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Middle and upper Eocene biostratigraphy (Foraminifera) of the Cascade Head area, Lincoln and Tillamook Counties, Oregon

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TO THE OFFICE OF GRADUATE STUDIES AND RESEARCH:

The members of the Committee approve the thesis of
Arden D. Callender, Jr. presented January 27, 1977.

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AN ABSTRACT OF THE THESIS OF Arden D. Callender, Jr. for the
Master of Science in Geology presented January 27, 1977.

Title: Middle and Upper Eocene Biostratigraphy (Foraminifera)
of the Cascade Head Area, Lincoln and Tillamook
Counties, Oregon.

APPROVED BY MEMBERS OF THE THESIS COMMITTEE:

Richard E. Thoms, Chairman

John Eliot Allen

Joseph J. Kohut

An almost complete sequence of middle and upper marine strata, informally designated in this study as the "Strata of Cascade Head", has yielded 334 species and varieties of fossil Foraminifera. The Foraminifera were collected from 38 localities in four stratigraphic sections measured along the Salmon River, Neskowin Creek, Cascade Head Road, and near the town of Three Rocks in the central Oregon Coast Range. Five species and one variety included within the genera *Dentalina*, *Elphidium*, *Nodosaria* (?), *Nonion*, *Uvigerina*,

and *Vulvulina* are described as new but are not formally designated. *Chilostomelloides eocenica* and *Triloculina tricarinata* are reported for the first time from Eocene deposits on the West Coast.

Ecologically diagnostic Foraminifera indicate that the majority of this sequence was deposited at depths comparable to the upper continental slope, although at times marine deposition fluctuated between middle neritic and middle bathyal depths. While benthonic forms suggest cool bottom conditions, the diversity of planktonic species indicate warm surface temperatures and generally open connections with ocean currents.

The lower portion of the Neskowin Creek Section is assigned to the upper Ulatisian Stage (*Amphimorphina californica* Zone) of Mallory whereas the balance of the "Strata of Cascade Head" can be correlated with Mallory's lower Narizian Stage (*Bulimina corrugata* Zone). Also, the *Uvigerina garzaensis* Subzone is recognized for the first time north of California in the Neskowin Creek Section. The "Strata of Cascade Head" correlates in part or as a whole in Oregon with the Coaledo? Formation of Baldwin, the Eocene beds at Cape Arago, the Moody Shale Member of the Toledo Formation, the Elkton Siltstone, Lorane Siltstone, and Sacchi Beach Members of the Tyee Formation, and the Yamhill Formation. In Washington it correlates with the Aldwell Formation, possibly the Crescent Formation, the Boundary Shale

Member of the Lyre Formation, the "Maynard Formation" of Thoms and Allison, and the McIntosh Formation. Californian equivalents include the Butano Formation, the Canoas Siltstone Member of the Kreyenhagen Formation, the Cozy Dell Shale, the Domengine Sandstone, the Markley Sandstone, the Matilija Formation, the Muir Sandstone, the Nortonville Shale, the Poway Conglomerate, and the Vacaville Shale.

MIDDLE AND UPPER EOCENE BIOSTRATIGRAPHY (FORAMINIFERA)
OF THE CASCADE HEAD AREA,
LINCOLN AND TILLAMOOK COUNTIES, OREGON

by

ARDEN D. CALLENDER, JR.

A thesis submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE
in
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INTRODUCTION

The Coast Range of Oregon is composed of a complex of deeply dissected, steep sided ridges that roughly parallels the Oregon Coast, and extends inland for 50 miles to the Puget-Willamette Trough and from the Columbia River southward some 250 miles to the Klamath Mountains. Deep weathering, landslides, and dense vegetation over much of the area obscure most of the underlying rocks and limit their exposure to stream beds and sea cliffs along the coast. In the vicinity of Cascade Head, on the western flanks of the central Oregon Coast Range, a structurally uncomplicated almost complete sequence of Eocene rocks is exposed along Neskowin Creek (Fig. 1-A). The sequence includes in ascending stratigraphic order, upper portions of the Siletz River Volcanic Series, "Strata of Cascade Head" of this report, and the volcanics of the Nestucca Formation.

Detailed geologic mapping of the intervals exposed for 3.5 miles along Neskowin Creek was accomplished during the Summer and Fall of 1972-74. The major stratigraphic section (Fig. 1-A), nearly 3650 feet thick, was measured on a traverse along the creek by Brunton compass and tape, using the United States Geological Survey Map OM 97 (Snively and Vokes, 1949) as a base. Because upper and

FIGURE 1. INDEX MAP

lower contacts with the "Strata of Cascade Head" were not exposed in this section, three supplementary sections were measured in adjacent areas where the contacts are more clearly defined. On such section was measured along the Salmon River (Fig. 1-B) where the lower contact with the Siletz River Volcanic Series is exposed. Farther to the west, contacts with the overlying volcanics of the Nestucca Formation were observed and sections were measured near the town of Three Rocks and on Cascade Head Road (Fig. 1-C,D).

Initially, 124 samples were collected from the Cascade Head area for this study. Finer-grained samples were disaggregated by the kerosene-water technique. More indurated samples, cemented by calcite, were broken down in a soil disaggregator. One hundred fifty grams of each sample was disaggregated, washed, and inspected for fossil content. Thirty percent of the samples (38 of the 124 samples) contained well preserved foraminiferal assemblages suitable for a biostratigraphic study.

These foraminiferal assemblages were evaluated in an attempt to gain further information pertaining to the geologic age, environment of deposition, and correlation of rocks designated in this investigation as the "Strata of Cascade Head". In addition, an effort was made to refine the local stratigraphic and structural problems in the area, and to a lesser degree, to investigate the physical relationships between these rocks and others

exposed within the Cascade Head area.

Regionally, the relatively uncomplicated sequence exposed in the Cascade Head area is important for its occurrence along the southern margin of a thick, complex sequence of Eocene volcanics named the Tillamook Volcanic Series. Knowledge of the biostratigraphy of the "Strata of Cascade Head", which is in part equivalent to the Tillamook Volcanic Series, should therefore aid in understanding the more complex stratigraphy of this vast accumulation of Eocene volcanics in northwestern Oregon.

GEOLOGY

Introduction

A sequence of more than 3630 feet of marine sedimentary and volcanic rocks comprising the "Strata of Cascade Head" and portions of the underlying Siletz River Volcanic Series and overlying volcanics of the Nestucca Formation is exposed in the vicinity of Cascade Head on the western flanks of the central Oregon Coast Range. The Siletz River Volcanic Series form rugged highlands and steep slopes in the eastern part of the area while gentler slopes are developed on the deeply weathered sediments of the "Strata of Cascade Head". Farther to the west, the volcanics of the Nestucca Formation form the prominent headland of Cascade Head. Exposure of these units within the Cascade Head area is almost entirely restricted to the two major westward flowing streams (Salmon River and Neskowin Creek) that traverse the area.

The Coast Range Province is composed of a series of gently folded Tertiary marine sedimentary and volcanic rocks which, east of the Cascade Head area, has been uplifted into a broad anticlinorium. In the central Oregon Coast Range, the Siletz River Volcanic Series and the Tyee Formation to the south form the central core of this structural high. Unconformably overlying these early

Tertiary sequences is a series of predominately marine sedimentary and volcanic rocks which is exposed on the flanks of the upwarp. On the eastern flank, the Tyee Formation grades laterally to the north into sediments of the Yamhill Formation. Numerous west-dipping sequences, ranging in age from middle Eocene to Miocene, are exposed on the western flank and form a narrow band that parallels the Oregon Coast. Basaltic dikes and sills of probable Miocene age (Snively and Vokes, 1949) occur abundantly throughout the area.

The areal extent of the "Strata of Cascade Head" appears to be quite limited. Its occurrence is essentially restricted to an area between Neskowin Creek and the Salmon River in Sec. 29 and 30, T6S, R9W. Strata of equivalent age, but different lithology, are exposed to the north along the Nestucca River and to the south near Devils Lake. Snively, MacLeod, and Wagner (1972) include these sequences within the "Yamhill Formation". East of the Cascade Head area, more typical sediments of the Yamhill Formation crop out along the eastern margins of the central Oregon Coast Range. Presumably the "Strata of Cascade Head" are either interbedded with or grade laterally into all of the aforementioned units. Further detailed geologic mapping may help resolve the nature of these contacts and the true areal extent of the "Strata of Cascade Head".

The thickest, most complete section of the "Strata of Cascade Head" is exposed along Neskowin Creek. Although

the subjacent and superjacent units are exposed in the section, the contacts with them are covered, and consequently are best described in areas to the east and west of the creek (Fig. 1-B,C,D). The "Strata of Cascade Head" rest with apparent unconformity upon volcanic breccias of the Siletz River Volcanic Series in both the Neskowin Creek and Salmon River Sections. This interpretation is strengthened by the presence of a basal sandstone unit within the "Strata of Cascade Head" in the Neskowin Creek Section, that directly overlies the volcanic breccias and contains numerous basaltic fragments of a composition similar to that of the underlying Siletz River Volcanic Series. At the mouth of the Salmon River near the town of Three Rocks, basaltic breccias of the volcanics of the Nestucca Formation unconformably overlie the "Strata of Cascade Head". Snavely (personal communication, 1976) reports a regionally recognizable unconformity, representing a major period of mid-to-late Eocene deformation and erosion, at the base of the Nestucca Formation. Evidence for this mid-to-late Eocene unconformity within the local area cannot be substantiated. Although the samples collected below the contact contained abundant Foraminifera, samples collected from sedimentary interbeds within the volcanics lacked diagnostic Foraminifera.

The dominant structural feature within the Cascade Head area consists of a northeast plunging anticline whose

axis lies just east of the town of Dolph (Snively and Vokes, 1949). The regional strike parallels this fold axis and strata exhibit gentle dips on either side of the fold; dips average less than 20° to the southeast and northwest.

Secondary folding on the western flank is evidenced in the increased outcrop thicknesses as noted by Snively and Vokes (1949), and in a series of minor folds mapped along Neskowin Creek by the present author. Only minor faulting affects the major section along Neskowin Creek. The continuity of foraminiferal samples across numerous covered intervals lends support to this interpretation.

In the following discussion, all thicknesses refer to stratigraphic thickness unless otherwise noted. Rocks were identified in hand specimen except in a few cases in which thin sections were examined. Lithologic descriptions are depicted graphically in Figures 4 and 5 (Fig. 4 in pocket). For further detailed descriptions of the petrology of the rocks in the central Oregon Coast Range the reader is referred to the works of Snively and Baldwin (1948), Snively and Vokes (1949), Snively and Wagner (1961), (1964), and Snively, MacLeod, and Rau (1969a).

Siletz River Volcanic Series

The Siletz River Volcanic Series was defined and described by Snively and Baldwin (1948) as a sequence of basalt flows, pillows, flow breccias, pyroclastics, and minor amounts of water-laid tuff exposed along the Siletz

River in the Euchre Mountain and Valsetz Quadrangles and adjacent areas. The base of the sequence is not exposed, but estimates of thickness range from approximately 500 feet in the southwest corner of the Sheridan Quadrangle to more than 10,000 feet in the Mary's Peak area (Baldwin, *et al.*, 1955). This unit, in conjunction with portions of the Tillamook Volcanic Series to the north and volcanics of the Umpqua Formation to the south, represents the oldest rocks exposed in the Oregon Coast Range and the major result of early Tertiary submarine volcanism in Oregon.

In the Cascade Head area, the Siletz River Volcanic Series forms a distinctive base for sections measured along Neskowin Creek and the Salmon River. Approximately 60 feet of olive-black¹, basaltic breccia, referable to this unit, is exposed in a number of small isolated outcrops along Neskowin Creek east of the bridge over the creek, three-fifths of a mile east of Neskowin Creek Campground. The outcrops characteristically lack bedding and commonly are cut by many thin, discontinuous calcite and zeolite veinlets. Exposures are deeply weathered and support a luxuriant growth of mosses and ferns. The first outcrop of the "Strata of Cascade Head" is exposed 29 feet west of the breccia. The southern portion of an extensive basaltic sill is exposed along the creek east of the breccia after

¹Color terms in this paper follow the Geological Society of America Rock-color chart (Goddard, 1970).

approximately half a mile covered interval.

In contrast to the Neskowin Creek Section, approximately 5000 to 6000 feet of rocks referable to the Siletz River Volcanic Series (Snively and Vokes, 1949) are exposed along the Salmon River which traverses the southern part of the Hebo Quadrangle. In the SE $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 30, T6S, R9W, less than 10 feet of basaltic breccia unconformably underlie the "Strata of Cascade Head". The breccia is well-bedded, olive-black in color and contains smaller basaltic fragments than those observed in the breccias exposed along Neskowin Creek. To the west it grades rapidly into numerous basalt flows which characterize the rest of the sequence exposed along the Salmon River.

A few samples collected from the finer-grained breccias were examined for foraminiferal content, but were found to be completely devoid of microfossils. However, foraminiferal assemblages as well as megafossils have been reported from sedimentary interbeds within the Siletz River Volcanic Series to the east and south of the Cascade Head area (*e.g.* Snively, MacLeod, and Rau, 1969a). Faunae from the sedimentary interbeds indicate that the volcanics are referable to Mallory's (1959) Ulatisian and possibly Penutian Stages.

"Strata of Cascade Head"

The first comprehensive geological report of the coastal area between Cape Kiwanda and Cape Foulweather was

published by Snavely and Vokes in 1949. In the report, they proposed the name Nestucca Formation to include a sequence of "brackish water and marine siltstone and claystone, sandstone, and intercalated volcanic material" which overlies the Siletz River Volcanic Series and Burpee (Tyee) Formation. A complete section is not exposed but estimates of thickness were approximately 7000 to 8000 feet in the Hebo Quadrangle. Two type sections were designated as occurring "along the north bank of the Salmon River from Otis to Three Rocks and in roadcuts along the north side of Nestucca Bay."

Initially, the present investigation was undertaken to evaluate foraminiferal assemblages from the type Nestucca Formation. Unfortunately the two type sections designated by Snavely and Vokes (1949) were not suitable for a biostratigraphic study; the section along the Salmon River is frequently obscured by landslides and the outcrops to the north on Nestucca Bay are noncontinuous, deeply weathered, and generally lack Foraminifera. However, between the two sections, a thick sequence of marine sedimentary and volcanic rocks, originally referable to the Nestucca Formation, is exposed along Neskowin Creek. The main emphasis of this study was placed upon these sedimentary rocks that comprise the lower member of the Formation.¹

¹Prior to Snavely's redesignation, the Nestucca Formation within the Cascade Head area was subdivided into three informal units by this author; a sedimentary lower member, a volcanic middle member, and a sedimentary upper member.

Subsequently, Snively (personal communication, 1976) has restricted the use of the term Nestucca Formation to include only the middle and upper members exposed to the northwest of the measured sections. The lower member is assigned to the "Yamhill Formation". Thus, strata previously mapped as the lower Nestucca Formation (Snively and Vokes, 1949) along the coast between Cape Kiwanda and Cape Foulweather are now referable to the "Yamhill Formation" of Snively, MacLeod, and Wagner (1972). It should be noted however, that rocks assigned to the "Yamhill Formation" of Snively, *et al.* (1972) which occur immediately to the north and south of the Cascade Head area, differ somewhat from the sediments of the type Yamhill Formation exposed some 25 miles to the east along Mill Creek. Strata of the type Yamhill Formation are predominately massive to thick-bedded and weather to a reddish-brown color whereas the outcrops along the Nestucca River and near Devils Lake are typically thin-bedded, more tuffaceous, and weather yellow-orange. These differences were observed during a reconnaissance of the areas surrounding Cascade Head and not as a result of detailed geologic mapping. The regional relationships between these units is unknown and beyond the scope of the present investigation.

The sequence exposed in the vicinity of Cascade Head however, differs conspicuously from both the sediments of

the type Yamhill Formation and strata referable to the "Yamhill Formation" of Snavely, *et al.* (1972) exposed to the north and south of the Cascade Head area. These rocks are decidedly more coarse-grained and have been strongly influenced by probable contemporaneous volcanism. In the type section along Mill Creek, the Yamhill Formation is composed of primarily siltstone and mudstone with lesser amounts of basaltic sandstone exposed in the middle and at the base of the section (Gaston, 1974, p. 12-14). Outcrops exposed to the north and south of the Cascade Head area consist primarily of thin-bedded, tuffaceous siltstone and mudstone. In contrast, most of the sequence exposed along Neskowin Creek is characterized by coarse to medium-grained sandstones that occur repeatedly throughout the section. Low in the sequence the sandstones are calcareous and often contain basaltic fragments. Above this is a small interval of micaceous, arkosic sandstone that rapidly grades upward into a thick sequence of volcanic wackes and graywackes which constitute the bulk of the section. Evidence of contemporaneous volcanism is reflected in the basaltic debris and tuffaceous composition of the volcanic wackes and graywackes. Flows of basaltic lava, volcanic breccia, basaltic tuff, and occasional ash beds are also interbedded with the clastics. Finer-grained sediments consisting of well-indurated, tuffaceous siltstones and mudstones, although frequently consisting of thick

sequences near the base of the section, are commonly interbedded with sandstones throughout most of the interval. Towards the top of the sequence rhythmically-bedded mudstone and volcanic sandstone become increasingly persistent. Most of the sediments exposed along Neskowin Creek, as well as the strata exposed to the north and south of the area, are characteristically thin-bedded and differ from the more massive to thick-bedded appearance of the type Yamhill Formation.

As a result of these differences, the rocks exposed in the vicinity of Cascade Head (Fig. 2,3) which occur above the Siletz River Volcanic Series and below the volcanics of the Nestucca Formation have been designated the "Strata of Cascade Head" in this investigation. The "Strata of Cascade Head" represent a coarse-grained, somewhat volcanoclastic facies of the finer-grained siltstones and mudstones of the "Yamhill Formation" of Snively, *et al.* (1972). Although the lateral relationships of this unit are unknown, it seems probable that these rocks become interbedded with or grade laterally into strata of the "Yamhill Formation" of Snively, *et al.* (1972) exposed to the north and south of the Cascade Head area and the Yamhill Formation to the east. If the term "Yamhill Formation" continues to be used in reference to the strata exposed in the areas surrounding Cascade Head, it is suggested that the rocks referred to informally as the

KEY

- VOLCANICS OF THE NESTUCCA FORMATION
- STRATA OF CASCADE HEAD
- SILETZ RIVER VOLCANIC SERIES

1000 0 2000 FEET

ENLARGED FROM USGS HEBO 15' QUADRANGLE (1955)

FIGURE 2. GEOLOGIC STRIP MAP, NESKOWIN CREEK

"Strata of Cascade Head" be elevated to the status of a member (the Cascade Head Member of the Yamhill Formation). The type section is designated to include the rocks exposed along Neskowin Creek from the bridge over the creek in Sec. 15, T6S, R10W, downstream to a point just west of where Prospect Creek joins Neskowin Creek.

The following discussion refers to the stratigraphic sections measured during the present investigation.

Neskowin Creek Section

The "Strata of Cascade Head" are exposed in a series of westward dipping benches that traverse Neskowin Creek for 3.5 miles (Fig. 1-A). In the section measured along the creek, rocks referable to this unit attain a thickness of 3495 feet.¹ Numerous covered intervals that are generally associated with the thinly-bedded mudstone and siltstone units occur commonly throughout the sequence. Towards the top of the section, the sequence is partially repeated on the limbs of an anticlinal and synclinal fold. A basalt flow, exposed on the limbs, provides a convenient marker for lithologic correlation across the folds. The thinning of this basalt to the southeast indicates that the flow originated in an area somewhere to the northwest.

¹The calculated thickness may be slightly high owing to the covered intervals (a total of 61 feet) at both the base and top of the section. The volcanic subjacent and superjacent units however, where observed in other areas, are very resistant to weathering and therefore the thickness given above seems reasonable.

Intrusives, which occur commonly in the surrounding areas, were encountered only near the middle of the section where three olivine augite basalt dikes cut a sequence of micaceous arkosic sandstone.

The section measured along Neskowin Creek can be separated into three generalized subdivisions based upon its coarser-grained constituents: a lower calcareous volcanic sandstone interval (570 feet), a middle micaceous arkosic sandstone interval (948 feet), and an upper volcanic sandstone interval (1977 feet). The lower 570 feet of the section is characterized by medium to light-gray, medium-grained, calcareous volcanic wacke. At the base of the section these well-indurated sandstones predominate in beds that seldom exceed 12 inches in thickness. Toward the top of the interval the calcareous sandstones become massive to faintly-bedded. Weathered surfaces have a pitted appearance because of clastic grains which have been etched in relief. Interbedded with the sandstones are minor amounts of thinly-bedded, olive-gray tuffaceous siltstone and mudstone that increase in thickness toward the center of the section and in places contain light-gray calcareous nodular concretions. In the middle part of the interval, the calcareous sandstones give rise to light-gray, fine-grained arkosic wackes that contain occasional carbonaceous zones. These sandstones lack the finely disseminated micaceous material that distinguishes the overlying arkosic

sandstone interval. Intercalated with the sandstone near the top of the sequence is a grayish-black, thickly-bedded, basaltic vitric tuff that contains quartz and calcite in veinlets and interstices. A light olive-gray lithic ash, altered to montmorillonite, is associated with this tuff.

Although the 948 foot interval overlying the lower calcareous sandstone is composed primarily of olive-gray mudstone, this sequence is distinguished lithologically by thickly-laminated beds of light to medium-gray, fine-grained, micaceous arkosic wacke. These sandstones become more prevalent toward the top of the interval where they are occasionally interbedded with or grade into micaceous siltstone. In fresh exposures, the sandstone is well-indurated, but it commonly weathers to a yellowish-orange, friable sand. The mudstones which form thick sequences in the lower two-thirds of the interval, are tuffaceous, thinly-bedded, and become progressively siltier toward the top of their exposure. Locally, light-gray calcareous concretions occur within both sandstone and mudstone units. Toward the top of the interval, flows of medium-gray basalt and olive-black basaltic breccia are intercalated with micaceous arkosic sandstones and silty mudstones. Calcite occurs quite frequently in veinlets in the breccia and basalt.

The uppermost interval, which directly overlies the micaceous arkosic sandstones, reaches a thickness of 1977

feet in the Neskowin Creek Section. Strata typically consist of alternating thin beds of olive-gray to black, fine to coarse-grained volcanic wacke or graywacke and olive-gray micaceous mudstone or siltstone. These alternations rarely exceed six inches in thickness and the basal contacts of the sandstone beds with the underlying mudstone and siltstone units are frequently undulatory because of load deformation. Thicker units of mudstone, siltstone or sandstone occur sporadically throughout the interval. The volcanic sandstones, which differentiate this sequence from underlying intervals, locally contain subangular to subrounded basaltic pebbles apparently derived from contemporaneous volcanism. In places the sandstones are micaceous, calcareous or glauconitic and usually weather to a brownish or reddish-orange color. The mudstones and siltstones typically weather to a yellowish-orange color and often contain tuffaceous and carbonaceous material. Light-gray calcareous concretions and nodules that parallel the bedding occur throughout the sequence. Near the top of the interval, a flow of medium-black basalt and vesicular basalt are intercalated with siltstone and sandstone units.

Numerous foraminiferal samples were collected principally from mudstone and siltstone units exposed along Neskowin Creek. Well preserved Foraminifera were found in 30 samples that are listed in the checklist under localities

PSUA0100 through PSUA0129. Further information regarding lithology and stratigraphic relationships of these samples is given in Figure 4 (in pocket).

Salmon River Section

In order to gain additional stratigraphic control at the base of the "Strata of Cascade Head", a small 197 foot thick supplementary section was measured along the Salmon River (Fig. 1-B). This sequence had previously been included within the Tyee Formation (Snively and Vokes, 1949; Snively, *et al.*, 1972) but in this investigation it is assigned to the "Strata of Cascade Head". Lithologically, the rocks exposed in the Salmon River Section differ from the rhythmically-bedded sandstone and mudstone of the Tyee Formation in that siltstone comprises most of the section. The fauna from the sequence also substantiates this interpretation; the Tyee Formation is assigned a late middle Eocene age (Beaulieu, 1971) whereas Foraminifera from the Salmon River Section are indicative of an early late Eocene age. In addition, it should be noted that although the sediments exposed along the Salmon River have been assigned to the "Strata of Cascade Head", differences occur between these rocks and strata exposed less than four miles away in the Neskowin Creek Section. In the Salmon River Section, micaceous arkosic wackes interbedded with tuffaceous siltstones occur at the same stratigraphic interval occupied by the lower calcareous sandstones in the

DESCRIPTION	FORMATION	THICK- NESS	PSU LOCALITY	LITHOLOGY	ZONE	STAGE	SERIES
Tuffaceous mudstone, medium-to dark-gray and olive-gray, pyritic in places, thinly-bedded, abundant pyritized Foraminifera. Includes light-gray calcareous concretionary layers toward top.	STRATA OF CASCADE HEAD	135'+	A0137		BULIMINA CORRUGATA	NARIZIAN	EOCENE
			A0136				
			A0135				
			A0134				
	STRATA OF CASCADE HEAD	25'	A0133		BULIMINA CORRUGATA	NARIZIAN	EOCENE
Micaceous arkosic wacke, light-to medium-gray, fine-grained, poorly-sorted, well-indurated, thickly-laminated. Includes interbeds of medium-to dark-gray and olive-gray tuffaceous mudstone.							
Tuffaceous mudstone, medium-to dark-gray and olive-gray, thinly-bedded, abundant pyritized Foraminifera.							
Micaceous arkosic wacke, light-to medium-gray, fine-grained, poorly-sorted, well-indurated, thickly-laminated. Includes subordinate interbeds of olive-gray, tuffaceous siltstone.							
	SILETZ RIVER VOLCANIC SERIES	40'+	A0132		BULIMINA CORRUGATA	NARIZIAN	EOCENE
Vesicular and amygdaloidal basalt, olive-black, calcite and zeolite common in amygdaloids and veinlets, moderately altered. Includes olive-black basaltic breccia toward top.							

Neskowin Creek Section. Since only the base of the sequence was examined in this investigation, further detailed geologic mapping along the Salmon River will be needed to demonstrate that this section belongs within the "Strata of Cascade Head". The absence of a lower calcareous sandstone interval in the Salmon River Section is discussed further on p. 75.

The majority of the section measured along the Salmon River is composed of medium to dark-gray and olive-gray, thinly-bedded siltstone and mudstone. Near the base of the sequence thickly-laminated beds of light to medium-gray, fine-grained micaceous arkosic wacke are interbedded with the siltstone and mudstone. These well-indurated sandstones appear quite similar to the micaceous arkosic sandstones exposed in the Neskowin Creek Section. Light-gray calcareous concretionary layers and nodules are associated with the siltstone and mudstone units near the middle of the sequence. Toward the top of the section, the sequence is cut by a olive-black basaltic dike.

Foraminifera, usually consisting of pyritized internal molds and casts, were identified from six samples collected from the finer-grained sediments and are listed in the checklist under localities PSUA0132 through PSUA0137.

Three Rocks and Cascade Head Road Sections

Because of limited exposure at the top of the Neskowin Creek Section, supplementary sections were sampled

at the mouth of the Salmon River near the town of Three Rocks and along Cascade Head Road approximately half a mile from its junction with Highway 101 (Fig. 1-C,D). In both sections the rocks are composed of thinly-bedded, olive-gray tuffaceous mudstone with minor amounts of light olive-gray tuffaceous siltstone. The Cascade Head Road Section is cut by numerous medium-black basaltic dikes. Well preserved Foraminifera occur abundantly throughout both sequences and were identified from two localities that are listed in the checklist under localities PSUA0130 (Cascade Head Road) and PSUA0131 (Three Rocks).

Volcanics of the Nestucca Formation

Although the Nestucca Formation is composed primarily of tuffaceous siltstone and sandstone and in places arkosic sandstone, more than 1000 feet of basalt flows, basaltic breccia, pillows, lapilli tuff, and minor amounts of interbedded siltstone is exposed at the base of the formation in the vicinity of Cascade Head. This sequence thins to the northeast, where it interfingers with sedimentary rocks of the Nestucca Formation (Snively and Vokes, 1949). The "Strata of Cascade Head" are overlain by this sequence of volcanic rocks in the Cascade Head area and presumably by the sedimentary rocks to the northeast. The volcanics of the Nestucca Formation form a lithologically distinct top to the three sections measured along Neskowin Creek, near Three Rocks, and along Cascade Head Road. In

all three sections the rocks directly overlying the "Strata of Cascade Head" are composed of olive-black basaltic breccia often containing calcite and zeolite in veinlets.

Three foraminiferal samples were collected from siltstone interbeds within the volcanics of the Nestucca Formation during a reconnaissance along Neskowin Creek. Two of the samples were completely devoid of microfossils and the third contained only one non-diagnostic species, *Bathysiphon eocenicus*. However, well preserved Foraminifera have been reported from the sedimentary rocks of the Nestucca Formation exposed to the north and south of the Cascade Head area that indicate these rocks are of latest Eocene age (Snively and Vokes, 1949).

FIGURE 6. STRATA OF CASCADE HEAD: CORRELATION OF SECTIONS

PALEONTOLOGY

The Foraminifera

The sequence of rocks exposed in the vicinity of Cascade Head, although possessing few larger fossils, contains an abundant and diverse microfauna. A total of 334 species and varieties of Foraminifera, referable to 81 genera and 27 families, were obtained from 38 localities. The calcareous perforate forms are decidedly dominant throughout the interval and account for 89 percent of the total assemblage. The arenaceous and calcareous imperforate groups, although important in some assemblages, occur less frequently and account for 11 percent of the total fauna (Fig. 7, in pocket).

The arenaceous Foraminifera are represented by 18 genera from 10 families, and include 40 species. They occur in subordinate amounts in most assemblages and are dominated by such genera as *Rhabdammina*, *Bathysiphon*, *Haplophragmoides*, *Spiroplectammina*, *Karreriella*, and *Tritaxilina*. The calcareous imperforate Foraminifera, particularly common in the basal Neskowin Creek Section, occur more sporadically throughout the section and include 11 species assigned to five genera from two families. The calcareous perforate Foraminifera are represented by 283 species referable to 58 genera from 15 families and,

as previously mentioned, are the dominant group in the sequence. The families represented by genera possessing the greatest number of individuals are as follows:

Lagenidae by *Robulus*, *Dentalina* and *Nodosaria*; Nonionidae by *Nonion*; Heterohellicidae by *Plectofrondicularia* and *Nodogenerina*; Buliminidae by *Bulimina*, *Bolivina*, and *Uvigerina*; Ellipsoidinidae by *Ellipsonodosaria*; Rotaliidae by *Gyroidina*, *Eponides*, and *Cancris*; Amphisteginidae by *Amphistegina*; Cassidulinidae by *Cassidulina*; Chilostomellidae by *Chilostomelloides*; Globigerinidae by *Globigerina* and *Subbotina*; and Anomalinidae by *Cibicides*.

An analysis of the faunas, by the percentage of each family as compared with the total faunal assemblage from the Cascade Head area, is shown in Figure 7. A complete list of the Foraminifera including their relative abundance in each locality is given in Figure 8.

Other Fossils

Numerous other microfossils were encountered during the course of the present study. Specific identification of these forms was not attempted since the emphasis of this report is placed primarily on the benthonic Foraminifera. The specimens however, were retained, mounted in the appropriate assemblage slide, and their occurrence and relative abundance noted in Figure 8. This group includes coral, diatoms, fragments of *Dentalium*, echinoderm plates and spines, fecal pellets, fish bone, teeth, and scales,

immature gastropods, other mollusk fragments, ostracods, placoid scales, Radiolaria, scolecodonts, shark teeth, and sponge spicules. Several of these forms deserve special notice.

Strata from the Cascade Head area are characterized by numerous Radiolaria which occur consistently throughout the sequence. In some localities, they make up over 50 percent of the assemblages and in samples devoid of Foraminifera, they may constitute as much as 100 percent of the total fauna. Although a great number of individuals were observed, very few species are represented.

Diatoms, echinoderm spines, ostracods and sponge spicules also occur in significant numbers throughout the sequence. Their relative abundance and stratigraphic range is shown in Figure 8.

A single fragment resembling the jaw of a polychaeta worm or scolecodont was one of the more interesting elements of the microfauna collected from the Neskowin Creek Section (PSUA0124). The slender, reddish-brown fragment is capped by three conical "tooth-like" projections and may represent a portion of the pharyngeal jaws known as the forceps. To the author's knowledge, scolecodonts have not previously been recorded from the Tertiary deposits of Oregon.

Larger marine invertebrates, in contrast to the abundant microfauna, occur very infrequently in strata exposed in the Cascade Head area. A molluscan fauna was

described by H. E. Vokes (Snively and Vokes, 1949) from a locality (MF-23) on the Salmon River near the town of Three Rocks. The locality, which is located approximately 500 feet southeast to PSUA0131 of this study, represents the only reported occurrence of macrofossils within the area of investigation. Vokes identified the following mollusks:

Solemya n. sp.
Acila (*Truncacila*) *decisa* (Conrad)
Acila (*Acila*?) n. sp.
Minormalletia n. sp.
Delectopecten n. sp. A. (concentric undulation)
Delectopecten n. sp. B. (smooth)
Pseudamussium (?) n. sp.
Dentalium stramineum Gabb
Calliophthalmus (?) n. sp.
Fulgurofusus cf. *F. washingtoniana* (Weaver)
Lyria? n. sp.

Vokes concluded that the fauna was of late Eocene age and correlated it with the faunas of the Moody Shale Member of the Toledo Formation, and with the Cowlitz and Coaledo Formations. A few poorly preserved mollusks from the Neskowin Creek Section were the only megafossils observed during this investigation. They were collected from a pebbly volcanic graywacke located 50 feet stratigraphically above PSUA0121. The fauna includes *Acila* sp., *Ostrea* sp., *Dentalium* sp., and fragmented low-spined gastropod.

SPECIMENS/SAMPLE	LEGEND 1-2 ☐ 6-10 ☐ 3-5 ☐ >10 ☐	SECTION PSU LOCALITY NUMBER	NESKOWIN CREEK																											CASCADE HD. RD.	THREE RKS.	SALMON R.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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SPECIMENS/SAMPLE	LEGEND 1-2 □ 6-10 ○ 3-5 ■ >10 ●	SECTION PSU LOCALITY NUMBER	NESKOWIN CREEK																				CASCADE HD RD	THREE RKS	SALMON R.																
			A0100	A0101	A0102	A0103	A0104	A0105	A0106	A0107	A0108	A0109	A0110	A0111	A0112	A0113	A0114	A0115	A0116	A0117	A0118	A0119	A0120	A0121	A0122	A0123	A0124	A0125	A0126	A0127	A0128	A0129	A0130	A0131	A0132	A0133	A0134	A0135	A0136	A0137	
SPECIES																																									
<i>Lenticulina</i> cf. <i>L. convergens</i> (Bornemann) [of Mallory]								□																																	
<i>Loxostomum applinae</i> (Plummer)																																									■
<i>Marginulina adunca</i> (Costa)							■	□	□						■				□																						
<i>N. adunca</i> [?] (Costa)															■																										
<i>N. cf. N. alaskanensis</i> Nuttall															■																										
<i>N. ezimia</i> Neugeboren							□																																		
<i>N. cf. N. ezimia</i> Neugeboren																□																									
<i>N. holmesii</i> Gaston																□																									
<i>N. huneri</i> [?] Howe																																									
<i>N. cf. N. inoonapioua</i> Hussey [of Sullivan]																																									
<i>N. munda</i> [?] Cushman																											□														
<i>N. regularis</i> d'Orbigny																																									
<i>N. subbullata</i> Hantken								○		□		□		□		□																									
<i>N. sp.</i>								□																																	
<i>N. [?] sp.</i>																																									
<i>Martinottiella eocenica</i> Cushman & Bermudes																																									
<i>N. [?] sp.</i>																																									
<i>Nassilina decorata</i> Cushman																																									
<i>Nodogenerina adolphina</i> (d'Orbigny)																																									
<i>N. cf. N. bradyi</i> Cushman																																									
<i>N. kressenbergensis</i> (Gumbel)								□																																	
<i>N. lepidula</i> (Schwager)																																									
<i>N. lepidula</i> [?] (Schwager)																																									
<i>N. spp.</i>																																									
<i>Nodosaria arundinea</i> Schwager								○																																	
<i>N. arundinea</i> [?] Schwager																																									
FIGURE 8 DISTRIBUTION OF FORAMINIFERA FROM THE STRATA OF CASCADE HEAD	FAUNULE OR ZONULE	AMPHISTEGINA-CHIRIDIOS																																							
		BULIMINA-BOLIVINA																																							
		BULIMINA-NODOSARIA																																							

SPECIMENS/SAMPLE	LEGEND 1-2 ☐ 6-10 ☐ 3-5 ☐ >10 ☐	SECTION PSU LOCALITY NUMBER	NESKOWIN CREEK																													
			A0100	A0101	A0102	A0103	A0104	A0105	A0106	A0107	A0108	A0109	A0110	A0111	A0112	A0113	A0114	A0115	A0116	A0117	A0118	A0119	A0120	A0121	A0122	A0123	A0124	A0125				
SPECIES			A0126	A0127	A0128	A0129	A0130	A0131	A0132	A0133	A0134	A0135	A0136	A0137	CASCADE HD RD				THREE RKS		SALMON R.											
<i>Nodosaria ohirana</i> Cushman & Stone																																
<i>N. delioiae</i> Martin																																
<i>N. cf. N. delioiae</i> Martin																																
<i>N. ewaldi</i> Reuss																																
<i>N. ewaldi</i> [?] Reuss																																
<i>N. (?) gyrata</i> Mallory																																
<i>N. (?) gyrata</i> Mallory n. var.																																
<i>N. holserioa</i> Schwager																																
<i>N. cf. N. holserioa</i> Schwager																																
<i>N. latejugata</i> Gumbel																																
<i>N. longicauda</i> d'Orbigny																																
<i>N. pyrula</i> d'Orbigny																																
<i>N. pyrula</i> [?] d'Orbigny																																
<i>N. sp. [of Mallory]</i>																																
<i>N. [?] spp.</i>																																
<i>Nonion durhami</i> Mallory																																
<i>N. durhami</i> [?] Mallory																																
<i>N. planatum</i> Cushman & Thomas																																
<i>N. planatum</i> [?] Cushman & Thomas																																
<i>N. sp. A. n. sp.</i>																																
<i>N. sp.</i>																																
<i>Parrella tenuioarinata</i> (Cushman & Siegfus)																																
<i>Planularia markleyana</i> Church																																
<i>P. cf. P. ouachitanaensis</i> Howe & Wallace [of Mallory]																																
<i>P. cf. P. truncana</i> (Gumbel)																																
<i>P. [?] sp.</i>																																
FIGURE 8 DISTRIBUTION OF FORAMINIFERA FROM THE STRATA OF CASCADE HEAD			AMPHISTEGINA CIBICIDES				BULIMINA-BOLIVINA				BULIMINA-NODOSARIA				CHILOSTOMELLOIDES- RHADAMMINA				NODOSARIA-DENIALINA				BULIMINA-NODOSARIA				BOLIVINA					
			 					
FAUNULE OR ZONULE			AMPHISTEGINA CIBICIDES				BULIMINA-BOLIVINA				BULIMINA-NODOSARIA				CHILOSTOMELLOIDES- RHADAMMINA				NODOSARIA-DENIALINA				BULIMINA-NODOSARIA				BOLIVINA					
			AMPHISTEGINA CIBICIDES				BULIMINA-BOLIVINA				BULIMINA-NODOSARIA				CHILOSTOMELLOIDES- RHADAMMINA				NODOSARIA-DENIALINA				BULIMINA-NODOSARIA				BOLIVINA					
			 					
			AMPHISTEGINA CIBICIDES				BULIMINA-BOLIVINA				BULIMINA-NODOSARIA				CHILOSTOMELLOIDES- RHADAMMINA																	

SPECIMENS/SAMPLE	LEGEND 1-2 ☐ 6-10 ☐ 3-5 ☒ >10 ☒	SECTION PSU LOCALITY NUMBER	NESKOWIN CREEK																												CASCADE HD RD	THREE RKS	SALMON R.													
			A0100	A0101	A0102	A0103	A0104	A0105	A0106	A0107	A0108	A0109	A0110	A0111	A0112	A0113	A0114	A0115	A0116	A0117	A0118	A0119	A0120	A0121	A0122	A0123	A0124	A0125	A0126	A0127	A0128	A0129	A0130	A0131	A0132	A0133	A0134	A0135	A0136	A0137						
SPECIES																																														
<i>Planulina</i> sp.				☐																																										
<i>Pleotofrondicularia gracilis</i> Smith																																☐														
<i>P. kerni</i> Cook																			☐																											
<i>P. oregonensis</i> Cushman, Stewart, & Stewart																					☐											☐			☐											
<i>P. packardi</i> var. <i>multilineata</i> Cushman & Simonson																						☒				☐											☐									
<i>P. packardi</i> var. <i>packardi</i> Cushman & Schenck																																	☒													
<i>P. aff. P. packardi</i> var. <i>packardi</i> Cushman & Schenck																				☐													☒	☐												
<i>P. searsi</i> Cushman, Stewart, & Stewart																																☐	☒													
<i>P. vaughani</i> Cushman																			☐	☐												☐														
<i>P. vokesi</i> Cushman, Stewart, & Stewart																					☒																									
<i>P. sp.</i> [of Weaver & Weaver]																																														
<i>P. sp.</i>																																														
<i>Pleurostomella acuta</i> Hantken										☐			☐																																	☐
<i>P. cf. P. acuta</i> Hantken																																														
<i>P. gredalensis</i> Cook																																														
<i>P. cf. P. gredalensis</i> Cook																																														
<i>P. paleocenica</i> Cushman																																														
<i>P. sp.</i>																																														
<i>Pseudoglandulina conica</i> (Neugeboren)																																														☐
<i>P. ovata</i> (Cushman & Applin)																																														
<i>Pseudohastigerina micra</i> (Cole)																																														☐
<i>Pullenia eocenica</i> Cushman & Siegfus																																														
<i>P. quinqueloba</i> (Reuss)																																														
<i>P. salisburyi</i> Stewart & Stewart																																														
<i>P. sp.</i>																																														
<i>P. [?] sp.</i>																																														
FIGURE 8 DISTRIBUTION OF FORAMINIFERA FROM THE STRATA OF CASCADE HEAD			FAUNULE OR ZONULE		AMPHISTEGINA-CIBICIDITES		BULIMINA-BOLIVINA		BULIMINA-NODOSARIA		CHILOSTOMELLOIDES- RHABDOMININA		NODOSARIA-DENTALINA		SPIROPLECTAMMINA		BATHYSIPHON		BULIMINA-NODOSARIA		BOLIVINA		BULIMINA-NODOSARIA		UYGERININA		BULIMINA-NODOSARIA																			

SPECIMENS/SAMPLE	LEGEND 1-2 ☐ 6-10 ☐ 3-5 ☐ >10 ☐	SECTION PSU LOCALITY NUMBER	NESKOWIN CREEK																														CASCADE HD RD	THREE RKS	SALMON R.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
			A0100	A0101	A0102	A0103	A0104	A0105	A0106	A0107	A0108	A0109	A0110	A0111	A0112	A0113	A0114	A0115	A0116	A0117	A0118	A0119	A0120	A0121	A0122	A0123	A0124	A0125	A0126	A0127	A0128	A0129	A0130	A0131	A0132	A0133	A0134	A0135	A0136	A0137																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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BIOSTRATIGRAPHY

Local Biostratigraphy

Eight distinct faunules (Fenton and Fenton, 1928, p. 20-22) are discernible from among the 38 foraminiferal assemblages collected from the "Strata of Cascade Head". Five of these faunules recur in at least two or more horizons within the sequence and thus, following the terminology of Fenton and Fenton (1928), are described as zonules. Measurements of these local biostratigraphic units, as well as the stratigraphic allocation of foraminiferal samples in the Neskowin Creek and Salmon River Sections, are calculated from the base of the "Strata of Cascade Head". The composition and stratigraphic occurrence of each faunule and zonule is given in the checklist (Fig. 8) and therefore will not be discussed here.

Paleoecology

The climate of the Eocene of the Cordilleran geosyncline has generally been interpreted as subtropical to tropical (Arnold, 1909, p. 532; Baldwin, 1964, p. 5). Foraminiferal faunas collected from the "Strata of Cascade Head" tend to support this interpretation in that these assemblages are composed of a rather large number of species, most of which are represented by a few individuals. Such

varied faunas are today found in subtropical to tropical climates whereas arctic and cool temperate climates contain a few species represented by numerous individuals. The cold water temperatures¹ indicated by many of the faunules and zonules in this study are probably a function of depth rather than actual surface conditions.

In this investigation, the environmental evaluation of each biostratigraphic unit is, for the most part, based on the dominant genera within each faunule, although to a lesser degree, the entire faunal assemblage has been taken into consideration. It is recognized that numerous biological, physical, and chemical factors (*e.g.* depth, temperature, light penetration, oceanic currents, food supply, competing organisms, nature of the substrate and salinity and oxygen content of sea water) influence the distribution of Foraminifera, but that depth and temperature are generally regarded as the most important environmental factors (*i.e.* Loeblich and Tappan, 1964; Smith, 1964; Sullivan, 1962; Hornaday, 1961). Therefore, in this study, paleoecologic interpretations are based primarily on depth and temperature. The principle references used in these interpretations are: Natland (1933), Galloway (1933), Kleinpell (1938), Mallory (1959), Bandy and Arnal (1960),

¹Temperature terms used herein are defined as follows:

warm	20°-16°C	(annual minimum surface temperature)
cool	16°-10°C	(annual minimum surface temperature)
cold	10°C and colder	(annual minimum surface temperature)

Smith (1964) and numerous University of California-Geological Sciences publications.

The greater part of the sequence exposed in the Cascade Head area was deposited in upper to middle bathyal¹ depths, although at times marine deposition fluctuated between middle neritic and bathyal. The absence of brackish water and littoral forms adds support to this interpretation. Planktonic Foraminifera, although completely absent in a few samples, occur commonly throughout the interval indicating good connections with open ocean currents. Bathymetric and temperature fluctuations (Fig. 9) are examined in greater detail in the following discussion of each individual faunule and zonule.

Amphistegina-Cibicides Zonule

The lowermost zonule, which is exposed only in the Neskowin Creek Section, is characterized by a faunule that apparently lived in warm shallow water (middle neritic) of normal marine salinity, possibly in lagoonal conditions. The most ecologically significant element included within this association is *Amphistegina*, which occurs in large numbers, and according to Cushman (1950, p. 300), lives

¹Bathymetric terms used herein are defined as follows:

<u>Neritic</u> (continental shelf)		<u>Bathyal</u> (continental slope)		<u>Abyssal</u>	
upper	0-60'	upper	600-1500'	upper	6000-8000'
middle	60-300'	middle	1500-3000'	lower	below 8000'
lower	300-600'	lower	3000-6000'

FIGURE 9. DEPTH AND TEMPERATURE VARIATION IN THE NESKOWIN CREEK SECTION

frequently on coral reefs and in warm shallow waters. He also states that "it is probable that the genus [*Amphistegina*] is limited to 30 fathoms in its living condition as, like other larger foraminifera, it seems to have commensal algae, the limits of which on account of the penetration of sunlight in the ocean are limited to this same depth." Shelf conditions are also suggested by the abundance of *Cibicides* with thick tests (e.g. *C. sandiegensis* and *C. mcmastersi*). This type of *Cibicides* is morphologically similar to *C. lobatula*, which has been recorded off the southern coast of California at neritic depths (Natland, 1933, chart). Similarly shallow depths are indicated by the presence of *Robulus*, a genus reported by Gaston (personal communication, 1976) from neritic depths. Other important calcareous forms in this zonule which favor shallow water include *Elphidium*, large *Eponides*, *Quinqueloculina*, *Triloculina* and ornate *Vaginulinopsis*. Normal saline conditions are suggested by the presence of the family Miliolidae, which according to Kleinpell (1938, p. 16) cannot tolerate waters of less than normal marine salinity. The presence of many unidentifiable solitary coral and megafossil fragments also supports an interpretation of warm shallow water conditions.

The conspicuous absence of arenaceous Foraminifera in the *Amphistegina-Cibicides* Zonule is difficult to explain. *Amphistegina* faunas, completely devoid of or containing few

arenaceous Foraminifera have also been noted by Phleger and Parker (1951, p. 61) in Recent waters of the Gulf of Mexico, by Bagley (1959, p. 50) from the lower Eocene of Washington, and by Boggs, Orr, and Baldwin (1973, p. 651) from the Rickreall Limestone Member of the Yamhill Formation. Raup and Stanley (1971, p. 210) state that "Arenaceous Foraminifera today are especially common in nearshore, low salinity environments and thus are used as paleoecologic indicators." Perhaps the normal saline conditions suggested by the abundance of the Miliolids in the basal Neskowin Creek Section prohibited the development of arenaceous forms. Further ecologic investigations of recent *Amphistegina* faunas may provide an explanation for the absence of arenaceous Foraminifera in these assemblages.

Planktonic Foraminifera are extremely rare in this zonule indicating limited open sea conditions or connections. In modern oceans, pelagic forms decrease in abundance shoreward from the outer shelf, and form a small percentage of the bottom assemblages in shallow waters and geographically restricted basins (Grimsdale and Morkhoven, 1955, in Smith, 1971, p. 13). Thus, the paucity of planktonic genera in the *Amphistegina-Cibicides* Zonule supports an interpretation of deposition at neritic depths in possibly lagoonal conditions.

Bulimina-Bolivina Faunule

This distinct faunule was collected from a siltstone interbed within the calcareous sandstones of the *Amphistegina-Cibicides* Zonule, approximately 10 feet above the base of the "Strata of Cascade Head" in the Neskowin Creek Section. Although many constituents of this association are essentially the same as those in the *Amphistegina-Cibicides* Zonule (e.g. *Amphistegina*, *Cibicides*, *Elphidium*, large *Eponides*, *Quinqueloculina*, *Robulus* and *Vaginulinopsis*), additional forms indicate a temporary deepening (lower neritic) of the water and a continuance of warm temperatures. Other siltstone interbeds encountered within these lower calcareous sandstones, although generally unfossiliferous, probably represent similar ecologic conditions.

Bolivina, *Bulimina* and *Cassidulina* make their first appearance in this faunule and are the most abundant forms present. *Bolivina*, represented by both a small striate and smooth species, is probably the most ecologically important of these forms; restricted almost exclusively to neritic depths. As a group, the Buliminids are generally euryopic, although certain morphologic types have definite bathymetric preferences. *Bulimina pachecoensis*, a form with small marginal spines, occurs abundantly in this faunule and most closely resembles *B. marginata* which today inhabits the central and outer shelf. The presence of *Bulimina corrugata*, which according to Weaver and Weaver

(1962, p. 11) prefers bathyal to abyssal optima, would seem to dispute these shallow depths but forms only a minor part of the total assemblage. *Cassidulina globosa*, a small rounded form whose Recent morphotype (*C. subglobosa*) is best developed at middle to lower neritic depths, is also suggestive of an outer shelf environment. Other significant genera occurring in lesser amounts that indicate a depth no greater than lower neritic include *Canceris* and *Guttulina*. Similarly, a depth not shallower than lower neritic is suggested by the presence of *Alabamina*, *Chilostomelloides*, *Saracenaria* and *Trifarina*.

Although the occurrence of such forms as *Amphistegina*, spinose Buliminids, *Quinqueloculina*, *Saracenaria*, and *Vaginulinopsis* indicate warm water temperatures, the introduction of many cold water genera (e.g. *Alabamina*, small costae Buliminids, *Cassidulina*, *Chilostomelloides*, *Nonion* and *Trifarina*) suggests slightly cooler bottom conditions existed during deposition of the *Bulimina-Bolivina* Zonule. These cooler bottom conditions however, are probably a reflection of depth, in that warmer temperatures are found in the shallower subjacent and superjacent zonule. Arenaceous forms continue to be absent from this faunule, possibly due to the same conditions encountered in the *Amphistegina-Cibicides* Zonule. Planktonic Foraminifera however, are abundant, signifying the existence of better connections with open ocean currents.

Bulimina-Nodosaria Zonule

The *Bulimina-Nodosaria* Zonule is best developed in the Neskowin Creek Section where it is repeated three times. It also characterizes the entire sequence exposed along the Salmon River. Foraminifera from this zonule are indicative of cooler and deeper water than that of the *Amphistegina-Cibicides* Zonule in the Neskowin Creek Section. Apparently the shallow water conditions encountered in the lower Neskowin Creek sequence never existed at the base of the Salmon River Section as these sediments are completely dominated by the deeper water *Bulimina-Nodosaria* Zonule.

A cold bathyal environment is suggested by the extremely diverse assemblage of calcareous perforate forms contained within this zonule. Shallow water forms (e.g. *Amphistegina*, *Elphidium*, large *Eponides*, and *Vaginulinopsis*), abundant in the underlying Neskowin Creek Section, have, for the most part, been replaced by deep water genera. Forms which normally inhabit shallow water, but have been reported from the upper limits of the continental slope (e.g. small, smooth forms of *Bolivina*, *Cancris* and *Nonion*), persist in reduced numbers, suggesting that depths no greater than upper bathyal existed during *Bulimina-Nodosaria* time. Similar conditions are indicated by the reduction in the number of shallow water Buliminids (i.e. *B. pachecoensis* and *B. curtissima*) and the first appearance of numerous smooth forms such as *B. pupoides* and *B. ovata* which favored

cold bathyal depths. The Lagenids (e.g. *Nodosaria*, *Dentalina*, *Marginulina*, and *Robulus*), relatively rare in the underlying faunules, are quite diverse and occur abundantly throughout this interval. Although individually these forms are somewhat eurybathic, diverse faunas, according to Cushman (1950, p. 44) "are characteristic of the continental shelf ... between 50 and 500 fathoms ...". Further support for this interpretation of maximum depth is offered by the abundance of *Nodogenerina* and *Ellipsonodosaria* which prefer shallow depths. *Cibicides* with thick tests, which commonly inhabit neritic and upper bathyal depths, continue to be well represented in this zonule as do forms with thin tests (e.g. *C. pachyderma* and *C. pseudoungerianus*) that are indicative of deeper bathyal conditions. The joint occurrence of these two forms restricts the deposition of this zonule to upper bathyal depths.

Deeper water forms include the Uvigerinids, represented by both costate (e.g. *U. churchi* and *U. sp. A.*) and spinose (e.g. *U. garzaensis* and *U. garzaensis* var. *nudorobusta*) forms, and strongly asymmetrical species of *Gyroidina* (e.g. *G. orbicularia* var. *planata* and *G. soldanii*). *Eponides umbonatus*, common throughout most of the interval, has been reported from the north Pacific at bathyal to abyssal depths. The abundance of these forms indicate depths no shallower than upper bathyal existed during the deposition of this zonule. Small costate Buliminids (e.g.

B. corrugata and *B. jarvisi*) reach the peak of their abundance in this zonule, also supporting an interpretation of cold temperatures at bathyal depths.

Arenaceous Foraminifera make their first appearance in this zonule, abundantly represented by *Bathysiphon*, *Spiroplectamina*, and *Tritaxilina*. Of these, *Tritaxilina* is the most stenobathic, restricted almost entirely to upper bathyal depths. The other forms are somewhat eurybathic, although an abundance of *Bathysiphon* has generally been interpreted as representing cold bathyal depths. Lesser arenaceous elements in this association include *Haplophragmoides*, *Karreriella*, and *Rhabdammina*, the presence of all of which agrees with the interpretation given above.

Pelagic forms are abundantly represented in this zonule, indicating open ocean conditions or connections. The extreme diversity of these forms suggests warm surface temperatures, in spite of the cold bottom conditions indicated by the benthonic forms.

Chilostomelloides-Rhabdammina Faunule

Continued cold bathyal depths are suggested by the rather meager fauna collected approximately 1611 feet above the base of the "Strata of Cascade Head" in the Neskowin Creek Section. The sparseness of this fauna is probably a result of preservation, as numerous external molds have been observed in hand specimens. Only *Chilostomelloides*

occurs abundantly in this faunule. Its Recent morphotype, *Chilostomella*, has been recorded by Hornaday (1961, p. 172) as a distinctly bathyal genus. Other calcareous forms present in this faunule in lesser amounts include *Globobulimina pacifica*, *Marginulina*, and *Nodosaria*. *Globobulimina pacifica* has been reported from the lower neritic and bathyal districts of the Pacific Ocean off southern California, but finds its optimum habitat at bathyal depths. *Marginulina* and *Nodosaria*, although found at neritic depths, seem to favor the upper limits of the continental slope. *Allomorphina*, which occurs only rarely in this faunule, also seems to flourish at bathyal depths.

From the foregoing discussion, it would appear that this faunule lived in cold bathyal depths, probably upper or possibly middle bathyal. Such an interpretation is substantiated by the arenaceous genera in this faunule, *Cyclammina* and *Rhabdammina*, both of which prefer cold bathyal depths. In addition, continued open ocean connections are suggested by the presence of numerous pelagic forms.

Nodosaria-Dentalina Zonule

Upper bathyal depths are again suggested for the next highest zonule in the Neskowin Creek Section as indicated by the persistence of many of the forms with deep water optima that were present in the underlying *Bulimina-Nodosaria* Zonule and *Chilostomelloides-Rhabdammina* Faunule.

Recurring deep water calcareous forms include *Globobulimina pacifica*, *Eponides umbonatus* and strongly asymmetrical species of *Gyroïdina*. All of these favor cold temperatures at bathyal depths. *Bolivina* and *Nonion* also reappear, suggesting depths no greater than upper bathyal. The Lagenids (e.g. *Dentalina*, *Nodosaria*, and *Robulus*) continue to be well diversified and, as previously noted, are characteristic of the upper limits of the continental slope. Similarly, *Cibicides* with both thick and thin tests reappear abundantly, indicating depths no shallower or deeper than upper bathyal. *Plectofrondicularia*, restricted exclusively to bathyal depths, occurs for the first time in abundance in this zonule.

Arenaceous forms, somewhat rare in this zonule, are represented by but a few individuals of *Bathysiphon*, *Haplophragmoides*, *Rhabdammina*, and *Spiroplectammina*. Although these forms can endure a great range of depths, they normally inhabit relatively cold, deep water. Planktonic Foraminifera still remain persistent, indicating continued open ocean conditions.

Bathysiphon-Spiroplectammina Faunule

Deposition in the bathyal zone (upper to possibly middle bathyal) is still indicated by this faunule, which is dominated by arenaceous forms. It was collected approximately 1931 feet above the base of the "Strata of Cascade Head" in the Neskowin Creek Section. Arenaceous

Foraminifera, as previously noted, have generally been considered to be of little bathymetric significance, since their distribution "is governed largely by the nature of the sea bottom" (Kleinpell, 1938, p. 16). Thus, the abundance of arenaceous forms in this faunule probably indicates locally modified bottom conditions rather than any radical changes in depth. Glaessner (1948, p. 190) states that "as a rule dominantly 'arenaceous' assemblages indicate cold water conditions." This inference seems to apply to the *Bathysiphon-Spiroplectammina* Faunule, as numerous calcareous forms also indicate cold water conditions. Among the arenaceous forms, *Spiroplectammina* and *Bathysiphon* are the most abundantly represented, the latter indicative of cold temperatures and bathyal depths. Also present in lesser numbers are *Cyclammina*, *Rhabdammina*, and *Textularia*. Of these, *Cyclammina* is the most ecologically significant, reported by DeLise (1967, p. 15) as favoring bathyal depths.

Calcareous perforate forms are well represented in this faunule, although not as abundantly as in the underlying intervals. The Lagenids (e.g. *Dentalina*, *Nodosaria*, and *Robulus*) remain diverse, suggesting upper bathyal depths. The persistence of *Chilostomelloides*, *Plectofrondicularia* and asymmetrical species of *Gyroidina*, all common in the underlying unit, also support an interpretation of bathyal depths as does the reappearance of numerous smooth Buliminids. Somewhat deeper bathyal

conditions may be indicated by the first abundant appearance of *Epistomina* and *Pleurostomella* which, although relatively eurybathic, prefer lower bathyal and abyssal depths. Open ocean conditions are again indicated by the presence of pelagic forms.

Bolivina Zonule

Somewhat shallower depths (lower neritic to upper bathyal) than those prevailing during deposition of the preceding interval are indicated for this zonule by the recurrence of such shallow water forms as small species of *Bolivina*, *Canceris*, *Cassidulina*, and *Nonion*, all of which favor lower neritic depths. Shallower water conditions are also suggested by the increased number of Lagenids (e.g. *Dentalina* and *Nodosaria*), shallow water *Cibicides* (thick test), and the reappearance of *Ellipsonodosaria*. Associated with these shallow water genera however, are a few deeper water forms (e.g. smooth and costate Buliminids, *Globobulimina*, *Gyroidina*, *Plectofrondicularia*, and both spinose and costate Uvigerinids) that normally exhibit a bathyal optimum. Similarly *Valvulineria* (*V. tumeyensis*), which is more characteristic of bathyal depths, becomes significant for the first time in this zonule. Although the majority of these deeper water forms prefer bathyal depths, most can tolerate an upper slope-lower shelf environment and therefore, their presence should not be considered in conflict with the bathymetric interpretation

given above. Also, these forms do not occur as abundantly as the shallower water genera, suggesting that they were not living within their environmental optimum.

Arenaceous Foraminifera are extremely rare in this zonule, consisting of only a few specimens of *Bathysiphon* and *Rhabdammina*. Although both of these forms favor deep bathyal depths, they are well within their environmental tolerances at upper bathyal depths. Cool bottom temperatures continue to be indicated by the presence of *Cassidulina*, *Gyroidina*, and *Valvulineria*, even though the depths are somewhat shallower. Planktonic Foraminifera are still well represented in this zonule, indicating continued open ocean conditions.

Uvigerina Zonule

The uppermost zonule in the Neskowin Creek Section contains a faunule which apparently lived in a deeper water environment than that of its local predecessor. It also characterizes the two supplementary sections measured near the town of Three Rocks and along Cascade Head Road. Deposition in this zonule took place at depths comparable to the upper or middle continental slope as evidenced in the diversity and abundance of genera with bathyal optima. Of these deeper water forms, spinose Uvigerinids (e.g. *U. garzaensis* and *U. garzaensis* var. *nudorobusta*) are the most abundantly represented, suggesting depths within the lower limits of the continental slope. Bathyal depths are

also indicated by the presence of *Eponides umbonatus*, *Epistomina*, *Gyroidina*, *Plectofrondicularia*, and *Valvulineria*. The occurrence of *Cassidulina globosa* in reduced numbers in this zonule is also in keeping with an interpretation of bathyal depths and strongly substantiates cold bottom conditions. The Buliminids, abundantly represented in the subjacent faunules, are relatively rare in this zonule, although a few smooth and costate species continue to be represented. The presence of these deep water forms however, is offset by the persistence of several shallow forms (e.g. various Lagenids, *Bolivina*, and *Cibicides* with thick tests). The association of both shallow and deep water forms in this zonule suggests a middle to possibly upper bathyal environment of deposition.

Arenaceous Foraminifera are again well represented in this zonule, reflecting a change in bottom conditions. The presence of *Bathysiphon* and *Haplophragmoides*, which occur locally in considerable abundance, adds support to an interpretation of cold bathyal depths. Other important forms include *Ammodiscus*, *Karreriella*, and *Rhabdammina*. Of these, *Karreriella* is the most stenobathic, favoring bathyal depths. Pelagic forms occur sporadically in this zonule, suggesting somewhat limited open ocean conditions locally.

Age and Correlation

Because the teilzones of many diagnostic Californian species vary somewhat in the Northwest, it is very difficult to apply rigidly the Californian foraminiferal stages of Mallory (1959) to Oregon sections. This is due primarily to the distance separating the Oregon sections from the type sections of the stages in California but also to variations in the local ecology. It also seems probable that a few species which occur within the basal sediments of the "Strata of Cascade Head" have been reworked from the underlying intervals. In addition, those species mentioned in the following discussion, whose teilzones extend into younger or older horizons in the "Strata of Cascade Head" have been excluded as important criteria from highly definitive age evaluations.

Several species, including *Discorbis baintoni*, *Loxostomum applinae*, *Nodosaria latejugata*, *Pullenia quinqueloba*, and *Trifarina advena* var. *californica*, have previously been recorded in California as ranging no higher than upper Ulatisian by Mallory (1959, p. 44); yet in the "Strata of Cascade Head" they occur within faunules assigned to the lower Narizian by this writer (see checklist, Fig. 8). *Pleurostomella paleocenica*, which seems restricted to the upper Ynezian in California (Mallory, 1959, p. 26), also occurs within these lower Narizian assemblages. Apparently the teilzones of these species extend into younger horizons

in the Oregon lower Tertiary as they occur jointly with highly diagnostic lower Narizian forms in the "Strata of Cascade Head". Similar range extensions have been recorded by authors in other lower Narizian sequences on the West Coast; both *Discorbis baintoni* and *Nodosaria latejugata* have been recorded by Gaston (1974, p. 20, 23) from the Yamhill Formation and *Pleurostomella paleocenica* has been recorded from the Upper Cozy Dell Shale by Weaver and Weaver (1962, p. 8). *Pullenia quinqueloba* has not only been recorded from both the upper and lower Narizian (in the Cozy Dell Shale by Weaver [1962, fig. 4], the Cozy Dell Shale and the Sacate Formation by both Weaver and Weaver [1962, p. 8] and Weaver and Molander [1964, fig. 4], the Blue Canyon Gorge Member of the Twin River Formation by Carroll [1959, fig. 6], and the Boundary Shale Member of the Lyre Formation by Bagley [1959, p. 43]), but also, according to Tipton, Kleinpell, and Weaver (1973, fig. 6, 9) it apparently ranges as high as Zemorrian and Saucesian in the Los Santos Shale.

Similarly, *Amphimorphina jenkinsi*, *Anomalina regina* var. *minor*, *Bulimina sculptilis*, *Plectofrondicularia packardi* var. *packardi*, and *Robulus mayi*, which in California range no lower than the upper Narizian (Mallory, 1959, p. 60), have extended their teilzones into lower Narizian rocks in the "Strata of Cascade Head". Several of these species have also been reported by other authors from lower

Narizian sequences on the West Coast. *Amphimorphina jenkinsi*, restricted entirely to the upper Narizian in California, and *Robulus mayi* have been reported by Weaver and Weaver (1962, p. 15) from the Matilija Formation and Upper Cozy Dell Shale, respectively. *Bulimina sculptilis* has been recorded from the Yamhill Formation by Gaston (1974, p. 19) and *Plectofrondicularia packardi* var. *packardi* has been reported by Weaver and Molander (1964, fig. 4) from the Cozy Dell Shale.

It is also important to note that, although major biostratigraphic units (stages and zones) are easily recognized in the "Strata of Cascade Head", the boundaries between these units are often difficult to delineate precisely. This is due to the absence of certain diagnostic forms at both the upper and lower boundaries of these units. Samples collected near the base of the *Bulimina corrugata* Zone in the Neskowin Creek Section, for example, contain species that have their last known occurrence in this zone but completely lack forms that have their first known occurrence, whereas samples collected near the top of the zone contain species that have their first known occurrence but lack forms that have their last known occurrence in this zone. Thus, only that portion of this interval, where both first and last appearing forms occur jointly, can be definitely assigned to the *Bulimina corrugata* Zone. The lack of either first known occurrences at the base of a zone

or last known occurrences at the top of a zone permit only an approximate boundary to be drawn between two biostratigraphic units.

On the basis of its contained foraminifers, the lower portion of the Neskowin Creek Section can be assigned to the upper Ulatisian Stage of Mallory (1958, p. 43-44), whereas the balance of the "Strata of Cascade Head" can be correlated with Mallory's lower Narizian Stage (1959, p. 57-60). Of the 3495 foot section measured along Neskowin Creek, the lower 168 feet is assigned to the *Amphimorphina californica* Zone (upper Ulatisian) and the upper 3178 feet is assigned to the *Bulimina corrugata* Zone (lower Narizian). The *Amphimorphina californica*-*Bulimina corrugata* boundary, lying somewhere within the 149 foot interval between these two units, cannot be delineated accurately because of the lack of certain diagnostic forms at the base and top of these units and the lack of a continuously fossiliferous sequence.

Although poorly preserved, Foraminifera from localities in the lowermost 168 feet of the section measured along Neskowin Creek are representative of Mallory's *Amphimorphina californica* Zone. This is indicated by the joint occurrence of *Bolivina huneri*, which ranges no higher than the upper Ulatisian, and *Gyroidina orbicularis* var. *planata*, which ranges no lower than the upper Ulatisian. Perhaps more importantly however, is the presence of *Amphistegina*

simiensis in this interval. This species, originally described by Cushman and McMasters from the middle Eocene Lajas Formation in California, has never been recorded from rocks younger than middle Eocene on the West Coast and seems to be somewhat restricted to this interval (Bagley, 1959, p. 31; Bandy, 1944, p. 366; and Fairchild, Wesendunk, and Weaver, 1969, p. 16). Regarding the range of the genus *Amphistegina* in the Northwest, Stewart (in Baldwin, 1964b, p. 12) states:

All published references to *Amphistegina* and *Discocyclina* in Oregon and Washington that have come into hand have assigned a middle Eocene age to the sediments in which these genera were found.

He further states on p. 13:

The files of the Oregon Department of Geology and Mineral Industries contain no record of the occurrence of *Discocyclinas* or *Amphisteginas* in Oregon rocks known to be younger than middle Eocene age, although it is not uncommon to find them in rocks of known middle Eocene age.

Also present in this interval is *Vaginulinopsis mexicana* var. *nudicostata*, a species reported by Mallory (1959, table 19) in California as ranging no higher than the *Amphimorphina californica* Zone. Additional forms which are common in, but not confined to, the upper Ulatisian include *Eponides mexicana*, *Cibicides sandiegensis* and *Cibicidoides coalingensis*.

The upper 3178 feet of the Neskowin Creek Section contains an extremely diverse foraminiferal congregation that can be best correlated with the *Bulimina corrugata*

Zone of Mallory. This is indicated by the presence of the following species known from horizons no older than lower Narizian:

Bolivina basisenta
Bulimina microcostata
Cibicides laurissae
Haplophragmoides latissimisuturalis (see Mallory, 1959, table 19, as *H. obliquicameratus*)
Nodogenerina cf. *N. bradyi* (see Mallory, 1959, table 19, as *N. bradyi*)
Nodosaria chirana
Planularia markleyana
Planularia cf. *P. ouachitaensis*
Plectofrondicularia packardi var. *multilineata*
Plectofrondicularia searsii
Plectofrondicularia vokesi
Pullenia salisburyi
Quinqueloculina imperialis
Uvigerina churchi
Uvigerina churchi var. *demicostata*
Uvigerina garzaensis
Uvigerina garzaensis var. *nudorobusta*
Valvulineria tumeyensis
Virgulina bramlettei

and from horizons no younger than lower Narizian:

Alabamina wilcoxensis var. *californica*
Anomalina crassisepta
Anomalina dorri var. *aragonensis*
Bulimina curtissima
Cibicides laimingi
Dentalina angusticostata
Dentalina hexacostata
Dentalina cf. *D. sherborni*
Globigerina decepta
Gyroidina soldanii var. *octocamerata*
Karrerella chapapottensis var. *monumentensis*
Marginulina eximia
Nodosaria deliciae
Nodosaria (?) *gyrata*
Nonion durhami
Plectofrondicularia kerni
Pseudohastigerina micra
Ramulina aff. *R. navarroana*
Robulus pseudovortex
Valvulineria scrobiculata

Additional evidence for this age determination is offered

by the following species: *Allomorphina macrostoma*, which Smith (1971, p. 21) reports as confined to the *Bulimina corrugata* Zone in the Santa Cruz Mountains of California; *Bulimina consanguinea* and *Karrerella elongata*, perhaps restricted to lower Narizian horizons (see Mallory, 1959, table 19) and *Cibicides pachyderma* and *Robulus* cf. *R. terryi*, both of which according to Mallory (1959, table 19) appear to range no higher than the lower Narizian. Species occurring abundantly in this interval that are characteristic of, but not confined to, the *Bulimina corrugata* Zone include *Bathysiphon eocenicus*, *Bulimina corrugata*, *Cibicides felix*, *Cibicidoides venezuelanus*, *Gyroidina orbicularis* var. *planata*, *Robulus altolimbatus*, *Spiroplectammina directa*, and *Tritaxilina colei*.

More particularly, the uppermost 1504 feet of the Neskowin Creek Section, between samples PSUA0115 and PSUA0129, can be assigned to the *Uvigerina garzaensis* Subzone of Mallory (1959, p. 60-61) as *Bolivina basisenta*, *Cibicides laurissae*, *Planularia markleyana*, *Plectofrondicularia searsi*, and *Plectofrondicularia vokesi* have been reported no lower than this subzone and *Nodosaria* (?) *gyrata* has been reported no higher. Other species characteristic of this subzone which occur within this interval include *Rhabdammina eocenica*, *Spiroplectammina directa*, and *Tritaxilina colei*. To the author's knowledge, this is the first record of the *Uvigerina garzaensis* Subzone in rocks

north of California. It should also be noted that although the upper subzone can be recognized in the Neskowin Creek Section, the presence of the lower or *Uvigerina churchi* Subzone cannot be demonstrated in this sequence because of the absence of the chronologic indicators which characterize the unit.

The three supplementary sections measured in the Cascade Head area are also assigned to the *Bulimina corrugata* Zone of Mallory. In the Cascade Head Road and Three Rocks Sections this is indicated by the presence of *Haplophragmoides latissimisuturalis* (see Mallory, 1959, table 19, as *H. obliquicameratus*), *Nodogenerina* cf. *N. bradyi* (see Mallory, 1959, table 19, as *N. bradyi*), *Plectofrondicularia packardi* var. *multilineata*, *Plectofrondicularia searsi*, *Pullenia salisburyi*, *Uvigerina garzaensis*, and *Uvigerina garzaensis* var. *nudorobusta* and to a lesser degree by the stratigraphic equivalence of these intervals with localities at the top of the Neskowin Creek Section. Also occurring within these intervals are *Bathysiphon eocenicus* and *Gyroidina orbicularis* var. *planata*, both of which are characteristic of lower Narizian horizons. Moreover, since both the Cascade Head Road and Three Rocks Sections occupy the same stratigraphic position as the upper Neskowin Creek Section, the *Uvigerina garzaensis* Subzone is probably represented in these sequences. However, because of the lack of chronologic indicators, these

sequences have not been assigned to this subzone. The Salmon River Section can be correlated with the *Bulimina corrugata* Zone of Mallory on the basis of the joint occurrence of the following species which are not known to occur above this zone:

Alabamina wilcoxensis var. *californica*
Bulimina curtissima
Clavulinoides californicus
Dentalina hexacostata
Gyroidina soldanii var. *octocamerata*
Marginulina eximia
Pseudohastigerina micra
Robulus pseudovortex

and species which are not known to occur below this zone:

Cibicides laurissae
Valvulineria tumeyensis
Virgulina bramlettei

Karrerella elongata, a species restricted to the lower Narizian Stage (Mallory, 1959, table 19), also appears in this interval. Other forms collected from this section which apparently range no higher than the *Bulimina corrugata* Zone (Mallory, 1959, table 19) include *Cibicides pachyderma*, *Cibicides spiropunctatus*, *Robulus* cf. *R. terryi*, and *Pseudoglandulina conica*. Also common in this interval are *Bathysiphon eocenicus*, *Bulimina corrugata*, and *Gyroidina orbicularis* var. *planata*, all of which characterize lower Narizian faunas. Finally, conflicting evidence is presented by the occurrence at the base of the Salmon River Section of single specimens of *Amphistegina simiensis* and *Marginulina huneri*, species reported by Mallory (1959, p. 94 and table 19) as occurring no higher than the upper

Ulatisian Stage. However, since these Ulatisian species, indicative of shallow water, occur with a highly diagnostic lower Narizian deep water assemblage, it seems probable that they have been reworked from the subjacent sedimentary interbeds of the Siletz River Volcanic Series, which characteristically contain a shallow water Ulatisian fauna (Stewart in Baldwin, 1964b, p. 12-13).

Although its lower limits have been clearly established in the Neskowin Creek Section, the upper boundary of the *Bulimina corrugata* Zone cannot be placed within the "Strata of Cascade Head". The highest samples in the Neskowin Creek, Cascade Head Road, and Three Rocks Sections contain faunas assigned to the *Bulimina corrugata* Zone. Thus, the boundary between the *Bulimina corrugata* and overlying *Amphimorphina jenkinsi* Zone must fall somewhere within the superjacent Nestucca Formation as foraminiferal samples collected by Snively and Vokes (1949) to the north and south of the Cascade Head area indicate that the Nestucca Formation is, for the most part, referable to the upper Narizian Stage of Mallory. The presence of *Plectofrondicularia packardi* var. *packardi* and *Amphimorphina jenkinsi*, species normally indicative of the upper Narizian Stage, near the top of the Neskowin Creek Section, suggests that this boundary probably lies somewhere close to the base of the superjacent unit.

Several West Coast Formations have yielded foraminiferal faunas that can be correlated with those of the "Strata of Cascade Head", either in part or as a whole. Of these, the Rickreall Limestone Member of the Yamhill Formation, as described by Stokesbary (1933, *in* Baldwin, 1964b, p. 21) from near the town of Dallas, Oregon, bears the closest faunal affinity to the upper Ulatisian portion of the "Strata of Cascade Head". Foraminiferal faunas from other basal calcareous lenses in the Yamhill Formation (see various authors *in* Baldwin, 1964b, p. 21-24, and Boggs, Orr, and Baldwin, 1973) are also strikingly similar to the Ulatisian faunas of the "Strata of Cascade Head". In California a similar assemblage has been reported from the upper Lajas Formation (upper Ulatisian) by Cushman and McMasters (1936). Other formations on the West Coast assigned to the upper Ulatisian which are at least in part equivalent to the lowermost "Strata of Cascade Head" include the Eocene beds at Cape Blanco (Bandy, 1944) and the Elkton Siltstone, Lorane Siltstone, and Sacchi Beach Members of the Tyee Formation of southwestern Oregon; as well as the McIntosh Formation and possibly the Crescent Formation of southwestern Washington. Californian equivalents include the Canoas Siltstone Member of the Kreyenhagen Formation, the Domengine Sandstone, the middle portion of the Matilija Formation, the upper part of the Muir Sandstone, the lower part of the Nortonville Shale,

and the upper Vacaville Shale.

It is interesting to note that in the Coast Range of Oregon and Washington, calcareous sediments are exposed at the base of most late middle to late Eocene age sequences which directly overlie lower Tertiary submarine basalts. To the north along the Olympic Peninsula, rocks of equivalent age comprising the Boundary Shale Member of the Lyre Formation (Bagley, 1959), the Aldwell Formation (Thoms, personal communication, 1976), and the "Maynard" Sandstone of Thoms (1959) and Allison (1959) in the Port Townsend area all possess basal calcareous strata. Similarly, calcareous sediments are exposed, as previously mentioned, at the base of the Yamhill Formation (Baldwin, 1964b) and the "Strata of Cascade Head". Foraminiferal assemblages from these calcareous units normally contain very similar constituents and are, for the most part, correlative. Baldwin (1964b, p. 21) attributes the basal calcareous strata of the Yamhill Formation to weathering of calcite veinlets and interstices within the Siletz River Volcanic Series, which formed a highland at the time. Calcareous sediments accumulated as lime-rich streams flowed into localized basins or lagoons where warm sea water and marine organisms aided deposition. Information gathered during this investigation is entirely compatible with Baldwin's interpretation as the basal "Strata of Cascade Head" contain a very warm shallow water fauna (middle neritic)

and numerous basaltic fragments presumably derived from weathering of the Siletz River Volcanic Series.

The extremely diverse foraminiferal assemblages collected from the lower Narizian portion of the "Strata of Cascade Head" permit correlation with many West Coast Formations. In Oregon and Washington, formations which are at least in part equivalent include the Aldwell Formation, the Coaledo? Formation of Baldwin (1961; to be formalized under the term Bateman Formation), the Boundary Shale Member of the Lyre Formation, the "Maynard Formation" of Thoms (1959) and Allison (1959), the McIntosh Formation, the Moody Shale Member of the Toledo Formation, and the Yamhill Formation. In California, lower Narizian equivalents include the Butano Formation, Cozy Dell Shale, Escobar Sandstone, lower Kreyenhagen Formation, lower Markley Sandstone, upper Matilija Sandstone, and the Poway Conglomerate.

Geologic History

A model reconstructing the middle Tertiary history of the "Strata of Cascade Head" can be developed as a result of the detailed information gained during this investigation. According to Snavely, Wagner, and MacLeod (1969, p. 36) western Oregon and Washington was the site of a large subsiding trough throughout most of the early Tertiary, which extended from Vancouver Island southward to the Klamath Mountains. During much of the early and

middle Eocene, vast submarine outpourings of basaltic lava (the Siletz River Volcanic Series in the Central Oregon Coast Range) accumulated on the floor of this rapidly subsiding basin. Toward the close of the volcanic period (lower Ulatisian), extrusion of lava exceeded the subsidence of the basin and in many places volcanic islands were formed. At the margins of these islands, calcareous sediments, derived from the weathering of the volcanics, were deposited in restricted embayments or lagoons (Baldwin, 1964b, p. 21). The lower calcareous sandstones of the Neskowin Creek Section were probably deposited in such an environment as upper Ulatisian faunas are indicative of warm shallow waters (middle neritic). Similarly, the basaltic fragments included within these deposits were apparently derived from the Siletz River Volcanic Series. Marine deposition fluctuated between middle and lower neritic depths during this time as a few siltstone interbeds within the calcareous sandstones contain lower neritic assemblages. The lack of upper Ulatisian strata at the base of the Salmon River Section, exposed less than four miles to the east, suggests that this area remained a topographic high during upper Ulatisian times since underlying and overlying rocks appear to be lithologically equivalent in both sections.

As early Narizian time began, the volcanic highs in the Cascade Head area were buried by arkosic sand and mud

during continued submergence of the basin. This is evident in the thick sequences of mudstone and thinly laminated beds of micaceous arkosic sandstone observed above the Siletz River Volcanic Series in the Salmon River Section and the lower calcareous sandstone in the Neskowin Creek Section. Foraminiferal assemblages from these sequences are essentially equivalent and indicate deposition took place at depths comparable to the upper continental slope (upper bathyal). Just prior to *Uvigerina garzaensis* Subzone time, a profound change occurred within the Cascade Head area as the sediments become dominated by volcanic material. This is evidenced by the basaltic debris and tuffaceous nature of the rocks exposed along Neskowin Creek. Flows of basaltic lava and breccia also occur sporadically, intercalated with the clastic sediments. Foraminiferal faunas indicate deposition took place primarily at upper bathyal depths. Shallower depths, as evidenced by coarse-grained sediments, probably correspond with increased periods of volcanism. Near the top of the sequence depths become progressively greater (middle bathyal) prior to the extrusion of the superjacent volcanics of the Nestucca Formation.

SYSTEMATIC CATALOGUE

In the following synonymies, all identifications are based primarily on published figures and descriptions. Special note is made herein of species that have been compared with type material on deposit at the University of California-Berkeley and Portland State University. No attempt has been made to develop a complete synonymy for each species and only the publications actually used in the identification are included. Nevertheless, the catalogue is reasonably complete in regard to publications on the West Coast Tertiary.

All of the type material is deposited in the micro-paleontological collections of the Earth Sciences Museum at Portland State University. All type and locality numbers refer to the collections at Portland State University. The systematic arrangement of the Foraminifera follows Cushman (1950) except in the case of planktonic Foraminifera, in which the classification of Loeblich and Tappan (1964) is used.

Phylum PROTOZOA

Class SARCODINA Butschli, 1882

Order FORAMINIFERA d'Orbigny, 1826

Family ASTORRHIZIDAE

Bathysiphon sp.

Hypotype no. 00196, loc. PSUA0131.

Several individuals from the Three Rocks Section differ from *B. eocenicus* (Mallory, 1959, pl. 1, fig. 4) in possessing a more coarsely arenaceous test.

Family HYPERAMMINIDAE

Genus *Hyperammina* H. B. Brady, 1878

Hyperammina [?] sp.

Hypotype no. 00197, loc. PSUA0100.

Fragmented specimens from the Neskowin Creek Section resemble Mallory's figure of *H. elongata* H. B. Brady (?) (1959, pl. 1, fig. 8, pl. 27, fig. 2) but lack the bulbous proloculus and tapering second chamber that characterize this genus (Loeblich & Tappan, 1964, p. C190; Smith, 1971, p. 24).

Family AMMODISCIDAE

Genus *Ammodiscus* Reuss, 1861

Ammodiscus incertus (d'Orbigny)

Ammodiscus incertus (d'Orbigny), Howe, 1939, p. 29, pl. 1, fig. 8; Franklin, 1944, p. 304, pl. 44, fig. 1; Ujiie & Watanabe, 1960, p. 127, pl. 1, fig. 9a, b; Weaver & Molander, 1964, p. 177, pl. 1, fig. 6.

Hypotype no. 00198, loc. PSUA0111

Ammodiscus cf. *A. incertus* (d'Orbigny) [of Mallory]

Ammodiscus cf. *A. incertus* (d'Orbigny), Mallory, 1959, p. 108, pl. 1, fig. 11, 12, pl. 39, fig. 2; Kleinpell & Weaver, 1963, p. 166, pl. 2, fig. 6; Weaver & Molander, 1964, p. 177, pl. 1, fig. 7.

Hypotype no. 00199, loc. PSUA0131.

Comparison of this species with the hypotypes of *A. incertus* suggest that the compressed shape of *A. cf. A. incertus* may have resulted from distortion during preservation. Further studies should prove the two to be synonymous.

Ammodiscus sp.

Hypotype no. 00200, loc. PSUA0129.

A few incomplete individuals are referable to this genus.

Family LITUOLIDAE

Genus *Haplophragmoides* Cushman, 1910

Haplophragmoides latissimisuturalis Smith

Haplophragmoides obliquicameratus Marks, 1951, p. 35, pl. 5, fig. 1a-c; Sullivan, 1962, p. 251, pl. 9, fig. 9a, b, 10a, b; Weaver, 1962, p. 369, pl. 1, fig. 4; Kleinpell & Weaver, 1963, p. 166, pl. 2, fig. 7; Fairchild, Wesendunk, & Weaver, 1969, p. 30, pl. 1, fig. 6a, b, 7a, b; Gaston, 1974, p. 46, [hypotype examined].

Haplophragmoides sp. Wilson, 1954, p. 131, pl. 12, fig. 4a, b.

Haplophragmoides sp. Smith, 1956, p. 87, pl. 9, fig. 3a, b.

Haplophragmoides cf. *H. obliquicameratus* Marks, Hornaday, 1961, p. 179, pl. 1, fig. 8a-c; Weaver & Molander, 1964, p. 178, pl. 1, fig. 12, 13.

Haplophragmoides latissimisuturalis Smith, 1971, p. 25, pl. 1, fig. 6a-c, pl. 2, fig. 1a, b.

Hypotype no. 00201, loc. PSUA0130.

Haplophragmoides obliquicameratus was described by Marks (1951, p. 35) in his revision of a number of species from the Vienna Basin. Subsequently, Smith (1971, p. 26) observed differences between *H. obliquicameratus* and forms previously referred to this species in West Coast Tertiary deposits and redescribed it as *H. latissimisuturalis*. In her

description she states:

The confusion with *H. obliquicameratus* results from mistaking chambers for sutures [chambers are commonly depressed and sutures raised upon fossilization]. Marks' description and figures (1951, p. 35, pl. 5, fig. 1a-c) depict a form with nonlimbate, depressed sutures. *H. obliquicameratus* also has about eleven chambers in the final whorl, compared to the six to eight of the California specimens.

Individuals from the "Strata of Cascade Head" are typical of the West Coast forms in that they average eight chambers in the final whorl and have limbate sutures.

Haplophragmoides sp.

Hypotype no. 00202, loc. PSUA0111.

Poorly preserved individuals seem best placed in this genus.

Genus *Cribrostomoides* Cushman, 1910

Cribrostomoides [?] sp.

Hypotype no. 00203, loc. PSUA0105.

Because its apertural characteristics cannot clearly be distinguished, a single specimen from locality PSUA0105 is questionably placed within this genus.

Genus *Cyclammina* H. B. Brady, 1876

Cyclammina clarki (G. D. Hanna)

? *Nonionina clarki* Hanna, 1923, p. 24, pl. 59, fig. 2a, b.

Cyclammina clarki ? (Hanna), Cushman & Schenck, 1928, p. 306, pl. 42, fig. 1; Weaver & Molander, 1964, p. 178, pl. 2, fig. 2a, b.

Cyclammina cf. *C. clarki* (Hanna), Wilson, 1954, p. 132, pl. 12, fig. 5a, b; Smith, 1956, p. 87, pl. 9, fig. 5a, b; Hornaday, 1961, p. 180, pl. 1, fig. 9a-c.

Cyclammmina clarki (Hanna), Mallory, 1959, p. 114, pl. 27, fig. 4a, b, pl. 39, fig. 4a, b; Sullivan, 1962, p. 251, pl. 2, fig. 3; Weaver & Weaver, 1962, p. 19, pl. 1, fig. 11, 12; Kleinpell & Weaver, 1963, p. 167, pl. 2, fig. 9; Gaston, 1974, p. 47, [hypotype examined].

Hypotype no. 00204, loc. PSUA0131.

Most published figures that have appeared in West Coast literature which refer to *C. clarki*, *C. clarki* ?, or *C. cf. C. clarki* can be divided into two groups: a group which is ovoid in plan view (Cushman and Schenck, 1928; Hornaday, 1961; Sullivan, 1962; Weaver and Weaver, 1962; Kleinpell and Weaver, 1963; and Weaver and Molander, 1964) and a group which is circular in plan view (Hanna, 1923; Wilson, 1954; Smith, 1956; and Mallory, 1959). Rather than regarding each group as a separate species, it is suggested that they be synonymized (the ovoid group representing distorted members of the circular group), since the only apparent difference between these forms is the shape of the test. It is interesting to note that in samples in which distorted specimens of *C. clarki* occur (PSUA0115, PSUA0117, and PSUA0131), other forms that appear to be distorted are also present (*Haplophragmoides latissimisuturalis* and *Ammodiscus cf. A. incertus*).

C. pacifica Beck is very difficult to differentiate from *C. clarki*. Both possess broadly rounded peripheries, slightly incised sutures, and average ten chambers in the final whorl (Hanna, 1923, p. 323; Beck, 1943, p. 591). Smith (1971, p. 30) has even synonymized the two forms.

Until further comparison of the primary type is accomplished these forms will remain separated in this investigation.

Cyclammina incisa (Stache)

[?] *Cyclammina incisa* (Stache), Cushman, Stewart, & Stewart, 1947a, p. 12, pl. 1, fig. 1a, b.

Cyclammina cf. *C. incisa* Stache, Smith, 1956, p. 88, pl. 9, fig. 4a, b; Sullivan, 1962, p. 252, pl. 2, fig. 1a, b.

Cyclammina incisa (Stache), Asano, 1958, pl. 13, fig. 20a, b; Kleinpell & Weaver, 1963, p. 167, pl. 2, fig. 11a, b; Smith, 1971, p. 30, pl. 2, fig. 3a, b; Tipton, Kleinpell, & Weaver, 1973, p. 41, pl. 1, fig. 2a, b.

Hypotype no. 00205, loc. PSUA0117.

C. incisa is differentiated from other members of its genus by slightly curved sutures, an acute somewhat lobate periphery, and a thin compressed test.

Cyclammina incisa [?] (Stache)

Hypotype no. 00206, loc. PSUA0116

Cyclammina samanica Berry

Cyclammina cf. *C. samanica* Berry, Cushman & Simonson, 1944, p. 193, pl. 30, fig. 2; Wilson, 1954, p. 132, pl. 12, fig. 5a, b.

Cyclammina samanica Berry, Mallory, 1959, p. 115, pl. 2, fig. 15a, b; Hornaday, 1961, p. 180, pl. 1, fig. 10a-c; Sullivan, 1962, p. 252, pl. 2, fig. 2; Weaver & Weaver, p. 19, pl. 1, fig. 13; Kleinpell & Weaver, 1963, p. 167, pl. 3, fig. 2; Weaver & Molander, 1964, p. 187, pl. 2, fig. 3a, b, 4a, b; DeLise, 1967, p. 23, pl. 1, fig. 2a, b; Fairchild, Wesendunk, & Weaver, 1969, p. 31, pl. 1, fig. 9a, b; Gaston, 1974, p. 48, [hypotype examined].

Hypotype no. 00207, loc. PSUA0137.

Typical specimens average eight chambers in the last whorl and are extremely compressed in lateral view.

Cyclammina sp.

Hypotype no. 00208, loc. PSUA0117.

Family TEXTULARIIDAE

Genus *Spiroplectammina* Cushman, 1927*Spiroplectammina directa* (Cushman & Siegfus)

Spiroplectoides directa Cushman & Siegfus, 1939, p. 26, pl. 6, fig. 7, 8.

Spiroplectammina directa (Cushman & Siegfus), Mallory, 1959, p. 116, pl. 3, fig. 5a, b; Fairchild, Wesendunk, & Weaver, 1969, p. 31, pl. 1, fig. 10; Gaston, 1974, p. 48, [hypotype examined].

Spiroplectammina cf. *S. directa* (Cushman & Siegfus), Fairchild, Wesendunk, & Weaver, 1969, p. 31, pl. 1, fig. 11.

Hypotype no. 00209 (microspheric individual), loc. PSUA0125.
Hypotype no. 00210 (megalospheric individual),
loc. PSUA0125.

Spiroplectammina tejonensis Mallory

Spiroplectammina tejonensis Mallory, 1959, p. 118, pl. 3, fig. 6a, b, 7a, b, 8a, b.

[Non] *Spiroplectammina tejonensis* Mallory, Tipton, Kleinpell, & Weaver, 1973, p. 41, pl. 1, fig. 4a, b.

Hypotype no. 00211, loc. PSUA0116.

Spiroplectammina sp. [of Wilson]

Textularia ? sp. Cushman & Simonson, 1944, p. 193, pl. 30, fig. 3.

Spiroplectammina sp. Wilson, 1954, p. 132, pl. 12, fig. 7a, b.

Spiroplectammina sp. Hornaday, 1961, p. 181, pl. 2, fig. 1a, b.

Textularia cf. *T. warreni* Cushman & Ellisor, Sullivan, 1962, p. 253, pl. 2, fig. 8a, b, 9.

Spiroplectammina mississippiensis (Cushman), Kleinpell & Weaver, 1963, p. 167, pl. 3, fig. 7a, b; Gaston, 1974, p. 49, [hypotype examined].

Hypotype no. 00212 (microspheric individual), loc. PSUA0131.
 Hypotype no. 00213 (megalospheric individual),
 loc. PSUA0116

Specimens collected from the Neskowin Creek and Three Rocks Sections are conspecific with *S. sp.* of Wilson (1954, pl. 12, fig. 7a, b). Placement of these specimens within the genus *Spiroplectammina* results from the presence of a planispiral coil in the early portion of the tests. The planispiral coil consists of four chambers followed by ten biserially arranged chambers in megalospheric individuals and 18 biserially arranged chambers in microspheric individuals. This distinctive species is characterized by slightly curved, limbate sutures and a very compressed test; the center and margins of the test are thicker than the areas between them.

Further study of comparative material will probably warrant the proposal of a new name.

Spiroplectammina spp.

Genus *Textularia* DeFrance, 1824

Textularia [?] sp.

Hypotype no. 00214, loc. PSUA0117.

Fragmented and poorly preserved individuals are questionably assigned to this genus.

Genus *Vulvulina* d'Orbigny, 1826

Vulvulina curta Cushman & Siegfus

Vulvulina curta Cushman & Siegfus, 1935, p. 91, pl. 14, fig. 1, 2; Mallory, 1959, p. 119, pl. 3, fig. 12a, b, 13a, b, pl. 27, fig. 6a, b; Fairchild, Wesendunk, & Weaver, 1969, p. 32, pl. 2, fig. 3a, b; Gaston, 1974, p. 49, [hypotype examined].

Vulvulina cf. *V. curta* Cushman & Siegfus, Weaver & Weaver, 1962, p. 20, pl. 2, fig. 3.

Hypotype no. 00215, loc. PSUA0133.

Vulvulina sp. A. [*species nova*]

(Pl. 1, fig. 1, 2)

Test comparatively large, much compressed, longer than broad, broadest at apertural end, curved after biserial stage, periphery slightly rounded and spinose; chambers distinct, earliest arranged in planispiral coil, four in number, followed by six to eight biserial chambers, later chambers uniserial, nine in number; sutures distinct, curved, depressed; wall finely arenaceous; aperture in adult, terminal, elongate

Dimensions of hypotypes:

00216; length 1.10 mm.; width .48 mm.

00217; length .79 mm.; width .48 mm.

Hypotype no. 00216, loc. PSUA0134.

Hypotype no. 00217, loc. PSUA0134.

This species most closely resembles *Vulvulina pennatula* (Batsch) var. *italica* Cushman (1932b, p. 78, pl. 10, fig. 6) but differs in the curvature of the test after the biserial stage and the more numerous chambers in the uniserial stage.

Specimens commonly break between the biserial and uniserial stages resulting in a biserial fragment that is easily confused with species of the genus *Spiroplectammina*. However, inspection of the apertural region should allow placement in the correct genus; *Spiroplectammina* has an aperture at the inner margin of the last chamber while *Vulvulina* has an elongate slit on the final chamber. The naming of this species must await publication in accordance with the International Code of Zoological Nomenclature (1961, p. 9, art. 11a).

Family VERNEUILINIDAE

Genus *Gaudryina* d'Orbigny, 1839*Gaudryina* cf. *G. laevigata* Franke [of Mallory]

Gaudryina (*Gaudryina*) *laevigata* Franke, Smith, 1957, p. 152, pl. 18, fig. 8a, b.

Gaudryina cf. *G. laevigata* Franke, Mallory, 1959, p. 122, pl. 4, fig. 3a, b.

Hypotype no. 00218, loc. PSUA0137.

Gaudryina [?] sp.

Hypotype no. 00219, loc. PSUA0108.

A single individual from the Neskowin Creek Section may represent this genus.

Genus *Clavulinoides* Cushman, 1936*Clavulinoides californicus* Mallory

Gaudryina (*Pseudogaudryina*) sp. Smith, 1957, p. 153, pl. 18, fig. 13a-c, 14a-c.

Clavulinoides californicus Mallory, 1959, p. 123, pl. 4, fig. 6a, b.

Hypotype no. 00220, loc. PSUA0137.

Family VALVULINIDAE

Genus *Dorothia* Plummer, 1931*Dorothia principiensis* Cushman & Bermudez

Dorothia principiensis Cushman & Bermudez, Cushman & Siegfus, 1939, p. 24, pl. 6, fig. 23; Bergquist, 1942, p. 18, pl. 1, fig. 12; Smith, 1957, p. 154, pl. 19, fig. 4a, b; Mallory, 1959, p. 125, pl. 27, fig. 8a, b, pl. 33, fig. 2a, b, pl. 36, fig. 3a, b; DeLise, 1967, p. 25, pl. 1, fig. 6a, b; Gaston, 1974, p. 50, [hypotype examined].

Hypotype no. 00221, loc. PSUA0106.

Dorothia spp.

Hypotype no. 00222, loc. PSUA0110.

Poor preservation prevented accurate identification of forms which resemble *Dorothia principiensis* Cushman and Bermudez. More than one species may be represented.

Genus *Karreriella* Cushman, 1933

Karreriella chapapotensis (Cole) var. *monumentensis* Mallory

Karreriella chapapotensis (Cole) var. *monumentensis* Mallory, 1959, p. 126, pl. 5, fig. 3a-c.

Hypotype no. 00223, loc. PSUA0111.

Poorly preserved specimens of this variety are easily confused with *Chiloguembelina cubensis* Palmer. *Karreriella chapapotensis* var. *monumentensis* however, can be distinguished by flattened chambers and a slit-like aperture surrounded by a distinct lip whereas *C. cubensis* possesses a low broadly arched aperture and more inflated chambers.

Karreriella elongata Mallory

Karreriella elongata Mallory, 1959, p. 127, pl. 5, fig. 4a-c; Tipton, Kleinpell, & Weaver, 1973, p. 43, pl. 1, fig. 15a, b.

Hypotype no. 00224, loc. PSUA0109.

Karreriella mediaaguaensis Mallory

Karreriella media-aguaensis Mallory, 1959, p. 127, pl. 5, fig. 5a, b, 6a, b; Sullivan, 1962, p. 255, pl. 4, fig. 5a, b; Fairchild, Wesendunk, & Weaver, 1969, p. 34, pl. 4, fig. 2a, b; Gaston, 1974, p. 50, [hypotype examined].

Hypotype no. 00225, loc. PSUA0131.

Karreriella [?] sp.

Hypotype no. 00226, loc. PSUA0108.

Poorly preserved specimens seem best placed in this genus.

Genus *Martinottiella* Cushman, 1933*Martinottiella eocenica* Cushman & Bermudez

Martinottiella eocenica Cushman & Bermudez, Mallory, 1959, p. 128, pl. 5, fig. 8a, b; Sullivan, 1962, p. 255, pl. 4, fig. 6a, b; Tipton, Kleinpell, & Weaver, 1973, p. 43, pl. 1, fig. 14a, b; Thoms, 1975, pl. 1, fig. 6a, b.

Hypotype no. 00227, loc. PSUA0116.

Martinottiella [?] sp.

Hypotype no. 00228, loc. PSUA0131.

Genus *Tritaxilina* Cushman, 1911*Tritaxilina colei* Cushman & Siegfus

Tritaxilina colei Cushman & Siegfus, 1935, p. 92, pl. 14, fig. 5, 6; Kleinpell, 1938, p. 194, pl. 3, fig. 5; Mallory, p. 128, pl. 27, fig. 9a, b; Weaver & Weaver, 1962, p. 21, pl. 2, fig. 10; Weaver, 1962, p. 372, pl. 1, fig. 2a, b; Kleinpell & Weaver, 1963, p. 168, pl. 4, fig. 3a-c; Rau, 1964, p. G15, pl. 5, fig. 2; DeLise, 1967, p. 25, pl. 1, fig. 7; Fairchild, Wesendunk, & Weaver, 1969, p. 34, pl. 4, fig. 8a, b; Smith, 1971, p. 35, p. 2, fig. 8; Gaston, 1974, p. 51, [hypotype examined].

Hypotype no. 00229, loc. PSUA0137.

Tritaxilina [?] sp.

Hypotype no. 00230, loc. PSUA0100.

Specimens from the basal Neskowin Creek Section are badly recrystallized and are questionably placed in this genus.

Family SILICINIDAE

Genus *Silicosigmoilina* Cushman & Church, 1929*Silicosigmoilina californica* Cushman & Church

Silicosigmoilina californica Cushman & Church, Smith, 1957, p. 155, pl. 19, fig. 8a, b, 12a, b; Mallory, 1959, p. 129, pl. 5, fig. 10a, b; Thoms, 1975, pl. 1, fig. 7.

Hypotype no. 00231, loc. PSUA0137.

Family MILIOLIDAE

Genus *Quinqueloculina* d'Orbigny, 1826*Quinqueloculina goodspeedi* [?] Hanna & Hanna

[?] *Quinqueloculina goodspeedi* Hanna & Hanna, 1924, p. 58, pl. 13, fig. 3, 4; Beck, 1943, p. 592, pl. 99, fig. 1, 2; Asano, 1958, pl. 11, fig. 2a, b; Rau, 1964, p. G15, pl. 5, fig. 1a-c.

Hypotype no. 00232, loc. PSUA0119.

The apertural characteristics and general outline of a specimen from the Neskowin Creek Section closely approaches *Q. goodspeedi*, but the surface of the test is badly worn making the specific identification uncertain.

Quinqueloculina imperialis Hanna & Hanna

Quinqueloculina imperialis Hanna & Hanna, 1924, p. 58, pl. 13, fig. 7, 8, 10; Beck, 1943, p. 592, pl. 98, fig. 9, 10; Cushman & Frizzell, 1943, p. 82, pl. 14, fig. 1; Rau, 1948, p. 159, pl. 27, fig. 12-14; Cushman, Stewart, & Stewart, 1947d, p. 74, pl. 9, fig. 3a-c; Asano, 1958, pl. 11, fig. 7a, b; DeLise, 1967, p. 26, pl. 1, fig. 8; Gaston, 1974, p. 51, [hypotype examined].

Hypotype no. 00233, loc. PSUA0119.

Quinqueloculina triangularis d'Orbigny

Quinqueloculina triangularis d'Orbigny, Cushman & Hanna, 1927, p. 57, pl. 6, fig. 8, 9; Smith, 1957, p. 155, pl. 19, fig. 7a-c; Mallory, 1959, p. 130, pl. 36, fig. 5a-c; Sullivan, p. 256, pl. 4, fig. 12a-c.

Hypotype no. 00234, loc. PSUA0123.

Quinqueloculina spp.

Numerous fragments, particularly common in the basal Neskowin Creek Section are best referred to this genus.

Genus *Massilina* Schlumberger, 1893*Massilina decorata* Cushman

Massilina decorata Cushman, 1922, p. 143, pl. 34, fig. 7; Cushman, 1935, p. 13, pl. 3, fig. 14-16; Cushman & McMasters, 1936, p. 510, pl. 74, fig. 8; Bergquist, 1942, p. 22, pl. 1, fig. 26; Franklin, 1944, p. 308, pl. 45, fig. 7; Mallory, 1959, p. 131, pl. 39, fig. 7a, b.

Hypotype no. 00235, loc. PSUA0107.

Genus *Spiroloculina* d'Orbigny, 1826*Spiroloculina* (?) cf. *S. lamposa* Hussey

Spiroloculina ? cf. *S. lamposa* Hussey, Smith, 1957, p. 155, pl. 19, fig. 10a, b, 11a, b; Mallory, 1959, p. 131, pl. 5, fig. 13a, b, pl. 36, fig. 6a, b.

Spiroloculina lamposa Hussey, Sullivan, 1962, p. 256, pl. 4, fig. 10a, b.

Spiroloculina cf. *S. lamposa* Hussey, Gaston, 1974, p. 52, [hypotype examined].

Hypotype no. 00237, loc. PSUA0137.

Spiroloculina wilcoxensis Cushman & Garrett

Spiroloculina wilcoxensis Cushman & Garrett, Cushman & Simonson, 1944, p. 194, pl. 30, fig. 4-6; Detling, 1946, p. 352, pl. 46, fig. 3; Hornaday, 1961, p. 181, pl. 2, fig. 3; Sullivan, 1962, p. 257, pl. 4, fig. 9; Weaver & Molander, 1964, p. 180, pl. 3, fig. 3; Phillips, Tipton, & Watkins, 1974, pl. 1, fig. 1.

Spiroloculina cf. *S. lamposa* Hussey, Weaver & Weaver, 1962, p. 21, pl. 2, fig. 12.

[?] *Spiroloculina wilcoxensis* Cushman & Garrett, Gaston, 1974, p. 52, [hypotype examined].

Hypotype no. 00236, loc. PSUA0127.

Genus *Triloculina* d'Orbigny, 1826*Triloculina tricarinata* d'Orbigny

Triloculina tricarinata d'Orbigny, Cushman & Henbest, 1940, pl. 9, fig. 7; Todd, 1957a, pl. 86, fig. 15a, b; Todd, 1970, p. A4, pl. 1, fig. 8.

Triloculina trigonula (Lamark), Howe, 1939, p. 39, pl. 3, fig. 1, 2.

Hypotype no. 00238, loc. PSUA0100.

Triloculina tricarinata is characterized by a sharply angled, triangular shaped test with flat sided chambers. To the author's knowledge this species has not been recorded from Eocene deposits on the West Coast.

Triloculina [?] sp.

Hypotype no. 00239, loc. PSUA0100.

These incomplete specimens probably represent *T. tricarinata*.

Family OPHTHALMIDIIDAE

Genus *Cornuspira* Schultze, 1854

Cornuspira byramensis Cushman

Cornuspira lewisensis Beck, 1943, p. 594, pl. 101, fig. 4, 5.

Cornuspira byramensis Cushman, Cushman & Frizzell, 1943, p. 83, pl. 14, fig. 4; Rau, 1948, p. 160, pl. 28, fig. 10, 11.

Hypotype no. 00240, loc. PSUA0117.

Two species of the genus *Cornuspira* were recorded from the Neskowin Creek Section. The nature of the periphery forms the basis for separating the two; *C. byramensis* has a rounded periphery and is circular in profile while *C. olygogyra* has flattened sides and is rectangular in section. *Cornuspira byramensis* is also more compressed than *C. olygogyra*.

Cornuspira olygogyra Hantken

Cornuspira olygogyra Hantken, Cushman, 1935, p. 15, pl. 4, fig. 14; Coryell & Embich, 1937, p. 293, pl. 41, fig. 15; Howe, 1939, p. 39, pl. 3, fig. 9, 10; Bergquist, 1942, p. 26, pl. 2, fig. 19.

Hypotype no. 00241, loc. PSUA0119.

See discussion under *C. byramensis*.

Family TROCHAMMINIDAE

Genus *Trochammina* Parker & Jones, 1859

Trochammina albertensis Wickenden

Trochammina albertensis Wickenden, Cushman, 1946a, p. 50, pl. 15, fig. 7a-c; Sullivan, 1962, p. 256, pl. 4, fig. 7a, b; Fairchild, Wesendunk, & Weaver, 1969, p. 32, pl. 2, fig. 7a-c.

Hypotype no. 00242, loc. PSUA0111.

Trochammina cf. *T. globigeriniformis* (Parker & Jones)

Trochammina cf. *T. globigeriniformis* (Parker & Jones), Smith, 1957, p. 156, pl. 19, fig. 16a-c; Mallory, 1959, p. 133, pl. 5, fig. 16.

Trochammina globigeriniformis (Parker & Jones), Gaston, 1974, p. 52, [hypotype examined].

Hypotype no. 00243, loc. PSUA0131.

Crushed individuals are conspecific with what has been referred to as *T. cf. T. globigeriniformis* in West Coast literature.

Trochammina sp.

Hypotype no. 00244, loc. PSUA0131.

Family LAGENIDAE

Genus *Robulus* Montfort, 1808

Robulus alatolimbatus (Gumbel)

Cristellaria alato-limbata (Gumbel), Cushman & Applin, 1926, p. 171, pl. 8, fig. 8.

Robulus alato-limbatus (Gumbel), Cushman, 1935, p. 15, pl. 6, fig. 2a, b; Coryell & Embich, 1937, p. 299, pl. 41, fig. 16; Howe, 1939, p. 40, pl. 4, fig. 18; Bergquist, 1942, p. 26, pl. 3, fig. 7; Wilson, 1954, p. 133, pl. 14, fig. 3a, b; Todd, 1975a, pl. 64, fig. 24a, b; Mallory, 1959, p. 133, pl. 6, fig. 16a, b, pl. 27, fig. 11a, b; Hornaday, 1961, p. 182, pl. 2, fig. 11a, b, 12a, b, 13a, b; Sullivan, 1962, p. 257, pl. 7, fig. 9a, b; Weaver & Weaver, 1962, p. 22, pl. 3, fig. 2a, b, 3; Weaver & Molander, 1964, p. 180, pl. 3, fig. 6a-c; DeLise, 1967, p. 27, pl. 1, fig. 9a, b; Thoms, 1975, pl. 1, fig. 23a, b.

Lenticulina alato-limbata (Gumbel), Fairchild, Wesendunk, & Weaver, 1969, p. 40, pl. 5, fig. 15a, b; Tipton, Kleinpell, & Weaver, 1973, p. 44, pl. 2, fig. 1a, b.

Lenticulina alatolimbata (Gumbel), Smith, 1971, p. 40, pl. 3, fig. 3a, b.

[?] *Robulus alato-limbata* (Gumbel), Gaston, 1974, p. 53, [hypotype examined].

Hypotype no. 00245, loc. PSUA0108.

Robulus alatolimbatus is characterized by a small close-coiled test, approximately seven chambers in the last whorl, a large central umbo, and a narrow peripheral keel.

Robulus alatolimbatus [?] (Gumbel)

Hypotype no. 00246, loc. PSUA0137.

Several poorly preserved specimens with a large central umbo resemble *R. alatolimbatus* but are much larger and have a greater number of chambers in the last whorl.

Robulus arcuato-striatus (Hantken) var. *carolinianus* Cushman

Robulus arcuato-striatus (Hantken) var. *carolinianus* Cushman, Cushman, 1935, p. 17, pl. 6, fig. 6a, b; Coryell & Embich, 1937, p. 299, pl. 41, fig. 18; Bergquist, 1942, p. 27, pl. 2, fig. 23; Wilson, 1954, p. 133, pl. 13, fig. 4a, b, 5a, b; Mallory, 1959, p. 134, pl. 6, fig. 9a, b, pl. 27, fig. 12a, b; Sullivan, 1962, p. 257, pl. 7, fig. 8a, b; Weaver & Weaver, 1962, p. 22, pl. 3, fig. 4a, b; Gaston, 1974, p. 53, [hypotype examined].

Robulus cf. *R. arcuato-striatus carolinianus* Cushman, Cushman & Simonson, 1944, p. 194, pl. 30, fig. 10.

Hypotype no. 00247, loc. PSUA0111.

This variety is distinguished by a large close-coiled test, strongly curved sutures, seven to nine chambers in the last whorl, and a radiate aperture.

Robulus articulatus (Reuss) var. *texanus* (Cushman & Applin)

Cristellaria articulata Reuss var. *texana* Cushman & Applin, 1926, p. 170, pl. 8, fig. 1, 2.

Robulus articulatus (Reuss) var. *texanus* (Cushman & Applin), Cushman & Dusenbury, 1934, p. 53, pl. 7, fig. 2, 3; Cushman, 1935, p. 16, pl. 4, fig. 16, 17; Bergquist, 1942, p. 28, pl. 3, fig. 6; Cushman & Frizzell, 1943, p. 83, pl. 14, fig. 10; Cushman & Simonson, 1944, p. 194, pl. 30, fig. 7; Mallory, 1959, p. 135, pl. 6, fig. 13a, b; Kleinpell & Weaver, 1963, p. 169, pl. 4, fig. 5a, b; Weaver & Molander, 1964, p. 180, pl. 3, fig. 7a, b; Gaston, 1974, p. 54, [hypotype examined]; Thoms, 1975, pl. 1, fig. 25.

Robulus texanus (Cushman & Applin), Beck, 1943, p. 595, pl. 103, fig. 1, 2, 4, 5; Rau, 1948, p. 163, pl. 29, fig. 16, 17; Todd, 1957a, pl. 64, fig. 20.

Lenticulina articulata (Reuss) var. *texana* (Cushman & Applin), Fairchild, Wesendunk, & Weaver, 1969, p. 41, pl. 5, fig. 19a, b.

Hypotype no. 00248, loc. PSUA0104.

As an adult, this variety is easily recognized by its chambers which uncoil revealing the central portion of the test.

Robulus articulatus (Reuss) var. *texanus* [?]
(Cushman & Applin)

Hypotype no. 00249, loc. PSUA0110.

A few fragmented specimens are questionably referred to this variety.

Robulus cf. *R. chehalisensis* Rau [of Smith]

Robulus cf. *R. chehalisensis* Rau, Smith, 1957, p. 157, pl. 20, fig. 3a, b; Weaver & Weaver, 1962, p. 22, pl. 3, fig. 5a, b.

Hypotype no. 00250, loc. PSUA0117.

Specimens from the Neskowin Creek Section appear conspecific with that figured by Smith.

Robulus chiranus Cushman & Stone

Robulus chiranus Cushman & Stone, Cushman, Stewart, & Stewart, 1947e, p. 98, pl. 12, fig. 5a, b; Cushman, Stewart, & Stewart, 1949, p. 130, pl. 14, fig. 3a, b; Cushman & Stainforth, 1951, p. 146, pl. 25, fig. 41; Hornaday, 1961, p. 182, pl. 3, fig. 1a, b, 2a, b, 4a, b; Sullivan, 1962, p. 257, pl. 7, fig. 1, 2a, b; Kleinpell & Weaver, 1963, p. 169, pl. 4, fig. 6; Weaver & Molander, 1964, p. 181, pl. 4, fig. 1a, b; DeLise, 1967, p. 27, pl. 1, fig. 10a, b.

Robulus aff. *R. warmani* Barbat & von Estorff, Wilson, 1954, p. 135, pl. 14, fig. 5a, b.

Lenticulina chiranus (Cushman & Stone), Smith, 1971, p. 41, pl. 3, fig. 4a, b; Tipton, Kleinpell, & Weaver, 1973, p. 44, pl. 2, fig. 2a, b.

Hypotype no. 00251, loc. PSUA0133.

Robulus coaledensis Detling

Robulus coalendensis Detling, 1946, p. 353, pl. 48, fig. 1a, b; Cushman & Stainforth, 1951, p. 146, pl. 25, fig. 40; Mallory, 1959, p. 136, pl. 7, fig. 11a, b, pl. 8, fig. 8a, b; Weaver & Molander, 1964, p. 181, pl. 4, fig. 2a, b, 3a, b.

[?] *Robulus coaledensis* Detling, Gaston, 1974, p. 54, [hypotype examined].

Hypotype no. 00252, loc. PSUA0123.

Robulus coaledensis is large, contains ten to eleven chambers in the final whorl and has markedly curved sutures.

Robulus cf. *R. coaledensis* Detling

Hypotype no. 00253, loc. PSUA0122.

Two specimens from the Neskowin Creek Section resemble *R. coaledensis* in that they have strongly curved sutures, but are smaller, thicker in peripheral view, and have only eight chambers in the last whorl.

Robulus inornatus (d'Orbigny)

Robulus inornatus (d'Orbigny), Cushman & Hanna, 1927, p. 51, pl. 4, fig. 4, 6; Cushman & Barksdale, 1930, p. 62, pl. 11, fig. 2a, b, 3; Beck, 1943, p. 595, pl. 104, fig. 1-4, 10, 14; Cooper, 1944, p. 350, pl. 55, fig. 26, 27; Detling, 1946, p. 353, pl. 47, fig. 4, 5; Cushman, Stewart, & Stewart, 1947c, p. 60, pl. 7, fig. 3a, b; Cushman, Stewart, & Stewart, 1947d, p. 74, pl. 11, fig. 6a, b; Cushman, Stewart & Stewart, 1947e, p. 97, pl. 13, fig. 2a, b; Wilson, 1954, p. 134, pl. 13, fig. 6a, b; Smith, 1956, p. 88, pl. 9, fig. 7a, b, 8a, b; Smith, 1957, p. 157, pl. 20, fig. 7a, b, 8a, b, 9a, b, 10a, b, 11a, b; Mallory, 1959, p. 137, pl. 7, fig. 15a, b, pl. 40, fig. 5a, b; Hornaday, 1961, p. 182, pl. 2, fig. 5a, b; Sullivan, 1962, p. 258, pl. 5, fig. 5a, b; Weaver, 1962, p. 372, pl. 2, fig. 3a, b; Kleinpell & Weaver, 1963, p. 169, pl. 4, fig. 7a, b, 8; Weaver & Molander, 1964, p. 181, pl. 4, fig. 6a, b, 7a, b.

Robulus inornata (d'Orbigny), Cushman & Schenck, 1928, p. 307, pl. 42, fig. 3a, b.

Lenticulina inornata (d'Orbigny), Fairchild, Wesendunk, & Weaver, 1969, p. 42, pl. 6, fig. 1; Tipton, Kleinpell, & Weaver, 1973, p. 45, pl. 2, fig. 9a, b.

[?] *Robulus inornatus* (d'Orbigny), Gaston, 1974, p. 55, [hypotype examined].

Hypotype no. 00254, loc. PSUA0111.

This widely recorded species is characterized by five to seven chambers in the final whorl, sutures which are tangent to a large prominent umbo, and a slit-like aperture.

Robulus inornatus [?] (d'Orbigny)

Hypotype no. 00255, loc. PSUA0105.

Numerous poorly preserved specimens, similar to *R. inornatus*, are included within this designation.

Robulus kincaidi Beck

Robulus kincaidi Beck, 1943, p. 595, pl. 102, fig. 1, 7; Mallory, 1959, p. 137, pl. 6, fig. 17a, b; Sullivan, 1962, p. 259, pl. 7, fig. 4a, b; Gaston, 1974, p. 56, [hypotype examined].

Robulus aff. *R. kincaidi* Beck, Smith, 1957, p. 158, pl. 20, fig. 6a, b.

Hypotype no. 00256, loc. PSUA0125.

This species differs recognizably from other members of the genus in that the last chamber makes up nearly one-half of the test.

Robulus cf. *R. kincaidi* Beck

Hypotype no. 00257, loc. PSUA0133.

Inflated specimens compare favorably with *R. kincaidi* but differ in that the final chamber does not make up one-half of the test.

Robulus limbosus (Reuss) var. *hockleyensis*
(Cushman & Applin)

Cristellaria limbosa (Reuss) var. *hockleyensis* Cushman & Applin, 1926, p. 171, pl. 8, fig. 3a, b, 4;

Robulus limbosus (Reuss) var. *hockleyensis* (Cushman & Applin), Cushman & Dusenbury, 1934, p. 52, pl. 7, fig. 1; Cushman, 1935, p. 16, pl. 4, fig. 15a, b, pl. 6, fig. 3a, b; Bergquist, 1942, p. 31, pl. 2, fig. 22; Cushman & Simonson, 1944, p. 194, pl. 30, fig. 9; Rau, 1948, p. 162, pl. 29, fig. 11, 12; Smith, 1956, p. 89, pl. 10, fig. 5a, b; Mallory, 1959, p. 139, pl. 6, fig. 15a, b; Weaver & Weaver, 1962, p. 23, pl. 4, fig. 5a, b; Gaston, 1974, p. 56, [hypotype examined].

Lenticulina limbosa (Reuss) var. *hockleyensis* (Cushman & Applin), Fairchild, Wesendunk, & Weaver, 1969, p. 42, pl. 6, fig. 2.

Hypotype no. 00258, loc. PSUA0110.

Robulus limbosus (Reuss) var. *hockleyensis* [?]
(Cushman & Applin)

Hypotype no. 00259, loc. PSUA0125.

Incomplete individuals that resemble this species are included here.

Robulus mayi Cushman & Parker

Robulus mayi Cushman & Parker, Bergquist, 1942, p. 31, pl. 3, fig. 2; Mallory, 1959, p. 139, pl. 6, fig. 11a, b; Sullivan, 1962, p. 259, pl. 7, fig. 5a, b; Weaver & Weaver, 1962, p. 23, pl. 4, fig. 6a, b; Gaston, 1974, p. 56, [hypotype examined].

Lenticulina mayi (Cushman & Parker), Tipton, Kleinpell, & Weaver, 1973, p. 45, pl. 2, fig. 10a, b.

Hypotype no. 00260, loc. PSUA0137.

Robulus mayi [?] Cushman & Parker

Hypotype no. 00261, loc. PSUA0110.

These specimens are similar to *R. mayi* in that the final chambers become elongate but poor preservation prevents positive identification.

Robulus cf. *R. midwayensis* (Plummer)

Hypotype no. 00262, loc. PSUA0137.

A few specimens with raised sutures resemble *R. midwayensis* but lack the central boss and have only six chambers in the final whorl.

Robulus propinquus cowlitzensis Beck

Robulus propinquus cowlitzensis Beck, 1943, p. 595, pl. 104, fig. 6, 12; Sullivan, 1962, p. 259, pl. 6, fig. 6, 7a, b, 8a, b; Weaver & Weaver, 1962, p. 23, pl. 4, fig. 7; Weaver & Molander, 1964, p. 181, pl. 4, fig. 8a, b; Gaston, 1974, p. 57, [hypotype examined].

Lenticulina propinqua cowlitzensis Beck, Fairchild, Wesendunk, & Weaver, 1969, p. 42, pl. 6, fig. 9a, b; Tipton, Kleinpell, & Weaver, 1973, p. 46, pl. 2, fig. 11a, b.

Hypotype no. 00263, loc. PSUA0123.

Robulus pseudovortex Cole

Robulus pseudovortex Cole, Cushman & McMasters, 1936, p. 510, pl. 74, fig. 12a, b; Franklin, 1944, p. 310, pl. 45, fig. 12; Smith, 1957, p. 158, pl. 20, fig. 12a, b, 13a, b; Mallory, 1959, p. 141, pl. 7, fig. 2, 3a, b, pl. 27, fig. 13a, b; Weaver & Weaver, 1962, p. 24, pl. 4, fig. 8a, b; Gaston, 1974, p. 57, [hypotype examined]; Thoms, 1975, pl. 1, fig. 27a, b.

Lenticulina pseudovortex (Cole), Fairchild, Wesendunk, & Weaver, 1969, p. 42, pl. 7, fig. 6a, b, 11a, b; Smith, 1971, p. 43, pl. 3, fig. 7a, b.

Hypotype no. 00264, loc. PSUA0112.

Robulus cf. *R. pseudovortex* Cole

Hypotype no. 00265, loc. PSUA0133.

Numerous specimens with recurved sutures compare favorably with this species but are larger, not as close-coiled, and average five or more chambers in the last whorl.

Robulus cf. *R. terryi* Coryell & Embich

Robulus cf. *R. terryi* Coryell & Embich, Smith, 1957, p. 159, pl. 21, fig. 1a, b; Mallory, 1959, p. 141, pl. 6, fig. 1a, b; Sullivan, 1962, p. 260, pl. 7, fig. 6a, b; Weaver & Weaver, 1962, p. 24, pl. 5, fig. 2a, b; Weaver & Molander, 1964, p. 182, pl. 5, fig. 2a, b.

Lenticulina cf. *L. terryi* (Coryell & Embich), Fairchild, Wesendunk, & Weaver, 1969, p. 43, pl. 7, fig. 8a, b; Tipton, Kleinpell, & Weaver, 1973, p. 46, pl. 2, fig. 8a, b.

Lenticulina terryi (Coryell & Embich), Smith, 1971, p. 43, pl. 3, fig. 8a, b.

Robulus terryi Coryell & Embich, Gaston, 1974, p. 57, [hypotype examined].

Hypotype no. 00266, loc. PSUA0104.

Coryell and Embich (1937, p. 299) originally described this species as:

Test free, close-coiled, with a wide carina; chambers 12 or 14 in number becoming narrower toward the umbilical area of the test; due to shortening, the chambers fail to cover preceding whorl entirely; sutures limbate, but not raised; slightly curved; orifice robuline on the last septal face.

Subsequently, authors have referred to a similar form occurring in West Coast deposits as *R. cf. R. terryi*. The most characteristic feature that links the two forms is the shortening of the later chambers, allowing the earlier chambers to be viewed through a transparent umbo. In all other features the two appear conspecific except for the number of chambers in the last coil (Tipton, Kleinpell, and Weaver, 1973, p. 46). Mallory reports this species, *R. cf. R. terryi*, as having five to 13 final chambers while most other authors figure a form with between six and ten chambers (Smith, 1957, pl. 21, fig. 1a, b; Sullivan, 1962, pl. 7, fig. 6a, b; Weaver and Weaver, 1962, pl. 5, fig. 2a, b; Weaver and Molander, 1964, pl. 5, fig. 2a, b; Fairchild, Wesendunk, and Weaver, 1969, pl. 7, fig. 8a, b; Smith, 1971, pl. 3, fig. 8a, b). Some authors have synonymized the two (Smith, 1971, p. 43; Gaston, 1974, p. 57) but further study of the primary types is suggested for conformation of their equivalence.

Robulus weaveri Beck

Robulus weaveri Beck, 1943, p. 595, pl. 103, fig. 3, 8; Rau, 1948, p. 162, pl. 28, fig. 18, 19; Mallory, 1959, p. 143, pl. 7, fig. 14a, b; Weaver & Weaver, 1962, p. 24, pl. 5, fig. 4a, b; Gaston, 1974, p. 58, [hypotype examined].

Hypotype no. 00267, loc. PSUA0108.

Robulus weaveri [?] Beck

Hypotype no. 00268, loc. PSUA0110.

Specimens with tests higher than broad resemble *R. weaveri* but are poorly preserved and questionably assigned to this species.

Robulus welchi Church

Robulus welchi Church, 1931, pl. C, fig. 13, 14; Beck, 1943, p. 596, pl. 102, fig. 4, 8; Cushman & Simonson, 1944, p. 195, pl. 30, fig. 11; Detling, 1946, p. 353, pl. 48, fig. 2a, b; Cushman, Stewart, & Stewart, 1947e, p. 97, pl. 12, fig. 4a, b; Cushman, Stewart, & Stewart, 1949, p. 130, pl. 14, fig. 8a, b; Smith, 1957, p. 159, pl. 21, fig. 4a, b, 5a, b, 6a, b; Mallory, 1959, p. 143, pl. 7, fig. 8a, b; Hornaday, 1961, p. 183, pl. 3, fig. 3a, b; Weaver & Weaver, 1962, p. 24, pl. 5, fig. 5a, b; Rau, 1964, pl. 5, fig. 6a, b; Weaver & Molander, 1964, p. 182, pl. 5, fig. 3a, b, 4a, b; Gaston, 1974, p. 58, [hypotype examined]; Thoms, 1975, pl. 2, fig. 1a, b.

Hypotype no. 00269, loc. PSUA0123.

Robulus spp.

This designation is used to include numerous poorly preserved specimens that are not identifiable at a specific level. More than one species is represented.

Genus *Lenticulina* Lamarck, 1804

Lenticulina cf. *L. convergens* (Bornemann) [of Mallory]

Lenticulina convergens (Bornemann) (?), Cushman & Barksdale, 1930, p. 64, pl. 11, fig. 8a, b.

Lenticulina (?) *convergens* (Bornemann), Cushman & Dusenbury, 1934, p. 54, pl. 7, fig. 7a, b.

Lenticulina convergens (Bornemann), Beck, 1943, p. 596, pl. 104, fig. 5, 9; Fairchild, Wesendunk, & Weaver, 1969, p. 41, pl. 5, fig. 11a, b.

[Non] *Lenticulina* cf. *L. convergens* (Bornemann), Cushman & Simonson, 1944, p. 195, pl. 30, fig. 12; Sullivan, 1969, p. 261, pl. 8, fig. 2a, b.

Robulus convergens (Bornemann), Smith, 1957, p. 157, pl. 20, fig. 5a, b.

Lenticulina cf. *L. convergens* (Bornemann), Mallory, 1959, p. 145, pl. 8, fig. 13a, b, 14a, b, pl. 27, fig. 15a, b.

Hypotype no. 00270, loc. PSUA0106.

Two individuals from the Neskowin Creek Section are conspecific with those figured by Mallory.

Genus *Planularia* Defrance, 1824

Planularia markleyana Church

Planularia markleyana Church, 1931, pl. A, fig. 6, pl. B, fig. 1, 10; Rau, 1948, p. 164, pl. 29, fig. 19; Mallory, 1959, p. 147, pl. 9, fig. 5a, b; Weaver & Weaver, 1962, p. 25, pl. 6, fig. 4a, b.

Hypotype no. 00271, loc. PSUA0127.

Planularia cf. *P. ouachitaensis* Howe & Wallace [of Mallory]

Planularia cf. *P. ouachitaensis* Howe & Wallace, Mallory, 1959, p. 147, pl. 9, fig. 6a, b.

Hypotype no. 00272, loc. PSUA0123.

Specimens from the Neskowin Creek Section have a slight keel but are otherwise identical to Mallory's figure.

Planularia cf. *P. truncana* (Gumbel)

Hypotype no. 00273, loc. PSUA0110.

A single specimen from the Neskowin Creek Section differs from *P. truncana* in having fewer chambers and a flattened apertural face.

Planularia [?] sp.

Hypotype no. 00274, loc. PSUA0106.

Poorly preserved, compressed individuals that possess keeled margins seem best placed in this genus. More than one species may be represented.

Genus *Marginulina* d'Orbigny, 1826*Marginulina adunca* (Costa)

Psecadium aduncum (Costa), Galloway & Morrey, 1931, p. 336, pl. 37, fig. 13.

Marginulina adunca (Costa), Mallory, 1959, p. 148, pl. 9, fig. 11a, b, 12a, b; Weaver & Molander, 1964, p. 183, pl. 6, fig. 4; Fairchild, Wesendunk, & Weaver, 1969, p. 44, pl. 8, fig. 1; Smith, 1971, p. 44, pl. 4, fig. 6; Gaston, 1974, p. 59, [hypotype examined].

Hypotype no. 00275, loc. PSUA0106.

Marginulina adunca [?] (Costa)

Hypotype no. 00276, loc. PSUA0113.

Three internal molds are referable to this species.

Marginulina cf. *M. alazanensis* Nuttall

Hypotype no. 00277, loc. PSUA0110.

These specimens differ from *M. alazanensis* (Sullivan, 1962, p. 261, pl. 8, fig. 8a, b) in possessing oblique sutures and more inflated chambers.

Marginulina eximia Neugeboren

Marginulina eximia Neugeboren, Bergquist, 1942, p. 36, pl. 4, fig. 8; Beck, 1943, p. 597, pl. 104, fig. 15, 16; Sullivan, 1962, p. 262, pl. 8, fig. 9a, b; Weaver & Molander, 1964, p. 183, pl. 6, fig. 5; Fairchild, Wesendunk, & Weaver, 1969, p. 44, pl. 8, fig. 4; Smith, 1971, p. 45, pl. 4, fig. 8; Tipton, Kleinpell, & Weaver, 1973, p. 46, pl. 3, fig. 1a, b; Gaston, 1974, p. 59, [hypotype examined].

Marginulina sp. Cushman & Simonson, 1944, p. 196, pl. 30, fig. 15, pl. 31, fig. 1-4.

Marginulina eximia Neugeboren (?), Mallory, 1959, p. 149, pl. 10, fig. 1a-c.

Hypotype no. 00278, loc. PSUA0104.

Marginulina cf. *M. eximia* Neugeboren

Hypotype no. 00279, loc. PSUA0108.

A single specimen from the Neskowin Creek Section resembles *M. eximia* but possesses a much narrower test.

Marginulina holmesi Gaston [nomen nudum]

Marginulina holmesi Gaston, 1974, p. 60, fig. on p. 60.

Hypotype no. 00280, loc. PSUA0107.

Marginulina holmesi was described from the Yamhill Formation in an unpublished master's thesis. An early compressed coiled portion followed by an elongate rectilinear stage distinguishes this species from other members of the genus. It resembles *M. jacksonensis* (Cushman and Applin) and *M. subtilius* (Nuttall) (Bergquist, 1942, p. 37-38, pl. 126, fig. 2, 3) except that the coiled portion of the test is at right angles to the rectilinear stage. The holotype was examined and Neskowin Creek specimens are conspecific.

Marginulina huneri [?] Howe

[?] *Marginulina huneri* Howe, 1939, p. 43, pl. 6, fig. 7;
Mallory, 1959, p. 150, pl. 27, fig. 18a, b.

Hypotype no. 00281, loc. PSUA0132.

One broken, pyritized specimen from the Salmon River Section is questionably referred to this species.

Marginulina cf. *M. inconspicua* Hussey [of Sullivan]

Marginulina cf. *M. inconspicua* Hussey, Sullivan, 1962, p. 262, pl. 8, fig. 6a, b; Weaver & Molander, 1964, p. 183, pl. 6, fig. 6.

Marginulina inconspicua Hussey, Fairchild, Wesendunk, & Weaver, 1969, p. 45, pl. 8, fig. 3a, b; Gaston, 1974, p. 61, [hypotype examined].

Hypotype no. 00282, loc. PSUA0133.

A single specimen from the Salmon River Section resembles this form.

Marginulina munda [?] Cushman

[?] *Marginulina munda* Cushman, Cushman & Deadrick, 1944, p. 331, pl. 51, fig. 4; Cushman, 1946a, p. 60, pl. 21, fig. 2, 3; Frizzell, 1954, p. 85, pl. 9, fig. 5; Sullivan, 1962, p. 262, pl. 8, fig. 5a, b; Fairchild, Wesendunk, & Weaver, 1969, p. 45, pl. 8, fig. 18.

Hypotype no. 00283, loc. PSUA0123.

Two specimens from the Neskowin Creek Section, although very similar to this species, are pyritized and too poorly preserved to permit positive identification.

Marginulina regularis d'Orbigny

Marginulina regularis d'Orbigny, Mallory, 1959, p. 150, pl. 10, fig. 6a, b.

Hypotype no. 00284, loc. PSUA0137.

Marginulina subbullata Hantken

Marginulina subbullata Hantken, Coryell & Embich, 1937, p. 297, pl. 42, fig. 2; Cushman, Stewart, & Stewart, 1949, p. 131, pl. 14, fig. 10a, b; Mallory, 1959, p. 151, pl. 9, fig. 13a, b, 14a, b, 15a, b; Weaver & Weaver, 1962, p. 26, pl. 6, fig. 11; Weaver & Molander, 1964, p. 183, pl. 6, fig. 7; Gaston, 1974, p. 61, [hypotype examined]; Thoms, 1975, pl. 1, fig. 19.

Hypotype no. 00285, loc. PSUA0106.

Marginulina sp.

Hypotype no. 00286, loc. PSUA0112.

Three specimens, similar to *M. laeviuscula* Cushman and Bermudez (?) of Mallory (1959, p. 150, pl. 10, fig. 5a, b), are insufficiently preserved for specific identification.

Marginulina [?] sp.

Hypotype no. 00287, loc. PSUA0137.

A single specimen resembling *M. sp.* of Fairchild, Wesendunk, and Weaver (1969, p. 45, pl. 8, fig. 7) differs in possessing a keel on the outer margin of the test. This specimen may also represent the genus *Saracenaria*.

Genus *Vaginulinopsis* Sylvestri, 1904

Vaginulinopsis cf. *V. asperuliformis* (Nuttall) Mallory

Vaginulinopsis cf. *V. asperuliformis* (Nuttall), Mallory, Weaver, 1962, p. 375, pl. 2, fig. 7.

Hypotype no. 00288, loc. PSUA0132.

Pyritized specimens from the Salmon River Section possess the same longitudinal costae which parallel the periphery of the test that Weaver figured (1962, pl. 2, fig. 7) and Mallory described (1959, p. 155). Further study of the variation within *V. asperuliformis* may show the two to be synonymous.

Vaginulinopsis mexicana (Cushman) var. *nudicostata*
(Cushman & G. D. Hanna)

Robulus mexicanus (Cushman) var. *nudicostatus* (Cushman & G. D. Hanna), Cushman & M. A. Hanna, 1927, p. 50, pl. 4, fig. 2; Cushman & McMasters, 1936, p. 511, pl. 74, fig. 15, 16.

Vaginulinopsis mexicana (Cushman) var. *nudicostata* (Cushman & G. D. Hanna), Smith, 1957, p. 162, pl. 22, fig. 3a, b; Mallory, 1959, p. 157, pl. 28, fig. 1a, b, pl. 40, fig. 2a, b, 3; Thoms, 1975, pl. 2, fig. 4a, b.

[?] *Vaginulinopsis mexicana* (Cushman) var. *nudicostata* (Cushman & G. D. Hanna), Gaston, 1974, p. 62, [hypotype examined].

Hypotype no. 00289, loc. PSUA0100.

Vaginulinopsis saundersi (Hanna & Hanna)

Cristellaria saundersi Hanna & Hanna, 1924, p. 61, pl. 13, fig. 5, 6, 15.

Vaginulinopsis saundersi (Hanna & Hanna), Beck, 1943, p. 598, pl. 105, fig. 1, 2, 4, 5, 10; Cushman & Stainforth, 1951, p. 147, pl. 26, fig. 8; Smith, 1957, p. 162, pl. 22, fig. 1a, b, 2a, b; Mallory, 1959, p. 157, pl. 11, fig. 10a, b; Kleinpell & Weaver, 1963, p. 170, pl. 6, fig. 6; Weaver & Molander, 1964, p. 184, pl. 6, fig. 9; Gaston, 1974, p. 63, [hypotype examined].

Hemicristellaria saundersi (Hanna & Hanna), Asano, 1958, pl. 10, fig. 3, 4.

Hypotype no. 00290, loc. PSUA0103.

Vaginulinopsis sp.

Hypotype no. 00291, loc. PSUA0102.

One specimen from the lower Neskowin Creek Section is badly recrystallized and can only be identified on a generic level.

Genus *Astacolus* Montfort, 1808

Astacolus [?] sp.

Hypotype no. 00292, loc. PSUA0123.

Compressed individuals seem referable to this genus.

Genus *Dentalina* d'Orbigny, 1826*Dentalina angusticostata* Cushman

Dentalina angusticostata Cushman, Cushman, 1946a, p. 70, pl. 24, fig. 7, 8; Frizzell, 1954, p. 86, pl. 9, fig. 30, 31.

? *Dentalina angusticostata* Cushman, Mallory, 1959, p. 161, pl. 12, fig. 3a, b.

Hypotype no. 00293, loc. PSUA0116.

Figures of *D. angusticostata* and *D. delicatula* Cushman (Cushman, 1946a, p. 70, pl. 25, fig. 1-6) are almost impossible to separate. Both have numerous longitudinal costae independent of the sutures, slender elongate tests, limbate sutures in the early portions of the test and depressed sutures between later chambers. The only differences appear to be in the length and inflation of the individual chambers; *D. angusticostata* has somewhat elongate inflated chambers while *D. delicatula* has smaller less inflated chambers. Numerous specimens from the Neskowin Creek Section have been referred to *D. angusticostata* on this basis. Further study of the variation between these two species however, may show the two to be synonymous.

Dentalina angusticostata [?] Cushman

Hypotype no. 00294, loc. PSUA0129.

Poorly preserved specimens are questionably placed in this designation.

Dentalina colei Cushman & Dusenbury

Dentalina colei Cushman & Dusenbury, 1934, p. 54, pl. 7, fig. 10-12; Beck, 1943, p. 598, pl. 105, fig. 18; Mallory, 1959, p. 162, pl. 12, fig. 9, pl. 41, fig. 3; Sullivan, 1962, p. 263, pl. 9, fig. 6a, b; Weaver & Weaver, 1962, p. 26, pl. 7, fig. 5; Weaver & Molander, 1964, p. 184, pl. 6, fig. 11; Fairchild, Wesendunk, & Weaver, 1969, p. 37, pl. 5, fig. 17; Gaston, 1974, p. 63, [hypotype examined].

Hypotype no. 00295, loc. PSUA0105.

Dentalina colei [?] Cushman & Dusenbury

Hypotype no. 00296, loc. PSUA0129.

Dentalina communis d'Orbigny

[Non] *Nodosaria communis* (d'Orbigny), Bagg, 1905, p. 29, pl. 5, fig. 2; Cushman, 1913, p. 54, pl. 28, fig. 1, 2; Cushman, 1918, p. 50, pl. 10, fig. 8.

Nodosaria communis (d'Orbigny), Bagg, 1912, p. 54, pl. 16, fig. 8, 9, [not fig. 5]; Cushman, 1922, p. 129, pl. 30, fig. 4.

Nodosaria (*Dentalina*) *communis* (d'Orbigny), Cushman & M. A. Hanna, 1927, p. 4, pl. 4, fig. 11, 12.

Dentalina communis d'Orbigny, Beck, 1943, p. 598, pl. 105, fig. 22; Detling, 1946, p. 353, pl. 48, fig. 4; Cushman, Stewart, & Stewart, 1947d, p. 76, pl. 9, fig. 9; Rau, 1948, p. 166, pl. 29, fig. 2; Puri, 1953, p. 99, pl. 23, fig. 14; Frizzell, 1954, p. 87, pl. 9, fig. 39, 40; Smith, 1957, p. 165, pl. 22, fig. 9; Todd, 1957a, pl. 65, fig. 4; Mallory, 1959, p. 162, pl. 12, fig. 11, [not pl. 41, fig. 6]; Weaver & Weaver, 1962, p. 26, pl. 7, fig. 6; Todd, 1966, pl. 12, fig. 1; Gaston, 1974, p. 64, [hypotype examined].

Dentalina cf. *D. communis* d'Orbigny, Cushman, Stewart, & Stewart, 1949, p. 131, pl. 15, fig. 2.

Hypotype no. 00297, loc. PSUA0132.

Dentalina cf. *D. communis* d'Orbigny

Nodosaria communis (d'Orbigny), Bagg, 1912, p. 54, pl. 16, fig. 5, [not fig. 8, 9]; Cushman, 1918, p. 50, pl. 10, fig. 8.

Dentalina cf. *D. communis* d'Orbigny, Weaver & Molander, 1964, p. 184, pl. 6, fig. 12; Fairchild, Wesendunk, & Weaver, 1969, p. 38, pl. 5, fig. 3.

Hypotype no. 00298, loc. PSUA0108.

This distinctive species is closely related to *D. communis* but differs in possessing more inflated chambers and oblique sutures.

Dentalina consobrina d'Orbigny

[Non] *Nodosaria consobrina* (d'Orbigny), Bagg, 1905, p. 29, pl. 5, fig. 3; Bagg, 1912, p. 54, pl. 15, fig. 5a-d.

Nodosaria (*Dentalina*) *consobrina* (d'Orbigny), Cushman & M. A. Hanna, 1927, p. 52, pl. 4, fig. 7, 8.

Dentalina consobrina d'Orbigny ?, Cushman & Schenck, 1928, p. 308, pl. 42, fig. 9-11.

Dentalina consobrina d'Orbigny, Cushman & Barksdale, 1930, p. 64, pl. 11, fig. 9, 10; Kleinpell, 1938, p. 210, pl. 3, fig. 12, 14, 15, pl. 17, fig. 4; Wilson, 1954, p. 135, pl. 14, fig. 7; Todd, 1957a, pl. 65, fig. 9-11; Mallory, 1959, p. 163, pl. 12, fig. 12, pl. 41, fig. 5; Hornaday, 1961, p. 184, pl. 4, fig. 9; Sullivan, 1962, p. 263, pl. 9, fig. 2, 3a, b; Kleinpell & Weaver, 1963, p. 170, pl. 6, fig. 3, 4, pl. 7, fig. 3; Todd, 1970, p. A7, pl. 2, fig. 11; Gaston, 1974, p. 65, [hypotype examined]; Thoms, 1975, pl. 1, fig. 13.

Nodosaria consobrina (d'Orbigny), Galloway & Morrey, 1931, p. 337, pl. 37, fig. 17; Bandy, 1944, p. 369, pl. 60, fig. 12; Detling, 1946, p. 353, pl. 48, fig. 5, 6.

Dentalina cf. *D. consobrina* d'Orbigny, Cushman & McMasters, 1936, p. 511, pl. 74, fig. 18-20.

Hypotype no. 00299, loc. PSUA0116.

Dentalina consobrina [?] d'Orbigny

Hypotype no. 00300, loc. PSUA0115.

Specimens that resemble this species but lack the initial bulbous chamber or basal spine are included here.

Dentalina cooperensis Cushman

Dentalina cooperensis Cushman, Cushman, 1935, p. 20, pl. 8, fig. 3, 4; Coryell & Embich, 1937, p. 298, pl. 42, fig. 8; Bergquist, 1942, p. 42, pl. 5, fig. 3; Cushman & Simonson, 1944, p. 196, pl. 31, fig. 5-7; Wilson, 1954, p. 135, pl. 14, fig. 8-10; Puri, 1957, p. 112, pl. 4, fig. 4; Todd, 1957a, pl. 65, fig. 3; Hornaday, 1961, p. 185, pl. 4, fig. 8a, b; Sullivan, 1962, p. 263, pl. 9, fig. 4a, b, 5a, b; Weaver & Molander, 1964, p. 184, pl. 6, fig. 13; Fairchild, Wesendunk, & Weaver, 1969, p. 38, pl. 5, fig. 4; Gaston, 1974, p. 65, [hypotype examined].

Hypotype no. 00301, loc. PSUA0112.

Although this species is similar in general outline to *D. communis*, it possesses less oblique sutures.

Dentalina dusenburyi Beck

Dentalina capitata (Boll) (?), Cushman & Dusenbury, 1934, p. 56, pl. 7, fig. 20.

Dentalina dusenburyi Beck, 1943, p. 599, pl. 105, fig. 20, 23; Cushman, Stewart, & Stewart, 1947d, p. 76, pl. 10, fig. 1-3; Rau, 1948, p. 167, pl. 30, fig. 24; Smith, 1956, p. 90, pl. 11, fig. 6; Asano, 1958, pl. 10, fig. 5, 6; Mallory, 1959, p. 163, pl. 12, fig. 14; Weaver & Molander, 1964, p. 184, pl. 6, fig. 14; DeLise, 1967, p. 31, pl. 2, fig. 11; Gaston, 1974, p. 66, [hypotype examined].

Hypotype no. 00302, loc. PSUA0130.

Dentalina eocenica Cushman (?) [of Mallory]

Dentalina eocenica Cushman ?, Mallory, 1959, p. 164, pl. 13, fig. 6.

Hypotype no. 00303, loc. PSUA0119.

A few pyritized individuals resemble Mallory's figure.

Dentalina hexacostata Howe

Dentalina hexacostata Howe, 1939, p. 44, pl. 5, fig. 13.

Dentalina hexacostata Howe ?, Mallory, 1959, p. 164, pl. 12, fig. 15, pl. 28, fig. 2.

Hypotype no. 00304, loc. PSUA0122.

Dentalina cf. *D. hexacostata* Howe

Hypotype no. 00305, loc. PSUA0116.

Howe (1939, p. 44) originally described *D. hexacostata* as "uniform in diameter throughout its length" and "decorated with six longitudinal widely spaced costae". Several specimens from the Neskowin Creek and Salmon River Sections possess six to eight widely spaced costae and slightly inflated terminal chambers. In all other respects however, the specimens compare favorably with *D. hexacostata*.

Dentalina jacksonensis (Cushman & Applin)

Nodosaria jacksonensis Cushman & Applin, 1926, p. 170, pl. 7, fig. 14-16.

Dentalina jacksonensis (Cushman & Applin), Cushman, 1935, p. 20, pl. 8, fig. 7-9; Coryell & Embich, 1937, p. 298, pl. 42, fig. 8; Bergquist, 1942, p. 43, pl. 5, fig. 13; Cushman & Simonson, 1944, p. 196, pl. 32, fig. 8; Franklin, 1944, p. 310, pl. 46, fig. 10; Todd, 1957a, pl. 65, fig. 5-8; Mallory, 1959, p. 165, pl. 12, fig. 18; Gaston, 1974, p. 66, [hypotype examined].

Hypotype no. 00306, loc. PSUA0116.

Dentalina kreyenhagenensis [?] Mallory

[?] *Dentalina kreyenhagenensis* Mallory, 1959, p. 165, pl. 12, fig. 23, 24, pl. 29, fig. 13, 14; Weaver & Weaver, 1962, p. 27, pl. 7, fig. 8.

Hypotype no. 00307, loc. PSUA0117.

Two fragmented specimens from the Neskowin Creek Section resemble Mallory's figure.

Dentalina pauperata d'Orbigny

[Non] *Nodosaria pauperata* (d'Orbigny), Bagg, 1905, p. 32, pl. 5, fig. 8; Bagg, 1912, p. 57, pl. 16, fig. 2a-f; Cushman, 1913, p. 51, pl. 25, fig. 7.

Nodosaria pauperata (d'Orbigny), Hanna, 1923, p. 322, pl. 58, fig. 3, 5.

Dentalina pauperata d'Orbigny, Kleinpell, 1938, p. 213, pl. 11, fig. 6; Cushman, Stewart, & Stewart, 1947a, p. 14, pl. 1, fig. 10; Smith, 1956, p. 91, pl. 11, fig. 7, Sullivan, 1962, p. 264, pl. 9, fig. 7; Kleinpell & Weaver, 1963, p. 170, pl. 6, fig. 5; Fairchild, Wesendunk, & Weaver, 1969, p. 38, pl. 5, fig. 5.

Hypotype no. 00308, loc. PSUA0128.

Dentalina pauperata [?] d'Orbigny

Hypotype no. 00309, loc. PSUA0132.

Incomplete specimens resembling *D. pauperata* are included here.

Dentalina cf. *D. sherborni* Bowen [of Mallory]

Dentalina cf. *D. sherborni* Bowen, Mallory, 1959, p. 166, pl. 13, fig. 2; Weaver & Weaver, 1962, p. 27, pl. 7, fig. 9, 10.

Hypotype no. 00310, loc. PSUA0111.

Individuals from the Neskowin Creek Section are conspecific with the specimen figured by Mallory.

Dentalina soluta Reuss

Nodosaria soluta (Reuss), Bagg, 1905, p. 34, pl. 5, fig. 11; Bagg, 1912, p. 59, pl. 15, fig. 2a, b, pl. 16, fig. 7; Cushman, 1913, p. 53, pl. 26, fig. 9-11; Cushman, 1926b, p. 597, pl. 17, fig. 19, [not pl. 18, fig. 9].

[Non] *Nodosaria soluta* (Reuss), Hanna, 1923, p. 322, pl. 58, fig. 6.

Dentalina soluta Reuss, Todd, 1957a, pl. 65, fig. 14; Todd, 1957b, pl. 28, fig. 8.

Dentalina soluta Reuss (?), Mallory, 1959, p. 167, pl. 13, fig. 1, pl. 28, fig. 4.

Hypotype no. 00311, loc. PSUA0129.

Dentalina spinosa d'Orbigny

Nodosaria spinosa (d'Orbigny), Galloway & Morrey, 1939, p. 339, pl. 38, fig. 4, [not fig. 5].

Dentalina spinosa d'Orbigny, Kleinpell, 1938, p. 215, pl. 4, fig. 3; Smith, 1956, p. 91, pl. 10, fig. 10; Smith, 1957, p. 165, pl. 22, fig. 10; Kleinpell & Weaver, 1963, p. 170, pl. 6, fig. 8, 10, 11.

[Non] *Dentalina spinosa* d'Orbigny, Mallory, 1959, p. 167, pl. 12, fig. 26; Sullivan, 1962, p. 264, pl. 9, fig. 17a, b, 18; Gaston, 1974, p. 67, [hypotype examined].

Hypotype no. 00312, loc. PSUA0131.

Dentalina spinosa, as figured by d'Orbigny (in Ellis and Messina) has short inflated chambers with prominent costae which are not continuous beyond the sutures. Individuals similar to *D. spinosa* but with elongate chambers and coarse spines are referred to in this report as *Nodosaria* cf. *N. deliciae* Martin and appear conspecific with Mallory's and Sullivan's figures of *D. spinosa*.

Dentalina spinosa d'Orbigny var. *ornatior* Smith

Dentalina spinosa d'Orbigny var. *ornatior* Smith, 1957, p. 165, pl. 22, fig. 11, 12; Thoms, 1975, pl. 1, fig. 15.

Hypotype no. 00313, loc. PSUA0104.

Dentalina substrigata [?] (Stache)

[?] *Dentalina substrigata* (Stache), Cushman & Dusenbury, 1934, p. 55, pl. 7, fig. 17-19; Mallory, 1959, p. 168, pl. 13, fig. 3.

Hypotype no. 00314, loc. PSUA0104.

These specimens resemble *D. substrigata* in the shape of the chambers and obliqueness of the sutures but differ in possessing finer costae.

Dentalina sp. A. [*species nova*]

(Pl. 1, fig. 3, 4)

Test large, circular in cross section; chambers increasingly elongate as added; sutures indistinct, depressed; chambers ornamented with high, continuous costae, usually eight in number, extending the entire length of the test, alternating with discontinuous costae, extending to a point just below the greatest breadth of each chamber, terminated with a node forming a band around the bottom of each chamber; aperture missing.

Dimensions of hypotypes:

00315; length 1.02 mm. broken; width .26 mm.

00316; length .48 mm. broken; width .26 mm.

Hypotype no. 00315, loc. PSUA0131.

Hypotype no. 00316, loc. PSUA0131.

This species most closely resembles *D. spinosa* d'Orbigny and *D. spinosa* d'Orbigny var. *ornatior* Smith but differs in possessing elongate chambers and discontinuous costae which terminate in a band of nodes at the base of each chamber. It may also be synonymous with *D. aff. D. spinosa* of Fairchild, Wesendunk, and Weaver (1969, p. 39, description only) but lack of figures or types prevent positive identification. The naming of this species must await publication in accordance with the International Code of Zoological Nomenclature (1961, p. 9, art. 11a).

Dentalina sp. B.

(Pl. 1, fig. 5)

Test large, compressed in cross section, sides parallel; chambers about equal in size, early chambers missing; sutures depressed; aperture raised, radiate, at the periphery of the terminal chamber.

Dimensions of hypotype:

00317; length .46 mm. broken; width .21 mm.

Hypotype no. 00317, loc. PSUA0134.

Most samples in which this species was found, although rich in Radiolaria, were commonly lacking Foraminifera and thus were not used in this investigation. All specimens were pyritized and missing early chambers. This species resembles *Dentalina* sp. of Smith (1957, p. 166, pl. 22, fig. 15) and Mallory (1959, p. 168, pl. 13, fig. 8a, b) except that they lack inflated chambers.

Dentalina [?] spp.

Fragmented and poorly preserved specimens of usually not more than one chamber are included here. More than one species may be represented but accurate identification is impossible.

Genus *Nodosaria* Lamarck, 1812

Nodosaria arundinea Schwager

Nodosaria arundinea Schwager, Galloway & Morrey, 1931, p. 337, pl. 37, fig. 15; Wilson, 1954, p. 136, pl. 14, fig. 12; Smith, 1956, p. 91, pl. 11, fig. 8; Mallory, 1959, p. 169, pl. 13, fig. 10, pl. 28, fig. 7, pl. 41, fig. 4; Hornaday, 1961, p. 185, pl. 4, fig. 5; Weaver, 1962, p. 376, pl. 2, fig. 14; Kleinpell & Weaver, 1963, p. 171, pl. 7, fig. 4; Gaston, 1974, p. 67, [hypotype examined]; Thoms, 1975, pl. 1, fig. 21.

Nodosaria longiscata d'Orbigny, Franklin, 1944, p. 311, pl. 46, fig. 1, [not fig. 2].

Nodosaria cf. *N. longiscata* d'Orbigny, Cushman, Stewart, & Stewart, 1947e, p. 98, pl. 13, fig. 1.

Nodosaria arundinea Schwager (?), Smith, 1957, p. 166, pl. 22, fig. 21.

Hypotype no. 00318, loc. PSUA0117.

Nodosaria longiscata d'Orbigny is commonly confused with

this species because of its elongate, slender test. *N. longiscata* however, has depressed sutures and shorter chambers than *N. arundinea*.

Nodosaria arundinea [?] Schwager

Hypotype no. 00319, loc. PSUA0119.

Several fragmented individuals lacking sutures are questionably assigned to this species.

Nodosaria chirana Cushman & Stone

Nodosaria chirana Cushman & Stone, Cushman, Stewart, & Stewart, 1949, p. 131, pl. 15, fig. 1; Cushman & Stainforth, 1951, p. 146, pl. 26, fig. 5; Mallory, 1959, p. 170, pl. 13, fig. 21; Hornaday, 1961, p. 185, pl. 4, fig. 7; Weaver & Weaver, 1962, p. 27, pl. 7, fig. 13; Gaston, 1974, p. 67, [hypotype examined].

[Non] *Nodosaria chirana* Cushman & Stone, Weaver, 1962, p. 376, pl. 2, fig. 12.

Hypotype no. 00320, loc. PSUA0117.

Nodosaria deliciae Martin

Nodosaria deliciae Martin, 1943, p. 17, pl. 6, fig. 3a, b; Smith, 1957, p. 167, pl. 22, fig. 18a, b; Mallory, 1959, p. 170, pl. 13, fig. 13a, b, pl. 36, fig. 10a, b.

[?] *Nodosaria deliciae* Martin, Gaston, 1974, p. 68, [hypotype examined].

Hypotype no. 00321, loc. PSUA0115.

Nodosaria cf. *N. deliciae* Martin

Dentalina spinosa d'Orbigny, Mallory, 1959, p. 167, pl. 12, fig. 26; Sullivan, 1962, p. 264, pl. 9, fig. 17, [not fig. 18]; Gaston, 1974, p. 67, [hypotype examined].

Hypotype no. 00322, loc. PSUA0133.

Except for more elongate chambers, several specimens with coarse spines resemble *N. deliciae*. They appear to be

identical with the figures of *D. spinosa* of Mallory and Sullivan. (see discussion under *D. spinosa*)

Nodosaria ewaldi Reuss

Nodosaria ewaldi Reuss, Cushman & Dusenbury, 1934, p. 56, pl. 7, fig. 21; Mallory, 1959, p. 170, pl. 13, fig. 23a, b; pl. 28, fig. 6.

Nodosaria ewaldi Reuss ?, Cushman, 1935, p. 22, pl. 9, fig. 2.

Hypotype no. 00323, loc. PSUA0128.

Nodosaria ewaldi (?) Reuss

Hypotype no. 00324, loc. PSUA0120.

Fragmented individuals that taper toward the sutures are questionably assigned to this species.

Nodosaria (?) *gyrata* Mallory

Nodosaria ? *gyrata* Mallory, 1959, p. 170, pl. 13, fig. 18, pl. 28, fig. 5.

[Non] *Nodosaria* (?) *gyrata* Mallory, Weaver & Weaver, 1962, p. 27, pl. 7, fig. 14.

Hypotype no. 00332, loc. PSUA0104.

Nodosaria (?) *gyrata* Mallory [*varietas nova*]

(Pl. 1, fig. 6, 7)

Variety differing from typical in the low, spiral costae which alternate with the normal higher costae.

Dimensions of hypotype:

00333; length .58 mm. broken; width .17 mm.

Hypotype no. 00333, loc. PSUA0104.

The alternating fine costae easily differentiates this variety from *N. (?) gyrata* (paratypes examined). It is referred to as a variety, rather than a subspecies, since it occurs within localities with *N. (?) gyrata*. It may

also represent local ecologic variation but until this is demonstrated, it should remain distinct. The naming of this variety must await publication in accordance with the International Code of Zoological Nomenclature (1961, p. 9, art. 11a).

Nodosaria holserica Schwager

Nodosaria holserica Schwager, Kleinpell, 1938, p. 218, pl. 4, fig. 9; Sullivan, 1962, p. 265, pl. 10, fig. 2a, b; Fairchild, Wesendunk, & Weaver, 1969, p. 36, pl. 4, fig. 5.

[Non] *Nodosaria holserica* Schwager, Smith, 1956, p. 91, pl. 10, fig. 9; Kleinpell & Weaver, 1963, p. 171, pl. 6, fig. 9; Gaston, 1974, p. 68, [hypotype examined].

Hypotype no. 00325, loc. PSUA0116.

Nodosaria cf. *N. holserica* Schwager

Nodosaria holserica Schwager, Smith, 1956, p. 91, pl. 10, fig. 9; Kleinpell & Weaver, 1963, p. 171, pl. 6, fig. 9.

Nodosaria cf. *N. holserica* Schwager, Fairchild, Wesendunk, & Weaver, 1969, p. 36, pl. 4, fig. 4, [not fig. 11].

Hypotype no. 00326, loc. PSUA0131.

Except for strongly constricted sutures, hispid individuals compare favorably with *N. holserica*.

Nodosaria latejugata Gumbel

Nodosaria latejugata Gumbel, Cushman & M. A. Hanna, 1927, p. 52, pl. 5, fig. 1-3; Cushman & McMasters, 1936, p. 512, pl. 75, fig. 11, 12; Bergquist, 1942, p. 45, pl. 4, fig. 12, 13; Kline, 1943, p. 27, pl. 2, fig. 10; Mallory, 1959, p. 171, pl. 13, fig. 20, pl. 28, fig. 8, pl. 41, fig. 1; Weaver & Weaver, 1962, p. 28, pl. 7, fig. 15, 16; Gaston, 1974, p. 68, [hypotype examined]; Thoms, 1975, pl. 1, fig. 22.

Nodosaria raphanus (Linnaeus), Hanna, 1923, p. 321, pl. 58, fig. 1.

[Non] *Nodosaria latejugata* Gumbel, Smith, 1957, p. 167, pl. 22, fig. 23.

Hypotype no. 00327, loc. PSUA0103.

Nodosaria longiscata d'Orbigny

Nodosaria longiscata d'Orbigny, Kleinpell, 1938, p. 218, pl. 9, fig. 16; Howe, 1939, p. 47, pl. 5, fig. 10; Bergquist, 1942, p. 46, pl. 4, fig. 26; Kline, 1943, p. 28, pl. 2, fig. 8; Weaver & Molander, 1964, p. 184, pl. 6, fig. 15; Todd, 1957a, pl. 65, fig. 15, 16; Phillips, Welton, & Welton, 1976, pl. 2, fig. 7.

[Non] *Nodosaria longiscata* d'Orbigny, Franklin, 1944, p. 311, pl. 46, fig. 1, 2; Sullivan, 1962, p. 265, pl. 10, fig. 1.

[Non] *Nodosaria* cf. *N. longiscata* d'Orbigny, Cushman, Stewart, & Stewart, 1947e, p. 98, pl. 13, fig. 1.

Hypotype no. 00328, loc. PSUA0123.

See discussion under *N. arundinea*.

Nodosaria pyrula d'Orbigny

Nodosaria pyrula d'Orbigny, Cushman, 1913, p. 49, pl. 26, fig. 1-3; Cushman & Schenck, 1928, p. 308, pl. 43, fig. 1, 2; Howe, 1939, p. 48, pl. 5, fig. 16; Wilson, 1954, p. 136, pl. 14, fig. 14; Mallory, 1959, p. 172, pl. 13, fig. 19, pl. 41, fig. 2; Hornaday, 1961, p. 185, pl. 4, fig. 6; Sullivan, 1962, p. 265, pl. 10, fig. 3a, b, 4a, b; Weaver & Weaver, 1962, p. 28, pl. 7, fig. 18; Kleinpell & Weaver, 1963, p. 171, pl. 7, fig. 5, 6; Weaver & Molander, 1964, p. 185, pl. 6, fig. 17; Fairchild, Wesendunk, & Weaver, 1969, p. 37, pl. 4, fig. 12; Gaston, 1974, p. 69, [hypotype examined]; Phillips, Tipton, & Watkins, 1974, pl. 1, fig. 7.

Nodosaria cf. *N. pyrula* d'Orbigny, Beck, 1943, p. 599, pl. 105, fig. 19, 20.

Dentalina pyrula (d'Orbigny), Puri, 1953, p. 100, pl. 23, fig. 12, 13.

Hypotype no. 00329, loc. PSUA0107.

Nodosaria pyrula [?] d'Orbigny

Hypotype no. 00330, loc. PSUA0112.

Bulbous, single chambered specimens seem best referred to this species.

Nodosaria sp. [of Mallory]

Nodosaria sp. Mallory, 1959, p. 173, pl. 13, fig. 17.

Hypotype no. 00331, loc. PSUA0137.

A costate fragment from the Salmon River Section appears identical to the specimen figured by Mallory.

Nodosaria [?] spp.

Accurate identification of numerous fragmented, single chambered specimens is impossible. More than one species is probably represented.

Genus *Pseudoglandulina* Cushman, 1929*Pseudoglandulina conica* (Neugeboren)

Pseudoglandulina conica (Neugeboren), Cushman & Barksdale, 1930, p. 65, pl. 12, fig. 1-3; Beck, 1943, p. 599, pl. 105, fig. 12; Smith, 1957, p. 168, pl. 23, fig. 1a, b, 2; Mallory, 1959, p. 173, pl. 33, fig. 4, pl. 36, fig. 11a, b; Weaver & Weaver, 1962, p. 28, pl. 8, fig. 1, 2; Weaver & Molander, 1964, p. 185, pl. 6, fig. 18, pl. 7, fig. 1; Gaston, 1974, p. 69, [hypotype examined].

Hypotype no. 00334, loc. PSUA0103.

Pseudoglandulina ovata (Cushman & Applin)

Nodosaria (*Glandulina*) *laevigata* d'Orbigny var. *ovata* Cushman & Applin, 1926, p. 26, pl. 7, fig. 12, 13.

Glandulina laevigata d'Orbigny var. *ovata* (Cushman & Applin), Cushman, 1935, p. 29, pl. 10, fig. 16, 17; Cushman, Stewart, & Stewart, 1947d, p. 76, pl. 9, fig. 7; Smith, 1956, p. 92, pl. 11, fig. 11a, b.

Pseudoglandulina ovata (Cushman & Applin), Mallory, 1959, p. 174, pl. 28, fig. 9a, b; Sullivan, 1962, p. 266, pl. 11, fig. 2a, b, 3, 4; Kleinpell & Weaver, 1963, p. 171, pl. 7, fig. 7a, b; Weaver & Molander, 1964, p. 185, pl. 7, fig. 2; Gaston, 1974, p. 70, [hypotype examined].

Hypotype no. 00335, loc. PSUA0110.

Genus *Saracenaria* DeFrance, 1824

Saracenaria cf. *S. moresiana* Howe & Wallace

Hypotype no. 00336, loc. PSUA0132.

Except for a keel along the outer margin of the test, a single specimen from the Salmon River Section is identical with specimens of *S. moresiana* as figured by Bergquist (1942, p. 48, pl. 3, fig. 14a, b), Weaver and Weaver (1962, p. 28, pl. 8, fig. 5), and Weaver and Molander (1964, p. 185, pl. 7, fig. 7).

Saracenaria sp.

Hypotype no. 00337, loc. PSUA0113.

A few individuals from the Neskowin Creek Section seem best referred to this genus.

Genus *Lagena* Walker & Jacob, 1798

Lagena acuticosta Reuss

[Non] *Lagena acuticosta* Reuss, Bagg, 1905, p. 45, pl. 14, fig. 28; Bergquist, 1942, p. 49, pl. 5, fig. 30.

Lagena acuticosta Reuss, Cushman, 1913, p. 23, pl. 8, fig. 9a, b, 10, pl. 23, fig. 2; Cushman, 1935, p. 23, pl. 9, fig. 5, 6; Kleinpell, 1938, p. 224, pl. 7, fig. 13; Cushman, 1946a, p. 94, pl. 39, fig. 14, 15; Cushman & Stainforth, 1951, pl. 148, pl. 26, fig. 10; Frizzell, 1954, p. 102, pl. 14, fig. 1, 2; Puri, 1957, p. 115, pl. 4, fig. 9a, b; Mallory, 1959, p. 174, pl. 14, fig. 1a, b, pl. 28, fig. 10a, b, pl. 41, fig. 8a, b; Weaver & Molander, 1964, p. 186, pl. 7, fig. 10; Gaston, 1974, p. 71, [hypotype examined]; Murray & Wright, 1974, pl. 6, fig. 2.

Lagena conscripta Cushman & Barksdale, Beck, 1943, p. 601, pl. 107, fig. 38; Sullivan, 1962, p. 66, pl. 10, fig. 10a, b.

Hypotype no. 00338, loc. PSUA0133.

Lagena conscripta Cushman and Barksdale has commonly been confused with *L. acuticosta* in West Coast literature. The apertural end of *L. conscripta*, as described by Cushman and Barksdale (1930, p. 66), has a "definite expanded area appearing almost like a secondary chamber" which indeed is very similar to the apertural end of *L. acuticosta*. They further state however, that the expanded area is "apparently due entirely to ornamentation which consists of several, 16-20, longitudinal costae". These costae which make up the "secondary chamber" are "increased slightly in number and not entirely confluent with those of the main body of the test". Of all of the figures examined for this investigation, none possessed an expanded apertural region composed of longitudinal costae. Therefore, these forms have been synonymized with *L. acuticosta*.

Lagena amphora Reuss

Lagena costata (Williamson) var. *amphora* Reuss, Cushman, 1913, p. 21, pl. 10, fig. 2, 3, pl. 12, fig. 2; Howe, 1939, p. 49, pl. 6, fig. 15; Puri, 1953, p. 102, pl. 21, fig. 6.

Lagena amphora Reuss, Mallory, 1959, p. 175, pl. 14, fig. 2a, b.

Hypotype no. 00339, loc. PSUA0133.

Lagena becki Sullivan

Lagena sp. A. Beck, 1943, p. 602, pl. 107, fig. 26.

Lagena sp. Smith, 1956, p. 92, pl. 10, fig. 4a, b.

Lagena becki Sullivan, 1962, p. 266, pl. 10, fig. 16a, b;
Fairchild, Wesendunk, & Weaver, 1969, p. 39, pl. 5,
fig. 10; Smith, 1971, p. 39, pl. 5, fig. 3.

Hypotype no. 00340, loc. PSUA0118.

Lagena costata (Williamson)

Lagena costata (Williamson), Cushman, 1913, p. 21, pl. 9,
fig. 6, pl. 10, fig. 1, pl. 12, fig. 1; Cushman, 1935,
p. 23, pl. 9, fig. 7, 8; Coryell & Embich, 1937, p. 299,
pl. 42, fig. 11; Beck, 1943, p. 601, pl. 107, fig. 36;
Franklin, 1944, p. 313, pl. 45, fig. 17; Mallory, 1959,
p. 175, pl. 14, fig. 3a, b, pl. 41, fig. 7a, b; Gaston,
1974, p. 71, [hypotype examined].

Lagena costata (?) (Williamson), Bergquist, 1942, p. 49,
pl. 5, fig. 23.

Hypotype no. 00341, loc. PSUA0125.

This species, as figured by various authors, has a highly
variable number of costae. It most closely resembles *L.*
strumosa Reuss (Sullivan, 1962, p. 267, pl. 10, fig. 9a, b)
but differs recognizably in having fewer costae, a long
apertural neck, and does not possess a basal spine.

Lagena costata [?] (Williamson)

Hypotype no. 00342, loc. PSUA0133.

Poorly preserved specimens are referred to this species.

Lagena hexagona (Williamson)

Lagena hexagona (Williamson), Cushman, 1913, p. 17, pl. 6,
fig. 2, 3; Cushman, 1931, p. 38, pl. 5, fig. 12; Cushman,
1935, p. 23, pl. 9, fig. 10; Howe, 1939, p. 50, pl. 6,
fig. 16; Bergquist, 1942, p. 50, pl. 5, fig. 24; Beck, 1943,
p. 602, pl. 107, fig. 23; Cushman, 1946a, p. 95, pl. 39,
fig. 16; Mallory, 1959, p. 175, pl. 14, fig. 7; Sullivan,
1962, p. 267, pl. 10, fig. 9a, b; Weaver & Molander, 1964,
p. 187, pl. 7, fig. 13; Fairchild, Wesendunk, & Weaver,
1969, p. 40, pl. 5, fig. 13; Gaston, 1974, p. 71, [hypotype
examined]; Phillips, Tipton, & Watkins, 1974, pl. 1,
fig. 5.

Entosolenia hexagona Williamson, Cushman & Simonson, 1944,
p. 198, pl. 32, fig. 8.

Hypotype no. 00343, loc. PSUA0137.

Lagena marginata (Walker & Boys)

Lagena marginata (Walker & Boys), Bagg, 1905, p. 27, pl. 4,
fig. 5; Cushman, 1913, p. 37, pl. 22, fig. 1-7; Kleinpell,
1938, p. 225, pl. 10, fig. 5; Smith, 1956, p. 92, pl. 10,
fig. 1a, b; Kleinpell & Weaver, 1963, p. 172, pl. 7,
fig. 12; Fairchild, Wesendunk, & Weaver, 1969, p. 40,
pl. 5, fig. 14; Gaston, 1974, p. 72, [hypotype examined].

[Non] *Lagena marginata* (Walker & Boys), Bagg, 1912, p. 49,
pl. 14, fig. 18a-c, 21a, b, 22a, b.

Entosolenia marginata (Walker & Boys), Bergquist, 1942,
p. 67, pl. 7, fig. 10.

Fissurina marginata (Walker & Boys), Murray & Wright, 1974,
pl. 6, fig. 5.

Hypotype no. 00344, loc. PSUA0101.

Lagena vulgaris Williamson

Lagena vulgaris Williamson, Cushman, 1946a, p. 95, pl. 40,
fig. 3; Mallory, 1959, p. 176, pl. 14, fig. 9a, b; Sullivan,
1962, p. 267, pl. 10, fig. 12a, b, 13; Weaver & Molander,
1964, p. 187, pl. 7, fig. 14; Gaston, 1974, p. 72,
[hypotype examined].

Hypotype no. 00345, loc. PSUA0112.

Family POLYMORPHINIDAE

Genus *Guttulina* d'Orbigny, 1839

Guttulina frankei Cushman & Ozawa

Guttulina frankei Cushman & Ozawa, Cushman & Frizzell, 1943,
p. 84, pl. 14, fig. 17, 18; Rau, 1948, p. 170, pl. 30,
fig. 17, 18.

Hypotype no. 00346, loc. PSUA0102.

A single recrystallized specimens was recovered from the
basal Neskowin Creek Section. Its greater size and somewhat

different chamber arrangement differentiate this species from *Guttulina irregularis* d'Orbigny.

Guttulina irregularis (d'Orbigny)

Polymorphina byramensis Cushman, Cushman, 1923, p. 31, pl. 5, fig. 1-5.

Guttulina byramensis (Cushman), Cushman & Schenck, 1928, p. 309, pl. 43, fig. 6-8; Detling, 1946, p. 354, pl. 48, fig. 10.

Guttulina irregularis (d'Orbigny), Cushman, 1935, p. 24, pl. 9, fig. 13-16; Bergquist, 1942, p. 54, pl. 6, fig. 5, [not fig. 6]; Beck, 1943, p. 602, pl. 106, fig. 3, 15; Cushman & Simonson, 1944, p. 196, pl. 31, fig. 10-12; Rau, 1948, p. 169, pl. 30, fig. 7, 8; Puri, 1957, p. 116, pl. 5, fig. 10a-c; Sullivan, 1962, p. 267, pl. 11, fig. 8a-c; Gaston, 1974, p. 72, [hypotype examined].

[Non] *Guttulina irregularis* (d'Orbigny), Howe, 1939, p. 52, pl. 6, fig. 20; Puri, 1953, p. 107, pl. 9, fig. 8, 9, 10; Asano, 1958, pl. 10, fig. 17; Mallory, 1959, p. 177, pl. 14, fig. 13a, b.

Guttulina cf. *G. irregularis* (d'Orbigny), Kleinpell, 1938, p. 228, pl. 2, fig. 7.

Guttulina sp. Wilson, 1954, p. 137, pl. 15, fig. 4a, b.

Guttulina problema d'Orbigny, Kleinpell & Weaver, 1963, p. 172, pl. 2, fig. 13.

Hypotype no. 00347, loc. PSUA0128.

The difficulty in separating *G. irregularis* from *G. problema* d'Orbigny has given rise to much confusion in the published literature. *Guttulina irregularis*, as figured by many authors, is identical to other forms referred to as *G. problema*. Some authors have even synonymized the two (Smith, 1956, p. 92; Kleinpell and Weaver, 1963, p. 172). Individuals referred to as *G. irregularis* in this investigation are small, triangular in outline, and consist of one or two early

chambers overlapped by two later chambers which usually extend back to the proloculus. *Guttulina problema* is similar except for its larger size, greater number of chambers, and later chambers which do not extend back to the proloculus but are added at higher levels. It is quite possible that *G. problema* represents a mature individual; *G. irregularis* being a juvenile. Further study of an ontogenetic series may show that *G. irregularis* and *G. problema* are synonymous; until this is accomplished, these forms remain separated.

Guttulina [?] sp.

Hypotype no. 00348, loc. PSUA0107.

A single specimen, questionably assigned to this genus, has early overlapping chambers terminated by a single uniserial chamber.

Genus *Ramulina* Rupert Jones, 1875

Ramulina aff. *R. navarroana* Cushman [of Mallory]

Ramulina aff. *R. navarroana* Cushman, Mallory, 1959, p. 178, pl. 33, fig. 5.

Hypotype no. 00349, loc. PSUA0112.

A single specimen from the Neskowin Creek Section compares well with the specimen figured by Mallory.

Family NONIONIDAE

Genus *Nonion* Montfort, 1808

Nonion durhami Mallory

Nonion havanense Cushman & Bermudez (?), Smith, 1957, p. 171, pl. 23, fig. 17a, b.

Nonion durhami Mallory, 1959, p. 181, pl. 15, fig. 4a, b, pl. 28, fig. 11a, b; Smith, 1971, p. 64, pl. 5, fig. 6a, b.

Hypotype no. 00350, loc. PSUA0106.

Specimens from the Neskowin Creek Section have radiate sutures, nine chambers in the last whorl, and compare favorably with Smith's (1957) and Mallory's figures. The specimen figured by Smith (1971) has somewhat limbate sutures and only seven chambers in the last whorl and may not represent this species.

Nonion durhami [?] Mallory

Hypotype no. 00351, loc. PSUA0103.

A single recrystallized specimen from the basal Neskowin Creek Section seems referable to this species.

Nonion planatum Cushman & Thomas

Nonion planatum Cushman & Thomas, Cushman & Dusenbury, 1934, p. 60, pl. 8, fig. 6a, b; Cushman, 1939, p. 4, pl. 1, fig. 15a, b; Howe, 1939, p. 58, pl. 7, fig. 24, 25; Bergquist, 1942, p. 61, pl. 6, fig. 24; Beck, 1943, p. 603, pl. 107, fig. 12, 13; Bandy, 1944, p. 370, pl. 60, fig. 15a-c; Cushman & Stainforth, 1951, p. 149, pl. 26, fig. 18; Todd, 1957a, pl. 65, fig. 28a, b; Mallory, 1959, p. 181, pl. 15, fig. 2a, b; Weaver & Weaver, 1962, p. 29, pl. 8, fig. 7a, b; Kleinpell & Weaver, 1963, p. 173, pl. 8, fig. 3a, b; Gaston, 1974, p. 73, [hypotype examined]; Thoms, 1975, pl. 2, fig. 9a, b.

Hypotype no. 00352, loc. PSUA0125.

This widely recorded species is easily recognized by slightly curved sutures which terminate in a thickened ring around the umbilici. Although most published figures of *N. planatum* depict a close coiled form with a rounded periphery, many specimens from the Neskowin Creek Section have a lobate outline. The amount of lobation varies; individuals with

completely lobate outlines grade into forms in which only the last one or two chambers are lobate. According to Rau (personal communication, 1976) this difference falls within the range of variation of *N. planatum* and thus does not warrant the proposal of a new specific name.

Nonion planatum [?] Cushman & Thomas

Hypotype no. 00353, loc. PSUA0131.

A few crushed specimens probably represent this species.

Nonion sp. A. [*species nova*]

(Pl. 1, fig. 8, 9)

Test longer than broad, compressed, bilaterally symmetrical, umbilical area slightly depressed, periphery subacute to rounded; chambers distinct, eight in number in the adult coil, increasing rapidly in size as added, slightly inflated; sutures distinct, slightly curved, moderately depressed; wall smooth; aperture indistinct, at the base of the last formed chamber.

Dimensions of hypotype:

00354; length .31 mm.; breadth .24 mm.; thickness .18 mm.

Hypotype no. 00354, loc. PSUA0119.

This species most closely resembles *Nonion mexicanum* Cole (Cushman, 1939, p. 6, pl. 1, fig. 23a, b, 24a, b) but differs from it in possessing an additional chamber in the final whorl, greater curvature of the sutures and larger, more inflated chambers. Specimens identical to *N. sp. A.* except for acute peripheries are probably the result of compaction and thus do not warrant a separate specific designation. The naming of this species must await publication in accordance with the International Code of Zoological Nomenclature (1961, p. 9, art. 11a).

Nonion sp.

Hypotype no. 00355, loc. PSUA0137.

Poorly preserved individuals are only identifiable at a generic level.

Genus *Elphidium* Montfort, 1808

Elphidium smithi Cushman & Dusenbury

Elphidium smithi Cushman & Dusenbury, 1934, p. 61, pl. 8, fig. 7a, b; Cushman, 1939, p. 40, pl. 10, fig. 19a, b.

Hypotype no. 00356, loc. PSUA0102.

A single specimen from the basal Neskowin Creek Section, although recrystallized, has numerous chambers, is of large size, and possesses the double row of pores which characterize this species.

Elphidium sp. A. [*species nova*]

(Pl. 1, fig. 10, 11)

Test small, longer than broad, compressed, bilaterally symmetrical, umbilical area slightly depressed, filled with numerous papillae which extend onto the base of the apertural face and early chambers, periphery subacute to rounded; early chambers obscured by papillae, later chambers distinct, increasing in size as added, slightly inflated, seven to eight in number; sutures depressed, retral processes distinct, appearing as a line of pores; wall smooth; aperture obscured by papillae.

Dimensions of hypotype:

00357; length .26 mm.; breadth .18 mm.; thickness .13 mm.

Hypotype no. 00357, loc. PSUA0101.

This species somewhat resembles the general outline of *Elphidium texanum* (Cushman and Applin) (Cushman, 1939, p. 39, pl. 10, fig. 17a, b) but the numerous papillae in the umbilical area and on the early chambers easily differentiates the

two. Several specimens with acute peripheries are included under this designation as they probably represent compressed individuals. The naming of this species must await publication in accordance with the International Code of Zoological Nomenclature (1961, p. 9, art. 11a).

Elphidium sp.

Hypotype no. 00358, loc. PSUA0127.

A few specimens resembling *Elphidium* sp. A. possess very weathered tests making specific identification impossible.

Family HETEROHELICIDAE

Genus *Plectofrondicularia* Liebus, 1903

Plectofrondicularia gracilis Smith

Plectofrondicularia gracilis Smith, 1956, p. 93, pl. 12, fig. 2-5; Kleinpell & Weaver, 1963, p. 174, pl. 8, fig. 11, [not fig. 8]; Fairchild, Wesendunk, & Weaver, 1969, p. 47, pl. 10, fig. 11.

[?] *Plectofrondicularia gracilis* Smith, Asano, 1958, text-fig. 5, 6.

Hypotype no. 00359, loc. PSUA0128.

This species intergrades with *Plectofrondicularia packardi* Cushman and Schenck var. *multilineata* Cushman and Simonson (Smith, 1956, p. 93) and in some cases the two are impossible to separate. Specimens assigned to this species from the Neskowin Creek Section differ from *P. packardi* var. *multilineata* in possessing a narrower test, more angular sutures, and six strong costae that alternate with a few finer costae.

Plectofrondicularia kerni Cook

Plectofrondicularia kerni Cook, Mallory, 1959, p. 212, pl. 18, fig. 2, pl. 33, fig. 10a, b; Sullivan, 1962, p. 269, pl. 13, fig. 7, 8, [not fig. 6]; Fairchild, Wesendunk, & Weaver, 1969, p. 47, pl. 10, fig. 4.

Hypotype no. 00360, loc. PSUA0116.

This species, as figured in the published literature, exhibits a large amount of variation in the number of longitudinal costae it possesses. According to Cook (*in* Mallory, 1959, p. 212), *Plectofrondicularia kerni* has 35 to 40 low, distinct costae whereas other published figures examined during this investigation depict a form with considerably fewer costae (5 to 17). A single specimen assigned to this species from the Neskowin Creek Section possesses ten longitudinal costae and all other respects is identical to the specimens figured by Mallory.

Plectofrondicularia oregonensis Cushman,
Stewart, & Stewart

Plectofrondicularia oregonensis Cushman, Stewart, & Stewart, 1947e, p. 100, pl. 13, fig. 8a, b, 9a, b; Cushman, Stewart, & Stewart, 1947d, p. 77, pl. 10, fig. 4a, b; Fairchild, Wesendunk, & Weaver, 1969, p. 48, pl. 9, fig. 6; Smith, 1971, p. 47, pl. 5, fig. 7.

[?] *Plectofrondicularia searsi* Cushman, Stewart, & Stewart, Mallory, 1959, p. 214, pl. 17, fig. 17.

[?] *Plectofrondicularia packardi packardi* Cushman & Schenck, Rau, 1964, p. G17, pl. 5, fig. 13.

Hypotype no. 00361, loc. PSUA0128.

This species, although similar to *Plectofrondicularia searsi* Cushman, Stewart, and Stewart (Sullivan, 1962, p. 270,

pl. 13, fig. 9), is distinguished by its small size and two strong median costae.

Plectofrondicularia packardi Cushman & Schenck
var. *multilineata* Cushman & Simonson

Plectofrondicularia packardi Cushman & Schenck var.

multilineata Cushman & Simonson, 1944, p. 197, pl. 32, fig. 2-4; Cushman & Stainforth, 1951, p. 150, pl. 26, fig. 26; Wilson, 1954, p. 138, pl. 15, fig. 9; Hornaday, 1961, p. 187, pl. 4, fig. 21; Sullivan, 1962, p. 270, pl. 12, fig. 10; Weaver & Molander, 1964, p. 187, pl. 8, fig. 3; DeLise, 1967, p. 33, pl. 2, fig. 14; Fairchild, Wesendunk, & Weaver, 1969, p. 48, pl. 9, fig. 16; Tipton, Kleinpell, & Weaver, 1973, p. 51, pl. 4, fig. 9; Phillips, Tipton, & Watkins, 1974, pl. 1, fig. 14; Phillips, Welton, & Welton, 1976, pl. 3, fig. 8.

Plectofrondicularia packardi multilineata Cushman & Simonson, Detling, 1946, p. 355, pl. 49, fig. 3, 5; Rau, 1948, p. 171, pl. 30, fig. 19; Asano, 1952, p. 40, pl. 4, fig. 4, pl. 5, fig. 3-5; Smith, 1956, p. 94, pl. 12, fig. 6; Asano, 1958, text-fig. 3; Smith, 1971, p. 48, pl. 6, fig. 1.

Plectofrondicularia packardi Cushman & Schenck var.

multi-lineata Cushman & Simonson, Weaver & Weaver, 1962, p. 30, pl. 8, fig. 11.

[Non] *Plectofrondicularia packardi multilineata* Cushman & Simonson, Rau, 1964, p. G16, pl. 5, fig. 15.

Hypotype no. 00362, loc. PSUA0131.

This variety, as figured by Cushman and Simonson (1944, pl. 32, fig. 2-4), exhibits some variation in the length of its longitudinal costae; in figure 4 the costae extend the entire length of the test while in figure 2 and 3 the costae are restricted to the lower one-half of the test. Specimens from the "Strata of Cascade Head" normally possess costae which extend the entire length of the test.

Plectofrondicularia packardi Cushman & Schenck
var. *packardi* Cushman & Schenck

Plectofrondicularia packardi Cushman & Schenck, 1928, p. 311, pl. 43, fig. 14, 15; Cushman & Simonson, 1944, p. 197, pl. 31, fig. 17, 18, pl. 32, fig. 1; Detling, 1946, p. 355, pl. 49, fig. 1; Asano, 1952, p. 39, pl. 5, fig. 1, 2; Wilson, 1954, p. 138, pl. 15, fig. 8; Asano, 1958, text-fig. 1, 2; Hornaday, 1961, p. 187, pl. 4, fig. 20.

[Non] *Plectofrondicularia packardi* Cushman & Schenck, Cushman, Stewart, & Stewart, 1947e, p. 100, pl. 13, fig. 7a, b.

Plectofrondicularia packardi packardi Cushman & Schenck, Smith, 1956, p. 94, pl. 12, fig. 1, 7; Sullivan, 1962, p. 270, pl. 12, fig. 11, 12; Phillips, Tipton, & Watkins, 1974, pl. 1, fig. 10, 11, [not fig. 12].

[?] *Plectofrondicularia packardi* Cushman & Schenck var. *packardi* Cushman & Schenck, Mallory, 1959, p. 213, pl. 17, fig. 16.

Plectofrondicularia packardi Cushman & Schenck var. *packardi* Cushman & Schenck, Kleinpell & Weaver, 1963, p. 174, pl. 8, fig. 5-7, 10, 14; Weaver & Molander, 1964, p. 188, pl. 8, fig. 4; Fairchild, Wesendunk, & Weaver, 1969, p. 48, pl. 9, fig. 20; Tipton, Kleinpell, & Weaver, 1973, p. 50, pl. 4, fig. 8.

[Non] *Plectofrondicularia packardi packardi* Cushman & Schenck, Rau, 1964, p. G17, pl. 5, fig. 13.

Hypotype no. 00363, loc. PSUA0128.

This widely recorded variety is characterized by a large, wide test, rounded sutures, and short costae on the early portion of the test.

Plectofrondicularia aff. *P. packardi* Cushman & Schenck
var. *packardi* Cushman & Schenck

Plectofrondicularia packardi Cushman & Schenck, Cushman, Stewart, & Stewart, 1947e, p. 100, pl. 13, fig. 7a, b.

Plectofrondicularia packardi packardi Cushman & Schenck, Rau, 1964, p. G17, pl. 5, fig. 13.

[?] *Plectofrondicularia packardi packardi* Cushman & Schenck, Phillips, Tipton, & Watkins, 1974, pl. 1, fig. 12, [not fig. 10, 11].

Hypotype no. 00364, loc. PSUA0131.

Individuals assigned to this variety are characterized by a large, slightly keeled test that increases rapidly in size as chambers are added, acutely angular sutures, and costae which cover the proloculus and extend to various lengths above the early portions of the test. It differs from *P. packardi* var. *packardi sensu stricto* in possessing acutely angulate sutures and from *P. searsi* Cushman, Stewart, and Stewart in possessing a much wider test.

This variety is most closely related to *P. packardi* var. *packardi s. s.* and in some instances, it is very difficult to differentiate the two. *Plectofrondicularia* aff. *P. packardi* var. *packardi* is restricted to the upper portions of the Neskowin Creek Section in which it occurs commonly with both *P. searsi* and *P. packardi* var. *packardi s. s.* Since it possesses characteristics of both, and intergrades with *P. packardi* var. *packardi s. s.*, specimens referred to this variety probably represent an intermediate form.

Plectofrondicularia searsi Cushman,
Stewart, & Stewart

Plectofrondicularia searsi Cushman, Stewart, & Stewart, 1947d, p. 78, pl. 10, fig. 5a, b, pl. 11, fig. 8a, b; Cushman, Stewart, & Stewart, 1949, p. 132, pl. 15, fig. 5a, b; Sullivan, 1962, p. 270, pl. 13, fig. 9; DeLise, 1967, p. 33, pl. 3, fig. 1; Smith, 1971, p. 48, pl. 6, fig. 2; Gaston, 1974, p. 75, [hypotype examined].

[Non] *Plectofrondicularia searsi* Cushman, Stewart, & Stewart, Mallory, 1959, p. 214, pl. 17, fig. 17.

Hypotype no. 00365, loc. PSUA0130.

See discussion under *P. oregonensis* and *P. aff. P. packardi* var. *packardi*.

Plectofrondicularia vaughni Cushman

Plectofrondicularia vaughni Cushman, Coryell & Embich, 1937, p. 303, pl. 42, fig. 15; Cushman & Stainforth, 1951, p. 150, pl. 26, fig. 27; Smith, 1956, p. 94, pl. 11, fig. 14; Sullivan, 1962, p. 271, pl. 12, fig. 7; Kleinpell & Weaver, 1963, p. 174, pl. 8, fig. 12; Weaver & Molander, 1964, p. 188, pl. 8, fig. 6; Fairchild, Wesendunk, & Weaver, 1969, p. 48, pl. 9, fig. 10; Smith, 1971, p. 48, pl. 6, fig. 3; Tipton, Kleinpell, & Weaver, 1973, p. 51, pl. 4, fig. 11; Phillips, Welton, & Welton, 1974, pl. 3, fig. 9.

Hypotype no. 00366, loc. PSUA0116.

Specimens with alternating early chambers appear identical to this widely recorded species.

Plectofrondicularia vokesi Cushman,
Stewart, & Stewart

Plectofrondicularia vokesi Cushman, Stewart, & Stewart, 1949, p. 132, pl. 15, fig. 4; Mallory, 1959, p. 214, pl. 17, fig. 18; Sullivan, 1962, p. 271, pl. 13, fig. 10; Weaver & Weaver, 1962, p. 30, pl. 8, fig. 16; Kleinpell & Weaver, 1963, p. 174, pl. 9, fig. 2; Weaver & Molander, 1964, p. 188, pl. 8, fig. 7; DeLise, 1967, p. 33, pl. 3, fig. 3; Fairchild, Wesendunk, & Weaver, 1969, p. 49, pl. 9, fig. 7.

Plectofrondicularia cf. *P. vokesi* Cushman, Stewart, & Stewart, Phillips, Tipton, & Watkins, 1974, pl. 1, fig. 13.

[Non] *Plectofrondicularia vokesi* Cushman, Stewart, & Stewart, Thoms, 1975, pl. 2, fig. 12.

Hypotype no. 00367, loc. PSUA0118.

Plectofrondicularia sp. [of Weaver & Weaver]

Plectofrondicularia sp. Weaver & Weaver, 1962, p. 30, pl. 8, fig. 16.

Hypotype no. 00368, loc. PSUA0121.

This species resembles *Plectofrondicularia minuta* Sullivan (1962, p. 269, pl. 13, fig. 1-4) but has fewer chambers in the biserial stage and more angular sutures.

Plectofrondicularia sp.

Hypotype no. 00369, loc. PSUA0124.

Several fragments can only be identified to a generic level.

Genus *Amphimorphina* Neugeboren, 1850

Amphimorphina jenkinsi (Church)

Plectofrondicularia jenkinsi Church, 1931, pl. A, fig. 5, 7-9; Detling, 1946, p. 355, pl. 49, fig. 2a, b, [? fig. 8].

Amphimorphina jenkinsi (Church), Mallory, 1959, p. 216, pl. 18, fig. 5; Weaver & Weaver, 1962, p. 31, pl. 9, fig. 2; Kleinpell & Weaver, 1963, p. 174, pl. 9, fig. 3; Gaston, 1974, p. 75, [hypotype examined].

[?] *Amphimorphina jenkinsi* (Church), Sullivan, 1962, p. 272, pl. 13, fig. 15.

Hypotype no. 00370, loc. PSUA0119.

Genus *Nodogenerina* Cushman, 1927

Nodogenerina adolphina (d'Orbigny)

[Non] *Nodosaria adolphina* (d'Orbigny), Bagg, 1905, p. 28, pl. 5, fig. 1.

[?] *Dentalina adolphina* d'Orbigny, Cushman & Schenck, 1928, p. 308, pl. 42, fig. 6.

Dentalina adolphina d'Orbigny, Bergquist, 1942, p. 40, pl. 5, fig. 1.

Nodogenerina adolphina (d'Orbigny), Mallory, 1959, p. 216, pl. 18, fig. 8a, b, pl. 29, fig. 8a, b, pl. 41, fig. 10; Sullivan, 1962, p. 272, pl. 13, fig. 17a, b; Weaver & Molander, 1964, p. 188, pl. 8, fig. 8; Gaston, 1974, p. 75, [hypotype examined].

Hypotype no. 00371, loc. PSUA0116.

Nodogenerina adolphina, as figured by various authors, occurs in two forms; a form with globular chambers separated by constricted sutures (Mallory, 1959, pl. 18, fig. 8a, b, pl. 29, fig. 8a, b) and a form that has a uniform diameter throughout its length except for the final chambers (Mallory, 1959, pl. 41, fig. 10; Weaver and Molander, 1964, pl. 8, fig. 8). Both forms are represented in the "Strata of Cascade Head" and are included under this designation.

Individuals assigned to this species are similar to *N. lepidula* Schwager (Weaver and Weaver, 1962, pl. 8, fig. 9) in that they both possess a row of spines around the lower margins of each chamber. *Nodogenerina adolphina* however, possesses a regular pattern of spines on the chambers and less constricted sutures whereas *N. lepidula* has a row of irregularly spaced spines and extremely constricted, limbate sutures.

Nodogenerina cf. *N. bradyi* Cushman

Nodogenerina bradyi Cushman, Mallory, 1959, p. 216, pl. 18, fig. 12.

Hypotype no. 00372, loc. PSUA0123.

Although the specimen figured by Mallory is similar to *N. bradyi*, it does not agree with Cushman's type description (1927, p. 79, no figure) or other published figures (Church, 1931, pl. C, fig. 6, 7; Detling, 1946, pl. 49, fig. 9, 10; Cushman, 1951, pl. 26, fig. 3, 7). *Nodogenerina bradyi* possesses fine spinose projections at the base of each chamber whereas the form figured by Mallory lacks these spinose

projections and is smaller in size. Specimens from the "Strata of Cascade Head" which appear identical to the form figured by Mallory have therefore been designated *N. cf. N. bradyi*.

Nodogenerina kressenbergensis (Gumbel)

Nodosaria kressenbergensis Gumbel, Weinzierl & Applin, 1929, p. 398, pl. 43, fig. 2.

Nodogenerina kressenbergensis (Gumbel) (?), Smith, 1957, p. 172, pl. 24, fig. 5.

Nodogenerina kressenbergensis (Gumbel), Mallory, 1959, p. 217, pl. 18, fig. 11, pl. 40, fig. 13.

Hypotype no. 00373, loc. PSUA0133.

This species is characterized by a small, delicate test and chambers joined to each other by long slender necks. One of Mallory's figures (1959, pl. 40, fig. 13) has costae around the central portion of each chamber and thus may represent another species.

Nodogenerina lepidula (Schwager)

Nodosaria lepidula Schwager, Galloway & Morrey, 1931, p. 337, pl. 38, fig. 1.

Nodogenerina lepidula (Schwager), Mallory, 1959, p. 217, pl. 18, fig. 10; Weaver & Weaver, 1962, p. 29, pl. 8, fig. 9; Weaver & Molander, 1964, p. 189, pl. 8, fig. 11; Gaston, 1974, p. 76, [hypotype examined]; Thoms, 1975, pl. 1, fig. 20.

Hypotype no. 00374, loc. PSUA0131.

See discussion under *N. adolphina*.

Nodogenerina lepidula [?] (Schwager)

Hypotype no. 00375, loc. PSUA0107.

Poorly preserved specimens that resemble *N. lepidula* in outline but lack surface ornamentation are included here.

Nodogenerina spp.

Hypotype no. 00376, loc. PSUA0133.

Specimens consisting of single chambers and fragments are questionably referred to this genus. More than one species may be represented.

Family BULIMINIDAE

Genus *Bulimina* d'Orbigny, 1826

Bulimina consanguinea Parker & Bermudez

Bulimina consanguinea Parker & Bermudez, Cushman & Parker, 1946, p. 99, pl. 23, fig. 5a-c; Mallory, 1959, p. 189, pl. 16, fig. 6.

Hypotype no. 00377, loc. PSUA0105.

Bulimina corrugata Cushman & Siegfus

Bulimina corrugata Cushman & Siegfus, 1935, p. 92, pl. 14, fig. 7a, b; Kleinpell, 1938, p. 252, pl. 4, fig. 13; Cushman & Parker, 1946, p. 93, pl. 22, fig. 2a, b; Smith, 1957, p. 174, pl. 24, fig. 8a, b; Asano, 1958, pl. 12, fig. 15; Mallory, 1959, p. 189, pl. 28, fig. 13a, b; Weaver, 1962, p. 378, pl. 3, fig. 5a-c; Weaver & Weaver, 1962, p. 31, pl. 9, fig. 3; Kleinpell & Weaver, 1963, p. 175, pl. 9, fig. 12; Rau, 1964, p. G17, pl. 5, fig. 11; Fairchild, Wesendunk, & Weaver, 1969, p. 53, pl. 11, fig. 5; Tipton, Kleinpell, & Weaver, 1973, p. 53, pl. 5, fig. 8a, b; Gaston, 1974, p. 77 [hypotype examined].

Hypotype no. 00378, loc. PSUA0104.

Several specimens from the Neskowin Creek Section differ slightly from *B. corrugata sensu stricto* in that the early chambers are visible rather than indistinct. In all other respects however, these specimens are identical to *B. corrugata* and are included in this species.

Bulimina curtissima Cushman & Siegfus

Bulimina curtissima Cushman & Siegfus, 1935, p. 93, pl. 14, fig. 9a, b; Cushman & Parker, 1946, p. 94, pl. 22, fig. 6a, b; Mallory, 1959, p. 189, pl. 15, fig. 18; Weaver & Weaver, 1962, p. 31, pl. 9, fig. 4; Gaston, 1974, p. 77, [hypotype examined].

[Non] *Bulimina curtissima* Cushman & Siegfus, Thoms, 1975, pl. 2, fig. 17a, b.

Hypotype no. 00379, loc. PSUA0111.

Bulimina cf. *B. curtissima* Cushman & Siegfus

Hypotype no. 00380, loc. PSUA0107.

A single specimen from the Neskowin Creek Section compares favorably with *B. curtissima* but has several spinose early chambers instead of comparatively few.

Bulimina decurtata Cushman & Stainforth

Bulimina decurtata Cushman & Stainforth, 1947, p. 80, pl. 17, fig. 11; Cushman & Stainforth, 1951, p. 153, pl. 26, fig. 47; Hornaday, 1961, p. 188, pl. 5, fig. 1a-c.

Hypotype no. 00381, loc. PSUA0118.

Bulimina decurtata is easily confused with *B. guayabalensis* Cole var. *ampla* Cushman and Parker (1946, pl. 22, fig. 13) and variants of *Globobulimina pacifica* Cushman var. *oregonensis* Cushman, Stewart, and Stewart in which the later chambers fail to encompass the earlier chambers (Hornaday, 1961, pl. 7, fig. 4-7). It differs from *B. guayabalensis* var. *ampla* in that the last three chambers make up a larger portion of the test and from *G. pacifica* var. *oregonensis* in its apertural characteristics and chamber patterns.

Bulimina elongata d'Orbigny

Bulimina achwageri Yokoyama (?), Cushman & Dusenbury, 1934, p. 62, pl. 8, fig. 11a, b.

Bulimina elongata d'Orbigny, Cushman & Parker, 1937, p. 49, pl. 7, fig. 1-3; Cushman & Parker, 1946, p. 108, pl. 25, fig. 14-17; Puri, 1953, p. 114, pl. 10, fig. 5, 6; Mallory, 1959, p. 190, pl. 16, fig. 12; Thoms, 1975, pl. 2, fig. 15.

Bulimina schwageri Yokoyama, Asano, 1952, p. 41, pl. 3, fig. 10; Asano, 1958, test-fig. 9.

Bulimina capitata Yokoyama (?), Smith, 1956, p. 95, pl. 13, fig. 7a, b.

Bulimina cf. *B. schwageri* Yokoyama, Fairchild, Wesendunk, & Weaver, 1969, p. 54, pl. 11, fig. 14a, b.

Hypotype no. 00382, loc. PSUA0123.

Most authors consider this species to be synonymous with *B. schwageri* (Cushman and Parker, 1946, p. 88). It is also similar to *B. capitata* but differs in possessing a decreasing chamber size in its later stages of growth.

Bulimina guayabalensis Cole var. *ampla* [?]
Cushman & Parker

Hypotype no. 00383, loc. PSUA0125.

Two poorly preserved specimens resemble *B. guayabalensis* var. *ampla* (Cushman & Parker, 1946, p. 96, pl. 22, fig. 13) in outline but the sutural patterns and apertural characteristics are indistinct.

Bulimina instabilis [?] Cushman & Parker

Hypotype no. 00384, loc. PSUA0112.

A single fragmented specimen with chambers arranged in a regular series and low costae is questionably referred to this species.

Bulimina jarvisi Cushman & Parker

Bulimina jarvisi Cushman & Parker, Cushman & Parker, 1946, p. 100, pl. 23, fig. 10, pl. 24, fig. 1; DeLise, 1967, p. 34, pl. 3, fig. 8a, b.

Hypotype no. 00385, loc. PSUA0134.

This species closely resembles *B. corrugata* (Cushman and Parker, 1946, pl. 22, fig. 2a, b) and *B. microcostata* Cushman & Parker (Cushman & Parker, 1946, pl. 22, fig. 9a-c) but has a much narrower, tapering test and fine irregular costae.

Bulimina lirata Cushman & Parker

Bulimina lirata Cushman & Parker, Cushman & Simonson, 1944, p. 198, pl. 32, fig. 13; Cushman & Parker, 1946, p. 95, pl. 22, fig. 10a-c; Smith, 1957, p. 174, pl. 24, fig. 13a-c; Mallory, 1959, p. 193, pl. 37, fig. 1a-c; Weaver & Weaver, 1962, p. 32, pl. 9, fig. 8, 9; Rau, 1964, p. 618, pl. 5, fig. 17a, b; Fairchild, Wesendunk, & Weaver, 1969, p. 54, pl. 11, fig. 9.

[?] *Bulimina lirata* Cushman & Parker, Gaston, 1974, p. 77, [hypotype examined].

Hypotype no. 00386, loc. PSUA0133.

Bulimina microcostata Cushman & Parker

Bulimina microcostata Cushman & Parker, Cushman & Parker, 1946, p. 95, pl. 22, fig. 9a-c; Mallory, 1959, p. 194, pl. 16, fig. 9; Hornaday, 1961, p. 188, pl. 6, fig. 2a-c; Sullivan, 1962, p. 274, pl. 14, fig. 6a, b; Weaver, 1962, p. 379, pl. 4, fig. 2a-c, 4a-c; Kleinpell & Weaver, 1963, p. 175, pl. 9, fig. 13; Weaver & Molander, 1964, p. 189, pl. 8, fig. 18; DeLise, 1967, p. 34, pl. 3, fig. 7; Fairchild, Wesendunk, & Weaver, 1969, p. 54, pl. 11, fig. 10a, b; Smith, 1971, p. 53, pl. 6, fig. 8a, b; Tipton, Kleinpell, & Weaver, 1973, p. 53, pl. 5, fig. 9a, b; Gaston, 1974, p. 78, [hypotype examined].

Hypotype no. 00387, loc. PSUA0119.

Bulimina ovata d'Orbigny

[?] *Bulimina ovata* d'Orbigny, Bagg, 1905, p. 22, pl. 3, fig. 1; Kleinpell, 1938, p. 255, pl. 12, fig. 14a, b.

Bulimina ovata d'Orbigny, Bagg, 1912, p. 38, pl. 9, fig. 6a, b; Cushman, 1935, p. 35, pl. 13, fig. 15a, b, 16a, b; Cushman & Parker, 1937, p. 47, pl. 6, fig. 4a-c, 5a-c; Cushman & Parker, 1946, p. 106, pl. 25, fig. 8a-c, 9a-c; Cushman, Stewart, & Stewart, 1947a, p. 18, pl. 2, fig. 8; Cushman, Stewart, & Stewart, 1947b, p. 46, pl. 5, fig. 9; Cushman & Stainforth, 1951, p. 151, pl. 26, fig. 44; Puri, 1953, p. 115, pl. 16, fig. 11; Mallory, 1959, p. 195, pl. 16, fig. 4; Sullivan, 1962, p. 274, pl. 14, fig. 7a, b; Weaver, 1962, p. 380, pl. 4, fig. 1a-c; Kleinpell & Weaver, 1963, p. 175, pl. 9, fig. 8; Weaver & Molander, 1964, p. 189, pl. 8, fig. 19; Tipton, Kleinpell, & Weaver, 1973, p. 53, pl. 5, fig. 10a, b; Gaston, 1974, p. 78, [hypotype examined]; Thoms, 1975, pl. 2, fig. 25.

[Non] *Bulimina ovata* d'Orbigny, Bergquist, 1942, p. 67, pl. 7, fig. 23.

Bulimina pupoides d'Orbigny, Asano, 1958, pl. 10, fig. 15a, b, [not fig. 16].

Praeglobobulimina ovata (d'Orbigny), Fairchild, Wesendunk, & Weaver, 1969, p. 55, pl. 11, fig. 16; Murray & Wright, 1974, pl. 6, fig. 16, 17.

Hypotype no. 00388, loc. PSUA0125.

This widely recorded species is closely related to *B. pupoides* d'Orbigny (Cushman & Parker, 1946, pl. 25, fig. 3-7) and in some cases it is almost impossible to separate the two. In the "Strata of Cascade Head", specimens of *B. ovata* are usually small, consist of few chambers, and possess oval shaped tests whereas *B. pupoides* is larger and has a slightly tapering test made up of numerous chambers. However, these are highly variable species and all of these characteristics may vary from specimen to specimen.

Bulimina ovata [?] d'Orbigny

Hypotype no. 00389, loc. PSUA0110.

Crushed individuals that resemble *B. ovata* are included here.

Bulimina pachecoensis Smith

Bulimina pachecoensis Smith, 1957, p. 175, pl. 24, fig. 14a-c; Thoms, 1975, pl. 2, fig. 20a, b.

Hypotype no. 00390, loc. PSUA0133.

These individuals have small tapering tests, inflated chambers in the last whorl, and costae extending onto the base of the final chambers.

Bulimina pachecoensis [?] Smith

Hypotype no. 00391, loc. PSUA0132.

Several poorly preserved specimens are questionably referred to this species.

Bulimina pupoides d'Orbigny

[?] *Bulimina pupoides* d'Orbigny, Bagg, 1905, p. 22, pl. 3, fig. 2.

Bulimina pupoides d'Orbigny, Cushman & Parker, 1937, p. 47, pl. 6, fig. 2a-c, 3a-c; Cushman & Parker, 1946, p. 105, pl. 25, fig. 3-7; Bandy, 1944, p. 377, pl. 62, fig. 9a, b; Asano, 1952, p. 41, pl. 5, fig. 6a, b, 8, 9; Todd, 1957a, pl. 66, fig. 5, [not fig. 6]; Asano, 1958, pl. 10, fig. 16, [not fig. 15a, b]; Mallory, 1959, p. 195, pl. 28, fig. 16a-c, [not pl. 36, fig. 17a-c].

[Non] (?) *Bulimina pupoides* d'Orbigny, Smith, 1957, p. 175, pl. 25, fig. 1a-c.

[Non] *Bulimina pupoides* Nuttall, Thoms, 1975, pl. 2, fig. 18a, b.

Hypotype no. 00392, loc. PSUA0125.

See discussion under *B. ovata*.

Bulimina cf. *B. reussi* Morrow [of Weaver]

Bulimina cf. *B. reussi* Morrow, Weaver, 1962, p. 380, pl. 3, fig. 6a-c; Weaver & Molander, 1964, p. 190, pl. 9, fig. 2a, b.

Hypotype no. 00393, loc. PSUA0134.

Specimens from the "Strata of Cascade Head" possess a greater number of chambers than *B. reussi* and appear identical to the forms figured by Weaver and Weaver and Molander.

Bulimina schencki Beck

Bulimina schencki Beck, 1943, p. 605, pl. 107, fig. 28, 33; Cushman & Parker, 1946, p. 98, pl. 30, fig. 16; Cushman, Stewart, & Stewart, 1947c, p. 61, pl. 8, fig. 4, 5; Cushman, Stewart, & Stewart, 1947e, p. 101, pl. 12, fig. 10-12; Mallory, 1959, p. 196, pl. 16, fig. 15; Rau, 1964, p. G18, pl. 5, fig. 10; Weaver & Molander, 1964, p. 190, pl. 8, fig. 15; Gaston, 1974, p. 78, [hypotype examined].

Hypotype no. 00394, loc. PSUA0121.

This form resembles *B. elongata* d'Orbigny but has more inflated chambers, a shorter tapering test, and a larger, rounded aperture (see discussion under *B. elongata*). *Bulimina schencki* also appears to be closely related to *B. capitata* Yokoyama. Examination of the primary types of these forms may show the two to be synonymous.

Bulimina sculptilis Cushman

Bulimina sculptilis Cushman, 1923, p. 23, pl. 3, fig. 3; Cushman & Schenck, 1928, p. 311, pl. 43, fig. 16; Franklin, 1944, p. 314, pl. 45, fig. 15; Cushman & Parker, 1946, p. 103, pl. 24, fig. 12a-c; Wilson, 1954, p. 139, pl. 15, fig. 12a, b; Smith, 1956, p. 95, pl. 12, fig. 9, pl. 13, fig. 4a, b; Hornaday, 1961, p. 189, pl. 5, fig. 4a, b; Sullivan, 1962, p. 274, pl. 14, fig. 8a, b; Kleinpell & Weaver, 1963, p. 175, pl. 9, fig. 9, 10, 14; Weaver & Molander, 1964, p. 190, pl. 9, fig. 3a, b, 4a, b; DeLise, 1967, p. 35, pl. 3, fig. 9; Tipton, Kleinpell, & Weaver, 1973, p. 53, pl. 5, fig. 11a, b; Gaston, 1974, p. 79, [hypotype examined]; Phillips, Tipton, & Watkins, 1974, pl. 2, fig. 4a, b, 5.

[?] *Bulimina sculptilis* Cushman, Ujiie & Watanabe, 1960, p. 130, pl. 2, fig. 15.

Hypotype no. 00395, loc. PSUA0104.

Bulimina spp.

Specimens included here are insufficiently preserved to warrant specific designation. More than one species may be represented.

Bulimina [?] sp.

Several fragmented and crushed specimens seem best referred to this genus.

Genus *Globobulimina* Cushman, 1927*Globobulimina pacifica* Cushman

Globobulimina pacifica Cushman, Kleinpell, 1938, p. 260, pl. 8, fig. 7; Beck, 1943, p. 606, pl. 107, fig. 16; Franklin, 1944, p. 314, pl. 46, fig. 19; Cushman & Parker, 1946, p. 134, pl. 29, fig. 37; Wilson, 1954, p. 139, pl. 15, fig. 14a, b; Asano, 1958, pl. 10, fig. 18; Mallory, 1959, p. 198, pl. 16, fig. 17; Weaver, 1962, p. 381, pl. 3, fig. 7a, b; Weaver & Weaver, 1962, p. 32, pl. 9, fig. 15; Kleinpell & Weaver, 1963, p. 176, pl. 9, fig. 11; Weaver & Molander, 1964, p. 190, pl. 9, fig. 5; Fairchild, Wesendunk, & Weaver, 1969, p. 55, pl. 11, fig. 16a, b; Smith, 1971, p. 54, pl. 7, fig. 1; Gaston, 1974, p. 79, [hypotype examined].

Globobulimina cf. *G. pacifica* Cushman, Rau, 1948, p. 171, pl. 30, fig. 5; Weaver & Weaver, 1962, p. 32, pl. 9, fig. 16; Smith, 1971, p. 54, pl. 7, fig. 2.

Hypotype no. 00396, loc. PSUA0107.

Included within this highly variable species are individuals in which the final chambers fail to overlap and enclose the earlier chambers. These variants are difficult to differentiate from *Bulimina decurtata* and *Bulimina guayabalensis* var. *ampla*, as previously mentioned (see discussion under *B. decurtata*). Also, *G. pacifica* is easily crushed and care must be taken not to mistake distorted specimens for *G. pacifica* var. *oregonensis* Cushman, Stewart, and Stewart (Hornaday, 1961, p. 190, pl. 7, fig. 4a-c, 5a, b, 6a, b, 7a-c) which is much broader and has contracted apertural and basal ends.

Globobulimina pacifica Cushman var. *compressa*
Hornaday

Globobulimina pacifica Cushman var. *compressa* Hornaday, 1961, p. 189, pl. 7, fig. 1a, b, 2a, b, 3a, b.

Hypotype no. 00397, loc. PSUA0111.

Since *G. pacifica* Cushman is highly variable, individuals referred to *G. pacifica* var. *compressa* may fall within the range of variation of *G. pacifica* as suggested by Hornaday (1961, p. 189). Examination of an ontogenetic series may show the two to be synonymous.

Globobulimina [?] sp.

Hypotype no. 00398, loc. PSUA0120.

Flattened specimens are questionably referred to this genus.

Genus *Virgulina* d'Orbigny, 1826*Virgulina bramlettei* Galloway & Morrey

Virgulina bramlettei Galloway & Morrey, Cushman & Laiming, 1931, p. 109, pl. 12, fig. 4a, b; Cushman, 1932a, p. 20, pl. 3, fig. 9a, b; Sullivan, 1962, p. 275, pl. 15, fig. 3, 4a, b; Kleinpell & Weaver, 1963, p. 176, pl. 9, fig. 5a-c; Gaston, 1974, p. 79, [hypotype examined].

Fursenkoina bramletti (Galloway & Morrey), Fairchild, Wesendunk, & Weaver, 1969, p. 68, pl. 21, fig. 4, pl. 22, fig. 11.

Fursenkoina bramlettei (Galloway & Morrey), Smith, 1971, p. 63, pl. 7, fig. 3a, b.

Hypotype no. 00399, loc. PSUA0115.

This species differs from *V. zetina* Cole (Cushman, 1932a, p. 22, pl. 3, fig. 15) in that the last few chambers make up the greater portion of the test.

Virgulina zetina Cole

Virgulina zetina Cole, Cushman, 1932a, p. 22, pl. 3, fig. 15; Cushman & McMasters, 1936, p. 513, pl. 75, fig. 26; Howe, 1939, p. 65, pl. 9, fig. 2; Weaver & Weaver, 1962, p. 33, pl. 10, fig. 1; Todd, 1966, pl. 5, fig. 5; Tipton, Kleinpell, & Weaver, 1973, p. 54, pl. 5, fig. 13.

Hypotype no. 00400, loc. PSUA0119.

See discussion under *V. bramlettei*.

Virgulina sp.

Hypotype no. 00401, loc. PSUA0133.

Several poorly preserved specimens resembling this genus are included here.

Genus *Bolivina* d'Orbigny, 1839*Bolivina basisenta* Cushman & Stone

Bolivina basisenta Cushman & Stone, Cushman, Stewart, & Stewart, 1947c, p. 61, pl. 8, fig. 7a, b; Cushman, Stewart, & Stewart, 1947e, p. 102, pl. 13, fig. 6a, b; Cushman, Stewart, & Stewart, 1949, p. 133, pl. 15, fig. 8a, b; Cushman & Stainforth, 1951, p. 155, pl. 26, fig. 53, Weaver & Weaver, 1962, p. 33, pl. 10, fig. 2a, b; Gaston, 1974, p. 80, [hypotype examined].

Hypotype no. 00402, loc. PSUA0121.

Specimens from the Neskowin Creek Section are characterized by a short test and spinose projections at the periphery of each chamber.

Bolivina basisenta Cushman & Stone var. *oregonensis*
Cushman, Stewart, & Stewart

Bolivina basisenta Cushman & Stone var. *oregonensis* Cushman, Stewart, & Stewart, 1949, p. 133, pl. 15, fig. 7a, b.

[?] *Bolivina basisenta* Cushman & Stone var. *oregonensis*
Cushman, Stewart, & Stewart, Weaver & Weaver, 1962, p. 33, pl. 10, fig. 3.

Hypotype no. 00403, loc. PSUA0121.

This variety differs from *B. basisenta* Cushman & Stone in the narrower, more tapering test and lack of spinose projections at the margins of each chamber.

Bolivina huneri Howe

Bolivina huneri Howe, 1939, p. 66, pl. 9, fig. 3, 4; Beck, 1943, p. 606, pl. 107, fig. 21; Mallory, 1959, p. 201, pl. 16, fig. 21; Weaver & Molander, 1964, p. 191, pl. 9, fig. 8.

Hypotype no. 00404, loc. PSUA0101.

This species, restricted to one locality in the basal Neskowin Creek Section, is characterized by fine longitudinal costae and a small narrow test.

Bolivina jacksonensis Cushman & Applin

Bolivina jacksonensis Cushman & Applin, 1926, p. 167, pl. 7, fig. 3, 4; Cushman, 1935, p. 37, pl. 14, fig. 11-13; Bergquist, 1942, p. 71, pl. 7, fig. 21, 27; Cushman & Simonson, 1944, p. 198, pl. 32, fig. 15; Cushman & Stainforth, 1951, p. 155, pl. 26, fig. 55, 56; Wilson, 1954, p. 140, pl. 15, fig. 15a, b; Hornaday, 1961, p. 190, pl. 6, fig. 8a, b; Weaver & Molander, 1964, p. 191, pl. 9, fig. 9; Gaston, 1974, p. 80, [hypotype examined].

[?] *Bolivina jacksonensis* Cushman & Applin, Todd, 1957a, pl. 66, fig. 17.

Hypotype no. 00405, loc. PSUA0125.

Bolivina kleinPELLI Beck

Bolivina kleinPELLI Beck, 1943, p. 606, pl. 107, fig. 39; Mallory, 1959, p. 201, pl. 16, fig. 20; Sullivan, 1962, p. 276, pl. 15, fig. 6a, b; Weaver & Molander, 1964, p. 191, pl. 9, fig. 10; Gaston, 1974, p. 81, [hypotype examined].

Brizalina kleinPELLI Beck, Fairchild, Wesendunk, & Weaver, 1969, p. 52, pl. 9, fig. 7a, b.

Hypotype no. 00406, loc. PSUA0137.

This distinctive species is easily recognized by its small size and sinuous sutures.

Bolivina scabrata [?] Cushman & Bermudez

Hypotype no. 00407, loc. PSUA0116.

A single pyritized specimen from the Neskowin Creek Section is questionably referred to this species.

Bolivina sp.

Numerous crushed and fragmentary specimens are identifiable at only the generic level. More than one species is probably represented.

Genus *Loxostomum* Ehrenberg, 1854*Loxostomum applinae* (Plummer)

Loxostoma applinae (Plummer), Kline, 1943, p. 50, pl. 5, fig. 7.

Loxostomum applinae (Plummer), Mallory, 1959, p. 202, pl. 17, fig. 1a, b; Weaver & Weaver, 1962, p. 33, pl. 10, fig. 8; Thoms, 1975, pl. 2, fig. 24.

Hypotype no. 00408, loc. PSUA0137.

This species closely resembles *Bifarina nuttalli* Cushman and Siegfus (Mallory, 1959, pl. 29, fig. 2a, b) but differs in possessing fewer uniserial chambers (Mallory, 1959, p. 204). Individuals from the Salmon River Section are completely biserial and appear identical with the specimen figured by Mallory.

Genus *Bifarina* Parker & Jones, 1872*Bifarina eleganta* (Plummer)

Bifarina eleganta (Plummer), Cole, 1938, pl. 2, fig. 3; Mallory, 1959, p. 204, pl. 17, fig. 2; Sullivan, 1962, p. 276, pl. 15, fig. 11a, b; Weaver, 1962, p. 381, pl. 4, fig. 8a, b; Weaver & Weaver, 1962, p. 34, pl. 10, fig. 9a, b; Gaston, 1974, p. 81, [hypotype examined].

Siphogenerinoides eleganta (Plummer), Kline, 1943, p. 46, pl. 4, fig. 18.

Hypotype no. 00409, loc. PSUA0137.

Genus *Chiloguembelina* Loebich & Tappan, 1956*Chiloguembelina cubensis* (Palmer)

Gumbelina cubensis Palmer, Bergquist, 1942, p. 62, pl. 6, fig. 26, 27; Mallory, 1959, p. 205, pl. 17, fig. 3.

Chiloguembelina cubensis (Palmer), Todd, 1966, p. 133,
pl. 8, fig. 1a, b, 4; Todd, 1970, p. A17, pl. 7, fig. 5.

Hypotype no. 00410, loc. PSUA0106.

See discussion under *Karrerella chapapotensis* (Cole) var.
monumentensis Mallory.

Genus *Uvigerina* d'Orbigny, 1826

Uvigerina churchi Cushman & Siegfus

Uvigerina churchi Cushman & Siegfus, 1939, p. 29, pl. 6,
fig. 16a, b; Mallory, 1959, p. 206, pl. 17, fig. 6;
Hornaday, 1961, p. 191, pl. 8, fig. 1-4; Weaver, 1962,
p. 381, pl. 5, fig. 2a, b; Weaver & Weaver, 1962, p. 34,
pl. 10, fig. 10; Rau, 1964, p. G20, pl. 6, fig. 9; DeLise,
1967, p. 36, pl. 3, fig. 11; Gaston, 1974, p. 82, [hypotype
examined].

Hypotype no. 00411, loc. PSUA0110.

Uvigerina churchi Cushman & Siegfus
var. *demicostata* Mallory

Uvigerina churchi Cushman & Siegfus var. *demicostata* Mallory,
1959, p. 207, pl. 17, fig. 10a, b; Weaver & Molander,
1964, p. 191, pl. 9, fig. 11; Gaston, 1974, p. 82,
[hypotype examined].

Hypotype no. 00412, loc. PSUA0111.

Uvigerina garzaensis Cushman & Siegfus

Uvigerina garzaensis Cushman & Siegfus, 1939, p. 28, pl. 6,
fig. 15a, b; Cushman & Simonson, 1944, p. 199, pl. 32,
fig. 20, 21; Detling, 1946, p. 357, pl. 50, fig. 8a, b;
Cushman, Stewart, & Stewart, 1949, p. 133, pl. 15, fig. 9;
Wilson, 1954, p. 141, pl. 16, fig. 4a, b; Smith, 1956,
p. 97, pl. 13, fig. 2a, b; Smith, 1957, p. 177, pl. 26,
fig. 9a, b; Mallory, 1959, p. 208, pl. 37, fig. 2a, b;
Hornaday, 1961, p. 191, pl. 8, fig. 5a, b; Sullivan, 1962,
p. 277, pl. 16, fig. 2, 3a, b; Weaver, 1962, p. 382, pl. 5,
fig. 5a, b; Weaver & Weaver, 1962, p. 34, pl. 10, fig. 11;
Weaver & Kleinpell, 1963, p. 177, pl. 10, fig. 7; Rau,
1964, p. G20, pl. 6, fig. 6a, b; Weaver & Molander, 1964,
p. 191, pl. 10, fig. 1; DeLise, 1967, p. 36, pl. 3, fig. 14;
Fairchild, Wesendunk, & Weaver, 1969, p. 56, pl. 12,
fig. 9a, b; Smith, 1971, p. 55, pl. 7, fig. 10; Tipton,
Kleinpell, & Weaver, 1973, p. 56, pl. 6, fig. 13a, b;
Gaston, 1974, p. 83, [hypotype examined].

Hypotype no. 00413, loc. PSUA0106.

Uvigerina garzaensis Cushman & Siegfus
var. *nudorobusta* Mallory

Uvigerina garzaensis Cushman & Siegfus var. *nudo-robusta*
Mallory, 1959, p. 208, pl. 17, fig. 11a, b, 13a, b;
Sullivan, 1962, p. 277, pl. 16, fig. 4a, b; Weaver &
Molander, 1964, p. 191, pl. 10, fig. 2; DeLise, 1967, p. 36,
pl. 3, fig. 15; Fairchild, Wesendunk, & Weaver, 1969, p. 56,
pl. 12, fig. 4a, b, 5a, b, 8a, b.

Uvigerina garzaensis Cushman & Siegfus subsp. *nudorobusta*
Mallory, Smith, 1971, p. 55, pl. 8, fig. 1.

Hypotype no. 00414, loc. PSUA0108.

Uvigerina sp. A. [*species nova*]

(Pl. 1, fig. 12, 13)

Test large, elongate, about twice as long as broad, rounded in section, fusiform, greatest width toward apertural end, initial end subacute to rounded, apertural end tapering to a slender neck; chambers distinct, numerous, inflated, increasing rapidly in size as added, overlapping in early portions, less so in later portions; sutures fairly distinct, depressed in later portions; wall ornamented with fine, longitudinal costae, continuous over adjacent chambers, frequently not extending onto the terminal chamber; aperture terminal, at end of short, stout neck.

Dimensions of hypotype:

00415; length .58 mm.; breadth .17 mm.

Hypotype no. 00415, loc. PSUA0134.

Individuals identical to these forms occur commonly in Narizian age deposits on the West Coast according to Rau (personal communication, 1976). This form differs recognizably from other previously recorded species in possessing an elongate test made up of inflated chambers ornamented by fine, longitudinal costae. It seems most closely related to *U. churchi* Cushman and Siegfus var. *demicostata* Mallory and *U. kernensis* Barbat and von Estorff (Smith, 1971, p. 56, pl. 8,

fig. 5) and may represent an intermediate form between the two. The naming of this species must await publication in accordance with the International Code of Zoological Nomenclature (1961, p. 9, art. 11a).

Uvigerina sp. A. [?] [*species nova*]

Hypotype no. 00416, loc. PSUA0121.

Numerous individuals with fine longitudinal costae resemble this species but are badly crushed and cannot be positively identified.

Uvigerina sp.

Hypotype no. 00417, loc. PSUA0129.

A single unidentifiable internal mold from the Neskowin Creek Section probably represents *Uvigerina garzaensis* var. *nudorobusta* Mallory (1959, pl. 17, fig. 11a, b).

Genus *Angulogerina* Cushman, 1927

Angulogerina cf. *A. occidentalis* Cushman

Hypotype no. 00418, loc. PSUA0125.

A single specimen from the Neskowin Creek Section resembles Sullivan's figure of this species (1962, pl. 15, fig. 15a, b) but has more closely arranged chambers and is not as elongate as *A. occidentalis*.

Genus *Trifarina* Cushman, 1923

Trifarina advena Cushman var. *californica* Mallory

Trifarina advena Cushman var. *californica* Mallory, 1959, p. 210, pl. 17, fig. 14a-d, pl. 29, fig. 6a-c, pl. 40, fig. 11a, b; Weaver & Weaver, 1962, p. 34, pl. 10, fig. 13; Thoms, 1975, pl. 2, fig. 23a, b.

Hypotype no. 00419, loc. PSUA0105.

Family ELLIPSOIDINIDAE

Genus *Pleurostomella* Reuss, 1860*Pleurostomella acuta* Hantken

Pleurostomella acuta Hantken, Smith, 1957, p. 179, pl. 26, fig. 12a-c; Mallory, 1959, p. 218, pl. 29, fig. 9a, b, pl. 37, fig. 7a-c.

Hypotype no. 00420, loc. PSUA0111.

Pleurostomella cf. *P. acuta* Hantken

Hypotype no. 00421, loc. PSUA0109.

A single individual from the Neskowin Creek Section is shorter, has more robust chambers, and is less tapering than *P. acuta*.

Pleurostomella gredalensis Cook

Pleurostomella gredalensis Cook, Mallory, 1959, p. 218, pl. 18, fig. 15, pl. 35, fig. 3a, b.

Hypotype no. 00422, loc. PSUA0109.

Pleurostomella cf. *P. gredalensis* Cook

Hypotype no. 00423, loc. PSUA0110.

A single specimen from the Neskowin Creek Section compares favorably with *P. gredalensis* except that the test is smaller and the final chamber is flattened.

Pleurostomella paleocenica Cushman

Pleurostomella cf. *brevis* var. *alternans* Schwager, Kline, 1943, p. 50, pl. 6, fig. 23.

Pleurostomella paleocenica Cushman, 1947, p. 86, pl. 18, fig. 14, 15; Mallory, 1959, p. 219, pl. 18, fig. 17, Weaver & Weaver, 1962, p. 35, pl. 11, fig. 2a, b.

Pleurostomella (?) *paleocenica* Cushman, Fairchild, Wesendunk, & Weaver, 1969, p. 67, pl. 21, fig. 12a, b.

Hypotype no. 00424, loc. PSUA0110.

Pleurostomella sp.

Hypotype no. 00425, loc. PSUA0111.

Obscure apertural characteristics prevent a few fragmented specimens from being assigned at a specific level.

Genus *Ellipsonodosaria* A. Silvestri, 1900

Ellipsonodosaria cf. *E. alexanderi* Cushman
[of Sullivan]

Ellipsonodosaria cf. *E. alexanderi* Cushman, Sullivan, 1962,
p. 278, pl. 21, fig. 1.

Hypotype no. 00426, loc. PSUA0126.

Specimens from the Neskowin Creek Section are identical to the individual figured by Sullivan. This species is easily confused with *Dentalina spinosa* d'Orbigny, *Nodosaria deliciae* Martin, and *Nodosaria* cf. *N. deliciae* Martin of this study when specimens are weathered and the spines are worn down or missing. *Ellipsonodosaria* cf. *E. alexanderi* however, has very small, short spines and weathered specimens display smaller areas of spinal attachment as compared to the other species.

Ellipsonodosaria plummerae Cushman

Ellipsonodosaria plummerae Cushman, Cooper, 1944, p. 352,
pl. 54, fig. 18, 19; Kline, 1943, p. 51, pl. 5, fig. 8;
Mallory, 1959, p. 223, pl. 19, fig. 3; Weaver & Weaver,
1962, p. 35, pl. 11, fig. 5; Thoms, 1975, pl. 2, fig. 26.

Ellipsonodosaria sagrinensis (Bagg), Cooper, 1944, p. 352,
pl. 54, fig. 22.

Nodogenerina aff. *N. sagrinensis* (Bagg), Smith, 1957, p. 172,
pl. 24, fig. 2, 3.

Hypotype no. 00427, loc. PSUA0117.

Individuals referred to this species exhibit a large amount

of variation in the number of spines ornamenting the chambers. All specimens however, show an increase in the number of spines as chambers are added.

Ellipsonodosaria sp. A. Cushman & Siegfus

Ellipsonodosaria sp. A. Cushman & Siegfus, Sullivan, 1962, p. 279, pl. 21, fig. 8, 9; Weaver & Weaver, 1962, p. 35, pl. 11, fig. 8, 10, [? fig. 9]; Weaver & Molander, 1964, p. 192, pl. 10, fig. 6.

[?] *Nodosaria clavaeformis* Neugeboren, Fairchild, Wesendunk, & Weaver, 1969, p. 35, pl. 4, fig. 16; Gaston, 1974, p. 67, [hypotype examined].

Nodosarella sp. A. (Cushman & Siegfus), Fairchild, Wesendunk, & Weaver, 1969, p. 68, pl. 21, fig. 11.

Hypotype no. 00428, loc. PSUA0119.

Individuals with a rounded proloculus followed by an elongate second chamber seem best referred to this species.

Genus *Ellipsoidina* Seguenza, 1859

Ellipsoidina [?] sp.

Hypotype no. 00429, loc. PSUA0109.

A single specimen with an ovate test and semilunate aperture is included under this designation. This individual however, may represent the genus *Ellipsobulimina* since both genera are identical externally and can only be separated by their internal characteristics.

Family ROTALIIDAE

Genus *Discorbis* Lamarck, 1804

Discorbis baintoni Mallory

Discorbis baintoni Mallory, 1959, p. 228, pl. 19, fig. 16a-c; Gaston, 1974, p. 84, [hypotype examined]; Thoms, 1975, pl. 2, fig. 29a-c.

Hypotype no. 00430, loc. PSUA0127.

Discorbis sp.

Hypotype no. 00431, loc. PSUA0107.

A single specimen from the Neskowin Creek Section is quite similar to *D. devilensis* Cook (Mallory, 1959, pl. 33, fig. 12a-c) but possesses a poorly preserved umbilical area making positive identification impossible.

Genus *Valvulineria* Cushman, 1926*Valvulineria scrobiculata* (Schwager)

Planulina scrobiculata (Schwager), Galloway & Morrey, 1931, p. 346, pl. 39, fig. 8a-c.

Valvulineria cf. *V. scrobiculata* (Schwager), Beck, 1943, p. 608, pl. 108, fig. 21-23.

[?] *Valvulineria scrobiculata* (Schwager), Todd, 1957a, pl. 68, fig. 3a-c.

Valvulineria scrobiculata (Schwager), Mallory, 1959, p. 232, pl. 20, fig. 6a, b; Kleinpell & Weaver, 1963, p. 178, pl. 11, fig. 1a-c; Weaver & Molander, 1964, p. 193, pl. 10, fig. 10a-c; Gaston, 1974, p. 84, [hypotype examined].

Hypotype no. 00432, loc. PSUA0105.

Valvulineria tumeyensis Cushman & Simonson

Eponides cf. *pygmaea* Hantken, Church, 1931, pl. A, fig. 1-3.

Valvulineria tumeyensis Cushman & Simonson, 1944, p. 201, pl. 33, fig. 13, 14; Hornaday, 1961, p. 191, pl. 9, fig. 1-4; Sullivan, 1962, p. 280, pl. 17, fig. 3-6; Weaver, 1962, p. 383, pl. 5, fig. 8a-c; Weaver & Weaver, 1962, p. 36, pl. 12, fig. 1a-c; Kleinpell & Weaver, 1963, p. 178, pl. 11, fig. 2a-c; Weaver & Molander, 1964, p. 193, pl. 11, fig. 1-3; Tipton, Kleinpell, & Weaver, 1973, p. 59, pl. 9, fig. 3a-c; Gaston, 1974, p. 85 [hypotype examined]; Phillips, Tipton, & Watkins, 1974, pl. 2, fig. 7, 8.

[?] *Valvulineria tumeyensis* Cushman & Simonson, Detling, 1946, p. 358, pl. 11, fig. 11a-c.

Valvulineria chirana Cushman & Stone, Cushman, Stewart, & Stewart, 1949, p. 134, pl. 16, fig. 2a-c.

Hypotype no. 00433, loc. PSUA0121.

This widely recorded species has been synonymized with *V. chirana* Cushman and Stone by many authors (Hornaday, 1961, p. 191; Kleinpell and Weaver, 1963, p. 178; Weaver and Molander, 1964, p. 178) in West Coast literature. Although the primary types were not observed, all published figures of *V. chirana* and *V. tumeyensis* examined during this investigation suggest the two forms are conspecific.

Valvulineria [?] sp.

Hypotype no. 00434, loc. PSUA0121.

Numerous flattened, poorly preserved specimens seem best to represent this genus.

Genus *Gyroidina* d'Orbigny, 1826

Gyroidina condoni (Cushman & Schenck)

Eponides condoni Cushman & Schenck, 1928, p. 313, pl. 44, fig. 6, 7a-c; Beck, 1943, p. 608, pl. 108, fig. 27, 29, 31; Detling, 1946, p. 358, pl. 50, fig. 12a-c.

Eponides condoni Cushman & Schenck ?, Kleinpell, 1938, p. 317, pl. 6, fig. 8, 15, 17.

Gyroidina condoni rotundiformis Cushman & Simonson, 1944, p. 201, pl. 33, fig. 17-19; DeLise, 1967, p. 38, pl. 4, fig. 2a-c.

Gyroidina cf. *planulata* Cushman & Renz, Cushman, Stewart, & Stewart, 1947e, p. 102, pl. 12, fig. 15a-c; Fairchild, Wesendunk, & Weaver, 1969, p. 73, pl. 23, fig. 7a-c.

Gyroidina condoni (Cushman & Schenck), Wilson, 1954, p. 142, pl. 16, fig. 10a-c; Smith, 1956, p. 97, pl. 14, fig. 6a-c, 7a-c; Hornaday, 1961, p. 192, pl. 9, fig. 5a-c; Sullivan, 1962, p. 280, pl. 18, fig. 2a-c; Weaver, 1962, p. 383, pl. 6, fig. 1a-c; Kleinpell & Weaver, 1963, p. 179, pl. 11, fig. 3a-c; Weaver & Molander, 1964, p. 193, pl. 11, fig. 4a-c; DeLise, 1967, p. 38, pl. 4, fig. 2a-c; Fairchild, Wesendunk, & Weaver, 1969, p. 73, pl. 23, fig. 11a-c; Tipton, Kleinpell, & Weaver, 1973, p. 60, pl. 9, fig. 1a-c;

Gaston, 1974, p. 85, [hypotype examined]; Phillips, Tipton, & Watkins, 1974, pl. 2, fig. 10a, b; Thoms, 1975, pl. 3, fig. 6a-c.

Hypotype no. 00435, loc. PSUA0123.

Gyroidina orbicularis d'Orbigny var. *planata* Cushman

Gyroidina orbicularis d'Orbigny var. *planata* Cushman, 1935, p. 45, pl. 18, fig. 3a-c; Cushman & Frizzell, 1943, p. 87, pl. 15, fig. 2-4; Cushman & Stainforth, 1951, p. 158, pl. 27, fig. 22, 23; Mallory, 1959, p. 235, pl. 29, fig. 16a-c; Weaver, 1962, p. 383, pl. 6, fig. 4a-c; Weaver & Weaver, 1962, p. 36, pl. 13, fig. 1a-c, 2a-c; Fairchild, Wesendunk, & Weaver, 1969, p. 73, pl. 23, fig. 9a-c; Tipton, Kleinpell, & Weaver, 1973, p. 60, pl. 9, fig. 2a-c.

Gyroidina orbicularis planata Cushman, Rau, 1948, p. 171, pl. 31, fig. 12-14; Rau, 1964, p. G21, pl. 6, fig. 10a-c; Gaston, 1974, p. 86, [hypotype examined]; Thoms, 1975, pl. 3, fig. 8a-c; Phillips, Welton, & Welton, 1976, pl. 2, fig. 18a-c.

[Non] *Gyroidina orbicularis* d'Orbigny var. *planata* Cushman, Sullivan, 1962, p. 280, pl. 18, fig. 1a-c.

[?] [lapsus calami] *Gyroidina orbicularis* d'Orbigny var. *planata* Cushman, DeLise, 1967, p. 38, pl. 4, fig. 4a-c.

Hypotype no. 00436, loc. PSUA0111.

Gyroidina soldanii d'Orbigny

[Non] *Rotalia soldanii* (d'Orbigny), Bagg, 1905, p. 51, pl. 10, fig. 5; Hanna, 1923, p. 325, pl. 59, fig. 3a-c.

[Non] *Gyroidina soldanii* d'Orbigny, Church, 1931, pl. C, fig. 1-3.

Gyroidina soldanii d'Orbigny, Cushman & Henbest, 1940, pl. 10, fig. 2a-c; Smith, 1956, p. 98, pl. 14, fig. 5a-c; Fairchild, Wesendunk, & Weaver, 1969, p. 73, pl. 24, fig. 1a-c, 4a-c; Smith, 1971, p. 66, pl. 9, fig. 1a-c; Hornaday, 1972, p. 45, pl. 2, fig. 1a-c, 2a-c.

Gyroidina orbicularis d'Orbigny var. *planata* Cushman, Sullivan, 1962, p. 280, pl. 18, fig. 1a-c.

Hypotype no. 00437, loc. PSUA0105.

The high variability of this species has led to much

confusion in the West Coast literature (Smith, 1971, p. 66). Specimens assigned to this species from the Neskowin Creek and Salmon River Sections are plano-convex, average ten to eleven chambers in the final whorl and have limbate sutures that are nearly radial on the ventral side and slightly curved on the dorsal side.

This species is easily distinguished from *G. soldanii* var. *octocamerata* Cushman and G. D. Hanna by its larger size, limbate sutures and greater number of chambers in the final whorl. It is much more difficult to differentiate from *G. orbicularis* var. *planata* Cushman since the two are closely related and often intergrade with one another. *Gyroidina soldanii* however, is usually subacute in peripheral view while *G. orbicularis* var. *planata* is more quadrate.

Gyroidina soldanii [?] d'Orbigny

Hypotype no. 00438, loc. PSUA0129.

Crushed individuals that resemble this species are included here.

Gyroidina soldanii d'Orbigny var. *octocamerata*
Cushman & G. D. Hanna

Gyroidina soldanii d'Orbigny var. *octocamerata* Cushman & G. D. Hanna, Cushman & M. A. Hanna, 1927, p. 56, pl. 5, fig. 7; Cushman & Schenck, 1928, p. 312, pl. 44, fig. 3-5; Cushman, 1935, p. 45, pl. 18, fig. 4a-c; Howe, 1939, p. 75, pl. 9, fig. 34-36; Cushman & Stainforth, 1951, p. 158, pl. 27, fig. 20, 21; Mallory, 1959, p. 236, pl. 30, fig. 1a-c, pl. 42, fig. 1a-c; Weaver, 1962, p. 384, pl. 6, fig. 6a-c.

Gyroidina soldanii octocamerata Cushman & G. D. Hanna, Galloway & Morrey, 1931, p. 343, pl. 39, fig. 1a-c; Smith, 1957, p. 181, pl. 27, fig. 5a-c; Gaston, 1974, p. 86, [hypotype examined]; Thoms, 1975, pl. 3, fig. 9a-c.

Hypotype no. 00439, loc. PSUA0117.

See discussion under *G. soldanii*.

Gyroidina cf. *G. soldanii* d'Orbigny var. *octocamerata*
Cushman & G. D. Hanna

Hypotype no. 00440, loc. PSUA0125.

A few small individuals possess chambers which increase very rapidly in size such that the final whorl extends further ventrally than that of *G. soldanii* var. *octocamerata sensu stricto*.

Gyroidina spp.

Numerous individuals are insufficiently preserved to warrant specific designation. More than one species is probably represented.

Genus *Eponides* Montfort, 1808

Eponides lotus (Schwager)

Globorotalia lotus (Schwager), Bandy, 1944, p. 370, pl. 61, fig. 1a-c.

Eponides lotus (Schwager), Ellis, Messina, Charmatz, & Ronai, 1969, fig. 1-31.

Hypotype no. 00441, loc. PSUA0112.

A few specimens included under this designation are more biconvex than most individuals from the "Strata of Cascade Head" but fall within the range of variation of this species.

Eponides mexicana (Cushman)

[?] *Rotalia soldanii* (d'Orbigny), Bagg, 1905, p. 51, pl. 10, fig. 5.

Rotalia soldanii (d'Orbigny), Hanna, 1923, p. 325, pl. 59, fig. 3a-c.

Pulvinulina mexicana Cushman, 1925, p. 300, pl. 7, fig. 7, 8.

Eponides mexicana (Cushman), Cushman & M. A. Hanna, 1927, p. 54, pl. 5, fig. 8, 9; Howe, 1939, p. 75, pl. 9, fig. 31-33, pl. 10, fig. 1-3; Smith, 1957, p. 182, pl. 27, fig. 10a-c; Mallory, 1959, p. 237, pl. 37, fig. 11a-c, pl. 41, fig. 9a-c; Weaver & Weaver, 1962, p. 37, pl. 13, fig. 4a-c; Gaston, 1974, p. 86, [hypotype examined]; Thoms, 1975, pl. 3, fig. 3a-c.

Eponides guayabalensis Cole var. *yeguaensis* Weinzierl & Applin, Cushman & Dusenbury, 1934, p. 62, pl. 9, fig. 1a-c.

Eponides yeguaensis Weinzierl & Applin, Cushman & McMasters, 1936, p. 514, pl. 76, fig. 1a-c; Beck, 1943, p. 608, pl. 108, fig. 1, 4.

Hypotype no. 00442, loc. PSUA0110.

Eponides mexicana [?] (Cushman)

Hypotype no. 00443, loc. PSUA0109.

Recrystallized and poorly preserved specimens are questionably referred to this species.

Eponides umbonata (Reuss)

Eponides umbonata (Reuss), Cushman, 1935, p. 48, pl. 19, fig. 10a-c; Cushman & Henbest, 1940, pl. 10, fig. 1a-c; Smith, 1957, p. 183, pl. 27, fig. 12a-c, 14a-c; Mallory, 1959, p. 239, pl. 30, fig. 3a-c, pl. 37, fig. 11a-c; Weaver & Weaver, 1962, p. 37, pl. 14, fig. 2a-c, 3a-c; Smith, 1971, p. 61, pl. 9, fig. 3a-c; Gaston, 1974, p. 87, [hypotype examined]; Thoms, 1975, pl. 3, fig. 5a-c.

Eponides umbonatus (Reuss), Kleinpell, 1938, p. 322, pl. 6, fig. 9, 12; Franklin, 1944, p. 316, pl. 47, fig. 5a-c; Cushman, Stewart, & Stewart, 1947a, p. 21, pl. 3, fig. 2a-c, 3a-c; Cushman & Stainforth, 1951, p. 159, pl. 27, fig. 28, 29; Todd, 1957a, pl. 68, fig. 9a, b; Smith, 1956, p. 98, pl. 15, fig. 2a-c; Sullivan, 1962, p. 281, pl. 18, fig. 7a-c, 8a-c; Kleinpell & Weaver, 1963, p. 179, pl. 12, fig. 3a-c; Phillips, Welton, & Welton, 1976, pl. 2, fig. 15a-c.

Eponides cf. *E. umbonata* (Reuss), Cushman & Simonson, 1944, p. 201, pl. 34, fig. 4, 5.

Hypotype no. 00444, loc. PSUA0116.

Eponides umbonata [?] (Reuss)

Hypotype no. 00445, loc. PSUA0135.

Specimens with poorly preserved sutures and slightly lobate chambers are included here.

Eponides waltonensis [?] Applin & Jordan

Hypotype no. 00446, loc. PSUA0100.

A single, recrystallized specimen from the basal Neskowin Creek Section resembles the specimen figured by Smith (1957, pl. 27, fig. 13a-c).

Eponides spp.

Individuals not referable to a specific level are included here. More than one species is probably represented.

Genus *Parrella* Finlay, 1939

Parrella tenuicarinata (Cushman & Siegfus)

Pulvinulinella tenuicarinata Cushman & Siegfus, 1935, p. 95, pl. 14, fig. 11a-c; Weaver & Weaver, 1962, p. 38, pl. 16, fig. 1a-c.

Parrella tenuicarinata (Cushman & Siegfus), Mallory, 1959, p. 240, pl. 21, fig. 5a-c.

Osangularia tenuicarinata (Cushman & Siegfus), Fairchild, Wesendunk, & Weaver, 1969, p. 74, pl. 24, fig. 5a-c.

[Non] *Parrella tenuicarinata* (Cushman & Siegfus), Gaston, 1974, p. 87, [hypotype examined].

Hypotype no. 00447, loc. PSUA0109.

When complete, this species is very distinctive and easily recognized by its extremely limbate, slightly curved dorsal sutures, sigmoid ventral sutures, and very wide keel. Normally however, the later chambers become detached, resulting in an individual composed of only the early chambers. These

smaller forms are easily confused with *Epistomina eocenica* Cushman and M. A. Hanna and many species of the genus *Eponides*. Nevertheless, upon close examination, these individuals can be separated by their distinctive dorsal and ventral sutures.

Genus *Epistomina* Terquem, 1883

Epistomina eocenica Cushman & M. A. Hanna

Epistomina eocenica Cushman & M. A. Hanna, 1927, p. 53, pl. 5, fig. 4, 5; Cushman & Schenck, 1928, p. 313, pl. 44, fig. 9a-c; Cushman & McMasters, 1936, p. 515, pl. 76, fig. 5a-c; Cushman & Frizzell, 1943, p. 87, pl. 15, fig. 9, 10; Rau, 1948, p. 172, pl. 31, fig. 1-3; Cushman & Stainforth, 1951, p. 159, pl. 27, fig. 32, 33; Gaston, 1974, p. 88, [hypotype examined].

[?] *Epistomina eocenica* Cushman & M. A. Hanna, Cushman & Simonson, 1944, p. 202, pl. 34, fig. 6; Sullivan, 1962, p. 282, pl. 20, fig. 2a-c; Fairchild, Wesendunk, & Weaver, 1969, p. 75, pl. 25, fig. 2a-c.

Hypotype no. 00448, loc. PSUA0121.

Although the specimens referred to this species vary greatly in size, they all compare well with the individual figured by Cushman and M. A. Hanna.

Genus *Cancris* Montfort, 1808

Cancris cocoaensis Cushman

Cancris cocoaensis Cushman, Weaver, 1962, p. 384, pl. 6, fig. 2a-c.

Ceratobulimina sp. Weaver & Weaver, 1962, p. 38, pl. 15, fig. 4a, b.

Hypotype no. 00449, loc. PSUA0137.

This species is characterized by a nearly biconvex test, five chambers in the final whorl, slightly curved dorsal sutures, and a broad apertural lip which projects over the

umbilical region. Specimens from the "Strata of Cascade Head" have been compared with Weaver's hypotypes and are conspecific.

Cancris joaquinensis Smith

Cancris joaquinensis Smith, 1956, p. 98, pl. 15, fig. 5a-c, 6a-c; Rau, 1964, p. G22, pl. 6, fig. 13a-c; Weaver & Molander, 1964, p. 194, pl. 12, fig. 5a-c; DeLise, 1967, p. 39, pl. 4, fig. 5a-c; Tipton, Kleinpell, & Weaver, 1973, p. 61, pl. 10, fig. 3a-c.

Valvulineria jacksonensis welcomensis Mallory, Gaston, 1974, p. 84, [hypotype examined].

Hypotype no. 00450, loc. PSUA0123.

Although the holotypes and paratypes of each were examined, this species is very difficult to separate from *Valvulineria jacksonensis* Cushman var. *welcomensis* Mallory (1959, pl. 20, fig. 3a-c, 5a-c). They are similar in outline, have approximately the same number of chambers in the final whorl, and both possess an apertural flap which extends into the umbilical region. However, *C. joaquinensis* differs in the nature of the spiral suture, displays more lobe shaped chambers, and has an elongate rather than rounded test.

Cancris [?] sp.

Hypotype no. 00451, loc. PSUA0105.

Specimens flattened during preservation are questionably referred to this genus. Several of these specimens may represent the genus *Valvulineria*.

Genus *Baggatella* Howe, 1939*Baggatella californica* Mallory

Baggatella californica Mallory, 1959, p. 186, pl. 15, fig. 15a, b; Weaver & Weaver, 1962, p. 37, pl. 15, fig. 2a-c.

Hypotype no. 00452, loc. PSUA0112.

Family AMPHISTEGINIDAE

Genus *Asterigerina* d'Orbigny, 1839*Asterigerina crassaformis* Cushman & Siegfus

Asterigerina crassaformis Cushman & Siegfus, 1935, p. 94, p. 14, fig. 10a-c; Cushman & Stainforth, 1951, p. 159, pl. 27, fig. 34, 35; Smith, 1957, p. 186, pl. 28, fig. 7a-c, 10a-c; Mallory, 1959, p. 242, pl. 37, fig. 13a-c; Sullivan, 1962, p. 282, pl. 20, fig. 3a-c; Weaver & Weaver, 1962, p. 37, pl. 15, fig. 3a-c; Rau, 1964, p. G22, pl. 6, fig. 14a-c; Fairchild, Wesendunk, & Weaver, 1969, p. 60, pl. 15, fig. 8a-c; Smith, 1971, p. 58, pl. 9, fig. 4a-c; Tipton, Kleinpell, & Weaver, 1973, p. 61, pl. 10, fig. 2a-c.

Hypotype no. 00453, loc. PSUA0125.

Genus *Amphistegina* d'Orbigny, 1826*Amphistegina simiensis* (Cushman & McMasters)

Asterigerina simiensis Cushman & McMasters, 1936, p. 515, pl. 77, fig. 1-4.

Amphistegina simiensis (Cushman & McMasters), Bandy, 1944, p. 375, pl. 62, fig. 4a-c; Fairchild, Wesendunk, & Weaver, 1969, p. 63, pl. 18, fig. 10a, b.

Hypotype no. 00454, loc. PSUA0100.

This species is similar to *Amphistegina californica* Cushman and M. A. Hanna (1927, pl. 6, fig. 3-5) but differs in its greater thickness and larger nodes which ornament the dorsal sutures. Recrystallized specimens from the basal Neskowin Creek Section are commonly weathered, exposing the secondary lobes.

Family CASSIDULINIDAE

Genus *Ceratobulimina* Toula, 1915*Ceratobulimina alazanensis* Cushman & Harris

Ceratobulimina alazanensis Cushman & Harris, 1927, p. 174, pl. 29, fig. 5a-c, pl. 30, fig. 3-5; Coryell & Embich, 1937, p. 302, pl. 43, fig. 8a, b; Franklin, 1944, p. 317, pl. 47, fig. 8a, b; Cushman, 1946b, p. 111, pl. 18, fig. 17, 18; Weaver & Molander, 1964, p. 194, pl. 13, fig. 1a, b; Smith, 1971, p. 70, pl. 10, fig. 3a-c; Gaston, 1974, p. 88, [hypotype examined].

[?] *Ceratobulimina alazanensis* Cushman & Harris, Bergquist, 1942, p. 91, pl. 9, fig. 17, 18.

Hypotype no. 00455, loc. PSUA0125.

This species somewhat resembles *C. washburnei* Cushman and Schenck (1928, pl. 45, fig. 1a-c) but is normally smaller in size and possesses different apertural characteristics; the aperture of *C. washburnei* is hidden by a thin arched plate whereas the aperture of *C. alazanensis* consists of an elongate slit in the center of the apertural face.

Genus *Alabamina* Toulmin, 1941*Alabamina scitula* Bandy

Alabamina scitula Bandy, Mallory, 1959, p. 226, pl. 19, fig. 13a-c.

Hypotype no. 00456, loc. PSUA0116.

This species differs from *Alabamina wilcoxensis* Toulmin var. *californica* Mallory in its smaller size, few chambers, and radial sutures on the ventral side of the test which are recurved near the umbilical area.

Alabamina wilcoxensis Toulmin var. *californica* Mallory

Alabamina wilcoxensis Toulmin var. *californica* Mallory, 1959, p. 227, pl. 19, fig. 11a-c, 12a-c; Gaston, 1974, p. 89, [hypotype examined].

[?] *Alabamina wilcoxensis* Toulmin var. *californica* Mallory, Thoms, 1975, pl. 3, fig. 12a-c.

Hypotype no. 00457, loc. PSUA0106.

Alabamina sp.

Hypotype no. 00458, loc. PSUA0130.

A single specimen from the Cascade Head Road Section resembles *A. wilcoxensis* var. *californica* but obscured sutures prevent positive identification.

Genus *Cassidulina* d'Orbigny, 1826

Cassidulina globosa Hantken

Cassidulina globosa Hantken, Church, 1931, pl. C, fig. 4, 5; Cushman, 1935, p. 49, pl. 20, fig. 12a, b; Bergquist, 1942, p. 92, pl. 9, fig. 13, 14; Beck, 1943, p. 609, pl. 108, fig. 7, 13, 14; Cushman & Simonson, 1944, p. 202, pl. 34, fig. 7; Detling, 1946, p. 358, pl. 51, fig. 3a, b; Cushman, Stewart, & Stewart, 1947d, p. 79, pl. 10, fig. 10a, b; Cushman, Stewart, & Stewart, 1947e, p. 103, pl. 12, fig. 14a, b; Cushman, Stewart, & Stewart, 1949, p. 135, pl. 16, fig. 3a, b; Asano, 1952, p. 42, pl. 4, fig. 3a-c; Wilson, 1954, p. 143, pl. 17, fig. 1a, b; Smith, 1956, p. 100, pl. 14, fig. 2a-c; Smith, 1957, p. 187, pl. 28, fig. 13a, b; Todd, 1957a, pl. 69, fig. 12a, b, pl. 73, fig. 15a, b; Asano, 1958, text-fig. 8a, b; Mallory, 1959, p. 226, pl. 33, fig. 11a, b; Hornaday, 1961, p. 193, pl. 10, fig. 3a-c; Sullivan, 1962, p. 283, pl. 20, fig. 5a, b; Weaver, 1962, p. 385, pl. 7, fig. 1a, b; Weaver & Weaver, 1962, p. 38, pl. 16, fig. 3a-c; Kleinpell & Weaver, 1963, p. 180, pl. 13, fig. 5a, b; Rau, 1964, p. G23, pl. 7, fig. 4a, b; Weaver & Molander, 1964, p. 195, pl. 13, fig. 4a, b; DeLise, 1967, p. 39, pl. 5, fig. 3a-c; Gaston, 1974, p. 89, [hypotype examined].

Globocassidulina globosa (Hantken), Fairchild, Wesendunk, & Weaver, 1969, p. 69, pl. 22, fig. 15a, b; Smith, 1971, p. 63, pl. 9, fig. 6a, b.

Hypotype no. 00459, loc. PSUA0121.

Family CHILOSTOMELLIDAE

Genus *Allomorphina* Reuss, 1850*Allomorphina macrostoma* Karrer

[?] *Allomorphina* cf. *macrostoma* Karrer, Cushman & McMasters, 1936, p. 516, pl. 76, fig. 7a, b.

[?] *Allomorphina macrostoma* Karrer, Hornaday, 1961, p. 193, pl. 11, fig. 5a-c.

Allomorphina macrostoma Karrer, Weaver & Molander, 1964, p. 195, pl. 13, fig. 6a, b, 7a, b; Fairchild, Wesendunk, & Weaver, 1969, p. 70, pl. 22, fig. 16a, b; Smith, 1971, p. 65, pl. 10, fig. 4a, b; Gaston, 1974, p. 90 [hypotype examined].

Hypotype no. 00460, loc. PSUA0113.

Genus *Chilostomelloides* Cushman, 1926*Chilostomelloides eocenica* Cushman

Chilostomelloides eocenica Cushman, 1926a, p. 78, pl. 11, fig. 20a-c; Kline, 1943, p. 57, pl. 6, fig. 8.

Hypotype no. 00461, loc. PSUA0111.

This distinctive species, common throughout the "Strata of Cascade Head", is characterized by its aperture which is attached to the previous chamber and not as free as in *Chilostomelloides oviformis* (Sherborn and Chapman) (Sullivan, 1962, pl. 21, fig. 12a, b). To the author's knowledge, this species has never been recorded from Eocene deposits of the West Coast.

Chilostomelloides oviformis [?] (Sherborn & Chapman)

Hypotype no. 00462, loc. PSUA0121.

A single pyritized specimen from the Neskowin Creek Section resembles Sullivan's figure (1962, pl. 21, fig. 12a, b) of *C. oviformis* but is badly fractured and missing test material.

Chilostomelloides sp.

Hypotype no. 00463, loc. PSUA0110.

Numerous flattened, poorly preserved individuals, which probably represent *C. eocenica*, are referred to this genus.

Genus *Pullenia* Parker & Jones, 1862

Pullenia eocenica Cushman & Siegfus

Pullenia eocenica Cushman & Siegfus, 1939, p. 31, pl. 7, fig. 1a, b; Asano, 1958, pl. 11, fig. 13a, b; Sullivan, 1962, p. 284, pl. 21, fig. 13a, b; Weaver & Weaver, 1962, p. 39, pl. 17, fig. 2a, b; Fairchild, Wesendunk, & Weaver, 1969, p. 72, pl. 23, fig. 8; Todd, 1970, p. A14, pl. 5, fig. 5a, b; Smith, 1971, p. 64, pl. 10, fig. 5a, b; Tipton, Kleinpell, & Weaver, 1973, p. 62, pl. 11, fig. 3a, b.

[?] *Pullenia eocenica* Cushman & Siegfus, Mallory, 1959, p. 246, pl. 30, fig. 4a, b.

Pullenia bulloides (d'Orbigny), Fairchild, Wesendunk, & Weaver, 1969, p. 72, pl. 23, fig. 1a, b.

Hypotype no. 00464, loc. PSUA0116.

This species differs from *Pullenia bulloides* (d'Orbigny) in possessing an aperture that extends from umbilicus to umbilicus instead of being restricted to the central portion of the apertural face.

Pullenia quinqueloba (Reuss)

[?] *Pullenia quinqueloba* (Reuss), Cushman, 1931, p. 57, pl. 10, fig. 4a, b; Cushman & Henbest, 1940, pl. 10, fig. 14; DeLise, 1967, p. 40, pl. 5, fig. 4.

Pullenia quinqueloba (Reuss), Bergquist, 1942, p. 94, pl. 9, fig. 8; Kline, 1943, p. 57, pl. 6, fig. 4, 7; Todd, 1957a, pl. 78, fig. 2a, b; Mallory, 1959, p. 246, pl. 34, fig. 1a, b; Weaver & Weaver, 1962, p. 39, pl. 17, fig. 3a, b; Weaver & Molander, 1964, p. 196, pl. 14, fig. 2a, b; Tipton, Kleinpell, & Weaver, 1973, p. 62, pl. 11, fig. 2a, b; Murray & Wright, 1974, pl. 18, fig. 13, 14; Thoms, 1975, pl. 4, fig. 1a, b.

Hypotype no. 00465, loc. PSUA0137.

Pullenia salisburyi R. E. & K. C. Stewart

Pullenia salisburyi R. E. & K. C. Stewart, Beck, 1943, p. 609, pl. 108, fig. 8, 12; Cushman & Frizzell, 1943, p. 88, pl. 14, fig. 16; Smith, 1957, p. 188, pl. 28, fig. 11a, b; Todd, 1957b, pl. 29, fig. 10a, b; Mallory, 1959, p. 247, pl. 34, fig. 3a, b, pl. 38, fig. 1a, b; Kleinpell & Weaver, 1963, p. 180, pl. 13, fig. 6a, b; Todd, 1967, p. A38, pl. 5, fig. 20a, b; Smith, 1971, p. 65, pl. 10, fig. 6a, b; Tipton, Kleinpell, & Weaver, 1973, p. 62, pl. 11, fig. 4a, b.

Hypotype no. 00466, loc. PSUA0105.

Pullenia sp.

Hypotype no. 00467, loc. PSUA0116.

A single specimen from the Neskowin Creek Section resembles *Pullenia eocenica* Cushman and Siegfus except for its much higher apertural face.

Pullenia [?] sp.

Hypotype no. 00468, loc. PSUA0115.

Poorly preserved individuals are questionably referred to this genus.

Family HANTKENINIDAE

Genus *Pseudohastigerina* Banner & Blow, 1959

Pseudohastigerina micra (Cole)

Nonion micrum Cole, Cushman, 1935, p. 30, pl. 11, fig. 14, 15; Cushman, 1939, p. 5, pl. 1, fig. 20-22; Howe, 1939, p. 58, pl. 7, fig. 22, 23; Todd, 1957a, pl. 65, fig. 26a, b; Mallory, 1959, p. 181, pl. 15, fig. 3a-c, pl. 28, fig. 12a, b; Thoms, 1975, pl. 4, fig. 3a, b.

Globigerinella micra (Cole), Sullivan, 1962, p. 285, pl. 22, fig. 7a, b, 8a, b.

Hastigerina micra (Cole), Fairchild, Wesendunk, & Weaver, 1969, p. 60, pl. 15, fig. 1a-c, 7a-c; Postuma, 1971, p. 228, 7 fig. on p. 229.

Globanomalina micra (Cole), Jenkins, 1971, p. 78, pl. 2, fig. 50-54.

Pseudohastigerina micra (Cole), Tipton, Kleinpell, & Weaver, 1973, p. 63, pl. 12, fig. 2a, b; Gaston, 1974, p. 91, [hypotype examined].

Hypotype no. 00469, loc. PSUA0111.

Family GLOBOROTALIIDAE

Genus *Globorotalia* Cushman, 1927

Globorotalia cf. *G. cerroazulensis* (Cole)

Hypotype no. 00470, loc. PSUA0137.

These individuals resemble *Globorotalia cerroazulensis* (Cole) (Postuma, 1971, 7 fig. on p. 185) but have smaller chambers and are more compressed in peripheral view.

Globorotalia [?] spp.

Numerous poorly preserved specimens seem best included here. More than one species is probably represented.

Family GLOBIGERINIDAE

Genus *Globigerina* d'Orbigny, 1826

Globigerina ciproensis angustiumbilocata Bolli

Globigerina ciproensis angustiumbilocata Bolli, Fairchild, Wesendunk, & Weaver, 1969, p. 61, pl. 16, fig. 2a-c, 5a-c.

Globigerina (*Globigerina*) *ciproensis angustiumbilocata* Bolli, Jenkins, 1971, p. 144, pl. 15, fig. 451-453.

Hypotype no. 00471, loc. PSUA0109.

Globigerina ciproensis angustiumbilocata [?] Bolli

Hypotype no. 00472, loc. PSUA0136.

A single specimen from the Salmon River Section is similar

in chamber arrangement to *G. ciperensis angustiumbilicata* Bolli but the apertural and umbilical areas are too poorly preserved for positive identification.

Globigerina cf. *G. concinna* Reuss

Hypotype no. 00473, loc. PSUA0109.

These specimens are identical in all respects with Tipton, Kleinpell, and Weaver's figure (1973, pl. 11, fig. 7a-c) of *Globigerina concinna* Reuss except for a smaller aperture. The true shape of the aperture however, is impossible to discern on most individuals since the apertural region is usually poorly preserved.

Globigerina decepta Martin

Globigerina decepta Martin, Smith, 1957, p. 188, pl. 28, fig. 14a-c; Mallory, 1959, p. 249, pl. 34, fig. 5a-c, pl. 38, fig. 2a-c; Sullivan, 1962, p. 284, pl. 22, fig. 3a-c; Weaver, 1962, p. 387, pl. 7, fig. 5a-c.

Globorotalia decepta (Martin), Smith, 1971, p. 59, pl. 11, fig. 1a-c.

Hypotype no. 00474, loc. PSUA0109.

Globigerina ouachitaensis Howe & Wallace

Globigerina ouachitaensis Howe & Wallace, Howe, 1939, p. 83, pl. 12, fig. 18, 19; Sullivan, 1962, p. 285, pl. 22, fig. 1a-c, 2a-c; Postuma, 1971, p. 152, 7 fig. on p. 153.

[Non] *Globigerina ouachitaensis* Howe & Wallace, Hornaday, 1961, p. 194, pl. 12, fig. 1a-c.

Globigerina (*Globigerina*) *ouachitaensis* Howe & Wallace, Jenkins, 1971, p. 153, pl. 16, fig. 489, 490.

Hypotype no. 00475, loc. PSUA0108.

Globigerina cf. *G. ouachitaensis* Howe & Wallace

Hypotype no. 00476, loc. PSUA0115.

Globigerina ouachitaensis Howe and Wallace, as described by Postuma (1971, p. 152), is ornamented with very fine spines on all chambers except for a smooth or nearly smooth final chamber. A number of individuals included in this designation are similar to this species except for a spinose final chamber.

Globigerina praebulloides Blow

Globigerina praebulloides Blow, Postuma, 1971, p. 268, 7 fig. on p. 269; Hornaday, 1972, p. 44, pl. 2, fig. 6a-c; McKeel & Lipps, 1975, p. 265, pl. 5, fig. 5a-c, 6a-c.

Hypotype no. 00477, loc. PSUA0119.

Globigerina prasaepis Blow

Globigerina prasaepis Blow, McKeel & Lipps, 1975, p. 265, pl. 4, fig. 1a-c.

Hypotype no. 00478, loc. PSUA0121.

Globigerina primitiva (Finlay)

Pseudogloboquadrina primitiva (Finlay), Jenkins, 1971, p. 170, pl. 18, fig. 555-561.

Globigerina primitiva (Finlay), Postuma, 1971, p. 154, 7 fig. on p. 155.

Hypotype no. 00479, loc. PSUA0106.

Globigerina cf. *G. yeguaensis* Weinzierl & Applin

Hypotype no. 00480, loc. PSUA0112.

Two specimens from the Neskowin Creek Section closely resemble McKeel and Lipps' figure (1975, pl. 2, fig. 1a-c) of *G. cf. G. yeguaensis*. These individuals differ from *Subbotina*

[Non] *Globigerina linaperta* Finlay, Fairchild, Wesendunk, & Weaver, 1969, p. 62, pl. 16, fig. 3a-c, 4a-c.

Globigerina (Subbotina) linaperta Finlay, Jenkins, 1971, p. 162, pl. 18, fig. 551-554.

[?] *Globigerina* cf. *G. linaperta* Finlay, Tipton, Kleinpell, & Weaver, 1973, p. 63, pl. 12, fig. 1a-c.

Subbotina linaperta (Finlay), McKeel & Lipps, 1975, p. 262, pl. 3, fig. 4a-c.

Hypotype no. 00483, loc. PSUA0105.

Subbotina linaperta [?] (Finlay)

Hypotype no. 00484, loc. PSUA0105.

Numerous individuals that lack the characteristic lip or possess poorly preserved apertural areas are included here.

Subbotina wilsoni (Cole)

Globorotalia bolivariana (Petters), Fairchild, Wesendunk, & Weaver, 1969, p. 61, pl. 15, fig. 2a-c, 3a-c, 4a-c, 5a-c; Gaston, 1974, p. 93, [hypotype examined].

Subbotina wilsoni (Cole), McKeel & Lipps, 1975, p. 265, pl. 5, fig. 2a-c.

Hypotype no. 00485, loc. PSUA0107.

This species is similar to *Globorotalia bolivariana* (Petters) but is smaller and does not possess short spines on the surface of the test.

Subbotina wilsoni [?] (Cole)

Hypotype no. 00486, loc. PSUA0107.

Poorly preserved individuals that seem to resemble this species are questionably placed in this designation.

Genus *Globigerinatheka* Bronnimann, 1952

Globigerinatheka index (Finlay)

Globigerinatheka (Globigerapsis) index index (Finlay), Jenkins, 1971, p. 187, pl. 22, fig. 641-645.

linaperta (Finlay) (McKeel and Lipps, pl. 3, fig. 4-c) in their larger size and different position of the aperture.

Globigerina spp.

Numerous poorly preserved specimens seem best referred to this genus. More than one species is probably represented.

Genus *Globorotaloides* Bolli, 1957

Globorotaloides turgida (Finlay)

Globorotaloides turgida (Finlay), Jenkins, 1971, p. 191, pl. 23, fig. 656-658.

Hypotype no. 00481, loc. PSUA0109.

Globorotaloides sp. [?] [of McKeel & Lipps]

Globorotaloides sp. [?] McKeel & Lipps, 1975, p. 262, pl. 3, fig. 1a-c, 2a-c.

Hypotype no. 00482, loc. PSUA0125.

A small individual ornamented with closely spaced spines and possessing five chambers in the last whorl appears to be very close if not conspecific with the specimens figured by McKeel and Lipps.

Genus *Subbotina* Brotzen & Pozaryska, 1961

Subbotina linaperta (Finlay)

Globigerina triloculinoides Plummer, Beck, 1943, p. 609, pl. 108, fig. 2, 3; Detling, 1946, p. 359, pl. 51, fig. 2a, b; Gaston, 1974, p. 92, [hypotype examined].

Globigerina cf. *G. triloculinoides* Plummer, Smith, 1957, p. 189, pl. 28, fig. 17a, b.

[?] *Globigerina triloculinoides* Plummer, Mallory, 1959, p. 250, pl. 30, fig. 6a, b, [not pl. 38, fig. 3a, b]; Sullivan, 1962, p. 285, pl. 22, fig. 5a, b, 6a, b, [not fig. 4a, b]; Weaver & Weaver, 1962, p. 40, pl. 18, fig. 3a, b, [not fig. 4a, b]; Weaver & Molander, 1964, p. 197, pl. 15, fig. 2a, b, [not fig. 1].

Globigerapsis index (Finlay), Postuma, 1971, p. 136,
7 fig. on p. 137.

Globigerinatheka index (Finlay), McKeel & Lipps, 1975,
p. 265, pl. 3, fig. 5a-c, pl. 5, fig. 1a-c.

Hypotype no. 00487, loc. PSUA0115.

Family ANOMALINIDAE

Genus *Anomalina* d'Orbigny, 1826

Anomalina crassisepta Cushman & Siegfus

Anomalina crassisepta Cushman & Siegfus, 1935, p. 95, pl. 14,
fig. 12a-c; Mallory, 1959, p. 258, pl. 35, fig. 4a-c;
Fairchild, Wesendunk, & Weaver, 1969, p. 74, pl. 25,
fig. 5a-c.

Hypotype no. 00488, loc. PSUA0105.

Anomalina dorri Cole var. *aragonensis* Nuttall

Anomalina dorri Cole var. *aragonensis* Nuttall, Cushman &
Siegfus, 1939, p. 32, pl. 7, fig. 5; Mallory, 1959, p. 259,
pl. 35, fig. 5a-c.

Anomalina dorri aragonensis Nuttall, Smith, 1957, p. 191,
pl. 15, fig. 1a-c, 2a-c.

Hypotype no. 00489, loc. PSUA0119.

Anomalina garzaensis Cushman & Siegfus

Anomalina garzaensis Cushman & Siegfus, 1939, p. 32, pl. 7,
fig. 3a-c; Mallory, 1959, p. 259, pl. 31, fig. 1a-c;
Sullivan, 1962, p. 286, pl. 23, fig. 5a-c; Weaver & Weaver,
1962, p. 41, pl. 20, fig. 3a-c; Weaver & Molander, 1964,
p. 198, pl. 16, fig. 4a-c; Tipton, Kleinpell, & Weaver,
1973, p. 64, pl. 12, fig. 3a-c; Gaston, 1974, p. 94,
[hypotype examined].

[?] *Anomalina garzaensis* Cushman & Siegfus, DeLise, 1967,
p. 41, pl. 6, fig. 3a-c.

Anomalina cf. *A. garzaensis* Cushman & Siegfus, Fairchild,
Wesendunk, & Weaver, 1969, p. 74, pl. 25, fig. 3a-c.

Hypotype no. 00490, loc. PSUA0111.

A single specimen from the Neskowin Creek Section appears

similar to published figures of *A. garzaensis* except that it possesses ten chambers in the last whorl instead of the 12 to 15 described by Cushman and Siegfus. However, since this species exhibits a great variation in the number of chambers in the adult whorl, this small individual, which may represent a juvenile, is included under this designation.

Anomalina cf. *A. garzaensis* Cushman & Siegfus

Hypotype no. 00491, loc. PSUA0101.

A single individual from the basal Neskowin Creek Section has inflated chambers and a more lobate outline than published figures of *A. garzaensis*.

Anomalina regina Martin var. *minor* Smith

Anomalina regina Martin var. *minor* Smith, 1957, p. 192, pl. 29, fig. 2a-c, 4a-c; Mallory, 1959, p. 261, pl. 23, fig. 6a-c.

Hypotype no. 00492, loc. PSUA0121.

Anomalina sp. *A.* Cushman [of Mallory]

Anomalina sp. *A.* Cushman, Mallory, 1959, p. 263, pl. 23, fig. 5a-c; Thoms, 1975, pl. 4, fig. 5a-c.

Hypotype no. 00493, loc. PSUA0111.

Anomalina [?] spp.

Flattened and poorly preserved specimens are included here. More than one species is probably represented.

Genus *Planulina* d'Orbigny, 1826

Planulina sp.

Hypotype no. 00494, loc. PSUA0101.

Two compressed individuals from the basal Neskowin Creek Section seem best referred to this genus.

Genus *Cibicides* Montfort, 1808*Cibicides cushmani* Nuttall

Cibicides cushmani Nuttall, Cushman & Siegfus, 1939, p. 33, pl. 7, fig. 7a-c; Mallory, 1959, p. 264, pl. 31, fig. 3a-c; Sullivan, 1962, p. 287, pl. 23, fig. 7a-c; Weaver & Weaver, 1962, p. 41, pl. 21, fig. 2a-c; Fairchild, Wesendunk, & Weaver, 1969, p. 65, pl. 19, fig. 2a-c; Tipton, Kleinpell, & Weaver, 1973, p. 65, pl. 13, fig. 2a-c; Thoms, 1975, pl. 4, fig. 9a-c.

[?] *Cibicides cushmani* Nuttall, Smith, 1957, p. 192, pl. 31, fig. 4a-c.

Cibicides hodgei Cushman & Schenck, Hornaday, 1961, p. 194, pl. 13, fig. 1a-c.

Cibicidina cushmani (Nuttall), Smith, 1971, p. 62, pl. 12, fig. 2a-c.

Hypotype no. 00495, loc. PSUA0137.

Cibicides cushmani, which ranges throughout most of the Eocene, is thought to be an older member of the *Cibicides hodgei* Cushman and Schenck lineage (Mallory, 1959, p. 265). In Narizian age strata the two intergrade and are very difficult if not impossible in some instances to separate from each other. *Cibicides cushmani* seems to be more plano-convex and has a triangular shaped apertural face while *C. hodgei* is more rounded in peripheral view and possesses large distinctive pores in the test and sutures. There is also a resemblance between this species and *Anomalina crassisepta* Cushman and Siegfus as noted by Beck (1943, p. 611). *Anomalina crassisepta* however, has nearly radial sutures on the ventral side of the test and is much thicker in peripheral view than *C. cushmani*.

Cibicides felix Martin

Cibicides felix Martin, Mallory, 1959, p. 265, pl. 25, fig. 2a-c, [not pl. 31, fig. 4a-c]; Weaver & Molander, 1964, p. 199, pl. 17, fig. 4a-c, [? fig. 3a-c].

[?] *Cibicides felix* Martin, DeLise, 1967, p. 42, pl. 7, fig. 1a-c.

Hypotype no. 00496, loc. PSUA0116.

Individuals from the "Strata of Cascade Head" are identical to the specimen figured by Mallory. This species is characterized by a plano-convex test consisting of seven to nine chambers in the last whorl, sigmoid sutures on the ventral surface, and a nearly circular test in outline (the last three chambers are usually lobate).

Cibicides cf. *C. felix* Martin

Hypotype no. 00497, loc. PSUA0116.

These individuals differ from *C. felix* in being slightly biconvex and usually possess a greater number of chambers in the final whorl.

Cibicides laimingi Mallory

Cibicides laimingi Mallory, 1959, p. 266, pl. 24, fig. 3a-c, 4a-c.

[?] *Cibicides laimingi* Mallory, Weaver, 1962, p. 390, pl. 9, fig. 2a-c; Weaver & Weaver, 1962, p. 41, pl. 21, fig. 4a-c; Fairchild, Wesendunk, & Weaver, 1969, p. 66, pl. 20, fig. 4a-c.

Hypotype no. 00498, loc. PSUA0111.

Cibicides laurissae Mallory

Cibicides laurissae Mallory, 1959, p. 267, pl. 24, fig. 8a-c; Weaver & Molander, 1964, p. 199, pl. 18, fig. 1a-c; DeLise, 1967, p. 42, pl. 7, fig. 4a-c; Gaston, 1974, p. 95, [hypotype examined].

[?] *Cibicides laurissae* Mallory, Thoms, 1975, pl. 4, fig. 11a-c.

Hypotype no. 00499, loc. PSUA0123.

Cibicides laurissae [?] Mallory

Hypotype no. 00500, loc. PSUA0100.

Plano-convex specimens from the basal Neskowin Creek Section resemble *C. laurissae* but are badly recrystallized and difficult to identify accurately.

Cibicides lobatus d'Orbigny

Cibicides lobatus d'Orbigny, Bandy, 1944, p. 374, pl. 62, fig. 1a-c; Rau, 1964, p. G24, pl. 7, fig. 9a-c; Gaston, 1974, p. 95, [hypotype examined].

Hypotype no. 00501, loc. PSUA0105.

Cibicides mcmastersi Beck

[?] *Cibicides* sp. A. Cushman & McMaster, 1936, p. 516, pl. 76, fig. 9a-c.

Cibicides mcmastersi Beck, 1943, p. 612, pl. 109, fig. 2, 4, 15, Gaston, 1974, p. 95, [hypotype examined].

Hypotype no. 00502, loc. PSUA0101.

These individuals are distinguished by their small size, plano-convex test, numerous chambers in the final whorl, and large ventral umbo.

Cibicides mcmastersi [?] Beck

Hypotype no. 00503, loc. PSUA0127.

Two small, fragmented specimens with a large ventral umbo and numerous chambers resemble this species but are too poorly preserved for positive identification.

Cibicides ouachitaensis Howe & Wallace
var. *alhambrensis* Smith

Cibicides ouachitaensis Howe & Wallace var. *alhambrensis*
Smith, 1957, p. 194, pl. 32, fig. 1a-c, 2a-c, 5a-c;
Mallory, 1959, p. 268, pl. 38, fig. 8a-c.

Hypotype no. 00504, loc. PSUA0136.

Although a few specimens are more compressed than the forms figured by Smith, most individuals included under this designation appear conspecific with both Smith and Mallory's figures.

Cibicides pachyderma (Rzehak)

Cibicides pachyderma (Rzehak), Galloway & Morrey, 1931
p. 345, pl. 39, fig. 6a-c; Mallory, 1959, p. 268, pl. 31,
fig. 5a-c; Gaston, 1974, p. 96, [hypotype examined]; Thoms,
1975, pl. 4, fig. 13a-c.

Hypotype no. 00505, loc. PSUA0137.

This species, although similar to *Cibicides ouachitaensis* Howe and Wallace var. *alhambrensis* Smith, is characterized by sutural thickenings over the umbilical area on the dorsal side of the test and nonlobate chambers.

Cibicides cf. *C. praecursorius* (Schwager)

Hypotype no. 00506, loc. PSUA0132.

A few specimens with irregularly sigmoid sutures somewhat resemble *C. cf. C. praecursorius* of Mallory (1959, pl. 25, fig. 5a-c).

Cibicides pseudoungerianus (Cushman)

Cibicides pseudoungerianus (Cushman), Cushman, 1935, p. 52,
pl. 23, fig. 1a-c; Coryell & Embich, 1937, p. 302, pl. 43,
fig. 15; Todd, 1953, p. 6, pl. 2, fig. 12a-c, 13a-c; Todd,
1957a, pl. 71, fig. 14a-c, pl. 80, fig. 10a-c; Fairchild,
Wesendunk, & Weaver, 1969, p. 66, pl. 20, fig. 3a-c.

Hypotype no. 00507, loc. PSUA0106.

Cibicides cf. *C. pseudoungerianus* (Cushman)

Hypotype no. 00508, loc. PSUA0109.

A few specimens from the Neskowin Creek Section resemble *C. pseudoungerianus* except for limbate sutures and a circular shaped test; the last three chambers of *C. pseudoungerianus* are lobate and normally possess depressed sutures.

Cibicides pseudouellorstorffi Cole (?)
[of Mallory]

Cibicides pseudouellorstorffi Cole (?), Mallory, 1959, p. 270, pl. 26, fig. 4a-c.

Hypotype no. 00509, loc. PSUA0106.

Cibicides sandiegensis Cushman & M. A. Hanna

Cibicides sandiegensis Cushman & M. A. Hanna, 1927, p. 55, pl. 6, fig. 1, 2; Mallory, 1959, p. 270, pl. 25, fig. 7a-c.

[?] *Cibicides sandiegensis* Cushman & M. A. Hanna, Thoms, 1975, pl. 4, fig. 14a-c.

Hypotype no. 00510, loc. PSUA0119.

Cibicides cf. *C. sandiegensis* Cushman & M. A. Hanna

Hypotype no. 00511, loc. PSUA0119.

These individuals differ from *C. sandiegensis* in that the umbilical area on the ventral side of the test is depressed rather than raised.

Cibicides spiropunctatus Galloway & Morrey

Cibicides spiropunctatus Galloway & Morrey, 1931, p. 346, pl. 39, fig. 7a-c; Mallory, 1959, p. 270, pl. 25, fig. 3a-c; Weaver, 1962, p. 390, pl. 9, fig. 4a-c; Weaver & Weaver, 1962, p. 41, pl. 22, fig. 1a-c; Fairchild, Wesendunk, & Weaver, 1969, p. 67, pl. 21, fig. 14a-c; Tipton, Kleinpell, & Weaver, 1973, p. 66, pl. 14, fig. 2a-c.

Hypotype no. 00512, loc. PSUA0137.

Adult forms of this species can be easily confused with

adult specimens of *Cibicides martinezensis* Cushman and Barksdale var. *malloryi* Smith (1957, pl. 21, fig. 9a-c). *Cibicides spiro punctatus* however, is nearly circular in outline except for the last two or three chambers which are lobate while *C. martinezensis* var. *malloryi* is completely lobate in outline.

Cibicides spp.

Abundant poorly preserved and fragmented specimens are included in this designation. More than one species is represented.

Genus *Cibicidoides* Brotzen, 1936

Cibicidoides coalingensis (Cushman & G. D. Hanna)

Anomalina coalingensis Cushman & G. D. Hanna, Cushman & Schenck, 1928, p. 315, pl. 45, fig. 6; Cushman & Dusenbury, 1934, p. 63, pl. 9, fig. 3a-c.

Anomalina cf. *A. coalingensis* Cushman & G. D. Hanna, Cushman & Simonson, 1944, p. 202, pl. 34, fig. 9, 10.

Cibicidoides coalingensis (Cushman & G. D. Hanna), Wilson, 1954, p. 145, pl. 17, fig. 4a-c; Smith, 1956, p. 101, pl. 16, fig. 2a-c; Smith, 1957, p. 195, pl. 30, fig. 2a-c, 3a-c; Mallory, 1959, p. 273, pl. 38, fig. 11a-c; Fairchild, Wesendunk, & Weaver, 1969, p. 75, pl. 25, fig. 1a-c; Gaston, 1974, p. 96, [hypotype examined]; Thoms, 1975, pl. 4, fig. 7a-c.

Cibicides cocoaensis (Cushman), Gaston, 1974, p. 94, [hypotype examined].

Hypotype no. 00513, loc. PSUA0103.

Cibicidoides venezuelanus (Nuttall)

Cibicides venezuelanus Nuttall, Cushman & Siegfus, 1939, p. 32, pl. 7, fig. 4a-c; Fairchild, Wesendunk, & Weaver, 1969, p. 67, pl. 21, fig. 6a-c.

Cibicidoides venezuelanus (Nuttall), Smith, 1957, p. 197, pl. 30, fig. 1a-c, 5a-c; Mallory, 1959, p. 274, pl. 31, fig. 6a-c; Gaston, 1974, p. 96, [hypotype examined].

[?] *Cibicides venezuelanus* Nuttall, Weaver, 1962, p. 391, pl. 9, fig. 3a-c.

Hypotype no. 00514, loc. PSUA0137.

Cibicidoides [?] sp.

Hypotype no. 00515, loc. PSUA0135.

Two specimens from the Salmon River Section are questionably assigned to this genus.

Family PLANORBULINIDAE

Genus *Gypsina* Carter, 1877

Gypsina globula [?] (Reuss)

Hypotype no. 00516, loc. PSUA0133.

A single specimen from the Salmon River Section appears conspecific with *G. globula* as figured by Cushman (1935, pl. 23, fig. 4, 5). More material however, is required for positive identification. To the author's knowledge, this species has not been recorded from Eocene deposits on the West Coast.

DESCRIPTIONS OF LOCALITIES

All of the following microfossil localities are in the general vicinity of Cascade Head on the western flank of the central Oregon Coast Range, Lincoln and Tillamook Counties, Oregon. Map data are based on the United States Geological Survey Map of the Hebo Quadrangle (15 minute series, scale 1:62500, 1955). Locality numbers refer to the collections of the Earth Sciences Museum at Portland State University, Portland, Oregon. Localities are listed below in respect to their appropriate stratigraphic section.

Neskowin Creek Section (Fig. 1-A)

The major stratigraphic section was measured along Neskowin Creek which traverses the southwesternmost corner of Lincoln County, Oregon. Neskowin Creek flows in a northwesterly direction from a point north of U. S. Forest Service Road S532 in the SW $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 15, T6S, R10W, to just south of the town of Neskowin, in Sec. 35, T6S, R11W, where it empties into the Pacific Ocean. The section was measured from an isolated outcrop referable to the Siletz River Volcanic Series 520 feet east of the bridge over Neskowin Creek in NE $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 15, T6S, R10W, downstream to a point approximately 480 feet west of where Prospect Creek converges with Neskowin Creek in SE $\frac{1}{4}$, NE $\frac{1}{4}$,

Sec. 6, T6S, R10W. The stratigraphic datum for this section is placed seven feet stratigraphically below the base of a 13 foot wide outcrop of medium-gray, calcareous volcanic wacke (the base of the "Strata of Cascade Head") which is exposed directly under the bridge. The datum occurs 13 feet stratigraphically below the contact between this sandstone and a nine foot bed of olive-gray, tuffaceous siltstone. All foraminiferal samples were collected from the "Strata of Cascade Head" along the banks of Neskowin Creek and are depicted graphically in Figure 2.

Locality PSUA0100

Located on the south bank of Neskowin Creek, 105 feet upstream from bridge, 10 feet stratigraphically above the base of the "Strata of Cascade Head" in medium-gray, calcareous volcanic wacke.

Locality PSUA0101

Located on the south bank of Neskowin Creek, 7.5 feet stratigraphically above sample PSUA0100, in olive-gray, tuffaceous siltstone interbedded with calcareous volcanic wacke.

Locality PSUA0102

Located on the north bank of Neskowin Creek, 54.5 feet stratigraphically above sample PSUA0101, in medium-gray, calcareous volcanic wacke.

Locality PSUA0103

Located on the north bank of Neskowin Creek, 95.5 feet stratigraphically above sample PSUA0102, in medium-gray, calcareous volcanic wacke.

Locality PSUA0104

Located on the north bank of Neskowin Creek, at confluence with small south flowing tributary, 149 feet stratigraphically above sample PSUA0103, in light olive-gray,

silty mudstone.

Locality PSUA0105

Located on the south bank of Neskowin Creek, 136 feet stratigraphically above sample PSUA0104, in olive-gray, silty mudstone.

Locality PSUA0106

Located on the south bank of Neskowin Creek, approximately 416 feet west of the Siuslaw National Forest Boundary, 254 feet stratigraphically above sample PSUA0105, in olive-gray mudstone.

Locality PSUA0107

Located on the north bank of Neskowin Creek, 54 feet stratigraphically above sample PSUA0106, in olive-gray, silty mudstone.

Locality PSUA0108

Located on the north bank of Neskowin Creek, seven feet stratigraphically above sample PSUA0107, in olive-gray, tuffaceous silty mudstone.

Locality PSUA0109

Located on the south bank of Neskowin Creek, 379.5 feet stratigraphically above sample PSUA0108, in olive-gray, silty mudstone.

Locality PSUA0110

Located on the south bank of Neskowin Creek, 58.5 feet stratigraphically above sample PSUA0109, in olive-gray, silty mudstone.

Locality PSUA0111

Located on the north bank of Neskowin Creek, 45 feet stratigraphically above sample PSUA0110, in olive-gray mudstone.

Locality PSUA0112

Located on the south bank of Neskowin Creek, 74.5 feet stratigraphically above sample PSUA0111, in olive-gray, tuffaceous silty mudstone.

Locality PSUA0113

Located on the north bank of Neskowin Creek, approximately 705 feet west of junction of Neskowin Creek with Sloan Creek, 293 feet stratigraphically above sample PSUA0112, in olive-gray, micaceous shaly siltstone interbedded with olive-gray, tuffaceous volcanic wacke.

Locality PSUA0114

Located on the north bank of Neskowin Creek, 36 feet stratigraphically above sample PSUA0113, in dark-gray, micaceous mudstone interbedded with olive-gray, calcareous volcanic wacke.

Locality PSUA0115

Located on the south bank of Neskowin Creek, 28 feet stratigraphically above sample PSUA0114, in olive-gray, micaceous mudstone interbedded with medium dark-gray, calcareous volcanic graywacke.

Locality PSUA0116

Located on the south bank of Neskowin Creek, approximately 84 feet west of junction of Neskowin Creek and Lewis Creek, 219.5 feet stratigraphically above sample PSUA0115, in olive-gray mudstone.

Locality PSUA0117

Located on the south bank of Neskowin Creek, 36.5 feet stratigraphically above sample PSUA0116, in olive-gray, silty mudstone.

Locality PSUA0118

Located on the south bank of Neskowin Creek, 142.5 feet stratigraphically above sample PSUA0117, in olive-black, micaceous silty shale interbedded with olive-black, granular volcanic graywacke.

Locality PSUA0119

Located on the north bank of Neskowin Creek, 27 feet stratigraphically above sample PSUA0118, in dusky yellowish-brown, carbonaceous shaly siltstone interbedded with olive-black volcanic graywacke.

Locality PSUA0120

Located on the south bank of Neskowin Creek, 90 feet stratigraphically above sample PSUA0119, in olive-gray, micaceous siltstone interbedded with olive-gray, pebbly volcanic graywacke.

Locality PSUA0121

Located on the south bank of Neskowin Creek, 45 feet stratigraphically above sample PSUA0120, in olive-gray, micaceous siltstone interbedded with olive-black, pebbly volcanic graywacke.

Locality PSUA0122

Located on the north bank of Neskowin Creek, 73 feet stratigraphically above sample PSUA0121, in olive-gray, micaceous silty mudstone interbedded with olive-gray, volcanic graywacke.

Locality PSUA0123

Located on the south bank of Neskowin Creek, approximately 80 feet east of junction of Neskowin Creek and Jim Creek, 78.5 feet stratigraphically above sample PSUA0122, in olive-gray, carbonaceous shaly siltstone interbedded with olive-gray, micaceous carbonaceous shale.

Locality PSUA0124

Located on the north bank of Neskowin Creek, 212 feet stratigraphically above sample PSUA0123, in olive-gray, micaceous siltstone interbedded with olive-gray, micaceous wacke.

Locality PSUA0125

Located on the north bank of Neskowin Creek, 90 feet stratigraphically above sample PSUA0124, in olive-gray, micaceous siltstone.

Locality PSUA0126

Located on the north bank of Neskowin Creek, 7.5 feet stratigraphically above sample PSUA0125, in olive-gray, micaceous siltstone.

Locality PSUA0127

Located on the north bank of Neskowin Creek, 442 feet stratigraphically above sample PSUA0126, in olive-gray siltstone.

Locality PSUA0128

Located on the south bank of Neskowin Creek, 285 feet stratigraphically above sample PSUA0127, in olive-gray, sandy siltstone.

Locality PSUA0129

Located on the south bank of Neskowin Creek, 710 feet east of junction of Neskowin Creek and Prospect Creek, five feet stratigraphically above sample PSUA0128, in olive-gray, sandy siltstone.

Cascade Head Road Section (Fig. 1-D)

This small supplementary section was measured along Cascade Head Road (U. S. Forest Service Road S61) approximately half a mile west of its junction with Highway 101 in Tillamook County, Oregon. The section, situated in the NE $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 7, T6S, R10W, was measured across the road and up the east side of the roadcut (this portion of Cascade Head Road is constructed on the contact between the "Strata of Cascade Head" and the volcanics of the Nestucca Formation). The stratigraphic datum for this section is the base of an outcrop of olive-black, basaltic breccia (the base of the volcanics of the Nestucca Formation) exposed in the west bank of the roadcut. The sample was collected from the "Strata of Cascade Head".

Locality PSUA0130

Located in a roadcut on the east side of Cascade Head Road, about 10 feet above road surface, just under small ridge at the western end of the roadcut, approximately 10 feet stratigraphically below the volcanics of the Nestucca Formation, in light olive-gray, tuffaceous siltstone.

micaceous arkosic wacke (at the base of the "Strata of Cascade Head"). All foraminiferal samples were collected from the "Strata of Cascade Head" along the banks of the Salmon River and are depicted graphically in Figure 3.

Locality PSUA0132

Located on the south bank of the Salmon River, 12.5 feet stratigraphically above the base of the "Strata of Cascade Head", in medium-gray mudstone.

Locality PSUA0133

Located on the south bank of the Salmon River, 63.5 feet stratigraphically above sample PSUA0132, in olive-gray mudstone.

Locality PSUA0134

Located on the north bank of the Salmon River, 12 feet stratigraphically above sample PSUA0133, in olive-gray mudstone.

Locality PSUA0135

Located on the north bank of the Salmon River, 346 feet east of a logging road that crosses the river, 53 feet stratigraphically above sample PSUA0134, in olive-gray mudstone.

Locality PSUA0136

Located on the north bank of the Salmon River, 17 feet stratigraphically above sample PSUA0135, in olive-gray mudstone.

Locality PSUA0137

Located on the north bank of the Salmon River, 34 feet stratigraphically above sample PSUA0136, in olive-gray mudstone.

Three Rocks Section (Fig. 1-C)

This small supplementary section was measured at the base of a sea cliff approximately half a mile northeast of the town of Three Rocks, Oregon. The section is situated in the SW $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 14, T6S, R11W, on the south side of Cascade Head at the mouth of the Salmon River. The stratigraphic datum for this section is the base of an outcrop of olive-black, basaltic breccia (at the base of the volcanics of the Nestucca Formation). The sample was collected from the "Strata of Cascade Head".

Locality PSUA0131

Located on the sea cliff on the south side of Cascade Head, about five feet above water level, approximately five feet stratigraphically below the volcanics of the Nestucca Formation in olive-gray mudstone.

Salmon River Section (Fig. 1-B)

This small stratigraphic section was measured along the Salmon River which traverses the southern portion of the Hebo Quadrangle in Lincoln County, Oregon. The section, located approximately two miles east of Rose Lodge, Oregon in the central portion of Sec. 29 and 30, T6S, R9W, was measured along the Salmon River from an outcrop referable to the Siletz River Volcanic Series approximately 3750 feet east of the logging road along the Treat River, upstream to a point about 1250 feet west of the western boundary of Van Duzer State Park. The stratigraphic datum for this section is at the base of an outcrop of medium-gray,

PLATE 1

1. *Vulvulina* sp. A. n. sp. x54. Hypotype no. 00217.
PSUA0134. Drawing from light microscope.
2. *Vulvulina* sp. A. n. sp. x33. Hypotype no. 00216.
PSUA0134. Scanning electron micrograph.
3. *Dentalina* sp. A. n. sp. x104. Hypotype no. 00316.
PSUA0131. Single chamber. Drawing from light microscope.
4. *Dentalina* sp. A. n. sp. x50. Hypotype no. 00315.
PSUA0131. Scanning electron micrograph.
5. *Dentalina* sp. B. x110. Hypotype no. 00317. PSUA0134.
Scanning electron micrograph.
6. *Nodosaria* (?) *gyrata* Mallory n. var. x88. Hypotype
no. 00333. PSUA0104. Scanning electron micrograph.
7. *Nodosaria* (?) *gyrata* Mallory n. var. x240. Hypotype
no. 00333. PSUA0104. Enlargement of figure 6 revealing
the alternating fine costae. Scanning electron
micrograph.
8. *Nonion* sp. A. n. sp. x167. Hypotype no. 00354. PSUA0119.
Apertural view. Scanning electron micrograph.
9. *Nonion* sp. A. n. sp. x125. Hypotype no. 00354. PSUA0119.
Side view. Scanning electron micrograph.
10. *Elphidium* sp. A. n. sp. x166. Hypotype no. 00357.
PSUA0101. Side view. Scanning electron microscope.
11. *Elphidium* sp. A. n. sp. x166. Hypotype no. 00357.
PSUA0101. Oblique apertural view. Scanning electron
micrograph.
12. *Uvigerina* sp. A. n. sp. x70. Hypotype no. 00415.
PSUA0134. Side view. Scanning electron micrograph.
13. *Uvigerina* sp. A. n. sp. x252. Hypotype no. 00415.
PSUA0134. Apertural view. Scanning electron micrograph.

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