JAN 93

THE GEOLOGICAL NEWSLETTER

GSOC

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

GEOLOGICAL SOCIETY
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ACTIVITIES

ANNUAL EVENTS: President's campout-summer. Picnic-August. Banquet-March. Annual Meeting February.
FIELD TRIPS: Usually one per month, via private car, caravan or chartered bus.
GEOLOGY SEMINARS: Third Wednesday, except June, July, August, 8:00 p.m. Room S17 in Cramer Hall, PSU.LIBRARY: Room S7, open 7:30 p.m. prior to evening meeting.
PROGRAMS: Evenings: Second and Fourth Fridays each month, 8:00 p.m. Room 371, Cramer Hall, Portland State University, SW Broadway at Mill Street, Portland, Oregon.
Luncheons: First and third Fridays each month, except holidays, at noon, Standard Plaza Cafeteria, third floor, Room A, 1100 SW Sixth Ave. Portland, Oregon.
MEMBERSHIP: per year from January 1: Individual, $15.00, Family, $25.00, Junior (under 18), $6.00. Write or call Secretary for membership applications.
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The Geological Society of the Oregon Country
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VISITORS WELCOME
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VOLUME 59, NO. 1

CALENDAR OF ACTIVITIES FOR JANUARY, 1993

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 P.M.).

Jan. 8 "Mount Robson, Pride of the Canadian Rockies" Slide presentation by Evelyn Pratt, President GSOC.

Jan. 22 "Exotic Terranes, Blue Mountains of Oregon". A video tape presentation. Introduction by Clay Kelleher, GSOC member.

FRIDAY LUNCHEONS (Standard Plaza, 1100 SW 6th Avenue, Rooms A & B. Third Floor Cafeteria. Programs at 12:00 Noon).

Jan 1 NEW YEARS DAY - No luncheon.

Jan. 15 "South Australia". A slide presentation by Frances Rusche, GSOC member.

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.)

Wednesday
Jan. 20 "Geology of the Black Hills". A slide presentation and discussion by Richard Bartels.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S-7. Open 7:00 - 8:00 P.M. prior to evening meetings.)

FIELD TRIPS

Due to minimal response to last month's inquiry regarding your wishes, no trips are scheduled. Call Alta Fosback at 641-6323 for further information.

EXTREA-EXTRA****OPEN HOUSE**** An OPEN HOUSE
January 31, 1993. An OPEN HOUSE well be held to celebrate the wedding of Alta Fosback and Harold Stauffer at the home of Charlene Holzwarth, 2524 NE 34th from 2 to 6 pm. All Gsocs and their famlies are invited. Bring your favorite cookies or !!!! No gifts please.

EARTHWATCH – VOLUNTEERS NEEDED FOR WORLDWIDE GEOLOGICAL RESEARCH

Earthwatch a non-profit organization that provides funding to field scientists world-wide, is is recruiting volunteers for a unique, hands-on experience assisting geological research.

EARTHWATCH is a tax-exempt, non profit institution that sponsors scholarly research by finding paying volunteers to help scientists on research expeditions around the world. The organization is a public charity under sections 501(c)3 and 509(a)2 of the Internal Revenue Code for charitable, educational, and scientific activities (Federal #23-7169440. **TURN TO PAGE 6 on EARTHWARCH for further details.**

COMPLETED FRACTURED GEOLOGY

EVELYN AND RALPH PRATT

1. **Country Rock**: music for drums, washboard, or gee-tar.
2. **Benioff zone:** a place where Benny is forbidden to go.
3. **Mantle plume**: one rose, daisy, etc., over the fireplace.
4. **Facies:** What folksies have in front of their headies.
5. **Quartzite:** land purchased for a building to house s judge and jury; where quietroom is located.
6. **Concordant:** one or two places where the Revolutionary War started, Lexington being the other.
7. Nuee **ardente**: one's latest boyfriend or girlfriend.
8. **Fireshock**: a hank of hair that hangs over a person's eyebrows.
9. **Lithology:** the science of how to become more limber.
10. **Aureole:** what you ask when the power's been off. "Aureole right no ?

SEE PAGE 6 FOR REAL DEFINITIONS

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THE GEOLOGICAL HISTORY OF CATS IN OREGON

Robert L.Gamer, Member of the Society of Vertebrate Paleontology

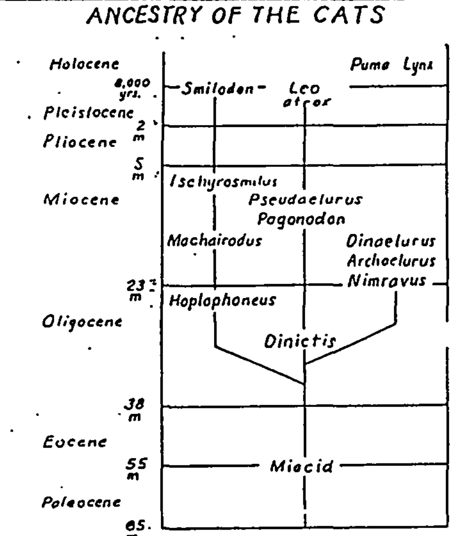
PART II - THE SABER TOOTH (OR STABBING) CATS

Editors Note: This is the second and last part of the geological history of cats in Oregon. It is an account of the saber tooth cats. An earlier issue of GSOC Newsletter, Vol. 58, No. 5, pages 28-30 contains Part One of the history of Oregon's biting cats.

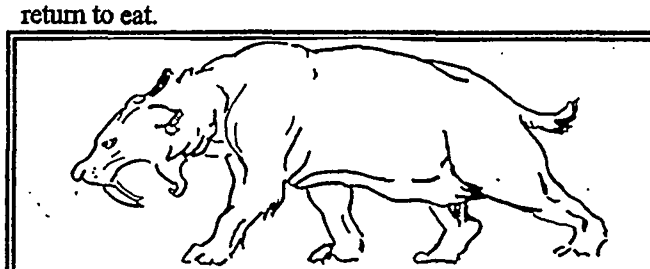
The second great division of the cat family is the saber tooth group. This group of cats all had long (4 and 1/2 to 12 inch) cannie teeth called sabers. They also had well developed carnassal teeth.

The ancient bones of Oregon's earliest sabber tooth cat, Hoplophoneus, are found in the Turtle Cove and Haystack Valley members of the John Day Formation. Both are of late Oligocene to early Miocene age. Hoploponeus is also found in the still earlier Oligocene beds in Nebraska. It is thought to be the ancestor of all the saber tooth cats that appeared in later times. It was a sleek preditor. Hoploponeus was larger than a lynx and heavier than Dinictis. Its canines were long, thin, stabbing blades that were serrated on both edges. Hopolphoneus had a flange on its lower jaw for sheathing the sabers. This flange covered and protected the sabers when Hoplophoneus closed its mouth the same way that a scabbard protects a sheathed sword. The bones of Maichairodus, an early descent of Hoplophoneus, was found in the Haystack Valley beds of the John Day Formation and the Drinkwater and McKay members of the Deschutes Formation farther to the east. The Deschutes Formation is made up of volcanic and continental sediments of lower Miocene age. Machairodus is also called the scimetar-tooth cat because its canine teeth were razor sharp like the scimeter of a Turkish sultan. It had long forelegs but short hind legs. Like most saber tooth cats Marchairodus was not a fast runner. It generally stalked unsuspecting bulky animals. Then it would rush in and stab them. They would die once the saber teeth cut into their neck arteries. Then Marchairodus would make a meal of them.

ANCESTRY OF THE CATS



Ischyrosmilus was another saber tooth cat. The bones of its specimens were found hear Hagerman, Idaho close to the Oregon border in the upper Miocene beds. Ischyrosmilus is sometimes called the "false saber tooth". It had 4.5 inch canine teeth. When it opened its mouth to stab its prey, a 90 degree angle was formed between the upper and lower jaws. When it closed its mouth the saber fit into a scabber-like flange in its lower jaw. Ischthrosmilus liked to feed on baby elephants. First it would slash their arteries killing the young elephants, then it would hide while the rampaging parents stormed through the brush searching for the killer. Eventually, the elephant couple would leave. Ischyromilus would then return to eat.



Smilodon was the last and best known of all the saber tooth cats. Smilodon is also called the "saber tooth tiger". Its bones occur in many Oregon gravel pits: however, it is found from California that the details of Smilodon became known.

About 1,000 Smilodon skeletons were found in the tar pits of Rancho la Brea on Los Angeles. These pits are at the "George C. Page Museum of LaBrea Discoveries". The museum and the pits are located at Wilshire Blvd. and Carson Avenue. Smilodon was a large, powerful beast about the size of an African lion. Its saber teeth were up to 12 inches long. They were serrated for easy penetration. Some paleontologists think Smilodon was a blood drinker, others think it also ate larger animals such as sloths, horses, and elephants. Anyway, over 1.5 million vertebate fossils were recovered from the tar pits. This shows that many animals who came here to drink were trapped in the tar. Because the animals stuck in the tar made an easy meal, the pits were one of Smilodon's favorite haunts. It could see that the animals stuck there couldn't get out. And so, Smilodon could eat them at its leasure. However, this was a dangerous practice. Often, while dining on another animal already stuck in the tar, Smilodon itself would get stuck. Then as Smilodon struggled, it would sink deeper and deeper into the tar until it drowned in the lake that covered the tar. No doubt, blood curdling roars and screams would rend the air when Smilodon realized what was happening, and it could not avoid its fate. When these cries were heard by other carnivores, they would come around and eat the helpless Smilodon. Like Russian roulette, it was a deadly game. All told 91% of the skeletons at Ranch la Brea were bones of meat-eating animals while only 9% were plant eaters.

During much of the Tertiary time cats (and other animals) migrated back and forth between America and Asia. They traveled along a passage way of land between Alaska and Siberia where the Aleutian Islands are located today. This passage rose out of the ocean and sank back into the ocean many times during the geologic past. It formed a broad land corridor during Paleocene and Eocene times. It was a more narrow land bridge at times during the early, middle and late Miocene as well as at times during the Pliocene. Also, it became a land bridge during the four glacial epochs of the Pleistocene. During each of these glacial epochs continental ice sheets covered the northern United States, Canada and northern Europe. The ice of these sheets took up so much water that sea levels fell. What had been a sea bottom in the Aleutian Chain dried up, became land, and formed land bridges into Asia. At such favorable times, cats journeyed back and forth between America and Siberia without much trouble..

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Savage, D.E., & Russell, D.E., 1983, "Mammalian Paleofaunas of the World"' addison-Wesley Publishing Company, 429 p.

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Scott, W.B., 1937, "A History of Lnad Mammals in the Western Hemisphere", Macmillan, New York, 786 p.

Shotwell, J.A., 1970, "Pliocene Mammals of S.E. Oregon and adjacent Idaho", University of Oregon Bulletin No 17, Nuseuim of Natural History, Eugene,Oregon 103 p.

Geology Field Camp Scholarship Fund Status

To: John E.Allen, Geological Society of Oregon
From: Gene Pierson, Geology Department, PSU.

As of December 1, 1992, there is a balance of $850.00 in the account. This includes the three $300.00 scholarships awarded this past summer. The recipients were all in Portland State University's Geology Field Camp held at Owhyee Reservior area near Twin Springs (south of Vale, Oregon). The recipients were Timothy Blackwood,Christopher Humphrey and Brett Broderson It is our understanding all three will be presenting a joint talk to the GSOC organization somethime this year. The schedulting should be done through our field camp director, Dr. Michael Cummings.

THE 1983 BORAH PEAK EARTHQUAKE

Dr. John H. Whitmore, GSOC

The October 28, 1983 Borah Peak, Idaho earthquake in a previously 'aseismic area' called attention to a unique and little known valley. The Lost River Valley is a graben between the Lost River Range on the east and the White Knob Mountains in the west. Borah Peak, at 12,662 feet, the highest point in Idaho, looms above the earthquake fault scarp, which at about 6500 feet elevation is little more than three miles to the west. For fully two-thirds the length of the Lost River Range, recent to late Pleistocene range-front fault scarps are visible on the slopes of alluvial fans. No such evidence of ground rupture has been found on the west side of the valley, but high angle faulting is suspected there, as well. The adjacent White Knob Mountains to the west are surmounted by Shelly Mountain, elevation 11, 278 feet.

As with many other range fault zones, the Lost River Fault ruptures segmentally. The 1983 earthquake produced surface rupture along the entire length of the Thousand Springs Segment. Worthy of note is the 2.9 mile gap in surface rupture which separates the Thousand

Springs Segment from the Warm Springs Segment. Although no ground rupture occurred here in 1983, Quaternary fault scarps show that there was rupture here in earlier earthquakes. This 'gap' is thought to result from a 'barrier' to propagation of slippage on the fault plane. Perhaps the fault was locked here. This gap is in line with the major cross structure between the White Knob Range and the Lost River Range, the lowest portion of which is Willow Creek Pass, between the drainages of the Lost River and the Salmon River. The other segment boundaries are characterized by alignment with bed rock ridges projecting from the White Knob Mountains to narrow the Lost River Valley, or by major change in direction of the Lost River Range. Bartlett Point and Chilly Buttes constitute the projecting ridge pointing to the boundary between the Thousand Springs Segment and the Mackay (pronounced 'Mackey') Segment. A ridge from Mackay Peak points to the juncture of the Mackay Segment and Pass Creek Segment. Sheep Mountain and Appendicitis Hill project eastward into Lost River Valley, where sharp change in direction in the axis of Lost River Range marks the junction of the Pass Creek Segment and the Arco Segment.

No vestiges of Late Pleistocene or Holocene faulting occur on the Pass Creek Segment. Fault scarps 50 to 74 feet high break the slopes of Late Pleistocene alluvial fans in the Arco Segment. In the Mackay Segment, a fault scarp about 38 feet high cuts the late Pleistocene alluvium at the mouth of Lower Cedar Creek Canyon.

The hypocenter of the October 28, 1983 earthquake was located about 6 miles beneath the surface, near the southern edge of Thousand Springs Valley. Fault movement propagated from the southeast to northwest in the Thousand Springs Segment. A 11.6 miles surface rupture occurred on that segment, with a maximum throw of 8 feet nine inches. The movement was primarily dip-slip, with the valley side down-thrown. There was approximately 17% left lateral slip as well. This movement generated a magnitude 7.3 earthquake. The 'barrier' between that segment and the Warm Springs segment apparently deflected fault rupture to the west, to form the 8.5 long Western Segment. The nature of that segment is poorly understood. A rupture 4.9 miles long occurred along the Warm Springs Segment, with maximum dip-slip throw of 3.25 feet, also with a left lateral slip component. Rupture here is believed to have been triggered by the earthquake, and not representing an extension of the Thousand Springs Segment rupture. Geodetic measurements indicate that the Lost River Range rose about 8 inches, while the Thousand Springs Valley dropped about 48 inches during the quake. (Stein,1985.)

The fault scarp is most readily accessible via the May-Patterson (Doublesprings Pass) Road. For most of its length, it cuts the colluvium . It is a bed-rock scarp on the flank of Dickey Peak, but scrambling on steep slopes is required to reach it there. Typical of Rocky Mountain fault scarps, it has a small graben at its foot, from one to 300 feet wide, and from an inch to three or four feet deep. If you walk along the trace of the fault you will find it has a right-stepping en enchelon pattern.

A most remarkable consequence of the earthquake was the torrential outpouring of ground water from the fissure system in the limestone of the North Chilly Butte and Thousand Springs Valley. This fissure is thought to be a high-angle fault, trending N15 degrees W. There was no movement on that fault in the 1983 earthquake, but it served as a conduit for ground water to escape after the valley floor dropped and drastically increased the pore pressure. A torrent of water poured from a large crack on to east side of the north butte, moving angular limestone boulders up to 3 feet on a side, trenching the road and covering it with debris. At least 47 craters were left on the valley floor, to the east and the north of the butte. Water fountains as high as 20 feet had sprouted from these craters, and from fissures between them, covering the plain with sand aprons from these craters. The largest of the craters was 72 feet in diameter and 16 feet deep. Some were only a foot or two in diameter, but 6 to 8 feet deep. Water issued from these vents for at least 48 hours, although diminished rate after an hour or two. The only eye-witness reported that a torrent of water came from the side of the butte first, then sand and dust erupted from cracks on the valley floor, appear toapparently propelled by air to an height of 12 to 18 inches for a few minutes, before water came forth from the lowland. Small amounts of water flowed from cracks on the top of the north arm of the butte, almost 100 feet above the valley floor. In addition, an astounding system of tunnels and collapse pits developed in the alluvium on the north slope of the butte.

About 1.2 miles north of the junction of Highway 93 with Trail Creek Road is Whisky Springs, where earthquake liquefaction of soil of the toe of an alluvial fan caused an extensive area of lateral spread which disrupted the highway. Although the highway has been repaired, the head-scarp and down-slope bulge of the earth flow remain.

A three mile drive on the Borah Peak-Cedar Road (4.5 ,lies north of the Trail Creek Road Junction) takes you to the fault scarp. About 340 feet southeast of the road is a scar of a complex rotational slump-debris flow which crosses the fault scarp. Triggered by the earthquake, it slid after the fault scarp was established. After examining the landslide, and its relation to the fault scarp, you can walk to the northwest, along the trace of the fault and see fine xamples of grabens and of en echrlon, right stepping fault scarps.

It is too late to see structural damage in the town. Most damaged buildings have been removed. However, houses still stand at the foot of a fresh talus slope in Chaliis, beneath beetling cliffs of Challis Formation. Since the earthquake, a large berm has been built at the foot of the slope The largest rockfall caused by the earthquake is located in the canyon of the Salmon River, about 5 miles upstreamfrom the junction of Highway 93 with Highway 75. Some 13,000 cubic yards of Challis Volcanics fell from the cliffs there.

About 12 miles south of Challis, near the mouth of Granview Canyon, a large, warm spring feeds the Warms Spring Creek. The flow of that spring increased so abundantly following the earthquake that there has been chronic excess stream flow in the creek ever since. The landowner has addressed that problem by building a hydro-electric plant with an intake canal about two miles long. It remains to be seen whether the spring will continue to provide enough water to drive the turbine.

In the headwaters of Antelope Creek, alluvium in a small tributary became saturated owing to new springs and increased water discharge consequent to the earthquake. Two days later, it formed a 272,000 cubic yard mudflow which moved 1.8 miles dow n valley on a slope of less than 8 degrees. Near it distal end, it broke aspen trees eight inches in diameter.

A trench has been excavated across the fault, enabling geologists to make detailed measurements and diagrams of the fault plane and the deposits on the down-thrown block. The fault plane has been carefully dissected out, revealing the scars of previous earthquakes in addition to those of the 1983 event.

It is obvious that movement has occurred repeatedly on the same planes, both on the main fault and on secondary planes associated with small grabens and horsts down-slope from the main scarp. Since material is unconsolidated sand and gravel, it is remarkable that the fracture plane remain so consistent.

Stein, R.G. & Barrienttos, S.E., HIGH ANGLE FAULTING IN THE INTERMOUNTAIN SEISMIC BELT: GEODETIC INVESTIGATION OF THE 1983 BORAH PEAK EARTHQUAKE, IDAHO.
Abstracts with programs, Geological Society of America (Rocky Mountain Section) ,vol.17,# 4: p 226, March,1985
, Rocky Mountain Section, The Geological Society of America, Boise State University, Boise, Idaho, April 22-24, 1985.
FIELD GUIDE, THE BORAH PEAK EARTHQUAKE OF OCTOBER 28, 1983. SURFACE FAULTINGH, MASS MOVEMENT AND QUATERNARY TECTONIC SETTING.

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DEFINITIONS FOR COMPLETELY GEOLOGY

1. **Country rock:** any rock older than and intruded by an eous body.
2. **Benloff zone:** the probable upper boundary of a lithosphereic plate, where it dips at an agle under another plate toward the mantle; earthquakes tend to cluster along it.
3. **Mantle plume:** a narrow colum of hot magma rising from earth's mantle through its crust.
4. **Facies:** general appearence or nature of one part of a rock body as contrasted with other parts.
5. **Quartzite:** metanorphosed sandstone.
6. **Concordant:** said of strata or of the contact between igneous and country rock, where bedding or structure are parallel to each other.
7. **Nuee ardente:** a cloud of red-hot ash and dust caused by very explosive volcanic activity. main one.
8. **Foreshock:** a small earthquake that precedes a main one.
9. **Lithology:** physical character of a rock.
10. Aureole: zone of contact metamorohism next to a pluton.

<u>THE EDITOR NEEDS ARTICLES AND OTHER ITEMS OF GEOLOGIC INTEREST FOR THE NEWSLETTER.THIS IS YOUR CHANCE TO GET YOUR NAME IN PRINT.IF YOU SEE A GEOLOGIC ARTICLE OF INTEREST, PLEASE SEND IT IN.</u>

PROPOSAL TO DESIGNATE A OREGON STATE FOSSIL AND A PROPOSAL TO PROTECT FOSSILS ON PUBLIC LANDS.

A letter that was passed on to the Editor and his wife from Dr. Lanny H. Fisk, PhD. via Mel Ashwill, GSOC from Madras regarding disignating a Oregon state fossil and a bill to protect and preserve fossils on public lands in Oregon.

Dear Mel:

Enclosed are the first drafts of a joint resolution to designate an Oregon state fossil and a bill to protect and preserve fossils on public lands. Please look over critically and give me some help. Feel free to share a copy with anyone else who may be interested in comments on how willing to help. I am particularly interested in comments on how effective the language of the first draft is, on one hand,protecting fossils and , on the other hand, not excluding collecting by "professional amateurs" like yourself, and even hobby collectors. Please look over the current draft with these things in mind. -In other word, answer the question: How would this legislation affect me and other paleontologists like me? I would be grateful for any all comments. I expect the bill will go through at least a dozen drafts before we go looking for sponsors in preparing a final draft.

EDITOR: These two proposals were written by Dr. Lanny H.Fisk, Ph.D, President and CEO, F & F GeoResource Associates, Inc. 66928 West Highway 20, Bend, Oregon 97701

THESE TWO DRAFTS OF PROPOSED STATE FOSSIL AND BILL TO PROTECT FOSSILS WILL BE IN THE GSOC LIBRARY.

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OREGON SUNSTONE-OFFICIAL STATE GEMSTONE

Oregon sunstone has been made the official State Gemstone by proclamation of Governor Neil Goldschmit and by a Joint Resolution of the Oregon State Assembly. Oregon sunstone, a rare gem variety of the feldspar group, occur in Lake and Harney Counties where they are dug from the soil and the underlying lava flows. Oregon sunstones are uncommon in their composition, clarity, and range of colors and occur in sufficient abundance to permit sustained production of faceted gems.

Feldspars usually occur in a large variety of rocks types, generally as small crystals that are typically opaque with rather dull colors of white and gray. Oregon sunstone, however, are large, brightly colored, transparent gem feldspars. They crystallized in molten rock as it slowly cooled deep in the earth's crust. This cooling and unique composition of these particular crystals permitted the formation of gem-grade crystals, which were later erupted with the lava flow and frozen in place as the lava cooled. Finally, disintegration of the lava by weathering freed the sunstones from the surrounding lava.

Sunstone crystals are as large as 3 inches across have been found. In color, the gems range from water clear through pale yellow, soft pink, and blood red to deep blue and green. Some of the deeper colored stones have bands of varying color. A few of the sunstone crystals show two different colors when viewed from different directions, but when they are observed from just the right direction, a pink to red metallic shimmer flashes from within the stone, as if from a collection of small spots or from a mirror surface. These color variation and shimmer (often called "schiller") are caused by tiny crystals of copper metal contained in varying amounts and sizes of stone. The darker stone contain larger amounts of copper.

For many years, collectors have prized sunstones from eastern Lake County, near Plush, Oregon, where the U.S. Bureau of Land Management has established as free, collecting area. Until recently, this was the only known occurrence. Two more occurrences in northern and southeastern Harney County have been discovered recently, allowing the mining of more marketable gems, and the geology of the area is favorable for the discovery of more deposits. Except for the BLM public collecting areas, all these producing are are held by mining claims and are not available for collecting without permission of the claim owners.

The collecting and mining of Oregon sunstones has had a positive effect on Oregon's tourism and gemstone industry. The retail value of cut stones currently ranges from $15 to over $100 per carat. Higher prices are for red, blue or green colors, for larger or clearer stones, and for elaborate cuts. A one-carat sunstone in a traditional round brilliant cut would be about the size of the eraser at the end of a pencil.

SOME ARTICLES ON SUNSTONES

The Ore Bin, v.34 no. 12, (Dec.1972: Oregon "sunstone". (N.V.Peterson).

Oregon Geology, v. 49, no. 2 (Feb. 1978), p. 23-24: Oregon sunstones, (R.P.Geitgey).

U.S. Bureau of Mines, Information Circular 6533 (1931); Feldspar gems (Amazone stone, moon stone, sunstone), 10 p. (I.Aitkens)

American Mineralogist, v. 51 (1966), p 177-197: Physical properties of calcic labradorite from Lake County, Oregon, (D.B.Stewart and others).

Journal of Gemology, vol. 18, no. 6 (1983, p 503=514: Heliolite, a transparent, facetable phase of calcic labradorite, (F.H.□Pough).

Geology, v. 13(1985), p. 644-647: Exsolution of metallic copper from Lake County labradorite (A.M. Hofmeister and G.R.Rossman).

The article written from DOGAMI. No author mentioned.

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EARTHWATCH continued:

These EARTHWATCH expeditions include 157 projects around the world. There are 24 projects in Geoscience, 19 projects in Marine Studies, 37 projects in Art and Archeology and 11 projects in Rain Forest Conservation and Ecology to name a few. Several projects closer to home(Oregon) are Big Bend Volcanoes, Big Bend National Park, Texas, Monitoring Volcanoes of the American West, Yellowstone Caldera, Wyoming, and Florida's Underground, Tallahassee, Florida. A couple of others some distance away are China's Holy Mountain, Mt. Huangshan, China and Mt. Olympus, Mt. Olympus, Greece.

All projects are led by scientists and are 10 days to three weeks in length. Volunteers are trained in the field: special skills are welcome but not necessary. Anyone over the age of 16 is eligible to apply. All project contributions which range from $500 to $2,200 are tax deductible. Volunteer contributions cover food, lodging and field equipment. Airfare is additional. For further information, call Andy Hudson at 800-776-0188, ext.182 or write EARTHWATCH, P.O.Box 403GP, Watertown, MA 02272

THE GEOLOGICAL NEWSLETTER INDEX

Compiled by Dorothy R. Waiste

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ARTICLES AND REPORTS

Also see: BANQUET and PRESIDENT'S FIELD TRIP

BANQUET

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THE GEOLOGICAL NEWSLETTER

GSOC

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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OF THE OREGON COUNTRY
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FIELD TRIPS: Usually one per month, via private car, caravan or chartered bus.
GEOLOGY SEMINARS: Third Wednesday, except June, July, August, 8:00 p.m. Room S17 in Cramer Hall, PSU.LIBRARY: Room S7, open 7:30 p.m. prior to evening meeting.
PROGRAMS: Evenings: Second and Fourth Fridays each month, 8:00 p.m.Room 371, Cramer Hall, Portland State University, SW Broadway at Mill Street, Portland, Oregon.
Luncheons: First and third Fridays each month, except holidays, at noon, Standard Plaza Cafeteria, third floor, Room A, 1100 SW Sixth Ave. Portland, Oregon.
MEMBERSHIP: per year from January 1: Individual, $15.00, Family, $25.00, Junior (under 18), $6.00. Write or call Secretary for membership applications.
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VOLUME 59, NO. 2

CALENDAR OF ACTIVITIES FOR FEBRUARY, 1993

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 P.M.)

Feb. 12 "Hart Mountain Detachment Zone". Illustrated lecture by Dr. John Whitmer, GSOC Member.

Feb 26 Review of student field work in the Owyhee area. Portland State University Geology student whose work was assisted by funds from GSOC.

FRIDAY LUNCHEONS (Standard Plaza, 1100 SW 6th Avenue, Rooms A & B. Third Floor Cafeteria. Programs at 12:00 Noon).

Feb 5 "Sea, Mountains and Climate". Presented by Jack Capell, Meteorologist for KGW TV.

Feb. 19 "Mount Robson, Pride of the Canadian Rockies". Presentation by Evelyn Pratt, President, GSOC.

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.)

Wednesday Feb. 17 "Origin of Magmas". Illustrations and discussion pertaining to Plate Tectonics.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S-7. Open 7:00 - 8:00 P.M. prior to evening meetings.)

FIELD TRIP

Wednesday Feb. 3 OMNIMAX Theatre (Ring of Fire). 1945 SE Water Ave. Meet at the theatre at 12:45 P.M.. Presentation begins at 1:00 P.M. Free parking. Carpool if possible.

58th ANNUAL BANQUET

March 12 Be sure to mark your calendar for this special occasion - the Annual Banquet. See page 8 for details.

*********DUES ARE DUE JANUARY 1, 1993.....DUES ARE DUE JANUARY 1, 1993*********

58th ANNUAL BANQUET NOTICE

PLACE: Grand Ballroom , third floor, Smith Memorial Center, Portland State University

DATE: Friday, March 12, 1993. **PUT A MARK ON YOUR CALENDER!!!!!!!!!**

TIME: 5 :30 p.m. Grand Ballroom open for viewing exhibits and purchasing items from the sales table. Dinner at 6:30 p.m. sharp.

CHAIRPERSON: Lois Sato, Assistants: Susan Barrett and Roberta Walter.

SPEAKER: DR.Ellen Morris Bishop. Geologist, author, college professor. Her articles have appeared in the Oregonian, Earth magazine and other publications. Topic will be announced in March Newsletter and at meeting.

TICKETS: Ticket chairpersons, Freda and Virgil Scott, 8012 SE Ramona Street, Portland, Oregon 97207. Send a stamped, self-addressed envolope for the return tickets. Tickets will be available at all GSOC meetings. **PLEASE PURCHASE YOU TICKETS EARLY.** It will be a help to the Banquet Committe and you have a better choice of table spaces.

PRICE: Cost of the banquet ticckets is $14.00 each. Bring tickets to banquet: they will collected at the table.

PARKING: The 5th floor of the parking structure No. 1, 1872 SW Broadway, between SW Harrison and SW Hall Streets,has been reserved from 3:30 p.m. for GSOC members that are helping set up the banquet and for those who are putting in exhibits. BE SURE YOU PARK ON THE FIFTH FLOOR!!!!!!! **READ ON--if your coming early to work on the banquet or your setting up an exhibit before 5:30 you must call Rosemary Kenney at 221-0757 so your name is on the check list at the check station at the entrance to the parking structure.** Do not park in the spaces marked " Reserved" or "Handicapped". From the 5th floor structure, a short stairway leads to a foot - bridge across Broadway to the level of the banquet room in Smith Memorial Center.

BANQUET SALES TABLE NEEDS GOOD MATERIAL

Proceeds from the sales table at the Annual Banquet go to help meet expenses of the banquet. Please bring SALEABLE material that will attract purchasers and be treasured by them. No large, heavy specimens, please. Limit your material to hand specimens or smaller. Suggested materials: minerals, slices of agate, crystals, fossils, thundereggs, tumbled agates, geodes, worthwhile books on geology or natural history and jewelery. If you need help in transporting your material to the building, phome Archie Strong at 244-1488 or Harold and Patricia Moore at 254-0135.

PROVIDE A BANQUET EXHIBIT

Displays for the Annual Banquet on March 12 are eagerly solicited. Exhibits of rocks, minerals, fossils, books, pictures or any hobby collection (geological or otherwise) are suitable. Please call Charlene Holzwarth at 284-3444 so space can be reserved . If possible, bring your own lamps and extension cords. The Exhibit Room will be open for setting up your material by 3:30 in the afternoon of the banquet. Hand truck is available. If coming to set up before 5:30 you must call Rosemary Kenney at 221-0757 as your name must be on a list at the entrance to the parking structure. **No one gets to park early without your name on the list. Call Rosemary 221-0757.**

WELCOME NEW MEMBERS

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Portland, OR 97213 Phone 287-1708

Rose Reiter
908 SW Gaines, #24
Portland, OR 97201

John Teskey
13880 SW Burlwood Street
Beaverton, OR , Phone 641-7746

Carolyn Mattews & Bruce Nelson
4922 NE Going Street
Portland, OR

MEMORIAL

Hebert Slicker, retired Oregon State Geologist, friend and trip leader for some interesting GSOC trips

Mrs. Kenneth Phillips, GSOC, wife of Kenneth Phillips and a charter member of the Geological Society of the Oregon Country.

Margery Robertson, GSOC member. A faithful and helpful member of the organization. She attended many of the Hancock Field Station spring activities.

THE ANNUAL SPRING HANCOCK FIELD STATION RETREAT WILL BE ON MAY 14-17, FRIDAY THROUGH MONDAY. MORE INFORMATION IN THE MARCH AND APRIL NEWSLETTER. PUT THE DATES ON YOUR CALENDAR. ALL GSOCS INVITED.

COMPLETELY FRACTURED GEOLOGY

by

Ralph and Eveyln Pratt

This is will be the last of these, unless there are great numbers of requests (5 or 6?!) to continue this column. Do GSOC'ers like this sort of thing, or would you prefer that the space be used for more serious articles?

1. **Stoping:** past tense of "to lean over," as in "I was stoping down to pick up a rock."
2. **Modified Mercalli Scale**: a set of notes invented by an opera director for his singers to use.
3. **Marine terrace:** a deck outside of a naval officers' club.
4. **Foreshore**: (a) eighty years, as in "Foreshore and seven years ago..." (b) an affirmative exclamation, as in "I'll be there foreshore!"
5. **Syenite:** a poisonous chemical that is used to leach gold from its ore.
6. **Seif:** a metal box for storing valuables.
7. **Berm**: a painful skin condition, as in "I sat out in the sun too long and got a bad berm."
8. **Syncline**: an inclination to be evil.
9. **Saurischian:** the way you describe a spot that you want to scratch but can't because it hurts.
10. **Phyllite**: the kind of lo caloric beer made in Philadelphia

Answers to COMPLETELY FRACTURED GEOLOGY, will be found on page 11 .

COAL - BED METHANE GAS A NEW ENERGY SOURCE

by

Andy Corcoran, Past President GSOC

In the past few years, coal - bed methane production in the U.S. has skyrocketed, reaching about 340 billion cubic feet in 1991. According to the Chicago-based Gas Research Institute that is up from 200 bcf in 1990, and only 160 bcf in 1988. This year, production could go as high as 600 bcf, which is almost half of Canada's gas exports to the U.S. The sharp increase is the result of at least two things, notes John Shiry of the Financial Post, a Canadian journal - tax credits and technological advances. At the present time, coal-bed methane, a gas produced by drilling directly into a coal bed, is being produced commercially in the San Juan Basin of Colorado and New Mexico, and in the Warrior Basin in Alabama and Mississippi. The increased interest has caused exploration companies to study other areas in the country as possible future producers into a coal bed methane, including he Pacific Northwest.

Geologic and Hydrologic Criteria for Coal-bed Methane Production

All coal beds contain methane, which is a colorless, orderless gas produced by decomposing organic matter. It is the principal constituent of natural gas; however, methane from coal beds is generally higher quality. Whether methane is present in commercial quantities depends upon several geologic and hydrologic factors. The most important influence is the grade of the coal. Coal beds that have been subjected to considerable heat and pressure during the geologic past generally produce a higher grade of coal and can have a heat value of 14,000 BTUs (British Thermal Units) per pound or greater.

Another important criterion is whether the coal beds have remained water-saturated throughout the geologic past. When the coal is formed, methane gas is absorbed into the microscopic pores of the coal structure and is retained because of water in the coal bed. If the coal bed loses its water, the methane may then dissipate into adjacent rock layers or be lost into the atmosphere.

All coals have a natural set of fractures called "cleats". The face cleat can extend for miles in one direction. A well developed cleat system is important for commercial production of coal-bed methane. The fractures serves as "plumbing" through which the coal-gas and water can flow.

Coal-bed Methane Production

A coal-bed methane production well is similar to a natural gas production well. After a hole is drilled and cased with steel pipe, a submersible pump is placed in the bottom to remove coal-bed production water. Production water is residual water trapped in the cleat system soon after the coal was formed. The casing is perforated at the level of the coal beds to allow the water and methane to enter. As the water in the coal bed is depleted the gas fraction is released and flows to the wellhead by following the network of cleat channels. The methane is then collected at the surface and transported by pipeline in a manner similar to conventional natural gas.

Marketing and Use of Coal-bed Methane

Coal-bed methane is used primarily for electric power generation and space heating in residential and commercial buildings. Several natural gas pipe lines connect the production wells in the Warrior Basin to the eastern and western United States. These pipelines are an important factor in the marketing and use of commercial quantities of coal-bed methane. The Forest City Basin in Missouri, not yet in production, also has extensive natural gas pipelines to various parts of the country. These could be utilized once the drilling and delivery and development phase has been completed. The lack of pipelines in San Juan Basin in the southwestern United States has hampered production of the coal-bed methane reserves in that region, although there are now 1,100 wells in operation, and new pipelines are under construction.

Coal - bed Methane Potential in the Pacific Northwest

Coals that contain significant amounts of methane are found in two large areas of Western Washington: Puget Lowlands province southeast of Seattle and the Bellingham Basin near the Canadian border. All of the coal beds are associated with sedimentary rocks of Eocene age.

Puget Lowlands

Coal has been mined for more than 100 years in the Green River district of southern King County near the town of Black Diamond. The coals occur in the Puget Group, which is estimated to be at least 6,500 feet thick.

In 1911, a well drilled on he bank of the Green River encountered gas in a white sandstone at a depth of about 850 feet. According to records of the Washington Department of Conservation and Development, the well produced gas at pressures as high as 600 pounds per square foot. After the drill penetrated the sandstone it "blew in" and eventually filled with water through which gas bubbled furiously and flared to a height of 18 feet. The well became known as the "Flaming Geyser" and was still flaring gas as late as 1927. Between 1928 and 1983, fifteen other wells were drilled within 10 miles of the Flaming Geyser, but none was successful. However, a Voyager Petroleum well, drilled a few years ago with a modern mud log and gas analyzer recorded numerous methane "kicks", even though the tests indicated that it would not be sufficient to produce commercial amounts.

Bellingham Basin

In 1934 there were five producing gas wells in the Old North Bellingham Basin with a combined production of 7,183,000 cubic feet per day. The depth of these wells varied from 166 feet to as much as 1,100 feet. Although these shallow wells were very prolific, they declined rapidly and soon "watered out". Some minor production, however, was maintained for several years and served a small local market. Many more shallow gas wells were discovered while drilling for water and were used for domestic purposes.

The gas was thought to be from conventional marine sources and that oil might be present. A Washington State Geological Report written in 1934 attributed it, instead' to a <u>non-marine</u> series of Tertiary sediments consisting of sandstones, shales and coal beds believed to be more than 12,000 feet thick The coal beds were considered to be the only source rock present, which was clearly shown by the gas analysis: 93%-97% methane with no petroleum fractions. These old wells normally produced from Quaternary surficial deposits which lay directly on top of the Tertiary sequence. There is no doubt that the coal gas tapped in these shallow porous water-laden sands originally came from the older sedimentary sequence that lies below. The early wells were doomed to fail for many reasons, but they did demonstrate the amount of gas that could be generated by these coals.

Production Technology

In order to <u>enhance</u> methane production, the coal beds have to be fractured, creating additional passageways for the gas to migrate into the drill hole. The fracturing technique is similar to that used to stimulate oil and gas wells. Special fluids are forced down the well under high pressure which causes fracturing outward from the well holes. Once the well is cleaned up for production, gas migrates along these stress fractures.

Canadian and American engineers have recently developed new techniques for increasing gas production, particularly in areas where normal fracturing methods have not been successful. One of the most promising is a method called "Cavity stress relief." Water is circulated rapidly to wash out particles of coal. A room-sized cavity can be produced within the coal formation relatively quickly. Once the water circulation stops, and the hole is cleaned up, the natural underground tensions cause the region around the cavity to become honeycombed with stress fractures, releasing methane.

Fiscal Incentives for Coal-bed Methane Production

Several years ago, the Federal Government provided a tax credit of about 85 cents per thousand cubic feet of production as an incentive to develop "unconventional" energy sources. Although the tax credits are scheduled to expire for wells drilled after 1992, coal-bed methane has truly become "big business."

The subsidies have had the desired effect of driving technology development. Coal-bed methane is no longer an "unconventional" source of nature gas, at least in the two main producing basins.

Interest in the exploration and development of the coal-bed methane potential in Western Washington is continuing even if the tax credits have expired. It seems likely that the Pacific Northwest will have a new source of thermal energy to meet the ever-increasing demands of our industrial and domestic market sometime before the end of this decade.

References:

Quarterly Review of Methane from Coal Seams Technology, Feb. 1991,in " Western Washington", p. 3.

Missouri Department of Natural Resources. Outlook: Fall 1992, Forest City Basin - Potential For A new Energy Source?, Vol. 5, No.1.

The Financial Post, June 4, 1992, "Coal-Bed Methane Gas Explodes on U.S. Market"

CORRECT ANSWERS TO COMPLETELY FRACTURED GEOLOGY

1. **Stoping**: extraction of ore in an underground mine by working laterally into a vein.
2. **Modified Mercalli scale:** a scale expressing the amount of damage done, or intensities, of earthquakes expressed in Roman numerals.
3. **Marine terrace:** a broad, gently sloping platform that may be exposed at low tide.
4. **Foreshore**: zone that is regularly covered and uncovered by the rise and fall of the tides.
5. **Syenite**: a group of mafic rocks lacking quartz.
6. **Seif:** a large symmetrical ridge of sand parallel to the wind direction.
7. **Berm**: a platform of wave-deposited sediment that is flat or slopes slightly landward.
8. **Syncline**: a downward fold of rock strata.
9. **Suarischian**: a dinosaur with lizard-like hips, as opposed to ornithischian, a dinosaur with bird-like hips.
10. **Phyllite**: a wrinkled- and silky-looking metamorphic rock intermediate between slate and mica schist.

THE FISHER FORMATION

by

Rosemary Kenney, GSOC

The Fisher formation was named by Schenk, from Fisher Butte, 8 miles west of Eugene Oregon. The formation is approximately 1500 feet thick, composed of a series of gravels and sands, and fresh water clay, together with tuffs and agglomerates, entirely of continental origin. In some places the formation makes bold outcrops and in others, where the finer tuffs have weathered to clay, the hillside is covered by landslides. The formation rests unconformable upon upper Eocene sandstone (where the Spencer formation becomes gritty in the upper part and may grade upward into the Fisher) and unconformably beneath the sandstone of the Eugene formation. The contact with the Eugene formation is marked in places by the presence of much fossil wood. In places the Fisher formation rests on Eocene formation containing marine invertebrate fauna characteristic of the Cowlitz formation which is similar in age to the Spencer formation.

The age of the Fisher formation is told largely by the flora, for it appears to be non-marine in origin. Leaves collected near the base of the formation at Comstock by Sanborn decided that they are late Eocene, the terrestrial equivalent of the Spencer formation. The beds are known to extend southward where they appear to be continuous with the Calapooya volcanics and the Colestin formatlon. Zircon in tuffs along the southeast of the Cottage Grove reservoir yielded a reservior fission track age of 39 million years.

The Comstock flora from the lower portion of the Fisher formation of west central Oregon reflects a warm, moist, tropical climate found in association with marine late Eocene shallow water molluscs. The most common plant genera are the tropical Cinnamonum(camphorwood), which comprises nearly one-fourth of the total specimens, Aralia (aralia)Magnolia (magnolia), Astronium (cashew family), Lonchocarpus (legume family), and Allophylus (soapberry family).

The Goshen flora is typlcal of a low latitude, tropical to sub-tropical rain forest in an inland protected situation. The flora was deposited near sea level as is shown by association with marine molluscs. Of the 49 species represented, Meliosma (sabina family), Allophylus (soapberry) Nectandra (laurel family), Ficus (fig) are the most common. Tetracera (liana vine) and Aristolochina (liana vine) are among the most abundant genera.

Chaney and Sanborn (1933) regard the flora as late Eocene/early Oligocene interval. Brown (1959) regards the Goshen flora as late Oligocene and correlative with the Rujada flora.

1.The subtropical character of the Goshen flora marks it as definitely of older Tertiary age; it is made up of genera and families which are common in the Cretaceous and Eocene of North America and many other parts of the world, and which are rare or absent in beds of younger than the upper Oligocene to lower Miocene. Its climatic implications indicate a relationship with Eocene rather than with Oligocene marine faunas."

2The Goshen flora shows its closest relationship to the Wilcox flora of the southeastern U.S., which is of lower Eocene age. Situated much nearer the neotropical source of Eocene distribution the southeastern U.S. would have been occupied by a flora from the south before it reached Oregon. The moderating effects of the climatic changes which appear to have been responsible for the northward movements of the flora during the early Tertiary would have been felt much sooner in the southwestern U.S. than in central Oregon. The younger age of the deposits containing the Goshen flora may, therefore, be due to the greater amount of time required for their migration to Oregon.

3.The Goshen flora shows a closer relatlon to the Eocene floras of Europe than to those of Oligocene age.

4.The stratigraphic position of the beds containing the Goshen flora are upper Eocene or lowermost Oligocene age.

As with all amphibians, the fragile nature of frog and toad skeletons makes them among the rarest of fossil vertebrates. An Oligocene Fisher formation locality near Goshen in Lane County periodically yields complete salamander remains in association with fossil leaves. A detailed description and illustrated paper by Van Frank (1955) deals with one such salamder, Paleotaricha oligoceniea. The skeleton is just under 5 inches long and occurs In an articulated condition in a remarkably well-preserved state

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##

A Mark Twain Comment On Geology*

Since my own day on the Mississippi, cut-offs have been made at Hurricane Island, at Island 100, at Napoleon, Arkansas, at Walnut Bend, and at Council Bend. These shortened the river, in the aggregate, 67 miles. In my own time a cut-off was made at American Bend, which shortened the river 10 miles or more.

Therefore, the Mississippi between Cairo and New Orleans was 1215 miles long 176 years ago. It was 1180 after the cut-off of 1722. It was 1040 after the American Bend cut-off. It has lost 67 miles since. Consequently, its length is only 973 miles at present.

Now, if I wanted to be one of those ponderous scientific people, and "let on" to prove what had occurred in the remote past by what had occurred in a given time in the recent past, or what will occur in the far future by what has occurred in late years, what an opportunity is here: Geology never had such a chance, nor such exact data to argue from! Nor "development of species," either! Glacial epochs are great things, but they are vague --vague. Please observe:

In the space of 176 years the Lower Mississippi has shortened itself 242 miles. That is an average of a trifle over one mile and a third per year. Therefore, any calm person, who is not blind or idiotic, can see that in the Old Oolitic Silurian Period, just a million years ago next November the lower Mississip River was upward of 1,300,000 miles long, and stuck out over the Gulf of Mexico like a fishing rod. And by the same token any person can see that the 742 years from now the Lower Mississippi will be only a mile and three-quarters long, and Cario and New Orleans will have joined their streets together, and be plodding comfortable along under the single mayor and mutual board of aldermen. There is something fascinating about science. One gets such wholesale returns of conecture out of such a trifling investment of fact.

*Taken from Life on the Mississippi. Article submitted by Andy Cocoran, GSOC.

DID YOU KNOW.

How Many Minerals Go Into A Computor?

It takes more than 33 elements to make a computor! Those vital computor ingredients are: aluminum, antimony, barite, beryllium, colbalt, columbium, copper, galium, germanium, gold, indium, iron, lanthanides, lithium, manganese, mercury, mica, quatz crystals, mercury, rhenium, selenium, silver, sytontium, tantalum, tellurium, tin, tungsten, vanadium, yttrium, zinc, zinc, and zirconium. And we can't forget the petroleum industry's role in the computor----many of the components noted above are housed in plastic.

From the Bulletin of the
Northwest Mining Association,
Fall, 1991

MAR 93

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FIELD TRIPS: Usually one per month, via private car, caravan or chartered bus.
GEOLOGY SEMINARS: Third Wednesday, except June, July, August, 8:00 p.m. Room S17 in Cramer Hall, PSU. LIBRARY:Room S7, open 7:30 p.m. prior to evening meeting.
PROGRAMS: Evenings: Second and Fourth Fridays EACH MONTH, 8:00 p.m.. Room 371, Cramer Hall, Portland State University, SW Broadway at Mill Street, Portland, Oregon.
LUNCHEONS: First and third Fridays each month, except holidays. at noon, Standard Plaza Cafeteria, third floor, Room A, 1100 SW Sixth Ave. Portland, Oregon.
MEMBERSHIP: per year from January 1: Individual, $15.00, Family, $25.00, Junior (under 18) $6.00. Write or call Secretary for membership applications.
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VOLUME 59, NO. Mar. 23

CALENDER OF ACTIVITIES FOR MARCH, 1993

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00P.M.)

Mar.12 58th ANNUAL BANQUET. Grand Ballroom, Smith Memorial Center, Portland State University. . Speaker: **Dr. Ellen Morris Bishop**, Geologist, author and college professor. Published articles in the Oregonian under title of Time/Travel and EARTH magazine. The title of her presentation is TRACKING THE ARC CONTINUNING THE DISCOVERY OF EASTERN OREGON'S PAST.

Mar. 26 "Mount Robson, Pride of the Canadian Rockies". Slide presentation by Evelyn Pratt, Past President, GSOC.

FRIDAY LUNCHEONS (Staandard Plaza, 1100 SE 6th Avenue, Rooms A & B. Third Floor Cafeteria. Programs at 12:00 noon.

Mar. 5 Plate Tectonics, Earthquakes and Volcanoes. Speaker, Don Barr, Past Pres. GSOC

Mar. 19 Earthquake --Are you prepared? Speaker, Vern Cope. "The Oregon Earthquake Handbook."

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.)

Mar. 17, Wednesday. "Geology of Minnesota". Illustrations and discussion pertaining to general geology of the of Minnesota. Seminars lead by Richard Bartels, geologist.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S-7. Open 7:00 - 8:00 P.M. prior to evening meetings.

FIELD TRIP

Apr.17 Lincoln City to Tillamook. LEADER: Dr. Paul Hammond. Travel by car. Meet at Shilo Inn, Lincoln City at 9:00 A.M. More information in the April .

May 14-17 Hancock Field Station Retreat. We'll review the geology of this area, view a great flower display , happy hour each afternoon and enjoy good companionship. Set these dates aside. More information in A pril Newsletter.

Wed. 3/24 OMNIMAX Theater (Ring of Fire; ends 3/31). 1945 SE Water St. Meet 6:30 PM for 7 PM show. Park free.

CURRENT RESEARCH ON EOCENE CONIFERS AT REPUBLIC, WASHINGTON

by

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&

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The fossil beds in and near Republic, in western Ferry County, are known for their superbly preserved leaves, flowers, fish, and insects. (See Washington Geologic Newsletter, v. 14, no. 4; Washington Geology, v. 19, no. 3.) These middle Eocene deposits also contain a remarkably diverse assemblage of fossil conifers. Many of these forms are the 49-m.y.-old ancestors of conifers that are now native only to China and Japan.

The fossils of the Republic upland forest include many of the earliest and best-documented records of Abies (true fir), Picea (spruce), Tsuga (hemlock), Thuja (arborvitae), and Chamaecyparis (false cedar), as well as such currently exotic conifers as Amentotaxus (Chinese yew), Sciadopitys (umbrella pine), and Pseudolarix (Chinese golden larch). The last three Asian genera are now extinct in North America. Five families of conifers occur in the Republic flora: Ginkgoaceae (ginkgo), Taxaceae (yew), Taxodiaceae (redwood), Pinaceae (pine), and Cupressaceae (cypress). A muitivariate analysis of leaves (dicotyledonous plants) led Wolfe and Wehr (1991) to conclude that the average mean annual temperature was about 10°C, which falls within a climate termed microthermal, that is, where the mean annual temperature is less than 13°C.

In contrast, fossils of somewhat older forests in the Puget Lowland record only two conifer families: redwood and cypress. The Eocene Chuckanut Formation contains remains of three genera of the redwood family, Metasequoia (dawn redwood), Sequoia (redwood), and Glyptostrobus (Chinese water pine). The cypress family is represented by only one genus, Mesocyparis, which is extinct. Also present in this coastal forest, recorded in the Chuckanut Formation near Bellingham and in the approximately contemporaneous Swauk Formation near Blewett Pass, are palm fronds and fossil ferns representing genera (Danae, Pteris, Cyathea, and Athyrium) (Pabst, 1968) that are today confined to Central America and the Southern Hemisphere. None of these fern or palm taxa is known in the Republic flora.

The fossil record is beginning to show that at least some conifer genera first evolved in paleoclimates similar to those in which they live today. The geologic history of Abies suggests that since its early appearance in the microthermal forests of the Okanogan Highlands (at Repubic and at Princeton, B.C.), it has had continuous confinement to upland temperate forests. The macroscopic fossil records for Tsuga and Picea suggest a similarly restricted climatic history. On the other hand, among the other pinaceous genera, Pinus, Keteleeria, and Pseudolarix have well-documented pre-middle Eocene histories in wider climatic ranges. Pseudolarix is known from older sedimentary rocks, the late Paleocene-early Eocene Golden Valley Formation of North Dakota, where it appears to have been part of a lowland flora that was subtropical (Gooch, 1992). Additionally, in contrast to its present restriction to 2,000- to 7,000-ft elevations from Alaska to northern California, Chamaecyparis is well documented in Eocene lowland coastal subtropical forests.

One troublesome aspect of conifer studies is the fact that fossil pinaceous seeds are easily misidentified, particularly if they are not well preserved or if only the non-seed-bearing side is exposed. Small winged seeds of Pinus are commonly confused with those of Picea. The winged seeds of Tsuga, Larix, Pseudotsuga, and Pseudolarix are often mistaken for each other. Because distinguishing conifer seeds is so difficult, the literature contains many instances of misassignments (e.g., Axelrod, 1987). This can lead to naming more genera or species than might be justifiable if the gradations of winged seed features within a population were known. (See examples of seeds, Plate 1.)

Only recently has a detailed and more satisfactory key to pinaceous winged seeds been available (Wolfe and Schorn, 1990). The many specimens of these seeds in the Republic lake bed strata promise to help clarify affinities and allow refinement of generic or specific characters.

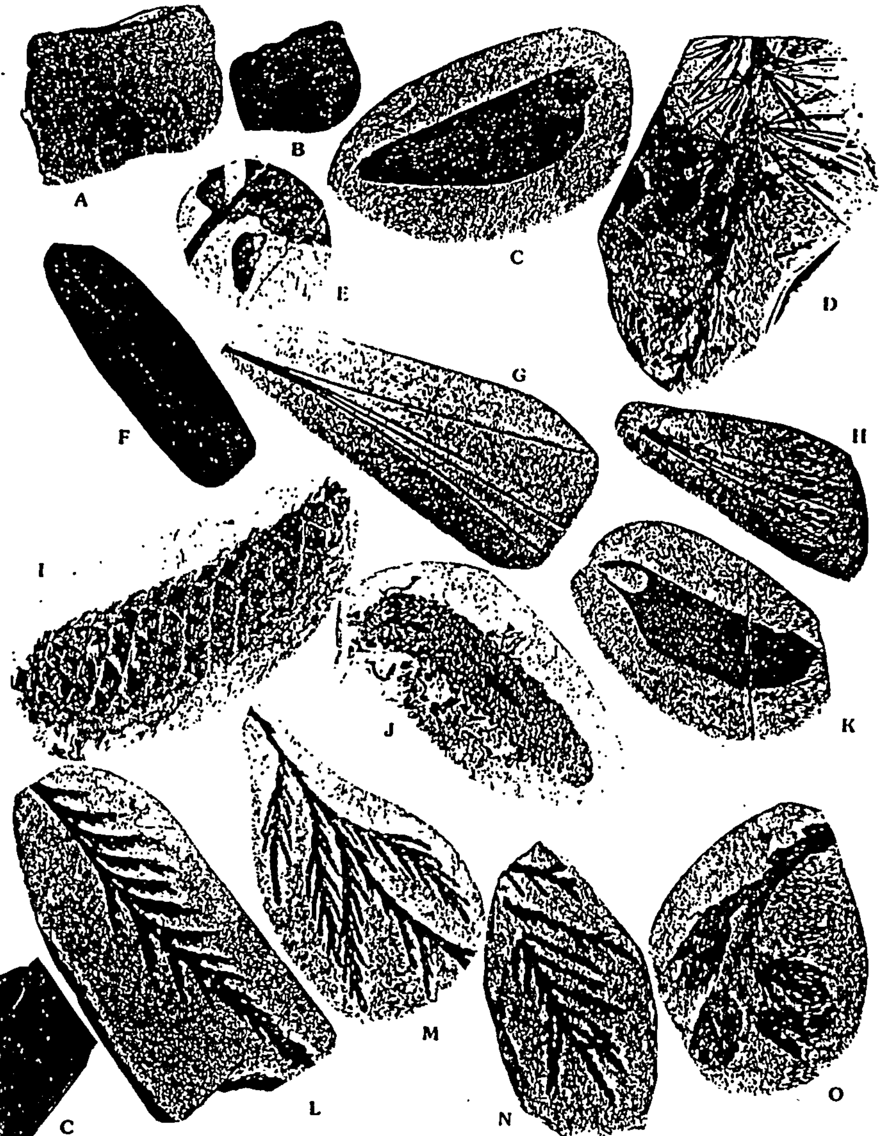
Fossil foliage of the cypress family has traditionally been hard to sort out. An historic example of the problem created by reliance on fossil cypress foliage is the story of Mesocyparis, which is found in the Chuckanut Formation. Newberry (1868) and later Pabst (1968), using the foliage characters, put this fossil in two different genera, but examination of distinctive cones (which are commonly attached to the foliage) shows that these fossils actually belong to a third, then new, genus (McIver and Basinger, 1987). Republics fossil cones are providing helpful keys to the conifer taxonomic puzzle. A Thuja cone found in 1977 confirms that arborvitae-like foliage in the fossil flora can safely be assigned to that genus. (Compare foliage and cones, Plate 2.)

Nancy Gooch of the Museum of Paleontology at the University of California, Berkeley, is studying a fossil conifer first found at Republic in 1937 by Roland Brown (U.S. Geological Survey). At that time Brown identified it as Picea, but three years later, he determined that the form is Pseudolarix. The winged seeds and cone scales of this genus were particularly important to correctly identifying its Eocene representative. This find became the first recognized fossil occurrence of the golden larch. Although the tree is now known from other localities, including Princeton, B.C. Republic has yielded more specimens of winged seeds and cone scales of this taxon than any other site in the world, providing a rare opportunity for examination of intraspecific variation (Gooch, 1992).

PLATE 1

A,B. Picea spp.winged seeds, x1.2
C,D, Pseudolarix sp.
C. winged seed, x2.5
D. Foliage, x1.2
E. Tsuga sp. winged seed (below leaf fragment.
F-K, Pinus spp.
F. two-needle foliage, x1.2
G. four-needle foliage, x1
H. five-needle foliage, x1
I. cone, x6
J. pollen cone, x1.2
K. hard pine seed wing, x1.75
L,M. Chamaecyparis sp. foliage
N,O. Thuja sp.
N. foliage, x1.3
O. Cones, x2

Photos by Alan Yen, scale approximate



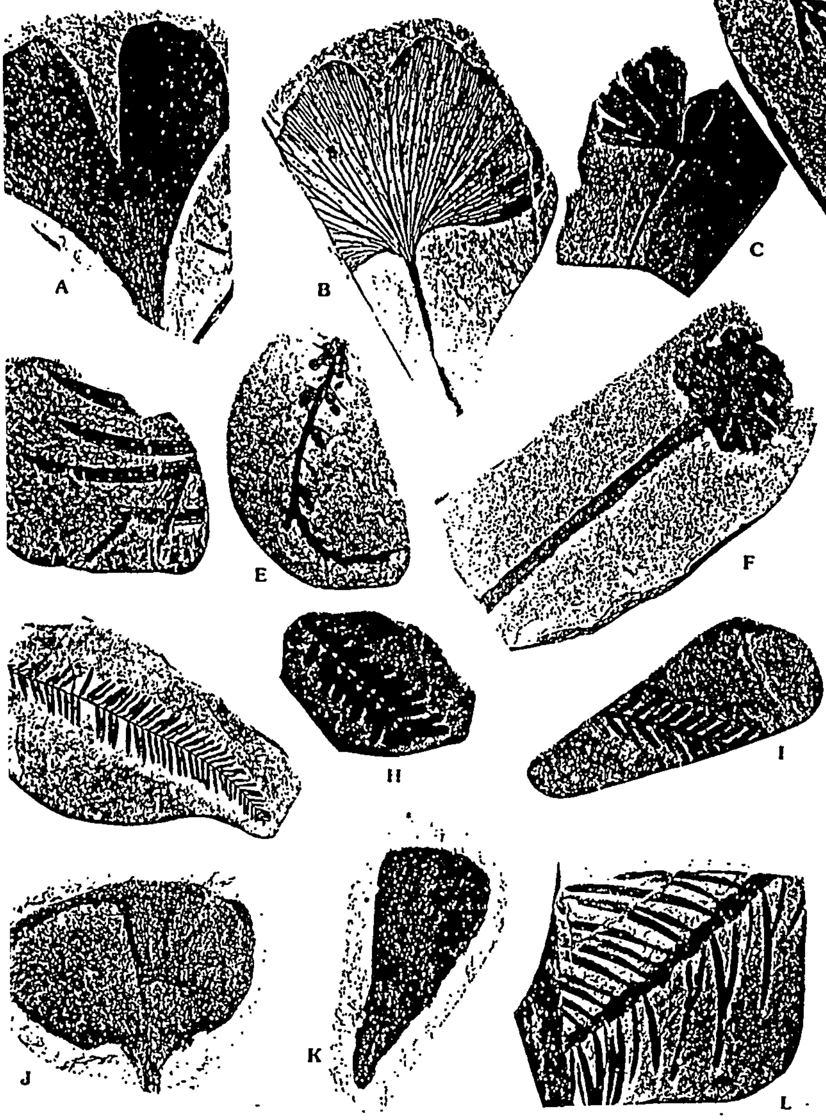


PLATE 2

A,B,C. a coniferophyte, Ginkgo sp. x1.
D. Amentotaxus sp. foliage
E-H Metasequoia sp.
E. pollen cone, x1.2
F. seed (female) cone, x2
G,H foliage, x1.2, x2 respectively
I. Sequoia sp. foliage, 1.2
J,K. Abies milleri
J. cone scale, x1.3
K. winged seed,x2
L. stem with needles, x1.5

Photos by Alan Yen:scale approximate

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A multidisciplinary approach to the geologic history of Tsuga is under way by University of Washington palynologist Estella Leopold, her students Cindy Updegrave and Katie Maier, and paleobotanists Wehr and Schorn. Work to date on the pollen and winged seeds suggests that this genus may have originated in the Eocene Okanogan highlands. The Thuja cone also assists in determining what some of the poorly preserved Thuja-like pollen might have come from. Samples from a locality known as One Mile Creek, in the Allenby Formation in British Columbia, which is of the same age as the Republic rocks, are yielding some well-preserved pollen that is confirming the presence of genera identified by macrofossils as well as hinting at others not yet found. These samples are also helping the work at Republic by offering excellent material for comparison.

Republic's fossils are also helping to change an old paleobotanical practice of identifying ancient plants to fit a preconceived paleoenvironment. Berry (1935) noted "It seems that Thuja fits into my picture of the environmental conditions better than Libocedrus." This thinking has led to some strained reconstructions of fossil forest floras, such as Chaney's redwood forest (Chaney, 1925), which consisted of trees assigned to genera that would be found in an equivalent modern forest. The "redwood" was actually Metasequoia whose foliage and cones are easily distinguished from Sequoia, and the paleoecological models based on this erroneous identification were therefore flawed. The amount of material available to Berry and Chaney was significantly less than is now known, and diagnostic techniques seem primitive in comparison to what is possible today. Work on the Republic material is directed toward refining both taxonomy and techniques.

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To visit the Republlc site, first check in wlth the Stonerose Interpretive Center, just downhlll from the site near the clty park. After registering at the Center, visitors can dig at the site Tuesday-Sunday, 10:00 a.m.-5:00 p.m. Bring a cold chisel and hammer. Take your finds to the Center for Identlflcatlon.

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OREGON MUSEUM OF SCIENCE AND INDUSTRY

(better known as OMSI)
Compiled by
John Eliot Allen

OMSI is located at 1945 S.E. Water Avenue, Portland, 97214-3354. Phone numbers: 797-4000 (Main number); 797-5600 (advance ticket sales), 1-800-957-6654 (long distance calls) 797-OMSI (hours, rates and events by recording). Seven other numbers give recordings on various theatres. shows, and events,etc.

Summer hours (from Memorial Day to Labor Day) Saturday through Wednesday 9:30 am to 7 pm, Thursday and Friday 9:30 am to 5:30 pm. Winter hours, Saturday through Wednesday 9:30 am to 5:30 Thursday and Friday 9:30 am to 9 pm.

Basic admission is $6.50 for adults, $4.00 for children and $5.50 for senior citizens. The 70mm supermovie OMNIMAX (Sky separate outside entrance) costs the same. The planetarim (Sky Theatre) is $4, $3 and $3.50. Combination tickets reduce total cost.

Annual membersnips range from $50 for single to $85 for families, and give free museum admission with reduced prices for OMNIMAX, Sky Theater (planetarium) and Laser Light Show.

The museum was designed for 100,000 visitors a year, but recently has handled 600,000 visitors. In February of 1991, construction began on a new $40 million, 210,000 square feet facility at a new 18 1/2 acre site on the east bank of the Willamette River in downtown Portland, and opened with great fanfare on 18 October 1992. It is expected that annual visitors will exceed a million in 1993.

This remarkable "next generation" museum is three times the size of the old one and contains, beside the $6 million OMNIMAX and a new $2 million planetarium called Sky Theater, 5 exhibit halls ranging from 6,000 to 14,000 square feet, a restaurant, science store,, and, importantly, 800 spaces for parking in 2 lots. The renovated power plant building and the new additions give a feeling of openness and spaciousness competely lacking in the old OMSI building. OMSI can easily accomodate parties of up to 4,300 for conventions, weddings, etc. The annual banquet and meeting of the Portland Chapter of Sigma Xi will be held at OMSI.

In its near 50-year long history, OMSI has never received any government subsidies. It has always operated on memberships, sales, admissions and private donations. The fund drive for the new facility was kicked off by the donation by Portland General Electric Company of its 82-year old steam generating station and the land around it. Several trusts and the National Science Foundation then each donated more than a million dollars, and many thousand private contributors gave from $25 to $100 each.

The goal of OMSI has alway been to draw television's non-thinking viewers and observers deeper into science, giving them an enjoyable eduacational experience as it makes them think. Classes and summer camps have always been parts of OMSI's program and the museum is now becoming more "customer-service oriented".

As much as possible, the exhibits in the six large areas of earth science, life science, information science, physical science, and changing or visiting exhibits are "interactive", which is now considered to be much more than just pushing a button. Visitors can design and try out model trucks, windmills and pape r airplanes using four wind tunnels. They can see how their own building designs react to simulated earthquakes with vibrating shaking tables. Both children and adults can load and unload simulated cargo with a 1-ton 15-foot steel crane. In the electronics lab, they can construct circuits and radios. In another area they can make their own holograms. Many of the exhibits in the old building have been renovated and moved to the new facility, but overall, 70 percent of the exhibits are new.

The new human embryology exhibit, when finished will be the most extensive of its kind in the world. It will display between 40 and 50 human embryo and fetus specimens (from old European university collections), representing different stages of developement in the womb. In the new information science area, visitors can beam messages into space with a 20 foot tower, experiment with video telephones and learn how satellites work. They will be able to walk about with cellular phones in different simulate geographic areas.

The travelling exhibits, now being cooperatively built and shown by a consortium of seven museums, occupy their own area, and they're what makes the new OMSI a world-class museum. Each exhibit may cost from $100,000 to $1,000,000 (cost of "Star Trek", and the last built by OMSI). Some of those now on tour include Super Heros: a High-Tech Adventure, Nature's Fury, Designer Genes and 1492: Two Worlds of Science., Science Circus will arrive soon.

The 330-seat OMNIMAX Theater is a five-story domed screen with a 6-channel state-of-the-art audio system that surrounds you as you experience the world's latest 70 mm film cinematic technology. The first showing is "Ring of Fire", illustrating the destructive volcanic activity of the Pacific Rim The new 200-seat Murdock Sky Theater's first showing is "Cosmic Fury", a 35-minute show narrated by James DePriest, the director of the Oregon Symphony.

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OREGON TRAIL

by

Rosemary Kenney, Past President, GSOC

The Oregon Trail is celebrating its 150th anniversary in 1992 and 1993. It has been said that there is no record in the world's history when so many people traveled so long a distance in such a short time. Some came to Oregon "because it was there", others to seek a more healthy place to live, and some left their homes to escape the law; but most came for free land.

The Trail was not surveyed or built under auspices of the government but originated with the spontaneous use of travelers. No transit ever located a foot of it; no level established its grades; no engineer sought out the fords or built any bridges or surveyed the mountain passes. There was no grading to speak of nor any attempt at metalling the road bed. The quality of this highway seems extraordinary.

Nearly all roads started out as trails - for game, for Indians, military, wagon trains or cattle. They are located where they are for convenience and not by chance. The first people to cross the plains generally traveled the path of least resistance, often sticking to hilltops or ridges or river bottoms where the ground was less rugged and the travel a little faster.

The Oregon Trail was used from early 1830 to mid-1870's, although peak use was 1842 to 1860. 50,000 people traveled over it in 1852. It covers over 2,000 miles from Independence, Missouri, to Oregon City, Oregon, and traverses six states: from Independence, Missouri, across northeast corner of Kansas, along the Big Blue River into Nebraska, where it followed the Platt River, then crossed the North Platt River across Wyoming to the Sweet River and South Pass. At Fort Bridger, the trail headed north to Fort Hall, Idaho, followed the Snake River to 3-Island Crossing to Fort Boise, Farewell Bend, Baker City, Oregon, over the Blue Mountains to the Columbia River and The Dalles, where the people either rafted down the Columbia River or took the Barlow Road to Oregon City.

It was not just one trail leading west but several trails: Oregon Trail, California Trail, Santa Fe Trail, Mormon Trail, Pony Express Trail, Overland Stage Road, all started at Independence, Missouri, and followed the same tracks before branching to different directions. Sometimes the Oregon Trail was one rut wide, sometimes five or six miles wide. The trip from Missouri to Oregon took four to five months, if they were lucky, with approximately twenty-three graves per mile. Most deaths were from cholera or accidents, less than one percent from Indian raids.

Geology played the most important part of where the Trail went. A shallow sea covered most of Kansas and Nebraska during Mississippian, Pennsylvanian and Permian Periods. This sea left behind layers of shale and limestone occasional coal. In the Cretaceous Period, chalk was deposited along with animal fossils. When the seas disappeared, there was deposition by wind and rivers, which built up an alluvial plain hundreds of feet deep. Then glaciers came down from the north, leaving clay, silt and large red quartzite boulders when they retreated. Winds came again and whipped up sediments of dust and sand into huge clouds forming vast blankets of loess and dunes of sand. The Platte River winds through this flat area, wide, shallow, and murky with sand. The river was difficult to ford because of its sandy bottom "Too thick to drink, too thin to plow." As the emigrants traveled west, the Trail began to rise. The Great Plains slope upward from 1500 feet above sea level in eastern Nebraska to more than 4000 feet in the western part.

When the Trail reached Wyoming, to the south lay the impenetrable walls of the Colorado Rockies; to the north lay the forbidding mountains in Montana and Idaho. The "Wyoming Basin" provided a natural pass for the wagons to cross the backbone of the Rocky Mountains. After this Basin was discovered in 1824, it virtually opened up the west because now wagons could cross the Rockies. But west of South Pass, the land became more rugged and difficult.

In the Paleozoic Era, the Rocky Mountain states were part of a broad submerged shallow continental shelf, the western edge of the inland sea. Marine waters periodically transgressed over this shelf, depositing sandstone, shale and limestone. The Rocky Mountains were uplifted during late Cretaceous and early Tertiary Periods. There were volcanic eruptions of rhyolitic ash in Nevada and Utah; and the ash was carried by winds and deposited in Wyoming. The entire intermountain region has been arched upwards, causing rivers to down-cut their channels, sometimes cutting across mountains instead of flowing around them.

The Eastern Snake River Plain of Idaho, is underlain mostly by lava with only a local and thin cover of sedimentary material. It is a wide lowland, dotted in places by hills and trenched by canyons of the river and its tributaries.

The Western Snake River Plain trends northwest and differs from the Eastern Snake River Plain. It is a Basin and Range fault block valley that filled with white rhyolite ash, black basalt lava flows, lake bed and valley-fill sediments as it dropped between faults.

The Eastern Blue Mountains in Oregon were the second most rugged area of the Trail. The mountains consist of sedimentary and volcanic rocks that were deposited on dry land or in freshwater lakes on top of older rocks after they had moved across some unknown breadth of ocean and had become part of the continent. Most of the rocks were severly deformed by folding and faulting. Columbia River basalt is wide spread along the northern slope of the Blue Mountains and form the range between Pendeleton and LaGrande. Block faulting has caused the rivers to carve narrow valleys in the uplifted resistant rocks.

After descending the Blue Mountains of Oregon, traveling was easier to The Dalles across the Deschutes-Umatilla Plateau which consists of beds of conglomerates, tuffaceous sedimentary rocks, sand, gravel, and silt overlying the Columbia River Basalt groups.

After the emigrants reached The Dalles, they still had the Cascades to cross before reaching the Willamette Valley. The final 100 miles was the most difficult and dangerous segment of their journey. From The Dalles, the Barlow Road went south across open and rolling country to Tygh Yalley, west along Barlow Creek to Summit Meadows, Laurel Hill, Sandy River, then on to Oregon City.

The Cascades originated as a volcanic arc which extended across continental and oceanic crust and may have been generated by subduction of the Pacific Plate. The present topography is the result of volcanic upbuilding. Sam Barlow stated that "God did not create a mountain that a man could not go over or around it." He blazed a road that had long steep climbs, steeper descends, huge boulders, towering trees, and swift rivers to ford. The most difficult hill on the 2,000 mile Trail was Laurel Hill, on the western slope of Mt. Hood. It was a 60% grade down. Rope snubs and tree drags were used to lower wagons and oxen the 300-foot drop. For many years the Barlow Road was a one-way road, all travel went west because no one was foolhardy enough to attempt to ascend Big and Little Laurel Hills with wagons.

They finally reached Oregon City. Some wagons had been on the Trail for nine months. The 300,000 people who made it were a hardy group. Just imagine cramming up to a ton and a half of worldly goods into a 10x4 foot canvas-topped wagon and starting out to the unknown. Travelers faced the unpredictable weather, violent winds, quicksands, floods, dust, and disease. Geology made it better or worse.

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1992 President's Field Trip
Wednesday, September 14, 1992
Coos Bay Region

by Dr. Ruth Keen

On this Wednesday morning we met Dr. Don Stensland at the Coos Bay Community College for a short session of color slides and lecture on the geology of the region we were to visit that day. Dr. Stensland is the most enthusiastic geologist. He teaches geology at the college and leads many field trips.

From there we went to Coos Bay Beaches: Charlston, Bastendorff, Sunset, Shore Acres, and North, Middle and South Cove.

This brought back many memories to me, because I grew up at Marshfield (now Coos Bay) and graduated from Marshfield High School.

My family moved from Oklahoma to Marshfield in 1910. We stayed in Portland for a month, then my father went by sea to Marshfield on the Breakwater. My mother would not go on the ocean. After my father found a house for us to live in, my mother, brother and I went by train to Drain, then by six horse stage coach to Scottsberg. When we climbed the steep roads over the high coast range the men got out and walked. They left my mother, brother and me to bounce around in the stage coach.

From Scottsberg we went down the Umpqua River on a river launch to Gardiner. At Gardiner there were no wharfs, so we transferred to a row boat, but it could not land either. Some of the men put on hip boots and carried each passenger ashore. My mother did not want to be carried, so she said to give her a pair of boots and she would wade ashore. But a man picked her up anyway and carried her ashore.

The next morning we somehow crossed the Umpqua River . We went by beach wagon that had wide wheels, along the wet sand beach at low tide to North Slough on Coos Bay. From there we took another launch to Marshfield where my father met us. My mother said she was not leaving until there was a train, and we did not. The railroad arrived my freshman year in high school.

When I first saw the Coos Bay beaches, an old growth Sitka Spruce forest came all the way to the sand of the beaches, and the Louis Simpsons lived at Shore Acres.

I never learned about the fascinating geology that surrounds those beaches until much later in college. Here there are text book examples of marine terraces, anticlines, synclines, faults, unconformities, conglomerates, sandstones, mudstones, fossils and most of the section of the geologic column from the Eocene to present. This is what we went to see under the direction of Dr. Stensland.

We spent most of the afternoon on the Whisky Run terrace that was formed approximately 83,000 years ago. This is the lowest terrace in the Coos bay area except for the one that is forming now. The elevations of all the terraces vary from place to place as the uplift during the Pleistocene was uneven.

For the geologic column of this area see Fourth Edition of the Geology of Oregon by Elizabeth L. Orr, William N. Orr, and Ewart M. Baldwin page 175.

The rocks at Sunset Bay are Lower Coaledo. At minus tides one can walk out to the island.

At Shore Acres, tipped beds of sandstone and mudstone are truncated and capped by flat lying upper Pleistocene beds. This is the major unconformity with about 60 million years missing.

Another outstanding feature at Shore Acres is the large round concretions. These occur in rows along the bedding plains. They are locally called cannon balls. Here Dr. Stensland told us about salt weathering which is the main force in exposing these concretions. From the salt water crystals crystals form between the grains of sandstone and press them apart. When the crystals dissolve the loosened grains fall away.

We observed a number of faults at this stop.

From Shore Acres we started toward the Coves, but stopped where a group of small islands were covered with sea lions that were calling continuously. It was high tide so we could see the many turbidity channels that are conspicuous there at low tide. At a beach near here I saw an area of sand that was all red garnets.

We continued on to the North, Middle and South Coves. These are in the Coaledo Formation. I collected a good fossil sand dollar at ocean level at South Cove many years ago. I still have it. At the foot of the cliff at either Middle or South Cove there used to be piles of concretions that looked like baseballs. They may have been picked up by now. Most of these concretions contain fossils. Sand dollars are common in this formation. From one of the view points looking south we can see several of the higher and older marine terraces. We did not have time to hike down to the beaches below these coves.

On the way back some of us walked out to Yokam Point where we observed a small seam of coal. This is Lower Coaledo . Coal occurs in the Upper and Lower Coaledo but not in the Middle. During the Upper Eocene when this was formed the coast was low and swampy with lagoons.

We did a quick drive around Bastendorff Beach where the Bastendorff Formation is found. Beyond this beach is Tunnel Point Formation. We did not stop to see the Empire Formation at Fossil Point. Here this formation is a coarse conglomerate and completely filled with fossil clams and snails. When I was working on my Masters Degree at the University of Oregon, I collected and identified twenty some species from this location.

One summer I attended the summer session at the University of Oregon marine Biological Station at Charleston. Under Dr. Earl Packard we studied marine shelles and fossils. Dr. Packard had located a fossil whale near Fossil Point. It was only exposed at low tide. We worked to excavate it but most had to be left. I have near heard whether any more work was ever done on it. By now it has probably weathered away.

I would like to tell you a few other things about the early days in Marshfield. The town was well named. About 1912 when we lived on Central Avenue where the Myrtle Arms Apartment is now, a slough ran behind our house. This is where I learned to row a boat.

To fill these marshes sand and mud was dredged up from the bay and spread out over the marsh. It was a good place to pick up shells of the clams and snails that came with the dredged sand and mud. It was weeks before we could walk on it as it was almost like quick sand. No one thought of the ecology that was being disturbed.

For many years the road to the beaches was two planks on each side over the sand. If you got off you were stuck. This is where I learned to drive a car.

Marshfield and North Bend were always rivals. When Marshfield changed its name to Coos Bay, it was hoped that North Bend would join in. It did not

All the marine terraces contain gold, platinum, magnatite, garnets and other minerals. Along in the twenties prospectors were working at extracting the gold, usually by hydraulic mining methods. They were unhappy when a white mineral stayed behind with the gold. It was hard to get rid of it. That mineral was planinum. During this time i remember seeing a man working at a small hydraulic setup on the Whiskey Run Terrace near Charleston.

Thanks to Dr. Don Stensland for a wonderful day at the Coos Bay beaches.

APPLICATION FOR MEMBERSHIP
THE GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

Date ________

Name ____________________ Spouse ____________________
Children under age 18 ____________________

Address ____________________ Phone ____________
City ____________ State ________ Zip ________
Occupation ____________________
Geological interests and hobbies ____________________
Individual $15.00 ____________ Family $25.00 ____________
Junior, under age 18, not included with family membership $6.00 ________

Make Check payable to: The Geological Society of the Oregon Country
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APR 93

THE GEOLOGICAL NEWSLETTER

GSOC

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

GEOLOGICAL SOCIETY
OF THE OREGON COUNTRY
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PORTLAND, OR 97207

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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1993-1994 ADMINISTRATION

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ACTIVITIES

ANNUAL EVENTS: President's Field Trip-summer, Picnic-August,Banquet-March, Annual Meeting-February.
FIELD TRIPS: Usually one per month, via private car, caravan or chartered bus.
GEOLOGY SEMINARS: Third Wednesday, except June, July, August. 8:00 pm, Rm. S17, in Cramer Hall, PSU. Library: Room S7, Open 7:30 P.M. prior to meetings.
PROGRAMS: Evenings: Second and Fourth Fridays each month, 8:00pm, Rm. 371, Cramer Hall, PSU, SW Broadway at SW Mill street, Portland, Oregon.
LUNCHEONS: First and Third Fridays each month, except holidays at noon. Bank of California Tower, 707 SW Washington, 4th floor Cafeteria, California Room, Portland, Oregon
MEMBERSHIP: per year from January 1: Individual, $15.00, Family, $25.00, Junior (under 18) $6.00. Write or call Secretary for membership applications.
PUBLICATIONS: THE GEOLOGICAL NEWSLETTER (ISSN 0270 5451) published monthly and mailed to each member. Subscriptions available to libraries and organizations at $10.00 a year. Individual subscriptions at $13.00 a year. Single copies $1.00. Order from Geological Society of the Oregon Country, P.O.Box 907, Portland, Oregon.
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THE GEOLOGICAL NEWSLETTER

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VOLUME 59, NO. 4

CALENDAR OF ACTIVITIES FOR APRIL, 1993

FRIDAY NIGHT LECTURES (Cramer Hall. PSU, Room 371, 8:00 P.M.)

April 9 "Galapagos Islands - Following Darwin's Footsteps." Illustrated lecture by Bernie Torrey, photographer. Will cover Quito, Capitol of Ecuador.

April 23 "Ethiopia and the Great Rift." Illustrated lecture by Bill Walters, retired civil engineer, US. government.

FRIDAY LUNCHES (Bank of California Tower, 707 SW Washington, 4th floor. Social Hr cafeteria 11:30AM. Program in California Rm. at 12:00)

April 2 "Railroading in Alaska." Presented by Frank Dennis, GSOC member.

April 16 "Wetlands and Society." Speaker, John Marshall, DOGAMI.

GEOLOGY SEMINAR (Cramer Hall, PSU , Room S - 17, 8:00 P.M.)

Wednesday April 21 "Glacial Geology of Minnesota." Illustrations and discussion led by Richard Bartels.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S - 7. Open 7:00 - 8:00 P.M. prior to evening meetings).

FIELD TRIP

April 17 *Lincoln City to Tillamook* led by **Dr. Paul Hammond.** Travel by car. Meet at Shilo Inn, Lincoln City, 9:00AM.

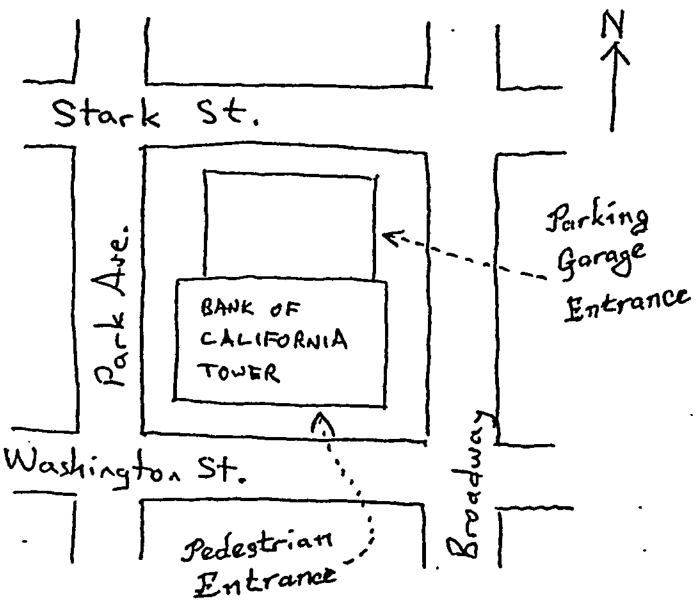
BE prepared for weather. Bring lunch, thermos(coffee, tea, milk etc), rain gear, cameras, and what ever else you might need for this trip. There will be 9 stops on this trip. When the trip is over we'll head back to the Shilo at Lincoln City--getting there between 4:00 and 4:30 pm.

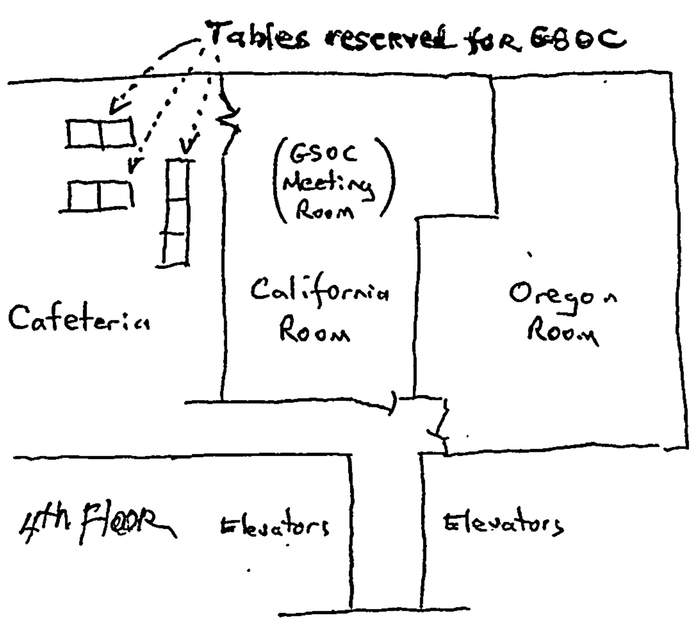
May 14-17 Hancock Field Station Retreat. We'll review the geology of this area, view a great flower display, happy hour each afternoon and enjoy good companionship. Set these dates aside. See page 26 for details.

GSOC NOON LUNCHEONS
NEW MEETING ROOM AND BUILDING STARTING APRIL 2, 1993

Bank of California Tower, 707 SW Washington Street, fouth floor Cafeteria and California Room. First and third Fridays each month: "social meeting" at 11:30 in cafeteria, program at noon in the California Room. (We are requested NOT to bring food or drinks into the California Room)

SEE MAPS BELOW





MEMORIAL

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Marjorie June Mason 1901-1993

Iva Lavel 1993

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Mr. and Mrs. Nicholas Lehmann
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Portland, OR 97211
245-34711

CORRECECTIONS

1992 Index, Page 2
-President's Field Trip, Reports by:
Change Evelyn Pratt y to Elinore Olson.
-Under Authors Add:
Olson, Elinore: President's Field Trip , Day 1--------66

GEOLOGY DEPARTMENT PORTLAND STATE UNIVERSITY, PORTLAND, OREGON 97207-0751

Memo To: Friends of the PSU Geology Department

From: Geology Faculty and Students

The Geology Department at Portland State University is now in the process of developing a computer lab for our students in the Department's undergraduate and graduate programs. We are asking for contributions from students, alumni, and private industry to match the Departments efforts to establish this new lab in Cramer Hall, details outlined below. This effort represents a major undertaking for the Department, at a time of decreasing State and University resources. However, the need for a computer lab is critical to our goals of geoscience education and professional development in the Portland Metro area.

Computers are now essential in our classroom teaching, course laboratory assignments, student projects and student thesis work in the Department. The student demand for computer literacy and familiarity with geologic application programs have greatly exceeded the few dedicated student computers and faculty offic\lab computors. Furthermore our advanced courses for graduate students and returning professionals require increasing computor support for ground water modeling, geologic database analysis, graphics presentation an computer-aided drafting/mapping (CAD,GIS,STRAT-LOG, etc.). In summary, we believe that an investment in a functional computer lab is critical to the educational development of our students, and to our on-going service to the professional communty.

The Department is remodeling the old Museum space on the ground floor in Crammer Hall around the corner from the the Department office to house the new computer lab. Department and student volunteers moved the specimen collections and central display cabinents to the new Museum of Natural History. Ondine Building on SW 6th and Hall, over the Christmas break. The remodeling of the lab should be completed by the end of the winter term. The computer lab is presently designed to accomodate 10 IBM computers, 2 Macintoshes and 2 digitizing CAD/GIS workstations. The Department will add to this minimum number of computers (13 new machines) as student use and resources increase in future years (up to 25 students) and for individual work on a drop-in basis (days and evenings).

The Geology Department is contributing $20,000 for the lab ($13,279 already committed) and is seeking matching suppotrt of $34,500 from outside sources. We will be sending out individual letters, making personal phone calls, and sponsoring an 'open lab' get-together with software demonstration to kick-off the fund raising for the new computer lab. Please contact Gene Pierson (Staff Geologist, (725-3377) or any of the Geology Department faculty support phone (725-3022) for additional information on planned hardware/software components, and (2) detailed budget of lab remodel and computer equipment.

We would greatly appreciate any contributions that you can make at this time for this very worthy cause. Please make checks payable to: Geology Development Fund, PSU Foundation, and mail to: Gene Pierson, Geology Department, Portland State University, Portland, Oregon 97207-0751. We intend to formally acknowledge all contributions, unless anonymity is requested. Thank you very much for assisting us in this endeavor.

+++

EDITOR NEEDS ARTICLES FOR THE NEWS LETTER. PLEASE SUBMIT ARTICLES YOU THINK WOULD BE OF INTEREST TO THE SOCIETY. MY SUPPLY IS RUNNING LOW

A table for the projector at the Noon Luncheons is needed. If have have one you don't anymore--donate it to GSOC. Call Clay Kelleher- 775-6263.

The U.S. Bureau of Mines valued processed materials made in the United States from nonfuel raw materials at $297 billion in 1991. U.S. mining of raw nonfuel minerals such as iron ore and stone totalled $ 31 billion, with recycled scrap materials adding $14 billion. Subsequent processing to form iron, steel, and cement resulted in domestic nonfuel mineral products totalling $297 billion. Present in every aspect of our lives, minerals and mineral-based materials are the life-blood of our industrialized economy.

HISTORY OF THE GEOLOGICAL SOCIETY OF THE OREGON COUNTRY
The First Fifty Years
1935 -1985
by
John Eliot Allen and Viola Oberson, Editors

A book titled "History of the Geological Society, The First Fifty Years" was planned by the Editors John Eliot Allen and Viola L. Oberson . The various chapters were assigned to some members of the Society. A completion data was set to correspond with the Societies 50th (Golden Anniversary). For a variety of reasons the book was not completed. The following article is an introduction to the book with background history of the Societies beginnings.

CHAPTER 1
INTRODUCTION

The Geological Society of the Oregon Country (familiarly known as "Geesock") is a unique institution in many ways. Its membership has always been dominantly non-professional and it has always been field-oriented with monthly field trips during much of the year. Many of the field trips have had road logs and extensive write-ups published in the Geological News Letter (later changed to Newsletter).

The Society has built up and maintained a voluminous library of geological publications on the Oregon Country and many books on earth sciences in general. It has conducted a twice-a-month evening meeting schedule with talks by members and visiting scientists . Many of these lectures were written up later and published in the Newsletter.

Luncheon meetings also have been held twice a month since the first year . The early luncheons were organized so that the "City

"Hall Boys" could discuss new theories and have rock speciemens identified. Leo F. Simon was chairman for many years in many different lunch rooms. Since 1971, with Laurette W. Kenney and Viola Oberson chairing the meetings for six year each, the luncheon attendence has grown from 60 to 90 persons.

The Society has also always had social events such as annual picnic held in August and a banquet in February or March. For many years the picnic was held in the crater of the cinder cone at Mount Tabor Park.

In 1971, president Albert R. Kenne y established the first ten-day "President's Campout", which has been held annually since then. Most of the "Special Publications" printed by the society were field guides and road logs for the trips taken on the campouts.

Also in 1971, the Past President's Panel (P 3) was organized by John Eliot Allen to serve as advisor and counselor to the Governing Board. It is made up of all past presidents and is chaired by the immediate past president of the Society. The meetings are held whenever there is a fifth Friday in a month. It can be a large meeting, for of, the 50 past presidents, 31 were alive in 1984. Of the fifty, only 11 are professional geologists.

During the excitement of the Mt. St. Helens eruption in 1980. the need for speakers on volcanism became so great that a "Speaker's Bureau was established, to give talks to the public.

Over the years, the society has sponsored or given classes in geology at the Oregon Museum of Science and Industry and elsewhere, and in recent years a regular bi-monthly Earth Study group has met on Thursday night.

More importantly, through the dedication and labor of a succession of 28 editors, the Society has published for fifty years almost without let-up, first a bi-monthly and later a monthly newsletter, without which this history would never have been written.

The results of scientific research by many young (and not so young) geologists have first seen the light of day in the Geological Newsletter. Contributions by the professional members are numerous throughout the history Society,. Articles on basic geology at abstracts of papers on Oregon
and helpful hints to the amateur geologist abound.

Present members would do well to brouse through the issues and study some of the early scientific articles; they will find many goodies. I did!

In the early 1930s, Dr. Edwin T. Hodge, professor of geology at Oregon State College in Corvallis, commuted the fifty miles to Portland once a week to teach a night class for the Extension Division of the Oregon System of Higher Education.

Early in 1935, the class decided to form a Geological Society of the Oregon Country. The first first Geoloqical Newsletter (v.1, n.1) published the names of the first officers of the Society: Dr. Hodge, president, Kenneth N. Phillips, vice-president, A.F. Pratt, secretary, and Lillian Neff, treasurer.

The first Consitittution (Apendix A), adopted April 15, gave the aims and objectives of the new Society as follows:
(1) To provide facilities for the members of the Society to study geology, particulary the geology of the Oregen Country.
(2) The establishement and maintenance of a library and museum of geological works, maps, and specimens.
(3) The encouragement of geological study among amateurs.
(4) The support and promotion of geologcal investigation in the Oregon Country.
(5) The designation, preservation and interpretation of important geologic features of the Oregon Country.

To support of these objectives, the president appointed 23 committees whose chairmen and members totalled 61 persons! Several people served on more than one committee.

The first membership list (v.1, n.2) included 66 members, among them seven professional geologists: Dr. E. T. Hodge, E L. Packard and W. D. Wilkinson of Oregon State College, Drs. W. D. Smith and Ethel Sanborn of the University of Oregon, and Wayne Felts and Claire Holdredge.

JASPER—BORN OF FIRE AND ICE

by Donald Barr, Past President, GSOC

Jasper is included in the silica group of minerals. The silica group is divided into groups: crystalline quartz which includes all varieties occurring in large crystals and cryptocrystalline which includes all varieties in which submicroscopic crystals form granular to fibrous aggregates and amorphous, which does not form crystals. The jaspers fall into the cryptocrystalline group along with chalcedony, chert, agate and flint.

The name jasper (a form of silica) applies to various forms of opaque to subtranslucent chalcedony of richly colored rock consisting of interlocking crystals of cryptocrystalline quartz too small to see with the naked eye or even under a microscope. Mineralogists can decern jasper's structure only by the way they diffract X-rays. The cryptocrystalline structure indicates how the stone comes into being. Jasper has various names applied to sub-varieties.

Jasper is born of fire and ice, the impact of hot lava and cold rock. Most common, the cold source rock is porphyry, a dark igneous rock that contains relatively large and conspicuous crystals in a fine- grained groundmass, that is, they melt while the other components of the rock remain solid.

This produces a silica-laden fluid that flows into cracks in the porphyry where it quickly cools and crystallizes. It is the rapid cooling that prevents the growth of large crystals and thus promotes the formation of jasper. Jasper may also form in sedimentary parent rock, again with lava as the heating agent.

Jasper is often found near deposits of iron ore, and often it contains iron compounds as impurities. These impurities usually give a red and brown color to the jasper, but there are also yellow and green jaspers. Red, brown and yellow come from different forms of iron oxide. The mossy green tones come from chlorites (mineral containing magnesium), aluminum and silicon) as well as iron and oxygen. It is rare if anyone finds a single color jasper. More often the stone displays deep hues in indistinct ribbons. One variety appears to have pictures of ruined buildings embedded within the stone. It is given the name of ruin marble. Such evocative shapes contributed to jaspers ancient popularity but also to its modern downfall. Many people nowadays find the pattern in the rock too garnish for their tastes.

Jasper has been popular in the Middle East and Europe for over 5,000 years. In ancient Egypt, Greece and Rome craftsmen worked the jasper into magic symbols, secret signs and large polished tablets. The Russian's czar's winter palace in St. Petersburg had a beautiful collection of carved jasper. The maharajahs of India had many beautiful ornaments made of it. Present-day rockhound still work with this beautiful rock

It is the cryptocrystalline structure of jasper with its tiny crystals, its density and hardness that enables the craftsmen to work the jasper and get a high luster polish.

REFERENCES:

Earth, January 1993, "Earth" Kalmbach Publishing Company, Waukesha, WI

"Dictionary of Geological Terms" 1976, The American Geological Institute, Anchor Press, Garden City, N.Y.

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

SUMMARY REPORT OF TOTAL CASH ON HAND, Jan.1st,1993

Total Cash Balance On Hand, Jan.1st 1992	$7,158.22
Balance Dec.31st 1991	4,807.64
Interest Earned, Year 1992	182.36
Total Balance Dec.31st,1992	4,990.00
Bank Amer. Sav. Acct. #21184-0095	
Balance Dec. 31st,1991	2.350.58
Balance Dec. 31st,1992	3,080.48
Surplus , Income Versus Expenditures	729.90
Interest Earned In 1992	182.36
Total Earned Surplus For 1992	912.26
U.S.Nat. Bank Checking Acct. #0253-319	
Total Cash Balance On Hand,Dec. 31st,1992	$8,070.48

REPORT OF TOTAL RECEIPTS,Jan.1st-Dec.31st,1992

Interest:Bank America Acct' No 21184-00895	182.36
Memberships:	
Receipts for Year 1992	$2,265.30
Receipts for Year 1993	140.00
Total Memberships	2,405.50
Newsletter Subscriptions:	145.00
Publication Sales:	45.23
Hospitality Rebates:	166.25
Luncheons:	42.50
Annual Banquet:	
Ticket Sales,Dinner	1,456.00
Sales Table,Donations	214.95
Total	1,670.95
Presidents Trip:	1,260.00
TOTAL ALL RECEIPTS FOR 1992	$5,917.79

GSOC Treasurers Report for 1992,(1 of 2 pages)

Archie K. Strong

Archie K. Strong,Treasurer

Sinkankas, John, " Mineralology, A First Course", D.Van Nostrand Co. Inc. Princeton, New Jersey, 1967.

BOOK REVIEW

Cope, Vern, **THE OREGON EARTHQUAKE HANDBOOK**, Vern Cope, Portland, Oregon 150pp. 1993.

This book reviews the geology of plate tectonics as related to the Pacific Northwest. The past history of earthquakes in the Pacific Northwest is disccussed putting the time between major quakes at about 300 years. A time frame for the next earthquake is proposed based on past earthquake information.

A good part of the book deals with being prepared for any natural disaster and particuarly an earthquake that is predicted for the Northwest sometime in the next 100 years . The author discusses everything from building codes, preparing the home such as securing the water heater to a wall, having as earthquake prepardness kit of items from first aid kit, clothing, blankets, where all the family would meet, food, water etc. Also the value of earthquake insurance is discussed. The author stresses the fact that an individual or family should have on hand a survival kit that would sustain the family for at least three days or longer..

The book is well written, providing step by step advice on preparing for an earthquake or any other natural disaster. This amnaul should be in every home. The book can be obtained from Vern Cope. Address Vern Cope, THE OREGON EARTHQUAKE HANDBOOK, P.O.Box 19843, Portland, Oregon 97280. Each book is $11.95. The book is available in some bookstores also.

by Don Barr

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

REPORT OF TOTAL EXPENDITURES,Jan.31st-Dec. 31st,1992

Newsletter:	
Printing	$747.50
Bulk Mailing,No.999 Permit	300.00
Editors Expense & Misc.	54.39
Business Managers Expense	32.23
Total	1,134.12
Permits & Fees:	160.00
Post Office Box Rental:	94.00
Portland State Rental:	56.00
Insurance,Liability & Feduciary:	556.00
Scholarship,PSU Geol. Summer Field:	400.00
Equipment Purchase & Repair:	
Audio-Visual Equipment Case	80.88
Projector Tubes & Miscellaneous	65.45
Total	146.37
Luncheons:	
Parking	35.00
Other Miscellaneous	42.72
Total	77.72
Stationery Supplies & Misc. Postage:	144.10
Guest Speakers & Related Expense All Meetings:	165.00
Administrative,President & Membership Directory:	169.23
Annual Banquet:	1, 346.27
Annual Presidents Trip:	556.72
TOTAL ALL EXPENDITURES,Jan.1-Dec.31	$5,005.53

*No Expenditures For Library Or Annual Picnic, In 1992.

GSOC Treasurers Report for 1992(Pg.2 of two Pgs.)

Archie K. Strong

Archie K. Strong, Treasurer

HANCOCK FIELD TRIP---MAY 14-17. We will stay at the Hancock Field Station located between Clarno and Fossil. The camp provides the food and lodging. We will may trips out to interesting places in the area. Flowers show be great this year. Further details and signup will appear in the may NEWSLETTER. Call Don Barr if you need information before that. 246-2785.

AVAILABLE PUBLICATIONS

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

THE GEOLOGICAL NEWSLETTER - monthly . . . . to libraries and institutions: $10 per year
with membership: $15 per year

GSOC PRESIDENTS FIELD TRIP GUIDEBOOKS	Pub. price	price mailed*
1. Central Oregon - Suplee area - 1965 (Fred Miller)	.25#	1.00
2. Mitchell area -- 1969 (Wally McClung)	.50#	2.50
3. Condon's First Island - Klamath Mts. -- 1970 (Louis Oberson)	.25#	2.50
4. Condon's Second Island - South Wallowas -- 1971 (Archie Strong)	1.50	2.50
5. Douglas County - N. Umpqua area -- 1973 (Geo. Malin)	1.00	2.50
6. Lincoln County coast -- 1974 (Clair Stahl)	.50#	2.50
7. Newberry Caldera -- 1976 (Opal Helfrich)	.75#	2.50
8. North Cascades, Wash. -- 1977 (Norm Hessel)	.75#	2.50
9. Sawtooth Mts., Idaho -- 1978 (Bob Waiste)	.50#	2.50
10. Central Oreg. Volcanic Wonderland -- 1982 (Ruth Keen)	2.50	3.00
11. Lewiston, Idaho area -- 1984 (Viola Oberson: Lloyd Wilcox, author)	1.25#	3.00
12. John Day Country -- 1985 (Don Parks)	2.00	3.00
13. Southwest Oreg. - Tyee country -- 1986 (Hazel Newhouse)	2.50	3.00
14. Western Cascades -- 1987 (Andy Corcoran)	2.50	3.00
15. N. Idaho -Montana -- 1988 (Joline Robustelli)	3.00	5.00
16. Vancouver Island -- 1989 (Rosemary Kenney ;John Whitmer,author)	3.50	5.00
17. Southeastern Oregon -- 1990 (Ruth Keen)	3.50	5.00
18. Central Washington -- 1991 (Walter Sunderland)	3.75	5.00
19. Cascadia subduction zone -Oreg.-Calif. -- 1992 (Evelyn Pratt)	3.00	5.00
MISC. TRIP LOGS		
!. Banks-Vernonia train trip - fossils -- 1964	.25	1.00
2. Columbia River Gorge -- 1965	.25	1.00
3. Deschutes River train trip	.25	1.00
4. Adventures in Central Oregon -- 1978 (LLoyd Wilcox)	.50#	1.00
5. Lower Columbia River - S. Wash. coast -- 1988 (John Whitmer)	1.00	2.00
6. Lewis River - Crazy Hills, Wash. -- 1990 (John Whitmer)	.50	2.00
7. Channeled Scabland, Wash. -- 1990 (John Whitmer)	1.00	2.00

= price reduction on oversupply

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MAY 93

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GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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OF THE OREGON COUNTRY
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PORTLAND, OR 97207

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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Bob Richmond 282-3817

Annual banquet
Chairperson:Susan Barrett639-4583

ACTIVITIES

ANNUAL EVENTS: President's Field Trip-summer, Picnic-August,Banquet-March, Annual Meeting-February.
FIELD TRIPS: Usually one per month, via private car, caravan or chartered bus.
GEOLOGY SEMINARS: Third Wednesday, except June, July, August. 8:00 pm, Rm. S17, in Cramer Hall, PSU. Library: Room S7, Open 7:30 P.M. prior to meetings.
PROGRAMS: Evenings: Second and Fourth Fridays each month, 8:00pm, Rm. 371, Cramer Hall, PSU, SW Broadway at SW Mill street, Portland, Oregon.
LUNCHEONS: First and Third Fridays each month, except holidays at noon. Bank of California Tower, 707 SW Washington, 4th floor Cafeteria, California Room, Portland, Oregon
MEMBERSHIP: per year from January 1: Individual, $15.00, Family, $25.00, Junior (under 18) $6.00. Write or call Secretary for membership applications.
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THE GEOLOGICAL NEWSLETTER

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P.O. Box 907 - Portland, OR 97207

VISITORS WELCOME
INFORMATION PHONE 284-4320

VOLUME 59, NO. 5

CALENDAR OF ACTIVITIES FOR MAY, 1993

FRIDAY NIGHT LECTURES (Cramer Hall. PSU, Room 371, 8:00 P.M.)

May 14 "Ancient Geology 15 billion years ago to the present"
Lecture by Chuck Dethloff, President, Rose City Astronomers.

May 28 "Visit to Newfoundland". Illustrated lecture by Dr. Donald Botteron, Vice President, GSOC.

FRIDAY LUNCHES (Bank of California Tower, 707 SW Washington, 4th floor. Social Hr. cafeteria 11:30AM. Program in California Rm. at 12:00 Noon)

May 7 To Be Announced

May 21 "Geology under the Tualatin Mountains: West Side Light Rail Tunnel". Presentation by Gary Peterson of Squier and Associates.

GEOLOGY SEMINAR (Cramer Hall, PSU , Room S - 17, 8:00 P.M.)

(Wed) May 19 Continuation of "Glacial Geology of Minnesota". Illustrations and discussion led by Richard Bartels.

GSOC LIBRARY

Cramer Hall, Portland State University, Room S - 7.
Open 7:00 - 8:00 P.M. prior to evening meetings.

FIELD TRIP

May 14-17 **Hancock Field Station Retreat.** We'll review the geology of this area, view a great flower display, happy hour each afternoon and enjoy good companionship. Set these dates aside. See page 28 for detatils.

INFORMATION ON THE COMING PRESIDENT'S FIELD TRIP ON PAGE 34

WELCOME NEW MEMBERS

Doris Manley
6610 NE 75th Street
Vancouver WA 98661

K.H. Lindsay
272 Greenwood Road
Lake Oswego Oregon 97034

Bill Greer

HANCOCK FIELD STATION ANNUAL TRIP MAY 14-17.

LOCATION: HANCOCK FIELD STATION: located between the towns of Antelope and Fossil on Highway 218. It is two miles east of Clarno after you cross the John Day River. Watch for the Hancock Field Station sign on the north side of the road.

TIME: Meet at the Station any time in the afternoon of the 14th. First meal will be the evening of the 14th.

COST: $26.00 a day. Meals include Friday evening the 14th, three meals Saturday and Sunday, the 15th and 16th, and two meal on the 17th. All checks if you pay by check are to be made to OMSI.

INSTRUCTIONS: Bring warm sleeping bags, extra blanket, flashlight, sunglasses, G-pick, binoculars and clothing for any kind of weather. We plan for great weather, but this is Oregon. Don't forget your soap, towels, toothbrush and anything else you need for comfort.

ACTIVITIES: Some walking and some car travel to see the geology and spring flowers. This should be a great year for flowers. They have had plenty of rain this year.

IMPORTANT:: IF YOU PLAN TO GO ON THIS FIELD TRIP, PLEASE CALL DON BARR AT 246-2785 BY May 11 AS I NEED TO INFORM THE STATION THE NUMBERS ATTENDING.

Evelyn Pratt, Retiring President, 1992: Farewell speech

A little over two years ago I joined GSOC. Someone - probably Don Turner - asked if I knew any good speakers on geologic topics. I admitted that I did. Before I knew quite how it happened, I was Vice-President. This led, the following year, to becoming President.

It's been a most rewarding experience. People such as Alta Fosback Stauffer, Walter Sunderland, Rosemary Kenney, Don Barr, Esther Kennedy, and many others helped me learn how GSOC worked and who the dedicated people are that make it work. If I named you all, we'd be here at least an extra hour.

Last spring and summer I took two field trips to prepare for leading the 1992 President's Field Trip. One field trip, led by Dr. Kays of the U of O, opened my eyes to the intricate geology of the Klamath Mountains. The other, with Drs. Bud Burke and Gary Carver of Humboldt State Univ., focused on earthquake geology of N Calif.'s Triple Junction. When the time came to write the President's Field Trip Guide, Dr. John Eliot Allen, Clair Stahl, Dr. John Whitmer, and nearly a dozen others gave generously of their time and knowledge. From this I've learned a tremendous amount about geology, about leading a group, and about the willingness and helpfulness of people who care.

Esther Kennedy, your incoming president, is well-known to GSOC'ers. She has set up the Annual Banquet for over a decade. In 1992 and 1993 she presented us with more than a dozen interesting and informative speakers. Already she has appointed her committee members and found a place to stay for the 1993 President's Field Trip. She knows our organization and the people in it.

Although it's really been a privilege to work with her, I do have one complaint. I wonder how many other GSOC'ers besides me have a hard time restraining themselves from gorging on the absolutely scrumptious cookies she brings to meetings. Esther, do you know what you're doing to my willpower - and my diet?

Once again, thanks for letting me serve as your president. It's been interesting, fun, and a pleasure meeting and working with all you geology buffs. Here's looking forward to a great year, with Esther leading us! Let's give her a big hand!

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COMPLETELY FRACTURED GEOLOGY

Ralph & Evelyn Pratt

1. MAFIC (adj): refers to actions of the type performed by Sicilian-based criminal group

2. MORAINE: (a) the fluffy white stuff on top of a lemon pie (b) a girl's name, popular in Ireland.

3. **SLICKENSIDE**: a comedy duo in the Icecapades.

4. **FISSURE** : someone trying to catch a trout.

5. **SPHALERITE:** a long-legged wading bird in the title of a well-known book, "Too Late the Sphalerite"

6. **PINGO TERRAIN:** a good location for a Chinese table-tennis tournaent.

7. **RADIOLARIA**: a funny DJ on KBOO

8. **GYPSUM:** said of a con man - "He sure gypsum!"

9. **PORPHYRY**: a crime which involves lying while under oath; "When the butler said he hadn't murdered the victim, he committed porphyry."

10. **GEOCOSMOLOGY**: the science of making the earth look beautiful.

CORRECT ANSWERS TO "COMPLETELY FRACTURED" GEOLOGY ON PAGE 31

CORRECT ANSWERS TO "COMPLETELY FRACTURED" GEOLOGY ON PAGE 31

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SW OREGON COMMUNITY COLLEGE FIELD TRIPS

Lead by Dr. Don Stensland, 888-2525, Ext. 253

April 8: Powers, Agness, Gold Beach; a few seats available; transportation fee $15.

April 22: Newport, Lincoln City, Cascade Head, Cape Kiwanda; a few seats available; transp. fee $13.

May 13-16: Central Oregon; a few seats available; Smith Rock, John Day Fossil Beds, Painted Hills Palisades, Fort Rock, etc. Transp. fee $90.

PRESIDENT ESTHER KENNEDY'S INTRODUCTORY ADDRESS

Since I did not campaign for this position, I have no promises to keep!! Instead I'm asking all of you to help me make this a good year with many interesting happenings. Share your ideas for programs and field trips. Attend luncheons, evening meetings and seminars. Bring a friend with you to meetings and on field trips. Perhaps a visitor with encouragement from you will become a member.

The President's Field Trip begins Saturday, September 25th and ends on October 1. Headquarters will be in Mount Vernon, Washington for five nights. We will stay overnight in Tacoma our first night out. We have exciting excursions planned and we hope all of you will participate.

Thank you for giving me the opportunity to serve this wonderful organizations as President.

Esther Kennedy

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NORTHWEST MUSEUM OF NATURAL HISTORY ASSOCIATION based at Portland State University is an association that GSOCs would find interesting. The following is from the Association News , December 1992. regarding an update on how the Museum is coming with its program and new facilities. Dr. Dave Taylor has spoken to the Society several times in the past couple of years.

The Mission Statement of the Museum is as follows: The Northwest Museum of Natural History was conceived to engage curiosity and to inspire appreciation for our natural historic heritage - as well as to explain and interpret the research methods through which professional scientists learn about the narural world. The Museum, a non-profit educational and cultural insitution will be a community resource for an informed citizenry.

Letter from the Director

Dear Friends:

This has been an exciting year for the Museum Association. Negotiations with Portland State University culminated with an agreement allowing the Association to occupy the ground floor of the Ondine Building on the Portland State Campus. Located at S.W. Sixth Avenue and Hall Street, the building is easily accessible by public transportation or automobile. We are delighted to have a home for the Museum. The Association Board of Trustees would like to thank Portland State University President Judith Ramaley; Dr. William Paudler, previous Dean of the College of Liberal Arts and Sciences; and Lindsay Ann Desrochers, Vice President of Finance and Administration along with her assistant Steve Sivage for making this arrangement possible. We also thank our members and friends who have given their support to this project.

We are anxious now to operate as a Museum, but first things first. We now need to focus on remodeling our space and establishing a Development Office. To do so, we must increase our operating revenues, expand our membership, and seek new revenue sources. We will need to increase the community's awareness of our organization, involve more individuals and continue to identify community resources.

But let us look ahead for just a minute and jump to an overview of our first exhibit themes designed to show our breadth of interest in natural history. One will naturally center on our Triceratops dinosaur skeleton, another will focus on our own human origins in East Africa, while the third will examine the plight of the Pacific Northwest salmon. Topics such as these on the cutting edge of research will be presented and - where appropriate - a worker in the field will be profiled. Through our exhibits, we will capture the excitement of the investigative process and allow Museum visitors to form their own conclusions about sensitive environmental issues facing us today.

As we begin the new year, once again we thank our supporters. We are rolling up our sleeves to work on development, but we will also take time out for a field trip or two or a lecture on natural history. We invite you to join us at work or play.

Sincerely,
Dave Taylor

(If you interested in becoming a member of the Northwest Museum of Natural History Association you can call 725-5900 for membeship categories. There are a numbei of membership categories, but two that would be of interest to most people are Friend/Family is $25.00 and Contributing/Individual is $15.00.]

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PALEOMAGNETISM TECTONICS OF THE CRESENT FORMATION NORTHERN OLYMPIC MOUNTAINS WASHINGTON

The following is the short summary of the research on the Olympic Penninsula by Andrew C. Warnock, recipient of the 1989-90 AFMS Scholarship Award.

Use of a small-diameter drill has allowed the paleomagnetic sampling of rims of fractured pillow basalts of the lower Crescent Formation in the northern Olympic Mountains. The pillows selected have spherical to slightly oblate morphologies which typically develop on horizontal or gently-dipping surfaces. Pillow keels and sedimentary interbeds were used to obtain bedding attitudes and top directions for use in structural corrections. All specimens were subjected to progressive thermal demagnetization. After removal of a low blocking-temperature recent overprint, stable end-points were reached by 580°C in 12 of the 34 sites sampled (large within-site; scatter was commonly observed in the remaining sites). Among the accepted sites, within-site scatter was small and correction for bedding tilt significantly reduced the scatter between sites. The mean paleomagnetic pole for this investigation (86.4° north latitude, 170.0° east longitude, A_{95}-16.5°) is indistinguishable from the early to middle Eocene pole expected for North America. When combined with previous results from subaerial basalt exposures of the upper Crescent Formation in and near the eastern Olympic Mountains, these results (80.7° north latitude 192.0° east longitude, A_{95}=8.0°, N=46) show no significant rotation (0.80 + 14.4 or poleward displacement (-3.6 + 8.5). Analysis of the magnetic mineralogy suggests that the remanence is early, probably primary. The pole, therefore, should be valid for tectonic interpretation of the region. A circular distribution virtual geomagnetic poles after correction for bedding tilt supports the hypothesis that the northern Crescent Formation experienced deformation due to the rise, in a dome-like fashion, of the sediments of the Olympic Core terrane. Erosion of a partial dome open to the west could have produced the curvature seen in the outcrop pattern of the Crescent Formation. The lack of significant rotation of the northernmost Coast Ranges contrasts with the net clockwise rotation seen to the south. The difference could be that irrotational northward translation, driven by oblique convergence, was accomodated by the north-south trending strike-slip faults to the east of the Olympic Mountains.NW NEWSLETTER, vol. 9303, March 1993

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MINING GIANTS JOIN GREAT DIAMOND RUSH

by Lain Jenkins

This article was taken from NORTHWEST NEWSLETTER, Volume 9303, March 1993 with permission.

A land rush on a scale overshadowing anything since the Alaskan gold rush of the 1890's is underway in northern Canada. But instead of private prospectors, global corporate giants, including Britain's RTZ, Australia's BHP and south African De Beers, are racing to stake out huge areas of the frozen north for diamonds

A century ago, lone explorers trudged on snowshoes through the semi-Artic wastes. Today's rush is based on technology.

The mining multinationals are fighting for space on the limited number of helicopters available to drop stakes onto the snow-covered land to mark their concessions.

"There have been amazing scenes" said Roger Chaplin, mining analyst at the roker Credit Lyonnais Laing, which has just completed a report on the rush.

Diamond analysts estimate that more than 23,000 square miles have been staked out so far. Within four years, it is suggested, the area could account for 20% of the world diamond production and 30% of gemstone production.

These expectations, if realized, would further damage the established diamond market, already suffering from the effects of the recession, a mining scramble in Angola and moves by Russia to leak diamonds on to the world market.

The excitment is based on an exploratory drilling by Dia Met, a tiny Caadian compaany. Its small sample showed the presence of an unusually large number of good quality diamonds. This set off the rush, with companies racing to get there before De Beers, the South African company which controls 80% of the world's diamonds.

A consortium of BHP and Dia Met is in the forefront of the race while RTZ, through its American arm Kennecott, in alliance with smaller companies, is fighting to catch up. Dia Met's shares have rocketed from under $1.00 to $19.25 on the Canadian stock exchange on the back of land rush.

De Beers is using its name and muscle to grab as much land as possible. Privately, it is skeptical that the area will yield as many diamonds as some geologists predict. However, it wants to cover itself just in case.

If the experts are right, Canada could, within four years, overtake Zaire as the world's largest producer of diamonds. Zaire accounts for 19% of the world production, with Botswana in second place with 16%, Russia wiuth 13%, south Africa with 8% and Namibia 2%.

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COMPLETELY FRACTURE GEOLOGY
by Evelyn and Ralph Pratt

1. **MAFIC** (adj): describes an igneous rock composed chiefly of dark magnesium- and iron-rich minerals.
2. **MORAINE:** a mound or ridge of unstratified till deposited by direct action of glacier ice.
3. **SLICKENSIDE:** a polished and striated rock surface, resulting from friction along a fault plane.
4. **FISSURE** : an extensive crack in the rocks; sometimes contains minerals
5. **SPHALERITE**, Zn, Fe)S, with perfect cleavage.
6. **PINGO TERRAIN** an Arctic area with many long-lasting rounds of soil-covered ice up to 50 m high and 400 m wide.
7. **RADIOLARIA**a: single-celled marine organisms with silica skeletons; their remains make up extensive areas of seafloor ooze .
8. **GYPSUM:** hydrous calcium sulfate, the most common sulfate mineral, with a hardness of 2 on Moh's scale; used in cement and plasterboard.
9. **PORPHYRY:** an igneous rock with conspicuous chunks in a fine-grained groundmass.
10. **GEOCOSMOLOGY** : the science that deals with the origin and geologic history of the earth's a planet in space.

DID YOU KNOW??????

With earthquakes in the news, we hear a lot of the Richter Scale to denote the strength of the quake. This scale was developed by Charles Richter, in 1935. Each number is ten tmes more powerful than the previous one. Thus a measurement of five would be ten times more powerful than a four, which is ten times more than a three. So a five would be 10 x 10 , that is 100 times more than a three. A quake of five can cause minor damage, while over 8 means total destruction.

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DAZZLING DISPLAYS AT BANQUET
by Charlene Holsworth

To celebrate the Oregon Trail Anniversary, a special display of all items available in Oregon Trail Information Booths and Made in Oregon Stores was the center of our bevy of beguiling banquet offerings this year. Member Teddy Pendergrass brougt Indian drums, minature prairie schooners and other historical items.

Phyllis Thorne brought many little Teasel People from West Virginia travels. Her colorfully dressed figures stood on tiers sc each could be admired.

Dr. John Allen displayed 4 sets of his brightly polished bookends with his photo card.

Past President Evelyn Pratt had time to bring a box of rocks and photos from the May convention.

Kenneth Ross brought 2 fine boxes of Agates even though he was not able to stay for the banquet.

Don Turner brought a minature train with several gondolas filled with various rock samples.

Rosemary Kenney's slides were displayed by Robert Richmond as he showed his slides of the National Parks.

Esther Kennedy showed her slides of the Fosback-Stauffer party. Esther also had her microscope set up to show some of her micromounts, and Emily Delano planned to show unidentified photos of the Oregon Country.

Frank Dennis brought two large books full of enlargements of photos he has taken on various trips throughout the world.

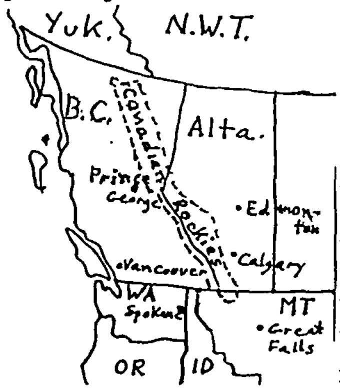
Elinore Olson showed her box ornamented with colorful feathers and hair ornaments collected from when she had taveled.

Bradford Kenyon brought his displays and Dorothy Barr showed fossils from her extensive collection.

Phyllis Bonebrake showed many of the place favors from previous banquets which brought back many good memories to all of us.

Richard Bartels joined us in our entertaining and educating endeavors. We are grateful for these members who went to extra effort to add to the pleasure of the fine banquet.

THE CANADIAN ROCKIES (Part One)
by Evelyn Pratt, Past President, GSOC.



Exactly where are the Rocky Mountains? The Cordillera,that great western North American mountain range, includes, highlands and associated valleys from thePacific to the Great Plains and from New Mexico to Alaska. Within the Cordillera those mountains which extend from theGreat Plains on the east to desert and coastal ranges on the west, in a strip from 75 to 400 miles wide from central New Mexico to northern British Columbia and Alberta, are the Rockies. In a very general way the Rocky Mountains can be divided into two distinct geological provinces:

1. a. The American Rockies consist mainly of large blocks uplifted along a north-south zone of weakness.
   b. The Canadian Rockies are a pile of sediments compressed between colliding plates.
2. a. The uplifted blocks of the American Rockies are two-billion-year-old granitic sections of North American plate which rose up through thick sedimentary rocks.
   b. The Canadian Rockies are sedimentary rocks pushed east by thrust faults- They have no granite core, nor is there much North American plate exposure.
3. a. Ancestral American Rockies rose in the Pennsylvanian, around 300 million years ago.
   b. Ancestral Canadian Rockies existed in the Cambrian and PreCambrian, 500-800 million years ago. By the Pennsylvanian, they were worn down to below sea level.
4. a. After the ancestral American Rockies were worn down, they were uplifted in the Paleocene, 60-70 million years ago, during the Laramide orogeny. They were uplifted again, with a lot of volcanics, in the Miocene, 30-35 million years ago.
   b. After the ancestral Canadian Rockies were worn down, they were uplifted in the late Jurassic and early Cretaceous, 125-145 million years ago, during the Nevadan orogeny.

Geology texts usually approach the Canadian Rockies from the Interior Plains (what we call the Great Plains). To us Pacific Coasters, this is backwards. When we travel to those Rocky Mountain jewels, Jasper and Banff National Parks, we first cross several other ranges. These probably result from the westward-moving North American plate accreting various terranes from Jurassic times on; they were uplifted earlier than the Canadian Rockies, and are mainly metamorphic and igneous rather than sedimentary. In general the Columbia Mountains from Prince George south to the U.S border - and similar ranges north to the Yukon - are lower, wetter, warmer, and have deeper valleys than the Rockies to the east.

Those of us accustomed to thinking of Oregon as fairly large are surprised by the size of Canadian provinces. Although the straight-line distance from Vancouver to Lake Louise is roughly the same as from Oregon's Pacific coast to it's Idaho border, its twice as far from northern Washington to the Yukon, and over three times farther from B.C.' s SE to NW corners.

PICTURES OF THE 1993 ANNUAL BANQUET
Pictures by Robert Richmond

1. Evelyn Pratt , outgoing President presenting a fellowship to Caly Kelleher.
2. Ellen Morris Bishop, geologist and writer, main speaker for the Banquet.
3. Past Presidents.
4. Evelyn Pratt, farewell speech to members.
5. The 1993-94 elected Board, President, Esther Kennedy, VicePresident, Dr. Donald Botteron, Secretary, Shirley O"Dell, Treasurer, Phyllis Thorne,
   Directors are Booth Joslin (3 years), Arthur Springer, (2 years) and Betty Turner (1 year).
6. Charter members, Mildred and Kenneth Phillips.
7. Eveyln Pratt passing the pick to the new President Esther Kennedy.
8. President Esther Kennedy giving here welcoming speech.
9. Head Table: Don Turner, Betty Turner, Phyllis Thorne, Ellen Morris Bishop, Eleanor McClung and Wally McClung.
10. Head Table: Evelyn Pratt, Ralph Pratt, Esther Kennedy, Dr. Donald Botteron, Betty Botteron, Shirley O'Dell, Booth Joslin, and Dr. Walter Sunderlund

A map of British Columbia's waterways highlights an interesting feature - their -SE to NW trend just west of the Rockies. Rivers and lakes in this part of British Columbia occupy a geologic feature that can be seen in photos taken from the moon: the Rocky Mountain Trench. South of Prince George and the Fraser Basin, it's a great down dropped ditch. North of there the Trench is a San-Andreas type strike-slip fault. Through only two to five miles wide, the Rocky Mountain Trench stretches from the U.S. to the Liard(pronounced LeeYard) plateau on the border between B.C. and the Yukon, then from north of the plateau to

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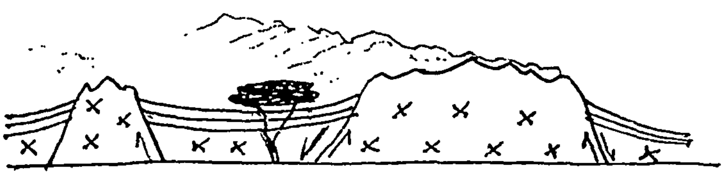
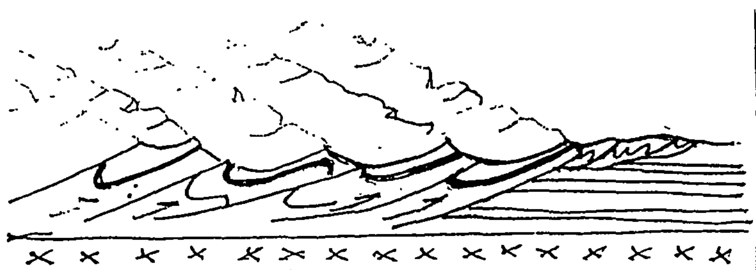
Alaska. Its been around for over 45 million years, so some major earth .movement must be taking place here.

This trench marks the western border of the Canadian Rockies. Into it pour meltwaters from the icefields and glaciers that now even, 10,000 years after the end of Pleistocene, mantle the heights of the northern Rockies. Headwaters of three of the continents's mightiest rivers flow through the Trench. Near Banff and Lake Louise, the Columbia and its great tributary, the Kootenay, are so close that in the 1890's an enterprising chap dug a canal between them to keep the unruly Kootenay from flooding land he wanted to sell. Then Canadian Pacific Railroad demanded a lock to take care of 20-odd feet of elevation difference between the two rivers. Shortly after he built the lock a boat bashed into it. No funds for repairs meant no more canal.

A few miles north of where the Columbia flows westward out of the Trench lies the settlement of Tete Juane Cache (called TAY-wan by non-French-speaking locals). From here the Fraser River heads northwest toward Prince George, where it leaves the Rocky Mountain Trench to flow south, then west to the Pacific. Up this river for countless millenia the salmon came to spawn, 600 miles from the ocean to Rearguard and Overland Falls by Mt. Robson. And



American Rockies



Canadian Rockies

from "Handbook of the Canadian Rockies": Ben Gadd (Corax Press, 1986)

down the river in the 1800's floated canoes, barges and steamboats taking the forests firs and logs and the mountains' gold and copper ore to the sea.

Some 25 years ago, still farther north in the Trench, damming of the Peace River created what is probably the world's largest man-made lake. Water from 225-mile-long Lake Williston eventually flows into the Mackenzie, the second largest river system in North America.

Between the Rocky Mountain Trench and the Interior Plains, from U.S. Glacier National Park to the south to the Liard River by British Columbia's northern border, rise the Canadian Rockies. (to be continued in the June issue of the Newsletter)

PRESIDENT'S FIELD TRIP PREVIEW

It is time to start planning for another exciting geological adventure, PRESIDENT'S FIELD TRIP. We leave Portland Saturday, September 25, staying the first night in Tacoma. The next five nights will be at the CottonTree in Mount Vernon. We return to Portland on Friday, October 1. Schedule for the trip is not firm yet but will include glacial deposits, rivers that changed courses, coal deposits, North Cascades, a short trip across the border to Canada, Mount Baker , Mount Shuksan, ferry trip to Friday Harbor in the San Juan and much more.

Price for the 6 nights and 6 days which includes all meals except the evening meal in Tacoma is $562.00 per person twin, and $692 single. Ferry trip to Friday Harbor is $10.00 extra.

Make your plans to go on this great President's Field Trip in September. Again the dates are September 25 through October 1. Further details and a schedule of daily events will appear in the June GEOLOGICAL NEWSLETTER.

Esther Kennedy, President, GSOC

A VALUABLE MINE

The lead from which "pencil points" are made comes from the principle plumbago mine in the world at Barrowdale, Cumberland, England (plumbago is a form of lead of graphite commonly known as black lead),

It is situated on a hill and instead of being worked constantly like other mines, it is opened only once a year, when a sufficient quanity is taken out to supply the world a year to come. Then it is closed with strong doors and locks until the next annual supply is required. From the time of Queen Elizabeth , it is said that all fine pencils in the world have been made of the black lead from this mine.

via *The Rock Chipper.*

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ABLE TO LIFT TALL BUILDINGS

One of the buildings of the General Electric Laboratory at Nela Park, near Cleveland, Ohio, was built upon a layer of iron pyrite. When the mineral was exposed to air it began to oxidize into rust. This rust was created at such a rate that the basement floors were lifted 15 inches in 15 years , an inch per year. The rust occupies more space than pyrite and the chemical action taking place has enough power to lift a building.-*Via-Hy Grader*

THE GEOLOGICAL NEWSLETTER

GSOC

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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VOLUME 59, NO. 6

CALENDAR OF ACTIVITIES FOR JUNE, 1993

FRIDAY NIGHT LECTURES (Cramer Hall. PSU, Room 371, 8:00 P.M.)

June 11 "The West Side Tunnel" presented by Joe Gildner, Tri-Met.

June 25 "Madagascar, The Big Red Island", Illustrated presentation by Rosemary Kenny, member GSOC.

FRIDAY LUNCHEONS (Bank of Calif. Tower, 707 SW Washington, 4th floor. Social Hr., cafeteria 11:30 AM. Program, Calif. Rm. 12:00 Noon)

June 4 To be announced

June 18 To be announced

GEOLOGY SEMINAR (Cramer Hall, PSU , Room S - 17, 8:00 P.M.)

NO SEMINARS UNTIL SEPTEMBER

GSOC LIBRARY

Cramer Hall, Portland State University, Room S - 7.
Open 7:00 - 8:00 P.M. prior to evening meetings.

FIELD TRIP

ADDITION TO THE MAY 1993 GEOLOGICAL NEWSLETTEER. PLEASE ADD DR. WALTER SUNDERLUND TO THE NAMES OF THE 1993-1994 ELECTED BOARD. PAGE 30, ITEM 5. SORRY WALT.

COMPLETELY FRACTURED GEOLOGY

Evelyn & Ralph Pratt

1. **Country Rock**: music for drums, washboard, and gee-tar.

2. **Benioff Zone**: a place where Benny is forbidden to go.

3. **Mantle Plume:** one rose, daisy, etc., over the fireplace.

4. **Facies:** what folksies have in front of their headies.

5. **Quartzite:** land purchased for a building to house a judge and jury; where the quartroom is located.

6. **Concordant:** one of two places where the Revolutionary War started, Lexington being the other.

7. **Nuee Ardente**: one's latest boyfriend or girlfriend.

8 **Foreshock:** a hank of hair that hangs over a person's eyebrows.

9. **Lithology:** study that teaches the science of how to become more limber.

10. **Aureole:** what you ask when the power's been off - "Aureole right now?"

ANSWERS TO FRACTURED GEOLOGY ARE ON PAGE_37__

CENTRAL OREGON COAST FIELD TRIP

by Don Barr, GSOC Past Pres.

The April 17th field trip led by Dr. Paul Hammond Professor of Geology, PSU along the central Oregon coast from Lincoln City to Cape Mears introduced the 18 GSOCers to the bed-rock geology of the area. Meeting at Shilo Inn with coffee in hand Dr. Hammond gave an introduction to the geology of the area and told of the plans for the day. At our first stop at the Kaufman Quarry we viewed the close-packed amygdaloidal pillow lavas in the upper part of the Siletz River Volcanics. These volcanics are interbedded with basaltic sandstone and siltstone containing shallow coccoliths. The second stop was to view the lower Salmon River Formation that includes calcareous ledges and concretions and some fossils. The group observed fingerlings being raised the Salmon River Fish Hatchery and the Otis Formation containing lithic and basaltic sandstone and siltstones. Lunch stop was at Cape Kiwanda which is made up of Miocene Astoria Formation. After lunch the group was led down the beach to the large hills of sand. In this part of the Astoria Formation there was a 3 foot dike of Depoe Bay basalt cut through the sandstone. Another stop was at a high point where the view to the south included Sand Lake, Cape Kiwanda and Cascade Head. Further on another viewpoint gave a view to the north that included Netarts Spit , Three Arch Rocks, Cape Mears and Netarts bay. It was pointed out that Netarts Spit is slowly eroding away. The stop at Netarts included a walk to an out cropping showing faults that may be related to a record of episodic, rapid Holocene subsidence of coastal estuaries in Oregon and Washington. This has been interpreted to represent deformation during a large subduction zone earthquakes along the convergent boundary. A breather stop at Wee Willies for coffee, pie and ice-cream was a welcome pause for the GSOCs. The last stop on the trip was at Cape Mears to view the middle Miocene basaltic flows and breccia. Here, too, the gang walked to the lighthouse and then to the large spruce tree known as the Octopus tree because it takes over the whole area around it. It was a wonderful geology trip led by Dr. Paul Hammond. He does a fantastic job of presenting geology. Thanks, Dr. Paul, for a great trip.

Nepheline Syenite: Toilet Bowls and Beer Bottles

by

Virginia T. McLemore Economic Geologist, NMBM&MR,
James Guilinger, Geologist, Addwest Minerals, Inc., Arvada Colorado.

What do nepheline syenite, toilet bowls, and beer bottles have in common? Did you know that everyone uses products made from nepheline syenite every day? Nepheline syenite is used in manufacturing glass, pottery, and ceramics. Someday nepheline syenite mined from the Cornudas Mountains, southern OteroCounty,New Mexico, may be used in making toilet bowls and amber-colored glass for beer and soda bottles. Other uses of nepheline syenite are in paints, rubber, plastics, stains, "soft" abrasives, metal primers, and sealers, and in foam backed carpet. Nepheline syenite is a product known only by a few, but used by many.

What is nepheline syenite? Nepheline syenite is an igneous or plutonic rock predominantly composed of feldspar and nepheline with varying amounts of other silicate minerals. Nepheline syenite, unlike many igneous rocks, does not contain any quartz. Commerical deposits of nepheline of greater than 60% of feldspar, 20-25% nepheline, and normally less than 0.5% dark-colored minerals. Because a small amount of iron results in colored glass or ceramics, a commerical deposit usually must contain small amounts of iron minerals. In addition, the deposit must be near the Earth's surface so that cheaper open-pit mining can be used. Commerical deposits must be large, containing thousands of tons of nepheline syenite.

Recently Addwest Minerals, Inc., from Arvada, Colorado, discovered that nepheline syenite in the Cornudus Mountains, Otero County, is suitable for making dark-colored ceramics and amber beverage bottles. The Cornudas nephine syenite is one of several plutons in southern Otero County, but is the only one that tests show contains material suitable for glass and ceramics. The Cornudas nepheline syenite consists of nepheline, feldspar and up to 10% iron-magnesium-rich, dark-colored minerals. These dark-colored minerals form an mineral aggregate that contains magnetite.The entire aggregrate can be separated from the crushed rock by a very strong magnet.

Once the dark minerals are removed, additional testing of rock characterestics such as the ability to melt under low temperatures, hardness, and tensile strength is necessary. Test results will be used to determine which market can utilize the nepheline syenite. Marketing studies are also necessary to determine how much to produce and at what price the nepheline syenite can be sold.

Finding and testing the nepheline syenite is only the first step in starting a mine. State and Federal permits must be obtained. An archeologist must examine the area to be mined. Archeological sites, such as Indian shelters and areas of broken pottery and arrowheads. indicating evidence of early inhabitants' activities will be protected from mining so that they can be studied by future generations. After marketing studies are finalized, a mine plan is developed based on the amount of nepheline syenite that can be sold. If all criteria are met, Addwest Minerals. Inc. will start mining. In a few years the toliet bowl in your house or some of you beverage bottles may be made from nepheline syenite mined right here in New Mexico.

Glossary of Mineral Terms.

Aluminosilicate--A compound containing Aluminum. silica, and oxygen.

Feldspar--A group of abundant rock-forming minerals found in all types of rocks. They are usually white to colorless to pink. and occur as lath-like crystals.

Feldpathoid-- Rare rock-forming minerals consisting of aluminosilicates and having relatively low silica contents.

Magnetite-- A black, opaque mineral that is strongly magnetic (attracted by a magnet) relative to other minerals. Magnetite is composed of iron and oxygen.

Nepheline-- A mineral of the feldspathoid group with the chemical formula (Na, K) $AlSiO_4$. Nepheline occurs as glassy-looking crystals or grains.

Nepheline syenite-- A plutonic igneous crystaline rock composed of feldspar and nepheline.

Pluton--An igneous intrusion

Silicate--A compound consisting, in part, of silica and oxygen.

Quartz--A silicate mineral with the chemical formula SiO_2.

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Harben, P.W., and Bates, R.L., 1990, Indusdtrail minerals--geology and workd deposits: Industrial Minerals Division, Metal Bulletin, PLC, London

The above article appeared in "Lite Geology" New Mexico Bureau of Mines and Mineral Resources, Winter, 1992.

DEFINITIONS FOR "COMPLETELY FRACTURED GEOLOGY"

1. **Country Rock**: any rock older than and intruded by an igneous body.
2. **Benioff Zone:** the probable upper boundary of a lithospheric plate, where it dips down under another plate toward the mantle; earthquakes tend to cluster long it..
3. **Mantle Plume:** a narrow column of hot magma rising from earth's mantle through its crust.
4. **Facies:** general appearance or nature of one part of a rock body as contrasted with other parts.
5. **Quartzite**: metamorphosed sandstone.
6. **Concordant:** said of strata or of the contact between igneous and country rock, where bedding or structures are parallel to each other.
7. **Nuee Ardente**: a cloud of red-hot ash and dust caused by explosive volcanic activity.

8. **Foreshock**: a small earthquake that precedes a main one.

9. **Lithology:** physical character of a rock.

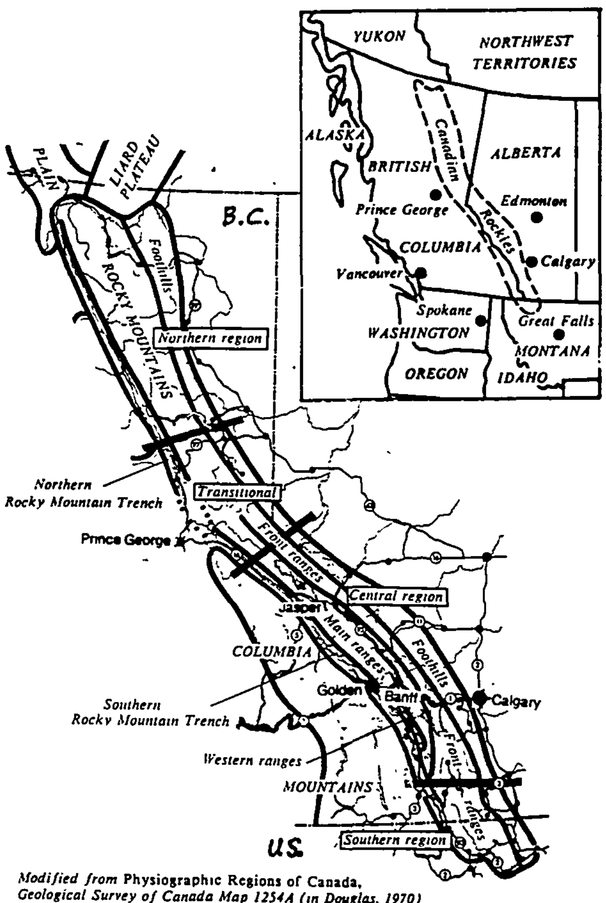
10. **Aaureole**: zone of contact metamorphism next to a pluton.

++

THE CANADIAN ROCKIES (Part 2)

by Evelyn Pratt
(From HANDBOOK OF THE CANADIAN ROCKIES by Ben Gadd

All mountains of western Canada are included in the term "Canadian Cordillera." The farthest east of these are the Canadian Rockies. Beyond, the Interior Plains stretch east to the Canadian Shield. The Liard (Lee-YARD) Plateau forms the Rockies' northern boundary, while division between U.S. and Canadian-style Rockies, roughly south of Montana's Glacier National Park, is less well-defined.



Modified from Physiographic Regions of Canada, *Geological Survey of Canada Map 1254A (in Douglas, 1970) and from International Geological Congress Guidebook A15-C15 (1972)*

The Canadian Rockies' western edge is the great Rocky Mt. Trench, 3-8 km wide. The Trench's northern portion, one of British Columbia's many long SE/NW strike-slip faults, runs ruler-straight from the Yukon border to the south end of Williston Lake. West of that fault B. C. has moved NW 400 km (250 mi.) relative to the rest of the continent. Slippage took place during 50 million years from Late Cretaceous to Eocene, with movement close to a cm a year. Frequent earthquakes must have knocked fox-sized horses and giant flightless birds of that time off their feet.

Around Prince George the northern San-Andreas-type Rocky Mt. Trench Fault muddies up into a bunch of smaller faults. Southeast of there a major normal fault separates the Trench's east side from the Canadian Rockies.

If you push your left thumb against the skin of your right hand, your skin simulates folds in the Rockies; what's underneath represents the North American Plate. But rock, less resilient than skin, tends to break. Pressure from the SW broke rock folds to produce typical Canadian Rockies thrust faults, with SW sides riding over fractured NE sides.

The long narrow mountain chain divides into even-narrower strips: south, front ranges and more eastern foothills; central, the main ranges, front ranges, and foothills; and north, front ranges? main ranges? (a classic "More work needs to be done" situation) and foothills. Each has its own plant communities and ecology. A minor part, the western ranges, extends from Radium Hot Springs to Golden.

Trans-Canada Highway 1 offers a good cross-section of the Canadian Rockies. Coming from the West Coast the highway drops down into the Trench at Golden, then climbs narrow, twisting Kicking Horse Canyon, which has been cut into the western ranges. Here a major thrust sheet from the Purcell (Columbia) Mts. plowed into soft Cambrian and Ordovician shale and accordion-pleated it. Shale, often metamorphosed into greenish-silver phyllite, characterizes both western and western main ranges. In the western ranges rock has been overturned and faults dip NE, while in the western main ranges they dip mainly SW. Except for one resistant limestone formation, both ranges erode easily. The western and all the main ranges are about 110-120 Ma.

The continental divide is at Kicking Horse Pass. East of here a dramatic change takes place: tough quartzite, limestone, and dolomite formations mark the eastern main ranges. They are carved through several kms of a single sheet thrust some 40 km from the SW. Beds are nearly flat-lying; folds are gentle. These are OLD rocks; lowest are 600-800 Ma purplish slate and brown gritstone (Miette Group). Higher is pinkish, cliff-forming quartzite (Gog); then dark limestone and pale dolomite of Mid-Cambrian formations; all topped by buff-colored Late Cambrian units. The high, erosion-resistant peaks trap moisture, causing icefields and glaciers to form.

Classic eastern-main-range Castle Mountain, with its steep walls and tower, rises at the junction of Trans-Canada 1 and Icefields Parkway (Hwy 93). The Parkway travels 287 km (roughly 180 miles) NW through eastern main ranges to the town of Jasper. The highway is rightly claimed to be the most beautiful in the world. Tapes and players can be rented at either Jasper or Banff for self-guided car tours.

Trans-Canada 1 crosses a thrust fault (Simpson Pass) between main ranges and front ranges a few kms east of the junction with Highway 93. About 80 Ma, pressure from the SW pushed Late Paleozoic limestone and Mesozoic shale of the front ranges into spectacular folds and repetitive thrust faults. The limestone strata slope gently upward from SW to NE, and erosion of shale valleys underneath creates dramatic NE-facing limestone cliffs. The pattern is repeated over and over again east almost to the Stoney Indian Reserve. Here gray-&-buff cliffs of Yamnuska Mountain. North of the junction with Highway 1A, show where the McConnell Thrust Fault runs along mountain bases. This remarkably sharp fault is the dividing line between the front ranges and the foothills.

After crossing some flats the thrust fault pattern continues east through the foothills. but glacial erosion and deposition obscures it somewhat. Resistant layers tend to be Interior Plains sandstone instead of limestone. Hogbacks gradually give way to flatlands, and our journey from west to east through the Canadian Rockies is over.

GARDEN OF EDEN IN IDAHO

by

Joyce Carrpenter, UI News Bureau Staff Writer

Panorama of flora in St.Maries River Valley some 22 million years ago in fossil (Photo courtesy of University of Idaho

Northern Idaho as a Garden of Eden may be a bit hard to visualize now, but fossil records being studied by University of Idaho paleontologists at sites near Clarkia indicate that 22 million years ago it may have been nearly that rich in plant life.

A partial list of plant species found in the site's fossil record by Dr. Charles Smiley, professor of geology and associate dean of the College of Mines and Earth Resources, and Bill Rember, geology graduate student, includes avocado, cherries, sweet gum, oaks, pine, holly, walnut and bay.

Some other species include maples, firs, pine, hydrangea, magnolia, willow, rose, tulip tree, birch, alder, grape, beech, chestnut and sassafras. Not all of the fossils are of beneficial species, though, since poison ivy is also included.

In all, the two men estimate that they have found and identified some 85 to 90 species of plants. Most of the species are related to plants normally found in a much warmer and more moist climate such as that of the wooded areas of the Carolinas or Georgia. Idaho's forests today are primarily coniferous and limited in number of species.

"The uplift of the Cascade range resulted in colder winters and drier summers in northern Idaho. The cooling climates with Pleistocene glaciation resulted in seasonal temperatures that were too cold for the Miocene forests to tolerate, " Smiley said. "So, the earlier warm-temperate, summer-wet died out in this region and were replaced by the cooler climate forests that are now seen in the Idaho mountains"

One important kind of conifer fossil discovered at the Clarkia research site is "Cunninghamia," the Chinese "fir," that is related to the bald cypress of the eastern United States and the California redwood, "Sequoia."

In Asia, this confier grows in the same forest with the dawn redwood of China, a fossil plant which has also been found in the Clarkia deposits.

Finding fossils from the dawn redwood along with other commonly associated tree species fossils led Rember to reason that the Chinese "fir" fossils might also be present at the site, although it is one of the rarest in western America. By keeping his eye peeled for this rare conifer, Rember finally found the fossils in a small isolated pocket of sand near the end of the locality.

The fossils of trees, shrubs and vines are so plentiful and diverse that only recently has work begun on the many "microfossils" found on the site. Diatoms, pollen and freshwater sponges are the chief components of the microfossil material, according to Smiley. Most of the higher plant fossils are represented by leaves, pollen and, in some instances, seeds, cones or nuts.

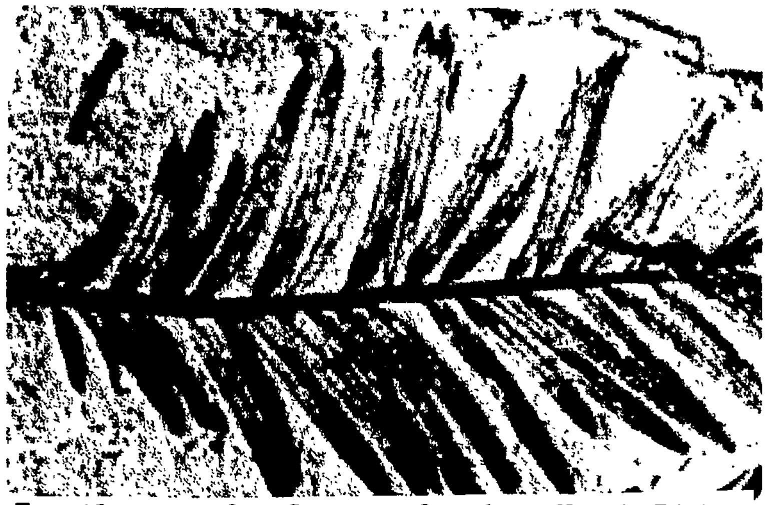
" This is an important fossil discovery of the kind you expect to find half way around the world", Smiley said. "Only, this time, we are lucky enough to have it right here in our backyard."

Rember said that in studying one lock of material of about 1.5 cubic feet, he found 1,294 fossil specimens, counting only megafossils. "I don't try to count the fossil pollen and diatoms in that sample," he said. Sheer numbers of microfossils in a block in that size would make an accurate count impossible, Rember indicated.

UI geologists find evidence of volcanic activity that produced a basaltic "dam" across a stream flowing through the present St. Maries River Valley where the site is located. The dam caused the stream to back up and form an "instant lake."

The fossils found here are of extremely high quality, Smiley said. In many cases, actual plant tissue has been preserved in such good condition that it may be compared with modern relatives by studying cell structure and leaf chemistry.

He said the lake bottom was "toxic" and had no oxygen so that the plant material and insects that dropped into the water were preserved. "Some of the leaves and beetles still have their original color when we find them. " Smiley said.



Fossil twig of a Sequoia found in North Idaho

Rember said the plant tissue can be etched from the lake bed sediment it is preserved in, but laboratory storage becomes a problem, since it is in such good condition that modern fungi will feed on it.

"We've only scratched the surface," Smiley said. "There is a lot more there waiting to be studied."

Recognizing the interest of private individuals in searching for fossils, the U. S. Forest Service has made available a site on Oviatt Creek, southwest of Elk River, for public fossil digging.

Dr. Smiley said, "This is a good place for school field trips. It is very accessible and there is a good variety of specimens to be found."

The Oviatt Creek site has been dated about 12.8 million years ago, or during the Miocene period. It was a lake which silted in and then was covered by basaltic lava, Smiley said. "It probably was a boggy meadow at the time of the lava flow."

To reach the site, travel from Bovill toward Elk River on Idaho Highway 8. Turn southwest on Park Road at its junction with the highway, about 4.5 to 5 miles west of Elk River. The junction is marked. The digging site is about three miles off the highway and is marked with a sign.

Smiley said that he or his graduate students would be happy to go with field trip groups to help explain what they are finding. "All we need is about two weeks notice." he said. He may be contacted through the UI Department of Geology.

Article published in INCREDIBLE IDAHO, Vol. 10, No.3, Winter 1978-79.

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VOLUME 59, NO. 7

CALENDAR OF ACTIVITIES FOR JULY, 1993

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 P.M.).

July 9 "Cruising the Sea of Cortez". Slide presentation by Frances Rusche, GSOC member.

July 23 "Hawaii: Geology, Sociology and Law". Presentation by Tom Matsuda, local attorney.

FRIDAY LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th floor. Social Hr., cafeteria 11:30 A.M.; Program, California Rm. at 12:00 noon).

July 2 To be announced.

July 16 To be announced.

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.).

No Seminars Until September.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S-7. Open 7:00 - 8:00 P.M. prior to evening meetings.)

FIELD TRIP: JULY 24. SATURDAY, **MT. ST.HELENS COLDWATER RIDGE VISITORS CENTER**

TRANSPORATION: BUS

COST: $28.00 includes picnic lunch at a park and coffee on the bus.

TIME: Leave from Harold and Alta Stauffer's house at 4904 NE Clackamas at 8:00 A.M. and return about 4:00 P.M. Stauffer's phone 287-1708. Further information --- call Esther Kennedy at 626 2374. Make check out to **Tourists to Anywhere** and send to Alta Stauffer by July 16th at the lastest.***THE TRIP NEEDS 30 PEOPLE TO SIGN UP FOR THE TRIP AND THE CLOSING DATE IS JULY 16TH***.

PRESIDENT'S FIELD TRIP: September 25, October 1, 1993. At this point in time the trip is full. If your interested in going, please call Esther Kennedy , 626 2374 to get on a standby list.

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P3 MEETING on Friday , July 30, 1993. Call Eveyln Pratt, Past President Chairperson at 223-2601. Meeting at Ione Plaza. Three food choices, $10.95 includes tip.

A NEW LOOK AT THE SAN JUAN ISLANDS - NORTH CASCADES

by John H. Whitmer

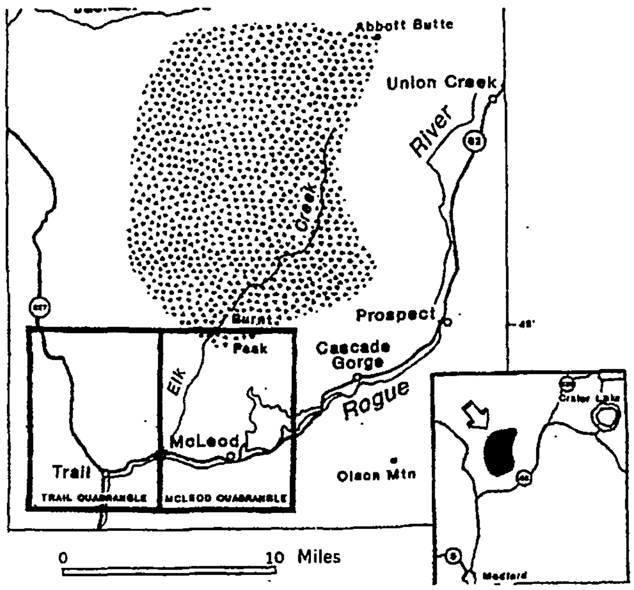
The 1993 President's Field Trip will be in a landscape that varies from exquisite to magnificent. The geology of the region is world-class, with many astonishing known geologic structures and processes and enough mysteries and unresolved controversies to challenge many future generations of geologists. Norman and Geneva Hessel led the 1977 President's campout to the North Cascades in 1977. They asembled an excellent field guide for the fine route they selected. Since then, geologists have accumulated an immense amount of information and applied new concepts of plate tectonic to the wonderful "Oregon Country." They were helped considerably by the eruption of Mount St. Helens, which did wonders for the science of Volcanology and greatly enhanced our undersanding about how the Cascades and information apply to the landscape, making it fascinating and astonishing as well as beautiful.

Nearly 7000 miles of Pacific Ocean floor has been swept (subducted) beneath the coast of Washington and Oregon and recycled into the magma. We will see how this has led to the folding and faulting of the Coast Range,the subsidence of the Puget and Willamette Lowlands, the inflation of the Cascade Range with magma, and the construction of a major stack of thrust-faulted sheets in the San Juan Islands -- North Cascade Mountains. We will see rocks that crystallized at a depth of 15 miles, indicating the scope of the North Cascades burial and uplift. We will see how a tremendous debris flow from Mount Rainier changed the landscape all the way to Puget Sound. And we will see the effect on the landscape of a glacier which extended from the British Columbia Mountains almost to Centralia. There will much to talk about and much to marvel at.

ANCIENT CALDERA COMPLEX REVEALED

Rocks of an ancient caldera complex are exposed thirty miles north of Medford. The southern margin of this volcanic feature was identified by geologists of the Oregon Department of Geology and Mineral Industries (DOGANI) who were mapping the geology of the McLeod and Trail quadrangles in Jackson County. Calderas are large, circular volcanic basins such as Crater Lake or Yellowstone. The igneous rocks beneath a caldera are referred to as a caldera complex.

The caldera complex is located four miles north of Lost Creek Lake along the upper reaches of Elk Creek in the Western Cascades. It is comprised mostly of silicic rocks,



generally rhyodacitic in composition, that define a chaotic assemblage of dikes, sills, stocks, vent breccias, and tuffs several miles across. U.S. Geological Survey (USGS) geologists led by James G. Smith reconnoitered the area during the late 1970's and determined that broad sheets of ash-flow tuff had been erupted 28 to 25 million years ago during what is referred to as late Oligocene time. They also mapped silicic intrusive stocks along the upper reaches of Elk Creek and along the Rogue-Umpqua divide. Stocks originate as large bodies of viscous igneous magma that migrate upward through the Earth's crust and sometimes breach the surface. The field evidence led the USGS geologists to first suspect the existence of a large caldera complex.

DOGAMI's new, more detailed mapping confirmed the presence of a caldera complex of great size and locally delineated its southern margin. The new mapping is sufficiently detailed to differentiate between the chaotic collage of silicic tuffs, dikes, and breccias, which is indicative of intra-caldera rocks, and bedded ash-flow tuffs, which are indicative of extra-caldaera rocks.

The size of the caldera complex has not yet been fully determined. However, similar rocks are known to crop out in a crude oval that extends approximately 15 miles north-south and 10 miles east-west. Further study will be required to determine if this tract of silicic rocks represents a single caldera system.

The original caldera shape has been nearly obliterated by 25 million years of erosion and burial by younger volcanic rocks. In most places, the rocks of the caldera complex have deteriorated from millions of years of weathering. Basalt and andesite lava flows have covered much of the caldera complex, especiually on the east side. Thick soils, landslides and dense vegetation have obscured many of the rocks of the caldera complex. These conditions have challenged efforts to map the caldera complex. Other conditions, however, have helped geologists: Elk Creek and its tributaries have cut deeply into the volcanic structure for perhaps millions of years; the Burnt Peak forest fire of 1987 removed large tracts of vegetation north of Burnt Peak; and logging roads have cut into soil-covered mountain slopes.

Caldera complexes often contain bodies of metal ore, originally deposited from hydrothermal fluids. USGS geochemists sampled the area during the late 1970s and early 1980s and determined that many of the rocks within the caldera complex were mineralized. DOGAMI geologists have found evidence of hydrothermal alteration in the rocks of the caldera complex, this time near the old Burnt Peak lookout. Eight miles northeast of Burnt Peak, the old Al Sarena gold and silver mine is thought to lie within the caldera complex. The Al Sarene Mine produced precious metals between 1909 and 1918, which were then valued at $24,000. Two years ago, the Al Sarene Mine was re-drilled and sampled by the Fisher-Watt Gold Company. Although the company decided not to pursue further exploration, company geologists did identify as much as 2 million tons of low-grade ore containing gold, silver, and lead.

The article above is a news release by DOGAMI on May 10, 1993.

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HANCOCK FIELD STATION FIELD TRIP, GSOCs, May 14-17, 1993

A group of GSOC'ers 29 strong invaded Hancock Field Station for a three day rendez-vous with nature. The three days were taken up with field trips to look at the geology of the area and the best display of flowers in many years. About 4:30 each day the group.gathered at the camp's first aid station for pre-dinner snacks, relaxation, and plenty of talk. After the evening meal some walked in the area and some participated in folk dancing. Later in the evening there was a slide show on geology and plants of different areas. One evening one of the camp teachers brought the telescope out for the GSOCS.
During he three days at Hancock the GSOCs visited and sampled the above described geology. Because of the wet spring the hills were very green and the flora was outstanding. A lot of film was used.

The pre-dinner gathering was headed up by Gale and Manuel with the rest of the group providing more goodies. In fact it could be said there was enough goodies the 29 participants could have eaten for a week and still had lots left over. All 29 GSOCs contributed to a wonderful weekend of interesting geology, beautiful flowers and great companionship. Next year we'll gather the GSOC's at the at the Hancock Field Station as we have done for the last 15 years. All are invited to attend.

The following information about the Field Station area was taken from AN INTRODUCTION TO THE NATURAL HISTORY OF HANCOCK FIELD STATION AND THE CLARNO BASIN, NORTH CENTRAL OREGON. Oregon Museum of Science and Industry Research Center, Third Edition, 1979. Editor . Bruce Hanson Permission granted to use the material.

Hancock Field Station is near the western border of Wheeler County, which is mostly range land too rough, steep or rocky to cultivate. This area supports a growth of shrubs, some dominant, with an understory of forbes (non-grass like herbs) and grasses.

GEOLOGY OF THE CAMP HANCOCK (HANCOCK FIELD STATION) AREA

by
Steve Manchester

The "Clarno Basin" is a broad lowland approximately 207 square miles, surrounded by lava-capped highlands which have been formed by the John Day River and its tributary , Pine Creek. Camp Hancock is situated approximately in the center of the basin. Here, exposed in stratigraphic succession, are the Eocene to Early Oligocene Clarno Formation, the mid-Oligocene to Early Miocene John Day Formation and the Miocene Columbia River Basalt Formation. Although no rocks older than Eocene outcrop in the Camp Hancock area, drill cores from two oil prospects in the camp area and stratigraphic relationships elsewhere in the Clarno Basin indicate that Cretaceous marine sediments exist about 3,400 feet below the surface at the camp. These sediments are tilted and eroded off to form an angular unconformity with the overlying Clarno Formation.

CLARNO FORMATION

The Clarno Formation is well exposed in the basin. Hancock sits on tuffs and clays belonging to the Clarno Formation. The Clarno was deposited during times of widespread volcanism and consists mainly of tuffs, mudstones, volcanic breccias, mudflows and andesitic lava flows. Points of particular interest in the camp area which illustrate the nature of the Clarno Formation include the Nut Beds, the Palisades, Red Hill and the Ignimbrite.

THE NUT BEDS

Located about one-fourth mile northwest of camp is a deposit of light, buff-colored sediments known among fossil collectors as the Nut Beds. These sediments consist of well-bedded tuffaceous siltstones, sandstones and conglomerated, standing out from the encasing Clarno tuffs because of their superior hardness. The abundance and distribution of fossil plant debris within the site, coupled with the stratigraphy, suggest that a lake delta deposit is represented.

Although older than most of the Clarno sediments in the Camp Hancock vicinity, the Nut Beds are higher in elevation than adjacent mudflow outcrops. An anticline has apparently uplifted the Nut Bed deposit to its present position above the younger mudflows (Bruce Hanson, oral communication, 1975).

THE PALISADES MUDFLOW

Heterogeneous mixtures of large and small rock fragments in volcanic ash area very constant and distinctive lithologic feature of the Clarno Formation. These units, know as mudflows, are generally lithified, commonly forming cliffs.

As a result of volcanic activity during the Clarno times, thick mantles of ash and other volcanic debris probably covered much of the terrain. One can imagine the saturation of such surface layers by tropical rains resulting in tremendous down-slope earth flows. These mudflows were very viscous, bouying up boulders and toppling large trees in their paths.

One such mudflow, or a series of mudflows, formed the beautiful wind-swept cliffs known as the Palisades about a mile southeast of camp. The same flows also outcrop thoughout most of Hancock Canyon. In these exposures can be found huge boulders that were carried along and large tree branches and trunks now fossilized, oriented as they were when carried by the mudflow more than 40 million years ago

RED HILL

Red Hill is the name given to a red-colored hill overlying the Nut Beds deposit. It is composed of mudstone and conglomerates in various shades of red, gray and green, now largely altered to clay. The red color of a thick upper layer has been washed over the surface of the lower layers, giving the entire hill a red color. Although best exposed in Red Hill, the same sequence of mudstones and conglomerates has also been found in Hancock Canyon (C.Bruce Hanson, written communication, 1976). The environment for deposition was apparently a quiet lake, a situation quite different from that existing at the time of earlier mudflows and lavas.

THE CLARNO IGNIMBRITE

The youngest unit of the Clarno Formation is a hard, flinty welded tuff, or ignimbrite. It is a common cliff former and is easily mapped. Because of its wide extent and relatively uniform thickness, it is used as a marker bed in interpreting stratigraphy.

Ignimbrites are formed from the cooling of hot, gaseous ash clouds released from volcanoes. Unlike normal volcanic ash eruption, the super heated material fuses together and flows when it reaches the ground, giving the superficial appearance of a lava flow, when weathered. Hand samples of ignimbrite may easily be identified from the presence of flattened pumice fragments.

The ignimbrite appears to represent the last major event of the Clarno Formation. A period of erosion without considerable deposition preceded deposition of the overlying John Day beds.

JOHN DAY FORMATION

The John Day Formation is perhaps the most colorful formation in the Pacific Northwest. Characterized by greens, reds, whites, and yellows, it is this formation that is responsible for the vari-colored strata of the Painted Hills Park, some 30 miles southeast of Camp Hancock. In the Camp Hancock area, John Day Formation is exposed along the lower slopes of Iron Mountain about two and a half miles north and below Black Butte about five miles west.

The John Day Formation consists mostly of waterlaid ashes or tuffs, with some welded tuffs and basalts. The fine grained nature of the volcanic ash, coupled with relatively fast burial, probably accounts for the abundance of well preserved fossils in the John Day Tuffs. The John Day Formation is overlain unconformably by the Columbia River Basalts.

COLUMBIA RIVER BASALT FORMATION

The youngest formation in the Clarno Basin is the Columbia River Basalt, which consists of a thick series of Miocene basalt flows. Extrusion of the Columbia River Basalts began about 20 million years ago and continued intermittently for several million years. These flows are unusual in their mode of origin. They are a plateau basalt, formed not by violent eruption, but by quiet, rapid flowing from fissures. The wide area covered by the lavas (approximately 150,000 square miles) indicates that such fissures occurred in many areas of eastern Oregon and Washington and western Idaho at various times during the Miocene.

Seventeen separate flows forming a total thickness of about 1,000 feet may be counted on Iron Mountain three miles north of the camp. No feeder dikes are known to occur in the Clarno Basin. However, a complex of multiple basalt dikes are exposed in Butte Creek, about eight miles north of Iron Mountain (Taylor, 1961)

SELECTED BIBLIOGRAPHY:

Hanson, C.B., in progress. A dissertation for the University of California at Berkeley on geology and

paleontology for the Camp Hancock area (nearing completion.(Now complete)

Taylor, E.M., 1960. Geology of the Clarno Basin, Mitchell Quadrangle, Oregon. Oregon State University Master's Thesis. 173 pp. (An excellent reference to general geology and petrology of the area. Photo copies for sale by the Oregon Department of Geology and Mineral industries, Portland.

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QUARTZ CRYSTAL PHANTOMS AND INCLUSIONS

by Rock H. Currier, Northwest Newsletter, March 1993

In the most simple terms a phantom or inclusion forms when dirt falls on a quartz crystal as it continues to grow. Of course the "dirt" was actually a coating of dust size crystals of another mineral or impurity that crystallized with silica at that particular moment. If the quartz that covers over the mineral "dust" is transparent you can look into the crystal and see he coating. The amount of dirt in the crystal is often quite small and not seen distinctly. In other words the outlined crystal often looks ghost-like, a "phantom".

If the crystal is standing straight up when the dust is deposited, the pyramid faces (roof) of the crystal are heavily coated and the prosms (sides) faintly coated. Usually the crystals are lying at an angle while the minerals are deposited. In that case the top or up faces of the crystal receive the bulk of the material. Quite often you see two or three prism faces and part of the termination dusted while the other parts of the earlier crystal can not be seen. This is because the other faces were on the bottom side and were protected from the mineral dust as it settled.

Sometimes the crystal growth cycle, mineral dust settling and continued crystal growth, repeats dozens of times. This can produce crystals with spectacular inclusions. Over time the mineral dust settling on a crystal changes in composition, leading to quartz crystal with multiple phantoms of different colors. Sometimes the dust that settles on a growing crystal is larger, visually distinct crystals of another mineral. At times the mineral dust that falls on a crystal does so when the crystal is very small and or it falls in large enough quantities to obscure the original crystal or crystals. These circumstances can give rise to "gardens" or "landscapes" of inclusions that may mimic the outline of the original crystal. If only one pure mineral comprises the inclusion, the garden color will be the color of that mineral. The color range possible with just one mineral, like hematite, can be remarkable. To the eye, visible hematite crystals are black but in fine particles they can be many shades of brown and red. When several minerals are found in a phantom or garden, each growing or being deposited in different sized crystals at the same time or different times, truly colorful and multicolored inclusion can result.

Other types of phantoms can result when dissolved impurities become included in as growing crystal. These tend to form on all sides of the crystal and not be so dependent on the angle in which the crystal is growing. If aluminum, as only one example, becomes included in a growing crystal at a particular time, it may turn that portion of the crystal smoky colored if the crystal encounters enough radiation in the ground. Amethysts and zoning in amethyst crystals are caused by similar phenomenon. Some times these impurities concentrate on only certain faces of the quartz crystal because the atomic structure of a particular crystal face will provide conditions that provide a better "home" for the impurities. You can now begin to comprehend the vast number of phantoms and inclusions possible in quartz crystals.

Phantoms are not the exclusive domain of quartz crystals but are found in all minerals. Even opaque mineral crystals have them. Phantoms are the rule rather than the exception. Even in absolutely clear quartz crystals you can usually find large numbers of phantoms if you study them carefully with sensitive scientific equipment.

Most of our phantom quartz crystals came from a mine that we worked in the mountains near a little town of Joaquim Felicio, State of Minas Gerais, Brazil. Almost all of the material has been identified as the mineral clinochlore which is often dark green in color. Red and yellow coloration is more likely caused by small amounts of various iron minerals. (Via The Rock Chipper)

HANCOCK FIELD STATION, MAY 14-17, 1993

Pictures of the area and some of the activities of the GSOCs.

1. Clarno Formation, NUT BEDS and RED HILL.
2. Hancock Field Station .
3. Afternoon Happy Hour and pre-dinner eating.
4. Gale guarding the Happy Hour Food.
5. Clarno Formation, Palisades, Part of the John Day National Monument.
6. Columbia River Basalt on the west end of the town of Fossil.

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ACTIVITIES

ANNUAL EVENTS: President's Field Trip-summer, Picnic-August,Banquet-March, Annual Meeting-February.
FIELD TRIPS: Usually one per month, via private car, caravan or chartered bus.
GEOLOGY SEMINARS: Third Wednesday, except June, July, August. 8:00 pm, Rm. S17, in Cramer Hall, PSU. Library: Room S7, Open 7:30 P.M. prior to meetings.
PROGRAMS: Evenings: Second and Fourth Fridays each month, 8:00pm, Rm. 371, Cramer Hall, PSU, SW Broadway at SW Mill street, Portland, Oregon.
LUNCHEONS: First and Third Fridays each month, except holidays,at noon. Bank of California Tower, 707 SW Washington, 4th floor Cafeteria, California Room, Portland, Oregon
MEMBERSHIP: per year from January 1: Individual, $15.00, Family, $25.00, Junior (under 18) $6.00. Write or call Secretary for membership applications.
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VOLUME 59, NO. 8

CALENDAR OF ACTIVITIES FOR AUGUST, 1993

ANNUAL PICNIC   N O T I C E !!!!!

August 13 LOCATION: Picnic will be held at the SUNDERLANDS. See enclosed map for directions on how to get there.
TIME: Come any time after 3:30 P.M. We wil eat at 6:30 P.M.
BRING: Hot dish, salad or dessert for three or more people and yourself. Bring your own table service including serving utensil. Coffee and juice will be provided.

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 P.M.).

August 27 No meeting.

FRIDAY LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th floor. Social Hr., cafeteria 11:30 A.M.; Program, California Rm. at 12:00 noon).

August 6 "Thirty-four years of Engineering in Alaska". Presented by John Bonebrake, GSOC member.

August 20 No meeting - Clay and family on camping trip.

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.).

No seminars until September.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S-7. Open 7:00 - 8:00 P.M. prior to evening meetings.)

PRESIDENT'S FIELD TRIP: September 25, October 1, 1993. At this time the trip is full, but if you are interested in going, please call Esther Kennedy, 626-2374 to put your name on the standby list.

Recommended reading in preparation for the trip:
(1) "Cascadia" by Bates McKee.
(2) "Cascade-Olympic Natural History". A Trailside Reference by Danial Mathews.
(3) "Fire and Ice" by Stephen L. Harris.
(4) "Geologic History and Rocks and Minerals" by Vaughn Livingston.
(5) "Washington Geologic Newsletter" Vol. 18, #1, 3/90
Vol. 19, #4, 12/91
Additional reading available at GSOC library.

EFFECTS OF HOLOCENE AND MODERN EARTHQUAKES IN NORTHERN CALIFORNIA

BY WENDY J. GERSTEL

On June 5, 1992 approximately 175 Friends of the Pleistocene (FOP) gathered at Patrick's Point State Park in Humbolt County, CA, for a 3-day field trip and meeting. The trip was led by faculty and students from Humbolt State University in Arcata, CA, and other geologists working in the area.

The general focus of the trip was past and recent geologic and tectonic processes along the northern coast of California. The processes relate directly to movement along faults associated with the Cascadia Subduction Zone., which also lies west of Washington. (Fig. 1). I attended the meeting as a representative of the Division of Geology and Earth Sciences. The Division wanted someone to examine the results of this tectonism to improve our understanding of the geologic evidence and hazards associated with the subduction zone and their possible relation to postulated similar events in Washington.

The tectonic regime north of Cape Mendocino in California is dominated by the Mendocino Triple Junction (Fig. 1). Subduction of the Gorda and Juan de Fuca plates under the North American plate has left a record of earthquake induced coastal subsidence and uplift (Atwater, 1987; Atwater and Yamaguchi, 1991). The Gorda and the Juan de Fuca plates converge with the North American plate at a rate of 3-4 cm/yr (Minster and Jordon, 1978). Convergence in northern California is absorbed by crustal shortening of the upper plate, at a rate approximately 3 cm/yr (Clark and Carver, 1992), in a series of oblique folds and thrust faults. Displacement of about 1 km in the last one million years has been documented through trenching investigations across several of these faults (Carver, 1987).

On the first day of the trip, we looked at evidence for the faulting associated with the Trinidad, McKinleyville, and Mad River faults, all part of the Mad River Fault Zone (Fig.2), as well as at ongoing geomorphic processes affecting the coast. A walk from the vista overlook on U.S. Highway 101 (Fig.2) down to Clam Beach and south to the mouth of the Mad River revealed textbook examples of the tectonic, geologic, and geomorphic processes shaping the coastal area. The recently eroded cliffs along the right (east) bank of the Mad River expose part of the McKinleyville fault in cross section and sediments of the Clam Beach terrace, a raised late Holocene marine terrace.

The mouth of the Mad River has been progressively migrating northward as it erodes the bluffs below the highway. We looked at the attempts of California's highway department to halt this northward progression by placing large volumes of sand and large riprap along the north and east side of the river. Although the river is temporarily confined to the constructed channel, most geologists on the trip thought it will just be a matter of time before the river re-establishes its northward migration.

The effects of this bluff and bank erosion are both positive and negative. The down side is the high cost of highway maintenance and the possible reconstruction of a segment of Highway 101. The benefits are scientific--opportunities to study the fluvial processes and to observe fresh exposures of faulting and marine terrace stratigraphy

Exposed in a sequence of strata at the mouth of the Mad River is a sequence of strata that suggests two or three sudden (coseismic) uplift events. Each of these events elevated the active wave-cut platform and at the same time displaced the shoreline westward. The newly exposed seafloor became the source for the construction of dunes, which are now exposed in the coastal bluff. The dune sequences created after each uplift event are separated in some places by a buried soil that indicates a period (interseismic) of nondeposition and weathering. The outer wood of the fossil trees rooted in the upper- most buried soil layered yielded ^{14}C ages of about 300 yr BP. A landslide deposit near the raised dunes covers a peat that developed behind the dunes. The peat provided a date similar to that of the buried trees. The landslide was therefore probably generated by the same uplift.

A visit to the Mad River Slough, a tributary to Humbolt Bay, west of Arcata (Fig. 2) gave us the opportunity to view evidence for postulated coseismic subsidence events. The northern portion of Humbolt Bay is located in the axis of the Freshwater syncline. Along with the fault zones mentioned earlier, this syncline is one of the largest features that make up the Cascadia fold and thrust belt. The relation of areas of uplift is evident all along the Cascadia Subduction Zone, including the coastal areas of Oregon and Washington. (See Shipman, 1990). At this stop, we looked at a sequence of estuarine muds and interbedded marsh peat deposits. The composite stratigraphic column in Fig. 5b shows the relation of the peat and mud layers, together with their associated ages ^{14}C ages. The existence of a peat layer does not necessarily represent a subsidence event; however,

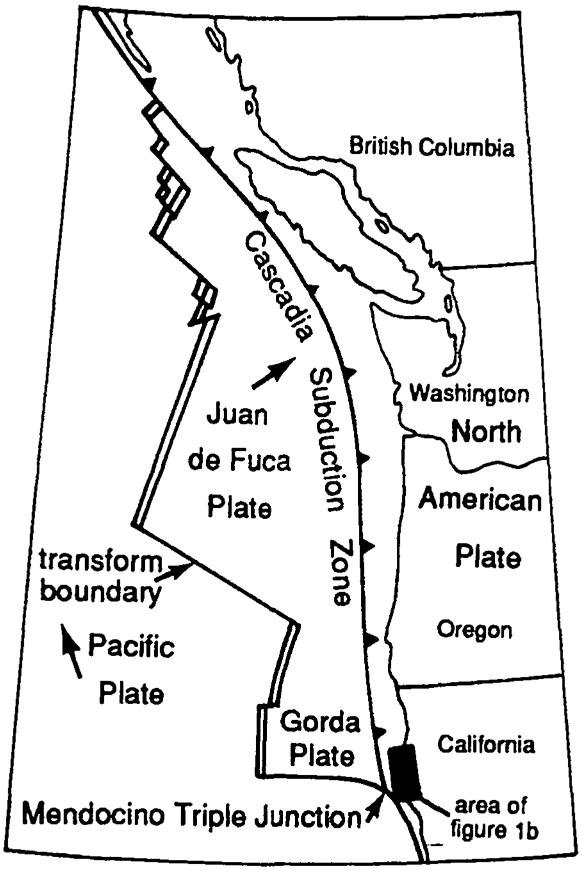

Figure 1. Diagram showing regional tectonics and relation between plates along the coasts of northern California, Oregon, and Washington.

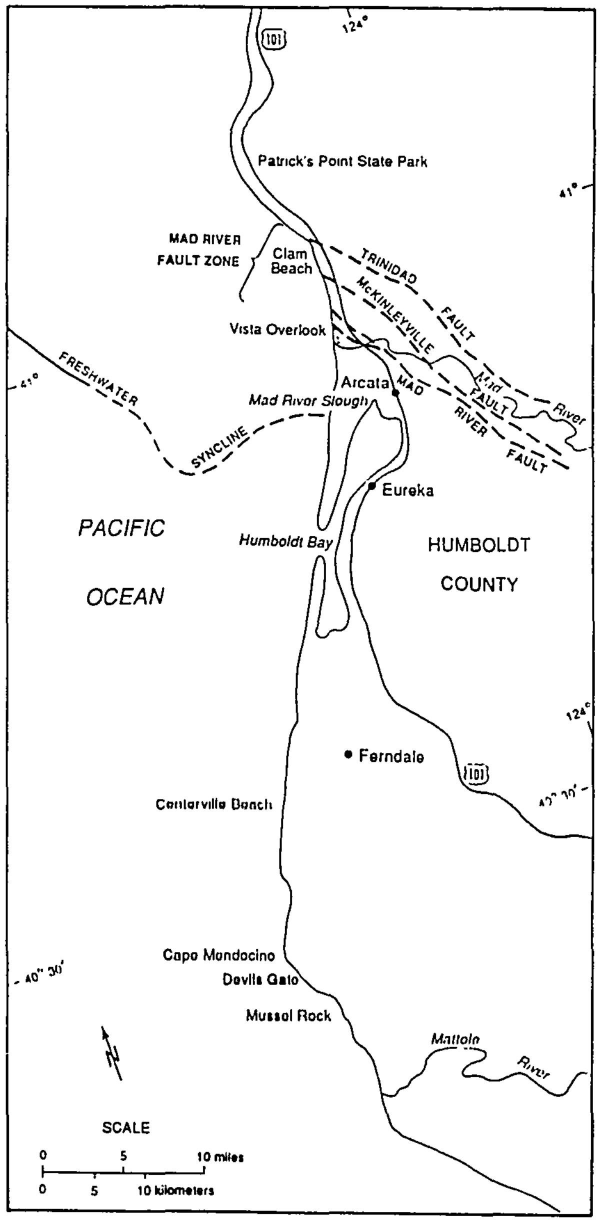

Figure 2. Map of the north coast of California and sites visited during the field trip. Fault zones are shown schematically (dashed lines) as primary active traces. The current position of the migrating channel of the Mad River is indicated by the dotted line just north of its mouth.

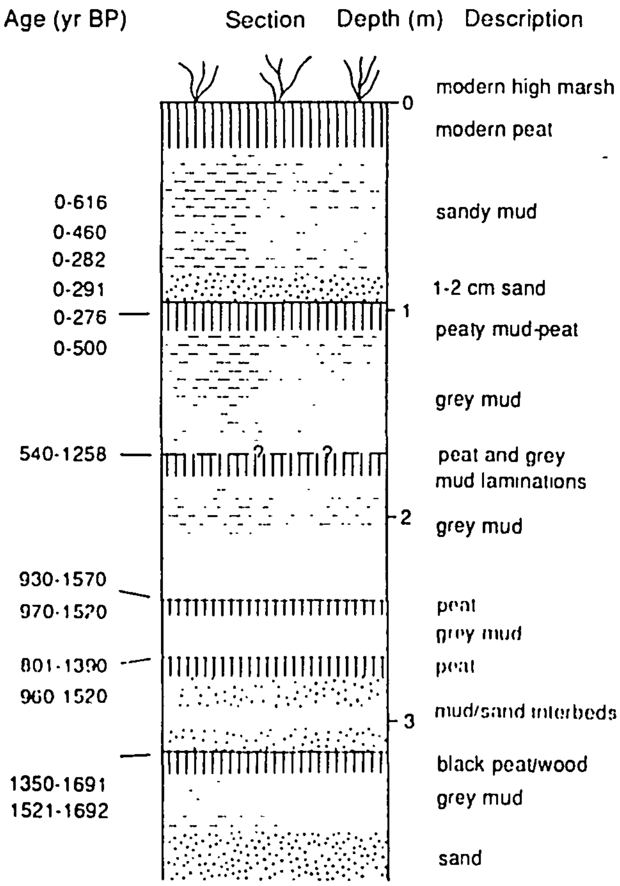

Figure 5b. Composite stratigraphic column for sediments of the Mad River Slough with ^{14}C dates for buried salt-marsh peats. Modified from Burke and Carver, 1992, fig. 6, p. 14.

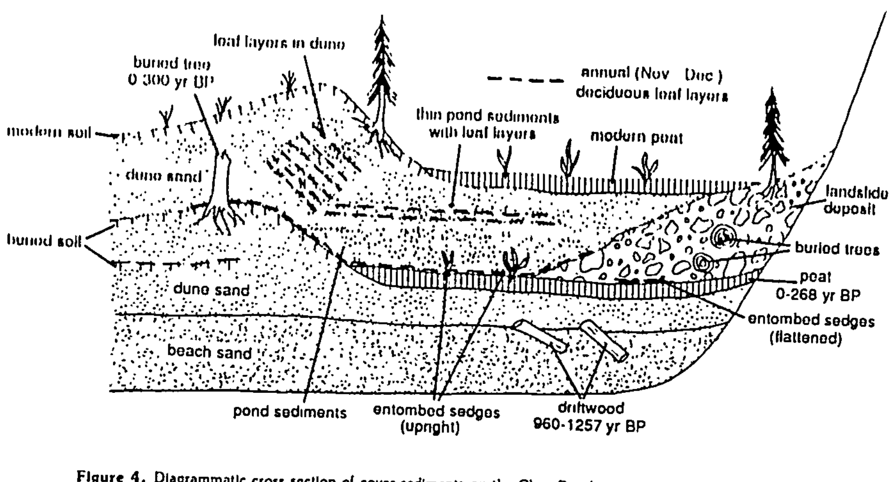

Figure 4. Diagrammatic cross section of cover sediments on the Clam Beach terrace at the mouth of the Mad River in northern California. Uplift events renewed sedimentation above the buried soils and beach sand. Modified from Burke and Carver, 1992, fig. 2, p. 10

Subsequent stops provided us with a variety of views of the surface expression and stratigraphy of the fold and fault systems. A highlight of the trip was the visit to the most recently affected coastal area. Here we saw the results of three earthquakes (magnitudes 7.0, 6.0, and 6.5, respectively that occurred on April 25 and 26, 1992. In the Cape Mendocino area, the earthquakes triggered land slides and rock falls: damaged and destroyed buildings, roads and bridges: and caused liquefaction of soils. In addition, the earthquakes created a spectacular stretch of coastline that has been raise at least 1 m. Analysis of the seismic data from the April 1992 earthquakes has led the trip leaders and other scientists to believe that the first of the April earthquakes might have been the first historic earthquake along Cascadia Subduction Zone. The data suggest that slip actually occurred along the boundary between the subducting and overriding plates, rather than being absorbed along faults within the upper (or lower) plate. This would support the argument that the plates are indeed locked during the time between earthquakes and not sliding past each other aseismically. However, the precise location of the earthquake's epicenter is difficult to determine, and each may, instead, have occurred on any one of the numerous northeast-dipping thrust faults in the area.

The stretch of the coast line that experienced maximum uplift during the most recent earthquakes lies between Devil's Gate and Mussel Rock north of the Matttole River Fig.2) . This stretch of beach offered an opportunity to view the active processes that formed the buried dunes and soils we saw at the mouth of the Mad River. A strong northwest wind was blowing during our visit to the beach site. Coarse sand from the recently exposed swash zone was being transported landward and deposited on top of the pre-existing finer beach sands. This created the unusual grain-size contrast .

As previously mentioned, further evidence of the most recent uplift is visible. The seaweed was killed when lifted out of the tidal zone; it has since turned white. The tide-line is now about 1 m lower, relative to the rocks, than its pre-earthquake position. Dead sea urchins, possibly shaken loose from their perches and washed up in a subsequent tsunami or other wave surge, litter the beach at the edge of the waves. Dead mussel beds have been recorded in the area.

A final series of stops related to the fluvial terraces along the Mattole River to the region's tectonic activity. Here, Dorothy Merritts, of Franklin and Marshall College in Lancaster, PA, discussed a proposed new model for the intricate relation that exists between stream gradient and tectonically and climatically induced base-level changes occurring in the mouths of coastal rivers. Some of the questions addressed by the model of Merritts and other (1992) include: How are strath terraces, which are cut into bedrock, formed and abandoned? Can terrace remnants be correlated along a river's longitudinal profile? and How far upstream are the effects of base-level changes transmitted?

Basing their model on the results of extensive detailed surveys of channels,bars, floodplains, and terraces of three large rivers near Mendocino Triple Junction, they concluded that, in contrast to classical fluvial response models, it is incorrect to assume (1) fluvial terraces merge with marine terraces, (2) strath surfaces form at times of sea-level highstand, and (3) abandonment due to vertical incision must occur during times of falling base level. In general, the model of Merritts and others proposes that the size and power of the river, and consequently the valley width, control the formation and preservation (0r lack of) of strath and fill terraces.

Although most current studies in Washington focus on evidence for coseismic subsidence (Atwater,1987; Atwater and Yamaguchi, 1991), areas of coastal uplift are also documented (Shipman, 1990) . Viewing first hand the consequences of coseismic uplift, subsidence, and ground shaking in northern California will help Washington geologists interpret the local stratigraphic record and more effectively evaluate and mitigate potential earthquake hazards in the Pacific Nothwest.

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The above article was taken from WASHINGTON GEOLOGY, Vol.20, No.4, December 1992 with permission. Some pictures not printed due to space limitation.

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COMPLETELY FRACTURED GEOLOGY

by Ralph & Evelyn Pratt

1. **Tufa:** not near, as in "That's tufa away."

2. **Patina**: what you say to a stubborn toddler - "If you don't get moving, I'll give you a patina rear."

3. **Rodule:** time for a Christmas nap

4. **Alate:** the reason Al's not hungry

5. **Intrusive:** when two warring factions declare temporary peace; opposed to <u>extrusive</u>, when they're battling

6. **Phreatic**: no rent charged for the top floor

7. **Aggradation:** what teenagers in a family cause a lot of

8. **Magma**: Latin for "Big Mama"

9. **Phylum**: answer to "What should I do with last year's canceled checks?"

10. **Tectonic:** a local electronics firm needs this to pep it up

*****CORRECT ANSWERS TO FRACTURED GEOLOGY ON P. 52.*****

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AFTER 87 YEARS, QUARREL OVER WHITE RIVER MAY END.

by Jill Leovy.

This article taken from The Seattle Times, Tuesday, April 13, 1993 and reprinted with permission. Pictures not printed.

Proposal would end payment from King County

Auburn - This could be the year that Pierce and King counties would put to rest the 87-year old quarrel over a river neither wanted. But the lingering suspicions may be as eternal as the river

If the quarrel is patched, King County would no longer pay thousands of dollars in annual flood - control cost to Pierce County - money it has been paying since the two feuding governments come to an uneasy agreement in 1914.

The rift dates back to one morning in 1906, after days of dreadful floods, when north Auburn settlers awake to an astonishing sight: The mighty White River - cause of so much of their woe had disappeared.

Instead of roaring north through Auburn to join the Green and Duwamish rivers, the river was flowing south- and was to do so forever after.

It didn't take long for flood weary Auburnites to decide the new landscape was good. To make sure it stayed that way, they built a dike.

No more were King County's farmers to be tormented by relentless floods of the White River. Instead, they had a brand new strip of gravel on which to build Main Street.

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++'I couldn't get a straight story on it.' Josie Emmons, author of a history of Auburn, on what caused the White River to change course.

++++++++++++++++++++++++++++++++++++

But down south, in Pierce County, that strange day took lives and transformed cropland into vast, shallow lakes. There, farmers seethed, even as neighbors to the north rejoices.

What cause the diversion? Rumors of foul play still bubble. But most hold to the story that a log jam of debris from upstream blocked the river's course and sent spilling down a new channel to the south.

What's clear is that diversion forever changed the history of Auburn Valley, said Gary Reese, local historian and manager of special collection at Tacoma

Since 1906, the White River has flowed mostly within the borders of Pierce County. It has doubled the volume of water in Puyallup River Basin and has prompted considerable diking and grooming downstream, said Tim Ramsaur, of Pierce County's river systems management.

Under the 1914 compromise, which was the outcome of court battles and legislation, King County was to pay a larger share of the costs of flood control on the river. But if the proposed amendment to the so-called Inter-County River Improvement agreement passes this year as planned, 70 years of payment will come to an end.

Though some cooperative efforts would continue, for the most part the two counties would part ways - King would manage its three miles of river north of the border, leaving Pierce to handle its 11 to the south, said David Clark, section manager of King County river program.

In some way, the amendment would close the book on the historic feud.

But dispute over how the cataclysm come to pass in the first place may never be settled.

"I couldn't get a straight story on it," said Josie Emmons, who wrote a history of Auburn for its centennial two years ago.

Emmons said conventional wisdom is that the logjam alone was enough to force the river southward where it joined the smaller Stuck River and flowed into the Puyallup. But retired Auburn schoolteacher, Edith Peterson-who was 11 at the time- said she remembers differently.

"It was done purposefully," she said, a little slyly. Peterson said several young men from Auburn, sick of floods, dynamited a hillside and blocked the river. How does she know? Her father told her, she said.

Historian Reese said the truth is clouded by folklore. It's common to try to blow up logjams to release them, so dynamiting may not have been done for mischievous ends, he said.

Reese, though, won't rule out human intervention: "There was a lot of pushing and shoving at the time"

Perhaps the rumors contributed to what King County's Clark calls acrimonious relations between the two counties following the 1914 agreement.

Such things cast a long shadow: Although both sides claim relations are much better than they were, disputes persist.

In recent years, for example, Pierce County has accused King County of shirking its bills. King County paid about 3.3 million of the 6.1 million spent on the White River flood control between 1914 and 1986-somewhat less than the 60 percent it owes, said Ramsaur. And for the past several years, King County has declined to pay its bills, period.

"We were asking them (Pierce County) to document how they were spending it and they never did," explained David Clark.

Both Clark and Ramsaur seem hopeful that the whole issue will go away soon with the approval of the amended agreement by each county's council. And that would probably suit those Auburn farmers just fine.

According to schoolteacher, Peterson, they never really wanted to say much about the radical new course of the area's largest river. "Would you?" she asked.

CORRECT ANSWERS TO "COMPLETELY FRACTURED GEOLOGY"

Modified from Dictionary of Geological Terms, 3rd Ed., AGI, Bates & Jackson

1. **Tufa:** calcareous & siliceous deposits of springs, lakes, & ground water

2. **Patina:** thin layer producedon surface of rock or on copper, formed by weathering

3. **Nodule:** small lump of mineral in a rock matrix of differing composition; also, manganese lumps on the ocean floor

4. **Alate**: winged or winglike; said of some fossil brachiopod shells

5. **Intrusive:** having to do with the emplacement of magma in pre-existing rock; extrusive describes igneous rock erupted onto earth's surface

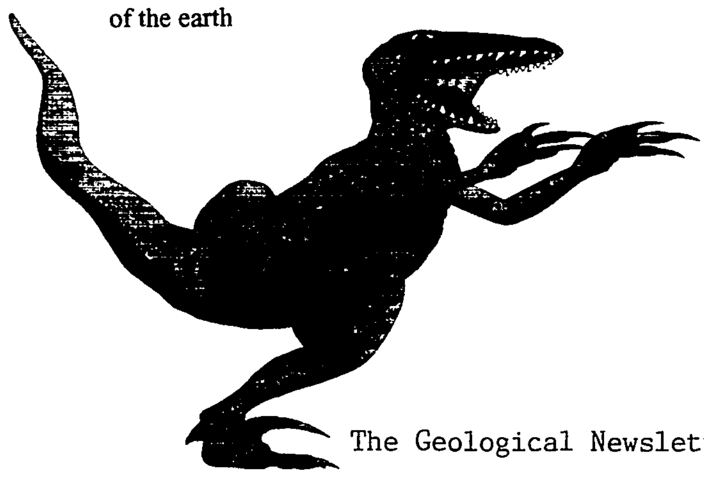
6. **Phreatic:** pertains to ground water

7. **Aggradation:** the process of building up a surface by deposition

8. **Magma:** molten rock within the earth

9. **Phylum:** one of the broad categories used in the classification of living things

10. **Tectonic:** having to do with major structural features nd deformations of the outer part of the earth



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THE GEOLOGICAL NEWSLETTER

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ANNUAL EVENTS: President's Field Trip-summer, Picnic-August,Banquet-March, Annual Meeting-February.
FIELD TRIPS: Usually one per month, via private car, caravan or chartered bus.
GEOLOGY SEMINARS: Third Wednesday, except June, July, August. 8:00 pm, Rm. S17, Cramer Hall, PSU. Library: Room S7, Open 7:30 P.M. prior to meetings.
PROGRAMS: Evenings: Second and Fourth Fridays each month, 8:00pm, Rm. 371, Cramer Hall, PSU, SW Broadway at SW Mill street, Portland, Oregon.
LUNCHEONS: First and Third Fridays each month, except holidays at noon. Bank of California Tower, 707 SW Washington, 4th floor Cafeteria, California Room, Portland,Oregon
MEMBERSHIP: per year from January 1: Individual, $15.00, Family, $25.00, Junior (under 18) $6.00. Write or call Secretary for membership applications.
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CALENDAR OF ACTIVITIES FOR SEPTEMBER, 1993

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 P.M.)

Sept. 10 "Costa Rica - Land of Peace and Beauty". A slide presentation by Lois Sato, GSOC member.

Sept. 24 No meeting.

FRIDAY LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th floor. Social Hr., cafeteria 11:30 A.M.; Program, California Rm. at 12:00 noon).

Sept. 3 No meeting.

Sept. 17 "Two Sides of the Baltic Sea". A slide presentation by Helen Nelson, GSOC member.

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.).

Sept. 15 "Geologic Time - Relative and Absolute Dating Methods". An illustrated presentation by Richard Bartels.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S-7. Open 7:00 - 8:00 P.M. prior to evening meetings.)

PRESIDENT'S FIELD TRIP: September 25 through October 1.

The trip is in the final stages of planning! A letter of information will be mailed to each person or couple. One thing to start thinking about is, the bus is full which makes it imperative to limit baggage. No trunks on this trip!

If anyone did not register in time and still is interested in going, get your name on the waiting list. Who knows I may not go!

Any questions? Call Alta Stauffer 287-1708 or Esther Kennedy 626-2374.

CITIES AND GEOLOGY

by Robert F. Legget

Review by Rosemary Kenney, Past President GSOC

Most cities have developed in too much of a rush to pay regard to the natural environment, particularly to geologic conditions. It is very often forgotten that the geological history of land is so important as a guide to city planning. Without accurate knowledge of subsurface conditions beneath the land that is to be used for city growth, sound planning cannot be carried out. Neglect of geological structure can lead to serious economic loss.

Rome was thought to have a population of 1 million people by A.D. 100, then declined. In 1800, there was no more than 50 cities in the world with a population of more than 100,000, and only one city with more than 1 million inhabitants - The City of London. In 1900, there were only 12 cities with over 1 million population. Today, there are more than 100 cities with more than 1 million people, 27 with more than 3 million, and a few with 5-7 million.

Hammurabi of Babylon (2067-2025 B.C.) stated "If a builder build a house for a man and do not make its construction firm and the house which he built collapse and cause the death of the owner of the house, that builder shall be put to death... If it destroy property, he shall restore whatever it destroyed and because he did not make the house which collapsed at his own expense." The Code of Hammurabi was probably the first set of building regulations ever recorded. They date back almost 4000 years.

Ancient cities grew from small settlements, founded for clearly recognizable reasons: near the sea coast, near the mouth of a river, near conenvient crossings for fords of rivers, supply of good drinking water, site for natural defense security, supply of good building material, and the development of mines are all results of local geological conditions.

Some cities just grew, with no planning of any sort. With others, building was carried out in defiance of nature of which time has taken its toll. The major part of city planning is to have a balance in the distribution of industries and population, both within cities and between cities and county districts, transportation facilities, community facilities, public utilities, housing and public buildings, aesthetic values, and natural environment are all considered. Geology is one of the most vital parts of this complex process. Knowledge of what the surface ground looks like, what lies beneath the surface, character of the materials that make up the land on which the city is to grow and the position and nature of the water in the ground beneath the site are all very important.

A new city can never be planned or designed in total disregard of its environment. Flood plains appear to be ideal areas for building but they provide difficult and expensive problems for building foundations, and there is always the potential hazard of flooding. Sloping ground that appears to be stable may be underlain by clay or are scars of old landslides. Limestone regions may have natural caves beneath the surface. Leaching of salt beds by ground water may cause settlement of ground surface.

Great Britain contains more varied geological conditions for its size than any other part of the world. Many cathedrals of England have suffered from foundation trouble. The towers of Winchester, Gloucester, and Worcester fell in the 12th century. York Minster, one of the largest medieval buildings in northern Europe, has serious cracks in the superstructure, and there is differential settling due to a stratum of brown clay.

The Tower of Pisa has its foundation problems. New York City developed from a small Indian settlement of Manhattan that was founded on the rocky island between Hudson River and Long Island Sound. Skyscrapers are proof of sound and strong foundations beds.

Some geological hazards are man-made. Venice is located at the head of the Adriatic Sea. Three local river were diverted, a sea-protection wall was built, and the city gradually developed by building upon the mud of the lagoon. There is now a progressive subsidence of the bed of the lagoon due to the pumping of ground water from the aquifers beneath it. There are many examples of subsidence due to mining. In England, a steam locomotive suddenly disappeared into old coal workings. Pittsburgh, Pennsylvania has problems with old coal mining shafts. People in Helena, Montana, have to be careful when digging basements for home because, of old gold mines.

When early man was unable to use caves for shelters, he was forced to find building material: wood, grass, soil to make adobe and bricks, and stone. Metals are obtained by the refining of ores mined from the ground. Trees that supply lumber are grown in soil, asphalt used in road construction comes from natural asphaltic deposits or from refining crude oil.

Every structure transfers the load it carried to the ground beneath it. Beneath every building, roadway, bridge, airport, railroad, there must be geological strata that is adequate to support the loads that these structures have to carry.

Geological conditions at any building site may be one of three general types:

1. Solid rock may be exposed at the surface or lie close to it so that structures can be built upon rock with minimum excavation. New York city is a good example.

2. Bedrock may lie below the surface at such a distance that piles or caissons can be used. Chicago is built on Niagara dolomite 30 m below ground surface.
3. Bedrock may be so far below the surface that it would be uneconomical. sometimes impossible to transfer loads to it. so all foundations must rest upon overlying strata. Bedrock at Saskatoon. Canada. is 1000 m below the surface of the ground.

Water supply and installation of the necessary pipes or tunnels in proper relation with the street layouts: the interrelationship of roadway arrangements to give convenience and efficiency to traffic. installation of necessary traffic controls at critical locations before roadways are finished. location of bridges so that they don't interfere with later installation of services. whether electrical power-supply cables are to be buried or suspended from poles. all depend on geological conditions underlying the site.

Tunnels, old mines. underground quarries. large underground excavations are not all bad. Many are used for other purposes: underground factories. underground storage areas. mushroom farms. underground marine docks. underground security systems. and underground power houses and pumping stations of hydroelectric projects are just a few.

So. without good geological planning. there are many hazards to cities: landslides: volcanic action; geologically active faults and slides: earthquakes: tsunamis; floods; mud flows: rock falls and slides; avalanches; sink holes; subsidence due to mining: soils: extraction of ground fluids; swelling of soils and rocks; changing sea levels; and permafrost and other temperature changes.

This is a fascinating book. I would recommend it to everyone, not just city planners.

WESTSIDE MAX FACTS GEOLOGY

The following material taken from WESTSIDE MAX FACTS: Going Underground: Design moves forward for the West Hill Tunnel.

GEOLOGY

Tri-Met has drilled more than one hundred holes. some more than 300 feet deep. to sample the subsurface soil. rock, and groundwater conditions that will be encountered during tunnel construction

This geotechnical exploration revealed the geology of the West Hills tunnel to be widely varied. Conditions range from hard rock to soft silt deposits. with abrupt changes in geology within short distances.

For about two miles. from the east tunnel portal to the Sylvan area. the tunnel will pass layers of Columbia River Basalt. a rock unique to the Pacific Northwest that dates back 13 to 17 million years.

West of Sylvan the subvsurface changes to Sandy River Mudstone. a finely grained silty clay. and Boring Lava. a harder and more stable rock. Along the alignment. Sandy River Mudstone is layered with Boring Lava. recording the turbulent volcanic activity that took place in the West Hills millons of years ago. Rock conditions change in the Sylvan area, presenting tunnelers with "mixed face" conditions--rock types of different texture. age and density combined with soil layers within the tunnel area.

WHAT ABOUT COPPER

Those pretty blue and green stains you often see on rock outcrops when on a field trip are known as "copper bloom" and they can be a guide to finding copper and its associated minerals. Copper is usually found in rather distorted. perhaps rounded. and complex crystals. The predominant crystal forms are cubes. Dodecahedrons and octahedons. however. sometimes they are hackly masses which are interesting. for there are unusual shapes---sometimes a man laughing. a dog or any other identification you might choose to make.

Everyone is familiar with the lovely color of pure copper; in fact, it is often used as an identifying term for associated colors. It can have a metallic luster, and while the hardness is only 2.5-3.0, it is very heavy, with a gravity of 8.9 and. like silver and gold. is malleable and ductile. Copper will lose the lovely " copper-red" color when exposed to air. in much the same way copper penny dulls after time. but you can always clean it and restore the beauty.

Copper is extremely important today as it has been since the earliest recorded history. Because of its excellence as an electrical conductor it is used in much of the electrical equipment so prevalent today. Can you imagine what it would be like not to have copper available for the power lines which bring the electricity into your homes from the generating source. How much we take for granted?

When copper is alloyed with zinc, you have brass. and for bronze you combine copper and tin. Much of the popular magnesium metal is alloyed with small amounts of copper because it makes it more desirable. There are really too many uses for copper to attempt to name them all. but it can be fun for a Trivial Pursuit sort of game to see just how many you can name.

The most famous area for large amounts of native copper is the Keweenaw Peninsula in Michigan. It has been mined for over a hundred years along the shores of Lake Superior. One huge mass was found which weighed about 420 tons. Native copper can also be found in shale in the Michigan area.

"Copper glance" chalcocite, is valuable copper ore. (Chalcocite in ore deposits, contain approximately 2 - 3 % copper, and when in pure form, such as crystal aggregates, the copper may be as high as 80%. Editor) However, when processed on a large scale, a tremendous amount of rock must be minted to obtain even a pound.

Most everyone has heard of peacock copper, but how about purple copper ore or variegated copper ore? All of these names describe Bornite, which is named for the Austrian mineralogist Von Born. This is easily identified by the bright iridescence, that often brings exclamations of pleasure at seeing such beauty.

If you haven't seen a Half Breed, you should !! True, some of them are more like nuggets, but when you see a truly lovely Half-Breed, you will see copper crystals combined with silver crystals, and they are something to behold. Even those who claim to only like cutting material will appreciate such beauty, and perhaps even want to decorate a shelf or table with a specimen.

Copper is widespread, and is always associated with various copper sulfides, which can interesting in themselves.

The article on What About Copper appeared in the Northwest Newsletter, Northwest Federation of Minerlalogical Societies,May 1993. No author mentioned.

THE BOILING JAM THEORY OF PLATE TECTONICS

(I thank Rolly Reid, geology professor at the University of Idaho, for introducing me to this concept.) author:

John H. Whitmer, M.D.

Those who were blessed with mothers who made jam have no trouble comprehending sea-floor spreading and subduction. We need only to visualize that wonderful sight of boiling jam with its restless bubbling and diverging currents. We remember how the hot jam rose in the center of the pan, causing an elevation of the surface of the fluid, with current moving swiftly away from that center of activity. The turbulence and bubbling made a foamy scum which floated persistently and accumulated in nearby depressions where surface currents converged. Those of us who were interested in physics, later learned with delight that these were convection cells, powered by the heat of the stove. Hot jam expanded and became less dense, rose to the surface, where it cooled, and moved away as the rising current displaced it and as gravity pulled it down the subtle surface slope. After traveling only an inch or two it cooled enough to become more dense than the hot jam beneath it, and it sank into a downwelling zone. The scum was too buoyant to sink: it accumulated in a light-colored mass where the surface currents converged.

The same process of physics operated in our earth on a gigantic scale. Earth's core severs as the stove which heats the mantle, causing convection currents. Thermal expansion causes the actual elevation of the surface of the mantle in the zone of upwelling. Cooling at the surface occurs; the cooled mantle becomes more dense and is drawn by gravity toward a downwelling zone, where it sinks rapidly. The continental crust, which averages 21 miles thick, corresponds to the scum on the jam. It formed by separation of the less dense minerals, those rich in silica, which are too buoyant to sink with the mantle convection currents. Mantle currents diverge from the upwelling zone (the oceanic rift) and converge at the downwelling zones, which are actually depressions on the mantle surface. Any silica-rich material which floats on the mantle will be carried inexorably to the depressions at the downwelling zones to accumulate there. This is what causes continents to form. Continents continue to grow as new "scum" is rafted toward them on the surface of the mantle and "accrete" or are "docked" upon the new continental margins. The rocks which result are not only lighter in density than oceanic rocks, but they are also lighter in color, having a smaller proportion of heavier, darker minerals. This process continues until the locations of the convection cells change. There have been super continents (Pangea; Gandwana) in ages past. However, when a continent reaches a certain critical size, it impedes release of heat from the underlying mantle, which increases in temperature and buoyancy until it begins to rise. What had for hundreds of millions of years been a downwelling zone becomes an upwelling zone and a spreading center. Then, diverging mantle currents tear the continents apart in a process which can be seen today in the Great Rift of Africa and in the Rio Grande Rift in Colorado and New Mexico.

Although we depict sea-floor crust as rigid plates, it is a mere surface membrane on the mantle when its average thickness (about 3.6 miles) is compared to the size of the earth. It moves with the mantle and is dragged beneath continents when mantle convection cells take it that way. The farther it travels from a spreading center (ridge) , the cooler it becomes, therefore more dense and inclined to sink. Ocean depth tends to be least at the ridges (spreading centers) where the crust and mantle are the hottest, most buoyant and most expanded. With increasing distance from the spreading center, oceans depth increases as mantle/crust temperature, buoyancy and expansion decrease. In some places, e.g., Iceland, an oceanic ridge rises above sea level. The depth of the old ocean basins is typically about 16,000 feet. However, the sea floor adjacent to the continental margin of Washington and Oregon is 9,000 feet below seal level and considerably warmer because of its shorter distance from the oceanic (Juan de Fuca) ridge. This makes our Cascadia Subduction Zone an unusual one and our Oregon Country unique.

THE PLEASURES OF AGE

Our Writer counts the ways
by Robert MacKenzie.

The pleasures of age are not less than the pleasures of youth, according to Somerset Maugham. who noted this when he had a lot of rings on his own tree. The novelist and playwright did allow. though. the pleasures of age are different from those of youth.

Assembling my own list of the pleasures one experiences with accrued mileage, I include the following:

1. You get to learn how everyone turns out. If life is sometimes like a slow movie, it's only by living a while that you see the plot play itself out. You watch the vitues, flaws and foibles of your friends, relatives and enemies lead to their consequences, good and bad. You find out whether it's true that nice guys finish last and how many cooks it takes to spoil the broth. And, of course, you are witness to your own unfolding drama or comedy. With any luck, by the time the fat lady sings, you have seen quite a show.

2. You stop doing things you don't enjoy, to please people you don't like. If standing around at a cocktail parties listening to strangers and distant acquaintances talk about the properties they have bought for a song is no longer you idea of fun, one day you simply stop doing it. If squeezing onto a jammed dance floor to gyrate to viciously overamplified music is something you stopped enjoying sometime in your youth but kept doing it because you thought that you were supposed to...well, sometime in maturity you wake up to the blessed revelation that you never have to do that again. Drop that invitation gently into the circular file, step out onto the porch and enjoy the sunset. Ah, Silence.

3. You learn you don't have to win the arguments. Hildy, a friend in her late 60s, said it this way: "I still have passionate opinions, but I'm not longer interested in arguing with all the people who aren't smart enough to see it my way. Let them rant. When they're bellowing away at some totally wrongheaded notion as though their entire ego structure depends on being right, I just smile and say, 'Hmmm'. It drives them crazy, and saves my breath"

4. You start choosing comfort over style. After a life time of aching feet, there comes a moment in a woman's life, when she packs her high-heeled shoes into a cardboard box and happily sends them off to the Salvation Army—keeping a pair or two for the occasional party. My mother, who used to say " You might as well be dead as out of style," arrived at great wisdom later in life—she kept only a few chic outfits in the closet, mainly for morale purposes, and opted for an old sweater and a pair of sneakers. Finally , you reach the highest fashion plateau of all, that realm of serene enlightenment in which you know how comfort is style.

5. You start getting a lot of help. Theaters, thrift shops and bus lines begin offering discounts long before your decrepit. The children who were so much work to raise actually start doing some work. For their parents. Sometimes. And even strangers pitch in "All I have to do is look a little helpless." says Hildy. " a bit stooped and confused. you know. and there are people wanting to carry my bags, drive me to the store and do my laundry. It's wonderful."

6. You learn about love---the long-haul kind that gets deeper and richer as the years pile up. It can be a friendship that outlasts the strains and the changes. "A friend is someone who knows all about you and still likes you." as the saying goes. And for the luckiest of us, it can be an enduring relationship with someone of the opposite sex. We all know widows and widowers who aren't interested in marrying again because they got and gave enough love in their marriages to last a lifetime.

7. You get the irreplaceable satisfaction of having been there, of having fought the fights and bitten the bullets and learned the lessons. Even if we only get partway up the mountains, we can look back and see the valley, smog and all. I'm thinking of the 97-year old grandfather of a good friend. He is confined to a nursing home these days but is sharp as a razor and a delight to visit. He is pleased to have done what he did and been where he has been. But ask him how the rest of us can get to 97, and he just grins. :Stay out of traffic, he says **The above article was sent in by Dr. John E. Allen, PSU. It is not geologic , but should be of interest to many in the Society.**

GEOLOGY DICTATED TRAVEL ROUTS

by Jim Evans , of the Baker City Herald

Permission to reprint this article was given by the Editor, Dean Brickay.

Pioneers and settlers learned early that geology determines where you can travel, camp, farm, or build cities and roads.

These factors were especially important as emigrants following the Oregon Trail crossed Eastern Oregon mountains, forded its streams and skirted its rock outcrops and wetlands.

Geologic maps show that mountains in America generally run north-south. Migrants headed west had trouble finding suitable passageways through those ranges.

But in the Northwest, the Columbia River has for eons been cutting through the Coast Range and the Cascades, opening areas east of the mountains to the Pacific Ocean via the river's gorge.

Land in the Willamette Valley was relatively flat and well-watered, and thus attractive to farmers and trappers.

But look now at Northeastern Oregon. Mountains here developed not always a North-South orientation. Pioneers had to pick their way through the rugged country however they could. Geology dictated their route, evidenced by modern Interstate 84 which follows basically the pioneer route. Wagons and cars had the same problem.

Travelers then and now enter Oregon near Ontario in the Snake River Valley. Pioneers left the river there to avoid the dramatic but rugged Hells Canyon country, a route still too tough for major roadways.

Northeastern Oregon has 14 valleys and several mountain ranges with peaks in the 8,000- to nearly 10,000 foot class.

Malheur County

Geologically, this sprawling county is largely an old lake bed, which explains the many hundreds of level farm acres.

Mark Ferns, head of the state geology office in Baker City, said increasing numbers of America and foreign geologists are studying the area.

Traditionally Eastern Oregon gold mining has centered on placer or hard rock mining operations, but Malheur County is the site of a proposed open pit mine.

Wallowa County

Wallowa County is known for its mountains, canyons and scenery. The Wallowa Mountains are often called "The Switzerland of America."

A popular attraction is the gondola that rises from near Wallowa Lake to 8000-foot Mount Howard.

Deep in Hells Canyon is the historic site of Chief Joseph's crossing of the Snake River during the Nez Perce tribe's dramatic flight from the "Land of Winding Waters" during the 1877 war.

In Joseph, visitors can see the internationally famous Valley Bronze foundry.

Other attractions include Wallowa Lake and the loop road over the mountains to Halfway. The lake was formed when a dam of glacial ice debris blocked the Wallowa River.

Grant, Umatilla and Union counties each have varied geology and many attractive features.

Roads are often paved, but given the high elevations weather can change dramatically in a short time.

A picture that accompanied this article wouldn't print good enough to in be included. The information included with the picture describes: The ruggedness of the Elkhorn Mountains offer a good example of how geology dictated travel routes for the pioneers. Because waterways always follow the easiest path downhill, early western explorers generally followed streams and rivers uphill and down. Pioneers followed the trails blazed by the explorers

ANCIENT USES FOR MINERALS

It is always interesting to learn about the stange ways in which minerals have been used. TIN, for instance, has been mined for thousands of years. The Phoenicians and other ancient people mined tin at the famous mines at Cornwall, England, and from that time till this, tin has been an important metal in the progress of civilization. Perhaps the most unusual use of tin was additive to put rustle in silk cloth. The luxurious swish of a lady's skirt in the era of elaborate clothes at the turn of the century was produced by a silk that was up to 25% tin by weight.

One of the strangest uses of lead ever recorded is found in the story of the Hanging Gardens of Babylon. This wonder of the ancient world was contained in a square four hundred feet on each side and built as several large terraces which attained the height of the city walls. The whole pile was supported by arches, one above the other, strengthened by a wall twenty-two feet thick surrounding it on all sides. On the top were first laid large flat stones, sixteen feet long and four feet wide. Over these was laid a layer of reeds mixed with a great quanity of bitumen upon which were set two rows of bricks cemented closely together. The whole garden was covered with thick sheets of lead upon which laid the mold of the garden and soil deep enough to take roots of the biggest trees. Amyitis, the wife of Nebuchadnezzar, longed for the hills and forest of her native land and her husband to please her, built this magnificant structure. The ancient garden with its lead shielding suggests a plan for a modern bomb shelter.

We are all familiar with the crystal ball of the fortune teller, cut from flawless quartz. Another more practical use for these smooth spheres was discovered by the oriental needle workers. These woman, skilled in the art of embroidery, used the balls to cool their hands and prevent moisture from soiling the fine silks on which they worked. The long slender crystals of selenite from the Cave of the Swords at Naica in Chihuahua, Mexico are beautiful to look at but they also have been put to practical use. Some of the crystals retain the water of crystallization in the form of a bubble in which the water moves to and fro. These crystals have been used as hand level by the native miners.

Obsidian is today one of the favorite cutting materials of lapidaries, and many interesting things can be done with it. One of the projects of the early Aztec stone worker was a mirror for his lady. Pieces of obsidian were so perfectly polished and fitted together there was no distortion in the reflected image, which of course, was very dark or black. Mirrors of the ancient Greek and Inca craftsmen were made of copper, silver, or bits of pyrite or marcasite, neatly fitted into wooden frames and then smoothed and polished. **This article appeared in the NORTHWEST LETTER**

Archaeopteryx

OCT 93

THE GEOLOGICAL NEWSLETTER

GSOC

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ACTIVITIES

ANNUAL EVENTS: President's Field Trip-summer, Picnic-August,Banquet-March, Annual Meeting-February.
FIELD TRIPS: Usually one per month, via private car, caravan or chartered bus.
GEOLOGY SEMINARS: Third Wednesday, except June, July, August. 8:00 pm, Rm. S17, Cramer Hall, PSU. Library: Room S7, Open 7:30 P.M. prior to meetings.
PROGRAMS: Evenings: Second and Fourth Fridays each month, 8:00pm, Rm. 371, Cramer Hall, PSU, SW Broadway at SW Mill street, Portland, Oregon.
LUNCHEONS: First and Third Fridays each month, except holidays at noon. Bank of California Tower, 707 SW Washington, 4th floor Cafeteria, California Room, Portland,Oregon
MEMBERSHIP: per year from January 1: Individual, $15.00, Family, $25.00, Junior (under 18) $6.00. Write or call Secretary for membership applications.
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VOLUME 59, NO. 10

CALENDAR OF ACTIVITIES FOR OCTOBER, 1993

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 P.M.)

Oct. 8 "Geological Nature of the Bonneville Dam Area". Presented by Jim Griffiths of the Army Corps of Engineers.

Oct. 22 "The Shifting Oregon Coastline". Presented by Dr. Kenneth Ames, Department of Anthropology, Portland State University.

FRIDAY LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th floor. Social Hr., cafeteria 11:30 A.M.; Program, California Rm. at 12:00 noon).

Oct. 1 No meeting.

Oct. 15 "Geomorphology and Stratigraphy of Soils in the Willamette Valley". Presented by Frank Reckendorf, Sedimentation Geologist, Soil Conservation Service, West National Technical Center.

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.).

Oct. 20 Slide presentation of the Grand Canyon.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S-7. Open 7:00 - 8:00 P.M. prior to evening meetings.)

FIELD TRIPS

No trips scheduled for October.

NOMINATING COMMITTEE APPOINTED AT LAST BOARD MEETING:

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Gale Rankin
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Margaret Steere
Rosemary Kenney

Insects of the Klondike Mountain Formation, Republic, Washington

by Standley E. Lewis
Dept. of Biological Sciences, St. Cloud State University
St. Cloud, MN 56301-4498

Records of Tertiary insects in North America have appeared in the literature for more than a century (for example, Scudder, 1890; Cockerell, 1915; Wilson, 1977; Kevan and Wighton, 1983; Lewis, 1989). A recent search of this literature shows that at least 133 sites are known in 17 states, and insects from several more sites in Canada have also been reported (Lewis and Heikes, 1991). Almost half of these sites are in rocks of Eocene age, and most of the Eocene localities (Lewis, 1989) are concentrated in Colorado and Wyoming (Fig. 1). Until recently, little study has been focused on the Eocene insects of Washington.

The lakebed strata of the Republic area are a bonanza for students of fossil insects. Through early 1992, these middle Eocene rocks have yielded at least 546 insect specimens, now available for study at the University of Washington's Thomas Burke Memorial Washington State Museum in Seattle, St. Cloud State University in St. Cloud, MN, and the Stonerose Interpretive Center in Republic. These specimens encompass at least 13 extant orders and 27 families (Table 1). The fossils represent both adult and immature forms of aquatic and terrestrial insects. The most common fossils are specimens representing an order that includes the spittlebugs, leafhoppers, and aphids (Homoptera) and an order that is made up of the true flies (Diptera). Each of these orders represents about 30 percent of the fossil fauna. Table 1 indicates the abundance of each group.

The Republic site has yielded the earliest Eocene records (ca 49 million years) for North American mayflies (Ephemeroptera) and earwigs (Dermaptera). Another first is the fossil record of beetle eggs deposited on leaves (Lewis and Carroll, 1991).

Most Republic insects are preserved by carbonization, a process in which carbon images or impressions remained as the insects slowly decayed under water. When the rock is split open, commonly both the impression and its counterpart are revealed. Having both representations of the specimen has been very helpful to researchers.

There is both direct and indirect evidence of insects at Republic. Direct evidence consists of the fossil wings and(or) body parts; wings are the most abundant traces (Plates 1 and 2). Among the many virtually complete specimens is a moth. (See Joseph, 1986.) Indirect evidence includes: the larval cases that enclosed immature insects; eggs deposited on leaves; leafcutter bee damage to *Prunus* leaves by chewing (Plate 3), mining, and skeletonization.

Table 1 compares faunas of other Eocene localities in the United States with those of the several sites in the Republic area. The localities in British Columbia and Washington are geologically and geographically similar—the sites at Republic and Princeton, B.C., represent upland lakes in volcanic terrain. Tertiary insect faunas for the western United States are also broadly similar at the family level.

Paleoenvironmental interpretation of the Republic localities is still in its infancy. It may be too early to state with certainty that both the Eocene insects and plants lived in precisely the same kinds of habitats as their modern descen-

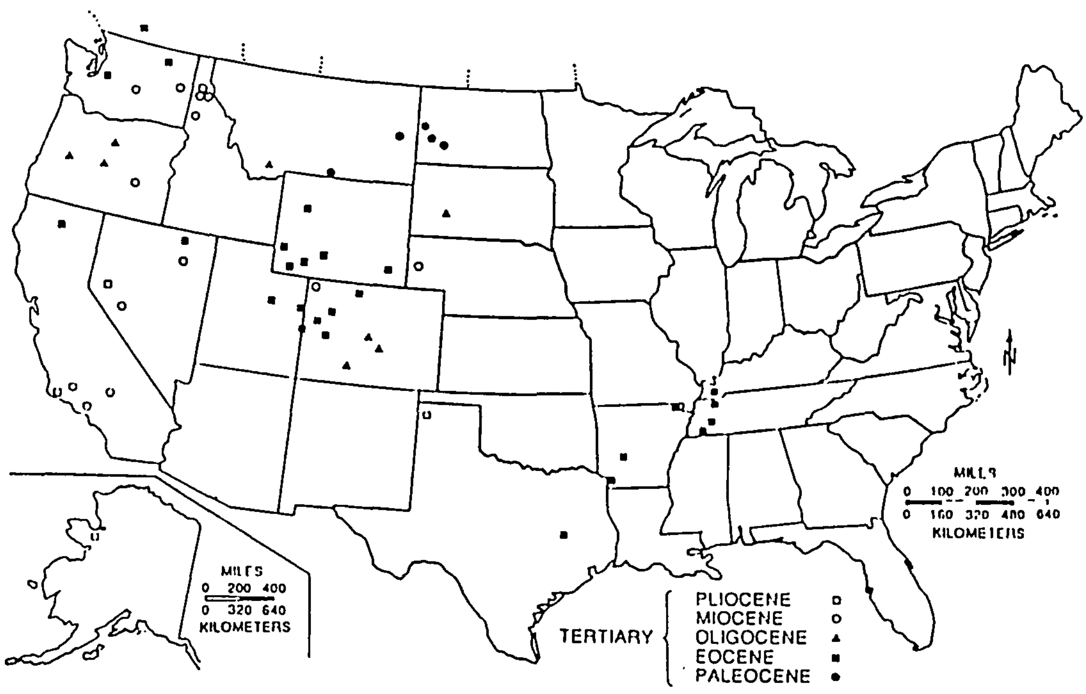

Figure 1. Geographic distribution of Tertiary insect localities in the United States.

Table 1. Fossil insects found at Republic sites; ( ), number of specimens; †, order found at Eocene sites in other states or provinces (see Fig. 1); AR, Arkansas; CA, California; CO, Colorado; KY, Kentucky; NV, Nevada; TN, Tennessee; UT, Utah; TX, Texas, WY, Wyoming; BC, British Columbia

Order	Family and genus	Common name	Modern habitat	†Other occurrences
Ephemeroptera	Heptageniidae (1)	mayflies	Streams and ponds	
	Unknown family (3)			
Odonata	Zacallitidae (2)	dragonflies	Streams and ponds	CA, CO, TX, BC
	Unknown family (3)			
Orthoptera	Blattoidea (3)	cockroaches	Terrestrial (wooded areas)	AR, CO, WY, BC
	Acrididae (1)	grasshoppers	Terrestrial (meadows)	
	Unknown family (4)			
Dermaptera	Forficulidae (2)	earwigs	Terrestrial (grasses, sedges, roots)	
Isoptera	Unknown family (5)	termites	Terrestrial (wooded areas)	TN, BC
Hemiptera	Pentatomidae (2)	stink bugs	Terrestrial (grasses)	AR, CO, WY, BC
	Unknown family (5)			
Homoptera	Cercopidae	spittlebugs, froghoppers.	Forests (pests on pines)	AR, CO, TN, WY, BC
	Palecphora (3)			
	Aphrophora (13)			
	Petrolystra (5)			
	Unknown genus (80)			
	Aphididae (2)	aphids	Plant feeders	
	Fulgoroidea (8)	planthoppers	Plant feeders	
Neuroptera	Unknown family (1)	dobsonflies, lace wings, etc.	Adults terrestrial	CO, BC
Coleoptera	Dytiscidae (1)	diving beetles	Streams and ponds	AR, CO, NV, TN, UT, WY, BC
	Carabidae (4)	ground beetles	Terrestrial (under stones, logs)	
	Elateridae (1)	click beetles	Terrestrial (on plants, under bark)	
	Lucanidae (1)	stag beetles	Terrestrial (wooded areas)	
	Cerambycidae (1)	round-headed borers	Tree borers	
	Chrysomelidae (7)	leaf beetles	Forests (pests on alders)	
	Curculionidae (5)	weevils	Plant feeders and plant pests	
	Unknown family (25)			
Trichoptera	Phryganeidae (5)	caddisflies	Streams and ponds	AR, CO, TN, WY, BC
	Limnephilidae (7)	caddisflies	Streams and ponds	
	Unknown family (13)			
Lepidoptera	Geometridae (1)	measuringworms	Terrestrial	CO, WY
	Unknown family (10)			
Diptera	Tipulidae (3)	crane flies	Damp areas with abundant vegetation	AR, CO, TN, UT, WY, BC
	Bibionidae (118)	march flies	Terrestrial (flowers)	
	Mycetophilidae (3)	fungus gnats	Damp areas with decaying vegetation	
Hymenoptera	Braconidae (1)	parasitic wasps	Terrestrial	AR, CO, KY, TN, TX, WY, BC
	Ichneumonidae (4)	parasitic wasps	Terrestrial	
	Formicidae (10)	ants	Terrestrial	
	Vespidae (1)	wasps	Terrestrial	
	Megachilidae (5)	leafcutter bees	Terrestrial	
	Unknown family (4)			
Unknown affiliation (162)				

dants. The present-day habitats of the orders and genera are indicated in Table 1. From this information we can speculate that the area surrounding the lake could have been a meadow near an upland mixed deciduous/conifer forest. The presence of certain terrestrial Diptera (especially Bibionidae) and Coleoptera in the rocks suggests nearshore deposition (Wilson, 1980), but some Hymenoptera and certain Diptera are strong fliers and could travel far from shore. The fossil plants also help shape our concept of the environment (Wolfe and Wehr, 1991). To date, however, there is little information about meadow plants that were probably present at this locality. Combining continuing study of the insect and plant fossils (including pollen) with examination of the geologic setting will improve our understanding of the Eocene environment and of insect evolution.

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Cockerell, T. D. A., 1915, Miocene fossil insects: Academy of Natural Science, Philadelphia, Proceedings No. 66, p. 634-648.

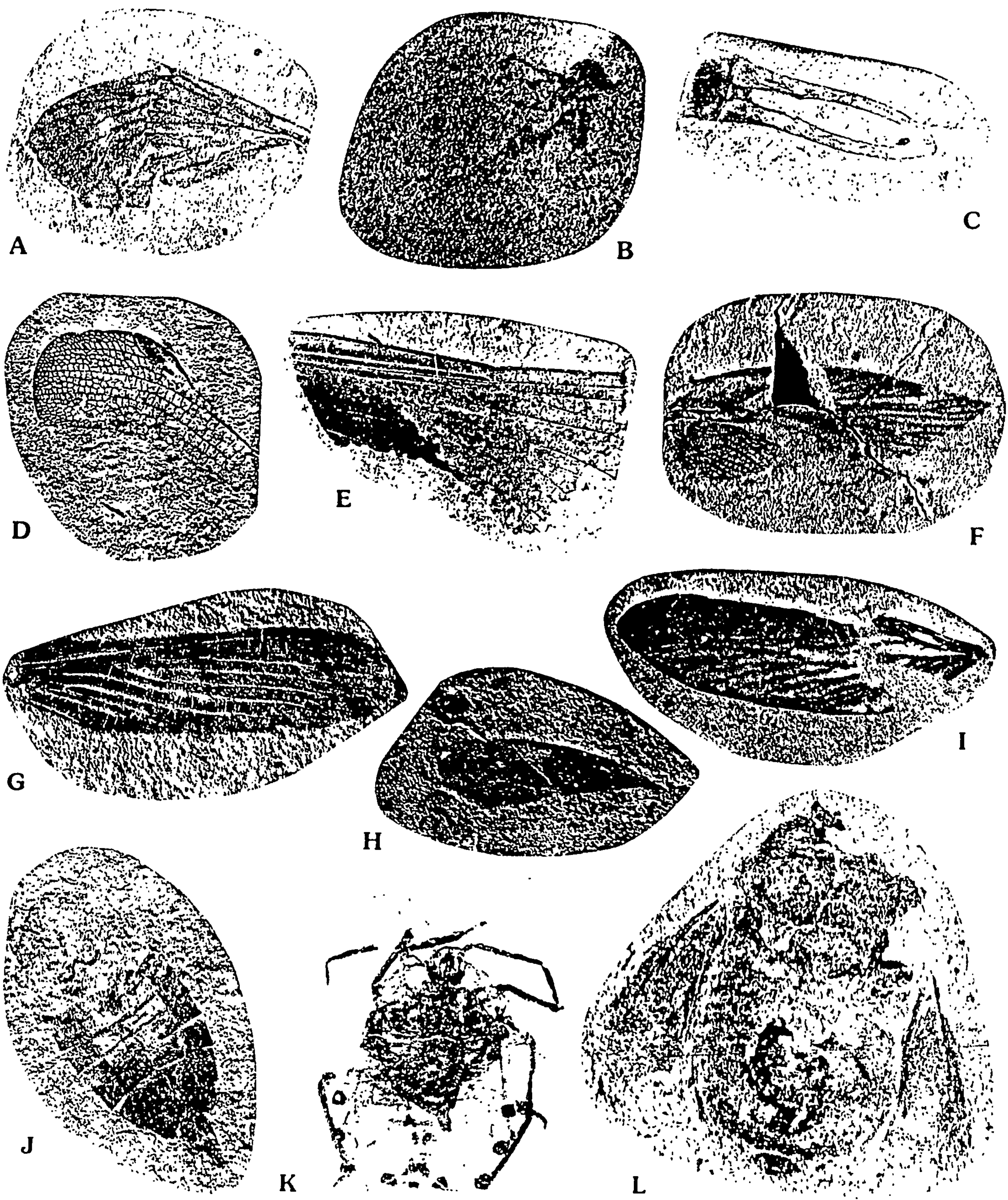

Plate 1. Wings, body parts, and bodies of insects in the middle Eocene lakebed strata at Republic, Washington; numbers are specimen catalog numbers for the Thomas Burke Memorial Washington State Museum collection at the University of Washington (UWBM) or the paleontological collection at St. Cloud State University (SCSU). **A,B**, Ephemeropterans; A, wing, UWBM 57198, x3.4; B, Family Heptageniidae, immature, UWBM 57158, x3.0. C, Dermaptera (Family Forficulidae), anal forceps of the female, UWBM 57160, x5.7. **D,E**, Odonatan wings; D, Family Zacallitidae, *Zacallites*(?) sp., apical end of wing, UWBM 72289, x4.8; E, basal portion of wing, SCSU 7B-16, x4.4. **F,G**, Orthopteran wings; F, Family Blattoidea, forewing, UWBM 72290, x4.2; G, forewing, SCSU 8-1, x4.7. **H**, Isopteran forewing, SCSU 7B-2, x4.5. **I-L**, Hemipterans; I, forewing, UWBM 72291, x5.0; J, Family Belostomatidae or Pentatomidae, abdomen, UWBM 56326, x2.2; K, Family Pentatomidae, dorsal view, UWBM 57176, x2.3; L, Family Pentatomidae, dorsal view, (Stonerose Interpretive Center collection), x4.6.

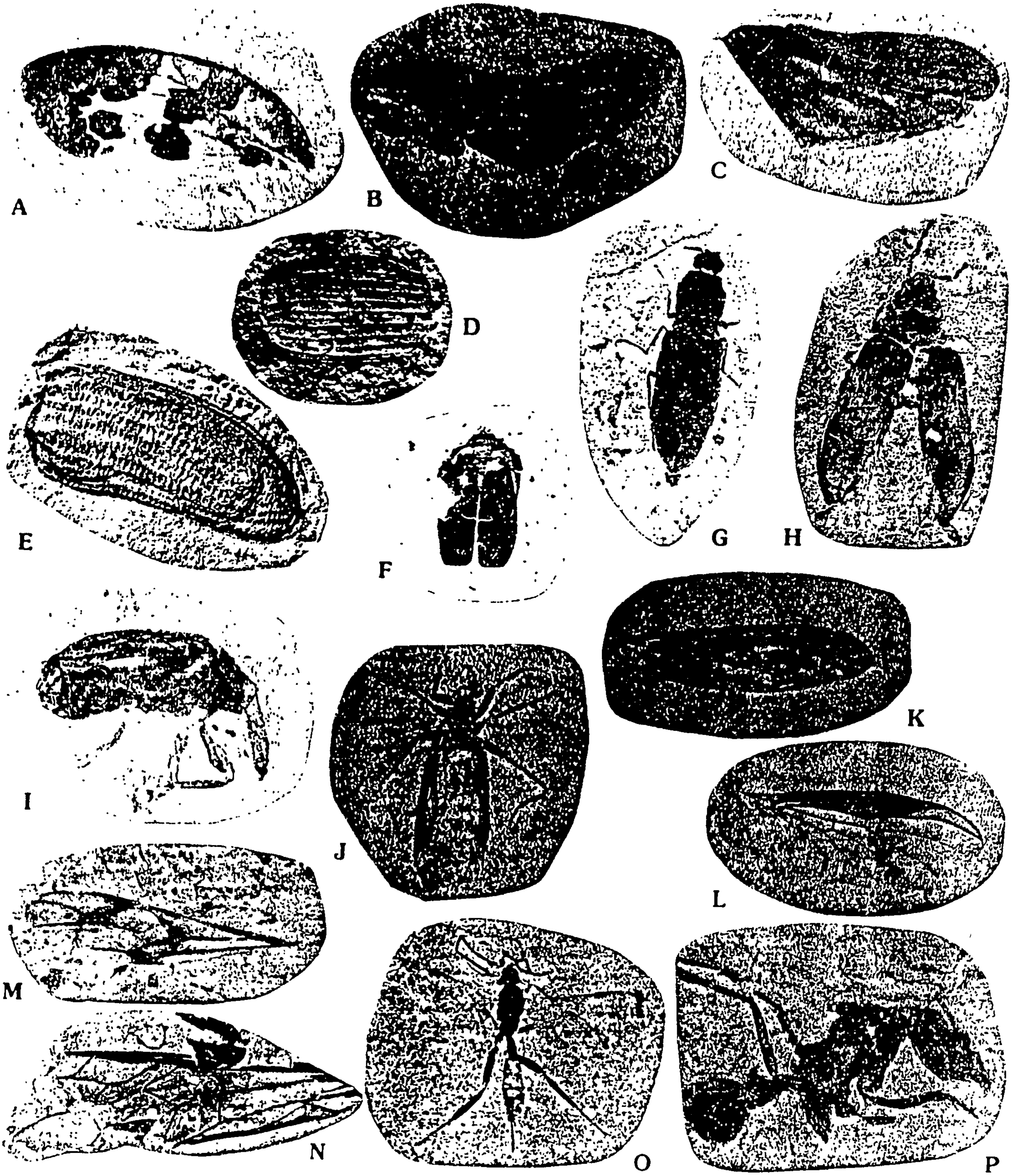

Plate 2. Wings and bodies of insects from the middle **Eocene** lakebed strata at Republic, Washington; numbers are specimen catalog numbers for the Thomas Burke Memorial Washington State Museum collection at the University of Washington (UWBM) or the paleontological collection at St. Cloud State University (SCSU). **A–C**, Homopterans (Family Cercopidae); A, forewing, UWBM 72296, x2.0; B, *Aphrophora* sp. wings, UWBM 57317, x1.8; C, *Aphrophora* sp. hindwing, UWBM 72297, x2.0. **D,E**, Coleopteran (Family Carabidae) forewings; D, SCSU 7B-15, x7.3; E, UWBM 57104, x4.2. **F–H**, Coleopteran bodies, dorsal views; F, UWBM 54811A, x4.9; G, (Family Elateridae), UWBM 57095, x3.6 [specimen from Princeton, B.C.]; H, UWBM 54097, **x3.6. I**, Coleopteran (Family Curculionidae) body, side view, UWBM 57096, x3.6. **J**, Dipteran (Family Bibionidae) body, dorsal view, UWBM 56684A, x3.4. **K,L**, Dipteran forewings; K, (Family Tipulidae), SCSU 7B-59, x4.4; L, (Family Bibionidae), SCSU loc. 7B, x4.2. **M,N**, Hymenopteran forewings; M, (Family Ichneumonidae), UWBM 57122, x3.7; N, unidentified family, UWBM 54840, x3.7. **O,P**, Hymenopteran bodies; O, (Family Braconidae), UWBM 57116, x4.5; P, (Family Formicidae) (Stonerose Interpretive Center collection NS-BR-2), x4.5

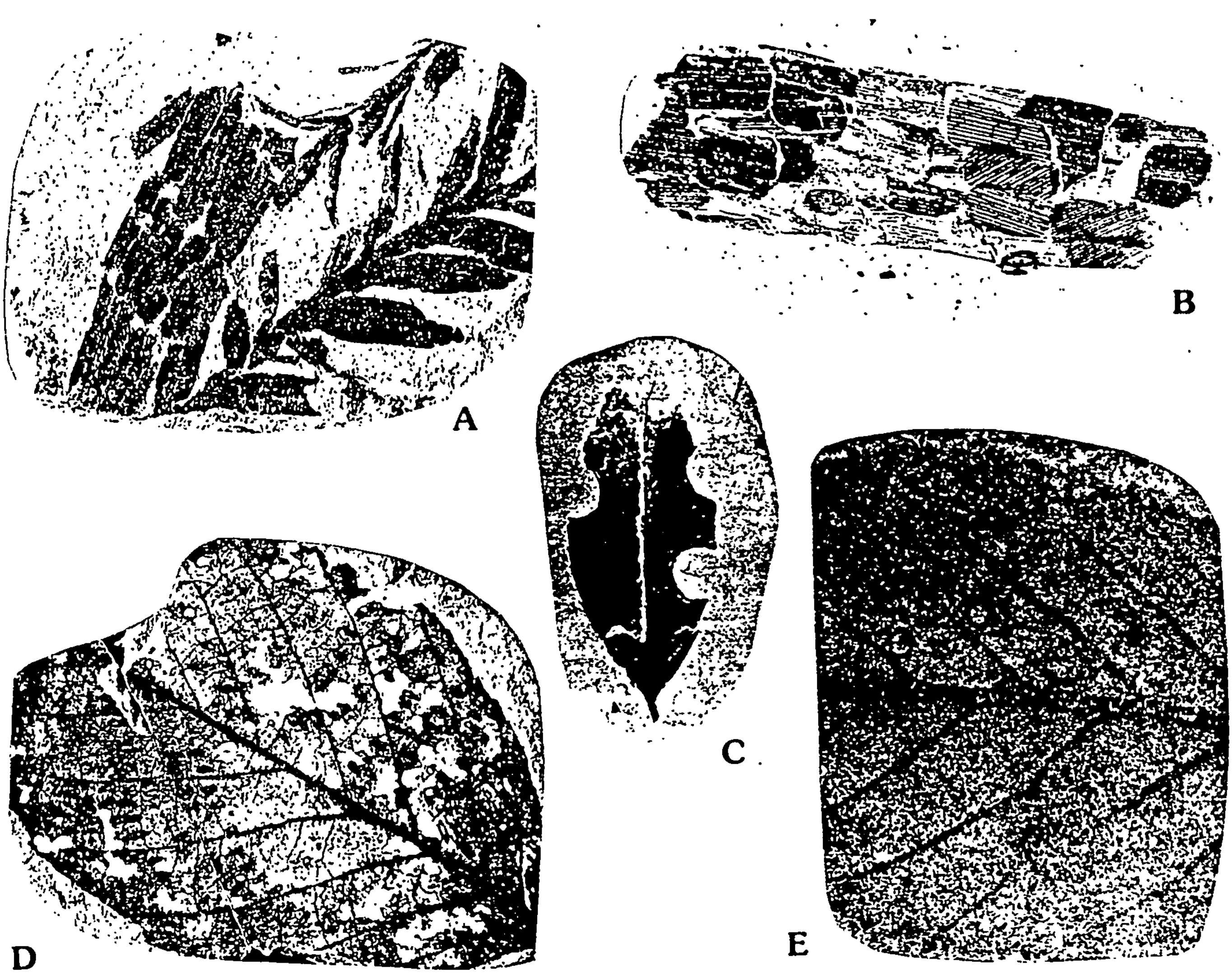

Plate 3. Indirect evidence of insects in the middle Eocene lakebed strata at Republic, Washington; numbers are specimen catalog numbers for the Thomas Burke Memorial Washington State Museum collection at the University of Washington (UWBM) or the paleontological collection at St. Cloud State University (SCSU). **A,B**, Cases of Trichoptera (Family Phryganeidae); A, UWBM 57163, x4.1; B, UWBM 55204, x2.3. **C**, Eggs of *Altica* sp. (Coleoptera, Chrysomelidae) on an alder leaf, UWBM 57187, x1.3. **D**, Leafcutter bee (Hymenoptera, Megachilidae) damage to a *Prunus* leaf, UWBM 57529, x0.9. **E**, Insect damage to a leaf, SCSU FR-1, x1.0.

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Wolfe, J. A.; Wehr, W. C., 1991, Significance of the Eocene fossil plants at Republic, Washington: Washington Geology, v. 19, no. 3, p. 18-24.

Note: Fossils are a nonrenewable resource. Searching for fossils at the Republic site is permitted from 10:00 a.m.-5:00 p.m., Tuesday-Saturday, and from 10:00 a.m.-4:00 p.m., Sundays until September 15, after which no digging will be allowed on Sundays. Register with the Stonerose Interpretive Center (next to the city park) before searching, and bring your specimens to the center. If you find a particularly fine or new fossil, the center will ask you to leave it with them to assist scientists with their on-going work. Please do not look for fossils in the marked areas set aside for research. ■

This article taken from Washington Geology, Vol. 20, No. 3 with permission.

THE GEOLOGICAL NEWSLETTER

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VOLUME 59, NO. !!

CALENDAR OF ACTIVITIES FOR NOVEMBER, 1993

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 P.M.)

Nov. 12 "James Hall Giant of Geology". A slide presentation by Andy Corchoran, GSOC member.

Nov. 26 Thanksgiving - No Meeting.

FRIDAY LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th floor. Social Hr., cafeteria 11:30 A.M.; Program, California Rm. at 12:00 noon).

Nov. 5 "Geology of the Union Pacific Railroad Proposed Blue Mountain Tunnel Site". Speaker: Bill Burgel.

Nov. 19 "Geologic Practice in Puerto Rico". Speaker: Ed Stearns.

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.)

Nov. 17 "Earthquakes and Earthquake Prepardness" by Beverly Vogt and Richard Bartells.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S-7. Open 7:00 - 8:00 P.M. prior to evening meetings.)

FIELD TRIPS

No Field Trips scheduled for November.

MEMORIAL

A dear friend Frances Rusche, Librarian for the Geological Society of the Oregon Country, died on September 3, 1993. A world traveler, she photographed the many exotic places she visited then shared her adventures with beutiful slide programs.

She was an avid gardener , and a collector of crystals and rock specimens. Her lovely hand work, needlepoint stitchery and stained glass graced the walls of her home.

She is gone but will be remembered as a gentle talented lady. We will miss you, Frances.

Esther Kennedy
President, GSOC 1993

AN OLIVINE LOCATION IN WASHINGTON STATE

by

Jim Forester. Bellevue Rock Club

We have a big producer of olivine near Bellingham - a mine in the Twin Sisters area of the Cascade Mountains. east of Bellingham.

What is olivine? A green mineral. a silicate of iron and magnesium. running from all magnesium and no iron to all iron and no magnesium. The Twin Sisters mine is an important producer. In the last year it produced 82.000 tons of crushed olivine. Uses? Crushed. it's used as a refractory lining for kilns and foundry molds. Much of it is shipped overseas, but the Olivine Corporation also builds kilns for export.

Olivine is hard (6 1\2 to 7) and alters easily to serpentine, which is also a magnesium silicate but with water (hydroxyl) added. The transparent variety is called peridot. Olivine is also known as chysolite, not to be confused with chysotile which is fibrous, asbestos variety of serpentine.

When you see dark colored rocks like gabbro, peridotite and basalt, they most likely contain some olivine. Crystals of the latter are found in the lava of Mount Vesuvius and crystals that have been altered to serpentine have been found in Norway.

COMPLETELY FRACTURED GEOLOGY

by Ralph and Evelyn Pratt. GSOC

1. **Dacite:** to make a choice, as in "I just can't dacite which dress to wear.
2. **Roche mountonnee:** fancy French term for baked old sheep.
3. **Pegmatite:** part of title from old romantic old song: "Pegmatite Heart."
4. **Albite:** what we say when we can't guess the answer to a riddle, "OK. albite. what is it?"
5. **Adit:** one way trip to a restaurant: "Just adit on to the bill."
6. **Ammonite:** after-dark sale at a gun shop.
7. **Caldera:** what Dera's husband is supposed to do if he'll be late for supper.
8. **Vesicle:** a small boat used on a lake. as opposed to a vessel. a large ocean-going ship.
9. **Pyroclast:** a place where one learns to line up pastries.
10. **Sinter:** a person who has done something evil or wrong.

CORRECT ANSWERS ON P. 67

THE OREGON COASTLINE USED TO BE MANY MILES FARTHER WEST

by Dr. Kenneth M. Ames, Anthropology Department. Portland State University

Documenting sea-level changes is one of the most difficult tasks facing the geologists and archaeologists who work along the world's coastlines. including Washington and Oregon.

If sea levels have fallen. then what was once the shore many not be a long way back from the modern shoreline: if the sea levels have risen. then the old shoreline may now be underwater.

As sea levels rise or fall, environments along the coast change. Estuaries. tidal flats, salt water marshes and rocky foreshores may dry up, or be drowned. Rivers must shift their courses. In some cases. entire coastlines disappear.

Seal levels change for a variety of reasons. One of the most important is the activity of glaciers. As glaciers expand. they take on water and the ocean shrink. resulting in lowered sea level. About 17.000 years ago. at the height of the most recent glaciation. the world's oceans were lower by about 300 to 500 feet. Britain was connected to Europe. North America and Asia were connected by a broad plain between Alaska and Siberia. and the Oregon Coast line was many miles west of Cannon Beach. The Columbia Gorge extended out past Astoria. As the glaciers melted. the seas rose.

But it's not quite that simple. Sea levels also appear to rise and fall because the land is acturally rising or falling. If the land falls-- subsides -- sea levels appear to rise; if the land rises. sea levels appear to fall.

The land may rise or fall as the result of changes in the Earth's crust as tectonic plates grind past. over or under each other. raising mountains and causing earthquakes.

Glaciers can affect the crust. As glaciers increase in size. their weight depresses the surface, and coastlines near a major glacial front will be lower. As the ice melts. and the weight is released. the crust rebounds upward.

Sea-level changes may be quite complex during periods of rapid deglaciation: the ice melts, releasing enormous volumes of water, and the ocean rises -- but faster than the land rebounds. In some places on the British Columbia coast, after deglaciation, the ocean rose more than 300 feet above present sea level because the land was still depressesd. The land rebounded, and in some areas sea levels were lower than they are now as the land rose. Sea levels stabilized when the land stabilized about 5000 years ago.

Sea level changes during the last 10,000 years along the Washington and Oregon coasts have not been quite that complex, because neither coast was glaciated. But sea levels have changed significantly.

Ian Hutchinson of the Institute for Quarternary Research at Simon Fraser University has put together an atlas of the sea-level changes for the coast from northern Vancouver Island to northern California.

His maps suggest that 10,000 years ago sea levels along the Washington and Oregon coasts were about 200 feet lower than they are now. This is best documented for the stretch of Oregon coast bwteeen Lincoln City and Florence. By 6,000 years ago, sea levels had risen to a point where they were 20 to 30 feet below present sea levels. Sea levels are about 4 to 6 feet below modern sea levels as recently as 1,000 to 2,000 years ago. There is evidence in places along the coast that the sea is still rising -- or the land is subsiding.

These rises may not have been as smooth as the graphs suggest. Major earthquakes, accompanied by rapid local subsidence, have been documented for Willapa Bay and the Lower Columbia River. As the land gradually rose, some places suddenly lowered as a result of a great earthquake.

The rising sea levels along the Washington and Oregon coast mean that early archaeological sites that were on the beach when they were occupied may now be under many feet of water -- or more likely, eroded away as the waters rose.

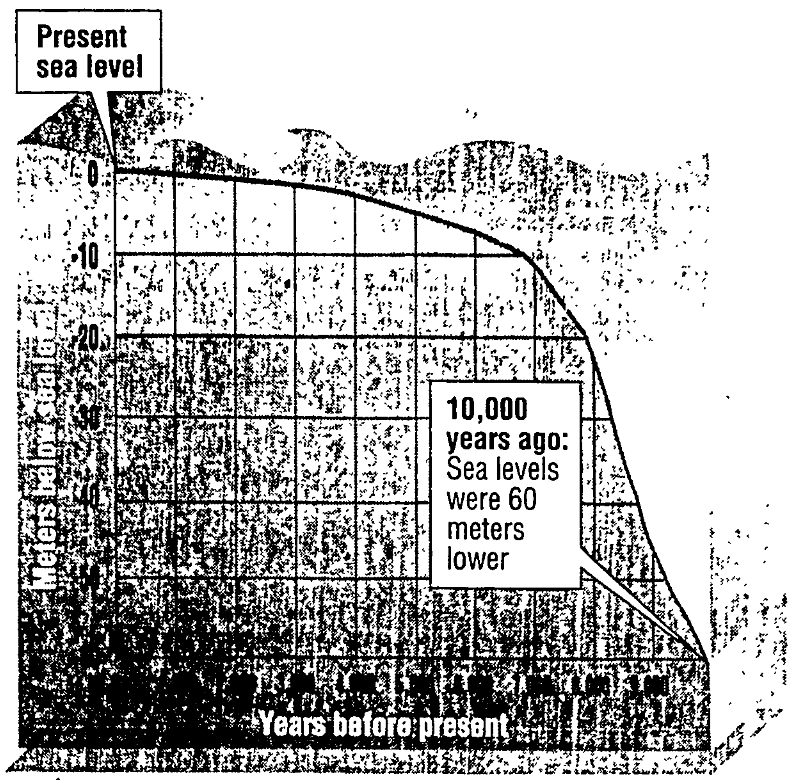
Occasionally early sites do turn up on the coast. Tahkenitch landing is the oldest dated site on the Oregon coast, with a radiocarbon date of about 9,000 to 8630 B.C. The site may have originally been on an estuary and animal remains found suggests that the site was near the ocean at that time; It is now about 1 1\4 miles inland.

People have probably lived along the Oregan coast for at least the last 10,000 to 11,000 years , and have had to adjust to changes as the ocean has risen. Some of these changes may have been gradual, others abrupt. Hutchinson's atlas provides critcial evidence for our understanding of these dynamics.

This article was in the Science Section of the Oregonian, August 25, 1993. Permission to print the article in the Geological Newsletter was given by the author, Dr. Kenneth M. Ames.

RISING OREGON COAST SEA LEVELS

Sea levels on a portion of the Oregon coast have risen during the last 10,000 years. A meter is slightly longer than a yard.



Source: "Holocene Sea Level Changes in the Pacific Northwest: A Catalogue of Radiocarbon Dates and an Atlas of Regional Sea Level Curves," by Ian Hutchinson, Institute for Quaternary Research, Simon Fraser University, 1992

CORRECT ANSWERS TO 'COMPLETELY FRACTURED GEOLOGY'

adapted from Dictionary of Geological Terms, ed. by Bates & Jackson for AGI.

1. **Dacite:** extrusive rock with a quatz content between andesite and rhyolite.

2. **Rocke moutonnee**: a glacially sculpted knob of bedrock oreinted in the direction of ice movement.

3. **Pegmatite:** very course-grained igneous rock with interlocking crystals.

4. **Albite:** a white or colorless plagioclase feldspar found in igneous and metamorphic rocks.

5. **Adit:** a horizontal passage from the surface into a mine.

6. **Ammonite:** an extinct mollusk similar to a nautilus.

7. **Caldera:** a large basinlike depression usually resulting from the collapse or explosion of a volcano.

8. **Vesicle:** a hardened gas-bubble cavity in a cooled igneous rock.

9. **Pyroclast:** an individual particle ejected during a volcanic eruption.

10. **Sinter:** spring-deposited kcalcite. or opal-type silica precipitated by geysers or hot springs.

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Portland, Oregon 97227

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Simi Valley, California 93063

CENOZOIC LAVAS OF THE WESTERN GRAND CANYON

by Otis Willoughby, Geologist, Environmental Health Scientist, Utah Department of Environmental Quality, Division of Solid Waste

On the walls of the western Grand Canyon, is recorded a history of at least twelve major volcanic events that flowed into the canyon and dammed the Colorado River. These basaltic flows represent some of the most recent geologic events that have shaped the canyon as we know it today.

Using relative and radiometric dating methods, geologists have been able to unravel the history of these dams. Each event produced basalt with unique lithology and morphology. The largest of the dams rose to a height of 2330 feet above the river. The lake that formed behind this dam reached well past Lake Powell. Shoreline sediments from these lakes can be seen above the shores of Lake Powell and in the Lee's Ferry area.

Each of these dams lasted only a relatively short time. Downcutting by the river and its sediments and undercutting by river hydraulics soon removed all but slivers of dam remnants on the canyon walls. These remnants record flows that ravels as much as 80 miles downstream. In the Buried Canyon area, the river changed course around the basaltic flows and eroded the less resistant sedimentary rocks in the canyon.

Other volcanic features in this area include Vulcan's Anvil, a volcanic neck located directly in the middle of the Colorado River, shows basaltic dikes, and sills. It sits perched on the north rim of the canyon.

The study of this area has greatly increased geologist's knowledge of the history and age of the Grand Canyon. Rates of erosion, slope retreat, and canyon downcutting can be extrapolated. It has also provided information as to the state of our man-made dams. How long we expect them to last and how quickly they can fill with sediments.

This article appeared in the Utah Geological Association Newsletter, Volume 24, No.2, February 1993.

THUNDEREGG COLLECTING IN OREGON

by Paul F. Lawson, mineral collector and retired Supervisor, Mined Land Reclamation Program, Oregon Department of Geology and Mineral Industries.

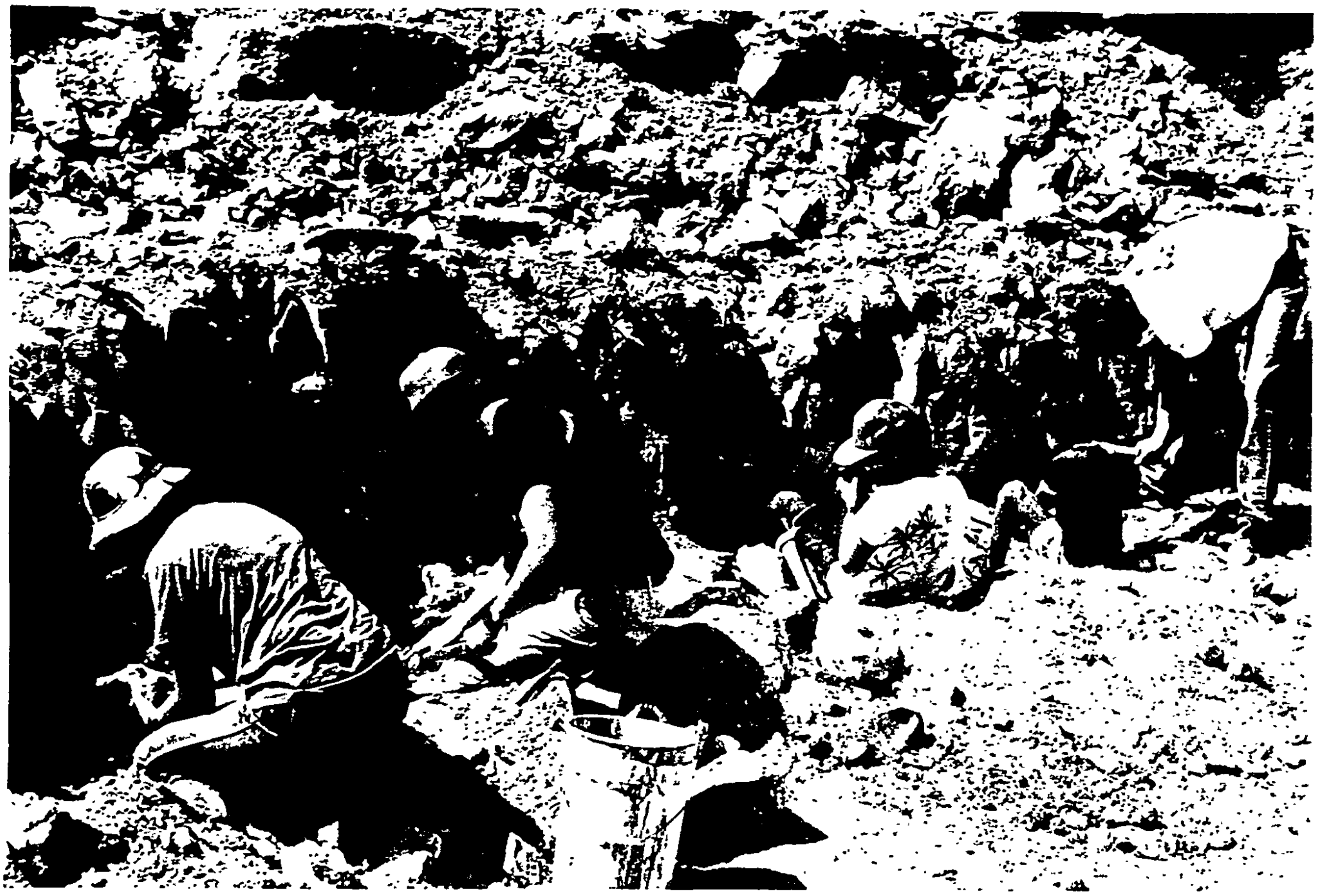
The Thunderegg was designated Oregon's official state rock by the Oregon Legislature in 1965. It selection was supported by a 2 to 1 vote by members of the mineral and gems clubs of Oregon and by the patrons of the Oregon Museum of Science and Industry (OMSI).

HISTORY

The Thunderegg has long been important to Oregonians. According to ancient Indian legend, when the Thunder Spirits living in the highest recesses of snowcapped Mount Hood and Mount Jefferson became angry with one another, amid violent thunder and lightening storms they would hurl masses of these spherical rocks at each other. The hostile gods obtained these weapons by robbing the nests of the Thunderbirds of their eggs, thus the source of the name "Thundereggs." The mountains are still key landmarks in the beautiful High Cascade Range, and millions of Thundereggs are on the lower lands as evidence of the legend and for all to enjoy.

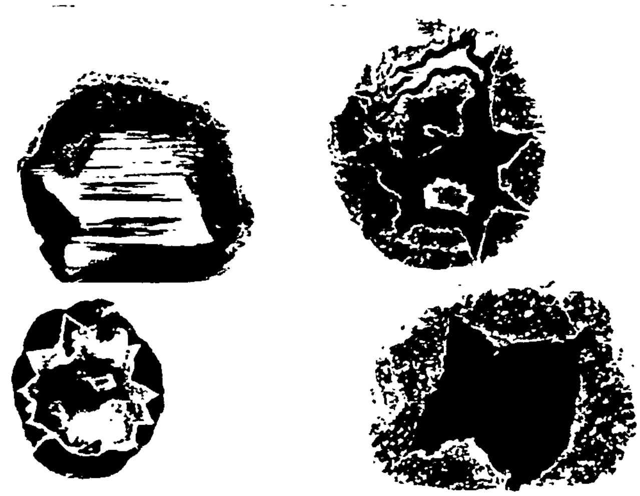
The Thunderegg has been highly prized by collectors, lapidarists, jewelry makers, and interior decorators for nearly 100 years. In 1893, Dr. George F. Kunz, Tiffany's famed gem authority, estimated that as much as $20,000 worth of opal-filled eggs from one Oregon deposit had been marketed in 1892. Since the mid-1930's thousands of visitors from every state in the Union and many overseas countries have come to Oregon to hunt Thundereggs. Many Oregonians have also joined them.

at gem or rock shows: from tailgaters at outdoor events: at gem



Digging for thundereggs in the Blue Beds at Richardson's Recreational Ranch. Photo courtesy of Lewis Birdsall.

Outside appearance of Thundereggs from different localities in Oregon: Madras-Prineville area (upper and lower left), southeastern Oregon area (upper right), Burns area (lower middle), and Lakeview area (lower right).



Typical inside appearance of Thundereggs that were cut and polished.

Thundereggs are made into beautiful jewelry, especially bolo ties and pendants, pen stands, bookends, and decorator pieces. Their value ranges from a $1 per slice or half egg to well over $100 per slice or single cabochom. Thundereggs and their products can be purchased through magazine ads:

well over $100 per slice or single cabochon. Thundereggs and thei products can be purchased though magazine ads: at gem or rock shows: from tailgaters at Outdoor events: at gem and lapidary shops: and at airport, motel, hotel, and gift shops or counters.

HOW THUNDEREGGS FORM

Although the Thunderegg is an hororary rock by Legislative decree, it actually is not a rock. It is a structure, sometimes a nodule, sometimes a geode, occurring in rhyolite, welded tuff, or perlitic rocks. However, without question, the Thunderegg is by far the most popular "rock" in Oregon.

Scientists do not agree on the processes forming Thundereggs. Some insist that the characterestic and unique internal pattern of typical Thundereggs is due to expansion and rupture of the rock by gases. Others claim the pattern is due to desiccation (drying) of a colloid or gel. Whatever the process, however, after the cavity that contains the egg is formed, further development is extremely variable in the amount of time needed to complete the egg, in the degree and type of infilling, and in other characterestics. Thundereggs range in size and weight from less than a inch and under an ounce to over a yard in diameter and over a ton in weight. Most eggs collected are between 2 and 6 inches in diameter.

HOW THUNDEREGGS LOOK

Typically, an egg has a russet-colored outer shell that is often knobby, and often has a characteristic ribbed pattern. Frequently, the inside of the outer shell has a relatively thin intermediate or transitional lining. This is sometimes composed of an iron or manganese compound, often with a thin coating of opal or chalcedony. Sometimes only opal or chalcedony is apparent. Finally, the center of the egg is usually filled with chalcedony or opal and may or may not have inclusions, patterns, or crystals. In some variants, the egg may be hollow or may have a thin layer of chalcedony coating the interior. This layer sometimes is topped with a coating of small quartz crystals.

Growths of algae-like tubes, or plumes, or "moss" of manganese or iron compounds or of clay may be free-standing or partially or wholly embedded in chalcedony. Some eggs with plumes ("flowers") in chalcedony are among the most valuable specimens. Several zeolites have been observed or reported in Thundereggs, clinopitolite is fairly common, and mordenite, natrolite, and mesolite have also been reported.

Thundereggs are sometimes found with fortification banding just inside the shell, then an area of horizontal layering, with the remaining central area filled with chalcedony or inward pointing crystals. Banding and layering vary in color, thickness, and content. Some layers are composed of a fibrous cristobalite (lussatite). Other eggs have partial botryoidal filling of an opal form of low cristobalite. This opal is often fluorescent because of the low content of uranium salts.

One collecting site in Oregon has eggs filled with carnelian. At another, the filling may contain cinnabar, which colors it pastel to intense red. Some eggs are filled with pastel jaspers. Other may have any one of a variety of opal fillings that may be opaque blue, opaque red, translucent pastel blue, translucent yellow, translucent red, white, or colorless. Some of the opal may be faceted, and a small percentage is true precious opal.

Some eggs have well-developed calcite crystals encased in chalcedony, and others contain pseudomorphs of chalcedony after calcite. Some eggs have layering that is fanned from one edge, because the egg was rotated by earth movement while the filling was deposited. This and other features suggest that the complete development of some eggs may have taken considerable time, and the filling-in of the egg may have recorded a series of geologic events. Some eggs contain brecciated rock fragments, while others show faulting, offset, and healing. One of the most unusual Thunderegg variants is up to 3 feet long and 2 to 3 inches in diameter and looks like a fat gray worm. In some areas, it is common to find the characterestic chalcedony core weathered out to its shell. If a complete egg is sawed in the right orientation, one or more conduits through which the filing materials flowed may be found. The beauty and complexities of many of the cut and polished eggs explain why Oregon rockhounds have long been fascinated by Thundereggs.

WHERE TO FIND THUNDEREGGS IN OREGON

Thundereggs may be collected at many sites in Oregon. Some localities occur in beautiful forested hill country, others in dry, desert-like terrain. It should be understood that Thundereggs have been eagerly collected in Oregon for fifty years. Therefore, on "free sites'" collectors must expect to dig and work for Thundereggs. Proper equipment, including shovel, pick, and bar makes the job easier. The "fee" site will almost always have some preparatory work (overburden removal) done. Also, eggs may usually be purchased at the site office. Some places may have tools for rent.

LOCATIONS

Madras-Prineville area
White Fir Spring (Natioanl Forest Land: free site)
Whistler Spring (National Forest land: free site(
For current information on these sites contact :
Prineville Ranger District
2321 East Third
Prineville, OR 97754
(503)447-3825
White Rock (or Wildcat Mountain)(National Forest land; free site)
Big Summit Ranger District
348855 Ochoco Ranger Station
Prineville, OR 97754
(503) 447-3845
A map of the area's free collecting sites (including sites for other rockhound materials) is available from:
Prinville Chamber of Commerce
390 North Fairview
Prineville, OR 97754
(503) 447-6304

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VOLUME 59, NO. 12

CALENDAR OF ACTIVITIES FOR DECEMBER, 1993

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371, 8:00 P.M.)

Dec. 10 Slide presentation by Evelyn Pratt covering the President's Field Trip in Western Washington, Sept. 25 to Oct. 1, 1993. Prints will also be displayed.

Dec. 24 Meeting canceled for Christmas holiday.

FRIDAY LUNCHEONS (Bank of California Tower, 707 SW Washington, 4th floor. Social Hr., cafeteria 11:30 A.M.; Program, California Rm. at 12:00 noon.)

Dec. 3 Slide presentation by Esther Kennedy covering the President's Field Trip in Western Washington, Sept. 25 to Oct. 1, 1993. Prints will also be displayed.

Dec. 17 "Geologic Practice in Puerto Rico". Speaker: Ed Stearns.

GEOLOGY SEMINAR (Cramer Hall, PSU, Room S-17, 8:00 P.M.)

Dec. 15 No Seminar in December.

GSOC LIBRARY (Cramer Hall, Portland State University, Room S-7. Open 7:00 - 8:00 P.M. prior to evening meetings)

FIELD TRIPS

WHERE: OLYMPIC PENINSULA
DATE : February 19, 20,21
LEADERS: Esther Kennedy, arrangements. More infomation, 626-2374
John Whitmer, Field trip leader.
DETAILS: February 19, Forks, Washington, February 20, Port Angeles, February 21 continue field trip on way home.
COST: $230.00 DBL, $290.00 SGL. Includes motel and three box lunches.

DUES ARE DUE JANUARY 1994-----DUES ARE DUE JANUARY 1994----DUES ARE DUE JANUARY 1994

The Nominating Committee has selected the following GSOC members as officiers for the 1994-1995 year. Elections to be held in January 1994.

President: Dr. Donald D. Botteron
Vice-President: Clay Kelleher
Secretary: Carol Cole
Treasurer: Phyllis Thorne
Director: 3 year Bill Greer

WELCOME NEW MEMBERS

David Knoblach
P.O.Box 44023
Tacoma, Washington 98444

Robert Walker Jr.
23631 Dorre Don Way SE
Maple Valley, Washington 98038

COMPLETELY FRACTURED GEOLOGY

Ralph & Evelyn Pratt

1. **arete**: last name of a person in an old French song: Arete, gentile Al Arête "

2. **biotic:** phrase used to encourage a customer to purchase an unwanted arthropod

3. **felsic**: as in, "Poor Jane couldn't go because she felsic."

4. **tarn:** what a Boy Scout does a good one of.

5. **Carlsbad twin:** a negative judgment about one of two same-age brothers

6. **colloid:** (1) a not-quite-purebred sheepherding dog (2) contraction of celluloid collar.

7. **stade:** to remain in the same place, as in "She stade home."

8. **benthic:** part of a phrase: "Those two have benthicker than thieves."

9. **conduit:** what a child says who is unable to tie his shoelaces.

10. **imbricate:** (1) to involve in some kind of illegal. activity, or (2) to build a baked-claystone wall around something.

The correct answers to Completely Fractured Geology are on page 76

PRESIDENT'S FIELD TRIP SEPTEMBER 1993.

Another great President's Field Trip was masterminded and carried out by President Esther Kennedy as leader and Dr. John Whitmer as field trip leader. The following is a day by day summary of the happenings.

DAY 1: PORTLAND TO TACOMA (Evelyn Pratt)

As we rolled N on I 5 Dr. John Whitmer compared plate tectonics to boiling jam:

1. Stove heat makes jam rise; earth's core heat makes liquid mantle rise.
2. Currents move both jam and mantle liquid from hot centers.
3. Cooling forms foamy scum on top of denser jam; cooling forms light silica crust on top of denser mantle.
4. As they get farther from heat, both cooled dense jam and cooled dense seafloor crust start to sink.
5. As jam moves against the pot wall and sinks, scum top piles up in wrinkles along the edge; As crust moves against the big land mass and sinks under it, sediments on top of the seafloor wrinkle against the continent and form coastal mountain ranges.

. Our own Coast Range, John believes, started to form 40 million years ago when a thick basalt plateau on the ocean floor rammed into the Pacific coast. It must have come from the SW to make all the SE-NW trending faults and folds in the Range's sedimentary and seafloor rocks. John made uncomplimentary remarks about the "weeds" (trees) covering all that lovely geology.

David Naflock joined us at Tenino to tell us about local sandstone and quarrying. Beaches were here 41 million years ago when the WA coastline was about where I-5 is now. At a nearby quarry Keith Phillips first demonstrated how he uses stonecutting tools on buff-and-gray Tenino Sandstone, then in traditional stonecutter's apron and dashing derby hat, played the bagpipe as we pulled out.

At Wilkeson David introduced us to Mr. Walker, this sandstone quarry's third-generation ex-owner. Vista House on the Columbia and WA's 15,000 ton state capitol dome are made of white Wilkeson sandstone. It often caps seams of soft coal from ancient swamps where Renton, Issaquah, and Black Diamond are now. We see the sandstone because it's been folded into anticlines; otherwise it would be buried under thousands of feet of glacial till produced by the last 2 million years of continental ice sheets. And why is sandstone so little used today? Concrete's cheaper and easier to work with.

Mt. Rainier is covered with easily-eroded volcanic blast products and huge volumes of ice. When the volcano is active, melting ice mixes with tephra to produce giant mudflows. Of all the products of an eruption, these mudflows are the most dangerous. 5000-year-old Osceola Mudflow, one of Mt. Rainier's largest, is 30' deep under Enumclaw and may have filled in an arm of Puget Sound. Around Wilkeson five mudflows hundreds of feet thick were under us. Moral: Think twice when looking at real estate near a glacier-covered volcano! ✿

DAY 2: TACOMA TO MT. VERNON (Evelyn Pratt)

Poor Tacoma! It is outrivaled by Big Brother Seattle, crime-ridden, and has a massive industrial waste problem. But what a setting! Homes built on Vashon Glacier drumlins have views of Commencement Bay, which continuing glacial outwash and mudflow sediments have failed to fill; of bluffs and beaches reflected in Tacoma Narrows' blue-green water; and of magnificent Mt. Rainier to the SE.

On this summery day Esther & John opted to head for the Bremerton ferry. Crossing the Tacoma Narrows Bridge we heard "The gospel according to John": When the Strait of Juan de Fuca iced in, water poured through the Narrows in an under-the-glacier tunnel. It reached the sea via the Chehalis, whose valley today is much too large for its river. More of "John's gospel": Structure is everything. Streams and glaciers follow structure. Glaciers don't gouge, they pluck; under-the-ice meltwater with its rock and sediment does the real work of digging out landscapes.

As the ferry ran a narrow passage between Bainbridge Is. and the Kitsap Peninsula, John pointed out a "bathtub ring" terrace resulting from an earthquake 1000 years ago which uplifted shorelines 15'. S of the Seattle Fault land rose; N of the fault it dropped, taking an Indian village with it. The deeply-buried, still-active fault is believed to be E-W reverse striking.

Puget Sound Lowland sinks from crustal movement faster than glacial sediment can fill it in. Water is 400' deep at the Narrows and 1600' deep by the ferry route. Terrain here is like cardboard with SE-NW-running corrugations. Bays fill the downs and bedrock mantled by glacial till forms the ups. "Structure is all." Our route E through Seattle and N of the Fault crossed the corrugations. We passed Beacon Hill, an anticlinal fold with a sandstone core veneered by till, with a huge hospital atop the steep N end. Down into Rainier Valley glacial trough we drove, through a tunnel in another anticline, across Lake Washington on the Floating Bridge, up onto Mercer Island drumlin, and across another channel toward Issaquah, the Whitmers' present home.

Out past Lake Sammamish we viewed the "Issaquah Alps" (very scenic, but alpine??). NE of I 90 gravel is quarried from a huge delta where N Fork Issaquah Channel emptied into Glacial Lake Sammamish. On a hilltop farther E we R&R'ed by the Snoqualmie Winery's lawns and flowers, seeing low glacially-deposited hills to the NE, mid-height Pre-Tertiary Melange, and Eocene plutons on the skyline (and buying much wine). Photographic Mt. Si, a 3400' knocker of metagabbro on metamorphosed muds, rose across the valley.

Last major stop was Snoqualmie Falls - very crowded on a sunny fall Sunday - where torrents of water drop from a high ledge of Cascade volcanics. On we drove to Mt. Vernon through glacial outwash channels, by kettle lakes and drumlins and high rugged peaks. We're convinced, John - the Puget Sound Lowland was really glaciated! ✿

Day3, Mount Baker - Harrison Lake , British Columbia(Elizabeth King)

"Dr. John, leads for fun;
Shows formations on the run;
With Nooksak, Chilliwak, thrusting faults along;
Twin Sisters started our North Cascades song."

From our Mount Vernon departure we immediately began to hear and view ongoing melange of plutons, strike-slips, buttons, thrust-faulting, shearing, dunite, landsliding, "Raisin-pudding", multi-rocks rafted from the ocean floor onto the Jaun de Fuca plate - Wrangellia. This is a new concept of our North Pacific geologic beginnings.

Beautiful lowland rural scenes gave way to ample time to enjoy the colorful autumn leaves, with ongoing views of the dunite formations of the Twin Sisters Ridge on our right; impressive pure olivine, a world class outcrop, although many "weeds" prevented intimate observations of their structures.

Following Dr. John's promotion of the Dutch Valley raw-milk cheese we stopped at "Everybody's Store" behind a (76) service station. What a treat we had enjoying cheese tasting and purchasing cheese and other delicious snacks. We had difficulity getting Dr. John away from the cheese tasting and John King from taking pictures of the gasoline pumps. On we drove toward the shining mountains, Komo Kulshan and Mount Shuksan. "According to the Gospel of Dr. John" (Dr. John Whitmer), Peter Misch , University of Washington Geology Professor, explains much of these tremendous geologic activities. However, as we drove along we were grateful to Dr. John for his knowledge as well as his non-ending descriptions of the formations.

Stopping at Austin Pass and Picture Lake enroute to our destination of Artists Point at 6,000 feet, we all thrilled at the unforgettable views everwhere. Collective member opinions nominated this area as the most impressive and incredible experience of the day.

On the return trip off the mountain an ailing diesel engine on the bus required a stop at Starving Sam's service station and convenience store where we enjoyed ice cream cones and other treats. However, the handicapped bus took us onward into Canada following the North Cascades to a final stop at Cultus Lake in the Fraser Valley graben which at one time was filled with 6,000 feet of ice leaving a terminal morraine. Returning across the border into a U.S. a recalcitrant bee precipitated a shortened inspection due to its landing on the inspectors head as he started toward the bus.

After a late dinner at Mount Vernon Cotton Tree Inn, Dr. E.H. (Ned) Brown, geology professor at Western Washington State University delivered an excellent lecture on he North Cascades Mountains. This was truly a day never to be forgotten, perfect weather and perfect scenery. A thought from one person who submitted written comments - " the most wonderful day I've ever spent."

Day 4, Anacortes, Fidalgo Island to Friday harbor, San Juan Island , Bill Greer

Our tour bus was not well. On Monday, 9/27/ 93, the diesel engine in our RAZ bus had a major mechanical failure (broken piston, broken valves and broken cylinder liner). This failure occurred shortly after we left on our return from the Summit Parking lot on Kulshan Ridge, at Mt. Baker area. The magnitude of this mechanical failure was not known until later in the week. Sometimes ignorance is bliss.

On Tuesday our friend and RAZ bus driver Jim Armson, using the sick bus, delivered the group to the Anacortes Ferry Terminal. Jim took the bus to Seattle for engine repair. Our group rode the ferry system as walk-on passengers. We all had box lunches. We had good visibility for about the first 15 minutes of our trip and then hit a fog bank for about 15 minutes. The rest of the trip the visibility was excellent.

For details of the geology of the San Juan Islands, please refer to the excellent notes: *President's Field Trip in Western Washington From Puget Lowlands to Cascade Highlands;* September 25-October 1, 1993, complied by John H. Whitmer. Dr. Whitmer notes that it has been only in the last ten years or so that the growth of this part of the northwest has been better understood.

One of the models for the San Juan Islands: material from the ocean floor, some of it from island arcs, has moved hundreds of miles, been shoved in a trench, cooked at high temperature and pressure, and elevated after being accreted to the North American continent. It is now proposed that this part of North America was accreted to the main North American land mass about the end of the Mesozoic Era 70 million years ago.

During the most recent ice age the San Juans were covered by Glacier Ice about 5000 feet thick.

The map of the San Juan Islands, Fig. 17, page 32, of Dr. Whitmer's notes show the major thrust faults and thrust sheets. These thrust sheets or nappes are presently dipping from the northwest down to the southwest and are layered like shingles, one on top of another. Long after the thrust faulting, the area was folded into synclines and anticlines.

The San Juan thrust sheets, thrust faults, and the local folding. Most recently the whole area was modified and shaped by glacial action.

Evelyn Pratt - GSOC prepared a two dimensional model of the San Juan thrust faults and local folding.

Most recently the whole area was modified and shaped by glacial action.

We had excellent weather. We toured the dock for views of marine life, pleasure boats, float planes and boat traffic. Many had lunch at a picnic shelter adjacent to the boat harbor. An excellent whale museum was visited by part of our group. Some of the party took a van tour of other areas of San Juan Island.

A replacement bus from Seattle was at the dock to meet us and we were returned to our motel in Mt. Vernon, Washington. It was a beautiful day for a field trip. We were not to see our driver friend Jim Armson until late in the day Thursday. He stayed with our RAZ bus in Seattle while it was repaired. ✵

Day 5, Fidalgo Island-Deception Pass- Whidbey Island. Rosemary Kenney

We started out slightly foggy and with an explanation of one of the geologic maps in our guide book. "If you know how to read a geologic map, you can know more about the rocks than the man who made the map".

The San Juan Islands contain rocks that were stuffed into an oceanic trench by the sinking of the ocean floor probably during Jurassic time, about 150 million years ago. The San Juan islands include large slabs of oceanic crust along with severely deformed and recrystallized sedimentary rocks. The trench contains a chaotic assortment of limestone, mudstone, chert, sandstone, pebble conglomerates and scrapes of oceanic crust. The rocks vary in age by at least 200 million years.

We spent most of the day on Fidalgo and Whidbey Islands, with the first stop at Washington park on the western shore of Anacortes. After a short walk through the park, admiring the tall fir and cedar trees and the madrone with its red, yellowish and brown peeling bark and masses of brilliant red berries, we arrived at the wave-cut terrace which is made up of serpentine, a hydrated slab of mantle rock. Major jointing is nearly vertical, with chromite layers, relict pyroxenes and original dunite-peridotite contacts. There are outcrops of gabbro cut by dikes, then basalts, breccias, tuffs, tuffaceous argillites and graywacke.

At Rosario's Head is an outcrop of pillow basalt overlain by ribbon chert in unfaulted contact. Ribbon chert consists of radiolarian chert alternating with layers of shale or slate and accumulates at the rate of a meter per million years.

The graywacke of the Fidalgo Ophiolite at Deception Pass is thought to be more that 1650 feet thick. This bedrock chasm at Deception Pass bridge was possibly cut by torrents of water in a sub-glacial tunnel. When we looked down at it, the tide was coming in very swiftly and strong. All of this, through mantle rock through gabbro, dikes, pillow basalt, ribbon cherts and graywacke gave us a good understanding of the ophiolite sequence.

We saw different rocks near Coupeville and Penn Cove. They are mostly glacial boulders and glaical till. After a refreshing and delicious ice cream stop in Coupeville we progressed north and east, past Mount Erie which is the highest point on Fidalgo Island to Fir Island. Fir Island was tidelands between the North Fork and South Fork of the Skagit River, but is now a true island completely surrounded by the two rivers and high leeves and converted to rich farmland. About two years ago the two rivers rose and flooded the island for several months. Now most of the buildings are built on high foundations. The hills near Conway were islands until the Skagit Delta deposits filled in the surrounding areas. Now there are tulip and dahlia farms and potato fields, even a Burma - Shave .

The Broccoli was unruly:
The Cauliflower Misbehaved.
They are good now,
Since Burma-Shave.

DAY 6, NORTH CASCADES, BETTY TURNER

On the sixth day the fog was thick in Mt. Vernon, but we left it behind as we traveled up the Skagit river valley. Esther's predictions of another beautiful day came true.

The valley is filled with alluvium and glacial deposits, burying a thrust fault which separates the Shuksan Greenschist (South) from the Chilliwack group rock (North). At Marblemount, Shuksan Greenschist is north and south of the valley. To the east, the Skagit Metamorphic Suite is the cystalline core of the Northwest Cascade mountain system. The tectonic processes which brought this up are not fully understood. They are the subject of much controversy. The crystalline core is in contact with many fault systems and extends 200 miles north to the British Columbia Cordillera. Mountains to the east were imported from Canada in the late Cretaceous period.

At Newhalem, where we stopped to examine Skagit

Gneiss the rest rooms were closed, so we made a side trip to the Forest Service center- a new and modern facility. Off-season travel may require spending an inordinate amount of time searching for open facilities.

Diablo Lake viewpoint features a geological display of rock found in the area, also a migmatite outcrop across the highway. Other outcrops were not convenient bus stops.

Ross Lake Overlook provides a view of the Ross Lake Fault zone - a strike-slip complex trending north, northwest. Beyond the overlook we followed the Ruby Creek, across Panther Creek on to the Golden Horn batholith to Washington Pass. The batholith is Eocene granodiorite. In June a debris torrent from a small stream covered the highway, and closed it.

At Washington Pass Overlook we had lunch with Liberty Bell Peak. Early Winter Spires and other features were in view. They are in the Methow Graben, the east side of the North Cascades uplift.

Returning the way we came, there was not enough time for a side trip to Baker Dam and Lake. We stopped for ice cream, but the store had burned down. Geological forces provided the soil for the crops we saw enroute, but Dr. Whitmer likes bare rocks. ❁

"93 President's Campout Song (to the turn of "This Old Man")

Dr. John leads for fun,
Shows formations on the run,
Nooksak, Chilliwack, thrust a fault along,
Sunshines as we sing this song.

Baker looms, Shuksan too,
Give a tremendous view,
Phyllite, andesite, autumn leaves of red
Cultus lake in the land of Zed.

Chuck-a-nut, anti-i-clines,
Raw cheese stop but none for wines,
Kames, moraines, and one Canadian bee,
Tour of Nugent, thrown in for free.

It's quite clear, that Esther dear,
Has planned this trip and brought us hear,
So we'd look and learn, and even have some wine,
And all her plans turned out fine.

And so we Kids, we forty-two,
Have spent this week with much to do,
We thank Alta, for her smiles and words and deeds,
She's clearly handled all our needs.

So now it's time, to say goodby,
To friends we made and were not shy,
Lets plan to do this once again next year,
For all our leaders let's
Cheer, Cheer, Cheer,

Correct answers to "COMPLETELY FRACTURED GEOLOGY " adapted from AGI's Dictionary of Geological Terms, 3rd Ed.

1. arete: a sharp-edged rock ridge between cirques in glacier- sculptured mountains.

2. biotic: refers to animal and plant life of a region.

3. felsic: refers to an igneous rock with a lot of light colored minerals, or these minerals.

4. tarn: a lake in a cirque.

5 Carlsbad twin: situation where one crystal grows parallel to and pentrates into a similar-sized crystal; common in orthoclase feldsar.

6. colloid; extremely fine, insoluble particles in a stable suspension: smake, jelly, foam, clay.

7. stade: a substage of a glacial stage, when glaciers are advancing (a time when they're retreating is an interstade).

8. benthic: pertaining to the ocean bottom

9. conduit: a passage filled with water under pressure

10. imbricate: to overlap, like singles on a roof.

DUES DUES DUES DUES DUES ARE DUE AS OF JANUARY 1,1994

Geologists Select the Great Books of Geology

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ABSTRACT
Textbooks and standard geology courses commonly do not provide complete preparation for a professional geologist. Students often lack adequate perspective on the origins and interrelationships of their science as well as its broader social, political, and economic aspects. Reading from a list of "Great Books of Geology" selected by a cross-section of geology faculty from throughout North America can help provide the necessary perspective. The list includes works of mostly historical importance and many currently popular geology books that express significant viewpoints. Two authors, McPhee and Gould, are cited with remarkable frequency. Students can be introduced to these books by making them available through the department or in seminars or discussion groups.

Keywords: Education – geoscience; geology – literature and libraries; history of geology; philosophy of science.

Introduction

What are the important books, other than texts, that every geologist should read?

This question was asked of every college and university in North America with a geology-degree program or that teaches geology as part of a science degree. Our purpose here is to summarize the responses in the form of a list of the "Great Books of Geology." A description of the data-gathering process is provided as well as a brief interpretation of the results.

Textbooks are not Sufficient

The inspiration for this survey came from "Reading beyond the textbook: Great books of biology": (Carter and Mayer, 1988). Their analysis of the shortcomings of the educational process apply as much to geology as biology. Some of their main points are summarized below, but reading the full text is recommended.

To begin with, Carter and Mayer cite two unfortunate conditions. First, a tendency to regard the course textbook as the only source of information, a condition referred to as "textbook infatuation." Second, a tendency to assume that learning is limited to the classroom and, as a subsidiary, only through the teacher, a situation called "classroom infatuation." Carter and Mayer conclude that "Despite the much-touted objective of creating independent learners and self-directed critical thinkers, the bulk of U.S. biology [geology] classrooms still are a formal setting with an authoritarian teacher." Intellectual shallowness is the result, with students planning careers in fields of science to which they are not committed in mind and spirit. "They do not read, think, or speak like biologists [geologists]."

In the case of geology students, too few are familiar with the history and interrelationships of major geologic concepts or the place of geology among the sciences. Many have no awareness or concern about the social, political, and economic context of geology. One way to gain such perspectives is by reading beyond the textbook and outside the classroom. In this article we provide a list of important books, other than textbooks, recommended by geology faculty. As suggested by Carter and Mayer for their list, these books are not intended for study in detail but should be read for perspective and enjoyment.

Selecting the Books

Institutions teaching geology were selected from the *Directory of Geoscience Departments* published by the American Geological Institute. About 900 departments were contacted, including departments in Canada and Mexico. One hundred thirty-four replies were received from departments and individuals. The age range of respondents was from 30 to 84, with the average age of about 50; 89 percent of the respondents were male. In these respects we believe that this is a representative cross section of geology faculty. However, the distribution of subdisciplines is not. Thirty-five (self-identified) subdisciplines were listed by 122 respondents, with paleontology (21) being by far the most common, followed by geochemistry (9) and sedimentology (7). In combination, the various kinds of stratigraphy, paleontology, and sedimentary geology totaled 30 (25 percent), resulting in a strong "soft rock" flavor that may be reflected in the books selected.

Four hundred ninety-five different books were listed; 360 of these were cited only once and another 63 were cited only twice. The following discussion focuses on the remaining 72 that were cited at least three times. Only the top 42 selections, those cited five times of more, are listed in Table 1. A more complete list can be obtained from the authors by requesting it.

Analysis of the Selections

Responses can be interpreted in several ways. One group (18 of the 72) consisted of books of mainly historical importance, those whose publication marked milestones in the science. These are probably not intended for reading in their entirety except by historians. On the other hand, most of the books have little historical significance, but were cited for other reasons. This is indicated by dates of publication. Of the 72 books cited three or more times, only thirteen were published before 1900 and only three before 1800. Of these 72, 31 (43 percent) have been published since 1980. Clearly this last group consists of currently popular books, not "Great Books" in the sense of their having achieved prominence over time. We wonder how many of these would appear on a similar list ten or twenty years from now.

Of the books that are not "milestones" of science but intended to be read, several categories can be recognized. The largest group (31 of the 72) are books about geology, probably intended for exploration of ideas and viewpoints, not for technical details. Mostly these are "popular" science books, such as those by McPhee and Gould, but there are also a few biographies and works of fiction.

Another large group (20 of the 72) includes history and philosophy of science and methodology of geology. Only two (Kuhn, 1962; Hawking, 1988) deal with broader aspects of science. A few (3) deal with what might be called "environmental ethics."

Perhaps the most surprising aspect of the list is the degree to which it is dominated by two authors: McPhee and Gould. McPhee had five books cited and received over 13 percent of the total citations received by the 72 most popular books. Gould had seven books in the group of 72 (and two

Journal of Geological Education, 1993, v. 41, p. 260

(29)*	1.	*Principles of Geology*, Lyell, 1830-1833
(28)	2.	*Wonderful Life*, Gould, 1989
(23)	3.	*Origin of Species*, Darwin, 1859
(22)	4.	*In Suspect Terrain*, McPhee, 1983
(21)	5.	*Basin and Range*, McPhee, 1981
(20)	6.	*Origins of Continents and Oceans*, Wegener, 1912
(17)	7.	*Illustrations of the Huttonian Theory*, Playfair, 1802
(16)	8.	*Rising from the Plains*, McPhee, 1986
(15)	9.	*Great Geological Controversies*, Hallam, 1983
(14)	10.	*Control of Nature, McPhee*, 1989
	11.	*Principles of Physical Geology*, Holmes, 1945
	12.	*Time's Arrow*, Time's Cycle, Gould, 1987
(13)	13.	*The Evolution of the Igneous Rocks*, Bowen, 1928
	14.	*The Fabric of Geology*, Albritton, 1963
(11)	15.	*The Meaning of Fossils*, Rudwick, 1972
(10)	16.	*The Structure of Scientific Revolutions*, Kuhn, 1962
	17.	*The Voyage of the Beagle*, Darwin, 1836 ??
(9)	18.	*The Birth and Development of the Geological Sciences*, Adams, 1954
	19.	*Exploration of the Colorado River*, Powell, 1875
	20.	*Theory of the Earth with Proofs and Illustrations*, Hutton, 1775
(8)	21.	*The Nature of the Stratigraphic Record*, Ager, 1973
	22.	*De Re Metallica*, Agricola, 1556
(7)	23.	*The Founders of Geology*, Geikie, 1897
	24.	*Giants of Geology*, Fenton, 1952
	25.	*Language of the Earth*, Rhodes, 1981
	26.	*An Ocean of Truth, Menard*, 1986
	27.	*Report on Geology of the Henry Mountains*, Gilbert, 1887
(6)	28.	*Conversations with the Earth*, Cloos, 1953
	29.	*The Dinosaur Heresies*, Baaker, 1986
	30.	*The Great Devonian Controversy*, Rudwick, 1985
	31.	*Ice Ages, Solving the Mystery*, Imbrie, 1979
	32.	*It Began with a Stone*, Faul, 1983
	33.	*Studies on Glaciers*, Agassiz, 1840
	34.	*System of Mineralogy*, Dana, 1837
(5)	35.	*Adventures in Earth History*, Cloud, 1970
	36.	*The Behavior of the Earth*, Allegro, 1983
	37.	*Chaos, Making of a New Science*, Gerick, 1987
	38.	*The Immense Journey*, Eiseley, 1957
	39.	*Principles of Stratigraphy*, Grabau, 1913
	40.	*Prodromos De Solido . . .* , Steno, 1669
	41.	*The Road to Jaramillo*, Glen, 1982
	42.	*Sand County Almanac*, Leopold, 1949

*Numbers in parentheses are number of times each book was listed by respondents.

Table 1. The Great Books of Geology.

others cited less than three times) for a total of 9 percent of the total citations. The second most popular book, Gould's *Wonderful Life*, was listed almost as often as the most popular book (28 versus 29). Even more startling, four of the top ten (neglecting a tie at tenth place) are by McPhee, including fourth, fifth, and eighth places. Actually, the popularity of these two authors is even greater than shown here because some respondents listed "anything by . . ." McPhee or Gould without citing specific titles that could be tabulated in our survey. It seems unlikely that the popular reading of any other discipline is so dominated by only two authors, including one (McPhee) who is not even a member of that profession.

What Do We Do with this List?

Recall that our purpose here was to direct the attention of students to books important to their professional development but not likely to be encountered in the usual classes.

The simplest approach would be to make some form of the list widely available to students, but an explanation of *why* these books are important also seems necessary. The best answers to this question in our opinion were provided by individual faculty members. To convey the significance of each book (why many geologists thought it was important), we are preparing annotations, including a brief description of content supplemented by our subjective opinions and comments by respondents to our survey. When this annotated list is complete, we will announce its availability in *JGE*. It would also be relatively easy for departments to maintain a small collection of recommended books, to be circulated with the encouragement of the faculty. A more substantial step would be to use these books as a basis for discussion among students and faculty, perhaps in small seminars as issues arise. The most formal and structured approach would be to offer credit courses involving extensive readings from the list, with scheduled debates, lectures, term papers, and so forth.

In the course of the survey, we discovered that a small number of schools already have such courses based, at least in part, on the Great Books of Geology, usually in the guise of a course on the history and philosophy of geology. Perhaps it would be useful to compile a summary of reading lists and formats along with suggestions as to what works and what doesn't. This shared experience could be used as a point of departure and means of encouragement for other geology departments. Readers are encouraged to contact the authors to express their interest or make suggestions regarding such a proposal.

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