THE ORE.-BIN

Volume 18, Nos. 1 to 12

1956
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STRATIGRAPHIC IMPLICATIONS OF SOME CENOZOIC FORAMINIFERA
FROM WESTERN OREGON

By R. E. Stewart

The stratigraphic sequence of fossil foraminifera in the Cenozoic of western Oregon and Washington is very similar to that of California. There are differences, of course, just as there are local variations within the two areas, but in a broad sense the resemblance is rather striking.

Due to the relatively few surface and well sections now available for use in published reports on the Pacific Northwest, as compared with California, it is impossible to zone the Cenozoic of Oregon and Washington in anywhere near the detail reported for the more arid oil-producing Cenozoic basins to the south. At the present time we have nothing comparable with Laiming's 16 detailed control sections and numerous well sections of Eocene strata (6++, p. 193), Goudkoff's well sections from 18 or 20 oil fields in west-side San Joaquin Valley Eocene to Pleistocene strata (6, p. 248), Kleinpell's 8 stratigraphic columns of central and southern California Miocene strata (6, p. 200), Ferguson's well sections from 17 oil fields in east-side San Joaquin Valley lower Miocene and Pliocene strata (6, p. 240), Wissler and Dreyer's 16,000 samples from oil fields in Santa Maria district middle Miocene to Pleistocene strata (6, pp. 235-237), and Wissler's 200,000 samples from Los Angeles Basin oil wells in middle Miocene to Pleistocene strata (6, p. 210).

During recent years, however, efforts to locate oil and gas have led to extensive detailed geological surveys and exploratory drilling in the Pacific Northwest by major oil companies. It is reasonable to assume that much of the information from these activities will eventually be released for publication, as has been the case in other explored areas (6++). In the meantime a very good general idea of local biostratigraphic relationships can be developed from scattered exposures and surface sections in the state.

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See bibliography.
The present paper is preliminary to the publication of more comprehensive studies which have been in progress over a period of years (10, pp. 3-4; 13, pp. 61-62; 19, pp. 32-33). It deals with apparent biostratigraphic relationships of only a few species of Cenozoic foraminifera from Oregon. Lists of species from several publications are given, but the inclusion of species in these lists does not necessarily indicate that they are restricted to the stratigraphic ranges covered by the publications from which they are taken.

No new formational names are proposed and no attempt is made to pass upon the merits of those that are already in the geological literature of the state. This paper is based primarily upon Pleistocene and Pliocene formations in the Cape Blanco area (see index map), Miocene in and near Astoria and Newport, Oligocene near Newport and Cape Arago, upper Eocene near Cape Arago, questionable upper or middle Eocene in Mill Creek (Polk County) and at Sacchi Beach south of Cape Arago, and middle Eocene near Comstock, Elkton, Glide, Basket Point, and Remote. Reference is made to other areas.

The basis for stratigraphic control is shown in figure 1 (see page 3). It is realized that the section as outlined is rather generalized, that there may be differences of opinion as to detail, and that future studies may result in considerable refinement and revision, but it is believed that the general stratigraphic sequence is approximately correct.

**PLEISTOCENE**

Elk River formation: Only one species of foraminifera, *Elphidiella hannai* (Cushman and Grant), has been observed in Pleistocene samples collected by the writer. However, Cushman and Grant (2, p. 79) named another, *Elphidiella oregonensis* (Cushman and Grant), from a sea-cliff locality 3 miles south of Cape Blanco, and Bandy (12, p. 272) listed 15 species, 5 of which were new, from two localities south of Cape Blanco. Bandy listed the following species from two foraminiferal zones which he recognized.
in this area. They are listed according to their relative abundance, considering the entire foraminiferal fauna as constituting one hundred percent.

Rotalia tenerrima zone

Rotalia tenerrima Bandy 18%, Discorbis ornatissimus var. oregonensis Bandy 15%, Elphidium granulosum (Galloway & Wissler) 13%, Cibicides lobatus (d'Orbigny) 10%, Elphidiella hannai (Cushman & Grant) (weathered and reworked) 10%, Rotalia subcorpulenta Bandy 10%, Cassidulina limbata (Cushman & Hughes) 5%, Fissurina lucida (Williamson) rare, Globigerina bulloides d'Orbigny rare, Quinqueloculina akneriana var. bellatula Bandy rare, Uvigerina bradyana Cushman rare.

Elphidiella zone

Elphidiella hannai (Cushman & Grant) 86%, oregonensis (Cushman & Grant) 5%, Elphidium hughesi Cushman & Grant 2%, Eponides blancoensis Bandy 2%, Nonionella basispinata (Cushman & Moyer) 2%, Quinqueloculina akneriana var. bellatula Bandy 2%, Cassidulina limbata (Cushman & Hughes) rare, Cibicides lobatus (d'Orbigny) rare, Elphidium granulosum (Galloway & Wissler) rare, Globigerina bulloides rare.

It is noted that the faunas of these zones indicate a very shallow cool-water type of environment.

Both of the Elphidiellas and Elphidium hannai occur in the upper Wildcat formation of Humboldt County, California, which appears to have been deposited under somewhat similar depth and temperature conditions during late Pliocene time.

PLIOCENE

Port Orford formation (middle or upper Pliocene): The only Oregon Pliocene strata from which foraminifera have been reported has a thickness of about 150 feet according to Bandy (12, p. 271), who lists the following foraminiferal fauna from the Port Orford formation: Elphidiella hannai (Cushman & Grant) 60%, Nonionella basispinata (Cushman & Moyer) 15%, Eponides frigidus (Cushman) 5%, blancoensis Bandy 3%, Gaudryina arenaria Galloway & Wissler 3%, Nonionella miocenica Cushman 3%, Textularia abbreviata d'Orbigny 3%, Polymorphina oregonensis Bandy 2%, Buliminella elegantissima d'Orbigny 1%, Cibicides lobatus d'Orbigny 1%, Marginulina glabra d'Orbigny 1%, Robertina californica Cushman & Parker 1%, unidentified fragments 2%.
Bandy states that this fauna correlates rather well with the Pliocene foraminifera of Humboldt County, California, and indicates a very shallow, cool environment of deposition.

**Empire formation (lower Pliocene):** In the Cape Blanco area the Empire formation is approximately 400 feet thick and contains a molluscan megafauna, but no foraminifera.

**Miocene**

The writer knows of no occurrence of marine sediments containing upper Miocene foraminifera in Oregon. The lower Montesano formation of Washington is probably of this age.

**Astoria formation (middle Miocene):** The Astoria foraminiferal fauna appears to be that of Kleinpell's upper Saucesian Stage, which may be uppermost lower Miocene in age (5, fig. 14). In this paper, however, the Astoria formation appears as middle Miocene in conformity with past general usage in the Pacific Northwest. The city of Astoria, Oregon, at the mouth of the Columbia River, is the type locality for both the Astoria formation of Oregon and Washington and the Miocene of the west coast (1, p. 293).

In pointing out the resemblance between the Astoria fauna and the fauna of his upper Saucesian Stage, Kleinpell lists the following species (4, p. 17; 5, p. 70): Anomalina (?) sp., Bolivina marginata Cushman, Bulimina inflata var. alligata Cushman & Laiming, Cassidulina limbata Cushman & Hughes, Cibicides floridanus (Cushman) ?, Dentalina pauperata d'Orbigny, D. quadrata Cushman & Laiming, Orbula universa d'Orbigny, Pulvinulinella parva Cushman & Laiming, Robulus americanus var. spinosus Cushman, R. simplex (d'Orbigny), R. warmani Barbat & von Estorff, Siphogenerina branneri (Bagg), S. kleinpellii Cushman, S. transversa Cushman, Sphaeroidina bulloides d'Orbigny.

The following species from an exposure of Astoria shale at Tenth Street and Harrison Avenue in Astoria was published by Cushman, Stewart and Stewart (10, pp. 12-39): Angulogerina astoriensis Cushman, Stewart and Stewart, Anomalina glabrata Cushman, Bolivina advena Cushman and Kleinpell, B. marginata Cushman var. adelaidana Cushman and Kleinpell, Bulimina alligata Cushman and Laiming, B. ovata d'Orbigny, Bulimina subfusciformis Cushman, Cancris cancriformis (Kleinpell), Cassidulina cf. globosa Hantken, C. laevigata d'Orbigny var. carinata Cushman, C. modeloesis Rankin, Cibicides floridanus (Cushman), Cyclammina incisa (Stach), Dentalina pauperata d'Orbigny, D. quadrulata Cushman and Laiming, Eponides healdi R. E. and K. C. Stewart, E. umbonatus (Reuss), Marginulina cf. dubia Neugeboren, Nadogenerina advena Cushman and Laiming, N. sp., Nodosaria anomala Reuss, N. parexilis Cushman and K. C. Stewart, Nonion cf. belrigense Barbat and Johnson, Planulina astoriensis Cushman, Stewart and Stewart, P. mexicana Cushman, Plectofrondicularia californica Cushman and R. E. Stewart, P. miocenica Cushman var. directa Cushman and Laiming, P. sp., Robulus cf. calcar (Linne), R. nikoborensis (Schwager), R. sp., Saracenaria cf. acutaullaricis (Fichtel and Moll), S. sp., Siphogenerina branneri (Bagg), S. kleinpellii Cushman, Sphaeroidina cf. bulloides d'Orbigny, Uvigerina subperegrina Cushman and Kleinpell, Valvulineria araucana (d'Orbigny).

In the vicinity of Depoe Bay and farther south along the coast between Otter Rock and Newport are other beds of Astoria age which have usually been referred to by authors as Astoria or "Astoria." Herron (18, pp. 17, 71), in a recent unpublished Masters thesis, has proposed...
the name Agate Beach formation for these beds. He gives the following list of foraminifera:

Angulogerina astorienesis Cushman, Stewart and Stewart, Bolivina advena Cushman, B. astorienesis Cushman, Stewart and Stewart, B. basisenta Cushman and Stone, Bulimina ovata d'Orbigny, B. pyrula d'Orbigny, Buliminella bassendorfensis Cushman and Parker, B. elegansissima d'Orbigny, Cassidulina laevigata d'Orbigny var. carinata Cushman, Cyclammina cancellata Brady var. obesa Cushman and Laiming, Cyclammina incisa (Stach), C. cf. simiensis Cushman and McMasters, C. sp., Eponides mansfieldi Cushman var. oregonensis Cushman, Stewart and Stewart, Globigerina bulloides d'Orbigny, Lagena acuticosta Reuss, L. costata (Williamson), Nonion costiferum (Cushman), N. incisum (Cushman), Nonionella miocenica Cushman, Pseudoparrella parva (Cushman and Laiming), Pygo sp., Quinquiloculina cf. vulgaris d'Orbigny, Q. sp., Robulus americanus (Cushman), R. nikkobrensiis (Schwager), R. cf. orbicularis (d'Orbigny), R. sp., Uvigerina subperegrina Cushman and Kleinpell, Virgulina punctata d'Orbigny.

Thirteen of the species in Herron's list had been recorded previously from Agate Beach by Cushman, Stewart and Stewart (10, pp. 43-55). They recorded one other species, Virgulina californiensis Cushman.

Nye shale (lower Miocene): In the area northward from Yaquina Bay toward Otter Rock, the "Astoria" beds for which Herron has proposed the name Agate Beach formation are underlain by other beds which have been variously called Nye shale, Nye mudstone, and Nye formation.

Kleinpell (4, p. 18; 5, p. 70) lists the following species from the Nye shale near Newport, of which he writes, "The closest affinities of the Nye shale Foraminifera are with the fauna from the 'Middle Member' of the Rincon shale in Los Sauces Creek, Ventura County, California..."

Bolivina advena Cushman, B. marginata Cushman, Bulimina pyrula (d'Orbigny), Buliminella curta Cushman, B. subsuffisformis Cushman, Cassidulina laevigata var. carinata Cushman, Globulina laevigata d'Orbigny, Globigerina bulloides d'Orbigny, Lagena perlucida (Montagu), Nodogenerina advena Cushman and Laiming, Nonion costiferum (Cushman), N. incisum (Cushman), Nonionella miocenica Cushman, Pseudoparrella parva (Cushman and Laiming), Pygo sp., Quinquiloculina cf. vulgaris d'Orbigny, Q. sp., Robulus americanus (Cushman), R. nikkobrensiis (Schwager), R. cf. orbicularis (d'Orbigny), R. sp., Uvigerina subperegrina Cushman and Kleinpell, Virgulina punctata d'Orbigny.

Heacock (16, pp. 4-5, 15) lists 40 species from the upper 2325 feet of the Nye formation. His list contains all of Kleinpell's species except Lagena perlucida (Montagu), but he refers Bulimina pyrula d'Orbigny, Bolivina marginata Cushman, Globulina laevigata d'Orbigny, and Virgulina bramletti Galloway and Morrey of Kleinpell's list to Bulimina ovata d'Orbigny, Bolivina marginata var. adelaidana Cushman and Kleinpell, Pseudoglabulina laevigata (d'Orbigny), and Virgulina californiensis Cushman respectively.

The species from Kleinpell's list which are common to both Heacock's and Kleinpell's lists are not repeated in the following list from Heacock's thesis: Anomalina glabrata Cushman, Bulimina alligata Cushman and Laiming, Cassidulina margareta Karrer, Cyclammina cf. cancellata H. B. Brady var. obesa Cushman and Laiming, Dentalina cf. isidroensis Cushman and Renz, D. subspina Neugeboren, Ellipsolagena bidens Cushman, Elphidium minutum (Reuss), Eponides mansfieldi Cushman var. oregonensis Cushman, Stewart and Stewart, Gyroidina soldanii d'Orbigny, Hemicristellaria (?) beali (Cushman), Lagena striata (Egger), L.
strumosa Reuss, Marginulina dubia Neugeboren, Nodogenerina lapidula (Schwager), Nonionella miocenica Cushman, Plectofrondicularia californica Cushman and Stewart, P. vaughani Cushman, Pseudoparrella parva (Cushman and Laiming), Robulus incornatus (d'Orbigny), R. nikobarenis (Schwager), Triloculina sp., Uvigerina beccarii Fornasini, U. subperegrina Cushman and Kleinpell.

Heacock concludes that the 2325 feet of the Nye formation which is covered by his thesis "... is 'Oligo-Miocene' in age, and represents at least part of the lower Saucesian Stage as that term is used in the California Miocene." Kleinpell's Saucesian Stage is part of the lower Miocene of his middle Tertiary section of California. (To be continued.)

NOLAN HEADS GEOLOGICAL SURVEY

Dr. Thomas B. Nolan has been appointed Director of the U.S. Geological Survey to succeed Dr. William E. Wrather, who is retiring. Dr. Nolan has been Assistant Director since December 1944 and with the Survey since 1924. In recent years he has been in charge of the Survey's studies of tungsten deposits in this country. Dr. Nolan is past president of the Society of Economic Geologists and a member of many scientific and professional organizations.

BROGAN TO HEAD METEOR STUDIES

Phil F. Brogan of Bend, Oregon, has been appointed Pacific Northwest Regional Director of the American Meteor Society, a position formerly held by the late J. Hugh Pruett, whom Brogan for many years assisted. Mr. Brogan is Associate Editor of the Bend Bulletin, and is widely known for his column on geological subjects which appears each Sunday in The Oregonian. As regional director of the AMS, he will be in charge of determining the paths of meteors in Oregon, Washington, Montana, Idaho, and northern California, and will supervise studies and research on meteoric astronomy.

VOLUME III OF MINERALS YEARBOOK AVAILABLE

Volume III of the U.S. Bureau of Mines Minerals Yearbook for 1952 is now available. This 1050-page book is made up of chapters covering the mineral industry of each of the forty-eight states, Alaska, and the Territories and possessions. It was prepared through the cooperation of industry and the various state geological surveys and mining bureaus. Volume III may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. The price is $3.75, cloth bound. Volume I on mineral commodities, priced at $4.00, and Volume II on mineral fuels, priced at $2.25, were published in 1955 and are also available from the Superintendent of Documents.
LAND WITHDRAWN ALONG ROGUE RIVER

The U.S. Bureau of Land Management has recently withdrawn or, within the next few months, will attempt to withdraw from mineral exploration a total of 23,248.73 acres of public land (see map) along the Rogue River in southwestern Oregon. Purpose of the withdrawals, according to Virgil T. Heath, State Supervisor of the Bureau of Land Management, "... is to ban mining claims and other forms of entry under the public land laws except the lease and sale of public domain lands under the terms of the Recreation Act of June 14, 1926." Since the land to be withdrawn is in a region long known for its mineral potential, a conflict results with the interests of prospectors and miners.

For more than thirty years power site withdrawals have prevented the location of mining claims on these lands along the Rogue River but the Mining Claims Rights Restoration Act of 1955 passed by the last session of Congress would have reopened them to mineral exploration. Government agencies, it would appear, anticipated passage of the bill and resorted to the "recreational withdrawal" so that they still might have complete control over the area and prevent possible mining. The necessity for continued mineral development on the public lands to maintain the long-range economy of a region and to insure national security is apparently being overlooked by these Federal bureaus and the organizations who feel that the "wilds" should not be disturbed except on weekends and holidays.

The withdrawals in the Rogue River area are being made in three separate actions. One notice (embracing 10,000 acres) was published in the Federal Register around the middle of 1955. Because no protests were received, the withdrawal was made. The lack of protests is not surprising for the Federal Register has a limited distribution and is seen only by a few people. Beginning July 1955, the Bureau of Land Management was supposed to give wider publicity to its official actions (see The Ore.-Bin, August 1955, page 64). The second notice of withdrawal, announced in the Federal Register and the press December 1955, resulted in protests from many interested parties, including the Oregon Mining Association and the Grants Pass and Josephine County Chamber of Commerce. It seems quite likely that hearings will be held on
this withdrawal according to a news article in the January 23, 1956, Grants Pass Courier. Whether or not they will be held is entirely up to the discretion of the State Supervisor of the Bureau of Land Management. The third notice of withdrawal has not been published but an application by the U.S. Forest Service for withdrawal has been filed with the Manager of the Land Office and this is sufficient to prevent location of mining claims until the withdrawal has been acted upon. When this notice is published it is hoped that the Bureau's revised method for giving publicity will be strictly adhered to rather than the minimum announcement made in December. Only by letting the people know what is being done with their land can sound public land policy be determined with any degree of satisfaction to the public.

Withdrawal of public lands has reached such proportions that the House Interior and Insular Affairs Committee is holding hearings to investigate the real needs of the various agencies of the Government. According to the Mining Congress Journal the Assistant Secretary of Interior for Land Management, Wesley A. D'Ewart, has halted the processing of all requests for land withdrawals, pending outcome of the hearings. The halt appears not to have been recognized in the local echelons of Government, however, for already this month three notices, in addition to those along the Rogue River, of Oregon withdrawals, totaling 9,634.13 acres, have been published in the Federal Register. These withdrawals are not in known mineralized areas.

H.M.D.

HOLDING OF GOLD COINS MAY BE RELAXED

According to an article in the January 4 Wall Street Journal the Treasury Department will soon announce that United States citizens can hold as many gold coins as they choose. If this announcement is made, it will acknowledge a situation that has been evident for some time: it is not practical to enforce the law prohibiting holding of all gold coins except those that are rare or unusual. Following passage of the April 5, 1933, law ordering surrender of gold coins, bullion, and certificates, the government soon found it very difficult and expensive to determine what was a rare or unusual coin. By the summer of 1952, attempts to police the holding of gold coin were practically nil and a new order was issued allowing collectors to import coin, provided it was minted before 1933. In 1954 export of gold coin was legalized.

The easing of the 1933 law is interpreted by Mitchell Gordon of the Wall Street Journal as another sign of gold's growing freedom in a world market. Earlier trends toward a "free" world gold market are Belgium's action in reopening of a "free" market January 3, 1956, a similar action by Britain early in 1954, and the liberalizing of gold trading rules in West Germany, France, and Italy. Increased confidence in local currencies is given as a factor in the relaxing of gold restrictions outside the United States.

The January 1956 Engineering and Mining Journal quotes Pick's World Currency Report on the world's price of "free" gold per fine ounce as follows:

<table>
<thead>
<tr>
<th>Coins</th>
<th>Bars</th>
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<tbody>
<tr>
<td>Dec. 31</td>
<td>Dec. 31</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>$40.75</td>
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<tr>
<td>Bombay</td>
<td>51.75</td>
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<tr>
<td>Paris</td>
<td>42.10</td>
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<tr>
<td>Manila</td>
<td>40.25</td>
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<tr>
<td>Tangier</td>
<td>40.00</td>
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Note: Prices are computed at the free or black market value of the U.S. dollar in the local markets.