

Oregonian 11/8/84

Oregon prime site for rare nickel-iron rock, josephinite

By JOHN ELIOT ALLEN

More than 3,500 chunks of rock from outer space, which fell to earth as meteorites, lie in the museums and university laboratories of the world.

Several hundred of them have been found within the last 10 years, scattered across the Antarctic ice cap. But they have been found over the centuries on every continent and early humans may have pounded out fragments of them for tools long before iron was smelted.

Only five meteorites have been recovered in Oregon, but a unique rock, *josephinite*, which closely resembles nickel-iron meteorites, has

been found here. It may represent material similar to that which is believed to make up the core of the earth. So far as I know, these pebbles and boulders are the only rocks that are named for an Oregon locality.

Josephinite is a naturally occurring nickel-iron — first described by W.H. Melville in 1892 — from Josephine Creek in Josephine County, which is the only place in the world where it is found in large nuggets. One of these is said to have weighed 100 pounds.

It is also found in New Zealand, where it is known as *awaruite*; in British Columbia, where it is known as *souesite*; and in the Ural Mountains, where it is known as *bobrovkite*. Everywhere but in Oregon it occurs only in grains up to a few millimeters in size and rarely exceeds 100 microns.

Josephinite is always associated with serpen-

tinized ultramafic (high in iron and magnesium) rocks, and the Oregon material is distinctly different from that found in other localities. The name *josephinite* is now used as a rock name, and the mineral names *awaruite* and *taenite* are used for the other occurrences and for the mineral components of *josephinite*. *Kamacite* is similar, with 5 to 7 percent nickel but is only found in meteorites, usually associated with *taenite*.

The ultramafic rock in Oregon and Northern California is known as *peridotite* and is largely made up of the mineral *olivine*, a magnesium-iron silicate. It weathers to a reddish color, which gives the common name "buckskin rock" to large areas in the Klamath Mountains. Eight-Dollar Mountain, west of Grants Pass, is *peridotite*.

The Klamath Mountain *peridotite* mass is up to 15 miles wide and 50 miles long, again possi-

bly the largest such mass in the United States. The mountain represents a slab thrust up through the crust from the underlying mantle during the Jurassic mountain-making period 150 million years ago.

The only nickel produced in the United States, at Riddle, is mined from weathered *peridotite* that contains the ore.

This rare rock *josephinite* is listed only 12 times in the Oregon literature. The definitive reference is by Botto, R.I., and Morrison, G.H., 1976, "Josephinite: a unique nickel-iron": American Journal of Science, v. 276, n. 3, p. 241-274. This publication is an abstract of a Ph.D. dissertation at Cornell University.

John Eliot Allen is professor emeritus of geology at Portland State University. Letters should be addressed to Allen at the Department of Geology, PSU, P.O. Box 751, Portland 97207.

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amusing gimmick book for holiday giving.

For those whose tastes range toward less high-flown sentiments, Rafter obliges with: "There, once was a happy brown noun/ Had cigarettes which could not drown/ They tipped and muttered/ And never quite sputtered/ Sacre bleu, do not call them a gown."

Well, they can't all be gems.

A HOT PROGRAM this Christmas is likely to be Electronic Arts new Adventure Construction Set. Programmed by Stuart Smith, creator of Fracas and Ali Baba and the Forty Thieves, ACS allows armchair dragon slayers to create their own graphic adventures.

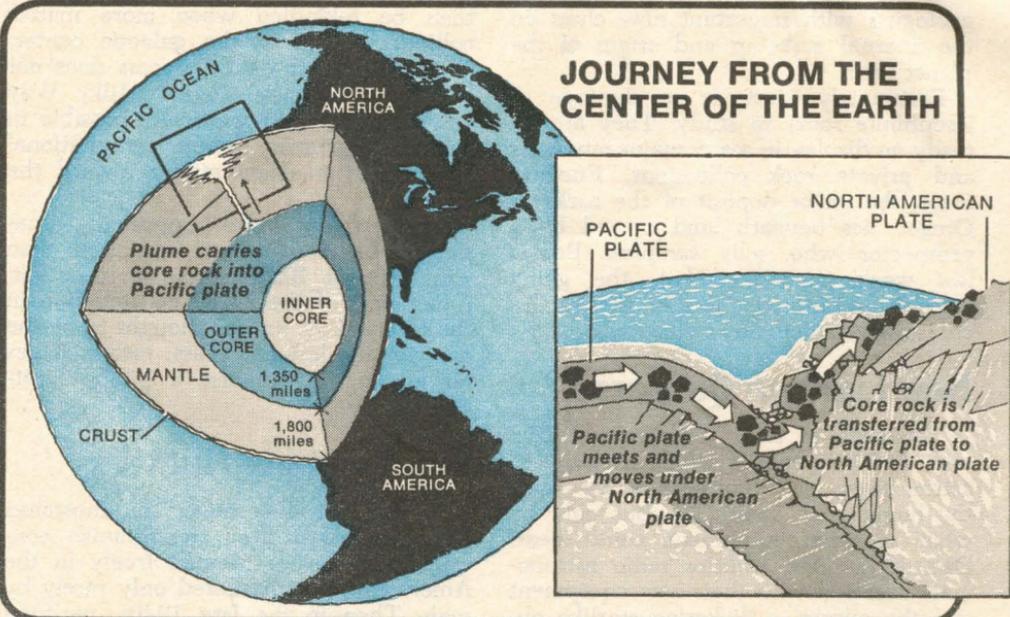
Adventure Construction Set will be released in December for the Commodore 64 and in January for the Apple II family.

Core of the Matter

When Cornell University graduate chemist Robert Botto began a course in geology last year, his professor urged him to get acquainted with his subject by examining a collection of rocks stored in the geology laboratory. All the rocks came from meteorites except one, a pock-marked gray stone labeled simply "This is not a meteorite." Intrigued, Botto and his professors decided to analyze the rock and trace its history. Last week, at the annual meeting of the American Geophysical Union, the Cornell scientists announced a startling conclusion: the rock, and a number of others like it, appears to have originated in the earth's core, reaching the surface only after an eons-

1,800 miles. Beneath the mantle is the core, consisting mainly of iron and nickel. The core is actually divided into two layers—a liquid outside, and a solid center. The Cornell analysis showed the density of josephinite to be similar to that deduced for the outer core, and the scientists concluded that the rocks started out as blobs of molten metal at the boundary between the outer core and the mantle.

To explain the movement of the rocks from there to their resting place in Josephine County, the geologists invoked two relatively recent theories. One, advanced just two years ago, envisions the upward movement of core rock through the solid mantle in hot funnels known as plumes, at a rate of a few



Ib Ohlsson

The Oregon trail: One theory of how rock got from the core to the crust

long journey through 1,800 miles of the solid earth.

Botto's rock had been dug up in 1892 in Josephine County, Ore., and christened josephinite. It consists predominantly of iron and nickel. Using methods of chemical analysis developed for studying rocks brought back from the moon, the Cornell scientists under the direction of George Morrison found it also contained the mineral garnet—strewn in mazelike patterns between the iron and nickel crystals. No other known rocks contain such a pattern which, according to Cornell geologist John Bird, could only have been caused by a great relaxation in the pressure on the rocks. The single realistic cause of such a relaxation, Bird told the American Geophysical Union, is a journey from the center of the earth.

Seismic studies over the years have shown that the earth's profile consists of three distinct levels. The crust, just 25 miles thick, contains mainly granite and basalt rocks. The mantle, a solid layer of denser rock, stretches down a further

yards a year. The other concept is that of plate tectonics, which holds that the continents and the sea bed glide across the underlying solid earth on huge "plates" of rock. The interaction of plumes and moving plates has been suggested as an explanation for the formation of volcanic ranges, such as those in Hawaii: a plate moves across the top of a plume, and the heat from the plume punches a series of holes in the plate.

Route: According to the Cornell scenario, the josephinite was carried through the mantle by a plume—solidifying on the way up—and incorporated into the plate that supports the bottom of the Pacific Ocean. This plate moves continually eastward, until it collides with and drops beneath the North American continental plate at the west coast of the U.S. At this point of collision, the Cornell scientists suggest, the josephinite rocks were detached from the Pacific plate and incorporated into the North American one, ending up in Oregon.

The interpretation is sure to spark

Josephinite
?

March 29, 1967

Mr. Philip Schneider
1749 S.W. Terrace Drive
Portland, Oregon 97201

Dear Phil:

Here is a copy of a letter from Ursula B. Marvin, Harvard University, which is extremely interesting. You will note that the studies indicate an exceedingly close similarity between the grains which you say came from Newberry Crater and the sample of josephinite which we also submitted for comparative studies. We have studied this matter and, in fact, are working very closely with Dr. Lange of Portland State College, and he has become very interested in your specimens.

Since the genesis of the josephinite found on Josephine Creek in Josephine County is still a matter of discussion, the possible occurrence of this same material in Newberry Crater opens up new avenues for a study of its origin.

The scoriaceous sample which you submitted a month ago is also of interest due to the fact that both nickel and cobalt were found.

We would like to suggest that at your convenience you might drop by the office so that we can discuss the matter of both the grains and the scoria further before making final plans for a trip to the area.

Sincerely yours,

Ralph S. Mason
Mining Engineer

RSM:lk
Encl.

April 7, 1967

Mrs. Ursula B. Marvin
Hoffman Laboratory
Harvard University
20 Oxford Street
Cambridge, Massachusetts

Dear Ursula:

Thank you very much for your letter of March 22 regarding the metal-bearing grains from Newberry caldera.

I am sending you under separate cover several more pieces of josephinite. These were obtained from a placer deposit on Josephine Creek, a tributary of the Illinois River in Josephine County, southwestern Oregon. The exact location is sec. 30, T. 38 S., R. 8 W. These are being sent to you in order to corroborate the lines you obtained for josephinite and for the metal-bearing grains.

I think the mystery of the metal-bearing grains has been solved. Yesterday when contacting Dr. Erwin F. Lange, Head of the General Science Department at Portland State College, in order to borrow some meteorites for a display, I learned that a large number of his meteorites had been stolen along with some very minute grains of josephinite and that the student suspected was the one who had turned in these grains to us stating that they were from Newberry caldera. I believe there is very little doubt but what this answers the mystery. However I still plan to go to the area that he originally gave us as soon as the roads are open in order to be doubly sure.

I will be sending you shortly a copy of a paper on Newberry caldera by Aaron Waters which I believe indicates quite strongly that there is no possibility of the josephinite-bearing serpentinite extending below Newberry caldera and I know of no Tertiary volcanics which contain nickel. It is possible, of course, to get serpentinite from volcanics but I think it quite unlikely in the Newberry area.

I want to thank you very much for all the work you have done for us on this and hope you are not as disappointed as I for frankly I thought we were onto something new and very different. In any event I do hope that you can make a trip to Oregon to see some of these very interesting calderas, volcanics, and yes, even the josephinite occurrences. Incidentally, Hole-in-the-Ground, a picture of which I sent you some time back, is only a matter of a few minutes drive from Newberry caldera.

April 7, 1967

In regard to your last question, "When does the snow melt in Oregon?" - I am not quite sure how I should answer this. In the western part of the State we have had very little snow this year, but in the high mountains (the location of Newberry caldera) it generally does not go off until the middle of June. Actually the best time to visit this area is in July or August.

Thank you very much once again and I hope that we can still send you FRDKs.

Regards,

Sincerely yours,

Hollis M. Dole
State Geologist

HD:jr

HARVARD UNIVERSITY
HOFFMAN LABORATORY

March 22, 1967

20 OXFORD STREET
CAMBRIDGE, MASSACHUSETTS 02138

Mr. Hollis M. Dole
Department of Geology and Mineral Resources
1069 State Office Building
Portland, Oregon 97201

Dear Mr. Dole:

Thank you for the additional metal-bearing grains from Newberry Crater and for the specimen of Josephinite.

My x-ray studies show that the two materials are almost identical. The Josephinite gives the patterns of metallic Ni and antigorite serpentine. The Newberry grains are also mainly metallic Ni plus antigorite. My films of the 2 materials are interchangeable excepting for the additional presence of very faint lines representing α -iron (a low nickel phase) in the Newberry material. So far I have found none of the quartz that was suggested by the probe results.

I have not finished work on these grains--they become more interesting all the time. I am, however, wondering whether there is any possibility that the Newberry grains are in fact Josephinite. I know there should be no connection, and I was not expecting any until I saw the x-ray films.

Could the collector have mixed his localities and sent you Josephinite grains as though they came from Newberry crater?

Does the Josephinite-bearing serpentinite extend to the Newberry area at depth?

Can modern volcanics develop veinlets of hydrated materials (serpentine) plus nickel, and has this happened at Newberry Crater?

RECEIVED
MAR 24 1967

STATE DEPT. OF GEOLOGY
MINERAL INDS.

(2)

I shall be anxiously awaiting the results of your own collecting in this area. I will keep you informed of my results as I get them--

When does the snow melt in Oregon?

Sincerely,



Ursula B. Marvin

UBM/am

SMITHSONIAN INSTITUTION
ASTROPHYSICAL OBSERVATORY

OFFICE OF THE DIRECTOR

60 GARDEN STREET
CAMBRIDGE, MASS. 02138
TELEPHONE 617 864-7910

AMJ
June 20, 1968

Hollis M. Dole
Dept. of Geology and Mineral Industries
1069 State office building
Portland, Oregon 97201

Dear Hollis,

Thank you for the beautiful specimens of josephinite. I surely have enough now for all the studies I would like to make.

The man on Josephine Creek must have a most interesting placer containing both gold and nickel-iron. I would expect him to find traces of platinum too, from the weathered serpentinite.

I can't say when, but I will visit Oregon somehow, someday.

Sincerely yours,

Ursula

Ursula B. Marvin

RECEIVED
JUN 24 1968

STATE DEPT. OF GEOLOGY
& MINERAL INDS.

June 10, 1968

Mrs. Ursula B. Marvin
Astrophysical Observatory
Smithsonian Institution
60 Garden Street
Cambridge, Massachusetts

Dear Ursula:

I am enclosing what I consider some pretty nice samples of josephinite. I think you will find these of interest as some of them quite definitely indicate that they occur in serpentine.

We have a pretty good source of this material now from a man who has a small gold mine on Josephine Creek, Josephine County, southwestern Oregon, from which incidentally the material I am sending you came.

I hope that you will be able to get out here sometime in the near future.

Best regards.

Sincerely yours,

Hollis M. Dole
State Geologist

HMD:jr
Encl.

April 18, 1968

Mrs. Ursula B. Marvin
Astrophysical Observatory
Smithsonian Institution
60 Garden Street
Cambridge, Massachusetts

Dear Ursula:

I was real pleased to receive your letter of March 30 noting that you are beginning a serious study of josephinite. Certainly this is long past due. Do you have enough material, and do you want more of it? Please do not hesitate to ask as I am sure I can get you any reasonable amount.

In reply to your question of whether or not josephinite is ever found in its parent rock, my inquiries and experience are that it never has been. However I believe in some of the pieces I sent you, serpentine was certainly part of the pebble and I have definitely seen pieces of serpentine in some of the larger pebbles of josephinite. I have a hunch that this material is recovered from placer gravels for the same reason that gold is - i.e., it has been concentrated there by erosion of fairly large areas.

Your meeting of The Meteoritical Society sounds most interesting. I would like very much to visit Quebec and the Malbaie Astrobleme. I have talked to Mike Dence about this on several occasions and have seen his photographs and heard his story on it and consequently I thirst to see it.

We have started a little project here in our State to see if we can't recover more meteorites. Ed Henterson doesn't think we will have any success but I think it is worth a go. Enclosed is our latest issue of THE ORE BIN announcing what we are trying to do. At least we will get to see a lot of rocks. And wouldn't it be wonderful if we could turn up another meteorite!

I still hope that you can get to Oregon and see some of our country. The Center for Volcanology at the University of Oregon, our Department, and the International Upper Mantle Committee are giving another conference in the Bend area on volcanics. This time it will be confined to andesites. So you are going to see more and more about the Oregon volcanics in the literature, which should make it more important that you come see it yourself. If ever you get out here, we would be most happy to take you on a tour of the State and show you the area from whence the josephinite comes.

April 18, 1968

Regards.

Sincerely yours,

HMD:jr
Encl.

Hollis M. Dole
State Geologist

P.S. Dr. Erwin Lange, Head of the General Science Department at Portland State College, informs me that he has a recollection of reading an article by Melville in which he states that josephinite was found in its parent rock. The reference is: "Josephinite, A New Nickel Iron" by W.H. Melville, Amer. Jour. Sci. (3), vol. 43, p. 509, 1892. You might also want to look at U.S. Geological Survey Bulletin 60 (1887-88), p. 21.

SMITHSONIAN INSTITUTION
ASTROPHYSICAL OBSERVATORY

OFFICE OF THE DIRECTOR

60 GARDEN STREET
CAMBRIDGE, MASS. 02138
TELEPHONE 617 864-7910

March 30, 1968

Hollis M. Dole
Dept. of Geology and Mineral Industries
1069 State Office Building
Portland, Oregon 97201

Dear Hollis,

It has been a full year since you sent me the pieces of josephinite, but I am at last beginning a serious study of them. Meanwhile, I have changed my office from the geology building to the observatory where I am equipping a new laboratory for mineralogical studies of the lunar samples.

I think that the composition and textures of the josephinite may prove very interesting and significant when compared to meteoritic metal. I will let you know my results as soon as I have any. I,ll also find out what Bill Pinson is doing with his samples.

Is josephinite ever found in its parent rock, or is it always in placer gravels?

I am enclosing a notice of the next meeting of the Meteoritical Society in case you might be interested in coming. We hope to make it a good meeting with a bit of geology along with the meteoritics.

With best wishes,

Sincerely,

Ursula

Ursula B. Marvin

RECEIVED

APR 4 1968

SMITHSONIAN INSTITUTION
DEPT. OF GEOLOGY
& MINERAL INDUSTRIES

*Melville, W.H.
Josephinite, A New
Nickel-Iron
Amer. J. Sci. (3)
Vol 43, pg 509, 1892
Bull #60, U.S.G.S. 1887-888-pg 21*

May 9, 1974

Mr. Jack Reed
Box 94
Asotin, Washington 99402

Dear Mr. Reed:

Thank you for your letter inquiring about possible sources of josephinite.

We would like to suggest that you write to our field office, P.O. Box 417, Grants Pass, Oregon 97526, and very possibly they can put ^{you} in touch with one of the local suppliers.

Enclosed is an article from the October 1947 issue of the Ore Bin which contains an article on the Jordan Craters area.

Sincerely yours,

Ralph S. Mason
Deputy State Geologist

RSM:lk
Encl.

Dear gentlemen,

Here enclosing in this letter is a report from Science News dated April 13, 1974, Vol. 105, No. 15, 237:

"A Piece of The Earth's Core? a group of Cornell University scientists believe that specimens of a mineral they have analyzed in their laboratory are pieces of the earth's outer core. If confirmed, the rocks would be the first samples of the core ever identified. The core's outer boundary lies at a depth of 2,900 kilometers, nearly half the distance to the center of the earth. The evidence was reported this week at the annual meeting of the American Geophysical Union in Washington by Cornell geologists John M. Bird and Mauria S. Weathers and chemists George H. Morrison and Robert F. Botts. The specimens are of the mineral josephinite, an iron-nickel alloy found along Josephine Creek in the Klamath Mountains of southwestern Oregon. Josephine is apparently unique, having no resemblance in size, texture or total composition to other terrestrial iron-nickel minerals. The density of the rocks precisely matches that of the earth's outer core, determined through accumulation of seismic data. The strongest evidence that the rocks are from the earth's core is the particular appearance of garnet in them. The garnet is aligned in strong maze-like patterns that outline the crystal structure of the metal in the rock. The Cornell scientists regard the configuration as proof that the garnet became exsolved from the iron-nickel alloy in the solid state. They believe that this phenomenon could only have occurred as a result of the relaxation of pressure as the materials ascended from the inner earth.

"We propose that the josephinite is outer core material, having come from the core/mantle region of the earth's interior," say Bird and his colleagues. How the material reached its present location is explainable by ramifications of the theory of plate tectonics. The material rose to the surface by some kind of convection mechanism as part of a slowly ascending plume of material from the deep mantle. It became incorporated in the Pacific crustal plate - a vast segment of the earth's crust and upper mantle underlying the Pacific Ocean. Westward movement of the Pacific plate eventually brought the portion containing the josephinite into contact with the Americas plate, where it was pushed up into its present location in the Klamath Mountains." That was interesting article.

T

How and where I can buy that a specimen of josephinite at least 1" or more in inches; in hence, do your department have any report on this mineral or its region in SW Oregon?

I read in The Arrow Book of States by Margaret Ronan on pg 80 which says here: "Not long ago a skeleton was dug up in central Oregon. It was the skeleton of a mighty Brontosaurus (dinosaur) - fifty feet from head to tail! Perhaps it lived on the giant palms and ferns that flourished when Oregon was a prehistoric jungle." I looked at a small geologic map of entire Oregon, and found the rocks of that age when dinosaurs lived in the region of Duplee in Crook County - I ask, which rock formation or outcropping yielded the dinosaur remains? What happened

to the dinosaur's skeleton after it was dug up there? only answers would be found in newspapers & reports made in that area at the time when it was dug out - or in geologists report made right after that I dont know of - Arrow book on States never give date when Oregon's first dinosaur remains was dug out.

Do you have any report on The Jordan Craters in eastern Oregon near Cow Creek Lakes, either in printed form or in Ore Bin? In The Mineralogist Magazine dated Dec. 1952, tell me that "The Jordan Craters, described here are perhaps the most remarkable of their kind in the United States, if not in the whole world. Being situated in a remote and isolated part of Eastern Oregon, they remained practically unknown, even to Oregon residents, for many years. The Jordan Craters are far more spectacular than the widely known "Craters of The Moon" in Idaho, an area which has been improved with good roads and made into a national monument some years ago. While the Jordan Craters do not cover as great an area as the Craters of the Moon, the former are far more rugged, interesting and spectacular. There seems to be little doubt that the Jordan Craters are no more than 700 years old as pointed out by Roy C. Whipple. Some geologists believe they are only 200 years old, but in any event they are well worth a visit by the rockologist." The writer in the same article tells that "From this point (a sign at Shegville) it is just 60 minutes to the Craters Parking area, according to legend on the sign. It is only 26 miles to the Craters but we didnt drive that 26 miles in any 60 minutes - it was more like 90 minutes, because the road, although in good condition for a desert road, is a slow one. We had been told to wear heavy soled shoes because the cinders and sharp edged lava formations are hard on ordinary shoes. We were glad we had followed that advice as we walked up the trail that leads to the edge of the large crater. as we were walking along the trail, a rather colorful bit of rock caught my eye, however, I found, when I tried to pick it up, that it was embedded in the surrounding rock. In tugging at it with my bare hands, I found its edges were razor-sharp and then I had loosened it I had cut my hands slightly several times. Afterwards, I exercised more care when handling these rocks. Authorities say these craters and lava flows are the newest in the Northwest and estimate that the eruptions which caused them occurred some 700 years ago. Although I didnt make any estimate of the size of the larger crater, people standing on the bottom and the further edge looked very small. Field glasses or binoculars are almost

we must be able to study the crater walls. The sides of the crater show that the last eruption broke up through several previous flows. On one side the molten lava had flowed through a break in the crater wall, nearly filling a canyon. One side of the old canyon is very easy to locate and follow. The flow through this break in the crater wall was so liquid that a narrow ditch-like channel was formed, which looks as though it was waiting and ready to carry just such another flow of lava. Gugs, hollow spots, jugs, and pits in these newer flows are evidence that tremendous gas pressure must have been exerted within the flows.

The porous condition of the lava formation produced a hollow sound as we walked over it. We all felt very insecure and wondered if it were possible to break through the top crust and drop into a deep fissure. I was also aware of the overhanging lava slab on the jugs and pits, and shuddered at the thought that they might break off and fall, with some of the visitors, as they were walking out on them, to the very edge and looking down into the jugs and pits. The surface opening of these gas-caused pits are usually small, widening into a larger hole lower down and making a mug-shaped pit, the top crust being estimated from one foot to six feet thick and overhanging from 5 to 20 feet. It would be almost impossible to climb out of one of these holes unless one had help from above and therefore, it would be a good idea for one member of an exploring party to carry a 50 or 60-foot rope, for use in helping to get one of the party should one be so unlucky as to fall into one of these places. By lunch time our former reluctance had been replaced by enthusiasm. Several people we talked with planned to return with rope ladders and color picture equipment and climb down into some of the crater's pits and jugs and photograph the beautiful ferns growing here. There had been a steady stream of tourists to the spot and we wondered, in view of the unusual scientific splendor of the spot, why it hadn't been converted into a state park or monument. We were told that earlier in the day a group of visitors had frightened a large bobcat from his home in one of the craters. That is only a small part of information I learned about the Northwest's mostly youngest volcanic fields of the Jordan Craters and I would like to know more about them. A report being made of them with maps, details and photos would be more interesting book to know about that Jordan Craters in Eastern Oregon.

Sincerely Yours,
Mr. Jack Reed