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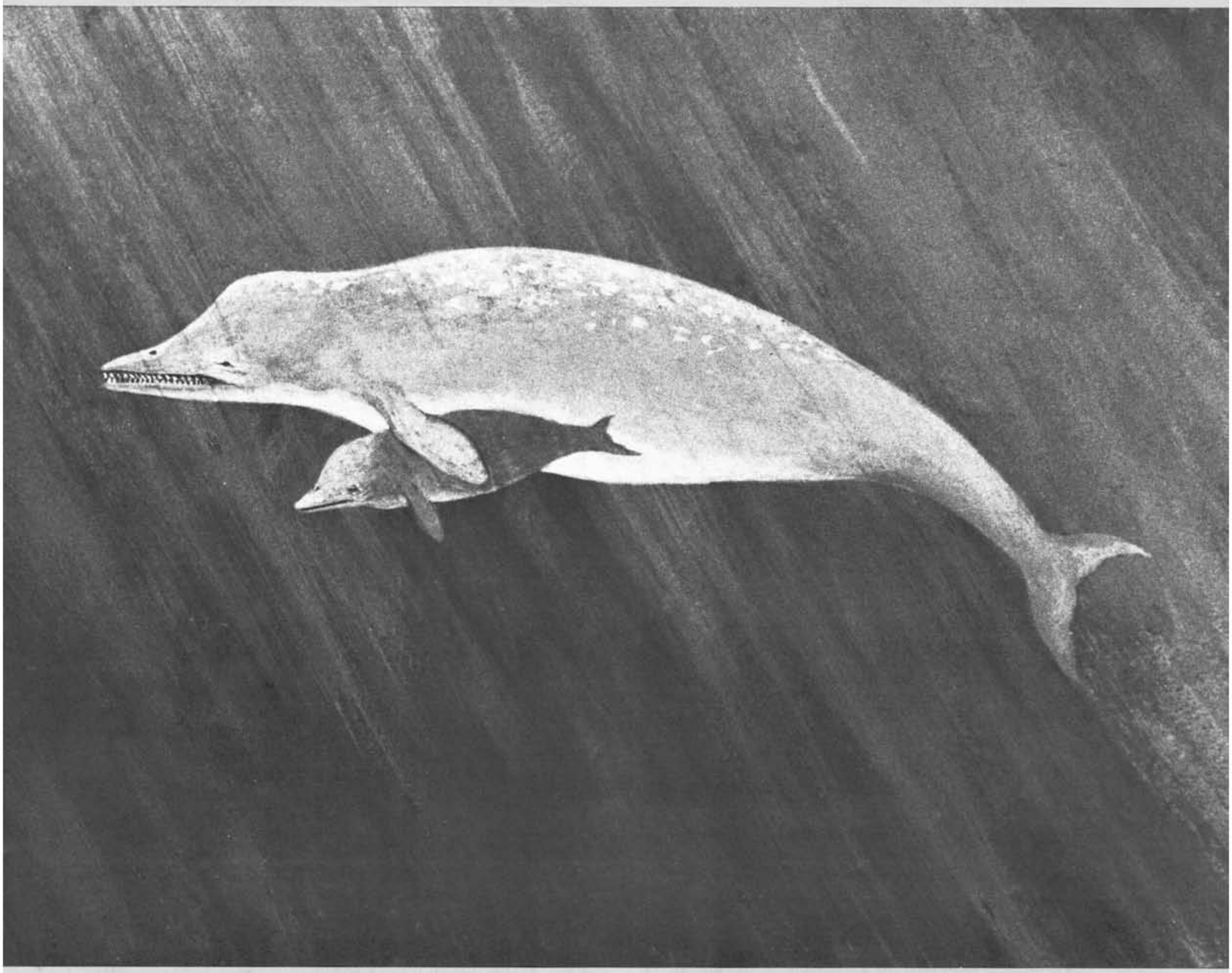

OREGON GEOLOGY

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COVER PHOTO

The primitive mysticete whale *Aetiocetus cotylalveus* Emlong. Taken from a painting by Pat Ray, University of Oregon, 1982. Article beginning on next page discusses some fossil whale discoveries in Oregon.

OIL AND GAS NEWS

Mist Gas Field

Reichhold Energy Corporation drilled Columbia County 43-5 in sec. 5, T. 6 N., R. 5 W. in 1982. The well was plugged and suspended, but had gas shows that were cased off by the surface casing. The company has recently reentered the well to perforate the shallow gas zone. Results of the August tests were poor, the formation appearing to be either tight or cement-damaged. Reichhold may plan a future new well to test the shallow gas.

DOGAMI well-sample collection

In July, the well-sample collection was improved by the processing of about 2,000 individual samples from 19 different wells. Many were duplicate samples which required washing, sieving, and proper storage for future use. These samples are available for use by anyone who desires to generate data from the well cuttings. More on the Oregon well-sample collection will appear in a future issue of *Oregon Geology*.

Recent permits

Permit no.	Operator, well, API number	Location	Status, proposed total depth (ft)
240	RH Exploration Rose 1 005-00002	NE¼ sec. 20 T. 5 S., R. 1 E. Clackamas County	Application; 3,500
241	RH Exploration Anderson 1 005-00003	SW¼ sec. 29 T. 5 S., R. 1 E. Clackamas County	Application; 3,500
242	RH Exploration Rose 2 005-00004	SW¼ sec. 20 T. 5 S., R. 1 E. Clackamas County	Application; 4,000
243	Reichhold Energy Corporation Investment Management 21-20 009-00117	NW¼ sec. 20 T. 6 N., R. 4 W. Columbia County	Location; 2,500

□

OAS announces awards and new officers

At its annual meeting in February, the Oregon Academy of Science (OAS) honored Carl Bond by presenting him with the Oregon Academy of Science Citation for Outstanding Scientific Achievement.

Each year, the Academy honors two young people, one male and one female, who have presented outstanding papers at the meeting, by offering them a full membership to OAS. This year, those chosen were H.B. Davis, Portland State University, and Louise Parsons, Oregon State University.

New OAS officers for 1983-1984 are President, Jay F. Evett; Vice-President, Michael L. Cummings; Secretary, Susan K. Humphreys; and Treasurer, Frederick A. Hirsch. □

CONTENTS

Fossil Cetacea (whales) in the Oregon Western Cascades

by William N. Orr and Paul R. Miller, Geology Department, University of Oregon, Eugene, OR 97403.

ABSTRACT

The fossil whale *Aetiocetus*, first described from Oregon Coast Range exposures of the Oligocene Yaquina Formation in Lincoln County, could be one of the specimens most important to the evolutionary study of Cetacea. The origin of Mysticeti or baleen (whale-bone) whales is obscured by their poor mid-Tertiary fossil record. The recovery of *Aetiocetus* remains in Marion County, Oregon, is followed here by notes on fragmentary remains of at least two juvenile specimens of *Aetiocetus* in the same area. In spite of a lull in mid-Tertiary cetacean diversity, the paleontological record of these large mammals in this interval is one of progressive discoveries. Several formations in the Coast Range, Willamette Valley, and Western Cascades show promise for future finds of fossil whale remains.

INTRODUCTION

Many significant fossil finds in Oregon have been made by interested lay persons. It is often difficult to distinguish plant and invertebrate remains from manganese stains, rock fracture patterns, and sedimentary structures. The distinctive appearance of fossil bone, however, seldom leaves any doubt in the mind of the amateur of the significance of the find. Fossil mammals are rarely abundant in marine rocks, and the history of their discovery in Oregon owes much to observant amateurs. Of the several occurrences of Cetacea reported here and from the northern Marion County area in the past, all of the initial finds were made by local residents (see Acknowledgments).

The fossil record of whales in Oregon is limited. In view of the abundance of favorable paleoenvironments here for preserving marine animals, there is every indication that more material will turn up as study of the paleontology of the marine rocks west of the Cascades proceeds. There is a pronounced worldwide lull in the diversity of Cetacea during the middle Tertiary. This lull aligns with the appearance of baleen (whale-bone) whales and may be indirectly related to major global environmental/temperature changes that were occurring in this interval.

FOSSIL CETACEA IN OREGON

Most Oregon cetacean fossils are from exposures of Tertiary rocks in the Coast Range. To date, the most productive formations for whale fossils are in the Neogene (Figure 1). Easily the most prolific in this regard is the Miocene Astoria Formation. From the early 1800's up to the present day, the Astoria has yielded a variety of marine mammals including cetacean remains. Best known of these are the mysticete cetothere *Cophocetus oregonensis* and porpoise remains reported by Packard and Kellogg (1934) and Kellogg (1928). The upper Miocene Empire Formation in the vicinity of Coos Bay south to Cape Blanco bears cetacean bone material and even fossil baleen (Packard, 1947). A well-preserved primitive toothed whale represented by the skull and most of the skeleton was described and illustrated by Emlong (1966) from a locality in the Oligocene Yaquina Formation in Lincoln County (Figure 2). Additional cetacean material from Emlong's extensive collection (now at the Smithsonian Institution) is reported from several Coast Range exposures (Ray, 1976). Whitmore and Sanders (1976) have briefly discussed three cetacean skulls from the upper Eocene-Oligocene Alsea Formation in Emlong's collection. As work on Oregon paleontology continues, additional cetacean remains will almost certainly turn up in other Tertiary marine formations. The Pittsburg

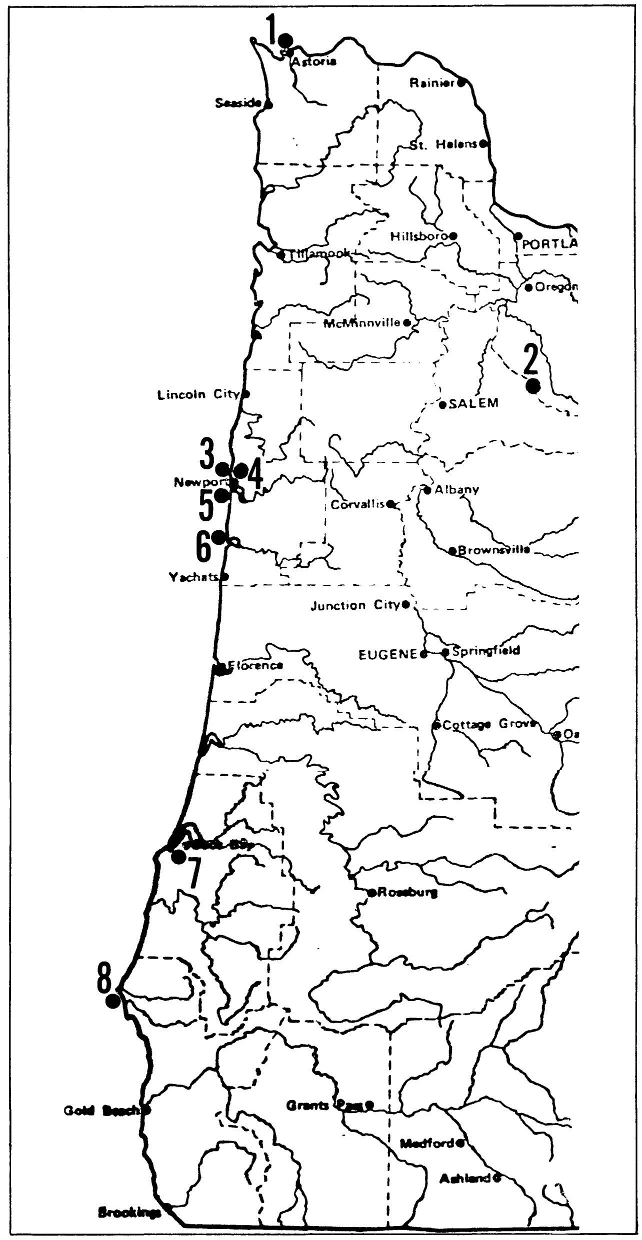

Figure 1. Distribution of fossil Cetacea in Oregon. Numbers on map indicate locations where fossils were found: 1. Astoria (Astoria Formation, Miocene, see Dana, 1849). 2. Scotts Mills ("Butte Creek beds," upper Oligocene, see Orr and Faulhaber, 1975). 3. Newport (Astoria Formation, Miocene, see Packard and Kellogg, 1934, and Kellogg, 1928). 4. Newport area (Astoria Formation [probably], Miocene, see Packard, 1940). 5. Seal Rocks (Yaquina Formation, upper Oligocene, see Emlong, 1966). 6. Alsea (Alsea Formation, Oligocene, see Emlong, 1966, and Whitmore and Sanders, 1976). 7. Coos Bay (Empire Formation; Miocene, see Packard, 1947). 8. Cape Blanco (Empire Formation, Miocene, see Packard, 1947).

Bluff and Cowlitz Formations in northwest Oregon have yielded bone fragments, but nothing has been described to date. Shallow-water intervals of the Eocene Yamhill as well as the Coaledo, Nestucca, Flournoy, Lookingglass, and Roseburg Formations also hold promise for cetacean remains. The Nye Formation has preserved marine vertebrates (turtles and desmostylids, Ray, 1976; sharks, Welton, 1972), but no cetacean remains from the unit are known to the present authors. In the Oregon upper Tertiary rocks, small bone pieces and fragments are not uncommon in the Port Orford Formation as well as the Cape Blanco beds of late Tertiary-Pleistocene age. Orr and Faulhaber (1975) described nine articulated vertebrae of a large cetacean from the "Butte Creek beds" of Oligocene age, exposed in northern Marion County. Although their specimen lacked the definitive skull, they regarded it as assignable to *Aetiocetus cotylalveus* described by Emlong (1966) from the Yaquina Formation. To date, this area of the Western Cascades is geographically the farthest inland unit bearing fossil cetaceans in Oregon. A thorough review of fossil marine mammals in Oregon is to be found in Ray (1976).

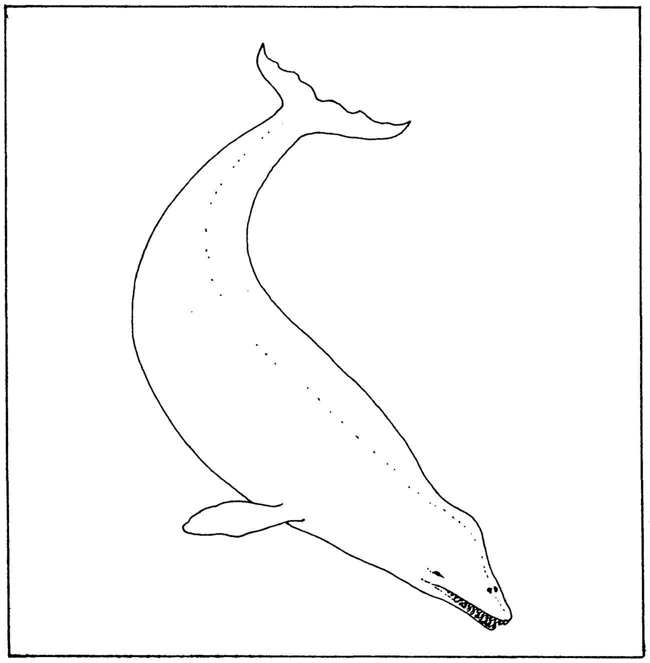

Figure 2. Aetiocetus cotylalveus *Emlong, showing position of nares. Sketch by Pat Ray, 1982.*

LOCALITY AND STRATIGRAPHY

In addition to several bone fragments, the "Butte Creek beds" have yielded whale cetacean fossil bones at three separate localities (Figure 3). These sites are all located within sec. 29, T. 6 S., R. 2 E. and are at almost the same stratigraphic interval. Orr and Miller (1982a,b) have delineated and mapped three informal subunits within the "Butte Creek beds" on the basis of lithology (Figure 4). Cetacean fossils here have all come from the lowermost of these three subunits very near the base of the section. The "Butte Creek beds" as originally recognized by Harper (1946) crop out over a 120-km^2 area in northern Marion and southern Clackamas Counties in the Western ("older") Cascades. A series of parallel streams running southeast to northwest deeply dissect the relatively soft Tertiary rocks and drain into the Willamette River to the northwest. These stream valleys, including (north to south) Butte Creek, Abiqua Creek, Silver Creek, and Drift Creek, afford the best look at the nearly flat-lying unit and permit a three-dimensional perspective. The "Butte Creek beds" are locally up to 500 m thick and comprise a broad range of shallow-water marine tuffaceous silt-

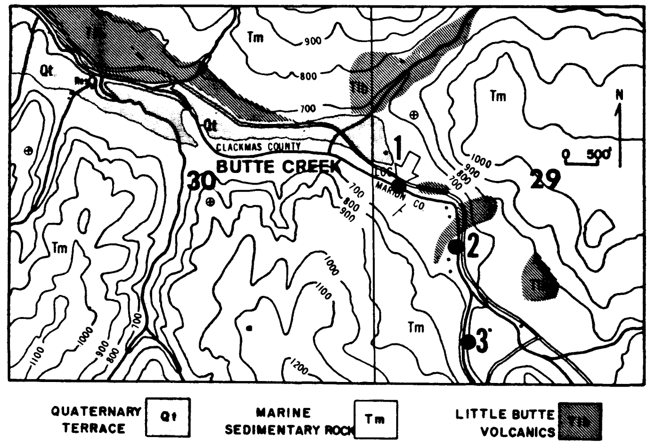

Figure 3. Fossil whale localities in northern Marion County, Oregon.

stones and sandstones with some thin bioclastic limestones. The unit rests unconformably on volcanic rocks of the Little Butte Volcanic Series and is overlain unconformably by the Miocene basalts of the Columbia River Basalt Group. Laterally the "Butte Creek beds" grade into the nonmarine volcanic rocks of the Little Butte Volcanic Series to the east. To date, the "Butte Creek beds" lack a formal formational designation.

The lowermost lithologic subunit designated by Orr and Miller (1982b) locally bears a prolific well-preserved assemblage of shallow, warm- (tropical-) water marine invertebrates dominated by molluscs. Addicott (1981) has reported a late Oligocene (Juanian molluscan Stage) scallop, "*Chalamys* sp. B," from this interval. Durham and others (1942) regarded the molluscs here as "lower Miocene" correlative in part with the "Vaqueros" of California. Orr and Miller (1982a,b) assigned the unit, on the basis of fossil molluscs, to the upper Oligocene Juanian Stage. More recently, Orr and Linder (1983a,b) identified several species of late Oligocene Echinoids from the same stratigraphic interval bearing cetacean bones. Butte Creek forms the Marion/Clackamas County line where it flows northwestward into the Willamette River. Detailed mapping has revealed that the stream trend here is following an old shoreline, with the Eocene basalt headlands (of the Little Butte Volcanic Series) to the northeast in Clackamas County and the Oligocene marine sequence to the southwest in Marion County. A traverse along the stream valley shows an intermittent chain of exhumed basalt sea stacks and mollusc-rich calcareous beach deposits. It is in the beach deposits that the best articulated cetacean fossils are preserved.

SYSTEMATICS

Order Cetacea
Suborder Mysticeti
Family Aetiocetidae Emlong
Genus *Aetiocetus*
Aetiocetus cf. *cotylalveus* Emlong

Materials from the lowermost unit of the "Butte Creek beds" recovered to date include nine vertebrae described by Orr and Faulhaber (1975; Locality 1 on map), a single vertebra of the same species 500 m upstream from the 1975 locality (Locality 3 on map), and an accumulation of vertebrae and ribs in stream-bed exposures about halfway between the two above sites (Locality 3 on map). The new material at Localities 2 and 3 is uncrushed and far better preserved than the 1975 material (Locality 1).

SINGLE VERTEBRA

A single worn vertebra was found on Butte Creek, 75 m upstream from the confluence of Coal Creek and Butte Creek. The

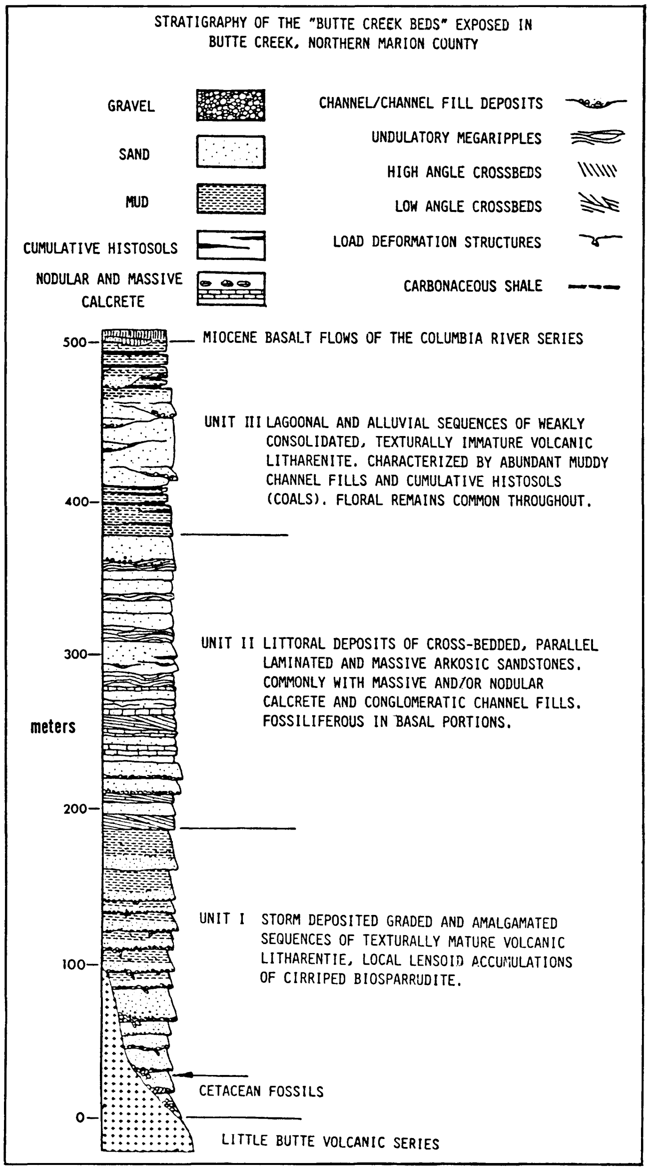

Figure 4. Stratigraphy of the "Butte Creek beds" in northern Marion County, Oregon.

specimen (Figure 5) measures 35 mm in diameter across the anterior centrum face and 36 mm across the posterior centrum face. Transverse processes are worn but display a spatulate shape. The latter processes project 40 mm beyond the centrum face in anterior view. Anterior-posterior length at the centrum faces is 50 mm. Metapophyses are also worn but project in an anterior direction 12 mm beyond the centrum face. The neural spine is damaged but projects 30 mm above the centrum face. The specimen compares well to lumbar vertebrae described by Orr and Faulhaber (1975) but is only half the size of the latter specimens.

VERTEBRAE AND RIBS

A series of seven vertebrae with ten associated ribs was collected on Butte Creek, about 150 m downstream from the confluence of Butte Creek and Coal Creek. Although most of the ribs are preserved lying in a parallel position, it is not clear that they are actually articulated with the vertebrae. These vertebrae bear a close resemblance to the specimens described by Emlong (1966) but are only about one-half their size. Average diameter of the centrum faces is 40 mm. The neural spine projects up to 27 mm above the centra and have a posterior rake. Anterior-posterior length of the vertebrae at the centra is 50 mm.

Ribs are up to 30 cm in length and are preserved whole. In cross section, the ribs are oval shaped with a longer diameter of 18 mm and shorter diameter of 13 mm.

DISCUSSION

Emlong (1966) originally classified his new genus and species *Aetiocetus cotylalveus* as an archaeocete (or primitive toothed whale) rather than as a mysticete (or baleen whale), predominantly because of the presence of multiple leaf-shaped teeth in the skull. Since its discovery and description, the genus has been the object of controversy. Thenius (1969) recognized that, in spite of its teeth, many of the anatomic features of *Aetiocetus* were, in fact, characteristic of a mysticete (Figure 6). He furthermore regarded the genus as transitional between archaeocetes and mysticetes. Van Valen (1968) similarly noted that, except for the teeth, *Aetiocetus* is a mysticete in every respect. In their review of Oregon Oligocene Cetacea, Whitmore and Sanders (1976) note several features of the skull, including the geometry of the nares, that might well be anticipated in ancestors to mysticete whales. They refer to *Aetiocetus* as a primitive mysticete, and there seems to be general agreement that the form is in the Archaeoceti-Mysticeti evolutionary line. Gastin (1976) suggests that evolving cetaceans might characteristically have a limited distributional range, which makes discovery of their fossils very fortuitous. He goes on, however, to note the transitional position of the toothed *Aetiocetus* of Emlong (1966) with its mysticete bone morphology.

We have followed Van Valen's (1968) designation here of *Aetiocetus* as a toothed mysticete. The evolutionary origin of the mysticetes or baleen whales is as unclear as the origin of the order Cetacea itself. With respect to the latter, much has been written on monophyly (single origin) or diphyly (double origin) for that order, and clearly the record awaits transitional forms between terrestrial vertebrates and Cetacea that will resolve the problem.

The potential for discovery of additional mid-Tertiary Oregon specimens to contribute to knowledge of the origin of mysticetes, however, remains high. Probably as significant as the taxonomic position of *Aetiocetus* is the fact that individuals of different growth stages are represented in the Marion County localities. The specimen described by Orr and Faulhaber (1975) was very close in size to the original described by Emlong (1966). Vertebrae and ribs described in the present work are all only about half as large as previous specimens. The rudiments of a population here are very encouraging with regard to future discoveries of additional specimens.

Many workers have alluded to the mid-Tertiary lull in cetacean diversity. Using data from Lipps (1970) and Romer (1966), Orr and Faulhaber (1975) were able to demonstrate a simultaneous

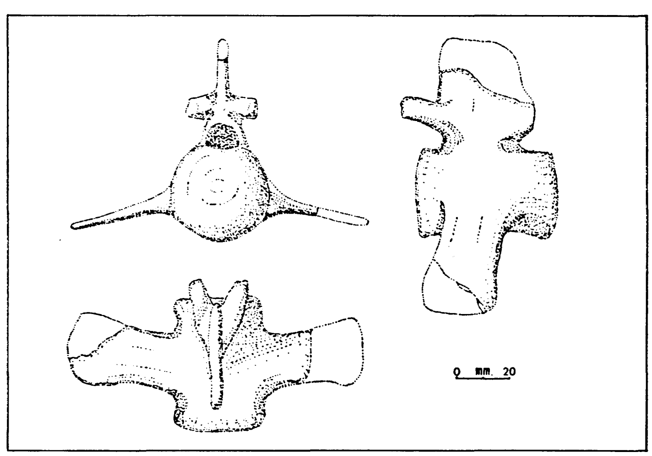

Figure 5. Lumbar vertebra from Butte Creek locality 3, northern Marion County, Oregon. Posterior, lumbar, and dorsal views.

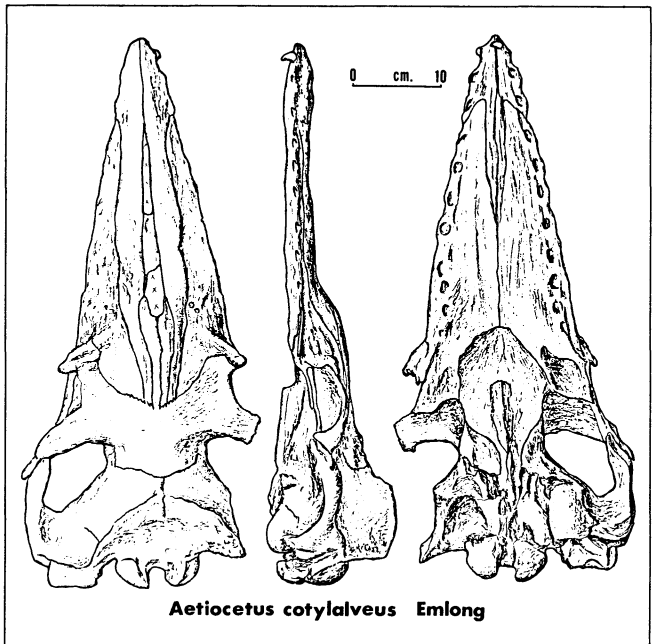

Figure 6. Aetiocetus cotylalveus *Emlong, after Emlong, 1966. Dorsal, lateral, and ventral views of the skull of Emlong's 1966 specimen, showing nares and tooth sockets.*

diversity lull in the Cetacea and marine plankton in this time interval. An inverse relationship suggested by them with respect to paleotemperature was that high water temperature accompanied low diversity. The thrust of this thesis was the notion that high ocean temperatures and subsequent thermal destratification of the water column somehow homogenized the plankton faunas with a resultant diversity crash. This diversity crash was then passed along to the ultimate consumers, the Cetacea. Barnes (1976) similarly produced graphs of cetacean diversity from the mid-Tertiary to the Holocene in the North Pacific and noted a related but not identical lull in the Oligocene as well as an even more profound dip in the middle Miocene. Although several explanations are reviewed, the latter author seems to favor a climatological relationship. Gastin (1976) records the close correlation between ocean temperature and modern cetacean distribution. He has correlated major events in cetacean evolution with known major temperature fluctuations in the Tertiary period. Lipps and Mitchell (1976) attribute the Oligocene diversity lull of Cetacea directly to the depauperate plankton faunas and flora that also characterize this interval. They appeal in turn to upwelling and the subsequent nutrient supply to explain the increasing and waning diversity of plankton. More recently, Fordyce (1977) and Kennett and others (1975) have looked at the timing of the remarkable post-Oligocene diversity recovery in Cetacea as well as in most groups of marine plankton and nekton. The latter authors have correlated these documented increases worldwide to the opening of the channel separating Australia and Antarctica by the sea-floor-spreading mechanisms (Figure 6). The development of this channel as Australia moved northward on the Indo-Australian Plate began well back in the early Tertiary. At about 38.5 m.y. B.P. in the late Oligocene, the geometry and width of the channel permitted the onset of the circum-Antarctic current. This current with its characteristic rich nutrient supply must have profoundly changed the food-chain structure within the oceans at that time.

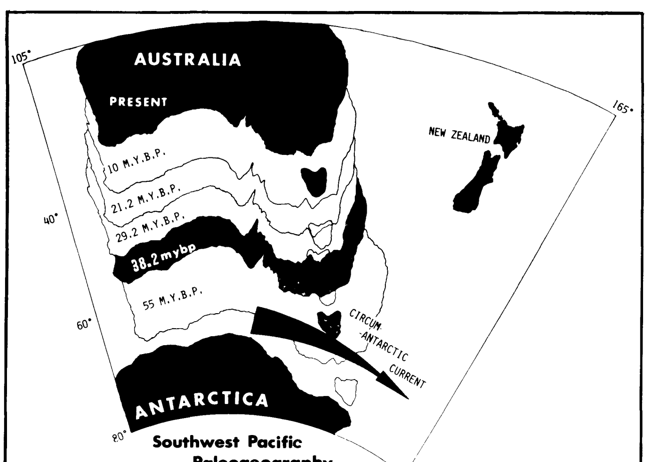

Figure 7. Tertiary paleogeography in the southern hemisphere. Modified after Fordyce (1977) and Kennett (1982).

ACKNOWLEDGMENTS

Several individuals materially helped in the recognition and acquisition of the cetacean fossils noted herein. Jake Fryberger and Glen Slentz are thanked for permitting the authors to map and collect on their property. Peter Schmidt and Dave Taylor recognized the cetacean remains and called them to the authors' attention. This work was funded by the National Science Foundation Division of Earth Sciences, Grant No. EAR 8108729.

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(Continued on page 102, **Fossil Cetacea***)*

North American Commission on Stratigraphic Nomenclature produces New Code

The 1982 North American Commission on Stratigraphic Nomenclature has adopted a new code which was printed in the *American Association of Petroleum Geologists Bulletin* (v. 67, no. 5, p. 841-875). Copies of the new code are available at $1 per copy postpaid from the American Association of Petroleum Geologists (AAPG), Box 979, Tulsa, OK 74101.

The Oregon Department of Geology and Mineral Industries has adopted the Code for its own geologic work.

For our readers' information, we are reprinting, with permission of AAPG, the foreword of the new code. Geologists are urged to obtain copies of the entire code and study it carefully.

FOREWORD

"This code of recommended procedures for classifying and naming stratigraphic and related units has been prepared during a four-year period, by and for North American earth scientists, under the auspices of the North American Commission on Stratigraphic Nomenclature. It represents the thought and work of scores of persons, and thousands of hours of writing and editing. Opportunities to participate in and review the work have been provided throughout its development, as cited in the Preamble, to a degree unprecedented during preparation of earlier codes.

"Publication of the International Stratigraphic Guide in 1976 made evident some insufficiencies of the American Stratigraphic Codes of 1961 and 1970. The Commission considered whether to discard our codes, patch them over, or rewrite them fully, and chose the last. We believe it desirable to sponsor a code of stratigraphic practice for use in North America, for we can adapt to new methods and points of view more rapidly than a worldwide body. A timely example was the recognized need to develop modes of establishing formal nonstratiform (igneous and high-grade metamorphic) rock units, an objective which is met in this Code, but not yet in the Guide.

"The ways in which this Code differs from earlier American codes are evident from the Contents. Some categories have disappeared and others are new, but this Code has evolved from earlier codes and from the International Stratigraphic Guide. Some new units have not yet stood the test of long practice, and conceivably may not, but they are introduced toward meeting recognized and defined needs of the profession. Take this Code, use it, but do not condemn it because it contains something new or not of direct interest to you. Innovations that prove unacceptable to the profession will expire without damage to other concepts and procedures, just as did the geologic-climate units of the 1961 Code.

"This Code is necessarily somewhat innovative because of: (1) the decision to write a new code, rather than to revise the old; (2) the open invitation to members of the geologic profession to offer suggestions and ideas, both in writing and orally; and (3) the progress in the earth sciences since completion of previous codes. This report strives to incorporate the strength and acceptance of established practice, with suggestions for meeting future needs perceived by our colleagues; its authors have attempted to bring together the good from the past, the lessons of the Guide, and carefully reasoned provisions for the immediate future.

"Participants in preparation of this Code are listed in Appendix I, but many others helped with their suggestions and comments. Major contributions were made by the members, and especially the chairmen, of the named subcommittees and advisory groups under the guidance of the Code Committee, chaired by Steven S. Oriel, who also served as principal, but not sole, editor. Amidst the noteworthy contributions by many, those of James D. Aitken have been outstanding. The work was performed for and supported by the Commission, chaired by Malcolm P. Weiss from 1978 to 1982.

"This Code is the product of a truly North American effort. Many former and current commissioners representing not only the ten organizational members of the North American Commission on Stratigraphic Nomenclature (Appendix II), but other institutions as well, generated the product. Endorsement by constituent organizations is anticipated, and scientific communication will be fostered if Canadian, United States, and Mexican scientists, editors, and administrators consult Code recommendations for guidance in scientific reports. The Commission will appreciate reports of formal adoption or endorsement of the Code, and asks that they be transmitted to the Chairman of the Commission (c/o American Association of Petroleum Geologists, Box 979, Tulsa, Oklahoma 74101, U.S.A.).

"Any code necessarily represents but a stage in the evolution of scientific communication. Suggestions for future changes of, or additions to, the North American Stratigraphic Code are welcome. Suggested and adopted modifications will be announced to the profession, as in the past, by serial Notes and Reports published in the *Bulletin* of the American Association of Petroleum Geologists. Suggestions may be made to representatives of your association or agency who are current commissioners, or directly to the Commission itself. The Commission meets annually, during the national meetings of the Geological Society of America."

–1982 NORTH AMERICAN COMMISSION ON STRATIGRAPHIC NOMENCLATURE

Field trip guide to zeolite deposits available

The International Committee on Natural Zeolites announces the publication of *Zeo-Trip '83*, a 72-page field trip guide to selected zeolite deposits in eastern Oregon, southwestern Idaho, and northwestern Nevada and to the Tahoe-Truckee Water Reclamation Plant in Truckee, California.

The International Committee on Natural Zeolites (ICNZ) is an informal organization created at Zeolite '76, the International Conference on the Occurrence, Properties, and Utilization of Natural Zeolites held in Tucson, Arizona, in 1976. The stated purpose of ICNZ is to promote and encourage the growing interest in natural zeolite materials throughout the scientific and technical community. During its seven-year history, ICNZ has served as a focal point of worldwide interest in natural zeolites and has been instrumental in the organization of conferences, symposia, and special sessions at national and international meetings on the subject of natural zeolites.

This field trip guide is the latest in a series of publications by ICNZ. *Oregon Geology* readers will be particularly interested in the trip guides by U.S. Geological Survey geologists Richard Sheppard and Arthur Gude, 3rd, to the Durkee, Sheaville, and Rome, Oregon, zeolite deposits. Included in the trip guides are geologic maps, discussions of the local geology, lithologic descriptions, chemical and mineralogical analyses, and photographs and scanning electron micrographs of interesting units and minerals.

Cost of this book is $12. It may be obtained by mail from Dr. F.A. Mumpton, Chairman, International Committee on Natural Zeolites, c/o Department of the Earth Sciences, State University College, Brockport, New York 14420. Additional information about ICNZ and its other publications may also be obtained from the same address. □

ABSTRACTS

The Department maintains a collection of theses and dissertations on Oregon geology. From time to time, we print abstracts of new acquisitions that we feel are of general interest to our readers.

GEOPHYSICAL AND GEOCHEMICAL ANALYSES OF SELECTED MIOCENE COASTAL BASALT FEATURES, CLATSOP COUNTY, OREGON, by Virginia Josette Pfaff (M.S., Portland State University, 1981)

The proximity of Miocene Columbia River basalt flows to "locally erupted" coastal Miocene basalts in northwestern Oregon and the compelling similarities between the two groups suggest that the coastal basalts, rather than being locally erupted, may be the westward extension of plateau basalts derived from eastern Oregon and Washington. Selected coastal basalts in Clatsop County, Oregon, were examined geochemically and geophysically; the data lend credence to a plateau origin for the coastal basalts.

Analysis by Instrumental Neutron Activation Analysis and fluxgate magnetometer allowed classification of 36 coastal basalt samples into three chemical types correlative with only those Columbia River basalt plateau flows also found in western Oregon: reversed (R_2) and normal (N_2) low Mg Depoe Bay Basalt, high Mg Depoe Bay Basalt, and Cape Foulweather Basalt (coastal) correlate respectively with reversed (R_2) and normal (N_2) low Mg Grande Ronde Basalt, high Mg Grande Ronde Basalt, and the Frenchman Springs Member of the Wanapum Basalt (plateau). Older Miocene coastal basalts (low Mg Depoe Bay) are found to occur furthest inland, separating the Eocene and plateau basalts to their east from the younger Miocene coastal basalts to their west. A seemingly regional series of low Mg Depoe Bay basalt dikes trending southwest from Nicolai Mountain is actually composed of both reversed and normal flows and can no longer be presumed to indicate a single long fissure. The high Mg Depoe Bay basalt breccia at Saddle Mountain overlies older low Mg basalt; adjacent dikes are also low Mg basalt and could not have served as feeders for the breccia peak. Although Cape Foulweather basalt outcrops along the South Fork of the Klaskanine River are abundantly phyric (Ginkgo unit), geochemically distinct Cape Foulweather basalt along Youngs River and west of the Lewis and Clark River is sparsely porphyritic (Sand Hollow unit). Distribution patterns based on isolated outcrops of basalt types lend themselves to varied interpretations but suggest topographic control by the Eocene highlands and stream valleys.

Gravity traverses conducted over coastal basalt features allow the formulation of models indicating the depth to which such features might extend. The linear, low Mg Depoe Bay basalt dikes underlying Fishhawk Falls (normally polarized) and Denver Point (reversed) extend only 107 m and 45 m, respectively, below the surface. The U-shaped Cape Foulweather basalt dike at Youngs River Falls may be modeled as a shallow (maximum depth 0.23 km below sea level) or deep (minimum depth 0.3 km below sea level) syncline. Alternatively, the basalt might encircle either a hill of somewhat denser sedimentary rock or a buried Eocene volcanic high, in which cases the basalt limbs independently extend 200-300 m below sea level. Arcuate segments of the low Mg Depoe Bay basalt "ring dike" on the Klaskanine River apparently are not connected at depth; the southwest crescent is 100 m deep, while the northeast crescent is an apophysis from a 150-m-thick basalt mass. Abundantly phyric Cape Foulweather basalt outcrops consistently proved to be shallow (100 m or less below the surface). Vertical dikes extending to the Eocene volcanic basement are not suitable for any of the features investigated, while shallow, near-surface basalt masses are either preferred or distinctly possible in all cases.

THE STRATIGRAPHIC RELATIONSHIPS OF THE COLUMBIA RIVER BASALT GROUP IN THE LOWER COLUMBIA RIVER GORGE OF OREGON AND WASHINGTON, by Terry Leo Tolan (M.S., Portland State University, 1982)

The western end of the lower Columbia River Gorge provides a natural cross section through the western flank of the Cascade Range. The oldest exposed unit in this area is the Oligocene to lower Miocene(?) Skamania Volcanic Series, which consists of basalt, andesite, and dacite flows and associated volcaniclastic material. The Skamania Volcanic Series formed a paleotopographic high in the Crown Point-Latourell, Oregon, area which later Columbia River Basalt Group (CRBG) flows surrounded but failed to cover. Flows of the Miocene CRBG within this area belong to the Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountains Basalt of the Yakima Basalt Subgroup. Thickness of the CRBG in this area ranges from 0 m to greater than 335 m at Multnomah Falls, Oregon. Because of pre-existing topography, regional deformation, and channel and canyon cutting by the ancestral Columbia River no one section contains all 22 CRBG flows that are found in this area. The Grande Ronde Basalt consists of five units recognizable on the basis of chemistry, paleomagnetic polarity, and lithology. These units are, from oldest to youngest, N_1 low-MgO unit, R_2 low-MgO unit, N_2 low-MgO unit, N_2 low-MgO Winter Water flow, and N_2 high-MgO unit. Few interbeds occur in the Grande Ronde section here along the northern margin of the CRBG, whereas the opposite is true for the southern margin in the Clackamas River area. The Wanapum Basalt consists of the Frenchman Springs and Priest Rapids Members. The Frenchman Springs Member is represented by five plagioclase-phyric to aphyric flows in the western half of this area. The Rosalia chemical type of the Priest Rapids Member is present in this area as a 220-m-thick intracanyon flow which overfilled a northwest-trending ancestral Columbia River channel at Crown Point, Oregon. The lower portion of this intracanyon flow consists of a thick, allogenic, bedded hyaloclastite deposit. The burial of the ancestral Columbia River channel by this intracanyon flow forced the Columbia River to shift northward and re-establish a new channel. Because this new channel, the Bridal Veil channel, of the ancestral Columbia River was only partially filled by an intracanyon flow of the Pomona Member of the Saddle Mountains Basalt, the Columbia River continued to occupy the Bridal Veil channel in post-Pomona time.

The Troutdale Formation in the thesis area was deposited by the ancestral Columbia River which occupied the Bridal Veil channel. This formation has been found to be divisible into lower and upper members. The lower member of the Troutdale Formation consists of quartzite-bearing, basaltic conglomerates and micaceous, arkosic sandstones which are confined to the Bridal Veil channel. Two Rhododendron lahars are also intercalated with the lower member conglomerates in the Bridal Veil channel. The upper member of the Troutdale Formation consists of vitric/lithic sandstones with minor basaltic conglomerates which contain Boring Lava clasts. Two Boring Lava flows are intercalated with the upper member, and Boring flows also cap the Bridal Veil channel in this area. Continued alluviation and Boring volcanism appear responsible for the final shift of the Columbia River to its present-day position. Field relationships now suggest the lower age of the Troutdale Formation is 12 million years. Circumstantial evidence suggests the upper age of this formation may be less than 2 million years.

The western end of the lower Columbia River Gorge appears to be relatively undeformed, with no major faults or folds discernible. This area has a relatively uniform 2° to 4° southwesterly dip attributable to Cascadian uplift. Stratigraphic evidence suggests that Cascadian uplift and erosion of the present-day gorge in this area may have begun as recently as 2 million years B.P. □

DOGAMI Governing Board adds new member

Sidney R. Johnson of Baker has been appointed by Governor Victor Atiyeh and confirmed by the Oregon Senate for a four-year term as member of the Governing Board of the Oregon Department of Geology and Mineral Industries. He succeeds C. Stanley Rasmussen, also of Baker, who was board chairman until his term ended on June 30.

Sidney R. Johnson (right) with Governor Atiyeh at swearing-in ceremony on April 27, 1983, in Salem.

Johnson is president of Johnson Homes in Baker. He is a graduate of Baker High School and, after serving in the U.S. Navy, attended the University of Washington and Eastern Oregon State College. He has served on the Baker City Council and as vice president of the Oregon Jaycees.

Serving with Johnson on the three-member board are Allen P. Stinchfield, a resident of North Bend and vice president of Menasha Corporation, Land and Timber Division; and Donald A. Haagensen, a Portland attorney and member of the law firm of Schwabe, Williamson, Wyatt, Moore, and Roberts. □

Salem meteorite to be on display at DOGAMI during October

Pieces of the Salem meteorite that fell on a house in Salem on May 13, 1981 (see *Oregon Geology*, v. 45, no. 6, p. 63-64) will be on display during the month of October in the Portland office of the Oregon Department of Geology and Mineral Industries. People wishing to see the pieces of meteorite should come to the main office, Room 1005, State Office Building, 1400 SW 5th, in downtown Portland. □

Check ownership of sand and gravel before planning development

Sand and gravel developers on private land in eastern Oregon and Washington should be certain that they own the materials before investing in development, according to William G. Leavell, Bureau of Land Management Director for the two states.

Leavell said that a recent U.S. Supreme Court decision confirms the fact that the sand and gravel is federally owned on land where only the surface is privately owned but where the U.S. has retained title to all coal and minerals in the original patent. This is the situation on 3.4 million acres in Oregon and 513,000 acres in Washington.

The decision deals with land passed from federal to private ownership under the Stock-Raising Homestead Act of 1916. A section of the act reserved federal title to all the coal and minerals. The key point is the Supreme Court confirmed that sand and gravel are minerals reserved to the U.S.

Leavell said, "This was the last of the homestead acts, providing for settlement of homesteads on land where the surface was chiefly valuable for grazing and raising forage crops."

Nationally, 33 million acres were transferred under the act to private owners who lived on the land for three years and made permanent improvements to increase the land's value for stock raising. In Oregon there were 8,282 such homesteads, and in Washington there were 1,600.

The recent ruling reversed a decision of the U.S. Tenth Circuit Court of Appeals in the case of James G. Watt, Secretary of the Interior, et al., petitioners v. Western Nuclear, Inc.

—BLM News

Member clubs of Oregon Council of Rock and Mineral Clubs listed

The following clubs are all members of the Oregon Council of Rock and Mineral Clubs, Inc. For more information about the Council and its activities, contact the Council's information officer, Harold Dunn, 91218 Donna Road, Springfield, OR 97477, phone (503) 746-3063. For information about specific clubs, contact the address given for that club.

Blue Mountain Gem and Mineral Club
504 N. Ave.
La Grande, OR 97850

Columbia Gorge Rockhounds
Rt. 2, Box 1380
Corbett, OR 97010

Columbia Rock and Gem Club
Rt. 5, Box 5838
St. Helens, OR 97051

Eugene Mineral Club
2708 Potter St.
Eugene, OR 97405

Far West Lapidary and Gem Society
PO Box 251
Coos Bay, OR 97420

Laneco Earth Science Organization
4057 Camellia St.
Springfield, OR 97477

Mile Hi Rock Rollers
936 No. 7th St.
Lakeview, OR 97630

Newport Agate Society
PO Box 411
Newport, OR 97365

Oregon Agate and Mineral Society
8242 SE 74th Ave.
Portland, OR 97206

Oregon Coast Agate Club
Box 293
Newport, OR 97365

Polk County Rockhound Society
233 NW Hillcrest Dr.
Dallas, OR 97338

Portland Earth Science Organization
2945 NE 108th
Portland, OR 97220

Rock and Arrowhead Social Club
PO Box 1803
Klamath Falls, OR 97601

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PO Box 1224
Grants Pass, OR 97526

South Douglas Gem and Mineral Club
PO Box 874
Myrtle Creek, OR 97457

Springfield Rock Club
PO Box 370
Springfield, OR 97477

Tek Rock Club
PO Box 491
Beaverton, OR 97075

Trails End Gem and Mineral Club
Rt. 3, Box 612
Astoria, OR 97103

Willamette Agate and Mineral Society
2511 Wayside Terr. NE
Salem, OR 97303 □

NEW DOGAMI PUBLICATIONS

NEW GEOLOGIC MAP OF BATES NE QUAD, EASTERN OREGON GOLD-MINING COUNTRY

A new geologic map of the northeastern portion of the Bates 15-minute quadrangle in eastern Oregon has just been published by the Oregon Department of Geology and Mineral Industries (DOGAMI). The new map, *Geology and Gold Deposits Map of the Northeast Quarter of the Bates Quadrangle, Baker and Grant Counties, Oregon*, by Howard C. Brooks, Mark L. Ferns, Greg R. Wheeler, and Dan G. Avery, has been released as Map GMS-29 in DOGAMI's Geological Map Series.

This new map is the latest eastern Oregon gold-country geologic map done by DOGAMI in cooperation with and funded in part by the U.S. Forest Service. Earlier maps of this series, which are also available from DOGAMI, include the Bullrun Rock, Rastus Mountain, Bourne, Mount Ireland, Granite, and Greenhorn 7½-minute quadrangles and the Mineral, Huntington, and Olds Ferry 15-minute quadrangles.

The new, four-color geologic map of the Bates NE quadrangle is at a scale of 1:24,000. It shows sedimentary, volcanic, and metamorphic geologic units that were deposited or formed over a period of time extending from the present day back to the pre-Permian (more than 280 million years ago). The geology of this area is very complex, and two cross sections are included to show the relationships of the 15 geologic units presented on the map.

Parts of this area have been mineralized, and the map covers the western part of the Greenhorn mining district. Shown on the map, therefore, are locations of numerous mines, prospects, and quartz veins. Included on the map sheet are a data table of mines and prospects, a list of references about the area, a table with chemical analyses of rock samples, and a discussion of mineral deposits in the Bates NE quadrangle. Cost of Map GMS-29 is $5.

RESULTS OF STREAM-SEDIMENT SAMPLING PROGRAM IN OCHOCO NATIONAL FOREST

The Oregon Department of Geology and Mineral Industries has released the results of a pilot program of geochemical surveying in the Ochoco National Forest. The report has been published as DOGAMI Open-File Report 0-83-4 and is entitled *Geochemical Survey of the Western Part of the Ochoco National Forest, Crook and Wheeler Counties, Oregon.*

The report consists of three parts: (1) a 38-page text discussing the geology and the mineral potential of the study area, sampling and analytical techniques used in the study, and computer-generated-element abundance maps; (2) a one-color map of the combined Lookout Mountain and Ochoco Reservoir 15-minute quadrangles, a nearby area of special interest, showing geology, sample locations, and analytical data; and (3) three microfiche containing raw data, statistical data, and sample location maps.

Funded by the U.S. Forest Service, the geochemical survey was conducted by DOGAMI staff members M.L. Ferns and H.C. Brooks in September and October of 1982. A total of 352 stream-sediment samples and 23 rock-chip samples were collected and analyzed for gold, silver, arsenic, copper, mercury, molybdenum, lead, and zinc. Results of the study show that geochemical sampling is an effective means to identify potential mineral resource areas for USFS land-use planning. Cost of Open-File Report 0-83-4 is $6.

NEW GEOLOGIC MAP OF WEST HALF OF VANCOUVER 1° BY 2° QUAD

A new geologic map published by the Oregon Department of Geology and Mineral Industries features about 55 million years of geologic history of Oregon's northwest corner, including the area of the Mist gas field and the coast from Seaside to Lincoln City. It is released jointly by DOGAMI and the U.S. Geological Survey.

The new map is published by DOGAMI as Open-File Report 0-83-6 in the Department's open-file series. Entitled *Preliminary Geologic Map of the West Half of the Vancouver 1° by 2° Quadrangle, Oregon*, the three-by-four-foot blackline map extends from Tillamook Head in the northwest to the edge of the Salem-Keizer area in the southeast. Produced in cooperation with the U.S. Geological Survey and funded in part by the Office of Coastal Zone Management, the map (scale 1:250,000) depicts 47 bedrock and surficial geologic units, reflecting the latest geologic thinking by leading scientists in the area and in universities of the region. Cost of Open-File Report 0-83-6 is $6.

All of the above publications may be purchased from the Portland office of the Oregon Department of Geology and Mineral Industries, 1005 State Office Building, Portland, OR 97201. All orders under $50 must include payment. □

New cartography fellowship available

The American Congress on Surveying and Mapping (ACSM) and the American Society of Photogrammetry (ASP) have announced a new fellowship, the John W. Pumpelly Fellowship Award in Cartography. The fellowship has been made possible through National Tire Wholesale, Inc. by John Reed Pumpelly and W. Pumpelly, topographic engineer and cartographer of the U.S. Geological Survey for more than 38 years.

The purpose of the award is to provide financial assistance to persons pursuing a full-time course of graduate study in cartography or a related field. The award consists of a $2,000 check to the recipient. Any member of the ACSM or ASP may apply. For details and application forms contact: Education Director, ACSM-ASP, 210 Little Falls Street, Falls Church, VA 22046.

—Design Graphics World

(**Fossil Cetacea**, *continued from page 98)*

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Thenius, E., 1969, Phylogenie der Mammalia. Stammesgeschichte der Säugetiere (einschliesslich der Hominiden): Berlin, Walter de Gruyter, 722 p.

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