

**A COLLECTION
OF ARTICLES
ON
METEORITES**

**From The Department's Monthly
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**STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES**

1968- THE YEAR OF THE METEORITE

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-1968-
The Year of the Meteorite

The year 1968 has been designated in Oregon as the year of the meteorite by a committee consisting of Hollis M. Dole, State Geologist, Phil F. Brogan, science writer and former associate newspaper editor at Bend, and the writer. This group firmly believes that there are in Oregon undiscovered meteorites that might be found if many people became more observing of their surroundings, and the group also feels that there may be undescribed or unreported meteorites in the possession of people who are unfamiliar with their importance to science.

Because of the tremendous interest in space exploration, meteorites as objects of scientific study have assumed a new importance. Unlike most geological specimens needed for research, scientists cannot go to a certain area and pick up more specimens as they are needed. For meteoritic specimens science is largely dependent upon lay people or amateurs in science to help uncover new materials. Meteorites are the only authentic samples of space matter now available for direct study. When the first astronauts return from the moon they will bring back rocks for research purposes, some of which will be examined in Oregon laboratories.

Considerable evidence exists that undiscovered meteorites have fallen somewhere in Oregon. Stories of someone knowing about a meteoritic fall are heard in many localities around the state. Nineteen hundred sixty-eight is the year that all of these stories should be investigated and, if true, the meteorites should be made known to science. Each year several brilliant meteors or fireballs streak across the Oregon skies, giving evidence that matter from space is reaching the earth*. What can be accomplished by

* A future article will deal with meteors and observed meteoritic falls.

carrying on a planned program of search for new meteorites is best exemplified by the results obtained by H. H. Nininger of Sedona, Ariz., who has found more new meteorites than any other person. When he first began his search in Nebraska in 1931 only 9 meteorites had been found in that state, while during the next 12 years 20 unknown meteorites were uncovered. Nininger had similar success in Wyoming where only one was known before 1933. By 1940 nine discoveries were listed.

Oregon, one of the larger states in the West, has had but four authentic meteoritic discoveries, and two of these are listed as lost meteorites. In the 1850's a government geologist, Dr. John Evans, forwarded a piece of meteorite along with other mineral specimens for analysis to a chemist in Boston. Before he could lead an expedition to Oregon to recover the main mass, estimated to weigh 10 or 11 tons, he died and with his death was lost the location of the find which was described as being on Bold Mountain 30 or 40 miles from Port Orford. The search for the Port Orford meteorite has continued for more than 110 years, but as yet the great meteorite has not been found, even though one often hears rumors to the contrary.

Some time in the distant past southern Oregon had a shower of iron meteorites, of which five individuals have been found in the Sams Valley area north of Medford. The largest individual piece weighed about 15 pounds and the rest were in the one- or two-pound size. Pieces of this shower are displayed in the museum of natural history at the University of Oregon and at the Jacksonville Museum. Other undiscovered pieces probably exist in the Sams Valley area.

In 1902 Ellis Hughes discovered the largest meteorite yet found in the United States, the 15.5-ton Willamette iron, a short distance from West Linn. After several court cases concerning the ownership of the celestial object, the great meteorite was sold and given to the American Museum of Natural History in New York, where it is viewed by thousands of visitors every year in the Museum's Hayden Planetarium.

The fourth Oregon meteorite was a 30-pound mass found near Klamath Falls about 1952. A piece was brought in for analysis to J. D. Howard, who sent it to H. H. Nininger. It proved to be authentic. The owner apparently never returned for the analysis and the small piece from the Klamath Falls iron is in the Nininger collection of meteorites at Arizona State University at Tempe while the main mass appears to be lost.

Where does one look and what does he look for in the search for new meteorites? This question has often been asked. The answer is rather complex, but helpful hints can be given. Meteorites may be found almost any place. They have been found lying on the top of the ground, and in the top several feet of soil. The plow has uncovered more of these than has any other instrument. A few have fallen through buildings. The writer believes that a major problem in finding new specimens of space matter is one of identification and recognition. Meteorites fall into three general classes:

1. The irons. These attract attention because they are heavy and are made up almost entirely of alloys of nickel-iron.

2. The stones. These resemble terrestrial rocks and are the most difficult to recognize. They are composed of silicates through which tiny particles of bright nickel-iron are distributed.

3. The stony-irons. These are an intermediate class being made up of a network of bright nickel-iron which is filled with the mineral olivine. These are called pallosites and are quite rare.

The following points are useful in the identification of meteorites:

1. All are heavier than the common volcanic rocks.
2. All are magnetic, except that stony meteorites may be only slightly magnetic.
3. Newly fallen specimens have a black or brown fusion coating and shallow pits resembling thumb prints.
4. They are irregular in shape.
5. Weathered specimens may appear very rusty in color.
6. Certain identifying tests can be done best in a scientific laboratory.

If one finds a specimen suspected of being meteoric what should he do? The committee hopes to involve a great many people in this search, particularly many high-school science teachers. It is hoped that science teachers all over the state will discuss meteoritic properties with students, and will also make the preliminary examination of specimens thought to be different from ordinary rocks. If the science teacher thinks that a new meteorite has possibly been uncovered, the information can be forwarded along with a small sample to any member of the committee. The sample will be analyzed and returned to the owner.

The following paperback books may be consulted for a more complete description and account of meteorites:

Heide, Fritz, 1964, *Meteorites*: University of Chicago Press, \$1.95.
Nininger, H.H., 1952, *Out of the Sky*: New York, Dover Pubs., \$1.85.
Watson, Fletcher, 1962, *Between the Planets*: New York, Doubleday & Co., \$1.25.

Also, in hardback form:

Mason, Brion, 1962: *Meteorites*: New York, John Wiley & Sons, \$7.95.

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THE RECOGNITION OF METEORITES

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After a meteorite has fallen to the surface of the earth, it becomes an object of concern to geologists, rockhounds, and even farmers and gardeners. In fact, the entire science of meteoritics is dependent on the alertness of many groups, both professional and lay, for the recovery of either old or newly fallen specimens. The writer, as well as the Oregon State Department of Geology and Mineral Industries, has received for identification from many well-meaning individuals a variety of rocks assumed to be different and meteoritic. Neither the Department nor the writer has yet found one meteorite among these rocks. However, it is hoped that, as more people become familiar with meteoritic characteristics, new meteorites of the Pacific Northwest will be made known.

The identification and subsequent recovery of meteorites is particularly difficult in this area because of the presence of so many volcanic rocks. While some meteorites resemble terrestrial volcanic rocks, they also have properties which are quite different.

In general, meteorites fall into one of three broad classes: (1) the irons, which are made up of a nickel-iron alloy; (2) the stones, which may have a gray to brown silicate groundmass through which small nickel-iron particles are distributed; and (3) the stony irons, which form an intermediate class. Of the stony irons, the Pallasites are best known, being formed of a metallic network in which the cavities are usually filled with crystals of the mineral olivine.

There is no single criterion by which all meteorites can be identified. The following points are useful in assessing an unusual specimen to determine if it is a meteorite:

1. Meteorites are heavier than ordinary rocks. The specific gravity ranges from about 3.0 for some stony varieties to about 8.0 for the iron, while most terrestrial rocks have a specific gravity well below 3.0. They are not porous or hollow, nor do they resemble cinders. The stony meteorites resemble terrestrial rocks and are often mistaken for them.

2. Meteorites are magnetic. The irons and stony irons are strongly attracted; the stony variety is only slightly attracted by a strong magnet.

3. Newly fallen meteorites usually have a black fusion coat and have shallow pits resembling thumb prints. Meteorites which have been exposed long to the weather may be brown or covered with rust, depending on the length of exposure.

4. On grinding a meteoritic specimen with an emery wheel, bright, shiny nickel-iron alloy becomes visible. The nickel-iron ranges from tiny specks in stony meteorites to the entire mass in the irons.

5. Meteorites are irregular in form and may be almost any shape. A number of known meteorites are cone shaped, but none are as round as a ball.

6. All meteorites contain the element nickel. A test for nickel is usually best done by a scientist.

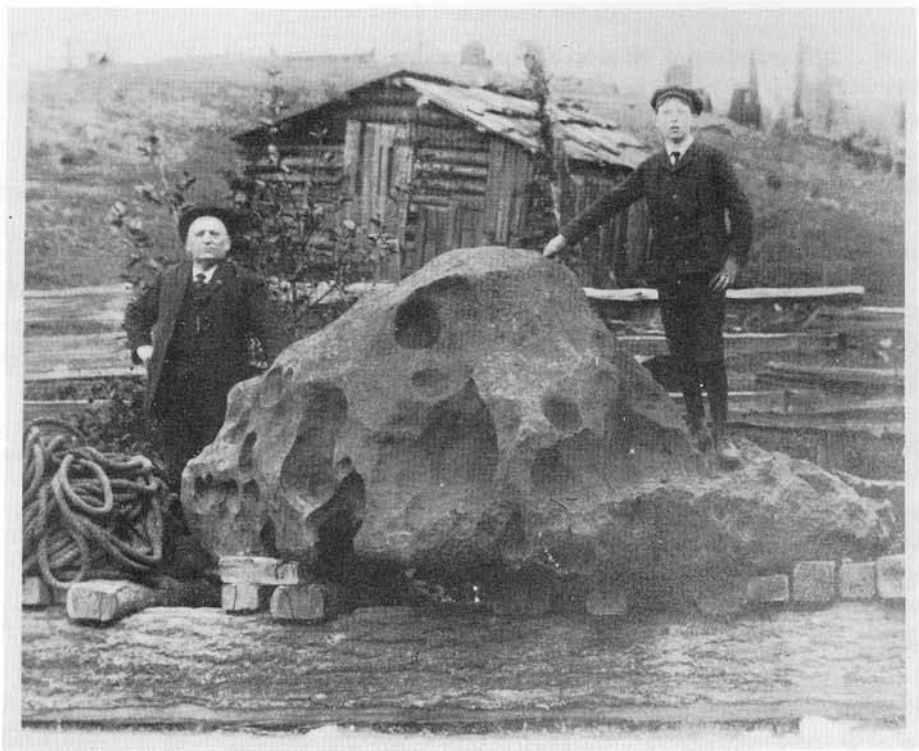
7. When the polished surface of an iron meteorite is treated or etched with dilute nitric acid, characteristic patterns known as Widmanstätten figures are formed. Terrestrial alloys do not form Widmanstätten figures. Etching is usually best done by a scientist.

Meteorites, particularly those that are newly fallen, are of value as objects of scientific study and research. They are, however, of little value in the hands of an untrained individual. While there is a great similarity among all meteorites of any one class, there are also differences which are of concern to specialists. Therefore, every new meteorite is of interest to science, since it may possess properties that are somewhat unique.

If, on the basis of the above criteria, a reader feels that a known specimen is a meteorite, a small sample should be cut off without mutilating the main mass and should be sent to the State Department of Geology and Mineral Industries or to the writer for more exhaustive examination. In the case of a small meteorite, the entire specimen may be sent. The examination and evaluation of the specimen is done free of charge and the piece will be promptly returned. If the specimen proves to be meteoritic, an offer for purchase can usually be arranged.

Since it is impossible that a scientist always be present at the site of a new discovery, the addition of new meteorites for research depends largely on the ability of many lay people to recognize meteorites when they see them and on their willingness to submit specimens for scientific examination and recording in the literature.

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THE WILLAMETTE AND OTHER LARGE METEORITES

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Occasionally an old, unpublished photograph of the Willamette meteorite comes to light, as is the case with the accompanying picture. The Willamette meteorite, found near Willamette (West Linn), Oregon in 1902 remains to this day the largest meteorite discovered on the American continent north of the Mexican border. Today it is on display in the Hayden Planetarium, a part of the American Museum of Natural History, New York City. The 15½-ton Willamette iron focuses attention on other large meteorites of the world.

Of the approximately 1,600 known meteoritic specimens in the world, there are 30 irons which weigh from one to 60 tons. Eight were found in Mexico and four in the United States west of the Rocky Mountains. The largest single individual yet discovered is the 60-ton Hoba West, and it remains where it was found near Grootfontein, South Africa, in 1920. The world's second most massive meteorite is the Ahnighito, the largest of the Cape York, Greenland, irons brought to the United States in 1897 by the famed Arctic explorer, Robert E. Peary. The Ahnighito, weighing 36½ tons, is also the property of the American Museum of Natural History. The next three largest meteorites remain where they were found. They are the Bacubirito, Sinola, Mexico; the Mbosi, Tanganyika, Africa; and the Armanity, Chino. Their weights are estimated at 27, 27, and 26 tons, respectively.

The Willamette is the world's sixth largest meteorite and the most massive one ever found in the United States. The second largest United States meteorite is the Navajo, found in 1922 in Apache County, Arizona. It weighs 4,814 pounds and is the largest meteorite in the collection of the Chicago Museum of Natural History. The third largest iron in this country is the Quinn Canyon, which was found in 1908 in Nevada and is now also in Chicago. It weighs 3,190 pounds. In 1938, deer hunters discovered the Goose Lake meteorite in the Modoc National Forest, California, less than a mile from the Oregon border. It weighs 2,573 pounds and is the largest meteorite in the collection of the U.S. National Museum (Smithsonian Institution) in Washington, D. C.

[Photograph courtesy of Richard G. Bowen.]

OREGON'S LOST METEORITES

By Dr. Erwin F. Lange*

Oregon's Port Orford meteorite has gained worldwide fame as a lost meteorite. Interest in the search for this meteorite has now extended over a period of a hundred years without success. In addition to the Port Orford meteorite, there is evidence that other lost meteorites exist in Oregon. The writer has received a number of letters from various places in Oregon referring to locations of supposed meteorites. To date, however, no samples have been received. The following three examples seem to be more authentic and perhaps more information concerning these specimens might be forthcoming.

1. In Pioneer History of Coos and Curry Counties, by Orvil Dodge, p. 442, is the following:

One of the largest meteors on record fell on the head of South Slough, Coos County, January 17, 1890, at 11 o'clock at night, knocking a hole in the hill thirty feet across. It came from the Northwest and lighted up the heavens in fine style. A report, as of thunder, awoke people for many miles around. It was plainly heard at Coquille City. Excavations reveal a chunk of lava twenty-two feet across that resembles slag from an iron furnace.

2. Listed as a doubtful fall in the Prior-Hey catalog of meteorites published by the British museum is a stony meteorite from Mulino, Oregon. A small stony meteorite was sent to the U.S. National Museum in 1927. The meteorite supposedly fell May 4, 1927. The records of the National Museum fail to indicate what happened to the specimen. Newspapers of the area fail to list any unusual meteoritic activity for that date.
3. In January, 1952, an unidentified rancher brought in to J.D. Howard of Klamath Falls a small piece of nickel-iron for analysis. This piece was broken off of a 30-pound mass.

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Mr. Howard, suspecting the specimen to be meteoritic, forwarded it to Dr. H. H. Nininger at Winslow, Arizona for verification. Dr. Nininger found it to be a meteorite. He then attempted to learn the location of the main mass, but so far has been unsuccessful. The small piece of the so-called Klamath Falls meteorite is in the Nininger collection at Arizona State University in Tempe. Somewhere in the Klamath Falls area there must be a 30-pound meteorite.

Persons having specimens thought to be meteoritic in nature are urged to send them to the State Department of Geology and Mineral Industries or to the writer for examination. A meteorite has value as an object of scientific value only and every one is different in form and composition.

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The Year of the Meteorite

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THE PORT ORFORD METEORITE*

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Introduction

From a confusing assemblage of notes and letters of Dr. John Evans comes a report of the existence of a large meteorite in the Port Orford area of southwestern Oregon. Dr. Evans, a geologist-explorer employed by the U. S. Government, conducted a survey of the Washington and Oregon Territories between 1851 and 1856. His final Oregon trip, made in 1856, was to Coos Bay and Port Orford on the southern Oregon coast.

Since 1859, when his discovery was made public, probably several hundred field parties have attempted to locate this meteorite. It is not surprising that none of the searches have been successful, for Dr. Evans' log of his trip makes no mention of a meteorite, and his directions in letters written after he returned to Washington, D. C., are vague and somewhat contradictory. For that matter, when Evans recalled the dimensions of the meteorite, he prefaced his remarks with this phrase: "I cannot speak with certainty." A critical analysis of the meager and conflicting data could well lead one to consider the possibility that the large mass commonly referred to as the "Port Orford meteorite" is a myth.

Several times within the past half century the phantom of this meteorite has been revived by printed articles. Hallister, 1963, wrote as follows:

* Published with the permission of the Secretary of the Smithsonian Institution.

"The Port Orford meteorite isn't the product of a sun-struck prospector's dream and it hasn't been spirited away. The searchers keep returning because they know a pallasite^{1/} is still there. Because somewhere in the western slope of southern Oregon mountains lies an eleven-ton rock from outer space worth anywhere up to \$2,200,000, and that evaluation in 1937 dollars. Today, thanks to inflation, the finder might even have a couple of million left for his pocket after squaring with Uncle Sugar."

Exaggerated statements, like the above, excite the public and encourage persons to undertake trips which expose them to physical hardships and to financial expenses they cannot afford.

Many of the accounts about this meteorite were written to stimulate the reader's imagination and to develop a desire to search for it, but these reports failed to give the reader the full facts. The majority of those who have searched for this meteorite would not have recognized it even if they had walked over it

Between 1938 and 1950 Prof. J. H. Pruett got a "lot of mileage" out of some rather careless writing about the Port Orford meteorite. The press may have asked him to prepare a popular article; if so, it was logical for him to discuss an Oregon meteorite for Oregon readers. Without question, Prof. Pruett was responsible for much of the interest in this meteorite, but if he had never written about it, someone else would have done so. Pruett over-simplified the difficulties of finding the meteorite and played upon people's desires to gain fame by finding a rare object and be rewarded for the effort. There were errors in Pruett's reports which have become magnified through retelling.

La Paz (1951) noted errors, but unfortunately not enough attention has been given to his critical review of Pruett's articles. Pruett's errors were: (1) the date given for the discovery of the Port Orford meteorite; (2) the year that Dr. Evans died; (3) the weight of the specimen in the U.S. National Museum; and (4) the statement that the Smithsonian Institution had offered \$1 per pound for almost any kind of meteorite.

Since we have criticized others, we must not overlook our part in what has happened. For years Henderson has felt rather strongly that the public has been misled by one-sided reports about the Port Orford meteorite. Although he has stated his views in scores of letters, these were not published. This was a mistake.

The purpose of this article is to publicize the facts as we see them and provide information for those interested in the background of this meteorite, or interested in searching for it.

Time may prove our opinions to be wrong, but possibly the best way to

^{1/} A meteorite composed essentially of the mineral olivine and metallic iron.

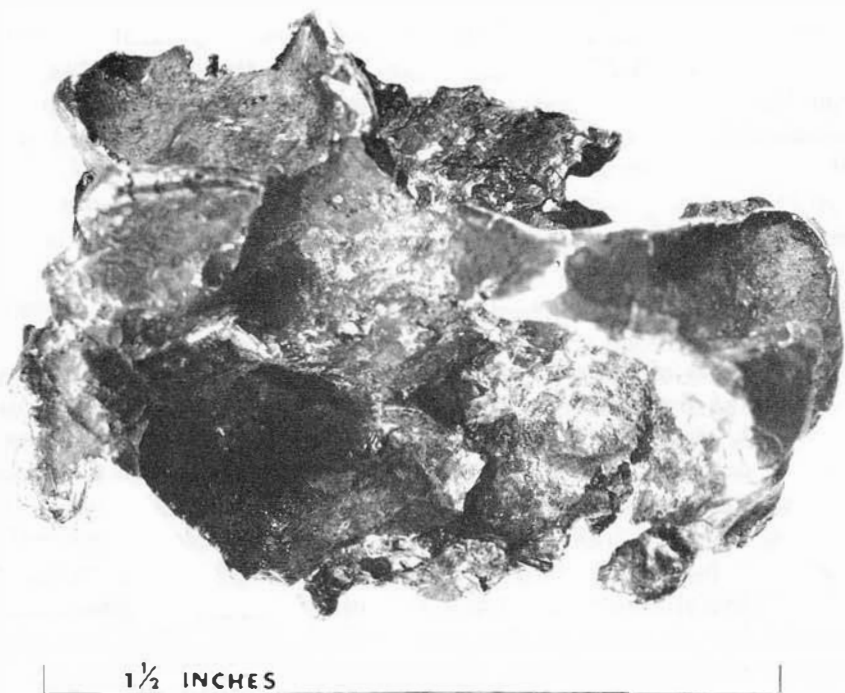


Figure 1. The Port Orford Meteorite. Photograph enlarged three times; actual size is about 1 by 1½ inches. Black fusion crust on the metal in certain depressions indicates that olivine was lost from those areas during the high-velocity flight. Unaltered olivine covered with fresh flight crust is present. This specimen shows no signs of long exposure to weathering in a humid climate. Sample is in the Smithsonian Institution, Washington, D. C.

locate the Port Orford meteorite is by searching among old documents and records for a possible notebook in which Dr. Evans may have made notations as he collected his specimens. Although that kind of search is not as much fun as walking over those wooded Oregon hills, it may be more helpful in finding the lost meteorite.

Known Specimens of the Port Orford Meteorite

Three museums have specimens labeled "Port Orford Meteorite." The largest sample weighs 24.2 grams (0.854 oz.) and is in the Smithsonian Institution (Figure 1). This one was in the collection of rocks and minerals Dr. Evans obtained in Oregon Territory in 1956 and examined by Dr. Charles T. Jackson, in Boston. After the specimen was identified as a meteorite, it remained in the Boston Natural History Society collections for about 60 years. In 1920 it was acquired by the Smithsonian Institution.

The triangular cut, lower left of Figure 1, may represent the spot from which was cut the 3.53 gram (0.125 oz.) sample now in K.K.Naturhistorischen Hofmuseums, Vienna. The 0.19 gram (0.007 oz.) bit in the India Geological Survey's collection, Calcutta, possibly was removed from one of the other four places where slivers of metal have been cut off. In addition to these cuts, some scrapings have been removed along one edge.

The specimen accessioned into the Smithsonian's collections is recorded as weighing 25 grams, but very likely the original weighing was not done on a precision balance. Today the specimen weighs 24.2 grams (less than one ounce).

The density of this specimen was found to be 6.30 gms/cm³.^{2/} Using the density of the metal phase from the Salta, Argentina, pallasite, as being probably the same as the metal in the Port Orford, and the average density of pallasitic olivines (Mason, 1963) for the olivine in this specimen, the calculated amount of olivine in this sample is about 30 percent.

Examination of the Port Orford specimen has revealed some significant features which may shed some light on its history: (1) The metal is not battered; (2) The olivine is bright and unusually free from alteration; and (3) The metal has numerous patches of fresh flight crust on it and in places these show delicate markings. These features indicate that this specimen was not removed from a large mass by a hammering operation. Also, it has not had long exposure to abrasion by running water or to weathering conditions in the soil. It is unwise to make a definite statement, but this evidence indicates that the meteorite is a comparatively recent fall, and if it is from western Oregon, where the climate is quite humid, it probably fell within the last 500 years.

Historical Account of the Port Orford Meteorite

Dr. Charles T. Jackson, a chemist in Boston, discovered the meteorite among a group of minerals which Dr. Evans collected in Oregon and brought it to the attention of the Boston Society of Natural History at its October 5, 1859, meeting. In the Proceedings of that Society (published in 1861) is the first published notice:

"... among some specimens recently received from Oregon Territory was a piece of meteorite containing crystals of olivine (and) yielding 9 percent of nickel. It was identical in appearance, and probably in composition, with the Pallas meteorite of Siberia; he thought it not improbable

^{2/} Pure iron has a density of 7.86. Native iron ranges between 7.4 and 7.8 because it frequently contains lighter inclusions.

that pieces may have fallen in the same meteoric shower in both countries, as has happened in other instances though less widely separated."

In two later meetings of the Society, Jackson read from letters Evans had written him from Washington. The first Evans letter, read November 2, 1859, stated:

"... the meteorite recently found in that Territory is identical with the Pallas meteorite of Siberia."

The second, read November 16, 1859, revealed:

"... (that) the mass, about 3 feet of which was above ground, was in the mountains, about 40 miles from Port Orford, on the Pacific, and easily accessible by mules. (And that) he hoped the society, as a body or individually, would take speedy and proper measures to secure its disposition by the Government in the Smithsonian Institution."

The next significant mention of this meteorite appeared in 1860 when W. K. Haidinger, authority on meteorites in Vienna, Austria, reported to the Vienna Academy that Mr. Nathaniel Holmes of St. Louis had informed him about the great meteorite Dr. John Evans found on his latest expedition to Oregon. Haidinger (1860) said it was partly embedded in the earth and was larger than the Siberian Pallas iron and gave the locality as:

"It lies in the Rogue River Mountains, not very far from Port Orford, on the Pacific, about in 42° 35' North Latitude and 123° to 124° West Longitude."

In 1861 Haidinger again reported to the Vienna Academy:

"Of the iron mass from Oregon, mentioned in the session of July 5 of last year, news of which was obtained from a letter from Mr. Nathaniel Holmes, of St. Louis, I have the honor to place in the Imperial Cabinet a piece weighing 3.53 grams,^{3/} which I owe to the friendly offices of Dr. Charles T. Jackson of New York City."

All our useful information about the Port Orford meteorite must be credited to Dr. Jackson's efforts to get data from Dr. Evans. After identifying this specimen, he corresponded with Evans in Washington but had no way of evaluating this information by discussing it with Evans. Evans died in May 1861, soon after the correspondence began.

Jackson, 1861, in a biographical sketch of Evans, said:

"One of the most interesting scientific discoveries made by Doctor Evans during his explorations in Oregon, was that of an enormous mass of meteoritic iron containing an abundance of chrysolite or olivine embedded in it. During the Indian war in that region, Doctor Evans ascended Bald Mountain, one of the Rogue River Range which is situated from thirty-five

^{3/} 3.53 grams = 0.125 oz.

to forty miles from Port Orford, a village and port of entry on the Pacific coast, and obtained some pieces of metallic iron, which he broke off from a mass projecting from the grass-covered soil on the slope of the mountain. He was not aware of its meteoric nature until the chemical analysis was made, but the singularity of its appearance caused him to observe very closely its situation, so that when his attention was called to the subject he readily remembered the position, form, appearance, and magnitude of the mass and manifested the most lively interest in procuring it for the Government collection in the Smithsonian Institution at Washington, a duty I doubt not he would have been commissioned to perform had his life been spared.

"By the aid of information contained in letters to me perhaps some traveler in those regions may be able to find this very interesting meteorite, and I shall, therefore, transcribe what he says of it. In reply to my inquiry, whether he felt confident he could again find this mass of meteoritic iron, he says in his letter of May 1, 1860:

"There cannot be the least difficulty in my finding the meteorite. The western face of Bald Mountain, where it is situated, is, as its name indicates, bare of timber, a grassy slope, without projecting rocks in the immediate vicinity of the meteorite. The mountain is a prominent landmark, seen for long distance on the ocean, as it is higher than any of the surrounding mountains. It would doubtless be best and most economical to make a preliminary visit to the locality, accompanied only by the two voyagers^{4/} alluded to in my last letter."

Apparently Evans thought about the ownership of this meteorite, for, after consulting the General Land Office and the Indian Bureau in Washington, he concluded the title was vested in the Indians, the land not yet having been ceded to the United States. Evans continues, according to Jackson, by saying:

"As to the cost of transportation of the meteorite to Port Orford, it is difficult to make an accurate estimate. It is situated in a mountainous region, thirty to thirty-five miles from the coast, and the only access to it is by mountain trails. It might be removed in pieces from one hundred to one hundred and fifty pounds in weight on pack mules; and accurate measurements made of the whole mass without great expense, say from \$1,200 to \$1,500. But to remove it entirely would either be impractical or involve great expense, unless indeed a river which passes the base of the mountain (Sixes River), and empties into the Pacific, should prove navigable for a raft of sufficient size for its transportation. There is water enough, but it

^{4/} Two of the Canadian Frenchmen employed by the Hudson Bay Company.

is no doubt much obstructed by fallen timber, and may have rapids, which it would be difficult to pass over with such a heavy load. In either mode of transportation my first duty would be to explore this river."

In another letter (not dated) to Jackson, Evans said:

"As to the dimensions of the meteorite I cannot speak with certainty, as no measurements were made at the time. But my recollection is that four or five feet projected from the surface of the mountain, that it was about the same number of feet in width, and perhaps three or four feet in thickness; but it is no doubt deeply buried in the earth, as the country is very mountainous, generally heavily timbered, and subject to washings from rains and melting of snow in the spring, so that in a few years these causes might cover up a large portion of it. The mass exposed was quite irregular in shape. . . ."

In another letter (not dated) Evans said:

"The locality is about forty miles from Port Orford, in the mountains which rise almost directly from the coast, only accessible by pack mules. But each mule might carry three hundred pounds weight, and if required make several trips, to secure the whole mass. It would, however, be necessary to take along suitable tools, to separate the mass, which might be desirable, be adjusted together afterwards. But I should suppose that each institution, which might furnish the funds, would desire a portion of the mass."

Jackson said that "every possible exertion was made in Congress, and with the departments at Washington, to induce the government to take measures for procuring this very valuable meteorite, and to cause it to be placed in the museum of the Smithsonian Institution, where it could readily be examined by scientific men, but Dr. Evans' death and the present unhappy state (Civil War) of the country seem to prevent the realization, for the present, of this enterprise."

Dr. Evans' log, a hand-written document stored in the Smithsonian's files, described the 1856 journey in the Port Orford region but contains no mention of a meteorite. Consequently the foregoing paragraphs give all the information that is available on location and size of the "missing" Port Orford meteorite. More recently published reports by other writers are largely recapitulations of former accounts.

Pointers to Keep in Mind While Reading Evans' Log

When reading the portion of Evans' log describing his travels near Port Orford, one should keep several possibilities in mind before forming an opinion about the reliability of the information given.

(1) In reading the existing copy of Evans' log one is impressed with the fact that nothing is said about seeing or collecting anything like a meteorite. This omission suggests that there may be a missing notebook with same comments about the rock specimens Evans collected on this trip. Such a record logically would remain with the specimens, or be turned over to the office from which Dr. Evans obtained support on his trip.

If it is assumed that Dr. Evans saw the meteorite, and failed to record it in the existing log, it does not prove he did not record the information elsewhere. If no other notebook of Dr. Evans' is ever found, then the location of the point of discovery of this meteorite may always remain in this confused state. The Evans' log is not very informative. The existing log somewhat resembles an outline Evans possibly might have been preparing to use in writing a readable story about his travels.

(2) Dr. Evans' log, together with comments in his letters to Jackson, are all we have to go on to relocate the position of the Port Orford meteorite. No one has established whether or not the handwritten log is the original copy and, as explained below, the majority of it is not in the handwriting of Dr. Evans. It could be a log transcribed by some member of the party.

The log is an unbound, hand-written document, measuring $12\frac{1}{2}$ by 8 inches. Its appearance indicates that someone was transcribing a previous document and had difficulty deciphering portions of it. Surely an experienced explorer, such as Dr. Evans, would not carry unbound paper into the field to keep notes on.

To better appraise the reliability of this document the Library of Congress supplied samples of Dr. Evans' handwriting of about this same year. Four pages were obtained and used as samples of Dr. Evans' script and were compared with 14 pages from the Evans log. Incidentally, five of the 14 pages were descriptions of his travels from Port Orford across the Rogue River Mountains.

The handwritten material was taken to the Federal Bureau of Investigation's laboratories for study. Their report states that "the majority of the handwriting of Evans' log in the Smithsonian's library was not written by the writer or writers of the specimen supplied by the Library of Congress as a sample of Dr. Evans' handwriting."

This finding does not disqualify the authenticity of the records but it evaluates them more accurately. The persons transcribing a previous record perhaps were instructed to omit the sections dealing with specimens or there may be another record book with data about Evans' collections.

(3) Dr. Evans may have taken a side trip from Port Orford prior to the journey described in the log. If the meteorite was obtained at that time, he might purposely have omitted it from the log.

(4) The meteorite, as Evans suggested, may have been covered by a landslide since it was seen.

(5) Port Orford, between 1850 and 1860, was a small seaport. The chief interest of the inhabitants was the development of the country and most folks were prospectors looking for outcrops of gold or other precious metal. Prospectors were working in the area before Evans got there. If one of them had located the meteorite, he either would have assumed it was iron ore or a precious metal, like silver. These men were keen enough to realize that iron ore in this remote place would have little value, while a silver strike would mean a fortune. Hence, the finder of such a specimen would probably think he had an outcrop worth investigating and would return to civilization to find out what he had. Such a prospector might have given someone in Port Orford a piece which later was given to Evans.

An Attempt to Follow Dr. Evans' Trek

During the summer of 1939 Henderson hiked the trails from Powers, Oregon, to within sight of Port Orford. The purpose was to determine how accurately Evans' route could be followed, using the log of his travels, and to try to find the meteorite. The log was discussed with personnel of the U.S. Forest Service, both in the field and in their regional offices, and the consensus was that the trails shown in Figure 2 are as good an interpretation as can be made of Dr. Evans' journey through this section of Oregon. Our confidence in the route was strengthened by the fact that although some simplification of old trails has taken place, generally speaking existing trails follow the old one. Prof. J. E. Allen, Department of Geology, Portland State College, Portland, Oregon, also reconstructed a map (Lange, 1958) of Evans' route basing his locations on Evans' log and referring to modern topographic maps.^{5/} The two trail maps agree fairly closely.

The portions of Dr. Evans' log describing the trek from Port Orford across the Rogue River Mountains is reproduced, followed by Henderson's comments, which are underscored.

Route from Port Orford across the Rogue River Mountains:

"Started Saturday, July 18, 1856. Started from Port Orford at 9 a.m. Bright and beautiful morning. Passed near Sawdust River three miles from

^{5/} These maps are the Agness, Langlois, Port Orford, and Powers 15-minute series (topographic). They are available at the U.S. Geological Survey, Denver Federal Center, Denver, Colorado, for 30 cents each.

town, through the woods four miles to Elk River. Saw small prairie, fine site for a farm. Passed through small prairies on Elk River, such prairies are occasionally found on this river as you ascend it; passed through two other small prairies. Finest white cedar trees all along the route in great numbers. Two miles further on crossed the Sixes River. Sandstone exposed along its shores. (Evans' distances do not agree with those scaled on present-day maps because he probably had no accurate way for measuring distance; also, his routes likely were more irregular than existing trails.) As we proceeded we crossed two high elevations, mountain ranges; our way has generally been along the divide between Elk River and the Ocean, running in a north west and S.E. direction. The woods are filled with a luxuriant growth of grass resembling timothy and this region would afford pasturage for thousands of stock. On a high divide fourteen miles from Port Orford saw an exposure crowning its summit, of fine grained grit or sandstone. This is the only exposure of rock in place met with on the route except before noticed. At 3 p.m. reached the summit of the highest elevation yet crossed on which is situated a large prairie of excellent grass at least eighteen inches in height. Passing along and up a still higher ridge, the light colored sandstone appeared in place. Had a magnificent view of the ocean to the N.W. and S.E. Sixes River is much larger than is laid down on the maps and Floras Creek much shorter. On our route we headed the latter whilst a fork of Sixes River overlaps it, and its valley appears on our right. (Evans seems to be advancing upstream along Crystal Creek from the Sixes and traveling in a general direction toward Eight Mile Prairie Mt.)

"The ridges on which we are traveling must be at least 1,000 to 1,200 feet above the ocean. Camped at a small spring surrounded by hills. The grass at least two feet high; along our route for the last six miles all through the tall fir, cedar and hemlock trees, the ground was covered with this luxuriant growth of grass, mingled with wild flowers. Blackberries and other berries were plenty on the slopes of the ridges. Distance traveled eighteen miles. (Surely Evans measured distances along the trails and not as a straight line from where his day's travel started. Thus his estimate of 18 miles by winding trails probably is something like 8 to 12 miles airline distance from Port Orford. After passing to the south and east of Grouse Mountain he apparently camped on the night of July 18 near Edson Butte. Edson Butte is situated approximately 42° 52' N., 124° 20' W. and is about 12 miles airline northwest of Port Orford.)

"Sunday, July 19, 1856. Started at 7-1/2 a.m. Our route for eight miles was along ridges covered with fine grass and flowers mentioned yesterday. On the different slopes every variety of spring and fall flowers. Passed through a chain of prairies, some of them several miles in extent, which like open woodlands were covered with grass three and a half feet

high - timothy and other grasses. The highest ranges run, a little west of north, and south of east, as our course is north of east we have occasionally to cross from ridge to ridge by connecting ridges of lesser elevation, sometimes to descend to the bed of small streams. Crossed a fork of the Sixes River at 11-1/2 a.m. (Within 3 hours after leaving his camp of the 18th, Evans arrived at a fork of the Sixes River. South and southeast of where I assumed he camped on the 18th, there are several small streams draining into the Sixes. If Evans referred to one of these as "a fork of the Sixes," then he pushed south from where we indicated he camped. Thus, Evans went in a different direction than the one he reported.)

"The trail follows the ridges as far as practicable and consequently our course from their direction is a winding one. Almost all the higher summits had rock in place, cropping out and crowning a considerable portion of it. Talcose slate seemed to be the prevailing rock, and the other slates seen on the shore of the ocean; also a light colored sandstone, and the compact or ashy colored rock seen on the beach. Outbursts of granite and trap or basalt were seen rising to a considerable elevation. Stopped on a prairie elevation for our horses to feed and rest. Saw marks and trails of elk all along the prairie, but not the animal itself. On almost every elevated ridge or mountain spur were seen exposures of rock just enumerated. Crossed two or three small creeks, forks of Sixes River, camped at 5 p.m. on a small creek tributary of Salmon River. (Evans camped after 8 hours on the trail and estimated his day's journey to be 21 miles. He averaged 2.5 miles per hour for the day, rather good for rough country and with some time out for observations. On this date or the next, Evans should have been about 40 miles from Port Orford, so if his 40 mile estimate is significant, this may be near the location he reported to Jackson for the meteorite. There are bald mountains near here but none is visible from Port Orford or from the sea.)

"The prairie in which we are camped is three quarters of a mile long by half mile wide, and very rich sandy loam; the grass, a kind of wild oats, is in places six to eight feet high and other grasses going to seed six or seven feet high. Timothy (wild) is very abundant in this and other prairies passed through, and is from three to five feet high; other grasses filling up the prairie and so dense as to render walking difficult is from two to two and a half feet, this is a fair example of the luxuriant growth of grasses, not only in the chain of prairies through which the trail passes, but on the ridges and intervening slopes between them. The climate is delightfully cool and bracing. The woods are filled with elk, deer and black bear, and there is no want for meat. Mr. Bray at our present camp had returned to his home but two days previous to our arrival, and had already two hanging up in his log cabin, so he said help yourselves for it is impossible for

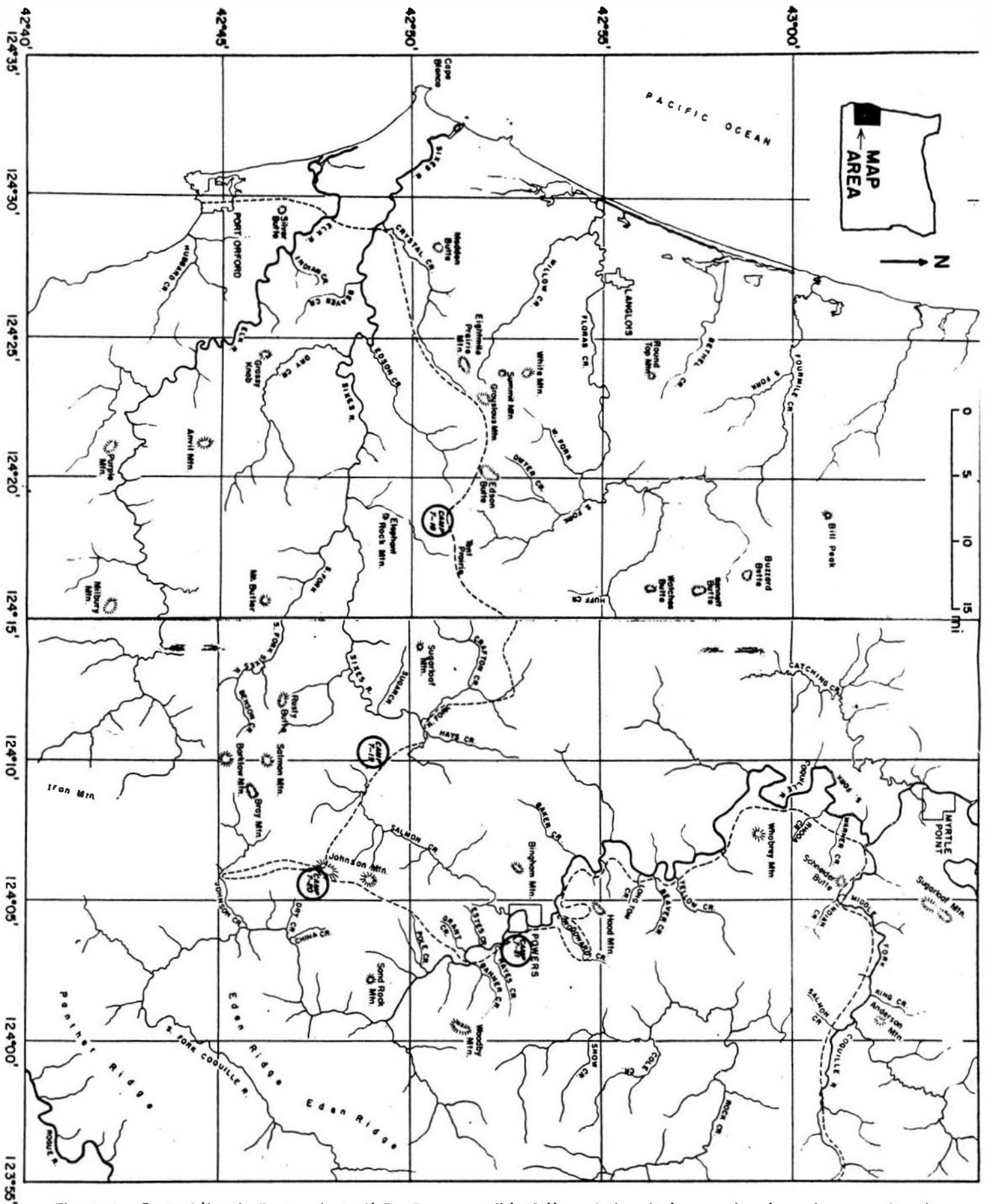


Figure 2. Dotted line indicates the trail Dr. Evans possibly followed; the circles are the places he camped on the nights of July 18, 19, and 21, 1856. This map was produced from data obtained from the Langlois and Powers, Oregon, maps of the U.S.G.S., 1954; also, from the U.S. Forest Service map of Port Orford Ranger District, Siskiyou National Forest, Oregon, September 1936, on which map Henderson traced his trail when he hiked from near Powers, Oregon, to within sight of the junction of the Sixes River and Crystal Creek.

me to eat it all and half an hour any morning will get me another. Distance traveled twenty one miles. (This places Evans in the vicinity of what is now known as the Powers Ranch, approximately 42° 48' N. and 124° 9' W. Mr. Bray's name is mentioned which may give another rather good reference point. Bray Mountain according to the Port Orford map of 1903 is located at 42° 46' N., 124° 7' W.)

"Monday, July 20, 1856. Collected a few specimens of grass. Amongst the grosses of this and other prairies is an abundance of mountain clover. The heads are not so large as the cultivated clover; the stalk is about two to two and a half feet high. The soil in this prairie is very good and produces fine vegetables. This prairie is nearly surrounded by high mountains, but there are other similar prairies hidden by tall trees in the immediate neighborhood; in fact the whole route is through a chain of prairies, some of them several miles long, along ridges covered with fine grass in the deep woods and occasionally in passing from ridge to ridge over high mountains. Noticed today a tree called chestnut oak. It has acorns like the white oak, but the foliage was more like the chestnut. Thermometer at 6 p.m. 48°.

"Tuesday, July 21, 1856. Started at 7-1/4 a.m. passed along two prairie ridges and woodland to a high and steep mountain estimated at two thousand feet in elevation, collected specimen of the rock along the route, talcose and other slates, gritty sandstone, granite, etc. The descent from the valley occupied one hour and a half. The descent to the gold mines of Johnson and others on the fork of the Coquille R. Abbott's branch, also occupied an hour and a half. The descent is much more gradual. The creek at the mines runs through steep mountains covered with timber. Saw a new species of laurel with rare and beautiful flowers. It seems strange to see in full beauty the flowers of early spring roses, etc. scattered along your pathway at this season of the year. Passed over a high (bald) mountain so called, but while of great elevation it is covered at the summit with most luxuriant grass and flowers. Thermometer at 12 m. 69°. The creek is bordered by high steep banks (mountains) its bed filled with large boulders of granite, gneiss, talcose and other slates, showing it to be to some extent a gold bearing region. But there is little quartz either in the rocks or in boulders, and the slate and other rocks, so far as has been discovered, do not contain many signs of gold. The distance to the Great Bend is only twelve miles from this place, but we have already visited the head waters of some of its small tributaries and collected specimens on the divide between this creek and Rogue River, which indicate the geology with sufficient certainty. Returned to Bald Mountain and camped. From our last camp to Johnson's diggings we had a mountain to cross at least two thousand feet in elevation. Distance traveled twelve miles." (The description places the Evans party in the vicinity of Johnson Mountain, along Johnson Creek.

Bald Mountain is mentioned twice in this day's log, first, going, and second, returning to camp. If there is one day in this log that is critical, this is it. This day he specifically mentions collecting rock specimens - on the way to the mountain and on the Rogue River divide. The "Great Bend," unfortunately, could be the bend in the south fork of the Coquille River, Big Bend of the Rogue River near Illahe, or the bend in the Rogue River at Agness where the Illinois River joins the Rogue. The latter does appear to be a little distant.)

An Appraisal of the Record

The record of the Port Orford meteorite is sketchy, to say the least. Because so little information is known, the situation lends itself to a wide variety of interpretations and we have perhaps introduced some more. Some writers appear to have purposely capitalized on the vagueness of the record, in order to produce a mystery story. These stories appeal to editors of popular journals and to the press. The reports on this meteorite, through a bit of literary legerdemain, gloss over or make light of the incompleteness of the record. Also, they have gone too far in stressing a greatly exaggerated value for this particular meteorite. No reason was given for the claim that this specimen has greater scientific importance than other meteorites. In view of what has happened, it is important to list the basic facts about the history of the Port Orford meteorite. They are as follows:

(1) A piece of meteoritic material, called the Port Orford meteorite, was found among the specimens Dr. Evans sent back from his travels in Oregon. This is about all we know. It was not established that this particular sample was found by Dr. Evans or given to one of his party.

(2) Evans was informed about the meteorite in a letter from Dr. Jackson. Jackson, in reporting this find to the Boston Society of Natural History on October 5, 1859, said: "Among some specimens recently received from Oregon Territory was a piece of meteorite." If he knew a locality, he surely would have reported it. On November 16, 1859, he read a letter from Dr. Evans, mailed from Washington, which reported the locality. This indicated Dr. Evans supplied the information but the question is, from what source did Dr. Evans get the locality information?

(3) Dr. Evans had a map of the area because, on July 18, he stated, "the Sixes River is much larger than it is laid down on the maps and Floras Creek is shorter." This shows that other records existed.

(4) The size of the meteorite is a pure guess, because Evans said in a letter to Jackson, "as to the dimensions--I cannot speak with certainty." Then he gives dimensions.

(5) Jackson, in 1861, stated in his biographical sketch of Evans,

"...when his attention was called to the subject he readily remembered the position, form, appearance, and magnitude of the mass...."

(6) The largest specimen of this meteorite is in the U.S. National Museum in Washington. There are two other smaller pieces in museums in Vienna, Austria, and Calcutta, India.

What Is the Value of a Meteorite?

This is a complicated subject that we shall attempt to answer by outlining the points the U.S. National Museum considers in estimating the values of meteorites. Before going into this, it is important to make one point clear--meteorites have no commercial value, that is, no mineral can be extracted from them and sold for more than the same mineral obtained from other sources. Meteorites are scientific specimens and are valuable only for the scientific information they contain.

The importance of meteorites is judged from two different points of view: (a) the scientific information which may be obtained from them; and (b) the prestige the meteorite adds to the collection. Generally speaking, freshly fallen meteorites are more desirable than old falls. Since the Port Orford meteorite is now a reasonably old fall, this feature would undoubtedly reduce its scientific value.

Size. The reward for the recovery of a very large or a very small meteorite can be considerably less than will be offered for the finding of one weighing between 50 and 500 pounds. Very large specimens are costly to transport from the field and since funds for the purchase of meteorites are limited, not much money may remain for the reward after the cost of recovering the specimen has been paid. For small meteorites, the reward is less because there is not enough material for a complete scientific investigation. Generally speaking, there is a relationship between weight and reward, but this relationship is not directly proportional to the weight of the meteorite.

Form. The physical shape of the meteorite plays an important role in evaluating the specimen. Meteorites that fall in a fixed position become streamlined and the fusion crust on their leading sides usually displays delicate flight markings. Such meteorites are more highly prized than those which have tumbled as they pass through the air. A body which constantly changed position during flight usually does not have an interesting shape.

Broken specimens are less desirable than one that is complete and unscorred. Although some meteorites fracture or break on impact with the ground, many of them show little or no damage. Unfortunately, those who recover meteorites frequently do more damage to them than nature did. People often perform useless tests on the meteorites and the only thing these

tests do is to materially lessen the scientific importance of the specimens. Hence, the rewards offered for meteorites which man has heated, broken apart with a hammer, or contaminated with acid are less than for the undamaged specimens.

Degree of preservation. This is most important. It is impossible to estimate what condition the Port Orford will be in when or if it is found. If it has disintegrated through weathering (alteration), it has lost much of its scientific as well as exhibition value.

We know the Port Orford meteorite should be a pallosite and frequently such meteorites have a tendency to decompose. However, the present specimen of the Port Orford meteorite appears to be stable.

A reward awaits the finder of the Port Orford meteorite, or any other meteorite found on public land, but the amount of the reward for the Port Orford meteorite may very well be less than would be offered for the discovery of any other meteorite that is new and of greater scientific importance. Under no conditions will the reward approach anything like \$2,200,000, the amount which has been publicized and is partly responsible for the present enthusiasm for, and interest in, the Port Orford meteorite.

The Ownership of Meteorites

The ownership of a meteorite depends upon where it is found. The courts have held that meteorites are the property of the owner of the land on which they fall, or are found, and the Antiquities Act, Public Law 209, June 8, 1906, specified that objects considered natural treasures are government property when located on federal land. Meteorites have been classified as notional treasures.

The Smithsonian Institution maintains the national collection of meteorites, thus, it claims meteorites found on public land. In the past, the Smithsonian Institution has rewarded those who have recovered meteorites on public land and turned them over to the government, and calculated the rewards on the same basis as for meteorites found on private land.

If a large meteorite is located on private land, the finder, if he is not the owner of the land, should contact the owner and arrive at some agreement as to how the reward should be shared, before a public announcement is made about the discovery of the specimen.

Acknowledgments

The authors are exceedingly grateful to Lawrence B. Isham for drafting the map showing the possible trail Dr. Evans followed in this portion of his travel, to Roy S. Clarke, Jr., of the U.S. Notional Museum, Washington,

D.C., for numerous helpful suggestions, and to staff members of the Oregon Department of Geology and Mineral Industries for assistance in preparing the manuscript for publication.

Bibliography

- Farrington, O. C., 1915. Catalogue of meteorites of North America to January 1, 1919: Nat. Acad. Sci., v. 13.
- Haidinger, W. K., 1860, Einige Neuere Nachrichten über Meteoriten, Namentlich die von Bokkeveld, New Concord, Trenzano, die Meteor-eisen von Nebraska, von Brazos, von Oregon: Sitzber. Akad. Wis. Math-Natur. Kl. Wien, v. 41, p. 568-572.
- _____, Meteoreisen von Rogue River Mountain in Oregon und von Taos in Mexico, gesandt von Hrn Dr. Charles T. Jackson: Sitzber. Akad. Wis Math-Natur. Kl. Wien, v. 44, pt. 2, p. 20-30.
- Hollister, H., 1963, Treasure from outer space: Argosy, p. 74.
- Jackson, C. T., 1861, Biographical sketch of the late John Evans, M.D.: Am. Jour. Sci., vol. 32, p. 313-314.
- _____, 1861, Proc. Boston Soc. Nat. Hist., v. 7.
- Lange, E. F., 1958, Oregon meteorites: Oregon Hist. Soc., v. 59, p. 1-16.
- _____, 1959, Dr. John Evans, U.S. Geologist to the Oregon and Washington Territories: Proc. Am. Philos. Soc., v. 103, p. 466-484.
- _____, 1962, Willomette meteorite, 1902-1962: Published for observance of 60th anniversary of discovery by West Linn Fair Board, 24 p.
- La Paz, L., 1951, A note on the lost Port Orford, Oregon, meteorite: Pop. Astron., v. 59, p. 101-103.
- Mason, B., 1963, The Pollosites: Am. Mus. Nat. Hist. Novitates, no. 2163, p. 1-19.
- Pruett, J. H., 1937, Treasure for the Finding: The Oreganian Magazine, Nov. 21, 1937.
- _____, 1939, The lost Port Orford meteorite: Sky, v. 3, no. 11, p. 18, 19, 22.
- _____, 1950, The lost Port Orford, Oregon, meteorite: Contr. the Meteorit. Soc., v. 4, p. 286-290.
- Shunard, B. F., 1861-1868, Trans. the Acad. of Science of St. Louis, v. 2, p. 162.

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THE SAMS VALLEY METEORITIC SHOWER

By Erwin F. Longe*

One of Oregon's important meteorites is the 15-pound Soms Volley iron found in 1894 by George P. Lindley of Medford. Recent investigations give evidence to the fact that the Soms Volley meteorite was not an individual fall as was commonly reported, but a shower of which five specimens were found. Three individuals can definitely be accounted for. Other specimens may yet be in the possession of residents of the Soms Volley and Medford areas. It is also quite likely that other meteorites will be found in the Soms Volley area.

The 15-pound and largest of the irons was found in the Sams Volley about 10 miles northwest of Medford (see accompanying map). It was discovered lying on rocky soil, but the exact location is not known. At the death of George P. Lindley, the meteorite became the property of his son, Nolo M. Lindley. It then became known to E. W. Liljegrán, also a resident of Medford. Young Lindley and Liljegrán arranged for the sale of the meteorite in October 1914 to the Foote Mineral Co. of Philadelphia, a firm that was very active in meteorite dealing at that time. The iron was first reported in the scientific literature by W. M. Foote, who mentioned that no other pieces were known to have been found.

Foote's description (Foote, 1915) suggests that the Soms Volley was an old fall, since the specimen was thinly oxidized on its outer surface and was lacking a fresh fusion coating. His published report on the meteorite carried three photographs in natural size -- two of external views and one of the polished and etched surface of a slice.

The mass measured about 6.75 by 4.75 by 3.5 inches. There were no piezoglyphs (thumbprints) or flow lines from atmospheric shaping. The specific gravity was 7.794. Chemical analysis indicated the composition to be: iron, 89.36%; nickel, 9.76%; and cobalt, 0.68%. There were traces of silicon, sulfur, and copper. Widmonstätten figures produced by etching a polished section were those of a medium octahedrite.

The 15-pound mass was sawed into slices by the Foote Mineral Co. and the pieces have become widely distributed, since they were sold to collectors and museums all over the earth. It is probably safe to say that the Soms

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Valley is Oregon's most widely distributed meteorite. Four large slices and other outer pieces were cut the long way so that each slice would have the greatest possible area. Recently the writer had the opportunity to examine one of these which is in the meteorite collection of the American Museum of Natural History in New York City. According to the museum's accession records, the slice which had been polished and etched was purchased from the Foote Mineral Co. for \$585.00. This slice, weighing 2.4 pounds, is one of the largest known existing pieces of the Soms Volley meteorite. A two-pound slice is in the meteorite collection of Harvard University.

The second specimen in the Soms Valley shower became known in 1938, when J. Hugh Pruett, astronomer at the University of Oregon, attempted to obtain a piece of the iron from the American Museum of Natural History. The museum proposed to give the University of Oregon a pound specimen if the University would stand the cost of cutting it and then of having the cut surface polished and etched. When the specimen arrived, Pruett was much astonished, for he wrote: (Brogan, 1939)

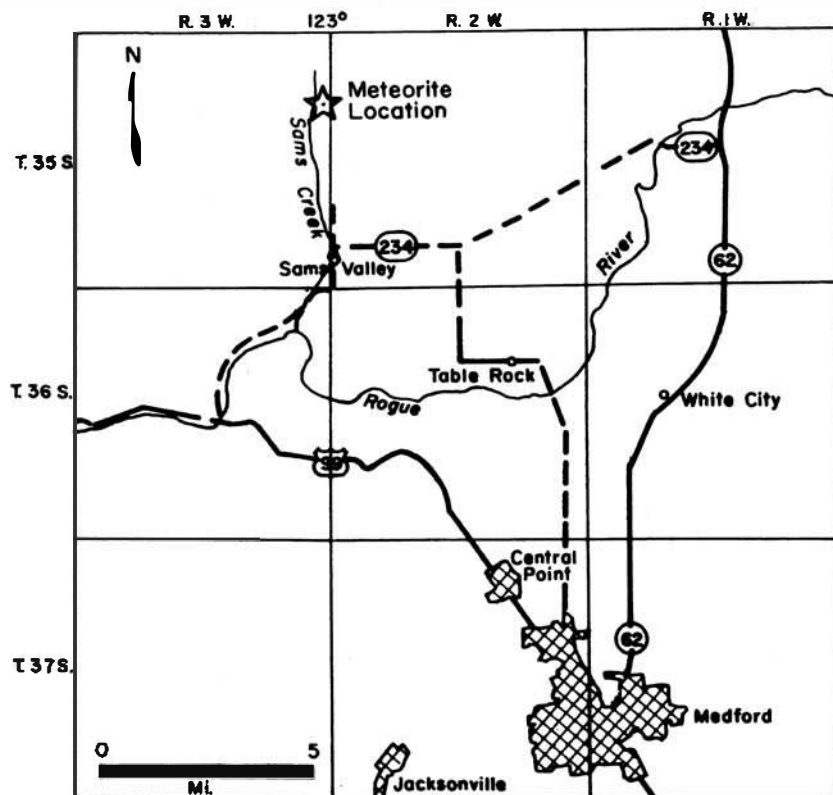
When the Soms Volley meteorite arrived it proved to be an entire individual and had not been cut from a larger piece. Catalog statements that it fell as one piece were apparently incorrect.

Later Pruett described the difficulty of cutting the very hard metal from space: (Pruett, 1949)

C. A. Coulter of the Eugene High School faculty was engaged to remove the slob with his motor-driven "diamond" saw. He estimated it would require about one hour, so set his price at \$1.50. He and his teen-age son, Donald, started about 10 a.m. on Saturday. Mr. Coulter soon telephoned the writer that the meteorite was so extremely hard that his saw would hardly make a dent in it.

As a last resort the humble hand-driven hack saw was put into use. Then began the back-breaking operation. "From morn to noon" they sawed; "from noon to dewy eve," but the "summer's day" was not yet done for them. At 9 p.m. the final sawdust was extracted and the slab fell off with a thud. With heavy sighs the sawyers admitted they had never before attempted to cut anything so hard. On the work bench lay 18 completely ruined hack-saw blades. But no persuasion would induce the acceptance of more remuneration than called for in the original contract.

While visiting the American Museum, the writer investigated the second Soms Valley meteoritic specimen. According to the museum's accession records, this specimen, weighing about 2.7 pounds, was obtained from E. W. Liljegrán of Medford by exchange. A note in the accession book stated that the specimen was found before 1918 about 6 miles from Sams



Index map of Sams Valley area near Medford, Oregon, showing meteorite location on Sams Creek.

Valley. The exact date and location of discovery are unknown. At the present time the American Museum has two pieces, the large slice and the half of the smaller one returned by Pruett. The museum also has two colored plaster casts of the original 15-pound meteorite.

The third specimen of the Sams Valley iron was made known in 1950 by Russell A. Morley, a geologist then living in Salem. During the summer of 1949, Morley and his mother visited the Jacksonville Museum in the hope of obtaining definite information regarding the exact location of the Sams Valley fall (Morley, 1950). While unsuccessful in this objective, they did find a two-pound meteorite in looking through a box of minerals. Morley had a local machinist remove a slice which, when polished and etched, produced Widmanstätten patterns characteristic of a medium octahedrite.

Morley then set out to determine the place of fall in the Sams Valley area. Most of the people he questioned were unfamiliar with any local



Two views of the 15-pound Sams Valley meteorite facsimile which is in the Museum of Natural History at the University of Oregon (photograph courtesy of J. Arnold Shotwell).

meteorites. After a long search, he was fortunate in locating Frank B. Payne, who owned property on Soms Creek (see map). Payne related to Morley how his father, W. M. Payne, had found three meteoritic specimens while panning in a small gulch on the property. The location is believed to be on the north bank of Soms Creek, about 10 feet above the stream in the NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 13, T. 35 S., R. 3 W. One of the specimens was given to a friend named Edward Cooper, whom Morley was unable to locate. The fate of the second specimen is unknown. The third one was the specimen in the Jacksonville Museum. These three meteorites found by the elder Payne in the late 1800's went unreported, because he thought they were of little importance.

Since the evidence is quite clear that the Soms Valley meteorite fell as a shower, it is likely that other specimens may yet be found in the general area. The writer is also hopeful that the other two specimens discovered by W. M. Payne may yet be in the hands of local residents and might be made known so they can be reported in the scientific literature.

Samples of the Soms Valley meteorite are exhibited in two places in Oregon. The Jacksonville Museum has its one piece prominently displayed amid a collection of rocks and minerals. The Museum of Natural History on the campus of the University of Oregon in Eugene has two pieces, the one obtained by Pruett from the American Museum of Natural History, and the other cut off the Jacksonville specimen by Morley. The properties of these two pieces are almost identical, indicating they came from the same fall. The Museum of Natural History at the University of Oregon also has a plaster facsimile of the Soms Valley 15-pound specimen in its meteorite collection. The accompanying photographs show two views of this facsimile at about half its actual size.

References

- Brogan, Phil F., 1939, Meteorite section given collection of University: The Oregonian, sec. 1, p. 14, April 2.
- Foote, W. M., 1915, Note on a new meteoric iron from Soms Valley, Jackson County, Oregon: Am. Jour. Sci., vol. 39, p. 80-86.
- Morley, Russell A., 1950, The discovery of an additional Soms Valley, Oregon, meteorite: Popular Astronomy, vol. 58, p. 236-238 (reprinted in Contributions of the Meteoritical Society [vol. 4, p. 261-263, 1950].)
- Pruett, J. Hugh, 1949, 'Heavenly' bodies scarce in Oregon: Sunday Oregonian, magazine section, p. 6, Jan. 16.

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DEPARTMENT DISPLAYS METEORITE SPECIMENS

Meteorites from the Ben Bones' mineral collection and from a collection on loan from Arizona State University are being displayed by the Department in several southern Oregon communities this summer. On exhibit are nine selected specimens that show the most common features of the four main types of meteorites. These include metallic irons, stony irons, chondrites, and achondrites.

Small community stores in broad valley areas have been selected for the first showings of the specimens. It is hoped that, during the short stay of the exhibit, local residents will become acquainted with what meteorites look like and will submit specimens to the Department for identification.

The meteorites have already been shown in the Table Rock store north of Central Point and in the Sams Valley store at Pruitts Junction, in the United States National Bank branch in White City, and at the Josephine County Fair. Between August 26 and September 4 they will be on display in the Crofts and Hobbies Building at the State Fair in Salem.

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TEKTITES AND OREGON'S VOLCANIC GLASSES

By Erwin F. Lange*

Small pieces of glassy materials that have been naturally etched by chemical action, eroded by wind-driven sand, or tumbled by running water are to be found in various localities in Oregon. These particles have been variously referred to as obsidianites, Apache tears, marekanites, and obsidian bombs. Often they resemble tektites and are sometimes mistaken for them. Since there is at the present time a great deal of interest in matter from space and in space research generally, and since the possibility exists that tektites are a form of space matter, a comparison of Oregon's volcanic glasses and tektites warrants careful consideration. The possibility also exists that tektites might be found in Oregon, although none have been reported to date. A general awareness of tektite properties is helpful in their identification.

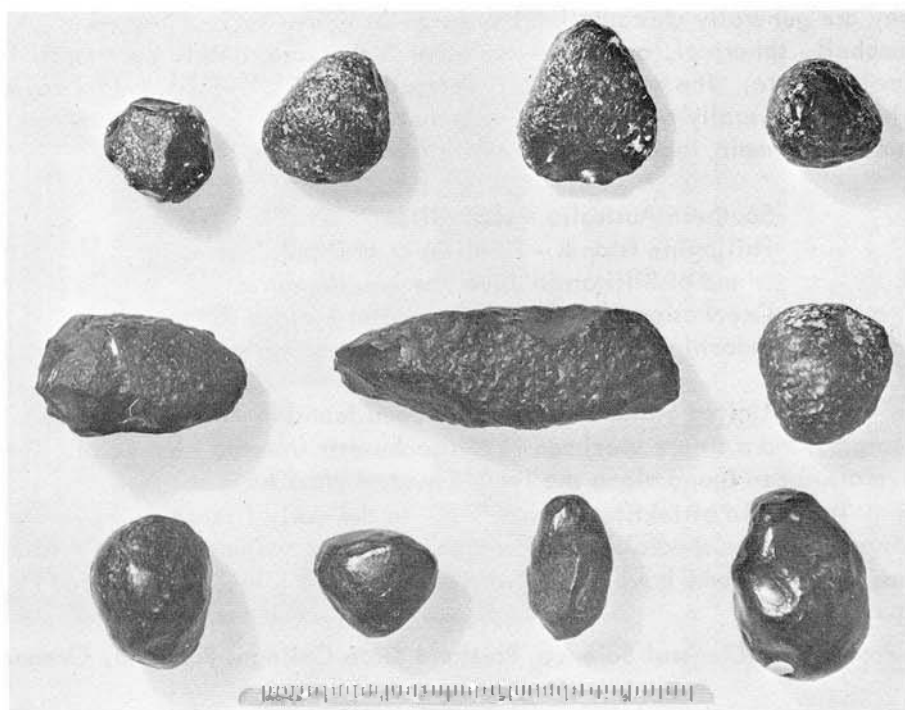
Tektites are small, naturally occurring glassy objects that have been found in a few somewhat restricted geographical areas throughout the world. They are generally characterized by peculiar shapes such as tear-drop, dumbbell, spherical, and disc, forms which indicate a rapid cooling from a molten state. The word tektite is derived from the Greek word for molten. Tektites are usually named after the geographical area in which they are found. The main localities and tektite names are as follows:

Southern Australia - australites
Philippine Islands - rizalites or philippinites
Island of Billiton in Java Sea - billitonites
Czechoslovakia - moldavites after Moldau River
Indochina and Malayan Area - indochinites

In the United States tektites have been found in Texas (bediasites), Georgia, and a single specimen in Massachusetts (Martha's Vinyard). They have also been found along the Ivory Coast of West Africa.

The origin of tektites is unknown. In the early literature they were looked upon as a special kind of volcanic glass or as remnants of prehistoric glass makers. Some have suggested that they were fulgurites produced by

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the fusing of sand or soil by lightning. Later they were regarded as glossy meteorites. In recent years, the formation of tektites has been considered to be associated with meteoritic, comet, or asteroid impact. One group looks upon the impact as occurring on the earth (Barnes, 1961), the other on the moon (O'Keefe, 1964). In either case, it is postulated that high temperatures and pressures produced by impact and explosion of large meteorites would splash materials outward and would form glassy objects shaped like tektites. Considerable support to the impact theory has developed by the discovery of nickel-iron spherules in a Philippine tektite by E.C.T. Chao of the U.S. Geological Survey and the more recent announcement* by Louis Walter of the National Aeronautics and Space Administration (NASA) of the discovery of coesite in tektites from Thailand. Coesite, a high-temperature, high-pressure form of quartz (SiO_2), is found in the great meteorite craters, and its presence is considered to be a criterion in the identification of craters formed by meteorite impact. Laboratory tests have shown that pressures and temperatures associated with volcanic activity are not sufficient to produce coesite.

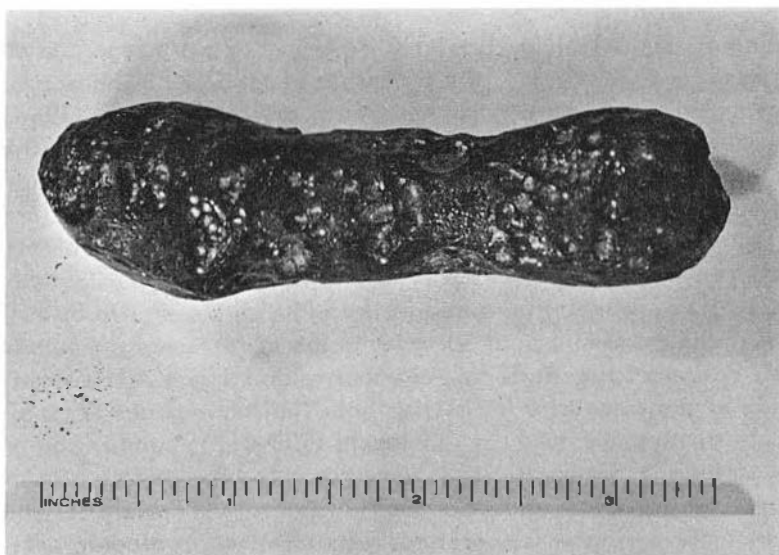
The age of tektites has been determined both by radioactive dating and by the geological formations in which they are found. Studies indicate the Texas bediasites belong to the Eocene (45,000,000 years), while the australites are the youngest group of about 5,000 years. All tektites from any particular group are of the same age.

The outer surface of most tektites has been modified by chemical action and abrasion. They are usually pitted and are sometimes covered with worm-like grooves. Similar surface features have been noted on pieces of western obsidian. Unlike obsidian, tektites have fine flow lines. On chipping or breaking tektites, like obsidian, exhibit conchoidal fracture.

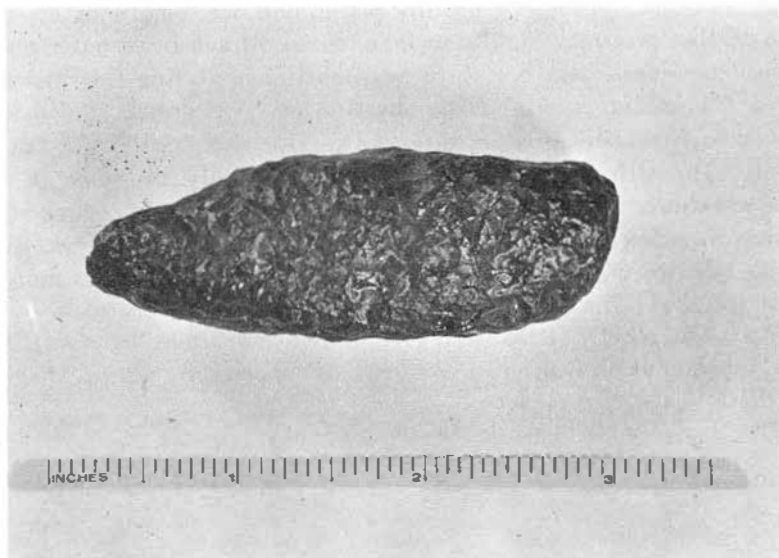
Although tektites and obsidian are similar chemically, they are also different. The silica and alumina content is roughly the same in each. Tektites are characterized by having a higher percentage of reduced (ferrous) iron oxide than ferric, while obsidians have but traces of the two kinds of iron. In tektites the content of soda and potash is usually less than in volcanic glasses. The difference in chemical composition is shown in the following table, which lists on analysis for obsidian from Newberry Volcano and the analysis of an indochinite tektite as reported by Barnes (1940):

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CoO	Na_2O	K_2O
Obsidian	72.35	13.98	0.60	1.78	0.30	1.30	5.04	3.92
Indochinite	72.26	13.18	- - -	5.32	2.15	2.42	1.43	2.15

* New tests show lunar surface may resemble sand found on beaches.
The Oregonian, March 1, 1965, p. 6.



Surface features of tektite from Thailand.



Surface features of obsidian pebble from Lake County, Oregon.

Internally tektites exhibit strain patterns and often have glassy inclusions. Volcanic glasses have opaque inclusions which are rarely found in tektites.

A pronounced difference between tektites and volcanic glasses occurs on heating. In the laboratories of the Oregon Department of Geology and Mineral Industries, a number of tektites and a variety of obsidian glasses were heated to 2,000°F (1,100°C) for five minutes in a muffle furnace. All samples of obsidian exploded or expanded. One variety became a white, frothy mass similar to styrofoam. Tektite fragments of similar size from Thailand, Viet Nam, and Australia under the same conditions retained their original shape and form but became coated with a bright metallic luster. Further studies of tektites and volcanic glasses will be made as different kinds of materials become available. The writer would appreciate receiving samples of unusual tektite-like glassy objects found in the West.

References

- Barnes, Virgil E., 1940, North American tektites: The Univ. of Texas Publ. 3945, p. 477.
_____, 1961, Tektites: Sci. Amer., v. 205, no. 5, p. 58-65.
Bruce, George A., 1958, Pseudo-tektites and other silica glasses: The Lapidary Jour., v. 12, no. 4, p. 510-525.
Clarke, Roy S., Jr., and Henderson, E.P., 1961, Georgia tektites and related glasses: Georgia Mineral Newsletter, v. 14, no. 4, p. 50-114.
Humiston, Lee E., and Zbur, Richard T., 1963, Comparison of surface features of tektites and geothermally etched obsidian: U.S. Naval Ordnance Test Station (NOTS Tech. Pub. 3142).
O'Keefe, J.A., 1964, Tektites and impact fragments from the moon: Sci. Amer., v. 210, no. 2, p. 50-57.
Mason, Brian, 1962, Meteorites: J. Wiley & Sons, Inc.

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Explanation of photographs on opposite page.

Upper photograph:

Top row: Tektites from Thailand.

Bottom row: Tektites from Dolot, Viet Nam.

Note: All tektites from collection of Portland State College.

Bottom photograph:

Top row: Obsidian pebbles from Orval Butler ranch, Crooked River, Crook County, Oregon.

Middle row: Obsidian pebbles from Thorn Lake, Lake County, Oregon.

Bottom row: Apache tears from Wasco County, Oregon.

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