JAN 92

THE GEOLOGICAL NEWSLETTER

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

GSOC

GEOLOGICAL SOCIETY
OF THE OREGON COUNTRY
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GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

SINCE 1935

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY
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Publicity 235-3579
Roberta L. Walter

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(Friday Evening)
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FIELD TRIPS: Usually one per month, via private car, caravan or chartered bus.
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VISITORS WELCOME
INFORMATION PHONE 284-4320

VOLUME 58, NO. 1

CALENDAR OF ACTIVITIES FOR JANUARY, 1992

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

Jan. 10 "Land of the Headhunters - Papua, New Guinea".
Speaker: Rosemary Kenney, Past President, GSOC.

Jan. 24 "The John Day Country".
Speaker: Don Barr, Past President, GSOC.

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

Jan. 3 "Sir Lanka---Land of Gems and Spices"
Speaker: Rosemary Kenney, Past President, GSOC

Jan. 17 Staff

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

Tuesday Jan. 21 Everyone attending the seminar is asked to bring four slides related to geology. Ruth Keen will give instructions at the meeting.

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

FIELD TRIP

A WALKING TOUR OF THE SOUTH PARK BLOCKS.

Date: January 18, 1992

Time: 10:30 A.M. Meet at Cramer Hall, PSU. Trip will take about 1½ hours.

Leader: Ralph Mason, Past President, GSOC.

Those wishing to have lunch together, please call Alta Fosback, 641-6323 by January 8 for reservations.

CORRECTION: Page 82, The Geological Newsletter, The award given to Melvin Ashwill should read The Harold L. Strimple Award.

CENTRAL OREGON FOSSIL LEAVES: THEIR IMPLICATIONS ABOUT PALEOCLIMATE AND THE GROWTH OF THE CENTRAL PORTION OF THE OREGON HIGH CASCADE MOUNTAINS.

Melvin S. Ashwill
940 SW Dover Lane
Madras, OR 97741
Ph. (503) 475-2907

ABSTRACT:

Parts of Oregon older than the Cretaceous period are generally thought to be accreted terranes. The Pennsylvanian Spotted Ridge flora and the Jurassic floras of Douglas and Curry counties thus were not in ancient Oregon while living. They represent island floras rafted to the continental margin of North America from some unknown distance west or south of Oregon.

When most of the state was raised above sea level in Eocene time, the climate was tropical, as shown by palms and other tropical plants found in Eocene fossil floras.

A major change from tropical to temperate vegetation during earliest Oligocene time is documented in five successive fossil floras found at Gray Butte, Jefferson County, Oregon.

An abrupt change from somewhat dry-temperate to semi-arid-temperate conditions took place about 7ma in central Oregon, and is reflected in fossil plants found near the Deschutes River. The change to aridity is believed to be the result of mountain building in the High Cascade Mountains of central Oregon as well as general region-wide crustal uplift.

INTRODUCTION:

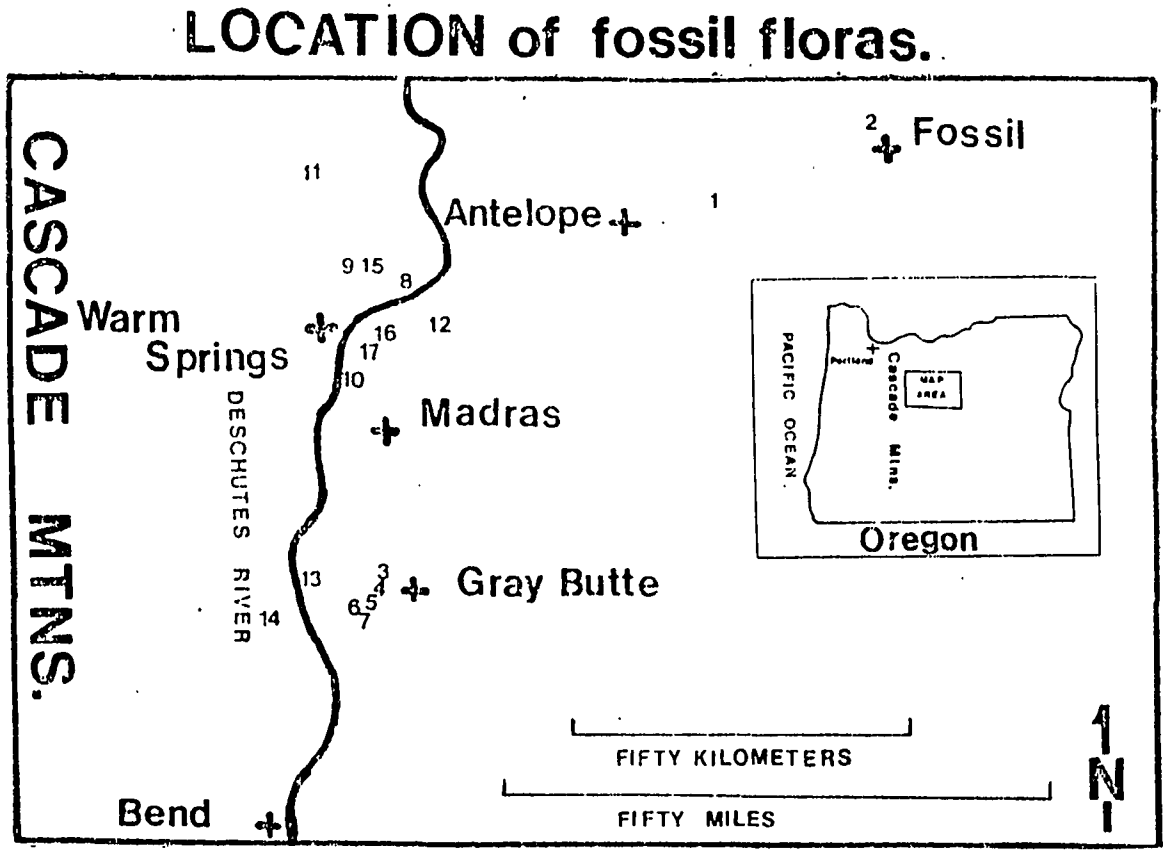
Ever since someone gazed in astonishment at the first fossil palm leaf to be found in rocks in the arctic, it has been obvious that fossil plants have a lot to tell us regarding past climates. The rich fossil plant beds of Oregon have provided raw material that has given us much significant information about tertiary plant communities.

Quantitative measurement of morphological features of leaves has given science the tools to make considered estimates of the ecological condition that prevailed when plants at a given fossil site once were alive. Such characters as leaf size, texture, presence of drip-tips, margins (whether toothed or entire) plus the relationship of fossil genera and species to climates where their modern counterparts live give important clues to the past. From such evidence, deductions can be made concerning approximate mean annual temperature, temperature extremes, seasonality and approximate abundance of rainfall at the fossil site during the time of deposition. A comparison of the fossil plant community at a locality with modern plant communities can sometimes give clues to the altitude of the site at the time fossilization occurred. Careful scholars do not use these criteria alone, but cross check and correlate with paleoecological data from the fields of archaeology, glaciology, geology, vertebrate and invertebrate paleontology, paleopedology (the study of fossil soils) and others.

GEOGRAPHIC SETTING OF THE STUDY AREA:

As is shown on the map (Fig. 1), the central Oregon area lies just to the east of the Cascade Mountains. The effect that this mountain range has on the weather of Oregon is extraordinary. The popular conception of the state is

FIG. 1



1-Hancock Field Station flora. 2-Fossil, Oregon flora. 3-Kings Gap flora. 4-Sumner Spring Flora. 5-Nichols Spring flora. 6- Canal Flora. 7-Trail Crossing flora. 8-Heath Ranch flora. 9-Horse Trap flora. 10-Pelton flora. 11-Foreman Point flora. 12-Vibbert flora. 13-Round Butte Dam flora. 14-Juniper Canyon flora. 15-Kahneeta flora. 16-Deschutes flora. 17-Rehermann flora.

that it is a wet, green area. The residents even call themselves "webfoot". The heavy annual rainfall west of the Cascade Mountains makes this appropriate there. In rising to surmount the Cascade Mountains, however, most of the moisture in the air is condensed and falls as rain or snow. When the dry air descends into central and eastern Oregon, the effect is dramatic. Except in very high elevations, this vast part of the state is semi-arid. Large portions of it are considered to be desert. At Madras, Oregon, for instance, the annual rainfall is only about eight inches. The area is largely mountainous. The canyon bottoms along the lower reaches of the Deschutes and John Day rivers are at elevations of around 300m above sea level. Most of the agricultural areas, however, lie from 450m to 1,000m above sea level. Plants not only have to deal with the aridity of the region, but a very short frost-free season due to the elevation and latitude. What little precipitation that falls there is very seasonal and plants that cannot survive prolonged dry periods have difficulty living. Native vegetation, often described as "sage and juniper" also includes grasses, bulbous and tuberous herbs and a few species of shrubs. Exceptions are large irrigated plots where crops are bountiful, elevations above 900m, where pine forests are common, and streamsides.

REGIONAL GEOLOGY:

For the past approximately two hundred million years, the North American continent has been drifting slowly northwest. It is believed that at the outset of this journey, the Oregon we know existed only as a patch of ocean off North America's western shore. Geologists have evidence to indicate that large and small chunks of ocean floor have become attached to the continental edge as North America has plowed through and over the Pacific Ocean floor. This process has served to extend the shoreline westward. It has also left a veritable jigsaw puzzle of a geologic record that is not yet completely worked out by researchers.

In Oregon, there is one Carboniferous age fossil flora called the Spotted Ridge flora (Mamay and Read, 1956), and several from the Jurassic age known as the Riddle and Elk River floras (Fontaine, 1905). Since the rocks at these sites are considered to be "exotic terranes" rafted to the shores of Oregon from some remote site, it is likely that the plants found in these deposits grew on some seamount (island) rather than an Oregon mainland.

It is not until we look at the record of Cretaceous time that we see marine strata that represent the rocks of near and offshore seas in situ. Fragmented leaves of Cretaceous age are found along with marine invertebrate fossils at some localities in the state.

No terrestrial fossils of uncontested Paleocene age have been so far found in Oregon. Indeed, rocks of this age are almost completely missing from the geologic record here. Since the dinosaurs died out at the end of the Cretaceous era, the above information explains why, with the exception of flying and marine serpents, no dinosaur remains have been recovered in Oregon.

Geologic formations from which central Oregon tertiary plant fossils are recovered include the Clarno Formation, largely Eocene in age, the John Day Formation, Oligocene and Miocene in age, the Columbia River Basalt Group, Miocene in age, the Miocene Simtustus and Mascall Formations, and the late Miocene-early Pliocene Deschutes Formation (some maps refer to it as the Madras Formation or the Dalles Formation). All of these formations are made up mostly of erupted volcanic materials, and include large quantities of ash, tuff, lava, mudflows, clays and sandstone. Material making up sedimentary units are mostly derived from volcanic rocks. Volcanics of the Clarno and John Day Formations are mostly silicic (andesites and rhyolites), while those of the other formations are mainly basaltic.

By far, most fossil leaf beds in central Oregon are found in tuffaceous siltstones from fossil lake or pond sediments. A significant number of fossil leaf beds do occur, however, in rocks that represent ancient mudflows. Fossil leaves from the mudflow beds typically are to some degree rolled and curled, while those from quiet water sediments are usually flat-lying.

PAST WORK IN CENTRAL OREGON:

Thomas Condon, a pioneer preacher and naturalist, made the first noteworthy collection of fossil leaves in the area. This was in the last half of the 19th century. However, the most comprehensive early studies of Oregon fossil floras began in 1916. That was the year that young Ralph Works Chaney, a botany student in Chicago, took a suggestion that he look at some fossil leaves in the gorge of the Columbia River. The experience not only led to a life as a paleobotanist for him but to a series of monumental studies of fossil floras of the state of Oregon (Chaney, 1924, 1927, 1938, 1956, 1959). Although Chaney collected leaf fossils from China, Mongolia, Japan and much of the western half of the United States, he returned to Oregon over and over throughout the rest of his life. His last trip to the state was a sentimental journey with some of his past students in 1969, just two years before he died. Chaney collected from more than twenty major sites in Oregon (Ashwill, 1987).

Most paleobotanists presently working in America have collected in the area at least once. Four of these have made significant collections in central Oregon. Jack A. Wolfe of the United States Geological Survey, Gregory J. Retallack of the University of Oregon, Herbert W. Meyer of Salem, Oregon, and Steven R. Manchester of Indiana University together have added extensively to our knowledge of Oregon paleobotany.

SEVENTEEN SELECTED FOSSIL FLORAS FROM CENTRAL OREGON:

From the more than fifty fossil leaf localities known in central Oregon, the following seventeen have been chosen for discussion in this paper,. Together, these floras illuminate what types of vegetation flourished in the region from Eocene time to Pliocene time. We as yet have found no significant fossil floras of late Pliocene nor Pleistocene time locally.

The ages of three of the localities studied have been measured. Ages of seven are estimates based on radiometric dating of overlying or underlying strata, and the remainder are based on stratigraphic position and correlation of floral components with those of other fossil floras in the western United States representing similar plant communities. When ages have not been confirmed by direct radiometric dating, a question mark is placed after age estimates.

HANCOCK FIELD STATION FOSSIL FLORA: LOCALITY MSA/F-38. **EOCENE**

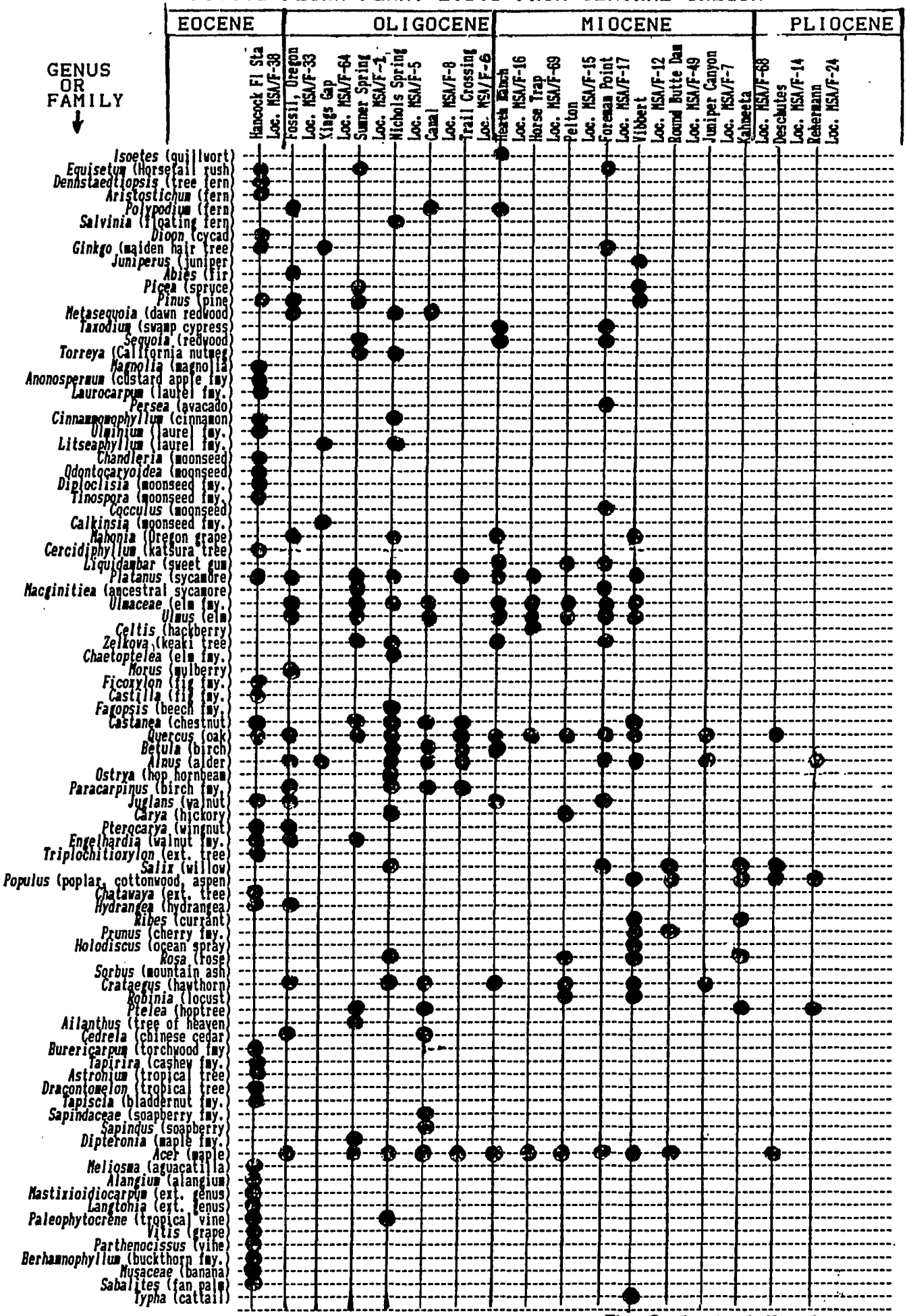
About forty four million years ago, at a place now known as Hancock Field Station, a remarkable assemblage of leaves, nuts, seeds and wood were entombed in sediments and became fossilized. The leaves remained impressions, but the nuts, seeds and wood were replaced by minerals. Thus they lend themselves to detailed study involving cross sectioning and microscopic examination (Bones, 1979; Manchester, 1981). Today, the spot is a paleobotanist's dream, and is usually the place first sought out when one arrives in Oregon. Collecting is restricted, and the field station is administered by the Oregon Museum of Science and Industry, Portland, Oregon.

Situated in a little valley just off Oregon highway 218 between the towns of Antelope and Fossil, this rustic research and education center is unique, and has an impressive history.

The fossil flora at Hancock Field Station (table 1) includes lianas and a high proportion of trees that today grow mostly in tropical areas (Manchester, 1981). Retallack notes that red, highly weathered fossil soils associated with the nut beds are compatible with a warm, wet tropical paleoenvironment (Retallack, 1981). The climate at the time of deposition was tropical, and temperatures were warm, humidity high (Retallack, 1981, 1987). It is an astonishing experience to view the harsh landscape at Hancock Field Station today and envision the same place as a tropical jungle with palms, lianas and bananas growing there.

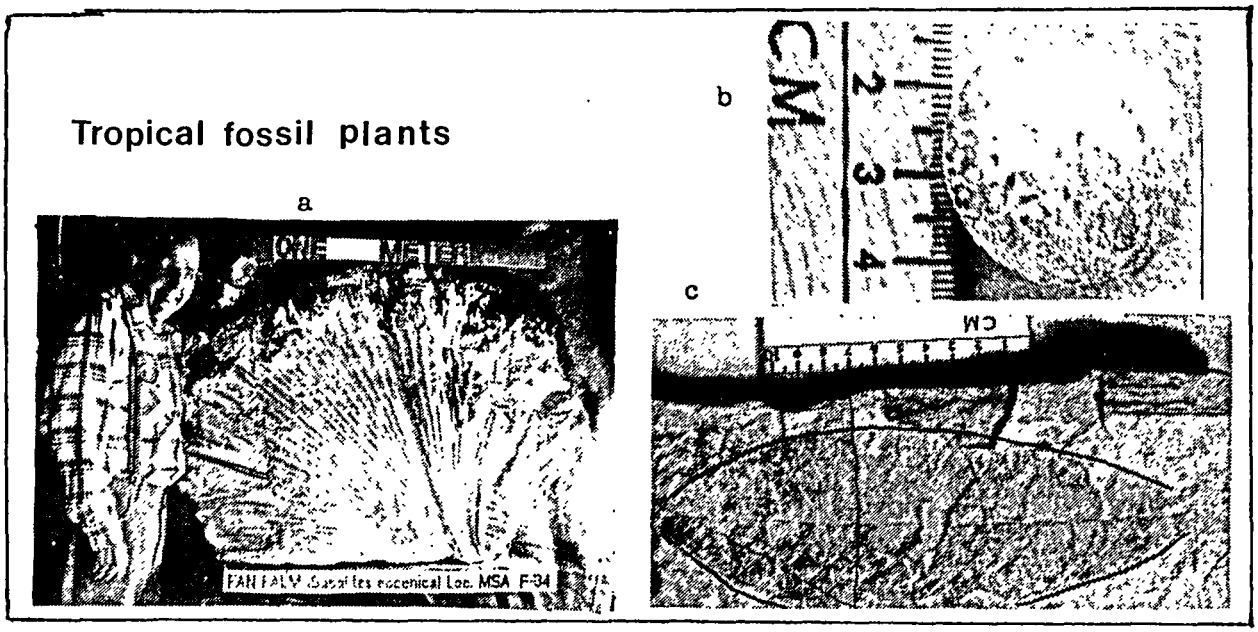
Table 1

SEVENTEEN FOSSIL FLORA PLANT LISTS FROM CENTRAL OREGON



In addition to the presence of tropical genera, the morphology of the fossil leaves provide evidence supporting the temperature estimates.

FIG. 2



a-Large fan palm (*Sabalites eocenica*) b-Tropical liana seed (*Paleophytocrene* sp.) c-Avocado leaf (*Persea* sp.) approximately eight inches long.

Modern tropical deciduous trees typically have leaves that are large and with entire margins (no teeth on the edges). Trees growing in temperate areas usually have smaller leaves with toothed margins (Bailey and Sinnott, 1916). Pioneering studies correlating toothed/entire leaf margins with climate done by Bailey and Sinnott were largely unused for decades. Recently, Jack A. Wolfe and others have seen the validity of their concept (Wolfe, 1978) and are currently doing field work to establish further data bases by studying this phenomenon in several tropical and temperate localities.

Several fossil floras in central Oregon, including the Clarno Formation flora at Hancock Field Station, support the observation that the climate there in mid to late Eocene time was tropical (Chaney, 1956).

OLIGOCENE

FOSSIL, OREGON FLORA: LOCALITY MSA/F-33.

The fossil plant association found at Fossil, Oregon documents the typical assemblage in central Oregon immediately following the major climatic cooling that took place in the beginning of the Oligocene epoch. The rocks of this flora have been age-dated at 32ma (Manchester, written comm., 1987). Wolfe feels that this climatic change was rapid (one to two million years duration), so the onset of the change is likely to have been 33ma to 34ma. Notably absent after the climatic change are such tropical and subtropical plants as palm, cycad, magnolia, cinnamon, fig, *Engelhardia* (tropical member of the walnut family), *Tapirira* (cashew family), *Astronium* (tropical tree), *Meliosma* (aguacatilla), and *Paleophytocrene* (tropical liana). Represented and typical of the temperate floras of the Oligocene in central Oregon are *Metasequoia* (dawn redwood), *Cercidiphyllum* (katsura), *Platanus* (sycamore), *Ulmus* (elm), *Alnus* (alder), *Quercus consimilis* (live oak), *Juglans* (walnut), *Crataegus* (hawthorn) and *Acer* (maple).

Seventeen percent of the dicotelydenous species found in this locality are entire margined, although several other localities in central Oregon thought to be of similar age produced percentages from twenty four to thirty four (Manchester and Meyer, 1987). Such measurements are indicators of a warm temperate paleoclimate at Fossil, Oregon 32ma.

The approximately ten to eleven degree (centigrade) decline in mean annual temperature believed to have taken place during the climatic deterioration is strikingly illustrated by the contrasting fossil plant communities of the Hancock Field Station flora and the Fossil, Oregon flora.

GRAY BUTTE FOSSIL FLORAS:

Documentation of most of the temperature decline event itself has come to light through the discovery of a number of fossil leaf localities on and near Gray Butte, a 1,554m peak about 29km south of Madras, Oregon (Ashwill, 1983).

Of the more than twenty fossil leaf sites, some extensive, some very small, found in this area, five stratigraphically successive ones host fossil floral communities that begin with mainly tropical plants, change to mixed tropical and temperate plants, and finish with a typical lower John Day Formation (lower Oligocene) assemblage of temperate plants.

1-KINGS GAP FLORA: LOCALITY MSA/F-64.

This, the most recently discovered of the five floras,has not yet been well collected and studied. However, eleven different dicot species plus Ginkgo are known to be present.Of the dicots, about sixty to seventy percent of the species have entire margined leaves. This suggests that the paleotemperature at the site was tropical in nature. Leaf sizes and textures support this observation,. Only two of the genera, *Ulmus* (elm), and *Alnus* (alder) are also found in younger floras at Gray Butte.

2-SUMNER SPRING FLORA: LOCALITY MSA/F-1.

Plants found at this site are mixed tropical and temperate in affinity (Ashwill, 1983). Of twenty two identified taxa, five are today found in tropical or subtropical conditions only. Sixteen grow today in temperate regions, and several of this sixteen taxa also grow in tropical climates.

**********THE SECOND PART OF THE PRECEDING ARTICLE BY MELVIN ASHWILL ON THE CENTRAL OREGON FOSSIL LEAVES WILL BE CONTINUED IN THE FEBRUARY ISSUE OF THE GEOLOGICAL NEWSLETTER.**********.

TREASURERS REPORT
GEOLOGICAL SOCIETY OREGON COUNTRY
January 1, 1991 to October 25, 1991

INCOME RECEIPTS:	
Memberships,(Annual Dues)	$3,035.00
Newsletter Subscriptions	120.20
Publications Sales:	
Sales At Annual Banquet	51.50
Other Sales	21.60
Annual Banquet, Dinner Ticket Sales	1,262.50
Annual Banquet Donation Sales	176.80
President's Field Trip	2,136.85
Miscellaneous Donations:	
Luncheons Surplus	15.47
General Meeting Surplus	90.00
Seminar Refreshments Surplus	61.56
Miscellaneous, Other:	
Historian Book Fund	4.99
U.S. Treasury	4.00
Memorial Donations	30.00
Total Cash Receipts	$7,010.47

SUMMARY OF CASH ON HAND:

Savings Account Number 70-015965-5	$4,769.25
Bank America, Sellwood-Moreland BR. (Statement 9-21-91)	
Checking Account Number 010- 319	$2154.49
U.S.National Bank, Burlingame Br. (October 25, 1991)	

Archie Strong
GSOC Treasurer

TREASURERS REPORT
GEOLOGICAL SOCIETY OREGON COUNTRY
January 1 to October 25, 1991

EXPENITURE DISBURSMENTS:

Printing: NEWSLETTER		
Budget Instant Press	$900.04	
Kramers	131.80	
Alpine Sec.Service	93.85	
		$1,125.19
Postage: NEWSLETTER		
Bulk Mailing Permit #999	260.00	$1385.19
Annual Banquet,(Held at P.S.U.):		
PSU Food Catering	$1,035.25	
Misc. Expenses, Photographs	68.74	
Banquet Program Printing	39.43	$1,143.42
Rental, meeting Room, PSU (Room No. 371, Cramer Hall)	$327.00	
Luncheons, (St. Plaza on S.W.6th		
Parking	$100.00	
Miscellaneous	15.47	$115.47
Insurance, Liability & Fidelity	$400.00	
Scholarship,(Annual $400.00)		
President's Field Trip, Annual (Includes Reconnaisance)	$1,401.08	
Postal Service, (Box 907 Rent)	93.00	
Equipment Repair and Maintenance (Electric Stapler Repair	57.00	
Library, Misc. Expenditures	12.94	
Oregon State Corporation Regist.	5.00	
Miscellaneous, Postage, Records and Stationary Supplies.	41.69	
TOTAL EXPENDITURES	$5,337.79	

Archie Strong
GSOC Treasurer

IN MEMORIUM

Irma Greisel passed away March, 1991. She was and educator and a long time GSOC member

Hughowen passed away in October, 1991. Along with being a active GSOC member he was a Master Gardener for Oregon and active in his church.

"The italics are mine."

THE GEOLOGICAL NEWSLETTER INDEX

Compiled by Dorothy R. Waiste

Volume 57

ARTICLES AND REPORTS

Also see PRESIDENT'S SUMMER FIELD TRIP

BANQUET

MEMORIALS

PRESIDENT'S SUMMER FIELD TRIP

SOCIETY BUSINESS AND AFFAIRS

AUTHORS

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VOLUME 58, NO. 2

CALENDAR OF ACTIVITIES FOR FEBRUARY, 1992

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

Feb. 14 Three video programs produced by the California Department of Water Resources.

1) "Geothermal: The Roaring Resource"
2) "Emergency Flood Fighting Techniques"
3) "Changing Patterns: Land Use Mapping in California"

All films shown as time and discussion sessions permit.

Feb. 28 "Trembles (Earthquakes)in the Pacific Northwest" Speaker, Jim Bela, President, Oregon Earthquake Awareness.

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

Feb. 7 "Dynamic Geology of the Southern Alps, New Zealand". Speaker: Scott Burns, Professor, PSU.

Feb. 21 To be announced

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

Tuesday Feb. 18 Everyone attending the seminar is asked to bring four slides related to geology. Ruth Keen will give instructions at the meeting.

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

FIELD TRIP

COLUMBIAN WHITE-TAILED DEER NATIONAL WILDLIFE REFUGE

Date: Saturday, February 22, 1992.

Time: 10:30 a.m. at the Refuge.

Leader: Robert Waiste (284-4320).

Details on page 12

57th ANNUAL BANQUET NOTICE

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

DATE: Friday, March 13, 1992. PUT A MARK ON YOUR CALENDAR!!!!!!

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

SPEAKER: Dr. William Orr, Ph.D. Geology Department, University of Oregon. "Up Dating Oregon Geology".

TICKETS: Ticket chairman, Freda and Virgil Scott, 8012 SE Ramona Street, Portland, OR 97206. Write or call them for reservations (771-3646), or send check to GSOC, P.O.Box 907 Portland, OR 97207. Send a stamped, self-addressed envelope for the return of the tickets. Tickets for sale at all GSOC meetings. PLEASE PURCHASE YOUR TICKETS EARLY.

PRICE: Cost of banquet tickets is $14.00 each. Bring tickets to the banquet; they will be collected at tables.

PARKING: The 5th floor of 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 attending the banquet. BE SURE YOU PARK ON THE FIFTH FLOOR !!!!. Do not park in spaces marked "Handicapped" or "Reserved."

From the 5th floor structure, a short stairway leads to a foot-bridge across Broadway directly 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 the expenses of the Banquet. So please bring SALEABLE material that will attract purchasers and treasured by them.No large, heavy specimens, please. Minerals, slices, crystals, fossils, thundereggs, tumbled agates, geodes, worthwhile books on geology or natural history. If you need help in transporting your donations to the building, phone Archie Strong, 244-1488 or Harold and Patricia Moore, 254-0135.

^^

PROVIDE A BANQUET EXHIBIT

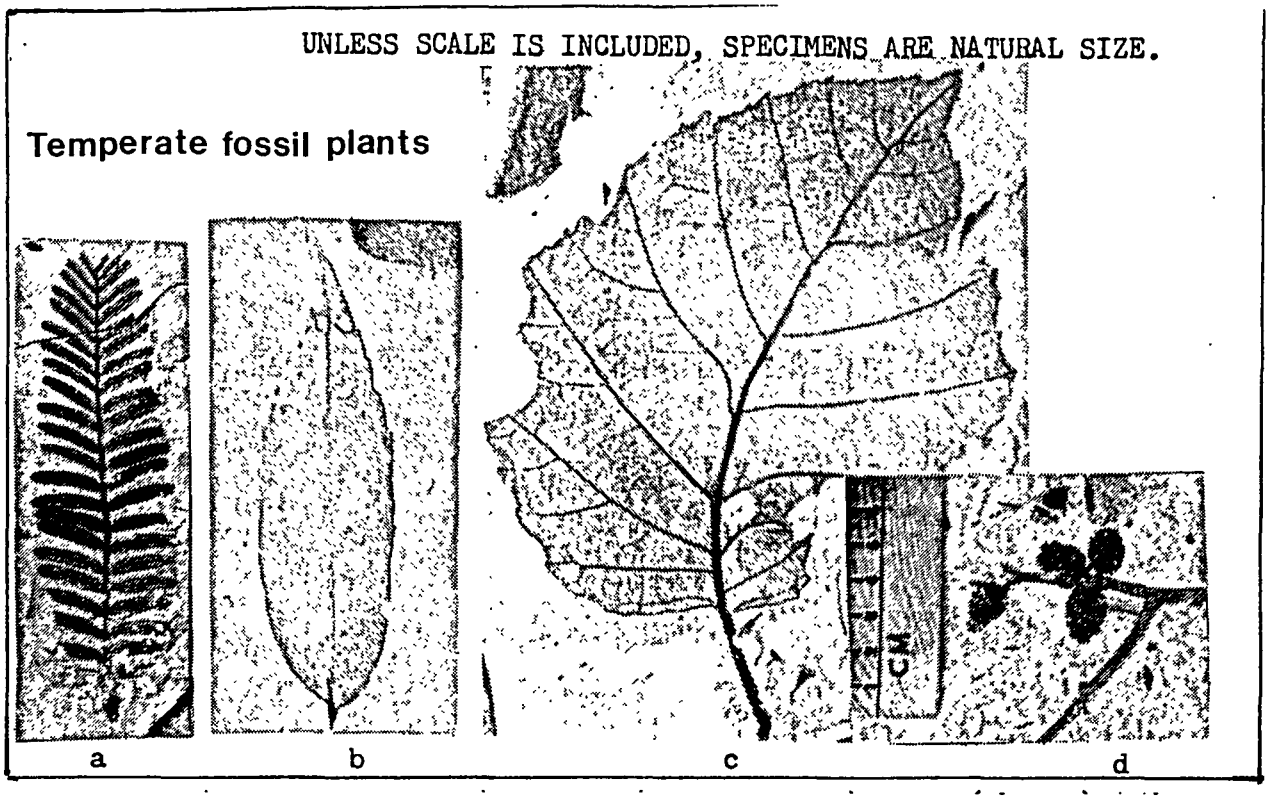
Displays for the Annual Banquet on March 13 are eagerly solicited. Exhibits of rocks, minerals, fossils, books, pictures, or any hobby collection (geological or otherwise) are suitable. Please call Donald Parks, 288-3600 or Rosemary Kenney , 221-0757 so space can be reserved. If possible, bring your 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.

The second part of Melvin Ashwill's article on "Central Oregon Fossil Leaves----- begins on the next page of the Geological Newsletter, Page 9 .#####

3-NICHOLS SPRING FLORA: LOCALITY MSA/F-5.

This flora also hosts mixed tropical and temperate plants (Ashwill, 1983). *Metasequoia* (dawn redwood), *Mahonia* (Oregon grape), *Platanus* (sycamore), *Quercus simulata* (live oak), *Betula* (birch), *Alnus* (alder), *Crataegus* (hawthorn) and *Acer* (maple) are typical of lower Oligocene plant assemblages in central Oregon. The three different maple species all are common to other fossil floras found in central Oregon and are of similar age (Wolfe, 1987).

FIG. 3



a-Dawn redwood (*Metasequoia occidentalis*) b-Live oak (*Quercus consimilis*) c-Alder (*Alnus* sp.) d-Alder cones (*Alnus* sp.)

Subtropical and tropical elements of the flora include *Torreya* (California nutmeg), *Cinnamomophyllum* (cinnamon), *Litseaphyllum* (laurel family) and *Paleophytocrene* (tropical liana).

4-CANAL FLORA: LOCALITY MSA/F-8.

In the Canal flora group of plants, tropical and subtropical elements are not present (Ashwill, 1983). All of the taxa found in this flora are common to many other "Bridge Creek" floras ("Bridge Creek" is a generic term often used in reference to the collective fossil floras found in the lower John Day Formation of central and eastern Oregon). The Bridge Creek flora (Chaney, 1924) was the first of these floras to be well studied.

Notable is the large number of twigs of *Metasequoia* (dawn redwood) found in this flora. *Metasequoia* today is a streamside tree found in the mountain valleys of central China. Although this genus has been found in older floras, it commonly is abundant in the "Bridge Creek" floras.

5-TRAIL CROSSING FLORA: LOCALITY MSA/F-6.

This fossil flora is located stratigraphically about 60m higher than the Canal flora. Plants found at this site are also typical of the "Bridge Creek" floras. The assemblage differs from the Canal flora mainly in the absence of *Metasequoia*. This may be the result of climatic change, or it may have happened because of local topographic changes.

The five Gray Butte floras, all within a 2.5km radius and in apparent stratigraphic succession have recorded the major climatic deterioration of the early Oligocene epoch.

The age of the Gray Butte area is presently unclear (Bishop and Smith, 1990). A radiometric measurement (Robinson, 1975), stratigraphic and fossil evidence (Smith, 1986; Ashwill, 1983) indicate an Oligocene to early Miocene age. Radiometric ages of a 1987 study suggest a late Miocene age (Obermiller, 1987). When funding becomes available for the making of definitive age determinations of the strata hosting the five Gray Butte floras discussed, we should have a more clear perception of the time involved in this dramatic climatic cooling event.

MIOCENE

HEATH RANCH FLORA: LOCALITY MSA/F-16.

The John Day Formation of central and eastern Oregon is known to host numerous fossil plant localities in its lower strata and numerous vertebrate fossil localities in its upper parts. The two types of fossils in general seem to be somewhat mutually exclusive in their occurrence. The Heath Ranch fossil flora near Warm Springs, Oregon is an exception to this generality. It lies near the middle part of the formation and fills a longstanding gap in the paleontological record.

The fossil site is located near the mouth of the Warm Springs River. It is exposed in a small hill at the base of a steep 300m slope in the clay-rich John Day Formation. Landsliding is common nearby, and we cannot at present be certain that the site was not originally higher stratigraphically than it is now. If it presently lies in its original stratigraphic position, it is likely to be about 27ma in age. If it has moved down slope, it is younger, but not likely younger than 22ma. More precise age estimates must await age determination of the site, or further geological field study.

The plant community collected at the Heath Ranch site indicates that the paleoclimate was moist, warm and equable. The presence of *Taxodium* (swamp cypress) suggests that the plants were growing in a lowland area. The oak leaves found here as well as in all other local floras younger than this one were lobed in contrast to the live oak leaves found in older sites (Fig. 4). This alteration of leaf morphology is thought to be the result of environmental stress because of changing climate.

PELTON FLORA: LOCALITY MSA/-15.

Near Pelton dam on the Deschutes River, the Pelton flora occurs between two flows of the Columbia River Basalt Group. The lower of the two flows has been age-dated at about 15.7ma (Smith, 1986).

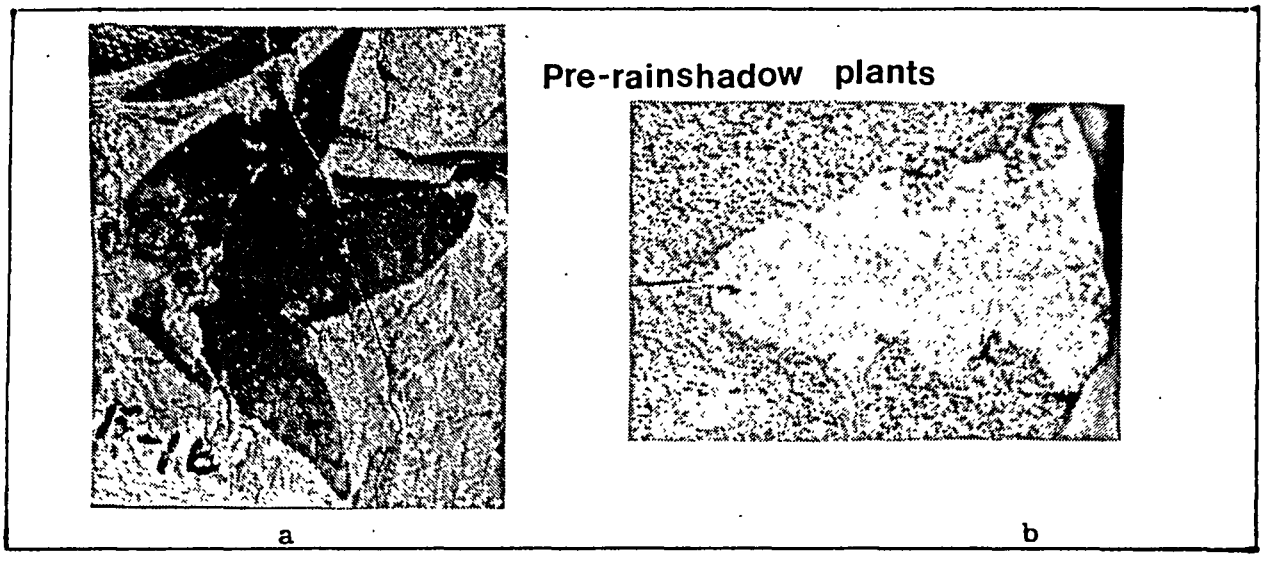
Among the plants listed in table 1 for this site, the two species of lobed oak, *Robinia* (locust), rose, and *Crataegus* (hawthorn) suggest a possible drier weather regime for this site at the time the trees grew here than regimes of older sites.

FOREMAN POINT FLORA: LOCALITY MSA/F-17.

The fossil leaves near Foreman Point just north of the Warm Springs Indian Reservation lie immediately beneath a flow of Columbia River basalt. Although a lower flow is not exposed at this place, lithology of the host rocks as well as chemical and magnetic polarity measurements of the flow makes it seem likely that the occurrence is between the same two flows as those that encase the Pelton flora (Gary A. Smith, personal comm., 1985). The age of the flora is probably about 15ma.

At about the time these lavas were erupted, the High Cascade Mountains (a later development than the Western Cascade Mountains) were beginning to be formed. Looking for signs of increased aridity in the fossil floras deposited at this time does not produce unambiguous evidence of any considerable rain shadow from a growing mountain range. The High Cascades apparently were not elevated enough at the time to be reflected in the fossil plant assemblage. The plants at the Pelton site contain some trees that grow in somewhat dry conditions, and this was at first sight taken to indicate a drying trend at the time of deposition. However, subsequent discovery of the Foreman Point fossils by Harry Phillips of Warm Springs, Oregon seems to negate this possibility. The plant community growing at Foreman Point 15ma is a diverse one, includes three conifer species (one of them swamp cypress) and the last *Ginkgo* (maiden hair tree), walnut and avocado so far found locally. Conditions were obviously quite moist when this group grew. It seems probable that the Pelton flora represents plants growing on a drier, perhaps sloping site. The Pelton and Foreman Point floras are roughly age-equivalent to the Mascall flora found about 140km to the east (Chaney, 1959).

FIG. 4



a-Sweet gum (*Liquidambar* sp.) b-White oak (*Quercus* sp.)

VIBBERT FOSSIL FLORA: LOCALITY MSA/F-12.

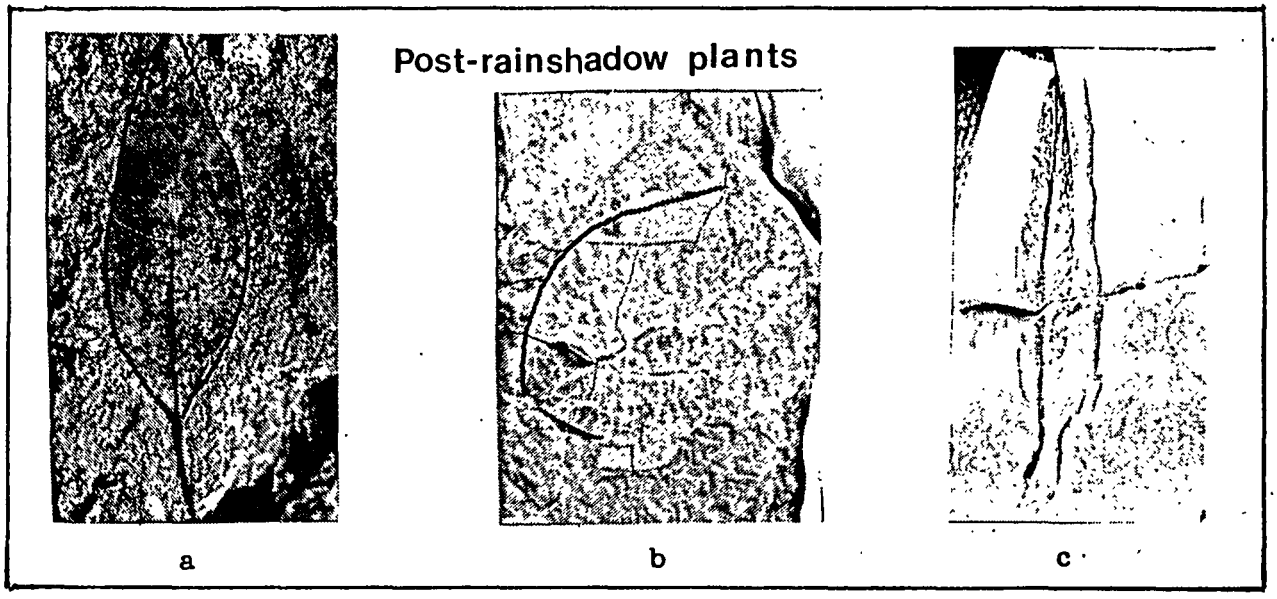
A mudflow that traveled down the ancestral Deschutes River about eight million years ago left a good record of the vegetation that bordered the stream near the town of Gateway, Oregon. Until the discovery of this flora, it was believed by many geologists and paleoclimatologists that by this point in time the High Cascade Mountains probably had become an effective barrier to the Pacific Ocean moisture. The finding of a fairly diverse mixed conifer-hardwood forest in the fossil record of that time shows that not to have been the case. It is true that most of the genera found at the Vibbert locality grow today in the drier areas of America. Certainly, all of the tropical and subtropical elements had disappeared from the scene by then. *Castanea* (chestnut), and *Platanus* (sycamore) make their last local appearance in this flora. The spruce (*Picea*) is surprising, since it today is mostly an upland or very moist lowland tree. Nevertheless, close scrutiny of the plant aggregation shows that with these few exceptions, modern equivalents to most can be found growing either in the immediate vicinity, or in the nearby Cascade Mountains. Crustal uplift and mountain building was making itself felt 8ma, but not to the extent seen today.

ROUND BUTTE DAM FOSSIL FLORA: LOCALITY MSA/F-49 and JUNIPER CANYON FOSSIL FLORA: LOCALITY MSA/F-7.

These two small floras, although several miles apart, are both situated approximately the same vertical distance stratigraphically above the Pelton basalt, which has been age-dated at 7.4ma. They are probably about six million years old. With only *Populus* (cottonwood), *Salix* (willow), *Quercus* (white and black oak), *Alnus* (alder), *Crataegus* (hawthorn),

Prunus (chokecherry) and *Acer* (maple) present in these fossil floras, we now see a depauperate assemblage that illustrates a marked decrease in annual rainfall in the area. The High Cascade Mountains had by 6ma made a very noteworthy impact on the local climate, abetted by a general crustal uplift of the entire region about seven million years ago (Edward Taylor, Oregon State University, pers. comm. 1987).

FIG. 5



a-Hop tree (*Ptelea* sp.) b-Chokecherry (*Prunus* sp.) c-Willow (*Salix sp.*)

PLIOCENE

KAHNEETA FOSSIL FLORA: LOCALITY MSA/F-68; DESCHUTES FOSSIL FLORA: LOCALITY MSA/F-14 and REHERMANN FOSSIL FLORA: LOCALITY MSA/F-24.

These three localities all are located about eighteen meters below the rimrocks of the Agency Plains lava flow, which has been age dated at about 5ma. The Deschutes flora site has been age dated twice, one reading being 4.4ma, and the second 5.4ma. The 4.4ma reading is likely spurious.

When Chaney studied the classic Deschutes flora (Chaney, 1938), he listed only five species. Later, the two impressions identified as *Prunus irivingi* (chokecherry) were reassigned to other genera. Since then the author has found one impression of *Quercus* (white oak) in stream sands at the base of the deposit. The number of species for the Deschutes flora thus remains at five.

Adding to this from the Kahneeta flora *Mahonia* (Oregon grape), another willow (*Salix*), another cottonwood (*Populus*), currant (*Ribes*), rose (*Rosa*), and from the Rehermann flora *Ptelea* (hop tree) we still have only eleven species of plants that are known from this final chapter in the story of past plant life in the Madras, Oregon area. All of the genera except Ptelea are found today growing either at streamside locally or in moister areas within a few miles of the sites.

The dry-climate aspect of these last plant assemblages reinforce the observation that the local climate underwent a marked change in the direction of aridity about seven million years ago, and with undoubted irregular swings, has continued in this trend to the present.

Unfortunately, no fossil floras younger than five million years of age have so far been located locally. Geological reasons for the change from depositional to erosional conditions bringing about this lack are explained by Smith (1986).

CONCLUSIONS:

The paleoclimate indicators of central Oregon fossil plant assemblages point to an early Oligocene major cooling of the formerly tropical climate to that of a more temperate regime. This parallels observations in many parts of the northern hemisphere.

Similarly, the continued cooling and drying conditions of Miocene to recent time in central Oregon mirrors northern hemispheric trends. A combination of regional uplift and High Cascade Mountains construction created a rain shadow about 7ma that resulted in a depauperate fossil flora in later deposits. The semi-arid climate created continues today in the area.

Generally, the highly diverse floras of Eocene time in this region were replaced by less diverse floras. Plants dependant on equable, warm, moist conditions became more and more rare in the record as time progressed. Finally, most of the more primitive plants are missing from the late Mio-Pliocene record in central Oregon. The survivors in this semi-arid paleoenvironment are plants that have evolved characters needed to live under harsh conditions.

ACKNOWLEDGEMENTS:

The author thanks Steven R. Manchester for helpful suggestions regarding the manuscript.

Part of the research involved in the study of fossil floras of central Oregon was supported by a grant from Mazamas, a mountaineering club in Portland, Oregon.

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* *

Details of the Saturday, February 22 trip to the White-tailed Deer Wildlife Refuge is as follows: Distance from Portland 80-85 miles. Allow 2 hours driving time. Take I-5 to Longview, WA, or US 30 to Rainier, OR, cross over the bridge to Longview. From Longview, take #432 and #4(route to Long Beach) west through Cathlamet. About 4 miles cross bridge over Elochoman River, go about one-tenth mile, turn left on Steamboat Slough Road at Refuge sign. Drive to the Headquarters and park. You may also drive around the perimeter of the refuge, about seven miles. We should see the Columbian White Tailed Deer and Elk. Keep your eyes open for birds.
**Take all-weather clothing, binoculars, cameras, lunch and good walking shoes.Dogs not allowed on the refuge.
*** Those willing to take passengers or wishing a ride, phone Robert Waiste or Alta Fosback-641-6323.

ANNUAL MEETING NOTICE

The annual meeting of the GEOLOGICAL SOCIETY OF THE OREGON COUNTRY will be held on Friday, February 28, 1992, at 8:00 p.m. in Room 371, Cramer Hall, Portland State University. Members do not have to be present to vote but their ballot(two ballots for family memberships) must be received before the program begins. At that time the ballots will be counted, results announced and short annual reports given by officers and committe members. A slide program will follow

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TO THE PEOPLE WHO HAVE SENT IN ARTICLES: They will get in the Geological Newsletter in time. Don't stop writing. One of these days I will run out of articles.

MAR 92

THE GEOLOGICAL NEWSLETTER

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

GSOC

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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 meetings.
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 on holidays, at noon, Standard Plaza Cafeteria, third floor, Room A, 1100 SW Sixth Avenue, 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 ea member. Subscriptions available to libraries and organizations at $10 a year (add $3.00 postage for foreign subscribers). Individual subscriptions at $13.00 a year. Single copies $1.00 Order from Geological Society of the Oregon Country, PO Box 907, Portland, OR 97207.
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VOLUME 58, NO. 3

CALENDER OF EVENTS FOR MARCH 1992

57th ANNUAL BANQUET (Grand Ballroom, Smith Memorial Center, Portland State University)

March 13

SPEAKER: Dr. William Orr, Ph.D, Geology Department, University of Oregon.

SUBJECT: UPDATING OREGON GEOLOGY

TIME: 5:30 P.M. Grand Ballroom for viewing exhibits and shopping the sales tables. Sit down time for dinner is 6:15 P.M. Dinner to served buffet style. Tables will be called by letter to be served. Menu consists of Baron of Beef, 3 salads, red potatoes,.mixed vegetables and rolls.

TICKETS: $14.00 each. Please call Virgil or Freda Scott at 771-3646 by March 10. (Tickets will be collected at the tables.

PARKING: Parking is reserved on the 5th floor of PSU parking structure No.1, 1872 SW Broadway. (DO NOT PARK IN SPACES MARKED "RESERVED").

FRIDAY NIGHT LECTURE; March 27

(Cramer Hall, Portland State University, Room 371, 8:00 P.M. Topic is WILSON RIVER LANDSLIDE,APRIL 5, 1991; A CASE HISTORY. Speaker is Sue D'Agnese, Project Geologist Oregon State Highway Division.

FRIDAY NOON LUNCHEON

March 6 — To be announced

March 20 — To be announced

GEOLOGY SEMINAR

March 18 — NOTICE THE DAY OF THE MEETING HAS BEEN CHANGED FROM TUESDAY TO WEDNESDAY. Topic to be announced.

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

FIELD TRIP

DATE: Saturday, March 21, 1992

TIME: 7:00 A.M. at Portland State University in front of Cramer Hall.

LEADER: Dr. Paul Hammond. Topic of the trip will be of Basalt Lava Flows and the "Sea". Travel by automobile--bring lunch and other essentials for weather. Trip will look at Central Oregon Coast.

FIELD TRIP

DATE: APRIL 6 & 7 Bus transportation and overnight in the Newport coastal area. SEE ALL THE DETAILS ON PAGE 20 OF THIS NEWSLETTER.

>>>>>>>>>REMINDER-REMINDER---PAY YOU GOSC DUES----PAY YOUR GSOC DUES<<<<<<<<<<

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++++++++++HANCOCK ANNUAL RETREAT MAY 10,11,12, 1992--DETAILS LATER++++++++++++

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SOMETIME IN THE PAST SEVERAL YEARS JOB DESCRIPTIONS WERE WRITTEN FOR ELECTED AND APPOINTED POSITIONS WITHIN THE GSOC. IF YOU HAVE SUCH INFORMATION PLEASE TURN IN THIS MATERIAL TO THE PRESIDENT. ALSO SOMEWHERE IN SOMEONE'S FILES ARE NOTEBOOKS CONTAINING PAST FIELD TRIPS GSOCS HAVE TAKEN AND WHO LED THE TRIPS. WHO EVER HAS THIS MATERIAL PLEASE TURN IN TO THE PRESIDENT.

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DARWIN' THREE MISTAKES

John H. Whitmer, M.D.

A review of an article by Kenneth J. HsO published in the June, 1986 issue of GEOLOGY.
GEOLOGY.

I read the ORIGIN OF SPECIES during the break between autumn and winter quarters of my sophomore year at Oregon State College. The book, indeed, changed my life, for as abruptly as turning on a light, it showed me that the biological sciences were true sciences. At the beginning of the winter quarter, I switched my major from engineering to pre-medicine. It therefore comes as a shock to see assertion that Darwin was mistaken.

Dr. HsO, of the Geological Institute, ETH, Zurich, Switzerland, is internationally recognized as a geologist. Last April, he was elected a foreign associate of the U.S. National Academy of Sciences. He began his article with the revelation that he did not bother to read the ORIGIN OF SPECIES or to check the scientific basis of the Darwinian theory until he started to write a book on the terminal Cretaceous mass extinctions. He thus realized belatedly that Darwin was wrong on some critical issues and that his mistakes have been misused by ideologists t- pursue their goals. He wrote, " This ess. is an attempt to point out these mistakes and an appeal to renounce social Darwinism." He characterizes evolution as "not so much of a theory as a history of life--of what it has been, not what it should be."

HsO asserts that Darwin's three mistakes were that he dismissed mass extinctions as artifacts of an imperfect geological record; he assumed that species diversity, like individuals of a given species, tends to increase exponentially with time; and he considered the interactions of organism to be the major cause of species extinctions. Prior to Darwin, paleontologists recognized major drastic changes in faunal populations. The Paleozoic, Mesozoic and Cenozoic eras were defined on the basis of rapid disappearance and appearance of organisms. Darwin rejected such concepts and argued that "successive (geological) formations were separated from one another by enormous blank intervals of time," and that extinctions occurred by gradually at uniform rates over long intervals of time. Modern stratigrap and paleontology show that Darwin greatly over-estimated the duration of the Cretaceous--Tertiary unconformity and that the record of marine life is virtually continuous in the deep sea. We now know that mass extinction is a reality and not an artifact of an imperfect fossil record. "Darwin erred when he ignored this most important phenomenon in the history of life."

Charles Darwin second mistake was to compare the trend of increased species diversity to that of a population growth." Darwin was influenced by the writings of Malthus, which have provided much support for the rationalizations of pessimists, but which have been contradicted by the events of history since their publication over 150 years ago. Darwin wrote that, "there is no exception to the rule that every organic being naturally increases at so high a rate, that if not destroyed, the earth would soon be covered by progeny of a single pair."

e next paragraph, he asserted, " Lighten ..y check, mitigate the destruction ever so little, and the number of species will almost instantaneously increase to any amount." HsO identifies this as one of the most common and serious fallacies of human reasoning, substituting individuals for classes. "When he (Darwin) persuaded us on the inevitability of natural selection in the struggle for life, he failed to distinguished between the reproduction of a single pair of individuals and the evolution of a single pair of species. Individuals could be increased exponentially by sexual reproduction, but virile new species cannot produced by hybridization: Darwin knew that. He had little basis to assume that species could diversify at an exponential rate." The paleontologists record shows that the number of species has increased at a much lower rate than Darwin envisioned, and that mass extinctions have interrupted its steady growth, but recovery has always been rapid because surviving organisms disperse and change to fill the niches left by the extinct species, a process called ·adiation." Malthus and the 19th century ,cial philosophy influenced Darwin to depict species aiming at mutual destruction in their struggle for life. A Contemporary, Peter Kropotkin, propounded the opposite view of mutual aid and symbiosis in evolution, but Darwin's concept of organisms killing the competition prevailed. Modern analysis of the evolution of fossil communities shows interdependence of plants, insect, and terrestrial animals. "New groups evolved, but they did not always ride over the dead bodies of the old. They ventured out and created new ecologic niches for themselves and for others as well."

Darwin's third mistake was to perceive the interaction of organisms (competition) as the most critical factor influencing the course of evolution. New species were adopted and favored by nature, while the old became extinct because they had been "beaten in the race for life." Darwin underestimated the critical importance of the viability of the environment for the ·vival of organism. HsO quotes James valentine for a summary of the modern view of paleontologists on extinction: "Extinctions are in some ways as a measure of the success of evolution in adapting organisms to particular environmental conditions. When those conditions vanish, the organisms vanish. Opportunities are thus created for selection to develop new kinds of organisms from among the survivors...The groups that disappeared were not necessarily less well adapted than or structurally inferior to the survivors, except in relation to the sequence of environmental changes that happened to occur. This sequence....is related to life forms clinging to adaptation as a means of survival. If the environmental changes had been different, different survivors would have emerged." It is now known that competition had little to do with mass extinctions. "Specialists on extinction have found little evidence that biotic competition had ever led to extinction until Homo Sapiens came onto the scene."

Darwin was influenced, not only by Malthus, but also by the Doctrine of uniformitarianism to choose a non-environmental cause for extinction. In Darwin's view, conditions changed slowly and gradually, affording ample time for species to adapt. Modern scientists are finding increasing evidence of cataclysms in the geologic record. It is now being said by some that Uniformitarianism is simply the condition between catastrophes. According to HsO, "when catastrophe comes, it strikes at random or by rules than transcend the plans and purposes of any victim. This is survival of the luckiest, not of the fittest."

It is HsO's contention that few modern paleontologists would agree with Darwin that "each new variety or...species will generally press hardest on its nearest kindred, and tends to exterminate them," yet this aspect of Darwinian theory has pervaded our social philosophy. Although perhaps a century and a half too late, HsO's insights are vitally important in the modern world. I earnestly recommend a careful reading of his essay.

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY FINANCIAL STATEMENT

January 1 through December 31,1990

TOTAL RECEIPTS:
Interest Received...$229.81
(Savings Acct. 21184-00895
Total..... $229.81
Memberships
For Year 1991.....$3155.00
For Year 1992.....$ 900.00
Total..... $4,055.00
Newsletter Subscriptions.$234.20
Total.....$234.20
Publication Sales.....$73.10
Total..... .$73.10
Hospitality Rebates:
General Meetings.....$ 60.00
Seminar Meetings.....$ 61.56
Luncheons.....$ 15.47
Field Trip Surplus.....$ 14.99
Total Donated.... $152.02
Memorial Donations.....$ 5.00
Total.....$ 5.00
Annual Banquet:
Ticket Sales, Dinner...$1,270.00
Donation Table.....$ 176.80
Total.....$1,446.80
President's Trip.....2,232.60.
Total.....$2,232.60
TOTAL RECEIPTS FOR 1991..... .$8,428.53
Archie Strong, Treasurer
GSOC

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GEOLOGICAL SOCIETY OF THE OREGON COUNTRY FINANCIAL STATEMENT
January 1 through December 31,1991

TOTAL EXPENDITURES:
Newsletter:
Budget Instant Press.$1,107.90
Kramers.....$ 297.99
Alpine Sec Services..$ 94.35
Miscellaneous Supplies 66.36
Totals.....$1,566.49
Portland State:
Meeting Room Rentals..$ 291.00
Total.....$ 291.00
US Postal Service:
PO Box Rental # 907..$ 93.00
Bulk Mailing Permit,#999.$160.00
Total.....$ 253.00
Insurance, Feduciary and Liability.....$556
Total.....$ 556.00
Scholarships PSU:.....$400.00
Total.....$ 400.00
Postage,Stationary Supply 70.93
Total.....$ 70.93
Luncheons, Standard Plaza Parking.....$ 147.97
Total.....$ 147.97
Equipment, Pur., Maint.$ 57.00
Total.....$ 57.00
Library, Supplies & Publ. 44.37
Total.....$ 44.37
Permits, Fees, Memberships.50.00
Total.....$ 50.00
Annual Banquet: (PSU)..$1,174.02
Total.....$1,174.02
President's Trip.....$2,232.60
Total.....$2,232.60
TOTAL EXPENDITURES FOR YEAR 1991.$6,502.84
Archie Strong, Treasurer
GSOC

****

SAVINGS ACCOUNT NO. 2118-00895
Bank America, PO Box 6400, Portland, O. 97228
Account Balance 1-01-1991.....$4,577.83
Total Interest Earned, 1991.....$ 229.81
Balance, December 31,1991.....$4,807.64
(No withdrawals in 1991)

Checking Account Balance 12/31/91. .$2,250.64
Archie Strong, Treasurer
GSOC

****

TECTONIC HISTORY OF THE GULF OF CALIFORNIA

Wallace R. McClung

The Gulf is bounded on the northeast by the North American plate which includes the North American continent and on the southwest by the Pacific plate, which is currently moving northwest with respect to the North American plate.

The east Pacific rise, a spreading system on

the Pacific plate near it's boundary with the North American plate has been partially)ducted underneath the North American ,iate during the last 30 million years. In the vicinity of the gulf subduction occurred on the west side of Baja, California which was then part of the Mexican mainland. Subduction ceased about 10 million years ago and the juncture between the two plates became a transform boundary.

By 6 to 4 million years ago the transform margin strengthened and a weaker inland zone broke to accommodate the shearing motion. Baja, California was ripped off the North American plate, became part of the Pacific plate and the Gulf of California was created. Baja, California has moved approximately 186 miles to the northwest from its original position.

The spreading center in the Gulf does not form a straight line of ridges and troughs because both spreading and transform motions are occurring. This combination of motions creates a zigzag pattern of troughs and faults.

its northern end the Gulf of California ,reading is linked to the Salton trough and the San Adreas fault system. The Salton trough is a structural continuation of the Gulf of California that has bean cutoff from the gulf by sediments deposited by the Colorado River.

EXPLORATION OF THE AREA

Lareto, which lies in the Gulf of California, was the city from which our exploration started. A few words of historical interest may seem appropriate for this community was the first settlement in Baja dating back to 1697.

The first Spanish to arrive were Cortez and his soldiers who found it barren of plunder. Next the padres moved in trying to convert the three Indian tribes living along the peninsula. But after passing around their brands of diseases there wasn't much left to convert and what was left attacked the missions so the padres moved north into lifornia.

The scenery from Lareto is spectacular from the volcanic range Sierra de La Giganta that rises abruptly from the narrow coastal plain and parallels the Gulf. This is a scarp of a fault block. To the west the dip slope is very gradual reaching the Pacific in about 30 miles.

We took a bus over this surface toward the Pacific where we boarded a ship anchored in protected waters which were separated from the ocean by long dunes.

It was in these warm waters that the gray whales calve. Apparently the calves don't have enough blubber to protect themselves from the cold arctic waters so they use the warm waters of these lagoons to begin their life cycles. The grays have the longest migrations of any mammal as they travel from the subtropical waters to the Arctic Ocean where they feed.

During the days of the whalers these shallow protected calving grounds was discovered and the avarice of the whalers exterminated the grays in this area so whaling along the California coast ceased. However, the gray whales were found off the coast of Korea and again were hunted almost to extinction. They were saved by an international agreement in 1938. The story has a happy ending because they can be seen along our coastline now during their migration. If a whale surfaces and doesn't have a dorsal fin, it is a gray.

We boarded a shallow draft 100 foot vessel equipped with zodiac inflatables, a geologist, botanist, marine biologist, superb cooks and a willing crew. Zodiacs were used to approach the cow and calf whales, and to go ashore on uninhabited islands where the botanist said they had three endemic plants: weird, weirder, and weirdest.

Cruising south we entered the Gulf at Cabo San Lucas where the oceanic waters and gulf waters intermix providing nutrients for the myriad varieties of marine life. The signature of Cabo is the Triassic rocks arising abruptly from the sea floor.

Uninhibited humpback whales stood on their tails, false killer whales rode our bow wave in a display of unrestrained exuberance.

North we cruised visiting numerous uninhabited islands arriving at our place of beginning where we disembarked at Lareto.

REFERENCES:

CALIFORNIA GEOLOGY, November, 1990
THE FORGOTTEN PENINSULA
by Joseph Wood Krutch

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BOOK REVIEW

ROCKS AND MINERALS is a book recently sent to us unsolicited for review. Written by Dr. Joel Arem - former crystallographic for the Smithsonian Institute in Washington, D.C.- it is a monograph on mineralogy and is practically a basic introductory course on the subject.

There are six chapters in the decomposition of minerals, chemical ions and bonds, physical properties, place of origin, and classification of minerals and gemstones as well as rock formations. There is even a page on moon rocks.

A table of chemical elements is followed by a chart of minerals with their names, composition and seven chemical properties.

It is in paperback on glossy paper with very sharp print and pictures. The 160 pages have 230 bright color illustrations. The index is complete; the book is small enough to carry in your pocket in the field or to rockfests.

Printed by Geoscience Press Inc., 12629 N. Tatum Blvd., Suite #201, Phoenix, AZ 85032, it costs $8.95 plus $2.00 postage and handling for the first copy and $0.75 per copy thereafter if ordered directly.
There is one copy in our library for circulation. I have ordered one for myself - a beautiful and useful book. Walter A. Sunderland, M.D. President, GSOC.

NEW FOSSIL DISCOVERIES FROM THE LATE CRETACEOUS OF CENTRAL UTAH

This article appeared in the Utah Geological Association Newsletter of January, 1992 and was reported on by Steven F. Robison of the USDA Forest Service, Ogden, Utah.

Recent discoveries from late Cretaceous rocks of the Wasatch Plateau in central Utah have yielded previously unknown fossils, and several fossils new to Utah. Among these discoveries are the tracks of at least four different types of birds from the Blackhawk Formation. Although dinosaur tracks have long been known from the Blackhawk Formation, tracks of other animals have not been recognized until recently. Bird tracks have been found in three different localities and include the only known tracks of large marine diving birds of the family Mesperonithidae. No fossil remains of this bird group are known from Utah. Associated with the heron-like bird trackway are the tracks of anuran (frog or toad). These tracks represent the only reported Mesozoic occurrence of these groups in Utah.

A new fossil vertebrate locality in the North Horn Formation has produced the first fossils of the dinosaur TYRANNOSAURUS from Utah. Associated with the tyrannosaurus were other dinosaurs including: ?RICHARDOESTESIA(a very small carnivore), a ceratopsain and a hadrosaur (duck bill). At least four types of dinosaur egg shell fragments were found at the locality as well as two types of crocodiles, three types of turtles, a mammal, and a freshwater shark. These finds help substantiate the Lancain age of the lower part of the North Horn Formation and show a very strong correlation with the vertebrate fauns from the Naashoibito Member of the Kirkland Shale in the San Juan Basin of New Mexico.

Geological Society of the Oregon Country

YOU ARE NEEDED!

An organization is as good as those who run it. Keep GSOC alive and active by chairing a committee. Previous chairs will help you; call them for more information.
(* = This is a particularly good activity to acquaint newcomers with other members.)

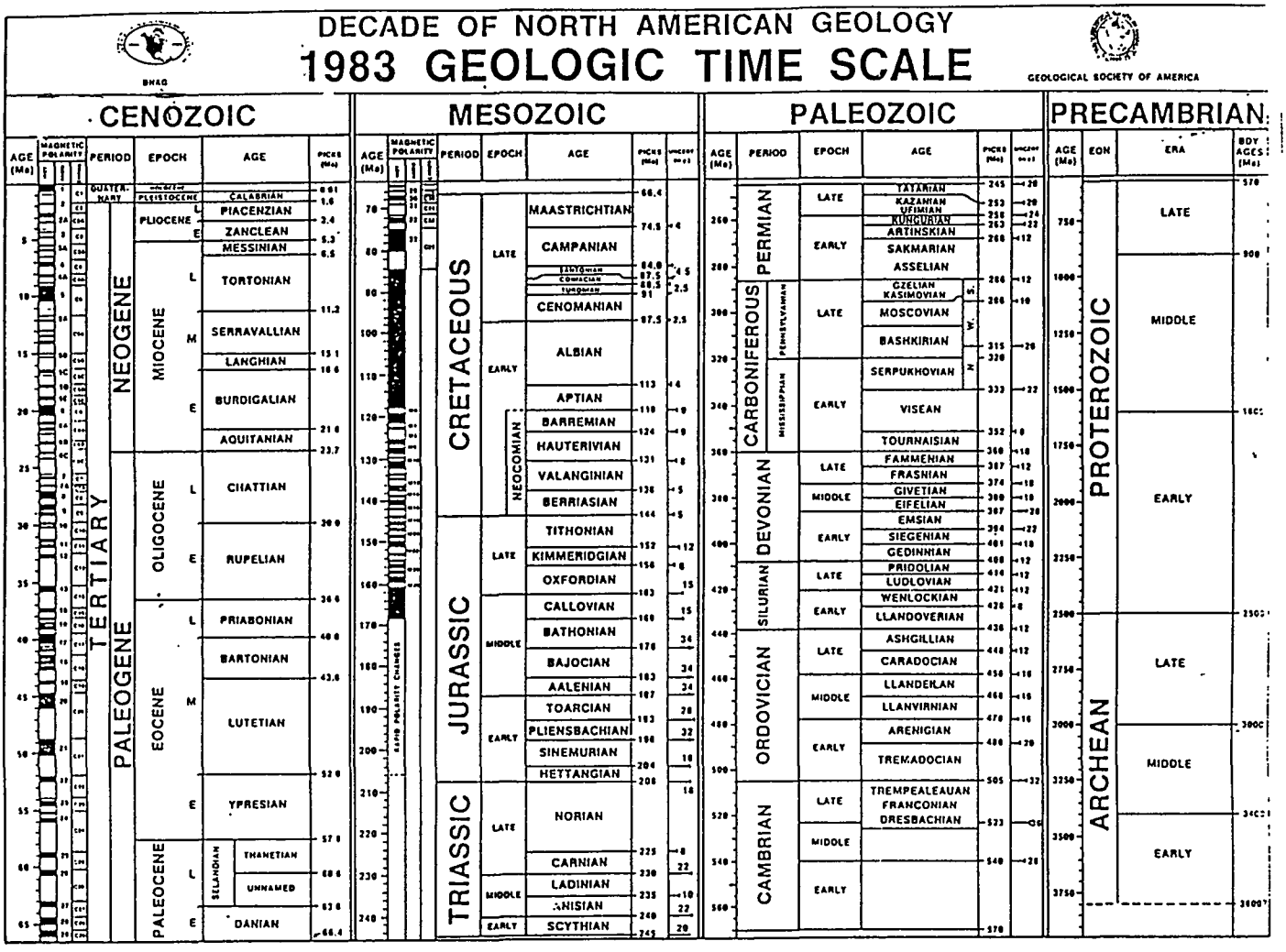
E.P.

COMMITTEE	1992 CHAIR	PREVIOUS CHAIR(S)	DESCRIPTION
Calligraphy	Clay Kelleher 775-6263	Helen Nelson 661-1731	Prepares certificates for speakers
Field Trips	Alta Fosback 641-6323	Alta Fosback	Takes suggestions for field trips; arranges transportation
Geology Seminars		Dr. Ruth Keen 222-1430	Decide, with members, what year's program is
Historian	Charlene Holzwarth, 284-3444	Mildred Washburn 649-2180	
Hospitality Fri. noon	Shirley O'Dell	Margaret Fink 289-0188	Hands out name tags; introduces guests, new members
Fri. eve	Shirley O'Dell	Gail Rankin & Manuel Boyes. 223-6784	
Library	Frances Rushe	Frances Rusche 654-5975	Catalogs publications;
* Membership			Seeks, welcomes, informs new members; encourages particip. of old memb.
Past Pres. Panel	Dr. W. Sunderland 625-6840	Dr. Ruth Keen 222-1430	
Programs Fri. noon		Clay Kelleher 775-6263	Takes suggestions; gets programs, speakers
Fri. eve	Esther Kennedy 287-3091	Evelyn Pratt 223-2601	
Props & P.A. Fri. noon		Dr. Don Botteron 245-6251	Sets up mikes, projectors for speakers
Fri. eve	Booth Joslin 636-2384	Booth Joslin	
Publications	Margaret Steere 246-1670	Margaret Steere	Cares for trip logs
Publicity		Bobbie Walter 235-3579	Publicizes GSOC; prev. experience w. PR helpful
Refreshments * Fri. eve Geol. Sem.	Dorothy Barr	Dorothy Barr 246-2785	Calls volunteers to bring snacks; fixes, or gets volunt. to fix, beverages (couple good)
Telephone	Connie Newton 255-5225	Cecelia Crater 235-5158	Notifies members of weddings, funerals, etc
Volunteer Speakers Bur.	Bob Richmond	Bob Richmond 282-3817	Provides GSOC speakers for schools, clubs
Annual Banquet		Esther Kennedy Gail Rankin	

##*#*#*# FRIDAY EVENING REFRESHMENTS#*#*#*#*#*#

Dr."Walt" has done a great job of providing and arranging refreshments for the FRIDAY NIGHT MEETINGS. YOUR NEXT PRESIDENT WILL NOT BE DOING THIS. A clipboard will be available each Friday evening meeting and during the ANNUAL BANQUET for you to sign up to contribute beverage and SIMPLE SNACKS for 2 Friday night meetings in 1992. It would be perferred if you would sign up for one month (2 meetings)Thank you for your help.

Evelyn Pratt



FIELD TRIP: APRIL 6 & 7 ,1992 Bus transportation and overnight in the Newport coastal area.

LEADER: Don Giles, Education Specialist, Hatfield Marine Center. TOPIC will be THE IMPORTANCE OF THE ESTUARY ON THE AREA.

TENTATIVE SCHEDULE: Leave from the Red Lion, Lloyd at 8:00 A.M. Arrive at Otter Crest at 10:30 A.M.. Meet with Don Giles at 11:00 A.M.. Lunch at 12:00--? (Rest stop in Corridor en route and possible orientation.
1:00 P.M. Leave on field trip. Activities to be scheduled as they best fit: Beverly Beach and Yaquina Head areas---Geology, Biology,Fossils Pre-history information.
Marine Science Center. Then check in Motel.
DAY 2. 9:00 to 12:00 Boat trips.
12:00 to 2:00 lunch and shop.
2:00 leave for home.

COSTS: $105.00 for single and $95.00 for double. Includes bus transportation, lodging,1 lunch, moving luggage, boat trip, and leader. CALL ALTA FOSBACK AT 641-6323 NO LATER THAN MARCH 28, 1992.

APR 92

THE GEOLOGICAL NEWSLETTER

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

GSOC

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OF THE OREGON COUNTRY
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Volunteer
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Connie Newton 255-5225
Volunteer Speakers Bureau
Bob Richmond 282-3817
Annual Banquet

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.
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 (add $3.00 postage for foreign subscribers). individual subscriptions at $13.00 a year. Single copies $1.00. Order from Geological Society of the Oregon Country,PO Box 907, Portland, 97207
TRIP LOGS: - Write to same address for price list.

VISITORS WELCOME
INFORMATION PHONE 284-4320

VOLUME 58, NO. 4

CALENDAR OF ACTIVITIES FOR APIRL, 1992

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

April 10 "Use of Industrial Minerals for Environmental Protection" Speaker: Ron Geitgey, Industrial Mineral Specialist.

April 24 "Assessing Geological Risk in Off-Shore Development". Illustrated presentation by Dr. Dwight A. Sangrey, President of Oregon Graduate Institute of Science and Technology.

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

April 3 "Geology in the Carbon Cycle". Speaker: Clay Kelleher, GSOC member and Graduate Student in Geology at Portland State University.

April 17 "Land and People of Spain". Speaker: Andy Corcoran, Past President, GSOC.

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

Wednesday
April 15 Technique of making a map of the Grand Canyon from slides. Illustrations and demonstration by Richard Bartels, GSOC member.

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

FIELD TRIPS

Newport Trip Refer to March Newsletter.

April 25 Glide Plant Wildflower Trip. Information on Page 26 this Newsletter.

May 10,11,12 Hancock Field Station Annual Trip. See information on Page 26 this Newsletter.

THE QUAKE NORTHWEST™

CASCADIA SUBDUCTION ZONE

The Cascadia subduction zone represents the fault boundary between the subducting (oceanic) Juan de Fuca Plate and the (continental) North American Plate. Strong geologic evidence indicates the plates are coming together (converging) at a rate of 1.5 in/
r along the 750 mile long Cascadia subduction zone. As the plates come together, the Juan de Fuca Plate, a small remnant of a once larger plate, is being overridden (and subducted) by the continental plate or North American Plate. As the subducted plate melts deep beneath the North American Plate, molten material or magma ultimately rises to the surface farther inland, creating the High Cascade Range and its active volcanoes, such as Mt. St.Helens.

Since the Cascadia subduction zone has physical characteristics resembling those of other subduction zones in southwestern Japan and South America (southern Chile and Columbia) that have experienced large shallow earthquakes, it is believed that the Cascadia subduction zone may be storing strain energy to be released rapidly in future very large "great" or "giant" earthquakes; even though there have not yet been large historic subduction earthquakes in the Pacific Northwest since the first permanent European settlements were established about 1810. A similar subduction zone occurs off the coast of Alaska, which experienced a devastating M 9.2 subduction earthquake in 1964. The tsunami or seismic sea wave generated by that earthquake caused $85 million damage in Alaska, $10 million damage in Canada, $115,000 damage in Washington, $745,000 in Oregon, and $11 million damage in California and killed 119 people, including 4 people in Oregon.

Recent geodetic survey strain measurements, reported by the U.S.Geological Survey in April 1991, have confirmed that mountains in the Olympic Peninsula are being shorten and compressed at the rate of an eighth of an inch per year in the direction of plate convergence, while portions of the Washington coast are also being uplifted, clear signs that earthquake strains are building in the region.

GREAT SUBDUCTION EARTHQUAKES

If the Cascadia subduction zone experiences an earthquake, a sequence of several" great" earthquakes (seismic movement or energy magnitude Mw8), occurring within days, years a decades of each other, or a "giant" earthquake (Mw 8.5-9.5) may occur as strains build up from centuries of plate convergence are suddenly released. Ground motions resulting from such "great" or "giant" subduction earthquakes would cause relatively strong shaking over very large areas of the Pacific Northwest, including the Puget Sound and Willamette Valley regions inland.

The largest recorded earthquake of this century was the (Mw 9.5) Chilean earthquake, which (because the dimensions of its rupture zone are comparable to those of the entire Cascadia subduction zone) is considered to represent the largest earthquake possible in the Pacific Northwest. The duration of strong shaking during such "giant" earthquakes (Mw 8.5-9.5) is expected to exceed 2 minutes, although the total length of shaking may be as long as 4 or 5 minutes. Average peak horizontal accelerations may be in the range of 0.61g for coastal sites and between one-third to one-half that, 0.25g for inland sites such as Puget Sound and the Willamette Valley [g is the acceleration due to the force of gravity]. Actual strong ground motions will depend upon earthquake source, seismic wave path, and local site effects.

TSUNAMIS

Tsunamis are long wave-length, long-period sea waves that are generated by an abrupt movement of large volumes of water, such as might occur when the seafloor shifts accompanying a large subduction earthquake event. Large and potentially destructive local tsunamis would be expected if large subduction earthquakes occur in the Pacific Northwest, with wave run-up heights ranging from 6-10 feet up to 60-65 feet possible. Large areas of coastline would probably experience as much as 6 feet of rapic subsidence coincident with the earthquake, called coseismic subsidence, further increasing the threat from tsunamis.

If one is on the beach or in a low coastal area during an earthquake, one should immediately move to higher ground which is safely above any possible run-up height. Should vast areas of extremely low tidal area become exposed immediately following an earthquake, by no means explore them or venture onto them, as subsequent incoming tsunamis or tidal waves may follow, from which there could be no escape. Multiple tsunamis may occur, as ocean basins continue to oscillate, so monitor radios for coastal safety information.

COASTAL SUBSIDENCE

The first geological evidence for great subduction earthquakes in the Pacific Northwest was discovered about 5 years ago, when Brian Atwater, a geologist with the U.S.Geological Survey, found evidence that trees and marsh lands in Washington State had dropped suddenly and been drowned by the ocean. Layers of sand overlying these deposits suggested the presence of subsequent tidal waves or tsunamis.

Great subduction earthquakes appear to occur in the Pacific Northwest about every 400-500 years, based on seafloor evidence and on radiocarbon age-dating of buried salt marsh(peat) deposits. These deposits record similar rapid subsidence during previous prehistoric subduction and earthquake events at a variety of coastal sites throughout Oregon and southwest Washington. Radiocarbon ages from several sites in northwestern Oregon indicate that the last four such earthquakes had an average time between events of 330-370 years. The last great subduction earthquake event affecting both Washington and Oregon appears to have occurred approximately 300 years ago.

OTHER EARTHQUAKES

While subduction zone earthquakes (Mw 8-9.5) comprise the greatest hazard, western Oregon is also subject to earthquakes in the downgoing Juan de Fuca Plate below the subduction zone, and in the overlying (continental) crust.

Lower-Plate (deep) earthquakes include the 1946 Vancouver Island (M 7.3), the 1949 Olympia (M 7.1), and the 1965 (M 6.5) Seattle earthquakes, among the largest to strike the Pacific Northwest in recorded history so far. Earthquakes of these magnitudes are also believed possible in western Oregon associated with the same subduction zone processes. The largest historical earthquake in Oregon, the 1873 Cape Blanco event, probably was a deep lower-plate earthquake.

Deep earthquakes originate at depths of 28-37 miles with in the subducted Juan de Fuca Plate. Ground shaking effects are expected to included approximately 10-15 seconds of strong shaking with a peak acceleration of 0.25g or less. Deep earthquakes in Puget Sound have characteristically lacked aftershocks.

Crust (shallow) earthquakes are recorded in the Portland pull-apart basin and on the Mt. Angel fault. Bigger Crustal earthquakes (west of the Cascades) are generally expected in the M 5.7-6.3 range, with an expected shaking duration of 10-20 seconds. Shallow earthquakes originate between the surface and depths of 0-19 miles.

Large crustal (shallow) earthquakes appear to have occurred in the Washington North Cascades (1872, estimated M 7.5); and the St. Helens Seismic zone in the southern Washington Cascades is though to be capable of producing a M 7.0 earthquake. in general, crustal(shallow) earthquakes have the potential for higher accelerations and longer durations than for the deeper lower-plate earthquakes events, such as the 1949 Olympia earthquake. Crustal earthquakes have usually been associated with aftershocks.

All earthquakes in eastern Oregon and Washington have been shallow crustal events; and no earthquakes have a magnitude exceeding 5.8 have been recorded there during the last 150 years. Moderate damaging earthquakes reported from eastern Oregon - Washington include the 1893 Umatilla (M 4.7) and the 1936 Miltonn-Freewater (M 5.8) earthquakes.

What to do during an earthquake[1]

Location	Action	Where	Hazards
Inside building	Drop and cover Turn away from glass In high rise: •Do not dash for exits •Never use elevators since power may fail	"Safety Spots": •Under sturdy desk •Under sturdy table •Along inside wall •In doorway •In corner	•Window glass •Overhead objects •Objects on wheels •Swinging doors •Collapsing fireplace chimneys •Kitchen refrigerator •Kitchen stove •Overhead cupboards •Supermarket display shelves
Outside building	Drop and cover (if necessary)	Building entryway (inside, where not subject to material falling from outside walls); in clearing, away from buildings, trees, wires and other overhead dangers	•Building facades •Brick or block walls •Overhead wires, downed electrical poles •Signs •Trees •Steep slopes
Outdoors in open	Stay in open areas	Away from falling objects	•Rockfall, landslide
School bus or other vehicles	Bring bus to stop Hold on to seat Stay in bus, vehicle	Side of road away from trees, buildings, power lines, and bridges	•Overpasses •Underpasses •Overhead wires
All locations	Protect oneself	Nearest place with "safety spot"	•Falling debris

[1]Washington Division of Geology and Earth Resources Information Circular 85, 1988

What to do after the shaking stops[1]

Steps	Specific Actions	Concerns
Check for injuries	Administer emergency first aid	•Move severely injured only if mandatory •Be prepared for aftershocks
Evacuate	Leave cautiously	•Put on shoes •Avoid elevators •Choose exits carefully •Be prepared for aftershocks
Check for safety	Turn off utilities if lines are broken Use flashlight, not candles Account for building occupants Confine pets	•Gas, water, sewage, electric lines may be broken •Electric sparks or flame may ignite gas •Clean up dangerous spills •May need to do search and rescue •Dog bites common after earthquakes
Get information	Use portable or car radio Use telephone only in emergency	•Are there nearby secondary hazards, like chemical spills, fire? •Avoid sight-seeing, unnecessary travel, or spreading rumors
Care for and comfort others	Reassure children, ill, handicapped and elderly Reunite family according to prior plan	•Need physical and emotional care •Avoid leaving them alone •More physical and emotional trauma than other individuals
Make shelter	Use large plastic garbage bags Use blankets, sleeping bags, tents	•Existing structures may be unsafe •Prevent hypothermia •Locate food and water

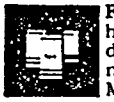
Checklist: Have on hand for any emergency[2]

Flashlights with spare batteries. Keep a flashlight beside your bed. Do not use matches or candles after an earthquake until you are certain no gas leaks exist.

Portable radio with spare batteries. Most telephones will be out of order or used for emergency purposes so radios will be your best source of information.

First Aid Kit; first aid knowledge. Have a first aid book such as the *American Red Cross Standard First Aid.* Have members of your household take basic Red Cross first aid and CPR courses.

Fire Extinguishers. Keep a fire extinguisher handy for small fires. Class ABC extinguishers are designed to use safely on any type of fire. Your fire department can demonstrate proper use. Have smoke detectors, properly installed.



Food. Canned and dried foods sufficient for a week for each household member. Dried grains, cereals, legumes, powdered milk, fruits and non-salted nuts are a good source of nutrition. Rotate into normal meals to maintain freshness. Manual can opener.

Water. 2 week supply of bottled water, stored in airtight containers and replaced every 6 months. Store 1 gallon drinking and cooking water per-person per-day. Also have water purification tablets (Halazone, Iodine etc.). Strapped water heater (shut off gas/elec.) is drinking water reservoir.

Special Items. Have at least a week's supply of medications and special foods needed for infant or those on limited diets. Eye glasses, money, food and water for pets.

Tools. Pipe wrench and crescent wrench - for turning off gas and water mains. Portable cooking stove such as butane or propane, which should only be used after you're sure there is no gas leak and with proper ventilation. Charcoal should be burned only out of doors; use of charcoal indoors will lead to carbon monoxide poisoning. Other tools and supplies: axe, shovel, broom, hammer, pliers, plastic sheeting, etc.

[2]Earthquake Safety Checklist, FEMA 1985; American Red Cross

Compiled 1991 by The Quake Northwest™ P.O. Box 33050, Portland, Oregon 97233

ROCK DRAWING OF THE COSO RANGE
CALIFORNIA

During the last 100,000 to 10,000 years of the ice age the Basin Range was much cooler and contained much more water than is seen today. All of this ice and water played a important part in the erosion of the land creating good sized stream beds and in depositing much debris in the basins.

The Coso Mountains are composed of volcanic debris and some sediments that were eroded by the great quanities of ice and water. One such channels was cut deeply into a Coso Mountain basaltic flow that is now called Little Petroglyph Canyon. The channel has remained dry for thousands of years. Enough time has elapsed since the end of the water flowing in this stream bed for ancient people, some as old as 3000 years ago or more, have produced beautiful "rock art" on all the smooth surfaces of basalt. It is estimated that there are 30,000 petroglyphs in Little Petroglyph Canyon and another canyon close by.

Rock drawings by the thousands decorate the walls of ancient basalt cliffs of the extreme northwestern corner of the Mojave Desert near the town of Ridgecrest, California. The area contains the largest concentration of petroglyphs (Indian rock art) in the Western Hemisphere and perhaps the world. The drawings are in two ancient stream beds cut into basalt. Other evidence of early man in the area includes hunting blinds, house rings, rock shelters, tool flaking sites, and grinding stones. The people who pecked the figures were probably the ancestors of the Panamint Shoshone Indians, who were living in the Coso Mountains when the first explorers and miners arrived. These people were hunters and gatherers who moved seasonally to harvest nuts, grasses and herbs.

Bighorn sheep are the most common petroglyph design, followed by pictures of men, from simple stick figures to those wearing elaborate clothing and heads. Other animals shown are dogs, deer, spear throwers, objects which resemble medicine bags, shields, and one-of-a-kind abstract drawings.

Many partly show spears, arrows, spearthrowers and bowmen, which seems to suggest a relationship with hunting magic. Also, many of the drawings are of sheep, along with the depictions of spears and arrows, often shown lodged in the backs of sheep. Hunting blinds, hunting decoys, and the stepped canyon walls which provide ideal sheep traps support the idea of hunting-related activities.

Many of the petroglyphs appear to be among the oldest consist of very abstract designs. The conclusion that most of the petroglyphs were probably made between one and three thousand years ago fits well within radiocarbon dates of charcoal recovered from one of the rock shelters located about one-half mile from Little Petroglyph Canyon.

It is known from related research that the use of spears and spear throwers gave way to the use of bows and arrows about 1500 to 2000 years ago. The spear thrower or "atlatl" is a common element in the Coso petroglyphs. Its presence strongly suggests that some petroglyphs were made prior to 500 A.D., the time at which the atlatl was replaced locally by the bow and arrow as a hunting weapon.

Some attempts are being made to date rock art by direct testing techniques. These include lichen growth, the pecking of one petroglyph over another, and the dating of the surface "desert varnish" which forms on desert rocks. Since their manufacture, many pertroglyphs have been wholly or partially covered with lichen growth which many be datable, if growth rates can be determined. Superimposition, the pecking of one drawing over an earlier one, can be used as a relative dating technique, particularly for determining style or content changes. Recently, several methods of varnish analysis through chemical and physical tests have been explored.

Absolute dating of petroglyphs in the Coso Range is now possible using a technique which is based on the analysis of trace elements in the varnish. The ratio of leachable to less leachable cations can be measured and this value compared with cations ratios from lava flows of a known age in the Coso area, yielding an absolute date. Five samples of revarnished

petroglyphs from the Coso range have now been dated. These calibrated ages range from 608 to 6555 before the present.

The sites are locate on Naval Weapons Center testing ranges , and access us limited to weekends during the spring and fall at the Navy's convenience. Reservations may be made through the Maturango Museum, P.O. Box 1776, Ridgecrest, California 93555.

By Don Barr GSOC

MAY 10,11,12. HANCOCK FIELD STATION ANNUAL TRIP

LOCATION: Hancock Field Station, located between between Antelope and Fossil on Highway #218. It is two miles east of Clarno. Watch for the Hancock Field Station sign on the north side of the road.

TIME: Meet anytime in the afternoon on Friday the 10th at the Station.

First meal will be the evening meal.

LEADER: Don and Dorothy Barr

INSTRUCTIONS: Bring warm sleeping bag. Extra blankets a good idea. Don't forget toothbrush, soap, towels,

Don't forget hiking shoes, flashlight, sunglasses, G-pick, binoculars and clothing for any kind of weather.

ACTIVITIES: Some walking and some car travel to see the spring flowers and the great geology of the area.

IMPORTANT: IF YOUR GOING ON THIS TRIP PLEASE CALL DON BARR AT 246-2785 BY MAY 5 I NEED TO INFORM THE HANCOCK FIELD STATION OF NUMBERS.

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====THIS LINE HAS BEEN ADDED TO THE FORM SENT OUT TO SPEAKERS " PLEASE LIMIT YOUR PRESENTATION TO 45 MINUTES TO ONE HOUR"

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APRIL 25 GLIDE WILD PLANT/FLOWER SHOW
(a 12 HOUR ----one day trip)

Bus price per person, based on 25 people, is $35.00 each.

DEADLINE FOR CANCELLATION of bus with no penalty is April 10th. Bring your own lunch on this one for both expense and time. There is a nominal entrance FEE, or a donation that we will pay as we enter.

Make checks payable to Raz Transportation Company or Alta Fosback, Tours, and send or give them to Alta. DEADLINE APRIL 10th.

RESERVATIONS: Alta Fosback
8942 SW Fairview Place
Tigard, OR 97223

Phone: 641-6323

ANNUAL BUSINESS MEETING REPORT
FEBRUARY 28, 1992

The annual business meeting of the 'Society' was called to order at 1945 p.m., Friday, February 28, 1992.

A ballot committee consisting of Dorothy and Robert Waiste and Peter Baer (member of the board) was appointed to count ballots.

Reports from all committees were read and submitted to the secretary; they are available for perusal by any member of the GSOC.

The ballot committee reported that all candidates were elected; the vote tally was certified by unanimous vote of the present members and the ballots destroyed. As of March 1st, 1992 the following officers are effective and will be sworn in at the annual banquet on March 13, 1992:

President:	Evelyn Pratt
President-elect:	Esther Kennedy
Secretary:	Shirley O'Dell
Treasurer:	Archie Strong
Board member:	Donald Botteron

After other business was conducted the meeting was turned over to Eveyln Pratt, President Elect, for introduction of the guest speaker.

Respectfully submitted

W A Sunderland

President GSOC for 1991-92

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JUN 92

THE GEOLOGICAL NEWSLETTER

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

GSOC

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OF THE OREGON COUNTRY
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GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

SINCE 1935

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(Friday evenings)
Volunteer
(Geology Seminar)
Dorothy Barr 246-2785
Telephone
Connie Newton 255-5225
Volunteer Speakers Bureau
Bob Richmond 282-3817
Annual Banquet

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.
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 (add $3.00 postage for foreign subscribers). individual subscriptions at $13.00 a year. Single copies $1.00. Order from Geological Society of the Oregon Country,PO Box 907, Portland, 97207
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THE GEOLOGICAL NEWSLETTER

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VOLUME 58, NO. 6

CALENDAR OF ACTIVITIES FOR JUNE, 1992

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

June 12 "Geology of North Island, New Zealand".
Speaker: Dr. H. Whitmer, M.D., Retired who participated in an 8-week geology/geography study tour of the region.

June 26 Mount Pinatubo Eruption in June 1991 in the Philippines.
Speaker, Dr Wolfe, Director, Cascade Volcano Observatory, Washington.

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

June 5 Daniel Kuhn, Amtrak Marketing Office. The Geography and Its Effects on Railroading in the West.

June 19 Dennis Olstead, DOGAMI, Petroleumn Geolgist. Christmas in Ecuador.

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

No seminars scheduled 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
June 5 JUNE 5 IS THE FINAL DAY TO INDICATE TO ALTA THAT YOU GOING ON THE BOHEMIA MINE TRP. CALL ALTA -- 641-6323. TRIP IS ON THE THE WEEKEND OF JUNE 13-14.

JUNE 6 Short-beautiful hike in the Columbia River Gorge. Ralph Pratt is the leader. Call him for details. 223-2601

September 9-17. President's Field Trip to include Klamath Mountains to Arcada California and then back up the coast. It's early, but would be helpful to the President and others who are helping to get an indicating if your going. Call the Pres.... 223-2601

THE BOARD AND OFFICERS OF THE GEOLOGICAL SOCIETY OF THE OREGON COUNTRY HAVE DETERMINED THAT GSOC WILL CONTINUE TO
HAVE 2 FRIDAY EVENING MEETING AND 2 FRIDAY NOON MEETINGS UNTIL SUCH TIME IT BECOMES DIFFICULT TO GET SPEAKERS

S. THE COLUMBIA RIVER BASALT; AN INDICATOR OF UPLIFT IN THE OREGON COUNTRY

by John H.Whitmer, M.D., GSOC

Research in the past decade has revealed truly fantastic geological processes which shaped the Oregon Country and made it a world class region. No science fiction writer could have conceived anything more outlandish than the Columbia River Basalt, which originated in huge fissures in the area where Washington, Oregon and Idaho meet, and flowed along stream valleys, canyons and lowlands, ponding in basins and crossing low divides. Several of these flows reached the seacoast, accumulating behind chilled margins along the beaches, filling estuaries and 'invading' the soft marine sediments to form dikes and sills. Today, the highest peaks in Clatsop County (e.g., Saddle Mountains, and others) consist of these basalt casts and most of the waterfalls and ridges in Clatsop County and adjacent part of Washington are held up by these sills and dikes of Columbia River Basalt (Niem and Niem, 1985; Walsh, Phillips et al, 1987.) At the other extreme, these intrustves have been found at depths of 7000 feet in onshore exploration wells (Niem and Niem, 1985) and 5000 feet beneath the ocean floor 12 miles offshore. The 3200 foot elevation of Saddle Mountain indicates at least that much uplift since the Miocene Grande Ronde Basalt filled a bay about 16 million years ago.

Columbia River Basalt provides evidence of at least 5000 feet uplift of the Cascade Range in Washington. The Miocene Pasco Basin was very likely no higher than it is today, about 400 feet above sea level. There was extensive ponding in the Pasco Basin and over what is now the Cascade Range. Now Columbia River Basalt forms a deep slope on the east side of the Cascades, having been uplifted from its lowland position and tilted toward the east. Lookout Mountain, prominently visible from I-90 just east of Cle Elum is a cuesta formed from that dip slope with an elevation of about 3000 feet. The rim of the basalt cuesta continues south from Cle Elum, at elevations up to 5600 feet, indicating that no less than 5000 feet of Cascade uplift has raised and tilted the Columbia River Basalt toward the east.

Crustal shortening (compression) and folding did not cause Cascade uplift. Normal faults and grabens occur in the Cascades, indicating extension or stretching of the crust. The folds and faults east of Hood Ri such as the Ortley Anticline, are compressional structures, but they are part of the Yakima Fold and Thrust Belt, not of the Cascades. Cascade extension and faulting facilitated movement of magma into the crust to form the many volcanoes and numerous dikes, sills, and stocks which underlie them. While the volcanoes and lava flows build up the range, the intruding dikes, sills, and stocks and other plutonic bodies inflate the crust, causing much Cascade uplift. This uplift raised and tilted the Columbia River Basalt on the eastern slope. At the same time, erosion proceeds at a very rapid pace, forming deep valleys in areas of great uplift, destroying large volcanoes that were sources of extensive volcanic clastic deposits (such as the Ohanepecosh Formation in the Central Washington Cascades) and exposing radial dike swarms (the bases of ancient volcanoes) and other intrusive structures. The source of the magma is the interaction of the subducting oceanic plate with the wedge of mantle trapped between it and the crust. (See page 30A of GSOC GUIDE BOOK FOR 1989 PRESIDENTS'S CAMPOUT - PORTLAND TO STRATHCONA PROVINCIAL PARK for illustration and more information.

The vast extent of the Columbia River Basalt, and its emplacement in lowlands, makes a wonderful indicato f deformation. Wherever you see it at higher elevat , you can be assured of considerable uplift since the Miocene epoch.

REFERENCES:

Niem and Niem, 1985, OIL AND GAS INVESTIGATIONS OF THE ASTORIA BASIN; OGI-14; Oregon Department of Geology and Mineral Industries, Portland, Oregon.

Walsh, T.J., 1987, GEOLOGIC MAP OF THE ASTORIA AND ILWACO QUADRANGLES, WASHINGTON, OFR 87-2, Washington Division of Geology and Earth Resources, Olympia, Washington.

Whitmer, J.H., GSOC GUIDEBOOK FOR 1989 PRESIDENT'S CAMPOUT - PORTLAND TO STRATHCONA PROVINCIAL PARK.

Hammond, P.E., 1989, GUIDE TO THE GEOLOGY OF THE CASCADE RANGE (Pages 77-95); Field Trip Guidebook T306, American Geophysical Union, Washington, D.C.

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A TRUE- FALSE QUIZ FOR THE PRESIDENT'S FIELD TRIP

by Evelyn Pratt

1. The Triple Junction near Arcata, California a

popular truck stop.
T/F?
2. In the Oregon Caves stalacTites stick to the ceiling ad stalagMites are Moored to the floor.
T/F?
3. "Flysch" is an abbreviated German word for a school of flying fish.
T/F?
4. Anyone going to the Oregon coast risks being put into a cell.
T/F?
5. Northern California Native Americans called Yuroks use claw-footed bathtubs with brass fixtures.
T/F?
6. According to GSOC'er Don Turner, an accreted terrane refers to extra railroad cars added on to the Burlington Northern.

T/F?

SEE PAGE 40 FOR ANSWERS

****

BOOK REVIEW

Economic Geology, U.S., edited by Gluskoter, H.,J.,Rice, D.D., and Taylor, R.B., Volume GNA P-2 of the Geology of North America, 1991 published by The Geological Society f America, P.O.Box 9140, Boulder, CO 80301, 630 p., 9 lates in slipcase, ISNB 0-8137-5214-0, hardbound, $80.00

During the 1978-1988 "Decade of North American Geology" (called DNAG) 1,800 geologists contributed more than 18,000 pages of text in 16 volumes of articles synthesizing various aspects of North American geology.

In addition, the Geological Society of America also published 6 volumes of field guides, 23 "Transects" (strip maps across the continental borders), 7 continental-scale geophysical and geological wall-maps, and 4 volumes entitled "Geologists and ideas", "Geomorphic systems", "The heritage of engineering geology", and "Archaeological geology".

The Society has sent GSOC a review copy of one of these 16 volumes, "Economic Geology, U.S." It contains 35 chapters on mineral deposits, oil and gas, and coal written by 65 authors, and published as a glossy-paper, 8 1/2 x 11 x 2 inch sized book with accompanying slipcase box of the same size containing 18 large maps. Notable ore deposits are described in detail with accompanying maps and illustrative diagrams on almost very page.

Obviously, there is little I can tell here about 630 pages of text. The mineral deposits of the Pacific Northwest are relatively few both in number and kind, and mostly lacking in activity for many years. The Pacific Northwest is or is not mentioned in the following chapters:

1. Introduction to Part I, Mineral Deposits of Pacific Northwest: No mention of Pacific Northwest States.

2 GOLD AND SILVER
Placer gold was discovered in SW Oregon in 1851, in NE Oregon in 1961 (p. 4), gold-quartz veins soon after (p. 6). Epithermal precious-metal deposits are associated with the Cascade volcanic arc in Oregon and Washington (p. 10). Deposits of "disseminated" epithermal gold deposits have been found throughout the Basin and Range Province (p.12, no mention of Oregon!) The Couer d'Alene gold, silver, copper, lead, zinc and cadmium deposits are described in several paragraphs (p.14-14).

3. Copper and molybdenum: The Turner-Albright, Oregon, is a domestic example of the Cyprus type of copper deposit (p.34).

4. Lead and zinc: The Couer d'Alene district of Idaho is an important source of zinc and silver (p.44,59).

5. Iron and manganese: No mention.

6. Nickel, cobalt, chromium, and platinum: Chromite in the Blue and Klamath Mountains of Oregon (p.96). Riddle nickel deposit (p.97.98). Platinum and chromite in the coastal beach sands. (p.98).

7. Uranium and vanadium: The Midnight Mine in Stevens County, Washington produced more than 10,000 tons of uranium oxide between 1955 and 1982 (p. 108, 117, 118), the second largest hardrock uranium mine in the U.S. A small amount was mined around the McDermitt caldera in extreme SE Oregon (p.119).

8. Other metals: Of the ten "other minerals" included (tungsten, tin, niobium, tantalum, titanium, rare-earth elements, thorium, beryllium, mercury and aluminum), the only northwest deposits mentioned are titanium (coastal ilmenite-bearing beach sands, p.137), and mercury (McDermitt, P.146).

9. Phosphate : The largest deposits in the U.S. lie in Montana and Idaho, where phosphate was first produced near Montpelier in 1906 (p.155). They occur in the

widespread Permian Phosphoria Formation (p.160).

10. Evaporites and brines: Potash, gypsum, sulfur, sodium carbonate, sodium sulfate, boron, lithium, bromine, iodine, magnesium. No mention.

11. Oil shale: No mention.

12. Other industrial minerals: Limestone and dolomite, crushed stone, cement, lime, sand and gravel, clays (5 kinds) barite, talc, feldspar, asbestos, fluorspar, kyanite, andalusite, sillimanite, wollastonite, zeolites.
"...Mica schist and gneiss containing kyanite and related minerals occur in Idaho, ...Washington and Oregon, but only in a few deposits are sufficiently large to be of possible economic importance". Zeolite-bearing Mesozoic marine volcaniclastic rocks occur in the Blue Mountains,other zeolites occur in the lower part of the Miocene John Day formation, central Oregon, and in Rainier National Park (p.209).

PART II. Oil and gas: Chapters 14 to 28. No mention.

PART III. Coal: Chapters 29-37. Chapter 36 mentions (p. 583) the Central Chehalis field in Washington, and Goose Creek basin in Idaho and Nevada, and Coos Bay field in Oregon and the Rogue River in Oregon and California, and describes the structural divisions into numerous allochthonous suspect terranes (p. 584), and gives a map showing their locations (p.585). Table 1 (p. 586)) shows Oregon as having 22 coal fields, the most important being Coos Bay, Rogue River and Eden Ridge, containing 572 million tons. Washington has 17 coal fields containing 50 billion tons. Idaho has 11 coal fields containing 354 million tons. The origin and composition of the coals are described in some detail (p.587-590).

The index is extensive (p. 603-622!).

John Eliot Allen
17, February, 1992
****

PAPUA - NEW GUINEA

By Rosemary Kenney, GSOC

New Guinea, second largest island in the world, lies between the equator and 12 degrees latitude, completely within the tropics. It is approximately 1500 miles long and 400 miles wide.

Politically, it is divided into two parts: the western half is Irian Jaya which became part of Indonesia in 1969. Papua-New Guinea is the eastern half which became an independent country in 1974.

Papua-New Guinea is approximately 86,000 square miles, slightly larger than the state of Utah, but has three times the population.

It has a wide range of physical conditions: hot, wet, swampy, lowlands, high valleys, and snow-covered mountains. Because it is near the equator, temperature and humidity are high throughout the year in all lowland areas. Variation in temperature is only about 15 degrees day and night and seasonal, 75 to 90 F. Temperatures are cooler in the highlands with snow on Mount Wilhelm.

Average rainfall is over 100 inches in most places, over 300 inches on some mountains but only 47 inches in Port Moresby. There are only two seasons: "Wet" and "Not So Wet".

Over three fourths of the country is covered with dense tropical rain forests, although there are four types of vegetation: lowlands, lower montane, montane, and alpine with myrtle trees, rhododendron, and alpine grasses. Forty eight species of rhododendrons are indigenous to Papua-New Guinea.

The people are Melanesian with dark skin and kinky ha... In fact, this is how the country got its name. Early Portuguese explorers named it "Ilhe do Papua" which means "Island of the Fuzzy Hair". The Spanish called it New Guinea" because it reminded them of Guinea in Africa. In 1884, the northeastern part, known as "Papua" was claimed by England. After World War I, League of Nations mandated both areas be administered by Australia. When the country became independent, the people could not decide on a name, so it became "Papua-New Guinea". They are still seaching for a shorter name.

It is believed that humans reached Papua-New Guinea by island-hopping across the Indonesian Archipelago from Asia more than 50,000 years ago. Parts of the Huon Peninsula has risen, due to volcanic activity, and evidence of early settlements have been exposed. 40,000 year old stone axes have been found. There is evidence in the Waghi Valley of gardening beginning 9,000 years ago. Papua-New Guineans are among the earliest farmers of the world.

Papua-New Guinea can be divided into five physio-graph... regions: South Coast, Central Cordillera, Intermont

Trough, Northern Mountains, and Islands.

So Coast is only about 200 feet high and largely covered with alluvium. Unlike the rest of New Guinea, which is geologically young and has frequent and severe earthquakes, this area is very stable and is an extension of the ancient Australian continental rocks that underlie the shallow waters of Torres Strait. The great delta plains of Fly, Bamu. Turama, and Kikori Rivers form part of the largest swamps in the world. For twenty miles inland from the coast, the island does not rise above sea level. The Fly River, largest in Papua-New Guinea, is over 700 miles long and is navigable for 500 miles. The entire area is so flat that the river is tidal for 150 miles from its mouth.

The Central Cordillera, the backbone of the island, consists of series of seven ranges, roughly parallel to each other. All the ranges are extremely steep and rugged. There has been so much faulting and old volcanic mountains are prominent. Karst land forms with sheer limestone walls, sink holes, and a subterranean river occur. As one Australian explorer wrote in his journal: "It is a frightful stretch of country. The rock is honeycombed and standing on end. The fissures and craters are large and small, appearing bottomless to the eye, impossible to cut a straight course. To find a way north, we walked up narrow and silent corridors of ro sometimes with the rumble of underground rivers be in our ears. Every step has to be watched for the limestone edges are as sharp as broken glass." The highest peak is Mount Wilhelm, 14,600 feet high, but all the ranges have peaks over 10,000 feet. The Owen-Stanley Range dips to the east, and is lower than the other ranges. The Trobiand Islands are coral islands built on top of submerged mountains.

The Intermontane Trough are plains of deposition formed by rivers carrying sediments down from the mountains. The rivers are braided or they meander through wide flood plains containing many scrolls, levees, cut-off meanders, swamps and lakes.

The Northern Mountains are of recent elevation and earth movements are common. Rivers flowing from the mountains are unsuitable for navigation and geologically recent coral is found 200-300 feet above sea level. Most of the Northern coastline drops suddenly to over 1000 fathoms deep in the ocean. It has rugged foreshores and rocky headlands and only brief patches of fringing coral reef.

The Islands are top of a submerged mountain range. Th are approximately 600 islands, with New Britain being the largest, with peaks over 6000 feet high. Volcanoes are common, some still active erupting in 1937 and 1951.

Papua-New Guinea is rich in minerals. Over 60% of the country' export income is from mining. Gold was discovered by the Australians in late 1800 and early 1900, but mining was defeated by the rough terrain and unfriendly people. Papua-New Guinea is now the third largest gold-producing country in the world. In 1984, the OK Tedi mine processed 17,000 tons of ore per day to produce 600,000 ounces of gold per year, plus small amounts of silver. An exceptionally high grade of ore is reported by Porgera Company. Operations began September, 1990, and in the first four weeks, 644,054 ounces of gold were recovered from 44,508 illion tons of ore. Most of the gold and copper mining activity is in the Highland Provinces, although one of the world's largest copper mines was on Bougainville Island. It is closed now, but another company is mining a copper mountains with a gold top in Southern Highland Province. Gold, silver, nickel, gas and petroleum are being discovered daily.

Most of the drilling for gas and oil is in the Highland Provinces and off-shore from Port Morsby, on a Miocene reef. Enough gas has been discovered to supply all the power needs at Porgera gold mine. One of the main problems is that there are too few roads in the Highlands Provinces, that sometime the road builders are just one jump ahead of the trucks hauling heavy equipment and drill pipe. Off-shore gas in the Gulf of Papua has been estimated at a reserve of 200 billion cubic feet of gas and 600,000 barrels of natural gas liquid. One of the richest wells is in the Highlands area, a remote location with extremely difficult access. It is at an altitude of over 3200 feet, amid nearly impenetrable limestone-Karst country all covered in dense tropical rain-forest jungle. It was deemed economical only if it contained 200 - 300 million barrels or more. It may have reservers of over 200 million barrels. Papua-New Guinea has a 44% success of drilling.

In additon to gold, silver and copper, some of the other minerals being mined are: aluminum, graphite, chromium, limestone, manganese, nickel, phosphate, lead, platinum, sulfur and zinc.

Some of the bitterest fighting of World War II was in Papua-New Guinea. Unless you know precisely where to look, you can walk right by bomb craters or bunkers and not see them. They are almost completely obliterated by the jungle in less than fifty years.

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TEEAGE FOSSIL FINDER DISCUSSES DISCOVERY
by Randy Hill, Mail Tribune Staff Writer

GRANTS PASS-- A 16 year-old fossil sleuth who made a paleontological "find of a life time" visited Fleming Middle School this week, telling several hundred students that it's never to late to start following their dreams.

Sam Jordon, now a junior at Grants Pass High School, gained national news media attention last year with his discovery. On a expedition to the Wallowa Mountains, Jordon unearthed the first fossilized skull of a shastasaurus, a prehistoric dolphin-like reptile.

Scientists described Jordon's find as the most important piece of evidence to date that the Pacific Northwest was once attached to Asia, but drifted across the Pacific Ocean about 150 million years ago, fusing with North America.

Expedition leader William Orr, a University of Oregon paleontologist, said professionals could spend a lifetime without making such a major find.

Jordons's enthusiasm was obvious Tuesday as he told five classes about this adventure, and how his drivin- interest and hard work put him in the right place at tl right time to find the gray foot-ball-sized rock.

"If have an interest in something, start looking into it right now," he said. "Start reading about it and talking to people who do it. People love to share information," he said.

"It's really good to get into something and not just think about it," Jordon said.

In Jordon's case, he hooked up with Janet Joyer, archaeologist for the Siskiyou National Forest, who helped him being digging on Forest Service sites and encouraged his pursuits.

Jordon earned a scholarship from the Oregon Museum of Science and Industry for a six-week paleontology expedition led by Orr.

His discovery, which came on the last day of searching, came in an outcropping of rock created by a new logging rod. He knew right away what he'd found from slides Orr showed the night before, he said.

The fossil is at the University of Oregon, bein- released from the rock by the use of a high-speed strea of sand, Jordon said.

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1. FALSE. The Triple Junction near Arcata is where the North American and Pacific Plates and Cascadia Subduction Zone meet.
2. TRUE. Some kind of mnemonic ("MEMORY-helping") trick such as this helps sort out confusing terms.
3. FALSE. "Flysch" is a Swiss-German term referring to a group of marine sedimentary rocks, a characteristic filling in a sea-floor depression next to an island arc.
4. TRUE. As used by Komar, Peterson, et al., the term "cell" refers to a beach contained between 2 rocky headlands - a very pleasant cell to be in on a sunny day!
5. TRUE. The Yuroks run a motel facing the main plaza in Arcata, California. It does indeed have claw-footed bathtubs with brass fixtures, and thanks to Alta Posback's adept wheeling and dealing, those of us who go on the President's Field Trip will be able to give them a try.
6. FALSE. (Don, don't sue me for libel! E.P.) The term "terrane" refers to a group of formations which have been rafted from somewhere else and now form part of the mainland. You might call this the "rafted and grafted theory.

JUL 92

THE GEOLOGICAL NEWSLETTER

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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.
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VISITORS WELCOME VOLUME 58, NO. 7

INFORMATION PHONE 284-4320 JULY 1992

CALENDAR OF ACTIVITIES FOR JULY

FRIDAY NIGHT LECTURES (Cramer Hall, PSU, Room 371; 8:00 p.m.)

July 10 "Preview of the GSOC President's field trip to the Oregon Caves, Klamath Mountains, the triple plate junction at Arcata, Calif., and return along the Oregon Coast," by Evelyn Pratt. Illustrated.

July 24 "Retracing the Oregon Trail," by Rosemary Kenney. Illustrated.

FRIDAY LUNCHEONS (Standard Plaza, 1100 SWth 6th Ave., Rooms A & B; Third Floor Cafeteria; program begins at 12:00 noon.

July 3 No meeting because of Fourth of July weekend.

July 17 Program to be announced.

GEOLOGY SEMINAR (NO SEMINARS UNTIL SEPTEMBER)

GSOC LIBRARY (Cramer Hall, PSU, Room S-17. Open 7:00-8:00 p.m. prior to evening meetings.)

FIELD TRIPS

Sept. 9 - 17: GSOC President's Field Trip. A bus tour south to the Oregon Caves, through the Klamath Mountains, to Arcata, Calif. to see where three tectonic plates are juggling for position, and return home via the Oregon Coast. A 9-day trip guaranteed to be fun and informative.

NOTICE: Please send your check for $250.00 made out to RAZ TRANSPORTATION CO. TO Alta Fosback as soon as possible; August 5 will be the deadline to hold your reservation. Additional fees to be determined later.

July-Aug. trips or hikes: Anyone interested in leading atrip by car or by hiking, please contact Alta Fosback 641-6323.

WELCOME NEW MEMBERS

Frances Person
1228 Edgecumb
St.Paul, Minnesota 55705

John Pratt
330 Reler Lane
Summerset, New Jersey

NEW FINDS IN PALEONTOLOGY

Connie Hofferber Jones
Hancock Field Station

The most exciting finds in paleontology aren't always new fossils.

Ted Fremd, paleontologist for the John Day Fossil Beds National Monument is more excited about finding out the actual age of fossils that have already been found.

"We're find some new species, but these aren't the main attraction right now. They're the icing on the cake," said Fremd from his office at the Visitors Center at the Sheep Rock Unit of the national monument.

A new radiometric dating procedure called *single crystal laser fusion argon/argon* being done at the Berkeley Geochronology Center in California is helping answer questions that have plagued paleontologists for years. In this procedure a single rock crystal from volcanic tuff is irradiated with a laser which gives a much more specific date than could be determined with the older potassium/argon dating. With the potassium/argon method, the date could be off as much as +/- 1.5 to 2 million years; the argon/argon method discrepancy is +/- .1 million years or 100,000 years.

"Many species of mammals only lasted for two million years, so it was hard to locate them in time with the old method," Fremd said.

Fremd said tested samples from the entire stratigraphic column from the top of the Rattlesnake tuff near Picture Gorge to the bottom of the Clarno Nut Beds near Hancock Field Station should give paleontologists new, more accurate dates for fossils.

"This wonderful basin has been sitting out there with fascinating fauna, but no one knows precisely how it fits in with the rest of the world," Fremd said. "We are finally able to put it into context.

Fremd recently visited the John Day Basin fossil collections at Yale University and the American Museum of Natural History in New York City which were collected in the late 1800s by Leander Davis for the two famous paleontology competitors, O.C. Marsh of Yale and E.D. Cope of the Philadelphia Academy of Sciences. There he saw many of the type specimens for the John Day area and is now able to compare them to the monument's specimens.

"I think we'll have to revise the hypertragulids (mouse deer)," Fremd said. "I think there is more variability within the population than would occur in a single species. When we got the calipers out and started measuring jaws there was too much diversity for one species."

Fremd gets nearly hyperbolic in his praise for the John Day Basin where he works, from Picture Gorge near Dayville on the east to just across the John Day River to the west. This area includes the Clarno and John Day Formations around Hancock Field Station and the famous Clarno Nut Beds.

"The John Day is amazingly well-documented with beautiful tuffs, flora as well as fauna, having been deposited in a time of climatic deterioration (wet and humid to desert). This was a global phenomenon, not an isolated event. The John Day Basin may be in a place to tell us about this climatic change."

"The John Day Basin has other peculiarities that make it an exciting place to study, " Fremd said. "Animals show up earlier in the John Day Basin than farther east in North America because it was on the route east from Asia." The last occurrence of a primate in North America before man arrived has been found in the John Day Basin.

Even though improving geologic dates of fossils has Fremd's interest right now, he still searches the John Day ash beds for fossils. A new exotic rodent, the size of a modern ground squirrel, has been found recently at Painted Hills Unit of the national monument. Other new finds are two dogs, including what may be a new genus, and a new mouse deer. He has also found fossils of a canid, or dog near Hancock Field Station which seems to be out of place in the stratigraphic column.

"These are exciting new finds," Fremd said, "because we can record them as not only new to the John Day Basin but new to the world."

As a taphonomist, Fremd looks at the biases that creep into the analysis of the fossil record. He must ask himself if the fossil record actually reflects what was going on 20 million years ago.

"For instance, from the number of mouse deer we find in the basin, we should believe that there were giant herds of hypertragulids crossing the prairies. But from mouse deer ıt are alive today in Indochina and Burma we know they ..re a solitary animal with very prominent musk glands to help them find one another, and they bark for the same reason. There is no reason to think 20 million years ago they were a herding animal. For some reason we just find a disproportionate large number of *Hypertragulus* bones."

Fremd said he believes there are probably more than two species of rhino that are so far identified, although these are difficult to determine as they changed little during the 7 million years of the John Day Formation. On the other hand canids had tremendous diversity during the John Day period and changed greatly through time. Some are tiny with skulls three to four inches in length; other are large "bear dogs" with skull 10 to 11 inches long. "Some were hyper-carnivores with only cutting and slicing teeth, and others were omnivores," he said.

Fremd has just started a new project to help him sort out all these puzzles. "Everything we are doing has to be done with specialists: mouse deer specialists, rodent specialists, dog specialists. Its just too complicated to try to figure it out alone."

..gging into history a bit, Fremd found that John Merriam, an elderly paleontologist in Oregon, put together a group of scientists which he called the John Day Associates. These biologists, botanists, archaeologists, and sedimentologists from all over the country met informally periodically for field research and published their work jointly from 1910 to 1930.

"He was away ahead of his time. Most scientists were covetous of their research and avoided competition. I think it might be time to reestablish the Associates," Fremd said. He has contacted various experts in paleobotany, palesols, geochronology and other earth science fields to hold field conferences and to publish their findings.

"I'm extremely excited about this. So far I've had almost a unanimous response," he said.

Fremd will have litle trouble finding things to keep him busy in Central Oregon. Even "Ralph Chaney said in the '920's: 'No where else on earth is there ıch a continuous record of flora and fauna.' "Fremd just has to figure out how it all goes together.

PRESIDENT'S FIELD TRIP QUIZ 7 PUN-SESSION

BY

President Evelyn Pratt

1. CHERT: What to say to someone who just fell down; "Chert yourself?" T/F?

2. PERIDOTITE: A general term for rocks that originated deep inside the earth, and have no feldspar and a lot of olivine. T/F?

3. RADIOMETRIC DATING: When you ask a member of the opposite sex to join you in a foreign car to listen to KBOO. T/F?

4. MOLD: An inside impression into which you can pour plaster of Paris to make a model of something. T/F?

5. UNCONFORMITY: A former erosional surface that is now buried. T/F?

6. ANAEROBIC: Someone who is opposed to exercise. T/F?

7. CONCRETION: A glob of harder rock in a softer formation, usually formed around a fossil. T?F?

8.MARINE TRANSGRESSION: Refers to the illegal occupation of an area by naval militia. T/F?

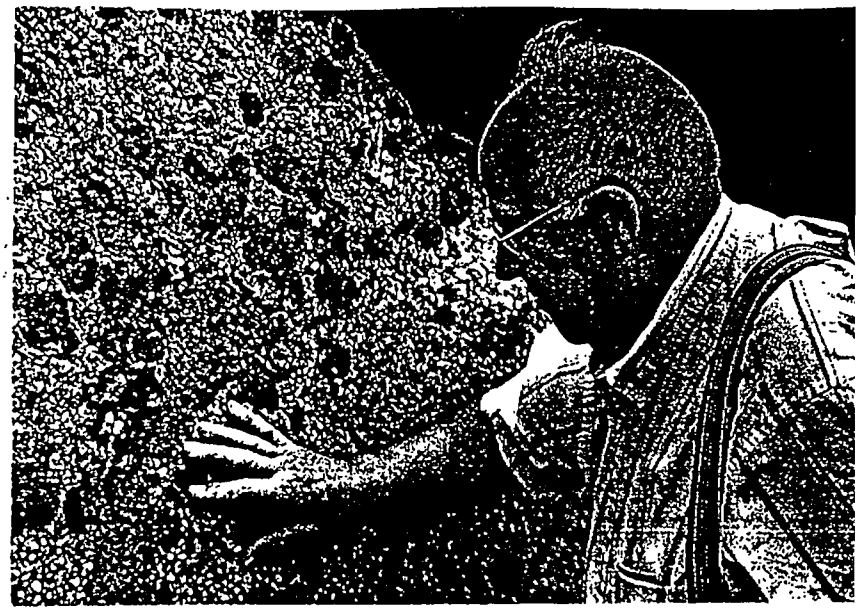
SEE PAGE 45 FOR ANSWERS

NEW FOSSIL RHINO STIRS INTEREST; AMATEUR PALEONTOLOGIST MAKES MAJOR CONTRIBUTION.

by Ellen Morris Bishop

"At first", Mel Ashwill said, " Just thought we had found a leaf site. Then I noticed teeth."

In his search for fossils near Post, Oregon, Ashwill and Madras high school teacher John Ries along with Paleontologist Steve Manchester had struck pay dirt. These were not just any teeth. Forty-one million years ago they belonged to a rhinoceros.



A primitive rhino at that, according to Bruce Hanson of the iversity of California, Berkeley, to whom Ashwill and paleontologist Steve Manchester sent the specimens for identification. This "dawn rhino" was a contemporary of three toed horses and brontotheres. Like modern rhinos, Teletaceras radinskyi had incisor tusks. It was the first "true"rhinoceros. It is known from only a few other sites: the Hancock fossil quarry in John Day Fossil Beds National Monument, and sites in Wyoming, eastern Canada, southern California, and Russia. Ashwill's find confirms Teletaceras' abundance in Oregon.

Why get all excited about old teeth? Well, partly because they indicate a tuff-laden, poorly consolidated rocks near Post are 41 million years old and belong to the Clarno Formation.

They also tell us something about the importance of amateur paleontology to the scienific community, and how vital just a few bones can be in furthering human knowledge.

Mel Ashwill has never sold his fossils or received a dime for his finds. A retired music teacher whose modest home and shop near Madras are filled with a well ordered collection of central Oregon plant fossils. Ashwill's joy is in the hunt for something beautiful that no-one has seen before. His love of fossils and his sixth sense for finding them, developed at an early age in upstate New York, where he unearthed his first oyster shells. He has been a dedicated amateur paleontologist ever since.

Dedicated enough, in fact, that last year the Paleontological Society, a prestigous international scientific group, recognized Ashwill's exceptional work with its Stripple Award, given annual to an amateur who has made outstanding contributions to science.

But Mel Ashwill has not always been tuned to professional paleontologists when his rambling hikes and sharp eyes unearth fossils. "At first, I just collected, " he said. Steve Manchester, now at the Flordia Museum of Natural History in Grainsville, persuaded Ashwill to share his finds with formal science about 15 years ago. Manchester specializes in paleobotany. Interested in the flora of the John Day Fossils Beds, he encourages Ashwill's work with plant fossils in central Oregon. The results transformed Ashwill's collection. It also transformed our knowledge of eastern Oregon's paleontology.

"Collecting in a more scientific way was more difficult, but I learned more about fossils too," Mel said. He now notes the exact location of each fossil he collects, including section, township, and range, and a photograph of the fossil and the locality.

Each fossil is unique, and each can impart new knowledge about an extinct plant or animal. But that information is useless unless the origin of the specimen is known precisely. " In the field of science, 'I think" and 'I' guess' are enough to fling a shadow of doubt that reduces the evidence to worthlessness.....Immediately upon collecting a fossil, I number and reference it in some permanent manner so the locality and other important information is not lost," he wrote in his 1989 Oregon Geology paper titled "Collecting Fossils in Oregon."

Many amateurs are reluctant to share their finds with scientists for fear their prize will be conscripted for "study", and never be seen again. Some amateurs worry their fossil will be considered insignificant, brushed aside by paleontologists who think "Why do you bother me with that?"

Ashwill never encountered either problem, and he rarely heard of such lamentable situations. "If I send somethings I am curious about, or think is significant, I'll send a photo of it to the appropriate professional," he said. "If it is important, they may ask to see it; if it is critical to their study, they may ask to copy it or keep it. But paleontologists have always returned my speciemens when I asked."

Teletaceras radinskyi— or at least his or her teeth– will be sent back to Ashwill in the next few weeks. The old rhino remains have been cleaned and replicated by Bruce hanson at Cal Berkely. Mel Ashwill will keep the real ones, labeled and impeccably ordered, for posterity. And with them, he will keep the more priceless treasure: the gratitude and goodwill of professionals worldwide, and the knowledge that

his trained eyes and conscientious effort have nudged a little closer to an understanding the earth.

The above article was published in TIME TRAVEL, Science Section of the Oregonian. Permission to reprint this article was granted by the author Ellen Morris Bishop, a geologist and free-lance writer who lives in Northeast Oregon.

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ANSWERS TO FIELD TRIP QUIZ AND PUN-SESSION

1. FALSE, at least geologically speaking. It is a quartz rock formed by the precipitation from seawater of silicon dioxide or of the shells of one-celled critters called radiolarians.
2. TRUE
3. Nice try, but no cigar - FALSE. Radiometric dating refers to the use of radioactive minerals in a rock to tell how old the rock is.
4. TRUE. The model you make is the cast. "Lava Cast Forest" isn't.
5. TRUE.
6. Welllll, no. An organism that is ANaerobic is one that can live without free oxygen. Examples: swamp bacteria, deep-sea worms by "black smokers."
7. TRUE. The hardpart is usually held together by the same tuff that limestone is made of: calcium carbonate.
8. Not in a geology newsletter! Actually, it's a term used to describe what happens when a large land area sinks and the sea gradually moves in over it.

MORE NEXT MONTH

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"SHOOTING STARS"

by Gordon Gilbertson

Talking to children about rocks and minerals I soon learned that for many of them the most interesting of all was when I told them about meteors. These rocks that fall from the sky looking like 'shooting stars' intrigued them.

I was surprised to find that out of a school class at least a few children had seen one fall or had seen a meteor collection.

Over the years I have written several times about these rocks from the sky, and I realize that we are always learning something new about them. Many of you have seen the fine display of meteors by a local collector at our own Regional shows.

You probably know that while many of them are rocks, other contain much iron. We now know that almost all meteors are 'non icy solids that have been ejected from comets.'

The meteors become great clusters left from a deteriorating comet. Out " sun orbiting earth" sometimes cut across a trail of cosmic debris and we many have several nights of good possibilities of seeing meteors in the sky.

Astronomers have been busy listing such meteor showers and have compiled lists of the particular shows that appear each month of the year.

Not too long ago, it was found that meteors contain in addition to iron and traces of many other elements, a remarkable number of diamonds. These are very tiny, but they are true diamonds suggesting the stellar origin of the comets. In any case, the meteorites themselves are much more valuable to a collection than the diamonds they contain.

Until recently I was somewhat puzzled by the absence of these objects from books on minerals. They are not found in lists of mineral species. However, they are given several names according to their position in space or on earth. If such an object Has not yet entered the earth's atmosphere, it is called a meteoroid. It is a meteor when atmospheric friction makes it incandescent. And it may be called a meteorite if it is recovered. Meteorites recovered following observed falls are called 'falls'. Those recognized in the field that cannot be definitely associated with observed falls are called 'finds'.

About 150 fall on land each year but only a few are immediately recovered after the fall. You can see from this why it is so hard to find meteorites. If one is seen, it is usually by a farmer or someone outside the United States.

However we now know there is almost zero danger of being hit by a meteor, but the danger to earth and to us is real. On June 30th, 1908, a huge fireball exploded in the sky over Siberia with the force of a 20 megaton nuclear bomb, leveling 400 miles of remote forest around the Tunguska River. This object was a 150 comet fragment, one of the meteors from the Taurids meteor shower. Scientist believe that Taurids were all shed by a huge comet, originally 100 miles or more across, that entered the solar system about 20,000 years ago. After 10,000 years, many big chunks have been breaking off each time it passes the sun. It is possible that such a chunk could again strike the earth. While many astronomers do not agree on all this, they think the possibility is worth taking seriously.

So there is now a committee of NASA experts recommending that a global network of telescopes be set up to hunt for potential meteors.

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Gordon Gilbertson, is Past President of the Oregon Agate and Mineral Society and Contributing Editor to the OREGON ROCKHOUND BULLETIN.

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The NATURE OF OREGON contains books, maps, articles,etc. on geology and related subjects run by the OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES. It is located in the new state office building just west of Lloyd Center. It has a dome top. Come in to see what is available. Submitted by Wally McClung.

****

GSOC PROPOSED BUDGET 1992

January 1, 1992 Beginning Balance			$7058.29
Projected Income			
Interest on Savings (Benj Franklin)		$159.00	
Membership Dues		3038.00	
Newsletter Subscriptions		150.00	
Trip Log Sales		50.00	
Miscellaneous		40.00	
Total Projected Income		3437.00	
Total Projected Resourses			10,495.29
Projected Expenses			
Newsletter		1800.00	
Room Rental PSU		291.00	
P.O. Box Rental		93.00	
Administrative Expenses	$500.00	1816.00	
Equipment Repair	100.00		
Insurance	556.00		
Campout Reconnaissance	200.00		
Membership Directory	230.00		
Picnic	30.00		
Library	50.00		
Corporate & Fees License	50.00		
Postage	100.00		
	1816.00		
Guest Speakers		550.00	
Dinners	250.00		
Honorarium	300.00		
	550.00		
PSU Scholarship		400.00	
T otal projected Expenses			4,950.00
Projected Ending Balance			5,545.29

1992 BANQUET TOTAL RECEIPTS	$1456.00
1992 BANQUET EXPENSES	1346.27
PROFIT	109.73

AUG 92

THE GEOLOGICAL NEWSLETTER

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

GEOLOGICAL SOCIETY
OF THE OREGON COUNTRY
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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.
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VOLUME 58, NO. 8
AUGUST 1992

CALENDAR OF ACTIVITIES FOR AUGUST

ANNUAL PICNIC

AUGUST 14: TIME: 6:00 (to visit); 6:30 to eat.
LOCATION: Alpenrose Dairy picnic area, 6149 SW Shattuck (½ mile south of Beaverton-Hillsdale Hwy)
BRING: Main dish, salad, or dessert for three of more people and yourself. Bring your own table service including serving utensil. Beverages (coffee and juice)will be provided.

FRIDAY NIGHT LECTURES

AUGUST 28: NO MEETING

FRIDAY LUNCHEONS (Standard Plaza, 1100 SW 6th Ave., Rooms A & B; Third Floor Cafeteria. Program begins at 12:00 noon.)

AUGUST 7: Mountains of Central Idaho, bu Don Barr. Illustrated.

AUGUST 21: The Oregon Trail, by Rosemary Kenney. Illustrated.

GSOC PRESIDENT'S ANNUAL "CAMPOUT" TOUR: SEPTEMBER 9 - 17

(See elsewhere in this Newsletter for description of trip)

RESERVATIONS: $250 downpayment due by Aug. 5. Final payment due Aug. 10. Important: BEFORE making out your check call Alta Tel. 641-6323 for the name of the payee.

Maximum of 36 people has been met. Any additional reservations will be placed on a waiting list.

TOTAL PRICE PER PERSON:

Single	1 bed	$600
2 people	1 bed	495
2 people	2 beds	510
3 or 4 people	2 beds	450

Complete itinerary will be mailed to participants by Sept. 1.

TENTATIVE ITINERARY: 1992 GSOC PRESIDENT'S FIELD TRIP, 9/9-9/17

COMPLETE DETAILS WILL BE MAILED TO PARTICIPANTS BY SEPTEMBER 1.
One dinner and some breakfasts are included. Lunches are not. We'll brown-bag it most days; you pick up needfuls the night before. It helps to have a thermos for beverages and an insulated container for lunches.

Wednesday, September 9. 7:45 A.M. Bus ready for loading at Red Lion Hotel\Lloyd Center. Lake Allison: turbidites, terranes, and plutons; John Roth's tour of the Oregon Caves. OREGON CAVES CHATEAU, Cave Junction, OR.

Thursday, September 10. John Roth's tour; local Klamath Mountain geology. GEOLOGY ROAD GUIDE TO SMITH RIVER. VALU-INN, Crescent City, California.

Friday, September 11. Effects of 1964 tsunami; faults, folds, and terraces of Cascadia subduction zone. ARCATA HOTEL, Arcata, California.

Saturday, September 12. AM, free time. PM, Ferndale's 7.0 quake. Triple Junction, where are you? (Samoa Cookhouse), Arcata Hotel, Arcata, California.

Sunday, September 13. Yurok Indians; beaches, redwoods. VALU-INN, Crescent City, California.

Monday, September 14. Clair Stahl's tour: south Oregon coast. HARBORVIEW HOTEL, Bandon, Oregon.

Tuesday, September 15. Don Stensland's tour; Powers, Agness, Gold Beach. HARBORVIEW HOTEL, Bandon, Oregon.

Wednesday, September 16. Don Stensland's tour: Coos Bay area. PONY VILLAGE, North Bend, Oregon.

Thursday, September 17. Joe Heinz's tour. Joe Heniz's dunes tour. 5-6:30 PM HOME AGAIN.

See front page(Activities Page) for costs, deadlines, loading areas, etc. I'm answering geological questions; Alta Fosback takes care of any questions you may have regarding food, lodging, parking, transportation, etc. We're looking forward to traveling with you in September. Your Pres. Evelyn Pratt.....

Current assessment of earthquake hazard in Oregon

by Robert S. Yeats, Department of Geology, Oregon State University, Corvallis, Oregon 97331

Five years ago, very few people were concerned about major earthquakes in the state of Oregon. Historical damaging earthquakes had been recorded in the adjacent states of Washington, Idaho, Nevada, and California, but not Oregon. This lack of concern is expressed today in seismic zoning maps, which put the state of Oregon in a lower seismic risk category than adjacent states.

Today, the earth science community appears to have reached a consensus that Oregon has been struck by large earthquakes in the past and therefore that Oregon is likely to be subjected to large earthquakes in the future. There is no agreement among earth scientists on whether Oregon will be subjected to a magnitude 9 or only a magnitude 7 earthquake. Nor is there compelling evidence for past large earthquakes directly beneath the heavily populated Willamette Valley. But the evidence found in marshes in estuaries on the Oregon coast is compelling enough for reevaluation of seismic zoning maps and of the seismic safety of critical facilities such as power plants, hospitals, and dams.

In evaluating earthquake hazards, it is not enough to show that crustal deformation has taken place in the recent past, because such deformation could take place slowly and smoothly, unaccompanied by earthquakes. It is necessary to show that deformation occurred in sudden jerks, as it does during an earthquake.

In Oregon and Washington, scientists have now shown that coastal marshes and coniferous forests have recently undergone sudden subsidence that killed the marshes and forests by inundating them with sea water. Sand commonly found overlying the marshland sediments shows strong evidence of having been deposited by a seismic sea wave, or tsunami. Sand of this kind has been reported from the Salmon River and Alsea Bay, Oregon, and from Willapa Bay, Washington.

Many attempts have been made to account for the buried marshes by nonseismic processes, notably gigantic, 500-year storms or a slow rise in sea level. Sea-level change in the last 5,000 years does not appear to be large enough to account for the marshland burials. Marshes on the East Coast and Gulf Coast of the United States have been subjected to great storms in the past, notably hurricanes, but these marshes do not show evidence of rapid burial. However,

marshes around the Gulf of Alaska and in southern Chile do show evidence of rapid burial, including burial after the 1960 Chile earthquake (magnitude 9.5) and the 1964 Alaska earthquake (magnitude 9.2). We cannot completely exclude the possibility that the marshes could have been mantled with sand by a gigantic Pacific storm occurring during a time of temporary sea-level rise in the last few thousand years. But this explanation has very little support among scientists because it is unlikely that a great storm and a temporary sea-level rise would have coincided seven or eight times in the last 5,000 years.

The only note of caution about correlating marsh subsidence with earthquakes is the absence of evidence of strong shaking of marsh deposits that would be expected during a great earthquake.

The most recent great coastal subsidence event occurred 300 to 400 years ago, as dated by carbon-14, and is known to have inundated many marshes and forests from Grays Harbor in Washington to Alsea Bay in Oregon. Carbon-14 dates from partially submerged archeological sites are consistent with submergence during the most recent event as well as an earlier event 3,100 years ago. However, carbon-14 dates do not permit us to say whether a given subsidence event occurred in one earthquake or in several over a period of 50 years. We could calculate the magnitude of an earthquake rupturing the subduction zone from Grays Harbor to Alsea Bay, but this would be considered as a maximum possible event. Tree-ring dating could increase the time resolution, but only where the subsidence

These probable subduction-zone earthquakes have occurred on average every 500 to 600 years, but there is so much variation in recurrence interval over the past 4,000 years that the average recurrence interval has little value in predicting the next earthquake.

Sediment cores from the abyssal sea floor at the foot of the continental slope west of Oregon provide evidence of strong shaking, perhaps related to the abrupt coastal subsidence. Sediments deposited on the continental shelf by major rivers, particularly the Columbia River, were apparently destabilized and sent down the continental slope as a high-density, sediment-charged flow analogous to a snow avalanche, but much larger. The most likely triggering mechanism was a giant earthquake. The cores also recovered deposits of ash from the Mount Mazama eruption that formed Crater Lake about 7,600 calendar years ago. Based on the number of turbidity-current deposits on top of the Mount Mazama ash, the average interval between successive turbidity-current deposits is about 500 to 600 years, with the most recent deposit about 300 years ago. These estimates resemble those for marshland subsidence events, adding support for the origin of both by great earthquakes.

Accurate repeated leveling surveys of Oregon highways provide evidence for deformation in the last 100 years. This releveling study is in its early stages, because the highways were last releveled in 1987, and the data are only partially analyzed. However, there is clear evidence of eastward tilting of the Coast Range toward the Willamette Valley, northward tilting of the coast between southern Oregon and Newport, and southward tilting of the coast between Astoria and Tillamook. We cannot say whether this deformation represents elastic strain accumulation prior to a future earthquake or whether this deformation has nothing to do with earthquakes. This is a profitable line of investigation, however, and future studies may lead to more definitive evidence from geodetic evidence of this kind.

Studies in the Willamette Valley have not yet produced evidence that the Portland Hills fault, Gales Creek fault, Corvallis fault, and other faults in the Valley are active and capable of producing earthquakes. In addition to these faults, there are broad folds in the Tualatin Valley and Portland basin. The faults are not long and throughgoing, as they are in California, but instead are relatively short and offset at right angles by other faults. The faults and folds are consistent with the observed stress field of western Oregon, which is characterized by the maximum compressive stress oriented north-south. These faults and folds clearly deform flows of the Columbia River Basalt Group deposited 16.5 to 12 million years ago. Most of these structures also deform semiconsolidated sediments that overlie Columbia River basalt, but these sediments are poorly dated. If these sediments are as young as a few hundred thousand years, then these faults would be shown to be capable of generating future earthquakes. Investigations to answer these questions are underway.

The only clear evidence for recent crustal earthquakes comes from the South Slough of Coos Bay, where marshes show evidence of at least eight burial events in the last 5,000 years. South Slough is in the axis of a syncline, or down-fold, and the buried marshes show that this syncline was formed by a series of earthquakes, possibly on a deeply buried fault that nowhere reaches the surface. Coos Bay is at the eastern margin of a zone of active faults and folds that extends north-northwestward offshore, parallel to the foot of the continental slope and not parallel to the coastline, which extends northward. These faults and folds respond to the northeastward subduction of the Juan de Fuca Plate beneath Oregon and are not in accord with the north-south principal compressive stresses measured elsewhere in western Oregon. Thus, we cannot apply the evidence for earthquakes at Coos Bay directly to the Willamette Valley, which is much farther inland from the trench.

Western Oregon has very few instrumentally recorded earthquakes, and most of these are in the Portland area, part of a zone that extends northward into Washington. Part of the reason for so few earthquakes is that Oregon has very few seismographs to record small earthquakes, as compared with adjacent states. For this reason, small earthquakes that could be recorded in Washington or California are not recorded in Oregon. However, the lack of larger earthquakes, magnitude greater than 2.5, is not an artifact of poor instrumentation. The Washington network has recorded many earthquakes in the North American crust and many more in the deep oceanic slab that is now being subducted, but none on the interface between the two plates, the place where subduction-zone earthquakes would occur. The absence of earthquakes could be explained by very smooth, frictionless subduction or by subduction having stopped entirely. Neither explanation is likely. The most logical explanation is that the subduction zone is completely locked and is building up strain for a future earthquake. Most of the San Andreas fault that ruptured in great earthquakes in 1857 and 1906 is seismically quiet, like the Willamette Valley. The Coos Bay region, with the only clear evidence for recent crustal earthquakes, is also seismically quiet. Even so, the compete absence of instrumentally recorded earthquakes on the subduction-zone interface is difficult to explain.

The lack of historical earthquakes should not be taken as evidence for low seismic hazard, because Oregon's recorded history spans less than 200 years, which is not sufficient time to be significant in earthquake-hazard evaluation. The submergence of archeological sites indicates that earthquakes affected Native American communities prior to the establishment of a culture that kept written records. The Armenian earthquake of December 1988 occurred in an area that had not had a major earthquake in 700 years, based on historical records. A large portion of that part of the San Andreas fault of California that ruptured in great earthquakes in 1857 and 1906 is now as seismically quiet as the Willamette Valley. The southern San Andreas fault has not had a major earthquake in several hundred years, and a long-range prediction experiment is now underway in that region.

In conclusion, the marsh evidence is convincing enough to issue a public warning about earthquake hazard in Oregon. We cannot say how large a subduction-zone earthquake could be, nor can we forecast when the next one might occur. We also have not been able to assess the earthquake hazard posed by local earthquake sources beneath the Willamette Valley. We are on the steep part of the learning curve, and there are many challenges ahead of us. □

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The above article CURRENT ASSESSMENT OF EARTHQUAKE HAZARD IN OREGON was done by Robert S.Yeats and appeared in OREGON GEOLOGY, Vol.51,Number 4, 1989.

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GET BUSY AND PREPARE FOR THE UNPREDICTABLE

by Jim Bela

Humbolt County was rocked by three large earthquakes and aftershocks greater than a magnitude of 6 last weekend. More seismic energy was released in that Northern California area than from all of Oregon's combined onshore earthquakes this century.

The southernmost segment of the Gorda plate apparently slipped relative to the rest of the Gorda plate. One preliminary assessment suggests that faulting may have been in direct response to movement on the underlying Cascadia subduction zone. If this small tip of the plate is capable of such strong ground shaking and devastation, it gives one wonder what the effect of the rupture of a much larger piece of the subduction plate might hold in store, especially if it occurred closer to home.

Unfortunately, earthquake preparedness in the Pacific Northwest is virtually nonexistent, a circumstance that is not all that surprising since earthquakes are few in the region's history.

Yet new evidence suggests that this area may have earthquakes 1000 times greater than the San Francisco earthquake of 1906, and that such earthquakes have rocked the Northwest within last 300 years.

Since these great subduction zone earthquakes have the potential to affect the whole society, with consequent need to reflect earthquake planning in daily decision affecting homes, school, work and regional (as well as government) planning, the need to build awareness is clear.

Contrary to popular belief, the major cost of an earthquake lies not so much in spectacular damage to major structures, such as high-rise buildings and long-span bridges, as it does in moderate damage to a large number of small, more ordinary structures.

The 1964 Alaska earthquake cost $350 million in repair and restoration. The recent Loma Prieta quake cost more than $6 billion in damage in the San Francisco Bay area, and many businesses that were affected are still not back to normal. The 7.1 magnitude quake, which lasted for only 15 seconds, destroyed more than 1000 homes and damaged another 23,000. At least 12,000 people were left homeless.

In larger earthquakes, such as those now known to be possible in the Pacific Northwest (where strong ground shaking may last for minutes rather than seconds), fire, police and medical professionals may be overwhelmed and unable to respond immediately to all emergency calls. State and federal emergency services advise everyone to be prepared to survive on their own for at least 72 hours following a major earthquake.

Many in the Northwest consider the Bay-area earthquake to be a major tremblor. As a TV and media event, it certainly . However, by all seismological standards it wasn't. Because the fault rupture began in the middle and broke in both directions simultaneously, the duration of shaking , which strongly controls the building damage, was significantly less than might be expected for a 7.1 earthquake.

To put this in perspective, a repeat of the magnitude 8.1 great San Francisco earthquake would be equivalent to six Loma Prieta earthquakes occurring one after another. Damage estimates for a repeat of that 1906 earthquake in the San Francisco Bay are in the range from $20 billion to $40 billion.

Large earthquakes differ from other disasters in that they are infrequent, usually unpredicted and potentially catastrophic. Whether an earthquake causes a disaster depends on three things: (1) the magnitude of the event, (2) the distance of the causative fault or "source zone" from the city, and (3) the degree of preparedness in the city.

An earthquake is just not the seconds or minutes of ground shaking. It is the loss of life, the trauma of survival and rescue, the loss of productivity and capital, social disruption, loss of business opportunities and the usually long period of recovery.

It is the duty of government and communities to recognize the danger and to make provisions against it. Western Oregon is subject to three potential earthquake sources: (1) "great" or "giant" thrust earthquake of magnitude of 8 to 9.5 originating from the Cascadia subduction zone characterized by strong shaking of a minute or two felt over large distances, including the Willamette and Rogue valleys; (2) deep earthquakes originating from down-going Juan de Fuca plate at depths of 28 to 37 miles, similar to the 1949 Olympia (magnitude 7.1) and the 1965 Seattle (6.5) quakes, which had 10 to 15 seconds of strong shaking and; (3) shallow crustal earthquakes, generally expected to the 5.7 to 6.3 range, with an expected shaking duration of 10 to 20 seconds, followed by aftershocks.

The best way to mitigate the effects of earthquakes, large or small, is to prepare for their occurrence. The California governor's Board of Inquiry, which studied the Loma Prieta quake, listed three challenges: (1) ensure that quake risks posed by new construction are acceptable; (2) identify and correct acceptable seismic safety conditions in existing structures, (3) develop and implement actions that foster rapid, effective and economic response to and recovery from damaging earthquakes.

There will be earthquakes in our future. But the future is not just the earthquake... nor is it just the tsunami or seismic sea wave crashing into our coastline. The future, simply, is our response-ability!

Since this is the International Decade of Natural Disaster Reduction, it would seem appropriate for Gov. Barbara Rob[illegible]

spell out some formal commitment to addressing the earthquake threat in Western Oregon seriously.

.ames Bela of Southeast Portland has a master's degrees in civil engineering and geology and is president and founder of Oregon Earthquake Awareness. The article by James Bela appeared in the Oregonian April 30, 1992. Permission was granted to reprint it in the THE GEOLOGICAL NEWSLETTER.

A booklet EARTHQUAKE PREPAREDNESS FOR OFFICE HOME FAMILY AND COMMUNITY produced by James Bela .It contains 32 pages of information on getting ready for an earthquake. It is available from Earthquake Awareness, P.O. Box 33050, Portland, Oregon 97233. The cost is $4.50

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FRACTURE GEOLOGY QUIZ--Evelyn Pratt, Pres., GSOC
ANSWERS ON PAGE ____

1. **OROGENY**: Sons and daughters of Oregon. T\F.
2. **PETRIFACTION**:How an organism gets stoned. T\F.
3. **GRAYWACKE**:An older geologist with far-out ideas. T\F
4. **Paleosol**:An ancient buried soil. T\F.
5. **ACURATE**:What Noah said to the Sea Monster: "That was my arcuate! T\F.
6. **TURBIDITY CURRENT** Sedimental sea-slide. T\F.
7. **AMPHIBOLE**:The fossil of a cold-blooded animal related to a frog. T\F.
8. **CONTINENTAL CRUST**:Term used to describe what a party-crasher from France or Germany has a lot of. T\F.
9. **UPWELLING**:The process that brings up deep, cold water so ⁵sh flourish and swimmers' toes freeze. T\F.
). **YARDANG**:The crosspiece that a snail hangs from: e.g., The pirate said, "I'll hang ye from YARDANG!. T\F.

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THE 18 MOST SIGNIFICANT EARTHQUAKES IN U.S. HISTORY

For National Earthquakes Awareness Week, April 2-8, 1989, the U.S.Geological Survey (USGS) released a list of 15 most significant earthquakes in the history of the United States.

Robert Wesson, chief of the Office of Earthquakes , Volcanoes, and Engineering at the USGS National Center in Reston, Virginia said the basis of selection of the 15 earthquakes is a combination of magnitude, damage and casualties.

Earthquakes are measured in two basic ways: magnitude and intensity. Magnitude is an instrumental measure of the amount of energy released by an earthquake, as indicated by ground motion. Magnitude scales theoretically have no upper limit. The Modified Mercalli Scale ((MMS) of intensity, using Roman numerals, is ⁵ased on human judgment of the amount of damage and affects caused by earthquakes and ranges from I (not felt) to XII (almost total destruction of human made structures.

The 15 most significant earthquakes in U.S.History , listed in order of the time of their occurrence, are as follows:

1. **Cape Ann, Massachusetts, November 18, 1755.** Estimated magnitude 6.0 maximum MMS intensity VIII. It was centered in the Atlantic 200 miles east of Cape Ann and was felt over 400,000 square miles from Nova Scotia south to Chesapeake Bay and from Lake George, N.Y., east into the Atlantic. Damage was heaviest on Cape Ann and in Boston, with about 100 chimneys destroyed.

2.. **New Madrid, Missouri, seismic zone, 1811-1812.** In the most violent series of earthquakes in U.S. history, three earthquakes (in this counted as one) hit the New Madrid seismic zone in southeastern Missouri and northeastern Arkansas on December 16, 1811, and January 23 and February 7, 1812, at estimated magnitudes of 8.4 to 8.7 and maximum MMS intensities of XI. Damage and casualties were not great because the area was sparsely populated, but the earthquakes were felt over the entire United States east of the Mississippi River and probably far to the west. The earthquakes caused extensive damage in the surface of the land.

3. **Virgin Islands, November 18,1867.** Estimated mangitude 7.5, maximum MMS intensity VIII. It was felt from the Dominican Republic to the Leeward Islands. Property damage occurred in the Virgin Islands and Puerto Rico, some caused by 20 foot sea waves triggered by the earthquake.

4. **Charleston, South Carolina, August 31, 1886.** Estimated magnitude 6.6, maximum MMS intensity X. It killed 60 people. Most buildings in the Charleston area were damaged or destroyed, with losses of $20 million. It was felt in New York City, Boston, Milwaukee, Havana, and Ontario.

5. **Charleston, Missouri, October 31, 1895.** Estimate magnitude was 6.2, maximum MMS intensity IX. It was near the junction of the Mississippi and Ohio Rivers and was the strongest shock in the New Madrid seismic zone since the three great earthquakes in 1811-1812. It was felt over 1 million square miles in 23 states and Canada, caused considerable damage, and created a four-acre lake near Charleston.

6. **San Francisco, California, April 18, 1906.** Estimated magnitude 8.3, maximum MMS intensity. Although known as the San Francisco earthquake, the 1906 shock actually ruptured in the San Andreas fault along a 270 mile long segment from San Benito County north to Humbolt County. Fault slip was up to 21 feet in Marin County. Damage was estimated at more than $24 million., directly from the earthquake and from fires that followed in San Francisco. The death toll from the earthquake and fires was more than 700 persons.

7. **Mona Passage, Puerto Rico, October 11, 1918.** Estimate magnitude 7.5, maximum MMS intensity IX. It was one of the most violent recorded on Puerto Rico and was followed by a tsunami that drowned many people. The death toll was 116, and damage was estimated at $4 million.

8. **Long Beach, California, March 10, 1933.** Although the magnitude was only 6.2, and the maximum MMS intensity VIII. This earthquake was one of the most destructive in the United

States because it was in a heavily settled area, with many poorly constructed buildings, including schools. About 115 people were killed, and hundreds more injured. Damage was estimated at $40 million. The earthquake led to sttricter construction codes in California to mitigate earthquake damage.

9. Olympia, Washington, April 13, 1949. Magnitude 7.1, maximum MMS intensity VIII. This earthquake caused heavy damage in Washington and Oregon. Eight people were killed, and many others were injured. The earthquake was felt eastward to western Montana and south to Cape Blanco, Oregon.

10. Hebgen Lake, Montana, August 17, 1959. Magnitude 7.3, maximum MMS intensity X. The strongest recorded earthquake in Montana was felt over 600,000 square miles, from Seattle, Washington to Banff, Alberta, Canada, to Dickinson, North Dakota, to Provo, Utah. It caused massive waves on Hebgen Lake that did not subside for 12 hours and also caused a large landslide that blocked the Madison River canyon, creating a large lake. At least 28 people were killed, and damage was extensive to summer homes and highways in the region.

11. Prince William Sound, Alaska, March 27, 1964. This magnitude 8.4 Good Friday earthquake is the the second l stongest in the world during the 20th century, topped only by a magnitude 8.6 earthquake in Chile in 1960. The maximum MMS intensity was X. The Alaska earthquake triggered extensive landsliding and generated tsunamis. It caused $311 million in damage in Anchorage and south-central Alaska and killed 131 people. As a result of this earthquake and a magnitude 6.5 tremor in the San Fernando Valley of California in 1971, the federal government, mostly through the USGS, greatly expanded its research of earthquakes.

12. Seattle, Washington, April 29, 1965. Magnitude 6.5, maximum MMS intensity VIII. The second strongest recorded earthquake in Washington was felt over 130,000 square miles of Washington, Idaho, Montana, and British Columbia. Seven people were killed, and damage was estimated at $12.5 million.

13. San Fernando, California, February 9, 1971. Magnitude 6.6, maximum MMS intensity XI. It killed 65 people, injured many more., and caused $1 billion in damage in the Los Angles area. As a result of this earthquake and the 1964 Good Friday earthquake in Alaska, the federal government greatly expanded its earthquake research and re-evaluated seismic design for hospitals and other critical facilities.

14. Coalinga, California, May 2, 1983. Magnitude 6.7, maximum MMS intensity VIII. It injured 45 people and caused $31 million in damage., with the worst damage in downtown Coalinga. The earthquake was felt from Los Angeles to Sacramento and from San Francisco to Reno.

15. Borah Peak, Idaho, October 25, 1983. Magnitude 7.0. maximum MMS intensity IX. The largest earthquake recorded in Idaho was felt over 300,000 square miles. Two children were killed in Challis, Idaho, and damage was estimated at $12.5 million.

The above article appeared in OREGON GEOLOGY, Vol. 5., Number 4, July 1989.

EDITOR's NOTE: Since the above list of earthquakes was published other earthquakes shook the west coast, August 17, 1991, the Honeydew at Mendocino Triple Junction, with magnitude 6.2 and MMs intensity of IV, March 7, 1992, Magnitude 5.3 , MMS intensity VII same area, June 28, 1992, Mohave Desert area 7.4 and 6.5. There have been others but these are to mention a few.

ANSWERS TO 'FRACTURED GEOLOGY QUIZ

1. Sounds good, but 'tain't so. Orogeny is the process of mountain-building, particularly by faulting and folding.
2. True fact. Petrifaction refers to the process of becoming stone.
3. Not true. Graywacke is a dark rock made of sand and clay particles that have mostly likely been deposited on a continental slope.
4. Right on!! Cross-sections of paleosols show up frequently in sea cliffs above northern California and southern Oregon beaches.
in5. Typical example of 7th grade humor, folks. 'Arcuate' refers to something curved or bowed, such as a sand dune.
6. That's it. A dense current of sediments suspended in water and moving down slope of a lake or ocean bottom is a turbidity current.
7. Not a fossil, but a group of minerals, with complex formulas involving silica, aluminum, oxygen, hydroxide, and a couple of metals. Amphiboles are common rock-formg minerals.
8. That's one definition. In geology, a continental crust is the name given to the lightweight "scum" of granitic continents that floats on the heavier mantle beneath it.
9. True. When light, warm surface water is transported away from a coast and heavier, cold deep water rises to replace it, it 's called "upwelling".
10. It would be hard to hang ANYone from a short segment of the crest of a sand dune, which is what a yardang is.

****

If you have sent in items to be published in the NEWSLETTER, they will be appearing in future issues. I do need more articles for future issues. Get you pens out and get your name in print.

****

Change of telephone number. Art and Mary May's new telephone number is 696-4400.

SEP 92

THE GEOLOGICAL NEWSLETTER

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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VOLUME 58, NO. 9

CALENDAR OF ACTIVITIES FOR SEPTEMBER, 1992

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

Sept. 11 No meeting scheduled due to GSOC President's Field Trip.

Sept. 25 "Bonneville Navigation Locks" by John Seger, U.S. Corps of Engineers.

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

Sept. 4: Geology and Natural History of the Olympic Mountains, by Don Barr, Past President, GSOC.

Sept. 18 To be Announced

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

Wednesday Sept. 16 "Classification of Igneous Rock" by Richard Bartels. Please bring one or two small samples of igneous rock to the meeting.

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

FIELD TRIP

Sept. 9 - 17, 1992
President's Annual Field Trip, a.k.a. "Campout". In S.W. Oregon and N.W. California participants will see dramatic evidence of the Geological happenings of the ancient and immediate past. Cancellations make space available off and on. If you still wish to join us contact Alta Fosback at (503)-641-6323.

Future trips:
Volunteers to lead day trips are NEEDED!
Dr. John Whitmer has volunteered for a 3 day trip. Date and destination to be announced.

A REQUEST HAS COME FROM DAVE THE MAINTENANCE MAN AT CAMP HANCOCK ASKING FOR PEOPLE TO VOLUNTEER SOMETIME TO HELP WITH MAINTENANCE AT THE CAMP. CALL DAVE AT 1-7634691

COMPLETELY FRACTURED GEOLOGY

BY RALPH AND EVELYN PRATT

There are NO right answers this time. That's what happens when two punsters collaborate. . . Right answers are on Page 56 .

1. OPHIOLITE - a little reading lamp mounted on a snakelike neck.

2. IMBRICATED - (1) involved, such as "The suspect was imbricated in the crime." (2) under the influence of alcolol.

3. MIDDEN - (1) a naval cadet (2) halfway between a leften and a righten.

4. SLIPFACE - a character in a Dick Tracy comic strip.

5. AMYGDALOIDAL - a Spanish word meaning "loyal friend.".

6. CLAST - (1) all characters in a play, (2) socio-economic levels, as in "upper clast" and "lower clast"

7. INDURATED - past tense of "to indure", as in "Yesterday the President indurated a lot of criticism."

8. SUBSIDENCE - refers to a job at the bottom of the pay scale.

9. TOMBOLO - the mate of a henbolo - together they produce little bolos, bolitos.

10. PLUTONIC - (1) companionship with not sexual involvement, (2) referring to a Walt Disney cartoon dog..

SIR LANKA
by ROSEMARY KENNEY

Sri Lanka has an area a little over 25,000 square miles, about half the size of Florida . It has about 17 million population with a density of about 670 people/squa mile. The Island lies between 5 and 10 degrees no of the equator, off the southern tip of India. It is shaped like a pear, or tear drop, 250 miles long and 140 miles at its widest.

Geologically, Sri Lanka is a southern continuation of the Indian Deccan Massif. More than 90% of Sri Lanka's surface lies on Precambrain strata, some dating back to 2 billion years. The metamorphic rock surface was created by the transformation of ancient sediments under intense heat and pressure during mountain building processes. These rocks were part of the supercontinent Gondwanaland. Beginning about 250 million years ago, forces within the earth's mantle began to separate the lands of the Southern Hemisphere, and the continental crustal plate that supported both India and Sri Lanka moved toward the northeast. About 45 million years ago, the India plate collided with the Asian continental plate, raising the Himalayas in northern India, and continued to advance slowly to the present time. Sri Lanka is stable, with practically no earthquakes or major volcanic events because it rides on the center of the India plate.

Extensive faulting and erosion over time have produced a wide range of topographic features, but 3 zones are distinguishable by elevation: Coastal Belt, Plains, and Central Highlands. Four fifths of the land is flat or gently rolling. One fifth is a mass of rugged hills. A coastal Belt up to about 1000 feet above sea level surrounds the island. Much of the coast consists of sandy beaches indented by coastal lagoons. In the northeast and southwest, where the coast cuts across the stratification of the crystalline rocks, there are rocky cliffs, bays, and offshore islands. These conditions have created one of the world's best natural harbors. Jaffna Peninsula arose by the elevation of Miocene limestone beds. The pensinula is a limestone block, unlike the rest of the island, which is formed from the crystalline gneiss and granite. In some places, these beds are exposed as low-lying cliffs, in other places they have weathered into fertile soil. The surface of the peninsula is dry, since the water seeps through the porus limestone to collect in underground pools or to join underground streams. Even thoug

surface receives 25 - 47 inches of rain a year, evaporation and seepage is so great that the area is considered drought area during February to September. What with the limestone outcrops and sand dunes along the coast, less than one third of the area is agriculturally productive.

Most of the island's surface consists of plains between 100 to 600 feet above sea level. In the southwest, ridges and valleys rise gradually to merge with the Central Highlands, giving the plains a dessected appearance. Extensive erosion in this area has worn down ridges and deposited rich soil for agriculture. In the southeast, the transition from plains to Central Highlands is abrupt, and the mountains appear to rise up like a wall, some 3000 to 4000 feet high. For about forty miles from the southeast to southwest is the Southern Mountain Wall, an almost unbroken sheer escarpment from 4000 to 5000 feet high, caused by differential erosion. A red lateritic soil covers relatively level ground that is studded with bare monolithic hills.

Central Highlands, in the south-central part of the island is the heart of the country. This area includes three mountains over 8000 feet in elevation. The mountains are remanents of old pre-Cambrian rocks, highly mineralized. The mountains are composed of a massive complex of mainly gneiss and schists. They were eroded down to a plain, then uplifted in two successive movements. One can find an erosional surface at 2000 feet and again at 6000 to 7000 feet. When rivers descend from one level to another, they form spectacular waterfalls.

Most of the surface of Sri Lanka resulted from several waves of intense folding and crumpling of the crust in Pre-Cambrain times, subsequent crustral displacement and deformation, and a prolonged differential weathering and erosion.

Sri Lanka rivers rise in the Central Highlands and flow in a radial pattern to the sea. Some flow north, some flow south, other east or west. Most rivers are short, sixty to ninety miles long. The longest is 206 miles. In the Central Highlands, river courses are frequently broken by discontinuities in the terrain. Wherever they encounter escarpments, numerous waterfalls and rapids have eroded passages through them. Once the rivers reach the plains they slow down and meander across the plains and deltas. The rivers are not useful for navigation because the upper reaches are wild and unnavigable; the lower reaches are shallow, muddy, and prone to flooding during the rainy seasons.

Sri Lanka has been famous since ancient times for its precious and semi-precious stones. Gem stones are found in association with alluvial deposits. The action of the rain and running streams loosened gem-bearing gravel from the rocks and deposited it in the valleys, which were then covered with layers of mud and sand to depths of five to twenty-five feet. The gem-bearing layers of sand and gravel occur sporadically as pocket, streaks and lenticles of limited extent at or near the surface. Mining of gems continues to be a small-scale non-mechanized industry. The gems are mined by workers with sieves in which they collect the gravel, then wash and sort out the precious stones. Out-put has increased so much that gemstones are a major export. Some of the stones found are sapphire, ruby, chrysoberyl (cat's eye), beryl, topaz, garnet, zircon, tourmaline, quartz, and moonstone.

Sri Lanka is fairly rich in mining and leads the world in graphite production. Some of the other minerals of importance are ilmenite which is used in the aero-space industry and in pain, thorium, apatite (source of phosphate), dolomite, and small amounts of iron.

No petroleum discoveries have been made in Sri Lanka, but there are oil refineries where crude oil is imported, refined, then distributed by export.

SRI LANKA - ITS GEOGRAPHY

Sinhales of Aryan ancestry migrated from northern India about 500 to 600 B.C. The Portuguese first visited in 1505 and occupied the country until they were pushed out by the Dutch in the mid-17th century. Great Britain annexed it in 1796. It became a crown colony in 1802 and was administered separately from India. It was under British hegemony until 1947 when Britain's India Empire came to an end. Ceylon became

independent in 1948 and changed its name to Sri Lanka, the old Sinhalese name.

74% of the population is Sinhalese who claim their ancestors migrated from northern India about 400 to 600 B.C. 13% of the population is Tamil whose ancestors migrated from southern India at a much later date. The Tamil live mostly in the northern Jaffna Peninsula, and want cultural and political autonomy. They are Hindu. The Sinhalese are mostly Buddhists.

Sri Lanka is classed as a Third World County, but has a higher life expectancy, 68 years, and lower infant mortality, (34 deaths/1000), than most developing countries. Literacy rate is high, about 90%, because schools are free. Even college is free, but the college entrance exams are so competitive that it is difficult to be admitted, only the brightest students are enrolled.

Rainfall varies and is influenced by monsoon winds. In the mountains and southwest it is over 150 inches per year; on the Plains about 100 to 150 inches and in the arid northwest and southern coasts about 24 to 75 inches.

Temperatures vary. Average daytime temperatures in the Central Highlands is 80 degrees, and 99 degrees on the coast. Day and night temperatures vary only 4 to 7 degrees.

The dominant economy is rice. The four major exports are rice, tea, rubber and coconut. Sri Lanka is the third largest producer of tea in the world.

Cinnamon and other spices are valuable exports. Cinnamon is indigenous to Sri Lanka. There was extensive spice trading with China and the Arabs until the Portuguese arrived in the 1500's. Then the Portuguese built up an international monopoly of cinnamon. The Dutch took over in mid-1600 and continued a monopoly until they were conquered by the British in 1796..

The article is an exerpt from a presentation given at a GSOC luncheon, January 3, 1992 by Rosemary Kenney, past president, GSOC.

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THE RIGHT ANSWERS TO "COMPLETELY FRACTURED GEOLOGY"

1. OPHIOLITE: a rock rich in serpentine, chlorite, epidote, and albite; a remnant of former oceanic crust.

2. **IMBRICATED**: overlapping like shingles on a roof characterestic of some zones of thrust faulting.

3. **MIDDEN**: a mound of shells and other refuse left by prehistoric people.

4. **SLIPFACE**: the steep side of a sand dune.

5. **AMYGDALOIDAL**: refers to a volcanic rock in which rounded cavities produced by gas or steam have later been filled with minerals.

6. **CLAST**: a grain of sediment - silt , sand, gravel, etc.

7. **INDURATED**: hardened.

8. **SUBSIDENCE**: sinking of the earth' crust.

9. **TOMBOLO**: a sand bar connecting an island to another island or to the mainland.

10. **PLUTONIC**: refers to rocks that solidified far below the earth's surface.

OREGON NONFUEL MINERAL PRODUCTION UP IN 1991

Oregon Department of Geology and Mineral Industries Geologist Frank Hladky reports, "Oregon's mineral industry showed an estimated increase of 16% in 1991; nonfuel production was estimated at a minimum of nearly 270 million." Oregon's mineral production value ranked 33rd in the Nation, up from 36th in 1990.

Mineral resources are extremely important. It is impossible to name a major industry that is not directly or indirectly dependent upon minerals. The U.S.Bureau of Mines reports that it requires about ten tons of nonfuel minerals for every American per year just to maintain our current way of life. That is 2 1/2 billion tons of raw materials in this country alone.

Nickel was mined in Douglas County by the nation's only significant nickel producer.

Sand, gravel, and crushed stone were the most valuable minerals produced, accounting for more than half of Oregon's total mineral production value.

Enough diatomite was mined in Lake, Harney, and Malheur Counties for Oregon production to rank third nationally.

Limestone for Bakers and Douglas Counties is used for cement, sugar processing, and soil and water conditioner.

Douglas County produced copper and zinc concentrates at the first underground mine to open in Oregon in many years.

Oregon was the nation's top producer of pumice, nearly all of which came from Deschutes County.

Bentonite and common clay were mined in several counties. Oregon bentonite from Malheur and Crook Counties is used as a sealant in irrigation ditches, reservoirs, and well drilling.

Gold from Baker and Douglas Counties ends up in products of all kinds including jewelry, currency, electronics, dentistry, and gold leaf.

Silica was mined in Coos, Douglas, and Jackson Counties. Much of this silica is used in nickel refining at the smelter near Riddle.

Soapstone, a form of talc, was mined in Jackson County. Oregon soapstone is used mainly for sculpture, including many Alaskan carvings.

Zeolote was mined in Malheur . Oregon zeolites are used for order control products including pet litter.

Perlite was mined in Baker County. Perlite is a special volcanic glass that cracked into small pellets when cooled. Uses of perlite include insulation, filters and potting soil

NATURE OF OREGON INFORMATION CENTER

A unique and innovative information center designed to help all those interested in exploring Oregon has recently opened to the public. The Nature of Oregon Center carries thousands of maps, brochures and publications available to those who like to hike, tour, camp, fish, pan for gold or just learn more about the state we live in. Located on the first floor in the new State Office Building at 800 NE Oregon Street (the building with the dome just south of Lloyd Center(, its hours are 100:00 a.m. to 5:00 p.m., Monday through Friday, phone (503) 731-4444.

"The following article was originally published in the Winter 1991 issue (vol. 21, no.4) of Arizona Geology, published by the Arizona Geological Survey, 845 N. Park Ave. Suite 100, Tuscon, AZ 85719. It is printed with the publisher's permission.'

Pinatubo Generates More Brilliant Sunrises and Sunsets — May Cause Cooler Global Temperatures and Higher Skin-Cancer Risks

"by Evelyn M. VandenDoler, Editor, Arizona Geology Survey;

Although more than 10,000 kilometers (6,200 miles) separate the United States from the Philippines, the eruption of Mount Pinatubo in June 1991 may affect both the climate and the skin-cancer risk in Arizona (Monastersky, 1991). The ash cloud that now circles the globe has already created the most brilliant sunrises and sunsets in the State in recent years.

After more than 2 months of intensified seismicity, deformation, and discharge of small smoky plumes, Mount Pinatubo began to erupt on June 9. The largest explosions occurred on June 14 and 15, creating an ash and gas cloud as high as 20 miles into the stratosphere (Geotimes, 1991; Global Volcanism Network, 1991). By July 7, the cloud had circled the globe (Figure 1). By mid-August, as shown on satellite images, the thickest cloud layer extended to 20° north and south of the Equator, or near the latitudes of Mexico City and Rio de Janeiro. A thinner layer extended to 35° north latitude, or almost as far north as Flagstaff (Associated Press, 1991). Based on satellite and aircraft measurements, Mount Pinatubo was probably the largest volcanic eruption of the century, spewing more than twice the amount of ash and gas as the 1982 eruption of El Chichón in Mexico. Mount Pinatubo could continue to erupt intermittently for several years (Associated Press, 1991).

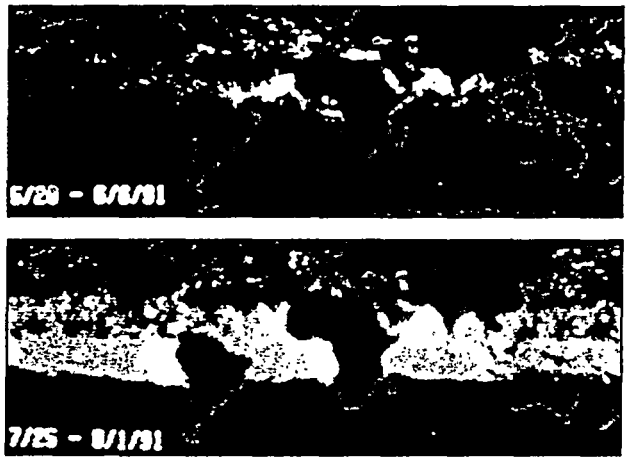

Figure 1. Images from a polar-orbiting satellite of the U.S. National Oceanic and Atmospheric Administration (NOAA). This satellite includes a high-resolution radiometer, which can measure the reflected sunlight from dust and haze in the atmosphere. Such measurements, however, can be obtained only for areas above the ocean on cloudless days. The top image was compiled from May 28 through June 6, before the eruption of Mount Pinatubo. Most of the reflectivity in this image is due to airborne dust from the Saharan and Arabian Deserts. The bottom image was compiled from July 25 through August 1, weeks after the aerosol cloud from Mount Pinatubo had circled the globe. Images courtesy of NOAA.

The haze that encircles the Earth includes both volcanic ash and sulfur dioxide aerosols. These aerosols formed when millions of tons of sulfur dioxide gas from the eruption reacted with water vapor in the stratosphere and created tiny drops (aerosols) of sulfuric acid, which are also contained in acid rain caused by air pollution. Scientists estimate that the aerosols will stay in the stratosphere for 2 to 3 years before they fall to the Earth's surface (Monastersky, 1991).

The haze filters sunlight, creating magnificent sunrises and sunsets. It also absorbs sunlight and reflects it back into space, which could cool the Earth's climate. In 1992 and 1993, after the haze disperses and becomes more evenly distributed around the Earth, mean global temperatures could decline by 0.5° C (about 1° F; Aldhous, 1991; Luhr, 1991). The eruption of El Chichón lowered global temperatures by a few tenths of a degree for 2 to 3 years (Associated Press, 1991). Although the temperature decrease due to Mount Pinatubo could last for 2 to 4 years, the decline may not be noticeable because normal climatic fluctuations are so much larger in any given area, s as Arizona, and because the mean global temperature naturally varies by 0.2° C (Luhr, 1991). In addition, an El Niño, a periodic warming of ocean waters, is developing in the Pacific Ocean. This event will warm the Earth for about a year, further masking the climatic effects of the volcanic haze (Monastersky, 1991). One scientist believes that the eruption of Mount Pinatubo and resultant reflection of sunlight are actually inducing the El Niño event and will shift the jet stream over the north Pacific farther south this winter, increasing precipitation and ending the 5-year drought in California (Geotimes, 1991). Despite the natural variation in global temperatures and the surface heating of the El Niño event, other scientists still believe that the global-scale cooling of 0.5° C will be large enough to be noticeable (Luhr, 1991).

The sulfur dioxide aerosols may also alter the chemistry of the stratosphere, thinning the protective ozone layer that surrounds the globe and allowing more ultraviolet radiation to reach the Earth's surface. This could increase the risk of skin cancer, especially in the mid- and high latitudes (Monastersky, 1991). Some scientists estimate that aerosols could cause a 15-perc reduction in ozone values during the winter and a 6- to 8-percent reduction during the summer in the mid-latitudes, which include Arizona. This increased radiation would increase the skin-cancer risk and may cause several thousand more cases of melanoma in the United States during the next few decades (Monastersky, 1991). The effect of the eruption on the ozone layer, however, is debatable. Some scientists believe that the data and computer models used to determine the level of ozone depletion are insufficient to make such predictions.

Whatever the effects of the Mount Pinatubo eruption, all scientists studying this event agree that it has provided, and will continue to offer during the next few years, a wealth of information on volcanic processes.

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THE GEOLOGICAL NEWSLETTER

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VOLUME 58, NO. 10

CALENDAR OF ACTIVITIES FOR OCTOBER, 1992

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

Oct. 9 — Slide presentation of the 1992 President's Field Trip.

Oct. 23 — "Florida" presented by Frances Rusche, GSOC member.

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

Oct. 2 — "Beautiful Hawaii". Presented by Mel Anderson, GSOC Member.

Oct. 16 — To be announced.

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

Wednesday Oct. 21 — "Classification of Igneous Rock" by Richard Bartels. Please bring one or two small samples of igneous rock to the meeting.

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

FIELD TRIP

Saturday Oct. 3 — A trip to study volcanics and other geology features of the Cascade Mountains near the Columbia River. Area visited depends on the fire danger. Bring sack lunch, possible toll fee for the Bridge of the Gods, and clothing as required by the weather.

CANCELLED

Meet 9:00 A.M. at the locks north of the railroad tracks at Cascade Locks Marine Park.

LEADER: Don Turner. Phone: 246-3192 for further information.

REFLECTIONS ON THE ECOLOGY OF SCIENCE

by a field geologist
John Eliot Allen

Introduction. Nearly thirty years ago I gave a talk, to some now forgotten organization or class, that had a title much like the above. I recently came upon my lecture notes, and thought it might be worth while to try to summarize that talk. Much of this ground was ably covered nearly a hundred years ago by Chamberlin (1897), and I have already written two short essays on these subjects (Allen, 1956, 1991). Seimon Muller (1983) wrote for his students in field geology a remarkably comprehensive directive that includes many of the ideas here as well as much else.

Policies and procedures in the scientific method.

1. Be highly skeptical of preconceived notions. Never omit careful search of the literature, but always look for flaws and inconsistencies in previous concepts. Don't accept without question superstition, dogma, hypothesis, theory or even law.

2. Supported by consuming curiosity and enthusiasm, carefully and accurately make and record your observations in your notebooks. Draw a sketch or diagram on every page of your notebook. Be persistent in collecting data, and amsssing the facts as you see them in the field and in experiments.

3. Organize and classify these observed and recorded facts; classify and "structuralize" them with diagrams to bring out relationships between groups of facts. Here one also can begin to abstract, simplify and throw out irrelevant data.

4. As you collect and organize facts, think of as many as possible answers (hypotheses) to the questions they raise, these can frequently guide your investigations. Eventually you will be able to select those which give the simplest explanations (Occam's Razor, or the Law of Parsimony). These may well be the spacial or mathematical models that will most probably explain the phenomena.

5. Field geologists choose their traverses on the basis of alternate hypotheses. "If this idea is correct, I should go this way, if that one is correct, I should go that way in order to prove which is right".

6. Never let your personal enthusiasm for one hypothesis allow you to overlook other possibilities (Chamberlin, 1878). "If you go into the field with something to prove, you will always find evidence for it; tread lightly when you start with a conclusion" (Muller, 1983).

7. The above steps do not necessarily or even usually occur in the order given. They may take a long time, which sometimes can end with a sudden perception of the underlying causes, an "inspiration", a "eureka", a giant leap to understanding. Serendipity, the accidental discovery of pertinent information, often inspires this leap. A "genius" makes the greatest leaps!

8. Field geologists should record <u>everything</u> in their field notebooks. Formalize in the field the preferred and other possible alternate hypotheses by writing down the arguments for and against each. You will find later that many of these paragraphs can be copied directly into your preliminary manuscript!

9. Publication is the final neccessary step, so that your new ideas may be reviewed and verified by your peers.

Cultural climates favorably or unfavorably affecting science.

Favorable	Unfavorable
Times of change	Times of stagnation
Presence of previous knowledge	Lack of science background
* Simultaneous discoveries	*"Times are not right"
Vistas for new exploration	Local interests only
* Economies expanding	* Depressed or static
* Industrial revolutions	* Hunting, nomadic cultures
* Political revolutions	* Tyranny, dictatorship
* Renunciation of dogmas	* Authoritarianism
Leisure to think	Pre-occupation with other values
Free communication	Iron curtains

One of the greatest and most optimistic changes that has occurred in our culture during this century has been the increase in communication, which has only recently, since this talk was given, exploded worldwide by the use of satellite relays for television, and fiber-glass cables for telephone fax and PC modem use.

Favorable personality characteristics for a scientist.

1. Curiosity - motivation by the ever questioning mind.
2. Enthusiasm - follows curiosity, results in persistence.
3. Persistence and concentration - keep after it, don't give up!
4. Skepticism - reasonably question and doubt every statement.
5. Honesty - never fake it.
6. Genius - the intangible ability to see relationships between facts, their causes and results.

Lessons for our time - beware of:

1. Increasing administrative duties for our best minds due to increasing size of goverment, businesses, schools. I've seen several fine geologists become deans!
2. Increasing regimentation, resulting from "soft money", subsidy (grants) by big goverment, big business and big research.
3. Distracting diversions from TV, motoring, golf, even reading, that decrease time for research.
4. Satisfaction with or even glorification of mediocrity (Peterson's Principle - one is promoted to one's level of incompetency)
5. Excessive nationalistic barriers (iron curtains).

What can we do about it?

1. Children are born with most of the personality characteristics cited above. It is therefor of greatest importance that during their early years parents and teachers encourage rather than stifle these traits, with the hope that they may carry over into maturity.

2. Scientists must make full use of the new technologies of communication. Field geologists can now locate themselves in the field by satellite, record their notes with a portable computer, search local libraries or national databases with their PC modem, and prepare their paper for publication; all without multiple retyping and carbon copies!

3. When scientists become executives, they should give employees as much freedom as possible. Encourage enthusiasm, give serendipity free rein. Hold regular staff meetings for exchange of ideas. Field chiefs should regularly talk over objectives and results with the crew. Don't tell them *how* to do the work or *where* to go. Just tell them *what* to do, and let them work out the *how*.

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Sci-meth/69
23 June, 10 & 28 July, 1992

****

39th Annual Pacific Northwest Regional Meeting of the American Geophysical Union, September 23-25, 1992. The meeting will feature two special sessions concerning Ocean Ridge Processes and Tectonics of the Cascadia Margin, consistent with the objectives of ODP drilling off Vancouver Island, as well as other sessions. The meeting will be held at the Newcombe Auditorium of the Royal B.C. Museum in Victoria, British Columbia. At this time the drill ship JOIDES RESOLUTION , the drill ship of the international scientific Ocean Drilling Program. A special tour of the drill ship will be arranged for interested meeting participants.

COMPLETELY FRACTURED GEOLOGY
by

EVELYN AND RALPH PRATT

1. ARKOSE: a local brand of gasoline.

2. BARCHAN: noise a dog makes, as in "His barchan is worse than his bitin".

3. CONVECTION: a large political meeting held to nominate candidates.

4. DIORITE: refers to an argument in the English Royal family where she' right and he's wrong.

5. INCLUSION: a phrase used to introduce the final comments in a speech, "Inclusion, let me summarize..."

6.LATERITE: a religious sect which believes it's sinful to be on time.

7. GRABEN: what children at the table are not supposed to do: "Quit graben you brother's dessert.

8. WAVE-CUT PLATFORM: a type of haircut popular with high schoolers.

9. GROIN: increasing ; as, "A groin boy needs lots of food."

10. GEOLOGY: scientific study of exclamations; also goshology.

***THE CORRECT DEFINITIONS ARE ON PAGE 64

COPPER CANYON,MEXICO

by

ROSEMARY KENNEY, PAST PRES,GSOC

The Sierra Madre Occidental consists of a long broad belt of plateaus, rugged mountains and deep gorges. It's the largest mountain range in Mexico, in terms of area, about one-sixth of Mexico's surface. It runs from the U.S.-Mexican border on the north to the state of Jalisco on the south, and is an extension of the Sierra Nevada Range in the United States.. It is often more than 100 miles or more wide. It constitutes an almost impossible barrier., sealing off the North Central Plain of Mexico. It forms the western rim of the Meseta Central and rises westward like an upturned edge but descends sharply as a great escarpment along most of the Pacific slope. It is the world's largest rhyolite-dominated volcanic province. Exposed rocks are dominated by rhyolite ash-flow tuffs that were extruded from the large caldera structures mostly between 36 and 27 million years ago.

The Meseta Central, or interior plateau, is rolling to nearly level plateau country but above the tableland are peaks of between 7,000 to 10,000 feet. It is characteristic Basin and Range morphology.

The barrier nature of the range results from the high, steep slope of its western edge; the land seems to stand on end. Steep, narrow and long north-south valleys have been eroded downward into strata of rocks weaker than those that cap the summit tablelands, or have been eroded along zones which have been crushed by faulting. These longitudinal valleys are separated by steep-sided ridges through which rivers pass in narrow gorges. To reach the outer edge of the mountains, the streams have to cut transverse valleys eastward and westward. The most spectacular canyons, or barrancas, are those leading westward as part of the Pacific drainage. Barranca de Cobre along the upper edges grow needle leaf evergreens and in the depth are tropical flora and fauna. The Sierra Madre Occidental volcanic pile includes an early Tertiary series of andesite and rhyolite, overlain by a thick sequence of ashflow tuff, followed by basalt extrusion of Pliocene age. Mineral resources are zoned in space and time. Copper-iron and lead-zinc-silver deposits are Cretaceous sediments. The lower volcanic series predominately contains gold-silver veins. Smaller amounts of mercury, manganese, fluorite and uranium are found in successive zones eastward from the Sierra Occidental axis.

Mining is the most important occupation in Sierra Madre Occidental. It ranks as one of the two leading mineral producing regions, noted for the output of silver, gold, lead, zinc, copper, antimony and manganese. Other minerals mined are gypsum, marble, limestone, traprock, iron ore and iron oxides.

The Chihuahua-Pacific Railroad was originally conceived to carry wheat from midwestern United States, across Mexico's Sierra Mader to ships waiting in the harbor of Topolobampo Bay, the only natural harbor along the North American Pacific coast that is similar in size to San Francisco Bay. The railway was conceived in 1872 and finished in 1961, after 90 years and 90 million dollars. It is 653 Km long from Chiheahua to Los Mochis, over 39 bridges and 86 tunnel.

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++

DEFINITIONS FOR COMPLETELY FRACTURED GEOLOGY.

1. ARKOSE: sandstone with more than 26% feldspar.

2. BARCHAN: a crescent-shaped dune with the horns of the crescent pointing down-wind.

3. CONVECTION: a very slow circulation of a substance driven by differences in temperature and density within that substance.

4. DIORITE: coarse-grained igneous rock composed of more or less equal amounts of feldspar and iron-magnesium rich minerals.

5. INCLUSION: a fragment of rock that is distinct from the body of igneous rock in which it is enclosed

6. LATERITE.: highly leached soil that forms in regions of tropical climate with high temperatures and very abundant rainfall.

7. GRABEN: a down-dropped block bounded by normal faults.

8. WAVE-CUT PLATFORM: a horizontal bench of rock formed beneath the surf zone as the coast retreats.

9. GROIN:. short wall built perpendicular to shore to trap moving sand and widen a beach.

10. GEOLOGY: scientific study of the earth.

++

GEOTHERMAL EXPLORATION OF ASCENSION ISLAND SOUTH ATLANTIC OCEAN

by
Dennis L.Nielson (1)and Susan G.Stiger(2)
(1) University of Utah Research Institute
(2) Idaho National Engineering Laboratory

Exploration on Ascension Island in the South Atlantic Ocean has resulted in the discovery of high-temperature geothermal fluids. Ascension is a volcanic island that has seen eruptions within the last 1,000 years. However, there are no geothermal manifestations at the surface and only limited amounts of hydrothermal alternation exposed.

Exploration began with geologic mapping and was followed by geophysical investigations that included electrical receptivity and aeromagnetic surveys. These data were used to site seven core holes for temperature gradient measurements.

A deep test well, Ascension #1, was drilled to a depth of 10,225. Several fluid entries were encountered and tested, but they lacked the permeability required to support production. Extensive quartz + epidote alteration was responsible for sealing of the lower fracture zones. In spite of this, a bottom hole temperature of 480 degrees F was recorded.

A second leg was drilled to explore for greater permeability. This leg was terminated by a mechanical failure before the target depth was reached.

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PRESIDENT'S FIELD TRIP: 1992
President, Evelyn Pratt

DAY 1: Portland to the Oregon Caves- Elinore Olson

Our guide book tells of the early waters that covered the Willamette Valley for forty of the last sixty million years, and of the volcanism, both under water and out of it, that built much of the Northwest. Evidence can be seen in the Valley.

Pleistocene glaciers scoured northern lands and melted. In what is now Montana, breaking of the 1/2 mile thick glacier released the waters of Lake Missoula many times, causing the Columbia River Gorge and leaving alien rocks 400 feet high on Willamette Valley slopes.

Marine sedimentary rocks and silts can be seen near Albany, as well as a gabbroic intrusion (Mary's Peak), and bumps of basalt-covered Eugene sandstone.

South of Roseburg we were aware of the pre-Tertiary Klamath Mountains - metamorphosed rock forming rough arcs facing the Pacific with points tapering eastward. These regions are classed as suspect accreted terranes. Across faults, sequences show:

abrupt change in the fossils
abrupt changes in folded strata, faults, & other structures
abrupt changes in magnetic characteristics
differences in volcanic aspects
differences in metamorphic rocks

Plate tectonics concepts seem very complex. The Klamath Mts. include serpentine intrusions and chromite deposits, followed by granitic intrusions. There is consistent proof that warm seas once covered Oregon. Volcanics are evident in the SW part of the state. The oldest terranes lie to the east underneath the Cascades andesites. Terranes get younger to the west where they're mostly Jurassic. Their content varies from island arc volcanics to sedimentary rocks, mostly metamorphosed. Into these wrinkled, shifting, eroded terranes came upward intrusions of lighterweight magma. These cooled and crystallized into granite plutons, some of which disintegrated into valleys. Grants Pass is in one of them.

Peridotite and serpentine outcrop frequently. The base of the great Farallon Plate may have consisted of dense minerals rich in iron and magnesium. It carried terranes and seafloor sediments. As it dove under the North American Plate, sediments and terranes and some of the dense minerals stuck to the plate. Then they wore down to a peneplain, and have been cut by rivers into deep-walled canyons. From Grants Pass to California, we were on the Jurassic Western Klamath terrane. A lot of it is made of Galice Formation marine slate, which we followed to Cave Jct.

Evening, Day 1: Oregon Caves - Elinore Olson

200 milion years ago limestone was deposited in sea-water somewhere off the Oregon coast. About 50 million years later it was forced into the Klamaths, and heated and recrystallized to marble by an igneous rock mass. Rainwater (a very weak acid) seeped into fractures, dissolving away calcite and as the water ran down and evaporated, redepositing the mineral as astonishingly beautiful dripstone formations. The caves may only be about a million years old, and the dripstones, which some calculate can grow an inch in a decade, are even younger.

Our guide John Roth told us that white cottage cheese-like "brumba" which forms near the opening of the cave was once added to animals' food to cure them of infection. He said the caves are in the Applegate formation, 240 Ma, which is related to areas east of Grants Pass. Chert, being harder and less soluble than marble, forms many cave ledges. The Oregon Caves haven't been building since the end of the last glacial age. They are fossil formations.

The Oregon Caves were made a national monument in 1909. The effort to meet tourist demands - excessive access, amusement park tactics, poor wiring - have taken their toll. In an effort to restore the caves, workers must cope with changing airflow, harmful human skin oils, CO_2 added by visitors' breath which encourages algal growth, and many, many 5-gallon buckets'worth of "junk". The latter are being removed by hand.

John Roth has had years of experience with caves, and is certainly dedicated to his field. He gave us a most worthwhile tour.

Day 2: Oregon Caves to Crescent City - Don Turner

An eventful night at the Oregon Caves Chateau: an ambulance was called to rush Manuel Boyes to the hospital in Grants Pass because of a heart condition. (He's doing well now, after quadruple bypass surgery.) We left Oregon Caves at 9:36 AM without Manuel and Gale. Our drive along Hwy 46 along Cave and Sucker Creeks created ooohs and aaahs over the steep drop-offs.

We picked up Lex Palmer, our morning guide, at the Illinois Valley Visitors Center in Cave Junction. At this up-to-date facility, he and others gave an interesting talk about the Illinois mining district. Mining started in the 1850's with placers, then hydraulic mining, then dredging. In 1855 Chinese miners were assessed $20/month Foreigners' Tax.

Then we paralleled $8 Mountain, made of Josephine peridotite (much olivine), which can alter into serpentine when water and pressure are added to it. We crossed the Illinois River, and were alerted to abundant poison oak. (I got it anyway.) In 1855 Chinese miners were assessed a $20/month Foreigners' Tax.

Some of us ate lunch at Pizza Deli, & some at the state park where hoses sprinkled both the picnic tables and the restroom entrances. Then we headed south on US 199. At 2:09 PM we ran right into California - no harm done. Soon after hitting California we passed through the Collier Tunnel, then continued down the Middle Fork of the Smith River. A short distance from the tunnel we viewed the Galice Formation, with metamorphosed ophiolite and chert lenses. Also saw green chlorides along the road. Evelyn gave an on-the-back-of-the-bus illustrated guide to ophiolites. We stopped at Patrick Creek Forest Camp, then 10.54 miles from Del Norte County, stopped again to look at the beautiful green water of the Smith River, several unknown species of wildflowers, and at what we think were Greg Harper's sheeted dikes.

We arrived safely in Crescent City, thanks to our faithful nursemaid Alta, our rocky Evelyn, and our brave and fearless driver Jim Armson.

Day 3 Crescent City to Arcata -Walt Sunderlund

This was a free morning; two groups rented cars and went on the Petrolia Loop. This included passing the Mussel Beach which rose during the 1991 earthquake. Consequently many shellfish died from exposure/ dessication and the members collected some shells.

The rest of us saw other sights in Arcata - toured shops and bookstores. I ran into several members in the Humbolt State University Museum on 14th and G Streets. Many of the exhibits fossils were well arranged and therefore informative.

We also enjoyed the Saturday Market in the City Square.

At 1315 the bus left for Eureka to look at some pre-1900 houses that have been restored - very gingerbready but beautiful. Traveling up the coast to Ferndale we passed over the wide alluvial plain of the (now small) Eel River. The plain is used for dairy farming now. After the earthquake of 1991 the Ferndale area many structures were damaged and are still undergoing repair . Many have new foundations and a significant number have been dismantled or burned because they were irreparable.

We drove out to Centerville Beach. This foredune is composed of wet sand but behind this dune the sand is very dry and therefore subject to wind action. A hollowed deflation zone is evident.

Traveling along Ret. 101 we could recognize marine terraces related to elevation of earlier beaches.

After freshening up at the hotel we drove out Somoa Road in the evening to the Cook House for an excellent banquet family style. We returned to the hotel by 7:40 pm.

Day 4: Arcata R & R; Humboldt State Pk to Petrolia to Fernwood (rented cars) - Don Parks

In order to visit important points of interest that were not accessible by bus, 5 members traveled by rented car on a 70-mile loop via the "Triple Junction" community of Petrolia. (Pratts did likewise. This meant doing without a morning of R&R, which a couple of us later regretted. EP) The car was piloted by Susy Sudbrock and Arthur Springer. The route led through Humboldt Redwood State Park and a stop for photos, including the world's tallest tree(359+ feet at last measurement). The steep and twisting road toward the coast was interrupted for a lunch stop and some tasty apples, free for the picking. We crossed the Mattole River, passed through Honeydew (where a giant baseball game involving that hamlet and Petrolia was taking place - EP) and, following the river northward, came to Petrolia. California's first drilled oil well in 1865 was located 3 miles east of this tiny community.

Petrolia gained further fame on April 25th this year as the approximate epicenter of the Cape Mendocino earthquake. We talked with the lady operating the small general store. The building replaced the former one which had burned as a result of the quake. She stated that out of 300 buildings in the area only 25 were not damaged.

The name "Triple Junction" refers to this area as the point where three major geologic features are presumed to meet: the San Andreas Fault, the Mendocino Fault, and the Cascadia Subduction Zone. A ten-mile section of the nearby coast was uplifted up to about 3 feet as a result of the quake. We visited Mussel Rock and saw evidence of this occurrence, then continued on to Ferndale and back to Arcata after a very rewarding day.

Day 5: Arcata to Crescent City - Susy Sudbrock

Dr. Lori Dengler, geophysics professor at Humboldt State University, told us about the geologic uniqueness of Humboldt County. Only in the last 5 or 6 years has there been much awareness of the importance of seismic studies in this sparsely populated, low-industry area. She spent 6 years compiling a list of damaging earthquakes and the potential for more. Last June she started writing an article for the March-April California. Geology. Since then there've been four quakes, so she had to revise her article four times.

April's earthquake illustrates the kinds of events you are likely to see in Oregon. Northern Calif. is much more akin to Oregon and WA geologically than to the rest of our state. The terrain, the kind of construction are very similar.

The Cascadia Subduction Zone comes on land somewhere near Petrolia. There was a sequence of three earthquakes in April. The term aftershock doesn't lessen what an earth-quake is. All aftershocks are earthquakes in their own right. They typically occur along the same fault as a larger quake that preceded them.

Location and magnitude can be determined at the same time and with the same amount of ease. But magnitude is preliminary, based on a few readings. After several weeks, when information from seismostations all over the world

comes in, a more accurate average can be arrived at. Usually it's larger.

The first earthquake Saturday in April occurred on a fault in the Gorda plate or perhaps by the North American plate.

The two on Sunday morning happened in distinctly different faults offshore. In this triple junction area, where the Gordo, North American, and Pacific plates come together, if you push one part, it's like pushing one piece of a jigsaw puzzle. We aren't surprised if something happens in other parts of the same system.

Since in historic times we only have a handful of onshore earthquakes large enough to use, let's focus on the the Saturday morning earthquake. It's the third in the sequence of really interesting earthquakes in this area, starting in Jan. 1990. (to be continued)

Day 6Crescent City to Bandon-Margaret Giddin

_ Got an early start this morning. We are leaving California for our Oregon beaches. First stop is Point St. George. The St George lighthouse 6 miles off shore could just be seen. It took around 30 years to complete and cost $704,000. It was abandonded.

We headed out on Hwy 101 following the Del Norte fault for 9 miles to the mouth of the Smith River. We stopped the bus for three beautiful deer crossing the highway.

90% of the Easter lillies grown in the US are grown here around Smith River, CA, Brookings,OR. Just outside of Brookings is Rainbow Rock. It consists of folded layers of chert. We stopped to take pictures of it. We took a walk to Cape Sebastian. Wonderful scenery! Elevation 700 feet. Then we gathered samples of serpentine rock north of Gold Beach.

We stopped at Stahl's home in Port Orford. Peigi seved us coffee, tea, and all kinds of goodies. How nice of them! From here we went to Bandon, where we stayed two nights.

Day 7,Klamath Mountain Geology-
Rosemary Kenney

_After an early start today with Dr. Don Stensland, Professor of Geology at Southwestern Oregon Community College at Coos Bay as our guide, we studied the Klamath Mountains. The Klamath Mountains are made up of largely pre-Tertiary sedimentary rocks originally deposited in widely separated areas of the coastal plain, continental shelf and seafloor, then all crushed, mixed and jammed together. Rocks of the Klamath Mountains are much older than those in any other part of western Oregon. This area may contain some of the oldest formations in the state. Of the four imbricated thrust sheets of the Klamath Mountains, two are in Oregon, the western Paleozoic and Triassic belt and the western Jurassic belt, both eastward dipping arcs. The other two sheets are in northern California. The western Paleozoic and Trassic belt includes the Applegate group which is a broad band of metavolcanic and metasedimentary rocks. These rocks were severely folded and eroded before the Late Jurassic sea invaded southwestern Oregon. The western Jurassic belt included the Rogue and Galice Formations. The metavolcanic rocks of the Rogue Formation grade upward and interfinger with the Galice Formation. Some of these rocks contain gold. The Galice Formation is composed of dark gray to black, fine-grained, thin-layered rocks, some sandstone, shale, and layers of coarse sand or small pebbles. The Rogue and Galice Formations were folded and truncated by erosion and were deposited in basins now rocks in the Klamath Mountains are so scrambled that it seems impossible to sort them out. After an interesting, long day, we returned to Bandon to refresh ourselves for another day of learning.

Day 8 - Myrtle Point and Bandon - Fran Pearson

Stardate; Tuesday, September 15, A.D., 1992: Aboard spaceship G-SOC-RAZ, piloted by Jim Arnson, captained by Evelyn Pratt, with chief executive officer Alta Fosback and information officer Don Stensland.

The day began early and energetically under the leadership of Dr. Don Stensland, Professor of Geology of SW Community College, Coos Bay. He began with a quotation from the book of Job, "Speak to the earth and it shall teach thee".

Travel stretched inland between Myrtle Point and Gold Beach. There were twelve stops not including lunch and an ice cream stop. We learned how rivers make levees and cut new banks leaving their signatures for future geologist to piece together. We compared the age and forces of geology which formed the Klamath Mountains and the much younger coastal range. We saw excellent examples of pillow basalts, layered chert, and serpentine. We ran our hands over ripples set in stone of an ancient sea bottom, and touched the uplifted sea trench op an old subduction zone.

We saw strata bent in anticline, syncline and recumbant formations. We saw Don demonstrate "dip" and "strike". We heard definition and composition of igneous, metamorphic and sedimenttary rock, and saw several examples of unconformity.

We learned the types of rock which lead to landslides,and saw a giant two mile long landslide along the Rogue River. We traveled on a lumpy road which was slowly sliding into the Coquille River, and viewed with pity an expensive new house at Gold Beach perched atop landslide soil.

Some non-geologic memories from the day was our lunch stop in a park under constuction. The rest rooms had been removed and we were forced to thread our way between large earth-movers to find a picnic spot. The constuction workers were amused. Esther handed out Vitamin C pills in an attempt to halt the spread of a wicked

cold virus which had been stalking the group since day 2. Several members earned badges this day as traffic directors and crossing guards by managing the safe road crssings we made to geologic sites. All members qualified for the GSOC Choral Group. This wonderful day ended in song after dinner together at Gold Beach. Our thanks to Don Stensland who encouraged the earth to teach us.

****DAY 9 FOLLOWS THE BOOK REVIEW++++**

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BOOK REVIEW
Geology of Oregon (4th Edition)

By Elizabeth.L.Orr, William Orr, and Ewart M.Baldwin, Kendall/Hunt Publishing Company, 2460 Kerper Blvd., Box 539, Dubuque, Iowa, 52004-0539, 1992, v + 254 p., softcover, (ISBN 0-8403-8058-5) : $25.00

On September 30 I was given a copy of the completely revised *Oregon Geology*, and I have just finished reading it from "kiver to kiver" with immense enjoyment.

Everybody I showed it to lay person or geologist, the lovely cover drew "Ohs and Ahs". What a great picture! But what are the names of the 4 kinds of lichens?

I am convincced that without a doubt it is a major original contribution to Oregon geological literature. The three authors really did their bibliographic homework (over a 1000 references!). And they didn't just record past literature, they interpreted it. I have never seen a better "State Geology" book, and it is, of course, a remarkable improvement over the previous editions of *Oregon Geology*. It will be many years before a 5th edition is justifiable, although I am sure that a second printing will come sooner than the authors imagine.

The format is clean, the paper is heavy and therefore the well-selected illustrations are sharp; the typeface is legible, except for a few words on some maps. Having bibliographies at the end of each chapter (as well as at the end of the book) is a good idea, especially since the authors did not and probably should not always refer to source literature within the text. When I tried the highly adequate index and glossary, I only missed seeing 5 or 6 words.

I was most impressed by the number and quality of the 92 maps, 80 drawings, 55 clear and understandable block diagrams, 35 line drawings, and 9 stratigraphic charts. The block diagrams are almost a necessity, of course, if one wants to graphically summarize, as the authors did for almost the first time, all the implications of convergence, subduction and rotation. Ever since I took 2 courses from William Morris Davis himself in 1931, I have been enamoured by block diagrams, and have used them many times in my teaching. The draftsman did a bang-up job.

I thought the organization was admirable - an introduction summarizes Oregon geology in 7 pages (!), and is followed by a history of geologic studies in Oregon since the days of Lewis and Clark. Eight chapters on the physiographic provinces start with the most complex areas, giving for each area a few paragraphs on physiography, geologic overview, terranes, geology, and stratigraphy and geologic history, structure, mining and minerals, and finally description of several outstanding localities to be visited. All this involved a little repetition here and there, which is probably a good thing, especially when the book is used for classes in Geology of Oregon.

Finally, I was amazed at the remarkble rarity of errors and typos! For a largely new book this is most incredible, whoever did the final editing should be complimented. I found only 32 places where I would suggest changes. When I prepared for the second printing of my own book "Cataclysms on the Columbia", I found more than 150 errata.

John Eliot Allen
Portland State University
Portland, OR 97207

Day 9, Shifting Sands of time - Helen Nelson

We drove beside quiet sloughs in sunny weather on our way to the Hauser PIT project and Oregon Dunes Recreation Area Center on our last day, September 17, 1992 GSOC Field trip.

At the end of a long narrow , bumpy road, we saw a bright yellow and white striped canopy. It sheltered an exhibit of artifacts, maps and pictures of both the Confederated Tribes of Lower Umpqua and Siuslaw and the University of Oregon archeology project under the auspices of the Forest Service "Passport In Time program". A few steps beyond were volunteers working under the supervision of professionals. One was an Indian offical.

A expert carefully removed a cubic foot of sand, marked by white strips on the bottom of the trench. He then brought the sand in white buckets to volunteers sitting on camp stools before screens on waiste high supports. They shook the sand through the screens to the ground beneath. The remainder, when we asked, contained bones and pieces of bones, shells, etc. Larger bones of deer, elk, and whales had been recovered from this siite.

The site itself, called a kitchen midden, was under 9 feet of sand and was located by radar beams from an airplane. Indians had camped here more than 3000 years ago, and

threw garbage out on the ground for about 1000 years. The site at the time was located on blueberry and cranberry bogs. The scientists surmise it must have been near a stream or slough. They have no evidence of whether the waterway moved or was filled in by sand. Our visit gave us an opportunity to see the actual work in archeology in progress.

Next stop was the headquarters at Reedsport we viewed two films on the Oegon Sand Dunes that I slept through; no report. After eating lunch on the outside picnic tables we met Joe Heinz, Earth Scientist researcher for Dunes Stablization for Lincoln County and two real estate development firms.

This particular stretch of coast is 55 miles of sand beaches between headlands. Sand moves out in the winter to form a bar out in the ocean, when the prevailing winds are from the southwest, and then moves back to cover the rocky shore in summer when prevailing winds are from the northwest. Little sand moves north and south from short litteral cells(beaches) between close placed headlands.

Clair Stall indentified the level of many wave cut terraces, cut when inland waters froze during the last ice age that ended about 10,000 years ago, and sea lelvel dropped 400 feet. During the present warming trend, sea levels arc increasing.

Joe Heinz explained the nature of sand dunes. They have a gentle side, 33% slope, the side the energy of the wind blows dry sand up the slope. At the crest, behind the flip side, 60% dip to the bottom. Some dunes have horns, formed when the wind blows directly over the dune to carry sand to both sides, forming hornlike protrusions. A dune starts when a wind eddy drops sand on both sides of or around an obstruction, perhaps a plant or similar object. As the wind changes prevailing direction from south to north, the is a cross-bedding, four feet down from the tops of the big dunes. A blowout is caused by wind-blown sand forms a hillock or mound.

Dunes are stabilized by being helped in place by wetness, plants, such as man planted grasses imported from Europe. Some plantings are too successful. In some places the blowing sand has partially covered living and dead trees. Other places left water-filled hollows.

The crest of oblique dunes angle N-NW and do move. Transverse dunes are at right angle to the west. They replace each other, I am not sure, but believe during the winter. Cross-bedding goes down four feet. The dunes contain woody organic vegetation matter.

Sands are ground rock, light tan blended with light gray in color. Their chemical material on the coast is made up up of 71 to 91% Quartz and feldspar. Southern dunes, those around Gold Beach contain more of the heavey minerals: dark gray i n color and contain some gold, silver, aluminum, etc. Sediments brought down by streams contain rocks that erode to sands.

Mr Heinz reported that 68% of the sites examined were in place 20 years ago. The 32% removed was undercutting by winds, human made roads, paths, and removing vegetation for other purposes.

The first attempt at stabilizing the dunes was to cover them with a light coating of oil. Another was to cover them with 2" wire mesh. Best dune stabilization method to be used is the one least harmful to the environment. Older dunes are now stabilized, with a small percentage suitable for recreational development.

Turn east at Florence to head for home . This was the end of a successful, pleasureable and enlightening trip.

WELCOME NEW MEMBERS

Chlovena B. Metzger
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Barbara Stross
1716 SE 24th, Portland, OR 97214
John Roth C/O Illinois Valley Visitor Center
201 Caves Hwy., Cave Junction, OR 97523
Susan Davis, Redwood National Park Hdqts.
1111 2nd. Ave., Crescent City, CA 95531
Dr. Lori Dengler, Geolcgy Department
Humbolt State University, Arcata, CA 95521
Donald E. Stensland, Pro. og Geology
SW Oregon Community College, Coos Bay, OR 97420
Joe Heinz
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Vickie Ozaki, National Park Service
Redwood National Forest
1125 16th St. , Arcata, CA 95521
Jim Armson
11123 SW 66th, Tigard, OR 97233
Harriet Billings
4718 NE Broadway St., Portland, OR 97213-2152

IN MEMORIAM

Gladys D. Baldwin was the wife ofRaymond L. Baldwin. Ray was very active in the Geological Society -Charter Member, Directors a number of times, Editor of the Newsletter, Business Manager, and was Vice President in 1946 when John Allen was President.

Dr. Clyde B. Hutt was an active member of the Geological Society. He graduated from University of Oregon Medical School

Dec. 92

THE GEOLOGICAL NEWSLETTER

GEOLOGICAL SOCIETY OF THE OREGON COUNTRY

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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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VOLUME 58, NO. 12

CALENDAR OF ACTIVITIES FOR DECEMBER, 1992

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

Dec. 11 "The Oregon Trail". Slide presentation by Rosemary Kenney, GSOC Member.

Dec. 25 No meeting - Christmas.

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

Dec. 4 To be announced.

Dec. 18 To be announced.

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

Wednesday
Dec. 16 Complete study of Igneous Rock and then begin "Origin of Magmas".

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

FIELD TRIPS

"To field Trip or not to Field Trip". See report on page 78 by Evelyn Pratt.

EXTRA-EXTRA ****** OPEN HOUSE***** An OPEN HOUSE will be held in honor of Alta Fosback and her fiance, Harold Stauffer at the home of Charlene Holzwarth 2524 NE 34th from 2 to 6 pm. All GSOCs and their families are invited. No gifts, please

NOMINATING COMMITTEE APPOINTED

The Board of Directors has appointed the following GSOC members to serve on the Nominating committee for this year: Don Parks (Chairperson), Clara Bartholomay, Rosemary Kenney, Robert Richmond, and Cherri Brinda.

1992 PRESIDENT'S FIELD TRIP- GSOC

Three-Cresent City to Arcata- by Bob Richmond

After a quiet night at the Valu-Inn at Cresent City, California, we awoke this morning to an overcast sky,choice of fast-food restaurants for breakfast, and an 8:30AM bus boarding time. After stowing our gear aboard the bus which was parked at the curb alongside the end of the motel, our President utilized a paper paste-up on the exterior wall to give us a chalk-talk on the Triple-Junction near Cape Mendicino, where the Gorda Plate, The Pacific Plate, and the North American Plate interface. We were to learn more of this in the next day or two.

Presently we were joined by Susan Davis, of the Redwood National Park Service, and Vicki Ozaki, a graduate student of Humbolt State University. About 9:30 AM we drove to Crescent City Bay waterfront where these two ladies gave us the historic account of the tsunami which inundated much of Crescent City following the 1964 earthquake which caused considerable damage in Anchorage, Alaska. They played a tape recording by the announcer for radio station KHAR in anchorage, describing his thoughts and actions during more than a half a minute of quake activity. We were handed a transcript of the first part of the recording along with a brief description of the earthquake particulars. The first slip reported to have occurred some 19 miles under Prince William Sound at 5:36 AM on March 27, 1964. The rupture extended horizontally for 500 miles approximately parallel to the Aleutian Trench, and later measurements showed a vertical fault displacement of over 19 feet, with crustal deformation over an area of roughly 78,000 square miles. The tsunami, which quickly followed, devastated low areas of Valdez and Seward with 120 lives lost by drowning. According to our leaders the tidal wave reached Crescent City hours later in the middle of the night, destroying 21 fishing boats in the harbor, 91 homes and 21 trailers in a 29 block area, and damaged 172 businesses, with a loss of 11 lives. A gasoline tank truck was overturned, bursting into flames which ignited the adjacent tank farm, adding a fiery display to the catastrophe. We were told the ground on which we were standing overlies the original town site and bay. This is now mostly open park area. Several theories have been postulated to explain why Crescent City should have been the only coastal community south of Alaska to have suffered serious effects from the tsunami, but no consensus was established. The opinions expressed indicated the town is in an unenviable position of being particularly susceptible to tidal action, having been hit at least 6 or 7 times in the last 50 years, though only once with the extent of damage suffered in 1964. Our group took solace in the fact that most of us live in the vicinity of Portland, and not in California. We returned Susan Davis to the Redwood National Park headquarters in town and continued our trip with Vicki Ozaki abroad as leader and commentator.

The tall stately redwoods engulfed us a few miles to the south. These trees remain everlastingly impressive, and one must be totally unobserving and unduly impatient to resent the slower pace necessary to wind through the forest of these giants among living things. Farther on we left Highway 101, driving through Requa to the Klamath Overlook north of the mouth of the Klamath River. The panoramic view of the delta and long sand spit was impressive even though shrouded in fog and low clouds, so not condusive to outstanding photography. We were informed that the entire delta and an area extending some distance up the Klamath River is the home of the Yurok Indians about whom we would learn more on our return trip north. Soon we passed through the clearing of Elk Prairie, but the Roosevelt Elk were all on leave this day; no doubt visiting brothers of another lodge. A couple of false starts later we located a picnic spot where our snack lunches were consumed with gusto in an open parking area surrounded by stand of redwoods.

NOMINATIONS FOR GSOC OFFICES FOR 1992

The Nominating Committee is pleased to inform the Society of the selections of nominees for GSOC offices for the year 1992.

President:	Esther A. Kennedy
President Elect:	Dr. Donald Botteron
Secretary:	Shirley O'Dell
Treasurer:	Phyllis M. Thorne
Director, 3 years:	Booth Joslin
Director, 2 years:	Arthur B. Springer, (to fill position currently held by Dr. Botteron)

When not surrounded by redwoods we have frequent exposures of the Franciscan Formation melange in folded and contorted form indicating a history of abuse by land movements of the converging tectonic plates of the triple junction area. South of Orick we passed several lagoons formed where drowned stream mouths have been closed off from the sea by sand pits. We passed Freshwater Lagoon on the seaward side where Highway 101 traverses the sand pit separating it from the open ocean, then skirted Stone and Big Lagoons on the landward sides, traveling on Big Lagoon Fault and wave-cut terraces by marine deposits. Here again occasional exposures of the Franciscan melange were evident. Anywhere we saw mixed up or contorted formations we could expect it was Franciscan. We crossed over Patrick's Point Fault, passed by the town of Trinidad, and stopped at Vista Point where we could see the mouth of the Mad River which has been moving north by building onto a long spit's northern end (some 1,000 feet in the last three years), and by carving out the beach beyond. Riprap has been added north of the mouth to slow further invasion of the beach, which will help protect Highway 101 at this point.

Vickie Ozaki continued to supply use with information on the geology of the area and an edifying discourse on later developments in 1964, which was definitely a bad year for this part of the country. A heavy snow pack and a sudden warm front in December of that year produced heavy runoffs on the west side of the Cascades and particularly in the coastal streams throughout Oregon and northern California. Resulting floods took out highway bridges over the Klamath and Mad Rivers, completely disrupting Highway 101 travel between Crescent City and Eureka. The bridge at the confluence of the Illinois with the Rogue River in southern Oregon was also swept away. Tributaries fed so much water into the Willamette River that flood damage occurred in Portland, as most of us remember. But the north coast of California was hardest hit and Crescent City was just recovering from the tsunami in March. Is there anyone left who would like to settle there?

We are now only a few miles from Arcata where we left Vicki Ozaki and proceeded to the Hotel, checking in about 4:30 PM. The establishment is an old three story building facing the town square to the south, and is now owned and operated by the Yurok Indian Tribe. We were all impressed with the old gold plated plumbing fixtures and the free-standing footed bathtubs with vertical rods and shower heads supporting enfolding shower curtains, sort of MOD-VICTORIAN, you might say. The elevator was slow; the wide carpeted stairways conveniently faster. Most of us participated in the planned prime rib dinner to which my wife and I had the pleasure of inviting her cousin, Dr. John Hewston, retired professor at Humbolt State University of this city. This was an unintended complication for Alta Fosback and our waitress, who had to collect the money and do all the arithmetic to settle fees, tips,etc.for the entire group, which they did without complaint sometime after the meal was over. Our evening ended with some free time for us after the enjoyable meal.

PALEOZOIC PORNOGRAPHY

While reading Stephen Gould's "Wonderful Life" which is a wonderful book on the Burgess shales in British Columbia, I ran across this mnemonic device for remembering the geologic time scale. It was invented by a graduate student of his who presumably saw the pornographic film
Cheap Meat

ERAS: **Cheap Meat performs passably**
Cenozoic Mesozoic Paleozoic PreCambrian

PERIODS
Quenching The Celibrate's Jejune Thirst
Quaternary Tertiary Cretaceous Jurassic Trassic

Portraiture **Presented Massively**
Permain Pennsylv. Mississippian

Drowing Sorrow Oneness Cursed
Devonian Silurian Ordovician Cambrain

EPOCHS:
Rare Pornography Purchased Meekly
Recent Pleistocene Pliocene Miocene

Oh Erogeny Paleobscene
Oligocene Eocene Paleocene

Submitted by Chlovena Metzer, new GSOC member.

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

GEOTHERMAL EXPLORATION IN CENTRAL OREGON 1974-1992

by Larry Chitwood, Geologist, Deschutes National Forest
1645 Highway 20 E, Bend, Oregon 97701

Exploration began in 1974 when leasing first became available on federal land. Now, 18 years later, exploration and research have demonstrated that exciting high

temperatures exist under Newberry Volcano, about 25 miles south of Bend. Currently, two companies - CE Exploration and Vulcan Power - are poised to drill deep production holes that may prove the existence of a geothermal reservoir capable of supporting the commercial production of electricity.

GEOTHERMAL ENERGY USES. Some people may not be aware of the meaning or uses of geothermal energy. "Geo" means earth, and "thermal;" of course means heat. Geothermal energy is heat from the earth normally in the form of hot water or steam. Geothermal energy is used throughout the world to produce electricity, to heat buildings, heat green houses, dry lumber, and for numerous other processes. An area called The Geysers, about 70 miles north of San Francisco is the largest geothermal development in the world. Here, the steam coming out of wells drives turbines and electric generators which currently produce a little over 2,000 megawatts of electrical energy, enough for 2,000,000 people, the equivalent of two Bonneville Dams. About 7,000 megawatts of electrical energy are produced today worldwide, the equivalent of seven Bonneville Dams.

PACIFIC NORTHWEST ENERGY PICTURE. Recent projections of electric use in the Pacific Northwest show a need for new electric generation within a few years. For the first time, the Bonneville Power administration (BPA) is including geothermal in its portfolio of electric power sources. It has established a pilot program to encourage development of geothermal energy at three geothermal prospects: Newberry Volcano, Vale in eastern Oregon, and the Medicine Lake Highlands south of Klamath Falls. Under the pilot program, the BPA will buy up to ten megawatts of power from each of the developers of these sites at prices higher than the market price. The BPA will also buy up to 300 megawatts of geothermal power from these and other developers at market value. This is good news to geothermal developers because, to date, no geothermal electricity has been produced in the Pacific Northwest (except from a research facility in Idaho several years ago).

LEASING HISTORY . Back in 1974, the BLM, which manages geothermal leasing , was flooded with lease applications for about 500,000 acres of land on the Deschutes National Forest in central Oregon. After long delays due mostly to environmental issues, the first leases were issued in 1982. By 1987, leases covered 338,000 acres. Then by July 1992, the number of leases fell to 82 covering 81,000 acres. The result was mostly the result of many years of exploration and research that more clearly defined the best geothermal prospects: Newberry Volcano and Tumalo Highlands (west of Bend).

EXPLORATION. In volcano country, an old rule-of-thumb says that if the volcanoes are less that one million years old and if there are great piles of volcanic deposits, the area is a good geothermal prospect. These geothermal prospects in central Oregon has in spades. Exploration quickly centered on Newberry Volcano and the central Oregon Cascades.

The exploration tools that have proved most valuable are geologic mapping and temperature gradient drill holes. However, numerous geophysical and geochemical studies have also proved valuable. The U.S.Geological Survey, with new direction to do research on alternative energy resources such as geothermal, began mapping the geology of Newberry Volcano in 1976, and in 1981 they completed a temperature gradient hole in the center of Newberry Crater. The 3,057-foot hole became a center point of major interest when the temperature at the bottom measured 509 degrees F. The hole produced steam for 20 hours during the test. The Journal of Geophysical Research, devoted a special section to the geology and geophysics of Newberry Volcano. The articles supported the view that Newberry was a good geothermal prospect. It may be situated over an active magma chamber which has been erupting every 2,000 years or so to produce The Big Obsidian Flow and other impressive silicic flows.

Drilling has provided the best evidence to date for the high geothermal potential of Newberry. Projections of temperatures beyond the bottom of each hole suggest that economic temperatures of greater than 400 degrees F. exist between 5,000 and 10,000 feet under the volcano's flanks. The most important remaining question is, are there fluids available, water or steam, from these hot regions that can be brought to the surface to generate electricity.

West of Bend, about eight shallow temperature gradient holes have been drilled on the east flank of the central Oregon Cascades. None has shown promising results. Holes drilled to the same depth on Newberry would not have shown much promise either. The most recent hole was drilled in 1992 in the Tumalo Highlands near Bearwallow Butte to the depth of somewhat more than 3,000 feet. Although drilled at the inner edge of a 300,000 year old caldera, temperatures are low. This area still remains a serious prospect.

NEWBERRY NATIONAL MONUMENT. In 1987, a specter of geothermal development in the mist of an important recreation area drove a small group of concerned

citizens of central Oregon to propose a national monument at Newberry. The small group grew to 25 people, known locally as the "monument committee." Then in 1990, a 56,000 acre national monument called Newberry National Volcanic Monument was created by Congress following the recommendations of a consensus of monument committee members who represented several diverse groups including environmentalists, recreation, geothermal developers, timber, local communities, and business. The activities of the monument committee were widely publicized, and it can be said that they were well-supported by citizens of central Oregon. Creation of the monument settled a major issue of where and where not to develop geothermal energy. Today, and perhaps for a few years in the future, modest covered 338,000 acres. Then by July 1992, the number fell to 82 covering 81,000 acres. This drop was mostly the result of many years of exploration and development can probably proceed.

CURRENT SITUATION. Estimates of electrical energy potential at Newberry vary widely from a low of 740 megawatts to 13,000 megawatts. Most estimates centered on 1500 megawatts; one and a half Bonnevilles. Even though some of this potential is now excluded by the national monument, geothermal developers believe that Newberry remains a major prospect for development.

FINDINGS AND SUMMARY. In summary, two areas of central Oregon show considerable promise for continued geothermal exploration and development: Newberry Volcano and Tumalo Highlands.

At **NEWBERRY** Newberry, five points can be made:

1. Exploration drilling must first penetrate a 1,000, to 2,000 foot thick cold region known as the rain blanket in order to observe a rise in temperature.
2. Temperatures of a least 400 degrees F.certainly exist under Newberry's flanks. This is a minimum temperature for commercial development in this particular setting.
3. Geothermal fluids are not known to exist within the upper 4,000 feet of Newberry flanks. It is not known if they exist below 4,000 feet.
4. Dry steam is known to exist within the center of Newberry Crater at a depth of 3,057 feet at a temperature of 509 degrees F.
5. Newberry has high potential for production of electric power. The next step is to drill deep wells 7,000 to 10,000 feet in an attempt to discover and prove out an economic geothermal reservoir.

At the **TUMULO HIGHLANDS,** three points can be made:

1. While exploration has proceeded much more slowly than at Newberry, the Highlands remain a promising prospect. It is the site of considerable young, silicic volcanism and is believed to be a buried caldera.
2. Limited drilling to date has shown no significant temperatures or temperature gradients down to about 3,000 feet.
3. The Tumalo Highlands have high potential for production of electric power. Exploration should continue by drilling temperature gradient holes to a depth of at least 4000 feet.

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IN MEMORIUM

IBeverly Ann Bock, long time Portland-area resident and GSOC member passed away on October 16, 1992. The family suggests remembrances be contributions to the Friends 0f Crystal Springs Rhododendron Garden or Kidney Association of Oregon.

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PAST PRESIDENT'S PANEL
Geological Society of the Oregon Country

In the belief that accumulated experience of the Past Presidents of the Geological Society of the Oregon Country should be made available to the society, and that past presidents should continue their interest in, and service to the society, this group agrees to hold one regular meeting a year in March, and to hold other meetings as needed for the accomplishments of special assignments, advice, and counseling to the board. As a matter of form, regular meetings are normally to be held on the first Friday of those months having five Fridays.

BY-LAWS

1. All living past presidents are members of the Past President's panel (hereinafter called P^3). The acting president of the society is an ex-officio member,

2. The immediate past president of GSOC shall be chairman of P^3, and may call special meetings at any time.

3. The acting president of the society may also call special meeting of P^3 .

4. The regular annual meeting of P^3 shall be held in March of each year.

5. The secretary for the year shall be the attending past president most nearly preceding the immediate past president of P^3.

6. A quorum shall consist of five members of P^3.

7. Wives or husbands, as the case may be, of past presidents of the society are included as guest at all P^3 meetings.

Revised October 29, 1976 (as voted).
J.B. Submitted by Dr. John Allen.
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COMPLETELY FRACTURED GEOLOGY

by Evelyn and Ralph Pratt

NOTE: REAL DEFINITIONS ON PAGE 77

1. Tectonics: a football team from the second largest U.S. state.

2. Albedo: Beginning of a country western hit - "Albedonly one in yer heart...".

3. Littoral drift: Leaning more and more toward the real thing.

4. Mesocratic: refers to a government run by middle-of-the-roaders.

5. Oredodont: A dental condition caused by eating too many chocolate cookies.

6. Maar: the opposite of loess.

7. Recumbent fold: A flock of sheep lying down.

8. Therapsids: Danger encountered in rivers, as, "We lost our lunches when the canoe tipped over in therapsids".

9. Correlation: (1) a cousin or other relation in one's own generation, (2) A ceremony in which a king or queen is crowned.

10. Baymouth bar:. A tavern in Waldport or Winchester.
##########

OREGON CAVES

by ARCHIE STRONG

As I present a summary of the GSOC tour of the Oregon Caves on September 9, 1992, I feel that I have at least set a personal record upon the completion of this tour. This represents my fourth tour of the Caves at twenty year intervals. My first tour was in 1932, followed by tours in 1952, 1972 and 1992. There have been numerous changes within the caves since my first tour in 1932.

Oregon as a State is blessed with memorials and scenes of nature which are unsurpassed. I should like to mention a few such as Crater Lake, the Wallowa, the Columbia River Gorge and Oregon beautiful coastline. Oregon Caves are outstanding in their own right, with its limestone-marble formations located on the Pacific coastal area of the Northwest.

Oregon Caves were discovered by Elijah Davidson (1849-1927) in 1874 while with a hunting party from the William's Creek Valley. Due to inaccessibility the caves, which actually consist of only one cave, remained undeveloped. In 1894 promoters from Oregon and California formed what they named The Caves Improvement Company, but their dreams of a road and rail access along with a 500 room lodge did not materialize. The first road which consisted of a one-lane gravel road was built to the Caves and it was not passable during the winter in 1922.

In 1903 the Caves area was included in the Siskiyous National Forest. In 1907 a committee of interested citizens led by Joaquin Miller (poet of the Sierras) began to develop a plan to preserve the area. In 1909 President Taft was influenced to set aside 489 acres as Oregon Caves National Monument. National Parks assumed control of Oregon Caves in 1933.

Geologically Oregon Caves could be a segment of Permian limestone formed by marine deposits on the ocean floor. Through folding and uplifting it has become part of the Applegate group of the Triassic period. Intrusions had a mixing with the granite stocks near the edges of the pluton such as occurs in this area. Other metasedimentary rocks are arigillite, chert, quartzite and marble. During periods of folding and uplift the Klamath Mountains were formed. Oregon Caves resulted from the later periods of flooding from heavy rainfall as well as melting ice. The extensive water action produced the caves. Subsequent action by water upon the calcium carbonate produced carbonic acid and the metamorphism into marble . Calcium carbonate in solution forms the icicle-like structures called stalactites and by dripping on the floor of the caves produces stalagmites. When the two structures join together a pillar-like structure is formed and is called speleeotherm. Coloration changes in the walls of the caves results from the minerals arigillite and graphite. These kinds of striations may appear along faults. Holes in the ceilings and walls of the caves are chert which is silica.

There are fewer formations in the interior of the caves as a result of less moisture, temperature and air pressure.

Oregon Caves are located at an elevation of 4,000 feet. The temperature inside ranges from 38-45 degrees F. The vertical ascent of the caves is 218 feet and horizontally .6 of a mile. The caves located in the Siskiyou-Klamath Mountains are some 7,530 feet in elevation on Mount Ashland. Pioneer geologist Thomas Condon recognized this area and it is so named "Condon's First Island". Geologically the oldest rocks and formations in Oregon occur south to the California border.

The Oregon Caves are accessible by Highway #46 at Cave Junction off Highway #199 west of Grants Pass. The accommodations at the immediate area include the Lodge and restaurant and are open from June 12 to September 8. There is a snack bar in operation throughout the year.

There are several miles of hiking and nature trails in the caves area. There are many beautiful and interesting flowers , shrubs and trees in the area. There is an intermingling of the flora from the Transition and Upper Sonoran Zones. Eight species of bats have been identified within the caves. In addition to the algae found inside the caves there is a constant introduction of new species. This becomes a problem with some 100,000 visitors who come to the caves each year. The ecology inside the caves is influenced by air circulation and temperature changes and artificial lights.

There is a program of restoration and development on-going continuously inside the caves. Enlargement of the caves and the removal of tons of mud and debris have been accomplished. Much of this work has been done by Scouts and Air Patrol. This type of hand labor is strenuous and difficult to perform during tourist hours.

The restructuring involves the installation of airlocks in all artificial passageways in order to control and check air pressure and airflow. Air changes affect the shape and size of the formations through chemical and temperature changes. A radio controlled lighting system is now planned. This will include improved lighting fixtures to reduce as much as possible artificial light to contral the growth of algae.

Preservation of our natural caves is vital to the recreation environment of the future generations. Cave formations such as the Oregon Caves are a product of vast amount of underground water and flooding. At today's rate of underground water flow some 100 years would be required to produce one inch of metamorphic marble from calcium carbonate.

In summary I should like to express appreciation for publication references by the National Park Service, our tour leader John Roth, GSOC President Eveyln Pratt, Ewart Baldwin for his *Geology of Oregon*, and to Frank Walsh and William Halliday for their publication *Oregon Caves Discovery and Exploration.*

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REAL DEFINITIONS FOR 'COMPLETELY FRACTURED GEOLOGY'

1. Tectonics: Branch of geology dealing with major structural or deformational features and their origin, relations and history.

2. Albedo: The amount of incoming radiation that reflects back into space from snow, ground, water and clouds.

3. Littoral drift: Material that is removed along the coast by current flowing parallel to the shore.

4. Mesocratic: Refers to an igneous rock composed of more or less equal amounts of light-colored and dark-colored minerals.

5. Oreodont: An extremely common Tertiary herbivore sometimes called a "pig-dog" because of its size and shape; probably ancestor of cattle, deer, and antelope.

6. Maar: a low, broad volcanic crater formed by many shallow explosive eruptions.

7. Recumbent fold: An overturned fold in which the axis is more or less horizontal.

8. Therapsids: Permian to Traissic (and perhaps much later) mammal-like reptiles, probably ancestors of mammals.

9. Correlation: Equivalent age relationships between rock units or geologic events in separate areas.

10. Baymouth bar: A ridge of sediment that cuts a bay off from the ocean.

##########

THERE ARE SEVERAL SETS OF BOUND COMPLETE SETS OF THE GEOLOGICAL NEWSLETTER FOR SALE. INQUIRE PRESIDENT

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THE INDEX FOR THE GEOLOGICAL NEWSLETTER WILL COME WITH THE JANUARY NEWSLETTER.

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THIS CHANGE IN THE BY-LAWS IS PROPOSED BY THE BOARD OF DIRECTORS OF THE GEOLOGICAL SOCIETY OF THE OREGON COUNTRY WILL BE VOTED ON BY THE MEMBERS IN JANUARY 1993.

ARTICLE XI

SECTION 1. During July the Board of Directors shall appoint a Nominating Committee consisting of five members, none of whom may be members of the Board. The Chair of this committee shall serve on the committee for one year after the term as Chair has expired.

Prior to the first day of October, the Nominating Committee shall file with the secretary the name of one nominee for each office to be balloted upon. These names shall be published in the November Newsletter. Any additional nominations shall be submitted to the secretary in writing over the signatures of at least ten members prior to the tenth day of November. With the approval of the nominees, these names shall be published in the December Newsletter and be included on the ballot.

SECTION 2. A ballot containing the names of all nominees shall be sent to each member, except Junior members in January.. All ballots returned shall be opened and counted by the Nominating Committee the second meeting in January under the supervision of a member of the Board of Directors. The results of the balloting shall be announced by the secretary. In case a majority of all the ballots shall not have been cast for any candidate for office, the two candidates having the highest number of votes shall be elected by a show of hands at the second meeting in January of the Society.

SECTION 3. All persons elected shall take office as of the first of March.

(This change in the By-laws will enable the incoming president to have more time to chose his or her committees. When the ballots are sent out, you'll be asked to vote for or against the changes.)

TO FIELD TRIP OR NOT TO FIELD TRIP

I believe that GSOC'ers like field trips. However, the turnout we've been getting is discouraging. Good leaders and geologically interesting places to go are available. We need to learn what YOU want, rather than what we can provide. Let us know!!

	YES	NO
1. I would like half-day trips near Portland.		
2. I prefer all-day trips to Mt. Hood, the Gorge, the coast, etc.		
3. I want to go one place and stay several days, taking field trips from there.		
4 I'd rather spend days staying overnight at different places, doing field trips as we go.		
5. I like a mix of the above.		
6. I enjoy looking at geology in general and being with friendly people.		
7. I prefer in-depth field trips where I can learn a lot.		
8. I like both of the above.		
9. I plan to go on a GSOC field trip some time in the next 4 months.		
10. I am willing to drive and can take ____ passengers.		

PLEASE BRING TO A FRIDAY MEETING OR MAIL TO OUR BOX NUMBER AS SOON AS POSSIBLE, SO WE CAN PRINT RESULTS IN THE NEXT NEWSLETTER. THANKS, EVELYN, YOU R PRES.