
OREGON STATE DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

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The Gem Minerals of Oregon

Dr. H. C. Dake

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State Governing Board: W. H. Strayer, Chairman, Baker Albert Burch, Medford E. B. MacNaughton, Portland
Earl K. Nixon, Director

The State Department of Geology and Mineral Industries is pleased to encourage interest in the Oregon semi-precious gem industry. That this is not a new industry is indicated by a statement by DeWitt Harry in the Sunday Oregonian under date of January 23, 1921. It reads:

"Five years ago there were two or three shops here that did some work on agates, but it is doubtful if more than fifty of the stones were prepared a day. During the last year fully a dozen firms have been in the business, four of them large ones, and the output has reached the great total of approximately one thousand finished stones daily; this total being surpassed in certain seasons of the year and again declining, according to market conditions. The wholesale value of the output is reliably estimated at fully \$250,000 for 1920 and the market has been proved to be a constantly increasing one until Portland has stepped into the same position in the world of agates that Amsterdam occupies in that of diamonds."

No data are available as to the present value of the semi-precious gem production in Oregon, but we are sure that the total amount would surprise most of us very much. This business is a hobby merely with many people and is not widely publicized. It is difficult to obtain accurate figures on production. A start has been made, and it is hoped that it will be possible late this year to include accurate figures on this interesting matter of semi-precious stones.

The Department is pleased to publish this paper of Dr. Dake's for the interest which we believe it will carry.

Earl K. Nixon, Director.

State Department of Geology
and Mineral Industries,
704 Lewis Building, Portland, Oregon,
March, 1938.

PREFACE

This paper was written in response to a wide public demand for information on the gem mineral resources of Oregon. It is not intended as a technical description of gem stones, but merely as an enumeration of the known occurrences of gem materials within the State. The reader is referred to standard works on gemmology for technical descriptions of the gems.

So far as is possible simple terms have been used in this paper to enable the layman and prospector to understand better the descriptions given. No attempt has been made to describe in detail all known gem deposits of Oregon - the scope of this paper would not permit. The intention has been primarily to call attention to an important mineral resource of the State. Frequently the prospector in the field has ample opportunity to collect valuable specimens, and he would do this if he were more familiar with the requirements of the lapidary industry. Numerous instances are known in Oregon and other western states in which prospectors have been able to keep themselves grubstaked through their ability to recognize minerals having a value other than for their metallic content. The prospector familiar only with gold or a few obvious metallic minerals is likely to overlook other valuable deposits.

Numerous local people have built up colorful and valuable collections of semi-precious gem minerals solely through their own efforts in the field during times of recreation. Gem minerals do not have a market like gold, silver, or copper; a buyer must be found first, but this is generally not difficult if the specimens collected or the deposit found is in commercial demand.

Most of the information given here was gained from observations made by the writer in the study of gemmology and mineralogy as an avocation over a period of fifteen years. Much of the data detailed is the result of field trips to the various localities in Oregon and by long association with local gem connoisseurs.

Appreciation is extended to the State Department of Geology and Mineral Industries for their aid and cooperation in making this paper generally available.

Dr. H. C. Dake

Portland, Oregon,
March, 1938.

OREGON GEM PRODUCTION.

Neither accurate nor complete reports on the value of the gem mineral production are available so only an approximate estimate can be given. Without question, the greater part of the value of the gems produced in Oregon is in the quartz class, where production has increased at a very rapid pace during the past few years.

According to the estimates given by the United States Bureau of Mines, some years past, the total production of quartz minerals for the entire country was less than \$100,000 per year. This estimate probably did not include cut gem stones and specimens but considered only the quartz used in the manufacturing industries.

Considering all the gems produced and specimens found and finished in Oregon in 1937, a conservative estimate would place their value in the thousands of dollars. With the rapid expansion of the local lapidary industry and the ever increasing number of individuals who are cutting gems as an avocation, the production for 1938 will undoubtedly be at least fifty percent greater than 1937. Exploitation, publicity, and marketing facilities are the present needs of this growing industry.

THE GEM MINERALS OF OREGON

The gem minerals found within the State of Oregon, and having commercial significance, are wholly of the semi-precious class; only a few instances are on record of occurrences of the precious group. Gem minerals of some types suitable for commercial lapidary cutting into gems or other ornaments are to be found in almost every county within the State; the greater part of this material being quartz or one of its many varieties.

In past years little or no attention has been given to the deposits of semi-precious gem minerals in Oregon, other than to a small amount of commercial collecting of agate, jasper, obsidian, rhodonite, and similar massive minerals. In short, this important potential resource of the State has been neglected.

NEW INDUSTRY

For many years the United States has been the largest world consumer of semi-precious gem stones, ornaments, and similar decorative objects. Much of the world's production of costume jewelry finds its market in the United States. Yet the lapidary industry of America has fallen behind in the cutting and polishing of these gems. The various factors which prevented the more rapid development of the American lapidary industry are being eliminated, thus increasing the demand for domestic supplies of American mined semi-precious gem minerals.

Moreover, through public education, a strong demand is being felt in the gem trade for natural, mined gems in preference to the numerous glass and similar fused substances, which after all hold no romantic significance as do the real stones. A great deal of the quartz type of gems, marketed in America from the foreign cutting centers, has been either heat or chemically treated to give the stone the proper (desired) commercial color. While a dyed or otherwise artificially colored stone or glass may be suitable for some purposes, in many instances it is possible to obtain the more desirable natural material at an attractive cost.

While the cutting centers of Europe continue to supply the bulk of our finished cut gems, in the past few years Oregon has taken the lead in supplying the country with fine quality cabinet specimens of semi-precious gem minerals. Owing to the fact that the quartz and agate minerals are found in Oregon in a greater variety of types and kinds and quantity, the lapidary industry of the State is undergoing a remarkable expansion and development. The numerous gem deposits of Oregon are supplying the leading museums and private collections of the country with colorful and valuable, cut and polished, exhibition specimens. The new prediction is here made that the country will continue to look to the new lapidary industry of Oregon for increasing production of semi-precious gems and cut specimens.

OREGON GEM MINING.

To date very little actual dirt or rock has been moved in Oregon in seeking the gem minerals, as practically all the specimens are found lying loose on the surface or in alluvial debris. Stream gravels in practically all parts of Oregon often yield excellent material, and the production of the beach deposits along the coast is well-known to every tourist.

In the recent discovery of a new type of moss agate in Jefferson County, a limited amount of hard rock mining was done by private collectors. This pocket of agate yielded some very high quality gem material, which has been locally termed "flower" agate. At least several thousand dollars worth of gem agate was removed from its matrix of rhyolite rock.

Antelope, in Wasco County, is another well-known field that has been a heavy producer of semi-precious gem materials. Very little actual mining has been done here, but for years tons of rough masses have been removed from the loose surface debris covering the rolling, sage-covered hills around Antelope. This material is valued at from five cents to one dollar per pound in the gem markets. One of the most valuable single specimens found here was a 300 pound quartz crystal-lined geode, found in 1934, and valued at no less than \$200.00.

GEM DISTRICTS OF OREGON

Four main districts constitute the chief gem producing areas of Oregon, although, as has been stated, good commercial semi-precious gems have been found in many counties.

BEACH DEPOSITS: - The semi-precious gem deposits found along the Oregon coast have for years supported a thriving local industry, - that of agate cutting. Increasing tourist travel to the many Oregon beach resorts has caused a heavy demand for the colorful agates and similar gems found on the beaches. The value of this local industry is a matter of conjecture, but it serves to support a surprisingly large number of local lapidary establishments.

The lure and fascination of seeking these treasures along the beaches is also no small factor in bringing numerous visitors to the Oregon Coast from distant interior points. The Lincoln County beaches appear to be the most productive, and single cut and polished specimens of agate found in this area have been sold for upwards of \$50.00.

SOUTHWEST OREGON: - The stream gravels and ledges and veins in this area produce a number of species and varieties of gem material. Often in

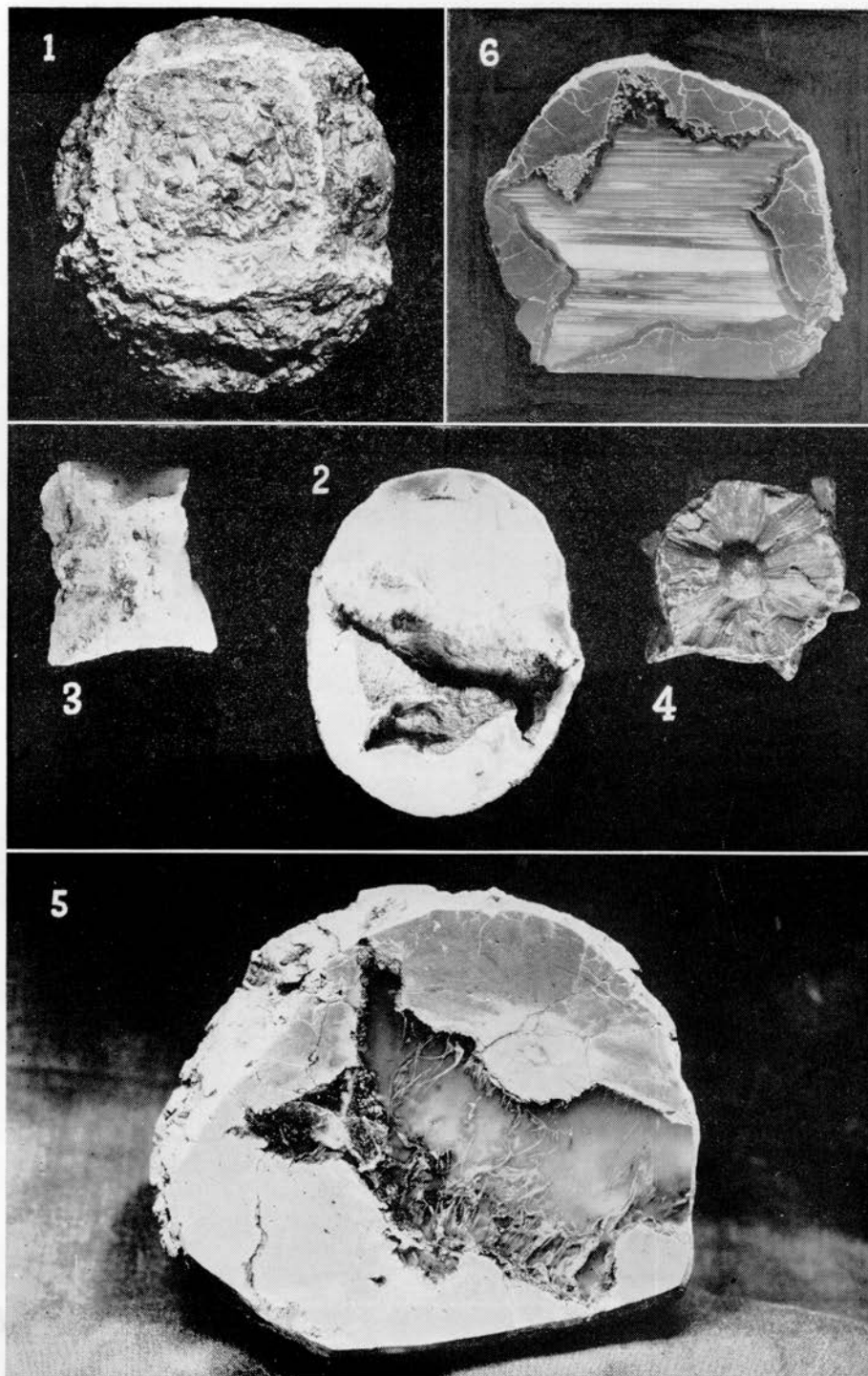


A PORTLAND LAPIDARY SHOP



OREGON GEM MINERALS

Exhibit of over 200 cut and polished Oregon gem minerals, on public display in Portland show window. Specimens exhibited by members of Oregon Agate and Mineral Society. Value of exhibit over \$10,000



TYPICAL AGATE FILLED NODULES

Rough and cut specimens of colorful agate filled nodules from the sage covered plains of Central Oregon

lode mining, non-metallic minerals in the gangue are encountered, which have value as gem stones or ornamental rock.

CENTRAL OREGON: - In the central part of Oregon, just east of the Cascade Mountains, and running north and south the length of the State, is an area which has without question been the most prolific producer of gems in Oregon. The principal producing counties include Jefferson, Deschutes and Wasco. The colorful agate-filled nodules, popularly known as "Thunder Eggs", have been found in great profusion in this area, and thousands have been gathered by commercial and private collectors. Agate-filled nodules are used principally for display purposes in public and private mineral and gem collections. They range in value up to twenty dollars, depending on their beauty and the cost of finishing.

Included in the Central Oregon Gem District is the opal locality of Opal Butte, in Morrow County, noted for its production of common, colored Hyaline opal. Some hard rock mining for specimens has been carried on in this area. Madras is situated in the center of the producing areas of agatized and opalized wood, quartz, crystal geodes, jasper, and agate-filled nodules. The Bend region is well-noted for the remarkable casts of wood, derived from weathered or eroded lava. These are frequently equal to the best jasperized wood found anywhere. The Warm Spring Reservation is particularly noted for its remarkable masses of black and white colored agate.

WILLAMETTE VALLEY: - The stream gravels of the Willamette Valley comprise the principal sources of semi-precious gems in this area. Vein deposits, carrying semi-precious gems, are known in the district, although little development has been done.

GEMS AND LOCALITIES.

The list of gem occurrences given here is not a complete one, and new deposits will be found from time to time. The data given here have been obtained by the writer largely from observations made in the field and from information previously published in The Mineralogist Magazine. Little has been written on the gem occurrences of Oregon.

DIAMOND: - No commercial deposits of diamond are known to exist in the State, but authentic stones have been found. In the gold placers of southwestern Oregon, a few diamonds have been found in a more or less accidental manner. So far as can be learned, the largest authentic diamond found in Oregon was a stone of good color and weighing nearly three carats in the rough. This gem was found in gold placer operations in Josephine County. Accurate records of other reputedly large stones are lacking. Since a diamond in the rough often appears no different from a water-worn pebble of agate, it is logical to assume that few stones would be found unless a search were made by experienced miners.

Formations, similar to those in which diamonds are known to occur in other parts of the world, have been noted in Oregon. Proof of the fact that diamonds do exist in these rocks is offered by the beach sands found at several points along the coast in Curry County. Microscopic-sized diamonds have been identified by the writer, and others, in the black sands of Curry County. These stones, however, are much too small for commercial value, and their origin is a matter of conjecture. It is assumed the diamond has its origin in the peridotite rocks of this part of the state; however, they may have been transported many hundreds of miles by glacial agencies.

GOLD: - When native gold occurs in a matrix of white and compact massive quartz, the material finds use as a gem stone or ornament. Many of the mining districts of Oregon have furnished fine examples of this "picture rock", as it is popularly termed. Generally the stone is cut and polished into rounded cabochon styles, suitable for wear in rings, watchfobs, brooches, and similar ornaments.

Many mines in Oregon have yielded rich and beautiful specimens of "picture rock", particularly the mines of Jackson, Josephine, and Baker Counties. Specimens of this kind, of suitable color and compactness bring a substantial premium over the actual gold value. A specific gravity test will aid in estimating the value of a specimen of this kind.

CINNABAR: - Like gold, cinnabar when found pure is usually not classed as a gem material, but when found in a suitable matrix material it is used by the lapidarist. In most cinnabar deposits, the cochineal-colored mineral is found in minor quantities, in a matrix of chalcedony or common white opaque opal. The contrasting bright red color of the disseminated mercury mineral, against the white matrix, makes a very attractive stone for gem cutting purposes. Specimens of this kind are found in practically all the cinnabar deposits of Oregon.

In Lake County, a low grade cinnabar deposit occurs as a brecciated matrix of white opal. Some of this has been found well-suited for the gem cutters' wheels. The terms "opalite" and "myrickite" are often used for specimens of this kind.

PYRITE: - This common sulphide of iron when found in proper quality finds some use as a gem. Good compact material can be cut into cabochon styles, while small crusts of brilliant crystals are used as decorative work in costume jewelry and similar ornaments. Pyrite suitable for this purpose is found in a number of mines of Oregon. Marcasite, the sulphide of iron which differs from pyrite only in crystal form, has the same applications in the gem cutting industry.

COBALTITE: - This metallic, cobalt-bearing mineral, finds limited use as a semi-precious gem material. It is a curiosity for connoisseurs but has small commercial application.

Cobaltite occurs at the old Standard Mine in Grant County, disseminated in a light-colored matrix of argillite, and can be used for cabochon cutting. It is associated in this deposit with maltese and chalcopyrite. Large specimens take an excellent polish.

QUARTZ:- As previously stated, the many varieties of the quartz family of minerals constitute by far the greater part of the value of the semi-precious gem mineral production of Oregon. Some two hundred or more varieties and sub-varieties of quartz minerals have been described by various writers, and almost half of these are found within the boundaries of this State. All members of the great quartz family of minerals are of essentially the same chemical composition. The various types differ only in the amount of coloring matter present, which in itself is relatively small. These impurities, the variations in markings, patterns, and similar inclusions are frequently sufficient to change wholly the appearance of the gem, yet from a chemical standpoint they are all of the same mineral species.

Prior to five years ago very little quartz from Oregon found its way into commercial channels. With the recent expansion of the local lapidary industry and with the growing demand for domestic sources of raw material, a very large number of previously unknown deposits of the quartz minerals have been brought to light. As an indication of the wide public interest being shown in this important Oregon resource, it can be stated that there are no less than five hundred individuals in the state who are engaged in a private way in the cutting and polishing of these Oregon gems. About half of this number are in the Portland district. This is in addition to the many commercial establishments which are scattered in various parts of the State.

Some of the production from these "home" lapidary shops finds its way into the markets, finally reaching the large museums and private collections of the country, or going directly into the jewelry manufacturing industry. No accurate estimate can be given of the value of this production, but it is unquestionably amounts to thousands of dollars annually. Some outstanding local private collections of this product have been built up to a point where they are receiving national recognition. Several of these private collections are conservatively valued at from \$5,000 to \$10,000. No other state in the Union can boast of such an array of local material of the quartz type.

No attempt will be made here to enumerate all the known varieties of quartz found in Oregon; only the best known and outstanding types will be detailed.

ROCK CRYSTAL: - Clear, colorless crystal quartz (Rock crystal) is found widely distributed throughout the state. It is prominent as a gangue in some of the mineralized metallic veins, as well as occurring in vugs in igneous rocks. Small crystals are more common; no commercial deposits of optical quartz, or radio quartz, have yet been developed. Some of the rock crystal found in Oregon is well-suited for gem cutting,

but little is utilized in this manner, since competition with other deposits prohibits this. Hence, most of the crystal quartz is utilized for cabinet and specimen purposes.

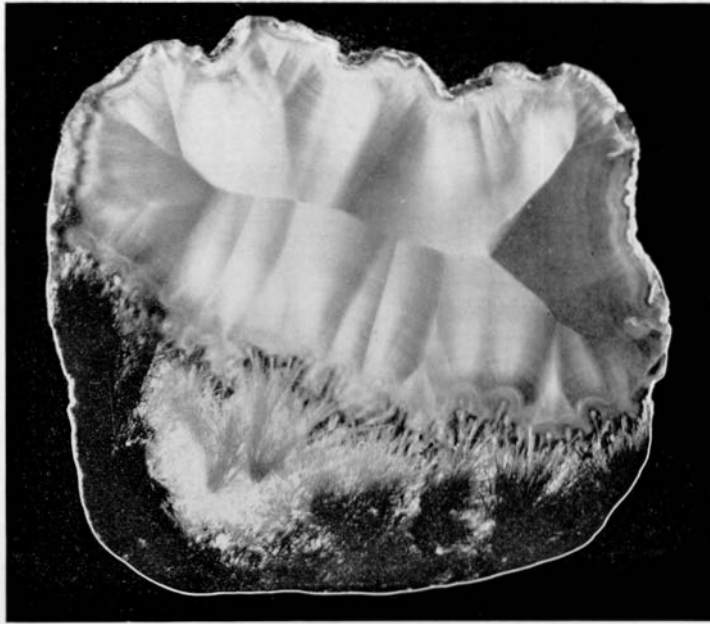
The crystal-lined geodes found in central Oregon, especially those of Antelope, are noted throughout the country for their remarkable beauty and size. Thousands of these hollow specimens have been gathered in central Oregon during the past ten years, depleting the surface of good material, but those remaining covered by the loose surface debris await extraction. Plowing operations and water erosion each year bring to light additional supplies in the central Oregon district. Under present market conditions it is doubtful if commercial mining operations would prove profitable. Many tons of inferior specimens of quartz crystal have been gathered in Central Oregon the past few years to be used as facings for homes, fireplaces, and rock garden displays. For years the region about Antelope and Madras has been visited by many tourists who come from distant places, and who are interested in gem and mineral collecting.

AMETHYST: - Well crystallized amethyst is found in limited quantities in the Central Oregon district, particularly in the region between Mitchell and Madras. The gem occurs in a manner similar to quartz, in crystal-lined geodes, or filling cavities in rhyolitic and basaltic rocks. The crystals, although excellent as specimens, are usually pale in color and not suitable for gem cutting. Relatively little gem-cutting grade of amethyst is produced in America, the bulk of the commercial supply coming from South America, where it occurs in a manner similar to that of Oregon. A few fine, large specimens have been found near Medford. Little or no development work has been done at any of the local amethyst deposits. A few specimens which have been found were encountered by collectors searching the surface outcroppings.

AGATE: - Agate and chalcedony are found in a very wide range of forms, at a large number of localities in the State. Among the many sub-varieties, Oregon leads in the production of the moss and iris types. While all agate is identical chemically, various inclusions, colors, markings, and patterns cause types to carry different names.

MOSS AGATE: - Specimens showing dendritic or moss-like growths are common in the numerous localities, particularly in central and southwestern Oregon. For centuries India and a number of other foreign countries have supplied the world markets with this popular and colorful gem, but many of these foreign deposits are becoming exhausted, or the present quality of this product is inferior. Moss Agate which occurs in quantity in Oregon is found in all the colors and forms found elsewhere in the world, and is equal, if not superior, in quality to foreign varieties.

The central Oregon district is noted for its remarkable green, red,



ONE OF OREGON'S FINEST

Cut and polished sagenite agate found on beach near Yachats
 (Photo courtesy J. Lewis Renton, Portland)



AGATIZED LOG

500-pound section of rare agatized teredo bored wood, found near Roseburg
 (Photo courtesy J. W. Wharton)



GEM SECTION—THE MINERALOGIST MUSEUM



COLORFUL ROCK GARDEN

Inferior quality gem materials find wide use as a decorative stone in rock gardens

yellow, and brown types, while the area about Medford produces both the colored and the black varieties. Central Point in southwestern Oregon yields high grade black moss agate, similar to the well-known Montana variety. The beach deposits produce small amounts of chalcedony with a rare type of white, moss-like inclusions. Moss agate is available in Oregon in large masses, suitable for both gem stone cutting and large carved ornaments. Much of the moss agate and similar materials used for carving in China is imported from Indian and South America, to be shipped later to America, the largest market. Although of a high commercial grade, Oregon moss agate has not found its way into these industries. Large sections, cut thin to permit light to pass through, are widely used for museum purposes. The value of the moss agate, like other types of agate, depends wholly upon quality. Inferior grades are worth only a few cents a pound, while high grade material will often bring a dollar or more per pound.

IRIS AGATE: - The Antelope locality produces the finest Iris Agate known anywhere in the world. Excellent specimens have also been found in other parts of Oregon, including the southern, coast and Willamette Valley districts. The use of this unique gem is adapted mainly for specimen purposes and is to be found in collections and museums throughout the country. When cut thin and polished on both sides and held towards a light, this remarkable gem shows seven brilliant prismatic colors in a single specimen. Iris agate was more or less unknown until local cutters developed this gem and introduced it into the markets.

Probably the worth of iris agate, which has been shipped from Oregon gem cutters during the past few years, has been in the thousands of dollars. The value of those specimens of inferior quality may be no more than the cost of cutting, but high grade examples may bring five dollars or more for a stone no larger than a postage stamp.

SAGENITIC AGATE: - Sometimes agates are found with acicular or needle-like inclusions of other minerals, these are given the general name of sagenite agate. The inclusions may be one of a number of minerals including rutile, geothite, actinolite, natrolite, mordenite, etc. Or the inclusions may be indicated merely as minute hollow tubes, the mineral which once occupied the space having been removed by leaching. Very rarely, native gold (visible) may be seen in transparent chalcedony, but in acicular growths. This type of agate is highly prized, for obviously specimens of this kind would hold considerable value for gem cutting purposes.

Sagenitic agate is found throughout Oregon, but some of the most valuable specimens have been found along the coast. A locality near Yachats produces a very fine quality sagenite agate. One rounded specimen, four inches in diameter, yielded several ^{superb} cut slabs, the best piece selling for \$50.00. Commercial collectors along the coast have attempted to find the source of these specimens, but they are generally found only following storms when additional material is cast upon the beach.

CHRYSTOPRASE: - Chalcedony, stained an apple-green color by nickel salts, becomes a valuable gem - chrysoprase. The only area in Oregon known to have produced this variety of agate is the Nickel Mountain region near Riddle, where limited amounts were found some years past. The nickel prospects here when in operation also produced some excellent material, but information is lacking as to what disposition was made of this. Green agate stained by ferrous iron and other metallic salts is common to Oregon, but in quality and value it does not rank with chrysoprase, which is quoted by the ounce rather than the pound.

AGATIZED WOOD: - Wood fossilized (petrified) by agate and chalcedony is found widely distributed, and is generally used for specimen or ornament cutting, unless good colors are present, when it may be used as a gem stone. The central Oregon region leads the state in the production of petrified woods. Large masses and even complete logs are found.

CARNELIAN AGATE: - The translucent, reddish, yellow, and brownish types of chalcedony are known under the names of carnelian and sard. They are common to all agate deposits of Oregon. It is thought the ultra violet light of the sun colors these gemmy pebbles and masses. Practically all the carnelian and sard of commerce has been altered by heat treatment in the foreign cutting centers, because the supply of the naturally colored material is said to be not equal to the demand.

ENHYDROS: - Small pebbles of translucent or transparent chalcedony, showing a bubble or bubbles of water sealed within are known as enhydros or "water agates". These unique and interesting specimens are valued chiefly as a novelty and for their scientific interest. They are found almost entirely in the beach deposits and find a ready sale to tourists.

JASPER: - The massive, opaque, or sub-translucent, variety of quartz is generally found in red colors, due to the presence of iron oxides as impurities in the silica. There are a number of sub-varieties of jasper found in Oregon including bloodstone, moss-jasper, jasp-agate, plasma, oregonite, medfordite, rogueite, polka-dot, jasp-opal, and a number of others. Some of these terms are local names, given to some distinctive occurrence.

The jasper of Oregon is frequently of excellent quality, available in large masses, and well suited for use in the lapidary industry. Central Oregon produces quantities of excellent jasper, often intergrown with chalcedony, and termed jasp-agate. One of the largest masses of gem jasper known in Oregon was that found by a man while plowing a wheat field near Antelope. This mass was so large that it required the use of a tractor to drag it from the field. Visitors were permitted to remove what they desired, and finally when the mass became small enough to move more conveniently it was disposed of to a Washington dealer. The true value of this huge specimen was not known to the owner, otherwise it could no doubt have been disposed of to better advantage. Jasper, like similar quartz minerals depends for its value upon quality. Its price varies from a few cents to a dollar or more per pound.

BLOODSTONE: - Good green colored bloodstone showing evenly distributed markings of red spots is by no means common and commands a good price. Probably the best material of this kind has been found on the beaches of Oregon. Bloodstone associated with jasper and chalcedony may be found in various parts of the state.

PLASMA: - The green colored type of jasper found in Baker County, near Durkee, has been given the name of Oregon "jade". It is, however, wholly different from jade, as it is lacking in translucency among other things. The plasma of Baker County is available in large masses, well suited for working into ornaments and decorative stone and should find use in the growing local lapidary industry. Green colored plasma is common to many parts of Oregon; it is often associated with and intergrown with a reddish-colored jasper. Plasma owes its color principally to the presence of ferrous iron salts, which lack the bright green colors of the nickel, copper, and chromium pigments.

OREGONITE--MEDFORDITE--ROGUEITE: - These sub-varieties of jasper are found in the southwestern Oregon district, as the last two names indicate. Oregonite is a type of orbicular jasper showing small circular markings on a background of red jasper, making it attractive as a gem stone. Oregonite has been developed and exploited widely by a Grants Pass jewelry firm, and the gem has met considerable popularity, but unfortunately the supply appears somewhat limited. The locality where oregonite is found has been kept more or less of a secret, but is supposed to be in Josephine County, north of Holland, where reputedly it is found in a ledge deposit. Medfordite, named after Medford, is a massive white quartz with areas of green. Rogueite is of a reddish color and found along the Rogue river.

POLKA-DOT: - The name polka-dot has been given to a gem material found on Pony Creek in Jefferson County. Except for color it resembles jasper in that it is opaque. It is a white quartz, with small circular areas of red, brown, yellow and black, resembling calico. A very large ledge of this material makes a prominent outcrop on the side of a steep hill on the west bank of Pony Creek. Tons of fragmentary specimens have been gathered on the hillside, but the supply seems as great as ever. Since the surface material represents fragments sloughed off by weathering, not all of this would be suitable for gem cutting. While no open cut large enough to prove the quality of the material below has been made, the surface shows every indication that superior quality material will be found at no great depth.

Polka-dot agate is well suited for gem stone cutting, especially where the circular areas are of bright colors and evenly distributed. The contrast between the snow-white background and the variegated dots makes it of commercial worth. It is also known as St. Stephen stone.

FOSSILS OF AGATE: - Agate and chalcedony are often found replacing some form of life. Along the coast agatized clams and other bivalves and forms of marine life are common. These are valued mainly for their extrinsic worth and are suitable for museum collections and study purposes.

One of the most outstanding forms of fossil life found in the State is the specimens of agatized wood showing teredo-bored holes. Teredo-bored wood which has been subsequently "petrified" is found in only a few parts of the world, and so far as can be learned no area has produced specimens equal to those of Oregon. The most interesting feature of the agatized teredo wood is the fact that not only are the agatized holes present, but the worm which did the drilling is also seen resting in his original burrow completely turned to chalcedony.

There are two principal localities in Oregon where agatized teredo-bored wood is found, along the Oregon coast and some twenty miles east of Roseburg. The former locality produces large water worn specimens, cast up by the waves. The Roseburg locality produces complete log sections weighing over 500 pounds. No scientific study has as yet been made of this material to determine the species of the teredo, although some of the wood has been identified by the writer as a type of redwood now extinct in that area. Specimens are of no special value for their beauty, but they do hold considerable scientific interest and are in demand by museums and collectors of fossil woods.

CAT'S EYE--MOONSTONE--AVENTURINE: - These are other varieties of quartz found in the state in minor quantities, and of limited value as gem stones.

OPAL: - Precious fire opal is rarely found in Oregon and no commercial deposits are known to the writer. Common opal is very plentiful and widely distributed; it is generally of little value unless well-colored and either translucent or transparent. Probably the most outstanding occurrence of common colored opal is that of Opal Butte in Morrow County, where very large nodular-like masses are found in a matrix of partly disintegrated basalt. Some mining has been done for these colored masses, and some years ago an effort was made to develop the area as a producer of precious fire opal, but it did not meet with success, as very little gem opal was found. The large masses of colored opal which have been mined in recent years have been sold for a few dollars up to ten and twenty dollars each. Specimens are generally spherical in shape and range in size up to a foot or more in diameter.

NODULES, AGATE-FILLED: - One of the recent developments in the production of gems in Oregon is the discovery of large deposits of spherical masses of "rock" filled with colored agate of various types. Seemingly these specimens have been overlooked for years; owing to their unattractive rough exterior, they appear to the casual observer as worthless rocks. It remained for local gem cutters to collect and study these specimens and learn their value as a source of gem material and for specimens.

The Central Oregon district has produced many thousands of these agate-filled nodules. Madras seems to be the center of production, but choice specimens are also found on the Warm Springs Indian Reservation

in Wasco County. The area south of Antelope is also a good producer. The nodules, also known as "Thunder Eggs" (old Indian legend has named them) seem to be associated only with rhyolitic rocks, and this seems to hold true for similar specimens found at various localities in Nevada and California. Perhaps the high silica content of the rhyolites is favorable for the deposition of these masses in the cavities of these bodies of igneous rock. Generally the nodules have an average diameter of about six inches, although they are found in perfect specimens as small as one-fourth of an inch and as large as three feet in diameter, all alike in exterior and interior appearance. In all probability they represent a phase of hydro-thermal activity, marked by the deposition of silica from the rising magmatic waters from within the slowly cooling bodies of rhyolite.

There are little or no exterior surface indications to aid in determining if a mass is worth while cutting. Only about one out of five will prove an outstanding specimen, the others will be only mediocre. Breaking with a heavy hammer blow will generally shatter the specimen. The nodules appear to occur in lenses or "beds", probably in areas where the lavas were especially vesicular, presenting numerous cavities where deposition could take place. A single "bed" or area may yield thousands of specimens, generally lying loosely upon the surface, or covered by a thin layer of loose surface soil. Rakes and hoes are the favorite tools of the nodule miners. How deep down the specimens may extend is a matter of conjecture, as the supply of nodules has been so great that digging deeply is seldom necessary. However, in Berkeley, California, where a deposit of agate-filled nodules was found within the city limits, specimens were encountered in the unaltered rhyolite at a depth of fifteen feet. The Berkeley specimens are very similar to those of Oregon, occur in the same matrix, and undoubtedly have the same genesis.

One locality, the Priday Ranch of Jefferson County, produces a remarkable type of nodules filled with what has been termed "flower" agate. Little of this was found on the surface, but shallow open cuts revealed additional specimens. Each locality appears to produce a distinctive type of nodule, instantly enabling experts to distinguish them as such. However, no two specimens are exactly alike in the interior colorings, markings, and patterns. It is customary to saw the specimens in the middle and polish the exposed surfaces. Some cut and polished specimens are worth no more than the cost of labor to finish, while others are worth up to twenty dollars or more. Some local collections exhibit hundreds of specimens, all finely finished and no two exactly alike. Oregon agate-filled nodules are in demand by museums, collectors, and gem cutters.

AGATIZED WOODS: - The petrified woods of Oregon, including those which are agatized, opalized and jasperized, are found at many localities. Some are of a drab color and suitable only for study purposes in furnishing geological clues to the former climatic conditions of the locality. In order to be suitable for gem cutting or as an ornamental stone, the specimen should show pleasing colors, good grain, and other attractive markings. Quantities of this material are used annually in the lapidary industry.

CORUNDUM:- Sapphire is the common name for the mineral corundum, when it occurs in a quality suitable for gem cutting. The mineral has been reported from Harney County but is not thought to exist in gem quality. Small sapphires are found in the beach sands along the coast, but too small in size to be of value.

HEMATITE:- The oxide of iron, hematite, finds use as a gem stone when available in dense, hard and compact masses, free of impurities, and alteration areas. Generally it is worked into cabochons, but intaglios and facet styles are also cut. Some fairly good quality gem hematite has been found in the iron deposits of Columbia County. Possibly when these deposits are developed in a commercial manner, better gem material will be encountered.

CHROMITE:- The black, heavy, hard mineral chromite, finds limited use as a gem material; it takes a good polish and is generally cut in cabochon forms. To be suitable for cutting, chromite should be fine grained and compact, the loose and friable material being worthless. The chromite deposits of Josephine and Grant Counties have produced limited amounts of chromite that could be utilized in the gem industry. The black irregular bands sometimes seen in pink rhodonite from southwestern Oregon are chromite.

PYROLUSITE:- This oxide of manganese in itself is not classed as a gem material; only when occurring within some other mineral can it be classed as such. Much of the moss and similar black markings seen in agate is due to the presence of pyrolusite as an impurity. The high quality agates found near Central Point often show attractive dendritic growths of this mineral.

MALACHITE AND AZURITE:- The green and blue copper carbonates are found in the zone of oxidation in practically all copper deposits in Oregon. Malachite and azurite are very desirable gem materials when found in dense and compact masses. Friable material and coatings are not suitable. When of good quality these secondary copper minerals will bring up to one dollar per pound in the gem-cutting trade.

FELDSPAR:- The most outstanding feldspar gem found in the state is the variety termed SUNSTONE. Good specimens suitable for cutting are found in the detrital surface material at localities in the central part of Lake County. The gem is also found here in the matrix of rhyolite and other igneous rocks. The sunstone of Lake County is frequently quite clear and shows the included scales and spangles of hematite to good advantage. This stone is perhaps most attractive when cut into the facet styles, and the small pebbles of Lake County are well suited for this purpose. The rough gem is sold by the ounce and good material showing the proper amount of included extraneous material brings a price well worth collecting the gem. Labradorite, another feldspar, is found in Oregon as constituent of rocks but is not found in gem quality.

RHODONITE: - Massive rhodonite of good color and quality is found at localities on Evans Creek and Cave Creek in southwestern Oregon. Large masses are available and are used for gem cutting as well as specimens. The gem is also found as water-worn pebbles in this same district. It is often associated with chromite which is present as small irregular black veins and disseminated areas. The granular-structural material is not as suitable for gem cutting as the fine-grained, compact masses. When of an attractive pink color the material has a greater value.

GARNET: - Several varieties of garnet are found in Oregon in good gem quality specimens. The **GROSSULARITE** variety is found over a wide area in the southwestern district, particularly along the Umpqua and Rogue rivers, where huge water worn boulders are picked up. Along the coast where the Rogue river enters the ocean, smaller water worn pebbles can be found. This variety of garnet is found in Oregon in a wide range of colors, including green, yellow, black, white, pink, grey and various intermediate shades and mixtures.

Grossularite garnet so strongly resembles true jadeite (jade) and nephrite, in hardness, specific gravity, toughness, greasy appearance, and feel, that it is sometimes mistaken for the other two. The most certain manner of distinguishing these similar appearing minerals is by optical tests. Curiously enough, the grossularite garnet is found in every color in which true jadeite occurs. Pebbles and boulders of this variety of garnet can easily be distinguished from agates and similar minerals, by the distinctly greater "heft" of the garnet. A fine quality of mixed pink and white grossularite is found in the gravels of the Chetco river, and at Brookings, along the coast near the California border.

Masses of grossularite garnet weighing over 100 pounds have been found in the upper reaches of the Umpqua river. Some are of a quality suitable for carving into ornaments. Small specimens have been sent to the Orient for carving and have made finished objects difficult to distinguish from jadeite and nephrite by ordinary means of testing. Like true jade, the Oregon garnet has about the same degree of translucency, and is equally well suited for lapidary cutting. To date this material has not been widely used, but it appears to hold excellent possibilities. The fine green and "mutton-fat" yellows are very attractive. This garnet is also known under the local name of Oregon "jade".

ALMANDITE: - The dark red variety of garnet known as almandite is found widely distributed throughout the state. A few localities produce specimens large enough for gem cutting, but in general the stone is lacking in translucency. One of the most interesting occurrences of this garnet is the star (asterated) variety found in Jackson and Wallowa counties. Star garnet, while found at other localities in the world, is by no means common. The dark color of the gem does not detract from the star effect.

For cutting purposes, single crystals a half inch or more in size are best. Not every garnet found in Oregon will reveal a moving star when the gem is cut into steep-sided cabochon style, but the localities mentioned here are most likely to furnish asterated specimens. Only cutting and polishing a rounded surface on the crystal will reveal a star if present. The valuation of a star garnet is uncertain, and depends upon size, quality, and what the buyer will pay. One choice and "fancy" specimen, about six carats in weight, recently sold in Portland for \$25.00.

Beautiful green colored uvarovite garnet is found associated with some of the Oregon chromite deposits, but so far there is no record of its occurrence in specimens large enough to permit gem cutting. This variety of garnet is of distinct value as a gem material, and in demand by the gem trade.

OLIVINE:- (Peridot). The dark colored basalts of eastern and central Oregon are frequently filled with minute crystals of green peridot, too small as a rule for gem purposes.

VESUVIANITE: - This gem mineral resembles grossularite garnet, and the two are sometimes found in close association.

TOURMALINE: - Little if any gem tourmaline is to be found in Oregon. Black crystals are sometimes found in mine workings, but these have little value as gems. An acicular reddish-brown tourmaline, not of gem quality, is found at the old Copperopolis mine in Grant County.

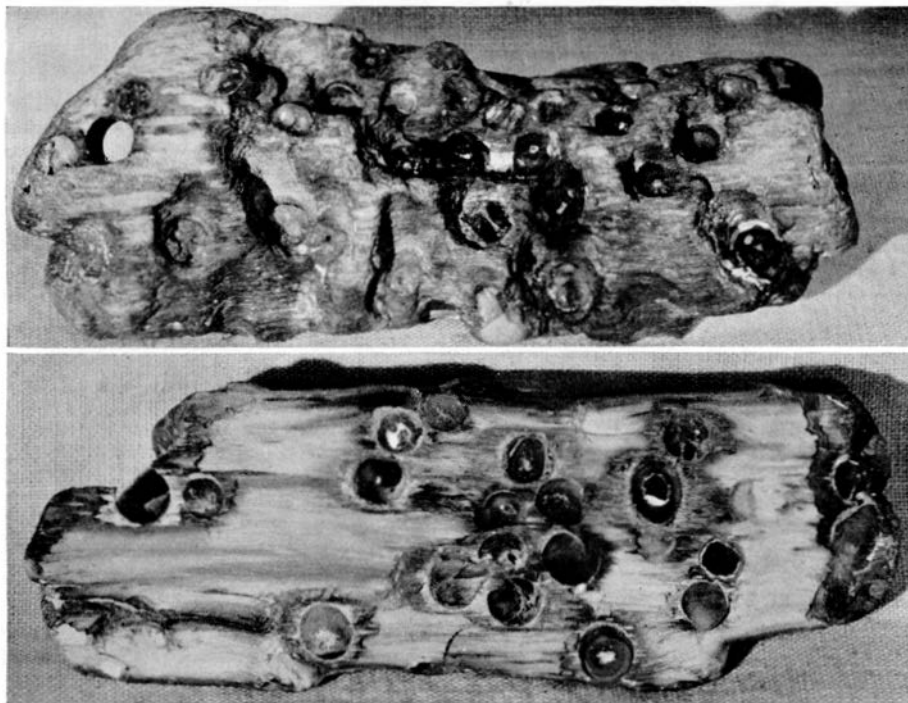
SERPENTINE: - Common green serpentine is found throughout southwestern Oregon, as well as in other districts. Generally it lacks good green color and translucency, which renders it suitable only for ornamental stone.

CHRYSOCOLLA: - Green colored silicate of copper, chrysocolla, is likely to occur in the zone of oxidation in any deposit of copper. Few specimens have been mined in the state. When of good quality and in compact masses this gem often brings over \$20.00 per pound in the rough form.

OBSIDIAN: - The volcanic glass referred to as obsidian, is classed as a rock and not as a mineral. At Glass Buttes, Lake County, Oregon, is an enormous deposit of a variety of obsidian known as "iridescent", owing to the fact that green, purple, bluish, and other shades are seen when viewed on the fractured surface. A great deal of this material has been utilized as a gem and ornamental stone. It is available in very large masses, and can be readily worked into paper weights, book ends, ink stands and similar useful ornaments. Some mining of iridescent obsidian has been carried on but the rock has never been exploited in a commercial manner, despite the fact that it can be obtained cheaply in quantity and is suitable for many uses.



AGATE FILLED NODULE
Huge agate filled nodule found in Southern Wasco County



TEREDO BORED WOOD—NOW AGATIZED