospects seen had been made from one to several years before. The following month a little further work was done on some of the prospects and very fine gem material was obtained. Good specimen and gem beryls are reported to have been found in the earlier work, but through misplaced confidence in a tramp miner, nothing was realized on them by the owners, who therefore became discouraged and stopped prospecting. The prospectors are now receiving good prices for their gem beryl, and it is hoped interest in mining for them will be revived.

Especially fine beryl has been obtained from a prospect on Eli Barnes's place, 1¼ miles N. 20° W. of All Healing Springs. This prospect is in a field on the west slope of a small hill about 200 yards northwest of the house. At the time of visit the work consisted of a trench about 20 feet long and 2 to 5 feet deep on a pegmatite vein striking about N. 15° W. The vein is about 4 feet thick and was exposed at both ends and in the bottom of the trench. The country rock is a gneiss, granitic in character, and has decomposed to a granular reddish earth covered by light sandy soil. The pegmatite is composed chiefly of orthoclase or microcline feldspar and quartz, with a little mica, black tourmaline, beryl, and garnet. The best beryl is reported to have been found along a quartz streak or vein from a few inches to 1 foot thick in the pegmatite. This quartz vein pinched out in the bottom of the trench but was exposed in the north end. The feldspar occurs in masses and rough crystals several inches thick, inclosing rough gray crystals and masses of quartz and other minerals. Some of the quartz is slightly cloudy or translucent dark gray. The black tourmaline occurs in the common rounded triangular crystals measuring up to an inch in thickness. Fragments of dark-red semigem garnet crystals more than an inch thick were observed. The beryl crystals occur in both the feldspar and the quartz, and some are closely associated with black tourmaline. Only inferior specimens of colorless, white, yellow, and greenish-yellow beryl crystals were found around the prospect, but a few better specimens were held by

[1] History of gems found in North Carolina: Bull. North Carolina Geol. and Econ. Survey No. 12, 1907, p. 38.

the owners. One of these was a beautiful light, clear straw-yellow crystal which has since been cut into two perfect gems weighing 1.5 and 0.4 metric carats. These stones are very brilliant but slightly pale for the best gems. Some of the light-colored and colorless beryls would yield very brilliant gems.

Since this prospect was examined in November, 1912, a beautiful clear yellow beryl crystal weighing 70.5 grams or 352.5 metric carats, has been found. This crystal has been fractured at the ends and measures in its present form 25 by 30.5 millimeters thick and 33 to 48 millimeters long. There are three larger cracks across the crystal and other smaller flaws. The prism faces have rhombic etchings. Much of the beryl is limpid and clear and of fine gem quality. It has a light golden or rich honey-yellow color.

Good beryl is reported to have been found in the prospect of Thomas Barnes, 2 miles N. 30° W. of All Healing Springs, on a spur extending east from a mountain ridge. The prospect has been opened by four pits and open cuts in a distance of about 125 feet in a N. 15° W. direction across the ridge. The deepest pit was about 10 feet. The country rock is mica schist and gneiss containing cyanite and garnet. These rocks strike about east and west with a vertical dip. The beryl occurs in pegmatite, cutting the country rock with a strike of N. 15° W. and a dip of about 70° W. The pegmatite is about 3 feet thick and incloses a quartz streak or vein 1 foot thick parallel with its walls through the whole distance opened. A quantity of mica was found along this quartz vein in the work, and for this mineral the prospect was in part opened. Mica crystals 6 inches in diameter were found, but the quality and quantity could scarcely be considered of commercial value. Golden, yellow, greenish, and colorless beryl crystals were found. The beryl occurs along the contact of the quartz streak with the feldspathic part of the pegmatite chiefly in granular to coarsely crushed glassy phases of the quartz. Black tourmaline occurs in the pegmatite, and some is associated with the beryl in the quartz. The largest beryl crystal found is reported to have been about 3 inches thick and 18 inches long. A section of this about 3 inches long was seen at Nathan Barnes's house. It was light-colored, mostly opaque, and not of gem quality. Small yellow to golden beryl crystals with fine clear portions were seen, indicating the occurrence of good gem material in the vein.

The presence of another pegmatite 15 feet west of the deep pit was shown in a small prospect pit.

At the prospect on James Chapman's place, formerly owned by Mike Swim, 1¾ miles N. 15° E. of All Healing Springs, a pit, now nearly filled up, 10 or 12 feet deep, was made on a pegmatite deposit. A vein striking about N. 25° W. was found inclosed in a gneiss of granitic nature. The presence of hard fine-grained biotite gneiss débris around the dump causes uncertainty as to whether the country rock may not be biotite gneiss injected by granite and not granite gneiss. A couple of hundred yards west of the prospect the country rock is cyanite schist. The pegmatite incloses a quartz streak about 1 foot thick. This quartz is mostly glassy and crystallized and some is smoky brown. The feldspar occurs in rather large masses, and a rough crystal with a cleavage face 8 inches across was seen on the

dump. Some graphic intergrowths of quartz and feldspar occur. In some of the blocks seen on the dump pegmatite appears to grade into coarse granite. Black tourmaline and muscovite and biotite mica were also present. Good golden and yellow beryl are reported to have been found in this prospect.

Golden and yellow beryl are also reported to have been found in a prospect on John Webster's place, about 1¼ miles N. 50° E. of All Healing Springs. This prospect has been opened by three small pits in a N. 15° W. direction, on a hillside. The deposit could be worked by a drift on the vein from the north, probably more than 30 feet lower than the present pits. The country rock is mica schist injected with granite. The beryls were found in pegmatite associated with a streak of glassy smoky quartz. The feldspar of the pegmatite occurs in masses which yield cleavage faces several inches across. Muscovite, biotite, black tourmaline, and beryl are accessory minerals of the pegmatite.

A distorted crystal of beryl measuring about 20 by 35 by 42 millimeters was found by Felix Webster in a field on George Teague's land a few hundred yards north of John Webster's prospect. This crystal has a pale-yellow color and is rather badly fractured. It contains clear portions sufficiently large to cut a few gems of less than one-half carat weight.

Specimens of beryl crystals from Cleveland County, N. C., with notes on their occurrence, were shown to the writer by Mr. George L. English, of Shelby, N. C. The prospect is on the Whisnant place, on the west side of Broad River, near Hollybush. It was opened by Messrs. Whisnant and Morrison, of Hollybush, by a shaft about 30 feet deep. The vein is pegmatite with considerable black tourmaline scattered through it. Many pounds of rough beryl crystals were found, and among them were a few crystals of gem quality. The latter were light-yellow and greenish with portions sufficiently free from flaws to cut. A gem of nearly two carats weight cut from a pale-yellow crystal was very brilliant and pretty.

CHRYSOPRASE.

ARIZONA.

The chrysoprase deposits of Riggs & Walker, about 20 miles west of Mineral Park, Mohave County, Ariz., briefly described in these reports for 1908 and 1911, have been taken over by John L. Riggs, of Chloride, Ariz. The peculiarity of the occurrence of this chrysoprase in rhyolite porphyry and not in serpentine, as is usual, has been mentioned. Mr. Riggs has kindly furnished additional specimens for examination. A feature of some of these specimens is a banding of fairly dark and light-green chrysoprase with layers of gray and pale-purplish cherty chalcedony. This stone would make unique cameos in which a variety of effects could be obtained. A large number of other patterns and contrasts of color can be secured by cutting brecciated jasper and flint matrix with a chalcedony and chrysoprase filling.

DIAMOND.

ARKANSAS.

According to John T. Fuller,[1] no great advances were made in diamond mining in Arkansas during 1912. The Ozark Diamond Mines Corporation erected a steam washing, crushing, and recovery plant, capable of treating 100 loads of 16 cubic feet per day, which ought to be in operation during 1913. A small washing plant was erected on the property of the Arkansas Diamond Co. and operated intermittently, recovering 35 diamonds. Additional test pits and one diamond drill hole were sunk.

Mr. Howard A. Millar [2] has kindly furnished notes on the work of the Kimberlite Diamond Mining & Washing Co. This company owns one of the later-discovered areas of peridotite and has a long term lease on the Mauney tract covering a part of the original peridotite area. A diamond washing plant is under construction on Prairie Creek, near the edge of the town of Kimberly. A tram 4,300 feet long is being built between the washing plant and the Mauney lease, and it is proposed to construct another tram to the other peridotite outcrop owned by the company. Actual washing is expected to begin in May, 1913. Five diamonds were found in 1912 during the course of cleaning around the mines preparatory to systematic mining. These stones were clear white and of good quality. A yellow or amber-colored diamond was found early in 1913. Mr. Millar mentions the finding of a fine white diamond weighing over 7½ carats by a Mr. Blanchard during 1912 on one of the later-discovered peridotite areas.

It has been practically impossible to determine the quantity and value of the diamonds found in the Arkansas field since the first discovery in August, 1906. Most of the stones are still held by the mining companies and few have been sold. It is estimated from the figures furnished the Survey and from reports in the press and those furnished by private persons that about 1,400 diamonds weighing nearly 550 carats have been found from August, 1906, through December, 1912. The total estimated value placed on this output in these reports amounts to $12,108.

The latest information concerning the geology of the Arkansas diamond region and the new peridotite areas is contained in a report by H. D. Miser,[3] from the manuscript copy of which the majority of the following notes have been abstracted:

At the time of Mr. Miser's visit, late in 1912, four areas of peridotite were known. The first of these was described by J. C. Branner and R. N. Brackett [4] and later by G. F. Kunz and H. S. Washington [5] after the discovery in 1906 of diamonds associated with it. This outcrop is 2 to 2½ miles S. 25° E. of Murfreesboro, in section 21, and covers an area of more than 50 acres. Three companies hold this area, the Arkansas Diamond Co., the Ozark Diamond Mines Corporation, and the Kimberlite Mining & Washing Co.

---

[1] Eng. and Min. Jour., Jan. 11, 1913, p. 75.
[2] Personal correspondence, dated St. Louis, Mo., June 13, 1912, and Feb. 8, 1913.
[3] New areas of diamond-bearing peridodite in Arkansas: Bull. U. S. Geol. Survey No. 540–U (in press).
[4] The peridotite of Pike County, Arkansas: Am. Jour. Sci., 3d ser., vol. 38, 1889, pp. 50–59.
[5] Diamonds in Arkansas: Trans. Am. Inst. Min. Eng., vol. 39, 1908, pp. 169–176.

The second area was described by A. H. Purdue,[1] but prospecting has developed further points of interest. It is 3 miles S. 75° E. of Murfreesboro, in sec. 14, and is held by the American Diamond Mining Co. The exposures of the peridotite and its weathered products are on a steep north hill slope. Prospecting has been carried on by shallow pits, trenches, cuts, a shaft, a tunnel, and drill holes. The peridotite exposures occur within an area of 2½ acres, but the drill holes show that this rock is much larger under and near the surface. Dikes extend outward from the mass of peridotite, or large bodies of the country rock are included in it, or probably both conditions exist.

On the property of the Kimberlite Diamond Mining & Washing Co., about one-fourth mile northwest of the American Diamond Mining Co.'s tract, in sec. 14, peridotite has been exposed in pits, trenches, and drill holes. The apparent form of intrusion, judging from present exposures, is that of a crescent-shaped dike with a northeast-southwest strike. This dike is at least 700 feet long and possibly 100 feet wide at the surface, but may be found wider after further prospecting.

There are two exposures of peridotite on the Grayson-McCloud Lumber Co.'s tract, about half a mile southwest of the American Diamond Mining Co.'s property. One of these is at the "Black Lick" near the northwest corner of sec. 23 and the other is about 900 feet to the east. Two test pits were made at these places by Mr. Miser, in which the greenish earth was found to retain the original texture of the peridotite. These two exposures may be on the same mass of peridotite. Hand specimens from these pits closely resemble the decomposed peridotite on the American Diamond Mining Co.'s property, in section 14.

The nature of the peridotite and its products from weathering are similar at the four areas discovered. The fresh peridotite is dark-greenish to brownish-black and in places presents a porphyritic texture. Altered phases become rather more greenish with an earthy appearance and grade into greenish and yellowish soil. A dark to black "gumbo" soil results from the presence of vegetable matter. Numerous inclusions occur in the peridotite, among which black shale, baked by the heat of intrusion, are common.

The rocks of this part of Arkansas are chiefly sedimentary and are of Ordovician, Carboniferous, Cretaceous, and Quaternary age. The Ordovician and Carboniferous rocks, consisting of shales, sandstones, novaculites, and cherts, outcrop a few miles north of the area in which the peridotite has been found. The peneplaned surface of the Carboniferous rocks is overlain by the Trinity formation, of the Lower Cretaceous, consisting of intercalated beds of marly clay, sand, gravel, and limestone. The Trinity formation is unconformably overlain by the Bingen sand, of the Upper Cretaceous, consisting of intercalated beds of gravel, sand, and clay.

The peridotite cuts the Trinity formation, the clays of which were baked to a hard semivitrified rock by the heat of the intrusion, but is overlain by the Bingen sand. At one place, near known peridotite areas, the gravel at the base of the Bingen sand contains altered grains of serpentine and fragments of peridotite. The age of intru-

[1] A new discovery of peridotite in Arkansas: Econ. Geology, vol. 3, 1908, pp. 525–528.

sion of the peridotite is shown by the facts stated to be between Lower and Upper Cretaceous. It seem reasonable to assume that the intrusion accompanied diastrophic movements of this period, during which there was a land elevation recorded by the unconformity noted.

INDIANA.

The finding of another diamond in August, 1912, in Morgan County, Ind., again attracts attention to that region. This stone was found by F. Doyle while panning for gold near the junction of Gold Creek and Sycamore Creek. Through the kindness of Messrs. Perry Bradford and R. L. Royse, of Centerton, Ind., the writer was afforded an opportunity to examine this diamond and another smaller crystal found in a previous year. The larger stone weighs 2.28 metric carats. It is a distorted flattened hexoctohedron with strongly curved faces. It is practically colorless with a small dark chrome-green spot near the surface, which gives the whole a slightly greenish cast in certain positions. If it were desired to cut this diamond it would yield a fine gem with probably very small waste. The other diamond weighs 0.135 metric carat. It is an elongated clear light-brownish crystal with curved faces, possibly also a hexoctohedron.

Probably as many as 20 diamonds in all have been found in Morgan and Brown counties during the last 35 years in panning and washing for gold. W. S. Blatchley[1] mentions eight diamonds examined by himself and states that he had "credible information concerning several others." The following notes are abstracted from Blatchley's report: The presence of gold in the gravels of Morgan County has been known over 60 years and was subsequently determined in numerous counties. Records show mining was in progress in 1850, and since that time the gravels at a number of localities have been washed intermittently. The earliest record of the discovery of diamond in Indiana is a note by E. T. Cox[2] mentioning a stone weighing 3 carats from Little Indian Creek, in Morgan County, and the discovery of several diamonds in Brown County, one of which weighed 4 carats. Of the eight diamonds seen by Blatchley, the largest was the Stanley diamond, found in 1900 in a branch of Gold Creek, Morgan County. This stone was an octohedron and weighed $4\frac{7}{8}$ carats. It had a peculiar greenish-yellow tinge with a black spot, not quite central. It was cut into two stones weighing $1\frac{1}{8}$ and $1\frac{1}{16}$ carats, respectively. The other stones ranged from less than one-eighth of a carat to $1\frac{23}{32}$ carats in weight and consisted of dodecahedral and hexoctohedral crystals of white, yellow, brownish-yellow, bluish, and pink colors.

A large variety of minerals and rocks are found associated with the gold and are accordingly associates of the diamonds. The concentrates obtained by the present writer from a deposit on Highland Creek, in Morgan County, contain large quantities of black sands and pebbles, composed of magnetite, hematite, titanic iron, pyrite or marcasite, and small quantities of corundum, garnet, zircon, cyanite, etc. Bowlders in the stream gravels consist of numerous basic rocks, as gabbro, diorite, diabase, and amphibolite, and also of granite,

[1] Gold and diamonds in Indiana: Twenty-seventh Ann. Rept. Indiana Dept. Geology and Nat. Resources, 1902, pp. 11–47.
[2] Eighth, Ninth, and Tenth Ann. Repts. Indiana Geol. Survey, 1878, p. 116.

garnetiferous granite, gneiss, and pegmatite. Some of the corundum approaches the gem variety, sapphire, in quality. A few clear blue stones have been found and numerous bronze-colored fragments, some of which show a strong chatoyancy when cut "en cabochon." The bedrock of this region is loose shale and sandy shale which has been lightly folded. Some of it contains quantities of sulphide concretions, pyrite or marcasite. This shale probably belongs to the Mississippian series which constitutes the lower part of the Carboniferous.

The gravel deposits of the creeks and streams in the areas mentioned are composed of material entirely foreign to the bedrock of this part of Indiana. They have resulted from the erosion of the glacial drift deposits of the region, the materials of which are derived from far to the north. Two areas of glacial drift have been mapped by Frank Leverett [1] in this part of Indiana, the older or pre-Wisconsin drift and the later or Wisconsin drift. Mr. Leverett has kindly furnished the following information: "The portions of Morgan and Brown counties in which gold and diamonds are found are covered by pre-Wisconsin drift, the Wisconsin drift lying north of these areas. In Morgan County Sycamore Creek heads in Wisconsin drift and runs through an area of the earlier drift. Highland and Cold creeks head in and flow through the pre-Wisconsin drift only."

Diamonds are reported to have been found associated with glacial drifts and at several localities in Wisconsin, near Milford, Ohio, and near Dowagiac, Mich. These finds have been summarized by W. H. Hobbs [2] in a discussion of the possibility of tracing back the route of the glacial drift matrix to the original source of the diamonds. A comparison of the weight, color, crystal form, and markings shows a wide variation in the nature of the stones found. By plotting the diamond localities and the glacial striæ recorded by the study of different geologists Hobbs concludes that the source of the diamonds is far northward beyond the Great Lakes in Canada.

CALIFORNIA.

Information concerning the finding of diamonds in Butte County, Cal., during 1912, has been furnished by Messrs. Harry Jacoby and M. J. Cooney, of Oroville, and D. L. Vinton, of Cherokee—all residents of that county. Three diamonds were found during washing for gold in the placers of Cherokee Flats. One stone found by John Hufford has been cut and is now in the possession of R. S. Powers, of Oroville. This diamond weighed $1\frac{1}{16}$ carats before cutting and yielded a fine white flawless gem weighing $\frac{17}{32}$ carat.

TEXAS.

Mr. L. M. Richard, of Stamford, Tex., has kindly furnished information concerning a reported discovery of a diamond in Texas. The find was made in June, 1911, by Elcy Black in loose sand and gravel in Foard County, section 64, block 44. The specimen was reported by the Klein Bros. Lapidary Co., of Chicago, Ill., to be a rough diamond, rather brown, but fairly clear, that would yield a cut gem

[1] Mon. U. S. Geol. Survey, vol. 38, 1899.
[2] Diamond field of the Great Lakes: Jour. Geology, vol. 7, 1899, pp. 375–388.

weighing about one-fourth of a carat. Mr. Richard states that this discovery has been proved authentic.

C. H. Gordon's map [1] of this part of Texas shows a large part of Foard County to be covered by the Seymour formation of Pleistocene age, consisting of sands and gravels overlain by fine silts. The valleys contain outcrops of Clear Fork and Double Mountain formations of Carboniferous (Permian) age. Recent alluvium is shown in some of the valleys. In places the later conglomerates, called "upland gravels," probably in part belonging to the Seymour formation, are cemented by lime into hard masses which have in some cases been mistaken for the Permian gravels.[2] M. J. Munn, of the United States Geological Survey, suggests that possibly some of the unconsolidated gravels in the region east and northeast of Foard County, in Texas and Oklahoma, are of more recent age than the Seymour. The presence of more than one gravel formation in the region, some of which resemble one another, makes difficult the placing of the reported diamond in its proper stratigraphic position. Mr. Richard refers it to the Clear Fork formation, but there is a possibility of its having come from gravels of the Seymour formation or from later gravels.

The nearest outcrops of eruptive rocks lie some 60 miles northeast of Foard County in the Wichita Mountains, Okla. They have been described by J. A. Taff [3] in four general classes as gabbro and related anorthosite, granite and associated aplite, granite porphyry and associated aporhyolite, and diabase. These rocks are considered older than Middle Cambrian and probably of pre-Cambrian age.

AFRICA.

UNION OF SOUTH AFRICA.

Cape Colony.—The production of diamonds during the fiscal year 1912 by the De Beers Consolidated Mines [4] amounted to 2,087,392 carats, as compared with 2,180,856 carats in 1911. Actual sales during the year amounted to 2,058,397 carats at £5,524,475 ($26,884,858). The total production of blue ground in 1912 amounted to 7,950,442 loads, as compared with 8,105,138 loads in 1911. The total quantity of blue ground and tailings washed during 1912 was 7,995,953 loads, as compared with 9,219,192 loads in 1911. The yield in carats of diamonds per load of blue ground wash increased from 0.28 to 0.31 at the De Beers and Kimberly mines, from 0.27 to 0.29 at the Wesselton mine, from 0.38 to 0.41 at the Bultfontein mine, and from 0.21 to 0.23 at the Dutoitspan mine. The De Beers mine has not been reopened since it was closed in 1908, but a small amount of prospecting was carried on. The main shaft at the Kimberly mine is 3,601 feet deep, and hoisting is now done from the 3,520-foot level. The value per carat of the diamonds obtained from the different mines was as follows: De Beers and Kimberly 53s. 11.47d., Wesselton 45s. 3.12d., Bultfontein 40s. 8.24d., and Dutoitspan 83s. 0.13d.

[1] Geology and underground waters of the Wichita region, north-central Texas: Water-Supply Paper U. S. Geol. Survey No. 317, 1913, Pl. 1.

[2] Udden, J. A., and Phillips, D. McM.: A reconnaissance report on the geology of the oil and gas fields of Wichita and Clay counties, Texas: Bull. Univ. Texas, No. 246, 1912, p. 107.

[3] Geology of the Arbuckle and Wichita mountains in Indian Territory and Oklahoma: Prof. Paper U. S. Geol. Survey No. 31, 1904.

[4] Twenty-fourth Ann. Rept. De Beers Consolidated Mines, for year ending June 30, 1912.

A feature of South African diamond mining during 1912 was the absorption of the Voorspoed [1] diamond mine, in Orange River Colony, by the De Beers Consolidated Mines.

GERMAN SOUTHWEST AFRICA.

The production of diamonds in German Southwest Africa [2] for the year ended March 31, 1912, amounted to 766,465 carats, which were sold for $4,712,831, as compared with 792,642 carats, sold for $4,888,279, in 1911. The production from April 1 to September 30, 1912, was large and amounted to 439,261 carats, sold for $2,837,539. A shortage of labor in the German Southwest Africa mines has been in part filled by importation of "Cape bays."

EMERALD.

NORTH CAROLINA.

The emerald mine near Shelby, N. C., described in these reports for 1909, 1910, and 1911, has been acquired by the Emerald Co. of America, with office in New York City. The property was formerly known as the Turner emerald mine, but is now called the "Old Plantation mine." This name and that of "Cotton boll pit" for the principal opening allude to the location and discovery of the mine in a cotton field on the Turner plantation.

The discovery of this emerald deposit was made in 1909, but the presence of emeralds in the region has been known for some years. George L. English, of Shelby, N. C., endeavored unsuccessfully to locate the source of two emeralds reported to have been found on the Border farm, about 1 mile east of Turner's, some 18 years ago. George F. Kunz [3] mentions the finding of an emerald about the year 1897 near Earle, N. C. Kunz describes this emerald as a broken fragment of good color, better than anything observed from North Carolina and closely resembling the material from the Muzo mine of Colombia. The stone was somewhat flawed but was cut into a trapeziform or subtriangular gem, weighing $4\frac{15}{16}$ carats. Earle is $3\frac{3}{4}$ miles southeast of the "Old Plantation mine," and it is possible that the stone referred to came from that deposit. Nevertheless, it is well to keep in mind the possibilities of the occurrence of other emerald deposits in this region, since rock associations similar to those at this mine occur at other places.

Mining and prospecting were continued at the Old Plantation mine through 1912 and are still in progress (April, 1913). Deposits of emeralds were opened in July and August, 1912, and 269 carats of irregularly shaped pieces and fragments of crystals were obtained. These lots of emeralds consisted of both clear and partly cloudy gem material, the color of some of which was a fine deep green.

Some emeralds of very fine quality have been obtained along with those of ordinary grade. The best stones have the deep grass or emerald green color characteristic of that gem, with only the average amount of flaws or defects usual in the fine-grade material. In other

[1] Min. and Eng. World, Dec. 21, 1912, quoting "Financial News."
[2] Jewelers' Circular Weekly, Jan. 29, 1913.
[3] History of the gems found in North Carolina: Bulletin North Carolina Geol. and Econ. Survey, No. 12, 1907, p. 42.

stones the color may be fine and deep, but defects, such as cracks, cloudiness, or silky inclusions, are prominent. Still other gems of paler color but containing only very slight flaws, if any, are found. The total yield of selected rough emeralds in 1912 is placed at 2,969 carats, with an estimated value of $12,875. This material should yield about 800 carats of cut gems with a greatly increased value, probably $25 a carat or more. Retail values for some of the better emeralds range up to $200 a carat, and one fine stone weighing a fraction over 2 carats was sold for $200 at wholesale value.

Prospecting and development of the deposit and separation of emeralds from the matrix have been carried on under the direction of Lovat Fraser, of New York. The deposit lies in a hill with moderate slope northwest and north, and has been opened by numerous pits, crosscut trenches, and open cuts within a distance of about 100 yards in an east and west direction. The principal development is the cotton-boll pit at the place of original discovery. In November, 1912, this consisted of an open cut of irregular shape about 75 feet long in an east and west direction and 10 to 25 feet deep with a shaft or pit several feet deeper in the bottom. A tunnel 15 feet long was run in from the east end of the cut and a crosscut trench 160 feet long extended north from the bottom of the pit for prospecting, drainage, and to facilitate mining. Other pits and trenches, both east and west, have been made close to the cotton-boll pit. A track about 250 feet long with a mine car is used in the big crosscut trench to carry vein material and waste rock to their respective dumps near a branch north of the mine. Later developments have been reported by Mr. Fraser, which consist of a deep pit about 90 feet south of east and a deep crosscut trench about 200 feet east of the cotton-boll pit.

The general geology of the region and of the emerald deposit was discussed in this report for 1911, but a brief summary is here given in order that the notes on later developments may be more easily understood. The region is composed of mica, garnet, kyanite, graphite, and hornblende gneisses and schists cut by granite, pegmatite, diorite, gabbro, hypersthenite, and other ferromagnesian rocks. The strike of the rock formations is variable between east-west and north-south where the strata are tilted, but over large areas they are essentially flat, with many small rather gentle folds.

The emeralds occur in pegmatite cutting hornblende hypersthenite. Olivine gabbro is closely associated with the hypersthenite either as a magmatic segregation from it or as a separate mass east of the cotton-boll pit. Ferromagnesian rocks closely allied to the hornblende hypersthenite occur at other localities in the region. The common constituents of these rocks are pale-green hornblende, light-brownish hypersthene, olivine, augite, biotite, pleonaste, magnetite, and a little pyrite and pyrrhotite. By weathering, a rock resembling chloritic soapstone is produced. Diorite, broken up by a later intrusion of biotite granite, surrounds the hornblende hypersthenite at the emerald mine. The granite also cuts the hypersthenite, and has become more basic near the contact with it and with the diorite by a partial absorption of those rocks. Pegmatite bodies cut the hornblende hypersthenite in various directions, but the majority have an easterly strike. Some of these have been found grading into pegmatitic granite or coarse granite, and it is probable that the pegmatites are closely associated with the granite masses near the emerald

deposit. The pegmatites form sheetlike or lenticular masses, and the emerald vein proved to be one of the latter. It had a warped east-west strike, and ran close to, if it did not join, a bulge or boss of pegmatitic granite encountered in the tunnel in the east end of the cut. The vein ranged from a seam up to 6 feet in thickness, with a length of about 40 feet and a depth of about 20 feet. It is possible that further work might expose other pegmatite lenses deeper and farther west opening out in the continuation of the seam left where the original vein pinched out. Other veins almost identical in appearance with the original emerald vein were found near by, and some of these are being prospected for emeralds.

The pegmatite of the emerald vein was medium to coarse grained, and was composed of quartz and feldspar, part of which was albite, with some black tourmaline and a little beryl. A few small irregular microlitic cavities were found, and in these the minerals assumed partly developed crystal form. In some of the pegmatites bluish-green apatite occurs, especially in the mass of pegmatitic granite. A few stout crystals of albite and of smoky and colorless quartz have been found in the pegmatite veins. Some of the quartz contains numerous light-colored needle-like inclusions of actinolite. The pegmatite is partly decomposed, so that some of it is ready for washing on sieves, but some is mined in large blocks, which have to be broken separately and examined for emeralds. So far true emeralds have been found in only one vein, but the similarity in the association of minerals and of inclosing rocks in the other pegmatites is considered promising.

In the opening 90 feet south of east of the cotton-boll pit a pegmatite vein was encountered carrying small, clear, nearly colorless beryl crystals and cylindrical rutile crystals, some of which show brilliant red streaks. The beryl crystals yield very brilliant stones when cut. The part of the vein opened appears to lie south of the hornblende hypersthenite area, and the vein will be prospected along its northerly strike to that rock. In the trench 200 feet east of the cotton-boll pit beryl crystals were found in pegmatite at a depth of 12 feet. These crystals were rough in form and of poor quality, with a greenish color. One piece contains some patches of true aquamarine. These beryl crystals ranged from small size up to 2 inches in diameter.

The emerald crystals are being cut preparatory to the market. Several fine specimens are still intact. A fire at the emerald mine in April, 1913, destroyed a quantity of the rough matrix specimens and associated minerals, so that now only a few of such specimens are available.

AUSTRALIA.

A discovery of green beryl and emerald has been reported near Poonah, on the Murchison gold field [1] in western Australia. The occurrence was brought to light through the efforts of H. P. Woodward, assistant government geologist, who assisted in tracing back specimens to their source. The crystals have been found scattered over the surface in dusty soil formed by the decomposition of schist country rock. No work had been done at the time of Mr. Woodward's visit. The formation has been traced nearly 2 miles in a

[1] Min. Jour., London, March 29, 1913.

north and south direction along the contact of granite with greenstones. Some specimens are associated with blue quartz which has doubtless come from pegmatite. The crystals found are described as green, some with rich color, translucent, weathered, and badly flawed.

FELDSPAR GEMS.

AMAZON STONE.

VIRGINIA.

Fine specimen and gem minerals have been obtained from some of the mica mines of the Amelia Courthouse region, Virginia. It is probable that the majority of them came from the A. H. Rutherfoord mine, 1¼ miles north of town, though the exact locality is not given in many of the descriptions of the fine minerals or on their accompanying labels in collections. Descriptions of this locality and its minerals have been given by W. F. Fontaine,[1] T. L. Watson,[2] and E. S. Bastin,[3] and their work is drawn on freely to supplement notes made by the writer in August, 1912. Additional information was kindly furnished by A. H. Rutherfoord.

This part of Amelia County is typical of the Piedmont Plateau region. The larger ridges are rather flat or gently rolling and rise to approximately one general level, 350 to 400 feet above sea level. Except near the larger water courses the slopes and hillsides in the valleys are rather light. Rock weathering has been deep and outcrops are not plentiful. The rock formations are biotite schist and gneiss, in some places garnetiferous, and in others highly feldspathic, resembling granite gneiss. Some of these phases may be metamorphosed granitic rocks. The strikes measured are generally northerly, with easterly and westerly variations. Pegmatites are common and some cut across the gneisses. The granitic rocks weather to light sandy soil and the schists and gneisses to reddish clay soils.

Fontaine mentions evidences of work by Indians or other persons at the Rutherfoord and other mica mines of this region. The mica vein is reported to have been removed to a depth of 10 feet on the outcrop and the rubbish to have been thrown back or washed into the workings. Mining by white men commenced in the Amelia mica mines in 1873 and has been more or less intermittent since that time.

At the Rutherfoord mine operations were conducted at two points about 90 yards apart in a northeast-southwest direction. The opening to the northeast is on a low hill and was called No. 1 by Fontaine; the other opening is in a bottom close to a branch and was designated No. 2 by the same writer. This distinction is very acceptable, in view of the fact that the first work was done at the upper place, which will be used in the following description. The outcrop at the lower place was discovered later in the stream bed, and the water was diverted to the north to facilitate working. At the time of Fontaine's examination in 1883, or earlier, there were shafts less than 80 feet deep at each place. In August, 1912, opening No. 1 consisted

[1] Notes on the occurrence of certain minerals in Amelia County, Va.: Am. Jour. Sci., 3d ser., vol. 25, 1883, pp. 330–339.
[2] Mineral resources of Virginia, Virginia Jamestown Exposition Commission, 1907, pp. 282 and 385–392.
[3] Quartz and feldspar: Mineral Resources U. S. for 1910, pt. 2, U. S. Geol. Survey, 1911, pp. 971–973.

of a pit, about 75 feet long in an east and west direction and 40 feet wide, and a shaft to the east of the pit. The pit was formed by the caving in of old shafts and tunnels. The shaft was made by the American Gem & Pearl Co., of New York, during the last decade and is reported to be 90 feet deep with a 40-foot drift at the 55-foot level. At opening No. 2 there is a pond about 50 feet wide and 150 feet long in an east and west direction, showing the surface area of the old work. It is reported that the deepest work here was a shaft 150 feet deep.

Present exposures of vein and country rock around the vein are very poor, and geologic observations are therefore limited. The country rock is biotite schist and gneiss characterized by the presence of considerable feldspar. An exposure of a slightly garnetiferous phase of this gneiss on the hillside between the two openings showed a strike of N. 55° W. and a dip of 20° NE. The extension of the workings indicates nearly parallel veins striking about east and west. Fontaine considers openings No. 1 and No. 2 on the same deposit, but calls attention to the difference of mineral associations in each. The impression gained by the present writer is that the two deposits are not connected, at least not near the surface.

The veins are pegmatite of somewhat unusual composition and texture for the southern Appalachian region. The normal minerals of pegmatite are present, but they occur in great variety associated with other minerals of interest as gems or specimens. Quartz occurs both in large and small irregular masses and in crystals ranging from small ones to those weighing 8 or 10 pounds. The ordinary quartz is glassy and opaque gray and the crystals are semitransparent to clear white, colorless, or smoky brown. The mica is muscovite of fine quality, with a clear light-brownish color in sheets a millimeter or more thick. Large quantities of fine stove mica were obtained during mining operations, and sheets measuring 22 by 24 inches are reported to have been cut from some of the crystals.

The variety of feldspars is unusual for a single pegmatite deposit. Potash feldspar occurs chiefly as microcline of gray-white, bluish-green, and green colors. In some of this material the colors are bright and the mineral is slightly translucent and yields fine grades of amazon stone for gem and ornamental use. Fontaine states that most of the amazon stone came from opening No. 2, but the later work of the American Gem & Pearl Co. for this mineral was at No. 1. Several thousand pounds of fine grade amazon stone, worth as many thousand dollars, is reported to have been obtained during this work, as well as considerable mica and other specimen minerals. Amazon stone of less attractive colors was found in masses of several pounds weight. In some of these masses considerable mica was intergrown. The mica plates range up to 2 inches in diameter. The other feldspars are albite and probably oligoclase. The albite occurs in clusters of white to colorless tabular crystals as much as half an inch in thickness and 3 inches in length. These crystals are grouped at various angles to one another and furnish beautiful cabinet specimens. Three large fine clusters of these albite crystals are held in the industrial office of the Southern Railway Co. in Washington, D. C. The largest of these measures probably 18 inches in length, 14 inches in width, and 12 inches in thickness. It is somewhat dome-shaped and is composed of beautiful clear and white interlocking tabular

crystals grouped together with interspaces and cavities between them. The whole mass weighs probably over a hundred pounds.

The mineral called "oligoclase" is the sodic variety and chemically not far removed from albite in composition. It occurs in rough crystals, some of which have perfect cleavage and measure several inches across. It is mostly white, with small colorless patches, but exhibits a beautiful pearly blue chatoyancy on one of the cleavage planes. In some specimens this pearly luster is seen over areas several inches across when the specimen is viewed in a favorable position. This oligoclase makes beautiful cabinet specimens if properly exhibited and yields very pretty gems when cut cabochon about parallel with the pearly cleavage. Cut gems are white to mottled gray and show a fine blue chatoyancy in one position.

Fontaine describes a pocket 4 or 5 feet long and high and 1 to 2 feet wide opened in pit No. 2 lined with numerous crystals of smoky quartz and "pure white crystals of albite, some as transparent as glass."

Large beryl crystals were found in pit No. 2, but few, if any, of gem quality. Fontaine describes them as 3 or 4 feet long and as much as 18 inches in diameter, surpassed in size only by those of New Hampshire. They were bluish green and dingy yellow and were associated with the quartz and feldspar. The beryls were closely intergrown with the feldspar, but they separated easily from inclosing quartz.

A quantity of beautiful transparent spessartite garnet of reddish-brown or hyacinth-red color was found during mining operations. This material was cut for gems and also supplied many mineral collections. Some of the crystals measured 3 inches in diameter and were composed of solid garnet. The better stones came from opening No. 2. Watson states that hyacinth gems were cut weighing from 1 to 100 carats. Nine cut gems in the United States National Museum range from 5.65 to 39.13 carats in weight. These gems are rather lighter in color than most zircon or essonite garnet varieties of hyacinth. There is a marked shade of red or pink in the brown which is thereby enhanced in beauty. All the nine stones mentioned contain flaws; some of the nine are a little cloudy from the abundance of these flaws, but others are transparent and brilliant in spite of the few cracks. The gems exhibited in the Natural History Museum in New York show the same characteristics.

The chlorophane variety of fluorite also occurs in the Rutherfoord mine and according to Fontaine was found chiefly in pit No. 2. Some pale-purple fluorite has also been found. This fluorite is not of value for ornamental use but is of interest for the ease with which it phosphoresces. G. F. Kunz [1] calls attention to the fact that the mineral from this locality phosphoresces by attrition with hard substances. In a dark room at 80° F. it glows with a white luminous light. In boiling water it gives off a green light and on heated iron an emerald-green light. These observations were confirmed by tests made by the writer on a specimen supplied by Mr. Rutherfoord. This specimen was grass-green and badly flawed. The surface was strongly etched and corroded. The mineral glowed with a yellowish light after continued heating when the intensity of the green began to fade.

[1] Chlorophane from Amelia County, Va.: Am. Jour. Sci., 3d ser., vol. 28, 1884, pp. 235-236.

Another mineral of interest because of its rarity and of the fine quality found here is microlite. A few exceptionally fine crystals have been cut for gems, as described by W. E. Hidden.[1] The particular crystal mentioned had a specific gravity of 6.13 and weighed 0.877 grams. It was perfectly transparent with a hyacinth-red color. When cut into "a gem it had all the brilliancy and beauty of a fine hyacinth or of an essonite garnet." Hidden also mentions red pyrope-colored microlites from the same locality in the Bement collection. These crystals measured nearly a centimeter across and were embedded in smoky quartz.

Other minerals of more or less interest found in the Rutherfoord mine were columbite, monazite, allanite, orlhite, helvite, apatite, galena, stibnite, zircon, and pyrochlore. Specimens of monazite 8 pounds in weight were found.

Amazon stone occurs at the Richeson, formerly Berry, mica mine, 1¼ miles N. 35° E. of Amelia Courthouse close to the track of the Richmond & Danville branch of the Southern Railway. The visible remains of the work here consist of a roughly circular pit about 35 feet in diameter and 15 feet deep to water with a cribbed shaft about 10 feet square in the bottom.

The country rock is rotted mica schist and gneiss, with gentle rolling folds approximating flat strata. The vein is a large pegmatite cutting the gneiss with an approximately east and west (possibly south of east) strike. Practically all the information available had to be obtained from a study of the dump. On the latter was a quantity of small blocks of pale semibleached amazon stone, white partly altered orthoclase or microcline, scrap mica of light color, and glassy translucent quartz. One bowlder of mottled yellow and reddish chalcedony or chalcedonic quartz was found at the side of the pit and one small crystal of columbite in the dump. The chalcedony would yield a rather attractive cheap gem if cut. Amazon stone of good color and quality might be found if the mine were reopened.

COLORADO.

There was renewed activity during 1912 in the mining of amazon stone and the beautiful associated minerals of the Crystal Peak region, 5 to 10 miles north of Florissant, Teller County, Colo. Claims have been worked by J. D. Endicott, of Canon City, Colo., around Crystal Peak for a number of years, and in 1912 the Crystal Peak Gem Co., of Cripple Creek, Colo., also operated several claims. A quantity of gem and specimen material was obtained, most of which is being prepared for the 1913 tourist trade, for which trade the native Colorado gems are always in much demand.

The minerals found are similar to those obtained in the Crystal Park region on the east side of Pikes Peak, described in this report for 1908. Crystals of amazon stone and smoky quartz are the most plentiful, but fine topaz and phenacite also occur associated with them. Other rarer minerals, as xenotine and fayalite, have also been found. The amazon stone, quartz, topaz, and phenacite are generally crystallized, and when not sufficiently good for gems they still afford fine specimens, either of single crystals or of groups of one or more crystals.

[1] A transparent crystal of microlite: Am. Jour. Sci., 3d ser., vol. 30, 1885, p. 82.

OPAL.

NEVADA.

A quantity of magnificent precious opal was mined during 1912 in Humboldt County, Nev. Two groups of claims have been located about 9 miles apart in Virgin Valley, a tributary of Thousand Creek. One group of claims has been developed by Ivan Dow, of Nevada City, Cal., and the gem material is handled by the International Gem Co., of New York City. The other deposit was located by J. F. Heeney and Deb Roop, of Reno, Nev., during 1912. Some beautiful gems were obtained during prospecting at this locality. A comparison of a few specimens from this deposit supplied by Messrs. Heeney and Roop, with a quantity in the office of the International Gem Co., shows that the type of gem and its occurrence are similar at the two localities.

The region has been described by J. C. Merriam [1] as composed of rocks of Tertiary age belonging to the Miocene. These rocks exposed in Virgin Valley consist in large part of volcanic ash and tuff, some of which have been deposited in shallow shifting lakes. The ash is somewhat indurated and has undergone considerable alteration, in the opal-bearing parts, through the agency of solutions, possibly those from which the opal was deposited. The locality has also proved of geologic interest for the mammalian fossils it contains. At certain horizons of the rock formations large logs of beautifully petrified wood are abundant and in one bed stems and leaves have accumulated in sufficient quantity to form a thin deposit of lignite. The opal occurs at the horizon carrying petrified wood, with which much of it is associated.

Of the many specimens of precious opal examined the majority were portions of petrified limbs or twigs of trees in which the opal appears to be a cast rather than a replacement of the body and texture of the wood. In some specimens there has been a partial replacement of the wood by gem opal, which therefore retains the texture and grain of the wood. Precious opal also occurs as a filling in cracks and cavities both in petrified wood and in the rock mass itself. The ordinary petrified wood examined consists of common opal and chalcedony. Limbs of trees up to 2 and 3 inches thick are reproduced in precious opal of gorgeous color or consist in part of common brown or black opal grading into gem opal. A piece of jet black common opal when heated in a closed tube gave off water and a strong tarlike odor showing the presence of inclusions of organic matter to which the color is doubtless due. A quantity of other variously colored common opal occurs with the gem variety, as translucent purplish, reddish-brown, gray, and white. A peculiar specimen consisted of volcanic ash through which was scattered a large number of small patches of opal. This opal has a magnificent play of green, yellow, blue, and red (or fire), but is exceedingly brittle, so that the small pieces can be crushed between the fingers into powder. The minute grains display their fine color and fire after the opal has been crushed. Specimens of charred wood also occur in the opal-bearing ash.

The best gem opal from this region is unexcelled in variety and brilliance of fire and color by that from other localities. The cut

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

gems exhibit wonderful flashes of green, blue, yellow, and red of various shades. 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 with 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 obtained from the opal of dark color yields 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. The majority of the dark-colored gems, no matter how beautiful in reflected light, become a rich reddish-brown color in transmitted light. Lighter-colored opal with good color and fire is also found and cuts into very beautiful gems.

CALIFORNIA.

The following information concerning the opal deposit of the American Opal Co., in San Bernardino County, Cal., was furnished to R. W. Pack, of the United States Geological Survey, by Mr. F. Saminfeld, superintendent of the mine, and kindly submitted for this report. The head office of the company is in Pasadena, Cal. The mine is 25 to 30 miles northwest of Barstow, in sec. 36, T. 31 S., R. 45 E., and extends into some adjoining quarter sections. The deposit has been worked for about three years, and during 1912 employed from 3 to 5 men. It is opened by a shaft 200 feet deep and by many feet of drifts and tunnels. The best opal, and that which is mined, occurs at ground-water level, about 200 feet deep, in a white volcanic tuff. This rock is not hard to mine and holds up well in the workings, requiring no timbering. According to Mr. Saminfeld about one-fourth of a ton of matrix and rough opal is shipped every ten days or two weeks.

Mr. F. M. Myrick, of Randsburg, Cal., kindly submitted specimens of precious opal which he obtained from a prospect 15 miles west of his bloodstone mine on Brown Mountain in the Death Valley region. This opal is light colored, and shows very pretty flashes of green, blue, and red. It is associated with chalcedony or agate.

AUSTRALIA.

The following notes are abstracted from a report by Consular Agent G. H. Prosser,[1] at Adelaide, South Australia. The production of opal in Australia has declined greatly and is now about 75 per cent less than during some previous years. The value of the output in 1911 has been estimated at about $300,000, of which $106,000 came from the White Cliff district and the remainder from the Wallangulla field, in the Walgett division. The total value of the opal produced since 1890 is estimated at $6,529,377. The Australian black opal has come from mines at the head of River Darling, in northern New South Wales, about 60 miles from the village of Walgett. The output of black opal has grown smaller each year, and during the first half of 1912 amounted to almost nothing. It is not thought that the deposits are exhausted, but fewer miners are at work and good finds are therefore less often made.

[1] Daily Cons. and Trade Repts., Sept. 21, 1912.

PETRIFIED WOOD.

ARIZONA.

The possibilities of the agatized and jasperized wood of the petrified forests of Arizona as gem material have been shown by many specimens cut and placed on exhibition by the United States National Museum in Washington. These consist of 35 gems cut into various rounded and elongated cabochon shapes and varying in size from that suitable for a stick pin to gems 2 by 2½ inches across. The range of colors shown by these gems is large and includes red, pink, yellow, and gray of various shades, with black and white and some purplish and greenish tints. Both bright and dull shades of color occur and sometimes are present in the same specimen. There are a variety of patterns, according to whether the gems are cut with the grain or at various angles across it. Irregularities in petrification also furnish other patterns. Selected specimens of the Arizona petrified wood can be cut into objects suitable for ornamental purposes or for low-priced jewelry, and in these ways should supply demand in the tourist trade of the Southwestern States.

PREHNITE.

Frederick A. Canfield, of Dover, N. J., reports the discovery of transparent prehnite at Great Notch, N. J., in 1912. This material is suitable for cutting, but occurs rather sparingly. A small quantity of prehnite is obtained from the quarries and road cuts in the trap rocks of New Jersey each year. Some of it is used as gems, but this material is translucent only, and not transparent like the prehnite of the recent discovery.

QUARTZ.

NORTH CAROLINA.

Quartz crystals of varied types are widespread over Alexander County, N. C. Some are simple crystals of clear colorless or smoky quality; others are of value as specimens because of the development of a large number of unusual crystal faces. Other crystals contain inclusions of rutile needles and other minerals or of water with movable bubbles. The quartz crystals range from small size to those of 50 pounds weight. An abundance of crystals were obtained during the operation of the emerald-hiddenite mine, and some of those obtained from one pocket have been described by W. E. Hidden.[1] They were remarkable for the inclusions of large cavities partly filled with water and bubbles. Some of the Alexander County smoky and colorless quartz crystals have been cut for gem purposes, and those inclosing rutile needles have yielded especially good sagenite or rutilated quartz gems.

Two prospects for quartz crystals were visited during the course of an examination of beryl prospects in Alexander County in November, 1912. One of these was on the land of Thomas Barnes, 2 miles N. 32° W. of All Healing Springs and about 250 yards west of the prospect on the same property described under beryl. The quartz pros-

[1] On a phenomenal pocket of quartz crystals: Trans. New York Acad. Sci., March, 1882.

pect is near the summit of a knob on the same mountain ridge as the beryl prospect. Two small pits were dug on a vein of glassy quartz, 2 to 5 inches thick, cutting gneiss composed of mica, garnet, and cyanite schist. Beautiful smoky quartz crystals were found in pockets along this vein. The crystals range in size up to 2 inches in thickness and over 3 inches in length. They are transparent and have a fine smoky-brownish color. A few crystals were obtained in sufficiently perfect condition to have value as specimens, but many were chipped by rough handling.

The other prospect is on the place of Moses Barnes, 2 miles N. 20° W. of All Healing Springs. The prospect is in the side of a hollow or ravine and has been opened by a small irregular-shaped shaft 18 feet deep. The country rock is a mica schist inclosing granite. The crystals follow a glassy quartz vein 3 to 6 inches thick, striking north and south, with a vertical dip. The crystals range from small, nearly perfect ones to stones nearly 6 inches thick. Aggregates of muscovite mica crystals are inclosed in or partly penetrate some of the quartz crystals. The quartz varies from clear or slightly smoky to fairly dark smoky in color. Some of the crystals would yield good cabinet specimens if carefully removed from the vein.

SAPPHIRE.

MONTANA.

There was considerable activity in sapphire mining in Montana during 1912. The mines producing blue gem sapphire in Fergus County reported large productions. The operators were the Yogo-American Sapphire Co. and the New Mine Sapphire Syndicate. These companies are operating on the same sapphire-bearing vein or dike at a distance of about 2 miles from each other.

In Granite County the placer mines of the American Gem Mining Syndicate on West Fork of Rock Creek were extensively operated during the working season. Other deposits in Granite County were prospected and worked with good results on a smaller scale by Richard Stingle, of Philipsburg, Mont. These claims lie northeast of those of the American Gem Mining Syndicate across a mountain divide on tributaries of the main prong of Rock Creek. Mr. Stingle claims a large yield of varicolored gem sapphire in proportion to the total quantity mined. The stones range from colorless to greenish-blue, light-green, yellow, orange, pink, and nearly ruby-red. Rough stones weighing 7 to 8 carats are found.

SPODUMENE.

KUNZITE AND HIDDENITE.

The production of spodumene gems in 1912 was confined to the kunzite variety in southern California. None of the emerald-green variety, hiddenite, was found in North Carolina. Mr. Salmons, of the Pala Chief Gem Mining Co., mentions two specimens of kunzite weighing 47½ ounces and 45 ounces, respectively, found at the Pala Chief mine in San Diego County. These have been placed in the A. F. Holden collection in Cleveland, Ohio. Dr. L. P. Gratacap, of

the Natural History Museum, New York, has furnished information concerning two other fine crystals placed in the Morgan collection. One of these is 9 inches high, 5 inches wide, and about three-fourths of an inch thick. It shows a fine deep suffused lilac coloration when viewed parallel to the vertical axis or length. The other crystal is 7 inches high, 5 inches wide, and three-fourths of an inch thick. Both are of gem quality and are free of all matrix and associations. They are strongly striated as usual, but have perfect terminations.

TOPAZ.

TEXAS.

The following notes on the occurrence of topaz in Mason County, Tex., have been abstracted in great part from a description by H. Conrad Meyer.[1] Topaz has been found at two places near Streeter and near Katemcy, respectively. Streeter is about 8 miles due west and Katemcy about 12 miles north of Mason, the county seat. This discovery of topaz was made in 1904 by the late R. L. Parker, of Streeter. Mr. Parker was attracted by the unusual weight of a supposed quartz crystal he had found in the bed of a stream on the land of Sam Awalt, near Streeter. He submitted it to a mineralogist, who pronounced it topaz. A careful search revealed the original matrix of the topaz, but the first work was confined chiefly to "dry washing" of the alluvial deposits. The topaz thus obtained consisted of waterworn crystals, with frosty-appearing surfaces. These were found to contain clear, limpid interiors when broken. Regular development of the topaz vein was not undertaken until 1908. Only a limited amount of work has been done on any of the deposits since 1910. In all a dozen or more prospect holes have been made at this locality.

Meyer refers to the report on the rare-earth minerals of Llano County, by F. L. Hess,[2] for a general description of the geology of the region. Hess speaks of the Llano region as an island of pre-Cambrian rocks intruded by plutonics and surrounded by an irregular zone of Cambrian and other Paleozoic rocks. The principal plutonic rocks are granites, which present several phases. An important variety, and one which Meyer mentions as the country rock at the topaz localities, is a rather coarse-grained red granite. The general geology of the Llano region, including a more complete description of this granite, has been given by Sidney Paige.[3]

The topaz occurs in pegmatite, but with different associations at the two localities. At the locality near Streeter the crystals are found in vugs partly filled with clay and associated with microcline feldspar, biotite, tourmaline, smoky quartz, and albite. The microcline is flesh-colored and occurs in large crystals. Smoky quartz, in many places intergrown with topaz, and biotite are quite abundant. The albite is found in fan-shaped laminated aggregates and is the clevelandite variety. Black tourmaline is sparingly present in small needle-like crystals. Some 200 pounds of good topaz crystals have been obtained. Besides the clear, colorless crystals, a small number of beautiful light-blue crystals, rivaling those of Siberia, have been

[1] Topaz and stream tin in Mason County, Tex.: Eng. and Min. Jour., Mar. 8, 1913, pp. 511–512.
[2] Bull. U. S. Geol. Survey No. 340, 1908, pp. 286–294.
[3] Llano-Burnet folio (No. 183), Geol. Atlas U. S., U. S. Geol. Survey, 1912.

found. Three specimens sent to the Survey by R. L. Parker, in 1907, were described in this report for that year, as (1) a cleavage fragment of a waterworn crystal, colorless and perfectly clear; (2) a perfectly clear crystal with a slight bluish tint; (3) a large crystal, weighing about 4½ ounces, clear in portions, with a delicate bluish-green tint. At that time Mr. Parker mentioned amber-colored topaz crystals as having been found. Meyer describes the largest crystal found here as about 3 inches in diameter, with a faint greenish-blue color.

An interesting discovery made by Meyer is that of the presence of stream tin or cassiterite in the concentrates from the dry placers. This mineral was found in broken crystals and angular grains of resin-yellow to brownish-black color and evidently was not far removed from its source.

The deposit near Katemcy was also found by R. L. and P. H. Parker and is on D. E. Amarine's property. Here the feldspar is greenish-blue microcline or amazon stone, which is reported to occur in large, cleavable masses with excellent color. Small specimens received at the Survey are light bluish-green and rather more transparent than usual with amazon stone. Transparent sea-green fluorite has also been found in the deposits near Katemcy. The topaz is intimately associated with quartz and feldspar, and the interstices are filled with a reddish felsitic rock. A specimen of the matrix furnished by Mr. P. H. Parker is composed of an agglomerated mass of brilliant, clear, glassy topaz crystals, gray and smoky quartz, tuffs or radiated groups of tabular albite or clevelandite crystals, gray microcline crystals, plates of muscovite mica, and red and gray fine felsitic rock inclosing minute black tourmaline needles and a few small plates of albite. The topaz crystals range up to an inch or more in thickness and are frozen in the rock. Meyer states that topaz composes about 80 per cent of the mass of this rock. A much smaller proportion of the topaz from this place is suitable for gem purposes than at the other locality described.

TOURMALINE.

The production of tourmaline in 1912 reported to the Survey amounted in value to $28,200, an increase over 1911, but far below the production of several preceding years, the maximum being that of 1909, which amounted to $133,192. The very large productions of those years were obtained chiefly from the numerous mines of southern California, where there was great activity in gem mining. These large outputs of tourmaline overstocked the market and caused the large decrease noted above. Maine has been an important contributor to the production of tourmaline during 1910, 1911, and 1912. This output came chiefly from a quarry near Poland, belonging to F. L. Havey, of Brunswick, Me. This property yields high-grade gem material in which green is the predominant color, but some crystals containing red and blue are found. Mr. Havey reports a production of 25,000 carats of fine green crystals, which, it is estimated, will cut into about 7,000 carats of gems. According to E. S. Bastin,[1] the prices received for native tourmaline in Maine are higher than those current in New York, because most of the stones are sold at retail to residents of the State or to summer tourists and have an enhanced value as souvenirs.

[1] Pegmatites and associated rocks of Maine: Bull. U. S. Geol. Survey No. 445, 1911, p. 144.

Even with the decreased activity in gem mining in southern California in 1912, some rich finds were made in San Diego County. Dr. L. P. Gratacap mentions three magnificent specimens of rubellite of fine, deep gerardia color, found in a pocket at Pala, that have been added to the Morgan collection in the Natural History Museum, New York. One of these is attached to a large, well-developed quartz crystal. The specimens are composed of compound fascicled groups with fine gem nuclei. One, irregular in shape, is 8 inches high and 3½ inches in diameter at the top, tapers to a base, and has small, divergent crystals. The second is 4 inches high and 3½ inches thick, and the third is 8 inches high and 2 to 2½ inches thick and is associated with albite and lepidolite.

TURQUOISE.

Two interesting articles on turquoise appeared in 1912. These were "The origin of turquoise in the Burro Mountains, New Mexico," by Sidney Paige,[1] and "The aboriginal use of turquois in North America," by Joseph E. Pogue.[2] Data for Paige's article were obtained during the course of geologic mapping of the Silver City quadrangle and the conclusions reached are the result of study of the local occurrence of turquoise and its relations to the general geology of the region. Pogue's paper is an extract from a manuscript report dealing with the ethnology, mythology, mineralogy, geology, and technology of turquoise, prepared during work for the United States National Museum.

Several deposits of turquoise have been operated in the Burro Mountains of Grant County, N. Mex. The most extensive mining was conducted by the Azure Co., and a large quantity of very fine grade gem material was obtained. Other deposits were developed by the American Gem & Turquoise Co. and M. M. Porterfield with varying success.

The occurrence is somewhat similar at the different deposits, the turquoise being found in seams, veinlets, and nodules in fracture zones in rocks of granitic and quartz monzonitic composition which have undergone more or less decomposition and alteration. Paige's article deals chiefly with the occurrence at the Azure mine and the following notes have been abstracted from it.

The turquoise occurs in granitic and quartz monzonitic intrusive rocks. The granite belongs to a pre-Cambrian complex and was intruded in late Cretaceous or post-Cretaceous time by a mass of quartz monzonite porphyry followed by dikes of similar rock. The region has been strongly fractured, and the turquoise occurs in marked fracture zones. Fracturing was followed or accompanied by solutions probably of magmatic origin, which deposited cupriferous pyrite and quartz, formed sericite, and completely destroyed or altered hornblende and biotite.

The quartz monzonite intrusions were exposed by a prolonged period of erosion following the uplift of Cretaceous rocks. An important feature was the extensive subaerial erosion of Pleistocene time in which planated surfaces were formed. The turquoise occurs from the surface to shallow depths and is related to the surface of planation. During this period copper-bearing sulphides were altered to

[1] Econ. Geology, June, 1912, pp. 382-392.
[2] Am. Anthropologist, new ser., vol. 14, No. 3, 1912, pp. 437-466.

carbonates and silicates; limonite formed in abundance; apatite was leached from the rock formations; and turquoise, jarosite, more sericite, and quartz were formed. The solutions from which the turquoise might have formed probably obtained the necessary phosphate and alumina from the decomposition of apatite and sericite. These minerals would have been readily attacked and leached by sulphate solutions formed by the oxidation of pyrite. The same solutions would have obtained sufficient copper to complete the formation of turquoise during the decomposition of cupriferous pyrite.

Pogue discusses the aboriginal use of turquoise in Central America, Mexico, and the United States as attested by historical evidence and by objects. The liberal use of footnotes refers the reader to various histories, works on anthropology, and museum collections where further information can be obtained. The esteem in which turquoise was held by the ancient inhabitants of the southwestern United States and Mexico is shown not to have abated among their present representatives, the Indian tribes of those regions. Thus the Pueblo, Zuni, Hopi, Navaho, Apache, and Ute tribes still bedeck themselves with ornaments of turquoise or use it for money.

VARISCITE.

The beautiful green mineral variscite has been used for gem and ornamental purposes under several names, such as "amatrice," "utahlite," and "chlorutahlite." The first variscite to be used as gems in the United States came from the mine of Don Maguire, of Ogden, Utah. This mine, located in Clay Canyon, 1½ miles west of Fairfield, Utah County, was discovered in October, 1894. G. F. Kunz[1] suggested the name utahlite for the mineral as a gem, and it was subsequently called chlorutahlite, under which name the material from this mine is now marketed. The next discovery was made in 1905 about 14 miles S. 65° W. of Tooele, in the foothills of the Stansbury Mountains. This material was described as "utahlite (variscite)" by Kunz,[2] but was later called "amatrice" by the Occidental Gem Corporation, of Salt Lake City,[3] and under this name it is now sold. Later discoveries were made at other localities in Utah and at many localities in Nevada, as set forth in these reports for 1909 and 1910. Practically all the minerals from these localities have been sold under the true name, variscite. There are two localities of interest in Utah—one in Washington County and one near Lucin, in Boxelder County. The former is worked by John A. Maynes, of Salt Lake City, and the latter is claimed by Edward Bird and Frank Edison, of Lucin. In Nevada variscite is widespread and has been prospected or mined at many places in Esmeralda County, especially near the deserted mining town of Columbus, near Candelaria, Coaldale, Blair Junction, and Sodaville.

The value of the production of variscite increased from several hundred dollars a year to several thousand dollars in 1907. During the next three years it was still greater, reaching a maximum of $35,938 in 1909. In 1911 and 1912 the output was less, but still sufficiently large to show that variscite has established a place for itself among American gem stones.

[1] Sixteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1894, p. 602.
[2] Mineral Resources U. S. for 1905, U. S. Geol. Survey, 1906, p. 1351.
[3] Mineral Resources U. S. for 1907 pt. 2, pp. 832–833; idem for 1908, pt. 2, pp. 853–856, U. S. Geol. Survey. Also Zalinski, E. R., Amatrice, a new Utah gem stone: Eng. and Min. Jour., May 22, 1909.

The greater part of the output of variscite in 1912 came from Utah, where three mines were operated. Mr. Maguire reports extensive development at his mine, with the discovery of some fine material. Unfortunately the claims of Bird & Edison, near Lucin, have fallen under litigation with the Southern Pacific Co., so that none of the finely marked "turtle-back" and brecciated variscite from this locality could be placed on the market. Only one producer from near Coaldale reported from Nevada in 1912.

Variscite is a hydrous aluminum phosphate with bright green color. It has a hardness of only four, and is therefore not suited to rough wear. In some occurrences it is associated with allied phosphate minerals, among which is wardite. Other associated minerals and rocks, such as quartz, chalcedony, chert, jasper and black "jasperoid," limonite, hematite, slate, and rhyolite, often form strong contrasts in color and pattern with the variscite, yielding unique matrix gems. The variations from light to dark emerald-green in variscite itself, with its unusual markings due to texture, lend further contrast to these gems. Innumerable effects can thus be secured in cutting variscite and its matrix to meet the fancy of the various purchasers. The attractiveness of variscite gems, along with the reasonable price for which they can be sold, should guarantee their continued use in certain lines of jewelry, especially in the western tourist trade. Select gems have sufficient beauty to make them high priced. Variscite is especially adapted to what has been called barbaric jewelry and is beautifully "set off" in rich colored filigree gold mounting.

GREEN MICA SCHIST.

T. Nelson Dale [1] has described an occurrence of green mica schist in Shrewsbury, Vt., which promises to have considerable use as an ornamental stone. The following notes have been abstracted from his description of this rock: The occurrence is in a small saddle on the north side of Round Hill, on the west flank of the Green Mountain Range, 3¾ miles southeast of Rutland station. It was discovered and is being prospected by Edward H. Foley, of Rutland. The schist belt is about 100 feet thick and has a strike of N. 15°–30° W., with a high east dip. It consists largely of chrome mica (fuchsite), with some chlorite, quartz, tourmaline, and a little magnetite. The rough rock has a bright verdigris-green to faintly greenish-gray color. Its luster ranges from glistening to waxy and its texture is foliaceous and plicated. The polished stone has a brilliant dark emerald-green color varied with fine wavy streaks of lighter green. The stone saws and polishes well and will be suitable for internal decorations if obtained in masses of sufficient size and soundness. A block measuring probably 18 by 12 by 8 inches presented to the United States National Museum was firm and solid through the whole mass. A cube measuring possibly 3½ inches square and two rectangular slabs—one about 7 by 12 inches square and the other smaller—were cut from one end and side of the block. The polished face of the cube is rich dark-green of nearly even color. The slabs show both plicated banded light and dark-green layers and large areas of a nearly even green color.

[1] The commercial marbles of western Vermont: Bull. U. S. Geol. Survey No. 521, 1912, pp. 50–51.

METRIC OR INTERNATIONAL CARAT.

A strong movement was started in October, 1912, by members of the gem and jewelry trade to introduce the metric or international carat into the United States in place of the carat of variable weight now in use. At a meeting of jewelers and dealers in precious stones held in New York City in October,[1] 1912, resolutions were passed that the jewelry trade of the United States should adopt the metric or international carat of 200 milligrams on and after July 1, 1913. A committee with M. D. Rothschild, president of the American Gem & Pearl Co., as chairman, was appointed to secure the approval of various trade organizations interested. These resolutions were prepared after an expression of approval by a large majority of the jewelers to whom cards asking for their opinion had been mailed.

The international carat will be adopted on July 1, 1913, and the committee mentioned above has been very active furnishing information and arranging for a supply of the new weights. These will be divided into 100 parts, the smallest, therefore, weighing 2 milligrams. Director Stratton, of the Bureau of Standards, of the Department of Commerce, Washington, D. C., in a letter to the committee representing the gem and jewelry trade, has promised his cooperation in introducing the new weights.[2] The attitude of the Bureau of Standards was further made known in an address of Dr. Louis A. Fischer before the Retail Jewelers' Association of the District of Columbia,[3] in which the use of former carat weights was shown to be very illogical and the new international carat most advantageous to all parties concerned. The following countries have adopted the international carat: Spain, France, Italy, Bulgaria, Denmark, Norway, Japan, Portugal, Roumania, Switzerland, Sweden, Belgium, and Germany. Interest in the international carat is being aroused in Great Britain, where it is likely that it will be accepted more readily after its use is established in the United States.

The metric or international carat is about 2½ per cent lighter than the old carat, so that 1 carat in the old system weighs 1.025 carats in the international system. Conversion from either system of weights into the other may be made by simple multiplication or division.

BIRTH STONES.

The American National Retail Jewelers' Association adopted a standard list of birth-month stones at its meeting in Kansas City, in August, 1912. The changes made in the lists ordinarily used were slight and consisted chiefly of the addition of alternative stones. The following is the list[4] that was adopted:

Birth-month stones.

January	Garnet.
February	Amethyst.
March	Bloodstone or aquamarine.
April	Diamond.
May	Emerald.
June	Pearl or moonstone.
July	Ruby.
August	Sardonyx or peridot.
September	Sapphire.
October	Opal or tourmaline.
November	Topaz.
December	Turquoise or lapis lazuli.

[1] Jewelers' Circular Weekly, Oct. 30, 1912.
[2] Jewelers' Circular Weekly, Mar. 5, 1913.
[3] Jewelers' Circular Weekly, Apr 2, 1913.
[4] Jewelers' Circular Weekly, Aug. 14, 1912.

PRODUCTION.

The total production of gems and precious stones during 1912 reported to the Survey showed a decrease in value of $23,970 from 1911. The value of the production in 1912, estimated in part from the quantities of rough mineral reported, was $319,722. There were large changes in the production of some minerals. Thus the output of opal increased from $1,875 in 1911 to $10,925 in 1912; kunzite, from $75 in 1911 to $18,000 in 1912; turquoise decreased from $44,751 in 1911 to $10,140 in 1912; chrysoprase and emerald also decreased. The statistics represent nearly the first values that the rough material brings or might be expected to bring. The same gem material may increase four or five times in value after elaboration and placing on the market.

Production of precious stones in the United States, 1906–1912.

	1906	1907	1908	1909	1910	1911	1912
Agates, chalcedony, onyx, etc.	$800	$650	$1,125	$750	$2,268	$8,128	$9,978
Amethyst	700	850	210	190	.....	725	363
Benitoite	.....	1,500	3,638	500	.....	.....	150
Beryl, aquamarine, blue, pink, yellow, etc.	9,000	6,435	7,485	1,660	5,545	2,505	1,765
Californite	.....	a 25,000	.....	a 18,000	a 8,000	150	275
Catlinite	.....	25	.....	.....	.....	.....	.....
Chiastolite	25	20	.....	.....	.....	25	.....
Chlorastrolite	.....	.....	25	2,400	a 2,000	1,992	350
Chrysocolla	.....	150	600	300	.....	.....	.....
Chrysoprase	a 32,470	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
Diopside	5	.....	120	.....	.....	.....	.....
Emerald	.....	1,320	.....	a 300	a 700	a 9,500	2,375
Epidote	.....	60	.....	15	.....	.....	10
Feldspar, amazonstone, sunstone, etc.	100	1,110	2,850	a 2,700	2,510	175	1,310
Garnet, almandine, pyrope, hyacynth, etc.	3,000	6,460	13,100	1,650	3,100	2,065	860
Gold quartz	.....	1,000	1,010	.....	1,000	1,700	1,900
Jasper, petrified wood, bloodstone, etc.	150	1,000	.....	100	475	2,240	6,005
Malachite, azurite, azurmalachite	.....	250	5,450	2,000	550	800	1,085
Opal	.....	180	50	200	270	a 1,875	a 10,925
Peridot	2,400	1,300	1,300	300	.....	360	8,100
Phenacite	250	25	95	50	50	.....	.....
Prase	50	.....	.....	.....	100	.....	.....
Pyrite	.....	400	.....	.....	.....	.....	265
Quartz, rock crystal, smoky quartz, rutilated quartz, etc.	3,050	2,580	3,595	2,689	1,335	2,140	2,448
Rose quartz	4,000	6,375	568	2,970	2,537	1,744	865
Rhodocrosite	.....	150	.....	.....	.....	.....	.....
Rhodonite	.....	.....	1,250	125	a 6,200	1,300	550
Ruby	600	2,000	.....	.....	.....	210	2,260
Rutile	.....	200	.....	25	.....	.....	.....
Sapphire	39,100	a 229,800	a 58,397	a 44,998	52,983	a 215,313	a 195,505
Smithsonite	.....	800	a 1,200	300	.....	25	650
Spodumene, kunzite, hiddenite	14,000	14,500	a 6,000	15,150	33,000	75	18,000
Thomsonite	.....	.....	35	100	610	1,500	450
Topaz	1,550	2,300	4,435	512	884	2,675	375
Tourmaline	a 72,500	a 84,120	a 90,000	a 133,192	a 46,500	16,445	a 28,200
Turquoise and matrix	22,250	23,840	a 147,950	a 179,273	a 85,900	a 44,751	10,140
Variscite, amatrice chlorutahlite, utahlite	2,000	7,500	14,250	35,938	a 26,125	a 5,750	a 8,150
Miscellaneous gems	.....	.....	.....	1,060	2,755	3,224	4,408
Total	208,000	471,300	415,063	534,380	295,797	343,692	319,722

a Estimated or partly so.

IMPORTS.

The imports of precious stones into the United States, as reported by the Bureau of Foreign and Domestic Commerce, were large and have been exceeded only by those of 1906. The greatest increase was in pearls, the value of which more than offset decreases in the value of imports of diamonds and other precious stones.

The following table shows the value of the diamonds and other precious stones imported into the United States from 1906 to 1912, inclusive:

Diamonds and other precious stones imported and entered for consumption in the United States, 1906–1912.

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	[1] 1,051,747	910,699	13,700,404
1909	758,865	50,265	8,471,192	.....	27,361,799	[1] 3,570,540	24,848	40,237,509
1910	213,701	54,701	9,212,378	.....	25,393,641	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	40,820,436
1912	452,810	94,396	9,414,514	.....	22,865,686	3,405,543	5,130,376	41,363,325

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

TEXT AND REFERENCE BOOKS.

[With publishers' prices.]

Bauer, Max, Precious stones; translated by L. J. Spencer, illustrated with colored plates; C. Griffin & Co., London, J. B. Lippincott Co., agents, Philadelphia. ($15.)

Claremont, Leopold, The gem cutter's craft; George Bell & Sons, London, 1906. ($5.)

Crookes, Sir William, Diamonds; Harper & Brothers, London and New York, 1909. (75 cents.)

Farrington, O. C., Gems and gem minerals; illustrated with colored plates; A. W. Mumford Co., Chicago, 1903. ($3.)

Goodchild, W., Precious stones; Archibald Constable & Co., Ltd., London, 1908. ($2.)

Kunz, G. F., Gems and precious stones of North America; illustrated with colored plates; Scientific Publishing Co., New York, 1890. ($10.)

——— Jewelers' materials and ornamental stones of California; Bull. California State Min. Bureau No. 37, San Francisco, 1905. (Price and postage, 45 cents.)

——— History of gems found in North Carolina; Bull. N. C. Geol. and Econ. Survey No. 12. (Free; postage, 10 cents.)

Rothschild, M. D., Handbook of precious stones; G. P. Putnam's Sons, New York, 1890. ($1.)

Smith, G. F. H., Gem stones; illustrated with colored plates; Methuen & Co., Ltd., London, 1912. ($2.10.)

Streeter, E. W., Precious stones and gems; illustrated with colored plates; George Bell & Sons, London, 1898. ($4.)

Tassin, Wirt, Catalogue of gems in the United States National Museum; Ann. Rept. U. S. Nat. Mus., 1900, pp. 476–670. Contains a good bibliography.

Williams, G. F., The diamond mines of South Africa; 2 vols., illustrated with colored plates; B. F. Buck & Co., New York, 1905. ($25.)

Wodiska, Julius, A book of precious stones; illustrated with colored plates; G. P. Putnam's Sons, New York, 1910. ($2.50.)