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ORIGIN AND OCCURRENCE OF
GEM STONES IN WASHINGTON

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INTRODUCTION

Precious and semi-precious gem stones have fascinated mankind since before the dawn of history. As symbols of wealth and importance, they have appealed to all who could acquire them. Because of rarity that gives high value, they have been worn as a visible expression of affluence and hoarded as an easily portable and convertible medium of exchange. But more fundamental than rarity in the universal appeal of gem stones is their beauty—an outstanding inherent property—and the facility with which they lend themselves to personal adornment.

Unfortunately, the intrinsic value of true gem stones restricts their accumulation to the wealthy. The average person can afford none at all, or, at most, only one or two, and so is unable to build up a collection of individual stones. Nevertheless, the urge to collect beautiful stones has persisted and, in recent years, has led to the realization by an ever-increasing number of everyday people that semi-precious and non-precious, yet highly attractive, agates, petrified wood, and other available mineral substances may be substituted for costly gems with an astonishing feeling of personal satisfaction.

Now that transportation is so simplified and good roads make nearly all regions accessible, the recreational pursuit of attractive gem-stone material is within the reach of all. Then, too, equipment for cutting and polishing has become more-or-less standardized and does not entail a prohibitive outlay of money, making it possible for anyone to transform rough agates and kindred materials into objects of beauty. As a hobby, there are few activities that so satisfy the basic desire to collect numbers of similar or related items under healthful outdoor conditions and at such slight expense. As a result, agate and mineral societies and clubs have been organized in most of the larger centers of population, so groups bound by a common interest can meet, exhibit their finds and collections, and discuss gathering areas and polishing techniques. Thirteen of these societies or clubs are now active in Washington; the membership of each ranges from about 25 to nearly 200 and in aggregate amounts to nearly 1,000 persons.

The growth of the hobby is indicated by the increasing number of letters received by the Division of Mines and Geology asking for information on collecting areas. As adequate response to inquiries cannot be made through correspondence, it was decided to prepare this report, gathering together all data on gem-stone oc-

currences that are in the files of the Division and including the personal observations made by the writer during the more than 30 years in which he has been interested in the subject. An effort has been made to avoid the use of technical terms so far as possible, but it is presumed that the reader either has or can obtain some basic knowledge of geology and mineralogy. Many easily understood texts are available in the public libraries or by purchase for those lacking an elementary knowledge of geology.

The subject of general mineral collecting is not considered here. Washington is well supplied with a large variety of metallic and nonmetallic minerals, and many enthusiasts get a great deal of pleasure out of collecting these materials. The mines and prospects of the state form the hunting ground for those who have this hobby, and many reports by the Division of Mines and Geology are available to them. Heretofore, however, no comprehensive report has been available to the usual collector interested in agate, jasper, petrified wood, and the few other mineral substances occurring in Washington—all classed, somewhat questionably, as gem stones. The present report is published in an effort to, in part at least, overcome this lack. It is realized that the list of localities where materials have been or can be collected is far from complete. Probably the members of the agate and mineral societies know of many places worth visiting in addition to those mentioned here. If these people will cooperate with the Division of Mines and Geology to the extent of supplying information on collecting localities, it may be possible to greatly improve this report in some future edition.

GEM-STONE VARIETIES OF WASHINGTON

Gem stones have acquired a host of names—some distinctive and useful, some confusing and needless. Schaller[1] has compiled a list of these, showing 867 names that have been applied to 119 mineral substances. He enumerates 193 separate names that have been given to the one mineral quartz—some, because the need for variety designation is indicated by a distinct variation in physical or optical properties, but the most, as a result of someone's whim or eccentricity. Similarly, 53 names are listed for the mineral garnet—some being desirable, as they indicate distinct varieties, and some, arbitrary and senseless. No useful purpose would be served here by enumerating the great variety of gem stones or by including detailed mineralogical descriptions of them. In the first place, only a few are known to occur in Washington and this account is concerned only with them; and secondly, because excellent mineralogies and other reference books are available in public libraries or through purchase for anyone desiring further information.

A collector working in Washington should be familiar with the following mineral substances.[2] Chemically, these are all more-or-less common varieties of silica—the element silicon combined with oxygen as silicon dioxide, SiO_2.

CRYSTALLINE QUARTZ

Quartz crystal; rock crystal.—Ordinary quartz, clear, colorless, or nearly so, occurring as individual crystals or as clumps of crystals, usually terminating in 6-sided pyramids when unbroken.

Amethyst; amethystine quartz.—Crystalline quartz having a clear purple or bluish-violet color, usually best shown near the crystal terminations.

Smoky quartz.—Crystalline quartz, usually clear, having a smoky-yellow to dark smoky-brown color.

Milky quartz.—Crystalline quartz, translucent to opaque, of milky white color. It commonly occurs as vein material and may contain gold and other metallic minerals.

CHALCEDONIC QUARTZ

Agate; chalcedony.—An extremely fine-grained or dense variety of translucent quartz that does not show crystal form (cryptocrystalline), which has a somewhat waxy luster, and which may occur in a considerable variety of colors. Many of the color variants of chalcedony have long had individual names. In ordinary usage *chalcedony* and *agate* are practically synonymous. Possibly, the

[1] Schaller, W. T., Gem names: U. S. Geol. Survey Mineral Resources for 1917, pp. 147-168, 1920.

[2] See also Dana, E. S., and Ford, W. E., a textbook of mineralogy: John Wiley & Sons, Inc., New York, 1932, or other standard texts and reference books.

term chalcedony implies a certain origin (a cavity filling) as well as a definite mineralogical composition and nature; while the term agate has come to have a more general connotation, implying only composition. Theoretically, chalcedony is of uniform color and agate is irregularly colored, usually in more-or-less wavy layers, a distinction that is not generally applied and which is not made in this report.

Bloodstone.—Similar to plasma but containing small inclusions of red jasper.

Carnelian; sard.—A clear red or brownish-red to brown chalcedony, pale to deep in shade.

Chert.—A dull, opaque dense quartzose rock occurring in various rather light colors. It is somewhat like chalcedony but is more impure and, usually, unattractive in appearance.

Flint.—A dark-gray, brown, or black extremely dense form of chert, commonly altered to white or light gray on the surface of nodules.

Jasper.—Ordinary jasper is a dense opaque siliceous rock having a uniform red color. Less commonly, it occurs in shades of yellow, brown, or even dark green, but always with an opacity that is characteristic. It seems unfortunate that the term jasper is not restricted to the red variety, for that is the color that is usually thought of when the material is mentioned. Some typical jaspers result from the crystallization of solutions of silica in which a sufficient amount of either finely divided or flocculent iron oxide is present to give the resultant quartzose mass the characteristic (usually red) color. Other jaspers, probably equally typical, result from the solidification to chalcedony (without crystallization) of similar iron-rich siliceous solutions. The most attractive specimens are those in which the red iron oxide is present in insufficient amount to entirely color the rock but appears as clots and irregular flocculent masses and swirls in a matrix that may be either translucent finely crystalline quartz or chalcedony. Brecciated red jasper is sometimes cemented by chalcedony or chert.

Spherulitic jasper.—The usual Washington form is an aggregate of red jasper spherulites, ranging in size from ½ millimeter to 4 millimeters in diameter, in a dark-brown to black matrix. The spherulites in some instances show concentric layering (a concretionary or oölotic structure) in contrasting shades of red, but this feature is not so obvious when a thin section is viewed under a petrographic microscope; then a radiating structure is apparent. Rarely, the spherulites have a center of crystalline quartz surrounded by yellow jasper which in turn is surrounded by red jasper. The individual spherulites are commonly cracked in a star pattern

which has later been filled with colorless chalcedony. The matrix in which the spherulites are embedded is a yellow to nearly colorless chalcedony so filled with dust-like particles of a metallic oxide (chiefly of iron and a minor amount of manganese) that it is opaque and shows a blue-black metallic luster to the unaided eye.

The spherulitic jasper of Washington is very similar to that of California which occurs in the San Francisco Bay region and was named and well described by W. T. Schaller of the U. S. Geological Survey.[1] Unfortunately, amateur mineralogists have applied the misnomer "orbicular jasper" to this material, a term that has now come into rather common use but which is entirely inapplicable and should be avoided. Orbicular is a term correctly applied to a peculiar mineralogic structural feature of granitic rocks,[2] while spherultic is properly a textural or structural term used to describe a certain feature of inorganic chemically deposited sediments such as chert, flint, and jasper.[3]

Prase.—Translucent to dull leek-green chalcedony.

Plasma.—Bright-green to dark grass-green subtranslucent or feebly translucent chalcedony.

Onyx.—Chalcedony in even, plane layers of contrasting color.

Sardonyx.—Onyx that has included layers of carnelian.

OPAL

Opal is an amorphous or colloidal form of silica (SiO_2) chemically combined with a small amount of water. It is not quite as hard as quartz and has a lower specific gravity.

Common opal.—A translucent to subtranslucent form of ordinary opal lacking "fire" or play of colors and occurring in various colors such as: white (milk opal), yellow, brown, red, green, and black.

Hyalite.—A transparent, colorless variety of common opal.

Precious opal.—A transparent to translucent variety of opal that exhibits a delicate play of colors.

Fire opal.—Precious opal showing fire-like flashes of color.

PETRIFIED WOOD

Silicified wood.—A replacement of wood by silica (quartz). The grain of the original wood is usually preserved.

Opalized wood.—A replacement of wood by opal, generally of the common variety. The original grain is usually preserved, but in some instances it is obliterated.

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[1] In Sterrett, D. B., Gems and precious stones: U. S. Geol. Survey Mineral Resources for 1910, pp. 870, 871, 1911.

[2] Johannsen, Albert, A descriptive petrography of the igneous rocks, vol. 2, pp. 248-259, 349-354, 387-388, Chicago, Ill., University of Chicago Press, 1932.

[3] Twenhofel, W. H., Principles of sedimentation, pp. 367-379, 570, New York, McGraw-Hill Book Co., 1939.

ORIGIN OF AGATE, JASPER, AND PETRIFIED WOOD

Washington is far less favored than are some states, for example Oregon and Montana, in the occurrence of agate and other materials of interest to the collector. Yet it is possible to find agate, jasper, silicified and opalized wood, and many other colorful materials in certain areas and, in favorable places there, in considerable quantity. Some consideration of the conditions under which these substances form and occur and of the applicable geology of the state adds interest to collecting and doubtlessly would increase the efficiency of the collector in pursuing his hobby. As the three most popular collector's items are agate, jasper, and opalized wood, the origin of these materials warrants attention.

MINERAL-BEARING SOLUTIONS

Water exists at most places at a greater or lesser depth in the ground; it may occur in the loose surficial deposits overlying the bedrock and to considerable depth in the bedrock itself. This is known as "ground water"; it is tapped for domestic and industrial use by dug or drilled wells and appears as springs where conditions are favorable. Ground water is seldom static, or free from movement; usually it slowly percolates through the strata under the influence of gravity. In its travel it dissolves and picks up mineral matter from the rocks through which it moves. Depending on the kind and solubility of the minerals composing the rock, the ground water may become feebly to strongly charged with various compounds of calcium ("lime"), sodium, iron, or many other elements. One compound that may be present in solution in this way is silica.

Water is also a component of molten igneous rocks, particularly those of the more acid (siliceous) varieties. Common examples of such rocks, when cooled, are granite and rhyolite. This hot so-called "magmatic" water has a strong dissolving action on the silicate minerals composing the rocks through which it travels. As the silicates are decomposed, silica is released, to be carried in probably a colloidal form by the water. The water may finally issue as a hot spring, as is common in regions of recent volcanic activity, or it may join and become a part of the ordinary ground water of the region.

Just as water, in working its way slowly through the rock of the earth's surface, dissolves and carries silica when conditions are favorable for such action, so it releases and deposits silica when conditions change to those favoring deposition. This change may be a variation in the chemical nature of the rock traversed, or the change may be to a lower pressure or temperature, or to some other conditions differing from those formerly prevailing. When the deposition of silica does occur it takes place in pore spaces and voids in the rock or other material that the solution happens to be in. In this way it may impregnate and "silicify" permeable rocks; it may

replace, molecule by molecule, the cells of deeply buried vegetal or other organic matter, thus causing "petrifaction"; or it may fill cracks and cavities that exist in the host rock. The collector is chiefly interested in petrifaction, whereby wood is silicified or opalized, and in cavity filling, whereby agates and related stones come into existence.

CAVITIES AND CAVITY FILLING

Open cavities in which silica-bearing solutions could deposit chalcedony were rare in some of the rock varieties that make up the bedrock of the state and fairly abundant in other varieties. Knowing this, one can predict in what formations agates and related cavity fillings may be expected and where the chances are against their occurrence.

Cavities were rare in the sedimentary rocks of Washington. In some states, notably Iowa, cavities are thought to have formed in some sedimentary beds through the removal of soluble ("limy") concretionary nodules, the empty spaces later to be filled by chalcedony or other minerals; so far as known, no instance of this process has been found in Washington. Cavities were rare, too, in metamorphic rocks and in almost all igneous rocks except those extrusive, volcanic varities known as rhyolite, andesite, and basalt. The metamorphoric rocks and the intrusive igneous rocks, such as granite, commonly show breaks that resulted from jointing, fracturing, and faulting; in these, under favorable conditions, were formed quartz veins and associated deposits of ore minerals. Open cavities or "vugs" may have occurred in the quartz veins and in the ore deposits, representing remnants of original openings, solution cavities, or volatile constituents (of the ore solutions) that later disappeared. These vugs may be lined or filled with crystals of quartz, calcite (calcium carbonate), or various other minerals; however, fillings of agate and jasper are rare under such circumstances.

The most favorable rocks, therefore, are the extrusive, volcanic varieties. These, in their original molten state sometimes contained considerable gas or entrapped steam. In consequence, as they cooled under conditions of lessened pressure, holes and cavities in the shape of the expanded gas bubbles commonly developed. The size of cavities formed in this way, their distribution through the rock, and their abundance, of course vary greatly, depending on the amount of gas originally present, its distribution through the rock mass, and the viscosity of the originally molten material. They may be so numerous (particularly in basalt) as to make the rock cellular, or "vesicular," giving it a spongelike appearance due to the myriad of smoothly rounded spaces, ranging from the size of a pinhead to that of a large bean or almond. Under exceptional conditions, and then chiefly in the more acid rocks—andesite and particularly rhyo-

lite—the holes or cavities may be relatively sparse but relatively large. Sizes comparable to those of oranges and grapefruit are common, and much larger cavities are formed occasionally. These, too, may be smoothly rounded, but it is far more usual for them to be irregular in outline, and sometimes they are collapsed to greatly elongated, relatively thin shapes.

Any such holes and cavities, in whatever kind of rock they occur, may be entirely empty; or they may be merely lined with some mineral, such as chalcedony, hyalite, or calcite. In such instances, either no mineral-bearing solution reached the cavities or an insufficient amount had access to the cavities to fill them. If the walls of a cavity are mineral-lined but the interior is empty, the result is a "geode." Great variations occur in these interesting forms. The wall lining may be very thin, or it may be so thick that but little space remains unoccupied. It may consist of but one mineral, or more than one mineral, or different varieties of a single mineral, depending on the nature of the solutions and on whether differing solutions were present at various times during the formation of the geode. For example: a common form of geode has an outer shell (the initial cavity lining) of chalcedony and, attached to and merging into it, an inner layer of crystalline quartz.

When the time for filling was adequate and the available minerals in solution were sufficient to entirely fill the cavity, the deposited mineral matter became a solid mass. The resultant nodule may show that it formed just as a geode does, in concentric, usually wavy, layers of one or more minerals separately deposited, or, more commonly, of different forms of the same mineral—for instance, chalcedonic and crystalline quartz, or variously colored forms of chalcedony. On the other hand, it may be obvious in some instances that the filling did not deposit as a lining on the more-or-less spherical walls of the cavity but rather as a gradual horizontal accumulation, sometimes layer upon layer, from the bottom to the top. In fact, the deposition of chalcedony as a complete wall lining (which, if the process had stopped, would have resulted in a geode) may have been followed by a final horizontal filling of what remained of the original cavity, giving horizontally banded agate surrounded by curved layers of the same material. Great variety exists in agate nodules, but the general process of formation of all is essentially the same.

Occurences of vesicular basalt are very common in southeastern and also in some parts of southwestern Washington. They may be seen in road cuts and quarries and in many other excavations where the bedrock is lava. In most instances, these small cavities or vesicles are either entirely devoid of mineral filling or have only a thin lining on their walls. In other places, the spaces are completely filled with zeolites (chiefly complex hydrous calcium silicates),

calcite, or, occasionally, chalcedony or even opal; then the rock is said to be "amygdaloidal" and the fillings are called "amygdules." In instances most commonly met with, amygdules are too small or too unattractive to interest the collector, and it is the larger, unfortunately rarer, cavity filling formed sometimes in basalt and more commonly in andesite and particularly in rhyolite that is sought for.

COLOR CHARACTERISTICS

The variations in color shown by chalcedony and other quartz varieties are generally considered to be due to minute amounts of various elements present as impurities. Thus, pure quartz is water-clear and colorless; some chalcedonies are also clear or they may be snow-white. Commonly, chalcedony is delicately to strongly colored yellow, brown, or red, owing to the presence of lesser or greater amounts of iron. Still other colors are green (from a trace of nickel or chromium); blue (probably from an iron compound); and black (probably from some organic material).

These coloring agents may have been present in the original silica-bearing solutions, so attractive stones were formed. In many instances, however, the solutions were relatively free from coloring matter and therefore produced unattractive nearly colorless, gray, or slightly yellowish agate nodules. Fortunately for the collector, during the ages that many of these drab agates have been buried since their original formation, they have been subject to the coloring effects of later mineral-bearing solutions; hence have absorbed coloring agents and have acquired attractive colors they did not originally possess. When colored subsequent to formation, the hue may be only a surface effect, or it may penetrate the stone to a considerable depth, or it may selectively color certain permeable layers of the agate in striking contrast to less permeable layers. Incidentally, advantage is sometimes taken of the variations in relative permeability of the different layers composing agates to color them artificially to spectacular hues; large Brazilian agates, occasionally seen in museums and in private collections, usually owe their brilliant contrasting color bands to this "gilding of the lily." Possibly the end justifies the means, as beautiful specimens result.

Opalized wood, common in various parts of eastern Washington, was colored when formed or later, in the same way that agates are. The petrifaction was an infinitely slow process. When the wood cells were replaced throughout by silica having essentially the same coloring trace-elements, a uniform color resulted. When the process was occasionally interrupted, so that part of the vegetal matter was replaced at one time and part at another, allowing time for changes in solution composition, a variegation in color and shades resulted.

The red of common jasper is due to ferric oxide included in considerable amount in a chalcedony or quartz matrix. The more

desirable jaspers variously known as variegated, "Egyptian," agate, and "calico" have clots and formless, flocculent masses of ferric oxide distributed at random through a chalcedony or quartz matrix that may be green, yellow, or translucent in delicate tints.

RELEASE AND REMOVAL FROM HOST ROCKS

Whenever rock is exposed to the atmosphere, weathering takes place. By this means the rock, over a long period of time, disintegrates, decomposes and softens, and even may become clay. Cavity fillings may be harder and more resistant to weathering than the original rock and so remain hard and unaltered when the host rock is completely decomposed. This is particularly true of chalcedonic fillings. In consequence, geodes, amygules, and agate nodules may be found as loose stones in a clay or grit, the residual material from what was originally a lava flow. It is more common, however, for erosion to carry away the residual products of rock decay, in which case the agate materials are also removed from their place of origin to finally come to rest in the gravels of ancient or modern stream beds and beaches.

It is relatively uncommon in Washington to find loose agate masses or nodules in the original shape and condition in which they were formed, even though they lie in a residual clay derived in place from the decomposition of the host rock. Usually the nodules have become fractured by stresses that affected the host rock at some time in its history, or they have been broken by frost action or have suffered other mechanical damage. Alluvial agates—those that have been transported by streams—are almost invariably angular, subangular, or rounded fragments of the original masses or nodules.

Under certain conditions of moderate erosion, it is possible for the agate nodules, together with similarly hard material from sedimentary beds that may have been associated with the old lava flows, to become concentrated on surfaces of gentle slope, while finer material of less weight is carried farther away. Concentrations of this kind exist on the bedrock surface of parts of southwestern Washington; for example, in the vicinity of Tono, Thurston County. However, sedimentary beds of sand and clay have commonly been deposited at a later time and so conceal the agate accumulations. This cover is relatively thin in some places, so there it is possible to dig down to the bedrock and discover any agates, jasper, and petrified wood that may lie on it.

REGIONS OF THE STATE AND THEIR COLLECTING POSSIBILITIES

When the foregoing considerations are applied to the regional geology of the state it becomes possible to estimate the possibilities of various areas as sources of agates and related materials. That an occasional agate is found in an unfavorable area, and that persistent search may fail to produce agates in a favorable area, are quite understandable. In the first instance, it is possible for chalcedonic material to form under quite adverse conditions. Then, too, glaciers and streams may carry agates from a distant source and leave them in places where their occurrence would not be expected. In the second instance, prolonged collecting may have depleted the occurrences in a favorable locality, the stones may be concealed by barren deposits or vegetation, or, despite appearances, the local conditions may not be as favorable as assumed.

NORTHEASTERN REGION

In a general way, the areas of granite and related rocks and of metamorphic rocks, common in the northern row of counties from the Cascade Mountains to the Idaho line, are not particularly favorable for the occurrence of agates, jasper, or petrified wood. However, in this region quartz veins are abundant, so milky quartz is of common occurrence, and occasionally quartz crystal and amethyst are found. The most attractive crystalline quartz is usually in vugs occurring in ore deposits and in various rock formations; their presence is entirely fortuitous and cannot be predicted.

SOUTHEASTERN REGION

That part of eastern Washington south of the northern row of counties and east of the Cascade Mountains is almost entirely underlain by the Columbia basalt flows. This rock, in the upper part of individual flows, is commonly vesicular and in some places is amygdaloidal, but, with a very few notable exceptions, mentioned later, it is mostly barren of material that is attractive to the collector. Interbedded with the lava in numerous places are beds of sand, "ashy" sands, and silty clays that commonly contain opalized wood. Occasionally, opalized wood, ranging in size from small fragments to nearly whole logs, is found where the wood was originally entrapped in the flows themselves, or between flows where little if any sedimentary material occurs. Also, later sedimentary deposits lying on top of the basalt bedrock are rather abundantly agatiferous in certain places, the chalcedonic material having originated an unknown distance away to be transported by ancient streams onto the lava plains.

NORTHERN CASCADE MOUNTAINS AND PUGET SOUND REGION

Conditions in the northern Cascade Mountains and extending approximately to the south boundaries of King County on the west

and Chelan County on the east are relatively unfavorable, though isolated agates are sometimes found, and some petrified wood and jasper occur in the Swauk sedimentary beds that extend northwestward from Wenatchee. Quartz veins are as abundant here as in the northeastern region, and mining or prospecting operations sometimes disclose quartz-crystal-filled vugs.

Occasional agates, jaspers, and pieces of petrified wood are found in the glacial deposits adjacent to Puget Sound, but they are relatively rare. The chance of finding interesting material is better on the beaches of the Sound, Admiralty Inlet, Hood Canal, and Strait of Juan de Fuca, for here gravels in endless amount are well exposed to the collector and favorable conditions exist for the harder, siliceous materials to be concentrated. As a result, these beaches continually yield a few agates to persistent search, but these are mostly small, of poor color, and too sparse to repay the time spent in their collection.

SOUTHERN CASCADE MOUNTAINS REGION

The southern Cascade Mountains region, together with the adjoining lowlands on either side, from King and Chelan Counties on the north to the Columbia River on the south, is relatively favorable for the occurrence of agates and related materials. Basalt is a common rock here, and much of this must have originally contained an unusual amount of water vapor or other gases, for voids of considerable size were formed in many places when the flows cooled. Andesite is an abundant rock throughout the region. Rhyolite underlies areas of considerable size in Kittitas and Pierce Counties and is associated with andesite in various places in other parts of the region. Chalcedony formed in rather large amounts in some of these rocks, so that it and related materials may now be found where weathering and erosion have released the nodules from the host rocks. Some of the material is in place, or nearly so, and occurs in residual clays and in disintegrated outcrops. Much of it, however, has been carried by streams a considerable distance from its place of formation.

Although this region, in general, is probably the best in the state from a collector's viewpoint, it does not contain any such excellent agate localities as are found, for example, in Oregon and Montana. One area here that is deserving of attention is along Swauk Creek and the Teanaway River in Kittitas County, the tributaries of these streams, and the adjacent hilly to mountainous terrain. Another area, less well defined, is along the west slope of the Cascade Mountains and in the adjacent foothills and lowlands from Tenino to Vancouver.

OLYMPIC PENINSULA

The Olympic Peninsula is somewhat more favorable than the northern Cascade Mountain area, though agates and petrified wood

seldom occur either in the sedimentary rocks that compose most of the region or in the basaltic rocks that form a horseshoe-shaped belt around the north, east, and south sides of the peninsula. However, these basalts in some places have "ellipsoidal" or pillowlike forms that were developed when they originally cooled as a result of being extruded into shallow water, and the spaces between the individual "pillows" and of the natural shrinkage cracks and joints of the rock are commonly filled with later mineral matter. The most usual filling materials are a siliceous limestone and a more-or-less calcareous chert; the latter may be white or variously colored by iron and manganese to shades of yellow, brown, pink, purple, and red. In general, it lacks translucency, brightness, and clearness of color, but some specimens have an interesting appearance. Another and far less common filling is jasper. This may be the usual red, but variegated and spherulitic varieties occur. Finding these more attractive materials in place within the area where volcanic rocks crop out is not impossible though it is very difficult. A better procedure is to search for pebbles and boulders of transported jasper in stream gravels of the area and along the ocean beaches to the west. Beach gravels from Grays Harbor north to Cape Flattery are quite productive, the best accumulations being probably in the La Push-Cape Johnson vicinity.

SOUTHWESTERN REGION

The Willapa Hills region of southwestern Washington (south of Grays Harbor) has an abundance of basaltic rock formations but lacks the more acid volcanic rock with which agates are usually associated. The agates found there along the beaches and streams—never abundantly—are mostly in, or are washed from, the unconsolidated Pleistocene sands and gravels that overlie the earlier bedrock. They originated far to the east and were transported into the area by streams during the time the glacial ice was present in the Puget Sound region. In some places a thin, sparse stratum of hard, siliceous pebbles and cobbles lies on the bedrock at the base of the Pleistocene beds; in this, agates, petrified wood, and jasper may usually be found. Fossilized marine shells (most commonly, forms similar to clams and snails) are abundant in some of the sedimentary rocks of the area. These sometimes have a chalcedonic filling and make interesting collector's items.

GEM-STONE LOCALITIES OF WASHINGTON

To obtain precise locations where agates and related materials have been found or where collections can be made is usually rather difficult. It may be done in some instances, but commonly the available information is based on hearsay, rumor, and unsubstantiated reports. Occasionally there is no question of a considerable number of agates having been found at some place, but the finder may have only a confused idea of where this is. If the find was recent, he could probably retrace his steps, but he may not be able to describe to another person the route followed. In western Washington particularly, explicit directions are needed because of concealing vegetation. All this may add zest to the search; certainly a well-deserved feeling of accomplishment attends the finding of an agate locality by following the usual indefinite directions. The best procedure is to accompany agate-club members or other individuals who have accidentally or through trial and error learned how to reach promising localities.

In the following pages, under county headings, is given information on the materials of most general interest to collectors and the best available data on their location. Some of the place designations are vague indeed, but people living in the vicinity may be able to supply further details.

CHELAN COUNTY

AGATES

Davenport property.—In secs. 7 and 8, T. 22 N., R. 17 E., on the north side of Negro Creek. It is reported that agate-lined geodes, whole and broken, have been found in this vicinity. No details are available.

MEXICAN, OR TRAVERTINE, ONYX

Blewett Pass.—The variety of calcium carbonate rock known as Mexican, or travertine, onyx, in blue, black, and buff colors, is reported to have been found cropping out at the top of a ridge 2 or 3 miles east (?) of the Blewett Pass summit. Other details are unknown.

QUARTZ CRYSTAL

Crown Point mine.—This is in the SE¼ sec. 8, T. 31 N., R. 16 E. at the head of the cirque west of Lyman Lake. An adit in diorite, 200 feet below the molybdenite vein, exposes a vuggy zone containing quartz crystals as much as 2 inches in length.

CLALLAM COUNTY

AGATES

Agate Bay or Agate Beach.—On the Strait of Juan de Fuca, just west of Crescent Bay, in T. 31 N., R. 8 W. Formerly, agates were

plentiful enough here to give the name to the bay or beach. They occur occasionally in the gravel of beaches all along the Strait, having come out of the transported gravel of the glacial drift that is abundant in the region. In the Crescent Bay area, however, it is possible that some additional agates have weathered out of the basalt which crops out in this vicinity.

(See also Grays Harbor County.)

JASPER

Ed. B. manganese claims.—West of Lake Crescent, 6½ miles airline, in the SE¼ of sec. 24, T. 30 N., R. 11 W. Ellipsoidal basalt is exposed in the gully occupied by Eureka Creek. In the creek bed near the tunnel of the Ed. B. group of manganese claims, spherulitic jasper in masses as much as 6 inches across forms the filling between the individual basalt pillows.

Lake Crescent.—A huge boulder of spherulitic jasper, weighing several tons, was found in a gully at about 2,000 feet in altitude approximately a mile northwest of the west end of Lake Crescent. This is between the Daisy and Peggy manganese claims. Some individual spherulites showed white and yellow centers in addition to the more common red varieties.

Ocean coast.—To the north and south of the mouth of the Quillayutte River (at La Push), particularly in the 2 miles of gravelly and bouldery beach north of the river and Rialto Beach, spherulitic jasper, plain jasper, and occasionally chalcedonic jasper of various kinds occur in considerable quantity as pebbles and cobbles. These materials may be found, also, in other gravelly beaches up and down the coast, as in the vicinity of Kalaloch, Jefferson County, but vagaries of the ocean current expose new gravels in one place while concealing gravels at another place, so gathering localities change from year to year.

Other localities.—Spherulitic jasper has been brought to the Division of Mines and Geology by Olympic Peninsula manganese prospectors but without locations being designated. It has been found as float on the Dungeness and Soleduck Rivers, indicating that the material is not uncommon within the belt of basaltic extrusive rocks with which the manganese is associated.[1] Variously colored chert also occurs in some places associated with ellipsoidal basalt, as near Staircase on the Skykomish River just above Lake Cushman.

CLARK COUNTY

(See Cowlitz County.)

[1]Green, S. H., Manganese deposits of the Olympic Peninsula, Washington: Washington Div. Mines and Mining Rept. of Inv. No. 7, 1945.

COWLITZ COUNTY

AGATES, GEODES, AND JASPER

Silver Lake locality.—East of the lake from the west quarter corner of sec. 8, T. 9 N., R. 1 E., northward and eastward along the railroad grade of the Weyerhaeuser Timber Co.; also along the road running northwest from the south center of sec. 8 and crossing the railroad grade in the SW¼ sec. 5. A perfect clear-quartz-lined geode, 4 inches across, was found by the writer in residual clay of the railroad cut just northeast of the road crossing, and fragments of geodes are common throughout the area. Most of the material is chalcedonic and of a poor gray to light-buff color; but better-colored material, together with highly colored jasperized wood, is reported to occur in the soil overlying "hardpan" at a depth of 6 to 24 inches in the W½ sec. 5.

Other localities.—The part of Cowlitz County 15 or 20 miles east of the Cowlitz River and extending from the north county line south to and possibly beyond the Lewis River is favorable for the occurrence of agates and related materials. Collections have been made in the hills east of Kalama and Kelso, and the whole region is deserving of attention. The Kalama area is particularly noted for the interesting zeolite fillings of a vesicular and vuggy basalt, in places considerably altered and softened, that forms the bedrock of the region. An abundance of excellent specimen material has been collected here.

DOUGLAS COUNTY

Moses Coulee.—Precious opal has been reported from Moses Coulee, but the occurrence could not be verified. It is reasonable to expect opal to be present somewhere there as amygdules in the great basalt outcrops of the coulee walls. Kunz' statement regarding Douglas County,[1] that "a rich golden semiopal of great beauty is found, also red, olive-green, and striking minglings of all three colors" probably refers to occurrences of opalized wood. He gives no location details.

FERRY COUNTY

AMETHYST

It is reported that amethystine quartz occurs 15 miles northeast of Republic. Further details are lacking, but miners and prospectors of the vicinity could probably supply information.

FRANKLIN COUNTY

AGATES

White Bluffs locality.—On the east side of the Columbia River, 16 miles upriver from Pasco, from Byers Landing to Ringold.[2] A

[1] Kunz, G. F., Precious stones: U. S. Geol. Survey 17th Ann. Rept., pt. 3, p. 915, 1896.
[2] U. S. Geol. Survey Pasco quadrangle topographic map.

stratigraphic thickness of about 150 feet of iron-stained gravels and cobbles crops out in the river banks and bluffs at the base of the White Bluffs (Ringold) exposures. The gravels are well-rounded and stream-worn. They consist of a great variety of rock types, among which quartzite is particularly abundant and agate and jasper are of frequent occurrence. The agates are chiefly gray and buff-colored chalcedony, but some have attractive red hues. Some of the jasper forms a matrix for an unusual breccia of white to cream-colored quartzite. The best collecting is in the draws and gullies and on the intervening spurs, where erosion has cleaned concealing coatings from the stones.

GRANT COUNTY

OPALIZED WOOD

Saddle Mountain.—Considerable opalized wood occurs between Othello and Beverly, in the Saddle Mountain area. Some relatively large parts of logs have been found, producing material of excellent color. Advantage can be taken here of deep excavations provided by canyons and gullies cut into the basalt and interbasalt sediments. Flake wood in the wash at the foot of a gully serves to indicate prospecting sites up the gully.

CHALCEDONY

Moses Lake vicinity.—Cores from a deep oil-test well in the northwest corner of sec. 19, T. 17 N., R. 28 E. showed a vesicular basalt at a depth of 3,850 feet in which occurred blue chalcedonic amygdules the size of one's thumb. Of course, these are inaccessible to a collector, but they indicate some possibilities in the outcropping basalt of the region.

GRAYS HARBOR COUNTY

AGATES

Ocean coast.—Agates are sometimes found in the beach gravels of the west coast of the Olympic Peninsula but they are not common. Many years ago, before collectors had so thoroughly worked the beaches, they were more numerous and some large collections of attractively colored material were made. One beach area that, 40 years ago, produced excellent red agates was from Copalis to Point Grenville.

The writer has found several ovoid frosted pebbles, the size of one's thumb, worn from single water-clear quartz crystals, in beach gravels immediately adjacent to the north side of Point Grenville.

SILICIFIED WOOD

Silicified wood, generally quite unattractive, weathers out of various formations of the Peninsula region and may be found as pebbles and boulders in stream and beach gravels. Specimens show-

ing fossilized teredo borings are sometimes found. Considerable wood occurs in the Quinault formation of Cape Elizabeth. Mostly, this is not petrified, but one unusual 6-inch log, 8 feet long, was found by the writer where wave action had partly eroded the enclosing sandstone. Part of this log was entirely silicified, part was carbonized and coaly, and part was a still unaltered, though darkened, wood from which shavings could be cut. A whittled piece of the wood gradually darkened to jet-black within a period of 3 months; it was then hard and susceptible to a high polish.

JASPER

Plain jasper is not uncommon in the gravels of streams flowing from the Olympic Mountains. Aside from the spherulitic variety (see Clallam County), this material is of but little interest to most collectors.

OTHER COLLECTOR'S ITEMS

Pyrite concretions, 1 to 2 inches in diameter, weather from shale cropping out along the ocean bluff near a small creek three-fourths of a mile south of the mouth of Raft River and also in a similar situation about half a mile south of Little Hogs Back, in the NW¼ sec. 4, T. 22 N., R. 13 W. The abundance varies greatly from time to time, but usually it is possible to collect large numbers of smoothly rounded to subangular masses of solid pyrite, surface oxidized to a brown color, from gravel accumulations of the upper beach.

JEFFERSON COUNTY

(See also Clallam and Grays Harbor Counties.)

QUARTZ CRYSTAL

Mount Anderson.—It is reported that clear quartz crystals as much as 2 inches in length are quite numerous in the NW¼SW¼ sec. 28, T. 26 N., R. 5 W. No further details are available.

Rustler Creek.—Quartz crystals 2 inches long and from 1 to 1½ inches in diameter are reported to occur in vuggy parts of a quartz vein that crops out in the SW¼SW¼ sec. 31, T. 25 N., R. 7 W.

KING COUNTY

QUARTZ CRYSTAL

Denny Mountain.—A thick bed of limestone crops out on the southwest side of Denny Mountain, above Denny Creek, about 1½ miles west of Snoqualmie Pass. This is in the W½NW¼ sec. 5 and the E½NE¼ sec. 6, T. 22 N., R. 11 E. At the northwest end of the main limestone body the writer found a loose slab of bluish-gray chalcedony, a foot or so across, covered with a stand of large clear quartz crystals. It obviously came from no great distance above the limestone outcrop. Incidentally, massive garnet, unattractive, so

far as observed, forms an irregular body 10 feet or more in width along the northeast side of the limestone; gray calcite crystals, many feet across, have formed from the recrystallization of the limestone at the upper northwest end of the limestone body; and large glittering crystals of specularite (micaceous hematite, an iron sesquioxide) are loose in the soil forming the side of a ravine marking the northwest end of the limestone exposure.

Bear Basin.—Miners and prospectors working on the North Fork Snoqualmie River report that large clear quartz crystals occur rather plentifully in a rock slide near the Bear Basin prospects. Further details are unknown but should be available from the miners.

Devil's Canyon.—In the S½ sec. 27, T. 25 N., R. 10 E., 300 feet above the Devil's Canyon prospect, is a vuggy zone about 400 feet wide in which are many clusters of clear quartz crystals. The individual crystals are mostly less than 2 inches long and ½ inch in diameter.

Clipper property.—In the north center of sec. 1, T. 23 N., R. 11 E., a vuggy zone contains clear quartz crystals.

KITTITAS COUNTY

AGATES

Virden locality.—Beautifully colored blue agates have been found in and near Horse Canyon, 1 to 2 miles south of Virden (also known as McCallum and Lauderdale Lodge), in the W½ sec. 34, T. 20 N., R. 17 E.

Liberty locality.—It is reported that rather abundant agate-filled geodes occur at the extreme heads of Williams Creek, Boulder Creek, and, particularly, an unnamed creek between these two. The head of the unnamed creek is about 5 miles northeast of Liberty at an altitude of 5,000 feet or so. All these streams head just below the precipitous escarpment forming the west side of Table Mountain. The mountain is capped by flows of Yakima basalt which are immediately underlain by flows and tuff beds of the Teanaway basalt. The latter is probably the source of the geodes; certainly it is favorable for their occurrence.

Chalcedony occurs as amygdules and as fillings in larger irregular cavities in the Teanaway basalt, which crops out in an east-west belt 2 miles wide that is crossed by the highway (U. S. 97) just south of Liberty. Specimens, including blue agates, have been found in road cuts and in the hills on either side of the highway.

Redtop-Cle Elum Lake locality.—The exposures of Teanaway basalt extend west of Liberty for about 5 miles, then swing to the north for about 8 miles, then extend westward some 17 miles to Cle Elum Lake. Throughout this distance the belt is from 1 to 4

miles in width. West of Cle Elum Lake the formation is exposed to a width of from ½ mile to 4 miles from near the junction of the Cle Elum and Yakima Rivers northwestward for at least 26 miles.[1] It would appear that the whole area of Teanaway basalt exposures is favorable for the occurrence of chalcedonic nodules and geodes. Attractive agates, some of a beautiful blue color, have been collected on Redtop, 5 miles northwest of Liberty; they have been reported on Crystal Mountain, in the vicinity of Ryepatch, which is 4½ miles west of Redtop; at Elbow Peak, in sec. 6, T. 21 N., R. 15 E., on a small island (during high water) near the west shore of Cle Elum Lake; and on Mount Baldy (Domerie Peak?) west of Cle Elum Lake.

Four exposures of rhyolite in the general Ryepatch vicinity should be investigated, as it is probable that agate nodules will be found there. These are: (1) an area of about three-fourths of a square mile, centering in the SE¼ sec. 1, T. 21 N., R. 15 E., and a connected area of about a square mile centering in the SW¼ sec. 11 of the same township; (2) an area of about three-fourths of a square mile centering in the southeast corner of sec. 7, T. 21 N., R. 16 E.; (3) an area of nearly a square mile centering in the SE¼ sec. 15, T. 21 N., R. 16 E.; and (4) a small area of possibly one-eighth of a square mile centering in the NE¼SW¼ sec. 24, T. 21 N., R. 16 E. It is possible that these are erosional remnants of a once much more extensive rhyolite flow and that some, at least, of the finds of agate nodules mentioned above represent material weathered from this original source.

Squaw Creek locality.—An old report of 1913 mentions onyx agate having been found as massive interbasalt-flow filling in the Squaw Creek area nearly on the Kittitas-Yakima County line about 10 miles east of the Yakima River. It is said that some was sold to a California lapidary as gem material.

Ellensburg locality.—Another old report mentions lavendar-blue chalcedony having been gathered in the sagebrush country around Ellensburg. No further location details are given.

OPALIZED WOOD

Ginkgo Petrified Forest State Park.—This is an area of 9½ square miles lying just west of the Columbia River and crossed by U. S. Highway 10. Two museums are maintained: one is about ½ mile and the other about 2½ miles from the bridge over the Columbia River at Vantage. An abundance of opalized wood, ranging from flakes to nearly whole logs, occurs in the park area. Small fragments may be found on the surface of the ground and in the soil. Larger pieces and logs are in place (where originally opalized), encased in basalt, lying between basalt flows, and in interbasalt pumiceous

[1] U. S. Geol. Survey Geol. Atlas, Mount Stuart and Snoqualmie folios (nos. 106 and 139), 1904, 1906.

sediments; many of the pieces have been naturally exposed by erosion or have been uncovered by dug pits. No collecting is permitted in the park, but opalized wood similar to that of the park occurs under similar conditions outside the park area in the eastern part of Kittitas County. Collecting should be good in the westerly extension of the Saddle Mountains, between Kittitas and West Beverly.

COMMON OPAL

A greenish-yellow brittle massive opal occurs as small to huge nodules, as irregular masses, and sometimes as veinlike bodies in the diatomite beds of the Kittitas region and in those of the Quincy region of Grant County. It probably represents a segregation and deposition of silica derived from the solution of some of the diatomite, which, incidentally, is itself a form of opal. The material is cellular and laminated in concentric layers, has an unattractive appearance, and is only collected as a curiosity.

KLICKITAT COUNTY

OPALIZED WOOD

Roosevelt locality.—An area of some 360 square miles in eastern Klickitat County is favorable for the occurrence of opalized wood, though the hills north of Roosevelt have received the most attention. The material is similar to that of Kittitas and Grant Counties and occurs under similar conditions. The draws and gullies between Rock Creek on the west and Alder Creek and its tributaries on the east dissect the lava flows, occasionally expose larger logs, and commonly carry smaller pieces and flakes that become a guide for prospecting.

LEWIS COUNTY

AGATES AND JASPER

Newaukum River locality.—A region greatly favored by collectors is the Newaukum River drainage of central Lewis County. Agates of considerable size and commonly of good color are found along that stream and its tributaries. In fact, conditions are relatively good for the occurrence of agates all along the front of basalt hills, extending from north to south across the country and forming the more westerly outliers of the Cascade Range. Chalcedonic nodules, together with considerable jasper, have formed here in cavities in the basalt. They have weathered out as the basalt decomposed, or have been eroded out by frost and stream action, and then have been carried westward and deposited in the stream gravels, on the bedrock, and in the Pleistocene alluvium, sometimes far from their place of formation. Collecting is not as good as formerly but is still fair, particularly after high water has brought in new material or has reworked older gravels and uncovered specimens that had been buried.

An interesting present source of agates and jasper is the Pleistocene bedrock cover. In some places this sand and clay mantle is very thick; in others, only a thin veneer. The farther from the basalt exposures of the Cascade foothills or elsewhere, the more opportunity there has been for ordinary rock fragments to be eliminated (through comminution to sand or decomposition to clay) and, hence, for the harder, tougher agate nodules to be isolated. They may be found where the soil has been washed away, leaving them exposed on the surface of the ground; or in the beds of streams that are flowing through and reworking the alluvium mantle; or in road cuts where the Pleistocene deposits have been excavated.

Chehalis River locality.—Hundreds of pounds of agates have been taken from the cuts and roadside ditches of State Highway 12, between Adna and Pe Ell. When the road cuts in secs. 24 and 25, T. 13 N., R. 4 W. were fresh, collecting was remarkably good, as nearly every pebble remaining in the sandy clay of the banks or washed down into the drainage ditch was an agate. Any new road in this vicinity is almost invariably productive of material of interest to the collector.

Centralia vicinity.—An abundance of agate flakes and fragments occurs on the ground surface of the west part of the Towner farm, 4½ miles east of Centralia, in the S½NE¼ sec. 12, T. 14 N., R. 2 W. This material, although worthless in itself because of small size, indicates that a careful search of the vicinity is warranted in the expectation of finding larger agates of attractive color.

PLASMA

An opaque, rather dull green chert, sometimes described as plasma, occurs as cavity fillings and irregular vein-like masses a few inches in width in the basalt of an abandoned road-rock quarry on a ridge south of the Skookumchuck River; this is near the head of Fall Creek, in the NW¼NW¼ sec. 35, T. 15 N., R. 1 E. A similar material, but containing specks of jasper and so described as bloodstone, occurs as loose boulders in the soil of a hillside immediately east of the quarry. Material worth collecting is not abundant but may be found by diligent searching throughout most of the region where basalt forms the bedrock.

PETRIFIED WOOD

Petrified wood is a common accompaniment of the coal of southwestern Washington. It is silicified but not opalized and, although showing original grain to good advantage, is usually dark gray to black and unattractive in appearance. Occasional specimens are nearly white in outer parts (possibly from bleaching or removal of carbon) and so present an interesting contrast with the black interior when cut and polished.

PERIDOT

Doty locality.—A bed composed entirely of loosely consolidated crystals of olivine, an iron-magnesium silicate, occurs interbedded with Eocene tuff near the center of sec. 15, T. 14 N., R. 5 W. Although the crystals are small, some are of gem quality and so should be classed as peridot, the clear green variety of olivine.

LINCOLN COUNTY

PRECIOUS OPAL

Davenport locality.—An old report mentions the discovery of fire opals near Davenport but gives no details. Fernquist,[1] in commenting on this, stated that he had found precious opal in vesicular basalt at two places in this vicinity: one, on the Kurtz farm, one-half mile north of Mondovi; and a second, a mile northwest of Mondovi.

MASON COUNTY

(See Clallam and Grays Harbor Counties.)

OKANOGAN COUNTY

THULITE

Tunk Creek.—Thulite, the pink variety of zoisite, a calcium aluminum silicate, occurs in lenses 3 feet across in a hornblende schist near Tunk Creek, in the N½ sec. 5, T. 35 N., R. 27 E. Some has been mined and used for brooches and as an ornamental facing stone.

TURQUOISE

Nespelem district.—A single specimen of turquoise was brought to the Division of Geology in 1937 for identification. It was found at a mining prospect on the Twin Pine, Eureka, or Sunflower claim, near the north center sec. 4, T. 31 N., R. 30 E.

QUARTZ CRYSTAL

Early Winters Creek.—A "deposit" of large slightly smoky quartz crystals is said to occur on the mountain just northwest of the lower part of the creek. No other details are available.

Toroda Creek.—Prospectors from the area adjacent to the headwaters of the East Fork Toroda Creek have reported that rather large quartz crystals have been found in their workings.

PACIFIC COUNTY

AGATES

Bear River locality.—Agates have been found among gravel concentrations on bedrock at the base of Pleistocene sands and clays in the NW¼ sec. 5, T. 10 N., R. 10 E. This is in a highway cut 2 miles north of the mouth of Bear River, but agates should be expected under similar conditions at many other places in the county.

[1] Fernquist, C. O., Personal communication.

CHALCEDONIC FOSSIL CASTS

Willapa locality.—Light-gray and yellowish-gray chalcedony casts of fossil pelecypods (clams), having no trace of shell remaining, have been found in considerable numbers in the vicinity of Willapa. Some specimens are in excellent condition, and a great many contain entrapped water, sometimes with a bubble that moves as the fossil is revolved. These are similar to water-bearing chalcedony nodules termed "enhydros." The most productive collecting method has been to wade at low water in the muddy stream, particularly near and in the mouths of tributary creeks, and examine all pebbles felt by the bare feet.

PEND OREILLE COUNTY

AMETHYST

Newport locality.—Amethystine quartz has been found with white and clear quartz in the vein of the Ries Mining Co. on the west bank of the Pend Oreille River 2 miles north of Newport, in sec. 12, T. 31 N., R. 45 E.[1]

THULITE

Timber Mountain.—Crystals of thulite have been found at three places on and near Timber Mountain, which is near the center of sec. 29, T. 36 N., R. 43 E.: (1) near the peak of the mountain, (2) in the west center sec. 29, and (3) in the south center sec. 32.[2] The crystals were all small (some as much as one-fourth of an inch long, mostly smaller), so are probably without value, but they indicate the possibilities of, particularly, pegmatite dikes of the area.

PIERCE COUNTY

AMETHYSTINE QUARTZ

Old Siegmund ranch.—A mile east of Clay City, near the center of the W½ sec. 30, T. 17 N., R. 5 E. A 25-foot quartz vein was shown to be somewhat amethystine when it was explored for gold by means of a tunnel driven many years ago. Some amethystine quartz is exposed in detached masses or small isolated outcrops along the strike of the vein in the hillside above the tunnel, and a slightly amethystine 2-foot quartz vein, that may be a continuation of the main vein or an offshoot from it, crops out at an elevation of about 1,400 feet near the hilltop beyond the bench lying east of the main vein.

SAN JUAN COUNTY

It is reported that fossil brachiopod and nautilus shells, replaced by white and brown chalcedony, were displayed at an exposition

[1]Jenkins, O. P., Lead deposits of Pend Oreille and Stevens Counties: Washington Div. Geology Bull. 31, p. 46, 1924.

[2]Park, C. F., Jr., and Cannon, R. S., Jr., Geology and ore deposits of the Metaline quadrangle, Washington: U. S. Geol. Survey Prof. Paper 202, p. 57, 1943.

held in Seattle and that a considerable number were sold. They were obtained in the San Juan Islands (at Sucia Island?).[1]

SKAGIT COUNTY

"NEPHRITE JADE"

Sedro Woolley locality.—A hard dark-green magnesium silicate rock occurs as lenses or nodules in serpentine about 5 miles southeast of Sedro Woolley, in the NW¼NW¼ sec. 16, T. 34 N., R. 5 E. The material has somewhat puzzling optical properties, so that on the basis of petrographic study it has been variously classified as nephrite jade, silicified serpentine, and anthophyllite. The occurrence was formerly controlled by Mr. James Stephens (now deceased), who sold some as jade. Later it became part of the property (quarry?) of the Northwest Talc & Magnesium Co., so may have been mined out.

A similar material, also reported to be nephrite jade, is said to occur adjacent to a body of amphibole asbestos in serpentine on the Scott claim, in the SW¼SE¼ sec. 27, T. 36 N., R. 5 E., about 6 miles northeast of Sedro Woolley.

SKAMANIA COUNTY

CHALCEDONY

Stevenson locality.—Buff-gray chalcedony has been found near the east fork of Spring Creek, about 4 miles northwest of Stevenson. Some of the material represented nearly the entire fillings of collapsed cavities and was as much as 10 inches in length. All occurred in the surface soil, though doubtless originating in the basalt of the region.

AMETHYST

Rainbow prospect.—A small amount of amethystine quartz shows on the dump of a shaft on the Rainbow prospect, 2½ miles northeast of Washougal, in the NW¼ sec. 5, T. 2 N., R. 5 E.

OPAL

Wind River locality.—The lava buttes on Wind River, about 17 miles, airline, north of Carson, are said to contain opals as amygdules. The variety and exact location are not known.

SNOHOMISH COUNTY

GARNET

Vesper Peak locality.—The 48-55 prospect is near the center of sec. 9, T. 29 N., R. 10 E. at an altitude of 5,500 feet on the northeast rim of Sultan Basin. It is held as a mineral claim by Mr. P. C. Crane of Snohomish. Garnet, probably of the variety grossularite, occurs

[1] Sterrett, D. B., Gems and precious stones: U. S. Geol. Survey Mineral Resources, 1909, p. 740, 1911.

both massively and as spectacular clusters of intergrown crystals lining cavities. A small amount of chalcedony is present, and various other minerals are found in association with the garnet.[1]

QUARTZ CRYSTALS

Silvertip Peak.—A few clear quartz crystals have been found near the Weden Creek-Silver Creek divide, to the southeast of the Mackinaw prospect. One of these crystals is said to have been 4 inches long and 2 inches in diameter; a clump of crystals, somewhat iron-stained, was 5 inches across and included some 30 individuals ranging from a fraction of an inch to 3 inches in length.

STEVENS COUNTY

Colville locality.—A small vein of thulite, about half an inch thick, occurs at the Smoky Bullion property, in the NE¼ sec. 3, T. 37 N., R. 39 E.

THURSTON COUNTY

AGATES, JASPER, AND PETRIFIED WOOD

As in Cowlitz and Lewis Counties, agates and related collector's items occur in the area of basalt of the eastern part of Thurston County and may be found under conditions and in places similar to those described in some detail under the heading of Lewis County. Collections have been made in the vicinity of Tono by finding places where the surface mantle of Pleistocene sedimentary material is thin, digging through it to bedrock, and then examining the pebbles and larger rock fragments that form a sparse accumulation on the bedrock surface. Interesting chalcedonic material, including a minutely banded opaque green chert, has been found in the canyon of the Skookumchuck River, south of Vail.

WHITMAN COUNTY

PRECIOUS OPAL

Whelan locality.—This occurrence is on the Odonnell farm, on the west line of the SW¼ sec. 20, T. 15 N., R. 46 E., about 3 miles east of Whelan Grange and about 7 miles northeast of Pullman. Precious opal, occurring as amygdules in basalt, was discovered here in the bottom 4 feet of a 22-foot well dug in 1890 on what was then the William Leasure farm. In 1891-2 several pits were opened and gem stones to the value of nearly $6,000 were mined and sold. Kunz[2] reports that "the opal is fine, in many respects equal to the best material from Hungarian or Australian mines." He mentions that the gems vary from the size of a half pea to that of a hen's egg, the smaller ones being very rich in color but the larger ones often having

[1]Carithers, Ward, and Guard, A. K., Geology and ore deposits of the Sultan Basin, Snohomish County, Washington: Washington Div. Mines and Geology Bull. 36, p. 70, 1945.

[2]Kunz, G. F., Precious stones: U. S. Geol. Survey Mineral Resources for 1891, pp. 549-550, 1893; and for 1892, p. 776, 1893.

little or no play in color. The work was carried on in open pits or quarries. As the largest opening progressed northward into a hill, the topsoil became deeper but the layer of basalt next to it and overlying the 4-foot opal-bearing stratum remained of about the same thickness. The opals occurred in "frozen" contact with the basalt matrix, as kernels in vesicles larger than the amygdule, and as loose stones in some places where the formerly surrounding basalt had decomposed to a "fat" very tenacious clay.

At the present time there is little to see in the old, grass-covered rubble piles, though occasionally milk opal and hyalite can be found, and there is always the possibility of finding precious opal in freshly broken basalt blocks. It is questionable, however, how much of the visible fragmental basalt is from the opal-bearing zone. As the land has a known value for wheat farming, it is doubtful that its prospective value for opal mining will be further tested.

Moses locality.—This is on the Snake River, 8 miles or so down river from Clarkston. Precious opal of excellent quality is reported[1] to have been found in a prospect hole high on the hillside. A visit to this place failed to verify the report, but common milk opal was found in scattered specimens. As some precious opal has been found in float along the railway below the prospect, it is reasonable to expect that further search in the vicinity of the prospect would be warranted.

SMOKY QUARTZ

Bald Butte.—At one time a considerable number of smoky-quartz crystals were found near Colton in a sand pit on the side of Bald Butte. Samples were brought by a Mr. Thomas to St. Scholasticas Academy, Colton, and there identified. Similar crystals have been found in the soil of the south slope of the Butte.

AMETHYSTINE QUARTZ

Ringo Hills.—It is reported that the hill west of Ringo Station, in sec. 18, T. 16 N., R. 46 E., and the nearest ridge to the northeast contain 75-foot bands of what appears to be vein quartz, traversing the usual quartzite of the hills; on the slope east of the railway some of this quartz is amethystine.[2]

YAKIMA COUNTY

AGATE

Zillah-Sunnyside locality.—It is reported that agates are abundant throughout a considerable area of old stream-worn gravels lying on a bench north of the Yakima River, in T. 10 N., R. 21 E. They have also been found in the present-day gravels of the river.

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[1]The Mineralogist: vol. 7, no. 2, 1939.

[2]Hodge, E. T., Market for Columbia River hydroelectric power using Northwest minerals, Section 2, Northwest silica materials: U. S. Army Corps of Engineers, Portland, Oregon, vol. 1, pt. 1, pp. 75-76, 1938.

Naches locality.—In 1891 specimens of alternately layered black and brown chalcedony (onyx) were found in the Naches vicinity by Mr. E. K. Curr. The material was said to have been very beautiful after polishing.

JASPER

In the NE¼ sec. 12, T. 13 N., R. 18 E., close to or just west of the confluence of the Yakima and Naches Rivers, a 1-foot bed of red and maroon jasper and irregular yellow opal phases occurs between two basalt flows on the hillside above the river. Fragments of the material show as float below the outcrop.

OPALIZED WOOD

Barrel Springs locality.—Opalized wood is plentiful near the Sunnyside road a few miles south of its junction with the Yakima-Cold Springs road. Indians formerly had a chipping ground at Barrel Springs, half a mile or so south of the junction, where material for arrowheads was roughed out. Flakes of opalized wood in the dry gullies of the vicinity indicate the occurrence of larger masses up the gullies. One draw, crossed by the Sunnyside road about 4 miles south of the junction, has a spectacular amount of silicified and opalized wood; this is probably in sec. 35, T. 12 N., R. 23 E. Up the draw (south), a quarter of a mile or so from the road, a bed as much as 15 feet thick of a unique conglomerate crops out between basalt flows. The bed is almost entirely silicified and opalized wood, occurring as small and large fragments and even as whole sections of logs and stumps. The largest seen was 5 or 6 feet in diameter. Petrified branch sections and knots are interesting, but the general gray color of most of the "wood" is not attractive. Presumably the interior of the large pieces has a more pleasing color, as is usual in the eastern Washington occurrences.

OBSIDIAN

Obsidian, volcanic glass, is not common in Washington as it is in Oregon, and hardly any known in place has an appearance which would be of interest to collectors. However, water-worn obsidian pebbles—brilliantly black when broken—have been found on bars of the Yakima River above Prosser, and it is reported that massive obsidian as well as water-worn pebbles occur a mile or so south of the highway between Mabton and Bickleton.