

**Paleontology of the marine Tertiary formations of Oregon and Washington,  
by Charles E. Weaver ...**

Weaver, Charles Edwin, 1880-  
Seattle, Wash., University of Washington press [1943]

<http://hdl.handle.net/2027/mdp.39015025862809>

# HathiTrust



[www.hathitrust.org](http://www.hathitrust.org)

**Public Domain, Google-digitized**  
[http://www.hathitrust.org/access\\_use#pd-google](http://www.hathitrust.org/access_use#pd-google)

We have determined this work to be in the public domain, meaning that it is not subject to copyright. Users are free to copy, use, and redistribute the work in part or in whole. It is possible that current copyright holders, heirs or the estate of the authors of individual portions of the work, such as illustrations or photographs, assert copyrights over these portions. Depending on the nature of subsequent use that is made, additional rights may need to be obtained independently of anything we can address. The digital images and OCR of this work were produced by Google, Inc. (indicated by a watermark on each page in the PageTurner). Google requests that the images and OCR not be re-hosted, redistributed or used commercially. The images are provided for educational, scholarly, non-commercial purposes.

B 3 9015 00203 699 7  
University of Michigan - BUHR



RECEIVED IN EXCHANGE  
FROM  
Washington Univ.  
Library

Science Libr

QE  
I  
.W32







Science Library

QE  
I  
.W32

UNIVERSITY OF WASHINGTON PUBLICATIONS  
IN  
GEOLOGY

Volume 5, pp. 1-274

December, 1942

PALAEONTOLOGY OF THE MARINE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON

BY  
CHARLES E. WEAVER

PART I

**Coelenterata, Vermes, Echinodermata, Molluscoidea, Mollusca :**  
**Pelecypoda ; Scaphopoda**



PUBLISHED BY THE UNIVERSITY OF WASHINGTON PRESS  
SEATTLE, WASHINGTON



## ERRATA

University of Washington Publications in Geology, Volume V, Parts I, II, III,  
printed December, 1942, issued December 31, 1943.

**Page 1**, add footnote: (332) Durham, J. W. Eocene and Oligocene coral  
faunas of Washington: Journ. Paleon., vol. 16, pp. 84-104, 1942.  
Thirty-three new and four old species of corals are described from  
the Tertiary formations of Washington and Oregon. The reader is  
referred to the above publication.

**Page 24.** *Nucula (Acila) cordata* Dall. This species is referred to under  
*Acila (Truncacila) nehalemensis* G.D.Hanna.

**Page 28.** *Acila (Truncacila) nelsoni* (Clark). Under Geologic range, for  
Upper Oligocene read Middle Oligocene.

**Page 106.** *Mytilus (Mytiloconcha) mathewsonii* Gabb. Under Type locality, read: "From the Miocene, south of Martinez, California." (The Vancouver Island record is a locality record only.)

**Page 122.** Family Cuspidariidae. Under Genotype, for *Neaera* read  
*Neoera*.

**Page 126.** *Crassatellites washingtoniana* Weaver. Under Geologic range,  
add: Lincoln Formation, Middle Oligocene. Under Observations,  
add: The species is an index fossil of the Lincoln Formation.

**Page 143.** *Thyasira bisecta* (Conrad). Under Geologic range, for Middle  
Oligocene to Recent read Middle Miocene (?).

**Page 184.** *Pitar (Lamelliconcha) clarki* (Dickerson). Under Topotypes,  
add:

(U.C. 31544.) Figured in the present report, pl. 42, fig. 1.

(U.C. 31543.) Figured in the present report, pl. 42, figs. 4, 5, 7, 8.

(U.C. 31545.) Figured in the present report, pl. 42, figs. 6, 9.

**Page 657.** Plate 4, figure 9—*Nuculana impressa* (Conrad). Second figure  
from bottom of plate on left-hand side was printed in error as  
figure 6. It should be figure 9.

**Page 726.** Plate 73, figure 9—*Turboella cowditzensis* Effinger. Second  
figure from top on right-hand side of plate was printed in error as  
figure 6. It should be figure 9.



UNIVERSITY OF WASHINGTON PUBLICATIONS  
IN  
GEOLOGY

**Volume 5, pp. 1-278**

**December, 1942**

**PALEONTOLOGY OF THE MARINE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON**

**BY  
CHARLES E. WEAVER**

**PART I**

**Coelenterata, Vermes, Echinodermata, Molluscoidea, Mollusca :  
Pelecypoda ; Scaphopoda**

**PART II**

**Mollusca : Gastropoda ; Cephalopoda ; Arthropoda**

**PART III**

**Bibliography, Faunal Localities, Correlation Chart,  
Faunal Tables, Plates, New Names, Index**

**PUBLISHED BY THE UNIVERSITY OF WASHINGTON PRESS  
SEATTLE, WASHINGTON**



## TABLE OF CONTENTS

(For list of genera and species, see Index, p. 759)

### PART I

Introduction . . . . .	(vii)
Previous work . . . . .	(ix)
Correlation table . . . . .	facing page (xii)
Description of species: Coelenterata, Vermes, Echino- dermata, Molluscoidea, Mollusca: Pelecypoda; Scaphoda . . . . .	1

### PART II

Description of species: Mollusca: Gastropoda; Cephalo- poda; Arthropoda . . . . .	279
Additional Species . . . . .	561

### PART III

Bibliography . . . . .	567
Faunal Localities . . . . .	585
Correlation Chart . . . . .	(opposing) 628
Faunal Tables . . . . .	629
Plates 1-104, and descriptions . . . . .	653
List of New Names . . . . .	758
Index . . . . .	759

(v)



## INTRODUCTION

The purpose of this work is to place on record the marine invertebrate faunas of the Tertiary formations in Oregon and Washington with original and supplementary descriptions of the species and illustrations of the holotypes and better preserved topotype and hypotype material. Usually there are listed under synonymy only those species from the Northwest. The writer has been engaged in a study of the Tertiary stratigraphy and paleontology of the Pacific Northwest since 1907, and during this time several other investigators have contributed many important papers which have made known the biologic characters of a part of these faunas and to some extent their stratigraphic relations. Due to the greater refinement in biologic classification in recent years, many of the earlier descriptions and identifications of genera and species have undergone much revision. Many of the Tertiary species occurring in Oregon and Washington are well represented in California and the numerous published papers on the Tertiary faunas farther south are evidence of the attempts made to arrive at a more accurate understanding of their biologic relations.

The descriptions of species in the earlier papers are sometimes very meager and often these works are difficult of access. Many of the illustrations are poor and the stratigraphic relations of many of the earlier described species are unknown. In some cases identifications of species have been based on descriptions and illustrations of hypotypes which were both generically and specifically incorrect.

For an understanding of the Tertiary faunas it is desirable that the biologic characters of the holotypes be studied. These at present are scattered in several museums in different parts of the country and probably always will remain there. The writer has studied these specimens and secured photographs of the same and these pictures are the basis for most of the illustrations used in this report. The present deposition of the type specimens, wherever known, is noted in the text.

The writer wishes to acknowledge his appreciation of the interest shown and the facilities extended for the study of these collections by those in charge of paleontological institutions where the holotype and topotype materials from Oregon and Washington are located. Among these are the U. S. National Museum, the Philadelphia Academy of Sciences, the California Academy of Sciences, the Museum of Comparative Zoology, the paleontological museums of the universities of California and Oregon and Stanford University. The writer is especially indebted to Dr. Paul Bartsch of the United States National Museum for furnishing the photographic services of that institution and for similar aid from Dr. B. L. Clark, Dr. Herdis Bentson, and Dr. J. Wyatt Durham, of the University of California, Dr. G. Dallas Hanna and Dr. L. G.

Hertlein of the California Academy of Sciences, Dr. H. G. Schenck and Dr. Myra Keen of Stanford University, and Dr. H. L. Clark of the Museum of Comparative Zoology. Acknowledgment is also made to the staff of the University of Washington Library science room for their cooperation in checking references, to Mrs. Betty Turner Halvorsen of the University of Washington Press for her invaluable aid in editing the manuscript, to the administration of the University of Washington for time granted from university teaching duties as well as financial aid for the photographs of fossils which are used in the illustrations. A large number of the photographs were retouched by Mr. John L. Ridgway of Pasadena, formerly in charge of illustrations for the U. S. National Museum. It is hoped that this work will be of aid to the future investigators of Tertiary paleontology and stratigraphy of the Pacific Northwest.

(viii)

## PREVIOUS WORK

The sandstones and shales exposed in and near Astoria, Oregon, yielded the first collections of Tertiary invertebrate marine fossils from the Pacific Coast of North America. These collections were made by James Dwight Dana and others<sup>1</sup> connected with the Wilkes Exploring Expedition, and were submitted to T. A. Conrad for investigation. The descriptions and illustrations were included as an appendage to the geological report on the Astoria region by Dana. The faunas were regarded as of Miocene age, the term Oligocene at that time being unknown.

Additional collections made at Astoria by J. K. Townsend were investigated by Conrad<sup>2</sup> and described in 1848. The occurrence of specimens of the genus *Aturia* in the shales near Astoria led Conrad later in 1865 to change his opinion concerning the Miocene age of the strata and to consider them as Eocene. Conrad did not visit the Oregon and Washington areas and there were no data available concerning the stratigraphic sequences from which the fossil specimens were obtained.

Fossil pelecypods in a collection made by Dr. John Evans from the Coos Bay and Willamette areas were described by B. F. Shumard<sup>3</sup> but were not accompanied by illustrations, and the types have been lost.

During the last quarter of the nineteenth century occasional stratigraphic and faunal studies of the Tertiary formations were made by Thomas Condon,<sup>4</sup> and the name "Astoria shales" was applied to the sandy shales which form the backbone of the Coast Ranges of northwestern Oregon. Collections of fossils were made by J. S. Diller<sup>5 6 7 8 9 10 11 12</sup>

<sup>1</sup> Conrad, T. A. Fossils from northwestern America: Mollusca. United States Exploring Expedition during the years 1838, 1839, 1840, 1841, and 1842, under the command of Charles Wilkes, U.S.N. Geology by James D. Dana. App. 1, pp. 723-729, 1849.

<sup>2</sup> Conrad, T. A. Fossil shells from the Tertiary deposits on the Columbia River, near Astoria. Am. Jour. Sci., 2nd ser., vol. 5, pp. 432-433, 1848.

<sup>3</sup> Shumard, B. F. Descriptions of new fossils from the Tertiary formation of Oregon and Washington territories and the Cretaceous of Vancouver Island, collected by Dr. John Evans, U. S. Geologist, under instructions from the Department of the Interior. Trans. St. Louis Acad. Sci., I, pp. 120-125, 1858.

<sup>4</sup> Condon, Thomas. Am. Naturalist, vol. 14, p. 457, 1880.

<sup>5</sup> Diller, J. S. Tertiary revolution in the topography of the Pacific Coast. U. S. Geol. Surv., 14th Ann. Rept., pt. I, pp. 397-434, 1892-1893.

<sup>6</sup> Diller, J. S. Cretaceous and Early Tertiary of Northern California and Oregon. Bull. Geol. Soc. Amer., vol. 4, pp. 205-224, 1893.

<sup>7</sup> Diller, J. S. A geological reconnaissance in Northwestern Oregon. U. S. Geol. Surv., 17th Ann. Rept., pt. I, pp. 441-520, 1896.

<sup>8</sup> Diller, J. S. U. S. Geol. Surv., Roseburg folio no. 49, 1898.

<sup>9</sup> Diller, J. S. The Coos Bay coalfield, Oregon. U. S. Geol. Surv., 19th Ann. Rept., pt. 3, pp. 309-370, 1899.

<sup>10</sup> Diller, J. S. U. S. Geol. Surv., Coos Bay folio no. 73, 1901.

<sup>11</sup> Diller, J. S. Topographic development of the Klamath Mountains. U. S. Geol. Surv., Bull. no. 196, 1902.

<sup>12</sup> Diller, J. S. U. S. Geol. Surv., Port Orford folio no. 89, 1903.

during his investigations in Oregon and these have been described in the numerous publications of W. H. Dall.<sup>18</sup> <sup>14</sup> <sup>15</sup> <sup>16</sup> <sup>17</sup> <sup>18</sup>

Paleontological contributions made by Arnold,<sup>19</sup> <sup>20</sup> <sup>21</sup> <sup>22</sup> Arnold and Hannibal,<sup>23</sup> Reagan,<sup>24</sup> <sup>25</sup> Weaver,<sup>26</sup> <sup>27</sup> <sup>28</sup> <sup>29</sup> <sup>30</sup> <sup>31</sup> Hannibal,<sup>32</sup> Weaver and Van Winkle,<sup>33</sup> Van Winkle,<sup>34</sup> Clark,<sup>35</sup> <sup>36</sup> Dickerson,<sup>37</sup> <sup>38</sup> <sup>39</sup> Howe,<sup>40</sup> Schenck,<sup>41</sup> <sup>42</sup> <sup>43</sup> <sup>44</sup> <sup>45</sup> <sup>46</sup> White,<sup>47</sup> <sup>48</sup> <sup>49</sup> Etherington,<sup>50</sup> Tegland,<sup>51</sup> <sup>52</sup> <sup>53</sup> Effinger,<sup>54</sup> Turner,<sup>55</sup> Durham,<sup>56</sup> Reinhart,<sup>57</sup> together with those already mentioned have placed on record more than 900 species of invertebrate fossils from Oregon and Washington.

<sup>18</sup> Dall, W. H. A table of North American Tertiary horizons, correlated with one another and with those of Western Europe, with annotations. U. S. Geol. Surv., 18th Ann. Rept., pt. 2, pp. 323-348, 1898.

<sup>14</sup> Dall, W. H. Contributions to the Tertiary fauna of Florida: Pelecypoda: I. Prionodesmacea; II. Teleodesmacea. Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, 1898.

<sup>16</sup> Dall, W. H. Contributions to the Tertiary fauna of Florida: Pelecypoda, concluded. Trans. Wagner Free Inst. Sci., vol. 3, pt. 5, 1900.

<sup>18</sup> Dall, W. H. Marine deposits bordering Klamath peneplain. (Quoted in J. S. Diller, Topographic Development of Klamath Mountains, U. S. Geol. Surv., Bull. no. 196, pp. 30-41, 1902.)

<sup>17</sup> Dall, W. H. Contributions to the Tertiary paleontology of the Pacific Coast. I. The Miocene of Astoria and Coos Bay, Oregon. U. S. Geol. Surv., Prof. Paper no. 59, 1909.

<sup>18</sup> Dall, W. H. Fossils of the Olympic Peninsula. Am. Jour. Sci., vol. 204, pp. 305-314, 1922.

<sup>19</sup> Arnold, R. Coal in Clallam County, Washington. U. S. Geol. Surv., Bull. no. 260, pp. 413-421, 1904.

<sup>20</sup> Arnold, R. The Tertiary and Quaternary Pectens of California. U. S. Geol. Surv., Prof. Paper no. 47, 1906.

<sup>21</sup> Arnold, R. Geological reconnaissance of the coast of the Olympic Peninsula, Washington. Bull. Geol. Soc. Am., vol. 17, pp. 451-468, 1906.

<sup>22</sup> Arnold, R. Environment of the Tertiary faunas of the Pacific Coast of the United States. Jour. Geol., vol. 17, no. 6, pp. 509-533, 1909.

<sup>23</sup> Arnold, R., and Hannibal, H. The marine Tertiary stratigraphy of the North Pacific Coast of America. Proc. Am. Phil. Soc., vol. 52, no. 212, pp. 559-605, 1913.

<sup>24</sup> Reagan, A. B. Some notes on the Olympic Peninsula, Washington. Trans. Kans. Acad. Sci., vol. 22, pp. 131-238, 1909.

<sup>25</sup> Reagan, A. B. Die Fossilien der Clallamformation mit denjenigen der Tertiärformationen in Vancouver-Insel und mit denjenigen der Astoria-Miocanformation in Oregon verglichen. Centralblatt für Mineral, Geol. und Paleo., no. 20, pp. 646-651, 1910.

<sup>26</sup> Weaver, C. E. A preliminary report on the Tertiary paleontology of Western Washington. Wash. Geol. Surv., Bull. no. 15, 1912.

<sup>27</sup> Weaver, C. E. Tertiary faunal horizons of Western Washington. Univ. Wash. Publ. Geol., vol. 1, no. 1, pp. 1-67, 1916.

<sup>28</sup> Weaver, C. E. Eocene of the Lower Cowlitz Valley, Washington. Proc. Calif. Acad. Sci., ser. 4, vol. 6, no. 1, pp. 1-17, 1916.

<sup>29</sup> Weaver, C. E. The Post-Eocene formations of Western Washington. Proc. Calif. Acad. Sci., ser. 4, vol. 6, no. 2, pp. 19-40, 1916.

<sup>30</sup> Weaver, C. E. The Oligocene of Kitsap County, Washington. Proc. Calif. Acad. Sci., ser. 4, vol. 6, no. 3, pp. 41-52, 1916.

<sup>31</sup> Weaver, C. E. Tertiary Formations of Western Washington. Wash. Geol. Surv., Bull. no. 13, pp. 1-327, 1916.

<sup>32</sup> Hannibal, Harold. Proc. Am. Phil. Soc., vol. 52 (1913), pp. 597-598.

<sup>33</sup> Weaver, C. E., and Palmer, K. Van Winkle. Fauna from the Eocene of Washington. Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 1-56, 1922.

- <sup>34</sup> Van Winkle, K. E. Paleontology of the Oligocene of the Chehalis Valley, Washington. Univ. Wash. Publ. Geol., vol. 1, no. 2, pp. 69-97, 1918.
- <sup>35</sup> Clark, B. L. Pelecypoda from the marine Oligocene of Western North America: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 69-136, 1925.
- <sup>36</sup> Clark, B. L. and Arnold, Ralph. Fauna of the Sooke formation, Vancouver Island, with description of a new coral by T. W. Vaughan. Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 123-234, 1923.
- <sup>37</sup> Dickerson, R. E. The fauna of the *Siphonalia sutterensis* Zone in the Roseburg Quadrangle, Oregon. Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 113-128, 1914.
- <sup>38</sup> Dickerson, R. E. Fauna of the type Tejon. Its relation to the Cowlitz phase of the Tejon group of Washington. Proc. Calif. Acad. Sci., ser. 4, vol. 5, pp. 33-98, 1915.
- <sup>39</sup> Dickerson, R. E. Climate and its influence upon the Oligocene faunas of the Pacific Coast, with descriptions of some new species from the *Molopophorus lincolnensis* Zone. Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 157-192, 1917.
- <sup>40</sup> Howe, H. V. Faunal and stratigraphic relationships of the Empire formation, Coos Bay, Oregon. Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 85-114, 1922.
- <sup>41</sup> Schenck, H. G. *Cassididae* of Western North America. Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, pp. 69-98, 1926.
- <sup>42</sup> Schenck, H. G., and Cushman, J. A. Two foraminiferal faunules from the Oregon Tertiary. Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 17, pp. 305-324, 1927.
- <sup>43</sup> Schenck, H. G. Diatoms in Western Oregon shales. Econ. Geol., vol. 22, pp. 565-568, 1927.
- <sup>44</sup> Schenck, H. G. Stratigraphic relations of Western Oregon Oligocene formations. Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, pp. 1-50, 1928.
- <sup>45</sup> Schenck, H. G. Cephalopods of the genus *Aturia* from Western North America. Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, pp. 435-490, 1931.
- <sup>46</sup> Schenck, H. G. Nuculid bivalves of the genus *Acila*. Geol. Soc. Am., Spec. Pap. no. 4, pp. 1-149, 1936.
- <sup>47</sup> White, C. A. On marine Eocene, fresh water Miocene, and other fossil Mollusca of Western North America. U. S. Geol. Surv., Bull. no. 18, 1885.
- <sup>48</sup> White, C. A. On the Puget Group of Washington Territory. Am. Jour. Sci., ser. 3, vol. 36, pp. 443-450, 1888.
- <sup>49</sup> White, C. A. On invertebrate fossils from the Pacific Coast. U. S. Geol. Surv., Bull. no. 51, 1889.
- <sup>50</sup> Etherington, T. J. Stratigraphy and fauna of the Astoria Miocene of Southwest Washington. Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 31-142, 1931.
- <sup>51</sup> Tegland, N. M. Correlation and affinities of certain species of *Pitaria*. Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, pp. 275-290, 1929.
- <sup>52</sup> Tegland, N. M. Gastropod genus *Galeodea* in the Oligocene of Washington. Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, pp. 397-444, 1931.
- <sup>53</sup> Tegland, N. M. The fauna of the type Blakeley, upper Oligocene of Washington. Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 81-174, 1933.
- <sup>54</sup> Effinger, W. L. The Gries Ranch fauna (Oligocene) of Western Washington: Jour. Paleon., vol. 12, pp. 355-390, 1938.
- <sup>55</sup> Turner, F. E. Stratigraphy and Mollusca of the Eocene of Western Oregon. Geol. Soc. Am., Spec. Pap. no. 10, pp. 1-130, 1938.
- <sup>56</sup> Durham, J. W. Gastropods of the family Epitoniidae from Mesozoic and Cenozoic rocks of the West Coast of North America including one new species by F. E. Turner and one by R. A. Bramkamp. Jour. Paleon., vol. 11, pp. 479-512, 1937.
- <sup>57</sup> Reinhart, P. W. Cretaceous and Tertiary Pelecypods of the Pacific Slope incorrectly assigned to the family Arcidae. Jour. Paleon., vol. 11, pp. 169-180, 1937.



**PALEONTOLOGY OF THE MARINE TERTIARY FORMATIONS  
OF OREGON AND WASHINGTON**

**PART I.**

**Coelenterata, Vermes, Echinodermata, Molluscoidea,  
Mollusca: Pelecypoda, Scaphopoda**

(xiii)



## DESCRIPTION OF SPECIES†

### COELENTERATA

#### Class Anthozoa

#### Family EUPSAMMIDAE Milne Edwards and Haime

Genus **BALANOPHYLLIA** Wood

**BALANOPHYLLIA cf. VARIABILIS** Nomland, 1916

Plate 1, figures 1, 2, 3

*Balanophyllia variabilis* Nomland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 66, pl. 4, figs. 2, 3, 4, 13, 1916; Effinger, Jour. Paleon., vol. 12, p. 388, pl. 47, fig. 20, 1938.

*Original description.* Corallum variable in shape from elongate to short cornute, curved in the direction of the lesser transverse axis. Cross-section elliptical to sub-circular. Wall strong, vesicles not numerous. Costae granular, rather wide, rounded, with narrow intercostal grooves; on some specimens a tendency is shown to have every fourth costa of more prominent development. Septa in five cycles, lateral faces granulated, thin at calice but becoming thicker as base is approached, third and fourth cycles fused to the third. Columella somewhat fascicular, in some sections cut near the calice, however, the columellar space seems to be traversed largely by extensions of septa of the first three cycles. Greater transverse diameter, 10.7 mm.; lesser transverse diameter, 10.3 mm.; height of corallum, perhaps about 45 mm.; but exact height unknown since in the material at hand no complete specimen of the longer variety could be found. (Nomland)

*Observations.* Specimens obtained from the lower Oligocene sandstone and conglomerate at Gries Ranch on Cowlitz River are poorly pre-

† The institutions which contain the type specimens are designated as follows: (U.W.)—University of Washington, Seattle, Washington.

(U.C.)—Museum of Invertebrate Paleontology, University of California, Berkeley, California.

(S.U.)—Stanford University Paleontological Type Collection, Palo Alto, California.

(C.A.S.)—California Academy of Sciences, Golden Gate Park, San Francisco, California.

(U.O.)—University of Oregon, Eugene, Oregon.

(U.S.N.M.)—United States National Museum, Washington, D.C.

(P.A.N.S.)—Philadelphia Academy of Natural Sciences, Philadelphia, Pennsylvania.

(M.C.Z.)—Museum of Comparative Zoology, Cambridge, Massachusetts.

(St. Louis A.S.)—St. Louis Academy of Natural Sciences, St. Louis, Missouri.

All types designated (U.W.) are now in the California Academy of Sciences and are registered with museum numbers of both institutions.

All illustrations excepting a few designated forms on Plates 103 and 104 are photographs of original type specimens and not reproductions of published figures.

The use of the term "syntype" for a single specimen in this paper indicates that only one of two or more specimens used as syntypes in the original description is figured in the present report.

served but the general shape of the corallum and the character and arrangement of the septae and cross-section of the corallum closely resemble the description given by Nomland for *Balanophyllum variabilis* from the middle Eocene.

*Hypotype.* (U.C. 15384.) Gries Ranch beds. Figured in the present report, pl. 1, figs. 1, 2, 3.

*Geologic range.* Gries Ranch beds, lower Oligocene, Washington; Eocene in California.

*Occurrence.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, northeast quarter of Section 25, T. 11 N., R. 2 W.

#### **BALANOPHYLLIA BLAKELEYENSIS Quayle, 1933**

Plate 1, figures 4, 5

*Balanophyllum blakeleyensis* Quayle, in Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 142, pl. 15, fig. 11, 1933.

*Observations.* This specimen from the Blakeley formation is not well preserved but has been figured, though not described, by Tegland. A description will appear later by Quayle in his monograph on the corals.

*Holotype.* (U.C. 32245.) Figured in the present report, pl. 1, figs. 4, 5.

*Geologic range.* Blakeley formation, uppermost Oligocene.

*Geographic distribution.* Kitsap County, Washington.

*Type locality.* (U.W. 13.) Restoration Point, west of Seattle.

#### **Family FUNGIDAE Dana**

##### **Genus SIDERASTREA DeBlainville**

#### **SIDERASTREA VANCOUVERENSIS Vaughan, 1923**

Plate 1, figures 7, 14

*Siderastrea vancouverensis* Vaughan, in Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 175, 176, pl. 40, figs. 1, 2, 1923.

*Original description.* Growth form explanate. Type about 20 mm. in horizontal diameter and 3.5 mm. thick. Calices large, polygonal, shallow. Lesser diameter about 6 mm.; greatest diameter, about 7 mm. Septa about 48, 4 so-called complete cycles; primaries and secondaries and a septal prolongation from junction of quaternaries to sides of tertiaries reach columella; quaternaries fuse to tertiaries about two-thirds of distance from wall to columella. Septa are thin, about 0.10 mm. thick except at wall; interseptal loculi much wider. The septal trabeculae are fine; the number to a long septum could not be made out with certainty because of the damaged condition of the specimen, but it is about 8 to a septum. Septal faces with pointed granulations. The columella is large, about 2 mm. in diameter, and papillate. Synapticula in one or two circles near the wall. (Vaughan in Clark and Arnold)

*Observations.* Examination of the published illustration of the type specimen and of several poorly preserved fragments collected by the writer from the Sooke formation at Sooke Bay shows this species to bear some resemblance to *Siderastrea mendenhalli* Vaughan from the Carrizo Creek beds in Imperial County, California, as has been noted by Vaughan.

It differs in the relatively greater diameter of the columella and in the proportionately lesser depth of the calices.

*Holotype.* (U.S.N.M., lost.) Reproduction of figure in (50, pl. 40, figs. 1, 2). Figured in the present report, pl. 1, figs. 7, 14.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South shore of Vancouver Island.

*Type locality.* One-half mile up Kirby Creek from its mouth, on east side of creek, Sooke Bay, Vancouver Island. (Clark and Arnold)

#### Family TURBONILIIDAE

Genus STEPHANOTROCHUS Mosely

STEPHANOTROCHUS sp. Dall, 1909

Plate 1, figure 6

*Stephanotrochus* sp. Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 141, 1909.

*Observations.* The specimen here figured occurs in the collection of the Wilkes Exploring Expedition in the U.S. National Museum and consists of a poorly preserved cross-section of a cup coral in sandstone. It was listed but not figured by Dall, who states that Vaughan referred it to the genus *Stephanotrochus* or some closely related form. The diameter of the cup as represented in the cross-section is about 55 mm. and it is nearly circular. The septa occur in five cycles, the third, fourth, and fifth of which are fused to the second. There appear to be about 54 septa, 13 of which are primary. The poor preservation of this specimen makes difficult the determination of the character of the columella.

*Holotype.* (U.S.N.M. 3575.) Figured in the present report, pl. 1, fig. 6.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Astoria, Oregon.

*Type locality.* Astoria, Oregon, from collection made by J. D. Dana under Wilkes Exploring Expedition.

#### VERMES

Class Annelida

Genus SERPULA Linnaeus

?SERPULA OCTOFORIS Dall, 1909

Plate 1, figure 13

?*Serpula octoforis* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 138, pl. 20, figs. 1, 2, 1909.

*Observations.* This specimen from the Empire formation at Coos Bay, Oregon, was described by Dall as possibly belonging to the genus *Serpula*, although its true biologic relationships are uncertain. It is in the collection of the U.S. National Museum and has been studied by the

writer. Its general character can be presented best by the published remarks of Dall: "A careful inspection of the fossil arouses doubts as to its true nature which I am unable to resolve definitely, and I have therefore placed it provisionally in the genus *Serpula*, with great doubt as to whether it will permanently remain there.

"The mass consists, as will be seen by the figure, of agglutinated tubules, radiating roughly from a common center or root which has not been preserved. On close examination the tubes appear more as if they had been bored through a solid substance than as if they had formed a solid mass by agglutination. They impinge upon each other at various points so that apertures open from one tube into another, which is something the shipworms sedulously avoid. The interior of the tubes is nearly smooth, more or less transversely striated toward the aperture, which, when perfectly preserved, is of a 'figure-of-eight' shape, but when, as usual, broken back by beach wear, is transversely oval. The contraction of the 'figure-of-eight' is marked in some cases by a faint ridge extending longitudinally a few millimeters into the tube. So far I have observed these ridges only on one side of the tube, the other side in each case having been broken or worn away. Notwithstanding the fact that the tubes look as if they were borings into a solid substance, the material of which they are composed appears in general to have been deposited either in layers parallel with the tube itself or concentrically where interstices appear to have been filled with matter of the same sort. There are a number of cavities evidently secondary due to the boring of *Pholas* or other boring mollusks into the mass, but this may have occurred after the original had been fossilized. The substance of the mass is not fossil wood as in the case of *Xylotrya* borings, but of the same appearance as the casing of the tubes themselves, and apparently of animal origin. But I have not found any recent *Serpula* which has apertures of the shape here described, nor which, in masses, has intercommunication between the tubes. Nor is there any sponge which closely approaches this enigmatical form in its tubulation. The borings of *Limnoria* are short, and occupy space in masses of wood, which these certainly did not, while the structure of tubular coral is entirely different. The explanation of the true relations of this fossil will be awaited with interest."

*Holotype.* (U.S.N.M. 153963.) Figured in the present report, pl. 1, fig. 13.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Type locality.* Coos Bay, Oregon (Camman Collection).

SERPULA sp. Clark and Arnold, 1923

Plate 61, figure 22

*Serpula* sp. Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 175, pl. 39, fig. 4, 1923.

*Holotype.* (U.C. 30255.) Figured in the present report, pl. 61, fig. 22.

*Geologic range.* Upper Oligocene.

*Type locality.* Near Muir Creek, Vancouver Island.

**ECHINODERMATA**

## Class Echinoidea

## Family FIBULARIIDAE Gray

## Genus ECHINARACHNIUS Gray, 1825

*Genotype.* *Phelsumaster parma* Lamarck

## ECHINARACHNIUS BLANCOENSIS (Kew), 1920

## Plate 3, figures 1, 2, 3, 4

*Scutella blancoensis* Kew, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 12, pp. 64, 65, pl. 11, figs. 1a, 1b, 1c, 1920.

*Echinarachnius blancoensis* Grant IV and Hertlein, Univ. Calif. at Los Angeles Publ. Math. & Phys. Sci., vol. 2, pp. 57, 58, pl. 26, figs. 5, 6, 7, 1938.

*Original description.* Test small. Measurements of specimen 11358: antero-posterior diameter 22.3 mm., transverse diameter 23.8 mm., greatest height 4.0 mm. Outline subovate, pointed behind. Apical system relatively large and eccentric anteriorly; four genital pores present. Upper surface considerably depressed, especially in the posterior area; rises to the apex, which is situated anterior to the apical system and comparatively close to the margin; anterior part of the upper surface of the test considerably more elevated than the posterior part, and with the margin thickened. Lateral petals elliptical in outline, rather long, narrow, and extending about three-fourths the distance to the margin. Inner rows of pores converging but little at their ends; outer rows converging close to the inner rows at the extremity of the petals with a few sporadic pores beyond the petals, the rows diverging widely. Poriferous areas comparatively wide, each being almost as wide as the interporiferous area. Odd anterior petal wide, broadly open at its extremity, and shorter than the paired petals; poriferous areas about as wide as those of the lateral petals, but the interporiferous area is nearly twice the width; inner rows of pores diverge to the end; outer rows diverge strongly until about one-half the distance to the end, whence they continue in parallel lines, gradually coming closer to the inner row, and, as the distal portion is approached, both rows strongly diverge. Outer rows of pores slightly sunken in all petals. Inferior surface flat, with very faint, straight, undivided ambulacral lines in indistinct broad grooves, which do not reach the margin. Peristome subpentagonal in outline and slightly anteriorly eccentric. Periproct round, supramarginal, and placed about its own diameter from the edge of the test. Tubercles on the superior surface very small and crowded; those of the inferior surface larger and placed in well defined scrobicules. (Kew)

*Observations.* The specimens of this species from conglomerate in the Montesano formation exposed on Sylvia Creek, north of Montesano in Washington, correspond in every detail with the type described by Kew from sandstones of the Empire formation at Cape Blanco, Oregon. It differs from the variety *etheringtoni* in the absence of the posterior marginal indentations at the extremities of the ambulacral areas of the bivium and in the slight attenuation of the posterior interambulacral margin. The variety *etheringtoni* occurs in the Astoria formation and is unknown in the Empire and Montesano formations.

*Hypotype.* (U.C. 12495.) Figured in the present report, pl. 3, figs. 1, 2.

*Hypotype.* (U.W. 368.) From Montesano formation—locality (U.W. 427). Figured in the present report, pl. 3, figs. 3, 4.

*Geologic range.* Empire and Montesano formations, upper Miocene and lower Pliocene.

*Geographic distribution.* Coast of Oregon near Cape Blanco, and Grays Harbor County, Washington.

*Type locality.* Sea cliffs north of the light house, Cape Blanco, Oregon. Occurs also in Washington in logging railroad cut on Sylvia Creek in Section 32, T. 18 N., R. 7 W.

**ECHINARACHNIUS BLANCOENSIS (Kew) var. ETHERINGTONI n. var.**

Plate 3, figures 7, 8

*Scutella blancoensis* Kew n. var. (?) Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 63, pl. 9, fig. 12, 1931.

*Description.* The size and relative dimensions of the test correspond closely to those of *Echinarachnius blancoensis*. The variety differs in having a slight marginal indentation in the area behind the posterior ambulacra. The part of the ambitus in the posterior interambulacral area is slightly attenuated. These characters have not been observed in the specimens of *E. blancoensis* from the Montesano and Empire formations. The posterior ambulacra in the bivium are proportionally shorter in the variety. This variety is known only from the Astoria formation of Grays Harbor County, Washington.

*Holotype.* (U.C. 31981.) Figured in the present report, pl. 3, figs. 7, 8.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 427.) Clemons logging road one-fourth mile south of the eight-mile post, Section 26, T. 17 N., R. 7 W.

**ECHINARACHNIUS NEWCOMBEI (Kew) 1920**

Plate 3, figures 5, 6

*Scutella newcombei* Kew, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 12, pp. 73, 74, pl. 8, figs. 2a, 2b, 1920; Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 131, 174, 232, pl. 41, figs. 1a, 1b, 1923.

*Echinarachnius newcombei* Grant IV and Hertlein, Univ. Calif. at Los Angeles Publ. Math. & Phys. Sci., vol. 2, p. 61, 1938.

*Original description.* Test of medium size. Approximate measurements of holotype: anteroposterior diameter 40 mm., transverse diameter 44 mm., greatest elevation 7.8 mm. Outline subcircular, with margin truncated in the odd anterior ambulacral area; margin slightly thicker in the anterior part. Apical system anteriorly eccentric to a slight degree. Upper surface much depressed; rises gradually to a low apex, which is anterior to the apical system. Ambulacral area nearly twice the width of the interambulacra at the ambitus; ambulacra petaloid. Lateral petals subelliptical in outline; angle between the axes of the anterior lateral petals is nearly 180°. Inner rows of pores diverge gradually for about two-thirds the length of the petal and then converge slightly to the end. Outer rows diverge somewhat more at first and converge to a greater degree in the distal end. The arrangement of pores gives the petals an appearance of having a slight tendency to be closed at their extremities. Each poriferous area about one-half the width of the interporiferous area. Odd anterior petal wider than the others due to the greater width of the interporiferous area; inner rows of pores in this petal diverge to the end; outer rows converge slightly in the distal part. This arrangement gives the petal a wide open, or flaring appearance. All petals extend about two-thirds the distance to the margin. Inferior surface flat, with ambulacral furrows extending from the peristome to the margin, and in the specimen

examined appear to be simple and undivided. Peristome central, rather large, and round. Periproct small, infra-marginal, and situated about midway from the posterior margin to the mouth. Tubercles on the upper surface small and crowded; those on the inferior surface somewhat larger, and placed in distinct scrobicules. (Kew)

*Observations.* This species from the Sooke formation of upper Oligocene age on Vancouver Island differs from *E. blancoensis* in the truncate character of the anterior margin, in a more rounded posterior margin, relatively shorter petals, and in a general larger size. It may be distinguished from *E. fairbanksi* of the Vaqueros formation of California in the relative greater width of the petals and in their not being elevated above the general level of the surface of the test.

*Holotype.* (S.U. 5164) (U.C. 11356). Figured in the present report, pl. 3, figs. 5, 6.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Jordan River on south coast of Vancouver Island.

*Type locality.* (S.U. N.P. 131.) Basal conglomerate of Sooke formation in sea cliffs one-half mile east of Slide Hill telegraph station, Jordan River, Vancouver Island.

## Family SCUTELLIDAE

Genus EOSCUTELLA Grant IV and Hertlein, 1938

*Eoscutella* Grant IV and Hertlein, Univ. Calif. at Los Angeles Publ. Math. & Phys. Sci., vol. 2, p. 54, 1938.

*Genotype.* *Scutella coosensis* Kew.

### EOSCUTELLA COOSENSIS (Kew), 1920

Plate 3, figures 12, 13

*Scutella coosensis* Kew, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 12, pp. 65, 66, pl. 8, figs. 1a, 1b, 1920.

*Eoscutella cooensis* Grant IV and Hertlein, Univ. Calif. at Los Angeles Publ. Math. & Phys. Sci., vol. 2, pp. 54, 55, pl. 20, fig. 8, 1938 (synonymy); Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 41, pl. 5, fig. 1, 1938.

*Original description.* Test of medium size, and greatly depressed. Measurements of holotype: anteroposterior diameter 52 mm., transverse diameter approximately 80 mm., greatest height approximately 8 mm. Marginal outline transversely suboval. Margin thin, with the upper surface gently and regularly arched to the summit, the latter being situated slightly anterior to the center of the test. Apical system central; madreporic area large, four genital pores present opposite the four lateral corners. Ambulacra extremely wide at the ambitus, the odd anterior one being four times the width of the adjoining interambulacra, the other ambulacra about three times the width of the adjoining areas. Petals of moderate size, symmetrical and reaching slightly over one-half the distance from the apical system to the margin; odd anterior and posterior lateral petals of equal length and somewhat shorter than the anterior lateral pair; all of same width, with very wide poriferous areas and narrow interporiferous areas, except that of the odd posterior petal, which is slightly wider than the others. Inner rows of oval pores extend in nearly parallel lines to the end of the petal, converging but little at their ends; outer rows of slit-like pores diverge at first to a much greater degree and then continue approximately parallel to the inner rows until near the extremity of the petal, when they sharply converge close to the inner rows; outer rows of pores in the odd anterior petal curve more

regularly from the base to the end. Lower surface nearly flat. Periproct very small and marginal. (Kew)

*Observations.* This species is characterized by its suboval outline, transverse elongation, moderately large size, and nearly parallel-sided petals. The odd anterior petal is shorter than the other two of the bivium and is relatively narrow and nearly closed in contrast to the broader and open petal of the similarly shaped *Echinarachnius vaquerosensis* Kew.

*Holotype.* (C.A.S. 446.) Figured in the present report, pl. 3, fig. 12.

*Hypotype.* (U.C. 33233.) Figured in the present report, pl. 3, fig. 13.

*Geologic range.* Coaledo formation, upper Eocene.

*Geographic distribution.* Coos County, Oregon.

*Type locality.* West of Yokam Point, Coos County, Oregon. North part of Section 4, T. 26 S., R. 14 W.

#### Genus ANORTHOSCATUM Lambert and Thiery, 1914

*Anorthoscutum* Lambert and Thiery, Essai Nomencl. Raison. Echinid., fasc. 4, p. 319, 1914.

*Genotype.* *Scutella interlineata* Stimpson.

#### ANORTHOSCATUM OREGONENSE (W. B. Clark), 1909

##### Plate 3, figure 14

*Scutella (Echinarachnius) oregonensis* W. B. Clark in Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 140, pl. 7, fig. 2, 1909; Clark, W. B., and Twitchell, M. W., U.S. Geol. Surv., Monog. no. 54, p. 195, pl. 90, fig. 1, 1915.

*Dendraster (Calaster) oregonensis* Clark, Kew, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 12, p. 132, pl. 33, figs. 2a, 2b, 1920.

*Dendraster oregonensis* Clark, Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 94, 1922.

*Anorthoscutum oregonense* Clark, Lambert & Thiery, Essai Nomencl. Raison. Echinid., fasc. 9, p. 584, 1925; Grant IV and Hertlein, Univ. Calif. at Los Angeles Publ. Math. & Phys. Sci., vol. 2, p. 92, 1938.

*Original description.* Disk small, subcircular, depressed, margin not notched at the ambulacral extremities, the edge rounded and blunt in the young, somewhat flatter in the larger specimens; anal pore above and within the margin; star symmetrical, the two posterior petals shorter, the apex behind the center; petals not reaching the margin; ambulacral furrows of the base feeble, hardly traceable; whole surface when perfect covered with prominent pustules, rather crowded, and originally bearing small spines; dome of the upper surface rising evenly rounded from the margin to the apex. Diameter of figured specimen (transverse), 28 mm.; maximum vertical diameter, 3 mm. (W. B. Clark in Dall)

*Supplementary description.* Test small. Measurements of specimen no. 449: anteroposterior diameter 25.4 mm., transverse diameter 26.5 mm., greatest height 2.3 mm. Outline subpentagonal to subcircular. Upper surface considerably depressed and arching to the summit, which is slightly anterior to the apical system; submarginal area somewhat flattened; margin thin. Apical system distinctly eccentric to the posterior. The ambulacra wider than the interambulacra at the ambitus the plates of the former becoming greatly enlarged beyond the extremities of the petals. Dorsal portions of the ambulacra petaloid. Petals large, subelliptical in shape asymmetric, and extending about four-fifths the distance to the margin; petals of the bivium shorter than the lateral petals of the trivium, with the odd anterior one longer than the

others. Rows of pores of the lateral petals nearly closing at their extremities; posterior inner rows in bivium and anterolateral pair nearly straight; anterior rows much curved. Poriferous area of the bivium wide, each being of about the same width as the interporiferous area; that of the lateral petals of the trivium not so wide, each being slightly more than half the width of the interporiferous area. Odd anterior petal wider than the others; poriferous area quite narrow, with a correspondingly large interporiferous area, and the rows of pores not converging so closely at their ends as in the other petals. A few pores continue beyond the extremities of the petals. Inferior surface flat except near the peristome, where it becomes faintly concave. Ambulacral furrows well marked, branching about one-third the distance from the peristome to the margin, with the latter again branching near the edge of the test; the main furrows die out when about two-thirds the distance to the margin. Peristome slightly eccentric posteriorly, round in outline, and of moderate size. Periproct supramarginal, and situated from the edge of the test a distance equal to the width of a marginal plate. Tubercles small, crowded, of the same size on the upper surface and near the margin on the under surface, but become larger, more noticeably scrobiculate, and less crowded toward the peristome. The internal skeleton consists of radiating partitions in the interambulacral areas, which connect with the upper surface near the margin, and from that place to the peristome extend as thick ridges on the floor; between these are intercommunicating pillars and irregularities on the lower surface. The auricles are well developed. (Kew)

*Observations.* This species, although smaller, resembles *A. interlineatum* Stimpson, but differs in its subpentagonal to subelliptical outline and in its more marked eccentric apical system. The petals also show a lesser degree of symmetry.

*Holotype.* (U.S.N.M. 153975.) Figured in the present report, pl. 3, fig. 14.

*Geologic range.* Empire and Montesano formations, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon, and Hoquiam, Washington.

*Type locality.* Fossil Point, Oregon (Camman collection).

**ANORTHOSEUTUM OREGONENSE (W. B. Clark) var. QUAYLEI Grant IV  
and Hertlein, 1938**

Plate 3, figures 10, 11

*Dendraster (Calaster) oregonensis gibbosus* Kew, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 12, p. 134, pl. 33, figs. 3a, 3b, 3c, 1920.

*Anorthoscutum oregonense quaylei* Grant IV and Hertlein, Univ. Calif. at Los Angeles Publ. Math. & Phys. Sci., vol. 2, p. 93, pl. 21, fig. 13; pl. 30, fig. 11, 1938.

*Observations.* This species has not been found in Oregon or Washington but since the type was obtained from the Wildcat formation in Humboldt County, California, only a short distance south of the Oregon boundary, the form is figured with the northern forms for comparison. It may be distinguished from *A. oregonense* in the greater elevation of the abactinal surface in the apical part and a lesser elevation toward the ambitus.

*Holotype.* (U.C. 11386.) Figured in the present report, pl. 3, figs. 10, 11.

*Geologic range.* Wildcat formation, Pliocene.

*Geographic distribution.* Northwestern California.

*Type locality.* (U.C. 1881.) Near Shively, Humboldt County, California.

**ANORTHOSCUTUM OREGONENSE** (W. B. Clark) var. **SEMIGIBBOSUS** (Howe), 1922

## Plate 4, figure 2

*Dendraster (Calaster) oregonensis* W. B. Clark var. *semigibbosus* Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 102, pl. 7, fig. 3, 1922.  
*Anorthoscutum oregonense semigibbosus* Howe, Grant IV and Hertlein, Univ. Calif. at Los Angeles Publ. Math. & Phys. Sci., vol. 2, p. 93, 1938.

*Observations.* The following three varieties of *Anorthoscutum oregonense* from the Pliocene of northwestern California and from Oregon and Washington have been described: *A. oregonense major* (Kew), *A. oregonense quaylei* Grant IV and Hertlein, and *A. oregonense semigibbosus* (Howe). The last-named only has been recognized in Oregon. The variety *semigibbosus* differs from the species *oregonense* in a more pronounced elevation of the abactinal surface but less than that in the variety *quaylei*. The variety *major* is a much larger form than the species *oregonense* or the varieties *semigibbosus* and *quaylei*.

*Holotype.* (S.U. 57.) Figured in the present report, pl. 4, fig. 2.

*Geologic range.* Empire formation, Pliocene.

*Geographic distribution.* Southwest coast of Oregon.

*Type locality.* (S.U. N.P. 27.) Cape Blanco, Oregon.

Genus **SCHIZASTER** L. Agassiz, 1836

*Schizaster* L. Agassiz, Mem. Soc. Sci. Nat. Neuchatel, vol. 1, p. 185, 1836.

*Genotype.* *Schizaster studeri* L. Agassiz.

## SCHIZASTER sp. Tegland, 1933

## Plate 3, figure 9

*Schizaster* sp. Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 88, 142, pl. 15, fig. 10, 1933; Grant IV and Hertlein, Univ. Calif. at Los Angeles Publ. Math. & Phys. Sci., vol. 2, p. 121, 1928.

*Observations.* A poorly preserved specimen of an echinoid from the upper Oligocene Blakeley formation was figured by Tegland and provisionally placed in the genus *Schizaster*, although a specific identification could not be made. Anteroposterior length 34 mm.; transverse lateral axis 34 mm. The test is moderately small and subcordiform in marginal outline. Maximum elevation at apical system, which is situated about one-third the axial length of test from posterior end. The ambulacra are moderately wide, the odd anterior ambulacrum lying in a moderately deep groove which forms a noticeable indentation on the anterior part of the ambitus. The anterolateral petals are about twice as long as the posterolateral and all four are slightly broader than the anterior petal and lie in somewhat shallower grooves. The interambulacra are somewhat elevated. The surface of the test is badly weathered and the tubercles are only faintly visible.

*Holotype.* (U.C. 32247.) Figured in the present report, pl. 3, fig. 9.

*Geologic range.* Blakeley formation, upper Oligocene.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, Washington.

Genus **BRISASTER** Gray, 1855

*Brisaster* Gray, Cat. Rec. Echin. Brit. Mus., p. 61, 1855.

*Genotype.* *Brissus fragilis* Duben and Koren.

## BRISASTER MAXIMUS H. L. Clark, 1937

## Plate 4, figure 5

*Brisaster maximus* H. L. Clark, Trans. San Diego Soc. Nat. Hist., vol. 8, no. 28, p. 368, pl. 24, fig. 9, 1937; Grant IV and Hertlein, Univ. Calif. at Los Angeles Publ. Math. & Phys. Sci., vol. 2, p. 122, 1938.

*Original description.* Length about 84 mm., with the width approximately 76 mm.; nearly the whole width is shown in the large mold. If the proportions were the same as in *townsendi*, the height was about 42 mm. In the Recent species the apex is far back of the middle of the dorsal surface, so that its center is only .40 of the test length from the posterior margin of the test; in the fossil the apex is so near the center that the anterior margin could not have been more than 4 or 5 mm. further away than the rear end of the test. As a result of this difference in the position of the apex, the distal ends of petals I and V are far from the test margin in *maximus*, while in *townsendi* they would overreach it if they did not diverge markedly from each other and from the longitudinal axis. The size of the petals and the angles which they make with the axis and with each other show very great diversity in *townsendi*, but it is rare for petals I and V to form as narrow an angle with each other as they do in *maximus* (about 80°); in *townsendi* the angle commonly exceeds 90° and may be much more.

The tuberculation of the test in *maximus* was apparently very much as in *townsendi*, the larger tubercles occurring beside the petals, especially near the distal ends. Fragments of the peripetalous fasciole can be distinguished here and there, most evidently around the tip of petal V and thence anteriorly towards petal IV. (H. L. Clark)

*Observations.* The holotype of this species has not been examined by the writer but the illustration is from a photograph furnished by Dr. H. L. Clark of the Museum of Comparative Zoology, who states in a personal communication, "I think you will understand from both the photograph and the description that no other view of the specimen would be possible. The specimen and its fellow are simply moulds of the upper surface. There is no trace of the actinal surface with any of the specimens. The photograph is misleading as all the surrounding matrix with several other specimens (fragments of dorsal moulds) has been blacked out. A curious 'defect?' of the photograph is that the petals which are strongly convex in the specimen, are concave as they were in the animal in life. The photograph is therefore much more life-like than the specimen."

*Holotype.* (M.C. Zool. 3830.) Figured in the present report, pl. 4, fig. 5.

*Geologic range.* Pittsburg Bluff beds, middle Oligocene.

*Geographic distribution.* Washington County, Oregon.

*Type locality.* Washington County, Oregon, from the center of the south line of Sec. 12, T. 3 N., R. 4 W.; in a dug well along road at C. H. Bonham farm; 1000 feet south of coal seam exposure; Pittsburg Bluff formation, Refugian stage; *Acila shumardi* zone, "Oligocene" of Pacific slope authors (J. T. Holman, coll., Stanford University). (Schenck)

**MOLLUSCOIDEA****Class Brachiopoda****Order TELOTREMATA****Family RHYNCHONELLIDAE****Genus HEMITHYRIS D'Orbigny****HEMITHYRIS ASTORIANA Dall, 1909**

## Plate 1, figure 12

*Terebratula nitens* Conrad, U.S. Explor. Exped. Geol., p. 726, pl. 19, figs. 1, 1a,  
1849.  
*Hemithyris astoriana* Dall (n. nom.), U.S. Geol. Surv., Prof. Pap. no. 59, p.  
137, 1909.

*Original description.* Ovate, smooth and glossy. Superior valve convex; inferior valve flattened toward the base; basal margin sinuous; beak prominent, curved. Valves very thin. This shell is remarkable for having the peculiar luster and consistence of many species of *Anomia*. The shell is partially removed, and the surface exhibits obsolete radiating lines. (Conrad, pl. 19, figs. 1, 1a)

*Observations.* This shell has been placed by Dall in the genus *Hemithyris*. He has compared it with the Recent form *Frieleia halli* Dall which it resembles in shape and profile but differs from in the deeper and wider fold. The umbones of the Astoria species are less prominent, the body less inflated, and the radial striations less well marked than in the form *Hemithyris psittacea*. The specimen figured in this report is the same as that by Conrad on pl. 19, fig. 1, in the Wilkes Exploring Expedition report.

*Holotype.* (U.S.N.M. 3487.) Conrad type. Figured in the present report, pl. 1, fig. 12.

*Geologic range.* Astoria formation, middle Miocene.

*Type locality.* Astoria, Oregon (collected by J. D. Dana).

**HEMITHYRIS sp. A**

## Plate 2, figures 12, 13, 14, 15, 17

*Observations.* This species will be described by Hertlein and Grant in a paper now in press to be published by the University of California.

*Paratype.* (U.W. 521) (C.A.S. 7373). Figured in the present report, pl. 2, fig. 15.

*Hypotype.* (U.W. 521a) (C.A.S. 7375A). Figured in the present report, pl. 2, fig. 12.

*Hypotype.* (U.W. 519a) (C.A.S. 7372A). Figured in the present report, pl. 2, fig. 13.

*Hypotype.* (U.W. 519) (C.A.S. 7372). Figured in the present report, pl. 2, figs. 14, 17.

*Geologic range.* Upper Eocene?

*Geographic distribution.* Northwest part of Puget Sound Basin.

*Type locality.* (U.W. 353.) One mile south of Quilcene on west shore of bay, Jefferson County, Section 24, T. 27 N., R. 2 W.

**HEMITHYRIS?** sp. Tegland, 1933

Plate 2, figure 7

*Hemithyris?* sp. Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 142, 1933.

*Original description.* Shell small, thin, imperforate, trigonal in outline. Dorsal valve with a medial groove which gives a bilobed aspect to the anterior margin. (Tegland)

*Observations.* This poorly preserved specimen from the Blakeley formation cannot be specifically identified but may belong to the genus *Hemithyris*.

*Holotype.* (U.C. 32246.) Figured in the present report, pl. 2, fig. 7.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Kitsap County, Washington.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, Washington.

Genus **RHYNCHONELLA** Fischer**RHYNCHONELLA WASHINGTONIANA** Weaver, 1912

Plate 2, figures 8, 9, 10, 11

*Rhynchonella washingtoniana* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 55, pl. 5, figs. 44, 45, 1912.

*Original description.* Shell sub-circular, medium size, thin and very slightly longer than wide; hinge line narrow and situated at middle of shell; dorsal valve evenly convex, sub-circular with no trace of medial fold; ventral valve with same convexity as dorsal; sinus distinct; margin sloping down at an angle of 40° from beak; base arcuate; beak prominent, incurved. Sculptured with about thirty radiating ribs, many of which are dichotomous; these are crossed by numerous concentric lines of growth; medial groove fairly distinct, but not deep; more pronounced towards basal margin. Dimensions: Ventral valve, altitude 20 mm.; longitude 17 mm.; thickness 2.5 mm. Dorsal valve, altitude 18 mm.; longitude 18 mm.; thickness 2.5 mm. (Weaver)

*Observations.* Well-preserved specimens of this species are abundant in the fauna of the Cowlitz formation at the type locality (U.W. 232). The ornamentation is characterized by the numerous sharply defined dichotomous radial ribs and moderately strong lines of growth.

*Holotype.* (U.W. 42) (C.A.S. 7374). Figured in the present report, pl. 2, figs. 9, 11.

*Paratype.* (U.W. 42a) (C.A.S. 7374A). Figured in the present report, pl. 2, figs. 8, 10.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

## Order NEOTREMATA

## Family DISCINIDAE

## Genus DISCINISCA Dall

## DISCINISCA OREGONENSIS Dall, 1909

Plate 2, figure 16

*Discinisca oregonensis* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 137, pl. 2, fig. 6, 1909.

*Original description.* Shell large, depressed-conic, of a blackish-brown color, subcircular when normal; upper valve only known; apex defective; general surface marked with concentric, not very conspicuous incremental lines crossed by very fine, numerous, radiating striae. Altitude of type specimen, about 8 or 9 mm.; maximum diameter, 35 mm. (Dall)

*Observations.* The muscle scars and internal hard anatomy are not available for study. The specimen has been compared by Dall with *Discinisca lugubris* Conrad of the Atlantic Coastal Plain but possesses a relatively lesser thickness and length.

*Holotype.* (U.S.N.M. 107779.) Figured in the present report, pl. 2, fig. 16.

*Geologic range.* Miocene of Coos Bay. (Dall)

*Type locality.* Coos Bay, Oregon. Collected by B. H. Camman; exact locality unknown.

## Family TEREBRATULIDAE

## Genus TEREBRATULINA D'Orbigny

## TEREBRATULINA OAKVILLENSIS (Weaver), 1912

Plate 1, figure 8

*Terebratula oakvillensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 79, 80, pl. 13, fig. 107, 1912.

*Original description.* Shell medium sized, elongate; posterior valve thin, beak small and moderately incurved; greatest width about two-fifths the length of the shell from the posterior end; above this the margins of shell taper sharply and evenly to the beak; anterior end very evenly and broadly rounded; dorsal valve thin but slightly more convex than the ventral. There is no distinguishable fold on the dorsal, nor sinus on the ventral valve. Surface of both valves ornamented by numerous very fine concentric striae. There are no radiating ribs. (Weaver)

*Observations.* This species occurs in a lower Oligocene conglomerate about ten feet above the surface of the Metchosin basalt of lower and middle Eocene age. The Cowlitz formation is absent at this locality. The surface of the shell is smooth except for very fine concentric growth lines and the posterior dorsal margins converge rapidly toward the umbo.

*Holotype.* (U.W. 82) (C.A.S. 544). Figured in the present report, pl. 1, fig. 8.

*Geologic range.* Lower part of Lincoln formation, lower middle Oligocene.

*Geographic distribution.* Eastern Grays Harbor County, Washington.

*Type locality.* (U.W. 169.) Sandstone overlying Eocene basalt one mile west of Oakville in Northern Pacific Railway cut, Section 19, T. 16 N., R. 4 W.

**TEREBRATULINA UNGUICULA Carpenter var. B**

Plate 1, figure 11

*Observations.* This variety somewhat resembles *T. oakvillensis* in general outline but differs in having a larger umbonal angle, straight to slightly convex dorsal margins rather than concave as in *T. oakvillensis*, and in numerous fine but sharply defined radiating ribs.

*Hypotype.* (U.W. 520) (C.A.S. 7375). Figured in the present report, pl. 1, fig. 11.

*Geologic range.* Upper Eocene?

*Geographic distribution.* Western part Puget Sound Basin.

*Type locality.* (U.W. 353.) From boulders not in place, one mile south of Quilcene on west shore of bay, Jefferson County, Section 24, T. 27 N., R. 2 W. Upper Eocene?

Family **TEREBRATELLIDAE** KingGenus **TEREBRATALIA** Beeches**TEREBRATALIA TRANSVERSA** (Sowerby) subsp. Clark and Arnold, 1923

Plate 2, figure 1

*Terebratula transversa* Sowerby, Proc. Zool. Soc., p. 94, 1846.

*Terebratalia transversa* Sowerby n. subsp. Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 176, 177, pl. 32, fig. 4, 1923.

*Observations.* The specimen figured by Clark from the sandstone exposed in the sea cliffs 1 to 1½ miles west of Owens Point, Port San Juan, Vancouver Island, resembles the Recent species *Terebratalia transversa* (Sowerby). It differs in having a larger number of finer radial ribs. The median fold is very poorly developed on the ventral valve. The dorsal valve is not represented.

This specimen differs from *Terebratalia* cf. *transversa caurina* Gould which occurs in Washington in the lower Oligocene on Port Discovery Bay in that the latter possesses a moderately developed median fold although the ribbing is about equally developed.

*Holotype.* (U.C. 30252.) Figured in the present report, pl. 2, fig. 1.

*Geologic range.* Sooke formation.

*Type locality.* Sea cliffs one to one and one-half miles west of Owens Point, Port San Juan, Vancouver Island.

**TEREBRATALIA TRANSVERSA** (Sowerby) var. **CAURINA** (Gould)

Plate 2, figures 2, 3

*Terebratula caurina* Gould, Proc. Boston Soc. Nat. Hist., vol. 3, p. 347, 1850.

*Original description.* (*Terebratula caurina* Gould). *T. parva*, fusco-cinerea, transversa, convexiuscula; quincuncialiter punctata, costis angulis ad; 12 interdum bifurcatis radiata; margine ventrali circulari, flexuoso; apice acuto, rectangulari. Lateribus rectilinearibus, incumbentibus; rostro brevi, vix curvato; foramine circulari, interrupto: apophysis branchialis tenuissima, angustata. Long. ½; lat. 11/20; alt.

1/5 poll. *Hab.* Puget Sound. *T. australis* is closely allied, but is more elongated and the ribs are less prominent. (Gould)

*Hypotypes.* (U.W. 517) (C.A.S. 7377) and (U.W. 517a) (C.A.S. 7377A). Figured in the present report, pl. 2, figs. 2, 3.

*Geologic range.* Upper Eocene?

*Geographic distribution.* Western part of Puget Sound Basin.

*Type locality.* (U.W. 353.) From boulders not in place, one mile south of Quilcene on west shore of bay, Jefferson County, Section 24, T. 27 N., R. 2 W. Upper Eocene?

#### ?TEREBRATALIA aff. OCCIDENTALIS Dall, 1871

Plate 2, figure 4

*Terebratalia occidentalis* Dall, Proc. Calif. Acad. Sci., vol. 4, p. 182, pl. 1, fig. 7, 1871.

*Original description.* Shell variable in size and shade of color, usually of a flesh tint, deeper on some of the lines of growth. Sculptured by radiating ribs variable in number (9 in the typical specimen), with rather smooth interspaces, only crossed by more or less prominent lines of growth. Hinge line long, somewhat arched in the middle; area wide, sharply carinated, flat, crossed by transversal lines of growth. Apex not prominent, usually eroded. Foramen large, incomplete, deltoid widely separated and differentiated from the area by deep grooves. Typical specimen .75 inch long, .6 inch wide and .2 thick. Habitat coast of California. This species closely resembles, in general appearance *Walheimia grayi* Davidson, but belongs to a different genus. (Dall)

*Hypotype.* (U.W. 518) (C.A.S. 7376). Figured in the present report, pl. 2, fig. 4.

*Geologic range.* Upper Eocene?

*Geographic distribution.* Living along coast of California.

*Type locality.* (U.W. 353.) From boulders not in place, one mile south of Quilcene on west shore of bay, Jefferson County, Washington, Section 24, T. 27 N., R. 2 W. Upper Eocene?

#### Genus TEREBRATELLA D'Orbigny

##### TEREBRATELLA? SOOKENSIS Clark and Arnold, 1923

Plate 1, figures 9, 10

*Terebratella? sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 176, pl. 36, figs. 4, 5a, 5b, 1923.

*Original description.* Shell medium in size, subcircular in outline, fairly heavy; incremental lines rather coarse. Pedicle valve with broad wide terminal opening; deltoid plates almost obsolete and separated by a wide gap. No medial fold on either valve. Brachial valve only slightly less ventricose than pedicle valve. None of specimens at hand show any evidence of radial ribbing. Dimensions of type (a pedicle valve) about average in size: Length, 14 mm.; height, 14.5 mm.; diameter of valve, 6 mm. (Clark and Arnold)

*Observations.* This may be distinguished from the other species of brachiopods of the Tertiary in Oregon and Washington by its subcircular

outline, lack of radial ribbing and medial fold, and the wide area between the deltoid plates.

*Holotype.* (U.C. 30235.) Figured in the present report, pl. 1, fig. 10.

*Cotype.* (U.C. 30248.) Figured in the present report, pl. 1, fig. 9.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Near mouth of Jordan River, south coast of Vancouver Island.

*Type locality.* Sea cliffs at mouth of Fossil Creek 2 miles west of Sherringham Point, Jordan River, Vancouver Island.

Genus LAQUEUS Dall, 1870

LAQUEUS aff. VANCOUVERENSIS Davidson, 1886

Plate 2, figures 5, 6

*Laqueus californicus* Koch var. *vancouverensis* Davidson, Trans. Linn. Soc., ser. 2, vol. 4, pt. 2, p. 113, pl. 18, figs. 10-13b, 1886.

*Original description* (*Laqueus californicus* Koch). Shell large, longitudinally oval, inflated; margins slightly sinuous. Dorsal valve uniformly convex, with occasionally a very slight tendency to depression close to the frontal margin. Ventral valve a little deeper than the dorsal one, with sometimes a slight indication of a mesial longitudinal elevation or flattened fold; beak incurved, truncated by a small circular foramen, margined anteriorly by two wide deltoid plates; beak-ridges sharply defined, leaving between them and the hinge-line a flattened space. Surface of valves smooth, with concentric lines of growth, shell-perforations rather large. Colour livid yellowish brown or light reddish brown. Length 2 inches 6 lines; breadth 1 inch 11 lines; depth 1 inch. In the interior of the dorsal valve the hinge-plate is bifid; cardinal process inconspicuous. The septum, of small elevation, extends from under the middle of the hinge-plate to a little more than a third of the length of the shell; the principal lamellae of the loop, after having been attached to the angles of the hinge-plate and giving off short curved crura, proceed a short distance, when they again give off two slightly oblique laminae, which become attached to the anterior edge of the mesial septum. The principal stems of the loop then extend to within a short distance of the frontal margin, where they become deflected in the shape of a horseshoe, giving off on each side a short lamella near their upper extremity, thus connecting the reflected portion with the principal stems of the loop close to the point where the two oblique lamellae leave for their attachment to the mesial septum. (Koch, in Davidson, p. 112)

*Observations.* This recent species from Vancouver Island originally was considered by Dall as *Laqueus californicus* Koch. Many specimens were examined by Davidson who noted that the shell outline varied from circular to ovate, was truncate anteriorly, and was characterized by a slight depression on the anterior third of the length of both valves. He pointed out also that the pedicle opening was proportionately larger in the Vancouver Island specimens than in the California forms but that the character of the loop was the same. Based on this evidence the northern form was made a variety of *L. californicus* Koch.

*Hypotype.* (C.A.S. 7371) (U.W. 516). Figured in the present report, pl. 2, fig. 5.

*Hypotype.* (U.W. 516A) (C.A.S. 7371A). Figured in the present report, pl. 2, fig. 6.

*Geologic range.* Upper Eocene?

*Geographic distribution.* Olympic Peninsula, Washington, to Queen Charlotte Island.

*Type locality.* Specimen figured from locality (U.W. 353). Upper Eocene?

## MOLLUSCA

### Class Pelecypoda

#### Family SOLENOMYACIDAE

##### Genus SOLEMYA Lamarck

*Solemya* Lamarck, Anim. s. Vert., vol. 5, p. 488, 1818.

*Genotype.* *Solemya australis* Lamarck.

Subgenus **Acharax** Dall, 1908

*Acharax* Dall, Nautilus, vol. 22, p. 2, 1908.

*Subgenotype.* *Solemya johnsoni* Dall.

#### SOLEMYA (ACHARAX) VENTRICOSA Conrad, 1849

Plate 5, figures 1, 2, 3

*Solemya ventricosa* Conrad, U.S. Explor. Exped. Geol., vol. 10, App. 1, p. 723, pl. 17, figs. 7, 8, 1849.

*Solemya ventricosa* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. 59, pp. 12, 101, 153, 1909.

*Original description.* Oblong; ventricose; dorsal and basal margins straight and parallel. Anterior side narrowed, the margin orbiculate. Posterior margin scalloped, the inferior half truncated obliquely inward. Beaks distant from the anterior extremity. Length, 3 inches; breadth, 1½ inches. Lateral surface smooth, radiated with narrow bands. Astoria, Oregon. (Conrad)

*Observations.* The two specimens upon which the original description of *S. ventricosa* Conrad was based were collected by James D. Dana from Astoria, Oregon. They were designated as No. 3567 and No. 3486 of the type collection of the Exploring Expedition in the U. S. National Museum. Both specimens are in a poor state of preservation and some of the details of ornamentation do not show in the illustrations.

Specimen No. 3567 which is represented in Conrad's report on plate 17, figure 7, occurs in a nodule of brownish-gray fine-grained calcareous shale. There are two valves, each of which is broken and incomplete. The illustration of Conrad in part appears to have been reconstructed.

Measurements made by the writer on No. 3567 show the anterior dorsal margin to be about 60 per cent of the length of the shell and the height approximately 33 per cent. The anterior third of the valve contains about 12 poorly preserved radiating bands which are separated in places by narrow interspaces consisting of two radiating lines and an intervening narrow rib. Five nearly equally spaced faint radiating bands occupy 20 per cent of the area of the valve immediately behind. The

posterior surface of the valves is so badly weathered that the ornamentation cannot be determined.

The figure of specimen No. 3486 as shown on plate 17, figure 8, in the Exploring Expedition report is fairly representative. It is a poorly preserved specimen of a right valve in which much of the shell material has been broken away. It probably represents a younger individual of the same species. The radiating ribs are broader and more equally developed than on No. 3567, but it is difficult to show these details in the illustration of this report.

A single poorly preserved specimen in the U. S. National Museum, occurring in a concretion from Astoria and made at a later time, resembles No. 3486. As far as the writer is aware no other specimens of *S. ventricosa* are on record. At the time when collections were made at Astoria by Dana, numerous trips were made to the surrounding areas and there is a possibility that some of the specimens may have come from other nearby localities in rocks of an age older than those in Astoria.

For many years the specimens of fossil Solemyas in Oregon and Washington were identified as *S. ventricosa*. In 1924 Clark described those from the upper Oligocene in Clallam County as *S. dalli*, and later, in 1933, Tegland (295, pp. 100-104) figured and discussed the nomenclature and relations of the two species. The large individuals represented by (U.C. 32085) and (U.C. 32086), and collected from the large bend in Willapa River about one mile below Holcomb, were identified as *S. ventricosa* of Miocene age. The writer has collected the same kind of Solemya from this locality and finds them associated with *Turcicula columbiana* Dall. Stratigraphically, this species occurs in the upper part of the Keasey formation of lower Oligocene age and is separated from the Miocene sandstones by 3,000 feet of middle Oligocene shales and sandstones. The nearest exposures of Miocene strata are 13,000 feet toward the northeast. Biologically these specimens differ from *S. ventricosa*, as described by Conrad, in their greater relative height as compared with the length, and the somewhat proportionally greater length of the anterior dorsal margin as compared with the posterior.

*Holotype.* (U.S.N.M. 3567.) Conrad type. Figured in the present report, pl. 5, fig. 1.

*Paratype.* (U.S.N.M. 3486.) Conrad type. Figured in the present report, pl. 5, fig. 2.

*Hypotype.* (U.S.N.M., no number.) A specimen collected later from 10th and Harrison Street, Astoria, Oregon. Figured in the present report, pl. 5, fig. 3.

*Geologic range.* Astoria formation, middle Miocene of Oregon.

*Type locality.* Astoria formation, middle Miocene in the city of Astoria, Oregon (Collected by James D. Dana).

**SOLEMYA (ACHARAX) DALLI Clark, 1925**

Plate 4, figures 6, 7, 8; plate 5, figures 4, 5, 6, 7, 8

*Solemya dalli* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 73, pl. 22, fig. 3, 1925.

*Solemya ventricosa* Conrad, Reagan, Trans. Kans. Acad. Sci., vol. 22, p. 174, pl. 1, fig. 1, 1909.

*Solemya (Acharax) dalli* Clark, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 103-104, pl. 4, figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 1933.

*Original description.* Shell fairly large, anterior dorsal edge long, parallel with ventral edge; beaks inconspicuous, well toward posterior end; posterior dorsal margin short and straight; posterior end acutely rounded; anterior end broadly subtruncated; nymph plate prominent, extending over half the distance from beaks to posterior end. Surface sculptured by numerous deeply incised radiating lines, which are obsolete on a fairly wide area just anterior to the posterior edge; interspaces between lines much narrower near posterior and middle of valve than toward anterior end; beginning near middle of valve the lines go in pairs, two radiating lines separated by a narrow interspace, these followed by a wide interspace, then again another pair of lines. Concentric lines of growth fairly heavy and rather irregular. Dimensions: Length about 55 mm.; height about 17 mm. (Clark)

*Observations.* The holotype of *S. dalli* was obtained from sandy shales of the upper Oligocene exposed in the sea cliffs about three-fourths of a mile west of the western mouth of Twin Rivers in Clallam County, Washington, where individuals of this species are abundant. It also occurs in brownish-gray sandy shales in the upper part of the Blakeley formation along the sea cliffs between the head of Blakeley Harbor and Restoration Point and at numerous other localities in Washington in strata of equivalent age. It has not been collected from the middle Oligocene Lincoln formation.

This species is characterized by the very long anterior dorsal margin and the relatively short height compared with the length. Measurements made on more than 100 specimens of *S. dalli* show that the length of the anterior dorsal margin averages about 75 per cent of that of the length of the shell. This is in contrast to 60 per cent for the holotype of *S. ventricosa* and 66 per cent for *S. willapaensis*. Measurements made on a similar number of specimens of *S. dalli* indicate that the average height of the shell is 35 per cent of the length in contrast to 31 per cent for *S. ventricosa* and 46 per cent for *S. willapaensis*.

The sculpture consists of numerous concentric, fairly heavy growth lines and radiating bands of unequal width which are separated by incised lines. This ornamentation varies in a minor degree in different individuals, but the prevailing characters serve to separate the species from *S. ventricosa* and *S. willapaensis*. On the anterior third of the surface of each valve are six fairly broad radiating flat-topped bands which are separated by an interspace one-third as wide, containing a pair of radiating incised lines. Between these lines and within the interspace lies a single narrow flat-topped rib. This type of sculpture continues up to the anterior dorsal margin. Immediately behind this sculpture and occupying the middle 25 per cent of the area of the valve are six radiating bands averaging about one-half the width of those on the anterior third of the valve and separated usually by single radiating lines. The sculpture of this area exhibits considerable variation in different individuals. In most specimens there exists a single very broad radiating band in front

of this area and beneath the umbo, which in some cases has a slightly wavy appearance. The posterior 25 per cent of the surface of the valve is characterized by from 10 to 15 closely spaced, flat-topped, narrow radiating ribs separated by faintly incised lines. The width and strength of this sculpture vary in individuals. The nymph plate is always prominent and occupies about 70 per cent of the posterior dorsal margin.

*Holotype.* (S.U. 5238.) Figured in the present report, pl. 5, figs. 5, 8.

*Hypotypes.* (U.W. 319.) Figured in the present report, pl. 4, fig. 6.

(U.C. 32105.) Figured in the present report, pl. 4, fig. 7.

(U.W. 319A.) Figured in the present report, pl. 4, fig. 8.

(S.U. 783.) Figured in the present report, pl. 5, fig. 4.

(U.C. 32105.) Figured in the present report, pl. 5, figs. 6, 7.

*Geologic range.* Upper Oligocene of Washington.

*Geographic distribution.* Puget Sound Basin and north slope of Olympic Peninsula, Washington.

*Type locality.* (S.U. N.P. 120.) One and one-half miles east of Twin Rivers, Clallam County, Washington.

#### SOLEMYA (ACHARAX) WILLAPAENSIS n. sp.

Plate 6, figures 2, 17

*Solemya ventricosa* Conrad, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 102, 103, pl. 4, figs. 11, 12, 1933.

*Description.* Shell large, subrectangular, moderately inflated with anterior dorsal margin long, straight and nearly parallel with the straight ventral margin; beaks low and situated about one-third the length of the shell from the posterior end; posterior dorsal margin slightly concave and sloping downward at an angle of about 15° where it merges into a rather sharply arcuate and somewhat produced posterior end; anterior margin nearly straight and sloping downward from 2° to 5° until it merges at an angle of less than 90° with the broadly subtruncate anterior end; ventral margin nearly straight and almost parallel to the anterior dorsal margin and making curved junctions with the anterior and posterior end; nymph plate slightly elevated and occupying about 65 per cent of the posterior dorsal margin. Surface ornamented by numerous radiating broad and nearly flat-topped ribs with interspaces of approximately equal width on the posterior and middle surface of the valves but narrower on the anterior. The height of the shell is about 40 per cent of the length. Dimensions: Length 87 mm.; height 39 mm.

*Observations.* The description of this species is based upon specimen (U.C. 32086). The specimen is broken and badly eroded but is representative of others collected from the same strata at nearby localities along Willapa River. This species has been found only in the lower Oligocene, while *S. dalli* is confined to the upper Oligocene and *S. ventricosa* to the middle Miocene. Although the details of ornamentation and relative shape may vary, the range of variation in each species seems to be limited sufficiently to make a separation possible. The ratio of height to length and the position of the umbones may be expressed as follows:

	Ratio of height to length	Ratio of length of anterior dorsal margin to length of shell
<i>S. willapaensis</i> . . . . .	46 per cent	66 per cent
<i>S. dalli</i> . . . . .	35 per cent	75 per cent
<i>S. ventricosa</i> . . . . .	31 per cent	60 per cent

The fewer number of radiating ribs on the posterior surface of *S. ventricosa*, together with the greater width and nearly equal interspaces, is in contrast to the other two species.

*Holotype.* (U.C. 32086.) Figured in the present report, pl. 6, figs. 2, 17.

*Geologic range.* Lower Oligocene.

*Type locality.* In the southwest quarter of Section 25, T. 13 N., R. 8 W., about 4000 feet N. 45° W. from Holcomb in the bend of Willapa River.

### Family NUCULIDAE

Genus **ACILA** H. and A. Adams, 1858 (Schenck, 1934)

*Acila* Schenck, Classification of nuculid pelecypods, Bull. Mus. Roy. Hist. Nat. Belg., vol. 10, no. 20, p. 41, June, 1934.

*Genotype.* *Nucula divaricata* Hinds, 1843.

#### Subgenus **TRUNCACILA** Schenck, 1931

*Truncacila* Schenck, in Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 115, 1931.

*Subgenotype.* *Nucula castrensis* Hinds.

#### **ACILA (TRUNCACILA) DECISA** (Conrad), 1855

Plate 6, figures 1, 4, 8; plate 7, figures 8, 9

*Nucula decisa* Conrad, in W. P. Blake, U.S. 33d Cong., 1st Sess., H. Ex. Doc. 129, Appendix to the Preliminary Geol. Rept. of W. P. Blake, pp. 11, 12, 1855; Rept. Pac. R.R. Surv., 5, p. 322, pl. 3, fig. 19, 1856. Not *Nucula decisa* Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 573 (*Acila shumardi* Dall), 1898.

*Nucula (Acila) stillwaterensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 6, pl. 8, fig. 8, 1922; Stewart, Phil. Acad. Nat. Sci., Spec. Publ. 3, p. 47, 1930.

*Acila (Truncacila) decisa* (Conrad), Schenck, Bull. Mus. Roy. Hist. Nat. Belg., vol. 10, no. 20, p. 42, 1934. *Ibid.*, vol. 11, no. 14, p. 5, 1935.

*Acila (Truncacila) decisa* (Conrad), Schenck, Geol. Soc. Am., Spec. Pap. no. 4, pp. 53-56, pl. 3, figs. 1-9, 11-15; pl. 4, figs. 1, 2; text figure 7 (22-77), 1936. (This report contains a complete synonymy and discussion of the species.) Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 41, 42, pl. 5, figs. 2, 3, 1938.

*Acila decisa* (Conrad), Merriam and Turner, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 24, p. 99, 1937.

*Original description.* (*N. decisa*, Conrad, pl. 3, fig. 19.) Suboval or sub-rhomboidal, posterior margin obliquely truncated; disk with divaricating striae. (Conrad)

*Description by Schenck of specimens from Umpqua formation in Oregon.* Shell truncate-ovate in outline (Pl. 3, figs. 1, 3, 4, 6), compressed; anterior dorsal margin convex; anterior extremity rounded; ventral margin broadly rounded; posterior margin abruptly truncate; primary bifurcation central; no rostral sinus; interior not available; length, 4.5 millimeters to 8.0 millimeters; height, 3.8 to 5.8 millimeters; semi-thickness ca 2.5 millimeters; angle of bifurcation, 45 to 52 degrees (306, p. 56).

*Original description* (*Nucula (Acila) stillwaterensis* Weaver and Palmer). Shell small, rectangular in outline; anterior dorsal margin nearly straight, posterior ventral margin nearly straight, sloping to a broadly rounded anterior end which approaches the dorsal margin with greater convexity; escutcheon impressed but not defined by an incised line; central portion of the area of the escutcheon raised, protruding slightly beyond the posterior margin; surface ornamented with radiating ribs medium in strength; above the central portion of the shell the divarication is single, below the mid-area the series of divarication is comparatively wide, the duplication increasing ventrad forming five sets along the ventral margin; the area of divarication occupying the middle third of the ventral portion of the shell; lunule not defined; surface with heavy, impressed growth lines forming wide undulations on the surface of the shell. Dimensions: length 11 mm.; height 9 mm.; width 8 mm. (Weaver and Palmer, 301, p. 6).

*Observations.* The original type of *Nucula decisa* Conrad came from Eocene rocks at an unknown locality near San Diego and is not available for examination. However, specimens have been collected from upper Eocene strata in the same vicinity which appear to be identical with that of Conrad although they have been named a new species. The specimen described as *Acila lajollaensis* by M. A. Hanna (159, p. 270) came from the San Diego region at locality (U. C. 5062). Since the holotype of *N. decisa* has been lost, and the exact locality is unknown, the holotype of *A. lajollaensis* has been chosen by Schenck as the neotype of *A. decisa*. A complete discussion of the synonymy and biologic characters of this species may be referred to in his monograph of the genus *Acila* (245.)

*Nucula (Acila) stillwaterensis* Weaver and Palmer was collected from locality (U.W. 319) in the lower part of the Cowlitz formation near Vader, Washington. The detailed investigations made by Schenck of the different species of the Pacific Coast *Acilas* indicate that the Cowlitz species probably is identical with *A. lajollaensis* from San Diego which in turn has been made the neotype of *A. decisa*.

Specimens of *Acila* which agree closely with *A. decisa* occur in the middle Eocene Umpqua formation of southern Oregon and in the upper Eocene west of Eugene in central Oregon. Minor non-specific differences in size and proportions may be noticed in the specimens from north to south but they do not seem sufficiently marked to warrant their separation into varieties. No other species of *Acila* have been recognized in any of the Eocene formations of Oregon or Washington.

*Type material.* The neotype of *Acila (Truncacila) decisa* (Conrad) is the specimen formerly described as *Acila lajollaensis* by M. A. Hanna which is preserved in the collections of the Museum of Paleontology of the University of California as neotype (No. 31132) and which is figured in the present report, pl. 6, figs. 1, 8. The holotype of *A. stillwaterensis* (U.W. 149) is refigured in the present report, pl. 6, fig. 4; pl. 7, figs. 8, 9.

*Hypotype.* (Holotype of *A. stillwaterensis* Weaver and Palmer). (U.W. 149.) Figured originally (301, pl. 8, fig. 8). Figured in the present report, pl. 6, fig. 4; pl. 7, figs. 8, 9.

*Geologic range.* Middle and upper Eocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* San Diego region, California. Occurs in Cowlitz formation locality (U.W. 319). McClarity Ranch, south bank of Stillwater Creek one mile west of Vader, Lewis County, Section 30, T. 11 N., R. 2 W.

## ACILA (TRUNCACILA) NEHALEMENSIS G. D. Hanna, 1924

## Plate 6, figure 9

*Nucula (Acila) cordata* Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 573 (1898) not *Nucula cordata* Goldfuss, Petref., 2, p. 155, pl. 125, fig. 6, 1838.

*Nucula (Acila) cordata* Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 5, p. 1196, pl. 40, fig. 4, 1900.

*Nucula (Acila) cordata* Dall, U.S. Geol. Surv., Prof. Pap. 59, p. 103, 1909.

*Acila nehalemensis* G. D. Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 13, no. 10, p. 155, 1924.

*Acila (Truncacila) nehalemensis* G. D. Hanna, Schenck, Bull. Mus. Roy. Hist. Nat. Belg., vol. 10, no. 20, p. 43, 1934; *ibid.*, vol. 11, no. 14, p. 5, table, 1935.

*Acila (Truncacila) nehalemensis* G. D. Hanna, Schenck, Geol. Soc. Am., Spec. Pap. no. 4, pp. 57-63, pl. 5, figs. 1, 5, 6, 7, 8, 10, 11, 12; text figure 7 (19), 1936.

**Description.** The specimen named *Nucula (Acila) cordata* by Dall, which came from the Keasey formation in Columbia County, Oregon, was figured (90, p. 1196, pl. 40, fig. 4), but not described.

A brief description of the holotype (U.S. Nat. Mus. No. 107450) has been given by Schenck (245, p. 58): The proterotypes are relatively small for the species, inflated, with no distinct rostral sinus; the holotype with secondary bifurcation at the posterior ventral margin (pl. 5, fig. 5). The cordate radial ribs extend to the ventral margin, no area of obsolete radial ribbing being developed. The escutcheon is crossed by the ribs. One can distinguish about nine concentric growth lines on the holotype. Dimensions of holotype no. 107450: Length 14.8 mm.; height 11.7 mm.; thickness 9.6 mm.; umbonal angle 100°; angle of bifurcation 60°; ratio of height to length 79 percent.

**Description of topotypes.** A more complete description by Schenck is given of topotype specimens collected from the center of the west line of Sec. 24, T. 6 N., R. 5 W., near Mist, Oregon.

Shell medium to large for subgenus; ovate; inflated; anterior dorsal margin straight; anterior extremity bluntly rounded; some specimens with truncate anterior extremity; posterior margin inclined from beaks to give somewhat rostrate appearance to shell, a feature accentuated on some specimens by an incipient rostral sinus; ventral margin strongly convex; radial ribs 400 microns wide when shell is 17.3 millimeters long; one fragment with ribs 560 microns wide, the maximum measured; interspaces narrower than the ribs; primary bifurcation central to anterior; secondary bifurcation present on majority of specimens; often a secondary bifurcation at posterior ventral side of shell; marked secondary bifurcation at ventral margin of some specimens; larger shells with a poorly defined area of obsolete radial ribbing; conspicuousness of concentric lines varies with specimen, but a minimum of six definite resting stages apparent on one topotype having a height of 13 millimeters; heart-shaped escutcheonal area fairly well-defined; margins of shell slightly raised to produce a ridge in the center of the escutcheon; lunule indistinct; interior smooth, nacreous; muscle scars impressed; pallial line entire; on one fragment, taxodont teeth noted, but number of teeth cannot be counted. The longest well preserved topotype is 17.2 millimeters, but this does not represent a maximum for the species. (Schenck, 245, p. 59)

**Observations.** The holotype of *Nucula (Acila) cordata* Dall came from an imperfectly described locality on the Nehalem River, near Mist in the Coast Ranges of northwestern Oregon. It has been obtained in collections made by the writer from tuffaceous shales and sandstones exposed on Rock Creek in Columbia County, Oregon, one mile east of Keasey and also in rocks of similar age at locality 513 in the banks of Willapa River 1,000 feet east of the town of Holcomb, Pacific County,

Washington, in association with *Turcicula columbiana* Dall. In 1924 it was pointed out by G. D. Hanna (153, p. 155) that the species name *cordata* was preoccupied and the name *nehalemensis* was substituted. For further biologic and stratigraphic discussion of this species the reader may consult the monograph of the genus *Acila* by Schenck (245).

*Paratype.* (U.S.N.M. 107401.) Figured originally by Dall as *Nucula (Acila) cordata* in Trans. Wagner Free Inst. Sci., vol. 3, pt. 5, pl. 40, fig. 4. Figured in the present report, pl. 6, fig. 9.

*Geologic range.* Lower Oligocene, Keasey formation.

*Geographic distribution.* Southwestern Washington and northwestern Oregon.

*Type locality.* On Nehalem River near Mist. (Diller)

**ACILA (TRUNCACILA) SHUMARDI (Dall), 1909**

Plate 7, figures 5, 6, 7, 11; plate 8, figures 2, 5

*Nucula decisa* Conrad, Dall, Trans. Wagner Free Inst. Sci., pt. 4, p. 573, 1898; not *Nucula decisa* Conrad, in Blake, Rept. Pac. R.R. Surv., vol. 5, p. 322, pl. 3, fig. 19, 1855.

*Nucula (Acila) decisa* Conrad, Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 5, p. 1196, pl. 40, figs. 1, 3, 1900.

*Nucula (Acila) shumardi* Dall, U.S. Geol. Surv., Prof. Pap. 59, p. 103, 1909.

*Nucula (Acila) shumardi* Dall, Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 75, 95, 97-98, 100, 102-103, 105, pl. 8, fig. 11, 1925.

*Nucula (Acila) shumardi* Dall, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 107, pl. 5, fig. 10, 1933.

*Nucula (Acila) conradi* Meek, Hertlein and Crickmay, Proc. Am. Phil. Soc., vol. 64, p. 254, 1925.

*Acila shumardi* Dall, Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 11, pp. 88, 95, 121, pl. 13, figs. 7, 8, 17, 1918; Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 89, 1922; Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 456, 1927; Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, pp. 11, 15, 20, 28, 34-35, 38, 41, 1928; Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 62, pl. 3, fig. 43, 1916.

*Acila (Truncacila) shumardi* (Dall), Schenck, Bull. Mus. Roy. Hist. Nat. Belg., vol. 10, no. 20, p. 43 (June), 1934; Schenck, Geol. Soc. Am., Spec. Pap. no. 4, pp. 64-67, pl. 4, figs. 5, 6, 7, 8, 9; pl. 6, figs. 1-11; text figures 7, 18, 1936.

*Description of proterotypes.* The holotype is a right valve; the paratypes are three specimens with valves tightly closed and one internal mold. All are worn. The holotype has 24 anterior and 12 posterior teeth; chondrophore broken; marginal plications evenly spaced. The paratypes exhibit lanceolate, indistinct lunules, outlined (as in most other species) by low, hinge-facing escarpments: Escutcheonal face nearly flat, no marked pouting being apparent; outlining the escutcheon area is a shallow groove; radial ribs cross escutcheon; no area of obsolete radial ribbing; number of concentric growth lines 16. The holotype has the following dimensions: length, 24.2 millimeters; height, 17.8 millimeters; umbonal angle 103 degrees, angle of bifurcation 60 degrees. The largest specimen of this species examined is 30.0 millimeters in length. (Schenck, 245, p. 64)

*Description of topotypes.* Owing to the inadequacy of the original description of the species, the following supplementary characterization is based upon many well-preserved specimens from the type locality. Young shells ovate; adults large for subgenus, quadrangular, inflated; anterior dorsal margin gently rounded, straight; anterior end evenly rounded; ventral margin gently rounded, convex; posterior end abruptly truncated by nearly straight posterior margin; beaks small, strongly in-

turned, opisthogyrate, appressed; lunule lanceolate, poorly defined; escutcheon pouting in middle; indistinct rostral sinus extending from near umbones to ventral margin, slightly anterior to posterior end; surface of shell sculptured by regular, convex-topped, comparatively narrow radial ribs separated by interspaces half as wide; ribs distinct on well-preserved young individuals, less distinct in ephobic stage; on an average adult (length 22.3 millimeters) radial ribs 350 microns wide at ventral margin; secondary bifurcation rarely developed, seemingly restricted to gerontic individuals, and, when present, situated near ventral margin; primary bifurcation develops soon in ontogeny; i.e., at least by the time the shell is 3 millimeters long; radial ribs curve from disk onto and across escutcheonal area, where they are cord-like and sometimes bifurcate distally; faint incremental lines of growth cross radial ribs; interior smooth, nacreous, muscle scars and simple pallial line distinct, impressed; marginal plications well developed; chondrophore inclined anteriorly and roughly parallel to dorsal margin; about 20 to 24 anterior and 8 to 12 posterior teeth. The range in length of the topotypes is up to 26.4 millimeters, heights up to 20.3 millimeters, and thickness up to 15.2 millimeters; umbonal angle generally about 90 degrees. (Schenck, 245, p. 65)

*Observations.* Specimens of *Acila* collected by Diller from Pittsburg Bluff were identified by Dall (89, pp. 102-103) as *Nucula (Acila) decisae*. Since the original type of *N. decisae* was lost and the figures and description were imperfect, a new name, *Nucula (Acila) shumardi*, was applied by Dall to the specimen from Pittsburg (89, p. 103). Further information concerning the synonymy, biology, and stratigraphic relations may be referred to in the complete discussion of the *Acilas* by Schenck (245, pp. 64-67).

Well-preserved specimens of *Acila (Truncacila) shumardi* occur in the massive brownish-gray shaly sandstones of the middle Oligocene at Pittsburg Bluff and numerous other localities in the Coast Range of northwestern Oregon. It is abundant also in the Lincoln formation of southwestern Washington and in the sea cliffs south of Port Townsend on Puget Sound. A more complete list of localities accompanies Schenck's report (245, pp. 65-66).

*Holotype.* (U.S.N.M. 406505.) Figured in the present report, pl. 8, fig. 5.

*Hypotype.* (U.W. 215.) Figured in the present report, pl. 7, figs. 5, 6; pl. 8, fig. 2.

*Hypotype.* (U.W. 246.) Figured in the present report, pl. 7, figs. 7, 11.

*Geologic range.* Pittsburg Bluff beds, Oregon, and Lincoln formation, Washington. Middle Oligocene.

*Geographic distribution.* Coast Range of western Oregon and Washington.

*Type locality.* (U.W. 476.) Pittsburg Bluffs, Columbia County, Oregon.

#### ACILA (TRUNCACILA) PACKARDI (Clark), 1925

Plate 4, figure 4; plate 5, figures 9, 10; plate 8, figure 32

*Acila shumardi* Harrison and Eaton, Mineral Resources Oregon, vol. 3, no. 1, pp. 6, 13, 1920.

*Nucula (Acila) packardi* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 75-76, pl. 8, figs. 8, 12, 1925.

*Acila packardi* Clark, Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 456, 1927; *ibid.*, vol. 18, p. 28, 1928.

*Acila (Truncacila) packardi* (Clark), Schenck, Bull. Mus. Roy. Hist. Nat. Belg., vol. 10, no. 20, p. 43, 1934; *ibid.*, vol. 11, no. 14, table, 1935; Schenck, Geol. Soc. Am., Spec. Pap. no. 4, pp. 75-77, pl. 7, figs. 1-12; text figure 7, 1936.

*Original description.* Shell medium size; beaks conspicuous, strongly inturned and opisthogyrous; anterior dorsal edge long and convex; posterior dorsal edge short and straight; truncate posterior end separated from both short posterior dorsal edge and ventral edge by distinct angles; escutcheonal area depressed, nearly flat and at almost right angles to main outer surface of valve. Immediately below beaks on the escutcheonal area is a smaller, more depressed area, which might be called a secondary escutcheon and on which the radial ribbing is very faint. Surface sculptured by radiating threads which diverge very near middle of valve; radial threads also cross main escutcheonal area on which they show a tendency to split. Chondrophore rather deeply immersed, 10 teeth posterior and about 17 teeth anterior to beaks; muscle scars strongly depressed. Dimensions: length 15.3 mm., height 12 mm. (Clark)

*Supplementary description.* The holotype of *packardi* is a slightly crushed specimen, 15.5 millimeters long and 12.3 millimeters in height; neither a rostral sinus nor an area of obsolete radial ribbing; concentric lines of growth about 8, closely spaced near ventral margin; radial ribs up to 400 microns wide, interspaces ca. half, or less, as wide; ribs cross escutcheonal area; hinge not exposed. (Schenck, 245, p. 75)

*Observations.* The species *A. packardi* is abundantly represented in the upper part of the dark gray Nye shale which is exposed in the sea cliffs at the town of Newport, Oregon. The majority of the specimens have been obtained from a section about 30 feet thick which is overlaid with a slight unconformity by the middle Miocene Astoria formation. The species of foraminifera which occur associated with *A. packardi* at this locality suggest, according to Schenck (245, p. 77), the possibility that the Nye shale may be of lower Miocene age.

*Holotype.* (U.C. 30297.) Figured in the present report, pl. 4, fig. 4; pl. 5, figs. 9, 10; pl. 8, fig. 32.

*Geologic range.* Nye shale, upper Oligocene (possibly lower Miocene).

*Type locality.* The holotype of this species is stated by Clark to have been obtained from locality (U.C. 4118), "railroad tunnel near Buxton toward Tillamook, Oregon, on branch line." The writer has examined the strata of the Keasey formation at this locality but was unable to obtain specimens of *A. packardi*. The species is abundant in the beach section of the Nye shale at Newport, Oregon, and it is possible that an error exists in the statement concerning the locality as has been suggested by Schenck (245, p. 76).

#### ACILA (TRUNCACILA) NELSONI (Clark), 1924

Plate 6, figure 5; plate 7, figure 21

*Nucula (Acila) nelsoni* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 74, pl. 8, fig. 1, 1924.

*Acila (Truncacila?) nelsoni* (Clark), Schenck, Bull. Mus. Roy. Hist. Nat. Belg., vol. 11, no. 14, table (May), 1935.

*Acila (Truncacila?) nelsoni* (B. L. Clark), Schenck, Geol. Soc. Am., Spec. Pap. no. 4, p. 77; text fig. 7, 1936.

*Original description.* Shell medium size, sub-ovate in outline; beaks rather conspicuous, strongly inturned and opisthogyrous. Anterior end broadly and regularly rounded; subtruncate posterior end joins ventral edge in acute curve or subangulation. Anterior dorsal slope long and gently convex. Escutcheon large, rather

strongly convex or pouting along the dorsal edge. Surface covered by fine divaricating threads. Escutcheon crossed obliquely by threads which are considerably finer than those on main surface of shell. Dimensions: length 14 mm.; height 9 mm. (Clark, 52, p. 74.)

*Supplementary description by Schenck.* This species is based on fragmentary and poorly preserved material; therefore, judgment as to its validity is withheld. The radial ribs are 230 microns wide, separated by narrow interspaces; line of primary bifurcations probably central; secondary bifurcation present. The holotype measures: length, 14.5 millimeters; height, 10.5 millimeters. (245, p. 77)

*Observations.* This species occurs in the upper part of the Lincoln formation on the north side of the Olympic Peninsula. It resembles *A. shumardi*, a species characteristic of the middle Oligocene of Oregon and Washington, and may be a variety of it. Secondary bifurcation of axial ribs tends to distinguish it from *A. shumardi*. The average width of these ribs also is about one-third greater.

*Holotype.* (S.U. 5202.) Figured in the present report, pl. 6, fig. 5.

*Paratype.* (S.U. 5203.) Figured in the present report, pl. 7, fig. 21.

*Geologic range.* Upper Oligocene.

*Type locality.* (U.W. 572.) In very massive grayish-brown sandy clay shale in sea cliff on south shore of Strait of Juan de Fuca, Clallam County, 8000 feet due west of the town of Gettysburg.

#### ACILA (TRUNCACILA) PUGETENSIS (Clark), 1925

##### Plate 6, figure 3

*Nucula (Acila) pugetensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 75, pl. 8, fig. 4, 1925.

*Acila (Truncacila) pugetensis* (Clark), Schenck, Bull. Mus. Roy. Hist. Nat. Belg., vol. 11, no. 14, table (May), 1935.

*Acila (Truncacila) pugetensis* (B. L. Clark), Schenck, Geol. Soc. Am., Spec. Pap. no. 4, pp. 77, 78, pl. 4, fig. 11; text figure 7, 1925.

*Original description.* Shell subtriangular, moderately convex; beaks fairly strongly inturned and moderately prosogyrous; posterior dorsal slope abrupt, about right angles with anterior dorsal edge which is rather strongly convex; escutcheonal area fairly broad, depressed nearly at right angles to main outer surface, and separated from it by obscure line of angulation. Surface sculptured by fairly coarse radial threads, the line of divarication of which is anterior to middle of valve. Hinge plate not exposed. Dimensions: Length 12 mm.; height 10 mm. (Clark)

*Observations.* The holotype of this species is stated to have been collected from Bean Point on the south end of Bainbridge Island, opposite Seattle. The strata at this locality occur in the Blakeley formation of the upper Oligocene about 1,000 feet stratigraphically below the well-known fossiliferous beds at Restoration Point. It is reported by Schenck (245, pp. 77, 78) to occur in a cliff on the east side of Duwamish Valley back of the Olympic foundry. These strata lie at least 1200 feet above the beds at the old Olympic brewery in South Seattle and probably correspond to the beds of the Blakeley formation at Restoration Point. The general outline of *A. pugetensis* is subtriangular in contrast to the sub-

quadrate-triangular form of *A. shumardi*. *Acila (Acila) gettysburgensis* is associated with the faunas of the upper Blakeley formation.

*Holotype*. (S.U. 5114.) Figured in the present report, pl. 6, fig. 3.

*Geologic range*. Upper part of Blakeley formation, uppermost Oligocene.

*Geographic distribution*. Puget Sound area, Washington.

#### ACILA (TRUNCACILA) CONRADI (Meek), 1864

Plate 4, figure 3; plate 6, figures 10, 11, 12, 18; plate 8, figures 4, 10

*Nucula divaricata* Conrad, Am. Jour. Sci., ser. 2, vol. 5, p. 432, figs. 1a, 1b, 1848.

*Nucula divaricata* Conrad, U.S. Expl. Exped. Geol., p. 725, pl. 18, figs. 6, 6a, 1849; not *Nucula divaricata* Hinds, Zool. Soc. London, p. 97, a Recent species, 1843.

*Nucula conradi* Meek, Checklist Miocene fossils of North America, p. 27, Nov., 1864.

*Nucula (Acila) conradi* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 74, 1924.

*Nucula (Acila) conradi* (Meek), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 64, pl. 1, figs. 1, 3, 18, 1931.

*Nucula (Acila) castrensis* Hinds, Reagan, Trans. Kans. Acad. Sci., vol. 22, p. 174, pl. 1, fig. 2, 1909.

*Acila conradi* Meek, Weaver, Univ. Wash. Publ. Geol., vol. 1, no. 1, p. 28, 1916.

*Acila conradi* (Meek), Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 95, 1922.

*Acila conradi* (Meek), Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, p. 35, 1928.

*Acila (Truncacila) conradi* (Meek), Schenck, Bull. Mus. Roy. Hist. Nat. Belg., vol. 10, no. 20, p. 42 (June), 1934.

*Acila (Truncacila) conradi* (Meek), Schenck, Geol. Soc. Am., Spec. Pap. no. 4, pp. 82-85, pl. 8, figs. 1-3, 5-10, 12-14; text fig. 7, 1936.

*Description by Conrad in 1848*. Subovate, convex, with divaricating striae, extremities rounded; ligament margin very oblique, slightly curved; basal margin curved; beaks near the anterior extremity. (67, p. 432)

*Description by Conrad in 1849*. Subovate, convex, with divaricating striae. Extremities, rounded; ligament margin very oblique, slightly arcuate; basal margin arcuate. Beaks near the anterior extremity. (68, p. 725)

*Observations*. For a detailed discussion of *A. conradi* one may consult the monograph by Schenck (245, pp. 82-85). The holotype was collected at Astoria, Oregon, from rocks of middle Miocene age and described as *Nucula divaricata* Conrad. The species name having been preoccupied by Hinds, it was changed in 1865 by Meek to *conradi*. The holotype (U.S.N.M. 5526), is preserved in the collection of the U.S. National Museum and consists of a poorly preserved cast and mold from a concretion together with a plaster cast. These specimens have been photographed and are figured in the present report, pl. 6, figs. 10, 18.

This species with well-defined secondary bifurcations of ribs is characteristic of the middle Miocene on the Pacific Coast and occurs abundantly in southwestern Washington, the north shore of the Olympic Peninsula east of Clallam Bay, at Astoria, and along the north coast of Oregon. Well-preserved specimens of this species from the sandstones

of the Astoria formation exposed in the sea-cliffs between Newport and Agate Beach, Oregon, have been investigated in detail by Schenck (245, p. 83). He states, "In profile they agree with the photograph; radial ribs ca 220-350 microns wide, separated by narrower interspaces; worn specimens with 13+ concentric lines of growth; line of primary bifurcation anterior to center of shell at ventral margin; angle of bifurcation 50 to 72 degrees; secondary bifurcation common; no rostral sinus; no apparent area of obsolete radial ribbing; ventral margin (interior) not markedly crenulate."

*Holotype.* (U.S.N.M. 5526) and (U.S.N.M. 5526a). Figured in the present report, pl. 6, figs. 10, 18.

*Hypotype.* (U.C. 31900). Astoria formation. Figured in the present report, pl. 4, fig. 3; pl. 6, fig. 12.

*Hypotype.* (U.C. 31899). Astoria formation. Figured in the present report, pl. 6, fig. 11.

*Hypotype.* (U.C. 32484). Locality (U.C. 3698). Lincoln County, Oregon. Figured in the present report, pl. 8, figs. 4, 10.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Western Oregon and Washington and Coast Ranges of southern California.

#### ACILA (TRUNCACILA) EMPIRENSIS Howe, 1922

Plate 6, figures 6, 7, 16

*Acila empirensis* Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 96, pl. 9, figs. 4, 5, 8, 1922.

*Acila (Truncacila) empirensis* Howe, Schenck, Bull. Mus. Roy. Hist. Nat. Belg., vol. 10, no. 20, p. 42, 1934.

*Acila (Truncacila) empirensis* Howe, Schenck, Geol. Soc. Am., Spec. Pap. no. 4, pp. 85-86, pl. 9, figs. 3, 4, 6-10, 12; text figure 7, 1936.

*Original description.* Shell ovate, moderately convex, with fairly prominent adjacent beaks, lunule long, lanceolate, and separated from the rest of the shell by a distinct ridge, sculpture of lunule coarser than that of adjacent parts of shell; escutcheonal area not sharply defined, but separated from the rest of the shell by subangulation, on the anterior side of which, extending from the beaks to ventral margin, is a broad depression. Sculpture of escutcheon immediately below beaks tends to become obsolete; sculpture of escutcheon finer than rest of shell, and on some specimens tends to bifurcate.

Ventral margin regularly arcuate; posterior dorsal edge convex, anterior dorsal edge fairly long and nearly straight; anterior end obliquely subtruncate; sculptured with coarse radial ribs, the sculpture being coarser on the posterior than on the anterior half of shell. Incremental lines heavy and irregular; the line of bifurcation meets the ventral edge anterior to the middle of shell; extending from beaks to posterior end and between ventral angulation and escutcheon, parallel to same, is a broad shallow depression which is more marked in adult specimens. Hinge teeth inaccessible. Length, 16 mm.; alt., 12 mm.; diam., 9 mm. (Howe, 166, p. 96)

*Supplementary description.* Shell large for subgenus, truncate-quadrata, inflated; anterior dorsal margin straight, but profile changes abruptly toward the bluntly rounded anterior extremity; ventral margin convex; posterior margin straight, except for a pouting in escutcheonal region; inturned beaks closely ap-

pressed; primary bifurcation distinct in umbonal area; secondary bifurcation on all shells; radial ribs up to 500+ microns wide, separated by equal interspaces; concentric lines up to 12+; no rostral sinus; area of obsolete radial ribbing well developed, up to 5 millimeters in width; escutcheonal area indistinctly defined, crossed by radial ribs; lunule sometimes defined by an abrupt termination of radial ribs, producing the appearance of a lanceolate depression; interior poorly preserved, one specimen 24+ anterior, 12+ posterior teeth; shell nacreous, ventral margin lacks marginal plications. Dimensions: hypotype no. 32467 (Univ. Calif. Col. Invert. Pal.); length 17 mm.; height 13 mm.; thickness 8 mm.; umbonal angle 107°; angle of bifurcation 58°; ratio of height to length 77 per cent. (Schenck, 245, p. 86)

*Observations.* This species occurs occasionally in the middle Pliocene sandstones and sandy shales of the Quinault and Quillayute formations on the western side of the Olympic Peninsula. It is reported by Schenck (245, p. 85) from the Montesano formation. The holotype came from boulders in the Coos conglomerate of the Empire formation at Coos Bay, Oregon. The Montesano formation probably was deposited during the upper half of the late Miocene and the early third of the Pliocene and it is possible that the Quinault formation may represent a still higher portion of the same stratigraphic sequence which was completed during the middle Pliocene.

*Holotype.* (U.C. 30032.) Locality (U.C. 3323.) Figured in the present report, pl. 6, figs. 6, 16.

*Topotype.* (U.C. 30033.) Figured in the present report, pl. 6, fig. 7.

*Geologic range.* Lower and middle Pliocene.

*Geographic distribution.* Western Oregon and Washington and possibly in the Yakataga district of Alaska.

*Type locality.* (U.C. 3323.) Coos Bay, Oregon, from Coos conglomerate.

#### ACILA (TRUNCACILA) BLANCOENSIS Howe, 1922

Plate 6, figures 13, 15

*Nucula (Acila) conradi* Meek, Dall, U.S. Geol. Surv., Prof. Pap. 59, p. 102, pl. 12, figs. 4, 5, 1909; not *Nucula conradi* Meek, 1864.

*Acila conradi* Meek, Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, no. 212, p. 590, 1913.

*Acila blancoensis* Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 95-96, pl. 9, fig. 3, 1922.

*Acila (Truncacila) blancoensis* (Howe), Schenck, Bull. Mus. Roy. Hist. Nat. Belg., vol. 10, no. 20, p. 42, 1934.

*Acila (Truncacila) blancoensis* Howe, Schenck, Geol. Soc. Am., Spec. Pap. no. 4, pp. 94-95, pl. 9, fig. 1; text figure 7, 1936.

*Description by Dall (Nucula (Acila) conradi* Meek). Shell ovate, moderately convex, with rather inconspicuous beaks, the young proportionately more elongated than the adult specimens; beaks adjacent, slightly recurved; lunule and escutcheon not defined by any bounding line and at the best obscure, especially the former, which can hardly be said to exist; ends of the shell rounded, the margins in the middle of the slightly impressed space usually assigned to the escutcheon, pouting a little; base regularly arcuate, anterior dorsal slope with a flatter, but still regular arch; surface sculptured with little-elevated radial threads somewhat variable in coarseness, separated by narrow sulci; these threads divaricate from a line near the middle of the valves and in old specimens a duplication of the divarica-

tion is frequent near the base; nearly all the specimens obtained are filled with a hard, tough matrix, so that the interior is inaccessible, but specimens from the upper layers of the Miocene of Fossil Point have 14 posterior and 24 anterior V-shaped hinge teeth; the inner margins of the valves are minutely crenate; the chondrophore is of moderate size and directed obliquely forward. Altitude of figured specimen, 14 mm.; longitude, 18 mm.; diameter, 8 mm. Fully adult specimens have a length of 20, a height of 16.5, and a diameter of 12 mm. (Dall, 101, p. 102)

*Supplementary description by Schenck.* Shell large for subgenus, ovate; moderately compressed; dorsal margin gently convex, sloping to broadly rounded anterior extremity; ventral margin convex; radial rings *ca* 230 microns wide near ventral margin, interspaces narrower; several bifurcations in addition to primary; individual ribs often dichotomize; narrow area of obsolete radial ribs; no rostral sinus. Holotype measures: length, 23 millimeters; height, 18.6 millimeters. (Schenck, 245, p. 95)

*Observations.* The holotype of this species came from the Coos conglomerate of the Empire formation at Coos Bay, Oregon. Schenck states that it occurs at the same locality as *Scutella blancoensis* Kew and that the latter species is present in the Astoria formation of western Washington. *S. blancoensis* has been collected by the writer from the sandstones of the uppermost Miocene and lowermost Pliocene part of the Montesano formation in Hoquiam, Washington. It seems probable that the Empire formation in part at least is correlative with the Montesano.

*Holotype.* (U.S.U. 59). Figured in the present report, pl. 6, fig. 15.

*Paratype.* (U.S.N.M. 153952.) Specimen previously figured by Dall as *Nucula* (*Acila*) *conradi* Meek (101, pl. 12, fig. 4). Figured in the present report, pl. 6, fig. 13.

*Geologic range.* Upper Miocene to lower Pliocene. Empire formation.

*Geographic distribution.* Western Oregon and Washington.

*Type locality.* Sea cliffs southeast of lighthouse for a mile along shore, Cape Blanco, Oregon (Schenck). Occurs also at Coos Bay at Fossil Point (Dall).

#### Subgenus *Acila* Adams, 1858

*Acila* Adams, Gen. Moll., vol. 2, p. 545, 1858.

*Subgenotype.* *Nucula divaricata* Hinds.

#### ACILA (ACILA) GETTYSBURGENSIS (Reagan), 1909

Plate 7, figures 1, 2, 3, 4; plate 8, figure 1

*Nucula* (*Acila*) *gettysburgensis* Reagan, Trans. Kans. Acad. Sci., vol. 22, pp. 171, 175, 177, pl. 1, fig. 3, 1909.

*Nucula* (*Acila*) *gettysburgensis* (Reagan), Dall, Am. Jour. Sci., ser. 5, vol. 4, no. 22, p. 306, 1922.

*Nucula* (*Acila*) *gettysburgensis* (Reagan), Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 105, 1933.

*Nucula* *gettysburgensis* Reagan, Weaver, Wash. Geol. Surv., Bull. 15, p. 18, 1912.

*Acila* *gettysburgensis* Reagan, Weaver, Univ. Wash. Publ. Geol., vol. 1, no. 1, pp. 28, 35, 1916.

*Acila gettysburgensis* Reagan, Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, pp. 458-459, 1927.

*Acila (Acila) gettysburgensis* (Reagan), Schenck, Bull. Mus. Roy. Hist. Nat. Belg., vol. 10, no. 20, p. 42, 1934.

*Acila (Acila) gettysburgensis* (Reagan), Schenck, Geol. Soc. Am., Spec. Pap. no. 4, pp. 78-81, pl. 12, figs. 1-15; pl. 13, figs. 4, 7, 9; text figure 8, 1936.

*Original description.* Shell resembling *N. (Acila) castrensis* Hds. but much larger. Shell trigonal, convex, medium thickness; umbones considerably posterior to center, turned posteriorly, posterior end 16, anterior extremity 24.5 from umbones; posterior end short, truncated, concave back of umbones; anterior end rounded to arcuate, forming an acute angle with the anterior extremity; ventral and cardinal margins subparallel; lunule area large, slightly scooped out, sculptured same as rest of shell; a low ridge fronts each valve back of the lunule area, back of which there is a wide, flat, curved sinus extending from the umbo to the ventral margin, widening as it approaches that margin; surface divaricately sculptured, also ornamented with about seven concentric low ridges; inside of shell not seen. Dimensions: Lat., 28; alt., 19.5. (Reagan, 230, p. 175)

*Supplementary description.* Shells smaller than 6 millimeters in length, truncate, primary bifurcation only, radial ribs 200 microns wide, no rostral sinus. Shells 10 millimeters long have a well-developed sinus, and show 4 concentric lines of growth. Shells 10-15 millimeters in length are rostrate, secondary bifurcation sometimes present, radial ribs 250 microns wide. Shells 15-20 millimeters in length have distinct rostral sinus; secondary bifurcation present on some specimens. Specimens 25-30 millimeters long with rostral sinus, 11 well defined concentric lines of growth; secondary bifurcation in area posterior to sinus generally present, on several a double bifurcation along line of primary bifurcation; radial ribs 300 microns wide, interspaces narrower. Specimens between 30-36 millimeters (the maximum length) may be gerontic individuals; 14 well-defined concentric lines of growth, narrow area of obsolete radial ribbing rarely present; secondary bifurcation posterior to sinus, so that the trough of the sinus is the "V" of the bifurcating lines; radial ribs up to 460 microns wide, separated by narrower interspaces. (Based upon a suite of 44 specimens from the type locality in Clallam County, Washington, by Schenck, 245, p. 79.)

*Observations.* *A. gettysburgensis* is a common species in the faunas which have been collected from the upper Oligocene Blakeley formation in western Washington. The holotype is stated by Reagan (230, p. 177) to have been collected from the upper series of the Clallam formation at Gettysburg in Clallam County on the south shore of the Strait of Juan de Fuca, but the exact locality was not defined. Numerous specimens have been collected by the writer from the shales in the sea cliff one mile west of Twin Rivers. Exposures of middle and upper Oligocene shales and shaly sandstones occur intermittently in the sea cliffs along the Strait from Crescent Bay westward to Pysht. These strata lie within the limbs of shallow northwestward-plunging anticlinal and synclinal folds. It is probable that these materials represent a continuous sequence of deposition. The 8,000 feet of sediments of the Blakeley formation exposed along the shores of Bremerton inlet in the Puget Sound Basin may have accumulated in part contemporaneously, although the lower members of this sequence are probably younger than the basal strata in the Clallam County section. A study of the faunal sequences in both areas, based upon foraminifera, will aid in more exact correlations. *A. gettysburgensis* occurs in all of the sediments from base to top which, on a lithologic basis, have been classed as a part of the Blakeley formation. It occurs also in the Nye shale at Newport, Oregon, which was probably in part deposited

contemporaneously with the upper portions of the Blakeley formation. It is reported by Schenck (245, pp. 78-80) to occur in the shales of the Astoria formation of middle Miocene age at Astoria, Oregon, but has not been observed by the writer at that locality.

*Holotype.* (U.S.N.M. 328302.) Reagan specimen. Figured in the present report, pl. 8, fig. 1.

*Hypotype.* (U.W. 211-A) Locality (U.W. 13). Figured in the present report, pl. 7, figs. 1, 2.

*Hypotype.* (U.W. 213.) Locality (U.W. 13). Figured in the present report, pl. 7, figs. 3, 4.

*Geologic range.* Upper Oligocene and possibly lower Miocene.

*Geographic distribution.* Western Oregon and Washington and possibly the Coast Ranges of California.

*Type locality.* In sea cliffs near Gettysburg, Clallam County, Washington.

#### Genus NUCULA Lamarck, 1799

*Nucula* Lamarck, Mem. Soc. d'Hist. Nat. de Paris, p. 97, 1799.

*Genotype.* *Arca nucleus* Linnaeus.

#### NUCULA HANNIBALI Clark, 1925

Plate 6, figure 14; plate 7, figures 19, 20

*Nucula hannibali* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 73-74, pl. 8, fig. 2, 1925.

*Original description.* Shell triangular, medium size; posterior end abruptly truncate; beaks moderately prominent and opisthogyrous; escutcheon fairly broad, almost at right angles to main surface of shell; divided into two parts, a narrow outer flat margin separated from an inner broader pouting area by distinct line; lunule well defined, long and narrow, slightly depressed, separated from outer surface by well-defined line. Surface covered by numerous fairly fine, somewhat irregularly spaced concentric undulations, also sculptured by numerous fine obscure radiating lines with interspaces averaging two or three times as wide as the lines. Radiating lines do not extend upon escutcheon or upon depressed area which borders anterior dorsal edge. Resilifer small and compressed, rather deeply submerged below hinge plate; on the type there are 21 teeth anterior to beak and 12 posterior. Dimensions: length 16 mm.; height 13 mm.; diameter of one valve about 4 mm. (Clark)

*Observations.* This species has been recognized in the shaly sandstones of the lower portion of the Blakeley formation which are exposed in the sea cliffs 3 miles west of Gettysburg, Washington. It differs from *N. washingtonensis* of the middle Miocene Astoria formation in the Grays Harbor area in the greater size of normal adults and proportional lesser thickness.

*Holotype.* (S.U. 5248.) Locality (S.U. N.P. 90). Figured in the present report, pl. 6, fig. 14; pl. 7, figs. 19, 20.

*Geologic range.* Upper Oligocene.

*Geographic distribution.* Olympic Peninsula, Washington.

*Type locality.* (S.U. N.P. 90.) Sea cliff at mouth of Duncan Creek, three miles west of Gettysburg, Washington. (Clark)

## NUCULA WASHINGTONENSIS Weaver, 1916

Plate 8, figures 3, 8

*Nucula washingtonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 34, pl. 3, figs. 27, 28, 29, 1916.

*Nucula washingtonensis* Weaver, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 64, pl. 1, figs. 10, 11, 12, 1931.

*Original description.* Shell very small, thick and robust; triangular outline; beaks small, low and decidedly incurved anteriorly. Posterior cardinal margin decidedly convex and very slightly truncated at the posterior end; anterior dorsal margin slopes downward from beaks at an angle of 60° and is somewhat concave; basal margin broadly arcuate. Lunule cordate and deeply impressed and sculptured by a faint continuation of the lines of growth from the valves. No radial sculpture is visible on any of the specimens examined. Shell material thick and exhibiting a pearly lustre. Surface marked by numerous very well developed lines of growth. This species is characterized by its small size and great thickness. Dimensions: altitude 7 mm.; longitude 9 mm.; thickness 5 mm. to 6 mm. (Weaver)

*Observations.* *N. washingtonensis* occurs in the Astoria formation in a cut along the North River branch of the Chicago, Milwaukee & St. Paul railway in Section 29, T. 17 N., R. 8 W. This species is not abundant but is characterized by the small size and great thickness of adult specimens.

*Holotype.* (U.W. 84) (C.A.S. 449). Figured in the present report, pl. 8, fig. 3.

*Topotype.* (U.C. 31898.) Figured in the present report, pl. 8, fig. 8.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor area, Washington. Reported by Etherington (140, p. 64) from the Kern River Temblor formation of southern California.

*Type locality.* (U.W. 230.) Railway cut on North River branch of the Union Pacific Railway about two miles south of its junction with the Grays Harbor branch in Section 29, T. 17 N., R. 8 W.

## NUCULA TOWNSENDI Dall, 1909

*Nucula cuneiformis* Conrad, Am. Jour. Sci., ser. 2, vol. 5, p. 432, fig. 2, 1848; not of Sowerby, 1837; Dall, U.S. Geol. Surv., Prof. Pap. 59, p. 150 (reprint), 1909.

*Nucula townsendi* Dall, n. nom., U.S. Geol. Surv., Prof. Pap. 59, p. 101, 1909.

*Original description.* Ovate, ventricose in the middle, with strong lines of growth; anterior side short, margin rounded; posterior cuneiform; subtruncated at the extremity; basal margin rounded. (Conrad, 67, p. 432)

*Observations.* The holotype of this species has been lost but a second specimen (No. 3526a, U.S.N.M.) collected by J. D. Dana from the same locality at Astoria, Oregon, was examined by the writer. Although poorly preserved, it has been described as follows by Dall:

"... the shell had coarse and somewhat irregular concentric narrow ridges with subequal interspaces that are marked by fine radiating sulci, which in some places crenulate the crests of the ridges and depressions. The short end seems more abruptly truncate than in Conrad's figure, and he does not mention the radial striae, but his figured specimen (now lost) seems to have been younger than the one here referred to. The shell much resembles *N. decussata* Sowerby." (101, p. 101)

*Geologic range.* Astoria formation, middle Miocene.

## Family NUCULANIDAE

## Genus NUCULANA Link, 1806

*Nuculana* Link, Beschr. Nat. Samml. Univ. Rostock, p. 155, 1806.

*Genotype.* *Arca rostrata* Gmelin = *Mya pernula* Müller.

## NUCULANA COWLITZENSIS (Weaver and Palmer), 1922

Plate 7, figures 10, 18; plate 8, figures 27, 29

*Leda cowlitzensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 6, pl. 10, fig. 4, 1922.

*Nuculana cowlitzensis* (Weaver and Palmer), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 42, pl. 5, fig. 4, 1938.

*Original description.* Shell small and thin, sub-oval in outline; posterior end rostrate and pointed; anterior end regularly and broadly rounded, ventral margin curved, posterior end sloping at an angle of 30° to the ventral line terminating at the dorsal margin in a beak; posterior dorsal margin directed downward and concave; lunule narrow and elongate, only slightly impressed and limited by a fine line; escutcheon narrow and impressed; surface ornamented with concentric ribbing which continues from the anterior margin, regularly to the rostrum, the ribs are numerous with only slight interspaces, they are prominent and have the appearance of slightly overlapping each other from the ventral region toward the umbones; a faint groove extends from the beaks to the posterior point of the ventral margin, just back of which the concentric sculpture is somewhat obliterated except for faint lines of growth. Dimensions: Length 20 mm.; height 11 mm.; (largest specimen). (Weaver and Palmer)

*Observations.* *N. cowlitzensis* differs from *N. gabbi* as figured by Stewart (267, pp. 55-58) as follows: anterior end more obtuse; distance from umbo to anterior end slightly longer; posterior dorsal margin more convex; anterior end narrower and shorter; ribbing finer. *N. cowlitzensis* is more rostrate than *Nuculana merriami* (Dickerson) which occurs in the lowermost Oligocene sandstones at Gries Ranch on Cowlitz River, Washington.

*Holotype.* (U.W. 150) (C.A.S. 7380). Figured in the present report, pl. 7, fig. 10; pl. 8, fig. 29.

*Hypotype.* (U.C. 33127.) Locality Yokam Point, Oregon (U.C. A-717). Figured in the present report, pl. 7, fig. 18; pl. 8, fig. 27.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Washington and Yokam Point, Oregon.

*Type locality.* (U.W. 343.) On west bank of Coal Creek, Cowlitz County, at the old Inman-Poulsen shops, about one-half mile above the junction of a small creek which enters from the east, in Section 2, T. 8 N., R. 3 W.

## NUCULANA VADERENSIS (Dickerson), 1915

## Plate 8, figure 28

*Leda vaderensis* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 52, pl. 1, fig. 3, 1915.

*Original description.* Shell robust, thick, with prominent, central beak; anterior dorsal margin slightly convex, sloping toward a well rounded anterior; posterior dorsal margin concave; ventral margin convex resembling that of *L. gabbi* closely; decoration consisting of very fine, round concentric ribs. This species differs from *L. gabbi* in its finer ribbing, in its greater convexity, and in the central position of its beak. Dimensions: Height, 7 mm.; length, 13 mm.; convexity, 2 mm. (Dickerson)

*Observations.* *N. vaderensis* resembles *N. gabbi* in general form but differs in the lesser development of the concentric ribs and its relatively greater height compared to length.

*Holotype.* (C.A.S. 252.) Figured in the present report, pl. 8, fig. 28.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwest Washington.

## NUCULANA MERRIAMI (Dickerson), 1917

## Plate 8, figures 21, 30

*Leda merriami* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 166, pl. 27, figs. 1a, 1b, 1917.

*Nuculana merriami* (Dickerson), Effinger, Jour. Paleon., vol. 12, p. 366, pl. 46, fig. 5, 1938.

*Original description.* Shell inflated, resembling *Leda alaeformis* Gabb in general shape; acutely rostrate, very inequilateral, very convex; beak prominent, high; anterior slope convex, ascending; posterior slope concave; anterior end bluntly rounded; base arcuate; escutcheon wide, nearly flat; incremental lines numerous, rounded; anterior teeth, 24; posterior teeth, 20 to 23; chondrophore sub-umbonal, not projecting. Dimensions: Length, 30 mm.; height, 22 mm.; convexity, 4.5 mm. (Dickerson)

*Observations.* *N. merriami* from the Gries Ranch beds of the lowermost Oligocene differs from *N. washingtonensis* of the Lincoln formation of the middle Oligocene in the proportionally lesser length of the area posterior to the umbo, the greater height, and the more pronounced concavity of the posterior dorsal margin. It is relatively higher and shorter than *N. cowlitzensis* of the upper Eocene Cowlitz formation.

*Holotype.* (C.A.S. 381.) Figured in the present report, pl. 8, fig. 30.

*Hypotype.* (U.C. 33509.) Figured in the present report, pl. 8, fig. 21.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 239.) East side of Cowlitz River three-fourths of a mile above ferry near Gries Ranch, Cowlitz County, northeast quarter of Section 25, T. 11 N., R. 2 W.

**NUCULANA PARKEI** (Anderson and Hanna) subsp. **COOSENSIS** Turner, 1938

Plate 7, figure 23; plate 8, figure 25

*Nuculana parkei* (Anderson and Hanna) subsp. *coosensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 42, pl. 5, fig. 5, 1938.

*Original description.* Shell small, elongate; beaks low, subcentral; anterior dorsal margin sloping; anterior sharply rounded; ventral margin gently convex; posterior extremity acute; posterior dorsal margin concave; ornamented by two posterior umbonal ridges, the upper terminating at the posterior extremity, and heavy concentric ribbing. (Turner)

*Observations.* The subspecies *coosensis* is proportionately lower than *Nuculana parkei* (Anderson and Hanna) and the posterior margin passes into the ventral margin with a more angulated junction. *N. parkei* contains a third median radiating rather faint umbonal ridge situated midway between the upper and lower umbonal ridges. Only two umbonal ridges are present on the subspecies.

*Holotype.* (U.C. 33205.) Figured in the present report, pl. 7, fig. 23; pl. 8, fig. 25.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* (U.C. A-838.) Rocks in bed of Middle Fork of Coquille River opposite Roseburg-Coos Bay Highway Survey station 834 + 34. (Turner)

**NUCULANA WASHINGTONENSIS** (Weaver), 1916

Plate 8, figures 18, 20, 26

*Leda washingtonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 34, pl. 3, figs. 25, 26, 1916.

*Leda lincolensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 35, pl. 3, figs. 23, 24, 1916.

*Leda washingtonensis* Weaver, n. subsp., Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 108, 109, pl. 5, fig. 19, 1933 (synonymy).

*Original description.* Shell of medium size, elongate and narrow; anterior dorsal margin two-fifths the length of shell, nearly straight and sloping downwards at an angle of 10° from the beaks; anterior end sharply rounded and merging into a slightly arcuate base; posterior dorsal margin slightly concave and deeply excavated; posterior end rostrate and obliquely truncate. On both valves a narrow but distinct groove extends from beaks to posterior end which becomes more deeply impressed near the latter. Surface of shell is sculptured by well marked concentric ribs which are flat topped and with interspaces of about equal width. Radiating ribs are absent. Beaks not very prominent; lunule linear and marked by very faint incised lines; escutcheon sunken, elongate-lanceolate, extending from beaks to posterior end and obliquely grooved with rounded outer edges. Hinge with 26 anterior and 21 posterior V-shaped teeth. Chondrophore small and subumbonal. Adductor muscle scars small; pallial sinus short. Dimensions: Altitude 8 mm.; longitude 20 mm.; thickness 7 mm. (Weaver)

*Observations.* *N. washingtonensis* and *N. lincolnensis* occur together in the shaly sandstones of the Lincoln formation at the type locality west of Centralia, Washington. Originally they were distinguished on minor differences in proportionate dimensions and strength of con-

centric ribs. As was pointed out by Tegland (272, p. 108) the two species probably are identical.

*Syntype.* (U.W. 86) (C.A.S. 451). Figured originally as *Leda lincolnensis* (296, pl. 3, fig. 24). Figured in the present report, pl. 8, figs. 18, 20.

*Syntype.* (U.W. 85) (C.A.S. 450). Figured originally as *Leda washingtonensis* (296, pl. 3, fig. 25). Figured in the present report, pl. 8, fig. 26.

*Geologic range.* Middle and upper Oligocene.

*Geographic distribution.* Western Washington.

*Type locality.* (U.W. 256.) In Union Pacific railway cut one-fourth mile northwest of Galvin Station in Section 27, T. 15 N., R. 3 W.

#### NUCULANA CHEHALISENSIS (Weaver), 1912

Plate 8, figures 11, 15, 16, 17

*Leda chehalisensis* Weaver, Wash. Geol. Surv., Bull. 15, p. 56, pl. 12, figs. 104, 105, 1912.

*Nuculana (Nuculana) chehalisensis* (Weaver), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 65, 66, pl. 1, figs. 2, 7, 9, 14; pl. 9, fig. 2, 1931.

*Original description.* Shell small, moderately convex, equivalve and nearly equilateral; beaks slightly elevated and curved forwards; lunule very large; cordate elongate and fairly deeply impressed; escutcheon long and narrow; anterior margin of shell concave, at first sloping steeply for a short distance from the beaks, and then straight to the anterior end; anterior end bluntly truncated upward; base broadly rounded; posterior margin very slightly convex and sloping downwards at a low angle; posterior end acutely rounded. Sculptured by equally spaced closely set concentric ribs with deeply grooved interspaces equal in width to the ribs. Dimensions: Altitude 10 mm.; longitude 15 mm.; thickness 3.5 mm. (Weaver)

*Observations.* *N. chehalisensis* is one of the characteristic fossils of the Astoria formation in southwestern Washington and occurs in the middle Miocene sandstones at Coos Bay and Agate Beach, Oregon. It differs from *N. ochsneri elmana* which is associated with it in the same strata by a relatively greater height in comparison with length, the lesser attenuation of the posterior end, greater concavity of posterior dorsal margin, and broader rounding of the anterior margin.

*Holotype.* (C.A.S. 539) (U.W. 43). Figured in the present report, pl. 8, fig. 11.

*Hypotype.* (U.C. 31905.) Astoria formation. Figured in the present report, pl. 8, fig. 15.

*Hypotype.* (U.C. 31904.) Astoria formation. Figured in the present report, pl. 8, fig. 16.

*Hypotype.* (U.C. 31907.) Astoria formation. Figured in the present report, pl. 8, fig. 17.

*Geologic range.* Middle Miocene, Astoria formation.

*Geographic distribution.* Western Washington and Oregon and Coast Ranges of southern California.

*Type locality.* (U.W. 63.) In northwest quarter of Section 28, T. 17 N., R. 7 W.

**NUCULANA OCHSNERI** (Anderson and Martin) var. **ELMANA** Etherington, 1931

Plate 7, figures 12, 13, 14; plate 8, figures 6, 7, 12, 19, 22

*Nuculana ochsneri* (Anderson and Martin) var. *elmana* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 66, pl. 1, figs. 4, 5, 6, 1931.

*Original description.* Shell small, elongate, moderately thin; beaks fairly prominent, evacuated behind the beak, rostrate, and acutely rounded posteriorly with both valves closed; anterior dorsal margin sloping evenly to the anterior end which is rounded; basal margin strongly and evenly rounded; surface sculptured by fine concentric lines; escutcheon narrow bearing a second incised line within the first; otherwise sculpture absent; lunule narrow, long and fairly deep. Dimensions of holotype no. 31908, Invert. Col. Mus. Pal. Univ. Calif.: length 18.8 mm.; height 6.7 mm.; thickness 7.2 mm. (Etherington)

*Observations.* This variety differs from the California middle Miocene species by a double incised line on the escutcheon and in finer concentric ribs. It occurs with *N. chehalensis* but is less abundant in number of individuals.

*Holotype.* (U.C. 31908.) Figured in the present report, pl. 7, figs. 12, 13, 14; pl. 8, figs. 6, 19, 22.

*Paratype.* (U.C. 31909.) Figured in the present report, pl. 8, fig. 7.

*Paratype.* (U.C. 31910.) Figured in the present report, pl. 8, fig. 12.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Western Washington.

*Type locality.* (U.W. 473.) Wynoochee River road in cut 150 yards south of railroad up Black Creek, Grays Harbor County, Section 26, T. 18 N., R. 8 W.

**NUCULANA ALKIENSIS** (Clark), 1925

Plate 8, figure 13

*Leda alkiensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 76, pl. 8, figs. 7, 10, 1925.*Leda alkiensis* Clark, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 108, pl. 5, figs. 13, 14, 15, 1933.

*Original description.* Shell rather broadly attenuated posteriorly; beaks a little anterior to median line; anterior dorsal edge gently convex; posterior dorsal edge straight; anterior end broadly and regularly rounded; posterior end bluntly pointed. Lunule and escutcheon depressed, elongate lanceolate in outline, pouting at the dorsal edges; the escutcheon wider and longer and pouting edge much more prominent. A somewhat obscure depression of sinus on main surface, just below escutcheon and parallel to it; this extends from beaks well down to posterior end. Surface smooth, except for fairly heavy but irregular lines of growth. Hinge line not exposed. Dimensions: length, 28 mm.; height, 13 mm.; length from posterior end to beaks, 15 mm. (Clark)

*Observations.* This species, which occurs in the Blakeley formation at Seattle, Washington, is characterized by the nearly straight dorsal margin, the abrupt termination of the posterior end, the weakly developed concentric ribs, and the slightly developed umbonal sinus on the posterior outer surface of the shell situated nearly parallel to and just below the

dorsal margin. *N. washingtonensis* is more rostrate, posterior dorsal margin more concave, and escutcheon and lunule not so pronounced.

*Holotype.* (S.U. 7.) Figured in the present report, pl. 8, fig. 13.

*Geologic range.* Upper Oligocene.

*Geographic distribution.* Puget Sound Basin.

*Type locality.* (U.W. 10.) About 1000 feet south of Alki Point in shale outcropping at the water's edge, Seattle, Washington, Section 15, T. 24 N., R. 3 E.

#### NUCULANA FRESNOENSIS (Dickerson), 1916

Plate 7, figures 15, 17, 22; plate 8, figures 14, 23, 24

*Leda fresnoensis* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 483, pl. 36, figs. 2a, 2b, 1916.

*Nuculana fresnoensis* (Dickerson), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 42, pl. 5, fig. 6; Merriam and Turner, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 24, p. 99, 1937.

*Original description.* Shell long, rather robust for this genus; beak prominent and situated two-fifths of the length from the anterior end. Anterior dorsal margin straight with moderate slope; the posterior dorsal margin slightly concave with a gentle slope to a narrowly rounded rostrum; posterior end, narrowly rounded; ventral margin, broadly convex. Very fine growth lines decorate the shell. Dimensions.—Height of broken specimen, the type, 13 mm.; length, 22 mm. (Dickerson)

*Observations.* The specimens of *Nuculana fresnoensis* (Dickerson) from the Tyee formation near Glide, Oregon, differ slightly from the type obtained at Lillis Ranch, north of Coalinga, California, in the lesser concavity of the posterior dorsal margin and a lesser curvature of the lower part of the posterior margin.

*Holotype.* (U.C. 11790.) Locality (U.C. 1817). Figured in the present report, pl. 7, fig. 22; pl. 8, figs. 14, 23.

*Hypotype.* (U.C. 33126.) Tyee formation, Oregon. Locality (U.C. A-685). Figured in the present report, pl. 7, figs. 15, 17; pl. 8, fig. 24.

*Geologic range.* Tyee formation in Oregon; Domengine in California; middle Eocene.

*Geographic distribution.* North of Coalinga, California, and Douglas County, Oregon.

*Type locality.* (U.C. 1817.) Lillis Ranch, Coalinga. Occurs in Oregon at locality (U.C. A-685) on the north bank of Umpqua River from 470 feet west of French Creek to the first riffle below the Lone Rock bridge, Douglas County.

#### NUCULANA WILLAMETTENSIS (Shumard), 1858

*Leda willamettensis* Shumard, Trans. St. Louis Acad. Sci., vol. 1, p. 121, 1858, no figure.

*Leda willamettensis* Shumard, Dall, U.S. Geol. Surv., Prof. Pap. 59, pp. 104, 187, 1909.

*Nuculana willamettensis* (Shumard), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 126, 1931.

*Original description.* Shell small, oblong, ovate, convex, inequilateral; buccal margin gently arched, and forming with the cardinal margin nearly a right angle; anal

side prolonged, rostrated, truncated at the extremity; basal margin slightly arched; cardinal border oblique in advance of the beak and slightly excavated behind; beak submedial, not very prominent. The surface markings are entirely obliterated on the only specimen we have obtained of this species. Occurs with *Lucina parilis* in dark-gray siliceous limestone, at Brook's lime quarry, Willamette Valley, 5 miles north of Salem, Oregon Territory. (Shumard)

*Observations.* The holotype has been lost and the species is known only from the description of Shumard. No figure of it was published. No specimens have been recognized in any of the collections.

*Holotype.* (St. Louis Acad. Sci.) Lost.

*Geographic distribution.* Five miles north of Salem, Oregon.

#### NUCULANA IMPRESSA (Conrad), 1849

Plate 4, figures 9, 10; plate 8, figure 31

- Nucula impressa* Conrad, U.S. Explor. Exped. Geol., p. 726, pl. 18, figs. 7a-7c, 1849. (Not Sowerby, 1825, nor Hall, 1845.)  
 Not "Yoldia impressa Conrad," Reagan, *fide* Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 306, 1922 (= *Yoldia reagani* Dall).  
*Yoldia (Portlandia) impressa* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. 59, pp. 105, 106, 1909.  
*Yoldia astoriana* Henderson, Nautilus, vol. 33, p. 122, 1920 (= New name for *Nucula impressa* Conrad, 1849).  
*Leda subimpressa* Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 97, pl. 10, fig. 3, 1922.  
*Yoldia (Portlandia) astoriana* Henderson, Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 13, p. 185, 1924.  
*Nuculana astoriana* (Henderson), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., no. 1, p. 122, pl. 32, figs. 46, 47, 48, 1931.

*Original description* (*Nucula impressa* Conrad). Oblong ovate, convex, with regular concentric impressed lines. Anterior extremity rostrate, slightly recurved, extremity truncated; ligament margin arcuate, slightly declining; rounded behind. Beaks submedial. Basal margin arcuate, slightly contracted near the anterior extremity. Astoria, Oreg. (Length 1 inch; breadth very nearly half an inch. Apical angle 155° to 160°. The fine lines of the surface are neat, but closely crowded.) (Conrad, 68)

*Original description* (*Leda subimpressa* Howe). Shell small, subovate, rounded anteriorly, rostrate posteriorly; posterior extremity subtruncate; surface sculptured by numerous broad incised lines on the ventral half of the shell—but these become obsolete or merge into irregular growth lines near the anterior and posterior ends, and are not well developed on the upper half of the shell. Beaks subcentral, slightly anterior. Lunule elongate, narrow, defined by an incised line, narrower than the escutcheon, which is also elongate and is sculptured by very fine growth lines.

A distinguishing feature of this shell is that a subimpressed area radiates from the beaks to the posterior margin—about one millimeter below the truncation. This subimpressed area is bounded on the two sides by faintly incised lines. *Dimensions.*—Length, 19 mm.; alt., 10 mm. Empire formation. (Howe, p. 97)

*Statement of Henderson.* *Nucula impressa* Hall is a *Yoldia*, and has priority over *Nucula impressa* Conrad, 1848, from the Tertiary of Oregon, which, as Dr. Dall informs me, is a *Portlandia*, and both are preoccupied by *Nucula impressa* Sowerby (Min. Conch., V. 1825), a Cretaceous shell of Europe. Hall's species may be known as *Yoldia fremonti*, and Conrad's species may be known as *Yoldia (Portlandia) astoriana*. (Henderson, p. 122)

*Observations.* The holotype of *Nucula impressa* Conrad came from the Astoria formation in Oregon. The holotype of *Leda subimpressa*

Howe came from the Empire formation of Coos Bay, Oregon. Both specimens are figured in this report and have been examined in detail by the writer. Howe's species is the same as *Yoldia impressa* (Conrad) as identified by Dall from the Empire formation. The biologic details of these specimens indicate that they are all identical with *Nucula impressa* Conrad from the Astoria formation, although the original illustration does not show the subimpressed area which is actually present on the holotype and whose presence on the specimen described by Howe led him to define *Leda subimpressa* as a new species. Grant and Gale (p. 122) recognized these forms as Nuculanas. As long as the species name *impressa* was applied to the genera *Nucula* and *Yoldia* it became invalid. The shells seem to belong to the genus *Nuculana*, and therefore the original name of Conrad may be retained.

*Holotype* ("*Nucula impressa* Conrad"). (U.S.N.M. 3490.) From Astoria formation at Astoria, Oregon. Conrad collection. Figured in the present report, pl. 4, figs. 9, 10.

*Holotype* ("*Leda subimpressa* Howe"). (S.U. 61.) From Empire formation at Coos Bay, Oregon. Figured in the present report, pl. 8, fig. 31.

*Geologic range.* Astoria and Empire formations.

#### NUCULANA ACUTA (Conrad), 1832

*Nucula acuta* Conrad, Am. Marine Conch., p. 32, pl. 6, fig. 1, 1832; not of Sowerby, 1837.

*Nucula acuta* Conrad, Conrad, Fossils of the Tertiary Formations of the U.S., pt. 3, p. 57, pl. 30, fig. 2, 1845.

*Leda acuta* Conrad, Oldroyd, I. S., Univ. Wash. Publ. Puget Sound Biol. Sta., vol. 4, p. 7, 1924.

*Leda acuta* Conrad, Oldroyd, I. S., Stanford Univ. Publ. Geol., vol. 1, p. 16, 1924.

*Leda acuta* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. 59, p. 103, 1909.

*Original description.* Shell ovate elongated, convex with numerous regular concentric striae, anterior side slightly recurved and very acute at the extremity, and with the dorsal margin sunk so as to form a lanceolate depression; beaks behind the center; fosset very small and hardly oblique. (Conrad, 64, p. 32)

*Supplementary description.* Ovate lanceolate, ventricose, with prominent concentric striae; anterior side longest, rostrated, compressed acute at the extremity, which is lightly recurved; anterior submargin carinated; posterior end acutely rounded; basal margin profoundly curved, slightly sinuous near the anterior extremity, obliquely subtruncated toward the posterior extremity. (Conrad, 66, p. 57)

*Observations.* This species is reported by Dall (101, p. 103) to occur abundantly in the sandstones of the Empire formation at Fossil Point, Coos Bay, Oregon. The species is living in both the Atlantic and Pacific and ranges in time from Miocene to Recent. Minor differences of non-varietal rank can be recognized among the Tertiary specimens of the Atlantic and Pacific coasts, but the ornamentation and outlines of living forms are more uniform and stabilized.

*Holotype.* In the Academy of Natural Sciences, Philadelphia.

*Hypotype.* (U.C. 154009.) Fossil Point, Oregon. Not figured in the present report.

*Geologic range.* Miocene to Recent on both the Atlantic and Pacific coasts. Empire formation of uppermost Miocene and lowermost Pliocene age in Oregon.

## NUCULANA WHITMANI (Dall), 1909

## Plate 9, figure 12

*Leda whitmani* Dall, U.S. Geol. Surv., Prof. Pap. 59, pp. 103, 104, pl. 14, fig. 4, 1909.

*Leda whitmani* Dall, Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 92, and table opposite, 1922.

*Nuculana whitmani* (Dall), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 124, 125, 1931.

*Original description.* Shell large, solid, inequilateral, the posterior side longer, the valves rather convex; beaks full, slightly recurved, sculptured with fine, distant, slightly elevated, concentric threads; anterior dorsum arched, the anterior end defective; posterior dorsum markedly concave, with a striated, strongly impressed lanceolate escutcheon, the opposed margins prominently raised; posterior end rostrate subtruncate, obliquely rounded; base arcuate; sculpture of concentric sulci obsolete on the dorsal half of the rostrum, feebler on the sides of the valve, and becoming deeper and stronger toward the basal margin; interior inaccessible. Length of remaining portion of valve, 23 mm.; length from beak to posterior end, 16 mm.; height, 17.; double diameter of valve, 8 mm. (Dall)

*Observations.* The holotype (U.S.N.M. 153970) upon which the description of this species was based has preserved only the posterior two-thirds of a right valve. The concentric ribs are fine, but progressively more prominent from the umbonal region toward the ventral margin. The posterior end is abruptly truncated.

*Holotype.* (U.S.N.M. 153970.) Figured in the present report, pl. 9, fig. 12.

*Geologic range.* Empire formation, late Miocene and early Pliocene.

*Geographic distribution.* Western Washington.

*Type locality.* From Miocene matrix inclosed as a pebble in the Coos conglomerate (member of Empire formation), Fossil Point, Coos Bay, Oregon. (Dall)

## Genus YOLDIA Moeller, 1842

*Yoldia* Moeller, Index Molluscorum Groenlandiae, p. 18, 1842.

*Genotype.* *Nucula arctica* Moeller = *Nucula myalis* Couthouy

## YOLDIA (PORTLANDIA) PACKARDI (Clark), 1918

## Plate 8, figures 33, 34

*Malletia packardi* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 11, p. 125, pl. 12, fig. 3; pl. 14, figs. 5, 6, 1918.

*Yoldia (Portlandia) packardi* (Clark), Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 77, pl. 9, fig. 7, 1925.

*Original description.* Shell rather small to medium in size; beaks anterior to the middle, opisthogyrous. Anterior dorsal slope straight; posterior dorsal slope rather strongly excavated; anterior end regularly rounded; posterior end regularly rounded but narrower than the anterior end, the ventral margin sloping up more obliquely to it than to the anterior end. Surface smooth except for somewhat irregular incremental lines. As shown on one of the specimens obtained from the diatomaceous shale of the Markley formation (fig. 6), the escutcheon is well defined, long and narrow and depressed almost at right angles to the main outer surface of the

shell. Lumule apparently absent. No well-defined chondrophore. About eighteen taxodont teeth posterior and about twenty-one anterior to the beak, the posterior and anterior rows of teeth meeting at the apex of the beaks. Dimensions: length, 17.5 mm.; height, 10 mm. (Clark)

*Observations.* *Y. packardi*, which occurs in the sandy shales of the Blakeley formation 2 miles east of Twin Rivers in Clallam County, bears a very close resemblance to *Y. chehalisensis* from the middle Oligocene of Grays Harbor. The umbones of the former are situated about 40 per cent of the length of the shell from the anterior end while in the latter they are nearly central. The anterior end of the former is more evenly rounded and the posterior dorsal margin more deeply concave, especially just below the umbo.

*Holotype.* (U.C. 11154.) A poorly preserved cast, from the Oligocene of Kirker Creek, Contra Costa County, California. Figured in the present report, pl. 8, fig. 34.

*Hypotype.* (S.U. 9.) From the upper Oligocene sandy shales two miles east of Twin Rivers, Clallam County, Washington. Figured in the present report, pl. 8, fig. 33.

*Geologic range.* Upper Oligocene.

*Geographic distribution.* Western Washington, and Coast Ranges of central California.

*Type locality.* (U.C. 2033.) Kirker Creek, Contra Costa County, California. Occurs also at locality (S.U. N.P. 122). One-half to three miles east of Twin Rivers, Clallam County, Washington.

#### **YOLDIA CHEHALISENSIS (Arnold), 1908**

Plate 8, figures 35, 36, 37, 38

*Malletia chehalisensis* Arnold, Proc. U.S. Nat. Mus., vol. 34, p. 365, pl. 33, figs. 9, 9a, 1908.

*Malletia chehalisensis* Arnold, Univ. Wash. Publ. Geol., vol. 1, p. 28 (check list, Delazine Creek), 1916.

*Yoldia (Yoldiella) chehalisensis* (Arnold), Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 79, 1925.

*Yoldia chehalisensis* (Arnold), Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 110, 111, pl. 5, figs. 16, 17, 18, 1933.

*Original description.* Shell attaining a length of 25 mm., oval, compressed, smooth; umbones rather inconspicuous, slightly anterior to middle, turned backward; anterior dorsal margin sloping straight from umbo; anterior extremity regularly rounded; posterior dorsal extremity above medial line, more attenuated than the anterior; posterior portion of base near extremity nearly straight, otherwise quite regularly curved. Surface smooth, except for faint concentric lines. Hinge consists of a row of sharp teeth flexed toward the umbo on each side of a prominent, projecting umbonal pit. Pallial sinus large and deep. Dimensions: length, 7.4 mm.; latitude, 4.5 mm.; diameter of single valve, 1.5 mm. (Arnold)

*Observations.* The holotype of this species came from the middle Oligocene sandy shales at Porter, Washington. As was pointed out by Clark (52, p. 79), the shell outline and presence of the chondrophore indicate that the shells should be referred to the genus *Yoldia* rather than *Malletia*. The species has been collected by the writer from the cliffs

along Chehalis River near the town of Porter and also at Restoration Point near Seattle. The species is characterized by the nearly central position of the umbones, the broadly and evenly rounded anterior margin, the slightly concave posterior dorsal margin, and the bluntly truncated posterior end.

*Holotype.* (U.S.N.M. 165447.) Figured in the present report, pl. 8, fig. 38.

*Hypotypes.* (U.C. 32107, 32094, 32093.) Oligocene of Washington. Figured in the present report, pl. 8, figs. 35, 36, 37.

*Geologic range.* Middle and upper Oligocene.

*Geographic distribution.* Western Washington.

#### **YOLDIA (PORTLANDIA) DUPREI** Weaver and Palmer, 1922

Plate 7, figure 16; plate 9, figure 9

*Yoldia duprei* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 7, pl. 10, figs. 2, 7, 1922.

*Original description.* Shell small, plump, and subelongate in outline; inequilateral, beaks situated not quite a third of the distance from the anterior end; ventral and dorsal margins nearly parallel; anterior dorsal margin sloping at about an angle of 10° from the dorsal margin, rounded below into the ventral margin which is only slightly rounded, posterior end extends upward at about an angle of 40° with the ventral margin, posterior terminating at the dorsal margin in a point; posterior dorsal end concave; lunule faintly developed; escutcheon more deeply impressed; surface smooth except for the concentric growth lines which are fine and delicate; shell with a beautiful polish; outline of the teeth seen through the shell in the cardinal region. Dimensions: length, 14.5 mm.; height, 8 mm.; width, 6 mm. (Weaver and Palmer)

*Observations.* This species has been recognized only in the upper Eocene Cowlitz formation of southwestern Washington and is characterized by the slightly developed umbonal ridge extending posteriorly to the ventral margin and the position of the umbones about 40 per cent of the length of the shell from the anterior end. It resembles *Y. chehalensis* in outline but is proportionately not so high.

*Holotype.* (U.W. 151) (C.A.S. 7388). Figured in the present report, pl. 7, fig. 16; pl. 9, fig. 9.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 329.) Bend in Cowlitz River, near Vader, Lewis County, Washington, Section 28, T. 11 N., R. 2 W.

#### **YOLDIA OLIMPIANA** Clark, 1925

Plate 9, figures 1, 2

*Yoldia olympiana* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 77, pl. 9, fig. 9, 1925.

*Yoldia cf. olympiana* Clark, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 111, pl. 5, fig. 20, 1933.

*Original description.* Shell thin; elongate ovate in outline; beaks anterior to median line. Strongly inturned and slightly opisthogynous; posterior end bluntly

pointed; anterior end broadly and regularly rounded. Lunule and escutcheon rather strongly depressed, pouting at dorsal edge; both elongate lanceolate in outline, escutcheon being the longer and wider. Surface of shell smooth, except for fairly heavy somewhat irregular incremental lines. Dimensions: length, 27 mm., length from posterior end to back, 14.5 mm., height, 14 mm. (Clark)

*Observations.* The holotype derived from upper Oligocene sandy shales in the sea cliffs three-fourths mile west of Twin Rivers in Clallam County, Washington, is characterized by a subrhomboid outline, nearly straight posterior dorsal margin, evenly rounded anterior end, inclined-truncate posterior end, and slightly developed posteriorly dissected umbonal ridge.

*Holotype.* (S.U. 10.) Figured in the present report, pl. 9, figs. 1, 2.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Western Washington.

*Type locality.* (U.W. 258.) In sea cliff one-half mile west of Twin Rivers, Clallam County, Washington, Section 27, T. 31 N., R. 10 W.

#### **YOLDIA NEWCOMBI** Anderson and Martin, 1914

##### Plate 9, figure 5

*Yoldia newcombi* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 54, pl. 3, fig. 3, 1914.

*Original description.* Shell small, thin, compressed, ovally elongated; valves equal, very inequilateral, greatly attenuated behind; beaks small, slightly raised, near the anterior extremity; escutcheon lanceolate, very long, bordered by a narrow groove; lunule indistinct; anterior dorsal margin short, nearly straight; anterior end well rounded; base ovately rounded; posterior extremity tapering to a narrow, rounded end, gaping; posterior dorsal margin broadly concave, with the opposed margins projecting above the escutcheon; posterior dorsal area flattened; umbones inconspicuous; interior inaccessible. Dimensions: length, 14 mm.; length of rostrum, 10.5 mm.; altitude, 5 mm.; thickness of both valves, 2.2 mm. (Anderson and Martin)

*Observations.* Specimens from the Blakeley formation one-half mile west of Twin Rivers in Clallam County, Washington, differ from other species in the Oligocene and Miocene of Oregon and Washington in the normal small size of adults, in the extreme anterior position of the umbo, in the elongate tapering and slightly truncate portion posterior to the beaks, and in the somewhat bluntly rounded anterior end.

*Holotype.* (C.A.S. 237.) Figured in the present report, pl. 9, fig. 5.

*Geologic range.* Upper Oligocene, Blakeley formation.

*Geographic distribution.* North side of Olympic Peninsula, Washington.

*Type locality.* (C.A.S. 213.) Clallam County, Washington.

**YOLDIA SAMMAMISHENSIS** Weaver, 1912

## Plate 9, figure 3

*Yoldia sammamishensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 56, pl. 13, fig. 106, 1912.

*Original description.* Shell thin, moderately compressed, equivalve, slightly inequilateral. Anterior end slightly longer than posterior; anterior margin slopes slightly upwards from the beak, then bends rather sharply, passes broadly around the anterior end and slopes at 45° to the base. Basal margin straight for some distance and then slopes upward at 20° and finally is obliquely truncated upwards at the posterior end; posterior margin slopes down from 45° from beak and then extends at an angle of 15° to the posterior end; posterior end slightly bent. Beaks low and directed posteriorly. Surface ornamented by moderately coarse to fine evenly spaced concentric ridges. There are nineteen posterior hinge teeth, anterior number undeterminable. Dimensions: longitude 60 mm.; altitude 32 mm.; diameter 9 mm. (Weaver)

*Observations.* Specimens of this species are known in the shaly sandstones of the lower part of the Blakeley formation on the east side of Lake Sammamish in the Puget Sound Basin. Adults of this species attain a normal size double that of other Oligocene species of Oregon and Washington. The umbones are nearly centrally situated and the dorsal margin forms nearly a straight line both in front of and behind the beaks.

*Holotype.* (U.W. 44) (C.A.S. 7387). Figured in the present report, pl. 9, fig. 3.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Puget Sound Basin, Washington.

*Type locality.* Blakeley formation two miles northeast of Issaquah, King County, Washington.

**YOLDIA CLALLAMENSIS** n. sp.

## Plate 9, figure 13

*Description.* Shell thin, very elongate; umbones situated 40 per cent the length of the shell from the anterior end, rather inconspicuous and slightly opisthogyrous; posterior margin attenuate and acutely rounded; anterior dorsal margin nearly straight; posterior dorsal margin very slightly concave; ventral margin on posterior three-fourths of shell slopes progressively upward toward the posterior end. Lunule and escutcheon narrow, elongate, and slightly depressed, the latter having a width about 3 times that of the former. Ornamentation consisting of fine irregular incremental lines. Dimensions: length, 50 mm.; height, 19 mm.; thickness of combined valves, 11 mm.

*Holotype.* (U.C. 32095.) Figured in the present report, pl. 9, fig. 13.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* North side of Olympic Mountains, Washington.

*Type locality.* (U.W. 680) (U.C. A-6). In sea cliffs one mile east of Twin Rivers, Clallam County, Washington.

**YOLDIA (PORTLANDIA) OREGONA (Shumard), 1858**

Plate 9, figures 8, 16

- Leda oregona* Shumard, Trans. St. Louis Acad. Sci., vol. 1, pp. 121, 122, 1858; Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 121, 1868-1869.  
*Nuculana oregona* Shumard, Meek, Checklist Miocene Fossils N. America, pp. 5, 27, 1864.  
*Neilo oregona* Shumard, Conrad, Am. Jour. Conch., vol. 1, p. 153, 1865.  
*Yoldia (Cnesterium) oregona* Shumard, Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 310, 1922; Dall, U.S. Geol. Surv., Prof. Pap. 59, pp. 105, 187, pl. 19, fig. 4, 1909.  
*Yoldia oregona* Shumard, Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, no. 22, pp. 576, 583, 588, 590, 1913; Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 67, pl. 1, fig. 8, 1931; Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 130, 1931.

*Original description.* Shell rather large, ovate, compressed, convex; anterior extremity strongly arched; posterior extremity rostrate, slightly recurved, truncated; basal margin forming a broad curve, slightly contracted near the posterior extremity; ligament margin slightly concave; beaks situated a little in advance of the middle; surface neatly ornamented with regular, concentric, impressed lines, becoming more approximate above; hinge with a line of closely set oblique teeth on each side of the beak. Length 20 lines; height, 10 lines. (Shumard)

*Observations.* The holotype upon which Shumard's description was based was never figured and the specimen has been lost. It was collected by Evans and Shumard from sandstones of probable Oligocene age in the Willamette Valley at an unknown locality south of Oregon City, Oregon. Specimens from 6 miles southwest of Salem, Oregon, possessing characters which correspond to Shumard's description have been described by Dall (101, p. 105). These specimens somewhat resemble *Y. cooperii* Gabb in general appearance but differ in the more nearly central position of the umbones, less acute posterior termination of the shell, and in a lesser number of anterior and posterior teeth. The specimen (140, p. 67) which has been described and figured as *Y. oregona* by Etherington (U.C. 31912) has a more attenuate posterior termination with the umbones situated 40 per cent of the length of the shell from the posterior end. *Y. sammamishensis* from the upper Oligocene of Washington is characterized by blunter posterior truncation and a more broadly rounded anterior.

*Holotype.* Lost.

*Hypotype.* (U.S.N.M. 110450.) Figured in the present report, pl. 9, fig. 16.

*Hypotype.* (U.C. 31912.) Astoria formation, Washington. Figured in the present report, pl. 9, fig. 8.

*Geologic range.* Oligocene and Miocene.

*Geographic distribution.* Willamette Valley and southwestern Washington.

*Type locality.* Six miles southwest of Salem, Oregon. The specimen (U.S.N.M. 110450) figured by Dall was collected at Hall's Ferry, five and one-half miles southwest of Salem, Marion County, Oregon. The species as figured by Etherington is common at many localities in the Astoria formation in southwest Washington.

**YOLDIA (PORTLANDIA) COOPERII Gabb, 1865**

Plate 9, figure 19

- Yoldia cooperii* Gabb, Proc. Calif. Acad. Sci., vol. 3, p. 189, 1865.  
*Yoldia cooperii* Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 31, pl. 9, fig. 54, 1869.  
*Yoldia cooperii* Gabb, Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 78, pl. 8, fig. 6, 1925.  
*Yoldia (Portlandia) cooperii* Gabb, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 67, 1931.  
*Yoldia cooperi* Gabb, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 128, pl. 1, fig. 13; pl. 14, fig. 3, 1931.

*Original description.* Shell thin, somewhat compressed, very inequilateral; beaks placed about a third of the length from anterior end, minute; anterior end narrow, sub-acuminate, posterior end broadly rounded; base most prominent just posterior to middle of shell; surface sculptured by numerous small concentric ribs, rarely dichotomous or anastomosing on widest part of shell; these ribs flat and abruptly truncated on side nearest beak, giving to surface under a glass appearance of an overlapping. Epidermis shining, olivaceous; internally a bluish white; muscular scars large, anterior triangular, posterior a third the largest, broadly suboval. (Clark, 52, p. 78)

*Observations.* The holotype is a Recent shell which was picked up on the beach at Santa Cruz, California. The shell is said to vary in outline from youth to maturity. Fossil specimens similar to the holotype of the Recent form occur at locality (U.W. 455) just above the contact with interbedded basaltic flows in the shales of the Astoria formation in a cut of the Union Pacific Railway in Section 36, T. 16 N., R. 5 W., in Grays Harbor County.

*Holotype.* (U.C. 30613.) Figured in the present report, pl. 9, fig. 19.

*Geologic range.* Miocene to Recent.

*Type locality.* Sea beach, near Santa Cruz, California.

**YOLDIA TEMBLORENSIS Anderson and Martin, 1914**

Plate 9, figure 4

- Yoldia temblorensis* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 54, pl. 3, 1914.  
*Yoldia temblorensis* Anderson and Martin, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 67, pl. 1, fig. 16, 1931.

*Original description.* Shell small, oblong ovate, thin, arcuate on lower margin, nearly straight above; beaks central, inconspicuous; hinge margin bent only six degrees from straight line; anterior end well rounded; posterior end rostrate, almost pointed, slightly open, angulated by an impressed line extending from the beaks downward to the posterior end below the siphonal opening; anterior end similarly crossed by an impressed zone extending from the beaks obliquely downward and forward; surface sculptured by regular lines of growth. (Anderson and Martin)

*Observations.* Several specimens of this species from the Astoria formation in southwestern Washington have approximately the same shell proportions as the holotype from Kern County, California. The shell is moderately inflated with umbones nearly central and the concentric sculpture well developed.

*Hypotype.* (U.C. 31911.) Astoria formation. Locality (U.W. 473). Figured in the present report, pl. 9, fig. 4.

*Geologic range.* Astoria formation and Temblor formation, middle Miocene.

*Geographic distribution.* Western Washington and southern San Joaquin Valley in California.

*Type locality.* (C.A.S. 106.) North bank of Kern River about three miles east of the Rio Bravo ranch house. Occurs in Washington at locality (U.W. 473). In road cut on Wynoochee River 150 yards south of railroad up Black Creek, Grays Harbor County, Section 26, T. 18 N., R. 8 W.

**YOLDIA SCISSURATA Dall var. STRIGATA Dall, 1909**

Plate 9, figures 15, 20

*Yoldia (Cnesterium) strigata* Dall, U.S. Geol. Surv., Prof. Pap. 59, p. 104, pl. 14, figs. 9, 9a, 1909.

*Yoldia strigata* Dall, Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, p. 590, 1913.

*Yoldia strigata* Dall, Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 32, 1916.

*Yoldia strigata* Dall, Weaver, Proc. Calif. Acad. Sci., ser. 4, vol. 6, p. 27, 1916.

*Yoldia strigata* Dall, Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 92, 1922.

*Yoldia scissurata* Dall var. *strigata* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 131, 1931.

*Original description.* Shell thin, compressed, equivalve, inequilateral, polished; anterior end longer, equally arcuate above and below, anteriorly somewhat attenuated; posterior end a little shorter, subtruncate, slightly recurved, dorsal slope slightly concave, with the opposed margins compressed and projecting in the middle of the narrow escutcheon; lunule linear or nearly so; truncate end a little concavely flexuous; posterior basal margin evenly convexly arcuate; base a little prominent toward the middle; beaks inconspicuous, flattish, not raised above the general arch of the dorsum; surface smooth except for obscure incremental lines, and numerous sharp, slightly elevated, somewhat flexuous, oblique, distant ridges with the long slope extending basally and the short slope abrupt and almost undercut; these ridges vary slightly in individuals but in general cover the sides of the shell nearly to the beaks, and are usually obsolete on the anterior dorsal areas and on the rostrum; the shell gets proportionately broader, vertically, with age. Longitude of figured specimen, 37 mm.: altitude, 19.5 mm.; diameter, 5.5 mm. An older but less perfect individual measures: longitude, 43.5 mm.; altitude, 23.0 mm.; diameter, 7.5 mm. (Dall)

*Observations.* The specimen from the Empire formation at Coos Bay, Oregon, which originally was given specific rank by Dall (101, p. 104) is a variety of *Yoldia scissurata* Dall. *Yoldia scissurata* var. *strigata* is characterized by a more bluntly truncated posterior end than in *scissurata* and the upward bending of the concentric growth lines is better developed on the posterior portion of the shell.

*Holotype.* (U.S.N.M. 153951.) Figured in the present report, pl. 9, fig. 20.

*Paratype.* (U.S.N.M. 153951a.) Figured in the present report, pl. 9, fig. 15.

*Geologic range.* Empire and Montesano formations of uppermost Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay area in Oregon and Grays Harbor in Washington.

*Type locality.* Coos Bay, Oregon (Camman Collection). (Dall)

**YOLDIA REAGANI Dall, 1922**

## Plate 9, figure 6

*Yoldia impressa* (Conrad), Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 177, pl. 1, fig. 4, 1909.

*Yoldia reagani* n. nom., Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 306, 1922.

*Description by Reagan.* The lines of the surface are neat, but closely crowded. The apical angle is about 160 degrees.

This species is very variable. The length varies from one to two and one-half inches; the breadth of the mature shells is usually about one-half inch.

The shells of this species are much more gibbous than the shells of *Yoldia cooperi*, and are also much shorter. (Reagan, 230, p. 177)

*Supplementary description.* A comparison with Conrad's type shows that the latter is vertically more attenuated toward both extremities and more compressed laterally, being undoubtedly distinct from the present shell, which is closely related to *Yoldia beringiana* and *Y. montereyensis* Dall, of the recent fauna. Both of them are of greater height from base to umbones, and more inflated than the fossil. (Dall, 108, p. 306)

*Observations.* The holotype of this species originally was referred by Reagan to *Y. impressa* Conrad. Later Reagan's collections were given to the U. S. National Museum and were restudied by Dall. A new species, *Y. reagani*, was created for this form although no formal description was presented.

*Holotype.* (U.S.N.M. 328303.) Figured originally by Reagan as *Yoldia impressa* Conrad (230, pl. 1, fig. 4). Figured in the present report, pl. 9, fig. 6.

*Geologic range.* Upper Oligocene, Blakeley formation.

*Geographic distribution.* Between Gettysburg and Clallam Bay, Washington.

*Type locality.* Gettysburg, East Clallam, Washington. (Reagan)

**Genus MALLETIA Desmoulin, 1832**

*Malletia* Desmoulin, Act. Soc. Linn. Bord., vol. 5, p. 85, 1832.

*Genotype.* *Malletia chilensis* Desmoulin.

**MALLETIA ABRUPTA (Conrad), 1848**

*Nucula abrupta* Conrad, Am. Jour. Sci., ser. 2, vol. 5, p. 423, fig. 3, 1848; reprinted by Dall, U.S. Geol. Surv., Prof. Pap. 59, p. 150, fig. 3, 1909.

*Neilo abrupta* Conrad, Am. Jour. Conch., vol. 1, p. 153, 1865.

*Neilo abrupta* Conrad, Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 122, 1868-1869.

*Malletia abrupta* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. 59, p. 106, 1909.

*Malletia abrupta* (Conrad), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 132, 1931.

*Original description.* Somewhat elliptical, convex; truncated anteriorly; ligament margin rectilinear, oblique; posterior margin obliquely truncated, contracted. (Conrad)

*Observations.* The specimen upon which the original description of this species was based was collected by J. K. Townsend from the vicin-

ity of Astoria, Oregon. The holotype is not available and the figure of Conrad's is a drawing which has been reproduced by Dall. Except for less prominent umbones the illustration resembles *M. pacifica* Dall which is living in Puget Sound. No specimens have been seen by the writer from the Tertiary of Oregon or Washington which could be identified with *M. abrupta*.

*Holotype.* Unknown.

*Geologic range.* Probably middle Miocene.

*Geographic distribution.* Astoria, Oregon.

## SUPERFAMILY ARCACEA

### Family PARALLELODONTIDAE

Genus PORTERIUS Clark, 1925

*Porterius* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 79, 80, pl. 8, fig. 3; pl. 9, figs. 1, 6, 1925; Reinhart, Jour. Paleon., vol. 11, p. 176, 1937.

*Genotype.* *Barbatia andersoni* Van Winkle, 1918 = *Barbatia gabbi* Dickerson, 1917.

#### PORTERIUS GABBI (Dickerson), 1917

Plate 9, figures 7, 10, 11, 14; plate 11, figure 3

*Barbatia gabbi* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 167, pl. 27, fig. 4, 1917.

*Barbatia andersoni* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, pp. 81, 82, pl. 6, fig. 2, 1918.

*Parallelodon (Porterius) andersoni* (Van Winkle), Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 79, 80, pl. 8, fig. 3; pl. 9, figs. 1, 6, 1925.  
"Barbatia" *andersoni* Van Winkle, Reinhart, Bull. Mus. Roy. Hist. Nat. Belg., vol. 11, no. 13, p. 7, 1935.

*Porterius gabbi* (Dickerson), Reinhart, Jour. Paleon., vol. 11, pp. 178, 179, pl. 27, figs. 1a, 1b, 2a, 2b, 3, 1937.

*Cucullaria (Porterius) gabbi* Dickerson, Effinger, Jour. Paleon., vol. 12, p. 366, pl. 46, fig. 6, 1938.

*Original description of Barbatia gabbi.* Shell small, with nearly straight hinge line; ventral margin very broadly rounded; anterior end narrowly rounded; posterior end rounded broadly, meeting the ventral margin at the extremity of a rounded indefinite umbonal slope.

This description is based upon a study of the growth lines of the broken type and checked by a specimen from another locality which shows a complete outline. (Dickerson, 123, p. 167)

*Original description of Barbatia andersoni.* Shell small, roughly rectangular in outline; dorsal margin straight, posterior end truncate and sloping at a low angle from the dorsal margin; ventral margin straight; anterior end broadly rounded; beaks very close to the anterior end. A poorly developed umbonal ridge extends from the beaks to the posterior extremity; a very slight radial depression extends from the middle of the shell to the ventral margin. The surface is ornamented with numerous radial ribs with interspaces of equal width.

*Barbatia andersoni* differs from *Barbatia merriami* in the constancy of its smaller size, in the absence of a marked umbonal ridge and in the lack of the groove above it. Dimensions: Altitude, 7 mm.; longitude, 13 mm.; thickness, 5 mm. (Van Winkle, 275, pp. 81, 82)

*Observations.* The holotype of "*Barbatia*" *andersoni* is an immature specimen and numerous topotypes which are well preserved appear to be identical with *Porterius gabbi* (Dickerson). The holotype of "B." *andersoni* was used by Clark (52, p. 79) for the description of the subgenus of *Porterius*. Reinhart (233, p. 176) has pointed out that it is not related to that genus and has raised *Porterius* to generic rank.

*Holotype.* (C.A.S. 385.) Figured by Dickerson as holotype of *Barbatia gabbi*. Figured in the present report, pl. 9, figs. 7, 11.

*Hypotype.* (U.W. 126) (C.A.S. 7392). Figured by Van Winkle as holotype of *Barbatia andersoni*. Figured in the present report, pl. 11, fig. 3.

*Hypotype.* (U.C. 30365.) Specimen of B. L. Clark. Figured in the present report, pl. 9, figs. 10, 14.

*Geologic range.* Lower middle Oligocene of western Washington and Oregon. Gries Ranch and Keasey formations.

*Type localities.* *Porterius gabbi* from locality (U.W. 239). South side of Cowlitz River at the old Gries Ranch in the northeast quarter of Section 25, T. 11 N., R. 2 W., Cowlitz County, Washington. "*Barbatia*" *andersoni* from locality (U.W. 364). Old log dam in Porter Creek about 2½ miles above its junction with Chehalis River in Section 14, T. 17 N., R. 3 W.

## Family ARCIDAE

### Genus GLYCYMERIS Da Costa, 1778

*Glycymeris* Da Costa, Historia Naturalis Testaceorum Britanniae, p. 168, 1778.

*Genotype.* *Arca glycymeris* Linnaeus, Syst. Nat. (10th ed.), p. 695, 1758.

### GLYCYMERIS SAGITTATA (Gabb), 1864

Plate 9, figures 17, 18; plate 11, figure 15

*Axinaea* (*Limopsis*) *sagittata* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 197, pl. 31, fig. 267a, 1864; vol. 2, pp. 196, 249, 1869.

*Glycymeris sagittata* Gabb, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, 1914.

*Glycymeris sagittata* (Gabb), Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 71, 72, pl. 12, fig. 10, 1930; Clark, Bull. Geol. Soc. Am., vol. 49, p. 693, 1938; Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 43, 44, pl. 6, figs. 1, 2, 3, 1938.

*Original description.* Shell subcircular, thin, equivalve, very slightly inequilateral; base regularly convex, sides unequally so, the posterior being a little the most prominent. Surface marked by numerous faint, radiating lines, which, on weathered surfaces, develop into strongly impressed grooves; along these lines are small pits, from which proceed downwards fine, impressed, diverging lines. Hinge composed of robust, radiating teeth. Inner margin finely crenulated. Area? (Gabb)

*Observations.* *G. sagittata* is a common species in the middle and upper Eocene of the Pacific Coast of North America and shows minor variations in its prevailing subquadrate outline and radial ornamentation.

*Hypotype.* (U.C. 33089.) Locality (U.C. A-858). Oregon. Figured in the present report, pl. 9, fig. 18; pl. 11, fig. 15.

*Hypotype.* (U.C. 32587.) Locality (U.C. 7161). Figured in the present report, pl. 9, fig. 17.

*Geologic range.* Middle and upper Eocene.

*Geographic distribution.* Western California, Oregon, and Washington.

*Type locality.* Uncertain (Fort Tejon, California?). Occurs in the Cowlitz formation in Washington.

**GLYCYMERIS SAGITTATA (Gabb) var. DICKERSONI Weaver and Palmer, 1922**

Plate 11, figures 9, 10, 13, 14

*Glycymeris sagittata* (Gabb) var. *dickersoni* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 10, 11, pl. 8, fig. 5, 1922.

*Original description.* Shell of medium size and subquadrate in outline; dorsal margin slightly convex; anterior margin nearly straight and sloping downward at an angle of 15 degrees with the dorsal margin and gradually passing into the regularly rounded, ventral margin; posterior margin broadly rounded, the posterior ventral margin regularly bowed; surface ornamented with numerous close-set, flat-topped radiating ribs which on the majority of the specimens examined are only well developed on the middle portion of the shell. The anterior and posterior surfaces of the adult specimens show a lack of, or at least poorly developed, radial sculpture, but the lines of growth are more strongly developed. In the young and more immature specimens, the radial ribs are better developed on the anterior and posterior areas, the outline is less quadrate, and the anterior and posterior margins slope downward making nearly equal angles with the dorsal margin, the posterior being a little more convex than the anterior. Dimensions (average): Length, 15 mm.; height, 14 mm.; width, 10 mm. (Weaver and Palmer)

*Observations.* The radiating and concentric sculpture in this variety seems to be less well developed, as exhibited on unweathered specimens, than in *Glycymeris sagittata* (Gabb). The diverging lines described for *G. sagittata* have not been noticed even on the worn specimens of this variety. The anterior margin is less rounded than in *G. sagittata*. The general outline of the shell is somewhat similar to *G. hannibali* Dickerson, but the width of the interspaces in *G. hannibali* is equal to that of the radiating ribs, while in *G. sagittata* var. *dickersoni* the ribs are very much wider in comparison.

*Holotype.* (U.W. 156) (C.A.S. 7404). Figured in the present report, pl. 11, figs. 10, 14.

*Hypotype.* (U.W. 156B) (C.A.S. 7404B). Figured in the present report, pl. 11, fig. 9.

*Hypotype.* (U.W. 156A) (C.A.S. 7404A). Figured in the present report, pl. 11, fig. 13.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 328.) Bend in Cowlitz River, near Vader, Lewis County, Washington, Section 28, T. 11 N., R. 2 W.

**GLYCYMERIS SAGITTATA** (Gabb) var. **KELSOENSIS** Weaver and Palmer, 1922

Plate 10, figure 1; plate 11, figure 16

*Glycymeris kelsoensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 11, 12, pl. 8, fig. 2, 1922.

*Original description.* Shell large and subquadrate; umbones large; cardinal area very narrow; hinge line straight; beaks situated near the mid-line of the shell; anterior dorsal margin abruptly rounded; anterior end straight rounding into the ventral margin; ventral margin curved to the posterior end; posterior end straight, oblique; posterior umbonal slope more convex than the anterior slope which flares out to the anterior margin; a slight flexure occurs at the posterior dorsal end; shell very convex; surface ornamented with 33 very flat, wide, radiating ribs with very narrow interspaces. Dimensions.—Length 37 mm.; height 33 mm.; thickness 22 mm. (Weaver and Palmer)

*Observations.* This variety differs from *G. sagittata* in the subangular junction of the dorsal and posterior margins and in the prolongation of the posterior end. The holotype is somewhat worn but the broad evenly rounded radiating ribs, very narrow interspaces, and the diverging lines upon the ribs indicate its very close relationship to *G. sagittata*. These differences appear to be of varietal and not specific rank.

*Holotype.* (U.W. 158) (C.A.S. 7399). Figured in the present report, pl. 10, fig. 1; pl. 11, fig. 16.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 343.) West bank of Coal Creek about one-half mile above Inman-Poulsen shops, Cowlitz County, Washington, in Section 2, T. 8 N., R. 3 W.

**GLYCYMERIS EOGENICA** (Weaver), 1912

Plate 10, figures 2, 3, 8

*Pectunculus eogenica* Weaver, Wash. Geol. Surv., Bull. 15, p. 28, pl. 5, figs. 52, 53, 1912.

*Pectunculus eogenica* Weaver var. *landesi* Weaver, Wash. Geol. Surv., Bull. 15, pp. 28, 29, pl. 5, fig. 54, 1912.

*Glycymeris eogenica* (Weaver), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, 1914; Clark, Bull. Geol. Soc. Am., vol. 49, p. 693, pl. 1, figs. 1, 6, 10, 13, 18, 1938.

*Glycymeris cf. G. eogenica* (Weaver), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 44, pl. 5, figs. 13, 14, 1938.

*Original description.* Shell sub-circular, thin, equivalve, and nearly equilateral; base regularly convex; sides sloping down directly from the beak, the anterior side much more steeply rounded than the posterior, the latter being regularly convex; junction of the posterior end and the base very slightly truncated. Surface marked by forty broad nearly flat-topped radiating ribs with very narrow interspaces, be-

tween which are raised threads; four or five very prominent lines of interrupted growth are present with fainter intervening concentric lines. Hinge robust with radiating teeth; pallial line very distinct, inner margin coarsely crenulated. Dimensions.—Altitude 23 mm.; longitude 25 mm.; thickness 7 mm. (Weaver)

*Observations.* This species is very abundant in the upper Eocene strata exposed in Coal Creek, Cowlitz County, Washington. Several layers averaging 3 feet in thickness are composed almost entirely of specimens of *G. eocenica* which present considerable variation in marginal outline. Specimens similar in both outline and radial ornamentation occur in the strata of the Umpqua River at Glide, Oregon. The species is common in the sandstones of the Markey formation between Vacaville and Putah Creek in Solano County, California. The presence of this species together with several gastropods suggests a correlation of a part of the strata on Coal Creek with the Markey formation of California which is regarded as lower Tejon. The Cowlitz formation on Olequa Creek in Lewis County, Washington, may be regarded as upper Tejon.

*Holotype.* (U.W. 1) (C.A.S. 476). Figured in the present report, pl. 10, fig. 3.

*Paratype* (U.W. 1A) (C.A.S. 476A). Figured in the present report, pl. 10, fig. 2.

*Paratype.* (U.W. 2) (C.A.S. 477). Holotype of *Pectunculus eocenica* Weaver var. *landesi* Weaver. Locality (U.W. 2). Figured in the present report, pl. 10, fig. 8.

*Geologic range.* Lower Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Washington and western Oregon.

*Type locality.* (U.W. 345.) At falls about one-half mile below school house on Coal Creek, Cowlitz County, Section 35, T. 9 N., R. 3 W.

#### GLYCYMERIS EOGENICA (Weaver) var. TEJONENSIS (Weaver), 1912

##### Plate 10, figure 12

*Pectunculus tejonensis* Weaver, Wash. Geol. Surv., Bull. 15, p. 29, pl. 15, fig. 134, 1912.

*Original description.* Shell moderately large, thick, elongated, equivalve and nearly equilateral; posterior and anterior margins very slightly convex, sloping steeply and nearly equally from the beak where they meet at a sharp angle; below they gradually grade into the base which is broadly and regularly rounded (posterior margin slightly more convex than anterior); beaks fairly prominent and incurved; a very slight depression on the posterior side of the umbones. Surface sculptured by numerous well-developed lines of growth and about thirty fairly distinct radiating ribs which are broad and flat with very narrow intermediate grooves. Dimensions.—Altitude 33 mm.; longitude 29 mm.; thickness 11 mm. (Weaver)

*Observations.* This species occurs together with *G. eocenica* in layers of sandstone where 75 per cent of the rock is composed of the shells of these forms. It also occurs alone in layers and each specimen varies little from the one figured in this report (pl. 10, fig. 12). The spe-

cies is characterized by the rapid tapering of the dorsal margin from the umbo.

*Holotype.* (U.W. 3) (C.A.S. 478). Figured in the present report, pl. 10, fig. 12.

*Geologic range.* Lower Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 345.) On Coal Creek, at falls about one-half mile below the school house, Cowlitz County, Washington, Section 35, T. 9 N., R. 3 W.

#### GLYCYMERIS CRESCENTENSIS Weaver and Palmer, 1922

Plate 10, figures 20, 21; plate 11, figure 12; plate 38, figure 10

*Glycymeris crescentensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 11, pl. 8, figs. 10, 12, 1922; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 44, pl. 5, fig. 15, 1938.

*Original description.* Shell small, sub-quadrata; anterior end straight and inclined downward at an approximate angle of 45 degrees from the dorsal margin to a point about one-half of the height of the shell, the remaining portion curving regularly into the ventral margin; posterior end rounded; surface delicately ornamented; the anterior portion with seven very wide radiating ribs obliquely sloping toward the anterior end, and which on the extreme anterior region decrease in size; when the shell is held with the anterior end directed toward the eye, the peculiar slope of the ridges causes the high point of each rib to appear as a very narrow rib, with a wide interspace about three times the width of the rib; the ornamentation on the posterior portion is composed of narrow, rounded, radiating ribs with interspaces of nearly equal width. The entire surface is also sculptured by numerous fine, concentric lines which give the ribs a microscopic, crenulated appearance. Dimensions.—Length 10 mm.; height 9 mm.; width 6 mm. (Weaver and Palmer)

*Observations.* This species occurs in the Crescent formation at Crescent Bay, Washington, in tuffaceous sandstones of middle Eocene age. It resembles *G. perrini* Dickerson from the Domengine of the Simi Hills in southern California but differs in the finer ribbing, lesser inflation, proportionally greater width, and in wider angles at the junctions of the dorsal margin with that of the anterior and posterior margins.

*Holotype.* (U.W. 157) (C.A.S. 7403). Figured in the present report, pl. 10, fig. 20; pl. 38, fig. 10.

*Paratype.* (U.W. 157A) (C.A.S. 7403A). Figured in the present report, pl. 10, fig. 21.

*Topotype.* (U.W. 157B) (C.A.S. 7403B). Figured in the present report, pl. 11, fig. 12.

*Geologic range.* Crescent formation, middle Eocene and Umpqua formation in Oregon.

*Geographic distribution.* Northern side of Olympic Mountains in Washington and Umpqua River Valley in southwest Oregon.

*Type locality.* (U.W. 358.) One-fourth of a mile east of Tongue Point near Port Crescent, Clallam County, Washington, Section 22, T. 31 N., R. 8 W.

**GLYCYMERIS FRESNOENSIS** Dickerson, 1916

Plate 11, figure 11

*Glycymeris fresnoensis* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 483, pl. 36, fig. 7, 1916; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 44, pl. 5, fig. 9, 1938.

*Original description.* Shell small, cordate, with beak decidedly twisted; anterior and posterior dorsal margins nearly straight with steep slope to arcuate ventral margin; decoration consisting of sharp dichotomous ribs. Dimensions.—Length, 7 mm.; height, 7 mm. (Dickerson)

*Observations.* Specimens closely resembling this species occur in the Crescent formation near Port Crescent, Washington, and in the Umpqua formation in southwestern Oregon. The radiating ribs are 16 in number and though prominent are less strongly developed than in the California specimens. They are flat-topped and about equal in width to the interspaces. Anterior and posterior dorsal margins slope considerably from the beak.

*Hypotype.* (U.C. 33658.) Figured in the present report, pl. 11, fig. 11.

*Geologic range.* Crescent formation in Washington, Umpqua formation of Oregon, and Domengine formation in California, middle Eocene.

*Type locality.* (U.C. 1817.) Southeast quarter of northwest quarter of Section 15, T. 18 S., R. 14 E., on branch of Salt Creek. (Dickerson)

Occurs also at (U.O. 144) Douglas County, Oregon, about 2½ miles up Fall Creek from Little River in northeast quarter of Section 6, T. 27 S., R. 3 W. (Turner)

**GLYCYMERIS ANDERSONI** Dickerson, 1917

Plate 10, figures 5, 11

*Glycymeris andersoni* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 166, 167, pl. 27, figs. 3a, 3b, 3c, 1917; Effinger, Jour. Paleon., vol. 12, p. 366, 1938.

*Original description.* Shell inflated equivalve, nearly equilateral; beaks small, base arcuate, meeting straight, anterior slope medially at anterior end and merging into the convex posterior; dorsal line straight; seven sloping teeth on either side of six nearly vertical smaller teeth which are centrally located on a strong, wide hinge plate. Dimensions.—Length, 27 mm.; height, 26 mm.; convexity, of right valve of type, 8 mm. (Dickerson)

*Observations.* Specimens of this species are fairly abundant at locality (U.W. 239) of the lower Oligocene Gries Ranch beds on Cowlitz River. This species has a proportionately greater width and lesser height than *G. sagittata* var. *dickersoni* which occurs near by in the Cowlitz formation, and somewhat stratigraphically lower down. The faintly developed broad radiating ribs average about 38 in number with extremely narrow interspaces.

*Holotype.* (C.A.S. 383.) Figured in the present report, pl. 10, fig. 5.

*Paratype.* (C.A.S. 384.) Figured in the present report, pl. 10, fig. 11.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz River Valley, southwestern Washington.

*Type locality.* (U.W. 239.) On south side of Cowlitz River at old Gries Ranch, in the northeast quarter of Section 25, T. 11 N., R. 2 W., Cowlitz County, Washington.

#### **GLYCYMERIS VANCOUVERENSIS Clark and Arnold, 1923**

Plate 10, figures 4, 7, 15

*Glycymeris vancouverensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 137, 138, pl. 27, figs. 2a, 2b, 5, 1923.

*Original description.* Shell medium in size, subcircular, fairly heavy; surface moderately convex; variable in outline; beaks central, inturned, not very conspicuous. Dorsal edges gently convex, posterior angulation into strongly arcuate ventral edge; posteriorly there is a broad, rounded, somewhat obscure truncation. On some of the smaller specimens this truncation is better defined, and there is a greater depression along the margin of this edge than is present on the majority of adult shells. Surface sculptured by about twenty-eight to thirty broad, flat-topped, sometimes obscure ribs with interspaces narrower than the tops of the ribs. On most of the specimens the radial ribbing is obsolete on the narrow areas paralleling the dorsal margins. Surface also covered by fairly heavy, somewhat irregular lines of growth which show as imbrications on some of the weathered specimens where they intersect the radial ribbing. Hinge plate moderately heavy; eight or nine taxodont teeth anterior to the beak and seven or eight posterior. Ligamental area separating anterior from posterior teeth covered by a number of oblique, multivincular ligamental grooves. Inner ventral margin strongly fluted. Dimensions of type specimen: height 27.5 mm.; length 28 mm. (Clark and Arnold)

*Observations.* As pointed out by Clark (50, p. 138) this species is similar in marginal outline to *G. migueliana* Dall, a Recent species from the west coast. The fossil form has a smaller apical angle and a relatively greater height than length.

The junctions of the dorsal margin with the anterior and posterior margins are more rounded than in *G. wishkahensis* of the upper Oligocene. The ligamental area in the latter species is relatively much smaller and the taxodont teeth fewer in number and relatively heavier.

*Holotype.* (U.C. 30036.) Figured in the present report, pl. 10, figs. 4, 7.

*Paratype.* (U.C. 30037). Figured in the present report, pl. 10, fig. 15.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Southeast shore of Vancouver Island.

*Type locality.* (S.U. N.P. 129.) Sooke sandstone and conglomerate; sea cliffs between mouths of Muir and Kirby Creeks, west of Otter Point, Sooke, Vancouver Island. (Clark)

**GLYCYMERIS WINLOCKENSIS** Effinger, 1938

Plate 10, figures 6, 13

*Glycymeris winlockensis* Effinger, Jour. Paleon., vol. 12, pp. 366, 367, pl. 45, figs. 2, 5, 1938.

*Original description.* Shell small, sub-circular, equilateral; valves of low convexity; beaks small, central; anterior and posterior dorsal margins nearly straight, sloping from the beaks at equal angles; hinge normal, bearing 18 prominent teeth equally divided on both sides of the beaks; ligamental area small, obscure; ornamentation consisting of about 50 slightly rounded, radiating ribs which are crossed by numerous wavy incremental lines; ventral margin internally denticulate, the ridges extending only a short distance from the margin. Dimensions.—Height, 16.8 mm.; length, 16.7 mm.; thickness of one valve, 4.4 mm. (Effinger)

*Observations.* The general outline of this species is somewhat similar to *G. wishkahensis* of the upper Oligocene of Washington. The ligamental area is smaller, the anterior and posterior rows of teeth approach more closely beneath the umbo, and the concentric ribs are not so heavy.

*Holotype.* (U.C. 14790.) Figured in the present report, pl. 10, figs. 6, 13.

*Geologic range.* Lower middle Oligocene, Gries Ranch beds.

*Geographic distribution.* Lower Cowlitz River Valley, southwest Washington.

*Type locality.* (U.W. 239). On north side of Cowlitz River about one and one-half miles east of Vader in the northeast quarter of Section 25, T. 11 N., R. 2 W., Cowlitz County, Washington.

**GLYCYMERIS CHEHALISENSIS** Weaver, 1916

Plate 10, figures 9, 10

*Glycymeris chehalensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 35, 36, pl. 3, figs. 34, 35, 1916.

*Original description.* Shell small, sub-triangular in outline, moderately convex, beaks central and small; anterior dorsal margin almost straight and sloping downward at an angle of 55°; posterior dorsal margin moderately convex and sloping at an angle of 40°; base sharply arcuate. Surface sculptured by 45 well developed, flat topped squarish radiating ribs separated by interspaces about once and one-half as wide as the ribs. Near the anterior and posterior ends of the shell the ribs become almost obsolete. The incremental lines are sharp and wavy and in the interspaces they curve downwards producing wavy lines which extend across the entire shell. The ribbing is very minutely shown on the interior surface of the shell. On the basal inner margin there are 24 flutings. Hinge set with 9 anterior and 9 posterior large well-developed V-shaped teeth. Area above teeth with four reticulating ridges and grooves. Anterior and posterior muscle scars are prominent and having a subrectangular outline. Dimensions.—Altitude 11 mm.; longitude 12 mm.; thickness 7 mm. (Weaver)

*Observations.* This species is very abundant in the middle Oligocene near the junction of Lincoln Creek and Chehalis River in Thurston County, Washington. It is characterized by the small size of adult individuals, the sub-triangular-ovate shape and the nearly straight and elongate posterior dorsal margin.

*Holotype.* (U.W. 87) (C.A.S. 452). Figured in the present report, pl. 10, figs. 9, 10.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Thurston County, Washington.

*Type locality.* (U.W. 256.) In railway cuts on Grays Harbor branch of Union Pacific, one-fourth mile northwest of Galvin in Section 27, T. 15 N., R. 3 W., Lewis County, Washington.

#### GLYCYMERIS GABBI Dall, 1909

Plate 10, figure 18

*Glycymeris gabbi* Dall, U.S. Geol. Surv., Prof. Pap. 59, p. 108, pl. 11, fig. 5, 1909.

*Original description.* Shell large, rather thin, compressed, suborbicular, nearly equilateral; beaks defective, probably rather elevated, separated by a narrower ligamental area with about half a dozen angular sulci divercating from the vertical of the umbones; dorsal slopes straight, nearly smooth, the posterior slope somewhat flattened; disk uniformly sculptured with about 34 narrow, flat radial ribs, separated by somewhat narrower channeled interspaces, the interspaces wider and the ribs narrower towards the ends of the shell; concentric sculpture of narrow, flat ridges, narrower and closer together toward the basal margin, but on the central part of the disk forming with the radial ribs nearly square reticulations; interior, as in other cases, filled with a refractory matrix. Altitude of shell, 51 mm.; latitude, 53 mm.; diameter, about 20 mm. (Dall)

*Observations.* It is possible, as pointed out by Grant and Gale (149A, p. 135), that this species and *G. larvata* G. D. Hanna may be synonymous with *G. grewingki* Dall. The differences in radiating and concentric sculpture are in part the result of weathering. However, since it is the purpose of this report to bring together and refigure all of the species of the Tertiary of Oregon and Washington, it may be helpful to the student to keep them separate. There seem to be differences in the number of radiating ribs and in their cross-sections as well as in the interspaces. A comparison by the writer of the holotypes in the U.S. National Museum indicates that *G. gabbi* is more equilateral than *G. grewingki*.

*Holotype.* (U.S.N.M. 153949B.) Figured in the present report, pl. 10, fig. 18.

*Geologic range.* Empire formation, uppermost Miocene and lowermost Pliocene.

*Geographic distribution.* Western Oregon and Washington.

*Type locality.* Coos Bay, Oregon (Camman Collection). (Dall)

#### GLYCYMERIS GREWINGKI Dall, 1909

Plate 10, figure 19

*Glycymeris grewingki* Dall, U.S. Geol. Surv., Prof. Pap. 59, p. 107, pl. 2, fig. 13, 1909.

*Glycymeris grewingki* Dall, Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 97, 1922.

*Glycymeris cf. grewingki* Dall, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 70, pl. 4, fig. 7; pl. 5, fig. 5, 1931.

*Glycymeris grewingki* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 135, 136, 1931.

*Original description.* Shell solid, suborbicular, subequilateral, equivalve; beaks prominent, moderately convex, slightly separated by the area which is narrow in

each valve forming a wide, very obtuse triangle with deeply incised angular sulci, radiating from the vertical of the beak; anterior slope slightly shorter and more rounded than the posterior, which is somewhat produced toward the lower portion; there is no distinct lunule or escutcheon; but a feebly differentiated anterior dorsal area is characterized by radial threads much finer than those on the anterior half of the disk; on the latter are about a dozen flat, little-elevated, radial ribs, separated by much narrower channeled sulci, the whole with more or less obsolete fine radial striation; these radial ribs are distinct when the surface of the shell is intact; the anterior half of the disk, except when decorticated, nearly smooth except for close-set uniform numerous radial threads which cover the entire surface; when decorticated the internal structure shows ribs much like those normally exposed on the anterior half of the disk. Altitude of figured specimen, 38 mm.; longitude, 38 mm.; diameter, 20 mm. (Dall)

*Holotype.* (U.S.N.M. 107784.) Figured in the present report, pl. 10, fig. 19.

*Geologic range.* Empire and Montesano formations, upper Miocene and lower Pliocene.

*Geographic distribution.* Western Oregon and Washington.

*Type locality.* Coos Bay, Oregon (Camman Collection). (Dall)

#### GLYCYMERIS LARVATA Hanna, 1924

Plate 10, figure 16

*Glycymeris conradi* Dall, U.S. Geol. Surv., Prof. Pap. 59, p. 107, pl. 11, fig. 2, 1909.

*Glycymeris larvata* Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 13, p. 167, 1924.

*Glycymeris larvata* Hanna, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 135, 1931.

*Original description.* Shell solid, suborbicular, equilateral, with small, rather pointed umbones nearly touching, and an extremely narrow, short ligamental area between them; dorsal slopes nearly straight, subequal, base and ends equally evenly rounded; dorsal area on each side of the beaks smooth, disk with about 30 flat, wide radial ribs, widest in the center of the disk and becoming gradually narrower toward the ends of the shell, separated by much narrower channeled sulci, and radially finely obsoletely striate; concentric sculpture of well-marked incremental lines, and toward the ends, with a certain number of low, irregular, feeble, concentric wrinkles. Altitude, 37 mm.; latitude, 39 mm.; diameter, 20 mm. (Dall)

*Holotype.* (U.S.N.M. 153949A.) Figured in the present report, pl. 10, fig. 16.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Western Oregon.

*Type locality.* Coos Bay, Oregon (Camman Collection). (Dall)

#### GLYCYMERIS TENUIMBRICATA Clark, 1918

Plate 12, figure 1

*Glycymeris tenuimbricata* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 11, p. 130, pl. 16, figs. 4, 8, 9, 10, 1918.

*Glycymeris tenuimbricata* Clark, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 70, pl. 1, fig. 17; pl. 4, fig. 6, 1931.

*Original description.* Shell subtrigonal, somewhat variable in outline and diameter, medium in size, equivalved, nearly equilateral, valves moderately convex. Apical angle about 90°; dorsal slopes straight, the anterior slope being a little the

shorter; ventral edge strongly and regularly convex; posterior dorsal margin, as a rule, slightly more depressed than anterior dorsal margin. Surface sculptured by twenty-three to twenty-nine radiating ribs which become obsolete near the dorsal edges; ribs separated by interspaces which generally average a little less than their width; surface also covered by heavy incremental lines which, on unweathered specimens, are very strongly and beautifully imbricated. Hinge plate fairly heavy, with seven or eight teeth anterior to the beak, and ten or eleven posterior to it. The teeth do not reach the ventral margin of the hinge plate; they are noticeably long and heavy near the ligamental area, which is narrow and ventrally is wedged in between the anterior and posterior rows of teeth; ligamental grooves numerous and well marked. Muscle impressions equal and fairly heavy. Dimensions.—Type specimen: length, 27.5 mm.; width, 26 mm.; paratype: height, 21 mm.; width, 20 mm. (Clark)

*Observations.* The holotype of this species came from Oligocene deposits located about one-half mile southwest of the town of Walnut Creek in Contra Costa County, California (43, p. 112).

Specimens which appear to be representative of this species occur in southwest Washington at locality (U.W. 409) in Section 35, T. 17 N., R. 7 W., in the basal fourth of the Astoria formation. The umbonal angle is greater in the northern species than in the holotype from California.

*Hypotype.* (U.C. 31902.) Locality (U.W. 409). Figured in the present report, pl. 12, fig. 1.

*Geologic range.* Middle Miocene.

*Geographic distribution.* Southwestern Washington and central California.

*Type locality.* (U.C. 1131.) One-half mile southwest of the town of Walnut Creek in creek bed about 100 yards east of Oakland and Antioch bridge, Contra Costa County, California.

The hypotype (U.C. 31902) occurs in the first large cut in the Astoria sandstone just above the contact with the Oligocene on Clemons logging road, Section 35, T. 17 N., R. 7 W., Grays Harbor County, Washington.

#### GLYCYMERIS PERRINI Dickerson, 1916

Plate 11, figure 17; plate 12, figure 2

*Glycymeris perrini* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 482, pl. 36, figs. 6a, 6b, 6c, 1916; Stewart, Phila. Acad. Nat. Sci., Spec. Publ. no. 3, pp. 73, 74, pl. 7, fig. 5, 1930 (synonymy); Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 44, 45, pl. 5, figs. 10, 11, 12 (synonymy), 1938.

*Original description.* Shell medium in size, nearly equilateral, cordate; beak small, prominent, slightly incurved, area very small; base broadly rounded; anterior end straight and slightly shorter than the posterior end. The base is denticulated on interior. Shell is decorated by numerous fine rounded radiating ribs which vary greatly in strength over various portions of the shell. Some of the ribs are dichotomous. Interspaces are very narrow. Concentric lines of growth cross these ribs and on weathered specimens are very prominent. Dimensions—Height, 12 mm.; length, 12 mm. (Dickerson)

*Observations.* The specimens of this species from Glide, Oregon, usually are slightly more inequilateral than the holotype described by Dickerson from the Domengine in California. A few specimens show

variations and are almost equilateral. The radiating ribs on the Oregon species generally are less well defined than on the California holotype.

*Hypotype.* (U.C. 33094.) Figured in the present report, pl. 11, fig. 17; pl. 12, fig. 2.

*Geologic range.* Upper Umpqua and Domengine formations, middle Eocene.

*Geographic distribution.* Douglas County, Oregon, and Coast Range of California.

*Type locality.* (U.C. 672.) S.E. quarter of N.W. quarter of Section 24, T. 18 S., R. 14 E. Occurs also at locality (U.C. A-662), in Douglas County, Oregon, on east bank of Little River in the center of Section 19, T. 26 S., R. 3 W.

#### GLYCYMERIS WISHKAHENSIS Clark, 1925

Plate 10, figures 14, 17

*Glycymeris wishkahensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 81, pl. 13, figs. 1, 2, 1925.

*Original description.* Shell fairly large, subcircular, only moderately ventricose; dorsal slopes approximately equal, straight or nearly so; beaks central; inconspicuous. Surface sculptured by about 27 low, broadly rounded radial ribs, with interspaces averaging about width of ribs; ribbing becomes obsolete along a narrow area bordering both anterior and posterior dorsal edges. Surface also covered by fairly heavy laminated concentric lines of growth which on crossing radiating ribs give shell reticulated or coarsely imbricated appearance. Hinge plate broad; ligamental area broader than high. Ten fairly heavy v-shaped teeth on each side of the beaks, the two rows of teeth being separated by a rather large gap just underneath ligamental area. Dimensions: height 47 mm.; greatest length approximately about the same as height. Sides of type specimen broken. (Clark)

*Observations.* The holotype of this species came from sandy shales of the upper Oligocene on Wishkah River, Grays Harbor County, Washington. It differs from *G. grewingki* in the more central position of the umbones and in the wider interspaces between the radiating ribs. The external ligamental area beneath the umbo is proportionately larger than in *G. tenuimbricata* and the distance between the anterior and posterior sets of taxodont teeth much greater.

*Holotype.* (C.A.S. 679.) Figured in the present report, pl. 10, figs. 14, 17.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* On the main branch of Wishkah River, about one mile above foot bridge which is 4 miles above junction with West Fork of Wishkah River, Grays Harbor County, Washington. (Clark)

#### Genus ARCA Linnaeus, 1758

*Arca* Linnaeus, Systema Naturae (10th ed.), p. 693, 1758.

*Genotype.* *Arca noae* Linnaeus.

Subgenus *Arca* s.s.**ARCA (ARCA) WASHINGTONIANA** Dickerson, 1917

## Plate 12, figure 5

*Arca washingtoniana* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 166, pl. 27, figs. 2a, 2b, 1917; Effinger, Journ. Paleon., vol. 12, p. 367, pl. 46, fig. 8, 1938.

*Arca (Arca) washingtoniana* Dickerson, Reinhart, Bull. Mus. Roy. Hist. Nat. Belg., vol. 11, no. 13, pp. 17, 19, 1935.

*Original description.* Shell roughly rectangular; small with beautiful beaded radial ribbing; anterior end straight, making right angles with straight hinge line and nearly straight base; posterior extremity, the pointed extension of a marked umbonal ridge which divides the posterior half of the shell into a flat, alate right triangle in its upper third; decoration consists of thirty to forty subequal beaded ribs. Dimensions: length, 5 mm. (Dickerson)

*Observations.* This species in general shape and ornamentation closely resembles *A. merriami* (Van Winkle), and the latter has been considered by Effinger as specifically identical. The beaks in nearly all specimens of *A. washingtoniana* seem to be more centrally situated than in *A. merriami*. The median umbonal groove in *A. merriami* is not so marked in *A. washingtoniana*.

*Holotype.* (C.A.S. 382.) The specimen is so badly broken that an illustration of it would not be worth while. Not figured in the present report.

*Hypotype.* (U.C. 33503.) Effinger figure. Figured in the present report, pl. 12, fig. 5.

*Geologic range.* Lower middle Oligocene, Gries Ranch beds.

*Geographic distribution.* Lower Cowlitz River Valley, Washington.

*Type locality.* (U.W. 239.) On south side of Cowlitz River in northeast quarter of Section 25, T. 11 N., R. 2 W., Cowlitz County, Washington.

**ARCA (ARCA) MERRIAMI** (Van Winkle), 1918

## Plate 11, figure 8; plate 12, figures 3, 6, 7, 8, 9, 12, 15

*Barbatia merriami* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 81, pl. 6, fig. 1, 1918.

*Arca merriami* (Van Winkle), Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 80, pl. 13, figs. 5, 6, 7, 8, 1925.

*Original description.* Shell of moderate size, thick, roughly rectangular in outline and inequilateral; dorsal margin nearly straight and merging into the posterior margin, which slopes to the posterior end of the umbonal ridge; ventral margin broadly arcuate; beaks situated about one-fourth the length of the shell from the anterior end. A marked umbonal ridge extends from the beaks to the posterior basal extremity; a deep broad umbonal groove situated immediately above this ridge and extending to the dorsal margin. Surface sculpture consists of numerous slightly sinuous radiating ribs with interspaces of about one-half their width. Lines of growth, which become more pronounced near the ventral margin, cross the radiating ribs. Dimensions. Altitude 19 mm.; longitude 40 mm.; thickness 22 mm. (Van Winkle)

*Supplementary description.* Some of the distinctive characters of this species, not brought out in original description, indicate that it is not a typical *Barbatia*.

First, there is a well defined broad byssal notch seen at about the middle of the ventral valve, and a broad fairly distinct depression on main surface of the shell extending from the notch well up toward the beaks; second, on the cardinal area, which is very broad, and at right angles to hinge, are the long but indistinct multivincular ligamental grooves. (Clark, 52, p. 80)

*Observations.* This species differs from *A. washingtoniana* in the large angle made by the junction of the posterior dorsal margin and the posterior end, the long upward bending of the posterior ventral margin, the more terminal position of the umbones, and in the more pronounced byssal notch.

*Holotype.* (U.W. 125, C.A.S. 7396.) Figured in the present report, pl. 11, fig. 8; pl. 12, fig. 3.

*Hypotype.* (S.U. 13.) Figured in the present report, pl. 12, figs. 6, 12.

*Hypotype.* (S.U. 14.) Figured in the present report, pl. 12, figs. 8, 15.

*Hypotype.* (U.C. 32400.) Figured in the present report, pl. 12, figs. 7, 9.

*Geologic range.* Lower middle Oligocene.

*Geographic distribution.* Grays Harbor area, Washington.

*Type locality.* (U.W. 364.) At the old log dam in Porter Creek about  $2\frac{1}{2}$  miles above its junction with Chehalis River in Section 14, T. 17 N., R. 5 W., Grays Harbor County, Washington.

#### Genus BARBATIA Gray, 1842

*Barbatia* Gray, Synopsis of the Contents of the British Museum (44th ed.), p. 81, 1842.

*Genotype.* *Arca barbatia* Linnaeus, Syst. Nat. (10th ed.), p. 693, 1758.

#### Subgenus Barbatia s.s.

##### BARBATIA (BARBATIA) COWLITZENSIS (Weaver and Palmer), 1922

###### Plate 12, figure 13

*Arca (Barbatia) cowlitzensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 9, pl. 8, fig. 9, 1922.

*Original description.* Shell medium in size, oblong in outline; inequilateral, beaks situated one-fourth of the distance from the anterior end; dorsal margin slightly curved, anterior end sloping from the dorsal margin at an angle of  $40^{\circ}$ , rounding into the ventral margin which extends obliquely, nearly parallel to the dorsal line; posterior end broadly rounded, sloping from the dorsal line at an angle of  $20^{\circ}$ ; beaks low and broad; valves convex, concave along the posterior and anterior borders; surface ornamented with numerous, fine, close-set, radiating ribs which cover the entire surface of the shell; interspaces very narrow, about one-third of the width of the rib. Dimensions.—Length 22 mm.; height 14 mm.; thickness 12 mm. (Weaver and Palmer)

*Observations.* This upper Eocene species is characterized by its sub-oblong shape and its extremely fine and numerous close-set radiating ribs which are equally distributed over the entire surface.

*Holotype.* (U.W. 154) (C.A.S. 7394). Figured in the present report, pl. 12, fig. 13.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 548.) On west branch Cowlitz River in northeast quarter of northeast quarter of Section 33, T. 11 N., R. 1 W., Cowlitz County, Washington.

Subgenus **Obliquarca** Sacco, 1898

*Obliquarca* Sacco, I Molluschi dei Terreni Terziarii del Piemonte e delle Liguria, pt. 26, p. 16, 1898.

*Subgenotype.* *Arca modioliformis* Deshayes, Description des Coq. Foss. de Paris, vol. 1, p. 214, pl. 32, figs. 5, 6, 1831.

**BARBATIA (OBLIQUARCA) SUZZALLOI** Weaver and Palmer, 1922

Plate 11, figure 7; plate 12, figure 10

*Barbatia suzzalloi* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 8, pl. 8, fig. 6, 1922.

*Original description.* Shell small, elongate in outline; inequilateral, beaks situated one-third distance from the anterior end; dorsal margin straight; anterior end nearly straight, sloping at about an angle of 15° with the dorsal margin, passing into the ventral margin with a broad bow; ventral margin straight, produced obliquely; posterior margin broadly pointed at the ventral end, sloping to the dorsal margin at about an angle of 40°; a mid-umbonal sulcus extends to the ventral margin, sloping obliquely from the beaks; surface sculptured by concentric lines of growth crossed by numerous fine, delicate, radiating ribs which bifurcate, forming two ribs of equal width on the lower region. The bifurcation of the ribs occurs over the whole of the shell including the posterior as well as the anterior region of the concaveness. Under the microscope these ribs show a beaded character, which are most numerous on the anterior, umbonal slope; cardinal area very narrow. Dimensions.—Length 20 mm.; height 10 mm.; width 8 mm. (Weaver and Palmer)

*Observations.* This species somewhat resembles *B. landesi* but differs in having an obtuse angle formed by the intersection of the posterior dorsal margin and the posterior margin instead of a nearly right angular junction as in the latter species. The radiating ribs are rounded to flat-topped while in *B. landesi* they are subangulate with numerous fine secondary ribs.

*Holotype.* (U.W. 153) (C.A.S. 7393). Figured in the present report, pl. 11, fig. 7.

*Hypotype.* (U.C. 32542.) Locality (U.C. 7164). Figured in the present report, pl. 12, fig. 10.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 548.) On west bank of Cowlitz River in northeast quarter of northeast quarter of Section 33, T. 11 N., R. 1 W., Cowlitz County, Washington.

**BARBATIA (OBLIQUARCA) LANDESI (Weaver and Palmer), 1922**

## Plate 12, figure 18

*Arca (Barbatia) landesi* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 9, 10, pl. 8, fig. 4, 1922.

*Original description.* Shell small, thin and delicate; elongate in outline; inequilateral, beaks situated about one-third of the distance from the anterior end; dorsal margin straight; anterior end well rounded, sloping from the dorsal margin at an angle of 35° and rounding into the ventral margin; ventral margin straight, nearly parallel with the dorsal margin; posterior end rounded ventrally, nearly vertical with the dorsal margin; surface sculptured with fine, radiating ribs which are uniform in character over the whole surface of the shell. On the anterior slope the ribs are separated by interspaces about twice the width of the ribs. Within the interspaces there may be developed threads; on the middle portion the ribs and the interspaces are narrow and about equal in width; approaching the posterior slope the ribs alternate in size; the central ribs are delicately beaded; the posterior ribs from the umbonal slope to the dorsal line are larger, with wider interspaces and are about 14 in number. Dimensions.—Length 19 mm.; height 6 mm.; width 4 mm. (Weaver and Palmer)

*Observations.* This species differs from *B. morsei* in the greater length of the anterior dorsal margin and the more strongly developed umbonal ridge and sulcus. The posterior dorsal and posterior margins form a rounded and nearly right-angular junction in contrast to the obtuse angle and acutely rounded posterior end in *B. suzzalloi*.

*Holotype.* (U.W. 155) (C.A.S. 7397). Figured in the present report, pl. 12, fig. 18.

*Geologic range.* Lower Cowlitz formation, upper Eocene.

*Geographic distribution.* Coal Creek, Cowlitz County, Washington.

*Type locality.* (U.W. 343.) On west bank of Coal Creek about one-half mile above Inman-Poulsen shops, Section 2, T. 8 N., R. 3 W., Cowlitz County, Washington.

**BARBATIA (OBLIQUARCA) MORSEI Gabb, 1864**

## Plate 12, figure 4

*Barbatia morsei* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 216, pl. 32, fig. 286, 1864.

*Barbatia morsei* Gabb, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, 1914; Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 42, 43, pl. 5, figs. 7, 8, 1938.

*Barbatia cf. morsei* (Gabb), Merriam and Turner, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 24, p. 99, 1937.

*Original description.* Shell small, thin, subcompressed, oblique, broadest posteriorly; beaks small, approximate, anterior; area long and very narrow, shorter than the shell; anterior end short and broad; posterior end oblique above, rounded below; base sinuous, slightly gaping. Surface depressed in the middle and towards the ends, ornamented by numerous fine radiating ribs, alternating pretty regularly in size in the middle of the shell. Hinge slender, composed of numerous small, oblique teeth. (Gabb)

*Observations.* This species has been listed by Dickerson (120, p. 115) from the east bank of the North Fork of the Umpqua River in the

southwest quarter of Section 18, T. 26 S., R. 3 W., in southwestern Oregon. The outlines and ornamentation of these specimens are similar to the form described by Gabb, but the ventral margin is more even.

*Holotype.* (U.C. 11984.) Holotype of Gabb. Figured in the present report, pl. 12, fig. 4.

*Geologic range.* La Jolla formation in California, upper Umpqua formation in Oregon.

*Geographic distribution.* Coast range of California and western Oregon.

*Type locality.* No locality number. Original label gives San Diego.

Subgenus *Acar* Gray, 1857

*Acar* Gray, Ann. Mag. Nat. Hist., ser. 2, vol. 19, p. 369, 1857.

*Subgenotype.* *Arca grodata* Broderip and Sowerby, Zool. Jour. London, vol. 4, p. 365, 1829.

**BARBATIA (ACAR) REINHARTI** Effinger, 1938

Plate 13, figures 6, 7, 11, 13

*Barbatia (Acar) reinharti* Effinger, Jour. Paleon., vol. 12, p. 367, pl. 45, figs. 3, 4; pl. 46, figs. 1, 2, 1938.

*Original description.* Shell small, heavy, trapezoidal in outline, beaks fairly prominent, situated one-fifth the length from anterior end; posterior dorsal area concave, bounded ventrally by a well developed umbonal ridge; anterior umbonal ridge less distinct; medial surface of the shell bearing a broad, shallow sulcus; dorsal margin straight, joining the sharply curved anterior end at right angles; posterior end almost straight, forming an angle of 125° with the dorsal edge and joining the ventral margin at an acute angle; ventral margin broadly sinuous, sculpture reticulate, consisting of about fifty fine, radial ribs crossed by numerous concentric growth lines which give the entire outer surface of the shell a beaded appearance; interior margin denticulate; hinge straight, bearing in the region directly beneath the beaks a strong, short tooth parallel to the axis of the hinge, on either side of which are transversely mounted curved teeth; teeth on anterior and posterior ends of hinge become progressively larger and lie diagonally across the hinge. Dimensions of holotype—height, 4.3 mm.; length, 8 mm.; thickness of one valve, 2.2 mm. (Effinger)

*Holotype.* (U.C. 33504.) Figured in the present report, pl. 13, figs. 6, 13.

*Paratype.* (U.C. 14793.) Figured in the present report, pl. 13, figs. 7, 11.

*Geologic range.* Lower middle Oligocene, Gries Ranch beds.

*Geographic distribution.* Lower Cowlitz River Valley, Cowlitz County, Washington.

*Type locality.* (U.W. 239.) On south side of Cowlitz River at old Gries Ranch in the northeast quarter of Section 25, T. 11 N., R 2 W., in Cowlitz County, Washington.

## Genus ANADARA Gray, 1847

*Anadara* Gray, Proc. Zool. Soc. London, p. 198, 1847.

*Genotype.* *Arca antiquata* Linnaeus, Syst. Nat. (10th ed.), p. 694, 1758.

## ANADARA (ANADARA) TRILINEATA (Conrad), 1856

Plate 12, figures 11, 19, 20

*Arca trilineata* Conrad, Proc. Acad. Nat. Sci. Phila., vol. 8, p. 314, 1856.

*Arca trilineata* Conrad, Pac. R.R. Repts., vol. 6, pt. 2, no. 2, p. 70, pl. 2, fig. 9, 1857.

*Arca (Scapharca) trilineata* Conrad, U.S. Geol. Surv., Prof. Pap. 59, pp. 110, 111, pl. 12, figs. 1, 2, 1909.

*Arca trilineata* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. 59, Appendix, p. 177, reprint of Conrad, 1856.

*Arca (Arca) trilineata* Conrad, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 139, 140, pl. 2, figs. 1, 4, 1931.

*Original description.* Trapezoidal, somewhat produced, inequilateral, ventricose; ribs 22-24, scarcely prominent, square, wider than the intervening spaces, ornamented with three impressed or four raised lines; disks concentrically wrinkled; summits prominent; beaks approximate. Length 3 inches. (Conrad, 71A, p. 314)

*Supplementary description.* Shell large, solid, inequilateral, very slightly inequivale; beaks small, rather high, incurved, and nearer the anterior end of the shell; separated by a long lozenge-shaped area with deeply incised ligamental furrows as figured; dorsal line on each side of the beaks nearly straight, from which anteriorly the margins are abruptly rounded away; base gently arcuate, posterior end more pointed, the dorsal margins oblique; sculpture of right valve of about 31 flat radial ribs, each mesially grooved, separated by narrower channeled interspaces and crossed by more or less conspicuous concentric threads which are less apparent in the interspaces; the left valve differs by having the ribs narrower and more rounded and the mesial sulci deeper and more channeled; toward the anterior end the concentric sculpture on the ribs is apparently more prominent and crowded; interior inaccessible. Longitude of figured specimen, 64 mm.; altitude (the beaks being defective), about 47 mm.; diameter, 36 mm. (Dall, 101, pp. 110, 111)

*Observations.* This species is characterized by its subtrigonal to sub-trapezoidal outline with radiating ribs showing secondary grooves. It is common in the Pliocene of the Pacific Coast of North America. It is less elongate than *A. devincta*.

*Hypotype.* (U.C. 11923.) Wilson's Ranch. Figured in the present report, pl. 12, fig. 11.

*Hypotype.* (U.C. 11922.) Wilson's Ranch. Figured in the present report, pl. 12, fig. 19.

*Hypotype.* (U.S.N.M. 153948.) Empire formation. Figured in the present report, pl. 12, fig. 20.

*Geologic range.* Upper Miocene to Pliocene.

*Geographic distribution.* California, western Oregon and western Washington.

*Type locality.* Santa Barbara, California.

**ANADARA? MICRONDONTA (Conrad), 1855**

Plate 12, figure 14

*Arca microdonta* Conrad, U.S. 33d Cong., 1st Sess., House Exec. Doc. 129. App. to the Preliminary Geol. Rept. of W. P. Blake, p. 13, July, 1855; Pac. R. R. Repts., vol. 5, p. 323, pl. 3, fig. 29, 1857.

*Arca (Scapharca) microdonta* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. 59, pp. 110, 166, 1909.

*Original description.* Rhomboidal, ventricose, thick in substance; anterior side very short; umbonal slope rounded; ribs 25, prominent, narrow, wider posteriorly, except on the posterior slope, where they are small and not prominent, about five in number. Cardinal teeth small, numerous, closely arranged, larger toward the extremities. Inner margin profoundly dentate; dorsal area rather wide and marked with about six impressed lines; beaks distant. (Conrad)

*Observations.* The holotype of *A. microdonta* came from an undetermined locality designated as "Tulare Valley," probably from rocks of Pliocene age. The specimen is well preserved with anteriorly situated umbones and a straight hinge line with 26 ribs and wide interspaces. The specimen (U.S.N.M. 3497) in the U.S. National Museum from Astoria, Oregon, which was regarded as being identical with the California species, is a poorly preserved cast which is inequilateral and may belong to *A. devincta*.

*Holotype.* (U.S.N.M. 1844.) Tulare Valley, California. Not figured in the present report.

*Hypotype.* (U.S.N.M. 3497.) Astoria, Oregon. Not figured in the present report.

*Hypotype.* (U.C. 11926.) Temblor formation, Santa Monica, California. Figured in the present report, pl. 12, fig. 14.

*Geologic range.* The Oregon specimen occurs in the Astoria formation, middle Miocene.

**ANADARA (ANADARA) DEVINCTA (Conrad), 1849**

Plate 12, figure 16; plate 13, figures 4, 8

*Arca devincta* Conrad, U.S. Explor. Exped., p. 726, pl. 18, figs. 10, 10a, 1849.

*Arca devincta* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. 59, pp. 109, 155, 1909.

*Arca (Anadara) devincta* Conrad, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., pp. 68, 69, pl. 2, figs. 1, 2, 3, 4, 5, 8; pl. 3, fig. 6, 1931.

*Original description.* Rhomboidal, ribs narrow, flattened, and little prominent anteriorly; on the posterior side wider, slightly convex, and longitudinally striated. Beaks distant. (Conrad)

*Observations.* *A. devincta* is extremely abundant in all of the fossil-bearing strata of the middle and upper Astoria formation in Washington and Oregon, and presents a wide range of variations in outline of form and in minor details of radial ornamentation. The number of radial ribs may vary from 28 to 32 and the outline is prevailingly quadrate. A possible ancestral form, *A. devincta montereyana*, characterized by a ten-

dency to elongation, prevails in the lower part of the Astoria formation in Washington.

*Holotype.* (U.S.N.M. 3499.) Specimen broken and in poor state of preservation. Not figured in the present report.

*Hypotype.* (U.C. 31923.) Astoria formation. Figured in the present report, pl. 12, fig. 16.

*Hypotype.* (U.C. 31916.) Astoria formation. Figured in the present report, pl. 13, fig. 4.

*Hypotype.* (U.C. 31924.) Astoria formation. Figured in the present report, pl. 13, fig. 8.

*Geologic range.* Middle Miocene.

*Geographic distribution.* Western California, Oregon, and Washington.

*Type locality.* Astoria, Oregon.

**ANADARA (ANADARA) DEVINCTA (Conrad) var. MONTEREYANA (Osmont), 1904**

Plate 13, figures 1, 5

*Arca montereyana* Osmont, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 4, p. 96, pl. 9, figs. 5a, 5b, 1904.

*Arca devincta* var. *montereyana* (Osmont), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 69, pl. 2, figs. 6, 7, 9, 1931.

*Original description.* Rhomboidal, inequilateral, nearly two-thirds of the length being behind the beak, posterior margin making a very obtuse angle with hinge-line. Ratio of length to height about  $1\frac{1}{2}$  to 1. Average size of adult about 51 x 33 mm. Beaks not prominent, turned rather sharply forward, narrow and close together, ligament area narrow. Hinge line long and straight. Basal margin nearly parallel to hinge line. Ribs 26-32, usually 27, prominent, square, flattened, a little wider than the interspaces and marked with a median groove. Occasionally, in the older specimens, two subsidiary grooves may appear toward the margin, as in *A. trilineata*. More or less distinct lines of growth often roughen the shell, especially in the larger individuals, and when these are fine and numerous they approach closely the beaded effect of *A. trilineata*. (Osmont)

*Observations.* Specimens of this variety occur in the lower portion of the middle Miocene Astoria formation in Grays Harbor County, Washington. It differs from *A. devincta* in its greater elongation and in the occasional bifurcation and trifurcation of the major ribs, although the furcation is not prominent on the holotype which came from the middle Miocene of Contra Costa County in California.

*Holotype.* (U.C. 11925.) Figured in the present report, pl. 13, fig. 5.

*Hypotype.* (U.C. 31928.) Astoria formation. Locality (U.W. 422). Figured in the present report, pl. 13, fig. 1.

*Geologic range.* Middle Miocene. Astoria formation.

*Geographic distribution.* Western California, Oregon, and Washington.

*Type localities.* Holotype from middle Miocene near Mount Diablo. In Washington from Astoria beds in Grays Harbor area. Locality (U.W. 422). In Union Pacific railway cut one mile east of end of South Montesano road, Grays Harbor County, Section 14, T. 17 N., R. 7 W.

**ANADARA (ANADARA) DEVINCTA** (Conrad) var. **MONTESANOANA** Etherington, 1931

Plate 13, figure 10

*Arca devincta montesanoana* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 69, 70, pl. 3, figs. 1, 2, 3, 4, 5, 7, 8, 1931.

**Original description.** Shell thick, subquadrate in outline; beaks elevated, subcentral; surface of the shell with 25-28 flattish channeled ribs varying in width from one-half to twice the width of the interspaces. Where the ribs are narrow they are bifurcated only once but usually develop four fine radial lines. On the adult the cardinal area is wide, with four or five chevron-shaped threads; muscle scars deep; border coarsely crenate. Dimensions: length 48 mm., height 42 mm., thickness 17.5 mm. (Etherington)

**Observations.** This species, which is common in the Montesano formation of western Washington, differs from *A. devincta* in having from 25 to 27 radiating ribs while the latter possesses from 29 to 33. The same character separates it from the variety *montereyana*.

**Holotype.** (U.C. 31922.) Figured in the present report, pl. 13, fig. 10.

**Geologic range.** Montesano formation, upper Miocene and lower Pliocene.

**Geographic distribution.** Western Washington.

**Type locality.** (U.W. 473.) In a cut on the Wynoochee River road about 150 yards south of the railroad which goes up Black Creek, Section 26, T. 18 N., R. 8 W., Grays Harbor County, Washington.

**ANADARA (ANADARA) OBISPOANA** (Conrad), 1857

Plate 11, figure 5; plate 13, figure 16; plate 26, figure 7

*Arca obispoana* Conrad, Pac. R. R. Repts., vol. 7, p. 192, pl. 5, fig. 1, 1857.

*Arca obispoana* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. 59, p. 192 (reprint), 1909.

**Original description** (*Arca obispoana*). Oblong, or trapezoidal; very inequilateral, ventricose; ribs about 26, little prominent, flattened; sides rectangular with the back; transversely rugose, or subcrenulated. This species has been described from very perfect casts in an argillaceous gray marl. (Conrad, pl. 5, fig. 1)

**Observations.** Specimens which appear to correspond to this species occur about 1,000 feet north of the mouth of Big Creek on Wishkah River in Grays Harbor County, Washington. They are elongate and trapezoidal in outline and the umbones are situated about 10 per cent the length of the shell from the anterior end. There are 28 radiating ribs, all of which are bifurcate.

**Holotype.** (U.S.N.M. 13330.) Figured in the present report, pl. 13, fig. 16.

**Hypotype.** (U.C. 32558.) Figured in the present report, pl. 11, fig. 5; pl. 26, fig. 7.

**Geologic range.** Astoria formation, middle Miocene.

**Geographic distribution.** Washington and southern California.

**Type locality.** San Luis Obispo Valley, California. Occurs in Washington, 1000 feet north of mouth of Big Creek on Wishkah River, Grays Harbor County.

## Family LIMOPSIDAE

## Genus LIMOPSIS Sasso, 1827

*Limopsis* Sasso, Giornal Ligustigo di scienze, lettere ed arti, year 1, p. 476, 1827.

*Genotype. Arca gurita* Brocchi.

## LIMOPSIS CARMANAHENSIS Clark, 1925

Plate 13, figures 12, 14

*Limopsis carmanahensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 80, 81, pl. 22, fig. 8, 1925.

*Original description.* Shell small, inequilateral, produced posteriorly; beaks fairly conspicuous, and rather strongly inturned; dorsal margins slightly convex; posterior end broadly but obscurely subtruncate; anterior end broadly and regularly rounded. Surface sculptured by numerous fine radial striations; when main surface of shell is uneroded, these are mostly concealed by fairly heavy, irregular lines of growth; however, radial striations fairly conspicuous on posterior depressed margins, even on uneroded specimens. Hinge plate not exposed. Dimensions: length 7.5 mm.; height 6.5 mm.; diameter of both valves 4 mm. (Clark)

*Observations.* The holotype of this species, which came from shaly sandstone of the lower Oligocene 3 miles west of Carmanah Point on the south coast of Vancouver Island, may be distinguished from *L. nitens* (Conrad) of the middle Oligocene at Astoria, Washington, by the poorly defined radial ribbing, the curved dorsal margin, and stronger development of the umbones.

*Holotype.* (S.U. 5249.) Figured in the present report, pl. 13, figs. 12, 14.

*Geologic range.* Lower Oligocene.

*Geographic distribution.* Southeastern Vancouver Island.

*Type locality.* (S.U. N.P. 141.) Three miles west of Carmanah Point, south shore of Vancouver Island.

## LIMOPSIS NITENS (Conrad), 1849

Plate 13, figure 15

*Pectunculus nitens* Conrad, U.S. Explor. Exped. Geol., p. 726, pl. 18, fig. 9, 1849.  
*Limopsis nitens* (Conrad), Dall, U.S. Geol. Surv., Prof. Pap. 59, pp. 106, 107, 155, 1909.

*Original description.* Suborbicular, oblique, smooth and polished with fine obsolete radiating lines, extremely neat. Hinge margin quite short, rectilinear; posterior margin, slightly arcuate.—Pl. 18, figs. 9, a, b, natural size. Length one-third inch; height 86/100 L. (Conrad)

*Supplementary description.* This species is a small, polished, nearly smooth shell which exhibits radial lines of minute punctures and in well-grown specimens has some small riblets near the basal angles. There are about five teeth on each side of the ligament, a short hinge line, and somewhat oblique valves. The valve margins appear to have been crenate, at least in the adult stage, and the valves show fine concentric sulci near the basal margin externally. The length is about 7 mm., the height 6.5 mm., and the diameter 3 mm. (Dall, 101, p. 106)

*Observations.* The holotype occurs in pieces of rock containing a large number of closely compacted specimens of this species. The writer has not observed the presence of this species in the formation at Astoria, but nodules containing large numbers of this species with the same lithology occur on the north side of Columbia River opposite Astoria in the cliffs at the river's edge about one-half mile east of Knappton. The specimens are all very small with inconspicuous beaks and a straight dorsal margin.

*Holotype.* (U.S.N.M. 3579.) Figured in the present report, pl. 13, fig. 15.

*Geologic range.* Upper Oligocene. Astoria formation(?).

*Geographic distribution.* Near mouth of Columbia River.

*Type locality.* City of Astoria, Oregon (J. D. Dana). Suggest it may have been collected from Knappton opposite Astoria on north side of Columbia River.

#### Genus TRINACRIA C. Mayer

*Trinacria* C. Mayer, Moll. Tert. du Mus. de Zurich, vol. 3, p. 62, 1868.

*Genotype.* *Trigonocoelis cuneus* Conrad, Am. Jour. Conch., vol. 1, p. 12, 1865.

#### TRINACRIA WILLIPAENSIS Clark, 1925

Plate 13, figures 2, 3

*Trinacria willipaensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 81, 82, pl. 9, figs. 5, 8, 10, 1925.

*Original description.* Shell medium in size, subtrapezoidal in outline; beaks in anterior third of shell, strongly inturned and prosogyrous; posterior end obliquely truncate; anterior end fairly broad and evenly rounded; outer surface smooth, except for fairly heavy, somewhat irregular lines of growth; surface bordering posterior dorsal margin strongly depressed, separated from remaining surface of shell by well-defined umbonal ridge between beaks and lower angle of posterior truncation. Hinge plate narrow, curved, bearing numerous taxodont teeth. Anterior to beaks are six or seven of these fairly heavy teeth, while posterior to beaks are approximately forty teeth, those nearest to beak being much the finer. Alivicular ligamental pit very small, beaks coming almost down to the hinge. Dimensions of type: length from beaks to posterior end 16 mm.; greatest height 10 mm. Dimensions of cotype: Length 15 mm.; length from beak to posterior end 11 mm.; greatest height 9 mm. (Clark)

*Observations.* The specimens of this species are small and occur in shaly sandstones of middle Oligocene age north of Holcomb on Willapa River. This species is the only occurrence of the genus in Oregon or Washington.

*Holotype.* (S.U. 16.) Figured in the present report, pl. 13, figs. 2, 3.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Southwestern Washington

*Type locality.* (S.U. 253.) In the cliffs on Willapa River north of Holcomb in Section 25, T. 13 N., R. 8 W., Pacific County, Washington.

## SUPERFAMILY PTERIACEA

## Family PEDALIONIDAE

Genus **PEDALION** Huddesford, 1770*Pedalion* Huddesford, in Lister, Hist. meth. Conchyl., p. 23, 1770.*Genotype.* *Ostrea ephippium* Linnaeus.

## PEDALION CLARKI Effinger, 1938

Plate 13, figure 9

*Pedalion clarki* Effinger, Jour. Paleon., vol. 12, pp. 367, 368, pl. 45, figs. 9, 10, 1938.

*Original description.* Shell large, moderately thick, trigonal in outline; beaks prominent, thin, sharply pointed, slightly prosogyrous; anterior margin almost straight, slightly concave; dorsal margin straight meeting the anterior margin at the beaks at an angle of about 65 degrees; valves moderately convex, sloping gradually along dorsal, posterior and ventral margins but sloping steeply to meet the opposite valve along the anterior margin; prominent byssal notch lacking; dorsal edge thickened to form an elongate, narrow hinge, the inner face of which bears about fifteen, narrow, transversely mounted, "U" shaped, ligamental grooves separated by flat areas about twice the width of the grooves. Dimensions of holotype.—Height (slightly incomplete), 160 mm.; length, 100 mm.; thickness of both valves, 45 mm. (Effinger)

*Paratype.* (U.C. 33514.) Figured in the present report, pl. 13, fig. 9.*Geologic range.* Gries Ranch beds, lower middle Oligocene.*Geographic distribution.* Lower Cowlitz River Valley, Cowlitz County, Washington.*Type locality.* (U.W. 239.) In south bank of Cowlitz River at the old Gries Ranch in the northeast quarter of Section 25, T. 11 N., R. 2 W.

## Family PTERIIDAE

Genus **PTERIA** Scopoli, 1777*Pteria* Scopoli, Introd. Hist. Natur., p. 397, 1777.*Genotype.* *Mytilus hirunda* Linnaeus.

## PTERIA CLARKI Weaver and Palmer, 1922

Plate 11, figure 4; plate 14, figures 11, 12

*Pteria clarki* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 12, 13, pl. 10, figs. 5, 12, 15, 1922.

*Original description.* Shell small to medium in size; oblique in outline; very inequilateral, beaks situated one-fifth of the distance from the anterior end; cardinal line straight, anterior end sloping sharply from the cardinal margin at an angle of 25° for a short distance then extending vertically to the ventral margin where it swings with a broad curve into the ventral margin; ventral margin broadly rounded and parallel with the dorsal line; posterior margin well rounded at the ventral end, extending nearly vertical or at a low angle into the dorsal mar-

gin; anterior ear small, posterior ear very broad, subcompressed; central area of the shell, extending obliquely from the beaks, broad and convex, often marked by an impressed groove which extends between the posterior and anterior slope of the body portion and the basal line of each ear; surface ornamented with prominent, close, concentric lines of growth; the growth lines curve sharply from the posterior dorsal line to the region of the body of the shell, where they turn at almost a right angle and follow the line of the umbonal slope for a short distance then curve regularly and extend parallel with the line of the ventral margin, anteriorly they extend parallel with the slope of the ear; shell of a light brown coloration, mottled with reddish brown spots; the larger and more mature specimens have a uniform color of reddish-brown. Dimensions.—Maximum height 37 mm.; width 31 mm.; thickness 14 mm. (Weaver and Palmer)

*Observations.* *P. clarki*, which occurs abundantly in the Cowlitz formation on Olequa Creek near the town of Vader in Cowlitz County, Washington, differs from *P. pellucida* (Gabb) in its stronger sculpture, less prominent umbones, and in a deeper sinuosity of the concentric growth lines where the ear joins the shell proper.

*Holotype.* (U.W. 159) (C.A.S. 7405). Figured in the present report, pl. 11, fig. 4.

*Paratype.* (U.W. 159B) (C.A.S. 7405B). Figured in the present report, pl. 14, fig. 11.

*Topotype.* (U.W. 159a) (C.A.S. 7405A). Figured in the present report, pl. 14, fig. 12.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 323.) In bed of small creek entering Olequa Creek one-half mile west of Vader, in Section 29, T. 11 N., R. 2 W., Cowlitz County, Washington.

## SUPERFAMILY OSTRACEA

### Family OSTREIDAE

#### Genus OSTREA Linnaeus, 1758

*Ostrea* Linnaeus, Syst. Nat. (10th ed.), p. 696, 1758.

*Genotype.* *Ostrea edulis* Linnaeus.

#### OSTREA IDRIAENSIS Gabb, 1869

##### Plate 15, figure 5

*Ostrea idriaensis* Gabb, Geol. Surv. Calif. Paleon., vol. 2, pp. 203, 252, pl. 33, figs. 103b, 103c, 103d; pl. 34, fig. 103, 1869.

*Ostrea columbiana* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 13, pl. 8, figs. 15, 16, 1922.

*Ostrea idriaensis* Gabb, Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 126, 127, pl. 8, fig. 3; pl. 17, fig. 1, 1930.

*Ostrea idriaensis* Gabb, Vokes, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 291, 292, 293, 294, 295, pl. 22, figs. 1, 2, 3, 4, 5, 6, 7; pl. 23, figs. 1, 2, 3, 4; pl. 24, figs. 1-11, 1935; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 46, pl. 6, fig. 9, 1938.

*Original description.* Shell moderately large, oblique, often curved, heavy; lower valve usually deep, more oblique than the upper; hinge straight or deflected to the

left, median groove pretty strongly marked; internal margins in the young shell, finely crenulated or pitted towards the beak, this character disappearing to a great extent in the adult. Surface of both valves roughly and very irregularly squamose. Muscular scar reniform to semicircular, and placed distinctly to one side of the middle. Length, from three to six inches. The specimens figured are all natural size, the greatest thickness of the specimen, fig. 103, is 1.25 inch, the fragment, 103a, has about an equal thickness indicating a shell, when entire, perhaps three inches through both valves. (Gabb)

*Original description (O. columbiana).* Shell large and elongate in outline; right valve very convex and irregular; left valve flat or concave with the anterior end straight dorsally, swinging into the ventral margin with a broad curve which continues ventrally to the posterior ventral end; posterior end with a more or less deep concave area at about one-third of the distance from the dorsal line; shell very thick; surface of the left valve rough and irregular with overlapping laminae; surface of the right valve smoother, the growth lines more regular than those of the left valve; left valve with a glossy, corneous outer layer over which are fine yet conspicuous radiating lines; beaks deflected posteriorly; anterior and posterior margins internally or laterally with coarse transverse grooves. Dimensions—Co-types: height right valve 58 mm.; width right valve 43 mm.; thickness right valve 10 mm.; height left valve 60 mm.; width left valve 44 mm.; convexity left valve 30 mm. (Weaver and Palmer)

*Supplementary Statement of Diagnostic Characters (Ostrea idriensis).* The characters which appear to be diagnostic for *Ostrea idriensis* Gabb are:

1. Valves discrepant in size; the lower much larger than the upper.
2. Shape variable; umbos generally straight or twisted to the left, but may be slightly twisted to the right.
3. Valves elongate and broader near the base.
4. Lower valve with rugose, coarse, concentric lamellae of growth, a superimposed radial ribbing commonly present; upper valve with finer lamellae of growth, ribbing not present.
5. Lines of the sides of the upper valves near the umbos, reflecting the denticulations present on the lateral margins of the body area of the shell.
6. Ligamental area of the lower valve consisting of a well-marked median groove with two prominent ridges, one on each side, which are bounded by small, linear, lateral grooves at the edges of the area.
7. Ligamental area of the upper valve with a median groove, and two lateral grooves complementary to the ridges of the ligamental area of the lower valve.
8. Ligamental area commonly twisted to the left, but may be straight or slightly twisted to the right.
9. Denticulations present on the lateral margins of the body area of the upper valve near the ligamental region, fitting into pits on the lateral margins of the body area of the lower valve.
10. Left margin of the lower valve commonly with an impressed area into which a corresponding protuberance on the upper valve is fitted.
11. Muscle scar reniform to subcircular; situated approximately one-sixth of the distance across the body area from the left side. (Vokes, 278, p. 291)

*Lectotype.* (M.C.Z. 15048.) Selected by Stewart. Not figured in the present report.

*Holotype.* *Ostrea columbiana* Weaver. (U.W. 160.) Lost.

*Topotype.* ("*Ostrea columbiana*") (U.W. 160A). Figured in the present report, pl. 15, fig. 5.

*Geologic range.* Middle and upper Eocene.

*Geographic distribution.* California, Oregon, and Washington.

*Type locality (O. columbiana).* (U.W. 340.) On Coal Creek, Cowlitz County, Washington, in Section 11, T. 8 N., R. 3 W.

**OSTREA IDRIAENSIS** Gabb var. **FETTKEI** Weaver, 1912

Plate 14, figures 8, 10, 14, 15

*Ostrea fettkei* Weaver, Wash. Geol. Surv., Bull. 15, p. 30, pl. 4, figs. 37, 39, 1912.  
*Ostrea fettkei* Weaver, Vokes, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 291, 1935.

*Original description.* Shell small, thin, somewhat curved, right valve nearly flat, left valve convex; hinge deflected to the left and median groove very well marked; internal margins in both old and young forms are pitted; shell inequivalve and slightly inequilateral; left valve ornamented by a marked median ridge extending from beak to basal margin; anterior to this ridge are two radiating ribs becoming obsolete toward the beak; posterior surface with six radiating ribs extending to the beak; these are crossed by a large number of concentric ribs and lines of growth. Dimensions.—Left valve, altitude 27 mm.; longitude, 17 mm.; thickness, 7 mm. (Weaver)

*Observations.* This variety occurs in the middle of the Cowlitz formation and is characterized by its small size and rather limited stratigraphic range. Radial ribbing is present on the lower two-thirds of the shell but the spacing and number vary on different specimens.

*Holotype.* (U.W. 5) (C.A.S. 479). Figured in the present report, pl. 14, figs. 8, 10.

*Paratype.* (U.W. 266) (C.A.S. 479a). Figured in the present report, pl. 14, fig. 14.

*Paratype.* (U.W. 265) (C.A.S. 479B). Figured in the present report, pl. 14, fig. 15.

*Geologic range.* Middle part of Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Cowlitz County, Washington.

*Type locality.* (U.W. 233.) One and one-half miles east of Vader on north bank of Cowlitz River in Section 27, T. 11 N., R. 2 W., Cowlitz County, Washington.

**OSTREA LINCOLNENSIS** Weaver, 1916

Plate 14, figures 1, 2, 3

*Ostrea lincolnensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 36, pl. 1, figs. 5, 6, 1916.

*Original description.* Shell of moderate size, thin and sub-oval in outline; slightly inequilateral; lower valve convex with a somewhat uneven surface sculptured by concentric lines of growth. There is no evidence of radial ribbing. Fine crenulations are present on the inner margins of both valves for a distance of one-fourth the length of the shell from the beaks on both the anterior and posterior dorsal margins. Dimensions.—Altitude, 65 mm.; longitude, 54 mm.; thickness, 20 mm. (Weaver)

*Observations.* This species is characterized by its regular concentric sculpture, relatively large size, lack of radial ribbing, broad ligamental pit, and lateral position of muscle scar.

*Holotype.* (U.W. 88) (C.A.S. 453). Figured in the present report, pl. 14, figs. 2, 3.

*Paratype.* (U.W. 88A) (C.A.S. 453A). Figured in the present report, pl. 14, fig. 1.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 256.) In railway cut of Union Pacific Railway one mile north of Galvin Station, in Section 27, T. 15 N., R. 3 W., Lewis County, Washington.

**OSTREA GRIESENSIS** Effinger, 1938

Plate 15, figures 1, 2

*Ostrea lincolnensis* Weaver, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 160, pl. 28, fig. 1, 1917.  
*Ostrea griesensis* Effinger, Jour. Paleon., vol. 12, p. 368, pl. 45, figs. 1, 8, 1938.

*Original description.* Valves large, moderately heavy, ovate to rounded in outline, of moderate convexity; beaks out-turned, opisthogyrous; ligamental area large, rough and in the left valve projecting internally to form an overhanging rostrum; ligamental groove distinct but shallow, moderately wide; anterior margin uniformly convex from the beaks to the ventral margin; posterior margin concave above, convex below; muscle scar distinct, sub-quadratae to subluniform, located slightly postero-ventrally of center of valve; internal surface smooth, undulating; external surface rugose; left valve more convex and attached over a wide area of the shell. Dimensions.—Height 92 mm.; length 60 mm.; thickness 15 mm. (Effinger)

*Observations.* *O. griesensis* occurs in the lowermost Oligocene and differs from the middle Oligocene species *O. lincolnensis* in the inward-extending ligamental plate and by the gyrate character of the umbones.

*Holotype.* (U.C. 33510.) Figured in the present report, pl. 15, fig. 2.

*Paratype.* (U.C. 33511.) Figured in the present report, pl. 15, fig. 1.

*Geologic range.* Lower middle Oligocene, Gries Ranch beds.

*Geographic distribution.* Lower Cowlitz Valley, Cowlitz County, Washington.

*Type locality.* (U.W. 239.) In south bank of Cowlitz River at the old Gries Ranch in the northwest quarter of Section 25, T. 11 N., R. 2 W., Cowlitz County, Washington.

**OSTREA TITAN** Conrad, 1854

*Ostrea titan* Conrad, Proc. Acad. Nat. Sci. Phila., vol. 6, p. 199, 1854.  
*Ostrea titan* Conrad, Pacific R. R. Repts., vol. 6, p. 72, pl. 4, fig. 17a; pl. 5, fig. 17a, 1857.  
*Ostrea (Crassostrea) titan* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. 59, pp. 111, 158, 178, 1909.

*Original description.* Produced from beak to base, straight or slightly curved, substance very thick, coarsely laminated; upper valve flat, very thick, somewhat gibbous; lower valve profoundly ventricose, umboñated, the summit rising above the beak of the opposite valve. (Conrad)

*Observations.* This species is reported by Dall as occurring in the Empire formation at Coos Bay, Oregon. It was not recognized in collections made by the writer. It is a characteristic fossil in the sandstones of the lower Pliocene and upper Miocene of the Coast Ranges of California.

*Hypotype.* (U.S.N.M. 153955.) Lost. Empire formation.

*Geologic range.* Upper Miocene and lower Pliocene.

*Type locality of Hypotype.* (U.S.N.M. 153955.) Coos Bay, Oregon (Camm Collection). (Dall)

**OSTREA SOOKENSIS** Clark and Arnold, 1923

Plate 14, figures 13, 16

*Ostrea sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 138, pl. 17, figs. 1, 2, 1923.

*Original description.* Shell fairly large and heavy; height greater than length; outline varying from subquadrate to subovate; inequivaled, left valve being more ventricose than right. Shell smooth with exception of irregular growth lamellations. Hinge plate broad and heavy. Ligamental area on right valve broad with large protuberance in middle bordered on either side by two fairly wide but shallow grooves; a wide and fairly deep ligamental pit on left valve; opposite protuberance on right valve. Muscle scar well developed, crescentic and more than one-third width of shell in length. Dimensions of type specimen (a right valve): Greatest length about 95 mm.; greatest height about 113 mm.; diameter of valve about 27 mm. (Clark and Arnold)

*Observations.* As pointed out by Clark and Arnold, this species differs from *O. titan* Conrad in a thinner and smaller shell of normal adults and in the deeper and more ventricose character of the ventral valve.

*Holotype.* (C.A.S. 591.) Figured in the present report, pl. 14, figs. 13, 16.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* Locality (C.A.S. 232). In sea cliffs east of the mouth of Kirby Creek, 6 miles west of Sooke, Vancouver Island.

**SUPERFAMILY PECTINACEA****Family PECTINIDAE****Genus PECTEN Mueller, 1776**

*Pecten* Mueller, Zoologiae Danicae Prodromus, p. 248, 1776.

*Genotype.* *Ostrea maxima* Linnaeus.

**Subgenus Chlamys Bolten, 1798**

*Chlamys* Bolten, Museum Boltenianum, pt. 2, p. 161, 1798.

*Subgenotype.* *Pecten islandicus* Mueller.

**PECTEN (CHLAMYS) LANDESI Arnold, 1906**

Plate 14, figures 4, 6, 7

*Pecten (Chlamys) landesi* Arnold, U.S. Geol. Surv., Prof. Pap. no. 47, pp. 51, 52, pl. 2, figs. 3, 4, 5, 1906.

*Original description.* Shell averaging about 34 millimeters in altitude, about as long as high, subcircular, inequivalve, equilateral, thin, slightly ventricose, and with serrate margins. Right valve more ventricose than left, and flattening toward the periphery in the adult; surface ornamented by from 25 to 40 subequal, rounded, more or less imbricate ribs, separated from each other by subequal, concave-bottomed interspaces, which average about as wide as the ribs; hinge line slightly longer than one-half length of disk; ears somewhat unequal, the anterior being slightly the longer; anterior ear sculptured by 4 prominent radials, while the pos-

terior has from 6 to 8 less prominent ones; byssal notch deep; whole surface of disk and ears crossed by numerous fine imbricating lamellae. Left valve more compressed than right, similarly sculptured, but with both ears slightly obliquely truncated, the anterior one showing a broad shallow notch. Hinge and muscle scars similar to *P. islandicus*. Dimensions.—Alt. 34 mm.; long. 33.5 mm.; hinge line 19 mm.; diameter 12 mm. (right valve 7 mm., left valve 5 mm.). (Arnold)

*Observations.* The radiating ribs of this species show some variation in different specimens but are characterized by being evenly rounded and equal in width to the interspaces. In some specimens they become dichotomous.

*Holotype.* (U.S.N.M. 164926.)\* Figured in the present report, pl. 14, fig. 6.

*Cotype.* (U.S.N.M. 164926.) Figured in the present report, pl. 14, figs. 4, 7.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 699) (U.S.N.M. 4091). In the banks of Stillwater Creek 300 feet west of its junction with Olequa Creek about 1200 feet due south of the northwest corner of Section 32, T. 11 N., R. 2 W., Cowlitz County, Washington.

#### PECTEN (CHLAMYS) COWLITZENSIS Weaver, 1912

Plate 11, figures 1, 2; plate 14, figure 9

*Pecten cowlitzensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 30, 31, pl. 5, fig. 46, 1912.

*Original description.* Shell small, somewhat higher than long, thin, nearly equivalve, equilateral, and with very slightly serrate margins; anterior and posterior margins slightly concave, sloping equally and steeply from the beak and merging into the regularly rounded base; angle at which margins intersect at beak is 80°; surface ornamented by forty-four equally spaced broadly rounded radiating ribs, separated from each other by narrower flat-bottomed to slightly concave interspaces; hinge line nearly two-thirds the length of the shell; ears unequal; surface sculptured by numerous fine concentric lines of growth. Dimensions.—Altitude 17 mm.; longitude 14.5 mm.; thickness 2.5 mm. (Weaver)

*Observations.* This species somewhat resembles *P. landesi* but may be distinguished from it by its broader radiating ribs and very narrow interspaces and lack of bifurcation of radial ribs near ventral margin. Many of the interspaces in *P. landesi* are as wide or wider than the ribs. The byssal notch is deeper in *P. landesi* than in *P. cowlitzensis* although not shown in the figured holotype of the latter.

*Holotype.* (U.W. 6) (C.A.S. 7417). Figured in the present report, pl. 11, figs. 1, 2; pl. 14, fig. 9.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz River Valley, southwestern Washington.

*Type locality.* (U.W. 232.) In west bank of Cowlitz River, 1,000 feet below bend and below locality 233 in Section 28, T. 11 N., R. 2 W., Cowlitz County, Washington.

\* Private correspondence with Dr. Paul Bartsch of the U. S. National Museum of date September 26, 1941, indicates that the type and the two cotypes of *Pecten landesi* Arnold (3 specimens) bear the same catalogue number (U.S.N.M. 164926).

## PECTEN (CHLAMYS) COLUMBIANUM Clark and Arnold, 1923

Plate 15, figure 3; plate 16, figure 1

*Pecten columbianum* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 139, pl. 23, figs. 1, 2, 1923.

*Original description.* Shell fairly large, height greater than length, dorsal slopes long and straight; apical angle less than 90 degrees; ears prominent, anterior ears about a third longer than posterior. Anterior right ear long and narrow, sculptured by four or five fairly heavy radiating ribs with interspaces slightly less than width of ribs; byssal notch deep and broad and on its dorsal edge are a number of fairly prominent ctenidial teeth, ten of these teeth on type. Posterior ear broad; four heavy radial ribs on posterior ear of type with interspaces somewhat wider than width of ribs with a finer riblet in at least two of interspaces. Main surface of shell sculptured by about 24 bifurcated fairly heavy, rounded radiating ribs which are slightly less prominent near the dorsal margins and tend to pair, each pair separated by a wider interspace than that separating the individual members of pair; most of these pairs might be described as individual bifurcating ribs, the bifurcations taking place well up toward the beaks; some of the pairs, however, may be traced as distinct ribs up to the beaks. Irregularity of interspacing between pairs is noticeable and some of the individual ribs are bifurcated. Fine interrib in some interspaces. Surface of shell sculptured by fairly heavy concentric lines of growth which produce rather coarse imbrications where they cross ribs. Imbrications probably appeared as spines on uneroded specimens. Left valve unknown. Dimensions of type specimen (smaller of two specimens figured): Height 82.5 mm.; length probably about 75 mm.; length of hinge line about 47 mm. Dimensions of cotype: Height 96 mm.; length about 85 mm. (Clark and Arnold)

*Observations.* *P. columbianum* differs from *P. porteriensis*, which it resembles somewhat closely in general outline and appearance, in the presence of numerous finer subsidiary radiating ribs on both the major ribs and interspaces and also in a larger number of closely spaced ribs on the ears. Fine concentric growth lines are well developed.

*Holotype.* (U.C. 30056.) Figured in the present report, pl. 16, fig. 1.

*Cotype.* (C.A.S. 592.) Figured in the present report, pl. 15, fig. 3.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Southern slope of Vancouver Island, Canada.

*Type locality.* (S.U. N.P. 130.) In basal sandstone in sea cliffs at mouth of Fossil Creek, 2 miles west of Sherrington Point, Jordan River, Vancouver Island.

## PECTEN (CHLAMYS) GRUNSKYI Hertlein, 1929

Plate 14, figure 5

*Pecten branneri* Arnold, Dickerson (not Arnold), Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 160, 161, pl. 28, fig. 2, 1917.

*Pecten branneri* Arnold, Van Winkle, Univ. Wash. Publ. Geol., vol. 1, p. 75, 1918.

*Pecten (Chlamys) grunskyi* Hertlein, Jour. Paleon., vol. 3, pp. 296, 297, 1929.

*Pecten (Chlamys) grunskyi* Hertlein, Effinger, Jour. Paleon., vol. 12, p. 368, 1938.

*Original description.* Shell rather small, higher than long, equilateral, thin, flattish; sides straight, base rounded; surface ornamented by 35 to 40 fine, low, rounded ribs, separated from each other by slightly wider interspaces, some of the ribs occur in pairs which on the umbo form a single rib; a few fine mid ribs are present but these disappear in the earlier part of the shell; a fine tessellate sculpture

is present on unweathered portions of the interspaces and ribs, otherwise the surface of the shell is ornamented only by very fine imbricating lines of growth. Anterior ear large with a deep byssal notch, ctenolium present on margin of shell near ear, about 6 to 8 radial ribs crossed by imbricating lines of growth ornament the anterior ear; posterior ear ornamented by about 6 to 8 subequal radial ribs which are crossed by concentric lines of growth. Altitude of right valve 24 mm.; longitude (approximately) 22 mm.; thickness (approximately) 1 mm.; apical angle about 90°. (Hertlein)

*Observations.* This species differs from *P. cowlitzensis* in having a smaller apical angle, about 5 more radial ribs with proportionately narrower interspaces, more sharply truncate posterior ear, and a lesser width compared to the height.

*Holotype.* (C.A.S. 424.) Figured in the present report, pl. 14, fig. 5.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 239.) On south side of Cowlitz River at old Gries Ranch in the northeast quarter of Section 25, T. 11 N., R. 2 W., Cowlitz County, Washington.

#### PECTEN (CHLAMYS) CORNWALLI Clark and Arnold, 1923

Plate 16, figures 2, 3, 5

*Pecten (Chlamys) cornwalli* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 140, pl. 25, figs. 1, 4, 5, 1923.

*Original description.* Shell somewhat variable in outline and sculpturing, nearly equilateral; height considerably greater than length; subequivalved; apical angle between 85 and 90 degrees. Dorsal edges straight or nearly so; the posterior edge slightly longer than anterior; dorsal margins rather strongly depressed. Left valve sculptured by 20-21 rounded, radial ribs, some of which may be twice as wide as the others; interspaces between ribs also variable some being wider than tops of ribs, others narrower. There appears to be no system in width and spacing of ribs, which is more regular on some specimens than on others. Radial ribbing does not extend on to depressed dorsal margins. Surface also covered by rather coarse imbricated concentric lines of growth. Ears equal with anterior and posterior edges straight; anterior ear sculptured by about eight rather obscure moderately fine radiating ribs; at least five or six of these ribs on posterior ear. Right valve sculptured by about twenty-one rounded radial ribs with interspaces averaging about width of ribs; ribbing somewhat narrower near dorsal margins, but taken as a whole much more regular than that of left valve; surface as a whole sculptured by heavy imbricating lines of growth. Ears unequal; anterior ear longer with a broad fairly deep byssal notch; four ctenidial teeth visible in notch and five in filled area back of notch on cotype. Four radial ribs on anterior ear; apparently five or six radial ribs on posterior ear but on specimens at hand almost obsolete. Ligamental pit deep; teeth absent. Dimensions of type (a left valve): Length, 47 mm.; height, 52 mm.; length of anterior dorsal margin, 29 mm.; length of posterior dorsal margin, 34 mm. Dimensions of cotype No. 30231, Univ. Calif. Coll. Invert. Pal. (a right valve): length, 55 mm.; height, 62.5 mm.; length of posterior dorsal margin, 37 mm.; length of anterior dorsal margin about 33 mm. (Clark and Arnold)

*Observations.* The medium size of mature individuals, relatively greater height compared to length, prominent growth lines, simple rounded radiating ribs, and deep ligamental pit serve to distinguish this species from others of the genus in Oregon and Washington.

*Holotype.* (U.C. 30059.) Figured in the present report, pl. 16, fig. 5.

*Paratype.* (U.C. 30231.) Figured in the present report, pl. 16, figs. 2, 3.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Southern side of Vancouver Island, Canada.

*Type locality.* (S.U. N.P. 129.) In the sandstone and conglomerate layers of the sea cliffs between the mouth of Muir and Coal Creeks west of Otter Point, Vancouver Island.

**PECTEN (CHLAMYS) WASHBURNEI Arnold, 1906**

Plate 17, figure 1

*Pecten (Chlamys) washburnei* Arnold, U.S. Geol. Surv., Prof. Pap. no. 47, pp. 119, 120, pl. 45, fig. 2, 1906.

*Original description.* Shell averaging over 100 millimeters in altitude, somewhat shorter than high, subequivalve, equilateral (except for the ears), rather thin; base regularly rounded; sides somewhat concave above. Left valve with about 65 more or less unequal faintly squamose low, squarish ribs; interspaces about as wide as the ribs, and sometimes ornamented by an intercalary thread or riblet; whole surface of disk ornamented by imbricating lamellae; anterior ear somewhat convex in front, and with a faint suggestion of a notch, sculptured by about 12 rather low imbricated radials; posterior ear about one-half as long as the anterior, obliquely truncated, and ornamented by faint radials and imbricating lamellae. Right valve unknown, but, judging by the affinity which this species bears to *P. islandicus*, it should be similar to the left valve with the exception that the anterior ear should have a deep byssal notch, and the ribs should be slightly broader and the interspaces correspondingly narrower. Dimensions.—Alt. 110 mm.; long. about 100 mm.; hinge line about 50 mm.; diameter 30 mm. (Arnold)

*Observations.* *P. washburnei* was referred to by Arnold as being closely allied to *P. islandicus* but differs in having a larger number of less prominent smoother radiating ribs. The posterior ears are less obliquely truncated and the adult specimens attain a larger size. Grant and Gale (149A, p. 162) consider *P. washburnei* as a variety of *P. islandicus*.

*Holotype.* (U.S.N.M. 164843.) Figured in the present report, pl. 17, fig. 1.

*Geologic range.* Middle Miocene (?).

*Geographic distribution.* Coast of Oregon.

*Type locality.* (U.S.N.M. 3593.) Near the mouth of Yachates River, Lincoln County, Oregon.

**Subgenus *Vertipecten* Grant IV and Gale, 1931**

*Vertipecten* Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 188, 189, 1931.

*Subgenotype.* *Pecten nevadanus* Conrad (+*P. bowersi* Arnold).

**PECTEN (VERTIPECTEN) PORTERENSIS Weaver, 1912**

Plate 16, figure 4; plate 19, figures 1, 4, 8

*Pecten porterensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 57, pl. 8, figs. 70, 72, 1912.

*Pecten (Chlamys) porterensis* Weaver, Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 83, pl. 11, figs. 1, 3, 1925.

*Pecten (Vertipecten) porterensis* Weaver, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 191, 1931.

*Original description.* Shell slightly higher than long, inequivalve, equilateral. Margins somewhat serrate, base rounded; sides sloping above; sides considerably concave above, the posterior being more so than the anterior; right valve with twenty nearly equal slightly rounded radiating ribs, which are always dichotomous and often trichotomous, and begin so about 40 mm. from the beak; interspaces unequal, nearly twice as broad as the ribs and always ornamented by at least one auxiliary rib which begins near the beak and often attains at least one-half the size of the regular ribs. The four anterior interradials are strongly imbricated or crenulated. Whole surface ornamented by very fine concentric striations; ears subequal; anterior ear with six radials and moderately fine concentric lines; byssal notch very pronounced; posterior ear with eight radials, strongly crenulated and truncated by a convex curve. Dimensions.—Longitude 86 mm.; altitude 100 mm.; diameter 23 mm. (Weaver)

*Supplementary description.* In his description of *P. porterensis*, Weaver included only the right valve; his figure was that of a very poor and imperfectly preserved specimen. But, at the same time, he figured a left valve, of which he makes no mention. This valve, as is true of many of the species belonging to this subgenus, has a considerably different sculpture from that of the right, the surface being covered by about 18 to 20 fairly heavy ribs, variable in width and prominence. Interspaces about equal to or wider than tops of ribs; on top of each rib is raised ridge or riblet, and there is a riblet in each interspace. Whole surface of shell beautifully imbricated. (Clark, 52, p. 83)

*Observations.* This species resembles *P. nevadanus* var. *perrini* Arnold and perhaps it should be considered a variety of *P. nevadanus*.

*Syntype.* (U.W. 45a) (C.A.S. 543). Figured in the present report, pl. 19, fig. 1.

*Syntype.* (U.W. 45) (C.A.S. 542). Figured in the present report, pl. 19, fig. 8.

*Hypotype.* (S.U. 19.) Figured in the present report, pl. 19, fig. 4.

*Hypotype.* (S.U. 18.) Figured in the present report, pl. 16, fig. 4.

*Geologic range.* Lower middle Oligocene.

*Type locality.* (U.W. 169.) In old quarry in sandstone overlying Eocene basalt, one mile west of Oakville, along track of Northern Pacific Railway in Grays Harbor County, Section 19, T. 16 N., R. 4 W.

**PECTEN (VERTIPECTEN) NEVADANUS Conrad var. FUCANUS Dall, 1898**

Plate 19, figure 7; plate 20, figure 1

*Pecten (Chlamys) fucanus* Dall, Trans. Wagner Inst. Sci., vol. 3, pt. 4, p. 704, pl. 26, fig. 7, 1898.

*Pecten (Chlamys) fucanus* Dall, Arnold, U.S. Geol. Surv., Prof. Pap. no. 47, p. 66, pl. 10, figs. 1, 2, 2a, 1906.

*Pecten (Chlamys) fucanus* Dall, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 71, 1931.

*Pecten (Vertipecten) nevadanus* Conrad var. *fucanus* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 190, pl. 7, figs. 1a, 1b, 1931.

*Original description.* This is a rather large species of the type of *P. hindsii* var. *strategus*, both valves moderately convex and with a fine subsidiary surface tessellation; sixteen squarish ribs, of which the median one in the left valve is stronger than the rest and surmounted by prominent imbricated scales; the others are simply radially striated, as are the interspaces, which carry a mesial elevated thread; the submargins are radially threaded, as are the subequal ears, which also bear marked concentric lamellae; the resilial pit is of moderate size and the cardinal edge is deeply grooved parallel to and just below the margin; the interior reflects the external ribbing. Alt. 85, lat. 80, convexity of left valve 16 mm. (Dall, 89, p. 704)

*Supplementary description.* Adult shell averaging nearly 100 millimeters in altitude, about as long as high, inequivalve (the left being the more convex), equilateral, moderately thin, and with nearly smooth margins. Right valve with from 14 to 17 more or less unequal prominent, rather squarish, radiately striae ribs, between which (especially the anterior and posterior ones) are occasionally intercalated small riblets; interspaces unequal and averaging somewhat narrower than the ribs; whole surface of disk sculptured by rather prominent lines of growth and a fine subsidiary tessellation; hinge line longer than one-half length of disk; ears equal in length; the anterior rather narrow and sculptured by 4 prominent radials and fine imbricating incremental lamellae; the posterior rectangularly truncated and sculptured by more, but less prominent radials and fine concentric lamellae; byssal notch profound. Left valve usually having 15 or 16 unequal prominent convex-topped ribs, the median one generally being stronger than the rest, with the second or third one from it on each side only a little less prominent; the prominent ribs, especially the median one, is generally surmounted by elevated imbricating scales; the other ribs are simply radially striated, as are the interspaces which often carry one or more elevated riblets; the submargins are radially threaded, as are the subequal ears, which are rectangularly truncated, and also bear marked concentric lamellae; the fine subsidiary tessellation is also present on well preserved specimens of this valve. The resilial pit is of moderate size, and the cardinal edge is deeply grooved parallel to and just below the margin. The interior of both valves reflects the external ribbing. (Arnold, 10, p. 66)

*Observations.* This species was considered by Grant and Gale (149A, p. 190) as a variety of *P. nevadanus* Conrad which occurs in the lower and middle Miocene of southern California. It differs in the smaller size of adults, in the broader flat-topped profile of the radiating ribs, in their common bifurcation and occasional radial striations.

*Plastoholotype.* (U.S.N.M. 107790.) Figured in the present report, pl. 20, fig. 1.

*Paratype.* (U.S.N.M. 164933.) Figured in the present report, pl. 19, fig. 7.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* North side of Olympic Peninsula, Washington.

*Type locality.* (U.W. 490.) In shaly sandstone in cliff of beach section 11,000 feet southeast of Slip Point and 13,000 feet due east of the town of Clallam Bay, Clallam County, in the northeast quarter of southeast quarter of Section 22, T. 32 N., R. 12 W.

#### Subgenus *Plagioctenium* Dall, 1898

*Plagioctenium* Dall, Trans. Wagner Free Inst. Sci., vol. 3, p. 696, 1898.

*Subgenotype.* *Pecten ventricosus* Sowerby = *P. gibbus* var. *circularis* Sowerby.

**PECTEN (PLAGIOTENIUM) ANDERSONI Arnold subsp. CLEMONENSIS Etherington, 1931**

Plate 19, figures 3, 5

*Pecten (Plagiostenium) andersoni clemonensis* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 72, pl. 4, figs. 2, 3; pl. 5, figs. 1, 2, 3; pl. 1, figs. 13, 15, 1931.

*Original description.* Shell medium sized, slightly wider than the height, sub-equilateral; left valve decidedly inflated; right valve slightly inflated; umbonal angle 90° on left valve, little more on the right valve; right valve sculptured with seventeen square, flat-topped ribs, smooth except for four or five faint radial riblets, crossed by looped concentric thread, especially visible near ventral margin of the shell; left valve with similar number of ribs, smooth, more rounded, usually narrower than interspaces; interspaces smooth except for concentric threads of which there are many more than on the right valve; auricles subequal; on the right valve the anterior auricle sculptured with four or five radial riblets crossed by concentric riblets giving the radials a more or less noded effect on unworn specimens. Byssal notch deep; posterior ear sculptured with three to four less prominent radials crossed by numerous concentric lamellae; left valve, both auricles sculptured with five to six fine radials crossed by fine concentric lamellae. Ctenolium includes seven or eight quite prominent denticles; single adductor muscle scar slightly posterior; ventral margins scalloped in harmony with the radial sculpturing. Type (U.C. 31932) (right valve). Length of hinge line 21.2 mm.; height 27.5 mm.; width 29.4 mm. (Etherington)

*Observations.* This variety which occurs in the middle Miocene Astoria formation of southwestern Washington bears a resemblance to the Astoria species *P. alockamanensis* in having a larger number of radiating ribs with broader interspaces and in a proportionately greater width compared with the height. As pointed out by Etherington, it differs from the species *andersoni* in the presence of secondary radial ribs on the flat-topped ribs of the right valve and in the more inflated right valve and the more pronounced rounding of the ribs.

*Holotype.* (U.C. 31933.) Locality (U.W. 427). Figured in the present report, pl. 19, fig. 5.

*Paratype.* (U.C. 31936.) Locality (U.W. 42). Figured in the present report, pl. 19, fig. 3.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 427.) In cut on Clemons logging road one-fourth mile south of the eight-mile post, Grays Harbor County, Section 26, T. 17 N., R. 7 W.

**PECTEN (PLAGIOTENIUM) ALOCKAMANENSIS Weaver, 1912**

Plate 17, figure 5

*Pecten alockamanensis* Weaver, Wash. Geol. Surv., Bull. 15, p. 58, pl. 13, fig. 115, 1912.

*Original description.* Shell small, much higher than long, equivalve, equilateral; sides straight and sloping regularly at an angle of 50° from the beak; base regularly rounded; left valve has 13 or 14 equally rounded ribs which are not sulcated; interspaces are flat-bottomed and slightly wider than the radiating ribs. Surface ornamented with fine incremental lines; anterior ear about one-third longer than posterior; byssal area moderately deep; posterior ear truncated and both ornamented by fine concentric lines. Dimensions.—Longitude 18 mm.; altitude 24 mm.; diameter 3 mm. (Weaver)

*Observations.* This species, which occurs near the base of the Astoria formation, differs from *P. andersoni clemonensis* in a lesser number of radiating ribs, narrower interspaces, and lesser width and greater height of shell.

*Holotype.* (U.W. 46) (C.A.S. 7418). Figured in the present report, pl. 17, fig. 5.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* North of Columbia River in southwest Washington.

*Type locality.* (U.W. 54). Near the head of Alochaman River, Wahkiakum County, Washington, in Section 2, T. 9 N., R. 5 W.

#### PECTEN (PLAGIOCTENIUM) NEAHENSIS Arnold, 1906

##### Plate 17, figure 2

*Pecten (Plagioctenium) neahensis* Arnold, U.S. Geol. Surv., Prof. Pap. no. 47, pp. 87, 88, pl. 15, figs. 2, 2a, 2b, 1906.

*Original description.* Adult shell averaging about 45 millimeters in altitude, somewhat longer than high, subequivalve, subequilateral, prominently ventricose, especially for about the first 25 millimeters of altitude, after which it is sometimes more compressed; sides concave above; base evenly rounded; margins smooth. Right valve with 19 prominent rounded ribs, separated by somewhat narrower interspaces; surface sculptured by fine incremental lirulae which loop back over the tops of the ribs; hinge line over one-half length of disk; ears subequal; anterior with 4 or 5 prominent radials, posterior with one or two less prominent ones; both ears sculptured by fine incremental lines; byssal notch rather prominent. Left valve a little less ventricose than right and with ribs narrower and more sharply convex above and the interspaces relatively broader; ears as in right valve. Dimensions: Alt. 43 mm.; long. 50 mm.; hinge line 28 mm.; diameter 28 mm. (Arnold)

*Observations.* This species may be distinguished from other species of the genus in Oregon and Washington by its greater width than height, broad rounded undivided radiating ribs nearly equal or often broader, and flat-surfaced interspaces.

*Holotype.* (U.S.N.M. 164843?-5912.) Figured in the present report, pl. 17, fig. 2.

*Geologic range.* Probably middle Miocene.

*Geologic range.* Probably middle Miocene.

*Type locality.* Uncertain, but labeled "near Neah Bay." Specimens of this species have been collected from locality (U.W. 490) in sandstone cliffs in the beach section 11,000 feet southeast of Slip Point and 13,000 feet due east of the town of Clallam Bay, Section 22, T. 32 N., R. 12 W., Clallam County, Washington.

#### Subgenus *Patinopecten* Dall, 1898

*Patinopecten* Dall, Trans. Wagner Free Inst. Sci., vol. 3, p. 695, 1898.

*Subgenotype.* *Pecten caurinus* Gould.

**PECTEN (PATINOPECTEN) PROPATULUS Conrad, 1849**

Plate 19, figure 6; plate 20, figure 2

*Pecten propatulus* Conrad, U.S. Explor. Exped., p. 726, pl. 18, figs. 13, 13a, 1849.

*Pecten propatulus* Conrad, Conrad, Am. Jour. Conch., vol. 1, p. 154, 1865.

*Pecten (Patinopecten) propatulus* Conrad, Dall, Trans. Wagner Free Inst. Sci., vol. 3, p. 699, 1898.

*Pecten (Patinopecten) propatulus* Conrad, Arnold, U.S. Geol. Surv., Prof. Pap. no. 47, pp. 64, 65, pl. 7, fig. 1; pl. 9, figs. 1, 1a, 2, 2a, 1906.

*Pecten (Patinopecten) propatulus* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 112, pl. 15, figs. 1, 2; pl. 16, fig. 1, 1909.

*Pecten (Patinopecten) propatulus* Conrad, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 192, 193, pl. 22, fig. 5, 1931.

*Original description.* Large subequivalve, suborbicular, compressed, costae about 17, rounded, narrow, interstices much wider than the ribs; ears unequal.—Pl. 18, figs. 13, 13a. Length and Height 4 inches. (Conrad)

*Supplementary description.* Shell averaging about 95 millimeters in altitude, as high as long, equivalve, equilateral, rather thin, somewhat ventricose and with smooth margins; base regularly rounded; sides straight and sloping at a rather low angle. Right valve with 15 or 16 subequal, squarish ribs, some of which are generally obsoletely medially sulcated; interspaces subequal, flat-bottomed, about as wide as ribs and sometimes containing faint intercalaries; whole surface ornamented with fine, sharp incremental lines; hinge line less than one-half length of the disk; anterior ear slightly longer than posterior, arcuate-ended, and ornamented above the byssal area by 4 or 5 prominent radiating riblets, which, with the byssal area, are crossed by numerous fine concentric lines; posterior ear rectangularly truncated, and ornamented by several radiating riblets and numerous incremental lines. Left valve somewhat similar to right, but with narrower, ridge-like ribs and the broader interspaces sometimes showing a more or less prominent intercalary riblet in the later stages of growth; surface, when perfect, microscopically tessellated; ears radiately and concentrically sculptured. Dimensions.—Alt. 93 mm.; long. 93 mm.; hinge line 38 mm.; diameter 12 mm. (Arnold 10, pp. 64, 65)

*Holotype.* (U.S.N.M.) Unable to find in collection.

*Topotype.* (U.C. 12080.) Figured in the present report, pl. 19, fig. 6.

*Topotype.* (U.S.N.M. No number—In Conrad Collection of Wilkes Exploring Expedition from Astoria, Oregon.) Figured in the present report, pl. 20, fig. 2.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Western Oregon and Washington.

*Type locality.* From sandstones in the city of Astoria, Oregon. The specimen is one of the collection made by the U.S. Exploring Expedition and no specific locality in the city of Astoria was given. It occurs in the Astoria formation at Clallam Bay, Washington, and north of Newport and at Yaquina Bay, Oregon, in rocks of similar age.

**PECTEN (PATINOPECTEN) COOSENSIS Shumard, 1858**

Plate 18, figures 1, 2; plate 21, figures 2, 5

- Pecten coosensis* Shumard, Trans. St. Louis Acad. Sci., vol. 1, p. 122, 1858.  
*Pecten (Patinopecten) coosensis* Shumard, Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 700, pl. 26, fig. 2, 1898.  
*Pecten (Patinopecten) coosensis* Shumard, Arnold, U.S. Geol. Surv., Prof. Pap. no. 47, p. 61, pl. 6, fig. 2; pl. 7, figs. 2, 2a, 1906.  
*Pecten (Patinopecten) coosensis* Shumard, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 112, 187, pl. 16, figs. 2, 2a; pl. 17, fig. 3, 1909.  
*Pecten (Patinopecten) coosensis* Shumard, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 193, 1931.

*Original description.* Shell large, suborbicular, much compressed; valves flattened convex, the superior one more depressed than the other, surface ornamented with from 27 to 31 coarse, radiating, prominent ribs, which are flattened, and marked with an obscure, median, longitudinal groove toward the pallear margin; on the inferior valve the ribs are about equal in width to the spaces, but on the superior one the spaces are much the widest; ribs and spaces crossed by numerous fine, subimbricating, concentric striae of growth; ears nearly equal, those of superior valve marked with distinct striae, and folds running parallel with their lateral borders; those on the anterior one are crossed by from six to eight indistinct, radiating ribs; anterior ear of lower valve deeply emarginate for the passage of the byssus, striated, and marked with three or four rather broad, radiating ribs; striae of posterior ear nearly vertical; ligamentary pit triangular and rather deep.

Apical angle, excluding the ears, 100°

This species is subject to more or less variation. In some specimens we find the ribs of the middle of the shell bearing a longitudinal, slightly elevated, rounded carina, with a shallow groove on either side, while toward the lateral margins they are marked only with a single median groove. In other specimens the ribs exhibit merely a plain surface, without groove or carina. (Shumard, 248, p. 122)

*Supplementary description.* Shell averaging about 110 millimeters in altitude, slightly longer than high, valves both well compressed, equilateral, and with margins smooth; sides only slightly concave, and sloping at only a moderately low angle. Right valve with 29 to 31 prominent T-rail shaped ribs, flattened and sometimes faintly dichotomous above, overhanging narrow, deep, almost flat-bottomed channels; whole surface sculptured with more or less prominent fine concentric lines; hinge line nearly equal to one-half length of disk; anterior ear rectangularly truncated, and sculptured by sharp incremental lines and sometimes by obsolete radial ridges. Left valve with narrower, rounded, concave-sided ribs and wider, round-bottomed interspaces; sculpture of numerous, sharp, raised, concentric lines; ears subequal, and having incremental and sometimes obsolete radial sculpture. Dimensions.—Alt. 110 mm.; long. 115 mm.; hinge line 54 mm.; diameter 26 mm. (Arnold, 10, pp. 61, 62)

*Hypotype.* (U.S.N.M. 107791.) Figured by Arnold and Dall. Figured in the present report, pl. 18, fig. 1.

*Hypotype.* (U.S.N.M. 107791-?) Figured by Arnold and Dall. Figured in the present report, pl. 21, fig. 5.

*Hypotype.* (U.S.N.M. 107791-?) Figured by Arnold and Dall. Figured in the present report, pl. 18, fig. 2.

*Hypotype.* (U.C. 32656.) Figured in the present report, pl. 21, fig. 2.

*Geologic range.* Empire and Montesano formations, upper Miocene and lower Pliocene.

*Geographic distribution.* Western Oregon and Washington (and southern California?).

*Type locality.* Coos Bay, Oregon (Shumard). Probably Empire formation.

**PECTEN (PATINOPECTEN) OREGONENSIS Howe, 1922**

Plate 19, figure 2; plate 22, figure 1

*Pecten oregonensis* Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 98, 99, pl. 11, figs. 1, 2; pl. 12, figs. 1, 2, 1922.

*Original description.* Shell averaging about 95 mm. in alt., 100 mm. long., equivalve, equilateral, only slightly ventricose, base regularly rounded, dorsal sides slightly concave and forming a 120 degree angle. Right valve with 17 to 21 wide, squarish ribs, which tend to bifurcate near the end in large specimens. The ribs near the posterior and anterior margins tend to split in such a way as to make the number of ribs variable, and at the same time to make the ribs near the center of the shell broadest.

The interspaces are sub-equal, flat-bottomed, narrower than the ribs. The whole surface ornamented with distinct incremental lines; hinge line less than half the disk; anterior ear longer than posterior with prominent byssal notch, above which it is ornamented by three or four radial ribs, crossed by prominent concentric lines; posterior ear rectangularly truncated and ornamented with incremental lines only. Left valve with low rounded ribs about half the width of interspaces, and ornamented by many very fine sharp concentric incremental lines. Posterior ear ornamented by prominent concentric sculpture. Anterior ear unknown. Dimensions.—Alt. 95 mm.; length 100 mm. (Howe)

*Observations.* This species is characterized by its broad slightly rounded to flat-topped radiating ribs which often become slightly dichotomous on the anterior and posterior surfaces and also near the ventral margin, the flat-bottomed and much narrower interspaces, and the distinct but faintly developed concentric lines of growth.

*Holotype.* (S.U. 25.) Empire formation. Figured in the present report, pl. 22, fig. 1.

*Paratype.* (U.C. 30027.) Empire formation. Figured in the present report, pl. 19, fig. 2.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Western Oregon.

*Type locality.* Coos Bay, Oregon.

Subgenus **Pseudamusium** Klein, 1853

*Pseudamusium* Klein, in Mörch, Cat. Conch. Yoldi, pt. 2, p. 59, 1853.

*Subgenotype.* *Ostrea hybrida* Gmelin.

**PECTEN (PSEUDAMUSIUM) VANWINKLEAE Clark, 1925**

Plate 15, figure 4

*Pecten vanwinkleae* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 82, 83, pl. 15, fig. 2, 1925.

*Original description.* Shell rather small, thin, height nearly equal to length, moderately convex; apical angle a little less than 90°, dorsal slopes nearly straight; ventral edge very arcuate; hinge margin about half the width of shell. Surface of shell sculptured by very fine radiating striae which can be seen only by aid of a lens, and by fairly prominent, broad, concentric undulations, which are very distinct near beaks but on type specimen become obsolete toward ventral edge;

dorsally, undulations are closely spaced, interspaces becoming broader ventrally. Both ears of right valve separated from main surface by distinct line of depression; end of anterior byssal notch only moderately deep. Surface of anterior ear noticeably concave, sculptured by fine radial striations similar to that seen on main surface; end cut off obliquely sloping down and out. Left valve unknown. Dimensions: Length about 14 mm.; height 13 mm.; length of hinge line 7 mm. (Clark)

*Observations.* This species is closely allied to *P. peckhami* as indicated by Clark (52, pp. 82, 83). It, together with *P. peckhami*, was placed in synonymy with *P. pedroanus* (Trask) by Grant and Gale (149A, pp. 236, 237). It seems probable that the minor distinctions noted on these three species are not sufficiently important to warrant their retention as separate units. However, since this paper is not an attempt to completely revise the classification, they are listed separately. The final conclusions should be based upon a biologic investigation of all the species of the family on the Pacific Coast.

*Holotype.* (S.U. 5226.) Figured in the present report, pl. 15, fig. 4.

*Geologic range.* Middle Oligocene, Washington.

*Geographic distribution.* Chehalis River Valley, Washington.

*Type locality.* (U.W. 701.) On Porter Creek 3,000 feet above its junction with Chehalis River in sandy shale.

#### Subgenus *Propeamussium* de Gregorio, 1884

*Propeamussium* de Gregorio, II Naturalista Siciliano, Anno 3, no. 4, p. 119, 1884.

*Subgenotype.* *Pecten (Propeamussium) ceciliae* de Gregorio.

#### PECTEN (PROPEAMUSSIUM) CLALLAMENSIS Arnold, 1906

Plate 17, figures 3, 6

*Pecten (Propeamussium) clallamensis* Arnold, U.S. Geol. Surv., Prof. Pap. no. 47, pp. 57, 58, pl. 3, figs. 1, 2, 3, 3a, 1906.

*Original description.* Adult shell averaging about 10 millimeters in altitude, subcircular, equivalve, equilateral, thin, compressed, and with smooth margins. Right valve ornamented externally by numerous equally elevated, sharp, slightly imbricate, concentric lamellae, separated by equal interspaces, each of which is about five times as wide as the thickness of a lamella; hinge line somewhat longer than one-half length of disk; ears decidedly unequal, the anterior being about twice as long as the posterior; anterior ear arcuate in front and sculptured by numerous regular, sharp, elevated, concentric lamellae and 5 or 6 slightly elevated, unequally spaced radials; byssal notch not profound; posterior ear rectangularly truncated and ornamented with concentric sculpture similar to that of the anterior; interior of disk strengthened by nine strong, rounded elevated, radiating ribs, which terminate abruptly at a length of 6 or 7 millimeters; the middle ribs are straight, but occasionally the lateral ones are faintly arcuate toward the middle rib. Left valve beautifully ornamented externally by numerous regular, thin, concentric, imbricating, prominently elevated lamellae which, sloping at an angle of about 45° toward the umbo, rise into 10 or 11 prominent rounded radiating pseudo-ribs, separated by somewhat wider interspaces, in nearly every one of which is an intercalated, imbricated pseudo-riblet; this riblet begins only after the shell has attained a height of about 1.5 to 2 millimeters; ears similarly sculptured to those of the right

valve. Dimensions.—Alt. (type, left valve) 10 mm.; long. 9.5 mm.; hinge line 5.5 mm.; diameter about 0.75 mm. (Arnold)

*Observations.* As pointed out by Arnold, this species is similar to *P. stanfordensis* but may be distinguished from it in having 9 instead of 10 ribs and in the lamellated character of its surface.

*Holotype.* (U.S.N.M. 164922.) Figured in the present report, pl. 17, figs. 3, 6.

*Geologic range.* Upper Oligocene.

*Geographic distribution.* Northern side of Olympic Peninsula, Washington.

*Type locality.* Locality (U.W. 681.) In sea cliffs one-half mile east of Pillar Point, Clallam County, Washington.

#### PECTEN (PROPEAMUSSIUM) WAYLANDI Arnold, 1906

Plate 22, figure 3

*Pecten (Propeamussium) waylandi* Arnold, U.S. Geol. Surv., Prof. Pap. no. 47, pp. 58, 59, pl. 3, figs. 4, 5, 1906.

*Original description.* Adult shell averaging about 9.5 millimeters in altitude, somewhat longer than high, subcircular, equivalve, equilateral; thin, somewhat convex in youth, but becoming more compressed with age; margins smooth. Disk of right valve sculptured by numerous fine lines of growth and numerous, more or less obsolete, fine radiating lines; hinge line equal to about one-half the length of the disk; ears subequal; anterior arcuate in front and faintly sculptured concentrically by sharp lines and radially by faint ridges; byssal notch narrow and shallow; posterior ear slightly obliquely truncated and sculptured by faint radial ridges and fine, sharp, concentric lines; interior of disk strengthened by 8 subequal, strong, narrow, smooth, convex-topped riblets, which are widely separated and which terminate abruptly at about 6 to 8 millimeters from the umbo; these internal riblets are usually straight, but the ones distant from the center are often slightly arcuate toward the center. Left valve, up to an altitude of 6 or 8 millimeters, ornamented by 8 more or less prominently elevated, narrow convex-topped radiating ridges, corresponding with the same number of equally long, smooth, convex-topped internal riblets; whole surface of disk sculptured by numerous subequal, inequidistant, sharp, radiating lines (usually varying from 5 to 7 between each major ridge) and faint incremental lines, the latter becoming prominent as the radiating ridges become obsolete; ears similar to those of right valve, with the exception that there is no byssal notch in the anterior one. Dimensions.—Alt. 9.5 mm.; long. 12 mm.; hinge line 5.5 mm.; diameter about 0.75 mm. (Arnold)

*Observations.* This species occurs with *P. clallamensis* in the upper Oligocene of Washington and is distinguished from it by less prominent and fewer radial ribs, and the fact that its height in proportion to width is a little greater.

*Holotype.* (U.S.N.M. 164924.) Figured in the present report, pl. 22, fig. 3.

*Geologic range.* Upper Oligocene.

*Geographic distribution.* North side of Olympic Peninsula.

*Type locality.* (U.W. 681.) In sea cliffs one and one-half mile east of Pillar Point, Clallam County, Washington.

Genus **PALLIOLUM** Monterosato, 1884*Palliolum* Monterosato, Nom. Gen. Conch. Medit., pp. 5, 6, 1884.*Genotype. "Pecten" incomparabilis* Risso. (See Stewart.)Subgenus **Delectopecten** Stewart, 1930*Delectopecten* Stewart, Acad. Nat. Sci. Phila., Spec. Pap. no. 3, pp. 119, 120, 1930.*Subgenotype. "Pecten" (*Pseudamusium*) vancouverensis* Whiteaves.**PALLIOLUM (DELECTOPECTEN) VANCOUVERENSIS** (Whiteaves) subsp. **SANJUANENSIS**  
(Clark and Arnold), 1923

## Plate 17, figure 4

*Pecten (Pseudamusium) vancouverensis* Whiteaves subsp. *sanjuanensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 140, 141, pl. 16, figs. 5, 6, 1923.*Pecten (Pseudamusium) pedroanus* (Trask) var. *vancouverensis* Whiteaves, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 288, 1931.

*Original description.* Shell small, subcircular, equivalved; hinge line about three-fourths length of valve. Anterior ears well defined but not separated from main surface by a distinct line; surface of ears sculptured by fine radial threads; byssal notch on left valve not deep. Posterior to byssal notch a rather pronounced groove separates main surface of valve from ear. Surface of valves covered by numerous fine, somewhat irregular spaced threads. Surface also covered by fairly heavy concentric undulations on and between which are finer lines of growth. Dimensions of type specimen: length 7 mm., height 7.5 mm. (Clark and Arnold)

*Observations.* In distinguishing the var. *sanjuanensis* from *P. vancouverensis*, Clark noted in the former a smaller byssal notch, a deeper groove posterior to it, and a lack of major concentric undulations.

*Holotype.* (U.C. 30221.) Figured in the present report, pl. 17, fig. 4.*Geologic range.* Oligocene. Sooke formation.

*Type locality.* (S.U. N.P. 133.) In the basal sandstones and conglomerates in the sea cliff one fourth mile east of Providence Cove, Port San Juan, Vancouver Island, B. C. (Clark and Arnold)

**PALLIOLUM (DELECTOPECTEN) PECKHAMI** (Gabb), 1869

## Plate 11, figure 6; plate 21, figure 4

*Pecten peckhami* Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 59, pl. 16, figs. 19, 19a, 1868-1869.*Pecten (Pseudamusium) peckhami* Gabb, Arnold, U.S. Geol. Surv., Prof. Pap. no 47, pp. 56, 57, pl. 3, figs. 6, 7, 8, 1906.*Pecten (Pseudamusium) peckhami* Gabb, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 113, 1909.*Pecten (Pseudamusium) pedroanus* (Trask), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 236, 237, 1931.*Palliolum (Delectopecten) peckhami* (Gabb), Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 119, 120, pl. 13, fig. 4, 1930.

*Original description.* Shell small, thin, subcircular, equivalve, or nearly so, slightly inequilateral; ears nearly equal in size. Upper valve, right ear not sepa-

rated by any distinct line from the remainder of the surface; the corresponding ear of the lower valve has the same character; left ear flat, the swell of the shell commencing with nearly a right angle with its surface; corresponding ear of lower valves produced, separated from the body of the shell by a marked groove and a deep narrow sinus. Surface marked by numerous small, irregular, concentric undulations, crossed by obsolete wavy radiating lines, which are most distinct on the ears. (Gabb)

*Supplementary description.* Shell averaging about 20 millimeters in altitude, subcircular, sub-equivale, slightly inequilateral, thin, usually compressed, and with smooth margins. Right valve with the disk showing several small, more or less obsolete, irregular concentric undulations, numerous fine incremental lines and numerous fine obsolete radiating lines; hinge line about two-thirds of the longitude of the disk; anterior ear produced, separated from the body of the shell by a marked groove and a deep, narrow sinus, and prominently sculptured by 6 or 7 radiating ridges and numerous concentric elevated incremental lines; posterior ear not separated by any distinct line from the disk surface and ornamented only by concentric lines and obsolete undulations. Left valve similar to right except that the anterior ear is flat, the swell of the shell commencing with nearly a right angle with the ear surface; surface of anterior ear usually sculptured only by incremental lines, but occasionally with radiating striae also. Dimensions.—Alt. 21 mm.; long. 21 mm.; hinge line 14 mm.; diameter 2 mm. (Arnold, 10, p. 56)

*Observations.* This species which is abundantly represented in the Miocene formations of the Coast Ranges of California occurs in the middle of the Blakeley formation in Washington. It is characterized by very fine radiating sculpture on well-preserved specimens as well as very fine concentric growth lines.

*Lectotype.* (M.C.Z. 15045.) Specimen selected by Stewart (267, pp. 119, 120, pl. 13, fig. 4). Figure reproduced and figured in the present report, pl. 21, fig. 4.

*Hypotype.* (U.C. 32640.) Tenth and Harrison Streets, Astoria, Oregon. Figured in the present report, pl. 11, fig. 6.

*Geologic range.* Late Oligocene and Miocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Ojai Ranch, Ventura County, California; in Washington it is common at Bean Point in Kitsap County at locality (U.W. 700) in the upper Oligocene.

## Family LIMIDAE

### Genus LIMA Cuvier, 1798

*Lima* Cuvier, Tabl. Elem. Hist. Nat. Anim., p. 421, 1798.

*Genotype.* *Ostrea lima* Linnaeus, Syst. Nat. (10th ed.), p. 699, 1758.

### LIMA BELLA Dickerson, 1917

#### Plate 21, figure 3

*Lima bella* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 172, pl. 29, fig. 11, 1917; Effinger, Jour. Paleon., vol. 12, pp. 368, 369, 1938.

*Original description.* Shell small with thin shell substance; ventral margin acutely rounded; posterior margin straight, sloping steeply from narrow straight hinge

line; anterior margin broadly arcuate; very fine radial ribs decorating shell. Dimensions.—Height, 9 mm.; length, 6 mm. (Dickerson)

*Observations.* The holotype of this species which occurs in the Gries Ranch lower Oligocene sediments on Cowlitz River is characterized by its small size. It appears to be an immature form, since several larger specimens have been collected by the writer. These resemble the holotype of *L. oakvillensis* in general appearance but differ in the large extended anterior ear.

*Holotype.* (C.A.S. 400.) Figured in the present report, pl. 21, fig. 3.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 239.) On the south side of Cowlitz River, 4 miles east of Vader in the northeast quarter of Section 25, T. 11 N., R. 2 W., Cowlitz County, Washington.

#### LIMA OAKVILLENSIS Clark, 1925

Plate 21, figure 1; plate 22, figure 7

*Lima (Radula) oakvillensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 84, pl. 15, figs. 1, 3, 1925.

*Original description.* Shell large, heavy; beaks not very conspicuous in proportion to size of shell. Posterior ear sharply set off from depressed posterior dorsal margin; upper margin of ear slants obliquely away from beak at a considerably greater angle than does anterior ear; anterior ear not separated from main surface of shell by a well defined line or depression. Posterior margins of shell strongly depressed, depressed areas smooth except for heavy concentric lines of growth; outer surface sculptured by heavy radial ribs, interspaces between which, in middle and anterior portion of the valves, average less than width of ribs while toward posterior margin interspaces become wider. Concentric lines which cross radial ribbing fairly heavy, producing rather strong imbrications on ribs. Hinge plate heavy, ligamental pit large, fairly deep. A very large proportion of ligament submerged. Dimensions of type (an imperfect specimen): Height a little over 5 inches; greatest diameter of valve about 17 mm. (Clark)

*Observations.* The species is characterized by its large adult size and the small depressed anterior ear. Immature individuals from the same locality conform in this respect. It is possible that *L. oakvillensis* may be a variety of *L. bella* Dickerson which occurs in the lower Oligocene on Cowlitz River.

*Holotype.* (S.U. 20.) Figured in the present report, pl. 22, fig. 7.

*Hypotype.* (U.C. 32405). Figured in the present report, pl. 21, fig. 1.

*Geologic range.* Lower middle Oligocene.

*Geographic distribution.* Chehalis River Valley, Washington.

*Type locality.* (U.W. 169.) In basal sandstone and conglomerates of old quarry one mile west of Oakville on Northern Pacific Railway in Section 19, T. 16 N., R. 4 W., Grays Harbor County, Washington.

**LIMA OREGONENSIS** Clark, 1925

Plate 22, figures 2, 6

*Lima (Plagiostoma) oregonensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 84, pl. 14, figs. 3, 4, 1925.

**Original description.** Shell large, equivalved, inequilateral, only moderately convex; beaks prominent overhanging ligamental pit. Posterior ear small, separated from main surface of shell by narrow, but rather sharply depressed dorsal margin. Anterior ear about twice as long as posterior ear and not separated from main surface of shell by a well defined line, sculptured by numerous rather fine closely spaced radial ribs. Main outer surface ventricose, smooth except on the dorsal margins where there is a narrow area covered by medium coarse closely spaced radial lines; this ribbing somewhat finer and not so distinct on anterior dorsal margin as ribbing on posterior dorsal margin. Dimensions of type specimen: Length about 63 mm.; height about 66 mm. (Clark)

**Observations.** Specimens of this species which occur in the Keasey formation near Holcomb in southwestern Washington and in the lower Oligocene strata on the south side of Bremerton Inlet are proportionately higher than those from the typical locality in Oregon.

**Holotype.** (U.C. 30303.) Figured in the present report, pl. 22, fig. 6.

**Paratype.** (U.C. 30312.) Figured in the present report, pl. 22, fig. 2.

**Geologic range.** Keasey formation, lower Oligocene.

**Geographic distribution.** Northwestern Oregon, southwestern Washington, and Puget Sound.

**Type locality.** In shaly sandstone at railroad tunnel ten miles west of Buxton toward Tillamook, Oregon. (Clark)

**LIMA PACKARDI** Weaver and Palmer, 1922

Plate 23, figure 15

*Lima packardi* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, pp. 14, 15, pl. 8, fig. 13, 1922.

**Original description.** Shell small; obliquely oval in outline; inequilateral; beaks minute; posterior dorsal margin straight, sloping only slightly from the beaks; posterior end slopes roundly from the dorsal line at an angle of 40°, passing below into the ventral margin at about the same angle; ventral margin curved, rounding more sharply into the anterior end; anterior end straight, extending at an angle of 60° with the cardinal line and extending directly from the anterior margin of the beaks; no anterior ear present; surface sculptured with numerous fine radiating ribs which on the posterior end of the shell have interspaces that are nearly equal in width to the rib, the ribs become broader on the middle portion of the shell with the interspaces about one-fourth of the width of the rib. Dimensions.—Height 10 mm.; width 7 mm. (Weaver and Palmer)

**Holotype.** (U.W. 162.) Type lost. Reproduction in Weaver and Palmer (301, pl. 8, fig. 13). Figured in the present report, pl. 23, fig. 15.

**Geologic range.** Cowlitz formation, upper Eocene.

**Geographic distribution.** Lower Cowlitz River, Washington.

**Type locality.** (U.W. 324.) In west bank of Olequa Creek about one-eighth mile north of Vader, Section 29, T. 11 N., R. 2 W., Lewis County, Washington.

## Family ANOMIIDAE

## Genus ANOMIA Linnaeus, 1758

*Anomia* Linnaeus, Syst. Nat. (10th ed.), p. 700, 1758.*Genotype.* *Anomia ephippium* Linnaeus.

## ANOMIA MCGONIGLENSIS Hanna, 1927

## Plate 22, figures 4, 5

*Anomia mcgoniglensis* Hanna, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 278, pl. 31, figs. 1, 2, 5, 7, 1927; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 46, pl. 6, figs. 4, 5, 6, 1938.

*Original description.* Shell of medium size and thickness, only moderately inflated, slightly distorted, shape varying from ovate to elongate, or irregular outline; surface striated by rough, prominent, concentric growth lines and scales; whole surface radially sculptured by many ribs; radial ribs are rounded, slightly nodulose where crossed by growth lines, vary in direction due to distortion of shell, separated by regularly concave shallow interspaces which vary in size about like the ribs; surface of the inner margin irregular, smooth, muscle scar very large, central, and just below the beak. Dimensions of cotype No. 31011: Altitude 29 mm., diameter 9 mm. (M. Hanna)

*Observations.* *A. mcgoniglensis* may be distinguished from *Pododesmus inornata* (Gabb) from the Eocene of California in the more strongly developed spiral and longitudinal ribbing.

*Cotype.* (U.C. 31012.) Figured in the present report, pl. 22, fig. 4.*Cotype.* (U.C. 31011.) Figured in the present report, pl. 22, fig. 5.

*Geologic range.* Upper Umpqua formation in Oregon; in California, middle Eocene.

*Geographic distribution.* La Jolla quadrangle, southern California and in southwestern Oregon.

*Type locality.* (U.C. 5080.) On north side of Soledad Valley formed by McGonigle Canyon joining Soledad Valley-La Jolla quadrangle near San Diego, California. Occurs in southwestern Oregon at locality (U.C. 999). Oyster bed on north bank of North Umpqua River near big riffle below bend at junction of Little River. (Turner)

## Genus PODODESMUS Philippi, 1837

*Pododesmus* Philippi, Wiegmann's Arch. f. Naturg., vol. 3, pl. 9, fig. 1, 1837.*Genotype.* *Pododesmus decipiens* Philippi.

## PODODESMUS NEWCOMBEI Clark and Arnold, 1923

## Plate 23, figures 2, 3, 5

*Pododesmus newcombei* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 141, pl. 21, figs. 3, 4, 5, 6, 1923.

*Original description.* Shell medium in size, irregularly subcircular; beaks inconspicuous, central. Right valve convex, with surface sculptured by fairly coarse, narrow rounded or spinous ribs, many of which are dichotomous below middle of shell;

interspaces between major ribs two or three times width of ribs. Dimensions of type specimen: Length 35 mm., height as restored 29 mm. (Clark and Arnold)

*Observations.* As was pointed out by Clark and Arnold, this species resembles *P. macrochisma* (Deshayes) except for a smaller number of radial ribs, wider interspaces, and, in general, a stronger sculpture.

*Holotype.* (U.C. 30041.) Figured in the present report, pl. 23, fig. 3.

*Cotype.* (C.A.S. 594.) Figured in the present report, pl. 23, fig. 2.

*Cotype.* (U.C. 30233.) Figured in the present report, pl. 23, fig. 5.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South shore, Vancouver Island.

*Type locality.* In sandstones and conglomerates exposed in the sea cliffs between the mouths of Muir and Coal creeks, Sooke Bay, Vancouver Island.

#### PODODESMUS INORNATA (Gabb), 1864

Plate 104, figures 8, 14

*Placunanomia inornata* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 217, pl. 32, fig. 288a, 1864.

*Placunanomia inornata* Gabb, Weaver, Wash. Geol. Surv., Bull. no. 15, p. 14, 1912.

"*Placunanomia*" *inornata* Gabb, Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 66, pl. 8, fig. 4, 1930.

*Original description.* Shell thin, irregular, inequivale; upper valve convex, usually narrowest near the beaks, broad towards the base; hinge-margin thickened; surface marked by fine radiating lines or smooth, usually concentrically undulated; lower valve concave, without the radiating lines; hinge line but little, if at all, thickened; foramen small, bordered on one side by a thickened margin. (Gabb)

*Observations.* Specimens of this species usually are small and the upper valve which possesses fine radial striations is strongly inflated and is sculptured with well-developed lines of growth.

*Paratype.* (P.A.N.S. 4442.) Stewart specimen (167, pl. 8, fig. 4.) Reproduction. Figured in the present report, pl. 104, figs. 8, 14.

*Geologic range.* Middle and upper Eocene.

*Geographic distribution.* California and Washington.

*Type locality.* Corral Hollow, in the Coast Ranges of central California. The Washington specimens occur at locality (U.W. 674) in the Cowlitz formation in massive gritty dark-gray standstone in Olequa Creek, Lewis County, about 800 feet S. 70° E. from the northwest corner of Section 29, T. 11 N., R. 2 W.

## SUPERFAMILY MYTILACEA

## Family MYTILIDAE

Genus **MYTILUS** Linnaeus, 1758*Mytilus* Linnaeus, Syst. Nat. (10th ed.), p. 704, 1758.*Genotype.* *Mytilus edulis* Linnaeus.**MYTILUS SAMMAMISHENSIS** Weaver, 1912

Plate 25, figure 12; plate 26, figure 6

*Mytilus sammamishensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 58, pl. 13, fig. 111, 1912.*Mytilus sammamishensis* Weaver, Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 143, 1923.

*Original description.* Shell small, moderately thick, elongate; left valve larger than right; beaks small, terminal; anterior margin nearly straight with an upward slope for some distance from the beaks and then broadly rounded to the posterior end; basal margin nearly straight but curving slightly toward the beak. Shell thickest about one-third distance up from the base, sloping sharply to the base and gradually to the anterior margin. Surface ornamented by numerous faint concentric striations and a few irregular lines of growth. Still possesses dark coloration. Dimensions.—Longitude 30 mm.; altitude 17 mm.; diameter 8 mm. (Weaver)

*Observations.* This species somewhat resembles *M. snohomishensis* from beds of approximately the same age, but is proportionately shorter with a pronounced posterior flare and a relatively longer hinge line.

*Holotype.* (U.W. 47) (C.A.S. 7411). Figured in the present report, pl. 25, fig. 12; pl. 26, fig. 6.

*Geologic range.* Blakeley formation, upper Oligocene.*Geographic distribution.* King County, Washington.

*Type locality.* (U.W. 188.) In tunnel of old King coal mine north of Issaquah, King County, in Section 22, T. 24 N., R. 7 W.

**MYTILUS SNOHOMISHENSIS** Weaver, 1912

Plate 23, figure 8; plate 26, figure 3

*Mytilus snohomishensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 59, pl. 13, fig. 110, 1912.*Mytilus snohomishensis* Weaver, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 245, 1931.

*Original description.* Shell small, moderately thick, elongate, narrow; beaks terminal and small; dorsal slope arcuate with a pronounced angle about one-third distance from the beak; base straight or very slightly concave; posterior end sharply rounded. Surface convex, sloping at a lower angle to the dorsal area and steeply to the base; ornamented by fine concentric striae and irregular lines of growth. Dimensions.—Longitude 33 mm.; altitude 15 mm.; diameter 7 mm. (Weaver)

*Observations.* This species may be distinguished from *M. mathewsonii* in the smaller size of adult specimens, in the more convexly rounded

dorsal margin, and in the more dorsal position of the place of greatest tumidity of the valves.

*Holotype.* (U.W. 49) (C.A.S. 7412). Figured in the present report, pl. 23, fig. 8; pl. 26, fig. 3.

*Geologic range.* Middle and upper Oligocene.

*Geographic distribution.* Northern part of Puget Sound Basin.

*Type locality.* (U.W. 228.) At Fiddler's Bluff in Northern Pacific Railway cut, 3 miles south of the city of Snohomish, Washington.

#### MYTILUS STILLAGUAMISHENSIS Weaver, 1912

##### Plate 23, figure 12

*Mytilus stillaguamishensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 59, 1912.

*Original description.* Shell large, thick, elongated; beaks terminal and not prominent; anterior margin broadly arcuate, basal margin nearly straight but in some specimens slightly concave; posterior end sharply rounded; greatest thickness of the shell about one-fourth the distance up from the base. Surface sloping steeply to the base and gradually to the anterior margin; surface ornamented by faint concentric lines of growth. Dimensions.—Longitude 90 mm.; altitude 37 mm.; diameter 28 mm. (Weaver)

*Observations.* Poorly preserved specimens of this species occur in thick beds at the type locality. It somewhat resembles *M. mathewsonii* but may be distinguished from it by its more concave ventral margin, its more attenuate anterior end, and in a lesser tumidity of the valves.

*Holotype.* (U.W. 48.) Figured in the present report, pl. 23, fig. 12.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Western Snohomish County, Puget Sound Basin, Washington.

*Type locality.* (U.W. 129.) In south bank of South Fork of Stillaguamish River in Section 11, T. 30 N., R. 6 E., Snohomish County, Washington.

#### MYTILUS FICUS Dall, 1909

##### Plate 23, figure 11

*Mytilus ficus* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 113, pl. 9, figs. 1, 4, 1909.

*Mytilus ficus* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 244, 1931.

*Original description.* Shell solid, thick, subpyriform, with rather blunt apical umbones; dorsal slope subarcuate, with a tendency to angulation somewhat behind the middle; posterior end ovately rounded; base somewhat swollen toward the middle, behind which it is nearly straight; apices slightly decurved; surface sculpture of incremental lines and coarse, wide, little-elevated, rounded wrinkles, without any radial furrows; interior filled with matrix. Longitude, 95 mm.; altitude, 47 mm.; diameter, 28 mm. (Dall)

*Observations.* As was pointed out by Dall, this species resembles *M. californicus* but lacks the radial sculpture.

*Holotype.* (U.S.N.M. 153950.) Figured in the present report, pl. 23, fig. 11.

*Geologic range.* Upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Coos Bay, Oregon (Camman Collection). (Dall)

**MYTILUS BUWALDANA** Van Winkle, 1918

Plate 23, figure 7; plate 26, figure 1

*Mytilus buwaldana* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 82, pl. 6, 1918.

*Original description.* Shell of moderate size, elongate, ventricose, moderately thick; hinge line nearly straight; the posterior dorsal margin slightly concave. At a distance of three-fourths the length of the shell from the anterior end the surface slopes rapidly to form a broadly rounded posterior margin where it merges at a very sharp angle into a slightly concave base. The maximum width of the shell is situated about one-third the length of the shell from the posterior end. A very pronounced umboinal ridge extends from the beaks through the middle portion of the shell and terminates near the junction of the ventral and posterior margins. This ridge is most strongly pronounced near the middle portion of the shell. Surface of shell is sculptured by very prominent concentric lines of growth, giving the surface of the shell a roughened appearance. Dimensions—Altitude 21 mm.; longitude 38 mm.; thickness 18 mm. (Van Winkle)

*Observations.* The holotype of this species is defective but is characterized by the broad flaring posterior end, the nearly straight dorsal margin, and the posterior position of the angle where the dorsal margin passes into the posterior margin. The concentric lines of growth are rugose.

*Holotype.* (U.W. 127.) Figured in the present report, pl. 23, fig. 7; pl. 26, fig. 1.

*Geologic range.* Lowermost Oligocene.

*Geographic distribution.* Chehalis River Valley, western Washington.

*Type locality.* (U.W. 169.) In sandstone overlying basalt at old quarry situated one mile west of Oakville along Northern Pacific Railway track in Section 19, T. 16 N., R. 4 W., Grays Harbor County.

**MYTILUS HANNIBALI** Clark and Arnold, 1923

Plate 23, figure 9

*Mytilus hannibali* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 142, pl. 16, fig. 3, 1923.

*Original description.* Shell small, long, slender, beaks fairly acute. Base straight to slightly convex; posterior dorsal margin long, straight to slightly convex; posterior angulation well defined and in posterior third of shell; posterior end fairly broad and regularly rounded. Umboinal ridge broad, not well defined; anterior slope, between base and highest point of convexity, steep; slope of surface posterior to highest point of convexity, gentle but becoming moderately steep near umbo. Surface covered by somewhat irregular concentric undulations on and between which are finer lines of growth. Four small cardinals on hinge plate, just below umbo, similar to those on hinge plate of *M. edulis* Linnaeus, a recent Atlantic-Pacific species. Dimensions: Length 32 mm., width measured at the posterior angulation 15 mm. (Clark and Arnold)

*Observations.* This species may be distinguished by its attenuate anterior end, long and straight dorsal and ventral margins, and rather acutely rounded posterior margin.

*Holotype.* (U.C. 30043.) Figured in the present report, pl. 23, fig. 9.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Southern shore of Vancouver Island.

*Type locality.* (S.U. N.P. 130.) Basal sandstone of Sooke formation in sea cliffs at mouth of Fossil Creek, 2 miles west of Sherringham Point, Jordan River, Vancouver Island.

**MYTILUS WASHINGTONENSIS** Clark, 1924

## Plate 23, figure 4

*Mytilus washingtonensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 85, pl. 9, fig. 3, 1924.

*Original description.* Shell small, rather wide for its length; beaks blunt, posterior end broadly and regularly rounded; base straight; posterior dorsal edge short; angulation very distinct and well anterior to middle of valve. Surface broadly and gently convex, anterior slope being much the steeper and shorter. No well defined umbonal ridge. Dimensions: Antero-posterior length 16 mm.; maximum width 11 mm. (Clark)

*Observations.* This species may be distinguished from other species of the genus occurring in Oregon and Washington by its small size, small length, relative great height, broadly convex dorsal margin, and evenly and broadly rounded posterior end.

*Holotype.* (S.U. 24.) Figured in the present report, pl. 23, fig. 4.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Northern side of Olympic Peninsula and Chehalis River Valley, Washington.

*Type locality.* (U.W. 702.) In shaly sandstone east of old shingle warehouse, Freshwater Bay, Clallam County, Washington.

**MYTILUS (MYTILOCONCHA?) VANCOUVERENSIS** Clark and Arnold, 1923

## Plate 24, figure 4; plate 25, figure 8

*Mytilus (Mytiloconcha?) vancouverensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 143, pl. 24, figs. 2, 3, 1923.

*Original description.* Shell medium to fairly large in size; variable in outline; beaks rather bluntly pointed. Base on some specimens straight, on others strongly concave; posterior extremity regularly rounded; posterior dorsal edge gently arcuate, without any well defined angle between it and posterior end. Surface smooth except for a broad rounded rib or undulation which extends from beak to posterior margin; on some specimens this ridge tends to become obsolete about halfway between posterior margin and highest point of convexity. Broken shells expose internal radiating lines which do not show upon outer surface. There is a distinct groove on the thickened area below the beaks. Dimensions: Length, 65 mm.; greatest width about 35 mm. (Clark and Arnold)

*Observations.* In the type, as well as in the majority of specimens of this species, the ventral margin becomes strongly concave about one-half the distance between the anterior and posterior ends. The shell material of the valves is thick, and faint radiating ribs, when present, are usually confined to the lower third of the valve and below the prominent radiating groove.

*Holotype.* (U.C. 30044.) Figured in the present report, pl. 25, fig. 8.

*Paratype.* (U.C. 30218.) Figured in the present report, pl. 24, fig. 4.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Southeast shore of Vancouver Island.

*Type locality.* (U.C. Newcombe 41.) About one-half mile up Kirby Creek from its mouth on the east side of the creek, Vancouver Island.

**MYTILUS (MYTILOCONCHA) MATHEWSONII Gabb, 1869**

Plate 23, figures 1, 10

*Mytilus mathewsonii* Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 30, pl. 8, fig. 51, 1869.

*Mytilus (Mytiloconcha) mathewsonii* Gabb, Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 142, pl. 27, fig. 1, 1923.

*Original description.* Shell very large, curved, width and thickness about equal in the centre, flatter towards the base; beaks terminal, blunt. Surface marked only by lines of growth and irregular concentric undulations. (Gabb)

*Observations.* Specimens of this species usually are about two-fifths as high as long and the ventral margin is only slightly concave, the place of greatest convexity being situated about one-third the length of the shell from the anterior end. The dorsal margin is never strongly convex. The lines of growth are moderately heavy. Posterior end is broadly rounded.

*Holotype.* (U.C. 30240.) Figured in the present report, pl. 23, figs. 1, 10.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Coast Ranges of California and Vancouver Island.

*Type locality.* (S.U. N.P. 130.) In the basal cliffs at the mouth of Fossil Creek, 2 miles west of Sheringham Point, Jordan River, Vancouver Island.

**MYTILUS WATERSI Etherington, 1931**

Plate 25, figure 11

*Mytilus watersi* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 73, pl. 4, figs. 1, 8, 1931.

*Original description.* Shell fairly large, elongated, strongly inflated; beaks thin and usually broken off. Base gently concave; posterior end uniformly rounded. Shell covered by heavy dermal layer characterized by prominent growth lines; highest point of convexity anterior to middle of the shell. Interior of shell obscure. Dimensions.—(Type U.C. no. 31938) Length 110 mm.; maximum altitude 50 mm.; thickness, single valve 34.4 mm. (Etherington)

*Observations.* The specimens of this species are characterized by their great thickness, rugose concentric lines of growth, and thick dermal layer. In some specimens the maximum thickness of a single valve amounts to approximately its height, although the average is about two-thirds.

*Holotype.* (U.C. 31938.) Figured in the present report, pl. 25, fig. 11.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Chehalis River Valley, Thurston County, Washington.

*Type locality.* (U.W. 433.) *Mytilus* zone occurring in trail up the hillside, above small creek flowing into a small lake at foot of bluff about one-half mile east of Independence Station, Thurston County, Section 11, T. 15 N., R. 4 W.

**MYTILUS STILLWATERENSIS** Weaver and Palmer, 1922

Plate 25, figure 13; plate 26, figure 2

*Mytilus stillwaterensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, p. 15, pl. 9, fig. 13, 1922.

*Original description.* Shell medium in size; outline subquadrate, convex; dorsal margin slightly rounded; anterior margin nearly straight; posterior end rounded, inflated at the ventral side; ornamentation consisting of coarse, radiating ribs with narrow interspaces; on the umbonal slope and along the dorsal margin many of the ribs bifurcate. Dimensions.—Length 22 mm.; width 16 mm.; thickness 10 mm. (Weaver and Palmer)

*Observations.* The holotype of this species is broken. The shell is relatively short and high with a broadly rounded posterior end. It is characterized by heavy flat-topped to rounded radial ribs with narrower interspaces. The ribs bifurcate about midway between anterior and posterior ends.

*Holotype.* (U.W. 163) (C.A.S. 7420). Figured in the present report, pl. 25, fig. 13; pl. 26, fig. 2.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 319.) At McClarity Ranch in south bank of Stillwater Creek one mile west of Vader, Lewis County, Washington, Section 30, T. 11 N., R. 2 W.

**MYTILUS DICHOTOMUS** Cooper, 1894

Plate 23, figure 14; plate 26, figure 10

*Mytilus dichotomus* Cooper, Calif. State Mining Bureau, Bull. no. 4, p. 49, pl. 5, fig. 64, 1894.

Not *Septifer dichotomus* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 186, 234, pl. 30, fig. 261, 1864.

*Mytilus dichotomus* Cooper, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 45, pl. 5, fig. 6, 1938.

*Original description.* Very similar to "*Septifer dichotomus*" Gabb, but without any trace of a septum inside the beaks. Outside also sculptured, as in *Modiola ornata* Gabb, and in several Tertiary or living species of this family. (Unfortunately the umbonal end of the specimen figured was broken off after it was arranged for drawing.) I illustrate this shell to show that such a *Mytilus* existed in the latest stage of the California Coal epoch, with a strong suspicion that it has already one or two names. Gabb's *Septifer* was described from one young specimen found at Tejon, very nearly in the same strata, and it is not unlikely that he was mistaken in the generic character, but if proved correct, the specific name suits this species as well. There is also Conrad's *Mytilus inezensis*, assigned to the Miocene Tertiary, which *prima facie* seems most probable, though there is room for doubt. This has not lately been confirmed among large numbers of Miocene fossils handled by me, and if found in the Miocene will probably be found to be the living *M. bifurcatus*, which also has its *Septifer bifurcatus* coexisting. In doubt as to the true value of the slight distinction between the two genera, I leave their correct names to be decided by future discoveries. (Cooper)

*Observations.* This species is small, moderately inflated with a nearly straight ventral margin. The dorsal margin is strongly convex with a tendency to angulation about two-fifths the length of the shell from the

anterior end. The posterior end is narrow, nearly straight, and forms rough angular junctions with both dorsal and ventral margins. The greatest thickness of the valves is attained about one-third the length of the shell from the anterior end. The radial sculpture is well marked and exhibits dichotomous branching on the posterior part of the shell.

*Hypotype.* (U.C. 33224.) Figured in the present report, pl. 23, fig. 14; pl. 26, fig. 10. Locality (U.C. A-829).

*Geologic range.* Cowlitz formation and upper Umpqua formation.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* (U.C. A829.) "California Coal Mine, Huron, Fresno County, California." Occurs also one mile below mouth of Sandy River, on south bank of Middle Fork of Coquille River. (Turner)

#### Genus VOLSELLA Scopoli, 1777

*Volsella* Scopoli, Introd. Hist. Nat., p. 397, 1777.

*Genotype.* *Mytilus modiolus* Linnaeus.

#### VOLSELLA DIRECTA (Dall), 1909

Plate 23, figure 6; plate 25, figure 2

*Modiolus directus* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 113, 114, pl. 12, figs. 11, 12, 1909.

*Modiolus directus* Dall, Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 8, pl. 42, fig. 4, 1915.

*Modiolus directus* Dall, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 73, pl. 4, fig. 4, 1931.

*Volsella recta* (Conrad), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 250, 1931.

*Original description.* Shell thin, elongate, covered with a brown periostracum of which the remaining portions show alternating zones of darker and lighter color; umbones low, inconspicuous, not very close to the posterior end of the valves, as figured; dorsal margin straight anteriorly, arcuate posteriorly, obliquely descending to the hinder end of the shell, which is bluntly rounded; umbonal ridge broad, prominent, extending from the beaks to the lower posterior end of the shell, the part of the disk immediately in front of it slightly excavated; basal margin slightly concave, arching anteriorly toward the subangulate anterior extremity, surface smooth or distally slightly concentrically wrinkled. Longitude, 105 mm.; altitude, 40 mm.; diameter, 26 mm. (Dall)

*Observations.* Specimens of this species from Astoria formation characterized by very prominent and sharply arched umbonal ridge which separates upper third of surface of valves from lower two-thirds. Umbones fairly prominent and situated about 5 per cent the length of shell from anterior end.

*Holotype.* (U.S.N.M. 153947.) Figured in the present report, pl. 25, fig. 2.

*Hypotype.* (U.C. 31939.) Figured in the present report, pl. 23, fig. 6.

*Geologic range.* Middle and upper Miocene.

*Geographic distribution.* Western Oregon and southwestern Washington.

*Type locality.* Coos Bay, Oregon (Camman Collection). (Dall) Occurs also in Washington at locality (U.W. 473). In road cut along Wynoochee River 150 yards south of railroad up Black Creek, Grays Harbor County. Section 26, T. 18 N., R. 8 W. (Astoria formation.)

**VOLSELLA PUGETENSIS (Dall), 1898**

## Plate 23, figure 13

*Modiolus pugetensis* Dall, Trans. Wagner Free Inst. Sci., vol. 3, p. 792, pl. 35, fig. 17, 1898.

*Original description.* Shell small, short in front, arched and produced behind; concavely impressed front, with a rounded ridge extending from the beaks to the lower posterior margin; surface 5 mm. A larger specimen measures 25 mm. from end to end, but is imperfect. (Dall)

*Observations.* The holotype of this species was collected by J. S. Diller and described by Dall. The strata exposed in the Renton mine are a part of the fresh and brackish water Puget Group, but a small exposure of marine Oligocene shales occurs about one mile toward the east. This species has not been recognized outside of the Renton area. It differs from the other Northwest species in its rounded margins and broad dorsal arching.

*Holotype.* (U.S.N.M. 153890.) Figured in the present report, pl. 23, fig. 13.

*Geologic range.* Upper part Puget Group = Cowlitz formation, upper Eocene.

*Geographic distribution.* King County, Washington.

*Type locality.* Renton coal mine, 8 miles south of Seattle, King County, Washington.

**VOLSELLA RESTORATIONENSIS (Van Winkle), 1918**

## Plate 24, figures 10, 11

*Modiolus restorationensis* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, pp. 82, 83, pl. 6, fig. 5, 1918.

*Modiolus restorationensis* Van Winkle, Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 85, pl. 9, fig. 2, 1925.

*Modiolus restorationensis* Van Winkle, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 111, 112, pl. 6, figs. 1, 13, 1933.

*Original description.* Shell of moderate size and somewhat elongate; hinge line nearly straight and about two-thirds the length of the shell. The posterior dorsal margin which is nearly straight, extends to the posterior end of the shell, where it merges abruptly into a very wide and broadly arcuate posterior margin. The maximum height of the shell is at the posterior end. The ventral margin is very slightly concave; anterior margin is narrow and slightly arcuate; beaks low, anteriorly pointed, and very near the anterior end. A well-defined umbonal ridge extends from the beaks to the junction of the posterior and basal margin, but becoming less conspicuous at the posterior end. Surface of shell ornamented with well developed concentric lines of growth as well as very fine radiating ribs. Dimensions.—Altitude 44 mm.; longitude 67 mm.; thickness 20 mm. (Van Winkle)

*Observations.* Specimens of this species are relatively thin, umbonal ridge broad and not prominent; posterior margin bluntly rounded, broad and flaring.

*Holotype.* (U.W. 128.) Figured in the present report, pl. 24, fig. 11.

*Topotype.* (U.C. 32111.) Tegland specimen. Figured in the present report, pl. 24, fig. 10.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Puget Sound Basin and southwestern Washington.

*Type locality.* (U.W. 13.) On the north side of Restoration Point at entrance to Port Blakeley, Puget Sound, Washington.

**VOLSELLA TRINOMINATA (Hanna), 1924**

Plate 24, figure 9; plate 25, figure 9

*Modiolus inflatus* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 114, pl. 12, figs. 8, 9, 1909.

*Modiolus inflatus* Dall, Weaver, Wash. Geol. Surv., Bull. no. 15, p. 18, 1912.

*Modiolus trinominata* G. Dallas Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 13, p. 171, 1924. New name for *Modiolus inflatus* Dall; not *Modiolus inflatus* (Toumey and Holmes), Pliocene Fossils of South Carolina, p. 33, pl. 14, fig. 3, 1855, as *Mytilus*.

*Volsella trinominata* (Hanna), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 251, 1931.

*Original description.* Shell short, stout, inflated, thin, externally smooth and polished, with traces of concentric zones of darker and lighter brownish coloration; umbones low, blunt, near the anterior end of the shell as figured; umbonal ridge inflated, distinct only on the anterior half of the shell; hinge line straight, about half as long as the shell, anterior dorsal margin arching into the wider, posterior, rounded end; base very slightly concave, anterior end narrower, rounded; sculpture only of more or less distinct incremental lines; interior brilliantly iridescent. Longitude, 48 mm.; altitude, 27 mm.; diameter, about 22 mm. (Dall)

*Observations.* The holotype of this species is listed from Coos Bay, Oregon. It may have come from the Tunnel Point sandstone of Oligocene age. The species occurs in the upper Oligocene at Restoration Point in Washington. It may be distinguished from *V. restorationensis* by its shorter dorsal margin, proportionately greater altitude in middle part of shell, and its more acutely arcuate posterior margin without the broad flare as in *V. restorationensis*.

*Holotype.* (U.S.N.M. 153946.) Figured in the present report, pl. 24, fig. 9.

*Topotype.* (U.W. 258.) Figured in the present report, pl. 25, fig. 9.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Coos Bay, Oregon, and Kitsap County, Washington.

*Type locality.* Coos Bay, Oregon (Camman Collection). Occurs also at Restoration Point, Kitsap County, Washington.

**VOLSELLA SOOKENSIS (Clark and Arnold), 1923**

Plate 24, figures 3, 5, 6, 7

*Modiolus sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 143, 144, pl. 26, figs. 1, 2, 4; pl. 40, fig. 3, 1923.

*Original description.* Shell fairly large, heavy, strongly convex; base straight to slightly concave; beaks only slightly offset from the anterior end. Angle between posterior dorsal edge and posterior end obscure and below the middle. Umbonal ridge prominent, with slope of surface anterior to it abrupt; surface posterior to this ridge also fairly steep. Surface smooth except for fairly heavy, somewhat irregular lines of growth. Dimensions: Greatest anteroposterior length about 95 mm.; width, measured from base to posterior angulation, about 43 mm. (Clark and Arnold)

*Observations.* Specimens of this species are large, beaks almost terminal, anterior end narrow and nearly straight, umbonal ridge prominent but less so than in *Volsella eugenensis* and dividing surface of shell into

nearly equal areas. Anterior dorsal margin about 50 per cent of length of shell in contrast to 65 per cent in *V. eugenensis*.

*Holotype.* (U.C. 30256.) Figured in the present report, pl. 24, figs. 5, 6.

*Paratype.* (U.C. 30038.) Figured in the present report, pl. 24, fig. 3.

*Paratype.* (C.A.S. 590.) Figured in the present report, pl. 24, fig. 7.

*Geologic range.* Upper Oligocene. Sooke formation.

*Geographic distribution.* Southeastern side of Vancouver Island at Sooke Bay.

*Type locality.* About one-half mile up Kirby Creek from its mouth, on the east side of the creek, Sooke Bay, Vancouver Island. (Clark and Arnold)

#### VOLSELLA PORTERENSIS (Clark), 1925

##### Plate 24, figure 2

*Modiolus porterensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 85, pl. 9, fig. 11, 1925.

*Original description.* Shell medium in size; base straight, or nearly so; posterior end somewhat acutely rounded; anterior end rather broad, not strongly produced; angulation on posterior margin fairly well-marked, situated about three-fourths the distance from anterior to posterior end; umbonal ridge distinct from beak for about half the distance to posterior end. Surface rather strongly arched. Posterior slope somewhat steeper and narrower than anterior slope. Dimensions: greatest length 29 mm.; width measured at posterior angulation 14 mm. (Clark)

*Observations.* This species from the lower middle Oligocene somewhat resembles *V. restorationensis* from the upper Oligocene but may be distinguished from it by a proportionately lesser height on the posterior third of the shell, by the more anterior position of the umbones, and by the more acutely rounded posterior margin with the broad flare of the latter species.

*Holotype.* (S.U. 26.) Figured in the present report, pl. 24, fig. 2.

*Geologic range.* Lower middle Oligocene.

*Geographic distribution.* Chehalis River Valley, Washington.

*Type locality.* (U.W. 364.) At the old log dam on Porter Creek about two and one-half miles above its junction with Chehalis River in Section 14, T. 17 N., R. 5 W., Grays Harbor County, Washington.

#### VOLSELLA EUGENENSIS (Clark), 1925

##### Plate 24, figure 8

*Modiolus eugenensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 86, pl. 9, fig. 4, 1925.

*Original description.* Shell fairly large; base usually slightly concave; anterior end moderately produced; posterior margin angulated well back of middle of valve; posterior to angulation, the edge turns in rather abruptly to posterior end, which is broadly rounded; umbones only moderately prominent; umbonal ridge very prominent; distinct to the posterior end. Surface of shell strongly

arched; posterior and anterior slopes about equal in width, both fairly steep. Surface, except for a smooth elongated triangular space between base and umbonal ridge, sculptured by fairly coarse, radial ribbing, which apparently does not extend on to depressed anterior dorsal margin. Dimensions: Greatest length, about 67 mm.; greatest width, 33 mm. (Clark)

*Observations.* This species somewhat resembles *V. sookensis* (Clark and Arnold), but differs in less prominent umbonal ridge and in having faintly developed radial striations on surface of valve above umbonal ridge.

*Holotype.* (U.C. 30319.) Figured in the present report, pl. 24, fig. 8.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Willamette Valley, Oregon.

*Type locality.* (U.C. 4182.) At the new city reservoir, Eugene, Oregon.

#### VOLSELLA KELSOENSIS (Weaver and Palmer), 1922

Plate 24, figure 1

*Modiolus kelsoensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 17, pl. 10, fig. 13, 1922.

*Original description.* Shell large, narrow, and elongate in outline; anterior end straight and vertical; ventral margin straight, rounding abruptly into the posterior end which is broadly pointed; the posterior dorsal margin is rounded obliquely to the dorsal line; beaks medium in size; umbonal ridge pronounced, narrow near the beaks, broadening posteriorly and occupying the whole width of the last third of the shell; the widening of the ridge gives the appearance of the fold being overturned. The shell is concave directly beneath the ridge in the middle portion of the shell and above, along the dorsal margin. The sculpture consists of prominent, radiating ribs over the umbonal and dorsal regions but which become obsolete on the middle area of the shell, producing a smooth unstriated area as in *Modiolaria*; character of the ribs anteriorly unknown. Dimensions.—Length 50 mm.; greatest height 15 mm.; thickness 16 mm. (Weaver and Palmer)

*Observations.* The holotype of this species is somewhat deformed but the shell is characterized by its straight to slightly curved and nearly parallel dorsal and ventral margins, the anterior position of the umbones, and the sharply folded umbonal ridge.

*Holotype.* (U.W. 166.) Figured in the present report, pl. 24, fig. 1.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 347.) Back of the Leybo place about one-half mile below the old Inman-Poulsen camp on Coal Creek, Cowlitz County, Washington, in Section 27, T. 9 N., R. 3 W.

#### VOLSELLA COLUMBIANA (Weaver and Palmer), 1922

Plate 25, figure 15

*Modiolus columbianus* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, pp. 17, 18, pl. 8, fig. 7, 1922.

*Original description.* Shell large, oval-elongate in outline; inequilateral, beaks situated close to anterior end; posterior margin straight; dorsal margin sloping obliquely upward from the beaks; posterior margin sloping at an angle of 45°

from the dorsal line, rounding shortly into the ventral margin; umbonal ridge high, extending broadly to the posterior ventral line; surface ornamented with medium, coarse, radiating ribs which become obsolete on the middle region of the shell below the umbonal ridge. In this respect the sculpture is like that of *M. kelsensis* n. sp. Dimensions.—Length 35 mm.; height 20 mm.; width 20 mm. (Weaver and Palmer)

*Observations.* The shell material of the holotype of this species is now destroyed for the most part, but at the time when it was originally collected by the writer there existed closely set fairly heavy radial ribs. The shell is characterized by the moderately short and slightly concave dorsal margin and rather sinuous ventral margin. The posterior margin terminates rather bluntly and turns downward obliquely.

*Holotype.* (U.W. 167) (C.A.S. 7408). Figured in the present report, pl. 25, fig. 15.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz River Valley, southwestern Washington.

*Type locality.* (U.W. 329.) On the north bank in bend of Cowlitz River one and one-half miles east of Vader, Lewis County, Section 28, T. 11 N., R. 2 W.

#### Subgenus *Brachidontes* Swainson, 1840

*Brachidontes* Swainson, Treat. Malac., p. 384, 1840.

*Subgenotype.* *Modiolus sulcata* Lamarck.

#### VOLSELLA (BRACHIDONTES) COWLITZENSIS (Weaver and Palmer), 1922

Plate 26, figure 4

*Modiolus (Brachydontes) cowlitzensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 16, 17, pl. 9, fig. 19, 1922.

*Brachydontes cowlitzensis?* (Weaver and Palmer), Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 100, pl. 8, fig. 12, 1930.

*Brachidontes cowlitzensis* (Weaver and Palmer), Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 45, 46, pl. 6, figs. 7, 8, 1938.

*Original description.* Shell medium in size; subovate in outline; dorsal line straight, curving regularly into the posterior end which extends almost vertically downward; posterior end broad and inflated; anterior end short; beaks low; umbonal slope prominent and arching downward, convex above with a prominent concavity beneath; surface ornamented with radiating ribs which over the posterior and umbonal regions are large and flat with narrow interspaces; on the middle portion of the shell the ribs are very fine and delicate; on the anterior end of the shell, there are five or six radiating ribs which are enlarged with wide spaces between, the interspaces equal to the width of the ribs; cardinal margin denticulate, the series of teeth are larger on the anterior margin, diminishing in size beneath the beaks and becoming obscure on the posterior end; shell very thin and fragile. Dimensions.—Length 15 mm.; thickness 7 mm. (Weaver and Palmer)

*Observations.* This species may be distinguished by its sharp umbonal ridge which is sharply deflected downward with less than one-fifth of the area of the surface of the shell beneath the ridge and the area above

only very slightly swelled. The radial ribs are more marked above the umbonal ridge than below it.

*Holotype.* (U.W. 165) (C.A.S. 7406). Figured in the present report, pl. 26, fig. 4.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz River Valley, southwestern Washington.

*Type locality.* (U.W. 329.) On north bank of Cowlitz River at bend one and one-half miles east of Vader, Lewis County, Section 28, T. 11 N., R. 2 W.

#### VOLSELLA (BRACHIDONTES) OLEQUAHENSIS (Weaver and Palmer), 1922

Plate 25, figure 16

*Modiolus (Brachydontes) olequahensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 15, 16, pl. 9, figs. 3, 17, 1922.

*Original description.* Shell median, elongate; posterior end obliquely produced; hinge line straight and long; ventral margin sloping broadly and obliquely to the posterior end; umbones strongly curved forming a sharp ridge on the dorsal margin; umbonal slope extending from the beaks to the posterior end; in younger specimens the dorsal margin of this ridge is more rounded; sculpture delicate, consisting of flat, radiating ribs which are larger over the dorsal and posterior regions continuing to the lower surface of the umbonal slope; the ribs on the middle portion of the shell are very much finer and more delicate, increasing in size on the short anterior end; hinge margin crenulated, distinct on the anterior portion, very fine beneath the beaks and becoming obscure on the posterior region; shell with a beautiful nacreous luster. Dimensions.—Length 21 mm.; length of umbonal slope 20 mm.; thickness 7 mm. (Weaver and Palmer)

*Observations.* The description of *V. olequahensis* was based on two specimens each of which has suffered injury. The figure (U.W. 164) is mounted on wax and due to the thinness and brittleness of the shell material the dorsal margin is broken. The original figure in (301, pl. 9, fig. 17) should be used for reference.

*Holotype.* (U.W. 164) (C.A.S. 7407). Figured in the present report, pl. 25, fig. 16.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz River Valley, southwestern Washington.

*Type locality.* (U.W. 324.) In the west bank of Olequa Creek, about one-eighth mile north of Vader, Lewis County, Section 29, T. 11 N., R. 2 W.

#### Genus SEPTIFER Recluz, 1848

*Septifer* Recluz, Rev. Zool., p. 275, 1848.

*Genotype.* *Mytilus bilocularis* Linnaeus.

## SEPTIFER DICHOTOMUS Gabb, 1864

Plate 25, figure 6

*Septifer dichotomus* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 186, 234, pl. 30, fig. 261, 1864.

*Original description.* Shell small, oblique, subquadrate; cardinal margin straight, anterior and posterior margins subparallel, basal irregularly convex; anterior side abruptly truncated at an acute angle to the rest of the surface. Surface marked, posterior to this angle, by a few large, irregular, radiating ribs, dichotomous, or with smaller ones interpolated. (Gabb)

*Observations.* The specimen from the Cowlitz formation differs from the type of Gabb from the Tejon formation in its relatively greater length as compared to height. The radiating ribs which are dichotomous are well developed over the entire surface of the valve and may have existed on the badly worn type specimen of Gabb. The ventral surface of the valve below the prominent umbonal ridge is nearly at right angles to the surface above and is ornamented with closely spaced radiating ribs. Approximately 80 per cent of surface of valve lies above the umbonal ridge.

*Hypotype.* (U.C. 32728.) Figured in the present report, pl. 25, fig. 6.

*Geologic range in Washington.* Cowlitz formation, upper Eocene.

*Geographic distribution in Washington.* Chehalis River Valley, Grays Harbor County, Washington.

*Locality in Washington.* (U.W. 703.) One mile northwest of Balch Station in the center of the north line of Section 1, T. 15 N., R. 5 W., Grays Harbor County, Washington.

## Genus CRENELLA Brown, 1827

*Crenella* T. Brown, Ill. Conch. Gt. Britain, vol. 1, pl. 31, figs. 12, 14, 1827; 2nd Ed., p. 75, pl. 23, figs. 12, 13, 14, 1844.

*Genotype.* *Mytilus decussatus* Montagu, 1808.

## CRENELLA PORTERENSIS Weaver, 1912

Plate 25, figures 3, 14

*Crenella porterensis* Weaver, Wash. Geol. Surv., Bull. 15, pl. 14, fig. 116, 1912.

*Crenella porterensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 36, 37, pl. 3, figs. 41, 42, 1916.

*Crenella porterensis* Weaver, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 112, pl. 6, fig. 2, 1933.

*Original description.* Shell of medium size, thin, moderately inflated, elongate ovate with distinct radial striations which diverge from a median line extending from beak to basal margin. These striations consist of flat topped ribs with flat bottomed interspaces of equal width. Beaks are small and terminal. Valves are almost equilateral showing faint crenulations near the beaks but none on margins of shell. Beaks are strongly recurved. Dimensions.—Altitude 13 mm.; longitude 18 mm.; thickness 9 mm. (Weaver)

*Observations.* This species differs from *C. washingtonensis* in larger size of adult individuals and in its subrectangular-ovate outline rather

than distinctly ovate form. The radial ribs are well developed, numerous, fine, and dichotomous.

*Holotype.* (U.W. 89) (C.A.S. 454A). Figured in the present report, pl. 25, fig. 3.

*Topotype.* (U.C. 32410.) Locality (U.W. 440). Figured in the present report, pl. 25, fig. 14.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Chehalis River Valley, Thurston and Lewis counties, Washington.

*Type locality.* (U.W. 256.) In railroad cut on Union Pacific Railway 1 mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

**CRENELLA WASHINGTONENSIS** Weaver, 1916

Plate 25, figure 4

*Crenella washingtonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 37, pl. 3, fig. 40, 1916.

*Original description.* Shell minute, delicate, ovate in outline and tumid. The beaks are almost central and curved anteriorly; margins of shell finely crenulated. These crenulations extend up to and beneath the beak. They are so prominent along the anterior and posterior margins just away from the beaks that they appear as broad V-shaped teeth. Immediately beneath the beaks there are four vertical ridges and intervening grooves which appear to be extensions of the crenulations. Surface of shell sculptured by 60 minute rounded ribs with narrow grooved interspaces about one-third as wide as the ribs. These are crossed by concentric lines of growth. Shell material is thin and has pearly luster on inner surface. Dimensions.—Altitude 3 mm.; longitude 2 mm.; thickness 2 mm. (Weaver)

*Observations.* This species is characterized by its microscopic size, ovate outline, and faintly developed sculpture.

*Holotype.* (U.W. 90) (C.A.S. 455). Figured in the present report, pl. 25, fig. 4.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Chehalis River Valley, Thurston and Lewis counties, Washington.

*Type locality.* (U.W. 256.) In railroad cut of Union Pacific Railway one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

## Order ANOMALODESMACEA

## Family PERIPLOMATIDAE

Genus COCHLODESMA Couthouy, 1839

*Cochlodesma* Couthouy, Boston Jour. Nat. Hist., vol. 2, p. 170, 1839.*Genotype.* "Anatina leana" Conrad.

## COCHLODESMA BAINBRIDGENSIS Clark, 1925

Plate 25, figure 1; plate 29, figure 2

*Cochlodesma bainbridgensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 86, pl. 13, figs. 3, 4, 1925.*Cochlodesma bainbridgensis* Clark, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 112, pl. 6, figs. 3, 4, 1933.

*Original description.* Shell thin, pearly, subovate in outline, equivalved; beaks nearly central, fairly prominent, inturned and slightly opisthogyrous; dorsal margins straight or nearly so; the posterior end acutely rounded; anterior end broadly and regularly rounded; valves only moderately inflated; toward posterior end, surface noticeably depressed. On right valve a fairly distinct ridge extends from beak to posterior end parallel to posterior dorsal edge; on left valve a corresponding ridge is either obsolete or absent. Surface of valves covered by fairly prominent somewhat irregular undulations on and between which are the finer lines of growth. Chondrophore fairly long, attached to the posterior dorsal edge along its entire length. Dimensions: Length of type 38 mm.; height 30 mm. (Clark)

*Observations.* This is the only species of the genus known to occur in Oregon and Washington. Because of the presence of concentric undulations, Grant and Gale (149A, p. 255) have suggested that the species may belong to the genus *Cyathodonta*. On the holotype these are not very pronounced.

*Holotype.* (S.U. 27.) Figured in the present report, pl. 29, fig. 2.*Paratype.* (S.U. 28.) Figured in the present report, pl. 25, fig. 1.*Geologic range.* Blakeley formation, upper Oligocene.*Geographic distribution.* Puget Sound Basin, Washington.

*Type locality.* (U.W. 13.) In sandstone cliff in north side of Restoration Point, opposite Seattle, Kitsap County, Washington. Section 12, T. 24 N., R. 2 E.

## Family THRACIIDAE

Genus THRACIA Blainville, 1824

*Thracia* (Leach) Blainville, Dict. Sci. Nat., vol. 32, p. 347, 1824.*Genotype.* *Thracia corbuloidea* Blainville.

## THRACIA TRAPEZOIDES Conrad, 1849

Plate 25, figure 7; plate 29, figure 5; plate 104, figure 11

*Thracia trapezoidea* Conrad, U.S. Explor. Exped. Geol., vol. 10, p. 723, pl. 17, fig. 6a, 1849.*Thracia trapezoidea* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 135, pl. 2, fig. 14; pl. 13, fig. 7, 1909.

*Thracia trapezoidea* Conrad, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 74, pl. 5, fig. 8, 1931.

*Thracia (Thracia) trapezoidea* Conrad, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 257, 258, pl. 13, fig. 8, 1931.

*Original description.* Trapezoidal, ventricose; flank flattened carinate, side anteriorly compressed. Surface faintly concentric undulate, and neatly but unequally marked with concentric striae. Beaks prominent, medial. Posterior margin truncated, basal margin tumid at middle. (Conrad)

*Supplementary description.* Shell thin, smooth, except for incremental lines which become sublamellose on the posterior dorsal area; valves slightly unequal, nearly equilateral, moderately convex, with an umbonal ridge bounding the lower side of the posterior dorsal area, in front of which the valves are slightly concave; dorsal slopes subequal, anterior end rounded, posterior squarely truncate; base arcuate, a little prominent in the middle; interior inaccessible. Longitude, 53 mm.; altitude, 40 mm.; diameter, 19 mm. (Dall, 101, p. 135)

*Holotype.* (U.S.N.M. 3604.) Conrad type (68, pl. 17, fig. 6a). Figured in the present report, pl. 104, fig. 11.

*Hypotype.* (U.C. 31942.) Locality (U.W. 427). Figured in the present report, pl. 25, fig. 7.

*Hypotype.* (U.W. 560.) Locality (U.W. 490). Figured in the present report, pl. 29, fig. 5.

*Geologic range.* Oligocene to Recent.

*Geographic distribution.* Western California, Oregon, and Washington.

*Type locality.* City of Astoria, Oregon, in Astoria formation, middle Miocene. Occurs also at locality (U.W. 427) in Astoria formation in Clemons logging road one-fourth mile south of the eight-mile post, Grays Harbor County, Section 26, T. 17 N., R. 7 W. It is present also at locality (U.W. 490) in the Astoria formation in sea cliff 11,000 feet southeast of Slip Point and 13,000 feet due east of Clallam Bay in the northeast quarter of the southeast quarter of Section 22, T. 32 N., R. 12 W., Clallam County, Washington.

#### THRACIA SCHENCKI Tegland, 1933

Plate 25, figures 5, 22

*Thracia schencki* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 112, 113, pl. 6, figs. 6, 7, 8, 9, 10, 11, 1933 (contains synonymy).

*Original description.* Typical thraciform; shell nacre-lined, inequivalve; right valve slightly higher, posterior end compressed and truncated, prominent ridge from umbo to postero-ventral margin. Left valve with shallow depression between ridge and mid-line; region of greatest convexity on anterior half of shell; no anterior depression. Dimensions of holotype: height, 27.8 mm.; length (slightly truncated), 35 mm. (Tegland)

*Observations.* This species may be distinguished from *T. trapezoidea* Conrad of the middle Miocene in its more acute umbonal angle and in the absence of the shallow anterior sinus. It is relatively higher and is more swollen along the middle vertical area.

*Holotype.* (U.C. 32113.) Figured in the present report, pl. 25, fig. 22.

*Paratype.* (S.U. 790.) Figured in the present report, pl. 25, fig. 5.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Western Washington.

*Type locality.* (U.W. 13.) In sandstone cliff on north side of Restoration Point, opposite Seattle, Section 12, T. 24 N., R. 2 E., Kitsap County, Washington.

**THRACIA CONDONI** Dall, 1909

Plate 25, figure 10; plate 29, figure 15

*Thracia condoni* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 135, 136, pl. 19, fig. 5, 1909.

*Original description.* Shell large, moderately convex, nearly equilateral, rounded in front, abruptly truncate behind, the base gently arcuate, the posterior dorsal slope slightly excavated, the anterior gently rounded; an obscure ridge extends from the beak toward the basal portion of the truncation, which is somewhat rounded; the beak in the right valve little elevated above the general hinge line; outer surface nearly smooth, more or less minutely granulose with variably prominent incremental lines; muscular impressions faint; pallial sinus wide, subquadrate, blunt in front, not reaching the vertical from the beak. Length, 60 mm.; height, 44 mm.; semidiameter, 8 mm. (Dall)

*Observations.* This species is relatively shorter than *T. schencki* Tegland and its middle area is less tumid.

*Holotype.* (U.S.N.M. 110460.) Figured in the present report, pl. 29, fig. 15.

*Hypotype.* (U.C. 12492.) Figured in the present report, pl. 25, fig. 10.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Willamette Valley, Oregon.

*Type locality.* Smith's quarry, Eugene, Oregon.

**THRACIA DILLERI** Dall, 1898

Plate 29, figure 3

*Thracia dilleri* Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, pp. 929, 1524, pl. 34, fig. 19, 1898.

*Description.* Shell of moderate size, thin, elongated, inequilateral, nearly equi-valve, moderately convex; anterior side shorter, surface concentrically feebly undulated, slightly granulose as usual in the genus; basal margin somewhat flexuous, an obscure ridge running to the middle of the base and another to the basal posterior angle in the left valve, a marked carina extending from the beaks near and almost parallel to the dorsal margin, the space between the margin and the carina wider in the right valve; posterior end subtruncate, produced, beaks adjacent, inconspicuous. Altitude, 30 mm.; longitude, 48 mm.; diameter, 16 mm. (Dall)

*Holotype.* (U.S.N.M. 107399.) Figured in the present report, pl. 29, fig. 3.

*Geologic range.* Coaledo formation, upper Eocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Cape Arago, Coos Bay area, Oregon.

**THRACIA cf. KARQUINEZENSIS** Weaver, 1905

Plate 25, figure 19; plate 26, figure 5

*Thracia cf. karquinezensis* Weaver, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 4, p. 117, pl. 12, fig. 5, 1905; Turner, Geol. Soc. Am., Spec. Pap. no. 10, pl. 8, fig. 20, 1938.

*Original description.* The shell is thin, moderately convex and marked with concentric striae. The beaks are prominent and located about one-third the distance

from the anterior end. The base is nearly straight. The upper margin of the wing is nearly parallel to the base. The anterior end is rounded and the posterior somewhat produced, the body of it where it joins on to the wing sloping downward toward the base and making an angle of about 45°. Dimensions: The maximum length of this specimen is 29 mm., and the distance from beak to base, 15 mm. Only one specimen has been found. (Weaver)

*Observations.* The Oregon specimen from the upper Coaledo formation bears a close resemblance to *Thracia karquinezensis* from the lower Eocene of California. The concentric ribbing on the Oregon form is rather pronounced. The dorsal margin of the left valve is slightly higher than that of the right. The broad shallow umbonal groove is only faintly developed and the umbonal angulated area behind it is broadly rounded.

*Hypotype.* (U.C. 33659.) Figured in the present report, pl. 25, fig. 19; pl. 26, fig. 5.

*Geologic range.* Martinez formation, California; lower Coaledo formation, Oregon.

*Geographic distribution.* Coast Ranges of California and southwestern Oregon.

*Type locality.* North and south sides of Carquinez Strait, California. Occurs at locality (U.C. A-712) in "Upper part of heavy sandstone bed which forms cliff on mainland facing Squaw Island," Oregon.

## Family PANDORIDAE

### Genus PANDORA Hwass, 1795

*Pandora* Hwass, Chemnitz, Neues Syst. Conchyl. Cab., vol. 11, p. 211, 1795.

*Genotype.* *Tellina inaequivalvis* Linnaeus.

### PANDORA WASHINGTONENSIS Weaver, 1916

#### Plate 25, figure 21

*Pandora washingtonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 37, 38, pl. 2, figs. 19, 20, 1916.

*Original description.* Shell small; right valve moderately convex and left valve slightly concave. On left valve anterior dorsal margin deeply concave; anterior end sharply rounded and somewhat flexuous as it passes into the ventral margin which is broadly arcuate; posterior dorsal margin very slightly concave just behind beaks but from that point to posterior end it is straight; posterior end sub-truncate and produced. From the beak a ridge extends to the junction of the posterior and ventral margins. Just above the ridge there is a flat to slightly concave surface. Both right and left valves possess concentric sculpture; lunule and escutcheon elongate and fairly distinct. Radial ribs are absent. (Weaver)

*Observations.* This species is relatively smaller than *P. vanwinkleae* Tegland; its posterior end is less rounded and more extended and it lacks radial sculpture on both valves in the type specimens.

*Holotype.* (U.W. 91) (C.A.S. 562). Figured in the present report, pl. 25, fig. 21.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Chehalis River Valley, Washington.

*Type locality.* (U.W. 256.) In railroad cut along Union Pacific Railway one-fourth mile north of Galvin Station, Lewis County, Washington, Section 27, T. 15 N., R. 3 W.

**PANDORA VANWINKLEAE** Tegland, 1933

Plate 25, figure 18

*Pandora vanwinkleae* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 113, pl. 7, figs. 1, 2, 1933.

*Original description.* Shell of medium size, thin, with nacreous inner layer; left valve concave, right valve convex; posterior dorsal margin straight; anterior dorsal margin slightly concave; anterior wing of left valve makes angle of 45° with margin and is marked off with incised line; posterior wing of same valve defined by faint ridge, with slight concavity either side of ridge. Region between wings of left valve is globose and ornamented with raised radiating lines. The corresponding portion of the right valve is similarly ornamented, but the wings are not so definitely marked. Both valves have concentric growth lines over the entire surface. Dimensions of holotype (with posterior broken away): length, 37 mm.; altitude, 27 mm. (Tegland)

*Observations.* This species is characterized by radial ribbing in both valves. It is relatively larger than *P. washingtonensis* and the posterior end is more rounded and extended.

*Holotype.* (U.C. 32114.) Figured in the present report, pl. 25, fig. 18.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Puget Sound Basin.

*Type locality.* (U.W. 13.) In sandstone cliff on north side of Restoration Point, opposite Seattle, Section 12, T. 24 N., R. 2 E., Kitsap County, Washington.

**Family POROMYACIDAE****Genus POROMYA** Forbes, 1844

*Poromya* Forbes, Rept. Brit. Assoc. Adv. Sci. for 1843, p. 143, 1844.

*Genotype.* *Poromya anatinoides* Forbes (= *Corbula granulata* Nyst and Westendorp).

**POROMYA TEGLANDAE** n. sp.

Plate 25, figure 23

*Poromya* n. sp., Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., p. 92, 1933.

*Description.* Shell of moderate size; umbones prosogyrate, sub-equalateral and extended posteriorly and slightly downward; anterior dorsal margin convexly rounded and sloping downward so as to merge imperceptibly with the broadly arcuate anterior margin which in turn curves into the evenly rounded ventral margin. The anterior dorsal and the anterior ventral margins form approximately two-thirds of a circle. Posterior dorsal margin straight and slopes down at an angle of 45° and passes into the subtruncate, slightly attenuate posterior margin. Posterior part of shell behind nearly vertical umboinal groove deflected toward the left producing a slight re-entrant in the outline of the posterior ventral margin; fairly strong concentric growth lines. Fragments of right

valve show a wide chondrophore immediately behind a strong cardinal tooth. Dimensions: length, 25 mm.; height, 22 mm.

*Holotype.* (U.C. 32134.) Figured in the present report, pl. 25, fig. 23.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Puget Sound Basin.

*Type locality.* (U.W. 13.) In sandstone cliffs on north side of Restoration Point, opposite Seattle, Section 12, T. 24 N., R. 2 E., Kitsap County, Washington.

#### Family CUSPIDARIIDAE

##### Genus CARDIOMYA A. Adams, 1864

*Cardiomya* A. Adams, Ann. Mag. Nat. Hist., ser. 3, vol. 13, p. 330, 1864.

*Genotype.* *Neaera gouldiana* Hinds.

##### CARDIOMYA COMSTOCKENSIS Turner, 1938

Plate 25, figure 20; plate 26, figure 16

*Cardiomya comstockensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 47, pl. 8, fig. 8, 1938.

*Original description.* Shell small, expanded portion almost equilateral, ornamented by twenty-five radial ribs which increase slightly in size posteriorly but do not alternate in strength; umbonal angle approximately sixty degrees; posterior extremity attenuated, length less than width of the expanded portion of the shell, ornamented by fine radiating riblets and crossed by fine growth lines. (Turner)

*Observations.* This is the only species of this genus yet recognized in Oregon and Washington. As already pointed out by Turner, it differs from *C. dolabraeformis* (Gabb) in possessing a larger number of finer ribs and in being less elongate.

*Holotype.* (U.C. 33225.) Figured in the present report, pl. 25, fig. 20; pl. 26, fig. 16.

*Geologic range.* Tyee formation, upper Eocene.

*Geographic distribution.* Western Oregon.

*Type locality.* (U.C. A-1134.) In road-cut at east end of highway overpass half a mile south of Comstock on the Pacific Highway.

## Order TELEODESMACEA

## Family CRASSATELLITIDAE

## Genus CRASSATELLITES Krueger, 1823

*Crassatellites* Krueger, Geschichte der Urwelt, vol. 2, p. 466, 1823.

*Genotype.* *Crassatellites sinuatus* Krueger (= *Crassatella gibbosula* Lamarck).

## CRASSATELLITES COWLITZENSIS Weaver, 1912

## Plate 104, figure 7

*Crassatellites cowlitzensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 31, pl. 4, fig. 40, 1912.

*Original description.* Shell small, comparatively thin, sub-triangular to subquadrate; beak situated about one-third the length of the shell from the anterior end; anterior margin slopes down steeply at first and then at an angle of 30° to the anterior end, which is sharply arcuate; base broadly rounded, with pronounced upward slope at the anterior end; posterior margin nearly straight and sloping down to the posterior end where it is abruptly truncated; an angular ridge extends from the beak to posterior end and is situated a little in front of the posterior margin. Surface sculptured by numerous well developed concentric lines of growth. Lunule long, narrow, and not very deeply impressed; escutcheon absent; hinge plate not very heavy; muscular scars well developed as well as pallial lines. Dimensions: altitude, 20 mm.; longitude, 26 mm.; thickness, 5 mm. (Weaver)

*Observations.* The holotype of this species has been lost but the topotype (U.W. 310) shows the external and internal characters of the right valve. It differs from the other Eocene species in the more anterior situation of the umbones, in the straight to slightly convex outline of the posterior dorsal margin, and the broad and rather bluntly truncated posterior margin.

*Hypotype.* Lost (U.W. 7). Reproduction in Weaver (286, pl. 4, fig. 40). Figured in the present report, pl. 104, fig. 7.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz River Valley, Washington.

*Type locality.* (U.W. 232.) In west bank of Cowlitz River 1000 feet below bend, Section 28, T. 11 N., R. 2 W., Lewis County, Washington.

## CRASSATELLITES MERRIAMI Weaver, 1916

## Plate 104, figures 4, 5

*Crassatellites merriami* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 38, 39, pl. 1, figs. 7, 8, 1916.

*Original description.* Shell small, moderately thick and sub-triangular; beaks low, wide, strongly incurved anteriorly and situated at a distance two-fifths the length of the shell from the anterior end; anterior end sharply arcuate; posterior dorsal margin nearly straight and sloping downwards at an angle of 20° to the posterior end; posterior end sharply arcuate. There is a ridge extending from the beak to the posterior angle and immediately anterior to this there is a slight depression also extending from the beak. Surface of shell ornamented with concentric lines of

growth and minor ribs which are not very strong but are evenly distributed over the surface of both valves. Dorsal inner margin of shell crenulate; muscle scars well developed; pallial line simple; posterior lateral tooth large and anterior cardinal well developed. Dimensions.—altitude 19 mm.; longitude 30 mm.; thickness 10 mm. (Weaver)

*Observations.* This species resembles *C. dalli* and *C. cowlitzensis* but differs in the less truncate posterior end and in the more strongly arcuate ventral margin. The umbones are more centrally situated in *C. dalli* and the height of that species is proportionately greater.

*Holotype.* (U.W. 93) (C.A.S. 456). Figured in the present report, pl. 104, figs. 4, 5.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz River Valley, Washington.

*Type locality.* (U.W. 241.) On Stillwater Creek one and one-half miles above junction with Olequa Creek in Section 30, T. 11 N., R. 2 W., Lewis County, Washington.

#### CRASSATELLITES DALLI Weaver, 1916

##### Plate 29, figures 1, 7

*Crassatellites dalli* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 39, pl. 2, figs. 15, 16, 17, 18, 1916.

*Crassatella dalli* (Weaver), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 47, pl. 10, fig. 18, 1938.

*Original description.* Shell large, thick, robust, roughly triangular, moderately convex and very noticeably attenuated at the posterior end; beaks prominent, high, broad, anteriorly incurved and situated a little less than one-third the distance of the length of the shell from the anterior end. Anterior dorsal margin slightly concave and sloping downward from the beaks at an angle of 40°; anterior margin evenly and sharply arcuate; basal margin broadly arcuate; posterior dorsal margin noticeably concave and sloping downwards from the beaks at an angle of about 55° for a short distance and then broadly curved to the posterior end where it is obliquely truncated. A noticeable ridge extends from the beaks to the posterior end and immediately anterior to this there is a broad but fairly well-defined groove. Surface of valves ornamented by well developed concentric lines of growth equally developed from beak to basal margin. Radiating ribs are absent. Inner margins of valves are finely but evenly crenulated. Lunule narrow, cordate and very deeply impressed and the concentric lines of growth on the valves continue across the surface of the lunule; escutcheon large, broad and deeply sunken especially near the beaks. Hinge plate very heavy and broad; posterior lateral teeth well developed; anterior right cardinal sharp and pointed; muscular scars deep and large; pallial line simple. (Weaver)

*Observations.* This species is generally well preserved and abundant in numbers of individuals in the upper Eocene of southwestern Washington and in southwestern Oregon. The adult shell attains considerable size and the umbones are subcentrally located. The considerable height of the shell compared with the length and the attenuation of the posterior

end aid in distinguishing the species from other associated species of the genus.

*Holotype.* (U.W. 94) (C.A.S. 457). Figured in the present report, pl. 29, fig. 7.

*Hypotype.* (U.W. 309.) Figured in the present report, pl. 29, fig. 1.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Washington and Coos Bay and Willamette Valley, Oregon.

*Type locality.* (U.W. 241.) On Stillwater Creek one and one-half miles above junction with Olequa Creek in Section 30, T. 11 N., R. 2 W., Lewis County, Washington.

**CRASSATELLITES UVASANA** (Conrad) subsp. **MATHEWSONII** (Gabb), 1864

Plate 26, figure 8; plate 29, figure 4; plate 61, figure 18

*Astarte matthewsonii* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 179, 233, pl. 30, fig. 258, 1864.

*Crassatella uvatasana* subsp. *matthewsonii* (Gabb), Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 143, pl. 8, figs. 9, 11; pl. 17, fig. 6, 1930.

*Crassatella uvatasana* (Conrad) *matthewsonii* (Gabb), Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 47, 48, pl. 10, figs. 19, 20, 21, 1938.

*Original description* ("*Astarte matthewsonii*"). Shell small, compressed, subquadrate, length and breadth about equal; beaks very prominent, strongly incurved, presented forwards, and overhanging the anterior end; cardinal margin straight and sloping downwards; posterior truncated; anterior deeply emarginate above, narrowly and prominently rounded below. Surface marked by fine, irregular, concentric lines variable in different specimens, but usually most prominent near the beaks. Lunule deeply impressed. (Gabb)

*Observations.* The form originally described by Gabb as "*Astarte matthewsonii*" has been considered by Stewart and Turner as a subspecies of *C. uvatasana* (Conrad). Forms such as *C. collina* and *C. semidentata* seem to lie with a *C. uvatasana* group, and *C. uvatasana matthewsonii* falls within the limits of this group. The varying characters involve the posterior part of the shell and the umbones. *G. uvatasana matthewsonii* may be distinguished from *C. uvatasana* in immature specimens in its finer ribbing and subquadrate outline, while shells of a similar stage of growth in *C. semidentata* are proportionately higher.

*Hypotype.* (U.C. 33628.) Figured in the present report, pl. 26, fig. 8; pl. 29, fig. 4; pl. 61, fig. 18.

*Geologic range.* Middle Eocene. Domengine and lower Umpqua formations.

*Geographic distribution.* California, Oregon, and Washington.

*Type locality.* Martinez, California. Occurs also in southwest Oregon at locality (U.C. 3608).

**CRASSATELLITES WASHINGTONIANA** Weaver, 1912

Plate 30, figures 1, 2, 4, 5, 6, 7, 8

*Crassatellites washingtoniana* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 32, pl. 4, fig. 42; pl. 5, fig. 51, 1912.

*Crassatellites washingtoniana* Weaver, Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 87, pl. 12, figs. 1, 2, 3, 4, 5, 1925.

*Original description.* Shell of moderate size, elongate, sub-trigonal, thick, equivalve, and very inequilateral; beaks about one-fourth of the length of the shell from the anterior end; incurved and pointing slightly forwards; anterior margin straight and sloping downwards steeply at an angle of  $60^{\circ}$ . It is then broadly rounded and merges into the base; posterior margin very slightly convex and sloping downwards at an angle of  $25^{\circ}$ ; posterior end broadly truncated; base broadly rounded; a fairly distinct ridge passes downwards on the surface from beak to posterior end and is situated a little in front of the posterior margin; lunule cordate, fairly large, distinct and deeply impressed. Surface sculptured by a well defined series of concentric ribs and lines of growth. Pallial line distinct and some distance from margin of shell; muscle scars strong and nearly equally developed; hinge plate heavy and teeth typically developed. Dimensions.—altitude 26 mm.; longitude 34 mm.; thickness 10 mm. (Weaver)

*Observations.* The holotype of this species was described from the well-known Cowlitz locality (U.W. 329) where the species is known by very fine specimens. It is one of the most common forms in the fauna of the Lincoln formation at the type locality (U.W. 256) where specimens are perfectly preserved. There are minor variations in the attenuation of the posterior end but there seem to be no recognizable differences among those forms in the Cowlitz and Lincoln formations.

*Syntypes.* (C.A.S. 480) (U.W. 8-B). Figured in the present report, pl. 30, figs. 2, 4; (U.W. 8) (C.A.S. 480A). Figured in the present report, pl. 30, fig. 1.

*Hypotype.* (S.U. 29.) Figured in the present report, pl. 30, figs. 5, 6.

*Hypotype.* (S.U. 30.) Figured in the present report, pl. 30, figs. 7, 8.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz River Valley, Washington.

*Type locality.* (U.W. 329.) At bend in Cowlitz River one and one-half miles east of Vader, Lewis County, Washington, Section 27, T. 11 N., R. 2 W. The species is not common at this locality. It occurs in great abundance at locality (U.W. 256) in railroad cut on Union Pacific Railway one mile north of Galvin Station, Lewis County, Washington, in Section 27, T. 15 N., R. 3 W.

**CRASSATELLITES STILLWATERENSIS** Weaver and Palmer, 1922

Plate 27, figures 2, 3, 5, 6; plate 29, figures 9, 13; plate 31, figure 2

*Crassatellites stillwaterensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, p. 18, pl. 9, figs. 1, 2, 1922.

*Original description.* Shell of moderate size, thick and trigonal in outline; inequilateral, beaks situated about one-third of the distance from the anterior end; beaks small; anterior margin sloping from the beaks at an angle of  $30^{\circ}$  for about half the length of the anterior end and then rounding into the ventral margin; ventral margin slightly curved; posterior truncate; extending vertically from the ventral

margin for about half the height of the shell and then sloping to the beaks at an angle of 25°; an umbonal slope extends from the beaks to the posterior ventral margin; hinge heavy; large resilium scar; one large middle cardinal with a thin anterior cardinal; margin of hinge plate grooved anteriorly; areas of lunule and escutcheon well developed; internal margin smooth; surface ornamented only with fine, concentric lines of growth. Dimensions.—length 43 mm.; height 32 mm.; thickness 18 mm. (Weaver and Palmer)

*Observations.* This species is very abundant in the Cowlitz formation on Stillwater Creek. Effinger (138, p. 369) has placed it in synonymy with *C. perrini* (Dickerson). The latter is a higher and proportionately shorter form with a very broad posterior margin and decidedly concave outline of the anterior dorsal margin.

*Holotype.* (U.W. 168) (C.A.S. 7419). Figured in the present report, pl. 27, figs. 2, 6; pl. 29, figs. 9, 13; pl. 31, fig. 2.

*Hypotype.* (U.C. 32762.) Figured in the present report, pl. 27, figs. 3, 5.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz River Valley, Washington.

*Type locality.* (U.W. 319.) At McClarity ranch in south bank of Stillwater Creek, one mile west of Vader, Lewis County, Section 30, T. 11 N., R. 2 W.

#### CRASSATELLITES PERRINI (Dickerson), 1917

Plate 26, figures 12, 13, 17, 18

*Astarte perrini* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 168, pl. 27, figs. 8a, 8b, 1917.

*Crassatella perrini* (Dickerson), Effinger, Jour. Paleon., vol. 12, p. 369, 1938.

*Original description.* Shell quadrate with prominent, sharply pointed beak which is one-third of shell length from acutely rounded anterior; posterior margin truncate; ventral margin broadly arcuate; posterior dorsal margin straight with gentle slope from beak to posterior; anterior dorsal slope concave with elongate narrow fairly distinct lunule; escutcheon indefinite. Dimensions: length, 15.5 mm.; height, 13 mm.; convexity, 3 mm. (Dickerson)

*Observations.* This species is oval to subquadrate in outline with broadly rounded to subtruncate posterior margin and strongly concave margin just in front of umbones.

*Holotype.* (C.A.S. 390.) Figured in the present report, pl. 26, figs. 12, 13.

*Hypotype.* (U.C. 12496.) Figured in the present report, pl. 26, figs. 17, 18.

*Geologic range.* Lower middle Oligocene, Gries Ranch beds.

*Geographic distribution.* Lower Cowlitz River Valley, Washington.

*Type locality.* (U.W. 239.) On south side of Cowlitz River, Cowlitz County, Washington, Section 25, T. 11 N., R. 2 W.

## CRASSATELLITES LINCOLNENSIS Weaver, 1916

Plate 26, figures 9, 11, 14, 15; plate 29, figures 10, 11; plate 30, figure 3

*Crassatellites lincolnensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 38, pl. 3, figs. 31, 32, 33, 1916.

*Original description.* Shell heavy, small, sub-quadrata in outline and equivale; beaks situated at a distance about one-fourth the length of the shell from the anterior end, moderately high, incurved and directed forwards; anterior dorsal margin very slightly concave; anterior end sharply but evenly rounded; posterior dorsal margin straight and sloping downwards at an angle of  $10^{\circ}$ ; posterior end sharply truncate and making an angle with the posterior dorsal slope of  $120^{\circ}$ ; basal margin broadly arcuate; a sharp ridge extends from beak to junction of base and posterior margin. Surface sculptured by fifteen extremely well developed concentric ribs upon which and between which there are fine concentric lines of growth. Pallial line simple and situated some distance from the margin of shell. Muscle scars strong and equally developed; hinge plate moderately developed. Dimensions.—altitude 11 mm.; longitude 13 mm.; thickness 5 mm. (Weaver)

*Observations.* This species may be distinguished by a lesser thickness of shell material, the very prominent flat to rounded concentric ribs with interspaces of lesser width and the subquadrata outline with steep anterior dorsal slope.

*Holotype.* (U.W. 92B) (C.A.S. 559). Figured in the present report, pl. 29, figs. 10, 11.

*Paratype.* (U.W. 92) (C.A.S. 456A). Figured in the present report, pl. 26, figs. 9, 14.

*Paratype.* (U.W. 456.) Figured in the present report, pl. 30, fig. 3.

*Paratype.* (U.W. 92a) (C.A.S. 456). Figured in the present report, pl. 26, figs. 11, 15.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Chehalis River Valley, Washington.

*Type locality.* (U.W. 256.) In railroad cut along Union Pacific Railway one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

## CRASSATELLITES CARMANAHENSIS Clark, 1925

Plate 29, figure 14

*Crassatellites carmanahensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 88, pl. 12, fig. 6, 1925.

*Original description.* Shell rather small, heavy, trigonal in outline; beaks fairly prominent, strongly inturned. Dorsal slopes steep, straight, posterior slope being longer. Posterior end acutely rounded; anterior end broadly rounded; ventral edge very gently arcuate. Lunule strongly depressed elongate, lanceolate, extending about two-thirds the length of anterior dorsal edge. Escutcheon long and narrow, not so strongly depressed as the lunule on type specimen. Surface of shell strongly depressed along posterior margin, the narrow depressed area being separated from remaining portion of shell by a fairly distinct angle. Surface sculptured by numerous, coarse, concentric undulations, on and between which are finer lines of growth. The two cardinals of left valve heavy, and do not meet dorsally; posterior cardinal

grooved, connecting with dorsal edge just anterior to beak. Resilifer groove narrow, elongate. Dimensions: length, about 28 mm.; height, 27 mm. (Clark)

*Observations.* This species may be distinguished from the other species of the genus in the Northwest by its relatively small umbonal angle, the nearly equal downward slope of the anterior and posterior slopes of the dorsal margin, and the relatively greater height of the shell compared to the length.

*Holotype.* (C.A.S. 704.) Figured in the present report, pl. 29, fig. 14.

*Geologic range.* Upper Oligocene.

*Geographic distribution.* Southern side of Vancouver Island.

*Type locality.* (C.A.S. 234.) In sea cliff one mile west of Carmanah Point, Vancouver Island.

#### Family SPHAERIIDAE

##### Genus CORBICULA Megerle von Mühlfeld, 1811

*Corbicula* J. K. Megerle von Mühlfeld, Gesellschaft naturforschender Freunde zu Berlin, Magazin, Jahrgang 5, pt. 1, p. 56, 1811.

*Genotype.* *Corbicula fluminalis* Megerle von Mühlfeld.

##### CORBICULA COWLITZENSIS Weaver, 1912

###### Plate 30, figure 9

*Corbicula cowlitzensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 33, pl. 14, fig. 117; pl. 15, figs. 132, 135, 1912.

*Corbicula cowlitzensis* Weaver, Coats, Nautilus, vol. 50, pp. 23, 24, 1936.

*Corbicula eufaulaensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 32, 33, pl. 14, fig. 119; pl. 15, fig. 131, 1912.

*Original description.* Shell sub-triangular in outline, nearly one-fourth longer than high, thick; beaks prominent, elevated and situated about two-fifths the length of the shell from the anterior end; valves convex; anterior margin slightly concave, short and sloping downwards at an angle of 50°; anterior end broadly rounded; basal margin evenly but very slightly rounded; posterior margin nearly straight, long and sloping downwards at an angle of 30°; posterior end obliquely truncated and narrow. Surface marked by well developed concentric lines of growth. Hinge plate thick, cardinal teeth very large, lateral teeth prominent. Dimensions.—altitude 28 mm.; longitude 36 mm.; thickness 10 mm. (Weaver)

*Original description (C. eufaulaensis).* Shell sub-circular, about one-fifth longer than high and very thick; beaks very prominent and situated nearly central; sometimes anterior to the center; valves very convex; anterior and posterior margins sloping at nearly the same angle, the former very slightly concave and the latter very slightly convex; both ends acutely but evenly rounded. Surface sculptured by prominent concentric lines of growth. Hinge plate and teeth well developed. Dimensions.—altitude 32 mm.; longitude 38 mm.; thickness 12.5 mm. (Weaver)

*Observations.* The specimens of this species show a great variation in shell outline from subcircular to elongate-suboval. The elevated um-

bones with concave anterior and dorsal margins, as in *C. olequahensis*, are lacking.

*Holotype* (*C. cowlitzensis*). (U.W. 10) (C.A.S. 482). Figured in the present report, pl. 30, fig. 9.

*Holotype* (*C. eufaulaensis*). Lost. Not figured in the present report.

*Geologic range*. Cowlitz formation, upper Eocene.

*Geographic distribution*. Western Washington.

*Type locality*. (U.W. 8.) Coal Creek, Cowlitz County, one mile north from Inman-Poulsen Logging Company store, Section 35, T. 9 N., R. 3 W.

#### **CORBICULA OLEQUAHENSIS (Weaver), 1912**

Plate 30, figures 10, 11

*Meretrix olequahensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 35, pl. 5, figs. 47, 48, 49, 50, 1912.

*Original description*. Shell thick, robust, somewhat inflated sub-triangular; beaks nearly central, prominent and strongly incurved; anterior margin sloping downward steeply and nearly straight, then extending outward with a decreasing slope until broadly truncated at the anterior end; base evenly rounded; posterior margin sloping steeply at first then decreasing and merging into the broadly rounded posterior end. Surface sculptured with somewhat prominent concentric ribs. No radiating ribs are present. Surface deeply excavated under the beaks. Inner surface smooth with strong pits and moderately deep pallial sinus; lateral teeth well developed. Dimensions.—altitude 35 mm.; longitude 38 mm.; thickness 15 mm. (Weaver)

*Observations*. This species is widely spread in the brackish water bed of the Cowlitz formation in southwestern Washington. It is characterized by its subtrigonal outline, high centrally placed umbones, and concave anterior and dorsal margins.

*Holotype*. (U.W. 13) (C.A.S. 484). Figured in the present report, pl. 30, fig. 10.

*Topotype*. (C.A.S. 484A.) Figured in the present report, pl. 30, fig. 11.

*Geologic range*. Cowlitz formation, upper Eocene.

*Type locality*. (U.W. 2.) Bank along Olequa Creek one mile above its junction with Stillwater Creek back of the old Cantwell place in Section 29, T. 11 N., R. 2 W., Lewis County, Washington.

#### **CORBICULA OREGONENSIS Hendon, 1938**

Plate 27, figure 1; plate 29, figure 8

*Corbicula oregonensis* Hendon, in Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 48, pl. 8, figs. 3, 4, 5, 1938.

*Original description*. Shell medium size, equivalve, ornamented by low wedge-shaped concentric ribs, wedges thinning marginally; beaks slightly in advance of the center; umbonal angle 95-120 degrees; anterior end broadly rounded; posterior end truncated; an umbonal ridge extends to the posterior ventral margin; area behind the ridge has the shape of a broadly obtuse angle; on internal casts a broad umbonal band

runs parallel and anterior to the umbonal angle; pallial line apparently simple; lateral teeth crenulate. Holotype (U.C. 33103): altitude 24.3 mm.; length 25.0 mm. (Hendon, in Turner)

*Observations.* This species is characterized by its elevated and prominent umbones and the acute angle formed by the anterior and posterior dorsal margins. The remainder of the shell is subovate in outline.

*Holotype.* (U.C. 33103.) Figured in the present report, pl. 27, fig. 1; pl. 29, fig. 8.

*Geologic range.* Upper Umpqua formation.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* Locality no. 139, Univ. Oregon. (U.C. A-673.) Along north bank of North Umpqua River from the bend a quarter of a mile north of Glide to Bradley Creek. (Turner)

#### CORBICULA PUGETENSIS White, 1889

Plate 30, figure 15

*Corbicula pugetensis* White, U.S. Geol. Surv., Bull. no. 51, p. 60, pl. 11, fig. 8, 1889.

*Original description.* Associated with the foregoing species at Carbonado is a form which differs so much from it as to warrant the application of a separate name. It is subvoid in marginal outline, considerably longer than high; valves moderately convex; beaks somewhat prominent, situated near the anterior end of the shell; surface marked by the ordinary concentric lines of growth. Height of an example of ordinary size, 35 mm.; length, 45 mm. (White)

*Observations.* The outline of this shell resembles some of the Veneridae in its subquadrate to oval form and anteriorly situated umbones and fine concentric lines of growth. It occurs in thin layers of shale interbedded with the thick layers of sandstone of the coal-bearing fresh- and brackish-water Puget Group.

*Holotype.* (U.S.N.M. 20106.) Figured in the present report, pl. 30, fig. 15.

*Geologic range.* Middle(?) and upper Eocene. (Puget Group.)

*Geographic distribution.* Puget Sound Basin, Washington.

*Type locality.* Carbonado, Pierce County, Washington.

#### CORBICULA BREVIDENS (White), 1889

Plate 29, figures 6, 12

*Cyrena brevidens* White, U.S. Geol. Surv., Bull. no. 51, pp. 58, 59, pl. 10, figs. 7, 8, 9, 10, 11, 1889.

*Original description.* Shell subtriangular in outline by lateral view; valves moderately convex; beaks prominent, situated a little in advance of the mid-length of the shell even in the shortest examples; cardinal teeth small; posterior lateral teeth small and slender; anterior lateral tooth of the left valve very short, and situated so near to the cardinal teeth as to appear like an accessory cardinal tooth; pallial sinus small and moderately deep. Surface marked by distinct concentric lines and undulations of growth.

The proportion of height to the length of the shell varies greatly in different examples. One example measures 27 mm. in height and 29 mm. in extreme length, while another measures 18 mm. in height and 26 mm. in extreme length. The average proportions are, however, between those of these two examples. (White)

*Observations.* This species is characteristically trigonal in outline but individuals vary from an equilateral triangle to forms of considerable length. The shells occur in reef-like beds from a few inches to three feet in thickness and are interbedded with the thick beds of sandstone and shale of the Puget Group.

*Syntypes.* (U.S.N.M. 20100) (U.S.N.M. 20100a?). Figured in the present report, pl. 29, figs. 6, 12.

*Geologic range.* Middle(?) and upper Eocene. (Puget Group.)

*Geographic distribution.* Puget Sound Basin, Washington.

*Type locality.* Palace Camp, Pierce County, Washington.

**CORBICULA WILLISI White, 1889**

Plate 30, figures 16, 17; plate 31, figure 1

*Corbicula willisi* White, U.S. Geol. Surv., Bull. no. 51, pp. 59, 60, pl. 11, figs. 3, 4, 5, 6, 7, 1889.

*Original description.* Shell subcircular in outline, the height and length being nearly equal; beaks prominent, elevated, and situated near or a little behind the mid-length of the shell; valves strongly convex, especially in the umbonal region; front margin regularly rounded, its convexity being continuous with the somewhat less convex basal margin; posterior margin slightly convex, nearly perpendicular, and abruptly rounded to the basal margin below and to the dorsal margin above; dorsal margin short, nearly straight; cardinal teeth well developed; lateral teeth also well developed and transversely crenulated; pallial sinus small. The surface is marked by the ordinary concentric lines of growth, and the larger examples usually have besides this a greater or less number of strong concentric undulations.

Height of the largest example in the collection, 54 mm.; length, 51 mm.; but the average size is considerably less. (White)

*Observations.* This species somewhat resembles *C. olequahensis* but differs in having narrow short and elongate cardinal teeth with deeper and broader intervening cardinal pits. The posterior dorsal margin usually is less concave and at times convex. The specimen figured on plate 31, figure 1, may belong to *C. olequahensis*.

*Syntypes.* (U.S.N.M. 20105) (U.S.N.M. 20105a?) (U.S.N.M. 20105b). Figured in the present report, pl. 30, figs. 16, 17; pl. 31, fig. 1.

*Geologic range.* Puget Group, Eocene.

*Geographic distribution.* King and Pierce counties, Washington.

*Type locality.* Carbonado, Pierce County, Washington. Exact location unknown.

**CORBICULA SOOKENSIS** (Clark and Arnold), 1923

Plate 27, figure 4; plate 30, figures 12, 13, 14; plate 38, figure 14; plate 39, figure 7

*Cyrene (Corbicula) sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 148, pl. 20, figs. 3a, 3b, 1923.

*Original description.* Shell medium in size, heavy, inequilateral; beaks fairly conspicuous and anterior to middle. Dorsal slopes nearly equal in length and steepness, both anterior and posterior ends broadly and nearly equally rounded; ventral edge strongly arcuate. Surface of shell covered by numerous moderately coarse, fairly regular, incremental lines. Hinge plate of right valve well exposed; all three cardinals fairly heavy, the middle one being strongly bifid; lateral claspers of right valve long and heavy, inner lamellae striated, a character of the subgenus *Corbicula*. Dimensions of the type specimen: height, 39 mm.; length, 40 mm. (Clark and Arnold)

*Observations.* Only the right valve of this species is known. It is characterized by its three heavy cardinal teeth with the middle one bifid and the long heavy clasping lamellae.

*Holotype.* (C.A.S. 586.) Figured in the present report, pl. 27, fig. 4; pl. 30, figs. 12, 13, 14; pl. 38, fig. 14; pl. 39, fig. 7.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Southeastern coast of Vancouver Island.

*Type locality.* (S.U. 231.) In the sea cliffs east of the mouth of Kirby Creek, 6 miles west of Sooke, Vancouver Island.

**Genus BATISSA Gray, 1853**

*Batissa* Gray, Ann. Mag. Nat. Hist., ser. 2, vol. 11, p. 38, 1853.

*Genotype.* *Batissa tenebrosa* Hinds.

**BATISSA DUBIA White, 1889****Plate 31, figure 3**

*Batissa dubia* White, U.S. Geol. Surv., Bull. no. 51, p. 61, pl. 11, figs. 1, 2, 1889.

*Original description.* Among the collections from Newcastle and Wilkeson are numerous compressed and distorted examples of a shell which I refer to the genus *Batissa*, but which is evidently specifically different from *B. Newberryi*. It is a smaller shell, subcircular in marginal outline, and has its beak situated a little in advance of the mid-length of the shell. The ligament is large and prominent, and one of the examples shows traces of the cardinal teeth similar in character to those of *B. Newberryi*. (White)

*Observations.* This species is represented by many specimens in the shales interbedded with thick sandstone layers of the fresh water part of the Puget Group at Newcastle and Wilkeson in the eastern part of the Puget Sound Basin. This species may be distinguished from *B. newberryi* in its subcircular-ovate form, the latter being elongate-ovate in outline.

*Holotype.* (U.S.N.M. 20097.) Figured in the present report, pl. 31, fig. 3.

*Geologic range.* Puget Group, middle(?) and upper Eocene.

*Geographic distribution.* Puget Sound Basin, Washington.

*Type locality.* Newcastle, King County, and Wilkeson, Pierce County, Washington.

**BATISSA NEWBERRYI** White, 1889

Plate 31, figure 6

*Batissa newberryi* White, U.S. Geol. Surv., Bull. no. 51, p. 60, pl. 9, figs. 1, 2, 3, 1889.

*Original description.* Shell large, subelliptical in marginal outline; valves moderately convex; beaks slightly prominent, situated behind the mid-length of shell; cardinal margin broadly arched; front margin somewhat abruptly rounded; basal margin broadly convex, and the posterior margin a little more narrowly rounded than the front; ligament large, prominent, and ending abruptly behind, as is usual in this genus; cardinal teeth three in each valve, the two posterior ones of the right valve being broad and strong, and all three teeth of the left valve being narrow; lateral teeth unknown.

Height of the most perfectly preserved example in the collection, 52 mm.; length, 81 mm.; but the average size is considerably larger than this. (White)

*Observations.* This species, as in the case of *B. dubia*, occurs in black shales interbedded with thick sandstone layers of the freshwater part of the Puget Group in the eastern part of the Puget Sound Basin. The species is characterized by its greater length than height and subovate outline.

*Holotype.* (U.S.N.M. 20108.) Figured in the present report, pl. 31, fig. 6.

*Geologic range.* Upper half of Puget Group, middle(?) and upper Eocene.

*Geographic distribution.* Puget Sound Basin, Washington.

*Type locality.* Exact location not known. The type came from Carbonado, Wilkeson (Flett's Creek), or Newcastle in the eastern part of the Puget Sound Basin. The species occurs in all of these localities.

**Genus VENERICARDIA Lamarck, 1801**

*Venericardia* Lamarck, Syst. Nat. Anim. sans Vert., p. 123, 1801.

*Genotype.* *Venericardia imbricata* Lamarck = *Venus imbricata* Gmelin. See Schmidt-Versuch, Conch.-Samml., pp. 57, 176, 1818.

**VENERICARDIA HORNII (Gabb) subsp. CALAFIA Stewart, 1930**

Plate 28, figures 6, 7; plate 31, figures 4, 5

*Cardita planicosta* Conrad, Diller, U.S. Geol. Surv., Folio no. 49, p. 3, 1898.

*Venericardia hornii* subsp. *calafia* Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 168, pl. 11, fig. 2, 1930; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 50, pl. 14, fig. 4, 1938.

*Original description.* Shell large, heavy, almost circular, with small beaks; 24 radiating ribs on each valve, decorticated at the beaks, but a few of the anterior ribs still showing the lateral ridges and two of the posterior ribs of the left valve distinctly noded but apparently not ridged; on the central region, the ribs flatten and disappear when the shell is about 42 mm. long, as shown by the growth lines the central area being quite smooth; the anterior ribs gradually give way to prominent growth lines while the posterior ribs remain more or less distinct, but not prominent, to the posterior margin; hinge of type specimen not exposed. Length, 95 mm.; height, 86 mm.; thickness of both valves, 53.5 mm.; no. 31450, Museum of Paleontology. (Stewart)

*Observations.* The subspecies *calafia* resembles the species *hornii* in number of ribs and ornamentation more than does the subspecies *lutmani*. The specimens of *calafia* from southwest Oregon have the radiating ribs less rounded than in the species *hornii* and the general outline of the shell is more orbicular than in the subspecies *lutmani*.

*Holotype.* (U.C. 33129.) Figured in the present report, pl. 28, figs. 6, 7; pl. 31, figs. 4, 5.

*Geologic range.* Middle Eocene, Tyee formation.

*Geographic distribution.* Oregon and California.

*Type locality.* Llajas Canyon, Simi Valley, California. Occurs in Oregon at locality (U.C. A-684) on north bank of Umpqua River from 470 feet west of French Creek to the first riffle below the Lone Rock Bridge. (Turner)

**VENERICARDIA HORNII** (Gabb) subsp. **LUTMANI** Turner, 1938

Plate 28, figure 1; plate 32, figure 1

*Venericardia hornii* subsp. *lutmani* Turner, Geol. Soc. Am., Spec. Pap. no 10, p. 50, pl. 13, fig. 4; pl. 14, fig. 2, 1938.

*Original description.* Shell heavy, subquadrate; beaks small; ribs 27 in number, the posterior 9 or 10 narrower and higher than the remainder, which are nearly obsolete with the exception of the anterior three or four, lunule very short, deep; ligamental groove long, narrow. (Turner)

*Observations.* This subspecies is distinguished from *V. hornii* by possessing 27 ribs and a low beak while the latter is characterized by 22 wide rounded closely spaced radial ribs. It differs from the subspecies *calafia* in having 3 or 4 more radial ribs. On the middle third of shell the width of ribs is approximately two-thirds that of the interspaces.

*Holotype.* (U.C. 33133.) Figured in the present report, pl. 28, fig. 1; pl. 32, fig. 1.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* (U.C. A-1233.) West of Roseburg, Oregon.

**VENERICARDIA HORNII** (Gabb) subsp. **CLARKI** Weaver and Palmer, 1922

Plate 27, figures 7, 9, 10, 17, 18; plate 32, figure 2; plate 33, figure 6

*Cardita planicosta* Lamarck, White, U.S. Geol. Surv., Bull. no. 18, pp. 8, 9, 10, pl. 1, figs. 1, 2, 3, 1885. (From Albany, Oregon.)

*Venericardia planicosta hornii* (Gabb), Waring, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pl. 11, figs. 3, 4, 5, 1917.

*Venericardia clarki* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 19, pl. 9, figs. 4, 5; pl. 10, fig. 8, 1922.

*Venericardia clarki* Weaver and Palmer, M. Hanna, Univ. Calif. Publ., Bull. Dept. Geol., Sci., vol. 15, p. 287, pl. 36, figs. 3, 8, 1925.

*Venericardia hornii* subsp. *clarki* Weaver and Palmer, Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 2, p. 169, 1930; Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 49, 50, pl. 14, figs. 1, 2, 3, 1918.

*Venericardia* (*Venericor*) cf. *clarki* Weaver and Palmer, Clark, Bull. Geol. Soc. Am., vol. 49, pp. 695, 696, pl. 2, figs. 9, 10, 11, 12, 15, 16, 1938.

*Original description.* Shell small and ovate; umbones small; anterior end slightly produced, sloping from the beaks at an angle of 20°, rounding into the ventral margin; ventral margin regularly rounded; posterior end rounded, passing from the ventral margin at about the same degree of convexity as the anterior end; posterior dorsal margin nearly straight or slightly curving to the posterior end; surface ornamented with 18 to 20 very well developed radiating ribs with rounded interspaces about half the width of the rib; the median portion of the ribs is raised and rounded, the base forming a lower ridge on each side of the ribs, giving them a tripartite character; the median, raised portion of the ribs is ornamented by fine nodes or pustules which occur on all the ribs on very young shells, and on the umbonal region and the anterior end of most shells; the ribs on the posterior end of the older specimens become broader and the pustulate condition obliterated; inner margin fluted. Dimensions: length, 17 mm.; height, 15 mm.; thickness, 11 mm. (Weaver and Palmer)

*Supplementary description.* Shell large, thick; posterior cardinal margin regularly and broadly curving, ventral margin broadly rounded, joining the posterior cardinal margin in a much smaller arc, which tends to give shell a subtrigonal outline; anterior margin moderately rounded but straightening out into a broad curve anterior to the small, well-defined lunule, which is circumscribed by a lateral groove anterior to the surface of the lunule, and not visible from the front of the shell; beaks prominent, anterior, and moderately high. The surface ornamentation consists of growth lines and twenty-one radial ribs (pl. 47, fig. 2), which are very well rounded on the umbo but broadly rounded near middle of shell, and flattened or nearly obsolete near margin, due to increased prominence of growth lines. Radial ribs may be separated into two groups. Posterior six to eight are much narrower, closer, and less distinct than other ribs of shell. Line of demarcation extends from beak to posterior dorsoventral point. Hinge massive but only moderately wide. Anterior cardinal of left valve slightly bifid, a character found in many of the valves of these species; large socket nearly straight on the anterior side but broadly curving on the posterior forming an angle of about forty degrees with the hinge line. Inner margin crenulate.

Dimensions of the plesiotypes figured: left valve: length, 110 mm.; altitude, 100 mm.; thickness, 37 mm.; right valve: length, 100 mm. (broken); altitude, 92 mm. (broken); thickness, 35 mm. (Hanna, 158, p. 288)

*Observations.* The holotype of this subspecies from near Vader, Washington, is small and immature and characteristically dwarfed. At other upper Eocene localities in Oregon and Washington the shell averages 5 inches in both length and height. The radial ribs vary from 19 to 21 and are prominent and sharp on the umbo area but broad and flat near the margin in large mature individuals.

*Holotype.* (U.W. 169) (C.A.S. 7430). Figured in the present report, pl. 27, figs. 7, 9, 17.

*Topotype.* (U.W. 169A) (C.A.S. 7430A). Figured in the present report, pl. 27, fig. 10.

*Hypotype.* (U.W. 339.) Figured in the present report, pl. 33, fig. 6.

*Hypotype.* (U.C. 33130.) Figured in the present report, pl. 27, fig. 18; pl. 32, fig. 2. Lower Coaledo formation.

*Geologic range.* Cowlitz formation, upper Eocene; Coaledo formation, upper Eocene.

*Geographic distribution.* Western Oregon and Washington.

*Type locality.* (U.W. 232.) In the north bank of Cowlitz River near the bend in Section 28, T. 11 N., R. 2 W.

**VENERICARDIA ARAGONIA** Arnold and Hannibal, 1914

Plate 28, figures 2, 3, 4, 5; plate 32, figures 3, 4, 5, 6, 10, 11

*Venericardia hornii* var. *aragonia* Arnold and Hannibal, Science, n. s., vol. 39, p. 907, June 19, 1914.

*Venericardia planicosta merriami* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 118, pl. 11, figs. 1a, 1b, December, 1914.

*Venericardia (Leuroactis) aragonia* Arnold and Hannibal, Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 170, 171, 172, 1930 (complete synonymy).

*Venericardia aragonia* Arnold and Hannibal, Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 48, 49, pl. 13, figs. 1, 2, 3, 5, 1938.

*Observations.* This species is characterized by its subtriangular outline, relatively high beaks, and nearly right-angle umbonal ridges making the posterior end of shell nearly at right angles to the sides. The lunule is large, broad and deep, concentric ribs are prominent and the radial ribs become nearly obsolete on posterior half of ventral margin and absent on anterior half. No formal description of this species has been made. Stewart (267, p. 170) has designated a specimen described and figured by Waring as *V. planicosta ionensis* as a neotype (281, p. 96, pl. 11, fig. 1) of *Venericardia aragonia* Arnold and Hannibal.

*Paratype.* (C.A.S. 241.) Figured originally by Dickerson as holotype of *V. planicosta merriami* (120, pl. 11, fig. 1a). Figured in the present report, pl. 32, figs. 3, 6.

*Hypotype.* (U.C. 33629.) From near Glide, Oregon. Figured in the present report, pl. 32, fig. 4; pl. 28, figs. 3, 5.

*Hypotype.* (U.C. 33791.) Locality (U.C. A-661). Figured in the present report, pl. 32, fig. 5.

*Hypotype.* (U.C. 33135.) Locality (U.C. A-662). Figured in the present report, pl. 28, figs. 2, 4; pl. 32, figs. 10, 11.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Western Oregon.

**VENERICARDIA CRESCENTENSIS** Weaver and Palmer, 1922

Plate 32, figures 8, 9; plate 33, figures 1, 2; plate 38, figure 7

*Venericardia crescentensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 19, 20, pl. 10, fig. 9, 1922.

?*Venericardia crescentensis* Weaver and Palmer, Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 170, 171, 1930.

*Original description.* Shell small and subquadrate in outline; posterior dorsal line straight, slightly oblique; posterior margin straight, extending almost at a right

angle to the dorsal margin and abruptly passing into the ventral margin which curves slightly to the anterior end; anterior moderately produced; surface ornamented with 22 wide flat-topped, radiating ribs with interspaces about one-third of the width of the ribs; on the posterior dorsal region the ribs become narrower and the interspaces wider; an umbonal ridge extends from the beaks to the posterior ventral point. Dimensions: length, 15 mm.; height, 12 mm.; thickness, 10 mm. (Weaver and Palmer)

*Observations.* This species may be distinguished from *V. aragonia* in the lack of the steep slope of the anterior dorsal margin and strong concave profile between the umbo and the anterior end and in lacking the broad convex posterior margin. The umbones are situated more posteriorly in *V. crescentensis*. The hinge is that of *Venericardia*.

*Holotype.* (U.W. 170) (C.A.S. 7433). Figured in the present report, pl. 32, fig. 8; pl. 38, fig. 7.

*Hypotype.* (U.C. 32791.) Figured in the present report, pl. 32, fig. 9.

*Hypotype.* (U.C. 30196.) Figured in the present report, pl. 33, figs. 1, 2.

*Geologic range.* Crescent formation, middle Eocene.

*Geographic distribution.* North side of Olympic Peninsula, Washington.

*Type locality.* (U.W. 358.) One-fourth mile east of Tongue Point, Crescent Bay, Clallam County, Washington, Section 22, T. 31 N., R. 8 W.

#### **VENERICARDIA HANNAI** Tegland, 1933

Plate 33, figures 3, 4, 8, 10

*Venericardia hannai* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 113, pl. 7, figs. 3, 4, 5, 6, 7, 8, 9, 1933.

*Original description.* Shell heavy, globose, chalky, rugose, higher than long; circular outline broken by the prominent, acute, nearly central beaks, making the shell slightly pear-shaped in outline. Lunule short, deeply impressed, and finely sculptured by growth lines; escutcheon not apparent. Radial ornamentation of about 18 heavy, prominent ribs which are strongly noded and separated by interspaces narrower than width of ribs. Hinge plate heavy, with strongly developed lamellae; left valve with two large cardinals radiating from beneath the umbo, the anterior cardinal triangular pyramid in form, the posterior, long and comparatively slender, nearly paralleling the ligamental groove; between cardinals a wide deep triangular socket. . . . Dimensions of holotype: height, 21 mm.; length, 19.2 mm.; maximum diameter (of single valve), 7.8 mm. (Tegland)

*Observations.* This species which is closely related to *V. hannibali* Clark from the Lincoln formation may be distinguished from it in being relatively higher and shorter, in having a lesser number of radiating ribs with wide interspaces and more strongly developed nodes. It may be distinguished from *V. castor* Dall in the fewer number of radiating ribs and the presence of nodes which are absent on the latter species. In general form these two species resemble each other.

*Holotype.* (U.C. 32147.) Figured in the present report, pl. 33, figs. 3, 8, 10.

*Paratype.* (U.C. 32143.) Figured in the present report, pl. 33, fig. 4.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Western Washington.

*Type locality.* Restoration Point opposite Seattle, Washington.

**VENERICARDIA HANNIBALI** Clark, 1925

Plate 33, figures 11, 14

*Venericardia (Cyclocardia) hannibali* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 88, pl. 19, figs. 6, 7, 1925.

*Original description.* Shell subcircular, fairly strong ventricose and only a little longer than high; beaks anterior to middle, strongly inturned and only slightly prosogyrous. Anterior dorsal edge short and straight; posterior dorsal edge gently convex, only slightly longer than anterior; anterior and posterior ends both broadly and regularly rounded; a small heart-shaped lunule. Sculptured by about 21 fairly prominent, beautifully nodose, rounded ribs; nodes rather small but prominent; surface also covered by fine, regular incremental lines. Two well developed cardinals in left valve; posterior cardinal long and slender, almost paralleling the well-developed ligamental groove. Anterior cardinal heavy, pyramidal, set at right angles to hinge plate. In right valve there is one large, heavy pyramid-shaped cardinal which is slightly bifurcated, an almost obsolete anterior cardinal joining the anterior dorsal edge. Nymph plates fairly heavy. Dimensions of type specimen: length, 13 mm.; height, 11.5 mm. (Clark)

*Observations.* This species may be distinguished from *V. hawaii* Tegland in having less conspicuous nodes and tubercles, in having a larger number of heavy ribs, and in being relatively longer and lower.

*Holotype.* (S.U. 32.) Figured in the present report, pl. 33, figs. 11, 14.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 362.) Exposure about one mile up Porter Creek from junction with Chehalis River on east bank in Section 22, T. 17 N., R. 5 W., Grays Harbor County, Washington.

**VENERICARDIA CASTOR** Dall, 1909

Plate 34, figures 1, 2, 3

*Venericardia castor* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 116, pl. 11, figs. 1, 3, 1909.

*Venericardia castor* Dall, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 114, pl. 7, figs. 10, 11, 12, 13, 14, 15, 1933.

*Original description.* Shell robust, solid, ventricose, thick, equivalve, inequilateral, with high, full, anteriorly recurved umbones; lunule short, cordate, defined by a deeply impressed line; escutcheon linear or none; ligament stout, seated on well-marked nymphs; sculpture of about 22 feebly defined flattish radial ribs, separated by much narrower, shallow, unchanneled interspaces, the whole crossed by rather rude, close-set, incremental lines; anterior dorsal slope shorter, excavated; posterior longer, convexly arcuate; base evenly rounded; interior smooth, muscular impressions somewhat impressed; margins with broad crenulations corresponding to the sculpture of the exterior. Altitude, 27 mm.; longitude, 25.5 mm.; maximum diameter, 17.0 mm. (Tegland)

*Observations.* As pointed out by Dall, this species resembles *V. subtenta* in its elevated umbones and oval shape but may be distinguished

in having a more deeply impressed lunule, coarser ribbing, and in being a relatively larger shell.

*Holotype.* (U.S.N.M. 153936.) Figured in the present report, pl. 34, fig. 2.

*Topotype.* (U.C. 32142.) Figured in the present report, pl. 34, fig. 1.

*Hypotype.* (U.C. 32130.) Figured in the present report, pl. 34, fig. 3.

*Geologic range.* Blakeley formation, upper Oligocene.

*Type locality.* (U.W. 704.) About one-sixth mile east of Twin Rivers, Clallam County, Washington, in the western half of Section 24, T. 31 N., R. 10 W.

#### VENERICARDIA SUBTENTA (Conrad), 1849

Plate 27, figures 8, 13, 14; plate 33, figures 5, 7, 9, 12; plate 34, figure 4

*Cardita subtenta* Conrad, U.S. Explor. Exped. Geol., p. 726, pl. 18, figs. 12, 12a, 1849.

*Venericardia subtenta* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 115, 116, 1909.

*Venericardia (Cyclocardia) subtenta* (Conrad), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 75, pl. 5, figs. 7, 9, 10, 12; pl. 9, fig. 1, 1931.

*Venericardia chehalensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 59, 60, pl. 12, figs. 101, 102; pl. 15, figs. 133, 137, 1912.

*Original description (Venericardia subtenta).* Not longer than high, broad obvate, ventricose, with about 22 rounded not very prominent radiate costae, and with strong concentric wrinkled lines. Posterior extremity somewhat truncate. (Conrad)

*Original description (Venericardia chehalensis).* Shell robust, thick, sub-triangular, equivalve and inequilateral; beaks not especially prominent for the genus with anteriorly recurved umbones; lunule very small, cordate; escutcheon absent; anterior margin very slightly concave and slopes at about 45° to anterior end where it rounds and merges into the base, which slopes at an angle of 40° to the posterior end, when it curves sharply upwards; posterior margin slopes gently at first from the beak for a short distance and then drops decidedly to the posterior end. Surface ornamented by twenty equally spaced radiating rounded, fairly well marked ribs; the interspaces are not deep and are nearly as wide as the ribs. These are crossed by numerous well developed concentric lines of growth. Hinge plate large; muscular scars very pronounced; pallial line distinct and about one-sixth the distance of shell from margin. Dimensions: longitude, 23 mm.; altitude, 28 mm.; diameter, 10 mm. (Weaver)

*Observations.* The form described as *V. chehalensis* is a common species in the Astoria formation, and although some of the specimens which were identified as belonging to this species show minor differences in outline of shell and strength of ribbing, these characters fall within the scope of *V. subtenta*, the holotype of which came from the Astoria formation.

*Holotype.* (U.S.N.M. 3502.) Figured in the present report, pl. 34, fig. 4.

*Hypotype.* (U.C. 31947.) Figured in the present report, pl. 33, fig. 5.

*Hypotype.* (U.C. 31948.) Figured in the present report, pl. 33, fig. 12.

Specimens originally identified as *V. chehalensis*:

*Syntype*. (U.W. 50) (C.A.S. 7432). Figured in the present report, pl. 27, figs. 8, 14.

*Syntype*. (U.W. 50-A) (C.A.S. 7432-A). Figured in the present report, pl. 27, fig. 13.

*Syntype*. (U.W. 50-B). Figured in the present report, pl. 33, fig. 7.

*Syntype*. (U.W. 50-C). Figured in the present report, pl. 33, fig. 9.

*Geologic range*. Astoria formation, middle Miocene.

*Geographic distribution*. Western Washington and Oregon.

*Type locality*. In the city of Astoria, Oregon (collected by J. D. Dana). The type locality of *V. chehalensis* is at (U.W. 65) on east branch of Clemons logging road in the eastern half of Section 29, T. 17 N., R. 7 W., Grays Harbor County, Washington.

### Family CARDITIDAE

#### Genus CARDITA Bruguiere, 1792

*Cardita* Bruguiere, Table Encycl. Meth., Vers, vol. 1, pt. 2, p. 401, 1792.

*Genotype*. *Cardita sulcata* Bruguiere.

#### Subgenus Carditamera Conrad, 1838

*Carditamera* Conrad, Fossils of the Medial Tertiary of the United States, no. 1, p. 11, pl. 6, fig. 2, 1838.

*Subgenotype*. *Cardita orata* Conrad.

#### CARDITA (CARDITAMERA) WEAVERI Dickerson, 1917

Plate 33, figure 13; plate 38, figures 5, 6

*Cardita (Carditamera) weaveri* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 167, pl. 27, figs. 5a, 5b, 1917.

*Paphia landesi* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, p. 83, pl. 6, fig. 3, 1918.

*Cardita (Carditamera) weaveri* Dickerson, Effinger, Jour. Paleon., vol. 12, p. 369, pl. 46, fig. 11, 1938.

*Original description*. Shell elongate-quadrata, small; hinge plate heavy, typical; rounded, radial beaded ribs cut by somewhat squamose incremental ribs decorating the shell. Dimensions: length, 7.5 mm.; height, 5 mm. (Dickerson)

*Original description* ("*Paphia landesi*"). Shell minute, approximately rectangular in outline, convex and very inequilateral; beaks low and situated about one-fifth the length of the shell from the anterior end; posterior dorsal margin elongate and nearly straight, merging abruptly into a sharply arcuate posterior margin. Ventral margin is straight and parallel to the dorsal margin; anterior dorsal margin slopes vertically from the beaks and then extends downwards at an angle of about 60°, where it curves sharply and merges into the ventral margin. Exterior of shell characterized by very strong ornamentation, especially on the posterior portion of the surface. Posterior surface decorated with seven very prominent radial ribs which tend to become obscure toward the beaks but which greatly increase in size at the posterior margin. Middle surface of shell is ornamented with similar radiating ribs, which progressively become less well defined, until at the anterior end they are

scarcely perceptible. The radiating sculpture is crossed by very prominent concentric ribs or lines of growth which have a somewhat wavy outline. At the intersections of the radial ribs and the lines of growth conspicuous scale-like nodes have been developed. The external ornamentation is impressed on the inner surface of the shell. Dimensions: altitude, 3 mm.; longitude, 5 mm.; thickness, 4 mm. (Van Winkle)

*Observations.* Shell small, moderately heavy, subquadrate to suboval in outline; dorsal and ventral margins nearly parallel and almost straight; posterior end obliquely truncate and slightly convex; and anterior end arcuate; umbos situated about 25 per cent the length of shell from anterior end; hinge plate heavy with two cardinal teeth in left valve and three in the right with the anterior merging into the margin of the lunule; ornamentation consists of radial ribs which are fine on the anterior and middle surface of shell but heavier on posterior part and these are crossed by wavy strongly developed concentric ribs.

*Holotype.* (C.A.S. 386.) Figured in the present report, pl. 33, fig. 13.

*Hypotype.* (U.C. 33523.) Figured in the present report, pl. 38, figs. 5, 6.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 239.) In the south bank of Cowlitz River at the old Gries Ranch in the northeast quarter of Section 25, T. 11 N., R. 2 W., Cowlitz County, Washington.

## Family THYASIRIDAE

### Genus THYASIRA Leach, 1818

*Thyasira* Leach, in Lamarck, Hist. Nat. Anim. sans Vert., vol. 5, p. 492, 1818.

*Genotype.* *Tellina flexuosa* Montagu.

### THYASIRA BISECTA (Conrad), 1849

#### Plate 34, figures 5, 6

*Venus bisecta* Conrad, U.S. Explor. Exped. Geol., vol. 10, p. 724, Geol. Atlas, pl. 17, figs. 10, 10a, 1849.

*Thyasira bisecta* Conrad, Dall in Spurr, U.S. Geol. Surv., 20th Ann. Rept., pt. 7, p. 264, 1900.

*Thyasira bisecta* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 118, 1909.

*Thyasira bisecta* Conrad, Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 180, pl. 1, fig. 7, 1909.

*Thyasira bisecta* (Conrad), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 281, 282, pl. 13, fig. 15, 1931.

*Original description.* Oblique, subrhomboidal, ventricose, with robust lines of growth. Anterior side very short, truncate, angulate below, having a submarginal vertical furrow, and the inferior margin at its termination slightly excavate. Posterior surface strongly excavate from the upper side of the beak to the posterior margin, and subcarinate below the excavation; ligament and superposterior margin form-

ing together a regular curve. Basal margin arcuate, a little tumid behind the middle. (Conrad)

*Holotype.* (U.S.N.M. 3518.) Conrad type. Figured in the present report, pl. 34, figs. 5, 6.

*Geologic range.* Middle Oligocene to Recent.

*Geographic distribution.* Pacific Coast of United States and Canada, Alaska and Japan.

*Type locality.* City of Astoria, Oregon, in middle Miocene.

#### **THYASIRA DISJUNCTA** (Gabb), 1869

Plate 34, figure 7; plate 104, figure 1

*Conchocele disjuncta* Gabb, Geol. Surv. Calif. Paleon., vol. 2, pp. 28, 99, pl. 7, figs. 48a, 48b, 1869.

*Thyasira disjuncta* (Gabb). Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 194, 195, pl. 15, fig. 1, 1930.

*Thyasira disjuncta* (Gabb), Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 114, 115, pl. 7, figs. 18, 19, 20, 21, 22, 1933.

*Original description.* Shell subquadrate; beaks terminal, anterior; anterior end abruptly and angularly truncated; base broadly rounded; cardinal margin arched, sloping downwards towards the posterior end. Surface marked only by lines of growth, except near the posterior part where the peculiar truncation takes place, the surface suddenly descending at a right angle to the curve of the shell, for a short distance, and then resuming its former direction. (Gabb)

*Lectotype.* (M.C.Z. 15017.) Selected by Stewart (267, p. 195). Reproduction of Stewart's figure (267, pl. 15, fig. 1). Figured in the present report, pl. 104, fig. 1.

*Hypotype.* (U.C. 32419.) Locality (U.W. 681). Figured in the present report, pl. 34, fig. 7.

*Geologic range.* Upper Oligocene(?) to Recent.

*Geographic distribution.* Pacific Coast of North America.

*Type locality.* Dead Man's Island, San Pedro Bay, southern California. (Stewart)

#### **Family LUCINIDAE**

##### **Genus LUCINA** Bruguiere, 1797

*Lucina* Bruguiere, Table Encycl. Meth., Vers, vol. 2, pl. 284, 1797.

*Genotype.* *Venus pensylvanica* Chemnitz, Conch. Cab., vol. 7, p. 12, pl. 37, fig. 394, 1817.

#### **LUCINA ACUTILINEATA** Conrad, 1849

Plate 34, figures 8, 11, 16

*Lucina acutilineata* Conrad, U.S. Explor. Exped. Geol., vol. 10, p. 725, pl. 18, figs. 2, 2a, 2b, 1849.

*Phacooides acutilineatus* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 116, 117, pl. 12, fig. 6, 1909.

*Phacooides (Lucinoma) acutilineatus* (Conrad), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 76, 77, pl. 4, fig. 5, 1931.

*Lucina (Myrtea) acutilineata* Conrad, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 286, 287, pl. 14, figs. 22a, 22b, 1931 (synonymy).

*Original description.* Suborbicular; ligament margin short, straight, and a little oblique; posterior margin somewhat truncate, widely, nearly direct; supero-anterior margin truncate. Surface with concentric lamelliform striae and intermediate fine lines; anteriorly with a slightly prominent fold. Basal margin orbiculate. This species is very nearly related to *L. contracta* (Say), a recent shell of the Atlantic coast, and fossil in the Miocene of Virginia. It differs from Say's species in being proportionally more elevated, and in having a much shorter ligament margin. (Conrad, 68, p. 725)

*Supplementary description of specimen from Empire formation.* Shell thin, flattish, suborbicular, equivalve, nearly equilateral; beaks low, inconspicuous, slightly behind the middle of the valve; valves little convex; lunule very small, narrow and short (in the figured specimen 2.5 mm. long), mostly situated on the right valve; sculpture, near the beaks, of fine, low, little-elevated, concentric lamellae, the interspaces hardly wider; away from the beaks the interspaces become gradually wider and the lamellae more elevated, between the latter the surface is sharply concentrically striated; ligament moderately long (in the figured specimen 8 mm.); dorsal slopes nearly straight, the remainder of the margins orbicularly rounded. Latitude of figured specimen, 23 mm.; altitude, 20.5 mm.; diameter, 7.5 mm. Fully adult specimens reach more than twice this size. (Dall, 101, p. 117)

*Observations.* This species is characterized by having a small, short and narrow lunule in contrast to the more elongate one in *L. hannibali*.

*Holotype.* (U.S.N.M. 3519.) Conrad type. Figured in the present report, pl. 34, figs. 8, 11.

*Hypotype.* (U.C. 31940.) Astoria formation. Locality (U.C. A-80.) Figured in the present report, pl. 34, fig. 16.

*Geologic range.* Middle Oligocene to Recent.

*Geographic distribution.* West Coast of North America.

*Type locality.* City of Astoria, Oregon, in middle Miocene. Occurs at many localities in the Astoria formation in western Washington.

#### LUCINA HANNIBALI (Clark), 1925

Plate 34, figures 9, 10, 12, 18

*Phacoides (Lucinoma) hannibali* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 89, pl. 22, figs. 2, 4, 1925.

*Phacoides (Lucinoma) hannibali* Clark, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 115, 116, pl. 8, figs. 5, 6, 7, 8, 9, 10, 11, 12, 13, 1925.

*Original description.* Shell subcircular to subtrapezoidal in outline; beaks anterior to middle, not very conspicuous, prosogyrous and fairly strongly inturned. Anterior end subtruncate, upper angle of subtruncated edge being more distinct than lower; posterior end broadly truncated; in this case both angles of the truncation are well defined and edge between the two angles is straight or nearly so; anterior dorsal edge short, straight, almost at right angles to the perpendicular to the beaks; posterior dorsal edge gently convex, about twice the length of anterior dorsal edge; ventral edge strongly arcuate; anterior portion of edge slopes up very rapidly to truncated anterior end; the change in slope on some specimens so sharp that it almost forms an angulation on the ventral edge. Lunule elongate, lanceolate depressed between these ridges and the dorsal edges, anterior depression being greater than posterior depression. Surface sculptured by numerous equally spaced, narrow lamellae, measuring, in some specimens, a millimeter or more in height. On anterior depressed area, lamellae break down into coarse, crowded incremental lines; interspaces be-

tween lamellae covered by fine irregular lines of growth. Dimensions: length, 49 mm.; height, 44 mm.; diameter, including both valves, 23 mm. (Clark)

*Observations.* This species may be distinguished from *L. acutilineata* Conrad in having the lunule situated along the entire length of the anterior dorsal margin, whereas in the latter species it is short, narrow and small and in the type specimen is confined more to the right valve than to the left. The posterior dorsal margin is longer in *L. hannibali* than in *L. acutilineata*.

*Holotype.* (S.U. 33.) Figured in the present report, pl. 34, figs. 9, 10.

*Hypotype.* (U.C. 32166.) Figured in the present report, pl. 34, fig. 12.

*Hypotype.* (U.C. 32168.) Figured in the present report, pl. 34, fig. 18.

*Geologic range.* Upper Oligocene.

*Geographic distribution.* Northwestern Washington.

*Type locality.* (U.W. 680.) In sandy shale about two miles west of Twin Rivers in sea cliff on south side of Strait of Juan de Fuca in Clallam County, Washington.

#### LUCINA COLUMBIANA (Clark and Arnold), 1923

Plate 34, figures 13, 14, 15, 17

*Phacoides columbianum* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 144, 145, pl. 25, figs. 2a, 2b, 1923.

*Phacoides columbianum* Clark and Arnold, Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 89, pl. 22, fig. 9, 1925.

*Original description.* Shell medium in size, suborbicular to roughly subquadrate in outline; beaks anterior to middle, strongly inturned, but only slightly prosogyrous; lunule depressed, narrow, and elongate. Anterior dorsal slope gently concave; posterior dorsal slope straight to slightly convex; anterior end broadly and regularly rounded; posterior end broadly subtruncate, lower angle of truncated edge being rather indistinct and rounded. Ventral edge fairly strongly arcuate. Surface of shell covered by narrow, raised concentric lamellae, which are separated by interspaces somewhat variable in width in which finer concentric lines of growth may be seen. On some specimens there is a slightly depressed area on surface just below anterior dorsal edge. Only a few of specimens studied exhibited a similarly depressed area just below posterior dorsal margin. Interior of type specimen, a left valve, shows two well defined cardinals and a heavy but somewhat indistinct anterior lateral. Dimensions of type specimen: length, 34 mm.; height, 32 mm. (Clark and Arnold)

*Observations.* The lunule of this species is elongate, narrow, and depressed in contrast with the small, narrow and short lunule of *L. acutilineata*. It may be distinguished from the closely related Recent species *L. annulatus* Reeve, as pointed out by Clark and Arnold, in having more prominent beaks, no depressed posterior area, and a less well defined anterior depressed area.

*Holotype.* (C.A.S. 593.) Figured in the present report, pl. 34, figs. 15, 17.

*Hypotype.* (U.C. 32842.) Figured in the present report, pl. 34, fig. 13.

*Hypotype.* (S.U. 34.) Figured in the present report, pl. 34, fig. 14.

*Geologic range.* Middle and upper Oligocene.

*Geographic distribution.* South side of Vancouver Island and western Washington.

*Type locality.* From Sooke sandstone and conglomerate in the sea cliffs between the mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island, B. C.

**LUCINA (HERE) DALLI** (Dickerson), 1917

Plate 35, figure 5

*Diplodonta dalli* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 171, pl. 29, fig. 8, 1917.

*Lucina (Here) dalli* (Dickerson), Effinger, Jour. Paleon., vol. 12, p. 370, 1938.

*Original description.* Shell medium, inflated, nearly equilateral, equivalve; anterior dorsal slope slightly concave beneath small inconspicuous beaks, thin, slightly convex; anterior broadly rounded; ventral margin arcuate; posterior slope nearly straight, sloping steeply to a medial point on posterior half, where it makes well marked angle with the nearly vertical posterior end. A shallow fluting extends from a point near beak to the middle of the straight posterior end. Concentric incremental growth lines decorate the shell. Dimensions: length, 22 mm.; height, 23 mm.; convexity, 7 mm. (Dickerson)

*Observations.* The hinge of this species is broad and on the right valve a posterior lateral is developed which fits into the laminae of the left valve; the anterior lateral of the right valve is represented by a small node which fits into a corresponding pit of the opposite valve. The lunule is deeply sunken in mature shells.

*Holotype.* (C.A.S. 398.) Figured in the present report, pl. 35, fig. 5.

*Geologic range.* Lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) In south bank of Cowlitz River at old Gries Ranch in Section 25, T. 11 N., R. 2 W.

**LUCINA (HERE) ARAGOENSIS** Turner, 1938

Plate 27, figure 15; plate 35, figure 12; plate 38, figure 4

*Lucina (Here) aragoensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 51, pl. 9, figs. 4, 5, 1938.

*Original description.* Shell small, heavy, orbicular, very inflated, slight posterior radial sulcus, and concentric lamellar ribbing. Lunule a deep pit with margins and bottom smoothly rounded. Ligament practically internal. Right hinge with one cardinal tooth and both anterior and posterior lateral. (Turner)

*Observations.* The lunule of this species differs from that of *L. dalli* (Dickerson) in that it lacks on its outer edge the sharp bounding margin, but, rather, bends inward in a smooth curve.

*Holotype.* (U.C. 33145.) Figured in the present report, pl. 27, fig. 15; pl. 35, fig. 12; pl. 38, fig. 4.

*Geologic range.* Coaledo formation, upper Eocene.

*Geographic distribution.* Southwestern Oregon and southwestern Washington.

*Type locality.* (U.C. A-858.) Cove in southwest corner of Cape Arago, Coos Bay, Oregon.

**LUCINA PACKI** Dickerson, 1916

Plate 34, figure 19; plate 38, figure 13

*Lucina packi* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 484, pl. 36, fig. 12, 1916.

*Lucina packi* Dickerson, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 52, pl. 9, fig. 11, 1938.

*Original description.* Shell small, subcircular in outline; posterior dorsal margin straight with moderate slope to a subtruncate posterior; beak subcentral, rounded, prominent; decoration consisting of very fine sharp concentric lines of growth. (Dickerson)

*Observations.* Fragments of forms which seem to be equivalent to the California species have been collected, but the material is too poor to figure. The figure in this report (pl. 34, fig. 19) is the specimen from the Simi Valley, California, which was figured by Turner to show the character of the shell. In Oregon, the specimens are from the Umpqua formation. This species resembles somewhat *Lucina meganensis* Clark and Woodford, but may be distinguished by its less strongly developed concentric ribs and better defined posterior raised umbonal band.

*Hypotype.* (U.C. 32823.) Figured in the present report, pl. 34, fig. 19.

*Hypotype.* (U.C. 12497.) Figured in the present report, pl. 38, fig. 13.

*Geologic range.* Middle Eocene.

*Geographic distribution.* West side of San Joaquin Valley in California, and in southwestern Oregon.

*Type locality.* (U.C. 3296.) Occurs in Oregon at localities (U.C. A-836) and (U.C. A-838) on the Middle Fork of Coquille River.

**LUCINA ROSEBURGENSIS** Hendon, 1938

Plate 27, figure 11; plate 35, figures 3, 4

*Lucina roseburgensis* Hendon, in Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 51, pl. 9, figs. 12, 13, 1938.

*Original description.* Shell thin, subquadrate, moderately compressed, ornamented by prominent irregularly spaced growth lines; beaks low; ligament almost submerged; lunule short, slightly depressed. Left hinge with one centrally placed cardinal and obscure anterior and posterior laterals. (Hendon, in Turner)

*Observations.* This species differs from *L. washingtonensis* in the more pronounced downward slope of the posterior dorsal margin and more prominent lamellar ribbing. The basal margin makes rounded sub-

angular junctions with the posterior and anterior margins in contrast to the purely rounded junctions in *L. washingtonensis*.

*Holotype.* (U.C. 33665.) Figured in the present report, pl. 35, figs. 3, 4; pl. 27, fig. 11.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* (U.C. A-665.) Douglas County, Oregon, on north bank of North Umpqua River upstream from bend about one-fourth mile north of Glide.

#### **LUCINA WASHINGTONENSIS Turner, 1938**

Plate 27, figure 16; plate 35, figure 2

*Lucina washingtonensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 51, pl. 9, figs. 8, 9, 1938.

*Original description.* Shell heavy, subquadrate; beaks low, nearly central; umbonal region slightly inflated; anterior dorsal margin compressed, elevated; posterior dorsal margin nearly straight; posterior area limited at the lower edge by a very faint, broad, raised fold; disc ornamented by closely set, concentric, lamellar ribbing. Hinge not known. (Turner)

*Observations.* This species which occasionally is present in the Cowlitz formation at Balch, Washington, in a fairly good state of preservation, is characterized by its moderate inflation, rather closely spaced lamellar ribbing, and subquadrate orbicular outline.

*Holotype.* (U.C. 33142.) Figured in the present report, pl. 27, fig. 16; pl. 35, fig. 2.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Oregon and southwestern Washington.

*Type locality.* (U.C. 7170.) Occurs also at (U.W. 42). Railway cut, Union Pacific Railway, 2000 feet east of the Oakville bridge over Chehalis River, Grays Harbor County, Section 1, T. 15 N., R. 5 W.

#### **LUCINA MUIRENSIS (Dickerson), 1914**

Plate 27, figure 12; plate 35, figure 1

*Phacooides muirensis* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 8, p. 132, pl. 10, figs. 11a, 11b, 1914.

*Codakia muirensis* Dickerson, Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 103, 104, pl. 8, fig. 19; pl. 9, fig. 10, 1938.

*Original description.* Shell small, suborbicular, convex; beaks nearly central; in some specimens slightly posterior to the center. Lunule narrow, small; escutcheon long, narrow; posterior dorsal margin nearly straight; anterior dorsal margin slightly excavated under the beaks; anterior and posterior extremities subtruncate; ventral margin broadly rounded. Surface is marked by strong concentric growth lines and by a very faint, narrow, posterior furrow which is absent in young specimens. Dimensions: height, 14.5 mm.; length, 15.5 mm.; convexity, 3:5 mm. (Dickerson)

*Observations.* This species differs from *Phacoides turneri* (Stanton) in the truncation of the extremities, in the slightly posterior position of the beak, and in the lesser prominence of the posterior furrow.

*Holotype.* (U.C. 11682.) Locality (U.C. 243). Not figured in the present report.

*Hypotype.* (U.C. 33663.) Locality (U.C. A-999). Oregon. Figured in the present report, pl. 27, fig. 12; pl. 35, fig. 1.

*Geologic range.* Martinez formation, lower Eocene, California; upper Umpqua formation, middle Eocene, southwest Oregon.

*Geographic distribution.* Coast Ranges of middle California and southwest Oregon.

*Type locality.* (U.C. 243.) Martinez formation at Muir Station, Contra Costa County, California. Occurs also at locality (U.C. A-999). Oyster bed on north bank of North Umpqua River below bend at junction of Little River. (Turner)

### Family UNGULINIDAE

#### Genus TARAS Risso, 1826

*Taras* Risso, Hist. Nat. Europ. Merid., vol. 4, p. 344, 1826.

*Genotype.* *Taras antiquatus* Risso.

#### TARAS PARILIS (Conrad), 1848

##### Plate 35, figure 6; plate 36, figure 4

*Loripes parilis* Conrad, Am. Jour. Sci., ser. 2, vol. 5, p. 432, fig. 7, 1848.

*Diplodonta parilis* Conrad, Dall, Trans. Wagner Free Inst. Sci., vol. 3, p. 1182, 1900.

*Diplodonta (Felaniella) parilis* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 117, pl. 11, fig. 6, 1909.

*Diplodonta (Felaniella) parilis* Conrad, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 76, pl. 5, figs. 4, 6, 1931.

*Taras parilis* (Conrad), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 294, 1931.

*Original description.* Lentiform, inequilateral, not ventricose, length and height equal, summit slightly prominent; margins very regularly rounded. (Conrad)

*Supplementary description.* Shell large, smooth, moderately thick, slightly oblique, equivalve, inequilateral, with a thick brown periostracum which is sometimes preserved in the fossils; beaks low, inconspicuous, nearer the anterior end; dorsal slopes rounded, the anterior shorter, the remainder of the margin rounded, somewhat produced below and behind; surface smooth when not pitted by the pressure of sand grains in the matrix, with only the sculpture of faint incremental lines; valves somewhat inflated, their interior margins smooth, hinge as usual in the genus. Altitude of figured specimen, 24 mm.; latitude, 24 mm.; diameter, 10 mm. (Dall, 101, p. 117)

*Observations.* This Miocene species resembles somewhat *T. harfordi* Anderson but differs in having a longer and straighter hinge line.

*Hypotype.* (U.C. 31944.) Locality (U.W. 415). Figured in the present report, pl. 35, fig. 6.

*Hypotype.* (U.S.N.M. 153930.) Empire formation. Figured in the present report, pl. 36, fig. 4.

*Geologic range.* Middle Miocene to Pliocene.

*Geographic distribution.* California, Oregon, and Washington.

*Type locality.* Middle Miocene from Astoria, Oregon. Occurs also at Coos Bay, Oregon, and at locality (U.W. 416). Clemons logging road on abandoned spur of railroad one-fourth mile north of junction of main line on the point of the first curve in the road, Section 23, T. 17 N., R. 7 W., Grays Harbor County, Washington. Astoria formation.

#### TARAS sp. (Dickerson)

##### Plate 35, figure 11

*Diplodonta* sp. Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pl. 29, fig. 9, 1917.

*Taras* sp. (Dickerson), Effinger, Jour. Paleon., vol. 12, pp. 369, 370, 1938.

*Observations.* This specimen from the Gries Ranch beds in Washington was figured by Dickerson but not described. Later it was discussed by Effinger but not figured because of its poor state of preservation. The umbo and dorsal marginal parts of the shell are broken away. The umbones appear to be anteriorly directed and the surface ornamentation has well-defined, equally spaced, fairly heavy concentric ribs with broad interspaces. The holotype is the only specimen which has been collected.

*Holotype.* (C.A.S. 444.) Figured in the present report, pl. 35, fig. 11.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz River Valley, Washington.

*Type locality.* (U.W. 239.) On south bank of Cowlitz River at old Gries Ranch in Section 25, T. 11 N., R. 2 W., Cowlitz County, Washington.

#### TARAS GRIESENSIS Effinger, 1938

##### Plate 35, figures 7, 14

*Taras griesensis* Effinger, Jour. Paleon., vol. 12, p. 369, pl. 45, figs. 11, 12, 1938.

*Original description.* Shell of moderate size, thin, orbicular, tumid, equilateral, approaching a hemisphere; beaks inconspicuous, slightly prosogyrous; anterior dorsal margin slightly concave; posterior dorsal margin straight, sloping at an angle of 32 degrees and abruptly merging into the almost perpendicular posterior margin; ventral margin arcuate; hinge small, dentition consisting of two cardinals in the left valve, anterior sub-umbonal and deeply bifid; posterior cardinal fused dorsally with the lower margin of ligamental groove; right valve unknown; anterior cardinal margin depressed; sculpture consists only of fine incremental lines. Dimensions of holotype: height, 15.5 mm.; length, 17 mm.; thickness, 5.8 mm. (Effinger)

*Observations.* This species is characterized by a somewhat depressed anterior dorsal margin, a narrow ligamental groove which is only moderately depressed, and, as pointed out by Effinger, the anterior cardinal tooth is situated almost at right angles to the hinge line.

*Holotype.* (U.C. 33520.) Figured in the present report, pl. 35, figs. 7, 14.

*Geologic range.* Lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz River Valley, southwest Washington.

*Type locality.* (U.W. 239.) On south bank of Cowlitz River at old Gries Ranch in Section 25, T. 11 N., R. 2 W., Cowlitz County, Washington.

## SUPERFAMILY CHAMACEA

## Family CHAMIDAE

Genus CHAMA Linnaeus, 1758

*Chama* Linnaeus, Syst. Nat. (10th ed), p. 691, 1758.*Genotype.* *Chama lazarus* Linnaeus.

## CHAMA GRUNSKYI Hanna, 1924

Plate 35, figures 9, 10, 13

*Chama pacifica* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 172, pl. 29, fig. 10, 1917.*Chama grunskyi* Hanna (new name), Proc. Calif. Acad. Sci., ser. 4, vol. 13, p. 162, 1924.*Chama grunskyi* Hanna, Effinger, Jour. Paleon., vol. 12, p. 369, pl. 46, figs. 9, 10, 1938.

*Original description.* Shell rugose, robust, nearly circular in outline, the height axis being but slightly greater than length; hinge plate heavy, arcuate; dentition obscure; irregular squamose incremental lines decorating the shell. Dimensions.—height of imperfect type, 14.5 mm. (Dickerson)

*Observations.* This is the only species of this genus so far recognized in the Tertiary deposits of Oregon and Washington.

*Holotype.* (C.A.S. 399.) Figured in the present report, pl. 35, fig. 9.*Hypotype.* (U.C. 33519.) Figured in the present report, pl. 35, fig. 10.*Hypotype.* (U.C. 33518.) Figured in the present report, pl. 35, fig. 13.*Geologic range.* Gries Ranch beds, lower middle Oligocene.*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 239.) In cliff on south side of Cowlitz River at old Gries Ranch in the northeast quarter of Section 25, T. 11 N., R. 2 W., Cowlitz County, Washington.

## SUPERFAMILY ERYCINACEA

## Family ERYCINIDAE

Genus KELLIA Turton, 1822

*Kellia* Turton, Conch. Insul. Brit., p. 56, 1822.*Genotype.* *Cardium rubrum* Montagu.

## KELLIA TWINENSIS Clark, 1925

Plate 35, figure 8

*Kellia? twinensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 90, 91, pl. 18, fig. 8, 1925.

*Original description.* Shell rather strongly ventricose, beaks prominent, strongly inturned, only slightly prosogyrous, nearly central; anterior dorsal edge gently

convex, posterior dorsal edge straight; anterior end broadly and regularly rounded, posterior end truncated, narrower than anterior end. A narrow depressed posterior dorsal margin on each valve; on right valve this depressed area is separated from main surface of shell by a fairly well-defined umbonal ridge which extends from beaks to lower angulation of truncated end; on the left valve, depressed posterior dorsal margin is somewhat broader than on the right valve and there is no well-defined umbonal ridge separating it from main surface of shell. The right valve appears to be somewhat larger than the left; the dorsal edge and beaks of the former overlap the latter. The writer is somewhat in doubt as to whether this last character might not be the result of one valve sliding over the other, as the type, a very beautiful specimen, is the only one in the collections at hand. Hinge plate not exposed, therefore the uncertainty of generic determination. Dimensions: length, 14 mm.; height, 11 mm.; diameter of both valves, 9 mm. (Clark)

*Observations.* This is the only species of the genus recognized in Oregon and Washington and it is represented by a single specimen.

*Holotype.* (S.U. 5236.) Figured in the present report, pl. 35, fig. 8.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* North side of Olympic Peninsula, Washington.

*Type locality.* (U.W. 680.) Two miles west of Twin Rivers in sea cliff on south side of Strait of Juan de Fuca, Clallam County, Washington.

### Family CORBIDAE

#### Genus CORBIS Cuvier, 1817

*Corbis* Cuvier, Regne Anim., vol. 2, p. 480, 1817.

*Genotype.* *Venus fimbriata* Linnaeus.

#### CORBIS WASHINGTONIANA Clark, 1925

##### Plate 37, figures 1, 3

*Corbis washingtoniana* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 90, pl. 21, figs. 1, 2, 1925.

*Original description.* Shell large, thick, irregularly subovate and in outline somewhat variable; beaks fairly prominent, strongly inturned, only slightly prosogyrous; anterior end from rather acutely to broadly and regularly rounded; posterior end broadly and abruptly truncated, truncated edge being at about right angles to ventral edge; anterior dorsal slope very slightly concave; posterior dorsal slope gently convex; ventral edge broadly and gently arcuate. Lunule fairly large, strongly depressed and sloping inward, very much broader on the right valve than on the left. Surface sculptured by fairly coarse and regular, closely spaced incremental lines. Shell, also, has an internal radiating structure which, on interior of shell near the ventral edge, shows rather strongly as rather coarse, but somewhat indistinct, raised ribs with narrow interspaces. Hinge plate heavy; two cardinals in right valve, posterior cardinal heavy; anterior cardinal thin, almost obsolete on some specimens; anterior lateral heavy, offset on platform from dorsal edge; a small but well-defined posterior lateral behind ligamental groove. Two well-defined cardinals in left valve, the anterior of which is bifid and heavier than the posterior. Anterior and posterior

lateral claspers well developed. Dimensions: length 65 mm.; greatest height 57 mm.; diameter of one valve about 19 mm. (Clark)

*Observations.* This is the only species of the genus known from Oregon and Washington.

*Holotype.* (S.U. 35.) Figured in the present report, pl. 37, figs. 1, 3.

*Geologic range.* Lower Oligocene.

*Geographic distribution.* North side of Olympic Peninsula, Washington.

*Type locality.* (U.W. 705.) On south shore of Mystery Bay, in inlet of Scow Bay, northeast side of Olympic Peninsula, in Section 32, T. 30 N., R. 1 E.

## SUPERFAMILY CARDIACEA

### Family CARDIIDAE

#### Genus LOXOCARDIUM Cossmann, 1886

*Loxocardium* Cossmann, Ann. Soc. Roy. Mal. Belg., vol. 5, p. 172, 1886.

*Genotype.* *Cardium formosum* Deshayes.

#### Subgenus *Schedocardia* Stewart, 1930

*Schedocardia* Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 255, 1930.

*Subgenotype.* *Cardium hatchetigbeense* Aldrich.

#### LOXOCARDIUM (SCHEDOCARDIA) BREWERII (Gabb), 1864

Plate 35, figures 15, 16, 18; plate 38, figures 1, 9; plate 104, figure 12

? *Cardium modestum* Conrad, in W. P. Blake, U.S. 33d Cong., 1st Sess. H. Ex. Doc. no. 129, Append., pp. 7, 11, 1855; Conrad, Rept. Pac. R. R. Surv., vol. 5, pp. 319, 322, pl. 3, fig. 15, 1856.

*Cardium brewerii* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 173, pl. 24, fig. 155, 1864.

*Plagiocardium (Schedocardia) brewerii* (Gabb), Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 256, pl. 12, fig. 6, 1930; Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 52, 53, pl. 9, figs. 6, 7, 1938.

*Arca columbiana* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 1, p. 8, pl. 7, fig. 1, 1922.

*Original description.* Shell moderate in size, subequilateral, subquadrate, a little wider than long; beaks central, strongly incurved; hinge-line nearly straight; anterior and basal margins forming a regular curve; posterior end abruptly truncated. Surface, in advance of a rounded, umbonal ridge, regularly convex; posterior slightly concave and sloping rapidly towards the posterior margin; ornamented by about twenty-five uniform subflattened ribs, with perfectly flat interspaces; the surface of these ribs is sometimes plain, sometimes faintly grooved longitudinally; the interspaces are crossed by numerous minute, squamose lines, which occasionally are visible on the ribs themselves. (Gabb)

*Original description (Arca columbiana).* Shell large and rectangular in outline; nearly equilateral; beaks prominent, umbonal area broad; hinge line straight; cardinal area narrow; dorsal line sloping slightly from the beaks; anterior end

rounded, passing into the ventral margin with a curve; ventral margin only slightly curved, extending abruptly into the posterior end; posterior end straight; posterior end is more flaring and concave than the anterior end; there is a tendency for a slight umbonal ridge to extend from the beaks to the posterior ventral margin; shell ornamented with 22 flat-topped, wide, very prominent radiating ribs with interspaces nearly equal to the width of the ribs. Dimensions.—length 40 mm.; height 35 mm.; thickness 30 mm. (Weaver and Palmer)

*Observations.* Specimens of this species from different localities show considerable variation in the angularity of the umbonal ridge and the number and prominence of the radiating ribs, which may vary in different individuals from 23 to 26.

*Lectotype.* (P.A.N.S. 4560.) Specimen selected by Stewart and figured (267, pl. 12, fig. 6). Figured in the present report, pl. 104, fig. 12.

*Hypotype.* (U.C. 32924.) Locality (U.W. 329). Figured in the present report, pl. 35, figs. 15, 16.

*Hypotype.* (U.C. 33637.) Locality (U.C. 665), Oregon. Figured in the present report, pl. 38, fig. 1; pl. 35, fig. 18.

*Hypotype.* (U.W. 152) (C.A.S. 7414). Figured originally as *Arca columbiana* Weaver and Palmer (301, pl. 8, fig. 1). Figured in the present report, pl. 38, fig. 9.

*Geologic range.* Domengine and Tejon (restricted sense) formations. Middle and upper Eocene.

*Geographic distribution.* California, Oregon, and Washington.

*Type locality.* Tejon Pass, California. Occurs also at many localities in southwest Oregon and in the Cowlitz formation in western Washington.

**LOXOCARDIUM (SCHEDOCARDIA) BREWERII (Gabb) var. OLDROYDI  
(Weaver and Palmer) 1922**

Plate 36, figure 7; plate 38, figures 2, 12

*Cardium breweri* Gabb, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 2, figs. 3a, 3b, 1915. (Cited in text, pp. 49, 50-51, as *Cardium breweri*.)

*Cardium oldroydi* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 20, pl. 8, figs. 3, 11, 1922.

*Original description.* Shell moderate in size, subovate, beaks central; posterior margin nearly straight, rounding into the dorsal and ventral margins; anterior and ventral margins regularly rounded; surface ornamented with about twenty-seven wide, flat-topped, radiating ribs with interspaces about half the width of the ribs; on both sides of each rib at the angle is a series of delicate nodes which are continuous from the beaks to the ventral margin. On the umbonal area they are minute, increasing in size downward; on the portion of the shell below the middle they are very conspicuous; the first two or three posterior interspaces are coarsely cross-striated, many begin to show a divided condition which ultimately gives rise to the bi-pustulate character of the ribs. The ribs have the appearance of being barbed. On one specimen several distinct, short, spiny tubercles occur, situated along a faint mid-groove of the ribs. The whole sculpture is beautiful and delicate. Anteriorly the ribs are often eroded and the presence of the fine nodes obscure; internal margin fluted or grooved. Dimensions.—length 26 mm.; height 25 mm.; thickness 20 mm. (Weaver and Palmer)

*Observations.* The variety *oldroydi* may be distinguished from *Loxocardium breweri* (Gabb) in a lesser sharpness of the posterior um-

bonal slope and the less concave posterior area. The ribs are nodose and tubercles are often developed.

*Holotype.* (U.W. 171) (C.A.S. 7438). Figured in the present report, pl. 38, figs. 2, 12.

*Paratype.* (U.W. 171a) (C.A.S. 7438A). Figured in the present report, pl. 36, fig. 7.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Cowlitz County, Washington.

*Type locality.* (U.W. 329.) On west bank of Cowlitz River one and one-half miles east of town of Vader, Cowlitz County, Washington, Section 28, T. 11 N., R. 2 W.

#### LOXOCARDIUM (SCHEDOCARDIA) OLEQUAHENSIS (Weaver), 1912

##### Plate 36, figure 11

*Cardium olequahensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 34, pl. 5, fig. 55, 1912.

*Cardium olequahensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 24, 1916.

*Original description.* Shell moderate in size, inequilateral and about as long as wide; beak central, incurved and inclined considerably forwards; anterior margin slightly concave sloping downwards rather steeply and merging into the base which is regularly rounded; posterior margin convex, sloping downward steeply and finally becoming vertical; posterior end slightly truncated. A prominent ridge extends from the beak to the base on the surface of the shell a little in front of the posterior margin. Surface ornamented by forty very slightly rounded radiating ribs which are very prominent on the central portion of the surface but less distinct near the anterior margin; interspaces are flat and about three-fourths the width of the ribs. These are crossed by concentric lines of growth. Dimensions.—altitude 20 mm.; longitude 20 mm.; thickness 6.5 mm. (Weaver)

*Observations.* This species bears some resemblance to *L. etheringtoni* Effinger but differs in having smaller beaks and in that the junction of the anterior and posterior dorsal margins makes a smaller angle.

*Holotype.* (U.W. 11) (C.A.S. 483-B). Figured in the present report, pl. 36, fig. 11.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.C. 6.) On Stillwater Creek one mile west of junction of Stillwater and Olequa creeks, Lewis County, Section 30, T. 11 N., R. 2 W.

**LOXOCARDIUM (SCHEDOCARDIA) ETHERINGTONI Effinger, 1938**

## Plate 35, figure 21

*Cardium lincolnensis* Weaver, Dickerson (not Weaver), Proc. Calif. Acad. Sci., ser. 4, vol. 7, pl. 29, figs. 6a, 6b, 1917.  
*Loxocardium etheringtoni* Effinger, Jour. Paleon., vol. 12, p. 370, pl. 45, figs. 6, 7, 1938.

*Original description.* Shell medium sized, thin, sub-ovate in outline, inequilateral in youth but becoming more equilateral in maturity; length slightly exceeding height; moderately convex; beaks centrally located, small slightly prosogyrous; anterior dorsal margin slightly convex; posterior dorsal margin almost straight, merging into steeply sloping truncate posterior end; ventral margin arcuate with an inconspicuous posterior umbonal ridge; hinge with two cardinals in each valve, left posterior cardinal obsolete, left anterior cardinal large, located a little anterior to the beaks and set diagonally across the hinge; right posterior cardinal slightly larger than right anterior cardinal, between these is a deep, triangular socket receiving left anterior cardinal; left valve with anterior and posterior laterals (the posterior may be obsolete in adult) received into corresponding sockets in right valve; ornamentation consisting of 46-47 small rounded ribs alternating with inter-rib areas of about equal width; extreme anterior and posterior ribs sometimes bear short spines; on mature uneroded specimens the central portion of the shell is almost smooth; margins serrate, the internal fluting extending only a short distance inward from the margins. Dimensions of holotype.—height 14.5 mm.; length 16.3 mm.; thickness 6.6 mm. (Effinger)

*Observations.* In general outline this species resembles *Nemocardium lincolnensis* (Weaver), and *L. olequahensis* (Weaver). It differs from the former in having a relatively greater length, in having 46 small rounded ribs instead of 29, and in its less truncate posterior margin. It may be distinguished from *L. olequahensis* in possessing relatively larger beaks and in having the junction of the anterior and posterior dorsal margins forming a larger angle.

*Holotype.* (U.C. 33524.) Figured in the present report, pl. 35, fig. 21.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Lewis County, Washington.

*Type locality.* (U.W. 239.) On south side of Cowlitz River, in bank, in northeast quarter of Section 25, T. 11 N., R. 2 W.

Genus **CERASTODERMA** (Poli) Mörch, 1853

*Cerastoderma* (Poli), Mörch, Cat. Conch. Yoldi., pt. 2, p. 34, 1853.

*Genotype.* *Cardium edule* Linnaeus.

## CERASTODERMA MEEKIANUM (Gabb), 1866

*Cardium meekianum* Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 27, pl. 7, fig. 46, 1866.

*Cardium meekianum* Gabb, Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, pp. 590, 592, 594, 1913.

*Cardium meekianum* Gabb, Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 310, 1922.

*Cerastoderma meekianum* Gabb, Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 262, 263, pl. 13, fig. 5, 1930.

*Lacvicardium (Cerastoderma) meekianum* (Gabb), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 310, 1931.

*Original description.* Shell resembling *C. corbis* (*californianum* and *nuttallii*), but oblique; beaks large, strongly incurved and pointed forwards; anterior end prominent and broadly rounded; posterior end abruptly truncated and very oblique. Surface marked by twenty-two large radiating ribs; these ribs, in the young shell, are acute, becoming rounded as it increases in size, and ultimately becoming distinctly flattened on top; they are crossed by irregular, curved, subsquamose plates which towards the beaks lose their lamellar character, and are represented by little tubercles; the posterior face of the shell is not costate, and the ribs are represented by only a few indistinct radiating lines; the interspaces between the ribs are narrow and flat, or concave. (Gabb)

*Observations.* This species differs from *C. coosensis* (Dall) in being more oblique, in having fewer radiating ribs, and in the lack of sculpture on the submargins.

*Holotype.* (P.A.N.S. 4497.) Not figured in the present report.

*Geologic range.* Upper Miocene and Pliocene.

*Geographic distribution.* California, Oregon and Washington.

*Type locality.* Eagle Prairie, Humboldt County, California. Pliocene.

**CERASTODERMA CORBIS (Martyn), 1788**

Plate 35, figure 17; plate 38, figure 8

*Cochlea corbis* Martyn, Univ. Conch., vol. 2, fig. 80, 1788.

*Cardium (Cerastoderma) corbis* Martyn, Arnold, Mem. Calif. Acad. Sci., vol. 3, p. 140, 1903.

*Cardium corbis* Martyn, Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 207, pl. 4, fig. 36, 1909.

*Cardium corbis* Martyn, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 119, 1909.

*Cardium (Cerastoderma) corbis* Martyn, Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 310, 1922.

*Original description.* Shell large, subtrigonal, ventricose, thick; umbones prominent, anterior to center; surface ornamented with about thirty-seven prominent, regular, squarish, close-set, radiating ridges, which are made more or less rugose by incremental ridges on their surface; near the posterior margin these ridges become more rounded and less prominent; between the ridges are equal, deep, canal-like grooves; margin crenulated; ligament short, external, prominent; each valve with one prominent cardinal tooth, and two laterals, one anterior and the other posterior; muscle impressions prominent, subequal. Dimensions: longitude, 71 mm.; altitude, 71 mm.; diameter, 57 mm. (Arnold, 8, p. 140)

*Observations.* This species may be distinguished by its regular and slightly rugose concentric ribs.

*Holotype.* (U.C. 31942.) Locality (U.W. 417). Figured in the present report, pl. 35, fig. 17; pl. 38, fig. 8.

*Geologic range.* Middle Miocene to Recent.

*Geographic distribution.* California, Oregon, and Washington.

*Occurrence.* (U.W. 417.) Clemons logging road, on abandoned spur at the point of the second curve in the road. Section 23, T. 17 N., R. 7 W., Grays Harbor County, Washington. Astoria formation.

## CERASTODERMA COOSENSE (Dall), 1909

## Plate 36, figure 12

*Cardium (Cerastoderma) coosense* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 118, 119, pl. 13, figs. 3, 4, 1909.

*Cardium meekianum* (Gabb), Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 206, pl. 4, fig. 35, 1909.

*Cardium coosense* Dall, Dall, Am. Jour. Sci., vol. 4, p. 310, 1922.

*Laevicardium (Cerastoderma) corbis* (Martyn) var. *coosense* (Dall), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 308, 1931.

*Original description.* Shell rounded, inflated, moderately thick, with prominent adjacent incurved umbones; anterior dorsal slope short, with a cordate smooth polished space (representing a lunule?) in front of them; posterior slope longer, with an elongate, rather narrow lanceolate escutcheon inclosing the ligamental nymphs (in the figured specimen 11.5 mm. long); base and ends rounded; surface with a well-marked polished periostracum which is frequently preserved in the fossils; sculpture of about 45 (44-49) radial ribs separated by narrower, partly channeled interspaces; the ribs on the anterior third of the shell are subangular, and the interspaces narrower, those on the posterior and middle part are flatter with the interspaces wider and more distinctly channeled; all the ribs are crossed by more or less evident incremental lines and these are emphasized at three or four resting stages on the disk; the margins are slightly crenulated by the sculpture. Altitude, 50 mm.; latitude, 48.5 mm.; diameter, 36.5 mm. in the figured specimen. (Dall)

*Observations.* This species may be distinguished from *C. corbis* (Martyn) in the larger number and greater prominence of the radiating ribs, and from *C. meekianum* in having a larger number of ribs. In the latter species the submarginal areas lack radial sculpture.

*Holotype.* (U.S.N.M. 153933.) Figured in the present report, pl. 36, fig. 12.

*Geologic range.* Empire formation, upper Miocene and Pliocene.

*Geographic distribution.* California, Oregon, and Washington.

*Type locality.* Coos Bay, Oregon (Camman collection). (Dall)

## CERASTODERMA SCAPOOSENSE (Clark), 1925

## Plate 35, figures 19, 20

*Cardium (Cerastoderma) scapoosense* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 91, pl. 22, fig. 5, 1925.

*Original description.* Shell subcircular, heavy; beaks fairly prominent, nearly central, strongly inturned and only slightly prosogyrous; dorsal slopes short; anterior slope slightly convex; posterior slope straight; ventral edge strongly convex. Surface sculptured by about 27 broad, prominent, nearly flat-topped radial ribs with interspaces somewhat narrower than the width of ribs; ligamental groove short. Cardinals and laterals small for the size of the shell. Dimensions: length, 48 mm.; height, 50 mm.; the margins were broken on all specimens studied. (Clark)

*Observations.* This species may be distinguished from *C. corbis* in having fewer and more broadly rounded radial ribs, in being less tumid, and in having less prominent beaks.

*Holotype.* (C.A.S. 680.) Figured in the present report, pl. 35, figs. 19, 20.

*Geologic range.* Middle and upper Oligocene.

*Geographic distribution.* Northwestern Oregon.

*Type locality.* Ten miles northwest of Scappoose, Oregon, in the northeast corner of Section 36, T. 4 N., R. 3 W.

**CERASTODERMA SOOKENSIS** (Clark and Arnold), 1923

Plate 37, figures 4, 5

*Cardium sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 145, pl. 22, figs. 1a, 1b, 2, 1923.

*Original description.* Shell fairly large and heavy; beaks rather inconspicuous for size of shell and slightly prosogyrous; dorsal slopes straight and about equal; posterior end very broadly and gently curved; anterior end broadly and regularly rounded. Surface sculptured by thirty-eight to forty fairly heavy and prominent flat-topped ribs, with flat-bottomed interspaces about equal to the width of the ribs. Near anterior and posterior ends ribbing becomes less prominent. Hinge plate heavy and broad for this genus; nymph plates prominent. Posterior cardinal of right valve prominent, broadly pyramidal and widely separated from anterior cardinal, which is almost obsolete and is attached to the anterior dorsal margin; posterior cardinal of left valve fairly long and slender, situated close to nymph plate; anterior cardinal prominent, narrow and subpyramidal. Cardinals separated by wide interspace. Anterior laterals heavy and well developed; posterior laterals small and tending to become obsolete. Dimensions: height of type specimen, 58 mm.; diameter of one valve, about 18 mm. (Clark and Arnold)

*Holotype.* (U.C. 30291.) Figured in the present report, pl. 37, figs. 4, 5.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Southwestern shore of Vancouver Island.

*Type locality.* In the Sooke sandstone and conglomerate exposed in the sea cliffs between the mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island. (Clark and Arnold)

**Genus NEMOCARDIUM Meek, 1876**

*Nemocardium* Meek, U.S. Geol. Surv. Territories, vol. 9, pp. 167, 168, 1876.

*Genotype.* *Cardium semi-asperum* Deshayes.

**NEMOCARDIUM LINTEUM (Conrad), 1855**

Plate 38, figure 3

*Cardium linteum* Conrad, in U.S. 33d Cong., 1st sess., House Exec. Doc. 129. App. to the Preliminary Geol. Rept. of W. P. Blake, pp. 7, 9, 1855; Pac. R. R. Repts., vol. 5, pp. 318, 320, pl. 2, fig. 1, 1856; Anderson and Hanna, Calif. Acad. Sci., Occas. Pap. no. 11, pp. 42, 166, pl. 3, fig. 3, 1925.

*Cardium cooperii* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 172, 232, pl. 24, fig. 154, 1864.

*Cardium linteum* (Conrad), Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 275, 276, pl. 8, fig. 6, 1930. (See this paper for extended synonymy.)

*Nemocardium linteum* (Conrad), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 52, pl. 10, fig. 10, 1938.

*Original description.* Cordate, ventricose subequilateral, with closely arranged radiating lines, umbonal slope subcarinated; posterior submargin with closely arranged smooth striae, fine, but much larger than those of the disk. (Conrad)

*Observations.* The specimen from Oregon identified by Turner as *N. linteum* closely resembles the type of Conrad. It is badly worn but the radial ribbing on the middle third of the valve is fine; that on the pos-

terior margin still fine but a little coarser; ribs on anterior third of double strength, twenty-three in number, and a little narrower than the inter-spaces. Some variation of these characters may be seen in different specimens.

*Hypotype.* (U.C. 33157.) Figured in the present report, pl. 38, fig. 3.

*Geologic range.* Middle and upper Eocene.

*Geographic distribution.* California and Oregon.

*Type locality.* Martinez area(?), California. Exact location unknown. (Stewart, 267, p. 276)

#### **NEMOCARDIUM LORENZANUM (Arnold), 1908**

Plate 35, figure 22; plate 36, figures 3, 5

*Cardium cooperii* Gabb var. *lorenzanum* Arnold, Proc. U.S. Nat. Mus., vol. 34, p. 366, pl. 33, fig. 6, 1908; Santa Cruz Folio, U.S. Geol. Surv., p. 4, fig. 17, 1909.

*Cardium lorenzanum* Arnold, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 116, 117, pl. 7, figs. 16, 17, 1933 (contains synonymy).

*Original description.* Shell attaining a length of only about 14 mm.; somewhat longer than high; end view of both valves together has a cordate appearance; outline of a single valve subcircular; shell very convex, thin; umbos small, prominent, turned slightly forward, projecting beyond dorsal margin; dorsal margin straight for short distance under umbo, bends off slightly more angularly posteriorly than it does anteriorly; extremities broad and regularly rounded, as is also the base; surface sculptured by fine incremental lines and by numerous fine radiating lines, those over the posterior end being larger and more prominent than those on the remainder of the shell, and distinctly separated from the latter by a faint angle in the surface of the shell extending from umbo to posterior ventral margin. Margin minutely crenulate. Lunule faint or lacking. Dimensions: length, 14 mm.; altitude, 12.5 mm.; diameter of single valve, 4.5 mm. (Arnold)

*Observations.* Specimens of this species are widely distributed in the middle and upper Oligocene of California, Oregon, and Washington. The shell is often well preserved and may be distinguished by its slightly greater width than height, subcircular to subovate outline, the differentiation of the posterior third of the shell from the remainder by a slight umbonal angle, and the existence of heavier radiating ribs on this posterior third than on other parts.

*Holotype.* (U.S.N.M. 165444.) Figured in the present report, pl. 36, fig. 3.

*Hypotype.* (U.C. 32116.) Blakeley formation. Figured in the present report, pl. 36, fig. 5.

*Hypotype.* (U.C. 32115.) Blakeley formation. Figured in the present report, pl. 35, fig. 22.

*Geologic range.* Middle and upper Oligocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* (U.W. 160.) Cliff in north bank of Chehalis River, Grays Harbor County, at the town of Porter, in Section 22, T. 17 N., R. 4 W.

**NEMOCARDIUM LINCOLNENSIS** (Weaver), 1916

## Plate 36, figure 6

*Cardium lincolnensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 40, pl. 3, figs. 36, 37, 1916.

*Original description.* Shell small, subquadrate in outline, moderately inflated, rather thin and nearly equilateral; beaks small; surface of shell sculptured by 29 radiating V-shaped ribs and very narrow interspaces, each of which contains a small thread-like rib. Concentric striations are very faintly developed. The anterior and posterior ribs are set with small flat nodes; middle portion of shell is almost smooth. Margin serrated and internal surface fluted half way to the umbonal cavity. Teeth well developed and cardinals set one above the other. Dimensions: altitude, 9 mm.; longitude, 11 mm.; thickness, 8 mm. (Weaver)

*Observations.* This species is very common in the Lincoln formation and is characterized by the slightly noded radiating ribs on the anterior and posterior thirds of the valve with unnoded and dichotomous ribs on the middle part. The outline is semi-quadrata to semi-oval. The small thread-like ribs in the interspaces as noted in the description are not usually present.

*Holotype.* (U.W. 95) (C.A.S. 458). Figured in the present report, pl. 36, fig. 6.

*Geologic range.* Middle and upper Oligocene.

*Geographic distribution.* Western Washington.

*Type locality.* (U.W. 256.) In railway cut along Union Pacific Railway one-fourth mile north of Galvin Station in Section 26, T. 15 N., R. 3 W.

**NEMOCARDIUM WEAVERI** (Anderson and Martin), 1914

## Plate 36, figures 1, 2

*Cardium weaveri* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 57, 58, pl. 1, figs. 3a, 3b, 1914.

*Original description* Shell of medium size, rounded at the base, somewhat trigonal, inflated; umbones prominent, curved inward and forward; anterior dorsal slope short and slightly concave with a cordate area immediately in front of the beaks; posterior dorsal slope long and slightly convex making a rather sharp curve into the arcuate base; a conspicuous ridge from the beaks to the posterior ventral extremity, giving the valves an angulated appearance and forming a prominent posterior dorsal area in each valve; sculpture consisting of numerous equally spaced radial striations which are replaced on the posterior dorsal area by flattened radial ribs separated by narrow interspaces, the radial ribs becoming obsolete near the margin: about twenty radial ribs on the posterior dorsal area, and between fifty-five and sixty fine radial striations on the remainder of the surface; hinge, typical of the genus *Cardium*. Dimensions: length of the type specimen, 50 mm.; altitude, 48 mm.; thickness, 38 mm. (Anderson and Martin)

*Observations.* This species is characterized by its pronounced angulation of the posterior part of the valves and by the presence of twenty flat-topped radial ribs posterior to the angle and about fifty radial striations on the surface anterior to the angle.

*Holotype.* (C.A.S. 113.) Figured in the present report, pl. 36, fig. 1.

*Paratype.* (C.A.S. 114.) Figured in the present report, pl. 36, fig. 2.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Northwestern Oregon.

*Type locality.* Cliffs at west end of railroad tunnel 3 miles southeast of Timber, Columbia County, Oregon. (Anderson and Martin)

#### **NEMOCARDIUM EUGENENSE (Clark), 1925**

Plate 36, figure 10

*Cardium eugenense* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 91, pl. 22, fig. 6, 1925.

*Original description.* Shell medium in size, subquadrate; height about equal to length; beaks fairly prominent; dorsal slopes straight and about equal; posterior end broadly subtruncate; anterior end broadly and regularly rounded; surface sculptured by about 26 broadly rounded to flat-topped ribs with interspaces narrower than the width of ribs; a fairly broad, slightly depressed posterior dorsal margin but with no well-defined angulation between depressed area and main surface of the shell. Dimensions: length, 11 mm.; height, 11 mm. (Clark)

*Observations.* This species which is related to *N. lincolnensis* may be distinguished from it by its relatively larger size, and by its fewer number of radiating ribs which are flat-topped to rounded in contrast to the V-shaped profile of *N. lincolnensis*. The secondary ribs of the latter species are absent on *N. eugenense*.

*Holotype.* (U.C. 30304.) Figured in the present report, pl. 36, fig. 10.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Willamette Valley, Oregon.

*Type locality.* An unknown locality near Eugene, Oregon. (Clark)

#### **Family VENERIDAE**

##### **Genus CHIONE Megerle von Mühlfeld, 1811**

*Chione* Megerle von Mühlfeld, Gesellschaft Naturf. Freunde zu Berlin, vol. 5, p. 51, 1811.

*Genotype.* *Venus dysera* Chemnitz.

##### **CHIONE SECURIS (Shumard), 1858**

Plate 36, figures 8, 9, 13; plate 37, figure 8; plate 39, figure 15

*Venus securis* Shumard, Trans. St. Louis Acad. Sci., vol. 1, p. 122, 1858.

*Chione securis* Shumard, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 120, pl. 11, fig. 8; pl. 13, figs. 2, 8, 9, 1909.

? *Venus (Chione) clallamensis* Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 183, pl. 1, fig. 13, 1909.

*Chione securis* (Shumard), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 80, 81, pl. 8, figs. 4, 5, 1931.

*Venus (Chione) securis* Shumard, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 320, pl. 17, fig. 1, 1931.

*Original description.* Shell large, ovate-subtrigonal, moderately convex, length a little greater than the height; basal margin and anterior extremity rounded; posterior extremity subangulated; buccal side very short, excavated under the beaks; posterior portion long, angulated from beak to posterior inferior end; corselet excavated superiorly, becoming nearly plane below, and forming almost a right angle with the umbonal region; ligament impression very deep and its edges strongly defined; lunule cordate, somewhat longer than wide, deeply impressed, and its edges strongly defined; beaks rounded, elevated, incurved, situated nearest the anterior extremity; surface marked with subimbricating ribs and fine striae, the ribs attenuated in front and posteriorly; on reaching the posterior angle they are suddenly directed obliquely upward over the corselet and reduced to fine imbricating striae. The anterior muscular impression is rather large, broad ovate and distinct; the posterior one is shallow subovate, broadly rounded below, narrow and truncated above; pallial impression broad and distinctly impressed; sinus triangular, not deep.

When the exterior crust of the shell is removed we find numerous radiating ribs extending from beak to base, crossed by very closely arranged concentric waved lines, and the whole surface presenting a remarkably elegant appearance. The dimensions for a full grown specimen are for the length, 2.2 in., height, 2.8 in., thickness, 1.3 in. (Shumard)

*Supplementary description.* Shell large for the genus, heavy, equivalve, inequilateral, with elevated blunt beaks and a short cordate, slightly impressed lunule but no well-defined escutcheon; sculpture of numerous, low, narrow, flattish, subequal radiating ribs, with narrower, shallower interspaces, crossed by low, irregular, less conspicuous, concentric lamellae; the radial sculpture becomes finer on the anterior portion of the shell near the margin, and is obsolete or absent on the posterior slope, though the concentric sculpture is more regular and close set on the posterior dorsal area; anterior slope of the valves short, the vertical of the beaks near the anterior fourth; posterior dorsal area markedly flattened, slightly arcuate; whole shell somewhat compressed; hinge as usual in the genus (see pl. 11, fig. 8), muscular impressions not very large, moderately impressed; pedal retractor scars distinct, separated from the anterior adductors and rather deeply impressed; pallial line with a short triangular sinus as figured; inner margins of the valves finely crenulate. Longitude of adult, 77 mm.; height, 70 mm.; diameter, 40 mm. (Dall)

*Observations.* This species is very abundant in the Astoria formation of southwest Washington. It attains considerable size and is characterized by its subtriangular outline, and by its broad slightly arcuate posterior dorsal margin which makes a subangular junction with the rather attenuate posterior end. The anterior dorsal margin immediately beneath the umbones is less concave than in *C. parapodema*, *C. ensifera*, or *ensifera* var. *chehalensis*, the three species which it most closely resembles.

*Holotype.* (St. Louis Acad. Sci.) Specimen lost.

*Hypotype.* (U.S.N.M. 153942.) Empire formation. Figured in the present report, pl. 36, figs. 8, 13.

*Hypotype.* (U.C. 31962.) Astoria formation. Figured in the present report, pl. 36, fig. 9; pl. 37, fig. 8.

*Hypotype.* (U.W. 242.) Astoria formation, two miles east of Clallam Bay, Washington. Figured in the present report, pl. 39, fig. 15.

*Geologic range.* Middle and upper Miocene and Pliocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Indefinite, but the following statement is made by Shumard (248, p. 123): "Collected by Doctor Evans in gray, fine-grained sandstone of the Miocene age, at the mouth of Coos Bay, Cape Blanco, and on the shores of the Columbia a short distance above Astoria, Oregon. At all of these localities it is quite common." It is common in Washington at locality (U.W. 418). Clemons logging road on abandoned spur north of junction of main line in Section 23, T. 17 N., R. 7 W., Grays Harbor County, Washington.

#### CHIONE PARAPODEMA (Dall), 1909

Plate 37, figures 6, 7

*Venus parapodema* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 122, pl. 11, fig. 11; pl. 13, fig. 1, 1909.

*Original description.* Shell small for the genus, subtriangular, equivalve, inequilateral, the anterior end shorter; beaks rather elevated, full, anteriorly directed over a deeply impressed, concentrically striated, cordate lunule; anterior slope short, excavated; posterior slope arcuate, slightly flattened, with no definite lunule; ligament strong, deep seated; base roundly arcuate; sculpture of numerous, flattish, crowded concentric low waves or ridges, slightly less prominent in the middle of the disk and becoming obsolete on the posterior slope; when eroded, rib-like radial structure of the shell is often developed, but the surface, when intact, has no radial sculpture; interior inaccessible. Longitude, 59 mm.; altitude, 53 mm.; diameter, 33 mm. (Dall)

*Observations.* It has been pointed out by Dall that this species resembles the Recent species *C. kennicottii* of the Northern Pacific. Among the Miocene species in Washington it resembles *C. ensifera chehalensis* but is proportionately less high and the posterior dorsal margin is less convex. It differs from *C. ensifera* in a more pronounced extension of the anterior end and a less angulate posterior extension.

*Holotype.* (U.S.N.M. 143944.) Figured in the present report, pl. 37, figs. 6, 7.

*Geologic range.* Middle and upper Miocene.

*Geographic distribution.* Western Oregon and Washington.

*Type locality.* Coos Bay, Oregon (Camman collection). (Dall)

#### CHIONE ENSIFERA (Dall), 1909

Plate 37, figure 9; plate 39, figures 2, 3

*Venus lamellifera* Conrad, U.S. Explor. Exped. Geol., p. 724, pl. 17, figs. 12, 12a, 1849.

? *Venus ensifera* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 122, 123, 1909.

*Chione (Chione) ensifera* (Dall), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 79, 80, pl. 7, figs. 4, 5, 6, 7, 8; pl. 8, fig. 1, 1931.

*Venus (Chione) securis* Shumard var. *ensifera* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 320, pl. 17, figs. 2a, 2b, 3, 1931.

*Original description* (*Venus lamellifera*). Subtrigonal; ventricose, ligament margin very oblique and slightly curved, long, posterior margin direct, truncate; basal arcuate. Lateral surface everywhere convex, and having thin concentric elevated lamellae. (Conrad)

*Original statement by Dall (? *Venus ensifera*). Conrad's specific name of 1849 had been previously used for another shell in 1873, so it is necessary to rename it. The lamellae were very profuse, and projected 2 or 3 mm. from the surface of the valve, which was finely closely radiately threaded between them. The hinge is inaccessible, but I should not be surprised if the shell proved to be a *Chione* when better specimens are available for study. It is however quite distinct from either of the *Chiones* described in this memoir from the Oregon Miocene.*

*Supplementary description (*Chione (Chione) ensifera*). Specimens from type locality. Shell medium sized, plump, subtrigonal, sculptured by numerous lamellae with fine radiations threaded between them; beak fairly prominent, situated about two-fifths the distance toward the anterior end; posterior dorsal slope curved slightly; posterior end pointed; ventral margin evenly rounded. Anterior dorsal margin slightly convex; anterior end slightly pointed; lunule incised, sculptured same as rest of shell. Escutcheon usually absent, though a ridge along the dorsal slope is usually present; concentric lines continue across to the edge of the shell. Hinge plate rather small: in the left valve posterior cardinal heavy, usually bifid; middle cardinal shell small, thin, knife-like; anterior cardinal thin, close to the edge of the shell. This tooth is often reduced until almost lost; pallial sinus small. Dimensions (U.C. 31956): length, 48.5 mm.; height, 43.5 mm.; thickness, 30.5 mm. (Etherington)*

*Observations.* The specimen (U.S.N.M. 3611) collected from Astoria, Oregon, by J. D. Dana and later described in 1849 by Conrad (68, p. 724, pl. 17, fig. 12a) as *Venus lamellifera* is very poorly preserved and as figured in the present report shows no surface sculpture but only the general shell outline. Other specimens in a better preserved condition have been obtained from the same area. The species is abundant in the Miocene of Washington and is well represented by figures in this report (pl. 39, figs. 2, 3). The species is less angulate posteriorly than the variety *chehalisensis*, the anterior end is slightly more attenuate, and the lunule more impressed.

*Holotype (*Venus lamellifera* Conrad).* (U.S.N.M. 3611.) Figured in the present report, pl. 37, fig. 9.

*Hypotype.* (U.C. 31959.) Figured in the present report, pl. 39, figs. 2, 3.

*Geologic range.* Middle and upper Miocene.

*Geographic distribution.* Western Oregon and Washington.

*Type locality.* Astoria formation, city of Astoria, Oregon. Abundantly represented at many localities in southwestern Oregon.

#### CHIONE ENSIFERA (Dall) var. CHEHALISENSIS Weaver, 1912

Plate 37, figure 2; plate 39, figure 1

*Chione chehalisensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 60, pl. 8, fig. 71, 1912.

*Chione (Chione) ensifera* var. *chehalisensis* (Weaver), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 80, 81, pl. 8, fig. 2; pl. 9, figs. 4, 5, 8, 11, 1931.

*Original description (C. chehalisensis).* Shell large, subtrigonal, very inequilateral, very thick, equivalve; beaks elevated, situated at the anterior fourth of the shell, medium sized and pointing anteriorly; lunule short, cordate and strongly im-

pressed; escutcheon large and elongate but not very well defined; posterior margin rounded and gradually sloping from the beaks until it becomes vertical; it is sharply flexed where it joins the basal margin. Basal margin evenly arcuate and sharply inclined upward to the anterior end. Anterior end slopes down abruptly from the beaks and then slopes about  $40^{\circ}$  to the anterior end; posterior portion of shell curved around broadly so as to form an angle of  $110^{\circ}$  bringing the real posterior margin 10 mm. anterior to the axis of the fold. Surface sculptured with about eighty rounded radial ribs which show up prominently as the outer surface of the shell becomes worn. The anterior twenty and the posterior twelve ribs are very fine and closely set, the medial forty-eight are about 1 mm. broad and 1 mm. apart, and more pronounced toward the base than toward the beak. These are crossed by numerous irregularly spaced crenate concentric lamellae. Dimensions: longitude, 65 mm.; altitude, 65 mm.; diameter, 33 mm. (Weaver)

*Observations.* *C. ensifera chehalensis* differs from *C. ensifera* in its more subarcuate outline, less produced anterior end, and more angulate posterior end. The posterior dorsal margin is more convex and the lunule is not so deeply impressed.

*Holotype.* (U.W. 51.) Lost. Not figured in the present report.

*Hypotype.* (U.C. 31966.) Astoria formation. Figured in the present report, pl. 37, fig. 2.

*Hypotype.* (U.C. 31964.) Locality (U.W. 416). Figured in the present report, pl. 39, fig. 1.

*Geologic range.* Montesano formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Western Washington.

*Type locality.* (U.W. 46.) In Union Pacific Railway cut at culvert "38 east," 24,000 feet west of South Elma, Grays Harbor County, Washington, Section 7, T. 17 N., R. 6 W.

#### CHIONE MONTESANOENSIS Weaver, 1912

##### Plate 38, figure 11

*Chione montesanoensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 61, 62, pl. 12, figs. 95, 97, 103, 1912.

*Original description.* Shell small, subangular to rounded, moderately thick, inequilateral, equivalve; lunule cordate, concentrically striated, projecting along the medial line and surrounded by a moderately deep groove. No escutcheon observed; beaks moderately high. Posterior dorsal margin nearly straight excepting just behind the beaks where it is slightly concave. It slopes downwards at an angle of  $45^{\circ}$  and then drops nearly vertical and merges into the evenly rounded base; anterior margin slopes steeply from the beak and then flares out and is slightly truncated at the anterior end, where it gently curves and merges into the basal margin. Surface sculptured by numerous concentric ridges evenly spaced and nearly equally developed from the beak to the base; these ridges are crossed by twenty-eight prominent radiating ribs which are equally developed from the beak to the base; at the posterior end of the shell these ribs are narrow; in the center and on the posterior portion of the shell they are broad with deep narrow grooves between them. The beak is sculptured as well as the surface of the shell. Hinge with three cardinal teeth and one obscure posterior lateral; muscular scars prominent; pallial line distinct with a small triangular sinus only extending into the shell about 4 mm. Dimensions: longitude, 25 mm.; altitude, 18 mm.; diameter, 8 mm. (Weaver)

*Observations.* This species has been obtained only from the conglomerates and sandstones in the lower part of the Montesano formation. The form somewhat resembles *Chione bisculpta* Dall from the Empire formation but differs from it in the proportionately greater height, the smaller size of the pallial sinus, and in the presence of alternating primary and secondary radial ribs on portions of the surface.

*Paratype.* (U.W. 52) (C.A.S. 503). Figured in the present report, pl. 38, fig. 11.

*Geologic range.* Lower part of Montesano formation, upper Miocene.

*Geographic distribution.* Grays Harbor County, western Washington.

*Type locality.* (U.W. 68.) In logging railroad cut on Sylvia Creek, in a basal conglomerate of the Montesano formation in Section 32, T. 18 N., R. 7 W.

#### **CHIONE CARMANAHENSIS Clark, 1925**

Plate 39, figures 4, 9, 10

*Chione carmanahensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 93, pl. 18, figs. 1, 2, 3, 4, 1925.

*Original description.* Shell medium in size, trigonal in outline; beaks prominent, strongly prosogyrous and inturned; posterior dorsal slope long and rather strongly convex for about a third of its length, beginning at the umbone, straight below this: anterior end broad and regularly rounded; ventral edge strongly arcuate. Surface sculptured by heavy concentric lamellations which are more prominent and farther apart near the umbones, becoming closely crowded near ventral edge; surface also sculptured by numerous fine radial ribs which extend to but not on escutcheon or lunule. Escutcheon very well defined as a long, narrow area which is depressed at more than a right angle to main surface of shell, surface smooth except for fine concentric lines of growth. Lunule large cordate in outline extending ventrally the entire length of anterior dorsal edge, only slightly depressed but separated by well-defined incised line. Hinge plate fairly heavy on left valve, posterior cardinal not very prominent, situated on top of nymph plate and extending ventrally only about one-third of its length, middle cardinal heavy and deeply bifid. Anterior cardinal long and prominent, not connecting with beak, giving it appearance of a lateral. Dimensions: length, 33 mm.; greatest height, about 32 mm.; length of posterior dorsal slope, about 29 mm.; length of anterior dorsal slope, about 9.5 mm. (Clark)

*Observations.* This species is characterized by the development of a very heavy anterior cardinal tooth having the appearance of a lateral.

*Holotype.* (C.A.S. 683.) Figured in the present report, pl. 39, figs. 4, 9.

*Paratype.* (C.A.S. 684.) Figured in the present report, pl. 39, fig. 10.

*Geologic range.* Upper Oligocene.

*Geographic distribution.* Southern shore of Vancouver Island.

*Type locality.* In exposures of sandstone in the cliffs along the beach one mile west of Carmanah Point, Vancouver Island.

**CHIONE VANCOUVERENSIS** Clark and Arnold, 1923

Plate 39, figures 5, 6, 11; plate 40, figure 1

*Chione vancouverensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 147, pl. 20, figs. 1a, 1b, 2a, 2b, 1923.

*Original description.* Shell subtrigonal in outline; beaks in anterior third of shell, prosogyrous and strongly inturned. Posterior dorsal slope long and gently convex; anterior and posterior ends regularly rounded. Lunule fairly large, heart-shaped, only slightly depressed but marked off by well defined incised line; escutcheon well defined, strongly depressed and more distinct and less coarsely sculptured on left valve than on right. Surface of shell covered by heavy somewhat irregularly spaced concentric lamellae which, when weathered, appear as rounded undulations. Concentric lamellae more widely and regularly spaced near the beaks, becoming more crowded and irregular toward ventral edge. Surface also sculptured by numerous fine radial striations or ribs, which are observable only on a weathered surface and are seen on lunule but not on escutcheon. Hinge plate heavy, ligamental groove deep. Three cardinals on each valve, posterior cardinal of left valve situated on top of nymph plate. Middle and anterior cardinals are heavy and blunt ventrally but are constricted and not so high just under umbo; upper surface of middle cardinal slightly grooved; posterior cardinal of right valve slightly bifid, anterior cardinal almost obsolete. Dimensions of type specimen (left valve): length, 44 mm.; greatest height, 39 mm.; dorsal margin, about 14 mm. (Clark and Arnold)

*Observations.* This upper Oligocene species is nearly as high as long with convexly rounded margins and no radial ornamentation. The concentric ribbing usually is smooth but in badly weathered specimens may appear rather well developed. The species in general outline resembles *C. ensifera* but has a slightly impressed lunule in contrast to the more deeply sunken one in the latter species.

*Holotype.* (U.C. 30052.) Figured in the present report, pl. 39, figs. 5, 6.

*Paratype.* (C.A.S. 584.) Figured in the present report, pl. 39, fig. 11; pl. 40, fig. 1.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South shore of Vancouver Island.

*Type locality.* In the sandstone and conglomerate of the Sooke formation in the sea cliffs between the mouths of Muir and Kirby creeks west of Otter Point, Sooke Bay, Vancouver Island.

**CHIONE BISCULPTA** Dall, 1909

Plate 40, figures 2, 3

*Chione bisculpta* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 121, pl. 11, figs. 10, 12, 1909.

*Original description.* Shell small, rounded, rather thick, with rather small, full, and high beaks, inequilateral, equivalve; lunule cordate, striated, defined by a marked sulcus; escutcheon, if any, obscure; posterior dorsal slope rather straight, base and ends of the shell evenly rounded; sculpture of concentric ridges, a few of which in the middle of the disk are more prominent and wider than the others, which become obsolete toward the base; these ridges are crossed and more or less reticulated by small, rounded, radial subequal, rather close-set ribs which are more conspicuous in the interspaces between the ridges; the beak in the type specimen is worn smooth,

but was probably originally sculptured; hinge with three radiating cardinal teeth, the anterior smallest; there are no indications of lateral teeth; internal margins of the valve coarsely feebly crenulate; muscular scars strongly impressed; pallial line distinct, deeply impressed with a small triangular sinus not reaching the middle of the shell. Longitude, 45 mm.; altitude, 42 mm.; double diameter of the valve, 31 mm. (Dall)

*Observations.* The holotype of this species consists of a single right valve containing a V-shaped lunule which penetrates deeply and whose bisector is nearly horizontal. The radiating ribs serve to distinguish it from many species. The slightly concave outline of the anterior dorsal margin resembles *C. securis* but the general outline of the shell is suborbicular rather than subtriangulate and the posterior margin is broadly rounded.

*Holotype.* (U.S.N.M. 153941.) Figured in the present report, pl. 40, figs. 2, 3.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon, and western side of Olympic Peninsula, Washington.

*Type locality.* Fossil Point, Coos Bay, Oregon (Camman collection). (Dall)

#### "VENUS (CHIONE ?) OLYMPIDEA" Reagan, 1909

##### Plate 39, figure 14

*Venus (Chione ?) olympidea* Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 182, pl. 1, fig. 12, 1909.

*Antigona olympidea* (Reagan) Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 307, 1922.

*Venus (Chione) olympidea* Reagan, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 321, 1931.

*Original description.* Description from a cast: Specimen medium-sized, suboval, convex to gibbous; surface ornamented with fine to coarse concentric lines of growth (judging from a few small fragments of the shell); beaks large, high, anterior, terminal, pointed forward; lunule area large; hinge robust; posterior muscular impression deep, circular; pallial sinus deep, small, triangular; pallial line deep, continuous. Dimensions: latitude, 37 mm.; altitude, 37.5 mm.; diameter, 27.5 mm.; from beak to posterior extremity, 37 mm.; to anterior extremity, 21 mm. (Reagan)

*Observations.* This species, slightly higher than long, is represented by a cast showing the relatively short, V-shaped pallial sinus situated rather high and with its bisector projecting inward and upward at an angle of about 20° from the horizontal. The anterior position of the beaks and the long slightly concave anterior dorsal margin and the broadly rounded posterior margin are characters which serve to distinguish the species.

*Holotype.* (U.S.N.M. 328311.) Figured in the present report, pl. 39, fig. 14.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* South shore of Strait of Juan de Fuca east of Clallam Bay.

*Type locality.* One mile east of Clallam Bay in sea cliffs.

Genus **VENERUPIS** Lamarck, 1818*Venerupis* Lamarck, Hist. Nat. Anim. sans Vert., vol. 5, p. 506, 1818.*Genotype.* *Venus perforans* Montagu.Subgenus **Protothaca** Dall, 1902*Protothaca* Dall, Proc. U.S. Nat. Mus., p. 364, 1902.*Subgenotype.* *Venus thaca* Molina.**VENERUPIS (PROTOTHACA) STALEYI** (Gabb), 1866

Plate 39, figure 17; plate 104, figure 3

*Dosinia staleyi* Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 24, pl. 7, fig. 42, 1866.  
*Tapes staleyi* Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 57, pl. 16, figs. 17, 17a, 1869.*Paphia (Tapes) staleyi* Reagan, Trans. Kansas Acad. Sci., p. 209, pl. 4, fig. 38c, 1909.*Venerupis (Protothaca) staleyi* (Gabb), Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 222, 223, pl. 15, fig. 4, 1930.*Original description.* Shell subcircular, thick, very inequilateral; beaks large, prominent, anterior. Lunule faint, rather large, slightly sunken. Surface smooth, marked by a few lines of growth near the base. Hinge robust. (Gabb, 144, p. 24)*Supplementary notations.* The original figured specimen of this species has not been found. The specimen figured here is the one which Gabb later used to illustrate this species and since it comes from the type locality, it is here designated a neotype. The lunule is large and circumscribed. The two cardinals of the right valve are distinctly bifid and the anterior border of the anterior cardinal pit is produced simulating a narrow anterior cardinal. The pallial sinus is deep, free and broad, the dorsal boundary being almost horizontal. Length, almost complete, 45.7 mm.; height, 41 mm.; thickness of right valve, 12.5 mm.; no. 4490. (Stewart, 267, p. 223)*Observations.* There exist several species of the genus *Venerupis* which show considerable variation in outline and strength of ribbing. Grant and Gale (149A, pp. 328-331) have considered *V. staleyi* and *V. staleyi hannibali* under synonymy with *V. staminea*. Future detailed biologic studies of the group may result in such a solution. The purpose for which this Northwest report is submitted does not permit sufficient time for such investigations and accordingly the *V. staleyi* and *V. staleyi hannibali* are placed as separate biologic units with figured specimens from the Northwest. The specimen of *V. staleyi* figured is the one figured by Reagan from the Quillayute formation (230, p. 209, pl. 4, fig. 38c). In outline it is close to the form of the badly worn specimen first figured by Gabb (144, pl. 7, fig. 42) and the specimen later figured by Gabb (144, pl. 16, figs. 17, 17a). This specimen still later was selected by Stewart as the neotype of the species (P.A.N.S. 4490).*Neotype.* (P.A.N.S. 4490.) Reproduction in Stewart (267, pl. 15, fig. 4). Figured in the present report, pl. 104, fig. 3.*Hypotype.* (U.S.N.M. 328344.) Reagan's specimen from Quillayute formation. Figured in the present report, pl. 39, fig. 17.

*Geologic range.* Pliocene.

*Geographic distribution.* Coast Ranges of California and western side of Olympic Peninsula, Washington.

*Type locality.* Mark West Creek, Sonoma County, California. Also occurs in Quillayute formation at mouth of Quillayute River, Clallam County, Washington.

**VENERUPIS (PROTOTHACA) STALEYI** (Gabb) var. **HANNIBALI** (Howe), 1922

Plate 40, figure 15

*Chione staleyi* (Gabb) Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 121, pl. 13, fig. 6, 1909.

*Paphia (Protothaca) staleyi* Gabb var. *hannibali* Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 98, pl. 10, fig. 1, 1922.

*Pullastra hannibali* (Howe) Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 223 (synonymy), 1930.

*Description (Chione staleyi).* Shell rounded quadrate, somewhat compressed, solid, very inequilateral, equivalve; beaks low, small, anteriorly directed; lunule cordate, strongly concentrically striated, slightly projecting in the middle line, bounded by a deeply impressed line; escutcheon elongate, narrow, lanceolate, wider on the left than on the right valve; posterior dorsal slope convexly arcuate, posterior end rounded-truncate, anterior end rounded, base moderately, evenly arcuate; surface sculptured with low, close-set concentric lamellae, crenate and reticulated by fine, close, subequal, rounded, radial ribs, the ribs have a tendency to associate in pairs and the sculpture is probably normally weaker on the beaks, where in the type specimen it is worn smooth; interior inaccessible, but the inner margins are probably crenate. Longitude, 53 mm.; altitude, 48 mm.; diameter, 25.5 mm.; altitude of lunule, 5.5 mm. (Dall, 101, p. 121)

*Notations.* Dall doubted the identity of this shell with *Paphia staleyi*. A comparison with well preserved material from the type locality of *Paphia staleyi* shows the following differences, on which the new variety has been based:

The sculpture of var. *hannibali* is relatively much coarser and is laid down in pairs. *Paphia staleyi* is decidedly plump, while var. *hannibali* is subcompressed. The beaks of var. *hannibali* are much smaller and lower and more anterior than those of *P. staleyi*. The lunule of *P. staleyi* is impressed while that of var. *hannibali* is defined by a deeply incised line. *Paphia staleyi* is subovate in shape, while var. *hannibali* is decidedly quadrate, the dorsal margin is straighter, and the posterior truncation very much more abrupt and rectangular. (Howe, 166, p. 98)

*Observations.* The above statement by Howe serves to distinguish the two forms. The specimens from the Quillayute are mostly alike in having greater height than the specimen from the Empire formation, which Howe later described as the variety *hannibali*. It would seem as though the latter form should have a varietal rank.

*Holotype.* (U.S.N.M. 153943.) This specimen was figured by Dall as *Chione staleyi* (101, p. 13, fig. 6) and later as *Paphia (Protothaca) staleyi* Gabb var. *hannibali* (166, pl. 10, fig. 1). Figured in the present report, pl. 40, fig. 15.

*Geologic range.* Empire formation of upper Miocene and lower Pliocene in Oregon, and Wildcat formation, lower Pliocene, California.

*Geographic distribution.* Coos Bay, Oregon, and northwestern California.

*Type locality.* Coos Bay, Oregon (Camman collection). (Dall)

**?VENERUPIS WASHINGTONIANA (Weaver), 1912**

*Tapes washingtoniana* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 35, 36, 1912.

*Original description.* Shell of moderate size, thin and inequilateral; beaks about one-third the length of shell from anterior end and directed forwards; anterior margin concave and sloping at an angle of 45° to the anterior end which is very acutely rounded; base broadly rounded; posterior margin slightly convex and sloping at a very low angle to the posterior end where it is broadly truncated. Surface ornamented by numerous well developed concentric ribs and lines of growth; no radiating ribs present. Lunule large, distinct and somewhat narrow, escutcheon absent. Dimensions.—Altitude 25 mm.; longitude 32 mm.; thickness 7 mm. (Weaver)

*Observations.* The holotype of this species was photographed in 1912 and both the specimen and figures were lost in the mail. Accordingly, no figure accompanied the original description. No other specimen of this species has been collected from the Eocene in the Northwest. The form is here listed merely as a matter of record.

*Holotype.* (U.W. 14.) Lost. Not figured in the present report.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 6.) On Stillwater Creek, one mile west of junction of Stillwater and Olequa creeks, Lewis County, Section 30, T. 11 N., R. 2 W.

**Genus MICROCALLISTA Stewart, 1930**

*Microcallista* Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 244, 1930.

*Genotype.* *Cytherea proxima* Deshayes.

**MICROCALLISTA (COSTACALLISTA) CONRADIANA (Gabb), 1864**

Plate 41, figures 5, 6; plate 46, figure 11; plate 104, figure 13

*Tapes conradiana* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 169, 232, pl. 32, fig. 282, 1864.

*Macrocallista conradiana* (Gabb), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, 1914 (Umpqua formation).

*Microcallista? conradiana* (Gabb), Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 244, 245, pl. 12, fig. 3, 1930 (contains synonymy).

*Macrocallista (Costacallista) conradiana* (Gabb), Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 55, 56, pl. 10, figs. 11, 12, 13, 14, 1938.

*Original description.* Shell long, narrow, very inequilateral, oblique; beaks prominent, and placed between a third and a fourth of the distance from the anterior end; cardinal margin sloping nearly straight to the posterior extremity, which is narrow and regularly rounded; basal margin most prominent under the beaks, very broadly rounded posteriorly, sloping upwards rapidly in advance to the anterior end. Lunule small, bordered by a simple impressed line. Surface ornamented by regular concentric ribs, nearly uniform throughout, rounded above, abruptly truncated on the side towards the beaks, and sloping towards the basal margin, so as to present an imbricated appearance, the overlapping being upwards. (Gabb)

*Observations.* This elongate species shows considerable variation in the ratio of length to height, and measurements made by Turner on

specimens from near Glide, Oregon, range from 1.35 to 1.63. Two common forms in the Northwest, *M. conradiana* var. *meganosensis* and *Macrocallista williamsoni*, are both relatively shorter and below the lower limit of 1.35.

*Holotype.* (P.A.N.S. 4561.) Figured in the present report, pl. 104, fig. 13.

*Hypotype.* (U.C. 33082.) Locality (U.C. A-662). Figured in the present report, pl. 46, fig. 11; pl. 41, fig. 5.

*Hypotype.* (U.C. 33109.) Figured in the present report, pl. 41, fig. 6.

*Geologic range.* Upper Eocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Near old Fort Tejon, southern California. Occurs in Oregon at locality (U.O. 144). Douglas County, two and one-half miles up Fall Creek from Little River on Mathews farm in N. E. quarter of Section 6, T. 27 S., R. 3 W.

**MICROCALLISTA (COSTACALLISTA) CONRADIANA (Gabb) var.  
MEGAEOSENSIS (Clark and Woodford), 1927**

Plate 41, figure 9; plate 55, figure 4

*Macrocallista meganensis* Clark and Woodford, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 17, p. 98, pl. 17, figs. 5, 6, 1927.

*Macrocallista (Costacallista) conradiana* var. *meganosensis* Clark and Woodford, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 56, pl. 10, figs. 15, 16, 1938.

*Original description (Macrocallista meganensis).* Shell elongate, oval in outline: beaks anterior of the median line. Anterior dorsal margin short and straight, merging with gradually increasing convexity into the broadly rounded anterior end. Posterior dorsal margin broadly and evenly rounded; posterior end narrow and evenly rounded. Beaks moderately prominent, prosogyrous. Lunule narrow, bordered by an impressed line. Surface ornamented by regularly concentric ribs which are rounded except in the vicinity of the beaks where they are steep and straight sided; the inter-spaces are narrow and the ribs overlap toward the beak. Dimensions.—Type: Length 16 mm.; height 11 mm.; thickness of one valve 5 mm. (Clark and Woodford)

*Observations.* Many of the southwestern Oregon specimens of the group of *Microcallista conradiana* are characteristically shorter than the species *M. conradiana* and correspond in general to the variety described by Clark and Woodford as *meganosensis* from north of Coalinga. It is proportionately shorter than *Macrocallista williamsoni* Weaver and Palmer, and possesses heavier, relatively low, broad slightly rounded ribs.

*Hypotype.* (U.C. 33065.) Figured in the present report, pl. 55, fig. 4; pl. 41, fig. 9.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* (U.C. A-662.) Douglas County, Oregon, on east bank of Little River between highway bridge and the first bend of the stream east of the junction with the North Umpqua River. Center of Section 19, T. 26 S., R. 3 W.

## Genus MACROCALLISTA Meek, 1876

*Macrocallista* Meek, Rept. U.S. Geol. Surv. Territories, vol. 9, p. 179, 1876.

*Genotype.* *Venus gigantea* Gmelin.

## MACROCALLISTA WILLIAMSONI Weaver and Palmer, 1922

Plate 39, figure 12; plate 43, figure 6

*Macrocallista williamsoni* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 21, 22, pl. 10, figs. 1, 2, 1922.

*Macrocallista cf. williamsoni* Weaver and Palmer, Effinger, Jour. Paleon., vol. 12, p. 371, 1918.

*Original description.* Shell large, oval-elongate in outline; inequilateral, beaks situated about one-fourth of the distance from the anterior end; beaks moderate in size; dorsal margin sloping from the beaks, posterior end passing from the dorsal line at an angle of 30° forming a broadly pointed margin, ventral margin regularly curving from the posterior margin and rounding into the anterior end; anterior slightly produced, concave beneath the beaks; surface sculptured with prominent, wide, concentric ribs which cover the entire surface of the shell; the interspaces very narrow, about one-fourth of the width of the ribs. Dimensions.—Length 39 mm.; height 28 mm.; thickness 10 mm. (Weaver and Palmer)

*Observations.* This species may be distinguished from *Microcallista conradiana* (Gabb) in being more elongate and less pointed posteriorly. The concentric ribs are broad with narrower interspaces.

*Holotype.* (U.W. 174) (C.A.S. 7484). Figured in the present report, pl. 43, fig. 6.

*Paratype.* (U.W. 174a) (C.A.S. 7484a). Figured in the present report, pl. 39, fig. 12.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Washington and southwestern Oregon.

*Type locality.* (U.W. 319.) At McClarity Ranch in the south bank of Stillwater Creek, one mile west of Vader, Lewis County, Section 30, T. 11 N., R. 2 W.

## MACROCALLISTA ANDERSONI Dickerson, 1915

Plate 40, figures 4, 5, 6, 12, 14; plate 46, figure 14

*Macrocallista (?) andersoni* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 54, pl. 4, figs. 1a, 1b, 1915.

*Macrocallista andersoni* Dickerson, Anderson and Hanna, Calif. Acad. Sci., Occ. Pap., vol. 11, pp. 162, 163, pl. 3, fig. 8, 1925; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 56, pl. 10, fig. 17, 1938.

*Original description.* Shell elliptical in outline; medium size; beak prominent, a third of shell length from anterior end; posterior dorsal margin nearly straight; posterior end subtruncate; anterior end well rounded; lunule and escutcheon distinct; a well marked shallow umbonal groove extending to the ventral margin near posterior end; hinge characters unknown; numerous lines of growth decorating the shell. The umbonal groove is the unique character of this species and serves to distinguish it from the other west coast venerid forms. Dimensions.—Height, 19 mm.; length, 26 mm.; convexity, 7 mm. (Dickerson)

*Observations.* This species is characterized by its marked posterior subtruncate margin, its prominent posterior umbonal ridge and umbonal groove immediately anterior to it, and numerous fairly prominent low, broad concentric ribs.

*Holotype.* (C.A.S. 269.) Figured in the present report, pl. 40, fig. 6.

*Paratype.* (C.A.S. 270.) Figured in the present report, pl. 40, figs. 4, 14.

*Hypotype.* (U.C. 33088.) Figured in the present report, pl. 40, fig. 5; pl. 46, fig. 14.

*Hypotype.* (U.C. 32981.) Figured in the present report, pl. 40, fig. 12.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Washington, and southern end of San Joaquin Valley, California.

*Type locality.* In east bank of Live Oak Creek about  $\frac{3}{4}$  mile from its mouth, Kern County, California.

#### MACROCALLISTA PITTSBURGENSIS (Dall) 1900

Plate 32, figure 7; plate 41, figures 4, 7, 10, 14

*Meretrix pittsburgensis* Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 5, pl. 36, fig. 22; pl. 43, fig. 15, 1900.

*Macrocallista pittsburgensis* (Dall), Dall, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1253, 1903.

*Macrocallista pittsburgensis* (Dall), Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 11, p. 146, 1918.

*Macrocallista pittsburgensis* (Dall), Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 92, pl. 18, fig. 9; pl. 19, figs. 4, 5, 1925.

*Macrocallista pittsburgensis* (Dall), Clark, Bull. Geol. Soc. Am., vol. 43, p. 816, pl. 19, figs. 1, 2, 1932.

*Original description.* Shell very inequilateral, subcompressed, elongate oval, with rather prominent, irregular, incremental lines; covered with a conspicuous periostracum which is preserved in the fossils; beaks small, low, somewhat anteriorly directed; lunule lanceolate, smooth, rather large, bounded by an incised line; anterior dorsal slope short, straight; posterior slope moderately arcuate, long; ends rounded; base arcuate; hinge normal; posterior right cardinal bifid; pallial sinus pointed in front, nearly reaching the middle of the shell. Length 36 mm.; height 21 mm.; diameter 11 mm.; the beaks one-fifth of the length from the anterior end. (Dall)

*Observations.* This species is one of the most common in the middle Oligocene in Oregon and southwest Washington. It may be distinguished by its subtriangulate outline, attenuate posterior end, slightly convex dorsal margin, and elongate lunule.

*Holotype.* (U.S.N.M. 107396.) Figured in the present report, pl. 41, fig. 10.

*Paratype.* (U.S.N.M. 107399.) Figured in the present report, pl. 41, fig. 14.

*Hypotype.* (U.C. 30358.) Figured in the present report, pl. 41, figs. 4, 7; pl. 32, fig. 7.

*Geologic range.* Middle and upper Oligocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Pittsburg, Oregon. Probably from locality (U.W. 476). Pittsburg Bluffs, Columbia County, Oregon, in road cut and cliff below in Nehalem River.

#### **MACROCALLISTA CATHCARTENSIS (Weaver), 1912**

Plate 40, figures 7, 8, 9, 11

*Chione cathcartensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 62, 63, pl. 10, fig. 79, 1912.

*Macrocallista cathcartensis* (Weaver), Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 117, 118, pl. 8, figs. 1, 2, 3, 1933.

*Original description.* Shell of moderate size, subtriangular, thick and very inequilateral; beaks situated a distance of one-sixth of the length of the shell from the anterior end, and strongly inclined forwards; anterior margin slightly concave and sloping downwards at an angle of 65°; anterior end very acutely rounded; posterior margin arcuate from beak to posterior end, where it forms a sharp angle with the base which slopes up decidedly to the anterior end and gradually to the posterior; sharp angular ridge extending from beak to posterior end and situated just in front of posterior margin; surface sculptured by numerous well developed roughened concentric lines of growth; lunule moderately large but not much impressed. Dimensions.—Altitude 33 mm.; longitude 44 mm.; thickness 10 mm. (Weaver)

*Observations.* This species is relatively higher and shorter than *M. pittsburgensis* and the posterior end is more broadly rounded and less attenuate. The shell is proportionately much thicker. The general outline of the shell is suboval-quadrata. The holotype was collected by the writer in 1907 from the Oligocene sandstone in a small gully on the north slope of Coal Creek Valley in King County, Washington.

*Holotype.* (U.W. 53) (C.A.S. 550). Figured in the present report, pl. 40, fig. 8.

*Hypotype.* (U.C. 32156.) Figured in the present report, pl. 40, fig. 7.

*Hypotype.* (U.C. 32155.) Figured in the present report, pl. 40, fig. 9.

*Hypotype.* (U.C. 32154.) Figured in the present report, pl. 40, fig. 11.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Puget Sound Basin, Washington.

*Type locality.* (U.W. 706.) In brown sandstone in small gully on wooded hillside on east side of Coal Creek about 6,000 feet N. 10° E. from the town of Newcastle, King County, Washington. Northeast quarter of Section 22, T. 24 N., R. 5 E. Occurs also at Restoration Point, Kitsap County, Washington.

#### **MACROCALLISTA WEAVERI Clark, 1918**

Plate 41, figures 1, 2, 3

*Macrocallista weaveri* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 11, p. 146, pl. 12, figs. 4, 7, 1918.

*Macrocallista weaveri* Clark, Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 92, pl. 18, figs. 10, 11, 12, 1925.

*Original description.* Shell medium in size, beaks in the anterior fourth strongly inturned and slightly prosogyrous. Posterior slope fairly long, nearly straight; ante-

rior slope short, straight; area anterior to the beaks rather strongly excavated. Ventral margin regularly arcuate; posterior end obliquely subtruncate. Surface sculptured by regularly spaced and rather deeply incised, concentric lines, between which are finer incremental lines. Extending from the beaks to the lower angle of the posterior subtruncate end is a fairly distinct ridge, the area posterior to which is rather strongly depressed. Lunule faint, larger on right valve than on left, marked off by slightly impressed lines. Escutcheon absent. Ligamental groove a little over half the length of the posterior dorsal margin. Dimensions.—Length, about 33 mm.; height, 22 mm.; greatest diameter, including both valves, 15 mm.; hinge unknown. (Clark)

*Observations.* The figures show variations in general outline of specimens from type locality. The holotype (U.C. 11155) from the Oligocene of middle California resembles figure 1 of this report. The species resembles somewhat *M. cathcartensis* but may be distinguished by the umbonal ridge extending from the umbo to the lower corner of the posterior end and the slightly concave surface immediately behind this ridge.

*Hypotype.* (C.A.S. 682.) Carmanah Point. Figured in the present report, pl. 41, figs. 1, 3.

*Hypotype.* (C.A.S. 681.) Carmanah Point. Figured in the present report, pl. 41, fig. 2.

*Geologic range.* Upper Oligocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington, and the south coast of Vancouver Island.

*Type locality.* (U.C. 1131.) Occurs also at locality (C.A.S. 234). One mile west of Carmanah Point, south coast of Vancouver Island.

#### Genus PITAR Römer, 1857

*Pitar* Römer, Krit. Untersuchung Venus, p. 15, 1857.

*Genotype.* *Venus tumens* Gmelin.

#### PITAR CALIFORNIANA (Conrad), 1855

Plate 40, figures 10, 13; plate 41, figures 15, 16, 17, 18, 19; plate 47, figures 6, 12

*Meretrix californiana* Conrad, in W. P. Blake, U.S. 33d Cong., 1st Sess., H. Ex. Doc. 129, Append., p. 9, 1855; Report Pac. R. R. Surv., vol. 5, p. 320, pl. 2, fig. 4, 1856.

*Pitaria californiana* (Conrad), Anderson and Hanna, Calif. Acad. Sci., Occ. Pap. no. 11, pp. 159, 160, pl. 5, figs. 1, 2, 1925.

*Pitar californiana* (Conrad), Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 53, 54, pl. 12, figs. 4, 5, 1938.

*Original description.* Subcordate, ventricose, inequilateral; posterior extremity truncated somewhat obliquely inwards; basal margin nearly straight in the middle; lunule lanceolate; anterior extremity acutely rounded. (Conrad)

*Observations.* This species which is fairly abundant in southwestern Oregon is characterized by the broadly rounded posterior margin and rather acutely rounded anterior. The concentric ribbing which is rather

fine on the upper half of the shell is characterized by broad flat-topped ribs with very narrow interspaces on the lower half. This latter aids in distinguishing the species from *P. uvasanus* (Conrad).

*Holotype.* (U.S.N.M. 1842.) From Canada de las Uvas. Figured by Conrad as *Meretrix californiana*. Figured in the present report, pl. 41, fig. 15.

*Hypotype* (U.W. 334.) Figured in the present report, pl. 40, fig. 10.

*Hypotype* (U.W. 333.) Figured in the present report, pl. 40, fig. 13.

*Hypotype* (U.C. 33055.) Figured in the present report, pl. 41, fig. 16.

*Hypotype* (U.C. 33081.) Figured in the present report, pl. 41, fig. 17; pl. 47, fig. 12.

*Hypotype* (U.C. 33035.) Figured in the present report, pl. 41, fig. 18.

*Hypotype* (U.C. 33080.) Figured in the present report, pl. 41, fig. 19; pl. 47, fig. 6.

*Geologic range.* Upper Eocene; Cowlitz formation.

*Geographic distribution.* Coos Bay and Willamette Valley, Oregon, and Coal Creek, Cowlitz County, Washington.

*Type locality.* Canada de las Uvas, Kern County, California. Exact place unknown. Occurs also at locality (U.W. 345). Coal Creek at large falls about one-half mile below school house, Cowlitz County, Washington, Section 35, T. 9 N., R. 3 W.

#### Subgenus *Calpitaria* Jukes-Brown, 1908

*Calpitaria* Jukes-Brown, Proc. Mal. Soc. London, no. 8, p. 155, 1908.

*Subgenotype.* *Callista sulcataria* (Deshayes).

#### PITAR (CALPITARIA) UVASANUS (Conrad), 1855

##### Plate 47, figure 13

*Meretrix uvasona* Conrad, U.S. 33d Cong., 1st sess., House Exec. Doc. 129. Append. to Preliminary Geol. Rept. of W. P. Blake, p. 9, 1855; Rept. Pac. R. R. Surv., vol. 5, p. 320, pl. 2, fig. 3, 1857.

*Meretrix uvasona* Conrad, Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 163, 231, pl. 30, fig. 248, 1864.

*Meretrix uvasona* Conrad, White, U.S. Geol. Surv., Bull. no. 51, p. 30, 1889.

*Meretrix tejonensis* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pp. 53, 54, pl. 3, figs. 2a, 2b, 1915.

*Pitar (Calpitaria) uvasonus* (Conrad), Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 235, 236, pl. 12, fig. 7, 1930.

*Original description.* Subtriangular, compressed, concentrically sulcated above, and having a few slight concentric undulations inferiorly; ligament slope very oblique, rectilinear; anterior extremity regularly rounded. (Conrad)

*Observations.* This species common in the upper Eocene of California is figured for comparison with *P. californiana* and *P. uvasonus duprei* and *P. uvasonus coquillensis*. It has not been recognized in Oregon and Washington.

*Hypotype.* (U.C. 33008.) Canada de las Uvas, California. Figured in the present report, pl. 47, fig. 13.

*Geologic range.* Tejon formation, upper Eocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington(?).

*Type locality.* Near old Fort Tejon, Tejon Pass, southern California. (Live Oak Canyon.)

**PITAR (CALPITARIA) UVASANUS (Conrad) subsp. COQUILLENSIS Turner, 1938**

Plate 41, figures 8, 11

*Pitar uvasanus* (Conrad) subsp. *coquillensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 54, pl. 11, figs. 14, 15, 16, 17, 1938.

*Original description.* Shell subtrigonal, elongate, ventral margin broadly rounded, posterior slightly attenuated; beaks elevated and fairly prominent, one third the total length from the anterior end; ribs thin, lamellae and spaces approximately 1.5 mm. apart; lunule slightly depressed. Left valve with three cardinals and anterior lateral; posterior cardinal much shorter than nymph, fused but demarcated by a superficial groove; median cardinal heavy, trigonal, entire, directed toward upper posterior margin; anterior cardinal thin, directed toward postero-ventral margin; anterior lateral elongate, parallel to shell margin. Right valve with three cardinals and anterior lateral socket; posterior cardinal narrow, elongate, slightly grooved, separated from nymph by narrow socket; median cardinal hemicone in form; anterior cardinal thin, auricular, slightly undercut; anterior lateral socket narrowing and undercutting umbonally. Pallial sinus not observed. Dimensions.—altitude 32.6 mm.; length 41.8 mm. (Turner)

*Observations.* This species somewhat resembles *P. uvasanus duprei* Hendon and "Macrocallista" *hornii* in its greater relative elongation and trigonal outline and differs from the latter in its thinner lamellae.

*Holotype.* (U.C. 33076.) Figured in the present report, pl. 41, figs. 8, 11.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.C. A-836.) Bed of Middle Fork of Coquille River opposite Roseburg-Coos Bay Highway Survey station 845 + 33.

**PITAR (CALPITARIA) UVASANUS (Conrad) subsp. DUPREI Hendon, 1938**

Plate 41, figures 12, 13

*Meretrix hornii* Gabb, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, 1914.  
*Pitar uvasanus* (Conrad) subsp. *duprei* Hendon, in Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 54, pl. 11, figs. 10, 11, 12, 13, 1938.

*Original description.* Shell small to medium size, ovate to subtrigonal, inequilateral, beak one third to one fourth the length back from anterior margin of shell; height varies with respect to width, young forms more ovate than mature specimens; ventral margin broadly rounded, surface ornamented by fine lamellar concentric ribs. Hinge poorly preserved but in so far as may be observed in the left valve the posterior cardinal at least partially fused with the nymph, the median trigonal and entire, anterior thin, anterior lateral slightly elongate. Right valve, posterior cardinal

grooved, median entire, rather thin, anterior thin and slightly undercut, lateral socket deep and rather close to anterior cardinal. (Hendon in Turner)

*Observations.* This subspecies somewhat resembles *P. eocenica* (Weaver and Palmer) but differs in its more rounded posterior margin, lower umbones, and thinner lamellar ribs.

*Holotype.* (U.C. 33645.) Figured in the present report, pl. 41, figs. 12, 13.

*Geologic range.* Umpqua formation, upper Eocene.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* (U.O. 139.) Douglas County, Oregon, on north bank of North Umpqua River upstream from the bend a quarter of a mile north of Glide.

#### **PITAR QUADRATUS (Gabb), 1864**

Plate 47, figure 4; plate 104, figure 2

? *Tapes quadrata* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 169, pl. 30, fig. 249, 1864.

*Marcia quadrata* (Gabb), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 49, 1915.

*Marcia quadrata* (Gabb), Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 24, 1916.

*Pitar quadratus* (Gabb), Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 234, pl. 7, fig. 9, 1930.

*Original description.* Shell small, compressed, subquadrate, somewhat variable in shape; cardinal and basal margins convex, subparallel; beaks anterior, nearly terminal; anterior margin deeply excavated under beaks, narrowly rounded below; posterior extremity obliquely truncated. Lunule long, narrow, and bordered by a sharp, impressed line. Surface marked by very fine lines of growth, sometimes obsolete. (Gabb)

*Observations.* The specimen figured on pl. 47, fig. 4, is common in the Cowlitz fauna at the type locality on Cowlitz River. It differs from the middle Eocene form in California in its more quadrate outline and its height is proportionately a little greater compared to length. The very fine concentric growth lines give the surface of the shell a smooth and polished appearance.

*Lectotype.* (P.A.N.S. 4464.) Reproduction of Stewart type (267, pl. 7, fig. 9). Figured in the present report, pl. 104, fig. 2.

*Hypotype.* (U.C. 33022.) Figured in the present report, pl. 47, fig. 4.

*Geologic range.* Middle Eocene: Crescent and Domengine formations. Upper Eocene: Cowlitz formation.

*Geographic distribution.* Coast Ranges of California and Washington.

*Type locality.* From Domengine beds in the vicinity of Clayton and Martinez, Contra Costa County, California.

**PITAR OREGONENSIS (Conrad), 1848**

Plate 42, figures 12, 13, 15, 21

*Cytherea oregonensis* Conrad, Am. Jour. Sci., ser. 2, vol. 5, p. 432, text figure 8, 1848. (Republished by Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 151, fig. 8, 1909.)

*Pitar oregonensis* (Conrad), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 344, 345, 1931.

*Pitar (Pitaria) oregonensis* (Conrad), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 78, 79, pl. 6, figs. 1, 2, 3, 1931.

*Original description.* Suborbicular, ventricose, inequilateral; summits prominent; surface with fine lines of growth; anterior extremity acutely rounded; basal margin rounded; posterior margin obtusely rounded. This species is remarkably similar in form to *C. ovata* Rogers, a fossil of the Virginia Miocene; but it wants the impressed concentric lines of that species. (Conrad)

*Supplementary description.* Shell large, thick, heavy, and subtrigonal in outline; beaks elevated, curving forward and situated about one-third the distance from the anterior end. Posterior margin nearly straight, sloping moderately without any trace of escutcheon developed, posterior end indefinite; anterior dorsal margin convex, anterior end evenly rounded passing into well arcuate base; lunule small, deeply incised, ornamentation similar to the shell; sculpture of all specimens worn, but apparently smooth with evenly developed concentric lines of growth; hinge plate heavy; right valve with long moderately heavy posterior cardinal tooth. Two fairly thin, short, knife-like anterior cardinals with deep socket for a short heavy cardinal from other valve. Socket for a large lateral from left valve. Interior of shell covered with matrix. (Etherington, 140, p. 78)

*Observations.* This species is characterized by its trigonal outline, its relatively small deep lunule, and lack of escutcheon.

*Holotype.* Lost.

*Hypotype.* (U.C. 31949.) Locality (U.W. 425). Figured in the present report, pl. 42, figs. 12, 13, 21.

*Hypotype.* (U.C. 31950.) Locality (U.W. 427). Figured in the present report, pl. 42, fig. 15.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Western Washington and Oregon.

*Type locality.* Astoria, Oregon. Occurs also at locality (U.W. 425). Bed of Rock Creek about one-fourth mile downstream from the falls and just below the old dam site, Grays Harbor County, Section 7, T. 16 N., R. 5 W.

**PITAR DALLI (Weaver), 1916**

Plate 43, figures 1, 2, 3, 4, 5, 8, 11

*Pitaria dalli* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 41, pl. 1, figs. 1, 2, 3, 4, 1916.

*Pitaria (Pitaria) dalli* Weaver, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, p. 278, pl. 21, figs. 4, 5, 6, 7, 8, 9, 1929.

*Original description.* Shell of medium size, inflated and ovate to sub-quadrata; beaks moderately high, incurved and situated a distance from the anterior end of the shell of one-fourth the length of the shell. Anterior dorsal margin short and slightly

concave; base evenly arcuate; posterior dorsal margin very slightly rounded, sloping downward from the beaks at an angle of  $5^{\circ}$  to a point one-fourth the length of the shell from the posterior end; from this point it becomes more sharply arcuate and merges into the base. Just below the posterior dorsal margin a very faint groove-like depression extends from the beaks to the posterior end. Surface concentrically striated by fairly well developed lines of growth. Lunule large, cordate, deep and described by a well-defined impressed line; pallial sinus simple and extending into the shell a distance of one-third the length of the shell. Hinge well developed. Anterior left lateral tooth prominent, short, compressed and very slightly bifid; posterior right cardinal bifid; right anterior lateral groove deeply incised; anterior right cardinal narrow and blade-like; posterior right cardinal bifid; anterior left lateral high and very slightly bifid; anterior left cardinal narrow and sharp; posterior left cardinal broad and rather low; groove between posterior lateral and posterior cardinal deep and broad. Dimensions.—Altitude 43 mm.; longitude 57 mm.; thickness 28 mm. (Weaver)

*Syntype.* (U.W. 97) (C.A.S. 460-C). Figured in the present report, pl. 43, figs. 1, 5.

*Syntype.* (U.W. 97-A) (C.A.S. 460-A). Figured in the present report, pl. 43, fig. 3.

*Syntype.* (U.W. 97-B) (C.A.S. 460-D). Figured in the present report, pl. 43, fig. 4.

*Topotype.* (U.C. 31528.) Figured in the present report, pl. 43, fig. 11.

*Topotype.* (U.C. 31531.) Figured in the present report, pl. 43, figs. 2, 8.

*Geologic range.* Middle Oligocene, Lincoln formation.

*Geographic distribution.* Chehalis Valley, southwestern Washington.

*Type locality.* (U.W. 256). In railroad cut on Union Pacific Railway one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

#### PITAR VANCOUVERENSIS (Merriam), 1897

Plate 43, figures 7, 10, 12

*Cytherea* sp. nov. Merriam, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 2, p. 106, 1896.

*Cytherea vancouverensis* Merriam, Nautilus, vol. 11, p. 64, 1897.

*Cytherea vancouverensis* Merriam, Proc. Calif. Acad. Sci., ser. 3, vol. 1, p. 178, pl. 33, fig. 2, 1899.

*Antigona vancouverensis* (Merriam), Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 146, pl. 19, figs. 2, 3, 1923.

*Original description.* Shell oval, narrowly rounded anteriorly. Beaks prominent. Lunule well marked. The somewhat weathered surface of the shell ornamented by numerous irregularly placed growth ridges. Length of type specimen 66(?) mm.; breadth, 48 mm. Hinge of right valve with three cardinal teeth and a long, deep tooth-pit for the reception of the anterior lateral tooth of the left valve. Pit between the two anterior cardinal teeth of the right valve ordinarily narrower and deeper than *C. newcombei*. (Merriam)

*Observations.* *P. vancouverensis* resembles *P. matthewsonii* Gabb but differs in the character of the depression of the escutcheon, which is absent on the right valve and not well developed in the left.

*Hypotype.* (S.U. 259.) Sooke formation. Figured in the present report, pl. 43, fig. 7.

*Hypotype.* (C.A.S. 583.) Collected in 1913. Sooke formation. Figured in the present report, pl. 43, figs. 10, 12.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Southeast side of Vancouver Island.

*Type locality.* (C.A.S. 231.) In sea cliffs east of the mouth of Kirby Creek, 6 miles west of Sooke, Sooke Bay, Vancouver Island.

**PITAR STOCKI** (Weaver and Palmer), 1922

Plate 39, figure 16; plate 47, figures 5, 10

*Pitaria stocki* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 21, pl. 10, fig. 6, 1922.

*Original description.* Shell medium in size and ovate in outline; very convex; beaks small; anterior end short, slightly curved, extending from the beaks at an angle of 35°; ventral margin arcuate, rounding into the anterior and posterior ends; surface ornamented with numerous flat, concentric ribs with interspaces about half the width of the ribs; concentric ribbing more pronounced on the anterior and posterior slopes and on the lower part of the shell; a very large lunule, extending nearly the length of the anterior end; lunule bounded by an impressed line; teeth normal. Dimensions.—Length 24 mm.; height 22 mm.; thickness 14 mm. (Weaver and Palmer)

*Observations.* In general outline this species resembles *Marcia bunkeri* from the middle Eocene at Glide, Oregon. It may be distinguished from the latter by the protruding anterior end, the less concave posterior dorsal margin, and the more strongly concave anterior dorsal margin.

*Holotype.* (U.W. 173.) Figured in the present report, pl. 39, fig. 16; pl. 47, figs. 5, 10.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 320.) On the south side of Stillwater Creek, below the graveyard about one and one-fourth miles from Vader, Lewis County, Section 30, T. 11 N., R. 2 W.

Subgenus **Lamelliconcha** Dall, 1902

*Lamelliconcha* Dall, Proc. U.S. Nat. Mus., vol. 26, p. 354, 1902.

*Subgenotype.* *Cytherea concinna* Sowerby.

**PITAR (LAMELLICONCHA) CLARKI** (Dickerson), 1917

Plate 42, figures 1, 2, 3, 4, 5, 6, 7, 8, 9

*Pitaria clarki* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 169, pl. 28, figs. 4a, 4b, 4c, 1917.

*Pitaria (Lamelliconcha) clarki* Dickerson, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, p. 279, pl. 22, figs. 1, 2, 3, 4, 1929.

*Pitar (Lamelliconcha) clarki* Dickerson, Effinger, Jour. Paleon., vol. 12, p. 371, 1938; Clark and Anderson, Bull. Geol. Soc. Am., vol. 49, p. 947, pl. 2, figs. 1, 2, 3, 4, 1938.

*Original description.* Shell ovate, solid, concentrically sulcate; pallial sinus ample, deep, reaching the middle of shell, but slightly ascending; hinge with strong

lateral in left valve, weak lateral in right; lunule not deeply impressed, bounded by an incised line, equally divided between the two valves; escutcheon elongate, poorly defined. Dimensions:—length of left valve, 41 mm.; height of left valve, 36.5 mm.; convexity of left valve, 7 mm. (Dickerson)

*Observations.* This species, in outline and ornamentation, resembles *P. eocenica* (Weaver and Palmer) and *P. dalli* (Weaver). It is relatively longer, somewhat more ovate than the former, relatively a little shorter than the latter, and lacks the sharply rounded anterior margin of *P. dalli*.

*Holotype.* (C.A.S. 393.) Figured in the present report, pl. 42, fig. 3.

*Syntype.* (C.A.S. 394.) Figured in the present report, pl. 42, fig. 2.

*Topotypes.* (U.C. 31544) (U.C. 31543) (U.C. 31545). Figured in the present report, pl. 42, figs. 1, 4, 5, 6, 7, 8, 9.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 239.) On east side of Cowlitz River at old Gries Ranch in northeast quarter of Section 25, T. 11 N., R. 2 W.

**PITAR (LAMELLICONCHA) EOCENICA (Weaver and Palmer), 1922**

Plate 39, figures 8, 13; plate 47, figures 7, 9

*Pitaria (Lamelliconcha) eocenica* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 20, 21, pl. 10, figs. 4, 16, 1922.

*Pitaria (Lamelliconcha) eocenica* Weaver and Palmer, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, p. 279, pl. 22, figs. 5, 6, 1929.

*Pitar (Lamelliconcha) eocenica* (Weaver and Palmer), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 55, pl. 11, fig. 9, 1938.

*Original description.* Shell medium in size; ovate; beaks prominent, situated about one-third distance from the anterior end; dorsal margin high; posterior end sloping roundly to the ventral margin; ventral margin regularly and broadly rounded; anterior end produced; concave beneath the beaks; lunule heart-shaped, impressed and bounded by an incised line; escutcheon very narrow; surface ornamented with numerous, lamellar, concentric ribs with interspaces about three times the width of the ribs. Dimensions.—Length 25 mm.; height 22 mm.; thickness 16 mm. (Weaver and Palmer)

*Observations.* This species may be distinguished from *Pitar uvasanus duprei* by its more quadrate outline, less attenuate posterior end, more broadly convex anterior end, and heavier and less closely spaced concentric ribs.

*Holotype.* (U.W. 172) (C.A.S. 7485). Figured in the present report, pl. 39, fig. 13; pl. 47, figs. 7, 9.

*Topotype.* (U.C. ?; Stewart collection?) Figured in the present report, pl. 39, fig. 8.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Coos Bay, Oregon, and lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 320.) In south bank of Stillwater Creek, below the graveyard, about one and one-fourth miles from Vader, Lewis County, Section 30, T. 11 N., R. 2 W.

Subgenus *Katherinella* Tegland, 1929

*Katherinella* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, p. 280, 1929.

*Subgenotype*. *Callocallista arnoldi* Weaver.

## PITAR (KATHERINELLA) ARNOLDI (Weaver), 1916

Plate 44, figures 1, 2, 3, 4, 5, 6, 7, 8, 12; plate 104, figure 10

*Callocallista arnoldi* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 40, 41, pl. 2, fig. 13, 1916.

*Pitaria (Katherinella) arnoldi* (Weaver), Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, pp. 280, 281, 282, pl. 23, figs. 1-11, 1929.

*Pitaria (Katherinella) arnoldi* (Weaver), Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 118, 1933.

*Original description*. Shell of medium size, thin and subquadrate in outline, beaks slightly elevated, strongly curved forwards and situated from the anterior end a distance of about one-fifth the length of the shell. Posterior dorsal margin nearly straight and sloping down from the beak at an angle of about 50° and passing into a very broadly rounded posterior margin; anterior dorsal margin slightly convex and sloping downward at an angle of 30°; anterior margin very slightly truncate to evenly rounded and passing into a broadly arcuate base. Lunule and escutcheon obscure. Surface sculptured by evenly developed concentric lines of growth; radiating ribs are absent. Hinge plate moderately heavy; in left valve there is one short, sharp, high, triangular lateral tooth with a deep groove above; there are two cardinal teeth, the anterior of which is flattened and makes an angle of 25° with the vertical axis of shell; posterior cardinal tooth is triangular in cross section with a long, deep groove behind; posterior lateral long and blade like; pallial sinus deep and extending in one-third the length of the shell. Dimensions.—Altitude 18 mm.; longitude 22 mm.; thickness 10 mm. (Weaver)

*Supplementary description*. Shell thin, smooth, with a long straight hinge line, small, thin, sharply recurved beaks. Left hinge with a long sharp lamination close to the posterior dorsal margin; a large triangular area which receives the long bifid cardinal of the right valve; a middle cardinal which varies from rather heavy and faintly bifid to thin and blade-like, this latter condition seemingly due to wear; a central socket; anterior cardinal thin and blade-like placed directly below the beak; a small anterior lateral rising sharply at the end of the hinge plate and sloping backward and upward, almost reaching the juncture of the cardinals. Hinge formula: Lm01010 R0101010. Pallial sinus rather narrowly pointed and reaching to the center of the shell. (Tegland, 270, p. 281)

*Observations*. The dentition of this species has been noted by Tegland as characteristic of the genus *Pitar*, the genotype of which is *P. tumens* of the Atlantic Coast. The prominent anterior lateral tooth, intermediate in position between a lateral and cardinal, serves to distinguish the dentition. The other characters are pointed out in the supplementary description.

*Holotype*. (U.W. 96) (C.A.S. 459). Figured in the present report, pl. 104, fig. 10; pl. 44, fig. 7.

*Hypotypes*. (U.C. 31533) (U.C. 31536) (S.U. 581) (U.C. 31532) (S.U. 580) (U.C. 31534) (U.C. 31535). Figured in the present report, pl. 44, figs. 1, 2, 3, 4, 5, 6, 8, 12.

*Geologic range.* Lincoln formation, middle Oligocene, and Blakeley formation, upper Oligocene.

*Geographic distribution.* Puget Sound Basin and southwestern Washington.

*Type locality.* (U.W. 256.) In railroad cut on Union Pacific Railway one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

**PITAR (KATHERINELLA) ARNOLDI (Weaver) subsp. ETHERINGTONI Tegland, 1929**

Plate 44, figures 9, 10, 13

*Pitaria (Katherinella) arnoldi* (Weaver) subsp. *etheringtoni* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, p. 283, pl. 23, figs. 12, 13, 14, 1929.

*Original description.* *Pitaria (Katherinella) arnoldi etheringtoni* differs from *P. arnoldi* in having a slight dorsal flattening of the valves and as a consequence a low ridge extending from the umbo to the postero-ventral margin. The anterior lateral tooth in the left valve is a little more pronounced and definitely reaches the dorsal margin of the hinge plate. The posterior cardinal is larger and distinctly bifid and in the latter feature it differs from all the other species considered in this paper. Judging from the material at hand the sub-species *etheringtoni* tends to have a rounder outline than *P. arnoldi*, only a single specimen of the latter being a rounded individual. (Tegland)

*Holotype.* (U.C. 31541.) Figured in the present report, pl. 44, figs. 9, 10.

*Paratype.* (U.C. 31539.) Figured in the present report, pl. 44, fig. 13.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Clallam County, north side of Olympic Peninsula, Washington.

*Type locality.* (U.W. 490.) In very shaly sandstone cliff, beach section 11,000 feet southeast of Slip Point and 13,000 feet due east of the town of Clallam Bay, Clallam County, in northeast quarter of southeast quarter of Section 22, T. 32 N., R. 12 W.

Genus **EOMERETRIX** Turner, 1938

*Eomeretrix* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 59, 1938.

*Genotype.* *Pitaria martini* Dickerson.

**EOMERETRIX MARTINI** (Dickerson), 1914

Plate 42, figures 14, 16, 18, 19, 20; plate 46, figures 9, 12, 13; plate 47, figures 1, 3

*Pitaria martini* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 117, pl. 11, figs. 2a, 2b, 2c, 1914.

*Eomeretrix martini* (Dickerson), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 60, pl. 11, figs. 18, 19, 20, 1938.

*Original description.* Shell of moderate size; elongate, with beaks slightly anterior of the center; anterior dorsal margin somewhat concave; the slightly convex posterior dorsal margin sloping less steeply than the anterior margin; anterior end sharply rounded; posterior end narrowly rounded; ventral margin convex, fluted; a

marked umbonal ridge extending to a point on the ventral margin two-fifths of the distance from the posterior end; a shallow groove running posteriorly, and parallel to the umbonal ridge; lunule long, narrow; escutcheon indistinct. Dimensions: height, 32 mm.; length, 42 mm. (Dickerson)

*Observations.* This species is characterized by its subtrigonal-elongate outline, moderately elevated umbones slightly anterior to the middle, moderately heavy hinge plate with three diverging cardinals in left valve, elongate anterior lateral and short posterior cardinal and anterior cardinals, the latter being trigonal, the three diverging cardinals of the right valve with the anterior lateral socket and elongate posterior cardinal. When the hinge is available this species may be distinguished from other species of other genera somewhat similar in outline.

*Holotype.* (C.A.S. 237.) Figured in the present report, pl. 42, fig. 18.

*Paratype.* (C.A.S. 238-A.) Figured in the present report, pl. 42, fig. 14.

*Topotype.* (U.C. 33668.) Figured in the present report, pl. 42, figs. 19, 20; pl. 46, figs. 9, 12.

*Topotype.* (U.C. 33108.) Figured in the present report, pl. 46, fig. 13.

*Topotype.* (U.C. 33112.) Figured in the present report, pl. 47, figs. 1, 3; pl. 42, fig. 16.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Umpqua River basin, southwestern Oregon.

*Type locality.* On east bank of Little River at junction with Umpqua River in center of Section 19, T. 26 S., R. 3 W.

#### Genus **TIVELINA** Cossmann, 1886

*Tivelina* Cossmann, Cat. Illustrée bas. Paris, vol. 1, p. 107, 1886.

*Genotype.* *Callista tellinaria* Lamarck.

#### **TIVELINA VADERENSIS** (Dickerson), 1915

Plate 42, figures 10, 11

*Macrocallista vaderensis* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 54, pl. 3, figs. 5a, 5b, 5c, 1915.

*Tivelina vaderensis* (Dickerson), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 57, pl. 11, figs. 5, 6, 7, 8, 1938.

*Original description.* Shell trigonal, with beak a third of shell length from broadly rounded anterior end; posterior dorsal margin sloping to a sharply pointed posterior; broadly rounded anterior extending from beak to nearly straight ventral margin; lunule and escutcheon indistinct. The trigonal form of this species makes it easily distinguishable from the other Eocene Veneridae. Dimensions:—height, 19 mm.; length, 26 mm.; convexity, 7 mm. (Dickerson)

*Observations.* This species is very common in the Cowlitz formation. The trigonal outline, dentition, and attenuate posterior end serve to distinguish it from other elements in the fauna. The form described by Turner from the middle Eocene of southwest Oregon resembles it in

outline but the latter specimens have a shorter and posterior cardinal pit and deeper and narrower anterior pit.

*Holotype.* (C.A.S. 267.) Figured in the present report, pl. 42, figs. 10, 11.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 232.) In north bank of Cowlitz River near bend, 2 miles east of Vader, Cowlitz County, Section 28, T. 11 N., R. 2 W. Occurs also in southwest Oregon at locality (U.C. A-661) in Douglas County on east bank of Little River between highway bridge and the first bend of the stream east of the junction with the North Umpqua River. Center of Section 19, T. 26 S., R. 3 W.

#### Genus **PACHYDESMA** Conrad, 1854

*Pachydesma* Conrad, Proc. Acad. Nat. Sci. Phila., ser. 1, vol. 7, p. 31, 1854.

*Genotype.* "*Cythera (Trigonella)" crassatelloides* Conrad = *Donax stultorum* Mawe.

#### **PACHYDESMA WEAVERI** (Dickerson), 1914

Plate 44, figures 11, 14, 15, 16, 21; plate 46, figures 2, 5, 10

*Tivela weaveri* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 117, pl. 11, figs. 3a, 3b, 3c, 1914.

*Pachydesma weaveri* (Dickerson), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 59, pl. 12, figs. 6, 7, 8, 9, 1938.

*Original description.* Shell trigonal, with beak central, equivale; the nearly straight anterior margin sloping steeply to a narrowly rounded anterior end; the slightly convex posterior margin sloping almost as steeply as the anterior; posterior end rounded broadly; base broadly rounded; hinge of right valve exhibiting three strong cardinals and a socket for a lateral in the anterior portion of hinge plate; pallial sinus appearing to be a small V-shaped one; lunule and escutcheon indistinct. Dimensions: Height, 29 mm.; width, 31 mm. (Dickerson)

*Supplementary description* Shell heavy, trigonal; beaks central, inflated; posterior dorsal margin straight or nearly so; anterior dorsal margin straight or slightly concave; anterior end broadly rounded; posterior end less broadly rounded; lunule faintly marked; pallial sinus round-bottomed V, ascending. Left hinge with three cardinal teeth and anterior lateral; posterior cardinal thin and fused to broad trigonal nymph which is sometimes partially divided or bifid; umbonal end of nymph with small excavation; median cardinal heavy, trigonal, vertical; anterior cardinal thin, sometimes directed inside of lateral and sometimes directly aligned with it. Right hinge with three cardinals and anterior lateral socket; anterior cardinal thin and closely hugging margin of shell; median cardinal heavy, trigonal; posterior cardinal elongate, narrow; nymph heavy, elongate, rugose. (Turner)

*Observations.* This species may be distinguished from *P. aragoensis* Turner by its well-rounded posterior margin and more tumid umbones.

*Holotype.* (C.A.S. 239.) Figured in the present report, pl. 44, figs. 14, 21.

*Topotype.* (U.C. 33108.) Figured in the present report, pl. 44, figs. 11, 16; pl. 46, fig. 10.

*Topotype.* (U.C. 33107.) Figured in the present report, pl. 44, fig. 15; pl. 46, figs. 2, 5.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Umpqua River Valley, southwestern Oregon and in Coast Ranges of southern California.

*Type locality.* In east bank of Little River at its junction with Umpqua River in the center of Section 19, T. 26 S., R. 3 W.

#### PACHYDESMA GASTONENSIS (Clark), 1925

Plate 44, figure 17; plate 51, figure 1

*Tivela gastonensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., voi. 15, pp. 93, 94, figs. 1, 2, 3, 1925.

*Original description.* Shell medium in size, equivalved, sub-equilateral; beaks central, only slightly prosogyrous; dorsal slopes straight, about equal; anterior and posterior ends broadly and regularly rounded; ventral edge gently arcuate. Surface sculptured by narrow raised, concentric, rounded undulations on and between which are finer lines of growth. A fairly large lanceolate shaped lunule not depressed, separated from the main surface by an incised line. Near beaks these are separated by wide inter-spaces, but toward ventral edge closely crowded together and less distinct. Three cardinals in each valve; anterior cardinal of right valve thin, situated close to dorsal edge; posterior cardinal bifid; three well-defined, apparently unbifid cardinals in left valve; anterior lateral not very prominent. Nymph plates heavy, with broad, flattened upper surface; this is especially true of surface of right valve. Pallial sinus short and v-shaped, apex pointing to anterior end. Dimensions of type: Height 44 mm.; length about 53 mm. (Clark)

*Observations.* Clark has pointed out certain close relations of this species with *Tivela inezana* Conrad from the lower Miocene of California. It may be distinguished in the broad rounding of the posterior margin, in the absence of raised concentric undulations, and in the less heavy hinge plate.

*Holotype.* (S.U. 5223.) Figured in the present report, pl. 44, fig. 17; pl. 51, fig. 1.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Northwestern Oregon.

*Type locality.* (S.U. N.P. 295.) In sandstone quarry, Scroggins Canyon, Gaston, Oregon.

#### PACHYDESMA ARAGOENSIS Turner, 1938

Plate 44, figures 18, 19, 20; plate 46, figures 1, 4, 7; plate 47, figure 2

*Pachydesma aragoensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 58, 59, pl. 12, figs. 1, 2, 3, 1938.

*Original description.* Shell moderately heavy, subtrigonal; low, irregularly developed concentric ribbing; posterior and anterior dorsal margin straight; umbos small; umbonal angle varying from 97°-110°; pallial sinus deep, short; lunule very long, narrow, lanceolate, not depressed, marked by a faintly impressed line. Left hinge with three diverging cardinal teeth and anterior lateral; posterior cardinal a thin lamellae fused to a heavy bifid nymph, a small excavation appears on the nymph under the umbo; median cardinal fairly heavy; anterior cardinal more elongate; anterior lateral parallel to shell margin and separated from it by a groove. Right

hinge with three cardinals and anterior lateral socket; anterior cardinal thin, close to shell margin and in projected line of inner margin of lateral socket, medial cardinal trigonal, posterior more elongate, nymph elongate, elevated. (Turner)

*Observations.* This species which is close to *P. weaveri* (Dickerson) may be distinguished by its straighter dorsal margin, by the more broadly rounded and extended anterior margin, and by the more sharply pointed and less inflated beaks.

*Holotype.* (U.C. 33114.) Figured in the present report, pl. 44, fig. 18; pl. 46, fig. 1; pl. 47, fig. 2.

*Paratype.* (U.C. 33116.) Figured in the present report, pl. 44, figs. 19, 20; pl. 46, figs. 4, 7.

*Geologic range.* Upper Eocene, lower Coaledo formation.

*Geographic distribution.* Southwest Oregon.

*Type locality.* (U.C. A-858.) Cove in southwest corner of Cape Arago, Coos Bay, Oregon.

**PACHYDESMAS CROWDERI n. sp.**

Plate 46, figure 8

*Description.* Shell subtriangular; anterior dorsal margin very slightly convex and sloping downward at an angle of 35° and merging into the evenly rounded anterior margin which in turn passes into the broadly arcuate ventral margin; posterior margin straight and sloping downward at same angle as the anterior; posterior umbonal angle extends downward posteriorly at an angle of 60° from the horizontal to the junction of the posterior and dorsal margins; surface behind angle very slightly concave; hinge not available on type specimen but fragments of shells which seem to belong to the same species indicate the specimen belongs to the genus *Pachydesma*.

*Holotype.* (U.C. 32966.) Figured in the present report, pl. 46, fig. 8.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.C. A-110.) Two miles south of Kelso, Cowlitz County, Washington.

Genus MARCIA H. and A. Adams, 1857

*Marcia* H. and A. Adams, Gen. Rec. Moll., vol. 2, p. 423, 1857.

*Genotype.* *Venus pinguis* Chemnitz.

**MARCTIA ANGUSTIFRONS (Conrad), 1849**

Plate 45, figures 1, 2, 3, 4

*Venus angustifrons* Conrad, U.S. Explor. Exped. Geol., p. 724, pl. 17, fig. 11, 1849.

*Dione angustifrons* Meek, Conrad, Am. Jour. Conch., vol. 1, p. 152, 1865.

*Venus (Chione) angustifrons* Conrad, Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 181, pl. 1, fig. 9, 1909.

*Marcia oregonensis* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 123, 124, pl. 2, fig. 12; pl. 11, fig. 9; pl. 12, fig. 3, 1909.

*Marcia (Mercimonia) angustifrons* (Conrad), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 81, pl. 6, figs. 4, 6, 7; pl. 7, fig. 3, 1931.

*Original description.* Obliquely cordate, ventricose. Anterior side narrow, rounded. Posterior extremity somewhat truncated, arcuate; ligament margin elevated, arcuate; basal margins arcuate. Exterior surface everywhere convex, marked with fine lines of growth. (Conrad, 68, p. 724)

*Supplementary description.* Shell thin, rather large, with moderately full, anteriorly twisted umbones situated at about the anterior fourth of the shell; equivalve, inequilateral, moderately convex; lunule cordate, bounded by an obsolete impressed line; escutcheon not defined; anterior slope rather straight, posterior arcuate; ends evenly rounded, the anterior slightly attenuated; base evenly arcuate; surface sculptured only with slightly elevated close-set concentric, incremental lines, a little stronger in front; ligament and hinge as usual in the genus; internal margins smooth, muscular impressions large, distinct; pallial line distinct with a short triangular sinus not reaching the middle of the shell. Longitude of large specimen, 60 mm.; altitude, 47.5 mm.; maximum diameter, 31.5 mm. (Dall, 101, p. 123)

*Observations.* The holotype of *Venus angustifrons* Conrad is from Astoria, Oregon. Dall considered it to be equivalent to *Cythere oregonensis* Conrad also from Astoria, Oregon. The type of this latter species is lost.

*Holotype.* ("*Venus angustifrons*") (U.S.N.M. 3492.) Figured by Conrad (68, pl. 17, fig. 11.) Figured in the present report, pl. 45, fig. 1.

*Hypotype.* (U.S.N.M. 153945.) Described by Dall (101, p. 123) from Coos Bay. Figured in the present report, pl. 45, fig. 3.

*Hypotype.* (U.C. 31951.) Astoria formation in southwestern Washington, locality (U.C. 9069). Figured in the present report, pl. 45, figs. 2, 4.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Western Oregon and Washington.

*Type locality.* City of Astoria, Oregon. Occurs also at many localities in the Astoria formation in the Grays Harbor area, southwestern Washington.

**MARCTIA ANGUSTIFRONS (Conrad) var. BREVILINEATA (Conrad), 1849**

Plate 45, figure 7

*Venus brevilineata* Conrad, U.S. Explor. Exped. Geol., p. 724, pl. 17, fig. 13, 1849 (reprint in Dall, 101, pp. 153, 154).

*Marcia oregonensis* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 123, 1909.

*Marcia angustifrons* var. *brevilineata* Conrad, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 82, pl. 6, figs. 6, 7, 1931.

*Original description ("V. brevilineata").* Subtrigonal, ventricose. Anterior extremity truncate; ligament margin elevated, curved; posterior margin subtruncate; basal margin strongly arcuate. The specimen is a cast and it is remarkable for a series of irregular vertical impressed lines or sulci, toward the base, which must correspond with prominent lines on the interior of the valve. (Length of cast 2 inches; height 80/100 L.; thickness 55/100 L. The irregular sulci on the lower half of the cast are nearly half an inch long, and extend upward from the pallial impression. The sinus in the pallial impression is acute triangular. The surface of the cast is faintly concentric undulate.) (Conrad, 68, p. 724)

*Observations.* This variety may be distinguished from *M. angustifrons* by the very anterior position of the beaks and in the specimens from locality (U.W. 415) by the nearly straight and vertical anterior end. (See Etherington, 140, pl. 6, figs. 6, 7.) Specimens (U.C. 31953) and (U.C. 31954).

*Holotype ("Venus brevilineata").* (U.S.N.M. 3608.) Figured by Conrad (68, pl. 17, fig. 13). Figured in the present report, pl. 45, fig. 7.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Northwestern Oregon near mouth of the Columbia River.

*Type locality.* Astoria, Oregon. Occurs also at locality (U.W. 415). Clemons logging road on abandoned spur of railroad 100 feet north of main line in first large cut in Section 23, T. 17 N., R. 7 W.

#### MARClA (MERCIMONIA) BUNKERI (Hanna), 1927

Plate 45, figure 5; plate 47, figures 8, 11

*Dosinia bunkeri* Hanna, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 287, pl. 42, figs. 4, 6, 1927.

*Mercimonia bunkeri* (Hanna), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 60, pl. 10, figs. 5, 6, 7, 8, 9, 1938.

*Original description by Turner.* Shell thin, moderately inflated, ovate, fine concentric ribs; escutcheon separated from disc by an angle; lunule moderate in size, very faint; beaks small, one third to one fourth the length from the anterior margin; ligament long and enclosed. Left hinge with three diverging cardinal teeth, posterior long and narrow, median and anterior shorter successively, entire, and forming an arch touching shell border. Right hinge with three diverging cardinal teeth, anterior and median elongate entire, posterior deeply grooved. In both valves the inner margin of the nymph is raised and has the appearance of an exceedingly long posterior cardinal. (Turner, p. 60)

*Hypotype.* (U.C. 33666.) Locality (U.C. 3608). Figured in the present report, pl. 45, fig. 5; pl. 47, figs. 8, 11.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Southern California and southwestern Oregon.

*Type locality.* San Diego, California. Occurs also at locality (U.C. A-662). Douglas County, Oregon, on east bank of Little River between highway bridge and the first bend of the stream east of the junction with the North Umpqua River, center of Section 19, T. 26 S., R. 3 W.

Genus **VENERELLA** Cossmann, 1886

*Venerella* Cossmann, Ann. Soc. Roy. Malac. Belg., vol. 21, p. 105, 1886.

*Genotype.* *Venerupis hermonvillensis* Deshayes.

Subgenus **Compsomyax** Stewart, 1930

*Compsomyax* Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 224, 1930.

*Subgenotype.* *Saxidomus gibbosus* Gabb. [*Venerella subdiaphana* (Carpenter).]

**VENERELLA (COMPSOMYAX) NEWCOMBEI** (Merriam), 1897

Plate 42, figure 17; plate 43, figure 9; plate 45, figures 6, 8, 15, 17, 18

*Cytherea* sp. nov. Merriam, Univ. Calif. Publ., Bull. Dept. Geol., Sci., vol. 2, p. 106, 1896.

*Cytherea newcombei* Merriam, Nautilus, vol. 11, p. 64, 1897.

*Cytherea* (?) *newcombei* Merriam, Proc. Calif. Acad. Sci., ser. 3, vol. 1, p. 178, pl. 23, figs. 1, 1a, 1899.

*Macrocallista newcombei* (Merriam), Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, p. 576, 1913.

*Saxidomus newcombei* (Merriam), Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 146, 147, pl. 21, figs. 1a, 1b, 2, 1923.

*Original description.* Shell subquadrate to oval, high, moderately thick, truncated anteriorly [should read posteriorly]. Beaks not prominent. Lunule faintly marked. Surface ornamented with numerous irregularly placed growth lines and ridges. On some well preserved specimens a large number of very faint, radial lines are visible. Length of large specimens, 70 mm.; breadth, 55 mm. Hinge of right valve with three cardinal teeth and a short pit for the anterior lateral tooth of the opposite valve. This pit for the reception of the anterior lateral tooth is shallower and much shorter than in the following species. (Merriam, 197, p. 178)

*Holotype.* (U.C. 11932.) Figured in the present report, pl. 42, fig. 17.

*Paratype.* (U.C. 11930.) Figured in the present report, pl. 43, fig. 9; pl. 45, fig. 18.

*Paratype.* (U.C. 11931.) Figured in the present report, pl. 45, fig. 6.

*Paratype.* (U.C. 30224.) Figured in the present report, pl. 45, figs. 8, 15.

*Paratype.* (U.C. 30225.) Figured in the present report, pl. 45, fig. 17.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* From Sooke sandstone and conglomerate in the sea cliffs between the mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

Genus **PELEYORA** Dall, 1902

*Pelecyora* Dall, Proc. U.S. Nat. Mus., no. 26, p. 346, 1902.

*Genotype.* *Cytherea hatchetigbeensis* Aldrich.

**PELEYCYORA AEQUILATERALIS** (Gabb), 1869

Plate 45, figure 9; plate 46, figures 3, 6; plate 104, figure 6

*Venus aequilateralis* Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 184, pl. 30, fig. 76, 1869.

*Pelecyora aequilateralis* (Gabb), Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 237, 238, pl. 8, fig. 13, 1930 (synonymy).

*Pelecyora aequilateralis* (Gabb) var., Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 57, pl. 10, figs. 1, 2, 3, 4, 1938.

*Original description.* Shell small, triangular, the three sides forming a nearly equilateral triangle, with curved sides; beaks small, pointed forwards, and placed very slightly in advance of the middle; cardinal margin sloping rapidly and slightly convex; base broadly and not very prominently convex, rounding up in advance, and uniting by a short curve with the anterior end; the posterior basal angle is much more acute than the anterior; anterior margin slightly excavated under the beaks, nearly straight below. Surface marked by small concentric ribs. Hinge composed of short, robust teeth; muscular scars large, the anterior being the deepest and most strongly marked; pallial sinus shallow; internal margin plain. Length .85 inch; width, .75 inch; height of single valve, .2 inch. (Gabb, 144, p. 184)

*Supplementary description.* Shell characterized by its trigonal shape, fine concentric ribbing and large, faintly marked lunule; pallial sinus deep, rounded, ascending; hinge plate very short. Right valve with three cardinal teeth and deep anterior lateral socket; anterior cardinal thin, close to lateral socket and slightly undercut in a specimen from locality A-844. On the remaining Oregon specimens this last feature is impossible to determine. Specimens from San Diego figured by M. Hanna (1927) show undercutting of the left anterior cardinal as do specimens of the genotype species in varying amount. Median cardinal short, trigonal, and heavy. Posterior cardinal elongate. Nymph apparently smooth and in this respect differs from the genotype. Left valve with three cardinals and anterior lateral. Anterior cardinal thin and close to lateral; median short, heavy, trigonal; posterior thin and almost completely fused with the nymph; lateral subtrigonal to elongate. (Turner, 274, p. 57)

*Lectotype.* (M.C.Z. 15039). Reproduction of Stewart's figure (267, pl. 8, fig. 13). Figured in the present report, pl. 104, fig. 6.

*Hypotype.* (U.C. 33265.) Locality (U.C. A-666). Figured in the present report, pl. 45, fig. 9; pl. 46, figs. 3, 6.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Southern California and southwestern Oregon.

*Type locality.* San Diego. Occurs also in Oregon at locality (U.C. A-666). Douglas County, on north bank of North Umpqua River upstream from the bend a quarter of a mile north of Glide. (Turner)

**PELEYCYORA cf. GABBI** (Arnold), 1909

Plate 45, figure 16; plate 46, figure 15

*Meretrix gabbi* Arnold, U.S. Geol. Surv., Bull. no. 396, p. 49, pl. 3, fig. 4, 1909.  
*Pelecyora cf. gabbi* (Arnold), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 58, pl. 12, fig. 10, 1938.

*Original description.* Shell attaining a length of 30 millimeters, inequilaterally trigonal in outline, gibbous, finely concentrically striated. Beaks prominent, turbid, bent forward, situated well toward the front of the shell; anterior dorsal margin sloping abruptly down to the narrow, sharply rounded extremity; posterior dorsal margin only slightly curved except near beak and near extremity, where it bends

abruptly down, obliquely truncating the end; lower angle of extremity sharper than upper; base regularly rounded, lunule not large; sculpture consisting of numerous sharp, fine, close-set concentric lines and a few lines of interrupted growth, the latter appearing closer together on the later stages of growth. Hinge and interior unknown. Dimensions.—Longitude 29 mm.; latitude 24 mm.; diameter of single valve, 11 mm. (Arnold)

*Observations.* The specimens from Oregon, which have been compared by Turner to *P. gabbi*, show some minor variations in outline. The similarly situated umbo is a little less prominent than in the type specimen from Coalinga. The posterior marginal end is less angulated and more rounded than in *P. aequilateralis*.

*Hypotype.* (U.C. 33119.) Locality (U.C. A-999). Figured in the present report, pl. 45, fig. 16; pl. 46, fig. 15.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Coalinga area, San Joaquin Valley, California, and southwest Oregon.

*Type locality for Oregon form.* Locality (U.C. A-999). Oyster bed on north bank of North Umpqua River near big ripple below bend at junction of Little River. Near Glide, Oregon. (Turner)

#### PELEYCYORA VICTORIANA (Clark and Arnold), 1923

Plate 45, figures 13, 14

*Venus victoriana* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 148, pl. 41, figs. 2a, 2b, 1923.

*Original description.* Shell fairly heavy, beaks well anterior to median line, rather strongly inturned and prosogyrous; posterior dorsal edge, long, gently convex; anterior dorsal edge straight, almost flush with beaks; anterior and posterior ends broadly and regularly rounded; lunule fairly broad and long, only slightly depressed; a marked escutcheonal area on left valve sloping inward extending entire length of posterior dorsal edge, separated from main outer surface of shell by a well defined line of angulation. Exterior surface of shell covered by heavy somewhat irregularly spaced rounded undulations on and between which are finer incremental lines. Interspaces between undulations on upper dorsal half of shell about twice as wide as width of undulations on ventral half. Posterior cardinal of left valve long and narrow and situated on nymph plate. Middle cardinal fairly heavy, bifid. Anterior cardinal narrow, rather long. Interspaces between cardinals noticeably wide and hinge plate heavy and broad. Internal radiating lines can be seen only on weathered portions of shell. Dimensions: Height, 46 mm.; length (posterior and broken), approximately 48 mm. (Clark and Arnold)

*Observations.* This species was described on the basis of a single left valve. No other specimens of the species have been collected.

*Holotype.* (U.C. 30410.) Figured in the present report, pl. 45, figs. 13, 14.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South coast of Vancouver Island.

*Type locality.* (Geol. Surv. Canada 315.) In cliff on shore 1½ miles east of Glacier Point, Vancouver Island.

## Family TELLINIDAE

## Genus TELLINA\* Linnaeus, 1758

*Tellina* Linnaeus, Syst. Nat. (10th ed.), p. 674, 1758.*Genotype*. *Tellina radiata* Linnaeus.

## TELLINA TOWNSENDENSIS Clark, 1925

Plate 45, figures 10, 11, 12; plate 50, figure 4; plate 51, figures 5, 10, 11

*Tellina townsendensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 94, pl. 12, figs. 11, 12, 1925.*Tellina oregonensis* Conrad, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 160, pl. 29, fig. 4, 1917 (Gries Ranch).*Tellina (Tellina) townsendensis* Clark, Effinger, Jour. Paleon., vol. 12, p. 371, pl. 46, fig. 14, 1938.

*Original description.* Shell elongate ovate in outline; beaks posterior to middle of valve. Anterior end regularly rounded; anterior dorsal margin long and gently convex; posterior dorsal edge straight to end of ligamental groove; from this point on, edge becomes broadly and gently convex; posterior end truncated. Surface of right valve with a sharply depressed posterior dorsal margin separated from main surface of shell by a distinct line, which connects the beaks with lower angle of truncated end. Surface of shell smooth. Left valve and hinge unknown. Dimensions: Length about 36 mm.; height 16 mm. (Clark)

*Observations.* This species may be distinguished from *T. eugenia* Dall by its less elongate pallial sinus and by the rather concave outline of the posterior dorsal margin.

*Holotype.* (S.U. 5208.) Figured in the present report, pl. 45, fig. 11; pl. 50, fig. 4; pl. 51, fig. 10.

*Hypotype.* (U.C. 32722.) Gries Ranch beds. Figured in the present report, pl. 45, fig. 10; pl. 51, figs. 5, 11.

*Hypotype.* (C.A.S. 408.) Figured by Dickerson (123, pl. 29, fig. 4). From Gries Ranch beds as *Tellina oregonensis* Conrad. Figured in the present report, pl. 45, fig. 12.

*Geologic range.* Lower Oligocene.

*Geographic distribution.* Wahkiakum and Lewis counties, southwestern Washington and Port Townsend Bay, Puget Sound.

*Type locality.* (U.W. 59.) On Fossil Creek near log dam in logging road cut 3 miles above the junction with Grays River, in northwest quarter of Section 11, T. 10 N., R. 6 W.

## TELLINA SOLEDADENSIS Hanna, 1927

Plate 48, figure 1

*Tellina soledadensis* Hanna, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 291, pl. 42, figs. 1, 2, 5, 1927.*Tellina soledadensis* Hanna, Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 60, 61, pl. 7, fig. 5, 1938.

*Original description.* Shell of moderate size; outline as shown in the figures; anterior rounded; anterior dorsal and posterior dorsal nearly straight, posterior

\* For *Tellina oregonensis* Conrad, species omitted during preparation of manuscript, see page 560.

sharply rounded, ventral broadly rounded; surface sculpturing consists of fairly closely set sharp concentric ridges which are much narrower than the intervening interspaces; concentric ribs cross many rounded radial ribs which are not as wide as the interspaces separating the concentric ribs; radial ribs separated only by lines of contact of two ribs and not by interspaces. Dimensions. *Cotype* 31368: Altitude 27 mm.; length 39 mm.; approximately. *Cotype* 31370: Altitude 29 mm.; length 38 mm.; broken. (Hanna)

*Observations.* This species may be distinguished from *T. remondii* Gabb in the more elongate anterior end and in the straight posterior dorsal margin in contrast to the concave line just below the umbo as in *T. remondii*.

*Hypotype.* (U.C. 33148.) Figured in the present report, pl. 48, fig. 1.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* San Diego County, California, and Douglas County, Oregon.

*Type locality.* (Paleon. Mus. Univ. Calif. A-661.) (U.C. 3975.) Two miles east of La Jolla, California. Occurs also in Oregon at locality (U.C. A-661). Douglas County, on east bank of Little River between highway bridge and the first bend of the stream east of the junction with the North Umpqua River, Section 19, T. 26 S., R. 3 W. (Turner)

#### TELLINA JOLLAENSIS Dickerson, 1916

##### Plate 48, figure 3

*Tellina jollaensis* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 487, pl. 37, fig. 3, 1916.

*Tellina jollaensis* Dickerson, Hanna, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 290, pl. 40, fig. 5, 1927.

*Tellina jollaensis* Dickerson, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 61, pl. 7, fig. 10, 1938.

*Original description.* Shell small, thin, with subcentral rounded beak; posterior dorsal margin with moderate slope to a pointed posterior; anterior dorsal margin with but a slight slope to a rounded anterior; ventral margin very broadly rounded; decoration consisting of fine lines of growth only. Dimensions.—Length, 24 mm.; height, 14 mm.; thickness of two valves, 5 mm. (Dickerson)

*Observations.* The specimen figured by Turner is poorly preserved and there is some question whether it should be identified with the form described by Dickerson from California. The posterior dorsal margin is nearly straight in contrast with the strong arching of the holotype from California. The exact identification will await the availability of better preserved material.

*Hypotype.* (U.C. 30972.) From locality (U.C. 5091), Tecolote Creek, San Diego County, California. Figured by Hanna (159, pl. 40, fig. 5). Figured in the present report, pl. 48, fig. 3.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* San Diego County, California, and southwestern Oregon.

*Type locality.* (U.C. 2226.) Occurs also at locality (U.C. 5091). Tecolote Creek Quadrangle, San Diego County, California. Occurs in southwestern Oregon at locality (U.C. A-838). Middle Fork of Coquille River opposite Roseburg-Coos Bay Highway Survey station 834 + 34. (Turner)

## TELLINA CASTACANA Anderson and Hanna, 1925

## Plate 51, figure 2

- Tellina longa* Gabb, Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, p. 672, 1913.  
*Tellina longa* Gabb, Weaver, Proc. Calif. Acad. Sci., ser. 4, vol. 6, p. 11, 1916.  
*Tellina castacana* Anderson and Hanna, Calif. Acad. Sci., Occas. Pap. no. 11, p. 153, pl. 2, fig. 13, 1925.  
*Tellina cf. castacana* Anderson and Hanna, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 61, pl. 7, fig. 8, 1938.

*Original description.* Shell small, thin, and inconspicuous; the anterior dorsal slope straight; basal margin almost straight; upper and lower marginal lines almost parallel, or the prolongation of them forming a very acute angle; anterior end regularly rounded; posterior end truncate, very slightly convex; angle at beak about  $143^{\circ}$ ; posterior and basal margins meeting in an angle of about  $50^{\circ}$ ; surface sculptured with fine, flat-topped, concentric ridges which are twice as wide on the anterior end as on the posterior; posterior slope flat, separated from remainder of surface by a sharp angle, in front of which, and near the margin is a shallow depression. Length of type, 13 mm.; height, 7.4 mm. (Anderson and Hanna)

*Observations.* The holotype of this species came from Live Oak Creek in Kern County, California. The form from Oregon was obtained from beds of the upper Coaledo formation at Yokam Point south of Coos Bay. The posterior end of the specimen figured by Turner (274, pl. 7, fig. 8) has been broken and the downward extension of the posterior dorsal margin is not represented in pl. 51, fig. 2. The shell is proportionately much lower than the type of *T. castacana* figured by Anderson and Hanna. It may be a new species.

*Hypotype.* (U.C. 33140.) Locality in southwest Oregon (U.C. A-718). Figured in the present report, pl. 51, fig. 2.

*Geologic range.* Tejon formation in California and upper Coaledo formation in southwestern Oregon; upper Eocene.

*Geographic distribution.* Kern County, California, and Coos Bay, Oregon.

*Type locality.* Live Oak Creek, Kern County, California. Occurs in Oregon at locality (U.C. 718) (U.W. 758), Yokam Point, Coos Bay area.

## TELLINA COWLITZENSIS Weaver, 1916

## Plate 51, figure 13; plate 57, figure 12

- Tellina cowlitzensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 42, pl. 2, fig. 14, 1916.  
*Tellina cf. cowlitzensis* Weaver, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 61, pl. 7, fig. 7, 1938.

*Original description.* Shell large, thin, compressed and about two-fifths longer than high; beaks a little anterior to the center and moderately prominent; anterior dorsal margin slopes downwards at a low angle and then becomes evenly and sharply arcuate and merges into a long but nearly straight base; posterior dorsal margin slopes downward sharply at first and then at a lower angle in a slightly sinuous manner to the posterior end where it is obliquely truncated; a well defined ridge passes from the beak to the posterior basal angle on the right valve; just an-

terior to this ridge there is a long groove-like depression which becomes more pronounced near the base. Surface ornamented by numerous moderately strong concentric lines of growth which are irregularly spaced; radiating ribs are absent. Dimensions—Altitude 37 mm.; longitude 57 mm.; thickness 5 mm. (Weaver)

*Observations.* This upper Eocene *Tellina* has been found in Washington only in the strata on Coal Creek in Cowlitz County. Turner has figured a form from the upper Eocene in the Willamette Valley, Oregon, which seems to be identical. It differs from *T. soledadensis* Hanna in having a more convex anterior dorsal margin, a sharper posterior umbonal angle and ridge, more attenuate posterior end, and in lacking radial ribbing.

*Holotype.* (U.W. 99) (C.A.S. 7463). Figured in the present report, pl. 51, fig. 13; pl. 57, fig. 12.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington, and in Willamette Valley, Oregon.

*Type locality.* (U.W. 248.) East bank of Coal Creek, Cowlitz County, about  $1\frac{1}{4}$  miles downstream from Inman-Poulsen Logging Company's store, southeast quarter of Section 10, T. 8 N., R. 3 W. Occurs also at locality (U.C. A-854) at Spencer, Willamette Valley, Oregon.

#### TELLINA LINCOLNENSIS Weaver, 1916

##### Plate 48, figure 2

*Tellina lincolnensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 42, pl. 3, fig. 30, 1916.

*Tellina (Moerella) lincolnensis* Weaver, Effinger, Jour. Paleon., vol. 12, pp. 371, 372, 1938.

*Original description.* Shell small, moderately convex and subrectangular in outline; beaks fairly prominent, directed forwards and situated a distance of two-thirds the length of the shell from the anterior end; anterior dorsal slope very slightly convex and elongate; anterior margin evenly but sharply rounded; posterior dorsal margin concave and merging into an evenly rounded posterior margin; basal margin evenly and broadly rounded. Surface sculptured by moderately developed concentric lines of growth only; a very slightly elevated ridge extends from beaks to the lower portion of posterior end of shell; posterior end slightly deflected to the right; pallial sinus of medium length. Dimensions—Altitude 7 mm.; longitude 12 mm.; thickness 3 mm. (Weaver)

*Observations.* This species may be distinguished from *T. obruta* of the Astoria formation in being relatively longer, in lacking the posterior umbonal angle of the valves. The posterior margin of *T. lincolnensis* is more rounded than in *T. obruta* and the posterior dorsal margin is somewhat more concave in outline.

*Holotype.* (U.W. 98) (C.A.S. 553). Figured in the present report, pl. 48, fig. 2.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Chehalis River Valley, Washington, and at Gries Ranch, lower Cowlitz River Valley.

*Type locality.* (U.W. 256.) In railroad cut on Union Pacific Railway 1 mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

## TELLINA GIBSONENSIS Van Winkle, 1918

## Plate 52, figure 5

*Tellina gibsonensis* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, pp. 83, 84, pl. 6, fig. 7, 1918.  
"Tellina" *gibsonensis* Van Winkle, Effinger, Jour. Paleon., vol. 12, p. 372, 1938.

*Original description.* Shell small, thin, inequilateral and smooth; beaks low, and situated about two-fifths the length of the shell from the anterior end; posterior end extended; posterior dorsal margin slopes down from the beaks at an angle of about 15° and gradually merges into the sharply arcuate posterior margin, which in turn merges into a very broadly rounded base; anterior margin sloping down from the beaks very sharply at first and then much more gently to the anterior end; anterior end truncated. A ridge or fold extends from the umbones to the anterior basal margin. Posterior to this fold there is a faint concavity which extends halfway down the surface and merges into the basal margin. Dimensions—Altitude 15 mm.; longitude 20 mm.; thickness 6 mm. (Van Winkle)

*Observations.* This species as yet has been recognized only in the Gries Ranch beds on Cowlitz River. It may be distinguished by the nearly central position of the beaks, the slightly concave portion of the surface of the shell just in front and behind the posterior umbonal ridge, and character of the posterior dorsal and the posterior margins.

*Holotype.* (U.W. 130) (C.A.S. 7461). Figured in the present report, pl. 52, fig. 5.

*Geologic range.* Lower and middle Oligocene. Gries Ranch beds and Lincoln formation.

*Geographic distribution.* Chehalis and lower Cowlitz River valleys, Washington.

*Type locality.* (U.C. 367.) On Gibson Creek a few hundred feet above where the creek crosses the Northern Pacific Railway, about 3 miles southeast of Porter, Grays Harbor County, Section 2, T. 16 N., R. 5 W.

## TELLINA PITTSBURGENSIS Clark, 1925

## Plate 48, figure 4

*Tellina pittsburgensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 95, pl. 12, figs. 8, 9, 1925.

*Original description.* Shell elongate, subovate; beaks inconspicuous, strongly inturned but not twisted. Anterior dorsal edge long, straight; posterior dorsal edge straight as far as posterior end of ligamental groove, beyond which it is slightly concave. Posterior end bluntly rounded to subtruncate, anterior end broadly and regularly rounded. On left valve a narrow, slightly depressed, posterior dorsal margin, on which between beak and posterior end, is a distinct sinus or groove. Main surface of shell, just anterior to posterior depressed area, slightly depressed, and on it a faint almost obsolete sinus. On right valve are two somewhat indistinct posterior umbonal ridges, one below lower angulation of subtruncated end and beak, the other between upper subangulation and beak; about halfway between these two ridges and parallel with them is a narrow but distinct groove; a narrow depressed margin posterior to the posterior umbonal ridge. Hinge plate not exposed. Dimensions.—Length 18 mm.; height 10 mm. (Clark)

*Observations.* This species originally was established on general outline and ornamentation. The hinge was not available for examination.

*Paratype.* (C.A.S. 705.) Figured in the present report, pl. 48, fig. 4.

*Geologic range.* Middle Oligocene, Pittsburg Bluff beds.

*Geographic distribution.* Northwestern Oregon.

*Type locality.* In sandstone cliff along Nehalem River near old Pittsburg lumber mill, just past bridge below Vernonia, Oregon.

**TELLINA KAMAKAWAENSIS Clark, 1925**

Plate 48, figure 7; plate 51, figure 7

*Tellina kamakawaensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 95, pl. 12, fig. 13, 1925.

*Original description.* Shell elongate ovate; beaks well posterior to middle of valve, posterior end rostrate and broadly but obscurely truncate, upper angulation of subtruncated end being nearly obsolete, rounding into posterior dorsal edge. Anterior dorsal edge long and gently convex, posterior dorsal edge straight. On both valves there is a fairly strongly depressed or beveled posterior dorsal margin, which is set off from main surface of shell by well-defined line of angulation. Surface smooth except for fairly heavy but regular lines of growth. Dimensions (a right valve)—Length 21 mm.; height 11 mm. (Clark)

*Observations.* This species, somewhat resembling *T. oregonensis* Conrad,\* differs in being relatively more elongate, in lacking the truncate posterior end of the latter, and in having the sulcus situated just anterior to the umbo.

*Holotype.* (S.U. 5218.) Locality (S.U. N.P. 272). Figured in the present report, pl. 48, fig. 7; pl. 51, fig. 7.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Wahkiakum County, southwestern Washington.

*Type locality.* In cliffs along Kamakawa River above big bend, one mile east of junction of main and middle forks, Skamokawa, Washington.

**TELLINA EUGENIA Dall, 1909**

Plate 48, figures 5, 8

*Tellina eugenia* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 124, pl. 19, fig. 3, 1909.

*Original description.* Shell narrow, elongate, with an attenuate obliquely truncate rostrum, the surface finely concentrically striate near the margin and with the posterior dorsal area with more elevated concentric lamellae; valves nearly equilateral, beaks low, dorsal slopes subequal, anterior end rounded, posterior attenuate and subtruncate; base nearly straight. Length, 55 mm.; height, 25 mm.; semi-diameter of cast, 3 mm. (Dall)

\* See page 560.

*Observations.* This species may be distinguished from *T. aragonia* Dall in being relatively longer and having a more attenuate and narrower posterior subtruncate margin.

*Holotype.* (U.S.N.M. 110459.) Figured in the present report, pl. 48, fig. 8.

*Hypotype.* (U.C. 33308.) Locality (U.C. 980). Figured in the present report, pl. 48, fig. 5.

*Geologic range.* Eugene formation, middle Oligocene.

*Geographic distribution.* Near Eugene, Willamette Valley, Oregon.

*Type locality.* Smith's quarry, Eugene, Oregon.

#### TELLINA VANCOUVERENSIS Clark and Arnold, 1923

Plate 48, figures 6, 9, 10; pl. 59, fig. 1.

*Tellina vancouverensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 149, 150, pl. 22, figs. 5, 6, 1923.

*Original description.* Shell medium in size; beaks posterior to center and rather inconspicuous. Anterior end broadly and regularly rounded; posterior end bluntly acute; anterior and posterior dorsal edges straight; ventral edge rather strongly arcuate; center of convexity anterior to middle. Surface of shell smooth with exception of concentric lines of growth; posterior dorsal margin depressed but without a well defined groove or angulation separating it from main portion of outer surface. Posterior cardinal of right valve and anterior cardinal of left valve broad and heavy, but anterior cardinal of right valve thin, almost obsolete, and situated well up on dorsal margin. A heavy elongated lateral in right valve separated by a fairly broad and deep groove from anterior dorsal margins; a small rather indistinct lateral just posterior to ligamental groove. Lateral obsolescent on left valve. Dimensions of type specimen: Length, 29 mm.; height, 21.5 mm. (Clark and Arnold)

*Observations.* The subtrapezoidal outline of this species, the expanded anterior part of the ventral margin, and the slightly concave part of the posterior ventral margin aid in distinguishing the species on superficial form.

*Holotype.* (C.A.S. 599.) Figured in the present report, pl. 48, figs. 6, 9, 10.

*Paratype.* (U.C. 30063.) Figured in the present report, pl. 59, fig. 1.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* In the Sooke sandstone and conglomerate exposed in the sea cliffs between the mouths of Muir and Kirby creeks west of Otter Point, Sooke Bay, Vancouver Island.

#### TELLINA BODEGENSIS Hinds subsp.? Clark and Arnold, 1923

Plate 48, figures 11, 17

*Tellina (Peronidia) bodegensis* Hinds n. subsp.? Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 149, pl. 22, figs. 7, 8, 1923.

*Original description.* The specimens referred to *T. bodegensis* agree very closely with that species in general outline and hinge characters. The posterior truncated end of the right valve of the Sooke form is apparently narrower. There are

too few specimens in the collection, however, to make it certain that this is a constant character and the form if not referable to the recent species is its precursor. Dimensions: (specimen no. 597), height, 17.6 mm.; length, 34 mm. (Clark and Arnold)

*Observations.* This variety may be distinguished from *T. bodegaensis* Hinds in having a narrower truncated posterior margin of the right valve.

*Holotype.* (C.A.S. 597.) Figured in the present report, pl. 48, fig. 11.

*Paratype.* (C.A.S. 598.) Figured in the present report, pl. 48, fig. 17.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South shore of Vancouver Island.

*Type locality.* (C.A.S. 321.) Sea cliffs east of the mouth of Kirby Creek, 6 miles west of Sooke, Vancouver Island.

#### TELLINA MERRIAMI Weaver, 1912

Plate 51, figures 4, 8; plate 60, figures 9, 11

*Tellina merriami* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 63, 64, pl. 9, fig. 74; pl. 10, fig. 81, 1912.

*Original description* Shell elongate, attenuated posteriorly, compressed slightly, inequivalve and nearly equilateral; surface smooth; beaks low, curved slightly forward; anterior margin very slightly convex and sloping at an angle of 15° which increases to 30° near the anterior end, which terminates in a sharp angle and is evenly rounded; posterior margin slopes from beak at an angle of about 40° with a very slight convexity midway between beak and posterior end; posterior end abruptly truncated; basal margin a broad regularly curved line excepting just anterior to the posterior end, when it is very slightly concave; posterior surface of right valve flexed, making an angle of about 125° and forming a ridge from the beak to posterior extremity; an obscure groove extends from beak to posterior end of basal margin. Surface sculptured by fine concentric incremental lines and near the margin a few prominent lines of interrupted growth. Dimensions.—Longitude 48 mm.; altitude 28 mm.; diameter 7 mm. (Weaver)

*Observations.* This species may be distinguished from *T. kincaidi* by the more central position of the umbones, the more attenuated posterior end, and the more pronounced folding of the posterior margin.

*Holotype.* (U.W. 55A) (C.A.S. 7462A). Figured in the present report, pl. 51, fig. 4; pl. 60, fig. 11.

*Paratype.* (U.W. 55) (C.A.S. 7462). Figured in the present report, pl. 51, fig. 8; pl. 60, fig. 9.

*Geologic range.* Base of Montesano formation, upper Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 68.) In old logging railway cut on Sylvia Creek, in conglomerate, in Grays Harbor County, Section 32, T. 18 N., R. 7 W.

## TELLINA KINCAIDI Weaver, 1912

## Plate 48, figure 16

*Tellina kincaidi* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 64, 65, pl. 10, fig. 82, 1912.

*Original description.* Shell elongate, sub-oval, moderately narrow, compressed, inequilateral, slightly inequivalve, attenuated anteriorly; beaks low and situated about one-third the distance from the posterior end of shell. Anterior dorsal margin of shell nearly straight and sloping downward to anterior end of shell at an angle of about 15°. At the anterior end it is sharply angulated and sharply curved to the basal margin which is nearly straight except near posterior end, where it is slightly incurved, due to the minor flexing of the valve. Posterior margin is slightly convex and slopes at an angle of 65° from the beak to posterior end of shell where it forms a sharp angle of 60° with the base. Posterior margin sharply bent inwards forming a prominent ridge from beak to base; just anterior to this ridge is an obscure groove more prominent near base. Surface sculptured by numerous fine concentric incremental lines irregularly spaced and occasional lines of growth. Dimensions.—Longitude 52 mm.; latitude 30 mm.; diameter 7 mm. (Weaver)

*Observations.* *T. kincaidi* occurs with *T. merriami* in the basal conglomerate of the Montesano formation and resembles it closely. It may be distinguished from the latter by less pronounced angulation of the posterior margin and a less attenuated posterior end.

*Holotype.* (U.W. 56) (C.A.S. 537). Figured in the present report, pl. 48, fig. 16.

*Geologic range.* Base of Montesano formation, upper Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 68.) Logging railway cut on Sylvia Creek, Grays Harbor County, Section 32, T. 18 N., R. 7 W.

## TELLINA ARAGONIA Dall, 1909

## Plate 48, figure 22

*Tellina aragonia* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 124, 125, pl. 14, fig. 3, 1909.

*Tellina aragonia* Dall, Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 92, 1922.

*Tellina aragonia* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 358, 1931.

*Original description.* Shell elongate, compressed, sub-equilateral, slightly inequivalve; beaks low, slightly behind the middle of the shell; right valve a little flatter than the other, with the rostrated posterior part of the shell somewhat bent to the right; dorsal slopes subequally oblique, the anterior slightly arcuate, the posterior slightly excavated; ligament strong on strong nymphs about (in the type) 15 mm. long; posterior end subrostrate, bluntly pointed below, with an obscure ridge from the beak forming on the right valve a narrow dorsal area; anterior end evenly rounded, base gently arcuate; surface smooth, finely concentrically grooved, with wider flattish interspaces, the sculpture strongest in front. Interior inaccessible for the most part but with no indication of any internal umbonal rib. Longitude, 62 mm.; latitude, 32; diameter, 12 mm. (Dall)

*Observations.* This species is somewhat similar to *T. oregonensis* Conrad\* from the middle Miocene but may be distinguished in being larger and more equilateral and in lacking the umbonal radial rib.

*Holotype.* (U.S.N.M. 153940.) Figured in the present report, pl. 48, fig. 22.

*Geologic range.* Upper Miocene and lower Pliocene. Empire formation at Coos Bay, Oregon, and Jacalitos formation, Coalina district, California.

*Geographic distribution.* Western side of San Joaquin Valley, California, and Coos Bay, Oregon.

*Type locality.* Coos Bay, Oregon (Camman Collection). (Dall)

#### TELLINA OBRUTA Conrad, 1848

Plate 48, figures 12, 13, 14, 15

*Tellina? obruta* Conrad, Am. Jour. Sci., ser. 2, vol. 5, p. 432, fig. 6, 1848.  
*Tellina (Moerella) obruta* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59,

p. 125, 1909. (Reprint of Conrad, p. 150.)

*Tellina (Moerella) obrupta* Conrad, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 83, pl. 9, figs. 6, 7, 9, 10, 1931.

*Original description.* Ovate, compressed, thin; very inequilateral; ligament margin elevated; basal margin rounded; anterior hinge margin straight and very oblique, extremity truncated. (Conrad)

*Observations.* Adults of this species normally are small and individuals show considerable variation in outline. Specimen (C.A.S. 404) from the Gries Ranch beds, which was identified by Dickerson, may not belong to this species. An inner and outer view are figured for comparison (pl. 48, figs. 13, 15).

*Holotype.* Lost.

*Hypotype.* (U.C. 31967.) Astoria formation. Figured in the present report, pl. 48, fig. 12.

*Hypotype.* (U.C. 31968.) Astoria formation. Figured in the present report, pl. 48, fig. 14.

*Hypotype.* (C.A.S. 404.) Gries Ranch beds. Figured in the present report, pl. 48, figs. 13, 15.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Northwest Oregon.

*Type locality.* Astoria, Oregon (collected by J. K. Townsend).

#### TELLINA NUCULANA Dall, 1909

Plate 48, figure 21

*Tellina (Moerella) nuculana* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 125, 126, pl. 18, fig. 2, 1909.

*Original description.* Shell small, subtrigonal, thin, compressed, very inequilateral, the beaks nearer the posterior end, which is obliquely truncate, dorsally compressed and very short; anterior end longer, rounded, base and dorsal slope subequally

See page 560.

rounded; outer surface nearly smooth, with faint concentric sculpture in harmony with the incremental lines; internal surface polished, muscular impressions obscure. Length, 10.5 mm.; height, 8.0 mm.; diameter, 3.0 mm. (Dall)

*Observations.* The specimen figured, which served as the type for Dall's description of the species, was broken out of a piece of rock collected by J. D. Dana at Astoria. The form is proportionately higher and shorter than *T. obruta* which it outwardly resembles. It resembles *Macoma calcarea*, but the hinge is unavailable for comparison.

*Holotype.* (U.S.N.M. 3529-A.) Figured in the present report, pl. 48, fig. 21.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Near mouth of Columbia River.

*Type locality.* Astoria, Oregon (collected by J. D. Dana).

#### TELLINA EMACERATA Conrad, 1849

Plate 48, figures 18, 20

*Tellina emacerata* Conrad, U.S. Explor. Exped. Geol., p. 725, pl. 18, fig. 4, 1849.  
*Tellina emacerata* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 125, 1909.

*Original description.* Elliptical, much compressed; anterior extremity obliquely truncate, straight from the apex, front reflected; dorsal margin posteriorly declining; posterior margin rounded; inferior margin arcuate. Lateral surface marked with fine, regular, closely arranged, concentric, impressed lines. (Conrad)

*Observations.* The type of this species is reported by Dall to be missing (101, p. 125). The writer, while studying the types of Conrad in the Wilkes Exploring Expedition collection in the U.S. National Museum, noticed specimen 3494 labeled *Tellina emacerata* in a piece of rock with other specimens. It appears to be the specimen figured by Conrad (68, pl. 18, fig. 4) although the drawing has been partially reconstructed. The specimen resembles somewhat *Macoma arctata* (Conrad).

*Holotype.* (U.S.N.M. 3494.) Conrad type. Figured in the present report, pl. 48, fig. 20.

*Hypotype.* (U.C. 33316.) Locality (U.C. 3330). Figured in the present report, pl. 48, fig. 18.

*Geologic range.* Astoria formation, middle Miocene.

*Type locality.* Astoria, Oregon (collected by J. D. Dana).

#### Genus MACOMA Leach, 1819

*Macoma* Leach, in Ross's Voyage of Discovery in H.M.S. Isabella and Alexander, Append. 2, p. 62, 1819.

*Genotype.* *Macoma tenura* Leach

**MACOMA SOOKENSIS** Clark and Arnold, 1923

## Plate 49, figure 4

*Macoma sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 151, pl. 19, fig. 5; pl. 25, fig. 3 (not pl. 26, fig. 3), 1923.

*Original description.* Shell medium in size, only slightly inflated, thin, beaks nearly central, inconspicuous. Posterior dorsal edge straight; anterior dorsal edge gently convex; posterior end bluntly and obliquely subtruncated; ventral margin rather strongly arcuate. Surface smooth except for moderately fine somewhat irregular incremental lines. On left valve a faint shallow groove close and parallel to posterior dorsal edge. Ligamental groove long and narrow. Right valve unknown. Dimensions of type: Length, 32 mm.; height, 22.5 mm. (Clark and Arnold)

*Observations.* This species, which is closely related to *M. nasuta* Conrad, may be distinguished in having less conspicuous beaks and a less well-developed groove on the posterior margin of the left valve. Due to error in explanation of plates and figures in Clark and Arnold's monograph (50), specimens of *Macoma sookensis* and *Cryptomya quadrata vancouverensis* have been confused. A comparison of the figures with the type specimens indicates that the conclusions herein are correct.

*Holotype.* (U.C. 30212.) Figured in the present report, pl. 49, fig. 4.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* From sandstone in sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

**MACOMA LORENZOENSIS** (Arnold) subsp. **ARNOLDI** Tegland, 1933

## Plate 48, figure 19

*Macoma lorenzoensis* (Arnold), Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 96, pl. 12, fig. 10, 1925.

*Macoma lorenzoensis* subsp. *arnoldi* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 119, 120, pl. 9, figs. 2, 3, 4, 5, 6, 7, 8, 1933.

*Original description* (*Tellina lorenzoensis*). Shell attaining a length of only about 14 mm.: somewhat longer than high; end view of both valves together has a cordate appearance; outline of a single valve subcircular; shell very convex, thin; umbo small, prominent, turned slightly forward, projecting beyond dorsal margin; dorsal margin straight for short distance under umbo, bends off slightly more angularly posteriorly than it does anteriorly; extremities broad and regularly rounded, as is also the base; surface sculptured by fine incremental lines and by numerous fine radiating lines, those over the posterior end being larger and more prominent than those on the remainder of the shell, and distinctly separated from the latter by a faint angle in the surface of the shell extending from the umbo to posterior ventral margin. Margin minutely crenulate. Lunule faint or lacking. Dimensions.—Length, 14 mm.; altitude, 12.5 mm.; diameter of single valve, 4.5 mm. (Arnold, 13, p. 367)

*Description* (*Macoma lorenzoensis* Arnold subsp. *arnoldi*). *Macoma lorenzoensis* subspecies *arnoldi* is more rounded, less elongate than Arnold's species; basal margin is more rounded, beaks more anteriorly placed. An immature Blakeley specimen (fig. 8) resembles more closely the California species in that the beaks are more centrally placed. (Tegland)

*Observations.* The variety *arnoldi* differs from *M. lorenzoensis* Arnold in being more robust and relatively less high than the latter. Its beaks are situated more anteriorly and the basal margin is more rounded.

*Holotype.* (U.C. 32160.) Figured in the present report, pl. 48, fig. 19.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Puget Sound Basin.

*Type locality.* Restoration Point, Kitsap County, Washington.

#### MACOMA SNOHOMISHENSIS Weaver, 1912

##### Plate 49, figure 2

*Macoma snohomishensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 66, pl. 13, fig. 109, 1912.

*Original description.* Shell small, thin, decidedly inequilateral, slightly inequivalve, attenuated posteriorly. Surface smooth and sculptured with fine concentric lines; beaks small, low and situated near the anterior end; posterior margin straight and slopes at an angle of 15°; posterior end evenly rounded; basal margin nearly straight. Anterior margin short and slopes down 45° from the beak and then slopes gradually around the anterior end and merges with the base. Dimensions: Longitude 23 mm.; altitude 12 mm.; diameter of entire shell 8 mm. (4 mm. for each valve). (Weaver)

*Holotype.* (U.W. 58) (C.A.S. 549). Figured in the present report, pl. 49, fig. 2.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Snohomish County, Puget Sound Basin, Washington.

*Type locality.* (U.W. 228.) Railroad cut one mile north of Cathcart Station, Snohomish County, Section 31, T. 28 N., R. 8 W.

#### MACOMA ARCTATA (Conrad), 1849

##### Plate 49, figures 3, 5, 12; plate 59, figure 15

*Tellina arctata* Conrad, U.S. Explor. Exped. Geol., p. 725, pl. 18, figs. 3, 3a, 1849.  
*Tellina arctata* Conrad, Trans. Kansas Acad. Sci., vol. 22, p. 184, pl. 2, figs. 16a, 16b, 1909.

*Macoma arctata* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 126, 1909.  
*Macoma (Psammacoma) arctata* (Conrad), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 84, 85, pl. 10, figs. 1, 2, 1931.

*Original description.* Oblong, subelliptical, compressed; front very obliquely truncate and a little sinuous, below reflected; basal margin arcuate; ligament margin declining, arcuate; posterior extremity rounded, beak nearest the anterior extremity. Length 2 inches; height 66/100 L.; thickness 26/100 L., or 40/100 H.; apical angle 124°. Valves very thin. (Conrad)

*Observations.* This species somewhat resembles *Macoma arctata* *wynoocheensis* Weaver but is relatively much shorter and the posterior dorsal margin slopes down at a much lesser angle and is straight or a little convex rather than concave as in the variety *wynoocheensis*. The umbones are a little more posteriorly situated.

*Holotype.* (U.S.N.M. 3489.) Conrad type. Figured in the present report, pl. 49, fig. 12.

*Hypotype.* (U.C. 31971.) Astoria formation. Locality (U.C. 9069). Figured in the present report, pl. 49, fig. 3.

*Hypotype.* (U.C. 31972.) Astoria formation in southwestern Washington. Locality (U.C. 9069). Figured in the present report, pl. 49, fig. 5.

*Hypotype.* (U.W. 366.) Locality (U.W. 270). Astoria formation. Figured in the present report, pl. 59, fig. 15.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Coast Ranges of western Oregon and Washington.

*Type locality.* Astoria, Oregon (collected by J. D. Dana). Occurs also at several localities in the Astoria formation in southwestern Washington.

#### MACOMA ARCTATA (Conrad) var. WYNOOCHEENSIS Weaver, 1912

##### Plate 49, figure 8

*Macoma wynoocheensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 66, pl. 15, figs. 128, 129, 130, 1912.

*Macoma (Psammacoma) arctata* Conrad, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 84, 85, 1931.

*Original description.* Shell of moderate size, thin, equivalve, inequilateral; beaks small and situated about two-fifths the length of shell from anterior end. Anterior margin slightly concave and sloping downward at an angle of  $37^{\circ}$ , obliquely truncated at anterior end; base broadly rounded; posterior margin straight and sloping at an angle of  $18^{\circ}$  to anterior end, which is acutely rounded. Surface sculptured by close set fine concentric lines of growth. Dimensions.—Altitude 37 mm.; longitude 50 mm.; thickness of both valves 14 mm. (Weaver)

*Observations.* The variety *wynoocheensis* differs from the species *M. arctata* in the lesser downward slope and slightly concave profile of the posterior dorsal margin and the broader posterior end of the shell.

*Holotype.* (U.W. 59) (C.A.S. 532). Figured in the present report, pl. 49, fig. 8.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, southwestern Washington.

*Type locality.* (U.W. 131.) In old logging railroad cut one mile west of Montesano, Grays Harbor County, Section 1, T. 17 N., R. 8 W.

#### MACOMA MONTESANOENSIS Weaver, 1912

##### Plate 49, figure 18

*Macoma montesanoensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 65, pl. 10, fig. 80, 1912.

*Original description.* Shell large, sub-oval to rounded triangular, inequilateral, slightly inequivalue; valves moderately convex, concentrically sculptured; beaks low, small, situated nearly medial, but in some specimens slightly posterior to middle. The anterior dorsal margin slopes gently at an angle of about  $15^{\circ}$  for a short distance, then curves more steeply; anterior end evenly rounded; posterior dorsal margin very slightly concave, sloping at an angle of  $45^{\circ}$  to the posterior end where it is sharply truncated; ventral margin regularly curved. On the right valve a sharp ridge, form-

ing an angle of 75° to 80° extends from the beak to the posterior extremity; immediately in front of this there is a very slight obscure fold more noticeable along the anterior margin. Surface sculptured by numerous impressed incremental lines somewhat irregularly distributed. Interior inaccessible. Dimensions.—Longitude 68 mm.; altitude 50 mm.; diameter of right valve 10 mm. (Weaver)

*Observations.* This species which occurs in the fine conglomerate in the base of the Montesano formation is characterized by its trigonal shape, the considerable slope and convexity of the posterior margin, and the posterior position of the umbo.

*Holotype.* (U.W. 57) (C.A.S. 529). Figured in the present report, pl. 49, fig. 18.

*Geologic range.* Montesano formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Grays Harbor County, western Washington.

*Type locality.* (U.W. 68.) In logging railway cut on Sylvia Creek in conglomerate north of Montesano in Section 32, T. 18 N., R. 7 W.

#### MACOMA TWINENSIS Clark, 1925

Plate 49, figures 6, 7; plate 55, figure 1

*Macoma twinensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 96, pl. 12, fig. 7, 1925.

*Macoma twinensis* Clark, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 120, pl. 8, figs. 14, 15, 16, 17, 1933.

*Original description.* Shell subovate; valves unequal and inequilateral; beaks posterior to medium [median] dorsal-ventral line; anterior dorsal edge gently convex; posterior dorsal edge straight; anterior end broadly and regularly rounded; the rosulate posterior end distinctly truncated and flexed to the right; right valve nearly flat with a narrow depressed posterior dorsal margin, separated from main surface of shell by a somewhat obscure line of angulation; a suggestion of a sulcus on the depressed area, just next to this line. Left valve more inflated than right, the posterior dorsal margin being less sharply depressed than that on the right valve. Dimensions of type specimen: Length 23.5 mm.; height 15 mm. (Clark)

*Observations.* This species which is closely related to *M. lorenzoensis* (Arnold) differs from the latter in that the shell is relatively thicker, posteriorly more attenuate, and longer in proportion to the height.

*Holotype.* (S.U. 48.) Locality (S.U. N.P. 122). Figured in the present report, pl. 49, fig. 6.

*Hypotype.* (U.C. 32149.) Locality (S.U. N.P. 122). Figured in the present report, pl. 49, fig. 7.

*Topotype.* (U.C. 32148.) Figured in the present report, pl. 55, fig. 1.

*Geologic range.* Upper Oligocene.

*Geographic distribution.* North side of Olympic Peninsula, Washington.

*Type locality.* (U.W. 680) (S.U. N.P. 122). In sandy shale about two miles west of the mouth of Twin Rivers in sea cliff on south side of Strait of Juan de Fuca, Clallam County, Washington.

**MACOMA INDENTATA** Carpenter subsp. **FLAGLERI** Etherington, 1931

## Plate 49, figure 10

*Macoma (Rexithaerus) indentata flagleri* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 85, pl. 10, figs. 3, 4, 1931.

*Original description.* Shell medium sized, subovate, inequivaled; right valve more inflated than left, fairly thin, umbones varying from almost central to slightly posterior; anterior dorsal slope long, end evenly rounded; posterior dorsal slope obliquely truncate, sloping at a greater angle; ligamentary area short, scooped out. Dentition characteristic of the group. (Etherington)

*Observations.* This variety differs from the Recent species *M. indentata* in possessing a slightly more prominent umbo and a somewhat less well-developed posterior angle.

*Holotype.* (U.C. 31973.) Figured in the present report, pl. 49, fig. 10.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Coast Range of western Washington.

*Type locality.* (U.W. 415.) In cut of abandoned spur of Clemons logging road one-fourth mile north of main line in the first large cut in Section 23, T. 17 N., R. 7 W.

**MACOMA ANDERSONI** Clark, 1915

## Plate 49, figure 9; plate 52, figure 7

*Macoma andersoni* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 8, pp. 473, 474, pl. 61, fig. 12, 1915.

*Original description.* Shell elongate, subovate; beaks posterior to middle, inconspicuous. Posterior dorsal edge slightly concave along ligamental groove, beyond this nearly straight to slightly convex; anterior dorsal edge long and gently convex; anterior end evenly rounded; posterior end bluntly pointed; ventral edge gently convex anteriorly and nearly straight posteriorly. On left valve along posterior margin is a narrow depressed area, which is only obscurely separated from the main surface of the valve; it widens quite perceptibly below the ligamental groove into a flange, somewhat similar to though not so wide or distinct as the flange seen on the posterior edge of *M. secta* Conrad, a Recent species and one which is also found in the same horizon; right valve slightly flexed and with posterior margin more strongly depressed than on left. Ligamental groove less than half the length of posterior dorsal edge. Surface of valves covered by fine incremental lines and occasional lines of interrupted growth. (Clark)

*Observations.* This species resembles *Macoma indentata flagleri* in general outline but may be distinguished by less elevated umbones, a long straight anterior dorsal margin, and a less well-defined posterior umbonal angle.

*Hypotype.* (U.C. 33325.) From Astoria formation in Lincoln County, Oregon. Figured in the present report, pl. 49, fig. 9; pl. 52, fig. 7.

*Geologic range.* Upper Miocene and lower Pliocene. San Pablo and Empire formations.

*Geographic distribution.* Coast Ranges of central California, and Coos Bay, Oregon.

*Type locality.* (U.C. 1470.) On south side of Mount Diablo, California. Occurs also in Astoria formation in beach section just north of Newport, Lincoln County, Oregon.

**MACOMA MOLINANA Dall, 1909**

## Plate 49, figure 15

*Macoma molinana* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 128, 129, pl. 14, fig. 12, 1909.

*Macoma molinana* Dall, Weaver, Wash. Geol. Surv., Bull. no. 15, p. 18, 1912.

*Macoma molinana* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 375, 1931.

*Original description.* Shell of moderate size, rather inflated, thin, nearly equivalve, not quite equilateral, the posterior end subrostrate and bent to the right; beaks small, low; anterior end longer, rounded in front, rather swollen; posterior end compressed, the dorsal margin rapidly descending to the narrow subtruncate termination; an obscure ridge, more evident on the right valve, bounds a narrow posterior dorsal area; ligament short; surface smooth or polished, sculptured only by irregularly distributed fine concentric striations in harmony with the incremental lines; hinge normal, the pallial sinus extending a little in front of the middle of the disk, rounded, not rising above the equator of the disk; muscular impressions large and distinct; a rather strong radial concave flexure behind the rostrum. Longitude of internal cast, 40 mm.; altitude, 28.5 mm.; diameter, 14 mm. (Dall)

*Observations.* This species differs from *M. nasuta* in being more wedge-shaped and flexuous and in having the anterior portion of the shell more inflated.

*Holotype.* (U.S.N.M. 154088.) Figured in the present report, pl. 49, fig. 15.

*Geologic range.* Oligocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* At Miller's Beach, Coos Bay, Oregon. Middle Oligocene (collected by Dall).

**MACOMA CALCAREA (Gmelin), 1792**

## Plate 49, figure 11

*Tellina calcarea* Gmelin, Syst. Nat. (13th ed.), vol. 1, pt. 6, p. 3236, 1792.

*Macoma calcarea* Gmelin, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 126, 127, pl. 14, fig. 8, 1909.

*Macoma calcarea* (Gmelin), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 369, 370, 1931 (synonymy).

*Original description.* "Testa ovali tenui alba, cardinis dente primario in altera valva fisso, alterius foveae inserto." (Gmelin)

*Supplementary description.* Shell thin, inequilateral, moderately inequivalue, with small, low pointed beaks and the shorter posterior extremity bent to the right; length of posterior part of shell to that anterior to the vertical of the beaks as 11 to 28, or thereabouts; left valve the larger and more inflated; surface smooth except for more or less pronounced incremental lines and in each valve an obscure ridge bordering an ill-defined posterior dorsal area; form of the shell essentially as figured, but varying to some extent in different individuals; hinge normal, pallial impression inaccessible. Longitude, 28.5 mm.; altitude, 18 mm.; diameter, 9 mm.; of which 5 mm. belongs to the left valve. (Dall, 101, p. 127)

*Observations.* In general outline this species resembles *M. arctata* but may be distinguished from it in the nearly horizontal and slightly con-

vex posterior dorsal margin, a more broadly rounded posterior margin, and in the less well-defined posterior umbonal angle.

*Hypotype.* (U.S.N.M. 153935.) Figured in the present report, pl. 49, fig. 11.

*Geologic range.* Middle Miocene to Recent.

*Geographic distribution.* Southern California to Alaska.

*Specimen figured.* (U.S.N.M. 153935.) From Fossil Point, north entrance to Coos Bay, Oregon. Upper Miocene or lower Pliocene.

#### MACOMA ASTORI Dall, 1909

##### Plate 49, figure 14

*Macoma astori* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 128, pl. 14, figs. 1, 11, 1909.

*Macoma astori* Dall, Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, p. 590, 1913.

*Macoma astori* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 369, 1931.

*Original description.* Shell suboval, nearly equilateral, slightly inequivalve, substrata, with the posterior extremity bent to the right; valves thin, moderately convex, the right valve slightly less so than the left; beaks low, adjacent, nearly medial; anterior dorsal slope arcuate, anterior end evenly rounded; posterior direct, posterior end bluntly pointed; base nearly evenly arcuate; surface smooth except for more or less impressed incremental lines somewhat zonally distributed; an obscure fold in each valve, near the margin, borders a posterior dorsal area; interior inaccessible. Longitude, 50 mm.; altitude, 35 mm.; diameter, 14 mm. The height of the original specimen of fig. 11, is 44 mm. (Dall)

*Observations.* This species is closely related to *M. edentula* Broderip and Sowerby but is less inflated and less inequilateral, the beaks in the former being situated nearer the posterior end of the shell.

*Holotype.* (U.S.N.M. 153937.) Figured in the present report, pl. 49, fig. 14.

*Geologic range.* Empire formation, upper Miocene or lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Fossil Point, Coos Bay, Oregon (Camman collection).

#### MACOMA NASUTA (Conrad), 1837

*Tellina nasuta* Conrad, Jour. Acad. Nat. Sci. Phila., ser. 1, no. 7, p. 258, 1837.

*Macoma nasuta* Conrad, Dall, Proc. U.S. Nat. Mus., vol. 23, pp. 307, 308, 1900.

*Macoma nasuta* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 127, 128, 1909.

*Macoma nasuta* Conrad, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 365, 366, pl. 20, figs. 11a, 11b, 1931 (synonymy).

*Original description.* Shell ovate, compressed, smooth but not polished; anterior side dilated; posterior side cuneiform, extremity truncated, much above the line of the base; fold carinated on the superior valve; beaks central, slightly prominent; epidermis extremely thin and deciduous, finely wrinkled brown; pallial impression of the left valve joining the anterior cicatrix at its lower posterior angle. Length, an inch and three quarters. Height, an inch and one third. (Conrad)

*Supplementary description.* Shell thin, suboval, nearly equilateral, slightly inequivale, the posterior end bent to the right; beaks small, low, adjacent, a little behind the middle of the shell; anterior dorsal slope passing evenly into the rounded anterior and arcuate basal curves; posterior dorsal slope straighter, more rapidly descending, the posterior end almost rostrate, bluntly pointed, with, in each valve, rounded ridge descending from the beaks toward the lower posterior angle, the ridge in the right valve more prominent; surface smooth or even polished, sculptured only by incremental lines of which the stronger are more or less zonally arranged; hinge normal. Longitude of an average specimen, 37 mm.; altitude, 25 mm.; diameter, 11 mm. (Dall, 101, p. 127)

*Holotype.* Lost.

*Geologic range.* Middle Oligocene to Recent.

*Geographic distribution.* Lower California to Alaska.

*Type locality.* Near San Diego, California; Recent. Occurs in Empire formation at Coos Bay.

**MACOMA INQUINATA** (Deshayes) var. **ARNHEIMI** Dall, 1916

Plate 49, figure 13

*Macoma inquinata* (Deshayes), Reagan, Trans. Kansas Acad. Sci., vol. 22, pp. 209, 210, pl. 4, fig. 39, 1909.

*Macoma inquinata* (Deshayes) var. *arnheimi* Dall, Proc. U.S. Nat. Mus., vol. 52, p. 414, 1916; Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 311, 1922; Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 367, 1931.

*Description ("Tellina inquinata").* T. testa trigona, crassa, solida, depressiuscula, inequilaterali, subepidermide squalidae fusca albofusca, farrugineo inquinata, transversum irregulariter striata, intus candida; Latere antico late obtuso, subsemicirculari, superne parum declivi; Latere postico cuneiformi, attenuato, superne recto et declige, extremitate obliquetruncato, inferne oblique angulato, flexura parum perspicua; Ligamento praelongo, incrassato; cardine bidentato, dentibus lateralibus nullis; sinu pallii magno, profundo, superne gibboso, deinde declivi et apice acuto. *Hab.* Columbia. (Deshayes, 116, pp. 357, 358)

*Description by Reagan.* Shell suboval, convex, equivale; umbones subcentral; posterior end evenly arcuate from umbo and acutely rounded from about half way between dorsal and ventral margins to posterior extremity; anterior end rather prominently dilated, especially so in front of umbo of right valve; interior of shell not seen. Dimensions of right valve of the largest and most perfect specimen obtained: Lat., 42; alt., 34; diam., 14; from umbo to posterior extremity, 29; to anterior extremity, 31. (Reagan, 230, p. 209)

*Holotype.* (U.S.N.M. 328341.) Originally figured by Reagan as *Macoma inquinata* (Deshayes) (230, pl. 4, fig. 39); later described by Dall as *Macoma inquinata* (Deshayes) var. *arnheimi* (Proc. U.S.N.M., vol. 52, p. 414, 1922). Figured in the present report, pl. 49, fig. 13.

*Geologic range.* Miocene to Recent. Quillayute formation in Washington, lower Pliocene.

*Geographic distribution.* Western Jefferson County, Washington (and San Pedro, California?).

*Occurrence.* Near mouth of Quillayute River, Washington.

## Family SANGUINOLARIIDAE

## Genus GARI Schumacher, 1817

*Gari* Schumacher, Essai Nouv. Syst. Test., pp. 44, 131, pl. 9, fig. 2, 1817.

*Genotype.* *Gari vulgaris* Schumacher (= "Tellina" *gari* Linnaeus).

## GARI MARTINI (Dickerson), 1917

## Plate 49, figure 17

*Psammobia martini* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 168, pl. 27, figs. 7a, 7b, 1917.

*Gari martini* (Dickerson), Effinger, Jour. Paleon., vol. 12, p. 373, 1938.

*Original description.* Shell elongate, flat; nearly flat posterior slope meeting disk of shell along a convex umbonal slope; anterior dorsal slope but slightly excavated under beak, sloping less steeply than the posterior dorsal margin. Dimensions:—Convexity 5 mm. (Dickerson)

*Observations.* The holotype figured by Dickerson from the Gries Ranch beds is a defective right valve of which the posterior and anterior portions are broken. Two other fragmentary specimens from the same locality were collected by the writer, and one of these, a part of a left valve, has a long and deep ligamental groove with a sharp flange lying above it. The hinge shows a small but distinct cardinal tooth and a poorly developed posterior cardinal. The species may be distinguished from *G. columbiana* (Weaver and Palmer) by the stronger development of the ligamental groove and the overlying flange.

*Holotype.* (C.A.S. 389.) Figured in the present report, pl. 49, fig. 17.

*Geologic range.* Lower middle Oligocene, Gries Ranch beds.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 239.) In bank on south side of Cowlitz River at old Gries Ranch, Cowlitz County, in northeast quarter of Section 25, T. 11 N., R. 2 W.

## GARI COWLITZENSIS (Weaver and Palmer), 1922

## Plate 49, figure 16

*Psammobia cowlitzensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 22, pl. 9, fig. 18, 1922.

*Original description.* Shell large and oblong in shape; inequilateral; anterior end shorter, convex; anterior dorsal margin sloping; shell rounded at both ends; posterior end broader, concave above; line of the escutcheon straight, slightly oblique; shell thin; pallial sinus large, rounded in front, reaching beyond the middle of the shell; ventral margin straight; sculpture unknown except for concentric lines of growth. Dimensions.—Length 53 mm.; height 28 mm.; thickness 12 mm. (Weaver and Palmer)

*Observations.* This species is closely related to *G. hornii* (Gabb) but is more inequilateral and is higher in proportion to the length.

*Holotype.* (U.W. 176.) Figured in the present report, pl. 49, fig. 16.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz River Valley, southwestern Washington.

*Type locality.* (U.W. 329.) North bank of Cowlitz River at, and extending several hundred feet below, the bend in the river, two miles east of Vader, Lewis County, Section 28, T. 11 N., R. 2 W.

#### GARI COLUMBIANA (Weaver and Palmer), 1922

Plate 50, figures 1, 3; plate 51, figure 12

*Psammobia columbiana* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 22, pl. 10, fig. 18, 1922.

*Gari columbiana* (Weaver and Palmer), Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 61, 62, pl. 7, fig. 12, 1938.

*Original description.* Shell large and oblong; inequilateral, the anterior end shorter; posterior end higher than the anterior; anterior and posterior dorsal lines straight and oblique, the anterior sloping at a greater angle; posterior and dorsal ends rounded below; ventral margin straight; surface of shell with coarse, concentric lines of growth. Dimensions.—Length 75 mm.; height 36 mm.; thickness 19 mm. (Weaver and Palmer)

*Observations.* This elongate-ovate shell is a distinctive element in the fauna of the Cowlitz formation in the Coal Creek area in Cowlitz County. It is not easily confused with other species of the genus of the Northwest area except possibly *G. hornii*. It has lower umbones and is more inequilateral than the latter species.

*Holotype.* (U.W. 175) (C.A.S. 7473). Figured in the present report, pl. 50, fig. 1.

*Hypotype.* (U.C. 33138.) Oregon specimen. Figured in the present report, pl. 50, fig. 3; pl. 51, fig. 12.

*Geologic range.* Cowlitz formation and lower Coaledo formation; upper Eocene.

*Geographic distribution.* Lower Columbia River Basin, southwestern Washington, and Coos Bay area, Oregon.

*Type locality.* (U.W. 342.) In banks of Coal Creek, Cowlitz County, Washington, about one-fourth mile above old Inman-Poulsen shops, Section 2, T. 8 N., R. 3 W.; also occurs at locality (U.C. A-857). Sunset Bay and Cape Arago, Oregon.

#### GARI OLEQUAHENSIS (Weaver and Palmer), 1922

Plate 52, figures 1, 2

*Psammobia olequahensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 23, pl. 9, figs. 11, 12, 1922.

*Original description.* Shell moderately large, thin; broad in outline; anterior end convex, shorter and sloping to a well rounded end; posterior end broadly rounded, concave above along a post-umbonal slope; posterior dorsal margin straight; ventral margin straight and parallel; surface with fine concentric lines of growth

which on the posterior end become more acute and slightly raised; obscure radiating lines occur on the posterior margin of the shell. Dimensions.—Co-types respectively: length 29 mm., 18 mm.; height 26 mm., 11 mm.; thickness 8 mm., 6 mm. (Weaver and Palmer)

*Observations.* This species is subquadrate in outline with rather blunt, broadly rounded posterior end with subangulate junctions with the ventral and dorsal margins. The umbones are slightly more elevated than in the case of *G. columbiana*.

*Holotype.* (U.W. 177) (C.A.S. 7471). Figured in the present report, pl. 52, fig. 1.

*Syntype.* (U.W. 177-A) (C.A.S. 7471-A). Figured in the present report, pl. 52, fig. 2.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz River Valley, southwestern Washington.

*Type locality.* (U.W. 324.) In west bank of Olequa Creek, about one-eighth mile north of Vader Station, Lewis County, Section 29, T. 11 N., R. 2 W.

#### **GARI OBSCURA (White), 1889**

##### Plate 50, figure 7

*Psammobia obscura* White, U.S. Geol. Surv., Bull. no. 51, p. 61, pl. 10, figs. 4, 5, 6, 1889.

*Original description.* Shell irregularly subelliptical in marginal outline; valves gently convex, but the postero-dorsal region is somewhat compressed; beaks not prominent, situated at about one-third the full length of the shell from the front; anterior margin rounded; basal margin broadly convex; dorsal margin behind the beaks nearly straight; postero-dorsal margin sloping downward and backward to the base. Surface marked by the usual distinct concentric lines of growth. Pallial line strong, and its sinus large and deep. Height, 29 mm.; length, 38 mm. (White)

*Observations.* This species is characterized by its rather high umbones, evenly rounded anterior and posterior ends, broadly concave posterior dorsal margin, and prominent umbonal ridge extending to junction of ventral and posterior margins. It has been observed only in the Puget Group, which is mostly of fresh-water origin.

*Holotype.* (U.S.N.M. 20102). Figured in the present report, pl. 50, fig. 7.

*Geologic range.* Puget Group, middle and upper Eocene.

*Geographic distribution.* Western foothills of Cascade Mountains in King and Pierce counties, Washington.

*Type locality.* From Palace Camp near Carbonado, Pierce County, Washington.

**GARI HORNII** (Gabb), 1864

Plate 50, figure 13; plate 51, figure 3

*Tellina hornii* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 160, 161, pl. 30, fig. 244, 1864.

*Tellina hornii* Gabb, Weaver, Wash. Geol. Surv., Bull. no. 15, p. 15, 1912.  
*Gari hornii* (Gabb), Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 282, 283, pl. 12, fig. 2, 1930 (synonymy).

*Original description.* Shell long, narrow, subequilateral; beaks small, subcentral; cardinal margins sloping slightly towards the ends; anterior extremity regular, slightly broader than the posterior, which is a little more prominent below than above; basal margin nearly straight. Surface marked only by faint lines of growth. (Gabb)

*Observations.* Several specimens have been collected from the Cowlitz formation in the Duwamish area at Seattle, Washington, which appear to belong to this species. Two specimens from near the type locality in Live Oak Canyon, at the south end of the San Joaquin Valley, California, are figured for comparison with *G. columbiana* (Weaver and Palmer).

*Holotype.* (U.C. 33357.) Locality (U.C. 7181). Figured in the present report, pl. 50, fig. 13.

*Holotype.* (U.C. 33356.) Locality (U.C. 7181). Figured in the present report, pl. 51, fig. 3.

*Geologic range.* Tejon formation, upper Eocene; also Cowlitz formation.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Near old Fort Tejon, Southern California.

**GARI HORNII** (Gabb) subsp. **UMPQUAENSIS** Turner, 1938

Plate 50, figure 10; plate 51, figure 9

*Gari hornii* (Gabb) subsp. *umpquaensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 62, pl. 7, fig. 11, 1938.

*Original description.* Shell medium size, elongate, almost equilateral; beaks slightly elevated and slightly inflated; small rostrum posterior to the beak; profile of anterior and posterior dorsal margins slightly concave; ventral margin practically straight, swinging upward more abruptly at the posterior end than at the anterior; sculptured only by concentric growth lines. Internal casts show traces of radial marking. Hinge not known. (Turner)

*Observations.* The subspecies *umpquaensis* may be distinguished from *G. columbiana* (Weaver and Palmer) and from *G. hornii* by having more elevated umbones and by being relatively more tumid.

*Holotype.* (U.C. 33149.) Umpqua formation. Locality (U.C. A-662). Figured in the present report, pl. 50, fig. 10; pl. 51, fig. 9.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Southwest Oregon.

*Type locality.* (U.C. A-662.) Douglas County, Oregon, on east bank of Little River between highway bridge and first bend of stream east of junction with North Umpqua River. Center of Section 19, T. 26 S., R. 3 W.

Genus **SANGUINOLARIA** Lamarck, 1799

*Sanguinolaria* Lamarck, Prodrome, Mem. Hist. Nat. Paris., vol. 1, p. 84, 1799.

*Genotype.* *Solen sanguinolentus* Gmelin.

**SANGUINOLARIA CAUDATA** White, 1889

Plate 50, figure 2

*Sanguinolaria? caudata* White, U.S. Geol. Surv., Bull. no. 51, p. 61, pl. 10, figs. 1, 2, 3, 1889.

*Original description.* Among the collections made at Carbonado are some imperfect examples of a somewhat extraordinary shell, which I refer provisionally to *Sanguinolaria*. Up to the time of its reaching nearly adult size its general shape and marginal outline agree with the recognized forms of *Sanguinolaria*; but from that time until fully grown the posterior portion became so greatly extended, that extreme examples reach nearly double the length which the shell had before the posterior elongation began. No trace of the hinge has been discovered, and the specimens found are so imperfect, that no satisfactory specific description can be given. The figures, however, on Plate X will serve to give a good idea of all that has been learned of this singular shell. (White)

*Observations.* This species occasionally is found in some of the shale layers of the fresh-water strata of the Puget Group. The specimen figured in this report is about two-thirds grown and is representative of most of the specimens seen. White figures two more mature specimens which are extremely elongate, as referred to in his description.

*Syntype.* (U.S.N.M. 20096.) Figured in the present report, pl. 50, fig. 2.

*Geologic range.* Puget Group, middle and upper Eocene.

*Geographic distribution.* King County, Puget Sound Basin, Washington.

*Type locality.* Newcastle coal mine, Newcastle, King County, Washington.

**SANGUINOLARIA HOWARDI** (Dickerson), 1915

Plate 50, figure 11

*Tellina howardi* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 55, pl. 4, figs. 2a, 2b, 1915.

*Sanguinolaria howardi* (Dickerson), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 62, pl. 8, fig. 2, 1938.

*Original description.* Shell large, oval, compressed; beak anterior of center; anterior and posterior dorsal margins nearly straight, sloping gently; anterior end rounded more broadly than posterior; ventral margin with very great curvature. This is the largest *Tellina* in the Tejon-Eocene. Dimensions.—Length of broken type, 43 mm.; height, 30 mm. (Dickerson)

*Observations.* This species occurs in the Cowlitz formation near Balch, Thurston County, Washington, and in the Willamette Valley, Oregon. The specimen figured in this report is the holotype from Live Oak Canyon at the south end of the San Joaquin Valley in California, from the type Tejon formation. In general outline the species somewhat re-

sembles *S. townsendensis* Clark from the Oligocene of Port Townsend Bay. It differs in that the anterior end is more narrowly rounded and the anterior dorsal margin slopes down at a larger angle and evenly rounds into the anterior margin.

*Holotype.* (C.A.S. 271.) Locality (C.A.S. 244). Live Oak Creek, Kern County, California. Figured in the present report, pl. 50, fig. 11.

*Geologic range.* Tejon and Cowlitz formations, upper Eocene.

*Geographic distribution.* Vicinity of Tejon Pass, southern California, and in the Chehalis Valley, west of Centralia, Washington.

*Type locality.* Live Oak Canyon, Kern County, California. Occurs also at locality (U.C. A-854) in the Spencer formation of the upper Eocene in the Willamette Valley.

#### SANGUINOLARIA TOWNSENDENSIS Clark, 1925

##### Plate 50, figure 8

*Sanguinolaria (Nuttalina) townsendensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 97, pl. 18, fig. 7, 1925.

*Original description.* Shell thin, medium in size, inequivaled, inequilateral; left valve slightly more convex than right; beaks rather inconspicuous, anterior to the middle; anterior dorsal margin short, gently convex; posterior dorsal margin long, nearly straight, on type specimen slightly convex posterior to the nymph plate. Anterior end broadly rounded; posterior end cut off by an oblique but somewhat obscure truncation; surface of shell covered by irregular medium-fine lines of growth. Nymph plate prominent, extending a little over one-third the length of posterior dorsal edge. Hinge plate unknown. Dimensions: Length 61 mm.; height 40 mm. (Clark)

*Observations.* This species which somewhat resembles the Recent form *S. nuttalli* Conrad may be distinguished in its relatively greater length in proportion to height, in the relatively greater length of the nymph plates, in the more attenuate character of the posterior end, and in the lesser depression of the posterior dorsal margin.

*Holotype.* (S.U. 50.) Figured in the present report, pl. 50, fig. 8.

*Geologic range.* Lincoln formation, lower Oligocene.

*Geographic distribution.* Port Townsend Bay, western Washington.

*Type locality.* From sandstone cliff between Classen's Wharf and the ship canal estuary, Port Townsend Bay, Washington.

#### Genus APOLYMETIS Salisbury, 1929

*Apolymetis* Salisbury, Proc. Malac. Soc. London, vol. 18, p. 258, 1929.

*Genotype.* "Tellina meyeri" Phil = *Tellina meyeri* Dunker.

**APOLYMETIS VANCOUVERENSIS** (Clark and Arnold), 1923

## Plate 50, figure 17

*Metis vancouverensis* (Clark and Arnold), Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 150, pl. 22, figs. 3, 4, 1923.

*Original description.* Shell medium in size; subovate in outline; moderately inflated; heavy. Beaks anterior to middle, fairly conspicuous, strongly inturned but only slightly prosogyrous. Anterior dorsal edge short, straight to slightly convex; posterior dorsal edge straight to slightly concave and nearly three times length of anterior edge; anterior end broadly rounded, slope being very abruptly downward from dorsal edge; posterior end narrower than anterior end, produced and rather broadly truncated. External surface smooth except for rather heavy somewhat irregular incremental lines and fine radiating lines on weathered surface. On left valve a distinct ridge extends from beak to angle of truncated posterior end; posterior to this surface strongly depressed while just anterior and parallel to ridge is a broad but shallow groove; on right valve posterior ridge not so prominent and only a faint indication of a depression in front of it. Ligament rather immersed as in the Recent west coast species *Metis alta*. Two small cardinals in each valve. Dimensions of type specimen (a right valve): Length, 44 mm.; height, 38 mm. (Clark and Arnold)

*Observations.* Clark has already pointed out the similarity of the general outline of this species to the Oligocene form *A. rostellata* Clark from the Coast Ranges in California. It may be distinguished from it in being relatively heavier with more strongly developed umbones and a less strongly produced posterior margin.

*Holotype.* (C.A.S. 588.) Figured in the present report, pl. 50, fig. 17.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Southern shore of Vancouver Island.

*Type locality.* From sandstone in sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

## Family SEMELIDAE

## Genus SEMELE Schumacher, 1817

*Semele* Schumacher, Essai d'un Nouv. Syst. Habit. Vers Test., p. 165, 1817.

*Genotype.* *Tellina reticulata* Spengler = *Tellina proficua* Pulteney.

**SEMELE REAGANI** Dickerson, 1917

## Plate 50, figures 5, 6

*Semele reagani* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 170, pl. 29, figs. 1a, 1b, 1c, 1d, 1917.

*Semele gayi* Arnold, Dickerson (not Arnold), Proc. Calif. Acad. Sci., ser. 4, vol. 7, pl. 29, figs. 2a, 2b, 1917.

*Semele reagani* Dickerson, Effinger, Jour. Paleon., vol. 12, p. 372, 1938.

*Original description.* Shell medium size with prominent subcentral beak; lunule and escutcheon obscure; anterior dorsal margin slightly concave; posterior dorsal margin straight, sloping to rounded posterior; anterior sub-truncate; a faint umbonal

ridge cutting fine rounded, growth lines decorating the shell. Dimensions:—Length, 13.5 mm.; height, 12.5 mm.; convexity, 2.5 mm. (Dickerson)

*Observations.* This species is fairly abundant at the type locality of the Gries Ranch beds on Cowlitz River, Washington. As already has been noted by Effinger (138, p. 372), specimens from the same locality which were figured by Dickerson as equivalent to *Semele gayi* Arnold appear to be immature specimens of *Semele reagani*. *S. reagani* may be distinguished from *S. vancouverensis* Clark and Arnold in the concave posterior dorsal margin, the less anterior situation of the umbones, and the more acutely rounded anterior margin.

*Holotype.* (C.A.S. 396.) Figured in the present report, pl. 50, fig. 5.

*Paratype.* (C.A.S. 397.) Figured in the present report, pl. 50, fig. 6.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz River Valley, southwestern Washington.

*Type locality.* (U.W. 239.) On north side of Cowlitz River four miles east of Vader, Lewis County, Washington, in the northeast quarter of Section 25, T. 11 N., R. 2 W.

#### SEMELE DIABLOI Dickerson, 1915

Plate 50, figure 15; plate 52, figure 13

*Semele diaboli* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 55, pl. 4, fig. 4, 1915; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 62, pl. 8, fig. 15, 1938.

*Original description.* Shell of medium size; beak sub-central; anterior dorsal margin sloping gently to a well rounded anterior end; posterior dorsal margin sloping steeply to a sharply rounded posterior; decoration, concentric growth lines only. Dimensions:—Length, 31 mm.; height, 24 mm. (Dickerson)

*Observations.* This species is almost subcircular in outline with low umbones which nearly merge into the dorsal margin. The holotype of this species which was described by Dickerson from the middle Eocene of Contra Costa County, California, has a lesser proportionate height, slightly higher umbones, a less concave posterior dorsal margin, and less convex posterior end. When a larger number of specimens from the Oregon locality are available for study, it is possible they may be found to represent a new species.

*Hypotype.* (U.C. 33639.) Figured in the present report, pl. 50, fig. 15; pl. 52, fig. 13.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* (U.O. 140.) Douglas County, Oregon, north bank of Little River about one and one-half miles above the mouth of the stream. Across the suspension bridge from Schrums farm near the mouth of Buckhorn Creek, northeast quarter of Section 25, T. 26 S., R. 3 W.

**SEMELE VANCOUVERENSIS** Clark and Arnold, 1923

Plate 50, figures 9, 12, 16

*Semele vancouverensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 151, pl. 27, figs. 3a, 3b, 4, 1923.

*Original description.* Shell small, broadly subovate, height about equal to length, beaks inconspicuous, slightly posterior to middle; posterior dorsal slope steep, straight; anterior dorsal slope nearly straight to slightly concave; posterior end broadly subtruncate. Surface of shell sculptured by numerous fine radial striations and numerous closely crowded irregularly spaced concentric, rounded undulations, interspaces between which appear as narrow grooves. Hinge plate heavy; two well developed, heavy cardinals in each valve; anterior and posterior laterals heavy and well developed. Dimensions of type specimen: Length, 13 mm.; height, 12 mm. (Clark and Arnold)

*Observations.* This species is characterized by its subovate-quadrata outline, height nearly equal to length, nearly straight posterior dorsal margin, broadly rounded anterior margin, and more acutely rounded posterior margin.

*Holotype.* (U.C. 30226.) Figured in the present report, pl. 50, fig. 9.

*Paratype.* (C.A.S. 596.) Figured in the present report, pl. 50, figs. 12, 16.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South coast of Vancouver Island.

*Type locality.* In sandstone in sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

**SEMELE SYLVIAENSIS** Weaver, 1912

Plate 50, figure 14; plate 52, figures 3, 15; plate 60, figure 10

*Semele sylviaensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 67, 68, pl. 12, fig. 100, 1912.

*Original description.* Shell moderately large, nearly as high as long, sub-equivalve, nearly equilateral, sub-oval and moderately thick; beaks not very prominent and pointing slightly forwards, and situated nearly central. Anterior margin sloping downwards about 45° just in front of beaks and then sloping gradually downwards at 30° to the anterior end, which is truncated and then rounds off into the base. Base regularly rounded; posterior margin slightly convex and sloping about 45° to posterior end, which is sharply rounded. Surface ornamented by fairly well developed concentric lines of growth. Dimensions.—Longitude 33 mm.; altitude 29 mm.; diameter 9 mm. (Weaver)

*Observations.* This species is common in the basal conglomerates of the Montesano formation just northwest of the city of Montesano. The two paratypes figured in this report were used by the writer in the original description of the species. Different specimens show considerable variations in the ratio of height to length.

*Holotype.* (U.W. 61) (C.A.S. 7458). Figured in the present report, pl. 52, fig. 15.

*Paratype.* (U.W. 61-B) (C.A.S. 7458-B). Locality (U.W. 68). Figured in the present report, pl. 50, fig. 14.

*Paratype.* (U.W. 61-A) (C.A.S. 7458-A). Locality (U.W. 68). Figured in the present report, pl. 52, fig. 3.

*Paratype.* (U.W. 61-C) (C.A.S. 7458-C). Locality (U.W. 68). Figured in the present report, pl. 60, fig. 10.

*Geologic range.* Lower Montesano formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Grays Harbor County, southwestern Washington.

*Type locality.* (U.W. 68.) In cut in a conglomerate in logging railway on Sylvia Creek, Grays Harbor County, Washington, Section 32, T. 18 N., R. 7 W.

#### SEMELE MONTESANOENSIS Weaver, 1912

##### Plate 52, figure 8

*Semele montesanoensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 67, pl. 12, figs. 98, 99, 1912.

*Original description.* Shell medium sized, sub-quadrata, inequilateral, equivalve, and moderately inflated; beaks somewhat prominent, pointing forwards and situated about two-thirds distance from the anterior end. Posterior margin slopes nearly straight at an angle of 50° from beak to a point about two-thirds the distance up from the base, where it is truncated at the posterior end; base broadly rounded; anterior margin slopes down sharply from the beak for a very short distance and slopes off at a lower angle for about 6 mm. and then passes as a broad curve around the anterior end where it merges with the base. Surface ornamented with well-defined concentric lines of growth. Shell material moderately thin and interior of right valve showing cardinal and lateral teeth fairly well developed; pallial line distinct. Dimensions.—Longitude 29 mm.; altitude 24 mm.; diameter 8 mm. (Weaver)

*Observations.* This species may be distinguished from *S. sylviaensis* by its proportionately greater length and lesser height, the more anterior position of the beaks, the lesser slope and slight concavity of the posterior dorsal margin.

*Holotype.* (U.W. 60-A) (C.A.S. 7457-A). Locality (U.W. 68). Figured in the present report, pl. 52, fig. 8.

*Geologic range.* Lower Montesano formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Grays Harbor County, southwestern Washington.

*Type locality.* (U.W. 68.) From a conglomerate layer in old logging railway cut on Sylvia Creek, Grays Harbor County, Washington, Section 32, T. 18 N., R. 7 W.

## Family SOLENIDAE

## Genus SOLEN Linnaeus, 1758

*Solen* Linnaeus, Syst. Nat. (10th ed.), p. 672, 1758.

*Genotype.* *Solen vagina* Linnaeus.

## SOLEN TOWNSENDENSIS Clark, 1925

Plate 53, figures 1, 9

*Solen (Plectosolen) townsendensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 97, 98, 1925.

*Solen townsendensis* Clark, Effinger, Jour. Paleon., vol. 12, pp. 372, 373, 1938.

*Original description.* Shell small, posterior dorsal and ventral edges parallel, posterior end broadly and regularly rounded; anterior end broadly rounded, greatest point of convexity being below the middle of edge. No well-defined depression or sulcus near anterior end. Dimensions of type: Length about 32 mm.; height about 8 mm. (Clark)

*Observations.* This species may be distinguished from *S. lincolniensis* Weaver by the absence of a strongly developed anterior sulcus and by the rounded instead of square posterior ventral margin. The species occurs also in the sandstones at Pittsburg Bluff in Columbia County, Oregon.

*Holotype.* (S.U. 51.) Figured in the present report, pl. 53, fig. 9.

*Hypotype.* (U.C. 33535.) Gries Ranch beds. Figured in the present report, pl. 53, fig. 1.

*Geologic range.* Lower Oligocene.

*Geographic distribution.* Wahkiakum County, southwestern Washington; Port Townsend Bay, Olympic Peninsula; and lower Cowlitz Valley.

*Type locality.* Bluffs along Skamokawa River above big bend one mile east of junction of main and middle forks, Wahkiakum County, Washington. Occurs also at locality (U.W. 239). East side of Cowlitz River near old Gries Ranch, Cowlitz County. Section 25, T. 11 N., R. 2 W.

## SOLEN CLALLAMENSIS Clark and Arnold, 1923

Plate 53, figures 3, 8

*Solen clallamensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 152, pl. 20, figs. 4, 5, 1923.

*Original description.* Shell medium in size, thin. Posterior dorsal edge gently concave; ventral edge straight; posterior end very broadly and regularly rounded; anterior end rather strongly rounded, greatest point of convexity slightly below middle. A well defined sulcus extends from upper to lower angle of posterior end. Hinge plate not exposed. Dimensions of type: Length, 52 mm.; greatest height, 11.5 mm. (Clark and Arnold)

*Observations.* As pointed out by Clark and Arnold, this species somewhat resembles the Recent West Coast species *Solena sicarius* (Gould) but may be distinguished from it in the greater convexity of the

anterior margin and in the greater prominence of the anterior sulcus and its situation a greater distance from the end.

*Holotype.* (U.C. 30242.) Figured in the present report, pl. 53, fig. 3.

*Paratype.* (U.C. 30232.) Figured in the present report, pl. 53, fig. 8.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* North side of Olympic Peninsula, Washington.

*Type locality.* In sea cliffs one and one-half miles west of Clallam Bay, Clallam County, Washington.

#### SOLEN LINCOLNENSIS Weaver, 1916

Plate 53, figures 2, 4, 5, 6

*Solen lincolnensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 43, pl. 2, figs. 9, 10, 11, 12, 1916.

*Original description.* Shell large, rather short, nearly straight and convex; anterior end obliquely truncated and making an angle with the dorsal margin of 125°; basal margin parallel with dorsal; beaks inconspicuous and situated at the junction of dorsal and anterior margin; surface smooth except for well developed lines of growth; posterior end broadly rounded; anterior muscular scar elongate and narrow and situated half way between dorsal and ventral margin; posterior scar short and quadrangular; pallial sinus broad but short. Dimensions.—Altitude 19 mm.; longitude 62 mm.; thickness 11 mm. (Weaver)

*Observations.* This species may be distinguished from *S. parallelus* Gabb by its being relatively shorter and by the more obliquely truncated anterior end.

*Syntype.* (U.W. 100-A) (C.A.S. 552-B). Figured in the present report, pl. 53, fig. 2.

*Syntype.* (U.W. 100-B) (C.A.S. 552). Figured in the present report, pl. 53, figs. 4, 5.

*Syntype.* (U.W. 100-D) (C.A.S. 552-A). Figured in the present report, pl. 53, fig. 6.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Chehalis River Valley, Washington.

*Type locality.* (U.W. 256.) In railroad cut on Union Pacific Railway one mile north of Galvin station, Lewis County, Section 27, T. 15 N., R. 3 W.

#### SOLEN CURTUS Conrad, 1848

*Solen curtus* Conrad, Am. Jour. Sci., ser. 2, vol. 5, p. 433, fig. 14, 1848.

*Solen (Plectosolen) curtus* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 129, 1909.

*Solen (Plectosolen) curtus* (?) Conrad, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 88, 1931.

*Original description.* Slightly curved, short, convex, equally wide at the extremities; anterior margin very obliquely truncated, reflected, rounded toward the base; posterior extremity truncated, slightly oblique. (Conrad)

*Observations.* The holotype of this species came from the Astoria formation at Astoria, Oregon. Fragments of a *Solen* similar to *S. curtus* occur in the sandstones of the Astoria formation south of Elma, Washington, but no complete shells were obtained.

*Holotype.* Lost.

*Geologic range.* Astoria formation, middle Miocene.

*Type locality.* Astoria, Oregon (collected by J. D. Dana).

**SOLEN CURTUS Conrad var. CONRADI Dall, 1909**

Plate 53, figure 7

*Solen (Plectosolen) curtus* var. ? *conradi* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 129, 130, pl. 12, figs. 7, 10, 1909.

*Original description.* Shell short, thin, wide, the extremities subequal in width; beaks terminal, ligament about one-fifth of the length; dorsal margin slightly arcuate, compressed and slightly pouting; posterior end truncate, gaping, with the angles rounded; base slightly arcuate; anterior end with the margins slightly thickened and expanded, obliquely truncate, the valves perceptibly constricted just behind the margin; surface except for lines of growth, polished; hinge normal; pallial sinus rather shallow and irregular in form. Length of figured specimen, 56 mm. Length of full-grown individual, 70 mm.; width, 18.; diameter, 11 mm. (Dall)

*Observations.* This variety may be distinguished from the published figure of *S. curtus* Conrad in being straighter, in having a well-developed dorsal area behind the hinge, and a more acute anterior basal angle.

*Holotype.* (U.S.N.M. 153934.) Figured in the present report, pl. 53, fig. 7.

*Geologic range.* Astoria and Empire formations, middle and upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon, and Clallam Bay, Washington.

*Type locality.* Coos Bay, Oregon (Camman Collection).

Genus **SOLENA Mörcb, 1853**

*Solena* Mörcb, Cat. Conch. Yoldi, pt. 2, p. 7, 1853.

*Genotype.* *Solen obliquus* Spengler.

**SOLENA COLUMBIANA (Weaver and Palmer), 1922**

Plate 51, figure 6; plate 52, figure 4; plate 53, figures 10, 12

*Solen columbianus* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 24, pl. 10, fig. 3, 1922.

*Solena (Eosolen) columbiana* (Weaver and Palmer), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 63, pl. 9, fig. 3, 1938.

*Original description.* Shell large and broad; dorsal region slightly convex; anterior end sloping from the dorsal line at an angle of 25° turning more vertically at the middle portion of the shell and passing below into the ventral margin at an

angle of 40°; dorsal line nearly straight; a deep, anterior sulcus extends obliquely from the beaks to the ventral margin parallel with the anterior margin; surface smooth except for the growth lines which are moderately conspicuous. Dimensions.—Length 45 mm.; height 21 mm.; thickness 4 mm. (Weaver and Palmer)

*Observations.* Turner has pointed out the close resemblance of this species to "*Solen novacula*" Anderson and Hanna. The former may be distinguished in having a faintly developed narrow ridge situated on the anterior margin of the umbonal furrow which is not present in the latter species. The dorsal margin is slightly concave but straight in "*S. novacula*."

*Holotype.* (U.W. 179) (C.A.S. 7472). Figured in the present report, pl. 52, fig. 4; pl. 51, fig. 6.

*Topotype.* (U.C. 33411.) Locality (U.C. 7167). Figured in the present report, pl. 53, fig. 10.

*Hypotype.* (U.C. 33227.) Upper Eocene in Willamette Valley. Figured in the present report, pl. 53, fig. 12.

*Geologic range.* Cowlitz formation, upper Eocene; Spencer formation, upper Eocene.

*Geographic distribution.* Cowlitz County, southwestern Washington, and Willamette Valley, Oregon.

*Type locality.* (U.W. 337.) About one-half mile above old dam, on west bank of Coal Creek, Cowlitz County, Section 11, T. 8 N., R. 3 W. Occurs also in Oregon at locality (U.C. A-985) in the Spencer formation in Willamette Valley.

#### SOLENA CLARKI (Weaver and Palmer), 1922

##### Plate 53, figure 11

*Solen clarki* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 23, 24, pl. 9, fig. 16, 1922.

*Original description.* Shell large and long; valves convex; ventral and dorsal margins parallel; anterior end oblique, rounded at the base; posterior tip unknown; a deep, anterior furrow extends from the umbones to the ventral margin, vertically inclined to the dorsal and ventral margins; surface with fine concentric lines of growth which extend parallel with the dorsal and ventral margins for about two-thirds of the length of the shell and then turn abruptly and continue to the dorsal margin at right angles to the dorsal line. Dimensions.—Length 52 mm.; height 17 mm.; thickness 12 mm. (Weaver and Palmer)

*Observations.* This species may be distinguished from "*Solen*" *parallelus* Gabb in that in the latter the dorsal and ventral margins are nearly parallel and the anterior umbonal furrow is deep and well developed.

*Holotype.* (U.W. 178) (C.A.S. 7474). Figured in the present report, pl. 53, fig. 11.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Cowlitz County, southwestern Washington.

*Type locality.* (U.W. 342.) About one-fourth mile above old Inman-Poulsen shops on Coal Creek, Cowlitz County, Section 2, T. 8 N., R. 3 W.

**SOLENA COOSENSIS** Turner, 1938

Plate 52, figure 16; plate 53, figure 13

*Solena (Eosolen) coosensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 62, 63, pl. 9, figs. 1, 2, 1938.

*Original description.* Shell thin, elongate, gaping at both ends, ornamented by growth lines and fine diagonal lines converging ventrally between the anterior furrow and the locus of the posterior ventral angle; dorsal and ventral margins practically parallel; dorsal margin slightly concave immediately behind the beaks; posterior area separated from the remainder of the shell by a conspicuous umbonal furrow; usually a slight ridge immediately anterior to the furrow; fine radial lines may occasionally be observed on the anterior area which is semicircular in outline. (Turner)

*Observations.* This species may be distinguished from *S. columbiana* (Weaver and Palmer), and also "*Solen novacula*" Anderson and Hanna, by the more pronounced and rounded anterior margin.

*Holotype.* (U.C. 33117.) Figured in the present report, pl. 52, fig. 16; pl. 53, fig. 13.

*Geologic range.* Tyee formation, middle Eocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* (U.C. A-704.) Approximately 450 feet down stream from private bridge across Rock Creek a quarter of a mile above old Roseburg-Coos Bay highway bridge. (Turner)

**SOLENA SICARIUS** (Gould), 1850

Plate 53, figure 16

*Solen sicarius* Gould, Proc. Boston Soc. Nat. Hist., vol. 3, p. 214, 1850; Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 32, 1916.

*Solen sicarius* Gould, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 385, 386, pl. 21, fig. 4, 1931 (synonymy).

*Original description.* "T. transversa, oblonga, retrosum angustata, sub-falcata, epidermide crasso, nitido, corneo induta, antice oblique truncata, postice rotundata: valvis valde excavatis, undulatis, areis triangularibus indistincte partitis; margine dorsali recto; M. ventrali arcuato; natibus terminalibus: cardo dente triangulari, erecto, recurvo in utrâque valvâ instructa. Long. 3½; lat. 7/20; alt. 9/10 poll." Hab. Strait of De Fuca, Oregon. "The only species to which this bears any resemblance is *S. viridis*, which has nearly the same hinge and general form, but which is a more delicate and more slender shell." (Gould)

*Observations.* This species attains considerable size when adult but the specimen figured on pl. 53, fig. 16, is rather small and is representative of the size of the average specimens of the species in the Astoria formation in Washington. The species is characterized by its strongly concave dorsal margin and parallel ventral margin.

*Hypotype.* (U.C. 33424.) Figured in the present report, pl. 53, fig. 16.

*Geologic range.* Astoria formation, middle Miocene to Recent.

*Geographic distribution.* Lower California to Strait of Juan de Fuca.

*Type locality.* Strait of Juan de Fuca; Recent. Occurs in Astoria formation at locality (U.W. 416). Clemons logging road, on abandoned spur of railroad one-fourth mile north of junction of main line on the point of the first curve in the road. Section 25, T. 17 N., R. 7 W.

**SOLENA EUGENENSIS** (Clark), 1925

## Plate 53, figures 14, 15

*Solen eugenensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 98, pl. 22, fig. 1, 1925.

*Original description.* Shell large, heavy for this genus; dorsal and ventral margins straight and parallel. Posterior end bluntly truncated to broadly rounded. Anterior end obliquely truncated, only slightly convex with a deep well-defined groove extending from just below cardinal tooth to ventral edge. A well defined margin of flange anterior to this groove. There is a distinct notch where groove joins ventral edge. Hinge plate exposed in the cast only sufficiently to show it to be a true Solen. Dimensions: Greatest height of shell 24 mm.; length (the posterior end broken) 98 mm. (Clark)

*Observations.* The close relationship of this species to *S. lorenzanum* Wagner and Schilling has been pointed out by Clark. It may be distinguished from the latter by the lesser angle made by the anterior umbonal sulcus and the posterior dorsal margin.

*Holotype.* (U.C. 30338.) Figured in the present report, pl. 53, figs. 14, 15.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Southwest Washington.

*Type locality.* (U.C. 4182.)

**Genus SILIQUA Megerle von Mühlfeld, 1811**

*Siliqua* Megerle von Mühlfeld, Mag. d. Ges. Naturf. Fr., vol. 5, p. 44, 1811.

*Genotype.* *Solen radiatus* Linnaeus, Syst. Nat. (10th ed.), p. 673, 1758.

**SILIQUA PATULA Dixon var. OREGONIA Dall, 1900**

## Plate 54, figure 1

*Siliqua (patula Dixon var.?) oregonia* Dall, Trans. Wagner Free Inst. Sci., vol. 3, p. 957, 1900.

*Original description.* A somewhat imperfect specimen from the Miocene shales collected by Mr. Diller; differs from *S. nuttallii* by its strong and straight clavicle, its proportionately wider shell, and its somewhat rostrate posterior extremity. It appears to be adult, and if so is much smaller than *S. patula*, which also has a more rounded posterior end. . . . The shell measures about 65 mm. long and 25 wide. The pallial sinus appears to be decidedly deeper and narrower than in *S. nuttallii*. (Dall, 90, p. 957)

*Observations.* *S. patula oregonia* which was described by Dall is represented by a single specimen from Two-Mile Creek near Coos Bay, Oregon, and is deposited in the collections of the U.S. National Museum. The shell material figured is largely broken away and the biologic details of the species are in part obscure.

*Holotype.* (U.S.N.M. 156887.) Figured in the present report, pl. 54, fig. 1.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* Two-Mile Creek, Coos Bay, Oregon.

## SUPERFAMILY MACTRACEA

## Family MACTRIDAE

## Genus SPISULA Gray, 1837

*Spisula* Gray, Charlesworth's Mag. Nat. Hist., n. s., vol. 1, p. 372, 1837.

*Genotype.* "Cardium" *solida* Linnaeus; later designated by Gray as *Mactra* (Proc. Zool. Soc. London, p. 185, 1847).

## SPISULA PACKARDI Dickerson, 1917

## Plate 54, figures 2, 4.

*Spisula packardi* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 169, 170, pl. 28, figs. 5a, 5b, 1917.

*Spisula packardi* Dickerson, Effinger, Jour. Paleon., vol. 12, p. 373, 1938.

*Mactra packardi* (Dickerson), Clark and Anderson, Bull. Geol. Soc. Am., vol. 49, p. 948, pl. 2, figs. 6, 7, 1938.

*Original description.* Shell large trigonal, equivalve, nearly equilateral, ventricose, ornamented by numerous fine concentric ridges which are more pronounced and more numerous on the anterior dorsal area than upon other portions of the shell; beaks moderately prominent; anterior dorsal area limited by a distinct ridge extending from the umbo to the anterior extremity; the margin of this area slightly curved; posterior dorsal slope slightly convex, limited by an indistinct ridge which extends from the beak to the base of the shell; anterior extremity more sharply pointed than the posterior; base very broadly rounded; hinge plate fairly broad; chondrophore oblique, shallow, apically roofed by a broad flat spur; left cardinal prominent, high, arms broad, extending from the dorsal to the ventral margin of the plate; ventral sinus, narrow, deep; right cardinal with a prominent anterior arm and with a well developed, but very thin, posterior arm; laminae long, fairly distant from beaks; anterior lateral formed from the margin of the plate, top acute; posterior lateral also with acute top, dorsal and ventral slopes nearly equal; anterior ventral lamina formed from upturned edge of the hinge plate not confluent with the anterior dorsal cardinal arm. Dimensions.—Length, 53 mm.; height, 39 mm.; convexity, 11 mm. (Dickerson)

*Observations.* Specimens of this species show a wide range of variation and the form has been recognized also in the San Emigdio formation at the south end of the San Joaquin Valley, and in the Wheatland formation on the east side of the Sacramento Valley whose age in part may be equivalent to that of the type Gries Ranch beds in Washington.

*Holotype.* (C.A.S. 395.) Figured in the present report, pl. 54, figs. 2, 4.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz River Valley, southwestern Washington.

*Type locality.* (U.W. 239.) On south bank of Cowlitz River, Lewis County, in northeast quarter of Section 25, T. 11 N., R. 2 W.

**SPISULA PACKARDI** Dickerson var. **YOKAMENSIS** Turner, 1938

Plate 54, figures 5, 8

*Spisula packardi* Dickerson var. *yokamensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 63, 64, pl. 7, figs. 1, 2, 1938.

*Original description.* The principal difference between *Spisula packardi* and the variety *yokamensis* is found in the shape of the area behind the posterior umbonal ridge. In the new variety this area is generally somewhat trigonal in outline while in the original species it is roughly trapezoidal. (Turner)

*Observations.* The surface of the posterior area in the holotype specimen is slightly convex and triangulate-subelliptical in outline and this character appears uniform in other specimens of the variety.

*Holotype.* (U.C. 33101). Figured in the present report, pl. 54, fig. 8.

*Paratype.* (U.C. 33102). Figured in the present report, pl. 54, fig. 5.

*Geologic range.* Lower Coaledo formation, upper Eocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.C. A-714.) Cliffs along north side of Sunset Bay, Coos Bay area, Oregon.

**SPISULA ACUTIROSTRATA** Packard var. ? Turner, 1938

Plate 52, figure 6; plate 54, figure 3

*Spisula acutirostrata* Packard, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 295, 1916.

*Spisula acutirostrata* Packard var.? Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 64, pl. 7, fig. 6, 1938.

*Original description* (*S. acutirostrata* Packard). Shell medium sized, slightly ventricose, trigonal in outline; inequilateral; sculptured by indistinct incremental lines of growth; beaks prominent, strongly incurved and acutely pointed; posterior dorsal margin somewhat convex; anterior margin also slightly convex. Anterior extremity of the cotype produced and slightly truncated, while the posterior end is more evenly rounded; ventral margin arcuate. Escutcheon of the type specimen impressed and broad; posterior dorsal area limited by a prominent angulation or ridge which extends from the umbo to the posterior extremity. Hinge plate rather wide; chondrophore deep, quite broad; left cardinal broken, but it was apparently low, heavy and not extending to the ventral margin of the plate. No accessories nor spur observable. Anterior lateral low, long; posterior lateral also rather low. Hinge of right valve unknown. The dimensions of the type are: height, 55 mm., length, 53 mm., convexity, 17 mm. (Packard)

*Observations.* The specimens from Cape Arago in Oregon were regarded by Turner as closely related to *S. acutirostrata* with the suggestion that they might constitute a variety of that species. They are characterized by a proportionately greater length and a tendency to elevation of the posterior dorsal margin.

*Holotype of variety.* (U.C. 33096.) Figured in the present report, pl. 52, fig. 6; pl. 54, fig. 3.

*Geologic range.* Lower Coaledo formation, upper Eocene.

*Geographic distribution.* Southwest Washington.

*Type locality.* (U.C. A-858.) Southwest corner of Cape Arago, Oregon.

**SPISULA RUSHI** Wagner and Schilling var. **ARAGOENSIS** Turner, 1938

Plate 52, figures 9, 17; plate 54, figure 6

*Spisula rushi* Wagner and Schilling var. *aragoensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 64, pl. 7, figs. 3, 4, 1938.

*Original description.* Shell thin, moderately elongate, ornamented only by fine concentric growth lines. Beak slightly in advance of median line. Anterior and posterior ends rounded. Anterior dorsal margin raised, straight. Posterior dorsal margin abutting, convex. Altitude 27.1 mm.; length 34.5 mm. (Turner)

*Observations.* This variety differs from *S. rushi* in the tendency for the anterior dorsal margins of the valves to approach each other at an angle. The anterior umbonal ridge is absent and that of the posterior end very faintly developed.

*Holotype.* (U.C. 33099.) Figured in the present report, pl. 52, fig. 17; pl. 54, fig. 6.

*Paratype.* (U.C. 33100.) Figured in the present report, pl. 52, fig. 9.

*Geologic range.* Lower Coaledo formation, upper Eocene.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* (U.C. A-715.) Silty sandstones east of lighthouse reefs on north shore of reservation. (Turner)

**SPISULA MERRIAMI** Packard, 1916

Plate 52, figures 11, 12; plate 54, figure 10

*Spisula merriami* Packard, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 294, pl. 27, figs. 3a, 4, 1916.*Spisula cf. merriami* Packard, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 64, pl. 6, fig. 12, 1938.

*Original description.* Shell small, trigonal, equivalve, nearly equilateral, ventricose, ornamented by numerous fine concentric ridges, which are more pronounced and less numerous on the anterior and posterior dorsal areas than upon the other portions of the shell; beaks moderately prominent, anterior dorsal area limited by a distinct ridge, extending from the umbo to the anterior extremity; the margin of this area is nearly straight; posterior dorsal slope slightly convex, limited by an indistinct ridge which extends from the beak to the base of the shell; anterior extremity more sharply pointed than the posterior; base very broadly rounded. Hinge plate relatively broad, chondrophore oblique, shallow, apically roofed by a broad flat spur; left cardinal prominent, high, arms broad, extending from the dorsal to the ventral margin of the plate; ventral sinus narrow, flat; right cardinal with a prominent anterior arm and a well-developed, although relatively thin posterior arm; laminae long, distant from the beaks; anterior lateral formed from the margin of the plate, top rounding, distant from the anterior arm of the cardinal; posterior lateral also with a rounding top, dorsal and ventral slopes nearly equal; anterior ventral lamina formed from the upturned edge of the hinge plate, not confluent with the anterior cardinal arm; anterior dorsal scarcely developed, considerably smaller than the corresponding posterior one. The dimensions of the type are: length 18.6 mm.; height 14.2 mm., convexity 4 mm. (Packard)

*Observations.* This species is closely related to *S. bisculpturata* which shows a prominent concentric ribbing over the entire surface of the

valves. In *S. merriami* the conspicuous concentric marking over the disk of the shell is absent and the outline of the shell itself is less equilateral.

*Hypotype.* (U.C. 33095.) Figured in the present report, pl. 54, fig. 10; pl. 52, figs. 11, 12.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* North Umpqua River, southwestern Oregon.

*Type locality.* (U.C. A-667.) North branch of Umpqua River from the bend a quarter of a mile north of Glide to Bradley Creek, a distance of about three-eighths of a mile. (Turner)

#### **SPISULA MERRAMI** Packard var. **LONGIFRONS** Turner, 1938

Plate 52, figures 10, 14; plate 54, figures 11, 13

*Spisula merriami* Packard var. *longifrons* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 65, pl. 6, figs. 10, 11, 1938.

*Original description.* Shell small, heavy, anteriorly produced; beaks small, somewhat elevated, posterior to median line; sculpture prominent, concentric, does not appear to be differentiated on either side of the rounded anterior and posterior dorsal angles; anterior and posterior dorsal margins meet abruptly. Dimensions.—Altitude 19.3 mm.; length 26.5 mm. (Turner)

*Observations.* The subspecies *longifrons* may be distinguished from *S. merriami* by its more pronounced anterior margin, less flaring dorsal margins, and less strongly developed increase in coarseness of sculpture marginally from the anterior and posterior umbonal angles.

*Holotype.* (U.C. 33097.) Figured in the present report, pl. 52, figs. 10, 14; pl. 54, figs. 11, 13.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* (U.C. A-838.) Bed of Middle Fork of Coquille River opposite Roseburg-Coos Bay Highway Survey station 834 + 34. (Turner)

#### **SPISULA BISULCUTURATA** Anderson and Hanna, 1925

Plate 54, figure 7

*Spisula bisulcaturata* Anderson and Hanna, Calif. Acad. Sci., Occ. Pap. vol. 11, pp. 149, 150, pl. 3, fig. 7, 1925 (synonymy).

*Original description.* Shell small, trigonal, produced posteriorly, moderately inflated; anterior dorsal slope very convex, bounded by a distinct ridge extending from the beak to the basal margin in a gentle curve; ridge immediately followed by a shallow depression; posterior dorsal slope straight, bounded by ridge similar to that of the anterior slope, but concave when compared to a vertical line from the beak to the margin of the shell; base of the shell forming the arc of a circle, the center of which is 5 mm. below the apex. Surface marked by fine, irregular lines of growth, or quite smooth except at the ends; anterior and dorsal slopes marked by distinct concentric ridges; the anterior slope bisulcaturate, bisected by a line extending from the beak to the margin, the anterior half having distinct

concentric ridges, the remainder showing chiefly radial sculpture. Length of type, 26.2 mm.; altitude, 19.0 mm.; ratio nearly 4:3; thickness of single valve, 6.0 mm. (Anderson and Hanna)

*Observations.* This species bears a close resemblance to *S. merriami* Packard but may be distinguished from that species by the development of prominent concentric ribbing over the entire surface of the valves. In *S. merriami* this ribbing is usually absent on the disk of the shell.

*Holotype.* (U.C. 33383.) Figured in the present report, pl. 54, fig. 7. Locality (U.C. 7161).

*Geologic range.* Tejon and Cowlitz formations, upper Eocene.

*Geographic distribution.* Southern end of San Joaquin Valley, California, and lower Cowlitz River Valley, southwestern Washington.

*Type locality.* Live Oak Canyon, Kern County, California. Occurs also in Washington at locality (U.C. 7161).

#### SPISULA PITTSBURGENSIS Clark, 1925

Plate 54, figure 9; plate 61, figures 1, 4

*Spisula pittsburgensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 101, 102, pl. 17, figs. 2, 4, 1925.

*Spisula pittsburgensis* Clark, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 120, 1933.

*Original description.* Shell thin, beaks fairly prominent, strongly inturned, slightly prosogyrous, and a little anterior to median line; posterior end rather narrowly rounded to subangulated, the subangulation being due to a fairly well-defined umbonal ridge seen on outer surface between beaks and posterior end. Anterior end obliquely truncated, narrower and more produced than posterior end, somewhat indistinct umbonal ridge between beaks and lower angulation of subtruncated anterior end; posterior dorsal edge long and gently convex; anterior dorsal edge straight; dorsal margins rather strongly depressed, the depressed areas being limited by the anterior and posterior umbonal ridges described above. Surface smooth except for somewhat irregular incremental lines. Hinge plate of left valve with small but fairly prominent deltoid cardinal; anterior lateral rather short, high with rounded top; posterior laterals somewhat longer than the anterior, acutely rounded on top; both laterals stand up well above the dorsal edges. The two cardinals of right valve are prominent, claspers long and narrow, and independent of the dorsal edges. Dimensions: Length 45 mm.; height 31 mm.; diameter (a single valve) 7 mm. (Clark)

*Observations.* This species may be distinguished from *S. albaria* of the upper Miocene in being proportionately longer and higher and less produced anteriorly.

*Holotype.* (S.U. 5202.) Figured in the present report, pl. 54, fig. 9; pl. 61, figs. 1, 4.

*Geologic range.* Pittsburg Bluff beds, middle Oligocene.

*Geographic distribution.* Columbia County, northwestern Oregon.

*Type locality.* (U.W. 476.) From bluffs along highway near old mill at Pittsburg, Columbia County, Oregon.

**SPISULA PITTSBURGENSIS** Clark subsp. **FRUSTRA** Tegland, 1933

Plate 54, figures 12, 15, 17

*Spisula albaria* Conrad, Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, p. 583, 1913.

*Spisula pittsburghensis* Clark subsp. *frustra* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 121, pl. 9, figs. 9, 10, 11, 12, 1933.

*Original description.* *Spisula pittsburghensis frustra* n. subsp. differs from *S. pittsburghensis* Clark in having a more acute umbonal angle, beak more centrally placed, greater height in proportion to length, and a greater degree of inflation just below the beak. The hinge structure corresponds very closely to that of Clark's species. (Tegland)

*Observations.* This subspecies may be distinguished from *S. pittsburghensis* in being higher in proportion to the length, more tumid below the umbones, having umbones more anteriorly situated, and in having a more acute umbonal angle.

*Holotype.* (U.C. 32197.) Figured in the present report, pl. 54, figs. 12, 15, 17.

*Geologic Range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Puget Sound Basin and north side of Olympic Peninsula.

*Type locality.* (U.W. 13.) In sandstone cliffs on north side of Restoration Point opposite Seattle, Kitsap County, Washington, Section 12, T. 24 N., R. 2 E.

**SPISULA VENERIFORMIS** Clark, 1925

Plate 54, figures 14, 16; plate 61, figures 2, 3

*Spisula veneriformis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 103, pl. 16, figs. 1, 2, 3, 1925.

*Original description.* Shell medium in size, ovate in outline; beaks in anterior third of shell fairly prominent, strongly inturned, only slightly prosogyrous. Anterior and posterior ends both broadly and regularly rounded; posterior dorsal edge long, gently convex; anterior dorsal edge short and gently convex. Surface of shell smooth, except for moderately fine incremental lines. Valves are most strongly convex just below beaks; toward posterior end and posterior dorsal margin valves are noticeably flattened and on this flattened area reaching from beaks to posterior end is a broad shallow sinus or zone of depression. On one or two of the specimens, however, it is well developed. Hinge plate rather heavy; resilifer pit deep, the two cardinals in the right valve well developed, both reaching nearly across hinge plate; anterior cardinal close to and connected with anterior dorsal margin. Cardinal in right valve apparently not deltoid. The deltoid tooth is a character common to almost all genera of the Mactridae; but in this species the cardinal consists of one heavy process extending from a beak to anterior edge of hinge plate. Laterals thin, fairly long, imperfectly exposed on the specimen at hand. Dimensions of type (somewhat smaller than the average specimen): Length 41 mm.; height 31 mm.; diameter of both valves about 21 mm. (Clark)

*Observations.* This species, as pointed out by Clark, is characterized by having a Spisula type of hinge plate and a Venerid general outline of the shell. The tooth of the left valve deltoid.

*Holotype.* (S.U. 5215.) Figured in the present report, pl. 61, figs. 2, 3.

*Paratype.* (S.U. 56.) Figured in the present report, pl. 54, fig. 14.

*Paratype.* (S.U. 55.) Figured in the present report, pl. 54, fig. 16.

*Geologic range.* Tunnel Point beds, middle Oligocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* In sea cliff at Tunnel Point, Coos Bay, Oregon.

**SPISULA TWINENSIS** Clark, 1925

Plate 55, figure 8

*Spisula twinensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 103, 104, pl. 16, fig. 6, 1925.

*Original description.* Shell medium in size, and thin; valves only moderately ventricose; beaks rather inconspicuous; anterior to the median line; posterior dorsal edge long and gently convex; anterior dorsal edge straight; anterior dorsal margin just below beaks rather strongly excavated, anterior and posterior ends broadly and regularly rounded. Between the beaks and the posterior end there are two or three somewhat indistinct umbonal ridges (three on the type specimen); the depressed posterior dorsal area rounds off gently as it connects with main surface of valve and it is on this rounded portion that the umbonal ridges or lines occur. Surface sculptured with numerous fairly fine internal radial ribs or lines, which are imperfectly exposed on weathered portions of shell. Hinge plate imperfectly exposed. Dimensions: Length 49 mm.; Height about 40 mm.; diameter of two valves 20 mm. (Clark)

*Observations.* This species may be distinguished from the other species of *Spisula* in the Northwest by the presence of internal radiating ribs and well-defined umbonal ridges.

*Holotype.* (S.U. 57.) Figured in the present report, pl. 55, fig. 8.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* North side of Olympic Peninsula.

*Type locality.* (U.W. 680.) In sandy shale about 2 miles west of Twin River in sea cliff on south side of Strait of Juan de Fuca, Clallam County, Washington.

**Subgenus Hemimactra Swainson, 1840**

**SPISULA (HEMIMACTRA) PRECURSOR Dall, 1909**

Plate 55, figure 5

*Spisula (Hemimactra) precursor* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 131, pl. 14, fig. 10, 1909.

*Original description.* Shell small, compressed, subequilateral, equivalve, with rather prominent, incurved smooth beaks and no trace of lunule or escutcheon; anterior end somewhat attenuated, rounded; posterior end broader, more convex, obsoletely obliquely subtruncate above; base evenly arcuate; surface of the valves smooth except for incremental irregularities; slightly, irregularly, concentrically wrinkled toward the extremities, especially on the dorsal slopes; valves not gaping behind; interior inaccessible. Altitude, 30 mm.; longitude, 41 mm.; diameter, 14 mm.; vertical of the beaks about 19 mm. behind the anterior extremity. (Dall)

*Observations.* This species may be distinguished from *S. albaria* by its blunter posterior margin and narrower anterior end. The shell itself is more compressed.

*Holotype.* (U.S.N.M. 153928.) Figured in the present report, pl. 55, fig. 5.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coast Ranges of central California and Coos Bay, Oregon.

*Type locality.* Coos Bay, Oregon (Camman collection).

**SPISULA (HEMIMACTRA) SOOKENSIS Clark and Arnold, 1923**

Plate 55, figures 2, 3, 6, 7

*Spisula (Hemimactra) sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 154, pl. 18, figs. 1, 2a, 2b, 1923.

*Original description.* Shell fairly large; beaks not very prominent, rather strongly inturned anterior to median line; anterior dorsal slope straight to gently concave; posterior dorsal slope long, slightly convex; ventral edge broadly and regularly arcuate. A fairly well defined ridge extends from beaks to posterior end. Weathered surface of shell shows evidence of internal radiating lines. External surface smooth except for rather heavy concentric lines of growth. Only two specimens belonging to this species were found in our collection. Both specimens are right valves and hinge plates were only imperfectly exposed; resilifer is deep; area for ligament very narrow and poorly developed. Posterior lateral well developed and a heavy deltoid tooth extends from ventral edge of hinge plate; anterior lateral long and thin. Dimensions of type: Height 74 mm.; length 85 mm.; diameter of one valve about 18 mm. (Clark and Arnold)

*Observations.* This species may be distinguished from *S. catilliformis* Conrad, which it somewhat resembles, in being less tumid, in having a less broadly rounded posterior margin, a less heavy hinge plate, and less well-developed lateral teeth.

*Holotype.* (U.C. 30066.) Figured in the present report, pl. 55, figs. 2, 7.

*Paratype.* (U.C. 30239.) Figured in the present report, pl. 55, fig. 6.

*Hypotype.* (C.A.S. 687.) Figured in the present report, pl. 55, fig. 3.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South shore of Vancouver Island.

*Type locality.* (S.U. N.P. 130.) In basal part of Sooke formation exposed in sea cliffs at mouth of Fossil Creek, 2 miles west of Sherringham Point, Jordan River, Vancouver Island.

**SPISULA (HEMIMACTRA) HANNIBALI Clark and Arnold, 1923**

Plate 56, figures 2, 6, 9

*Spisula (Hemimactra) hannibali* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 153, 154, pl. 19, figs. 1a, 1b, 4, 1923.

*Original description.* Shell fairly large, moderately heavy, inequilateral; beaks very slightly anterior to middle, fairly prominent, strongly inturned, and only

slightly prosogyrous. Posterior dorsal slope slightly convex and approximately same length as anterior dorsal slope which is straight; anterior end acutely rounded; posterior end subtruncate. Surface smooth except for fairly heavy lines of growth; two somewhat distinct ridges on both valves, one extending from beak to upper angle of subtruncate posterior end, other from beak to anterior end; surface of shell between these ridges and dorsal edges strongly depressed. Laterals thin but fairly prominent; posterior lateral acutely rounded; anterior lateral long and thin. Resilifer elongate, triangulate, and in right valve overhung by a small spur. Cardinals fairly large. Dimensions of type specimen: Length, 75 mm.; height, 58 mm. (Clark and Arnold)

*Observations.* This species may be distinguished from *S. brevirostrata* Packard in being proportionately longer than high.

*Holotype.* (U.C. 30062.) Figured in the present report, pl. 56, figs. 2, 9.

*Paratype.* (U.C. 30228.) Figured in the present report, pl. 56, fig. 6.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South shore of Vancouver Island.

*Type locality.* (S.U. 129.) In sea cliffs between the mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

#### Subgenus *Mactromeris* Conrad, 1868

*Mactromeris* Conrad, Am. Jour. Conch., vol. 3, pt. 3, Append., p. 45, 1868.

*Subgenotype* (fide Dall, 1898). *Spisula ovalis* Gould = *Spisula polynyma* Stimpson.

#### SPISULA (MACTROMERIS) ALBARIA (Conrad), 1848

Plate 57, figures 5, 10

*Mactra albaria* Conrad, Am. Jour. Sci., ser. 2, vol. 5, p. 432, fig. 4, 1848.

*Spisula (Mactromeris) albaria* (Conrad) Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 86, pl. 10, figs. 8, 9, 1931.

*Mactra (Spisula) albaria* Conrad, Grant IV and Gale (in part), Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 395, 396, 1931.

*Original description.* Triangular, ventricose; beaks medial; umbonal slope angulated; anterior and posterior margins nearly equally oblique; posterior extremity truncated, direct; basal margin regularly curved. (Conrad)

*Hypotype.* (U.C. 31979.) Figured in the present report, pl. 57, fig. 5.

*Hypotype.* (U.C. 30029.) Figured in the present report, pl. 57, fig. 10.

*Geologic range.* Upper Miocene to Recent.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Astoria, Oregon. (Astoria formation.) This species is abundant and widely distributed in strata of upper Miocene and Pliocene age. The figured specimen (U.C. 31979) is from locality (U.W. 416.) Clemons logging road, on abandoned spur of railroad one-fourth mile north of junction of main line on the point of the first curve in the road. Section 25, T. 17 N., R. 7 W. Astoria formation.

**SPISULA (MACTROMERIS) ALBARIA (Conrad) subsp. ARNOLDI (Dall), 1922**

## Plate 57, figure 7

*Tivela crassatelloides* Conrad, Reagan, Trans. Kansas Acad. Sci., vol. 22, pp. 208, 209, pl. 4, figs. 37a-c, 1909.

*Mactra (Spisula) arnoldi* Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 310, 1922.

*Description by Reagan.* Shell large, thick, almost equilateral-triangular in shape, ventricose; umbones subcentral to slightly anterior to center, not very prominent; anterior dorsal margin straight to near middle transverse line of shell, rather equally rounded at base; posterior extremity more obtusely rounded than anterior (in some cases it is almost angular); ventral margin elliptically to prominently and evenly arcuate; surface sculptured with very fine to coarse incremental lines according to age of specimen; a posterior submarginal angulation ridge is shown on some specimens, but is nearly or entirely obsolete in old specimens; cartilage-pit triangular, not wide, rather deep, separated from posterior ligamental groove by a prominent thick ridge; cardinal ridges (teeth) three in number, prominent, thick, anterior lateral tooth elongated. Dimensions of medium-sized mature specimen: Lat., 96; alt., 80; diam., 37; umbones to anterior extremity, 69; to posterior extremity, 72.

*Observations.* This variety has been observed only in the Quillayute formation. *Spisula albaria* shows considerable variation in outline but the specimens grouped under the variety *arnoldi* are more triangular and proportionately higher. The typical *Spisula albaria* seems to be absent from the Quillayute area.

*Holotype.* (U.S.N.M. 328342.) Figured in the present report, pl. 57, fig. 7.

*Geologic range.* Quillayute formation, lower Pliocene.

*Geographic distribution.* Western Jefferson County, Washington.

*Type locality.* Near mouth of Quillayute River, Washington.

**SPISULA (MACTROMERIS) ALBARIA (Conrad) subsp. SCAPOOSENSIS Clark, 1925**

## Plate 57, figures 1, 3

*Spisula albaria scapoosensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 101, pl. 16, figs. 4, 5, 1925.

*Original description.* Shell moderately thick, beaks fairly prominent, nearly central, strongly inturned and only slightly prosogyrous; posterior and anterior end broadly rounded. A well-defined umbonal ridge between beaks and lower part of posterior end; posterior to this line surface strongly depressed, also a corresponding obscure anterior umbonal ridge limiting a strongly depressed anterior dorsal area. Surface smooth except for rather fine somewhat irregular incremental lines. Hinge plate well developed, claspers of right valve long, thin; the outer posterior clasper only about half the length of inner clasper; outer anterior clasper very feeble, almost obsolete. Cardinals well developed, the anterior cardinal close up to and fused with anterior dorsal margin; resilifer pit fairly broad, only moderately deep. Dimensions: Length approximately 50 mm.; anterior end broken, height 42 mm.; diameter of one valve 12 mm. (Clark)

*Observations.* This subspecies may be distinguished from *S. albaria* in having a more strongly developed hinge plate with heavier cardinal teeth. The second anterior cardinal tooth in the right valve merges into the dorsal margin while in the latter species it is clearly separated from the margin. The outer of the two anterior claspers is nearly obsolete

and the outer of the two posterior claspers is more poorly developed than the one anterior to it.

*Holotype.* (C.A.S. 688.) Figured in the present report, pl. 57, figs. 1, 3.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Northwestern Oregon.

*Type locality.* (C.A.S. 168.) Ten miles northwest of Scappoose, Oregon, in the northeast corner of Section 36, T. 4 N., R. 3 W.

**SPISULA (MACTROMERIS) ALBARIA (Conrad) subsp. OREGONENSIS Clark, 1925**

Plate 56, figures 1, 5, 8

*Spisula albaria oregonensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 100, 101, pl. 17, figs. 5, 6, 7, 1925.

*Original description.* Shell subequilateral, beaks a little anterior to median line, strongly inturned but only slightly prosogyrous. Posterior end broadly rounded with faint suggestion of being truncated, the result of a somewhat obscure umbonal ridge between beaks and posterior end; anterior end broadly and regularly rounded; posterior dorsal edge long and gently convex; anterior dorsal edge straight, dorsal margin rather strongly depressed; surface smooth except for rather coarse irregular incremental lines. Hinge plate fairly heavy; anterior cardinal of right valve fused with dorsal margin and does not extend to anterior edge of the chondrophore; claspers fairly heavy and well-developed, both of the posterior claspers are short; the tops come to a sharp point; both anterior claspers well developed, the inner one being the longer and best developed; outer claspers fused to dorsal margins. Deltoid cardinal heavy, covering almost entire width of hinge plate. Laterals prominent, tops round, posterior or lateral longer than anterior with abrupt ventral slope. Dimensions of type specimen: Length 67 mm.; height 54 mm.; diameter, one valve, 15 mm. (Clark)

*Observations.* As pointed out by Clark, the subspecies *oregonensis* may be distinguished from *S. albaria* in possessing more prominent umboines and in being proportionately higher than long. The hinge plate is heavier and the laterals are short and heavy in contrast to the long narrow teeth of *S. albaria*. *S. albaria oregonensis* differs from *S. albaria scapoosensis* in having more prominent umboines, in being proportionately higher than long and in the more prominent posterior umbonal ridge; the hinge plate is heavier with relatively shorter laterals.

*Holotype.* (C.A.S. 701.) Figured in the present report, pl. 56, fig. 8.

*Paratype.* (C.A.S. 703.) Figured in the present report, pl. 56, fig. 1.

*Paratype.* (C.A.S. 702.) Figured in the present report, pl. 56, fig. 5.

*Geologic range.* Empire formation.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* (C.A.S. 41.) On prominent point on east shore of Coos Bay about one and one-half miles north of the bridge crossing South Slough, locally known as Fossil Point: near southwest corner of Section 36, T. 25 N., R. 14 W.

**SPISULA (MACTROMERIS) ALBARIA (Conrad) var. COOSENSIS Howe, 1922**

Plate 56, figure 3; plate 57, figures 2, 11

*Spisula (Hemimactra) albaria* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 130, 131, pl. 10, fig. 1, 1909.  
*Spisula albaria* (Conrad) Packard (in part), Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, pp. 290, 291, pl. 24, fig. 1; pl. 25, figs. 3-8, 1916.  
*Spisula albaria* var. *coosensis* Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 99, 100, pl. 9, figs. 6, 7, 1922.

*Original description.* These specimens from Astoria and Newport all show the left cardinal to extend uniformly from the beaks to the edge of the chondrophore, while in var. *coosensis* the left cardinal extends only two-thirds of this distance.

In the right valve of *Spisula albaria*, the posterior portion of the cardinal parallels the dorsal margin and is fused to it, while in var. *coosensis*, though partially fused to the dorsal margin, it does not parallel it by any means, but makes a ten degree angle. (Howe)

*Supplementary description.* Shell large, solid, ventricose, rounded-triangular, subequilateral, equivalve, with prominent, minutely pointed, slightly recurved beaks; surface smooth, except for more or less evident incremental lines; the lunule and escutcheon are not defined by any sulcus, but the dorsal slopes are wide and flattish; anterior end more attenuated, posterior end wider, more arcuate, and with the valves a little gaping on the distal part of the dorsal slope, both ends rounded and the base evenly arcuate; valves very convex, especially behind the vertical of the beaks, which is nearly in the exact middle of the valves; hinge as usual in the genus; pallial sinus moderate, angular; the inner margin of the valves entire. Altitude, 72 mm.; longitude, 90 mm.; diameter, 43 mm. (Dall, 101, p. 131)

*Supplementary notation.* Hinge plate wide, chondrophore oblique, rather deep and partially roofed by an accessory; spur distinct in most specimens; cardinals large, heavy, arms widely diverging; dorsal edge of the left cardinal is fused to the margin of the shell; ventral sinus somewhat excavated; right cardinal prominent, anterior arm short, posterior arm heavy, extending in a straight line from near the beak to the ventral margin of the plate; anterior lateral short, top evenly rounded, smooth, distant from and in alignment with the anterior arm of the cardinal; posterior lateral long, slightly higher than the margin of the shell arising from the ventral edge of the hinge plate; laminae long, the ventral ones also arising from the edges of the plate; the dorsal ones are small, rising from the margin of the plate. Pallial sinus deep, rounded, not extending in front of the vertical of the beaks. The dimensions of the type as inferred from the original cut, are: length, 45 mm.; height, 35 mm. (Packard, 218, p. 290)

*Holotype.* (U.C. 30028.) Figured in the present report, pl. 57, figs. 2, 11.

*Hypotype.* (U.S.N.M. 153929.) Figured in the present report, pl. 56, fig. 3.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene. Merced formation, California.

*Geographic distribution.* Coos Bay, Oregon, and Coast Ranges of California.

*Type locality.* (U.C. 3325.)

**SPISULA (MACTROMERIS) ALBARIA (Conrad) subsp. *GOODSPEEDI* Etherington, 1931**

Plate 56, figure 7

*Spisula (Mactromeris) albaria* (Conrad) subsp. *goodspeedi* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 86, 87, pl. 9, fig. 3, 1931.

*Original description.* Shell slightly inequilateral, moderately thick; beaks almost central, fairly prominent; posterior end broadly rounded with faint suggestion of truncation; anterior dorsal margin fairly straight, anterior end sharply rounded, ventral edge evenly rounded, interior inaccessible. Dimensions (type U.C. no. 31980).—Length 45.0 mm.; altitude 37.0 mm. (Etherington)

*Observations.* This subspecies differs from *S. albaria* in having a more elevated and sharper beak and a triangular outline.

*Holotype.* (U.C. 31980.) Figured in the present report, pl. 56, fig. 7.

*Geologic range.* Montesano formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 422.) In a cut on Union Pacific railway one mile east of the end of the South Montesano road, Grays Harbor County, in Section 14, T. 17 N., R. 7 W.

**Family MESODESMATIDAE****Genus ERVILIA Turton, 1822**

*Ervilia* Turton, Brit. Biv., p. 56, 1822.

*Genotype.* *Mya nitens* Montagu.

**ERVILIA OREGONENSIS Dall, 1898**

Plate 56, figure 4

*Ervilia oregonensis* Dall, Trans. Wagner Free Inst. Sci., vol. 3, p. 916, pl. 33, fig. 16, 1898.

*Original description.* Shell small, oval, moderately inflated, smooth and more or less polished; inequilateral, the beaks low, small, closely adjacent; the anterior end slightly more acute than the posterior end; interior unknown. Lon. 7.5, alt. 5, diam. 3.25 mm. (Dall)

*Observations.* The holotype of this species was collected many years ago by Diller while he was engaged in a preliminary study of the geology of the Coast Ranges of Oregon and the exact locality is not definite. It is probably from Oligocene rocks in Columbia County.

*Holotype.* (U.S.N.M. 107406.) Figured in the present report, pl. 56, fig. 4.

*Geologic range.* Oligocene.

*Geographic distribution.* Columbia County, Oregon.

*Type locality.* Nehalem River, Columbia County, Oregon (holotype collected by J. S. Diller).

Genus **ANATINA** Schumacher, 1817

*Anatina* Schumacher, Ess. Nouv. Syst. Habit. Vers Test., p. 125, 1817.

*Genotype*. *Anatina pellucida* Schumacher.

**ANATINA?** **ROSEBURGENSIS** Hendon, 1938

Plate 57, figure 8

*Anatina roseburgensis* Hendon, unpublished thesis, Univ. Oregon.

*Anatina?* *roseburgensis* Hendon ms. Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 65, pl. 8, fig. 18, 1938.

*Original description.* Shell small inflated, inequivalve and inequilateral, left valve with a median depression from umbo to basal margin. Surface ornamented with concentric growth lines. Anterior end rounded, posterior angular. Shell has an umbonal ridge running to the posterior end. (Hendon-Turner)

*Holotype.* (C.A.S. 1746.) Figured in the present report, pl. 57, fig. 8.

*Geologic range.* Umpqua formation.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* (C.A.S. 24.) On east bank of North Fork of Umpqua River near the bend of the river, one-quarter of a mile north of Glide post office in the southwest quarter of Section 18, T. 26 S., R. 3 W.

Genus **PSEUDOCARDIUM** Gabb, 1866

*Pseudocardium* Gabb, Geol. Surv. Calif. Paleon., vol. 2, pp. 20, 21, 1866.

*Genotype.* *Pseudocardium gabbi* (Remond) = *Mulinia densata* Conrad.

**PSEUDOCARDIUM EUGENENSE** (Clark), 1925

Plate 57, figure 4

*Mulinia eugenensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 104, pl. 14, figs. 1, 2, 1925.

*Original description.* Shell large, fairly heavy, beaks anterior to median line and only moderately prominent; strongly inturned but slightly prosogyrous; posterior end broadly and regularly rounded, anterior end acutely rounded to broadly subtruncate; on the type there are two well-developed umbonal ridges, one between beaks and posterior end, the other from beak to anterior end. Posterior dorsal edge long, gently convex; anterior dorsal edge rather short, straight, separated from the obliquely truncated anterior end by an obscure angulation. Surface smooth except for heavy irregular lines of growth, dorsal margins rather strongly depressed, limited by umbonal ridges. Hinge of type, a right valve, imperfectly exposed. It shows prominent, thin laterals, over half an inch in length. Resilifer pit deep, and the cardinal small. Dimensions of type: Length 103 mm.; height 82 mm.; diameter of one valve about 25 mm. (Clark)

*Observations.* This middle Oligocene species from the Willamette Valley may be distinguished from *P. yaquinense* from the middle Oligo-

cene of the Oregon Coast in the absence of the strong posterior umbonal ridge and a more convex ventral margin.

*Holotype.* (U.C. 30372.) Figured in the present report, pl. 57, fig. 4.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Willamette Valley, Oregon.

*Type locality.* (U.C. 4082.) At bend in road 3 miles south of Eugene, Oregon.

**PSEUDOCARDIUM YAQUINENSE** (Clark), 1925

Plate 57, figure 6

*Mulinia? yaquinensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 105, pl. 17, fig. 1, 1925.

*Original description.* Shell moderately inflated, fairly heavy; beaks nearly central, strongly inturned but very slightly prosogyrous; posterior dorsal edge long, gently convex; anterior dorsal edge gently concave; posterior end broadly rounded; anterior end obliquely truncated. Dorsal margins fairly broad and strongly depressed, separated from main surface of shell by umbonal ridges. Surface smooth except for fairly heavy somewhat irregular incremental lines. Hinge plate not exposed. Dimensions: Length about 54 mm.; height about 36 mm.; greatest diameter of one valve 11 mm. (Clark)

*Observations.* This species may be distinguished from *P. eugenense* by the more central position of the umbones, the more produced anterior end and by a somewhat straighter ventral margin.

*Holotype.* (U.C. 30325) (S.U. 58). Figured in the present report, pl. 57, fig. 6.

*Geologic range.* Yaquina formation, middle Oligocene.

*Geographic distribution.* Yaquina Bay, Oregon.

*Type locality.* (U.W. 684.) In massive brownish-gray coarse sandstone exposed on east shore of Yaquina Bay, 3,500 feet north of the town of Yaquina, Lincoln County, Oregon.

**PSEUDOCARDIUM DENSATA** (Conrad) var. **ALTUM** Weaver, 1912

Plate 60, figure 7

*Pseudocardium gabbi* (Remond) var. *altus* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 69, pl. 7, fig. 69, 1912.

*Pseudocardium gabbi* (Remond) var. *elongatus* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 68, pl. 10, fig. 78, 1912.

*Pseudocardium gabbi* (Remond) var. *robustum* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 69, pl. 7, fig. 68, 1912.

*Original description* (*P. gabbi* var. *altus*). This variety is large, somewhat compressed; beaks moderately high but not especially prominent for the genus. Anterior and posterior margins have steep slopes, the latter being more pronounced. The altitude is much greater in proportion to the longitude than in the case of the other varieties. Dimensions.—Longitude 75 mm.; altitude 78 mm.; diameter 30 mm. (Weaver)

*Original description* (*P. gabbi* var. *elongatus*). This variety differs from variety *altus* in its relatively greater length and thickness. It might seem best to regard them as the same, but out of a large number of specimens they can be dis-

tinctly separated and do not show gradations from one to the other. They occur at a definite horizon in the same formation and can be used for stratigraphic purposes. Dimensions.—Longitude 73 mm.; altitude 55 mm.; diameter 34 mm. (Weaver)

*Original description* (*P. gabbi* var. *robustum*). A line passed from the beak along the outer surface of the shell to the base forms a nearly perfect semicircle; just back of the anterior margin of the shell a prominent ridge occurs on this point; about two thirds distance from the beak is a blunt protuberance or shoulder; a less marked one occurs on the posterior margin. Dimensions.—Longitude 80 mm.; altitude 70 mm.; diameter 35 mm. (Weaver)

*Holotype* (var. *altum*). (U.W. 62) (C.A.S. 7505). Figured in the present report, pl. 60, fig. 7.

*Holotype* (var. *elongatus*). Lost.

*Holotype* (var. *robustum*). (U.W. 64) (C.A.S. 7504).

*Geologic range*. Montesano formation, upper Miocene and lower Pliocene.

*Geographic distribution*. Grays Harbor County, Washington.

*Type locality* (*Pseudocardium gabbi* var. *altus*). (U.W. 61.) On old Vance logging road in coarse-grained sandstone, Grays Harbor County, Washington, Section 28, T. 18 N., R. 6 W.

#### PSEUDOCARDIUM OREGONENSE (Dall), 1909

Plate 58, figures 1, 5

*Mulinia oregonensis* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 132, pl. 9, figs. 2, 3; pl. 13, fig. 5, 1909.

*Original description*. Shell solid, heavy, rude, elevated, much higher than long, with very prominent incurved beaks, equivalve, inequilateral; beaks full, rounded, anteriorly recurved, without any distinctly marked lunule or escutcheon; surface with heavy, rude, irregular concentric waves or incremental thickenings; dorsal margins rapidly declining, basal margin nearly straight; surface in front of the beaks deeply concave; interior margins of the valve smooth, hinge heavy with relatively large chondrophore or ligamental pit. Altitude, 45 mm.; latitude, 35 mm.; diameter, 50 mm. (Dall)

*Observations*. This species is characterized by its very heavy and rugose growth lines and irregularities of surface.

*Holotype*. (U.S.N.M. 153927.) Figured in the present report, pl. 58, fig. 1.

*Paratype*. (U.S.N.M. 153927-A.) Figured in the present report, pl. 58, fig. 5.

*Geologic range*. Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution*. Coos Bay, Oregon.

*Type locality*. Fossil Point, Coos Bay, Oregon (Camman collection).

**PSEUDOCARDIUM UNDILIFERUM Weaver, 1912**

Plate 60, figure 6; plate 61, figure 9

*Pseudocardium gabbi* (Remond) var. *undiliferum* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 69, pl. 9, fig. 76, 1912.  
*Mulinia undilifera* (Weaver), Packard, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, pp. 308, 309, pl. 34, figs. 1a, 1b, 2, 3, 1916.

*Original description.* Shell typically small, anterior margin slightly convex with a slope of  $60^{\circ}$ ; posterior margin nearly straight with slope of  $45^{\circ}$ ; posterior surface of shell undulatory because of broad groove extending from beak to margin. These characters are constant and do not seem to grade into the other varieties. Several hundred specimens from the same locality show these characteristics. Dimensions.—Longitude 50 mm.; altitude 40 mm.; diameter 20 mm. (Weaver)

*Observations.* This species is characterized by umbonal rounded ridges and grooves which produce a sinuous outline for the ventral margin. The specimens at the type locality are always about 20 per cent longer than high and vary little in general shape.

*Holotype.* (U.W. 65) (C.A.S. 7503). Figured in the present report, pl. 60, fig. 6; pl. 61, fig. 9.

*Geologic range.* Montesano formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Grays Harbor County, western Washington.

*Type locality.* (U.W. 68.) In old logging railway cut in conglomerate on Sylvia Creek, Grays Harbor County, Washington, Section 32, T. 18 N., R. 7 W.

**PSEUDOCARDIUM NEWCOMBEI (Clark and Arnold), 1923**

Plate 58, figures 6, 9, 12

*Mulinia newcombei* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 153, pl. 15, figs. 1, 2, 3, 4a, 4b; pl. 16, figs. 1a, 1b, 1923.

*Original description.* Shell medium to large, heavy, inequilateral; beaks nearly central, conspicuous, strongly inturned, only slightly prosogyrous. Dorsal slopes fairly steep, nearly equal; posterior dorsal edge slightly convex; anterior dorsal edge straight to slightly convex; anterior rounded; posterior end broadly rounded to obscurely truncate. Two ridges on surface of each valve, one extending from beak to anterior end, the other from beak to lower angulation of sub-truncated posterior end. These ridges are prominent on the larger specimens but rather obscure on the smaller ones. Surface of shell strongly depressed between ridges and dorsal edges; covered by heavy, irregular lines of growth. Weathered surfaces of shell show fairly prominent and coarse internal radial striations. Pallial sinus short, broad, subacute anteriorly. Hinge plate heavy; laterals and claspers long and heavy. Resiliifer rather shallow. Cardinals not prominent; anterior cardinal of right valve fused with inner dorsal margin. Dimensions of type, an immature specimen: length, 50 mm.; height, 43 mm. (Clark and Arnold)

*Observations.* This is the only species of the genus in the Oligocene beds on Vancouver Island. It somewhat resembles *P. eugenense* Clark of the Oligocene of Oregon but is proportionately higher and the anterior end is more acutely rounded.

*Paratype.* (U.C. 30219.) Locality (S.U. N.P. 129). Figured in the present report, pl. 58, figs. 6, 9.

*Paratype.* (U.C. 30047.) Locality (S.U. 129). Figured in the present report, pl. 58, fig. 12.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South shore of Vancouver Island.

*Type locality.* (S.U. 129.) Sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

#### PSEUDOCARDIUM LANDESI Weaver, 1912

Plate 60, figures 5, 8

*Pseudocardium landesi* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 69, 70, pl. 9, fig. 75, 1912.

*Pseudocardium landesi* Weaver, Packard, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 309, 1916.

*Original description.* Shell thick, equivalve, nearly equilateral; anterior and posterior margins sloping steeply and at about same angle; base evenly rounded; beaks prominent and pointing slightly forwards; escutcheon narrow but fairly well defined. Surface ornamented with heavy concentric lines of growth; hinge moderately heavy. Dimensions.—Longitude 45 mm.; altitude 53 mm.; diameter 25 mm. (Weaver)

*Observations.* This species, as may be seen in fig. 8, plate 60, is characterized by its great thickness, incurved umbones, and central position of the beaks.

*Holotype.* (U.W. 66) (C.A.S. 7499). Figured in the present report, pl. 60, figs. 5, 8.

*Geologic range.* Montesano formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Grays Harbor County, western Washington.

*Type locality.* (U.W. 68.) In old logging railroad cut in conglomerate on Sylvia Creek, Grays Harbor County, Washington, Section 32, T. 18 N., R. 7 W.

#### PSEUDOCARDIUM OLYMPICA (Dall), 1922

Plate 57, figure 9; plate 58, figure 11

*Mactra exoleta* Gray, Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 212, pl. 4, fig. 42a, 1909; Arnold, Mem. Calif. Acad. Sci., vol. 3, p. 175, pl. 19, fig. 4, 1903.

*Mactra hemphilli* (Dall), Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 212, pl. 4, fig. 43, 1909.

*Mulinia olympica* Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 311, 1922; Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 398, 1931.

*Description* ("*Mactra hemphilli*" of Quillayute formation). Shell subtrigonal, subequilateral, convex, thin; umbones subcentral, slightly elevated, turned slightly forward; anterior end evenly rounded; posterior dorsal margin evenly arcuate; posterior end most produced near base; surface sculptured with fine incremental lines. (Reagan, p. 212)

*Lectotype.* Dall did not designate a type for *Pseudocardium olympica* but referred to both of Reagan's species. The specimen figured by Reagan as *Mactra exoleta* is here designated as the lectotype (U.S.N.M. 328351). Figured in the present report, pl. 57, fig. 9.

*Hypotype* (specimen figured by Reagan as *Mactra hemphilli*). (U.S.N.M. 328348). Figured in the present report, pl. 58, fig. 11.

*Geologic range.* Quillayute formation, lower Pliocene.

*Geographic distribution.* Western Jefferson County, Washington.

*Type locality.* Near mouth of Quillayute River.

Genus SCHIZOTHAERUS Conrad, 1853

*Schizothaerus* Conrad, Proc. Acad. Nat. Sci. Phila., vol. 6, p. 199, 1853.

*Genotype.* *Schizothaerus nuttallii* (Conrad) = *Lutraria (Cryptodon) nuttallii* Conrad, Jour. Acad. Nat. Sci. Phila., vol. 7, p. 235, 1837.

SCHIZOTHAERUS NUTTALLII (Conrad) var. PAJAROANUS (Conrad), 1857

Plate 58, figure 10

*Venus pajaroana* Conrad, U.S. Pacific R. R. Reports, vol. 7, p. 192, pl. 4, figs. 1, 2, 1857.

*Schizothaerus pajaroanus* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 130, 1909; Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 92, 1922.

*Schizothaerus nuttallii* (Conrad) var. *pajaroanus* (Conrad), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 405, 406, pl. 22, figs. 6a, 6b, 8, 1931 (synonymy).

*Original description.* Obliquely ovate-obtuse, ventricose, very inequilateral; anterior margin obtusely rounded, posterior side sub-cuniform; posterior end truncated obliquely inward. (Conrad)

*Observations.* This species, having the dentition of the genus *Schizothaerus*, may be distinguished from *Spisula albaria* by the slight posterior gape and its inequilateral outline. The variety *pajaroanus* differs from *S. nuttallii* by its lesser posterior gape and lesser tumidity of the valves.

*Holotype.* (U.S.N.M. 13318.) (Conrad type.) Figured in the present report, pl. 58, fig. 10.

*Hypotype.* (U.S.N.M. 153929-A.) Empire formation, Oregon (Camman collection). (Dall.) Not figured in the present report.

*Geologic range.* Upper Miocene and Pliocene.

*Geographic distribution.* Coast Range of central California, Coos Bay, Oregon, and Grays Harbor County, Washington.

*Type locality.* "Pajaro River, Santa Cruz." (Conrad)

## Genus PLATYDON Conrad, 1837

*Platydon* Conrad, Jour. Acad. Nat. Sci. Phila., vol. 7, p. 235, 1837.

*Genotype.* *Platydon cancellata* Conrad.

## PLATYDON CANCELLATA (Conrad), 1837

Plate 58, figure 3

*Mya (Platydon) cancellata* Conrad, Jour. Acad. Nat. Sci. Phila., vol. 7, p. 236, pl. 18, fig. 2, 1837.

*Platydon cf. cancellatus* Conrad, Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 155, pl. 16, fig. 4, 1925.

*Original description (Mya (Platydon) cancellata).* Shell sub-elliptical, ventricose, with numerous prominent, slightly undulated concentric striae; a slight furrow extends from beak to base; posterior side with radiating striae; obsolete, or wanting on the posterior slope; umbo prominent; posterior side short; cardinal tooth very erect, dilated, bimarginate. Length, three inches. (Conrad, 65, p. 236)

*Observations.* A single specimen, a right valve, from locality (S.U. N.P. 129) of the Sooke formation was figured by Clark and Arnold and was considered as closely related to *Platydon cancellata* (Conrad) which lives on the coast today between Bolinas Bay and San Diego. The Recent species shows considerable range in variation of outline and the upper Oligocene specimen seems to fall within the limits of this range. The similarities between the two include even the ornamentation. The dentition of the Oligocene form is unknown.

*Hypotype.* (U.C. 30061.) Figured in the present report, pl. 58, fig. 3.

*Geologic range.* Sooke formation, upper Oligocene and Recent.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* In sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

## Genus MYADESMA Clark, 1922

*Myadesma* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 116, 117, pl. 13, figs. 3, 3a, 4, 6; pl. 14, figs. 3a, 3b, 1922.

*Genotype.* *Myadesma dalli* Clark.

## MYADESMA DALLI Clark, 1922

Plate 58, figures 4, 7, 8; plate 61, figures 6, 11

*Myadesma dalli* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 117, pl. 13, figs. 2, 3, 4, 6; pl. 14, figs. 3a, 3b, 1922.

*Myadesma dalli* Clark, Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 152, pl. 28, figs. 1a, 1b, 2, 3, 4, 5, 1923.

*Original description.* Shell fairly large, roughly trapezoidal in outline, heavy, moderately conspicuous beaks, near posterior end. Posterior dorsal slope steep. The posterior dorsal ridge beginning a little below the beaks, gently convex. Anterior

dorsal edge long and straight to very gently convex, almost paralleling the long ventral edge. Surface smooth except for fairly heavy incremental lines. Pallial sinus short and broad. For characters of the hinge see description of the genus. Dimensions of the type.—Length 63.5 mm.; height 38.5 mm. (Clark)

*Holotype.* (S.U. 225.) Figured in the present report, pl. 58, fig. 4; pl. 61, figs. 6, 11.

*Cotype.* (U.C. 30251.) Figured in the present report, pl. 58, fig. 7.

*Cotype.* (C.A.S. 589.) Figured in the present report, pl. 58, fig. 8.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* In sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

#### MYADESMA HOWEI Clark, 1922

##### Plate 58, figure 2

*Myadesma howei* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 117, 118, pl. 13, fig. 1; pl. 14, figs. 1, 2, 1922.

*Original description.* Shell fairly large, roughly subquadrate in outline; anterior end, as characteristic of the genus, very much produced, broadly rounded. The anterior dorsal edge long, very gently convex, posterior dorsal slope very abrupt, the angle between the two dorsal edges being about 110°; posterior dorsal edge gently convex. Posterior end subangulate. Chondrophore of left valve long and narrow; cemented to it is a well developed lithodesma. Posterior tooth not well developed but represented by a fairly distinct ridge on the hinge plate between the beak and the posterior dorsal edge. Pallial sinus short, broad, posteriorly narrowly rounded. Dimensions of type specimen.—Length 65.5 mm.; height 33 mm. plus. (Clark)

*Holotype.* (U.C. 30328.) Figured in the present report, pl. 58, fig. 2.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Willamette Valley, Oregon.

*Type locality.* (U.C. 3622.) Eugene formation near Eugene, Oregon, and from Tunnel Point sandstone at Coos Bay.

#### Genus CRYPTOMYA Conrad, 1848

*Cryptomya* Conrad, Proc. Acad. Nat. Sci. Phila., vol. 4, p. 121, 1848.

*Genotype.* *Sphaenia californica* Conrad.

#### CRYPTOMYA QUADRATA Arnold subsp. VANCOUVERENSIS Clark and Arnold, 1923

##### Plate 49, figure 1; plate 59, figure 13

*Cryptomya quadrata* Arnold, subsp. *vancouverensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 155, pl. 26, fig. 3 (not pl. 19, fig. 5), 1923.

*Original description.* Shell small, thin; beaks inconspicuous, subcentral. Anterior end broadly rounded; posterior end broadly truncated; anterior dorsal edge

gently convex; posterior dorsal edge straight. On right valve a narrow depressed posterior dorsal margin is separated from beaks to posterior dorsal edge. Ventral edge gently and regularly convex. Dimensions of type: Length, about 18 mm.; height, 14 mm. (Clark and Arnold)

*Observations.* This subspecies may be distinguished from *C. quadrata* in its less prominent umbones and narrower depressed posterior dorsal margin. Due to error in explanation of plates and figures in Clark and Arnold's monograph (50), specimens of *Macoma sookensis* and *Cryptomya quadrata vancouverensis* have been confused. A comparison of the figures with the type specimens indicates that the conclusions herein are correct.

*Holotype.* (C.A.S. 585.) Figured in the present report, pl. 49, fig. 1; pl. 59, fig. 13.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South coast of Vancouver Island.

*Type locality.* In the sea cliffs east of the mouth of Kirby Creek, six miles west of Sooke, Vancouver Island.

#### CRYPTOMYA WASHINGTONIANA Weaver, 1912

##### Plate 59, figure 5

*Cryptomya washingtoniana* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 70, pl. 13, fig. 114, 1912.

*Original description.* Shell small, slightly inequilateral, inequivalue, beaks small; posterior margin sloping abruptly for a very short distance and then nearly straight at an angle of 45° until it drops off nearly vertical to the posterior end; base evenly arcuate. Anterior margin straight and slopes at about 20° to the anterior end which is regularly rounded and merges into the base. Surface ornamented by fairly well developed concentric lines of growth. Dimensions.—Longitude 31 mm.; altitude 24 mm.; diameter 5 mm. (Weaver)

*Holotype.* (U.W. 67) (C.A.S. 505). Figured in the present report, pl. 59, fig. 5.

*Geologic range.* Montesano formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 68.) In logging railway cut on Sylvia Creek, Grays Harbor County, in conglomerate, Section 32, T. 18 N., R. 7 W.

#### CRYPTOMYA OREGONENSIS Dall, 1909

##### Plate 59, figure 4

*Cryptomya oregonensis* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 132, 133, pl. 11, fig. 4, 1909.

*Original description.* Shell small, thin, subequilateral, moderately inequivalue; beaks low, subcentral, adjacent; right valve slightly larger; dorsal slopes subequal, the posterior slightly compressed and subangular, the anterior evenly declining to the rounded anterior margin; posterior end bluntly rounded, base evenly arcuate; surface rude, the only sculpture being the irregular, more or less marked, concentric, incre-

mental lines; interior mostly inaccessible, the hinge apparently typical, but very heavy and strong for the size of the shell. Longitude, 22 mm.; altitude, 15 mm.; diameter, 8 mm. (Dall)

*Observations.* This species differs from *C. ovalis* Conrad in that the umbones have a more anterior position and the anterior portion of the shell is less tumid.

*Holotype.* (U.S.N.M. 153931.) Figured in the present report, pl. 59, fig. 4.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Fossil Point, Coos Bay, Oregon (Camman collection).

Genus **MYA** Linnaeus, 1758

*Mya* Linnaeus, Syst. Nat. (10th ed.), p. 670, 1758.

*Genotype.* *Mya truncata* Linnaeus.

**MYA ARENARIA** Linnaeus var. **JAPONICA** Jay, 1856

Plate 59, figure 18

*Mya japonica* Jay, in Perry's U.S. Japan Exped., vol. 2, p. 292, pl. 1, figs. 7, 10 (U.S. 33d Cong. 2d Sess., House Ex. Doc. no. 97), 1856.

*Mya truncata* Linnaeus, Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 214, pl. 5, fig. 46, 1909.

*Mya intermedia* Dall, Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 312, 1922.

*Mya (Mya) arenaria* Linnaeus var. *japonica* Jay, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 412, 413, pl. 21, fig. 13, 1931.

*Description by Jay.* Shell ovate, convex, very thick, transversely wrinkled, rounded at both extremities, but slightly attenuated at the posterior end, color dingy white and chalky, tooth robust, its inner face smooth and rounded, its outer face divided near the posterior side by a deep furrow, and the anterior edge turned up in shape like a tooth, anterior muscular impression oval, posterior quadangular; the pallial impression very profound. Volcano Bay, Island of Gedo. This shell is very similar to the *Mya arenaria*, but differs in the pallial impressions, which are much more profound, the tooth more thickened, a deep notch on its posterior, and an elevation on the anterior side, and the whole shell much more ponderous and incrassated. (Jay, 168-A, p. 292)

*Description by Reagan.* Posterior extremity of shell (cast) broken. Shell large, rather thin; valves unequal, elongated, rounded in front and gaping behind, with a sinus troughlike area back of front margin, the one in the right valve being wider and deeper than the one in the left valve; umbones of medium size, placed anteriorly and pointed forward; surface smooth except for very fine incremental lines of growth. Dimensions: Alt. 61. (Reagan, 230, p. 214)

*Observations.* For a discussion of the relations of *Mya arenaria* Linnaeus and *Mya japonica* Jay one may refer to Grant and Gale (149-A, pp. 412 and 413).

*Hypotype.* (U.S.N.M. 328352.) Figured by Reagan as *Mya truncata*. Figured in the present report, pl. 59, fig. 18.

*Geologic range.* Miocene to Recent. In Washington, occurs in Quillayute formation.

*Geographic distribution.* Coast Ranges of California and Washington, and living in waters of northern Pacific.

*Occurrence in Washington.* Near mouth of Quillayute River.

#### Subgenus *Antiguamya* Effinger, 1938

*Antiguamya* Effinger, Jour. Paleon., vol. 12, p. 373, pl. 46, figs. 3, 4, 7, 1938.

*Subgenotype.* *Mya arnoldi* (Dickerson) = *Saxicava arnoldi* Dickerson.

#### MYA (ANTIGUAMYA) ARNOLDI (Dickerson), 1917

Plate 59, figures 2, 6, 14

*Saxicava arnoldi* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 171, pl. 29, figs. 5a, 5b, 1917.

*Mya (Antiguamya) arnoldi* (Dickerson), Effinger, Jour. Paleon., vol. 12, p. 373, pl. 46, figs. 3, 4, 7, 1938.

*Original description.* Shell small, inflated, with thin shell substance; beaks conspicuous, large, approximate; hinge line nearly straight; anterior and posterior truncated; pronounced, oval, gaping posteriorly; base arcuate. Dimensions:—Length of imperfect type, 12 mm. (Dickerson)

*Observations.* Effinger pointed out that the specimen figured by Dickerson possessed the hinge characters of the genus *Mya* but that certain characters of the shell such as the constriction of the gape, the strong umbonal grooves, and the short shell did not fit *Mya* s.s. Accordingly he created a new subgenus *Antiguamya* to take care of this form.

The species may be distinguished by its evenly rounded anterior margin, its concave posterior ventral margin, and its truncate posterior end. A well-defined constriction extends from the umbones to the posterior ventral margin. The hinge of the left valve has a large spoon-shaped chondrophore with a prominent ridge on the anterior margin.

*Holotype.* (C.A.S. 388.) Figured in the present report, pl. 59, fig. 14.

*Hypotype.* (U.C. 33540.) Figured in the present report, pl. 59, fig. 2.

*Hypotype.* (U.C. 33541.) Figured in the present report, pl. 59, fig. 6.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz River Valley, Washington.

*Type locality.* (U.W. 239.) In south bank of Cowlitz River at the old Gries Ranch, Lewis County, in the northeast quarter of Section 25, T. 11 N., R. 2 W.

**MYA TRUNCATA Linnaeus, 1758**

## Plate 59, figure 12

*Mya truncata* Linnaeus, Syst. Nat. (10th ed.), p. 670, 1758; Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 132, 1909; Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 414, 415, 1931 (synonymy).

*Description by Linnaeus.* Testa ovata postice truncata, cardinis dente antrosum porrecto obtusissimo.

*Description by Grant and Gale.* Shell of medium size, elongate, dorsal margins extending nearly in a straight line, parallel to the ventral margin, the beaks rising somewhat above them, anterior end broadly rounded, posterior end somewhat narrower and longer, with a bluntly rounded, squarely truncated, or even concave extremity; sculpture of irregularly undulating growth lines; chondrophore of left valve shorter, broader, shallower, and with more angulated corners than that of *arenaria*, the posterior ridge separated from the main hollow of the chondrophore by a shallow furrow and smaller ridge, but not so clearly so as in *arenaria*, not extending beyond the edge of the chondrophore, the rest of the interior as in *arenaria*; pallial sinus very variable. Dimensions: Length, 65 mm.; altitude, 45 mm.; convexity of the two valves, 30 mm. (149-A, p. 414)

*Observations.* A few specimens of this species, which appear equivalent to the living forms in the North Pacific Ocean, have been obtained from the sandstones of the Empire formation at Coos Bay, Oregon.

*Holotype.* (London?).

*Hypotype.* (U.S.N.M. 153956.) Figured in the present report, pl. 59, fig. 12.

*Geologic range.* Miocene to Recent. Empire formation.

*Geographic distribution.* Large areas of marine water of northern hemisphere.

*Occurrence.* Coos Bay, Oregon (Camman collection).

## Family CORBULIDAE

## Genus CORBULA Bruguiere, 1797

*Corbula* Bruguiere, Encycl. Meth., pl. 230, 1797.

*Genotype.* *Corbula sulcata* Lamarck.

**CORBULA COWLITZENSIS Dickerson, 1917**

## Plate 59, figure 9; plate 61, figures 7, 8, 10

*Corbula cowlitzensis* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 168, 169, pl. 28, figs. 3a, 3b, 3c, 1917.

*Corbula cowlitzensis* Dickerson, Jour. Paleon., vol. 12, p. 373, 1938.

*Original description.* Shell small, thick, equivalve with inconspicuous beak; anterior dorsal margin convex, sloping steeply to an acutely rounded anterior; ventral margin very broadly rounded; posterior slope, a triangular area with apex at beak, nearly flat, shallowly grooved and separated from the rest of the shell by a very sharp ridge which extends from the beak to the posterior end. Dimensions:—Length, 6 mm.; height, 4 mm.; convexity, 2 mm. (Dickerson)

*Observations.* This species may be distinguished from *C. dickersoni* Weaver and Palmer by its round-topped concentric ribs with broad undulations and U-shaped interspaces as compared with the more numerous nearly flat-topped concentric ribs of the latter.

*Holotype.* (C.A.S. 391.) Figured in the present report, pl. 59, fig. 9; pl. 61, fig. 7.

*Paratype.* (C.A.S. 392.) Figured in the present report, pl. 61, figs. 8, 10.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz River Valley, western Washington.

*Type locality.* (U.W. 239.) In south bank of Cowlitz River at the old Gries Ranch, Lewis County, in the northeast quarter of Section 25, T. 11 N., R. 2 W.

#### **CORBULA PARILIS** Gabb, 1864

##### Plate 59, figure 16

*Corbula parilis* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 150, pl. 29, figs. 239, 239a, 1864; Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 288, pl. 3, fig. 5, 1930 (synonymy); Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 65, 66, pl. 8, figs. 11, 12, 13, 14, 1938.

*Original description.* Shell nearly equivalve, small, somewhat inequilateral; beaks prominent, broad, strongly incurved, and inclined slightly forward. Anterior end sloping downwards abruptly, and regularly rounded below; posterior obliquely truncated and biangular; a distinct umbonal ridge passes from the beaks to the posterior angle in both valves, most acute on the left. Basal margin of the right valve regularly and broadly convex, straighter on the left. Surface marked by prominent, concentric ribs, crossed by fine, radiating lines. (Gabb)

*Observations.* Specimens of this species from (U.C. 33151), Little River near Glide, Oregon, correspond to one of Gabb's types. It is characterized by its strongly developed and rounded concentric ribs which are few in number, attenuation of posterior end, bending of posterior umbonal ridge and steep slope of anterior dorsal margin, and prominent beaks. The specimen figured is the holotype of Gabb recently discovered in the type collections of the University of California.

*Holotype.* (U.C. 33151.) Martinez, California. Figured in the present report, pl. 59, fig. 16.

*Geologic range.* Middle Eocene, upper Umpqua formation.

*Type locality.* Near Martinez, California. Occurs in Oregon at locality (U.C. A-662) in east bank of Little River at center of Section 19, T. 26 S., R. 3 W., Douglas County.

**CORBULA HORNII Gabb, 1864**

Plate 59, figures 7, 17; plate 61, figure 5

*Corbula hornii* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 149, 150, pl. 29, fig. 238, 1864; vol. 2, p. 176, pl. 29, figs. 62, 62a, 62b, 1869.

*Corbula (Caryocorbula) hornii* Gabb, Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, pp. 287, 288, pl. 12, figs. 4, 5, 1930 (synonymy).

*Corbula hornii* Gabb, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 66, pl. 8, figs. 16, 17, 1938.

*Original description.* Shell rather large, broad, narrow and very convex; beaks central; anterior end produced and regularly rounded; posterior end obliquely truncated; cardinal margins sloping equally; basal broadly and regularly convex; on the left valve a sharp angular ridge passes from the beaks to the posterior basal margin, behind which the surface is concave. The right valve has nearly the same form as the left; is perhaps a little more convex, and wants entirely the posterior umbonal ridge, the surface being rounded instead of angular. Surface unknown. (Gabb)

*Observations.* *Corbula hornii* from southwest Oregon is a larger species than the other Eocene forms. It may be distinguished from *Corbula dickersoni* in having a corresponding greater ratio of length to height and a less well-defined posterior umbonal angle and truncation. The umbones are more centrally placed.

*Hypotype.* (U.C. 33159.) South Cove, Coos Bay. Figured in the present report, pl. 59, fig. 7; pl. 61, fig. 5.

*Hypotype.* (C.A.S. 274.) Figured in the present report, pl. 59, fig. 17.

*Geologic range.* Tejon formation, upper Eocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Grapevine canyon, Kern County, California. Occurs also at locality (U.C. A-835). Cove in southwest corner of Cape Arago, Coos Bay, Oregon.

**CORBULA DICKERSONI Weaver and Palmer, 1922**

Plate 61, figures 13, 16, 17, 20

*Corbula dickersoni* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 24, 25, pl. 9, figs. 9, 10, 1922.

*Corbula hornii* Gabb, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 84, pl. 4, figs. 5a, 5b, 1915.

*Corbula dickersoni* Weaver and Palmer, Clark, Bull. Geol. Soc. Am., vol. 49, p. 700, pl. 1, fig. 17, 1938.

*Original description.* Shell small, sub-trigonal in outline; thick; inequilateral, beaks situated nearer the anterior end; beaks low and inconspicuous; anterior dorsal end sloping from the beaks at an angle of 25° rounding into the ventral margin; ventral margin slightly rounded, ending abruptly in the truncated, posterior ventral end; posterior end sloping from the dorsal line at an angle of 30°, narrowly truncate at the base; a sharp ridge extends from beaks to the posterior ventral margin; valves very convex; left valve tends to be more pointed posteriorly and the ventral line less straight; surface ornamented with fine, distinct concentric ribs with interspaces about half the width of the ribs; concentric ribs terminate at the umbonal ridge, the area between the ridge and the anterior margin smooth except for lines of growth. Crossing the concentric ribs there are commonly threadlike, radiating lines on the lower portion of the shell, which extend from a mid-line to the umbonal ridge.

These lines are very fine and often microscopic with very wide interspaces between, where they cross the concentric ribs they give the surface a cancellated appearance. Dimensions.—Length 12 mm.; height 8 mm.; thickness 6 mm. (Weaver and Palmer)

*Observations.* Specimens of this species are very abundant in the Cowlitz formation east of Vader and may be distinguished from *C. hornii* in being less equilateral, in the anterior end being less produced, and the posterior end more pointed.

*Holotype.* (U.W. 180) (C.A.S. 7452). Figured in the present report, pl. 61, fig. 13.

*Syntype.* (U.W. 180-B) (C.A.S. 7452-B). Figured in the present report, pl. 61, figs. 16, 20.

*Syntype.* (U.W. 180-A) (C.A.S. 7452-A). Figured in the present report, pl. 61, fig. 17.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz River Valley, southwestern Washington.

*Type locality.* (U.W. 329.) North bank of Cowlitz River two miles east of Vader, Lewis County, Section 28, T. 11 N., R. 2 W.

#### "CORBULA" STILLWATERENSIS Weaver and Palmer, 1922

*Corbula stillwaterensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 25, pl. 8, fig. 14, 1922.

*Original description.* Shell large, sub-ovate; rostrate, beaks large and prominent; valves very convex; dorsal margin slightly convex, anterior end rounded; ventral margin rounded anteriorly, sloping slightly upward in the region of the rostrated posterior end; extreme margin of the posterior end broken; dorsal margin concave, sloping to the beaks at an angle of 40°; shell thin, smooth, except for the fine lines of growth. Dimensions.—Length 22 mm.; height 16 mm.; thickness 13 mm. (Weaver and Palmer)

*Observations.* The type of this species is lost and no other specimens are available for study. Effinger (138, p. 373) has pointed out that the form is closely related to *Mya (Antiguamya) arnoldi* (Dickerson). Until the type is found or additional material from the type locality is available, the exact identification is uncertain. The posterior end of the holotype was broken away and it is not certain that the form is a *Corbula*.

*Holotype.* (U.W. 181.) Lost.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 319.) At McClarity Ranch on the south bank of Stillwater Creek, one mile west of Vader, Lewis County, Section 30, T. 11 N., R. 2 W.

**CORBULA COMPLICATA** G. D. Hanna, 1924

Plate 59, figures 8, 10; plate 61, figures 15, 21

*Corbula dilata* Waring, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 92, pl. 15, fig. 2, 1917.Not *Corbula dilata* Echinwald, Naturh. Skizze Lithuae, etc., p. 250, 1830.*Corbula complicata* G. D. Hanna (new name), Proc. Calif. Acad. Sci., ser. 4, vol. 13, p. 163, 1924.*Corbula complicata* G. D. Hanna, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 66, pl. 8, figs. 9, 10, 1938.

*Original description.* "Shell small, thick, very convex, equivale, somewhat inequilateral; beaks prominent, broad, strongly incurved and inclined forward. Anterior end sloping downwards; abruptly and regularly rounded below; posterior obliquely truncated and biangular; a distinct umbonal ridge passes from the beaks to the posterior angle in both valves. Basal margin of right valve regularly and broadly convex, straight on the left." Surface marked by prominent concentric band-like ribs, the upper edges of which are angulated. (Waring)

*Observations.* This species resembles to some extent *C. dickersoni* and *C. parilis*. It is relatively more elongate than the former and has less strongly developed concentric ribs and a less attenuated posterior end than the latter.

*Hypotype.* (U.C. 33646.) Locality (U.C. A-661). Figured in the present report, pl. 59, fig. 8; pl. 61, figs. 15, 21.

*Hypotype.* (U.C. 33155.) Locality (U.C. A-667). Figured in the present report, pl. 59, fig. 10.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Southwestern Washington, and Ventura County, California.

*Type locality.* McCray Wells, Ventura County, California. Occurs also at locality (U.C. A-661), Douglas County, Oregon. East bank of Little River between highway bridge and first bend of stream east of junction with North Umpqua River. Section 19, T. 26 S., R. 3 W.

**CORBULA TORREYENSIS** Hanna, 1927

Plate 61, figure 12

*Corbula torreyensis* Hanna, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 296, pl. 44, figs. 6, 7, 8, 9, 10, 15, 16, 1927.*Corbula torreyensis* Hanna, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 66, pl. 8, figs. 6, 7, 1938.

*Original description.* Shell small, subtrigonal, moderately inflated, fairly heavy; ventral margin straight to broadly rounded, but more sharply rounded to the nearly straight anterior; dorsal surface nearly straight; posterior truncated; a keel or ridge extends from the beak to the posterior ventral point; anterior to the keel the surface is slightly concave; posterior to the keel the surface is deeply concave forming a slight indentation on the truncate posterior end; ridge prominent and elevated; prominent depressions both anterior and posterior to the beak, a slight secondary radial ridge borders the escutcheon area; surface concentrically crossed by fine growth lines; interior of the shell not seen; rostrum of the type slightly broken. Dimensions. *Type:* Altitude 2.8 mm., length 4.5 mm., diameter of both valves 2.2 mm. (Hanna)

*Observations.* This species is characterized by its marked posterior elongation, truncate posterior margin, very sharp and prominent umbonal ridge which assumes the form of a keel and subsidiary ridge behind the keel. Concentric ribbing is only moderately developed.

*Hypotype.* (U.C. 33156.) Locality (U.C. A-673). Figured in the present report, pl. 61, fig. 12.

*Geologic range.* Middle Eocene. Upper Umpqua formation.

*Geographic distribution.* Southwest Oregon.

*Type locality.* (U.C. 3981.) La Jolla quadrangle near San Diego, California, in a small gully one-fourth mile south of the mouth of Soledad Valley. Occurs also in southwest Oregon at locality (U.C. A-673), on north bank of Umpqua River one-fourth mile south of Glide.

#### CORBULA EVANSANA Shumard, 1858

*Corbula evansana* Shumard, Trans. St. Louis Acad. Sci., vol. 1, p. 120, 1858; Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 186, 187 (reprint), 1909.

*Original description.* Shell subtrigonal, gibbous, slightly inequivalve, inequilateral, length greater than the height; buccal margin short, rounded; canal end oblique, prolonged, somewhat rostrate, obliquely truncated at the extremity; posterior slope forming nearly a right angle with the umbo. An elevated sharp carina extends from the beak of each valve to the posterior inferior extremity, and interior to this is a second carina, which is somewhat rounded and usually most distinct in the right valve; basal margin obtusely rounded, slightly produced near the middle, and in most specimens slightly contracted posteriorly; beaks flattened near the anterior margin, convex, rather prominent, incurved; surface marked with fine, rather distinct, concentric striae, and generally with several distinct folds. The cardinal tooth of the right valve is thick, trigonal, and placed under the beak nearest the buccal side, while the cavity for receiving the tooth of the opposite side is triangular, deep, and situated directly under the beak. The substance of the shell is rather thick, and at the cardinal margin quite robust. Length  $7\frac{1}{2}$  lines; height, about 5 lines; thickness  $4\frac{1}{2}$  lines. These proportions vary somewhat with the age of the shell. (Shumard)

*Observations.* The holotype of this species is lost and no topotypes or hypotypes are known. The original description is quoted here for reference.

*Holotype.* Lost.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* In dark aluminous shale at Davis's coal mine and at the coal mines of Port Orford. (Shumard)

#### Genus PHAENOMYA Weaver and Palmer, 1922

*Phaenomya* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pl. 9, figs. 6, 7, 8, 1922.

*Genotype.* *Phaenomya vaderensis* Weaver and Palmer.

**PHAENOMYA VADERENSIS** Weaver and Palmer, 1922

## Plate 61, figure 14

*Phaenomya vaderensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 26, pl. 9, figs. 6, 7, 8, 1922.

*Original description.* Shell medium; inequilateral, beaks situated about one-third of the distance from the anterior end; trigonal in outline, very convex; beaks high and prominent; anterior end concave; anterior margin sloping roundly to the ventral margin; ventral margin straight; posterior end truncate, passing into the ventral margin at a right angle and sloping to the beaks at an angle of 35°; a slight umbonal ridge extends from the beaks to the ventral margin; surface smooth except for the concentric lines of growth. Dimensions.—Length 28 mm.; height 20 mm.; thickness 13 mm. (Weaver and Palmer)

*Observations.* This species is very abundant at locality (U.W. 315) and has been found only in the Cowlitz formation in Olequa and Stillwater creeks west and southwest of Vader in Lewis County.

*Holotype.* (U.W. 183) (C.A.S. 7464). Figured in the present report, pl. 61, fig. 14.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 315.) At the log dam on west bank of Olequa Creek just below railroad bridge, about one-third mile below the junction with Stillwater Creek, near Vader, Lewis County, Section 32, T. 11 N., R. 2 W.

## Family SAXICAVIDAE

## Genus PANOPÆ Menard de la Groye, 1807

*Panope* Menard de la Groye, Ann. Mus. d'Hist. Nat. Paris, vol. 9, pp. 135, 136, 1807.

*Genotype.* *Mya glycimeris* Gmelin.

**PANOPÆ SNOHOMISHENSIS** Clark, 1925

## Plate 59, figures 3, 19

*Panope snohomishensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 105, pl. 10, fig. 1; pl. 11, fig. 2, 1925.

*Original description.* Shell elongate, ovate in outline, thin; beaks fairly prominent, anterior to medial line, strongly inturned but not prosogyrous. Posterior dorsal edge long, straight; anterior dorsal edge short, slightly convex; anterior end broadly and regularly rounded; posterior end bluntly rounded, gaping, narrower than anterior end. Surface covered by heavy somewhat irregular undulations on and between which are finer incremental lines. Hinge plate not exposed. Dimensions of type specimen: Length 61 mm.; height 37 mm.; greatest diameter of both valves 23 mm. (Clark)

*Observations.* This species differs from *P. generosa* Gould in the general outline of the shell and in having a more obtusely rounded posterior margin.

*Holotype.* (S.U. 59.) Locality (S.U. N.P. 146). Figured in the present report, pl. 59, fig. 19.

*Paratype.* (S.U. 60.) Locality (S.U. N.P. 146). Figured in the present report, pl. 59, fig. 3.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Snohomish County, Puget Sound Basin, Washington.

*Type locality.* (U.W. 12.) In Northern Pacific Railway cut one-half mile north of Cathcart Station, Snohomish County (locally known as Fiddler's Bluff), Section 6, T. 27 N., R. 6 E.

#### PANOPE GENEROSA Gould, 1850

Plate 60, figures 2, 4

*Mya abrupta* Conrad, U.S. Explor. Exped. Geol., vol. 10, p. 723, Geol. Atlas, pl. 17, fig. 5, 1849.

*Panopaea generosa* Gould, Proc. Boston Soc. Nat. Hist., vol. 3, p. 215, 1850; Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 188, pl. 3, fig. 20, 1909.

*Panope generosa* Gould, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 88, 1931.

*Panope (Panope) generosa* Gould, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 424, 425, pl. 21, figs. 12a, 12b, 1931 (synonymy).

*Panope generosa* Gould, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 121, pl. 9, fig. 13, 1933.

*Original description (Mya abrupta).* Subelliptical, slightly ventricose, widely gaping posteriorly. Surface marked with concentric undulations. Beaks separated, nearly medial, slightly prominent. Anterior margin acute, orbiculate; posterior margin abrupt, arcuate, somewhat reflexed; basal (inferior) margin arcuate; dorsal margin short, straight, nearly parallel with the base. (Length  $2\frac{3}{4}$  inches; height 57/100 L.; thickness (and breadth of gaping behind) 32/100 L., or 56/100 H. Apical angle 162°.) (Conrad)

*Original description (Panopaea generosa).* Testa magna, ponderosa, calcarea, sub-quadrilateralis, concentrica undulosuplicosa, epidermide flavid, rugoso induta, antice rotundata, postice truncata et valde hians; umbonibus submedianis, acutis, elevatis, undulatis; cardo gracilis, dente elevato oblique trianguli instructus; cavitas ad apicem profunda; cicatrice musculari lato, bene impresso; sinu siphonali minime profundo. Long. 6; alt. 4; lat. 3 poll. (Gould, 149, p. 215).

*Observations.* This species is closely related to *P. snohomishensis* Clark but is a relatively shorter shell.

*Holotype (Mya abrupta).* (U.S.N.M. 3608.) Not figured in the present report.

*Hypotype.* (U.C. 32199.) Blakeley formation. Figured in the present report, pl. 60, figs. 2, 4.

*Geologic range.* Miocene to Recent.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality (Mya abrupta).* Astoria, Oregon (Astoria formation).

*Type locality (Panope generosa).* Puget Sound, Recent.

**PANOPE (PANOMYA) AMPLA (Dall) var. CHRYYSIS (Dall), 1909**

Plate 60, figure 1

*Panomya (ampla var. ?) chrysis* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 133, pl. 11, fig. 7, 1909.

*Original description.* Shell of moderate size, rude, rather thin, inequilateral, equivalve, gaping in front and more widely behind; beaks slightly anterior, with two obscure ridges, one extending vertically, the other from the beak to the basal posterior angle, separated by a shallow, ill-defined constriction; dorsal slopes sub-equal oblique, the anterior end obliquely subtruncate and widely gaping; base nearly straight; valves convex, compressed a little near the base; hinge teeth obsolete; pallial impressions as usual in the genus, broken up irregularly as figured. Longitude of shell, 51 mm.; width, 38 mm.; diameter, 23 mm. (Dall)

*Observations.* This variety differs from *P. ampla* in having much thinner valves; the anterior margin shows a less oblique truncation.

*Holotype.* (U.S.N.M. 154093.) Figured in the present report, pl. 60, fig. 1.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Goldwashers Gully, Coos Bay (collected by Dall).

**PANOPE RAMONENSIS Clark, 1925**

Plate 59, figure 11

*Panope ramonensis* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 106, pl. 10, figs. 2, 3, 1925.

*Original description.* Shell elongate subquadrate, ventral and dorsal margins approximately parallel. Beaks prominent, strongly inturned, only slightly prosogyrous and a little in front of median line. Anterior and posterior dorsal edges straight, at right angles to the line drawn perpendicularly to beaks and in line with each other. Posterior end broadly truncated and gaping; anterior end broadly and regularly rounded. Surface covered by fairly heavy, irregular, rounded undulations on and between which are finer incremental lines; concentric undulations on umbones and for considerable distance below fairly regular; below this they become very irregular and on adult specimens may become almost obsolete. A fairly broad, shallow depression or sinus between beak and lower angle of truncated posterior end; this zone of depression more noticeable on some specimens than on others. Nymph plates rather short, fairly prominent, with well defined ridge upon upper surface. A prominent heavy blunt tooth just below beaks on each valve extending approximately one-eighth of an inch beyond nymph plate. Dimensions of the type specimen: Length 64 mm.; height about 37 mm.; diameter of one valve 10 mm. (Clark)

*Observations.* This species occurs in the middle Miocene of the Olympic Peninsula and may be distinguished from *P. snohomishensis* by the more central position of the umbones, its elongate character, and the nearly equal development and rounding of the posterior and anterior ends. It differs from *P. generosa* Gould, which occurs both fossil and living on the Pacific Coast, in the central position of the beaks, the depressed sinus between umbo and upper part of posterior end, and the proportionately greater length of the shell compared with the height.

*Hypotype.* (U.W. 365.) Astoria formation. Locality (U.W. 270). Figured in the present report, pl. 59, fig. 11.

*Geologic range.* Astoria formation in Washington.

*Geographic distribution.* Western Washington and Coast Ranges of southern California.

*Type locality.* (U.C. 1131) in southern California. Occurs also at locality (U.W. 270), cliff, south shore of Strait of Juan de Fuca, Clallam County, Section 21, T. 32 N., R. 12 W.

### Family PHOLADIDAE

Genus **ZIRFAEA** Gray, 1840

*Zirfaea* Gray, Synop. Cont. Brit. Mus. (42nd ed.), p. 150, 1840.

*Genotype.* *Pholas crispatus* Linnaeus.

**ZIRFAEA** sp. Clark and Arnold, 1923

Plate 60, figure 3

*Zirfaea* sp. Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 156, pl. 16, fig. 2, 1923.

*Original description.* Shell small, oblong, thin. Surface divided near middle into anterior and posterior area by well defined groove which extends from beaks to ventral edge. Posterior area covered by somewhat irregular, coarse, concentric lines of growth. Posterior area sculptured by series of concentric laminations provided with short rasplike teeth so characteristic of genera in this family. Broad, thin, callus covers strongly inturned beaks. Posterior end rounded, gaping. Anterior gap, if present, appears to have been very small. A broad, heavy muscular plate, characteristic of this genus, extends almost vertically to beaks. Dimensions of type: Length, about 24 mm.; width, about 14 mm. (Clark and Arnold)

*Observations.* This poorly preserved specimen somewhat resembles the West Coast Recent species *Z. gabbi* Tryon but may be distinguished from it in that the anterior end is not so strongly gaping and it possesses a heavier internal muscular plate.

*Holotype.* (U.C. 30065.) Figured in the present report, pl. 60, fig. 3.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South coast of Vancouver Island.

*Type locality.* (S.U. 129.) In sea cliffs between the mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

Genus **PHOLADIDEA** Goodall, 1819

*Pholadidea* Goodall, in Turton, Conch. Dict., p. 147, 1819.

*Genotype.* *Pholadidea loscombiiana* Goodall = *Pholas papyraceus* Turton, Conch. Insul. Brit., p. 2, pl. 1, figs. 1-4, 1822.

**PHOLADIDEA CALIFORNICA (Conrad), 1837**

*Pholas californica* Conrad, Jour. Acad. Nat. Sci. Phila., ser. 1, vol. 7, p. 236, pl. 18, fig. 5, 1837.

*Parapholas californica* Conrad, Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 92, 1922.

*Pholadidea (Parapholas) californica* (Conrad), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 435, 1931 (synonymy).

*Original description.* Shell elongated, with eight accessory valves; two of which are on the basal margin, extending nearly its entire length; anterior side gibbous, with the concentric lines lamellar, crowded, undulated, and crossed by numerous impressed lines; valves much contracted submedially, with an oblique groove; umbonal slope angulated; posterior side with elevated laminae; extremity truncated; apophysis oblique, dilated; hinge margin within greatly thickened posteriorly. Length, four inches. (Conrad)

*Observations.* No specimens of this species have been seen by the writer. The species is reported by Arnold and Hannibal (19, p. 590) and Howe (166, p. 92), from the Coos conglomerate of the Empire formation at Coos Bay, Oregon. The species occurs living in the waters of the Pacific between Monterey Bay and San Diego.

*Geologic range.* Upper Miocene to Recent.

*Type locality.* San Diego, California. Recent.

**PHOLADIDEA PENITA (Conrad), 1837**

*Pholas penita* Conrad, Jour. Acad. Nat. Sci. Phila., vol. 7, p. 237, pl. 18, fig. 7, 1837.

*Pholadidea penita* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 134, 1909.

*Pholadidea (Pholadidea) penita* (Conrad), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 434, pl. 24, figs. 1a, 1b, 1931 (synonymy).

*Original description.* Shell ovate, elongated, contracted submedially and grooved; anterior side inflated, with decussating lines, the radiating striae having a granulated appearance, posterior side subcuneiform, extremity truncated, with a membranous expansion or appendage; apophysis oblique, slender, spoon shaped at the extremity. (Conrad)

*Observations.* This species occurs in the Camman collection from the Empire formation at Coos Bay and is in the U.S. National Museum. It occurs in the Pleistocene beds at San Pedro, California, and occurs living in the Pacific Ocean from San Diego northward to Alaska.

*Hypotype.* (U.S.N.M. 153957.) From Coos Bay; Empire formation. Not figured in the present report.

*Geologic range.* Upper Miocene to Recent.

*Geographic distribution.* Southern California to Alaska.

*Type locality.* Near San Diego; Recent.

## Family TEREDIDAE

## Genus TEREDO Linnaeus, 1758

*Teredo* Linnaeus, *Systema Naturae* (10th ed.), p. 651, 1758.

*Genotype.* *Teredo navalis* Linnaeus.

Calcareous tubes which may belong to the genus *Teredo* are common in all the marine shallow-water sandstones and shales of all the Tertiary formations in Oregon and Washington. They generally are associated with fossil wood. The pallets, which are not found among the fossil forms, are used in designating genera, and accordingly it becomes almost impossible to classify the Tertiary specimens. The following names occur in the literature of Northwest tube-like specimens: *Teredo pugetensis* White, 1889; *Teredo substriata* Dana, 1849; and *Teredo* sp. Clark and Arnold, 1923.

## "TEREDO PUGETENSIS" White, 1889

## Plate 60, figure 12

*Teredo pugetensis* White, U.S. Geol. Surv., Bull. no. 51, p. 62, pl. 8, 1889.

*Original description.* The shell of this species is not known, the specimens in the collection consisting only of the tubes, solidly filled with stony material in a mass of partially carbonized and partially silicified wood. The tubes are large, most of them extending in the direction of the wood fiber, and terminate at the distal end in almost true hemispheric convexity. The diameter of the tubes, as seen in the specimens in hand, varies from 25 mm. to 32 mm. (White)

*Holotype.* (U.S.N.M. 20107.) Figured in the present report, pl. 60, fig. 12.

*Type locality.* Carbonado, Pierce County, Washington, in the Puget Group. Eocene.

## "TEREDO" sp. Clark and Arnold, 1923

*Teredo* sp. Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 156, 1923.

*Original description.* A number of medium sized pieces of fossil wood were found in the collections from the Sooke near Muir Creek. One specimen was of special interest because of the large size of the *Teredo* tubes in it. The tubes are over half an inch in diameter and the walls are nearly a quarter of an inch thick. (Clark and Arnold)

*Type locality.* Sooke Bay, Vancouver Island, in sandstones of Sooke formation; upper Oligocene.

## Class Scaphopoda

## Genus DENTALIUM Linnaeus, 1758

*Dentalium* Linnaeus, Syst. Nat. (10th ed.), p. 785, 1758.

*Genotype.* *Dentalium elephantinum* Linnaeus.

**DENTALIUM STRAMINEUM** Gabb, 1864

*Dentalium stramineum* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 139, pl. 21, fig. 101, 1864; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 96, 1938.

*Original description.* Shell moderate in size, slightly curved. Section varying from circular to elliptical. Surface marked by about thirty small, regular, rounded ribs, with sometimes finer ones interpolated. (Gabb)

*Geologic range.* Middle and upper Eocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* "Northeast of Martinez," Contra Costa County, California.

**DENTALIUM PETRICOLA** Dall, 1909

*Teredo substriatum* Conrad (in part), U.S. Explor. Exped. Geol., p. 728, pl. 20, figs. 7, 7b, 1849.

*Dentalium petricola* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 136, 1909.

*Original description.* Nearly straight and evenly cylindrical, very slightly tapering. Surface minutely and very neatly striate longitudinally. (Conrad)

*Supplementary description* (*Dentalium petricola*). This species is similar to the other in size and form, but perfectly smooth. It occurs less frequently than *D. conradi*, but is not very uncommon in the rocks of the Oregonian Miocene. (Dall)

*Syntypes.* (U.S.N.M. 3528) and (U.S.N.M. 3481 in part). Not figured in the present report.

*Geologic range.* Astoria and Empire formations, middle Miocene to lower Pliocene.

*Geographic distribution.* Western Oregon and Washington.

*Type locality.* Astoria, Oregon.

**DENTALIUM CONRADI** Dall, 1909

## Plate 100, figure 20

*Teredo substriatum* Conrad, U.S. Explor. Exped. Geol., p. 728, pl. 20, fig. 7a, 1849.

*Dentalium conradi* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 136, 1909.

*Original description.* Nearly straight and evenly cylindrical, very slightly tapering. Surface minutely and very neatly striate longitudinally. (Conrad)

*Supplementary description* (*Dentalium conradi*). This large, finely striated Dentalium seems to be rather frequent in the Miocene of Clallam Bay. The name used by Conrad being preoccupied, I have proposed a new one. (Dall)

*Holotype.* (U.S.N.M. 3481 in part.) Type of Conrad and later of Dall. Figured in the present report, pl. 100, fig. 20.

*Geologic range.* Miocene.

*Geographic distribution.* Coos Bay and Astoria, Oregon, and Clallam County, Washington.

*Type locality.* Astoria, Oregon (collected by J. D. Dana).

**DENTALIUM PORTERENSIS Weaver, 1912**

## Plate 61, figure 19

*Dentalium porterensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 79, pl. 13, fig. 113, 1912.

*Original description.* Shell large, slightly curved: angle of divergence 9° to 14°; cross section circular; shell substance very thick in both young and old specimens; surface nearly smooth but showing about 35 very faint longitudinal lines; maximum diameter 9 mm. (Weaver)

*Holotype.* (U.W. 81) (C.A.S. 7517). Figured in the present report, pl. 61, fig. 19.

*Geologic range.* Lincoln formation, Oligocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 90.) In bluff, north side of Chehalis River, 2240 feet west of Porter Station along Northern Pacific Railway track. Grays Harbor County, Section 21, T. 17 N., R. 5 W.

UNIVERSITY OF WASHINGTON PUBLICATIONS  
IN  
GEOLOGY

Volume 5, pp. 275-562

December, 1942

PALEONTOLOGY OF THE MARINE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON

BY  
CHARLES E. WEAVER

PART I

Coelenterata, Vermes, Echinodermata, Molluscoidea Mollusca :  
Pelecypoda, Scaphopoda

PART II

Mollusca : Gastropoda ; Cephalopoda ; Arthropoda

PART III

Plates, Faunal Tables, Bibliography

Faunal Localities, Index

PUBLISHED BY THE UNIVERSITY OF WASHINGTON PRESS  
SEATTLE, WASHINGTON



**PALEONTOLOGY OF THE MARINE TERTIARY FORMATIONS  
OF OREGON AND WASHINGTON**

**PART II.**

**Mollusca: Gastropoda; Cephalopoda; Arthropoda**



GASTROPODA  
SUPERFAMILY DOCOGLOSSA  
Family ACMAEIDAE

Genus ACMAEA Eschscholtz, 1830

*Acmaea* Eschscholtz, in Kotzebue, Neue Reise um die Welt in den Jahren 1823-26, vol. 2, appendix, p. 24, Weimar, 1830. (English translation: A new voyage round the world, vol. 2, appendix, p. 350, London, 1830.) Genus without species according to Woodring, Carnegie Inst. Publ., no. 385, p. 458, 1928.

*Genotype.* *Acmaea mitra* Eschscholtz (by subsequent designation), Dall, Am. Jour. Conch., vol. 6, pt. 3, p. 238, 1871.

ACMAEA OCITATIA Hanna, 1924

Plate 62, figure 6

*Patella subquadrata* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 182, pl. 31, figs. 13a, 13b, 1917.

Not *Patella subquadrata* Dunker, Paleontographica, no. 1, p. 113, pl. 13, fig. 18, 1847.

*Acmaea ocititia* G. D. Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 13, p. 156, 1924.

*Acmaea ocititia* G. D. Hanna, Effinger, Jour. Paleon., vol. 12, p. 374, 1938.

*Original description.* Shell of moderate height, broad, marked by low rounded, obscure radial ribs with shallow interspaces only half as wide as ribs; apex two-fifths of shell length from anterior. Dimensions: Length, 6.5 mm.; height, 3.5 mm. (Dickerson)

*Observations.* This species which is very abundant at the type locality occurs in the same fauna with *A. simplex* Dickerson and differs from the latter in having very faintly developed radial ribs, a more centrally placed apex, and a somewhat lesser height. As pointed out by G. D. Hanna, the species name *subquadrata* was a homonym of the form from Europe named *Patella subquadrata* by Dunker in 1847.

*Holotype.* (C.A.S. 440.) Figured in the present report, pl. 62, fig. 6.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Lewis County, Washington.

*Type locality.* (U.W. 239.) From south bank of Cowlitz River at old Gries Ranch, in northeast quarter of Section 25, T. 11 N., R 2 W.

ACMAEA GEOMETRICA (Merriam), 1897

Plate 62, figure 4

*Patella geometrica* Merriam, Nautilus, vol. 11, p. 65, 1897.

*Patella geometrica* Merriam, Proc. Calif. Acad. Sci., ser. 3, vol. 1, p. 178, pl. 23, fig. 4, 1899.

*Acmaea geometrica* (Merriam), Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 171, pl. 34, fig. 5, 1923.

*Original description.* Shell large and heavy, up to fifty millimeters or more in length, suborbicular. Apex elevated, well forward. Surface ornamented by about twenty broad, strong, radial ribs, which are much wider than the interspaces. Radial ribs crossed by numerous, prominent, narrow, sometimes leafy, transverse ridges. (Merriam)

*Observations.* This species is characterized by its large size, high anteriorly placed apex, and coarse radial and transverse sculpture with very narrow radial interspaces. The following dimensions of the holotype not noted in the original description are: Length, 53 mm.; width, 48 mm.; height, 28 mm. The specimen figured by Clark and Arnold from the Sooke formation as a paratype (U.C. 30241) in (50, pl. 34, fig. 5) has a relatively lesser height than that of the holotype.

*Holotype.* (U.C. 11933.) Figured in the present report, pl. 62, fig. 4.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* In sandstone of Sooke formation exposed in sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

#### ACMAEA HANNIBALI Clark and Arnold, 1923

##### Plate 62, figure 18

*Acmaea hannibali* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 171, pl. 38, figs. 1a, 1b, 1923.

*Original description.* Shell large, thin, coniform; variable in height and steepness of slope; apex nearly central, base subcircular, longer in anteroposterior direction; sides straight. Surface sculptured by about twenty heavy prominent narrow-topped ribs; a less prominent or secondary rib in each interspace and in interspaces between secondary ribs several finer striations or riblets. Dimensions of type specimen: Height, about 20 mm.; anteroposterior width of body whorl, 92 mm.; width of aperture at right angles to anteroposterior line, 75 mm. (Clark and Arnold)

*Observations.* This species is characterized by its very large size, nearly central position of apex, heavy but narrow and somewhat irregularly spaced major radiating ribs, and its very broad interspaces containing secondary ribs and striations. There are moderately developed concentric irregular growth lines. This species differs from *A. victoriana* in its average smaller size and in the lack of secondary and tertiary intercalated radiating ribs.

*Holotype.* (U.C. 30213.) Figured in the present report, pl. 62, fig. 18.

*Geologic range.* Lower Astoria formation, middle Miocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* Basal sandstone of Astoria formation in sea cliffs one-fourth mile east of Providence Cove, Port San Juan, Vancouver Island.

**ACMAEA MITRA** Eschscholtz subsp. *SOOKENSIS* Clark and Arnold, 1923

## Plate 62, figure 3

*Acmaea mitra* Eschscholtz subsp. *sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 171, pl. 35, figs. 2a, 2b, 1923.

*Original description.* Shell fairly heavy, base subovate, wider posteriorly than anteriorly. Apex bluntly pointed, anterior to middle. Surface sculptured by moderately fine, almost obsolete ribbing. Ribbing obsolete on some specimens; on others it shows more or less distinctly toward margin of aperture but not on upper part of whorl. Dimensions of type specimen: Height, about 20 mm.; greatest width of aperture, about 35 mm. (Clark and Arnold)

*Observations.* This species may be distinguished by the well-developed concentric growth lines and almost total lack of radial ribbing. The apex is situated about one-third the length of shell from anterior end. The anterior end of aperture is narrower than the posterior. *Acmaea mitra* Eschscholtz has the apex less anteriorly situated than in the subspecies and less ovate shaped outline of the aperture.

*Holotype.* (U.C. 30071.) Figured in the present report, pl. 62, fig. 3.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* Sandstone in sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Vancouver Island.

**ACMAEA PERSONA** Eschscholtz subsp. *VANCOUVERENSIS* Clark and Arnold, 1923

## Plate 62, figures 2, 7

*Acmaea persona* Eschscholtz subsp. *vancouverensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 172, pl. 35, figs. 1a, 1b, 1923.

*Original description.* Shell medium in size, apex blunt, well anterior to middle; aperture ovate, anterior end narrow. Surface sculptured by numerous rounded rather fine radiating ribs which are almost obsolete on type from apex to about one-third the distance to aperture. Dimensions of type: Length of aperture, about 13 mm.; width, 9 mm.; height, about 4 mm. (Clark and Arnold)

*Observations.* Specimens of this species are of moderate size and are characterized by well-developed fine radial ribbing which becomes obsolete on the upper third of the surface of the shell. The apex is situated about one-third the length of shell from the anterior end. This subspecies may be distinguished from *Acmaea persona* in having a larger number of more regularly spaced and finer radiating ribs.

*Holotype.* (U.C. 30216.) Figured in the present report, pl. 62, figs. 2, 7.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* Sooke sandstones exposed in sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

**ACMAEA VICTORIANA** Clark and Arnold, 1923

Plate 62, figures 1, 8, 11

*Acmaea victoriana* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 172, pl. 34, figs. 1a, 1b, 2a, 2b, 4, 1923.

*Original description.* Shell medium in size, fairly heavy; variable in outline, aperture typically elongate ovate; apex slightly anterior to middle. Surface sculptured by numerous radiating ribs arranged in cycles according to their prominence; 21 major ribs on type specimen with well developed second cycle in broad interspaces and third cycle developed in remaining interspaces; on some specimens a faintly developed fourth cycle. Dimensions of type specimen: Greatest length of aperture, about 57 mm.; greatest width, 42 mm.; height (apex broken) about 25 mm. (Clark and Arnold)

*Observations.* This medium-sized species is characterized by the nearly central, or very slightly anterior to the center, position of the apex and the arrangement of the radiating ribs in primary, secondary, and tertiary cycles.

*Holotype.* (U.C. 30290.) Figured in the present report, pl. 62, figs. 1, 11.

*Cotype.* (U.C. 30215.) Figured in the present report, pl. 62, fig. 8.

*Geologic range.* Lower Astoria sandstone, middle Miocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* Basal Astoria sandstone in sea cliffs one-fourth mile east of Providence Cove, Port San Juan, Vancouver Island.

**ACMAEA SIMPLEX** Dickerson, 1917

Plate 62, figure 10; plate 63, figure 25; plate 64, figure 1

*Acmaea simplex* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 181, pl. 31, figs. 11a, 11b, 1917.

*Acmaea clarki* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 85, pl. 6, fig. 4, 1918.

*Acmaea simplex* Dickerson, Jour. Paleon., vol. 12, p. 374, 1938.

*Original description.* Shell small, high, smooth except for concentric growth lines, with apex at one-third of length from anterior end; anterior, with very steep slope. This form is very similar to, or identical with, a small species found in some limestones at the head of San Lorenzo River in Santa Cruz County. Dimensions: Length, 6 mm.; height, 3.5 mm. (Dickerson)

*Original description (Acmaea clarki Van Winkle).* Shell small, high and thin; smooth except for concentric lines of growth; apex situated about midway between the anterior and posterior ends. Dimensions.—Altitude 8 mm.; diameter of base 10 mm. by 12 mm. (Van Winkle)

*Observations.* The shell material of *Acmaea clarki* Van Winkle was broken off completely at the time the specimen was photographed in 1918 and radial ornamentation was only faintly developed. In general outline it resembles *A. simplex*, and the apex of the former is a little more centrally placed. *A. clarki* may be a synonym of *A. simplex* as suggested by Effinger, and with some reserve is so considered here until well-

preserved specimens are secured which permit a better biologic discrimination.

*Holotype.* (C.A.S. 438.) Figured in the present report, pl. 62, fig. 10.

*Holotype (Acmaea clarki Van Winkle).* (U.W. 133) (C.A.S. 7628). Figured in the present report, pl. 63, fig. 25; pl. 64, fig. 1.

*Geologic range.* Gries Ranch beds and Oakville conglomerate of the lower middle Oligocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch in the northeast quarter of Section 25, T. 11 N., R. 2 W.

#### ACMAEA DICKERSONI Van Winkle, 1918

Plate 63, figure 23; plate 64, figure 2

*Acmaea dickersoni* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 84, pl. 7, fig. 15, 1918.

*Original description.* Shell small and high; apex situated about one-third the length of the shell from the anterior end; base semi-oval in outline; anterior end steep. Surface marked by numerous radiating ribs which are crossed by faint revolving lines of growth. (Van Winkle)

*Observations.* This shell may be distinguished from *A. simplex* and *A. oakvillensis* by its greater height and the relatively narrow anterior and broad posterior dimensions of the aperture. The radial ribs are heavier and less numerous than in *A. oakvillensis*. It differs from *A. persona vancouverensis* in the outline of the aperture and in the absence of the closely spaced, sharp and fine but slightly wavy radiating ribs.

*Holotype.* (U.W. 132) (C.A.S. 7627). Figured in the present report, pl. 63, fig. 23; pl. 64, fig. 2.

*Geologic range.* Lower middle Oligocene. Conglomerate at base of Lincoln formation.

*Geographic distribution.* Eastern part of Grays Harbor County, Washington.

*Type locality.* (U.W. 169.) In quarry on Northern Pacific Railway one mile west of Oakville, Grays Harbor County, Section 19, T. 16 N., R. 4 W.

#### ACMAEA OAKVILLENSIS Van Winkle, 1918

Plate 63, figure 30; plate 64, figure 3

*Acmaea oakvillensis* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 84, pl. 7, fig. 18, 1918.

*Original description.* Shell small, thin and moderately low; apex situated about one-third the length of the shell from the anterior end; anterior end with moderate slope; outline of shell oval; surface sculptured with numerous radiating ribs with wider interspaces. These are crossed by revolving lines of growth. Dimensions: Altitude 4 mm.; diameter of base 13 mm. by 9 mm. (Van Winkle)

*Observations.* This species along with *A. simplex* and *A. dickersoni* lived on a gravelly beach which was transgressing over a land surface

composed of basaltic lava. It is characterized by the nearly oval outline of the aperture, rather low apex, and fine radial ribbing. It differs from *A. dickersoni* in its lesser height, slightly more central position of apex, and in having heavier, rounded, slightly sinuous and more numerous radiating ribs.

*Holotype.* (U.W. 131) (C.A.S. 7626). Figured in the present report, pl. 63, fig. 30; pl. 64, fig. 3.

*Geologic range.* Lower middle Oligocene. Conglomerate at base of Lincoln formation.

*Geographic distribution.* Eastern Grays Harbor County, Washington.

*Type locality.* (U.W. 169.) In quarry on Northern Pacific Railway one mile west of Oakville, Grays Harbor County, Section 19, T. 16 N., R. 4 W.

### Family FISSURELLIDAE

#### Genus DIODORA Gray, 1821

*Diodora* Gray, London Medical Repository, Monthly Jour. and Rev., vol. 15, p. 233, 1821.

*Genotype.* *Patella apertura* Montagu.

#### DIODORA STILLWATERENSIS (Weaver and Palmer), 1922

Plate 63, figure 20; plate 64, figures 4, 7, 12

*Fissuridea stillwaterensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 27, pl. 11, figs. 3, 6, 1922.

*Original description.* Shell medium in size, outline elliptical; apex situated a little in advance of the middle; anterior slope moderately steep; angle of the posterior slope less than that of the anterior; surface ornamented with about 28 primary, radiating ribs between which are ribs secondary in size, in most cases there is a third, smaller, radiating rib between the primary and secondary ribs; the alternation in the size of the ribs is most conspicuous nearer the apex of the shell and on the anterior and posterior slopes; the radiating ribs are crossed by numerous, revolving lines which give the shell a close, cancellated appearance. Dimensions: Greater diameter 19 mm.; lesser diameter 13 mm.; altitude 8 mm.; apical angle 113°. (Weaver and Palmer)

*Observations.* This species of relatively small size is characterized by the slight elevation of upper rim of the apex, with its position slightly anterior to the center, and the presence of major, secondary and tertiary radiating ribs. Some well-preserved specimens show the aperture on the inside of the shell surrounded by a distinct callus which is sharply truncated posteriorly.

*Holotype.* (U.W. 184) (C.A.S. 7625). Figured in the present report, pl. 63, fig. 20; pl. 64, figs. 4, 7.

*Topotype.* (U.C. 33457.) Figured in the present report, pl. 64, fig. 12.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 319.) At McClarity ranch on south bank of Stillwater Creek, one mile west of Vader, Lewis County, Section 30, T. 11 N., R. 2 W.

Genus **MEGATHURA** Nuttall, 1890

*Megathura* Nuttall, in Pilsbry, Tyron's Man. Conch., ser. 1, vol. 12, p. 182, 1890.

*Genotype.* *Megathura californica* Nuttall.

**MEGATHURA VANCOUVERENSIS** Clark and Arnold, 1923

Plate 62, figures 5, 9

*Megathura vancouverensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 173, pl. 34, figs. 3a, 3b, 1923.

*Original description.* Shell medium size, low, conical; aperture elongate, elliptical with a fairly large perforation anterior to center. Perforation surrounded internally by callus which is characteristic of the genus. Surface sculptured by numerous strap-like radiating ribs which are separated by narrow but deeply incised lines; about 70 of these ribs on type. Margin of aperture apparently entire. Dimensions of type: greatest length of aperture, about 20 mm.; height of shell, about 19 mm. (Clark and Arnold)

*Observations.* This species may be distinguished from the Recent West Coast species *M. crenulata* (Sowerby) in possessing only 70 radiating ribs in contrast to nearly 200 in the latter form. It is also narrower and more elevated in proportion to width. The height of the holotype is about 6 mm. rather than 19 mm. as stated in the original description.

*Holotype.* (U.C. 30077.) Figured in the present report, pl. 62, figs. 5, 9.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* Basal sandstones of the Sooke formation in the sea cliffs at the mouth of Fossil Creek, two miles west of Sherringham Point, Jordan River, Vancouver Island.

Genus **PUNCTURELLA** Lowe, 1827

*Puncturella* Lowe, Zool. Jour., vol. 3, p. 78, 1827.

*Genotype.* *Patella noachina* Linnaeus.

**PUNCTURELLA?** sp. Clark and Arnold, 1923

Plate 62, figure 14

*Puncturella?* sp. Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 174, pl. 38, fig. 3, 1923.

*Observations.* This small poorly preserved specimen was considered by Clark and Arnold as probably belonging to the genus *Puncturella*. The perforation is situated near the apex, which although broken, is spirally recurved. The fissure is somewhat lance shaped and lies somewhat obliquely. There are primary and secondary radiating ribs.

*Holotype.* (U.C. 30217.) Figured in the present report, pl. 62, fig. 14.

*Geologic range.* Probably lower part of Astoria formation, middle Miocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* From sandstones exposed in sea cliffs one and one-half miles west of Owens Point, Port San Juan, Vancouver Island.

## Family TROCHIDAE

Genus CALLIOSTOMA Swainson, 1840

*Calliostoma* Swainson, Treatise on Malacology, p. 218, 1840.*Genotype.* *Trochus conulus* Linnaeus.

## CALLIOSTOMA MEA Tegland, 1933

Plate 62, figure 12

*Calliostoma mea* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 140, 141, pl. 15, figs. 6, 7, 1933.

*Original description.* Shell nacreous, small, conical, high spired, with linear channeled suture and angulate whorls, four in number (apical whorl missing); two posterior whorls worn leaving a concave shoulder and a strong angulation on the lower part of the whorl; penultimate whorl with rounded angulation just below suture, convex shoulder, peripheral angulation just above the anterior suture line; posterior and peripheral angulations tubercled by the crossing of from 15 to 16 transverse ribs which tend to disappear on the shoulder. Body whorl rounded, upper portion ornamented as penultimate whorl, the presutural angle of the previous whorl becoming the basal keel of the body whorl; basal keel not tubercled; between peripheral carina and basal keel is the rounded groove and another below the keel; base flatly convex, sculptured with about six low spirals which become fainter toward the umbilical region. Umbilical area covered by pillar lip. Aperture rounded with slightly reflected outer lip; inner lip calloused. On surface of holotype remain portions of the thin calcareous outer shell. Dimensions of holotype: height, 10.7 mm.; diameter, 8.1 mm. (Tegland)

*Observations.* This species differs from *C. pacificum* of the middle Miocene in the greater convexity of the body whorl and whorls of the spire, the relatively higher spire, the more strongly developed callus on the aperture and in the angulation of the whorls and lack of spiral ribs.

*Holotype.* (U.C. 32223.) Figured in the present report, pl. 62, fig. 12.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Puget Sound area, Washington.

*Type locality.* (U.W. 13.) At Restoration Point, Kitsap County, opposite Seattle.

## CALLIOSTOMA PACIFICUM Anderson and Martin, 1914

Plate 62, figure 16

*Calliostoma pacificum* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 64, 65, pl. 8, figs. 2a, 2b, 1914; Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 89, pl. 11, figs. 8, 12, 1931.

*Original description.* Shell conical, thick, with about five convex whorls; spire moderately high; whorls of the spire ornamented with ten almost equally prominent spiral threads separated by narrower interspaces; two of the spiral threads nearest the posterior margin are centrally grooved; suture distinct, impressed; body-whorl slightly concave near the suture, convex over the central portion, sharply rounded at the base, sculptured the same as the whorls of the spire; the base ornamented with eighteen or twenty very fine spiral lines; aperture subcircular; outer lip smooth; col-

umella thickened and incrusted. Dimensions.—Altitude of the type specimen, 15 mm.; diameter of the last whorl, 14.5 mm. (Anderson and Martin)

*Observations.* The well-developed spiral sculpture on the base of the body whorl, relatively lower spire, and lack of strong spiral angulation on whorls serve to distinguish this species from *C. mea* Tegland. The outline of the shell somewhat resembles *C. delezinensis* but the whorls are far less convex.

*Holotype.* (C.A.S. 134.) Figured in the present report, pl. 62, fig. 16.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Lincoln County, Oregon, and Grays Harbor County, Washington.

*Type locality.* (U.W. 691.) Cliffs along ocean five and one-half miles north of the entrance to Yaquina Bay, Lincoln County, Oregon. Occurs also in Washington at locality (U.W. 425) on Rock Creek one-fourth mile down stream from the falls and just below the old dam site, Section 7, T. 16 N., R. 5 W.

#### CALLIOSTOMA DELEZINENSIS Weaver, 1912

##### Plate 64, figure 5

*Calliostoma delezinensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 72, pl. 6, figs. 59, 60, 61, 63, 1912.

*Original description.* Shell small, largest specimens not over 12 mm. in altitude, conical; whorls six, convex; body whorl with upper surface very slightly convex and sloping up to suture at an angle of 45°; lower surface broadly convex and nearly horizontal; sculpture on body whorl with eight prominent revolving ribs above the angle and ten below, all equally spaced; lines of growth fairly well marked; on some specimens these ribs are very slightly nodose, but it is not characteristic. Interspaces concave, smooth and contain no revolving thread. Sculpture of spire similar to body whorl. Suture distinct and impressed; aperture sub-oval; inner lip smooth; outer lip thin. Dimensions: Altitude 13 mm.; diameter 20 mm.; altitude of spire 8 mm.; angle of spire 80°. (Weaver)

*Observations.* *C. delezinensis* is characterized by the strongly impressed suture, marked convexity of body whorl and whorls of spire, fairly strong equally spaced spiral ribs, and adult specimens usually of smaller size than *C. mea* and *C. pacificum*. The spiral ornamentation somewhat resembles that of *C. pacificum*. The holotype and syntypes of this species are lost and a topotype (U.W. 70) (C.A.S. 7629) has been selected as a neotype.

*Neotype.* (U.W. 70) (C.A.S. 7629). Figured in the present report, pl. 64, fig. 5.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.W. 44.) Grays Harbor County, southwestern Washington, 18,000 feet up from the Union Pacific Railway crossing, Section 26, T. 17 N., R. 6 W.

**CALLIOSTOMA CAMMANI** Dall, 1909

Plate 63, figures 3, 9

*Calliostoma cammani* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 96, pl. 2, figs. 8, 9, 1909.  
*Calliostoma cammani* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 834, 1931.

*Original description.* Shell thin, depressed-conic, of about four whorls; upper surface of the whorls with three strong, rounded revolving cords with wider inter-spaces, the channel between the posterior and the next anterior cord wider than the others; the third cord somewhat more prominent than the others, so that it forms the periphery of the whorl; below it, separated by a pronounced sulcus, is a similar but less prominent cord which forms the margin of the basal surface and on which the suture is laid; base flattish with several hardly raised flattened spiral bands, a stronger, more or less nodulous one surrounding the umbilical area, which is white with a depressed callous surface bounded by a rounded ridge; the pillar smooth, arcuate, ending in a blunt point beyond which the basal lip is thin and simple; upper surface with faint oblique incremental lines hardly interrupting the general smoothness; outer lip thin, sharp, produced at its upper termination along the whorl and crenulated by the spiral sculpture; aperture wider than high, pearly within, a thin wash of callus on the body; nucleus decollate in the type; there is a faint depression behind the pillar, but the shell is imperforate. Altitude of decollate type, 15 mm.; maximum diameter, 25 mm. (Dall)

*Observations.* This species in general form and character of ornamentation somewhat resembles *Tegula lahondaensis* var. *stantoni* Dall but may be distinguished from it in having a relatively lesser height and flatter base with slightly developed spiral bands upon it. The low height of the body whorl as well as the whorls of the spire serve to separate it from the other three species of *Calliostoma* occurring in Oregon and Washington.

*Holotype.* (U.S.N.M. 107776.) Figured in the present report, pl. 63, figs. 3, 9.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Coos Bay, Oregon (collection of B. H. Camman).

Genus **TURCICA** A. Adams, 1854

*Turcica* A. Adams, Proc. Zool. Soc. London, pt. 22, p. 37, pl. 27, fig. 1, 1854.

*Genotype* *Turcica monilifera* A. Adams.

**TURCICA GABBI** Dall, 1909

Plate 63, figure 4

*Turcica gabbi* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 97, pl. 4, fig. 5; pl. 6, fig. 11, 1909.  
*Turcica gabbi* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 838, 1931.

*Original description.* Shell thin, pearly, elevated, conic, with more than four ample whorls; apex decollate; whorls sculptured with (on the upper whorls five)

subequal, low, rounded cords with wider smooth interspaces, the peripheral cord and the one in front of it somewhat stronger than the others; suture slightly constricted; base with similar but more closely set and smaller revolving cords, with subequal interspaces; umbilical region imperforate, callous, smooth; pillar with two strong rounded knobs; basal and outer lip thin, simple; a thin wash of callus on the body. Altitude, 30 mm.; maximum diameter, 25 mm. (Dall)

*Observations.* This species is the only one known in the Tertiary formations of Oregon and Washington and has been referred to by Dall as the precursor of *T. caffea* Gabb of the Pliocene and Recent of California. It may be distinguished from the latter in being relatively higher and with less complex ornamentation.

*Holotype.* (U.S.N.M. 153968.) Figured in the present report, pl. 63, fig. 4.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Near Fossil Point, Coos Bay, Oregon (collection of B. H. Camman).

#### Genus **TEGULA** Lesson, 1835

*Tegula* Lesson, Illus. Zoologie, liv. 17, pl. 51, 1835.

*Genotype.* *Tegula elegans* Lesson.

#### Subgenus **Chlorostoma** Swainson, 1840

*Chlorostoma* Swainson, Treat. Malac., p. 350, 1840.

*Subgenotype.* *Trochus argyrostomus* Gmelin.

#### **TEGULA (CHLOROSTOMA) ARNOLDI** (Weaver), 1912

*Chlorostoma arnoldi* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 71, 72, pl. 6, fig. 62, 1912.

*Original description.* Shell very small; spire low, whorls five; suture distinct and impressed; body whorl flattened; convex above; sharply angulated and flat below; sculptured by five distinct revolving ribs on upper surface and set with nodes; between these ribs the interspaces are broad and concave; under surface similarly sculptured. Dimensions: Altitude 9 mm.; diameter 13 mm.; altitude of spire 4 mm.; angle of spire 110°. (Weaver)

*Observations.* The holotype of this species is lost and no suitable material is available for the establishment of a neotype. It may be distinguished from the other species of *Tegula* in the Northwest and also from *Callostoma cammani* in having beaded spiral ornamentation on the upper surface of the body whorl and in its faint development on the whorls of the spire.

*Holotype.* (U.W. 69.) Lost. Not figured in the present report.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Eastern Grays Harbor County, Washington.

*Type locality.* (U.W. 160.) Bluff on north side of Chehalis River, in Northern Pacific railway cut, Grays Harbor County, Washington, Section 22, T. 17 N., R. 4 W.

**TEGULA (CHLOROSTOMA) LAHONDAENSIS (Arnold) var. STANTONI Dall, 1909**

Plate 62, figures 13, 15

*Tegula (Chlorostoma) stantoni* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 95, pl. 2, figs. 10, 11, 1909.

*Tegula* (? *Chlorostoma*) *lahondaensis* (Arnold) var. *stantoni* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 828, 829, 1931.

*Original description.* Shell thin, elevated, internally nacreous, with five or more whorls; nucleus decollate in the type specimen; surface of whorls finely axially striated by incremental lines; upper surface with three about equidistant spiral cords, the middle one a little more prominent than the others, the suture being laid just below the outer cord, which shows above the junction of the whorls like a narrow thread; base smooth for the most part, roundly convex, with a faint sulcus near the peripheral thread, and two or three flat spirals around the umbilical region; umbilicus imperforate, hardly depressed; pillar thin, arcuate, outer lip and base thin and simple, aperture obstructed by a hard matrix; upper surface of whorls slanting evenly from the suture. Altitude of decollate type, about 25 mm.; maximum diameter of base, 35 mm. (Dall)

*Observations.* Although in outward appearance and ornamentation *T. lahondaensis stantoni* somewhat resembles *Callostoma cammani* Dall, it may be distinguished from it by its relatively greater height and more convex base which, except at the inner and outer periphery, lacks spiral ornamentation. The variety *stantoni* differs from *T. lahondaensis* in having a relatively greater height and more pronounced spiral ornamentation.

*Holotype.* (U.S.N.M. 107777.) Figured in the present report, pl. 62, figs. 13, 15.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon, and Santa Cruz County, California.

*Type locality.* Coos Bay, Oregon (B. H. Camman collection).

Genus **MARGARITES** Leach, 1847

*Margarites* Leach ms, in Gray, Ann. Mag. Nat. Hist., vol. 20, p. 271, 1847.

*Genotype.* *Helix margarita* Montagu.

Subgenus **Lirularia** Dall, 1909

*Lirularia* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 98, 1909.

*Subgenotype.* *Margarita lirulata* Carpenter.

**MARGARITES (LIRULARIA) CONDONI** Dall, 1909

Plate 62, figures 17, 19

*Margarites (Lirularia) condoni* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 98, pl. 6, figs. 7, 8, 1909.

*Margarites (Lirularia) condoni* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 841, 1931.

*Original description.* Shell small, turbinate, with about five whorls; nucleus small, defective in the specimens; subsequent whorls narrowly subtabulate near the

suture, rounded above and below; axial sculpture of fine, not crowded threads, which cover most of the surface, being most conspicuous in the sulci, but to a greater or less extent modifying or nodulating the raised spiral sculpture also; on the last whorl between the suture and umbilicus the surface is sculptured with about ten strong spiral threads, of which the previous whorls show four or five; the thread in front of the suture is small and nodulous; the next one, forming the boundary of the tabulation, is stronger than any of those succeeding, except at the umbilicus, where the cords increase in size and are conspicuously nodulous; the umbilicus is little or not at all perforate, the specimens not being decisive on that point; aperture subcircular, outer lip simple, inner lip arcuate, thin; body with a marked callus which extends over the umbilical region and may, in a perfectly adult specimen, almost or entirely close the umbilical chink; base roundly convex. Altitude of larger specimen, 13.5 mm.; maximum diameter, 13 mm. (Dall)

*Observations.* This species which is relatively of about the same size as *M. pupillus* (Gould) of the Pliocene and Recent of the West Coast of North America has a less elevated body whorl. The arrangement, shape, and spacing of the spiral ribs resemble that of *M. lirulatus* (Carpenter) although this latter species averages smaller in size.

*Holotype.* (U.S.N.M. 153922.) Figured in the present report, pl. 62, figs. 17, 19.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Coos Bay, Oregon (B. H. Camman collection).

#### Genus **TURCICULA** Dall, 1881

*Turcicula* Dall, Bull. Mus. Comp. Zool., vol. 9, p. 42, 1881.

*Genotype.* *Margarita* (*Turcicula*) *imperialis* Dall.

#### **TURCICULA WASHINGTONIANA** Dall, 1909

Plate 63, figures 8, 14, 28

*Turcicula washingtoniana* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 99, 100, pl. 17, figs. 1, 2; pl. 18, fig. 4, 1909.

*Turcicula washingtoniana* Dall, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 141, pl. 15, figs. 1, 2, 3, 4, 5, 1933.

*Original description.* Shell large, depressed-conic, pearly, of five or more whorls; nucleus defective; later whorls with two more or less nodose spiral ridges, next to the anterior one of which the suture is laid; these are separated by nearly smooth, much wider interspaces; periphery vertically compressed, distally bluntly rounded; base with four or five obscure spirals, about equally spaced; umbilical region imperforate, with a thin wash of callus; aperture inaccessible; axial sculpture chiefly incremental, with some obsolete traces of narrow riblets near the posterior keel. Altitude of shell (decollate), 35 mm.; maximum diameter, 55 mm.; minor diameter, 46 mm. (Dall)

*Observations.* This species may be distinguished from *T. columbiana* Dall in being proportionately less high, in lacking the nodose ornamentation, and in having a more compressed aperture. It occurs in

the Blakeley formation, while *T. columbiana* is confined to the Keasey formation.

*Holotype.* (U.S.N.M. 110448.) Figured in the present report, pl. 63, fig. 14.

*Topotype.* (U.C. 32221.) Figured in the present report, pl. 63, fig. 8.

*Hypotype.* (S.U. 802.) Figured in the present report, pl. 63, fig. 28.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Puget Sound Basin and Thurston County, Washington.

*Type locality.* (U.W. 13.) At Restoration Point, Kitsap County, opposite Seattle, Washington.

#### TURCICULA COLUMBIANA Dall, 1909

Plate 63, figure 1; plate 101, figures 1, 2, 3

*Turcicula columbiana* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 100, pl. 3, figs. 2, 11, 1909.

*Original description.* Shell large, thin, depressed, pearly, of about five whorls; nucleus defective in the type; subsequent whorls with a rounded carinal ridge at the periphery which more or less overhangs the subsequent suture; surface between the suture and periphery with (on the penultimate whorl 15) oblique, axial ribs, which a little more than half-way from the suture rise into rather sharp nodules more or less distinctly connected by an obscure spiral ridge; beyond the nodules the ribs become faint and the whorl is somewhat constricted between them and the carinal ridge; other axial sculpture of rather prominent incremental lines; base with about six obscure spiral ridges with much wider interspaces, the inner three less prominent and closer together, leaving a smooth space in the umbilical region; here there is a smooth callus with the center depressed and the periphery thickened and slightly raised; pillar smooth, arcuate; outer and basal lips, in the type, thin, sharp, simple; a thin wash of callus on the body. Altitude of shell, 37 mm.; maximum diameter, 50 mm. (Dall)

*Observations.* This species may be distinguished from *T. washingtoniana* Dall in its more elevated spire, nodose ornamentation, and less compressed aperture. As pointed out by Dall, the former somewhat resembles the Pacific Coast Recent form *T. bairdi* but is shorter, larger, and has better developed ornamentation. This species is a characteristic form among the fauna of the Keasey formation in Oregon and Washington.

*Holotype.* (U.S.N.M. 107397.) Figured in the present report, pl. 63, fig. 1. Figured by Dall (101, pl. 3, fig. 2).

*Hypotype.* (U.W. 350) (C.A.S. 7780). Figured in the present report, pl. 101, figs. 1, 2, 3.

*Geologic range.* Keasey formation, lowermost Oligocene.

*Geographic distribution.* Columbia County, northwestern Oregon, and Pacific County, southwestern Washington.

*Type locality.* Rock Creek, Columbia County, Oregon.

**Genus SOLARIELLA S. Wood, 1842**

*Solariella* S. Wood, Ann. Mag. Nat. Hist., vol. 9, p. 531, 1842.

*Genotype.* *Solariella maculata* S. Wood.

**SOLARIELLA OLEQUAHENSIS Weaver and Palmer, 1922**

Plate 64, figures 6, 9

*Solariella olequahensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 27, 28, pl. 12, figs. 10, 12, 1922.

*Original description.* Shell small; whorls five angulated; aperture round; suture impressed, slightly channelled; body whorl sharply angulated at the base; between the angle of the whorl and the suture there are two revolving ribs on the penultimate whorl and three revolving ribs on the body whorl, below the angle of the whorl four revolving ribs occur, all cut by radiating striae which give the sculpture a nodose or beaded appearance; base of the body whorl has revolving ribs less pronounced than on the rest of the shell; umbilicus deep, moderately wide for the size of the shell, interior and margin beaded by radiating striae; where portions of the outer layer of shell material has been peeled off a nacreous inner layer is revealed. Dimensions: Cotypes measuring respectively: altitude 2.25 mm., 4 mm.; width of body whorl 4 mm., 5.25 mm. (Weaver and Palmer)

*Observations.* Specimens of this species are distinguished by sharp angulation of lower surface of body whorl, deep umbilicus, and only moderately strong spiral ornamentation on base of body whorl.

*Holotype.* (U.W. 185) (C.A.S. 7630). Figured in the present report, pl. 64, figs. 6, 9.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 326.) Bluff on west bank of Olequa Creek about 500 feet below the little falls back of the Armstrong place about one-half mile north of Vader, Lewis County, Section 29, T. 11 N., R. 2 W.

**SOLARIELLA CRESCENTENSIS Weaver and Palmer, 1922**

Plate 63, figure 27

*Solariella crescentensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 28, pl. 12, fig. 11, 1922.

*Original description.* Shell small, whorls four, rounded; suture impressed, slightly channelled; aperture round; surface of the whorls ornamented with prominent, revolving ribs crossed by radiating lines which dissect the revolving ridges into nodes or beads. This sculpture extends with equal prominence over the whole surface of the whorls and umbilical area. Dimensions: Altitude 4 mm.; width of body whorl 5 mm. (Weaver and Palmer)

*Observations.* This species is characterized by well-defined beaded revolving ribs on the basal surface of the body whorl, in contrast to their fainter development on *S. olequahensis*. The angulation of the whorls also is less marked.

*Holotype.* (U.W. 186) (C.A.S. 7631). Figured in the present report, pl. 63, fig. 27.

*Geologic range.* Crescent formation, middle Eocene.

*Geographic distribution.* Crescent Bay, north side of Olympic Peninsula.

*Type locality.* (U.W. 358.) In sea cliffs one-fourth mile east of Tongue Point, Port Crescent, Clallam County, Washington, Section 22, T. 31 N., R. 8 W.

#### **SOLARIELLA KINCAIDI Tegland, 1933**

Plate 63, figure 29

*Solariella kincaidi* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, no. 3, p. 141, pl. 15, fig. 8, 1933.

*Original description.* Shell turbinate, with nacreous inner layer; whorls rounded; outer layer of shell calcareous, ornamented with spiral and transverse ribbing giving a crosshatched appearance. The outer layer is almost completely removed from the surface of the shell, leaving inner nacreous layer exposed. Nacreous layer longitudinally ornamented with the same spiral ribbing which appears on the outside surface, but transversely with growth lines only. Dimensions: Altitude, 3 mm.; diameter, 3 mm. (Tegland)

*Observations.* This species may be distinguished from the other species of this genus occurring in the Tertiary of Oregon and Washington by its rounded and less angulated whorls and by its proportionately greater height. The spire of the type is broken, but fragments of specimens of the species from the same locality indicate that the spire consists of four whorls somewhat more flattened than the body whorl. The transverse ribbing is less well developed than the spiral.

*Holotype.* (U.C. 32260.) Figured in the present report, pl. 63, fig. 29.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Kitsap County, Puget Sound Basin, Washington.

*Type locality.* (U.W. 13.) In sandstone on north side of Restoration Point, opposite Seattle, Kitsap County, Washington, Section 12, T. 24 N., R. 2 E.

#### **Family NERITIDAE**

##### **Genus NERITA Linnaeus, 1758**

*Nerita* Linnaeus, Syst. Nat. (10th ed.), p. 776, 1758.

*Genotype.* *Nerita exuvia* Linnaeus.

##### **NERITA COWLITZENSIS Dickerson, 1915**

Plate 63, figure 11

*Nerita cowlitzensis* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pp. 58, 59, pl. 5, figs. 7a, 7b, 1915.

*Original description.* Shell very small with spire immersed; whorls three, rapidly increasing in size; surface of subglobose body-whorl divided into three portions by a strong spiral line at the shoulder and a second medial one; mouth semilunar;

outer lip thickened, dentate, callus heavy, closing umbilicus completely; beaded spiral threads crossed by axial ribs decorating shell. Dimensions: Length, 7 mm.; width of body-whorl, 8 mm. (Dickerson)

*Observations.* *N. cowlitzensis* resembles closely *N. triangulata oregonensis* but is characterized by a very heavy callus. The strong spiral line at the slightly angulated shoulder of the whorl is constant in different specimens and aids in distinguishing the species from *N. washingtoniana*.

*Holotype.* (C.A.S. 290.) Figured in the present report, pl. 63, fig. 11.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) On north bank of Cowlitz River near head and one and one-half miles east of the town of Vader, Section 28, T. 11 N., R. 2 W.

#### **NERITA WASHINGTONIANA** Weaver and Palmer, 1922

Plate 64, figure 8

*Nerita washingtoniana* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, pp. 28, 29, pl. 11, fig. 4, 1922.

*Original description.* Shell small, semi-globose; spire minute absorbed by the body whorl; body whorl rounded; aperture elliptical; outer and inner lip finely dentate; callus large; surface with microscopic, spiral lines covered by dark brown, spiral stripes. The original coloration of the bands is preserved in part and their contour suggests that they would apparently extend regularly over the surface of the body whorl without a zigzag or wavy pattern. Dimensions: Altitude 3 mm.; width of body whorl 3.75 mm. (Weaver and Palmer)

*Observations.* Specimens of this species are never more than two-thirds the size of *N. cowlitzensis*. The dentition of the inner and outer lips is less pronounced.

*Holotype.* (U.W. 187) (C.A.S. 7591). Figured in the present report, pl. 64, fig. 8.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz River Valley, Washington.

*Type locality.* (U.W. 329.) At bend in Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

#### **NERITA TRIANGULATA** Gabb var. **OREGONENSIS** Turner, 1938

Plate 64, figures 10, 13

*Nerita triangulata* Gabb var. *oregonensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 95, pl. 19, figs. 10, 11, 12, 1938.

*Observations.* This variety was never formally described by Turner. As pointed out by him, the variety *oregonensis* may be distinguished from *N. triangulata* Gabb of the La Jolla formation in being less sharply angulate and in having less well developed spiral ribs. The variety contains two small denticulations at the posterior end of the columella which also occur on *N. cowlitzensis* Dickerson from the Cowlitz formation but

it lacks the callus of the latter species. Measurements of the holotype: height, 9.0 mm.; diameter, 12.0 mm.

*Holotype.* (U.C. 33204.) Figured in the present report, pl. 64, figs. 10, 13.

*Geologic range.* Umpqua formation.

*Geographic distribution.* Southwest Oregon.

*Type locality.* North bank of Umpqua River near big riffle below bend at junction of Little River, Oregon.

#### Genus **NERITINA** Lamarck, 1816

*Neritina* Lamarck, Encycl. Meth., Vers, vol. 2, pl. 455, 1816.

*Genotype.* *Nerita pulligera* Linnaeus.

#### **NERITINA MARTINI** Dickerson, 1915

##### Plate 63, figure 10

*Neritina martini* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 59, pl. 5, figs. 8a, 8b, 1915.

*Original description.* Shell medium in size with two and a half whorls; spire immersed; body-whorl very wide, rounded to sub-quadrata, with flattened top which is perpendicular to axis of shell; outer lip sharp, smooth within, entire; callus large with straight interior edge which is slightly dentate; surface decorated by sinuous axial growth lines. This is the first representative of this genus reported from the West Coast Eocene. Dimensions: Length, 18 mm.; width of body-whorl, 21 mm. (Dickerson)

*Observations.* This species, the only one of the genus recognized in Oregon and Washington, is characterized by its well-developed callus, straight slightly dentate upper lip, and subangular upper surface of body whorl.

*Holotype.* (C.A.S. 291.) Figured in the present report, pl. 63, fig. 10.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) In north bank of Cowlitz River near bend and one and one-half miles east of the town of Vader, Section 28, T. 11 N., R. 2 W.

#### Family **TURBINIDAE**

#### Genus **ASTRAEA** ("Bolten") Roeding, 1798

*Astraea* Roeding, in Bolten, Mus. Boltenianum, pt. 2, p. 79, 1798.

*Genotype.* *Trochus imperialis* Gmelin.

#### Subgenus **Pachypoma** Gray, 1850

*Pachypoma* Gray, Figures of Molluscous Animals, vol. 4, p. 88, 1850.

*Subgenotype.* *Trochus inaequalis* Martyn.

**ASTRAEA (PACHYPOMA) INAEQUALIS (Martyn), 1784**

Plate 63, figures 2, 24

*Trochus inaequalis* Martyn, Universal Conchologist, vol. 1, pl. 31, table, 1784.  
*Astraea (Pachypoma) precursor* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 93, pl. 6, figs. 5, 6, 1909.  
*Astraea inaequalis* Martyn, Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, p. 594, 1913.  
*Astraea (Pachypoma) inaequalis* (Martyn), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 820, 821, pl. 31, figs. 4a, 4b, 10, 1931 (synonymy).

**Description** (*Astraea (Pachypoma) precursor*). Shell small for the group, solid, depressed, with about four or five whorls; apex decollated in the types; upper surface of the whorls flattish, with a deep sulcus near the periphery which is formed by a stout, rounded, slightly undulated cord having a wide, shallow sulcus on the basal side also; the suture is laid directly under this cord; upper surface of the whorls sculptured with about 30 stout oblique rounded ribs with subequal shallow interspaces, the ribs crossed close behind the suture by three or four obscure sulci, faintly nodulating them, the outermost sulcus is the deepest, and nearly cuts off the distal end of the ribs; the surface is also marked by well-defined incremental lines; base flattish, with five strong conspicuously nodulous cords with deep narrower interspaces; umbilical region callous, smooth, concave, with a peripheral ridge; columella arcuate, callous, pearly, with a thin layer of callus on the body, outer lip simple. Altitude, 25 mm.; maximum diameter, 3.5 mm. (Dall)

**Observations.** Grant and Gale have pointed out that the name *precursor* is preoccupied in the genus *Astraea*. Specimens of *A. inaequalis* (Martyn) from the Recent of western North America show much variation and many of the varieties off the coast of Vancouver Island cannot be distinguished from the forms described by Dall as *A. precursor*.

**Holotype.** (U.S.N.M. 153919.) Figured in the present report, pl. 63, figs. 2, 24.

**Geologic range.** Upper Miocene to Recent.

**Geographic distribution.** San Diego to Vancouver Island.

**Type locality** (Northwest species of *A. precursor* Dall). Empire formation at Coos Bay, Oregon (B. H. Camman collection).

**Genus HOMALOPOMA Carpenter, 1864**

*Homalopoma* Carpenter, Brit. Assoc. Adv. Sci., Rept. for 1863, p. 537, 1864.

**Genotype.** *Turbo sanguinea* Linnaeus.

**HOMALOPOMA PACIFICA (Anderson and Martin), 1914**

Plate 63, figures 16, 19

*Calliostoma pacificum* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 64, 65, pl. 8, figs. 2a, 2b, 1914.

*Calliostoma pacificum* Anderson and Martin, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 89, pl. 11, figs. 8, 12, 1931.

**Original description.** Shell conical, thick, with about five convex whorls; spire moderately high; whorls of the spire ornamented with ten almost equally prominent spiral threads separated by narrower interspaces; two of the spiral threads nearest

the posterior margin are centrally grooved; suture distinct, impressed; body-whorl slightly concave near the suture, convex over the central portion, sharply rounded at the base, sculptured the same as the whorls of the spire; the base ornamented with eighteen or twenty very fine spiral lines; aperture subcircular; outer lip smooth, columella thickened and incrusted. Dimensions: Altitude of the type specimen, 15 mm.; diameter of the last whorl, 14.5 mm. (Anderson and Martin)

*Observations.* This species is characterized by the presence of eighteen to twenty-five spiral lines on the base of the body whorl and usually ten equally spaced and developed spiral ribs on each of the whorls of the spire. It differs from *H. wattsi* in having a smaller apical angle and slightly more convex whorls.

*Hypotypes.* (U.C. 31982) (U.C. 31983). Figured in the present report, pl. 63, figs. 16, 19.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Oregon coast north of Yaquina Bay.

*Type locality.* (U.W. 691.) In stratified medium-grained sandstone exposed on ocean beach on south side of Yaquina Head, on coast of Oregon, Lincoln County, five and one-half miles north of the entrance to Yaquina Bay.

#### **HOMALOPOMA WATTSSI (Dickerson), 1916**

Plate 64, figures 11, 14

*Monodonta wattsi* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 494, pl. 40, figs. 3a, 3b, 1916.

*Homalopoma wattsi* (Dickerson), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 96, pl. 15, fig. 16, 1938.

*Original description.* Turbinate, with five convex whorls; the first two are smooth; the remaining whorls are decorated by slightly nodose spiral lines. A fairly well developed collar with spiral threads upon it is found on the body-whorl just below the linear suture. The threads upon this collar and upon the base are finer than those of the central portion of the whorls. Outer lip simple; inner lip thinly callused; a single tooth characteristic of the genus is found upon the columella. Dimensions: Length 6 mm.; width of body whorl, 7 mm. (Dickerson)

*Observations.* *H. wattsi* is distinguished by the first two smooth whorls of the spire and the collar with spiral threads on the extreme upper surface of the body whorl. There is present a small node in the middle and base of the inner lip. The outlines of the whorls are slightly less convex than in *H. pacifica*.

*Hypotype.* (U.C. 33212.) Figured in the present report, pl. 64, figs. 11, 14.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* Coast Ranges of southern California and southwestern Oregon.

*Locality in Oregon.* (U.C. A-836.) Bed of Middle Fork of Coquille River opposite Roseburg-Coos Bay Highway Survey station 845 + 33. (Turner)

**HOMALOPOMA UMPQUAENSIS** Merriam and Turner, 1937

Plate 64, figures 20, 21

*Homalopoma umpquaensis* Merriam and Turner, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 24, p. 104, pl. 6, fig. 6, 1937.  
*Homalopoma umpquaensis* Merriam and Turner, Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 95, 96, pl. 15, fig. 14, 1938.

*Original description.* Shell small, heavy, turbinate, ornamented by heavy spiral lines the seventh and eleventh of which are much stronger forming angulations at the center and lower margin of the body whorl, base of whorl with approximately six similar spiral threads, aperture entire, basal inner lip slightly flaring and bearing a small double node, umbilicus closed. Dimensions: Length, 7.3 mm.; diameter, 7.0 mm. (Merriam and Turner)

*Observations.* This species is characterized by heavy spiral ribbing, a tendency to angulation of the surface of the whorls, and a small double node on the base of the inner lip. *H. wattsi* has a small node on the center and also on the base of the inner lip.

*Holotype.* (U.C. 33207.) Figured in the present report, pl. 64, figs. 20, 21.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* (U.C. A-662.) East bank of Little River between highway bridge and the first bend of the stream east of the junction with North Umpqua River. Center of Section 19, T. 26 S., R. 3 W.

**HOMALOPOMA sp.** Effinger, 1938

*Homalopoma* sp. Effinger, Jour. Paleon., vol. 12, p. 374, 1938.

*Observations.* Effinger reports the presence of several broken specimens of the genus *Homalopoma* from the fauna of the Gries Ranch beds in Washington which have many characters in common with *H. wattsi* of the lower Umpqua formation in Oregon, but which differ in having a lower spire and coarser spiral ribs.

*Holotype.* (U.C. 33555.) Not figured in the present report.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley and possibly Port Discovery Bay, Olympic Peninsula.

*Type locality.* (U.W. 239.) In south bank of Cowlitz River at old Gries Ranch in the northeast quarter of Section 25, T. 11 N., R. 2 W.

**HOMALOPOMA VANCOUVERENSIS** (Clark and Arnold), 1923

Plate 63, figures 5, 12

*Leptothyra vancouverensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 173, pl. 37, figs. 3a, 3b, 1923.

*Original description.* Shell turbonate; height equal to width of body whorl; apex acute. Number of whorls five or six; base of body whorl flattened without sharp line of angulation between it and sides; sutures deeply depressed. Whorls

of spire sculptured by eight or nine fairly prominent flat-topped ribs, with inter-spaces averaging slightly less than width of ribs; seven spiral ribs and twelve or thirteen finer ribs on the base. Aperture subcircular, discontinuous; umbilical tract covered by thin callus wash. Dimensions: Height, 10 mm.; greatest width of body whorl, 10 mm. (Clark and Arnold)

*Observations.* This species is characterized by the rounded sub-angular junction of the basal surface of the body whorl with the middle third of the surface of the whorl, the flat-topped spiral ribs in the spire, and the strongly impressed sutures.

*Holotype.* (U.C. 30206.) Figured in the present report, pl. 63, figs. 5, 12.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* In basal sandstones of the Sooke formation exposed in sea cliffs between the mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

#### Genus CIRSOCHILUS Cossmann, 1888

*Cirsochilus* Cossmann, Cat. Illus. Coq. Eoc. Paris, pt. 3, p. 76, 1888.

*Genotype.* *Delphinula striata* Lamarck.

#### CIRSOCHILUS WASHINGTONIANUS Effinger, 1938

Plate 63, figures 15, 31

*Cirsochilus washingtonianus* Effinger, Jour. Paleon., vol. 12, p. 374, pl. 46, figs. 27, 28, 1938.

*Original description.* Shell small, turinate, spire low, number of whorls four, nuclear whorls flat consisting of about one and one-half volutions; body whorl comparatively large, tricarinate, suture linear, distinct, lying directly upon the middle carina of the preceding whorl; upper surface of body whorl flat, ornamented by eight distinct incised spiral lines which are separated by flat areas which are slightly wider toward the suture than those near the carina; surface between upper and medial carinae narrow, concave bearing three small rounded revolving ribs; surface between medial and lower carinae slightly less concave than that directly above and ornamented by three similar spiral ribs; lower surface of body whorl only moderately convex, broad, ornamented by eleven incised spiral striae which become more closely spaced progressively toward the outer margin; umbilicus narrow, deep; aperture rounded, incised, posterior margin protruding farther than anterior; outer lip thin, lower inner lip thick, parietal wall lacking a noticeable deposit of callus; longitudinal ornamentation consisting only of fine somewhat sinuous incremental lines. Dimensions: holotype: altitude, 2.2 mm.; maximum diameter, 3 mm. (Effinger)

*Observations.* This microscopic shell from the Gries Ranch beds is distinguished by the tricarinate body whorl with its nearly flat upper surface, ornamentation as defined in original description, and thick lower inner lip.

*Holotype.* (U.C. 33553.) Figured in the present report, pl. 63, figs. 15, 31.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) In south bank of Cowlitz River at old Gries Ranch in northeast quarter of Section 25, T. 11 N., R. 2 W.

## Genus LIOTIA Gray, 1847

*Liotia* Gray, Proc. Zool. Soc. London, pt. 15, p. 145, 1847.

*Genotype.* *Delphinula cancellata* Gray.

## LIOTIA WEAVERI Effinger, 1938

Plate 63, figures 13, 18

*Liotia weaveri* Effinger, Jour. Paleon., vol. 12, pp. 374, 375, pl. 46, figs. 15, 21, 1938.

*Original description.* Shell small, thin, planorboid, three and one-half to four whorls, increasing uniformly in size; upper surface flat, suture distinct; umbilicus broadly open, extending up to the nuclear whorls, columellar wall turreted; nuclear whorls about one and one-half, smooth; aperture holostomate, round, very slightly flaring, sub-hexagonal in outline, internally nacreous; ornamentation of body whorl consisting of six spiral ribs, two prominent ribs forming the upper and lower angulation of the whorl respectively, between which are two slightly less prominent ribs; two less conspicuous spiral ribs lie on the umbilical slope, one located medially on this surface and the other forming the umbilical margin; longitudinal ornamentation consisting of sixteen longitudinal ribs which are especially prominent on the peripheral portion of the whorl but which become obscure on the inner surface of the whorl; prominent rounded nodes formed at juncture of the longitudinal ribs and angulation; whorls also sculptured by numerous fine, slightly sinuous, regularly spaced longitudinal riblets which are more strongly developed in the peripheral region. Dimensions: holotype: altitude, 1.3 mm.; maximum diameter, 2.4 mm. (Effinger)

*Observations.* This very minute gastropod is fairly abundant in the microscopic marine fauna of certain strata in the Gries Ranch beds and is characterized by its planorboid form, broadly open umbilicus, subhexagonal cross-section of volutions, and ornamentation as designated in original description by Effinger.

*Holotype.* (U.C. 33556.) Figured in the present report, pl. 63, fig. 18.

*Hypotype.* (U.C. ?.) Figured in the present report, pl. 63, fig. 13.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) In south bank of Cowlitz River at old Gries Ranch in northeast quarter of Section 25, T. 11 N., R. 2 W.

## Family MELANELLIIDAE

## Genus MELANELLA Bowdich, 1822

*Melanella* Bowdich, Elements of Conchology, vol. 1, p. 27, 1822.*Genotype.* *Melanella dufresnii* Bowdich.

## MELANELLA CLARKI (Dickerson), 1917

## Plate 63, figure 6

*Eulima clarki* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 179, 180, pl. 31, fig. 8, 1917.*Melanella (Melanella) clarki* (Dickerson), Effinger, Jour. Paleon., vol. 12, p. 376, 1938.

*Original description.* Shell minute with nine whorls; first three whorls naticoid; others slightly convex with linear distinct suture and two obscure spiral threads on fourth and fifth whorls; aperture subquadrate; outer lip thin. Dimensions: Length, 4 mm.; width of body-whorl, 1 mm. (Dickerson)

*Observations.* Numerous specimens of this species from the Gries Ranch beds, as pointed out by Effinger, show great variation in relative height of spire, angulation and rounding of whorls, shape of canal and character of ornamentation. Effinger (p. 376) states "The typical form is slender, with slightly rounded whorls, and shows a slight angulation on the base of the body whorl below which may be several spiral ribs." He considered *Pyramidella? praecursor* Hanna = "*Eulima smithi*" Van Winkle as falling within the range of variation in *M. clarki*.

*Holotype.* (C.A.S. 433.) Figured in the present report, pl. 63, fig. 6.*Geologic range.* Gries Ranch beds, lower middle Oligocene.*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) In south bank of Cowlitz River at old Gries Ranch, Cowlitz County, Washington, northeast quarter of Section 25, T. 11 N., R. 2 W.

## MELANELLA sp. Effinger, 1938

*Melanella* sp. Effinger, Jour. Paleon., vol. 12, p. 376, 1938.

*Observations.* There occur in the collections made by Effinger and now deposited in the Paleontological Museum at the University of California several poorly preserved and broken specimens belonging to the genus *Melanella* which came from the Gries Ranch (lower middle Oligocene) beds in Washington. The following description has been presented by Effinger. "The shell is vitreous, straight spired and has about eight flat-sided whorls, the suture is linear and but slightly impressed. The shape and character of the whorls of the spire resemble *M. oldroydi* Bartsch (1), a recent Pacific coast species. Maximum dimensions: Altitude (incomplete), 4.6 mm.; diameter, 1.7 mm."

*Holotype.* (U.C. 33558.) Not figured in the present report.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) Southwest bank of Cowlitz River at old Gries ranch, Cowlitz County, Washington, northeast quarter of Section 25, T. 11 N., R. 2 W.

**MELANELLA DILLERI** (Anderson and Martin), 1914

Plate 63, figure 7

*Eulimella dilleri* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 67, pl. 7, fig. 24, 1914.

*Original description.* Shell small, elongated, turriculated, solid, with eight to ten whorls; apex acute, whorls smooth, flatly convex; body-whorl sharply rounded below into a convex base; suture impressed, distinct; aperture subrectangular; inner lip reflexed; columella straight, without plications. Dimensions: Altitude of the figured specimen, apex broken, 9.5 mm.; maximum width of the shell, 3.5 mm. (Anderson and Martin)

*Observations.* This species is characterized by its impressed suture lines, convex whorls, and slightly attenuate posterior part of body whorl. It is slenderer than *M. clarki*.

*Holotype.* (C.A.S. 140.) Figured in the present report, pl. 63, fig. 7.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Coast of Oregon immediately north of Yaquina Bay.

*Type locality.* Lincoln County, Oregon, in sea cliff one-fourth mile north of lighthouse at Cape Foulweather.

Genus **STROMBIFORMIS** Da Costa, 1778

*Strombiformis* Da Costa, Brit. Conch., p. 107, 1778.

*Genotype.* *Strombiformis glaber* Da Costa.

**STROMBIFORMIS WASHINGTONI** (Reagan), 1909

Plate 63, figure 26

*Eulima washingtoni* Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 223, pl. 6, fig. 60, 1909.

*Eulima smithi* Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 223, pl. 6, fig. 61, 1909.

*Strombiformis washingtoni* Reagan, Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 313, 1922.

*Strombiformis washingtoni* Reagan, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 864, 865, 1931.

*Original description.* Shell small, elongated, not curved to one side, thin; spire very acute; whorls six to ten; suture distinct, impressed, aperture elongate-ovate; outer lip thin, rather arcuate. Dimensions: Axial length of medium-sized specimen, 12 mm.; lat., 3 mm. (Reagan)

*Observations.* The rounded shoulders of the whorl of the form described by Reagan as *Eulima smithi* grade in many specimens into the form described as *E. washingtoni*. The two forms occur in the same strata and appear to be co-specific. This has been pointed out by Dall (101, p. 313) and also noted by Grant and Gale (149A, p. 865).

*Holotype.* (U.S.N.M. 328368.) Figured in the present report, pl. 63, fig. 26.

*Geologic range.* Quillayute formation, lower Pliocene.

*Geographic distribution.* Near mouth of Quillayute River on western side of Olympic Peninsula, Washington.

*Type locality.* (U.W. 111.) Mouth of Maxfield Creek, Clallam County, southwest quarter of northeast quarter of Section 28, T. 28 N., R. 14 W.

### Family PYRAMIDELLIDAE

#### Genus TURBONILLA Risso, 1826

*Turbanilla* Risso, Hist. Nat. Eur. Mer., vol. 4, p. 224, 1826.

*Genotype.* *Turbanilla typica* Dall and Bartsch.

#### Subgenus Pyrgolampros Sacco, 1892

*Pyrgolampros* Sacco, I Moll. del Piedmonte e della Liguria, p. 85, 1892.

*Subgenotype.* *Pyrgolampros mioperplicatus* Sacco.

#### TURBONILLA (PYRGOLAMPROS) ROCKENSIS Etherington, 1931

##### Plate 63, figure 17

*Turbanilla (Pyrgolampros) rockensis* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 90, pl. 13, fig. 12, 1931.

*Original description.* Shell moderately slender, medium sized, with about 7 whorls. Surface smooth except for faint axial ribbing. Suture distinct, whorls moderately rounded, body whorl less than one-fourth the height of the shell; aperture pyriform, posterior angle acute, outer lip thin, columella slightly twisted. Dimensions: Altitude, 8.1 mm.; maximum diameter, 2.4 mm.; altitude of spire, 4.6 mm. (Etherington)

*Observations.* This species which closely resembles the Recent species *T. oregonensis* Dall, as pointed out by Etherington, may be distinguished from it in the lack of faint radial ribbing. Dall and Bartsch (97) define this subgenus as "Turbanillas with low, broad, rounded vertical ribs, which almost always disappear as they pass over the periphery and base of the last whorl, and many fine faint, wavy spiral striations." The species was placed in the subgenus *Pyrgolampros* by Etherington on the basis of its faint axial ribbing and the character of the aperture.

*Holotype.* (U.C. 32037.) Figured in the present report, pl. 63, fig. 17.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, southwestern Washington.

*Type locality.* (U.W. 425.) Seam of fossils in the bed of Rock Creek about one-fourth mile down stream from the falls and just below the old dam site, Grays Harbor County, Section 7, T. 16 N., R. 5 W.

## Genus PYRAMIDELLA Lamarck, 1799

*Pyramidella* Lamarck, Soc. d'Hist. Nat. de Paris, p. 76, 1799.

*Genotype.* *Trochus dolabratus* Linnaeus.

## PYRAMIDELLA VADERENSIS Weaver and Palmer, 1922

Plate 64, figures 15, 16, 17

*Pyramidella (Syrnola) vaderensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, pp. 29, 30, pl. 11, figs. 16, 17, 1922.

*Original description.* Shell small, slender and thin with a maximum of ten whorls which have nearly flat surfaces; suture very distinct; surface smooth except for numerous, very faintly developed lines of growth; base of body whorl ornamented by six very narrow, moderately deep, revolving grooves which do not extend upon the upper surface of the whorl; aperture entire, semi-ovate and narrow posteriorly but broader and rounded anteriorly. The columella is characterized by having one fold; outer lip with two or three internal, spiral ribs. These do not appear to be present on the young shells. Dimensions.—Altitude 8 mm.; width of body whorl 2.25 mm.; apical angle 15°. (Weaver and Palmer)

*Observations.* This species, although close to the form described by Dickerson as *Odostomia packi*, differs in possessing a smaller number of whorls and one columella plait, and in the lack of strong spiral ribs on the body whorl. It comes from the same locality as the specimen figured but not described by Dickerson as *Odostomia* n. sp.

*Syntypes.* (U.W. 188, 188-A) (C.A.S. 7621, 7621-A). Figured in the present report, pl. 64, figs. 15, 16 = (U.W. 188); fig. 17 = (U.W. 188-A).

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 329.) In north bank of Cowlitz River 1½ miles east of Vader in Section 28, T. 11 N., R. 2 W.

## PYRAMIDELLA PRAECURSOR G. D. Hanna, 1924

Plate 64, figure 22

*Eulima smithi* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, p. 85, pl. 7, fig. 22, 1918.

*Pyramidella* (?) *praecursor* G. D. Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 13, p. 178, 179, 1924.

"*Pyramidella*" (?) *praecursor* G. D. Hanna, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 864, 1931.

*Original description.* Shell minute, conical in outline and smooth except for very faint lines of growth; whorls seven in number; spire about twice the length of the body whorl; suture distinct, linear and appressed; aperture oval; canal short, broad and twisted to the left; outer lip thin; inner lip slightly calloused and reflected. Dimensions: Altitude 3 mm.; altitude of spire 1.5 mm.; maximum diameter of shell 1 mm.; angle of spire 37°. (Van Winkle)

*Observations.* A specimen from the Pliocene Quillayute formation in the Olympic Peninsula was described by Reagan (247, p. 223) as *Eulima washingtoni*, which came from the same strata. Reagan presented his collection to the U. S. National Museum and the results of a

restudy of the fauna were published by Dall (111, p. 313) in 1922. The species *smithi* was placed in synonymy with *Strombiformis washingtoni*. In 1918 a specimen from the Gries Ranch beds was named *Eulima smithi* by Van Winkle (298, p. 85). This specimen was renamed as "*Pyramidella*" (?) *precursor* by G. D. Hanna (160, p. 178) in 1924.

*Holotype.* (U.W. 134) (C.A.S. 7620). Figured in the present report, pl. 64, fig. 22.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 330.) In south bank of Cowlitz River, 4 miles east of Vader, Washington, Section 25, T. 11 N., R. 2 W.

#### **PYRAMIDELLA (SYRNOLA) DILLERI (Anderson and Martin), 1914**

*Eulimella dilleri* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 67, pl. 7, fig. 24, 1914.

*Pyramidella dilleri* (Anderson and Martin), Bartsch, Proc. U.S. Nat. Mus., vol. 52, p. 640, 1917.

*Original description.* Shell small, elongated, turricated, solid, with eight to ten whorls; apex acute; whorls smooth, flatly convex; body-whorl sharply rounded below into a convex base; suture impressed, distinct; aperture subrectangular; inner lip reflexed; columella straight, without plications. (Anderson and Martin)

*Holotype.* (C.A.S. 140.) Not figured in the present report.

*Geologic range.* "Miocene." (Bartsch)

*Type locality.* "One-fourth mile north of lighthouse at Cape Foulweather, 4 miles north of Yaquina Bay, Oregon." (Bartsch)

#### **Genus ODOSTOMIA Fleming, 1817**

*Odostomia* Fleming, Edinburgh Encycl., vol. 7, pt. 1, p. 76, 1817.

*Genotype.* *Turbo plicatus* Montagu.

#### **ODOSTOMIA WINLOCKIANA Effinger, 1938**

Plate 64, figures 23, 24, 30

*Odostomia (Odostomia) winlockiana* Effinger, Jour. Paleon., vol. 12, p. 375, pl. 46, figs. 13, 17, 20, 1938.

*Original description.* Shell small, elongate-conic; whorls five with white polished surface; nuclear whorls small, heterostrophic and mounted at an angle of about 45 degrees to the main axis of coiling, deeply immersed; post-nuclear whorls gently convex, upper portion of each whorl somewhat appressed immediately below the suture; body whorl of slightly greater altitude than the spire, broadly and evenly rounded and slightly inflated; aperture sub-oval, outer lip thin, anterior portion slightly flaring; lower portion of the inner lip free giving the appearance of a slight umbilical fissure; columella with a single fold which is generally obsolete as seen from the unbroken aperture; ornamentation consisting of microscopic incremental lines only. Dimensions: Altitude 3.1 mm.; altitude of spire, 1.4 mm.; maximum diameter 1.3 mm.; apical angle 25 degrees. (Effinger)

*Observations.* *Odostomia winlockiana* has relatively lower whorls on the spire, strongly impressed sutures, elongate aperture, and slightly perforate umbilicus. The spire is more slender than the specimen figured by Effinger as *O. hiltoni* (138, pl. 47, figs. 4, 5). However, the specimen in the collection in the Paleontological Museum at the University of California labeled *O. hiltoni* with the Museum number (U.C. 33565), and figured in this report on pl. 64, fig. 29, is relatively shorter with a proportionately shorter spire than in the case of *O. winlockiana*.

*Holotype* (U.C. 33565.) Figured in the present report, pl. 64, figs. 24, 30.

*Paratype.* (U.C. 14882.) Figured in the present report, pl. 64, fig. 23.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 330.) In south bank of Cowlitz River, 4 miles east of Vader, Washington, Section 25, T. 11 N., R. 2 W.

#### ODOSTOMIA HILTONI (Van Winkle), 1918

Plate 64, figures 18, 19, 29

*Eulima hiltoni* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, pp. 85, 86, pl. 7, fig. 12, 1918.

*Odostomia (Evalea) hiltoni* (Van Winkle), Effinger, Jour. Paleon., vol. 12, p. 375, pl. 47, figs. 4, 5, 1938.

*Original description.* Shell minute, slender, thin, and elongate; smooth except for very faint lines of growth; whorls seven in number; suture distinct linear and very appressed; aperture semi-oval as observed in other specimens. Dimensions: Altitude of shell 4 mm.; altitude of spire 3 mm.; maximum diameter 1.5 mm.; angle of spire 25°. (Van Winkle)

*Supplementary description by Effinger.* Shell minute, somewhat fusiform, whorls five, smooth, vitreous, slightly convex, somewhat turreted by the deeply appressed suture. Body whorl generally a little more than half the total altitude of the shell. Aperture elongate, melanelliform, narrowing gradually to an acute angle above and abruptly rounded below; inner lip bearing a thin deposit of callus in the parietal region; columella with a distinct fold visible from the aperture. Nuclear whorls greatly tilted and deeply immersed in the spire, heterostrophic. Ornamentation consists of very faint incremental lines and microscopic spiral threads.

*Observations.* The type of this species is lost. The investigation of a large number of specimens of the species by Effinger has led him to believe that the original description was based upon a type in which the aperture was broken and that the part of the description based upon the aperture was from a specimen belonging to another genus. Effinger (138, pl. 47, figs. 4, 5) figures two specimens as *O. hiltoni* and designates them as two views of specimen (U.C. 33562). The specimen in the type collection of the Paleontological Museum of the University of California named *Odostomia hiltoni* and designated (U.C. 33562) is less slender than the figured specimen and has a relatively lower spire.

*Hypotype.* (U.C. 33562.) Figured in the present report, pl. 64, figs. 18, 19, 29.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 239.) In south bank of Cowlitz River at old Gries Ranch, Cowlitz County, Washington, northeast quarter of Section 25, T. 11 N., R. 2 W.

#### **ODOSTOMIA GRIESENSIS Effinger, 1938**

Plate 64, figures 26, 27, 28

*Odostomia griesensis* Effinger, Jour. Paleon., vol. 12, pp. 375, 376, pl. 46, figs. 23, 24, 25, 1938.

*Original description.* Shell small, heavy, somewhat rugose, imperforate, whorls five; spire high, narrow; nuclear whorls mounted at right angles to axis of spire; deeply immersed, unornamented; post nuclear whorls very slightly convex; suture linear, slightly appressed; body whorl moderately large, evenly convex; aperture sub-ovate; outer lip simple, anterior portion slightly elongate, alate; parietal portion of inner lip covered by a moderate deposit of callus; lower portion of inner lip slightly excavated; columellar plait small; ornamentation consisting of retractive lines of growth. Dimensions of holotype: altitude 3 mm.; altitude of spire 1.4 mm.; maximum diameter 1.2 mm. (Effinger)

*Observations.* This species is characterized by the slight convexity of the body whorl and the whorls of the spire, the slightly impressed suture, the imperforate umbilicus, and the excavated lower inner lip.

*Holotype.* (U.C. 33564.) Figured in the present report, pl. 64, fig. 28.

*Paratype.* (U.C. 14810.) Figured in the present report, pl. 64, figs. 26, 27.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 239.) In south bank of Cowlitz River at old Gries ranch, Cowlitz County, Washington, northeast quarter of Section 25, T. 11 N., R. 2 W.

#### **ODOSTOMIA (EVALEA) PLEIOREGONA Bartsch, 1917**

*Odostomia (Evalea) pleioregona* Bartsch, Proc. U.S. Nat. Mus., vol. 52, p. 666, pl. 42, fig. 5; pl. 45, fig. 6, 1917.

*Original description.* Shell broadly conic, white. Nuclear whorls deeply immersed in the first of the succeeding turns, above which the tilted edge of the last volution only projects. Postnuclear whorls flattened, appressed at the summit. All of them marked by very fine, closely spaced, spiral striations and decidedly retractively slanting, fine incremental lines. Suture moderately impressed. Periphery of the last whorl inflated, obtusely angulated. Base short, well rounded. Aperture large, slightly effused anteriorly; posterior angle acute; outer lip thin; inner lip oblique, slightly revolute and appressed to the base for its posterior half and provided with a strong, oblique fold at its insertion; parietal wall covered with a thick callus. (Bartsch)

*Holotype.* (U.S.N.M. 252430.) Not figured in the present report.

*Geologic range.* "Elk River beds, upper Pliocene." (Bartsch)

*Type locality.* "At mouth of Elk River, near Port Orford, Oregon." (Bartsch)

**ODOSTOMIA (EVALEA) ORFORDENSIS** Bartsch, 1917

*Odostomia (Evalea) orfordensis* Bartsch, Proc. U.S. Nat. Mus., vol. 52, p. 667, pl. 43, fig. 2, 1917.

*Original description.* Shell small, oval. Nuclear whorls decollated. Post-nuclear whorls at the summit, well rounded, marked by slightly reformatively slanting, incremental lines and exceedingly fine spiral striations. Suture moderately constricted. Periphery of the last whorl well rounded. Base moderately long, well rounded. Aperture oval; posterior angle acute; inner lip curved and appressed to the base; parietal wall covered with a thick callus. (Bartsch)

*Holotype.* (U.S.N.M. 252431.) Not figured in the present report.

*Geologic range.* "Elk River beds, upper Pliocene." (Bartsch)

*Type locality.* "Mouth of Elk River, near Port Orford, Oregon." (Bartsch)

**Genus MATHILDA Semper, 1865**

*Mathilda* Semper, Jour. Conch., vol. 13, p. 330, 1865.

*Genotype.* *Turbo quaricarinatus* Brocchi.

**MATHILDA UMPQUAENSIS Turner, 1938**

Plate 64, figures 34, 35

*Mathilda umpquaensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 81, pl. 21, fig. 2, 1938.

*Original description.* Shell small, slender; suture impressed; whorls convex, six in number; spire whorls ornamented by six prominent spiral ribs; body whorl with twelve revolving ribs and faint traces of axial markings; aperture elongate, terminating at the anterior end in a rounded "V," without canal. Dimensions: Length 21.2 mm.; diameter 7.6 mm. (Turner)

*Observations.* The species of the genus *Mathilda* differ from those of *Turritella* in having a dextral nucleus and in being coiled at about 90° to the axis of the spire.

*Holotype.* (U.C. 33218.) Figured in the present report, pl. 64, figs. 34, 35.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* (U.C. A-691.) Five hundred to six hundred feet downstream from Hughes Ferry, on north bank of North Umpqua River west of Glide. (Turner)

## Family EPITONIIDAE

Genus EPITONIUM ("Bolten") Roeding, 1798

*Epitonium* Roeding, in Bolten, Mus. Boltenianum, pt. 2, p. 91, 1798.

*Genotype*. *Epitonium pretiosum* (Lamarck) = (*Scalaria pretiosa* Lamarck  
= *Turbo scalaris* Linnaeus).

Subgenus **Gyroscala** de Bouri, 1877

*Gyroscala* de Bouri, Etude sous-genres Scalidae, p. 15, 1887.

*Subgenotype*. *Epitonium commutatum* (Monts.).

**EPITONIUM (GYROSCALA) EFFINGERI** Durham, 1937

Plate 64, figures 25, 33

*Epitonium (Gyroscala) effingeri* Durham, Jour. Paleon., vol. 11, p. 485, pl. 56,  
fig. 25, 1937.

*Original description*. Shell small, thin, slightly corroded, four convex whorls (incomplete); sutures broad, moderately deep; ornamented by 10 thin, knife-like varices continuous over all whorls; no extra callus deposited over base of preceding whorl at suture; basal keel slightly visible; no spiral sculpture apparent except for well-marked basal keel over which varices continue to aperture; aperture ovate. Diameter of holotype: 6.1 mm.; height, 10.3 mm.; four whorls. (Durham)

*Observations*. This small shell is characterized by its prominent basal keel over which the varices continue and by the lack of spiral ribs. It is the only representative of the subgenus *Gyroscala* in the Tertiary formations of Oregon and Washington.

*Holotype*. (U.C. 30146.) Figured in the present report, pl. 64, figs. 25, 33.

*Geologic range*. Gries Ranch beds, lower middle Oligocene.

*Geographic distribution*. Lower Cowlitz Valley, Washington.

*Type locality*. (U.W. 239.) In south bank of Cowlitz River, Cowlitz County, Washington, Section 25, T. 11 N., R. 2 W.

Subgenus **Clathrus** Oken, 1815

*Clathrus* Oken, Lehrb. Zoologie, p. 256, 1815.

*Subgenotype*. *Epitonium communis* (Lamarck) = (*Turbo clathrus* Linnaeus).

**EPITONIUM (CLATHRUS) WEAVERI** Durham, 1937

Plate 65, figure 1

*Epitonium (Clathrus) weaveri* Durham, Jour. Paleon., vol. 11, p. 487, pl. 56,  
fig. 6, 1937.

*Original description*. Shell moderately large, rather thin; both the apex and body whorl broken off in type, leaving four incomplete whorls semicircular in outline; sutures rather deep; ornamented by six highly prominent knife-like

varices strongly reflexed posteriorly; varices lapping about one-third height of preceding whorl onto the varices of that whorl, forming a continuous varix over all the whorls; no spiral ornamentation present. Diameter of holotype, 20.8 mm.; height, 39.7 mm.; whorls (incomplete), 4. (Durham)

*Observations.* This species is characterized by large well-developed varices which continue from whorl to whorl over the spire.

*Holotype.* (C.A.S. 7002.) Figured in the present report, pl. 65, fig. 1.

*Geologic range.* Keasey formation, lowermost Oligocene.

*Geographic distribution.* Willapa Valley, Pacific County, Washington.

*Type locality.* (U.W. 513.) In bank of Willapa River 1000 feet east of Holcomb, Pacific County, Washington, in southwest corner of Section 31, T. 13 N., R. 7 W.

#### Subgenus *Cirsotrema* Mörch, 1852

*Cirsotrema* Mörch, Cat. Conch. Yoldi, p. 49, 1852.

*Subgenotype.* *Epitonium varicosum* (Lamarck).

#### EPITONIUM (CIRSTREMA) CLALLAMENSE Durham, 1937

Plate 65, figure 2; plate 67, figures 26, 27

*Epitonium (Cirsotrema) clallamense* Durham, Jour. Paleon., vol. 11, p. 491, pl. 56, figs. 27, 28, 1937.

*Original description.* Shell moderately large to large in size; rather heavy; about 9 well-rounded whorls; sutures deep; ornamented by 8 to 10 heavy varices with a prominent angulation just below the suture; interspaces approximately one and one-half times as wide as varices; 3 low, broad spiral ribs on the central portion of the whorl, above these there are 2 or 3 indistinct spirals; the three more prominent spirals can be seen on the outer surface of the varices on well-preserved specimens; character of the aperture indeterminate. Diameter of holotype, 15.5 mm.; height, 26.8 mm.; whorls (incomplete), 3. (Durham)

*Observations.* This species closely resembles *E. saundersi* but is distinguished by a smaller number of more strongly developed varices.

*Holotype.* (C.A.S. 7003.) Figured in the present report, pl. 65, fig. 2.

*Paratype.* (U.C. 30170.) Figured in the present report, pl. 67, figs. 26, 27.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Southern side of Vancouver Island, northern side of Olympic Peninsula, and Grays Harbor area.

*Type locality* (C.A.S. 210.) East end of Clallam Bay, Washington.

**EPITONIUM (CIRSOTREMA) SAUNDERSI Tegland, 1933**

Plate 64, figures 31, 32; plate 65, figures 3, 4, 5, 6, 7, 10

*Epitonium (Arctoscala) saundersi* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 133, pl. 13, figs. 7, 8, 9, 1933.  
*Epitonium (Cirsotrema) saundersi* Tegland, Durham, Jour. Paleon., vol. 11, pp. 491, 492, pl. 57, fig. 21, 1937.

*Original description.* Shell of medium height, whorls rounded, closely adherent, greatest diameter at about middle of whorl; number of whorls unknown, probably about eight; surface ornamented with fifteen continuous blade-like varices, strongly reflexed; spiral sculpture consisting of three low, wide adjacent ribs on region of greatest convexity, subordinate to varices; body whorl rounded, with decided basal keel, varices extending to aperture; aperture rounded; outer lip decidedly reflexed; inner lip with callus of same width as outer lip on lower portion; no umbilicus. Dimensions of holotype: height, 28.7 mm.; diameter, 11.8 mm. (Tegland)

*Observations.* As pointed out by Durham, the number of varices differs on different specimens, and on the holotype there are three low broad spirals in addition to the three described, two below the section and one above. Some of the varices are slightly reflexed from the younger whorls onto the older.

*Holotype.* (U.C. 32227.) Figured in the present report, pl. 64, figs. 31, 32; pl. 65, figs. 3, 4.

*Paratype.* (U.C. 32226.) Figured in the present report, pl. 65, figs. 5, 10.

*Hypotype.* (U.C. 30173.) Figured in the present report, pl. 65, figs. 6, 7.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Central part of Puget Sound area.

*Type locality.* (U.W. 13.) Restoration Point opposite Seattle, Washington.

**EPITONIUM (CIRSOTREMA) HOWEI Durham, 1937**

Plate 65, figure 8

*Epitonium (Cirsotrema) howei* Durham, Jour. Paleon., vol. 11, p. 492, pl. 56, fig. 8, 1937.

*Original description.* Shell of moderate size, fairly heavy, having about seven whorls (incomplete); whorls well rounded; sutures deep; ornamented by nine prominent varices strongly reflexed posteriorly, bending slightly back as they leave the suture and then straightening out to form slight coronating points just below the suture; interspaces nearly three times as wide as base of varices; on median half of whorl there are about four low, heavy threads twice as broad as their interspaces; areas above and below the four spirals apparently obsolete of spiral ornamentation; between the lowest two spirals there is usually a fine secondary rib, faint expressions of the spiral ribs show on the outer surface of the varices; "basal keel" very prominent; aperture slightly ovate. Diameter of holotype, 10.8 mm.; height, 21.4 mm.; whorls (incomplete), 4. (Durham)

*Observations.* This relatively small species with strongly rounded whorls, deeply impressed sutures, and prominent posteriorly reflexed varices is distinct from other Pliocene forms.

*Holotype.* (C.A.S. 7004.) Figured in the present report, pl. 65, fig. 8.

*Geologic range.* Empire formation, lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* (C.A.S. 12.) Coos Bay, Oregon.

Subgenus **Boreoscala** Kobelt, 1902

*Boreoscala* Kobelt, Icon. der Schalentragenden Europäischen Meeresconchyliden, p. 23, 1902.

*Subgenotype.* *Epitonium greenlandicum* (Perry).

**EPITONIUM (BOREOSCALA) EARLTURNERI** Durham, 1937

Plate 65, figures 9, 15

*Epitonium (Boreoscala) earlturneri* Durham, Jour. Paleon., vol. 11, p. 493, pl. 56, fig. 9, 1937.

*Original description.* Holotype (incomplete), large, moderately heavy; approximately two well-rounded whorls, including body whorl, remain; sutures rather deep; ornamented by 14-16 very prominent, rather close set varices that are strongly reflexed posteriorly so that in a cross-section profile they are hook-shaped; at the suture varices are reflexed against those of preceding whorl; spirally ornamented by about 14 prominent rounded threads slightly narrower than corresponding interspaces; for a slight distance below suture, in addition, there are several very fine spiral threads; in interspaces between the larger spirals there are three secondary spiral threads of much finer size; near base of the well-rounded body whorl there is a moderately heavy spiral marking the slight angulation of the basal disk; aperture broadly elliptical. Diameter of holotype, 22 mm.; height, 31 mm.; whorls, 2. (Durham)

*Observations.* This is a fairly large shell but the type is a broken specimen. It somewhat resembles *E. coosense* Durham but has 14 to 16 heavy varices in contrast to 9 or 10 in the latter species. This spiral ribbing is also somewhat coarser in the latter but the different development may be the result of weathering.

*Holotype.* (U.C. 30154.) Figured in the present report, pl. 65, figs. 9, 15.

*Geologic range.* Lower Coaledo formation, upper Eocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* (U.C. A-715.) Silty sandstones east of lighthouse reefs on north shore of reservation. (Turner)

**EPITONIUM (BOREOSCALA) INSECURITUM** Hanna, 1924

Plate 65, figure 11; plate 67, figures 10, 11

*Epitonium (Boreoscala) washingtonensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 30, pl. 11, fig. 19, 1922.

*Epitonium insecuritum* Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 13, p. 165 (new name), 1924.

Not *Epitonium washingtonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 43, pl. 4, figs. 46, 47, 1916.

*Epitonium (Boreoscala) insecuritum* Hanna, Durham, Jour. Paleon., vol. 11, p. 493, pl. 56, fig. 19, 1937.

*Original description.* Shell large, elongate and thick; whorls eight or nine, convex, bulbous in shape; suture distinct; surface ornamented by about 10 rounded, slightly elevated, revolving ribs with numerous finer, intervening striae; the revolving ribs are crossed by ten very strong varices which extend over all the whorls, the varix of each lower whorl overlapping at the suture, the corresponding varix of the succeeding whorl; every other varix thickened; all are striate longitudinally; interspaces about two or three times the width of the varices; the basal, spiral rib slightly angulates the body whorl; aperture subovate, margin stoutly thickened. Dimensions.—Altitude 35 mm.; width of body whorl 17 mm.; apical angle 30°. (Weaver and Palmer)

*Observations.* The holotype of this species is lost. A plastotype of the holotype (U.C. 32367) is in the collection of the Paleontological Museum of the University of California. Examination of numerous topotypes shows only eight major spiral ribs with interspaces two and one-half times as wide.

*Holotype.* (U.W. 189) (C.A.S. 557). Lost.

*Plastoholotype.* (U.C. 32367.) Figured in the present report, pl. 65, fig. 11.

*Hypotype.* (U.C. 12501.) Figured in the present report, pl. 67, figs. 10, 11.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 319.) At McClarity Ranch on south bank of Stillwater Creek, 1 mile west of Vader, Lewis County, Section 30, T. 11 N., R. 2 W.

#### EPITONIUM (BOREOSCALA) CONDONI Dall, 1909

Plate 65, figures 12, 13, 16, 17

*Epitonium (Arctoscala) condoni* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 53, pl. 3, figs. 1, 12, 1909.

*Epitonium (Boreoscala) condoni* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 856, 1931.

*Epitonium (Boreoscala) condoni* (Dall), Durham, Jour. Paleon., vol. 11, p. 494, pl. 57, fig. 4, 1937 (see synonymy); Effinger, Jour. Paleon., vol. 12, p. 376, 1938.

*Original description.* Shell large, strong, elongated with about 15 varices to the whorl, crossed by 10 or more little-elevated sharp narrow spirals, with wider interspaces occupied by faint spiral striae; whorls eight or more, rather inflated, closely adherent, with their greatest diameter somewhat in front of the middle of the whorl; no umbilicus; varices similar, usually equidistant, striate or rugose axially and continuous with those of the preceding whorl; the angle at the front of the junction with the preceding whorl filled with a callous deposit; the interspaces are about twice as wide as the varices, the spiral sculpture sharp but not conspicuous, being more crowded toward the suture, especially in front of it; in well-preserved specimens they seem to crenulate the edges of the varices; aperture somewhat higher than wide; base (so far as observed) without any disk or bounding keel. Length of eight whorls, 73 mm.; maximum diameter, 22 mm.; diameter at truncated apex, 4 mm.; altitude of figured specimens, 32 and 70 mm. (Dall)

*Supplementary notations.* The two widely separated variants of this species were originally described by Dall as distinct and assigned to two different subgenera. After examination of considerable material I believe that they are members

of a single highly plastic species for the following reasons: (1) whenever more than one or two specimens are collected from a locality both kinds are present; (2) both have the same number of primary spiral ribs; (3) there are numerous specimens with intermediate characters; (4) each variant with the shape of *oregonense* can be duplicated, if one disregards the callus, in the *condoni*; (5) the amount of callus in the suture varies from less than in the typical *condoni* to more than in the typical *oregonense*; and (6) as far as can be determined, the characters vary independently of one another.

The species as now defined, has the following variations: number of varices on *condoni*, 10 to 15, on *oregonense* 12 to 21; apical angle 16 to 34 degrees, with 24 as average; whorls moderately convex to nearly flat; almost none to over half of each whorl covered by callus deposited in and above the sutures by the varices. On *condoni* (s.s.) the spiral ribs are as follows: five prominent primary ribs on the main part of the whorl; above these there are three or four more closely crowded and less prominent primaries below the suture, the lowest of these being occasionally as prominent as the lower five primaries; on well-preserved specimens successively finer secondary and tertiary ribs can be seen. The first five primary spirals usually produce nodes at their intersection with the varices. On typical *oregonense*, the callus of the suture may cover three of the five prominent primaries of the last whorl. The basal keel is moderately prominent and below it there are 12 to 15 closely spaced spirals. The aperture is ovate and the auricle is moderately prominent. Diameter of holotype (U.C. no. 30156), 15.2 mm.; height, 49 mm.; whorls (nuclear missing), 8. (Durham, 137, p. 494)

*Holotype*. (*E. condoni*). (U.S.N.M. 135122.) Figured in the present report, pl. 65, fig. 16.

*Hypotype*. (U.C. 30156.) Figured in the present report, pl. 65, figs. 12, 13.

*Hypotype*. (C.A.S. 409.) Figured in the present report, pl. 65, fig. 17.

*Geologic range*. Eugene formation, middle Oligocene.

*Geographic distribution*. Willamette Valley and Columbia County, Oregon; Oak Bay and Scow Bay in northeast portion of Olympic Peninsula, Washington.

*Type locality*. Near Eugene, Oregon. (Dall)

#### **EPITONIUM (BOREOSCALA) CONDONI Dall var. EUGENENSE Durham, 1937**

Plate 65, figures 14, 20; plate 66, figures 1, 2

*Epitonium (Boreoscala) condoni* (Dall) var. *eugenense* Durham, Jour. Paleon., vol. 11, pp. 494, 495, pl. 57, fig. 1, 1937.

*Original description*. Varices 20 to 21; whorls only slightly convex; callus covering about two-fifths of the whorl; spirals apparently nearly obsolete (absent on the type, which is slightly corroded); spire high. Diameter of holotype, 16.0 mm.; height, 44.5 mm.; whorls (incomplete), 4.3. (Durham)

*Observations*. This variety closely resembles *E. condoni* var. *hadlockense* Durham but may be distinguished from it in having 20 instead of 16 varices and in that the callus covers about two-fifths of the whorl rather than one-half as in the latter variety.

*Holotype*. (C.A.S. 7006.) Figured in the present report, pl. 65, figs. 14, 20.

*Paratype*. (C.A.S. 7006-A.) Figured in the present report, pl. 66, figs. 1, 2.

*Geologic range*. Eugene formation, middle Oligocene.

*Geographic distribution*. Near Eugene, Oregon.

*Type locality*. (C.A.S. 239.) Near Eugene, Oregon. (Durham)

**EPITONIUM (BOREOSCALA) CONDONI Dall var. HADLOCKENSE Durham, 1937**

Plate 66, figure 3

*Epitonium (Boreoscala) condoni* (Dall) var. *hadlockense* Durham, Jour. Paleon., vol. 11, p. 495, pl. 57, fig. 9, 1937.

*Original description.* About 16 varices, whorls only slightly convex; callus very heavy, covering over half of the whorl; varices with a slight posterior curve as they leave the suture. Diameter of holotype, 13.3 mm.; height, 27.4 mm.; whorls (incomplete), 3.5 (Durham)

*Observations.* The holotype of this species is broken. The varices are fewer than in the variety *eugenense* and the callus covers a somewhat larger area of the whorl.

*Holotype.* (U.C. 30162.) Figured in the present report, pl. 66, fig. 3.

*Geologic range.* Lower middle Oligocene.

*Geographic distribution.* Port Hadlock, Washington.

*Type locality.* (U.C. A-1825.) Near Port Hadlock on shore of Port Townsend Bay, Washington.

**EPITONIUM (BOREOSCALA) CONDONI Dall var. OREGONENSE Dall, 1909**

Plate 65, figures 18, 19; plate 66, figure 4

*Epitonium (Catenoscala) oregonense* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 54, pl. 3, fig. 3, 1909.

*Epitonium oregonense* Dall, Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, pp. 11, 14, 15, 1928.

*Epitonium (Boreoscala) condoni* (Dall) var. *oregonense* Dall, Durham, Jour. Paleon., vol. 11, p. 495, pl. 57, fig. 5, 1937.

*Original description.* Shell resembling *E. condoni*, but differing by its nearly flat *Terebra*-like whorls with two more varices to the whorl, and by a band of callus extending from the suture over the preceding whorl and its varices to the periphery of the whorl, covering about half the exposed portion of the whorl and on the earlier whorls even more than half; the younger whorls show little or no spiral sculpture and it is quite faint on the later whorls of the adult where the edges of the varices seem to exhibit little or no crenation. Length of two whorls, 20 mm.; least diameter of the upper whorl (of the two), 12 mm.; greatest diameter of the second whorl, 15.5 mm. Altitude of figured specimen, 32 mm. (Dall)

*Supplementary description.* Distinguished by having the callus covering three of the five lower primary spiral ribs, giving the whorls a flat appearance; varices continue straight anteriorly from the band of callus at the suture. (Durham)

*Holotype.* (U.S.N.M. 135123.) Figured in the present report, pl. 65, fig. 18.

*Hypotype.* (U.C. 33493.) Figured in the present report, pl. 65, fig. 19.

*Hypotype.* (S.U. 5966.) Figured in the present report, pl. 66, fig. 4.

*Geologic range.* Eugene formation, middle Oligocene, and Gries Ranch beds, lower middle Oligocene of Washington.

*Geographic distribution.* Eugene, Oregon, and lower Cowlitz River Valley, Washington.

*Type locality.* Near Eugene, Oregon. (Dall)

**EPITONIUM (BOREOSCALA) CONDONI Dall var. QUIMPERENSE Durham, 1937**

Plate 66, figures 5, 14

*Epitonium (Boreoscala) condoni* (Dall) var. *quimperense* Durham, Jour. Paleon., vol. 11, p. 495, pl. 57, fig. 2, 1937.

*Original description.* Resembles the typical form, but varices make a sharp posterior curve upon leaving the suture, straightening out on upper third of whorl and continuing straight anteriorly from there; whorls well rounded; suture rather deep beneath callus which is moderately heavy. Diameter of holotype, 17.6 mm.; height, 47.5 mm.; whorls (incomplete), 6.5. (Durham)

*Observations.* The shell of this variety is rather heavy and resembles *E. condoni* var. *woodmanense* Durham from which it differs in having a lesser curvature of the varices immediately beneath the sutures, in a larger number of varices, and in having a somewhat more widely distributed callus.

*Holotype.* (U.C. 30158.) Figured in the present report, pl. 66, figs. 5, 14.

*Geologic range.* Gries Ranch beds and Woodman's Wharf beds, lower middle Oligocene.

*Geographic distribution.* Scow Bay on northeast corner of Olympic Peninsula and lower Cowlitz Valley, Washington.

*Type locality.* (U.C. A-1603.) Woodman's Wharf, Scow Bay, Washington.

**EPITONIUM (BOREOSCALA) CONDONI Dall var. TOWNSENDENSE Durham, 1937**

Plate 66, figures 9, 10

*Epitonium (Boreoscala) condoni* (Dall) var. *townsendense* Durham, Jour. Paleon., vol. 11, p. 495, pl. 57, fig. 11, 1937.

*Original description.* Varices very prominent, slightly reflexed posteriorly; spiral ornamentation heavy, producing prominent nodes or varices; basal keel more prominent than on typical form. Diameter of holotype, 13.3 mm.; height, 32.2 mm.; whorls (incomplete), 6.5. (Durham)

*Observations.* This variety may be distinguished from the other varieties of the species *condoni* in the rather strong spiral ribbing and the prominent serrations or nodes where these ribs intersect the varices. The whorls are strikingly convex and the callus is inconspicuous.

*Holotype.* (U.C. 30135.) Figured in the present report, pl. 66, figs. 9, 10.

*Geologic range.* Gries Ranch beds and Woodman's Wharf beds, lower middle Oligocene.

*Geographic distribution.* Scow Bay, Olympic Peninsula, and lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.C. A-10.) Woodman's Wharf, Scow Bay, Washington.

**EPITONIUM (BOREOSCALA) CONDONI** Dall var. **WOODMANENSE** Durham, 1937

Plate 66, figures 7, 8

*Epitonium (Boreoscala) condoni* (Dall) var. *woodmanense* Durham, Jour. Paleon., vol. 11, pp. 495, 496, pl. 57, fig. 8, 1937.

*Original description.* Varices 12 to 14; callus thin or thick, covering about one-third of the whorl; whorls only slightly convex; spire short; angle of spire 34 degrees.

*Observations.* This variety, which somewhat resembles *E. condoni quimperense* Durham, may be distinguished from it by having fewer but sharper varices which curve only very slightly posteriorly just beneath the suture.

*Holotype.* (U.C. 30157.) Figured in the present report, pl. 66, figs. 7, 8.

*Geologic range.* Gries Ranch beds and Woodman's Wharf beds, lower middle Oligocene.

*Geographic distribution.* Scow Bay, Olympic Peninsula, and Gries Ranch beds, southwestern Washington.

*Type locality.* (U.C. A-1802.) Woodman's Wharf, Scow Bay, Washington.

**EPITONIUM (BOREOSCALA) CONDONI** Dall subsp. **JANEROBERTSAE** Durham, 1937

Plate 66, figures 6, 15

*Epitonium (Boreoscala) condoni* (Dall) subsp. *janerobertsae* Durham, Jour. Paleon., vol. 11, p. 497, pl. 57, figs. 6, 10, 1937.

*Original description.* Shell with six or more only slightly convex whorls, ornamented by 8 to 11 low, broad varices, usually about twice as wide as high but occasionally much wider; sutures possibly moderately deep, but completely filled with callus material deposited by the varices, which covers one-half or more of the preceding whorl, completely filling interspaces; basal keel on body whorl nearly obsolete; above keel are five low, almost obsolete primary spiral ribs, above which are faint indications of less prominent primaries; spiral ribs indiscernible on whorls of spire; aperture ovate. Diameter of holotype, 20.2 mm.; height, 56.5 mm.; whorls (incomplete), 6.5. Diameter of paratype, 11.4 mm.; height, 34.8 mm.; whorls (incomplete), 6. (Durham)

*Observations.* Durham has found this species to be present in strata somewhat stratigraphically higher than those containing the varieties *oregonense*, *woodmanense*, and *quimperense*. It closely resembles *E. condoni oregonense*.

*Holotype.* (U.C. 30160.) Figured in the present report, pl. 66, figs. 6, 15.

*Geologic range.* Lower Oligocene.

*Geographic distribution.* Oak Bay, northeastern corner of Olympic Peninsula, Washington.

*Type locality.* (U.C. A-1824.) Oak Bay, Washington.

**EPITONIUM (BOREOSCALA) CONDONI** Dall subsp. **REFULLERI** Durham, 1937

Plate 66, figure 11

*Epitonium (Boreoscala) condoni* (Dall) subsp. *refulleri* Durham, Jour. Paleon., vol. 11, p. 497, pl. 57, fig. 3, 1937.

*Original description.* Distinguished by very straight-sided whorls, shallow sutures, with little callus in sutures; varices not prominent; spiral ribs almost obsolete. Diameter of holotype, 16.3 mm.; height, 41.1 mm., whorls (incomplete), 4. (Durham)

*Holotype.* (S.U. 498.) Figured in the present report, pl. 66, fig. 11.

*Geologic range.* Keasey formation, lowermost Oligocene.

*Geographic distribution.* Columbia and Linn counties, Oregon.

*Type locality.* (S.U. N.P. 1.) Keasey, Oregon.

**EPITONIUM (BOREOSCALA) KEASEYENSE** Durham, 1937

Plate 66, figure 12

*Epitonium (Boreoscala) keaseyense* Durham, Jour. Paleon., vol. 11, p. 498, pl. 57, fig. 17, 1937.

*Original description.* Shell large, fairly heavy, about eight or nine moderately-convex whorls, greatest convexity slightly below center; sutures fairly deep; nine fairly heavy axial varices, each reflexed against the corresponding one of the preceding whorl and depositing a triangular area of callus in the adjacent sutural area; some varices much wider than others; about 13 primary spiral ribs, of which the first eight are equidistant, with interspaces twice their width, the remaining five become closer together as they approach the suture; spiral ribs pass up posterior side of varices to the top, slightly offset posteriorly as they pass on to top of varices; on better preserved areas of the type, progressively finer secondary and tertiary spirals are discernible; basal keel moderately prominent; below it 12 to 15 closely spaced spiral ribs; aperture ovate. Diameter of holotype, 12.3 mm.; height, 29.1 mm.; whorls (incomplete), 6. (Durham)

*Observations.* As noted by Durham, this species is characterized by 9 to 11 varices and 13 major spiral ribs closely spaced on the upper surface of the whorls.

*Holotype.* (S.U. 497.) Figured in the present report, pl. 66, fig. 12.

*Geologic range.* Keasey and Gries Ranch formations, lower and lower middle Oligocene.

*Geographic distribution.* Columbia County, Oregon, and lower Cowlitz Valley, Washington.

*Type locality.* (S.U. N.P. 292.) Strassel, Oregon.

**EPITONIUM (BOREOSCALA) KEASEYENSE** Durham subsp. **SCHENCKI** Durham, 1937

Plate 66, figures 13, 17, 18

*Epitonium (Boreoscala) keaseyense* Durham subsp. *schencki* Durham, Jour. Paleon., vol. 11, p. 498, pl. 57, figs. 14, 15, 16, 1937.

*Original description.* Characterized by wider and heavier varices than in the typical species, without spiral ribs passing on to their top. Also, on later whorls the secondary spiral ribs are usually as prominent as the primaries, thus giving the appearance of many spiral ribs. Diameter of holotype, 20.2 mm.; height, 38.6 mm.; whorls (incomplete), 4.5. (Durham)

*Observations.* The type of this variety came from the lower Oligocene of northwest Oregon. Specimen (U.C. 30163), figured on pl. 66, figs. 17, 18, was collected from beds equivalent in age to the Keasey formation in Oregon and is of exceptionally large size. The spiral ribbing is only faintly developed.

*Holotype.* (S.U. 326.) Figured in the present report, pl. 66, fig. 13.

*Paratype.* (U.C. 30163.) Figured in the present report, pl. 66, figs. 17, 18.

*Geologic range.* Keasey formation, lowermost Oligocene.

*Geographic distribution.* Northwestern Oregon and southwestern Washington.

*Type locality.* (S.U.-Holman 35.) Washington County, Oregon, near center of Section 8, T. 3 N., R. 4 W.

**EPITONIUM (BOREOSCALA) COOSENSE** Durham, 1937

Plate 66, figure 16

*Epitonium (Boreoscala) coosense* Durham, Jour. Paleon., vol. 11, p. 499, pl. 56, fig. 30, 1937.

*Original description.* Shell large, fairly heavy, having about nine well-rounded whorls; sutures deep; ornamented by nine or ten heavy lamellar varices with interspaces about twice their width; varices curve posteriorly from suture for a short distance and then straighten out; on central portion of body whorl are three rounded nearly equidistant spiral threads with interspaces three to four times their width; on upper third of whorls are about seven closely spaced, rounded spirals tending to become obsolete on later whorls, their interspaces approximately equal in width to the spiral threads; immediately below the three primary spirals are three to four flat spirals with interspaces not as wide as the flat spirals; indistinct secondary spiral threads may be seen between the three primaries; the spirals pass over varices, making small nodes at their intersection; base of body whorl marked by a prominent keel with varices passing over it; aperture probably round. Diameter of holotype, 18.1 mm.; height, 45.8 mm.; whorls (incomplete), 7. (Durham)

*Observations.* This Pliocene shell is larger than *E. howei* and has an elliptical aperture in contrast to the circular outline of *E. howei*.

*Holotype.* (C.A.S. 7007.) Figured in the present report, pl. 66, fig. 16.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* (C.A.S. 12.) Near Coos Bay, Oregon. (Durham)

Subgenus *Sthenorytis* Conrad, 1863

*Sthenorytis* Conrad, Proc. Phila Acad. Nat. Sci., vol. 14, p. 565, 1863.

*Subgenotype. Epitonium expansum* (Conrad).

**EPITONIUM (STHENORYTIS) CRESCENTENSE** Durham, 1937

## Plate 67, figure 2

*Epitonium (Sthenorytis?) crescentense* Durham, Jour. Paleon., vol. 11, p. 500, pl. 56, figs. 11, 15, 1937.

*Original description.* Type incomplete, large, and moderately heavy; paratype smaller, more complete, in a poorer state of preservation; apparently about five rapidly enlarging well-rounded whorls; sutures deep; ornamented by six varices of irregular width, some broad flat and heavy, others relatively narrow and rounded, having a tendency to be reflexed posteriorly; at suture the varices overlap onto those of preceding whorl or merely onto the preceding whorl; on body whorl of the paratype there is a faint basal keel marked by a spiral rib; no other spiral ornamentation present; aperture apparently nearly circular on the paratype. Diameter of holotype, 24.5 mm.; height, 27.9 mm.; whorls (incomplete), 2. (Durham)

*Observations.* The imperfectly preserved specimens of this species are characterized by the six very large broad varices and the rapid increase in the size of the whorls.

*Holotype.* (U.C. 30164.) Figured in the present report, pl. 67, fig. 2.

*Geologic range.* Lowermost Oligocene.

*Geographic distribution.* Port Crescent, Clallam County, Washington.

*Type locality.* (U.C. A-1813.) Port Crescent, Washington.

Genus **OPALIA** H. and A. Adams, 1853

*Opalia* H. and A. Adams, Gen. Rec. Moll., vol. 1, p. 223, 1853.

*Genotype.* *Opalia australis* (Lamarck).

**OPALIA (OPALIA) RUGIFERA** (Dall), 1909

## Plate 67, figure 1

*Epitonium (Opalia) rugiferum* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 52, pl. 3, fig. 10, 1909.

*Opalia (Opalia) rugifera* (Dall), Durham, Jour. Paleon., vol. 11, p. 501, 1937.

*Original description.* Shell large, strong, stout, with seven or eight well-rounded whorls, crossed by (on each) about 13 stout, axially rugose varices, which are continuous up the spire, being appressed at the suture; the only spiral sculpture consists of a stout thread circumscribing the base and becoming embedded under the well-marked suture with the growth of the whorls; apex lost; spire rather acute, rapidly enlarging; aperture oval; varices less than half as wide as the interspaces, somewhat excavated on the posterior side. Length of seven whorls 60 mm.; diameter at truncate apex 4 mm.; maximum diameter of last whorl, 24 mm. (Dall)

*Observations.* This species is known only from the Keasey formation in northwest Oregon. It is a large shell without spiral sculpture and is characterized by 13 heavy rounded varices.

*Holotype.* (U.S.N.M. 135121.) Figured in the present report, pl. 67, fig. 1.

*Geologic range.* Keasey formation, lowermost Oligocene.

*Geographic distribution.* Columbia County, Oregon.

*Type locality.* (U.C. A-10.) Rock Creek, Columbia County, Oregon.

**OPALIA (OPALIA) BRAVINDERI** Durham, 1937

Plate 67, figures 17, 18

*Opalia (Opalia) bravinderi* Durham, Jour. Paleon., vol. 11, p. 501, pl. 56, fig. 13, 1937.

*Original description.* Shell small, rather thin, having eight whorls, with protoconch missing; whorls only slightly convex; sutures shallow; axial ribs 10 or 11, from one-half to two-thirds the width of their interspaces; on larger specimens occasional extra axial ribs are intercalated; the ribs have a rather convex outline from suture to suture, becoming less prominent as they reach the sutures; in earlier whorls the ribs are rather thin and almost knife-like; body whorl with a prominent basal keel; aperture nearly oval. Diameter of holotype, 3.8 mm.; height, 10.4 mm.; whorls, 8. (Durham)

*Observations.* This species may be distinguished by its relatively small size and shallow suture and small number of straight broadly rounded varices whose margins extend well over into the intervening interspaces. The spiral ribs on the holotype are rather faint as the result of weathering of the specimens.

*Holotype.* (U.C. 30167.) Figured in the present report, pl. 67, figs. 17, 18.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Puget Sound area, Washington.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, opposite Seattle.

**OPALIA (OPALIA) WISHKAHENSIS** Durham, 1937

Plate 67, figures 3, 4, 5

*Opalia (Opalia) wishkahensis* Durham, Jour. Paleon., vol. 11, p. 502, pl. 56, fig. 17, 1937.

*Original description.* Shell medium, moderately heavy; whorls rather convex in outline; sutures deep for Opalia; oldest whorls of spire broken, probably about eight; ornamented by 15 or 16 moderately prominent rounded varices with interspaces of equal width, continuous from whorl to whorl; body whorl with a prominent basal keel which is usually barely visible in sutures of the preceding whorls. Diameter of holotype, 9.6 mm.; height, 21.3 mm.; whorls (incomplete), 4. (Durham)

*Observations.* This species may be distinguished from the other Northwest species of *Opalia* by the larger number of varices.

*Holotype.* (C.A.S. 7008.) Figured in the present report, pl. 67, fig. 3.

*Paratype.* (C.A.S. 7009.) Figured in the present report, pl. 67, figs. 4, 5.

*Geologic range.* Montesano formation, upper Miocene or lower Pliocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (C.A.S. 202.) Wishkah River, Washington.

#### Subgenus *Rugatiscala* de Boury, 1913

*Rugatiscala* de Boury, Jour. Conch., vol. 61, p. 72, 1913.

*Subgenotype.* *Opalia levesquei* (de Boury).

#### OPALIA (RUGATISCALA) COWLITZENSIS Durham, 1937

##### Plate 67, figure 16

*Opalia (Rugatiscala) cowlitzensis* Durham, Jour. Paleon., vol. 11, p. 505, pl. 57, fig. 18, 1937.

*Original description.* Shell minute but moderately heavy; about five well-rounded whorls; protoconch broken; slightly tabulate on top; sutures deeply ornamented by about 15 prominently rounded axial ribs slightly wider than their interspaces and dying out as they reach the suture; last axial rib of body whorl and one opposite it are considerably heavier than the rest, with a tendency for the corresponding ones on each whorl to be heavier; nine rather prominent spiral threads, slightly heavier than their interspaces, most prominent on greatest convexity of whorl, and faint evidence of a tenth one just above keel; body whorl has well-defined basal keel with about five spiral threads below it; aperture entire and nearly elliptical, but lower portion wider than upper; inner lip slightly thinner than outer lip. Diameter of holotype, 1.3 mm.; height, 3.4 mm.; whorls, 4. (Durham)

*Observations.* This microscopic species is characterized by its deeply impressed sutures, convex whorls, and nearly elliptical aperture.

*Holotype.* (U.C. 30171.) Figured in the present report, pl. 67, fig. 16.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) Cliff in north bank of Cowlitz River one and one-half miles east of Vader, Lewis County, Section 29, T. 11 N., R. 2 W.

#### Genus ACRILLA H. Adams, 1860

*Acrilla* H. Adams, Proc. Zool. Soc. London, vol. 28, p. 241, 1860.

*Genotype.* *Scalaria acuminata* Sowerby.

#### Subgenus FERMINOSCALA Dall, 1908

*Ferminoscala* Dall, Bull. Mus. Comp. Zool., vol. 43, p. 315, 1908.

*Subgenotype.* *Acrilla ferminiana* (Dall).

**ACRILLA (FERMINOSCALA) ARAGOENSIS (Turner), 1937**

Plate 67, figure 9

*Epitonium aragoensis* Turner, ms.*Acrilla (Ferminoscala?) aragoensis* (Turner), Durham, Jour. Paleon., vol. 11, pp. 506, 507, pl. 57, fig. 24, 1937.*Acrilla (Ferminoscala?) aragoensis* (Turner), in Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 80, pl. 15, figs. 23, 24, 1938.

*Original description by Turner.* Shell large for the genus, heavy, slender; whorls ornamented by about 15 low axial ribs, which bend sharply and become tangent to suture, and numerous fine spiral riblets, which are indistinguishable at suture and increase in strength toward anterior portion. Dimensions: length, 31.0 mm. (incomplete), diameter, 13.6 mm.

*Observations.* This species as noted by Durham may be distinguished from *Epitonium condoni* Dall, *Opalia rugifera* (Dall) and *A. dickersoni* Durham in less prominent axial ribs and a smaller axial angle. The following additional notations have been made by Durham: "This species has about seven primary spiral threads with interspaces two to three times their width. Below these primaries, and above the prominent basal keel are about six closely spaced secondary spirals; below the basal keel there are about 20 fine closely set spirals of varying sizes, interspaces of which are not wider than the spirals; on better-preserved parts of the holotype secondary and tertiary spiral threads may be discerned; varices form a sharp node passing over the prominent basal keel and continue to the aperture.

"It is possible that this is not a *Ferminoscala* but belongs in some other subgenus of *Acrilla*."

*Holotype.* (U.C. 33237.) Figured in the present report, pl. 67, fig. 9.

*Geologic range.* Coaledo formation, upper Eocene.

*Type locality.* (U.C. A-858.) Coos Bay, Oregon, cove in southwest corner of Cape Arago. (Turner)

**ACRILLA (FERMINOSCALA) BERTHIAUMEI Durham, 1937**

Plate 67, figures 12, 13

*Acrilla (Ferminoscala) berthiaumei* Durham, Jour. Paleon., vol. 11, p. 507, pl. 57, fig. 23, 1937.

*Original description.* Holotype small, incomplete; paratype large, only one whorl; complete shell probably of 9 or 10 whorls; thin whorls convex; sutures moderately deep; 20 varices on largest whorl of holotype, about 30 on paratype, which is a body whorl; varices not as prominent as spiral ribs, of which there are five to six prominent primaries, equal in width to their interspaces; faint evidence of two very fine secondaries in interspaces; basal keel moderately prominent, below which are about 9 or 10 spiral ribs, a little wider than their interspaces; aperture ovate, inner lip reduced to a very thin band of callus. Diameter of holotype, 2.8 mm.; height, 6 mm.; whorls (incomplete), 5. (Durham)

*Observations.* This species possesses an apical angle of about 27 degrees and has 5 or 6 major spiral ribs, while the angle of *A. dickersoni* is 16 degrees and the number of major ribs is 6 or 7.

*Holotype.* (U.C. 30183.) Figured in the present report, pl. 67, figs. 12, 13.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 232.) Cliff in north bank of Cowlitz River one and one-half miles east of Vader, Lewis County, Section 29, T. 11 N., R. 2 W.

#### ACRILLA (FERMINOSCALA) BECKI Durham, 1937

Plate 67, figure 14

*Acrilla (Ferminoscala) becki* Durham, Jour. Paleon., vol. 11, pp. 507, 508, pl. 56, fig. 26; pl. 57, fig. 20, 1937.

*Original description.* Shell tall, slender, thin; about nine post-nuclear whorls; sutures deep; whorls moderately convex; axial sculpture of 17 to 25 irregularly spaced small, rounded thread-like varices, bending slightly backward as they leave suture and then continuing over whorl approximately parallel to right side of spire; interspaces from two to six times width of varices; spiral sculpture of 10 or 11 primary rounded ribs with interspaces approximately equal in width; the uppermost of these primaries may be nearly obsolete; there is usually a fine secondary in interspaces on center of whorl, sometimes almost as prominent as primaries; basal keel slightly more prominent than primary spirals; below it are 10 to 12 closely spaced spirals; aperture ovate, inner lip very thin. Diameter of holotype, 5.7 mm.; height, 18.2 mm.; whorls, 9. (Durham)

*Observations.* This species, somewhat similar in size to *A. lincolensis*, differs in the lesser convexity and number of whorls and narrower interspaces between the major spiral ribs.

*Holotype.* (U.C. 30169.) Figured in the present report, pl. 67, fig. 14.

*Geologic beds.* Woodman's Wharf, lower middle Oligocene.

*Type locality.* (U.W. 158.) Just north of Woodman's Wharf on east shore of Port Discovery Bay, Jefferson County, Washington, Section 5, T. 29 N., R. 1 W.

#### ACRILLA (FERMINOSCALA) DICKERSONI Durham, 1937

Plate 67, figures 7, 8, 21

*Epitonium washingtonensis* Weaver, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 166, pi. 31, figs. 7a, 7b, 1917.

Not *Epitonium washingtonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 43, pl. 4, figs. 46, 47, 1916.

Not *Epitonium (Boreoscala) washingtonensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, p. 30, pl. 11, fig. 19, 1922.

*Acrilla (Ferminoscala) dickersoni* Durham, Jour. Paleon., vol. 11, p. 508, pl. 57, figs. 12, 13, 1937; Effinger, Jour. Paleon., vol. 12, pp. 376, 377, 1938.

*Original description.* Shell of moderate size, thick, about 10 moderately rounded whorls; sutures fairly deep; tall, rather slender; ornamented by about 30 low, nearly square varices curving slightly posteriorly from suture and then straightening

out and passing over whorl nearly parallel to left side of shell; interspaces vary from as wide to twice as wide as varices, of which some are considerably heavier than others; spiral ornamentation of seven low rounded ribs with equal interspaces; a band the width of two of these ribs below the ribs and above the basal keel having no spiral ornamentation; seventh spiral, which is a short distance below the suture, is sometimes rather obscure; basal keel only slightly more prominent than spiral ribs above it, while below it there are about eight or nine spiral ribs with interspaces equal to them; aperture ovate; inner lip thin. Diameter of paratype, 5.5 mm.; height, 16.2 mm.; whorls, 7 (incomplete). (Durham)

*Observations.* In general outline this species resembles *A. lincolnensis* (Weaver) but it differs from the latter in having much better developed axial varices which intersect the spiral ribs producing a cancellated sculpture which is only faintly noticeable on *A. lincolnensis*. There are differences also in the proportionate number of axial ribs as well as width of interspaces.

*Holotype.* (C.A.S. 432.) Figured in the present report, pl. 67, fig. 21. Figured by Dickerson (123, pl. 31, figs. 7a, 7b) as *Epitonium washingtonensis*.

*Paratype.* (U.C. 33571.) Figured in the present report, pl. 67, figs. 7, 8.

*Geologic range.* Gries Ranch beds, Washington, lower middle Oligocene; San Emigdeo formation, California, lower Oligocene.

*Type locality.* (U.W. 239.) In south bank of Cowlitz River, Cowlitz County, Washington, Section 25, T. 11 N., R. 2 W.

#### ACRILLA (FERMINOSCALA) LINCOLNENSIS (Weaver), 1916

Plate 67, figure 6

*Mesalia lincolnensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 45, pl. 5, fig. 85, 1916.

*Acrilla (Ferminoscala) lincolnensis* (Weaver), Durham, Jour. Paleon., vol. 11, pp. 508, 509, pl. 56, fig. 24, 1937 (see synonymy).

*Original description.* Shell long and narrow with eleven whorls; spire very elevated and whorls convex; on body whorl are usually twelve revolving rounded ribs of moderate development and between these are slightly concave interspaces of double width; revolving threads are absent within the interspaces; there are usually eight similar ribs on each whorl of the spire; on the extreme upper portion of each whorl for a short distance below the suture the sculpture is less distinct; longitudinal sculpture represented only by faintly developed lines of growth; body whorl obliquely angulated at base and surface below angle is not ornamented; aperture circular; outer lip thin; inner lip slightly callused. Dimensions.—Altitude of shell 21 mm.; altitude of spire 14 mm.; maximum diameter of shell 10 mm.; angle of spire 22°. (Weaver)

*Observations.* The spiral ribs of this species are distinct in contrast to the poorly developed axial varices. It is closely related to both *A. dickersoni* and *A. beckii* Durham. The distinctions between these three are largely in the details of spiral and axial ornamentation.

*Holotype.* (C.A.S. 464.) Figured in the present report, pl. 67, fig. 6.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Upper Chehalis River Valley, Lewis County, Washington.

*Type locality.* (U.W. 256.) In railroad cut of Union Pacific one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

Subgenus *Undiscala* de Boury, 1909

*Undiscala* de Boury, Jour. Conch., vol. 57, p. 256, 1909.

Subgenotype. *Opalia undosa* (Sowerby).

**ACRILLA (UNDISCALA) WASHINGTONENSIS (Weaver), 1916**

## Plate 67, figure 22

*Epitonium washingtonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 30, 43, pl. 4, figs. 46, 49, 1916.  
 Not *Epitonium washingtonensis* Weaver, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 160, pl. 31, figs. 7a, 7b, 1917.  
 Not *Epitonium (Boreoscalia) washingtonensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, p. 30, pl. 11, fig. 19, 1922.  
*Acrilla (Undiscala) washingtonensis* (Weaver), Durham, Jour. Paleon., vol. 11, p. 510, pl. 56, fig. 18, 1937.

*Original description.* Shell long, narrow and conical with nine whorls; spire high; whorls moderately convex by about 30 longitudinal ribs which extend over the entire surface of the whorls with the exception of that portion of the area of the body whorl below the basal angle; these ribs are crossed by prominent rounded revolving ribs of which there are 13 upon the body whorl and eight on each of the whorls of the spire; the revolving ribs are commonly arranged in pairs of two, with wide, nearly flat interspaces between each pair. Suture distinct; base of body whorl flattened and smooth except for presence of eight minute revolving ribs; a faintly developed revolving keel is developed on the basal angle; aperture broadly ovate; inner lip heavily callused. Dimensions.—Altitude of shell 23 mm.; altitude of spire 17 mm.; thickness 9 mm.; angle of spire 19°. (Weaver)

*Observations.* The following additional notations have been made by Durham: This species has 20 to 24 fairly prominent rounded axial ribs with interspaces of slightly greater width; eight prominent primary spiral ribs with interspaces twice as wide; spiral ribs heaviest near base of whorl, less prominent near top; secondary spiral ribs found in interspaces, becoming nearly as prominent as primaries near top of whorl; basal keel a little more prominent than lower primary spirals, about 12 closely spaced obscure revolving ribs below it.

*Holotype.* (C.A.S. 557.) Figured in the present report, pl. 67, fig. 22.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Upper Chehalis River Valley, Lewis County, Washington.

*Type locality.* (U.W. 256.) In cut of Union Pacific Railway one mile north of Galvin Station, Lewis County, Washington, Section 27, T. 15 N., R. 3 W.

**ACRILLA (UNDISCALA?) OLIMPICENSIS Durham, 1937**

## Plate 67, figure 15

*Acrilla (Undiscala?) olympicensis* Durham, Jour. Paleon., vol. 11, p. 510, pl. 56, fig. 16; pl. 57, fig. 22, 1937.

*Original description.* Shell of medium size; originally about eight or nine moderately convex whorls; sutures fairly deep; ornamented by approximately 25 prominent, very distinctive axial ribs, which have appearance of true axial ribs on lower

part of whorl but are strongly compressed laterally on upper part so as to simulate varices; on central portion of whorl are three fairly prominent spiral ribs with inter-spaces slightly greater in width, and below lowest one faint evidence of a fourth spiral rib is occasionally seen just above the prominent basal keel; on upper portion of whorl for a space about equal to that occupied by the three primary ribs, there is no evidence of any spiral ornamentation, and it is in this area that axial ribs become varix-like; axial ribs pass over basal keel to aperture; numerous fine spiral ribs superimposed on axial ribs on basal disk; aperture ovate. Diameter of internal mold of holotype, 5.6 mm.; height, 11.8 mm.; whorls, 6 (incomplete). (Durham)

*Observations.* This species is characterized by a rapid increase anteriorly in the diameter of the whorls, in having relatively deep sutures, and a subcancellate sculpture in which the sharp axial varices are twice as prominent as the spiral ribs which intersect them. It may be distinguished from other species of the series largely on details of axial and spiral ornamentation.

*Holotype.* (U.C. 30185.) Figured in the present report, pl. 67, fig. 15.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* North side of Olympic Peninsula in Clallam County, Washington.

*Type locality.* (U.C. A-6.) West of Twin Rivers in sea cliff, Clallam County, Washington. (Durham)

#### Family LITTORINIDAE

##### Genus LITTORINA Ferrusac, 1822

*Littorina* Ferrusac, Tabl. Syst., pp. 11, 34, 1822.

*Genotype.* *Nerita littoralis* Linnaeus.

##### LITTORINA OLIGOCENICA Dickerson, 1917

Plate 63, figure 22; plate 67, figure 19

*Littorina oligocenica* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 178, pl. 31, fig. 1, 1917.

*Littorina oligocenica* Dickerson, Effinger, Jour. Paleon., vol. 12, p. 379, 1938.

*Original description.* Shell minute with five whorls; whorls nearly flat, suture distinct, linear; body-whorl about two-thirds the shell length; mouth rounded; outer lip thin. Dimensions: Length 3 mm.; width of body-whorl, 1 mm. (Dickerson)

*Observations.* This species from the lower Oligocene differs from the Cowlitz species *L. mountsoloensis* in its larger size, wider aperture, less deeply incised sutures, and wider axial angle.

*Holotype.* (C.A.S. 426.) Figured in the present report, pl. 63, fig. 22; pl. 67, fig. 19.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, Cowlitz County, Washington, in northeast quarter of Section 25, T. 11 N., R. 2 W.

**LITTORINA PETRICOLA** Dall, 1909

Plate 67, figure 20

*Littorina petricola* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 80, pl. 4, fig. 9, 1909.

*Littorina petricola* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 781, 1931.

*Original description.* Shells of moderate size, thick, solid, turbinate, with five gradually increasing whorls; suture distinct, not channeled; upper surface of whorls lightly flattened, periphery and base rounded, axis imperforate; surface sculptured with inconspicuous incremental lines and numerous subequal close-set spiral threads, about two to a millimeter; aperture subovate; outer lip thick, sharp edged, not reflected; pillar thick, arcuate; base slightly subangular, throat obscurely spirally lirate or grooved. Altitude, 17 mm.; maximum diameter, 15.5 mm. (Dall)

*Observations.* This is the only species of the genus known from the Miocene or Pliocene formations in Oregon and Washington. It is much larger than the Eocene and Oligocene species from Oregon and Washington. It differs from *L. sookensis* Clark and Arnold in a fairly deep rather than appressed suture. The aperture is relatively wider and shorter than in *L. sookensis*.

*Holotype.* (U.S.N.M. 153991.) Figured in the present report, pl. 67, fig. 20.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* At Fossil Rock, Coos Bay, Oregon. (Dall)

**LITTORINA SOOKENSI** Clark and Arnold, 1923

Plate 67, figures 23, 24, 29

*Littorina sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 165, pl. 37, figs. 4a, 4b, 5a, 5b, 1923.

*Original description.* Shell fairly large for this genus, heavy, very variable in outline. Apex blunt. Nuclear whorls large and covered by lower whorls. Sutures rather strongly appressed, appressed area usually forming a well defined sutural band or collar. Body whorl two-thirds to three-fourths the height of shell; sides of whorl rather strongly convex, with an angulation about one-fourth distance from suture to anterior end; angulation not well marked on type, surface between angulation and sutural band flat; angulation on cotype much more pronounced and surface above it does not slope up to suture at as steep an angle as on type, and sutural band is much more pronounced. Surface sculptured by numerous spiral ribs which show considerable variation in width and number. About 22 of these ribs can be distinguished on body whorl of type while on cotype there are only about 15. Aperture subcircular to subovate. Inner lip depressed and covered by heavy callus. Umbilical area strongly depressed as on many species of genus *Thais*. Dimensions of type: Height, 22.5 mm.; greatest width of body whorl, 17.5 mm.; height of body whorl, 16.5 mm.; dimensions of cotype: Height, 14 mm.; greatest width of body whorl, 15 mm.; height of body whorl, 12 mm. (Clark and Arnold)

*Observations.* This species is characterized by its relatively short spire, subangulation of upper fourth of body whorl, and heavy callus on inner lip.

*Holotype.* (C.A.S. 581.) Figured in the present report, pl. 67, figs. 23, 24.

*Cotype.* (U.C. 30214.) Figured in the present report, pl. 67, fig. 29.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South shore of Vancouver Island.

*Type locality.* In the sea cliffs east of the mouth of Kirby Creek, six miles west of Sooke, Vancouver Island. (Clark and Arnold)

#### **LITTORINA MOUNTSOLOENSIS Weaver and Palmer, 1922**

*Littorina mountsoloensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 30, 31, pl. 11, fig. 12, 1922.

*Original description.* Shell small, smooth; apex acute, spire about one-half the length of the body whorl; whorls six, sides straight; suture linear and only minutely excavated; aperture oval; anterior end of outer lip not completely entire. Dimensions: Altitude 7 mm.; width of body whorl 4 mm. (Weaver and Palmer)

*Holotype.* (U.W. 190.) Holotype lost. Not figured in the present report.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 319.) McClarity Ranch on south bank of Stillwater Creek, one mile west of Vader, Lewis County, Section 30, T. 11 N., R. 2 W.

#### **Family NATICIDAE**

##### **Genus NATICA Scopoli, 1777**

*Natica* Scopoli, Introductio ad Historiam Naturalem, p. 392, 1777.

*Genotype.* *Nerita vitellus* Linnaeus.

##### **Subgenus Tectonatica Sacco, 1890**

*Tectonatica* Sacco, Bollettino Musei Zoologia Anatomia Comparata R. Università Torino, vol. 5, p. 33, 1890.

*Subgenotype.* *Natica tectula* Bonelli.

##### **NATICA (TECTONATICA) DALLI Cossmann, 1925**

###### **Plate 67, figure 30**

*Natica (Cryptonatica) consors* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 86, 87, pl. 5, fig. 10; pl. 6, fig. 9, 1909.

*Natica clausa* Broderip and Sowerby, Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 93, 1922.

*Tectonatica dalli* n. nom. Cossmann, Essais de Paléoconchologie comparée, vol. 13, p. 121, 1925.

Not *Natica multipunctata* var. *consors* s.v. Wood, Mon. Crag. Moll., pt. 1 (Pal. Soc.), p. 148, pl. 16, figs. 9d, 9e, 1848.  
Not *Natica (Natica) dalli* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 138, pl. 14, figs. 8, 9, 10, 11, 12, 1933.

*Original description.* Shell small, solid, rather thick, with four whorls; spire rather low, sutures appressed, general profile dome-like; whorls evenly rounded, smooth except for lines of growth, the specimens show no spiral striation; aperture subovate, the body with a moderate callus, which extends to the upper part of the pillar and evenly fills the umbilicus, but is rather abrupt on the side away from the pillar, so that a sort of sulcus bounds the umbilical callosity on that side, though there is no perforation; outer lip thin, entire. Altitude, 29 mm.; maximum diameter, 26.5 mm. (Dall, 101)

*Observations.* This species occurs in the Empire formation along with *N. oregonensis* (Conrad), from which it differs in having a more depressed profile and differences in the arrangement of the callus in the umbilical area.

*Holotype.* (U.S.N.M. 153917.) Figured in the present report, pl. 67, fig. 30.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay area (and Astoria?), Oregon.

*Type locality.* Fossil Point, Coos Bay, Oregon. (Dall)

#### NATICA (TECTONATICA) OREGONENSIS (Conrad), 1865

##### Plate 100, figure 27

*Sigaretus scopulosus* (pro parte) Conrad, U.S. Explor. Exped. Geol., pl. 19, figs. 6b, 6c, 1849.

*Lunatia oregonensis* Conrad, Am. Jour. Conch., vol. 1, p. 151, 1865.

*Natica oregonensis* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 86, pl. 4, fig. 7, 1909.

*Description by Dall.* Shell ovate, solid, with four or five whorls, the spire rather elevated, and the general form not unlike that of *Lunatia pallida* Broderip and Sowerby, of the recent fauna; surface nearly smooth, with moderately conspicuous incremental lines; base somewhat produced; body with a polished callus which seems to have been dark colored, and which extends to and over the upper part of the pillar, filling the umbilicus with a nearly circular prominent callus, separated by a sulcus from the base on the left and with a sharply cut semicircular sulcus above it between the body callus and the umbilical callus; outer lip thin, simple. Altitude of type figured, 32 mm.; maximum diameter, 27.5 mm.

*Hypotype.* (U.S.N.M. 153914.) Figured in this report, pl. 100, fig. 27.

*Geologic range.* Empire formation, Coos Bay, and Astoria formation, Astoria, Oregon.

*Geographic distribution.* Coast Ranges of Oregon.

*Type locality.* Coos Bay, Oregon. (Dall)

**NATICA (TECTONATICA) SAXEA Conrad, 1849**

## Plate 68, figure 4

*Natica saxea* Conrad, U.S. Explor. Exped. Geol., p. 727, pl. 19, figs. 7a, 7b, 1849; Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 155 (reprint), 1909.  
*Natica (Natica) saxea* Conrad, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 93, pl. 12, figs. 2, 3, 7, 14, 1931.

*Original description.* Subglobose. Whorls five, convex, with distinct lines of growth; a broad brown band at base of the shell, and a lighter-colored brown band revolves on the upper part of the whorls, contiguous to the suture; a narrow darker band margins the suture. Umbilicus large, partially covered by a callus. (Conrad.) Dimensions.—Specimen (U.C. 31997). Altitude: 43.5 mm.; maximum diameter: 46.5 mm.; altitude of aperture: 36 mm. (Conrad)

*Observations.* Numerous specimens from the Astoria formation in Washington correspond to the specimen figured by Conrad from Astoria, Oregon. The type appears to have been lost. The large funicle and largely open umbilicus are characteristic of this species.

*Holotype.* Lost.

*Hypotype.* (U.C. 31997.) Figured in the present report, pl. 68, fig. 4, locality (U.W. 415).

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Coast Ranges of western Oregon and southwestern Washington.

*Type locality.* (U.W. 710.) Astoria, Oregon. Occurs also at locality (U.W. 415) in Washington, Clemons logging road, on abandoned spur of railroad 100 feet north of main line in the first large cut in Section 23, T. 17 N., R. 7 W.

**NATICA (TECTONATICA) CLARKI Etherington, 1931**

## Plate 67, figure 25

*Natica (Natica) clarki* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 93, pl. 12, fig. 12, 1931.

*Original description.* Shell small, ovate, spire moderately high almost equal to that of the aperture; whorls 5, convex, usually possessing a definite shoulder at the suture; whorls smooth except for fine microscopic growth lines. Protoconch smooth, pale milky color in contrast to the dark brown color of the whorls of the spires; suture abutting; aperture semi-lunar; outer lip thin, inclined about 20 degrees from the vertical; smooth; umbilicus closed showing a very small funicle.

In a single individual an operculum was found which differed from the usual type of ss. in that the surface was covered with numerous faint striations. Dimensions: Altitude 17.2 mm.; maximum diameter 16.1 mm.; altitude of aperture 14.3 mm. (Etherington)

*Holotype.* (U.C. 31996.) Figured in the present report, pl. 67, fig. 25.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Northwestern Oregon and southwestern Washington.

*Type locality.* (U.W. 425.) Seam of fossils in bed of Rock Creek about one-fourth mile downstream from the falls and just below the old dam site, Grays Harbor County, Section 7, T. 16 N., R. 5 W.

**NATICA (TECTONATICA) TEGLANDAE** Hanna and Hertlein, 1938

## Plate 68, figures 5, 6, 7

*Natica (Natica) dalli* Tegland (not Cossmann), Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 138, pl. 14, figs. 8, 9, 10, 11, 12, 1933.  
*Natica teglandi* Hanna and Hertlein (n. name), Jour. Paleon., vol. 12, p. 108, 1938.  
Not *Tectonatica dalli* Cossmann (a new name for *Natica (Cryptonatica) consors* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 86, pl. 5, fig. 10, 1909), Essais de Paléoconchologie comparée, vol. 13, p. 121, 1925.

*Original description.* Shell large, globose, smooth, with suture abutting; whorls four, apical whorls lacking on the type form. Spire low, with rounded whorls. Body whorl obliquely ovate, with definite shoulder and subconvex to slightly flattened sides; umbilical region large and deep, with a well-developed funicle spiraling into the funnel; an umbilical limb, distally defined by a low ridge, winding about the umbilical opening, terminating at the anterior end of aperture, causing a subangulation of the aperture at this point. Aperture semilunar, acutely angulate posteriorly and slightly angulate anteriorly, outer lip simple, inner lip with thin parietal callus, not very large, spreading out on the body whorls and separated from the funicle by a definite semilunar sulcus. Outline of the body callus not very distinct on holotype. Dimensions of holotype: height, 21 mm.; diameter, 22.3 mm.; of largest paratype: height, 26.5 mm.; diameter, 29.2 mm. (Tegland)

*Observations.* This relatively large species from the upper Oligocene bears a close relationship to *N. weaveri* Tegland from the middle Oligocene of Washington but differs from it in the well-defined funicle, larger umbilicus, and average larger size of shell.

*Holotype.* (U.C. 32215.) Figured in the present report, pl. 68, figs. 5, 6, 7.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* King and Kitsap counties, Puget Sound Basin, Washington.

*Type locality.* (U.W. 13.) Restoration Point, opposite Seattle, Washington.

**NATICA (TECTONATICA) WEAVERI** Tegland, 1933

## Plate 68, figures 8, 9, 13

*Natica (Natica) weaveri* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 138, 139, pl. 14, figs. 13, 14, 15, 16, 17, 1933.  
*Natica (Natica) cf. weaveri* Tegland, Effinger, Jour. Paleon., vol. 12, p. 377, 1938.

*Original description.* Shell small, thin, smooth to polished, with suture abutting; discernible whorls four, rounded. Body whorl subconvex with definable shoulder. Aperture ear-shaped, outer lip regular, inner lip with thin parietal callus and small funicle (umbilical callus) separated by definite sinus; funicle narrow anteriorly, definitely traceable into umbilical funnel; umbilical ridge or limb slightly developed. Operculum as in *Natica* subsp. with two raised laminae on outer edge, each with groove to left of it, inner straight edge minutely denticulate; early part of coil obscured by callosity. Dimensions: height, 19.5 mm.; diameter, 20.2 mm. (Tegland)

*Observations.* This species from the Lincoln formation is noted by Effinger as occurring rarely in the Gries Ranch fauna. It is characterized

by its globose body whorl, appressed suture, and luniform umbilicus with well-developed funicle.

*Holotype.* (U.C. 32183.) Figured in the present report, pl. 68, fig. 9.

*Paratype.* (U.C. 32185.) Figured in the present report, pl. 68, fig. 8.

*Paratype.* (U.C. 32186.) Figured in the present report, pl. 68, fig. 13.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Upper Chehalis River Valley, Lewis County, Washington.

*Type locality.* (U.W. 256.) Cut on Union Pacific Railway one mile north of Galvin Station, Lewis County, Washington, Section 27, T. 15 N., R. 3 W.

#### NATICA (TECTONATICA) OLIGOCENICA Van Winkle, 1918

##### Plate 67, figure 28

*Natica oligocenica* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 86, pl. 7, fig. 23, 1918.

*Original description.* Shell small with five whorls the surfaces of which are evenly rounded except the posterior which is somewhat flattened; spire a little elevated for the genus; shell smooth except for faintly developed longitudinal lines of growth; suture distinct and appressed. The lower portion of body whorl merges into the base with a rounded angulation; surface of base below the angulation is deep and broad with the umbilical opening at its center. Dimensions: altitude of shell 5 mm.; altitude of spire 1.5 mm.; maximum diameter 4.5 mm.; angle of spire 90°. (Van Winkle)

*Observations.* This species is very small, with relatively high spire and flattened, wide body whorl.

*Holotype.* (U.W. 136) (C.A.S. 7527). Figured in the present report, pl. 67, fig. 28.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Upper Chehalis Valley, Lewis County, Washington.

*Type locality.* (U.W. 352.) Cut along Union Pacific Railway one mile north of Galvin Station, Lewis County, Washington, Section 27, T. 15 N., R. 3 W.

#### Genus POLINICES Montfort, 1810

*Polinices* Montfort, Conch. Syst., vol. 2, p. 222, 1810.

*Genotype.* *Polinices albus* Montfort.

**POLINICES (POLINICES) HORNII (Gabb), 1864**

Plate 68, figures 1, 2, 3; plate 100, figure 28

*Lunatia hornii* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 106, 224, pl. 29, fig. 217, 1864.*Lunatia hornii* Gabb, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 43, pl. 4, fig. 11, 1915.*Polinices hornii* Gabb, Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 324, 325, pl. 30, fig. 15, 1926.*Polinices hornii* (Gabb), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 88, pl. 19, figs. 8, 9, 1938.

*Original description.* Shell subglobose; spire small, acute, not prominent; whorls five, almost entirely enveloped, except for the newer portions of the penultimate volution. Aperture semilunar, rounded below; outer lip acute, nearly straight; columellar lip with a moderately large callus, thickened above, smaller and flat below, continuing as a thickened lip almost to the anterior end of the mouth. Umbilicus small, partially covered. Surface marked by irregular lines of growth. (Gabb)

A specimen chosen by Stewart (266-A, p. 324) as a lectotype (P.A.N.S. 4214) has the following dimensions: Altitude 32.5 mm.; diameter 33 mm.

*Lectotype.* (P.A.N.S. 4214.) A reproduction of Stewart's figure (266-A, pl. 30, fig. 15) is figured in the present report, pl. 100, fig. 28.

*Hypotype.* (U.C. 33744.) Figured in the present report, pl. 68, fig. 1.

*Hypotype.* (U.C. 33184.) Figured in the present report, pl. 68, figs. 2, 3.

*Geologic range.* Tejon and Cowlitz formations, upper Eocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Tejon Pass, California. Common in Cowlitz formation in lower Cowlitz Valley, Washington.

**POLINICES (POLINICES) VICTORIANA Clark and Arnold, 1923**

Plate 68, figures 10, 11, 12, 14

*Polinices (Euspira) victoriana* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 170, pl. 33, figs. 1a, 1b, 5a, 5b, 1923.

*Original description.* Shell heavy, globose, of moderate size and somewhat variable in outline. Number of whorls five; spire low, sutures rather strongly appressed. Surface smooth except for fairly heavy somewhat irregular incremental lines. Aperture subovate, inner lip thickened by a callus which spreads out wedge shaped on body whorl and is usually thickened near middle of inner lip opposite umbilical opening but below which it thins very rapidly. Dimensions of type specimen: height, about 30 mm.; greatest width of body whorl, 29 mm. (Clark and Arnold)

*Observations.* Specimens of this species show considerable variation in the character and extent of the callus, as has already been pointed out by Clark and Arnold. The callus opposite the umbilical opening is thick on the younger specimens but tends to disappear on fully grown individuals.

*Holotype.* (C.A.S. 582.) Figured in the present report, pl. 68, figs. 12, 14.

*Cotype.* (U.C. 30203.) Figured in the present report, pl. 68, figs. 10, 11.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* Sea cliffs east of mouth of Kirby Creek, six miles west of Sooke, Vancouver Island. (Clark and Arnold)

**POLINICES (POLINICES) RECTUS Tegland, 1933**

Plate 68, figures 15, 20

*Polinices (Euspira) rectus* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 139, 140, pl. 14, fig. 22, 1933.

*Original description.* Shell thin, smooth, ovate, with fine incremental lines. Whorls four, apical whorls lacking on holotype; earlier whorls rounded with sutures abutting. Body whorl obliquely ovate with definite shoulder and subconvex sides. Aperture ear-shaped; outer lip simple, thin; inner lip reflected into thin parietal callus which coalesces with funiculum without a sulcus and fills the umbilicus. Callus narrow but heavy. Dimensions: height, 14 mm.; diameter, 12 mm. (Tegland)

*Observations.* This species shows a close relationship to *P. washingtonensis* var. *lincolnensis* from the middle Oligocene of Washington but differs in the lesser obliqueness of the body whorl and in the smaller and narrower callus.

*Holotype.* (U.C. 32191.) Figured in the present report, pl. 68, figs. 15, 20.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Kitsap County, Puget Sound Basin, Washington.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, opposite Seattle.

**POLINICES (POLINICES) GESTERI (Dickerson), 1916**

Plate 68, figure 19

*Natica gesteri* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 496, pl. 38, fig. 6, 1916.

*Original description.* Shell small, high, with five whorls. The spire, one-fourth the shell length, has slightly convex, smooth whorls. The body-whorl which is unusually elongate for this genus is gently convex. Aperture semilunar; outer lip simple; inner lip incrusted; umbilicus small, narrow, resembling that of *Lunatia hornii* Gabb. The greater length of this species distinguishes it from other naticoid forms of the Tejon. Dimensions: Length, 15 mm.; width of body-whorl, 9 mm. (Dickerson)

*Observations.* This species, the holotype of which is from the Domengine formation in California, is characterized by its relatively great length and high spire. The holotype is figured. The specimens in Oregon occur at Glide in the lower Umpqua formation.

*Holotype.* (U.C. 11829.) Figured in the present report, pl. 68, fig. 19.

*Geologic range.* Upper Umpqua formation, middle Eocene of Oregon and Meganos formation in California.

*Geographic distribution.* Douglas County, Oregon, and Coast Ranges of middle California.

*Occurrence in Oregon.* (U.C. A-661.) On east bank of Little River between the highway bridge and the first bend of the stream east of the junction with North Umpqua River, Section 19, T. 26 S., R. 3 W.

*Type locality.* (U.C. 475.) Northeast quarter of southeast quarter of Section 22, T. 1 S., R. 1 W., Contra Costa County, California. (Dickerson)

**POLINICES (POLINICES) WASHINGTONENSIS (Weaver), 1916**

Plate 68, figures 18, 23

*Natica washingtonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 44, pl. 5, figs. 73, 74, 75, 76, 1916.

*Polinices washingtonensis* (Weaver), Clark and Anderson, Bull. Geol. Soc. Am., vol. 49, p. 954, pl. 3, figs. 16, 17, 1938.

*Original description.* Shell small, high and narrow; whorls four and one-half and sculptured only by moderately developed lines of growth. General outline and shape of shell is similar to *Natica lincolnensis* but differs from it in that the umbilical opening is entirely absent. Aperture semi-oval; inner lip heavily callused; the callus extends some distance from the inner lip over on to the surface of the shell. Dimensions: Altitude of shell 14 mm.; altitude of spire 3 mm.; maximum diameter of shell 11 mm.; angle of spire 60°. (Weaver)

*Observations.* This species from the middle Oligocene of Washington has the umbilical opening closed by a moderately heavy callus. In general form it is more elongate than *Natica (Tectonatica) oregonensis* (Conrad).

*Holotype.* (U.W. 103) (C.A.S. 7516). Figured in the present report, pl. 68, fig. 18.

*Paratype.* (U.W. 103-A) (C.A.S. 7516-A). Figured in the present report, pl. 68, fig. 23.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Upper Chehalis Valley, Lewis County, Washington.

*Type locality.* (U.W. 256.) Cut along Union Pacific Railway one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

**POLINICES (POLINICES) WASHINGTONENSIS (Weaver) var.  
LINCOLNENSIS (Weaver), 1916**

Plate 68, figure 22; plate 69, figures 4, 7

*Natica lincolnensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 44, 45, pl. 5, figs. 71, 72, 1916.

*Polinices lincolnensis* (Weaver), Effinger, Jour. Paleon., vol. 12, p. 377, 1938.

*Original description.* Shell very high, elongate-ovate and with five whorls; spire highly elevated but not so much as in the case of the "*Lunatia*" *oregonensis* Conrad which it in many respects resembles. Shell smooth except for moderately developed lines of growth; upper surface of body whorl slopes downwards very sharply so as to give the shell an elongate appearance; base conspicuously produced; inner lip strongly callused and the callus extending well on to the surface of the body whorl; outer lip thin and simple; umbilical opening large; aperture semi-oval; many specimens show distinct color banding. Dimensions: altitude, 30 mm.; altitude of spire 5 mm.; maximum diameter 24 mm.; angle of spire 100°. (Weaver)

*Observations.* This variety differs from *P. washingtonensis* in having the umbilicus widely open in contrast to the heavy deposit of callus which covers the umbilicus in the latter. This variety has been noted by Effinger as occurring in the Gries Ranch beds without the presence of *P. washingtonensis*. The fauna from the Wheatland formation exposed on the eastern side of the Sacramento Valley in California, which is considered as uppermost Eocene in age by Clark and Anderson, contains specimens which have been considered by them as *Polinices washingtonensis* (Weaver). They recognize the wide range in variation of this species and consider the specimens from Washington which were described as *Polinices lincolnensis* (Weaver) as falling within this range of variations. At many localities specimens having the characters of *P. lincolnensis* as originally described are present without the specimens resembling closely *P. washingtonensis*. Perhaps the former may be considered as a variety of the latter.

*Holotype.* (C.A.S. 463.) Figured in the present report, pl. 68, fig. 22.

*Cotype.* (U.W. 104-A) (C.A.S. 7515-A). Figured in the present report, pl. 69, figs. 4, 7.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Upper Chehalis Valley, Lewis County, Washington.

*Type locality.* (U.W. 256.) Cut in Union Pacific Railway one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

#### **POLINICES (POLINICES) HOTSONI Weaver and Palmer, 1922**

Plate 69, figures 1, 2

*Polinices hotsoni* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 32, pl. 9, figs. 14, 15, 1922.

*Polinices (Euspira) hotsoni* Weaver and Palmer, Clark, Bull. Geol. Soc. Am., vol. 49, p. 703, pl. 4, figs. 36, 41, 1938.

*Original description.* Shell large; spire short; suture distinct and appressed; whorls four in number; upper surfaces of the whorls slightly rounded to nearly straight; smooth except for lines of growth; body whorl very much elongated; callus thick, sometimes nearly covering the umbilical opening; umbilicus narrow and deep; aperture oblong.

This species is characterized by having the body whorl strikingly elevated with an elongate rather narrow aperture. Dimensions: altitude 25 mm.; width of body whorl 20 mm.; apical angle 97°. (Weaver and Palmer)

*Observations.* This species is common in both the Cowlitz formation of Washington and the Markley formation in the Coast Ranges of middle California. The character of the callus is closely related to that on *P. lewisii* (Gould) and it has been suggested by Clark that *P. hotsoni* may be ancestral to the latter species.

*Holotype.* (U.W. 193-A) (C.A.S. 7830). Type specimen located at Berkeley after printing of plates and not figured in this report. Specimen now at California Academy of Sciences.

*Hypotype.* (U.W. 193) (C.A.S. 7514). Figured in the present report, pl. 69, figs. 1, 2.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 370.) Scantigrease Falls, Cowlitz County, Section 18, T. 9 N., R. 2 W.

Subgenus **Neverita** Risso, 1826

*Neverita* Risso, Hist. Nat. Eur. Merid., vol. 4, p. 149, pl. 4, fig. 43, 1826.

*Subgenotype.* *Neverita josephina* Risso.

**POLINICES (NEVERITA) GLOBOSA** (Gabb), 1869

Plate 68, figures 21, 24; plate 69, figures 5, 6; plate 100, figure 29

*Neverita globosa* Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 161, pl. 27, fig. 39, 1869.

*Neverita globosa* Gabb, Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 326, 327, pl. 28, fig. 6, 1926.

*Neverita globosa* Gabb, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 89, pl. 19, figs. 6, 7, 13, 14, 15, 1938 (see synonymy).

*Original description.* Shell subglobose, spire low, acute; whorls rounded, five and a half, rapidly increasing in size, the last sloping above and slightly flattened on the side; umbilicus small but well marked. Aperture suboval, narrower above than below; outer lip simple, inner lip with a heavy callus, prominent above, slightly flattened on the inner face, the portion over the umbilicus flat, rather thin, and sometimes bearing a faint transverse groove. Length, 0.75 inch; width, 0.72 inch; length of aperture, 0.68 inch; width of aperture, 0.32 inch. (Gabb)

*Supplementary notes.* The Oregon specimens show a greater range of variation than has been observed at any California locality. On the one extreme the whorls are more angular and the spire more subdued and on the other are higher spires and whorls possessing but the slightest angulation at the shoulder. The size range is likewise greater in the northern representatives. (Turner)

*Holotype.* (Mus. Comp. Zool. 27859.) (Fide Stewart, 266A, p. 326.) A reproduction of the figured specimen of Stewart (266A, pl. 28, fig. 6) is figured in the present report, pl. 100, fig. 29.

*Hypotype.* (U.C. 33160.) From locality (U.C. A-662). Figured in the present report in duplicate, pl. 68, figs. 21, 24; plate 69, figs. 5, 6.

*Geologic range.* Umpqua formation in Oregon, middle Eocene; middle Eocene in California.

*Geographic distribution.* Coast Ranges of California and Oregon.

*Type locality.* "Ten miles west of Griswolds." Near New Idria, San Benito County, California. The hypotype figured by Turner on pl. 19, fig. 15, no 33160, was obtained from locality (U.C. A-662), Douglas County, Oregon, on east bank of Little River between the highway bridge and the first bend of the stream east of the junction with the North Umpqua River. Section 19, T. 26 S., R. 3 W. (Turner)

**POLINICES (NEVERITA) WEAVERI** (Dickerson), 1915

Plate 68, figures 16, 17; plate 69, figure 3

*Neverita weaveri* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 57, pl. 4, fig. 10a (not fig. 10b), 1915.

*Neverita weaveri* Dickerson, Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 326, 1926.

*Polinices weaveri* (Dickerson), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 88, pl. 20, figs. 14, 16, 1938.

*Original description.* Shell small, subglobose with very low spire of three whorls; aperture semilunar, entire; outer lip thin, curving backward; umbilicus completely covered in the type, a mature specimen, but partially open in young forms; outer lip and umbilicus in same plane which cuts axis of shell at a forty-five degree angle. Dimensions: Height, 9 mm.; width of body whorl, 11 mm. (Dickerson)

*Holotype.* (C.A.S. 278.) Figured in the present report, pl. 69, fig. 3.

*Hypotype.* (U.C. 33163.) Figured in the present report, pl. 68, figs. 16, 17.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 232.) In north bank of Cowlitz River one and one-half miles east of Vader, Lewis County, Washington.

**POLINICES (NEVERITA) NOMLANDI** (Dickerson), 1917

Plate 69, figures 8, 9, 12

*Neverita nomlandi* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 173, 174, pl. 30, figs. 2a, 2b, 1917; Effinger, Jour. Paleon., vol. 12, p. 377, 1938.

*Original description.* Shell medium in size, very wide, smooth, with nearly spire [sic]; spire whorls, minute, flat-sided; body-whorl with a nearly flat upper portion sloping from suture to middle, where whorl becomes more convex; aperture semilunar; outer lip thin; inner lip covered by a callus which is rounded in the umbilical space which it covers—in most cases completely. Dimensions:—Length, 13 mm.; width of body whorl, 17 mm. (Dickerson)

*Observations.* This species differs from *P. weaveri* in its average larger size and in that the callus does not cover the umbilical opening.

*Holotype.* (C.A.S. 411.) Figured in the present report, pl. 69, figs. 8, 9, 12.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 239.) In south bank of Cowlitz River at old Gries Ranch, Cowlitz County, Washington, northeast quarter of Section 25, T. 11 N., R. 2 W.

**POLINICES (NEVERITA) RECLUZIANA** (Deshayes) var. **VANCOUVERENSIS**

Clark and Arnold, 1923

Plate 70, figures 5, 6, 9

*Polinices (Neverita) recluziana* Deshayes var. *vancouverensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 169, pl. 33, figs. 2a, 2b, 3, 1923.

*Original description.* Shell fairly large, heavy, subspherical in outline; spire low; suture appressed. Body whorl large, regularly and rather strongly con-

vex; approximately eight-tenths height of shell. Surface smooth. Inner lip covered by broad flat callus which partly or fully covers broad umbilicus. A well defined groove extends across middle of callus as on typical *Natica recluziana*. Aperture broadly elliptical. Dimensions of type specimen: height 28.5 mm.; width 30 mm. (Clark and Arnold)

*Observations.* This species differs from the Recent *P. recluziana* in the absence of the spiral depression on the body whorl immediately below the suture and in the more spherical shape of the body whorl.

*Holotype.* (U.C. 30204.) Figured in the present report, pl. 70, figs. 5, 6.

*Cotype.* (C.A.S. 684.) Figured in the present report, pl. 70, fig. 9.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* In Sooke sandstone in sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

#### POLINICES (NEVERITA) SECTA (Gabb), 1864

Plate 70, figures 3, 4, 7, 8; plate 100, figure 30

*Neverita secta* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 108, 109, pl. 29, fig. 220, 1864.

*Neverita weaveri* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 4, fig. 10b (not pl. 4, fig. 10a), 1915.

*Neverita secta* Gabb, Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 325, 326, pl. 30, fig. 17, 1926.

*Original description.* Shell obliquely subglobose; spire moderately elevated; whorls five, almost entirely enveloped; apex acute; suture linear. Mouth acute behind, broadly rounded in advance; outer lip broadly rounded, acute; inner lip nearly straight, with moderately heavy callus, a portion of which is developed into a large triangular mass, which nearly fills the umbilicus; across this and below the middle is a well-marked transverse groove. Umbilicus broad but nearly closed. Surface marked by lines of growth. (Gabb)

Dimensions of holotype (P.A.N.S. 4212). Height 22 mm.; width 22.5 mm. (Stewart)

*Observations.* *P. (Neverita) secta* may be distinguished from *P. (Neverita) weaveri* (Dickerson) in its average large size and in having the sulcus on the callus and the umbilicus not entirely covered with callus.

*Holotype.* (P.A.N.S. 4212.) Reproduction of Stewart's figure (266-A, pl. 30, fig. 17). Figured in the present report, pl. 100, fig. 30.

*Hypotype.* (U.C. 33763.) From locality (U.C. 7162). Figured in the present report, pl. 70, figs. 3, 4, 8.

*Hypotype.* (C.A.S. 277.) Figured in the present report, pl. 70, fig. 7.

*Geologic range.* Tejon and Cowlitz formations, upper Eocene.

*Geographic distribution.* South end of San Joaquin Valley and Coast Ranges of California, and lower Cowlitz Valley, Washington.

*Type locality.* Tejon Pass, Kern County, California; occurs also (U.W. 232) in north bank of Cowlitz River one and one-half miles east of Vader, Lewis County, Section 28, T. 11 N., R. 2 W.

**POLINICES (NEVERITA) INEZANA (Conrad), 1857**

Plate 70, figure 15; plate 101, figures 7, 8, 9, 11

*Natica inezana* Conrad, Pac. R. R. Repts., vol. 8, p. 195, pl. 10, figs. 5, 6, 1857.

*Polinices (Neverita) inezana* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 87, 88, 1909 (discussion).

*Original description.* Subglobose; whorls five; spire prominent; volutions depressed or slightly channeled above, scalariform; umbilicus of ovata-acute outline, patentous toward the base. (Conrad)

*Observations.* The specimen (U.S.N.M. 153988) from the Empire formation at Coos Bay has been referred to by Dall as having "the open part of the umbilicus behind the umbilical (?) and to the left of it, with no dividing sulcus, and by these characters can be recognized at a glance." This specimen, from the Camman collection of Dall, closely resembles "*Natica*" *inezana* Conrad from the Santa Ynez Mountains of California, the holotype of which is figured in the present report on pl. 101, fig. 7.

A specimen figured by Reagan (230, pl. 3, fig. 28) as *Polinices (Neverita) recluziana* and now deposited in the U.S. National Museum as no. 328931 was re-examined by Dall (101, p. 309) and identified as *Neverita? inezana* Conrad. This specimen is figured in the present report, pl. 70, fig. 15.

*Holotype.* (U.S.N.M. 12539.) (From the Santa Ynez Mountains, California.) This specimen is figured in the present report, pl. 101, figs. 7, 9.

*Hypotype.* (U.S.N.M. 153988.) (Dall, pp. 87, 88.) Figured in the present report, pl. 101, figs. 8, 11.

*Hypotype.* (U.S.N.M. 328931.) Originally described by Reagan (230, pl. 3, fig. 28) and later discussed by Dall (101, p. 309); figured in the present report, pl. 70, fig. 15.

*Geologic range.* Astoria formation, middle Miocene; Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Santa Ynez Mountains, California and Coast Ranges of northwestern Oregon.

*Type locality.* Santa Ynez Mountains, California

**Subgenus *Euspira* Agassiz, 1838**

*Euspira* Agassiz, in Sowerby, Min. Conch. Gt. Brit., German ed., pp. 14, 320, 1838.

*Subgenotype.* *Natica glauconoides* Sowerby.

**POLINICES (EUSPIRA) NUCIFORMIS (Gabb), 1864**

Plate 70, figures 1, 2; plate 103, figure 2

*Lunaria nuciformis* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 107, 224, pl. 28, fig. 218, 1864.

*Euspira nuciformis* (Gabb), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 323, 324, pl. 30, fig. 16, 1926.

*Polinices (Euspira) nuciformis* (Gabb), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 88, pl. 20, figs. 4, 5, 1938; Clark, Bull. Geol. Soc. Am., vol. 49, pp. 703, 704, pl. 4, figs. 26, 31, 1938.

*Original description.* Shell small subglobose; spire moderately high; whorls not enveloped to such an extent as in the preceding species, five to six in number; the extreme apical whorl very minute. Mouth wide, broadly rounded in advance. Outer lip nearly straight, or slightly more prominent near the suture; inner lip simple, or but slightly thickened. Umbilicus open, deeply perforated. Surface marked only by lines of growth. (Gabb)

*Observations.* The species, which occurs in the Umpqua formation of southwest Oregon, ranges through much of the Eocene in California and is represented in the Cowlitz formation of Washington by the variety which was described by Dickerson as *cowlitzensis*.

*Lectotype.* (Stewart, 289, p. 323) (P.A.N.S. 4213). Reproduction of Stewart's lectotype (266A, pl. 30, fig. 16) figured in the present report, pl. 103, fig. 2.

*Hypotype.* (U.C. 33162) of Turner. Figured in the present report, pl. 70, figs. 1, 2.

*Geologic range.* Tejon and Umpqua formations, middle and upper Eocene.

*Geographic distribution.* Coast Ranges of California and Southwestern Oregon.

*Type locality.* Tejon Pass, Kern County, California. Abundant at locality (U.C. A-662). Douglas County, Oregon, on east bank of Little River between the highway bridge and the first bend of the stream east of junction with North Umpqua River, Section 19, T. 26 S., R. 3 W.

#### POLINICES (EUSPIRA) NUCIFORMIS (Gabb) var. COWLITZENSIS (Dickerson), 1915

Plate 69, figures 10, 11, 13, 14, 15, 16, 17, 18, 19

*Lunatia cowlitzensis* Dickerson, Proc. Calif. Acad. Sci. ser. 4, vol. 5, pp. 50, 57, pl. 4, figs. 12a, 12b, 1915.

*Lunatia cowlitzensis* Dickerson, Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 323, 324, 1926.

*Lunatia cowlitzensis* Dickerson, B. L. Clark, Bull. Geol. Soc. Am., vol. 49, p. 704, 1938.

*Original description.* Shell of medium size, high, with five rounded whorls; umbilical chink small, long, narrow; callus long, slightly widening above umbilical chink; aperture semilunar. Dimensions:—Length, 30 mm.; width of body-whorl, 21 mm. (Dickerson)

*Observations.* This variety may be distinguished from *P. nuciformis* (Gabb) by its stronger callus, more appressed suture, and in the aperture having a proportionately greater width than height.

*Holotype.* (C.A.S. 281.) Figured in the present report, pl. 69, figs. 10, 11, 15.

*Paratype.* (C.A.S. 282.) Figured in the present report, pl. 69, figs. 16, 17.

*Hypotype.* (U.C. 33733.) Figured in the present report, pl. 69, figs. 13, 14, 18, 19.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bend of Cowlitz River one mile east of Vader, Lewis County, Section 28, T. 11 N., R. 2 W.

## POLINICES (EUSPIRA) GALIANOI Dall, 1909

Plate 70, figures 11, 14

*Polinices (Euspira) galianoi* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 88, 89, pl. 5, figs. 12, 13, 1909; Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 93 and table, 1922.

*Polinices (Lunatia) lewisii* (Gould), Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 225, pl. 6, fig. 64, 1909.

*Polinices (Lunatia) galianoi* Dall, Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 314, 1922.

*Polinices (Euspira) galianoi* Dall, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 94, 95, pl. 12, figs. 1, 5, 8, 20, 1931.

*Polinices (Euspira) galianoi* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 805, 1931.

*Original description.* Shell of moderate size, solid, rather thick, moderately elevated, smooth except for the incremental lines and occasional faint spiral striae; external coat usually wanting, in which case the whorl in front of the suture seems narrowly tabulate or even channeled, while the spiral striation is much stronger and the incremental lines coarser and often elevated; normally there are about six whorls and the spire is somewhat dome shaped, the whorl appressed at an inconspicuous suture; umbilicus moderate, open, its upper angle near the pillar lip filled with a small subtriangular callus; aperture ovate, narrower above, a thin callus on the body, the outer lip thin, simple. Altitude of figured specimens (fig. 12), 54 mm., (fig. 13), 43 mm.; maximum diameter of the first, 48 mm. (Dall)

*Observations.* This species is extremely abundant in the Empire formation of Oregon and the Montesano formation of Washington. It varies considerably in shape of body whorl as well as in the amount of concealment of the umbilicus.

*Holotype.* (U.S.N.M. 153916.) Figured in the present report, pl. 70, fig. 11.

*Hypotype.* (U.C. 32002.) Figured in the present report, pl. 70, fig. 14.

*Geologic range.* Montesano and Empire formations, upper Miocene and lower Pliocene; Merced and Purisima formations, Pliocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Empire formation, Coos Bay, Oregon. (Dall)

## Genus AMAURELLINA "Bayle" Fischer, 1885

*Amaurellina* "Bayle" Fischer, Man. Conch., p. 766, 1885.

*Genotype.* *Amaurellina spirata* (Lamarck).

## Subgenus EUSPIROCROMMIUM Sacco, 1890

*Euspirocrommium* Sacco, Bull. Mus. Zool. Anat. Comp., Torino, vol. 5, p. 42, 1890.

*Subgenotype.* "*Natica*" *elongata* Michelotti.

**AMAURELLINA (EUSPIROCROMMIUM) CLARKI Stewart, 1926**

Plate 70, figures 10, 18

*Amauropsis alveata* (Conrad), Arnold, U.S. Geol. Surv., Bull. no. 396, p. 13, pl. 4, fig. 21, 1909; Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 5, fig. 9, 1915.

*Amaurellina (Euspirocrommium) clarki* Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 336, 337, 338, pl. 26, figs. 8, 9, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 86, pl. 20, fig. 3, 1938.

*Original description.* Shell large, rather heavy; spire high, apex broken, 6½ whorls present—possibly nine originally—early whorls rounded and suture linear and slightly channeled; penultimate whorl flattened posteriorly, shoulder rounded; body whorl with a distinct shoulder, sides slightly inflated, suture barely appressed; surface marked only with incremental lines, most prominent near the suture and inner lip; aperture large, biangulate posteriorly, rounded anteriorly; outer lip thin, broken, inner lip and umbilicus covered with a continuous callus. Height of holotype (fig. 8) Museum of Paleontology no. 31385 (incomplete) 42 mm.; width of body whorl, 31.3 mm. Width of specimen 31386 (fig. 9) 31.5 mm. (Stewart)

*Observations.* The specimens of this species from the Eocene of Oregon differ from the type from California in the irregular convex development of the spire, in contrast with the concave profile in specimens from California, and in having a moderately channeled suture.

*Hypotype.* (U.C. 33686.) Originally figured by Turner (Locality U.C. A-661) (pl. 20, fig. 3). Figured in the present report, pl. 70, figs. 10, 18.

*Geologic range.* Domengine formation in Simi Valley, California; Umpqua formation in Oregon, middle Eocene. Cowlitz formation, Washington, upper Eocene.

*Geographic distribution.* Coast Ranges of California and southwestern Oregon.

*Type locality.* (U.C. 7004.) Simi Valley, southern California. Occurs also in Douglas County, Oregon, Section 19, T. 26 S., R. 3 W.

**AMAURELLINA HENDONI Turner, 1938**

Plate 70, figures 12, 13, 16, 17

*Amauropsis alveata* (Conrad), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 115, 116, 1914.

*Amaurellina hendoni* Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 86, 87, pl. 20, figs. 7, 8, 11, 1938.

*Original description.* Shell naticoid, spire elevated, shoulder tabulate with or without fine spiral ornamentation, which, depending upon degree of development and weathering, may appear either as threads or grooves; body whorl occasionally striated and tending to show a break in curvature near the center, aperture auricular, inner lip straight, umbilicus open. Length, 23.8 mm.; diameter, 20.2 mm. (Turner)

Dimensions of holotype (U.C. 33630) : Length, 23.8 mm.; diameter, 20.2 mm.

Dimensions of paratype (U.C. 33177) : Length, 24.3 mm.; diameter, 22.5 mm.

*Observations.* This species is closely related to the California form, *A. moragai lajollaensis*, from the Domengine. It differs in its larger umbilicus, more globose shape, and less angulated shoulder.

*Holotype.* (U.C. 33630.) Figured in the present report, pl. 70, figs. 13, 16.

*Paratype.* (U.C. 33177.) Figured in the present report, pl. 70, figs. 12, 17.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* (U.C. A-661.) Douglas County, Oregon, center of Section 19, T. 26 S., R. 3 W.

**Genus AMPULLINA Bowdich, 1822**

*Ampullina* Bowdich, Elem. Conch., vol. 1, p. 31, 1822.

*Genotype.* *Ampullina depressa* Bowdich.

**AMPULLINA (CROMMIUM) ANDERSONI (Dickerson), 1914**

Plate 71, figures 1, 2, 3, 4

*Amauropsis andersoni* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 120, pl. 12, figs. 2a, 2b, 1914.

*Amauropsis umpquaensis* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 120, pl. 12, figs. 3a, 3b, 1914.

*Ampullina (Crommium) andersoni* (Dickerson), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 87, pl. 19, figs. 1, 2, 4, 5, 1938.

*Original description.* Shell of medium size, solid, thick, moderately elevated, smooth except for growth-lines, with five whorls; spire whorls rounded, their upper half being slightly tabulate, this tabulation better marked on the body-whorl but none of the specimens has this feature as well developed as *Amauropsis alveata* (Conrad). The body-whorl is decidedly globose with semilunar mouth; outer lip simple; inner lip slightly incrusted and nearly covering a small narrow umbilicus. Dimensions: Length, 27 mm.; width of body-whorl, 25 mm. (Dickerson)

*Original description (Amauropsis umpquaensis).* Shell large, solid, thick, much elevated, smooth except for incremental lines, with six or seven whorls; spire-whorls rounded and their upper third somewhat tabulated. This species is much longer than *A. andersoni* Dickerson or *A. alveata* Gabb, and the spire is much higher; body-whorl longer than the width; outer lip simple, with a marked shouldering at linear impressed suture; inner lip covered by a thin callus which nearly covers a small narrow umbilicus. Dimensions: Length, 41 mm.; width of body-whorl, 33 mm. (Dickerson)

*Observations.* As has been pointed out by Turner, many specimens from southwest Oregon have characteristics which grade one into the other and the differences which originally were used to separate the species, such as globosity, width of umbilicus, and height of spire, do not permit of this separation.

*Holotype.* (C.A.S. 244.) Figured in the present report, pl. 71, fig. 2.

*Holotype ("Amauropsis umpquaensis").* (C.A.S. 245.) Figured in the present report, pl. 71, fig. 1.

*Topotype.* (U.C. 33681.) Figured in the present report, pl. 71, figs. 3, 4.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* East bank of Little River at its junction with the Umpqua, Roseburg Quadrangle, Section 19, T. 26 S., R. 3 W.

**AMPULLINA SOOKENSIS** (Clark and Arnold), 1923

Plate 71, figures 5, 6

*Polinices (Ampullina?) sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 170, pl. 33, figs. 4a, 4b, 1923.

*Original description.* Shell medium in size, suborbicular; whorls five in number; spire about one-third height of shell. Suture slightly appressed. Whorls gently convex, greatest convexity near base of whorl. Aperture broadly subovate. Inner lip reflexed anteriorly and nearly covering the closed to subperforate umbilicus; posteriorly there is a thin wash of callus on body whorl. Dimensions of type: Height, 15 mm.; greatest width of body whorl, 12 mm.; height of body whorl, 10.5 mm. (Clark and Arnold)

*Observations.* This species is not easily confused with other species in the Sooke formation, but has a somewhat close relationship, as pointed out by Clark, to *A. gabbi* Clark, but differs in possessing a higher spire, a relatively smaller diameter of the body whorl, and a slightly appressed suture.

*Holotype.* (U.C. 30205.) Figured in the present report, pl. 71, figs. 5, 6.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* Sooke sandstone exposed in sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

Genus **AMAUROPSIS** Mörch, 1857

*Amauropsis* Mörch, Rink's Grönland, geographisk og statistisk beskrevet, Append., p. 81, 1857.

*Genotype.* *Natica helicoides* Johnson.

**AMAUROPSIS OREGONENSIS** (Dall), 1909

Plate 71, figures 7, 11

*Ampullina (Amauropsis) oregonensis* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 91, pl. 3, fig. 7, 1909.

*Amauropsis oregonensis* (Dall), Stewart, Acad. Nat. Sci. Phila., vol. 78, p. 332, 1926.

*Amauropsis oregonensis* (Dall), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 807, 1931.

*Original description.* Shell elevated, thin, with a narrowly channeled suture and about five whorls; apex rather blunt, whorls evenly rounded, recalling some of the species of *Campeloma*; surface smooth, almost polished, with one or two resting stages, indicated by slight axial ridges, on the last whorl; base rounded, with apparently no umbilical chink; aperture rounded, margin slightly oblique and somewhat thickened. Altitude, 19.5 mm.; maximum diameter, 14.5 mm. (Dall)

*Observations.* This species is represented by a single specimen in the U.S. National Museum. It may be distinguished from *A. blakeleyensis* in its higher spire, greater height compared to diameter, and lesser convexity of the body whorl.

*Holotype.* (U.S.N.M. 107780.) Figured in the present report, pl. 71, figs. 7, 11.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Coos Bay, Oregon. (Dall)

#### AMAUROPSIS BLAKELEYENSIS (Tegland), 1933

Plate 71, figure 10

*Polinices (Euspira) blakeleyensis* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 139, pl. 14, fig. 18, 1933.

*Original description.* Shell thin, smooth with fine growth lines. Number of whorls, four. Other lip thin, simple; inner lip with light callus which is simple and without sulcus. Umbilicus closed, growth lines simple and become tangent to the suture as they turn toward the aperture. Dimensions: height, 2.3 cm.; diameter, 2.24 cm. (Tegland)

*Observations.* As indicated by Tegland, this species is characterized by its elevated spire and in the growth lines being deflected toward the aperture and thereby becoming tangent to the suture. The body whorl is more tumid than in *A. oregonensis*.

*Holotype.* (U.C. 32216.) Figured in the present report, pl. 71, fig. 10.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Kitsap county, Puget Sound, Washington.

*Type locality.* (U.W. 13.) Restoration Point, opposite Seattle, Washington.

#### Genus CERNINA Gray, 1842

*Cernina* Gray, Syn. Brit. Mus., pp. 60, 90, 1842.

*Genotype.* *Natica fluctuata* G. B. Sowerby.

#### Subgenus EOCERNINA Gardner and Bowles, 1934

*Eocernina* Gardner and Bowles, Jour. Wash. Acad. Sci., vol. 24, no. 6, p. 243, 1934.

*Subgenotype.* *Natica hannibali* Dickerson.

#### CERNINA (EOCERNINA) HANNIBALI (Dickerson), 1914

Plate 71, figures 8, 9, 21, 23

*Natica hannibali* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 119, pl. 12, figs. 5a, 5b, 1914; Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, pl. 38, figs. 9a, 9b, 1916.

*Natica (Cryptonatica) hannibali* Dickerson, Waring, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pl. 15, figs. 21-23, 1917.

*Ampullina hannibali* (Dickerson), M. A. Hanna, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 306, pl. 48, figs. 1, 2, 3, 10, 1927.

*Globularia hannibali* Dickerson, Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 331, 1926.

*Cernina (Eocernina) hannibali* (Dickerson), Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 87, 88, pl. 19, fig. 3, 1938.

*Original description.* Shell large, with low, partially immersed spire and very large subquadrate body-whorl; whorls five or six in number, the penultimate whorl partially covered by body-whorl; upper portion of body-whorl and the penultimate whorl forming a somewhat flattened surface above which the small spire rises abruptly; sides of spire-whorls only slightly convex and sloping away from the immersed linear suture with a uniform angle; the portion of the body-whorl near the suture rising above the suture and forming a distinct ridge; the portion of the whorl a short distance below this ridge concave, making a groove similar to that of the genus *Gyrodes*; a marked swelling below this groove making a shoulder about a third of the whorl length below the suture; anterior two-thirds of body-whorl only slightly convex; peculiar incremental lines mark the body-whorl and further emphasize its peculiarities; these lines bowed forward in the vicinity of the groove and outward on the lower portion of the whorl; outer lip simple; inner lip incrusted by a thin callus which completely covers the umbilicus, which is continuous with the outer lip; mouth very narrow anteriorly but very broad near the base. Dimensions: Length, 42 mm.; width of body-whorl, 35 mm. (Dickerson)

*Observations.* This species is conspicuous by the large size of mature individuals, relatively low spire, somewhat extended outer lip, and the complete covering of the umbilicus by a coating of callus.

*Holotype.* (C.A.S. 243.) Figured in the present report, pl. 71, figs. 8, 9.

*Hypotype.* (U.C. 33684) (Specimen of Turner, from Glide, Oregon). Figured in the present report, pl. 71, figs. 21, 23.

*Geologic range.* Domengine formation of California and Umpqua formation of southwestern Oregon.

*Geographic distribution.* Coast Ranges of California and Oregon.

*Type locality.* Douglas County, Oregon, in the east bank of Little River at its junction with the Umpqua, Section 19, T. 26 S., R. 3 W.

#### Genus SINUM ("Bolten") Roeding, 1798

*Sinum* Roeding, in Bolten, Mus. Boltenianum, pt. 2, p. 14, 1798.

*Genotype.* *Helix haliotoides* Linnaeus.

#### SINUM SCOPULOSUM (Conrad), 1849

Plate 71, figures 12, 14, 17, 18

*Sigaretus scopulosis* Conrad, U.S. Explor. Exped. Geol., p. 727, pl. 19, figs. 6, 6a, 1849; Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 155, 1909 (reprint); Reagan, Trans. Kansas Acad. Sci., vol. 22, pp. 172, 194, pl. 3, fig. 30, 1909.

*Sinum scopulosum* (Conrad), Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 91, 92, pl. 4, fig. 10; pl. 5, fig. 8, 1909; Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 327, 328, pl. 32, fig. 4, 1926; Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 806, 1931; Dall, Am. Jour. Sci., vol. 4, p. 309, 1922; Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 95, 96, pl. 12, fig. 13, 1931; Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 140, pl. 14, fig. 23, 1933.

*Original description.* Obliquely oval, somewhat ventricose, flattened on the upper half of the body whorl. Disks with numerous revolving lines. (Conrad)

*Supplementary description.* Shell of moderate size, obconic, solid, of three or more rapidly enlarging whorls; last whorl much the largest; nucleus minute, of one whorl, smooth; aperture ample, oblique, at angle of 45° to the vertical of the axis; suture distinct, appressed; surface sculptured with narrow straplike spirals (about three to 1 mm.) separated by narrow channeled sulci, and crossed by more or less evident incremental lines; base and periphery rounded; base excavated behind the gyrate pillar lip, but not showing any umbilical chink so far as can be determined; outer lip simple; body with no marked callosity. Altitude, about 24 mm.; maximum diameter, 25 mm. (Dall, 101, p. 92)

*Observations.* This supposedly long-range species shows considerable variation in different localities and from strata of different ages. Specimens from the upper Oligocene at Blakeley are flatter and have a greater diameter than those from the Astoria formation. Specimen (U.S.N.M. 3553) which was collected by J. D. Dana at Astoria, Oregon, and which was described by Conrad in the reports of the Wilkes Exploring Expedition on p. 727 and figured on pl. 19, figs. 6, 6a, is fairly well preserved and shows fine revolving striae. The spire is very low. Dimensions: altitude, 21 mm.; diameter, 22 mm.

*Holotype.* (U.S.N.M. 3553.) Figured in the present report, pl. 71, figs. 12, 14.

*Hypotype.* (U.S.N.M. 153913) (Dall). Figured in the present report, pl. 71, fig. 18.

*Hypotype.* (U.C. 33003.) Figured in the present report, pl. 71, fig. 17.

*Geologic range.* Middle and upper Miocene and lower Pliocene; common in Astoria formation in Oregon and Washington.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Astoria formation, Astoria, Oregon.

#### SINUM OBLIQUUM (Gabb), 1864

Plate 71, figure 13; plate 103, figure 6

*Naticina obliqua* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 109, 225, pl. 21, fig. 112, 1864; Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, figs. 5a, 5b, 1915.

*Sinum obliquum* (Gabb), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 327, pl. 30, fig. 7a; Clark, Bull. Geol. Soc. Am., vol. 49, p. 704, pl. 3, figs. 32, 37, 1908.

*Original description.* Shell small, oblique; spire slightly prominent; whorls four, rapidly increasing in size; suture faintly canalicular. Surface marked by numerous compound revolving lines, minutely waved laterally, and showing a tendency to an alternation of larger and smaller ones; these are crossed by irregular lines of growth, which completely encircle the whorls, and are most distinct and crowded in the umbilicus. Aperture patulous, acute behind. Inner lip slightly thickened, and forming a small incrustation on the preceding whorl. Umbilicus moderate in size. (Gabb)

*Observations.* This early Tertiary species differs from the later Tertiary form *S. scopulosum* in its proportionately lower spire, its compound slightly wavy spiral ribs, and alternation in size of the spiral ribs.

*Lectotype of Stewart.* (P.A.N.S. 4215.) Reproduction of specimen figured by Stewart (266-A, pl. 30, fig. 7a). Figured in the present report, pl. 103, fig. 6.

*Hypotype.* (U.C. 23796) (locality U.C. 7161). Figured in the present report, pl. 71, fig. 13.

*Geologic range.* Tejon and Cowlitz formations, upper Eocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Tejon Pass, Kern County, California.

#### SINUM OCCIDENTIS Weaver and Palmer, 1922

Plate 71, figure 15

*Sinum occidentis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, pp. 32, 33, pl. 11, figs. 8, 26, 1922.

*Original description.* Shell large, depressed, body whorl spreading, spire low; suture appressed; aperture distended; whorls three, sculptured by numerous, spiral striae of equal prominence; interspaces about equal to the width of the striae; basal portion of the body whorl smooth except for the lines of growth crowding at the umbilical area; umbilicus slight. Dimensions.—Altitude 8 mm.; length of body whorl 15 mm.; width of body whorl 12 mm. (Weaver and Palmer)

*Observations.* This upper Eocene species from Washington resembles closely *S. obliquum* but has a relatively lesser height and lacks the alternation in size of the spiral ribs.

*Holotype.* (U.W. 194) (C.A.S. 7509). Figured in the present report, pl. 71, fig. 15.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 319.) McClarity Ranch on south bank of Stillwater Creek, 1 mile west of Vader, Lewis County, Section 30, T. 11 N., R. 2 W.

#### Family CALYPTRAEIDAE

##### Genus CALYPTRAEA Lamarck, 1799

*Calyptraea* Lamarck, Mem. Soc. Hist. Nat. Paris, vol. 1, p. 78, 1799.

*Genotype.* *Patella chinensis* Linnaeus.

##### CALYPTRAEA DIEGOANA (Conrad), 1855

Plate 71, figures 16, 20; plate 103, figure 3

*Trochita diegoana* Conrad, U.S. 33d Cong., 1st Sess., H. Ex. Doc. 129, Appendix to Preliminary Geol. Rept. of W. P. Blake, pp. 7, 17, 1855; Rept. Pac. R. R. Surv., vol. 5, pt. 2, pp. 319, 327, pl. 5, fig. 42, 1857.

*Galerus excentricus* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 136, 228, pl. 20, fig. 95; pl. 29, figs. 232, 232a, 1864.

*Calyptraea excentrica* (Gabb), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, 1914.

*Calyptraea diegoensis* (Conrad), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 340, 341, pl. 27, fig. 15, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 89, 90, pl. 20, figs. 1, 2, 1938; Effinger, Jour. Paleon., vol. 12, p. 378, 1938.

*Original description.* Conical; volutions three, rounded, smooth; body whorl ventricose. (Conrad)

*Observations.* It has been pointed out by Stewart that probably all the Eocene specimens of this genus from California, Oregon, and Washington belong to the species *C. diegoana* which exhibits considerable variation geographically. This species has a long time range and wide geographical distribution and generally individuals are extremely abundant at most localities. The more important characters involved in variation are height, convexity of whorls, and position of apex and spire in respect to diameter of shell. Stewart (266A, p. 340) has called attention to close resemblance of this species to "*Galerus excentricus*" Gabb which probably is specifically equivalent to *C. diegoana*. The specimen (U.S. N.M. 4235) selected by Stewart as the lectotype of *C. diegoana* which came from the upper Eocene of southern California has been figured by Stewart (266-A, pl. 27, fig. 15) and is reproduced in this Northwest report on pl. 103, fig. 3. Dimensions: height, 52.7 mm.; maximum diameter, 20.4 mm.

*Lectotype.* (U.S.N.M. 4235.) Reproduction of specimen figured by Stewart (266-A, pl. 27, fig. 15). Figured in the present report, pl. 103, fig. 3.

*Hypotypes.* (U.C. 33719) (U.C. 33717). Figured in the present report, pl. 71, figs. 16, 20.

*Geologic range.* Middle and upper Eocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Probably San Diego County, California.

#### CALYPTRAEA WASHINGTONENSIS Weaver, 1916

Plate 71, figures 19, 22

*Calyptrea washingtonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 44, pl. 3, fig. 44, 1916.

*Calyptrea washingtonensis* Weaver, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 137, pl. 14, fig. 25, 1933.

*Original description.* Shell averages medium size for the genus; nearly circular in outline; apex very slightly excentric; spire moderately elevated; whorls four and one half; shell thin and sculptured by well developed lines of growth; radial sculpture entirely absent; aperture semi-elliptical. This species is much shorter than *Calyptrea excentrica* (Gabb) and is only very slightly excentric. Dimensions. Altitude of shell 9 mm.; altitude of spire 5 mm.; maximum diameter of shell 21 mm.; angle of spire 55°. (Weaver)

*Observations.* This form which occurs in the middle Oligocene of Washington may be a variety of *C. diegoana*. It is more concentric, and has a more circular outline than the Eocene specimens; the septum in nearly all the Oligocene specimens is more convex with a more sinuous edge.

*Holotype.* (U.W. 102) (C.A.S. 461-B). Figured in the present report, pl. 71, fig. 22.

*Hypotype.* (U.C. 32187.) From Blakeley formation (Tegland, 272, pl. 14, fig. 25.) Figured in the present report, pl. 71, fig. 19.

*Geologic range.* Lincoln and Blakeley formations, middle and upper Oligocene.

*Geographic distribution.* Western Washington and Oregon.

*Type locality.* (U.W. 256.) Cut along Union Pacific Railway 1 mile north of Galvin Station, Lewis County, Washington, Section 27, T. 15 N., R. 3 W.

**CALYPTREA MAMMILLARIS Broderip subsp. VANCOUVERENSIS Clark and Arnold, 1923**

Plate 72, figures 5, 7

*Calyptrea (Galerus) mammillaris* Broderip subsp. *vancouverensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 167, pl. 36, figs. 3a, 3b, 1923.

*Original description.* Shell large, heavy; apex usually rather blunt, excentric on all specimens examined; whorls three to four; sutures obscure. Surface smooth except for heavy incremental lines; septum heavy and well developed. Dimensions of type: Height of shell, about 35 mm.; greatest width of body whorl, about 61 mm. (Clark and Arnold)

*Observations.* The subspecies *vancouverensis* may be distinguished from the Recent *C. mammillaris* in possessing a more prominent excentric apex and minor differences in the edge of the septum.

*Holotype.* (U.C. 30072.) Figured in the present report, pl. 72, figs. 5, 7.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* Sooke sandstone exposed in sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

**CALYPTREA SOOKENSIS Clark and Arnold, 1923**

Plate 72, figures 1, 3, 4

*Calyptrea sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 168, pl. 36, figs. 1a, 1b, 2, 1923.

*Original description.* Shell medium in size; apical angle variable; some specimens fairly high with steep sides, others very low and flattened; apex acute, central or nearly so; whorls four; sides of whorls flat to slightly convex; sutures obscure. Surface covered by numerous medium coarse radiating ribs, with inter-spaces averaging about equal to width of ribs. Septum well developed; long, gentle convexity near middle of anterior edge of septum, and between this and other edge is a deeper but shorter concavity. Dimensions of type specimen: height, 11 mm.; greatest width of body whorl, 27 mm. (Clark and Arnold)

*Observations.* This upper Oligocene species from Vancouver Island differs from *C. filosa* of the Miocene of California in having heavier spiral

ribs and wider interspaces, and from *C. mammillaris* subsp. *vancouverensis* in having ornamentation consisting of radiating ribs.

*Holotype.* (U.C. 30080.) Figured in the present report, pl. 72, figs. 3, 4.

*Cotype.* (U.C. 30237.) Figured in the present report, pl. 72, fig. 1.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* Sooke sandstone exposed in sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

#### CALYPTREA INORNATA (Gabb), 1866

Plate 72, figures 2, 6; plate 103, figure 16

*Trochita inornata* Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 51, pl. 14, figs. 8, 8a, 1866.

*Calyptrea (Trochita) inornata* Gabb, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 82, pl. 5, figs. 6, 7; pl. 6, fig. 4, 1909.

*Trochita inornata* Gabb, Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 195, pl. 3, fig. 31, 1909; Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 310, 1922.

*Original description* (*Trochita inornata*). Shell low, irregular, slightly oblique, nearly circular; volutions about two to two and a half; suture linear, indistinct; surface entirely without ornament, bearing only a few lines of growth; margin of internal plate sinuous. Diameter, 1.1 inch; height, .6 inch. (Gabb)

*Supplementary description* (*Calyptrea inornata*). Shell large, rather elevated, having about three whorls, the last of which is much the largest; form in general as figured, apex defective in all the specimens; shell thin, smooth except for lines of growth, but with irregularities due to its individual situs in each case; internal plate smooth, concave, its reflection forming a narrow umbilical chink; convexity of the whorls varying in different individuals, in some marked, in others the slope from the apex to the margin is nearly flat. Altitude of largest specimen, about 14 mm. (decapitate); latitude, 40 mm. Another specimen with more convex whorls has an altitude of 16 mm. and a maximum latitude of 32 mm. (Dall)

*Observations.* The specimens on the Pacific Coast, both Tertiary and Recent, which have been referred to as *Calyptrea inornata* (Gabb) and *C. mammillaris* Broderip show marked variations in form of shell, in part due to differences in physical conditions of environment. A biologic study of the species may result in the establishment of several subspecies. Stewart (266-A, p. 341) considered that *C. inornata* might be a subspecies of *C. mammillaris*.

*Holotype.* (P.A.N.S. 4339.) A reproduction of the figure by Stewart (266A, pl. 32, fig. 10) is figured in the present report, pl. 103, fig. 16.

*Hypotype.* (U.S.N.M. 153921.) Figured in the present report, pl. 72, figs. 2, 6.

*Geologic range.* Pliocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* From the Purisima formation at Half Moon Bay, California. Occurs also at Rocky Point, Coos Bay, Oregon. (Dall)

## Family HIPPONICIDAE

## Genus HIPPONIX De France, 1819

*Hipponeix* De France, Jour. Phys. Chim. Hist. Nat. Arts, vol. 88, p. 217, 1819.

*Genotype.* *Patella cornucopia* Lamarck.

## HIPPONIX ARNOLDI Dickerson, 1917

## Plate 72, figure 8

*Hipponeix arnoldi* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 180, 181, p. 31, figs. 10a, 10b, 10c, 10d, 1917.

*Hipponeix arnoldi* Dickerson, Effinger, Jour. Paleon., p. 379, pl. 47, fig. 8, 1938.

*Original description.* Shell oval, low with anterior meeting dorsal surface at an acute angle at apex; growth stages very prominently marked by shingle-like edges of the successive margins; a great number of very fine radial lines roughly alternating in size further decorate the shell. Dimensions:—Length, 13 mm.; height, 3.5 mm. (Dickerson)

*Observations.* *H. arnoldi* was considered by Effinger as a distinct species but represented by many variations, as in the changing position of the apex and in the strength and character of the radiating ribs as well as other details of ornamentation.

*Syntype.* (C.A.S. 436.) Figured in the present report, pl. 72, fig. 8.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) North bank of Cowlitz River at old Gries Ranch in northeast quarter of Section 25, T. 11 N., R. 2 W.

## HIPPONIX ARNOLDI Dickerson var. ORNATA Dickerson, 1917

## Plate 72, figure 11

*Hipponeix ornata* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 181, pl. 31, figs. 12a, 12b, 1917.

*Original description.* Shell with high apex bent forward so that it distinctly overhangs anterior; anterior end is vertical; posterior slope meeting base at an angle of about 30 degrees; very numerous, subequal rounded radial ribs which become nodose at junction with concentric growth lines forming principal decoration. Dimensions:—Length, 10.5 mm.; height, 5 mm. (Dickerson)

*Observations.* The variety *ornata* may be distinguished from *H. arnoldi* in its slightly greater height, forward attenuation of the apex, and the slight development of nodose ribs where they intersect the concentric lines of growth.

*Holotype.* (C.A.S. 439.) Figured in the present report, pl. 72, fig. 11.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 239.) On south bank of Cowlitz River at old Gries Ranch in northeast quarter of Section 25, T. 11 N., R. 2 W.

## Family CREPIDULIDAE

Genus **CREPIDULA** Lamarck, 1799*Crepidula* Lamarck, Mem. Soc. Hist. Nat. Paris, ser. 1, vol. 1, p. 78, 1799.*Genotype.* *Patella fornicata* Linnaeus.**CREPIDULA PILEUM** (Gabb), 1864

Plate 72, figures 10, 16; plate 103, figure 15

*Crypta (Spirocrypta) pileum* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 137, 228, pl. 29, figs. 233a, 233b, 1864.*Crepidula pileum* (Gabb), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 341, 342, pl. 29, figs. 2, 3, 1926 (synonymy).*Crepidula pileum* (Gabb), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 90, pl. 20, fig. 6, 1938.*Crepidula (Spirocrypta) pileum* (Gabb), Clark, Bull. Geol. Soc. Am., vol. 49, pp. 701, 702, pl. 4, fig. 19, 1938.*Crepidula pileum* (Gabb), Effinger, Jour. Paleon., vol. 12, p. 378, 1938.

*Original description.* Shell deep, usually more or less oblique; whorls about one and a half, increasing very rapidly in size. Surface marked only by very fine lines of growth. Margin of the internal plate concave at the sides, convex in the middle, surface concave; the upper or right hand edge curved downwards abruptly, and uniting with the side at an acute angle; the posterior portion of the plate running up spirally into the apex. (Gabb)

*Observations.* This species which is common in the Cowlitz formation and the Gries Ranch beds may be distinguished from *C. inornata* Dickerson, a middle Eocene species, in that the spiral end is low and uncoils against the shell whereas in the latter species it is somewhat elevated above the shell.

*Lectotype.* (P.A.N.S. 4221) (Stewart, 266-A, pl. 29, fig. 3). Figured in the present report, pl. 103, fig. 15.

*Hypotype.* (U.C. 33217.) Lower Coaledo formation, locality (U.C. A-858). Figured in the present report, pl. 72, fig. 10.

*Hypotype.* (U.C. 33722.) Figured in the present report, pl. 72, fig. 16.

*Geologic range.* Tejon and Cowlitz formations, upper Eocene. In Gries Ranch beds (Gries Ranch beds, Effinger), lowermost Oligocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Tejon Pass, Kern County, California.

**CREPIDULA PILEUM** (Gabb) var. **DICKERSONI** Weaver and Palmer, 1922

Plate 72, figures 14, 17

*Crepidula* n. sp. Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 5, figs. 6a, 6b, 1915.*Crepidula dickersoni* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 31, pl. 11, fig. 2; pl. 12, fig. 9, 1922.

*Original description.* Shell small to medium in size; sub-ovate; whorls about three and smooth except for lines of growth; spire twisted, apex raised above the

margin of the body whorl; shell varies in height; septum well developed, extending about half the length of the shell, outer half of the margin of the septum convex, inner half concave. Dimensions: Altitude (length) 12 mm.; width of body whorl 10 mm.; height above base 6 mm. (These measurements were taken on the largest specimen.) (Weaver and Palmer)

*Observations.* This variety is distinguished from *C. pileum* in the greater elevation of the apex above the margin of the aperture of the body whorl, which character seems to be constant among large numbers of specimens examined.

*Holotype.* (U.W. 191) (C.A.S. 7596). Figured in the present report, pl. 72, figs. 14, 17.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* (U.W. 329.) North bank of Cowlitz River 1 mile east of Vader, Lewis County, Section 28, T. 11 N., R. 2 W.

#### CREPIDULA STILLWATERENSIS Weaver and Palmer, 1922

*Crepidula stillwaterensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, pp. 31, 32, pl. 11, fig. 24, 1922.

*Original description.* Shell large and globose; whorls two, smooth; anterior end rising abruptly and only slightly convex on top; spire not twisted; apex situated just above the margin of the shell; body whorl elevated. Dimensions.—Altitude 15 mm.; width of body whorl 12 mm.; height 10 mm. (Weaver and Palmer)

*Observations.* This species differs from *C. pileum dickersoni* in the relatively lower position of the apex from the margin of the aperture, and from *C. pileum* in having two instead of three whorls on the spire and in the strong convexity of the body whorl.

*Holotype.* (U.W. 192) (C.A.S. 7597). Lost. Not figured in the present report.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 320.) South bank of Stillwater Creek, below graveyard, one and one-fourth miles west of Vader, Lewis County, Section 30, T. 11 N., R. 2 W.

#### CREPIDULA SOOKENSIS Clark and Arnold, 1923

Plate 72, figures 9, 12, 18

*Crepidula sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 166, 167, pl. 32, figs. 2a, 2b, 3; pl. 35, figs. 5a, 5b, 1923.

*Original description.* Shell fairly large, heavy, variable in outline, larger specimens usually strongly ventricose and dorsal convexity rather narrow; smaller specimens vary from low, flat to strongly and broadly ventricose forms. Apex rather inconspicuous but on larger specimens very close to edge of aperture, on others about a quarter of distance between aperture and highest point of convexity. Aperture broadly ovate in outline; septum well developed, smooth, with surface varying from flat to fairly strongly concave, usually occupying more than

half area of aperture; anterior edge of septum broadly emarginate as figured; emargination shows considerable variation. Surface of the shell smooth except for heavy incremental lines. Dimensions of type specimen: Length, 53 mm.; height, 29 mm. (Clark and Arnold)

*Observations.* *C. sookensis* differs from *C. princeps* in its relatively inconspicuous apex, which is twisted laterally instead of upward. Although each of these species varies greatly, *C. sookensis* is proportionately shorter.

*Holotype.* (U.C. 30293.) Figured in the present report, pl. 72, figs. 12, 18.

*Syntype.* (C.A.S. 580.) Figured in the present report, pl. 72, fig. 9.

*Geologic range.* Sooke formation, upper Oligocene

*Geographic distribution.* South side Vancouver Island.

*Type locality.* Sooke sandstone exposed in the sea cliffs between the mouths of Muir and Kirby creeks west of Otter Point, Sooke Bay, Vancouver Island. (Clark and Arnold)

#### CREPIDULA PRINCEPS Conrad, 1856

Plate 73, figures 4, 13, 14

*Crepidula princeps* Conrad, Rept. Pac. R. R. Surv., vol. 5, p. 326, pl. 6, figs. 52, 52a, 1856; Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 84, pl. 8, figs. 1-4; pl. 9, fig. 5; pl. 10, fig. 2, 1909; Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 789, 790, 1931 (see synonymy).

*Original description.* Oblong ovate, thick and ponderous, contracted or compressed superiorly; upper side or portion of the shell sloping; back regularly rounded; beak prominent, rounded, laterally curved; apex distant from the margin of the aperture; diaphragm very large, with a very sinuous margin. (Conrad)

*Supplementary description.* Shell large, pretty uniform in character, of about one and a half whorls; nucleus wanting, the apex curved sharply in and up; between the first and second whorls a wide deep sulcus; surface marked by more or less conspicuous incremental lines; upper surface of the last whorl flattish, periphery evenly rounded, a wide very shallow, inconspicuous sulcus in front of the suture near the aperture, opposite the right-hand end of the internal septum; this sulcus is more or less conspicuous according to the individual, but traces may almost invariably be noted; aperture entire, the margin simple, anteriorly sharp, posteriorly merging into a sort of broad pillar lip, especially in senile specimens; aperture ovate, short, nearly circular; septum wide, smooth, concave, occupying nearly half of the area of the aperture, its ends produced, especially on the left, its edge widely emarginate as figured. Length of adult specimen, 82 mm.; of aperture, 56 mm.; maximum width of specimen, 54 mm.; aperture, 44 mm.; altitude, 32 mm. (Dall)

*Hypotypes.* (U.S.N.M. 153967.) Figured in the present report, pl. 73, fig. 13; (U.S.N.M. 498452), on pl. 73, fig. 14; (U.C. 31989) on pl. 73, fig. 4.

*Geologic range.* Empire and Montesano formations in Oregon and Washington, upper Miocene and lower Pliocene. Pliocene and Pleistocene of California, Oregon, and Washington.

*Type locality.* "Santa Barbara," California. Pleistocene. Abundant at Fossil Rock, Coos Bay, Oregon, in the Empire formation.

**CREPIDULA PRAERUPTA Conrad, 1849**

Plate 73, figures 1, 2, 3

*Crepidula praerupta* Conrad, U.S. Explor. Exped. Geol., p. 727, pl. 19, figs. 9, 9a, 10a, 10b, 1849.

*Crepidula praerupta* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 83, pl. 7, fig. 8, 1909.

*Crepidula (Crepidula) praerupta* Conrad, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 92, pl. 11, figs. 2, 15, 1931 (see synonymy).

*Original description.* Oblique, oblong, somewhat elliptical and ventricose, with simple lines of growth. Sides flattened, beak narrowed and laterally curved; the side toward which the apex is directed, slightly contracted, and having a somewhat sinuous margin. (Conrad)

*Supplementary description.* Shell of moderate size, solid, ovate, of about one whorl; surface smooth except for irregular lines of growth; apex low, blunt, adherent, with no sutural sulcus, the extreme point of the shell elevated above the plane of the aperture, in the specimen figured, to an extent equal to about half the total height of the shell; margin simple, interior obstructed by matrix. Longitude, 30 mm.; maximum latitude, 20 mm.; altitude, 12 mm. (Dall, 101)

*Observations.* This species differs from *C. princeps* in its thicker and more bluntly pointed apex, its appressed apex, and more inflated shell. The specimen collected at Astoria by J. D. Dana and described and figured by Conrad (68, pl. 19, fig. 9) is figured in this report on pl. 73, fig. 2.

*Holotype.* (U.S.N.M. 3564.) Figured in the present report, pl. 73, fig. 2.

*Hypotypes.* (U.S.N.M. 153925-B.) Figured in the present report, pl. 73, fig. 1; (U.C. 31987), on pl. 73, fig. 3.

*Geologic range.* Astoria and Empire formations, middle and upper Miocene and lower Pliocene.

*Geographic distribution.* Coast Ranges of Oregon and Washington.

*Type locality.* Astoria, Oregon, in Astoria formation.

**CREPIDULA (CREPIDULA) ROSTRALIS (Conrad), 1849**

Plate 72, figures 13, 15

*Crepidula* sp. (?) Conrad, U.S. Explor. Exped. Geol., pl. 19, figs. 11a, 11b, 1849.

*Crepidula rostralis* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 83; reprint, p. 155, 1909.

*Crepidula praerupta* Conrad, Anderson, Proc. Calif. Acad. Sci., ser. 3 (Geology), vol. 2, p. 204, pl. 16, figs. 68, 69, 1905.

*Crepidula (Crepidula) rostralis* Conrad, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 91, pl. 11, figs. 9, 10, 11, 1931.

*Original description.* This species, of which there is only a cast in the collection, is very much depressed, with the summit narrow and nearly straight, subacuminate, broadest across the beak, the sides there being somewhat dilated. (Conrad)

*Observations.* This species differs from *C. praerupta* in that the tip of the beak touches the outer lip of the shell and is not directed along

the outer lip as in the latter. The holotype (U.S.N.M. 110447) was collected by J. D. Dana in 1842 at Astoria, Oregon, and later in 1849 was described and figured by Conrad as *Crepidula* sp. (Reports on the Geology of the Wilkes Exploring Expedition, pl. 19, figs. 11a, 11b).

*Holotype.* (U.S.N.M. 110447.) Specimen collected by J. D. Dana, no. 22. Figured in the present report, pl. 72, fig. 15.

*Hypotype.* (U.C. 31985.) Locality (U.W. 425). Figured in the present report, pl. 72, fig. 13.

*Geologic range.* Astoria and Temblor formations, middle Miocene.

*Geographic distribution.* Northwestern Oregon and southwestern Washington; Kern River Miocene, southern California.

*Type locality.* Astoria, Oregon.

#### CREPIDULA UNGANA Dall, 1904

Plate 73, figure 5

*Crepidula ungana* Dall, Harriman Alaska Exped., vol. 14, p. 119, pl. 10, figs. 8, 9, 1904.

*Crepidula ungana* Dall, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 137, pl. 14, figs. 1, 2, 1933.

*Original description.* Shell about the size of *C. fornicate* Lam., ovate, vertically somewhat compressed, having about a whorl and a half; surface rudely and irregularly concentrically sculptured by the incremental lines, without spines or spiral sculpture; apex small, narrow and recurved to half the height of the shell above the base, its nuclear part pointing nearly vertically; aperture rather narrow, wider in front, the columellar margin somewhat reflexed below the spire. Maximum length of shell 38, width 25, height 18 mm. (Dall)

*Observations.* Specimens of *Crepidula* from the Blakeley formation have been figured by Tegland and agree closely with *C. ungana* Dall from Unga Island, Alaska, which has been referred to the Miocene. The species is characterized by the anterior position of the beaks and notable convexity of the anterior part of body whorl.

*Hypotype.* (U.C. 32210.) Figured in the present report, pl. 73, fig. 5.

*Geologic range.* Blakeley formation, upper Oligocene in Washington and western Alaska.

*Geographic distribution.* Puget Sound Basin, Washington, and western Alaska.

*Type locality.* Coal Bluff, Unga Island, Alaska; also at locality (U.W. 13), Restoration Point, Kitsap County, Washington.

#### Family VIVIPARIDAE

##### Genus VIVIPARUS Montfort, 1810

*Viviparus* Montfort, Conch. Syst., vol. 2, p. 246, 1810.

*Genotype.* *Viviparus fluviatorum* Montfort = *Helix vivipara* Linnaeus.

**VIVIPARUS WASHINGTONIANUS** Arnold and Hannibal, 1912

## Plate 73, figure 8

*Viviparus washingtonianus* Arnold and Hannibal, Proc. Malac. Soc., vol. 10, p. 194, pl. 8, fig. 32, 1912.

*Original description.* Shell small, seldom over 20 mm. in altitude, similar to *V. subpurpureus* of the Gulf States, but with a decidedly elevated spire, but slightly impressed sutures, and more slender nuclear whorls. Whorls appressed, decidedly sloping, and distinctly sub-carinate at the periphery; habitat apparently lacustrine. Altitude 20, breadth 15, altitude of aperture 12 mm. (Arnold and Hannibal)

*Holotype.* (U.C. 33801.) Figured in the present report, pl. 73, fig. 8.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 328.) East bank of Olequa Creek about one and one-half miles north of Vader, where creek runs near the railroad track, Lewis County, Washington, Section 20, T. 11 N., R. 2 W.

## Family RISSOIDAE

## Genus TURBOELLA Leach, 1847

*Turboella* Leach, Ann. and Mag. Nat. Hist., ser. 1, vol. 20, p. 271, October, 1847.

*Genotype.* *Turbo parvus* Montagu.

**TURBOELLA COWLITZENSIS** Effinger, 1938

## Plate 73, figure 9

*Turbella cowlitzensis* Effinger, Jour. Paleon., vol. 12, p. 379, pl. 47, figs. 9, 18, 19, 1938.

*Original description.* Shell minute, heavy, conical, whorls six; post-nuclear whorls moderately convex; base of body whorl indistinctly angulated; aperture subovate; outer lip evenly rounded, joining the parietal region above to form an acute angle; inner lip bearing a moderately heavy callus; lower portion of aperture abruptly rounded at juncture of inner and outer lip; outer lip thickened a short distance back of aperture; ornamentation consisting of prominent, evenly spaced protractive axial ribs, which number eleven on the body whorl, not extending below the angulation. Dimensions: holotype 33,557, altitude 3 mm.; maximum diameter 1.5 mm.; paratype 33,826, altitude 2.7 mm.; maximum diameter 1.4 mm. (Effinger)

*Observations.* This is the only known species of the genus *Turboella* in Oregon or Washington and it may be distinguished from *Turboella elegans* Palmer from the Capay shale of Vacaville, California, by the absence of spiral ribbing.

*Holotype.* (U.C. 33557.) Figured in the present report, pl. 73, fig. 9.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch in northeast quarter of Section 25, T. 11 N., R. 2 W.

## Genus HYDROBIA Hartmann, 1821

*Hydrobia* Hartmann, Neue Alpina, vol. 1, p. 258, 1821; Hartmann, in Sturm, Deutschlands Fauna, vol. 6, pt. 5, p. 47, 1821.

*Genotype.* *Cyclostoma acutum* Draparn.

## HYDROBIA PONTIS Weaver and Palmer, 1922

Plate 73, figure 6

*Hydrobia pontis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 33, pl. 11, 1922.

*Original description.* Shell small and fragile; sub-conic; whorls about six, regularly increasing; suture distinct; whorls angulated medially, the upper portion of the whorl sloping at an angle of 45°, the lower half of the whorl at an angle of 20°; growth lines prominent, crossed by fine, revolving striae, of which the medial are the most pronounced; the shell has a nacreous luster; aperture ovate or quadrate; umbilicus minute. Dimensions.—Altitude 9 mm.; width of body whorl 4 mm. (Weaver and Palmer)

*Holotype.* (U.W. 195) (C.A.S. 7602). Figured in the present report, pl. 73, fig. 6.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 315), at dam just below railroad bridge at Vader, Lewis County, on west bank of Olequa Creek one-third mile below its junction with Stillwater Creek, Section 32, T. 11 N., R. 2 W.

## Genus ALVANIA (Leach) Risso, 1826

*Alvania* Leach ms, Risso, Hist. Nat. Eur. Merid., vol. 4, p. 140, 1826.

*Genotype.* *Turbo cimex* Linnaeus.

## ALVANIA LETTANA (Van Winkle), 1918

Plate 73, figures 10, 15, 16, 17, 18, 19

*Rissoa lettana* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, pp. 86, 87, pl. 7, fig. 13, 1918.

*Alvania lettana* (Van Winkle), Effinger, Jour. Paleon., vol. 12, p. 379, pl. 47, figs. 21, 22, 23, 1938.

*Original description.* Shell minute, thick and moderately robust; whorls five and broadly convex; suture distinct and linear; surface ornamented by 21 well developed longitudinal ribs which extend over the upper two-thirds of the surface of the body whorl and become obsolete below; on the body whorl these are crossed by 18 equally spaced and equally developed revolving ribs; between each of these is an interspace of about one-half the width of the ribs; aperture approximately oval but incurving slightly posteriorly; inner lip thickened but not calloused; outer lip entire and moderately thick. Dimensions.—Altitude of shell 1.5 mm.; altitude of spire 0.75 mm.; maximum diameter of shell 1 mm.; angle of spire 35°. (Van Winkle)

*Observations.* This is the only species of the genus in the Pacific Northwest and, as pointed out by Effinger, it may be distinguished from the Recent species *A. acutilirata* (Carpenter), which lives near San Diego,

in the greater number of revolving threads and axial ribs and from the Tejon species *A. vinosula* Anderson and Hanna in its oval instead of subquadrate aperture and in that the axial ribs do not extend so far down on the body whorl.

*Holotype.* (U.W. 137) (C.A.S. 7624). Figured in the present report, pl. 73, fig. 10.

*Hypotype.* (U.C. 33551.) Figured in the present report, pl. 73, fig. 19.

*Hypotype.* (U.C. 33552.) Figured in the present report, pl. 73, figs. 15, 16, 17, 18.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, Cowlitz County, in northeast quarter of Section 25, T. 11 N., R. 2 W.

### Family ARCHITECTONIDAE

Genus ARCHITECTONICA ("Bolten") Roeding, 1798

*Architectonica* Roeding, in Bolten, Mus. Boltenianum, p. 78, 1798.

*Genotype.* *Trochus perspectivus* Linnaeus.

#### ARCHITECTONICA COGNATA Gabb, 1864

Plate 73, figure 20; plate 103, figure 19

*Architectonica cognata* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 117, pl. 20, figs. 72, 72a, 72c, 1864.

*Architectonica (Stellaxis) cognata* Gabb, Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 343, 344, pl. 28, figs. 7, 8, 1926.

*Architectonica (Stellaxis) cognata* Gabb, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 90, pl. 18, fig. 17, 1938.

*Original description.* Shell, low conical; whorls six to six and a half, flat or slightly convex and sloping above, acutely carinate on the margin. Mouth quadrangular, oblique. Surface marked by oblique lines of growth and faint revolving lines, sometimes obsolete. Near the margin, on the upper surface, is a prominent isolated rib. Under surface convex in the middle, and concave near the outer margin; in this concavity is another rib, somewhat larger than the one above. The rest of this side of the shell is like the upper surface. Margin of the umbilicus coarsely crenulated. (Gabb)

*Observations.* This species occurs in the Domengine of Simi Valley in California and is represented by specimens in strata of similar age in Douglas County, Oregon. It may be distinguished from *A. horrii* of the Tejon of California in the lack of the shallow sutures which surround the umbilicus in the latter species, in having a single rather than a double keel, a higher spire, and less convex upper surface.

*Lectotype.* (P.A.N.S. 4224.) Reproduction of specimen figured by Stewart (266-A, pl. 28, fig. 8). Figured in the present report, pl. 103, fig. 19.

*Hypotype.* (U.C. 33191.) From Oregon locality (U.C. A-662). Figured in the present report, pl. 73, fig. 20.

*Geologic range.* Domengine formation, Simi Valley, California, and Umpqua formation, Oregon; middle Eocene.

*Geographic distribution.* Coast Ranges of southern California and southwestern Oregon.

*Type locality.* Possibly near Martinez, California. The Oregon species listed by Turner is from locality (U.C. A-662). In Douglas County on east bank of Little River in Section 19, T. 26 S., R. 3 W.

#### ARCHITECTONICA BLANDA Dall, 1909

Plate 73, figure 7

*Architectonica blanda* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 80, 81, pl. 3, figs. 4, 5, 1909.

*Original description.* Shell of moderate size, with a very narrow deep suture, and about five whorls; surface nearly smooth, with (on upper side of the whorl) about six spiral sulci, spaced as figured, the posterior four of which are sharply incised, the next anterior slightly and the last more widely channeled; the periphery is formed by (in front of the above-mentioned anterior channel) a broad, rounded spiral, followed by a much narrower one, and that by a wider one, the three rather close set and the last marginating the base; base flattish, with (near the periphery three, and nearer the umbilical region a group of four or five) sharp narrow sulci, the interspaces flat and marked only by obscure incremental lines; umbilicus rather narrow, obscured by hard matrix, as is the aperture. Altitude, 10 mm.; maximum diameter, 19 mm. (Dall)

*Observations.* This is the only species of the genus from the upper Tertiary in Oregon and Washington. It resembles somewhat *A. compressa* Wiedey from the Temblor formation in Orange County, California, in having a higher spire and less developed ornamentation.

*Holotype.* (U.S.N.M. 107414.) Figured in the present report, pl. 73, fig. 7.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Fall Creek, Clatsop County, Oregon.

*Type locality.* Locality "Station 2697 of Diller, U.S. Nat. Mus. (in Clatsop County on Fall Creek, Oregon)."'

#### Family TURRITELLIDAE

##### Genus TURRITELLA Lamarck, 1799\*

*Turritella* Lamarck, Mem. Soc. Hist. Nat. Paris, ser. 1, vol. 1, p. 74, 1799.

*Genotype.* *Turritella terebra* (Linnaeus).

##### TURRITELLA ANDERSONI Dickerson, 1916

Plate 73, figure 12

*Turritella andersoni* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 501, pl. 42, figs. 9, 9b, 1916.

*Turritella andersoni* Dickerson, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 83, pl. 22, figs. 4, 5, 6, 1938.

*Original description.* Shell very elongate with about sixteen whorls which increase but slightly in size. The sides of the whorls are flat and in the type are

\* The monograph by Charles W. Merriam, *Fossil Turritellas from the Pacific Coast Region of North America* (31), was published while the present paper was in press. Therefore, references in his report to species described in the present report are not included in the synonymy. Anyone interested in the Tertiary Turritellas of Oregon and Washington should consult his monograph.

decorated by minute obscure spiral threads crossed by small sinuous growth lines. Suture impressed, linear. Dimensions: length of broken type, 28 mm.; width of last whorl on type, 8 mm. (Dickerson)

*Hypotype.* (U.C. 33111.) From Glide, Oregon. Figured in the present report, pl. 73, fig. 12.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, southwestern Oregon, and Coast Ranges of central and southern California.

*Type locality.* (U.C. 1817.) Fresno County, California. Occurs at Glide, Oregon.

**TURRITELLA ANDERSONI** Dickerson subsp. **GLIDENSIS** Merriam, 1938

Plate 73, figure 11

*Turritella andersoni* Dickerson subsp. *glidensis* Merriam ms, in Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 83, pl. 22, figs. 16, 21, 1938.

*Original description.* The *Turritella* most like this subspecies occurs in the Llajas formation in the region of the Simi Valley, Ventura County, California. These two subspecies are the largest of the *T. andersoni* group. The shell is heavy. On the Oregon forms the whorls are flat-sided and the profile even from whorl to whorl. The ornamentation consists of fairly coarse spiral ribs with the lowermost one heavier than the remainder. The Southern California subspecies is marked by the tendency of the whorls to separate. Holotype, U.C. 33690; locality, Glide; length 40.7 mm. (inc.); diameter 11.9 mm. (Merriam in Turner)

*Paratype.* (U.C. 33691.) Figured in the present report, pl. 73, fig. 11.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, southwestern Oregon.

*Type locality.* Glide, Douglas County, Oregon.

**TURRITELLA ANDERSONI** Dickerson subsp. **COMSTOCKENSIS** Merriam, 1938

Plate 74, figure 4

*Turritella andersoni* Dickerson subsp. *comstockensis* Merriam ms, in Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 83, pl. 22, figs. 1, 2, 3, 1938.

*Original description.* *Turritella andersoni comstockensis* is separated from *T. andersoni* s. s. and from the subspecies *lawsoni* on the basis of the differences in the range of variation as seen at this locality. The shape of the whorls varies in outline from a form rounded at the bottom and projecting far over the top (posterior) of the succeeding whorl to those which closely approximate the straightness in profile of *T. andersoni* but are slightly more indented at the suture. As a whole the assemblage is more like *T. lawsoni* than *T. andersoni*. (Merriam in Turner)

*Holotype.* (U.C. 33271.) Figured in the present report, pl. 74, fig. 4.

*Geologic range.* Comstock-Tyee beds of Oregon and upper Llajas and type Domengine formations of California, middle Eocene.

*Geographic distribution.* Western side of Willamette Valley south of the town of Comstock and in the Coast Ranges of southern California.

*Type locality.* Tyee formation, in road cut at east end of highway overpass one-half mile south of Comstock on the Pacific highway, Oregon.

from  
figs

**TURRITELLA BRAMKAMPI Merriam**

## Plate 74, figure 13

*Turritella bramkampi* Merriam and Turner,  
Geol. Sci., vol. 24, p. 105, pl. 6, figs. 3, 4  
*Turritella bramkampi* Merriam and Turner,  
Pap. no. 10, pp. 83, 84, pl. 21, figs. 3, 9, 1

*Original description.* Shell of medium size 41 mm., with body whorl diameter about 13.5 mm. tation to altitude; typically with broad, obtusely co spiral swelling above whorl middle, or occupying up swelling bounded sharply above and below by ar whorls with convex profile; ornamented by about f weight of spiral swelling extremely variable. Late almost complete suppression of swelling, when wh below well-developed posterior bevel surface. (Me

*Holotype.* (U.C. 33295.) Figured in the pres

*Geologic range.* Lower Umpqua formation, m

*Geographic distribution.* Southwestern Oregon County, California.

*Type locality.* Locality (U.C. A-838). In be River opposite Roseburg-Coos Bay Highway Survey

**TURRITELLA UVASANA Conrad subsp. STEW.**

## Plate 74, figure 9

*Turritella uvatasana* Conrad subsp. *stewarti* Merriam, in Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 84, pl. 21, fig. 11, 1938.

*Original description.* The *Turritellas* in the Cowlitz formation of Washington in the vicinity of Poulsom (U.C. loc. 7167) have been described as a new subspecies of *T. uvatasana* Conrad by Merriam. They are distinguished by their large size and comparatively coarse spiral ribbing with the heaviest spirals occurring at the widest portion of the whorl, giving a somewhat keeled effect. (Merriam in Turner)

*Hypotype.* (U.C. 33287.) Figured in the present report, pl. 74, fig. 9.

*Geologic range.* Coaledo, Cowlitz, and Tejon formations, upper Eocene.

*Geographic distribution.* Coast Ranges of southwestern Washington and western Oregon.

*Type locality.* (U.C. 853.) Quarry in hilltop across depression to the south of the club house on golf links one and one-half miles west of Corvallis, Oregon.

**TURRITELLA UVASANA Conrad subsp. HENDONI Merriam, 1938**

## Plate 74, figures 1, 6

*Turritella uvatasana* Conrad, Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, p. 572, 1913; Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, 1914.

*Turritella uvatasana* Conrad subsp. *hendoni* Merriam in Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 84, pl. 21, figs. 7, 12-16, 1938.

*Original description.* The forms not in the Umpqua formation which most closely resemble this subspecies are found in beds regarded as Domengine in the

vicinity of Pacheco, Contra Costa County, California. The new subspecies is characterized by its slender form and flat-sided whorls with many fine ribs and inter-ribs. It is abundant at Glide. (Merriam in Turner)

*Holotype.* (U.C. 33288.) Figured in the present report, pl. 74, fig. 1.

*Paratype.* (U.C. 33291.) Figured in the present report, pl. 74, fig. 6.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* In east bank of Little River in the center of Section 19, T. 26 S., R. 3 W.

**TURRITELLA UVASANA Conrad subsp. HENDONI Merriam var. A Turner, 1938**

Plate 74, figure 2

*Turritella uvatasana* Conrad subsp. *hendoni* Merriam ms var. A, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 84, pl. 22, figs. 11, 14, 1938.

*Original description.* As a group, the forms here referred to as "var. A" do not show the conspicuous flattening of the sides of the whorls nor the numerous intercalated riblets seen in *T. uvatasana hendoni* s. s. The whorl is slightly more inflated anteriorly. Variety "A" occurs in the Tyee, at the type locality, at Comstock, and along the North Umpqua River in beds referred to the Tyee. (Merriam in Turner)

*Holotype.* (U.C. 33281.) Figured in the present report, pl. 74, fig. 2.

*Geologic range.* Tyee formation at Comstock, Oregon; upper Eocene.

*Geographic distribution.* At Comstock, Willamette Valley, and along North Umpqua River, Oregon.

*Type locality.* In road cut at east end of overpass one-half mile south of Comstock on Pacific Highway (Tyee formation).

**TURRITELLA UVASANA Conrad subsp. HENDONI Merriam var. B Turner, 1938**

Plate 74, figure 21

*Turritella uvatasana hendoni* Merriam ms var. B, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 85, pl. 22, figs. 7, 10, 12, 13, 1938.

*Original description.* *T. hendoni* var. B, like var. A, does not show the conspicuous flattening of the sides of the whorls nor the numerous fine intercalated riblets. The majority of the specimens of this variety differ from var. "A" in the less inflated anterior portion of the whorls. Variety "B" occurs near Cleveland associated with *T. merriami* Dickerson var. (Merriam in Turner)

*Holotype.* (U.C. 33283.) Figured in the present report, pl. 74, fig. 21.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* West of Roseburg, southwestern Oregon.

*Type locality.* Locality (U.C. A-1174). About one mile west of Cleveland in ravine 300 yards south of road (lower Umpqua formation).

**TURRITELLA UVASANA Conrad subsp. OLEQUAHENSIS Weaver and Palmer, 1922**

Plate 74, figure 11

*Turritella olequahensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, p. 34, pl. 12, fig. 15, 1922.

*Original description.* Shell large; whorls 14 or 15; sides of whorls straight with an abrupt, deep excavation just above the suture; suture linear; surface sculptured with six, prominent revolving ribs which are equal in size and have interspaces three times the width of the rib; interspaces with fine, intervening striae; growth lines prominent, very convex, sloping from the suture at an angle of 25° as far as the middle portion of the whorl then passing to the suture below at an angle of 30°. Dimensions.—Approximate altitude of shell 120 mm.; width of lower whorl 16 mm. (Weaver and Palmer)

*Holotype.* (U.W. 197.) Figured in the present report, pl. 74, fig. 11.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, southwestern Washington.

*Type locality.* Locality (U.W. 329). In north bank of Cowlitz River one and one-half miles east of Vader, Lewis County, Section 28, T. 11 N., R. 2 W.

**TURRITELLA UVASANA Conrad subsp. WASHINGTONIANA Weaver and Palmer, 1922**

Plate 74, figures 3, 16

*Turritella washingtoniana* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, pp. 34, 35, pl. 12, figs. 13, 14, 16, 1922.

*Original description.* Shell medium in size and conical in outline; whorls many, straight to very slightly concave, sloping from the suture about four-fifths of the length of the whorl to the base where it makes a sharp angle; surface below the angle beveled; suture moderately deep, appressed surface of the shell sculptured with six, equal prominent revolving ribs on each whorl with interspaces equal to three times the width of the ribs; finer spiral lines occur on the beveled area and in the interspaces; on the first eight or ten whorls of the shell, the lower two revolving ribs are enlarged making a bicarinate sculpture; on the succeeding two or three whorls the three lower revolving ribs may be enlarged while the remaining whorls will have the six revolving ribs of equal prominence. Illustrations have been given to show the rib development. (Plate XI, Figures 13, 14, 16.) Figures 13 and 14 are specimens of apical whorls which show the bicarinate condition. Figure 16 is a specimen with both the apical and lower whorls present. The change from the bicarinate through the tricarinate condition to the uniform size of the ribs is illustrated. Dimensions.—Approximate altitude of shell 45 mm.; width of lower whorl 8 mm.; apical angle 18°. (Weaver and Palmer)

*Holotype.* (*Turritella washingtoniana* Weaver and Palmer.) (U.W. 198) (C.A.S. 7535). Figured in the present report, pl. 74, fig. 3.

*Hypotype.* (U.W. 195-A.) Cowlitz formation. Figured in the present report, pl. 74, fig. 16.

*Geologic range.* Cowlitz formation at Balch, upper Eocene.

*Geographic distribution.* Chehalis Valley, Washington.

*Type locality.* Locality (U.W. 42). In railroad cut, Union Pacific Railway, 2000 feet east of Oakville bridge over Chehalis River, Grays Harbor County, Section 1, T. 15 N., R. 5 W.

**TURRITELLA MERRIAMI** Dickerson var. Turner, 1938

## Plate 74, figure 10

*Turritella merriami* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 7, p. 284, pl. 13, figs. 6a, 6b, 6c, 1913.  
*Turritella merriami* Dickerson var. Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 85, 86, pl. 22, figs. 8, 9, 1938.

*Original description* (*Turritella merriami*). Shell moderate in size, elongate; whorls number about fifteen or sixteen; the first four whorls are rounded and marked by three strong revolving ribs with a single riblet between each pair. The fifth, sixth, seventh and eighth whorls are also convex, but the center of the convexity is below the middle of the whorl; these whorls are marked by five nearly equal revolving ribs, equally spaced. The rest of the whorls are markedly different from the upper eight whorls. The first revolving rib below the suture is much larger than the rest, and the space between it and the impressed suture is flattened horizontally making a tabulate shoulder. The next three ribs are equal and equally spaced. The fifth rib is stronger than the three above and a persistent riblet is found between it and the fourth rib; the space between it and the suture is twice as great as the space between the ribs above. The lower whorls are flattened between the first rib and the suture. Dimensions: Length of broken specimen (see figure 6b, plate 13), 30 mm. (Dickerson)

*Notations concerning T. merriami* var. The variety of this species from the Umpqua formation in the vicinity of Cleveland differs from the Oroville form in its less prominent, less sharply defined keel at the shoulder of the whorls. (Turner)

*Holotype*. (U.C. 33279.) Figured in the present report, pl. 74, fig. 10.

*Geologic range*. Umpqua formation, middle Eocene.

*Geographic distribution*. West of Roseburg, Douglas County, Oregon.

*Type locality*. Locality (U.C. A-1176). One mile west of Cleveland in ravine 300 yards south of road (lower Umpqua formation).

**TURRITELLA MEGANOSENSIS** Clark and Woodford subsp. **PROTUMESCENS**

Merriam and Turner, 1937

## Plate 74, figures 14, 18

*Turritella meganensis* Clark and Woodford subsp. *protumescens* Merriam and Turner, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 24, p. 104, pl. 6, figs. 8, 9, 10, 1937.

*Turritella meganensis* Clark and Woodford subsp. *protumescens* Merriam and Turner, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 85, pl. 22, fig. 15, 1938.

*Original description*. Shell fairly large and heavy for the genus. Adolescent whorls nearly straight-profiled as in *T. meganensis* Clark and Woodford s.s. Mature volutions with a heavy spiral flange occupying upper or posterior third. Numerous fine spiral ribs present on adolescent whorls, but becoming weaker or obsolete on adult volutions. Adult whorl profile concave below flange. In the nuclear stages the whorls are evenly convex, passing through a stage characterized by two well-developed primary ribs above which are weaker secondary threads. The two primaries come to lie in the lower whorl half. Nuclear and early adolescent ornamentation quite different from that of adult stages of growth. (Merriam and Turner)

*Holotype*. (U.C. 15353.) Figured in the present report, pl. 74, fig. 14.

*Hypotype*. (U.C. 33278.) Figured in the present report, pl. 74, fig. 18.

*Geologic range.* Lower Umpqua and lower Llajas formations, middle Eocene.

*Geographic distribution.* Douglas County, southwestern Oregon and Simi Valley, Los Angeles Basin, California.

*Type locality.* (U.C. 7195.) In the creek bed and about 20 yards north of the second falls or 100 yards north of the mouth of the first small draw which enters Llajas Canyon west of the point where the Meganos conglomerate crosses the road near Santa Susana, California. (R. B. Stewart)

**TURRITELLA BUWALDANA** Dickerson subsp. **COOSENSIS** Merriam, 1938

Plate 74, figure 20

*Turritella buwaldana* Dickerson subsp. *cooensis* Merriam ms., Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 85, pl. 22, figs. 17, 18, 19, 20, 1938.

*Original description.* This subspecies is characterized by flat-sided whorls with four ribs ordinarily more conspicuous than the remainder. The lowermost one is the heaviest, producing a slight keel close to the bottom of the whorl. (Merriam in Turner)

*Holotype.* (U.C. 33274.) Figured in the present report, pl. 74, fig. 20.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, southwestern Oregon.

*Type locality.* Locality (U.C. A-836). In bed of Middle Fork of Coquille River opposite Roseburg-Coos Bay Highway Survey station 845 + 43 (lower Umpqua formation).

**TURRITELLA OREGONENSIS** (Conrad), 1865

Plate 74, figure 12

*Turritella* sp. Conrad, U.S. Explor. Exped. Geol., Atlas, pl. 20, figs. 13, 14 (no description), 1849.

*Cerithiopsis? oregonensis* Conrad, Am. Jour. Conch., vol. 1, p. 151, 1865. (A name for the figured specimen of 1849.)

*Turritella oregonensis* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 78, 1909.

*Description.* A small, slender *Turritella* with about eight whorls; suture obscure; in front of it the whorl is flattish with two to five small, close-set spiral threads, in front of which are two (on the last whorl three) much stronger elevated spirals, with a deep groove between them, the anterior marginating the base, which is flattish with a few weaker spirals; there is no axial sculpture except lines of growth; apex decollate, length of remainder 22.5 mm.; diameter at decollement, 3.0 mm.; maximum diameter of last whorl, 7.0 mm. (Dall)

*Holotype.* (U.S.N.M. 110446.) Figured in the present report, pl. 74, fig. 12.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Astoria, Oregon.

*Type locality.* Astoria, Oregon.

**TURRITELLA VADERENSIS** Weaver and Palmer, 1922

## Plate 74, figure 8

*Turritella vaderensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, pp. 35, 36, pl. 10, fig. 19, 1922.

*Original description.* Shell large; sides of the whorls straight; suture very appressed; first revolving rib above the suture very sharp and protruding, below this rib the surface is beveled to concave and contains two fine revolving threads with finer, microscopic striae; in the area above the lower, pronounced or primary rib, between the rib and the suture above, there are two revolving ribs of secondary size; these ribs are smaller than the first but are still prominent and tend to become nodose; between the lower secondary and the primary rib below, there are two spiral threads, between which are finer, spiral lines; between the secondary ribs, as well as between the upper secondary rib and the suture, there is a finer spiral rib or thread; the finer ribs are minutely nodose. Dimensions. Width of median whorl 10 mm. (Weaver and Palmer)

*Holotype.* (U.W. 199) (C.A.S. 7533). Figured in the present report, pl. 74, fig. 8.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* Locality (U.W. 329). North bank of Cowlitz River one and one-half miles east of Vader, Lewis County, Washington, Section 28, T. 11 N., R. 2 W.

**TURRITELLA VADERENSIS** Weaver and Palmer var. **KINCAIDI** Weaver and Palmer, 1922

## Plate 74, figure 7

*Turritella vaderensis* Weaver and Palmer var. *kincaidi* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, p. 36, pl. 10, fig. 17, 1922.

*Original description.* Shell large; number of whorls unknown; sides of the whorls straight; suture distinct, linear; surface ornamented with revolving ribs of unequal size; revolving rib on the lower portion of the whorl above the suture prominent and rounded; area below this rib and the suture excavated; between the primary rib and the suture above there are two revolving ribs of secondary size between which are smaller yet distinct revolving ribs; between the revolving ribs there are microscopic revolving striae; the ribs have the tendency to become delicately nodose; growth lines fine, very convex, swinging from the suture at an angle of 20° to the middle of the whorl and passing to the suture below at the same angle. Dimensions.—Width of median whorl 11 mm. (Weaver and Palmer)

*Holotype.* (U.W. 200) (C.A.S. 7534). Figured in the present report, pl. 74, fig. 7.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* Locality (U.W. 329). North bank of Cowlitz River one and one-half miles east of Vader, Washington, Section 28, T. 11 N., R. 2 W.

**TURRITELLA PORTERENSIS** Weaver, 1912

## Plate 74, figure 5

*Turritella porterensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 73, pl. 11, figs. 83, 84, 1912.

*Original description.* Shell of moderate size, elongated, subconical; whorls ten to twelve, convex; suture impressed; the lower third of each whorl is broadly angulated; there are three revolving ribs on the angulated area; above this convex angulated portion of the whorl the surface slopes decidedly upwards; it is flat to slightly concave; near the suture the upper portion of whorls become decidedly impressed; at the base of each whorl is a deep wide unsculptured groove; aperture ovoid, broadly rounded below; inner lip incrusted; outer lip simple. Dimensions.—Altitude 34 mm.; width of body whorl 10.5 mm.; angle of spire 19°. (Weaver)

*Holotype.* (U.W. 72) (C.A.S. 506). Figured in the present report, pl. 74, fig. 5.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Southwestern Washington and northwestern Oregon.

*Type locality.* Locality (U.W. 160). Bluff at Porter Station in Northern Pacific Railroad cut, Grays Harbor County, Section 22, T. 17 N., R. 4 W.

**TURRITELLA BLAKELEYENSIS** Weaver, 1912

## Plate 74, figures 15, 17

*Turritella blakeleyensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 72, 73, pl. 11, fig. 85; pl. 6, figs. 64, 67, 1912.

*Turritella blakeleyensis* Weaver, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 135, 136, 137, pl. 14, figs. 3, 4, 5, 6, 7, 1933 (see synonymy).

*Original description.* Shell elongated; whorls twelve and flattened to slightly concave; suture impressed; just above the suture is one small revolving rib; above that a deep groove; then the surface slopes outwards forming an angle; on this angle are one or two large revolving ribs; the remainder of the surface up to the suture is flat to concave and sculptured with five not very distinct revolving ribs; aperture suboval. Dimensions.—Altitude 65 mm.; width of base 16 mm.; angle of spire 14°. (Weaver)

*Holotype.* (U.W. 71) (C.A.S. 547). Figured in the present report, pl. 74, fig. 15.

*Topotype.* (U.C. 32195.) Figured in the present report, pl. 74, fig. 17.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Western Washington.

*Type locality.* Locality (U.W. 13). Restoration Point, Kitsap County, opposite Seattle.

**TURRITELLA DIVERSILINEATA** J. C. Merriam, 1897

Plate 74, figure 19

*Turritella diversilineata* Merriam, Nautilus, vol. 11, p. 65, 1897.  
*Turritella diversilineata* Merriam, Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 11, pp. 170, 171, pl. 22, fig. 5, 1918.

*Original description.* Shell medium in size. The imperfect type specimen shows seven flattened whorls, which are strongly beveled below. Flattened sides ornamented by five revolving ribs, of which the lowest, standing on the angle of whorl, is much stronger than the others. On some of the whorls there are indications of revolving sculpture on the beveled surface between the lowest rib and the suture. (J. C. Merriam)

*Holotype.* (U.C. 11224.) Figured in the present report, pl. 74, fig. 19.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Carmanah Point, Vancouver Island.

*Type locality.* Carmanah Point, Vancouver Island.

**Genus TURRITELLOPSIS** G. O. Sars, 1878

*Turritellopsis* G. O. Sars, Moll. Reg. Arct. Norv., p. 186, 1878.

*Genotype.* *Turritellopsis acicula* (Stimpson).

**TURRITELLOPSIS WEAVERI** (Van Winkle), 1918

Plate 75, figures 4, 5

*Turritella weaveri* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 87, pl. 7, fig. 14, 1918.  
*Turritellopsis weaveri*? (Van Winkle), Effinger, Jour. Paleon., vol. 12, p. 377, pl. 47, figs. 6, 7, 1938.

*Original description.* Shell minute, elongate and thin; whorls seven and slightly convex; suture sunken in a deep groove the larger part of which groove lies immediately above the suture line. The lower portion of the surface of each whorl is decorated with two very pronounced revolving ribs with interspaces of double width but containing no intervening threads; upper half of each whorl decorated with two similar but less well developed revolving ribs and interspaces. Longitudinal sculpture is absent except for numerous lines of growth; aperture oval; outer lip thin; inner lip slightly calloused. Dimensions.—Altitude of shell 2.5 mm.; altitude of spire 1.5 mm.; maximum diameter of shell 1.0 mm.; angle of spire 35°. (Van Winkle)

*Observations.* Effinger has called attention to the similarity of this form to *Turritellopsis acicula* (Stimpson), a Recent species and genotype from the North Atlantic, in the axial and transversal sculpture and the deep sutural groove. The nuclear whorls in the Washington specimens are more elevated in contrast to the plani-spiral character in the Recent species.

*Holotype.* (U.W. 138.) Lost.

*Hypotypes.* (U.C. 33572) (U.C. 14806). Figured in the present report, pl. 75, figs. 4, 5.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 330.) South bank of Cowlitz River at old Gries Ranch, northeast quarter of Section 25, T. 11 N., R. 2 W.

## Family THIARIDAE (MELANIIDAE)

## Genus LOXOTREMA Gabb, 1868

*Loxotrema* Gabb, Am. Jour. Conch., vol. 4, p. 147, pl. 14, fig. 21, 1868.

*Genotype.* *Loxotrema turrita* Gabb.

## LOXOTREMA TURRITA Gabb, 1868

Plate 75, figures 1, 2, 3; plate 103, figure 18

*Loxotrema turrita* Gabb, Am. Jour. Conch., vol. 4, p. 147, pl. 14, fig. 21, 1868; Geol. Surv. Calif. Paleon., vol. 2, pp. 168, 227, pl. 28, fig. 49, 1869.

*Loxotrema turritum* Gabb, Stewart, Acad. Nat. Sci. Phila., vol. 78, p. 347, pl. 26, figs. 3, 4, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 81, pl. 17, figs. 12, 13, 1938 (see synonymy).

*Original description.* Shell elongated, turreted, spire elevated, nearly twice the length of the aperture; whorls about six to six and a half, slightly convex on the sides, abruptly truncated and flat on the upper margin. Body whorl marked by eight or ten revolving lines on the anterior half, crossed by sinuous lines of growth; both sets of markings very variable in distinctness in different specimens. Aperture obliquely subquadrate, bordered on the inner side by a raised lip, the top retreating upwards, and very obliquely backwards; outer lip thick above and below, very thin in the middle, and with a strongly sinuous margin, most prominent near the anterior end; inner lip thick, its margin somewhat raised above the surface of the body whorl; anterior extremity of aperture not notched, but produced, and slightly channelled.

Length, 1.65 inches; width of body whorl, 0.8 inch; length of aperture (internal measure), 0.6 inch; width, 0.45 inch. (Gabb)

*Observations.* This widely distributed middle Eocene species of California occurs in southwest Oregon; the general characters of outline and ornamentation are approximately the same as those of the specimens in rocks of same age in the Coast Ranges of California. It is the only species of the genus in the Coast Ranges and is abundant and very distinctive.

*Lectotype.* (P.A.N.S. 4228.) Reproduction of specimen figured by Stewart (266-A, pl. 26, fig. 4). Figured in the present report, pl. 103, fig. 18.

*Hypotype.* (U.C. 33642.) From locality (U.C. A-661). Figured in the present report, pl. 75, figs. 1, 2.

*Hypotype.* (U.C. 33800.) Figured in the present report, pl. 75, fig. 3.

*Geologic range.* Tyee and Domengine formations, middle Eocene.

*Geographic distribution.* San Diego, Simi Valley, and Coast Range areas in California; also Douglas County, Oregon.

*Type locality.* "Ten miles west of Griswolds" (Gabb). Near Mount Diablo, central California. Occurs also at locality (U.C. A-661) in Douglas County, Oregon, in east bank of Little River in center of Section 19, T. 26 S., R. 3 W.

## Family CERITHIIDAE

## Genus GONIOBASIS Lea, 1862

*Goniobasis* Lea, Proc. Acad. Nat. Sci. Phila., vol. 14, p. 262, 1862.

*Genotype.* *Melania olivula* Conrad.

## GONIOBASIS COOMBSI n. nom.

Plate 75, figures 6, 7, 11, 12

*Goniobasis olequaensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 45, pl. 11, fig. 13, 1922; Henderson, Geol. Soc. Am., Spec. Pap. no. 3, p. 224, 1935.

*Original description.* Shell small and elongate; whorls five or six; whorls rounded; suture distinct, appressed; surface ornamented with eleven longitudinal, prominent ribs with interspaces three times the width of the ribs; the ribs are curved and increase in size at the middle point of the whorl where they tend to become pointed; on the whorls of the spire the longitudinal ridges may be crossed just above the suture with one prominent revolving rib; on the body whorl there are about eight pronounced revolving ribs which occur on the lower half of the whorl and extend to the base of the whorl; aperture ovate, entire; fine microscopic growth lines may be seen between the longitudinal ridges. Dimensions.—Altitude 9 mm.; width of body whorl 4 mm. (Weaver and Palmer)

*Observations.* The transfer of *Ambloxus olequaensis* Arnold and Hannibal to the genus *Goniobasis* causes *Goniobasis olequaensis* Weaver and Palmer to become a homonym of the earlier species. Accordingly the new name *Goniobasis coombsi* is proposed. This species is characterized by well-defined longitudinal ribbing and well-defined spiral ribbing over the greater part of the surface of whorls. The whorls also are more convex than in the case of *G. hannibali* and *G. olequaensis* (Arnold and Hannibal).

*Holotype.* (U.W. 212) (C.A.S. 7604). Figured in the present report, pl. 75, figs. 11, 12.

*Hypotype.* (U.W. 212-A) (C.A.S. 7604-A). Figured in the present report, pl. 75, figs. 6, 7.

*Geologic range.* Freshwater beds in Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley and northern part of Puget Sound Basin in Skagit County, Washington.

*Type locality.* (U.W. 315.) At the dam below railroad bridge on Olequa Creek one-third mile below junction of Olequa and Stillwater creeks, near Vader, Lewis County, Section 32, T. 11 N., R. 2 W.

## GONIOBASIS HANNIBALI Weaver and Palmer, 1922

Plate 75, figures 8, 9, 10

*Goniobasis hannibali* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 44, 45, pl. 12, figs. 2, 3, 1922.

*Goniobasis olequaensis hannibali* Weaver and Palmer, Henderson, Geol. Soc. Am., Spec. Pap. no. 3, p. 224, 1935.

*Original description.* Shell medium, thin and polished; elongate-conic in shape; whorls probably eight, specimens usually broken at fourth or fifth whorl;

sides of the whorls very slightly convex; suture linear; aperture subovate, produced below, not sinuated but widely united at the anterior end. Surface ornamented with from sixteen to twenty vertical ridges or plications which are developed in parallel waves over all the whorls; crossing the longitudinal ribs there are usually six spiral lines or ribs with interspaces half their width; at the intersection of the vertical and spiral ribs fine nodes are produced which give the longitudinal ridges a beaded appearance; the vertical riblets do not continue over the basal portion of the body whorl, that region ornamented by spiral lines only. Dimensions.—Altitude 18 mm. (measurements taken of five whorls); width of body whorl 7 mm. (Weaver and Palmer)

*Observations.* This species, although close to *Goniobasis olequaensis* (Arnold and Hannibal), may be distinguished from it in the slightly greater convexity of the whorls and the presence of weakly developed longitudinal ribs. It may be distinguished from *G. coombsi* Weaver (formerly *G. olequahensis* Weaver and Palmer) by the moderately strong spiral ribbing on the middle and upper surfaces of the whorls in the latter species.

*Holotype.* (U.W. 211) (C.A.S. 7603). Figured in the present report, pl. 75, figs. 8, 9, 10.

*Geologic range.* Freshwater beds in Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley and Puget Sound Basin, Washington.

*Type locality.* Locality (U.W. 315), one-third mile below junction of Olequa and Stillwater creeks near Vader, Lewis County, Section 32, T. 11 N., R. 2 W.

#### GONIOBASIS DRAKEI (Arnold and Hannibal), 1912

Plate 75, figure 13

*Pachychilus drakei* Arnold and Hannibal, Proc. Malac. Soc., vol. 10, p. 183, pl. 8, fig. 26, 1912; Henderson, Geol. Soc. Am., Spec. Pap. no. 3, p. 213, 1935.

*Original description.* Shell large, averaging about 45 mm. in altitude, elevated-conical, whorls long and slightly convex, sutures impressed, periphery rounded, aperture elliptical, outer lip sinuate; habitat apparently lacustrine, at least in part. Altitude 45, breadth 14, altitude of body-whorl 12 mm. (Arnold and Hannibal)

*Observations.* This large species represented by a single individual is slightly deformed. It may be distinguished from the other species of the genus associated with it in the strata by narrow and rounded longitudinal ribs and the low flat-topped spiral ribs and extremely narrow interspaces.

*Holotype.* (S.U. 458.) Figured in the present report, pl. 75, fig. 13.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* "Bluffs along Olequa Creek at bend below Little Falls—(Vader)." Lewis County, Washington. (Hannibal)

**GONIOBASIS OLEQUAENSIS** (Arnold and Hannibal), 1912

Plate 75, figure 14

*Amblopus olequaensis* Arnold and Hannibal, Proc. Malac. Soc., vol. 10, pp. 178, 179, pl. 8, fig. 27, 1912.

*Goniobasis olequaensis olequaensis* (Arnold and Hannibal), Henderson, Geol. Soc. Am., Spec. Pap. no. 3, p. 224, 1935.

*Original description.* Shell slender-conic, similar in general outline and size to *A. virginicus*, but more regularly elongate, with proportionally longer whorls, straight-sided above and bending in rapidly at the suture somewhat after the manner of *Pleorocera bitaeniata*; sculptured forms with vertical plications and spiral ridges and frills as in *A. plicifera*; aperture deeply sinuate and slightly produced below; habitat apparently lacustrine at least in part. Altitude (estimated), 32 mm.; breadth, 9.5 mm.; altitude of body-whorl, 9 mm. (Arnold and Hannibal)

*Observations.* The holotype of *Amblopus olequaensis* Arnold and Hannibal belongs to the genus *Goniobasis*. In 1922 a specimen from the same Cowlitz formation was described by Weaver and Palmer (301, pl. 11, fig. 13) as *Goniobasis olequahensis* and a second specimen also was described as *G. hannibali* Weaver and Palmer. It appears that the specimen *Amblopus olequaensis* Arnold and Hannibal is close to *Goniobasis hannibali* but differs in that the sides of the whorls are flatter and in the lack of any indications of longitudinal ribbing. The form *Goniobasis olequahensis* Weaver and Palmer has pronounced longitudinal ribbing. It must be renamed because in transferring *Amblopus olequaensis* to the genus *Goniobasis* the species of Arnold and Hannibal has priority.

*Holotype.* (S.U. 459.) Figured in the present report, pl. 75, fig. 14.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 670.) In Olequa Creek about 300 feet S. 80° E. from the northwest corner of Section 20, T. 11 N., R. 2 W.

**GONIOBASIS SOOKENSIS** Clark and Arnold, 1923

Plate 75, figures 16, 17

*Goniobasis sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 164, 165, pl. 32, figs. 1a, 1b, 1923; Henderson, Geol. Soc. Am., Spec. Pap. no. 3, p. 224, 1935.

*Original description.* Shell fairly large for this genus; apex broken on all specimens at hand; suture slightly appressed; sides of whorls flattened; broad, shallow concavity just below suture, which, on whorls of spire, extends anteriorly approximately two-thirds height of whorl; below this surface is gently convex. Surface covered by fine longitudinal and spiral ribs, interspaces between which are about equal to width of ribs, thus dividing surface into small equilateral rectangles; longitudinal ribbing becomes obsolete on anterior portion of the body whorl. Base of body whorl rounded and sloping rather steeply. Aperture ovate; outer lip thin, striated internally; inner lip with thin wash of callus. Dimensions of type (apex broken): Height, 33.5 mm.; height of body whorl, 13.5 mm.; greatest width of body whorl, 12.5 mm. (Clark and Arnold)

*Observations.* This species may be distinguished from *G. kettlemanensis* Arnold in having a smaller apical angle, a more circular shaped aperture, more numerous and equally spaced spiral ribs, and moderately developed equally spaced longitudinal ribs which are faintly present on *G. kettlemanensis*.

*Holotype.* (U.C. 30076.) Figured in the present report, pl. 75, figs. 16, 17.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South side of Vancouver Island.

*Type locality.* Sooke sandstone exposed in sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

#### Genus **POTAMIDES** Brongnairt, 1810

*Potamides* Brongnairt, Ann. Mus. Hist. Nat. (Paris), vol. 15, p. 368, 1810.

*Genotype.* *Potamides lamarcki* Brongnairt (*fide* Cossmann).

#### **POTAMIDES CARBONICOLA** Cooper, 1894

Plate 75, figures 15, 19

*Potamides carbonicola* Cooper, Calif. State Min. Bur., Bull. no. 4, p. 44, pl. 1, figs. 14-19, 1894; Arnold, U.S. Geol. Surv., Bull. no. 396, p. 13, pl. 4, figs. 2, 3, 1909; Bull. no. 398, p. 70, pl. 26, figs. 2, 3, 1910; M. A. Hanna, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 312, pl. 55, figs. 2, 7, 9, 1927; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 82, pl. 21, fig. 1, 1938.

*Original description.* Form columnar, slowly tapering (first whorls eroded); third or fourth strongly sculptured, with twelve to fifteen subvertical ridges, curved toward the left, and crossed by three revolving ridges, causing a cancellated surface. The ridges vary in development on different parts of one shell as well as on different specimens. Sometimes one and sometimes the other set of ridges has the most strength, and often one or two of the revolving ones being higher than the third, causes an angular projection either at the middle of the whorl or along the suture, the whorls being flat when all are equal, and twelve or more in number. No thickening of lips or varices shown in the specimens. Length, 1.50 inch; breadth, 0.50 to 0.75; mouth, 0.12 long and wide. (Cooper)

*Observations.* Specimens of this species are abundant and show a wide range of variation in character of ornamentation. The three spiral ribs which usually are present vary from a faintly developed thread which may or may not be lined with coarse nodes. The number and strength of auxiliary spiral ribs also vary on specimens from different localities. The character of the ornamentation in some specimens may vary from one whorl to the next.

*Hypotype.* (U.C. 33183.) Locality (U.C. A-661). Upper Umpqua formation. Figured in the present report, pl. 75, fig. 15.

*Hypotype.* (U.C. 31377.) Locality (U.C. 5089). Near La Jolla, California. Figured in the present report, pl. 75, fig. 19.

*Geologic range.* Tyee and Domengine formations, middle Eocene.

*Geographic distribution.* Southwestern Washington, western Oregon, and west side of San Joaquin Valley, California.

*Type locality.* "Head-wall of 'California Coal Mine,' near Huron, Fresno County, east slope of Mt. Hamilton Range." (Cooper.) Specimen figured by Turner collected at locality (U.C. A-661). Douglas County, Oregon, on east bank of Little River in center of Section 19, T. 26 S., R. 3 W.

**POTAMIDES LEWISIANA** Weaver, 1912

Plate 75, figure 23

*Potamides lewisiana* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 37, pl. 2, figs. 22, 25, 1912; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 82, pl. 20, figs. 12, 13, 1938.

*Original description.* Shell small, elongate, turreted; whorls nine to ten, slightly convex and in some specimens faintly angulated. Suture distinct and impressed. Surface sculptured by fourteen distinct revolving ribs each of which is set with small beadlike nodes; no intervening revolving threads present. Longitudinal ribs are sometimes present, sometimes confined to the whorls of the spire only and sometimes confined to the body whorl. The faint angulation which is often present is confined to the surface just below the suture. Aperture narrow and elliptical; inner lip incrusted; outer lip thin. Dimensions.—Altitude 24 mm.; diameter 7 mm.; angle of spire 20°. (Weaver)

*Observations.* This species which somewhat resembles *Elimia schencki* B. L. Clark (56, p. 708, pl. 3, figs. 20, 33, 34) differs in having a very slightly developed shoulder on the upper part of each whorl. The longitudinal ribs are most strongly developed on the posterior whorls of the spire and become progressively fainter toward the body whorl where they are noticeable mostly on the angulated surface.

*Holotype.* (U.W. 16) (C.A.S. 486). Figured in the present report, pl. 75, fig. 23.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington, and Douglas County, southwestern Oregon.

*Type locality.* (U.W. 327.) East bank of Olequa Creek back of Cantwell place, 1 mile north of Vader, Lewis County, Section 20, T. 11 N., R. 2 W.

**POTAMIDES FETTKEI** Weaver, 1912

Plate 75, figures 18, 21, 22, 26

*Potamides fettkei* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 36, pl. 2, figs. 23, 24, 1912.

*Original description.* Shell small, elongated, and turreted; whorls nine, very slightly convex and somewhat angulated; suture fairly distinct and linear. Surface ornamented with thirteen revolving ribs, three above and ten below the revolving angle; each rib is set with small bead-like nodes. Between each set of nodose ribs there is a small revolving thread which is smooth. The revolving angle is set with ten large flattened nodes; whorls of spire similarly sculptured. Aperture moderately broad, ovate; inner lip very slightly thickened; outer lip smooth. Dimensions.—Altitude 19 mm.; diameter 5 mm.; angle of spire 23°. (Weaver)

*Observations.* This species which is very abundant in the brackish water facies of the Cowlitz formation in Washington is closely related to *Thiara markleyensis* B. L. Clark which has been described recently from the Markley formation of the upper Eocene of middle California. It may be distinguished by the larger number and closer spacing of the nodes on the Washington species. It differs from *Thiara calafi* B. L. Clark from the Markley formation also in this character. The Washington species *P. fettkei* contains minor revolving ripples between the evenly noded spiral ribs and these are absent on *Thiara markleyensis*.

*Syntype.* (U.W. 15) (C.A.S. 7589). Figured in the present report, pl. 75, figs. 18, 22.

*Syntype.* (U.W. 15-A) (C.A.S. 7589-A). Figured in the present report, pl. 75, figs. 21, 26.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 327.) East bank of Olequa Creek 1 mile north of Vader, Lewis County, Section 20, T. 11 N., R. 2 W.

#### POTAMIDES PACKARDI (Dickerson), 1915

##### Plate 75, figure 25

*Melania packardi* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 60, pl. 6, fig. 6, 1915.

*Original description.* Shell elongate, slender, with flat-sided whorls; about twelve parallel axial ribs which are crossed by six or seven weaker spiral lines decorate each whorl; rectangular spaces between two sets of lines having greater length parallel to spiral lines; suture wavy, distinct. Dimensions: Length of broken type, 18 mm.; width of body-whorl, 8 mm. (Dickerson)

*Observations.* This species is represented by a vast number of specimens at the well-known fossil locality (U.W. 232) in the bend of Cowlitz River. The spire of the type is broken but the species is characterized by the somewhat impressed sutures, the evenly developed spiral ribs of equal strength and nearly equal spacing on all of the whorls, the interspaces of about double width, and the fairly strong longitudinal ribs extending across the surface of all the whorls.

*Holotype.* (C.A.S. 299.) Figured in the present report, pl. 75, fig. 25.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

## Genus CERITHIOPSIS Forbes and Hanley, 1853

*Cerithiopsis* Forbes and Hanley, Hist. Brit. Moll., vol. 3, p. 364, 1853.

*Genotype.* *Murex tuberculatus* Montagu.

## CERITHIOPSIS PREUSSI G. D. Hanna, 1924

Plate 75, figures 20, 24, 27

*Cerithiopsis oregonensis* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 121, pl. 11, figs. 5a, 5b, 1914.

*Cerithiopsis preussi* G. D. Hanna (new name), Proc. Calif. Acad. Sci., ser. 4, vol. 13, p. 161, 1924; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 81, pl. 21, figs. 4, 5, 1938.

Not *Cerithiopsis? oregonensis* Conrad, Am. Jour. Conch., vol. 1, p. 151, 1865 (name for pl. 20, figs. 13, 14, U.S. Explor. Exped. Geol., Atlas, vol. 10, 1849).

*Original description.* Shell elongate conic; upper whorls missing; remaining whorls, except the body-whorl, marked by three strong, equally spaced spiral lines of same strength crossed by axial ribs, the crossing being marked by rounded nodes; a very fine thread found between the spiral lines; suture impressed, linear; body-whorl marked by four rows of nodes instead of three, as in the spire whorls, the last row being weaker than the others; fine threads between these spiral lines; base marked by four or five nodose spiral lines and threads, the spiral lines being smaller than those on rest of the whorl; aperture ovate-quadrata, with narrow anterior sinus; outer lip thin; canal twisted. Dimensions: Length of broken type, 20 mm.; width of body-whorl, 4.5 mm. (Dickerson)

*Observations.* As pointed out by Dickerson, this species may be distinguished from *C. excelsa* Dall in that its whorls are nearly flat and in the smaller number of larger ribs. The name *Cerithiopsis oregonensis* was used in 1865 by Conrad at an earlier date than that employed by Dickerson, and the species name *preussi* was substituted by G. D. Hanna. However, the species described by Conrad is now identified as *Turritella oregonensis*.

*Holotype.* (C.A.S. 246.) Figured in the present report, pl. 75, figs. 20, 24.

*Topotype.* (U.C. 33653.) Figured in the present report, pl. 75, fig. 27.

*Geologic range.* Tyee formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-661.) East bank of Little River, Douglas County, in center of Section 19, T. 26 S., R. 3 W.

## CERITHIOPSIS VADERENSIS (Dickerson), 1915

Plate 76, figure 2

*Melania vaderensis* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pp. 60, 61, pl. 6, fig. 7, 1915.

*Original description.* Shell elongate-conic with nearly flat sided whorls; whorls decorated by seventeen or eighteen slightly sinuous axial ribs crossed by four spiral lines of nearly equal strength; suture wavy, distinct. Dimensions:—Length of broken type, 19 mm.; width of body whorl, 6 mm. (Dickerson)

*Observations.* This species from the Cowlitz formation may be distinguished from *C. merriami* from the Gries Ranch beds in the details of spiral ornamentation. On the Eocene species there are four spiral ribs above the angulation, whereas there are three on the Oligocene form; there are three spiral ribs on the basal plate on this species and six to eight on *C. merriami*.

*Holotype.* (C.A.S. 300.) Figured in the present report, pl. 76, fig. 2.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

#### CERITHIOPSIS EXCELSA Dall, 1909

##### Plate 76, figure 1

*Cerithiopsis excelsus* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 75, pl. 3, fig. 9, 1909.

*Cerithiopsis excelsa* Bartsch, Proc. U.S. Nat. Mus., vol. 40, p. 352, pl. 36, fig. 1, 1911.

*Cerithiopsis alternata* Gabb, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, 1914.

*Cerithium excelsum* (Dall), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 355, 1926.

*Cerithiopsis excelsa* Dall, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 82, pl. 21, fig. 6, 1938.

*Original description.* Shell large for the genus, slender, with about 14 whorls; apex defective; later whorls with a closely appressed suture and moderately rounded; sculpture of numerous, slightly concavely arcuate, little-elevated, axial ribs with subequal or wider interspaces, crossed by numerous fine rounded threads with wider interspaces; the spiral threads overrun the ribs and (especially three or four which are stronger than the rest) are minutely nodulous in most cases at the intersections; here and there the whorls are crossed by a swollen varix, indicating a previous resting stage; base rather rounded, with about six prominent spiral threads, with wider interspaces which sometimes carry a much finer intercalary thread; canal short, recurved; aperture obstructed by matrix, the outer lip at resting stages slightly expanded and thickened. Altitude, 20.5 mm., maximum diameter, 6.5 mm. (Dall)

*Observations.* This species differs from *C. preussi* G. D. Hanna in having a larger number of less developed and somewhat more rounded whorls.

*Holotype.* (U.S.N.M. 107400.) Figured in the present report, pl. 76, fig. 1.

*Geologic range.* Tyee formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-661.) On east bank of Little River in center of Section 19, T. 26 S., R. 3 W.

## CERITHIOPSIS WASHINGTONIANA (Dickerson), 1915

Plate 76, figures 3, 4, 5

*Triforis washingtoniana* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 63, pl. 6, fig. 13, 1915.

*Triforis martini* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 176, 177, pl. 30, fig. 9, 1917.

*Cerithiopsis washingtoniana* (Dickerson), Effinger, Jour. Paleon., vol. 12, p. 380, pl. 47, fig. 25, 1938.

*Bittium washingtoniana* (Dickerson), Bartsch, Proc. U.S. Nat. Mus., vol. 52, p. 676, 1917.

*Original description* ("*Triforis washingtoniana*"). Shell elongate, conic with nine nearly plane-sided whorls, whorls decorated by three rows of nodes made by the crossing of three strong spiral lines and about eighteen axial ribs which are parallel to axis; one or two intercalary threads occur between the horizontal rows of nodes; suture indistinct. Dimensions:—Length, 20 mm.; width of body-whorl, 45 mm. (Dickerson)

*Original description* ("*Triforis martini*"). Shell elongate-conic, with eight slightly convex whorls; whorls decorated by three rows formed by the crossing of three strong spiral lines and about 16 axial ribs which are parallel to the axis; one beaded intercalary thread with small beads twice as numerous as nodes occurs in addition; suture wavy, indistinct, canal short. Dimensions:—Length, 13 mm.; width of body-whorl, 3 mm. (Dickerson)

*Observations.* Specimens of this species are very abundant in the Cowlitz formation and show considerable variation. Effinger (138, p. 380) considered "*Triforis*" *washingtoniana* Dickerson and "*Triforis*" *martini* Dickerson as synonymous. The holotypes of Dickerson of these two species show only very minor differences in sculpture and these differences fall within the range of variations as observed in numerous individuals occurring in the Cowlitz formation and in the Gries Ranch beds. The specimen figured by Effinger (138, pl. 47, fig. 25) from the Gries Ranch beds on Cowlitz River differs from Dickerson's holotype (C.A.S. 421) of "*T. martini*" from the same Gries Ranch beds in having a greater apical angle and in being more tumid.

*Holotype* ("*Triforis washingtoniana*"). (C.A.S. 350.) Figured in the present report, pl. 76, fig. 3.

*Hypotype* (Holotype of "*Triforis martini*"). (C.A.S. 421.) Figured in the present report, pl. 76, fig. 4.

*Hypotype*. (U.C. 33584.) Effinger. From Gries Ranch beds (*Cerithiopsis washingtoniana*). (138, p. 380.) Figured in the present report, pl. 76, fig. 5.

*Geologic range* ("*Triforis washingtoniana*"). Cowlitz formation, upper Eocene.

*Geologic range* ("*Triforis martini*"). Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality* ("*T. washingtoniana*"). (U.W. 232.) North bank of Cowlitz River one and one-half miles west of Vader, Lewis County, Section 28, T. 11 N., R. 2 W.

*Type locality* ("*T. martini*"). (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, Section 25, T. 11 N., R. 2 W.

**CERITHIOPSIS NEWCOMBEI** (Clark and Arnold), 1923

## Plate 76, figure 7

*Cerithidea newcombei* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 163-164, pl. 31, figs. 4a, 4b, 1923.

*Original description.* Shell medium in size, turreted, number of whorls probably not more than ten or eleven. Apical whorls missing on all specimens at hand. Sutures strongly depressed and whorls rather strongly convex. Surface covered by fairly coarse spiral ribbing; four or sometimes five spiral ribs exposed on whorls of spire with interspaces averaging a little wider than width of ribs; eight spiral ribs on body whorl, anterior three of which are heavier than others and have wider interspaces; anterior rib of the three well down on base, which is round and without angulation between it and sides of whorl. Surface also sculptured with about thirteen radial ribs which are somewhat heavier than spiral ribs. Aperture broadly subovate; edge of outer lip on all specimens at hand broken but was apparently thin and slightly reflexed. Inner lip with thin wash of callus. Canal short, narrow. Dimensions of type: Height (apex broken), 19.5 mm.; height of body whorl, 7 mm.; greatest width of body whorl, 8 mm. (Clark and Arnold)

*Observations.* The revolving ribs on this species are very poorly developed or entirely absent on the base near the canal and the ribs just above this area are heavier and better developed than on other parts of the whorl.

*Holotype.* (U.C. 30088.) Figured in the present report, pl. 76, fig. 7.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Sooke Bay, Vancouver Island.

*Type locality.* Sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

**CERITHIOPSIS MERRIAMI** (Dickerson), 1917

## Plate 76, figure 6

*Epitonium merriami* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 175, 176, pl. 30, figs. 7a, 7b, 1917.

*Cerithiopsis merriami* (Dickerson), Effinger, Jour. Paleon., vol. 12, p. 380, 1938.

*Original description.* Shell medium in size; number of whorls unknown; apical angle small, suture, sharp, distinct, linear; each whorl is decorated by three strong spiral lines crossed by about 20 axial ribs parallel to axis; pits between the two ribbing systems rectangular, with shorter dimensions parallel to axis; split rectangles occurring above and below suture. A cotype shows that the first three nuclear whorls are smooth. Dimensions: Length of broken type, 13 mm. (Dickerson)

*Observations.* As pointed out by Effinger, this species somewhat resembles *C. vaderensis* (Dickerson) from the Cowlitz formation but may be distinguished from it in having three instead of four spiral ribs above the angulation. The basal plate is sculptured with six to eight spiral ribs rather than three as in *C. vaderensis*.

*Holotype.* (C.A.S. 417.) Figured in the present report, pl. 76, fig. 6.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) In south bank of Cowlitz River, Cowlitz County, northeast quarter of Section 25, T. 11 N., R. 2 W.

#### CERITHIOPSIS FASTENI Van Winkle, 1918

Plate 76, figure 8

*Cerithiopsis fasteni* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, pp. 87, 88, pl. 7, fig. 8, 1918.

*Original description.* Shell minute, slender and elongate; whorls eight in number and decorated with twelve very prominent longitudinal ribs which extend over the surface of all the whorls; these are crossed by four broad, well defined revolving ribs with interspaces of double width; within each interspace there is a single revolving thread. At the intersection of the longitudinal and revolving ribs are rounded moderately prominent nodes; suture distinct with a fine revolving cord immediately above it; lower end of the middle portion of the body whorl merges at a sharp angle into a nearly flat base; which is decorated with four revolving ribs; aperture roughly oval in outline; canal short and incised. Dimensions.—Altitude of shell 5 mm.; altitude of spire 3 mm.; maximum diameter of shell 2 mm.; angle of spire 35°. (Van Winkle)

*Observations.* This species may be distinguished from *C. howardi* in having eight instead of eleven whorls, lower third of each whorl more strongly angulated, each whorl with one or two less spiral ribs, upper third of surface of each whorl more concave.

*Holotype.* (U.W. 139) (C.A.S. 7588). Figured in the present report, pl. 76, fig. 8.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 330.) In south bank of Cowlitz River at old Gries Ranch, Section 25, T. 11 N., R. 2 W.

#### CERITHIOPSIS HOWARDI Dickerson, 1917

Plate 76, figure 10

*Cerithiopsis howardi* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 175, pl. 30, figs. 6a, 6b, 1917.

*Bittium howardi* (Dickerson), Effinger, Jour. Paleon., vol. 12, p. 380, 1938.

*Original description.* Shell elongate-conic with 11 whorls, the first three smooth nuclear; fourth, fifth, sixth and seventh whorls decorated by 12 axial ribs crossed by three spiral lines, the uppermost being the weakest; rounded nodes at crossings; eighth whorl similarly decorated except that the uppermost spiral line is equal in strength with the other two; ninth, tenth and eleventh whorls exhibiting two or more weaker spiral lines bordering upper and lower sutures, which are impressed and slightly wavy; base smooth; outer lip, thin, sharp; canal very short, nearly straight. Dimensions:—Length of type 7 mm. (Dickerson)

*Observations.* An examination of the base of the holotype shows three weakly developed spiral ribs. It may be distinguished from *C. fasteni* in having eleven instead of eight whorls and in possessing on each whorl one or two more spiral ribs. The angulation of the whorl is a little less distinct.

*Holotype.* (C.A.S. 415.) Figured in the present report, pl. 76, fig. 10.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, Section 25, T. 11 N., R. 2 W.

#### Genus BITTIUM Leach, 1847

*Bittium* Leach, in Gray, Ann. Mag. Nat. Hist., vol. 20, p. 270, 1847.

*Genotype.* *Murex reticulatus* Montagu == (*Strombiformis reticulatus* Da Costa).

#### BITTIUM ESCHRICHTII (Middendorff), 1849

##### Plate 76, figure 9

*Turritella eschrichtii* Middendorff, Mem. Acad. Imp. Sci. St. Petersburg, vol. 8, p. 396, pl. 11, fig. 1, August, 1849.

*Bittium (Stylium) eschrichtii* Middendorff, Dall, Proc. U.S. Nat. Mus., vol. 33, no. 1564, p. 178, 1907; Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 76, pl. 14, fig. 2, 1909; Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 761, pl. 24, fig. 9, 1931; Bartsch, Proc. U.S. Nat. Mus., vol. 40, pp. 387-388, 1911.

*Description by Dall.* Shell large for the genus, moderately thick, solid, with about ten whorls, including the nucleus; the latter is dextral, smooth, slender, and rather blunt at the apex; on the subsequent whorls sculpture of (on the spire four; on the last whorl, including the base, about ten) flat, wide, straplike revolving ridges, separated by much narrower channeled interspaces; the ridges are rarely made duplex by an incised line, and are crossed by evident incremental lines also visible in the channels, and on the last whorl there is sometimes a fine intercalary thread in some of the channels; the whole surface bears more or less obsolete, extremely fine striation; the recent shell is livid or whitish, with irregular brownish streaks and patches on the posterior half of the whorls; base rounded; canal extremely short, not recurved; aperture roughly semilunate, outer lip thin, simple; a thin wash of callus on the body, the pillar smooth, shorter than the aperture, a little twisted anteriorly. Altitude, 15 mm.; maximum diameter, 5 mm. (Dall, 101, p. 76)

*Description by Bartsch.* Shell broadly elongate-conic, rather coarse, varying in color from white to chestnut brown. The nucleus consists of a single, smooth, white whorl, well rounded. Post-nuclear whorls well rounded, marked by four strong, somewhat flattened, spiral keels between the sutures, which are separated by deep, strong, spiral grooves about two-thirds as wide as the keels. In addition to this spiral sculpture, the whorls are marked by numerous fine, spiral striations and fine lines of growth. Periphery of the last whorl marked by a sulcus as wide as the sulci between the keels on the spire. Base well rounded, marked by eight equally spaced spiral cords, which grow successively weaker from the periphery to the umbilical area. In addition to these cords the base is marked by fine spiral lines and fine lines of growth. Aperture oval, somewhat effuse anteriorly; posterior

angle obtuse; outer lip thin rendered wavy by the external sculpture; columella short, very broad at base, somewhat twisted and reflected; parietal wall glazed with a thin callus. The specimen described and figured (Cat. No. 122558, U.S.N.M.) has nine post-nuclear whorls and measures: Length 14 mm., diameter 5 mm., and was collected on the beach at Sitka, Alaska. (Bartsch, 24-A, pp. 387, 388)

*Hypotype.* (U.S.N.M. 153992.) From Fossil Rock, Coos Bay, Oregon. Figured in the present report, pl. 76, fig. 9.

*Geologic range.* Pliocene to Recent.

*Geographic distribution.* Coast Ranges of California, northward to Alaska.

*Type locality in Northwest.* Fossil Rock, Coos Bay; Empire formation, upper Miocene and lower Pliocene.

#### Genus **BENOISTIA** Cossmann, 1899

*Benoistia* Cossmann, Bull. Géol. Soc. France, ser. 3, vol. 28, p. 556, 1899.

*Genotype.* *Cerithium muricoides* Lamarck.

#### **BENOISTIA UMPQUAENSIS** Turner, 1938

Plate 76, figures 11, 12

*Benoistia umpquaensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 82, pl. 21, figs. 8, 10, 1938.

*Original description.* Shell heavy, turbinate, angulated at middle of whorl; suture at angle; ornamented with eight nodose axial ribs above the angulation, and a total of 11 revolving ribs on the body whorl, middle one slightly stronger at the angle, single fine inter-ribs separating the primary spirals; spiral lines below are separated by finer inter-ribs; aperture round; short canal set in anterior lip; callous covering umbilicus and forming a fasciole; inner lip with plication near posterior limit. (Turner)

*Observations.* An important character of this species is the suture at the angle of the whorl instead of below and the angle at the middle of the whorl instead of above. Turner distinguishes it in this manner from *Trichotropis lajollaensis* Hanna.

*Holotype.* (U.C. 33192.) Figured in the present report, pl. 76, figs. 11, 12.

*Geologic range.* Tyee formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-661.) East bank of Little River in center of Section 19, T. 26 S., R. 3 W.

#### Family **TRICHOTROPIDAE**

#### Genus **TRICHOTROPIS** Sowerby, 1829

*Trichotropis* Sowerby, Zool. Jour., vol. 4, p. 373, 1829.

*Genotype.* *Trichotropis bicarinata* Sowerby.

## TRICHOTROPIS OREGONENSIS (Conrad), 1865

## Plate 76, figure 13

*Cancellaria? oregonensis* Conrad, U.S. Explor. Exped. Geol. (no name), pl. 20, fig. 8, 1849; Conrad, Am. Jour. Conch., vol. 1, p. 151, 1865.

*Trichotropis oregonensis* (Conrad), Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 77, 78, 1909 (description from a cast); Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 767, 1931.

*Original description by Dall.* The specimens are internal casts and external molds with the shelly matter disintegrated. A gutta-percha cast, however, reveals the sculpture fairly well. The shell has about five whorls, subtabulate with a high angular shoulder, the whorls rapidly increasing; the pillar is smooth, without plaits, and the aperture rounded except at the anterior end, where there is an angle, but no canal or sulcus; the pillar is thin, simple, and oblique; the sculpture consists, above the shoulder and on the base, of fine threads with about equal interspaces; over the middle of the whorl there are six or eight stronger cords with much wider interspaces; the axial sculpture on the last whorl consists of 10 to 12 narrow, sharpish ribs, stronger and more rounded on the shoulder, which extend clear across the whorl; there are also very fine, close lines, like emphasized incremental lines, over most of the surface. Length of shell, about 25 mm.; of last whorl, 19 mm.; maximum diameter, 17 mm. (Dall, 101, pp. 77, 78)

*Observations.* The specimens collected by J. D. Dana from the middle Miocene at Astoria were in part figured by Conrad in 1849 but not named. The figure in this Northwest report was made from a plasto-type which in turn had been made earlier from an external mold in a concretion now deposited in the U. S. National Museum (3554). Its characters are well described in Dall's statement.

*Plastotype.* (U.S.N.M. 3554.) Conrad specimen (68, pl. 20, fig. 8). Figured in the present report, pl. 76, fig. 13.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Astoria, Oregon.

*Type locality.* Astoria, Oregon. (Dana)

## TRICHOTROPIS CORONATA Gould, 1860

*Trichotropis (Iphinoe) coronata* Gould, Proc. Boston Soc. Nat. Hist., vol. 7, p. 324, 1860.

*Trichotropis (Iphinoe) coronata* Gould, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 106, 1931.

*Original description.* T. ovato-rhomboidea, turrita, tenuis, cinerea, epidermide fibroso ad carinam in fimbriam cirrosam producto induta; umbilico lato, profundo, acuté marginato; anfr. 6 citó crescentibus, posticé tabulatis, ad angulum carinatis; apertura ovato-triangularis, labro simplici; columella recta, anticé vix reflexa, acuta, subcanaliculata; operculum ovatum, corneum, apice terminali. Long. 25 millim.; lat. 15 millim. Hab. Arctic Ocean, Straits of Semiavine, 20 fathoms, mud. W. S. May perhaps be *T. ciliata*, Kruger, which I have not seen. A very curious and elegant species. (Gould, 150, p. 324)

*Observations.* The middle Miocene specimens from Washington resemble the Recent species except for the lack of spiral ribs on the an-

terior portion of the body whorl and for minor differences in the shape of the whorls.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 473.) Wynoochee River road in cut 150 yards south of railroad up Black Creek, Grays Harbor County, Section 26, T. 18 N., R. 8 W.

#### TRICHOTROPIS (IPHINOE) cf. UNICARINATA Sowerby, 1866

Plate 76, figures 14, 15, 16

*Trichotropis unicarinata* G. B. Sowerby, Thesaurus Conchyliorum, vol. 3, p. 323, fig. 10, 1866.

*Original description.* Angulatim subovalis, laevigata; spirâ productâ, anfractibus supra angulatim carinatis, supra angulum complanatis, depressis; ultimo magno, carinâ minutè carinatâ, umbilico latissimo, margine carinato; aperaturâ oblique subquadrata, termine obliquè acuminata; labro externo medio rotundato, supra et infra contracto. (G. B. Sowerby, p. 323)

*Observations.* A specimen (U.C. 33832) from locality (U.C. 9064) = (U.W. 473) in the Astoria formation closely resembles the type of Sowerby. The dimensions of specimen (U.C. 33832) are: altitude of shell, 13 mm.; altitude of broken spire, 3 mm.; maximum diameter of shell, 8.5 mm.

*Hypotype.* (U.C. 33832.) Figured in the present report, pl. 76, figs. 14, 15, 16.

*Geologic range.* In Washington, Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 473.) Wynoochee River road in cut 150 yards south of railroad up Black Creek, Grays Harbor County, Section 26, T. 18 N., R. 8 W.

#### TRICHOTROPIS ALIENENSIS Effinger, 1938

Plate 76, figure 17

*Trichotropis alienensis* Effinger, Jour. Paleon., vol. 12, pp. 381, 382, pl. 46, fig. 22, 1938.

*Original description.* Shell small, thin; spire turreted, consisting of about five whorls, which increase rapidly in size; upper surface of whorls flat, smooth, markedly tabulate; body whorl sharply biangulate, each angle bearing a strong spinal cord; medial surface tapering slightly anteriorly and ornamented by two spiral threads; interspaces flat, about twice the width of spiral thread; lower surface of body whorl slightly concave, smooth; aperture subquadrate; outer lip thin; inner lip concave, covered with a thin deposit of callus; columella bearing a distinct longitudinal groove, which extends posteriorly up into a very small umbilical opening; anterior canal very short; growth lines strongly retractive on upper surface of whorl, almost perpendicular on medial surface, curved on surface so as to be concave posteriorly. Dimensions: holotype 33,586, altitude (incomplete) 6.6 mm., maximum diameter 5.8 mm. (Effinger)

*Observations.* *T. alienensis* from the lower middle Oligocene may be distinguished from *T. unicarinata* of middle Miocene age by the bicar-

inate character of the whorl and the somewhat concave surface between the upper and lower carinae. The surface of whorl from suture to upper carina slopes downward in contrast to its nearly flat position in *T. unicarinata*. The aperture also is proportionately much broader.

*Holotype.* (U.C. 33586.) Figured in the present report, pl. 76, fig. 17.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries ranch, Section 25, T. 11 N., R. 2 W.

### Family STROMBIDAE

#### Genus ECTINOCHILUS Cossmann, 1889

*Ectinochilus* Cossmann, Ann. Soc. Roy. Malac. Belg., vol. 24, p. 87, 1889.

*Genotype.* "Strombus" canalis Lamarck.

#### Subgenus Cowlitzia Clark and Palmer, 1923

*Cowlitzia* Clark and Palmer, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 283, pl. 51, figs. 11, 12, 13, 14, 1923.

*Subgenotype.* *Rimella* (*Cowlitzia*) *washingtonensis* (Clark and Palmer).

#### ECTINOCHILUS (COWLITZIA) WASHINGTONENSIS (Clark and Palmer), 1923

##### Plate 76, figures 18, 19, 20, 23, 24

*Rimella canalifera* Gabb var. *elongata* Weaver, Geol. Surv. Wash., Bull. no. 15, pl. 2, fig. 18 (not fig. 19), 1912.

*Rimella simplex* Dickerson, in part (not Gabb), Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 6, figs. 1a, 1b, 1915.

*Cowlitzia washingtonensis* Clark and Palmer, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 283, 284, pl. 51, figs. 11, 12, 13, 14, 1923.

*Ectinochilus* (*Cowlitzia*) *washingtonensis* Clark and Palmer, Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 367, 368, 1926.

*Original description.* Shell fairly heavy; apex acute; number of whorls 10 or 11 with sides moderately convex; sutures slightly appressed. Surface sculptured by narrow, rounded, longitudinal ribs; these are much more numerous on the upper whorls of the spire than on the lower whorls. On the body whorl of the holotype there are 9 of these ribs which stand up very prominently, forming elongate nodes reaching a little over one-third of the distance from the suture to the anterior end; on the penultimate whorl there are 11 longitudinal ribs, which are not nodose and reach from the posterior suture not quite to the anterior suture; on the fourth from the last whorl there are 18 longitudinal ribs which reach from suture to suture, while on the whorl posterior to this there are between 26 and 27 of these ribs. Entire surface covered by fine, closely crowded longitudinal striae. Surface also sculptured by fairly heavy, rounded, spiral ribs with interspaces averaging somewhat wider than the width of ribs. There are about 27 of these spiral ribs on the body whorl of the holotype and 11 on the penultimate whorl. Outer lip subangulated, thickened and reflected posterior to subangulation; thickened edge continues posteriorly to form one side of posterior canal; anterior to subangulation edge of outer lip broadly curved and serrated. On the holotype

there are 7 of these serrations. Inner lip covered by a heavy callus, which continues posteriorly to form other side of long posterior canal, which is very narrow but not closed, and crosses 3 whorls, ending obliquely on second whorl posterior to penultimate whorl. Canal very short, slightly flexed posteriorly, with fairly deep, well developed notch. Dimensions of holotype: Height 38.5 mm.; height of body whorl 24 mm.; greatest width of body whorl 16 mm. (Clark and Palmer)

*Observations.* Figures 23, 24 equal form originally described by Weaver (286, pl. 2, fig. 18, not figure 19) as *Rimella canalifera* Gabb var. *elongata* Weaver.

*Holotype.* (C.A.S. 770.) Figured in the present report, pl. 76, fig. 19.

*Hypotype.* (C.A.S. 295.) Figured in the present report, pl. 76, fig. 18.

*Hypotype.* (U.C. 33817.) Figured in the present report, pl. 76, fig. 20.

*Hypotype.* (U.W. 17) (C.A.S. 7617). Figured in the present report, pl. 76, figs. 23, 24.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River, Lewis County, Washington, Section 28, T. 11 N., R. 2 W.

#### Subgenus *Vaderos* Clark and Palmer, 1923

*Vaderos* Clark and Palmer, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 281, 282, pl. 51, figs. 7, 8, 1923.

*Subgenotype.* *Rimella elongata* (Weaver).

#### ECTINOCHILUS (VADEROS) ELONGATA (Weaver), 1912

Plate 76, figure 22

*Rimella canalifera* Gabb var. *elongata* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 37, pl. 2, fig. 19, 1912.

*Rimella elongata* Weaver, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 59, pl. 6, fig. 2, 1915.

*Ectinochilus (Vaderos) elongatus* (Weaver), Clark and Palmer, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 282, pl. 51, fig. 8, 1923.

*Original description.* Shell small, fusiform, elongate; spire very much elevated; whorls ten (a constant character), slightly convex; suture moderately deep. Surface marked by twenty-three narrow knife-like longitudinal ribs. These extend over all the whorls except the last two which form the apex; interspaces twice as broad as the ribs and broadly concave. These ribs extend over the upper two-thirds of the body whorl and over all the whorls of the spire. They are crossed by thirty-three distinct revolving ribs which are very closely spaced on that part of the surface where the longitudinal ribs are present; below that the revolving ribs are twice as far apart. Aperture long and narrow; posterior angle of the mouth is continued in a deep canal (in some specimens fairly broad), slightly curved along the spire to the apex; anterior canal short; outer lip somewhat thickened; inner lip heavily incrusted by a callous. Dimensions.—Altitude 19 mm.; diameter 7 mm.; altitude of spire 11 mm.; angle of spire 32°. (Weaver)

*Holotype.* Lost (U.W. 17-A). (286, pl. 2, fig. 19; not fig. 18.) Not figured in the present report.

*Hypotype.* (U.C. 33819.) Figured in the present report, pl. 76, fig. 22.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Lewis County, Section 28, T. 11 N., R. 2 W.

Subgenus *Macilentos* Clark and Palmer, 1923

*Macilentos* Clark and Palmer, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 280, pl. 51, figs. 8, 10, 1923.

*Subgenotype.* *Rimella macilenta* White.

**ECTINOCHILUS (MACILENTOS) MACILENTA** White subsp. **OREGONENSIS** Hendon, 1938

Plate 76, figures 25, 26, 27

*Rimella canalifera* Gabb, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, 1914.

*Rimella oregonensis* Hendon, unpublished thesis, Univ. Oregon.

*Rimella (Macilentos) macilenta* White subsp. *oregonensis* Hendon ms, Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 94, 95, pl. 18, figs. 1, 2, 3, 4, 1938.

*Original description.* Shell small, cuneiform, slender, whorls slightly convex, crossed by 9 to 11 sharp axial ribs and marked by numerous fine flat spiral ribs. Axial ribs tend to shorten or draw into nodes on adult whorls. Anterior canal but slightly extending beyond lower margin of outer lip. Posterior canal almost closed, ascending the spire almost to the apex and turning to the right. Outer lip smooth, thickened, and reflexed, in some specimens the flaring portion showing a slight flexure which is probably an expression of the "stromboid" notch. Below widest portion of the outer lip is a sharp angulation, and the margin swings directly to the canal. (Hendon in Turner)

*Observations.* The subspecies *oregonensis* differs from *Ectinochilus macilenta* in having fewer longitudinal ribs which on the anterior whorls are short and occasionally assume the form of nodes, whereas the nodes are lacking in the species *macilenta* and there may be as many as 16 longitudinal ribs.

*Holotype.* (U.C. 33633.) Figured in the present report, pl. 76, fig. 27.

*Paratype.* (U.C. 33634.) Figured in the present report, pl. 76, figs. 25, 26.

*Geologic range.* Tye formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. 142.) East side of Buckhorn Creek near its junction with Little River, Douglas County, Oregon, northeast quarter of Section 25, T. 26 S., R. 3 W. (Turner)

Genus **TEREBELLUM** (Klein 1753) Lamarck, 1799

*Terebellum* (Klein, 1753), Lamarck, Mem. Soc. d'Hist. Natur. de Paris, vol. 1, p. 69, 1799.

*Genotype.* *Terebellum subulatum* Lamarck.

**TEREBELLUM ANDERSONI** (Dickerson), 1917

Plate 76, figure 28

*Seraphs andersoni* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 180, pl. 31, figs. 9a, 9b, 1917.

*Terebellum andersoni* (Dickerson), Effinger, Jour. Paleon., vol. 12, pp. 380, 381, 1938.

*Original description.* Shell smooth, spindle form, with five whorls; the body-whorl swollen and five times as long as spire; spire whorls nearly flat-sided; suture linear; outer lip, thin, sharp; aperture elongate, narrow; canal short, slightly twisted toward the rear. Dimensions:—Length, 38 mm.; width of body-whorl, 11 mm. (Dickerson)

*Observations.* In Oregon and Washington, specimens of this genus are known only from the Gries Ranch beds or strata of equivalent age. As pointed out by Effinger, the exposed spire on the shell suggests its relationship to the genus *Terebellum* rather than *Seraphs*.

*Holotype.* (C.A.S. 434.) Figured in the present report, pl. 76, fig. 28.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, Section 25, T. 11 N., R. 2 W.

Genus ERATOPSIS Hoernes and Auringer, 1880

*Eratopsis* Hoernes and Auringer, Abhand. der K. Geol. Reich., Band 12, Heft 1, p. 63, pl. 8, figs. 8, 9, 10, 1880.

*Genotype.* *Eratopsis barrandei* Hoernes and Auringer.

ERATOPSIS CRESCENTENSIS Weaver and Palmer, 1922

Plate 76, figure 21

*Eratopsis crescentensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 36, 37, pl. 11, figs. 10, 22, 1922.

*Original description.* Shell small, ob-ovate; spire concealed; columella region attenuated; slight canal; aperture narrow; outer lip thickened, crenulated internally; surface ornamented by spiral ribs which anastomose in the dorsal region; along the mid-dorsal line, the ribs are interrupted more or less by a shallow groove. Dimensions.—Altitude 6 mm.; width 4 mm. (Weaver and Palmer)

*Observations.* This species is the only representative of the genus in Oregon and Washington. The type of the genus is *E. barrandei* from the Miocene of Italy. The anterior portion of the shell of *E. crescentensis* is more constricted than in the case of the type.

*Holotype.* (U.W. 201) (C.A.S. 7587). Figured in the present report, pl. 76, fig. 21.

*Geologic range.* Crescent formation, middle Eocene.

*Geographic distribution.* Crescent Bay, Clallam County, Washington.

*Type locality.* (U.W. 358.) One-fourth mile east of Tongue Point, Crescent Bay, Section 22, T. 31 N., R. 8 W.

## Family CYPRAEIDAE

## Genus CYPRAEA Linnaeus, 1758

*Cypraea* Linnaeus, Syst. Nat. (10th ed.), p. 718, 1758.

*Genotype.* *Cypraea tigris* Linnaeus.

## CYPRAEA OAKVILLENSIS Van Winkle, 1918

Plate 76, figures 29, 30

*Cypraea oakvillensis* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 88, pl. 7, fig. 19, 1918.

*Original description.* Shell moderately large, sub-oval in outline and thick; broadest about one-third the length of the shell from the posterior end; surface smooth except for very faint lines of growth; aperture narrow and of about equal width from the anterior to posterior ends; outer lip strongly incurved and bearing fourteen teeth or crenulations on both the inner and outer lips. Dimensions.—Altitude of shell 23 mm.; maximum diameter of shell 15 mm. (Van Winkle)

*Observations.* The shell material of the holotype of this species now is largely broken away but when originally collected was smooth and ornamented only by lines of growth.

*Holotype.* (U.W. 140) (C.A.S. 7606). Figured in the present report, pl. 76, figs. 29, 30.

*Geologic range.* Lowermost Lincoln formation, lower middle Oligocene.

*Geographic distribution.* Eastern Grays Harbor County, Washington.

*Type locality.* (U.W. 169.) Oakville quarry, in sandstone overlying basalt, one mile west of Oakville, on Northern Pacific track, Grays Harbor County, Section 19, T. 16 N., R. 4 W. Lower Oligocene.

## Genus CYPRAEOGEMMULA Vredenburg, 1920

*Cypraeogemmula* Vredenburg, Records of the Geol. Surv. India, vol. 51, pt. 2, p. 114 (no plates), Nov., 1920.

*Genotype.* *Cypraeogemmula liliputana* Schilder = (*Trivia scabriuscula* Von Koenen).

## CYPRAEOGEMMULA WARNERI Effinger, 1938

Plate 77, figure 2

*Cypraeogemmula warneri* Effinger, Jour. Paleon., vol. 12, p. 381, pl. 47, figs. 29, 35, 1938.

*Original description.* Shell minute, somewhat pyriform, globular; outline from dorsal or ventral aspect asymmetrical in relation to antero-posterior axis; margin of outer lip evenly rounded, opposite side convex above but straight to slightly concave below. Aperture somewhat cassiform, narrowing above and terminating in a short but deep posterior canal, which is strongly reflected toward the spire, widening slightly below and terminating in a straight deep anterior canal. Outer lip sharply inflected, slightly wider above than below and ornamented by about 28 prominent transverse ridges, most of which extend completely across inflected surface, giving rise to a denticulated inner margin. Inner lip demarcated by a prominent longitudinal ridge extending across the body whorl from tip of an-

terior to tip of posterior canal; surface widest in central portion of shell, concave especially below; ornamented by 20 prominent transverse ribs similar to outer lip. Fossula obsolete; spire visible, consisting of about four whorls; nuclear whorls small, naticoid, smooth, consisting of about one and one-half volutions. Body whorl conspicuously ornamented by about 24 strong, rounded, somewhat nodose revolving ribs, which are strongest in the central portion of the whorl, becoming finer on anterior and posterior areas; interspaces wide and generally bearing a smooth interrib. Ornamentation continuous over entire dorsal surface, there being a complete absence of any longitudinal dorsal groove. Dimensions: holotype 33,588, altitude 4.1 mm.; maximum diameter 3 mm. (Effinger)

*Observations.* This species is the only representative of the genus on the Pacific Coast. The only other species known to the writer is the genotype, *Trivia scabriuscula* Von Koenen, from Oligocene beds at Lattdorf, Germany.

*Holotype.* (U.C. 33588.) Figured in the present report, pl. 77, fig. 2.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, Section 25, T. 11 N., R. 2 W.

### Family FICIDAE

#### Genus FICUS ("Bolten") Roeding, 1798

*Ficus* Roeding, in Bolten, Museum, Boltenianum, pt. 2, p. 148, 1798.

*Genotype.* *Ficus communis* Roeding.

#### FICUS MODESTUS (Conrad), 1848

Plate 77, figure 1; plate 103, figure 1

*Pyrula modesta* Conrad, Am. Jour. Sci., ser. 2, vol. 5, p. 433, fig. 12, 1848.

*Ficus pyriformis* Gabb, Geol. Surv. Calif. Paleon., vol. 2, pp. 48, 77, pl. 14, fig. 4, 1869.

*Ficus modestus* Conrad, U.S. Geol. Surv., Prof. Pap. no. 59, p. 74, 1909; Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 372, pl. 31, fig. 2, 1926.

*Ficus (Ficus) modesta* (Conrad), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 742, 1931.

*Ficus modestus* (Conrad), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 96, pl. 11, fig. 6, 1931.

*Original description.* Pyriform, thin, with approximate prominent alternated revolving lines reticulated with minute longitudinal lines; spire very short, conical; upper portion of body whorl regularly rounded. (Conrad)

*Observations.* The holotype of "Pyrula" *modesta* Conrad which came from Astoria, Oregon, has been lost. Its similarity to *F. pyriformis* Gabb has been pointed out by Stewart and by Grant and Gale. They have noted also its close relationship to the living *F. dussumieri* (Valenciennes) although the anterior part of the body is more constricted in the former.

*Holotype.* Lost.

*Holotype* (*Ficus pyriformis* Gabb). (P.A.N.S. 4325.) Reproduction of specimen figured by Stewart (266, pl. 31, fig. 2). Figured in the present report, pl. 103, fig. 1.

*Hypotype*. (U.C. 31995.) Figured in the present report, pl. 77, fig. 1.

*Geologic range*. Astoria formation, middle Miocene.

*Geographic distribution*. Coast Ranges of California, Oregon, and Washington.

*Type locality*. Astoria, Oregon. (Dall)

#### Subgenus *Trophosycon* Cooper, 1894

*Trophosycon* Cooper, Calif. State Mining Bureau, Bull. no. 4, p. 53, 1894.

*Genotype*. *Agasoma?* (*Trophosycon*) *kernianum* Cooper = (*Sycotyphus ocoyanus* Conrad).

#### **FICUS (TROPHOSYCON) CLALLAMENSIS** Weaver, 1912

##### Plate 77, figure 7

*Ficus clallamensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 74, pl. 9, fig. 73, 1912.

*Trophosycon clallamensis* (Weaver), English, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 8, p. 250, 1914.

*Ficus (Trophosycon) clallamensis* Weaver, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 750, 1931.

*Original description*. Shell large, subpyriform, robust, subangulated; top of body whorl flattened, and very slightly convex; upper part of whorl sharply angulated, angle about 125°, and carries a series of thirteen unequally spaced nodes which are more or less flattened towards the outer lip; interspaces between the nodes equal in width to the nodes; these nodes die out a short distance above the angle as well as below; an obscure lower angle occurs but carries no nodes; spire very low but rises as a distinct cone above the nearly level surface of the body whorl; whorls four; surface of body whorl ornamented with fourteen widely spaced but not very prominent revolving ribs, four of which are above the row of nodes and ten below; interspaces broad and flat with no additional ribs. Surface of shell crossed by numerous very fine lines of growth. Aperture broad and canal short. Dimensions.—Altitude of shell 90 mm. from broken portion of canal; latitude 75 mm.; altitude of body whorl from broken portion of canal 83 mm.; altitude of spire above body whorl 6 mm. (Weaver)

*Observations*. This species has, on the subangulate shoulder of the body whorl, faintly developed nodes suggestive of its subgeneric position.

*Holotype*. (U.W. 74) (C.A.S. 7525). Figured in the present report, pl. 77, fig. 7.

*Geologic range*. Astoria formation, middle Miocene.

*Geographic distribution*. Clallam County, Washington.

*Type locality*. (U.W. 490.) In sea cliff on south shore of Strait of Juan de Fuca 13,000 feet due east of Clallam Bay, Washington, in the northeast quarter of southeast quarter of Section 22, T. 32 N., R. 12 W.

**FICUS (TROPHOSYCON) RESTORATIONENSIS** Van Winkle, 1918

## Plate 77, figure 13

*Ficus restorationensis* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 88, pl. 7, fig. 20, 1918; Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 123, 1933.

*Original description.* Shell large and moderately thin; spire low; whorls six and rounded; body whorl very large and somewhat elongate; suture distinct; surface ornamented with 43 revolving ribs with interspaces of triple width. In the middle of each interspace are small revolving threads. The revolving ribs are crossed by very prominent longitudinal lines of growth; aperture narrow; canal very slightly twisted. Dimensions.—Altitude of shell 69 mm.; altitude of spire 10 mm.; maximum diameter of shell 40 mm.; angle of spire 85°. (Van Winkle)

*Observations.* The holotype of *F. restorationensis* is somewhat crushed but the body whorl is far less convex than in *F. clallamensis* and the prominent very slightly convex to nearly flat upper surface of the body whorl of the former species is represented by an evenly rounded surface on the latter. It is more closely related to *F. modestus* but has a proportionately lower spire and faintly developed longitudinal ribs which are very slightly nodose on the upper shoulder of the body whorl.

*Holotype.* (U.W. 141) (C.A.S. 7526). Figured in the present report, pl. 77, fig. 13.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Kitsap County, Puget Sound Basin.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, Washington, opposite Seattle.

**FICUS (TROPHOSYCON) CHEHALISENSIS** Weaver, 1916

*Ficus chehalisensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 46 (not figured), 1916.

*Original description.* Shell small and pyriform; spire low; whorls four; surface of whorls smooth except for numerous closely spaced somewhat indistinct lines of growth; revolving ribs or angles are absent; on upper margin of body whorl just below suture there is a slightly impressed groove. Aperture semi-lunar and elongated; canal elongate and slightly deflected outwards. Dimensions.—Altitude of shell 17 mm.; altitude of spire 3 mm.; maximum diameter of shell 7 mm.; angle of spire 112°. (Weaver)

*Observations.* This species has never been figured, although in the text of the original descriptions it is listed as figured on pl. 5, fig. 84. The type has been lost but originally was not well preserved. It has a close resemblance to *F. wynoochensis* Weaver but is more slender and lacks the rather subangulate shoulder present on the body whorl of the latter species.

*Holotype.* (U.W. 107.) Lost.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 229.) Cuts along road and in bank of Wynoochee River one mile south of junction with Bitter Creek, Grays Harbor County, Section 35, T. 18 N., R. 8 W.

**FICUS (TROPHOSYCON) WYNNOOCHENSIS** Weaver, 1916

## Plate 77, figure 4

*Ficus wynoochensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 45, 46, pl. 3, figs. 38, 39, 1916.

*Original description.* Shell of moderate size; sub-pyriform and evenly rounded; whorls five; body whorl large; spire very low; surface of body whorl ornamented by thirteen distinct, flat topped revolving ribs; in the interspaces between each of these ribs there are well-defined revolving threads; these ribs are crossed by strongly marked lines of growth. Canal elongated and slightly curved; aperture narrow. Dimensions.—Altitude of shell 40 mm.; altitude of spire 5 mm.; maximum diameter of shell 32 mm.; angle of spire 98°. (Weaver)

*Observations.* This species is more tumid than *Ficus modestus* but somewhat resembles *F. clallamensis*. It differs from the latter in having a relatively higher spire, more angulate upper shoulder of the body whorl, longer and flatter middle surface of the body whorl, and more pronounced spiral ribbing. This has been worn off on the holotype of *F. clallamensis* but on topotype specimens this ornamentation is far less developed.

*Holotype.* (U.W. 106) (C.A.S. 556). Figured in the present report, pl. 77, fig. 4.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 229.) Cuts along highway and in bank of Wynoochee River one mile south of junction with Bitter Creek, Grays Harbor County, Section 35, T. 18 N., R. 8 W.

Genus **FICOPSIS** Conrad, 1866

*Ficopsis* Conrad, Am. Jour. Conch., vol. 2, p. 100, 1866.

*Genotype.* *Ficopsis remondii* (Gabb) = (*Hemifusus remondii* Gabb).

**FICOPSIS REMONDII** (Gabb), 1864

## Plate 77, figure 12

*Fusus (Hemifusus) remondii* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 87, pl. 18, fig. 36, 1864.

*Ficopsis remondii* Gabb, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 61, pl. 6, fig. 8, 1915.

*Ficopsis remondii* (Gabb), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 376, 377, pl. 30, figs. 1, 2, 1926 (synonymy); Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 92, 93, pl. 15, fig. 20, 1938.

*Original description.* Shell fusiform, spire low; whorls five, rounded or sub-angular. Aperture long, moderately wide. Inner lip simple; outer lip thin, acute; canal long, straight. Body whorl rounded, or in some specimens marked by three faint angles on widest part, the lower two placed nearer than the middle and upper ones. Surface closely cancellated by numerous fine, linear ribs, sharply defined, the included spaces being flat. (Gabb)

*Notations by Turner.* *Ficopsis remondii* varies individually and stratigraphically in the degree of angulation of the whorls. Only the slightly angulate form of this species occurs in the vicinity of Cape Arago but at most other localities in Oregon it is found associated with the more angulate variety.

*Lectotype.* (P.A.N.S. 4184.) Reproduction of specimen figured by Stewart (266, pl. 30, fig. 1.) Not figured in the present report.

*Hypotype.* (U.C. 33182.) Oregon specimen. Figured in the present report, pl. 77, fig. 12.

*Geologic range.* Tejon and Coaledo formations, upper Eocene.

*Geographic distribution.* Coast Ranges of Oregon, California, and Washington.

*Type locality.* Coast Ranges of southern California; place uncertain. Common in Oregon at locality (U.C. A-858). A cove in southwest corner of Cape Arago (lower Coaledo formation). (Turner)

#### FICOPSIS REMONDII (Gabb) var. CRESCENTENSIS Weaver and Palmer, 1922

##### Plate 77, figure 10

*Ficopsis remondii* (Gabb) var. *crescentensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 39-40, pl. 11, fig. 14, 1922; Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 41, 1930; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 93, pl. 15, fig. 19, 1938.

*Original description.* Shell medium in size, fusiform and slender; spire low; whorls four and angulated at the middle; body whorl tri-carinated; canal long; aperture wide and elongate; surface ornamented with delicate longitudinal ribs which are crossed by spiral ribs of the same size and character which give the shell a cancellated sculpture. Dimensions.—Altitude 17 mm.; width of body whorl 10 mm.; angle of spire 60°. (Weaver and Palmer)

*Observations.* The specimens of this species differ from *F. remondii* (Gabb) in having three well-developed spiral carinae which lack prominent nodes at the intersection with the longitudinal ribs, as is the case in *F. hornii* Gabb and *F. cowlitzensis* (Weaver).

*Holotype.* (U.W. 205) (C.A.S. 7616). Figured in the present report, pl. 77, fig. 10.

*Geologic range.* Crescent, Umpqua, and Domengine formations, middle Eocene.

*Geographic distribution.* Southwestern Oregon, north side of Olympic Peninsula, and in San Diego and Contra Costa counties, California.

*Type locality.* (U.C. 3608.) Near Martinez, Contra Costa County, California. Occurs also in southwest Oregon.

#### FICOPSIS COWLITZENSIS (Weaver), 1912

##### Plate 77, figures 3, 5, 6, 8, 9, 11

*Hemifusus cowlitzensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 45, pl. 1, figs. 1, 4, 1912.

*Ficopsis cowlitzensis* (Weaver), Dickerson, Proc. Calif. Acad. Sci. ser. 4, vol. 5, p. 61, pl. 6, fig. 10, 1915; Anderson and Hanna, Calif. Acad. Sci., Occ. Pap. no. 11, p. 112, 1925; Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 378, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 93, pl. 15, fig. 21, 1938; Clark, Bull. Geol. Soc. Am., vol. 49, p. 709, pl. 3, figs. 1, 7, 1938.

*Original description.* Shell unequally fusiform, spire low, whorls five, the last always tri-carinate, the others with rounded carinae. Last two whorls forming

the apex smooth and rounded. Whorls convex; portions between the carinae concave; that above the upper carina nearly straight and sloping up at a low angle to the suture; that below the lower carina very slightly concave. Surface of body whorl sculptured by three carinae which are crossed by twenty-six longitudinal ribs extending from the suture to the extreme lower end of the shell. Their intersections are marked by nodes and tubercles. Between the longitudinal ribs are lines of growth. Between the carinae above and below them are numerous distinct revolving threads; eight above the upper carina, eight between upper and middle carinae, seven between the middle and lower, and twenty-three on the surface below the lowest carina. On the lower surface every alternating thread is a little more distinct. Aperture generally broad and extending to the end of the canal; canal much longer than spire and slightly curved outwards; inner lip smooth and somewhat calloused; outer lip thin. Dimensions.—Altitude 40 mm. and 32 mm.; diameter 22 mm. and 18 mm.; altitude of spire 5 mm. and 3 mm.; angle of spire 65° and 61°. (Weaver)

*Observations.* This species is abundantly represented in a number of specimens and in geographical distribution in Oregon and Washington. Specimens in the Cowlitz formation at locality (U.W. 233) at the bend in Cowlitz River are usually in a perfect state of preservation and although they show some variations in proportionate dimensions, there is little variation in the details of ornamentation except in prominence of nodes on the carinae.

*Holotype.* (U.W. 27) (C.A.S. 7615). Figured in the present report, pl. 77, figs. 5, 9.

*Paratype.* (U.W. 27-A) (C.A.S. 7615-A). Figured in the present report, pl. 77, figs. 6, 11.

*Hypotype.* (U.W. 314 from locality U.W. 232.) Figured in the present report, pl. 77, fig. 3.

*Hypotype.* (U.W. 530 from locality U.W. 232.) Figured in the present report, pl. 77, fig. 8.

*Geologic range.* Cowlitz and Coaledo formations, upper Eocene.

*Geographic distribution.* Western Oregon and Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

#### **FICOPSIS MEGANOSENSIS Clark and Woodford var. *PACKARDI***

Merriam and Turner, 1937

Plate 77, figure 14

*Ficopsis cooperi* Gabb, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, 1914.

*Ficopsis packardi* Hendon, unpublished thesis, Univ. Oregon.

*Ficopsis meganensis* Clark and Woodford var. *packardi* Merriam and Turner, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 24, p. 102, pl. 6, fig. 7, 1937; Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 93, 94, pl. 15, figs. 22, 26, 27, 1938.

*Original description.* Shell turreted, fusiform, without definite flexure of the outer lip at point of mergence with anterior canal. Shoulder sloping, tabulate, body whorl convex, ornamentation consisting of three spiral rows of nodes around the body whorl and a reticulate sculpture of fine raised threads. Although the nodes

are in spiral alignment they are not aligned along the growth lines. (Merriam and Turner)

*Observations.* This variety from the Umpqua formation may be distinguished from *F. meganensis* from the early middle Eocene of California in having a relatively high spire and three rows of nodes in place of four.

*Paratype.* (U.C. 33636.) Figured in the present report, pl. 77, fig. 14.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon, and near Covelo (Round Valley), Coast Ranges of northern California.

*Type locality.* (U.C. A-662.) Bank of Little River, Douglas County, Oregon, in center of Section 19, T. 26 S., R. 3 W.

#### Genus **TROPHON** Montfort, 1810

*Trophon* Montfort, Conchyl. Syst., vol. 2, p. 483, 1810.

*Genotype.* *Trophon magellanicus* (Gmelin) = *Buccinum geversianum* Pallas.

#### **TROPHON OREGONENSIS** Anderson and Martin, 1914

Plate 78, figure 1

*Trophon oregonensis* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 80, 81, pl. 5, fig. 5, 1914.

*Original description.* Shell large, thick, fusiform, with six or seven angulated whorls; spire elevated; whorls of the spire angulated near the middle, surface flat and smooth above, smooth and sloping inward below; whorls ornamented with nine or ten prominent projecting spines which are excavated in front and convex behind and extending downward to the suture in front forming short varices; suture impressed, wavy; body-whorl ventricose, sharply concave at the anterior margin; aperture ovate; canal moderately long; slightly twisted. Dimensions:—Altitude of the figured specimen, 58 mm.; maximum diameter of the last whorl, 40 mm. (Anderson and Martin)

*Observations.* This species, as pointed out by Anderson and Martin, is the only one of the genus so far known in Oregon and Washington. It differs from *T. kernensis* in that the anterior whorls have a more pronounced angulation and contain nodes in place of excavated spires. It bears a close resemblance to *T. gabianus* Anderson which has less prominent spires and spiral ribs and interspaces on the surface of the body whorl below the shoulder.

*Holotype.* (C.A.S. 176.) Figured in the present report, pl. 78, fig. 1.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Lincoln County, coast of Oregon.

*Type locality.* (U. W. 691.) Beach section on Oregon coast on south side of Yaquina Head, Lincoln County, five and one-half miles north of entrance to Yaquina Bay.

## Family CASSIDIDAE

## Genus GALEODEA\* Link, 1807

*Galeodea* Link, Beschreibung der Nat.-Sammlung der Univ. Rostock, pt. 3, p. 113, 1807.

*Genotype.* *Galeodea echinophora* (Linnaeus).

## GALEODEA SUTTERENSIS Dickerson, 1916

## Plate 78, figures 6, 7

*Galeodea sutterensis* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 492, pl. 40, figs. 1a, 1b, 1916; Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 84, pl. 15, figs. 1, 2, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 92, pl. 18, fig. 19, 1938.

*Original description.* Shell large, solid with great body-whorl and short spire; whorls seven, tabulate; spire whorls exhibiting a well-marked nearly square shoulder which is nodose at the crossing of the fine sinuous growth lines and the strong spiral line marking the shoulder; fine spiral lines subequal in strength decorating whorls; body-whorl at shoulder marked by fourteen sharp, elongate spinous nodes; one or two rows of nodes decorating body-whorl in addition to shoulder nodes; mouth oval; outer lip thickened; inner lip heavily incrusted; canal long and twisted. Dimensions.—Length, 35 mm.; width of body-whorl, 27 mm. (Dickerson)

*Observations.* As pointed out by Turner, the Oregon specimens may be distinguished from *G. susanae* Schenck by the somewhat higher spire. The anterior canal also is somewhat longer and reflexed. Otherwise it closely resembles the latter species.

*Hypotype.* (U.C. 33167.) Figured in the present report, pl. 78, figs. 6, 7.

*Geologic range.* Capay and lower Umpqua formations, middle Eocene.

*Geographic distribution.* Marysville Buttes, west side of Sacramento Valley, California, and Douglas County, Oregon.

*Type locality.* (For holotype, U.C. 1853.) Marysville Buttes, California. Occurs also at locality (U.C. A-834). Along middle fork of Coquille River opposite Roseburg-Coos Bay Highway Survey station 794 + 84.

## GALEODEA SUSANAE Schenck, 1926

## Plate 78, figures 2, 3

*Cassidaria tuberculata* (Gabb), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, 1914.

*Galeodea susanae* Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 85, pl. 15, figs. 3-7, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 92, pl. 18, fig. 18, 1938.

*Original description.* Shell large when adult, whorls embracing to the ambitus, with two rows of spinose tubercles and a heavy callus. Sculpture: The slightly angulated early whorls distinctly reticulated; nodes appearing soon in ontogeny; each whorl embracing up to the row of nodes; penultimate whorl marked by fine spirals and a row of nodes above suture; body whorl marked by 8 or 9 spines on posterior row and 6 to 8 pointed nodes on anterior row; spiral striae

\* For a revision of this group, see J. W. Durham, "Notes on Pacific Coast Galeodeas," *Journal of Paleontology*, vol. 16, no. 2, pp. 183-191, March, 1942.

somewhat more pronounced than axial lines, but not enough so to eradicate fine reticulation. No indication of a third row of nodes. Spire about one-half height of body-whorl. Whorls four or more. Aperture narrowly ovate, with a moderately narrow, distinct posterior canal and emargination where posterior row of spines develops, and anterior canal recurved and not as long as in *G. sutterensis* Dickerson. Inner lip with a heavy callus free anteriorly. Outer lip reflected and heavy, emarginated, not dentate as in *G. tuberculiformis* Hanna. Dimensions: Type specimen, altitude, 44.5 mm.; greatest convexity (including spines), 41 mm.; without spines, 29.8 mm. (Schenck)

*Observations.* The species has a lower spire than *G. sutterensis* Dickerson, and the upper spiral row of spires generally is lapped over by each anterior whorl. It also has a shorter anterior canal and better-developed posterior canal. The outer lip is emarginated.

*Holotype.* (C.A.S. 1753.) Figured in the present report, pl. 78, figs. 2, 3.

*Geologic range.* Capay and upper Umpqua formations, middle Eocene.

*Geographic distribution.* Coast Ranges of southern California and southwestern Oregon.

*Type locality.* (C.A.S. 372.) At Alico Canon, Simi Valley, California. Occurs also at locality (U.C. A-662), in Douglas County, Oregon, on east bank of Little River near center of Section 19, T. 26 S., R. 3 W.

#### GALEODEA CRESCENTENSIS Weaver and Palmer, 1922

Plate 78, figures 4, 5

*Galeodea tuberculata* (Gabb) var. *crescentensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, p. 37, pl. 11, figs. 18, 20, 1922.

*Galeodea crescentensis* Weaver and Palmer, Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 85, pl. 15, fig. 8, 1926; Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, pp. 409, 410, pl. 59, figs. 2, 3, 1931.

*Original description.* Shell of medium size, spire acute; whorls six; suture appressed; canal short, reflected; callus thin, spreading; three small plications on the anterior end of the columella; aperture elongate, outer lip thickened with a groove along the interior of the margin; two rows of parallel tubercles on the body whorl, whorls of the spire also tuberculated with small tubercles which occur in two faint rows; entire surface of the shell sculptured by revolving, flat, imbricating ribs. Dimensions.—Altitude 16 mm.; width of body whorl 11 mm.; apical angle 87°. (Weaver and Palmer)

*Observations.* This middle Eocene species which occurs east of Tongue Point, Washington, has fairly well-developed tubercles along the two carinae of the body whorl and on the single carina on each whorl of the spire. The spiral ribs are low, broad, and nearly flat-topped, and the interspaces only a fraction of this width. The shell is proportionately higher and less tumid than *G. tri-tuberculata* (Weaver).

*Holotype.* (U.W. 202) (C.A.S. 7612-A). Figured in the present report, pl. 78, figs. 4, 5.

*Geologic range.* Crescent formation, middle Eocene.

*Geographic distribution.* Port Crescent, Clallam County, Washington.

*Type locality.* (U.W. 568.) In sea cliff on west shore of Crescent Bay, Clallam County, Washington.

## GALEODEA DALLI Dickerson, 1917

Plate 78, figures 8, 9

*Galeodea dalli* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 176, pl. 30, fig. 8a, 1917.

*Galeodea (?) dalli* Dickerson, Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 86, 1926; Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, p. 110, 1931; Effinger, Jour. Paleon., vol. 12, p. 382, 1938.

*Original description.* Shell globose, highly decorated by three rows of rounded nodes on the body-whorl and by wavy spiral lines of variable strength; four spiral whorls flat sided; fourth whorl marked by 10 nodes; suture wavy, indistinct; body whorl square shouldered, decorated by three rows, about 13 to each row on upper half, lower row of lesser strength than others; canal short, twisted backward; a prominent siphonal fasciole present; inner lip marked by 10 indefinite lirations; inside of outer lip grooved to match the more prominent interspaces. Dimensions: —Length of broken type, 15 mm. (Dickerson)

*Observations.* It has been pointed out by both Tegland and Effinger that *G. dalli* may be distinguished from *G. fax* Tegland of the middle Oligocene by the presence of only two rows of nodes on the body whorl. On one specimen of *G. dalli* from the Gries Ranch beds a third row of nodes is beginning to develop on the body whorl. The character of the spire on the two species is much alike.

*Holotype.* (C.A.S. 419.) Figured in the present report, pl. 78, figs. 8, 9.

*Geologic range.* Gries Ranch beds, lowermost Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Cowlitz County, Washington.

*Type locality.* (U.W. 239.) South side of Cowlitz River, Cowlitz County, in northeast quarter of Section 25, T. 11 N., R. 2 W.

## GALEODEA TRI-TUBERCULATA (Weaver), 1912

Plate 78, figures 10, 11, 12, 13, 14, 15; plate 79, figures 1, 2, 3, 4, 8

*Morio tuberculatus* Gabb var. *tri-tuberculatus* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 39, 40, pl. 3, fig. 35, 1912.

*Stramonita petrosa* Conrad, Pac. R.R. Repts., vol. 5, p. 327, pl. 6, figs. 47, 47a, 1857.

*Galeodea tri-tuberculata* (Weaver), Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, p. 37, pl. 11, figs. 23, 27, 1922.

*Galeodea petrosa* (Conrad), Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 82, pl. 14, figs. 5, 11, 1926.

*Galeodea tri-tuberculata* (Weaver), Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, pp. 408, 409, pl. 59, fig. 1; pl. 60, figs. 1, 2, 3, 4, 1931.

*Original description.* This form is undoubtedly *M. tuberculatus* Gabb, as described in Vol. 1, Paleontology of California, but there are certain variations from his original description which are constant on every specimen collected in Washington. Since the California and Washington localities are so widely separated and the material here so perfectly preserved it seems best to place this form on record as a variety. Gabb states that his figure is partially a restoration based on several fragments especially the aperture: Gabb's description (42, p. 104) is here quoted: "Shell short, robust, thin; whorls seven, spire low. Surface marked by two, rarely three, rows of small tubercles; two bounding the widest portion of the volution, with a plane or slightly concave surface between them; the third, which occurs rarely, is placed below the others; besides these, the whole surface is orna-

mented by fine revolving striae. Aperture broad; outer lip thick, longitudinally striate externally, inner surface crenulate; columellar lip covered by a broad plate, plicate or crenulate anteriorly. Canal strongly recurved. A distinct varix nearly as large as the outer lip, occurs on the body whorl, and sometimes there is a smaller one on the penultimate volution. I have not always been able to detect the latter."

In the variety of *tri-tuberculatus* the whorls always carry three rows of tubercles (never only two). The varix on the body whorl is much smaller; canal much more strongly recurved than shown in Gabb's figure; columellar lip less extensively developed; aperture narrower. These variations are characteristic of all specimens collected. (Weaver, 286, p. 40)

*Observations.* The specimen described by Conrad (71, p. 327, pl. 6, figs. 47 and 47a) as *Stramonita petrosa* from the type locality of the Tejon Eocene near Tejon Pass in southern California is close to and probably identical with the form originally described as *Morio tuberculatus* Gabb var. *tri-tuberculatus*. This was pointed out by Schenck (237, p. 82) and later it was shown by Tegland (271, p. 408) that *Dolium petrosum* Conrad and *Stramonita petrosa* Conrad each belonged to the genus *Galeodea*. *Dolium petrosum* was described in 1849 and the Eocene species in 1857, causing the latter to become a homonym of the former. Accordingly, *Galeodea tri-tuberculata* (Weaver) was considered by Tegland as the holotype.

*Holotype.* (U.W. 19) (C.A.S. 7612). Figured in the present report, pl. 78, figs. 14, 15.

*Hypotype.* (U.C. 31312.) Figured in the present report, pl. 78, fig. 10.

*Hypotype.* (U.C. 31311.) Figured in the present report, pl. 78, fig. 11.

*Hypotype.* (U.W. 524.) Figured in the present report, pl. 78, figs. 12, 13.

*Hypotype.* (C.A.S. 297.) Figured in the present report, pl. 79, figs. 1, 2, 3, 4.

*Hypotype.* (U.C. 32080.) Figured in the present report, pl. 79, fig. 8.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* South end San Joaquin Valley, California, and lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

#### GALEODEA PETROSA (Conrad), 1849

Plate 79, figures 5, 6, 7

*Dolium petrosum* Conrad, U.S. Explor. Exped. Geol., Append., p. 727, pl. 19, figs. 3a, 3b, 4a, 4b, 5a, 5b, 1849.  
*Galeodea petrosa* Conrad, Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, pp. 418, 419, 420, pl. 65, figs. 1-15, 1931.

*Original description.* Ovate globose with revolving ribs about on the body whorl; shoulder angulate, tuberculate, below the angle having a slightly concave space, with a revolving prominent line. Spire scalariform and rather elevated; volutions 5.—Pl. 19, figs. 3a, b, 4a, b, 5a, b, natural size. (Conrad)

*Observations.* The species is known definitely only from the Astoria formation, middle Miocene. The form described by Dall as *Eudolium petrosum* Conrad (101, p. 71, pl. 14, fig. 6) is from beds of upper Oligocene age and appears to be identical with *Galeodea apta* Tegland, an Oligocene species from the Olympic Peninsula.

*Holotype.* (U.S.N.M. 3536, Conrad type.) Figured in the present report, pl. 79, figs. 6, 7.

*Hypotype.* (U.C. 32082.) This specimen, from a small area of middle Miocene strata east of Twin River, Clallam County, Washington, is figured in the present report, pl. 79, fig. 5.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Astoria and Yaquina Bay, Oregon, and Clallam County, Washington.

*Type locality.* Astoria, Oregon. (Conrad)

#### GALEODEA FAX Tegland, 1931

Plate 79, figures 9, 10, 11

*Galeodea fax* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, pp. 410, 411, 412, pl. 60, figs. 5, 6, 7, 1931.

*Galeodea cf. fax* Tegland, Effinger, Jour. Paleon., vol. 12, p. 382, 1938.

*Original description.* Shell rather thin, globose, of moderate size for the genus, the four rows of nodes on the body whorl giving the shell a quadrate appearance. Spire prominent, measuring two-thirds of the height of the body whorl, tabulate or coronated; protoconch eroded, first three whorls rounded, worn smooth of ornamentation, fourth whorl also rounded but faintly showing thirteen or fourteen small nodes; fifth, sixth, and ultimate whorls with twelve to fourteen nodes which emphasize the shoulder angle; entire shell ornamented by spirals; spirals crossed by growth lines which swing backward on the shoulder, easily discernible but not of sufficient emphasis to produce a cancellated appearance. Suture appressed, crenulate, a narrow collar covering the second line of nodes. Body whorl globose, ornamented by three prominent and a fourth fainter line of nodes, fourteen on the shoulder, sixteen in the second row, seventeen in the third row and a greater number in the fainter fourth row; shoulder horizontal, flat to concave, ornamented by seven flattened spirals with shallow uneven interspaces which tend to hold a secondary riblet nearer the angle; space between shoulder and second row of nodes with about nine similar spirals of unequal distinctness of a very low profile; in next space three slightly more definite riblets; between the last two rows of nodes one wider central spiral with a smaller on either side, with fine but distinct interthreads; below last row of nodes on base of whorl, five heavy ribs with finer riblets disappearing into the broad anterior sulcus above the twisted columella. Aperture ovate, outer lip defective, on inner lip remnants of a very thin callus which partially obscures the body ornamentation, thickened on the columella. Canal twisted, incomplete. Height 52 mm.; width 40.7 mm.; spire 17.6. (Tegland)

*Observations.* A single specimen of *Galeodea* which has been compared to *G. fax* by Effinger was obtained from the Gries Ranch beds. This species may be distinguished from *G. tri-tuberculata* (Weaver) of the Cowlitz formation, as pointed out by Tegland, in having a stronger siphonal fasciole, a better-defined anterior sulcus, and a suture with an

appressed collar. The species is common in the middle Oligocene of Oregon and Washington.

*Holotype.* (U.C. 32064.) Figured in the present report, pl. 79, figs. 9, 10.

*Paratype.* (U.C. 32066.) Figured in the present report, pl. 79, fig. 11.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Grays Harbor region, Washington, and Columbia County, Oregon.

*Type locality.* (U.W. 160.) Railroad cut at Porter, Grays Harbor County, Washington, in Section 22, T. 17 N., R. 4 W.

#### GALEODEA REX Tegland, 1931

Plate 80, figures 2, 4, 6

*Eudolium petrosum* (Conrad), Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, p. 583, 1913; Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 6, 30, 1916; Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 163, 1917; Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 76, 1918.

*Eudolium* n. sp. Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., pp. 75, 93, 1925 (Faunal lists).

*Galeodea rex* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, pp. 413, 414, 415, pl. 60, fig. 12; pl. 61, figs. 1-4; pl. 62, figs. 1-6, 1931.

*Original description.* Shell large, tabulate, globose, heavily noded; surface ornamented by heavy spiral ribs, which grow more pronounced anteriorly; intercalaries rarely present; spire high for the genus, measuring half the height of the whorl. Adult shell with about eight whorls; suture appressed into a narrow collar, crenulate due to its position on the median line of the second row of the nodes; nodes widened and compressed postero-anteriorly; penultimate whorl angulate with about eleven or twelve nodes; shoulder with only slight upward slope flattened, ornamented by six raised spirals with interspaces twice the width of the ribs; vertical area between the noded revolving keels containing usually four heavy subequal spirals with interspaces varying from width to twice width of spirals; body whorl wider than high, with two or three revolving rows of heavy tubercles; small immature shell may have fourth row of tubercles, but on the adult shell the fourth keel if pronounced is merely crenulated; shoulder angle with twelve to fourteen nodes, an occasional shell with a greater number, about nineteen in second and third rows; nodes on first two keels flattened with brief valleys between; shoulder and space between first two keels ornamented as on penultimate whorl; between rows two and three are two heavy slightly flattened or squared ribs with interspaces or valleys similarly shaped and a little wider; one large rib between last row of nodes and crenulate spiral; below this usually five more heavy ribs, the last bordering the anterior groove. Anterior sulcus, usually carrying one faint riblet in the valley, defined posteriorly by a spiral rib, anteriorly by a sharp carina which is formed a little posterior to the fold of the siphonal fasciole. Aperture ovate, outer lip moderately thickened and sharply reflected; inner lip covered by a thin callus which conforms to the ornamentation of the body whorl, partially filling the grooves between the spiral ribs, thickened on the columella; columella twisted, rope-like, long visible portion equaling height of body whorl (measured on same side), ending in a shallow siphonal fasciole. Canal moderately long and sharply reflected at the tip; height of adult shell ranging between 175 mm. and 190 mm. (Tegland)

*Observations.* As noted by Tegland, this species is characterized by its large size, strong tabulation, prominent, relatively broad, full-topped

spiral ribs without secondary ribs in the interspaces, and strong compressed nodes.

*Holotype.* (U.C. 32067.) Figured in the present report, pl. 80, fig. 4.

*Paratype.* (U.C. 32070.) Figured in the present report, pl. 80, fig. 2.

*Paratype.* (U.C. 32069.) Figured in the present report, pl. 80, fig. 6.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Puget Sound Basin and north side of Olympic Peninsula.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, opposite Seattle, Washington.

#### GALEODEA APTA Tegland, 1931

Plate 79, figures 12, 13; plate 80, figures 1, 3, 5

*Eudolium petrosum* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 71, pl. 14, fig. 6, 1909.

*Trachydolium dalli* Howe, nomen nudum, Pan. Am. Geol., vol. 45, p. 305, 1926 (homonym of *Galeodea dalli* Dickerson). See Tegland (294A, p. 45).

*Galeodea apta* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, pp. 415, 416, 417, pl. 63, figs. 1-10, 1931.

*Original description.* Shell large, thin, with rounded whorls; spire moderately high; early whorls of spire more tabulate in appearance than later ones of which the shoulder is convex, suture appressed, crenulate on the second row of nodes; body whorl ornamented by flattened spiral ribs less heavy than on *Galeodea rex*, interlineations present, with a tendency toward increase in number of spirals due to intercalaries taking on prominence; nodes, if present on shoulder angle, number between fourteen and twenty-three; usually about five spirals on the shoulder. Anterior sulcus pronounced and bordered anteriorly by a sharp keel. Aperture elongate-ovate; outer lip reflected, inner lip covered by a thin callus; columella with length almost equaling height of body whorl, twisted and coated on the apertural side by a heavy callus; canal sharply reflected at the tip. (Tegland)

*Observations.* The studies of Tegland show this important upper Oligocene species to differ from *G. rex* Tegland in being relatively smaller and less tabulate with somewhat rounded shoulders. The spiral ribs are narrower and more numerous and the interspaces much wider. The nodes are smaller in size and more numerous.

*Holotype.* (U.C. 32071.) Figured in the present report, pl. 79, fig. 13; pl. 80, fig. 3.

*Hypotype.* (U.S.N.M. 110425.) Figured in the present report, pl. 79, fig. 12.

*Paratype.* (U.C. 32074.) Figured in the present report, pl. 80, fig. 1.

*Paratype.* (S.U. 599.) Figured in the present report, pl. 80, fig. 5.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Twin Rivers area, Clallam County, Washington.

*Type locality.* (U.W. 258.) In sea cliff one-half mile west of Twin Rivers, Clallam County, Section 27, T. 31 N., R. 10 W.

**GALEODEA OREGONENSE** (Dall), 1909

Plate 81, figure 1; plate 101, figure 12

*Eudolium oregonense* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 71, 72, pl. 7, fig. 7, 1909.

*Original description.* Shell thin, globose, strongly spirally sculptured, with about five whorls exclusive of the nucleus; earlier whorls with three or four, last whorl with about 11 major spiral ridges, squarish, often irregularly squarely nodulus, with wider channeled interspaces, smooth, or containing one or more smaller intercalary ridges; the posterior major spiral runs close to the suture giving it a channeled effect; the spirals on the apical whorls are often reticulated by obscure axial riblets subnodulous at the intersections, but these disappear on the later whorls, though the major spirals often continue to show irregular nodulation; last whorl much the largest, terminating in the adult in a slightly reflected and thickened outer lip with obscure denticulations on its inner edge; canal short, deeply excavated, with a deep sulcus behind it, twisted and more or less plicate; a thin wash of callus on the body. Altitude of shell, 69 mm.; of last whorl, 60 mm.; maximum diameter, 51 mm. Another specimen measures, respectively, 75, 64, and 53 mm. (Dall)

*Holotype.* (U.S.N.M. 153895.) Figured in the present report, pl. 101, fig. 12.

*Hypotype.* (S.U. 207.) Figured in the present report, pl. 81, fig. 1.

*Geographic range.* Tunnel Point sandstone, middle Oligocene.

*Geographic distribution.* Coos Bay, Oregon, and southwestern Washington.

*Type locality.* Coos Bay, Oregon. Camman collection.

**Genus PHALIUM Link, 1807**

*Phalium* Link, Beschr. Rostock Samml., pt. 3, p. 112, 1807.

*Genotype.* *Phalium glaucum* (Linnaeus).

**Subgenus Bezoardica Schumacher, 1817**

*Bezoardica* Schumacher, Essai Vers Test., pp. 75, 248, 1817.

*Subgenotype.* *Bezoardica areola* (Gmelin).

**PHALIUM (BEZOARDICA) AEQUISULCatum Dall, 1909**

Plate 81, figure 2

*Phalium (Bezoardica) aequisulcatum* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 63, 64, pl. 5, figs. 1, 4, 1909; Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 79, pl. 13, figs. 5, 6, 12, 13, 14, 15, 16, 1926.

*Original description.* Shell of moderate size, solid, heavy, ovate, with about five whorls beside the (decollate) nucleus; suture distinct, not channeled; sculpture of (on the last whorl 19) even, flat, straplike, raised, subequal spirals, separated by channeled, narrower, equal sulci or interspaces most of which carry a single minute intercalary thread, which on the base is as a rule slightly nearer the posterior side of the channel in which it lies; there are faint traces of fine spiral striation, and the posterior four or five of the major spirals are somewhat beaded or granulated by axial sulci which do not appear in the channels; the varices except the terminal one are inconspicuous and irregular; two specimens, including the largest, show none; the figured specimen, which is smaller though better preserved, has indications of two besides the terminal varix; aperture longer than wide,

subovate; outer lip reflected and thickened, internally denticulate; body with a thin smooth callus (not in figured specimen); canal deep, short, twisted, recurved, with a deep smooth sulcus behind it. Altitude of figured specimen, 45 mm.; of a larger but still immature individual (decollate), 60 mm.; maximum diameter, respectively, 30 and 39 mm. (Dall)

*Observations.* This species may be distinguished from *P. turricula* Dall in its smaller size, the presence of the single intercalary thread, and in having 19 instead of 15 spiral ribs. The spire is proportionately lower than in *P. egberti* Schenck and it lacks the somewhat reticulated sculpture and slightly developed nodes on the body whorl of that species.

*Holotype.* (U.S.N.M. 153896.) Figured in the present report, pl. 81, fig. 2.

*Geologic range.* Empire and Montesano formations, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon, and Grays Harbor County, Washington.

*Type locality.* Coos Bay, Oregon, from Camman collection. (Dall)

#### PHALIUM (BEZOARDICA) TURRICULA Dall, 1909

Plate 81, figure 3; plate 101, figure 14

*Phalium (Bezoardica) turricula* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 63, pl. 4, fig. 6, 1909; Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 79, pl. 14, fig. 1, 1926.

*Original description.* Shell large, moderately thick with an unusually elevated spire, with five sculptured whorls and a smooth nucleus of about two and a half whorls; axial sculpture of (on the penultimate whorl about 20) faint, obscure, somewhat flexuous ridges, chiefly noticeable from the nodulations which occur when the raised spirals cross them; the ridges are almost wholly absent from the last half of the last whorl; faint incremental lines also occur; spiral sculpture of (between the sutures 4, on the last whorl 15) narrow revolving ridges with much wider interspaces but no intercalary small threads; where the ridges cross the axial ridges they are more or less undulated and swollen, the peripheral ridge on the spire has these projections particularly marked; there is no spiral striation; the suture is wound on the fourth spiral and, when the latter is nodulous, is undulated more or less; the type specimen has two varices, which is exceptional in this group and may be an individual aberration; aperture longer than wide, the outer lip thickened and reflected, internally denticulate; body with a callus which is raised at its anterior margin; canal short, deep, strongly reflected, with a deep wide sulcus behind it; the outer lip is constricted just before forming the varix. Altitude, 80 mm. (Dall)

*Holotype.* (U.S.N.M. 153898.) Figured in the present report, pl. 81, fig. 3; pl. 101, fig. 14.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Coos Bay, Oregon, Camman collection. (Dall)

**PHALIUM (BEZOARDICA) EGBERTI Schenck, 1926**

Plate 81, figure 4

*Phalium (Bezoardica) egberti* Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 80, pl. 13, fig. 7, 1926.  
*Phalium (Bezoardica) cf. egberti* Schenck, Effinger, Jour. Paleon., vol. 12, p. 382, 1938.

*Original description.* Shell thick, medium size, globose, with acute spire about one-half height of body whorl. This ultimate whorl rounded, not sharply angulated. Callus smooth, thin, and quite adherent except anteriorly. Varices indistinct. Reflected anterior canal with deep sulcus behind siphonal fasciole. Sculpture: Spire whorls marked by fairly distinct spiral threads crossed by faint growth striae. On the body whorl spirals strap-like, distinct anteriorly but becoming progressively indistinct posteriorly; interspaces shallow; growth striae developing into fine threads on crossing spiral sulcations so as to give shell finely reticulated appearance. Halfway between the greatest convexity of body whorl and the suture is a row of small nodes, with two other rows of incipient nodes anterior to first row. Dimensions: Type specimen, altitude 25.5 mm., greatest convexity, 16 mm. (Schenck)

*Observations.* This moderately large species differs from the other species of the genus in the Northwest in the presence of closely set spiral primary and secondary ribs which are crossed by fairly well-developed fine unequally spaced longitudinal ribs. Faintly developed nodes are present on the angulated part of the upper surface of the body whorl.

*Holotype.* (S.U. 79.) Figured in the present report, pl. 81, fig. 4.

*Geologic range.* Beds at Discovery Bay and Gries Ranch beds, lowermost Oligocene.

*Geographic distribution.* Discovery Bay and lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 158.) Woodman Station, Discovery Bay, Olympic Peninsula, Section 5, T. 29 N., R. 1 W.

**PHALIUM (BEZOARDICA) IANI Schenck, 1926**

Plate 81, figure 5

*Phalium (Bezoardica) iani* Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 80, pl. 13, figs. 8, 9, 10, 11, 1926.  
*Phalium (Semicassis) iani* (Schenck), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 102, 1931.

*Original description.* Shell fairly thick, medium size, globose; acute spire half the height of body whorl; five whorls; appressed sutures; short, reflected canal; fairly distinct varices. Sculpture: Consists of broad, flat revolving lines (11 on body whorl) with well-defined equal interspaces in which there is one (sometimes two) intercalary thread; on upper part of body whorl longitudinal lines form two rows of low nodes, about 20; on early whorls, axial ridges appear to develop earlier than the nodes. Dimensions: Type specimen, altitude 30 mm. (part of canal lacking): greatest convexity 19.5 mm. (Plate 13, figures 9, 10, 11, show variations in size). (Schenck)

*Observations.* The adult forms of this species are smaller than the others from the Northwest. The species resembles somewhat *P. aequisulcatum* but possesses fewer and wider spiral ribs and has two spiral rows

of tubercles on the upper surface of the body whorl and sometimes three rows on the penultimate.

*Holotype.* (C.A.S. 1747.) Figured in the present report, pl. 81, fig. 5.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Willapa River Valley, Pacific County, Washington.

*Type locality.* (U.W. 707.) Near Menlo, Pacific County, Washington.

### Family CYMATIIDAE

Genus CYMATIUM ("Bolten") Roeding, 1798

*Cymatium* Roeding, in Bolten, Mus. Boltenianum, p. 129, 1798.

*Genotype.* *Murex femorale* Linnaeus.

#### CYMATIUM WASHINGTONIANUM (Weaver), 1912

Plate 81, figures 6, 9, 11, 12

*Ranella washingtoniana* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 41, pl. 2, fig. 14, 1912.

*Bursa washingtoniana* (Weaver), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pp. 64, 65, pl. 4, figs. 4, 6, 1915.

*Cymatium cf. washingtoniana* (Weaver), Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 90, 91, pl. 16, fig. 17, 1938.

*Original description.* Shell medium size and robust; spire moderately high; whorls seven to eight, angulated and convex, last two of apex being smooth and not sculptured; body whorl with pronounced revolving angle about one-fourth the length of the whorl down from the suture; surface between angle and suture nearly straight (occasionally slightly concave); surface below the angle broadly convex. Suture compressed, distinct but somewhat undulating; varices prominent, bladelike and continuous. In addition to the varices the surface is ornamented by nine distinct longitudinal ribs. These are crossed by seventeen prominent revolving lines. The one on the angle and the four immediately below it are set with sharp spine like nodes at the intersection with the longitudinal ribs. Surface above the angle sculptured by a very large number of fine revolving threads but no prominent revolving ribs. Between the more prominent revolving ribs below the angle there are numerous fine revolving threads. Aperture broad, sub-oval, narrowing at the posterior end; inner lip not heavily incrusted; canal short and not strongly recurved; outer lip thickened by the varix. Dimensions.—Altitude 35 mm.; diameter 23 mm.; altitude of spire 17 mm.; angle of spire 60°. (Weaver)

*Observations.* Specimens of this species from the Cowlitz formation are large and usually well preserved. This species may be distinguished from *C. cowlitzense* in a well-defined angulation at the base of the upper third of the surface of the body whorl, the straight to slightly concave surface upward to the suture, and the larger number of spiral ribs.

*Holotype.* (U.W. 21) (C.A.S. 488.) Figured in the present report, pl. 81, fig. 6.

*Hypotype.* (U.C. 33863.) Figured in the present report, pl. 81, fig. 12.

*Topotype.* (C.A.S. 312.) Figured in the present report, pl. 81, figs. 9, 11.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington, and Coos Bay, Oregon.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

**CYMATIUM COWLITZENSE** (Weaver), 1912

Plate 81, figures 7, 8, 10, 13; plate 82, figures 1, 4

*Ranella cowlitzensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 41, 42, pl. 2, fig. 15; pl. 3, figs. 26, 27, 1912.

*Original description.* Shell small and robust; spire high; whorls six, convex and without any angle. Suture distinct and impressed. Varices very large and extending over all of the whorls. Surface sculptured by eight unequally developed longitudinal ribs extending over the entire surface of the whorls. These are crossed on the body whorl by nine equally developed and equally spaced revolving ribs. Where these intersect the longitudinal ribs, low rounded nodes are developed, which are most conspicuous on the central part of the whorl. Between each of the revolving ribs there are four or five fine revolving threads. Aperture small, elliptical, equally acuminate above and below, anterior end forming a nearly closed canal which is short and strongly curved backwards. Inner lip very heavily incrusted; outer lip thick and crenulated. Dimensions.—Shell small, fusiform; spire moderately high; spire 12 mm.; angle of spire 40°. (Weaver)

*Observations.* This species lacks the angulation of the body whorl; upper surface of whorl more convex and number of spiral ribs about 60 per cent of the number of *C. washingtonianum*.

*Holotype.* (U.W. 22) (C.A.S. 7593). Figured in the present report, pl. 81, fig. 10.

*Paratype.* (U.W. 22-A) (C.A.S. 7593-A). Figured in the present report, pl. 81, fig. 13.

*Hypotype.* (U.C. 33868.) Figured in the present report, pl. 81, fig. 7; pl. 82, figs. 1, 4.

*Hypotype.* (C.A.S. 329.) Figured in the present report, pl. 81, fig. 8.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

**CYMATIUM ETHERINGTONI** n. sp.

Plate 82, figures 2, 3, 10

*Description.* Shell moderately small; spire a little less than one-third the height of shell and containing 4 whorls with the nucleus broken away; suture moderately impressed; anterior canal short and slightly deflected to the left; outer lip faintly denticulate; inner lip moderately calloused but callus not extending out on to body whorl. Ornamentation consisting of prominent heavy rounded major ribs and interspaces about four times as

wide which are best developed on upper third of surface of body whorl and less than one-half as prominent on the lower two-thirds; interspaces on upper surface of body whorl containing usually 4 secondary riblets and one or two on lower surface; revolving ribs crossed by nine well-rounded heavy longitudinal ribs with interspaces about one and one-half times as wide; two varices about 2 mm. wide and 33 mm. high, one on the outer lip and the other 180 degrees around; position of varix on penultimate whorl 90 degrees to the right. Dimensions: Altitude, 34.5 mm.; altitude of spire, 10 mm.; maximum diameter of body whorl, 19.5 mm.

*Holotype.* (U.C. 33869.) Figured in the present report, pl. 82, figs. 2, 3, 10.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

#### CYMATIUM PACIFICUM Dall, 1909

Plate 82, figure 9

*Cymatium (Linatella) pacificum* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 57, pl. 6, fig. 10, 1909.

*Original description.* Shell large, thin, except for the parietal callus, with five or more convex whorls which are subtabulate near the suture; sculpture of (on the upper whorls 4, and on the last whorl about 10) squarish revolving ridges with decidedly wider interspaces, smooth or with sparse obsolete spiral striation; axial sculpture only of lines of growth and a moderate terminal varix in the adult, which is defective in the specimen; nucleus lost; aperture with a short, rather straight canal, with a feeble siphonal fasciole; a broad sheet of callus over the body and pillar, the outer lip slightly expanded and varicose; body behind the pillar destitute of marked spiral sculpture. Altitude of shell, 106 mm.; of last whorl, 82 mm.; maximum diameter, 60 mm. (Dall)

*Holotype.* (U.S.N.M. 153899.) Figured in the present report, pl. 82, fig. 9.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Coos Bay, Oregon. Camman collection. (Dall)

#### Genus PSEUDOPERISSOLAX Clark, 1918

*Pseudoperissolax* Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 11, pp. 180, 181, 1918.

*Genotype.* *Busycon? blakei* Conrad.

**PSEUDOPERISSOLAX BLAKEI** (Conrad), 1855

Plate 82, figures 13, 17

*Busycyon ? blakei* Conrad, U.S. 33rd Congress, 1st Sess., House Exec. Doc. 129, Append. to Preliminary Geol. Rept. of W. P. Blake, p. 11, 1855; Pac. R. R. Repts., vol. 5, p. 322, pl. 2, fig. 13, 1857.

*Perissolar blakei* (Conrad), Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 92, 223, pl. 21, fig. 110, 1864; vol. 2, pp. 149, 217, 1869; Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pp. 44, 98, pl. 11, fig. 4, 1915; Stewart, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 41, 1930.

*Perissolar blakei* Conrad, Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 11, p. 180, 1918.

*Pseudoperissolar blakei* (Conrad), Anderson and Hanna, Calif. Acad. Sci., Occ. Pap. no. 11, p. 69, pl. 10, fig. 10; pl. 12, fig. 6, 1925; Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 429, 430, pl. 28, fig. 1, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 91, 92, pl. 17, fig. 11, 1938; Clark, Bull. Geol. Soc. Am., vol. 49, p. 718, pl. 3, figs. 5, 6, 12, 1938.

*Original description.* Fusiform, body whorl bicarinated; shoulder profoundly tuberculated; tubercles acute, transversely compressed; lower angle distant, entire. Surface covered with rather fine unequal or alternated wrinkled lines; upper side of the whorls flattened and sloping; whorls of the spire angulated and tuberculated in the middle. (Conrad)

*Observations.* This species from the upper Eocene at Sunset Bay, southwest Oregon, corresponds to those of the upper Eocene of California. It differs from specimens in the middle and lower Eocene of California which have a sharper angle on the upper shoulder and finer spiral ribbing.

*Holotype.* (U.C. 33242.) Figured in the present report, pl. 82, figs. 13, 17.

*Geologic range.* Lower Coaledo and Tejon formations, upper Eocene.

*Geographic distribution.* Coast Ranges of California, and Coos Bay, Oregon.

*Type locality.* (U.C. A-708.) East slope of Squaw Island near Cape Arago lighthouse, Coos Bay, Oregon. (Turner)

**PSEUDOPERISSOLAX TROPHONOIDES** Tegland, 1933

Plate 82, figures 5, 6

*Pseudoperissolar ? trophonoides* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 133, 134, pl. 13, figs. 10, 11, 1933.

*Original description.* Shell small, smooth, bicarinated. Whorls angulate, greatly constricted, probably five or six in number, three on the incomplete holotype. Posterior whorls showing only one central angulation, shoulder convex. Body whorl wider than high, ornamented by two revolving keels, the posterior keel forming the major angle, faintly crenulated; growth lines discernible but not pronounced, swinging backward to the angle without sinuation. Aperture subrectangular, inner lip with narrow callus. Apex and canal missing on both holotype and paratype. Dimensions of holotype: height, 10 mm.; width, 9.6 mm. (Tegland)

*Holotype.* (U.C. 32220.) Figured in the present report, pl. 82, figs. 5, 6.

*Geologic range.* Blakeley formation, upper Eocene.

*Geographic distribution.* Kitsap County, Puget Sound Basin, Washington.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, Washington.

Genus **SASSIA** Bellardi, 1873

*Sassia* Bellardi, Mem. Acc. Sci. Torino, ser. 2, vol. 27, p. 249, 1873.

*Genotype.* *Triton apenninicum* Sassi.

**SASSIA BILINEATA** (Dickerson), 1916

Plate 82, figures 8, 11, 12, 15

*Fasciolaria bilineata* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 493, pl. 37, figs. 6a, 6b, 1916; M. A. Hanna, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 319, 1927.

*Sassia bilineata* (Dickerson), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 91, pl. 18, fig. 20, 1938.

*Original description.* Shell fusiform with moderately long, narrow canal; seven or eight whorls. The first three nuclear whorls, smooth. The last four or five whorls are decorated by two very strong spiral lines, the upper one of which marks a very prominent shoulder on the whorls of mature specimens. These spiral lines are crossed by eight to ten axial ribs which extend from suture to suture. The space between the wavy suture and the shoulder is covered by fine spiral threads; outer lip crenulate; inner lip with three oblique plaits.

The younger specimens do not show the shouldering on the whorls but have rounded whorls instead. The number of whorls was obtained from a study of a young specimen.

*Dimensions.*—Height of broken type, 15 mm.; width of body whorl, 9 mm. (Dickerson)

*Supplementary description.* The specimen figured here is much larger than the type specimen described by Dickerson and shows more marked distortion. However, the younger whorls seem identical. The axial ribs vary between 8 and 12 and occasionally one is more prominent, forming a varix. There are at least eight primary spiral lines of nearly equal strength on the body whorl. The canal is likewise ornamented by spiral lines. On the body whorl and upper portion of the canal the primary spirals are separated by two secondary threads. The inner lip is crenulate with a heavy plication near its posterior limit and three prominent elongate denticulations on the columella as well as smaller crenulations. A ridge follows the margin of the anterior canal on the inner lip. Dimensions of hypotype (U.C. 33673) from locality (U.C. A-662): length 30.8 mm.; diameter 15.6 mm. (Turner)

*Hypotype.* (U.C. 33673.) Figured in the present report, pl. 82, figs. 8, 11, 12, 15.

*Geologic range.* Lower Tejon and upper Umpqua formations, middle and upper Eocene.

*Geographic distribution.* Rose Canyon, San Diego County, California, and Douglas County, Oregon.

*Type locality.* (U.C. A-662.) Douglas County, Oregon, in center of Section 19, T. 26 S., R. 3 W.

Genus **RANELLINA** Conrad, 1865

*Ranellina* Conrad, Am. Jour. Conch., vol. 1, pp. 21, 191, 1865.

*Genotype.* *Ranellina macrurii* (Conrad).

**RANELLINA PILSBRYI** Stewart, 1926

## Plate 82, figure 7

- Fusus californicus* (Conrad), Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 85, 86, pl. 28, figs. 205, 205a, 1864.  
*Clavilithes californicus* (Conrad), Anderson and Hanna, Calif. Acad. Sci., Occ. Pap. no. 11, p. 63, pl. 13, figs. 1, 2, 1925.  
*Nyctilochus hornii* (Gabb), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 7, fig. 8, 1915; Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, pl. 42, fig. 3, 1916.  
*Ranellina pilsbryi* Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 384, pl. 30, figs. 8, 9, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 91, pl. 16, fig. 3, 1938.

*Original description.* Shell of medium size, spire high, early whorls broken away, suture linear; whorls angulated and with a small collar; antepenultimate whorl nodose at the shoulder, later whorls smooth but for spiral ribs and irregularly developed, noninterrupted varices, which do not reach above the shoulder. Length of holotype (fig. 8) no. 31382 (incomplete) 20 mm., width, 13.5 mm. No. 31383 (fig. 9) shows a moderately long and almost straight canal; length (incomplete), 18 mm.; width 10.7 mm. (Stewart)

*Observations.* This species in the Northwest is known only from the upper Eocene at Comstock. It corresponds closely to the specimens in the upper Eocene at the type Tejon.

*Hypotype.* (U.C. 33214.) Figured in the present report, pl. 82, fig. 7.

*Geologic range.* Tejon, Domengine, and Tyee formations, middle Eocene.

*Geographic distribution.* Coast Ranges of California and Comstock area, Oregon.

*Type locality.* (U.C. 1134.) In road cut at east end of highway overpass half a mile south of Comstock on the Pacific Highway, Oregon. (Turner)

**Genus ARGOBUCCINUM Klein, 1846**

*Argobuccinum* Klein, in Herrmannsen, Ind. Gen. Malacoz., vol. 1, p. 77, 1846.

*Genotype.* *Murex argus* Linnaeus.

**ARGOBUCINUM CAMMANI Dall, 1909**

## Plate 83, figure 1

*Argobuccinum (Fusitriton) cammani* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 55, pl. 4, fig. 11, 1909.

*Ranella (Priene) cammani* (Dall), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 739, 1931.

*Original description.* Shell thin, rather slender, strongly constricted at the sutures; apex and canal defective in the specimens; varices resembling the ribs but larger, irregularly distributed, about two to a whorl; suture appressed; whorls subtabulate, sculptured with about 16 rounded ribs with much wider interspaces, slightly arcuate and obscurely nodulose where crossed by the stronger spirals; the ribs become obsolete on the base of the whorl; spiral sculpture in front of the shoulder of the whorl, of about nine more or less elevated straplike bands, faintly, finely spirally striate, with subequal or wider interspaces also more or less striated, the spirals grow stronger and the interspaces deeper toward the base; pillar smooth,

more or less callous. Altitude of figured fragment, 36.5 mm.; maximum diameter, 30 mm. (Dall)

*Observations.* This species is characterized by the constriction of the spire at the sutures.

*Holotype.* (U.S.N.M. 153907.) Figured in the present report, pl. 83, fig. 1.

*Geologic range.* Empire and Montesano formations, upper Miocene.

*Geographic distribution.* Coos Bay area, Oregon, and Grays Harbor County, Washington.

*Type locality.* Coos Bay, Oregon, Camman collection. (Dall)

#### **ARGOBUCINUM COOSENSE Dall, 1909**

##### Plate 83, figure 2

*Argobuccinum (Fusitriton) cooense* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 55, 56, pl. 7, fig. 4, 1909.

*Original description.* Shell slender, elongate, with four or more whorls, the type with the apex and anterior end of the canal defective; varices rounded, prominent, about two to a whorl, in the figure the profile includes a varix at each edge of the last whorl giving the shell a wider aspect than it presents from another angle; suture appressed, the shell not constricted in the sutural region; sculpture of 19 or 20 slightly arcuate ribs extending from the suture well over the periphery and then becoming gradually obsolete; the whorl is crossed by 28 to 30 flat, little-elevated straplike subequal spirals, slightly swollen where they cross the ribs, separated by subequal or narrower interspaces, which as well as the spirals, are faintly, finely spirally striate; canal elongate, more or less arcuate and recurved, pillar smooth. Altitude of figured specimen, 54 mm.; diameter at varices, 28 mm.; between the varices, 24 mm. (Dall)

*Observations.* This species differs from *A. oregonense* in minor details of sculpture, is less inflated, and has a larger number of ribs.

*Holotype.* (U.S.N.M. 153903.) Figured in the present report, pl. 83, fig. 2.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Coos Bay, Camman collection. (Dall)

#### **ARGOBUCINUM OREGONENSE (Redfield), 1846**

##### Plate 83, figure 15

*Triton oregonense* Redfield, Ann. Lyc. Nat. Hist. New York, vol. 4, p. 165, pl. 11, fig. 2, 1846.

*Tritonium (Priene) oregonensis* Redfield, Arnold, Mem. Cal. Acad. Sci., vol. 3, pp. 286, 287, 1903.

*Argobuccinum (Fusitriton) oregonense* Redfield, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 56, 1909.

*Ranella (Priene) oregonensis* (Redfield), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 737, 738, pl. 27, fig. 12, 1931.

*Supplementary description.* Shell large, fusiform; spire elevated; apex blunt; whorls eight to ten, convex; nuclear whorls smooth, except for obsolete spiral striations; cancellated sculpture of nearly equally prominent spiral and transverse

rounded ridges; suture deeply impressed; discontinuous rounded varices at every half to two-thirds revolution on upper whorls; aperture subovate; outer lip not thickened, slightly effuse on adult shells; canal long, narrow, recurved; inner lip incrusted; columella slightly twisted; umbilicus obsolete. (Arnold)

*Observations.* This species which occurs in the rocks of the Empire formation at Fossil Rock, Coos Bay, Oregon, occurs in the Pliocene and Pleistocene in southern California and is found living on the western side of the Pacific from the Pribilof Islands southward to Japan and on the eastern side southward as far as Monterey Bay. (Dall, 1922.) It is known in the Tertiary of the Northwest only in Humboldt County, California, and at Coos Bay, Oregon, and has not been recognized in western Washington.

*Hypotype.* (U.S.N.M. 153996.) Figured in the present report, pl. 83, fig. 15.

*Geologic range.* Upper Miocene to Recent.

#### ARGOBUCCINUM PACIFICUM Dall, 1909

##### Plate 83, figure 5

*Argobuccinum (Priene) pacifica* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 56, 57, pl. 5, fig. 9; pl. 6, fig. 2, 1909.

*Ranella (Priene) pacifica* (Dall), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 735, 1931.

*Original description.* Shell large, stout, with about one inconspicuous varix to a whorl, the only prominent varix being the terminal one of the adult; whorls four or more, inflated, rotund; apex and anterior end of canal defective in the specimen; suture very distinct but not channeled; sculpture of (on the penultimate whorl) about 20 subequal rounded ribs, extending from the suture over the periphery of the whorl and becoming obsolete on the base, about one on each whorl slightly varicose; incremental lines hardly noticeable; spiral sculpture of (on the last whorl about 20) subequal, flattish ridges with nearly equal interspaces, growing coarser toward the canal, not swollen or perceptibly nodulose where they cross the ribs, nor spirally striated; canal short without marked fasciole, anteriorly defective in the specimen, deeply indented; outer lip more or less flaring, especially in front; aperture obstructed by matrix but the outer lip probably denticulate within. Altitude, 60 mm.; maximum diameter of last whorl, 50 mm. (Dall)

*Observations.* The species occurs both in the Empire formation at Coos Bay and also in the Purisima formation in California. The specimens from both locations are partly broken and Dall suggested that the spire probably had 6 whorls.

*Holotype.* (U.S.N.M. 153902.) Figured in the present report, pl. 83, fig. 5.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene in Oregon, and Purisima formation, in California.

*Geographic distribution.* Coast Ranges of central California and Coos Bay, Oregon.

*Type locality.* Coos Bay, Camman collection. (Dall)

**ARGOBUCINUM MATHEWSONII** (Gabb), 1869

Plate 83, figures 3, 4

*Ranella matthewsonii* Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 8, pl. 2, fig. 13, 1869.

*Argobuccinum cf. matthewsonii?* (Gabb), Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 134, 135, pl. 13, figs. 12, 13, 14, 1933.

*Original description.* Shell moderate in size, robust, sub-compressed; spire high; number of whorls unknown; suture strongly impressed, bordered by a small, though abrupt truncation of the succeeding whorl; varices prominent, rounded, continuous. Mouth small; inner lip heavily incrusted; canal abruptly recurved. Surface marked by numerous, rounded, longitudinal ribs, crossed by square revolving ribs, with smaller ones interposed, and with flat interspaces. (Gabb)

*Observations.* This species was based on three poorly preserved specimens, but the characters present are very similar to those of *A. matthewsonii* (Gabb) from California. Tegland has distinguished *A. matthewsonii* from *A. vancouverense* (Clark and Arnold) in the absence of tabulate sutures. Attention has been called to the similarity of the ribbing to that of *A. oregonense*.

*Hypotype.* (U.C. 32232.) Figured in the present report, pl. 83, fig. 3.

*Hypotype.* (U.C. 32234.) Figured in the present report, pl. 83, fig. 4.

*Geologic range.* Blakeley formation, upper Oligocene, and Oligocene south of Martinez, California.

*Geographic distribution.* Coast Ranges of central California and Kitsap County, Washington.

**ARGOBUCINUM DILLERI** Anderson and Martin, 1914

Plate 83, figure 6

*Argobuccinum dilleri* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 71, 72, pl. 4, fig. 7, 1914.

*Original description.* Shell large, solid, with nine or ten strongly sculptured whorls; spire high; whorls convex, tabulated, sculptured with eighteen low, rounded axial ribs and numerous spiral cords which alternate in size; the spiral sculpture on the penultimate whorl consisting of four pairs of double strap like cords, between each pair of which are three less prominent cords, the middle one being slightly larger than those on either side; the interspaces are narrower than the cords; the double cords produce nodulation on the axial ribs; two rugose discontinuous varices crossing each whorl from suture to suture; entire surface faintly spirally striate; canal and aperture partly defective. Dimensions:—Altitude of the figured specimens, 65 mm.; maximum diameter of the body-whorl, 44 mm. (Anderson and Martin)

*Observations.* This species may be distinguished from *A. oregonense* in the lack of well-developed longitudinal ribs. Such ribs are faintly represented in *A. dilleri* and are set with sharp, flattened axial nodes. The spire is proportionately shorter in *A. oregonense* and the varices are less prominent.

*Holotype.* (C.A.S. 152.) Figured in the present report, pl. 83, fig. 6.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Yaquina Bay area, Oregon.

*Type locality.* (U.W. 691.) Sandstone exposed on ocean beach on south side of Yaquina Head, coast of Oregon, Lincoln County, five and one-half miles north of entrance to Yaquina Bay.

**ARGOBUCINUM VANCOUVERENSE** (Clark and Arnold), 1923

Plate 83, figures 8, 12

*Bursa vancouverensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 163, pl. 37, figs. 1a, 1b, 2a, 2b, 1923.

*Original description.* Shell heavy, robust, fairly large; spire high; apex broken on all specimens examined. Body whorl with narrow but conspicuous tabulation at suture, corresponding tabulations on spire indistinct. Surface sculptured by about sixteen longitudinal, rather coarse, rounded ribs, crossed by coarse, broadly rounded flat-topped, revolving ribs; surface nodose where sets of ribbing intersect. Interspaces between spiral ribbing about equal to or somewhat wider than width of ribs with narrow revolving riblet in each interspace. On whorls of spire four and on body whorl about ten major spiral ribs; one minor spiral riblet on narrow tabulation of body whorl; two fairly strong, ropelike varices on body whorl, one on or near outer lip, other on opposite side of whorl. On the only two specimens of this species at hand, varices on whorls of spire not distinguishable from general longitudinal ribbing. Outer lip thickened, crenulated internally; inner lip with heavy callus. Canal short, straight, partly closed. Dimensions of type specimen: Height of body whorl, about 33 mm.; greatest width, 36 mm. (Clark and Arnold)

*Observations.* *A. vancouverense* resembles somewhat *A. matthewsonii* in general shape and appearance but differs in its broad nearly flat-topped spiral ribs with narrow interspaces each of which is nearly filled with a secondary spiral riblet. The spiral major ribs of *A. matthewsonii* are about one-third as wide and are distinctly rounded and the sutures are not tabulate as in *A. vancouverense*.

*Holotype.* (C.A.S. 578.) Figured in the present report, pl. 83, figs. 8, 12.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* Sooke Bay, Vancouver Island.

*Type locality.* Sooke sandstone exposed in sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Vancouver Island.

**ARGOBUCINUM GOODSPEDI** (Tegland), 1933

Plate 83, figures 9, 10, 11

*Gyrineum goodspedi* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 135, pl. 13, figs. 5, 6, 1933.

*Original description.* Shell robust with six or more globose whorls. Whorls crossed by 12 or 13 rounded varices of which about three to each whorl are more pronounced. Anterior margin of the pronounced rib shows a distinct overlapping edge, indicating temporary arrested growth; spiral ornamentation on posterior whorls consisting of four major bifid revolving ribs with single intercalary. Body whorl with six major spirals, with intercalary. Dimensions of holotype (a half grown shell): height, canal and apex missing, 33.5 mm.; diameter, 21 mm. (Tegland)

*Observations.* Both the type and paratype are partly broken but the species seems to differ from other species of the genus on the Pacific Coast in the bifid character of the spiral ribs. The varices are heavy,

rounded, and broad, and are present across the entire surface of each whorl.

*Holotype.* (U.C. 32228.) Figured in the present report, pl. 83, figs. 9, 10.

*Paratype.* (U.C. 32231.) Figured in the present report, pl. 83, fig. 11.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Restoration Point, Kitsap County, Washington.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, Washington.

#### ARGOBUCCINUM SYLVIAENSE (Weaver), 1912

Plate 83, figure 7

*Gyrinum sylviaensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 73, 74, pl. 14, fig. 126, 1912.

*Original description.* Shell large, moderately elongated, with six rounded whorls; suture distinct; four continuous rounded lateral varices, which are very distinct, on the body whorl and the first whorl of the spire; on the remaining whorls they are obscure; between each of the varices there are four distinct, broad rounded ribs extending from suture to suture over the body whorl and all of the whorls of the spire; interspaces equally developed (about two-thirds the width of the ribs and concave); canal moderately short and curved. On the specimen figured it is broken; aperture obscured. Surface of body whorl sculptured by 23 broad nearly flat topped revolving ribs separated by moderately deep grooves each of which contains a smaller intermediate riblet; the same sculpture occurs on each whorl of the spire. Dimensions.—Altitude of figured specimen from base of broken canal 56 mm.; maximum diameter 30 mm.; elevation of spire 20 mm.; angle of spire 30 mm. (Weaver)

*Observations.* This species has been recognized only in the conglomerate lenses of the Montesano formation in the Grays Harbor area of Washington. The major spiral ribs are fairly heavy on the middle and lower parts of the whorls but somewhat less distinct on the upper third. The secondary longitudinal ribs are relatively strong on the upper half of the body whorl but tend to become indistinct or disappear entirely towards the base.

*Holotype.* (U.W. 73) (C.A.S. 7601). Figured in the present report, pl. 83, fig. 7.

*Geologic range.* Montesano formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 68.) In basal conglomerate of Montesano formation six miles north of Montesano.

#### Genus GYRINEUM Link, 1807

*Gyrineum* Link, Beschr. Rostock Samml., p. 123, 1807.

*Genotype.* *Murex gyrinus* Linnaeus.

**GYRINEUM KEWI** (Dickerson), 1915

## Plate 83, figure 14

*Nyctilochus kewi* Dickerson, Proc., Calif. Acad. Sci., ser. 4, vol. 5, p. 64, pl. 7, figs. 5a, 5b, 1915.  
*Gyrineum kewi* (Dickerson), Anderson and Hanna, Calif. Acad. Sci., Occ. Pap. no. 11, p. 56, pl. 10, fig. 4; pl. 13, fig. 12, 1925; Clark, Bull. Geol. Soc. Am., vol. 49, p. 717, pl. 2, fig. 32, 1938.

*Original description.* Shell stout, with six whorls; spire only two-fifths the length of shell; the first two whorls smooth, the third, fourth and fifth whorls slightly convex and decorated by four strong spiral lines with a thread between each two and by fourteen axial ribs which make rounded nodes at the intersections with spiral ribs; of the spiral ribs, the lower two are the strongest and they occur near the base of the whorl at the place of greatest width; decoration of the body whorl similar to the decorated spire whorls; the largest spiral rib marking the shoulder which is located two-fifths of the whorl length below its sinuous suture; the spiral ribs above and below the shoulder not as well marked as those on the upper whorls; two rounded varices extending over the whorls; these varices about 180° apart being slightly discontinuous; canal short, twisted; mouth broadly oval. Dimensions:—Length of spire, 21 mm.; width of body whorl, 15 mm. (Dickerson)

*Observations.* *G. kewi* is distinguished from *Cymatium cowlitzense* (Weaver) and *C. washingtonianum* (Weaver) in having a shorter spire, and from the latter species in having rounded instead of pointed nodes.

*Holotype.* (U.C. 11054.) Figured in the present report, pl. 83, fig. 14.

*Geologic range.* Tejon, Markley, and Cowlitz formations.

*Geographic distribution.* Kern County, California, and lower Cowlitz Valley, Washington.

*Type locality.* (U.C. 458.) West side of Grapevine Canyon, Kern County, California.

**GYRINEUM MEDIOCRO** Dall, 1909

## Plate 83, figure 13

*Gyrineum mediocre* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 54, 55, pl. 7, fig. 6, 1909.

*Original description.* Shell large, solid, with five or more whorls and heavy prominent, rounded, continuous lateral varices; suture distinct with a narrow tabulation just in front of it; whorls rotund, canal short with no marked fasciole or sulcus behind it; axial sculpture of small rounded riblets (about 15 between the varices on the penultimate whorl), which on the upper whorls extend from suture to suture, on the later whorls become obsolete soon after passing the angle of the tabulation which they usually nodulate, and are more or less obsolescent on the last half of the last whorl in some specimens, while in the variety (see Pl. VII, fig. 9) they are more or less persistent; spiral sculpture of (on the penultimate whorl about 17) sulci alternately feeble and strong, as usual stronger on the canal; the interspaces are broad, flat, and finally spirally striate, except on the canal, where they become rounded and rugose or even beaded; canal short with a deep indentation, recurved, but without a marked sulcus behind it; varices heavy behind, with no sutural canal, more slender in front, denticulate within; a rather pronounced callus on the body and pillar; details of the aperture obscured by matrix. Altitude of figured specimen, 44 mm.; of a larger one, about 60 mm.; maximum diameter, respectively 30 and 43 mm. (Dall)

*Observations.* The spire of this species is relatively shorter than those of other species of the genus in the Northwest. The spiral ribs are very broad and nearly flat, and each is incised faintly by a median spiral groove which is just barely noticeable. The spiral interspaces are extremely narrow and not deep.

*Holotype.* (U.S.N.M. 153900.) Figured in the present report, pl. 83, fig. 13.

*Geologic range.* Empire and Quillayute formations, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon, and lower Quillayute Valley, western side of Olympic Peninsula.

*Type locality.* Coos Bay, Camman collection. (Dall)

#### **GYRINEUM CORBICULATUM Dall, 1909**

Plate 84, figures 1, 3

*Gyrineum mediocre* Dall var. *corbiculatum* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 55, pl. 7, fig. 9, 1909.

*Gyrineum corbiculatum* Dall, Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pl. 7, fig. 5, 1922.

*Ranella (Priene) corbiculata* (Dall), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 735, 1931.

*Original description.* This has the general form of the preceding [*Gyrineum mediocre*] and differs from it chiefly in being less compressed and with less prominent varices, the riblets continuous over the last whorl, the spiral bands more numerous and narrower, separated by excavated channels instead of narrow sulci. The specimen is rather poorly preserved. Altitude, 70 mm.; maximum diameter, 42 mm. (Dall)

*Observations.* This form, which was described by Dall as a variety of *G. mediocre*, is more tumid and the upper surface of each whorl a short distance below the suture makes an angular junction with the middle surface of the whorl. The longitudinal ribs are a little stronger and relatively more numerous. The spiral ribs are narrower and slightly rounded and the intersection of these ribs with the longitudinal ribs gives the surface of the whorl a subcancellate appearance.

*Holotype.* (U.S.N.M. 153870.) Figured in the present report, pl. 84, fig. 1.

*Hypotype.* (C.A.S. 577.) Figured in the present report, pl. 84, fig. 3.

*Geologic range.* Empire and Quillayute formations.

*Geographic distribution.* Coos Bay, Oregon, and Quillayute Valley, Washington.

*Type locality.* Coos Bay, Camman collection. (Dall)

#### **GYRINEUM MACKINI n. sp.**

Plate 84, figures 2, 9

*Description.* Shell of moderate size; spire about two-sevenths the length of shell and containing five and one-half whorls; canal moderately long, narrow, reflexed, and end of described specimen slightly broken;

aperture subelliptical; outer lip very slightly denticulated; inner lip with moderately thick callus which extends only a short distance on to surface of body whorl. Ornamentation consisting of about thirteen major revolving ribs with intervening secondary and tertiary riblets; major ribs on middle surface of body whorl averaging 2 mm. in height and 3 mm. in width with a broad inverted U-shaped top; interspaces about one and one-half times width of major ribs with a single secondary rib along the middle; occasional tertiary riblets on upper third of surface of body whorl without regular arrangement. There are two varices at 180 degrees to each other, one of which is located on outer lip. Dimensions: Altitude of shell, 72 mm.; altitude of spire, 19 mm.; maximum diameter of body whorl, 34 mm.

*Holotype.* (U.C. 12499.) Figured in the present report, pl. 84, figs. 2, 9.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Grays Harbor area, Washington.

*Type locality.* (U.C. A-410.) Three-fourths mile west of Porter, Grays Harbor County, Washington.

#### Genus **OLEQUAHIA** Stewart, 1926

*Olequahia* Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 382, 383, 1926.

*Genotype.* *Olequahia washingtoniana* (Weaver).

#### **OLEQUAHIA WASHINGTONIANA** (Weaver), 1912

Plate 84, figures 6, 10, 11

*Cassidaria washingtoniana* Weaver, Geol. Surv. Wash., Bull. no. 15, pp. 38, 39, pl. 3, fig. 28, 1912.

*Nyctilochus washingtoniana* (Weaver), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 90, pl. 7, fig. 9, 1915.

*Olequahia washingtoniana* (Weaver), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 383, 1926.

*Original description.* Shell large, thick, angulated, globularly ovate and profusely ornamented; whorls eight, upper three smooth and rounded; body whorl large; spire relatively short. On the spire are two very large revolving ribs or carinae which are set with tubercles or spines. The carinae form an upper and lower angle to the whorl; between these the surface is concave; above the upper angle the surface is flat and forms nearly a right angle with the surface of the central part of the whorl. Surface below the lower angle slightly concave and sloping downwards to the canal; on it are two less prominent revolving ribs carrying spines. Whorls of spire are similarly developed. Surface ornamented by eleven longitudinal ribs beginning at the suture and covering the whorl but less conspicuous on the lower portion of whorl. Surface crossed by nine prominent revolving ribs; the upper two situated on the angle of the whorl forming the carinae. Where these intersect the longitudinal ribs, nodes or spines are developed. Sometimes a third carinae is developed. Between each set of the large revolving ribs is one less prominent rib and on either side of that, two small revolving threads. Spire similarly ornamented. Suture distinct and slightly undulating. Inner lip expanded and with heavy callous covering the surface up to the upper angle of the body whorl; outer lip thick and crenulated; posterior sinus distinct but small; aperture broad and oval; canal broken. Dimensions.—Altitude from broken end

of spire 44 mm.; diameter 32 mm.; altitude of spire 13 mm.; angle of spire 98°. (Weaver)

*Observations.* This species may be distinguished by its relatively higher spire, its strongly angulated body whorl and three prominent noded carinae, the upper and middle of which are situated at the junctions of the upper and middle thirds of the surface of the body whorl and the middle and lower thirds. The third, less well-defined carina is situated just below the top of the lower third.

*Holotype.* (U.W. 18) (C.A.S. 7611). Figured in the present report, pl. 84, figs. 10, 11.

*Paratype.* (C.A.S. 314.) Figured in the present report, pl. 84, fig. 6.

*Geologic range.* Cowlitz formation.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

#### OLEQUAHIA LINCOLNENSIS (Weaver), 1916

Plate 84, figures 4, 5, 13

*Strepsidura lincolnensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 49, pl. 4, figs. 62, 63, 1916.

*Original description.* Shell of medium size, spire short and canal moderately elongate; whorls six in number, the body whorl being exceptionally large; upper portion of each whorl is angulated and surface above the angle is very slightly concave and merges gradually into the surface below the angle of the whorl above; surface sculptured by four square topped ribs above the angle with broad flat bottomed interspaces of triple width within which are three to five revolving threads; middle portion of surface below angle has three well defined revolving ribs and the interspaces are set with two or three minor ribs; lower part of body whorl sculptured with ten very prominent ribs with interspaces of double width each of which is set with a single small revolving thread; revolving ribs are crossed by fourteen longitudinal ribs which are well defined on middle portion of whorl but somewhat obscure on upper and lower portions. Aperture semi-elliptical; anterior end extended into a somewhat elongate slightly twisted canal; outer lip thick; inner lip heavily calloused with the callus extending over a portion of the ornamented surface of shell but so thin that the ornamentation shows distinctly through; no plications are present on the inner lip or columella. Dimensions.—Altitude of shell 41 mm.; altitude of spire 10 mm.; maximum diameter of shell 26 mm.; angle of spire 65°. (Weaver)

*Observations.* This species is characterized by the strongly convex body whorl which is moderately angulated especially at the junction of the upper and middle thirds. It has fewer spiral ribs than does *O. washingtoniana*, and a different arrangement. The callus also is heavier

*Holotype.* (C.A.S. 466-A.) Figured in the present report, pl. 84, figs. 4, 5.

*Topotype.* (U.C. 32449.) Figured in the present report, pl. 84, fig. 13.

*Geologic range.* Lincoln formation.

*Geographic distribution.* Western Washington.

*Type locality.* (U.W. 256.) In Union Pacific railway cut one-fourth mile northwest of Galvin Station in Section 27, T. 15 N., R. 3 W., Lewis County, Washington.

## Family NEPTUNEIDAE

Genus NEPTUNEA ("Bolten") Roeding, 1798

*Neptunea* Roeding, in Bolten, Mus. Boltenianum, p. 115, 1798.*Genotype.* *Fusus antiquus* Linnaeus.

## NEPTUNEA TEGLANDAE new name

Plate 84, figures 8, 14

*Ancistrolepis clarki* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 131, 132, pl. 12, fig. 14, 1933.

*Original description.* Shell large, robust, with six or seven rounded whorls; posterior whorls ornamented with two heavy, flat-topped revolving ribs which divide the whorls into three subequal areas; shoulder, base of whorl, and interspace concave; suture almost abutting. Body whorl broadly rounded, curving into a short canal; region of greatest convexity ornamented with four revolving, flat-topped equally spaced ribs; concavities between ribs and adjoining suture smooth with extremely faint spiral striations; anterior portion, including canal, ornamented with about ten heavy revolving ribs with interspaces equal to width of ribs; aperture ovate; what was evidently a smooth callus almost entirely removed from inner lip; canal short, narrow, and slightly recurved. Faint growth lines closely set over entire surface, but general appearance of shell is smooth to polished. Dimensions of holotype: altitude (spire and canal slightly broken), 63 mm.; diameter, 49 mm. (Tegland)

*Observations.* This species is distinguished from *N. landesi* by a relatively shorter spire and body whorl, a more definite angulation of the whorls, and by the body whorls being divided into three surfaces separated by strong short carinae. The spiral ornamentation is of a different character.

The name *Neptunea (Neptunea) clarki* (Meek) = *Chrysodomus clarki* Meek (Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 417, pl. 79, figs. 1a, 1b, November 23, 1923) antedates the species described by Tegland and is thus a homonym. The species is here renamed *Neptunea teglandae*.

*Holotype.* (U.C. 32217.) Figured in the present report, pl. 84, fig. 8.*Paratype.* (U.C. 32218.) Figured in the present report, pl. 84, fig. 14.*Geologic range.* Blakeley formation, upper Oligocene.*Geographic distribution.* Kitsap County and north side of Olympic Peninsula.*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, opposite Seattle.

## NEPTUNEA LANDESI (Tegland), 1933

Plate 84, figures 7, 12

*Ancistrolepis landesi* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 132, 133, pl. 13, figs. 1, 2, 3, 4, 1933.

*Original description.* Shell large (incomplete specimen, 80 mm.), heavy with more than six (possibly ten) rounded whorls; entire shell spirally sculptured.

Suture abutting. Posterior whorls with central angulation formed by a heavy revolving keel, second similar carina placed centrally between angle and anterior suture; shoulder ornamented by smaller secondary spirals, a cluster of four above the angle, then two, more widely spaced; between the cluster of four and medial angle is a valley more or less pronounced, depending upon the prominence of the anterior spiral of the group; fine tertiary spirals on the entire surface but very faint just below the medial keel. Body whorl rounded; posterior portion ornamented like preceding whorls; anterior portion with two additional, evenly spaced carinae and sometimes a third close to the second; spiral threads between carinae; below last carina ten or more closely spaced spirals of secondary value. Aperture ovate, canal short and slightly recurved. Dimensions of holotype: height (incomplete), 70 mm.; greatest diameter, 36 mm. (body whorl broken: would probably have been at least 46 mm.). (Tegland)

*Observations.* This species is less robust and relatively higher than *N. teglandae* and the whorls are more evenly rounded and less angulated and have a different type of spiral ornamentation.

*Holotype.* (S.U. 789.) Figured in the present report, pl. 84, fig. 12.

*Paratype.* (U.C. 32229.) Figured in the present report, pl. 84, fig. 7.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Kitsap County, Washington.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, opposite Seattle.

#### NEPTUNEA DIMINUTA Etherington, 1931

##### Plate 85, figure 1

*Neptunea diminuta* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 102, 103, pl. 12, fig. 10, 1931.

*Original description.* Shell medium sized; whorls five; nuclear portion badly eroded but apparently smooth; axial sculpture appears on third whorl of the spire; spire about one-half the size of body whorl; body whorl plump, covered with fine revolving lines with narrow interspaces. Axial ribs prominent, about 14 in number; shoulder fairly prominent sloping sharply to the suture with very faint indication of nodes where axial ribs cross the shoulder; canal moderately long, slightly reflected; siphonal fasciole indistinct; aperture moderately wide, outer lip thin; inner lip smooth, slightly washed with callus; pillar slightly twisted. Dimensions (type U.C. no. 32011).—Altitude 13.0 mm.; maximum diameter 5.7 mm.; altitude of aperture 7.9 mm. (Etherington).

*Observations.* This shell is small, with rounded whorls which are only slightly angulated just below the sutures. The combined spiral and longitudinal ribs give the shell a slightly reticulated sculpture.

*Holotype.* (U.C. 32011.) Figured in the present report, pl. 85, fig. 1.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 425.) In bed of Rock Creek, one-fourth mile down stream from the falls and just below old dam site, Grays Harbor County, Section 7, T. 16 N., R. 5 W.

**NEPTUNEA CLALLAMENSIS (Weaver), 1912**

*Chrysodomus clallamensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 43, 44, pl. 15, fig. 136, 1912.

*Original description.* Shell of moderate size, sub-fusiform; spire moderately high; whorls seven, convex; body whorl regularly convex with very faint angulation a short distance below the suture; suture distinct and impressed. Surface ornamented with thirty very low revolving ribs between each pair of which there is a very fine revolving thread; about twenty-five faint longitudinal ribs are present. This sculpture is present on all the whorls. Canal of medium length and somewhat bent backwards; inner lip incrusted; outer lip somewhat thickened; aperture broad. Dimensions.—Altitude 37 mm.; diameter 18 mm.; altitude of spire 16 mm.; angle of spire 45°. (Weaver)

*Observations.* This species usually is poorly preserved but is fairly common in the middle Miocene sandstones just east of Clallam Bay, Washington. The holotype has been lost. The strongly reticulated ornamentation is characteristic of the shell.

*Holotype.* (U.W. 25.) Lost.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Clallam County, Washington.

*Type locality.* (U.W. 210.) At Slip Point, south shore Strait of Juan de Fuca, one mile northeast of Clallam Bay.

**NEPTUNEA BAIRDII (Dall), 1909**

Plate 85, figures 2, 3

*Chrysodomus bairdii* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 43, 44, pl. 2, fig. 4, 1909.

*Original description.* Shell of moderate size, with about 5 tabulate whorls; apex defective in the specimens; suture narrowly channeled, with a single spiral cord in front of the channel, the tabulation slightly excavated and bordered in front by a similar spiral ridge which forms the summit of the shoulder of the whorl; below the shoulder the whorl is moderately convex and spirally sculptured by slightly elevated, alternating revolving ridges, of which one at the periphery is slightly more conspicuous than the others; these ridges, alternately larger and smaller, are separated by linear interspaces, and the larger spirals become more conspicuous anteriorly; aperture wide, angulated by the carina at the shoulder; canal defective in all the specimens; pillar callous, smooth. Altitude of figured specimen, 46 mm.; maximum diameter, 28 mm. (Dall)

*Observations.* Dall has pointed out that this species is closely related to the Recent *N. tabulatus* Baird and that it may be the precursor of that form. It differs from it by shorter and rounded whorls, by non-constricted sutures, and in details of sculpture.

*Holotype.* (U.S.N.M. 153905.) Figured in the present report, pl. 85, fig. 2.

*Hypotype.* (S.U. 5880.) Figured in the present report, pl. 85, fig. 3.

*Geologic range.* Empire formation, upper Miocene, and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Coos Bay, Camman collection. (Dall)

## NEPTUNEA POSTPLANATA (Dall), 1909

Plate 85, figure 12

*Chrysodomus postplanatus* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 43, pl. 7, fig. 5, 1909.

*Chrysodomus gettysburgensis* Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 190, pl. 3, fig. 26, 1909.

? *Chrysodomus postplanatus* Dall, Am. Jour. Sci., vol. 4, p. 309, 1922.

*Neptunea* (? *Sulcosiphon*) *postplanata* (Dall), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 659, 1931.

*Original description.* Shell large, solid, strong, with about 7 tabulated whorls; spire rather elevated, as in *C. liratus* Martyn, with a well-defined suture, in front of which the margin is somewhat appressed, then descends to a flattish tabulation bordered anteriorly by a conspicuous angle of about 90°, in front of which the whorl exhibits a moderate convexity extending to the base; the surface is more or less distinctly sculptured by flat straplike spirals, separated by much narrower interspaces, which are filled by a much smaller spiral of the same character in some specimens, while in others the intercalary spiral may be wanting or the whole sculpture, as in the figured specimen, more or less obsolete; the axial sculpture comprises only more or less conspicuous incremental lines; canal short, somewhat recurved; aperture defective in the specimens. Altitude of figured specimen, 90 mm.; maximum diameter, 50 mm. (Dall)

*Observations.* This species is characterized by a relatively high spire, and by the strongly angulated upper surface of body whorl, which is nearly flat and makes a nearly right angle with middle surface of whorl which is ornamented with numerous closely spaced strap-like spiral ribs.

*Holotype.* (U.S.N.M. 107781.) Figured in the present report, pl. 85, fig. 12.

*Geologic range.* Quillayute formation, Pliocene.

*Geographic distribution.* Lower Quillayute Valley, west side of Olympic Peninsula.

*Type locality.* (U.W. 111.) Near junction of Maxfield Creek and Quillayute River in northeast quarter of Section 28, T. 28 N., R. 14 W., Clallam County, Washington.

## NEPTUNEA PACKARDI (Weaver), 1916

*Chrysodomus packardi* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 47, 48, pl. 4, figs. 5, 7, 8, 1916.

*Original description.* Shell small, thick and elongate-ovate; whorls five to six in number, tabulated and ornamented with both revolving and longitudinal ribs; there is a prominent angle near the upper portion of each whorl; surface above angle very slightly concave and sculptured by five narrow, rounded revolving ribs between each of which there are flat bottomed interspaces of double their width; on the angulated portion of each whorl there are three cord-like revolving ribs with interspaces of equal width; immediately below the angle there are ten ribs with flat surfaced interspaces three to four times wider than the ribs; near the anterior end of the whorl the ribs become fainter and closer together. The revolving ribs are crossed by 13 longitudinal ribs which produce prominent nodes on the angulated portion of the whorls but are only faintly noticeable above and below the angles. Aperture sub-oval; outer lip arcuate and thin; inner lip smooth; columella short and curved with two moderately developed plications and a small anterior sulcus. Dimensions.—Altitude of shell 9 mm.; altitude of spire 4 mm.; maximum diameter of shell 7 mm.; angle of spire 55°. (Weaver)

*Observations.* This middle Oligocene species is small with strong tabulation of upper part of each whorl. The holotype is lost.

*Holotype.* (U.W. 110.) Lost.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Thurston County, Washington.

*Type locality.* Cut on Union Pacific Railway one-fourth mile north of Galvin Station, in Section 27, T. 15 N., R. 3 W.

#### NEPTUNEA LINCOLNENSIS (Weaver), 1916

*Chrysodomus lincolnensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 47 (unfigured), 1916.

*Original description.* Shell of medium size; spire short; whorls six; suture distinct but not channeled; all the whorls are angulated and upon the angles are small nodes; body whorl large and somewhat elongate; a prominent angulation exists upon it just above the middle portion; between this angulation and the suture the upper surface is very slightly concave and merges into the lower surface of first whorl of spire as a continuous surface so that the suture appears merely as a line; middle and lower portion of body whorl evenly rounded; surface sculptured by prominent revolving ribs; there are four of these on the upper surface of the whorl; three on the middle portion and eleven below; between the ribs are broad flat interspaces three times the width of the ribs; within the interspaces are set one to three fine revolving threads; the revolving ribs are crossed by fifteen longitudinal ribs which are well developed on the middle portion of each whorl but become somewhat obscure on the upper surface and entirely disappear on the lower; where these cross the angulated areas somewhat flattened nodes are produced; very minute nodes are present upon the more prominent revolving ribs on the middle portion of the shell. Outer lip thick but smooth; inner lip heavily calloused; callus extends out some distance on to the surface of the body whorl; but is so thin that the sculpture of it shows plainly through. Canal twice as long as spire and slightly reflexed at anterior end; moderately deep and faintly channeled. Dimensions.—Altitude of shell 12 mm.; altitude of spire 5 mm.; maximum diameter of shell 5 mm.; angle of spire 50°. (Weaver)

*Observations.* This species was described but not figured and the type has been misplaced. It is fairly common in the middle Oligocene near Galvin, Thurston County, Washington.

*Holotype.* (U.W. 109.) Lost.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Thurston County, Washington.

*Type locality.* (U.W. 256.) Cut on Union Pacific Railway one-fourth mile north of Galvin Station in Section 27, T. 15 N., R. 3 W.

#### Genus LIOMESUS Stimpson, 1865

*Liomesus* Stimpson, Canadian Naturalist and Geologist, n. s., vol. 2, p. 366, 1865.

*Genotype.* *Buccinum dalei* Sowerby.

**LIOMESUS SULCULATUS Dall, 1909**

Plate 85, figures 6, 7

*Liomesus sulcatus* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 44, pl. 5, figs. 2, 3, 1909.

*Monoceros engonatum* Conrad, Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 220, pl. 6, fig. 55, 1909.

*Liomesus ? sulcatus* Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 313, 1922.

*Liomesus sulcatus* Dall, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 666, 667, 1931.

*Original description.* Shell of moderate size, with about five well-rounded whorls; suture distinct, not channeled; sculpture of (on the last whorl about 15) clear-cut, uniform, flat-topped spiral ridges with equal or wider, not channeled, interspaces; the whole surface marked with very fine, almost microscopic spiral striae, which in the event of wear may disappear; the posterior ridge may be near the suture (giving a channeled aspect) or at some little distance from it; in general the interspaces become narrow anteriorly; aperture ovate, the pillar rather callous, the body with more or less callus, both smooth; the canal short, deep. Altitude of figured specimen, the apex being defective, 33 mm.; maximum diameter, 22.5 mm. (Dall)

*Observations.* This species is the only one of the genus so far recognized in the Northwest Tertiary formations. Its ornamentation is characterized by prominent flat-topped spiral ribs varying from 14 to 16 in number and spiral interspaces of about equal width.

*Holotype.* (U.S.N.M. 153904.) Figured in the present report, pl. 85, fig. 6.

*Hypotype.* (S.U. 62.) Figured in the present report, pl. 85, fig. 7.

*Geologic range.* Empire, Montesano, and Quillayute formations, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon, and Grays Harbor County and lower Quillayute Valley, Washington.

*Type locality.* Coos Bay, Camman collection. (Dall)

Genus **CANTHARUS** ("Bolten") Roeding, 1798

*Cantharus* Roeding, in Bolten, Mus. Boltenianum, p. 132, 1798.

*Genotype.* *Cantharus globularis* Bolten = *Buccinum tranquebaricum* Gmelin.

**CANTHARUS COWLITZENSIS Clark, 1938**

*Cantharus (Eocantharus) cowlitzensis* Clark, Geol. Soc. Am., vol. 49, pp. 714, 715, pl. 4, figs. 7, 8, 9, 10, May 1, 1938.

*Original description.* Shell fusiform with a fairly high spire (apex broken); number of whorls, six or seven; sutures appressed, surface sculptured by a series of fairly coarse, closely spaced, spiral ribs; there are nine of these ribs on the penultimate whorl and nineteen on the body whorl. Surface also sculptured by a series of heavy, rounded, longitudinal ribs which on the whorls of the spire, reach from suture to suture, and on the body whorl extend well down onto the canal. There are six of these ribs on the body whorl and seven on the spire. Aperture elongate ovate; outer lip ornamented internally by a series of elongate denticulations; inner lip smooth; canal short with a fairly deep umbilical fasciole. Dimensions: holotype 30889, height 23 mm., height of body whorl 12 mm., greatest diam-

eter of body whorl 11.4 mm.; paratype 30890, height 22 mm. (apex broken), height of body whorl 13.7 mm., greatest diameter of body whorl 11 mm. (Clark)

*Observations.* This upper Eocene species is common in southwest Washington and has been described by Clark from the Markley formation in the Coast Ranges of central California.

*Holotype.* (U.C. 30889.) Not figured in the present report.

*Geologic range.* Cowlitz formation, upper Eocene; upper Coaledo formation, Oregon.

*Geographic distribution.* Lower Cowlitz Valley, Washington; Coos Bay area, Oregon.

*Type locality.* (U.W. 232.) North bank Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

#### CANTHARUS BENTSONAE Turner, 1940

Plate 85, figures 4, 5

*Cantharus cowlitzensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 79, pl. 16, fig. 22, June 1, 1938.

*Cantharus bentsonae* Turner, n. nom., Jour. Paleon., vol. 14, p. 518, 1940.

*Original description.* Shell of medium size, thick, turreted; canal short; columella stout with thin callous; there appear to be very faint plications on the anterior portion suggesting *Latirus*; whorls shouldered, ornamented on body whorl with 17 conspicuous revolving riblets separated by a finer thread; suture appressed forming a band at the posterior limit of the whorl. (Turner)

*Observations.* As pointed out by Turner this species may be distinguished from *Siphonalia sutterensis* Dickerson by its longer spire; from *S. clarki* Dickerson by its shorter canal; and from *S. sopenahensis* (Weaver) by the absence of longitudinal ribs.

*Holotype.* (U.C. 33208.) Holotype of Turner. Figured in the present report, pl. 85, figs. 4, 5.

*Geologic range.* Upper Coaledo formation, upper Eocene.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* (U.C. 7164.) Yokam Point, Coos Bay, Oregon.

#### CANTHARUS PERRINI Dickerson, 1915

Plate 85, figure 8

*Cantharus perrini* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 65, pl. 7, figs. 10a, 10b, 1915.

*Original description.* Shell small, short, stout with large inflated body-whorl marked by strong spiral lines which alternate in size; whorls six; first two smooth; third, fourth and fifth whorls flat-sided and decorated by three strong spiral lines with two of lesser strength between; body-whorl decorated by eight or nine strong spiral lines with alternating threads; aperture oval; outer lip dentate and lirate within; siphonal fasciole well developed; umbilicus subimperforate. Dimensions: —Length, 12 mm.; width of body-whorl, 7 mm. (Dickerson)

*Observations.* This species is abundant in the Cowlitz formation of Washington and differs from *C. cowlitzensis* in having a much shorter

spire and in lacking the angulate shoulder of that species. The spiral ribs on the former are less numerous, heavier, and more rounded than on the latter species.

*Holotype.* (C.A.S. 315.) Figured in the present report, pl. 85, fig. 8.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) On north bank of Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

#### CANTHARUS MERRIAMI (Weaver and Palmer), 1922

Plate 85, figures 9, 13

*Urosalpinx merriami* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, p. 39, pl. 11, fig. 15, 1922.

*Cantharus (Calicantharus) merriami* (Weaver and Palmer), Clark, Bull. Geol. Soc. Am., vol. 49, pp. 713, 717, 1938.

*Original description.* Shell of medium size; whorls five and convex; suture appressed; surface decorated with prominent, revolving ribs possessing a width about equal to the interspaces; within the interspaces there are interstitial riblets; over the surface of the shell there are wide, rounded, radiating ridges, the exact number and extent can not be determined, the species being described from one worn specimen. Canal short, twisted outer lip dentate; aperture sub-oval; a slight umbilicus present. Dimensions.—Altitude 17 mm.; width of body whorl 9.5 mm.; apical angle 50°. (Weaver and Palmer)

*Observations.* Clark, in his study of the fauna of the Markley formation, pointed out that the Cowlitz specimen originally described as *Urosalpinx merriami* Weaver and Palmer did not belong to that genus. He regarded it as belonging to his new subgenus *Calicantharus*, and closely related to *Cantharus (Calicantharus) californicus* Clark from the Markley formation of California.

*Holotype.* (U.W. 204) (C.A.S. 7623). Figured in the present report, pl. 85, figs. 9, 13.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Coal Creek, Cowlitz County, Washington.

*Type locality.* (U.W. 336.) One-fourth mile above old dam on Coal Creek, Cowlitz County, Washington, in Section 11, T. 8 N., R. 3 W.

#### Genus UMPQUAIA Turner, 1938

*Umpquaia* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 79, 1938.

*Genotype.* *Umpquaia oregonensis* Turner.

**UMPQUAIA OREGONENSIS** Turner, 1938

Plate 85, figures 15, 16, 18, 20

*Umpquaia oregonensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 79, 80, pl. 16, figs. 20, 21, 1938.

*Original description.* Shell of medium size, spire less than half the height; suture impressed; early whorls convex and tangent to preceding whorl at suture; later whorls developing a flat, sharp-edged flange-like shoulder which projects out as far as the convex portion of the whorl. Upper surface of the flange ornamented only by cross growth lines, surface in part convex and in part concave; body whorl ornamented with fine spiral riblets and sinuous growth lines below the shoulder; early whorls may have been cancellated; canal short, straight, margins elevated; columella heavy with well-defined fasciole much as in *Cantharus*; outer lip apparently thin; inner lip incrusting particularly at posterior portion of aperture. (Turner)

*Holotype.* (U.C. 33202.) Figured in the present report, pl. 85, figs. 16, 18.

*Paratype.* (U.C. 33674.) Figured in the present report, pl. 85, figs. 15, 20.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-661.) East bank of Little River, Douglas County, Oregon, in center of Section 19, T. 26 S., R. 3 W.

**Genus SIPHONALIA Adams, 1863***Siphonalia* Adams, Ann. & Mag. Nat. Hist., ser. 3, vol. 2 (no. 63), p. 202, 1863.

*Genotype.* *Siphonalia cassidariaeformis* (Reeve).

**SIPHONALIA PACKI** (Dickerson), 1917

Plate 85, figure 17

*Strepsidura packi* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 177, 178, pl. 30, figs. 11a, 11b, 1917.*Siphonalia packi* (Dickerson), Effinger, Jour. Paleon., vol. 12, pp. 383, 384, 1938.

*Original description.* Shell fusiform, with seven whorls; the first four naticoid; the fifth and sixth whorls decorated by about 12 pointed nodes located medially and marking a prominent shoulder; a flat sutural band is found just beneath suture on last three whorls; space between sutural band and nodes covered by undulating spiral threads, two on fifth, six on sixth, nine on body-whorl; space between suture and nodes similarly decorated; body whorl large, being two-thirds of shell length, marked by three rows of equally spaced nodes, the uppermost, the most prominent and lowermost, the weakest; further decoration consisting of numerous spiral threads cut by growth lines; aperture oval; columella slightly incrusted; canal twisted, short. Dimensions:—Length of type, 29 mm.; width of body whorl, 18 mm. (Dickerson)

*Observations.* This middle Oligocene species differs from the Cow-litz form *Siphonalia bicarinata* Dickerson, as pointed out by Effinger, by its broader, less concave shoulder, shallower siphonal notch, heavier su-

tural band, less distinct siphonal fasciole, coarser spiral ribbing, and the occasional presence of a third row of nodes on the body whorl.

*Holotype.* (C.A.S. 425.) Figured in the present report, pl. 85, fig. 17.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank Cowlitz River at old Gries Ranch, Lewis County, Washington, in Section 25, T. 11 N., R. 2 W.

#### SIPHONALIA BICARINATA Dickerson, 1915

Plate 85, figures 11, 19

*Siphonalia bicarinata* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 66, pl. 8, figs. 1a, 1b, 1c, 1d, 1915.

*Original description.* Shell fusiform; whorls seven, decorated by two spiral rows of twelve nodes; shoulder of whorl distinct, nodose; portion between shoulder and wavy suture marked by spiral threads of sub-equal strength; portion below shoulder marked by ribs of variable strength; body-whorl large, with biangular outer lip. Dimensions: Length, 20 mm.; width of body whorl, 11 mm. (Dickerson)

*Observations.* This species may be distinguished from *S. sutterensis* by its two spiral rows of nodes.

*Holotype.* (C.A.S. 316.) Figured in the present report, pl. 85, fig. 11.

*Hypotype.* (U.C. 15392.) Figured in the present report, pl. 85, fig. 19.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank Cowlitz River, one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

#### SIPHONALIA BICARINATA Dickerson subsp. MONOSPINA Hendon, 1938

Plate 85, figures 10, 14

*Siphonalia bicarinata* Dickerson subsp. *monospina* Hendon, in Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 78, pl. 16, figs. 14, 15, 16, 18, 1938.

*Original description.* This subspecies is recognized as a complex of individuals slightly different in their range of variability from the Cowlitz complex. Both groups are rather variable. The type of *S. bicarinata* figured by Dickerson (1915, pl. 8, figs. 1a, 1b) seems to be the exception rather than the rule in a collection of about 40 specimens from the Cowlitz. None of the specimens from an equally large Umpqua collection shows the double row of nodes present on the type. Many of them, however, correspond very closely to the other specimens figured by Dickerson (1915, pl. 8, figs. 1c, 1d).

In both Cowlitz and Umpqua forms the nodes or spines differ greatly in their development. In some they appear as sharp spines while in others they may appear only as a faint strengthening of the spiral lines on the axial ribs. (Hendon in Turner)

*Observations.* An examination of many specimens of *S. bicarinata* shows great variation in the strength of the two spiral rows of nodes; the

specimens from the Umpqua formation are characterized by the presence of a single row or occasionally a very faintly developed second row.

*Holotype.* (U.C. 33678.) Figured in the present report, pl. 85, figs. 10, 14.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-665.) On north bank Umpqua River upstream from bend one-fourth mile north of Glide.

#### SIPHONALIA CLARKI Dickerson, 1914

Plate 86, figure 14

*Siphonalia clarki* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 121, 122, pl. 11, figs. 4a, 4b, 1914; Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 78, 79, pl. 16, figs. 19, 23, 24, 1938.

*Original description.* Shell fusiform, with high spire; nine whorls; spire-whorls distinctly shouldered and decorated by about nine rounded nodes which exhibit two apices where two strong spiral lines cross them; space between appressed wavy suture and shoulder concave, and covered by about ten spiral threads; flat space below the suture marked by two strong spiral lines and by eight to ten spiral threads, this area parallel to the axis of the shell; shoulder located one-third of a whorl length below the suture; body-whorl marked by nodes which vary in strength with different individuals, and shouldered about one-sixth of a whorl-length below the suture; concave space between the suture and the shoulder marked by about twelve spiral threads; area below the shoulder marked by spiral lines of variable strength and by a flat-bottomed sulcus located half the whorl-length below the shoulder; outer lip thin, dentate and lirate within; inner lip covered by a thin callus; umbilicus subimperforate; canal short, twisted to the left. Dimensions: Length of figured specimens, 40 mm.; width of body-whorl, 17 mm. (Dickerson)

*Observations.* This species bears a similarity to *Siphonalia sutterensis* in general form and ornamentation. It differs in having a longer spire, heavier shell, and relatively more elongate canal.

*Holotype.* (C.A.S. 247.) Figured in the present report, pl. 86, fig. 14.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-661.) East bank Little River, Douglas County, under bridge at junction with Umpqua River in center of Section 19, T. 26 S., R. 3 W.

#### SIPHONALIA SOOPENAHENSIS (Weaver), 1912

Plate 86, figures 1, 2, 3, 4, 5, 6, 7, 8, 15

*Hemifusus sopenahensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 44, 45, pl. 1, figs. 2, 3, 1912; Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 67, pl. 8, figs. 2a, 2b, 1915.

*Tritonium sopenahensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 40, pl. 1, fig. 6, 1912.

*Original description.* Shell large, robust, moderately elongate and convex; whorls seven to eight and very convex; suture undulating and fairly distinct;

middle three-fifths of each whorl convex; upper part concave, then vertical to the suture; lower part slightly concave; upper or seventh whorl of shell smooth and rounded; other whorls highly ornamented. Surface ornamented by ten very prominent longitudinal ribs which extend over almost the whole shell, except a small area just below the suture; at the extreme lower portion of the body whorl they become somewhat obscure. Surface of body whorl up as far as the upper portion of the convex part sculptured by fifteen very prominent revolving ribs. Alternating with these is a less prominent rib, on either side of which is a fine raised thread. This sculpture extends to the end of the canal. Surface of the whorl above upper end of convex portion is sculptured by seven revolving ribs alternating with fine threads. At the intersection of the revolving lines and longitudinal ribs on the convex part of the shell, distinct, short spines are developed; sculpture of whorls on spire similar. Canal short and bent to the left. Anterior sinus fairly deep; inner lip smooth and calloused; outer lip smooth; aperture large, semi-elliptical and extending to the end of the canal. Dimensions.—Altitude 45 mm.; diameter 22 mm.; altitude of spire 15 mm.; angle of spire 45°. (Weaver)

*Observations.* Specimens of this species in the Cowlitz formation of Washington are extremely abundant and well preserved and are characterized by relatively high spire, rounded and only slightly angulate body whorl, thin, well developed callus, and a spiral ribbing pattern.

*Holotype.* (U.W. 20-A) (C.A.S. 7592-A). Figured in the present report, pl. 86, fig. 1.

*Paratype.* (U.W. 26) (C.A.S. 7574). Figured in the present report, pl. 86, figs. 2, 15.

*Paratype.* (U.W. 20) (C.A.S. 7592). Figured in the present report, pl. 86, figs. 7, 8.

*Hypotypes.* (U.W. 531) (U.W. 532) (U.W. 533) (U.W. 534). Figured in the present report, pl. 86, figs. 3, 4, 5, 6.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank Cowlitz River, one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

#### SIPHONALIA WASHINGTONENSIS (Weaver), 1916

Plate 86, figures 9, 10, 11, 13

*Strepsidura washingtonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 48, 49, pl. 5, figs. 81, 82, 83, 1916.

*Original description.* Shell of medium size with six and one-half whorls; spire moderately elongate and about four-fifths as long as the body whorl; body whorl sculptured with two well pronounced revolving ridges and a third one less well defined and situated anterior to the other two. Suture distinct; upper portion of body whorl tabulated and slightly concave; surface between the two revolving ridges very slightly concave; revolving ribs crossed by twelve well defined longitudinal ribs which begin upon the upper surface of whorl a short distance from the suture and extend over the entire surface until within a short distance of the end of the canal; sharp angular nodes are developed at the points where they cross the three revolving ridges; upper surface of whorl sculptured with 15 revolving threads between each of which there is a flat surfaced interspace of equal width; there are seven similar revolving threads on the middle of the whorl and

between each a very broad interspace within which is set a minute revolving thread; anterior portion contains 15 revolving threads with interspaces three times as wide. All the whorls of spire distinctly sculptured; aperture sub-elliptical; outer lip relatively thin and smooth; inner lip heavily calloused; posterior end of aperture broad; anterior end narrow and extended into an elongated and reflected canal; a well defined fasciole is present; plications are absent on inner lip. Dimensions.—Altitude of shell 34 mm.; altitude of spire 12 mm.; maximum diameter of shell 21 mm.; angle of spire 60°. (Weaver)

*Observations.* This species is closely related to *S. oregonensis* but may be distinguished from it in having a higher spire, twelve instead of nineteen longitudinal ribs, in the spacing and general character of the revolving threads, and the presence of a non-ornamented band just posterior to the siphonal fasciole at the end of the canal.

*Holotype.* (C.A.S. 465.) Figured in the present report, pl. 86, fig. 10.

*Syntype.* (C.A.S. 465-A.) Figured in the present report, pl. 86, fig. 9.

*Topotype.* (U.C. 32450.) Figured in the present report, pl. 86, fig. 11.

*Hypotype.* (U.W. 312.) Figured in the present report, pl. 86, fig. 13.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Thurston County, Washington.

*Type locality.* (U.W. 256.) In Union Pacific Railway cut one-fourth mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

#### SIPHONALIA OREGONENSIS (Dall), 1909

##### Plate 86, figure 12

*Strepsidura oregonensis* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 51, pl. 3, fig. 6, 1909.

*Original description.* Shell small, short, stout, rather heavy for its size, with five and a half whorls; last whorl much the largest, with one small and two large revolving ridges, the posterior of which tends to tabulate the whorl; edges of the whorl in front of the appressed suture slightly swollen, the space between it and the shoulder of the whorl somewhat concave; the space between the shoulder and the next anterior revolving ridge also moderately excavated, and similarly between the anterior ridge and the canal; axial sculpture of about 17 longitudinal ridges, flexuous behind the shoulder, obsolete between the spiral ridges and on the base, more or less nodulous on the spiral ridges as figured; apical whorls nearly smooth; subsequent whorls spirally sculptured with fine, more or less alternated, sometimes paired threads; canal short, flexuous, with a strong siphonal fasciole; pillar and body conspicuously callous; outer lip defective in the specimen; callosity smooth, with no trace of an umbilical chink. Altitude, 30 mm.; maximum diameter, 21 mm. (Dall)

*Observations.* This species is common in the middle Oligocene of Columbia County, Oregon. The aperture of the type is filled with rock material but other well-preserved specimens show the plications on the edge of the pillar.

*Holotype.* (U.S.N.M. 107395.) Figured in the present report, pl. 86, fig. 12.

*Geologic range.* Pittsburg Bluff beds, middle Oligocene.

*Geographic distribution.* Columbia County, Oregon.

*Type locality.* (U.W. 500.) In fine-grained brownish gray sandstone in road cut at Pittsburg Bluffs, Columbia County, Oregon.

Genus **BUCCINOFUSUS** Conrad, 1866

*Buccinofusus* Conrad, Smiths. Misc. Coll. no. 200, p. 17, 1866.

*Genotype.* *Buccinofusus diegoensis* (Gabb) = (*Tritonium diegoensis*).

**BUCCINOFUSUS TURNERI** n. sp.

Plate 89, figures 1, 2; plate 101, figure 13

*Buccinofusus* ? n. sp. Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 79, pl. 15, fig. 10, 1938.

*Description.* Shell moderately large, heavy with spire and anterior canal partly broken; spire possibly consisting of five whorls two of which are preserved; body whorl moderately inflated with pronounced rounded posterior shoulder and concave surface immediately above; whorls of spire less strongly inflated but with rounded subangularity near middle part; surface ornamented with nine longitudinal ribs which are prominent on the middle portion of body whorl, become fainter above the shoulder toward the suture, and gradually fade away on the lower third of the surface of the body whorl; moderately heavy on the entire surface of the whorls of spire which are preserved; suture slightly impressed; spiral ribs equally but not strongly developed on upper surface of body whorl between angle and suture; twelve almost equally developed but stronger flat-topped spiral ribs with slightly narrower flat-bottomed interspaces on middle third of body whorl; eight narrower rounded revolving ribs on lower third; inner lip evenly and heavily calloused but callus terminating abruptly and not extending far on to the surface of body whorl; preserved part of canal reflexed. Dimensions: Altitude of preserved part of shell, 19 mm.; height of preserved part of spire, 7.0 mm.; maximum diameter of body whorl, 9.0 mm.

*Holotype.* (U.C. 33206.) Figured in the present report, pl. 89, figs. 1, 2; pl. 101, fig. 13.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* Southwestern Oregon.

*Type locality.* (U.C. A-691.) Six hundred feet down stream from Hughes Ferry, on north bank of North Umpqua River west of Glide, Oregon. (Turner)

Genus **PARVISIPHO** Cossmann, 1889

*Parvisipho* Cossmann, Cat. Eoc., vol. 4, p. 147, 1889.

*Genotype.* *Fusus terebralis* Lamarck.

**PARVISIPHO LEWISIANA** (Weaver), 1912

Plate 86, figure 16

*Hemifusus lewisiana* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 46, pl. 1, fig. 9, 1912.

*Original description.* Shell of moderate size, elongate and fusiform; spire high and acute; whorls seven and rounded; upper two smooth with no ornamen-

tation; body whorl convex; whorls of spire slightly convex and relatively long; suture distinct. Surface ornamented by eighteen fairly distinct longitudinal ribs which are more prominent on the spire than on the body whorl; they become indistinct on lower surface of body whorl; these are crossed by nineteen distinct flat topped revolving ribs alternating with nineteen fine revolving threads. Aperture moderately large, relatively narrow; canal short and slightly deflected outwards; two indistinct plications are generally present; inner lip moderately calloused; outer lip thick and crenulated within. Dimensions.—Altitude 25 mm.; diameter 10 mm.; altitude of spire 10 mm.; angle of spire 37°. (Weaver)

*Holotype.* (U.W. 28) (C.A.S. 7575). Figured in the present report, pl. 86, fig. 16.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

#### Genus SEARLESIA Harmer, 1914

*Searlesia* Harmer, Pliocene Moll. Gt. Brit., vol. 1, p. 135, pl. 13, fig. 1 (vol. 67 of Mon. Paleon. Soc.), 1914.

*Genotype.* *Trephon costifer* S. V. Wood.

#### SEARLESIA DIRA Reeve subsp. MIOCENICA Etherington, 1931

Plate 86, figures 17, 18

*Searlesia dira* Reeve subsp. *miocenica* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 103, pl. 12, figs. 11, 18, 1931.

*Original description.* Shell fusiform, rather small for the genus, spire acute, rather slender, body whorl about the same height as spire; number of whorls more than four, the tip of the spire is broken in all specimens; sutures appressed; whorls fairly convex, with decided concavity just below the suture; this is very distinct on certain specimens while on the type it is not quite so prominent; surface of body whorl covered with fairly coarse spirals (18-20) separated by narrower interspaces which become wider towards the anterior end of the shell; the whorls of the spire have, in addition to the spiral lines, a row of axial ribs which do not apparently pass beyond the body whorl. Aperture elongate-ovate; outer lip thin; inner lip with slightly incrusted callus; columella imperforate, canal short and slightly reflexed. Dimensions:—Holotype, altitude 31.1 mm.; maximum diameter 16.0 mm. (Etherington)

*Observations.* This subspecies may be distinguished from *S. dira* in having a well-defined sutural callus and immediately above the suture a concave depressed area.

*Holotype.* (U.C. 32005.) Figured in the present report, pl. 86, fig. 17.

*Paratype.* (U.C. 32006.) Figured in the present report, pl. 86, fig. 18.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 425.) In Rock Creek one-fourth mile down stream from falls and just below old dam site, Grays Harbor County, Section 7, T. 16 N., R. 5 W.

**SEARLESIA BRANNERI** Clark and Arnold, 1923

Plate 86, figures 19, 20

*Searlesia branneri* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 159, pl. 30, figs. 3a, 3b, 1923.

*Original description.* Shell fusiform, medium in size, and fairly heavy; spire acute, about same height as body whorl; number of whorls six or seven; sutures appressed; whorls fairly regularly convex, with upper part of each whorl appressed into distinct collar. Surface covered by rather coarse spiral ribs which alternate with less prominent and narrower spiral ribbing; interspaces between major spiral ribs about equal to width of ribs; on most of specimens examined major spiral ribbing is somewhat heavier near anterior end of body whorl; eight major spiral ribs on anterior whorl of spire and sixteen on body whorl of type specimen. Surface also covered by about twelve rather prominent rounded longitudinal ribs which, on whorls of spire, extend from suture to suture; on body whorl the longitudinal ribs extend from a little below collar to about half to two-thirds distance to anterior end; on some specimens longitudinal ribbing is obsolete or nearly so. Aperture elongate-ovate; outer lip sharp, rather deeply grooved internally; inner lip with fairly heavy but narrow callus; columella imperforate; canal short and rather strongly reflexed. Dimensions: Height, about 76 mm.; greatest width of body whorl, 22.5 mm.; height of body whorl, 32.5 mm. (Clark and Arnold)

*Observations.* This species may be distinguished from *S. dira*, the Recent species which it in many respects resembles, in having a well-defined sutural collar, heavier and fewer spiral ribs, and the presence of longitudinal ribs on both spire and body whorl.

*Holotype.* (U.C. 30068.) Figured in the present report, pl. 86, figs. 19, 20.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South coast of Vancouver Island.

*Type locality.* Sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Vancouver Island.

**Genus BRUCLARKIA Trask, 1926**

*Bruclarkia* Trask, in Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 397, 398, 399, 1926.

*Genotype.* *Clavella gravida* Gabb.

**BRUCLARKIA ACUMINATA (Anderson and Martin), 1914**

Plate 87, figures 1, 2, 3, 4

*Agasoma acuminatum* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 73, 74, pl. 5, figs. 4a, 4b, 1914; Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 15, 1915; Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 11, pp. 182, 183, pl. 19, figs. 1, 3, 5, 1918; Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 160, pl. 29, figs. 1a, 1b, 2, 3a, 3b, 1923.

*Bruclarkia acuminatum* (Anderson and Martin), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 490, 491, 1931.

*Original description.* Shell rather large, fusiform; spire elevated though shorter than the mouth, with five or six whorls; whorls angulated a little below

the middle, tuberculated on the angles, flattened and sloping regularly above, flattened below; suture distinct and bordered by a wrinkled collar which is ornamented with two or three spiral threads; aperture ovate, elongated into a long recurved canal; canal moderately wide; outer lip thin and simple, not lirate within; inner lip slightly incrusted; surface of the shell ornamented with numerous revolving threads of three alternating sizes, a few of which are coarser than the others, one or two bearing tubercles on the body-whorl. Dimensions:—Altitude of the type specimen, 60 mm.; maximum latitude of the shell, 30 mm. (Anderson and Martin)

*Observations.* This species may be distinguished from *B. columbianum* in the greater length and lesser apical angle of the spire, the greater convexity and angularity of the whorls of the spire, and in the absence of three strong spiral flat-noded carinae on the body whorl.

*Holotype.* (C.A.S. 157.) Figured in the present report, pl. 87, fig. 2.

*Paratype.* (U.C. 30210.) Figured in the present report, pl. 87, fig. 1.

*Paratype.* (U.C. 30083.) Figured in the present report, pl. 87, fig. 3.

*Paratype.* (U.C. 30084.) Figured in the present report, pl. 87, fig. 4.

*Geologic range.* Middle and upper Oligocene.

*Geographic distribution.* Northwestern Oregon and south coast of Vancouver Island.

*Type locality.* Ten miles northwest of Scappoose, Oregon.

#### BRUCLARKIA COLUMBIANA (Anderson and Martin), 1914

Plate 87, figures 7, 8

*Agasoma columbianum* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 73, pl. 5, figs. 6a, 6b, 1914.

*Original description.* Shell large for the genus, conical above and below, revolute, tuberculated; spire high, having five or six conical whorls, sloping evenly to an acute apex; body-whorl angulated, carrying three rows of laterally elongated tubercles; the upper row most prominent and separated from the next row below by a concave surface; aperture ovate, broad in the middle, narrow before and extended into a moderately long recurved canal; outer lip thin and entire; inner lip incrusted; surface of the shell ornamented chiefly with revolving threads, three of which are prominent, forming the angles and elevated into tubercles; the spiral threads alternating in size and of three or four ranks, crossed at unequal intervals by sinuous lines of growth; suture broadened by thickened and wrinkled collar; canal wide and curved; the aperture is greater in length than the height of the spire. Dimensions:—Altitude of the type specimen, 56 mm.; maximum width of the shell, 40 mm.; length of the aperture, 35 to 40 mm. (Anderson and Martin)

*Observations.* This species is characterized by the mergence of the sides of all the whorls of the spire, and the upper third of the surface of the body whorl, into a nearly continuous plane. A wide apical angle, relatively short spire, and triangulation of the body whorl are other characteristics.

*Holotype.* (C.A.S. 155.) Figured in the present report, pl. 87, fig. 7.

*Hypotype.* (U.C. 32442.) Figured in the present report, pl. 87, fig. 8.

*Geologic range.* Pittsburg Bluff beds, middle Oligocene.

*Geographic distribution.* Coast Ranges of Oregon, Washington and California.

*Type locality.* (U.W. 476.) At Pittsburg Bluffs, Columbia County, Oregon, in highway cut.

## BRUCLARKIA OREGONENSIS (Conrad), 1848

Plate 86, figures 21, 22

- Fusus oregonensis* Conrad, Am. Jour. Sci., ser. 2, vol. 5, p. 433, fig. 13, 1848; Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 151, fig. 13, 1909 (reprint).  
*Priscofusus nodiferus* Conrad, U.S. Explor. Exped. Geol., pl. 20, figs. 12, 12a, 1849.  
*Sycotyphus oregonensis* Conrad, Am. Jour. Conch., vol. 1, p. 151, 1865.  
*Fusus (Priscofusus) stanfordensis* Arnold, Proc. U.S. Nat. Mus., vol. 34, p. 383, pl. 35, fig. 7, 1908.  
*Chrysodonius nodiferus* Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, p. 590, 1913.  
*Agasoma oregonense* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 74, pl. 4, figs. 3a, 3b, 1914.  
*Bruclarkia oregonense* Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 456, 1927; Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 104, 105, pl. 11, figs. 1, 3, 4, 5, 7, 1931.

*Original description.* Fusiform, with unequal prominent revolving lines, a few of which are considerably larger than the others on the upper portion of the body whorl; they are also coarser toward the base and alternated in size; shoulder with a series of tubercles; one of the larger striae on the body whorl somewhat tuberculated; a prominent line margins the suture; spire conical, the volutions reticulated and tuberculated. (Conrad)

*Original description ("Agasoma oregonense").* Shell of moderate size, fusiform; spire elevated, with seven or eight whorls; whorls angulated near the middle, flat or slightly convex above, cylindrical below, ornamented with numerous spiral threads of alternating magnitude, and irregularly raised axial lines of growth which are most pronounced on the upper whorls where they form nodes on the angulations; suture impressed; body-whorl large, ventricose, slightly constricted in front of the suture, with a rounded shoulder at the posterior third, concave above, convex below, sculptured similar to the whorls of the spire, but lacking the nodes on the shoulder; aperture ovate, outer lip simple, inner lip smooth; canal long and recurved. Dimensions:—Altitude of the type specimen, 55 mm.; width of the body whorl, 27 mm. (Anderson and Martin)

*Observations.* *B. oregonensis* is characterized by its high spire, convex, slightly angulated body whorl, angulated whorls of spire, and deeply impressed sutures.

*Hypotype* (Holotype of "Agasoma oregonense" Anderson and Martin). (C.A.S. 159.) Figured in the present report, pl. 86, fig. 21.

*Hypotype.* (U.C. 31991.) Figured in the present report, pl. 86, fig. 22.

*Geologic range.* Oligocene.

*Geographic distribution.* Eastern Columbia County, Oregon.

*Type locality.* (C.A.S. 168.) Ten miles northwest of Scappoose, Columbia County, Oregon.

## BRUCLARKIA YAQUINANA (Anderson and Martin), 1914

Plate 87, figure 6

- Agasoma yaquinanum* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 75, pl. 4, figs. 5a, 5b, 1914.

*Original description.* Shell pyriform, with five or six tabulated whorls; spire rather low; whorls angulated near the middle, flat above and below giving the shell a beautifully tabulated appearance, sculptured with eleven spiral threads, six above and five below the angle, and a large number of indistinct axial ribs which

produce sharp nodulations on the larger spiral threads and especially on the angulations; body-whorl inflated, with a broad tabulation sculptured with twelve or fourteen major spiral cords between which are three intercalary threads, the middle one of which is slightly larger than those on either side; the interspace between these secondary spirals again occupied by very fine intercalary lines; axial ribbing almost obsolete on the body-whorl except on the angulation where they form nodes; suture appressed; aperture ovate; lips smooth and simple; canal moderately long and slightly recurved; columella twisted. Dimensions:—Altitude of the type specimen, 25 mm.; maximum latitude of the shell, 14 mm. (Anderson and Martin)

*Observations.* The body whorl of this species has four moderately prominent spiral carinae, the upper of which carries prominent nodes. The longitudinal ribs are very faintly developed on the body whorl but are more prominent on the whorls of the spire.

*Holotype.* (C.A.S. 161.) Figured in the present report, pl. 87, fig. 6.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Coast of Lincoln County, Oregon.

*Type locality.* (U.W. 691.) Sandstone exposed on beach south of Yaquina Head, Lincoln County, Oregon, five and one-half miles north of entrance to Yaquina Bay.

#### BRUCLARKIA THOR Tegland, 1933

Plate 87, figures 5, 9

*Bruclarkia thor* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 130, 131, pl. 12, figs. 9, 10, 11, 12, 1933.

*Original description.* Shell small, spire medium in height, one-fourth of length of shell, whorls five or six in number. Posterior whorls cancellated owing to equal value of transverse and spiral ribbing, a small tubercle formed at each intersection; on posterior whorls transverse ribs, 18 in number, extend from suture to suture; on body whorl they begin at the suture, turn slightly to the right, and disappear on the lower portion of the whorl. Shoulder of body whorl flat, ornamented with six spirals; from shoulder angle to canal ornamented with six prominent revolving ribs, the anterior three noded; canal portion carries seven or eight flat ribs with narrow interspaces; aperture oval, narrowing into canal; canal open, slender, and straight; outer lip thin; inner lip smooth; suture appressed. Dimensions.—Holotype U.C. no. 32174, height, 13.0 mm.; diameter, 7.0 mm. (Tegland)

*Observations.* As pointed out by Tegland, *B. thor* is somewhat similar to *Whitneyella lincolnensis* (Van Winkle) but differs in that the posterior whorls are cancellated with tubercles at intersections and the body whorl is triangulate.

*Holotype.* (U.C. 32174.) Figured in the present report, pl. 87, fig. 9.

*Paratype.* (U.C. 32181.) Figured in the present report, pl. 87, fig. 5.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Kitsap County, Washington.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, opposite Seattle, Washington.

## Family THAISIDAE

Genus THAIS ("Bolten") Roeding, 1798

*Thais* Roeding, in Bolten, Mus. Boltenianum, p. 54, 1798.*Genotype.* *Thais neritoides* (Lamarck).

## THAIS LIMA (Martyn), 1788

Plate 87, figures 12, 13

*Buccinum lima* Martyn, Univ. Conch., vol. 2, pl. 46, 1788.*Purpura lima* Martyn, Anderson, Proc. Calif. Acad. Sci., ser. 3, vol. 2, p. 202, pl. 15, figs. 62, 63, 1905.*Thais lima* Martyn, Clark, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 8, p. 423, pl. 68, fig. 8, 1915.*Thais (Nucella) lima* Martyn, Dall, Proc. U.S. Nat. Mus., vol. 49, p. 566, pl. 75, figs. 4, 5, 6, 1915; Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 97, pl. 12, figs. 9, 17, 1931; Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 717, 718, pl. 32, fig. 15, 1931.

*Original description.* Shell of three and a half to four rounded whorls, not including the nucleus; moderately thick with a spire much shorter than the aperture, the last whorl much the largest; with a tolerably uniform spiral sculpture of alternated major and minor spiral cords; aperture large, outer lip not reflected and seldom thickened, more or less crenulated by the sculpture; pillar slightly arcuate, flattened anteriorly, the canal narrow and curved to the left; umbilicus sometimes sealed, at others showing a deep narrow perforation behind the callus of the reflected pillar. (Dall)

*Observations.* Specimens from the Astoria formation in Washington have been studied by Etherington, who states, "Altitude 20.4 mm.; maximum diameter 13.2 mm.; height of body whorl 15.8 mm. This species is close to *Nucella canaliculata* Duclos, forms of which apparently occur in the Miocene associated with individuals resembling *Nucella lima* Mart. All the Miocene forms have been here referred, however, to *Nucella lima*."

This species, which today lives in the Pacific Ocean at several places from Mexico northward to Alaska and Japan, shows considerable variation in shell characters. Specimens which have been identified with the living form range from middle Miocene to Recent. Specimens from the Astoria formation in the Grays Harbor area of southwest Washington are similar to those described by F. M. Anderson from beds of equal age in the Kern River area in southern California and represent the earliest appearance of forms which probably belong to this species.

*Hypotype.* (U.S.N.M. 338329.) Quillayute area. Figured in the present report, pl. 87, fig. 12.

*Hypotype.* (U.C. 32004.) Astoria formation. Figured in the present report, pl. 87, fig. 13.

*Geologic range.* Miocene to Recent (in Washington, Astoria and Quillayute formations).

*Geographic distribution.* Fossil: Coast Ranges of California and southwestern Washington. Recent: from Arctic Ocean to coast of Mexico.

*Type locality.* Nootka Sound.

*Occurrence.* King George Sound (living) (Grant and Gale); in Washington (U.W. 425), in Rock Creek, Section 7, T. 16 N., R. 5 W., Astoria formation. It occurs also in the Pliocene deposits on the western side of the Olympic Peninsula near the mouth of the Quillayute River.

#### THAIS PRECURSOR Dall, 1909

Plate 87, figures 10, 11

*Thais (Nucella) precursor* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 51, pl. 4, 1909.

*Original description.* Shell solid, subglobose, with four rapidly enlarging whorls; nucleus small, rather blunt; suture distinct, whorls evenly rounded; sculpture more or less variable but usually of simple, little-elevated spiral cords with narrower interspaces crossed by more or less evident lines of growth; aperture ovate, outer lip thickened but slightly reflected; body smooth; pillar short, concavely arcuate, moderately callous, and slightly flattened; behind the callus a narrow closed umbilical chink, and a strong, prominent, rounded siphonal fasciole; canal short, deeply indented. Altitude, 32 mm.; maximum diameter, 25 mm. (Dall)

*Observations.* This species has been considered by Grant and Gale (149-A, p. 718) as synonymous with the Recent form *Thais (Nucella) canaliculata* (Duclos). The latter shows great variation in different specimens, and *T. precursor* possibly may fall within this range.

*Holotype.* (U.S.N.M. 153995.) Figured in the present report, pl. 87, fig. 11.

*Hypotype.* (U.S.N.M. 328330.) Figured in the present report, pl. 87, fig. 10.

*Geologic range.* Pleistocene (?) beds and Empire formation.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Fossil Rock, Coos Bay. (Dall)

#### THAIS LAMELLOSA (Gmelin), 1790

Plate 88, figure 7

*Buccinum lamellosum* Gmelin, Syst. Nat. (13th ed.), p. 3498, 1790.

*Purpura lapillus* var. *quillayutea* Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 221, pl. 6, figs. 59a, 59b, 1909.

*Nucella* (?var.) *quillayutea* Reagan, Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 313, 1922.

*Thais (Nucella) lamellosa* Gmelin, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 50, 1909; Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 716, 717, pl. 32, figs. 14, 26, 1931.

*Original description* (*Purpura lapillus* var. *quillayutea* Reagan). Shell with elevated spire, extended beak, rounded volutions; volutions numbering five or six, with strongly marked suture lines, their full, rounded, ventricose forms relieving the suture; aperture large, semilunar in outline, terminating in a narrow canal below; outer lip thick; inner lip incrusted; canal a little recurved; surface sculpture mostly removed, except very fine oblique lines of growth parallel to the apertural margin. Dimensions: Alt. of body whorl, including canal, 40; width, 31; longest diameter of aperture, 33, transverse diameter, 18. (Reagan)

*Observations.* This species shows great variation. The specimens from the Quillayute formation in Washington and the Empire formation in Oregon closely resemble the description of Gmelin.

*Hypotype.* (Holotype of *Purpura lapillus* var. *quillayutea* Reagan, U.S.N.M. 328364.) Figured in the present report, pl. 88, fig. 7.

*Geologic range.* Upper Miocene to Recent (Washington, in Quillayute formation; Oregon, in Coos conglomerate).

*Geographic distribution.* Recent: from Bering Strait to southern California and Japan. Fossil forms occur in Empire formation in Oregon and the Wildcat, Merced, Purisima, Jacalitos, Etchegoin, and Pico formations in California and the Quillayute of Washington.

#### THAIS CLALLAMENSIS (Reagan), 1909

Plate 87, figure 15

*Pisiana clallamensis* Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 190, pl. 3, fig. 25, 1909.

? *Buccinum clallamensis* (Reagan), Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 309, 1922.

*Original description.* Shell of medium size, biturbinate to fusiform; spire broadly conical, elevated; whorls five or six (top of spire broken), angularly ventricose; three low angular ridges revolve on each whorl—one just in front of the suture, its posterior slope joining the suture, and two on the body of the whorl with a somewhat wide band between them; upper side of volutions obliquely sloping; lower side rounded; surface ornamented with very fine revolving lines; suture distinct; aperture oval-pyriform; outer lip thick; umbilicus perforate. Dimensions: Height of body whorl and first whorl of spire, 35; height of body whorl, 30; lat. of body whorl, 23; aperture, 22 x 14. (Reagan)

*Observations.* The type specimen of this species is badly worn and it was suggested by Dall (108, p. 309) that it might belong to the genus *Buccinum*.

*Holotype.* (U.S.N.M. 328327.) Figured in the present report, pl. 87, fig. 15.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* South shore of Strait of Juan de Fuca, Clallam County, between Clallam Bay and Pyht, Washington.

*Type locality.* Sea cliffs two miles east of the town of Clallam, Clallam County, Washington.

#### THAIS IMPERIALIS (Dall), 1909

Plate 88, figure 3

*Chrysodomus imperialis* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 42, 43, pl. 7, figs. 1, 3; pl. 18, fig. 1, 1909; Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 313, 1922.

*Neptunea maxfieldi* Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 219, pl. 6, fig. 54, 1909.

*Thais?* (*Straminata?*) *imperialis* (Dall), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 715, 716, 1931.

*Original description.* Shell globose, very thick and heavy, with four or five well-rounded rapidly increasing whorls; last whorl comprising most of the shell; surface sculptured with obscure little elevated rounded axial ridges, irregular in size and distribution, from the posterior ends of which narrow, sharp, oblique, somewhat irregular laminae extend across the suture to the preceding whorl, giving the effect of a rude fringe or series of "gathers"; posterior surface of the whorl otherwise smooth, the anterior surface in front of the periphery with little elevated, rather sparse spiral threads, which, as usual, grow coarser though not more crowded toward the canal; canal deep, very short, hardly recurved, with hardly any trace of a siphonal fasciole; aperture wide, ovate, the pillar short, thick, the body with a moderately short callus, the outer lip hardly reflected, somewhat thickened. Altitude of figured specimen, 52 mm.; maximum diameter, 42 mm. (Dall)

*Observations.* This species is fairly abundant in the sandstones and conglomerate lenses of the Montesano and Quillayute formations in Washington and also in the Empire formation in Oregon. Many of the specimens in the Montesano formation show faint spiral sculpture on all of the whorls.

*Holotype.* (U.S.N.M. 153897.) Figured in the present report, pl. 88, fig. 3.

*Geologic range.* Empire, Montesano, Quinault, and Quillayute formations, upper Miocene and lower Pliocene formations in Washington; Jacalitos, Etche-goin, and Merced formations in California.

*Type locality.* Coos Bay, Oregon, Camman collection. (Dall)

\***THAIS NEHALEMENSIS** Anderson and Martin, 1914

Plate 88, figures 1, 2

*Thais neahaleensis* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 83, 84, pl. 6, fig. 3, 1914.

*Original description.* Shell solid, fusiform with about six whorls; spire moderately elevated; apex acute; whorls of the spire concave with a raised anterior margin or collar which is ornamented with twelve to fourteen prominent nodes, the nodes partly obscured by the overlapping of the succeeding whorl; concave area smooth or marked by very fine spiral lines; suture indistinct due to the overlapping of the whorls; body-whorl large, more than three-fourths the total length of the shell, angulated near the middle, concave above, ornamented with thirteen prominent nodes and numerous revolving threads of three or more ranks which alternate regularly; nodes most prominent at the angle, fading out above and on the anterior portion of the whorl; the spiral threads most prominent on the nodose area; aperture oval, outer lip simple, inner lip incrusted, smooth; posterior sinus broad and shallow; canal short and broad, recurved. Dimensions:—Length of the shell, 33 mm.; maximum diameter of the body-whorl, 19 mm.; length of the aperture and canal, 21 mm.; width of the aperture, 8 mm. (Anderson and Martin)

*Observations.* The general appearance of this species differs from the other species of the genus recorded from Oregon and Washington. The principal characters of form are the subfusiform shape, relatively high spire, subangulate contour of middle border of body whorl, and concave upper surface above the angle.

*Holotype.* (C.A.S. 183.) Figured in the present report, pl. 88, figs. 1, 2.

*Geologic range.* Middle Oligocene.

\* Research after this paper was in page proof indicates that this species belongs to the genus *Nckewis*.

*Geographic distribution.* Columbia County, Oregon.

*Type locality.* Ten miles northwest of Scappoose, Columbia County, Oregon.

**THAIS CORNWALLI** Clark and Arnold, 1923

Plate 88, figures 4, 6

*Thais cornwalli* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 162, pl. 31, figs. 1, 2, 3, 1923.

*Original description.* Shell medium in size, fairly heavy whorls probably five or six in number, apex lacking on all specimens at hand. All whorls angulated; angulation on body whorl the most prominent and about one-third the distance from suture to anterior end of canal; surface above angulation is almost flat to slightly concave and slopes up rather steeply to suture, below which it is gently convex down to canal. Surface sculptured by heavy spiral ribs which, on specimens at hand, are well preserved only on body whorl on and below angle; six major ribs on body whorl separated by interspaces of about width of ribs; a minor riblet in most interspaces; above angulation five or six ribs which are not so heavy nor so wide as those below. Aperture not exposed; canal short, slightly reflexed; columella subperforate. Dimensions: Height (body whorl and first whorl of spire only) 28 mm.; greatest width of body whorl, 14 mm. (Clark and Arnold)

*Observations.* This species is characterized by a few heavy rounded spiral ribs with interspaces of about equal width, each containing a small but well-defined secondary spiral rib. An extra heavy spiral rib occupies the revolving angle at the base of the upper third of this surface of the body whorl. The maximum diameter of the body whorl is proportionately greater than in *Thais neahemensis*.

*Syntypes.* (U.C. 30229) (C.A.S. 579). Figured in the present report, pl. 88, figs. 4, 6.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South shore Vancouver Island.

*Type locality.* Sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Vancouver Island.

Genus **SISTRUM** Montfort, 1810

*Sistrum* Montfort, Conch. Syst., vol. 2, pp. 594, 595, 1810.

*Genotype.* *Sistrum album* Montfort == "Buccinum echinatum" Lamarck."

**SISTRUM HANNAI** Howe, 1922

Plate 87, figures 14, 16

*Sistrum hannai* Howe, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 102, pl. 8, figs. 1, 5, 1922.

*Original description.* Shell very thick, heavy; spire low and sharp; suture indistinct; body whorl inflated, ornamented with about twenty-one low, flat, spiral ribs; outer lip heavily thickened and inner surface of outer lip ornamented with a heavy bifid tooth. Canal short and deep; umbilicus well defined, subperforate. (Howe)

*Observations.* This species is the only representative of the genus in Oregon and Washington. The heavy shell, narrow aperture, bifid tooth

just above the center of the outer lip, and relatively low spire serve to distinguish this form from other species of the Empire formation.

*Holotype.* (C.A.S. 576.) Figured in the present report, pl. 87, figs. 14, 16.

*Geologic range.* Coos conglomerate, Empire formation, Pliocene.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Fossil Point, three miles south of Empire City, Coos County, Oregon.

#### Genus RAPANA Schumacher, 1817

*Rapana* Schumacher, Ess. Nouv. Syst. Hab. Vers Test., pp. 65, 214, 1817.

*Genotype.* *Rapana besoar* Linnaeus.

#### RAPANA PERRINI Clark and Arnold, 1923

##### Plate 88, figure 5

*Rapana perrini* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 161, 162, pl. 31, fig. 7, 1923.

*Original description.* Shell small, fusiform; apex acute; number of whorls five or six. Sutures rather strongly appressed. Body whorl broad, about height of shell, biangulate; surface of whorl between upper angulation and suture steep and slightly concave; a series of about ten or twelve fairly coarse longitudinal ribs between angulations. Tendency of ribbing to become heavier on angles gives shell a noded appearance. Surface of whorl below angulation gently concave. Two or three heavy spiral ribs on anterior portion of canal. Aperture ovate, outer lip apparently thin; inner lip flattened and covered by a heavy callus. Canal short, straight, and closed. Dimensions: Height, 12 mm.; greatest width of body whorl, 9 mm. (Clark and Arnold)

*Observations.* The holotype of this species is the only known specimen in the Pacific Northwest, although the genus lives off the coast of China. This relatively small species is characterized by its biangulate body whorl, steeply sloping nearly straight surface between suture and upper angle of whorl, low spire, and spiral ribbing on anterior part of body whorl and canal.

*Holotype.* (U.C. 30211.) Figured in the present report, pl. 88, fig. 5.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South shore of Vancouver Island.

*Type locality.* Sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

#### Family MURICIDAE

#### Genus PURPURA Martyn, 1784

*Purpura* Martyn, Univ. Conch., vol. 2, pl. 66, 1784.

*Genotype.* *Purpura foliata* Martyn.

**PURPURA FOLIATA Martyn, 1784**

Plate 88, figure 10

*Purpura foliata* Martyn, Univ. Conch., vol. 2, pl. 66, 1784.  
*?Aporrhais (Aporrhoges) quillayutensis* Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 226, pl. 6, fig. 65, 1909.

*Purpura foliata* Martyn, Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 314, 1922.

*Purpura (Purpura) foliata* Martyn, Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 705, 1931.

*Description* ("*Aporrhais (Aporrhoges) quillayutensis*" Reagan). Volutions five or more, convex; suture distinct; body whorl large, thick, lip expanded, terminating in a single posterior large, lobe-like extension; anterior sinus nearly obsolete; posterior canal very short and obtuse; surface sculpture unknown (a few fragments of the shell on the cast seem to indicate that it was smooth); inside of outer lip ridged, the ridges radiating outward. Dimensions: Axial length, more than 60; breadth of body volution, including lip, 45; extension of lip, 21. (Reagan)

*Observations.* The genotype *Purpura foliata* was figured by Martyn but not described. The species from the Quillayute formation in Washington described and figured by Reagan later was considered by Dall to be identical with *Purpura foliata*. The specimen figured in this paper is Reagan's holotype described as *?Aporrhais (Aporrhoges) quillayutensis* (U.S.N.M. 328373).

*Geologic range.* Quillayute formation and Recent.

*Geographic distribution.* Recent, southern California to Alaska; Pliocene, western side of Olympic Peninsula.

*Type locality.* Sitka, Alaska. Recent.

**PURPURA PERPONDEROSA Dall, 1909**

Plate 88, figure 8

*Purpura perponderosa* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 46, pl. 2, figs. 2, 6, 1909.

*Original description.* Shell large, very heavy, with about four whorls exclusive of the nucleus; with three thick varices continuous up the spire, probably sharp edged when intact, but rounded by wear in the type specimen; spiral sculpture of (on the early whorls two, on the last whorl four or five) distant, moderately elevated, spiral cords; aperture large, the outer lip denticulate within, with a projecting spine or tooth anteriorly; body with a callous deposit, canal short, nearly closed, sutures obscure. Altitude, 73 mm.; maximum diameter, 41 mm. (Dall)

*Observations.* Dall considers this species the precursor of *P. foliata* Martyn. The body whorl has a proportionately lesser diameter and the upper surface of the body whorl merges somewhat into the surface of the spire in contrast to the sharper indentation between body whorl and spire in *P. foliata*.

*Holotype.* (U.S.N.M. 107778.) Figured in the present report, pl. 88, fig. 8.

*Geologic range.* Empire formation.

*Geographic distribution.* Coos Bay, Oregon.

*Type locality.* Coos Bay, Camman collection. (Dall)

Genus **UROSALPINX** Stimpson, 1865

*Urosalpinx* Stimpson, Am. Jour. Conch., vol. 1, pt. 1, p. 58, February 25, 1865.

*Genotype.* *Fusus cinereus* Say.

**UROSALPINX TEJONENSIS** (Weaver), 1912

Plate 88, figure 13

*Hemifusus tejonensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 47 (not figured), 1912.

*Urosalpinx tejonensis* (Weaver), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 8, figs. 5a-d, 1915; B. L. Clark, Bull. Geol. Soc. Am., vol. 49, p. 717, 1938.

*Original description.* Shell of moderate size, robust; spire moderately low; whorls seven and very slightly convex; upper portion of body whorl very slightly concave; suture not very distinct and slightly sinuous. Surface ornamented by fifteen fairly well developed longitudinal ribs which are most prominent on middle portion of whorl. They are not present on the extreme upper and lower portions. These ribs are crossed by eighteen prominent revolving ribs, alternating with as many minor revolving threads. Low nodes are present on middle six or seven revolving ribs at the intersections with the longitudinal ribs. Aperture moderately broad, acute at posterior and anterior ends; canal straight; inner lip smooth and much calloused; outer lip thin. Dimensions.—Altitude 28 mm.; diameter 16 mm.; altitude of spire 7 mm.; angle of spire 63°. (Weaver)

*Observations.* *Urosalpinx tejonensis* (Weaver) was described but not figured in 1912. The type upon which the description was based later was placed in the museum of the California Academy of Sciences and the specimen was figured by Dickerson (121, pl. 8, fig. 5b) as a cotype under the genus *Urosalpinx*.

*Holotype.* (U.W. 30) (C.A.S. 321). Figured in the present report, pl. 88, fig. 13.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

**UROSALPINX HANNIBALI** Dickerson, 1915

Plate 88, figure 14

*Urosalpinx hannibali* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pp. 69, 70, pl. 9, figs. 7a, 7b, 1915.

*Original description.* Shell fusiform with ten beautiful nearly continuous rounded axial ribs; whorls seven or eight in number, very convex and decorated by spiral lines which alternate in strength and by rounded ribs; aperture rounded, suddenly contracted below into a short, narrow, twisted canal; inner lip slightly calloused. Dimensions:—Length, 16 mm.; width of body whorl, 8 mm. (Dickerson)

*Observations.* This species occurs in the Cowlitz formation, locality (U.W. 232) along with *U. tejonensis*. It may be distinguished from

the latter by less numerous and much finer spiral ribs, stronger longitudinal ribs which extend from suture to suture, lesser diameter of the body whorl as well as the whorls of the spire, and a lack of subangulation of the whorls which is present on *U. tejonensis*.

*Holotype.* (C.A.S. 334.) Figured in the present report, pl. 88, fig. 14.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

#### **UROSALPINX** sp. Effinger, 1938

Plate 88, figures 11, 12

*Urosalpinx* n. sp. Effinger, Jour. Paleon., vol. 12, p. 383, pl. 46, figs. 19, 26, 1938.

*Original description.* Shell small, heavy; body whorl moderately convex, decorated by eight prominent longitudinal ribs, which extend the full length of the body whorl, and crossed by about 30 fine spiral ribs which are separated by peculiarly punctate narrow intercostal areas; aperture ovate; outer lip bearing about five denticles; canal moderately short, slightly reflected, umbilicus partially open; spire unknown. Dimensions: hypotype 33596, altitude of body whorl 14.4 mm., maximum diameter 9.3 mm. (Effinger)

*Observations.* The specimens described from the Gries Ranch beds are defective and lack the spire. The spiral ornamentation on the body whorl resembles more closely that of *U. hannibali* and *U. tejonensis* but the body whorl does not suddenly contract into the short and straight canal.

*Holotype.* (U.C. 33596.) Figured in the present report, pl. 88, figs. 11, 12.

*Geologic range.* Gries Ranch beds, lowermost Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South side Cowlitz River near old Gries Ranch in northeast quarter of Section 25, T. 11 N., R. 2 W.

#### Genus MUREX Linnaeus, 1758

*Murex* Linnaeus, Syst. Nat. (10th ed.), p. 746, 1758.

*Genotype.* *Murex tribulus* Linnaeus.

#### **MUREX COOSENSIS** Turner, 1938

Plate 88, figure 19

*Murex (Alipurpura) coosensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 80, pl. 15, fig. 25, 1938.

*Original description.* Shell small, thick; fusiform; protoconch small; spire less than half the total length; early whorls with seven axial ribs which decrease in number on the later whorls to form three varices; approximately 17 spiral ribs

between the suture and end of the canal; canal intermediate in length; aperture not known. (Turner)

*Observations.* This species may be distinguished by the well-developed, sharp, elongate varices on the anterior whorls.

*Holotype.* (U.C. 33179.) Figured in the present report, pl. 88, fig. 19.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-836.) Middle fork of Coquille River opposite Roseburg-Coos Bay Highway Survey station 845 + 33.

#### MUREX PACKARDI Dickerson, 1915

Plate 88, figures 17, 18

*Murex packardi* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 69, pl. 9, figs. 6a, 6b, 1915.

*Original description.* Shell of medium size, fusiform, with five decidedly convex whorls; varices about three to each whorl but irregularly spaced; varices very characteristically ruffled; about twelve large, rugose, spiral lines cross the slightly sinuous varices; two well marked axial, nodose ribs found between the varices on body-whorl; canal nearly closed, narrow, twisted slightly to right. Dimensions:—Length, 41 mm.; width of body-whorl, 25 mm. (Dickerson)

*Observations.* This species may be distinguished from *M. cowlitzensis* by its more convex body whorl, lack of strong spiral angulation, heavier and more ruffled varices, heavier callus on inner lip, and proportionately higher spire.

*Holotype.* (C.A.S. 333.) Figured in the present report, pl. 88, figs. 17, 18.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality* (U.W. 232.) North bank Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

#### MUREX COWLITZENSIS Weaver, 1912

Plate 88, figures 9, 15

*Murex cowlitzensis* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 49, pl. 1, fig. 7, 1912.

*Original description.* Shell of moderate size, heavy and spinous; spire short; whorls six, angulated and with six varices continuous on all whorls; angle situated on upper third of body whorl; surface below angle very slightly concave; surface above straight and sloping upward at a low angle; angle between upper and lower surfaces of whorl 78°; suture impressed and distinct. Whorls of spire flattened. Surface ornamented with fifteen revolving ribs each of which is separated from the adjoining one by two very small closely set revolving striae. At the intersection of angle and varices large rough spines are developed. Aperture broad, oval, nearly closed at anterior end and extending nearly to the end of canal. Canal long, heavy and bent; inner lip heavily calloused; outer lip moderately thick. Dimensions.—Altitude 40 mm.; diameter 28 mm.; altitude of spire 11 mm.; angle of spire 80°. (Weaver)

*Observations.* This species is characterized by its strong angulation of the body whorl, large diameter of body whorl at angulation, well-defined sharp and bladelike varices which are not greatly ruffled, and nodes at intersections of varices and carina on angulated part of body whorl.

*Holotype.* (U.W. 33) (C.A.S. 7595). Figured in the present report, pl. 88, figs. 9, 15.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader in Section 28, T. 28 N., R. 2 W.

#### MUREX SOPENAHENSIS Weaver, 1912

Plate 88, figure 16; plate 89, figures 3, 4

*Murex sopenahensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 48, 49, pl. 1, fig. 8, 1912.

*Original description.* Shell moderately large, heavy and somewhat spinose; spire moderately high; whorls nine and angular; body whorl with revolving angle at base of upper third of whorl; surface above this angle straight to slightly convex; surface below angle slightly convex. Surface sculptured by eight prominent revolving ribs below the angle and between each two there are three minor revolving threads; above the angle there are ten small, but well developed revolving threads. Varices are present but weakly developed. On the angle at the intersections with the varices are flattened or spinose nodes; sometimes these are present on the varices a short distance below the angle. Angle formed by upper and lower surfaces of the body whorl is 88°. Aperture broad and oval and narrowing a short distance from anterior end of canal. Canal long and bent; inner lip smooth and calloused; outer lip moderately thin. Dimensions.—Altitude to broken end 28 mm.; diameter 19 mm.; altitude of spire 11 mm.; angle of spire 63°. (Weaver)

*Observations.* This species is characterized by its angulated body whorl, sharp flat spines on angle, only faintly developed varices, relatively thin callus on inner lip, and fairly heavy spiral lines of growth.

*Holotype.* (U.W. 32) (C.A.S. 495). Figured in the present report, pl. 88, fig. 16.

*Hypotype.* (U.W. 32-A) (C.A.S. 495-A). Figured in the present report, pl. 89, fig. 4.

*Hypotype.* (U.W. 32-B) (C.A.S. 495-B). Figured in the present report, pl. 89, fig. 3.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader in Section 28, T. 11 N., R. 2 W.

**MUREX CALAMITUS Hanna, 1924**

Plate 89, figures 8, 9

*Murex vaughani* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 174, pl. 30, figs. 3a, 3b, 1917.

*Murex calamitus* Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 13, p. 172, 1924.

*Trophon calamitus* (Hanna), Effinger, Jour. Paleon., vol. 12, pp. 382, 383, pl. 47, fig. 32, 1938.

*Original description.* Shell small; body whorl marked by five lamella-form flexuous ribs which extend the entire length of the whorl; these ribs developing nodes twisted toward the right at the shoulder, located a short distance below a sinuous suture; aperture oval, above, narrower, below. Dimensions:—Length of the body-whorl of type, 12 mm.; width of body-whorl, 11 mm. (Dickerson)

*Observations.* This species is distinct from the other species of the genus in Oregon and Washington. It is characterized by its elevated spire, sharply angulated whorls, only faintly developed spiral ribs, and very strong and sharp varices which at the angle on the body whorl are twisted toward the right.

*Holotype.* (C.A.S. 412.) Figured in the present report, pl. 89, fig. 8.

*Hypotype.* (U.C. 33615.) Figured in the present report, pl. 89, fig. 9.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch in northeast quarter of Section 25, T. 11 N., R. 2 W.

**Family BUCCINIDAE****Genus PSEUDOLIVA Swainson, 1840**

*Pseudoliva* Swainson, Treat. Malac., pp. 82, 306, text fig. 3a, 1840.

*Genotype.* *Pseudoliva plumbea* Chemnitz.

**PSEUDOLIVA KIRBYI Clark, 1938**

Plate 89, figure 7

*Pseudoliva inornata* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 62, pl. 7, figs. 1b, 1c (not 1a), 1915.

*Pseudoliva kirbyi* Clark, Bull. Geol. Soc. Am., vol. 49, pp. 709, 710, pl. 4, figs. 3, 4, 1938.

*Original description.* Shell with a low, rather acute spire which has a small, smooth, loosely coiled helicoid protoconch of about two whorls, below which the main part of the shell is made up of three whorls; sutures appressed, surface of body whorl for a short distance below suture slightly concave; below this is a rather strong narrow zone of convexity which forms a subangulation; anterior to this the anterior-posterior profile of the whorl is only slightly convex. The anterior two whorls of the spire are ornamented by a series of moderately heavy but somewhat indistinct longitudinal ribs which reach from suture to suture; this ribbing is obsolete on the body whorl; surface of shell otherwise smooth except for the sinus groove which is a little anterior to the middle of the body whorl; aperture narrow, elongate, subovate; outer lip thin, inner lip covered by a fairly

heavy callus; umbilical fasciole lacking; anterior siphonal notch fairly deep. Dimensions: holotype 12476, height 14.4 mm., height of aperture 11.6 mm., greatest width of body whorl 9.0 mm.; paratype 12477, height 15.0 mm., height of aperture 11.5 mm., greatest width of body whorl 8.8 mm. (Clark)

*Observations.* Clark, who described this species from the Markley formation, noted that specimens from the Cowlitz formation figured by Dickerson on pl. 7, figs. 1b and 1c as *P. inornata* Dickerson are equivalent to *P. kirbyi* Clark. It differs in the lesser tumidity of the body whorl and in having better defined axial ribbing on the spire. It also lacks the heavy siphonal fasciole and recurved ridge.

*Hypotype.* (C.A.S. 307.) Locality (U.W. 232.) Figured by Dickerson (121, pl. 7, fig. 1b) as *P. inornata*. Figured in the present report, pl. 89, fig. 7.

*Geologic range.* Markley and Cowlitz formations, upper Eocene.

*Geographic distribution.* Coast Ranges of middle California and lower Cowlitz Valley, Washington.

*Type locality.* Markley formation, California, at locality (U.C. A-1297). From sandstone cliff on northeast bank of Pleasant Creek three-fourths of a mile east of B.M. 257. Occurs also in Washington at locality (U.W. 232) in west bank and cliff of Cowlitz River 1000 feet below bend, in Section 28, T. 11 N., R. 2 W. (Cowlitz formation).

#### PSEUDOLIVA DILLERI Dickerson, 1914

Plate 89, figures 5, 6, 10, 11, 12

*Pseudoliva dilleri* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 122, 123, pl. 12, figs. 1a-d, 1914; Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 77, 78, pl. 18, figs. 7, 8, 1938.

*Original description.* Shell biconical; whorls five; spire of moderate height, with conical nodose whorls; suture wavy, indistinct, and bordered by a nodose rim on the succeeding whorl; body-whorl marked by two angulations, both being nodose, but the lower one the stronger; a nearly flat, narrow horizontal space just below the suture rim, this area marked, in addition to spiral lines, by the backward bending lines which mark the former position of a sharp V-shaped posterior sinus; a slightly nodose shoulder terminating this narrow shelf sloping downward to a point a third the length of the body-whorl where another occurs; this second angulation ornamented by prominent rounded tubercles about twelve in number; space between this angulation and the end of the short, slightly-twisted canal marked in its midportion by a deeply impressed groove and by numerous fine spiral lines; a persistent ribbon-like band, much wider than the space between these spiral lines, about half-way between the tuberculated shoulder and the median groove. This line occurs on most specimens. Dimensions: Length, 34 mm.; width of body-whorl, 29 mm. (Dickerson)

*Observations.* As pointed out by Dickerson, this species differs from *P. volutaeformis* Gabb by its biangulate body whorl, and the larger number of strong banded spiral ribs and nodes.

*Holotype.* (C.A.S. 248.) Figured in the present report, pl. 89, fig. 5.

*Topotype.* (U.C. 33268.) Locality (U.C. A-662). Figured in the present report, pl. 89, figs. 6, 10.

*Topotype.* (U.C. 33679.) Locality (U.C. A-667.) Figured in the present report, pl. 89, figs. 11, 12.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-667.) At junction of Umpqua and Little rivers, Douglas County, Oregon.

#### PSEUDOLIVA UMPQUAENSIS Turner, 1938

Plate 89, figure 13

*Pseudoliva ? umpquaensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 78, pl. 18, figs. 9, 10, 1938.

*Original description.* Shell moderate in size, piriform, spire low, shoulder smooth, rounded; anterior half of body whorl below the shoulder ornamented by fine spiral lines; suture impressed, paralleled by fine revolving threads which disappear shortly posterior to the shoulder; typical *Pseudoliva* medial spiral groove obsolete or lacking. (Turner)

*Observations.* This species is characterized by an impressed instead of appressed suture. It may be distinguished from *P. inornata* by a shorter spire and the absence of the medial spiral groove.

*Syntype.* (U.C. 33175.) Figured in the present report, pl. 89, fig. 13.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-671.) In north bank of Umpqua River from the bend a quarter of a mile north of Glide to Budley Creek.

#### PSEUDOLIVA VOLUTAEFORMIS Gabb, 1864

Plate 89, figure 20; plate 103, figure 5

*Pseudoliva volutaeformis* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 99, 223, pl. 28, fig. 212, 1864; Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 400, pl. 29, fig. 7, 1926 (synonymy).

*Original description.* Shell thick, robust, resembling in shape the subgenus *Athleta* of the *Volutae*. Spire elevated, acute; whorls five and a half, sloping; suture irregular; body whorl sloping inwards convexly. Aperture long, rather narrow, biangular above, deeply notched below; outer lip simple, acute; inner lip heavily incrusted; columella slightly twisted in advance. Surface ornamented by a row of prominent, compressed tubercles on the angle of the body whorl, and below this by a series of revolving, impressed lines, faint above the median groove, more distinct below. (Gabb)

*Observations.* This species closely resembles *P. dilleri* but lacks the fine spiral ribs on the middle surface of the body whorl.

*Lectotype.* (P.A.N.S. 4201 Stewart.) Figured in the present report, pl. 103, fig. 5.

*Hypotype.* (U.C. 15410.) Figured in the present report, pl. 89, fig. 20.

*Geologic range.* Tejon and Cowlitz formations, upper Eocene.

*Geographic distribution.* Coast Ranges of California and lower Cowlitz Valley, Washington.

*Type locality.* Near old Fort Tejon, Grapevine Canyon, Kern County, California.

**PSEUDOLIVA PACKARDI** Van Winkle, 1918

## Plate 89, figure 26

*Pseudoliva packardi* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 90, pl. 7, fig. 16, 1918.

*Original description.* Shell minute, smooth and moderately thick; whorls four in number; spire very inconspicuous; body whorl swollen; suture linear and indistinct; aperture elongate, narrow at posterior end but gradually increasing in width toward the anterior end where it merges into a very short canal, which is slightly notched. Dimensions.—Altitude of shell 4 mm.; altitude of spire 75 mm.; maximum diameter of shell 2 mm.; angle of spire 82°. (Van Winkle)

*Observations.* This minute species is characterized by its lack of ornamentation, its nearly straight inner lip, very short spire, and very short anterior canal.

*Holotype.* (U.W. 144) (C.A.S. 7607). Figured in the present report, pl. 89, fig. 26.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch in northeast quarter of Section 25, T. 11 N., R. 2 W.

## Family PYRENIDAE

## Genus AMPHISSA H. and A. Adams, 1853

*Amphissa* H. and A. Adams, Gen. Rec. Moll., vol. 1, p. 111, 1853.

*Genotype.* *Buccinum corrugatum* Reeve.

**AMPHISSA DESCEPTA** (Etherington), 1931

## Plate 89, figure 19

*Columbella descepta* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 101, pl. 14, figs. 6, 11, 15, 1931.

*Original description.* Shell small, spire moderately high, acute, whorls about five; nuclear portion obscure; suture distinct; sculpturing consisting of fine revolving lines crossed by faint axial lines; aperture elongate about equal to one third the total height of the shell; outer lip showing slight thickening near middle and faint notch near the suture. Inner lip smooth, slightly calloused; pillar short, canal moderately open. Dimensions.—Type U.C. no. 32055, altitude 13.5 mm.; maximum diameter 7.0 mm. (Etherington)

*Observations.* This small shell possesses a moderately long anterior canal and faint reticulate sculpture.

*Holotype.* (U.C. 32055.) Figured in the present report, pl. 89, fig. 19.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Southwestern Washington.

*Type locality.* (U.C. 416.) On abandoned spur of Clemons logging road one-fourth mile north of main junction of main line on point of first curve of road. Section 25, T. 11 N., R. 7 W.

## Family NASSARIIDAE

## Genus NASSARIUS Dumeril, 1806

*Nassarius* Dumeril, Zool. Analytique, p. 166, 1806.

*Genotype.* *Buccinum arcularia* Linnaeus.

## NASSARIUS ARNOLDI (Anderson), 1905

## Plate 89, figure 14

*Nassa arnoldi* Anderson, Proc. Calif. Acad. Sci., ser. 3, vol. 2, p. 204, pl. 16, figs. 70, 71, 1905.

*Nassarius (Hima) arnoldi* (Anderson), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 99, pl. 12, figs. 15, 19, 1931.

*Nassarius (Usita) arnoldi* (Anderson), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 679, 1931.

*Original description.* Shell small, acutely ovate; spire moderately elevated, bearing 5 whorls; aperture circular, outer lip always bordered by a thickened varix; columella short, bearing only a slight, or no sulcus; surface ornamented by spiral and longitudinal ridges forming a reticulation as in the young of *N. penguinis* Hds. (Anderson)

*Observations.* This species is characterized by its small size, symmetrical shape, short columella, and poorly developed sulcus.

*Holotype.* Lost.

*Hypotype.* (U.C. 32012.) Figured in the present report, pl. 89, fig. 14.

*Geologic range.* Temblor and Astoria formations, middle Miocene.

*Geographic distribution.* Eastern and western borders of southern San Joaquin Valley, California, and Grays Harbor County, Washington.

*Type locality.* Kern River, California. In Washington at locality (U.W. 425) on Rock Creek in Section 7, T. 16 N., R. 5 W.

## NASSARIUS ANDERSONI (Weaver), 1912

## Plate 89, figures 15, 16, 17, 18

*Nassa andersoni* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 75, pl. 6, fig. 56, 1912.

*Nassarius (Hima) andersoni* (Weaver), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 100, pl. 12, figs. 4, 16, 1931.

*Original description.* Shell small and symmetrical; spire moderately high; body whorl somewhat inflated; surface of body whorl evenly convex; suture distinct; linear end slightly impressed; aperture elliptical to oval; columella very short and sharply bent backwards with a distinct, though not especially deep, sulcus; inner lip incrusted; outer lip with well developed varix. Surface sculptured with especially well developed longitudinal and revolving ribs; body whorl with twenty-two equally developed and equally spaced longitudinal ribs, crossed by eight equally spaced and equally developed flat topped revolving ribs with flat-bottomed interspaces of double width; these are equally prominent between the longitudinal ribs as well as upon them. Dimensions.—Altitude 9 mm.; diameter 4.5 mm.; altitude of spire 4 mm.; angle of spire 50°. (Weaver)

*Observations.* This species occurs in great numbers in the Astoria formation in the Grays Harbor area and is one of the characteristic forms

of those beds. It resembles somewhat *N. arnoldi* but differs in its more inflated outer lip, coarser reticulate ornamentation, and in having more prominent but fewer longitudinal ribs which extend across the entire surface of the whorls from suture to suture.

*Holotype.* (U.W. 75) (C.A.S. 538). Figured in the present report, pl. 89, fig. 15.

*Hypotype.* (U.C. 32015.) Figured in the present report, pl. 89, figs. 16, 17, 18.

*Geologic range.* Montesano formation, upper Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 117.) In bank of Wishkah River, Grays Harbor County, Washington, Section 30, T. 20 N., R. 8 W.

#### NASSARIUS LINCOLNENSIS (Anderson and Martin), 1914

##### Plate 89, figure 25

*Nassa lincolnensis* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 77, pl. 7, figs. 14a, 14b, 1914.

*Original description.* Shell small, globose, with four or five rather rapidly enlarging whorls; spire of medium height; apex blunt; whorls tabulated, convex, sculptured with three spiral bands between which are equal interspaces, and twelve axial ribs separated by wider interspaces; the intersection of the axial and spiral ribs producing nodes which are most prominent on the angle of the whorls; body-whorl convex, with sixteen axial ribs and eight flat topped spiral bands, the whole surface finely spirally striate; aperture ovate; outer lip simple; inner lip incrusted; columella very short with a distinct anterior sulcus. Dimensions:—Altitude, 10 mm.; diameter of the last whorl, 6 mm. (Anderson and Martin)

*Observations.* This species is characterized by its tabulated whorls, reticulated ornamentation with nodes at the intersection of longitudinal and spiral ribs, and short columella.

*Holotype.* (C.A.S. 167.) Figured in the present report, pl. 89, fig. 25.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Oregon coast, Lincoln County, Oregon.

*Type locality.* (U.W. 691.) South side of Yaquina Head, coast of Oregon, five and one-half miles north of entrance to Yaquina Bay.

#### Genus TRITIARIA Conrad, 1865

*Tritiaria* Conrad, Am. Jour. Conch., vol. 1, p. 21, 1865.

*Genotype.* *Buccinum mississippiensis* Conrad.

#### Subgenus Antillophos Woodring, 1928

*Antillophos* Woodring, Carnegie Inst. Wash., Publ. no. 385, p. 259, 1928.

*Subgenotype.* *Cancellaria candei* d'Orbigny.

**TRITIARIA (ANTILLOPHOS) DUMBLEI (Anderson) var. CHEHALISENSIS (Weaver), 1916**

Plate 89, figures 23, 24, 29, 30

*Nassa chehalensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 46, pl. 5, figs. 69, 70, 1916.*Tritiaria (Antilophos) dumblei* var. *chehalensis* (Weaver), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 100, 101, pl. 12, figs. 6, 21, 22, 1931.

*Original description.* Shell small and elongate-ovate; whorls five in number and convex; suture impressed; surface of body whorl ornamented with thirty equally spaced revolving ribs which are crossed by ten equally developed longitudinal ribs; as a result the surface has a reticulated appearance; aperture narrow; outer lip thick and inner surface crenulated; inner lip slightly callused; columella short with no sulcus at anterior end. Dimensions.—Altitude of shell 13 mm.; altitude of spire 6 mm.; maximum diameter of shell 5 mm.; angle of spire 45°. (Weaver)

*Observations.* This variety is closely related to *Tritiaria dumblei* but differs in being a shorter and heavier shell with a larger apical angle of the spire and shorter columella.

*Holotype.* (U.W. 108) (C.A.S. 564). Figured in the present report, pl. 89, fig. 24.

*Hypotype.* (U.C. 32010.) Figured in the present report, pl. 89, fig. 23.

*Hypotype.* (U.C. 32008.) Figured in the present report, pl. 89, figs. 29, 30.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 230.) A cut in North River branch of Chicago, Milwaukee and St. Paul Railway in Section 27, T. 17 N., R. 8 W.

**Genus MOLOPOPHORUS Gabb, 1869**

*Molopophorus* Gabb, Geol. Surv. Calif. Paleon., vol. 2, pp. 156, 157, 1869.

*Genotype.* *Bullia (Molopophorus) striata* Gabb.

**MOLOPOPHORUS ANTIQUATUS (Gabb), 1864**

Plate 89, figures 31, 32; plate 103, figure 12

*Nassa antiquata* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 97, pl. 18, fig. 50, 1864.

*Molopophorus antiquatus* (Gabb), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 390, 391, pl. 28, fig. 4, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 77, pl. 15, fig. 11, 1938.

*Original description.* Shell thin, proportionally broader than the preceding species; whorls five, rounded, suture impressed. Surface ornamented by fine longitudinal ribs, almost linear and numerous, crossed by revolving impressed lines, closely placed above, more distant below. Aperture ovate, very narrowly rounded posteriorly; columella very slightly incrusted, broad; canal but slightly recurved. Length of the specimen, 0.7 inch; probable length when perfect, 0.8 inch. (Gabb)

*Observations.* This species may be distinguished from *M. bretzi* by the presence of moderately developed fine spiral ribs. The sutures also are somewhat more depressed than on the Cowlitz species.

*Holotype.* (P.A.N.S. 4198.) Figured in the present report, pl. 103, fig. 12.

*Hypotype.* (U.C. 33246.) Figured in the present report, pl. 89, figs. 31, 32.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-836.) Middle Fork of Coquille River opposite Roseburg-Coos Bay Highway Survey station 845 + 33.

#### **MOLOPOPHORUS CALIFORNICUS Clark and Woodford subsp. *LONSDALEI* Turner, 1938**

Plate 89, figure 28

*Molopophorus californicus* Clark and Woodford subsp. *lonsdalei* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 77, pl. 15, figs. 7, 8, 1938.

*Original description.* Shell small, fusiform; spire approximately half the total length, apical angle between 35 and 40 degrees; suture impressed with heavy collar anterior to it; collar with three strong spiral riblets; six convex whorls, with slight shoulder anterior to the sutural collar, ornamented by faint spiral riblets which become much stronger between the body of the whorl and the anterior siphonal fasciole; spiral ornamentation crossed by 18 narrow axial ribs per whorl which cross both the shoulder and sutural collar; siphonal fasciole conspicuous, bordered by sharp ridges. (Turner)

*Observations.* This variety may be distinguished from *M. californicus* in that the longitudinal ribs extend across the shoulder and sutural collar, and also by the absence of the spiral groove at base of sutural collar.

*Holotype.* (U.C. 33244.) Figured in the present report, pl. 89, fig. 28.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* Six hundred feet downstream from Hughes Ferry, on north bank of North Umpqua River west of Glide, Douglas County, Oregon. (Turner)

#### **MOLOPOPHORUS BRETZI (Weaver), 1912**

Plate 89, figure 22

*Ancillaria bretzi* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 53, pl. 2, fig. 21, 1912.

*Original description.* Shell small, robust; spire high; whorls seven, convex; suture distinct; just below the suture there is a small band formed by a grooving of the upper margin of whorl. Surface of shell sculptured with twenty-five longitudinal transverse ribs extending over the entire whorl from suture to plications; between each rib are five fine longitudinal threads; no revolving lines are present. Aperture broad; posterior end narrowing; anterior very wide; inner lip somewhat incrusted; columella with four plications; outer lip thin; anterior sinus deep. Dimensions.—Altitude 15 mm.; diameter 8 mm.; altitude of spire 4 mm.; angle of spire 52°. (Weaver)

*Observations.* This species is very abundant and is a characteristic species among the fauna of the Cowlitz formation. It may be distinguished by its relatively small size, lack of spiral ribs, and by a plication on the anterior portion of the columella between the siphonal fasciole and the margin of the canal.

*Holotype.* (U.W. 39) (C.A.S. 500). Figured in the present report, pl. 89, fig. 22.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank Cowlitz River one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

#### MOLOPOPHORUS STEPHENSONI Dickerson, 1917

##### Plate 90, figure 1

*Molopophorus stephensi* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 177, pl. 30, figs. 10a, 10b, 1917; Effinger, Jour. Paleon., vol. 12, p. 383, 1938; Clark and Anderson, Bull. Geol. Soc. Am., vol. 49, pl. 3, fig. 13, 1938.

*Original description.* Shell small, rugose, solid with four whorls; nuclear whorls smooth, large; third and fourth whorls characteristically marked by nodose collar which is definitely set off by a rounded groove from the lower portion of the whorl; third and fourth whorls decorated by 12 sharp axial ribs crossed by equally spaced spiral threads; suture wavy, sunken; canal short, recurved with strong siphonal fasciole.

The young individual figured has about 18 slightly sinuous axial ribs instead of 12. Dimensions:—Length, 13 mm.; width of body-whorl, 8 mm. (Dickerson)

*Observations.* This species is characterized by its high spire, fine ornamentation, and cancellated sculpture of posterior whorls of spire.

*Holotype.* (C.A.S. 422.) Figured in the present report, pl. 90, fig. 1.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, Lewis County, northeast quarter of Section 25, T. 11 N., R. 2 W.

#### MOLOPOPHORUS EFFINGERI new name

##### Plate 90, figures 2, 3

*Molopophorus bramkampi* Effinger, Jour. Paleon., vol. 12, p. 383, p. 47, figs. 1, 10, 1938.

*Original description.* Shell small, fusiform; spire high, consisting of eight moderately convex whorls; suture linear, moderately depressed; body whorl about equal in length to spire, evenly convex; aperture fusiform; canal short, strongly reflected, deep; siphonal fasciole distinct, forming a moderately deep groove across the columella; ornamentation consisting of prominent incremental lines, which show a very slight flexure on the lower portion of the body whorl, and numerous small, slightly retractive longitudinal ribs, which become more prominent on middle whorls of spire, but are obsolete on body whorl; nuclear whorls large, turbinated,

consisting of about two unornamented whorls. Dimensions: holotype 33,592, altitude 17.1 mm., maximum diameter 7.8 mm., apical angle 35°. (Effinger)

*Observations.* This species is closely related to *M. bretzi* (Weaver) but differs in having a relatively higher spire, two more whorls to the spire, a more depressed suture, and slightly shorter anterior canal. A specimen from the Wheatland formation was described by Clark and Anderson (57, pp. 951, 952, pl. 4, figs. 3, 7, 8) in June, 1938. The Gries Ranch specimen described by Effinger was described in July, 1938, and therefore becomes a homonym. A new name, *Molopophorus effingeri*, is proposed.

*Holotype.* (U.C. 33592.) Figured in the present report, pl. 90, figs. 2, 3.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch in Section 25, T. 11 N., R. 2 W.

#### MOLOPOPHORUS GABBI Dall, 1909

Plate 90, figures 4, 6

*Molopophorus gabbi* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 45, pl. 3, fig. 8, 1909; Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 78, pl. 6, figs. 5a, 5b, 1914.

*Original description.* Shell small, stout, solid, of four and a half strongly sculptured whorls; apex smooth, of about two whorls, the nucleus normal, rather large for the size of the shell; subsequent whorls with a rounded cord in front of the suture, which at first is rather closely beaded; the nodules, however, become less close set and more spinose with growth, and on the last whorl, in some specimens, even sharply prominent and their number about a dozen; in front of this nodulous cord (which differs in prominence in different individuals) the whorl is more or less constricted; on the periphery are more or less prominent axial ribs, obsolete on the base, with wider interspaces, in number equal to the sutural nodulations, in strength variable with the individual; some specimens (like that figured) there may be on each rib two, or on others four, sharp subspinose nodulations, corresponding to spiral sculpture which is obsolete in the interspaces; both nodules and ribs may become obsolete near the aperture; base rounded with more or less obscure spiral threads; suture well marked, deep, but usually obscured by thread-like callosities which overrun it; canal very short, deeply excavated and recurved, producing a strong siphonal fasciole consisting of two sharp ridges and an intervening rather deep, smoothly excavated channel; aperture narrow behind, with a simple, sharp, outer lip; the body with a thin, widely extended callus, extending from the end of the canal nearly to the suture and over more than one-fourth of the last whorl. Altitude, 19 mm.; maximum diameter, 12 mm. (Dall)

*Observations.* This species of Oligocene age occurs in Columbia County, Oregon, not far from the occurrence of *M. dalli* also of Oligocene age. The two species are similar but *M. gabbi* may be distinguished by the following characteristics: two spiral carinae, often noded; the faintly developed spiral ribbing; the more slightly elongate anterior canal; and a smaller surface on the body whorl between the upper carina and suture.

*Holotype.* (U.S.N.M. 107377.) Figured in the present report, pl. 90, figs. 4, 6.

*Geologic range.* Pittsburg Bluff beds, middle Oligocene.

*Geographic distribution.* Columbia County, Oregon.

*Type locality.* (U.W. 500.) Road cut along Nehalem River at Pittsburg, Columbia County, Oregon.

#### MOLOPOPHORUS NEWCOMBEI (Merriam), 1899

Plate 90, figure 5

*Nassa* (?) n. sp. Merriam, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 2, p. 106, 1896.

*Nassa newcombei* Merriam, Nautilus, vol. 2, p. 63, 1897; Merriam, Proc. Calif. Acad. Sci., ser. 3, vol. 1, p. 179, pl. 23, fig. 3, 1899.

*Alectryon newcombei* (Merriam), Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, p. 576, 1913.

*Molopophorus newcombei* (Merriam), Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 160, 161, pl. 31, figs. 8a, 8b, 1923.

*Original description.* Shell between 25 and 30 mm. in length. Whorls five, with a well marked shoulder, ornamented by numerous longitudinal and transverse ribs which give the middle portion of the whorls a tessellated appearance. The upper revolving rib, which forms the angle of the shoulder, is stronger than the others and is usually separated from them by a distinct groove. On the last whorl the transverse ribs (about 25) are dominant on the upper portion, excepting the shoulder, and are latticed by the less conspicuous revolving sculpture. On the lower portion of the whorl the transverse ribs disappear leaving the well defined revolving ribs uninterrupted. (Merriam)

*Observations.* This upper Oligocene species from Vancouver Island is characterized by its relatively high spire, comparatively slender shape, the prominent spiral groove and collar above it just beneath the suture, the numerous longitudinal ribs on spire and on upper half of body whorl which fade out and disappear on the lower half, and the faintly developed spiral ribs on upper half of body whorl.

*Paratype.* (U.C. 30075.) Figured in the present report, pl. 90, fig. 5.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South shore of Vancouver Island.

*Type locality.* Sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island. (Clark)

#### MOLOPOPHORUS LINCOLNENSIS Weaver, 1916

Plate 90, figure 7

*Molopophorous lincolnensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 50, pl. 4, figs. 60, 61, 1916.

*Original description.* Shell small, solid with four and one-half whorls; spire about one-third the length of body whorl; apex of spire usually smooth; body whorl moderately convex and upper margin developed into a cord like ridge which is entirely free from nodes and situated just below the suture; surface of body whorl slopes down very sharply from the collar and develops a rather pronounced

concave constriction just above the convex portion of whorl. Suture well defined and deep; sculpture of shell consists almost entirely of fairly defined longitudinal lines of growth together with nine axial ribs confined chiefly to the middle portion of the whorl; nodes are entirely absent. Aperture semi-elliptical; outer lip covered with well marked callus; anterior end of aperture extended into a short canal moderately excavated and deeply notched and recurved so as to form a strong siphonal fasciole. Dimensions.—Altitude of shell 25 mm.; altitude of spire 5 mm.; maximum diameter of shell 14 mm.; angle of spire 62°. (Weaver)

*Observations.* This species is one of the most abundant and characteristic in the fauna of the Lincoln formation. The shell material is heavy, spiral ribbing lacking, and the longitudinal ribs which vary in strength of development in different individuals are most prominent on the middle surface of body whorl but may extend up to the suture in some individuals.

*Syntype.* (U.W. 113) (C.A.S. 467). Figured in the present report, pl. 90, fig. 7.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Thurston County, Washington.

*Type locality.* (U.W. 256.) Union Pacific Railway cut 1,000 feet north of Galvin Station, Lewis County, Washington, Section 27, T. 15 N., R. 3 W.

#### MOLOPOPHORUS CLARKI (Weaver), 1912

Plate 90, figure 12

*Brachysphingus clarki* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 48, pl. 4, fig. 38; pl. 6, fig. 57, 1912.

*Original description.* Shell of moderate length, heavy and thick; spire moderately high (never as low as in *B. sinuatus* Gabb); body whorl very large; whorls of spire five and distinct (never hidden); suture linear and distinct; body whorl moderately convex with often a faint depression on the upper portion just below the suture. Surface smooth except for well developed sinuous lines of growth; no revolving ribs are present on any specimen examined. Aperture broad and long, and very deeply notched at the anterior end; a prominent fold extends from the upper part of this notch around lower part of whorl; inner lip thickly incrusted; outer lip thin. Dimensions.—Altitude 34 mm.; diameter 18 mm.; altitude of spire 8 mm.; angle of spire 65°. (Weaver)

*Observations.* This species from the Cowlitz formation resembles somewhat *M. fishii* Gabb but may be distinguished from it in its relatively higher spire, greater convexity of the body whorl, broader upper part of aperture, and more elongate anterior canal. They resemble each other in complete lack of spiral and longitudinal ribs.

*Holotype.* (U.W. 31) (C.A.S. 494). Figured in the present report, pl. 90, fig. 12.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 5.) On Olequa Creek just above junction with Stillwater Creek, Section 32, T. 11 N., R. 2 W.

**MOLOPOPHORUS DALLI** Anderson and Martin, 1914

## Plate 90, figure 8

*Molopophorus dalli* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 78, pl. 6, figs. 7a, 7b, 1914.

*Original description.* Shell moderate in size, stout, conical above, not strongly sculptured, with five whorls; spire rather high for the genus, tapering evenly except for the sutural collar; younger whorls ornamented with beaded collars, older whorls with beads obsolete; body-whorl with distinct constriction below collar; mouth ovate, narrowed above; outer lip thin and smooth; inner lip widely calloused; canal very short, wide, recurved; pillar partly encircled by strong plication which forms the outer border of the canal; surface marked by irregular axial ridges crossed by spiral cords. Dimensions.—Length, 39 mm.; width, 25 mm. (Anderson and Martin).

*Observations.* This species may be distinguished from *M. gabbi* in the greater convexity of body whorl, in well-defined spiral ribbing, and in lack of spiral carinal noded ribs.

*Holotype.* (C.A.S. 168.) Figured in the present report, pl. 90, fig. 8.

*Geologic range.* Middle Oligocene.

*Geographic distribution.* Columbia County, Oregon.

*Type locality.* From bluff along county road 12,000 feet southwest of Clatskanie, Oregon.

**MOLOPOPHORUS BIPPLICATUS** (Gabb) var. **QUADRANODOSUM** (Weaver), 1912

*Cuma biplicata* Gabb var. *quadrannodosum* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 75, 76, pl. 11, figs. 91, 92, 93; pl. 14, fig. 122, 1912.

*Original description.* Shell small, thick, with five angulated, sculptured whorls; the two whorls of apex rounded and smooth; each of the remaining whorls has its upper portion terminating in a collar set with nodes agreeing in number with those on the body of the whorl; body whorl convex in center, straight or very slightly concave above the center and just below the collar. Same true on lower two whorls of spire. Spire moderately low; on the surface are sixteen to eighteen axial ribs which extend down to the base of the body whorl although less distinct than on the center; they do not extend up to the collar but reappear as nodes on the rim of the collar. These are crossed by eleven or twelve smaller revolving ribs which are closely set on the lower part of the whorl, but more widely spaced on convex portion where their intersection with axial ribs produces nodes. In over 100 specimens examined there are always four nodes to each axial rib on the convex part of whorl and 16 to 18 rows. Spire moderately low; suture distinct; canal short; slightly bent with two plications; inner lip heavily calloused, extending up to the central part of convex portion of shell; outer lip thin; aperture broad. Dimensions.—Altitude 32.5 mm.; diameter 22 mm.; elevation of spire 6 mm.; angle of spire 70°. (Weaver)

*Observations.* This variety may be distinguished from the other forms of the genus *Molopophorus* in the character of ornamentation. The four spiral ribs on middle of body whorl which are prominently noded are distinctive characters.

*Holotype.* (U.W. 76.) Lost.

*Geologic range.* Middle Oligocene of Washington.

*Type locality.* (U.W. 57.) On branch of Wilson Creek, Wahkiakum County, Washington, in Section 36, T. 10 N., R. 6 W.

**MOLOPOPHORUS FISHII (Gabb), 1869**

Plate 90, figures 9, 10, 11

*Ancillaria fishii* Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 9, pl. 2, fig. 15, 1869.  
*Bullia buccinoides* Merriam, Proc. Calif. Acad. Sci., ser. 3, vol. 1, p. 179, pl.

23, fig. 5, 1899.

*Ancilla fishii* Gabb, Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 161, pl. 31, figs. 9a, 9b, 10a, 10b, 1923.

*Original description.* Shell small, broad; spire high; whorls six; suture covered. Aperture narrow, acute posteriorly, broad in advance; inner lip moderately incrusted, with a single small fold in advance; outer lip acute, anterior sinus deep. (Gabb)

*Observations.* This species varies greatly in robustness and relative height of spire. Its lack of spiral ribbing and usual absence of longitudinal ribbing give it a similarity to *M. clarki*. The anterior canal is somewhat shorter and the posterior part of the aperture is much narrower.

*Hypotype.* (U.C. 11929.) Figured in the present report, pl. 90, figs. 9, 10.

*Hypotype.* (U.C. 30086.) Figured in the present report, pl. 90, fig. 11.

*Geologic range.* Sooke formation and upper Oligocene of California.

*Geographic distribution.* South shore of Vancouver Island and north side Mount Diablo, California.

*Type locality.* South of Martinez, Contra Costa County, California. Occurs in the Pacific Northwest in sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

**MOLOPOPHORUS ANGLONANA (Anderson), 1905**

Plate 90, figures 14, 15, 16, 18, 23

*Bullia (Molopophorus) anglonana* Anderson, Proc. Calif. Acad. Sci., ser. 3, vol. 2, p. 205, pl. 16, figs. 74, 75, 76, 1905.

*Molopophorus anglonana* (Anderson), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 97, 98, pl. 13, figs. 1, 2, 3, 4, 5, 7, 10, 14, 15, 16, 1931.

*Original description.* Shell moderate in size, 1 inch in length,  $\frac{3}{4}$  inch in width; spire moderately elevated; aperture broad, lip simple, notched above; columella crusted, whorls angulated, bearing tubercular, or spinose nodes above, and on lower part of body whorl; surface ornamented with lines of growth and with revolving lines, strongest on the lower portion of the body whorl. The anterior notch is deep, and bordered by two strong folds which extend upward, revolving obliquely around the columella, forming a wide canal, shown only in figure 74. (Anderson)

*Observations.* The type of this species was destroyed during the San Francisco earthquake and fire and a topotype (C.A.S. 91) has been selected as a neotype and is here figured (pl. 90, figs. 18, 23). The following measurements are for this specimen: height of shell, 33 mm.; height of spire, 6 mm.; maximum diameter of shell, 21 mm. The specimens (U.C. 32018) and (U.C. 32016) are from the Astoria formation in Washington. There is much variation in the strength of the longi-

tudinal ribs in different specimens and in some cases spiral ribbing is nearly absent.

*Holotype.* Lost.

*Neotype.* (C.A.S. 91.) Locality (C.A.S. 65). Figured in the present report, pl. 90, figs. 18, 23.

*Hypotype.* (U.C. 32018.) Figured in the present report, pl. 90, fig. 16.

*Hypotype.* (U.C. 32016.) Figured in the present report, pl. 90, fig. 15.

*Hypotype.* (U.C. 32019.) Figured in the present report, pl. 90, fig. 14.

*Geologic range.* Kern River Miocene, California; Astoria Miocene, Washington, middle Miocene.

*Geographic distribution.* Miocene beds at south end of San Joaquin Valley, California, and Grays Harbor County, Washington.

*Type locality.* Kern River, California. In Washington this species is common at locality (U.W. 425), Rock Creek, one-fourth mile down stream from the falls and just below old dam site, Grays Harbor County, Section 7, T. 16 N., R. 5 W.

#### **MOLOPOPHORUS ANGLONANA (Anderson) var. MATHEWI Etherington, 1931**

Plate 90, figures 17, 19

*Molopophorus anglonana* Anderson var. *mathewi* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 98, 99, pl. 13, figs. 3, 6, 8, 9, 13, 1931.

*Original description.* Shell medium in size; spire moderately elevated; nucleus globose, smooth, early whorls characterized by axial ribbing and numerous revolving ribbing which is lost usually on the last whorl. The only ornamentation being the axial lines of growth; maximum diameter of the shell below the center-line of the body whorl; aperture subrounded to subquadrate with a faintly developed stromboid notch; outer lip thin; inner lip smooth; anterior canal open, reflected; pillar short, stout, with thin wash of callus; siphonal fasciole well developed as in all species of *Molopophorus*. Dimensions: Altitude of holotype (U.C. 32028), 25.1 mm.; maximum diameter, 17.5 mm.; height of body whorl, 19.5 mm. (Etherington)

*Observations.* This species is smooth except for lines of growth, as in the case of *M. clarki* and *M. fishii*. The spire of the variety *mathewi* is proportionately higher and the whorls of the spire somewhat more convex. The greatest convexity of the body whorl is below its middle part. The shell characters and ornamentation suggest a closer relationship to *M. clarki* and *M. fishii* than to *M. anglonana*.

*Holotype.* (U.C. 32028.) Figured in the present report, pl. 90, figs. 17, 19.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 416.) Clemons logging road, on abandoned spur of railroad one-fourth mile north of junction of main line on the point of first curve in road, Section 25, T. 17 N., R. 7 W.

## Family FASCIOLARIIDAE

## Genus LATIRUS Montfort, 1810

*Latirus* Montfort, Conchyliologie Systématique, vol. 2, p. 531, 1810.*Genotype.* *Latirus auranticus* Montfort.**LATIRUS EOCENICA (Weaver), 1912**

Plate 89, figures 21, 27; plate 90, figures 13, 20, 22; plate 103, figure 13

*Nassa eocenica* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 42, 43, pl. 3, fig. 32, 1912.*Amphissa eocenica* (Weaver), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 8, figs. 6a, 6b, 6c, 1915.*Cominella eocenica* (Weaver), Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, pp. 38, 39, pl. 12, figs. 5, 6, 1922; Effinger, Jour. Paleon., vol. 12, p. 384, pl. 47, figs. 30, 31, 1938.*Latirus (Peristernia) eocenica* (Weaver), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 74, pl. 17, fig. 7, 1938.

*Original description.* Shell small and fusiform; spire moderately high; whorls eight and convex, last two on apex, smooth, rounded and without ornamentation; upper portion of each whorl surrounded by a deep depression, above which a low collar extends upward to the suture; suture distinct. Surface of shell ornamented by eighteen longitudinal ribs which are very distinct on the spire but faint in the body whorls; they begin at the suture and extend the length of the whorls with the exception of the body whorl where they disappear a short distance below the convex portion; body whorl sculptured by eleven very prominent revolving ribs; alternating with these are eleven less prominent revolving lines on either side of which is a fine but distinct revolving thread. Sculpture similar on the spire. Canal short and fairly strongly recurved; aperture moderately narrow and tapering towards the end of the canal; inner lip slightly incrusted; outer lip crenulated. Dimensions.—Altitude 18 mm.; diameter 10 mm.; altitude of spire 6 mm.; angle of spire 57°. (Weaver)

*Observations.* On this species, just below the collar, is a deep groove which causes the lower bordering spiral rib to become slightly nodose. The species is abundant in the fauna of the Cowlitz formation in Washington.

*Holotype.* (U.W. 23) (C.A.S. 489). Figured in the present report, pl. 90, fig. 13. A reproduction of Weaver's figure (286, pl. 3, fig. 32) is figured in the present report, pl. 103, fig. 13.

*Hypotype.* (C.A.S. 323.) Dickerson's figure (pl. 8, fig. 6c). Figured in the present report, pl. 90, fig. 20.

*Hypotype.* (U.W. 203) (C.A.S. 7632). Figured in the present report, pl. 90, fig. 22.

*Hypotype.* (U.C. 33593.) From Gries Ranch beds. Figured in the present report, pl. 89, figs. 21, 27.

*Geologic range.* Cowlitz formation, upper Eocene, and Gries ranch beds, lower Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington, and Douglas County, Oregon.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

**LATIRUS ROSEBURGENSIS** Hendon, 1938

Plate 90, figures 21, 28

*Latirus roseburgensis* Hendon, in Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 74, 75, pl. 16, figs. 1, 6, 1938.

**Original description.** Shell fusiform, spire approximately half the length, suture impressed, whorls convex with 11 slightly oblique irregular axial ribs which are crossed by coarse spiral lines. These are more prominent where crossing the axial ribs and tend to form long thin nodes on the ribs. Penultimate whorl of holotype has six spiral lines though they seem to have more, owing to the central portion of some being eroded away leaving the two edges standing as separate ribs. Approximately 15 major spiral lines on the body whorl and canal. Fine lines occasionally appear in the interspaces. Aperture small, canal short and slightly bent, outer lip denticulate, inner lip thinly incrusted. Two faint plications on the columella. (Hendon in Turner)

**Observations.** This species may be distinguished from *L. eocenica* in having slightly more convex whorls, finer and more numerous spiral ribs, heavier longitudinal ribs, and in lacking the deep groove just below the collar and the nodes which are present upon the latter.

**Holotype.** (U.C. 33672.) Figured in the present report, pl. 90, figs. 21, 28.

**Geologic range.** Lower Umpqua formation, middle Eocene.

**Geographic distribution.** Douglas County, Oregon.

**Type locality.** (U.C. A-836.) Middle fork of Coquille River opposite Roseburg-Coos Bay Highway Survey station 845 + 33.

Genus **WHITNEYELLA** Stewart, 1926

*Whitneyella* Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 401, 402, 1926.

**Genotype.** "*Hemifusus washingtonianus*" Weaver.

**WHITNEYELLA SINUATA** (Gabb) var. **ARAGOENSIS** Turner, 1938

Plate 90, figures 25, 29

*Whitneyella sinuata* (Gabb) var. *aragoensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 75, pl. 16, figs. 10-13, 1938.

**Original description.** Shell elongate, fusiform; spire one-third of total length, angle of apex 45 to 58 degrees; whorls with shoulder posterior to the middle; profile concave between suture and shoulder; suture appressed and generally anterior to the greatest diameter of the preceding whorl; ornamented by fine revolving riblets of alternating strength and approximately 10 axial ribs which are strongest at the shoulder, taper, and disappear anteriorly; canal moderately long and reflected slightly backward and to the left. (Turner)

**Observations.** This variety may be distinguished from *W. sinuata* by stronger ribs on the posterior surface of the whorls. It differs from *W. coosensis* in being more convex between suture and shoulder.

**Holotype.** (U.C. 33197.) Figured in the present report, pl. 90, figs. 25, 29.

**Geologic range.** Lower Coaledo formation, upper Eocene.

**Geographic distribution.** Coos Bay area, Oregon.

**Type locality.** (U.C. A-858.) Southwest corner of Cape Arago, Coos Bay, Oregon.

**WHITNEYELLA OREGONENSIS** Turner, 1938

Plate 90, figures 24, 27, 30

- (?) *Strepsidura whitneyi* Gabb, Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, p. 572, 1913.  
*Whitneyella oregonensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 75, 76, pl. 16, figs. 7, 8, 1938.

*Original description.* Shell medium size, fusiform; whorls bulbous; spire low, subconical; suture grooved; strengthening of two closely adjoining spiral threads just below produce a narrow collar; growth lines slightly sinuous, swinging gently forward near the suture. Surface with well-marked spiral threads commonly separated by one or more finer lines. Early whorls with many well-marked longitudinal ribs which later become obsolete. Adult whorls tend to develop occasional irregular varices. Outer lip thin, incurved. Inner lip incrusting, particularly near the posterior portion of the aperture, apparently resorbing somewhat on the columella. Anterior canal slender, bent slightly near the tip, no fasciole observed. (Turner)

*Observations.* This species, as pointed out by Turner, resembles *Ranellina pilosbryi* Stewart. It may be distinguished by the larger angle of the spire, more convex whorls, and the somewhat concave outline of the surface of the whorl just below the suture.

*Holotype.* (U.C. 33193.) Figured in the present report, pl. 90, figs. 24, 27.

*Paratype.* (U.C. 33194.) Figured in the present report, pl. 90, fig. 30.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-662.) East bank of Little River between highway bridge and first bend of stream east of junction with North Umpqua River. Center of Section 19, T. 26 S., R. 3 W.

**WHITNEYELLA COOSENSIS** Turner, 1938

Plate 90, figure 26

- Whitneyella? coosensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 76, pl. 16, figs. 5, 9, 1938.

*Original description.* Shell small to medium in size, slender, fusiform; spire conical; early whorls cancellate; later whorls ornamented only by fine spiral riblets with finer intercalated threads; suture impressed, two riblets immediately anterior to the suture form a narrow collar; canal long, slender. (Turner)

*Observations.* The holotype of this species (U.C. 33195) is figured on pl. 90, fig. 26. The specimen figured by Turner as the holotype (274, pl. 16, fig. 5) is also given in the explanation of plates as (U.C. 33195). The holotype has a broken canal but the figured specimen has the canal entire. It may be distinguished from *W. oregonensis* by its long canal, smaller apical angle, narrower aperture, and less convex whorls.

*Holotype.* (U.C. 33195.) Figured in the present report, pl. 90, fig. 26.

*Geologic range.* Lower Coaledo formation, upper Eocene.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* (U.C. A-715.) East of Lighthouse Reefs at Cape Arago, Oregon.

**WHITNEYELLA GABBI** (Dickerson), 1917

Plate 91, figures 1, 2, 3, 4

- Fasciolaria gabbi* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 174, 175, pl. 30, figs. 4a, 4b, 1917.  
 "Fasciolaria" *gabbi* Dickerson, Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 402, 1927.  
*Whitneyella gabbi* (Dickerson), Effinger, Jour. Paleon., vol. 12, p. 384, pl. 47, figs. 33, 34, 1938.

*Original description.* Shell fusiform with short spire consisting of seven whorls; first three whorls smooth, naticoid; fourth, fifth, sixth and seventh whorls marked by four strong equally spaced spiral lines with one or more intercalary threads, and by 12 axial ribs which give rise to prominent pointed nodes at the intersection of the spiral lines; sides of these whorls nearly flat in outline, sloping steeply to a wavy suture which is bordered by slight collar formed by the first strong spiral line of the next whorl; body-whorl large, rugose, with greatest width one-fourth of whorl length below suture; space below suture slightly concave and marked by about 10 spiral threads; shoulder of whorl marked by a very strong spiral line with three or four threads between it and the next line of almost equal strength; space below second spiral line covered by three spiral lines of moderate strength and by about 25 to 30 threads; 12 axial ribs intersecting these various spiral lines making nodes at crossings; canal long, straight; inner lip slightly incrusted. Dimensions:—Length, 24 mm.; width of body-whorl, 12 mm. (Dickerson)

*Observations.* This species may be distinguished from the closely allied *W. washingtoniana* (Weaver) in having a heavier collar, less prominent apical ribs, and lack of reticulate ornamentation.

*Holotype.* (C.A.S. 413.) Figured in the present report, pl. 91, figs. 1, 2.

*Hypotype.* (U.C. 33595.) Figured in the present report, pl. 91, fig. 3.

*Hypotype.* (U.C. 33594.) Figured in the present report, pl. 91, fig. 4.

*Geologic range.* Gries Ranch beds, lower Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Washington, Section 28, T. 11 N., R. 2 W.

**WHITNEYELLA WASHINGTONIANA** (Weaver), 1912

Plate 91, figures 5, 7, 8, 9, 10, 11

*Hemifusus washingtoniana* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 46, 47, pl. 2, figs. 11, 12, 1912.

*Whitneyella washingtoniana* (Weaver), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 402, 1926.

*Original description.* Shell of moderate size and fusiform; whorls eight, convex, and slightly angulated; body whorl concave above angle; suture distinct and sinuous. Surface ornamented with thirteen longitudinal ribs which are most prominent on the middle portion of whorl. These are crossed by twenty distinct revolving ribs which are set with spiny nodes at the intersections with the longitudinal ribs. Alternating with each revolving rib is a revolving thread. Aperture moderately broad, somewhat elongated and continuing to end of canal. Canal straight and moderately long; inner lip smooth and calloused; outer lip thin. Dimensions.—Altitude 29 mm.; diameter 15 mm.; altitude of spire 10 mm.; angle of spire 57°. (Weaver)

*Observations.* This species was chosen by Stewart as the type of the genus *Whitneyella*, which is characterized by low spire and overlapping whorls and by straight to slightly bent canal. Hundreds of specimens of this species have been examined and a wide range of variation may be seen. Usually there is a concave surface just below the collar and suture, which differ greatly in height and amount of concaveness. The body whorl is broadly convex, while *W. lincolnensis* from the middle Oligocene has a greater diameter and is rather acutely arched. The latter species may be a variety of *W. washingtoniana*.

*Syntypes.* (U.W. 29-A) (C.A.S. 7565-A) (U.W. 29) (C.A.S. 7565). Figured in the present report, pl. 91, figs. 10, 11.

*Hypotype.* (C.A.S. 493.) Figured in the present report, pl. 91, fig. 5.

*Hypotype.* (U.W. 501.) Figured in the present report, pl. 91, figs. 7, 8.

*Hypotype.* (U.W. 503.) Figured in the present report, pl. 91, fig. 9.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.C. 232.) North bank of Cowlitz River, one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

#### WHITNEYELLA LINCOLNENSIS (Van Winkle), 1918

Plate 91, figures 6, 13, 14; plate 103, figure 20

*Hemifusus lincolnensis* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, pp. 89, 90, pl. 7, fig. 10, 1918.

*Whitneyella lincolnensis* (Van Winkle), Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pl. 12, fig. 13, 1933.

*Original description.* Shell of moderate size and moderately convex; whorls seven in number and slightly angulated; upper surface of body whorl above the angle moderately concave; middle portion strongly convex and merging into a sharply sloping base; the upper portion of the surface of the whorl develops into a collar which comes in contact with the whorl above and along a well developed suture line. Surface of whorl ornamented by 13 well defined longitudinal ribs which are present on all of the whorls but are confined to the middle portion of each; they disappear entirely on the upper and lower thirds of the surface; they are crossed by numerous well defined revolving ribs and intervening threads; two well marked ribs are present on the collar just below the suture; eight nearly square topped, moderately well defined lines ornament the upper third of the surface of the body whorl; these are equally spaced and equally developed; they are separated by interspaces of double width and contain no revolving threads; the middle portion of the whorl possesses four very prominent revolving ribs which are equally spaced and which when crossing the longitudinal ribs form fairly well developed nodes; between each of these four prominent ribs there are three less well defined minor ribs of about the same magnitude as those on the upper third of the surface of the body whorl; between each of the minor ribs are interspaces of approximately equal width but containing no ornamentation. The lower portion of the body whorl including the canal is ornamented with 13 equally developed and fairly prominent rounded revolving ribs with interspaces of triple width; in the middle of each interspace is a minor revolving thread; canal about one and one-half times as long as the spire, twisted to the left and backward; aperture elliptical and terminating in an open canal; inner lip moderately calloused, callous extending for some distance over on to the sculpture of the body whorl;

outer lip thin. Dimensions.—Altitude of shell 33 mm.; altitude of spire 8 mm.; maximum diameter of shell 16 mm.; angle of spire 53°. (Van Winkle)

*Observations.* This species which is similar to *W. gabbi* is distinguished from it by having a prominent collar with a concave area immediately anterior to it, by the absence of longitudinal ribs, and by the reflected condition of the anterior portion of the canal. It differs from *W. washingtoniana* in a more marked twisting of the anterior canal, a greater proportionate diameter of the body whorl, and a more acute arching of the middle of the body whorl.

*Holotype.* (U.W. 143) (C.A.S. 7564). Figured in the present report, pl. 91, fig. 14; pl. 103, fig. 20.

*Hypotype.* (C.A.S. 508.) Figured in the present report, pl. 91, fig. 6.

*Topotype.* (U.C. 32182.) Figured in the present report, pl. 91, fig. 13.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Thurston County, Washington.

*Type locality.* (U.W. 352.) Union Pacific railway cut one mile north of Galvin Station, Lewis County, Washington, Section 27, T. 15 N., R. 3 W.

#### WHITNEYELLA BUWALDANA (Dickerson), 1915

Plate 91, figure 12

*Fasciolaria buwaldana* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 73, pl. 11, figs. 2a, 2b, 1915.

*Original description.* Shell fusiform with probably eight convex whorls; whorls slightly shouldered a short distance below a wavy, impressed suture; spire-whorls decorated by nine axial ribs crossed by seven, very wavy, spiral lines of equal size; body whorl decoration similar except that the spiral lines over the widest part of whorl alternate in strength; aperture elongate-oval, widest in middle, narrowing below into a slightly sinuous canal of medium length. Dimensions:—Length, 19.5 mm.; width of body-whorl, 7.5 mm. (Dickerson)

*Observations.* This species from the Cowlitz formation differs from all the other species of the genus in being slenderer, having a proportionately more elongate spire, and in lacking the concave area on upper part of body whorl just below suture.

*Holotype.* (C.A.S. 346.) Figured in the present report, pl. 91, fig. 12.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington..

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

#### WHITNEYELLA MARKLEYENSIS (Clark), 1938

Plate 82, figures 14, 16; plate 91, figure 15

*Perse markleyensis* Clark, Bull. Geol. Soc. Am., vol. 49, pp. 719, 720, pl. 2, figs. 13, 14, 17, 18, 19, 20, 21, 22, 27, 28, 1938.

*Original description.* Shell fusiform with a moderately high and acute spire; first two nuclear whorls smooth, the third barely showing the longitudinal sculp-

turing; number of whorls six, sutures appressed; surface of shell sculptured by narrow, thread-like spiral ribs, with interspaces on the body whorl slightly wider than the width of the ribs. Anteriorly, there is a finer interrib in each interspace; this is also true of the area next to the suture; there are about 27 of the major spiral ribs on the body whorl, and about eight on the first whorl of the spire; here the ribs are more closely spaced than on the body whorl; this appears to be due to the fact that the secondary ribbing has become as strong as the primary. Surface also sculptured by a fairly heavy, rounded, longitudinal ribbing. On the whorls of the spire these ribs cross from suture to suture, but on the body whorl they extend only a little less than half way to the anterior end; the number of longitudinal ribs increases in going from the anterior to the posterior whorls; there are eight of these ribs on the body whorl, twelve on the next whorl, and about fourteen on the whorl posterior to that. Aperture elongate ovate (outer lip broken on holotype); inner lip without a callus, the spiral ribs extending on to it. Canal fairly long, slightly reflexed. Dimensions: holotype 30863, height 25.0 mm.; height of aperture 18.0 mm.; greatest width of body whorl about 11.0 mm. (Clark)

*Observations.* The species *W. markleyensis* is common in the Markley formation in California and has been reported by Clark as occurring in the Cowlitz formation in Washington, although as yet it has not been found by the writer.

The form *W. markleyensis* var. *collarus* (Clark) occurs in the Cowlitz formation. The following characters are stated by Clark to distinguish it from *W. markleyensis*: "This variant is distinguished from the typical form by the fact that : (1) it has a somewhat higher spire; (2) the suture is more strongly appressed, resulting in a rather strong sutural band or collar; (3) the most distinctive character is that the longitudinal ribs on the body whorl do not increase in number from the anterior to the posterior, as on the typical form, but decrease; thus, on the specimen of this variant here figured (paratype 30863, pl. 2, fig. 28), there are fourteen of these ribs on the body whorl, ten on the whorl next to it, and only eight on the whorl posterior to that; (4) the secondary spiral ribs are well developed on the entire body whorl but on the holotype of the species, they are obsolete near the middle of the body whorl; (5) there are a greater number of these spiral ribs on the body whorl; thus, on the variant, there are fourteen of the major spiral ribs on the anterior whorl of the spire, whereas there are only eight or nine on the typical form. The canal and aperture on the specimen of the variant here figured are broken. Specimens referable to this variety are found in the Lower Cowlitz of Washington, locality 7170."

*Paratype.* (U.C. 30868) = *W. markleyensis* var. *collarus* (Clark) from locality (U.C. 7170), Cowlitz formation. Figured in the present report, pl. 91, fig. 15.

*Holotype.* (U.C. 30863.) Markley formation, California. Figured in the present report, pl. 82, figs. 14, 16.

*Paratype.* (U.C. 30868.) Figured in the present report, pl. 91, fig. 15.

*Geologic range.* Markley and Cowlitz formations, upper Eocene.

*Geographic distribution.* West side of Sacramento Valley, California, and Cowlitz Basin, southwest Washington.

**Genus FUSINUS Rafinesque, 1815**

*Fusinus* Rafinesque, Anal. de la Nature, p. 145, 1815.

*Genotype.* *Murex colus* Linnaeus.

**FUSINUS MERRIAMI Dickerson, 1916**

Plate 91, figures 16, 17

*Fusinus merriami* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, pp. 493, 494, pl. 40, figs. 2a, 2b, 1916; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 75, pl. 17, fig. 8, 1938.

*Original description.* Shell with long, acuminate spire and with long, straight, narrow canal; whorls, eleven in number; the first two rounded; the other whorls are angulated at a point about two-thirds of a whorl-length below the suture. The last nine whorls have the angle marked by ten flat pointed nodes which are decidedly upturned on the body-whorl. The space above the angle of a whorl is decorated by seven to ten spiral lines and by five growth lines of about the same strength. Below the angle are found three or four spiral lines which alternate in size. The decoration on the body-whorl is similar to that of the spire-whorls. The spiral lines below the angle on the body-whorl are eight in number. Dimensions.—Length of nearly perfect specimen, 24 mm.; width of body-whorl, 7 mm.; length of spire, 10 mm. (Dickerson)

*Observations.* This species is characterized by its relatively high spire, sharply angulated whorls, the angulation being situated a distance of about two-thirds the length of the whorl below the suture, and the flat sharp nodes on the angle.

*Hypotype.* (U.C. 33220.) Figured in the present report, pl. 91, figs. 16, 17.

*Geologic range.* Tyee formation in Oregon and Domengine formation in California, middle Eocene.

*Geographic distribution.* Southwestern Oregon and Coast Ranges of California.

*Oregon locality.* (U.C. A-685.) North bank North Umpqua River from 470 feet west of French Creek to first riffle below Lone Rock bridge.

**FUSINUS GESTERI Dickerson, 1917**

Plate 91, figures 19, 20

*Fusinus gesteri* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 179, pl. 31, fig. 4, 1917.

"*Fusinus*" *gesteri* Dickerson, Effinger, Jour. Paleon., vol. 12, p. 384, pl. 47, figs. 16, 17, 1938.

*Original description.* Shell with six and a half whorls; the first three elevated, smooth, with but slight convexity; fourth and fifth whorls decorated by about 10 wavy, equally spaced spiral lines crossed by 10 sinuous axial ribs; body-whorl with axial ribs covering upper third of shell; the lower portion being covered by spiral lines only; aperture constricted medially; inner lip but slightly callosous. Dimensions:—Length, 14 mm.; width of body-whorl 6 mm. (Dickerson)

*Observations.* This species is characterized by its broad longitudinal ribs which are well developed on the first three whorls anterior to the nuclear whorls and which become less prominent on the whorls anterior to

these. The canal of the holotype (pl. 91, fig. 19) is broken although it is present in Dickerson's original figure.

*Holotype.* (C.A.S. 429.) Figured in the present report, pl. 91, fig. 19.

*Hypotype.* (U.C. 33601.) Figured in the present report, pl. 91, fig. 20.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch in northeast quarter of Section 25, T. 11 N., R. 2 W.

#### FUSINUS EMPIRENSIS Anderson and Martin, 1914

##### Plate 91, figure 21

*Fusinus empireensis* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 84, pl. 5, fig. 7, 1914.

*Original description.* Shell solid, fusiform, with eight or nine convex whorls; spire elevated; whorls moderately convex, sculptured with seven or eight coarse rounded spiral cords alternating in prominence, the cords on the anterior portion slightly more elevated than those on the posterior, frequently giving the whorls an angulated appearance; body-whorl with eighteen spiral cords, axial sculpture consisting of lines of growth; suture distinct, channeled; aperture rounded or circular; inner lip smooth, slightly incrusted; canal defective in the type, probably of moderate length. Dimensions:—Altitude, 50 mm.; canal defective; latitude of the last whorl, 23 mm. (Anderson and Martin)

*Observations.* This species is characterized by its large size, elevated spire, its moderately heavy spiral ribs, and lack of longitudinal ribs.

*Holotype.* (C.A.S. 185.) Figured in the present report, pl. 91, fig. 21.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* East shore of Coos Bay, opposite Coos Bay Bar, and 300 feet north of southwest corner of Section 30, T. 25 S., R. 13 W.

#### FUSINUS WILLISI (Dickerson), 1915

##### Plate 91, figure 18

*Fusinus willisi* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 73, pl. 2, figs. 1a, 1b, 1915.

*Original description.* Shell elongate-conic; number of whorls unknown; whorls convex, decorated by twelve nearly continuous axial ribs made nodose by intersection of eight strong, spiral lines; suture wavy, distinct; aperture elongate-oval; outer lip simple; inner lip slightly incrusted. Dimensions:—Length of broken type, 17.5 mm.; width of body-whorl, 7 mm. (Dickerson)

*Observations.* This species is slender with relatively high spire, twisted anterior canal, and fairly well-defined longitudinal ribs. This is in contrast to *F. gesteri* with its flattened whorls and proportionately lower spire and shorter body whorl.

*Holotype.* (C.A.S. 345.) Figured in the present report, pl. 91, fig. 18.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, in Section 28, T. 11 N., R. 2 W.

**FUSINUS MONTESANOENSIS (Weaver), 1912**

Plate 91, figure 24

*Fusus montesanoensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 76, 77, pl. 6, fig. 58, 1912.

*Original description.* Shell large, solid, with six rounded whorls; suture distinct and slightly appressed; apex acute; body whorl plump with four faint but distinct angles, the upper one being most pronounced; spirally sculptured by five major revolving ribs between each of which are four or five less distinct ribs; about 13 or 14 faint varices cross the whorls and appear especially on the angles of the whorls of the spire as nodes. They are not very prominent on the body whorl. In addition there are numerous barely noticeable fine incremental lines; aperture moderately wide; canal long and nearly straight. Some of these specimens retain their original coloring. Dimensions.—Altitude of specimen 60 mm.; maximum diameter 37 mm.; apical angle 35°. (Weaver)

*Observations.* This species has been observed only in the sandstones of the Montesano formation and is not common. The holotype figured on pl. 91, fig. 24, is badly broken and a better idea of it may be obtained in the original illustration (286, pl. 6, fig. 58). The major wide and flat-topped ribs, together with the secondary and tertiary spiral ribs and faintly developed longitudinal ribs, are characteristic of the species. The rounded angulation at the upper part of the whorls and the subtabulate area just above it and below the suture also aid in separating it from other species of the genus in the Northwest.

*Holotype.* (U.W. 77) (C.A.S. 7562). Figured in the present report, pl. 91, fig. 24.

*Geologic range.* Montesano formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 68.) Logging railway cut on Sylvia Creek, Grays Harbor County, Section 32, T. 18 N., R. 7 W.

Subgenus **Priscofusus** Conrad, 1865

*Priscofusus* Conrad, Am. Jour. Conch., vol. 1, p. 150, 1865.

*Subgenotype.* *Fusus geniculus* Conrad.

**FUSINUS (PRISCOFUSUS) GENICULUS (Conrad), 1849**

## Plate 92, figure 10

*Fusus geniculus* Conrad, U.S. Explor. Exped. Geol., Append., p. 728, pl. 20, fig. 3,  
1849.

*Fusinus (Priscofusus) geniculus* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no.  
59, p. 40, 1909.

*Original description.* Fusiform, with closely arranged revolving lines, alternate  
in size. Whorls of the spire angulated below the middle, and with longitudinal ribs  
on the inferior half. Body whorl with short ribs on the angle, and beneath the  
revolving lines are larger and more prominent than above. (Conrad)

*Observations.* As pointed out by Dall, this specimen is more elongate and slenderer than *F. corpulentus* and the longitudinal ribs are better developed and more elongate and appear on the body whorl.

*Holotype.* (U.S.N.M. 3552.) Conrad specimen. Figured in the present report,  
pl. 92, fig. 10.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Astoria, Oregon, and Clallam Bay area, Washington.

*Type locality.* Astoria, Oregon. (Dana, Dall)

**FUSINUS (PRISCOFUSUS) CORPULENTUS (Conrad), 1849**

## Plate 92, figure 1

*Fusus corpulentus* Conrad, U.S. Explor. Exped. Geol., Append., p. 728, pl. 20,  
fig. 4, 1849.

*Fusinus (Priscofusus) corpulentus* Conrad, Dall, U.S. Geol. Surv., Prof. Pap.  
no. 59, p. 39, 1909.

*Original description.* Fusiform. Body whorl ventricose, suddenly contracted at  
base, flattened and sloping toward the suture; whorls of the spire angulated and  
nodulous in the middle, flat and sloping above. (Conrad)

*Observations.* This species, which was designated by Dall as the  
type of the subgenus *Priscofusus*, is characterized by the spire being  
longer than the canal, the lack of lirations inside of the aperture, and  
a relatively short canal. The specimen figured is one of Conrad's original types.

*Holotype.* (U.S.N.M. 3551.) Conrad type. Figured in the present report, pl.  
92, fig. 1.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Astoria, Oregon.

*Type locality.* Astoria, Oregon. (Dana, Dall)

**FUSINUS (PRISCOFUSUS) MEDIALIS (Conrad), 1849**

## Plate 93, figure 7

*Cerithium mediale* Conrad, U.S. Explor. Exped. Geol., Append., p. 728, pl. 20, figs. 1, 1a, 1849.

*Priscofusus medialis* Conrad, Am. Jour. Conch., vol. 1, p. 150, 1865.

*Fusinus (Priscofusus) medialis* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 41, 1909.

*Original description.* Turreted, with fine acute revolving lines; whorls angulated in the middle, and having a row of tubercles on the angle; suture impressed; whorls contracted beneath the suture. (Conrad)

*Observations.* This species is characterized by an appressed suture, conical spire, and prominent marginal nodules. The specimen figured is one of Conrad's types.

*Holotype.* (U.S.N.M. 3532.) Conrad type. Figured in the present report, pl. 93, fig. 7.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Astoria, Oregon.

*Type locality.* Astoria, Oregon. (Dana, Dall)

**FUSINUS (PRISCOFUSUS) NODIFERUS (Conrad), 1865**

(No name) Conrad, U.S. Explor. Exped. Geol., Append., pl. 20, figs. 12, 12a, 1849.

*Priscofusus nodiferus* Conrad, Am. Jour. Conch., vol. 1, p. 150, pl. 20, fig. 12, 1865.

*Fusinus (Priscofusus) nodiferus* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 41, 1909.

*Observations.* The type of this species is lost but from original illustrations the species appears to be shorter and more robust than the other species described by Conrad.

*Holotype.* (U.S.N.M. Lost.)

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Near mouth of Columbia River.

*Type locality.* Astoria, Oregon. (Dana)

**FUSINUS (PRISCOFUSUS) sp. indet. Dall, 1909**

## Plate 92, figures 3, 5, 6

*Fusinus (Priscofusus) sp. indet.* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 40, 41, 1909.

*Original description.* Shell small, short, whorls rapidly increasing (apex and outer lip wanting), with a subangular shoulder near the middle of the whorl, above which the surface is slightly excavated; on the angle of the shoulder is a series of (on the last whorl 10 or 12) short nodular riblets or projections, over which the fine sharp spiral threads which cover the shell pass without becoming swollen; the spirals are separated by subequal interspaces and are, for the most part, alternately larger and smaller; on the upper whorls a more prominent thread runs close behind the suture; the spiral sculpture is crossed by rather sharp, close, distinct incremental

lines; pillar short, callous, twisted, obliquely truncate toward the extremity; canal moderately wide, slightly recurved. Length of last and penultimate whorls, 27.5 mm.; of aperture, about 18.0 mm.; maximum diameter just behind the aperture, 13.0 mm. (Dall)

*Observations.* Three specimens (all numbered U.S.N.M. 3544) were collected by J. D. Dana from the vicinity of Astoria, Oregon, under the Wilkes Exploring Expedition but were not figured. The form based on this material was described by Dall (101, p. 40) in 1909 but the specimens were not figured. The material is very poorly preserved but is figured in this report on pl. 92, figs. 3, 5, 6. As pointed out by Dall, the species is more angulate than *F. corpulentus* and shorter than *F. geniculus*.

*Holotype.* (U.S.N.M. 3544.) Conrad material. Figured in the present report, pl. 92, figs. 3, 5, 6.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Near mouth of Columbia River.

*Type locality.* Astoria, Oregon. (Dana, Dall)

#### FUSINUS (PRISCOFUSUS) OREGONENSIS (Conrad), 1865

Plate 92, figures 2, 4

(No name) Conrad, U.S. Explor. Exped. Geol., Append., pl. 20, figs. 10, 11, 1849. *Priscofusus oregonensis* Conrad, Am. Jour. Conch., vol. 1, p. 150, pl. 20, figs. 10, 11, 1865; Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 40 (referred to as *Fusinus (Priscofusus) geniculus*), 1909.

*Holotype.* (U.S.N.M. 3517, plaster cast.) Conrad material. Figured in the present report, pl. 92, fig. 4.

*Paratype.* (U.S.N.M. 3535.) Conrad material. Figured in the present report, pl. 92, fig. 2.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Near mouth of Columbia River.

*Type locality.* Astoria, Oregon. (Dana, Dall)

#### FUSINUS (PRISCOFUSUS) HANNIBALI Clark and Arnold, 1923

Plate 93, figures 1, 2, 5

*Fusinus (Priscofusus) hannibali* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 158, pl. 30, figs. 1a, 1b, 2, 1923.

*Original description.* Shell medium in size; apex acute; number of whorls eight or nine; body whorl, including the canal, about two thirds height of shell; suture rather strongly appressed, forming a distinct sutural collar; sides of whorls fairly strongly convex; surface covered with numerous fine spiral threads; most of inter-spaces between spiral threads narrower than tops of threads; every other thread is usually heavier and more prominent than threads on either side of it; twelve or thirteen of these heavy spiral ribs on anterior whorls of spire and about thirty-two on body whorls. Surface also sculptured by from nine to eleven fairly heavy, rounded, prominent, longitudinal ribs; posteriorly these ribs do not extend on to sutural collar; on whorls of spire they extend to suture in front; on some specimens longitudinal ribbing on body whorl is obsolete or nearly so; on others, however, ribbing is well

developed and extends about a third the distance from suture to anterior end. Outer lip sharp, with coarse internal striations; inner lip incrusted with fairly heavy callus. Canal rather short for this genus, slightly reflexed; umbilicus imperforate. Dimensions of type specimen (apical whorls broken): Height, 50.5 mm.; height of body whorl, 29.5 mm.; greatest width of body whorl, 23.5 mm. (Clark and Arnold)

*Observations.* This species, which resembles *F. chehalisensis* (Weaver), may be distinguished from it in having a relatively shorter canal, lower spire, and in being more slender.

*Holotype.* (U.C. 30069.) Figured in the present report, pl. 93, fig. 1.

*Cotype.* (U.C. 30070.) Figured in the present report, pl. 93, figs. 2, 5.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South shore of Vancouver Island.

*Type locality.* Sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

#### FUSINUS (PRISCOFUSUS) CHEHALISENSIS (Weaver), 1912

Plate 92, figures 7, 8, 9; plate 93, figure 6; plate 104, figure 17

*Drillia chehalisensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 78, 79, pl. 6, figs. 65, 66, 1912.

*Drillia hecoxi* (Arnold), Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 30, pl. 4, fig. 48, 1916.

*Original description.* Shell large, slender, fusiform; apex acute; whorls 9 or 10, angulated, very slightly concave above the angle, slightly convex below the angle on the body whorl, but approximately straight on the whorls of the spire; suture distinct, appressed. Ten well defined wavelike ridges cross each whorl at the angle forming nodes; above the angle these twist to the right and dwindle away half way to the suture; below the angle they twist downwards to the left for a very short distance and disappear. Body whorl sculptured by 30 rounded, well defined, equally developed revolving lines. This ornamentation is also characteristic of the spire. Canal long and twisted outward; inner lip smooth and heavily incrusted with callous. Outer lip sharp; posterior sinus fairly well marked; aperture elongate and elliptical; surface ornamented by numerous lines of growth corresponding in curvature to the posterior sinus; angle of spire 25°. Dimensions.—Altitude 80 mm.; diameter 25 mm. and 22 mm.; length of spire 39 mm. and 37 mm. (Weaver)

*Observations.* This species has the same spiral and longitudinal ribbing as *F. hannibali* Clark and Arnold. It has a larger canal, higher spire, and more slender form. The species is widely spread geographically in the middle and upper Oligocene formations of Washington and usually is well preserved.

*Hypotype.* (C.A.S. 507-B.) Figured in the present report, pl. 92, fig. 7.

*Hypotype.* (C.A.S. 551.) Figured in the present report, pl. 92, fig. 8.

*Hypotype.* (U.W. 80-A) (C.A.S. 7545-A). Figured in the present report, pl. 92, fig. 9.

*Hypotype.* (U.W. 80-B) (C.A.S. 7545-B). Figured in the present report, pl. 93, fig. 6.

*Hypotype.* (U.W. 80-E.) Figured in the present report, pl. 104, fig. 17.

*Geologic range.* Lincoln and Blakeley formations, middle and upper Oligocene.

*Geographic distribution.* Puget Sound Basin, southwestern Washington and northwestern Oregon.

*Type locality.* (U.W. 31.) Union Pacific railway cut one-half mile north of Galvin Station, Lewis County, Section 36, T. 15 N., R. 3 W.

**FUSINUS (PRISCOFUSUS) SANCTAECRUCIS (Arnold), 1908**

Plate 91, figures 22, 23; plate 103, figure 14

*Fusus sanctaeccrucis* Arnold, Proc. U.S. Nat. Mus., vol. 34, p. 372, pl. 33, fig. 3, 1908.

*Fusinus (Priscofusus) cf. sanctaeccrucis* (Arnold), Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 129, pl. 12, fig. 3, 1933.

*Original description.* Shell about 45 mm. in length, slender, fusiform; apex acute. Whorls 6 or 7, convex below, flat to concave above; about 12 slightly oblique (sloping downward toward the left), narrow, wave-like ridges extend across each whorl from a short distance below the upper margin to the lower margin, becoming best developed on the angle of the whorl; a flat, narrow, roughened band from the upper margin of the whorl; surface sculptured by numerous fine, equal, equidistant, raised spiral lines, most prominent between the longitudinal ridges; suture distinct, slightly wavy. Canal long, narrow, bowed slightly outward. Dimensions.—Length (restored), 44 mm.; latitude, 12 mm.; length of body whorl, 30 mm. (Arnold)

*Observations.* This species from the upper Oligocene of Washington resembles the Oligocene species from Santa Cruz, California, and is characterized by fine spiral ribbing, compressed transverse nodes, and appressed sutural collar.

*Paratype.* (S.U. 5418.) Figured in the present report, pl. 91, figs. 22, 23.

*Hypotype.* (U.C. 32207.) From Blakeley formation. (Tegland) Figured in the present report, pl. 103, fig. 14.

*Geologic range.* Blakeley and San Lorenzo formations, upper Oligocene.

*Geographic distribution.* Kitsap County, Washington, and Santa Cruz County, California.

*Type locality.* Santa Cruz County, California, on Bear Creek 4 miles above its junction with San Lorenzo River; in Washington at Bean Point, Kitsap County.

**FUSINUS (PRISCOFUSUS) STEWARTI Tegland, 1933**

Plate 93, figures 3, 4, 10, 14

*Drillia chehalensis* Weaver, Van Winkle, Univ. Wash. Publ. Geol., vol. 1, p. 76 (check-list of Blakeley fauna), 1918.

*Fusinus (Priscofusus) stewarti* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 129, 130, pl. 12, figs. 4, 5, 6, 7, 8, 1933.

*Original description.* Shell elongate, fusiform, adult shell with about eight whorls; entire shell ornamented with closely spaced spiral ribbing with intercalaries sometimes barely discernible threads and sometimes subequal to major ribbing; major angulation of whorl accented by slightly compressed crescentic tubercles usually twelve in number on body whorl, nine or ten on penultimate whorl; tubercled angulation slightly anterior to mesial line on posterior whorls; posterior portion of whorl appressed into a sutural collar. Body whorl subcylindrical below shoulder angle, rapidly constricting below the second obtuse angulation into a slender canal (usually broken away on specimens collected); inner lip with narrow callus extending from

posterior notch to tip of canal; canal gently recurved with obscure elongate siphonal fasciole. Dimensions of holotype: height, 36 mm.; greatest diameter, 14.5 mm. (Tegland)

*Observations.* This species may be distinguished from *F. sanctae-crucis* in being a smaller shell and in having spiral ribbing which lacks the uniformity of alternating primary and secondary ribs. The transverse ornamentation has shorter tubercles.

*Holotype.* (U.C. 32238.) Figured in the present report, pl. 93, fig. 3.

*Paratype.* (U.C. 32240.) Figured in the present report, pl. 93, fig. 4.

*Paratype.* (U.C. 32239.) Figured in the present report, pl. 93, fig. 10.

*Paratype.* (U.C. 32241.) Figured in the present report, pl. 93, fig. 14.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Kitsap County, Washington.

*Type locality.* Restoration Point, opposite Seattle.

**FUSINUS (PRISCOFUSUS) LINCOLNENSIS (Anderson and Martin), 1914**

Plate 93, figures 8, 9

*Turris lincolnensis* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 88, 89, pl. 6, fig. 8, 1914.

Not *Turris lincolnensis* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 92, pl. 7, fig. 24, 1918 (renamed "Borsonella" *nuncapatia* G. D. Hanna, 1924).

*Original description.* Shell large, fusiform, with seven or eight whorls; spire high, with an acute apex; whorls of the spire obtusely angulated a little anterior to the middle, nearly flat above and below, slightly concave near the suture; ornamentation consisting of prominent nodes and fine spiral threads separated by wider interspaces carrying fine intercalary lines, fifteen nodes and about twenty-four major spiral threads on the penultimate whorl; suture distinct, appressed; body-whorl ventricose, ornamented with a row of nodes a little above the middle producing a slight angular appearance, convex above and below, constricted at the suture; spiral sculpture similar to that of the whorls of the spire; aperture oval, with a broad and shallow posterior sinus; canal moderately long. Dimensions:—Altitude of the figured specimen, apex and canal defective, 43 mm.; width of the last whorl, 24 mm. (Anderson and Martin)

*Observations.* This species, which resembles *F. coli* (Dall), differs in being angulated and in having nodes instead of ribs.

*Holotype.* (C.A.S. 211.) Figured in the present report, pl. 93, figs. 8, 9.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Lincoln County, Oregon.

*Type locality.* (U.W. 691.) Sandstone cliff along ocean south of Yaquina Head, five and one-half miles north of entrance to Yaquina Bay, Oregon.

**FUSINUS (PRISCOFUSUS) CARLSONI** (Anderson and Martin), 1914

Plate 93, figures 11, 13

*Turris carlsoni* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 89, pl. 5, figs. 2a, 2b, 1914.

*Original description.* Shell large and solid, fusiform, with about eight whorls; spire high, with an acute apex; whorls of the spire with a subdued angular appearance below the middle, slightly concave above, convex below, ornamented with a row of nodes on the angulation, and numerous spiral striations somewhat alternating in prominence; suture appressed, bordered by a sutural collar; body-whorl ventricose, convex near the middle of the whorl, with inconspicuous or obsolete nodes, spiral sculpture the same as on the upper whorls; on some specimens the lower portion of the body-whorl is marked by raised cords and intercalary lines in place of the incised lines or striations; aperture oval, with a simple outer lip; columella incrusted, smooth, with an anterior sulcus; canal moderately long, curved to the left. Dimensions:—Altitude of the type specimen, canal defective, 44 mm.; width of the last whorl, 21 mm.; length of the aperture, including the canal, 25 mm. (Anderson and Martin)

*Observations.* This species may be distinguished from *F. chehalensis* in the smaller apical angle, relatively wider, lower, and less angulate whorls, and finer and more numerous spiral ribs.

*Holotype.* (C.A.S. 212.) Figured in the present report, pl. 93, figs. 11, 13.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Lincoln County, Oregon.

*Type locality.* (U.W. 691.) Ocean cliff south of Yaquina Head, five and one-half miles north of entrance to Yaquina Bay, Oregon.

**FUSINUS (PRISCOFUSUS) CAMMANI** (Dall), 1909

Plate 94, figure 9

*Turris cammani* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 25, 26, pl. 4, figs. 12, 13, 14, 1909.

*Priscofusus cammani* (Dall), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 491, 1931.

*Original description.* Shell large, of five or more whorls, rather inflated, the whorl divided by an obtuse carina a little above the periphery; behind this carina the whorl is flattened and closely appressed at the suture; in front of the carina the whorl is rounded, with a short, wide canal; the axial sculpture consists chiefly of the incremental lines, which are sinuous in conformity with the broad, shallow sinus of the immature shell; transverse sculpture comprising the carina and numerous spiral threads with narrower interspaces, the threads coarser on the base of the shell; aperture wide, ovate, short, without callosities on the body; outer lip blunt but not varicose or reflected, with a large, moderately deep sinus between the carina and the suture, the anterior part of the lip produced. Altitude of specimen showing upper whorls (fig. 12), 47 mm.; maximum diameter, 30 mm. Altitude of fragment showing last whorl (figs. 13, 14), 44 mm.; maximum diameter, 33 mm. (Dall)

*Observations.* In general shape this species somewhat resembles *F. lincolnensis* (Anderson and Martin). It may be distinguished from it in the more marked angulation of the whorls and in the lack of longitudinal ribs.

*Holotype.* (U.S.N.M. 153909.) Figured in the present report, pl. 94, fig. 9.

*Geologic range.* Empire formation, upper Miocene.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* Coos Bay, Oregon. (Camman collection)

**FUSINUS (PRISCOFUSUS) COOSENSIS (Dall), 1909**

## Plate 93, figures 15, 18

*Turris coosensis* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 24, 25, pl. 2, fig. 3, 1909.

*Priscofusus coosensis* (Dall), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 491, 1931.

*Original description.* Shell large, solid, with at least five well-rounded whorls markedly constricted at the sutures; the earlier whorls are axially sculptured with about 14 more or less flexuous rounded ribs extending from the shoulder nearly or quite to the suture in front, which is strongly appressed; these ribs are obsolete over most of the last whorl; the lines of growth are more or less perceptible and indicate a marked but shallow sinus between the shoulder and the suture; owing to the defective condition of this part of the shell, the figure does not show this situation on the side represented, but it is distinct in places on the opposite side of the specimen; the spiral sculpture is strong over the whole shell except just in front of the sutures and consists of strong cords separated by well-defined but narrower channels which sometimes contain an intercalary small thread; the larger cords are about a millimeter wide, and at the shoulder there is one that is a little wider and more prominent than the others, but does not carinate the whorls, which are gently excavated in the region of the anal fasciole; the aperture was short and wide, but is defective in the specimen. Altitude of shell, 67 mm.; maximum diameter of last whorl, 34 mm. (Dall)

*Observations.* This species may be distinguished from *F. cammani* (Dall) in having more constricted sutures, coarser spiral sculpture, and longitudinal ribbing.

*Holotype.* (U.S.N.M. 107783, in part.) Figured in the present report, pl. 93, figs. 15, 18.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* Coos Bay, Oregon. (Dall)

**FUSINUS (PRISCOFUSUS) COLI (Dall), 1909**

## Plate 94, figure 4

*Turris coli* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 26, pl. 4, fig. 2, 1909.

*Original description.* Shell rather large and heavy for the genus, of over five whorls; the apex defective, the fragment on which this description is based comprising somewhat less than four complete whorls; anterior portion of the shell with the canal missing; whorls swollen, except above the shoulder, where they are constricted and widely appressed to the preceding whorl; suture not conspicuous and rather sinuous; axial sculpture on each whorl of 9 or 10 robust rounded ribs with subequal interspaces, beginning below the constriction, on the upper whorls reaching the suture in front, on the last whorl hardly perceptible beyond the periphery of the whorl, and where a resting stage has coincided with a rib, showing traces of the sharp edge of the original margin; the lines of growth indicate a wide, shallow sinus having its maximum depth at the shoulder of the whorl; spiral sculpture of fine, numerous, rounded, low threads having sharply defined but usually narrower interspaces, which on the later whorls often carry a smaller intercalary thread; the spirals do not enlarge in passing over the ribs and toward the base are frequently crossed by fine slightly elevated incremental lines which give a certain roughness to the sculpture without being very conspicuous; the fractured end of the pillar is solid and heavy, and in the type there is no indication of any thickening of the outer lip or any callosity on the body. Altitude of specimen as figured, 35 mm.; maximum diameter, 22 mm. (Dall)

*Observations.* This species resembles somewhat *F. lincolnensis*. It may be distinguished from it by the subangulate surface of the body whorl about one-third the height of the whorl below the suture, and in having a well-defined collar just below and in contact with the suture. The character of the longitudinal ribs is nearly the same on both species.

*Holotype.* (U.S.N.M. 107783, in part.) Figured in the present report, pl. 94, fig. 4.

*Geologic range.* Empire formation, upper Miocene.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* Coos Bay (Camman collection). (Dall)

Genus **STREPTOCHETUS** Cossmann, 1889

*Streptochetus* Cossmann, Essais paléoconchologie comparée, vol. 4, p. 29, 1889.

*Genotype.* *Fusus intortus* Lamarck.

**STREPTOCHETUS** sp. Turner, 1938

Plate 94, figure 7; plate 104, figures 9, 16

*Streptochetus* sp. Turner, Geol. Soc. Am., Spec. Pap. no 10, p. 77, pl. 17, fig. 14, 1938.

*Observations.* This specimen from the Umpqua formation in Oregon is the only one of the genus from the Northwest. It is represented by a single specimen which is not in a very good state of preservation.

*Holotype.* (U.C. 33680.) Figured in the present report, pl. 94, fig. 7; pl. 104, figs. 9, 16.

*Geologic range.* Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.O. 138.) Bank of Little River between highway bridge and first bend of stream east of junction with North Umpqua River, center of Section 19, T. 26 S., R. 3 W.

Genus **FULGUROFUSUS** Cossmann, 1906

*Fulgurofusus* Cossmann, Essais paléoconchologie comparée, vol. 7, p. 227, 1906.

*Genotype.* *Fusus quercolis* Harris.

**FULGUROFUSUS WASHINGTONIANA** (Weaver), 1912

Plate 93, figures 12, 16, 17; plate 101, figures 4, 5

*Fusus washingtoniana* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 50, pl. 2, fig. 10, 1912; Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 72, pl. 9, fig. 8, 1915.

*Original description.* Shell moderately small; spire pagodaform and elongate; whorls eleven and very sharply angulated; body whorl with angle at lower half of middle third of surface. Surface above angle straight and sloping upwards at an angle

of 45°; lower surface straight and sloping downwards making an angle with the upper surface of 100°; lower surface of whorls of spire straight and nearly horizontal. Surface ornamented with thirteen longitudinal ribs which are limited to flattened nodes on the angle and gradually disappear toward the suture; twenty-eight equally spaced revolving ribs are present. Suture distinct and undulating. Longitudinal lines of growth well developed. Canal long and straight; inner lip incrusted; outer lip thin. Dimensions.—Altitude, apex to broken end of spire 25 mm.; diameter 13 mm.; altitude of spire 15 mm.; angle of spire 50°. (Weaver)

*Observations.* This species, fairly abundant and usually well preserved, is from the Cowlitz formation east of Vader, Washington. The shape of the whorls and the ornamentation are distinct and the species may be distinguished easily from other forms in the faunas of Oregon and Washington.

*Holotype.* (U.W. 34) (C.A.S. 7559). Figured in the present report, pl. 101, fig. 4.

*Paratype.* (C.A.S. 497.) Figured in the present report, pl. 93, fig. 16.

*Hypotype.* (U.C. 15478.) Figured in the present report, pl. 93, fig. 12.

*Hypotype.* (U.W. 570.) Figured in the present report, pl. 93, fig. 17.

*Hypotype.* (U.W. 504.) Figured in the present report, pl. 101, fig. 5.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River, one and one-half miles east of Vader, Lewis County, Section 28, T. 11 N., R. 2 W.

## Family VOLUTIDAE

### Genus MIOPLEIONA Dall, 1909

*Miopleiona* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 35, 1909.

*Genotype.* *Miopleiona indurata* (Conrad).

### MIOPLEIONA INDURATA (Conrad), 1849

Plate 94, figures 5, 8, 13

*Rostellaria indurata* Conrad, U.S. Explor. Exped. Geol., p. 727, 1849.

*Miopleiona indurata* Conrad, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 35, pl. 18, fig. 5 (not fig. 6), 1909.

*Original description.* Subfusiform, with oblique, curved, rounded ribs, whorls contracted or narrow toward the suture. The specimens are fragments of casts. The lip does not appear to have been greatly expanded. (Conrad)

*Observations.* This Miocene species may be distinguished from the Oligocene form *M. weaveri* Tegland by being smooth and lacking the numerous well-defined fine spiral ribs.

*Holotype.* (U.S.N.M. 5908.) Conrad specimen = *Rostellaria indurata* Conrad. Figured in the present report, pl. 94, fig. 8.

*Hypotype.* (U.S.N.M. 112409.) Figured in the present report, pl. 94, fig. 5.

*Hypotype.* (U.C. 15490.) Figured in the present report, pl. 94, fig. 13.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Near mouth of Columbia River and on Oregon coast near Yaquina Bay.

*Type locality.* Astoria, Oregon. (Dall)

#### MIOPLEIONA OREGONENSIS Dall, 1909

##### Plate 94, figure 12

*Miopleiona oregonensis* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 35, 36, pl. 18, figs. 3, 7, 1909.

*Psephaea prevostiana* (Crosse) var. *oregonensis* (Dall), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 634, pl. 27, figs. 6, 10, 1931.

*Original description.* Shell rather thin for its size, subovate, with about six whorls, the apical whorls rapidly diminishing; nucleus small, its characters unknown; subsequent whorls with arcuate rounded ribs and wider interspaces, the ribs numbering about 14 on the penult and 20 on the last whorl; surface otherwise smooth except for incremental lines, the ribs feebler on the last whorl; body rather turbid, the suture distinct, not appressed, the whorl in front of it sometimes showing an obscure marginal ridge or slight tabulation; strength of the ribs variable in different specimens; aperture semi-ovate; sulcate at the posterior commissure; pillar straight, with one strong and one feeble plait about the middle of it, rather widely separated; outer lip thin, slightly reflected, produced in the adult at the posterior commissure. Length of largest (but imperfect) specimen, about 160 mm.; of restored smaller type specimen, 110 mm.; of aperture, 68 mm.; maximum diameter, 45 mm. (Dall)

*Observations.* This species is more robust and lacks the spiral ribbing of *M. weaveri*; it has fewer longitudinal ribs, and a relatively shorter spire.

*Holotype.* (U.S.N.M. 153894.) Figured in the present report, pl. 94, fig. 12.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay, Oregon, and Coast Ranges of central and northern California.

*Type locality.* Goldwashers Gully, Coos Bay, Oregon. (Dall)

#### MIOPLEIONA WEAVERI Tegland, 1933

##### Plate 94, figures 6, 10, 11

*Miopleiona indurata* (Conrad), Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 35  
(in part), pl. 18, fig. 6 (not fig. 5) = *M. indurata* (Conrad), 1909.

*Miopleiona weaveri* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23,  
pp. 127, 128, pl. 11, figs. 1, 2, 3, 4, 5, 1933.

*Original description.* Shell long, slender; spire and aperture about equal in height; entire surface ornamented by fine reticulate sculpturing overlying 11 to 14 sinuous transverse ribs which tend to disappear on the body whorl. Aperture spindle-shaped; inner lip covered by a regular oval-shaped callus which is thickest posteriorly. Canal and outer lip missing on all specimens. Dimensions of holotype (medium sized shell lacking canal and apex): height, 95 mm.; diameter, 37.5 mm.; of largest paratype with apex and canal missing: height, 119.3 mm.; diameter, 55.5 mm. (Tegland)

*Observations.* This species is slenderer than *M. indurata*, and has stronger longitudinal ribs and well-defined fine spiral ribbing.

*Holotype.* (U.C. 32243.) Figured in the present report, pl. 94, fig. 10.

*Paratype.* (U.C. 32248.) Figured in the present report, pl. 94, fig. 6.

*Hypotype.* (U.S.N.M. 110428.) Dall's specimen (101, pl. 18, fig. 6). Figured in the present report, pl. 94, fig. 11.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Kitsap and Clallam counties, Washington.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, opposite Seattle.

#### Genus VOLUTOCORBIS Dall, 1890

*Volutocorbis* Dall, Trans. Wagner Free Inst. Sci., vol. 3, p. 75, 1890.

*Genotype.* *Volutocorbis limopsis* (Conrad).

#### VOLUTOCORBIS OREGONENSIS Turner, 1938

##### Plate 94, figure 2

*Volutocorbis? oregonensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 73, pl. 18, fig. 16, 1938.

*Original description.* Shell medium size, volutaform, slender, spire approximately one-third total length, ornamented by 10 longitudinal ribs extending from the suture well down on the body whorl and by well-marked spiral threads covering entire whorl and canal. Aperture very elongate and narrow, outer lip thin, inner lip not well exposed; columella slender. (Turner)

*Observations.* This species is characterized by its high spire, slender outline, and fine equally developed spiral ribs which extend over the entire shell.

*Holotype.* (U.C. 33223.) Figured in the present report, pl. 94, fig. 2.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-690.) About 500 feet down stream from Hughes Ferry on north bank of North Umpqua River west of Glide, Oregon.

#### Family MARGINELLIDAE

#### Genus MARGINELLA Lamarck, 1799

*Marginella* Lamarck, Mem. Soc. Hist. Nat. Paris, p. 70, 1799.

*Genotype.* *Voluta glabella* Linnaeus.

**MARGINELLA SHEPARDAE** Tegland, 1933

## Plate 94, figure 1

*Marginella shepardae* Tegland, Univ. Calif. Pub., Bull. Dept. Geol. Sci., vol. 23, p. 127, pl. 10, figs. 22, 23, 1933.

*Original description.* Shell small, smooth. Spire depressed, sutures showing only faintly, whorls four or five in number. Body whorl, which practically envelopes the entire form, globose posteriorly, tapering anteriorly; aperture narrow, acute at posterior end, of rather uniform width, and ending in open canal; inner lip with four plications of which the anterior is the strongest fold and the posterior or fourth showing faintly; outer lip parallel to the body of the shell, simple, smooth, with no inner crenulations, and not thickened. Dimensions: height, 6.9 mm.; width, 4.9 mm. (Tegland)

*Observations.* This species, which somewhat resembles *M. instabilata* Hanna of the lower Oligocene, differs in being larger and more robust and in having a partially immersed spire, a more broadly reflected outer lip, and in always having four columellar plications instead of five.

*Holotype.* (U.C. 32208.) Figured in the present report, pl. 94, fig. 1.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Kitsap County, Washington.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, opposite Seattle.

**MARGINELLA INSTABILATA** Hanna, 1924

## Plate 94, figure 3; plate 95, figures 26, 27

*Marginella pacifica* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 178, pl. 31, fig. 2, 1917.

Not *Marginella pacifica* Pease, Am. Jour. Conch., vol. 3, p. 280, pl. 23, fig. 20, 1868.

*Marginella instabilata* Hanna, Proc. Calif. Acad. Sci., ser. 4, vol. 13, p. 170, 1924.

*Hyalina (Cystiscus) instabilata* (Hanna), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 632, 1931; Effinger, Jour. Paleon., vol. 12, pp. 384, 385, pl. 47, fig. 13, 1938.

*Original description.* Shell minute, egg-shaped, smooth; whorls four; spire nearly immersed; suture obscure; body-whorl thickest in middle; outer lip slightly thickened; inner lip bearing five sub-equally spaced plaits, of which the last two are the strongest; canal, short, wide. This form is very numerous at the type locality. Dimensions:—Length, 3 mm.; width of body-whorl, 1.7 mm. (Dickerson)

*Observations.* This species is distinguished from other Northwest species by its small size and five columellar plications. It is known only from the Gries Ranch beds.

*Holotype.* (C.A.S. 427.) Figured in the present report, pl. 95, figs. 26, 27.

*Hypotype.* (U.C. 33604.) Figured in the present report, pl. 94, fig. 3.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, Section 25, T. 11 N., R. 2 W.

Genus **PERSICULA** Schumacher, 1817

*Persicula* Schumacher, Essais d'un Nouv. Syst. des Habit. des Vers Test., p. 235, 1817.

*Genotype.* *Persicula variabilis* Schumacher = *Voluta persicula* Linnaeus.

**PERSICULA CHEHALISENSIS** n. sp.

Plate 94, figure 14

*Description.* Shell small, highly polished, smooth, subconic-ovate in outline and sides of body whorl very slightly depressed; spire completely concealed; posterior surface of body whorl evenly rounded and flattened at apex; aperture narrow, slightly oblique and extending a distance approximately nine-tenths the length of shell; outer lip broken; inner lip moderately calloused and containing four plait, the anterior two of which are exceptionally heavy and sharp, the posterior two about one-third as heavily developed, more broadly rounded with interspaces of slightly greater width; anterior end of shell heavy, moderately wide and not deeply notched. Dimensions: Altitude, 8.2 mm.; maximum diameter, 4.0 mm.

*Holotype.* (U.C. 12541.) Locality (U.C. 9004). Figured in the present report, pl. 94, fig. 14.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 407) (U.C. 9004). Clemons logging road, about 4600 feet northwest of Saginaw trail at siding near the ten-mile post. Grays Harbor County, Section 36, T. 17 N., R. 7 W.

Genus **LYRIA** Gray, 1847

*Lyria* Gray, Proc. Zool. Soc. London, pt. 15, p. 141, 1847.

*Genotype.* *Voluta nucleus* Lamarck.

**LYRIA COQUILLENSIS** Turner, 1938

Plate 95, figures 1, 4

*Lyria coquillensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 73, pl. 18, fig. 12, 1938.

*Original description.* Shell large, heavy; nucleus small; spire slightly greater than one-third of the total length; suture appressed; adult whorls ornamented by six elongate axial nodes; early whorls by about 12; growth lines prominent; columella heavy with broad callous and four heavy plications below the middle of the aperture; reflection of the anterior extensions of the inner lip forms a slight fasciole; aperture broadens anteriorly; margin of outer lip smooth and rounded. Dimensions: length 72.8 mm.; diameter 34.5 mm. (Turner)

*Observations.* This large species may be distinguished from *L. andersoni* Waring by its larger size and shorter longitudinal ribs.

*Holotype.* (U.C. 33174.) Figured in the present report, pl. 95, figs. 1, 4.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-836.) Middle fork of Coquille River opposite Roseburg-Coos Bay Highway Survey station 845 + 33.

#### **LYRIA ANDERSONI Waring, 1917**

Plate 95, figures 2, 3, 7, 28, 29

*Cancellaria irelaniana* Cooper, Arnold, U.S. Geol. Surv., Bull. no. 396, pl. 4, fig. 22, 1909; Arnold, U.S. Geol. Surv., Bull. no. 398, p. 286, pl. 26, fig. 22, 1910.

*Lyria andersoni* Waring, Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 97, 98, pl. 15, fig. 12, 1917; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 73, pl. 18, fig. 5, 1938.

*Original description.* Shell subfusiform, eight-whorled; first whorls nuclear; spiral sculpture covering entire shell save protoconch; transverse sculpture of eight prominent, transverse folds extending entire height of whorls; abruptly truncated above and gradually impressed below; aperture long and narrow, outer lip slightly in advance of a transverse fold; inner lip with wash of callous and three or four plaits; canal slightly turned backward and notched; a spiral fold on the canal represents the former positions of the notch. This species does not develop tubercles on the whorls as does *Cancellaria irelaniana* Cooper. Locality 8, L. S. J. U. Pal. Coll. (Waring)

*Observations.* *L. andersoni* is a smaller shell than *L. coquillensis* but has heavier and larger longitudinal ribs which are present over most of the surface of the whorls. It lacks the nodes on the shoulder as represented in the specimens of *L. coquillensis* from the upper Umpqua formation.

*Plastoholotype.* (S.U. 4816.) Figured in the present report, pl. 95, figs. 28, 29.

*Hypotype.* (U.C. 33168.) From upper Umpqua formation. Figured in the present report, pl. 95, figs. 2, 3.

*Hypotype.* (U.C. 15790.) From Domengine formation, Coalinga, California. Figured in the present report, pl. 95, fig. 7.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon, and Coalinga area, California.

*Type locality.* (S.U. 8.) California.

*Northwest locality.* (U.C. A-844.) Four hundred fifty feet downstream from bend on north bank of North Umpqua River across from lower end of island at junction of Little River, Douglas County, Oregon. (Turner)

#### **Family MITRIDAE**

##### **Genus MITRA Martyn, 1784**

*Mitra* Martyn, Univ. Conch., vol. 1, explanatory table, pl. 19, 1784.

*Genotype.* *Mitra tessellata* Martyn.

**MITRA CRETACEA** Gabb var. Turner, 1938

Plate 95, figures 5, 6

*Mitra cretacea* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 103, pl. 28, fig. 215, 1864; Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 406, pl. 27, figs. 9, 10, 1926.

*Mitra cretacea* Gabb var. Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 74, pl. 15, fig. 9, 1938.

*Observations.* This middle Eocene specimen from Oregon, as noted by Turner, has heavier nodes than occur on *Mitra cretacea* Gabb and the whorls are more strongly angulated.

*Holotype.* (U.C. 33221.) Figured in the present report, pl. 95, figs. 5, 6.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-996.) Roseburg Quadrangle, Oregon. Three-quarters of a mile northwest of forks of Umpqua River, opposite old Poor Farm.

**MITRA DOUGLASENSIS** Hendon, 1938

Plate 95, figures 10, 11

*Mitra douglasensis* Hendon, in Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 74, pl. 15, fig. 6, 1938.

*Original description.* Shell small, fusiform, fairly heavy; spire about half the total length; suture impressed; whorls convex with noded collar adjacent to the suture; whorls on spire ornamented by three heavy spiral riblets and 18 closely set axial ribs which intersect and give a nodose appearance; body whorl with 10 revolving riblets and no axial riblets; canal short; columella heavy with at least three strong plications perpendicular to it. (Hendon in Turner)

*Observations.* This species may be distinguished from the other species of the genus in Oregon and Washington by its noded collar and very strong spiral ribs.

*Holotype.* (U.C. 33632.) Figured in the present report, pl. 95, figs. 10, 11.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-667.) North bank of Umpqua River from a bend a quarter of a mile north of Glide to Bradley Creek, Douglas County, Oregon.

**MITRA WASHINGTONIANA** Weaver, 1912

Plate 95, figures 8, 9, 16

*Mitra washingtoniana* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 52, 53, pl. 2, fig. 16, 1912; Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 11, figs. 11a, 11b, 1915.

*Mitra cf. washingtoniana* Weaver, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 74, pl. 15, figs. 17, 18, 1938.

*Original description.* Shell very small, sub-fusiform and smooth; spire moderately long; whorls seven and very convex; body whorl regularly convex; suture

distinct and moderately deep; surface sculptured by fine microscopic revolving threads and very fine closely set lines of growth. This sculpture is very indistinct with the unaided eye but can clearly be made out with a hand lens; the upper surface of each whorl immediately below the suture is set with minute, closely-spaced longitudinal ribs which disappear a short distance below on the whorl. Aperture narrow, elongate, continuing but becoming very narrow at end of canal; canal short; inner lip somewhat incrusted and set with four oblique folds, the posterior of which are the larger. Dimensions.—Altitude 12 mm.; diameter 5.5 mm.; altitude of spire 4.5 mm.; angle of spire 58°. (Weaver)

*Observations.* The species is abundant in the fauna at the type locality of the Cowlitz formation and several poor specimens have been obtained from the upper Umpqua formation in southwestern Oregon. Only the faintest indications of longitudinal ornamentation are visible on this species.

*Holotype.* (C.A.S. 357.) Figured in the present report, pl. 95, fig. 9.

*Hypotype.* (U.C. 15499.) Figured in the present report, pl. 95, fig. 8.

*Hypotype.* (U.W. 38) (C.A.S. 499). Figured in the present report, pl. 95, fig. 16.

*Geologic range.* Cowlitz and upper Umpqua formations, upper and middle Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington, and Douglas County, Oregon.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Lewis County, Washington, Section 28, T. 11 N., R. 2 W.

### Family HARPIDAE

Genus **HARPA** ("Bolten") Roeding, 1798

*Harpa* Roeding, in Bolten, Museum Boltenianum, p. 149, 1798.

*Genotype.* *Buccinum harpa* Linnaeus.

#### **HARPA CRESCENTIS** Weaver and Palmer, 1922

Plate 95, figures 12, 13

*Harpa crescentensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, p. 40, pl. 11, fig. 21, 1922.

*Harpa?* *crescentensis* Weaver and Palmer, Vokes, Jour. Paleon., vol. 11, p. 12, pl. 2, fig. 9, 1937.

*Original description.* Shell small and globose; whorls five, apex minute; body whorl inflated; spire short, whorls broad and rounded; suture distinct slightly impressed; inner lip smooth, canal moderately elongate, slightly notched at the anterior end; aperture oblong; surface of the body whorl ornamented with sharp, lamellar, curved, longitudinal ribs with interspaces equal to about three times the width of the ribs; the longitudinal ribs extend from the suture line to the lower portion of the whorl where they curve and fold into the callus on the columella; the longitudinal ribs are present but only faintly developed on the whorls of the spire; faint, revolving striae occur on the upper portion of the body whorl which on the lower region of the shell become conspicuous, these ribs are separated by spaces about twice the width of the rib. Dimensions.—Length 6 mm.; width of body whorl 3.5 mm.; apical angle 65°. (Weaver and Palmer)

*Observations.* The fossil material at the type locality of the Crescent formation in Washington has yielded a few poorly preserved specimens of *Harpa crescentensis*. Two other species of *Harpa* occur in the Eocene of California: *H. mutica californiensis* Vokes and *H. clarki* Vokes. Vokes (278-A, pp. 10, 11) has called attention to the similarity of these forms to the Lutetian stage of the Paris Basin.

*Holotype.* (U.W. 206) (C.A.S. 7576). Figured in the present report, pl. 95, figs. 12, 13.

*Geologic range.* Crescent formation, middle Eocene.

*Geographic distribution.* Crescent Bay, Clallam County, Washington.

*Type locality.* (U.W. 568.) Sandy tuff in sea cliff on western shore of Crescent Bay, Clallam County, immediately above the basalt of the Metchosin formation.

Genus CRYPTOCHORDA Mörsch, 1858

*Cryptochorda* Mörsch, Jour. de Conch., ser. 2, vol. 3, p. 43, 1858.

*Genotype.* *Buccinum stromboides* Hermanns.

CRYPTOCHORDA CALIFORNICA (Cooper), 1894

Plate 95, figures 19, 23

*Ancilla (Oliverato) californica* Cooper, Cat. Calif. Fossils, California State Min. Bur., Bull. no. 4, p. 43, pl. 1, figs. 6-11, 1894.  
*Oliverato californica* Cooper, Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 7, pp. 286, 287, pl. 13, figs. 4a, 4b, 1913.  
*Ancilla (Oliverato) californica* (Cooper), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, pl. 12, figs. 4a, 4b, 1914.  
*Cryptochorda californica* (Cooper), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 72, pl. 18, figs. 11, 15, 1938.

*Original description.* About half of spire (the nuclear whorls) invisible in adult; mouth with lips nearly parallel at middle; narrower at ends in the young, with about ten faint ridges along columella, not passing inside; no umbilicus. Dorsal surface marked by ridges from irregular thickness of the callus, and a deep oblique furrow running from the anterior notch toward the left, as in *Pseudoliva*, etc. Parallel to this, about six light ridges remain permanent behind it, thickened but not obscured by callus. General form becoming more ovate with age, but always narrower in front. Length, about 1.50 inch; breadth, about 0.85; mouth, 1.12 inch long, 0.50 wide. Eight specimens examined. (Cooper)

*Observations.* In the Northwest, this species occurs only in the Eocene of southwest Oregon. It has a relatively slightly higher spire than the specimens from Marysville Buttes.

*Hypotype.* (U.C. 33169.) Figured in the present report, pl. 95, fig. 23.

*Hypotype.* (U.C. 33243.) Figured in the present report, pl. 95, fig. 19.

*Geologic range.* Upper Umpqua and Domengine formations, middle Eocene.

*Geographic distribution.* Douglas County, Oregon; Aliso Canyon, Ventura County, and Marysville Buttes, California.

*Type locality.* Marysville Buttes, California. Occurs in Douglas County, Oregon, at locality (U.C. A-662). East bank of Little River between highway bridge and first bend of stream east of junction with North Umpqua River. Center of Section 19, T. 26 S., R. 3 W.

## Family OLIVIDAE

## Genus ANCILLA Lamarck, 1799

*Ancilla* Lamarck, Mem. Soc. Hist. Nat. Paris, p. 70, 1799.*Genotype.* *Ancillaria candida* Lamarck.

## ANCILLA GABBI Cossmann, 1899

## Plate 95, figure 18

*Ancillaria elongata* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 100, pl. 18, fig. 54, 1864; M. A. Hanna, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 323, pl. 53, figs. 9-13, 1927.*Ancilla gabbi* Cossmann, Essais Paléon. Comp., vol. 3, p. 60, 1899; Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 411, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 72, pl. 18, fig. 6, 1938.

*Original description.* Shell small, slender, elongated; spire high, whorls six, sides flattened, suture obliterated (from an impression in the matrix). Aperture narrow, acuminate posteriorly, columella folded in advance. Surface smooth. Length, 0.4 inch; width of body whorl, 0.14 inch. (Gabb)

*Observations.* This species in general outline resembles *Olivella matthewsonii* var. *umpquaensis* but differs in the generic distinction of its subdivided basal fasciole. The shell is a little more slender and the spire relatively higher.

*Holotype.* Lost.*Hypotype.* (U.C. 33243.) Figured in the present report, pl. 95, fig. 18.*Geologic range.* Tyee and Domengine formations, middle Eocene.*Geographic distribution.* Southern Willamette Valley, Oregon.

*Type locality.* Near San Diego, California. Perhaps 1,000 feet east of the summit of Soledad Mountain on the east side of the canyon in the bottom of Rose Creek. Occurs in Oregon at locality (U.C. A-1134). In road cut at east end of highway overpass half a mile south of Comstock on Pacific Highway.

## Genus OLIVELLA Swainson, 1831

*Olivella* Swainson, Zool. Illus., ser. 2, vol. 2, pl. 58, and explanations, 1831.*Genotype.* *Oliva purpurata* Swainson.

## OLIVELLA MATHEWSONII Gabb, 1864

## Plate 103, figure 7

*Olivella matthewsonii* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 100, 223, pl. 18, fig. 54, 1864; p. 220, 1869; Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 26, 27, 1916; Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 410, 411, pl. 29, fig. 13, 1926.

*Original description.* Small, fusiform, spire somewhat elevated; whorls five, suture deeply channelled and margined above by a slightly raised rib. Surface smooth. Anterior end, with two or three plications. Aperture acute behind, broad in front, and deeply notched. Length, 0.8 inch. (Gabb)

*Observations.* This species has been recognized in the Northwest only in the Cowlitz formation. The few specimens obtained are slenderer than those of the variety *O. matthewsonii umpquaensis* Turner from the upper Umpqua formation in southwest Oregon.

*Lectotype.* (P.A.N.S. 4202.) (Stewart, 266-A, pl. 29, fig. 13.) Figure reproduced in the present report, pl. 103, fig. 7.

*Geologic range.* Domengine, Tejon, and Cowlitz formations, middle and upper Eocene.

*Geographic distribution.* Coast Ranges of California and western Washington.

*Type locality.* Domengine formation at Martinez, California. In Washington at locality (U.W. 232). North bank of Cowlitz River one and one-half miles east of Vader, Lewis County, Section 28, T. 11 N., R. 2 W.

#### OLIVELLA MATHEWSONII Gabb var. UMPQUAENSIS Turner, 1938

Plate 95, figures 15, 17

*Olivella matthewsonii* Gabb, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, 1914; Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, p. 572, 1913.

*Olivella matthewsonii* Gabb var. *umpquaensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 72, pl. 18, figs. 13, 14, 1938.

*Original description.* Shell smooth, spindle shaped, fairly robust; suture channeled; columella with two closely adjoining prominent plaits at its extremity which cross at an angle of approximately 40 degrees. Dimensions: Holotype (U.C. 33650) : length 11.9 mm.; diameter 5 mm. (Turner)

*Observations.* This variety may be distinguished from *O. matthewsonii* by the better marked subdivisions of the basal fasciole and in having a more slender outline.

*Holotype.* (U.C. 33650.) Figured in the present report, pl. 95, figs. 15, 17.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. 3608.) Near Glide, Oregon.

#### OLIVELLA PEDROANA (Conrad), 1855

Plate 95, figures 25, 30

*Strephona pedroana* Conrad, U.S. 33d Cong., 1st sess., House Ex. Doc. 129. Appendix to Preliminary Geol. Rept. of W. P. Blake, p. 17, 1855; Pacific R.R. Repts., vol. 5, p. 327, pl. 6, fig. 51, 1856.

*Olivella pedroana* Conrad, Arnold, Mem. Calif. Acad. Sci., vol. 3, p. 221, 1903; Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 32, 33, pl. 6, fig. 1, 1909; Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 189, pl. 3, fig. 24, 1909; Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 626, 627, pl. 24, fig. 10, 1931 (see synonymy).

*Olivella pedroana* (Conrad) var. Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 106, pl. 14, fig. 10, 1931.

*Original description.* Small, elliptical, spire conical, about equal in length to the aperture; base of columella with a prominent fold. (Conrad)

*Supplementary description.* Shell small, smooth, bluntly pointed, with about six whorls; suture narrowly channeled; aperture narrow, outer lip sharp, simple; inner lip with a wash of callus; siphonal callus broad, smooth (the shell above its posterior edge slightly eroded in the figured specimen, which has also lost its apex); pillar short, twisted, with one strong plait sharply grooved in the middle, and thus presenting the aspect of two plaits; canal short and wide. Altitude of decollate specimen figured, 13.0 mm.; maximum diameter, 6.7 mm. (Dall)

*Hypotype.* (U.C. 32022.) Figured in the present report, pl. 95, fig. 25.

*Hypotype (*Olivella pedroana* Conrad) from Quillayute formation.* (U.S.N.M. 328326.) Figured in the present report, pl. 95, fig. 30.

*Geologic range.* Middle Miocene to Recent.

*Geographic distribution.* Lower California to Alaska.

*Type locality.* San Pedro, California; Recent. In Oregon and Washington it occurs in Astoria, Montesano, Empire, and Quillayute formations.

### Family CANCELLARIIDAE

#### Genus CANCELLARIA Lamarck, 1799

*Cancellaria* Lamarck, Mem. Soc. Hist. Nat. Paris, p. 71, 1799.

*Genotype.* *Voluta reticulata* Linnaeus.

#### "CANCELLARIA" LANDESI Van Winkle, 1918

Plate 95, figures 14, 24

*Cancellaria landesi* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 91, pl. 7, fig. 17, 1918.

"*Cancellaria*" *landesi* Van Winkle, Effinger, Jour. Paleon., vol. 12, p. 385, 1938.

*Original description.* Shell small; whorls five in number; body whorl greatly enlarged; whorls angulated and decorated with four broad, flat topped revolving ribs with interspaces of equal width; the upper rib lies upon the angulated portion of the whorl; body whorl ornamented by seven broad, prominent, revolving ribs with equal interspaces. There is a prominent shoulder on body whorl a short distance below the suture; ten prominent axial ribs cross the revolving ribs, giving the surface an angulated appearance. Suture distinct and slightly sinuous; aperture oval and slightly notched at the anterior end; outer lip thin and slightly crenulated; inner lip slightly calloused; canal very short; columella with one strong oblique fold. Dimensions.—Altitude of shell 7 mm.; altitude of spire 2 mm.; maximum diameter of shell 5 mm.; angle of spire 61°. (Van Winkle)

*Observations.* This very small shell may be distinguished by its moderately elevated spire, rounded whorls but sub-angulate shoulders, weak longitudinal ribs, and very heavy but few spiral ribs and interspaces of equal or greater width. The aperture is broader than in the other species except *C. rotunda*.

*Holotype.* (U.W. 145) (C.A.S. 7550). Figured in the present report, pl. 95, figs. 14, 24.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, Section 25, T. 11 N., R. 2 W.

**CANCELLARIA WASHINGTONENSIS** Weaver, 1916

## Plate 95, figure 21

*Cancellaria washingtonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 51, pl. 5, figs. 77, 78, 1916.

*Original description.* Shell small and thin with six very strongly tabulated whorls; spire moderately high; whorls angulated a short distance below suture; upper slope of whorl makes an angle of  $110^{\circ}$  with lower portion and is nearly at right angles to axis of spire; surface of upper slope nearly flat and sculptured by six nearly flat topped moderately developed revolving ribs; between these are somewhat wider interspaces each of which is set within a minute revolving thread; on the angulated portion of whorl there are three closely set revolving ribs a little better developed than those on the surface above; on the surface below the angle there are twenty revolving ribs with interspaces of double width and each set with a fine revolving thread; twenty-four moderately developed longitudinal ribs cross the revolving ribs; these are distinct over the entire surface of the whorls except above the angle and below the suture; aperture elongate-elliptical; posterior end of aperture truncated giving a sub-rectangular outline; outer lip thin and smooth; inner lip slightly callused; plications are absent on the columella; canal of moderate length, slightly reflexed and with a small anterior sulcus. Dimensions.—Altitude of shell 11 mm.; altitude of spire 5 mm.; maximum diameter of shell 6 mm.; angle of spire  $54^{\circ}$ . (Weaver)

*Observations.* This species, when compared with the other forms of the genus in Oregon and Washington, has a relatively higher spire, strongly angulated shoulders on the whorls, and longitudinal ribs, moderately strong on the surface of whorls of spire below the carinae, but less strong on the body whorl.

*Holotype.* (U.W. 115) (C.A.S. 558). Figured in the present report, pl. 95, fig. 21.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Lewis County, Washington.

*Type locality.* (U.W. 256.) Union Pacific railway cut one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

**CANCELLARIA WYNNOCHENSIS** Weaver, 1916

## Plate 95, figures 20, 22

*Cancellaria wynnochensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 50, 51, pl. 4, figs. 51, 52, 53, 54, 1916.

*Cancellaria (Calcarata) wynnochensis* Weaver, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 107, pl. 14, fig. 5, 1931.

*Original description.* Shell of moderate size, solid with five whorls; spire about equal in length to body whorl and canal; whorls convex and sub-tabulated on upper surface; suture distinct and slightly channeled; surface moderately reticulate and ornamented by twenty-two prominent longitudinal ribs which are equally developed on whorls of spire as well as on the body whorl; on the latter they extend to the end of the canal; on the body whorl the longitudinal ribs are crossed by fifteen distinct revolving ribs and alternating with each of these are fine revolving threads. Aperture semi-elliptical; outer lip not determinable; inner lip heavily calloused; canal short and slightly deflected outwards; two rather distinct plications are present on the lower end of the columella; canal short and twisted to left with siphonal fasciole. Dimensions.—Altitude of shell 27 mm.; altitude of spire 11 mm.; maximum diameter of shell 16 mm.; angle of spire  $60^{\circ}$ . (Weaver)

*Observations.* This species may be distinguished from *C. weaveri* Etherington by the angulation or carina on the shoulder of the whorl and by the more strongly developed longitudinal ribs. The cancellated sculpture is in rectangles instead of squares. The anterior canal also is more elongate.

*Holotype.* (U.W. 114) (C.A.S. 563-A). Figured in the present report, pl. 95, fig. 20.

*Topotype.* (U.C. 32021.) Figured in the present report, pl. 95, fig. 22.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 229.) Cliff on east side of Wynoochee River one-half mile below mouth of Bitter Creek in Section 35, T. 18 N., R. 8 W.

#### CANCELLARIA VETUSTA Gabb, 1869

Plate 96, figures 2, 3; plate 103, figure 4

*Cancellaria vetusta* Gabb, Geol. Surv. Calif. Paleon., vol. 2, pp. 12, 79, pl. 2, fig. 19, 1869; Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 412, 413, pl. 31, fig. 1a, 1926.

*Cancellaria (Calcarata) vetusta* Gabb, Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 107, 108, pl. 14, figs. 2, 4, 23, 1931.

*Original description.* Shell small, spire not so long as the mouth; whorls five or five and a half; increasing rapidly in size, angulated and truncated above, sloping convexly inwards below; suture moderately well marked, undulated. Surface marked by longitudinal ribs commencing at the suture, passing obliquely backwards to the angle, and then downwards to the anterior end; these are crossed by fine revolving square ribs, with broad, flat interspaces, and with sometimes smaller ones intercalated. Aperture long, biangular above, and narrowing in advance; inner lip heavily incrusted, bearing two heavy folds, and two or three fine ones above. Umbilicus narrow, covered by a very thick expansion of the inner lip, and in one specimen showing a slight perforation. Length about one inch. (Gabb)

*Observations.* This species from the lower part of the Astoria formation in southwest Washington resembles *C. wynoochensis* in general appearance. It differs in its less strongly developed longitudinal ribs and stronger spiral ribs. The surface of the whorl between the spiral angle or shoulder and suture is more concave.

*Lectotype.* (P.A.N.S. 4295.) Miocene of California. Reproduction of Stewart's figure (266-A, pl. 31, fig. 1a). Figured in the present report, pl. 103, fig. 4.

*Hypotype.* (U.C. 32060.) Astoria formation. Figured in the present report, pl. 96, fig. 2.

*Hypotype.* (U.C. 32033.) Astoria formation. Figured in the present report, pl. 96, fig. 3.

*Geologic range.* San Ramon and Astoria formations, upper Oligocene and middle Miocene.

*Geographic distribution.* Mount Diablo area in California and Grays Harbor County, Washington.

*Type locality.* South of Martinez in California, and at locality (U.W. 425) in Rock Creek about one-fourth mile down stream from the falls and just below the old dam site, Grays Harbor County, Section 7, T. 16 N., R. 5 W.

**CANCELLARIA** sp. indet. Etherington, 1931

## Plate 96, figure 1

*Cancellaria* sp. indet., Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 108, pl. 13, fig. 11, 1931.

*Original description.* Dimensions.—Type U.C. no. 32036, height of spire, 22.0 mm. Incomplete specimen.

*Observations.* A single large broken specimen of the genus *Cancellaria* has been figured by Etherington. It is characterized by strong cancellated whorls, vertical nearly straight sides of whorls of spire, nearly right-angular junction of upper and middle surfaces of spire, rather short whorls, and relatively high spire.

*Holotype.* (U.C. 32036.) Figured in the present report, pl. 96, fig. 1.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.C. 9017) (U.W. 415). Clemons logging road on abandoned spur of railroad 100 feet north of main line in the first large cut in Section 23, T. 17 N., R. 7 W.

**CANCELLARIA WEAVERI** Etherington, 1931

## Plate 96, figure 4

*Cancellaria (Crawfordina) weaveri* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 108, 109, pl. 14, figs. 1, 3, 17, 1931.

*Original description.* Shell moderate size, with five moderately rounded whorls, cancellately sculptured; with about 26 axial ribs crossing 17-18 revolving ribs of equal strength; tubercles tend to develop on the junction of the two sets of ribbing. The less numerous revolving ribbing tends to produce small rectangles in the intervening spaces; suture moderately deep; aperture semi-ovate; columella straight; slightly developed siphonal fasciole, slightly reflected at top; parietal callus thin; pillar with two plaits of equal strength, both oblique. Dimensions of type: Altitude, 27.0 mm.; maximum diameter, 16.4 mm.; altitude of spire, 12.5 mm. (Etherington)

*Observations.* This species may be distinguished from *C. oregonensis* Dall by the equally spaced intersections of the longitudinal and spiral ribs and by the presence of only two columellar plaits, whereas *C. oregonensis* has four. *C. weaveri* is associated with *C. wynoochensis* Weaver but differs from it in the lack of strong noded carinae on the shoulder of the whorl.

*Holotype.* (U.C. 32017.) Figured in the present report, pl. 96, fig. 4.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 431.) Clemons logging road 900 feet west of Saginaw trail on the Delezine side of the divide between Delezine and Workman creeks, Grays Harbor County, Section 6, T. 16 N., R. 6 W.

**CANCELLARIA CONDONI** Anderson, 1905

## Plate 96, figures 5, 6

*Cancellaria condoni* Anderson, Proc. Calif. Acad. Sci., ser. 3, vol. 2, p. 200, pl. 15, figs. 49, 50, 1905; Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 86, pl. 8, figs. 8a, 8b, 8c, 8d, 1914.

*Original description.* Shell of moderate size, 1-1½ inch in length; ½-¾ inch wide; spire high; whorls angular, slightly sloping above; surface ornamented with strong revolving lines, with wide interspaces, crossed by strong varical ridge forming tubercular nodes on the upper angle of the whorls; inner lip crusted, bearing 2 spiral folds on the columella. (Anderson)

*Observations.* This species somewhat resembles *C. washingtonensis* but may be distinguished from it in the slightly concave surface of whorl between angle and suture, in the presence of strong nodes on the angulated shoulder, and in its very heavy callus.

*Holotype?* (C.A.S. 67.) Figured in the present report, pl. 96, fig. 5.

*Hypotype.* (C.A.S. 197.) Figured in the present report, pl. 96, fig. 6.

*Geologic range.* Astoria formation and Kern River Miocene, middle Miocene.

*Geographic distribution.* Kern River, California, and Grays Harbor County, Washington.

*Type locality.* Kern River, California. Locality (U.C. A-79).

**CANCELLARIA ROTUNDA** Anderson and Martin, 1914

## Plate 96, figure 7

*Cancellaria rotunda* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 87, pl. 8, figs. 4a, 4b, 1914.

*Original description.* Shell globose; thin, with five well rounded whorls; spire rather short; apex blunt; whorls of the spire convex; ornamented with thirteen prominent rounded axial ribs with wider interspaces, and five or six spiral threads with very small intercalary lines; suture depressed; body-whorl comprising the greater portion of the shell, evenly globose, sculptured the same as the whorls of the spire, with thirteen axial ribs and sixteen spiral threads; the axial ribs much more pronounced than the spiral threads; the interspaces between the spiral threads carrying intercalary lines; aperture semi-circular; outer lip thickened; inner lip incrusted; canal short; columella with two plications on the anterior portion. Dimensions:—Altitude of the type, 14 mm.; maximum latitude of the shell, 12 mm.; altitude of an entire specimen, about 21 mm. (Anderson and Martin)

*Observations.* This species may be distinguished by its globose appearance, rather short spire, complete absence of angulation of the whorls, strongly developed longitudinal ribs, and both major and minor spiral ribs.

*Holotype.* (C.A.S. 205.) Figured in the present report, pl. 96, fig. 7.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Lincoln County, Oregon.

*Type locality.* (U.W. 690.) Cliffs along ocean front about 3,000 feet north of Yaquina Bay, Lincoln County, Oregon.

**CANCELLARIA SANJOSEI** Anderson and Martin, 1914

## Plate 96, figure 8

*Cancellaria sanjosei* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 87, pl. 6, figs. 2a, 2b, 1914.

*Original description.* Shell small, ovate, thick, with five or six rather rapidly enlarging whorls; spire elevated; whorls slightly convex or flat, with a narrow tabulation, sculptured with seven or eight flat spiral cords, the alternate cords being slightly more prominent than those adjacent; suture distinct; body-whorl large, about five-sixths of the total length of the shell, tabulated above, sculptured with fourteen major spiral cords with alternate small intercalary threads; aperture elongate-oval, outer lip thick, columella with two plications and an anterior sulcus; canal short. Dimensions:—Altitude of the type specimen, 20 mm.; diameter of the body-whorl, 11.5 mm. (Anderson and Martin)

*Observations.* This species is characterized by its large, elongate, semi-oval body whorl, relatively short spire, and flattened whorls of spire. The holotype is badly weathered, but on better-preserved specimens moderately developed primary and secondary spiral ribs are present while longitudinal ribbing is only faintly developed.

*Holotype.* (C.A.S. 207.) Figured in the present report, pl. 96, fig. 8.

*Geologic range.* Astoria formation and Kern River Miocene of California.

*Geographic distribution.* Grays Harbor County, Washington, and eastern San Luis Obispo County, California.

*Type locality.* (C.A.S. 126.) Near center of Section 34, T. 28 S., R. 15 E., eastern San Luis Obispo County, Washington: Locality (U.W. 473). Cut on Wynoochee River highway 500 feet south of Black Creek railway, Grays Harbor County, Section 26, T. 18 N., R. 8 W.

**CANCELLARIA OREGONENSIS** Dall, 1909

## Plate 96, figure 9

*Cancellaria oregonensis* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 28, 29, pl. 2, fig. 7, 1909.

*Original description.* Shell heavy, with five and a half rather rapidly enlarging whorls; suture distinct, almost channelled; whorls full, handsomely rounded, apex small and blunt; sculpture reticulate, strong, composed of (on the last whorl, about 14) strong elevated cordlike spiral ridges with wider interspaces (which on the last whorl frequently carry a small intercalary thread) crossed by axial riblets of very similar character (but without intercalaries) so spaced that their intersections with the major spirals form almost exactly square and equal reticulations, which are deeper and sharper on the upper whorls; the axial sculpture becomes gradually obsolete on the base, but the spirals, as usual, are somewhat coarser there; aperture ovate, narrow in front, forming a short curved canal which is followed by a well-marked siphonal fasciole, separated from the callus of the pillar in the adult by a very narrow chink; body with a mere wash of callus; pillar straight, with two strong middle plaits, a feebler posterior one, and, in the fully adult, the semblance of a fourth anterior plait laid on the edge of the pillar; outer lip moderately thickened, slightly reflected in the adult, probably internally lirate when full grown, though this is not shown on the specimens in hand. Altitude of figured specimen, 43 mm.; of adult, 49 mm.; maximum diameter of figured specimen, 23 mm.; of adult, 27 mm. (Dall)

*Observations.* This symmetrically built species is characterized by its reticulate sculpture consisting of equally developed spiral and longi-

tudinal ribs, its lack of angulate shoulders on the whorls, and the presence of two strong and one weak columellar plaits.

*Holotype.* (U.S.N.M. 107788.) Figured in the present report, pl. 96, fig. 9.

*Geologic range.* Empire formation, upper Miocene, and lower Pliocene.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* Coos Bay, Camman collection. (Dall)

#### Genus **BONELLITIA** Jousseaume, 1887

*Bonellitia* Jousseaume, Le Naturaliste, ser. 2, vol. 1, p. 222, fig. 3, 1887.

*Genotype.* *Solatia solat* Adams.

#### **BONELLITIA (ADMETULA) PAUCIVARICATA** (Gabb), 1864

Plate 96, figures 10, 12, 13; plate 103, figures 9, 10, 17

*Tritonium paucivaricatum* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 95, pl. 28, figs. 209, 209a, 1864.

*Cancellaria stantoni* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 7, p. 282, pl. 12, figs. 2a, 2b, 1913.

*Admete (Bonellitia) stantoni* (Dickerson), Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, pp. 40, 41, 42, pl. 11, figs. 1, 5, 1922.

*Cancellaria paucivaricata* (Gabb), Anderson and Hanna, Calif. Acad. Sci., Occ. Pap. no. 11, p. 81, pl. 8, figs. 3, 4, 1925.

*Bonellitia (Admetula) paucivaricata* (Gabb), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 413, pl. 29, fig. 5, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 71, pl. 15, figs. 12, 13, 1938.

*Original description.* Shell short, robust; spire elevated, whorls six, convex, convexly truncated above; mouth broad, outer lip crenulated internally; inner lip incrusted, recurved, and dentate anteriorly. Suture deep. Surface marked by numerous small, longitudinal ribs, very oblique above, more transverse below; these are crossed by numerous, alternating, revolving lines. Length, .6 inch. (Gabb)

*Supplementary description.* The apex of the lectotype, here figured, is worn. The axial ribs are very regular and evenly spaced. There are twelve axial ribs on both the penultimate and body whorls. The penultimate whorl has six widely spaced spiral ribs with fine secondary ribs in the posterior three interspaces. Ten widely spaced spiral ribs are on the body whorl. The posterior interspace has two secondary spiral ribs; there is a single rib on each of the next two interspaces; the next three interspaces are smooth, while on the anterior portion of the whorl, the secondary ribs are irregularly developed. Varices are absent. The columella is not exposed. Height, 15 mm.; width, 9 mm. (Stewart)

*Lectotype.* (P.A.N.S. 4194.) Figured in the present report, pl. 103, fig. 17.

*Hypotype.* (U.C. 15534.) Locality (U.C. 7161). Figured in the present report, pl. 96, fig. 10.

*Hypotype.* (U.C. 33239.) Locality (U.C. A-662). Figured in the present report, pl. 96, figs. 12, 13.

*Hypotype.* (U.W. 207) (C.A.S. 7551). Figured in the present report, pl. 103, figs. 9, 10.

*Geologic range.* Capay formation, lower Coaledo and Cowlitz formations, upper Eocene.

*Type locality.* Tejon Pass, California. In Washington the species occurs at locality (U.W. 232) on Cowlitz River; in Oregon, at locality (U.C. 715) at Cape Arago.

Genus **ADMETE** Kröyer, 1842

*Admete* Kröyer, in Möller, Index Moll. Groenland, p. 15, 1842.

*Genotype.* *Admete crispa* Möller.

**ADMETE CLATSKANIENSIS** Anderson and Martin, 1914

## Plate 96, figure 14

*Admete clatskanensis* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 88, pl. 8, figs. 3a, 3b, 1914.

*Original description.* Shell small, ovate, thin, with six tabulated whorls, nucleus excluded; spire high, with an acute apex; whorls angulated at the middle, flat above, convex below, sculpture consisting of twelve broad, rounded axial ribs which are most prominent on the angle where they are slightly nodose, becoming obscure near the suture and on the anterior portion of the body whorl, crossed by ten spiral threads on the penultimate whorl, four above the angle and six below, the latter alternating in prominence; suture distinct, channeled; body-whorl convex, with fifteen spiral threads which alternate in size, the interspaces on the anterior portion containing a small intercalary thread; aperture oval; outer lip arcuate; canal short; columella with two small plications and a small anterior sulcus. Dimensions:—Altitude of the type specimen, 10 mm.; maximum diameter of the last whorl, 5 mm. (Anderson and Martin)

*Observations.* This species is characterized by its high spire, rounded whorls, subtabulate shoulders, rounded axial ribs, short canal, and two poorly developed plications on the columella.

*Holotype.* (C.A.S. 209.) Figured in the present report, pl. 96, fig. 14.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Northwestern Columbia County, Oregon.

*Type locality.* Two and one-half miles southwest of Clatskanie, Columbia County, Oregon.

## Family CONIDAE

Genus **CONUS** Linnaeus, 1758

*Conus* Linnaeus, Syst. Nat. (10th ed.), pp. 712-718, 1758.

*Genotype.* *Conus marmoreus* Linnaeus.

**CONUS REMONDII** Gabb subsp. **COMSTOCKENSIS** Turner, 1938

## Plate 96, figure 15

*Conus remondii* Gabb subsp. *comstockensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 68, pl. 15, fig. 5, 1938.

*Original description.* Shell unequally biconic, spire about one-third of the total length; body whorl concave in profile ornamented by more than 20 broad, flat bands separated by incised spirals which grow deeper toward the anterior extremity of the whorl; tabulation of the shoulder ornamented by seven revolving riblets; growth lines on body arcuate with convexity toward the aperture. Depth of anal sinus behind the shoulder slightly greater than half the width of the shoulder; shoulder ornamented by approximately 18 trigonal nodes which disappear rapidly anterior to the shoulder. Dimensions (U.C. 33215): length 13.1 mm.; diameter 6.8 mm. (Turner)

*Observations.* This species may be distinguished from *C. remondii* by a slight concavity on the sides of the body whorl and the presence of small spiral ribs on the tabulated part of the shoulder of the whorl. It differs from *C. warreni* by having triangular rather than rectangular nodes on the shoulder.

*Holotype.* (U.C. 33215.) Figured in the present report, pl. 96, fig. 15.

*Geologic range.* Tyee formation, middle Eocene.

*Geographic distribution.* Southern Willamette Valley, Oregon.

*Type locality.* (U.C. A-1134.) In road cut at east end of highway overpass one-half mile south of Comstock, on Pacific highway.

#### **CONUS WARRENI** Hendon, 1938

Plate 96, figures 11, 16

*Conus warreni* Hendon, in Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 68, 69, pl. 15, figs. 3, 4, 1938.

*Original description.* Shell unequally biconic, body whorls more than twice the length of the spire; seven whorls; shoulder angulate and ornamented by 20 subdued nodes; suture linear, space between suture and shoulder concave and marked with three or four spiral threads; body whorls ornamented with 17 flat spiral ribs separated by very narrow interspaces. Growth lines are visible on the exterior surface of the body whorl. Dimensions (U.C. 33635) : length 16.8 mm.; diameter 9.0 mm. (Hendon in Turner)

*Observations.* *C. warreni* is closely related to *C. ruckmani* Dickerson from the Cowlitz formation but differs in having broad spiral ribs and narrow interspaces.

*Holotype.* (U.C. 33635.) Figured in the present report, pl. 96, figs. 11, 16.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-661.) East bank of Little River between highway bridge and the first bend of the stream east of junction with North Umpqua River, center of Section 19, T. 26 S., R. 3 W.

#### **CONUS HORNII** Gabb var. **UMPQUAENSIS** Hendon, 1938

Plate 96, figure 18

*Conus hornii* var. *umpquaensis* Hendon, in Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 69, pl. 15, figs. 1, 2, 1938.

*Original description.* Shell small, unequally biconic; body whorl twice the length of the spire; six to eight whorls; shoulders angulate, smooth; space between suture and shoulder is concave, crossed by a few crescentic growth lines which become obsolete toward the upper part of the whorl. Dimensions (U.C. 33656) : length 11.8 mm.; diameter 6.0 mm. (Hendon in Turner)

*Observations.* This variety is characterized by a higher spire than *C. hornii* from Tejon Pass, California.

*Holotype.* (U.C. 33656.) Figured in the present report, pl. 96, fig. 18.

*Geologic range.* Upper Umpqua and Llajas formations, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.O. 144.) Two and one-half miles up Fall Creek from Little River on Mathews farm, in northeast quarter of Section 6, T. 27 S., R. 3 W.

#### CONUS VADERENSIS Weaver and Palmer, 1922

Plate 96, figures 17, 19, 24, 25

*Conus hornii* Gabb, Weaver, Wash. Geol. Surv., Bull. no. 15, pl. 2, fig. 17, 1912; not *Conus hornii* Gabb, 1864.

*Conus remondii* Gabb, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 11, fig. 7, 1915; not *Conus remondii* Gabb, 1864.

*Conus vaderensis* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, pp. 43, 44, pl. 12, figs. 7, 8, 1922.

*Original description.* Shell of medium size, biconical; whorls four to five with three to four smooth, apical whorls which are very pointed; suture appressed; area between the suture and the shoulder of the whorls concave and sculptured with fine, curved striae; shoulder decorated with 16 or 18 nodes; body whorl covered with revolving, microscopically raised ribs crossed by longitudinal lines. The spiral ribs or lines are better developed on the posterior region of the whorl; aperture long and narrow with parallel sides. Dimensions.—Altitude of shell 29 mm.; width of body whorl 12 mm.; apical angle 60°. (Weaver and Palmer)

*Observations.* This species differs from *C. remondii* Gabb in having a concave profile on the side of the body whorl; in the latter species this is straight and regularly conical. It differs from *C. cowlitzensis* Weaver in that the spire is relatively about one-half as high.

*Holotype.* (U.W. 210) (C.A.S. 7539). Figured in the present report, pl. 96, figs. 24, 25.

*Hypotype.* (C.A.S. 335.) Locality (U.W. 232). Figured in the present report, pl. 96, fig. 17.

*Hypotype.* (C.A.S. 351.) Locality (U.W. 232). Figured in the present report, pl. 96, fig. 19.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

#### CONUS COWLITZENSIS Weaver, 1912

Plate 96, figure 20

*Conus cowlitzensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 54, 55, pl. 2, fig. 20, 1912.

*Original description.* Shell biconical; spire a little over one-fourth of total length; whorls seven and a half to eight, and very sharply angulated; upper two forming the apex are smooth and rounded; angle set with nodes. Body whorl conical below the angle; nearly flat above but sloping close to the suture making the upper surface of each whorl decidedly convex; eighteen very distinct nodes on the

angle; these do not continue above or below as ribs; although blunt and rounded they are pointed slightly to the left. Surface marked by forty revolving lines below the angle which are more distinct toward base of whorl; portion of whorl above angle obscurely sculptured by revolving lines. Numerous faint lines of growth are present. Aperture linear and narrow, and extending to end of spire. The spire varies somewhat in length but the upper surface of whorls are extremely convex. Dimensions.—Altitude 38 mm.; diameter 15 mm.; altitude of spire 13 mm.; angle of spire 50°; angle of lower part of body whorl 33°. (Weaver)

*Observations.* This species which resembles *C. vaderensis* has a higher spire and relatively greater diameter.

*Holotype.* (U.W. 41) (C.A.S. 502). Figured in the present report, pl. 96, fig. 20.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River, one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

#### CONUS WEAVERI Dickerson, 1915

Plate 96, figure 26

*Conus weaveri* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pp. 74, 75, pl. 11, fig. 10, 1915.

*Original description.* Shell small, wide, short, with six whorls; decoration consisting of numerous spiral lines most prominent on lower part of body-whorl. Dimensions:—Length, 15.5; width of body-whorl, 9.5 mm. (Dickerson)

*Observations.* This species may be distinguished from *C. hornii* by greater diameter and prominent spiral ribs. It differs from *C. cowlitzensis* and *C. remondii* in the absence of nodes.

*Holotype.* (C.A.S. 356.) Figured in the present report, pl. 96, fig. 26.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

#### CONUS RUCKMANI Dickerson, 1917

Plate 96, figures 21, 22, 23

*Conus ruckmani* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 179, pl. 31, figs. 6a, 6b, 1917; Effinger, Jour. Paleon., vol. 12, pp. 385, 386, pl. 47, figs. 27, 28, 1938.

*Conus washingtonensis* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, p. 92, pl. 7, fig. 9, 1918.

*Original description* (*Conus ruckmani*). Shell small with six whorls; surface of each whorl between wavy, linear suture and shoulder, concave and marked by three or four spiral threads cut by numerous, crescentic growth lines; 18 to 24 rounded nodes decorating shoulder whorls; body-whorl marked by about 20 granular spiral ribs. Dimensions:—Length, 12.5 mm.; width of body-whorl, 7 mm. (Dickerson)

*Original description (Conus washingtonensis).* Shell minute; spire high, averaging between two-thirds and three-fourths of the length of the body whorl; whorls seven to seven and a half in number; suture linear and appressed; on the middle of the surface of each whorl, just above the shoulder, there is a revolving groove; between the groove and the suture there is a convex revolving fold. Ornamentation of the shell consists of very faintly developed flat-topped revolving ribs with interspaces of equal width; outer lip thin; inner lip without callous; aperture narrow. Dimensions.—Altitude of shell 3.5 mm.; altitude of spire 1 mm.; maximum diameter of shell 2 mm.; angle of spire 60°. (Van Winkle)

*Observations.* This species may be distinguished from *C. remondii* Gabb by the absence of the deep convex anal notch. *C. ruckmani* has coarser spiral ribs and a smaller number of nodes.

*Holotype (Conus ruckmani).* (C.A.S. 431.) Figured in the present report, pl. 96, fig. 21.

*Hypotype.* (U.C. 33624.) Figured in the present report, pl. 96, figs. 22, 23.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, Lewis County, Section 25, T. 11 N., R. 2 W.

## Family TURRIDAE

### Genus EXILIA Conrad, 1865

*Exilia* Conrad, Jour. Acad. Nat. Sci. Phila., n. s., vol. 4, pp. 291, 292, pl. 47, fig. 34, 1865.

*Genotype.* *Exilia pergracilis* Conrad.

### EXILIA DICKERSONI (Weaver), 1912

Plate 96, figures 28, 29; plate 101, figure 6; plate 104, figure 15

*Fusus dickersoni* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 50, 51, pl. 3, fig. 29; pl. 14, fig. 124, 1912.

*Exilia dickersoni* (Weaver), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 9, fig. 9, 1915; Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 418; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 69, pl. 17, fig. 5, 1938.

*Original description.* Shell elongated, slender and fusiform; spire longer than aperture; whorls eleven, very slightly convex; suture very distinct, impressed and linear. Surface ornamented with fifteen prominent longitudinal ribs which extend over all the whorls; these are crossed by twenty-two revolving ribs on the body whorl; between these ribs are broad, deep, flat-bottomed interspaces. Aperture narrow; inner lip highly incrusted; outer lip thin. Canal moderately long. Dimensions.—Altitude 45 mm.; diameter 9 mm.; altitude of spire 28 mm.; angle of spire 23°. (Weaver)

*Observations.* This species resembles *E. weaveri* Dickerson from the lower Oligocene, but may be distinguished from it by its more prominent longitudinal ribs, lesser convexity of the whorls, and less extended sinal angle of the growth lines.

*Syntype.* (C.A.S. 498.) Figured in the present report, pl. 96, fig. 28.

*Syntype.* (U.W. 35-B.) Figured in the present report, pl. 104, fig. 15.

*Syntype.* (U.W. 35.) Figured in the present report, pl. 101, fig. 6.

*Hypotype.* (C.A.S. 335.) Specimen figured by Dickerson (121, pl. 9, fig. 9) as *Exilia dickersoni* (Weaver). Figured in the present report, pl. 96, fig. 29.

*Geologic range.* Cowlitz and lower Coaledo formations, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington, and Coos Bay, Oregon.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Lewis County, Section 28, T. 11 N., R. 2 W.

#### EXILIA WEAVERI Dickerson, 1917

Plate 96, figure 27

*Exilia weaveri* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 173, pl. 30, figs. 1a, 1b, 1917; Effinger, Jour. Paleon., vol. 12, pp. 386, 387, 1938.

*Original description.* Shell long, slender, spindle form; number of whorls nine or ten; spire whorls decorated by about twelve sub-equal spiral threads crossed by slightly sinuous growth lines; a nearly central spiral line slightly stronger than rest occurring at widest diameter of each spire whorl; fine beading, a result of the intersection of the two systems of threads further decorating whorls; suture linear, distinct; body-whorl exhibiting sinuous, axial sculpture more prominent than spiral; aperture elongate-oval; canal long, slender; columella nearly smooth. Dimensions:—Length of broken type, 23.5 mm.; width of body whorl, 7.5 mm. (Dickerson)

*Observations.* This species which bears resemblances to *E. dickersoni* is characterized by its less strongly developed longitudinal ribs, more convex whorls, and deep posterior sinus. It differs from *E. lincolnensis* in having less well-developed nodes and more convex whorls without anterior and posterior angulation.

*Holotype.* (C.A.S. 410.) Figured in the present report, pl. 96, fig. 27.

*Geologic range.* Gries Ranch beds, lower Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, Section 25, T. 11 N., R. 2 W.

#### EXILIA LINCOLNENSIS Weaver, 1916

Plate 96, figure 30

*Exilia lincolnensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 51, 52, pl. 4, figs. 49, 50, 1916.

*Original description.* Shell large, slender, fusiform and having nine and one-half to ten whorls; spire high and apex very acute; whorls moderately angulated, the angle being situated about one-third the length of the whorl from the suture; on the body whorl there is developed a very faint angle on the middle of the lower half; the surface of the middle of the whorl between the upper and lower angles is very slightly concave; surface of whorl between posterior angle and suture is very slightly convex; suture distinct; shell ornamented by eleven longitudinal ribs which are very prominent on the posterior surfaces and angulated portions of whorls but which become obscure on the anterior half of the body whorl; posterior slope of whorl between suture and angle is ornamented by three

well defined rounded revolving ribs with interspaces of double width; three similar ribs occur upon the angulated areas and four on the surface between the posterior and anterior angulations; surface of body whorl below anterior angle ornamented by twenty-five well defined ribs; intervening revolving threads are entirely absent from the ornamentation of this species. Aperture elongate-oval; canal long, deep and straight; outer lip simple; inner lip slightly callused. Dimensions.—Altitude of shell 35 mm.; altitude of spire 21 mm.; maximum diameter of shell 8 mm.; angle of spire 20°. (Weaver)

*Observations.* This species is related to *E. mclellani* Tegland and *E. weaveri* Dickerson. It differs from the former in that the nodes extend from the middle of each whorl posteriorly to the suture and from the latter by more strongly developed longitudinal ribs, less convex whorls, and a shallower posterior sinus.

*Holotype.* (U.W. 116) (C.A.S. 468). Figured in the present report, pl. 96, fig. 30.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Lewis County, Washington.

*Type locality.* (U.W. 256.) Union Pacific railway cut one mile north of Galvin Station, Lewis County, Section 27, T. 15 N, R. 3 W.

#### EXILIA MCLELLANI Tegland, 1933

Plate 97, figure 2

*Exilia mclellani* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 126, pl. 10, figs. 19, 20, 21, 1933.

*Original description.* Shell long, slender, with nine or ten whorls ornamented with nine crescentic nodes which curve to the right; radial ribbing in the nature of ridges with shallow valleys between, widening toward anterior of shell. Nodes centrally placed on posterior whorls; six ridges on shoulder, four more pronounced, more widely spaced on angle, four between angle and anterior suture; suture indistinct, appressed, regular. Incremental lines swing backward below suture and back on angle giving nodes their crescentic form; shoulder of whorls concave; the crescent-shaped nodes, distinctive type of radial ribbing, the numerous whorls, and acute apical angle make this form recognizable even though the type specimen lacks the apical whorls and is minus the body whorl and canal. Dimensions of holotype: height, 24 mm.; width, 11 mm. (Tegland)

*Observations.* This species may be distinguished from *E. lincolnensis*, to which it bears some resemblance, in that the middle of the posterior whorls contain nodes which do not extend to the posterior suture and the posterior area is depressed into a collar. The growth lines are deflected backward.

*Holotype.* (U.C. 32170.) Figured in the present report, pl. 97, fig. 2.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Kitsap County, Washington.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, opposite Seattle.

## Genus AFORIA Dall, 1889

*Aforia* Dall, Bull. Mus. Comp. Zool., vol. 18, p. 99, 1889.*Genotype*. *Surcula circinata* Dall.

## AFORIA CLALLAMENSIS (Weaver), 1916

## Plate 97, figure 1

*Turris clallamensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 52, pl. 4, fig. 59, 1916.*Leucosyrinx clallamensis* (Weaver), Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 123, 124, pl. 10, figs. 3, 4, 1933.

*Original description.* Shell large and solid with nine or ten whorls which are moderately inflated; each whorl is sharply angulated by well defined carinae at or just a little below the central portions; immediately below the posterior carina or angle a second less well developed angle is present which is more conspicuous on the body whorl and less well upon the whorls of the spire; surface of whorls above angle slightly concave; suture distinct; surface of body whorls below angles ornamented by sixteen revolving ribs which are crossed by numerous closely set longitudinal lines of growth. Aperture very narrow; inner lip smooth and callused; outer lip smooth; canal elongate and straight. Dimensions.—Altitude of shell 85 mm.; altitude of spire 38 mm.; maximum diameter of shell 28 mm.; angle of spire 30°. (Weaver)

*Observations.* The holotype of this species is not well preserved but topotypes, as pointed out by Tegland, have growth lines with notch on posterior shoulder which indicate the position of the posterior sinus; a spiral flattened rib lies beneath.

*Holotype.* (U.W. 117) (C.A.S. 555). Figured in the present report, pl. 97, fig. 1.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Clallam County, Washington, near mouths of Twin Rivers.

*Type locality.* (U.W. 258.) Sea cliff one-half mile west of Twin Rivers, Clallam County, Section 27, T. 31 N., R. 10 W.

AFORIA CLALLAMENSIS (Weaver) subsp. **WARDI** (Tegland), 1933

## Plate 97, figures 6, 10

*Leucosyrinx clallamensis wardi* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 124, pl. 10, figs. 5, 6, 7, 8, 1933.

*Original description.* Shell large, pagodaform, nine whorls on type specimen; whorls acutely angulated on lower third of whorl, concave above and below angle; deep sinus on middle of shoulder clearly shown by growth lines; lower portion of whorl sculptured by numerous spiral lines numbering about ten on penultimate whorl. Body whorl has secondary anterior angulation forming a basal keel, the distance between the two angles being less than width of shoulder; entire anterior portion of body whorl, including canal, sculptured by spiral lines; aperture triangular, canal long and straight. Dimensions of holotype (canal incomplete): height, 40.4 mm.; diameter of body whorl, 23.5 mm. (Tegland)

*Observations.* This subspecies *wardi* may be distinguished from *A. clallamensis*, as pointed out by Tegland, in having a wider apical angle,

longer shoulder, less pronounced angulation below major keel, more acute angulation, and lack of raised band on shoulder adjacent to keel.

*Paratype.* (U.C. 32204.) Figured in the present report, pl. 97, fig. 6.

*Hypotype.* (U.C. 14961.) Figured in the present report, pl. 97, fig. 10.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Seattle, Washington.

*Type locality.* (U.W. 9.) Northern Pacific railway cut 100 feet east of Seattle Brewing and Malting Company brewery at Georgetown, South Seattle.

#### AFORIA PACKARDI (Weaver), 1916

##### Plate 97, figure 3

*Turris packardi* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 55, pl. 5, fig. 64, 1916.

*Original description.* Shell small and fusiform; spire moderately elevated and about one and two-fifths as long as the canal; whorls eight in number and very angular; a well developed keel is present upon the angulated area of each whorl; surface of whorl above angle is very slightly concave and ornamented by very faint revolving lines; the middle portion of each whorl has two very prominent revolving cord like ribs with very narrow groove like interspaces; anterior surface of body whorl sculptured with 13 revolving ribs which are less well defined than those upon the middle portion; interspaces on lower portion very narrow; lines of growth quite prominent and conforming to the outline of the posterior sinus. Suture distinct; aperture subpyriform; canal of moderate length and deeply channeled. Dimensions.—Altitude of shell 24 mm.; altitude of spire 9 mm.; maximum diameter of shell 11 mm.; angle of spire 42°. (Weaver)

*Observations.* This species is represented by large numbers of individuals among the fauna of the Lincoln formation in Washington. It is characterized by its pagodaform spire, angulate whorls, slightly concave surface between angle and suture, and very faint spiral ribbing, except on angulate portion where two very heavy spiral cords are situated.

*Holotype.* (U.W. 122) (C.A.S. 473). Figured in the present report, pl. 97, fig. 3.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Western Lewis County, Washington.

*Type locality.* (U.W. 256.) Union Pacific railway cut one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

#### Genus ANTIPLANES Dall, 1902

*Antiplanes* Dall, Proc. U.S. Nat. Mus., vol. 24, p. 513, 1902.

*Genotype.* *Pleurotoma (Surcula) perversa* Gabb.

#### ANTIPLANES PERVERSA (Gabb), 1865

##### Plate 97, figure 4

*Pleurotoma (Surcula) perversa* Gabb, Proc. Calif. Acad. Sci., ser. 1, vol. 3, p. 183, 1865; Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 6, pl. 1, fig. 10, 1869.

*Turris (Antiplanes) perversa* Gabb, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 26, 27, pl. 5, fig. 5, 1909.

*Spirotropis (Antiplanes) perversa* (Gabb), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 553, 554, pl. 26, figs. 22, 23a, 23b, 1931 (synonymy).

*Original description.* Shell small, sinistral, elongate, slender; spire high, apex usually bent to one side; whorls eleven to twelve, convex, two nuclear whorls rather loosely twisted and more convex than the others; suture deep; body whorl nearly half of the entire length of the shell. Aperture broadest in the middle, narrowing regularly in advance; inner lip moderately incrusted; outer lip simple; sinus rather broad, shallow, rounded, and adjoining the suture; canal of variable length, often much larger than in the specimen figured. Color, in living specimens, a light reddish-brown. (Gabb)

*Supplementary description.* Shell of medium to large size, more often sinistral than dextral, spire elevated, of variable height, whorls eleven to twelve, flattened or rounded, smooth except for growth lines and on well-preserved specimens extremely fine spirals, protoconch of about two smooth, rounded, loosely coiled whorls; aperture varying around two-fifths length of shell, outer lip thin, with a deep rounded notch a short distance below the suture, columella smooth, somewhat flexuous, of variable length, inner lip slightly resorbed; operculum with a terminal nucleus like that of typical *Spirotropis*. (Grant and Gale)

*Holotype.* Lost.

*Hypotype.* (U.S.N.M. 110383.) Figured in the present report, pl. 97, fig. 4.

*Geologic range.* Empire and Montesano formations. Upper Miocene and lower Pliocene. California: Merced and Purisima formations, Pliocene, Pleistocene, Recent.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington. Living from Lower California to Alaska.

*Type locality.* Pleistocene at San Pedro, California. Occurs in Empire formation at Coos Bay, Oregon.

#### ANTIPLANES IMPECUNIA (Dall), 1909

##### Plate 97, figure 11

*Turris (Antiplanes) impecunia* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 27, pl. 4, fig. 3, 1909.

*Original description.* Shell small, smooth, dextral, of five or six whorls; whorls flattish, sculptured only by faint incremental lines (the band at the suture in the photographic figure is due to the weathering and is absent from the opposite side of the shell); suture indistinct; aperture obstructed by matrix; the anal sinus, as indicated by the incremental lines, rather wide and deep for so small a shell; canal short and well marked by the constriction over it at the anterior part of the whorl. Altitude, 18 mm.; maximum diameter, 7 mm. (Dall)

*Observations.* This species is characterized by its relatively short canal and compact form.

*Holotype.* (U.S.N.M. 153912.) Figured in the present report, pl. 97, fig. 11.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* Coos Bay, Camman collection. (Dall)

**Genus SUAVODRILLIA Dall, 1918**

*Suavodrillia* Dall, Proc. U.S. Nat. Mus., p. 331, 1918.

*Genotype.* *Drillia kennicottii* Dall.

**SUAVODRILLIA THURSTONENSIS (Weaver), 1916**

Plate 97, figure 7

*Turris thurstonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 54, 55, pl. 5, figs. 79, 80, 1916.

*Antiplanes thurstonensis* (Weaver), Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 125, pl. 10, fig. 14, 1938.

*Original description.* Shell small and moderately elongated with seven whorls, all of which are ornamented; there are three revolving folds upon the body whorl; posterior surface of whorls at suture nearly at right angles to axis of spire; middle portion of surface nearly at right angles to posterior surface and forming a sharply angulated ridge; from this ridge the surface is slightly concave to the broadly rounded middle angle of whorl; between the middle and anterior angles there is a narrow flat surfaced groove containing a single faint revolving rib; anterior surface of whorl sculptured by ten poorly defined revolving ribs and interspaces of equal width; longitudinal ribs are absent with the exception of wavy lines of growth which conform to the curvature of the posterior sinus. Aperture moderately elongate and slightly wider posteriorly than anteriorly; anterior end opens in form of a wide but slightly twisted canal; outer lip smooth; inner lip very slightly calloused and containing a well defined axial groove extending from the end of the canal to the posterior end of the aperture; the surface of the whorl extends up sharply to and terminates at the groove. Dimensions.—Altitude of shell 17 mm.; altitude of spire 11 mm.; maximum diameter of shell 6 mm.; angle of spire 35°. (Weaver)

*Observations.* A specimen of this species has been described and figured by Tegland from the Blakeley formation at Restoration Point. It conforms to the type found in the Lincoln formation.

*Holotype.* (U.W. 121) (C.A.S. 472). Figured in the present report, pl. 97, fig. 7.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Western Lewis County and possibly Kitsap County, Washington.

*Type locality.* (U.W. 256.) Union Pacific railway cut one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

**Genus LORA Gistel, 1848**

*Lora* Gistel, Naturgeschichte des Tierreichs für höhere Schulen, p. 9, 1848.

*Genotype.* *Bela exarata* Möller.

**LORA TABULATA (Carpenter), 1864**

Plate 97, figure 12

*Mangelia tabulata* Carpenter, Brit. Assoc. Adv. Sci., Rept. for 1863, pp. 628, 658, 1864.

"*Bela fidicula* Gould," Reagan, Trans. Kansas Acad. Sci., vol. 22, p. 217, pl. 5, fig. 50, 1909.

*Lora miona* Dall, Am. Jour. Sci., ser. 5, vol. 4, p. 312, 1922.

*Lora tabulata* (Carpenter), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 520, 521, 1931.

*Description.* Shell small, thin; spire elevated; apex subacute; whorls five (to seven), angular, forming a broad shoulder at the suture; surface ornamented with about sixteen prominent, subacute, axially arranged ribs, which extend from suture to suture, the ribs forming an angle forward across the table-like band to connect with the ridge in front of it across the suture on the next whorl above; surface also sculptured with spiral sulcations, which become spiral lines on the lower part of the body whorl to its lower extremity; a knuckle-shaped ridge begins at the notch in the lip and borders the tabular area in front of suture from lip to apex, caused by a slight elevation on each rib where it forms the angle to cross from whorl to suture; suture deeply impressed, distinct; aperture subelliptical; canal short; body whorl ventricose, without transverse sculpture on the lower part; pillar smooth internally; striate externally. Dimensions: Axial length, 9; greatest lat., 4; height of body whorl, including canal, 6; of aperture, including canal, 6. (Reagan)

*Observations.* This species is characterized by its high spire, whorls with rounded angulation, vertical and slightly convex sides, and, beneath the angle, the slightly sloping nearly flat surface between angle and suture. The ornamentation consists of strong longitudinal ribs crossed by spiral ribs of lesser strength.

*Hypotype* (Holotype of "*Bela fidicula* Gould" of Reagan). (U.S.N.M. 328357.) Figured in the present report, pl. 97, fig. 12.

*Geologic range.* Upper Miocene to Recent. Quillayute formation in Washington.

*Occurrence in Washington.* Near mouth of Quillayute River, western side of Olympic Peninsula.

#### Genus SPIROTROPIS Sars, 1878

*Spirotropis* Sars, Moll. Reg. Arct. Norv., p. 242, 1878.

*Genotype.* *Spirotropis carinata* Philippi.

#### SPIROTROPIS WINLOCKENSIS Effinger, 1938

Plate 97, figures 5, 8, 9

*Surcula dickersoni* (Weaver), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 161, pl. 31, figs. 3a, 3b, 1917.

*Spirotropis (Spirotropis) winlockensis* Effinger, Jour. Paleon., vol. 12, p. 386, pl. 46, figs. 12, 16, 1938.

*Original description.* Shell small, high-spined; postnuclear whorls eight, turreted, angle situated slightly below center of exposed portion of whorl; surface above angulation flat or very slightly concave, ornamented by seven revolving threads; angulation fairly sharp, bearing two prominent rounded spiral ribs, one located on the angulation, the other immediately above; surface below the angulation and above the suture tapering inward anteriorly, bearing four strong spiral ribs; surface of body whorl below angulation convex above, concave below, ornamented by 22 to 23 spiral ribs, between which are sometimes developed finer spiral threads; suture linear, distinct; canal moderately long, deeply channeled, twisted very slightly to the left; outer lip thin; inner lip smooth and covered by only a thin callus wash; nuclear whorls two, smooth, the first rather flat and having the appearance of being mounted on the side of a higher second whorl; posterior sinus located medially on surface above the angulation, symmetrical, strongly U-shaped. Dimensions: holotype, 33.607, altitude 16.4 mm., maximum diameter 6.5 mm., apical angle 32°. (Effinger)

*Observations.* This species may be distinguished by well-developed spiral ribbing on the upper surface of the whorls, by a deep and symmetrical anal notch, and by well-marked angulation. It is closely related to *S. dickersoni* (Weaver) in shape of whorl and character of angulation, and as a whole shows considerable variation.

*Holotype.* (U.C. 33607.) Figured in the present report, pl. 97, figs. 5, 8.

*Hypotype.* (C.A.S. 428.) Dickerson's figure (123, pl. 31, fig. 3b). Figured in the present report, pl. 97, fig. 9.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, Section 25, T. 11 N., R. 2 W.

#### **SPIROTROPIS WASHINGTONENSIS Etherington, 1931**

Plate 97, figures 13, 14

*Spirotropis washingtonensis* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 113, pl. 14, figs. 8, 22, 34, 1931.

*Original description.* Shell medium sized, with about six whorls; spire high; suture impressed, sharply angulated on shoulder with faint trace of nodes; body whorl about one-fourth the height of shell; sinus deep; canal short, straight; inner lip callus; outer lip thin. Dimensions of holotype (U.C. 32042): Altitude 18.5 mm. (Etherington)

*Observations.* As pointed out by Etherington, the angulate character of the shoulder distinguishes this species from the other species of the genus in Oregon and Washington.

*Holotype.* (U.C. 32042.) Figured in the present report, pl. 97, fig. 14.

*Paratype.* (U.C. 32044.) Figured in the present report, pl. 97, fig. 13.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 473.) Cut in Wynoochee River highway 500 feet south of Black Creek railroad track, Grays Harbor County, Section 26, T. 18 N., R. 8 W.

#### **SPIROTROPIS DICKERSONI (Weaver), 1916**

Plate 97, figures 15, 16

*Turris dickersoni* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 54, pl. 5, fig. 66, 1916.

*Original description.* Shell small and elongate; whorls ten in number and angular; spire elevated and conical; upper surface of whorls concave and ornamented by very faintly developed revolving ribs; a prominent keel is developed upon the angulated portion of each whorl and this is sculptured by three rounded ribs with interspaces of equal width; about thirty similar ribs are present on the lower surface of the body whorl; longitudinal sculpture represented by moderately developed lines of growth which conform to the posterior sinus. Aperture sub-pyriform; outer lip thin; inner lip callused with a noticeable groove separating the callus from ornamented portion of the whorl; canal of moderate length; deeply channeled and nearly

straight. Dimensions.—Altitude of shell 18 mm.; altitude of spire 10 mm.; maximum diameter of shell 7 mm.; angle of spire 35°. (Weaver)

*Observations.* This species exhibits a wide degree of variation in the angle of the spire, the shape of the whorl, and in the character of angulation.

*Holotype.* (U.W. 120) (C.A.S. 471). Figured in the present report, pl. 97, fig. 15.

*Topotype.* (U.C. 15964.) Figured in the present report, pl. 97, fig. 16.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Western Lewis County, Washington.

*Type locality.* (U.W. 256.) Union Pacific railway cut one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

#### SPIROTROPIS KINCAIDI (Weaver), 1916

##### Plate 97, figures 18, 19, 25

*Turris kincaidi* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 53, pl. 5, fig. 67, 1916.

*Turricula kincaidi* (Weaver), Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci.,

vol. 23, pp. 126, 127, pl. 10, figs. 12, 13, 1916.

*Spirotropis kincaidi* (Weaver), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 548, 1931.

*Original description.* Shell small and turreted; whorls eight in number; the middle portion of the surface of each whorl is ornamented with a revolving keel along the angle; the upper surface of each above the angle is nearly smooth except for faintly developed revolving striae; angulated portion sculptured by three cord like rounded ribs with narrower grooved interspaces; lower portion of body whorl with fourteen similar cord like rounded ribs but with narrower grooved interspaces; the whorls are ornamented in addition by nineteen longitudinal ribs which form nodes on the angulated portions of the whorls but which become obscure above and below the angles; the numerous fine lines of growth exhibit the sharp curvature characteristic of the posterior sinus; suture distinct; aperture sub-pyriform; outer lip thin; inner lip callused and with faint groove separating the ornamented portion of the whorl from the callused area; canal moderately elongate and nearly straight. Dimensions.—Altitude of shell 22 mm.; altitude of spire 13 mm.; maximum diameter of shell 11 mm.; angle of spire 37°. (Weaver)

*Observations.* Specimens of this species occur also in the Blakeley formation and have been figured by Tegland. There is considerable variation in the strength of ornamentation and in the development of nodes on the heavily rounded carinae. On the holotype these nodes are missing but they range from barely noticeable to fairly well developed on other specimens in the same beds.

*Holotype.* (U.W. 119) (C.A.S. 470). Figured in the present report, pl. 97, fig. 18.

*Hypotype.* (U.C. 32175.) Blakeley formation. Figured in the present report, pl. 97, fig. 25.

*Topotype.* (U.C. 15963.) Figured in the present report, pl. 97, fig. 19.

*Geologic range.* Lincoln formation, middle Oligocene; Blakeley formation, upper Oligocene.

*Geographic distribution.* Western Lewis County, Washington.

*Type locality.* (U.W. 256.) Union Pacific railway cut one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

Genus **BORSONELLA** Dall, 1908

*Borsonella* Dall, Bull. Mus. Comp. Zool., vol. 43, p. 258, 1908.

*Genotype.* *Pleurotoma (Borsonia) dalli* Arnold.

**BORSONELLA NUNCAPATIA** Hanna, 1924

*Turris lincolnensis* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 92, 1918.  
(Stated to be figured on pl. 7, fig. 24, but through error in preparation of plate was omitted.)

Not *Turris lincolnensis* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pp. 88, 89, pl. 6, fig. 8, 1914 (Oregon coast).

*Borsonella ? nuncapatia* Hanna (new name), Proc. Calif. Acad. Sci., ser. 4, vol. 13, p. 158, 1924.

*Original description* (*Turris lincolnensis* Van Winkle). Shell small; spire elevated; whorls six in number; each whorl is characterized by a very pronounced angle situated at about one-third the distance of the length of the whorl below the suture; the angle between the upper and lower surface of each whorl is approximately 110°. The surface above the angle is very slightly concave; below the angle it is straight to very slightly convex; suture greatly impressed. Surface of whorls is ornamented with numerous very fine revolving striae; longitudinal ornamentation is absent except for fine lines of growth; aperture roughly trigonal in outline; outer lip with a sharp angle at its junction with the shoulder of the whorl; canal short with a very slight notch at its anterior end; outer lip thin; inner lip with very slight callous. Dimensions.—Altitude of shell 16 mm.; altitude of spire 5.5 mm.; maximum diameter of shell 9 mm.; angle of spire 53°. (Van Winkle)

*Observations.* This small shell came from the type locality of the Lincoln formation and was collected by the writer. At the time the specimens were being mounted for photographing, this holotype was accidentally crushed. No other topotypes are known.

*Holotype.* (U.W. 147.) Destroyed (the specimen described but not figured by Van Winkle).

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Western Lewis County, Washington.

*Type locality.* (U.W. 352.) Union Pacific railway cut one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

Genus **GEMMULA** Weinkauf, 1876

*Gemmula* Weinkauf, Jahrb. der Deutschen Mal. Gesell., vol. 2, p. 287, 1876.

*Genotype.* *Pleurotoma gemmata* Hinds, in Reeve.

**GEMMULA BARKSDALEI** n. sp.

Plate 97, figures 20, 21

*Turris monilifera* Cooper, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 10, figs. 6, 9, 1915.

*Description.* Shell small and moderately slender; apical angle 35°; four whorls intact, remainder broken; suture appressed; whorls sharply angulated a short distance above the sutures, the surfaces above and below the angle being slightly concave and the two surfaces meeting at the

carina where they form an average angle of about 120°. There occurs a second small carina just below the suture. Twenty longitudinal ribs cross the carinae but fade away immediately above and below the angulated surface and in crossing make a U-shaped bend with the convex side facing posteriorly. On the penultimate whorl are five spiral ribs above the angle and three below, and two heavy, noded ribs on the carina. There are five weak nearly equally spaced spiral ribs on the body whorl between the suture and the carina, three heavier similar ribs on the carina, and nine unequally spaced and unequally heavy spiral ribs beneath the angle on the lower surface of the whorl. Axial lines of growth are heavy and all make a U-shaped bend posteriorly along the carina. Canal short and slightly deflected. Aperture subovate. Dimensions (U.C. 15934 from Cowlitz formation) : Altitude, 21 mm.; maximum diameter, 11 mm.; angle of spire, 35°.

*Holotype.* (U.C. 15934.) Cowlitz formation. Figured in the present report, pl. 97, figs. 20, 21.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) At bend in Cowlitz River, Section 28, T. 11 N., R. 2 W.

#### GEMMULA FASTENI Weaver and Palmer, 1922

Plate 97, figures 17, 22, 23

*Turris* n. sp. Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 10, fig. 5, 1915.  
*Gemmula fasteni* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 42, pl. 12, figs. 1, 4, 1922.

*Original description.* Shell small and slender; whorls nine; nuclear whorls three, smooth; suture appressed; whorls angulated by a central, spiral carina which is formed by two close, fine revolving ribs upon which occur numerous delicate nodes. The whorls of the spire carry about three spiral ribs below the carina and about five or six above, the body whorl has from 10 to 12 ribs below the carina; longitudinal sculpture consists only of growth striae, the sinuosity of which occurs at the carina, in the middle region of the whorl; canal short; aperture sub-ovate. Dimensions.—Altitude 12 mm.; width of body whorl 4 mm. (Weaver and Palmer)

*Observations.* This small upper Eocene shell is characterized by the prominent lower noded spiral carina and an upper moderately developed very faintly noded carina, the surface between being very strongly concave. The heavy spiral ribs on the lower half of the body whorl, together with the broad and deep interspaces, are distinctive characteristics.

*Holotype.* (U.W. 208) (C.A.S. 7556). Figured in the present report, pl. 97, fig. 17.

*Topotype.* (U.W. 208-A.) Figured in the present report, pl. 97, figs. 22, 23.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

## Genus HEMIPLEUROTOMA Cossmann, 1889

*Hemipleurotoma* Cossmann, Ann. Soc. Roy. Malac. Belg., vol. 24 (ser. 4, vol. 4), p. 260, 1889.

*Genotype.* *Pleurotoma archimedis* Bellardi.

## HEMIPLEUROTOMA PULCHRA (Dickerson), 1915

Plate 97, figures 26, 27, 28

*Turris pulchra* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 71, pl. 10, figs. 4a, 4b, 1915.

*Hemipleurotoma pulchra* (Dickerson), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 71, pl. 17, figs. 15, 17, 1938.

*Original description.* Shell fusiform with nine whorls; first four turbo-form, smooth; others sharply angulated by a shoulder a third of whorl below suture; decorated by twelve to fourteen sub-equal spiral lines which are slightly nodose where the fine sinuous axial ribs cross them; a beaded sutural collar occurring just below indistinct suture; aperture elongate with greatest width above, narrowing below into a slender canal; outer lip thin; inner lip but slightly calloused. Dimensions:—Length, 20 mm.; width of body-whorl, 6.5 mm. (Dickerson)

*Observations.* This species, as pointed out by Turner, is characterized by its delicate sculpture and even angulated whorls, with the anal sinus situated at the shoulder.

*Holotype.* (C.A.S. 338.) Figured in the present report, pl. 97, fig. 28.

*Hypotype.* (U.C. 15950.) Figured in the present report, pl. 97, fig. 26.

*Hypotype.* (U.C. 33235.) (Turner.) Figured in the present report, pl. 97, fig. 27.

*Geologic range.* Cowlitz and upper Coaledo formations, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington, and Coos Bay area, Oregon.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Lewis County, Section 28, T. 11 N., R. 2 W. Occurs in Oregon at Yokam Point, Coos Bay.

## HEMIPLEUROTOMA BORGENAE (Tegland), 1933

Plate 98, figure 9

*Cryptogemma borgenae* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 125, pl. 10, figs. 9, 10, 11, 1933.

*Original description.* Shell pagodaform, elongate, of medium size, regular, of general smooth appearance; suture abutting. Whorls sharply angulate on anterior portion of whorl, posterior portion concave, smooth, glossy, with very faint revolving lines; angle with two flat revolving ribs; body whorl medially angulate; shoulder above angle with eight to ten faint to microscopic spirals which show more clearly on a weathered specimen; growth lines show characteristic of posterior sinus which reverses just above the angle; concave portion below angle sculptured by about 20 clearly marked flat revolving ribs with very narrow interspaces; interspaces widen on canal; aperture triangulate; outer lip thin; inner lip with narrow callus wash defined by incised line. Canal open; length and degree of curvature uncertain. Dimensions of incomplete holotype: height, 25 mm.; greatest diameter, 12 mm. (Tegland)

*Observations.* Tegland has pointed out the similarity of the specimens of this species to *Aforia packardi* (Weaver) but notes that in the latter the whorls are closely crowded and the anal sinus is situated on the middle of the shoulder and not on the angulated part, as in *H. borgenae*.

*Holotype.* (U.C. 32172.) Figured in the present report, pl. 98, fig 9.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Kitsap County, Washington.

*Type locality.* (U.W. 13.) Restoration Point, Kitsap County, opposite Seattle.

#### Genus **SURCULITES** Conrad, 1865

*Surculites* Conrad, Am. Jour. Conch., vol. 1, p. 213, 1865.

*Genotype.* *Surcula (Surculites) annosa* Conrad.

#### **SURCULITES MATHEWSONII** (Gabb), 1864

Plate 97, figures 24, 29; plate 98, figures 1, 5

*Fusus matthewsonii* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 83, pl. 18, fig. 33, 1864; Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 8, pl. 16, fig. 2, 1914.

*Surculites matthewsonii* (Gabb), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 420, 421, pl. 26, figs. 12, 13, 14, 1926.

*Surculites matthewsonii* (Gabb), Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 69, 70, pl. 17, figs. 6, 10, 1938 (synonymy).

*Original description.* Shell fusiform, spire turreted; whorls seven, angular. Aperture about as long as the spire, narrow; inner lip slightly incrusted, outer lip simple. Body whorl biangular; the upper angle acute and more prominent than the lower, which is obtuse. Surface marked by alternating ribs, some of which are linear, while others are quite broad. (Gabb)

*Observations.* The specimens of this species from the middle Eocene of Oregon correspond to the type from central California. It is characterized by its high pagodaform spire, sharply angulated whorls, elongate aperture, and alternating major and minor spiral ribs. The shell has the appearance of being heavy.

*Holotype.* Unknown.

*Hypotype.* (U.C. 33631.) Locality (U.O. 139). Figured in the present report, pl. 97, figs. 24, 29; pl. 98, fig. 1.

*Hypotype.* (U.C. 33209.) (Turner.) Locality (U.C. A-661). Figured in the present report, pl. 98, fig. 5.

*Geologic range.* Upper Umpqua and Capay formations, middle Eocene.

*Geographic distribution.* Douglas County, Oregon, and at Marysville Buttes and near Martinez, California.

*Type locality.* Near Martinez; in Oregon at locality (U.C. A-661), Douglas County, on Little River in center of Section 19, T. 26 S., R. 3 W.

## Genus MEGASURCULA Casey, 1904

*Megasurcula* Casey, Trans. St. Louis Acad. Sci., vol. 14, p. 147, 1904.

*Genotype.* *Pleurotoma (Surcula) carpenteriana* Gabb.

## MEGASURCULA WYNOCHEENSIS (Weaver), 1912

Plate 98, figures 2, 8

*Turris wynoocheensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 70, 71, pl. 11, figs. 87, 88, 89, 94, 1912; Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 52, 53, pl. 5, fig. 65, 1916.

*Pseudotoma wynoocheensis* (Weaver), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 110, pl. 14, figs. 25, 29, 1931.

*Surculites wynoocheensis* (Weaver), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 493, 1931.

*Original description.* Shell large with eight whorls; each whorl sharply angulated by a carina near the upper portion; surface of body whorl below angle convex, above very concave; it slopes at a sharp angle from the carina and then just below the suture abruptly bends and extends outward to the suture where it terminates in a very narrow band or cord; the surface of each whorl of the spire below the carina is nearly flat and nearly vertical; the surface above the carina is similar to the body whorl; the carina is crossed with ribs producing fourteen sharp nodes which entirely disappear on the surface immediately above the carina as well as within 2 mm. below it, except on the whorls of the spire where they extend down to the suture; transverse sculpture consists of numerous spiral threads which are much more pronounced on the surface of the whorl below the carina than above; on body whorl, below carina, there are fourteen evenly spaced major threads; midway between each of these is a less prominent thread and on each side of this a minor thread; above the carina up to the suture the same sculpture prevails, only less prominent; axial sculpture consists of numerous lines of growth conforming to the posterior sinus whose angle is above the carina. Inner lip smooth, aperture moderately broad. Extreme end of canal broken in every specimen but tending to bend slightly outwards. Older specimens relatively more elongate. Dimensions.—Altitude 35 mm. and 60 mm.; diameter 17 mm. and 25 mm.; elevation of spire 14 mm. and 22 mm. Angle of spire 52° and 38°. (Weaver)

*Observations.* The general form of this species resembles the Pleistocene form *Megasurcula cooperi* (Arnold) but may be distinguished in the more delicate spiral ribbing, more appressed suture, and in a deeper concavity beneath the suture.

*Syntype.* (U.W. 68) (C.A.S. 469). Figured in the present report, pl. 98, fig. 2.

*Topotype.* (U.C. 32024.) Etherington (140, pl. 14, fig. 25). Figured in the present report, pl. 98, fig. 8.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 67.) Cut on old Chehalis Logging Company road one mile west of Montesano, Grays Harbor County, Section 6, T. 17 N., R. 7 W.

## MEGASURCULA CARPENTERIANA (Gabb), 1865

Plate 98, figure 7; plate 103, figure 8

*Pleurotoma (Surcula) carpenteriana* Gabb, Proc. Calif. Acad. Sci., ser. 1, vol.

3, p. 183, 1865; Gabb, Geol. Surv. Calif. Paleon., vol. 2, p. 5, pl. 1, fig. 8, 1869.

*Pseudotoma carpenteriana* (Gabb), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 423, 1926; Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 109, 110, pl. 14, figs. 31, 35, 1931.

*Surculites (Megasurcula) carpenterianus* (Gabb), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 497, 498, pl. 25, figs. 4a, 4b, 1931 (synonymy).

*Original description.* Shell large, fusiform; spire about as long as the mouth; whorls eight, subflattened on the sides, slightly convex below; suture impressed. Surface marked by numerous fine revolving ribs, rounded and sometimes alternating in size, especially on the lower part of the body whorl. Aperture narrow; inner lip faintly incrusted; outer lip acute; sinus very broad and shallow; canal moderate, slightly twisted. (Gabb)

*Supplementary description.* Shell large, high spired, biconic; whorls with a variable amount of angulation, sometimes almost smoothly rounded with hardly any concavity above the angle, sometimes with a strong angle surmounted by more or less distinct nodes, the increase in the size of the whorls usually somewhat accelerated as the shell approaches its full growth so that the outline of the spire is slightly concave and the young specimens are more slender than the adults, spiral sculpture of numerous cords varying in strength as in *remondii*, crossed by more or less prominent growth lines; aperture varying in length from half to a little more than half the length of the shell, with practically the same features as those of *remondii*. (Grant and Gale, 149-A, p. 498)

*Observations.* This middle Miocene species of Washington resembles *M. remondii* (Gabb) but the former is relatively longer and slenderer and the sutural collar is less well developed.

*Lectotype.* (See Stewart, 226, p. 423.) (Gabb, 144, p. 5, pl. 1, fig. 8.) (U.C. 11996.) Figured in the present report, pl. 103, fig. 8.

*Hypotype.* (U.C. 32041.) From locality in Washington (U.W. 418.) Figured in the present report, pl. 98, fig. 7.

*Geologic range.* Empire and Montesano formations, upper Miocene and lower Pliocene. In California: Pliocene, Pleistocene, and Recent.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* Fulgor's Point, Santa Barbara County, California. Occurs at Coos Bay, Oregon, and in the Astoria formation, middle Miocene, in Washington at locality (U.W. 418), Clemons logging road, on abandoned spur north of junction of main line. Northern limit of the continuous exposures on the abandoned spur from locality (U.W. 415), Section 23, T. 17 N., R. 7 W.

#### MEGASURCULA REMONDII (Gabb), 1866

##### Plate 98, figure 6

? *Metula remondii* Gabb, Geol. Surv. Calif. Paleon., vol. 2, pp. 3, 4, pl. 1, fig. 5, 1866.

*Bathytorma carpenteriana* Gabb, Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 27, 28, pl. 4, fig. 8, 1909.

*Pseudotoma remondii* Gabb, Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 422, 423, pl. 31, fig. 5, 1926.

*Original description.* Shell broadly fusiform, spire elevated; whorls four or five (?) subangulated; suture impressed. Surface marked by numerous small revolving ribs, rounded with acute interspaces, and more or less regularly alternating in size; these ribs are crossed by strong lines of growth, so as to present in some specimens an approach to a regular reticulation. Body whorl three-fourths of the whole length of the shell, broadly and regularly convex in the middle, with usually a revolving depression just below the suture; sometimes this groove or depression is replaced by a flat space. Mouth long and narrow; inner lip slightly incrusted; outer lip unknown; canal straight. (Gabb)

*Supplementary description.* Shell ovate-fusiform, solid, of five or more whorls; sculpture chiefly with fine close-set spiral threads subequal in size, with linear interspaces, and almost obsolete above the shoulder; whorls moderately convex, above the rounded shoulder moderately excavated with a closely appressed suture; axial sculpture of rather inconspicuous incremental lines, most evident between the suture and the shoulder, where they are concavely arcuate in harmony with the wide, shallow anal sinus; aperture ovate-elongate, with a short canal and smooth pillar often obscurely thickened mesially. Altitude of figured specimen, 48 mm.; maximum diameter, 22 mm. (Dall)

*Observations.* This species may be distinguished from *M. carpenteriana* in being shorter and more robust and in having a less developed sutural collar. It differs from *M. gabbiana* (Dall) in its relatively larger size, shallower anal sinus, and less well defined sculpture.

*Hypotype of Bathytoma carpenteriana* (Gabb). (Dall, p. 27, pl. 4, fig 8.) (U.S. N.M. 153911.) Figured in the present report, pl. 98, fig. 6.

*Geologic range.* Upper Miocene to Recent. Empire and Montesano formations in Oregon and Washington.

*Geographic distribution.* Coast Ranges of Oregon, California, and Washington.

*Type locality.* Arroyo San Antonio, near Tomales Bay, Marin County, California. Occurs in Empire formation, Coos Bay. (Dall)

#### MEGASURCULA GABBIANA (Dall), 1909

##### Plate 98, figure 3

*Bathyntoma gabbiana* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 28, pl. 4, fig. 1, 1909.

*Original description.* Shell solid, short-fusiform, with five or more whorls; apex defective in the specimen figured; whorls moderately convex, excavated between the shoulder and the preceding suture; suture closely appressed; sculpture chiefly of coarse spiral cords, with shallow wider interspaces occasionally carrying a small intercalary thread; of the former there are in the figured specimen about nine between the canal and the shoulder, with a row of small subrectangular, rather distant sharply elevated modulations on the spiral nearest the shoulder; above the shoulder are three to five small, less elevated, and more closely set spiral threads; on the earlier whorls the nodules come about midway between the sutures; the nodules on the last whorl of the figured specimen are about 2.5 mm. from center to center, the whole number being uncertain on account of erosion of the type specimen, which also prevents their appearance in the photographic figure; axial sculpture of coarse lines of growth, especially prominent above the shoulder, where they indicate a wide shallow sinus; aperture elongate-ovate, with a short canal and distinct siphonal fasciole; pillar smooth, probably with an obscure thickening on its middle part. Altitude of figured specimen, 33 mm.; maximum diameter, 16 mm. (Dall)

*Observations.* This species in general shape resembles *M. carpenteriana* but differs in the subangulation of the whorls and small nodes on the angle. There are minor differences in the details of ribbing.

*Holotype.* (U.S.N.M. 153910.) Figured in the present report, pl. 98, fig. 3.

*Geologic range.* Empire formation.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* Coos Bay. (Dall)

**MEGASURCULA CONDONANA** (Anderson and Martin), 1914

Plate 98, figures 4, 10, 12

*Bathytoma condonana* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 89, 90, pl. 7, fig. 8, 1914.

*Pseudotoma condonana* (Anderson and Martin), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 110, 111, pl. 14, fig. 20, 1931.

*Surculites (Megasurculites) condonanus* (Anderson and Martin), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 497, 1931.

*Original description.* Shell of moderate size, ovate, with elevated spire and acute apex; whorls six or seven, ornamented with a row of nodes near the anterior margin, concave above, finely cancellated with numerous spiral threads and fine axial ribs; the penultimate whorl carrying twelve nodes on the angulation; suture distinct, strongly appressed; body-whorl large, ventricose, angulated above the middle, concave above, convex below, marked in front of the angle with numerous raised spiral ridges with wider interspaces carrying small intercalary threads. Dimensions: Altitude of the figured specimen, 16.5 mm.; diameter of the body-whorl, 9.5 mm. (Anderson and Martin)

*Observations.* This species is characterized by its large body whorl, noded ribs on the angulated part of the whorls situated not far above the sutures, and moderately strong spiral ribbing.

*Holotype.* (C.A.S. 214.) Figured in the present report, pl. 98, fig. 4.

*Hypotype.* (U.C. 32062.) Figured in the present report, pl. 98, figs. 10, 12.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Lincoln County, Oregon, and Grays Harbor County, Washington.

*Type locality.* (U.W. 691.) Exposures in ocean cliff on south side of Yaquina Bay. Occurs in Grays Harbor County, Washington, at locality (U.W. 425), in Rock Creek 1200 feet down stream from the falls just below the old dam site, Section 7, T. 16 N., R. 5 W.

**MEGASURCULA ETHERINGTONI** n. sp.

Plate 98, figure 13; plate 101, figure 10

*Pseudotoma* n. sp. (?) Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20 p. 110, pl. 14, fig. 33, 1931.

*Description.* Shell ovate-fusiform, heavy and probably of five whorls; body whorl subangulate with angle situated near middle portion; surface of body whorl above angle very slightly concave, below very slightly convex; surface of whorls of spire nearly straight; suture closely appressed; spiral sculpture consisting of very faint spiral threads above angle and of slightly stronger major and minor ribs below the angle; faintly developed nodes on angulated part of whorls; axial growth lines numerous and sinuous toward the right (posteriorly), the maximum curvature being near the middle of the surface between suture and angle. Dimensions of broken holotype: Altitude, 27 mm.; maximum diameter, 25 mm.

*Holotype.* (U.C. 32038.) Figured in the present report, pl. 98, fig. 13; pl. 101, fig. 10.

*Geologic range.* Astoria formation.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 425.) In Rock Creek 1200 feet down stream from falls and just below old dam site, Section 7, T. 16 N., R. 5 W.

#### Genus NEKEWIS\* Stewart, 1926

*Nekewis* Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 421, 422, 1926.

*Genotype.* "*Fasciolaria*" *washingtoniana* Weaver.

#### NEKEWIS WASHINGTONIANA (Weaver), 1912

Plate 98, figures 11, 18; plate 103, figure 11

*Fasciolaria washingtoniana* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 52, pl. 1, fig. 5, 1912.

*Surcula washingtoniana* (Weaver), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 10, figs. 7a, 7b, 1915.

*Nekewis washingtoniana* (Weaver), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 422, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 70, pl. 16, figs. 2, 4, 1938.

*Surculites (Clinura) washingtonianus* (Weaver), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 494, 1931.

*Original description.* Shell moderately large, robust and turreted; spire high; whorls eight, angulated; angle situated at lower part of upper third of body whorl, concave above and concave to flat below. Surface ornamented by thirteen very distinct revolving ribs confined almost entirely to the angulated area where they exist as short spine-like nodes; twenty-five revolving ribs are present, each of which is separated from the one next to it by a very small revolving thread; they all appear beaded, due to the intersections with the prominent lines of growth. Lines of growth are sinuous and above the angle curved to the right in accordance with the posterior sinus. Suture distinct and sinuous. Canal very narrow, angle in outer lip; columella slightly bent in advance with two very faint plications; inner lip calloused; outer lip thin. Dimensions.—Altitude 44 mm.; diameter 22 mm.; altitude of spire 8 mm.; angle of spire 49°. (Weaver)

*Observations.* Specimens of this species have been described by Turner from the upper Eocene of Oregon. The species is characterized by its turriform-subpagodaform shape, high spire, strongly angulated whorls, moderately strong longitudinal ribs which form sharp nodes on the angulated parts of whorl, and the closely crowded primary and secondary spiral ribs developed over the entire surface of all the whorls.

*Holotype.* (U.W. 37) (C.A.S. 7563). Figured in the present report, pl. 103, fig. 11.

*Hypotype.* (C.A.S. 341.) Locality (U.W. 232). Figured in the present report, pl. 98, fig. 11.

*Hypotype.* (C.A.S. 341-A.) Locality (U.W. 232). Figured in the present report, pl. 98, fig. 18.

*Geologic range.* Cowlitz formation, upper Eocene and lower Umpqua formation, middle Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington, and southwest Oregon.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

\* See note, page 449.

Genus **TURRICULA** Schumacher, 1817

*Turricula* Schumacher, Ess. d'un Nouv. Syst., p. 217, 1817.

*Genotype.* *Turricula flammea* Schumacher.

**TURRICULA COOPERI** (Dickerson) subsp. **UMPQUAENSIS** Turner, 1938

Plate 98, figures 14, 15

*Turricula cooperi* (Dickerson) subsp. *umpquaensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 70, pl. 17, figs. 1, 2, 3, 1938.

*Original description.* Shell heavy fusiform, spire turreted; whorls with faint spirals posterior to the shoulder and growth lines alone anterior to the shoulder; canal straight and of moderate length; outer lip of aperture not known; columella smooth with inner lip slightly resorbing. Dimensions of holotype: Length (incomplete) 39.7 mm.; diameter 17.3 mm. (Turner)

*Observations.* This subspecies differs from *T. cooperi* (Dickerson) in being relatively heavier and having a scalar spire in contrast to the evenly tapering spire of the latter.

*Holotype.* (U.C. 33230.) Figured in the present report, pl. 98, figs. 14, 15.

*Geologic range.* Lower Umpqua formation, middle Eocene.

*Geographic distribution.* Roseburg Quadrangle, U.S.G.S., Douglas County, Oregon.

*Type locality.* (U.C. A-996.) About 3,500 feet northwest of forks of Umpqua River, opposite entrance to old Poor Farm.

**TURRICULA CRENOATOSPIRA** (Cooper), 1894

Plate 98, figures 21, 25

*Surcula crenatospira* Cooper, Caiif. State Min. Bur., Bull. no. 4, p. 39, pl. 1, figs. 2, 3, 4, 1894; Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 7, pp. 278, 279, pl. 11, fig. 4, 1913.

*Turricula crenatospira* (Cooper), Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 71, pl. 17, fig. 9, 1938.

*Original description.* Nuclear whorls three, smooth, large, the apical immersed; other spiral whorls five, turreted, gradually enlarging, each with about nine rounded tubercles horizontally flattened, forming a chain around the middle, and connected by two strong revolving ribs, making a sharp angle. Above this are five or six fainter ribs, crossed by strong sinuated lines of growth, and below a similar sculpture, the whole surface being thus divided by strong reticulations, extending forward on body-whorl about half its length. Mouth simple, sinus moderate above angle, canal long straight, aperture as long as spire. Length, about 1.75 inch; breadth, 0.80; mouth and canal, 1 inch long, 0.40 wide. (Cooper)

*Observations.* This species, as represented by specimens in Oregon and Washington, is characterized by its heavy shell, elongate, angulate, and tabulate body whorl, strong and somewhat heavy nodes on the angle, and primary, secondary, and tertiary spiral ribs.

*Hypotype.* (U.C. 33240.) Figured in the present report, pl. 98, figs. 21, 25.

*Geologic range.* Lower Umpqua formation in Oregon and Capay formation in California. Middle Eocene.

*Geographic distribution.* Middle fork of Coquille River, Douglas County, Oregon, and Marysville Buttes, California.

*Type locality.* Marysville Buttes, California. Occurs in Oregon at locality (U.C. A-836). Middle fork of Coquille River opposite Roseburg-Coos Bay Highway Survey station 845 + 33.

#### TURRICULA WASHINGTONENSIS (Weaver), 1912

Plate 98, figures 16, 17, 22

*Pleurotoma washingtoniana* Weaver, Wash. Geol. Surv., Bull. no. 15, p. 78, pl. 3, fig. 31, 1912.

*Turris washingtonianus* Weaver, Univ. Wash. Publ. Geol., vol. 1, pl. 4, fig. 45, 1916.

*Original description.* Shell small, slender, apex acute; whorls 7 to 8, distinctly angulated and nodose; lower surface of whorl slightly convex; upper surface concave; surface of body whorl sculptured by ten distinct revolving ribs all of which are confined to the angulated ridge and the surface below it. Three obscure ribs appear above in some specimens; of those occurring below three are stronger than the remainder; angular ridge of body whorl set with 16 nodes which also occur on all whorls of spire; surface of shell strongly sculptured with incremental lines which are undulating and correspond to the sharply incised posterior sinus; apex of sinus above angular ridge. Canal moderately long and nearly straight with one faint plication; inner lip smooth; outer lip thin; aperture narrow, and elongate. Dimensions.—Altitude to broken end of canal 28 mm.; diameter 10 mm.; elevation of spire 16 mm.; angle of spire 20°. (Weaver)

*Observations.* This species is characterized by its subfusiform spire with heavy noded cord-like spiral angles and with smooth concave surface above, spirally striated surface below. Different specimens show great variation of apical angle and strength of nodes.

*Syntype.* (C.A.S. 560.) Figured in the present report, pl. 98, fig. 17.

*Topotype.* (U.C. 32175.) Figured in the present report, pl. 98, fig. 22.

*Hypotype.* (C.A.S. 545.) Figured in the present report, pl. 98, fig. 16.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 90.) Bluff along Northern Pacific railway track 2,200 feet west of Porter Station, Grays Harbor County, Section 21, T. 17 N., R. 5 W.

#### TURRICULA WORCESTERI (Van Winkle), 1918

Plate 98, figures 19, 20, 23, 24

*Turris worcesteri* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, p. 91, pl. 7, fig. 21, 1918.

*Original description.* Shell small or slender with six or seven whorls; the middle portion of the whorls are marked by broad, sharply angulated, revolving folds; on the surface between these folds and the suture are two revolving ribs. Body whorl is ornamented with 14 revolving ribs with interspaces of equal width;

the first two ribs just below the prominent revolving fold are moderately prominent, the others decreasing in size as they approach the anterior end; aperture elongate-elliptical, wider posteriorly; canal short, wide and twisted to the left; inner lip calloused. Dimensions.—Altitude of shell 10 mm.; altitude of spire 4 mm.; maximum diameter of shell 14 mm.; angle of spire 44°. (Van Winkle)

*Observations.* This small shell from the Lincoln formation is characterized by its rather convex spire, whorls with three prominent equally spaced spiral ribs on middle portion, and concave and smooth surface above, with raised collar containing two heavy spiral threads just below the suture. The callus is heavy and passes over entire columella.

*Holotype.* (U.W. 146-A) (C.A.S. 7555-A). Figured in the present report, pl. 98, figs. 19, 24.

*Paratype.* (U.W. 146) (C.A.S. 7555). Figured in the present report, pl. 98, figs. 20, 23.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Western Lewis County, Washington.

*Type locality.* (U.W. 352.) Union Pacific railway cut one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

#### TURRICULA (PLEUROFUSIA) COWLITZENSIS (Weaver), 1912

Plate 99, figures 1, 2, 7

*Surcula cowlitzensis* Weaver, Wash. Geol. Surv., Bull. no. 15, pp. 53, 54, pl. 3, figs. 30, 36; pl. 11, fig. 86, 1912; Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, pl. 10, figs. 7a, 7b, 1915; Anderson and Hanna, Calif. Acad. Sci., Occ. Pap. no. 11, p. 85, 1925.

*Original description.* Shell slender, elongate, biconical and fusiform; length of spire equal to that of canal; whorls eleven and sharply angulated; suture distinct, impressed and linear; surface below angle slightly convex, that above distinctly concave; surface of body whorl ornamented with fifteen longitudinal ribs which extend over the whorls of spire; these entirely disappear just above the angle and a short distance below and form conspicuous nodes on the angle; there are sixteen equally spaced revolving ribs from base to angle and between each is a broad flat-bottomed interspace containing a fine revolving thread; in addition there are fine lines of growth which are sinuous and conform to the posterior sinus. Aperture narrow and elongate terminating in a long narrow canal; posterior end with a deep sinus; inner lip smooth and incrusted; outer lip thin; canal long and straight. Dimensions.—Altitude 45 mm.; diameter 7 mm.; altitude of spire 22 mm.; angle of spire 30°. (Weaver)

*Observations.* This symmetrical and highly ornamented gastropod is abundant and nearly always well preserved in the Cowlitz fauna at the type locality (U.W. 232). The form is slender and the fusiform spire about equal in length to canal. A prominent angulated zone on the base of upper third of body whorl and just above suture on whorls of spire is noded and contains four or five heavy spiral ribs. The middle surface of body whorl below angle has heavy equally spaced rounded spiral ribs. These become less prominent on lower third of body whorl and pass into fine threads on canal. The growth lines are strongly deflected to the right

about the middle of concave area above angle of the apex of curve. The species cannot easily be confused with others of the Northwest.

*Holotype.* (U.W. 40) (C.A.S. 7544). Figured in the present report, pl. 99, figs. 1, 7.

*Paratype.* (U.W. 40-A.) Figured in the present report, pl. 99, fig. 2.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

#### TURRICULA (PLEUROFUSIA) ORNATA (Dickerson), 1915

Plate 99, figure 3

*Drillia ornata* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 5, p. 71, pl. 10, fig. 3, 1915.

*Original description.* Shell elongated, fusiform; spire high; whorls eight, angular; suture distinct; surface marked by ten to twelve large rounded oblique ribs most prominent at shoulder and below, becoming obsolete above; these are crossed by numerous prominent, spiral ribs with very narrow interspaces; sinus located very slightly above the shoulder; aperture elongate; wide above, narrow below. Dimensions:—Length, 17 mm.; width of body whorl, 6 mm. (Dickerson)

*Observations.* This shell may be distinguished from *T. cowlitzensis* by its relatively shorter spire, more angulated whorls, central location of angle, equally developed spiral ribs, and well-developed longitudinal ribs crossing the surface of the whorls.

*Holotype.* (C.A.S. 337.) Figured in the present report, pl. 99, fig. 3.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

#### Genus CLAVATULA Lamarck, 1801

*Clavatula* Lamarck, Syst. Anim. sans Vert., p. 84, 1801.

*Genotype.* *Clavatula coronata* (Chemnitz) Lamarck.

#### CLAVATULA ARNOLDI (Van Winkle), 1918

Plate 99, figures 4, 11, 12

*Hemifusus arnoldi* Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 1, p. 89, pl. 7, fig. 11, 1918.

*Clavatula arnoldi* (Van Winkle), Effinger, Jour. Paleon., vol. 12, p. 386, pl. 47, figs. 24, 26, 1938.

*Original description.* Shell minute, slender and moderately thick; whorls seven in number; suture distinct, appressed and sinuous; upper surface of body whorl concave; spire about equal in length to body whorl and canal; whorls

sharply angulated about one-third the distance below the suture line; surface of whorls decorated by 13 prominent longitudinal ribs which become obscure on the posterior surface of the body whorl; these are crossed by six prominent, rounded revolving ribs; surface of whorls above the angle ornamented by four small revolving ribs with interspaces of triple width. On the angulated portion of the whorls somewhat prominent nodes are formed by the intersection of the longitudinal and revolving ribs; body whorl ornamented by 18 prominent, flat-topped revolving ribs which progressively become less developed toward the end of the canal; between these are interspaces of double width which contain no revolving threads; outer lip short, broad and slightly reflected to the left. Dimensions.—Altitude of shell 6 mm.; altitude of spire 3.5 mm.; maximum diameter of shell 3 mm.; angle of spire 35°. (Van Winkle)

*Observations.* Specimens which seem to belong to this species from the Gries Ranch beds have been figured by Effinger and described as follows: "The growth lines show the presence of a moderately concave, unsymmetrically rounded anal notch, which lies on the upper surface of the whorl above the angulation, very much as in the typical form. The nuclear whorls are somewhat larger than those of the typical nucleus and are distinctly naticoid, having about two and one-half volutions, which are smooth except for the last one-half turn ornamented by three to four spiral ribs."

*Holotype.* (U.W. 142.) Lost.

*Hypotype.* (U.C. 33608.) Figured in the present report, pl. 99, fig. 4.

*Hypotype.* (U.C. 33609.) Figured in the present report, pl. 99, figs. 11, 12.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.C. 239.) South bank of Cowlitz River at old Gries Ranch in northeast quarter of Section 25, T. 11 N., R. 2 W.

#### Genus **PSEUDOMELATOMA** Dall, 1918

*Pseudomelatoma* Dall, Proc. U.S. Nat. Mus., vol. 54, p. 317, 1918.

*Genotype.* *Drillia penicillata* Carpenter.

#### **PSEUDOMELATOMA KERNENSIS** (Anderson and Martin), 1914

##### Plate 99, figures 5, 6

*Mangilia kernensis* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 94, 95, pl. 7, figs. 6a, 6b, 1914.

*Pseudomelatoma kernensis* (Anderson and Martin), Etherington, Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 20, p. 112, pl. 14, fig. 32, 1931.

*Original description.* Shell slender and small, fusiform, with seven or eight whorls, spire high with an acute apex; whorls angulated a little above the middle, concave above, convex below, sculptured with twelve to fourteen axial ribs and about ten spiral threads, five of moderate size below the angle and four or five very fine spiral lines above the angle; axial ribs most prominent below the angle and rising to small nodes on the shoulder; interspaces equal in width to the ribs and frequently carrying intercalary lines; suture distinct, appressed; body-whorl ornamented with ten to twelve spiral threads between which are secondary spiral

lines; aperture elliptical, with a simple outer lip; columella slightly incrusted, straight; canal short, posterior sinus deep and narrow, near the suture. Dimensions:—Altitude of the type, 6 mm.; diameter of the last whorl, 2 mm. (Anderson and Martin)

*Observations.* This small and slender species represented by a few specimens in the Astoria formation in Washington is characterized by its high spire, subangulated whorls, and nearly equally developed longitudinal and spiral ribs whose intersections give the ornamentation a reticulated appearance.

*Holotype.* (U.C. 32054.) Figured in the present report, pl. 99, figs. 5, 6.

*Geologic range.* Barker's Ranch, Kern County, California, Miocene; Astoria formation, Washington, middle Miocene.

*Geographic distribution.* Kern County, California, and Grays Harbor County, Washington.

*Type locality.* Barker's Ranch, Kern County, California. Occurs in Washington at locality (U.W. 425), in Rock Creek about 1,200 feet down stream from the falls and just below the old dam site, Grays Harbor County, Section 7, T. 16 N., R. 5 W.

#### Genus THESBIA Jeffreys, 1867

*Thesbia* Jeffreys, Brit. Conch., vol. 4, p. 359, 1867.

*Genotype.* *Tritonium?* *nana* Loven.

#### THESBIA COLUMBIANA (Anderson and Martin), 1914

Plate 99, figure 13

*Drillia columbiana* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 94, pl. 7, figs. 4a, 4b, 1914.

*Original description.* Shell fusiform, small, with six or seven whorls; spire high, with an acute apex; whorls angulated a little below the middle, concave above with very fine spiral striations, flat below with two or three spiral threads, crossed by axial lines of growth; suture distinct, channeled; body-whorl convex in front of the shoulder, sculptured with nine or ten spiral threads having slightly wider interspaces which occasionally contain very fine intercalary lines; the spiral threads replaced by seven or eight striations on the anterior portion of the body-whorl; aperture ovate, with simple outer lip; canal short; columella twisted; posterior sinus broad and moderately deep. Dimensions:—Altitude of the type, with defective apex, 9 mm.; diameter of the last whorl, 4.5 mm. (Anderson and Martin)

*Observations.* This small shell may be distinguished from *T. antiscelli* by its angulated rather than convexly rounded whorls, its wider and slightly concave area between angle and suture, and its more deeply channeled suture.

*Holotype.* (C.A.S. 231.) Figured in the present report, pl. 99, fig. 13.

*Geologic range.* Lower and middle Miocene.

*Geographic distribution.* Barker's Ranch area, Kern County, California, and northwestern Oregon.

*Type locality.* (C.A.S. 65.) West bank of small canyon one and one-fourth miles northeast of Barker's ranch house in Kern County, California.

## THESBIA ANTISELLI (Anderson and Martin), 1914

Plate 99, figures 8, 9, 10

*Drillia antiselli* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 93, pl. 7, figs. 2a, 2b, 1914.

*Clathodrillia (Moniliopsis) antiselli* (Anderson and Martin), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 112, pl. 14, figs. 16, 18, 19, 1931.

*Original description.* Shell small, solid, rather broadly fusiform; spire high with an acute apex; whorls six or seven, angulated a little in front of the middle, concave above, convex below, marked with four spiral lines, one on the angle and three below; suture distinct; body-whorl with ten or eleven spiral lines in front of the shoulder; aperture elliptical, with simple outer lip; canal short and broad, slightly recurved; columella incrusted, smooth, with anterior sulcus. Dimensions:—Altitude of the type specimen, 17.5 mm.; diameter of the last whorl, 7.5 mm.; length of the aperture, including the canal, 9 mm. (Anderson and Martin)

*Observations.* This species is characterized by its numerous delicate spiral ribs, shallow sinus, and prominent angle on the whorl with concave surface between it and the suture.

*Holotype.* (C.A.S. 226.) Figured in the present report, pl. 99, fig. 10.

*Hypotype.* (U.C. 32045.) Figured in the present report, pl. 99, figs. 8, 9.

*Geologic range.* Lower Miocene of Kern River, California, and Astoria formation, Washington.

*Geographic distribution.* Kern County, California, and Grays Harbor County, Washington.

*Type locality.* Kern River area, locality (U.C. 65). Occurs in Washington at locality (U.W. 416). On abandoned spur of Clemons logging road north of junction of main line, Section 25, T. 17 N., R. 7 W.

## THESBIA WORKENSIS (Etherington), 1931

Plate 99, figures 14, 15, 20

*Clathodrillia (Moniliopsis) workensis* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 111, 112, pl. 14, figs. 12, 24, 26, 28, 30, 1931.

*Original description.* Shell small, slender, with about six whorls; nucleus eroded; spire with sides slightly flattened; sculpturing consisting of four or five revolving lines; narrow interspaces; body whorl about ten revolving lines, sinus narrow, situated a little above the shoulder, sides moderately rounded; canal slightly reflected; columella medium length; aperture narrow. Dimensions of type: Altitude 13.6 mm.; maximum diameter 6.5 mm.; height of body whorl 9.1 mm. (Etherington)

*Observations.* This small shell is characterized by its flat to very slightly convex whorls, moderately appressed sutures, broad, flat to round-topped spiral ribs, and narrow interspaces.

*Holotype.* (U.C. 32047.) Figured in the present report, pl. 99, fig. 20.

*Paratypes.* (U.C. 32049) (U.C. 32050). Figured in the present report, pl. 99, figs. 14, 15.

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington.

*Type locality.* (U.W. 416.) On abandoned spur of Clemons logging road north of junction of main line, Section 25, T. 17 N., R. 7 W.

**THESBIA OCOCYANA** (Anderson and Martin), 1914

Plate 99, figures 16, 21, 22, 23, 25

*Drillia ocoyana* Anderson and Martin, Proc. Calif. Acad. Sci., ser. 4, vol. 4, pp. 93, 94, pl. 7, figs. 1a, 1b, 1914.*Clathodrillia (Moniliopsis) ocoyana* (Anderson and Martin), Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 111, pl. 14, figs. 14, 21, 1931.

*Original description.* Shell small, elongate, solid, with seven or eight whorls; spire elevated; whorls slightly convex or nearly flat, sculptured with numerous spiral grooves, eight on the whorls of the spire and about twenty-five on the body whorl; the interspaces between the spiral grooves on the body whorl slightly raised and often divided by a small intercalary groove; numerous faint axial lines are visible on the upper whorls of some specimens; suture strongly appressed; body whorl sharply rounded on the anterior margin, and angulated near the posterior margin on some specimens, concave above, broadly convex below; aperture elliptical oblique, with an arcuate outer lip and a shallow posterior sinus; canal very short; columella concave, incrusted, with an umbilical chink. Dimensions:—Altitude of the type specimen, 22 mm., with the first few whorls broken; diameter of the last whorl, 10 mm.; length of the aperture, including the canal, 10 mm. (Anderson and Martin)

*Observations.* This species is characterized by very slightly convex whorls which are sculptured by numerous low, flat-topped spiral ribs with very narrow interspaces. The maximum convexity is a little below middle of whorl and the sutures are strongly appressed.

*Holotype.* (C.A.S. 228.) Figured in the present report, pl. 99, figs. 16, 25.

*Hypotype.* (U.C. 32052.) Locality in Washington (U.W. 416). Figured in the present report, pl. 99, figs. 21, 22, 23.

*Geologic range.* Kern River Miocene, California, and Astoria formation, Washington, middle Miocene.

*Geographic distribution.* Kern County, California, and Grays Harbor County, Washington.

*Type locality.* Kern River, Kern County, California. In Washington, at locality (U.W. 416), on abandoned spur of Clemons logging road north of junction of main line, Section 25, T. 17 N., R. 7 W.

**THESBIA MUIRENSIS** (Clark and Arnold), 1923

Plate 99, figures 17, 18, 19

*Antiplanes muirensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 157, 158, pl. 30, figs. 4, 5a, 5b, 6, 1923.

*Original description.* Shell medium in size; spire acute, consisting of about seven whorls; sutures depressed. Whorls of spire subangulate; subangulation occurring a little below middle of whorl. Surface above subangulation gently convex but below it slightly concave. Body whorl rather strongly convex with only slight indication of subangulation that occurs on whorls of spire. Surface of shell sculptured by rather heavy spiral ribbing, interspaces between which average somewhat less than width of ribs. On whorls of the spire and above subangulation there are four of these spiral ribs including the one that forms subangulation; below this are three spiral ribs. On body whorl spiral ribbing becomes coarser below middle. On type and cotype three of these ribs stand out more prominently than the others and are separated by fairly wide interspaces in each of which is a riblet. Aperture broadly

subovate; canal broken. Dimensions: Height of spire, 8 mm.; greatest width of body whorl, about 7 mm. (Clark and Arnold)

*Observations.* This species differs from *T. ocoyana* in the greater convexity of the whorls, the heavier and larger number of similar low flat-topped spiral ribs, and longer canal.

*Holotype.* (U.C. 30067.) Figured in the present report, pl. 99, fig. 19.

*Cotype.* (U.C. 30254.) Figured in the present report, pl. 99, figs. 17, 18.

*Geologic range.* Sooke formation, upper Oligocene.

*Geographic distribution.* South coast of Vancouver Island.

*Type locality.* Sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

#### Genus CLAVUS Montfort, 1810

*Clavus* Montfort, Conch. Syst., vol. 2, p. 434, 1810.

*Genotype.* *Clavus flammulatus* Montfort.

#### Subgenus Crassispira Swainson, 1840

*Crassispira* Swainson, Treat. Malac., pp. 152, 313, 1840.

*Subgenotype.* *Pleurotoma bottoe* Valenciennes.

#### CLAVUS (CRASSISPIRA) FRYEI (Weaver and Palmer), 1922

Plate 99, figures 26, 27, 28, 29

*Clathrodrillia (Moniliopsis) fryei* Weaver and Palmer, Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 42, 43, pl. 11, fig. 25, 1922.

*Original description.* Shell small and slender with seven whorls, the last two of which are smooth; sides of whorls nearly straight but slightly concave at the suture; canal short, wide; aperture subovate; suture appressed; sutural band on the upper portion of whorl bounded below by a depression; the sutural sinus, formed by the lines of growth, makes at the lower margin of the sutural band a reentrant curve at an angle of approximately 50°; whorls decorated by seven revolving lines, with 19 on the body whorl; the spiral lines are crossed by 12 or 13 longitudinal ribs which follow the curves of the growth lines. These ribs continue over the length of the whorls of the spire but are only slightly developed on the body whorl, becoming obsolete on the lower regions of that whorl. Dimensions.—Altitude 7.5 mm.; width of body whorl 2 mm. (Weaver and Palmer)

*Observations.* This small shell is fairly abundant in the fauna of the Cowlitz formation at the type locality (U.W. 232). It is characterized by its slender build, moderately convex whorls, slightly wavy longitudinal lines, slightly developed collar just below suture, and moderately strong and equally spaced spiral ribs.

*Holotype.* (U.W. 209) (C.A.S. 7554). Figured in the present report, pl. 99, figs. 28, 29.

*Paratype.* (U.W. 209-A) (C.A.S. 7554-A). Figured in the present report, pl. 99, figs. 26, 27.

*Geologic range.* Cowlitz formation, upper Eocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.C. 232.) North bank of Cowlitz River one and one-half miles east of Vader, Section 28, T. 11 N., R. 2 W.

#### Family PHILINIDAE

##### Genus MEGISTOSTOMA Gabb, 1864

*Megistostoma* Gabb, Geol. Surv. Calif. Paleon., vol. 1, p. 144, 1864.

*Genotype.* *Megistostoma gabbianum* (Stoliczka).

##### MEGISTOSTOMA CAMINOENSIS M. A. Hanna, 1927

###### Plate 99, figure 24

*Megistostoma caminoensis* M. A. Hanna, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 330, pl. 57, figs. 9, 10, 1927; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 68, pl. 20, fig. 15, 1938.

*Original description.* Shell thin, flattened, involute, ovate; spire hidden; body whorl enlarging very rapidly, constituting the major portion of the shell; aperture large; outer lip entire, slightly thickened, broadly rounded; anterior portion of the aperture less rounded than the outer; posterior portion of the outer lip produced onto a sharply rounded process which extends some distance beyond the spire; inner lip smooth, rounded, thickened; sculpturing consists of irregular growth lines and about seventy flat-topped, square irregularly spaced spiral threads, separated by interspaces of two to three times their width. Dimensions. Type: Altitude 21 mm., maximum diameter 17 mm.; minimum diameter at right angles to the maximum 9 mm. (M. A. Hanna)

*Observations.* *M. caminoensis* is the only species of this genus known in Oregon and Washington.

*Hypotype.* (U.C. 33688.) Figured in the present report, pl. 99, fig. 24.

*Geologic range.* Rose Canyon shales, California, Domengine; upper Umpqua formation, Oregon. Middle Eocene.

*Geographic distribution.* Rose Canyon, San Diego County, California, and at Glide, Douglas County, Oregon.

#### Family ACTEONIDAE

##### Genus ACTEON Montfort, 1810

*Acteon* Montfort, Conch. Syst., vol. 2, pp. 314, 316, 1810.

*Genotype.* *Acteon tornatilis* (Gmelin) = *Voluta tornatilis* Gmelin.

##### ACTEON UMPQUAENSIS Turner, 1938

###### Plate 99, figures 34, 35, 36

*Acteon ? umpquaensis* Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 67, pl. 17, fig. 4, 1938.

*Original description.* Shell small, slender, spire about equal to half the total length; surface smooth except for faint growth lines; suture impressed; aperture

elongate, rounded anteriorly; single medial plication on the columella at the upper margin of the light callous which appears on the lower half of the inner lip. (Turner)

*Observations.* This small, non-ornamented, slender shell with elongate aperture and single plication on the inner lip is distinct from the other species of the genus *Acteon* in Oregon and Washington.

*Holotype.* (U.C. 33210.) Figured in the present report, pl. 99, figs. 34, 35, 36.

*Geologic range.* Upper Umpqua formation, middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. A-667.) Bank of North Umpqua River between the bend a quarter of a mile north of Glide and Bradley Creek.

#### ACTEON MOODYI Dickerson, 1916

Plate 99, figures 32, 33

*Acteon moodyi* Dickerson, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, p. 488, pl. 38, figs. 10a, 10b, 1916.

*Acteon* sp. cf. *moodyi* Dickerson, Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 67, pl. 15, fig. 15, 1938.

*Original description.* Shell ovate; spire low, conical; whorls five and a half, the first two being smooth nuclear. The shell is decorated by strong, evenly spaced, equal spiral lines, four of which mark the third whorl, five the fourth, and about eighteen the body whorl. Whorls convex, rounded; suture linear; mouth suboval; outer lip simple; columella marked by the faint single plait of this genus. Dimensions.—Length, 9 mm.; width of body whorl, 5 mm. (Dickerson)

*Observations.* The specimens of *A. moodyi* from the lower Umpqua formation in southwest Oregon resemble the type from California, but the spire is somewhat higher and the columella shows heavier plications.

*Hypotype.* (U.C. 33222.) Locality (U.C. A-691.) Figured in the present report, pl. 99, figs. 32, 33.

*Geologic range.* Oregon: lower Umpqua formation, middle Eocene. California: middle Eocene.

*Geographic distribution.* Douglas County, Oregon.

*Type locality.* (U.C. 672.) Occurs in Oregon at locality (U.C. 691), six hundred feet downstream from Hughes Ferry, on north bank of North Umpqua River west of Glide.

#### ACTEON BOULDERANA Etherington, 1931

Plate 99, figure 37

*Acteon boulderana* Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 113, pl. 14, fig. 9, 1931.

*Original description.* Shell medium sized, ovate, with five whorls; body whorl large; suture distinct; sculpturing of body whorl consists of wide revolving lines with narrow interspaces; slight indication of bifurcation of wider ribs which does not show on the ribs of the spire; aperture elongate-ovate. Dimensions (type 32057).— $\times 2$ , altitude 10.0 mm.; maximum diameter 6.0 mm.; altitude of body whorl 7.5 mm. (Etherington)

*Observations.* This species in general outline and in character of ornamentation resembles *A. chehalensis* but may be distinguished in its

more strictly ovate outline, its relatively higher spire, greater convexity of the whorls of spire, and in having slightly more rounded ribs, although this appears to depend on the amount of weathering of the specimens.

*Holotype.* (U.C. 32057.) Figured in the present report, pl. 99, fig. 37.

*Geologic range.* Kern River Miocene, California, and Astoria formation, Washington. Middle Miocene.

*Geographic distribution.* Grays Harbor County, Washington, and Kern County, California.

*Type locality.* (U.W. 425.) Rock Creek about 1200 feet down stream from the falls and just below the old dam site, Grays Harbor County, Section 7, T. 16 N., R. 5 W.

#### ACTEON CHEHALISENSIS (Weaver), 1916

Plate 99, figures 38, 39, 40

*Acteocina chehalisensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 55, pl. 4, figs. 55, 56, 1916.

*Original description.* Shell small and moderately elongate; spire about one-fifth as long as body whorl and consisting of four whorls; surface of body whorl sculptured by thirty-two nearly flat topped revolving ribs with interspaces, every alternating one of which is twice as wide as the ribs; suture distinct; aperture narrow behind and wide in front; outer lip smooth; inner lip callused with the callus extending around the anterior end of the non-channelled canal; a very faintly developed groove extends around the base of the body whorl. Dimensions.—Altitude of shell 10 mm.; altitude of spire 3 mm.; maximum diameter of shell 6 mm.; angle of spire 50°. (Weaver)

*Observations.* This species is characterized by the subovate and somewhat elongate body whorl which converges toward the suture so that the profile of the spire does not merge directly into that of the body whorl as in the case of *A. boulderana*. The spiral ribs are more numerous than in *A. parvum*.

*Holotype.* (U.W. 123) (C.A.S. 474). Figured in the present report, pl. 99, figs. 39, 40.

*Topotype.* (U.C. 15548.) Figured in the present report, pl. 99, fig. 38.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Western Lewis County, Washington.

*Type locality.* (U.W. 352.) Union Pacific railway cut one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

#### ACTEON PARVUM Dickerson, 1917

Plate 99, figures 30, 31

*Acteon parvum* Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 172, pl. 29, figs. 12a, 12b, 1917; Effinger, Jour. Paleon., vol. 12, p. 387, pl. 47, fig. 2, 1938.

*Original description.* Shell small, number of whorls probably five; body-whorl cylindrical; decoration consisting of about 20 flat equally spaced spiral lines with peculiarly pitted interspaces; outer lip thin; inner lip slightly incrusted; aperture, narrow above, elongate and widened below. Dimensions:—Length of broken type, 6 mm. (Dickerson)

*Observations.* This species differs from *A. chehalensis* (Weaver) of the middle Oligocene in the greater robustness of the body whorl, relatively lower spire, and the lesser number of punctate spiral striae.

*Holotype.* (C.A.S. 401.) Figured in the present report, pl. 99, fig. 30.

*Hypotype.* (U.C. 33613.) Gries Ranch beds. Figured in the present report, pl. 99, fig. 31.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch in northwest quarter of Section 25, T. 11 N., R 3 W.

### Family ACTEOCINIDAE

#### Genus VOLVULELLA Newton, 1891

*Volvulella* Newton, Syst. List Brit. Olig. Eoc. Moll., p. 268, 1891 (new name for *Volvula* A. Adams).

*Genotype.* *Volvula rostrata* A. Adams.

#### VOLVULELLA TABORI Effinger, 1938

##### Plate 100, figure 1

*Volvulella tabori* Effinger, Jour. Paleon., vol. 12, p. 387, pl. 47, fig. 11, 1938.

*Original description.* Shell minute, thin, fusiform, convolute; posterior and medial portion of aperture narrow; anterior portion moderately dilated, slightly flaring below; lower portion of inner lip bearing an inconspicuous fold, which extends to the lower margin of the aperture; umbilicus represented by a small fissure; sculpturing consisting of minute, incised, spiral lines which are more prominently developed on the lower half of the body whorl. Dimensions: holotype 33,612, altitude 2.7 mm., maximum diameter 1.1 mm. (Effinger)

*Observations.* This species is the only representative of the genus in Oregon and Washington, and the oldest geologically on the Pacific Coast. The shell is characterized by its concealed spire, narrow aperture somewhat widened anteriorly, faintly developed fold on columella, and barely visible spiral lines.

*Holotype.* (U.C. 33612.) Figured in the present report, pl. 100, fig. 1.

*Geologic range.* Gries Ranch beds, lower middle Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch in northwest quarter of Section 25, T. 11 N., R. 2 W.

### Family SCAPHANDRIDAE

#### Genus SCAPHANDER Montfort, 1810

*Scaphander* Montfort, Conch. Syst., vol. 2, p. 335, 1810.

*Genotype.* *Bulla lignaria* Linnaeus.

**SCAPHANDER COSTATUS** (Gabb), 1864

Plate 100, figure 2; plate 103, figure 21

*Cylichna costata* Gabb, Geol. Surv. Calif. Paleon., vol. 1, pp. 143, 144, pl. 21, fig. 107, 1864.

*Scaphander costata* (Gabb), M. A. Hanna, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 329, pl. 57, figs. 2, 3, 5, 1927.

*Scaphander (Mirascapha) costatus* (Gabb), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 437, 438, pl. 27, fig. 5, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, p. 67, pl. 17, fig. 16, 1938.

*Original description.* Shell elongated, subcylindrical, widest anteriorly; spire hidden; whorls (from casts) three or four. Surface marked by very numerous, flattened, revolving ribs, with narrow interspaces. Aperture linear; inner lips incrusted. A single small fold in advance, on the columella. (Gabb)

*Observations.* This species is characterized by moderately wide and elongate aperture, elevated outer lip, and elongate anterior end. The course of the parietal part of inner lip is less deflected to the left than in other species of the genus from the Northwest.

*Lectotype.* (P.A.N.S. 4338.) Reproduction of Stewart's figure (266a, pl. 27, fig. 5). Figured in the present report, pl. 103, fig. 21.

*Hypotype.* (U.C. 33219.) Oregon, locality (U.C. A-836). Figured in the present report, pl. 100, fig. 2.

*Geologic range.* Middle and upper Eocene. Occurs in Spencer, Tyee, upper and lower Umpqua formations in Oregon, and Domengine formation in California.

*Geographic distribution.* Coast Ranges of Oregon, California, and Washington.

*Type locality.* Domengine formation near Martinez, California. Occurs at locality (U.C. A-836). Bed of Middle Fork of Coquille River opposite Roseburg-Coos Bay Highway Survey station 845 + 33. Lower Umpqua formation. (Turner)

**SCAPHANDER WASHINGTONENSIS** Weaver, 1916

Plate 100, figure 3

*Scaphander washingtonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, p. 56, pl. 5, fig. 68, 1916; Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 123, 1931.

*Original description.* Shell ranging from small to moderate in size for the genus and somewhat elongate; posterior end slightly attenuated; apex imperforate; outer lip produced considerably above it; aperture moderately broad at posterior end but much more so at anterior; all specimens of the species show a very well defined callus on the inner lip as well as on the anterior end of the canal; outer lip reflected completely back upon itself; pillar arcuate; surface of shell ornamented by sixty to sixty-five flat topped revolving ribs; the interspaces averaging about the same width on the posterior half of the shell but on the anterior half become only half as wide. Dimensions.—Altitude of shell 17 mm.; maximum diameter of shell 10 mm. (Weaver)

*Observations.* This species may be distinguished from *Scaphander oregonensis* Dall by its relatively greater diameter and by being less constricted apically. It is shorter and has a lesser diameter than *S. conradi*.

*Holotype.* (U.W. 124) (C.A.S. 475). Figured in the present report, pl. 100, fig. 3.

*Geologic range.* Lincoln formation, middle Oligocene.

*Geographic distribution.* Western Lewis County, Washington.

*Type locality.* (U.W. 352.) Union Pacific railway cut one mile north of Galvin Station, Lewis County, Section 27, T. 15 N., R. 3 W.

**SCAPHANDER WASHINGTONENSIS** Weaver subsp. **GORDONI** Tegland, 1933

## Plate 100, figure 4

*Scaphander washingtonensis* Weaver, Univ. Wash. Publ. Geol., vol. 1, pp. 30, 31 (in part), 1916; Van Winkle, Univ. Wash. Publ. Geol., vol. 1, p. 76, 1918.

*Scaphander washingtonensis* subsp. *gordoni* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 123, pl. 10, figs. 1, 2, 1933.

*Original description.* This subspecies differs from Weaver's species in having a longer body whorl with a corresponding lessening in size of the expanded portion of the aperture. Eleven specimens of the subspecies from Restoration Point, ranging in size from a minute immature shell 6.5 mm. in length to an adult form of 16 mm. (incomplete), larger than the holotype, all show the differences described. Dimensions of holotype: height, 15 mm.; diameter, 9.5 mm. (Tegland)

*Holotype.* (U.C. 32209.) Figured in the present report, pl. 100, fig. 4.

*Geologic range.* Blakeley formation, upper Oligocene.

*Geographic distribution.* Kitsap County, Washington.

*Type locality.* (U.W. 13). Restoration Point, Kitsap County, opposite Seattle.

**SCAPHANDER WASHINGTONENSIS** Weaver subsp. **GOODSPEEDI** Effinger, 1938

## Plate 100, figures 5, 6

*Scaphander washingtonensis* Weaver subsp. *goodspeedi* Effinger, Jour. Paleon., vol. 12, p. 387, pl. 47, figs. 14, 15, 1938.

*Original description.* Shell small, thin, ovate in outline; posterior end truncate, narrow, imperforate; aperture narrow posteriorly, greatly expanded anteriorly; lower portion of inner lip covered by a narrow rounded rim of callus disappearing beneath the parietal wall which lacks any noticeable deposit of callus; outer lip simple, slightly attenuate posteriorly; ornamentation consisting of about 30 to 35 deeply incised narrow, spiral striae which alternate with broad flat-topped ridges, varying in width from twice that of the striation on the anterior and posterior ends to three or four times on the medial portion of body whorl. Dimensions: Holotype 33,611, altitude 4.2 mm., maximum diameter 2.3 mm. (Effinger)

*Observations.* This subspecies may be distinguished from *S. washingtonensis* in being slightly more robust, by the somewhat wider anterior part of the aperture, and by the disappearance of the callus from the rim of the lower inner lip beneath the parietal wall.

*Holotype.* (U.C. 33611.) Figured in the present report, pl. 100, figs. 5, 6.

*Geologic range.* Gries Ranch beds, lower Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch, in northeast quarter of Section 25, T. 11 N., R. 2 W.

**SCAPHANDER JUGULARIS** (Conrad), 1855

## Plate 100, figure 7

*Bulla jugularis* Conrad, U.S. 33d Cong., 1st sess., House Exec. Doc. 129, Appendix to Preliminary Geol. Rept. of W. F. Blake, p. 19, July, 1855; Pacific R. R. Repts., vol. 5, p. 328, pl. 7, figs. 62, 62a, 62b, 1865; Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 170 (reprint), 1909.

*Scaphander jugularis* (Conrad), Anderson, Proc. Calif. Acad. Sci., ser. 3, vol. 2, p. 201, pl. 15, figs. 56, 57, 1905; Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, p. 114, pl. 14, figs. 7, 27, 1931; Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 452, 1931.

*Original description.* Oblong elongate, much contracted toward the apex; acutely rounded at the base. (Conrad)

*Supplementary description.* Shell not large, 1-1½ inches in length, width ½ as great; contracted toward the posterior end; aperture wide, ovate; inner lip crusted; whorl loosely convolute, narrowing behind; surface ornamented by revolving lines crossed by oblique lines of growth. The revolving lines consist of flattened ridges and rounded grooves of equal width. (Anderson)

*Observations.* This species is characterized by its ovate form, convex body whorl with nearly even curvature toward posterior and anterior ends, and very faintly developed spiral lines.

*Holotype.* (U.C. 32058.) Astoria formation. Figured in the present report, pl. 100, fig. 7.

*Geologic range.* Ocoya Creek Miocene, California, and Astoria formation, Washington.

*Geographic distribution.* Kern County, California, and Grays Harbor County, Washington.

*Type locality.* "A few miles south of Ocoya Creek, Kern County, California." Washington: locality (U.W. 425). Rock Creek 1200 feet down stream from the falls and just below the old dam site, Grays Harbor County, Section 7, T. 16 N., R. 5 W.

#### SCAPHANDER CONRADI Dall, 1909

##### Plate 100, figure 8

*Scaphander conradi* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 22, pl. 6, fig. 3, 1909; Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 452, 1931.

*Original description.* Shell of moderate size, rather broadly pyriform, the posterior end somewhat rapidly attenuated; apex imperforate, outer lip produced a little behind it and merging in the apical callus as usual in the genus; aperture narrow behind, wide in front, where it is evenly rounded, the pillar widely arcuate and moderately callous; exterior closely, finely, and sharply sulcate, the alternate sulci usually stronger and having a more or less punctate aspect; the sculpture faintly affects the outer surface of the internal cast, which also has a faint indication of a constriction about the posterior fourth of the shell. Altitude of shell, 19 mm.; maximum diameter, 12.5 mm. (Dall)

*Observations.* As pointed out by Dall, this species may be distinguished from *S. oregonensis* Dall by "its shorter and more broadly pyriform profile."

*Holotype.* (U.S.N.M. 154137.) Figured in the present report, pl. 100, fig. 8.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* Coos Bay. (Dall)

## SCAPHANDER OREGONENSIS Dall, 1909

## Plate 100, figure 9

*Scaphander oregonensis* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, pp. 22, 23, pl. 5, fig. 7, 1909; Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 452, 1931.

*Original description.* Shell small, slightly attenuated behind, more swollen in front, the outer lip not thickened, the body without perceptible callus, the pillar arcuate; the outer surface spirally finely sulcate, the interspaces wider than the sulci; the interior polished, with a faint indication of the external sulci and of an obsolete constriction around the posterior third of the shell. Longitude, 13.0 mm.; maximum latitude, 7.2 mm. (Dall)

*Observations.* This somewhat elongate species resembles *S. costatus* but differs in the nearly straight to slightly convex middle half of the shell and the anterior convergence lower down than in *S. costatus*.

*Holotype.* (U.S.N.M. 154136.) Figured in the present report, pl. 100, fig. 9.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Geographic distribution.* Coos Bay area, Oregon.

*Type locality.* Coos Bay. (Dall)

## Genus CYLICHNINA Monterosato, 1884

*Cyllichnina* Monterosato, Nom. Gen. e Spec. Conch. Medit., p. 143, 1884.

*Genotype.* "Bulla" *umbilicata* Montagu.

## CYLICHNINA TANTILLA (Anderson and Hanna), 1925

## Plate 100, figures 10, 11, 12, 14, 15

*Cylichnina costata* Gabb, Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 4, p. 115, 1914.

*Cylichnella tantilla* Anderson and Hanna, Calif. Acad. Sci., Occ. Pap. no. 11, pp. 140, 141, pl. 7, figs. 4, 8, 9, 1925.

*Cyllichnina tantilla* (Anderson and Hanna), Stewart, Proc. Acad. Nat. Sci. Phila., vol. 78, pp. 439, 440, pl. 27, figs. 2, 3, 4, 1926; Turner, Geol. Soc. Am., Spec. Pap. no. 10, pp. 67, 68, pl. 20, figs. 9, 10, 1938.

*Original description.* Shell small, spindle shaped, the ends tapering to almost equally blunt points; apex narrowly umbilicate; outer lip simple and straight; lower columellar wall having a very low plication; umbilicus not perforate, and the area covered by a slight expansion of the columella; surface uniformly striated by narrow impressed lines, or about 50 narrow spiral channels, or grooves in the surface of the shell; the ridges between, relatively wide and flat-topped; toward the aperture there is a tendency for them to divide in older specimens, so that the number of raised spiral lines increased with the age of the individual. Length of type, 7.1 mm.; diameter, 3.0 mm. (Anderson and Hanna)

*Observations.* This species differs from *Scaphander costatus* (Gabb) in its narrower aperture, cylindrical shape, and more delicate spiral ribs.

*Holotype.* (C.A.S. 958.) Figured in the present report, pl. 100, figs. 14, 15.

*Hypotype.* (U.C. 33172.) Oregon, locality (U.C. A-662.) Figured in the present report, pl. 100, figs. 10, 11, 12.

*Geologic range.* Upper Umpqua formation in Oregon and Tejon formation of Grapevine Canyon, Kern County, California. Middle and upper Eocene.

*Geographic distribution.* Coast Ranges of California, Oregon, and Washington.

*Type locality.* (C.A.S. 711.) Grapevine Canyon, Kern County, California. Described by Turner from Oregon at locality (U.C. A-662), bank of Little River, Douglas County, in center of Section 19, T. 26 S., R. 3 W.

#### CYLICHNINA TURNERI Effinger, 1938

Plate 100, figure 13

*Haminea cf. petrosa* (Conrad), Dickerson, Proc. Calif. Acad. Sci., ser. 4, vol. 7, p. 160, 1917; Van Winkle, Univ. Wash. Publ. Geol., vol. 1, no. 2, p. 76, 1918.

*Cylichnina turneri* Effinger, Jour. Paleon., vol. 12, pp. 387, 388, pl. 47, fig. 3, 1938.

*Original description.* Shell minute, cylindrically ovate, sides slightly and evenly arcuate; apex sharply truncate, perforate; central portion of aperture narrow, posterior portion slightly dilated, anterior portion moderately dilated; inner lip sloping with moderate convexity from apex to one-fourth the length from anterior end, slope breaking where free portion of inner lip joins parietal wall; anterior portion of aperture abruptly and evenly rounded; columella bearing an inconspicuous fold, above which is a distinct umbilical groove; umbilicus partly open; sculpture consisting of many fine spiral striae rather uniformly distributed over external surface of shell, alternating with broad, flat-topped areas. Dimensions: holotype 33,619, altitude 3.2 mm., maximum diameter 1.5 mm. (Effinger)

*Observations.* This species resembles *C. tantilla* (Anderson and Hanna) but may be distinguished from it by a distinctly developed umbilical groove, and in the absence of heavy callus on the inner lip.

*Holotype.* (U.C. 33619.) Figured in the present report, pl. 100, fig. 13.

*Geologic range.* Gries Ranch beds, lower Oligocene.

*Geographic distribution.* Lower Cowlitz Valley, Washington.

*Type locality.* (U.W. 239.) South bank of Cowlitz River at old Gries Ranch in northeast quarter of Section 25, T. 11 N., R. 2 W.

#### Genus HAMINOEA Turton and Kingston, 1830

*Haminoea* Turton and Kingston, The Teignmouth, Dawlish, and Torquay Guide, pt. 2, Nat. Hist. of the District, sign. S. 8, 1830.

*Genotype.* *Bulla hydatis* Linnaeus.

#### HAMINOEA PETROSA (Conrad), 1849

Plate 100, figures 16, 17, 18, 19, 23

*Bulla petrosa* Conrad, U.S. Explor. Exped. Geol., vol. 10, p. 727, pl. 19, fig. 8, 1849.

*Cylichnina oregonensis* Conrad, Am. Jour. Conch., vol. 1, p. 151, 1865.

*Haminea petrosa* Conrad, Arnold, Proc. U.S. Nat. Mus., vol. 34, pl. 33, fig. 17, 1908; Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 23, 1909.

*Haminoea petrosa* (Conrad), Grant IV and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 460, 1931.

*Original description.* Cylindrical, narrow, sides gently curved. (Conrad)

*Observations.* The type of this species collected at Astoria by J. D. Dana and described and figured by Conrad is a very poorly preserved specimen and somewhat crushed, so that the figure appears wider proportionately than it actually is. The shell has nearly parallel sides which terminate rather bluntly both anteriorly and posteriorly.

*Holotype.* (U.S.N.M. 3607.) Conrad type from Astoria. Figured in the present report, pl. 100, fig. 23.

*Hypotype.* (U.C. 32059.) Astoria formation, locality (U.W. 425). Figured in the present report, pl. 100, figs. 18, 19.

*Topotype.* (U.C. 11305.) Figured in the present report, pl. 100, figs. 16, 17.

*Geologic range.* Oligocene of Santa Cruz County, California, and Astoria formation in Oregon and Washington.

*Geographic distribution.* Near mouth of Columbia River, Oregon, and Santa Cruz County, California.

*Type locality.* Astoria, Oregon. Collected by J. D. Dana.

### Family GADINIIDAE

#### Genus GADINIA Gray, 1824

*Gadinia* Gray, Philos. Mag. (London), vol. 63, p. 274, 1824.

*Genotype.* *Gadinia afra* Gmelin.

#### GADINIA RETICULATA Sowerby subsp. SOOKENSIS Clark and Arnold, 1923

Plate 100, figures 21, 22

*Gadinia reticulata* subsp. *sookensis* Clark and Arnold, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, p. 157, pl. 35, figs. 3, 4, 1923.

*Original description.* Shell heavy, variable, large for this genus. Apex central, bluntly acute. Surface covered by numerous medium coarse radiating lines which, on larger specimens, are nearly obsolete. Dimensions of type specimen: Height, 40 mm.; width of body whorl, about 31 mm. (Clark and Arnold)

*Observations.* This subspecies may be distinguished from *G. reticulata* Sowerby in being a relatively larger shell and in having less well defined spiral ribbing.

*Holotype.* (U.C. 30085.) Figured in the present report, pl. 100, fig. 22.

*Cotype.* (U.C. 30234.) Figured in the present report, pl. 100, fig. 21.

*Geologic range.* Sooke formation, upper Oligocene.

*Type locality.* Sea cliffs between mouths of Muir and Kirby creeks, west of Otter Point, Sooke Bay, Vancouver Island.

### Family LIMNAEIDAE

#### Genus SEGMENTINA Fleming, 1818

*Segmentina* Fleming, Encycl. Brit., suppl. to eds. 4-6, vol. 3, p. 309, 1818.

*Genotype*. *Nautilus lacustris* Lightfoot, Phil. Trans., vol. 76, pt. 1, p. 163, 1786.

#### SEGMENTINA DURHAMI Hanna and Hertlein, 1938

Plate 100, figures 24, 25, 26

*Segmentina durhami* Hanna and Hertlein, Jour. Paleon., vol. 12, p. 109, pl. 21, figs. 3, 4, 5, 1938.

*Original description*. Shell large for the genus, consisting of  $4\frac{1}{2}$  whorls, evenly rounded on the periphery and very obtusely, roundly angulated above and below; sculpture fine, evenly spaced riblets or growth ridges; first  $3\frac{1}{2}$  whorls of spire almost flat; last whorl slightly elevated above this plane, all regularly increasing in size; umbilicus broadly and evenly concave; the outside of the body whorl is largely stripped of shell material, but a short distance back of the termination there are three short, spiral, slightly descending ridges of callus embedded in the matrix; these are believed to be the remains of the apertural teeth, so characteristic of the genus; the lower one of these crosses the periphery. Greatest diameter, 12 mm.; height, 5.2 mm. (Hanna and Hertlein)

*Observations*. This is the only species of this genus known in Oregon or Washington. As pointed out by Hanna and Hertlein, *S. durhami* resembles *S. armigera* (Say) which lives in the rivers of the eastern United States but proportionately is nearly twice as large a shell when specimens of the same stage of growth are compared.

*Holotype*. (C.A.S. 5620). Figured in the present report, pl. 100, figs. 24, 25, 26.

*Geologic range*. Oligocene.

*Geographic distribution*. Northern part of Puget Sound Basin, Washington.

*Type locality*. One-quarter of a mile north of Woodman's Station on east shore of Port Discovery Bay, Olympic Peninsula, in Section 5, T. 29 N., R. 1 W.

### CEPHALOPODA

#### Class Nautiloidea

#### Genus ATURIA Bronn, 1838

#### ATURIA ANGUSTATA (Conrad), 1849

Plate 102, figures 1, 2, 3, 4, 5, 6, 7, 10

*Nautilus angustatus* Conrad, U.S. Explor. Exped. Geol., vol. 10, p. 728, pl. 20, figs. 5, 6, 1849.

*Aturia angustata* (Conrad), Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, pp. 457-462, 1931 (synonymy).

*Original description*. Compressed. Septa sinuous and profoundly angulated toward the periphery; from the angle the outer margin of the septa is parallel with the periphery, and anteriorly suddenly becomes transverse across the margin or periphery. (Conrad)

*Supplementary description of topotype material by Schenck*. The better of the two topotypes available for examination is one from the Condon Museum,

herein figured as University of Oregon Neotype no. 77. One side and a part of the venter are free from the matrix. The comparatively narrow, compressed venter and the tongue-shaped, pinched-in lateral lobes are well displayed, but the siphuncle is hidden. The point of each lobe closely approximates the previously-formed septum; that is, the connective is very narrow. In outline, the specimen resembles Conrad's photograph, which, however, was obviously based on an imperfect specimen and the septal margins are not correctly delineated. The neotype measures about 110 mm. in altitude; the later-formed lobes are about 10 mm. wide at the apertural end, and 21 mm. in length.

The other topotype (L.S.J.U. no. 449), collected from between First and Thirteenth streets, Astoria, Oregon, is a damaged specimen measuring about 45 mm. in altitude.

*Holotype.* (U.S.N.M. 3610.) Conrad type. Astoria, Oregon. Figured in the present report, pl. 102, fig. 10.

*Paratype.* (U.S.N.M. 3534.) Figured in the present report, pl. 102, figs. 4, 7.

*Hypotype.* (C.A.S. 5221.) Figured in the present report, pl. 102, fig. 2.

*Hypotype.* (C.A.S. 5219.) Figured in the present report, pl. 102, fig. 3.

*Hypotype.* (U.W. 367.) Figured in the present report, pl. 102, fig. 5.

*Hypotype.* (S.U. 180.) Figured in the present report, pl. 102, fig. 6.

*Hypotype.* (U.S.N.M. 3572.) Figured in the present report, pl. 102, fig. 1.

*Geologic range.* Middle Oligocene to middle Pliocene.

*Geographic distribution.* Coast Ranges of Oregon, Washington, and California.

*Type locality.* Astoria, Oregon.

**ATURIA ANGUSTATA** (Conrad) subsp. **GRANDIOR** Schenck, 1931

Plate 102, figures 8, 9

*Aturia angustata* Conrad, Arnold and Hannibal, Proc. Am. Phil. Soc., vol. 52, p. 581, 1913.

*Aturia angustata* (Conrad) subsp. *grandior* Schenck, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, pp. 462, 463, pl. 73, figs. 1, 2; pl. 74, pl. 75, pl. 76; text figures 4-9, 1931.

*Original description.* Shell large, flanks gently convex, venter narrow but evenly rounded; umbilicus closed; siphuncle subdorsal, composed of distinct shell layers as described on page 445 of this paper. The lateral lobes have the shape and pinched-in character of the neotype of *angustata* and are similarly approximating. The lobes, seen in apertural view, are midway between the venter and the center of the siphuncle. Height of outer whorl, 75 mm.; width of outer whorl, 54 mm.; median height, 45 mm.; height of preceding whorl, ca. 21 mm.; lateral lobes, 29 mm. in length and 14 mm. in width. The dimensions of the paratype are as follows: height of outer whorl, ca. 103 mm., suggesting that the altitude of the shell must have been at least 150 mm.; median height, 67 mm.; height of preceding whorl, 30 mm.; diameter of siphuncle, 11 mm. (Schenck)

*Holotype.* (S.U. 524.) Oligocene. Figured in the present report, pl. 102, figs. 8, 9.

*Geologic range.* Lower and middle Oligocene.

*Geographic distribution.* Southwest and northeast parts of Olympic Peninsula, Washington.

*Type locality.* (U.W. 709) (S.U.N.P. 207). Vance Creek, two and one-half miles above its junction with Skokomish River, Mason County, Washington. This species occurs also east of Classens Wharf, Port Townsend Bay, Washington.

## ARTHROPODA

### Class Crustacea

#### Family CIRRIPEDIA

##### Genus BALANUS Linnaeus

###### BALANUS TINTINNABULUM Linnaeus var. COOSENSIS Dall, 1909

Plate 4, figure 1

*Balanus tintinnabulum* Linnaeus var. *cooensis* Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 138, pl. 19, figs. 1, 6, 1909.

*Original description.* The fine *Balanus* which I have figured does not preserve the opercular valves in any of the four specimens obtained. As the specific characters are largely dependent on the sculpture and form of these appendages, I have referred the specimens to the recent species to which they seem most nearly allied, as a variety, pending the discovery of the opercular valves. The specimen figured is about 50 mm. in the greatest diameter and 30 mm. in height. (Dall)

*Holotype.* (U.S.N.M. 153960.) Figured in the present report, pl. 4, fig. 1.

*Geologic range.* Empire formation, upper Miocene and lower Pliocene.

*Type locality.* Coos Bay, Oregon (Camman collection). (Dall)

## Order DECAPODA

### Family PINNOTHERIDAE de Haan

##### Genus PINNIXIA White

###### PINNIXIA EOCENICA Rathbun, 1926

*Pinnixa eocenica* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 34, 35, pl. 1, figs. 3, 4, 1926.

*Occurrence.* Washington: west bank of Olequa Creek about one-eighth mile north of Vader Station, Lewis County, Section 29, T. 11 N., R. 2 W.

*Geologic range.* Cowlitz formation, upper Eocene.

### Family GONEPLACIDAE Rathbun

##### Genus PILUMNOPLAX Stimpson, 1858

###### PILUMNOPLAX CARMANAHENSIS Rathbun, 1926

*Pilumnoplax carmanahensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 38, 39, pl. 9, figs. 1-4, 1926.

*Occurrence.* British Columbia: sandstone shale sea cliffs for 3 miles west of Carmanoli Point, Vancouver Island.

*Geologic range.* Oligocene.

**PILUMNOPLAX HANNIBALANUS** Rathbun, 1926

*Pilumnoplax hannibalanus* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 39-41, pl. 10, figs. 1-4, 1926.

*Occurrence.* Washington: conglomerate sea cliffs at Koitlah Point west of Neah Bay, middle Oligocene. Sandy shale bluffs along Cowlitz River, 1½ miles below mouth of Drew Creek on Olequah Creek, Lewis County.

*Geologic range.* Upper Eocene to middle Oligocene.

**Genus BRANCHIOPLAX** Rathbun, 1926**BRANCHIOPLAX WASHINGTONIANA** Rathbun, 1926

*Branchioplax washingtoniana* Rathbun, Am. Jour. Sci., vol. 41, p. 345, 1916; U.S. Nat. Mus., Bull. no. 138, pp. 42-44, pl. 9, fig. 7, 1926.

*Occurrence.* Alaska: west end Bering Lake, Oligocene. Washington: Port Townsend Bay, in lower Oligocene sandstones.

*Geologic range.* Lower and middle Oligocene.

**Genus EUCRATE de Haan, 1835****EUCRATE MARTINI** Rathbun, 1926

*Eucrate martini* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 44, 45, pl. 8, figs. 2, 3, 1926.

*Occurrence.* Oregon: Rocky Point, 4 miles east of Yaquina City.

*Geologic range.* Oligocene.

**Family XANTHIDAE Alcock****Genus ZANTHOESIS M'Coy, 1849****ZANTHOESIS VULGARIS** Rathbun, 1926

*Zanthopsis vulgaris* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 48-53, plates 13, 14, 1926.

*Occurrence.* Southern part of Vancouver Island, western Washington, and western Oregon.

*Geologic range.* Oligocene and Recent.

**ZANTHOESIS HENDERSONIANUS** Rathbun, 1926

*Zanthopsis hendersonianus* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 53-54, pl. 10, figs. 5, 6, 1926.

*Occurrence.* Oregon: one mile south of Springfield Junction, Southern Pacific railroad, Lane County, in Oligocene. California: Llajas Canyon, Simi Valley, in Santa Susana shale of middle Eocene.

*Geologic range.* Middle Eocene to middle Oligocene.

## Family CANCRIDAE Alcock

Genus **CANCER** Linnaeus, 1758**CANCER BAINBRIDGENSIS** Rathbun, 1926

*Cancer bainbridgensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, p. 60, pl. 16, figs. 2, 3, 1926.

*Occurrence.* Washington: at Bean Point, Bainbridge Island, Puget Sound Basin.

*Geologic range.* Upper Oligocene.

## Family PORTUNIDAE Dana

Genus **PORTUNITES** Bell, 1857**PORTUNITES TRIANGULUM** Rathbun, 1926

*Portunites triangulum* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 68-71, pl. 17, figs. 3-6, 1926.

*Occurrence.* Washington: Thurston and Grays Harbor counties. Oregon: Clatsop and Lincoln counties.

*Geologic range.* Middle Oligocene.

**PORTUNITES INSCULPTA** Rathbun, 1926

*Portunites insculpta* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 71, 72, pl. 17, figs. 1, 2, 1926.

*Occurrence.* Oregon: Basket Point, Umpqua River, 12 miles below mouth of Calapooia River.

*Geologic range.* Middle Eocene.

## Family LEUCOSIIDAE Dana

Genus **PERSEPHONA** Leach, 1817**PERSEPHONA BIGRANULATA** Rathbun, 1926

*Persephona bigranulata* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 78, 79, pl. 11, figs. 5-8, 1926.

*Occurrence.* Oregon: one mile south of Springfield Junction, Southern Pacific railroad, Lane County.

*Geologic range.* Middle Oligocene.

## Family CALAPPIDAE Dana

Genus **CALAPPA** Weber, 1795**CALAPPA LANENSIS** Rathbun, 1926

*Calappa lanensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 79, 80, pl. 19, figs. 1, 2, 1926.

*Occurrence.* Oregon: one mile south of Springfield Junction, Southern Pacific railroad, Lane County.

*Geologic range.* Middle Oligocene.

Genus **MURSIA** Leach, 1823**MURSIA YAQUINENSIS** Rathbun, 1926

*Mursia yaquinensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 81, 82, pl. 19, figs. 3-5, 1926.

*Occurrence.* Oregon: four miles east of Yaquina City, Lincoln County.

*Geologic range.* Middle Oligocene.

**MURSIA MARCUSANA** Rathbun, 1926

*Mursia marcusana* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 82, 83, pl. 19, figs. 6, 7, 1926.

*Occurrence.* Washington: Restoration Point, Kitsap County, and at Alki Point in Seattle.

*Geologic range.* Upper Oligocene, Blakeley formation.

Family **HOMOLIDAE** HendersonGenus **PALEHOMOLA** Rathbun, 1926**PALEHOMOLA GORRELLI** Rathbun, 1926

*Palehomola gorrelli* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 86, 87, pl. 21, figs. 1, 2, 1926.

*Occurrence.* Oregon: Judkins Ridge, near Eugene.

*Geologic range.* Middle Oligocene.

Family **DROMIIDAE** AlcockGenus **GRAPTOCARCINUS** Roemer, 1887**GRAPTOCARCINUS (?) sp.** Rathbun, 1926

*Graptocarcinus (?) sp.* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 88, 89, pl. 21, fig. 3, 1926.

*Occurrence.* Oregon: Springfield Junction, one mile west of Springfield, Lane County.

*Geologic range.* Middle Oligocene.

Family **RANINIDAE** DanaGenus **RANINA** Lamarck, 1801**RANINA AMERICANA** Withers, 1924

*Ranina americana* Withers, Ann. Mag. Nat. Hist., ser. 9, vol. 14, p. 125, pl. 4, figs. 1-3, 1924; Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 91, 92, pl. 23, figs. 1-4, 1926.

*Occurrence.* Washington: Clallam Bay, Clallam County, and in sea cliffs at Koitlah Point, west of Neah Bay.

*Geologic range.* Middle Oligocene.

**Genus RANINOIDES Milne Edwards, 1837****RANINOIDES VADERENSIS Rathbun, 1926**

*Raninoides vaderensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 93, 94, pl. 22, fig. 5, 1926.

*Occurrence.* Washington: one mile west of junction of Olequa and Stillwater creeks on the latter, west of Vader, Lewis County, in Section 30, T. 11 N., R. 2 W. Oregon: at Basket Point on Umpqua River, 12 miles below mouth of Calapooia River, Douglas County.

*Geologic range.* Middle and upper Eocene.

**RANINOIDES LEWISIANUS Rathbun, 1926**

*Raninoides lewisiatus* Rathbun, U.S. Nat. Mus., Bull. no. 138, p. 94, pl. 22, fig. 4, 1926.

*Occurrence.* Washington: railroad bluff along Olequa Creek one and one-half miles south of Vader, Lewis County.

*Geologic range.* Upper Eocene, Cowlitz formation.

**RANINOIDES WASHBURNI Rathbun, 1926**

*Raninoides washburni* Rathbun, U.S. Nat. Mus., Bull. no. 138, p. 95, pl. 22, fig. 6, 1926.

*Occurrence.* Oregon: near Eugene, Lane County, in middle Oligocene rocks and at Basket Point on Umpqua River, 12 miles below mouth of Calapooia River, Douglas County.

*Geologic range.* Middle Eocene and middle Oligocene.

**RANINOIDES EUGENENSIS Rathbun, 1926**

*Raninoides eugenensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, p. 96, pl. 24, fig. 4, 1926.

*Occurrence.* Oregon: near Eugene, Lane County, and one mile west of Springfield Junction on Southern Pacific railroad, Lane County.

*Geologic range.* Middle Oligocene.

**RANINOIDES FULGIDUS Rathbun, 1926**

*Raninoides fulgidus* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 96-98, pl. 23, fig. 6, 1926.

*Occurrence.* Oregon: at points one and also one and one-fourth miles west of Springfield Junction, Southern Pacific railroad, Lane County.

*Geologic range.* Middle Oligocene.

**RANINOIDES ASPER Rathbun, 1926**

*Raninoides asper* Rathbun, U.S. Nat. Mus., Bull. no. 138, p. 98, pl. 23, fig. 5, 1926.

*Occurrence.* Oregon: one mile west of Springfield at Springfield Junction, Lane County.

*Geologic range.* Middle Oligocene.

**Genus RANIDINA** Bittner, 1893**RANIDINA WILLAPENSIS** Rathbun, 1926

*Ranidina willapensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, p. 99, pl. 21, figs. 4, 5, 1926.

*Occurrence.* Tuffaceous cliffs on Willapa River one mile north of Holcomb, Pacific County, Washington.

*Geologic range.* Lower Oligocene, Keasey formation.

**Genus EUMORPHOCORYSTES** von Binkhorst, 1857**EUMORPHOCORYSTES NASELENSIS** Rathbun, 1926

*Eumorphocorystes naseleensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 100, 101, pl. 24, figs. 9, 10, 1926.

*Occurrence.* Washington: shale cliffs along Nasel River near mouth of Salmon Creek, Pacific County.

*Geologic range.* Middle Oligocene.

**Family CALLIANASSIDAE** Bate**Genus CALLIANASSA** Leach, 1814**CALLIANASSA UMPQUAENSIS** Rathbun, 1926

*Callianassa umpquaensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 110-111, pl. 25, figs. 8-12, 1926.

*Occurrence.* Washington: Olequa Creek, Lewis County, in Cowlitz formation. Oregon: Basket Point, on Umpqua River, 12 miles below mouth of Calapooia River in middle Eocene.

*Geologic range.* Middle and upper Eocene.

**CALLIANASSA KNAPPTONENSIS** Rathbun, 1926

*Callianassa knapptonensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 112-113, pl. 38, fig. 4, 1926.

*Occurrence.* Washington: north bank of Columbia River, three-fourths mile northeast of Knappton, Pacific County.

*Geologic range.* Middle Oligocene.

**CALLIANASSA COWLITZENSIS** Rathbun, 1926

*Callianassa cowlitzensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 113, 114, pl. 26, figs. 1-3, 1926.

*Occurrence.* Washington: Coal Creek, Cowlitz County, in Section 2, T. 8 N., R. 3 W.

*Geologic range.* Cowlitz formation, upper Eocene.

**CALLIANASSA CLALLAMENSIS** Withers, 1924

*Callianassa clallamensis* T. H. Withers, Ann. Mag. Nat. Hist., ser. 9, vol. 14, p. 122, pl. 4, figs. 4-7, 1924; Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 114, 115, pl. 26, figs. 6-12, 1926.

*Occurrence.* Washington: cliffs on Nasel River half a mile above mouth of Salmon Creek, Pacific County, and in cliffs along south shore of Strait of Juan de Fuca three-fourths mile west of West Twin River, Clallam County.

*Geologic range.* Middle Oligocene.

**CALLIANASSA TWINENSIS** Rathbun, 1926

*Callianassa twinensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 115-117, pl. 27, figs. 1-4, 1926.

*Occurrence.* Washington: south shore of Strait of Juan de Fuca three-fourths mile west of West Twin River and half a mile east of East Twin River, Clallam County; also in cliffs on south side of Richs Passage, Bremerton Inlet, Puget Sound, Kitsap County.

*Geologic range.* Upper Oligocene.

**CALLIANASSA BANDONENSIS** Rathbun, 1926

*Callianassa bandonensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 118-119, pl. 27, figs. 5-8, 1926.

*Occurrence.* Oregon: shales in sea cliffs south of mouth of Five Mile Creek, Bandon.

*Geologic range.* Oligocene.

**CALLIANASSA PORTERENSIS** Rathbun, 1926

*Callianassa porteriensis* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 119, 120, pl. 28, figs. 1-5, 1926.

*Occurrence.* Washington: on cliffs along Chehalis River near Porter, Grays Harbor County, in Section 22, T. 17 N., R. 5 W. Oregon: in cliffs on north coast of Yaquina Bay between Rocky Point and Oysterville, Lincoln County.

*Geologic range.* Lower and middle Oligocene.

**CALLIANASSA OREGONENSIS** Dana, 1849

*Callianassa oregonensis* Dana, U.S. Explor. Exped. Geol., p. 722, Atlas, pl. 17, fig. 3, 1849; Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 121, 122, pl. 28, figs. 6-9, 1926.

*Occurrence.* Washington: one and a half miles north of Willapa on Wilson Creek, Pacific County. Oregon: one-fourth mile west of Springfield Junction, Lane County.

*Geologic range.* Middle Oligocene.

Genus **UPOGEBIA** Leach, 1814**UPOGEBIA (UPOGEBIA) EOCENICA** Rathbun, 1926

*Upogebia (Upogebia) eocenica* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 124, 125, pl. 29, figs. 1, 2; pl. 30, 1926.

*Occurrence.* Washington: railroad bluff along Olequa Creek, one and a half miles south of Vader, Lewis County.

*Geologic range.* Cowlitz formation, upper Eocene.

Family **ALBUNEIDAE** OrtmanGenus **BLEPHARIPODA** Randal, 1840**BLEPHARIPODA BRUCEI** Rathbun, 1926

*Blepharipoda brucei* Rathbun, U.S. Nat. Mus., Bull. no. 138, pp. 126-127, pl. 28, figs. 10, 11, 1926.

*Occurrence.* Washington: sea cliffs between Classens Wharf and ship canal estuary, Port Townsend Bay.

*Geologic range.* Lower Oligocene.

## ADDITIONAL SPECIES

(Omitted in Preparation of Manuscript)

### TELLINA OREGONENSIS Conrad, 1848

*Tellina oregonensis* Conrad, Am. Jour. Sci., ser. 2, vol. 5, p. 432, fig. 5, 1848; Am. Jour. Conch., vol. 1, p. 152, 1865; Dall, U.S. Geol. Surv., Prof. Pap. no. 59, p. 124, 1909; Etherington, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, pp. 83, 84, pl. 10, figs. 6, 7, 1931.

*Original description.* Elliptical, thin, much compressed; valves flattened, and having regular concentric fine lines; anterior submargin somewhat angulated, the margin nearly direct, truncated; beaks rather nearest to the anterior extremity; posterior end acutely rounded. In the cast, an oblique shallow furrow meets the apex on the posterior side. (Conrad)

*Observations.* The writer has been unable to locate the holotype of this species and accordingly it is not figured in this report. It is listed by Dall, p. 124, as (U.S.N.M. 110458). The type was collected by J. K. Townsend from near Astoria, Oregon, from strata now recognized as a part of the Astoria formation. A reproduction of Conrad's original figure is reproduced in the report by Dall on p. 150. This species is fairly abundant in the middle Miocene strata in southwestern Washington. Hypotypes from these beds were figured by Etherington on pl. 10, figs. 6, 7, and listed as (U.C. 31967) and (U.C. 31977) and the reader is referred to this publication.

Through error the description of this species was removed from the manuscript of the present report and was not discovered until after the report was in page proof. For the same reason, the illustrations of the hypotypes were not included in the plates containing illustrations.

*Holotype.* (U.S.N.M. 110458; probably lost.)

*Geologic range.* Astoria formation, middle Miocene.

*Geographic distribution.* Astoria, Oregon, southwestern Washington; Coast Range of middle California.

*Type locality.* Astoria, Oregon.

### TURCICULA TURBONATA Clark, 1932

*Turcicula turbonata* Clark, Bull. Geol. Soc. Am., vol. 43, pp. 826-827, pl. 20, fig. 11, 1932.

*Turcicula clarki* Tegland, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 92, 1933 (nomen nudum). In faunal list.

*Original description.* Shell pearly, fairly heavy, broadly conical to subturbonate, considerably wider than high; number of whorls six or seven; apex broken on all specimens at hand; sutures impressed channeled. Sides of whorls flat giving the appearance to the shell of a broad, flat-sided cone. Surface smooth except for an almost obsolete spiral rib situated a little below the middle of the penultimate and body whorl. Base of body whorl only gently convex, separated from the sides by a well-defined

angulation. Surface of the base sculptured by several fairly heavy spiral ribs; this ribbing is very imperfectly preserved on the specimens at hand. Aperture subquadrate in outline; a slightly depressed umbilical area covered by a heavy callus. Dimensions of the type specimen (apex broken): Height about 37 millimeters; greatest width of body whorl 58 millimeters. Another specimen from the same locality had a diameter of 82+ millimeters, with a height of about 55 millimeters. (Clark)

*Observations.* The holotype of *Turcicula turbonata* was collected from the Poul Creek formation of upper Oligocene age from strata exposed on Johnston Creek about eight miles west of Ice Bay on the south coast of Alaska. A specimen of the same species earlier had been collected by Hannibal from the Twin River beds of the upper Blakeley formation in Clallam County, Washington, and deposited in the paleontological collection of Stanford University. The Alaska specimen was described by Clark in 1932 as *Turcicula turbonata*. In the following year the Washington specimen was listed as *Turcicula clarki* by Tegland (272, p. 92), but not described.

*T. turbonata* differs from *T. washingtoniana* Dall of the Blakeley formation in Washington in lacking the angularity and rounding of the whorls and also in the absence of spiral ornamentation. In *T. turbonata* the surfaces of the whorls of the spire as well as of the body whorl form a nearly continuous plane from the apex to the basal angle of the body whorl. The apical angle approximates that of the average for *T. washingtoniana* but is considerably greater than that of *T. columbiana* from the Keasey formation of lower Oligocene age in Washington and Oregon. The latter form is characterized also by ornamentation of the whorls.

*Holotype.* (U.C. 32420.) Figured by Clark (54a, pl. 20, fig. 11). Not figured in the present report.

*Geologic range.* Poul Creek formation of upper Oligocene age in Alaska; Twin River beds of upper Blakeley formation in Washington.

*Geographic distribution.* Southwestern Alaska and northwestern Washington.

*Type locality.* Locality (U.C. 3857). About eight miles west of Icy Bay and one and one-half miles north of the Pacific Ocean on Johnston Creek in southeastern Alaska. Occurs also west of Twin Rivers in the sea cliffs in Clallam County, Washington.

UNIVERSITY OF WASHINGTON PUBLICATIONS  
IN  
GEOLOGY

Volume 5, pp. 563-790

December, 1942

PALEONTOLOGY OF THE MARINE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON

BY  
CHARLES E. WEAVER

PART I

Coelenterata, Vermes, Echinodermata, Molluscoidea, Mollusca :  
Pelecypoda ; Scaphopoda

PART II

Mollusca : Gastropoda ; Cephalopoda ; Arthropoda

PART III

Bibliography, Faunal Localities, Correlation Chart,  
Faunal Tables, Plates, New Names, Index

PUBLISHED BY THE UNIVERSITY OF WASHINGTON PRESS  
SEATTLE, WASHINGTON



**PALEONTOLOGY OF THE MARINE TERTIARY FORMATIONS  
OF OREGON AND WASHINGTON**

**PART III.**

**Bibliography, Faunal Localities, Correlation Chart, Faunal Tables,  
Plates, New Names, Index**

(565)



## BIBLIOGRAPHY

- (1) 1858 ADAMS, H., and ADAMS, A. Genera of recent mollusca. Vols. 1 and 2 (text), vol. 3 (plates) : London, Van Voorst, 1853-1858.
- (2) 1905 ANDERSON, F. M. A stratigraphic study of the Mount Diablo Range of California: Proc. Calif. Acad. Sci., ser. 3, vol. 2, pp. 155-248.
- (3) 1911 ANDERSON, F. M. The Neocene deposits of Kern River, California, and the Temblor Basin: Proc. Calif. Acad. Sci., ser. 4, vol. 3, pp. 73-148.
- (4) 1914 ANDERSON, F. M. Fauna of the Oligocene (?) of Oregon (abstract) : Bull. Geol. Soc. Am., vol. 25, p. 154.
- (5) 1914 ANDERSON, F. M., and MARTIN, BRUCE. Neocene record in the Temblor Basin, California, and Neocene deposits of the San Juan district, San Luis Obispo County: Proc. Calif. Acad. Sci., ser. 4, vol. 4, no. 3, pp. 15-112.
- (6) 1925 ANDERSON, F. M., and HANNA, G. D. Fauna and stratigraphic relations of the Tejon Eocene at the type locality in Kern County, California: Calif. Acad. Sci., Occas. Pap. 11, pp. 5-227.
- (7) 1902 ARNOLD, RALPH. Bibliography of literature referring to the geology of Washington: Wash. Geol. Surv., Ann. Rept. 1901, vol. 1, pp. 321-338.
- (8) 1903 ARNOLD, RALPH. Paleontology and stratigraphy of the marine Pliocene and Pleistocene of San Pedro, California: Mem. Calif. Acad. Sci., vol. 3, pp. 1-420.
- (9) 1905 ARNOLD, RALPH. Coal in Clallam County, Washington: U.S. Geol. Surv., Bull. no. 260, pp. 413-421.
- (10) 1906 ARNOLD, RALPH. The Tertiary and Quaternary pectens of California: U.S. Geol. Surv., Prof. Pap. 47, pp. 3-146.
- (11) 1906 ARNOLD, RALPH. Geological reconnaissance of the coast of the Olympic Peninsula, Washington: Bull. Geol. Soc. Am., vol. 17, pp. 451-468.
- (12) 1907 ARNOLD, RALPH. New and characteristic species of fossil mollusks from the oil-bearing Tertiary formations of Southern California: Proc. U.S. Nat. Mus., vol. 32, pp. 525-546.
- (13) 1908 ARNOLD, RALPH. Descriptions of new Cretaceous and Tertiary fossils from the Santa Cruz Mountains, California: Proc. U.S. Nat. Mus., vol. 34, pp. 345-389.
- (14) 1909 ARNOLD, RALPH. Environment of the Tertiary faunas of the Pacific Coast of the U.S.: Jour. Geol., vol. 17, pp. 509-533.
- (15) 1909 ARNOLD, RALPH. Paleontology of the Coalinga district: U.S. Geol. Surv., Bull. no. 396, pp. 3-101.
- (16) 1909 ARNOLD, RALPH. Notes on some rocks from the Sawtooth Range of the Olympic Mountains, Washington: Am. Jour. Sci., ser. 4, vol. 28, pp. 9-14.
- (17) 1909 ARNOLD, RALPH, BRANNER, J. C., and NEWSOM, J. F. U.S. Geol. Surv., Geol. Atlas, Santa Cruz folio (no. 163).
- (18) 1910 ARNOLD, RALPH, and ANDERSON, ROBERT. Geology and oil resources of the Coalinga district, California: U.S. Geol. Surv., Bull. no. 398, pp. 1-354.

- (19) 1913 ARNOLD, RALPH, and HANNIBAL, H. The marine Tertiary stratigraphy of the North Pacific Coast of America: Proc. Am. Phil. Soc., vol. 52, no. 212, pp. 559-605.
- (20) 1914 ARNOLD, RALPH, and HANNIBAL, H. Dickerson on California Eocene: Science, n.s., vol. 39, pp. 906-908.
- (21) 1907 BARTSCH, PAUL. West American molluscs of the genus *Triphoritis*: Proc. U.S. Nat. Mus., vol. 33, no. 1569, pp. 249-262.
- (22) 1908 BARTSCH, PAUL. New marine mollusks from the West Coast of America: Proc. U.S. Nat. Mus., vol. 33, pp. 177-183.
- (23) 1912 BARTSCH, PAUL. Additions to the West American pyramidellid mollusk fauna, with descriptions of new species: Proc. U.S. Nat. Mus., vol. 42, pp. 261-289.
- (24) 1909 BARTSCH, PAUL, and DALL, W. H. A monograph of West American pyramidellid mollusks: U.S. Nat. Mus., Bull. no. 68, pp. 1-233.
- (24a) 1911 BARTSCH, PAUL. The Recent fossil mullusks of the genus *Bittium* from the West Coast of America. Proc. U.S. Nat. Mus., vol. 40, pp. 387-388.
- (25) 1913 BRETZ, J. H. Glaciation of the Puget Sound region: Wash. Geol. Surv., Bull. no. 8, pp. 9-244.
- (26) 1919 BRETZ, J. H. The late Pleistocene submergence in the Columbia River Valley of Oregon and Washington: Jour. Geol., vol. 27, pp. 489-506.
- (27) 1863 CARPENTER, P. P. Supplementary report on the present state of our knowledge with regard to mollusca of the West Coast of North America: Rept. Brit. Assoc. Adv. Sci., pp. 517-686.
- (28) 1864 CARPENTER, P. P. Descriptions of new marine shells from the coast of California: Proc. Calif. Acad. Nat. Sci., vol. 4, pp. 155-159, 175-177, 207-224.
- (29) 1918 CHANEY, R. W. The ecological significance of the Eagle Creek flora of the Columbia River Gorge: Jour. Geol., vol. 26, pp. 577-592.
- (30) 1920 CHANEY, R. W. Flora of the Eagle Creek formation: Chicago Univ., Walker Museum Contr., vol. 2, pp. 115-181.
- (31) 1920 CHANEY, R. W. Further discussion of the ecological composition of the Eagle Creek flora (abstract): Bull. Geol. Soc. Am., vol. 31, p. 222.
- (32) 1925 CHANEY, R. W. A comparative study of the Bridge Creek flora and the modern Redwood forest: Carnegie Inst. Wash., Publ. 349, I, pp. 1-22.
- (33) 1925 CHANEY, R. W. The mascall flora—its distribution and climatic relation: Carnegie Inst. Wash., Publ. 349, II, pp. 23-48.
- (34) 1933 CHANEY, R. W., and SANBORN, ETHEL I. The Goshen flora of West Central Oregon: Carnegie Inst. Wash., Publ. no. 439, pp. 1-103.
- (35) 1912 CLAPP, C. H. Preliminary report on Southern Vancouver Island: Canada Dept. Mines, Geol. Surv., Mem. 13, pp. 1-208.
- (36) 1913 CLAPP, C. H. Geology of the Victoria and Saanich map-areas: Canada Dept. Mines, Geol. Surv., Mem. 36, pp. 1-143.
- (37) 1914 CLAPP, C. H. Geology of the Nanaimo map-area: Canada Dept. Mines, Geol. Surv., Mem. 51, pp. 1-135.

- (38) 1917 CLAPP, C. H. Sooke and Duncan map-areas, Vancouver Island: Canada Dept. Mines, Mem. 96, Geol. ser. 80, pp. 1-445.
- (39) 1912 CLARK, B. L. The Neocene section at Kirker Pass on the north side of Mount Diablo: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 7, pp. 47-60.
- (40) 1915 CLARK, B. L. Fauna of the San Pablo Group of Middle California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 8, pp. 385-572.
- (41) 1915 CLARK, B. L. The occurrence of Oligocene in the Contra-Costa Hills of Middle California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, no. 2, pp. 9-21.
- (42) 1917 CLARK, B. L. Astoria series (Oligocene) in the region of Mount Diablo, Middle California: Bull. Geol. Soc. Am., vol. 28, pp. 227-229.
- (43) 1918 CLARK, B. L. The San Lorenzo series of Middle California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 11, no. 2, pp. 45-234.
- (44) 1918 CLARK, B. L., and ARNOLD, RALPH. Marine Oligocene of the West Coast of North America: Bull. Geol. Soc. Am., vol. 29, pp. 297-308.
- (45) 1918 CLARK, B. L. Meganos group, a newly recognized division in the Eocene of California: Bull. Geol. Soc. Am., vol. 29, pp. 281-296.
- (46) 1921 CLARK, B. L. Correlation of Tertiary marine formations of the West Coast of North America: B. P. Bishop Mus., Spec. Publ. no. 7, pt. 3, pp. 801-818.
- (47) 1921 CLARK, B. L. The marine Tertiary of the West Coast of the United States: Its sequence, paleogeography, and the problems of correlation: Jour. Geol., vol. 29, pp. 586-614.
- (48) 1921 CLARK, B. L. The stratigraphic and faunal relationships of the Meganos group, middle Eocene of California: Jour. Geol., vol. 29, pp. 125-165.
- (49) 1922 CLARK, B. L. A new family and new genus from the Tertiary of the Pacific Coast: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 115-122.
- (50) 1923 CLARK, B. L., and ARNOLD, RALPH. Fauna of the Sooke formation, Vancouver Island, with description of a new coral by T. W. Vaughan: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, no. 5, pp. 123-234.
- (51) 1923 CLARK, B. L., and PALMER, DOROTHY KEMPER. Revision of the Rimella-like gastropods from the west coast of North America: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 277-288.
- (52) 1925 CLARK, B. L. Pelecypoda from the marine Oligocene of Western North America: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, no. 4, pp. 69-136.
- (53) 1926 CLARK, B. L. The Domengine horizon, middle Eocene of California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, no. 5, pp. 99-118.
- (54) 1930 CLARK, B. L. Tectonics of the Coast Ranges of Middle California: Bull. Geol. Soc. Am., vol. 41, pp. 747-828.
- (54a) 1932 CLARK, B. L. Fauna of the Poul and Yakataga formations (upper Oligocene) of southern Alaska: Bull. Geol. Soc. Am., vol. 43, pp. 797-846.
- (55) 1936 CLARK, B. L., and VOKES, H. E. Summary of marine Eocene sequence of Western North America: Bull. Geol. Soc. Am., vol. 47, pp. 851-878.

- (56) 1938 CLARK, B. L. Fauna from the Markley formation (upper Eocene) on Pleasant Creek, California: Bull. Geol. Soc. Am., vol. 49, pp. 683-730.
- (57) 1938 CLARK, B. L., and ANDERSON, C. A. Wheatland formation and its relation to early Tertiary andesites in the Sierra Nevada: Bull. Geol. Soc. Am., vol. 49, pp. 931-956.
- (57a) 1937 CLARK, H. L. A new sea-urchin from the "Oligocene" of Oregon: Trans. San Diego Soc. Nat. Hist., vol. 8, no. 28, pp. 367-372.
- (58) 1891 CLARK, W. B. Correlation papers, Eocene: U.S. Geol. Surv., Bull. no. 83, pp. 15-173.
- (59) 1915 CLARK, W. B., and TWITCHELL, N. W. The Mesozoic and Cenozoic Echinodermata of the United States: U.S. Geol. Surv., Mono. 54, pp. 1-341.
- (60) 1871 CONDON, T. The Willamette Sound: The Overland Monthly, vol. 7, pp. 468-473.
- (61) 1880 CONDON, T. in E. D. COPE. 1880. Corrections of the geological maps of Oregon: Am. Nat., vol. 14, no. 6, pp. 457-458.
- (62) 1906 CONDON, T. A new fossil pinniped (*Desmatophoca oregonensis*) from the Miocene of the Oregon Coast: Univ. Oregon Bull., vol. 3, suppl. 3, pp. 5-14.
- (63) 1910 CONDON, T. Oregon geology: A revision of the "Two Islands." Ed. by Ellen Condon McCormack, pp. 1-187, XVII, Portland, Ore.
- (64) 1832 CONRAD, T. American marine conchology.
- (65) 1837 CONRAD, T. A. Description of new marine shells, from Upper California: Jour. Phila. Acad. Nat. Sci., vol. 7, pt. II, pp. 227-268.
- (66) 1845 CONRAD, T. A. Fossil medial Tertiary, United States.
- (67) 1848 CONRAD, T. A. Fossil shells from Tertiary deposits on the Columbia River near Astoria: Am. Jour. Sci., ser. 2, vol. 5, pp. 432-433.
- (68) 1849 CONRAD, T. A. Fossils from the Northwestern America: mollusca: U.S. Expl. Exped., under command of Charles Wilkes, vol. 10 (Geol.), app. I., pp. 723-729.
- (69) 1849 CONRAD, T. A. Descriptions of new fossil and Recent shells of the United States: Jour. Phila. Acad. Nat. Sci., n.s., vol. 1, pp. 207-209.
- (70) 1849 CONRAD, T. A. Descriptions of new fresh-water and marine shells: Proc. Phila. Acad. Nat. Sci., vol. 4, pp. 155-156.
- (71) 1856 CONRAD, T. A. Descriptions of the fossil shells: Pac. R.R. Repts., vol. 6, pt. II (U.S. 33d Cong., 2d sess., Senate Exec. Doc. 78; House Exec. Doc. 91), pp. 312-316.
- (71a) 1856 CONRAD, T. A. Descriptions of three new genera, 23 new species of middle Tertiary fossils from California, and one from Texas: Proc. Phila. Acad. Nat. Sci., vol. 8, pp. 312-316.
- (72) 1857 CONRAD, T. A. Description of the Tertiary fossils collected on the survey: Pac. R.R. Repts., vol. 6, pt. II (U.S. 33d Cong., 2d sess., Senate Exec. Doc. 78; House Exec. Doc. 91), pp. 69-73.
- (73) 1857 CONRAD, T. A. Report on the paleontology of the survey: Pac. R.R. Repts., vol. 7 (U.S. 33d Cong., 2d sess., Senate Exec. Doc. 78; House Exec. Doc. 91), pp. 189-196.

- (74) 1865 CONRAD, T. A. Catalogue of older Eocene shells of North America: Am. Jour. Conch., vol. 1, pp. 150-154.
- (75) 1866 CONRAD, T. A. Check list of the invertebrate fossils of North America, Eocene and Oligocene: Smiths. Misc. Coll., vol. 7, publ. 200, pp. 1-41.
- (76) 1863 COOPER, J. G. On some new genera and species of California mollusca: Proc. Calif. Acad. Nat. Sci., vol. 2, pp. 202-207.
- (77) 1888 COOPER, J. G. Catalogue of California fossils: Calif. State Min. Bur., Seventh Ann. Rept., pp. 1-65.
- (78) 1880 COPE, E. D. Corrections of the geological maps of Oregon: Am. Nat., vol. 14, pp. 457-458.
- (79) 1936 CULVER, HAROLD E. Geology of Washington. Part 1, General features of Washington geology. (To accompany the preliminary geologic map, 1936.) State of Wash., Dept. Cons. and Dev., Bull. no. 32, pp. 1-70.
- (80) 1927 CUSHMAN, J. A., and HANNA, G. D. Foraminifera from the Eocene near Coalinga, California: Proc. Calif. Acad. Sci., ser. 4, vol. 16, pp. 206-229.
- (81) 1927 CUSHMAN, J. A., and GRANT, U. S., IV. Late Tertiary and Quaternary elphidiums of the West Coast of North America: Trans. San Diego Soc. Nat. Hist., vol. 5, pp. 69-82.
- (82) 1928 CUSHMAN, J. A. and SCHENCK, H. G. Two foraminiferal faunules, from the Oregon Tertiary: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 17, pp. 305-324.
- (83) 1931 CUSHMAN, J. A., and LAIMING, BORIS. Miocene foraminifera from Los Sauces Creek, Ventura County, California: Jour. Paleon., vol. 5, pp. 79-120.
- (84) 1889 DALL, W. H. Preliminary report on the collection of mollusca and brachiopoda obtained in 1887-8. Expl. of steamer "Albatross": Proc. U.S. Nat. Mus., vol. 12, pp. 219-362.
- (85) 1892 DALL, W. H. On some new or interesting West American shells obtained from the dredgings of the U.S. Fish Commission steamer "Albatross" in 1888: Proc. U.S. Nat. Mus., vol. 14, pp. 173-191.
- (86) 1892 DALL, W. H., and HARRIS, G. D. Correlation papers: Neocene: U.S. Geol. Surv., Bull. 84, pp. 223-226.
- (87) 1895 DALL, W. H. Report on mollusca and brachiopoda dredged in deep water chiefly near the Hawaiian Islands, with a list of illustrations of hitherto unfigured species from Northwest America: Expl. of steamer "Albatross": Proc. U.S. Nat. Mus., vol. 17, pp. 675-733.
- (88) 1898 DALL, W. H. A table of North American Tertiary horizons, correlated with one another and with those of Western Europe, with annotations: U.S. Geol. Surv., Eighteenth Ann. Rept., pt. 2, pp. 323-348.
- (89) 1898 DALL, W. H. Contributions to the Tertiary fauna of Florida: Pelecypoda: I. Prionodesmacea; II. Teleodesmacea: Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, pp. 571-947.
- (90) 1900-03 DALL, W. H. Contributions to the Tertiary fauna of Florida: Pelecypoda: Trans. Wagner Free Inst. Sci., vol. 3, pts. 5, 6.
- (91) 1900 DALL, W. H. Synopsis of the Solenidae of North America and the Antilles: Proc. U.S. Nat. Mus., vol. 22, pp. 107-112.

- (92) 1890-95 DALL, W. H. Contributions to the Tertiary fauna of Florida: *Trans. Wagner Free Inst. Sci.*, vol. 3, pts. 1, 2, 3.
- (93) 1902 DALL, W. H. Marine deposits bordering the Klamath peneplain. Quoted in J. S. Diller: Topographic development of Klamath Mountains: U.S. Geol. Surv., Bull. no. 196, pp. 30-41.
- (94) 1904 DALL, W. H. An historical and systematic review of the frog shells and tritons: *Smiths. Misc. Coll.*, vol. 47, pp. 114-145.
- (95) 1904 DALL, W. H. Relation of the Miocene of Maryland to that of other regions and to the Recent fauna: *Maryland Geol. Surv., Miocene*, pp. 139-155.
- (96) 1907 DALL, W. H. Notes on some upper Cretaceous Volutidae with descriptions of new species and a revision of the groups to which they belong: *Smiths. Misc. Coll. (quart. issue)*, vol. 50, pt. I, pp. 1-23.
- (97) 1907 DALL, W. H., and BARTSCH, PAUL. The pyramidellid molluscs of the Oregonian faunal area: *Proc. U.S. Nat. Mus.*, vol. 33, pp. 491-534.
- (98) 1908 DALL, W. H. A revision of the Solenomyiacidae: *Nautilus*, vol. 22, pp. 1-2.
- (99) 1908 DALL, W. H. The mollusca and brachiopoda: Reports on dredging operations . . . carried on by the U.S. Fish Commission steamer "Albatross": *Bull. Harvard Mus. Comp. Zool.*, vol. 43, pp. 205-487.
- (100) 1908 DALL, W. H. (See item 99.)
- (101) 1909 DALL, W. H. Contributions to the Tertiary paleontology of the Pacific Coast. I. The Miocene of Astoria and Coos Bay, Oregon: *U.S. Geol. Surv., Prof. Pap. 59*.
- (102) 1917 DALL, W. H. Pacific Coast of America: *Proc. U.S. Nat. Mus.*, vol. 53, pp. 471-488.
- (103) 1918 DALL, W. H. Changes in and additions to molluscan nomenclature: *Proc. Biol. Soc. Wash.*, vol. 31, p. 138.
- (104) 1919 DALL, W. H. Notes on *Chrysodomus* and other mollusks from the North Pacific ocean: *Proc. U.S. Nat. Mus.*, vol. 54, pp. 207-234.
- (105) 1919 DALL, W. H. Notes on nomenclature of the mollusks of the family Turridae: *Proc. U.S. Nat. Mus.*, vol. 54, pp. 313-333.
- (106) 1920 DALL, W. H. Description of new species of mollusca from the North Pacific ocean in the collection of the United States National Museum: *Proc. U.S. Nat. Mus.*, vol. 56, pp. 293-371.
- (107) 1921 DALL, W. H. Summary of the marine shell-bearing mollusks of the Northwest Coast of America: *U.S. Nat. Mus., Bull. no. 11*, pp. 1-212.
- (108) 1922 DALL, W. H. Fossils of the Olympic Peninsula: *Am. Jour. Sci.*, vol. 22, pp. 305-314.
- (109) 1912 DALY, R. A. North American Cordillera at the forty-ninth parallel: *Canada Dept. Mines, Geol. Surv., Mem. 38*.
- (110) 1849 DANA, J. D. Geological observations on Oregon and Northern California: U.S. Expl. Exped., under command of Charles Wilkes, vol. 10 (Geol.), chap. 27, pp. 611-678.
- (111) 1878 DAWSON, G. M. Report on a reconnaissance of Leech River and vicinity: *Geol. Surv. Canada, Rept. of Progress, 1876-77*, pp. 95-102.

- (112) 1887 DAWSON, G. M. Report on a geological examination of the northern part of Vancouver Island and adjacent coasts: Geol. Surv. Canada, Ann. Rept. 1886, pp. 1B-107B.
- (113) 1890 DAWSON, G. M. Notes on the Cretaceous of the British Columbia region, the Nanaimo group: Am. Jour. Sci., ser. 3, vol. 39, pp. 180-183.
- (114) 1895 DAWSON, G. M. Report on the area of the Kamloops map sheet, British Columbia: Geol. Surv. Canada, Seventh Ann. Rept.
- (115) 1885-88 DAVIDSON, THOMAS. A monograph of recent brachiopoda: Trans. Linn. Soc., pp. 7-248.
- (116) 1854 DESHAYES, G. P. Description of new shells from the collection of Hugh Cummings, Esq.: Proc. Zool. Soc. London, vol. 22, pp. 317-371.
- (117) 1913 DICKERSON, R. E. Fauna of the Eocene at Marysville Buttes, California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 7, pp. 257-298.
- (118) 1914 DICKERSON, R. E. Fauna of the Martinez Eocene of California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 8, no. 6, pp. 61-189.
- (119) 1914 DICKERSON, R. E. Note on the faunal zones of the Tejon group: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 8, pp. 17-25.
- (120) 1914 DICKERSON, R. E. The fauna of the *Siphonalia sutterensis* Zone in the Roseburg Quadrangle, Oregon: Proc. Calif. Acad. Sci., ser. 4, vol. 4, no. 4, pp. 113-128.
- (121) 1915 DICKERSON, R. E. Fauna of the type Tejon. Its relation to the Cowlitz phase of the Tejon group of Washington: Proc. Calif. Acad. Sci., ser. 4, vol. 5, no. 3, pp. 33-98.
- (122) 1916 DICKERSON, R. E. Stratigraphy and fauna of the Tejon Eocene of California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, pp. 363-524.
- (123) 1917 DICKERSON, R. E. Climate and its influence upon the Oligocene faunas of the Pacific Coast, with descriptions of some new species from the *Molopophorus lincolensis* Zone: Proc. Calif. Acad. Sci., ser. 4, vol. 7, no. 6, pp. 157-192.
- (124) 1892-93 DILLER, J. S. Tertiary revolution in the topography of the Pacific Coast: U.S. Geol. Surv., Fourteenth Ann. Rept., pt. I, pp. 397-434.
- (125) 1893 DILLER, J. S. Cretaceous and early Tertiary of Northern California and Oregon: Bull. Geol. Soc. Am., vol. 4, pp. 205-224.
- (126) 1896 DILLER, J. S. A geological reconnaissance in Northwestern Oregon: U.S. Geol. Surv., Seventeenth Ann. Rept., pt. I, pp. 441-520.
- (127) 1898 DILLER, J. S. U.S. Geol. Surv., Geol. Atlas, Roseburg folio (no. 48).
- (128) 1899 DILLER, J. S. The Coos Bay coal field, Oregon: U.S. Geol. Surv., Nineteenth Ann. Rept., pt. 3, pp. 309-370.
- (129) 1901 DILLER, J. S. U.S. Geol. Surv., Geol. Atlas, Coos Bay folio (no. 73).
- (130) 1902 DILLER, J. S. Topographic development of the Klamath Mountains: U.S. Geol. Surv., Bull. no. 196.
- (131) 1903 DILLER, J. S. U.S. Geol. Surv., Geol. Atlas, Port Orford folio (no. 89).
- (132) 1906 DILLER, J. S. U.S. Geol. Surv., Geol. Atlas, Redding folio (no. 138).

- (133) 1907 DILLER, J. S. Age of the pre-auriferous gravels in California: *Jour. Wash. Acad. Sci.*, vol. 8, pp. 405-406.
- (134) 1914 DILLER, J. S. Mineral resources of Southwestern Oregon: *U.S. Geol. Surv., Bull.* no. 546.
- (135) 1915 DILLER, J. S., and others. Guidebook of the Western United States: pt. D. The Shasta Route: *U.S. Geol. Surv., Bull.* no. 614.
- (136) 1926 DIXON, DOROTHY E. Bibliography of the geology of Oregon: *Univ. Oregon Publ. Geol.*, vol. 1, pp. 1-125.
- (137) 1937 DURHAM, J. WYATT. Gastropods of the family Epitoniidae from Mesozoic and Cenozoic rocks of the West Coast of North America, including one new species by F. E. Turner and one by R. A. Bramkamp: *Jour. Paleon.*, vol. 11, pp. 479-512.
- (138) 1938 EFFINGER, W. L. The Gries Ranch fauna (Oligocene) of Western Washington: *Jour. Paleon.*, vol. 12, pp. 355-390.
- (139) 1914 ENGLISH, W. A. The agasoma-like gastropoda of California Tertiary: *Univ. Calif. Publ., Bull. Dept. Geol. Sci.*, vol. 8, pp. 243-356.
- (140) 1931 ETHERINGTON, T. J. Stratigraphy and fauna of the Astoria Miocene of Southwest Washington: *Univ. Calif. Publ., Bull. Dept. Geol. Sci.*, vol. 20, no. 5, pp. 31-142.
- (141) 1912 EVANS, GEORGE W. The coal field of King County: *Wash. Geol. Surv., Bull.* no. 3, pp. 1-247.
- (142) 1864 GABB, W. M. Paleontology: *Calif. Geol. Surv.*, vol. 1.
- (143) 1866 GABB, W. M. On the subdivisions of the Cretaceous formation in California: *Proc. Calif. Acad. Nat. Sci.*, vol. 3, pp. 301-306.
- (144) 1866-69 GABB, W. M. Tertiary invertebrate fossils: *Pal. Calif.*, vol. 2, sec. 1, pt. 1, pp. 1-38. Tertiary invertebrate fossils (continued): sec. 1, pt. 2, pp. 39-63. Synopsis of Tertiary invertebrate fossils of California: *Pal. Calif.*, vol. 2, sec. 1, pt. 3, pp. 65-124.
- (145) 1869 GABB, W. M. Cretaceous and Tertiary fossils of California: *Calif. Geol. Surv.*, vol. 2, pp. 1-299.
- (146) 1926 GARDNER, JULIA. The molluscan fauna of the Alum Bluff group of Florida: *U.S. Geol. Surv., Prof. Pap.*, 142-A, B, C, D, E.
- (147) 1935 GLOVER, S. L. Oil and gas possibilities of western Whatcom County: *State of Wash., Dept. Cons. and Dev., Div. Geol., Rept.* no. 2, pp. 1-69.
- (148) 1936 GLOVER, S. L. Preliminary report on petroleum and natural gas in Washington: *State of Wash., Dept. Cons. and Dev., Div. Geol., Rept.* no. 4, pp. 1-24.
- (149) 1850 GOULD, A. A. On the relation of shells from the East and West Coast of America: *Proc. Boston Soc. Nat. Hist.*, vol. 3, pp. 200-220.
- (149a) 1931 GRANT, U. S., IV, and GALE, H. R. Pliocene and Pleistocene mollusca of California: *Mem. San Diego Soc. Nat. Hist.*, vol. 1, pp. 1-1036.
- (152) 1938 GRANT, U. S., IV, and HERTLEIN, L. G. The West American Cenozoic Echinoidea: *Univ. Calif. at L. A. Publ. in Math. and Physical Sci.*, vol. 2, pp. 1-225.

- (153) 1924 HANNA, G. D. Rectifications of nomenclature: Proc. Calif. Acad. Sci., ser. 4, vol. 13, pp. 151-186.
- (154) 1924 HANNA, G. D., and HANNA, M. A. Foraminifera from the Eocene of Cowlitz River, Lewis County, Washington: Univ. Wash. Publ. Geol., vol. 1, no. 4, pp. 57-64.
- (155) 1925 HANNA, G. D. The age and correlation of the Kreyenhagen shale in California: Bull. Am. Assoc. Petrol. Geol., vol. 9, pp. 990-999.
- (156) 1927 HANNA, G. D. The lowest known Tertiary diatoms in California: Jour. Paleon., vol. 1, pp. 103-126.
- (157) 1938 HANNA, G. D., and HERTLEIN, L. G. New Tertiary molluscs from Western North America: Jour. Paleon., vol. 12, pp. 106-110.
- (158) 1925 HANNA, M. A. Notes on the genus *Venericardia* from the Eocene of the West Coast of North America: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 281-306.
- (159) 1927 HANNA, M. A. An Eocene invertebrate fauna from the La Jolla Quadrangle, California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, pp. 247-398.
- (159a) 1912 HANNIBAL, HAROLD. A synopsis of the Recent and Tertiary freshwater mollusca of the Californian province: Proc. Malacological Soc., vol. 10, pp. 112-211.
- (160) 1920 HARRISON and EATON. Report on investigation of oil and gas possibilities of Western Oregon: The Mineral Resources of Oregon, vol. 3, no. 1, pp. 1-40.
- (161) 1859 HEER, O. Fossil plants of Vancouver Island and Bellingham Bay: Am. Jour. Sci., vol. 78, pp. 85-89.
- (162) 1882 HEILPRIN, A. On the age of the Tejon Rocks of California, and the occurrence of ammonitic remains in Tertiary deposits: Proc. Phila. Acad. Nat. Sci., vol. 34, pp. 196-214.
- (163) 1912 HENDERSON, C. W., and WINSTANLEY, J. B., with subject index by GRAHAM J. MICHAEL. Bibliography of the geology, paleontology, mineralogy, petrology, and mineral resources of Oregon: Univ. Oregon Bull., n.s., vol. 10, no. 4, pp. 4-50.
- (164) 1935 HENDERSON, JUNIUS. Fossil non-marine mollusca of North America: Geol. Soc. Am., Spec. Pap. no. 4, pp. 1-313.
- (165) 1925 HERTLEIN, L. G., and CRICKMAY, C. H. A summary of the nomenclature and stratigraphy of the marine Tertiary of Oregon and Washington: Proc. Am. Phil. Soc., vol. 64, no. 2, pp. 224-282.
- (166) 1922 HOWE, H. V. Faunal and stratigraphic relationships of the Empire formation, Coos Bay, Oregon: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, no. 3, pp. 85-114.
- (167) 1922 HOWE, H. V. The Miocene of Clatsop and Lincoln counties, Oregon: Unpublished Thesis, Leland Stanford Junior Univ., Calif.
- (168) 1926 HOWE, H. V. Astoria: Mid-Tertiary type of Pacific Coast: Pan-Am. Geol., vol. 45, pp. 295-306.
- (168a) 1856 JAY, J. C. List of shells: Expedition to Japan under Commodore M. C. Perry in 1852 to 1854, vol. 2, p. 292.

- (169) 1923 JENKINS, OLAF P. Geological investigation of the coal fields of western Whatcom County, Washington: State of Wash., Dept. Cons. and Dev., Bull. no. 28 (Geol. ser.), pp. 1-135.
- (170) 1924 JENKINS, OLAF P. Geological investigation of the coal fields of Skagit County, Washington: State of Wash., Dept. Cons. and Dev., Bull. no. 29 (Geol. ser.), pp. 1-163.
- (171) 1911 KEEP, J. West Coast shells: San Francisco, pp. 1-346.
- (172) 1922 KELLOGG, R. Pinnipeds from Miocene and Pleistocene deposits of California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 13, no. 4, pp. 59-60, 62-63, 106, 107.
- (173) 1920 KEW, W. S. W. Cretaceous and Cenozoic Echinoidea of the Pacific Coast region of North America: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 12, pp. 23-236.
- (174) 1938 KLEINPELL, R. M. Miocene stratigraphy of California: Amer. Assoc. Petrol. Geol., Publishers. Pp. 1-450.
- (175) 1889 KNOWLTON, F. H. Notes on the fossil plants of the Puget epoch (in Tacoma folio no. 54, U.S. Geol. Surv., by B. Willis and G. O. Smith), p. 4.
- (176) 1900 KNOWLTON, F. H. Fossil plants associated with the lavas of the Cascade Range: U.S. Geol. Surv., Twentieth Ann. Rept., pt. 3, pp. 37-64.
- (177) 1902 KNOWLTON, F. H. Fossil flora of the John Day Basin, Oregon: U.S. Geol. Surv., Bull. no. 204.
- (178) 1911 KNOWLTON, F. H. Flora of the auriferous gravels of California (in The Tertiary gravels of the Sierra Nevada of California, by W. Lindgren): U.S. Geol. Surv., Prof. Pap. 73, pp. 57-64.
- (179) 1919 KNOWLTON, F. H. Catalogue of Mesozoic and Cenozoic plants of North America: U.S. Geol. Surv., Bull. no. 696.
- (180) 1935 LA MOTTE, R. S. An upper Oligocene florule from Vancouver Island: Carnegie Inst. Wash., Publ. no. 455, pp. 49-56.
- (181) 1935 LA MOTTE, R. S. Plant fossils in a marine upper Miocene deposit near Aberdeen, Washington (abstract): Proc. Geol. Soc. Am., vol. 48, p. 348.
- (182) 1894 LAWSON, A. C. Note on the Chehalis sandstone: Am. Geol., vol. 13, pp. 436-437.
- (183) 1859 LESQUEREUX, L. On fossil plants collected by Dr. John Evans at Vancouver Island and at Bellingham Bay, Washington Territory. In a letter from L. Lesquereux to J. D. Dana dated Columbus, Ohio, May 12, 1859: Am. Jour. Sci., vol. 78, pp. 85-89.
- (184) 1859 LESQUEREUX, L. Species of fossil plants collected by John Evans at Nanaimo (Vancouver Island) and at Bellingham Bay, Washington Territory; Am. Jour. Sci., vol. 77, pp. 360-363.
- (185) 1878 LESQUEREUX, L. Report on fossil plants of the auriferous gravel deposits of the Sierra Nevada: Mem. Harvard Mus. Comp. Zool., vol. 6, no. 2.
- (186) 1883 LESQUEREUX, L. Contributions to the fossil flora of the Western Territories. The Cretaceous and Tertiary flora: U.S. Geol. Surv. of the Territories, vol. 8, pt. 3.

- (187) 1888 LESQUEREAUX, L. Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc.: Proc. U.S. Nat. Mus., vol. 11, pp. 11-38.
- (188) 1913 LOUDERBACK, G. C. The Monterey series of California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 7, pp. 177-241.
- (189) 1906 McCORMACK, ELLEN C. A student's geological map of Oregon, with notes: Univ. Oregon Bull., n.s., vol. 3, no. 5, pp. 3-25.
- (190) 1914 McCORMACK, ELLEN C. A study of Oregon Pleistocene: The Oregon *Desmostylus* skull: Univ. Oregon Bull., n.s., vol. 12, no. 2, pp. 2-12.
- (191) 1857 MEEK, F. B. On Cretaceous fossils from Vancouver and Sucia Islands: Trans. Albany Inst., vol. 4, pp. 37-39.
- (192) 1861 MEEK, F. B. Descriptions of new Cretaceous fossils from Vancouver and Sucia Islands: Proc. Phila. Acad. Nat. Sci., vol. 13, pp. 314-318.
- (193) 1864 MEEK, F. B. Check list of the invertebrate fossils of North America: Smiths. Misc. Coll., vol. 4, publ. 183, pp. 1-32.
- (194) 1876 MEEK, F. B. Descriptions and illustrations of fossils from Vancouver and Sucia Islands: U.S. Geol. Surv. of the Territories, vol. 2, pp. 351-374.
- (195) 1896 MERRIAM, J. C. Note on two Tertiary faunas from the rocks of the southern coast of Vancouver Island: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 2, no. 3, pp. 101-108.
- (196) 1897 MERRIAM, J. C. New species of Tertiary molluscs from Vancouver Island: Nautilus, vol. 2, pp. 64-65.
- (197) 1899 MERRIAM, J. C. The fauna of the Sooke Beds of Vancouver Island: Proc. Calif. Acad. Sci., ser. 3, vol. 1, pp. 175-180.
- (198) 1899 MERRIAM, J. C. The Tertiary sea-urchins of Middle California: Proc. Calif. Acad. Sci., ser. 3, vol. 1, no. 5, pp. 161-170.
- (199) 1901 MERRIAM, J. C. A contribution to the geology of the John Day Basin: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 2, pp. 269-314.
- (200) 1911 MERRIAM, J. C. Notes on the genus *Desmostylus* of Marsh: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 6, pp. 403-412.
- (201) 1915 MERRIAM, J. C. Tertiary vertebrate faunas of the north Coalinga region of California. A contribution to the study of paleontologic correlation in the Great Basin and Pacific Coast provinces: Trans. Am. Phil. Soc., n.s., vol. 22, pt. 3, pp. 191-234.
- (202) 1917 MERRIAM, J. C. Age of strata referred to the Ellensburg formation in the White Bluffs of the Columbia River: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 10, pp. 255-266.
- (203) 1937 MERRIAM, C. W., and TURNER, F. E. The Capay Eocene of Northern California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 24, pp. 91-114.
- (204) 1925 NELSON, R. N. A contribution to the paleontology of the Martinez Eocene of California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, pp. 397-466.
- (205) 1857 NEWBERRY, J. S. Coal of Coos Bay, Bellingham Bay, Vancouver Island, and Cape Flattery: R.R. Repts., vol. 6, pt. II (U.S. 33d Cong., 2d sess., Senate Exec. Doc. 78), pp. 63-67.

- (207) 1863 NEWBERRY, J. S. Descriptions of the fossil plants collected by Mr. George Gibbs, geologist to the United States Northwest Boundary Commission, under Mr. Archibald Campbell, U.S. Commissioner: Boston Jour. Nat. Hist., vol. 7, pp. 506-524.
- (208) 1898 NEWBERRY, J. S. The later extinct floras of North America (edited by A. Hollick): U.S. Geol. Surv., Mono. no. 35.
- (209) 1914 NEWCOMBE, C. F. Pleistocene raised beaches at Victoria, B. C.: Ottawa Nat., vol. 28, no. 8, pp. 107-110.
- (210) 1916 NOMLAND, JОРGEN O. Corals from the Cretaceous and Tertiary of California and Oregon: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, pp. 59-76.
- (211) 1917 NOMLAND, JОРGEN O. New fossil corals from the Pacific Coast: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 10, pp. 185-190.
- (212) 1917 NOMLAND, JОРGEN O. Fauna of the Santa Margarita beds in the north Coalinga region of California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 10, pp. 293-326.
- (213) 1913 O'Donnell, G. Bibliography of Washington geology and geography: Wash. Geol. Surv., Bull. no. 12.
- (214) 1924 OLROYD, I. S. Marine shells of Puget Sound and vicinity: Publ. Puget Sound Biol. Sta., vol. 4, pp. 1-272.
- (215) 1924 OLDRYOD, I. S. The marine shells of the West Coast of North America: Stanford Univ. Publ. Geol., vols. 1 and 2.
- (216) 1925 OLDRYOD, I. S. The fossils of the lower San Pedro fauna of the Nob Hill Cut, San Pedro, California: Proc. U.S. Nat. Mus., vol. 65, art. 22, pp. 1-39.
- (217) 1904 OSMONT, V. C. Arcas of the California Neocene: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 4, pp. 89-100.
- (218) 1916 PACKARD, E. L. Mesozoic and Cenozoic mactrinae of the Pacific Coast of North America: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 9, pp. 261-360.
- (219) 1921 PACKARD, E. L. An addition to the marine mammalian fauna of Newport, Oregon (abstract): Geol. Soc. Am. Bull., vol. 32, p. 146.
- (220) 1923 PACKARD, E. L. An aberrant oyster from the Oregon Eocene: Univ. Oregon Publ., vol. 2, pp. 1-6.
- (221) 1934 PACKARD, E. L., and KELLOGG, R. A new Cetothere from the Miocene Astoria formation of Newport, Oregon: Carnegie Inst. Wash., Publ. no. 447, pp. 1-62.
- (222) 1923 PALMER, KATHERINE VAN W. Orbitolites from the Eocene of Oregon: Bull. Am. Paleon., vol. 10, pp. 13-14.
- (223) 1926 PALMER, KATHERINE VAN W. The Veneridae of Eastern America: Cenozoic and Recent: Paleontographica Americana, vol. 2, pp. 209-428.
- (224) 1927 PALMER, R. H. Geology and petroleum possibilities of the Olympic Peninsula, Washington: Bull. Am. Assoc. Petrol. Geol., vol. 11, pp. 1321-1328.
- (225) 1927 PALMER, R. H. The Hoh formation of Washington: Jour. Geol., vol. 35, pp. 276-278.

- (226) 1923 PALMER, DOROTHY B. K. A fauna from the middle Eocene shale near Vacaville, California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, pp. 289-318.
- (226a) 1908 RATHBUN, MARY J. Description of fossil crabs from California: Proc. U.S. Nat. Mus., vol. 35, pp. 341-349.
- (227) 1916 RATHBUN, MARY J. Description of a new genus and species of fossil crab from Port Townsend, Washington: Am. Jour. Sci., vol. 41, pp. 344-346.
- (228) 1917 RATHBUN, MARY J. Description of a new species of crab from the California Pliocene: Proc. U.S. Nat. Mus., vol. 53, pp. 451-452.
- (229) 1926 RATHBUN, MARY J. The fossil stalk-eyed crustacea of the Pacific Slope of North America: U.S. Nat. Mus., Bull. no. 138, pp. 1-155.
- (230) 1909 REAGAN, A. B. Some notes on the Olympic Peninsula, Washington: Trans. Kans. Acad. Sci., vol. 22, pp. 131-238.
- (231) 1910 REAGAN, A. B. Die Fossilien der Clallamformation mit denjenigen der Tertiärformationen in Vancouver-Insel und mit denjenigen der Astoria-Miocanformation in Oregon verglichen: Centralblatt für Mineral, Geol. und Paleo., no. 20, pp. 646-651.
- (232) 1935 REINHART, P. W. Classification of the Pelecypod family Arcidae. Bull. Mus. Roy. Hist. Nat. Belgique, vol. 11, no. 13. Pp. 68.
- (233) 1937 REINHART, P. W. Cretaceous and Tertiary Pelecypods of the Pacific Slope incorrectly assigned to the family Arcidae: Jour. Paleon., vol. 11, pp. 169-180.
- (234) 1937 REINHART, P. W. Three new species of the Pelecypod family Arcidae from the Pliocene of California: Jour. Paleon., vol. 11, pp. 181-185.
- (235) 1878 RICHARDSON, J. Report on the coal fields of Nanaimo, Comox, Cowichen, Burrard Inlet, and Sooke, B. C.: Geol. Surv. Canada, Rept. of Progress 1876-77, pp. 160-192.
- (236) 1925 SCHENCK, H. G. Physiography of the Eugene Quadrangle, Oregon (abstract): Bull. Geol. Soc. Am., vol. 36, p. 203.
- (237) 1926 SCHENCK, H. G. Cassididae of Western America: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, pp. 69-98.
- (238) 1927 SCHENCK, H. G. Diatoms in Western Oregon shales: Econ. Geol., vol. 22, pp. 565-568.
- (239) 1927 SCHENCK, H. G. Marine Oligocene of Oregon (abstract): Bull. Geol. Soc. Am., vol. 38, p. 202.
- (240) 1927 SCHENCK, H. G. Marine Oligocene of Oregon: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, no. 12, pp. 449-460.
- (241) 1927 SCHENCK, H. G., and CUSHMAN, J. A. Two foraminiferal faunules from the Oregon Tertiary: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 17, no. 9, pp. 305-324.
- (242) 1928 SCHENCK, H. G. Stratigraphic relations of Western Oregon Oligocene formations: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, no. 1, pp. 1-50.
- (243) 1931 SCHENCK, H. G. Cephalopods of the genus *Aturia* from Western North America: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, no. 19, pp. 435-490.

- (244) 1935 SCHENCK, H. G. What is the Vaqueros formation of California and is it Oligocene? *Bull. Am. Assoc. Petrol. Geol.*, vol. 19, no. 4, pp. 521-536.
- (245) 1936 SCHENCK, H. G. Nuculid bivalves of the genus *Acila*: *Geol. Soc. Am., Spec. Pap.*, no. 4, pp. 1-149.
- (246) 1939 SCHENCK, H. G. Revised nomenclature for some Nuculid Pelecypods: *Jour. Paleon.*, vol. 13, pp. 21-41.
- (247) 1938 SCHENCK, H. G., and REINHART, P. W. The Pelecypod genus *Striarca* from the Indo-Pacific province: *Archiv für Naturgeschichte*, Band 7, Heft 2, pp. 305-314.
- (248) 1858 SHUMARD, B. F. Descriptions of new fossils from the Tertiary formations of Oregon and Washington Territories and the Cretaceous of Vancouver Island: *Trans. St. Louis Acad. Sci.*, vol. 1, no. 2, pp. 120-123.
- (249) 1901 SMITH, G. O. U.S. Geol. Surv., Geol. Atlas, Ellensburg folio (no. 86).
- (250) 1902 SMITH, G. O. Pacific Coast coal fields: U.S. Geol. Surv., Twenty-second Ann. Rept., pt. 3.
- (251) 1904 SMITH, G. O. U.S. Geol. Surv., Geol. Atlas, Mount Stuart folio (no. 106).
- (252) 1904 SMITH, G. O., and CALKINS, F. C. A geological reconnaissance across the Cascade Range near the Forty-ninth Parallel: U.S. Geol. Surv., Bull. no. 235.
- (253) 1906 SMITH, G. O., and CALKINS, F. C. U.S. Geol. Surv., Geol. Atlas, Snoqualmie folio (no. 139).
- (254) 1912 SMITH, J. P. Geologic range of Miocene invertebrate fossils of California: *Proc. Calif. Acad. Sci.*, ser. 4, vol. 3, pp. 161-182.
- (255) 1919 SMITH, J. P. Climatic relations of the Tertiary and Quaternary faunas of the California Region: *Proc. Calif. Acad. Sci.*, ser. 4, vol. 9, no. 4, pp. 123-173.
- (256) 1917 SMITH, W. D. A summary of the salient features of the geology of the Oregon Cascades, with some correlations between the geology of the East Coast of Asia with that of the West Coast of America: *Univ. Oregon Bull.*, n.s., vol. 14, no. 16, pp. 1-54.
- (257) 1919 SMITH, W. D., and PACKARD, E. L. The salient features of the geology of Oregon: *Jour. Geol.*, vol. 27, no. 2, pp. 79-121.
- (258) 1924 SMITH, W. D. Petroleum possibilities of Western Oregon: *Econ. Geol.*, vol. 19, pp. 455-465.
- (259) 1925 SMITH, W. D. Physical and economic geography of Oregon: The Willamette Valley: *The Commonwealth Review*, Univ. Oregon, vol. 7, pp. 137-194.
- (260) 1926 SMITH, W. D., and PACKARD, E. L. Physical and economic geography of Oregon: The Coast Range Province: *The Commonwealth Review*, Univ. Oregon, vol. 8, nos. 2-3, pp. 254-297.
- (261) 1893 SMITH, W. H. Ancient glacial moraine and drift at the mouth of the Columbia River: *Sci. Am. Suppl.*, 36.
- (262) 1915 SMITH, W. S. Petrology and economic geology of the Skykomish Basin, Washington: *School of Mines Quart.*, vol. 36, pp. 154-185.
- (263) 1916 SMITH, W. S. Stratigraphy of the Skykomish Basin, Washington: *Jour. Geol.*, vol. 24, pp. 559-582.

- (264) 1917 SMITH, W. S. Physiography of the Skykomish Basin, Washington: Ann. N. Y. Acad. Sci., vol. 37, pp. 205-213.
- (265) 1900-01 SPURR, J. E. The ore deposits of Monte Cristo, Washington: U.S. Geol. Surv., Twenty-second Ann. Rept., pt. 2, pp. 777-865.
- (266) 1866 SOWERBY, G. B. Thesaurus Conchyliorum, vol. 3. London, Sowerby.
- (266a) 1926 STEWART, R. B. Gabb's California fossil type gastropods: Proc. Phila. Acad. Nat. Sci., vol. 78, pp. 287-447.
- (267) 1930 STEWART, R. B. Gabb's California Cretaceous and Tertiary type Lamellibranchs: Phila. Acad. Nat. Sci., Spec. Publ. 3, pp. 1-314.
- (268) 1932 TALIAFERRO, N. L. Geology of the Yakataga, Katalla, and Nichawak districts, Alaska: Bull. Geol. Soc. Am., vol. 43, pp. 749-782.
- (269) 1928 TEGLAND, NELLIE M. *Thyasira disjuncta* Gabb not *Thyasira bisecta* Conrad. The Recent West Coast shell: Nautilus, vol. 41, pp. 129-130.
- (270) 1929 TEGLAND, NELLIE M. Correlation and affinities of certain species of *Pitaria*: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, pp. 275-290.
- (271) 1931 TEGLAND, NELLIE M. Gastropod genus *Galeodea* in the Oligocene of Washington: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, pp. 397-444.
- (272) 1933 TEGLAND, NELLIE M. The fauna of the type Blakeley, upper Oligocene of Washington: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, no. 3, pp. 81-174.
- (273) 1922 TRASK, P. D. The Briones formation of Middle California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 13, pp. 161-174.
- (274) 1938 TURNER, F. E. Stratigraphy and Mollusca of the Eocene of Western Oregon: Geol. Soc. Am., Spec. Pap. no. 10, pp. 1-130.
- (275) 1918 VAN WINKLE, KATHERINE E. Paleontology of the Oligocene of the Chehalis Valley, Washington: Univ. Wash. Publ. Geol., vol. 1, no. 2, pp. 69-97.
- (276) 1924 VAUGHAN, T. W. On the relative value of species of smaller foraminifera for the recognition of stratigraphic zones: Bull. Am. Assoc. Petrol. Geol., vol. 7, pp. 517-531.
- (277) 1924 VAUGHAN, T. W. Criteria and status of correlation and classification of Tertiary deposits: Bull. Geol. Soc. Am., vol. 24, pp. 677-742.
- (278) 1935 VOKES, H. E. Notes on the variation and synonymy of *Ostrea idriaensis*: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, pp. 291-303.
- (278a) 1937 VOKES, H. E. The gastropod genus *Harpa* in the Eocene of the Western United States: Jour. Paleon., vol. 11, pp. 10-12.
- (278b) 1937 VOKES, H. E. Nautiloid Cephalopods from the Eocene of California: Jour. Paleon., vol. 11, pp. 3-9.
- (279) 1939 VOKES, H. E. Molluscan faunas of the Domengine and Arroyo Hondo formations of the California Eocene: Ann. New York Acad. Sci., vol. 38, pp. 1-246.
- (280) 1923 WAGNER, C. M., and SCHILLING, K. H. The San Lorenzo group of the San Emigdio region, California: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 14, no. 6, pp. 235-276.
- (281) 1917 WARING, CLARENCE A. Stratigraphic and faunal relations of the Martinez to the Chico and Tejon of Southern California: Proc. Calif. Acad. Sci., ser. 4, vol. 7, pp. 41-124.

- (282) 1914 WASHBURNE, C. W. Reconnaissance of the geology and oil prospects of Northwestern Oregon: U.S. Geol. Surv., Bull. no. 590.
- (283) 1905 WEAVER, C. E. Contribution to the paleontology of the Martinez group: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 4, pp. 101-123.
- (284) 1907 WEAVER, C. E. Notes on the bed rock geology of the Olympic Peninsula, Washington: Seattle, The Mountaineer, pp. 58-64.
- (285) 1911 WEAVER, C. E. Geology and ore deposits of the Blewett mining district, Washington: Wash. Geol. Surv., Bull. no. 6.
- (286) 1912 WEAVER, C. E. A preliminary report on the Tertiary paleontology of Western Washington: Wash. Geol. Surv., Bull. no. 15, pp. 1-80.
- (287) 1912 WEAVER, C. E. Geology and ore deposits of the Index mining district, Washington: Wash. Geol. Surv., Bull. no. 7.
- (288) 1913 WEAVER, C. E. Geology and ore deposits of the Covada mining district, Washington: Wash. Geol. Surv., Bull. no. 16.
- (289) 1913 WEAVER, C. E. Tertiary paleontology of Western Washington: Bull. Geol. Soc. Am., vol. 24, pp. 131-132.
- (290) 1914 WEAVER, C. E. Lower Miocene of Washington: Bull. Geol. Soc. Am., vol. 25, pp. 153-154.
- (291) 1915 WEAVER, C. E. Geologic structure in Western Washington: Bull. Geol. Soc. Am., vol. 26, pp. 135-136.
- (292) 1915 WEAVER, C. E. Geology of portion of Western Washington: Bull. Geol. Soc. Am., vol. 26, p. 397.
- (293) 1915 WEAVER, C. E. Pre-Pleistocene geology in the vicinity of Seattle, Washington: Bull. Geol. Soc. Am., vol. 26, p. 130.
- (294) 1916 WEAVER, C. E. Eocene of the lower Cowlitz Valley, Washington: Proc. Calif. Acad. Sci., ser. 4, vol. 6, no. 1, pp. 1-17.
- (295) 1916 WEAVER, C. E. Tertiary faunal horizons of Western Washington: Univ. Wash. Publ. Geol., vol. 1, no. 1, pp. 1-67.
- (296) 1916 WEAVER, C. E. Tertiary formations of Western Washington: Wash. Geol. Surv., Bull. no. 13, pp. 1-327.
- (297) 1916 WEAVER, C. E. The Oligocene of Kitsap County, Washington: Proc. Calif. Acad. Sci., ser. 4, vol. 6, no. 3, pp. 41-52.
- (298) 1916 WEAVER, C. E. The possible occurrence of oil and gas fields in Washington: Trans. Am. Inst. Min. Eng., vol. 52, pp. 239-249.
- (299) 1916 WEAVER, C. E. The post-Eocene formations of Western Washington: Proc. Calif. Acad. Sci., ser. 4, vol. 6, no. 2, pp. 19-40.
- (300) 1918 WEAVER, C. E. Paleogeography of the Oligocene of Washington: Bull. Geol. Soc. Am., vol. 20, pp. 165-166.
- (301) 1922 WEAVER, C. E., and PALMER, KATHERINE VAN WINKLE. Fauna from the Eocene of Washington: Univ. Wash. Publ. Geol., vol. 1, no. 3, pp. 1-56.
- (302) 1930 WEAVER, C. E. Eocene lavas in Western Washington: Bull. Geol. Soc. Am., vol. 41, p. 87.

- (303) 1937 WEAVER, C. E. Tertiary stratigraphy of Western Washington and Northwestern Oregon: Univ. Wash. Publ. Geol., vol. 4, pp. 1-266.
- (304) 1938 WEAVER, C. E. Geology and its relation to the occurrence of oil in Washington: Univ. Wash. Eng. Exper. Station Bull. 98. Pp. 1-16.
- (305) 1934 WELLS, F. G., and WATERS, A. C. Quicksilver deposits of Southwestern Oregon: U.S. Geol. Surv., Bull. no. 850, pp. 1-58.
- (306) 1935 WELLS, F. G., and WATERS, A. C. Basaltic rocks in the Umpqua formation: Bull. Geol. Soc. Am., vol. 48, pp. 961-972.
- (307) 1885 WHITE, C. A. On marine Eocene, fresh-water Miocene, and other fossil mollusca of Western North America: U.S. Geol. Surv., Bull. no. 18.
- (308) 1888 WHITE, C. A. On the Puget Group of Washington Territory: Am. Jour. Sci., ser. 3, vol. 36, pp. 443-450.
- (309) 1889 WHITE, C. A. On invertebrate fossils from the Pacific Coast: U.S. Geol. Surv., Bull. no. 51, pp. 479-493.
- (310) 1876-1903 WHITEAVES, J. F. On the fossils of the Cretaceous rocks of Vancouver and adjacent islands in the Straits of Georgia: Geol. Surv. Canada, Mesozoic fossils, vol. 1, pts. 1-5.
- (311) 1895 WHITEAVES, J. F. On some fossils from the Nanaimo group of the Vancouver Cretaceous: Trans. Roy. Soc. Canada, ser. 2, vol. 1, sec. 4, pp. 119-133.
- (312) 1928 WIEDEY, L. W. Notes on the Vaqueros and Temblor formations of the California Miocene, with descriptions of new species: Trans. San Diego Soc. Nat. Hist., vol. 5, pp. 95-182.
- (313) 1916 WILLIAMS, I. A. The Columbia River Gorge: Its geologic history interpreted from the Columbia River Highway: The Mineral Resources of Oregon, vol. 2, no. 3, pp. 7-130.
- (315) 1923 WILLIAMS, I. A., and PARKS, H. M. Report on the Limonite iron ores of Columbia County, Oregon: The Mineral Resources of Oregon, vol. 3, pp. 1-44.
- (316) 1886 WILLIS, B. Report on the coal fields of Washington Territory: U.S. Tenth Census, vol. 15, Mining Industries, pp. 759-771.
- (317) 1887 WILLIS, B. Changes in river courses in Washington Territory due to glaciation: U.S. Geol. Surv., Bull. no. 40.
- (318) 1896 WILLIS, B. The geology of the Cascade Mountains: Johns Hopkins Univ., Circ. 15, p. 90.
- (319) 1898 WILLIS, B. Some coal fields of Puget Sound: U.S. Geol. Surv., Eighteenth Ann. Rept., pt. 3, pp. 393-436.
- (320) 1898 WILLIS, B. Stratigraphy and structure of the Puget Group, Washington: Bull. Geol. Soc. Am., vol. 9, pp. 2-6.
- (321) 1899 WILLIS, B., and SMITH, G. O. U.S. Geol. Surv., Geol. Atlas, Tacoma folio (no. 54).
- (322) 1903 WILLIS, B. Physiography and deformation of the Wenatchee-Chelan district, Cascade Range: U.S. Geol. Surv., Prof. Pap. 19, pp. 41-97.

- (323) 1924 WITHERS, T. H. Some decapod crustaceans (*Callianassa* and *Ranina*) from the Oligocene of Washington: Ann. Mag. Nat. Hist., ser. 9, vol. 14, pp. 121-127.
- (324) 1925 WOODRING, W. P. Miocene mollusks from Bowden, Jamaica, Pelecypoda: Carnegie Inst. Wash., Publ. 366, pp. 1-210.
- (325) 1928 WOODRING, W. P. Miocene mollusks from Bowden, Jamaica, Gastropoda: Carnegie Inst. Wash., Publ. 385, pp. 3-541.
- (326) 1914 WOODRUFF, E. G. The glacier coal field of Whatcom County, Washington: U.S. Geol. Surv., Bull. no. 541-I, pp. 389-398.
- (327) 1895 WOODWARD, H. On some decapod crustacea from the Cretaceous formation of Vancouver Island: Rept. Brit. Assoc. Adv. Sci., pp. 696-697.
- (328) 1896 WOODWARD, H. On some podophthalmatous crustacea from the Cretaceous formation of Vancouver and Queen Charlotte Islands: Quart. Jour. Geol. Soc. London, vol. 52, pp. 221-228.
- (329) 1900 WOODWARD, H. Further notes on podophthalmous crustacea from the upper Cretaceous formation of British Columbia, etc.: Geol. Mag., n.s., vol. 7, pp. 392-401, 433-435.

#### Publications Received While in Press

- (330) 1940 BENTSON, HERDIS. A systematic study of the fossil gastropod *Exilia*: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 25, no. 5, pp. 199-238.
- (331) 1942 DURHAM, J. W. Eocene and Oligocene coral faunas of Washington: Journ. Paleon., vol. 16, pp. 84-104.
- (332) 1942 DURHAM, J. W. Reef corals from the California middle Eocene: Proc. Calif. Acad. Sci., ser. 4, vol. 23, no. 34, pp. 503-510.
- (333) 1941 MERRIAM, CHARLES W. Fossil Turritellas from the Pacific Coast region of North America: Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 26, no. 1, pp. 1-214.
- (334) 1943 REINHART, P. W. Mesozoic and Cenozoic Arcidae from the Pacific slope of North America: Geol. Soc. Am., Spec. Pap., no. 47, pp. 1-117.
- (335) 1942 SCHENCK, H. G., and CHILDS, T. S., Jr. Significance of *Lepidocyclina* (*Lepidocyclina*) *californica*, New species in the Vaqueros formation (Tertiary), California: Stanford Univ. Publ. Geol., vol. 3, no. 2, pp. 1-59.
- (336) 1940 WOODRING, W. P., STEWART, R., and RICHARDS, R. W. Geology of the Kettleman Hills oil field, stratigraphy, paleontology and structure: U.S. Geol. Surv., Prof. Pap. 195, pp. 1-170.

## FAUNAL LOCALITIES

### LOCALITY NO.

- 1 About 1½ miles east of Vader, Lewis County, on the west bank of Cowlitz River, in massive sandy shales of marine origin, situated in southwest quarter of Section 27, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 2 On Olequa Creek about 1 mile above the junction of Olequa and Stillwater creeks, back of the old Cantwell place, Lewis County, Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 3 On a small creek about one-third mile from its junction with Brinn Creek, under an old bridge, Lewis County, Section 25, Township 11 N., Range 3 W. Cowlitz formation, upper Eocene.
- 5 At a ledge just above the junction of Olequa and Stillwater creeks at Vader, Lewis County, Section 32, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 6 On Stillwater Creek, 1 mile west of junction of Stillwater and Olequa creeks, Lewis County, Section 30, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 7 On Coal Creek, Cowlitz County, 1½ miles north from Inman-Poulsen Logging Company's store. Cowlitz formation, upper Eocene.
- 8 In Coal Creek, Cowlitz County, 1 mile north from Inman-Poulsen Logging Company's store, Section 35, Township 9 N., Range 3 W. In brackish water shales, Cowlitz formation, upper Eocene.
- 9 In Northern Pacific Railway cut 100 feet east of Seattle Brewing & Malting Company's brewery at Georgetown, South Seattle, King County, Section 20, Township 24 N., Range 4 E. Blakeley formation, upper Oligocene.
- 10 About 1,000 feet south of Alki Point, West Seattle, in shales outcropping at the water's edge, King County, Section 15, Township 24 N., Range 3 E. Blakeley formation, upper Oligocene.
- 11 At northeast corner of rock outlier at Duwamish station, King County, Section 10, Township 23 N., Range 4 E. In marine sandstone, Cowlitz formation, upper Eocene.
- 12 In Northern Pacific Railway cut one-half mile north of Cathcart Station, Snohomish County, Section 6, Township 27 N., Range 6 E., locally known as Fiddler's Bluff. Middle Oligocene.
- 13 In marine sandstones on north side of Restoration Point (opposite Seattle), Kitsap County, Section 12, Township 24 N., Range 2 E. Upper Oligocene.
- 14 On the south fork of Ostrander Creek, 200 feet south from a point where the logging road crosses, which is 1,130 feet from the town of Ostrander, Cowlitz County, Section 12, Township 8 N., Range 2 W. In brackish water shales, Cowlitz formation, upper Eocene.

(585)

## LOCALITY NO.

- 18 In banks of Coal Creek 6,500 feet up creek from Inman-Poulsen Logging Company's store, Cowlitz County, Section 35, Township 9 N., Range 3 W. Cowlitz formation, upper Eocene.
- 20 In Cowlitz County, 13,000 feet up Coal Creek from wagon bridge crossing, in central portion of eastern part of Section 35, Township 35 N., Range 3 E. Cowlitz formation, upper Eocene.
- 21 In Cowlitz County, 14,000 feet up Coal Creek from wagon bridge crossing. Cowlitz formation, upper Eocene.
- 22 On east side of Ilwaco Point, Pacific County, Section 4, Township 9 N., Range 11 W., in shales which are interbedded with basalts. Middle Eocene.
- 23 In bluff on north side of Columbia River one-half mile east of the town of Ilwaco, Pacific County, Section 34, Township 10 N., Range 9 W. Probably middle Oligocene.
- 24 At Knappton, on north side of Columbia River, in bluff back of cook house of Knappton Lumber Mill, Pacific County, Section 8, Township 9 N., Range 9 W. Upper Oligocene.
- 25 In back of Nasel River 2½ miles east of the town of Nasel, Pacific County, Section 11, Township 10 N., Range 9 W. Astoria formation, middle Miocene.
- 27 In a fine dark-colored tuffaceous shale, 700 feet up Alder Creek from its junction with the east fork of Nasel River, Pacific County, Section 15, Township 11 N., Range 8 W. Oligocene.
- 28 In Pacific County, 12,000 feet up Hull Creek from the hotel at town of Grays River, Section 6, Township 10 N., Range 7 W. Oligocene.
- 29 Pacific County, 15,000 feet up Hull Creek from hotel at town of Grays River, Section 6, Township 10 N., Range 7 W. Oligocene.
- 30 Sea cliff between Point Grenville and Taholah, Grays Harbor County, Section 13, Township 21 N., Range 13 W. Pliocene.
- 31 In Union Pacific Railway cut one-half mile west of Galvin, Lewis County, Section 36, Township 15 N., Range 3 W. Middle Oligocene.
- 32 In sandy shale, 2,000 feet west of the county bridge over Lincoln Creek, near Galvin Station, Lewis County. Middle Oligocene.
- 33 About 6,000 feet east of Helsing Junction, Thurston County, in embankment of Union Pacific Railway. Middle Oligocene.
- 34 On Grays River, 2 miles beyond its junction with Blaney Creek, Pacific County, Section 19, Township 11 N., Range 6 W., in a dark tuffaceous shale. Oligocene.
- 35 On Nemah River, at bridge crossing 4 miles east of Nemah Post Office, Pacific County, Section 33, Township 12 N., Range 8 W. Oligocene.
- 36 Exposure at old road trestle along Willapa River at town of Willapa, Pacific County, Section 32, Township 14 N., Range 7 W. Oligocene.

**LOCALITY NO.**

- 37 Near Northern Pacific Railway bridge below Lebam Station, Pacific County, Section 6, Township 12 N., Range 7 W. Oligocene.
- 38 Near bridge over Chehalis River at power station northwest of Pe Ell Station, Lewis County, Section 34, Township 13 N., Range 5 W. Lower Oligocene.
- 39 On west side of Chehalis River, 1 mile northwest of Pe Ell Station, Lewis County, Section 33, Township 13 N., Range 5 W. Oligocene.
- 41 In bank of small creek below Booth's house near junction with Stillwater Creek, Lewis County, Section 25, Township 11 N., Range 3 W. Cowlitz formation, upper Eocene.
- 42 In railway cut, Union Pacific Railway, 2,000 feet east of the Oakville bridge over Chehalis River, Grays Harbor County, Section 1, Township 15 N., Range 5 W. Cowlitz formation, upper Eocene.
- 43 On Delezine Creek, 16,000 feet up from the Union Pacific Railway crossing, Grays Harbor County, Section 26, Township 17 N., Range 6 W. Middle Miocene.
- 44 On Delezine Creek, 18,000 feet up from the Union Pacific Railway crossing, Grays Harbor County, Section 26, Township 17 N., Range 6 W. Middle Miocene.
- 45 On Delezine Creek, 25,000 feet up from the Union Pacific Railway crossing, Grays Harbor County, Section 33, Township 17 N., Range 6 W. Middle Oligocene.
- 46 In Union Pacific Railway cut at culvert 38 east, 24,000 feet west of South Elma, Grays Harbor County, Section 7, Township 17 N., Range 6 W. Montesano formation.
- 47 Chicago, Milwaukee & St. Paul Railway cut 1,000 feet south from Union Pacific Railway track, Grays Harbor County, Section 29, Township 17 N., Range 8 W. Middle Miocene.
- 49 On North River, Grays Harbor County, Section 25, Township 16 N., Range 8 W. Middle Miocene.
- 50 In the banks of Wynoochee River, Grays Harbor County, 35,000 feet north of Otter Post Office and 12,000 feet south of Reinken's farm, Section 22, Township 19 N., Range 8 W. Middle Miocene.
- 51 On Wynoochee River, 500 feet north of locality 50, Grays Harbor County. Middle Miocene.
- 52 In bluff on Wishkah River, northwestern part of Aberdeen, at a point where road to Grand Forks first reaches river after leaving Aberdeen, Grays Harbor County, Section 9, Township 17 N., Range 9 W. Montesano formation.
- 53 In west bank of A洛chaman River, Wahkiakum County, Section 35, Township 10 N., Range 5 W. Middle Miocene.
- 54 In west bank of A洛chaman River, 400 feet south of locality 53. Fossils abundant. Middle Miocene.

**LOCALITY NO.**

- 56 In bank of creek, Wahkiakum County, northwest quarter of Section 6, Township 9 N., Range 5 W. Middle Miocene.
- 57 In bluff on branch of Wilson Creek, Wahkiakum County, Section 36, Township 10 N., Range 6 W. Oligocene.
- 59 On Fossil Creek near log dam, Wahkiakum County, east part of Section 10 and west part of Section 11, Township 10 N., Range 6 W. Oligocene.
- 60 Bluff of Chehalis River along Union Pacific Railway track at milepost 37, about 4 miles west of South Elma, Grays Harbor County, Section 11, Township 17 N., Range 7 W. Montesano formation.
- 61 Vance logging road at old milepost, in coarse-grained sandstone, Grays Harbor County, Section 28, Township 18 N., Range 6 W. Montesano formation.
- 63 East branch of Clemons logging road, south of Montesano in Grays Harbor County, northwest quarter of Section 28, Township 17 N., Range 7 W. Middle Miocene.
- 64 East branch of Clemons logging road one-half mile east of where county road crosses, Grays Harbor County, Section 27, Township 17 N., Range 7 W. Middle Miocene.
- 65 On east branch of Clemons logging road, one-half mile east of where county road crosses, Grays Harbor County, Section 29, Township 17 N., Range 7 W. Middle Miocene.
- 66 On east branch of Clemons logging road, 1 mile west of county road intersection, Grays Harbor County, Section 29, Township 17 N., Range 7 W. Middle Miocene.
- 67 Bluff on Chehalis Logging Company road 1 mile west of Montesano, Grays Harbor County, Section 6, Township 17 N., Range 7 W. Middle Miocene.
- 68 Logging railway cut on Sylvia Creek, in a conglomerate of upper Miocene age, Grays Harbor County, Section 32, Township 18 N., Range 7 W. Base of Montesano formation.
- 69 Along logging railway in cut on Sylvia Creek, one-half mile north of locality 68, in conglomerates. Base of Montesano formation.
- 70 North branch of Wilson Creek, 500 feet north of junction of north and east forks, Wahkiakum County, Section 36, Township 10 N., Range 6 W. Oligocene.
- 71 Middle fork of Skamokawa River, about 2 miles from junction with main river, Wahkiakum County, Section 32, Township 10 N., Range 6 W. Oligocene.
- 72 On McDonald Creek, 2 miles above its junction with the middle fork of Wilson Creek, Wahkiakum County, Section 28, Township 10 N., Range 6 W. Oligocene.
- 73 Nasel River, Pacific County, northern half of Section 6, Township 10 N., Range 8 W. Oligocene.
- 74 Nasel river, Pacific County, southern half of Section 6, Township 10 N., Range 8 W. Oligocene.

## LOCALITY NO.

- 75 Nasel River, Pacific County, Section 25, Township 11 N., Range 9 W. Oligocene.
- 76 Nasel River, Pacific County, Section 6, Township 10 N., Range 8 W. Oligocene.
- 77 Nasel River, Pacific County, Section 6, Township 10 N., Range 8 W. Oligocene.
- 80 On Willapa River, 1,600 feet above first railroad bridge below Holcomb, Pacific County, Section 25, Township 13 N., Range 8 W. In Oligocene shales.
- 81 One-half mile up Green Creek from Willapa River, Pacific County, Section 26, Township 13 N., Range 8 W. Oligocene.
- 82 About 1,200 feet above highway bridge near mouth of Green Creek, Pacific County. Oligocene.
- 83 Green Creek, 7,500 feet up from Willapa River, Pacific County. Oligocene.
- 84 Green Creek, 7,750 feet from Willapa River, Pacific County. Oligocene.
- 85 Green Creek, 8,250 feet from Willapa River, Pacific County. In Oligocene shales.
- 86 Green Creek, 8,880 feet from Willapa River, Pacific County. In Oligocene shales.
- 87 Green Creek, 11,350 feet from Willapa River, Pacific County. In Oligocene shales.
- 90 In bluff, north side of Chehalis River, 2,240 feet west of Porter Station along Northern Pacific Railway track, Grays Harbor County, Section 21, Township 17 N., Range 5 W. Lower Oligocene.
- 92 On North River branch of Chicago, Milwaukee & St. Paul Railway grade, 3,000 feet north of point where road goes up Vesta Creek, near Chamber's farm, Grays Harbor County, Section 25, Township 16 N., Range 8 W. Middle Miocene.
- 94 Bluff back of Lincoln School in Hoquiam, Grays Harbor County. Poorly preserved specimens of *Anorthoscutum oregonensis*. Montesano formation.
- 96 About 28,000 feet up Falls Creek from Brooklyn, Pacific County, Section 10, Township 15 N., Range 6 W. Middle Miocene.
- 97 In a small creek entering North River just north of Grays Harbor-Pacific County line, Section 34, Township 15 N., Range 7 W. Middle Miocene.
- 98 Bluff on Willapa River, between Holcomb and the railroad bridge west of town, Pacific County, Section 36, Township 13 N., Range 8 W. Lower Oligocene.
- 99 On Wishkah River road 1 mile north of Aberdeen, Grays Harbor County, Section 4, Township 17 N., Range 9 W. Montesano formation.
- 100 In road cut on Wishkah River 1½ miles below Wishkah Post Office, Grays Harbor County, Section 11, Township 18 N., Range 9 W. Middle Miocene.
- 101 In bank of river, 1 mile beyond Wishkah Post Office, Grays Harbor County, Section 35, Township 19 N., Range 9 W. Middle Miocene.

## LOCALITY NO.

- 102 Station 837, Neah Bay-Cape Flattery traverse, in the cliffs, about one-half mile west of Koitlah Point, Clallam County. Oligocene.
- 103 At Station 996, Neah Bay-Cape Flattery traverse, in the sea cliffs about 1 mile west of Koitlah Point, Clallam County. Oligocene.
- 105 On the coastline, about 200 feet east of Slip Point Lighthouse, west of Clallam Bay, Clallam County. Middle Miocene.
- 109 On coast at base of cliff, Slip Point, east of Clallam Bay, Clallam County. Middle Miocene.
- 111 Mouth of Maxfield Creek, Clallam County, southwest quarter of northeast quarter of Section 28, Township 28 N., Range 14 W. Pliocene.
- 112 Clallam County, southeast quarter of northwest quarter of Section 16, Township 28 N., Range 14 W. Pliocene.
- 113 Clallam County, 20 feet east of line of Lot 1, Section 27, Township 28 N., Range 14 W. Pliocene.
- 114 Clallam County, northeast quarter of northwest quarter of Section 27, Township 28 N., Range 14 W. Pliocene.
- 115 In brown sandstone on Soleduck River bluff, Clallam County, about center of Section 20, Township 28 N., Range 14 W. Pliocene.
- 117 Station 161, Wishkah River traverse, in bank of river, Grays Harbor County, Section 30, Township 20 N., Range 8 W. Middle Miocene.
- 118 In bank, middle fork of Wishkah River, 300 feet south of locality 117. Middle Miocene.
- 119 Middle fork of Wishkah River, 1,200 feet south of locality 117 in bank of river. Middle Miocene.
- 120 In bank of river, middle fork of Wishkah River, 100 feet south of locality 117. Middle Miocene.
- 121 Middle branch of Wishkah River, Grays Harbor County, in east central part of Section 31, Township 20 N., Range 8 W. Middle Miocene.
- 122 Middle branch of Wishkah River, 800 feet west of locality 121. Middle Miocene.
- 123 Middle branch of Wishkah River, Grays Harbor County, south central part of Section 36, Township 20 N., Range 9 W. Middle Miocene.
- 124 Middle branch of Wishkah River, 1,000 feet southwest of locality 123. Middle Miocene.
- 125 Middle branch of Wishkah River, Grays Harbor County, southwest quarter of Section 1, Township 19 N., Range 9 W. Middle Miocene.
- 126 On road to Copalis, 1½ miles north of Hoquiam, in a cut on west side of road, Grays Harbor County, Section 34, Township 18 N., Range 10 W. Montesano formation.

**LOCALITY NO.**

- 128 On North River branch of Chicago, Milwaukee & St. Paul Railway, Grays Harbor County, Section 29, Township 17 N., Range 8 W. Middle Miocene.
- 129 In south bank of south fork of Stillaguamish River, Snohomish County, Section 11, Township 30 N., Range 6 E. Oligocene.
- 130 On west bank of Wilson Creek, 1 mile west of Willapa Post Office, Pacific County, Section 21, Township 14 N., Range 8 W. Middle Miocene.
- 131 Logging railroad cut 1 mile west of Montesano, Grays Harbor County, Section 1, Township 17 N., Range 8 W. Middle Miocene.
- 132 North River branch of Chicago, Milwaukee & St. Paul Railway, 300 feet south and up hill from culvert 38 of Union Pacific Railway track, Grays Harbor County, Section 29, Township 17 N., Range 8 W. Middle Miocene.
- 133 North River branch of Chicago, Milwaukee & St. Paul Railway, 200 feet to the southwest of locality 132. Middle Miocene.
- 135 Railway cut on North River branch of Chicago, Milwaukee & St. Paul Railway, Grays Harbor County, northeast quarter of northwest quarter of Section 29, Township 17 N., Range 8 W. Middle Miocene.
- 136 Railroad cut 300 feet west of locality 135. Middle Miocene.
- 137 Bluff in road along east side of Wynoochee River 1 mile south of Bitter Creek, Grays Harbor County, Section 35, Township 18 N., Range 8 W. Middle Miocene.
- 138 In bank of Wynoochee River, along road 600 feet north of locality 137. Middle Miocene.
- 140 Cut in south side of "Think of Me" Hill in East Aberdeen, Grays Harbor County. Montesano formation.
- 141 Northern Pacific Railway cut 3,000 feet east of locality 140, Aberdeen, Grays Harbor County. Montesano formation.
- 142 Northern Pacific Railway cut, 270 feet east of locality 141, Aberdeen. Montesano formation.
- 144 Stratum 20 feet stratigraphically above that at locality 142, in the Northern Pacific Railway cut east of Aberdeen. Montesano formation.
- 145 In cut at Aberdeen, Grays Harbor County, at corner Summit and Chehalis streets. Montesano formation.
- 146 On Chicago, Milwaukee & St. Paul Railway at Cosmopolis, Grays Harbor County, Section 23, Township 17 N., Range 9 W. Montesano formation.
- 147 Railroad cut on Chicago, Milwaukee & St. Paul Railway track 400 feet east of locality 146. Montesano formation.
- 148 Ocean bluff 1 mile north of Point Grenville, Grays Harbor County, Section 13, Township 21 N., Range 13 W. Pliocene

**LOCALITY NO.**

- 151 Log dam number 35 on the west fork of Wishkah River, Grays Harbor County, Section 35, Township 20 N., Range 9 W. Middle Miocene.
- 152 In canyon of west branch of Wishkah River, 100 feet south of locality 151. Middle Miocene.
- 154 North side of Restoration Point, Kitsap County. Upper Oligocene.
- 155 Small creek emptying into Coal Creek, King County, Section 23, Township 24 N., Range 5 E. Upper Oligocene.
- 156 About 1 mile west of Lake Sammamish, King County, southeast quarter, Section 13, Township 24 N., Range 5 E. Upper Oligocene.
- 157 About 1 mile east of locality 156, Section 14, Township 24 N., Range 5 E. Oligocene.
- 158 One-fourth mile north of Woodman's Station on shore of Port Discovery Bay, Jefferson County, Section 5, Township 29 N., Range 1 W. Lower Oligocene.
- 159 On east shore of Port Discovery Bay, 300 feet north of locality 158. Lower Oligocene.
- 160 Bluff at Porter Station, in Northern Pacific Railroad cut, Grays Harbor County, Section 22, Township 17 N., Range 4 W. Middle Oligocene.
- 161 In wagon-road cut one-half mile east of Porter, Grays Harbor County, Section 27, Township 17 N., Range 4 W. Middle Oligocene.
- 162 On western shore, Port Townsend Bay, Jefferson County, Section 36, Township 30 N., Range 1 W. Oligocene.
- 163 On western shore, Port Townsend Bay, 200 feet north of locality 162, Jefferson County, Section 36, Township 30 N., Range 1 W. Oligocene.
- 164 At Restoration Point, Kitsap County. Upper Oligocene.
- 165 Oak Bay, on western shore just south of the ship canal spit, Jefferson County, Section 7, Township 29 N., Range 1 E. Oligocene.
- 166 In Northern Pacific Railway cut, 600 feet west of Porter Station, Grays Harbor County, Section 22, Township 17 N., Range 5 W. Middle Oligocene.
- 167 Road cut on Wilson Creek, Pacific County, Section 21, Township 14 N., Range 8 W. Oligocene.
- 168 Old embankment along Willapa River at trestle one-half mile south of Willapa Post Office, Section 27, Township 14 N., Range 8 W., Pacific County. Oligocene.
- 169 Oakville quarry, in sandstone overlying basalt, 1 mile west of Oakville, on Northern Pacific track, Grays Harbor County, Section 19, Township 16 N., Range 4 W. Lower Oligocene.
- 170 Half Moon Creek, Pacific County, Section 34, Township 13 N., Range 7 W. Oligocene.

## LOCALITY NO.

- 172 Street cut, Columbia City, Seattle, at 50th Avenue South and 1½ blocks south of Ferdinand Street. Oligocene.
- 173 Street grade, Columbia City, Seattle, corner 42nd Street and Juneau Street. Oligocene.
- 174 Bank of small stream entering Satsop River from west, Grays Harbor County, Section 23, Township 18 N., Range 7 W. Montesano formation.
- 175 Bank of small stream entering Satsop River from west, Grays Harbor County, Section 23, Township 18 N., Range 7 W. Montesano formation.
- 176 Bank of small stream entering Satsop River from west, Grays Harbor County, Section 23, Township 18 N., Range 7 W. Montesano formation.
- 177 Ocean cliff south of Hoh River, Jefferson County, Section 32, Township 26 N., Range 13 W. Middle Miocene.
- 178 Bluff along south shore of Strait of Juan de Fuca, 1½ miles west of Twin Post Office, Clallam County, Section 22, Township 31 N., Range 10 W. Oligocene.
- 179 About 1,000 feet west of mouth of West Twin River, Clallam County, Section 22, Township 31 N., Range 10 W. Oligocene.
- 180 Oak Bay, Jefferson County, in cliff in north half of Section 18, Township 20 N., Range 1 E. Oligocene.
- 181 Cape Elizabeth, Grays Harbor County, Section 34, Township 21 N., Range 13 W. Pliocene.
- 182 About 600 feet south of keyhole at Cape Elizabeth, Grays Harbor County. Pliocene.
- 185 About 1¼ miles north of Point Grenville, Grays Harbor County, Section 25, Township 21 N., Range 13 W. Pliocene.
- 187 Cut along street car track in north end of Columbia City, Seattle. Upper Oligocene.
- 188 King coal mine north of Issaquah, King County, Section 22, Township 24 N., Range 7 W. Lower Oligocene.
- 189 Conglomerate bank along Sylvia Creek, Grays Harbor County, Section 32, Township 18 N., Range 7 W. Montesano formation.
- 192 Columbia City, Seattle, from hill 6 blocks west of City Hall. Upper Oligocene.
- 193 Bluff, north side of mouth of Raft River, Grays Harbor County, Section 21, Township 23 N., Range 13 W. Middle Miocene.
- 194 At culvert 38, in bluff along Union Pacific Railway track, 14 miles west of South Montesano, Grays Harbor County. Montesano formation.
- 195 Pacific County, Section 25, Township 10 N., Range 9 W. Oligocene.
- 196 In bank of a creek 2 miles west of Winlock, Lewis County, Section 20, Township 12 N., Range 2 W. Oligocene.

## LOCALITY NO.

- 197 Three-fourths mile north of Point Grenville, Grays Harbor County. Pliocene.
- 199 Cut in left hand branch of Clemons logging road, three-fourths mile west of road intersection, Grays Harbor County, Section 20, Township 17 N., Range 7 W. Middle Miocene.
- 200 Cut in Northern Pacific Railway 1 mile east of railroad bridge over Wishkah River at Aberdeen, Grays Harbor County. Montesano formation.
- 201 In cliffs along ocean, 1½ miles north of Point Grenville, Grays Harbor County. Pliocene.
- 202 In cliffs along ocean 1¾ miles north of Point Grenville, Grays Harbor County. Pliocene.
- 203 In cut of Northern Pacific Railway 500 feet west of railway station at Porter, Grays Harbor County. Middle Oligocene.
- 204 Cliff along shore line, north of Cape Elizabeth, Grays Harbor County, northwest quarter, Section 15, Township 22 N., Range 13 W. Pliocene.
- 205 North of Cape Elizabeth, Grays Harbor County, east central portion of Section 9, Township 22 N., Range 13 W. Pliocene.
- 206 Exposure on Germany Creek, Cowlitz County, Section 12, Township 9 N., Range 4 W. Middle Miocene.
- 207 Cut in bank at Olympia Foundry, South Seattle, in a bluff along east side of Duwamish Valley, King County, north half of Section 20, Township 24 N., Range 4 E. Oligocene.
- 209 Bluff in main branch of Wishkah River, Grays Harbor County, Section 27, Township 19 N., Range 9 W. Montesano formation.
- 210 At Slip Point, south shore of Strait of San Juan de Fuca, one mile northeast of Clallam Bay.
- 215 In cut on North River branch of Chicago, Milwaukee & St. Paul Railway, Grays Harbor County, Section 29, Township 17 N., Range 8 W. Middle Miocene.
- 218 Denny-Renton mine number 2, at Taylor, King County, second level, Section 3, Township 22 N., Range 7 E. In brackish water phase of upper Eocene. Puget Group.
- 219 Denny-Renton Coal mine number 6, at Taylor, King County, Section 3, Township 22 N., Range 7 E. In brackish water phase of upper Eocene. Puget Group.
- 220 In a small creek one-half mile east of Duwamish, at a point where a well has been sunk, King County. Cowlitz formation, upper Eocene.
- 221 Fossil ledge above Franklin bridge in Green River, King County, Section 10, Township 21 N., Range 7 E. Brackish water of upper Eocene. Puget Group.
- 222 Cut in Northern Pacific Railway track, 1 mile south of Duwamish Station, King County, Section 14, Township 23 N., Range 4 E. Brackish water Eocene. Cowlitz formation.

**LOCALITY NO.**

- 224 In coarse-grained cross-bedded sandstone, logging road cut, Grays Harbor County, Section 5, Township 18 N., Range 6 W. Upper Miocene. Montesano formation.
- 226 About 1 mile up Olequa Creek above Winlock, Lewis County, Section 29, Township 12 N., Range 2 W. Oligocene.
- 228 Railroad cuts 1 mile north of Cathcart Station, along Northern Pacific Railway, Snohomish County, Section 31, Township 28 N., Range 9 E. Middle Oligocene.
- 229 In cuts along road and Wynoochee River bank, 1 mile south of junction with Bitter Creek, Grays Harbor County, Section 35, Township 18 N., Range 8 W. Middle Miocene. Collection of August, 1913.
- 230 A cut in the North River branch of Chicago, Milwaukee & St. Paul Railway about 2 miles beyond its junction with the Union Pacific Railway, Grays Harbor County, Section 27, Township 17 N., R. 8 W. Collected July, 1913. Middle Miocene.
- 231 Olequa Creek, about three-fourths mile north of Vader, just south of big bend in creek. A thin layer of fossils. Lewis County, Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 232 West bank and cliff of Cowlitz River, 1,000 feet below bend and below locality 233, Cowlitz County, Section 28, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 233 West bank and cliff of Cowlitz River at bend, Cowlitz County, Section 28, Township 11 N., Range 2 W. Fossils in an excellent state of preservation. Cowlitz formation, upper Eocene.
- 234 A thin layer of sandstone in Olequa Creek about three-fourths mile north of Vader, just south of big bend in creek, Lewis County, Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 235 West bank of the mill pond of the O'Connell Lumber Company up Olequa Creek, one-half mile above depot at Winlock, Lewis County, Section 28, Township 12 N., Range 2 W. Occurs in residual patches. Oligocene.
- 236 Stillwater Creek, Lewis County, 2,200 feet above its junction with Olequa Creek, Section 30, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 237 Olequa Creek, one-fourth mile above Vader Station, in east bank of creek just north of point where small creek enters Olequa Creek from the east, Lewis County, Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 238 On Olequa Creek, three-fourths of a mile north of Vader, in bend just north of anticlinal axis, about 500 feet south of locality 231. Lewis County, Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 239 On east side of Cowlitz River three-fourths of a mile above ferry near Gries Ranch, Cowlitz County, northeast quarter of Section 25, Township 11 N., Range 2 W. Lower Oligocene.
- 240 East bank of Olequa Creek about one-third mile below its junction with Stillwater Creek, just below the Northern Pacific Railroad bridge, Lewis County, Section 32, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.

## LOCALITY NO.

- 241 In bank of Stillwater Creek about 1½ miles above junction with Olequa Creek, Lewis County, Section 30, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 242 Between localities 233 and 232, in bank of Cowlitz River, Cowlitz County, Section 28, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 243 Coal Creek, at the main camp of the Inman-Poulsen Logging Company, on the north bank of the creek immediately back of the Y. M. C. A. shack. There is a 10-foot bank composed in large part of massed and broken shells, Cowlitz County, Section 27, Township 9 N., Range 3 W. Cowlitz formation, upper Eocene.
- 244 Bank of Coal Creek, about one-half mile below Inman-Poulsen Company's store. Oysters. Cowlitz County, near center of Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 245 In bank of Coal Creek, Cowlitz County, about one-fourth mile downstream from Inman-Poulsen Company's store. An oyster bed about 12 inches thick. In northeast corner of Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 246 East bank of Coal Creek, about one-fourth mile below school house in a small sandy ledge at foot of cliff, Cowlitz County, Section 35, Township 9 N., Range 3 W., near center of section. Cowlitz formation, upper Eocene.
- 247 Coal Creek, Cowlitz County, about 1½ miles below Inman-Poulsen Company's store, at the old dam in the extreme southwest quarter of Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 248 East bank of Coal Creek, Cowlitz County, about 1¼ miles downstream from Inman-Poulsen Logging Company's store, southeast quarter of southeast quarter of Section 10, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 249 East of Coal Creek, Cowlitz County, about 1¼ miles below Inman-Poulsen Logging Company's store, on the west bank of the creek and opposite locality 248. Mostly oysters. Section 10, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 250 Alochaman River, Wahkiakum County, about one-half mile above the forks on the east branch. A small ledge at the water's edge, at the foot of a 30-foot cliff. Near boundary line between Sections 24 and 25, Township 10 N., Range 5 W. Middle Miocene.
- 251 Alochaman River, on the Clinton Olmstead homestead, Wahkiakum County, near the center of the southeast quarter of Section 26, Township 10 N., Range 5 W. Middle Miocene.
- 255 In railroad cut on the Union Pacific Railway one-fourth mile north of Galvin Station, Section 26, Township 15 N., Range 3 W. Middle Oligocene.
- 256 In railroad cut on Union Pacific Railway 1 mile north of Galvin Station, Lewis County, Section 27, Township 15 N., Range 3 W. Middle Oligocene.
- 257 North bank of Columbia River, 200 feet west of the mouth of Sisson Creek, Wahkiakum County, Section 6, Township 9 N., Range 8 W. Middle Miocene.

**LOCALITY NO.**

- 258 In sea cliff one-half mile west of Twin Post Office, Clallam County, Section 27, Township 31 N., Range 9 W. Oligocene.
- 259 In sea cliff 2 miles west of Gettysburg, Clallam County, northwest quarter Section 29, Township 31 N., Range 9 W. Oligocene.
- 261 Cliff on north shore of Columbia River about one-half mile east of Knappton, Pacific County. Fossils occur in nodules. Section 9, Township 9 N., Range 9 W. Oligocene.
- 262 About 1½ miles west of Galvin Station in bluff along Union Pacific Railway, Lewis County, Section 26, Township 14 N., Range 3 W. Oligocene.
- 263 Bluffs along bank of Cowlitz River, Cowlitz County, Section 28, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 264 Bluff on south side of Bear River, Pacific County, on line between Sections 20 and 21, Township 10 N., Range 10 W. Oligocene.
- 265 Bluff on east side of Shoalwater Bay, Pacific County, Section 29, Township 11 N., Range 10 W. Oligocene.
- 267 East shore of Port Discovery Bay, Jefferson County, Section 5, Township 29 N., Range 1 W. Oligocene.
- 268 South shore, Strait of Juan de Fuca, about 3 miles west of Pillar Point, Clallam County, Section 32, Township 31 N., Range 12 W. Middle Miocene.
- 269 Shore of Strait of Juan de Fuca, 1½ miles west of the coal mine, Clallam County, Section 23, Township 32 N., Range 12 W. Middle Miocene.
- 270 Cliff, south shore of Strait of Juan de Fuca, Clallam County, Section 21, Township 32 N., Range 12 W. Middle Miocene.
- 271 Cliff, south shore of Strait of Juan de Fuca, about 1,000 feet west of locality 258, Clallam County, Section 22, Township 31 N., Range 9 W. Oligocene.
- 272 Cliff, south shore of Strait of Juan de Fuca, about 1 mile west of locality 259, Clallam County, Section 19, Township 31 N., Range 9 W. Oligocene.
- 273 Cliff, south shore of Strait of Juan de Fuca, one-half mile east of east fork of Twin River and just east of rock bluff, Clallam County, Section 24, Township 31 N., Range 10 W. Oligocene.
- 274 Cliff, south shore of Strait of Juan de Fuca, Clallam County, Section 21, Township 31 N., Range 10 W. Oligocene.
- 276 Old Washington Geological Survey Collection of 1902 from Cowlitz County, Section 11, Township 9 N., Range 2 E. Cowlitz formation, upper Eocene.
- 277 Old Washington Geological Survey Collection of 1902 from Cowlitz County, Section 25, Township 9 N., Range 2 W. The Pecten locality east of Castle Rock. Cowlitz formation, upper Eocene.

## LOCALITY NO.

- 278 Old Washington Geological Survey Collection of 1902 from Cowlitz County, Section 13, Township 9 N., Range 2 W. Cowlitz formation, upper Eocene.
- 279 Old Washington Geological Survey Collection of 1902 from Cowlitz County, on Arkansas Creek, 3 miles west of Castle Rock. *Pecten braniceri* is common. Cowlitz formation, upper Eocene.
- 280 Old Washington Geological Survey Collection of 1902 from Lewis County, in hill at Chehalis one-half mile southeast of hotel. Cowlitz formation, upper Eocene.
- 281 Old Washington Geological Survey Collection of 1902, Lewis County, Olequa Creek, 1 mile up creek from Winlock. Middle Oligocene.
- 282 Old Washington Geological Survey Collection of 1902, Cowlitz County, 12 miles west of Kelso. Cowlitz formation, upper Eocene.
- 283 Old Washington Geological Survey Collection of 1902, Cowlitz County, 12 miles west of Kelso. Cowlitz formation, upper Eocene.
- 285 About 1 mile west of Oakville, Grays Harbor County, Section 19, Township 16 N., Range 4 W. Oligocene.
- 288 From falls on Scantigrease Creek, near Castle Rock, Cowlitz County, southeast quarter of Section 18, Township 9 N., Range 2 W. Cowlitz formation, upper Eocene.
- 289 Near an old coal prospect, Cowlitz County, Section 31, Township 10 N., Range 2 W. Cowlitz formation, upper Eocene.
- 290 Near *Pecten* locality, Cowlitz County, Section 24, Township 9 N., Range 2 W. Cowlitz formation, upper Eocene.
- 291 Near Winlock, Lewis County, Section 28, in bluff of Olequa Creek west from mill pond, near junction of west branch of Olequa Creek. Oligocene.
- 292 West branch of Olequa Creek, one-half mile above junction of main creek. Oligocene.
- 293 North end of big slide on Northern Pacific Railway cut one-half mile north of Tenino, Thurston County, Section 17, Township 16 N., Range 1 W. Cowlitz formation, upper Eocene.
- 294 McClarity Ranch on south bank of Stillwater Creek, 1 mile west of Vader, Lewis County, Section 30, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 295 In bed of Olequa Creek at milepost 73 on Northern Pacific Railway, 1½ miles north of Vader, Lewis County, Section 20, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 296 On Booth Ranch, 2¼ miles up Stillwater Creek from junction with Olequa Creek, Section 24, Township 11 N., Range 3 W. Cowlitz formation, upper Eocene.
- 297 On Olequa Creek, one-eighth mile north of railway station at Vader, Lewis County, Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.

**LOCALITY NO.**

- 298 Three-fourths mile west of Vader on Stillwater Creek, Lewis County, Section 30, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 299 Rock bluff in Northern Pacific Railway cut, 2,850 feet south of milepost 76 and three-fourths mile north of Olequa railway station, Lewis County, Section 4, Township 10 N., Range 2 W. Cowlitz formation, upper Eocene.
- 300 Bank of Olequa Creek, at the old Cantwell place north of Vader, Lewis County, Section 20, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 304 The west end of rock island west of Point Glover quarry near entrance to Bremer-ton Inlet, Kitsap County, Section 8, Township 24 N., Range 2 E. Middle Oligocene.
- 305 At Bean Point, south end of Bainbridge Island, Kitsap County, Section 14, Township 24 N., Range 2 E. Middle Oligocene.
- 315 On the west bank of Olequa Creek, at dam just below the railroad bridge, about one-third mile below the junction with Stillwater Creek, near Vader, Lewis County, Section 32, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 316 On the east bank of Olequa Creek, at dam just below the railroad bridge, about one-third of a mile below the junction with Stillwater Creek, near Vader, Lewis County, opposite locality 315, Section 32, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 317 On the south bank of Stillwater Creek at its junction with Olequa Creek, near Vader, Lewis County, Section 32, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 318 On the north bank of Stillwater Creek at its junction with Olequa Creek, opposite locality 317, near Vader, Lewis County, Section 32, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 319 At McClarity Ranch on the south bank of Stillwater Creek, 1 mile west of Vader, Lewis County, Section 30, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 320 On the south bank of Stillwater Creek, below the graveyard, about  $1\frac{1}{4}$  miles from Vader, Lewis County, Section 30, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 321 On Booth Ranch  $2\frac{1}{4}$  miles up Stillwater Creek from its junction with Olequa Creek, near Vader, Lewis County, Section 25, Township 11 N., Range 3 W. Cowlitz formation, upper Eocene.
- 322 Under an old bridge, on small creek, about one-third mile from its junction with Brinn Creek, Lewis County, Section 24, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 323 In bed of small creek entering Olequa Creek on the east, opposite locality 324, Lewis County, Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.

**LOCALITY NO.**

- 324 In west bank of Olequa Creek, about one-eighth mile north of Vader Station, Lewis County, Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 325 On Olequa Creek, one-fourth mile above Vader Station, in the east bank of creek, just north of point where the small creek enters Olequa Creek on the east, Lewis County, Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 326 Bluff on west bank of Olequa Creek, about 500 feet below the little falls back of Armstrong place about one-half mile north of Vader, Lewis County, Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 327 East bank of Olequa Creek back of Cantwell place, about 1 mile north of Vader, Lewis County, Section 20, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 328 East bank of Olequa Creek about 1½ miles north of Vader, where creek runs near railroad track. Seam of brackish water fossils. Lewis County, Section 20, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 329 West bank of Cowlitz River at, and extending several hundred feet below, the bend in the river, near Vader, Lewis County, Section 28, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 330 On the east bank of Cowlitz River, about 1 mile above the ferry, on Gries Ranch, 4 miles east of Vader, Lewis County, Section 25, Township 11 N., Range 2 W. Lower Oligocene.
- 331 In railroad bluff about 1½ miles south of Vader, about 700 feet below railroad post No. 79, Lewis County, Section 4, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 332 Bluffs along Stillwater Creek about one-half mile above the junction of Olequa and Stillwater creeks, near Vader, Lewis County, Section 30, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 333 A thin layer on Stillwater Creek about three-fourths mile above its junction with Olequa Creek, near Vader, Lewis County, Section 30, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 334 On Cowlitz River, about three-fourths mile below Olequa Station and about 800 feet below post No. 81, where path leads down the bank to the river, Lewis County, Section 4, Township 10 N., Range 2 W. Cowlitz formation, upper Eocene.
- 335 At old dam, about three-fourths mile above the junction of Mosquito and Coal creeks, Cowlitz County, Section 10, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 336 About one-fourth mile above the old dam on Coal Creek, Cowlitz County. Brackish water shells and fossil leaves found in high water bed across from high bluffs. Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.

## LOCALITY NO.

- 337 About one-half mile above old dam, on west bank of Coal Creek, Cowlitz County; fossil seam in high bank. Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 338 About 400 feet below locality 339, on Coal Creek, Cowlitz County, Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 339 About one-fourth mile below Inman-Poulsen shops, at bend in creek about 200 feet below high bluff where railroad is visible, Coal Creek, Cowlitz County. Large oyster bed. Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 340 About 200 feet below railroad trestle on east bank of Coal Creek, Cowlitz County. Oyster beds. Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 341 At Inman-Poulsen shops (old Inman-Poulsen store) about 2½ miles up Coal Creek from Solo, Cowlitz County, Section 2, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 342 About one-fourth mile above Inman-Poulsen shops on Coal Creek, Cowlitz County, Section 2, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 343 On west bank of Coal Creek at Inman-Poulsen shops, about one-half mile above the spot where small creek enters on the east, Cowlitz County, Section 2, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 344 On Coal Creek, at falls about one-fourth mile above road bridge, Cowlitz County, Section 35, Township 9 N., Range 3 W. Cowlitz formation, upper Eocene.
- 345 On Coal Creek, at large falls about one-half mile below the schoolhouse, Cowlitz County, Section 35, Township 9 N., Range 3 W. Cowlitz formation, upper Eocene.
- 346 At small falls just below bridge at schoolhouse settlement on Coal Creek, Cowlitz County, Section 35, Township 9 N., Range 3 W. Cowlitz formation, upper Eocene.
- 347 Back of old Leybo place, about one-half mile below old Inman-Poulsen camp, on Coal Creek, Cowlitz County, Section 27, Township 9 N., Range 3 W. Cowlitz formation, upper Eocene.
- 348 On Coal Creek just above old Leybo place, about one-half mile above the foot bridge, Cowlitz County, Section 27, Township 9 N., Range 3 W. Cowlitz formation, upper Eocene.
- 349 At old Inman-Poulsen camp, about 6 or 6½ miles up Coal Creek, just above where small creek enters on the east side. Cowlitz County, Section 27, Township 9 N., Range 3 W. Cowlitz formation, upper Eocene.
- 350 On Coal Creek, about one-fourth mile below the old Inman-Poulsen camp, Cowlitz County, Section 27, Township 9 N., Range 3 W. Cowlitz formation, upper Eocene.

## LOCALITY NO.

- 351 On the east bank of Cowlitz River, about one-fourth mile below Gries Ranch; small seam in the river bed, Lewis County, Section 26, Township 11 N., Range 2 W. Lower Oligocene.
- 352 In railroad cut on Union Pacific Railway, 1 mile north of Galvin Station, Lewis County, Section 27, Township 15 N., Range 3 W. Middle Oligocene.
- 353 From boulders not in place, 1 mile south of Quilcene on west shore of bay, Jefferson County, Section 24, Township 27 N., Range 2 W. Upper Eocene.
- 354 About one-half mile north of Centralia on the Northern Pacific Railway, Lewis County, Section 4, Township 14 N., Range 2 W. Cowlitz formation, upper Eocene.
- 355 From cliffs about 1 mile north of Point Grenville, north of Moclips, Grays Harbor County, Section 13, Township 21 N., Range 13 W. Pliocene.
- 356 From cuts on grade of Willapa Harbor branch of Milwaukee Railway at Sudbury, 15 miles east of Raymond at Summit, and 4 miles east of P. and E. junction, Pacific County. Middle Miocene.
- 357 From cuts in grade of Willapa branch of Milwaukee Railway, about 2 miles east of P. and E. junction, 13 miles east of Raymond, Pacific County. Middle Miocene.
- 358 At Joyce Station, one-fourth mile east of Tongue Point, Port Crescent, Clallam County, Section 22, Township 31 N., Range 8 W. Middle Eocene.
- 359 In road cut just east of Porter, Grays Harbor County, Section 27, Township 17 N., Range 4 W. Middle Oligocene.
- 360 From bluffs at Porter Station in Northern Pacific Railway cuts, Grays Harbor County, Section 22, Township 17 N., Range 4 W. Middle Oligocene.
- 361 Exposure on east bank of Porter Creek just above where road crosses creek at the town of Porter, Grays Harbor County, Section 27, Township 17 N., Range 5 W. Middle Oligocene.
- 362 Exposure about 1 mile up Porter Creek from station, on east bank just above the bridge, Grays Harbor County, Section 22, Township 17 N., Range 5 W. Middle Oligocene.
- 363 Exposure on Porter Creek,  $1\frac{1}{2}$  miles from Porter Station, Grays Harbor County, Section 22, Township 17 N., Range 5 W. Middle Oligocene.
- 364 Exposure at old dam about 3 miles up Porter Creek from station, Grays Harbor County, Section 14, Township 17 N., Range 5 W. Lower Oligocene.
- 365 Bluff on west bank of Porter Creek about  $3\frac{1}{2}$  miles up Porter Creek from station, Grays Harbor County, Section 22, Township 17 N., Range 5 W. Lower Oligocene.

**LOCALITY NO.**

- 366 At contact between the Oligocene sediments and Eocene basalt, 4½ miles up Porter Creek, Grays Harbor County, Section 14, Township 17 N., Range 5 W. Lower Oligocene.
- 367 On Gibson Creek, a few hundred feet above where the creek crosses the Northern Pacific Railway, about 3 miles southeast of Porter, Grays Harbor County, Section 2, Township 16 N., Range 5 W. Oligocene.
- 368 At German's place, Castle Rock, Cowlitz County, Section 24, Township 9 N., Range 2 W. Cowlitz formation, upper Eocene.
- 369 Head of Arkansas Creek, Cowlitz County, Section 24, Township 10 N., Range 3 W. Cowlitz formation, upper Eocene.
- 370 At Scantigrease Falls, Cowlitz County, Section 18, Township 9 N., Range 2 W. Cowlitz formation, upper Eocene.
- 371 Old locality 26, collection of 1902; Cowlitz County, below the Pecten locality 277. Cowlitz formation, upper Eocene.
- 372 Old locality 10, collection of 1902; on Coal Creek in Cowlitz County 12 miles west of Kelso. Probably same as locality 349. Cowlitz formation, upper Eocene.
- 375 Oregon. Old K. V. W. Collection locality 2; on Rogers' place, Benton County, Oregon, northwest of Bell Fountain Pen Co., Section 27, Township 13 S., Range 6 W. Eocene?
- 376 Oregon. Old K. V. W. Collection locality 31; in old quarry, about 1½ miles northwest of Albany, Linn County, just off main road from North Albany station. Plant remains. Eocene?
- 377 Oregon. Old K. V. W. Collection locality 1; in an old quarry on Cobb place; in gulch behind house about 1½ miles northwest of Albany Lumber Company, Linn County. This is the old Judge Thornton place locality. Specimens 1, 7, 207, 214, 219, Condon collection, Univ. of Oregon.
- 378 Oregon. Old K. V. W. Collection locality 9; about one-half mile above the bridge on the Nehalem River just above Grand Rapids, half-way between Jewell and Elsie, Clatsop County. This locality is near the old Mishawaka Ford, as reported by Diller.
- 379 Oregon. Old K. V. W. Collection locality 23; about 2½ miles south of Sumner, Coos County, on the old Coquille Road, about 1¼ miles below the summit of the long, high hill. U. S. Nat. Museum locality 2,984 and 2,994.
- 380 Oregon. Old K. V. W. Collection locality 20; on Squaw Island, Coos County, between Sunset Bay and Cape Arago Lighthouse. Eocene.
- 381 Oregon. Old K. V. W. Collection locality 32; Cretaceous locality. Rocky Point, about 2 miles below Port Orford, Curry County.
- 382 Oregon. Old K. V. W. Collection locality 18; on Four Mile Creek under old bridge, at Sam Smith's old place, now Delong place, Coos County, Section 4, Township 30 S., Range 14 W. U. S. Nat. Museum locality 3,026 and 2,995.

## LOCALITY NO.

- 383 Oregon. Old K. V. W. Collection locality 3; in an old quarry on hill just south of golf links, at the Country Club, about 2 miles southwest of Corvallis, Benton County.
- 384 Oregon. Old K. V. W. Collection locality 19: about one-fourth mile below summit on the main road to Marshfield from Bandon; north of Five Mile Creek, about 1 mile up the road from Sacchi Ranch at mouth of Five Mile Creek, Coos County. Stanford University locality No. 40.
- 385 Oregon. Old K. V. W. Collection locality 33; Riverton Mine at Riverton, Coos Bay. Material from dumps taken from 300 feet below surface.
- 386 Oregon. Old K. V. W. Collection locality 25. About one-fourth mile below Riverton, Coos County. In river bank just below where coal seam outcrops in road.
- 387 Oregon. Old K. V. W. Collection locality 26. On Rink Creek about 2 miles southeast of Coquille, Coos County. Several miles up the creek from main road beyond old logging works. U. S. Nat. Museum locality 2,992.
- 388 Oregon. Old K. V. W. Collection locality 17. About 250 yards below Rasser's old mill, on small creek, about 2½ miles southeast of Bandon, Coos County. In a swamp.
- 389 Oregon. Old K. V. W. Collection locality 15. Three miles below Peel, several hundred yards below the bridge in the west bank of Little River, Douglas County.
- 390 Oregon. Old K. V. W. Collection locality 12. Just above mouth of Little River and the North Umpqua River on east bank of Little River, under and above bridge that crosses Little River, Douglas County, Section 19, Township 26 S., Range 3 W. Cal. Acad. Sci. locality 24. Stanford Univ. locality 99. A dark shale overlies sandstone and contains a fauna.
- 391 Oregon. Old K. V. W. Collection locality 16. About 200 yards above the swinging bridge over Little River, in the west bank about a mile above the junction of Little River and north fork of the Umpqua, Douglas County.
- 392 Oregon. Old K. V. W. Collection locality 14. About 7 miles above Peel on the east bank of Little River, about one-fourth mile below Bond place, Section 11, Township 27 S., Range 3 W. Douglas County.
- 393 Oregon. Old K. V. W. Collection locality 13; on east bank at bend of North Umpqua River just above Glade, Douglas County, Section 18, Township 26 S., Range 3 W. Cal. Acad. Sci. locality 24. Stanford Univ. locality 99.
- 402 Calif. A-20. Tuffaceous sandstone overlying basalt on the Clemons logging railway at spur A-21, 1 mile south of camp 5 (headquarters), in Grays Harbor County, Section 9, Township 16 N., Range 6 W. Basal Porter of the Lincoln formation, middle Oligocene.
- 403 Calif. 9,001. On the Clemons logging road 2 miles south of Saginaw trail and one-fourth mile south of camp 5 (headquarters), Grays Harbor County, Section 9, Township 16 N., Range 6 W. Sandy phase of the Lincoln formation, middle Oligocene.

**LOCALITY NO.**

- 404 Calif. 9,003. Clemons logging road, about 1,000 feet northwest of Saginaw trail. One of a series of cuts on the Delezine side of the divide between Delezine and Workman creeks, Grays Harbor County, northwest quarter of Section 6, Township 16 N., Range 6 W. Lincoln formation, middle Oligocene.
- 405 Calif. 9,005. Clemons logging road about 2,200 feet northwest of Saginaw trail. One of a series of cuts on the Delezine side of the divide between Delezine and Workman creeks. Northwest of locality 404, Grays Harbor County, northwest quarter of Section 6, Township 16 N., Range 6 W. Lincoln formation, middle Oligocene.
- 406 Calif. 9,013. Clemons logging road, about 3,000 feet northwest of Saginaw trail. A large cut through the divide between Delezine Creek and Workman Creek. Northwest of locality 405. Grays Harbor County, southeast quarter of Section 36, Township 17 N., Range 7 W. Lincoln formation, middle Oligocene.
- 407 Calif. 9,004. Clemons logging road, about 4,600 feet northwest of Saginaw trail at siding near the 10-mile post. Northwest of locality 406. Grays Harbor County, Section 36, Township 17 N., Range 7 W. Lincoln formation, middle Oligocene.
- 408 Calif. 9,010. Clemons logging road, about 6,200 feet northwest of the Saginaw trail in a small cut on the west side of the tracks at the old siding on the main line, about one-eighth mile south of the contact between the Lincoln and Astoria formations. Northwest of locality 407. Grays Harbor County, northeast quarter of Section 36, Township 17 N., Range 7 W. Lincoln(?) formation, middle Oligocene.
- 409 Calif. 9,026. Clemons logging road, 6,600 feet northwest of the Saginaw trail in the first large cut in the Astoria sandstone just above the contact with the Oligocene; about one-fourth mile northwest of locality 408 and 100 feet south of locality 410. Glycymeris Zone of the Astoria formation. Grays Harbor County, Section 35, Township 17 N., Range 7 W.
- 410 Calif. 9,025. Clemons logging road about 100 feet northwest of the Saginaw trail and 200 feet south of the 9-mile post, Grays Harbor County, northeast quarter of Section 35, Township 17 N., Range 7 W. Astoria formation.
- 411 Calif. A-362. Clemons logging road about 150 feet above locality 410. Mostly wood fragments. Grays Harbor County, Section 26, Township 17 N., Range 7 W. Astoria formation.
- 412 Calif. 9,022. Clemons logging road about 2 miles northwest of Saginaw trail at a curve on the main line in a large cut on an abandoned spur. It is stratigraphically the equivalent of the strata containing locality 417. Grays Harbor County, Section 23, Township 17 N., Range 7 W. Astoria formation.
- 413 Calif. 9,024. Clemons logging road about 10,400 feet northwest of Saginaw trail on the main line west of locality 412. It is stratigraphically equivalent to the beds containing the fauna of locality 415. Grays Harbor County, Section 23, Township 17 N., Range 7 W. Astoria formation.

## LOCALITY NO.

- 414 Calif. 9,000. Clemons logging road about one-half mile south of Saginaw trail in a large cut about one-fourth mile south of the 12-mile post and northwest of locality 420. Section 5, Township 16 N., Range 6 W. Lincoln formation, middle Oligocene.
- 415 Calif. 9,017. Clemons logging road on abandoned spur of railroad 100 feet north of main line in the first large cut in Section 23, Township 17 N., Range 7 W. Astoria formation.
- 416 Calif. 9,008. Clemons logging road, on abandoned spur of railroad one-fourth mile north of junction of main line on the point of the first curve in the road. Outcrop continues from locality 415 and contains numerous layers of fossils. Section 25, Township 17 N., Range 7 W. Astoria formation.
- 417 Calif. 9,023. Clemons logging road, on abandoned spur at the point of the second curve in the road. The outcrop continues from locality 416. Section 23, Township 17 N., Range 7 W. Astoria formation.
- 418 Calif. 9,015. Clemons logging road, on abandoned spur north of junction of main line. Northern limit of the continuous exposures on the abandoned spur from locality 415. Section 23, Township 17 N., Range 7 W. Astoria formation.
- 419 Calif. 9,020. Clemons logging road, on abandoned spur north of junction with main line about 200 feet north of locality 418 on the south slope of the hill. Last fossiliferous outcrop on the abandoned spur. Section 23, Township 17 N., Range 7 W. Astoria formation.
- 420 Calif. 9,002. Clemons logging road, 1½ miles south of Saginaw trail and one-fourth mile north of Headquarters Camp. Southeast quarter of Section 5, Township 16 N., Range 6 W. Lincoln formation, middle Oligocene.
- 421 Calif. 9,014. On O. W. R. & N. Railway 1 mile east of end of South Montesano road, where the high bluffs appear against the river, Grays Harbor County, Section 14, Township 17 N., Range 7 W. Astoria formation.
- 422 Calif. 9,019. On O. W. R. & N. Railway 1 mile east of the end of South Montesano road, between localities 60 and 421, Grays Harbor County, Section 14, Township 17 N., Range 7 W. Astoria formation.
- 423 Calif. 4,214. One-fourth mile west of Balch in a cut in the Balch logging road, 200 feet south of the contact with the O. W. R. & N. Railway. Fossils are largely foraminifera. Grays Harbor County, Section 1, Township 15 N., Range 5 W. Astoria formation.
- 424 Calif. A-359. Near localities 43 and 44, at old dam site on Delezine Creek 20 feet below the basalt flow, Grays Harbor County, Section 26, Township 17 N., Range 6 W. Astoria formation.
- 425 Calif. A-373. Seam of fossils in the bed of Rock Creek about one-fourth mile downstream from the falls and just below the old dam site, Grays Harbor County, Section 7, Township 16 N., Range 5 W. Astoria formation.
- 426 Calif. A-374. On Rock Creek about 1 mile above locality 424, just below basalt flow, Grays Harbor County, Section 12, Township 16 N., Range 6 W. Astoria formation.

**LOCALITY NO.**

- 427 Calif. A-340. Clemons logging road one-fourth mile south of the 8-mile post. Zone characterized by *Pecten andersoni*. Grays Harbor County, Section 26, Township 17 N., Range 7 W. Astoria formation.
- 428 Calif. A-21. Balch logging road on the divide between Garrard and Davis creeks, on the section line. Logging road leaves Garrard road on Lemmon's ranch 200 yards east of Garrard schoolhouse, about one-half mile west of locality 462. Grays Harbor County, northeast quarter of Section 3, Township 15 N., Range 5 W. Lincoln formation, middle Oligocene.
- 429 Calif. A-341. Cut in O. W. R. & N. Railway about three-fourths mile east of South Montesano, Grays Harbor County, northwest quarter of Section 17, Township 17 N., Range 7 W. Astoria formation.
- 430 Calif. 9,007. Vesta Creek, 2,100 feet above junction with main line of Saginaw Logging Railroad. Exposure consists of a small layer of *Arcas* in a cut on the side of the track. Grays Harbor County, Section 32, Township 16 N., Range 7 W. Astoria formation.
- 431 Calif. 9,012. Clemons logging road, about 900 feet northwest of Saginaw trail. One of a series of cuts on the Delezine side of the divide between Delezine and Workman creeks. Northwest of locality 414, Grays Harbor County, Section 6, Township 16 N., Range 6 W. Lincoln formation, middle Oligocene.
- 432 Calif. A-389. Pecten Zone 30 feet stratigraphically above strata containing locality 433, mostly east, and best exposed on the west side of the same canyon as locality 433, Thurston County, Section 11, Township 15 N., Range 4 W. Astoria formation.
- 433 Calif. A-388. Mytilus Zone occurring in trail up the hillside, above small creek flowing into a small lake at foot of bluff about one-half mile east of Independence Station, Thurston County, Section 11, Township 15 N., Range 4 W. Astoria formation.
- 434 Calif. 9,068. About 2,500 feet above point 6,696 on the C. C. L. T. logging road. In three large cuts on the divide between Sylvia and Still creeks. These outcrops are about one-half mile south of the locality where the Schafer logging road crosses the divide between Black and Still creeks, Grays Harbor County, Section 9, Township 18 N., Range 7 W. Montesano formation.
- 435 Calif. 4,210. One-fourth mile below log dam on Porter Creek, Grays Harbor County, Section 14, Township 17 N., Range 5 W. Sandy phase of Lincoln formation, middle Oligocene.
- 436 Calif. 4,211. Outcrop along state highway just east of bridge over Mox Chehalis Creek near Malone, Grays Harbor County, Section 16, Township 17 N., Range 5 W. Lincoln formation, middle Oligocene.
- 437 Calif. 9,058. In the second large cut on the O. W. R. R. one-half mile west of Independence and 200 feet west of the railroad bridge over Independence Creek. Represents the uppermost portion of the Blakeley formation as exposed in the Independence section. Thurston County, Section 10, Township 15 N., Range 4 W. Blakeley formation, upper Oligocene.

**LOCALITY NO.**

- 438 Calif. A-393. Cut in curve in railroad about 4 miles east of Helsing Junction, Thurston County, Section 15, Township 15 N., Range 3 W. Lincoln shales resting beneath the Blakeley sandstone.
- 439 Calif. 9,070. C. C. L. T. logging road about 3 miles above dam on Sylvia Creek. The outcrop occurs in small cuts along the west bank of Sylvia Lake, Grays Harbor County, Section 32, Township 18 N., Range 3 W. Lincoln shales resting beneath the Blakeley sandstone.
- 440 Calif. A-9. About 1½ to 2 miles north of Galvin, in railroad cut along Chehalis River. These outcrops appear rather striking from the opposite side of the river, and occur just south of the bridge over Chehalis River, Thurston County, Section 22, Township 15 N., Range 3 W. Lincoln formation, middle Oligocene.
- 441 Calif. A-11. The first creek canyon northwest of Oakville in Grays Harbor County, Section 19, Township 16 N., Range 4 W. Lincoln formation, middle Oligocene.
- 442 Calif. A-16. About 2 miles east of Helsing Junction along Union Pacific Railway cut just below the contact between shale and sandstone of Blakeley formation; Independence section. Thurston County, Section 15, Township 15 N., Range 3 W. Sandstone phase of Blakeley formation, upper Oligocene.
- 443 Calif. A-17. One-half mile east of Helsing Junction. Shale phase along cut of Union Pacific Railway. Very prominent outcrop showing contact between the Blakeley shale below and overlying sandstone. Thurston County, Section 7, Township 15 N., Range 3 W. Blakeley formation, upper Oligocene.
- 444 Calif. A-18. Three-fourths mile west of Independence, about 50 feet west of locality 469, Thurston County, Section 8, Township 15 N., Range 3 W. Sandstone phase of Blakeley formation, upper Oligocene.
- 445 Calif. A-19. Outcrop of massive sandstone, 3 miles east of Helsing Junction along Union Pacific Railway cut three-fourths mile west of locality 438, Thurston County, Section 15, Township 15 N., Range 3 W. Blakeley formation, upper Oligocene.
- 446 Calif. A-344. Schafer logging railway, in cut on the divide between Still and Black creeks, one-half mile above Still Creek, Grays Harbor County, northwest half of Section 5, Township 18 N., Range 7 W. Montesano formation.
- 447 Calif. A-350. Outcrop on hillside west of the curve of the highway nearest to the hill in the northern part of the section, Grays Harbor County, Section 35, Township 18 N., Range 7 W. Montesano formation.
- 448 Calif. A-351. Outcrop in highway cut at the south end of the highway bridge over the west middle fork of Satsop River. Contact between Astoria and Lincoln formations. Grays Harbor and Mason counties, near line, Section 31, Township 19 N., Range 6 W.
- 449 Calif. A-353. Outcrop in massive sandstone along highway about 5 miles above the state highway up the east side of east fork of Satsop River, Grays Harbor County, lower part of Section 6, Township 18 N., Range 6 W. Middle Miocene.

## LOCALITY NO.

- 450 Calif. A-355. Fossils in basal conglomerate south of Schafer logging railway, at the top of the hill, about one-half mile east of locality 224, Grays Harbor County, southwest half of Section 4, Township 18 N., Range 6 W. Montesano formation.
- 451 Calif. A-356. Fossils in conglomerate in logging railway cut on the divide between the east fork of Cloquallum River and a branch of Wildcat Creek, Grays Harbor County, Section 7, Township 18 N., Range 5 W. Montesano formation.
- 452 Calif. A-360. Cut in Workman Creek logging railway near where the railway goes up to the top of the hill, Grays Harbor County, northwest quarter of Section 20, Township 17 N., Range 6 W. Middle Miocene.
- 453 Calif. A-361. Cut along the Malone logging railway where the grade starts down a branch of Mox Chehalis Creek near the section line, Grays Harbor County, between sections 10 and 11, Township 17 N., Range 5 W. Lincoln formation, middle Miocene.
- 454 Calif. A-366. Cut in abandoned logging railway at the head of the grade up the divide between Gibson Creek and Cedar Creek, Grays Harbor County, Section 1, Township 16 N., Range 5 W. Lincoln formation, middle Oligocene.
- 455 Calif. A-369. Fossils found immediately above the contact with interbedded basalt flow within the shale member of the Astoria formation, in cut on Union Pacific Railway about one-fourth mile northwest of locality 17, Grays Harbor County, Section 36, Township 16 N., Range 5 W. Astoria formation, middle Miocene.
- 456 Calif. A-370. Cut in Balch Logging Railway one-fourth mile north of locality 438, Grays Harbor County, Section 34, Township 16 N., Range 5 W. Sandstone phase of Lincoln formation, middle Oligocene.
- 457 Calif. A-371. Outcrop in small cut on the Williams Creek logging railroad about a mile above the old Camp IV, 300 feet up the second left-hand fork on the logging railroad, Grays Harbor County, Section 18, Township 16 N., Range 5 W. Sandy phase of the Lincoln formation, middle Oligocene.
- 458 Calif. A-372. Cut on switchback of Williams Creek logging railroad on the first right-hand fork of the railroad above old Camp IV. Outcrop about 1 mile above the old Camp IV, Grays Harbor County, Section 18, Township 17 N., Range 5 W. Lincoln formation, middle Oligocene.
- 459 Calif. A-375. Casts of fossils in shale below locality 425, at point where the trail crosses Rock Creek, Grays Harbor County, Section 7, Township 16 N., Range 5 W. Lincoln formation, middle Oligocene.
- 460 Calif. A-377. About 500 feet south of locality 402, in somewhat hardened tuffaceous sandstone, Grays Harbor County, Section 9, Township 16 N., Range 6 W. Basal Lincoln formation, Oligocene.
- 461 Calif. A-378. At curve one-fourth mile south of locality 460, on the main line of Clemons logging railroad, Grays Harbor County, Section 16, Township 16 N., Range 6 W. Lincoln formation, Oligocene.

## LOCALITY NO.

- 462 Calif. A-379. Cut in Balch logging railroad below contact with basal Lincoln formation in bluish-gray sandstone. Above the switchback near the top of the hill, nearly 1 mile above where the logging railroad crosses the Garrard Creek highway near Lemmon's Ranch, Grays Harbor County, Section 2, Township 15 N., Range 5 W. Cowlitz formation, upper Eocene.
- 463 Calif. A-380. About 100 yards up a small creek which flows from the north and crosses Garrard Creek highway just west of the junction with that highway and the South Prairie fork, Grays Harbor County, Section 3, Township 15 N., Range 5 W. Lincoln formation, middle Oligocene.
- 464 Calif. A-381. Cut in the Independence Creek logging railroad in thin-bedded bluish sandy shale, nearly 1 mile south of where the railroad crosses Independence Creek, Lewis County, Section 35, Township 15 N., Range 5 W. Cowlitz formation, upper Eocene.
- 465 Calif. A-382. Outcrop in creek canyon below road, 200 feet after crossing Grays Harbor-Lewis County line, Lewis County, Section 13, Township 15 N., Range 5 W. Sandstone phase of Cowlitz formation, upper Eocene.
- 466 Calif. A-384. Basal sandstone of the Lincoln formation along the Union Pacific Railway track about one-half mile west of locality 469, not far from the contact with the basalt. Grays Harbor County, Section 10, Township 15 N., Range 4 W. *Pitar dalli* most common fossil. Lincoln formation, middle Oligocene.
- 467 Calif. A-385. Sandstone outcrops on the east bank of a small creek, 1,300 feet west of railroad bridge over Independence Creek, Grays Harbor County, Section 10, Township 15 N., Range 4 W. *Pitar dalli* most common fossil. Sandstone phase of Lincoln formation near contact with Lincoln shale, middle Oligocene.
- 468 Calif. A-386. About 300 feet east of locality 467 near top of the Lincoln shale. Badly slumped and covered with vegetation. Grays Harbor County, Section 10, Township 15 N., Range 4 W. Lincoln formation, middle Oligocene.
- 469 Calif. A-387. Shale of Blakeley age overlying 80 feet of sandstone of the same age. Slickensides show in the cut about 900 feet west of Independence Creek railroad bridge along the Union Pacific Railway, west of the station of Independence; 800 feet west of locality 437. Thurston County, Section 10, Township 15 N., Range 4 W. Blakeley formation, upper Oligocene.
- 470 Calif. A-390. About 200 yards west of where Helsing Creek leaves the canyon. Fossil casts in Miocene sandstone. Thurston County, Section 11, Township 15 N., Range 4 W. Astoria formation, middle Miocene.
- 471 Calif. A-391. Cut in the road crossing from Lincoln Creek to Independence Creek 200 feet from main highway up Lincoln Creek. Lower Lincoln formation rests here upon the marine Cowlitz sandstone of the Eocene. Thurston County, Section 20, Township 15 N., Range 3 W. Lincoln formation, middle Oligocene.
- 472 Calif. A-392. Cut along the Northern Pacific Railway in Blakeley shale near contact with the underlying sandstone of the same age. About 1 mile east of the 1-mile post of Helsing Junction. Shale outcrop is characterized by the presence of a whitish intercalated bed about 1 foot in thickness. Thurston County, southeast quarter of Section 8, Township 15 N., Range 3 W. Blakeley formation, upper Oligocene.

## LOCALITY NO.

- 473 Calif. 9,069. Wynoochee River road in cut 150 yards south of railroad up Black Creek, Grays Harbor County, Section 26, Township 18 N., Range 8 W. Astoria formation, middle Oligocene.
- 474 Calif. A-414. Clemons logging railroad about one-half mile southwest of locality 461, on the spur of the railroad which follows a divide between the two branches of Vesta Creek, 200 feet southwest of the junction with the main line. Grays Harbor County, Section 16, Township 16 N., Range 6 W. Lincoln formation, middle Oligocene.
- 475 One-half mile east of Duwamish and east of Northern Pacific Railway tracks in a small creek which crosses the road, King County. Many fossils of marine origin. Cowlitz formation, upper Eocene.
- 476 From Pittsburg Bluffs, Columbia County, Oregon, in road cut. Middle Oligocene.
- 477 In brown sandstone, a 6-inch layer of fossils, in road cut 1.3 miles south of Mason County line, on east branch of Satsop River and four-tenths mile south of a creek trending along a ridge which seems to be the basal contact of the Montesano formation. Mason County, Section 12, Township 18 N., Range 6 W. Montesano formation.
- 478 Fossils from upper 6 feet of exposed part of Nye shale, Newport Beach, Lincoln County, Oregon, just south of Jump Off Joe Rock. Upper Oligocene.
- 479 At north end of Agate Beach on coast of Oregon, north of the city of Newport, and near intrusive rock, Lincoln County. Astoria formation, middle Miocene.
- 480 In the Yaquina sandstone exposed on the north shore of Yaquina Bay about 2,000 feet north of town of Yaquina, Lincoln County, Oregon. Middle Oligocene.
- 481 Yaquina sandstone on shore of Yaquina Bay, Oregon, 2,500 feet north of Yaquina. Middle Oligocene.
- 482 Burpee formation in road cut, 1 mile east of Toledo, Lincoln County, Oregon. Eocene.
- 483 In Keasey formation on Rock Creek, 1 mile east of Keasey, Columbia County, Oregon. Lower Oligocene.
- 484 East of lighthouse, on Strait of Juan de Fuca, just east of Gettysburg, Clallam County. Oligocene.
- 485 About 1 mile east of Twin, on south shore of Strait of Juan de Fuca, Clallam County. Oligocene.
- 488 Sandstone at Newport, Lincoln County, Oregon, 30 feet above Nye shale on beach. Astoria formation, middle Miocene.
- 490 Very shaly sandstone in cliff, beach section 11,000 feet southeast of Slip Point and 13,000 feet due east of the town of Clallam Bay, Clallam County, northeast quarter of southeast quarter, Section 22, Township 32 N., Range 12 W. Astoria formation, middle Miocene.

**LOCALITY NO.**

- 491 Gray medium-grained sandstone in beach cliff along south shore of Strait of Juan de Fuca, approximately 15 miles N. 20 degrees W. of the town of Pysht, Clallam County, southwest quarter of southwest quarter, Section 33, Township 32 N., Range 11 W. Astoria formation, middle Miocene.
- 492 Dark grayish-brown fine-grained tuffaceous shaly sandstone exposed on the west side of Crescent Bay, 9,000 feet N. 10 degrees E. of the town of Joyce, Clallam County, southwest quarter of Section 20, Township 31 N., Range 8 W. Crescent formation, middle Eocene.
- 493 Brownish-gray shaly sandstone in cliff section along the south shore, Strait of Juan de Fuca, about 11,000 feet west of Gettysburg, Clallam County, in northeast corner Section 30, Township 31 N., Range 9 W. Upper Oligocene.
- 494 In massive medium- to coarse-grained brown sandstone, west side of Wishkah River, eastern part of Aberdeen, Grays Harbor County, Section 4, Township 17 N., Range 9 W. Montesano formation.
- 495 From road cut in Wynoochee Valley on east side of Wynoochee River, Grays Harbor County, northeast corner Section 14, Township 19 N., Range 8 W. Near top of upper Oligocene.
- 496 From road cut on west side of Wynoochee River 800 feet north of locality 495, Grays Harbor County. Fine-grained gray shale of upper Oligocene; contains foraminifera.
- 497 In road cut and river bank on east side of Wynoochee River 3½ miles N. 30 degrees W. from the town of Montesano, Grays Harbor County, west line of Section 26, Township 18 N., Range 8 W. Astoria formation, middle Miocene.
- 498 Massive micaceous brownish-gray sandstone with conglomerate lenses, in bank of river, west fork of Satsop River, Grays Harbor County, northeast quarter of Section 28, Township 19 N., Range 7 W. Astoria formation, middle Miocene.
- 499 Massive sandy brown shale in sea cliff, south side of Strait of Juan de Fuca, 15,000 feet due east of the town of Twin, Clallam County, center of north line of Section 30, Township 31 N., Range 9 W. Upper Oligocene.
- 500 Fine-grained brownish-gray massive sandstone in road cut at Pittsburg Bluff, Columbia County, Oregon. Middle Oligocene.
- 501 Massive sandstone in embankment of Chicago, Milwaukee Railway, Grays Harbor County, in western part of Section 1, Township 31 N., Range 7 W. Astoria formation, middle Miocene.
- 502 In massive sandstone, Grays Harbor County, northeast quarter of northeast quarter Section 11, Township 31 N., Range 7 W. Astoria formation, middle Miocene.
- 503 Massive brown medium-grained sandstone in railway cut, Grays Harbor County, northwest quarter of northeast quarter of Section 11, Township 31 N., Range 7 W. Astoria formation, middle Miocene.
- 504 Brownish-gray sandy shale exposed in the bank of Smith Creek, Pacific County, northwest quarter of Section 32, Township 15 N., Range 8 W. Oligocene.

**LOCALITY NO.**

- 505 Sandstone containing fossil tree trunks overlain by lava flows, Fall River, 17,000 feet S. 5 degrees E. of the town of Brooklyn, Pacific County, western part of Section 1, Township 14 N., Range 7 W. Astoria formation, middle Miocene.
- 506 Massive grayish-brown sandstone with intercalated shale layers in logging road cut 16,000 feet S. 30 degrees E. from the town of Brooklyn, Pacific County, southwest quarter of Section 31, Township 15 N., Range 6 W. Astoria formation, middle Miocene.
- 507 In logging road cut, 1,500 feet north of locality 506, Pacific County. Very fossiliferous. Astoria formation, middle Miocene.
- 508 Dark clay shale in road cuts on west side, south fork of Chehalis River 1 mile north of the town of Pe Ell, Lewis County, Section 33, Township 13 N., Range 5 W. Lower Oligocene.
- 509 In the banks of a small creek under the Northern Pacific Railway bridge, about 7,000 feet N. 25 degrees E. of the town of Pe Ell on the west side of the south branch of Chehalis River, Lewis County, Section 23, Township 13 N., Range 5 W. Horizontal layers of massive medium-grained gray sandstone. Middle Oligocene.
- 510 Massive brownish-gray medium-grained sandstone exposed in steep cliffs, the west bank of south branch of Chehalis River, Lewis County, about 3 miles N. 5 degrees E. of Pe Ell in northwest quarter of Section 14, Township 13 N., Range 5 W. Basal portion of Astoria formation, middle Miocene.
- 511 Medium-grained massive gray sandstone exposed in the west bank of south branch of Chehalis River, about 13,000 feet N. 10 degrees E. of Pe Ell, Lewis County. Upper portion of Lincoln formation, middle Oligocene.
- 512 Medium-grained gray sandstone exposed in west bank of south fork of Chehalis River, 12,500 feet N. 10 degrees E. of Pe Ell, Lewis County, in southeast quarter of Section 15, Township 13 N., Range 5 W. Lincoln formation, middle Oligocene.
- 513 Coarse-grained gray tuffaceous sandstone exposed in the banks of Willapa River, 1,000 feet east of the town of Holcomb, Pacific County, in southwest corner of Section 31, Township 13 N., Range 7 W. Lincoln formation, middle Oligocene.
- 514 Gray pebbly sandstone in highway cut 1 mile east of the town of Grays River, Wahkiakum County, northwest quarter of Section 17, Township 10 N., Range 6 W. Oligocene.
- 515 Massive shaly sandstone beneath basalt exposed in road cut 7,000 feet N. 15 degrees E. from the town of Skamokawa, Wahkiakum County, southeastern corner Section 6, Township 9 N., Range 6 W. Astoria formation, middle Miocene.
- 516 Brownish-gray massive sandy shale containing foraminifera, 1 mile N. 12 degrees E. from the town of Skamokawa, Wahkiakum County, northeast quarter of Section 8, Township 9 N., Range 6 W. Astoria formation, middle Miocene.

## LOCALITY NO.

- 517 Dark-gray medium-grained sandstone in highway cut 4 miles due east of the town of Grays River, Grays Harbor County, northwest quarter of Section 14, Township 10 N., Range 7 W. Middle Oligocene.
- 518 Massive medium-grained gray stratified sandstone in sea cliffs, eastern side of Grays Bay, Grays Harbor County, south half of Section 9, Township 9 N., Range 8 W. Astoria formation, middle Miocene.
- 519 Medium-grained brownish-gray shaly sandstone resting stratigraphically upon Astoria basalt, exposures in bank of Columbia River 2 miles due east of the town of Altoona on the property of J. G. Elliott, Wahkiakum County, near the center of Section 14, Township 9 N., Range 8 W. Upper portion of Astoria formation, middle Miocene.
- 520 Dark gray massive soft sandy clay shale exposed in road cut about 1 mile south of the town of Deep River, Wahkiakum County, western half of Section 20, Township 10 N., Range 8 W. Oligocene.
- 521 Gray-brown sandy shale exposed in road cut at south end of bridge over Nasel River, Pacific County, north portion of Section 22, Township 10 N., Range 10 W. Oligocene.
- 522 Massive and stratified fine-grained greenish-gray sandstone exposed in the west bank of Grays River, Wahkiakum County, south half of Section 4, Township 10 N., Range 7 W. Oligocene.
- 524 Dark gray sandy shale and massive shaly sandstone, south shore of Alsea Bay, one-half mile east of the city of Waldport, Lincoln County, Oregon. Oligocene.
- 525 Stratified brownish-gray shaly sandstone exposed in road and sea cliff 8,000 feet S. 45 degrees W. from the town of Waldport, Lincoln County, Oregon. Middle Miocene.
- 527 Dark brownish-gray sandy shale in the north bank of Rock Creek at the first bridge crossing three-fourths mile east of Keasey, Columbia County, Oregon. Lowermost Oligocene.
- 528 Massive medium-grained sandstone at summit of divide between Columbia River and Nehalem Valley, Columbia County, Oregon, in the center of Township 5 N., Range 3 W. Oligocene.
- 529 Brownish-gray massive sandstone in road cut west of Pisgah home, Washington County, Oregon, southwest corner of Township 4 N., Range 2 W. Oligocene.
- 530 Massive brownish-gray shaly sandstone in road cut east of Timber, Washington County, Oregon, Section 23, Township 3 N., Range 5 W. Oligocene.
- 531 Massive sandy shale in road cut, Washington County, Oregon, Section 29, Township 3 N., Range 4 W. Oligocene.
- 532 Stratified, firmly consolidated medium- to coarse-grained sandstone in quarry on Skoggins Creek, Washington County, Oregon, Section 21, Township 1 N., Range 4 W. Oligocene.

**LOCALITY NO.**

- 533 Stratified sandy shale and shaly sandstone in cliff near junction of Dungeness River and Gray Wolf Creek, Clallam County, near the middle of Section 30, Township 29 N., Range 3 W. Lower Eocene?
- 534 Stratified layers of brownish-gray sandstone and shale on the west shore of Hood Canal, 3,000 feet south of Lilliwaup Bay, Mason County, southwestern quarter of Section 30, Township 23 N., Range 3 W. Blakeley formation, upper Oligocene.
- 535 Massive gray shaly sandstone 3.8 miles south of Cosmopolis, Grays Harbor County, Section 36, Township 17 N., Range 9 W. Astoria formation, middle Miocene.
- 536 Stratified layers of brownish-gray sandstone exposed on the west fork of Wishkah River, 50 feet south of old log dam, Grays Harbor County, Section 35, Township 20 N., Range 9 W. Astoria formation, middle Miocene.
- 537 Massive medium-grained sandstone in road cut, east side of west fork of Wishkah River, Grays Harbor County, Section 35, Township 20 N., Range 9 W. Astoria formation, middle Miocene.
- 538 Massive bluish-gray medium- to coarse-grained sandstone in the banks of Stillwater Creek, Lewis County, southeast quarter of Section 30, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 539 Massive brown sandstone in Stillwater Creek, Lewis County, southeast quarter of southwest quarter of Section 30, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 540 From nodules in coarse gray sandstone at the junction of Stillwater and Olequa creeks, Lewis County, northwest quarter of Section 32, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 541 Medium-grained brownish-gray shaly sandstone exposed in south bank of Olequa Creek, Lewis County, south of junction with Stillwater Creek, beneath Northern Pacific Railway bridge 500 feet east of center of Section 32, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 542 Calcareous sandstone layers in massive medium-grained dark-brown sandstone exposed in Salzer Creek near the Salzer Schoolhouse, Lewis County, Section 25, Township 14 N., Range 1 W. Cowlitz formation, upper Eocene.
- 543 Light-brown gray slightly shaly fine-grained sandstone exposed on Bunker Creek road, Lewis County, Section 23, Township 14 N., Range 4 W. Oligocene.
- 544 Interstratified medium-grained sandstone and light-gray sandy shale, Lewis County, northeast quarter of Section 20, Township 14 N., Range 4 W. Oligocene.
- 545 Massive light brownish-gray thinly stratified sandy shale and shaly sandstone in the bank of Olequa Creek 1 mile southwest of Winlock, Lewis County, 500 feet due east of the center of western boundary of Section 33, Township 12 N., Range 2 W. Middle Oligocene.
- 546 Marine medium- to coarse-grained massive sandstone exposed on eastern side of Northern Pacific Railway, 3,000 feet N. 30 degrees W. of Olequa Station, Cowlitz County, northeast quarter of southeast quarter of Section 5, Township 10 N., Range 2 W. Cowlitz formation, upper Eocene.

## LOCALITY NO.

- 547 Massive light brownish-gray sandstone and interstratified brown shale exposed in Northern Pacific Railway cut, Cowlitz County, northeast quarter of northeast quarter of Section 5, Township 10 N., Range 2 W. Cowlitz formation, upper Eocene.
- 548 Massive brownish- to bluish-gray stratified sandstone exposed in the west bank of Cowlitz River, Cowlitz County, northeast quarter of northeast quarter of Section 33, Township 11 N., Range 1 W. This locality is approximately the same as locality 232. Middle portion of Cowlitz formation, upper Eocene.
- 549 In a fine-grained brownish-gray clay shale, 12 feet stratigraphically below locality 548, on the west bank of Cowlitz River, Cowlitz County. Middle portion of Cowlitz formation, upper Eocene.
- 550 On the west bank of Cowlitz River, Cowlitz County, in the middle portion of Cowlitz formation, 16 feet stratigraphically below locality 549. Upper Eocene.
- 551 Brownish-gray medium-grained sandstone containing many *Aviculas*, in bed of Olequa Creek about 1,000 feet north of the highway bridge west of the town of Vader and at the entrance of a small creek which comes in from the east near the brick plant, Lewis County, southwest quarter of southwest quarter of Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 552 Coarse brownish-gray sandstone in bank of Olequa Creek, Lewis County, about 3,000 feet north of highway bridge over creek, west of town of Vader and immediately south of small falls in southwest quarter of northwest quarter of Section 29, Township 11 N., Range 2 W. Contains numerous specimens of *Venericardia hornii*, Cowlitz formation, upper Eocene.
- 553 Massive grayish-brown shaly sandstone exposed in the bank of Olequa Creek, Lewis County, 700 feet due south of northwest corner of Section 20, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 554 Stratified dark-gray sandy medium- to fine-grained shale and thin layers of coarse gray ripple-marked sandstone containing fresh-water fossils, Lewis County, southeast quarter of northwest quarter of Section 20, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 555 Below the coal seam, a 10-foot stratum of brownish-gray sandstone containing many specimens of *Corbicula* and *Mellania*. Lewis County, northwest quarter of northwest quarter of Section 20, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 556 Massive dark-gray very fine-grained sandy shale exposed in the bank of Olequa Creek, Lewis County, the northeast corner of the southwest quarter of the southwest quarter of Section 17, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 557 Carbonaceous sandy shale and thinly laminated brownish-gray shaly sandstone containing numerous brackish water fossils exposed in the bank of Olequa Creek, Lewis County, 600 feet due south of the center of the north line of Section 17, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.

**LOCALITY NO.**

- 558 About 300 feet up Olequa Creek, Lewis County, north of locality 557. Cowlitz formation, upper Eocene.
- 559 Massive thinly stratified micaceous shaly sandstone exposed in the banks of Olequa Creek, Lewis County, southeast corner of southwest quarter of southeast quarter of Section 5, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 560 Grayish-brown medium-grained sandstone with interstratified layers of hard concretionary sandstone containing specimens of *Acila shumardi* and other middle Oligocene fossils, in bank of Olequa Creek, Lewis County, 800 feet due east of the center of the west line of Section 33, Township 12 N., Range 2 W. Middle Oligocene.
- 561 Light-gray shaly sandstone at concrete bridge in town of Winlock, Lewis County, in bank of Olequa Creek 500 feet due north of the center of the south line of Section 28, Township 12 N., Range 2 W. Middle Oligocene.
- 562 Shaly sandstone in the south bank of Cowlitz River, Cowlitz County, at the old Gries Ranch, northeast corner of northwest quarter of northwest quarter of Section 25, Township 11 N., Range 2 W. This locality is at the downstream end of the exposure and represents a faunal facies in the lower portion of the Lincoln formation of middle Oligocene or upper-lower Oligocene.
- 563 Massive creamy-gray shaly sandstone exposed in a series of very fine cuts, in a new highway from Winlock to Adna near the summit of the grade, Lewis County, Section 10, Township 12 N., Range 3 W. Middle Oligocene.
- 564 Dark-gray very fine-grained shaly sandstone with thin interstratified layers of coarser sandstone, in road cut 200 feet north of Arkansas Creek, Cowlitz County, northwest corner of southeast quarter of northwest quarter of Section 17, Township 9 N., Range 2 W. Lower Oligocene.
- 565 Brownish-gray sandy shale containing foraminifera, in logging road cut, Lewis County, northwest quarter of Section 15, Township 10 N., Range 3 W. Oligocene.
- 566 Massive brownish-gray medium- to coarse-grained somewhat gritty sandstone in the banks of Stillwater Creek, McClarity Ranch, Lewis County, southwest quarter of southwest quarter of Section 30, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 567 Tuffaceous brownish-gray medium-grained sandstone above the Metchosin basalt on the west side of the headland which forms the western entrance to Crescent Bay, south shore of Strait of Juan de Fuca, Clallam County. Crescent formation, middle Eocene.
- 568 Dark brownish-gray stratified sandy marine tuff containing marine fossils, in sea cliff on western shore of Crescent Bay, Clallam County, immediately above the volcanic layers. Crescent formation, middle Eocene.
- 569 Stratified brownish-gray tuffaceous sandstone immediately south of Tongue Point, on the shore, eastern side of Crescent Bay, Clallam County, Washington. Crescent formation, middle Eocene.

**LOCALITY NO.**

- 570 Brownish-gray concretionary, rather massive sandy shale, dipping at an angle of 22 degrees toward the southwest, exposed in sea cliff on the south side of the Strait of Juan de Fuca, 11,000 feet due east of Gettysburg, Clallam County, northeastern corner of Section 25, Township 31 N., Range 9 W. Middle Oligocene.
- 571 Slightly stratified shaly sandstone exposed in the sea cliff 4,000 feet S. 80 degrees E. from the town of Gettysburg, Clallam County, eastern quarter of Section 27, Township 31 N., Range 9 W. Middle Oligocene.
- 572 Very massive grayish-brown sandy clay shale in sea cliff on south shore of Strait of Juan de Fuca, Clallam County, 8,000 feet due west of the town of Gettysburg. Upper portion of middle Oligocene.
- 573 Thinly stratified alternating layers of brownish-gray medium-grained sandstone and sandy shale exposed in sea cliff on south side of Strait of Juan de Fuca, 17,000 feet due east of the town of Twin, Clallam County, southeastern corner of Section 19, Township 31 N., Range 9 W. Upper part of middle Oligocene.
- 574 Massive brownish-gray sandy shale exposed in sea cliff on south shore of Strait of Juan de Fuca, Clallam County, 9,000 feet due east of Twin and 4,000 feet east of southwest corner of Section 19, Township 31 N., Range 9 W. Lower portion, upper Oligocene.
- 575 Massive medium-grained brownish-gray shaly sandstone in road cut on Grays River, Wahkiakum County, 11,500 feet N. 80 degrees E. of the town of Grays River in west central part of Section 9, Township 10 N., Range 7 W. Middle Oligocene.
- 576 Calcareous nodules in a brownish-gray sandy shale exposed in the cliff section on the north side of Columbia River, about 5,000 feet N. 80 degrees E. from the town of Knappton, Pacific County, northeast quarter of Section 9, Township 9 N., Range 9 W. Middle Oligocene.
- 577 Brownish-gray sandy shale exposed in the banks of the middle fork of Skamokawa River, Wahkiakum County, west half of Section 32, Township 10 N., Range 6 W. Upper portion of middle Oligocene.
- 578 Well-stratified brownish-gray shale containing some white tuffaceous layers, road cut about four-tenths mile west of ferry pier in the town of Waldport, Lincoln County, Oregon, and on the south shore of Alsea Bay. Oligocene.
- 579 Massive medium-grained sandstone in beach section on the coast of Oregon, 3,000 feet north of entrance to Yaquina Bay, and about 2,000 feet north of the recreation pier at the town of Newport, Lincoln County. Astoria formation, middle Miocene.
- 580 Massive medium-grained gray sandstone containing nodules with marine fossils, road cut on southwestern side of Tillamook Bay, Tillamook County, Oregon, 3 miles in a direction N. 70 degrees W. from the town of Tillamook, northwest quarter of Section 22, Township 1 S., Range 10 W. Astoria formation, middle Miocene.

**LOCALITY NO.**

- 581 Massive reddish-brown shaly sandstone exposed in creek at bridge crossing, approximately 4½ miles N. 30 degrees W. from the bridge over Cowlitz River at the city of Kelso, Cowlitz County, northwest corner of Section 18, Township 8 N., Range 2 W. Upper Eocene?
- 582 Carbonaceous massive sandstone exposed in walls and banks of Coal Creek, Cowlitz County, Washington. Approximately 1,000 feet N. 40 degrees E. from southwest corner of Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 583 Massive tuffaceous sandstone intercalated with basaltic flows on Germany Creek, Cowlitz County, southeast quarter of Section 14, Township 9 N., Range 4 W. Astoria formation, middle Miocene.
- 584 Massive compact grayish-brown medium-grained sandstone exposed at falls on Scantigrease Creek 3½ miles S. 75 degrees W. from the town of Castle Rock, Cowlitz County, in the southeast quarter of southeast quarter of Section 18, Township 9 N., Range 2 W. Upper Eocene.
- 585 Gray shaly sandstone exposed in road cut near Nasel River, 6,000 feet west of town of Deep River, Wahkiakum County. Oligocene.
- 586 Brownish-gray shaly sandstone exposed in road cut about 2 miles west of town of Deep River, Wahkiakum County, and 500 feet east of the county line. Oligocene.
- 587 Sandy clay shale in Nasel River just north of main highway to town of Deep River, Wahkiakum County, in the south half of Section 11, Township 10 N., Range 9 W. Oligocene.
- 588 Well-stratified steeply dipping brownish-gray shales and sandstone, on south side of river, at highway bridge near mouth of Nasel River, Pacific County, north half of Section 22, Township 11 N., Range 10 W. Oligocene.
- 589 Bluish-gray clay shales interstratified with clayey sandstones, exposed in sea cliff of Willapa Bay at the town of Bay Center, Pacific County, Section 7, Township 13 N., Range 10 W. Marine Pleistocene terrace deposit.
- 590 Sandy shale with numerous concretions containing fossil crabs, in bank of Willapa River, one-half mile north of Holcomb, Pacific County, northeast corner of Section 36, Township 13 N., Range 8 W. Middle Oligocene.
- 591 Massive grayish-brown sandstone on Fern Creek, Pacific County, northwest quarter of Section 4, Township 12 N., Range 6 W. Oligocene.
- 592 Massive dark grayish-brown sandstone on Fern Creek, northwest quarter of Section 5, Township 12 N., Range 6 W. Pacific County. Oligocene.
- 593 Massive very light-gray tuffaceous shaly sandstone on road between Adna and Winlock, Lewis County, Section 10, Township 12 N., Range 3 W. Oligocene.
- 594 Massive medium-grained brownish-gray sandstone in highway cut on Lake Creek, Lewis County, Section 32, Township 13 N., Range 3 W. Oligocene.

**LOCALITY NO.**

- 595 Dark-gray tuffaceous sandy shale in road and railway cut one-half mile southeast of Pluvius Station, Pacific County, in Section 4, Township 12 N., Range 6 W. Keasey formation, lowermost Oligocene.
- 597 Massive brownish-gray sandstone in road cut, Half Moon Creek, 1,000 feet north of the town of Labam, Pacific County, west half of Section 3, Township 12 N., Range 7 W. Oligocene.
- 598 In highway cut on road between Raymond and Aberdeen, Pacific County, Section 31, Township 16 N., Range 8 W. Oligocene.
- 599 In road cut and cliff on east side of Willapa River one-half mile south of the town of Willapa, Pacific County, west half of Section 27, Township 14 N., Range 8 W. Oligocene.
- 600 Massive brownish-gray sandstone in highway cut on road from Vesta to Arctic, Grays Harbor County, southwest quarter of Section 22, Township 16 N., Range 8 W. Astoria formation, middle Miocene.
- 601 Massive medium-grained brown sandstone in highway cut on road from Brooklyn to Vesta on north side of North River, in Section 11, Township 15 N., Range 7 W., and approximately 2 miles in a direction N. 25 degrees W. from the town of Brooklyn in Pacific County. Astoria formation, middle Miocene.
- 602 From massive cross-bedded brownish-gray sandstone in highway cut 2 miles east of town of Brooklyn on North River, Pacific County, northwest corner of Section 20, Township 15 N., Range 6 W. Astoria formation, middle Miocene.
- 603 Massive nearly flat pebbly brownish-gray sandstone exposed in highway cut on north side of Chehalis River, 1,500 feet east of Wishkah River, in the eastern part of the city of Aberdeen, Grays Harbor County, northeast corner of Section 9, Township 17 N., Range 9 W. Montesano formation.
- 604 Massive medium- to coarse-grained gray sandstone in road cut, in valley of east fork of Satsop River, Grays Harbor County, northeast corner of Section 7, Township 18 N., Range 6 W. Lower portion of Montesano formation.
- 605 Massive brown sandstone of Montesano formation resting unconformably upon the gray tuffaceous sandy shales of the Astoria formation, in highway cut on middle fork of Satsop River, Grays Harbor County, north central portion of Section 6, Township 18 N., Range 6 W. Boring molluscs at contact. Montesano formation.
- 606 Massive brownish-gray sandstone in cliff of road cut, east side of Hoquiam River in city of Hoquiam, Grays Harbor County, northwest quarter of Section 12, Township 17 N., Range 10 W. Montesano formation.
- 607 Brownish-gray stratified shale exposed in road cut on east side of Hoko River, Clallam County, Section 28, Township 32 N., Range 13 W. Upper Oligocene.
- 608 Thickly stratified grayish-brown argillaceous sandstone, in road cut on west side of Wynoochee River, Grays Harbor County, Section 33, Township 19 N., Range 8 W. Montesano formation.

**LOCALITY NO.**

- 609 Brown medium-grained fossiliferous sandstone, exposed in road cut 1.3 miles south of Mason County line, on the east side of east fork of Satsop River, north half of Section 7, Township 18 N., Range 6 W. Montesano formation.
- 610 Exposures of nearly horizontal strata of coarse pebbly sandstone, conglomerate, and sandy shale, in road cut 1 mile east of Wishkah River at Aberdeen, Grays Harbor County, eastern half of Section 3, Township 17 N., Range 9 W. Montesano formation.
- 611 Brownish-gray sandy shale exposed in highway cut between Raymond and Aberdeen, 3 miles north of line between Pacific and Grays Harbor counties, Section 31, Township 16 N., Range 8 W. Middle Oligocene.
- 612 Stratified grayish-brown shale in road cut between Seaside and Nehalem, northwestern Oregon, and 4 miles along the highway south of the line between Clatsop and Tillamook counties, Section 13, Township 3 N., Range 10 W. Oligocene.
- 613 Dark grayish-brown sandy shale in highway cut one-half mile south of town of Olney, Clatsop County, Oregon, northeast quarter of Section 24, Township 7 N., Range 9 W. Oligocene.
- 614 Brownish-gray sandy shale exposed in beach cliff and railway grade on west side of Yaquina River, 3,000 feet S. 70 degrees W. from the town of Toledo, Lincoln County, Oregon. Lower Oligocene.
- 615 Brownish-gray sandy shale and shaly sandstone exposed in west fork of Yaquina River, along railway grade about 11,500 feet S. 8 degrees W. from town of Toledo, Lincoln County, Oregon. Lower Oligocene.
- 616 Grayish-brown sandy shale exposed in beach cliff and railway grade, about 1,800 feet west of locality 615. Lincoln County, Oregon. Lower Oligocene.
- 617 Stratified grayish-brown sandstone and 10 per cent of shale, in river cliff about 2,100 feet S. 45 degrees W. from locality 615 on north side of Yaquina River, Lincoln County, Oregon. Lower Oligocene.
- 618 Massive brownish-gray sandy shale exposed in sea cliff, on south side of Strait of Juan de Fuca, Clallam County, southwest quarter of Section 19, Township 31 N., Range 9 W. Upper Oligocene.
- 619 Brownish-gray sandy shale exposed in sea cliff on south shore of Strait of Juan de Fuca, Clallam County, northwest quarter of Section 26, Township 31 N., Range 9 W. Upper Oligocene.
- 620 Massive brown micaceous sandstone containing poorly preserved marine fossils, in road cliff 1½ miles southeast of town of Mist, Columbia County, Oregon, Section 19, Township 6 N., Range 4 W. Oligocene.
- 621 Massive medium-grained brownish-gray sandstone exposed on beach at Newport, Lincoln County, Oregon, about 400 feet south of keyhole in eastern part of Section 7, Township 11 S., Range 11 W. Astoria formation, middle Miocene.

**LOCALITY NO.**

- 622 Grayish-brown medium-grained carbonaceous sandstone exposed in road cut between Pe Ell and Doty about 6,000 feet south of town of Doty, Lewis County, north central part of Section 14, Township 13 N., Range 5 W. Astoria formation, middle Miocene.
- 623 Massive carbonaceous sandstone in Coal Creek, Cowlitz County, 1,200 feet N. 10 degrees E. from the southwest corner of Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 624 Massive brown sandstone in bank of Coal Creek, Cowlitz County, about 200 feet northeast of locality 623. Cowlitz formation, upper Eocene.
- 625 Massive brown shaly sandstone exposed in banks of Coal Creek, Cowlitz County, about 300 feet northeast of locality 624. Cowlitz formation, upper Eocene.
- 626 Massive brownish-gray sandstone exposed in walls of canyon of Coal Creek, Cowlitz County, about 1,800 feet N. 10 degrees E. of southwest corner of Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 627 Massive brownish-gray sandstone exposed in Coal Creek, Cowlitz County, about 500 feet N. 45 degrees E. of locality 626. Cowlitz formation, upper Eocene.
- 628 Brown sandstone by side of diabase dike, in Coal Creek, Cowlitz County, about 2,800 feet N. 40 degrees E. from southwest corner of Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 629 Coarse-grained brownish-gray sandstone exposed in canyon of Coal Creek, Cowlitz County, about 150 feet northeast of locality 628. Cowlitz formation, upper Eocene.
- 630 Fine-grained stratified brownish-gray sandstone exposed in walls of canyon of Coal Creek, Cowlitz County, about 2,700 feet S. 43 degrees E. from northwest corner of Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 632 Brownish-gray shaly sandstone in Coal Creek, Cowlitz County, about 400 feet N. 30 degrees W. of locality 630. Cowlitz formation, upper Eocene.
- 633 Massive micaceous grayish-brown sandstone in Coal Creek, Cowlitz County, 1,600 feet S. 70 degrees W. of northeast corner of Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 634 Massive brownish-gray sandstone in Coal Creek, Cowlitz County, about 1,400 feet S. 65 degrees W. of northeast corner of Section 11, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 635 Brownish-gray medium-grained sandstone in banks of Coal Creek, Cowlitz County, about 1,100 feet due west of northeast corner of Section 2, Township 8 N., Range 3 W. Cowlitz formation, upper Eocene.
- 636 Interstratified sandstone and shale in Coal Creek, Cowlitz County, about 1,000 feet N. 15 degrees W. of southeast corner of Section 35, Township 9 N., Range 3 W. Cowlitz formation, upper Eocene.

**LOCALITY NO.**

- 637 Thinly stratified light grayish-brown shaly sandstone exposed in bank of Olequa Creek, about 2 miles south of town of Winlock, Lewis County, 2,500 feet N. 30 degrees W. of southeast corner of Section 4, Township 11 N., Range 2 W. Upper part of Cowlitz formation, upper Eocene.
- 638 Dark-gray clay shale exposed in Olequa Creek, Lewis County, about 2,100 feet N. 80 degrees W. of southeast corner of Section 8, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 639 Medium-grained dark-gray clay shale exposed in Olequa Creek, Lewis County, about 1,800 feet N. 50 degrees W. of southeast corner of Section 5, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 640 Brownish-gray shaly sandstone in Olequa Creek, Lewis County, 300 feet south of locality 639. Cowlitz formation, upper Eocene.
- 641 Thinly stratified micaceous shaly sandstone in Olequa Creek, Lewis County, about 500 feet N. 70 degrees W. of southeast corner of Section 5, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 642 Sandy shale in Cowlitz Creek, about 2,200 feet S. 60 degrees W. of the northwest corner of Section 17, Township 11 N., Range 2 W., Cowlitz County. Cowlitz formation, upper Eocene.
- 643 Brown shaly sandstone about 300 feet south of locality 642, Cowlitz County. Cowlitz formation, upper Eocene.
- 644 Brown shaly sandstone in Olequa Creek, Lewis County, about 400 feet S. 70 degrees W. of locality 643. Cowlitz formation, upper Eocene.
- 645 Massive dark-gray very fine-grained sandy shale in west bank of Olequa Creek, Lewis County, at bend in river about 2,000 feet N. 30 degrees E. of southwest corner of Section 17, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 646 Brown sandy shale, about 500 feet down Olequa Creek, Lewis County, from locality 645. Cowlitz formation, upper Eocene.
- 647 Brown shaly sandstone, in Olequa Creek, Lewis County, stratigraphically beneath a coal seam in northwest corner of Section 20, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 648 Brown shaly sandstone, 500 feet due south of locality 647, Lewis County. Cowlitz formation, upper Eocene.
- 649 Grayish-brown massive shaly sandstone in Olequa Creek, Lewis County, 700 feet due south of northwest corner of Section 20, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 650 Massive gritty dark-gray sandstone in Olequa Creek, Lewis County, 800 feet S. 60 degrees E. of northwest corner of Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.

**LOCALITY NO.**

- 652 Light creamy-gray shaly sandstone, exposed at bridge over Olequa Creek at town of Winlock, Lewis County. Middle Oligocene.
- 653 Grayish-brown micaceous sandstone exposed in railway cut, Cowlitz County, southwest corner of southwest quarter of southeast quarter of Section 32, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 654 Dark grayish-brown carbonaceous sandstone exposed in Coal Creek, Cowlitz County, 900 feet S. 45 degrees W. of northeast corner of Section 26, Township 9 N., Range 3 W. Cowlitz formation, upper Eocene.
- 655 Brownish-gray shaly sandstone in Coal Creek, Cowlitz County, about 1,000 feet S. 60 degrees W. of northwest corner of Section 26, Township 9 N., Range 3 W. Cowlitz formation, upper Eocene.
- 656 Light-gray shaly sandstone exposed in Olequa Creek, 1,200 feet S. 40 degrees W. of the concrete bridge in Winlock, Lewis County, and 1,800 feet due east of southwest corner of Section 28, Township 12 N., Range 2 W. Middle Oligocene.
- 657 Massive brown medium-grained sandstone in Olequa Creek, Lewis County, about 2,500 feet N. 15 degrees E. from southwest corner of Section 33, Township 12 N., Range 2 W. Middle Oligocene.
- 658 Hard brown medium-grained sandstone in Olequa Creek, Lewis County, 2,200 feet S. 30 degrees W. of northeast corner of Section 5, Township 11 N., Range 2 W. Lowermost Oligocene.
- 659 Light-gray massive fine-grained very thinly stratified micaceous sandstone exposed in Olequa Creek, Lewis County, 2,900 feet S. 20 degrees W. of northeast quarter of Section 5, Township 11 N., Range 2 W. Uppermost part of Cowlitz formation, upper Eocene.
- 660 Dark-gray sandy clay shale in Olequa Creek, Lewis County, 4,000 feet S. 18 degrees W. of northeast corner of Section 5, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 661 In Olequa Creek, Lewis County, about 100 feet due south of locality 660. Cowlitz formation, upper Eocene.
- 662 Massive light-gray sandstone in Olequa Creek, Lewis County, about 2,500 feet S. 10 degrees E. of northwest corner of Section 33, Township 12 N., Range 2 W. Middle Oligocene.
- 663 Dark-gray sandy carbonaceous shale in Olequa Creek, Lewis County, about 2,300 feet S. 65 degrees E. of northwest quarter of Section 17, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 664 Dark-gray sandy shale, 250 feet south of locality 663 in Olequa Creek, Lewis County. Cowlitz formation, upper Eocene.
- 665 Dark-brown shaly sandstone, about 200 feet south of locality 664 in Olequa Creek, Lewis County. Cowlitz formation, upper Eocene.

**LOCALITY NO.**

- 666 Bluish-gray medium-grained sandstone exposed in Olequa Creek, Lewis County, about 250 feet south of locality 665. Cowlitz formation, upper Eocene.
- 667 Thinly stratified brownish-gray micaceous sandy shale exposed in Olequa Creek, Lewis County, about 800 feet S. 17 degrees E. of northwest corner of Section 17, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 668 Massive fine-grained dark-gray sandy shale in Olequa Creek, Lewis County, about 2,000 feet N. 50 degrees E. of southwest corner of Section 17, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 669 Cross-bedded brown sandstone in Olequa Creek, Lewis County, about 400 feet N. 80 degrees E. of southwest corner of Section 17, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 670 Brown coarse-grained sandstone exposed in Olequa Creek, Lewis County, about 300 feet S. 80 degrees E. of northwest corner of Section 20, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 671 Brown carbonaceous sandstone exposed in Olequa Creek, Lewis County, about 1,000 feet due south of northwest corner of Section 20, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 672 Brown carbonaceous sandstone in Olequa Creek, Lewis County, about 1,800 feet S. 40 degrees E. of northwest corner of Section 20, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 673 Massive brown sandstone in Olequa Creek, Lewis County, about 2,200 feet S. 43 degrees E. of northwest corner of Section 20, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 674 Massive gritty dark-gray sandstone in Olequa Creek, Lewis County, about 800 feet S. 70 degrees E. of northwest corner of Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 675 Brownish-gray massive sandstone in bank of Olequa Creek, Lewis County, beneath Northern Pacific Railway bridge, about 1,400 feet due east of the northwest corner of Section 32, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 676 Brown tuffaceous gritty sandstone exposed in Northern Pacific Railway cut, Cowlitz County, about 2,500 feet S. 5 degrees W. from northeast corner of Section 5, Township 10 N., Range 2 W. Cowlitz formation, upper Eocene.
- 677 Reddish-brown sandstone exposed in Northern Pacific Railway cut, Cowlitz County, about 800 feet S. 50 degrees W. from northeast corner of Section 5, Township 10 N., Range 2 W. Cowlitz formation, upper Eocene.
- 680 Sandy shale about 2 miles west of Twin River in sea cliff on south side of Strait of Juan de Fuca in Clallam County, Washington.
- 681 In sea cliffs one-half mile east of Pillar Point, Clallam County, Washington.

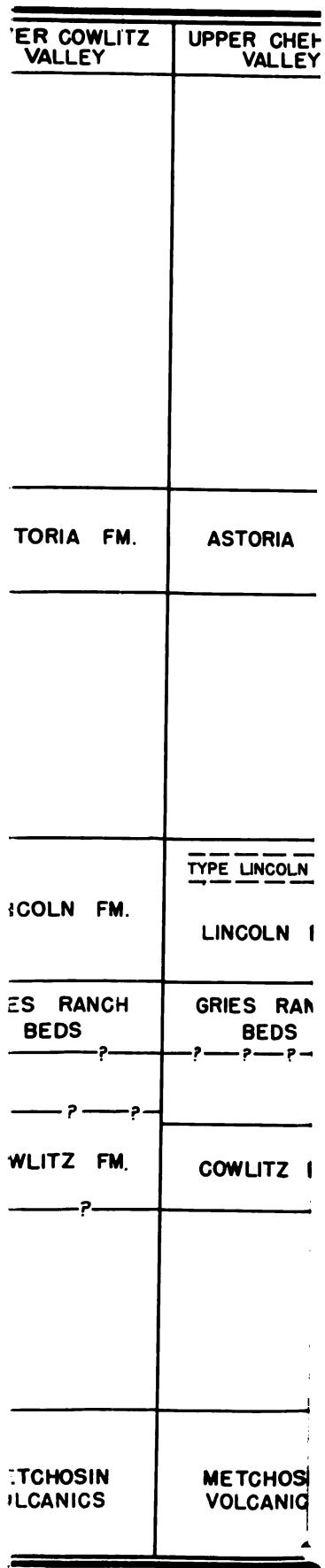
## LOCALITY NO.

- 682 Brownish-gray tuffaceous sandstone exposed on east side of Yaquina River, Lincoln County, Oregon, about 8,000 feet S. 15 degrees W. from the town of Toledo. Lowermost Oligocene.
- 683 Brownish-gray medium-grained sandstone exposed on north side of Yaquina River, about 20,000 feet S. 30 degrees E. from the town of Toledo, Lincoln County, Oregon. Lower Oligocene.
- 684 Massive brownish-gray coarse sandstone exposed on east shore of Yaquina Bay, 3,500 feet north of the town of Yaquina, Lincoln County, Oregon. Middle Oligocene.
- 685 Same sandstone 1,500 feet north of town of Yaquina, Lincoln County, Oregon. Yaquina formation, middle Oligocene.
- 686 Approximately 1,000 feet north of locality 685, on east shore of Yaquina Bay, Lincoln County, Oregon. Yaquina formation, middle Oligocene.
- 687 Dark grayish-brown sandy shale exposed in sea cliffs on north shore of Yaquina Bay, Lincoln County, Oregon, about 4,000 feet S. 60 degrees E. of center of city of Newport. Nye formation, upper Oligocene.
- 688 Grayish-brown sandy shale exposed in sea cliff on north shore of Yaquina Bay, Lincoln County, Oregon, about 1,000 feet N. 48 degrees W. of locality 687, about 4,500 feet S. 40 degrees W. of northeast corner of Section 9, Township 11 S., Range 11 W. Nye formation, upper Oligocene.
- 689 Dark-gray sandy shale exposed on ocean beach just below contact with overlying Astoria sandstone at Newport, Lincoln County, Oregon. Uppermost part of Nye formation, upper Oligocene.
- 690 Coarse-grained brown sandstone in beach section at keyhole just north of Newport, Lincoln County, Oregon. Astoria formation, middle Miocene.
- 691 Stratified medium-grained sandstone exposed on ocean beach on south side of Yaquina Head, on coast of Oregon, Lincoln County, 5½ miles north of the entrance to Yaquina Bay. Astoria formation, middle Miocene.
- 692 Tuffaceous dark brown sandy shale near top of basaltic flow, on western side of Crescent Bay, Clallam County, Washington. Crescent formation, middle Eocene.
- 698 Coarse-grained brown sandstone exposed in Olequa Creek, Lewis County, about 1,900 feet N. 18 degrees W. of southwest corner of Section 29, Township 11 N., Range 2 W. Cowlitz formation, upper Eocene.
- 699 Dark greenish sandstone exposed in Stillwater Creek, 300 feet west of its junction with Olequa Creek about 1,200 feet due south of the northwest corner of Section 32, Township 11 N., Range 2 W., Cowlitz County.
- 700 Bean Point, Kitsap County.
- 701 On Porter Creek 3,000 feet above its junction with Chehalis River, in sandy shales. Lincoln formation, middle Oligocene.

## LOCALITY NO.

- 702 Shaly sandstone at point east of old shingle warehouse. Freshwater Bay, in Section 21, Township 31 N., Range 8 W.
- 703 Calif. 7,170. One mile west of Balch Station, Grays Harbor County, Section 1, Township 15 N., Range 5 W.
- 704 One-sixth mile east of Twin River in cliff, Clallam County, Washington, in western half of Section 24, Township 31 N., Range 10 W.
- 705 South Shore of Mystery Bay. An inlet of Scow Bay, northeastern side of Olympic Peninsula, in Section 32, Township 30 N., Range 1 E.
- 706 In brown sandstone in small gully on wooded hillside on east side of Coal Creek about 6,000 feet N. 10 degrees E. from the town of New Castle, King County, Washington, in northeast quarter of Section 22, Township 24 N., Range 5 E.
- 707 C. A. S. Locality 187. Menlo, Pacific County, Washington.
- 708 C. A. S.-187. Menlo, Pacific County, Washington.
- 709 Vance Creek,  $2\frac{1}{2}$  miles above its junction with Skokomish River, Mason County, Washington.
- 710 Generalized location at Astoria, Oregon, for the faunal collection made by James D. Dana and described by Conrad.







### **FAUNAL TABLES\***

- U.W. = Paleontological Collection, University of Washington,  
Seattle, Washington.
- U.C. = Collection Museum of Invertebrate Paleontology, Uni-  
versity of California, Berkeley, California.
- C.A.S. = Paleontological Collection, California Academy of Sci-  
ences, Golden Gate Park, San Francisco, California.
- S.U. = Stanford University Paleontology Type Collection,  
Palo Alto, California.
- U.S.N.M. = United States National Museum, Washington, D. C.
- P.A.N.S. = Philadelphia Academy of Natural Sciences, Philadel-  
phia, Pennsylvania.
- M.C.Z. = Museum of Comparative Zoology, Cambridge, Massa-  
chusetts.
- St. L.A.S. = St. Louis Academy of Sciences, St. Louis, Missouri.
- U.O. = Paleontological Collection, University of Oregon, Eu-  
gene, Oregon.

\* The following symbols are used in the Faunal Tables: H. = Holotype;  
Hp. = Hypotype; P. = Paratype; S. = Syntype; C. = Cotype; L. = Lectotype;  
Ph. = Plastoholotype; T. = Topotype; N. = Neotype; U = upper part of for-  
mation; L = lower part of formation; X = occurrence in formation.

**LIST OF FAUNA IN THE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON**

Digitized by Google

Type and museum number	Location of specimen		
U.P. 15384 H. 32245 H. Lost H. 3575	U.C. U.C. U.S.N.M. U.S.N.M.	COELENTERATA	
H. 153963 H. 30255	U.S.N.M. U.C.	VERMES	
		ECHINODERMATA	
U.C. U.C. S.U. C.A.S. U.S.N.M.		7. <i>Echinorachnius blanensis</i> (Kew) 8. <i>Echinorachnius blanensis</i> (Kew) var. <i>etheringtoni</i> n. var. 9. <i>Echinorachnius newcombei</i> (Kew) 10. <i>Eosactella coosensis</i> (Kew) 11. <i>Anorthocidium oregonense</i> (W. B. Clark)	H.P. 12495 H. 31981 H. 5164 H. 446 H. 153975
U.C. U.C. S.U. U.C. M.G.Z.		12. <i>Anorthocidium oregonense</i> (W. B. Clark) var. <i>quaylei</i> 13. <i>Anorthocidium oregonense</i> (W. B. Clark) var. <i>semigibbosus</i> 14. <i>Schizaster</i> sp. Tegland 15. <i>Brisaster maximus</i> H. L. Clark	H. 11386 H. 57 H. 32247 H. 3830
U.W. U.C. U.W. U.S.N.M. U.W.		MOLLUSCOIDEA	
P. 3487 P. 521 H. 32246 H. 42 H. 107779 H. 82		16. <i>Hemithyris astoriana</i> Dall 17. <i>Hemithyris</i> sp. A. 18. <i>Hemithyris</i> ? sp. Tegland 19. <i>Rhynchonella washingtoniana</i> Weaver 20. <i>Discinisa oregonensis</i> Dall 21. <i>Terebratula oakhillensis</i> (Weaver) 22. <i>Terebratula unguicula</i> Carpenter var. B. 23. <i>Terebratula transversa</i> (Sowerby) subsp. Clark and Arnold 24. <i>Terebratula transversa</i> (Sowerby) var. <i>caurina</i> Gould 25. ? <i>Terebratula</i> aff. <i>occidentalis</i> Dall 26. <i>Terebratella</i> ? <i>soknei</i> Clark and Arnold 27. <i>Laqueus</i> aff. <i>vancouverensis</i> Davidson	H.P. 520 H. 30252 H.p. 517 H.D. 518 H. 30235 H.p. 516

Original from  
UNIVERSITY OF MICHIGAN

PELECYPODA	
28. <i>Solemya (Acharax) ventricosa</i> Conrad.	U.S.N.M. H. 3567
29. <i>Solemya (Acharax) dalli</i> Clark.	S.U. H. 5238
30. <i>Solemya (Acharax) willapaensis</i> n. sp.	U.C. H. 32086
31. <i>Acila (Truncacilia) decisca</i> (Conrad)	U.W. H.p. 149
32. <i>Acila (Truncacilia) nebulosensis</i> G. D. Hanna	U.S.N.M. P. 107401
33. <i>Acila (Truncacilia) shumardi</i> (Dall)	U.S.N.M. H. 406505
34. <i>Acila (Truncacilia) packardi</i> (Clark)	U.C. H. 30297
35. <i>Acila (Truncacilia) nelsoni</i> (Clark)	S.U. H. 5202
36. <i>Acila (Truncacilia) pugnatrix</i> (Clark)	S.U. H. 5114
37. <i>Acila (Truncacilia) contraria</i> (Meek)	U.S.N.M. H. 5526
38. <i>Acila (Truncacilia) empiresis</i> Howe	U.C. H. 30032
39. <i>Acila (Truncacilia) blancaensis</i> Howe	S.U. H. 59
40. <i>Acila (Acila) gettyshburgensis</i> (Reagan)	U.S.N.M. H. 328302
41. <i>Nucula hannibalis</i> Clark	S.U. H. 5248
42. <i>Nucula washingtonensis</i> Weaver	U.W. H. 84
43. <i>Nucula tennesseensis</i> Dall	U.S.N.M. H. Lost
44. <i>Nuculana coalitensis</i> (Weaver and Palmer)	U.W. H. 150
45. <i>Nuculana waderensis</i> (Dickerson)	C.A.S. H. 252
46. <i>Nuculana merriami</i> (Dickerson)	C.A.S. H. 381
47. <i>Nuculana parkeri</i> (Anderson and Hanna) subsp. <i>coosensis</i> Turner	U.C. H. 33205
48. <i>Nuculana washingtonensis</i> (Weaver)	U.W. S. 85-86
49. <i>Nuculana chehalensis</i> (Weaver)	U.W. H. 43
50. <i>Nuculana ochseni</i> (Anderson and Martin) var. <i>elmana</i> Etherington	U.C. H. 31908
51. <i>Nuculana alkienensis</i> (Clark)	S.U. H. 7
52. <i>Nuculana fresnoensis</i> (Dickerson)	U.C. H. 11790
53. <i>Nuculana wilmettensis</i> (Shumard)	St.L.A.S.
54. <i>Nuculana impressa</i> (Conrad)	P.A.N.M. H. 3490
55. <i>Nuculana acuta</i> (Conrad)	P.A.N.S. H. ?
56. <i>Nuculana whitmani</i> (Dall)	U.S.N.M. H. 153970
57. <i>Yoldia (Portlandia) packardi</i> (Clark)	U.C. H. 11154
58. <i>Yoldia chehalensis</i> (Arnold)	U.S.N.M. H. 165447
59. <i>Yoldia (Portlandia) duplex</i> Weaver and Palmer	U.W. H. 151
60. <i>Yoldia olympiana</i> Clark	S.U. H. 10
61. <i>Yoldia newcombi</i> Anderson and Martin	C.A.S. H. 237
62. <i>Yoldia sammamishensis</i> Weaver	U.W. H. 44
63. <i>Yoldia clallamensis</i> n. sp.	U.S.N.M. H. 32095
64. <i>Yoldia (Portlandia) oregonia</i> (Shumard)	U.C. H.p. 10450
65. <i>Yoldia (Portlandia) cooperii</i> Gabb	U.C. H. 30613
66. <i>Yoldia temblorensis</i> Anderson and Martin	U.S.N.M. H. 31911
67. <i>Yoldia scissurata</i> Dall var. <i>strigata</i> Dall	U.S.N.M. H. 153951
68. <i>Yoldia reagani</i> Dall	U.S.N.M. H. 328303
69. <i>Malletia abruptia</i> (Conrad)	? H. Lost
70. <i>Portierius gibbi</i> (Dickerson)	C.A.S. H. 385
71. <i>Glycymeris sagittata</i> (Gabb)	U.C. H.p. 33089
72. <i>Glycymeris sagittata</i> (Gabb) var. <i>dickersoni</i> Weaver, Palmer	U.W. H. 156
73. <i>Glycymeris sagittata</i> (Gabb) var. <i>kelsoensis</i> Weaver, Palmer	U.W. H. 158
74. <i>Glycymeris eocenica</i> (Weaver)	U.W. H. 1
75. <i>Glycymeris eocenica</i> (Weaver) var. <i>tejonensis</i> (Weaver)	U.W. H. 3

**LIST OF FAUNA IN THE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON**

PELECYPODA (Continued)

Location of specimen	Type and museum number	Puget Group	Crescent formation	Cowellit formation	Tyee formation	Comstock formation	Fisher formation	Toldeo formation	Bassendorff formation	Keesey formation	Grimes Ranch beds	Tunnel Point beds	Vaduima formation	Eugene formation	Pittsburgh Bluff beds	Limcoln formation	Nye shale	Blakely formation	Astoria formation	Montesano formation	Empire formation	Cape Blanco beds	Quinault formation	Quillayute formation	Willapa Pleistocene	Pudget Sound Pleistocene	Sooke formation	Wildcat formation
	H. 157 H.P. 33658	X																										
	H. 383																											
	C.A.S.																											
	H. 30036																											
	U.C.																											
	H. 14790																											
	U.W.																											
	H. 87																											
	U.S.N.M.																											
	H. 153949B																											
	U.S.N.M.																											
	H. 107784																											
	H. 153949A																											
	U.C.																											
	H. 31902																											
	U.C.																											
	H. 33094																											
	C.A.S.																											
	H. 679																											
	C.A.S.																											
	H. 382																											
	U.W.																											
	H. 125																											
	U.W.																											
	H. 154																											
	U.W.																											
	H. 153																											
	U.W.																											
	H. 11984																											
	U.C.																											
	H. 33504																											
	U.S.N.M.																											
	H. 153948																											
	U.S.N.M.																											
	H. 1844																											
	U.P.																											
	H. 3497																											
	U.S.N.M.																											
	H. 3499																											
	U.C.																											
	H. 11925																											
	U.S.N.M.																											
	H. 31922																											
	H. 13330																											
	H. 5249																											
	H. 3579																											
	H. 16																											
	U.C.																											
	P. 33514																											
	H. 159																											
	H. 160-A																											
	H. 5																											

Original from  
UNIVERSITY OF MICHIGAN

108.	<i>Ostrea lincolnensis</i> Weaver	U.W.	H. 88
109.	<i>Ostrea griesensis</i> Effinger	U.C.	H. 33510
110.	<i>Ostrea titan</i> Conrad	U.S.N.M.	Hp. 153955
111.	<i>Ostrea sookensis</i> Clark and Arnold	C.A.S.	Lost
112.	<i>Pecten (Chlamys) landesi</i> Arnold	U.S.N.M.	H. 591
113.	<i>Pecten (Chlamys) cowtitzensis</i> Weaver	U.W.	H. 164926
114.	<i>Pecten (Chlamys) columbianum</i> Clark and Arnold	U.C.	H. 6
115.	<i>Pecten (Chlamys) grunskyi</i> Hertlein	C.A.S.	30056
116.	<i>Pecten (Chlamys) corrugatus</i> Clark and Arnold	U.C.	H. 424
117.	<i>Pecten (Chlamys) washburnei</i> Arnold	U.S.N.M.	H. 30059
118.	<i>Pecten (Vertipecten) portoricensis</i> Weaver	U.W.	H. 164843
119.	<i>Pecten (Vertipecten) menadensis</i> Conrad var. <i>fucanus</i> Dall	U.S.N.M.	S. 45
120.	<i>Pecten (Plagiopecten) andersoni</i> Arnold subsp. <i>clementensis</i> Etherington	U.C.	Ph.107790
121.	<i>Pecten (Plagiopecten) alcockianensis</i> Weaver	U.W.	H. 31933
122.	<i>Pecten (Plagiopecten) neahensis</i> Arnold	U.S.N.M.	H. 46
123.	<i>Pecten (Patinopecten) propatulus</i> Conrad	U.S.N.M.	H. 164843?
124.	<i>Pecten (Patinopecten) coosensis</i> Shumard	U.S.N.M.	5912
125.	<i>Pecten (Patinopecten) oregonensis</i> Howe	S.U.	H. Conrad
126.	<i>Pecten (Pseudamusium) vanwinkleae</i> Clark	S.U.	col.
127.	<i>Pecten (Propeamussium) clallamensis</i> Arnold	S.U.	Hp. 107791
128.	<i>Pecten (Propeamussium) waylandi</i> Arnold	U.S.N.M.	H. 25
129.	<i>Pallidium (Delectopecten) vancouverensis</i> (Whiteaves) subsp. <i>sanjanensis</i> (Clark and Arnold)	U.S.N.M.	H. 5226
130.	<i>Pallidium (Delectopecten) peckhami</i> (Gabb)	U.C.	H. 164922
131.	<i>Lima bella</i> Dickerson	C.A.S.	H. 164924
132.	<i>Lima oakensis</i> Clark	S.U.	H. 30221
133.	<i>Lima oregonensis</i> Clark	U.C.	L. 15045
134.	<i>Lima packardi</i> Weaver and Palmer	U.W.	L. 400
135.	<i>Anomia mcgonigleensis</i> Hanna	U.C.	H. 30303
136.	<i>Pododesmus newcombei</i> Clark and Arnold	U.C.	H. 162 Lost
137.	<i>Pododesmus ornatus</i> (Gabb)	U.C.	C. 31012
138.	<i>Mytilus sammamishensis</i> Weaver	P.A.N.S.	H. 30041
139.	<i>Mytilus snokomishensis</i> Weaver	U.W.	P. 4442
140.	<i>Mytilus stillaguamishensis</i> Weaver	U.W.	H. 47
141.	<i>Mytilus fucus</i> Dall	U.S.N.M.	H. 49
142.	<i>Mytilus brasiliana</i> Van Winkle	U.W.	H. 30043
143.	<i>Mytilus hammonia</i> Clark and Arnold	U.C.	H. 24
144.	<i>Mytilus washingtonensis</i> Clark	S.U.	H. 30044
145.	<i>Mytilus (Mytiloconcha?) vancouverensis</i> Clark and Arnold	U.C.	H. 30240
146.	<i>Mytilus (Mytiloconcha) mathewsonii</i> Gabb	U.C.	H. 31938
147.	<i>Mytilus watersi</i> Etherington	U.W.	H. 163
148.	<i>Mytilus stiliwaterensis</i> Weaver and Palmer	U.W.	H. 127
149.	<i>Mytilus dichotomus</i> Cooper	U.C.	H. 30043
150.	<i>Volsella directa</i> (Dall)	U.S.N.M.	H. 33224
151.	<i>Volsella pugilensis</i> (Dall)	U.S.N.M.	H. 153947
152.	<i>Volsella restorationensis</i> (Van Winkle)	U.W.	H. 153890
153.	<i>Volsella trinominala</i> (Hanna)	U.S.N.M.	H. 128
			H. 153946

**LIST OF FAUNA IN THE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON**

PELECYPODA (Continued)

Type and museum number	Location of specimen	Puglet group	Crescent formation	Cowbitz formation	Cowbitz f. at Black	Cowbitz f. at Duwamish	Umpqua formation	Tyee formation	Caldeido formation	Comstock formation	Fisher formation	Toledo formation	Bassendof formation	Keesey formation	Gries Ranch beds	Eugeene formation	Yaquma formation	Tumel Point beds	Limcoln formation	Nye shale	Blakely formation	Astoria formation	Montesano formation	Empire formation	Cape Blanca beds	Quillayute formation	Willapa Pleistocene	Pudget Sound Pleistocene	Sooke formation	Widcat formation
H. 30256 H. 26	U.C. S.U.	U.C. U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 30319	U.C.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 166	U.W.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 167	U.W.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 165	U.W.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 164	U.W.	U.C.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 32728	U.C.	U.C.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 89	S.U.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 90	U.W.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 3604	U.S.N.M.	U.S.N.M.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 32113	U.C.	U.S.N.M.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 110460	U.S.N.M.	U.S.N.M.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 107399	U.C.	U.C.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 33659	U.C.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 91	U.W.	U.C.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 32114	U.C.	U.C.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 32134	U.C.	U.C.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 32225	U.C.	U.C.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 7 Lost	U.W.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 93	U.W.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 94	U.W.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 33628	U.C.	U.C.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
S. 480A	C.A.S.	C.A.S.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 168	U.W.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 390	U.W.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 92B	U.W.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 704	U.W.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 10	U.W.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 13	U.W.	U.W.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 33103	U.C.	U.C.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
H. 20106	U.S.N.M.	U.S.N.M.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
S. 20100	U.S.N.M.	U.S.N.M.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

188.	<i>Corbicula willisi</i> White.	(Clark and Arnold)	U.S.N.M. C.A.S.	S. 20105 H. 586
189.	<i>Corbicula sookeensis</i> (Clark and Arnold)		U.S.N.M.	H. 20097
190.	<i>Batissa dubia</i> White.		U.S.N.M.	H. 20108
191.	<i>Batissa newberryi</i> White.		U.C.	H.p. 33129
192.	<i>Venericardia horrida</i> (Gabb) subsp. <i>calafaya</i> Stewart.		U.C.	H. 33133
193.	<i>Venericardia horrida</i> (Gabb) subsp. <i>luteum</i> Turner.		U.W.	H. 169
194.	<i>Venericardia horrida</i> (Gabb) subsp. <i>clarkii</i> Weaver, Palmer.		C.A.S.	P. 241
195.	<i>Venericardia aragonia</i> Arnold and Hannibal.		U.W.	H. 170
196.	<i>Venericardia crescentensis</i> Weaver and Palmer.		U.C.	H. 32147
197.	<i>Venericardia hawaii</i> Tegland.		S.U.	H. 32
198.	<i>Venericardia hannibali</i> Clark.		U.S.N.M.	H. 153936
199.	<i>Venericardia caslori</i> Dall.		U.S.N.M.	H. 3502
200.	<i>Venericardia subtilis</i> (Conrad).		C.A.S.	H. 386
201.	<i>Cardita (Carditamera) weaversi</i> Dickerson.		U.S.N.M.	H. 3518
202.	<i>Thyasira bisecta</i> (Conrad).		M.C.Z.	L. 15017
203.	<i>Thyasira disjuncta</i> (Gabb).		U.S.N.M.	H. 3519
204.	<i>Lucina acutifilosa</i> Conrad.		S.U.	H. 33
205.	<i>Lucina hannibali</i> (Clark).		U.C.	H. 33142
206.	<i>Lucina columbiana</i> (Clark and Arnold).		U.C.	H. 11682
207.	<i>Lucina (Here) dalli</i> (Dickerson).		U.S.N.M.	H.p. 153930
208.	<i>Lucina (Here) aragonis</i> Turner.		C.A.S.	H. 444
209.	<i>Lucina pacifica</i> Dickerson.		U.C.	H. 33145
210.	<i>Lucina roseburgensis</i> Hendon.		U.C.	H.p. 32823
211.	<i>Lucina washingtonensis</i> Turner.		U.C.	H. 33665
212.	<i>Lucina murensis</i> (Dickerson).		U.C.	H. 35
213.	<i>Taras parvus</i> (Conrad).		S.U.	H. 399
214.	<i>Taras</i> sp. (Dickerson).		C.A.S.	H. 5236
215.	<i>Taras griesensis</i> Effinger.		U.C.	H. 33520
216.	<i>Chama grunskyi</i> Hanna.		S.U.	H. 35
217.	<i>Kellia twinensis</i> Clark.		P.A.N.S.	L. 4560
218.	<i>Corbis washingtoniana</i> Clark.		U.W.	H. 171
219.	<i>Loxocardium (Schedocardia) breweri</i> (Gabb) var. <i>oldroydi</i> (Weaver and Palmer).		U.W.	X
220.	<i>Loxocardium (Schedocardia) olequahensis</i> (Weaver).		U.C.	H. 33524
221.	<i>Loxocardium (Schedocardia) etherringtoni</i> Effinger.		P.A.N.S.	H. 4497
222.	<i>Cerastoderma meekianum</i> (Gabb).		U.C.	H.p. 31942
223.	<i>Cerastoderma corbis</i> (Martyn).		U.S.N.M.	H. 153933
224.	<i>Cerastoderma corbis</i> (Martyn).		C.A.S.	H. 680
225.	<i>Cerastoderma coosense</i> (Dall).		U.C.	H. 30291
226.	<i>Cerastoderma scapoense</i> (Clark).		U.C.	H.p. 33157
227.	<i>Cerastoderma sookeensis</i> (Clark and Arnold).		U.W.	H. 165444
228.	<i>Nemocardium lineatum</i> (Conrad).		C.A.S.	H. 113
229.	<i>Nemocardium lorenzatum</i> (Arnold).		U.C.	H. 30304
230.	<i>Nemocardium lincolnense</i> (Weaver).		St.L.A.S.	H. Lost
231.	<i>Nemocardium weaveri</i> (Anderson and Martin).		U.S.N.M.	H. 143944
232.	<i>Nemocardium engelense</i> (Clark).		U.W.	H. 3611
233.	<i>Chione securis</i> (Shumard).		C.A.S.	H. 51 Lost
234.	<i>Chione parapodema</i> (Dall).		U.W.	P. 52
235.	<i>Chione ensifera</i> (Dall).		U.W.	H. 683
236.	<i>Chione ensifera</i> (Dall) var. <i>chehalensis</i> Weaver.		C.A.S.	X
237.	<i>Chione monesanoensis</i> Weaver.			X
238.	<i>Chione carmanahensis</i> Clark.			X

**LIST OF FAUNA IN THE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON**

PELECYPODA (Continued)

Type and museum number	Location of specimen	Pugeot group	Crescent formation	Tyee formation	Comstock formation	Fisher formation	Toledo formation	Bassendorff formation	Keesey formation	Grits Ranch beds	Tunnel Point beds	Yaquma formation	Eugene formation	Pittsburgh Bluff beds	Lincoln formation	Nye shale	Astoria formation	Montesano formation	Cape Blanco beds	Quimault formation	Willapa Pleistocene	Pudget Sound Pleistocene	Sooke formation	Wildcat formation
U.C. H. 30052 H. 153941 U.S.N.M. U.S.N.M. U.S.N.M. U.S.N.M.	U.C. "Venus ( <i>Chione?</i> ) <i>olympidea</i> " Reagan 240. <i>Chione basculpta</i> Dall 241. "Venus ( <i>Chione?</i> ) <i>olympidea</i> " Reagan 242. <i>Venerupis (Protolhaca) staleyi</i> (Gabb) 243. <i>Venerupis (Protolhaca) staleyi</i> (Gabb) var. <i>hannibali</i> (Howe) 244. ? <i>Venerupis washingtoniana</i> (Weaver) 245. <i>Microcalista (Costacallista) corradiana</i> (Gabb) 246. <i>Microcalista (Costacallista) corradiana</i> (Gabb) var. 247. <i>Macrocalista williamsoni</i> Weaver and Palmer 248. <i>Macrocalista andersoni</i> Dickerson 249. <i>Macrocalista pittsburghensis</i> (Dall) 250. <i>Macrocalista cathartensis</i> (Weaver) 251. <i>Macrocalista weaveri</i> Clark 252. <i>Pitar californiana</i> (Conrad) 253. <i>Pitar (Calpitaria) wasanus</i> (Conrad) 254. <i>Pitar (Calpitaria) wasanus</i> (Conrad) subsp. <i>cognillensis</i> Turner 255. <i>Pitar (Calpitaria) wasanus</i> (Conrad) subsp. <i>dupreii</i> Hendon 256. <i>Pitar quadratus</i> (Gabb) 257. <i>Pitar oregonensis</i> (Conrad) 258. <i>Pitar dolii</i> (Weaver) 259. <i>Pitar vancouverensis</i> (Merriam) 260. <i>Pitar stocki</i> (Weaver and Palmer) 261. <i>Pitar (Lamelliconcha) clarki</i> (Dickerson) 262. <i>Pitar (Lamelliconcha) eoce nica</i> (Weaver and Palmer) 263. <i>Pitar (Katherinella) arnoldi</i> (Weaver) 264. <i>Pitar (Katherinella) arnoldi</i> (Weaver) subsp. <i>etheringtoni</i> Tegland 265. <i>Eomeretrix marina</i> (Dickerson) 266. <i>Tivelina vaderensis</i> (Dickerson) 267. <i>Pachydesma weaveri</i> (Dickerson) 268. <i>Pachydesma gastronensis</i> (Clark)																							

269.	<i>Pachydesma aragoensis</i> Turner	U.C.	H. 33114
270.	<i>Pachydesma creveneri</i> n. sp.	U.C.	H. 32966
271.	<i>Marcia angustifrons</i> (Conrad)	U.S.N.M.	H. 3492
272.	<i>Marcia angustifrons</i> (Conrad) var. <i>brevilineata</i> (Hanna)	U.S.N.M.	H. 3608
273.	<i>Marcia</i> ( <i>Mercimonia</i> ) <i>bunkeri</i> (Hanna)	U.C.	Hp. 33666
274.	<i>Venerella</i> ( <i>Compsomyx</i> ) <i>newcombei</i> (Merriam)	U.C.	H. 11932
275.	<i>Pelecyora aequilateralis</i> (Gabb)	M.C.Z.	L. 15039
276.	<i>Pelecyora cf. gabbii</i> (Arnold)	U.C.	Hp. 33119
277.	<i>Pelecyora victoriana</i> (Clark and Arnold)	U.C.	H. 30410
278.	<i>Tellina townsendensis</i> Clark	S.U.	H. 5208
279.	<i>Tellina solidaeensis</i> Hanna	U.W.	Hp. 33148
280.	<i>Tellina jollaensis</i> Dickerson	U.C.	Hp. 30972
281.	<i>Tellina castacana</i> Anderson and Hanna	U.W.	H. 99
282.	<i>Tellina cordilobensis</i> Weaver	U.W.	H. 98
283.	<i>Tellina lineolothensis</i> Weaver	U.W.	H. 130
284.	<i>Tellina gibsonensis</i> Van Winkle	C.A.S.	P. 705
285.	<i>Tellina pitshurgensis</i> Clark	S.U.	H. 5218
286.	<i>Tellina kamakawaensis</i> Clark	U.W.	H. 110459
287.	<i>Tellina engenia</i> Dall	U.S.N.M.	C.A.S.
288.	<i>Tellina vancouverensis</i> Clark and Arnold	U.W.	H. 599
289.	<i>Tellina bodegensis</i> Hinds n. subsp.? Clark and Arnold	U.W.	H. 597
290.	<i>Tellina merriami</i> Weaver	U.W.	H. 55A
291.	<i>Tellina kincaidi</i> Weaver	U.S.N.M.	H. 153940
292.	<i>Tellina aragonia</i> Dall	U.C.	H. Lost
293.	<i>Tellina obruta</i> Conrad	U.W.	H. 3529A
294.	<i>Tellina nuculana</i> Dall	U.S.N.M.	H. 3494
295.	<i>Tellina emarginata</i> Conrad	U.C.	H. 30212
296.	<i>Macoma sookensis</i> Clark and Arnold	U.C.	H. 32160
297.	<i>Macoma lorenzoensis</i> (Arnold) subsp. <i>arnoldi</i> Tegland	U.C.	H. 58
298.	<i>Macoma smohomishensis</i> Weaver	U.S.N.M.	H. 3489
299.	<i>Macoma arcuata</i> (Conrad) var.	U.W.	H. 59
300.	<i>Macoma arcuata</i> (Conrad) var. <i>wynooccheensis</i> Weaver	U.W.	H. 57
301.	<i>Macoma montesanoensis</i> Weaver	S.U.	H. 48
302.	<i>Macoma twinnensis</i> Clark	U.C.	H. 31973
303.	<i>Macoma indentata</i> Etherington	U.C.	Hp. 33325
304.	<i>Macoma andersoni</i> Clark	U.S.N.M.	H. 154088
305.	<i>Macoma moliniana</i> Dall	U.S.N.M.	H. 153935
306.	<i>Macoma calarea</i> (Gmelin)	U.S.N.M.	H. 153937
307.	<i>Macoma astori</i> Dall	U.S.N.M.	H. Lost
308.	<i>Macoma nasuta</i> (Conrad)	U.S.N.M.	H. 328341
309.	<i>Macoma inquinata</i> (Deshayes) var. <i>arnheimii</i> Dall	C.A.S.	H. 389
310.	<i>Gari martini</i> (Dickerson)	U.W.	H. 176
311.	<i>Gari coerulea</i> (Weaver and Palmer)	U.W.	H. 175
312.	<i>Gari columbiana</i> (Weaver and Palmer)	U.W.	H. 177
313.	<i>Gari oregonensis</i> (Weaver and Palmer)	U.S.N.M.	H. 20102
314.	<i>Gari obscura</i> (White)	U.C.	Hp. 33357
315.	<i>Gari hornii</i> (Gabb)	U.C.	H. 33149
316.	<i>Gari hornii</i> (Gabb) subsp. <i>umpquaensis</i> Turner	U.S.N.M.	S. 20096
317.	<i>Sanguinolaria caudata</i> White	C.A.S.	H. 271
318.	<i>Sanguinolaria howardi</i> (Dickerson)	S.U.	H. 50
319.	<i>Sanguinolaria townsendensis</i> Clark	C.A.S.	H. 588
320.	<i>Apolmetis vancouverensis</i> (Clark and Arnold)		

**LIST OF FAUNA IN THE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON**

PELECYPODA (Continued)

Type and museum number	Location of specimen	Puget group	Crescent formation	Cowbitz formation	Cowbitz f. at Black	Cowbitz f. at Duwamish	Umpqua formation	Tyee formation	Coldedo formation	Fisher formation	Toledo formation	Bassendorff formation	Keesey formation	Tunnel Point beds	Yaqumua formation	Eugene formation	Pittsburg Buff beds	Nye shale	Blakely formation	Astoria formation	Montesano formation	Cape Blanco beds	Quinault formation	Willapa Pleistocene	Pudget Sound Pleistocene	Sooke formation	Wildcat formation
H. 396 H.p. 33639 U.C. H. 30226 U.C. H. 61 U.W. H. 60 A U.W. H. 51 S.U. H. 30242 U.W. S. 100 A U.W. H. Lost H. 153934 U.S.N.M. U.W. H. 179 U.W. H. 178 U.C. H. 33117 H.p. 33424 U.C. H. 30338 U.S.N.M. C.A.S. H. 156887 U.C. H. 395 C.A.S. H. 33101 U.C. H. 33096 U.C. H. 33099 U.C. H. 33097 U.C. H. 33383 U.C. H. 5202 U.C. H. 32197 U.C. H. 5215 S.U. H. 57 U.S.N.M. U.C. H. 30066 U.C. H. 30062 U.C. H. 31979 U.S.N.M. H. 328342 C.A.S. H. 688																											
321. <i>Semele reaganii</i> Dickerson.....	C.A.S.																										
322. <i>Semele diahloii</i> Dickerson.....	U.C.																										
323. <i>Semele vancouverensis</i> Clark and Arnold.....	U.C.																										
324. <i>Semele syriacaensis</i> Weaver.....	U.W.																										
325. <i>Semele montesanoensis</i> Weaver.....	U.W.																										
326. <i>Solen townsendensis</i> Clark.....	S.U.																										
327. <i>Solen clallamensis</i> Clark and Arnold.....	U.C.																										
328. <i>Solen lincolnensis</i> Weaver.....	U.W.																										
329. <i>Solen curtius</i> Conrad.....	U.S.N.M.																										
330. <i>Solen curtius</i> Conrad var. <i>conradii</i> Dall.....	U.W.																										
331. <i>Solena columbiana</i> (Weaver and Palmer)	U.S.N.M.																										
332. <i>Solena clarkei</i> (Weaver and Palmer)	U.W.																										
333. <i>Solena coosensis</i> Turner.....	U.C.																										
334. <i>Solena sicarius</i> (Gould)	U.C.																										
335. <i>Solena eugenensis</i> (Clark)	U.S.N.M.																										
336. <i>Siliqua patula</i> Dixon var. <i>oregona</i> Dall.....	C.A.S.																										
337. <i>Spisula packardi</i> Dickerson.....	U.C.																										
338. <i>Spisula packardi</i> Dickerson var. <i>yokamensis</i> Turner.....	U.C.																										
339. <i>Spisula acutirostrata</i> Packard var.? Turner.....	U.C.																										
340. <i>Spisula rusti</i> Wagner and Schilling var. <i>aragensis</i> Turner.....	U.C.																										
341. <i>Spisula merriami</i> Packard.....	U.C.																										
342. <i>Spisula merriami</i> Packard var. <i>longifrons</i> Turner.....	U.C.																										
343. <i>Spisula bicuspidata</i> Anderson and Hanna.....	U.C.																										
344. <i>Spisula pittsburghensis</i> Clark.....	S.U.																										
345. <i>Spisula pittsburghensis</i> Clark subsp. <i>frustra</i> Tegland.....	U.C.																										
346. <i>Spisula veniformis</i> Clark.....	S.U.																										
347. <i>Spisula tennesseensis</i> Clark.....	S.U.																										
348. <i>Spisula (Hemimactra) precursor</i> Dall.....	U.S.N.M.																										
349. <i>Spisula (Hemimactra) sookeensis</i> Clark and Arnold.....	U.C.																										
350. <i>Spisula (Hemimactra) kannabali</i> Clark and Arnold.....	U.C.																										
351. <i>Spisula (Machromeris) albaria</i> (Conrad).....	U.C.																										
352. <i>Spisula (Machromeris) albaria</i> (Conrad) subsp. <i>arnoldi</i> (Dall).....	U.S.N.M.																										
353. <i>Spisula (Machromeris) albaria</i> (Conrad) subsp. <i>scapoensis</i> Clark.....	C.A.S.																										

354. <i>Spisula (Mactromeris) albaria</i> (Conrad) subsp. <i>oregonensis</i> Clark	C.A.S.	H. 701
355. <i>Spisula (Mactromeris) albaria</i> (Conrad) var. <i>coosensis</i> Howe.	U.C.	H. 30028
356. <i>Spisula (Mactromeris) albaria</i> (Conrad) subsp. <i>goodspeedi</i> Etherington	U.C.	H. 31980 H. 107406
357. <i>Ervilia oregonensis</i> Dall	C.A.S.	H. 1746
358. <i>Anatina?</i> <i>roseburrensis</i> Hendon.	U.C.	H. 30372
359. <i>Pseudocardium eugeneense</i> (Clark)	U.C.	H. 30325
360. <i>Pseudocardium yaquiniense</i> (Clark)	U.W.	H. 62
361. <i>Pseudocardium densata</i> (Conrad) var. <i>alutum</i> Weaver	U.S.N.M.	H. 153927
362. <i>Pseudocardium oregonense</i> (Dall)	U.W.	H. 65
363. <i>Pseudocardium unduliferum</i> Weaver	U.C.	P. 30219
364. <i>Pseudocardium newcombei</i> (Clark and Arnold)	U.W.	H. 66
365. <i>Pseudocardium landesi</i> Weaver	U.S.N.M.	L. 328351
366. <i>Pseudocardium olympica</i> (Dall)	U.S.N.M.	H. 13318
367. <i>Schizothaerus nthaliae</i> (Conrad) var. <i>pajaroensis</i> (Conrad)	U.S.N.M.	H. 30061
368. <i>Playdon cancellata</i> (Conrad)	U.C.	H. 225
369. <i>Myadesma dalli</i> Clark	S.U.	
370. <i>Myadesma howei</i> Clark	U.C.	H. 30328
371. <i>Cryptomya quadrata</i> Arnold subsp. <i>vancouverensis</i>	C.A.S.	H. 585
Clark and Arnold	U.W.	H. 67
372. <i>Cryptomya washingtoniana</i> Weaver	U.S.N.M.	H. 153931
373. <i>Cryptomya oregonensis</i> Dall	U.S.N.M.	P. 328352
374. <i>Mya arenaria</i> Linnaeus var. <i>japonica</i> Jay	C.A.S.	H. 388
375. <i>Mya (Artigamya) arnoldi</i> (Dickerson)	U.S.N.M.	H. 153956
376. <i>Mya truncata</i> Linnaeus	C.A.S.	H. 391
377. <i>Corbula coulitzensis</i> Dickerson	U.C.	H. 33151
378. <i>Corbula parilis</i> Gabb	U.W.	H. 180
379. <i>Corbula hornii</i> Gabb	U.C.	H. 181 Lost
380. <i>Corbula dickersoni</i> Weaver and Palmer	U.W.	H. 33159
381. "Corbula" <i>stillwaterensis</i> Weaver and Palmer	U.C.	H. 33156
382. <i>Corbula complicata</i> G. D. Hanna	U.C.	H. 33646
383. <i>Corbula torreensis</i> Hanna	U.C.	H. Lost
384. <i>Corbula evansana</i> Shumard	U.W.	H. 183
385. <i>Phaeomya vaderensis</i> Weaver and Palmer	S.U.	H. 59
386. <i>Panope sphaeromisensis</i> Clark	U.C.	H. 32199
387. <i>Panope generosa</i> Gould	U.S.N.M.	H. 154093
388. <i>Panope (Panomya) amplia</i> (Dall) var. <i>chrysis</i> (Dall)	U.W.	H. 365
389. <i>Panope ramonensis</i> Clark	U.C.	H. 30065
390. <i>Zirfaea</i> sp. Clark and Arnold		
391. <i>Pholadidea californica</i> (Conrad)	U.S.N.M.	H. 153957
392. <i>Pholadidea penita</i> (Conrad)	U.S.N.M.	H. 20107
393. "Teredo praelensis" White		
394. "Teredo" sp. Clark and Arnold		

#### SCAPHOPODA

395. <i>Dentalium stramineum</i> Gabb	U.S.N.M.	S. 3528
396. <i>Dentalium petricola</i> Dall	S. 3481	
397. <i>Dentalium contradi</i> Dall	H. 3481	
398. <i>Dentalium porteri</i> Weaver	H. 81	

**LIST OF FAUNA IN THE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON**

Location of specimen	Type and museum number	Puget group	Fisher formation	Tyee formation	Cowpita formation	Cowpita f. at Duwamish	Cowpita f. at Bach	Crescent formation	Bassendort formation	Keesey formation	Grits Ranch beds	Tunnel Point beds	Yadquina formation	Eugene formation	Pittsburgh Buff beds	Lincroft formation	Nye shale	Blakely formation	Astoria formation	Montesano formation	Empire formation	Cape Blanco beds	Oumatuck formation	Willapa Pleistocene	Sooke formation	Wildcat formation	
GASTROPODA																											
399. <i>Acmaea ocellata</i> Hanna.....	C.A.S. H. 440																										
400. <i>Acmaea geometrica</i> (Merriam).....	U.C. H. 11933																										
401. <i>Acmaea hannithali</i> Clark and Arnold.....	U.C. H. 30213																										
402. <i>Acmaea mitra</i> Eschscholtz subsp. <i>sookeensis</i> Clark, Arnold.....	U.C. H. 30071																										
403. <i>Acmaea persona</i> Eschscholtz subsp. <i>vancouverensis</i> Clark and Arnold.....	U.C. H. 30216																										
404. <i>Acmaea victoriana</i> Clark and Arnold.....	U.C. H. 30290	X																									
405. <i>Acmaea simplex</i> Dickerson.....	C.A.S. H. 438																										
406. <i>Acmaea dickersoni</i> Van Winkle.....	U.W. H. 132																										
407. <i>Acmaea oakmillerensis</i> Van Winkle.....	U.W. H. 131																										
408. <i>Diadora stillwaterensis</i> (Weaver and Palmer).....	U.W. H. 184																										
409. <i>Megalhra vancouverensis</i> Clark and Arnold.....	U.C. H. 30077																										
410. <i>Puncturella?</i> sp. Clark and Arnold.....	U.C. H. 30217																										
411. <i>Callostoma mea</i> Tegland.....	U.C. H. 32223																										
412. <i>Callostoma pacificum</i> Anderson and Martin.....	C.A.S. H. 134																										
413. <i>Callostoma delezinensis</i> Weaver.....	U.W. N. 70																										
414. <i>Callostoma cammani</i> Dall.....	U.S.N.M. H. 107776																										
415. <i>Turicica gibbi</i> Dall.....	U.S.N.M. H. 153968																										
416. <i>Tegula (Chlorostoma) arnoldi</i> (Weaver).....	U.W. H. 69 Lost																										
417. <i>Tegula (Chlorostoma) lahontaeensis</i> (Arnold) var. <i>stantoni</i> Dall.....	U.S.N.M. H. 107777																										
418. <i>Margarites (Lirularia) condonii</i> Dall.....	U.S.N.M. H. 153922																										
419. <i>Turicula washingtoniana</i> Dall.....	U.S.N.M. H. 110448																										
420. <i>Turicula columbiana</i> Dall.....	U.S.N.M. H. 107397																										
421. <i>Solariella olequatensis</i> Weaver and Palmer.....	U.W. H. 185																										
422. <i>Solariella crescentensis</i> Weaver and Palmer.....	U.W. H. 186																										
423. <i>Solariella kincaidi</i> Tegland.....	U.C. H. 32260																										
424. <i>Nerita contorta</i> Dickerson.....	C.A.S. H. 290																										
425. <i>Nerita washingtoniana</i> Weaver and Palmer.....	U.W. H. 187																										
426. <i>Nerita triangulata</i> Gabb var. <i>oregonensis</i> Turner.....	U.C. H. 33204																										
427. <i>Nerita martini</i> Dickerson.....	C.A.S. H. 291																										
428. <i>Astraea (Pachypoma) inaequalis</i> (Martyn).....	U.S.N.M. H. 153919																										
429. <i>Homalopoma pacifica</i> (Anderson and Martin).....	U.C. H. 31982																										
430. <i>Homalopoma wallisi</i> (Dickerson).....	U.C. H. 33212																										
431. <i>Homalopoma umphquensis</i> Merriam and Turner.....	U.C. H. 33207																										
432. <i>Homalopoma</i> sp. Effinger.....	U.C. H. 33555																										

433.	<i>Homalopoma vancouverensis</i> (Clark and Arnold)	U.C.	H. 30206
434.	<i>Cirsachilus washingtonianus</i> Effinger	U.C.	H. 33553
425.	<i>Liotia weaveri</i> Effinger	U.C.	H. 33556
436.	<i>Melanella clarki</i> (Dickerson)	C.A.S.	H. 433
437.	<i>Melanella</i> sp. Effinger	U.C.	H. 33558
438.	<i>Melanella dilleri</i> (Anderson and Martin)	C.A.S.	H. 140
439.	<i>Strombiformis washingtoni</i> (Reagan)	U.S.N.M.	H. 328368
440.	<i>Turbonilla (Pyrgolampris) rockensis</i> Etherington	U.C.	H. 32037
441.	<i>Pyramidella vaderensis</i> Weaver and Palmer	U.W.	S. 188-A
442.	<i>Pyramidella precursor</i> G. D. Hanna	U.W.	H. 134
443.	<i>Pyramidella (Synnola) dilleri</i> (Anderson and Martin)	C.A.S.	H. 140
444.	<i>Odostomia winlockiana</i> Effinger	U.C.	H. 33565
445.	<i>Odostomia hiltoni</i> (Van Winkle)	U.C.	H. 33562
446.	<i>Odostomia griesensis</i> Effinger	U.C.	H. 33564
447.	<i>Odostomia (Endea) pleioregona</i> Bartsch	U.S.N.M.	H. 252430
448.	<i>Odostomia (Endea) orfordensis</i> Bartsch	U.C.	H. 252431
449.	<i>Mathilda umphquensis</i> Turner	U.C.	H. 3218
450.	<i>Epitonium (Gyroscalum) effingeri</i> Durham	U.C.	H. 30146
451.	<i>Epitonium (Clathrus) weaveri</i> Durham	C.A.S.	H. 7002
452.	<i>Epitonium (Cirsotrema) clallamense</i> Durham	C.A.S.	H. 7003
453.	<i>Epitonium (Cirsotrema) saundersi</i> Tegland	U.C.	H. 32227
454.	<i>Epitonium (Boreoscalum) howei</i> Durham	C.A.S.	H. 7004
455.	<i>Epitonium (Boreoscalum) earthurneri</i> Durham	U.C.	H. 30154
456.	<i>Epitonium (Boreoscalum) insecuritum</i> Hanna	U.W.	H. 189 Lost
457.	<i>Epitonium (Boreoscalum) condoni</i> Dall	U.S.N.M.	H. 135122
458.	<i>Epitonium (Boreoscalum) condoni</i> Dall var. <i>eugenense</i> Durham	C.A.S.	H. 7006
459.	<i>Epitonium (Boreoscalum) condoni</i> Dall var. <i>hadlockense</i> Durham	U.C.	H. 30162
460.	<i>Epitonium (Boreoscalum) condoni</i> Dall var. <i>oregonense</i> Dall	U.S.N.M.	H. 135123
461.	<i>Epitonium (Boreoscalum) condoni</i> Dall var. <i>woodmanense</i> Durham	U.C.	H. 30158
462.	<i>Epitonium (Boreoscalum) condoni</i> Dall var. <i>janeirobertsae</i> Durham	U.C.	H. 30135
463.	<i>Epitonium (Boreoscalum) condoni</i> Dall var. <i>townsendense</i> Durham	U.C.	H. 30157
464.	<i>Epitonium (Boreoscalum) condoni</i> Dall var. <i>refulleri</i> Durham	U.C.	H. 30160
465.	<i>Epitonium (Boreoscalum) condoni</i> Dall subsp. <i>schenckii</i> Durham	S.U.	H. 498
466.	<i>Epitonium (Boreoscalum) keaseyense</i> Durham	S.U.	H. 497
467.	<i>Epitonium (Boreoscalum) keaseyense</i> Durham subsp.	C.A.S.	H. 326
468.	<i>Epitonium (Boreoscalum) coosense</i> Durham	U.C.	H. 7007
469.	<i>Epitonium (Sthenorvius) crescentense</i> Durham	U.S.N.M.	H. 30164
470.	<i>Opalia (Opalia) rugifera</i> (Dall)	U.C.	H. 135121
471.	<i>Opalia (Opalia) bravenderi</i> Durham	C.A.S.	H. 30167
472.	<i>Opalia (Opalia) wishkahensis</i> Durham	U.C.	H. 7008
473.	<i>Opalia (Rugatiscala) corallizensis</i> Durham	U.C.	H. 30171

**LIST OF FAUNA IN THE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON**

GASTROPODA (Continued)

Type and museum number	Location of specimen	Puget group	Crescent formation	Cowellit at Black	Cowellit at Duwamish	Umpqua formation	Fisher formation	Comstock formation	Tyne formation	Coalbed formation	Toledo formation	Bassendorff formation	Kearsey formation	Gretz Ranch beds	Tumel Point beds	Yadumia formation	Eugene formation	Pittsburgh Bluff beds	Lincolin formation	Nye shale	Blakely formation	Astoria formation	Montesano formation	Empire formation	Cape Blanca beds	Oquinault formation	Willapa Pleistocene	Pudget Sound Pleistocene	Sooke formation	Wildcat formation
H. 33237 H. 30183	U.C. U.C.																													
H. 30169	U.C.																													
H. 432	C.A.S.																													
H. 464	C.A.S.																													
H. 557	C.A.S.																													
H. 30185	C.A.S.																													
H. 426	C.A.S.																													
H. 153991	U.S.N.M.																													
H. 190 Lost	U.W.																													
H. 153917	U.S.N.M.																													
H. 153914	U.P.																													
H. 31997	U.C.																													
H. 31996	U.C.																													
H. 32215	U.C.																													
H. 32183	U.C.																													
H. 136	U.W.																													
H. 4214	P.A.N.S.																													
H. 582	C.A.S.																													
H. 32191	U.C.																													
H. 11829	U.C.																													
H. 103	U.W.																													
H. 463	C.A.S.																													
H. 193A	U.W.																													
H. 27859	M.C.Z.																													
H. 278	C.A.S.																													
H. 411	C.A.S.																													
H. 30204	U.C.																													
H. 4212	P.A.N.S.																													
H. 12539	U.S.N.M.																													
H. 4213	P.A.N.S.																													
H. 281	C.A.S.																													

507.	<i>Polinices (Euspira) galloisii</i> Dall		H. 153916	U.S.N.M.
508.	<i>Amaurellina (Euspiracrommium) clarki</i> Stewart		H. 33686	U.C.
509.	<i>Amaurellina hendoni</i> Turner		H. 33630	U.C.
510.	<i>Ampullina (Crommium) andersoni</i> (Dickerson)		H. 244	C.A.S.
511.	<i>Ampullina sookensis</i> (Clark and Arnold)		H. 30205	U.C.
512.	<i>Amauroopsis oregonensis</i> (Dall)		H. 107780	U.S.N.M.
513.	<i>Amauroopsis blakeleyensis</i> (Tegland)		H. 32216	U.C.
514.	<i>Cernina (Eocernina) hammibali</i> (Dickerson)		C.A.S.	
515.	<i>Sinum scopulosum</i> (Conrad)		H. 3553	U.S.N.M.
516.	<i>Sinum obliquum</i> (Gabb)		L. 4215	P.A.N.S.
517.	<i>Sinum occidentis</i> Weaver and Palmer		H. 194	U.W.
518.	<i>Calyptraea diegoana</i> (Conrad)		H. 4235	U.S.N.M.
519.	<i>Calyptraea washingtonensis</i> Weaver		H. 102	U.W.
520.	<i>Calyptraea mammularis</i> Broderip subsp. <i>vancouverensis</i> Clark and Arnold			
521.	<i>Calyptraea inornata</i> (Gabb)		H. 30072	U.C.
522.	<i>Calyptraea sookensis</i> Clark and Arnold		H. 30080	U.C.
523.	<i>Hipponix arnoldi</i> Dickerson		H. 4339	P.A.N.S.
524.	<i>Hipponix arnoldi</i> Dickerson var. <i>ornata</i> Dickerson		S. 436	C.A.S.
525.	<i>Crepidula pileum</i> (Gabb)		H. 439	C.A.S.
526.	<i>Crepidula pileum</i> (Gabb) var. <i>dickersoni</i> Weaver, Palmer		L. 4221	P.A.N.S.
527.	<i>Crepidula stillwaterensis</i> Weaver and Palmer		H. 191	U.W.
528.	<i>Crepidula sookensis</i> Clark and Arnold		H. 192	U.W.
529.	<i>Crepidula princeps</i> Conrad		H. 30293	U.C.
530.	<i>Crepidula praerupta</i> Conrad		H. 153967	U.S.N.M.
531.	<i>Crepidula (Crepidula) rostralis</i> (Conrad)		H. 3564	U.S.N.M.
532.	<i>Crepidula ungana</i> Dall		H. 110447	U.S.N.M.
533.	<i>Viviparus washingtonianus</i> Arnold and Hannibal		H. 32210	U.C.
534.	<i>Turboella coulteri</i> Effinger		T. 33801	U.C.
535.	<i>Hydrobia pontis</i> Weaver and Palmer		H. 33557	U.W.
536.	<i>Alania lettana</i> (Van Winkle)		H. 195	U.W.
537.	<i>Architeclonica cognata</i> Gabb		H. 137	U.W.
538.	<i>Architeclonica blanda</i> Dall		H. 4224	P.A.N.S.
539.	<i>Turritella andersoni</i> Dickerson		H. 10744	U.S.N.M.
540.	<i>Turritella andersoni</i> Dickerson subsp. <i>glidensis</i> Merriam		H. 33111	U.C.
541.	<i>Turritella andersoni</i> Dickerson subsp. <i>comstockensis</i> Merriam		H. 33691	U.C.
542.	<i>Turritella bramkampi</i> Merriam and Turner		H. 33271	U.C.
543.	<i>Turritella uvasana</i> Conrad subsp. <i>stewarti</i> Merriam		H. 33295	U.C.
544.	<i>Turritella uvasana</i> Conrad subsp. <i>hendoni</i> Merriam		H. 33287	U.C.
545.	<i>Turritella uvasana</i> Conrad subsp. <i>hendoni</i>		H. 33288	U.C.
546.	Merriam var. A Turner		H. 33281	U.C.
547.	<i>Turritella uvasana</i> Conrad subsp. <i>olequahensis</i> Weaver and Palmer		H. 33283	U.C.
548.	<i>Turritella uvasana</i> Conrad subsp. <i>washingtoniana</i> (Weaver and Palmer)		H. 197	U.W.
549.	<i>Turritella merriami</i> Dickerson var. Turner		H. 198	U.W.
550.	<i>Turritella meganensis</i> Clark and Woodford subsp. <i>prolumescens</i> Merriam and Turner		H. 33279	U.C.
			H. 15353	U.C.

(642-643)

LIST OF FAUNA IN THE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON

GASTROPODA (Continued)

Type and museum number	Location of specimen	Puget group	Crescent formation	Coaledo formation	Comstock formation	Fisher formation	Toldeo formation	Bassendort formation	Keesey formation	Greech beds	Tunnel Point beds	Yaqchina formation	Eugene formation	Pittsburgh Bluff beds	Lincroft formation	Nye shale	Blakely formation	Moresando formation	Empire formation	Cape Blanco beds	Quinault formation	Quillayute formation	Willapa Pleistocene	Puget Sound Pleistocene	Sooke formation	Widcat formation
551. <i>Turritella buwaldana</i> Dickerson subsp. <i>coosensis</i> Merriam.	U.C. H. 33274	X																								
552. <i>Turritella oregonensis</i> (Conrad).	U.S.N.M. H. 110446																									
553. <i>Turritella vaderensis</i> Weaver and Palmer.	U.W. H. 199																									
554. <i>Turritella vaderensis</i> Weaver and Palmer var. <i>kincaidi</i> Weaver and Palmer.	U.W. H. 200																									
555. <i>Turritella porterensis</i> Weaver.	U.W. H. 72																									
556. <i>Turritella blakelevensis</i> Weaver.	U.W. H. 71																									
557. <i>Turritella diversilineata</i> J. C. Merriam.	U.C. H. 11224																									
558. <i>Turritellopis weaveri</i> (Van Winkle).	U.W. H. 138 Lost																									
559. <i>Loxotrema turrita</i> Gabb.	P.A.N. S. L. 4228																									
560. <i>Goniobasis coombsi</i> new name.	U.W. H. 212																									
561. <i>Goniobasis hannibali</i> Weaver and Palmer.	U.W. H. 211																									
562. <i>Goniobasis drakei</i> (Arnold and Hannibal).	S.U. H. 458																									
563. <i>Goniobasis olequaensis</i> Arnold and Hannibal	S.U. H. 459																									
564. <i>Goniobasis sookensis</i> Clark and Arnold.	U.C. H. 30076																									
565. <i>Potamides carbonicola</i> Cooper	U.C. H. 33183																									
566. <i>Potamides lewisiensis</i> Weaver	U.W. H. 16																									
567. <i>Potamides fettkei</i> Weaver	U.W. S. 15																									
568. <i>Potamides packardi</i> (Dickerson)	C.A.S. H. 15A																									
569. <i>Cerithiopsis preussi</i> G. D. Hanna.	C.A.S. H. 246																									
570. <i>Cerithiopsis vaderensis</i> (Dickerson).	C.A.S. H. 300																									
571. <i>Cerithiopsis excelsa</i> Dall.	U.S.N.M. H. 107400																									
572. <i>Cerithiopsis washingtoniana</i> (Dickerson)	C.A.S. H. 350																									
573. <i>Cerithiopsis newcombei</i> (Clark and Arnold)	U.C. H. 30088																									
574. <i>Cerithiopsis merriami</i> (Dickerson)	C.A.S. H. 417																									
575. <i>Cerithiopsis fasteni</i> Van Winkle.	U.W. H. 139																									
576. <i>Cerithiopsis howardi</i> Dickerson.	C.A.S. H. 415																									
577. <i>Bithium escharichtii</i> (Middendorff)	U.S.N.M. H. 153992																									
578. <i>Benostiaumpquensis</i> Turner.	U.S.N.M. H. 33192																									
579. <i>Trichotropis Oregonensis</i> (Conrad).	Pl. 3554																									
580. <i>Trichotropis coronata</i> Gould.																										
581. <i>Trichotropis Urophoe</i> cf. <i>unicarinata</i> Sowerby.	U.C. H. 33832																									
582. <i>Trichotropis alienensis</i> Effinger.	U.C. H. 33586																									

Original from  
UNIVERSITY OF MICHIGAN

583.	<i>Ectinochilus (Cowliftia) washingtonensis</i> (Clark & Palmer)	C.A.S. U.W.	H. 770 H.17A Lost
584.	<i>Ectinochilus (Vaderos) elongata</i> (Weaver)	U.W.	H. 33633
585.	<i>Ectinochilus (Macilemios) macilentia</i> White subsp. <i>oregonensis</i> Hendon	U.C. C.A.S.	H. 434 H. 201
586.	<i>Terebellum andersoni</i> (Dickerson)	U.W.	H. 140
587.	<i>Bratopsis crescentensis</i> Weaver and Palmer	U.W.	H. 33588
588.	<i>Cypraea oakvilleensis</i> Van Winkle	U.W.	H. 31995
589.	<i>Cypraeogemmula warneri</i> Effinger	U.C.	H. 74
590.	<i>Ficus modestus</i> (Conrad)	U.W.	H. 141
591.	<i>Ficus (Trophosycon) dallmannii</i> Weaver	U.W.	H. 107 Lost
592.	<i>Ficus (Trophosycon) restorationis</i> Van Winkle	U.W.	H. 106
593.	<i>Ficus (Trophosycon) chehalensis</i> Weaver	U.W.	L. 4184
594.	<i>Ficus (Trophosycon) wynoochensis</i> Weaver	P.A.N.S.	
595.	<i>Ficopsis remondii</i> (Gabb)	U.W.	H. 205
596.	<i>Ficopsis remondii</i> (Gabb) var. <i>crescentis</i> Weaver and Palmer	U.W.	H. 27
597.	<i>Ficopsis coulteri</i> (Weaver)	U.W.	P. 33636
598.	<i>Ficopsis megalonensis</i> Clark and Woodford var. <i>packardii</i> Merriam and Turner	U.C. C.A.S.	H. 176 H. 3167
599.	<i>Trophon oregonensis</i> Anderson and Martin	U.C. C.A.S.	H. 1753
600.	<i>Galeodea sutterensis</i> Dickerson	U.W.	H. 202
601.	<i>Galeodea susanae</i> Schenck	U.C. C.A.S.	H. 419
602.	<i>Galeodea crescentensis</i> Weaver and Palmer	U.W.	H. 19
603.	<i>Galeodea dalli</i> Dickerson	U.C. C.A.S.	H. 3536
604.	<i>Galeodea tri-tuberculata</i> (Weaver)	U.C. U.S.N.M.	H. 32064
605.	<i>Galeodea petrosa</i> (Conrad)	U.C. U.S.N.M.	H. 32067
606.	<i>Galeodea fax</i> Tegland	U.C. U.S.N.M.	H. 32071
607.	<i>Galeodea rex</i> Tegland	U.C. U.S.N.M.	H. 153895
608.	<i>Galeodea apia</i> Tegland	U.C. U.S.N.M.	H. 153896
609.	<i>Galeodea oregonense</i> (Dall)	U.C. U.S.N.M.	H. 153898
610.	<i>Phalium (Besoardica) aquisulcatum</i> Dall	U.C. U.S.N.M.	H. 79
611.	<i>Phalium (Besoardica) turricula</i> Dall	U.C. U.S.N.M.	
612.	<i>Phalium (Besoardica) egberti</i> Schenck	S.U.	
613.	<i>Phalium (Besoardica) iani</i> Schenck	C.A.S.	
614.	<i>Cymatium washingtonianum</i> (Weaver)	U.W.	H. 1747
615.	<i>Cymatium cowliftense</i> (Weaver)	U.W.	H. 21
616.	<i>Cymatium etheringtoni</i> , n. sp.	U.C. U.S.N.M.	H. 22
617.	<i>Cymatium pacificum</i> Dall	U.C. U.S.N.M.	H. 33869
618.	<i>Pseudoperissolax blakei</i> (Conrad)	U.C. U.S.N.M.	H. 33220
619.	<i>Pseudoperissolax trophonoides</i> Tegland	U.C. U.S.N.M.	H. 33673
620.	<i>Sassia bilineata</i> (Dickerson)	U.C. U.S.N.M.	H. 33214
621.	<i>Ranellina pilifuryi</i> Stewart	U.S.N.M.	H. 153907
622.	<i>Argobuccinum communi</i> Dall	U.S.N.M.	H. 153903
623.	<i>Argobuccinum coosense</i> Dall	U.S.N.M.	H. 153996
624.	<i>Argobuccinum oreonse</i> (Redfield)	U.S.N.M.	H. 153902
625.	<i>Argobuccinum pacificum</i> Dall	U.C. U.S.N.M.	H. 32232
626.	<i>Argobuccinum mathewsoni</i> (Gabb)	C.A.S.	H. 152
627.	<i>Argobuccinum dilleri</i> Anderson and Martin	C.A.S.	
628.	<i>Argobuccinum vancouverense</i> (Clark and Arnold)	C.A.S.	H. 578
629.	<i>Argobuccinum goodspeedi</i> (Tegland)	U.C.	H. 32228
630.	<i>Argobuccinum sylvianense</i> (Weaver)	U.W.	H. 73

(644-645)

**LIST OF FAUNA IN THE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON**

GASTROPODA (Continued)

Location of specimen	Type and museum number	Puget group	Crescent formation	Cowlitz f. at Duwamish	Umpqua formation	Tyee formation	Caledo formation	Comstock formation	Fisher formation	Toledo formation	Keesey formation	Grits Ranch beds	Tunnel Point beds	Yaduma formation	Eugene formation	Pittsburgh Bluff beds	Limeohn formation	Nye shale	Blakely formation	Astoria formation	Montesano formation	Cape Blanco beds	Willapa Pleistocene	Pudget Sound Pleistocene	Sooke formation	Wildcat formation
631. <i>Gyrineum kerri</i> (Dickerson)	U.C. H. 11054	X																								
632. <i>Gyrineum mediocre</i> Dall	H. 153900																									
633. <i>Gyrineum corrugatum</i> Dall	U.S.N.M. H. 153870																									
634. <i>Gyrineum mackini</i> n. sp.	U.C. H. 12499																									
635. <i>Oleknania washingtoniana</i> (Weaver)	U.W. H. 18																									
636. <i>Oleknania lincolnensis</i> (Weaver)	C.A.S. H. 466A																									
637. <i>Neptunea teglandae</i> new name	U.C. H. 32217																									
638. <i>Neptunea landesi</i> (Tegland)	S.U. H. 789																									
639. <i>Neptunea diminuta</i> Etherington	U.W. H. 32011																									
640. <i>Neptunea clallamensis</i> (Weaver)	U.W. H. 25 Lost																									
641. <i>Neptunea hairdii</i> (Dall)	U.S.N.M. H. 153905																									
642. <i>Neptunea postplanata</i> (Dall)	U.S.N.M. H. 107781																									
643. <i>Neptunea packardi</i> (Weaver)	U.W. H. 110 Lost																									
644. <i>Neptunea lincolnensis</i> (Weaver)	U.W. H. 109 Lost																									
645. <i>Liomesus sulcatus</i> Dall	U.S.N.M. H. 153904																									
646. <i>Cantharus cowilensis</i> Clark	U.C. H. 30889																									
647. <i>Cantharus bentsonae</i> Turner	U.C. H. 33208																									
648. <i>Cantharus perrini</i> Dickerson	C.A.S. H. 315																									
649. <i>Cantharus merriami</i> (Weaver and Palmer)	U.W. H. 204																									
650. <i>Umpqua oregonensis</i> Turner	U.C. H. 33202																									
651. <i>Siphonalia packi</i> (Dickerson)	C.A.S. H. 425																									
652. <i>Siphonalia bicarinata</i> Dickerson	C.A.S. H. 316																									
653. <i>Siphonalia bicarinata</i> Dickerson subsp. <i>monospina</i> Hendon	U.C. H. 33678																									
654. <i>Siphonalia clarki</i> Dickerson	C.A.S. H. 247																									
655. <i>Siphonalia sopenahensis</i> (Weaver)	U.W. H. 20A																									
656. <i>Siphonalia washingtonensis</i> (Weaver)	C.A.S. H. 465																									
657. <i>Siphonalia oregonensis</i> (Dall)	U.S.N.M. H. 107395																									
658. <i>Buccinofusus turneri</i> n. sp.	U.C. H. 33206																									
659. <i>Parnsipia lewisiiana</i> (Weaver)	U.W. H. 28																									
660. <i>Searlesia dira</i> Reeve subsp. <i>moenica</i> Etherington	U.C. H. 32005																									
661. <i>Searlesia branneri</i> Clark and Arnold	U.C. H. 30068																									
662. <i>Brucilaria acuminata</i> (Anderson and Martin)	C.A.S. H. 157																									
663. <i>Brucilaria columbiana</i> (Anderson and Martin)	C.A.S. H. 155																									
664. <i>Brucilaria oregonensis</i> (Conrad)	C.A.S. H. 159																									

665.	<i>Brucarkia yaqinana</i> (Anderson and Martin)	C.A.S. H. 161 H. 32174	U.C. U.S.N.M.		
666.	<i>Brucarkia thor</i> Tegland		U.S.N.M.		
667.	<i>Thais lima</i> (Martyn)		U.S.N.M.		
668.	<i>Thais precursor</i> Dall		H. 153995		
669.	<i>Thais lamelloosa</i> (Gmelin)		U.S.N.M.		
670.	<i>Thais callamensis</i> (Reagan)		Hp. 328364		
671.	<i>Thais imperialis</i> (Dall)		U.S.N.M.		
672.	<i>Thais nehalimensis</i> Anderson and Martin		H. 153897		
	(See note, page 449)		H. 183		
673.	<i>Thais cornwalli</i> Clark and Arnold	C.A.S. S. 579 S. 30229	U.C. C.A.S.		
674.	<i>Sistrum hawaii</i> Howe		H. 576		
675.	<i>Rapana perrini</i> Clark and Arnold		H. 30211		
676.	<i>Purpura foliata</i> Martyn		Hp. 328373		
677.	<i>Purpura perponderosa</i> Dall		U.S.N.M.		
678.	<i>Urosalpinx tejonensis</i> (Weaver)		H. 107778		
679.	<i>Urosalpinx hannibali</i> Dickerson		U.W.		
680.	<i>Urosalpinx</i> sp. Effinger		C.A.S. H. 334		
681.	<i>Murex coesensis</i> Turner		U.C. H. 33596		
682.	<i>Murex packardi</i> Dickerson		U.C. H. 33179		
683.	<i>Murex cowtitzensis</i> Weaver		C.A.S. U.W.		
684.	<i>Murex sopanensis</i> Weaver		U.W.		
685.	<i>Murex calamitus</i> Hanna		C.A.S. H. 412		
686.	<i>Pseudoliva kirbyi</i> Clark		C.A.S. HP. 307		
687.	<i>Pseudoliva dilleri</i> Dickerson		U.C. H. 248		
688.	<i>Pseudoliva umquaensis</i> Turner		P.A.N.S. S. 33175		
689.	<i>Pseudoliva volutaeformis</i> Gabb		U.W.		
690.	<i>Pseudoliva packardi</i> Van Winkle		U.W.		
691.	<i>Amphissa decepta</i> (Etherington)		U.C. H. 32055		
692.	<i>Nassarius arnoldi</i> (Anderson)		Holotype Lost U.C. U.W.		
693.	<i>Nassarius andersoni</i> (Weaver)		H. 32012		
694.	<i>Nassarius lincolnensis</i> (Anderson and Martin)		H. 75		
695.	<i>Tritaria (Antillophos) dimblei</i> (Anderson) var. <i>chehalensis</i> (Weaver)		H. 167 C.A.S. U.W. P.A.N.S.		
696.	<i>Molopophorus longituberculatus</i> (Gabb)		H. 108 H. 4198		
697.	<i>Molopophorus californicus</i> Clark and Woodford subsp. <i>lonsdalei</i> Turner		U.C. H. 33244		
698.	<i>Molopophorus breizi</i> (Weaver)		U.W. C.A.S. H. 39		
699.	<i>Molopophorus stephensi</i> Dickerson		H. 422		
700.	<i>Molopophorus effingeri</i> new name		H. 33592		
701.	<i>Molopophorus gabbi</i> Dall		H. 107337		
702.	<i>Molopophorus newcombei</i> (Merriam)		P. 30075		
703.	<i>Molopophorus lincolnenensis</i> Weaver		S. 113		
704.	<i>Molopophorus clarki</i> (Weaver)		U.W. C.A.S. H. 31		
705.	<i>Molopophorus dalli</i> Anderson and Martin		H. 168		
706.	<i>Molopophorus bisplicatus</i> (Gabb) var.		H. 76 Lost U.C. Holotype C.A.S.		
707.	<i>Molopophorus fishii</i> (Gabb)		H. 11929		
708.	<i>Molopophorus angionana</i> (Anderson)		N. 91		

**LIST OF FAUNA IN THE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON**

GASTROPODA (Continued)

	Location of specimen	Type and museum number
709. <i>Molopophorus anglonana</i> (Anderson) var. <i>matthewi</i> Etherington	U.C.	H. 32028
710. <i>Latirus eocenica</i> (Weaver)	U.W.	H. 23
711. <i>Latirus roeselburgensis</i> Hendon	U.C.	H. 33672
712. <i>Whitneyella sinuata</i> (Gabb) var. <i>aragoensis</i> Turner	U.C.	H. 33197
713. <i>Whitneyella oregonensis</i> Turner	U.C.	H. 33193
714. <i>Whitneyella coosensis</i> Turner	U.C.	H. 33195
715. <i>Whitneyella gabbi</i> (Dickerson)	C.A.S.	H. 413
716. <i>Whitneyella washingtoniana</i> (Weaver)	U.W.	S. 29A
717. <i>Whitneyella lincolnensis</i> (Van Winkle)	U.W.	H. 143
718. <i>Whitneyella buwaldaana</i> (Dickerson)	C.A.S.	H. 346
719. <i>Whitneyella markleyensis</i> (Clark)	U.C.	P. 30868
720. <i>Fusinus merriami</i> Dickerson	U.C.	H.P. 33220
721. <i>Fusinus gestieri</i> Dickerson	C.A.S.	H. 429
722. <i>Fusinus empireensis</i> Anderson and Martin	C.A.S.	H. 185
723. <i>Fusinus willisi</i> (Dickerson)	C.A.S.	H. 345
724. <i>Fusinus montesanoensis</i> (Weaver)	U.W.	H. 77
725. <i>Fusinus (Prisofusus) geniculus</i> (Conrad)	U.S.N.M.	H. 3552
726. <i>Fusinus (Prisofusus) corpulentus</i> (Conrad)	U.S.N.M.	H. 3551
727. <i>Fusinus (Prisofusus) medialis</i> (Conrad)	U.S.N.M.	H. 3532
728. <i>Fusinus (Prisofusus) notiferus</i> (Conrad)	U.S.N.M.	H. Lost
729. <i>Fusinus (Prisofusus)</i> sp. indet. Dall	U.S.N.M.	H. 3544
730. <i>Fusinus (Prisofusus) oregonensis</i> (Conrad)	U.S.N.M.	H. 3517
731. <i>Fusinus (Prisofusus) hammoniae</i> Clark and Arnold	U.C.	H. 30069
732. <i>Fusinus (Prisofusus) chehalisensis</i> (Weaver)	C.A.S.	H. 551
733. <i>Fusinus (Prisofusus) sanctaerucias</i> (Arnold)	S.U.	P. 5418
734. <i>Fusinus (Prisofusus) stewarti</i> Tegland	U.C.	H. 32238
735. <i>Fusinus (Prisofusus) lincolnensis</i> (Anderson & Martin)	C.A.S.	H. 211
736. <i>Fusinus (Prisofusus) carlsoni</i> (Anderson and Martin)	C.A.S.	H. 212
737. <i>Fusinus (Prisofusus) commansi</i> (Dall)	U.S.N.M.	H. 153909
738. <i>Fusinus (Prisofusus) consensis</i> (Dall)	U.S.N.M.	H. 107783
739. <i>Fusinus (Prisofusus) colii</i> (Dall)	U.S.N.M.	H. 107783
740. <i>Strophocheilus</i> sp. Turner	U.C.	H. 33680
741. <i>Fulgurofusus washingtoniana</i> (Weaver)	U.W.	H. 34

742.	<i>Miopleionia indurata</i> (Conrad)		H. 5908
743.	<i>Miopleionia oregonensis</i> Dall		H. 153894
744.	<i>Miopleionia weaveri</i> Tegland		X
745.	<i>Volutocoris oregonensis</i> Turner	L	
746.	<i>Marginella sheppardae</i> Tegland		
747.	<i>Marginella instabilata</i> Hanna	X	
748.	<i>Persicula chehalensis</i> n. sp.	X	
749.	<i>Lyria coquillensis</i> Turner		
750.	<i>Lyria andersoni</i> Waring		
751.	<i>Mitra cretacea</i> Gabb var. Turner	X	
752.	<i>Mitra douglasensis</i> Hendon		
753.	<i>Mitra washingtoniana</i> Weaver		
754.	<i>Harpa crescentensis</i> Weaver and Palmer		
755.	<i>Cryptochorda californica</i> (Cooper)		
756.	<i>Ancilla gabbi</i> Cossmann		
757.	<i>Olivella mathewsonii</i> Gabb		
758.	<i>Olivella mathewsonii</i> Gabb var. <i>umpquaensis</i> Turner		
759.	<i>Olivella pedraea</i> (Conrad)		
760.	" <i>Cancellaria</i> " landesi Van Winkle	X	
761.	<i>Cancellaria washingtonensis</i> Weaver		
762.	<i>Cancellaria wynoochensis</i> Weaver		
763.	<i>Cancellaria vetus</i> Gabb		
764.	<i>Cancellaria</i> sp. indet. Etherington		
765.	<i>Cancellaria weaveri</i> Etherington		
766.	<i>Cancellaria condoni</i> Anderson		
767.	<i>Cancellaria rotunda</i> Anderson and Martin		
768.	<i>Cancellaria sanjosei</i> Anderson and Martin		
769.	<i>Cancellaria oregonensis</i> Dall		
770.	<i>Bonellia (Admetula) paucivaricata</i> (Gabb)	X	
771.	<i>Admete clatskanensis</i> Anderson and Martin		
772.	<i>Conus remondii</i> Gabi subsp. <i>constockensis</i> Turner	X	
773.	<i>Conus warreni</i> Hendon		
774.	<i>Conus horridi</i> Gabb var. <i>umpquaensis</i> Hendon		
775.	<i>Conus eudorensis</i> Weaver and Palmer		
776.	<i>Conus columbensis</i> Weaver		
777.	<i>Conus weaveri</i> Dickerson		
778.	<i>Conus ruckmani</i> Dickerson		
779.	<i>Exilia dickersoni</i> (Weaver)		
780.	<i>Exilia weaveri</i> Dickerson		
781.	<i>Exilia lincolnensis</i> Weaver		
782.	<i>Exilia mellellani</i> Tegland		
783.	<i>Aforia callamensis</i> (Weaver)		
784.	<i>Aforia callamensis</i> (Weaver) subsp. <i>wardi</i> (Tegland)		
785.	<i>Aforia packardi</i> (Weaver)		
786.	<i>Antiplanes perversa</i> (Gabb)		
787.	<i>Antiplanes impecunia</i> (Dall)		
788.	<i>Suanodrilia thurstoniensis</i> (Weaver)		
789.	<i>Lora labulata</i> (Carpenter)	X	
790.	<i>Spirotropis winlockensis</i> Effinger		
791.	<i>Spirotropis washingtonensis</i> Etherington	X	

Digitized by Google

Original from  
 UNIVERSITY OF MICHIGAN

**LIST OF FAUNA IN THE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON**

Type and museum number	Location of specimen	Pugeot group		Crescent formation	Cowpitz f. at Blackch	Cowpitz f. at Duvamish	Umpqua formation	Tyee formation	Comstock formation	Toldeo formation	Fisher formation	Keesey formation	Grice Ranch beds	Trumel Point beds	Yaduma formation	Eugene formation	Pittsburg Bluff beds	Lincroft formation	Nye shale	Astoria formation	Montesano formation	Empire formation	Cape Blanco beds	Quillayute formation	Willapa Pleistocene	Sooke formation	Wildcat formation			
		GASTROPODA (Continued)	H.																											
792. <i>Spirotropis dickersoni</i> (Weaver)	U.W.	H. 120																												
793. <i>Spirotropis kinecaudi</i> (Weaver)	U.W.	H. 119																												
794. <i>Borsonella nuncapatia</i> Hanna	U.W.	H. 147																												
795. <i>Gemmula barksdalei</i> n. sp.	U.C.	H. 159.34																												
796. <i>Gemmula fasteni</i> Weaver and Palmer	U.W.	H. 208																												
797. <i>Hemipleurotoma pulchra</i> (Dickerson)	C.A.S.	H. 338																												
798. <i>Hemipleurotoma borgnae</i> (Teplitz)	U.C.	H. 32172																												
799. <i>Surculites matthewsonii</i> (Gabb)	U.C.	H.P. 333631																												
800. <i>Megasurcula wyooocensis</i> (Weaver)	U.W.	S. 68																												
801. <i>Megasurcula carpenteriana</i> (Gabb)	U.C.	L. 11996																												
802. <i>Megasurcula remondii</i> (Gabb)	U.S.N.M.	H. 153911																												
803. <i>Megasurcula gabbiiana</i> (Dall)	U.S.N.M.	H. 153910																												
804. <i>Megasurcula condonana</i> (Anderson and Martin)	C.A.S.	H. 214																												
805. <i>Megasurcula etheringtoni</i> n. sp.	U.C.	H. 32038																												
806. <i>Nekeria washingtoni</i> (Weaver)	U.W.	H. 37																												
807. <i>Turridula cooperi</i> (Dickerson) subsp. <i>umpquaensis</i> Turner	U.C.	H. 33230																												
808. <i>Turridula crenospira</i> (Cooper)	U.C.	H.P. 33240																												
809. <i>Turridula washingtonensis</i> (Weaver)	C.A.S.	S. 560																												
810. <i>Turridula worcesterae</i> (Van Winkle)	U.W.	H. 40																												
811. <i>Turridula (Pleurofusia) cowdierensis</i> (Weaver)	U.W.	H. 337																												
812. <i>Turridula (Pleurofusia) ornata</i> (Dickerson)	C.A.S.	H. 142																												
813. <i>Clavatula arnoldi</i> (Van Winkle)	U.W.	H.P. 33308																												
814. <i>Pseudomelatoma kennensis</i> (Anderson and Martin)	U.C.	H.P. 32054																												
815. <i>Thesbia columbiana</i> (Anderson and Martin)	C.A.S.	H. 231																												
816. <i>Thesbia antisepti</i> (Anderson and Martin)	C.A.S.	H. 226																												
817. <i>Thesbia workensis</i> (Etherington)	U.C.	H. 32047																												
818. <i>Thesbia ocoyana</i> (Anderson and Martin)	C.A.S.	H. 228																												
819. <i>Thesbia muiensis</i> (Clark and Arnold)	U.C.	H. 30067																												
820. <i>Clavus (Crassispira) freyi</i> (Weaver and Palmer)	U.W.	H. 209																												
821. <i>Megistostoma camionensis</i> M. A. Hanna	U.C.	H.P. 33688																												
822. <i>Acteon umquaensis</i> Turner	U.C.	H. 33210																												
823. <i>Acteon moodyi</i> Dickerson	U.C.	H.P. 33222																												
824. <i>Acteon boulderana</i> Etherington	U.C.	H. 32057																												

825.	<i>Acteon chehalensis</i> (Weaver).....	U.W. C.A.S. U.C. P.A.N.S. U.W.	H. 123 H. 401 H. 33612 L. 4338 H. 124	X
826.	<i>Acteon parvum</i> Dickerson .....	U.C.	H. 32209	X
827.	<i>Vohrulella tabori</i> Effinger .....			
828.	<i>Scaphander costatus</i> (Gabb).....			
829.	<i>Scaphander washingtonensis</i> Weaver .....			
830.	<i>Scaphander washingtonensis</i> Weaver subsp. <i>gordoni</i> Tegland .....	U.C.	H. 32209	X
831.	<i>Scaphander washingtonensis</i> Weaver subsp. <i>goodspeedi</i> Effinger .....	U.C.	H. 33611 H.p. 32058	X
832.	<i>Scaphander jugularis</i> (Conrad) .....	U.C.	H. 154137	X
833.	<i>Scaphander conradi</i> Dall .....	U.S.N.M.	H. 154136	X
834.	<i>Scaphander oregonensis</i> Dall .....	C.A.S.	H. 958	
835.	<i>Cylichnina tanikillia</i> (Anderson and Hanna)	U.C.	H. 33619	
836.	<i>Cylichnina turneri</i> Effinger .....	U.S.N.M.	H. 3607	X
837.	<i>Haminoea petrosa</i> (Conrad) .....			
838.	<i>Gadina reticulata</i> Sowerby subsp. <i>sookeensis</i> Clark and Arnold .....	U.C. C.A.S.	H. 30085 H. 5620	L
839.	<i>Segmentina durhami</i> Hanna and Hertlein .....			
	CEPHALOPODA			
840.	<i>Aturia angustata</i> (Conrad) .....	U.S.N.M.	H. 3610	X
841.	<i>Aturia angustata</i> (Conrad) subsp. <i>grandior</i> Schenck .....	S.U.	H. 524	X
	ARTHROPODA			
842.	<i>Balanus tintinnabulum</i> Linnaeus var. <i>coosensis</i> Dall .....	U.S.N.M.	H. 153960	X
843.	<i>Pinnixia eocenica</i> Rathbun .....			
844.	<i>Pilumnopanax carmanahensis</i> Rathbun .....			X
845.	<i>Pilumnopanax kantishanensis</i> Rathbun .....			
846.	<i>Branchiopanax washingtoniana</i> Rathbun .....			
847.	<i>Eucrate marlini</i> Rathbun .....			
848.	<i>Zanthopsis vulgaris</i> Rathbun .....			
849.	<i>Zanthopsis hendersonianus</i> Rathbun .....			
850.	<i>Cancer bainbridgeensis</i> Rathbun .....			
851.	<i>Portunus triangulum</i> Rathbun .....			
852.	<i>Portunus insculpta</i> Rathbun .....			
853.	<i>Persephona bigranulata</i> Rathbun .....			
854.	<i>Calappa lanensis</i> Rathbun .....			
855.	<i>Mursia yaquimensis</i> Rathbun .....			
856.	<i>Mursia marcusana</i> Rathbun .....			
857.	<i>Paleomola gorelli</i> Rathbun .....			
858.	<i>Graphiocarcinus</i> (?) sp. Rathbun .....			
859.	<i>Ranina americana</i> Withers .....			
860.	<i>Raninoides waderensis</i> Rathbun .....			X
861.	<i>Raninoides lewisianus</i> Rathbun .....			
862.	<i>Raninoides washburni</i> Rathbun .....			X

(650-651)

**LIST OF FAUNA IN THE  
TERTIARY FORMATIONS OF  
OREGON AND WASHINGTON**

ARTHROPODA (Continued)

		Type and museum number
		Location of specimen
	PUGET GROUP	Crescent formation
X:	X X	Cowlitz f. at Black
		Cowlitz f. at Duwamish
		Umpqua formation
		Fisher formation
		Coastock formation
		Tyee formation
		Caledo formation
		Toledo formation
		Bassendorff formation
X		Kearny formation
		Gries Ranch beds
		Tunnel Point beds
		Yaduma formation
	X XX	Eugene formation
L	X X X	Pittsburg Bluff beds
		Limcoln formation
		Nye shale
	X X	Blakely formation
		Astoria formation
		Montesano formation
		Cape Blanco beds
		Quinalt formation
		Willapa Pleistocene
		Sooke formation
		Willapa Sound Pleistocene
		Widcat formation

ADDITIONAL SPECIES (See pages 561-2)

878.	<i>Tellina oregonensis</i> Conrad.....	U.S.N.M.	H. 110458
879.	<i>Upogebia (Upogebia) eocenia</i> Rathbun.....	U.C.	H. 32420

(652)

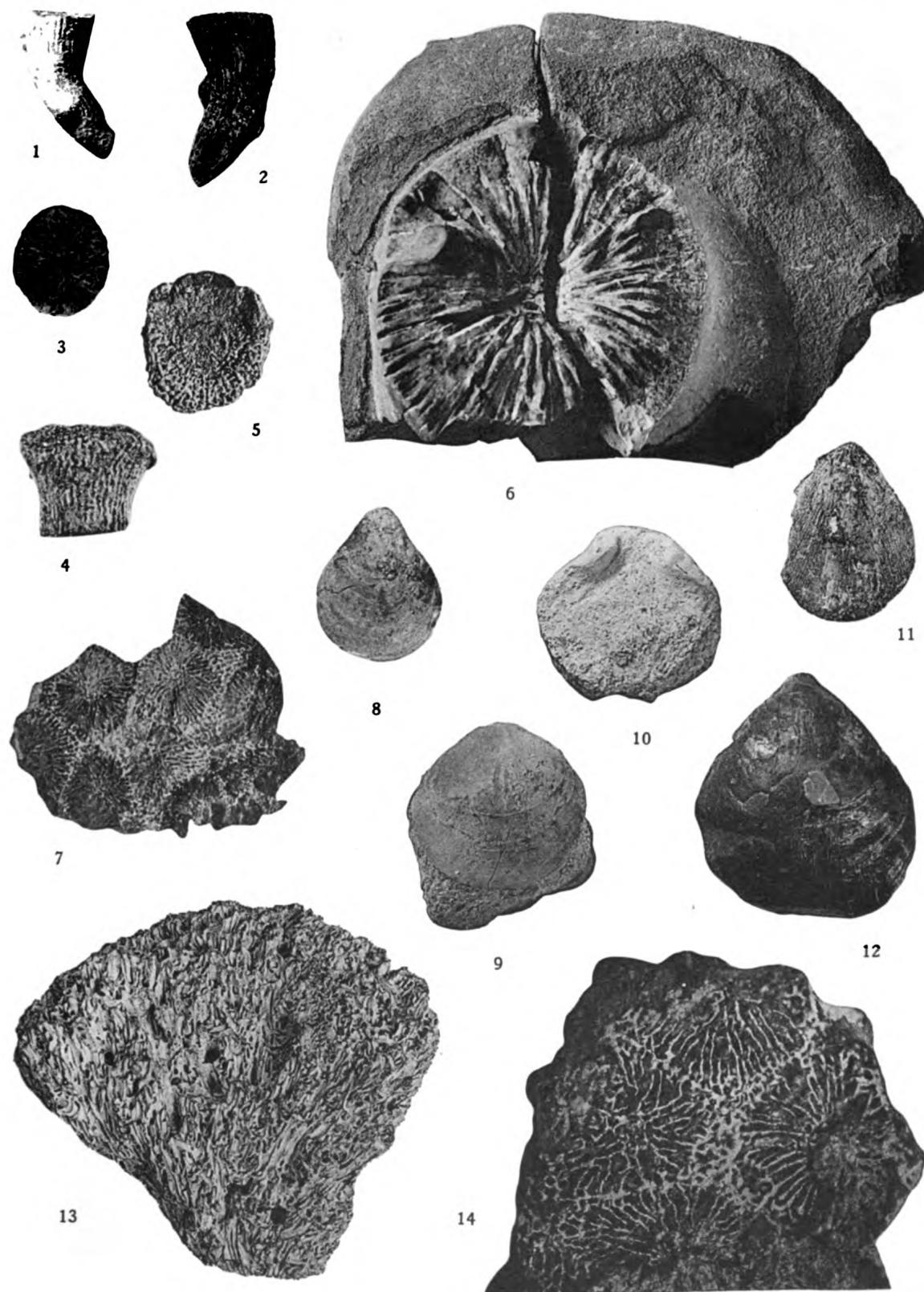
## **DESCRIPTION OF PLATES**

**(653)**

## PLATE 1

	PAGE
Fig. 1. <i>Balanophyllia</i> cf. <i>variabilis</i> Nomland ( $\times 1.6$ ), hypotype (U.C. 15384). Figured originally, 138, pl. 47, fig. 20.....	1
Fig. 2. <i>Balanophyllia</i> cf. <i>variabilis</i> Nomland ( $\times 2$ ), hypotype (U.C. 15384). Figured originally, 138, pl. 47, fig. 20.....	1
Fig. 3. <i>Balanophyllia</i> cf. <i>variabilis</i> Nomland ( $\times 3$ ), hypotype (U.C. 15384)....	1
Fig. 4. <i>Balanophyllia blakeleyensis</i> Quayle ( $\times 4$ ), holotype (U.C. 32245). Figured originally, 272, pl. 15, fig. 11.....	2
Fig. 5. <i>Balanophyllia blakeleyensis</i> Quayle ( $\times 4$ ), holotype (U.C. 32245). Figured originally, 272, pl. 15, fig. 11.....	2
Fig. 6. <i>Stephanotrochus</i> sp. Dall ( $\times 1$ ), type of Dana (U.S.N.M. 3575).....	3
Fig. 7. <i>Siderastrea vancouverensis</i> Vaughan ( $\times 2$ ), holotype (U.S.N.M., lost). Figured originally, 50, pl. 40, fig. 2.....	2
Fig. 8. <i>Terebratulina oakvillensis</i> (Weaver) ( $\times 1.4$ ), holotype (U.W. 82) (C.A.S. 544). Figured originally, 286, pl. 13, fig. 107.....	14
Fig. 9. <i>Terebratella?</i> <i>sookensis</i> Clark and Arnold ( $\times 2$ ), cotype (U.C. 30248). Figured originally, 50, pl. 36, fig. 4.....	16
Fig. 10. <i>Terebratella?</i> <i>sookensis</i> Clark and Arnold ( $\times 2$ ), holotype (U.C. 30235). Figured originally, 50, pl. 36, fig. 5b.....	16
Fig. 11. <i>Terebratulina unguicula</i> Carpenter var. B ( $\times 1.5$ ), hypotype (U.W. 520) (C.A.S. 7375) .....	15
Fig. 12. <i>Hemithyris astoriana</i> Dall ( $\times 2$ ), holotype (U.S.N.M. 3487) (= old <i>Terebratula nitens</i> Conrad). Figured originally, 68, pl. 19, fig. 1.....	12
Fig. 13. ? <i>Serpula octoforis</i> Dall ( $\times 0.5$ ), holotype (U.S.N.M. 153963). Figured originally, 101, pl. 20, fig. 1.....	3
Fig. 14. <i>Siderastrea vancouverensis</i> Vaughan ( $\times 4.4$ ), holotype (U.S.N.M., lost). Figured originally, 50, pl. 40, fig. 1.....	2

(654)



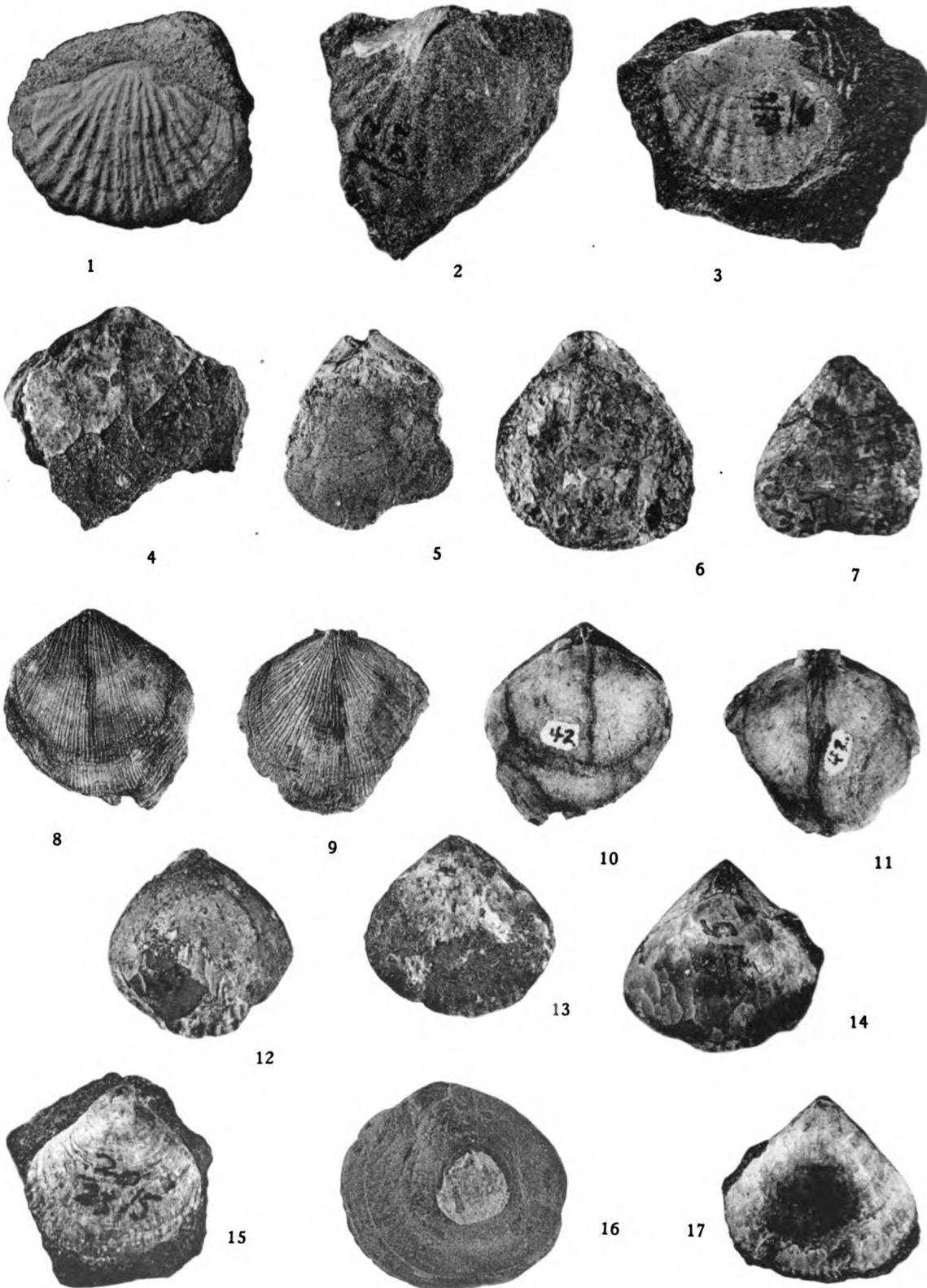


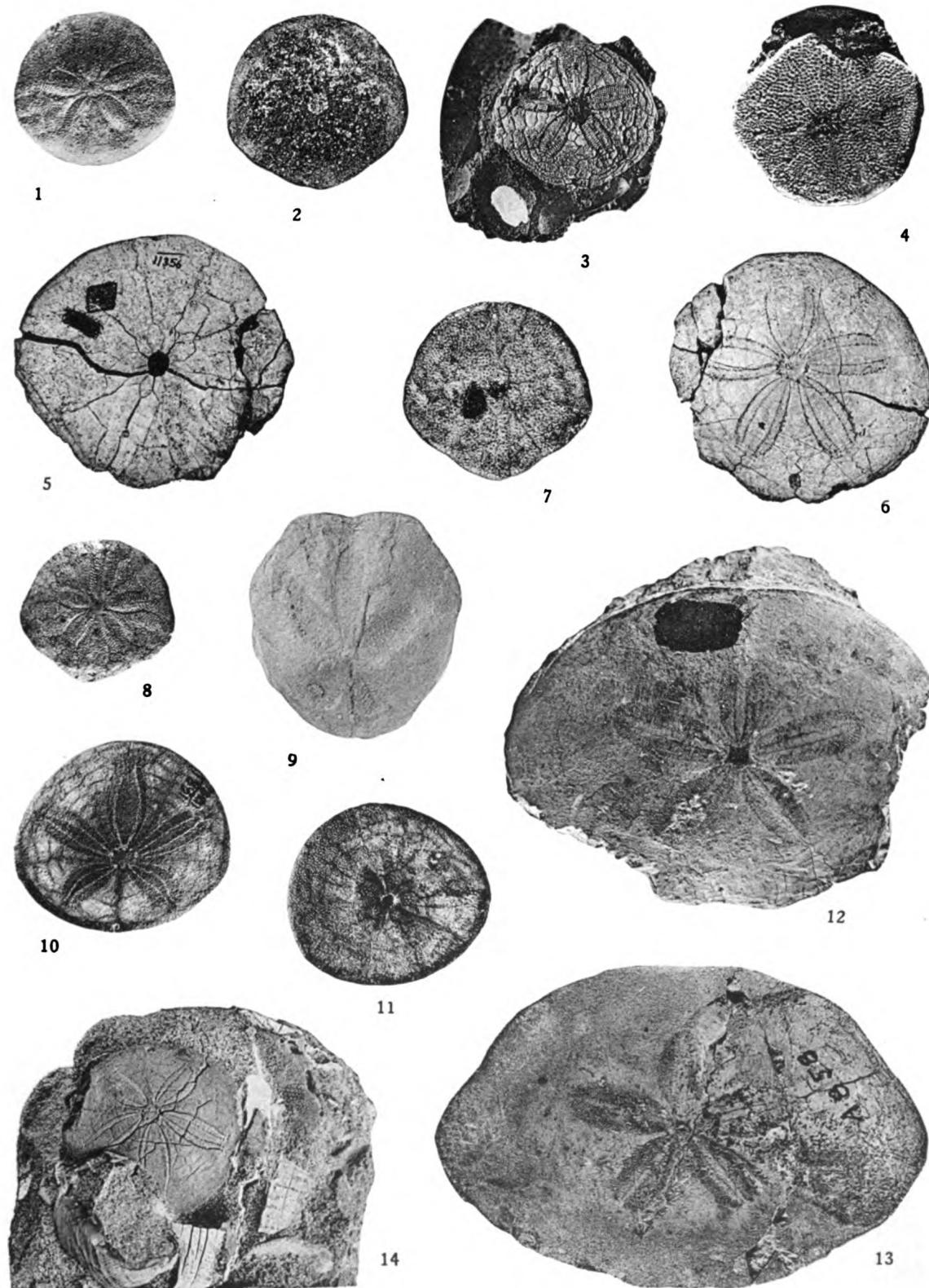
PLATE 2

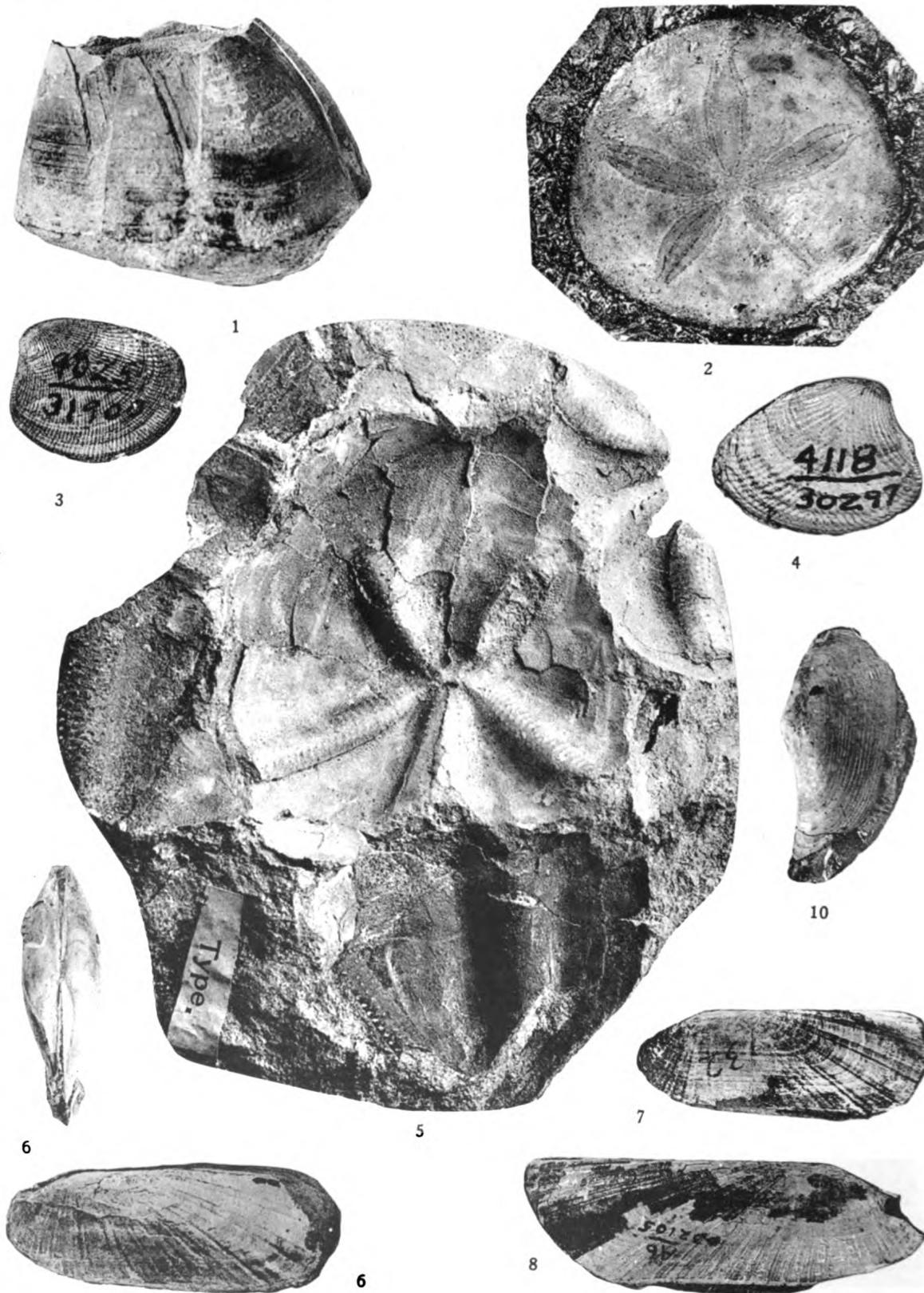
	PAGE
Fig. 1. <i>Terebratalia transversa</i> (Sowerby) subsp. Clark and Arnold ( $\times 2$ ), holotype (U.C. 30252). Figured originally, 50, pl. 32, fig. 4.....	15
Fig. 2. <i>Terebratalia transversa</i> (Sowerby) var. <i>caurina</i> (Gould) ( $\times 1.5$ ), hypotype (U.W. 517) (C.A.S. 7377).....	15
Fig. 3. <i>Terebratalia transversa</i> (Sowerby) var. <i>caurina</i> (Gould) ( $\times 1.5$ ), hypotype (U.W. 517-A) (C.A.S. 7377-A).....	15
Fig. 4. ? <i>Terebratalia</i> aff. <i>occidentalis</i> Dall ( $\times 1.5$ ), hypotype (U.W. 518) (C.A.S. 7376) .....	16
Fig. 5. <i>Laqueus</i> aff. <i>vancouverensis</i> Davidson ( $\times 2$ ), hypotype (U.W. 516) (C.A.S. 7371) .....	17
Fig. 6. <i>Laqueus</i> aff. <i>vancouverensis</i> Davidson ( $\times 1.5$ ), hypotype (U.W. 516-A) (C.A.S. 7371-A) .....	17
Fig. 7. <i>Hemithyris?</i> sp. Tegland ( $\times 2$ ), holotype (U.C. 32246). Blakeley formation .....	13
Fig. 8. <i>Rhynchonella washingtoniana</i> Weaver ( $\times 1.5$ ), paratype (U.W. 42-A) (C.A.S. 7374-A). Figured originally, 286, pl. 5, fig. 44.....	13
Fig. 9. <i>Rhynchonella washingtoniana</i> Weaver ( $\times 1.5$ ), holotype (U.W. 42) (C.A.S. 7374). Figured originally, 286, pl. 5, fig. 45.....	13
Fig. 10. <i>Rhynchonella washingtoniana</i> Weaver ( $\times 1.5$ ), paratype (U.W. 42-A) (C.A.S. 7374-A). Figured originally, 286, pl. 5, fig. 44.....	13
Fig. 11. <i>Rhynchonella washingtoniana</i> Weaver ( $\times 1.5$ ), holotype (U.W. 42) (C.A.S. 7374). Figured originally, 286, pl. 5, fig. 45.....	13
Fig. 12. <i>Hemithyris</i> sp. A ( $\times 2$ ), hypotype (U.W. 521-A) (C.A.S. 7375-A)....	12
Fig. 13. <i>Hemithyris</i> sp. A ( $\times 2$ ), hypotype (U.W. 519-A) (C.A.S. 7372-A)....	12
Fig. 14. <i>Hemithyris</i> sp. A ( $\times 2$ ), hypotype (U.W. 519) (C.A.S. 7372).....	12
Fig. 15. <i>Hemithyris</i> sp. A ( $\times 2$ ), paratype (U.W. 521) (C.A.S. 7373).....	12
Fig. 16. <i>Discinisca oregonensis</i> Dall ( $\times 3$ ), holotype (U.S.N.M. 107779). Figured originally, 101, pl. 2, fig. 6.....	14
Fig. 17. <i>Hemithyris</i> sp. A ( $\times 2$ ), hypotype (U.W. 519) (C.A.S. 7372).....	12

## PLATE 3

	PAGE
Fig. 1. <i>Echinarachnius blancoensis</i> (Kew) ( $\times 1$ ), hypotype (U.C. 12495).....	5
Fig. 2. <i>Echinarachnius blancoensis</i> (Kew) ( $\times 1$ ), hypotype (U.C. 12495).....	5
Fig. 3. <i>Echinarachnius blancoensis</i> (Kew) ( $\times 2$ ), hypotype (U.W. 368).....	5
Fig. 4. <i>Echinarachnius blancoensis</i> (Kew) ( $\times 2$ ), hypotype (U.W. 368).....	5
Fig. 5. <i>Echinarachnius newcombei</i> (Kew) ( $\times 0.9$ ), holotype (S.U. 5164). Figured originally, 173, pl. 8, fig. 2b.....	6
Fig. 6. <i>Echinarachnius newcombei</i> (Kew) ( $\times 0.9$ ), holotype (S.U. 5164). Figured originally, 173, pl. 8, fig. 2a.....	6
Fig. 7. <i>Echinarachnius blancoensis</i> (Kew) var. <i>etheringtoni</i> n. var. ( $\times 2.3$ ), holotype (U.C. 31981). Figured originally, 140, pl. 9, fig. 12.....	6
Fig. 8. <i>Echinarachnius blancoensis</i> (Kew) var. <i>etheringtoni</i> n. var. ( $\times 2$ ), holotype (U.C. 31981). Figured originally, 140, pl. 9, fig. 12.....	6
Fig. 9. <i>Schizaster</i> sp. Tegland ( $\times 2$ ), holotype (U.C. 32247). Figured originally, 272, pl. 15, fig. 10.....	10
Fig. 10. <i>Anorthoscutum oregonense</i> (W. B. Clark) var. <i>quaylei</i> Grant IV and Hertlein ( $\times 1$ ), holotype (U.C. 11386). Figured originally, 173, pl. 33, fig. 3b.....	9
Fig. 11. <i>Anorthoscutum oregonense</i> (W. B. Clark) var. <i>quaylei</i> Grant IV and Hertlein ( $\times 1$ ), holotype (U.C. 11386). Figured originally, 173, pl. 33, fig. 3b.....	9
Fig. 12. <i>Eoscutella coosensis</i> (Kew) ( $\times 1.1$ ), holotype (C.A.S. 446). Figured originally, 173, pl. 8, fig. 1a.....	7
Fig. 13. <i>Eoscutella coosensis</i> (Kew) ( $\times 1$ ), hypotype (U.C. 33233). Figured by Turner, 274, pl. 5, fig. 1.....	7
Fig. 14. <i>Anorthoscutum oregonense</i> (W. B. Clark) ( $\times 1.2$ ), holotype (U.S.N.M. 153975). Figured originally, 101, pl. 7, fig. 2.....	8

(656)





## PLATE 4

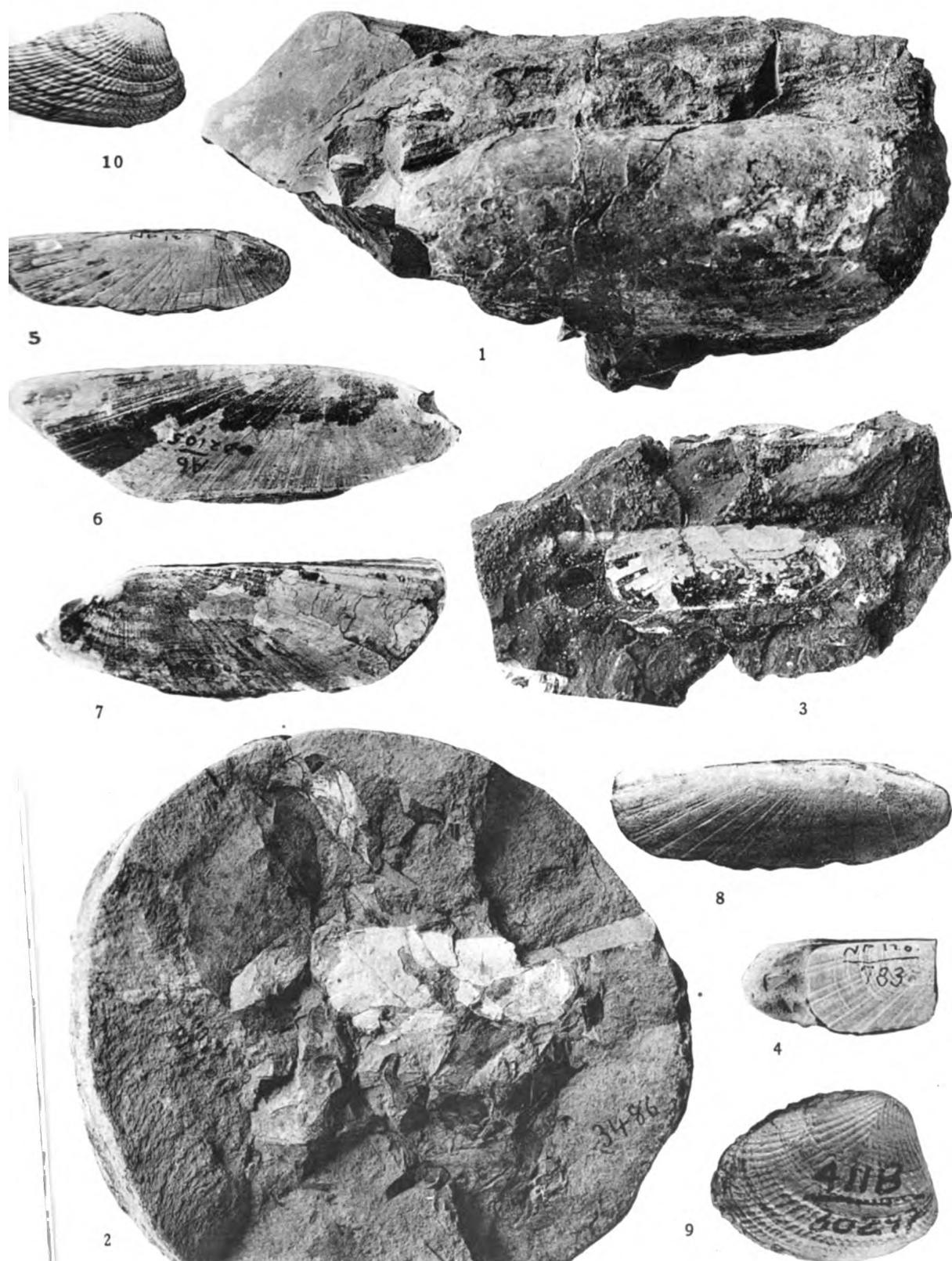
	PAGE
Fig. 1. <i>Balanus tintinnabulum</i> Linnaeus var. <i>coosensis</i> Dall ( $\times 1.1$ ), holotype (U.S.N.M. 153960). Figured originally, 101, pl. 19, fig. 1.....	553
Fig. 2. <i>Anorthoscutum oregonense</i> (W. B. Clark) var. <i>semigibbosus</i> (Howe) ( $\times 1$ ), holotype (S.U. 57). Figured originally, 166, pl. 7, fig. 3.....	10
Fig. 3. <i>Acila (Truncacila) conradi</i> (Meek) ( $\times 1.5$ ), hypotype (U.C. 31900). Figured by Etherington, 140, pl. 1, fig. 1.....	29
Fig. 4. <i>Acila (Truncacila) packardi</i> (Clark) ( $\times 2.1$ ), holotype (U.C. 30297). Figured originally, 52, pl. 8, fig. 12.....	26
Fig. 5. <i>Brisaster maximus</i> H. L. Clark ( $\times 1$ ), holotype (M.C.Z. 3830). Fig- ured originally, 57-A, pl. 24, fig. 9.....	11
Fig. 6. <i>Solemya (Acharax) dalli</i> Clark ( $\times 1$ ), hypotype (U.W. 319) (at bot- tom of plate) .....	20
Fig. 7. <i>Solemya (Acharax) dalli</i> Clark ( $\times 1$ ), hypotype (U.C. 32105). Fig- ured by Tegland, 272, pl. 4, fig. 7 .....	20
Fig. 8. <i>Solemya (Acharax) dalli</i> Clark ( $\times 1$ ), hypotype (U.W. 319-A).....	20
Fig. 9. <i>Nuculana impressa</i> (Conrad) ( $\times 1.5$ ), holotype of <i>Nucula impressa</i> Conrad (U.S.N.M. 3490). Figured originally, 68, pl. 18, fig. 7. (In the present work, printed by error as figure 6 on lower left-hand side of plate.) .....	42
Fig. 10. <i>Nuculana impressa</i> (Conrad) ( $\times 1.5$ ), holotype of <i>Nucula impressa</i> Conrad (U.S.N.M. 3490). Figured originally, 68, pl. 18, fig. 7.....	42

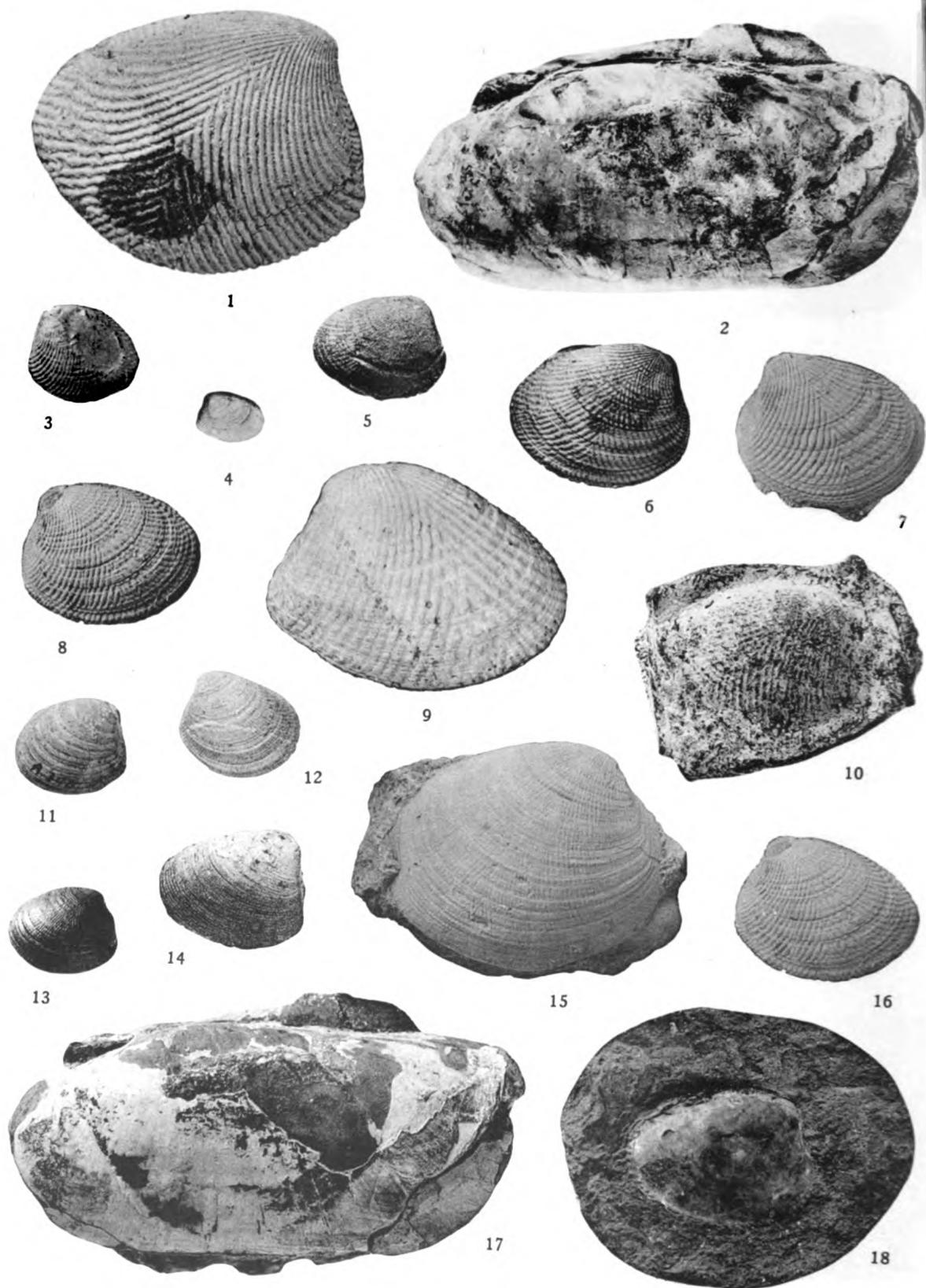
(657)

PLATE 5

	PAGE
Fig. 1. <i>Solemya (Acharax) ventricosa</i> Conrad ( $\times 1$ ), holotype (U.S.N.M. 3567) (Conrad type, Explor. Exped. Rept.). Figured originally, 68, pl. 17, fig. 7	18
Fig. 2. <i>Solemya (Acharax) ventricosa</i> Conrad ( $\times 1$ ), paratype (U.S.N.M. 3486) (Conrad type, Explor. Exped. Rept.). Figured originally, 68, p. 17, fig. 8	18
Fig. 3. <i>Solemya (Acharax) ventricosa</i> Conrad ( $\times 1$ ), hypotype (U.S.N.M., no number) .....	18
Fig. 4. <i>Solemya (Acharax) dalli</i> Clark ( $\times 1$ ), hypotype (S.U. 783). (Twin River, N.P. 120, west of Twin River.) Figured by Tegland, 272, pl. 4, fig. 5. ....	20
Fig. 5. <i>Solemya (Acharax) dalli</i> Clark ( $\times 0.7$ ), holotype (S.U. 5238). Fig- ured originally, 52, pl. 22, fig. 3.....	20
Fig. 6. <i>Solemya (Acharax) dalli</i> Clark ( $\times 1$ ), hypotype (U.C. 32105). Figured by Tegland, 272, pl. 4, fig. 7.....	20
Fig. 7. <i>Solemya (Acharax) dalli</i> Clark ( $\times 1$ ), hypotype (U.C. 32105). Fig- gured by Tegland, 272, pl. 4, fig. 7.....	20
Fig. 8. <i>Solemya (Acharax) dalli</i> Clark ( $\times 1$ ), holotype (S.U. 5238). Dupli- cate of pl. 5, fig. 5. Figured originally, 52, pl. 22, fig. 3.....	20
Fig. 9. <i>Acila (Truncacila) packardi</i> (Clark) ( $\times 2.1$ ), holotype (U.C. 30297). Figured originally, 52, pl. 8, figs. 8, 12. Duplicate figure of holotype..	26
Fig. 10. <i>Acila (Truncacila) packardi</i> (Clark) ( $\times 1.5$ ), holotype (U.C. 30297). Figured originally, 52, pl. 8, figs. 8, 12. Duplicate figure of holotype....	26

(658)



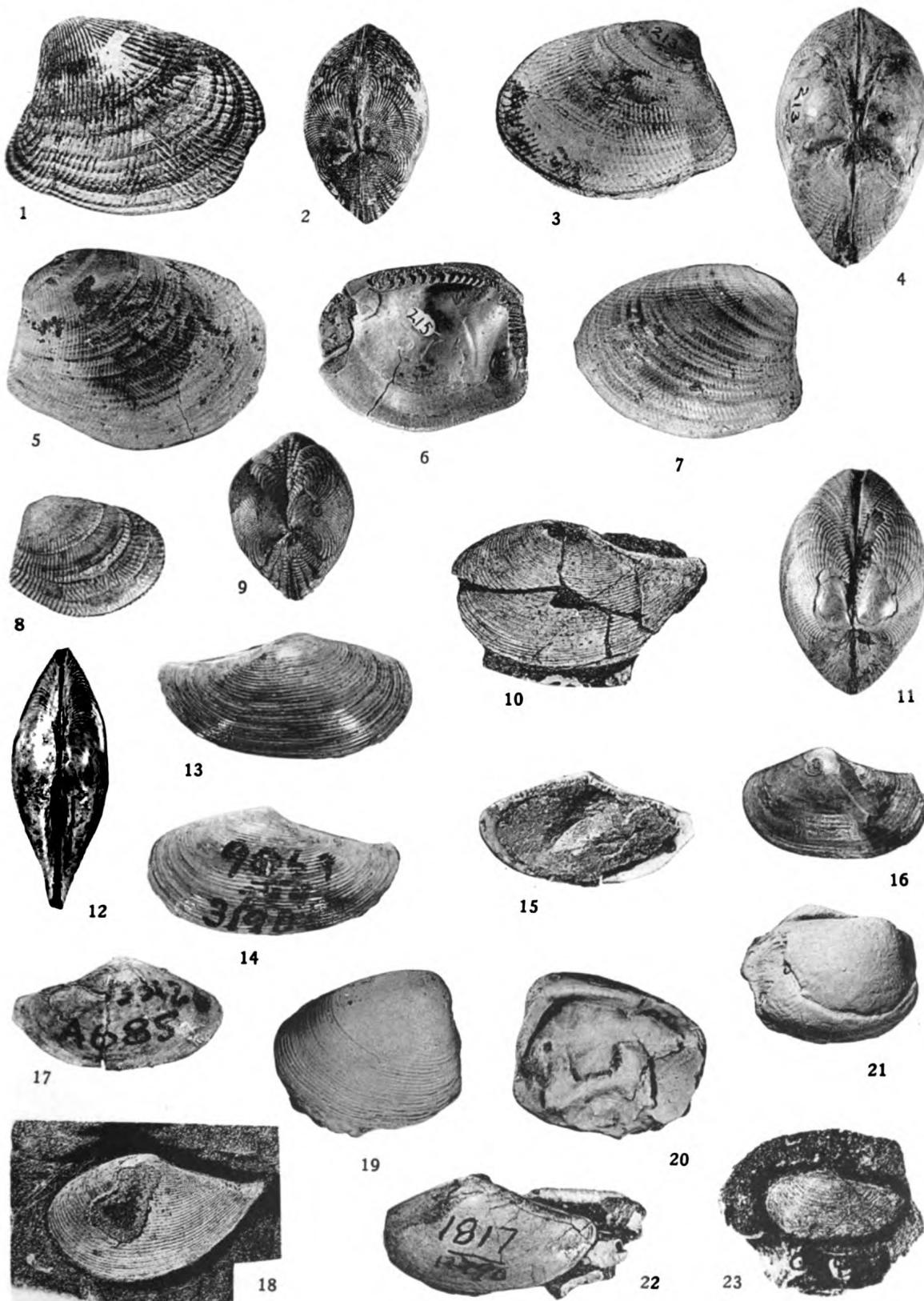


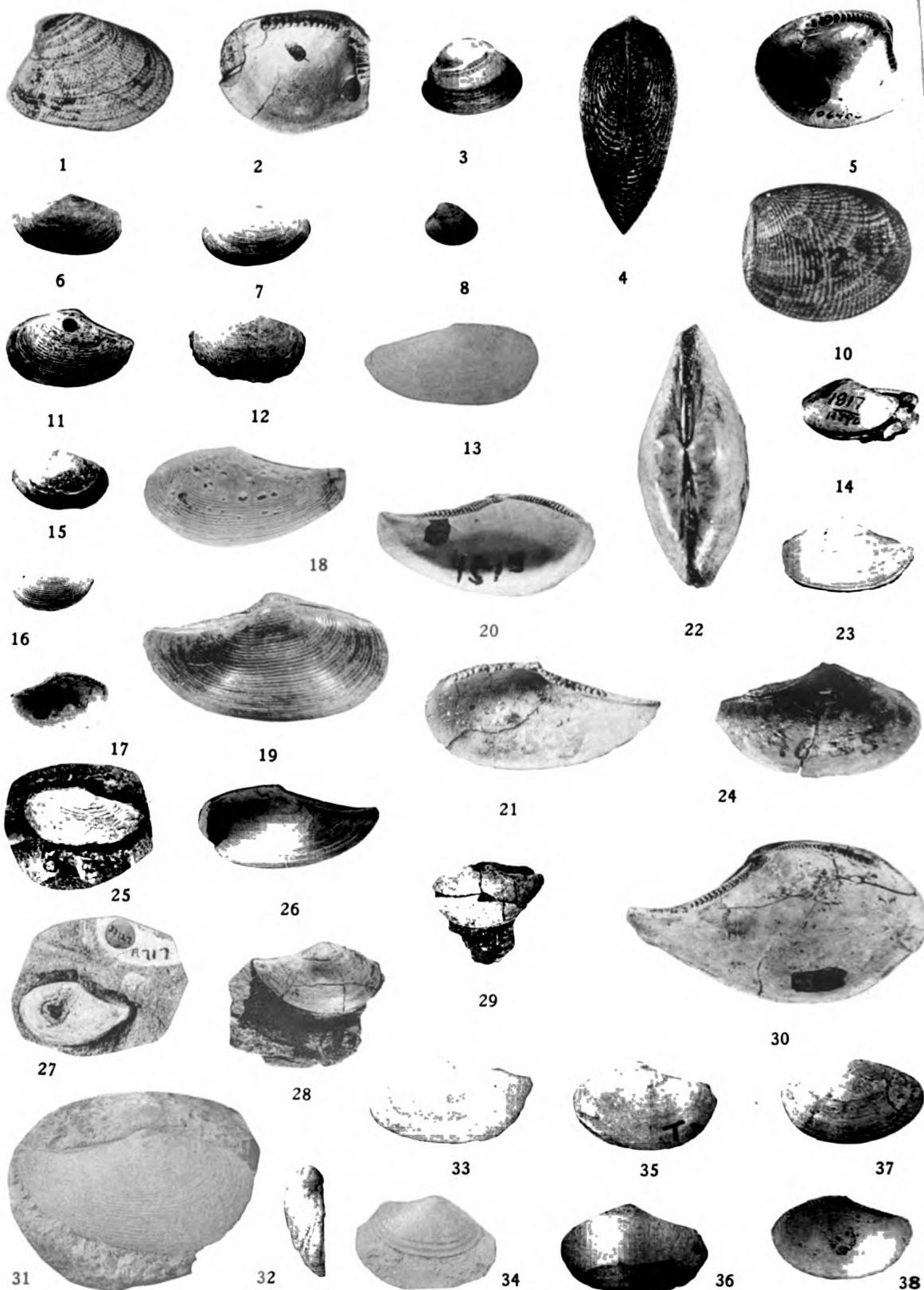
## PLATE 6

	PAGE
Fig. 1. <i>Acila (Truncacila) decisa</i> (Conrad) ( $\times 5$ ), neotype (U.C. 31132). Figured originally by Hanna, 159, pl. 25, fig. 1, as <i>Acila lajollaensis</i> ....	22
Fig. 2. <i>Solemya (Acharax) willapaensis</i> n. sp. ( $\times 1$ ), holotype (U.C. 32086). Figured by Tegland, 272, pl. 4, fig. 12.....	21
Fig. 3. <i>Acila (Truncacila) pugetensis</i> (Clark) ( $\times 1.4$ ), holotype (S.U. 5114). Figured originally, 52, pl. 8, fig. 4.....	28
Fig. 4. <i>Acila (Truncacila) decisa</i> (Conrad) ( $\times 1$ ), holotype of <i>A. stillwaterensis</i> Weaver and Palmer (U.W. 149). Figured originally, 301, pl. 8, fig. 8. ....	22
Fig. 5. <i>Acila (Truncacila) nelsoni</i> (Clark) ( $\times 1.8$ ), holotype (S.U. 5202). Figured originally, 25, pl. 8, fig. 1.....	27
Fig. 6. <i>Acila (Truncacila) empirensis</i> Howe ( $\times 2$ ), holotype (U.C. 30032). Figured originally, 166, pl. 9, fig. 5.....	30
Fig. 7. <i>Acila (Truncacila) empirensis</i> Howe ( $\times 2$ ), topotype (U.C. 30033). Figured originally, 166, p. 9, fig. 8.....	30
Fig. 8. <i>Acila (Truncacila) decisa</i> (Conrad) ( $\times 2$ ), neotype (U.C. 31132). Holotype of <i>A. lajollaensis</i> Hanna. Reverse of pl. 6, fig. 1.....	22
Fig. 9. <i>Acila (Truncacila) nchalemensis</i> G. D. Hanna ( $\times 2$ ), paratype (U.S.N.M. 107401). Figured originally by Dall as <i>Nucula (Acila) cordata</i> , 90, pl. 40, fig. 4.....	24
Fig. 10. <i>Acila (Truncacila) conradi</i> (Meek) ( $\times 1$ ), holotype (U.S.N.M. 5526) (old <i>N. conradi</i> Dall). Figured originally by Conrad as <i>Nucula divaricata</i> , 68, pl. 18, fig. 6. Plastocast.....	29
Fig. 11. <i>Acila (Truncacila) conradi</i> (Meek) ( $\times 1$ ), hypotype (U.C. 31899). Figured by Etherington, 140, pl. 1, fig. 3.....	29
Fig. 12. <i>Acila (Truncacila) conradi</i> (Meek) ( $\times 1$ ), hypotype (U.C. 31900). Figured by Etherington, 140, pl. 1, fig. 1. Duplicate.....	29
Fig. 13. <i>Acila (Truncacila) blancoensis</i> Howe ( $\times 1$ ), paratype (U.S.N.M. 153952). Figured originally as <i>Nucula (Acila) conradi</i> Meek by Dall, 101, pl. 12, fig. 4.....	31
Fig. 14. <i>Nucula hannibali</i> Clark ( $\times 1.6$ ), holotype (S.U. 5248). Figured originally, 52, pl. 8, fig. 2.....	34
Fig. 15. <i>Acila (Truncacila) blancoensis</i> Howe ( $\times 2$ ), holotype (S.U. 59). Figured originally, 166, pl. 9, fig. 3.....	31
Fig. 16. <i>Acila (Truncacila) empirensis</i> Howe ( $\times 2$ ), right valve of holotype (U.C. 30032). Figured originally, 166, pl. 9, fig. 4.....	30
Fig. 17. <i>Solemya (Acharax) willapaensis</i> n. sp. ( $\times 1$ ), holotype (U.C. 32086). Figured by Tegland, 272, pl. 4, fig. 12.....	21
Fig. 18. <i>Acila (Truncacila) conradi</i> (Meek) ( $\times 1$ ), paratype (U.S.N.M. 5526-A). Figured originally as <i>Nucula divaricata</i> , 68, pl. 18, fig. 6a....	29

## PLATE 7

	PAGE
Fig. 1. <i>Acila (Acila) gettysburgensis</i> (Reagan) ( $\times 2$ ), hypotype (U.W. 211-A)	32
Fig. 2. <i>Acila (Acila) gettysburgensis</i> (Reagan) ( $\times 1.5$ ), hypotype (U.W. 211-A) .....	32
Fig. 3. <i>Acila (Acila) gettysburgensis</i> (Reagan) ( $\times 2$ ), hypotype (U.W. 213) ..	32
Fig. 4. <i>Acila (Acila) gettysburgensis</i> (Reagan) ( $\times 2$ ), hypotype (U.W. 213) ..	32
Fig. 5. <i>Acila (Truncacila) shumardi</i> (Dall) ( $\times 2$ ), hypotype (U.W. 215).....	25
Fig. 6. <i>Acila (Truncacila) shumardi</i> (Dall) ( $\times 1.7$ ), hypotype (U.W. 215)....	25
Fig. 7. <i>Acila (Truncacila) shumardi</i> (Dall) ( $\times 1.7$ ), hypotype (U.W. 246)....	25
Fig. 8. <i>Acila (Truncacila) decisa</i> (Conrad) ( $\times 2.1$ ), holotype of <i>A. stillwaterensis</i> Weaver and Palmer (U.W. 149). Figured originally, 301, pl. 8, fig. 8. ....	22
Fig. 9. <i>Acila (Truncacila) decisa</i> (Conrad) ( $\times 2.1$ ), holotype of <i>A. stillwaterensis</i> Weaver and Palmer (U.W. 149). Figured originally, 301, pl. 8, fig. 8. ....	22
Fig. 10. <i>Nuculana cowlitzensis</i> (Weaver and Palmer) ( $\times 2$ ), holotype (U.W. 150) (C.A.S. 7380). Figured originally, 301, pl. 10, fig. 4.....	36
Fig. 11. <i>Acila (Truncacila) shumardi</i> (Dall) ( $\times 1.7$ ), hypotype (U.W. 246)....	25
Fig. 12. <i>Nuculana ochsneri</i> (Anderson and Martin) var. <i>elmana</i> Etherington ( $\times 2.2$ ), holotype (U.C. 31908). Figured originally, 140, pl. 1, fig. 4..	40
Fig. 13. <i>Nuculana ochsneri</i> (Anderson and Martin) var. <i>elmana</i> Etherington ( $\times 2.2$ ), holotype (U.C. 31908). Figured originally, 140, pl. 1, fig. 4....	40
Fig. 14. <i>Nuculana ochsneri</i> (Anderson and Martin) var. <i>elmana</i> Etherington ( $\times 2.2$ ), holotype (U.C. 31908). Figured originally, 140, pl. 1, fig. 4....	40
Fig. 15. <i>Nuculana fresnoensis</i> (Dickerson) ( $\times 2$ ), hypotype (U.C. 33126). Figured by Turner, 274, pl. 5, fig. 6.....	41
Fig. 16. <i>Yoldia (Portlandia) duprei</i> Weaver and Palmer ( $\times 2.1$ ), holotype (U.W. 151) (C.A.S. 7388). Figured originally, 301, pl. 10, fig. 7.....	46
Fig. 17. <i>Nuculana fresnoensis</i> (Dickerson) ( $\times 2$ ), hypotype (U.C. 33126). Figured by Turner, 274, pl. 5, fig. 6.....	41
Fig. 18. <i>Nuculana cowlitzensis</i> (Weaver and Palmer) ( $\times 3$ ), hypotype (U.C. 33127). Figured originally by Turner, 274, pl. 5, fig. 4.....	36
Fig. 19. <i>Nucula hannibali</i> Clark ( $\times 2$ ), holotype (S.U. 5248). Figured originally, 52, pl. 8, fig. 2.....	34
Fig. 20. <i>Nucula hannibali</i> Clark ( $\times 2$ ), holotype (S.U. 5248). Figured originally, 52, pl. 8, fig. 2.....	34
Fig. 21. <i>Acila (Truncacila) nelsoni</i> (Clark) ( $\times 2$ ), paratype (S.U. 5203).....	27
Fig. 22. <i>Nuculana fresnoensis</i> (Dickerson) ( $\times 1.5$ ), holotype (U.C. 11790). Figured originally, 122, pl. 36, fig. 2a.....	41
Fig. 23. <i>Nuculana parkei</i> (Anderson and Hanna) subsp. <i>coosensis</i> Turner ( $\times 20.1$ ), holotype (U.C. 33205). Figured originally, 274, pl. 5, fig. 5..	38



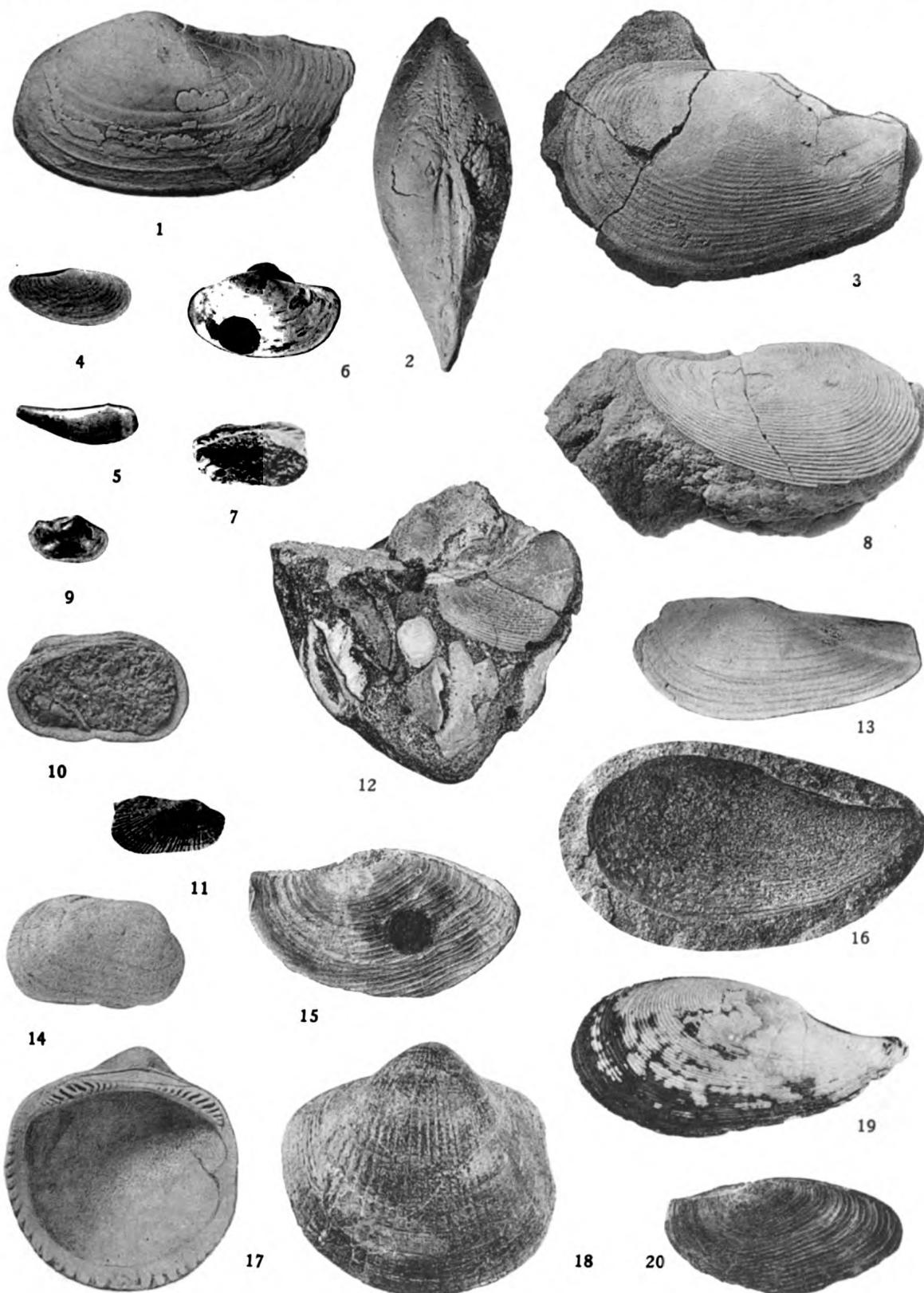


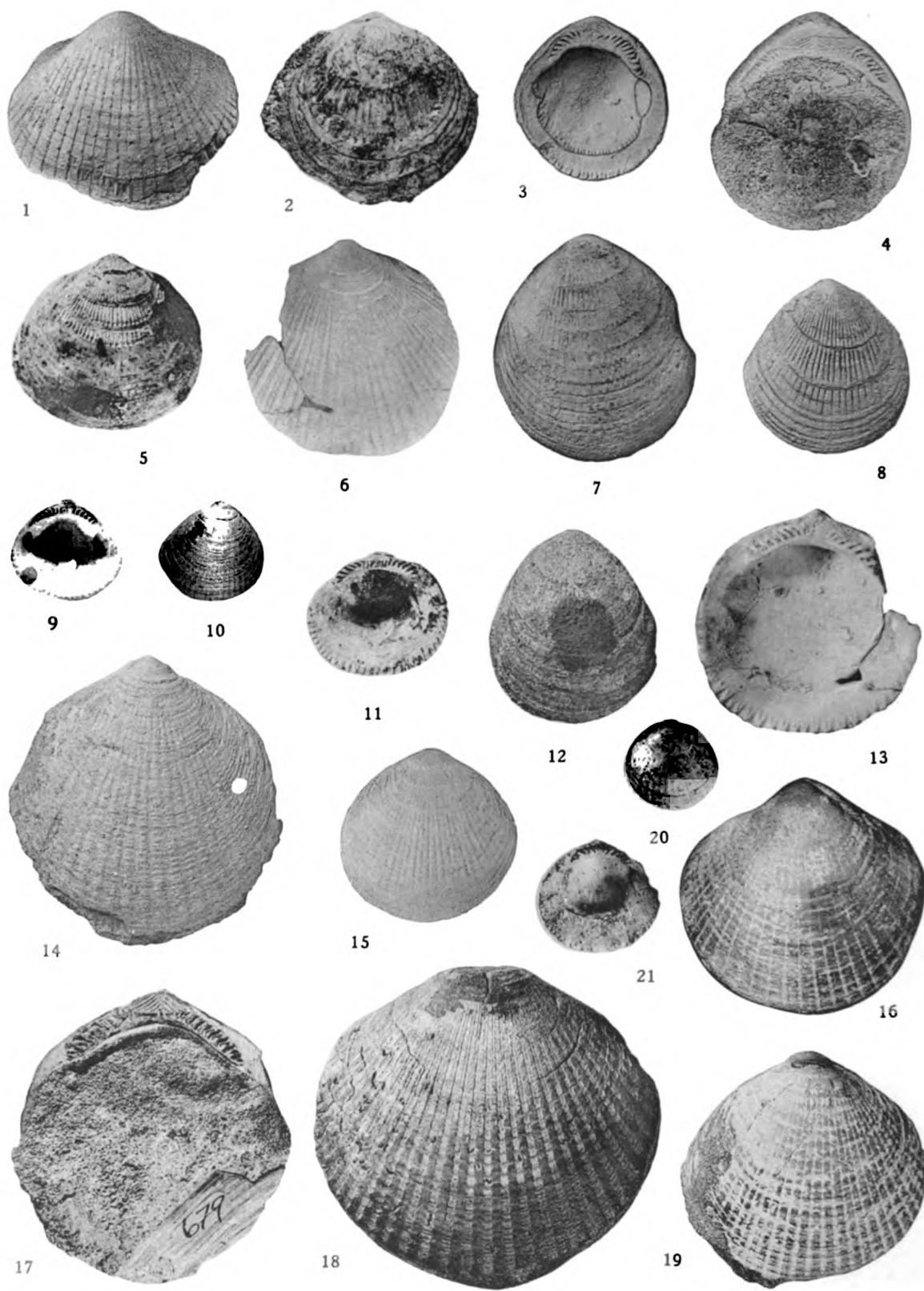
## PLATE 8

	PAGE
Fig. 1. <i>Acila (Acila) gettysburgensis</i> (Reagan) ( $\times 1$ ), holotype (U.S.N.M. 328302). Figured originally, 230, pl. 1, fig. 3.....	32
Fig. 2. <i>Acila (Truncacila) shumardi</i> (Dall) ( $\times 1$ ), hypotype (U.W. 215). Duplicate of pl. 7, fig. 6; inside view, right valve.....	25
Fig. 3. <i>Nucula washingtonensis</i> Weaver ( $\times 1.8$ ), holotype (U.W. 84) (C.A.S. 449). Figured originally, 295, pl. 3, fig. 29.....	35
Fig. 4. <i>Acila (Truncacila) conradi</i> (Meek) ( $\times 2$ ), hypotype (U.C. 32484).....	29
Fig. 5. <i>Acila (Truncacila) shumardi</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 406505). Figured by Dall as <i>Nucula (Acila) decisa</i> Conrad, 90, pl. 40, figs. 1, 3. Inside view.....	25
Fig. 6. <i>Nuculana ochsneri</i> (Anderson and Martin) var. <i>elmana</i> Etherington ( $\times 1$ ), holotype (U.C. 31908). Figured originally, 140, pl. 1, fig. 4.....	40
Fig. 7. <i>Nuculana ochsneri</i> (Anderson and Martin) var. <i>elmana</i> Etherington ( $\times 1$ ), paratype (U.C. 31909). Figured originally, 140, pl. 1, fig. 6.....	40
Fig. 8. <i>Nucula washingtonensis</i> Weaver ( $\times 1$ ), topotype (U.C. 31898). Figured by Etherington, 140, pl. 1, fig. 12.....	35
Fig. 10. <i>Acila (Truncacila) conradi</i> (Meek) ( $\times 2$ ), hypotype (U.C. 32484).....	29
Fig. 11. <i>Nuculana chehalensis</i> (Weaver) ( $\times 1.2$ ), holotype (U.W. 43) (C.A.S. 539). Figured originally, 286, pl. 12, fig. 104.....	39
Fig. 12. <i>Nuculana ochsneri</i> (Anderson and Martin) var. <i>elmana</i> Etherington ( $\times 1$ ), paratype (U.C. 31910). Figured originally, 140, pl. 1, fig. 5.....	40
Fig. 13. <i>Nuculana alkienensis</i> (Clark) ( $\times 1$ ), holotype (S.U. 7). Figured originally, 52, pl. 8, fig. 10.....	40
Fig. 14. <i>Nuculana fresnoensis</i> (Dickerson) ( $\times 0.7$ ), holotype (U.C. 11790). Duplicate figure. Figured originally, 122, pl. 36, fig. 2a.....	41
Fig. 15. <i>Nuculana chehalensis</i> (Weaver) ( $\times 0.9$ ), hypotype (U.C. 31905). Figured by Etherington, 140, pl. 1, fig. 2.....	39
Fig. 16. <i>Nuculana chehalensis</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 31904). Figured by Etherington, 140, pl. 1, fig. 9.....	39
Fig. 17. <i>Nuculana chehalensis</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 31907). Figured by Etherington, 140, pl. 1, fig. 14.....	39
Fig. 18. <i>Nuculana washingtonensis</i> (Weaver) ( $\times 1.6$ ), syntype (U.W. 86) (C.A.S. 451). Figured originally as <i>Leda lincolensis</i> , 295, pl. 3, fig. 24.....	38
Fig. 19. <i>Nuculana ochsneri</i> (Anderson and Martin) var. <i>elmana</i> Etherington ( $\times 2$ ), holotype (U.C. 31908). Figured originally, 140, pl. 1, fig. 4.....	40
Fig. 20. <i>Nuculana washingtonensis</i> (Weaver) ( $\times 1.6$ ), syntype (U.W. 86) (C.A.S. 451). Figured originally as <i>Leda lincolensis</i> , 295, pl. 3, fig. 24.....	38
Fig. 21. <i>Nuculana merriami</i> (Dickerson) ( $\times 3.5$ ), hypotype (U.C. 33509). Figured by Effinger, 138, pl. 46, fig. 5.....	37
Fig. 22. <i>Nuculana ochsneri</i> (Anderson and Martin) var. <i>elmana</i> Etherington ( $\times 2.2$ ), holotype (U.C. 31908). Figured originally, 140, pl. 1, fig. 4.....	40
Fig. 23. <i>Nuculana fresnoensis</i> (Dickerson) ( $\times 1$ ), holotype (U.C. 11790). Duplicate. Figured originally, 122, pl. 36, fig. 2a.....	41
Fig. 24. <i>Nuculana fresnoensis</i> (Dickerson) ( $\times 2$ ), hypotype (U.C. 33126). Figured by Turner, 274, pl. 5, fig. 6.....	41
Fig. 25. <i>Nuculana parkei</i> (Anderson and Hanna) subsp. <i>coosensis</i> Turner ( $\times 2$ ), holotype (U.C. 33205). Figured originally, 274, pl. 5, fig. 5.....	38
Fig. 26. <i>Nuculana washingtonensis</i> (Weaver) ( $\times 1.5$ ), syntype (U.W. 85) (C.A.S. 450). Figured originally as <i>Leda washingtonensis</i> , 295, pl. 3, fig. 25.....	38
Fig. 27. <i>Nuculana cowlitensis</i> (Weaver and Palmer) ( $\times 1.3$ ), hypotype (U.C. 33127). Figured by Turner, 274, pl. 5, fig. 4.....	36
Fig. 28. <i>Nuculana vaderensis</i> (Dickerson) ( $\times 1.8$ ), holotype (C.A.S. 252). Figured originally, 121, pl. 1, fig. 3.....	37
Fig. 29. <i>Nuculana cowlitensis</i> (Weaver and Palmer) ( $\times 0.8$ ), holotype (U.W. 150) (C.A.S. 7380). Duplicate of pl. 7, fig. 10. Figured originally, 301, pl. 10, fig. 4.....	36
Fig. 30. <i>Nuculana merriami</i> (Dickerson) ( $\times 1.5$ ), holotype (C.A.S. 381). Figured originally, 123, pl. 27, fig. 1b.....	37
Fig. 31. <i>Nuculana impressa</i> (Conrad) ( $\times 2$ ), holotype? (S.U. 61). Figured by Howe as <i>Leda subimpressa</i> Howe, 166, pl. 10, fig. 3.....	42
Fig. 32. <i>Acila (Truncacila) packardi</i> (Clark) ( $\times 1.5$ ), holotype (U.C. 30297). Figured originally, 52, pl. 8, fig. 8.....	26
Fig. 33. <i>Yoldia (Portlandia) packardi</i> (Clark) ( $\times 1$ ), hypotype (S.U. 9). Figured originally, 52, pl. 9, fig. 7.....	44
Fig. 34. <i>Yoldia (Portlandia) packardi</i> (Clark) ( $\times 1$ ), holotype (U.C. 11154). Figured originally, 43, pl. 12, fig. 3. From California.....	44
Fig. 35. <i>Yoldia chehalensis</i> (Arnold) ( $\times 2$ ), hypotype (U.C. 32107). Figured by Tegland, 272, pl. 5, fig. 16.....	45
Fig. 36. <i>Yoldia chehalensis</i> (Arnold) ( $\times 2$ ), hypotype (U.C. 32094). Figured originally, 272, pl. 5, fig. 17.....	45
Fig. 37. <i>Yoldia chehalensis</i> (Arnold) ( $\times 2$ ), hypotype (U.C. 32093). Figured originally, 272, pl. 5, fig. 18.....	45
Fig. 38. <i>Yoldia chehalensis</i> (Arnold) ( $\times 3$ ), holotype (U.S.N.M. 165447). Figured originally, 13, pl. 33, fig. 9.....	45

## PLATE 9

	PAGE
Fig. 1. <i>Yoldia olympiana</i> Clark ( $\times 2$ ), holotype (S.U. 10). Figured originally, 52, pl. 9, fig. 9.....	46
Fig. 2. <i>Yoldia olympiana</i> Clark ( $\times 2$ ), holotype (S.U. 10). Figured originally, 52, pl. 9, fig. 9.....	46
Fig. 3. <i>Yoldia sammamishensis</i> Weaver ( $\times 0.9$ ), holotype (U.W. 44) (C.A.S. 7387). Figured originally, 286, pl. 13, fig. 106.....	48
Fig. 4. <i>Yoldia temblorensis</i> Anderson and Martin ( $\times 1$ ), hypotype (U.C. 31911). Figured by Etherington, 140, pl. 1, fig. 16.....	50
Fig. 5. <i>Yoldia newcombi</i> Anderson and Martin ( $\times 1.3$ ), holotype (C.A.S. 237). Figured originally, 5, pl. 3, fig. 2.....	47
Fig. 6. <i>Yoldia reagani</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 328303). Figured originally by Reagan as <i>Yoldia impressa</i> Conrad, 230, pl. 1, fig. 4.....	52
Fig. 7. <i>Porterius gabbi</i> (Dickerson) ( $\times 2$ ), holotype (C.A.S. 385). Figured as <i>Barbatia gabbi</i> , 123, pl. 27, fig. 4.....	53
Fig. 8. <i>Yoldia (Portlandia) oregona</i> (Shumard) ( $\times 1$ ), hypotype (U.C. 31912). Figured by Etherington, 140, pl. 1, fig. 8.....	49
Fig. 9. <i>Yoldia (Portlandia) duprei</i> Weaver and Palmer ( $\times 1$ ), holotype (U.W. 151) (C.A.S. 7388). Figured originally, 301, pl. 10, fig. 7.....	46
Fig. 10. <i>Porterius gabbi</i> (Dickerson) ( $\times 1.5$ ), hypotype (U.C. 30365). Figured by Clark, 52, pl. 9, fig. 6, as <i>Parallelodon andersoni</i> (Van Winkle).....	53
Fig. 11. <i>Porterius gabbi</i> (Dickerson) ( $\times 2$ ), holotype (C.A.S. 385). Figured as <i>Barbatia gabbi</i> , 123, pl. 27, fig. 4.....	53
Fig. 12. <i>Nuculana whitmani</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 153970). Figured originally, 101, pl. 14, fig. 4.....	44
Fig. 13. <i>Yoldia clallamensis</i> n. sp. ( $\times 0.9$ ), holotype (U.C. 32095).....	48
Fig. 14. <i>Porterius gabbi</i> (Dickerson) ( $\times 1.5$ ), hypotype (U.C. 30365). Figured by Clark as <i>Parallelodon andersoni</i> (Van Winkle), 52, pl. 8, fig. 3.....	53
Fig. 15. <i>Yoldia scissurata</i> Dall var. <i>strigata</i> Dall ( $\times 1.2$ ), paratype (U.S.N.M. 153951-A).....	51
Fig. 16. <i>Yoldia (Portlandia) oregona</i> (Shumard) ( $\times 1$ ), hypotype (U.S.N.M. 110450). Figured by Dall, 101, pl. 19, fig. 4.....	49
Fig. 17. <i>Glycymeris sagittata</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 32587). Cowlitz formation, locality (U.W. 319).....	54
Fig. 18. <i>Glycymeris sagittata</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 33089). Figured by Turner, 274, pl. 6, fig. 1.....	54
Fig. 19. <i>Yoldia (Portlandia) cooperii</i> Gabb ( $\times 1$ ), holotype (U.C. 30613). Living form.....	50
Fig. 20. <i>Yoldia scissurata</i> Dall var. <i>strigata</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153951). Figured originally, 101, pl. 14, fig. 9.....	51



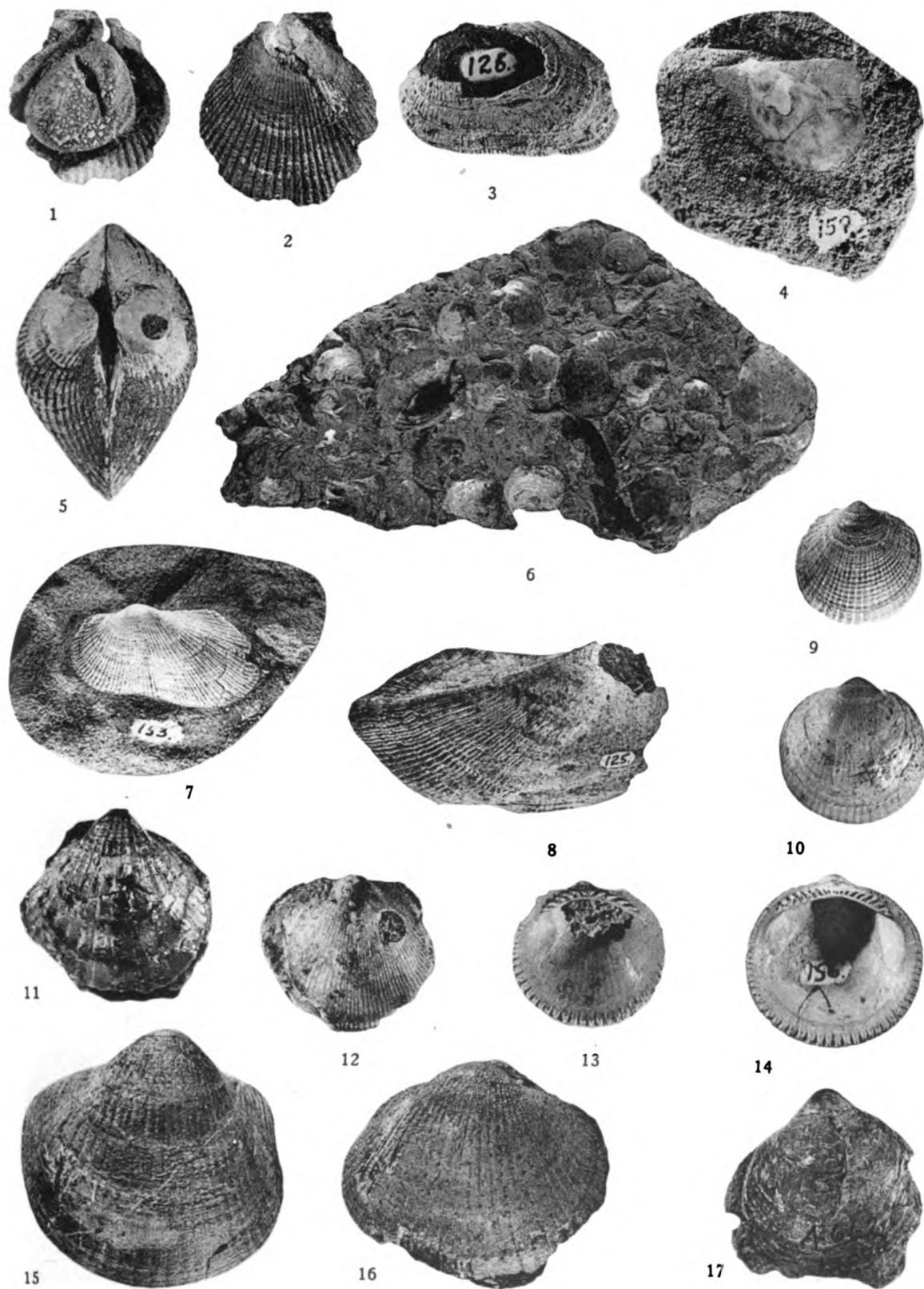


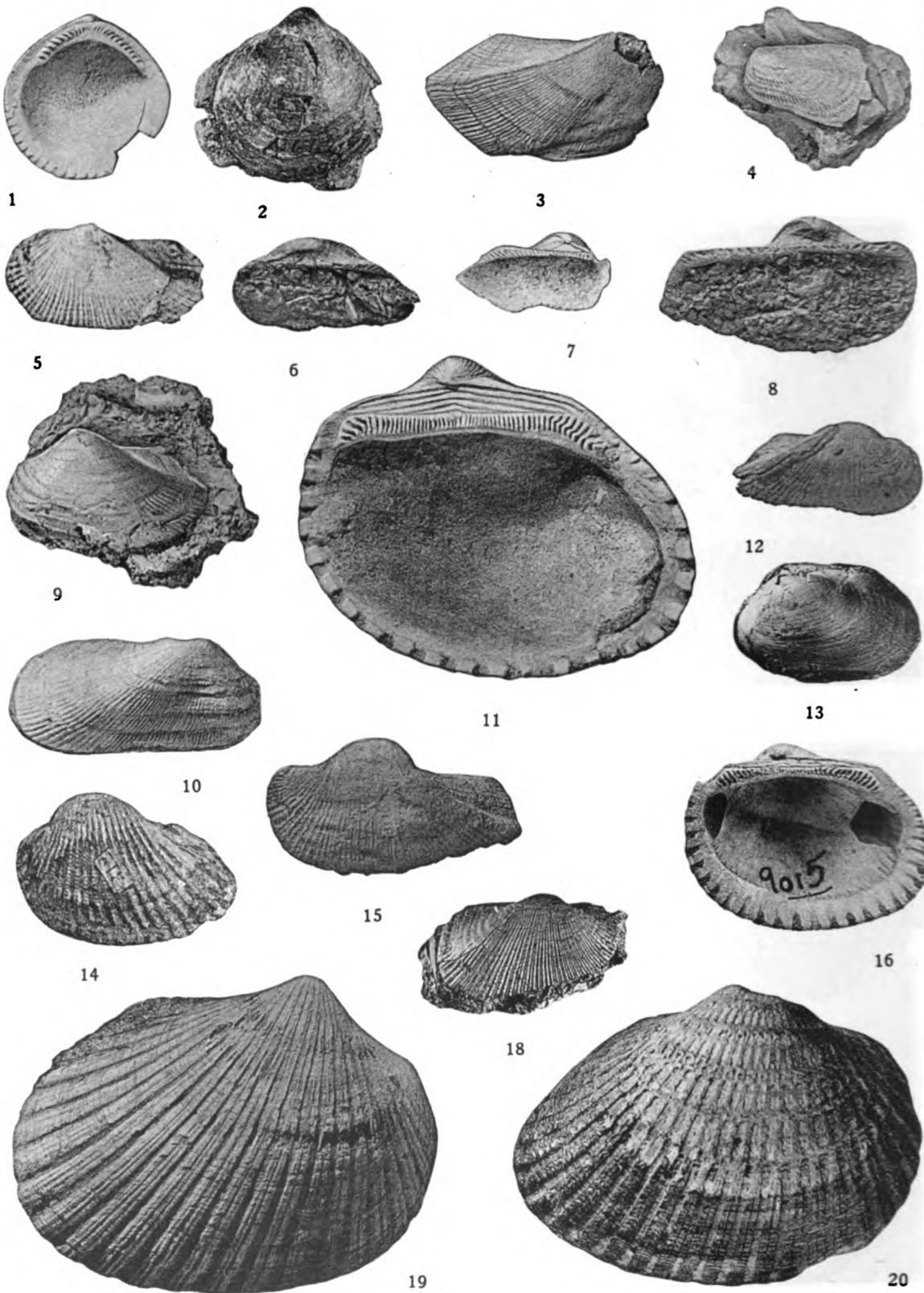
## PLATE 10

	PAGE
Fig. 1. <i>Glycymeris sagittata</i> (Gabb) var. <i>kelsoensis</i> Weaver and Palmer ( $\times 1$ ), holotype (U.W. 158) (C.A.S. 7399). Figured originally, 301, pl. 8, fig. 2.	56
Fig. 2. <i>Glycymeris eocenica</i> (Weaver) ( $\times 1.3$ ), paratype (U.W. 1-A) (C.A.S. 476-A). Figured originally, 286, pl. 5, fig. 52.....	56
Fig. 3. <i>Glycymeris eocenica</i> (Weaver) ( $\times 1.2$ ), holotype (U.W. 1) (C.A.S. 476). Figured originally, 286, pl. 5, fig. 52.....	56
Fig. 4. <i>Glycymeris vancouverensis</i> Clark and Arnold ( $\times 1.2$ ), holotype (U.C. 30036). Figured originally, 50, pl. 27, fig. 2b.....	60
Fig. 5. <i>Glycymeris andersoni</i> Dickerson ( $\times 1.1$ ), holotype (C.A.S. 383). Figured originally, 123, pl. 27, fig. 3a.....	59
Fig. 6. <i>Glycymeris winlockensis</i> Effinger ( $\times 2.1$ ), holotype (U.C. 14790). Figured originally, 138, pl. 45, fig. 2.....	61
Fig. 7. <i>Glycymeris vancouverensis</i> Clark and Arnold ( $\times 1.2$ ), holotype (U.C. 30036). Figured originally, 50, pl. 27, fig. 2a.....	60
Fig. 8. <i>Glycymeris eocenica</i> (Weaver) ( $\times 1.2$ ), paratype (U.W. 2) (C.A.S. 477). Figured originally as holotype of <i>Pectunculus eocenica</i> Weaver var. <i>landesi</i> , 286, pl. 5, fig. 54.....	56
Fig. 9. <i>Glycymeris chehalensis</i> Weaver ( $\times 1.2$ ), holotype (U.W. 87) (C.A.S. 452). Figured originally, 295, pl. 3, fig. 35.....	61
Fig. 10. <i>Glycymeris chehalensis</i> Weaver ( $\times 1.2$ ), holotype (U.W. 87) (C.A.S. 452). Figured originally, 295, pl. 3, fig. 35.....	61
Fig. 11. <i>Glycymeris andersoni</i> Dickerson ( $\times 2$ ), paratype (C.A.S. 384). Figured originally, 123, pl. 27, fig. 3b.....	59
Fig. 12. <i>Glycymeris eocenica</i> (Weaver) var. <i>tejonensis</i> (Weaver) ( $\times 1$ ), holotype (U.W. 3) (C.A.S. 478). Figured originally, 286, pl. 15, fig. 134....	57
Fig. 13. <i>Glycymeris winlockensis</i> Effinger ( $\times 2.1$ ), holotype (U.C. 14790). Figured originally, 138, pl. 45, fig. 5.....	61
Fig. 14. <i>Glycymeris wishkahensis</i> Clark ( $\times 1$ ), holotype (C.A.S. 679). Figured originally, 52, pl. 13, fig. 2.....	65
Fig. 15. <i>Glycymeris vancouverensis</i> Clark and Arnold ( $\times 1$ ), paratype (U.C. 30037). Figured originally, 50, pl. 27, fig. 5.....	60
Fig. 16. <i>Glycymeris larvata</i> Hanna ( $\times 1$ ), holotype (U.S.N.M. 153949-A). Figured originally, 101, pl. 11, fig. 2.....	63
Fig. 17. <i>Glycymeris wishkahensis</i> Clark ( $\times 1$ ), holotype (C.A.S. 679). Figured originally, 52, pl. 13, fig. 1.....	65
Fig. 18. <i>Glycymeris gabbi</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153949-B). Figured originally, 101, pl. 11, fig. 5.....	62
Fig. 19. <i>Glycymeris grawingki</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 107784). Figured originally, 101, pl. 2, fig. 13.....	62
Fig. 20. <i>Glycymeris crescentensis</i> Weaver and Palmer ( $\times 1.5$ ), holotype (U.W. 157) (C.A.S. 7403). Figured originally, 301, pl. 8, fig. 10.....	58
Fig. 21. <i>Glycymeris crescentensis</i> Weaver and Palmer ( $\times 2$ ), paratype (U.W. 157-A) (C.A.S. 7403-A). Figured originally, 301, pl. 8, fig. 12.....	58

## PLATE 11

	PAGE
Fig. 1. <i>Pecten (Chlamys) cowlitzensis</i> Weaver ( $\times 2.3$ ), holotype (U.W. 6) (C.A.S. 7417). Figured originally, 286, pl. 5, fig. 46.....	83
Fig. 2. <i>Pecten (Chlamys) cowlitzensis</i> Weaver ( $\times 1.8$ ), holotype (U.W. 6) (C.A.S. 7417). Figured originally, 286, pl. 5, fig. 46.....	83
Fig. 3. <i>Porterius gabbi</i> (Dickerson) ( $\times 2.5$ ), hypotype (U.W. 126) (C.A.S. 7392). Figured originally as holotype of <i>Barbatia andersoni</i> , 275, pl. 6, fig. 2.....	53
Fig. 4. <i>Pteria clarki</i> Weaver and Palmer ( $\times 2$ ), holotype (U.W. 159) (C.A.S. 7405). Figured originally, 301, pl. 10, fig. 5.....	77
Fig. 5. <i>Anadara (Anadara) obispoana</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 32558). Locality (U.C. 9021).....	74
Fig. 6. <i>Palliolum (Delectopecten) peckhami</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 32640). From Astoria formation at 10th and Harrison Streets, Astoria, Oregon .....	96
Fig. 7. <i>Barbatia (Obliquarca) suzalloi</i> Weaver and Palmer ( $\times 1.5$ ), holotype (U.W. 153) (C.A.S. 7393). Figured originally, 301, pl. 8, fig. 6.....	68
Fig. 8. <i>Arca (Arca) merriami</i> (Van Winkle) ( $\times 1.3$ ), holotype (U.W. 125) (C.A.S. 7396). Figured originally, 275, pl. 6, fig. 1.....	66
Fig. 9. <i>Glycymeris sagittata</i> (Gabb) var. <i>dickersoni</i> Weaver and Palmer ( $\times 1.5$ ), hypotype (U.W. 156-B) (C.A.S. 7404-B). Locality (U.W. 329) .....	55
Fig. 10. <i>Glycymeris sagittata</i> (Gabb) var. <i>dickersoni</i> Weaver and Palmer, ( $\times 1.8$ ), holotype (U.W. 156) (C.A.S. 7404). Figured originally, 301, pl. 8, fig. 5.....	55
Fig. 11. <i>Glycymeris fresnoensis</i> Dickerson ( $\times 3$ ), hypotype (U.C. 33658). Figured by Turner, 274, pl. 5, fig. 9.....	59
Fig. 12. <i>Glycymeris crescentensis</i> Weaver and Palmer ( $\times 2$ ), topotype (U.W. 157-B) (C.A.S. 7403-B).....	58
Fig. 13. <i>Glycymeris sagittata</i> (Gabb) var. <i>dickersoni</i> Weaver and Palmer ( $\times 1.5$ ), hypotype (U.W. 156-A) (C.A.S. 7404-A). Locality (U.W. 329) .....	55
Fig. 14. <i>Glycymeris sagittata</i> (Gabb) var. <i>dickersoni</i> Weaver and Palmer ( $\times 2$ ), holotype (U.W. 156) (C.A.S. 7404). Figured originally, 301, pl. 8, fig. 5.....	55
Fig. 15. <i>Glycymeris sagittata</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 33089). Figured by Turner, 274, pl. 6, fig. 1.....	54
Fig. 16. <i>Glycymeris sagittata</i> (Gabb) var. <i>kelsoensis</i> Weaver and Palmer ( $\times 1$ ), holotype (U.W. 158) (C.A.S. 7399). Figured originally, 301, pl. 8, fig. 2.	56
Fig. 17. <i>Glycymeris perrini</i> Dickerson ( $\times 1$ ), hypotype (U.C. 33094). Figured by Turner, 274, pl. 5, fig. 10.....	64



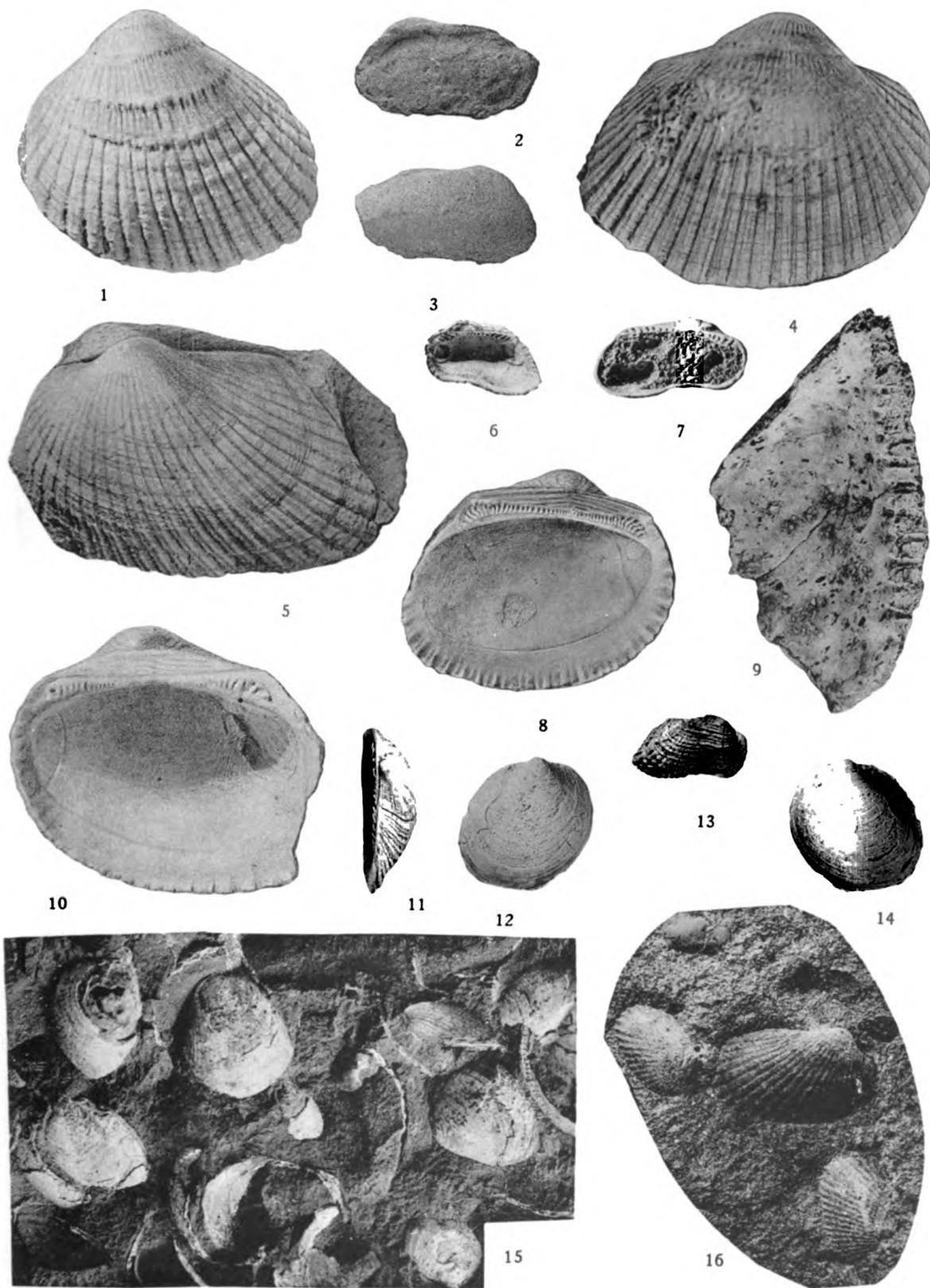


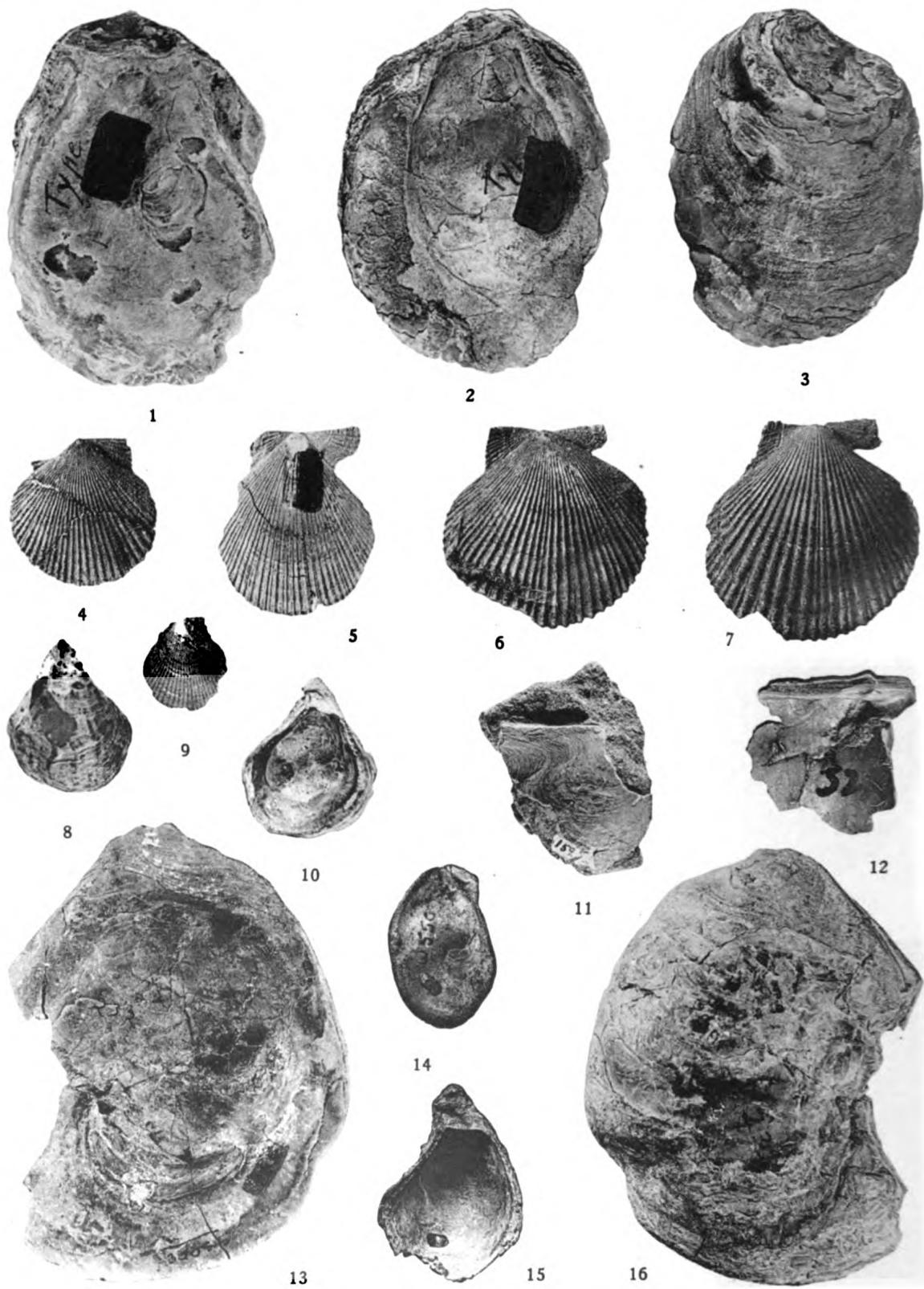
## PLATE 12

	PAGE
Fig. 1. <i>Glycymeris tenuimbricata</i> Clark ( $\times 1$ ), hypotype (U.C. 31902). Figured originally, 140, pl. 4, fig. 6.....	63
Fig. 2. <i>Glycymeris perrini</i> Dickerson ( $\times 1$ ), hypotype (U.C. 33094). Figured by Turner, 274, pl. 5, fig. 10.....	64
Fig. 3. <i>Arca (Arca) merriami</i> (Van Winkle) ( $\times 0.9$ ), holotype (U.W. 125) (C.A.S. 7396). Figured originally, 275, pl. 6, fig. 1 .....	66
Fig. 4. <i>Barbatia (Obliquarca) morsei</i> Gabb ( $\times 1$ ), holotype (U.C. 11984). Figured originally by Gabb, 142, pl. 32, fig. 286.....	69
Fig. 5. <i>Arca (Arca) washingtoniana</i> Dickerson ( $\times 3.3$ ), hypotype (U.C. 33503). Figured by Effinger, 138, pl. 46, fig. 8.....	66
Fig. 6. <i>Arca (Arca) merriami</i> (Van Winkle) ( $\times 1.5$ ), hypotype (S.U. 13). Figured by Clark, 52, pl. 13, fig. 6.....	66
Fig. 7. <i>Arca (Arca) merriami</i> (Van Winkle) ( $\times 1.5$ ), hypotype (U.C. 32400). ....	66
Fig. 8. <i>Arca (Arca) merriami</i> (Van Winkle) ( $\times 1.5$ ), hypotype (S.U. 14). Figured by Clark, 52, pl. 13, fig. 7.....	66
Fig. 9. <i>Arca (Arca) merriami</i> (Van Winkle) ( $\times 1.7$ ), hypotype (U.C. 32400). Locality (U.C. 4209).....	66
Fig. 10. <i>Barbatia (Obliquarca) suzzalloi</i> Weaver and Palmer ( $\times 1$ ), hypotype (U.C. 32542). Locality (U.C. 7164).....	68
Fig. 11. <i>Anadara (Anadara) trilineata</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 11923). Locality, Wilson's Ranch.....	71
Fig. 12. <i>Arca (Arca) merriami</i> (Van Winkle) ( $\times 1.5$ ), hypotype (S.U. 13). Figured by Clark, 52, pl. 13, fig. 5.....	66
Fig. 13. <i>Barbatia (Barbatia) cowlitensis</i> (Weaver and Palmer) ( $\times 1.4$ ), holotype (U.W. 154) (C.A.S. 7394). Figured originally, 301, pl. 8, fig. 9.....	67
Fig. 14. <i>Anadara ? microdonta</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 11926). Temblor formation, Santa Monica, California.....	72
Fig. 15. <i>Arca (Arca) merriami</i> (Van Winkle) ( $\times 1.5$ ) hypotype (S.U. 14). Figured by Clark, 52, pl. 13, fig. 8.....	66
Fig. 16. <i>Anadara (Anadara) devincta</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 31923). Figured by Etherington, 140, pl. 2, fig. 3.....	72
Fig. 18. <i>Barbatia (Obliquarca) landesi</i> (Weaver and Palmer) ( $\times 1.5$ ), holotype (U.W. 155) (C.A.S. 7397). Figured originally, 301, pl. 8, fig. 4.....	69
Fig. 19. <i>Anadara (Anadara) trilineata</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 11922). Locality, Wilson's Ranch.....	71
Fig. 20. <i>Anadara (Anadara) trilineata</i> (Conrad) ( $\times 1$ ), hypotype (U.S.N.M. 153948). Figured by Dall, 101, pl. 12, fig. 2.....	71

## PLATE 13

	PAGE
Fig. 1. <i>Anadara (Anadara) devincta</i> (Conrad) var. <i>montereyana</i> (Osmont) ( $\times 1$ ), hypotype (U.C. 31928). Locality (U.W. 422). Astoria formation.	73
Fig. 2. <i>Trinacria willipaensis</i> Clark ( $\times 2$ ), holotype (S.U. 16). Figured originally, 52, pl. 9, fig. 10.....	76
Fig. 3. <i>Trinacria willipaensis</i> Clark ( $\times 2$ ), holotype (S.U. 16). Figured originally, 52, pl. 9, fig. 5.....	76
Fig. 4. <i>Anadara (Anadara) devincta</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 31916). Figured by Etherington, 140, pl. 2, fig. 8.....	72
Fig. 5. <i>Anadara (Anadara) devincta</i> (Conrad) var. <i>montereyana</i> (Osmont) ( $\times 1$ ), holotype (U.C. 11925). Figured by Osmont, 217, pl. 9, fig. 5....	73
Fig. 6. <i>Barbatia (Acar) reinharti</i> Effinger ( $\times 2.2$ ), holotype (U.C. 33504). Figured originally, 138, pl. 46, fig. 2.....	70
Fig. 7. <i>Barbatia (Acar) reinharti</i> Effinger ( $\times 2.2$ ), paratype (U.C. 14793). Figured originally, 138, pl. 45, fig. 4.....	70
Fig. 8. <i>Anadara (Anadara) devincta</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 31924). Figured by Etherington, 140, pl. 2, fig. 4.....	72
Fig. 9. <i>Pedalion clarki</i> Effinger ( $\times 0.4$ ), paratype (U.C. 33514). Figured originally, 138, pl. 45, fig. 10.....	77
Fig. 10. <i>Anadara (Anadara) devincta</i> (Conrad) var. <i>montesanoana</i> Etherington ( $\times 1$ ), holotype (U.C. 31922). Locality (U.W. 470). Montesano formation. Figured originally, 140, pl. 3, fig. 5.....	74
Fig. 11. <i>Barbatia (Acar) reinharti</i> Effinger ( $\times 2.2$ ), paratype (U.C. 14793). Figured originally, 138, pl. 45, fig. 3.....	70
Fig. 12. <i>Limopsis carmanahensis</i> Clark ( $\times 3$ ), holotype (S.U. 5249). Figured originally, 52, pl. 22, fig. 8.....	75
Fig. 13. <i>Barbatia (Acar) reinharti</i> Effinger ( $\times 2.2$ ), holotype (U.C. 33504). Figured originally, 138, pl. 46, fig. 1.....	70
Fig. 14. <i>Limopsis carmanahensis</i> Clark ( $\times 3$ ), holotype (S.U. 5249). Figured originally, 68, pl. 18, fig. 9.....	75
Fig. 15. <i>Limopsis nitens</i> (Conrad) ( $\times 3$ ), holotype (U.S.N.M. 3579). Figured originally, 68, pl. 18, fig. 9.....	75
Fig. 16. <i>Anadara (Anadara) obispoana</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 13330). Figured originally, 73, pl. 5, fig. 1.....	74





## PLATE 14

	PAGE
Fig. 1. <i>Ostrea lincolnensis</i> Weaver ( $\times 1$ ), paratype (U.W. 88-A) (C.A.S. 453-A). Figured originally, 295, pl. 1, fig. 5.....	80
Fig. 2. <i>Ostrea lincolnensis</i> Weaver ( $\times 1$ ), holotype (U.W. 88) (C.A.S. 453). Figured originally, 295, pl. 1, fig. 6.....	80
Fig. 3. <i>Ostrea lincolnensis</i> Weaver ( $\times 1$ ), holotype (U.W. 88) (C.A.S. 453). Figured originally, 295, pl. 1, fig. 6.....	80
Fig. 4. <i>Pecten (Chlamys) landesi</i> Arnold ( $\times 1$ ), cotype (U.S.N.M. 164926). Figured originally, 10, pl. 2, fig. 4. (See footnote, page 83.).....	82
Fig. 5. <i>Pecten (Chlamys) grunskyi</i> Hertlein ( $\times 1.1$ ), holotype (C.A.S. 424). Figured originally, 123, pl. 28, fig. 2.....	84
Fig. 6. <i>Pecten (Chlamys) landesi</i> Arnold ( $\times 1$ ), holotype (U.S.N.M. 164926). Figured originally, 10, pl. 2, fig. 5. (See footnote, page 83.).....	82
Fig. 7. <i>Pecten (Chlamys) landesi</i> Arnold ( $\times 1$ ), cotype (U.S.N.M. 164926). Figured originally, 10, pl. 2, fig. 5. (See footnote, page 83.).....	82
Fig. 8. <i>Ostrea idriensis</i> Gabb var. <i>fettkei</i> Weaver ( $\times 1.2$ ), holotype (U.W. 5) (C.A.S. 479). Figured originally, 286, pl. 4, fig. 37.....	80
Fig. 9. <i>Pecten (Chlamys) cowlitzenensis</i> Weaver ( $\times 0.8$ ), holotype (U.W. 6) (C.A.S. 7417). Duplicate of pl. 11, fig. 2. Figured originally, 286, pl. 5, fig. 46.....	83
Fig. 10. <i>Ostrea idriensis</i> Gabb var. <i>fettkei</i> Weaver ( $\times 1.2$ ), holotype (U.W. 5) (C.A.S. 479). Figured originally, 286, pl. 4, fig. 37.....	80
Fig. 11. <i>Pteria clarki</i> Weaver and Palmer ( $\times 1$ ), paratype (U.W. 159-B) (C.A.S. 7405-B). Figured originally, 301, pl. 10, fig. 12.....	77
Fig. 12. <i>Pteria clarki</i> Weaver and Palmer ( $\times 1$ ), topotype (U.W. 159-A) (C.A.S. 7405-A) .....	77
Fig. 13. <i>Ostrea sookensis</i> Clark and Arnold ( $\times 0.7$ ), holotype (C.A.S. 591). Figured originally, 50, pl. 17, fig. 1.....	82
Fig. 14. <i>Ostrea idriensis</i> Gabb var. <i>fettkei</i> Weaver ( $\times 1$ ), paratype (U.W. 266), (C.A.S. 479-A) .....	80
Fig. 15. <i>Ostrea idriensis</i> Gabb var. <i>fettkei</i> Weaver ( $\times 1$ ), paratype (U.W. 265) (C.A.S. 479-B) .....	80
Fig. 16. <i>Ostrea sookensis</i> Clark and Arnold ( $\times 0.7$ ), holotype (C.A.S. 591). Figured originally, 50, pl. 17, fig. 1.....	82

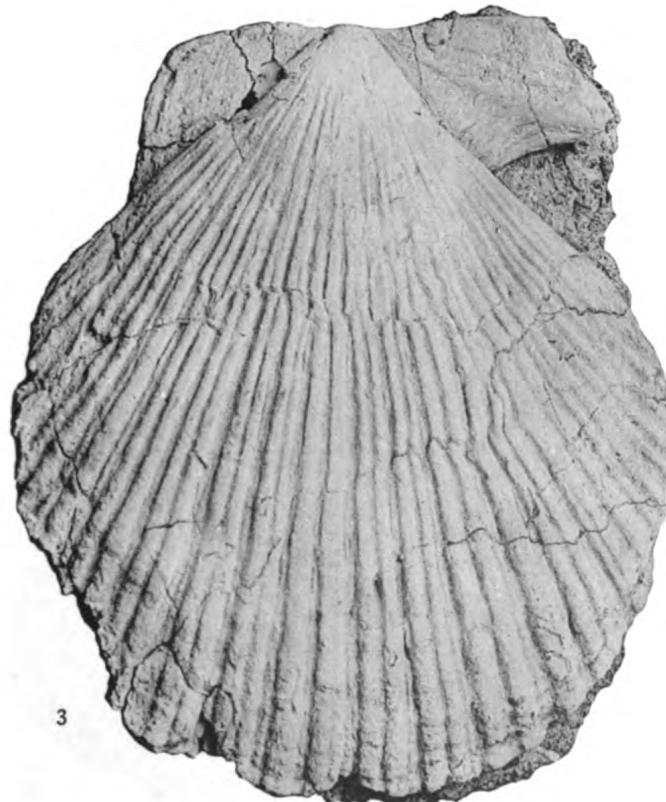
PLATE 15

	PAGE
Fig. 1. <i>Ostrea griesensis</i> Effinger ( $\times 1.5$ ), paratype (U.C. 33511). Figured originally, 138, pl. 45, fig. 8.....	81
Fig. 2. <i>Ostrea griesensis</i> Effinger ( $\times 1.5$ ), holotype (U.C. 33510). Figured originally, 138, pl. 45, fig. 8.....	81
Fig. 3. <i>Pecten (Chlamys) columbianum</i> Clark and Arnold ( $\times 1$ ), cotype (C.A.S. 592). Figured originally, 50, pl. 23, fig. 2.....	84
Fig. 4. <i>Pecten (Pseudamusium) vanwinkleae</i> Clark ( $\times 3$ ), holotype (S.U. 5226). Figured originally, 52, pl. 15, fig. 2.....	93
Fig. 5. <i>Ostrea idriacensis</i> Gabb ( $\times 1$ ), topotype of " <i>Ostrea columbiana</i> " (U.W. 160-A).....	78

(668)

UNIV. OF WASH. PUBL. IN GEOL.

[WEAVER] VOL. V, PL. 15



UNIV. OF WASH. PUBL. IN GEOL.

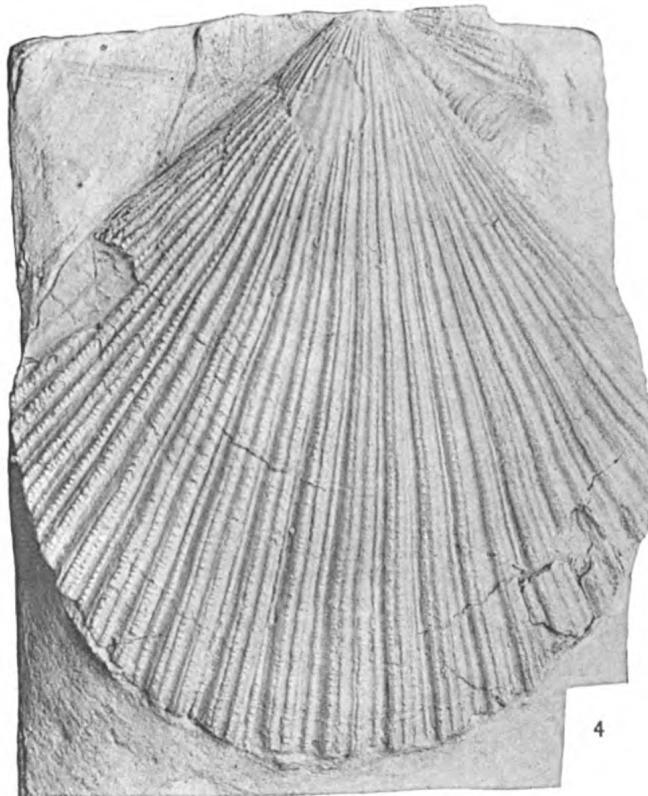
[WEAVER] VOL. V, PL. 16



1



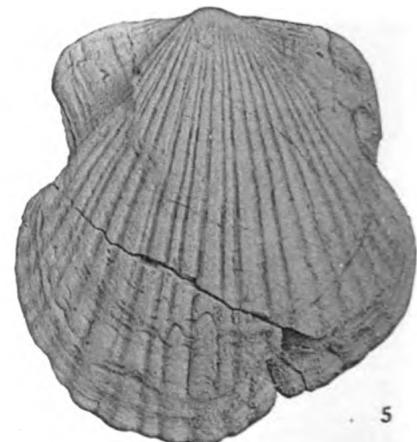
2



4



3



5

PLATE 16

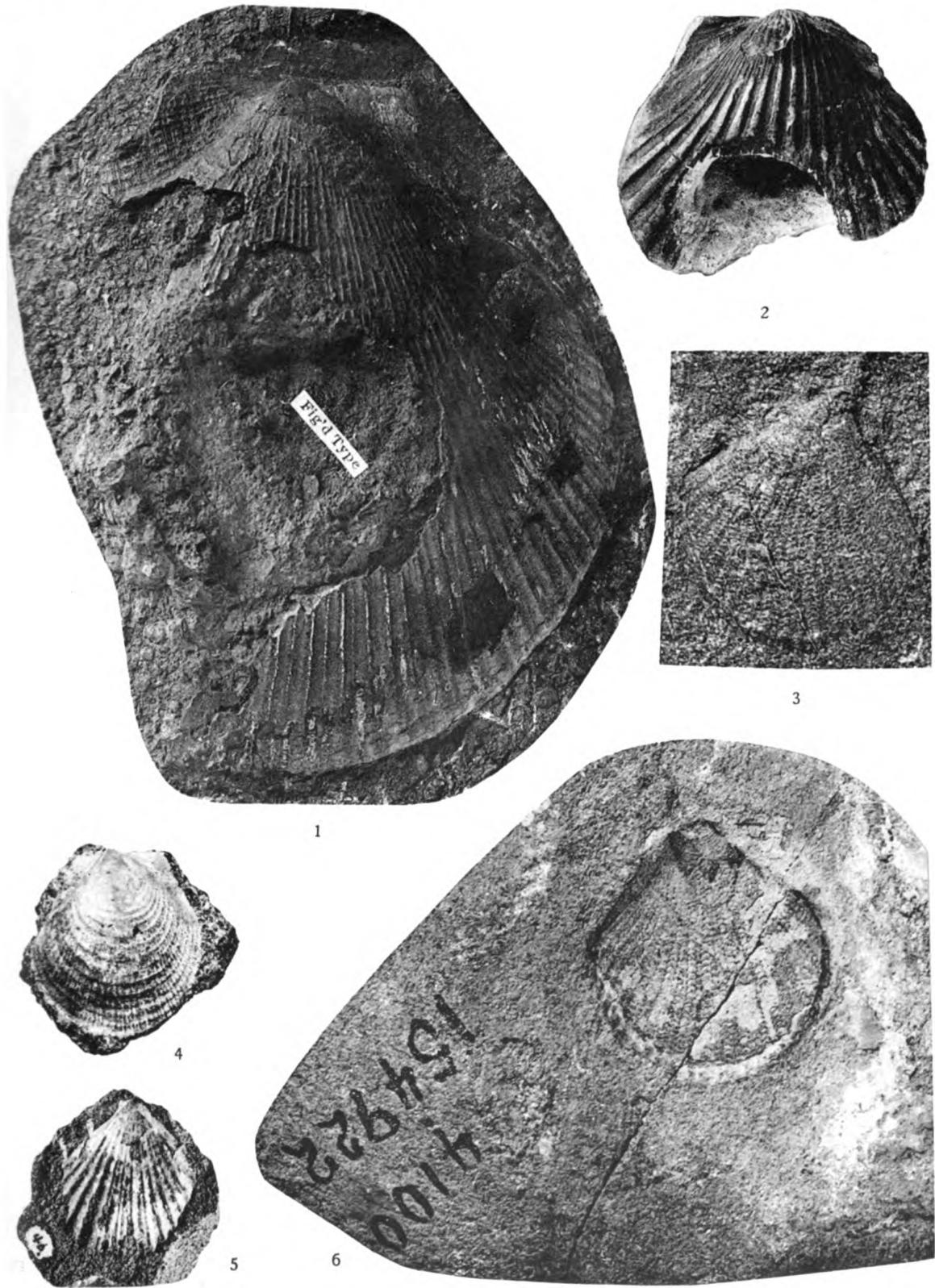
	PAGE
Fig. 1. <i>Pecten (Chlamys) columbianum</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30056). Figured originally, 50, pl. 23, fig. 1.....	84
Fig. 2. <i>Pecten (Chlamys) cornwalli</i> Clark and Arnold ( $\times 1.2$ ), paratype (U.C. 30231). Figured originally, 50, pl. 25, fig. 5.....	85
Fig. 3. <i>Pecten (Chlamys) cornwalli</i> Clark and Arnold ( $\times 1$ ), paratype (U.C. 30231). Figured originally, 50, pl. 25, fig. 5.....	85
Fig. 4. <i>Pecten (Vertipecten) portoricensis</i> Weaver ( $\times 1$ ), hypotype (S.U. 18). Figured by Clark, 52, pl. 11, fig. 3.....	87
Fig. 5. <i>Pecten (Chlamys) cornwalli</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30059). Figured originally, 50, pl. 25, fig. 1.....	85

(669)

PLATE 17

	PAGE
Fig. 1. <i>Pecten (Chlamys) washburnei</i> Arnold ( $\times 1$ ), holotype (U.S.N.M. 164843). Figured originally, 10, pl. 45, fig. 2.....	86
Fig. 2. <i>Pecten (Plagioctenium) neahensis</i> Arnold ( $\times 1$ ), holotype (U.S.N.M. 164843?-5912). Figured originally, 10, pl. 15, fig. 2.....	90
Fig. 3. <i>Pecten (Propeamussium) clallamensis</i> Arnold ( $\times 4$ ), holotype (U.S. N.M. 164922), modeling clay squeeze. Figured originally, 10, pl. 3, fig. 3a.	94
Fig. 4. <i>Palliolium (Delectopecten) vancouverensis</i> (Whiteaves) subsp. <i>sanjuanensis</i> (Clark and Arnold) ( $\times 3$ ), holotype (U.C. 30221). Figured originally, 50, pl. 16, fig. 5.....	96
Fig. 5. <i>Pecten (Plagioctenium) alockamanensis</i> Weaver ( $\times 1$ ), holotype (U.W. 46) (C.A.S. 7418). Figured originally, 286, pl. 13, fig. 115.....	89
Fig. 6. <i>Pecten (Propeamussium) clallamensis</i> Arnold ( $\times 4$ ), holotype (U.S. N.M. 164922). Figured originally, 10, pl. 3, fig. 3.....	94

(670)



UNIV. OF WASH. PUBL. IN GEOL.

[WEAVER] VOL. V, PL. 18

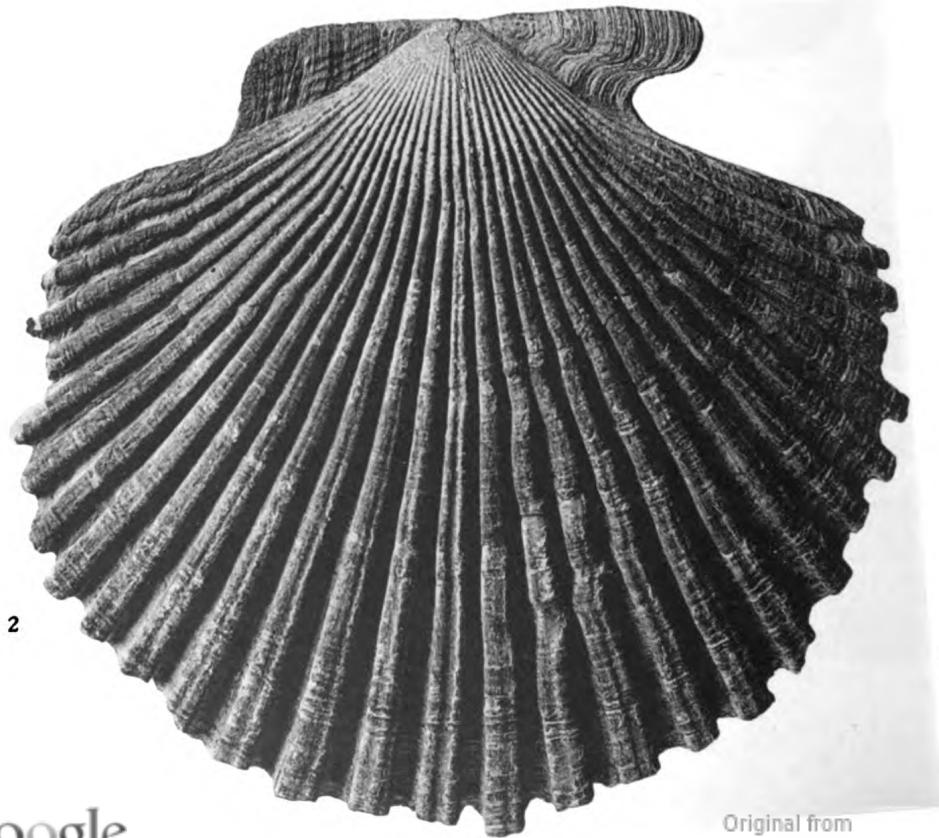
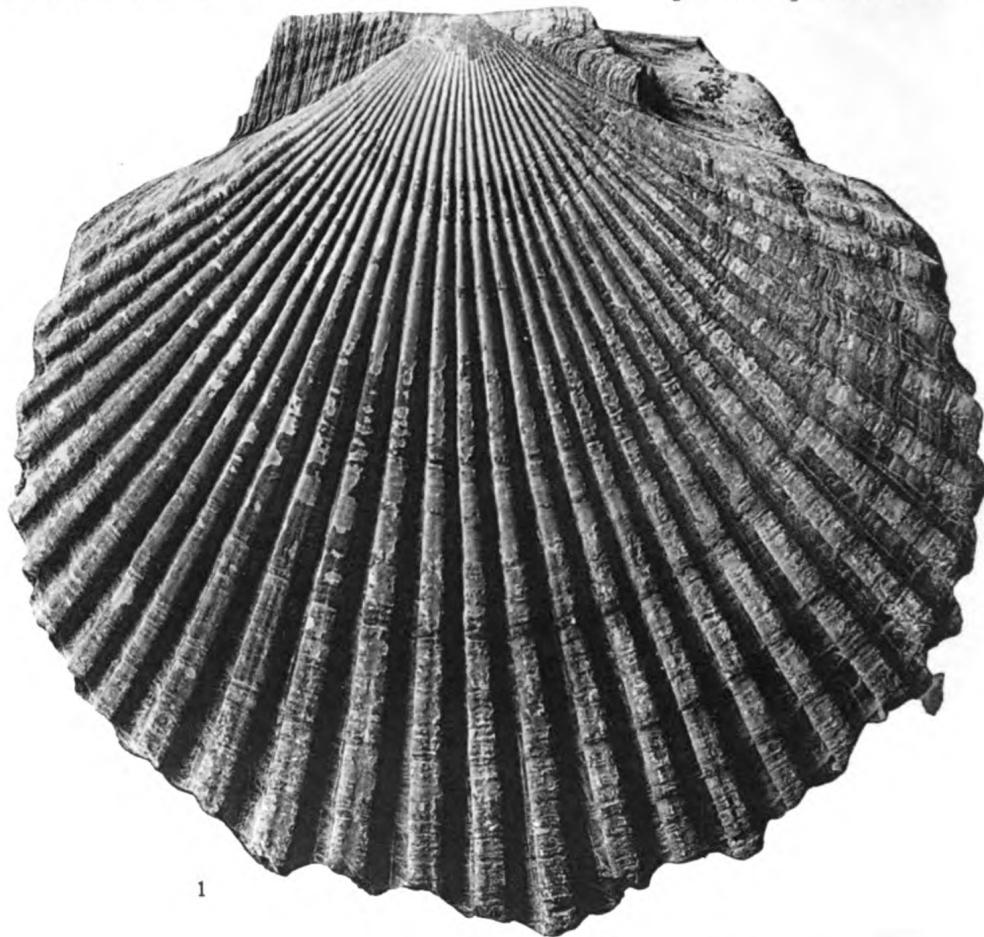


PLATE 18

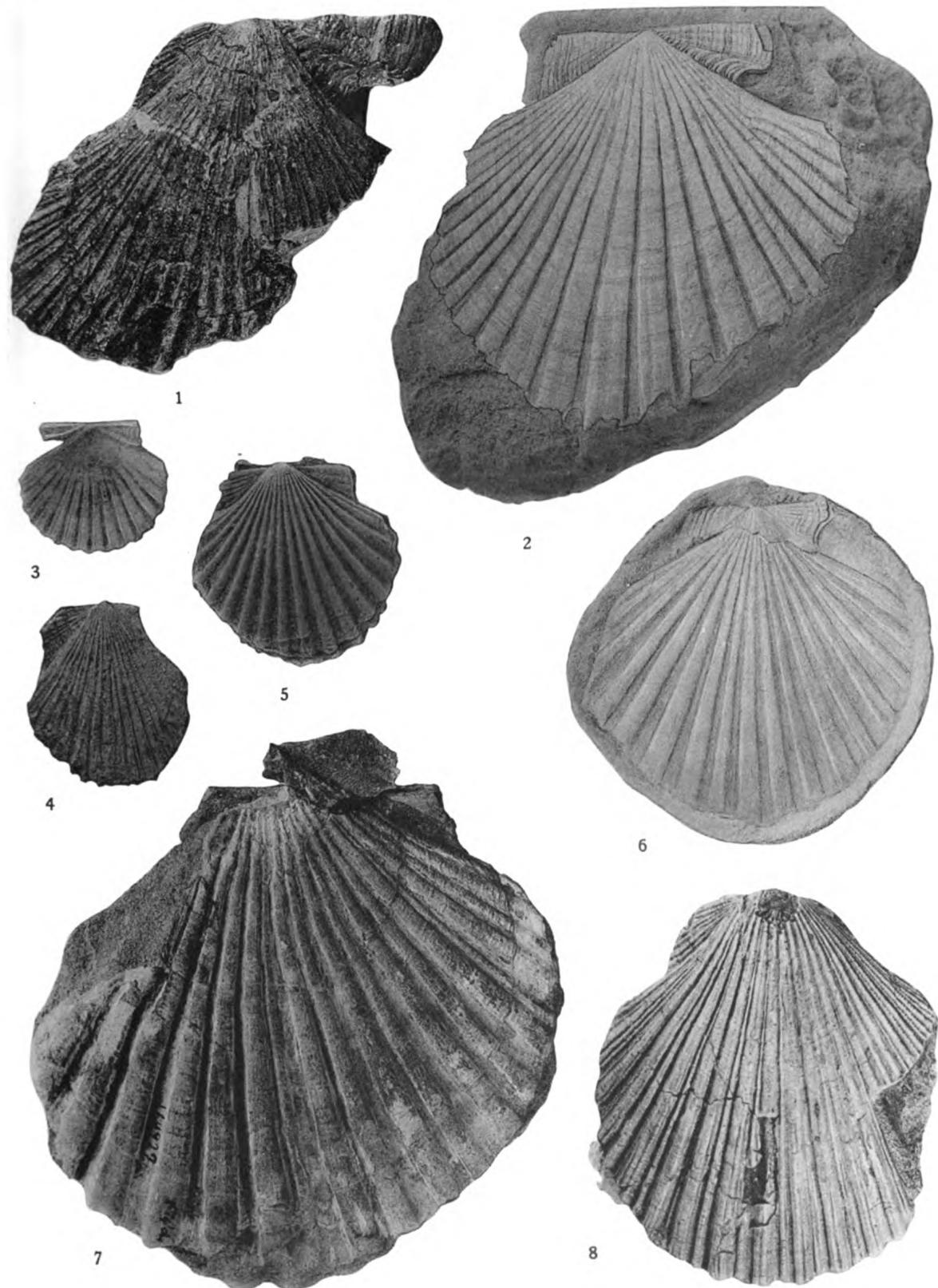
	PAGE
Fig. 1. <i>Pecten (Patinopecten) coosensis</i> Shumard ( $\times 1$ ), hypotype (U.S.N.M. 107791). Figured by Arnold, 10, pl. 7, fig. 2. Figured by Dall, 101, pl. 16, fig. 2.....	92
Fig. 2. <i>Pecten (Patinopecten) coosensis</i> Shumard ( $\times 1$ ), hypotype (U.S.N.M. 107791-?). Figured by Dall, 89, pl. 26, fig. 2.....	92

(671)

## PLATE 19

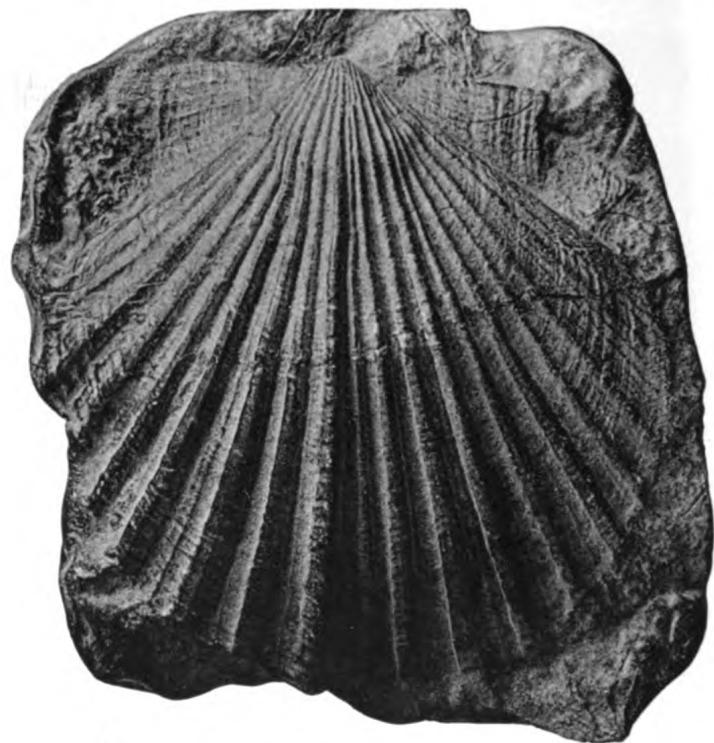
	PAGE
Fig. 1. <i>Pecten (Vertipecten) portoricensis</i> Weaver ( $\times 1$ ), syntype (U.W. 45-A) (C.A.S. 543). Figured originally, 295, pl. 8, fig. 72.....	87
Fig. 2. <i>Pecten (Patinopecten) oregonensis</i> Howe ( $\times 1$ ), paratype (U.C. 30027). Locality (U.C. 3320). Base of Empire formation. Figured originally, 166, pl. 12, fig. 1.....	93
Fig. 3. <i>Pecten (Plagioctenium) andersoni</i> Arnold subsp. <i>clemonensis</i> Etherington ( $\times 1.2$ ), paratype (U.C. 31936). Figured originally, 140, pl. 1, fig. 13..	89
Fig. 4. <i>Pecten (Vertipecten) portoricensis</i> Weaver ( $\times 1$ ), hypotype (S.U. 19). Figured by Clark, 52, pl. 11, fig. 1.....	87
Fig. 5. <i>Pecten (Plagioctenium) andersoni</i> Arnold subsp. <i>clemonensis</i> Ethering- ton ( $\times 1$ ), holotype (U.C. 31933). Figured originally, 140, pl. 4, fig. 2..	89
Fig. 6. <i>Pecten (Patinopecten) propatulus</i> Conrad ( $\times 0.5$ ), topotype (U.C. 12080). .....	91
Fig. 7. <i>Pecten (Vertipecten) nevadanus</i> Conrad var. <i>fucanus</i> Dall ( $\times 1$ ), para- type (U.S.N.M. 164933). Figured by Arnold, 10, pl. 10, fig. 1.....	87
Fig. 8. <i>Pecten (Vertipecten) portoricensis</i> Weaver ( $\times 0.7$ ), syntype (U.W. 45) (C.A.S. 542). Figured originally, 286, pl. 8, fig. 70.....	87

(672)



UNIV. OF WASH. PUBL. IN GEOL.

[WEAVER] VOL. V, PL. 20



1



2

PLATE 20

	PAGE
Fig. 1. <i>Pecten (Vertipecten) nevadanus</i> Conrad var. <i>fucanus</i> Dall ( $\times 1$ ), plasto-holotype (U.S.N.M. 107790). Figured by Arnold, 10, pl. 10, fig. 2.....	87
Fig. 2. <i>Pecten (Patinopecten) propatulus</i> Conrad ( $\times 1$ ), topotype, specimen in Conrad Collection of U.S.N.M., no number. From Astoria, Oregon. With collection of Wilkes Exploring Expedition.....	91

(673)

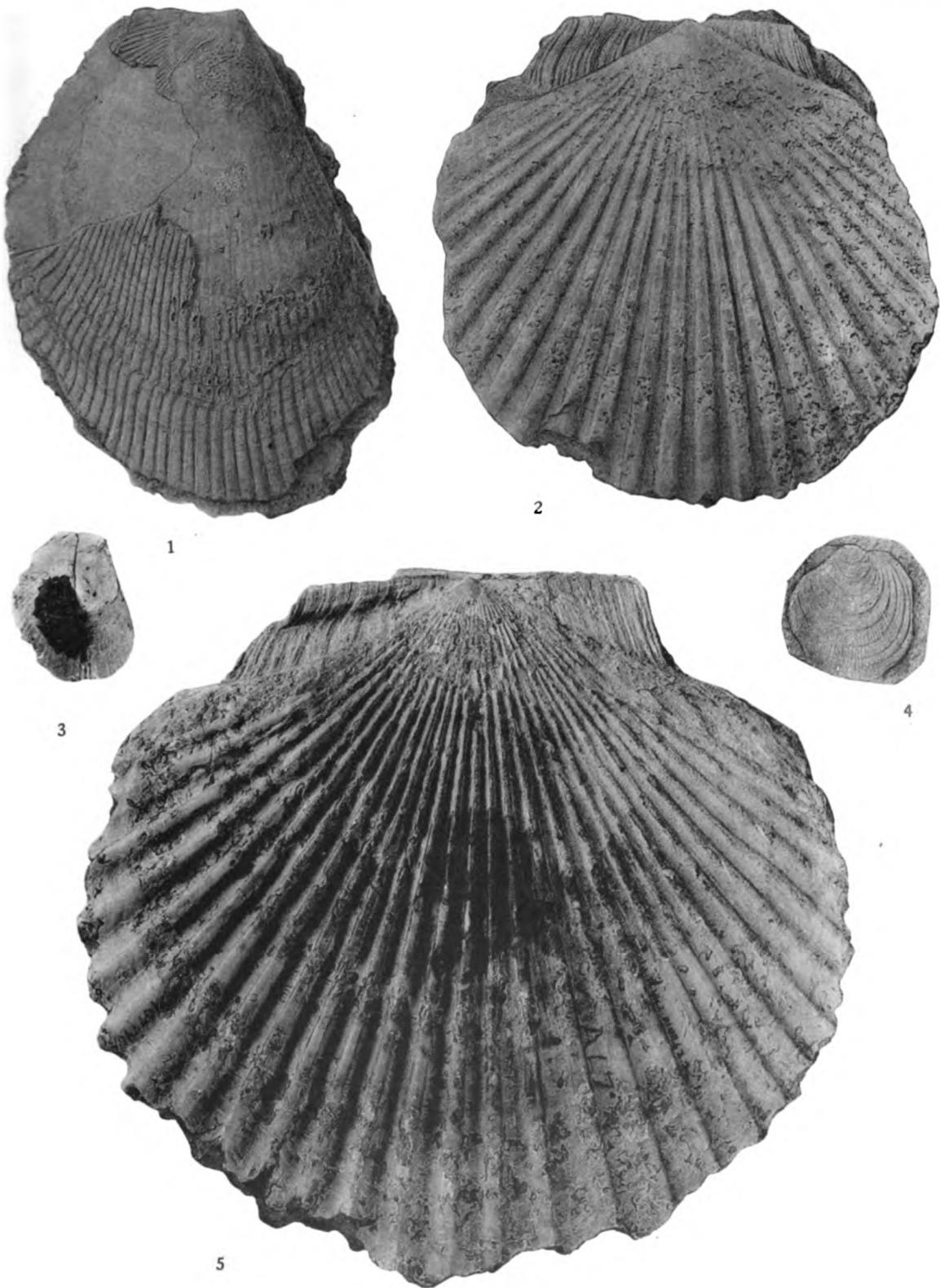
PLATE 21

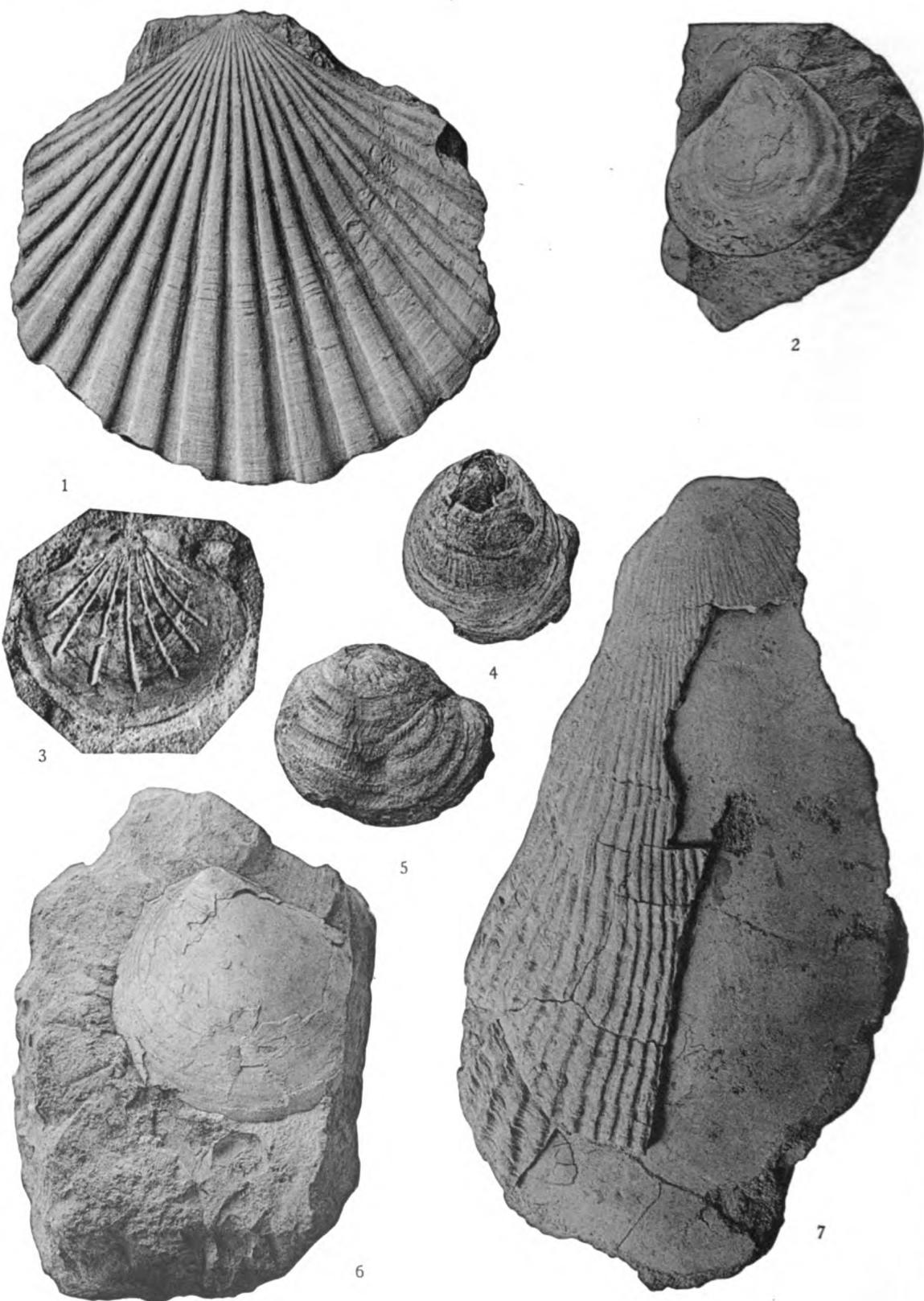
	PAGE
Fig. 1. <i>Lima oakvillensis</i> Clark (X 1), hypotype (U.C. 32405). Locality (U.W. 169). ....	98
Fig. 2. <i>Pecten (Patinopecten) coosensis</i> Shumard (X 1.5), hypotype (U.C. 32656). Coos Bay.....	92
Fig. 3. <i>Lima bella</i> Dickerson (X 2.2), holotype (C.A.S. 400). Figured originally, 123, pl. 29, fig. 11.....	97
Fig. 4. <i>Palliolum (Delectopecten) peckhami</i> (Gabb) (X 1), lectotype (M.C.Z. 15045). Stewart's figure, 267, pl. 13, fig. 4.....	96
Fig. 5. <i>Pecten (Patinopecten) coosensis</i> Shumard (X 1), hypotype (U.S.N.M. 107791). Figured by Arnold, 10, pl. 6, fig. 2. Figured by Dall, 101, pl. 17, fig. 3. ....	92

(674)

UNIV. OF WASH. PUBL. IN GEOL.

[WEAVER] VOL. V, PL. 21





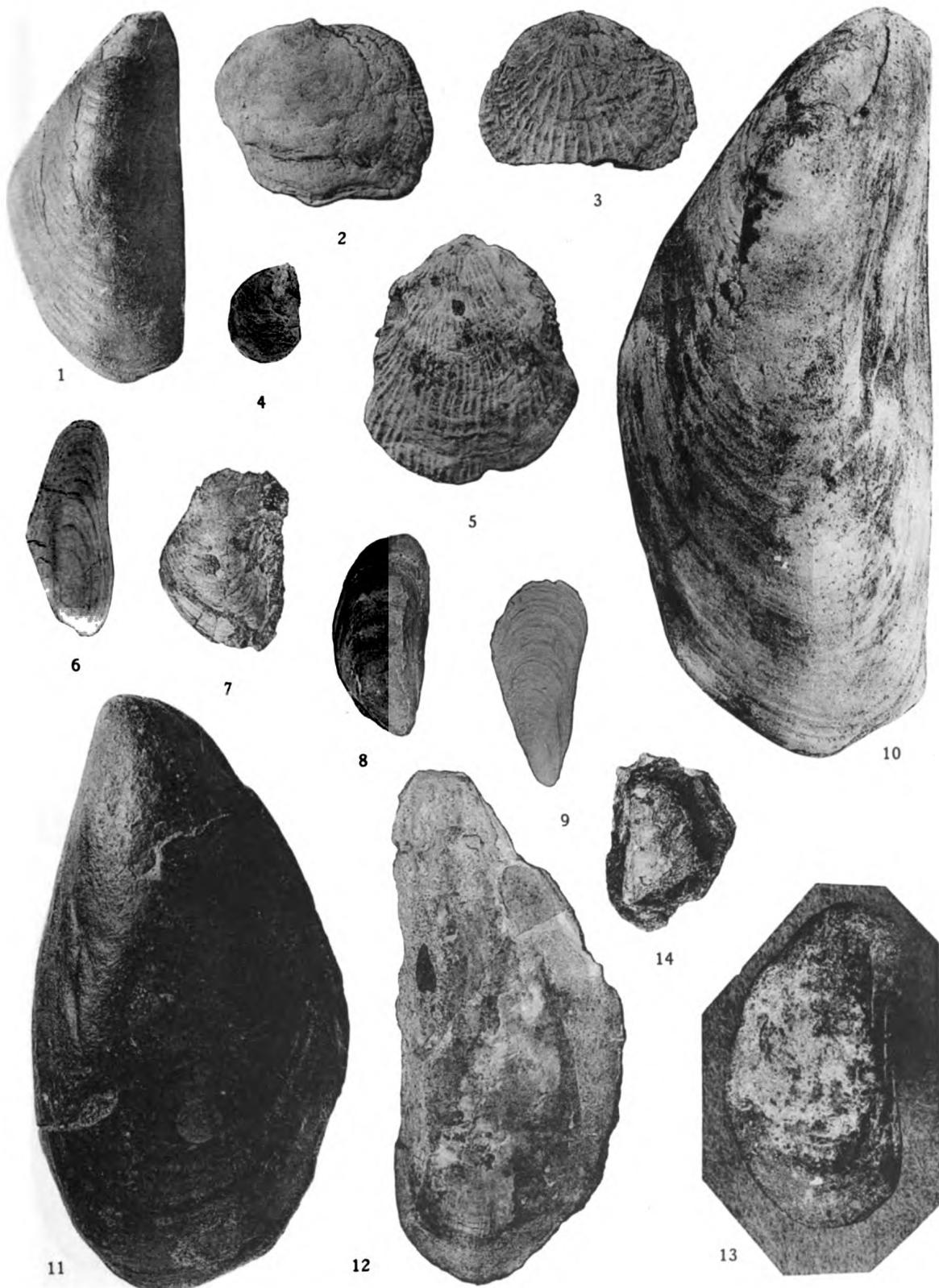
## PLATE 22

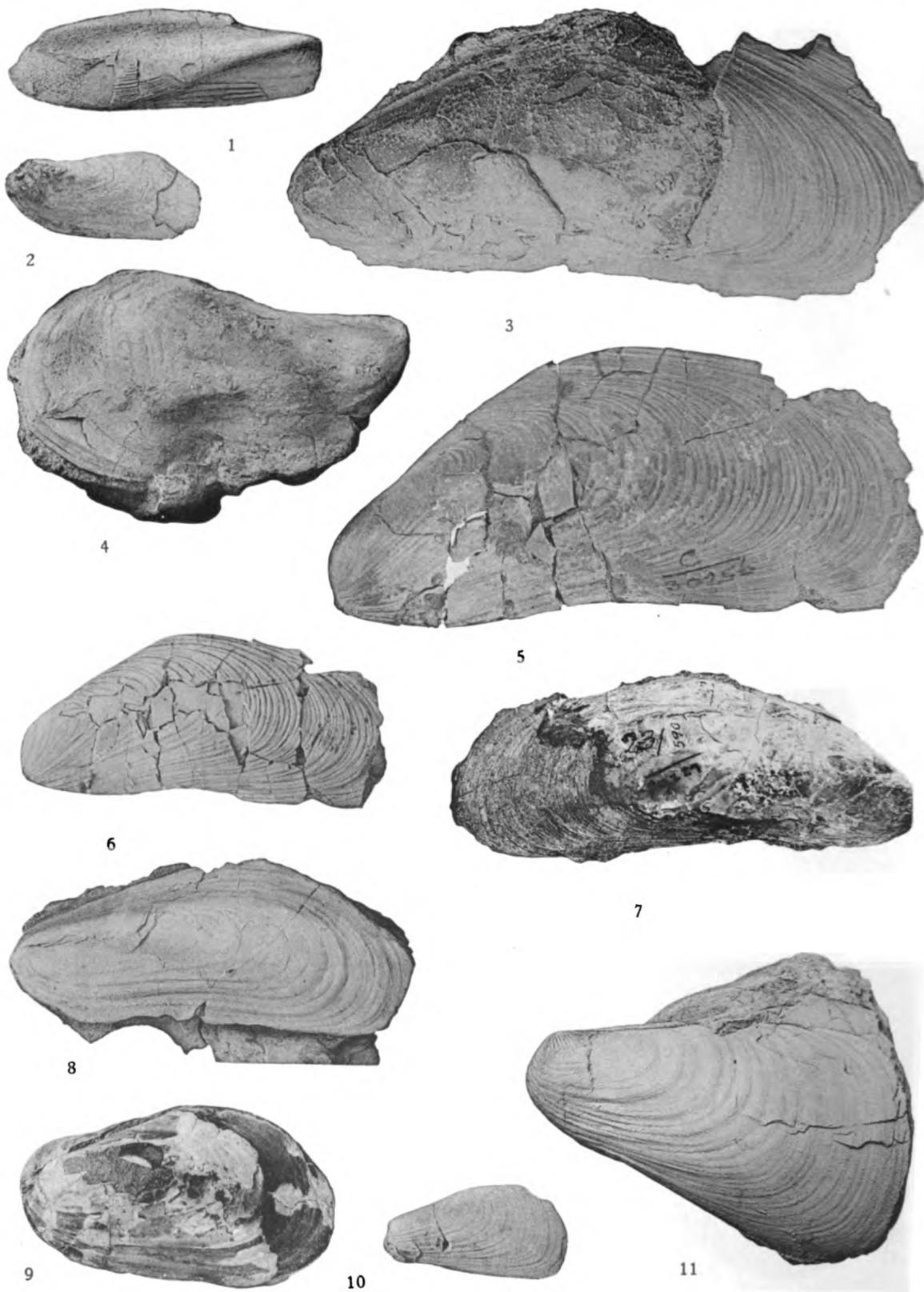
	PAGE
Fig. 1. <i>Pecten (Patinopecten) oregonensis</i> Howe ( $\times 0.7$ ), holotype (S.U. 25). Locality (S.U. N.P. 44). Figured originally, 166, pl. 11, fig. 1. Empire formation. ....	93
Fig. 2. <i>Lima oregonensis</i> Clark ( $\times 0.6$ ), paratype (U.C. 30312). Figured originally, 52, pl. 14, fig. 3.....	99
Fig. 3. <i>Pecten (Propeamussium) waylandi</i> Arnold ( $\times 3$ ), holotype (U.S.N.M. 164924). Figured originally, 10, pl. 3, fig. 4.....	95
Fig. 4. <i>Anomia mcgoniglensis</i> Hanna ( $\times 1$ ), cotype (U.C. 31012). Figured originally, 159, pl. 31, fig. 7.....	100
Fig. 5. <i>Anomia mcgoniglensis</i> Hanna ( $\times 1$ ), cotype (U.C. 31011). Figured originally, 159, pl. 31, fig. 5.....	100
Fig. 6. <i>Lima oregonensis</i> Clark ( $\times 0.6$ ), holotype (U.C. 30303). Figured originally, 52, pl. 14, fig. 4.....	99
Fig. 7. <i>Lima oakvillensis</i> Clark ( $\times 1$ ), holotype (S.U. 20). Locality (U.W. 169). Figured originally, 52, pl. 15, fig. 1.....	98

(675)

## PLATE 23

	PAGE
Fig. 1. <i>Mytilus (Mytiloconcha) mathewsonii</i> Gabb ( $\times 0.5$ ), hypotype (U.C. 30240). Figured by Clark and Arnold, 50, pl. 27, fig. 1.....	106
Fig. 2. <i>Pododesmus newcombei</i> Clark and Arnold ( $\times 1$ ), cotype (C.A.S. 594). Figured originally, 50, pl. 21, fig. 5.....	100
Fig. 3. <i>Pododesmus newcombei</i> Clark and Arnold ( $\times 2$ ), holotype (U.C. 30041). Figured originally, 50, pl. 21, fig. 4.....	100
Fig. 4. <i>Mytilus washingtonensis</i> Clark ( $\times 1$ ), holotype (S.U. 24). Figured originally, 52, pl. 9, fig. 3.....	105
Fig. 5. <i>Pododesmus newcombei</i> Clark and Arnold ( $\times 1$ ), cotype (U.C. 30233). Figured originally, 50, pl. 21, fig. 6.....	100
Fig. 6. <i>Volsella directa</i> (Dall) ( $\times 0.6$ ), hypotype (U.C. 31939). Figured by Etherington, 140, pl. 4, fig. 4.....	108
Fig. 7. <i>Mytilus buwaldana</i> Van Winkle ( $\times 0.7$ ), holotype (U.W. 127). Figured originally, 275, pl. 13, fig. 110.....	104
Fig. 8. <i>Mytilus snohomishensis</i> Weaver ( $\times 1$ ), holotype (U.W. 49) (C.A.S. 7412). Figured originally, 286, pl. 13, fig. 110.....	102
Fig. 9. <i>Mytilus hannibali</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30043). Figured originally, 50, pl. 16, fig. 3.....	104
Fig. 10. <i>Mytilus (Mytiloconcha) mathewsonii</i> Gabb ( $\times 1$ ), hypotype (U.C. 30240). Figured by Clark and Arnold, 50, pl. 27, fig. 1.....	106
Fig. 11. <i>Mytilus ficus</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153950). Figured originally, 101, pl. 9, fig. 1.....	103
Fig. 12. <i>Mytilus stillaguamishensis</i> Weaver ( $\times 0.8$ ), holotype (U.W. 48). Not previously figured.....	103
Fig. 13. <i>Volsella pugetensis</i> (Dall) ( $\times 3$ ), holotype (U.S.N.M. 153890). Figured originally, 89, pl. 35, fig. 17.....	109
Fig. 14. <i>Mytilus dichotomus</i> Cooper ( $\times 0.9$ ), hypotype (U.C. 33224). Figured by Turner, 274, pl. 5, fig. 16.....	107
Fig. 15. <i>Lima packardi</i> Weaver and Palmer ( $\times 1$ ), holotype (U.W. 162). Reproduction of figure in 301, pl. 8, fig. 13. (Through error, this figure omitted.) .....	99





## PLATE 24

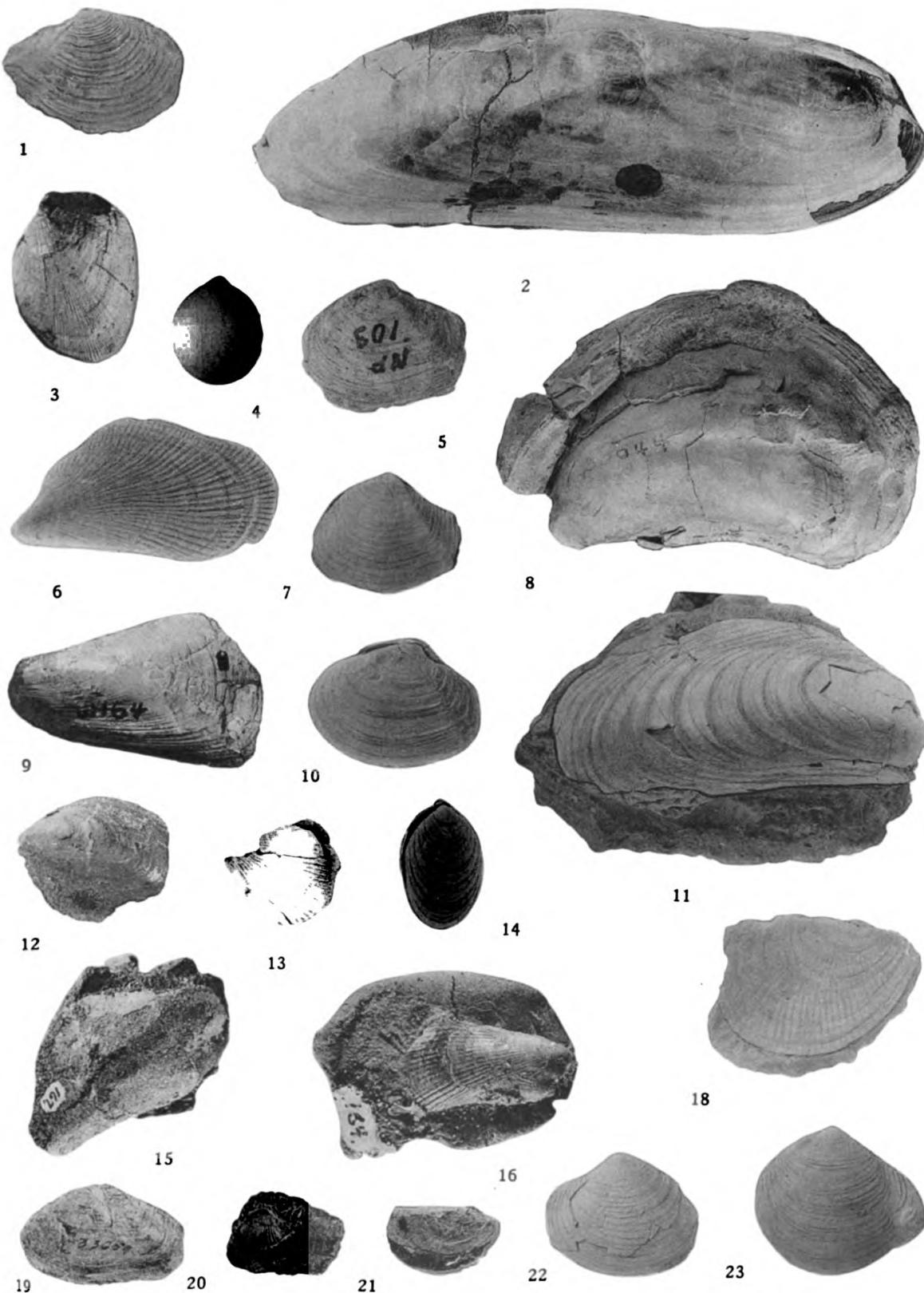
	PAGE
Fig. 1. <i>Volsella kelsoensis</i> (Weaver and Palmer) ( $\times 1$ ), holotype (U.W. 166). Figured originally, 301, pl. 10, fig. 13.....	112
Fig. 2. <i>Volsella porterensis</i> (Clark) ( $\times 1$ ), holotype (S.U. 26). Figured originally, 52, pl. 9, fig. 11.....	111
Fig. 3. <i>Volsella sookensis</i> (Clark and Arnold) ( $\times 1$ ), paratype (U.C. 30038). Figured originally, 50, pl. 26, fig. 2.....	110
Fig. 4. <i>Mytilus (Mytiloconcha) vancouverensis</i> Clark and Arnold ( $\times 1$ ), para-type (U.C. 30218). Figured originally, 50, pl. 24, fig. 3.....	105
Fig. 5. <i>Volsella sookensis</i> (Clark and Arnold) ( $\times 1$ ), holotype (U.C. 30256). Figured originally, 50, pl. 40, fig. 3.....	110
Fig. 6. <i>Volsella sookensis</i> (Clark and Arnold) ( $\times 0.6$ ), holotype (U.C. 30256). Duplicate of pl. 24, fig. 5. Figured originally, 50, pl. 40, fig. 3.....	110
Fig. 7. <i>Volsella sookensis</i> (Clark and Arnold) ( $\times 0.6$ ), paratype (C.A.S. 590). Figured originally, 50, pl. 26, fig. 1.....	110
Fig. 8. <i>Volsella eugenensis</i> (Clark) ( $\times 0.8$ ), holotype (U.C. 30319). Figured originally, 52, pl. 9, fig. 4.....	111
Fig. 9. <i>Volsella trinominata</i> (Hanna) ( $\times 1$ ), holotype (U.S.N.M. 153946). Figured originally, 101, pl. 12, fig. 9.....	110
Fig. 10. <i>Volsella restorationensis</i> (Van Winkle) ( $\times 0.5$ ), topotype (U.C. 32111). Figured by Tegland, 272, pl. 6, fig. 1.....	109
Fig. 11. <i>Volsella restorationensis</i> (Van Winkle) ( $\times 1$ ), holotype (U.W. 128). Figured originally, 275, pl. 6, fig. 5.....	109

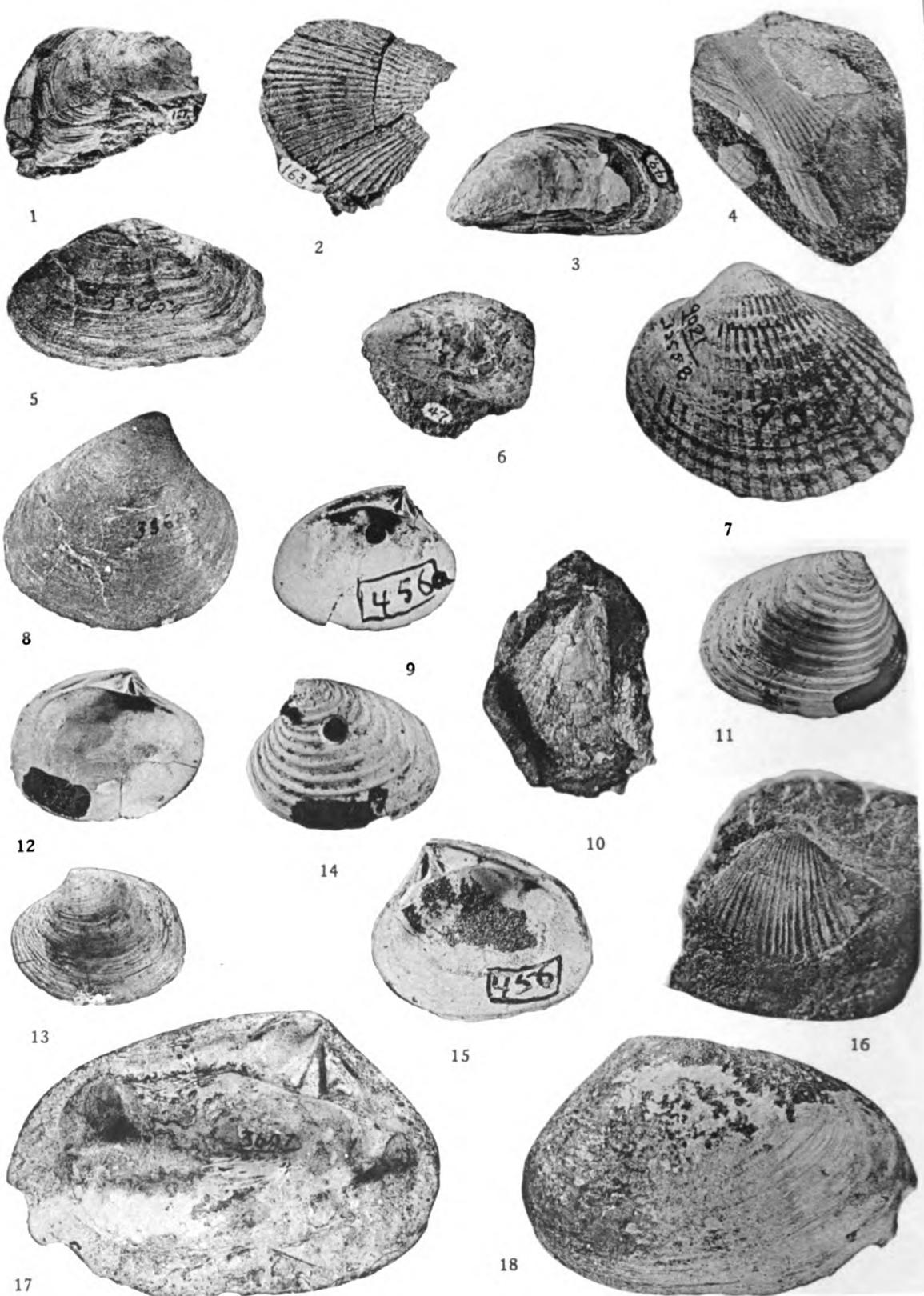
(677)

## PLATE 25

## PAGE

Fig. 1. <i>Cochlodesma bainbridgensis</i> Clark ( $\times 1$ ), paratype (S.U. 28). Figured originally, 52, pl. 13, fig. 4.....	117
Fig. 2. <i>Volsella directa</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 153947). Figured originally, 101, pl. 12, fig. 12.....	108
Fig. 3. <i>Crenella porterensis</i> Weaver ( $\times 1.5$ ), holotype (U.W. 89) (C.A.S. 454-A). Figured originally, 295, pl. 3, fig. 42.....	115
Fig. 4. <i>Crenella washingtonensis</i> Weaver ( $\times 5$ ), holotype (U.W. 90) (C.A.S. 455). Figured originally, 295, pl. 3, fig. 40.....	116
Fig. 5. <i>Thracia schencki</i> Tegland ( $\times 1$ ), paratype (S.U. 790). Figured originally, 272, pl. 6, fig. 9.....	118
Fig. 6. <i>Septifer dichotomus</i> Gabb ( $\times 1$ ), hypotype (U.C. 32728).....	115
Fig. 7. <i>Thracia trapesoides</i> Conrad ( $\times 0.6$ ), hypotype (U.C. 31942). Figured by Etherington, 140, pl. 5, fig. 8.....	117
Fig. 8. <i>Mytilus (Mytiloconcha) vancouverensis</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30044). Figured originally, 50, pl. 24, fig. 2.....	105
Fig. 9. <i>Volsella trinominata</i> (Hanna) ( $\times 1$ ), topotype (U.W. 258).....	110
Fig. 10. <i>Thracia condoni</i> Dall ( $\times 1$ ), hypotype (U.C. 12492). Locality (U.C. A-1).....	119
Fig. 11. <i>Mytilus watersi</i> Etherington ( $\times 0.5$ ), holotype (U.C. 31938). Figured originally, 140, pl. 4, fig. 1.....	106
Fig. 12. <i>Mytilus sammamishensis</i> Weaver ( $\times 0.8$ ), holotype (U.W. 47) (C.A.S. 7411). Figured originally, 286, pl. 13, fig. 111.....	102
Fig. 13. <i>Mytilus stillwaterensis</i> Weaver and Palmer ( $\times 0.7$ ), holotype (U.W. 163) (C.A.S. 7420). Figured originally, 301, pl. 9, fig. 13.....	107
Fig. 14. <i>Crenella porterensis</i> Weaver ( $\times 1.1$ ), topotype (U.C. 32410). Locality (U.W. 440).....	115
Fig. 15. <i>Volsella columbiana</i> (Weaver and Palmer) ( $\times 1$ ), holotype (U.W. 167) (C.A.S. 7408). Figured originally, 301, pl. 8, fig. 7.....	112
Fig. 16. <i>Volsella (Brachidontes) olequahensis</i> (Weaver and Palmer) ( $\times 1.2$ ), holotype (U.W. 164) (C.A.S. 7407). Figured originally, 301, pl. 9, fig. 3.	114
Fig. 18. <i>Pandora vanwinkleae</i> Tegland ( $\times 0.9$ ), holotype (U.C. 32114). Figured originally, 272, pl. 7, fig. 1.....	121
Fig. 19. <i>Thracia cf. karquinezensis</i> Weaver ( $\times 1$ ), hypotype (U.C. 33659). Figured by Turner, 274, pl. 8, fig. 20.....	119
Fig. 20. <i>Cardiomya comstockensis</i> Turner ( $\times 1$ ), holotype (U.C. 33225). Figured originally, 274, pl. 8, fig. 8.....	122
Fig. 21. <i>Pandora washingtonensis</i> Weaver ( $\times 1.5$ ), holotype (U.W. 91) (C.A.S. 562). Figured originally, 295, pl. 2, fig. 20.....	120
Fig. 22. <i>Thracia schencki</i> Tegland ( $\times 0.7$ ), holotype (U.C. 32113). Figured originally, 272, pl. 6, fig. 6.....	118
Fig. 23. <i>Poromya teglandae</i> n. sp. ( $\times 0.7$ ), holotype (U.C. 32134). West of Twin Rivers, Washington.....	121



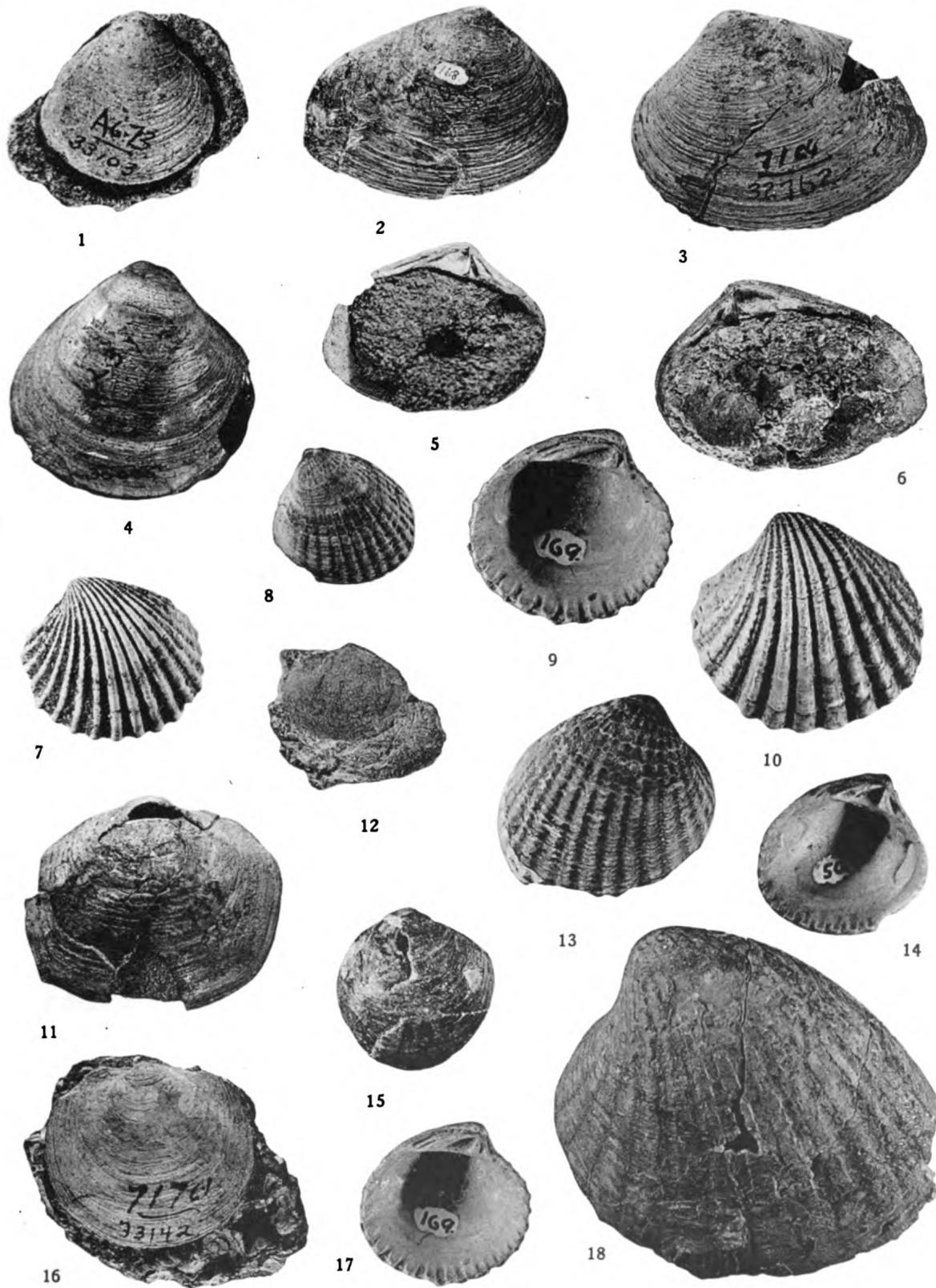


## PLATE 26

	PAGE
Fig. 1. <i>Mytilus buwaldana</i> Van Winkle ( $\times 0.8$ ), holotype (U.W. 127). Duplicate of pl. 23, fig. 7. Figured originally, 275, pl. 6, fig. 6.....	104
Fig. 2. <i>Mytilus stillwaterensis</i> Weaver and Palmer ( $\times 1.2$ ), holotype (U.W. 163) (C.A.S. 7420). Figured originally, 301, pl. 9, fig. 13. Duplicate of pl. 25, fig. 13.....	107
Fig. 3. <i>Mytilus snohomishensis</i> Weaver ( $\times 1.3$ ), holotype (U.W. 49) (C.A.S. 7412). Duplicate of pl. 23, fig. 8. Figured originally, 286, pl. 13, fig. 110. 102	
Fig. 4. <i>Volsella (Brachidontes) cowlitzensis</i> (Weaver and Palmer) ( $\times 3$ ), holotype (U.W. 165) (C.A.S. 7406). Figured originally, 301, pl. 9, fig. 19. 113	
Fig. 5. <i>Thracia cf. karquinezensis</i> Weaver ( $\times 1.7$ ), hypotype (U.C. 33659). Figured by Turner, 274, pl. 8, fig. 20.....	119
Fig. 6. <i>Mytilus sammamishensis</i> Weaver ( $\times 0.9$ ), holotype (U.W. 47) (C.A.S. 7411). Duplicate figure of pl. 25, fig. 12. Figured originally, 286, pl. 13, fig. 111. ....	102
Fig. 7. <i>Anadara (Anadara) obispoana</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 32558). Locality: Wishkah River, 1000 feet north of mouth of Big Creek, Grays Harbor County, Washington.....	74
Fig. 8. <i>Crassatellites uvasana</i> (Conrad) subsp. <i>mathewsonii</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 33628). Figured by Turner, 274, pl. 10, fig. 20.....	125
Fig. 9. <i>Crassatellites lincolnensis</i> Weaver ( $\times 2.2$ ), paratype (U.W. 92) (C.A.S. 456-A). ....	128
Fig. 10. <i>Mytilus dichotomus</i> Cooper ( $\times 1.3$ ), hypotype (U.C. 33224). Figured by Turner, 274, pl. 5, fig. 16.....	107
Fig. 11. <i>Crassatellites lincolnensis</i> Weaver ( $\times 2.3$ ), paratype (U.W. 92-A) (C.A.S. 456) .....	128
Fig. 12. <i>Crassatellites perrini</i> (Dickerson) ( $\times 2$ ), holotype (C.A.S. 390). Figured originally, 123, pl. 27, fig. 8b.....	127
Fig. 13. <i>Crassatellites perrini</i> (Dickerson) ( $\times 1.8$ ), holotype (C.A.S. 390). Figured originally, 123, pl. 27, fig. 8a.....	127
Fig. 14. <i>Crassatellites lincolnensis</i> Weaver ( $\times 2.2$ ), paratype (U.W. 92) (C.A.S. 456-A). ....	128
Fig. 15. <i>Crassatellites lincolnensis</i> Weaver ( $\times 2.3$ ), paratype (U.W. 92-A) (C.A.S. 456). ....	128
Fig. 16. <i>Cardiomya comstockensis</i> Turner ( $\times 3$ ), holotype (U.C. 33225). Figured by Turner, 274, pl. 8, fig. 8.....	122
Fig. 17. <i>Crassatellites perrini</i> (Dickerson) ( $\times 1.2$ ), hypotype (U.C. 12496). Locality (U.C. 3607). .....	127
Fig. 18. <i>Crassatellites perrini</i> (Dickerson) ( $\times 1.2$ ), hypotype (U.C. 12496). Locality (U.C. 3607). ....	127

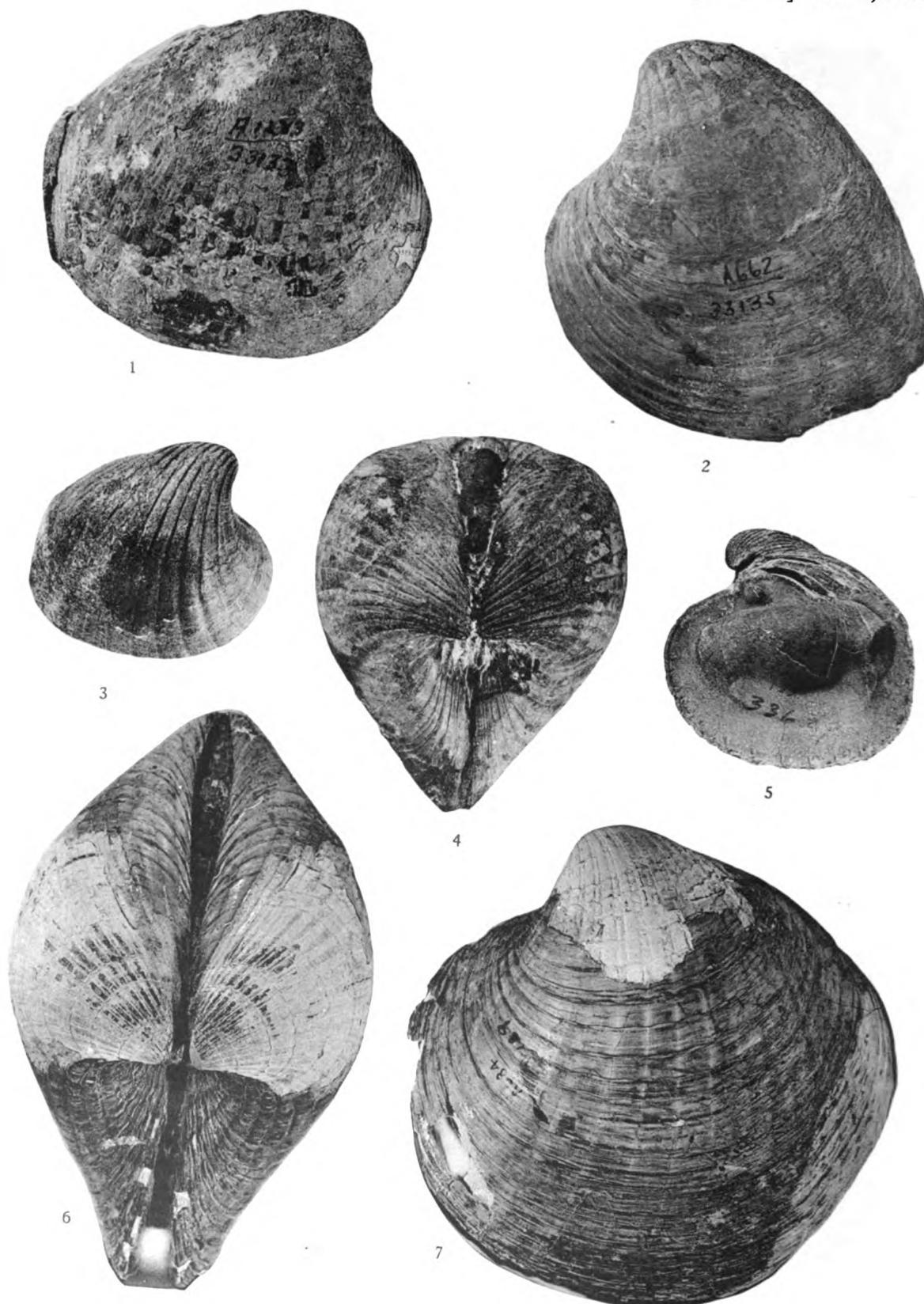
## PLATE 27

	PAGE
Fig. 1. <i>Corbicula oregonensis</i> Hendon ( $\times 1$ ), holotype (U.C. 33103). Figured by Turner, 274, pl. 8, fig. 5.....	130
Fig. 2. <i>Crassatellites stillwaterensis</i> Weaver and Palmer ( $\times 1$ ), holotype (U.W. 168) (C.A.S. 7419). Figured originally, 301, pl. 9, fig. 1.....	126
Fig. 3. <i>Crassatellites stillwaterensis</i> Weaver and Palmer ( $\times 1.5$ ), hypotype (U.C. 32762). .....	126
Fig. 4. <i>Corbicula sookensis</i> (Clark and Arnold) ( $\times 1$ ), holotype (C.A.S. 586). Figured originally, 50, pl. 20, fig. 3a.....	133
Fig. 5. <i>Crassatellites stillwaterensis</i> Weaver and Palmer ( $\times 1$ ), hypotype (U.C. 32762). .....	126
Fig. 6. <i>Crassatellites stillwaterensis</i> Weaver and Palmer ( $\times 1$ ), holotype (U.W. 168) (C.A.S. 7419). Figured originally, 301, pl. 9, fig. 2.....	126
Fig. 7. <i>Venericardia hornii</i> (Gabb) subsp. <i>clarki</i> Weaver and Palmer ( $\times 1.8$ ), holotype (U.W. 169) (C.A.S. 7430). Figured originally, 301, pl. 10, fig. 8. ....	135
Fig. 8. <i>Venericardia subtenta</i> (Conrad) ( $\times 1$ ), syntype of <i>V. chehalensis</i> (U.W. 50) (C.A.S. 7432). Figured as <i>V. chehalensis</i> , 286, pl. 12, fig. 101. ....	140
Fig. 9. <i>Venericardia hornii</i> (Gabb) subsp. <i>clarki</i> Weaver and Palmer ( $\times 2$ ), holotype (U.W. 169) (C.A.S. 7430). Figured originally, 301, pl. 10 fig. 8. ....	135
Fig. 10. <i>Venericardia hornii</i> (Gabb) subsp. <i>clarki</i> Weaver and Palmer ( $\times 1.7$ ), topotype (U.W. 169-A) (C.A.S. 7430-A).....	135
Fig. 11. <i>Lucina roseburgensis</i> Hendon ( $\times 1.2$ ), holotype (U.C. 33665). Figured by Turner, 274, pl. 9, fig. 12.....	147
Fig. 12. <i>Lucina muirensis</i> (Dickerson) ( $\times 1.5$ ), hypotype (U.C. 33663). Figured by Turner, 274, pl. 9, fig. 10. Locality (U.C. A-719).....	148
Fig. 13. <i>Venericardia subtenta</i> (Conrad) ( $\times 2$ ), syntype of <i>V. chehalensis</i> (U.W. 50-A) (C.A.S. 7432-A).....	140
Fig. 14. <i>Venericardia subtenta</i> (Conrad) ( $\times 1.3$ ), syntype of <i>V. chehalensis</i> (U.W. 50) (C.A.S. 7432). Figured originally, 286, pl. 12, fig. 101.....	140
Fig. 15. <i>Lucina (Here) aragoensis</i> Turner ( $\times 1.8$ ), holotype (U.C. 33145). Figured by Turner, 274, pl. 9, fig. 4.....	146
Fig. 16. <i>Lucina washingtonensis</i> Turner ( $\times 1$ ), holotype (U.C. 33142). Figured by Turner, 274, pl. 9, fig. 8.....	148
Fig. 17. <i>Venericardia hornii</i> (Gabb) subsp. <i>clarki</i> Weaver and Palmer ( $\times 1.7$ ), holotype (U.W. 169) (C.A.S. 7430). Figured originally, 301, pl. 10, fig. 8. ....	135
Fig. 18. <i>Venericardia hornii</i> (Gabb) subsp. <i>clarki</i> Weaver and Palmer ( $\times 2$ ), hypotype (U.C. 33130). Figured by Turner, 274, pl. 14, fig. 1.....	135



UNIV. OF WASH. PUBL. IN GEOL.

[WEAVER] VOL. V, PL. 28



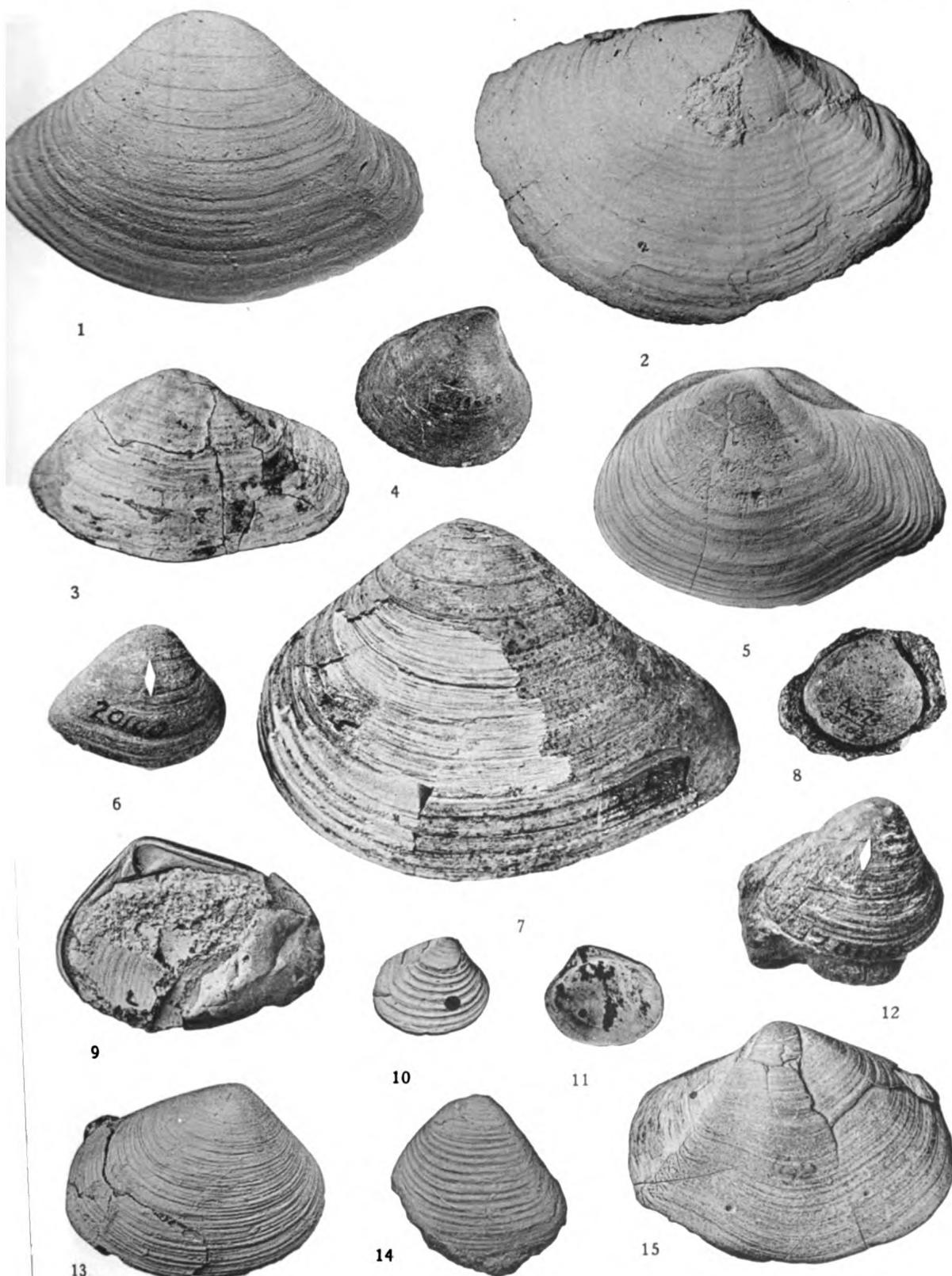
## PLATE 28

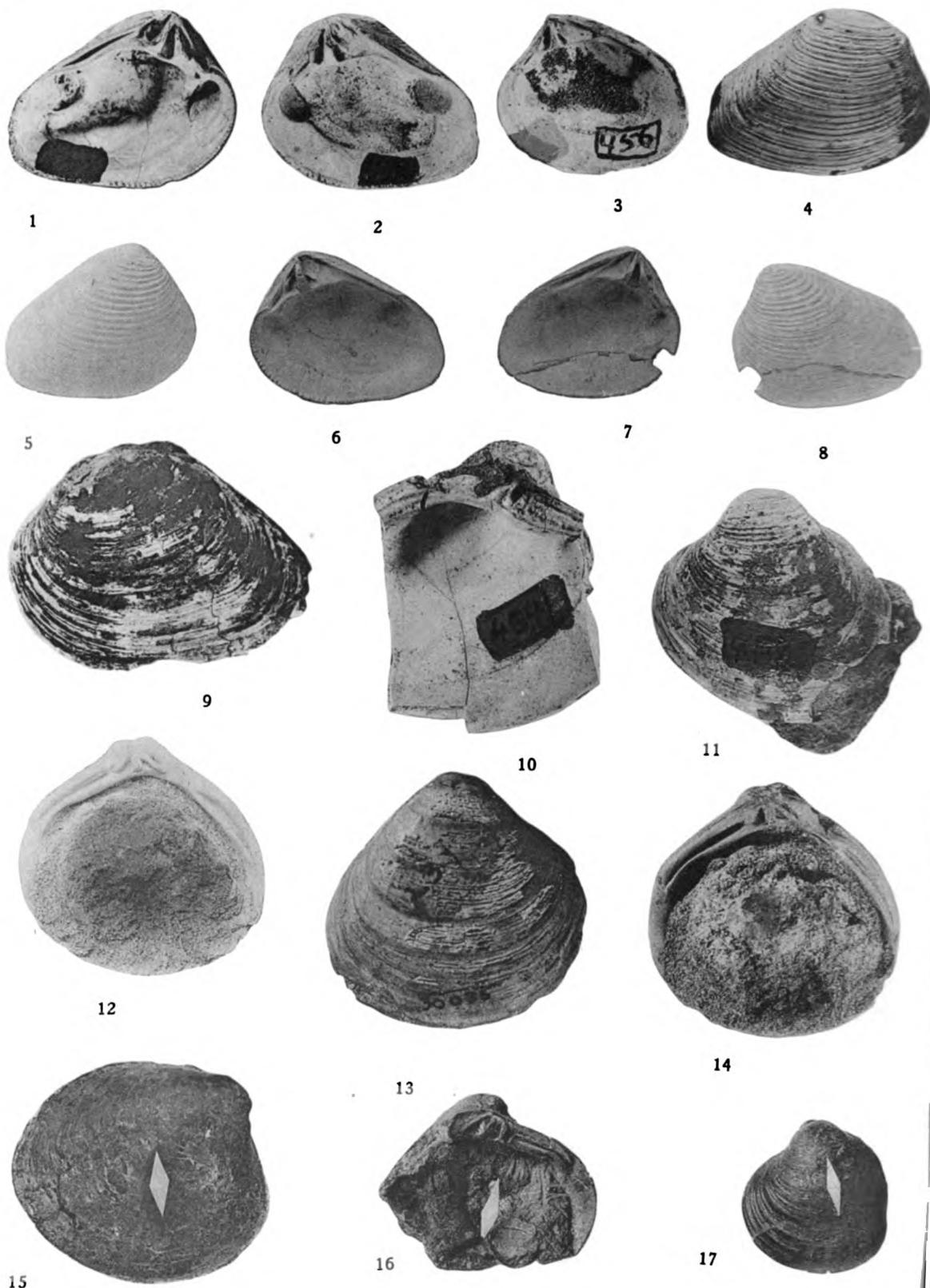
	PAGE
Fig. 1. <i>Venericardia hornii</i> (Gabb) subsp. <i>lutmani</i> Turner ( $\times 0.5$ ), holotype (U.C. 33133). Figured by Turner, 274, pl. 13, fig. 4.....	135
Fig. 2. <i>Venericardia aragonia</i> Arnold and Hannibal ( $\times 0.7$ ), hypotype (U.C. 33135). Figured by Turner, 274, pl. 13, fig. 3.....	137
Fig. 3. <i>Venericardia aragonia</i> Arnold and Hannibal ( $\times 1.2$ ), hypotype (U.C. 33629). Figured by Turner, 274, pl. 13, fig. 2.....	137
Fig. 4. <i>Venericardia aragonia</i> Arnold and Hannibal ( $\times 0.7$ ), hypotype (U.C. 33135). Figured by Turner, 274, pl. 13, fig. 5.....	137
Fig. 5. <i>Venericardia aragonia</i> Arnold and Hannibal ( $\times 1.3$ ), hypotype (U.C. 33629). Figured by Turner, 274, pl. 13, fig. 2. Reverse side.....	137
Fig. 6. <i>Venericardia hornii</i> (Gabb) subsp. <i>calafia</i> Stewart ( $\times 0.8$ ), hypotype (U.C. 33129). Figured by Turner, 274, pl. 14, fig. 4.....	134
Fig. 7. <i>Venericardia hornii</i> (Gabb) subsp. <i>calafia</i> Stewart ( $\times 0.8$ ), hypotype (U.C. 33129). .....	134

(681)

## PLATE 29

	PAGE
Fig. 1. <i>Crassatellites dalli</i> Weaver ( $\times 1$ ), hypotype (U.W. 309). Locality (U.W. 241). . . . .	124
Fig. 2. <i>Cochlodesma bainbridgensis</i> Clark ( $\times 2$ ), holotype (S.U. 27). Figured originally, 52, pl. 13, fig. 3. . . . .	117
Fig. 3. <i>Thracia dilleri</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 107399). Figured originally, 89, pl. 34, fig. 19. . . . .	119
Fig. 4. <i>Crassatellites uvasana</i> (Conrad) subsp. <i>mathewsonii</i> (Gabb) ( $\times 0.7$ ), hypotype (U.C. 33628). Figured by Turner, 274, pl. 10, fig. 20. . . . .	125
Fig. 5. <i>Thracia trapezoides</i> Conrad ( $\times 1$ ), hypotype (U.W. 560). Astoria formation, Clallam County, Washington. . . . .	117
Fig. 6. <i>Corbicula brevidens</i> (White) ( $\times 1$ ), syntype (U.S.N.M. 20100). Figured originally, 309, pl. 10, fig. 8. . . . .	131
Fig. 7. <i>Crassatellites dalli</i> Weaver ( $\times 1.2$ ), holotype (U.W. 94) (C.A.S. 457). Figured originally, 295, pl. 2, fig. 18. . . . .	124
Fig. 8. <i>Corbicula oregonensis</i> Hendon ( $\times 0.8$ ), holotype (U.C. 33103). Duplicate of pl. 27, fig. 1. Figured by Turner, 274, pl. 8, fig. 5. . . . .	130
Fig. 9. <i>Crassatellites stillwaterensis</i> Weaver and Palmer ( $\times 1$ ), holotype (U.W. 168) (C.A.S. 7419). Figured originally, 301, pl. 9, fig. 2. . . . .	126
Fig. 10. <i>Crassatellites lincolensis</i> Weaver ( $\times 1.3$ ), holotype (U.W. 92-B) (C.A.S. 559). Figured originally, 295, pl. 3, fig. 32. . . . .	128
Fig. 11. <i>Crassatellites lincolensis</i> Weaver ( $\times 1.3$ ), holotype (U.W. 92-B) (C.A.S. 559). Figured originally, 295, pl. 3, fig. 32. . . . .	128
Fig. 12. <i>Corbicula brevidens</i> (White) ( $\times 1$ ), syntype (U.S.N.M. 20100-A). Figured originally, 309, pl. 10, fig. 7. . . . .	131
Fig. 13. <i>Crassatellites stillwaterensis</i> Weaver and Palmer ( $\times 1$ ), holotype (U.W. 168) (C.A.S. 7419). Figured originally, 301, pl. 9, fig. 1. . . . .	126
Fig. 14. <i>Crassatellites carmanahensis</i> Clark ( $\times 1$ ), holotype (C.A.S. 704). Figured originally, 52, pl. 12, fig. 6. . . . .	128
Fig. 15. <i>Thracia condoni</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 110460). Figured originally, 101, pl. 19, fig. 5. . . . .	119





## PLATE 30

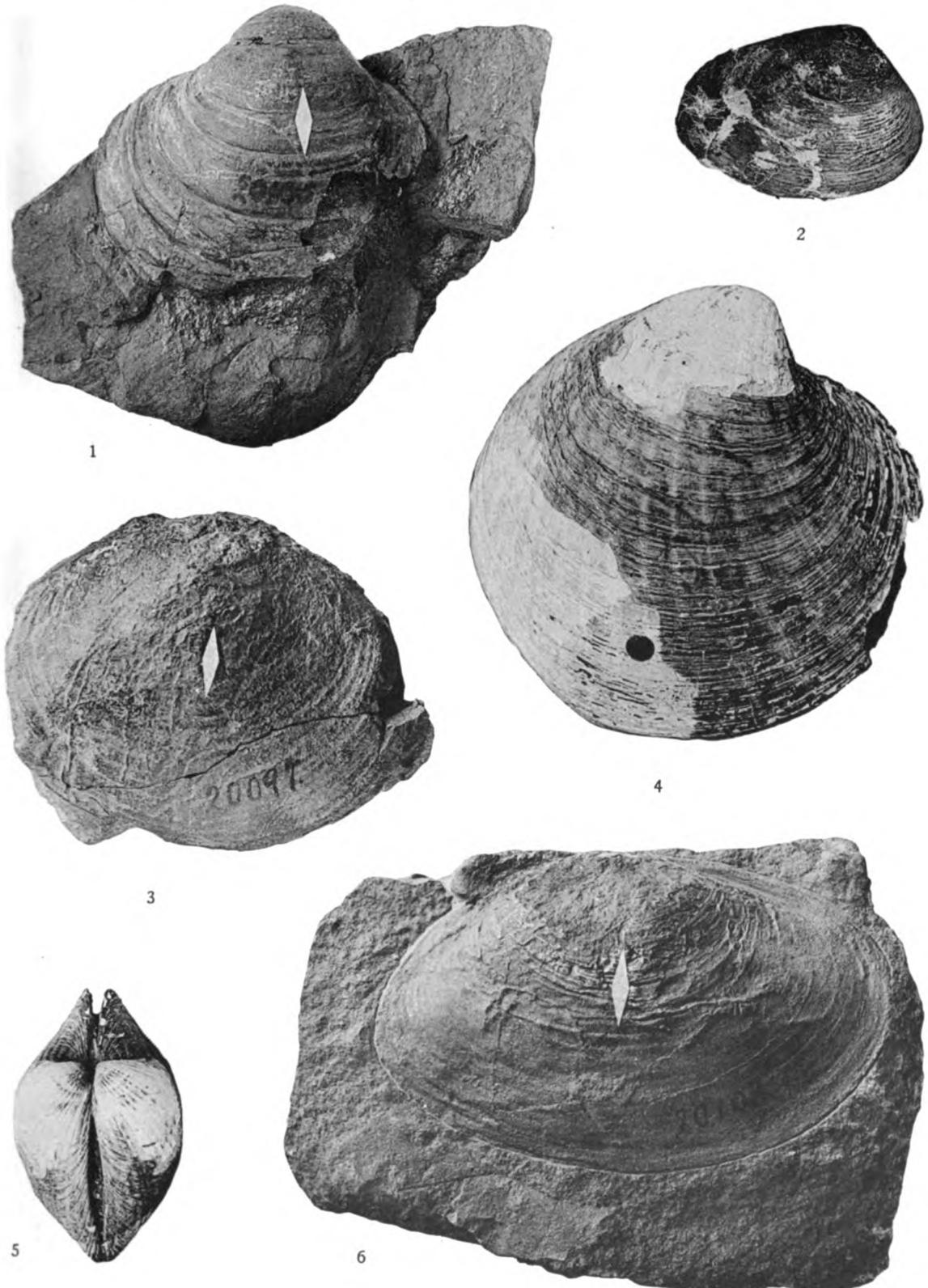
	PAGE
Fig. 1. <i>Crassatellites washingtoniana</i> Weaver ( $\times 1$ ), syntype (C.A.S. 480-A) (U.W. 8).....	126
Fig. 2. <i>Crassatellites washingtoniana</i> Weaver ( $\times 1$ ), syntype (C.A.S. 480) (U.W. 8-B).....	136
Fig. 3. <i>Crassatellites lincolnensis</i> Weaver ( $\times 2$ ), paratype (U.W. 456).....	128
Fig. 4. <i>Crassatellites washingtoniana</i> Weaver ( $\times 1$ ), syntype (C.A.S. 480) (U.W. 8-B).....	126
Fig. 5. <i>Crassatellites washingtoniana</i> Weaver ( $\times 1$ ), hypotype (S.U. 29). Fig- ured by Clark, 52, pl. 12, fig. 4.....	126
Fig. 6. <i>Crassatellites washingtoniana</i> Weaver ( $\times 1$ ), hypotype (S.U. 29). Fig- ured by Clark, 52, pl. 12, fig. 2.....	126
Fig. 7. <i>Crassatellites washingtoniana</i> Weaver ( $\times 1$ ), hypotype (S.U. 30). Fig- ured by Clark, 52, pl. 12, fig. 5.....	126
Fig. 8. <i>Crassatellites washingtoniana</i> Weaver ( $\times 1$ ), hypotype (S.U. 30). Fig- ured by Clark, 52, pl. 12, fig. 1.....	126
Fig. 9. <i>Corbicula cowlitzensis</i> Weaver ( $\times 1.4$ ), holotype (U.W. 10) (C.A.S. 482). Figured originally, 286, pl. 14, fig. 117.....	129
Fig. 10. <i>Corbicula olequahensis</i> (Weaver) ( $\times 1.4$ ), holotype (U.W. 13) (C.A.S. 484). Figured originally, 286, pl. 5, fig. 48.....	130
Fig. 11. <i>Corbicula olequahensis</i> (Weaver) ( $\times 1$ ), topotype (C.A.S. 484-A).....	130
Fig. 12. <i>Corbicula sookensis</i> (Clark and Arnold) ( $\times 1$ ), holotype (C.A.S. 586). Figured originally, 50, pl. 20, fig. 3b.....	133
Fig. 13. <i>Corbicula sookensis</i> (Clark and Arnold) ( $\times 1$ ), holotype (C.A.S. 586). Figured originally, 50, pl. 20, fig. 3a.....	133
Fig. 14. <i>Corbicula sookensis</i> (Clark and Arnold) ( $\times 1$ ), holotype (C.A.S. 586). Figured originally, 50, pl. 20, fig. 3b.....	133
Fig. 15. <i>Corbicula pugetensis</i> White ( $\times 0.9$ ), holotype (U.S.N.M. 20106). Fig- ured originally, 309, pl. 11, fig. 8.....	131
Fig. 16. <i>Corbicula willisi</i> White ( $\times 1$ ), syntype (U.S.N.M. 20105). Figured or- iginally, 309, pl. 11, fig. 6.....	132
Fig. 17. <i>Corbicula willisi</i> White ( $\times 1$ ), syntype (U.S.N.M. 20105-A?). Figured originally, 309, pl. 11, fig. 5.....	132

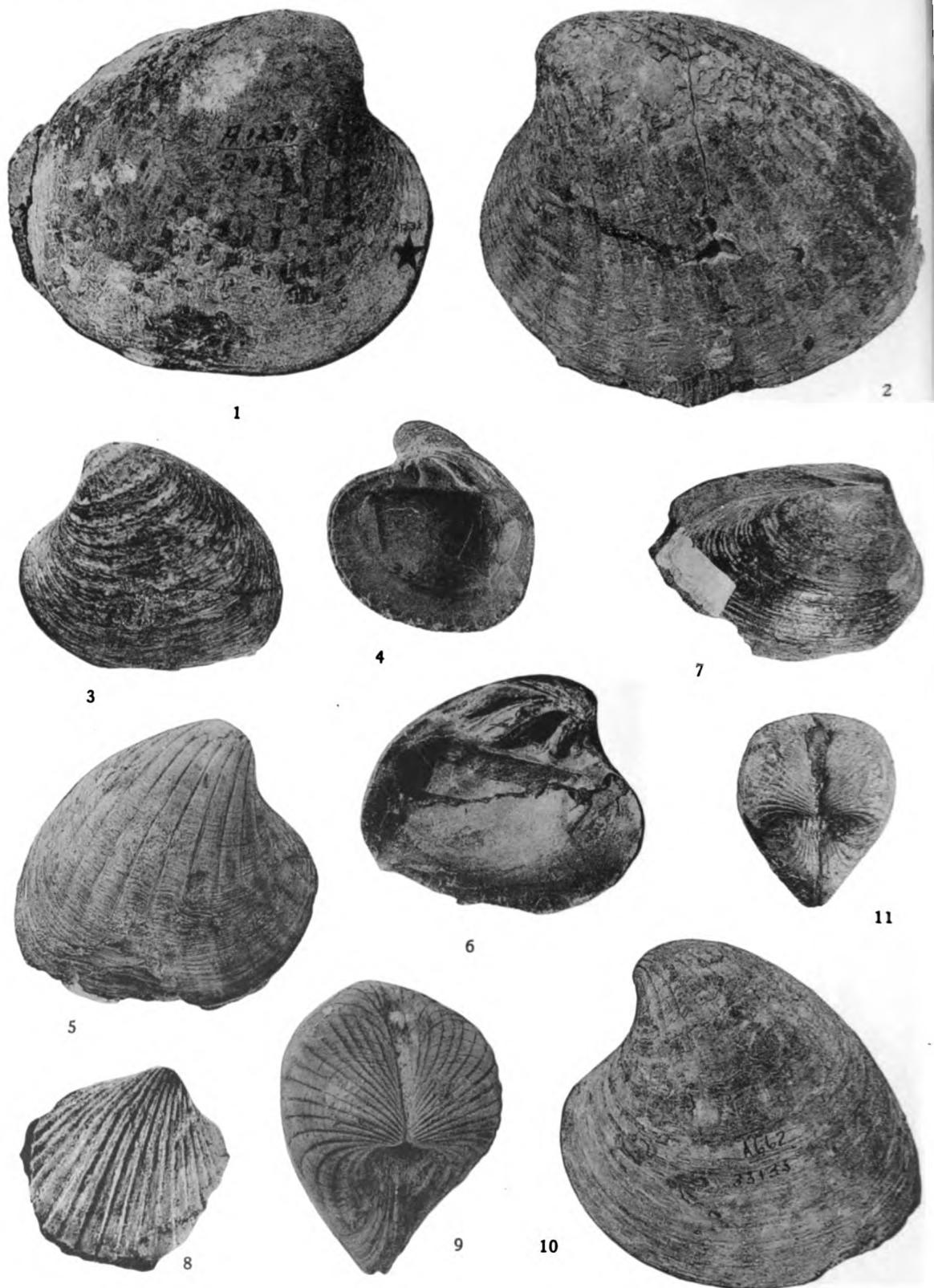
(683)

PLATE 31

	PAGE
Fig. 1. <i>Corbicula willisi</i> White ( $\times 1$ ), syntype (U.S.N.M. 20105-B?). Figured originally, 309, pl. 11, fig. 3.....	132
Fig. 2. <i>Crassatellites stillwaterensis</i> Weaver and Palmer ( $\times 1$ ), holotype (U.W. 168) (C.A.S. 7419). Figured originally, 301, pl. 9, fig. 1.....	126
Fig. 3. <i>Batissa dubia</i> White ( $\times 1$ ), holotype (U.S.N.M. 20097). Figured originally, 309, pl. 11, fig. 1.....	133
Fig. 4. <i>Venericardia hornii</i> (Gabb) subsp. <i>calafia</i> Stewart ( $\times 0.6$ ), hypotype (U.C. 33129). Figured by Turner, 274, pl. 14, fig. 4.....	134
Fig. 5. <i>Venericardia hornii</i> (Gabb) subsp. <i>calafia</i> Stewart ( $\times 0.4$ ), hypotype (U.C. 33129). .....	134
Fig. 6. <i>Batissa newberryi</i> White ( $\times 1$ ), holotype (U.S.N.M. 20108). Figured originally, 309, pl. 9, fig. 1.....	134

(684)





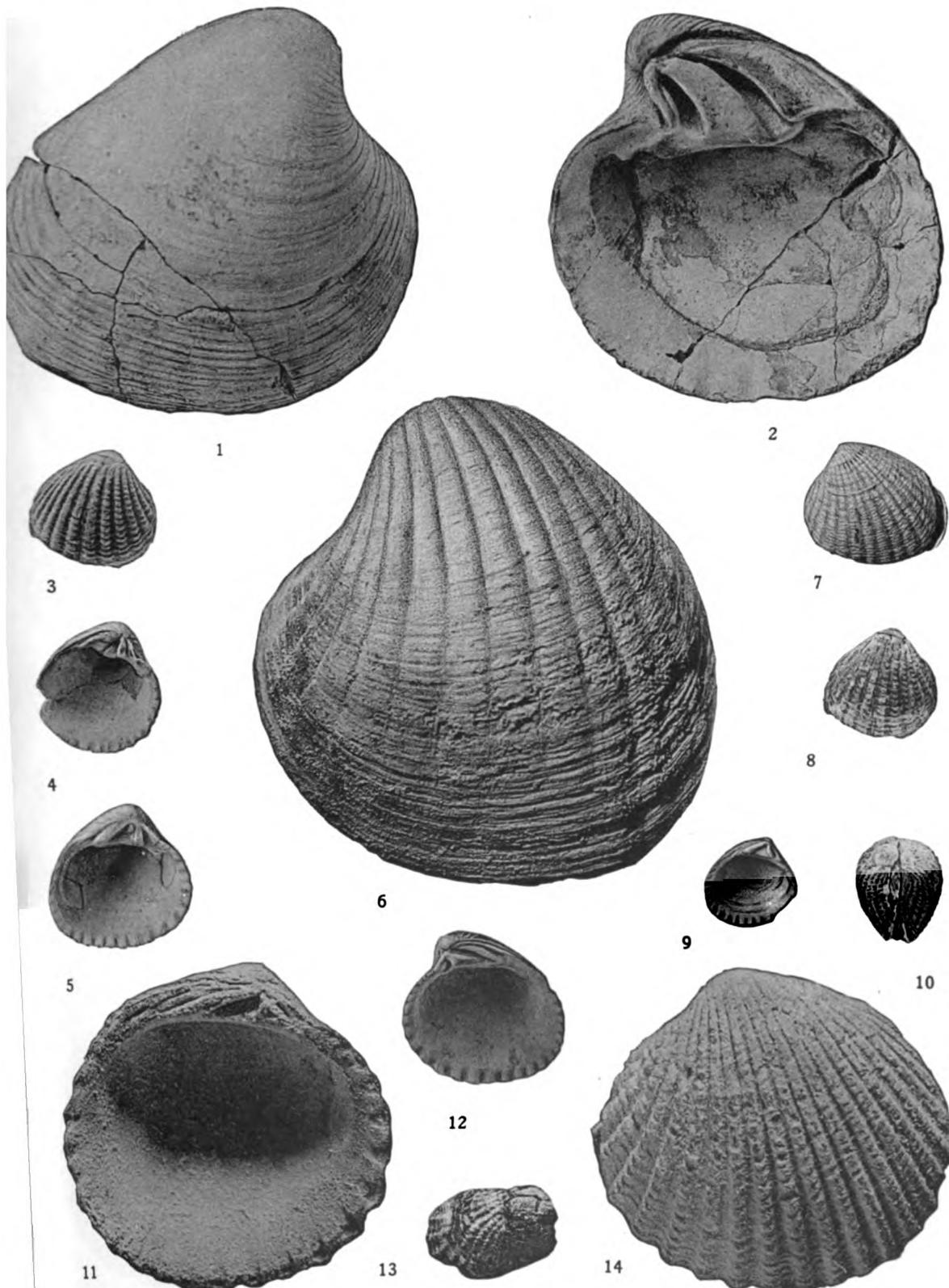
## PLATE 32

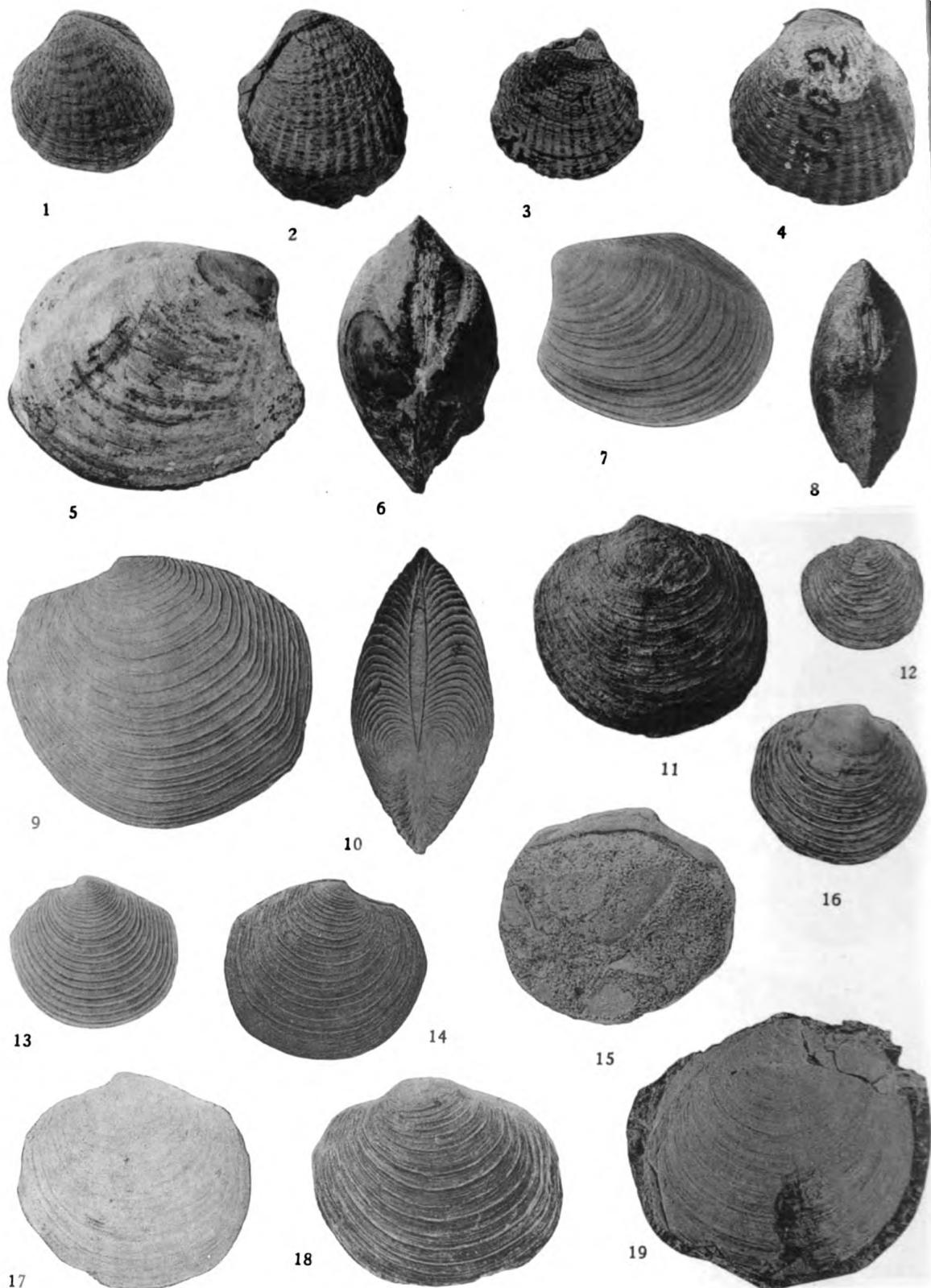
	PAGE
Fig. 1. <i>Venericardia hornii</i> (Gabb) subsp. <i>lutmani</i> Turner ( $\times 0.6$ ), holotype (U.C. 33133). Figured originally, 274, pl. 13, fig. 4.....	135
Fig. 2. <i>Venericardia hornii</i> (Gabb) subsp. <i>clarki</i> Weaver and Palmer ( $\times 1.8$ ), hypotype (U.C. 33130). Figured by Turner, 274, pl. 14, fig. 1.....	135
Fig. 3. <i>Venericardia aragonia</i> Arnold and Hannibal ( $\times 0.6$ ), paratype (C.A.S. 241). Figured originally by Dickerson as holotype of <i>V. planicosta merriami</i> , 120, pl. 11, fig. 1a.....	137
Fig. 4. <i>Venericardia aragonia</i> Arnold and Hannibal ( $\times 1$ ), hypotype (U.C. 33629). Locality (U.C. A-661). Figured by Turner, 274, pl. 13, fig. 1, Reverse side.....	137
Fig. 5. <i>Venericardia aragonia</i> Arnold and Hannibal ( $\times 0.4$ ), topotype (U.C. 33791). Locality (U.C. A-661).....	137
Fig. 6. <i>Venericardia aragonia</i> Arnold and Hannibal ( $\times 0.6$ ), paratype (C.A.S. 241). Figured originally by Dickerson as holotype of <i>V. planicosta merriami</i> , 120, pl. 11, fig. 1a.....	137
Fig. 7. <i>Macrocallista pittsburgensis</i> (Dall) ( $\times 1$ ), hypotype (U.C. 30358).....	175
Fig. 8. <i>Venericardia crescentensis</i> Weaver and Palmer ( $\times 2.5$ ), holotype (U.W. 170) (C.A.S. 7433). Figured originally, 301, pl. 10, fig. 9.....	137
Fig. 9. <i>Venericardia crescentensis</i> Weaver and Palmer ( $\times 0.5$ ), hypotype (U.C. 32791). Locality (U.C. 3608).....	137
Fig. 10. <i>Venericardia aragonia</i> Arnold and Hannibal ( $\times 0.65$ ), hypotype (U.C. 33135). Figured by Turner, 274, pl. 13, fig. 10.....	137
Fig. 11. <i>Venericardia aragonia</i> Arnold and Hannibal ( $\times 0.35$ ), hypotype (U.C. 33135). Figured by Turner, 274, pl. 13, fig. 3.....	137

(685)

## PLATE 33

	<b>PAGE</b>
Fig. 1. <i>Venericardia crescentensis</i> Weaver and Palmer ( $\times 0.4$ ), hypotype (U.C. 30196). Locality (U.C. A-1547).....	137
Fig. 2. <i>Venericardia crescentensis</i> Weaver and Palmer ( $\times 0.5$ ), hypotype (U.C. 30196). Locality (U.C. A-1547).....	137
Fig. 3. <i>Venericardia hawaii</i> Tegland ( $\times 1$ ), holotype (U.C. 32147). Figured originally, 272, pl. 7, fig. 4.....	138
Fig. 4. <i>Venericardia hawaii</i> Tegland ( $\times 1$ ), paratype (U.C. 32143). Figured originally, 272, pl. 7, fig. 5.....	138
Fig. 5. <i>Venericardia subtenta</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 31947). Figured by Etherington, 140, pl. 9, fig. 1.....	140
Fig. 6. <i>Venericardia hornii</i> (Gabb) subsp. <i>clarki</i> Weaver and Palmer ( $\times 1$ ), hypotype (U.W. 339). Cowlitz formation, locality (U.W. 566).....	135
Fig. 7. <i>Venericardia subtenta</i> (Conrad) ( $\times 1$ ), syntype (U.W. 50-B). Figured as <i>V. chehalisensis</i> , 286, pl. 15, fig. 137.....	140
Fig. 8. <i>Venericardia hawaii</i> Tegland ( $\times 1$ ), holotype (U.C. 32147). Figured originally, 272, pl. 7, fig. 4.....	138
Fig. 9. <i>Venericardia subtenta</i> (Conrad) ( $\times 1$ ), syntype of <i>V. chehalisensis</i> (U.W. 50-C).....	140
Fig. 10. <i>Venericardia hawaii</i> Tegland ( $\times 1$ ), holotype (U.C. 32147). Figured originally, 272, pl. 7, fig. 3.....	138
Fig. 11. <i>Venericardia hannibali</i> Clark ( $\times 4$ ), holotype (S.U. 32). Figured originally, 52, pl. 19, fig. 7.....	139
Fig. 12. <i>Venericardia subtenta</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 31948). Figured by Etherington, 140, pl. 5, fig. 12.....	140
Fig. 13. <i>Cardita (Carditamera) weaveri</i> Dickerson ( $\times 3$ ), holotype (C.A.S. 386). Figured originally, 123, pl. 27, fig. 5a.....	141
Fig. 14. <i>Venericardia hannibali</i> Clark ( $\times 4$ ), holotype (S.U. 32). Figured originally, 52, pl. 19, fig. 6.....	139



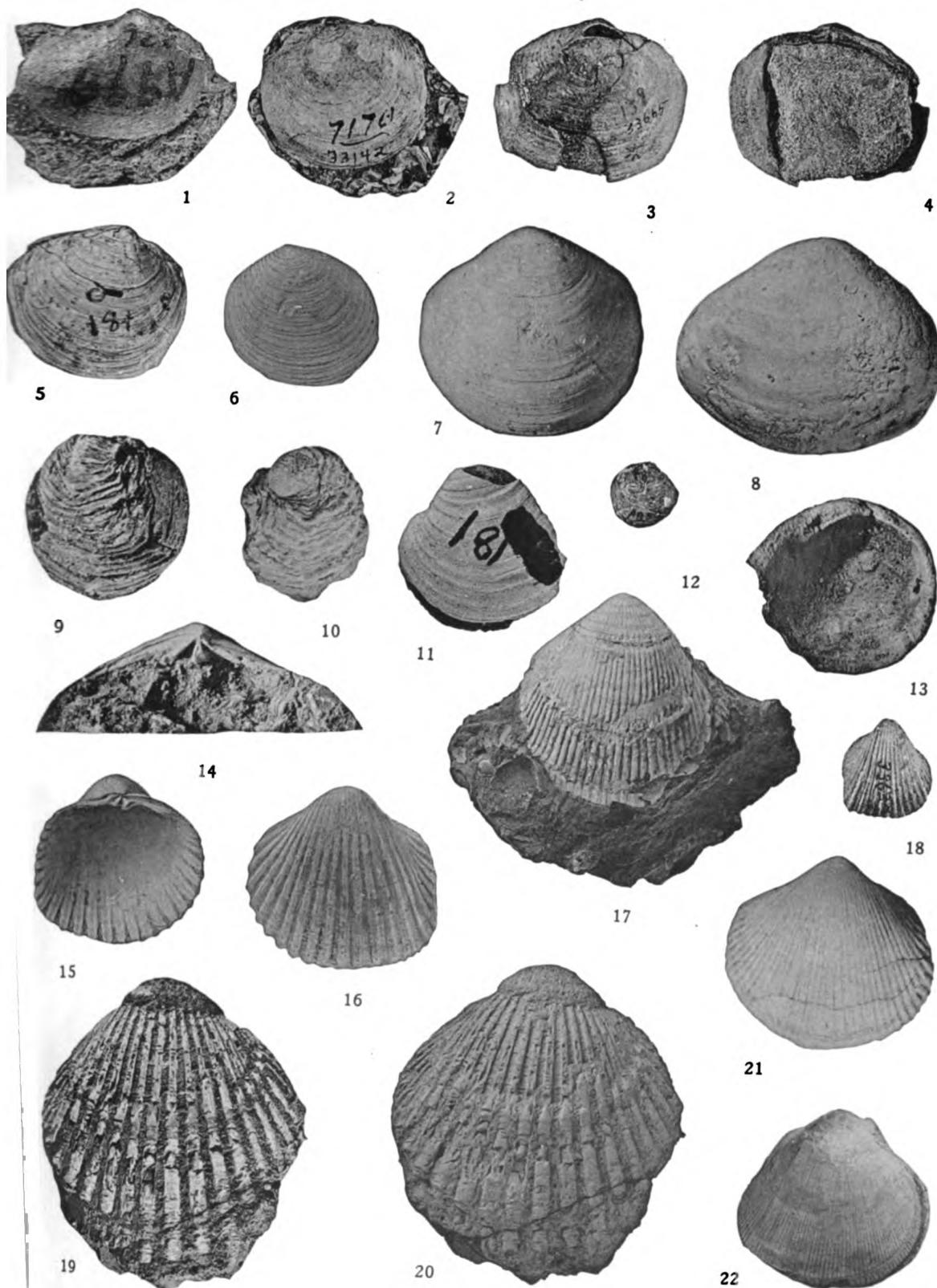


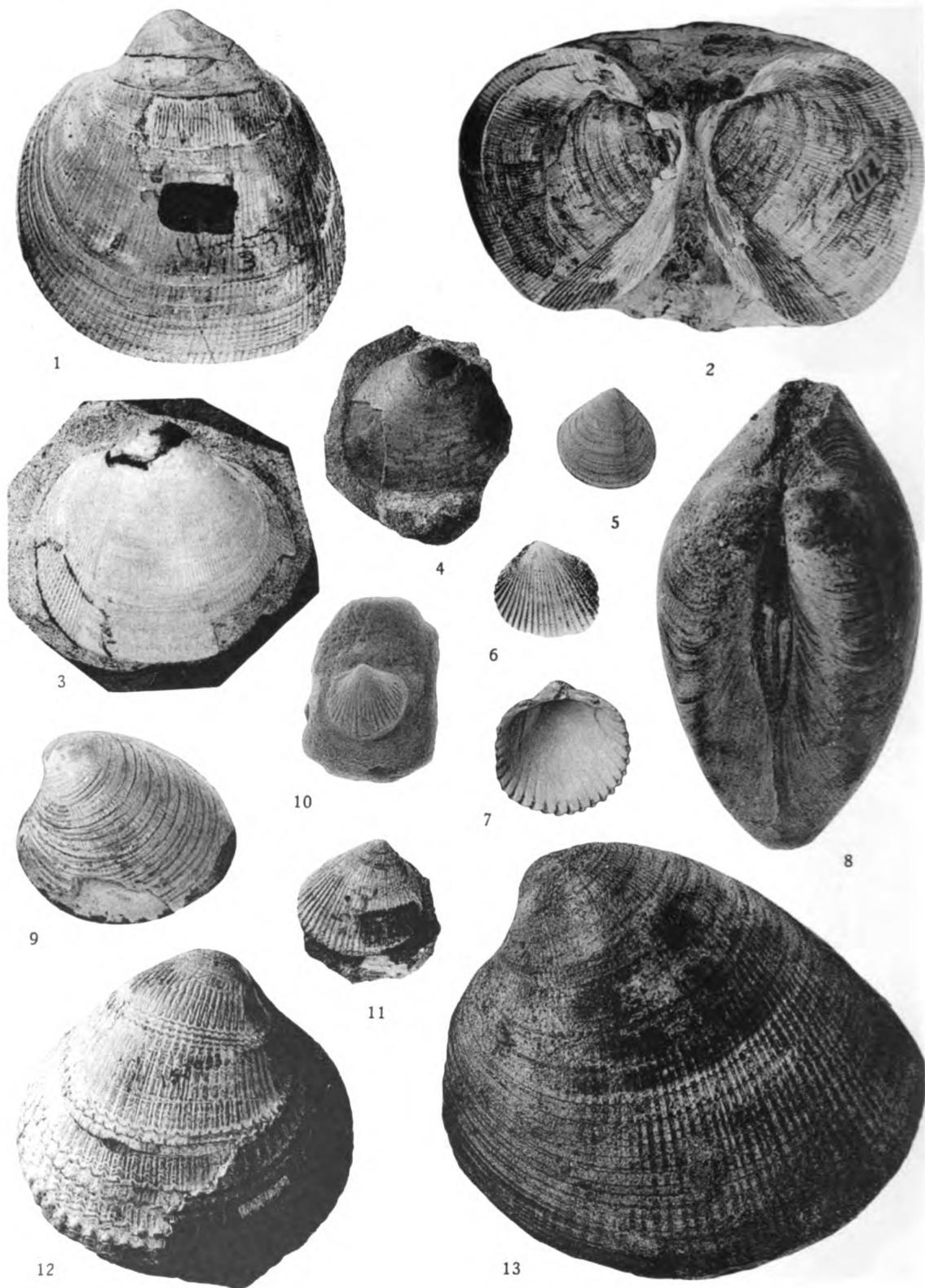
## PLATE 34

	PAGE
Fig. 1. <i>Venericardia castor</i> Dall ( $\times 1$ ), topotype (U.C. 32142). Figured by Tegland, 272, pl. 7, fig. 10.....	139
Fig. 2. <i>Venericardia castor</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153936). Figured originally, 101, pl. 11, fig. 1.....	139
Fig. 3. <i>Venericardia castor</i> Dall ( $\times 1$ ), hypotype (U.C. 32130). Figured by Tegland, 272, pl. 7, fig. 14.....	139
Fig. 4. <i>Venericardia subtenta</i> (Conrad) ( $\times 2$ ), holotype (U.S.N.M. 3502). Conrad type. Figured originally, 68, pl. 18, fig. 12.....	140
Fig. 5. <i>Thyasira bisecta</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 3518). Conrad type. Figured originally, 68, pl. 17, fig. 10.....	142
Fig. 6. <i>Thyasira bisecta</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 3518). Conrad type. Figured originally, 68, pl. 17, fig. 10.....	142
Fig. 7. <i>Thyasira disjuncta</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 32419). Locality (U.W. 681).....	143
Fig. 8. <i>Lucina acutilineata</i> Conrad ( $\times 1$ ), holotype (U.S.N.M. 3519). Conrad type. Figured originally, 68, pl. 18, fig. 2.....	143
Fig. 9. <i>Lucina hannibali</i> (Clark) ( $\times 1$ ), holotype (S.U. 33). Figured originally, 52, pl. 22, fig. 4.....	144
Fig. 10. <i>Lucina hannibali</i> (Clark) ( $\times 1$ ), holotype (S.U. 33). Figured originally, 52, pl. 22, fig. 2.....	144
Fig. 11. <i>Lucina acutilineata</i> Conrad ( $\times 1$ ), holotype (U.S.N.M. 3519). Conrad type. Figured originally, 68, pl. 18, fig. 2b.....	143
Fig. 12. <i>Lucina hannibali</i> (Clark) ( $\times 1$ ), hypotype (U.C. 32166). Figured by Tegland, 52, pl. 8, fig. 12.....	144
Fig. 13. <i>Lucina columbiana</i> (Clark and Arnold) ( $\times 1$ ), hypotype (U.C. 32842). Locality (U.C. 4213).....	145
Fig. 14. <i>Lucina columbiana</i> (Clark and Arnold) ( $\times 1$ ), hypotype (S.U. 34). Figured by Clark, 50, pl. 22, fig. 9.....	145
Fig. 15. <i>Lucina columbiana</i> (Clark and Arnold) ( $\times 1.1$ ), holotype (C.A.S. 593). Figured originally, 50, pl. 25, fig. 2a.....	145
Fig. 16. <i>Lucina acutilineata</i> Conrad ( $\times 1$ ), hypotype (U.C. 31940). Astoria formation, locality (U.C. 80). Figured by Etherington, 140, pl. 4, fig. 5.	143
Fig. 17. <i>Lucina columbiana</i> (Clark and Arnold) ( $\times 1$ ), holotype (C.A.S. 593). Figured originally, 50, pl. 25, fig. 2b.....	145
Fig. 18. <i>Lucina hannibali</i> (Clark) ( $\times 1$ ), hypotype (U.C. 32168). Figured by Tegland, 272, pl. 8, fig. 10.....	144
Fig. 19. <i>Lucina packi</i> Dickerson ( $\times 1$ ), hypotype (U.C. 32823). From Simi Valley, California, locality (U.C. 3296). Figured by Turner, 274, pl. 9, fig. 11. Specimens in Oregon too fragmentary to figure.....	147

## PLATE 35

	PAGE
Fig. 1. <i>Lucina muirensis</i> (Dickerson) ( $\times 2$ ), hypotype (U.C. 33663). Figured by Turner, 274, pl. 9, fig. 10.....	148
Fig. 2. <i>Lucina washingtonensis</i> Turner ( $\times 0.8$ ), holotype (U.C. 33142). Locality (U.C. 7170). Figured by Turner, 274, pl. 9, fig. 8.....	148
Fig. 3. <i>Lucina roseburgensis</i> Hendon ( $\times 1$ ), holotype (U.C. 33665). Figured by Turner, 274, pl. 9, fig. 12.....	147
Fig. 4. <i>Lucina roseburgensis</i> Hendon ( $\times 1$ ), holotype (U.C. 33665). Figured by Turner, 274, pl. 9, fig. 13.....	147
Fig. 5. <i>Lucina (Here) dalli</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 398). Figured originally, 123, pl. 29, fig. 8.....	146
Fig. 6. <i>Taras parilis</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 31944). Locality (U.W. 415). Figured by Etherington, 140, pl. 5, fig. 6.....	149
Fig. 7. <i>Taras griesensis</i> Effinger ( $\times 2$ ), holotype (U.C. 33520). Figured originally, 138, pl. 45, fig. 12.....	150
Fig. 8. <i>Kellia twinensis</i> Clark ( $\times 3$ ), holotype (S.U. 5236). Locality (S.U. N.P. 120). Figured originally, 52, pl. 18, fig. 8.....	151
Fig. 9. <i>Chama grunskyi</i> Hanna ( $\times 2$ ), holotype (C.A.S. 399). Figured originally as <i>C. pacifica</i> , 123, pl. 29, fig. 10.....	151
Fig. 10. <i>Chama grunskyi</i> Hanna ( $\times 2.3$ ), hypotype (U.C. 33519). Figured by Effinger, 138, pl. 46, fig. 9.....	151
Fig. 11. <i>Taras</i> sp. (Dickerson) ( $\times 1.9$ ), holotype (C.A.S. 444). Figured originally, 123, pl. 29, fig. 9.....	150
Fig. 12. <i>Lucina (Here) aragoensis</i> Turner ( $\times 1$ ), holotype (U.C. 33145). Figured by Turner, 274, pl. 9, fig. 4.....	146
Fig. 13. <i>Chama grunskyi</i> Hanna ( $\times 2.4$ ), hypotype (U.C. 33518). Figured by Effinger, 138, pl. 46, fig. 10.....	151
Fig. 14. <i>Taras griesensis</i> Effinger ( $\times 3$ ), holotype (U.C. 33520). Figured originally, 138, pl. 45, fig. 11.....	150
Fig. 15. <i>Loxocardium (Schedocardia) brewerii</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 32924). Locality (U.W. 329). ....	153
Fig. 16. <i>Loxocardium (Schedocardia) brewerii</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 32924). Locality (U.W. 329)....	153
Fig. 17. <i>Cerastoderma corbis</i> (Martyn) ( $\times 0.7$ ), hypotype (U.C. 31942). Locality (U.W. 417). Figured by Etherington, 140, pl. 5, fig. 11.....	157
Fig. 18. <i>Loxocardium (Schedocardia) brewerii</i> (Gabb) ( $\times 0.8$ ), hypotype (U.C. 33637). Figured by Turner, 274, pl. 9, fig. 6.....	153
Fig. 19. <i>Cerastoderma scapoosense</i> (Clark) ( $\times 1$ ), holotype (C.A.S. 680). Figured originally, 52, pl. 22, fig. 5.....	158
Fig. 20. <i>Cerastoderma scapoosense</i> (Clark) ( $\times 1$ ), holotype (C.A.S. 680). Duplicate of pl. 35, fig. 19.....	158
Fig. 21. <i>Loxocardium (Schedocardia) etheringtoni</i> Effinger ( $\times 2$ ), holotype (U.C. 33524). Figured originally, 138, pl. 45, fig. 6.....	156
Fig. 22. <i>Nemocardium lorenzanum</i> (Arnold) ( $\times 2$ ), hypotype (U.C. 32115). Blakeley formation. Figured by Tegland, 272, pl. 7, fig. 17.....	160





## PLATE 36

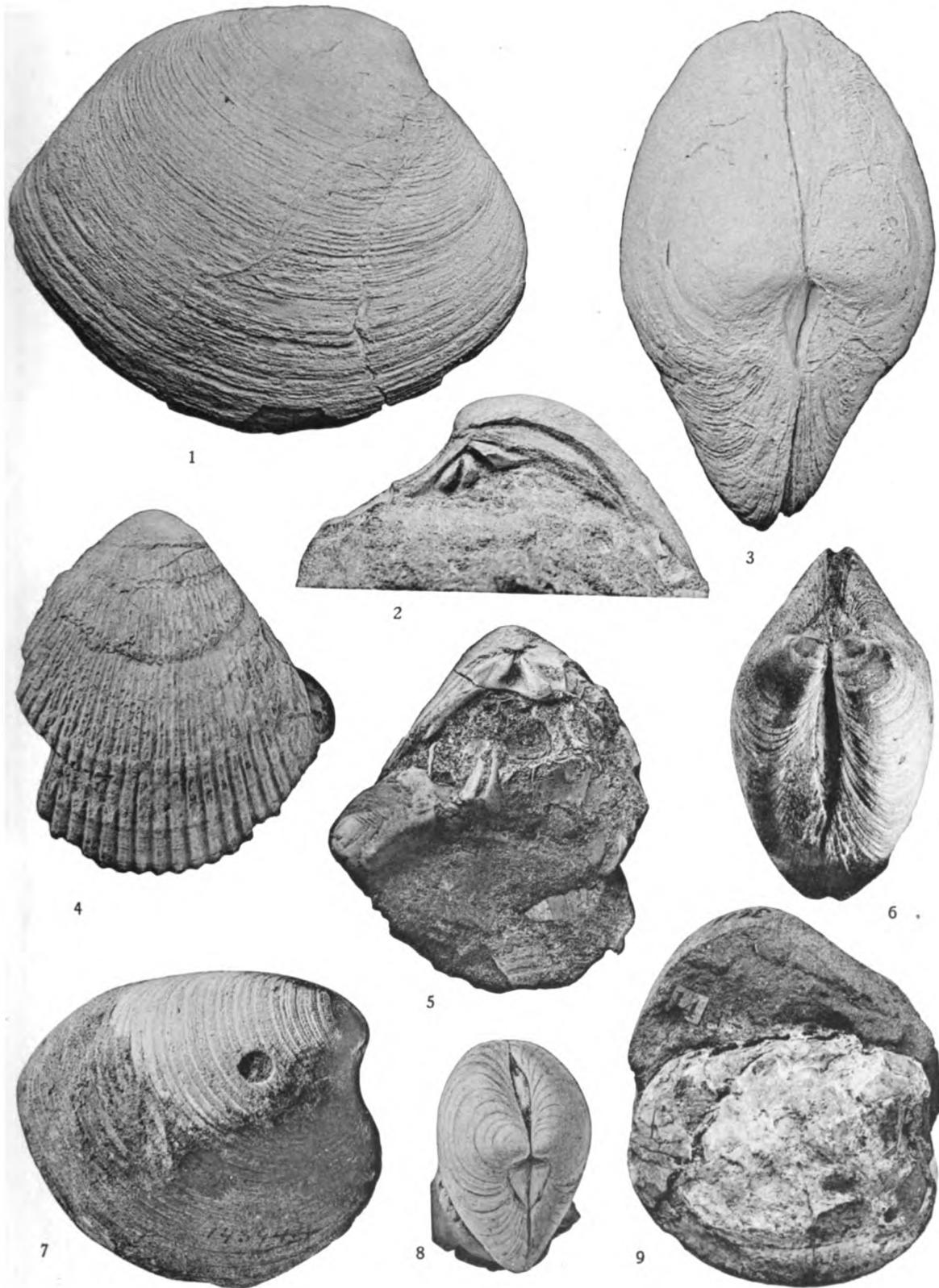
	PAGE
Fig. 1. <i>Nemocardium weaveri</i> (Anderson and Martin) ( $\times 1.2$ ), holotype (C.A.S. 113). Figured originally, 5, pl. 1, fig. 2b.....	161
Fig. 2. <i>Nemocardium weaveri</i> (Anderson and Martin) ( $\times 0.8$ ), paratype (C.A.S. 114). Figured originally, 5, pl. 1, fig. 3a.....	161
Fig. 3. <i>Nemocardium lorenzanum</i> (Arnold) ( $\times 3$ ), holotype (U.S.N.M. 165444). Figured originally, 13, pl. 33, fig. 6.....	160
Fig. 4. <i>Taras parilis</i> (Conrad) ( $\times 1$ ), hypotype (U.S.N.M. 153930). Figured by Dall, 67, pl. 11, fig. 6.....	149
Fig. 5. <i>Nemocardium lorenzanum</i> (Arnold) ( $\times 1$ ), hypotype (U.C. 32116). Blakeley formation. Figured by Tegland, 272, pl. 7, fig. 16.....	160
Fig. 6. <i>Nemocardium lincolnensis</i> (Weaver) ( $\times 1.7$ ), holotype (U.W. 95) (C.A.S. 458). Figured originally, 295, pl. 3, fig. 36.....	161
Fig. 7. <i>Loxocardium (Schedocardia) brewerii</i> (Gabb) var. <i>oldroydi</i> (Weaver and Palmer) ( $\times 1$ ), paratype (U.W. 171-A) (C.A.S. 7438-A). Figured originally, 301, pl. 8, fig. 11.....	154
Fig. 8. <i>Chione securis</i> (Shumard) ( $\times 1$ ), hypotype (U.S.N.M. 153942). Figured by Dall, 101, pl. 13, fig. 9.....	162
Fig. 9. <i>Chione securis</i> (Shumard) ( $\times 0.7$ ), hypotype (U.C. 31962). Locality (U.W. 418). Figured by Etherington, 140, pl. 8, fig. 4.....	162
Fig. 10. <i>Nemocardium eugenense</i> (Clark) ( $\times 1$ ), holotype (U.C. 30304). Figured originally, 52, pl. 22, fig. 6.....	162
Fig. 11. <i>Loxocardium (Schedocardia) olequahensis</i> (Weaver) ( $\times 1$ ), holotype (U.W. 11) (C.A.S. 483-B). Figured originally, 286, pl. 5, fig. 55.....	155
Fig. 12. <i>Cerastoderma coosense</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 153933). Figured originally, 101, pl. 13, fig. 4.....	158
Fig. 13. <i>Chione securis</i> (Shumard) ( $\times 1$ ), hypotype (U.S.N.M. 153942). Figured by Dall, 101, pl. 13, fig. 8.....	162

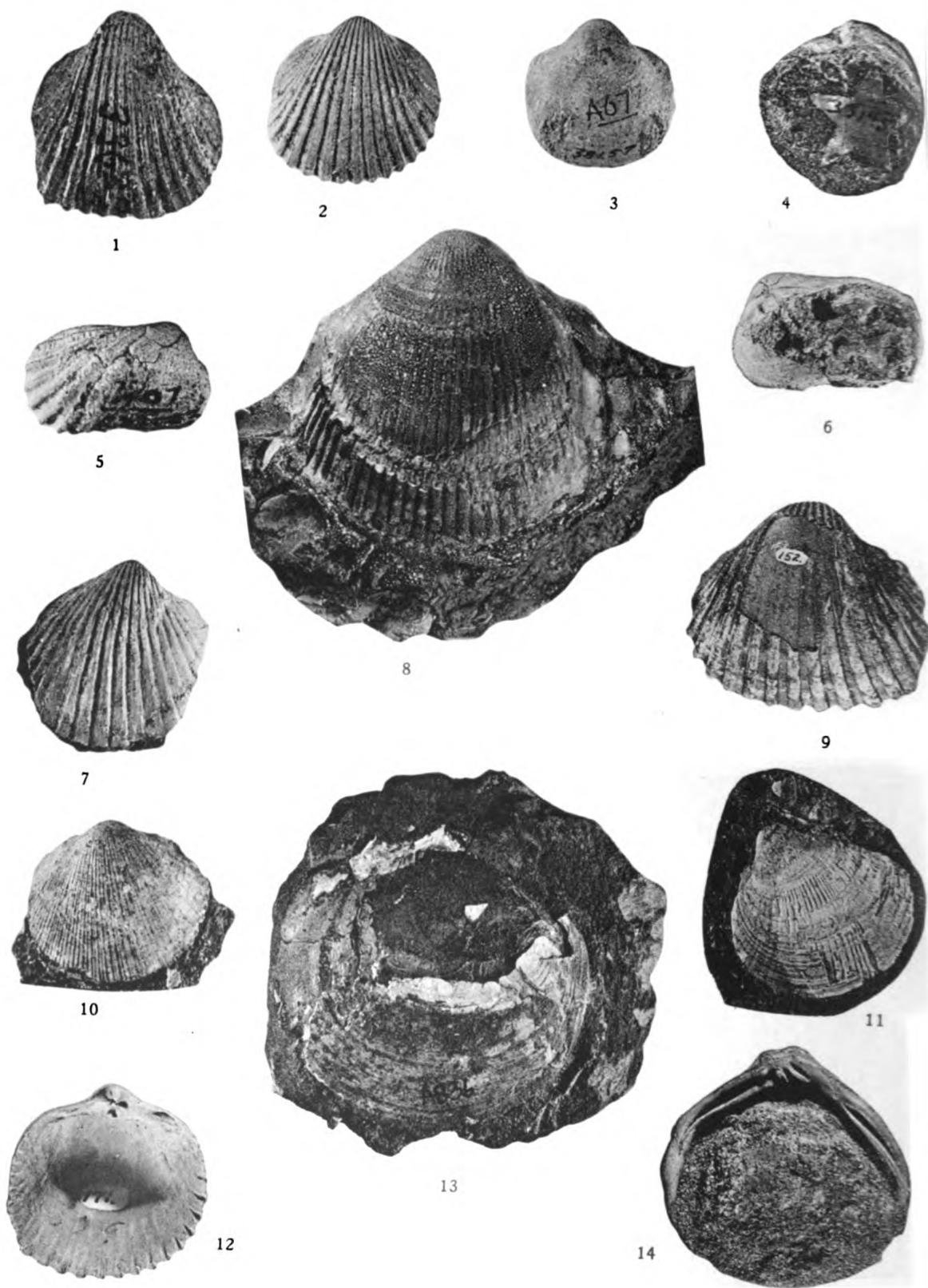
(689)

## PLATE 37

	PAGE
Fig. 1. <i>Corbis washingtoniana</i> Clark ( $\times 1.4$ ), holotype (S.U. 35). Figured originally, 52, pl. 20, fig. 3.....	152
Fig. 2. <i>Chione ensifera</i> (Dall) var. <i>chehalensis</i> Weaver ( $\times 1$ ), hypotype (U.C. 31966). Figured by Etherington, 140, pl. 9, fig. 11.....	165
Fig. 3. <i>Corbis washingtoniana</i> Clark ( $\times 1.4$ ), holotype (S.U. 35). Figured originally, 52, pl. 20, fig. 2.....	152
Fig. 4. <i>Cerastoderma sookensis</i> (Clark and Arnold) ( $\times 1$ ), holotype (U.C. 30291). Figured originally, 50, pl. 22, fig. 1b.....	159
Fig. 5. <i>Cerastoderma sookensis</i> (Clark and Arnold) ( $\times 1$ ), holotype (U.C. 30291). Figured originally, 50, pl. 22, fig. 1a.....	159
Fig. 6. <i>Chione parapodema</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 143944). Figured originally, 101, pl. 13, fig. 1.....	164
Fig. 7. <i>Chione parapodema</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 143944). Figured originally, 101, pl. 11, fig. 11.....	164
Fig. 8. <i>Chione securis</i> (Shumard) ( $\times 0.7$ ), hypotype (U.C. 31962). Locality (U.W. 418). Figured by Etherington, 140, pl. 8, fig. 4.....	162
Fig. 9. <i>Chione ensifera</i> (Dall) ( $\times 1$ ), holotype of " <i>Venus lamellifera</i> ," Conrad type (U.S.N.M. 3611). Figured originally, 68, pl. 17, fig. 12a.....	164

(690)





## PLATE 38

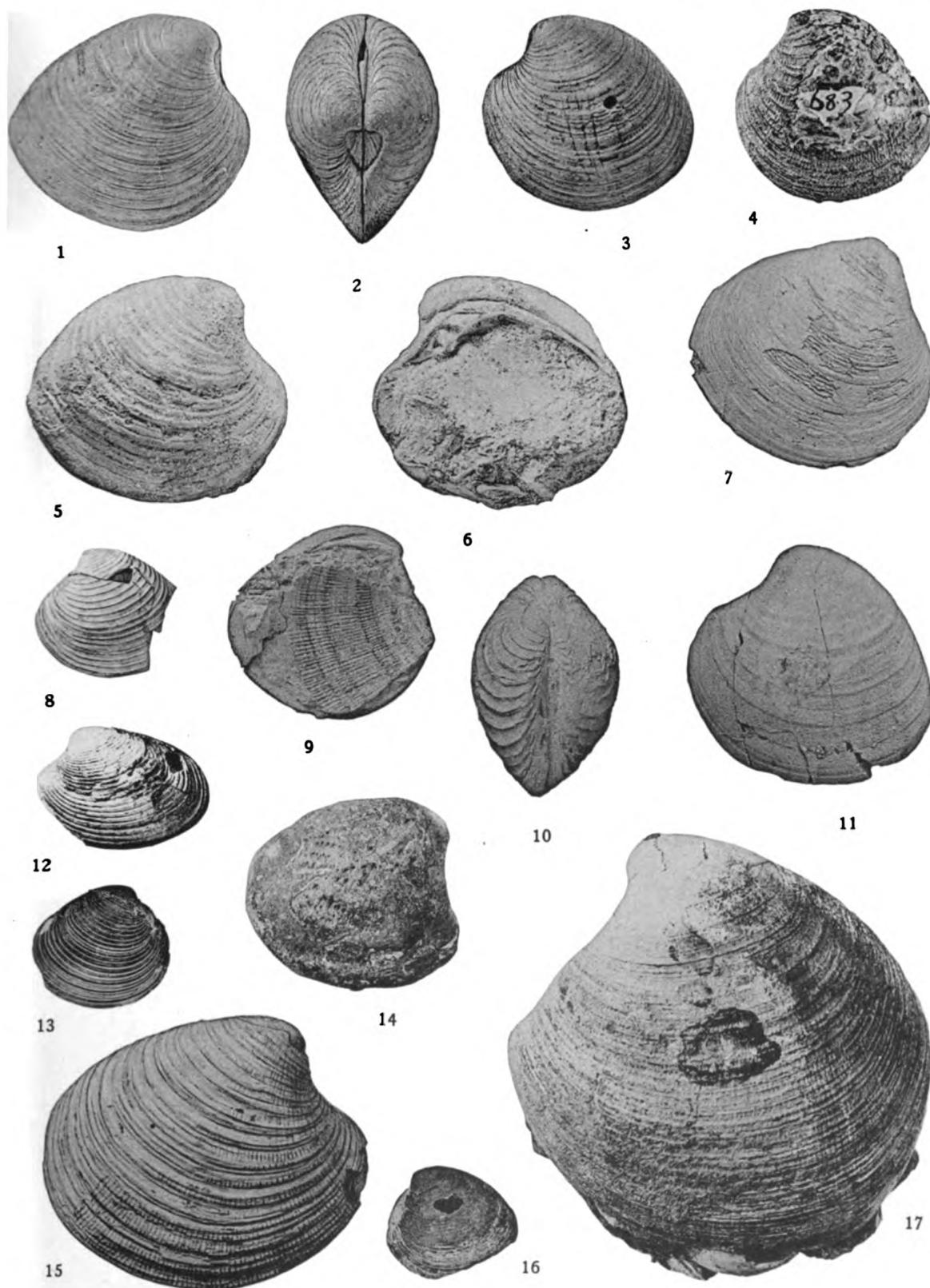
	PAGE
Fig. 1. <i>Loxocardium (Schedocardia) brewerii</i> (Gabb) ( $\times 1.7$ ), hypotype (U.C. 33637). Figured by Turner, 274, pl. 9, fig. 6.....	153
Fig. 2. <i>Loxocardium (Schedocardia) brewerii</i> (Gabb) var. <i>oldroydi</i> (Weaver and Palmer) ( $\times 1.5$ ), holotype (U.W. 171) (C.A.S. 7438). Figured originally, 301, pl. 8, fig. 3.....	154
Fig. 3. <i>Nemocardium linteum</i> (Conrad) ( $\times 20.2$ ), hypotype (U.C. 33157). Figured by Turner, 274, pl. 10, fig. 10. Locality (U.C. A-677).....	159
Fig. 4. <i>Lucina (Here) aragoensis</i> Turner ( $\times 2$ ), holotype (U.C. 33145). Figured by Turner, 274, pl. 9, fig. 4. Inner view.....	146
Fig. 5. <i>Cardita (Carditamera) weaveri</i> Dickerson ( $\times 2$ ), hypotype (U.C. 33523). Figured by Effinger, 138, pl. 46, fig. 11.....	141
Fig. 6. <i>Cardita (Carditamera) weaveri</i> Dickerson ( $\times 2$ ), hypotype (U.C. 33523). Figured by Effinger, 138, pl. 46, fig. 11.....	141
Fig. 7. <i>Venericardia crescentensis</i> Weaver and Palmer ( $\times 2.5$ ), holotype (U.W. 170) (C.A.S. 7433). Figured originally, 301, pl. 10, fig. 9.....	137
Fig. 8. <i>Cerastoderma corbis</i> (Martyn) ( $\times 1$ ), hypotype (U.C. 31942). Locality (U.W. 417). Figured by Etherington, 140, pl. 5, fig. 11.....	157
Fig. 9. <i>Loxocardium (Schedocardia) brewerii</i> (Gabb) ( $\times 1$ ), hypotype (U.W. 152) (C.A.S. 7414). Holotype of <i>Arca columbiana</i> Weaver and Palmer. Figured, 301, pl. 8, fig. 1.....	153
Fig. 10. <i>Glycymeris crescentensis</i> Weaver and Palmer ( $\times 3$ ), holotype (U.W. 157) (C.A.S. 7403). Figured originally, 301, pl. 8, fig. 10.....	58
Fig. 11. <i>Chione montesanoensis</i> Weaver ( $\times 1.4$ ), paratype (U.W. 52) (C.A.S. 503). Locality (U.W. 68).....	166
Fig. 12. <i>Loxocardium (Schedocardia) brewerii</i> (Gabb) var. <i>oldroydi</i> (Weaver and Palmer) ( $\times 1.3$ ), holotype (U.W. 171) (C.A.S. 7438). Figured originally, 301, pl. 8, fig. 3.....	154
Fig. 13. <i>Lucina packi</i> Dickerson ( $\times 1$ ), hypotype (U.C. 12497). Locality (U.C. A-836).....	147
Fig. 14. <i>Corbicula sookensis</i> (Clark and Arnold) ( $\times 1$ ), holotype (C.A.S. 586). Figured originally, 50, pl. 20, fig. 3b.....	133

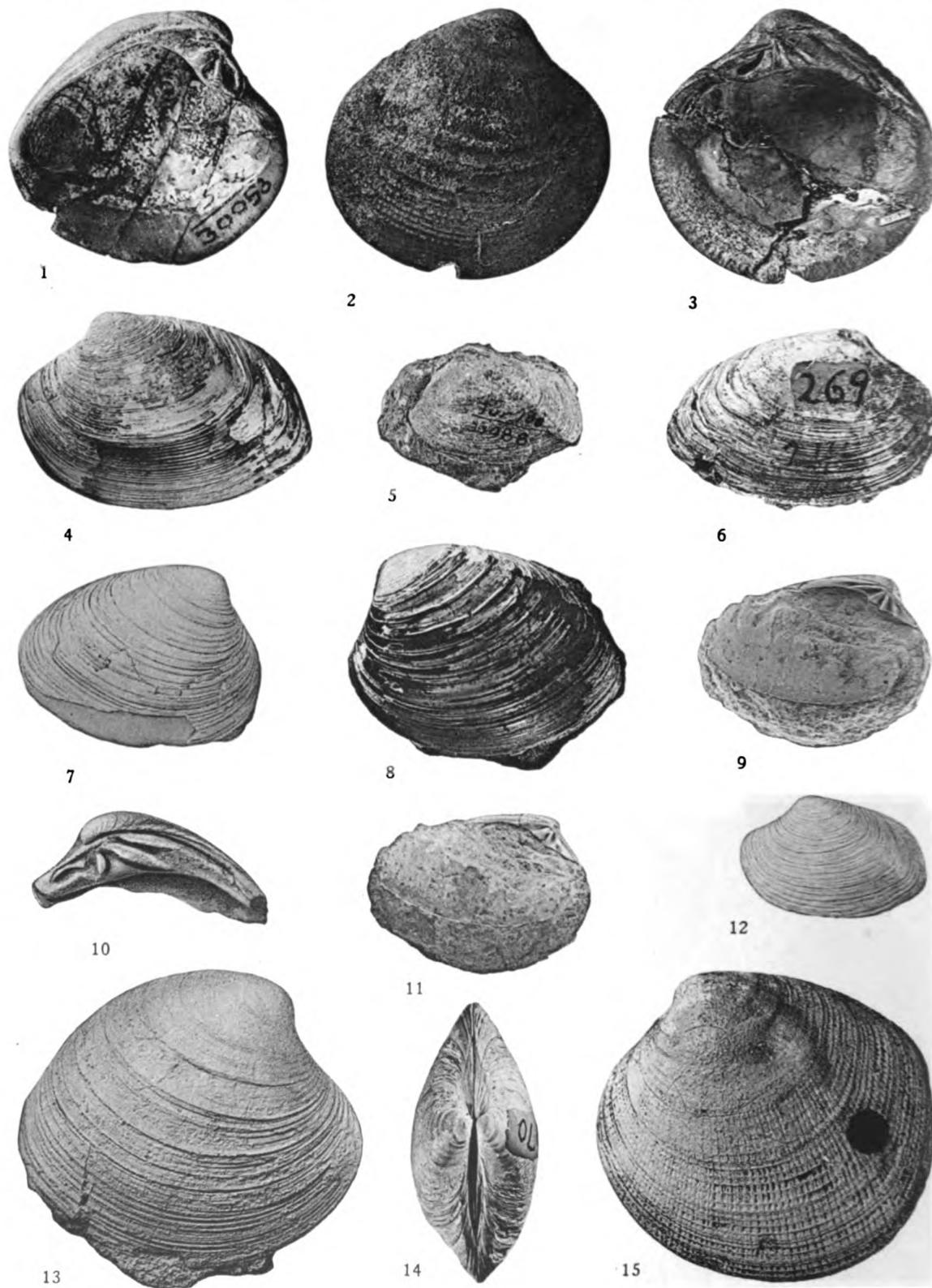
(691)

## PLATE 39

	PAGE
Fig. 1. <i>Chione ensifera</i> (Dall) var. <i>chehaliscensis</i> Weaver ( $\times 0.6$ ), hypotype (U.C. 31964). Figured by Etherington, 140, pl. 9, fig. 4.....	165
Fig. 2. <i>Chione ensifera</i> (Dall) ( $\times 0.6$ ), hypotype (U.C. 31959). Figured by Etherington, 140, pl. 8, fig. 1.....	164
Fig. 3. <i>Chione ensifera</i> (Dall) ( $\times 0.6$ ), hypotype (U.C. 31959). Figured by Etherington, 140, pl. 8, fig. 1.....	164
Fig. 4. <i>Chione carmanahensis</i> Clark ( $\times 1$ ), holotype (C.A.S. 683). Figured originally, 52, pl. 18, fig. 3.....	167
Fig. 5. <i>Chione vancouverensis</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30052). Figured originally, 50, pl. 20, fig. 2a.....	168
Fig. 6. <i>Chione vancouverensis</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30052). Figured originally, 50, pl. 20, fig. 2b.....	168
Fig. 7. <i>Corbicula sookensis</i> (Clark and Arnold) ( $\times 1$ ), holotype (C.A.S. 586). Figured originally, 50, pl. 20, fig. 3a.....	133
Fig. 8. <i>Pitar (Lamelliconcha) cocenica</i> (Weaver and Palmer) ( $\times 1$ ), topotype (U.C. ?; Stewart collection?). Figured by Tegland, 270, pl. 22, fig. 6..	184
Fig. 9. <i>Chione carmanahensis</i> Clark ( $\times 1$ ), holotype (C.A.S. 683). Figured originally, 52, pl. 18, fig. 4.....	167
Fig. 10. <i>Chione carmanahensis</i> Clark ( $\times 1$ ), paratype (C.A.S. 684). Figured originally, 52, pl. 18, fig. 1.....	167
Fig. 11. <i>Chione vancouverensis</i> Clark and Arnold ( $\times 1$ ), paratype (C.A.S. 584). Figured originally, 50, pl. 20, fig. 1a.....	168
Fig. 12. <i>Macrocallista williamsoni</i> Weaver and Palmer ( $\times 0.8$ ), paratype (U.W. 174-A) (C.A.S. 7484-A). .....	174
Fig. 13. <i>Pitar (Lamelliconcha) cocenica</i> (Weaver and Palmer) ( $\times 0.9$ ), holotype (U.W. 172) (C.A.S. 7485). Figured originally, 301, pl. 10, fig. 16.....	184
Fig. 14. " <i>Venus (Chione?) olympidea</i> " Reagan ( $\times 0.8$ ), holotype (U.S.N.M. 328311). Figured originally, 230, pl. 1, fig. 12.....	169
Fig. 15. <i>Chione securis</i> (Shumard) ( $\times 1$ ), hypotype (U.W. 242). Astoria formation, two miles east of Clallam Bay, Washington.....	162
Fig. 16. <i>Pitar stocki</i> (Weaver and Palmer) ( $\times 0.9$ ), holotype (U.W. 173). Figured originally, 301, pl. 10, fig. 6.....	183
Fig. 17. <i>Venerupis (Prototthaca) staleyi</i> (Gabb) ( $\times 1$ ), hypotype (U.S.N.M. 328344). Figured originally by Reagan as <i>Tapes staleyi</i> Gabb, 230, pl. 4, fig. 38.....	170

(692)





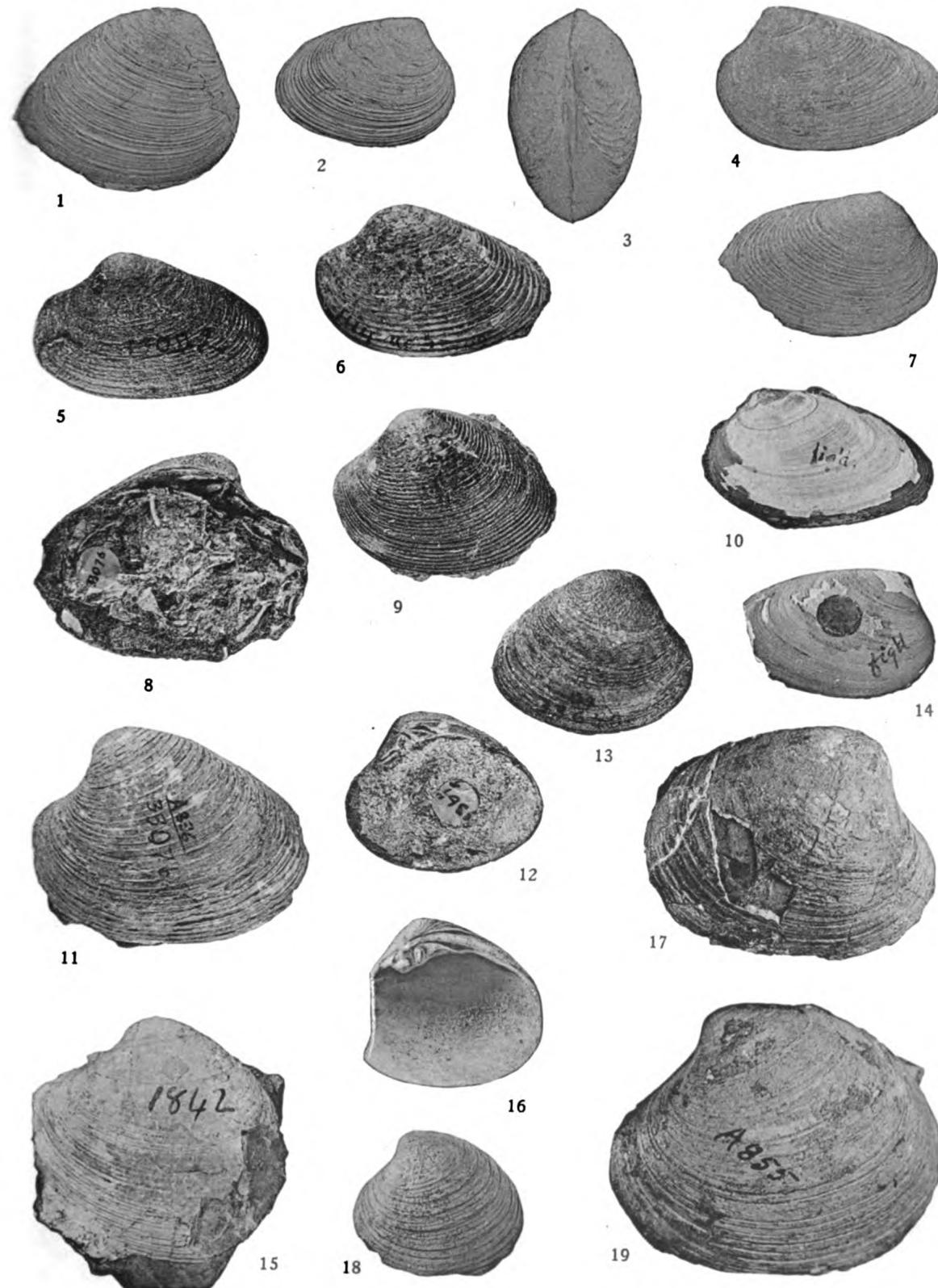
## PLATE 40

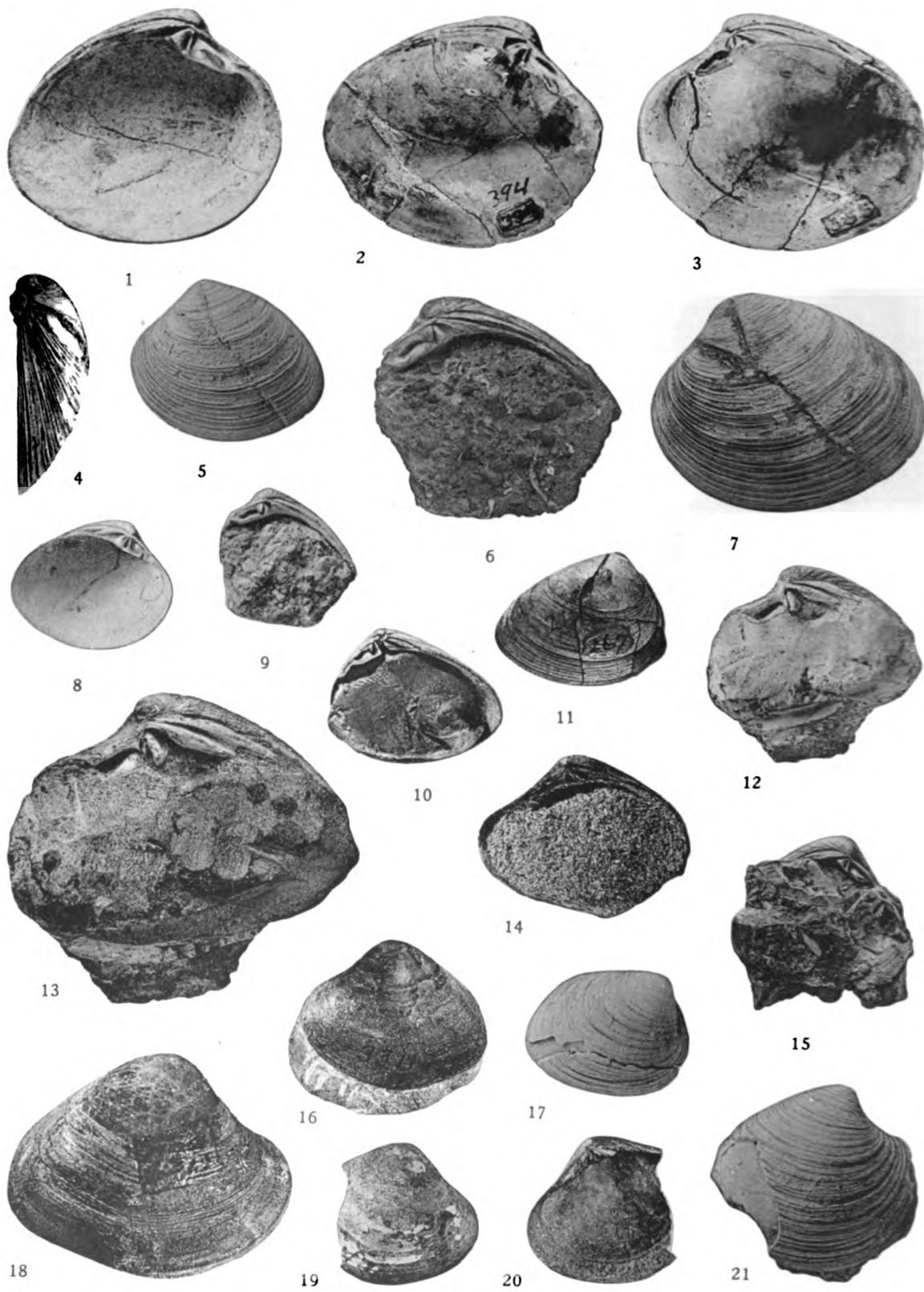
	PAGE
Fig. 1. <i>Chione vancouverensis</i> Clark and Arnold ( $\times 1$ ), paratype (C.A.S. 584). Figured originally, 50, pl. 20, fig. 1a.....	168
Fig. 2. <i>Chione biseulpta</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153941). Figured originally, 101, pl. 11, fig. 10.....	168
Fig. 3. <i>Chione biseulpta</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153941). Figured originally, 101, pl. 11, fig. 12.....	168
Fig. 4. <i>Macrocallista andersoni</i> Dickerson ( $\times 1$ ), paratype (C.A.S. 270).....	174
Fig. 5. <i>Macrocallista andersoni</i> Dickerson ( $\times 0.6$ ), hypotype (U.C. 33088). Coaledo formation, Sunset Bay. Figured by Turner, 274, pl. 10, fig. 17..	174
Fig. 6. <i>Macrocallista andersoni</i> Dickerson ( $\times 1.1$ ), holotype (C.A.S. 269). Figured originally, 121, pl. 4, fig. 1a.....	174
Fig. 7. <i>Macrocallista cathcartensis</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 32156). Locality (U.C. 681). .....	176
Fig. 8. <i>Macrocallista cathcartensis</i> (Weaver) ( $\times 1$ ), holotype (U.W. 53) (C.A.S. 550). Figured originally, 286, pl. 10, fig. 79.....	176
Fig. 9. <i>Macrocallista cathcartensis</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 32155). Locality (U.C. 681). .....	176
Fig. 10. <i>Pitar californiana</i> (Conrad) ( $\times 1$ ), hypotype (U.W. 334). Locality (U.W. 345). Cowlitz formation on Coal Creek.....	177
Fig. 11. <i>Macrocallista cathcartensis</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 32154). Figured by Tegland, 272, pl. 8, fig. 1.....	176
Fig. 12. <i>Macrocallista andersoni</i> Dickerson ( $\times 1$ ), hypotype (U.C. 32981).....	174
Fig. 13. <i>Pitar californiana</i> (Conrad) ( $\times 1$ ), hypotype (U.W. 333). Locality (U.W. 345). Cowlitz formation on Coal Creek.....	177
Fig. 14. <i>Macrocallista andersoni</i> Dickerson ( $\times 1$ ), paratype (C.A.S. 270). Figured originally, 121, pl. 4, fig. 1b.....	174
Fig. 15. <i>Venerupis (Protothaca) staleyi</i> (Gabb) var. <i>hannibali</i> (Howe) ( $\times 1$ ), holotype (U.S.N.M. 153943). Figured originally by Dall, 101, pl. 13, fig. 6, and later by Howe, 166, pl. 10, fig. 1.....	171

(693)

## PLATE 41

	PAGE
Fig. 1. <i>Macrocallista weaveri</i> Clark ( $\times 1$ ), hypotype (C.A.S. 682). Figured by Clark, 52, pl. 18, fig. 12.....	176
Fig. 2. <i>Macrocallista weaveri</i> Clark ( $\times 1$ ), hypotype (C.A.S. 681). Figured by Clark, 52, pl. 18, fig. 11.....	176
Fig. 3. <i>Macrocallista weaveri</i> Clark ( $\times 1$ ), hypotype (C.A.S. 682). Figured by Clark, 52, pl. 18, fig. 10.....	176
Fig. 4. <i>Macrocallista pittsburgensis</i> (Dall) ( $\times 1$ ), hypotype (U.C. 30358). Figured by Clark, 52, pl. 19, fig. 5. Alsea Bay, Oregon. Locality (U.C. 3720). 175	
Fig. 5. <i>Microcallista (Costacallista) conradiana</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 33082). Figured by Turner, 274, pl. 10, fig. 13.....	172
Fig. 6. <i>Microcallista (Costacallista) conradiana</i> (Gabb) ( $\times 1.4$ ), hypotype (U.C. 33109). Figured by Turner, 274, pl. 10, fig. 12.....	172
Fig. 7. <i>Macrocallista pittsburgensis</i> (Dall) ( $\times 1$ ), hypotype (U.C. 30358). Figured originally, 52, pl. 19, fig. 4. Alsea Bay, Oregon. Locality (U.C. 3720) 175	
Fig. 8. <i>Pitar (Calpitaria) uvasanus</i> (Conrad) subsp. <i>coquillensis</i> Turner ( $\times 1$ ), holotype (U.C. 33076). Figured by Turner, 274, pl. 11, fig. 15.....	179
Fig. 9. <i>Microcallista (Costacallista) conradiana</i> (Gabb) var. <i>meganosensis</i> (Clark and Woodford) ( $\times 1$ ), hypotype (U.C. 33065). Figured by Turner, 274, pl. 10, fig. 15.....	173
Fig. 10. <i>Macrocallista pittsburgensis</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 107396). Figured originally, 90, pl. 36, fig. 22.....	175
Fig. 11. <i>Pitar (Calpitaria) uvasanus</i> (Conrad) subsp. <i>coquillensis</i> Turner ( $\times 1$ ), holotype (U.C. 33076). Figured by Turner, 274, pl. 11, fig. 15.....	179
Fig. 12. <i>Pitar (Calpitaria) uvasanus</i> (Conrad) subsp. <i>duprei</i> Hendon ( $\times 1$ ), holotype (U.C. 33645). Figured by Turner, 274, pl. 11, fig. 11.....	179
Fig. 13. <i>Pitar (Calpitaria) uvasanus</i> (Conrad) subsp. <i>duprei</i> Hendon ( $\times 1$ ), holotype (U.C. 33645). Figured by Turner, 274, pl. 11, fig. 11.....	179
Fig. 14. <i>Macrocallista pittsburgensis</i> (Dall) ( $\times 1$ ), paratype (U.S.N.M. 107399). 175	
Fig. 15. <i>Pitar californiana</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 1842). From Canada de las Uvas, California. Figured by Conrad as <i>Meretrix californiana</i> , 71, pl. 2, fig. 4.....	177
Fig. 16. <i>Pitar californiana</i> (Conrad) ( $\times 0.8$ ), hypotype (U.C. 33055). Cowlitz formation.....	177
Fig. 17. <i>Pitar californiana</i> (Conrad) ( $\times 0.8$ ), hypotype (U.C. 33081). Figured by Turner, 274, pl. 12, fig. 5.....	177
Fig. 18. <i>Pitar californiana</i> (Conrad) ( $\times 0.5$ ), hypotype (U.C. 33035). Cowlitz formation.....	177
Fig. 19. <i>Pitar californiana</i> (Conrad) ( $\times 1.2$ ), hypotype (U.C. 33080). Figured by Turner, 274, pl. 12, fig. 4.....	177





## PLATE 42

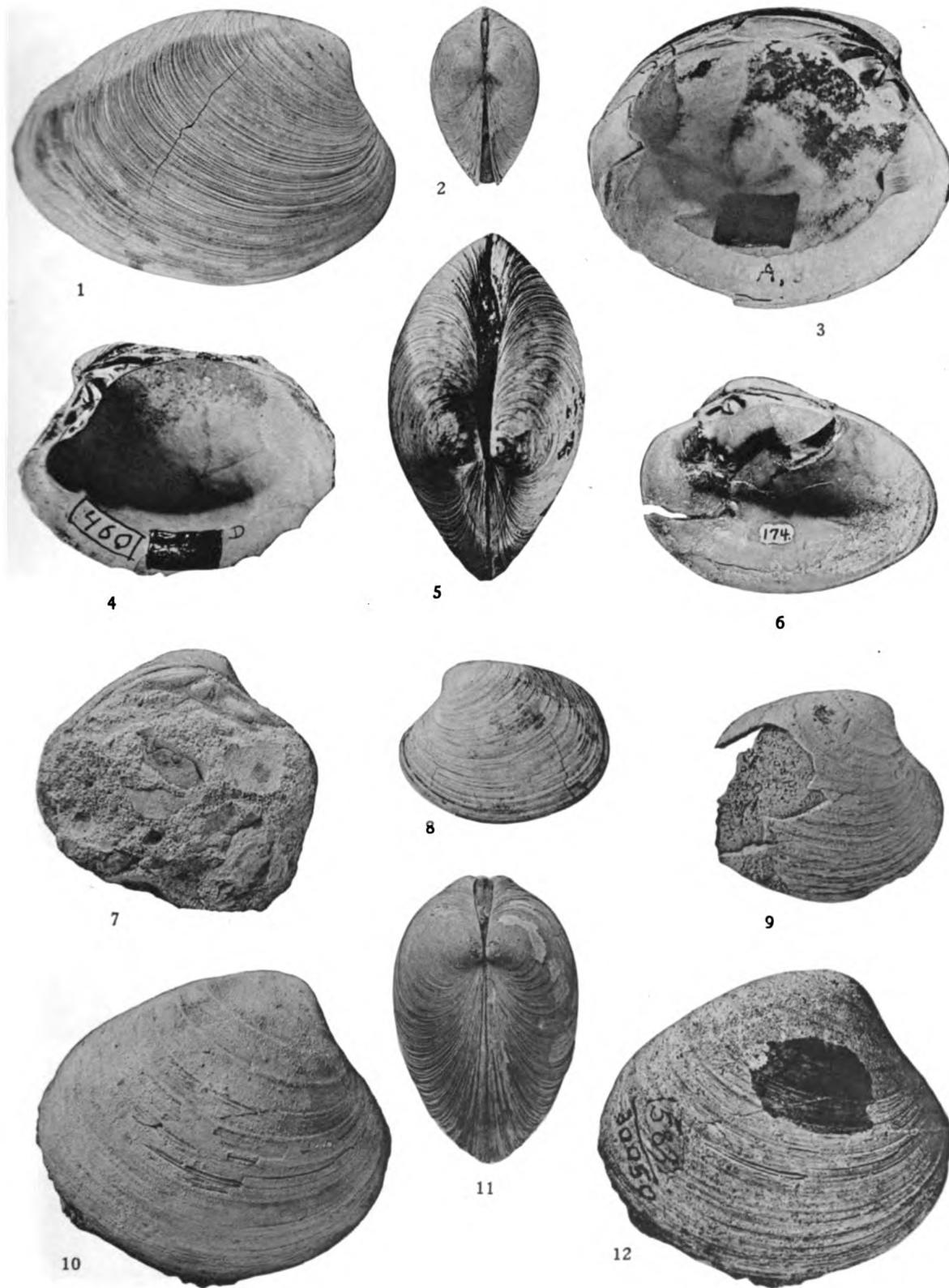
	PAGE
Fig. 1. <i>Pitar (Lamelliconcha) clarki</i> (Dickerson) ( $\times 1$ ), topotype (U.C. 31544). Figured by Tegland, 270, pl. 22, fig. 1.....	183
Fig. 2. <i>Pitar (Lamelliconcha) clarki</i> (Dickerson) ( $\times 1$ ), syntype (C.A.S. 394). Figured originally, 123, pl. 28, fig. 4c.....	183
Fig. 3. <i>Pitar (Lamelliconcha) clarki</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 393). Figured by Dickerson, 123, pl. 28, fig. 4b.....	183
Fig. 4. <i>Pitar (Lamelliconcha) clarki</i> (Dickerson) ( $\times 1$ ), topotype (U.C. 31543). Figured by Tegland, 270, pl. 22, fig. 2.....	183
Fig. 5. <i>Pitar (Lamelliconcha) clarki</i> (Dickerson) ( $\times 0.7$ ), topotype (U.C. 31543). Figured by Tegland, 270, pl. 22, fig. 3.....	183
Fig. 6. <i>Pitar (Lamelliconcha) clarki</i> (Dickerson) ( $\times 1$ ), topotype (U.C. 31545). Figured by Tegland, 270, pl. 22, fig. 4.....	183
Fig. 7. <i>Pitar (Lamelliconcha) clarki</i> (Dickerson) ( $\times 1$ ), topotype (U.C. 31543). Figured by Tegland, 270, pl. 22, fig. 3.....	183
Fig. 8. <i>Pitar (Lamelliconcha) clarki</i> (Dickerson) ( $\times 0.5$ ), topotype (U.C. 31543). Locality (U.C. 3607).....	183
Fig. 9. <i>Pitar (Lamelliconcha) clarki</i> (Dickerson) ( $\times 0.5$ ), topotype (U.C. 31545). Figured by Tegland, 270, pl. 22, fig. 4.....	183
Fig. 10. <i>Tivelina vaderensis</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 267). Figured originally, 121, pl. 3, fig. 5a.....	187
Fig. 11. <i>Tivelina vaderensis</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 267). Figured originally, 121, pl. 3, fig. 5a.....	187
Fig. 12. <i>Pitar oregonensis</i> (Conrad) ( $\times 0.7$ ), hypotype (U.C. 31949). Figured by Etherington, 140, pl. 6, fig. 1.....	181
Fig. 13. <i>Pitar oregonensis</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 31949). Figured by Etherington, 140, pl. 6, fig. 1.....	181
Fig. 14. <i>Eomeretrix martini</i> (Dickerson) ( $\times 1$ ), paratype (C.A.S. 238-A). Figured originally, 120, pl. 11, fig. 2c.....	186
Fig. 15. <i>Pitar oregonensis</i> (Conrad) ( $\times 0.9$ ), hypotype (U.C. 31950). Figured by Etherington, 140, pl. 6, fig. 3.....	181
Fig. 16. <i>Eomeretrix martini</i> (Dickerson) ( $\times 1$ ), topotype (U.C. 33112). Figured originally, 120, pl. 11, fig. 18.....	186
Fig. 17. <i>Venerella (Compsomyax) newcombei</i> (Merriam) ( $\times 0.5$ ), holotype (U.C. 11932). Figured originally, 197, pl. 23, fig. 1.....	193
Fig. 18. <i>Eomeretrix martini</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 237). Figured originally, 120, pl. 11, fig. 2a.....	186
Fig. 19. <i>Eomeretrix martini</i> (Dickerson) ( $\times 0.6$ ), topotype (U.C. 33668). Figured by Turner, 120, pl. 11, fig. 20.....	186
Fig. 20. <i>Eomeretrix martini</i> (Dickerson) ( $\times 0.6$ ), topotype (U.C. 33668). Figured by Turner, 120, pl. 11, fig. 20.....	186
Fig. 21. <i>Pitar oregonensis</i> (Conrad) ( $\times 0.7$ ), hypotype (U.C. 31949). Figured by Etherington, 140, pl. 6, fig. 2.....	181

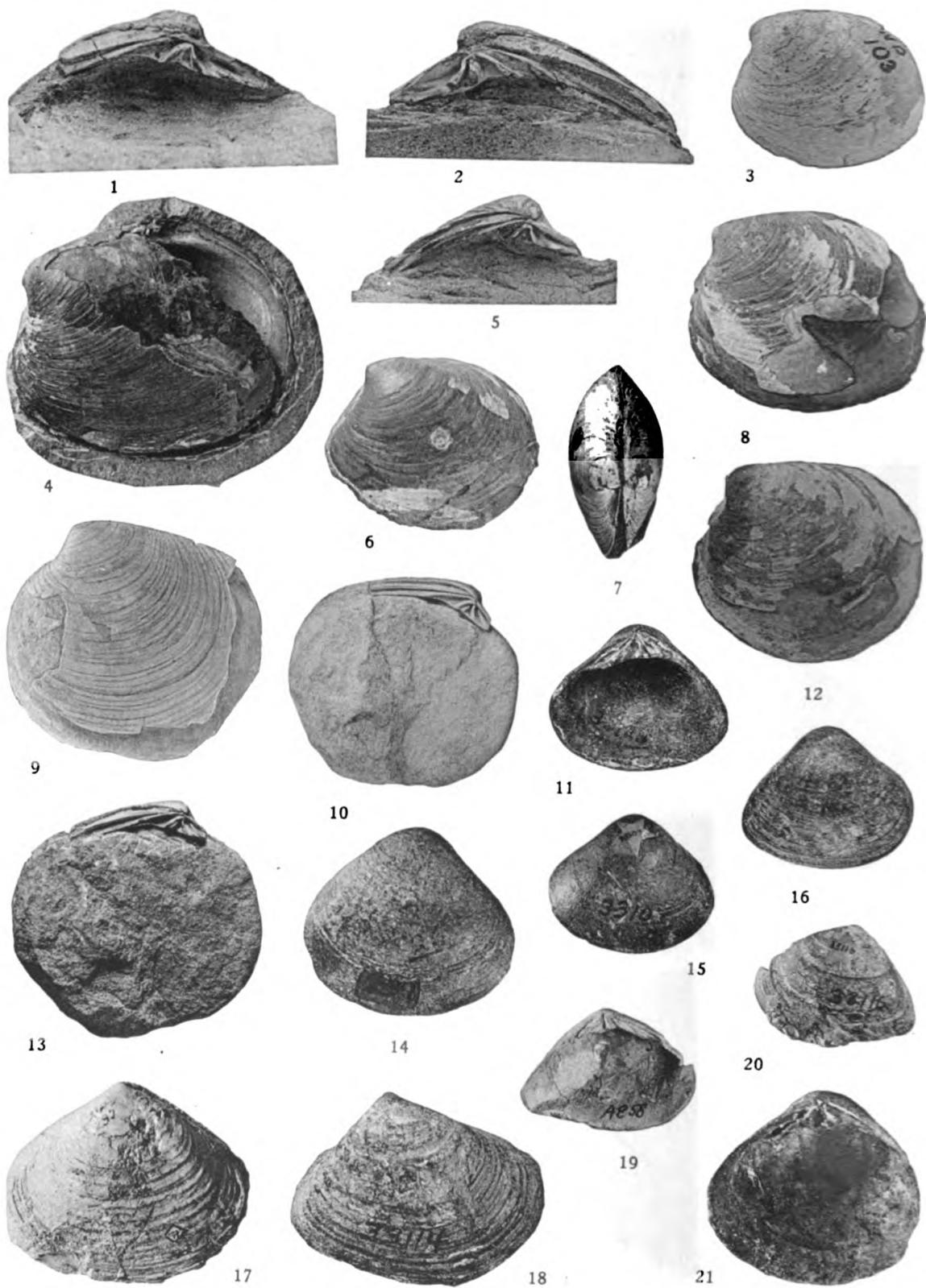
(695)

PLATE 43

	PAGE
Fig. 1. <i>Pitar dalli</i> (Weaver) ( $\times 1$ ), syntype (U.W. 97) (C.A.S. 460-C). Figured originally, 295, pl. 1, fig. 4.....	181
Fig. 2. <i>Pitar dalli</i> (Weaver) ( $\times 1$ ), topotype (U.C. 31531). Figured by Tegland, 270, pl. 21, fig. 4.....	181
Fig. 3. <i>Pitar dalli</i> (Weaver) ( $\times 1$ ), syntype (U.W. 97-A) (C.A.S. 460-A). Figured originally, 295, pl. 1, fig. 1.....	181
Fig. 4. <i>Pitar dalli</i> (Weaver) ( $\times 1$ ), syntype (U.W. 97-B) (C.A.S. 460-D). Locality (U.W. 256). .....	181
Fig. 5. <i>Pitar dalli</i> (Weaver) ( $\times 1$ ), syntype (U.W. 97) (C.A.S. 460-C). Figured originally, 295, pl. 1, fig. 4.....	181
Fig. 6. <i>Macrocallista williamsoni</i> Weaver and Palmer ( $\times 0.9$ ), holotype (U.W. 174) (C.A.S. 7484). Figured originally, 301, pl. 10, fig. 11.....	174
Fig. 7. <i>Pitar vancouverensis</i> (Merriam) ( $\times 1$ ), hypotype (S.U. 259). Figured by Clark and Arnold, 50, pl. 10, fig. 2.....	182
Fig. 8. <i>Pitar dalli</i> (Weaver) ( $\times 1$ ), topotype (U.C. 31531). Figured by Tegland, 270, pl. 21, fig. 5.....	181
Fig. 9. <i>Venerella (Compsomyax) newcombei</i> (Merriam) ( $\times 0.5$ ), paratype (U.C. 11930). .....	193
Fig. 10. <i>Pitar vancouverensis</i> (Merriam) ( $\times 1$ ), hypotype (C.A.S. 583). Figured by Clark and Arnold, 50, pl. 19, fig. 3.....	182
Fig. 11. <i>Pitar dalli</i> (Weaver) ( $\times 1$ ), topotype (U.C. 31528). Figured by Tegland, 270, pl. 21, fig. 9.....	181
Fig. 12. <i>Pitar vancouverensis</i> (Merriam) ( $\times 1$ ), hypotype (C.A.S. 583). Figured by Clark and Arnold, 50, pl. 19, fig. 3.....	182

(696)





## PLATE 44

	PAGE
Fig. 1. <i>Pitar (Katherinella) arnoldi</i> (Weaver) ( $\times 2$ ), hypotype (U.C. 31533). Figured by Tegland, 270, pl. 23, fig. 1.....	185
Fig. 2. <i>Pitar (Katherinella) arnoldi</i> (Weaver) ( $\times 2$ ), hypotype (U.C. 31536). Figured by Tegland, 270, pl. 23, fig. 3.....	185
Fig. 3. <i>Pitar (Katherinella) arnoldi</i> (Weaver) ( $\times 1$ ), hypotype (S.U. 581). Figured by Tegland, 270, pl. 23, fig. 6.....	185
Fig. 4. <i>Pitar (Katherinella) arnoldi</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 31532). Figured by Tegland, 270, pl. 23, fig. 10.....	185
Fig. 5. <i>Pitar (Katherinella) arnoldi</i> (Weaver) ( $\times 1$ ), hypotype (S.U. 580). Figured by Tegland, 270, pl. 23, fig. 2.....	185
Fig. 6. <i>Pitar (Katherinella) arnoldi</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 31534). Figured by Tegland, 270, pl. 23, fig. 7.....	185
Fig. 7. <i>Pitar (Katherinella) arnoldi</i> (Weaver) ( $\times 1.4$ ), holotype (U.W. 96) (C.A.S. 459). Figured originally, 295, pl. 2, fig. 13.....	185
Fig. 8. <i>Pitar (Katherinella) arnoldi</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 31532). Figured by Tegland, 270, pl. 23, fig. 11.....	185
Fig. 9. <i>Pitar (Katherinella) arnoldi</i> (Weaver) subsp. <i>etheringtoni</i> Tegland ( $\times 1$ ), holotype (U.C. 31541). Figured originally, 270, pl. 23, fig. 12... .	186
Fig. 10. <i>Pitar (Katherinella) arnoldi</i> (Weaver) subsp. <i>etheringtoni</i> Tegland ( $\times 1$ ), holotype (U.C. 31541). Figured originally, 270, pl. 23, fig. 12... .	186
Fig. 11. <i>Pachydesma weaveri</i> (Dickerson) ( $\times 0.7$ ), topotype (U.C. 33108). Fig- ured by Turner, 274, pl. 12, fig. 9.....	188
Fig. 12. <i>Pitar (Katherinella) arnoldi</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 31535). Figured by Tegland, 270, pl. 23, fig. 8.....	185
Fig. 13. <i>Pitar (Katherinella) arnoldi</i> (Weaver) subsp. <i>etheringtoni</i> Tegland ( $\times 1$ ), paratype (U.C. 31539).....	186
Fig. 14. <i>Pachydesma weaveri</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 239). Fig- ured originally, 120, pl. 11, fig. 3a.....	188
Fig. 15. <i>Pachydesma weaveri</i> (Dickerson) ( $\times 0.6$ ), topotype (U.C. 33107). Fig- ured by Turner, 274, pl. 12, fig. 6.....	188
Fig. 16. <i>Pachydesma weaveri</i> (Dickerson) ( $\times 0.7$ ), topotype (U.C. 33108). Fig- ured by Turner, 274, pl. 12, fig. 9.....	188
Fig. 17. <i>Pachydesma gastonensis</i> (Clark) ( $\times 0.7$ ), holotype (S.U. 5223). Fig- ured originally, 52, pl. 19, fig. 1.....	189
Fig. 18. <i>Pachydesma aragoensis</i> Turner ( $\times 0.7$ ), holotype (U.C. 33114). Fig- ured originally, 274, pl. 12, fig. 3.....	189
Fig. 19. <i>Pachydesma aragoensis</i> Turner ( $\times 0.8$ ), paratype (U.C. 33116). Fig- ured originally, 274, pl. 12, fig. 1.....	189
Fig. 20. <i>Pachydesma aragoensis</i> Turner ( $\times 0.8$ ), paratype (U.C. 33116). Fig- ured originally, 274, pl. 12, fig. 1.....	189
Fig. 21. <i>Pachydesma weaveri</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 239). Fig- ured originally, 120, pl. 11, fig. 3b.....	188

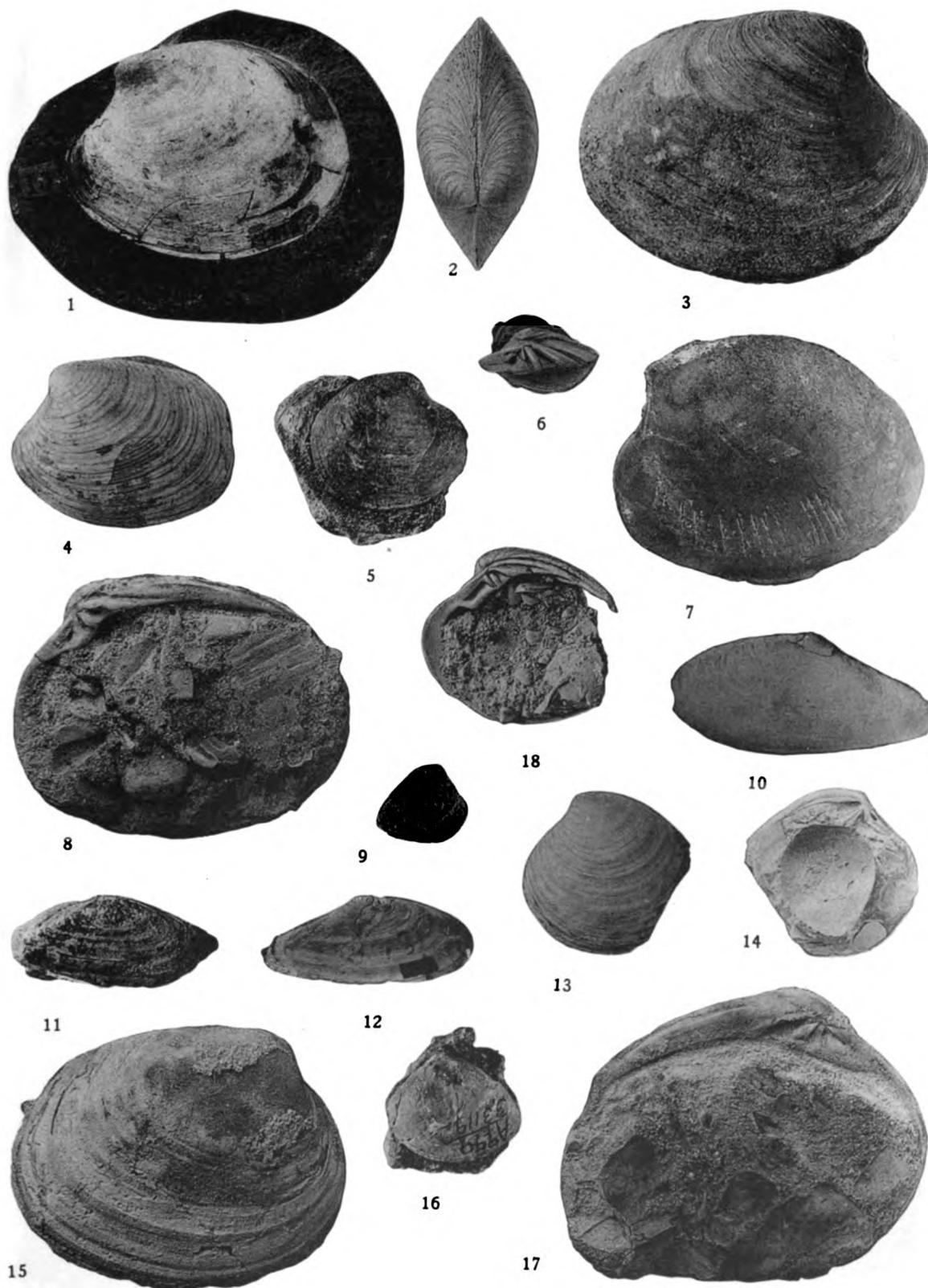
(697)

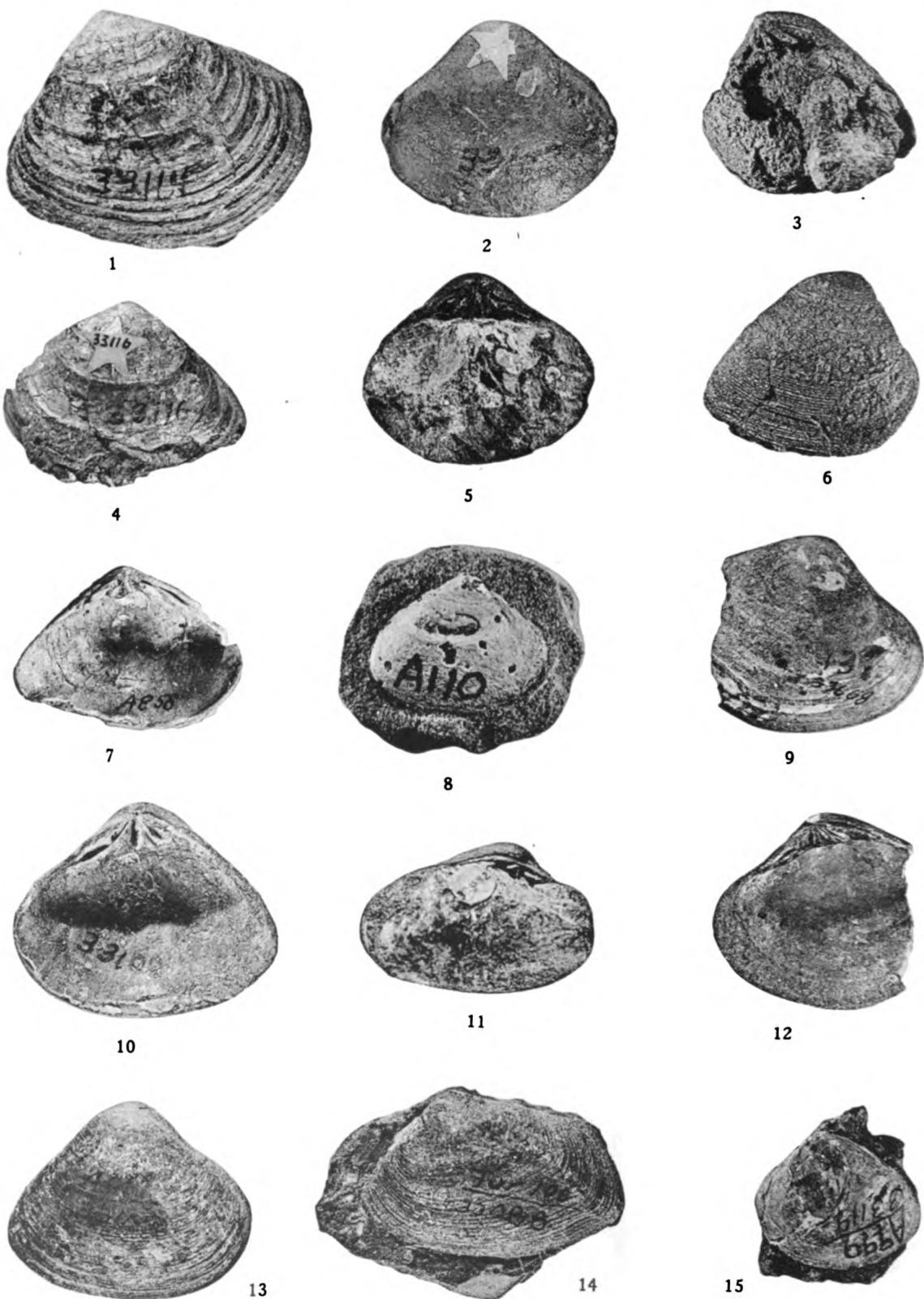
## PLATE 45

PAGE

Fig. 1. <i>Marcia angustifrons</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 3492). Figured by Conrad as <i>Venus angustifrons</i> , 68, pl. 17, fig. 11. Astoria, Oregon. ....	191
Fig. 2. <i>Marcia angustifrons</i> (Conrad) ( $\times 0.8$ ), hypotype (U.C. 31951). Locality (U.C. 9069). Figured by Etherington, 140, pl. 7, fig. 3. ....	191
Fig. 3. <i>Marcia angustifrons</i> (Conrad) ( $\times 1$ ), hypotype (U.S.N.M. 153945). Empire formation, Coos Bay. ....	191
Fig. 4. <i>Marcia angustifrons</i> (Conrad) ( $\times 0.8$ ), hypotype (U.C. 31951). Locality (U.C. 9069). Figured by Etherington, 140, pl. 6, fig. 4. ....	191
Fig. 5. <i>Marcia (Mercimonia) bunkeri</i> (Hanna) ( $\times 0.8$ ), hypotype (U.C. 33666). Figured by Turner, 274, pl. 10, fig. 5. ....	192
Fig. 6. <i>Venerella (Compsomyax) newcombei</i> (Merriam) ( $\times 0.5$ ), paratype (U.C. 11931). ....	193
Fig. 7. <i>Marcia angustifrons</i> (Conrad) var. <i>brevilineata</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 3608). Holotype of " <i>Venus brevilineata</i> " as figured by Conrad, 68, pl. 17, fig. 13. ....	191
Fig. 8. <i>Venerella (Compsomyax) newcombei</i> (Merriam) ( $\times 1$ ), paratype (U.C. 30224). Figured by Clark and Arnold, 50, pl. 21, fig. 1b. ....	193
Fig. 9. <i>Pelecyora aequilateralis</i> (Gabb) ( $\times 0.8$ ), hypotype (U.C. 33265). Figured by Turner, 274, pl. 10, fig. 3. Locality (U.C. A-666) ....	194
Fig. 10. <i>Tellina townsendensis</i> Clark ( $\times 1$ ), hypotype (U.C. 32722). Figured by Effinger, 138, pl. 46, fig. 14. ....	196
Fig. 11. <i>Tellina townsendensis</i> Clark ( $\times 1$ ), holotype (S.U. 5208). Figured originally, 52, pl. 12, fig. 12. ....	196
Fig. 12. <i>Tellina townsendensis</i> Clark ( $\times 1$ ), hypotype (C.A.S. 408). Figured by Dickerson as <i>Tellina oregonensis</i> Conrad, 123, pl. 29, fig. 4. ....	196
Fig. 13. <i>Pelecyora victoriana</i> (Clark and Arnold) ( $\times 0.5$ ), holotype (U.C. 30410). Figured originally, 50, pl. 41, fig. 2b. ....	195
Fig. 14. <i>Pelecyora victoriana</i> (Clark and Arnold) ( $\times 0.5$ ), holotype (U.C. 30410). Figured originally, 50, pl. 41, fig. 2a. ....	195
Fig. 15. <i>Venerella (Compsomyax) newcombei</i> (Merriam) ( $\times 1$ ), paratype (U.C. 30224). Figured by Clark and Arnold, 50, pl. 21, fig. 1a. ....	193
Fig. 16. <i>Pelecyora cf. gabbi</i> (Arnold) ( $\times 0.9$ ), hypotype (U.C. 33119). Figured by Turner, 274, pl. 12, fig. 10. Locality (U.C. A-999) ....	194
Fig. 17. <i>Venerella (Compsomyax) newcombei</i> (Merriam) ( $\times 1$ ), paratype (U.C. 30225). Figured by Clark and Arnold, 50, pl. 21, fig. 2. ....	193
Fig. 18. <i>Venerella (Compsomyax) newcombei</i> (Merriam) ( $\times 0.5$ ), paratype (U.C. 11930). Inside view of specimen figured on pl. 43, fig. 9. ....	193

(698)





## PLATE 46

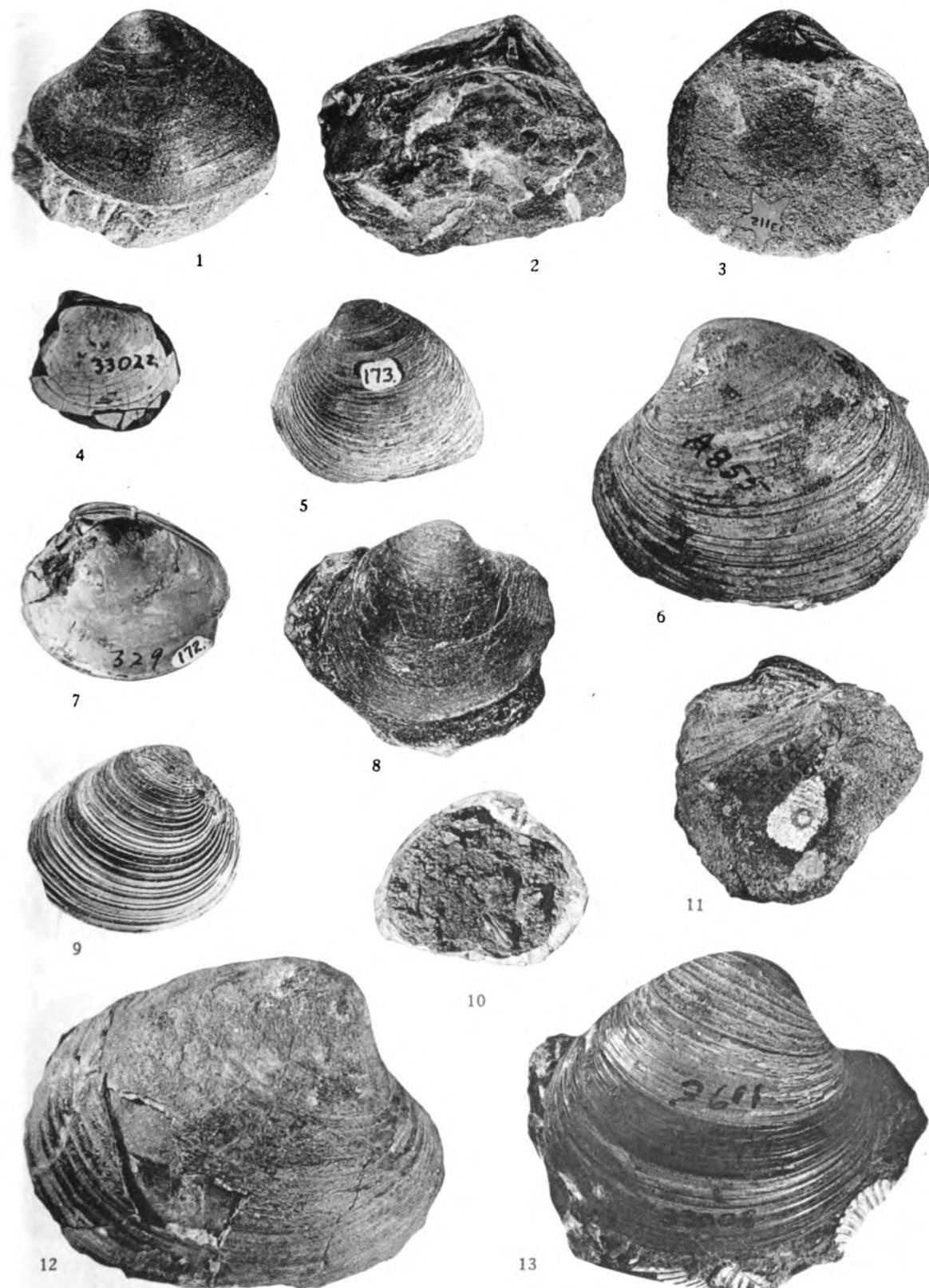
	PAGE
Fig. 1. <i>Pachydesma aragoensis</i> Turner ( $\times 1$ ), holotype (U.C. 33114). Figured by Turner, 274, pl. 12, fig. 3.....	189
Fig. 2. <i>Pachydesma weaveri</i> (Dickerson) ( $\times 1$ ), hypotype (U.C. 33107). Figured originally by Turner, 274, pl. 12, fig. 6.....	188
Fig. 3. <i>Pelecyora aequilateralis</i> (Gabb) ( $\times 2$ ), hypotype (U.C. 33265). Figured by Turner, 274, pl. 10, fig. 3.....	194
Fig. 4. <i>Pachydesma aragoensis</i> Turner ( $\times 1$ ), paratype (U.C. 33116). Figured by Turner, 274, pl. 12, fig. 1.....	189
Fig. 5. <i>Pachydesma weaveri</i> (Dickerson) ( $\times 1$ ), hypotype (U.C. 33107). Figured by Turner, 274, pl. 12, fig. 6.....	188
Fig. 6. <i>Pelecyora aequilateralis</i> (Gabb) ( $\times 2$ ), hypotype (U.C. 33265). Figured by Turner, 274, pl. 10, fig. 3.....	194
Fig. 7. <i>Pachydesma aragoensis</i> Turner ( $\times 1$ ), paratype (U.C. 33116). Figured by Turner, 274, pl. 12, fig. 1.....	189
Fig. 8. <i>Pachydesma crowderi</i> n. sp. ( $\times 1$ ), holotype (U.C. 32966). Locality (U.C. A-110). .....	190
Fig. 9. <i>Eomeretrix martini</i> (Dickerson) ( $\times 1.2$ ), topotype (U.C. 33668). Figured by Turner, 274, pl. 11, fig. 20.....	186
Fig. 10. <i>Pachydesma weaveri</i> (Dickerson) ( $\times 1$ ), hypotype (U.C. 33108). Figured by Turner, 274, pl. 12, fig. 9.....	188
Fig. 11. <i>Microcallista (Costacallista) conradiana</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 33082). Figured by Turner, 274, pl. 10, fig. 13. Locality (U.C. A-662)..	172
Fig. 12. <i>Eomeretrix martini</i> (Dickerson) ( $\times 1.2$ ), topotype (U.C. 33668). Figured by Turner, 274, pl. 11, fig. 20.....	186
Fig. 13. <i>Eomeretrix martini</i> (Dickerson) ( $\times 1$ ), topotype (U.C. 33108).....	186
Fig. 14. <i>Macrocallista andersoni</i> Dickerson ( $\times 1.2$ ), hypotype (U.C. 33088). Figured by Turner, 274, pl. 10, fig. 17.....	174
Fig. 15. <i>Pelecyora cf. gabbi</i> (Arnold) ( $\times 1$ ), hypotype (U.C. 33119). Figured by Turner, 274, pl. 12, fig. 10.....	194

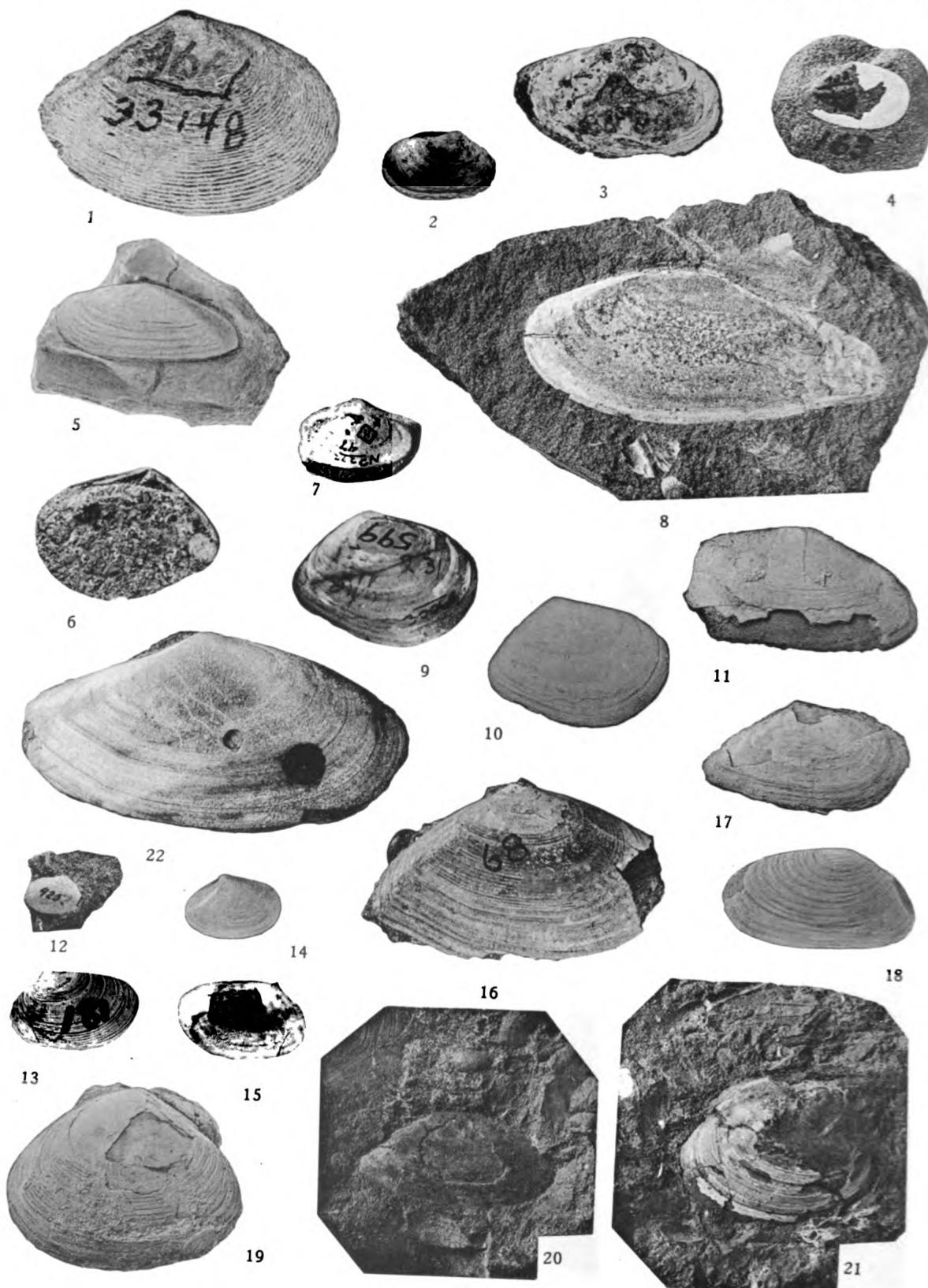
(699)

## PLATE 47

	PAGE
Fig. 1. <i>Eomeretrix martini</i> (Dickerson) ( $\times 1$ ), topotype (U.C. 33112). Figured by Turner, 274, pl. 11, fig. 18.....	186
Fig. 2. <i>Pachydesma aragoensis</i> Turner ( $\times 1$ ), holotype (U.C. 33114). Figured by Turner, 274, pl. 12, fig. 3.....	189
Fig. 3. <i>Eomeretrix martini</i> (Dickerson) ( $\times 1$ ), topotype (U.C. 33112). Figured by Turner, 274, pl. 11, fig. 18.....	186
Fig. 4. <i>Pitar quadratus</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 33022). Locality (U.C. 7162). Cowlitz formation.....	180
Fig. 5. <i>Pitar stocki</i> (Weaver and Palmer) ( $\times 1.4$ ), holotype (U.W. 173). Figured originally, 301, pl. 10, fig. 6.....	183
Fig. 6. <i>Pitar californiana</i> (Conrad) ( $\times 1.2$ ), hypotype (U.C. 33080). Figured by Turner, 274, pl. 12, fig. 4.....	177
Fig. 7. <i>Pitar (Lamelliconcha) eocenica</i> (Weaver and Palmer) ( $\times 1.3$ ), holotype (U.W. 172) (C.A.S. 7485). Figured originally, 301, pl. 10, fig. 14.....	184
Fig. 8. <i>Marcia (Mercimonia) bunkeri</i> (Hanna) ( $\times 1.3$ ), hypotype (U.C. 33666). Figured by Turner, 274, pl. 10, fig. 5.....	192
Fig. 9. <i>Pitar (Lamelliconcha) eocenica</i> (Weaver and Palmer) ( $\times 1.3$ ), holotype (U.W. 172) (C.A.S. 7485). Figured originally, 301, pl. 10, fig. 16.....	184
Fig. 10. <i>Pitar stocki</i> (Weaver and Palmer) ( $\times 1.4$ ), holotype (U.W. 173). Figured originally, 301, pl. 10, fig. 6.....	183
Fig. 11. <i>Marcia (Mercimonia) bunkeri</i> (Hanna) ( $\times 1.3$ ), hypotype (U.C. 33666). Figured by Turner, 274, pl. 10, fig. 5.....	192
Fig. 12. <i>Pitar californiana</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 33081). Figured by Turner, 274, pl. 12, fig. 5.....	177
Fig. 13. <i>Pitar (Calpitaria) uvasanus</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 33008)....	178

(700)





## PLATE 48

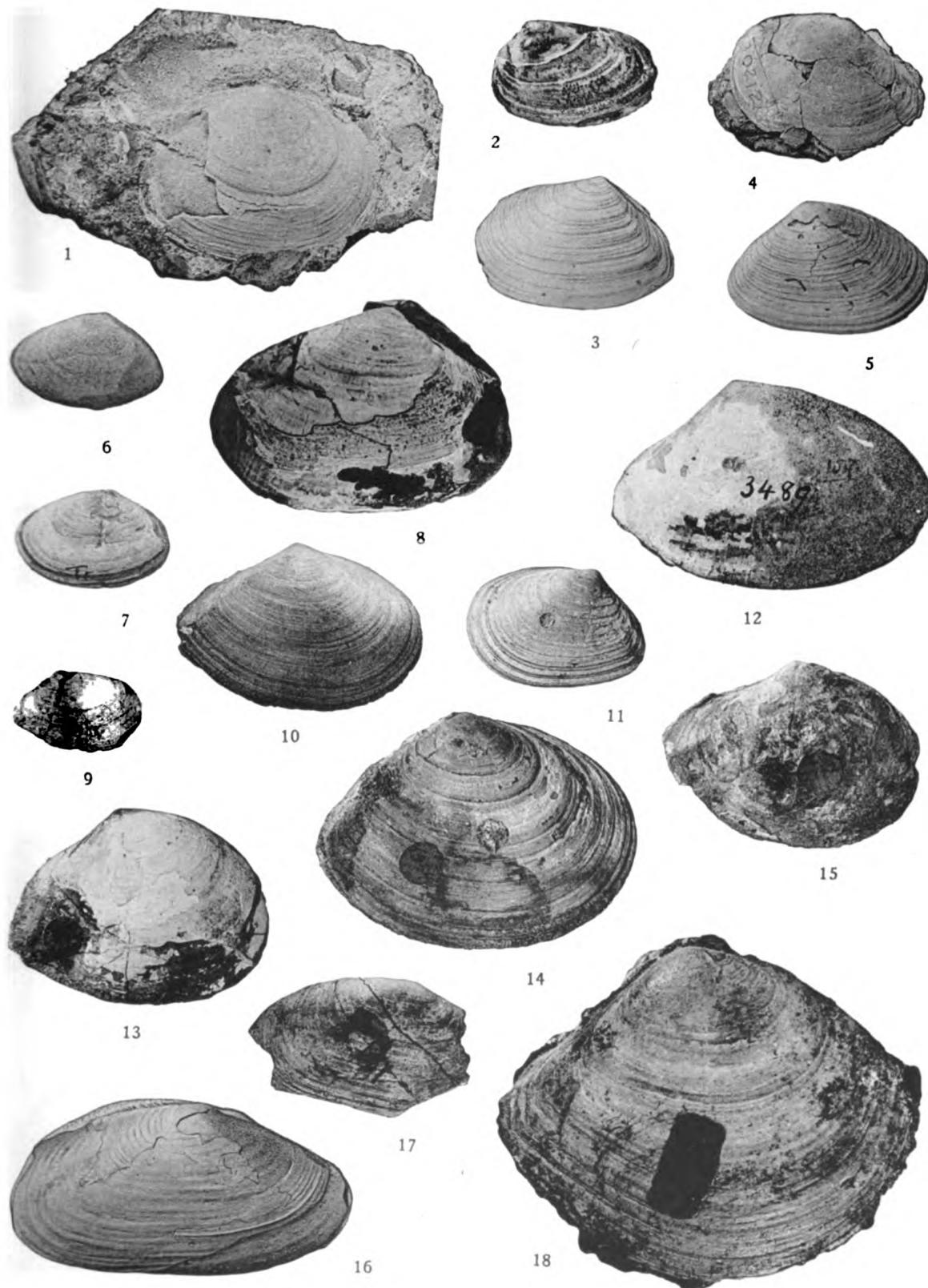
	PAGE
Fig. 1. <i>Tellina soledadensis</i> Hanna ( $\times 2.2$ ), hypotype (U.C. 33148). Figured by Turner, 274, pl. 7, fig. 5.....	196
Fig. 2. <i>Tellina lincolnensis</i> Weaver ( $\times 1.4$ ), syntype (U.W. 98) (C.A.S. 553). Figured originally, 295, pl. 3, fig. 30.....	199
Fig. 3. <i>Tellina jollaensis</i> Dickerson ( $\times 1$ ), hypotype (U.C. 30972). Figured by Hanna, 159, pl. 40, fig. 5.....	197
Fig. 4. <i>Tellina pittsburgensis</i> Clark ( $\times 1$ ), paratype (C.A.S. 705). Figured originally, 52, pl. 12, fig. 9.....	200
Fig. 5. <i>Tellina eugenia</i> Dall ( $\times 1$ ), hypotype (U.C. 33308). Locality (U.C. A-980). .....	201
Fig. 6. <i>Tellina vancouverensis</i> Clark and Arnold ( $\times 1$ ), holotype (C.A.S. 599.) Figured originally, 50, pl. 22, fig. 5.....	202
Fig. 7. <i>Tellina kamakawaensis</i> Clark ( $\times 1$ ), holotype (S.U. 5218). Locality (S.U. N.P. 272). Figured originally, 52, pl. 12, fig. 13.....	201
Fig. 8. <i>Tellina eugenia</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 110459). Figured originally, 101, pl. 19, fig. 3.....	201
Fig. 9. <i>Tellina vancouverensis</i> Clark and Arnold ( $\times 1$ ), holotype (C.A.S. 599.). Figured originally, 50, pl. 22, fig. 6.....	202
Fig. 10. <i>Tellina vancouverensis</i> Clark and Arnold ( $\times 1$ ), holotype (C.A.S. 599.). Figured originally, 50, pl. 22, fig. 6.....	202
Fig. 11. <i>Tellina bodegensis</i> Hinds n. subsp.? Clark and Arnold ( $\times 1$ ), holotype (C.A.S. 597). Figured originally, 50, pl. 22, fig. 7.....	202
Fig. 12. <i>Tellina obruta</i> Conrad ( $\times 1$ ), hypotype (U.C. 31967). Figured by Etherington, 140, pl. 9, fig. 6.....	205
Fig. 13. <i>Tellina obruta</i> Conrad ( $\times 1.8$ ), hypotype (C.A.S. 404). From Gries Ranch beds. Figured by Dickerson, 123, pl. 29, fig. 3a.....	205
Fig. 14. <i>Tellina obruta</i> Conrad ( $\times 1$ ), hypotype (U.C. 31968). Locality (U.C. A-79). .....	205
Fig. 15. <i>Tellina obruta</i> Conrad ( $\times 1.8$ ), hypotype (C.A.S. 404). Figured by Dickerson, 123, pl. 29, fig. 3b.....	205
Fig. 16. <i>Tellina kincaidi</i> Weaver ( $\times 1$ ), holotype (U.W. 56) (C.A.S. 537). Figured originally, 286, pl. 10, fig. 82.....	204
Fig. 17. <i>Tellina bodegensis</i> Hinds n. subsp.? Clark and Arnold ( $\times 1$ ), paratype (C.A.S. 598). Figured originally, 50, pl. 22, fig. 8.....	202
Fig. 18. <i>Tellina emacerata</i> Conrad ( $\times 1.1$ ), hypotype (U.C. 33316). Locality (U.W. 253). .....	206
Fig. 19. <i>Macoma lorenzoensis</i> (Arnold) subsp. <i>arnoldi</i> Tegland ( $\times 1$ ), holotype (U.C. 32160). Figured originally, 272, pl. 9, fig. 2.....	207
Fig. 20. <i>Tellina emacerata</i> Conrad ( $\times 1$ ), holotype (U.S.N.M. 3494). Conrad type. Figured by Conrad, 68, pl. 18, fig. 4.....	206
Fig. 21. <i>Tellina nuculana</i> Dall ( $\times 3$ ), holotype (U.S.N.M. 3529-A). Figured originally, 101, pl. 18, fig. 2.....	205
Fig. 22. <i>Tellina aragonia</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153940). Figured originally, 101, pl. 14, fig. 3.....	204

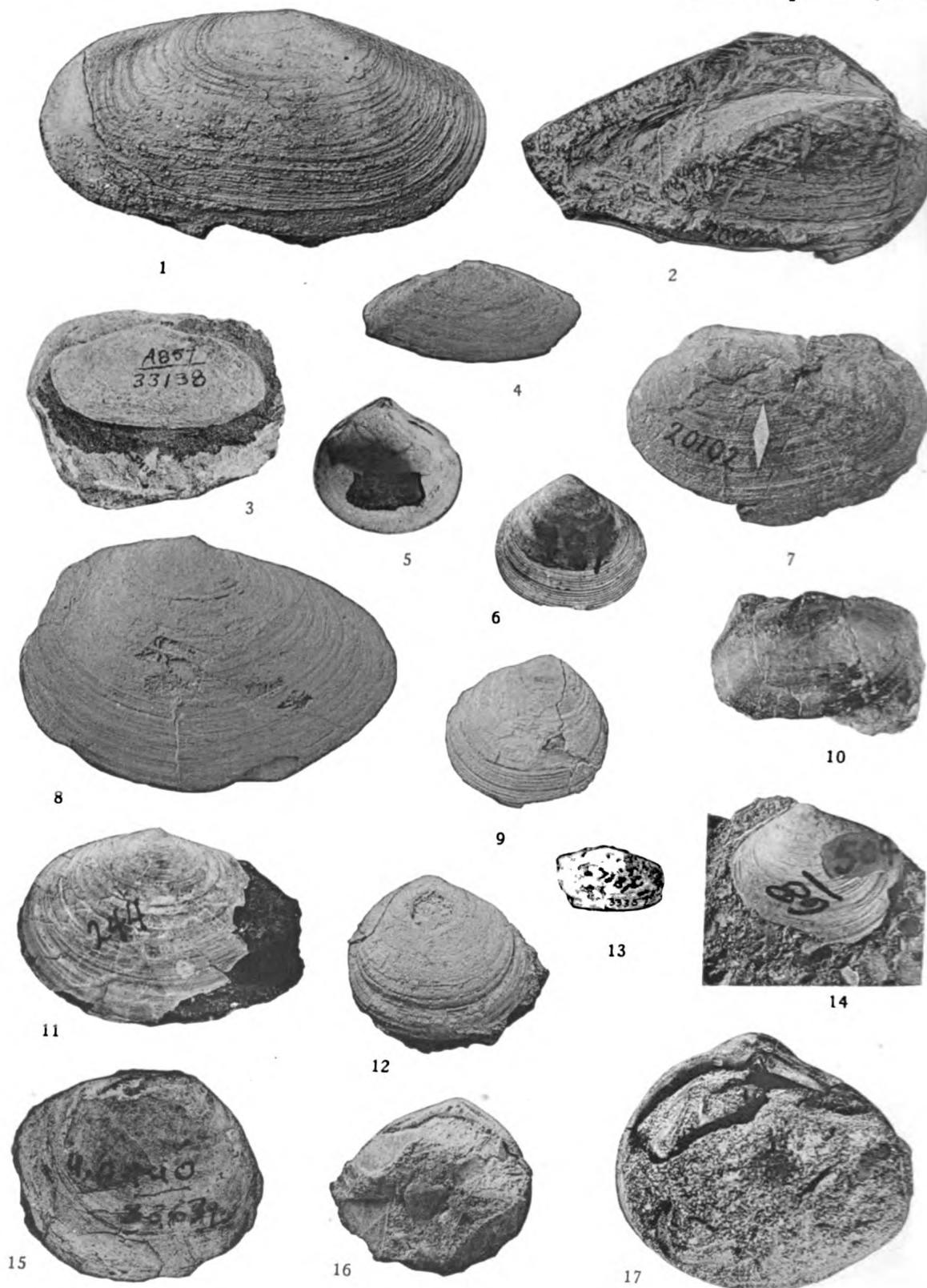
(701)

## PLATE 49

	PAGE
Fig. 1. <i>Cryptomya quadrata</i> Arnold subsp. <i>vancouverensis</i> Clark and Arnold ( $\times 2$ ), holotype (C.A.S. 585). Figured originally, 50, pl. 26, fig. 3.....	251
Fig. 2. <i>Macoma snohomishensis</i> Weaver ( $\times 1$ ), holotype (U.W. 58) (C.A.S. 549). Figured originally, 286, pl. 13, fig. 109.....	208
Fig. 3. <i>Macoma arctata</i> (Conrad) ( $\times 1.8$ ), hypotype (U.C. 31971). Figured by Etherington, 140, pl. 10, fig. 1. Locality (U.C. 9069).....	208
Fig. 4. <i>Macoma sookensis</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30212). Figured originally, 50, pl. 25, fig. 3.....	207
Fig. 5. <i>Macoma arctata</i> (Conrad) ( $\times 1.8$ ), hypotype (U.C. 31972). Figured by Etherington, 140, pl. 10, fig. 2. Astoria formation. Locality (U.C. 9069). 208	208
Fig. 6. <i>Macoma twinensis</i> Clark ( $\times 1$ ), holotype (S.U. 48). Locality (S.U. N.P. 122). Figured originally, 52, pl. 12, fig. 7.....	210
Fig. 7. <i>Macoma twinensis</i> Clark ( $\times 1$ ), hypotype (U.C. 32149). Locality (S.U. N.P. 122). Figured by Tegland, 272, pl. 8, fig. 15.....	210
Fig. 8. <i>Macoma arctata</i> (Conrad) var. <i>wynoocheensis</i> Weaver ( $\times 1$ ), holotype (U.W. 59) (C.A.S. 532). Figured originally, 286, pl. 15, fig. 130.....	209
Fig. 9. <i>Macoma andersoni</i> Clark ( $\times 1$ ), hypotype (U.C. 33325).....	211
Fig. 10. <i>Macoma indentata</i> Carpenter subsp. <i>flagleri</i> Etherington ( $\times 1$ ), holotype (U.C. 31973). Figured originally, 140, pl. 10, fig. 4.....	211
Fig. 11. <i>Macoma calcarea</i> (Gmelin) ( $\times 1$ ), hypotype (U.S.N.M. 153935). Figured by Dall, 101, pl. 14, fig. 8.....	212
Fig. 12. <i>Macoma arctata</i> (Conrad) ( $\times 1.7$ ), holotype (U.S.N.M. 3489). Conrad type. Figured originally, 68, pl. 18, fig. 4.....	208
Fig. 13. <i>Macoma inquinata</i> (Deshayes) var. <i>arnheimi</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 328341). Figured by Reagan, 230, pl. 4, fig. 39.....	214
Fig. 14. <i>Macoma astori</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153937). Figured originally, 101, pl. 14, fig. 1.....	213
Fig. 15. <i>Macoma molinana</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 154088). Figured originally, 101, pl. 14, fig. 12.....	212
Fig. 16. <i>Gari cowlitzensis</i> (Weaver and Palmer) ( $\times 1$ ), holotype (U.W. 176). Figured originally, 301, pl. 9, fig. 18.....	215
Fig. 17. <i>Gari martini</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 389). Figured originally, 123, pl. 27, fig. 7a.....	215
Fig. 18. <i>Macoma montesanoensis</i> Weaver ( $\times 1$ ), holotype (U.W. 57) (C.A.S. 529). Figured originally, 286, pl. 10, fig. 80.....	209

(702)





## PLATE 50

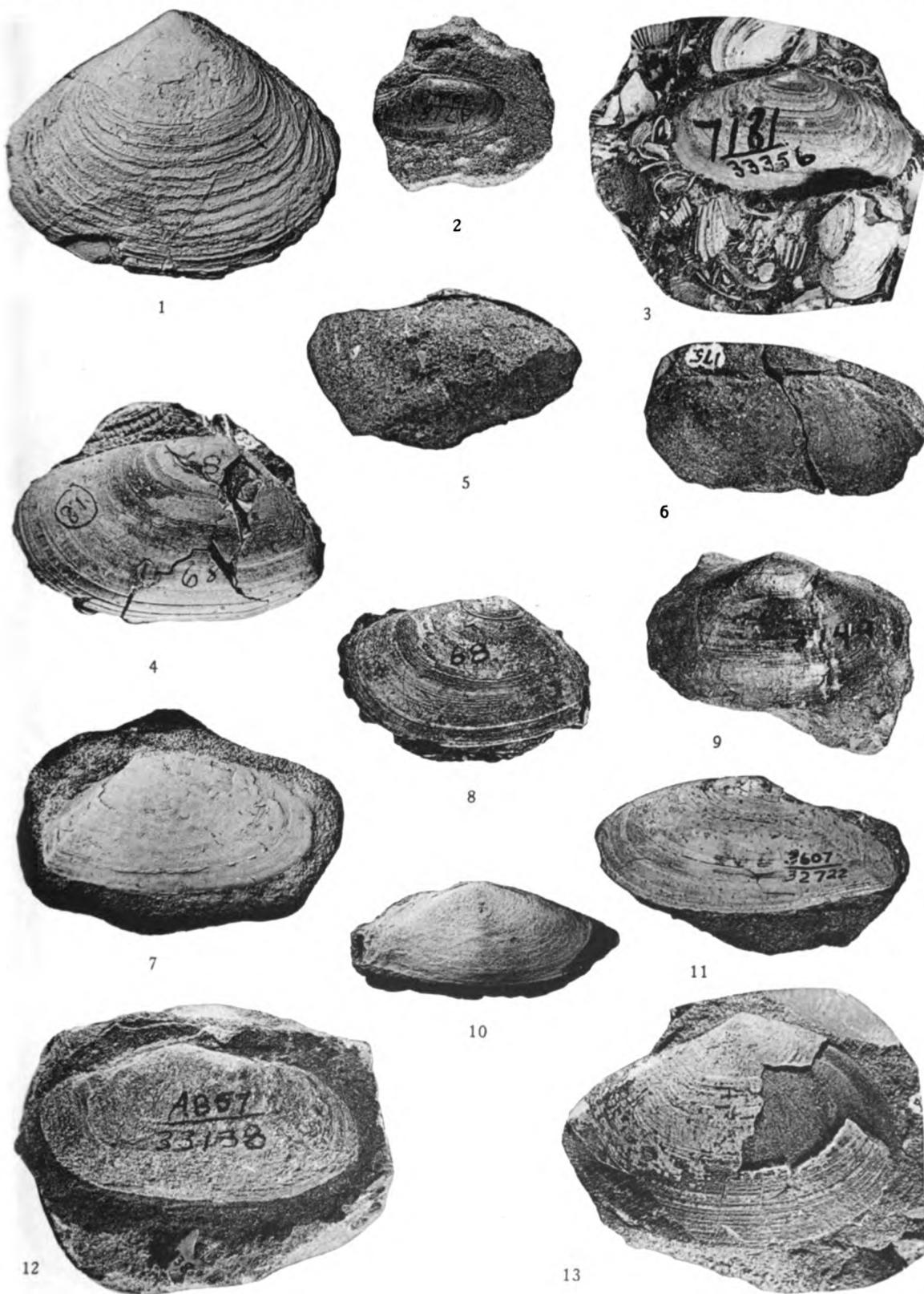
	PAGE
Fig. 1. <i>Gari columbiana</i> (Weaver and Palmer) ( $\times 1$ ), holotype (U.W. 175) (C.A.S. 7473). Figured originally, 301, pl. 10, fig. 18.....	216
Fig. 2. <i>Sanguinolaria caudata</i> White ( $\times 1$ ), syntype (U.S.N.M. 20096). Figured originally, 309, pl. 10, fig. 1.....	219
Fig. 3. <i>Gari columbiana</i> (Weaver and Palmer) ( $\times 0.7$ ), hypotype (U.C. 33138). Figured by Turner, 301, pl. 7, fig. 12.....	216
Fig. 4. <i>Tellina townsendensis</i> Clark ( $\times 1$ ), holotype (S.U. 5208). Figured originally, 52, pl. 12, fig. 12.....	196
Fig. 5. <i>Semele reagani</i> Dickerson ( $\times 2$ ), holotype (C.A.S. 396). Figured originally, 123, pl. 29, fig. 1b.....	221
Fig. 6. <i>Semele reagani</i> Dickerson ( $\times 2$ ), paratype (C.A.S. 397). Figured originally, 123, pl. 29, fig. 1d.....	221
Fig. 7. <i>Gari obscura</i> (White) ( $\times 1.3$ ), holotype (U.S.N.M. 20102). Figured originally, 309, pl. 10, fig. 4.....	217
Fig. 8. <i>Sanguinolaria townsendensis</i> Clark ( $\times 1$ ), holotype (S.U. 50). Figured originally, 52, pl. 18, fig. 7.....	220
Fig. 9. <i>Semele vancouverensis</i> Clark and Arnold ( $\times 2$ ), holotype (U.C. 30226). Figured originally, 50, pl. 27, fig. 4.....	223
Fig. 10. <i>Gari hornii</i> (Gabb) subsp. <i>umpquaensis</i> Turner ( $\times 0.8$ ), holotype (U.C. 33149). Locality (U.C. A-662), Oregon. Figured originally, 274, pl. 7 fig. 12 .....	218
Fig. 11. <i>Sanguinolaria howardi</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 271). Figured originally, 121, pl. 4, fig. 2a.....	219
Fig. 12. <i>Semele vancouverensis</i> Clark and Arnold ( $\times 2.1$ ), paratype (C.A.S. 596). Figured originally, 50, pl. 27, fig. 3a.....	223
Fig. 13. <i>Gari hornii</i> (Gabb) ( $\times 0.1$ ), hypotype (U.C. 33357). Locality (U.C. 7181). Type Tejon. Live Oak Canyon, California.....	218
Fig. 14. <i>Semele sylviaensis</i> Weaver ( $\times 1$ ), paratype (U.W. 61-B) (C.A.S. 7458-B). Locality (U.W. 68).....	223
Fig. 15. <i>Semele diabloti</i> Dickerson ( $\times 2.2$ ), hypotype (U.C. 33639). Figured by Turner, 274, pl. 8, fig. 15.....	222
Fig. 16. <i>Semele vancouverensis</i> Clark and Arnold ( $\times 2$ ), paratype (C.A.S. 596). Figured originally, 50, pl. 27, fig. 3b.....	223
Fig. 17. <i>Apolymetis vancouverensis</i> (Clark and Arnold) ( $\times 1$ ), holotype (C.A.S. 588). Figured originally, 50, pl. 22, fig. 4.....	221

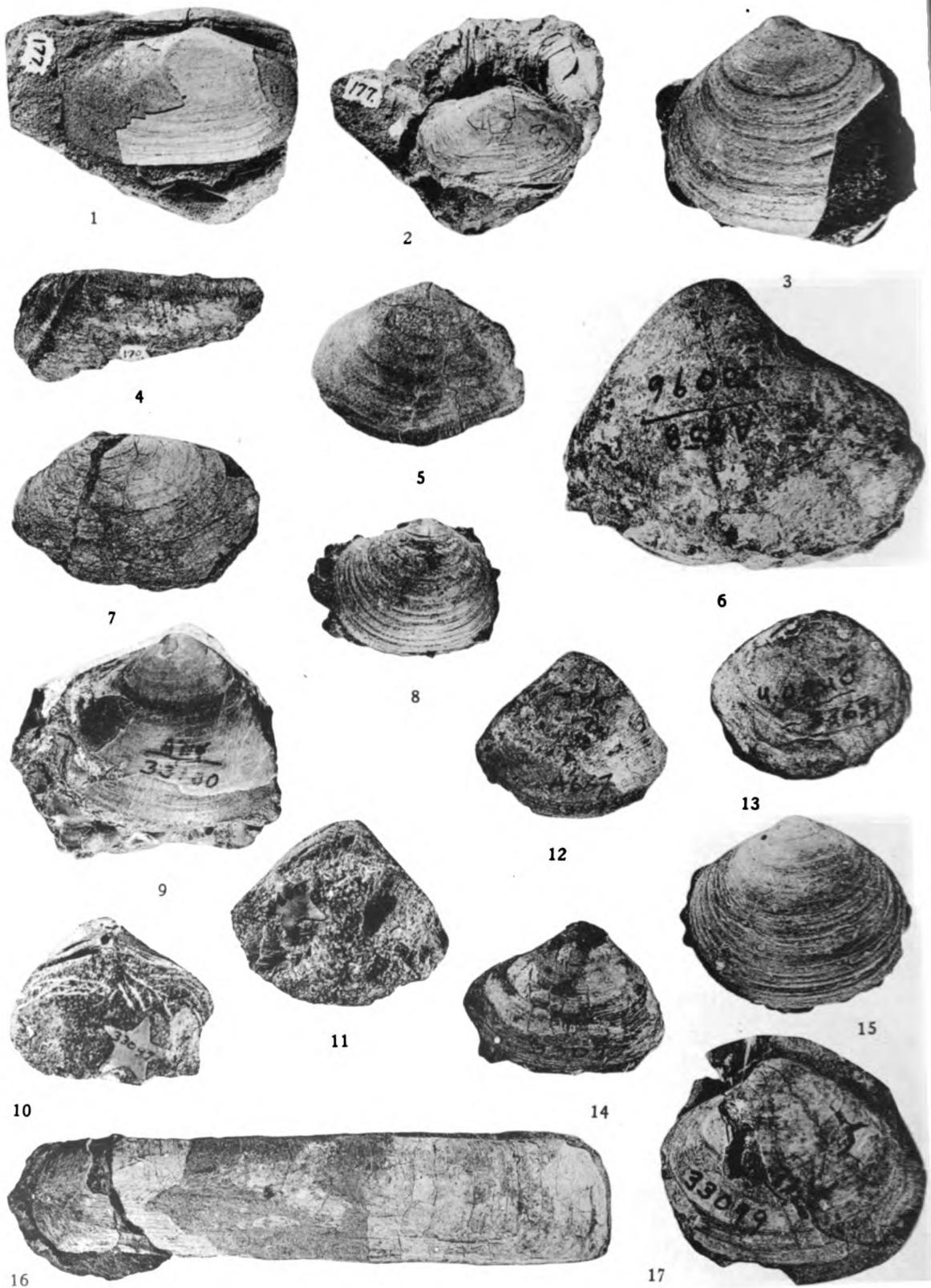
(703)

## PLATE 51

	PAGE
Fig. 1. <i>Pachydesma gastonensis</i> (Clark) ( $\times 1$ ), holotype (S.U. 5223).....	187
Fig. 2. <i>Tellina castacana</i> Anderson and Hanna ( $\times 1$ ), hypotype (U.C. 33140). Figured by Turner, 274, pl. 7, fig. 8.....	198
Fig. 3. <i>Gari hornii</i> (Gabb) ( $\times 1.5$ ), hypotype (U.C. 33356). Locality (U.C. 7131). South end of San Joaquin Valley, California.....	218
Fig. 4. <i>Tellina merriami</i> Weaver ( $\times 1$ ), holotype (U.W. 55-A) (C.A.S. 7462-A). Figured originally, 286, pl. 10, fig. 81.....	203
Fig. 5. <i>Tellina townsendensis</i> Clark ( $\times 1$ ), hypotype (U.C. 32722).....	196
Fig. 6. <i>Solena columbiana</i> (Weaver and Palmer) ( $\times 0.8$ ), holotype (U.W. 179) (C.A.S. 7472). .....	227
Fig. 7. <i>Tellina kamakawaensis</i> Clark ( $\times 2$ ), holotype (S.U. 5218). Figured originally, 52, pl. 12, fig. 13.....	201
Fig. 8. <i>Tellina merriami</i> Weaver ( $\times 1$ ), paratype (U.W. 55), (C.A.S. 7462). Figured originally, 286, pl. 9, fig. 74.....	203
Fig. 9. <i>Gari hornii</i> (Gabb) subsp. <i>umpquaensis</i> Turner ( $\times 1$ ), holotype (U.C. 33149). Figured by Turner, 274, pl. 7, fig. 11.....	218
Fig. 10. <i>Tellina townsendensis</i> Clark ( $\times 1$ ), holotype (S.U. 5208). Figured originally, 52, pl. 12, fig. 12.....	196
Fig. 11. <i>Tellina townsendensis</i> Clark ( $\times 1$ ), hypotype (U.C. 32722). Figured by Effinger, 52, pl. 46, fig. 14. Gries Ranch beds.....	196
Fig. 12. <i>Gari columbiana</i> (Weaver and Palmer) ( $\times 1.2$ ), hypotype (U.C. 33138). Figured by Turner, 274, pl. 7, fig. 12.....	216
Fig. 13. <i>Tellina cowlitzensis</i> Weaver ( $\times 1$ ), holotype (U.W. 99) (C.A.S. 7463). Figured originally, 295, pl. 11, fig. 14.....	198

(704)





## PLATE 52

## PAGE

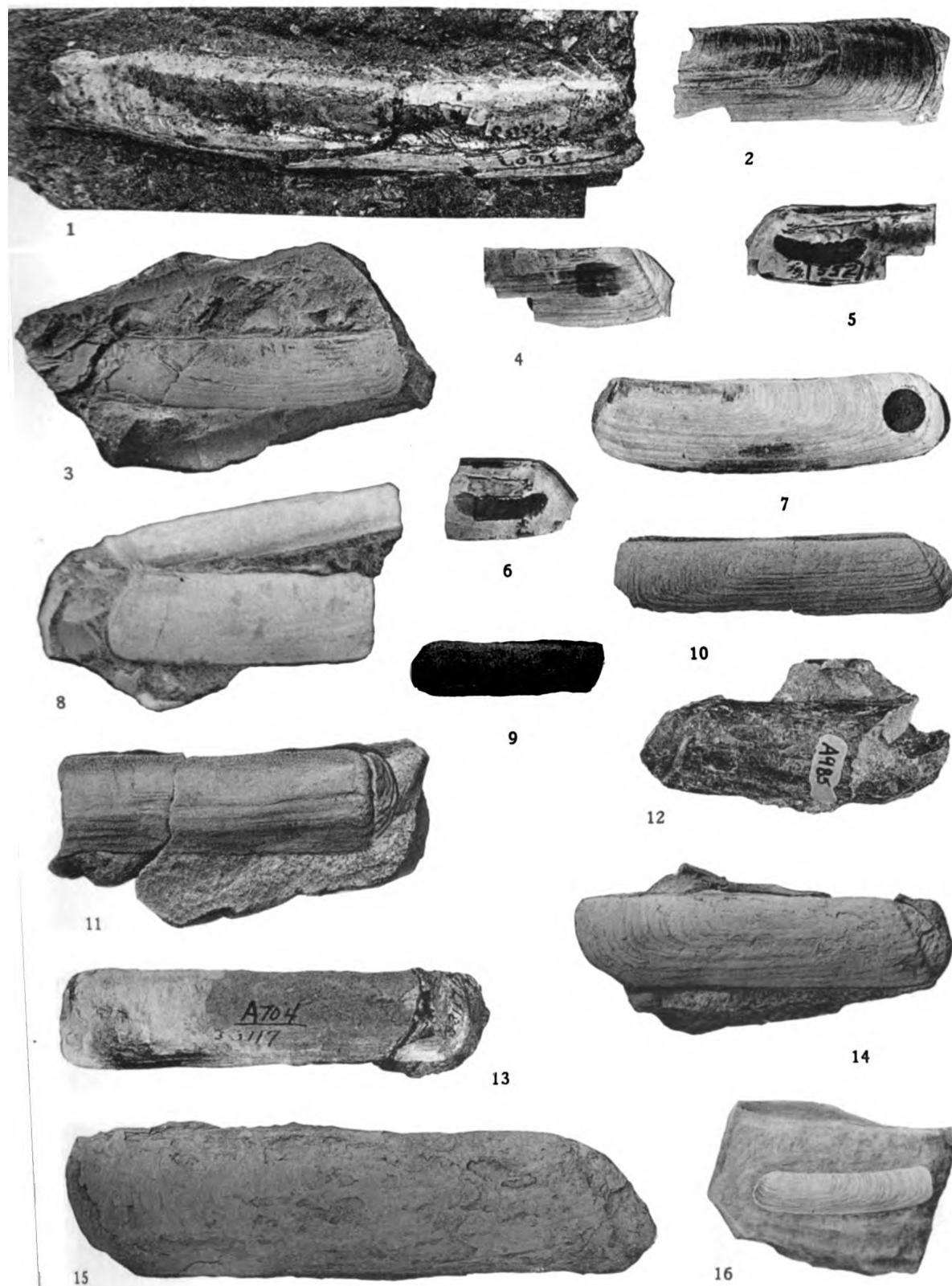
- |   |     |
|---|-----|
| <b>Fig. 1.</b> <i>Gari olequahensis</i> (Weaver and Palmer) ( $\times 1.2$ ), holotype (U.W. 177) (C.A.S. 7471). Figured originally, 301, pl. 9, fig. 12.....               | 216 |
| <b>Fig. 2.</b> <i>Gari olequahensis</i> (Weaver and Palmer) ( $\times 1.2$ ), syntype (U.W. 177-A) (C.A.S. 7471-A). Figured originally, 301, pl. 9, fig. 11.....            | 216 |
| <b>Fig. 3.</b> <i>Semele sylviaensis</i> Weaver ( $\times 1.5$ ), paratype (U.W. 61-A) (C.A.S. 7458-A). Locality (U.W. 68).....   | 223 |
| <b>Fig. 4.</b> <i>Solena columbiana</i> (Weaver and Palmer) ( $\times 0.8$ ), holotype (U.W. 179) (C.A.S. 7472). Figured originally, 301, pl. 10, fig. 3.....               | 227 |
| <b>Fig. 5.</b> <i>Tellina gibsonensis</i> Van Winkle ( $\times 1.5$ ), holotype (U.W. 130) (C.A.S. 7461). Figured originally, 275, pl. 6, fig. 7.....                       | 200 |
| <b>Fig. 6.</b> <i>Spisula acutirostrata</i> Packard var.? Turner ( $\times 1.1$ ), holotype (U.C. 33096). Figured by Turner, 274, pl. 7, fig. 6.....                        | 232 |
| <b>Fig. 7.</b> <i>Macoma andersoni</i> Clark ( $\times 3$ ), hypotype (U.C. 33325).....   | 211 |
| <b>Fig. 8.</b> <i>Semele montesanoensis</i> Weaver ( $\times 0.9$ ), holotype (U.W. 60-A) (C.A.S. 7457-A). Figured originally, 286, pl. 12, fig. 99.....                    | 224 |
| <b>Fig. 9.</b> <i>Spisula rushi</i> Wagner and Schilling var. <i>aragoensis</i> Turner ( $\times 1$ ), paratype (U.C. 33100). Figured by Turner, 274, pl. 7, fig. 3.....    | 233 |
| <b>Fig. 10.</b> <i>Spisula merriami</i> Packard var. <i>longifrons</i> Turner ( $\times 1.2$ ), holotype (U.C. 33097). Figured by Turner, 274, pl. 6, fig. 11.....          | 234 |
| <b>Fig. 11.</b> <i>Spisula merriami</i> Packard ( $\times 1.2$ ), hypotype (U.C. 33095). Figured by Turner, 274, pl. 6, fig. 12.....  | 233 |
| <b>Fig. 12.</b> <i>Spisula merriami</i> Packard ( $\times 1.2$ ), hypotype (U.C. 33095). Figured by Turner, 274, pl. 6, fig. 12.....  | 233 |
| <b>Fig. 13.</b> <i>Semele diabolo</i> Dickerson ( $\times 1.8$ ), hypotype (U.C. 33639). Figured by Turner, 121, pl. 8, fig. 15.....  | 222 |
| <b>Fig. 14.</b> <i>Spisula merriami</i> Packard var. <i>longifrons</i> Turner ( $\times 1.2$ ), holotype (U.C. 33097). Figured by Turner, 274, pl. 6, fig. 11.....          | 234 |
| <b>Fig. 15.</b> <i>Semele sylviaensis</i> Weaver ( $\times 1$ ), holotype (U.W. 61) (C.A.S. 7458). Figured originally, 286, pl. 12, fig. 100.....                           | 223 |
| <b>Fig. 16.</b> <i>Solena coosensis</i> Turner ( $\times 1$ ), holotype (U.C. 33117). Figured by Turner, 274, pl. 9, fig. 1.....  | 229 |
| <b>Fig. 17.</b> <i>Spisula rushi</i> Wagner and Schilling var. <i>aragoensis</i> Turner ( $\times 1.3$ ), holotype (U.C. 33099). Figured by Turner, 274, pl. 7, fig. 4..... | 233 |

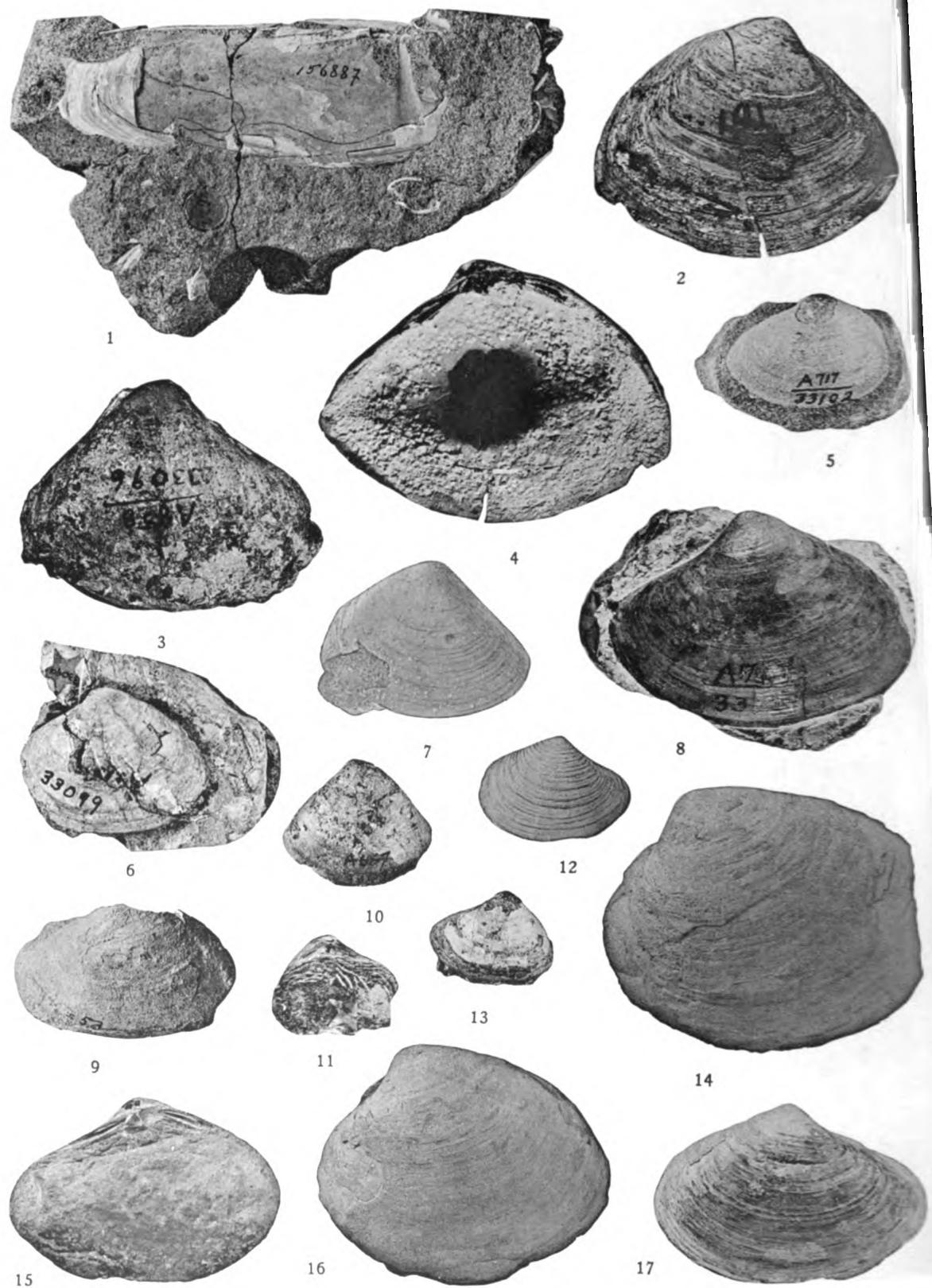
(705)

## PLATE 53

	PAGE
Fig. 1. <i>Solen townsendensis</i> Clark ( $\times 1$ ), hypotype (U.C. 33535). Gries Ranch beds .....	225
Fig. 2. <i>Solen lincolnensis</i> Weaver ( $\times 1$ ), syntype (U.W. 100-A) (C.A.S. 552-B). Figured originally, 295, pl. 2, fig. 11.....	226
Fig. 3. <i>Solen clallamensis</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30242). Figured originally, 50, pl. 20, fig. 4.....	225
Fig. 4. <i>Solen lincolnensis</i> Weaver ( $\times 1$ ), syntype (U.W. 100-B) (C.A.S. 552). Figured originally, 295, pl. 2, fig. 12.....	226
Fig. 5. <i>Solen lincolnensis</i> Weaver ( $\times 1$ ), syntype (U.W. 100-B) (C.A.S. 552). Figured originally, 295, pl. 2, fig. 9.....	226
Fig. 6. <i>Solen lincolnensis</i> Weaver ( $\times 1$ ), syntype (U.W. 100-D) (C.A.S. 552-A). Figured originally, 295, pl. 2, fig. 10.....	226
Fig. 7. <i>Solen curtus</i> Conrad var. <i>conradi</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153934). Figured originally, 101, pl. 12, fig. 7.....	227
Fig. 8. <i>Solen clallamensis</i> Clark and Arnold ( $\times 1$ ), paratype (U.C. 30232). Figured originally, 50, pl. 20, fig. 5.....	225
Fig. 9. <i>Solen townsendensis</i> Clark ( $\times 1$ ), holotype (S.U. 51). Figured originally, 52, pl. 22, fig. 10.....	225
Fig. 10. <i>Solena columbiana</i> (Weaver and Palmer) ( $\times 1$ ), topotype (U.C. 33411). Locality (U.C. 7167). .....	227
Fig. 11. <i>Solena clarki</i> (Weaver and Palmer) ( $\times 1$ ), holotype (U.W. 178) (C.A.S. 7474). Figured originally, 301, pl. 9, fig. 16.....	228
Fig. 12. <i>Solena columbiana</i> (Weaver and Palmer) ( $\times 1$ ), hypotype (U.C. 33227). Figured by Turner, 274, pl. 9, fig. 3.....	227
Fig. 13. <i>Solena coosensis</i> Turner ( $\times 0.8$ ), holotype (U.C. 33117). Figured originally, 274, pl. 9, fig. 1.....	229
Fig. 14. <i>Solena eugenensis</i> (Clark) ( $\times 0.6$ ), holotype (U.C. 30338). Figured originally, 52, pl. 22, fig. 1.....	230
Fig. 15. <i>Solena eugenensis</i> (Clark) ( $\times 1$ ), holotype (U.C. 30338). Figured originally, 52, pl. 22, fig. 1.....	230
Fig. 16. <i>Solena sicarius</i> (Gould) ( $\times 1$ ), hypotype (U.C. 33424). Locality (U.W. 416). Astoria formation. .....	229

(706)





## PLATE 54

	PAGE
Fig. 1. <i>Siliqua patula</i> Dickson var. <i>oregonia</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 156887). From Two-Mile Creek, Coos Bay, Oregon.....	230
Fig. 2. <i>Spisula packardi</i> Dickerson ( $\times 1$ ), holotype (C.A.S. 395). Figured originally, 123, pl. 28, fig. 5a.....	231
Fig. 3. <i>Spisula acutirostrata</i> Packard var.? Turner ( $\times 0.9$ ), holotype (U.C. 33096). Figured by Turner, 274, pl. 7, fig. 6.....	232
Fig. 4. <i>Spisula packardi</i> Dickerson ( $\times 1$ ), holotype (C.A.S. 395). Figured originally, 123, pl. 28, fig. 5b.....	231
Fig. 5. <i>Spisula packardi</i> Dickerson var. <i>yokamensis</i> Turner ( $\times 1$ ), paratype (U.C. 33102). Figured originally, 274, pl. 7, fig. 1.....	232
Fig. 6. <i>Spisula rushi</i> Wagner and Schilling var. <i>aragoensis</i> Turner ( $\times 0.8$ ), holotype (U.C. 33099). Locality (U.C. A-715). Figured originally, 274, pl. 7, fig. 4.....	233
Fig. 7. <i>Spisula biseptata</i> Anderson and Hanna ( $\times 1.1$ ), hypotype (U.C. 33383). Locality (U.C. 7161).....	234
Fig. 8. <i>Spisula packardi</i> Dickerson var. <i>yokamensis</i> Turner ( $\times 1$ ), holotype (U.C. 33101). Figured originally, 274, pl. 7, fig. 2.....	232
Fig. 9. <i>Spisula pittsburgensis</i> Clark ( $\times 0.7$ ), holotype (S.U. 5202). Figured originally, 52, pl. 17, fig. 2.....	235
Fig. 10. <i>Spisula merriami</i> Packard ( $\times 0.8$ ), hypotype (U.C. 33095). Figured by Turner, 274, pl. 6, fig. 12. Locality (U.C. A-667).....	233
Fig. 11. <i>Spisula merriami</i> Packard var. <i>longifrons</i> Turner ( $\times 0.7$ ), holotype (U.C. 33097). Figured by Turner, 274, pl. 6, fig. 11. Locality (U.C. A-838). .....	234
Fig. 12. <i>Spisula pittsburgensis</i> Clark subsp. <i>frustra</i> Tegland ( $\times 0.5$ ), holotype (U.C. 32197). Figured by Tegland, 272, pl. 9, fig. 9. Locality (U.C. 681)	236
Fig. 13. <i>Spisula merriami</i> Packard var. <i>longifrons</i> Turner ( $\times 0.7$ ), holotype (U.C. 33097). Figured by Turner, 274, pl. 6, fig. 11.....	234
Fig. 14. <i>Spisula veneriformis</i> Clark ( $\times 1$ ), paratype (S.U. 56). Figured originally, 52, pl. 16, fig. 1.....	236
Fig. 15. <i>Spisula pittsburgensis</i> Clark subsp. <i>frustra</i> Tegland ( $\times 1$ ), holotype (U.C. 32197). Figured by Tegland, 272, pl. 9, fig. 10.....	236
Fig. 16. <i>Spisula veneriformis</i> Clark ( $\times 1$ ), paratype (S.U. 55). Figured originally, 52, pl. 16, fig. 2.....	236
Fig. 17. <i>Spisula pittsburgensis</i> Clark subsp. <i>frustra</i> Tegland ( $\times 1$ ), holotype (U.C. 32197). Figured by Tegland, 272, pl. 9, fig. 9.....	236

(707)

## PLATE 55

	PAGE
Fig. 1. <i>Macoma twinensis</i> Clark ( $\times 1$ ), topotype (U.C. 32148). Locality (U.C. A-6). Figured by Tegland, 272, pl. 8, fig. 14.....	210
Fig. 2. <i>Spisula (Hemimactra) sookensis</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30066). Figured originally, 50, pl. 18, fig. 2b.....	238
Fig. 3. <i>Spisula (Hemimactra) sookensis</i> Clark and Arnold ( $\times 1$ ), hypotype (C.A.S. 687). .....	238
Fig. 4. <i>Microcallista (Costacallista) conradiana</i> (Gabb) var. <i>meganosensis</i> (Clark and Woodford) ( $\times 0.7$ ), hypotype (U.C. 33065). Figured by Turner, 274, pl. 10, fig. 15.....	173
Fig. 5. <i>Spisula (Hemimactra) precursor</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153928). Figured originally, 101, pl. 14, fig. 10.....	237
Fig. 6. <i>Spisula (Hemimactra) sookensis</i> Clark and Arnold ( $\times 1$ ), paratype (U.C. 30239). Figured originally, 50, pl. 18, fig. 1.....	238
Fig. 7. <i>Spisula (Hemimactra) sookensis</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30066). Figured originally, 50, pl. 18, fig. 2a.....	238
Fig. 8. <i>Spisula twinensis</i> Clark ( $\times 1$ ), holotype (S.U. 57). Figured originally, 52, pl. 16, fig. 6.....	237

(708)

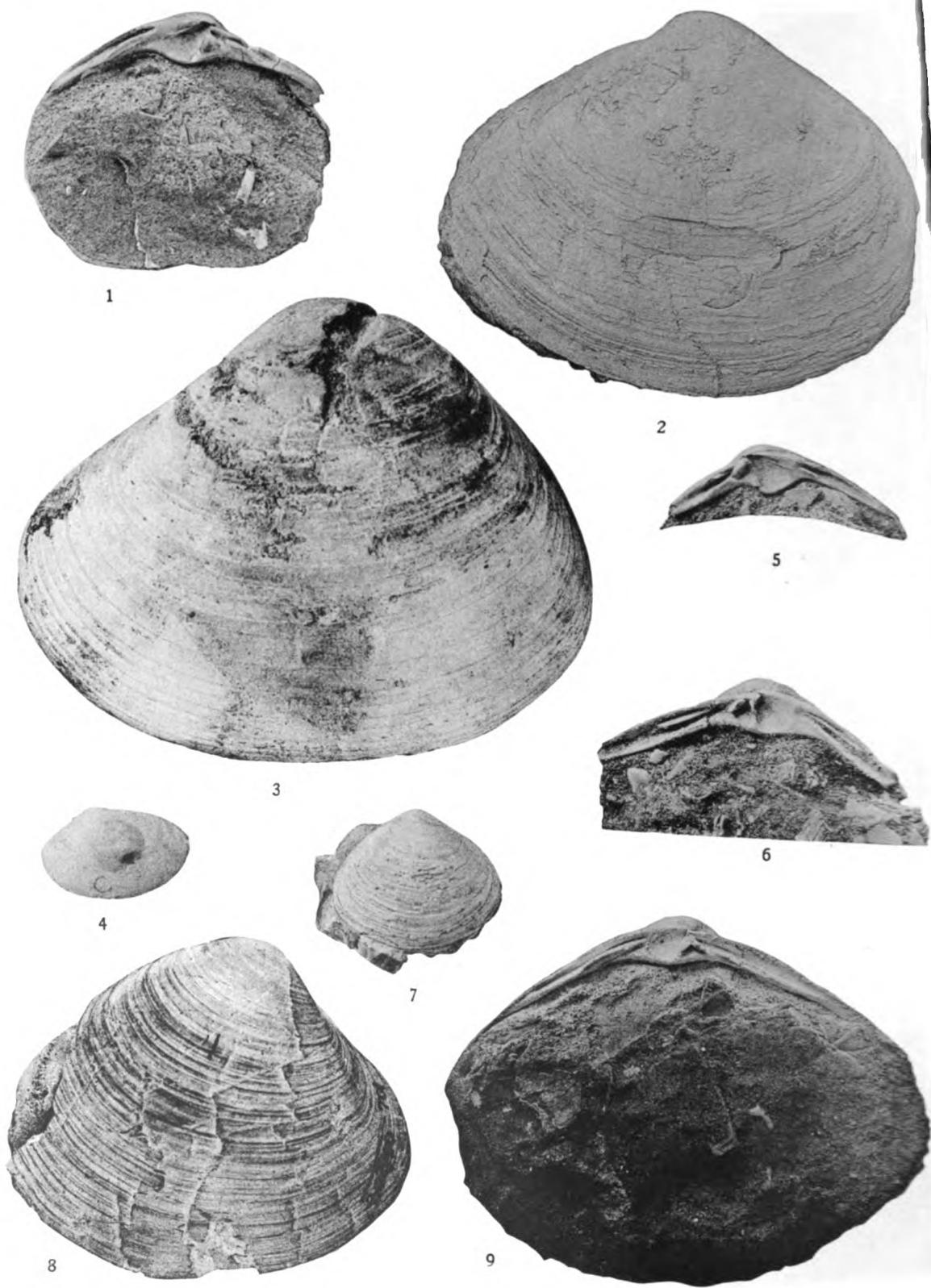
UNIV. OF WASH. PUBL. IN GEOL.

[WEAVER] VOL. V, PL. 55



UNIV. OF WASH. PUBL. IN GEOL.

[WEAVER] VOL. V, PL. 56



## PLATE 56

PAGE

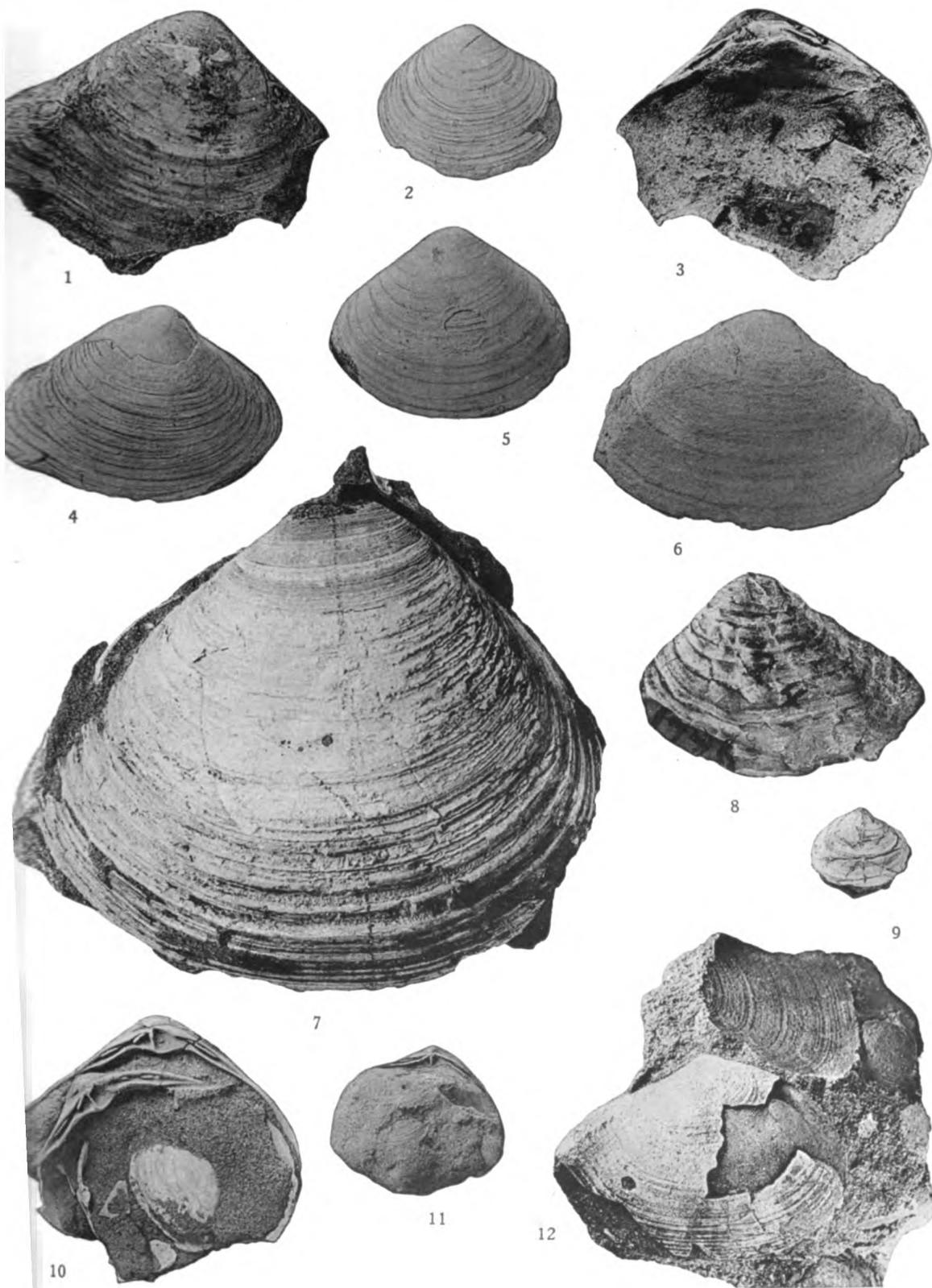
- |   |     |
|---|-----|
| Fig. 1. <i>Spisula (Mactromeris) albaria</i> (Conrad) subsp. <i>oregonensis</i> Clark<br>( $\times 1$ ), paratype (C.A.S. 703). Figured originally, 52, pl. 17, fig. 7.....   | 241 |
| Fig. 2. <i>Spisula (Hemimactra) hannibali</i> Clark and Arnold ( $\times 1$ ), holotype<br>(U.C. 30062). Figured originally, 50, pl. 19, fig. 1a.....   | 238 |
| Fig. 3. <i>Spisula (Mactromeris) albaria</i> (Conrad) var. <i>coosensis</i> Howe ( $\times 1$ ),<br>hypotype (U.S.N.M. 153929). Opposite valve of specimen figured by<br>Dall, 101, pl. 10, fig. 1. Empire formation..... | 242 |
| Fig. 4. <i>Ervilia oregonensis</i> Dall ( $\times 3.2$ ), holotype (U.S.N.M. 107406). Figured<br>originally, in Trans. Wag. Free Inst. Sci., vol. 3, pl. 33, fig. 16.....   | 243 |
| Fig. 5. <i>Spisula (Mactromeris) albaria</i> (Conrad) subsp. <i>oregonensis</i> Clark<br>( $\times 1$ ), paratype (C.A.S. 702). Figured originally, 52, pl. 17, fig. 5.....   | 241 |
| Fig. 6. <i>Spisula (Hemimactra) hannibali</i> Clark and Arnold ( $\times 1$ ), paratype<br>(U.C. 30228). Figured originally, 50, pl. 19, fig. 4.....  | 238 |
| Fig. 7. <i>Spisula (Mactromeris) albaria</i> (Conrad) subsp. <i>goodspeedi</i> Etherington<br>( $\times 0.5$ ), holotype (U.C. 31980). Locality (U.W. 422). Figured orig-<br>inally, 140, pl. 9, fig. 3.....              | 243 |
| Fig. 8. <i>Spisula (Mactromeris) albaria</i> (Conrad) subsp. <i>oregonensis</i> Clark<br>( $\times 1$ ), holotype (C.A.S. 701). Figured originally, 52, pl. 17, fig. 6.....   | 241 |
| Fig. 9. <i>Spisula (Hemimactra) hannibali</i> Clark and Arnold ( $\times 1$ ), holotype<br>(U.C. 30062). Figured originally, 50, pl. 19, fig. 1b.....   | 238 |

(709)

## PLATE 57

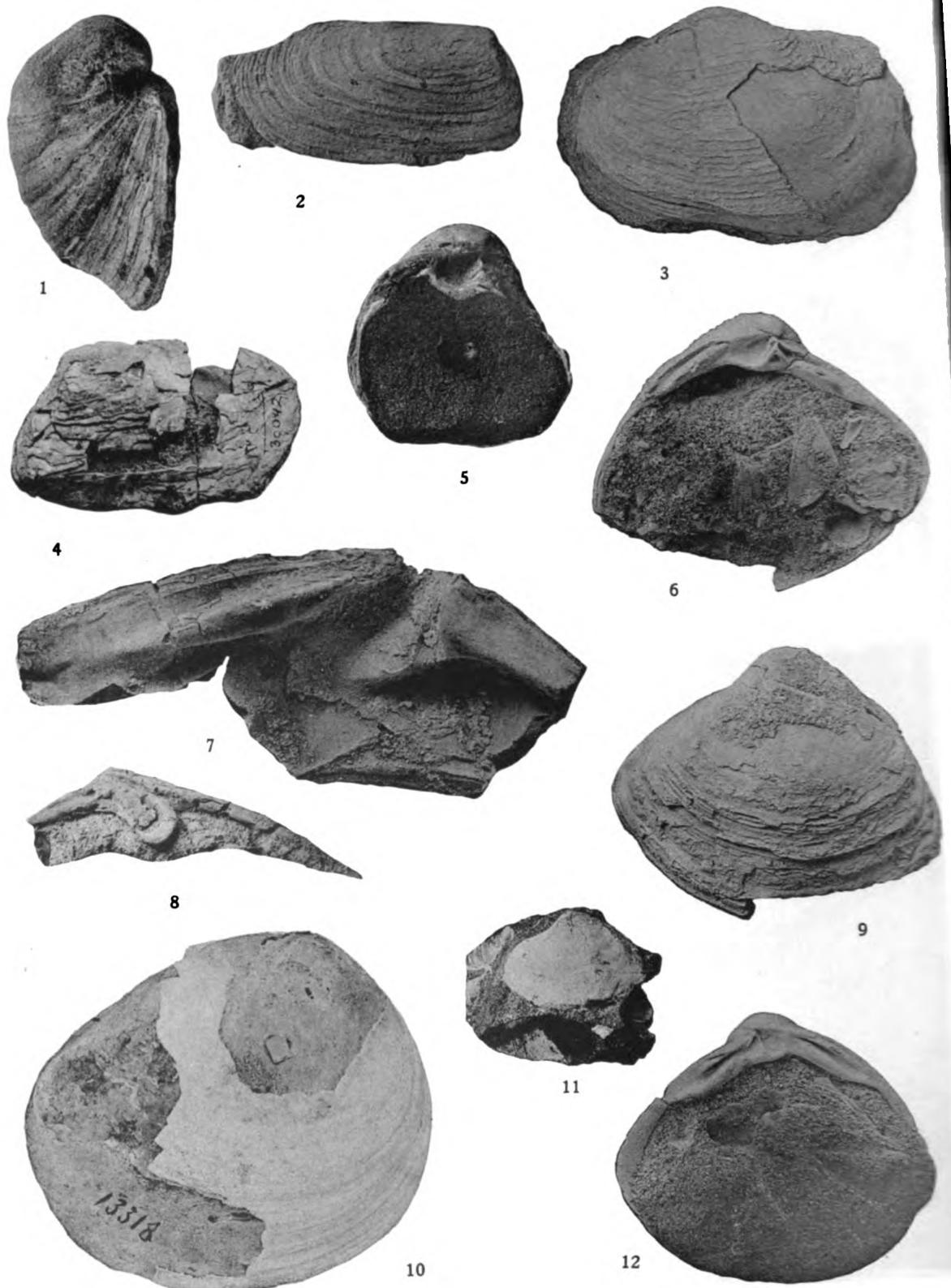
	PAGE
Fig. 1. <i>Spisula (Mactromeris) albaria</i> (Conrad) subsp. <i>scapoosensis</i> Clark ( $\times 1$ ), holotype (C.A.S. 688). Figured originally, 52, pl. 16, fig. 4.....	240
Fig. 2. <i>Spisula (Mactromeris) albaria</i> (Conrad) var. <i>coosensis</i> Howe ( $\times 1$ ), holotype (U.C. 30028). Figured by Howe, 166, pl. 9, fig. 7. Astoria for- mation. Locality (U.C. 3325).....	242
Fig. 3. <i>Spisula (Mactromeris) albaria</i> (Conrad) subsp. <i>scapoosensis</i> Clark ( $\times 1$ ), holotype (C.A.S. 688). Figured originally, 52, pl. 16, fig. 5.....	240
Fig. 4. <i>Pseudocardium eugencise</i> (Clark) ( $\times 2.5$ ), holotype (U.C. 30372). Figured originally, 52, pl. 14, fig. 2. Locality (U.C. 4082).....	244
Fig. 5. <i>Spisula (Mactromeris) albaria</i> (Conrad) ( $\times 0.6$ ), hypotype (U.C. 31979). Figured by Etherington, 140, pl. 10, fig. 8. Locality (U.W. 416).....	239
Fig. 6. <i>Pseudocardium yaquinense</i> (Clark) ( $\times 1$ ), holotype (U.C. 30325) (S.U. 58). Figured originally, 52, pl. 17, fig. 1.....	245
Fig. 7. <i>Spisula (Mactromeris) albaria</i> (Conrad) subsp. <i>arnoldi</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 328342). Figured originally by Reagan as <i>Tivella</i> <i>crassatelloides</i> , 230, pl. 4, fig. 37a.....	240
Fig. 8. <i>Anatina?</i> <i>roseburgensis</i> Hendon ( $\times 1.8$ ), holotype (C.A.S. 1746). Fig- ured by Turner, 274, pl. 8, fig. 18.....	244
Fig. 9. <i>Pseudocardium olympica</i> (Dall) ( $\times 1$ ), lectotype (U.S.N.M. 328351). Figured by Reagan as <i>Mactra exolcta</i> Gray, 230, pl. 4, fig. 42a.....	248
Fig. 10. <i>Spisula (Mactromeris) albaria</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 30029). Figured originally by Howe, 166, pl. 9, fig. 6. Merced formation.....	239
Fig. 11. <i>Spisula (Mactromeris) albaria</i> (Conrad) var. <i>coosensis</i> Howe ( $\times 1$ ), holotype (U.C. 30028). Figured originally, 166, pl. 9, fig. 7. Astoria formation. Locality (U.C. 3325).....	242
Fig. 12. <i>Tellina cowlitzensis</i> Weaver ( $\times 0.8$ ), holotype (U.W. 99) (C.A.S. 7463). Figured originally, 295, pl. 11, fig. 14.....	198

(710)



UNIV. OF WASH. PUBL. IN GEOL.

[WEAVER] VOL. V, PL. 58



## PLATE 58

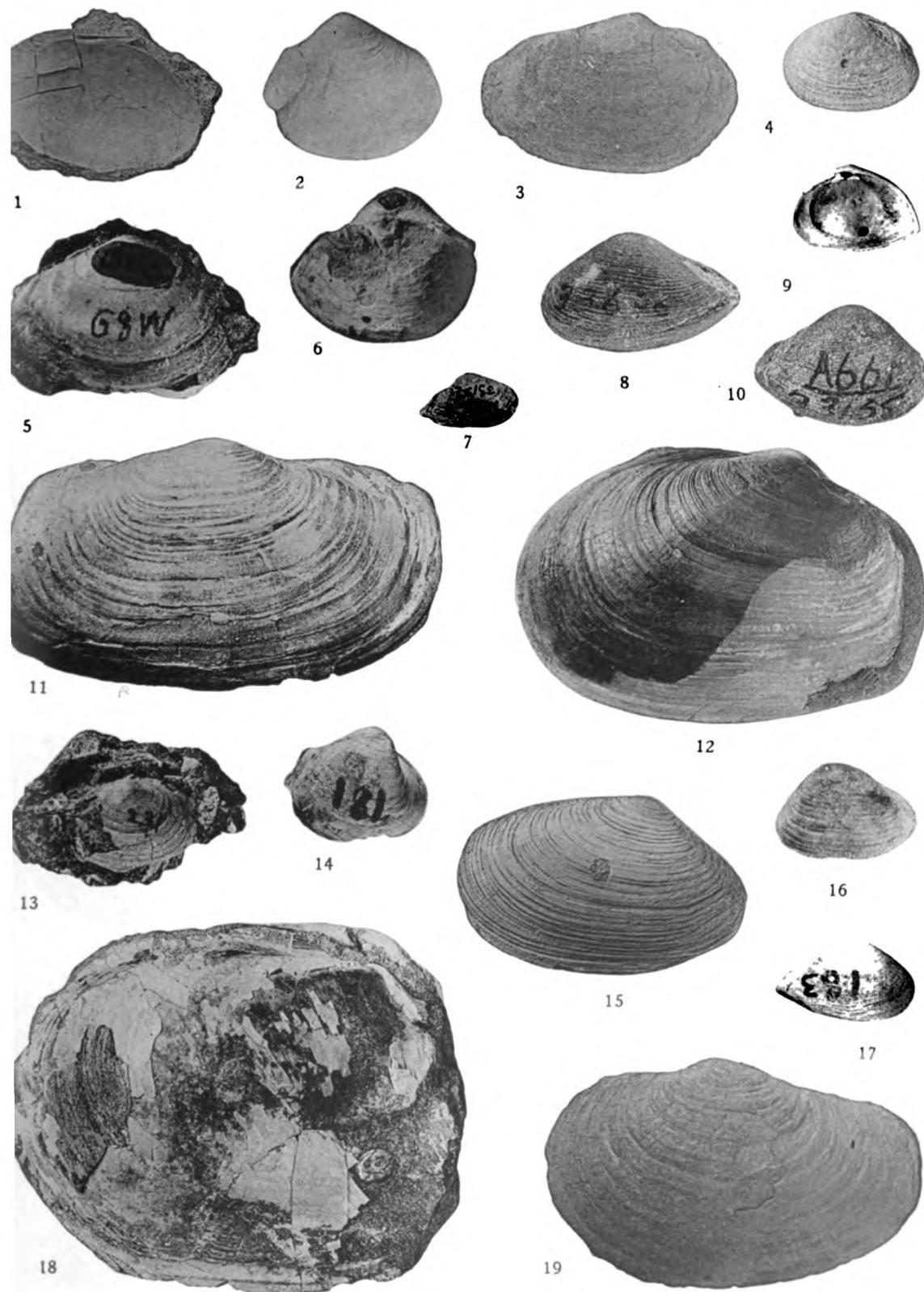
	PAGE
Fig. 1. <i>Pseudocardium oregonense</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 153927). Figured originally, 101, pl. 13, fig. 5.....	246
Fig. 2. <i>Myadesma howei</i> Clark ( $\times 0.7$ ), holotype (U.C. 30328). Figured by Clark, 52, pl. 14, fig. 1.....	251
Fig. 3. <i>Platydon cancellata</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 30061). Figured by Clark and Arnold, 50, pl. 16, fig. 4.....	250
Fig. 4. <i>Myadesma dalli</i> Clark ( $\times 0.7$ ), holotype (S.U. 225). Figured by Clark, 52, pl. 28, fig. 1b.....	250
Fig. 5. <i>Pseudocardium oregonense</i> (Dall) ( $\times 1$ ), paratype (U.S.N.M. 153927-A). Figured originally, 101, pl. 9, fig. 2.....	246
Fig. 6. <i>Pseudocardium newcombei</i> (Clark and Arnold) ( $\times 1$ ), paratype (U.C. 30219). Figured originally, 50, pl. 15, fig. 4a.....	247
Fig. 7. <i>Myadesma dalli</i> Clark ( $\times 2$ ), cotype (U.C. 30251). Figured originally, 52, pl. 28, fig. 4.....	250
Fig. 8. <i>Myadesma dalli</i> Clark ( $\times 2$ ), cotype (C.A.S. 589). Figured originally, 52, pl. 28, fig. 3.....	250
Fig. 9. <i>Pseudocardium newcombei</i> (Clark and Arnold) ( $\times 1$ ), paratype (U.C. 30219). Figured originally, 50, pl. 15, fig. 4b.....	247
Fig. 10. <i>Schizothaerus nuttallii</i> (Conrad) var. <i>pajaroanus</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 13318). Pajaro River, California. Figured originally, 73, pl. 4, fig. 1.....	249
Fig. 11. <i>Pseudocardium olympica</i> (Dall) ( $\times 1$ ), hypotype (U.S.N.M. 328348). Figured by Reagan as <i>Mactra hemphilli</i> (Dall), 230, pl. 4, fig. 43.....	248
Fig. 12. <i>Pseudocardium newcombei</i> (Clark and Arnold) ( $\times 1$ ), paratype (U.C. 30047). Figured originally, 50, pl. 15, fig. 2.....	247

(711)

## PLATE 59

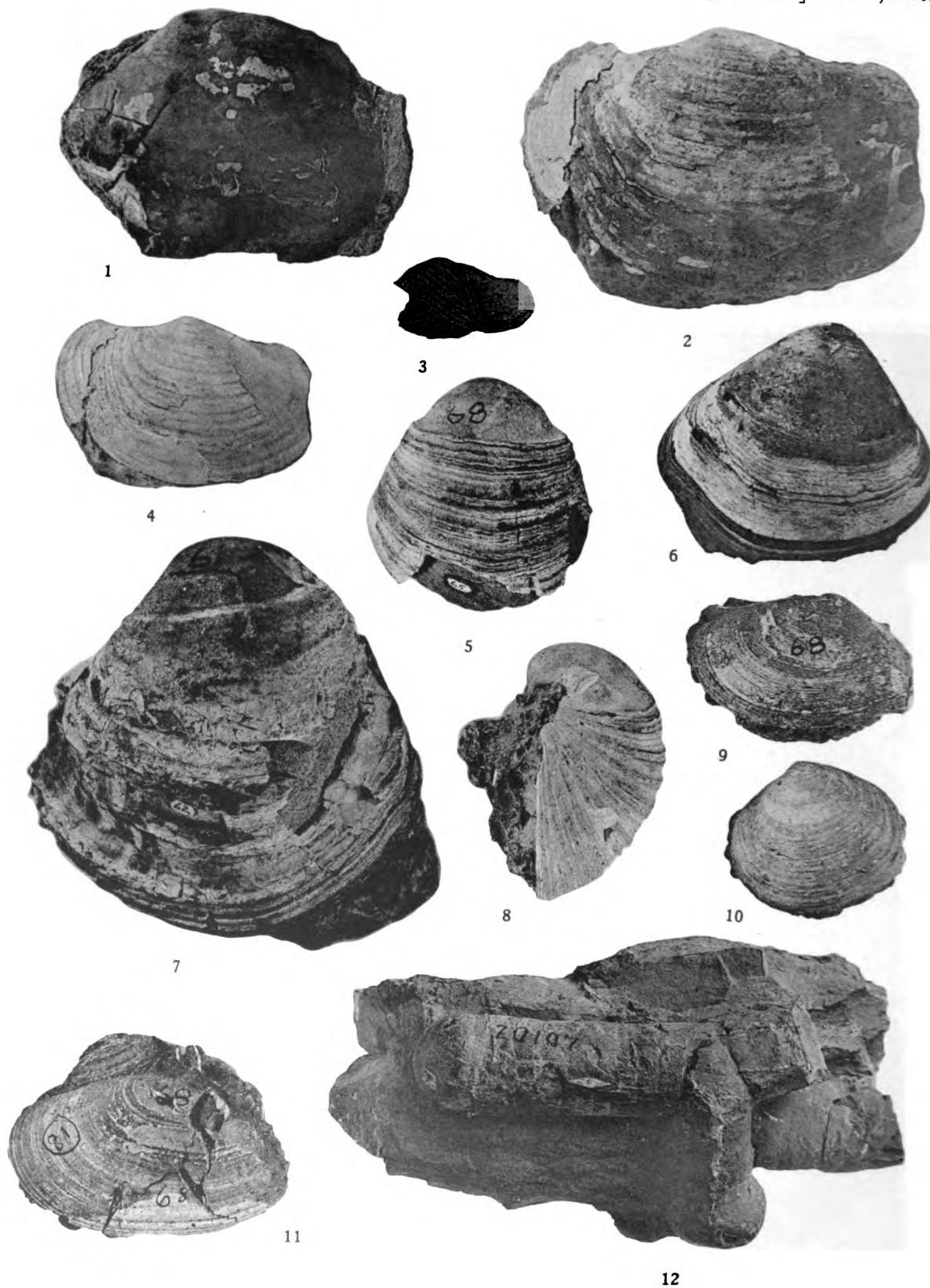
	PAGE
Fig. 1. <i>Tellina vancouverensis</i> Clark and Arnold ( $\times 2$ ), paratype (U.C. 30063). Figured originally, 50, pl. 22, fig. 5.....	202
Fig. 2. <i>Mya (Antiguamya) arnoldi</i> (Dickerson) ( $\times 2$ ), hypotype (U.C. 33540). Figured by Effinger, 138, pl. 46, fig. 3.....	254
Fig. 3. <i>Panope snohomishensis</i> Clark ( $\times 1$ ), paratype (S.U. 60). Locality (S.U. N.P. 146). Figured originally, 52, pl. 11, fig. 2.....	261
Fig. 4. <i>Cryptomya oregonensis</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153931). Figured originally, 101, pl. 11, fig. 4.....	252
Fig. 5. <i>Cryptomya washingtoniana</i> Weaver ( $\times 1.2$ ), holotype (U.W. 67) (C.A.S. 505). Figured originally, 286, pl. 11, fig. 114.....	252
Fig. 6. <i>Mya (Antiguamya) arnoldi</i> (Dickerson) ( $\times 2$ ), holotype (U.C. 335451). Figured by Effinger, 138, pl. 46, fig. 7.....	254
Fig. 7. <i>Corbula hornii</i> Gabb ( $\times 0.5$ ), hypotype (U.C. 33159). Figured by Turner, 274, pl. 8, fig. 17. South Cove, Coos Bay, Oregon.....	257
Fig. 8. <i>Corbula complicata</i> G. D. Hanna ( $\times 2.5$ ), hypotype (U.C. 33646). Figured by Turner, 274, pl. 8, fig. 9.....	259
Fig. 9. <i>Corbula cowlitzensis</i> Dickerson ( $\times 3$ ), holotype (C.A.S. 391). Figured originally, 123, pl. 28, fig. 3b. Locality (C.A.S. 181).....	255
Fig. 10. <i>Corbula complicata</i> G. D. Hanna ( $\times 2.5$ ), hypotype (U.C. 33155). Figured by Turner, 274, pl. 8, fig. 10.....	259
Fig. 11. <i>Panope ramonensis</i> Clark ( $\times 1$ ), hypotype (U.W. 365). Locality (U.W. 270).....	263
Fig. 12. <i>Mya truncata</i> Linnaeus ( $\times 1$ ), hypotype (U.S.N.M. 153956). Empire formation, Coos Bay, Oregon.....	255
Fig. 13. <i>Cryptomya quadrata</i> (Arnold) subsp. <i>vancouverensis</i> Clark and Arnold ( $\times 1$ ), holotype (C.A.S. 585). Figured originally, 50, pl. 26, fig. 3.....	251
Fig. 14. <i>Mya (Antiguamya) arnoldi</i> (Dickerson) ( $\times 2$ ), holotype (C.A.S. 388). Figured originally, 123, pl. 29, fig. 5b.....	254
Fig. 15. <i>Macoma arctata</i> (Conrad) ( $\times 1$ ), hypotype (U.W. 366). Locality (U.W. 270). Astoria formation.....	208
Fig. 16. <i>Corbula parilis</i> Gabb ( $\times 3$ ), holotype (U.C. 33151). Martinez, California. Figured originally, 274, pl. 8, fig. 13.....	256
Fig. 17. <i>Corbula hornii</i> Gabb ( $\times 1$ ), hypotype (C.A.S. 274).....	257
Fig. 18. <i>Mya arenaria</i> Linnaeus var. <i>japonica</i> Jay ( $\times 1$ ), hypotype. Specimen figured by Reagan as <i>Mya truncata</i> Linnaeus (U.S.N.M. 328352), 230, pl. 5, fig. 46.....	253
Fig. 19. <i>Panope snohomishensis</i> Clark ( $\times 1$ ), holotype (S.U. 59). Locality (S.U. N.P. 146). Figured originally, 52, pl. 10, fig. 1.....	261

(712)



UNIV. OF WASH. PUBL. IN GEOL.

[WEAVER] VOL. V, PL. 60



## PLATE 60

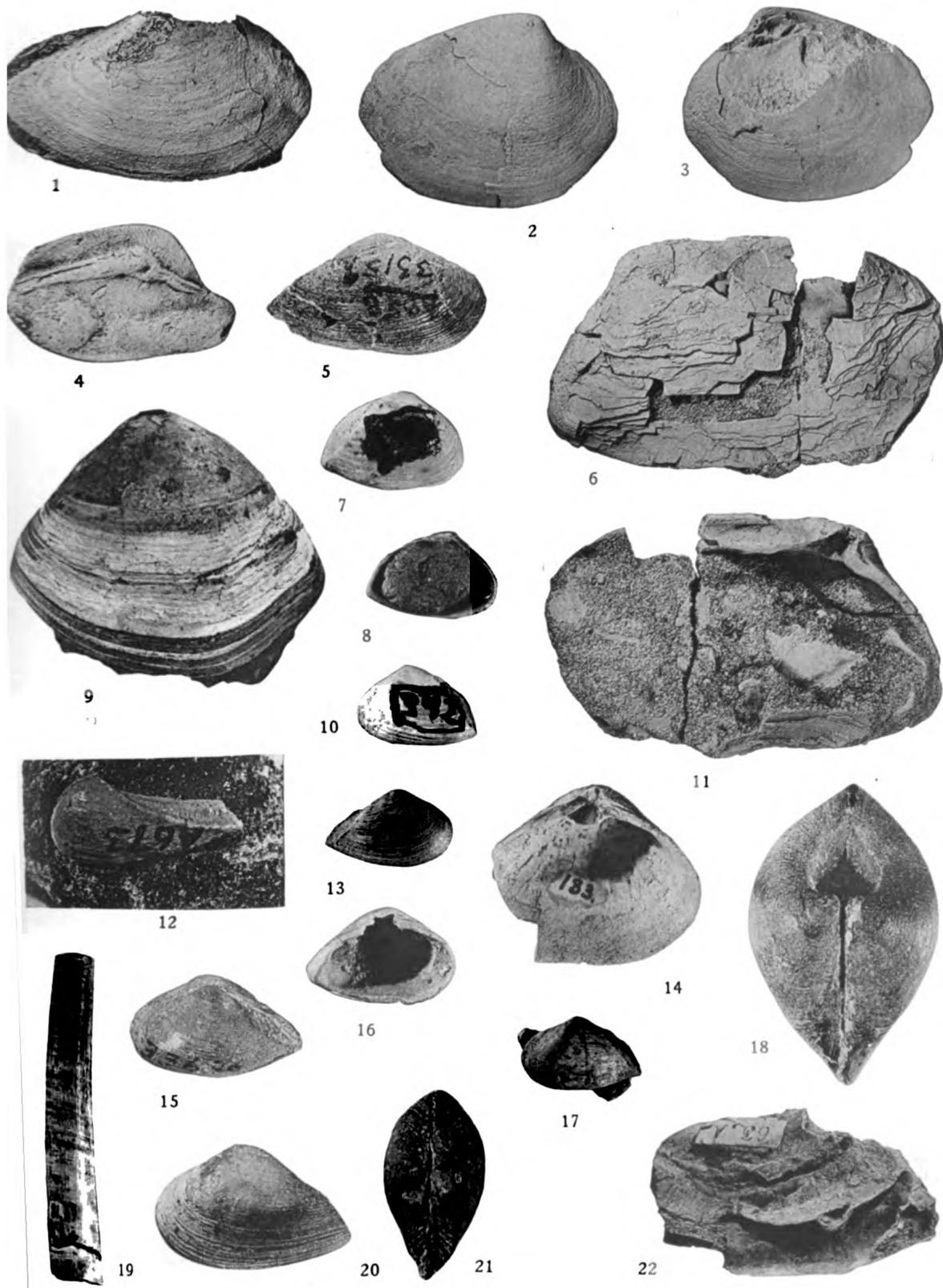
	PAGE
Fig. 1. <i>Panope (Panomya) ampla</i> (Dall) var. <i>chrysia</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 154093). Figured originally, 101, pl. 11, fig. 7.....	263
Fig. 2. <i>Panope generosa</i> Gould ( $\times 1$ ), hypotype (U.C. 32199). Blakeley formation. Figured by Tegland, 272, pl. 9, fig. 13.....	262
Fig. 3. <i>Zirfaea</i> sp. Clark and Arnold ( $\times 1$ ), holotype (U.C. 30065). Locality (S.U. N.P. 129). Figured by Clark and Arnold, 50, pl. 16, fig. 2.....	264
Fig. 4. <i>Panope generosa</i> Gould ( $\times 0.5$ ), hypotype (U.C. 32199). Figured by Tegland, 272, pl. 9, fig. 13.....	262
Fig. 5. <i>Pseudocardium landesi</i> Weaver ( $\times 0.7$ ), holotype (U.W. 66) (C.A.S. 7499). Figured originally, 286, pl. 9, fig. 75.....	248
Fig. 6. <i>Pseudocardium undiliferum</i> Weaver ( $\times 0.7$ ), holotype (U.W. 65) (C.A.S. 7503). Figured originally, 286, pl. 9, fig. 76.....	247
Fig. 7. <i>Pseudocardium densata</i> (Conrad) var. <i>altum</i> Weaver ( $\times 0.8$ ), holotype (U.W. 62) (C.A.S. 7505). Figured originally, 286, pl. 7, fig. 69.....	245
Fig. 8. <i>Pseudocardium landesi</i> Weaver ( $\times 1$ ), holotype (U.W. 66) (C.A.S. 7499). Figured originally, 286, pl. 9, fig. 75.....	248
Fig. 9. <i>Tellina merriami</i> Weaver ( $\times 1$ ), paratype (U.W. 55) (C.A.S. 7462). Figured originally, 286, pl. 9, fig. 74.....	203
Fig. 10. <i>Semele sylviaeensis</i> Weaver ( $\times 1$ ), paratype (U.W. 61-C) (C.A.S. 7458-C). Locality (U.W. 68).....	223
Fig. 11. <i>Tellina merriami</i> Weaver ( $\times 1$ ), holotype (U.W. 55-A) (C.A.S. 7462-A). Figured originally, 286, pl. 10, fig. 81.....	203
Fig. 12. "Teredo pugetensis" White ( $\times 0.5$ ), holotype (U.S.N.M. 20107). Figured by White, 309, pl. 8.....	266

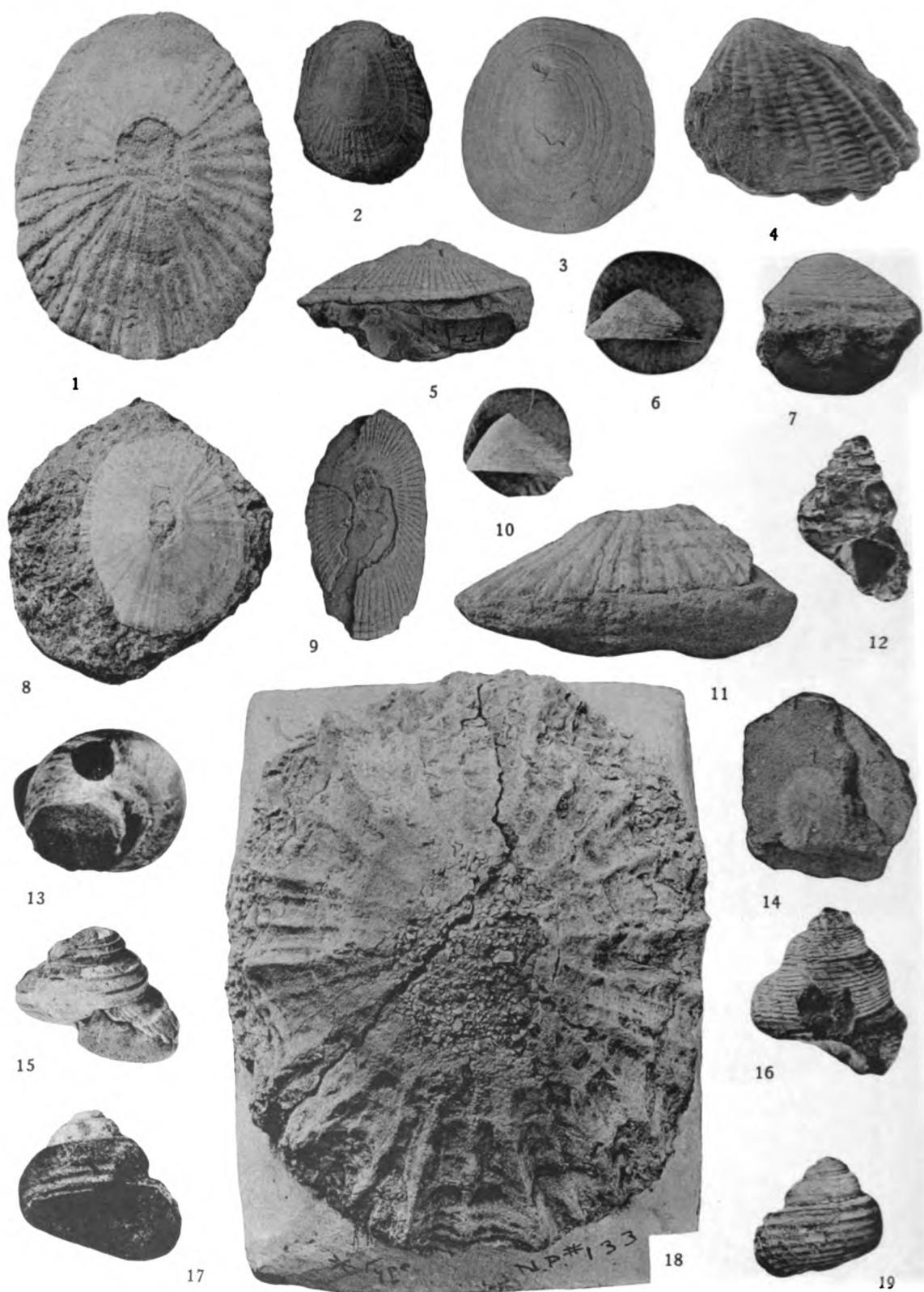
(713)

## PLATE 61

	PAGE
Fig. 1. <i>Spisula pittsburgensis</i> Clark ( $\times 1$ ), holotype (S.U. 5202). Figured originally, 52, pl. 17, fig. 2.....	235
Fig. 2. <i>Spisula veneriformis</i> Clark ( $\times 1$ ), holotype (S.U. 5215). Figured originally, 52, pl. 16, fig. 3.....	236
Fig. 3. <i>Spisula veneriformis</i> Clark ( $\times 1$ ), holotype (S.U. 5215). Figured originally, 52, pl. 16, fig. 3.....	236
Fig. 4. <i>Spisula pittsburgensis</i> Clark ( $\times 1$ ), holotype (S.U. 5202). Figured originally, 52, pl. 17, fig. 4.....	235
Fig. 5. <i>Corbula hornii</i> Gabb ( $\times 1.5$ ), hypotype (U.C. 33159). Figured by Turner, 274, pl. 8, fig. 17. South Cove, Coos Bay, Oregon.....	257
Fig. 6. <i>Myadesma dalli</i> Clark ( $\times 1$ ), holotype (S.U. 225.) Figured by Clark, 52, pl. 28, fig. 1b.....	250
Fig. 7. <i>Corbula cowlitzensis</i> Dickerson ( $\times 3.5$ ), holotype (C.A.S. 391). Figured originally, 123, pl. 28, fig. 3a.....	255
Fig. 8. <i>Corbula cowlitzensis</i> Dickerson ( $\times 3.5$ ), paratype (C.A.S. 392). Figured originally, 123, pl. 28, fig. 3c.....	255
Fig. 9. <i>Pseudocardium undiliferum</i> Weaver ( $\times 1$ ), holotype (U.W. 65) (C.A.S. 7503). Figured originally, 286, pl. 9, fig. 76.....	247
Fig. 10. <i>Corbula cowlitzensis</i> Dickerson ( $\times 3$ ), paratype (C.A.S. 392). Figured originally, 123, pl. 28, fig. 3c.....	255
Fig. 11. <i>Myadesma dalli</i> Clark ( $\times 1$ ), holotype (S.U. 225). Figured by Clark, 52, pl. 28, fig. 1a.....	250
Fig. 12. <i>Corbula torreyensis</i> Hanna ( $\times 3$ ), hypotype (U.C. 33156). Figured by Turner, 274, pl. 8, fig. 7.....	259
Fig. 13. <i>Corbula dickersoni</i> Weaver and Palmer ( $\times 1.6$ ), holotype (U.W. 180) (C.A.S. 7452). Figured originally, 301, pl. 9, fig. 10.....	257
Fig. 14. <i>Phaenomya vaderensis</i> Weaver and Palmer ( $\times 1.3$ ), holotype (U.W. 183) (C.A.S. 7464). Figured originally, 301, pl. 9, fig. 6.....	261
Fig. 15. <i>Corbula complicata</i> G. D. Hanna ( $\times 2$ ), hypotype (U.C. 33646). Figured by Turner, 274, pl. 8, fig. 9.....	259
Fig. 16. <i>Corbula dickersoni</i> Weaver and Palmer ( $\times 2$ ), syntype (U.W. 180-B) (C.A.S. 7452-B). Figured originally, 301, pl. 9, fig. 9.....	257
Fig. 17. <i>Corbula dickersoni</i> Weaver and Palmer ( $\times 2.5$ ), syntype (U.W. 180-A) (C.A.S. 7452-A).....	257
Fig. 18. <i>Crassatellites urasana</i> (Conrad) subsp. <i>mathewsonii</i> (Gabb) ( $\times 1.3$ ), hypotype (U.C. 33628). Figured by Turner, 274, pl. 10, fig. 19.....	125
Fig. 19. <i>Dentalium porteriensis</i> Weaver ( $\times 1$ ), holotype (U.W. 81) (C.A.S. 7517). Figured originally, 286, pl. 13, fig. 113.....	268
Fig. 20. <i>Corbula dickersoni</i> Weaver and Palmer ( $\times 2.5$ ), syntype (U.W. 180-B) (C.A.S. 7452-B). Figured originally, 301, pl. 9, fig. 10.....	257
Fig. 21. <i>Corbula complicata</i> G. D. Hanna ( $\times 1.2$ ), hypotype (U.C. 33646). Figured by Turner, 274, pl. 8, fig. 9.....	259
Fig. 22. <i>Serpula</i> sp. Clark and Arnold ( $\times 1$ ), holotype (U.C. 30255). Figured originally, 50, pl. 39, fig. 4.....	4

(714)



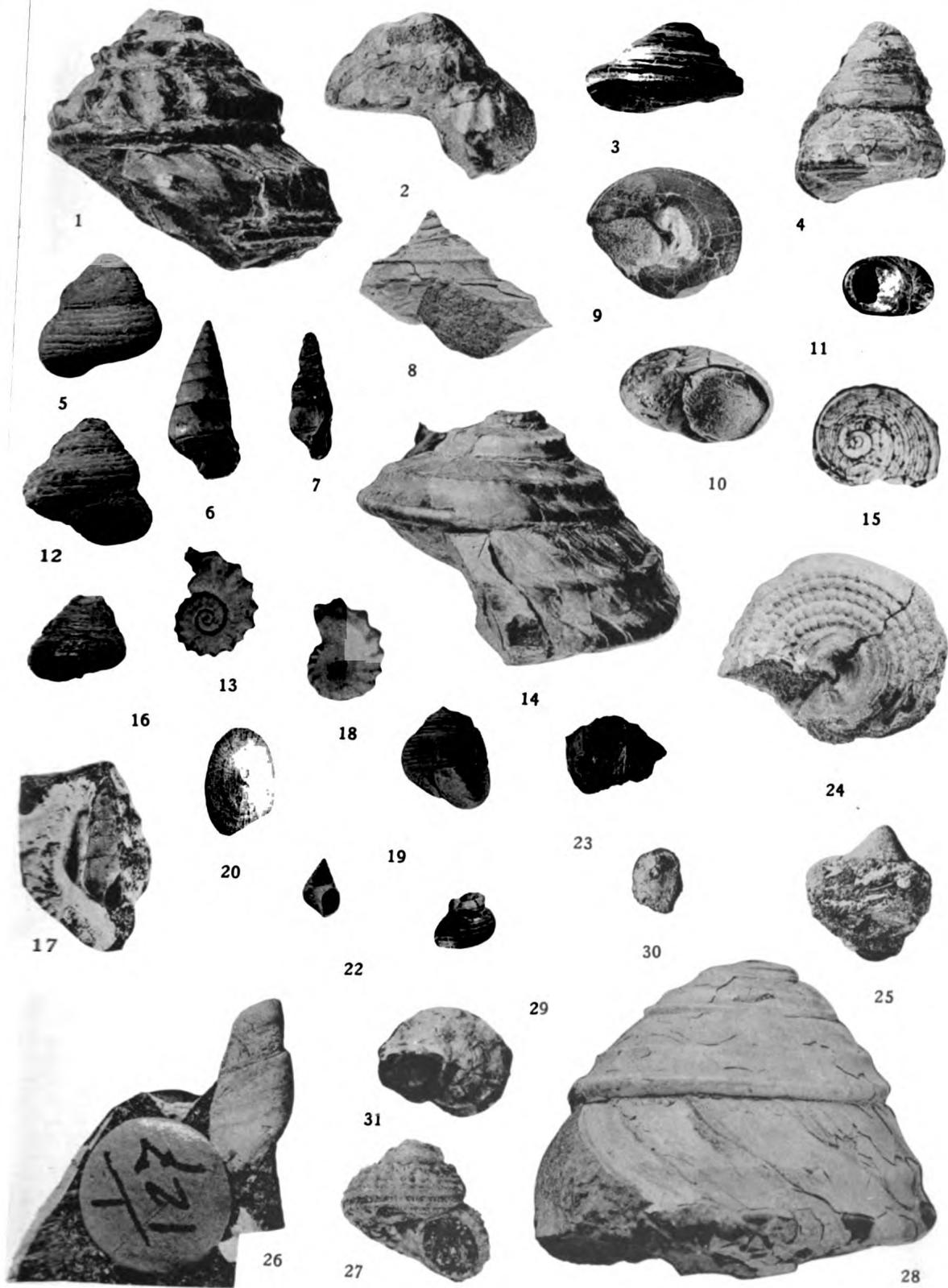


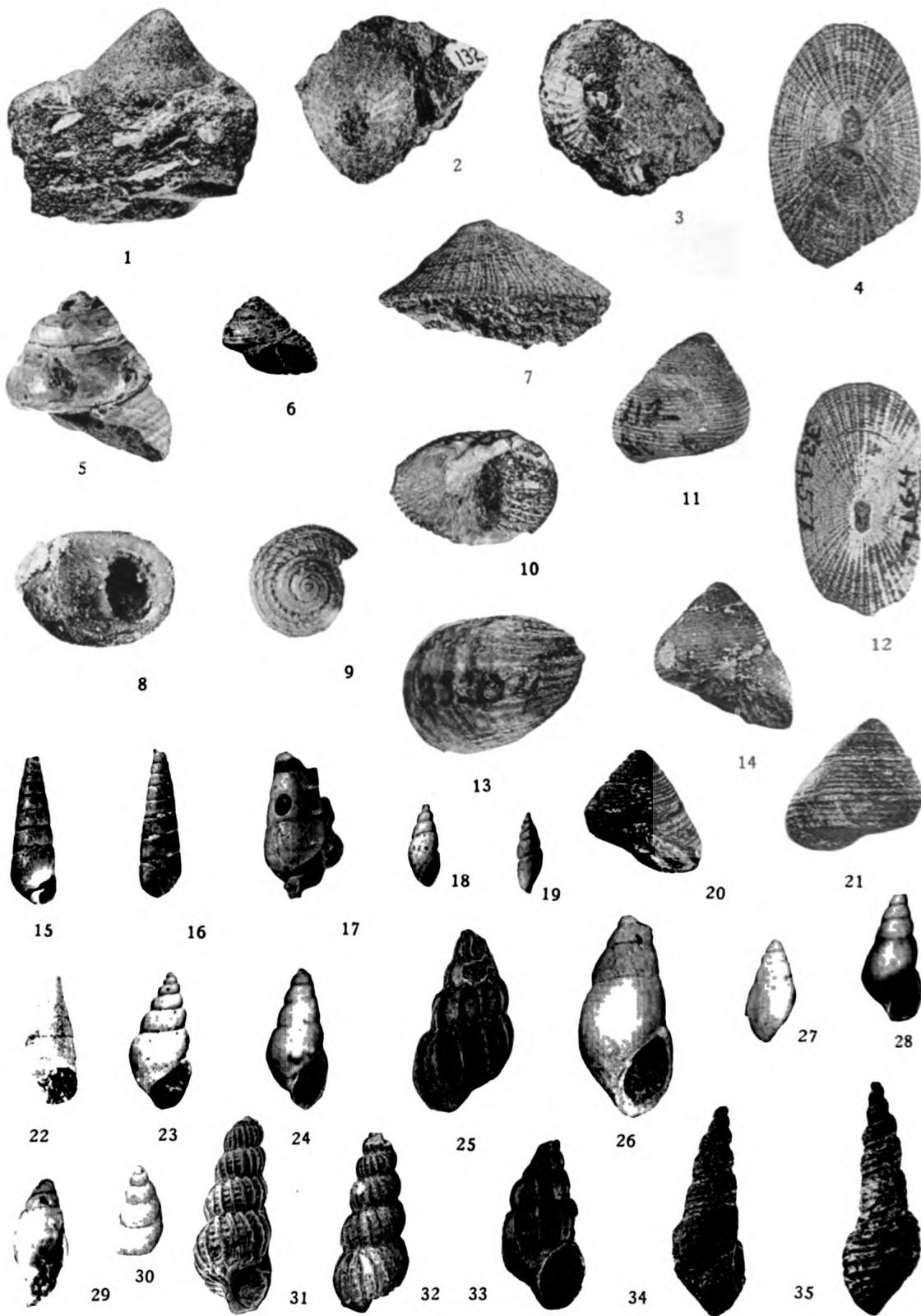
## PLATE 62

	PAGE
Fig. 1. <i>Acmaea victoriana</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30290). Figured by Clark and Arnold, 50, pl. 34, fig. 1b.....	282
Fig. 2. <i>Acmaea persona</i> Eschscholtz subsp. <i>vancouverensis</i> Clark and Arnold ( $\times 1.9$ ), holotype (U.C. 30216). Figured by Clark and Arnold, 50, pl. 35, fig. 2a.....	281
Fig. 3. <i>Acmaea mitra</i> Eschscholtz subsp. <i>sookensis</i> Clark and Arnold ( $\times 0.6$ ), holotype (U.C. 30071). Figured by Clark and Arnold, 50, pl. 35, fig. 2a. 281	
Fig. 4. <i>Acmaea geometrica</i> (Merriam) ( $\times 1.4$ ), holotype (U.C. 11933). Figured originally by Merriam as <i>Patella geometrica</i> , 197, pl. 23, fig. 4.....	279
Fig. 5. <i>Megathura vancouverensis</i> Clark and Arnold ( $\times 1.8$ ), holotype (U.C. 30077). Figured originally, 50, pl. 34, fig. 3a.....	285
Fig. 6. <i>Acmaea ocititia</i> Hanna ( $\times 2.3$ ), holotype (C.A.S. 440). Originally described as <i>Patella subquadrata</i> by Dickerson, 123, pl. 31, figs. 13a, 13b. 279	
Fig. 7. <i>Acmaea persona</i> Eschscholtz subsp. <i>vancouverensis</i> Clark and Arnold ( $\times 1.9$ ), holotype (U.C. 30216). Figured by Clark and Arnold, 50, pl. 35, fig. 1a.....	281
Fig. 8. <i>Acmaea victoriana</i> Clark and Arnold ( $\times 1$ ), cotype (U.C. 30215). Figured by Clark and Arnold, 50, pl. 34, fig. 2a.....	282
Fig. 9. <i>Megathura vancouverensis</i> Clark and Arnold ( $\times 1.8$ ), holotype (U.C. 30077). Figured originally, 50, pl. 34, fig. 3a.....	285
Fig. 10. <i>Acmaea simplex</i> Dickerson ( $\times 3$ ), holotype (C.A.S. 438). Figured by Dickerson, 123, pl. 31, fig. 11b.....	282
Fig. 11. <i>Acmaea victoriana</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30290). Figured by Clark and Arnold, 50, pl. 34, fig. 1a.....	282
Fig. 12. <i>Calliostoma mea</i> Tegland ( $\times 2.3$ ), holotype (U.C. 32223). Figured originally, 272, pl. 15, figs. 6, 7.....	286
Fig. 13. <i>Tegula (Chlorostoma) lahondaensis</i> (Arnold) var. <i>stantoni</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 107777). Figured originally, 101, pl. 2, fig. 11.....	290
Fig. 14. <i>Puncturella?</i> sp. Clark and Arnold ( $\times 1$ ), holotype, (U.C. 30217). Figured originally, 50, pl. 38, fig. 3.....	285
Fig. 15. <i>Tegula (Chlorostoma) lahondaensis</i> (Arnold) var. <i>stantoni</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 107777). .....	290
Fig. 16. <i>Calliostoma pacificum</i> Anderson and Martin ( $\times 1.7$ ), holotype (C.A.S. 134). Figured originally, 5, pl. 8, figs. 2a, 2b.....	286
Fig. 17. <i>Margarites (Lirularia) condoni</i> Dall ( $\times 1.7$ ), holotype (U.S.N.M. 153922). Figured originally, 101, pl. 6, fig. 8.....	290
Fig. 18. <i>Acmaea hannibali</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30213). Figured by Clark and Arnold, 50, pl. 38, fig. 1a.....	280
Fig. 19. <i>Margarites (Lirularia) condoni</i> Dall ( $\times 1.7$ ), holotype (U.S.N.M. 153922). Figured originally, 101, pl. 6, fig. 7.....	290

## PLATE 63

	PAGE
Fig. 1. <i>Turcicula columbiana</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 107397). Figured originally, 101, pl. 3, figs. 2, 11.....	292
Fig. 2. <i>Astraea (Pachypoma) inaequalis</i> (Martyn) ( $\times 1$ ), holotype of <i>A. precursor</i> (U.S.N.M. 153919). Figured by Dall, 101, pl. 6, fig. 6.....	297
Fig. 3. <i>Calliostoma cammani</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 107776). Figured originally, 101, pl. 2, fig. 8.....	288
Fig. 4. <i>Turcica gabbi</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153968). Figured originally, 101, pl. 4, fig. 5.....	288
Fig. 5. <i>Homalopoma vancouverensis</i> (Clark and Arnold) ( $\times 2$ ), holotype (U.C. 30206). Figured originally as <i>Leptothyra vancouverensis</i> , 50, pl. 37, fig. 3b.....	299
Fig. 6. <i>Melanella clarki</i> (Dickerson) ( $\times 6$ ), holotype (C.A.S. 433). Figured originally as <i>Eulima clarki</i> , 123, pl. 31, fig. 8.....	302
Fig. 7. <i>Melanella dilleri</i> (Anderson and Martin) ( $\times 2$ ), holotype (C.A.S. 140). Figured originally as <i>Eulinella dilleri</i> , 5, pl. 7, fig. 24.....	303
Fig. 8. <i>Turcicula washingtoniana</i> Dall ( $\times 1$ ), topotype (U.C. 32221). Figured by Tegland, 272, pl. 15, fig. 2.....	291
Fig. 9. <i>Calliostoma cammani</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 107776). Figured originally, 101, pl. 2, fig. 9.....	288
Fig. 10. <i>Neritina martini</i> Dickerson ( $\times 1.2$ ), holotype (C.A.S. 291). Figured originally, 121, pl. 5, fig. 8a.....	296
Fig. 11. <i>Nerita cowlitzensis</i> Dickerson ( $\times 2$ ), holotype (C.A.S. 290). Figured originally, 121, pl. 5, figs. 7a, 7b.....	294
Fig. 12. <i>Homalopoma vancouverensis</i> (Clark and Arnold) ( $\times 2$ ), holotype (U.C. 30206). Figured originally as <i>Leptothyra vancouverensis</i> , 50, pl. 37, fig. 3a.....	299
Fig. 13. <i>Liotia weaveri</i> Effinger ( $\times 7$ ), hypotype (U.C. ?). Not previously figured. Locality (U.W. 239).....	301
Fig. 14. <i>Turcicula washingtoniana</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 110448). Figured originally, 101, pl. 18, fig. 4.....	291
Fig. 15. <i>Cirsochilus washingtonianus</i> Effinger ( $\times 7$ ), holotype (U.C. 33553). Figured originally, 138, pl. 46, fig. 27.....	300
Fig. 16. <i>Homalopoma pacifica</i> (Anderson and Martin) ( $\times 1.7$ ), hypotype (U.C. 31982). Figured by Etherington, 140, pl. 11, fig. 8.....	297
Fig. 17. <i>Turbanilla (Pyrgolampros) rockensis</i> Etherington ( $\times 2.5$ ), holotype (U.C. 32037). Figured originally, 140, pl. 13, fig. 12.....	304
Fig. 18. <i>Liotia weaveri</i> Effinger ( $\times 6$ ), holotype (U.C. 33556). Figured originally, 138, pl. 46, figs. 15, 21.....	301
Fig. 19. <i>Homalopoma pacifica</i> (Anderson and Martin) ( $\times 1.8$ ), hypotype (U.C. 31983). Figured originally by Etherington, 140, pl. 11, fig. 12.....	297
Fig. 20. <i>Diodora stillwaterensis</i> (Weaver and Palmer) ( $\times 1$ ), holotype (U.W. 184) (C.A.S. 7625). Figured originally, 301, pl. 11, fig. 6, as <i>Fissuridea stillwaterensis</i> .....	284
Fig. 22. <i>Littorina oligocenea</i> Dickerson ( $\times 3$ ), holotype (C.A.S. 426). Figured originally, 123, pl. 31, fig. 1.....	328
Fig. 23. <i>Acmaea dickersoni</i> Van Winkle ( $\times 1.2$ ), holotype (U.W. 132) (C.A.S. 7627). Figured originally by Van Winkle, 275, pl. 7, fig. 15.....	283
Fig. 24. <i>Astrea (Pachypoma) inaequalis</i> (Martyn) ( $\times 1$ ), holotype of <i>A. precursor</i> (U.S.N.M. 153919). Figured by Dall, 101, pl. 6, fig. 5.....	297
Fig. 25. <i>Acmaea simplex</i> Dickerson ( $\times 0.8$ ), hypotype (U.W. 133) (C.A.S. 7628). Figured originally as the holotype of <i>Acmaea clarki</i> by Van Winkle, 275, pl. 6, fig. 4.....	282
Fig. 26. <i>Strombiformis washingtoni</i> (Reagan) ( $\times 2.5$ ), holotype (U.S.N.M. 328368). Figured originally as <i>Eulima washingtoni</i> , 230, pl. 6, fig. 60.....	303
Fig. 27. <i>Solariella crescentensis</i> Weaver and Palmer ( $\times 5.2$ ), holotype (U.W. 186) (C.A.S. 7631). Figured originally, 301, pl. 12, fig. 11.....	293
Fig. 28. <i>Turcicula washingtoniana</i> Dall ( $\times 1.2$ ), hypotype (S.U. 802). Figured by Tegland, 272, pl. 15, fig. 5.....	291
Fig. 29. <i>Solariella kincaidi</i> Tegland ( $\times 3$ ), holotype (U.C. 32260). Figured originally, 272, pl. 15, fig. 8.....	294
Fig. 30. <i>Acmaea oakvillensis</i> Van Winkle ( $\times 0.7$ ), holotype (U.W. 131) (C.A.S. 7626). Figured originally by Van Winkle, 275, pl. 7, fig. 18.....	283
Fig. 31. <i>Cirsochilus washingtonianus</i> Effinger ( $\times 7$ ), holotype (U.C. 33553). Figured originally, 138, pl. 46, fig. 28.....	300



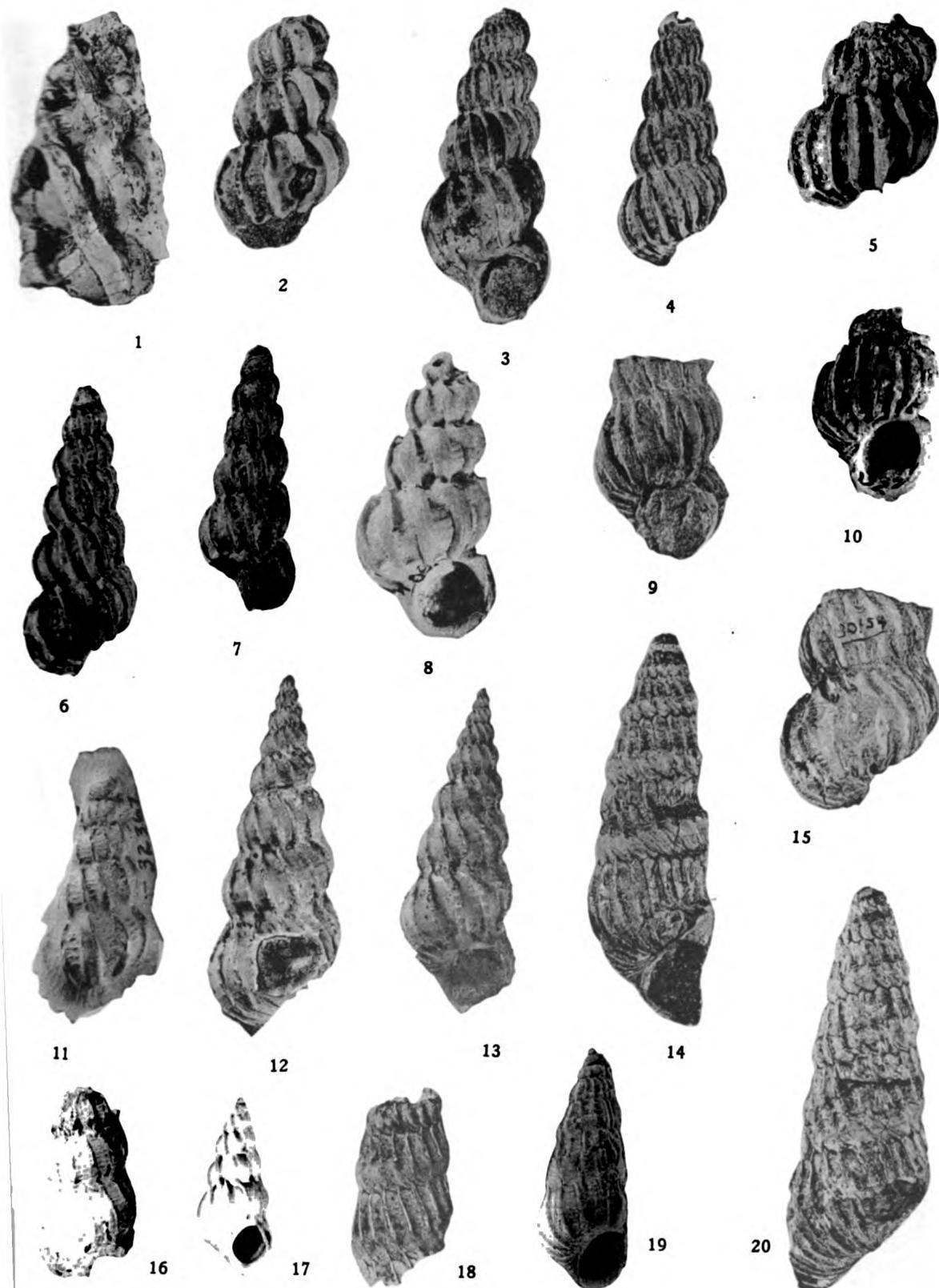


## PLATE 64

	PAGE
Fig. 1. <i>Acmaea simplex</i> Dickerson ( $\times 2.3$ ), hypotype (U.W. 133) (C.A.S. 7628). Figured originally as <i>Acmaea clarki</i> Van Winkle, 121, pl. 6, fig. 4. This figure is duplicate of the poor figure on pl. 63, fig. 25 of this report.....	282
Fig. 2. <i>Acmaea dickersoni</i> Van Winkle ( $\times 2$ ), holotype (U.W. 132) (C.A.S. 7627). Figured originally by Van Winkle, 275, pl. 7, fig. 15.....	283
Fig. 3. <i>Acmaea oakvillensis</i> Van Winkle ( $\times 2.1$ ), holotype (U.W. 131) (C.A.S. 7626). Figured originally by Van Winkle, 275, pl. 7, fig. 18. This figure is a duplicate of poor figure, pl. 63, fig. 30, in this report.....	283
Fig. 4. <i>Diodora stillwaterensis</i> (Weaver and Palmer) ( $\times 2$ ), holotype (U.W. 184) (C.A.S. 7625). Figured originally as <i>Fissuridea stillwaterensis</i> , 301, pl. 11, fig. 6.....	284
Fig. 5. <i>Calliostoma delcinsensis</i> Weaver ( $\times 2$ ), neotype (U.W. 70) (C.A.S. 7629). Holotype lost but figured originally, 286, pl. 6, figs. 59, 60, 61, 63.....	287
Fig. 6. <i>Solariella olequahensis</i> Weaver and Palmer ( $\times 3$ ), holotype (U.W. 185) (C.A.S. 7630). Figured originally, 301, pl. 12, fig. 12.....	293
Fig. 7. <i>Diodora stillwaterensis</i> (Weaver and Palmer) ( $\times 2$ ), holotype (U.W. 184) (C.A.S. 7625). Figured originally as <i>Fissuridea stillwaterensis</i> , 301, pl. 11, fig. 6.....	284
Fig. 8. <i>Nerita washingtoniana</i> Weaver and Palmer ( $\times 6$ ), holotype (U.W. 187) (C.A.S. 7591). Figured originally, 301, pl. 11, fig. 4.....	295
Fig. 9. <i>Solariella olequahensis</i> Weaver and Palmer ( $\times 3$ ), holotype (U.W. 185) (C.A.S. 7630). Figured originally, 301, pl. 12, fig. 10.....	293
Fig. 10. <i>Nerita triangulata</i> Gabb var. <i>oregonensis</i> Turner ( $\times 2$ ), holotype (U.C. 33204). Figured originally, 274, pl. 19, fig. 12.....	295
Fig. 11. <i>Homalopoma wattsi</i> (Dickerson) ( $\times 2$ ), hypotype (U.C. 33212). Figured by Turner, 274, pl. 15, fig. 16.....	298
Fig. 12. <i>Diodora stillwaterensis</i> (Weaver and Palmer) ( $\times 1$ ), topotype (U.C. 33457).....	284
Fig. 13. <i>Nerita triangulata</i> Gabb var. <i>oregonensis</i> Turner ( $\times 2$ ), holotype (U.C. 33204). Figured originally, 274, pl. 19, fig. 11.....	295
Fig. 14. <i>Homalopoma wattsi</i> (Dickerson) ( $\times 2$ ), hypotype (U.C. 33212). Figured by Turner, 274, pl. 15, fig. 16.....	298
Fig. 15. <i>Pyramidella vaderensis</i> Weaver and Palmer ( $\times 3$ ), syntype (U.W. 188) (C.A.S. 7621). Figured originally, 301, pl. 11, fig. 17.....	305
Fig. 16. <i>Pyramidella vaderensis</i> Weaver and Palmer ( $\times 3$ ), syntype (U.W. 188) (C.A.S. 7621). Figured originally, 301, pl. 11, fig. 17.....	305
Fig. 17. <i>Pyramidella vaderensis</i> Weaver and Palmer ( $\times 3$ ), syntype (U.W. 188-A) (C.A.S. 7621-A). Figured originally, 301, pl. 11, fig. 16.....	305
Fig. 18. <i>Odostomia hiltoni</i> (Van Winkle) ( $\times 4.8$ ), hypotype (U.C. 33562). Figured by Effinger, 138, pl. 47, fig. 5.....	307
Fig. 19. <i>Odostomia hiltoni</i> (Van Winkle) ( $\times 4.8$ ), hypotype (U.C. 33562). Figured by Effinger, 138, pl. 47, fig. 4.....	307
Fig. 20. <i>Homalopoma umpquaensis</i> Merriam and Turner ( $\times 3$ ), holotype (U.C. 33207). Figured by Turner, 274, pl. 15, fig. 14.....	299
Fig. 21. <i>Homalopoma umpquaensis</i> Merriam and Turner ( $\times 3$ ), holotype (U.C. 33207). Figured by Turner, 274, pl. 15, fig. 14.....	299
Fig. 22. <i>Pyramidella praecursor</i> G. D. Hanna ( $\times 7$ ), holotype (U.W. 134) (C.A.S. 7620). Figured originally by Van Winkle as <i>Eulima smithi</i> , 275, pl. 7, fig. 22.....	305
Fig. 23. <i>Odostomia winlockiana</i> Effinger ( $\times 7$ ), paratype (U.C. 14882). Figured originally, 138, pl. 46, fig. 20.....	306
Fig. 24. <i>Odostomia winlockiana</i> Effinger ( $\times 8.4$ ), holotype (U.C. 33565). Figured originally, 138, pl. 46, fig. 17.....	306
Fig. 25. <i>Epitonium (Gyroscala) effingeri</i> Durham ( $\times 3$ ), holotype (U.C. 30146). Figured by Durham, 137, pl. 56, fig. 25.....	310
Fig. 26. <i>Odostomia griesensis</i> Effinger ( $\times 16$ ), paratype (U.C. 14810). Figured originally, 138, pl. 46, fig. 23.....	308
Fig. 27. <i>Odostomia griesensis</i> Effinger ( $\times 8$ ), paratype (U.C. 14810). Figured originally, 138, pl. 46, fig. 25.....	308
Fig. 28. <i>Odostomia griesensis</i> Effinger ( $\times 6.5$ ), holotype (U.C. 33564). Figured originally, 138, pl. 46, fig. 24.....	308
Fig. 29. <i>Odostomia hiltoni</i> (Van Winkle) ( $\times 8$ ), hypotype (U.C. 33562). Not previously figured.....	307
Fig. 30. <i>Odostomia winlockiana</i> Effinger ( $\times 11$ ), holotype (U.C. 33565). View showing nucleus. Figured originally, 138, pl. 46, fig. 13.....	306
Fig. 31. <i>Epitonium (Cirsotrema) saundersi</i> Tegland ( $\times 1.2$ ), holotype (U.C. 32227). Figured originally by Tegland, 272, pl. 13, fig. 7.....	312
Fig. 32. <i>Epitonium (Cirsotrema) saundersi</i> Tegland ( $\times 1$ ), holotype (U.C. 32227). Figured originally by Tegland, 272, pl. 13, fig. 7.....	312
Fig. 33. <i>Epitonium (Gyroscala) effingeri</i> Durham ( $\times 2.7$ ), holotype (U.C. 30146). Figured originally, 137, pl. 56, fig. 25.....	310
Fig. 34. <i>Mathilda umpquaensis</i> Turner ( $\times 1.5$ ), holotype (U.C. 33218). Figured by Turner, 274, pl. 21, fig. 2.....	309
Fig. 35. <i>Mathilda umpquaensis</i> Turner ( $\times 1.5$ ), holotype (U.C. 33218). Figured by Turner, 274, pl. 21, fig. 2.....	309

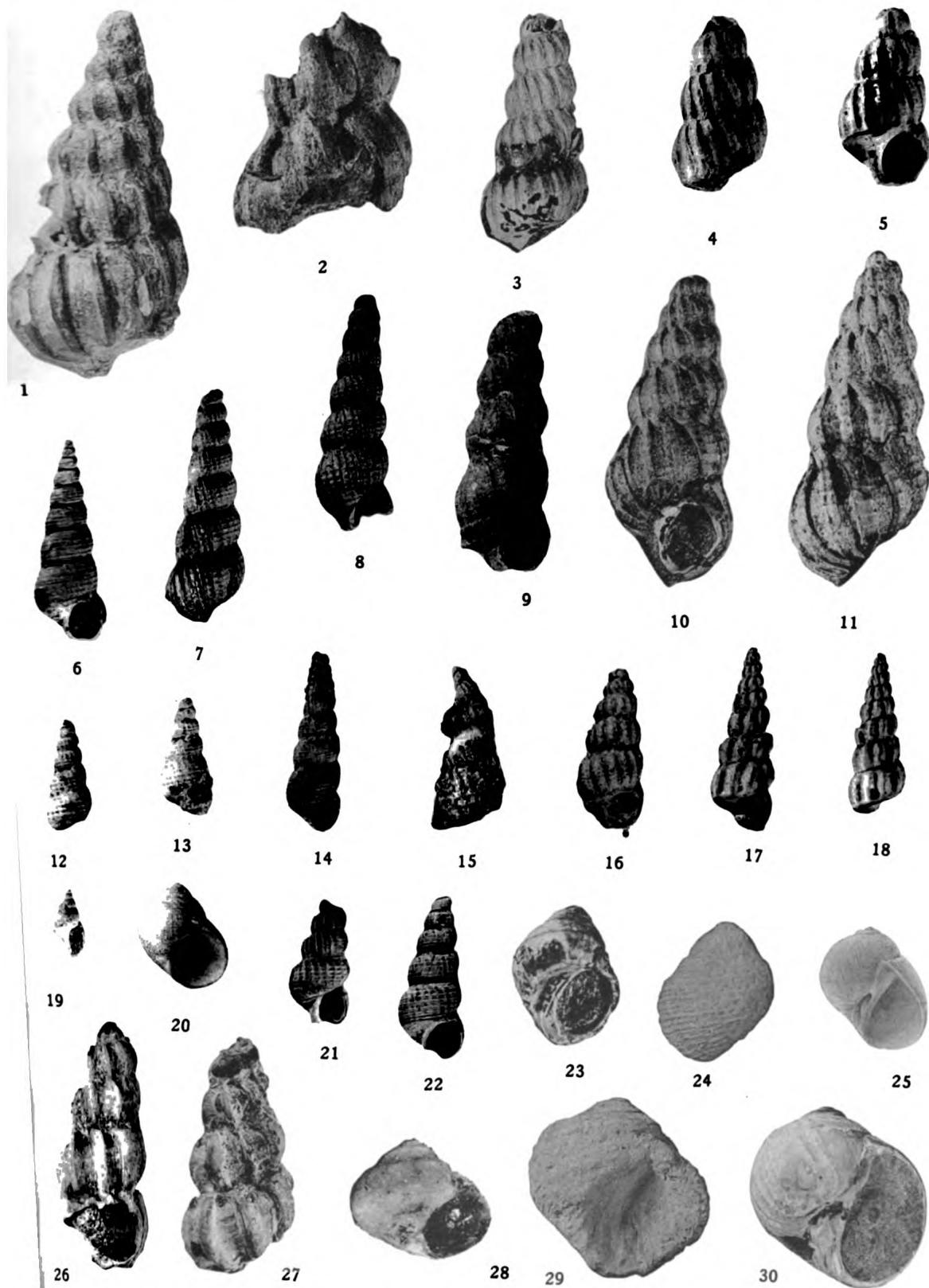
## PLATE 65

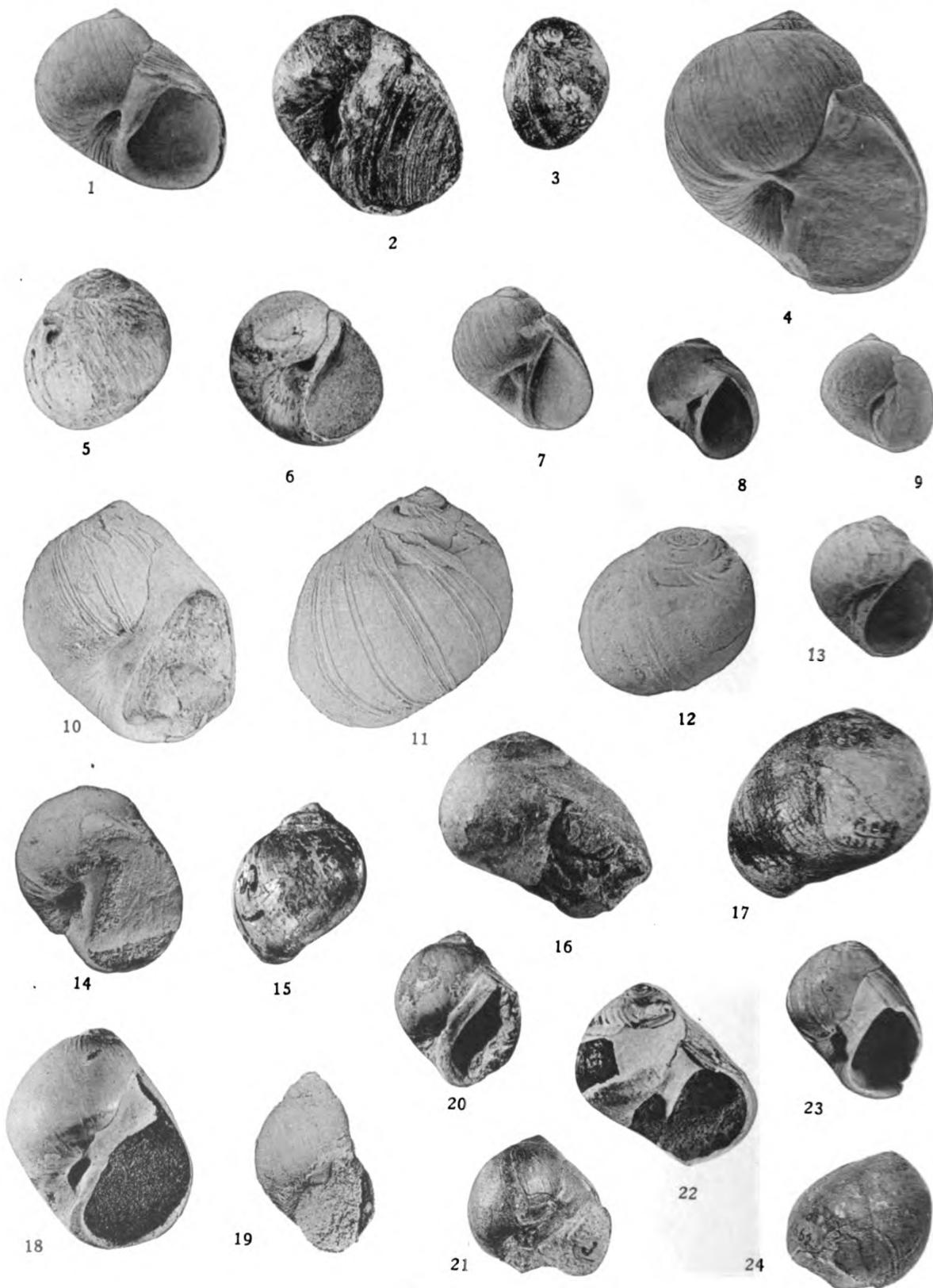
	PAGE
Fig. 1. <i>Epitonium (Clathrus) weaveri</i> Durham ( $\times 2.2$ ), holotype (C.A.S. 7002). Figured originally, 137, pl. 56, fig. 6.....	310
Fig. 2. <i>Epitonium (Cirsotrema) clallamense</i> Durham ( $\times 1.4$ ), holotype (C.A.S. 7003). Figured originally, 137, pl. 56, fig. 27.....	311
Fig. 3. <i>Epitonium (Cirsotrema) saundersi</i> Tegland ( $\times 1.7$ ), holotype (U.C. 32227). Figured originally by Tegland, 272, pl. 13, fig. 7.....	312
Fig. 4. <i>Epitonium (Cirsotrema) saundersi</i> Tegland ( $\times 1.4$ ), holotype (U.C. 32227). Figured originally by Tegland, 272, pl. 13, fig. 7.....	312
Fig. 5. <i>Epitonium (Cirsotrema) saundersi</i> Tegland ( $\times 1$ ), paratype (U.C. 32226). Rear view of specimen figured by Tegland, 272, pl. 13, figs. 8, 9.....	312
Fig. 6. <i>Epitonium (Cirsotrema) saundersi</i> Tegland ( $\times 4$ ), hypotype (U.C. 30173). .....	312
Fig. 7. <i>Epitonium (Cirsotrema) saundersi</i> Tegland ( $\times 4$ ), hypotype (U.C. 30173). .....	312
Fig. 8. <i>Epitonium (Cirsotrema) howei</i> Durham ( $\times 2$ ), holotype (C.A.S. 7004). Figured originally, 137, pl. 56, fig. 8.....	312
Fig. 9. <i>Epitonium (Boreoscala) earlturneri</i> Durham ( $\times 1$ ), holotype (U.C. 30154). Figured originally, 137, pl. 56, fig. 9.....	313
Fig. 10. <i>Epitonium (Cirsotrema) saundersi</i> Tegland ( $\times 1$ ), paratype (U.C. 32226). Figured originally by Tegland, 272, pl. 13, figs. 8, 9.....	312
Fig. 11. <i>Epitonium (Boreoscala) insecuritum</i> Hanna ( $\times 1$ ), plastoholotype (U.C. 32367). This form originally was described by Weaver and Palmer as <i>Epitonium washingtoniana</i> and the holotype which now is lost was figured originally, 301, pl. 11, fig. 19.....	313
Fig. 12. <i>Epitonium (Boreoscala) condoni</i> Dall ( $\times 1.2$ ), hypotype (U.C. 30156). Figured originally by Durham, 137, pl. 57, fig. 4.....	314
Fig. 13. <i>Epitonium (Boreoscala) condoni</i> Dall ( $\times 1.2$ ), hypotype (U.C. 30156). Figured originally by Durham, 137, pl. 57, fig. 4.....	314
Fig. 14. <i>Epitonium (Boreoscala) condoni</i> Dall var. <i>eugenense</i> Durham ( $\times 1$ ), holotype (C.A.S. 7006). Figured originally, 137, pl. 57, fig. 1.....	315
Fig. 15. <i>Epitonium (Boreoscala) earlturneri</i> Durham ( $\times 1.1$ ), holotype (U.C. 30154). Figured originally, 137, pl. 56, fig. 9.....	313
Fig. 16. <i>Epitonium (Boreoscala) condoni</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 135122). Figured originally, 101, pl. 3, fig. 1.....	314
Fig. 17. <i>Epitonium (Boreoscala) condoni</i> Dall ( $\times 1$ ), hypotype (C.A.S. 409)...	314
Fig. 18. <i>Epitonium (Boreoscala) condoni</i> Dall var. <i>oregonense</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 135123). Figured originally by Dall as the holotype of <i>Epitonium oregonense</i> , 101, pl. 3, fig. 3.....	316
Fig. 19. <i>Epitonium (Boreoscala) condoni</i> Dall var. <i>oregonense</i> Dall ( $\times 1$ ), hypotype (U.C. 33493).....	316
Fig. 20. <i>Epitonium (Boreoscala) condoni</i> Dall var. <i>eugenense</i> Durham ( $\times 1$ ), holotype (C.A.S. 7006). Figured originally, 137, pl. 57, fig. 1.....	315



## PLATE 67

	PAGE
Fig. 1. <i>Opalia (Opalia) rugifera</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 135121). Figured originally, 101, pl. 3, fig. 10.....	321
Fig. 2. <i>Epitonium (Sthenorystis) crescentense</i> Durham ( $\times 1.4$ ), holotype (U.C. 30164). Figured originally, 137, pl. 56, fig. 11.....	321
Fig. 3. <i>Opalia (Opalia) wishkahensis</i> Durham ( $\times 1.8$ ), holotype (C.A.S. 7008). Figured originally, 137, pl. 56, fig. 17.....	322
Fig. 4. <i>Opalia (Opalia) wishkahensis</i> Durham ( $\times 2.5$ ), paratype (C.A.S. 7009). Figured originally, 137, pl. 56, fig. 17.....	322
Fig. 5. <i>Opalia (Opalia) wishkahensis</i> Durham ( $\times 2.5$ ), paratype (C.A.S. 7009). Figured originally, 137, pl. 56, fig. 17.....	322
Fig. 6. <i>Acrilla (Ferminoscala) lincolensis</i> (Weaver) ( $\times 1.6$ ), holotype (C.A.S. 464). Figured originally, 295, pl. 5, fig. 85.....	326
Fig. 7. <i>Acrilla (Ferminoscala) dickersoni</i> Durham ( $\times 2.4$ ), paratype (U.C. 33571). Figured originally, 137, pl. 57, fig. 12.....	325
Fig. 8. <i>Acrilla (Ferminoscala) dickersoni</i> Durham ( $\times 2.4$ ), paratype (U.C. 33571). Figured originally, 137, pl. 57, fig. 12.....	325
Fig. 9. <i>Acrilla (Ferminoscala) aragoensis</i> (Turner) ( $\times 1.4$ ), holotype (U.C. 33237). Figured originally, 137, pl. 57, fig. 24, and 274, pl. 15, fig. 24.....	324
Fig. 10. <i>Epitonium (Boreoscala) insecuritum</i> Hanna ( $\times 1$ ), hypotype (U.C. 12501).....	313
Fig. 11. <i>Epitonium (Boreoscala) insecuritum</i> Hanna ( $\times 1$ ), hypotype (U.C. 12501).....	313
Fig. 12. <i>Acrilla (Ferminoscala) berthiaumei</i> Durham ( $\times 3$ ), holotype (U.C. 30183). Figured originally, 137, pl. 57, fig. 23.....	324
Fig. 13. <i>Acrilla (Ferminoscala) berthiaumei</i> Durham ( $\times 3$ ), holotype (U.C. 30183). Figured originally, 137, pl. 57, fig. 23.....	324
Fig. 14. <i>Acrilla (Ferminoscala) becki</i> Durham ( $\times 1.7$ ), holotype (U.C. 30169). Figured originally, 137, pl. 57, fig. 20.....	325
Fig. 15. <i>Acrilla (Undiscala?) olympicensis</i> Durham ( $\times 2.2$ ), holotype (U.C. 30185). Figured originally, 137, pl. 56, fig. 16.....	327
Fig. 16. <i>Opalia (Rugatiscala) cowlitzensis</i> Durham ( $\times 7.5$ ), holotype (U.C. 30171). Figured originally, 137, pl. 57, fig. 18.....	323
Fig. 17. <i>Opalia (Opalia) bravenderi</i> Durham ( $\times 3$ ), holotype (U.C. 30167). Figured originally, 137, pl. 56, fig. 13.....	322
Fig. 18. <i>Opalia (Opalia) bravenderi</i> Durham ( $\times 2.5$ ), holotype (U.C. 30167). Figured originally, 137, pl. 56, fig. 13.....	322
Fig. 19. <i>Littorina oligocenica</i> Dickerson ( $\times 4$ ), holotype (C.A.S. 426). Figured originally, 123, pl. 31, fig. 1.....	328
Fig. 20. <i>Littorina petricola</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153991). Figured originally, 101, pl. 4, fig. 9.....	329
Fig. 21. <i>Acrilla (Ferminoscala) dickersoni</i> Durham ( $\times 2.6$ ), holotype (C.A.S. 432). Figured by Dickerson as <i>Epitonium washingtonensis</i> , 123, pl. 31, figs. 7a, 7b.....	325
Fig. 22. <i>Acrilla (Undiscala) washingtonensis</i> (Weaver) ( $\times 1.1$ ), holotype (C.A.S. 557). Figured originally, 295, pl. 4, figs. 46, 47.....	327
Fig. 23. <i>Littorina sookensis</i> Clark and Arnold ( $\times 1$ ), holotype (C.A.S. 581). Figured originally, 50, pl. 37, fig. 5b.....	329
Fig. 24. <i>Littorina sookensis</i> Clark and Arnold ( $\times 1$ ), holotype (C.A.S. 581). Figured originally, 50, pl. 37, fig. 5a.....	329
Fig. 25. <i>Natica (Tectonatica) clarki</i> Etherington ( $\times 1$ ), holotype (U.C. 31996). Figured originally, 140, pl. 12, fig. 12.....	332
Fig. 26. <i>Epitonium (Cirsotrema) clallamense</i> Durham ( $\times 1.5$ ), paratype (U.C. 30170). Figured originally, 137, pl. 56, fig. 28.....	311
Fig. 27. <i>Epitonium (Cirsotrema) clallamense</i> Durham ( $\times 1.5$ ), paratype (U.C. 30170). Figured originally, 137, pl. 56, fig. 28.....	311
Fig. 28. <i>Natica (Tectonatica) oligocenica</i> Van Winkle ( $\times 4$ ), holotype (U.W. 136) (C.A.S. 7527). Figured originally, 275, pl. 7, fig. 23.....	334
Fig. 29. <i>Littorina sookensis</i> Clark and Arnold ( $\times 1.3$ ), cotype (U.C. 30214). Figured originally, 50, pl. 37, fig. 4b.....	329
Fig. 30. <i>Natica (Tectonatica) dalli</i> Cossmann ( $\times 1$ ), holotype (U.S.N.M. 153917). Figured originally by Dall, 101, pl. 5, fig. 10.....	330





## PLATE 68

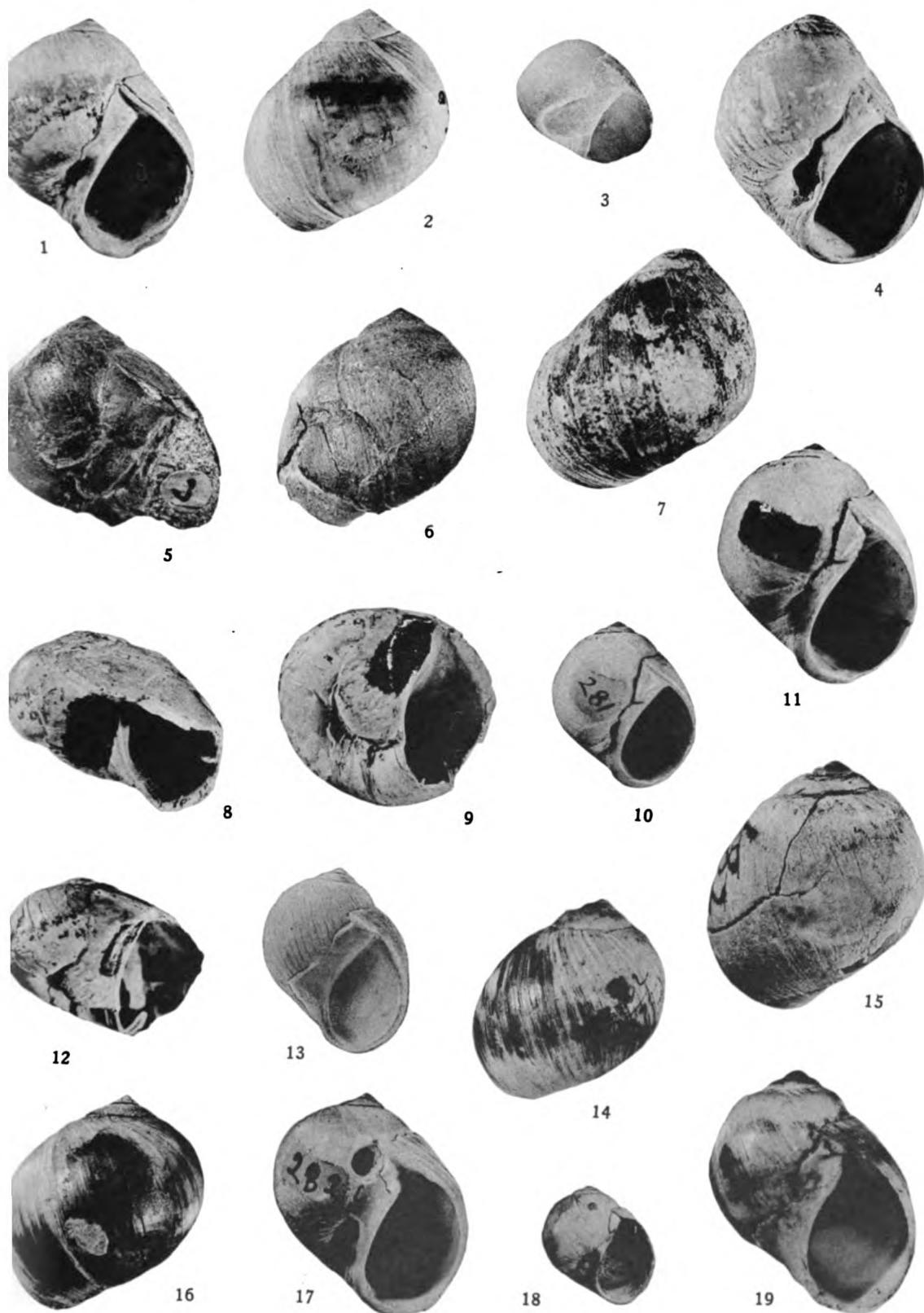
	PAGE
Fig. 1. <i>Polinices (Polinices) hornii</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 33744). Previously unfigured. From locality (U.C. 7161).....	335
Fig. 2. <i>Polinices (Polinices) hornii</i> (Gabb) ( $\times 1.2$ ), hypotype (U.C. 33184). Figured by Turner, 274, pl. 19, fig. 9.....	335
Fig. 3. <i>Polinices (Polinices) hornii</i> (Gabb) ( $\times 0.8$ ), hypotype (U.C. 33184). Figured by Turner, 274, pl. 19, fig. 8.....	335
Fig. 4. <i>Natica (Tectonatica) saxeae</i> Conrad ( $\times 1.1$ ), hypotype (U.C. 31997). Figured originally, 140, pl. 12, fig. 2.....	332
Fig. 5. <i>Natica (Tectonatica) teglandae</i> Hanna and Hertlein ( $\times 1.1$ ), holotype (U.C. 32215). Figured originally, 157, pl. 14, fig. 8.....	333
Fig. 6. <i>Natica (Tectonatica) teglandae</i> Hanna and Hertlein ( $\times 1.1$ ), holotype (U.C. 32215). Figured originally, 157, pl. 14, fig. 9.....	333
Fig. 7. <i>Natica (Tectonatica) teglandae</i> Hanna and Hertlein ( $\times 1$ ), holotype (U.C. 32215). Figured originally, 157, pl. 14, fig. 9.....	333
Fig. 8. <i>Natica (Tectonatica) weaveri</i> Tegland ( $\times 1$ ), paratype (U.C. 32185). Figured originally, 272, pl. 14, fig. 16.....	333
Fig. 9. <i>Natica (Tectonatica) weaveri</i> Tegland ( $\times 1$ ), holotype (U.C. 32183). Figured originally, 272, pl. 14, fig. 13.....	333
Fig. 10. <i>Polinices (Polinices) victoriana</i> Clark and Arnold ( $\times 1$ ), cotype (U.C. 30203). Figured originally, 50, pl. 33, fig. 1b.....	335
Fig. 11. <i>Polinices (Polinices) victoriana</i> Clark and Arnold ( $\times 1$ ), cotype (U.C. 30203). Figured originally, 50, pl. 33, fig. 1a.....	335
Fig. 12. <i>Polinices (Polinices) victoriana</i> Clark and Arnold ( $\times 1$ ), holotype (C.A.S. 582). Figured originally, 50, pl. 33, fig. 5a.....	335
Fig. 13. <i>Natica (Tectonatica) weaveri</i> Tegland ( $\times 1.2$ ), paratype (U.C. 32186). Figured originally, 272, pl. 14, fig. 17.....	333
Fig. 14. <i>Polinices (Polinices) victoriana</i> Clark and Arnold ( $\times 1$ ), holotype (C.A.S. 582). Figured originally, 50, pl. 33, fig. 5b.....	335
Fig. 15. <i>Polinices (Polinices) rectus</i> Tegland ( $\times 2$ ), holotype (U.C. 32191). Figured originally, 272, pl. 14, fig. 22.....	336
Fig. 16. <i>Polinices (Neverita) weaveri</i> (Dickerson) ( $\times 1$ ), hypotype (U.C. 33163). Figured by Turner, 274, pl. 20, fig. 14.....	340
Fig. 17. <i>Polinices (Neverita) weaveri</i> (Dickerson) ( $\times 1$ ), hypotype (U.C. 33163). Figured by Turner, 274, pl. 20, fig. 14.....	340
Fig. 18. <i>Polinices (Polinices) washingtonensis</i> (Weaver) ( $\times 2.3$ ), holotype (U.W. 103) (C.A.S. 7516). Figured originally, 295, pl. 5, fig. 73.....	337
Fig. 19. <i>Polinices (Polinices) gesteri</i> (Dickerson) ( $\times 2$ ), holotype (U.C. 11829). Figured originally, 121, pl. 38, fig. 6.....	336
Fig. 20. <i>Polinices (Polinices) rectus</i> Tegland ( $\times 2$ ), holotype (U.C. 32191). Figured originally, 272, pl. 14, fig. 22.....	336
Fig. 21. <i>Polinices (Neverita) globosa</i> (Gabb) ( $\times 0.8$ ), hypotype (U.C. 33160). Figured by Turner, 274, pl. 19, fig. 15.....	339
Fig. 22. <i>Polinices (Polinices) washingtonensis</i> (Weaver) var. <i>lincolnensis</i> (Weaver) ( $\times 1$ ), holotype (C.A.S. 463). Figured originally, 295, pl. 5, fig. 71.....	337
Fig. 23. <i>Polinices (Polinices) washingtonensis</i> (Weaver) ( $\times 1.5$ ), paratype (U.W. 103-A) (C.A.S. 7516-A). Figured originally, 295, pl. 5, fig. 76..	337
Fig. 24. <i>Polinices (Neverita) globosa</i> (Gabb) ( $\times 0.8$ ), hypotype (U.C. 33160). Figured originally, 274, pl. 19, fig. 15.....	339

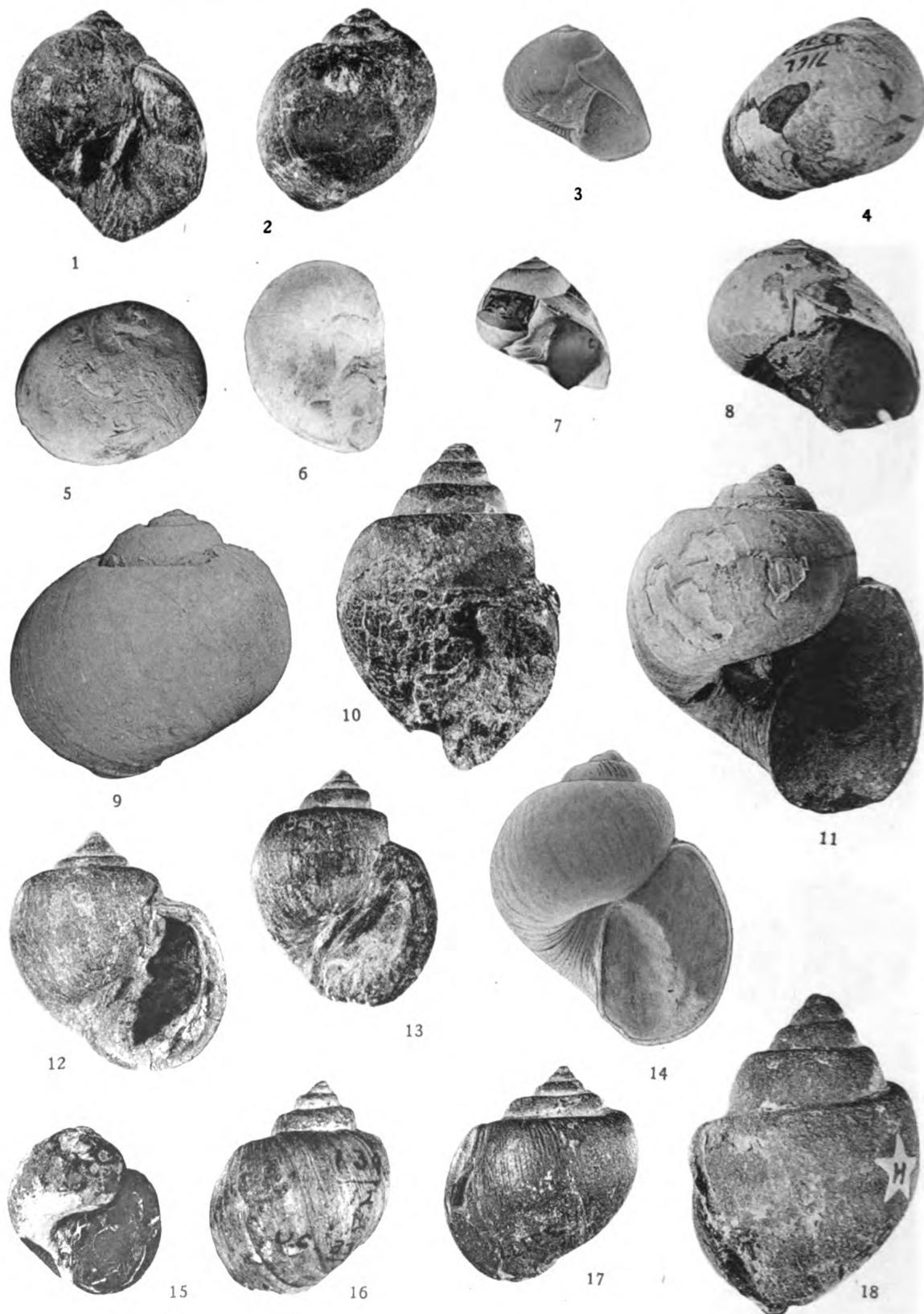
(721)

## PLATE 69

	PAGE
Fig. 1. <i>Polinices (Polinices) hotsoni</i> Weaver and Palmer ( $\times 1.5$ ), hypotype (U.W. 193) (C.A.S. 7514). Figured originally, 301, pl. 9, fig. 14.....	338
Fig. 2. <i>Polinices (Polinices) hotsoni</i> Weaver and Palmer ( $\times 1.5$ ), hypotype (U.W. 193) (C.A.S. 7514). Figured originally, 301, pl. 9, fig. 15.....	338
Fig. 3. <i>Polinices (Neverita) weaveri</i> (Dickerson) ( $\times 2$ ), holotype (C.A.S. 278). Figured originally, 121, pl. 4, fig. 1a.....	340
Fig. 4. <i>Polinices (Polinices) washingtonensis</i> (Weaver) var. <i>lincolnensis</i> (Weaver) ( $\times 1.3$ ), cotype (U.W. 104-A) (C.A.S. 7515-A). Figured originally, 295, pl. 5, fig. 72.....	337
Fig. 5. <i>Polinices (Neverita) globosa</i> (Gabb) ( $\times 0.7$ ), hypotype (U.C. 33160). Figured by Turner, 274, pl. 19, fig. 15.....	339
Fig. 6. <i>Polinices (Neverita) globosa</i> (Gabb) ( $\times 0.7$ ), hypotype (U.C. 33160). Figured by Turner, 274, pl. 19, fig. 15.....	339
Fig. 7. <i>Polinices (Polinices) washingtonensis</i> (Weaver) var. <i>lincolnensis</i> (Weaver) ( $\times 1.3$ ), cotype (U.W. 104-A) (C.A.S. 7515-A). Figured originally, 295, pl. 5, fig. 72.....	337
Fig. 8. <i>Polinices (Neverita) nomlandi</i> (Dickerson) ( $\times 2$ ), holotype (C.A.S. 411). Figured originally, 123, pl. 30, fig. 2b.....	340
Fig. 9. <i>Polinices (Neverita) nomlandi</i> (Dickerson) ( $\times 2$ ), holotype (C.A.S. 411). Figured originally, 123, pl. 30, fig. 2b.....	340
Fig. 10. <i>Polinices (Euspira) nuciformis</i> (Gabb) var. <i>cowlitzensis</i> (Dickerson) ( $\times 0.8$ ), holotype (C.A.S. 281). Figured originally, 121, pl. 4, fig. 12a..	343
Fig. 11. <i>Polinices (Euspira) nuciformis</i> (Gabb) var. <i>cowlitzensis</i> (Dickerson) ( $\times 1.2$ ), holotype (C.A.S. 281). Duplicate of fig. 10. Figured originally, 121, pl. 4, fig. 12a.....	343
Fig. 12. <i>Polinices (Neverita) nomlandi</i> (Dickerson) ( $\times 1.8$ ), holotype (C.A.S. 411). Figured originally, 123, pl. 30, fig. 2b.....	340
Fig. 13. <i>Polinices (Euspira) nuciformis</i> (Gabb) var. <i>cowlitzensis</i> (Dickerson) ( $\times 1$ ), hypotype (U.C. 33733). Not previously figured. Locality (U.C. 7162). .....	343
Fig. 14. <i>Polinices (Euspira) nuciformis</i> (Gabb) var. <i>cowlitzensis</i> (Dickerson) ( $\times 1.2$ ), hypotype (U.C. 33733). Not previously figured. Locality (U.C. 7162). .....	343
Fig. 15. <i>Polinices (Euspira) nuciformis</i> (Gabb) var. <i>cowlitzensis</i> (Dickerson) ( $\times 1.3$ ), holotype (C.A.S. 281). Figured originally, 121, pl. 4, fig. 12a.	343
Fig. 16. <i>Polinices (Euspira) nuciformis</i> (Gabb) var. <i>cowlitzensis</i> (Dickerson) ( $\times 1.4$ ), paratype (C.A.S. 282). Figured originally, 121, pl. 4, fig. 12b.	343
Fig. 17. <i>Polinices (Euspira) nuciformis</i> (Gabb) var. <i>cowlitzensis</i> (Dickerson) ( $\times 1.4$ ), paratype (C.A.S. 282). Figured originally, 121, pl. 4, fig. 12b..	343
Fig. 18. <i>Polinices (Euspira) nuciformis</i> (Gabb) var. <i>cowlitzensis</i> (Dickerson) ( $\times 1$ ), hypotype (U.C. 33733A). Locality (U.C. 7162). Previously unfigured. .....	343
Fig. 19. <i>Polinices (Euspira) nuciformis</i> (Gabb) var. <i>cowlitzensis</i> (Dickerson) ( $\times 1.4$ ), hypotype (U.C. 33733). Duplicate of fig. 13, pl. 69.....	343

(722)





## PLATE 70

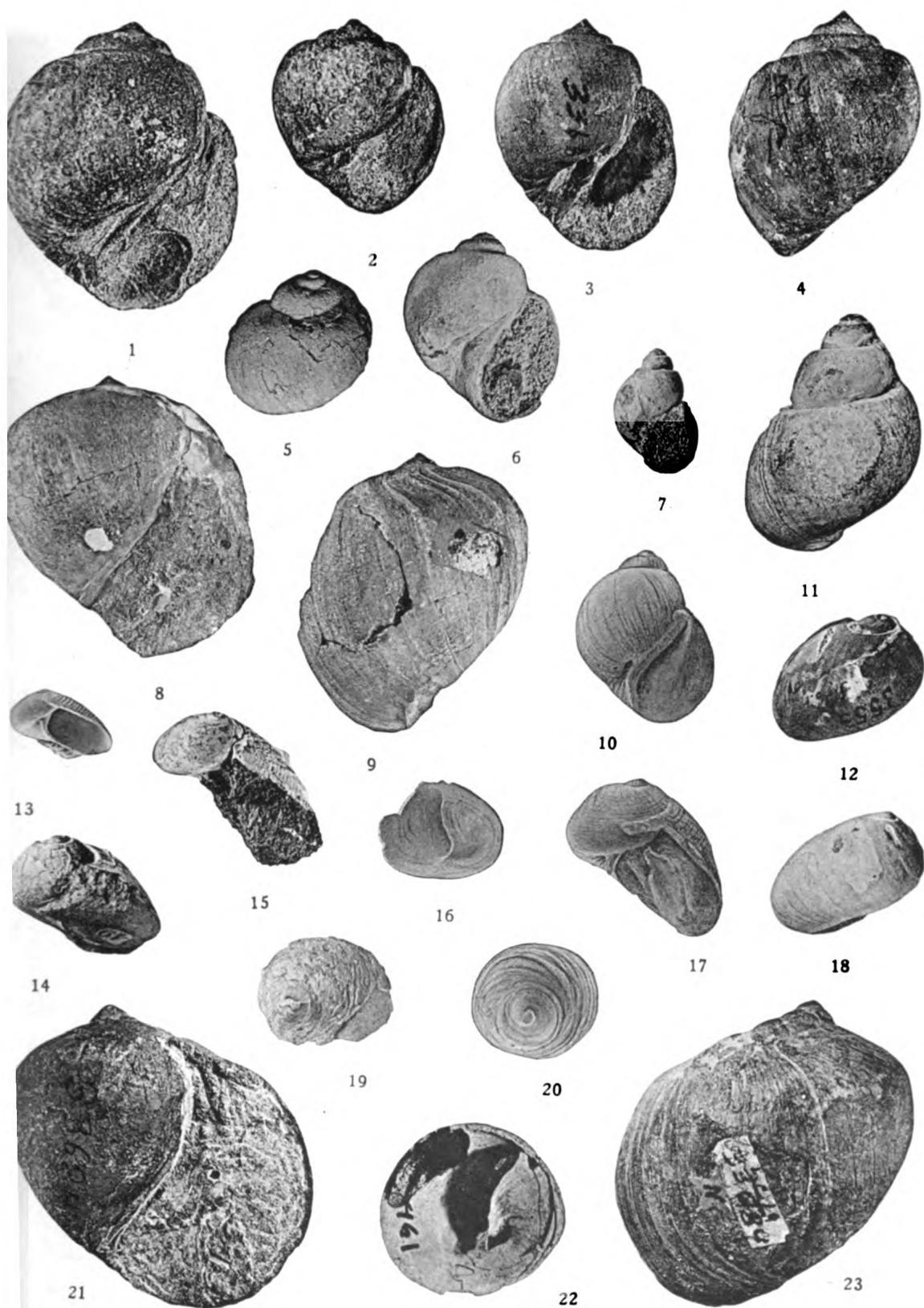
	PAGE
Fig. 1. <i>Polinices (Euspira) nuciformis</i> (Gabb) ( $\times 1.4$ ), hypotype (U.C. 33162). Figured by Turner, 274, pl. 20, fig. 5.....	342
Fig. 2. <i>Polinices (Euspira) nuciformis</i> (Gabb) ( $\times 1.4$ ), hypotype (U.C. 33162). Figured by Turner, 274, pl. 20, fig. 5.....	342
Fig. 3. <i>Polinices (Neverita) secta</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 33763). Locality (U.C. 7162). Not previously figured.....	341
Fig. 4. <i>Polinices (Neverita) secta</i> (Gabb) ( $\times 1.4$ ), hypotype (U.C. 33763). Locality (U.C. 7162). Not previously figured.....	341
Fig. 5. <i>Polinices (Neverita) recluziana</i> Deshayes var. <i>vancouverensis</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30204). Figured originally, 50, pl. 33, fig. 2a.....	340
Fig. 6. <i>Polinices (Neverita) recluziana</i> Deshayes var. <i>vancouverensis</i> Clark and Arnold ( $\times 1$ ) holotype (U.C. 30204). Figured originally, 50, pl. 33, fig. 2b .....	340
Fig. 7. <i>Polinices (Neverita) secta</i> (Gabb) ( $\times 1$ ), hypotype (C.A.S. 277). Figured originally, 121, pl. 4, fig. 9.....	341
Fig. 8. <i>Polinices (Neverita) secta</i> (Gabb) ( $\times 1.4$ ), hypotype (U.C. 33763).....	341
Fig. 9. <i>Polinices (Neverita) recluziana</i> Deshayes var. <i>vancouverensis</i> Clark and Arnold ( $\times 1$ ), cotype (C.A.S. 684). Figured originally, 50, pl. 33, fig. 3 .....	340
Fig. 10. <i>Amaurellina (Euspirocrommium) clarki</i> Stewart ( $\times 1$ ), hypotype (U.C. 33686). Figured by Turner, 274, pl. 20, fig. 3.....	345
Fig. 11. <i>Polinices (Euspira) galanoi</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153916). Figured originally, 101, pl. 5, fig. 12.....	344
Fig. 12. <i>Amaurellina hendoni</i> Turner ( $\times 1.6$ ), paratype (U.C. 33177). Figured originally, 274, pl. 20, fig. 8.....	345
Fig. 13. <i>Amaurellina hendoni</i> Turner ( $\times 1.5$ ), holotype (U.C. 33630). Figured originally, 274, pl. 20, fig. 11.....	345
Fig. 14. <i>Polinices (Euspira) galanoi</i> Dall ( $\times 0.8$ ), hypotype (U.C. 32002). Fig- ured by Etherington, 140, pl. 12, fig. 1.....	344
Fig. 15. <i>Polinices (Neverita) inezana</i> (Conrad) ( $\times 1$ ), hypotype (U.S.N.M. 328931). Figured originally by Reagan, 230, pl. 3, fig. 28.....	342
Fig. 16. <i>Amaurellina hendoni</i> Turner ( $\times 1.5$ ), holotype (U.C. 33630). Figured originally, 274, pl. 20, fig. 11.....	345
Fig. 17. <i>Amaurellina hendoni</i> Turner ( $\times 1.6$ ), paratype (U.C. 33177). Figured originally 274, pl. 20, fig. 8.....	345
Fig. 18. <i>Amaurellina (Euspirocrommium) clarki</i> Stewart ( $\times 1$ ), hypotype (U.C. 33686). Figured by Turner, 274, pl. 20, fig. 3.....	345

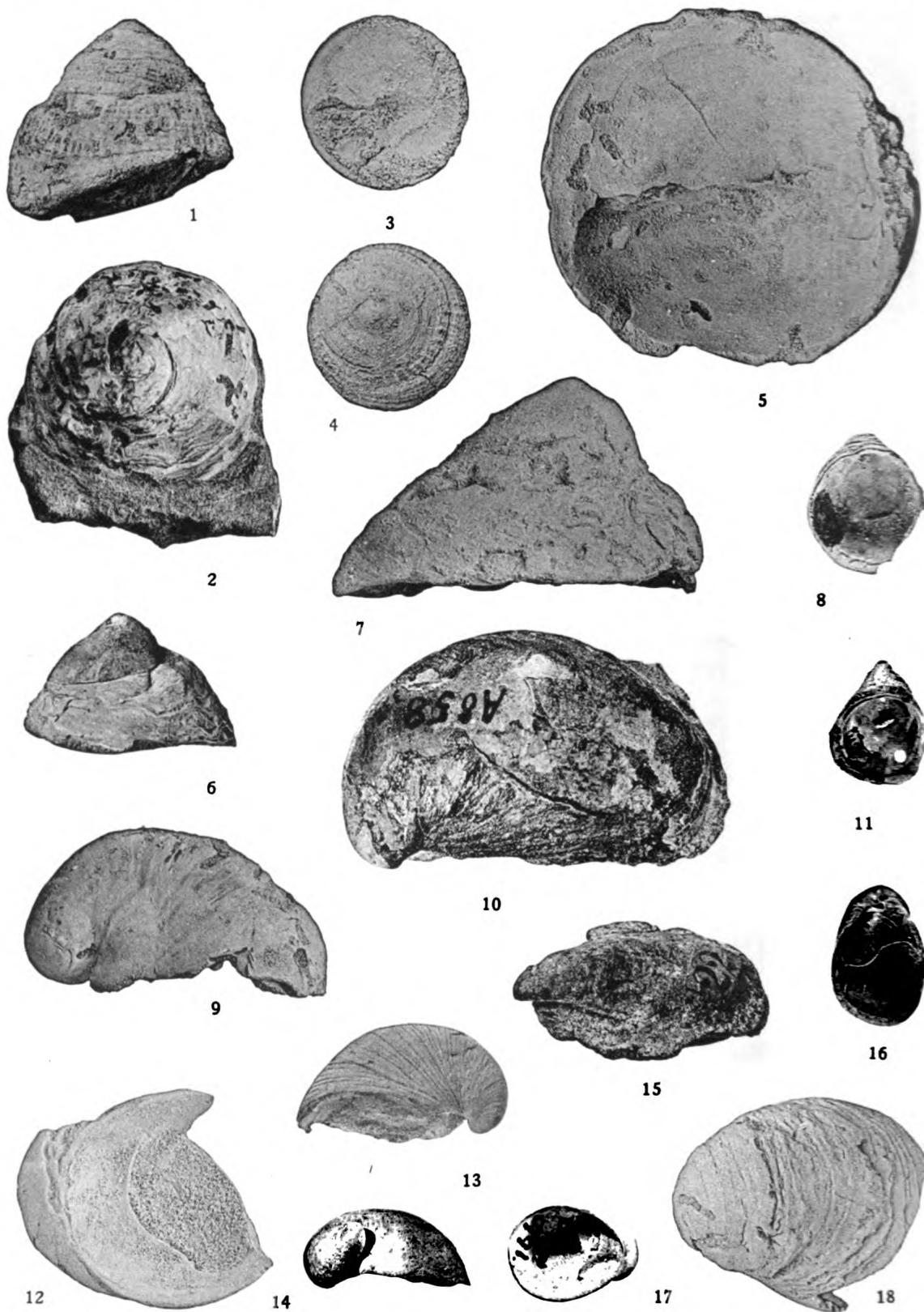
(723)

## PLATE 71

	PAGE
Fig. 1. <i>Ampullina (Crommium) andersoni</i> (Dickerson) ( $\times 1$ ), holotype of <i>A. umpsquaensis</i> (C.A.S. 245). Figured originally, 120, pl. 12, figs. 3a, 3b..	346
Fig. 2. <i>Ampullina (Crommium) andersoni</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 244). Figured originally, 120, pl. 12, fig. 2a, 2b.....	346
Fig. 3. <i>Ampullina (Crommium) andersoni</i> (Dickerson) ( $\times 1.1$ ), topotype (U.C. 33681). Figured originally, 274, pl. 19, fig. 2.....	346
Fig. 4. <i>Ampullina (Crommium) andersoni</i> (Dickerson) ( $\times 1.1$ ), topotype (U.C. 33681). Figured originally, 274, pl. 33, fig. 4a.....	346
Fig. 5. <i>Ampullina sookensis</i> (Clark and Arnold) ( $\times 1.7$ ), holotype (U.C. 30205). Figured originally, 50, pl. 33, fig. 4b.....	347
Fig. 6. <i>Ampullina sookensis</i> (Clark and Arnold) ( $\times 2$ ), holotype (U.C. 30205). Figured originally, 50, pl. 33, fig. 4a.....	347
Fig. 7. <i>Amauroopsis oregonensis</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 107780). Figured originally by Dall as holotype of <i>Ampullina oregonensis</i> , 101, pl. 3, fig. 7.....	347
Fig. 8. <i>Cernina (Eocernina) hannibali</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 243). Figured originally, 120, pl. 12, fig. 5b.....	348
Fig. 9. <i>Cernina (Eocernina) hannibali</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 243). Figured originally, 120, pl. 12, fig. 5a.....	348
Fig. 10. <i>Amauroopsis blakeleyensis</i> (Tegland) ( $\times 1.2$ ), holotype (U.C. 32216). Figured originally, 272, pl. 14, fig. 18.....	348
Fig. 11. <i>Amauroopsis oregonensis</i> (Dall) ( $\times 2$ ), holotype (U.S.N.M. 107780). Figured originally, 101, pl. 3, fig. 7.....	347
Fig. 12. <i>Sinum scopulosum</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 3553). Figured originally by Conrad, 68, pl. 19, figs. 6, 6a.....	349
Fig. 13. <i>Sinum obliquum</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 23796). Not previously figured.....	350
Fig. 14. <i>Sinum scopulosum</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 3553). Figured originally by Conrad, 68, pl. 19, figs. 6, 6a.....	349
Fig. 15. <i>Sinum occidentis</i> Weaver and Palmer ( $\times 3$ ), holotype (U.W. 194) (C.A.S. 7509). Figured originally, 301, pl. 11, figs. 8, 26.....	351
Fig. 16. <i>Calyptraea diegoana</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 33719). Locality (U.C. A-9). Previously unfigured.....	351
Fig. 17. <i>Sinum scopulosum</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 33003). Figured originally by Etherington, 140, pl. 12, fig. 13.....	349
Fig. 18. <i>Sinum scopulosum</i> (Conrad) ( $\times 0.9$ ), hypotype (U.S.N.M. 153913). Figured originally by Dall, 101, pl. 4, fig. 10.....	349
Fig. 19. <i>Calyptraea washingtonensis</i> Weaver ( $\times 1$ ), hypotype (U.C. 32187). Figured by Tegland, 272, pl. 14, fig. 25.....	352
Fig. 20. <i>Calyptraea diegoana</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 33717). Locality (U.C. 7161). Previously unfigured.....	351
Fig. 21. <i>Cernina (Eocernina) hannibali</i> (Dickerson) ( $\times 1$ ), hypotype (U.C. 33684). Figured by Turner, 274, pl. 19, fig. 3.....	348
Fig. 22. <i>Calyptraea washingtonensis</i> Weaver ( $\times 1.4$ ), holotype (U.W. 102) (C.A.S. 461-B). Figured originally, 295, pl. 3, fig. 44.....	352
Fig. 23. <i>Cernina (Eocernina) hannibali</i> (Dickerson) ( $\times 1$ ), hypotype (U.C. 33684). Figured by Turner, 274, pl. 19, fig. 3.....	348

(724)



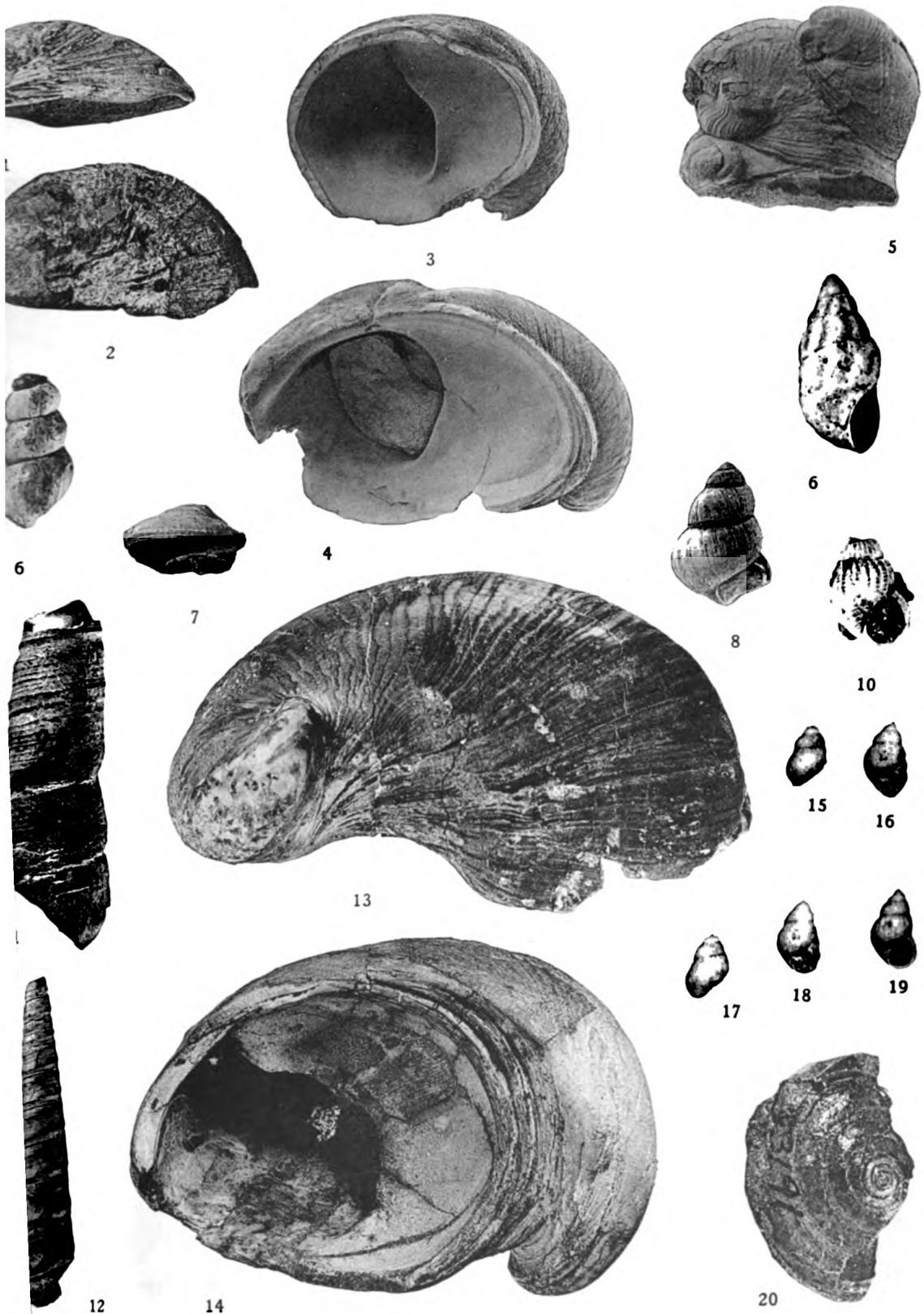


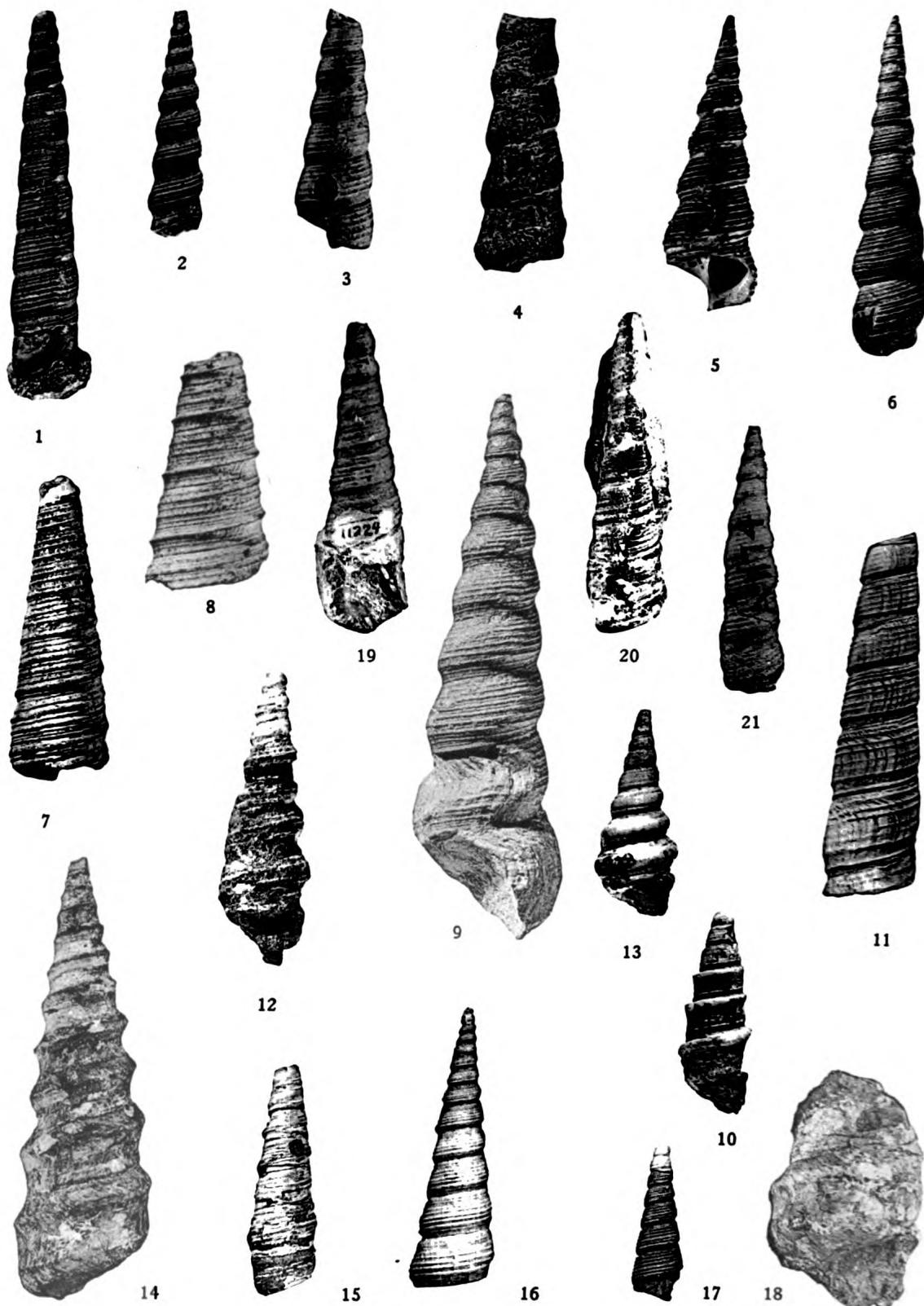
## PLATE 72

	PAGE
Fig. 1. <i>Calyptraea sookensis</i> Clark and Arnold ( $\times 1$ ), cotype (U.C. 30237). Figured originally, 50, pl. 36, fig. 2.....	353
Fig. 2. <i>Calyptraea inornata</i> (Gabb) ( $\times 1$ ), hypotype (U.S.N.M. 153921). Figured by Dall, 101, pl. 5, fig. 11.....	354
Fig. 3. <i>Calyptraea sookensis</i> Clark and Arnold ( $\times 0.9$ ), holotype (U.C. 30080). Figured originally, 50, pl. 36, fig. 1b.....	353
Fig. 4. <i>Calyptraea sookensis</i> Clark and Arnold ( $\times 0.9$ ), holotype (U.C. 30080). Figured originally, 50, pl. 36, fig. 1b.....	353
Fig. 5. <i>Calyptraea mammillaris</i> Broderip subsp. <i>vancouverensis</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30072). Figured originally, 50, pl. 36, fig. 3b....	353
Fig. 6. <i>Calyptraea inornata</i> (Gabb) ( $\times 0.8$ ), holotype (U.S.N.M. 153921). Figured by Dall, 101, pl. 6, fig. 4.....	354
Fig. 7. <i>Calyptraea mammillaris</i> Broderip subsp. <i>vancouverensis</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30072). Figured originally, 50, pl. 36, fig. 3a....	353
Fig. 8. <i>Hipponix arnoldi</i> Dickerson ( $\times 1.8$ ), syntype (C.A.S. 436). Figured originally, 123, pl. 31, fig. 10b.....	355
Fig. 9. <i>Crepidula sookensis</i> Clark and Arnold ( $\times 1$ ), syntype (C.A.S. 580). Figured originally, 50, pl. 32, fig. 3.....	357
Fig. 10. <i>Crepidula pileum</i> (Gabb) ( $\times 1.2$ ), hypotype (U.C. 33217). Figured by Turner, 274, pl. 20, fig. 6.....	356
Fig. 11. <i>Hipponix arnoldi</i> Dickerson var. <i>ornata</i> Dickerson ( $\times 2$ ), holotype (C.A.S. 439). Figured originally, 123, pl. 31, fig. 12a.....	355
Fig. 12. <i>Crepidula sookensis</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30293). Figured originally, 50, pl. 35, fig. 5a.....	357
Fig. 13. <i>Crepidula</i> ( <i>Crepidula</i> ) <i>rostralis</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 31985). Locality (U.W. 425). Figured by Etherington, 140, pl. 11, fig. 10.	359
Fig. 14. <i>Crepidula pileum</i> (Gabb) var. <i>dickersoni</i> Weaver and Palmer ( $\times 2$ ), holotype (U.W. 191) (C.A.S. 7596). Figured originally, 301, pl. 12, fig. 9. ....	356
Fig. 15. <i>Crepidula</i> ( <i>Crepidula</i> ) <i>rostralis</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 110447). Figured originally by Conrad, 68, pl. 19, figs. 11a, 11b.....	359
Fig. 16. <i>Crepidula pileum</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 33722). Not previously figured. ....	356
Fig. 17. <i>Crepidula pileum</i> (Gabb) var. <i>dickersoni</i> Weaver and Palmer ( $\times 1.8$ ), holotype (U.W. 191) (C.A.S. 7596). Figured originally, 301, pl. 11, fig. 2. ....	356
Fig. 18. <i>Crepidula sookensis</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30293). Figured originally, 50, pl. 35, fig. 5a.....	357

## PLATE 73

	PAGE
Fig. 1. <i>Crepidula praerupta</i> Conrad ( $\times 1$ ), hypotype (U.S.N.M. 153925-B). Figured by Dall, 101, pl. 7, fig. 8.....	359
Fig. 2. <i>Crepidula praerupta</i> Conrad ( $\times 1$ ), holotype (U.S.N.M. 3564). Original Conrad specimen, 68, pl. 19, fig. 9.....	359
Fig. 3. <i>Crepidula praerupta</i> Conrad ( $\times 1$ ), hypotype (U.C. 31987). Figured originally by Etherington, 140, pl. 11, fig. 2.....	359
Fig. 4. <i>Crepidula princeps</i> Conrad ( $\times 1$ ), hypotype (U.C. 31989). Figured originally by Etherington, 140, pl. 11, fig. 14. Locality (U.C. 9068).....	358
Fig. 5. <i>Crepidula ungana</i> Dall ( $\times 1$ ), hypotype (U.C. 32210). Figured by Tegland, 272, pl. 14, fig. 1.....	360
Fig. 6. <i>Hydrobia pontis</i> Weaver and Palmer ( $\times 2.7$ ), holotype (U.W. 195) (C.A.S. 7602). Figured originally, 301, pl. 11, fig. 9.....	362
Fig. 7. <i>Architectonica blanda</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 107414). Figured originally, 101, pl. 3, fig. 5.....	364
Fig. 8. <i>Viriparus washingtonianus</i> Arnold and Hannibal ( $\times 1$ ), topotype (U.C. 33801). .....	361
Fig. 9. <i>Turboella cowlitzenensis</i> Effinger ( $\times 9$ ), holotype (U.C. 33557). Figured originally, 138, pl. 47, fig. 9. (In the present work, printed by error as figure 6 on right-hand side of plate.).....	361
Fig. 10. <i>Alvania lettana</i> (Van Winkle) ( $\times 11$ ), holotype (U.W. 137) (C.A.S. 7624). Figured originally, 275, pl. 7, fig. 13.....	362
Fig. 11. <i>Turritella andersoni</i> Dickerson subsp. <i>glidensis</i> Merriam ( $\times 1.5$ ), paratype (U.C. 33691). Figured originally, 274, pl. 22, fig. 21.....	365
Fig. 12. <i>Turritella andersoni</i> Dickerson ( $\times 1.5$ ), hypotype (U.C. 33111). Figured by Turner, 274, pl. 22, fig. 6.....	364
Fig. 13. <i>Crepidula princeps</i> Conrad ( $\times 1$ ), hypotype (U.S.N.M. 153967). Empire formation. ....	358
Fig. 14. <i>Crepidula princeps</i> Conrad ( $\times 1$ ), hypotype (U.S.N.M. 498452). Figured by Dall, 101, pl. 8, fig. 2.....	358
Fig. 15. <i>Alvania lettana</i> (Van Winkle) ( $\times 5.5$ ), hypotype (U.C. 33552). Figured by Effinger, 138, pl. 47, fig. 22.....	362
Fig. 16. <i>Alvania lettana</i> (Van Winkle) ( $\times 6$ ), hypotype (U.C. 33552). Figured by Effinger, 138, pl. 47, fig. 21.....	362
Fig. 17. <i>Alvania lettana</i> (Van Winkle) ( $\times 6$ ), hypotype (U.C. 33552). Duplicate of fig. 15.....	362
Fig. 18. <i>Alvania lettana</i> (Van Winkle) ( $\times 5.5$ ), hypotype (U.C. 33552). Duplicate of fig. 16.....	362
Fig. 19. <i>Alvania lettana</i> (Van Winkle) ( $\times 5$ ), hypotype (U.C. 33551). Figured by Effinger, 138, pl. 47, fig. 23.....	362
Fig. 20. <i>Architectonica cognata</i> Gabb ( $\times 2$ ), hypotype (U.C. 33191). Figured by Turner, 274, pl. 18, fig. 17.....	363





## PLATE 74

## PAGE

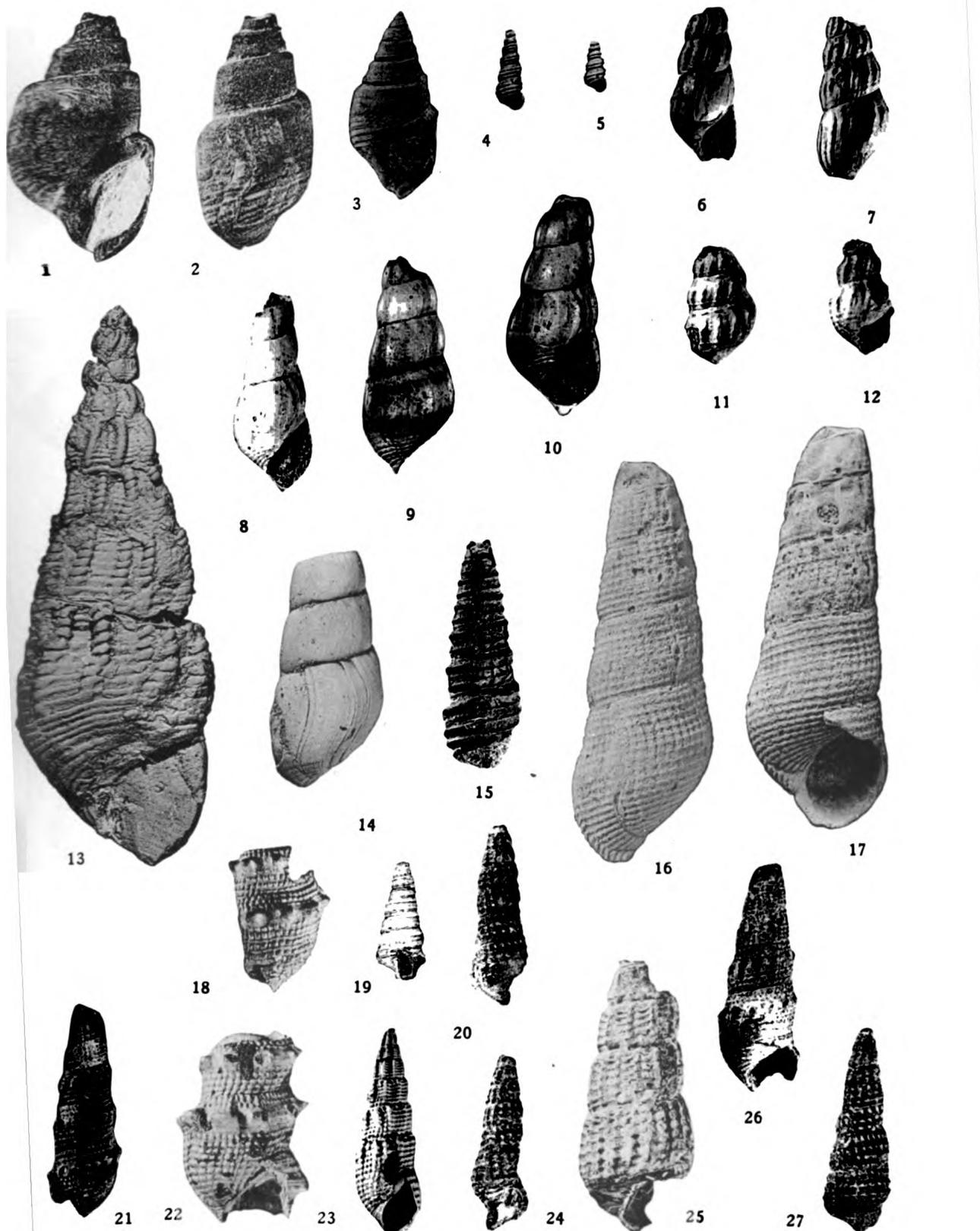
- Fig. 1. *Turritella uvasana* Conrad subsp. *hendoni* Merriam ( $\times 1.3$ ), holotype (U.C. 33288). Figured originally, 203, pl. 21, fig. 16..... 366
- Fig. 2. *Turritella uvasana* Conrad subsp. *hendoni* Merriam var. A Turner ( $\times 1$ ), holotype (U.C. 33281). Figured originally, 203, pl. 22, fig. 11.. 367
- Fig. 3. *Turritella uvasana* Conrad subsp. *washingtoniana* Weaver and Palmer ( $\times 0.8$ ), holotype of *Turritella washingtoniana* Weaver and Palmer (U.W. 198) (C.A.S. 7535). Figured originally, 301, pl. 12, fig. 14.... 368
- Fig. 4. *Turritella andersoni* Dickerson subsp. *comstockensis* Merriam ( $\times 1.3$ ), holotype (U.C. 33271). Figured originally 274, pl. 22, fig. 1.. 365
- Fig. 5. *Turritella porterensis* Weaver ( $\times 1.4$ ), holotype (U.W. 72) (C.A.S. 506). Figured originally, 286, pl. 11, fig. 83..... 372
- Fig. 6. *Turritella uvasana* Conrad subsp. *hendoni* Merriam ( $\times 1.3$ ), paratype (U.C. 33291). Figured originally, 274, pl. 21, fig. 12..... 366
- Fig. 7. *Turritella vaderensis* Weaver and Palmer var. *kincaidi* Weaver and Palmer ( $\times 1.6$ ), holotype (U.W. 200) (C.A.S. 7534). Broken part figured originally, 301, pl. 10, fig. 17..... 371
- Fig. 8. *Turritella vaderensis* Weaver and Palmer ( $\times 1.5$ ), holotype (U.W. 199) (C.A.S. 7533). Figured originally, 301, pl. 10, fig. 19..... 371
- Fig. 9. *Turritella uvasana* Conrad subsp. *stewarti* Merriam ( $\times 1.3$ ), hypotype (U.C. 33287). Figured originally, 274, pl. 21, fig. 11..... 366
- Fig. 10. *Turritella merriami* Dickerson var. Turner ( $\times 1.0$ ), holotype (U.C. 33279). Figured originally, 274, pl. 22, fig. 9..... 369
- Fig. 11. *Turritella uvasana* Conrad subsp. *olequahensis* Weaver and Palmer ( $\times 1.0$ ), holotype (U.W. 197). Figured originally, 301, pl. 12, fig. 15.. 368
- Fig. 12. *Turritella oregonensis* (Conrad) ( $\times 2.0$ ), holotype (U.S.N.M. 110446). Figured originally as *Cerithiopsis?* *oregonensis*, 68, pl. 20, fig. 13.... 370
- Fig. 13. *Turritella bramkampi* Merriam and Turner ( $\times 1.0$ ), holotype (U.C. 33295). Figured originally, 203, pl. 6, fig. 4..... 366
- Fig. 14. *Turritella meganensis* Clark and Woodford subsp. *protumescens* Merriam and Turner ( $\times 1.0$ ), holotype (U.C. 15353). Figured originally, 203, pl. 6, fig. 8..... 369
- Fig. 15. *Turritella blakeleyensis* Weaver ( $\times 0.6$ ), holotype (U.W. 71) (C.A.S. 547). Figured originally, 286, pl. 11, fig. 85..... 372
- Fig. 16. *Turritella uvasana* Conrad subsp. *washingtoniana* Weaver and Palmer ( $\times 1.0$ ), hypotype (U.W. 195-A)..... 368
- Fig. 17. *Turritella blakeleyensis* Weaver ( $\times 1.0$ ), topotype (U.C. 32195). Figured originally, 272, pl. 14, fig. 4..... 372
- Fig. 18. *Turritella meganensis* Clark and Woodford subsp. *protumescens* Merriam and Turner ( $\times 0.8$ ), hypotype (U.C. 33278). Figured originally, 274, pl. 22, fig. 15..... 369
- Fig. 19. *Turritella diversilinata* J. C. Merriam ( $\times 1.0$ ), holotype (U.C. 11224) 373
- Fig. 20. *Turritella buwaldana* Dickerson subsp. *coosensis* Merriam ( $\times 1.4$ ), holotype (U.C. 33274) .. 370
- Fig. 21. *Turritella uvasana* Conrad subsp. *hendoni* Merriam var. B Turner ( $\times 1.2$ ), holotype (U.C. 33283)..... 367

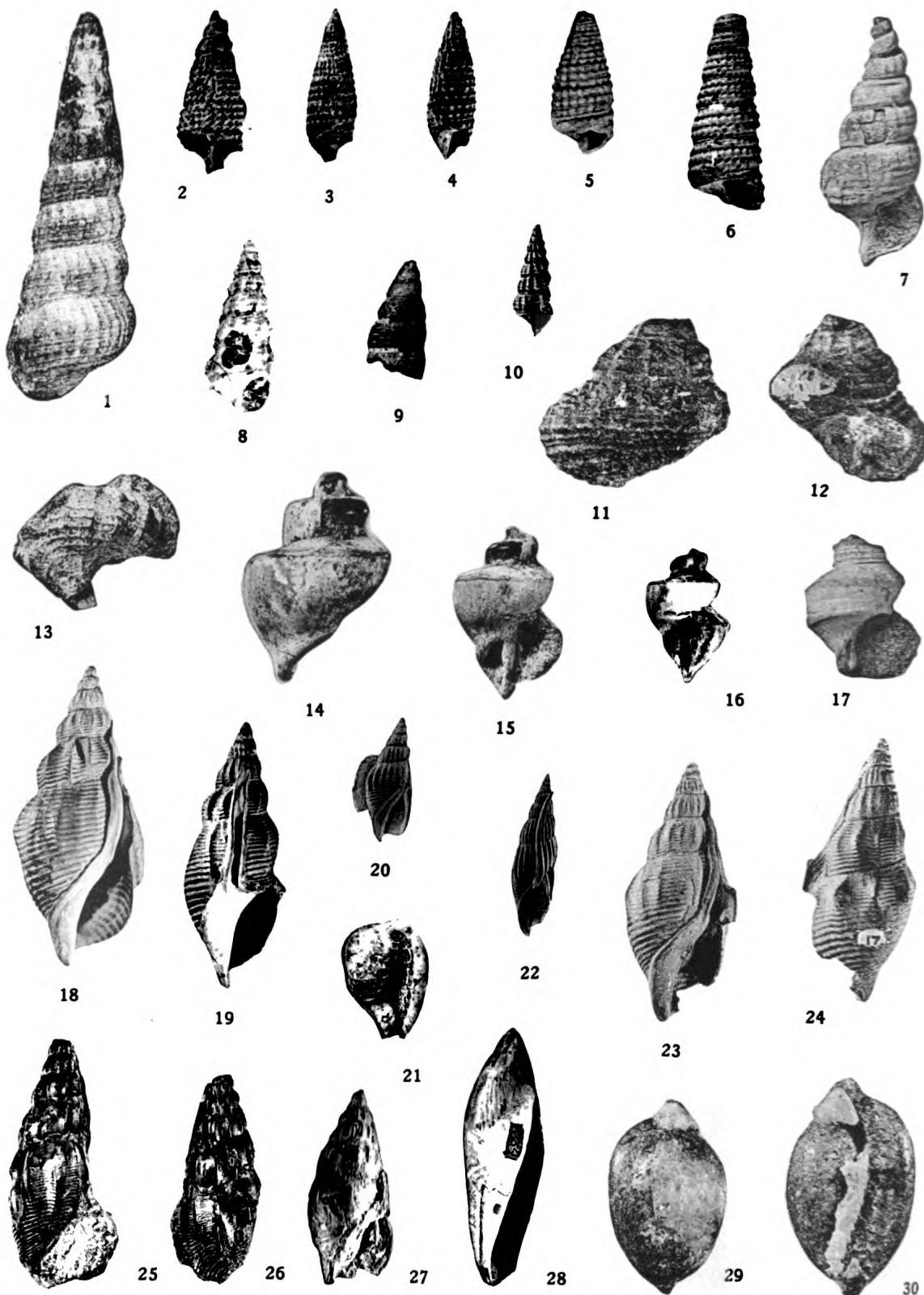
(727)

## PLATE 75

	PAGE
Fig. 1. <i>Loxotrema turrita</i> Gabb ( $\times 1.3$ ), hypotype (U.C. 33642). Figured by Turner, 274, pl. 17, fig. 12.....	374
Fig. 2. <i>Loxotrema turrita</i> Gabb ( $\times 1.3$ ), hypotype (U.C. 33642). Figured by Turner, 274, pl. 17, fig. 13.....	374
Fig. 3. <i>Loxotrema turrita</i> Gabb ( $\times 1$ ), hypotype (U.C. 33800). Locality (U.C. 3608) .....	374
Fig. 4. <i>Turritellopsis weaveri</i> (Van Winkle) ( $\times 5$ ), hypotype (U.C. 33572). Figured by Effinger, 138, pl. 47, fig. 7.....	373
Fig. 5. <i>Turritellopsis weaveri</i> (Van Winkle) ( $\times 5$ ), hypotype (U.C. 14806). Figured by Effinger, 138, pl. 47, fig. 6.....	373
Fig. 6. <i>Goniobasis coombsi</i> n. nom. ( $\times 2.7$ ), hypotype (U.W. 212-A) (C.A.S. 7604-A). Locality (U.W. 315). Figured originally as <i>G. olequahensis</i> Weaver and Palmer, 301, pl. 11, fig. 13.....	375
Fig. 7. <i>Goniobasis coombsi</i> n. nom. ( $\times 2.7$ ), hypotype (U.W. 212-A) (C.A.S. 7604-A). Locality (U.W. 315). Figured originally as <i>G. olequahensis</i> Weaver and Palmer, 301, pl. 11, fig. 13.....	375
Fig. 8. <i>Goniobasis hannibali</i> Weaver and Palmer ( $\times 2$ ), holotype (U.W. 211) (C.A.S. 7603). Figured originally, 301, pl. 12, fig. 3.....	375
Fig. 9. <i>Goniobasis hannibali</i> Weaver and Palmer ( $\times 2$ ), holotype (U.W. 211) (C.A.S. 7603). Figured originally, 301, pl. 12, fig. 3.....	375
Fig. 10. <i>Goniobasis hannibali</i> Weaver and Palmer ( $\times 2$ ), holotype (U.W. 211) (C.A.S. 7603). Figured originally, 301, pl. 12, fig. 3.....	375
Fig. 11. <i>Goniobasis coombsi</i> n. nom. ( $\times 2$ ), holotype (U.W. 212) (C.A.S. 7604). Figured originally as <i>G. olequahensis</i> Weaver and Palmer, 301, pl. 11, fig. 13.....	375
Fig. 12. <i>Goniobasis coombsi</i> n. nom. ( $\times 2$ ), holotype (U.W. 212) (C.A.S. 7604). Locality (U.W. 315). Figured originally as <i>G. olequahensis</i> Weaver and Palmer, 301, pl. 11, fig. 13.....	375
Fig. 13. <i>Goniobasis drakei</i> (Arnold and Hannibal) ( $\times 2$ ), holotype (S.U. 458). Figured originally, 159-A, pl. 8, fig. 26.....	376
Fig. 14. <i>Goniobasis olequaensis</i> (Arnold and Hannibal) ( $\times 2$ ), holotype (S.U. 459). Figured originally as <i>Ambloxus olequaensis</i> by Arnold and Hannibal, 159, pl. 8, fig. 27.....	377
Fig. 15. <i>Potamides carbonicola</i> Cooper ( $\times 1.3$ ), hypotype (U.C. 33183). Figured by Turner, 274, pl. 21, fig. 1.....	378
Fig. 16. <i>Goniobasis sookensis</i> Clark and Arnold ( $\times 2$ ), holotype (U.C. 30076). Figured originally, 50, pl. 32, fig. 1a.....	377
Fig. 17. <i>Goniobasis sookensis</i> Clark and Arnold ( $\times 2$ ), holotype (U.C. 30076). Figured originally, 50, pl. 32, fig. 1b.....	377
Fig. 18. <i>Potamides fettkei</i> Weaver ( $\times 3$ ), syntype (U.W. 15) (C.A.S. 7589). Figured originally, 286, pl. 2, fig. 23.....	379
Fig. 19. <i>Potamides carbonicola</i> Cooper ( $\times 1$ ), hypotype (U.C. 31377). Locality (U.C. 5089). Figured originally by M. A. Hanna, 159, pl. 55, fig. 2....	378
Fig. 20. <i>Cerithiopsis preussi</i> G. D. Hanna ( $\times 1.5$ ), holotype (C.A.S. 246). Figured originally by Dickerson as <i>Cerithiopsis oregonensis</i> , 120, pl. 11, fig. 5b.....	381
Fig. 21. <i>Potamides fettkei</i> Weaver ( $\times 2$ ), syntype (U.W. 15-A) (C.A.S. 7589-A). Figured originally, 286, pl. 2, fig. 24.....	379
Fig. 22. <i>Potamides fettkei</i> Weaver ( $\times 3$ ), syntype (U.W. 15) (C.A.S. 7589). Figured originally, 286, pl. 2, fig. 23 .....	379
Fig. 23. <i>Potamides lewisiiana</i> Weaver ( $\times 1.3$ ), holotype (U.W. 16) (C.A.S. 486). Figured originally, 286, pl. 2, fig. 25.....	379
Fig. 24. <i>Cerithiopsis preussi</i> G. D. Hanna ( $\times 1.5$ ), holotype (C.A.S. 246). Figured originally by Dickerson as <i>Cerithiopsis oregonensis</i> , 120, pl. 11, fig. 5a.....	381
Fig. 25. <i>Potamides packardi</i> (Dickerson) ( $\times 2.5$ ), holotype (C.A.S. 299). Figured originally, 121, pl. 6, fig. 6.....	380
Fig. 26. <i>Potamides fettkei</i> Weaver ( $\times 2$ ), syntype (U.W. 15-A) (C.A.S. 7589-A). Figured originally, 286, pl. 2, fig. 24.....	379
Fig. 27. <i>Cerithiopsis preussi</i> G. D. Hanna ( $\times 2$ ), topotype (U.C. 33653). Figured by Turner, 274, pl. 21, fig. 5.....	381

(728)





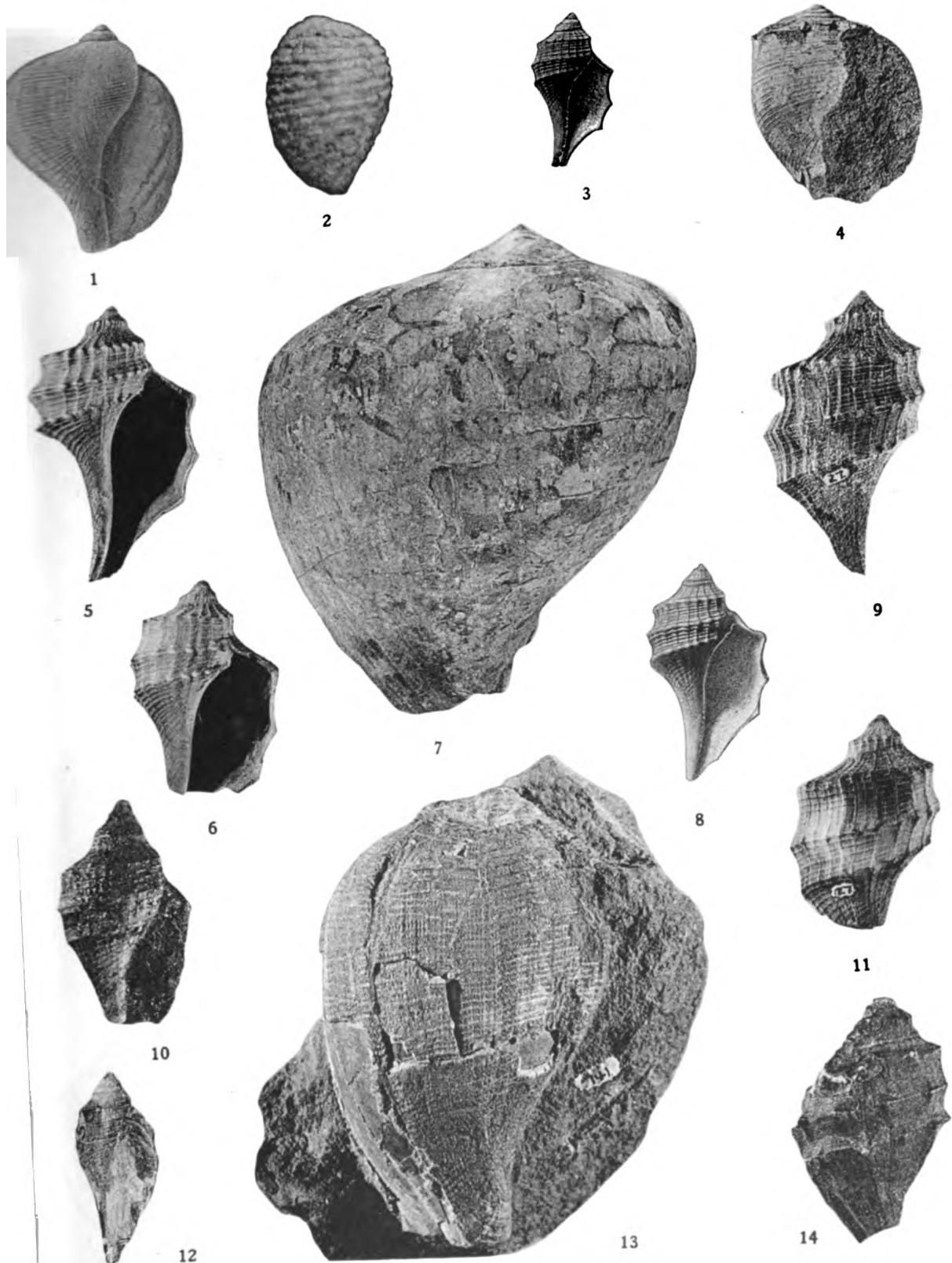
## PLATE 76

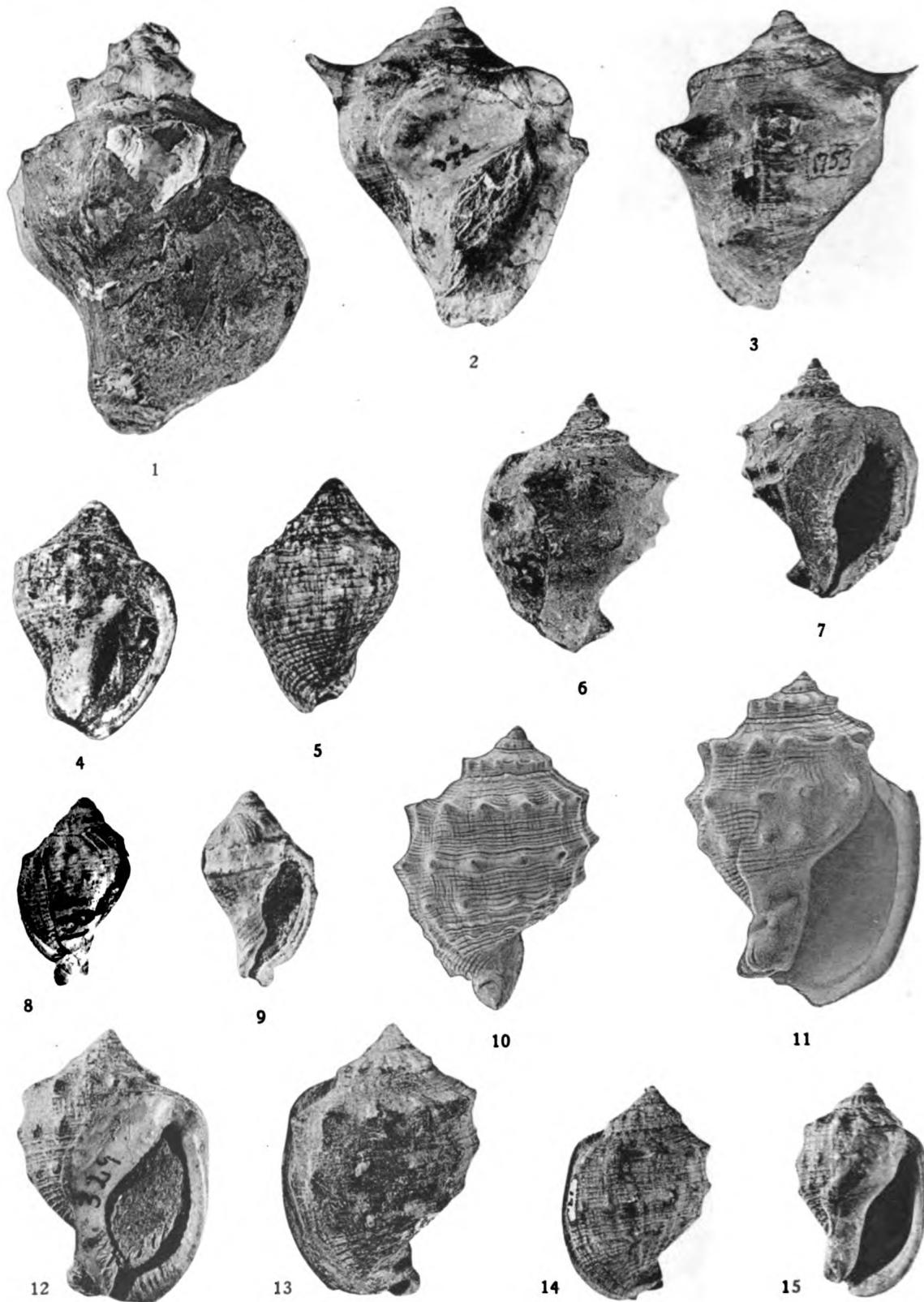
	PAGE
Fig. 1. <i>Cerithiopsis excelsa</i> Dall ( $\times 3$ ), holotype (U.S.N.M. 107400). Figured originally, 101, pl. 3, fig. 9.....	382
Fig. 2. <i>Cerithiopsis vaderensis</i> (Dickerson) ( $\times 1.3$ ), holotype (C.A.S. 300). Figured originally, 121, pl. 6, fig. 7.....	381
Fig. 3. <i>Cerithiopsis washingtoniana</i> (Dickerson) ( $\times 1.2$ ), holotype (C.A.S. 350). Figured originally as <i>Triforis washingtoniana</i> , 121, pl. 6, fig. 13. ....	383
Fig. 4. <i>Cerithiopsis washingtoniana</i> (Dickerson) ( $\times 1.8$ ), hypotype (C.A.S. 421). Figured originally as <i>Triforis martini</i> , 123, pl. 30, fig. 9.....	383
Fig. 5. <i>Cerithiopsis washingtoniana</i> (Dickerson) ( $\times 2$ ), hypotype (U.C. 33584). Figured by Effinger, 138, pl. 47, fig. 25.....	383
Fig. 6. <i>Cerithiopsis merriami</i> (Dickerson) ( $\times 2.2$ ), holotype (C.A.S. 417). Figured originally, 123, pl. 30, fig. 7a.....	384
Fig. 7. <i>Cerithiopsis newcombei</i> (Clark and Arnold) ( $\times 2$ ), holotype (U.C. 30088). Figured originally, 50, pl. 31, fig. 4a.....	384
Fig. 8. <i>Cerithiopsis fasteni</i> Van Winkle ( $\times 5.5$ ), holotype (U.W. 139) (C.A.S. 7588). Figured originally, 275, pl. 7, fig. 8.....	385
Fig. 9. <i>Bittium eschrichtii</i> (Middendorff) ( $\times 1.2$ ), holotype (U.S.N.M. 153992). Figured originally, 101, pl. 14, fig. 2.....	386
Fig. 10. <i>Cerithiopsis howardi</i> Dickerson ( $\times 2.5$ ), holotype (C.A.S. 415). Figured originally, 123, pl. 30, fig. 6a.....	385
Fig. 11. <i>Benoistia umpquaensis</i> Turner ( $\times 2$ ), holotype (U.C. 33192). Figured by Turner, 274, pl. 21, figs. 8, 10.....	387
Fig. 12. <i>Benoistia umpquaensis</i> Turner ( $\times 2$ ), holotype (U.C. 33192). Figured by Turner, 274, pl. 21, figs. 8, 10.....	387
Fig. 13. <i>Trichotropis oregonensis</i> (Conrad) ( $\times 1$ ), plastotype (U.S.N.M. 3554). Figured originally by Conrad, 68, pl. 20, fig. 8.....	388
Fig. 14. <i>Trichotropis (Iphinoe) cf. unicarinata</i> Sowerby ( $\times 3$ ), hypotype (U.C. 33832). Astoria formation. Locality (U.W. 473).....	389
Fig. 15. <i>Trichotropis (Iphinoe) cf. unicarinata</i> Sowerby ( $\times 2$ ), hypotype (U.C. 33832). Astoria formation. Locality (U.W. 473).....	389
Fig. 16. <i>Trichotropis (Iphinoe) cf. unicarinata</i> Sowerby ( $\times 1.7$ ), hypotype (U.C. 33832). Astoria formation. Locality (U.W. 473).....	389
Fig. 17. <i>Trichotropis alienensis</i> Effinger ( $\times 3.3$ ), holotype (U.C. 33586). Figured originally, 138, pl. 46, fig. 22.....	389
Fig. 18. <i>Ectinochilus (Cowlitzia) washingtonensis</i> (Clark and Palmer) ( $\times 1$ ), hypotype (C.A.S. 295). Figured originally, 51, pl. 6, fig. 1b.....	390
Fig. 19. <i>Ectinochilus (Cowlitzia) washingtonensis</i> (Clark and Palmer) ( $\times 1$ ), holotype (C.A.S. 770). Figured originally, 51, pl. 51, fig. 11.....	390
Fig. 20. <i>Ectinochilus (Cowlitzia) washingtonensis</i> (Clark and Palmer) ( $\times 2$ ), hypotype (U.C. 33817).....	390
Fig. 21. <i>Eratopsis crescentensis</i> Weaver and Palmer ( $\times 3$ ), holotype (U.W. 201) (C.A.S. 7587). Figured originally, 301, pl. 11, fig. 10.....	393
Fig. 22. <i>Ectinochilus (Vaderos) elongata</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 33819).....	391
Fig. 23. <i>Ectinochilus (Cowlitzia) washingtonensis</i> (Clark and Palmer) ( $\times 2$ ), hypotype (U.W. 17) (C.A.S. 7617). Figured originally as <i>Rimella canalifera</i> Gabb var. <i>elongata</i> Weaver, 286, pl. 2, fig. 18, <i>not</i> fig. 19.....	390
Fig. 24. <i>Ectinochilus (Cowlitzia) washingtonensis</i> (Clark and Palmer) ( $\times 2$ ), hypotype (U.W. 17) (C.A.S. 7617). Figured originally as <i>Rimella canalifera</i> Gabb var. <i>elongata</i> Weaver, 286, pl. 2, fig. 18, <i>not</i> fig. 19.....	390
Fig. 25. <i>Ectinochilus (Macilentos) macilenta</i> White subsp. <i>oregonensis</i> Hendon ( $\times 1.8$ ), paratype (U.C. 33634). Figured originally, 274, pl. 18, fig. 2....	392
Fig. 26. <i>Ectinochilus (Macilentos) macilenta</i> White subsp. <i>oregonensis</i> Hendon ( $\times 1.8$ ), paratype (U.C. 33634). Figured originally, 274, pl. 18, fig. 2..	392
Fig. 27. <i>Ectinochilus (Macilentos) macilenta</i> White subsp. <i>oregonensis</i> Hendon ( $\times 2$ ), holotype (U.C. 33633). Figured originally, 274, pl. 18, fig. 4....	392
Fig. 28. <i>Terebellum andersoni</i> (Dickerson) ( $\times 1.1$ ), holotype (C.A.S. 434). Figured originally, 123, pl. 31, figs. 9a, 9b.....	392
Fig. 29. <i>Cypraea oakvillensis</i> Van Winkle ( $\times 1.4$ ), holotype (U.W. 140) (C.A.S. 7606). Figured originally, 275, pl. 7, fig. 19.....	394
Fig. 30. <i>Cypraea oakvillensis</i> Van Winkle ( $\times 1.7$ ), holotype (U.W. 140) (C.A.S. 7606). Figured originally, 275, pl. 7, fig. 19.....	394

## PLATE 77

	PAGE
Fig. 1. <i>Ficus modestus</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 31995). Figured by Etherington, 140, pl. 11, fig. 6.....	395
Fig. 2. <i>Cypraeogemmula warneri</i> Effinger ( $\times 7$ ), holotype (U.C. 33588). Figured originally, 138, pl. 47, figs. 29, 35.....	394
Fig. 3. <i>Ficopsis cowlitzensis</i> (Weaver) ( $\times 1$ ), hypotype (U.W. 314).....	399
Fig. 4. <i>Ficus (Trophosycon) wynoochensis</i> Weaver ( $\times 0.8$ ), holotype (U.W. 106) (C.A.S. 556). Figured originally, 295, pl. 3, figs. 38, 39.....	398
Fig. 5. <i>Ficopsis cowlitzensis</i> (Weaver) ( $\times 1.2$ ), holotype (U.W. 27) (C.A.S. 7615). Figured originally, 286, pl. 1, fig. 1.....	399
Fig. 6. <i>Ficopsis cowlitzensis</i> (Weaver) ( $\times 1.5$ ), paratype (U.W. 27-A) (C.A.S. 7615-A). Figured originally, 286, pl. 1, fig. 4.....	399
Fig. 7. <i>Ficus (Trophosycon) clallamensis</i> Weaver ( $\times 1$ ), holotype (U.W. 74) (C.A.S. 7525). Figured originally, 286, pl. 9, fig. 73.....	396
Fig. 8. <i>Ficopsis cowlitzensis</i> (Weaver) ( $\times 1$ ), hypotype (U.W. 530).....	399
Fig. 9. <i>Ficopsis cowlitzensis</i> (Weaver) ( $\times 1.2$ ), holotype (U.W. 27) (C.A.S. 7615). Figured originally, 286, pl. 1, fig. 1.....	399
Fig. 10. <i>Ficopsis remondii</i> (Gabb) var. <i>crescentensis</i> Weaver and Palmer ( $\times 2$ ), holotype (U.W. 205) (C.A.S. 7616). Figured originally, 301, pl. 11, fig. 14.....	399
Fig. 11. <i>Ficopsis cowlitzensis</i> (Weaver) ( $\times 1.5$ ), paratype (U.W. 27-A) (C.A.S. 7615-A). Figured originally, 286, pl. 1, fig. 4.....	399
Fig. 12. <i>Ficopsis remondii</i> (Gabb) ( $\times 0.7$ ), hypotype (U.C. 33182). Figured by Turner, 274, pl. 15, fig. 20.....	398
Fig. 13. <i>Ficus (Trophosycon) restorationensis</i> Van Winkle ( $\times 1.3$ ), holotype (U.W. 141) (C.A.S. 7526). Figured originally, 275, pl. 7, fig. 20.....	397
Fig. 14. <i>Ficopsis meganensis</i> Clark and Woodford var. <i>packardi</i> Merriam and Turner ( $\times 1.5$ ), paratype (U.C. 33636). Figured by Turner, 274, pl. 15, fig. 22. ....	400

(730)





## PLATE 78

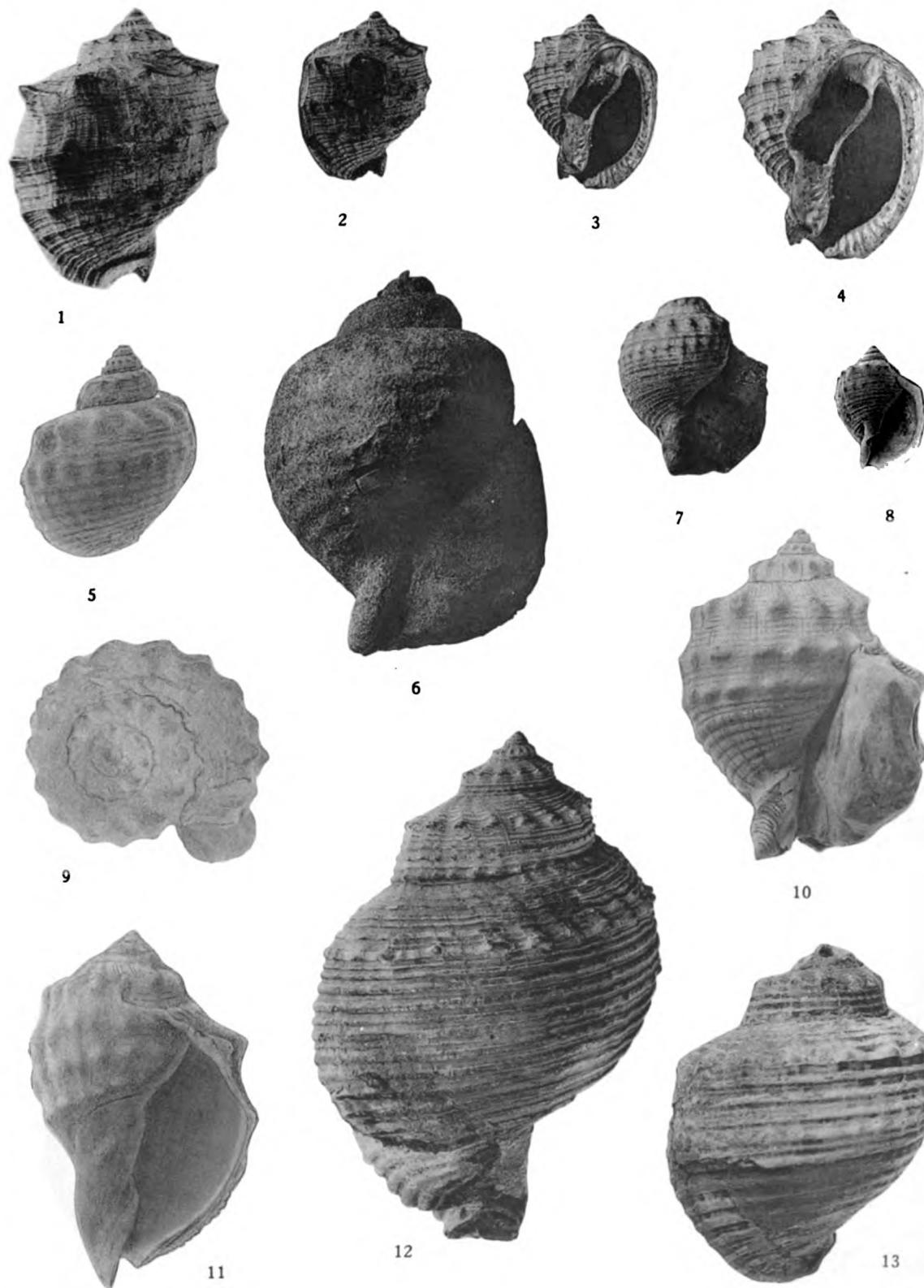
	PAGE
<b>Fig. 1.</b> <i>Trophon oregonensis</i> Anderson and Martin ( $\times 1.2$ ), holotype (C.A.S. 176). Figured originally, 5, pl. 5, fig. 5.....	401
<b>Fig. 2.</b> <i>Galeodea susanae</i> Schenck ( $\times 1.1$ ), holotype (C.A.S. 1753). Figured originally, 237, pl. 15, fig. 4.....	402
<b>Fig. 3.</b> <i>Galeodea susanae</i> Schenck ( $\times 1.1$ ), holotype (C.A.S. 1753). Figured originally, 237, pl. 15, fig. 3.....	402
<b>Fig. 4.</b> <i>Galeodea crescentensis</i> Weaver and Palmer ( $\times 2.1$ ), holotype (U.W. 202) (C.A.S. 7612-A). Figured originally, 301, pl. 11, fig. 18.....	403
<b>Fig. 5.</b> <i>Galeodea crescentensis</i> Weaver and Palmer ( $\times 2.1$ ), holotype (U.W. 202) (C.A.S. 7612-A). Figured originally, 301, pl. 11, fig. 20.....	403
<b>Fig. 6.</b> <i>Galeodea sutterensis</i> Dickerson ( $\times 1.2$ ), hypotype (U.C. 33167). Figured by Turner, 274, pl. 18, fig. 19.....	402
<b>Fig. 7.</b> <i>Galeodea sutterensis</i> Dickerson ( $\times 1.2$ ), hypotype (U.C. 33167). Figured by Turner, 274, pl. 18, fig. 19.....	402
<b>Fig. 8.</b> <i>Galeodea dalli</i> Dickerson ( $\times 3$ ), holotype (C.A.S. 419). Figured originally, 123, pl. 30, fig. 8a.....	404
<b>Fig. 9.</b> <i>Galeodea dalli</i> Dickerson ( $\times 3$ ), holotype (C.A.S. 419). Figured originally, 123, pl. 30, fig. 8a.....	404
<b>Fig. 10.</b> <i>Galeodea tri-tuberculata</i> (Weaver) ( $\times 2$ ), hypotype (U.C. 31312). Figured originally, 237, pl. 14, fig. 6.....	404
<b>Fig. 11.</b> <i>Galeodea tri-tuberculata</i> (Weaver) ( $\times 2$ ), hypotype (U.C. 31311). Figured originally, 237, pl. 14, fig. 5.....	404
<b>Fig. 12.</b> <i>Galeodea tri-tuberculata</i> (Weaver) ( $\times 2.5$ ), hypotype (U.W. 524). Locality (U.W. 329).....	404
<b>Fig. 13.</b> <i>Galeodea tri-tuberculata</i> (Weaver) ( $\times 2.5$ ), hypotype (U.W. 524). Locality (U.W. 329).....	404
<b>Fig. 14.</b> <i>Galeodea tri-tuberculata</i> (Weaver) ( $\times 1.5$ ), holotype (U.W. 19) (C.A.S. 7612). Figured originally, 286, pl. 3, fig. 35.....	404
<b>Fig. 15.</b> <i>Galeodea tri-tuberculata</i> (Weaver) ( $\times 1.5$ ), holotype (U.W. 19) (C.A.S. 7612). Figured originally, 286, pl. 3, fig. 35.....	404

(73)

## PLATE 79

	PAGE
Fig. 1. <i>Galeodea tri-tuberculata</i> (Weaver) ( $\times 2$ ), hypotype (C.A.S. 297). Duplicate of fig. 2. Cowlitz Eocene. Locality (U.W. 232).....	404
Fig. 2. <i>Galeodea tri-tuberculata</i> (Weaver) ( $\times 1$ ), hypotype (C.A.S. 297). Duplicate of fig. 1. Cowlitz Eocene. Locality (U.W. 232).....	404
Fig. 3. <i>Galeodea tri-tuberculata</i> (Weaver) ( $\times 1$ ), hypotype (C.A.S. 297). Duplicate of fig. 4. Cowlitz Eocene. Locality (U.W. 232).....	404
Fig. 4. <i>Galeodea tri-tuberculata</i> (Weaver) ( $\times 2$ ), hypotype (C.A.S. 297). Duplicate of fig. 3. Cowlitz Eocene. Locality (U.W. 232).....	404
Fig. 5. <i>Galeodea petrosa</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 32082). Figured by Tegland, 271, pl. 65, fig. 7.....	405
Fig. 6. <i>Galeodea petrosa</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 3536). Figured originally, 68, pl. 19, figs. 3a, 3b, as <i>Dolium petrosum</i> Conrad.....	405
Fig. 7. <i>Galeodea petrosa</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 3536-A?). Figured originally, 68, pl. 19, figs. 4a, 4b, as <i>Dolium petrosum</i> Conrad.....	405
Fig. 8. <i>Galeodea tri-tuberculata</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 32080). Cowlitz Eocene. Locality (U.W. 232).....	404
Fig. 9. <i>Galeodea fax</i> Tegland ( $\times 1$ ), holotype (U.C. 32064). Figured originally, 271, pl. 60, fig. 5.....	406
Fig. 10. <i>Galeodea fax</i> Tegland ( $\times 1$ ), holotype (U.C. 32064). Figured originally, 271, pl. 60, fig. 6.....	406
Fig. 11. <i>Galeodea fax</i> Tegland ( $\times 1$ ), paratype (U.C. 32066). Figured originally, 271, pl. 60, fig. 10.....	406
Fig. 12. <i>Galeodea apta</i> Tegland ( $\times 1$ ), hypotype (U.S.N.M. 110425). Figured by Dall, 101, pl. 14, fig. 6, as <i>Eudolium petrosum</i> .....	408
Fig. 13. <i>Galeodea apta</i> Tegland ( $\times 1$ ), holotype (U.C. 32071). Figured by Tegland, 271, pl. 63, fig. 1.....	408

(732)



UNIV. OF WASH. PUBL. IN GEOL.

[WEAVER] VOL. V, PL. 80



PLATE 80

	PAGE
Fig. 1. <i>Galeodea apta</i> Tegland ( $\times 1$ ), paratype (U.C. 32074). Figured originally, 271, pl. 63, fig. 6.....	408
Fig. 2. <i>Galeodea rex</i> Tegland ( $\times 0.8$ ), paratype (U.C. 32070). Figured originally, 271, pl. 60, fig. 12.....	407
Fig. 3. <i>Galeodea apta</i> Tegland ( $\times 1$ ), holotype (U.C. 32071). Duplicate of pl. 79, fig. 13.....	408
Fig. 4. <i>Galeodea rex</i> Tegland ( $\times 0.8$ ), holotype (U.C. 32067). Figured originally, 271, pl. 61, fig. 2.....	407
Fig. 5. <i>Galeodea apta</i> Tegland ( $\times 1$ ), paratype (S.U. 599). Figured originally, 271, pl. 64, fig. 2.....	408
Fig. 6. <i>Galeodea rex</i> Tegland ( $\times 1$ ), paratype (U.C. 32069). Figured originally, 271, pl. 62, fig. 1.....	407

(733)

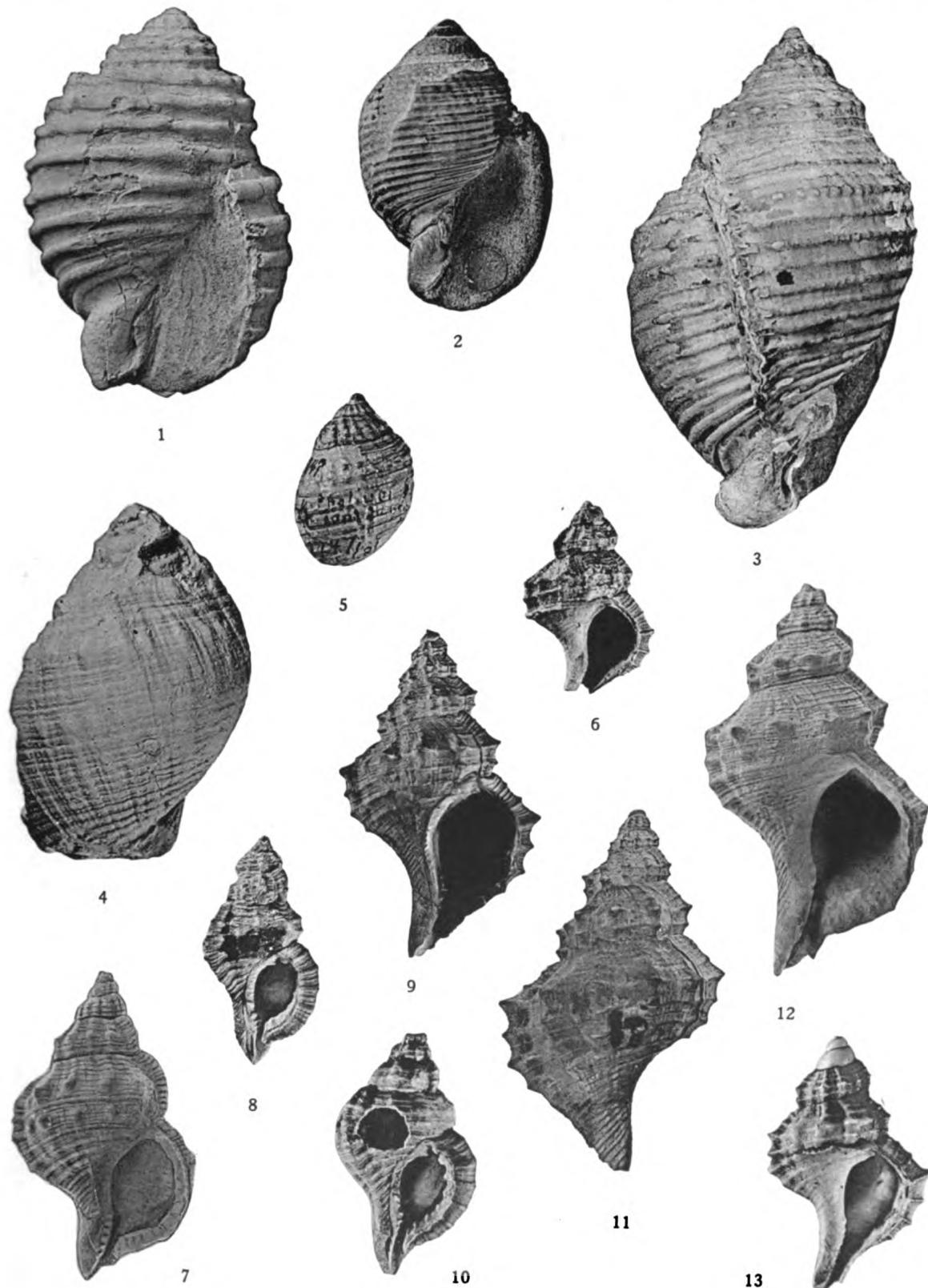
PLATE 81

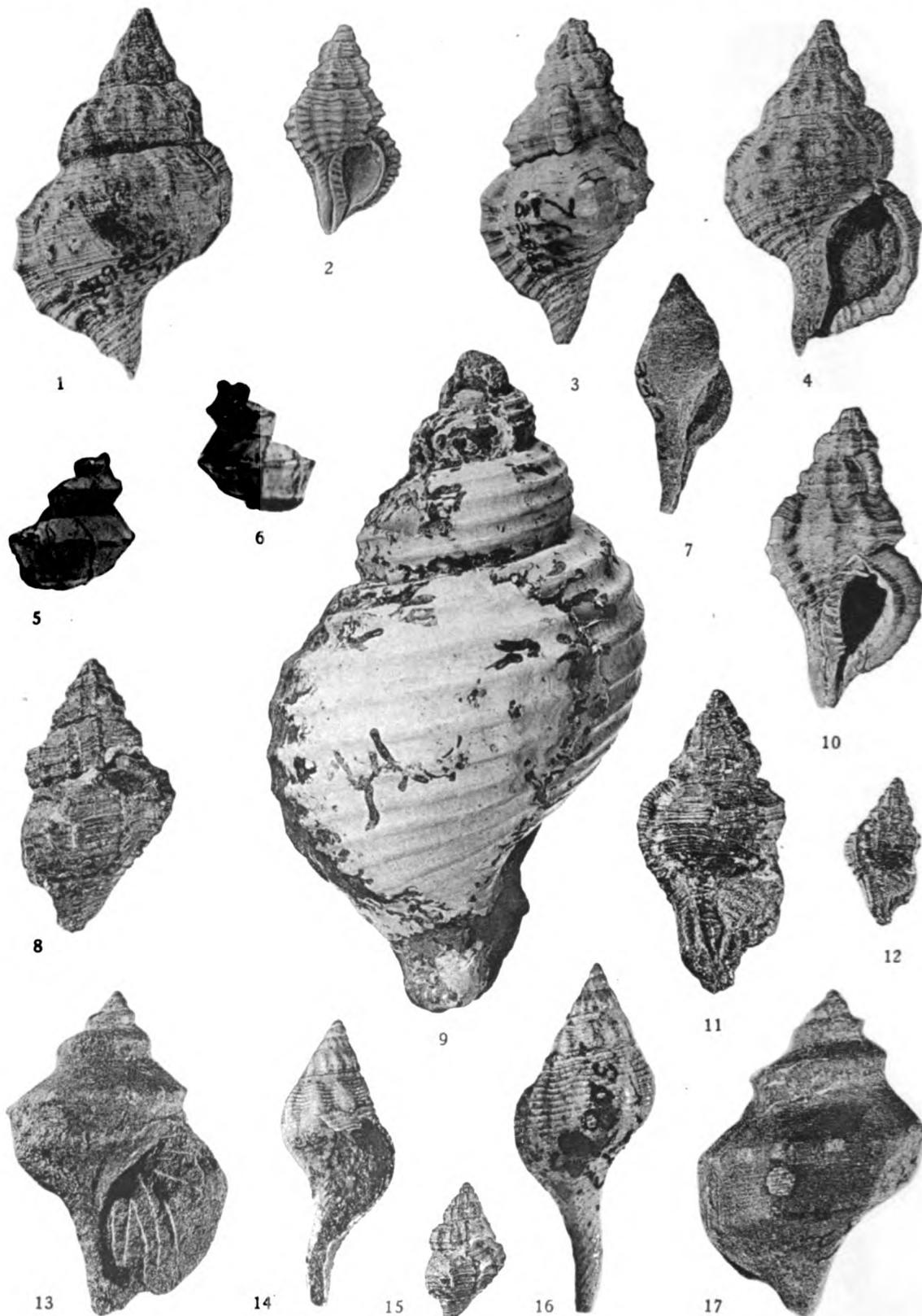
	PAGE
Fig. 1. <i>Galeodea oregonense</i> (Dall) ( $\times 1$ ), hypotype (S.U. 207).....	409
Fig. 2. <i>Phalium (Besoardica) aequisulcatum</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153896). Figured originally, 101, pl. 5, fig. 1.....	409
Fig. 3. <i>Phalium (Besoardica) turricula</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153898). Figured originally, 101, pl. 4, fig. 6.....	410
Fig. 4. <i>Phalium (Besoardica) egberti</i> Schenck ( $\times 2$ ), holotype (S.U. 79). Figured originally, 237, pl. 13, fig. 7.....	411
Fig. 5. <i>Phalium (Besoardica) iani</i> Schenck ( $\times 1$ ), holotype (C.A.S. 1747). Figured originally, 237, pl. 13, fig. 7.....	411
Fig. 6. <i>Cymatium washingtonianum</i> (Weaver) ( $\times 1$ ), holotype (U.W. 21) (C.A.S. 488). Originally figured by Weaver as <i>Ranella washingtoniana</i> , 286, pl. 13, fig. 14.....	412
Fig. 7. <i>Cymatium cowlitzense</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 33868).....	413
Fig. 8. <i>Cymatium cowlitzense</i> (Weaver) ( $\times 1$ ), hypotype (C.A.S. 329).....	413
Fig. 9. <i>Cymatium washingtonianum</i> (Weaver) ( $\times 1$ ), topotype (C.A.S. 312) ..	412
Fig. 10. <i>Cymatium cowlitzense</i> (Weaver) ( $\times 1$ ), holotype (U.W. 22) (C.A.S. 7593). Figured originally, 286, pl. 3, fig. 26.....	413
Fig. 11. <i>Cymatium washingtonianum</i> (Weaver) ( $\times 1$ ), topotype (C.A.S. 312) ..	412
Fig. 12. <i>Cymatium washingtonianum</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 33863) ..	412
Fig. 13. <i>Cymatium cowlitzense</i> (Weaver) ( $\times 1$ ), paratype (U.W. 22-A) (C.A.S. 7593-A). Figured originally, 286, pl. 3, fig. 27.....	413

(734)

UNIV. OF WASH. PUBL. IN GEOL.

[WEAVER] VOL. V, PL. 81





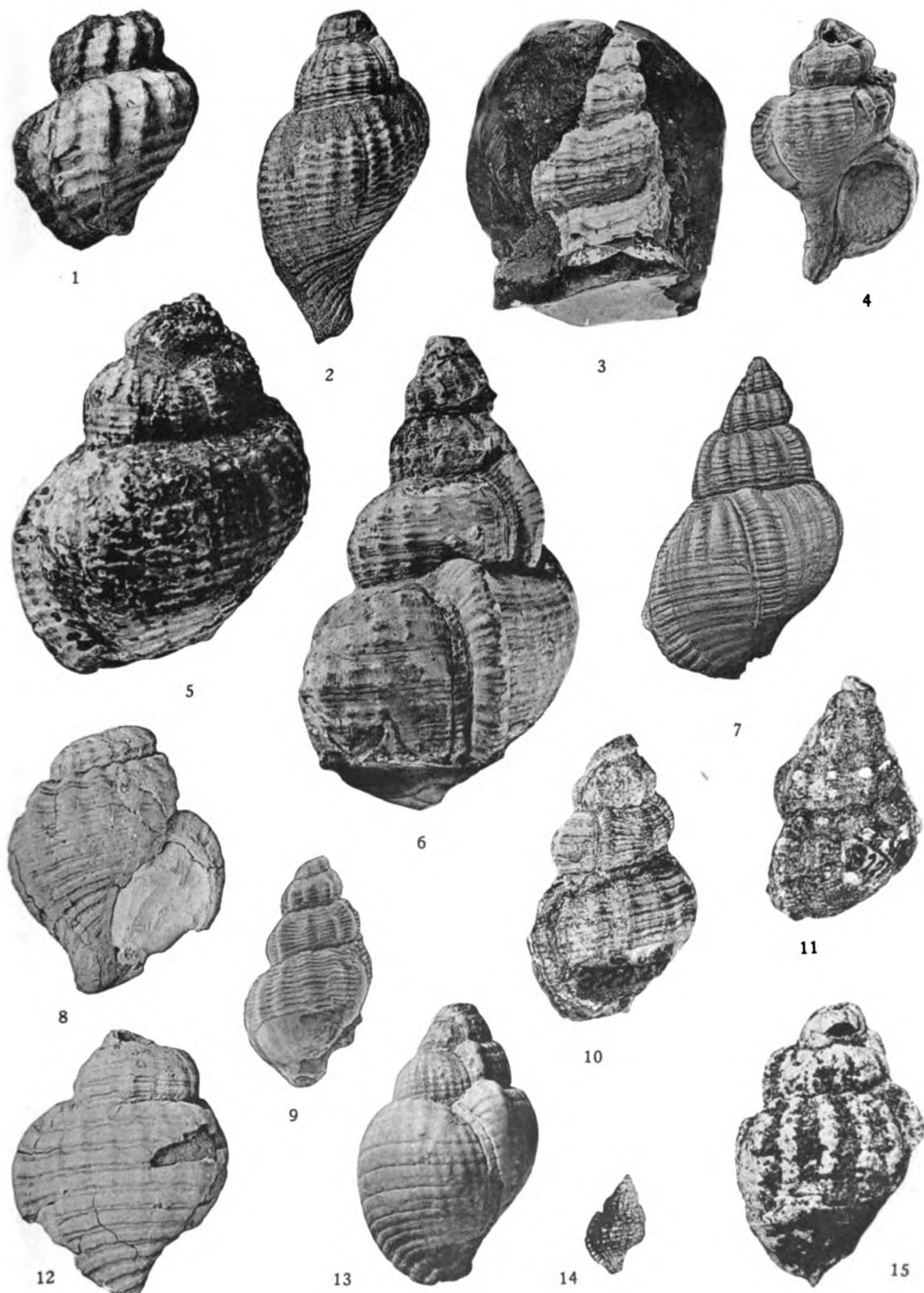
## PLATE 82

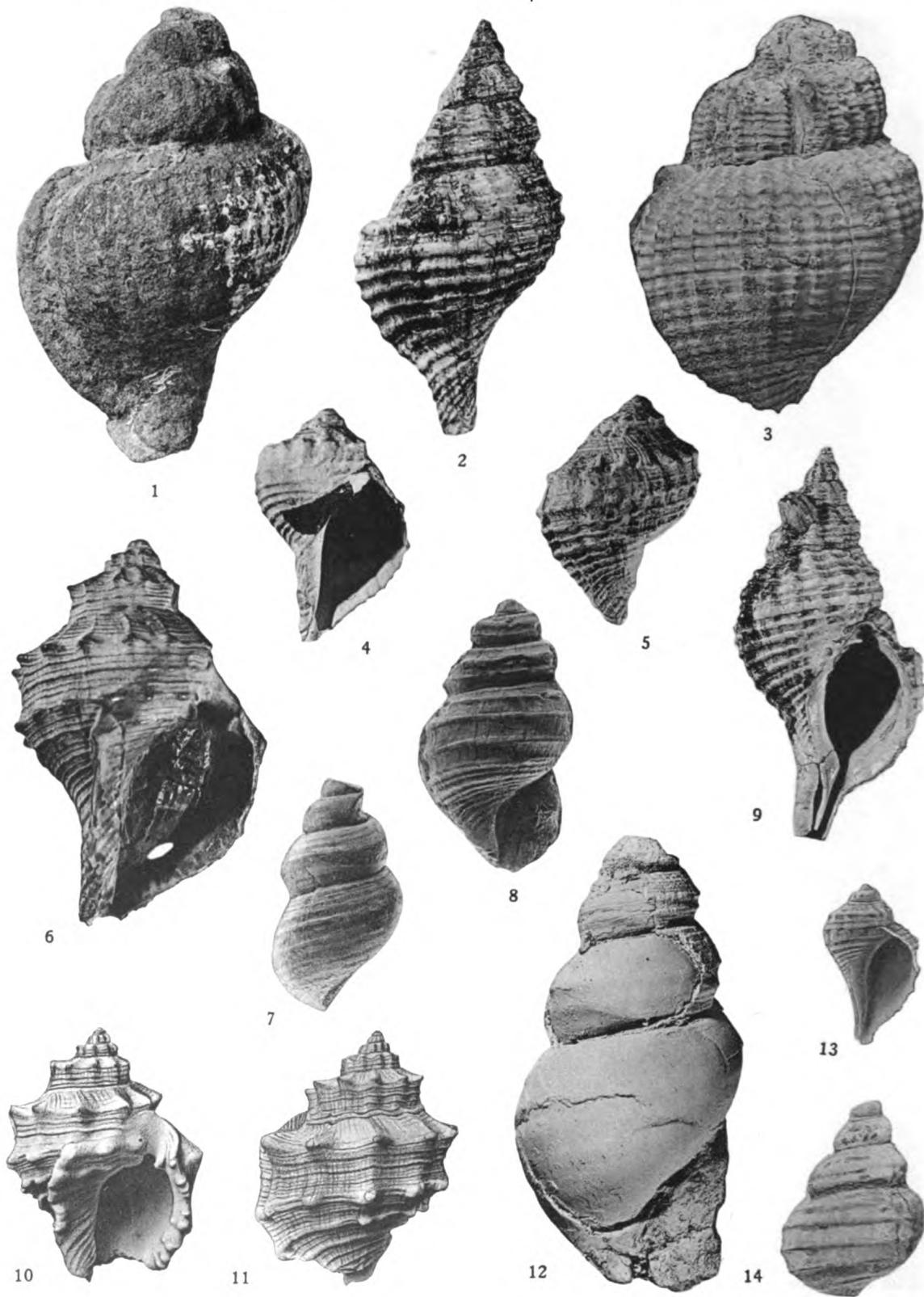
	PAGE
Fig. 1. <i>Cymatium cowlitzense</i> (Weaver) ( $\times 2$ ), hypotype (U.C. 33868).....	413
Fig. 2. <i>Cymatium etheringtoni</i> n. sp. ( $\times 1$ ), holotype (U.C. 33869).....	413
Fig. 3. <i>Cymatium etheringtoni</i> n. sp. ( $\times 1.5$ ), holotype (U.C. 33869).....	413
Fig. 4. <i>Cymatium cowlitzense</i> (Weaver) ( $\times 2$ ), hypotype (U.C. 33868).....	413
Fig. 5. <i>Pseudoperissolax trophonoides</i> Tegland ( $\times 2$ ), holotype (U.C. 32220). Figured originally, 272, pl. 13, fig. 10.....	415
Fig. 6. <i>Pseudoperissolax trophonoides</i> Tegland ( $\times 2$ ), holotype (U.C. 32220). Figured originally, 272, pl. 13, fig. 10.....	415
Fig. 7. <i>Ranellina pilsbryi</i> Stewart ( $\times 1.8$ ), hypotype (U.C. 33214). Figured by Turner, 274, pl. 16, fig. 3.....	417
Fig. 8. <i>Sassia bilineata</i> (Dickerson) ( $\times 1.5$ ), hypotype (U.C. 33673). Figured by Turner, 274, pl. 18, fig. 20.....	416
Fig. 9. <i>Cymatium pacificum</i> Dall ( $\times 1.1$ ), holotype (U.S.N.M. 153899). Fig- ured originally, 101, pl. 6, fig. 10.....	414
Fig. 10. <i>Cymatium (etheringtoni)</i> n. sp. ( $\times 1.4$ ), holotype (U.C. 33869). Du- plicate of pl. 82, fig. 2.....	413
Fig. 11. <i>Sassia bilineata</i> (Dickerson) ( $\times 1.5$ ), hypotype (U.C. 33673). Figured by Turner, 274, pl. 18, fig. 20.....	416
Fig. 12. <i>Sassia bilineata</i> (Dickerson) ( $\times 0.7$ ), hypotype (U.C. 33673). Figured by Turner, 274, pl. 18, fig. 20.....	416
Fig. 13. <i>Pseudoperissolax blakei</i> (Conrad) ( $\times 1.2$ ), hypotype (U.C. 33242). Figured by Turner, 274, pl. 17, fig. 11.....	415
Fig. 14. <i>Whitneyella markleyensis</i> (Clark) ( $\times 1.8$ ), holotype (U.C. 30863). Fig- ured originally, 56, pl. 2, fig. 27.....	477
Fig. 15. <i>Sassia bilineata</i> (Dickerson) ( $\times 0.7$ ), hypotype (U.C. 33673). Figured by Turner, 274, pl. 12, fig. 20.....	416
Fig. 16. <i>Whitneyella markleyensis</i> (Clark) ( $\times 2$ ), holotype (U.C. 30863). Fig- ured originally, 56, pl. 2, fig. 27.....	477
Fig. 17. <i>Pseudoperissolax blakei</i> (Conrad) ( $\times 1.2$ ), hypotype (U.C. 33242). Figured by Turner, 274, pl. 17, fig. 11.....	415

(735)

## PLATE 83

	PAGE
Fig. 1. <i>Argobuccinum canimani</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153907). Figured originally, 101, pl. 4, fig. 11.....	417
Fig. 2. <i>Argobuccinum coosense</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153903). Figured originally, 101, pl. 7, fig. 4.....	418
Fig. 3. <i>Argobuccinum mathewsonii</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 32232). Figured by Tegland, 272, pl. 13, fig. 14.....	420
Fig. 4. <i>Argobuccinum mathewsonii</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 32234). Figured by Tegland, 272, pl. 13, fig. 13.....	420
Fig. 5. <i>Argobuccinum pacificum</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153902). Figured originally, 101, pl. 5, fig. 9.....	419
Fig. 6. <i>Argobuccinum dilleri</i> Anderson and Martin ( $\times 1.1$ ), holotype (C.A.S. 152). Figured originally, 5, pl. 4, fig. 7.....	420
Fig. 7. <i>Argobuccinum sylviae</i> (Weaver) ( $\times 1$ ), holotype (U.W. 73) (C.A.S. 7601). Figured originally, 286, pl. 14, fig. 126.....	422
Fig. 8. <i>Argobuccinum vancouverense</i> (Clark and Arnold) ( $\times 1$ ), holotype (C.A.S. 578). Figured originally, 50, pl. 37, fig. 2b.....	421
Fig. 9. <i>Argobuccinum goodspeedi</i> (Tegland) ( $\times 1.1$ ), holotype (U.C. 32228). Figured originally, 272, pl. 13, fig. 5.....	421
Fig. 10. <i>Argobuccinum goodspeedi</i> (Tegland) ( $\times 1.4$ ), holotype (U.C. 32228). Figured originally, 272, pl. 13, fig. 5.....	421
Fig. 11. <i>Argobuccinum goodspeedi</i> (Tegland) ( $\times 1$ ), paratype (U.C. 32231). Figured originally, 272, pl. 13, fig. 6.....	421
Fig. 12. <i>Argobuccinum vancouverense</i> (Clark and Arnold) ( $\times 1$ ), holotype (C.A.S. 578). Figured originally, 50, pl. 37, fig. 2a.....	421
Fig. 13. <i>Gyrineum mediocre</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153900). Figured originally, 101, pl. 7, fig. 6.....	423
Fig. 14. <i>Gyrineum kewi</i> (Dickerson) ( $\times 0.6$ ), holotype (U.C. 11054). Figured originally, 121, pl. 7, fig. 5a.....	423
Fig. 15. <i>Argobuccinum oregonense</i> (Redfield) ( $\times 1$ ), hypotype (U.S.N.M. 153996). From Fossil Rock, Coos Bay, Oregon (Dall).....	418





## PLATE 84

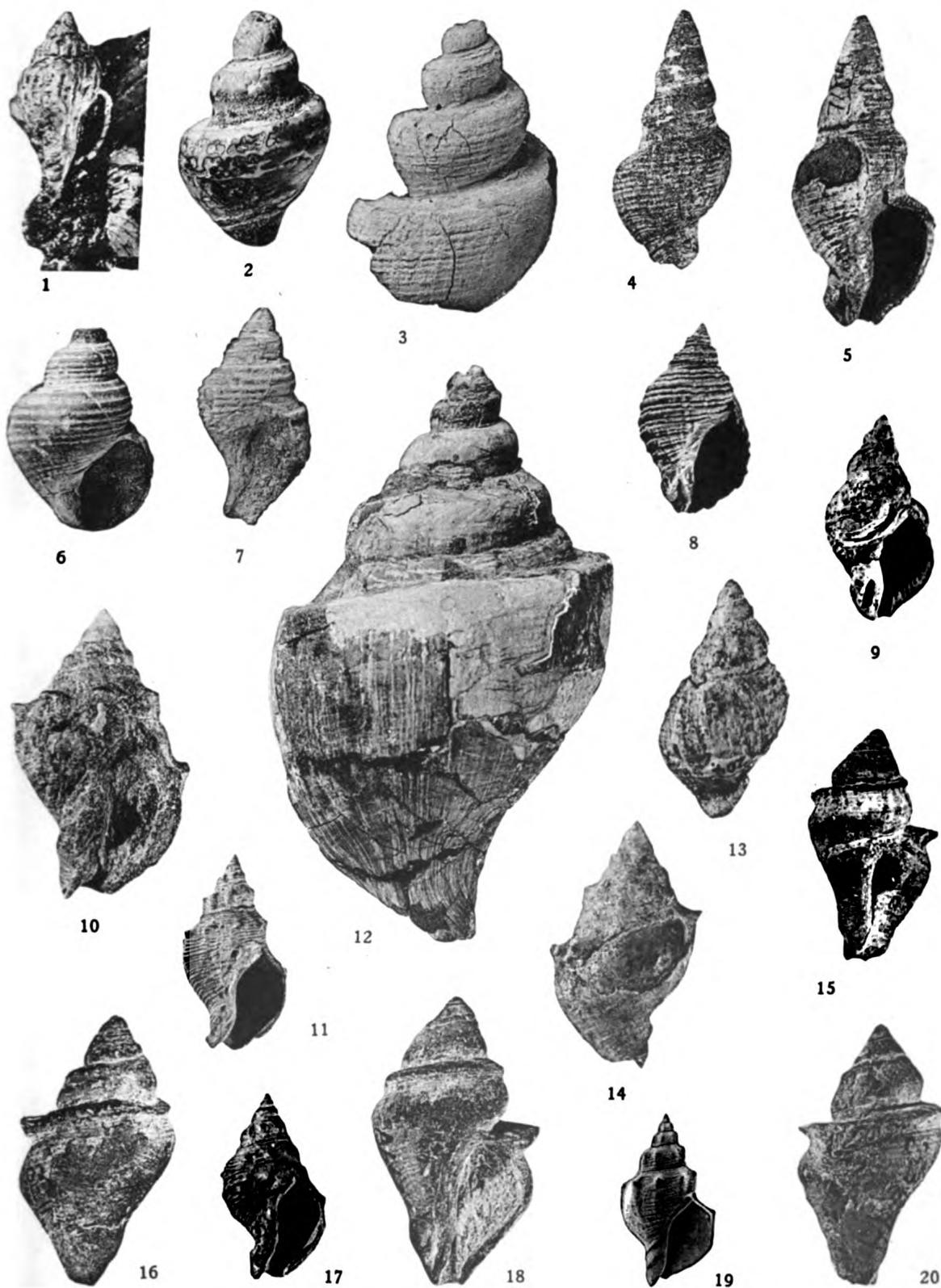
	PAGE
Fig. 1. <i>Gyrineum corbiculatum</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153870). Figured originally, 101, pl. 7, fig. 9.....	424
Fig. 2. <i>Gyrineum mackini</i> n. sp. ( $\times 0.9$ ), holotype (U.C. 12499).....	424
Fig. 3. <i>Gyrineum corbiculatum</i> Dall ( $\times 1 ?$ ), hypotype (C.A.S. 577). Figured originally, 101, pl. 7, fig. 5.....	424
Fig. 4. <i>Olequahia lincolnensis</i> (Weaver) ( $\times 1.1$ ), holotype (C.A.S. 466-A). Figured originally, 295, pl. 4, fig. 62.....	426
Fig. 5. <i>Olequahia lincolnensis</i> (Weaver) ( $\times 1.1$ ), holotype (C.A.S. 466-A). Figured originally, 295, pl. 4, fig. 62.....	426
Fig. 6. <i>Olequahia washingtoniana</i> (Weaver) ( $\times 1$ ), paratype (C.A.S. 314). Figured originally, 286, pl. 7, fig. 9.....	425
Fig. 7. <i>Neptunea landesi</i> (Tegland) ( $\times 0.6$ ), paratype (U.C. 32229). Figured originally, 272, pl. 13, fig. 3.....	427
Fig. 8. <i>Neptunea teglandae</i> n. nom. ( $\times 0.7$ ), holotype (U.C. 32217). Figured originally, 272, pl. 12, fig. 14.....	427
Fig. 9. <i>Gyrineum mackini</i> n. sp. ( $\times 0.9$ ), holotype (U.C. 12499).....	424
Fig. 10. <i>Olequahia washingtoniana</i> (Weaver) ( $\times 1$ ), holotype (U.W. 18) (C.A.S. 7611). Figured originally, 286, pl. 3, fig. 28.....	425
Fig. 11. <i>Olequahia washingtoniana</i> (Weaver) ( $\times 1$ ), holotype (U.W. 18) (C.A.S. 7611). Figured originally, 286, pl. 3, fig. 28.....	425
Fig. 12. <i>Neptunea landesi</i> (Tegland) ( $\times 1$ ), holotype (S.U. 789). Figured originally, 272, pl. 13, fig. 2.....	427
Fig. 13. <i>Olequahia lincolnensis</i> (Weaver) ( $\times 1$ ), topotype (U.C. 32449). Locality (U.C. A-9).....	426
Fig. 14. <i>Neptunea teglandae</i> n. nom. ( $\times 1$ ), paratype (U.C. 32218). Figured originally, 272, pl. 12, fig. 15.....	427

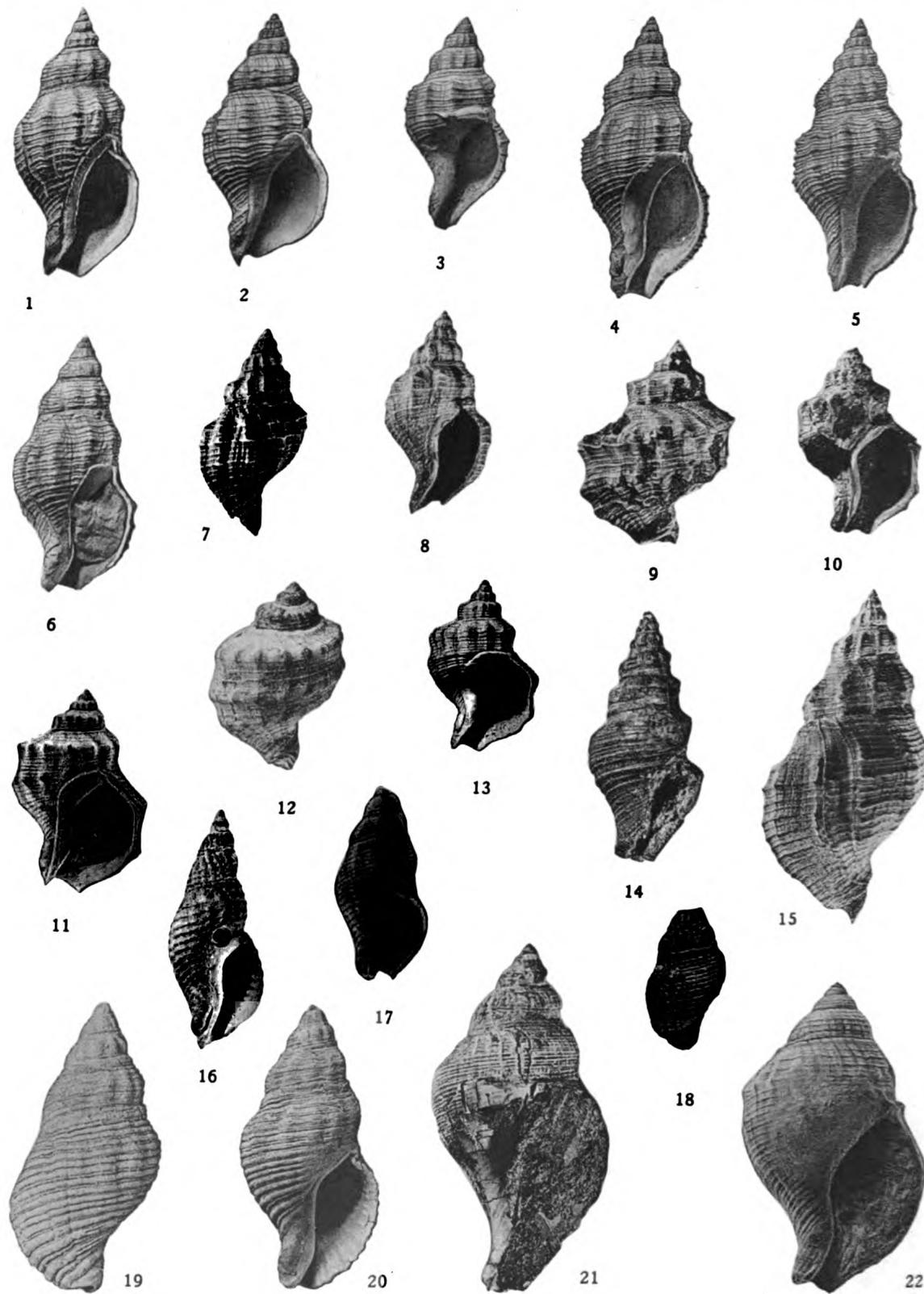
(737)

## PLATE 85

	PAGE
Fig. 1. <i>Neptunea diminuta</i> Etherington ( $\times 2.2$ ), holotype (U.C. 32011). Figured originally, 140, pl. 12, fig. 10.....	428
Fig. 2. <i>Neptunea bairdii</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 153905). Figured originally, 101, pl. 2, fig. 4.....	429
Fig. 3. <i>Neptunea bairdii</i> (Dall) ( $\times 1$ ), hypotype (S.U. 5880). Figured originally by Howe, 166, pl. 7, fig. 1.....	429
Fig. 4. <i>Cantharus bentsonae</i> Turner ( $\times 1.2$ ), holotype (U.C. 33208). Figured by Turner as <i>C. cowlitzensis</i> , 274, pl. 16, fig. 22.....	433
Fig. 5. <i>Cantharus bentsonae</i> Turner ( $\times 1.4$ ), holotype (U.C. 33208). Figured by Turner as <i>C. cowlitzensis</i> , 274, pl. 16, fig. 22.....	433
Fig. 6. <i>Liomesus sulcatus</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153904). Figured originally, 101, pl. 5, fig. 3.....	432
Fig. 7. <i>Liomesus sulcatus</i> Dall ( $\times 1$ ), hypotype (S.U. 62). Figured by Howe, 166, pl. 8, fig. 3.....	432
Fig. 8. <i>Cantharus perrini</i> Dickerson ( $\times 1.3$ ), holotype (C.A.S. 315). Figured originally, 121, pl. 7, fig. 10a.....	433
Fig. 9. <i>Cantharus merriami</i> (Weaver and Palmer) ( $\times 2$ ), holotype (U.W. 204) (C.A.S. 7623). Figured originally, 301, pl. 11, fig. 15.....	434
Fig. 10. <i>Siphonalia bicarinata</i> Dickerson subsp. <i>monospina</i> Hendon ( $\times 1.9$ ), holotype (U.C. 33678). Figured by Turner, 274, pl. 16, fig. 18.....	436
Fig. 11. <i>Siphonalia bicarinata</i> Dickerson ( $\times 1.5$ ), holotype (C.A.S. 316). Figured originally, 121, pl. 8, fig. 1b.....	436
Fig. 12. <i>Neptunea postplanata</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 107781). Figured originally, 101, pl. 7, fig. 5.....	430
Fig. 13. <i>Cantharus merriami</i> (Weaver and Palmer) ( $\times 2$ ), holotype (U.W. 204) (C.A.S. 7623). Figured originally, 301, pl. 11, fig. 15.....	434
Fig. 14. <i>Siphonalia bicarinata</i> Dickerson subsp. <i>monospina</i> Hendon ( $\times 1.7$ ), holotype (U.C. 33678). Figured by Turner, 274, pl. 16, fig. 15.....	436
Fig. 15. <i>Umpquaia oregonensis</i> Turner ( $\times 1.3$ ), paratype (U.C. 33674). Figured originally, 274, pl. 16, fig. 20.....	435
Fig. 16. <i>Umpquaia oregonensis</i> Turner ( $\times 1.3$ ), holotype (U.C. 33202). Figured originally, 274, pl. 16, fig. 21.....	435
Fig. 17. <i>Siphonalia packi</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 425). Figured originally, 274, pl. 30, fig. 11a.....	435
Fig. 18. <i>Umpquaia oregonensis</i> Turner ( $\times 1.3$ ), holotype (U.C. 33202). Figured originally, 274, pl. 16, fig. 21.....	435
Fig. 19. <i>Siphonalia bicarinata</i> Dickerson ( $\times 1$ ), hypotype (U.C. 15392).....	436
Fig. 20. <i>Umpquaia oregonensis</i> Turner ( $\times 1.3$ ), paratype (U.C. 33674). Figured originally, 274, pl. 16, fig. 20.....	435

(738)





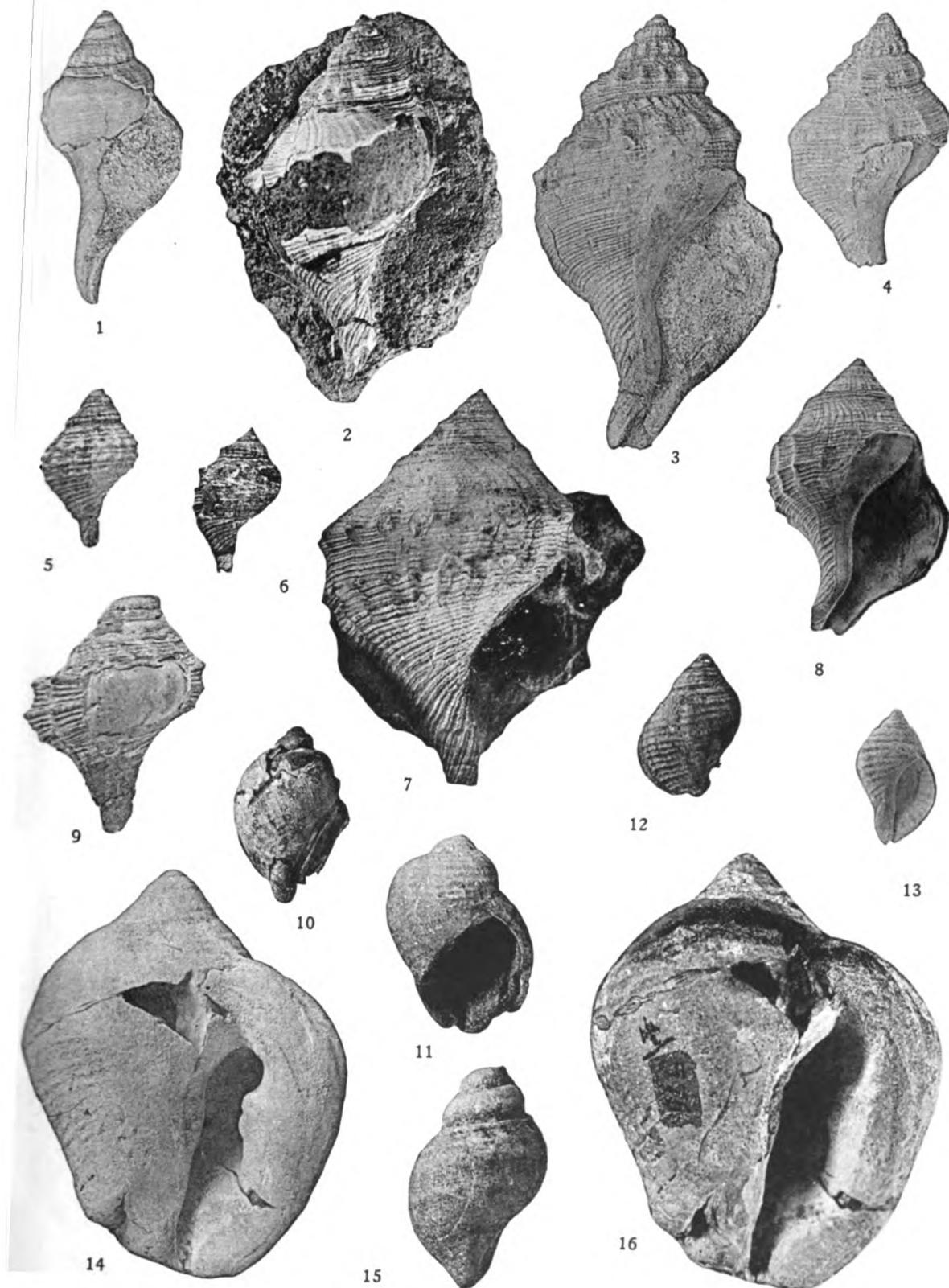
## PLATE 86

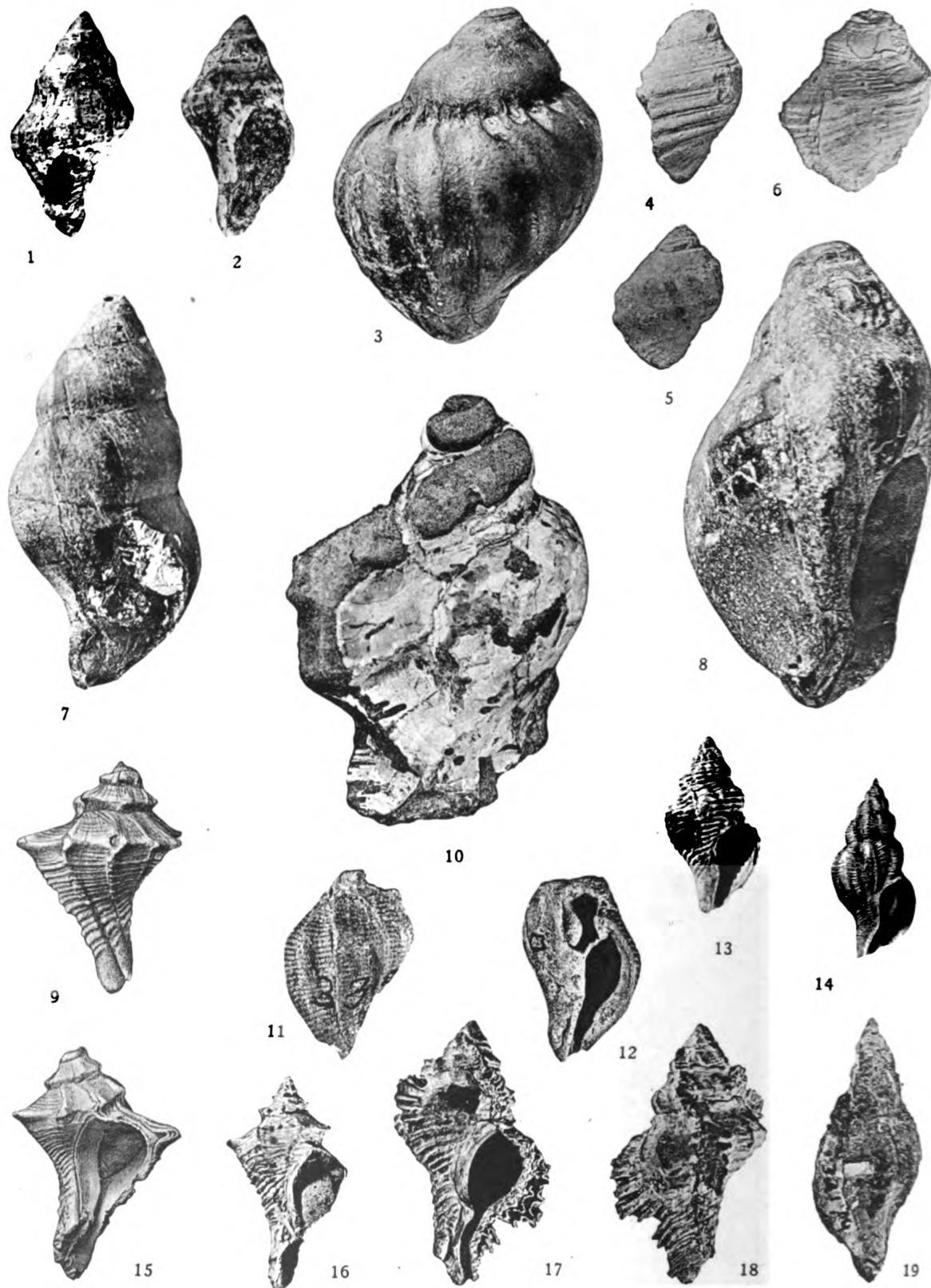
	PAGE
Fig. 1. <i>Siphonalia sopenahensis</i> (Weaver) ( $\times 1$ ), holotype (U.W. 20-A) (C.A.S. 7592-A). Figured originally, 286, pl. 1, fig. 2.....	437
Fig. 2. <i>Siphonalia sopenahensis</i> (Weaver) ( $\times 0.9$ ), paratype (U.W. 26) (C.A.S. 7574). Figured originally as <i>Hemifusus sopenahensis</i> , 286, pl. 1, fig. 3.....	437
Fig. 3. <i>Siphonalia sopenahensis</i> (Weaver) ( $\times 1$ ), hypotype (U.W. 531).....	437
Fig. 4. <i>Siphonalia sopenahensis</i> (Weaver) ( $\times 1$ ), hypotype (U.W. 532).....	437
Fig. 5. <i>Siphonalia sopenahensis</i> (Weaver) ( $\times 1$ ), hypotype (U.W. 533).....	437
Fig. 6. <i>Siphonalia sopenahensis</i> (Weaver) ( $\times 1$ ), hypotype (U.W. 534).....	437
Fig. 7. <i>Siphonalia sopenahensis</i> (Weaver) ( $\times 2$ ), paratype (U.W. 20) (C.A.S. 7592). Figured originally as <i>Tritonium sopenahensis</i> , 286, pl. 1, fig. 6....	437
Fig. 8. <i>Siphonalia sopenahensis</i> (Weaver) ( $\times 2$ ), paratype (U.W. 20) (C.A.S. 7592). Figured originally as <i>Tritonium sopenahensis</i> , 286, pl. 1, fig. 6....	437
Fig. 9. <i>Siphonalia washingtonensis</i> (Weaver) ( $\times 1$ ), syntype (C.A.S. 465-A). Figured originally, 286, pl. 5, fig. 82.....	438
Fig. 10. <i>Siphonalia washingtonensis</i> (Weaver) ( $\times 1$ ), holotype (C.A.S. 465). Figured originally, 286, pl. 5, fig. 81.....	438
Fig. 11. <i>Siphonalia washingtonensis</i> (Weaver) ( $\times 1$ ), topotype (U.C. 32450)...	438
Fig. 12. <i>Siphonalia oregonensis</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 107395). Figured originally, 101, pl. 3, fig. 6.....	439
Fig. 13. <i>Siphonalia washingtonensis</i> (Weaver) ( $\times 1$ ), hypotype (U.W. 312). Figured originally, 286, pl. 5, fig. 83.....	438
Fig. 14. <i>Siphonalia clarki</i> Dickerson ( $\times 1$ ), holotype (C.A.S. 247). Figured originally, 120, pl. 11, fig. 4a.....	437
Fig. 15. <i>Siphonalia sopenahensis</i> (Weaver) ( $\times 1.3$ ), paratype (U.W. 26) (C.A.S. 7574). Duplicate of pl. 86, fig. 2.....	437
Fig. 16. <i>Parvisipho lewisiana</i> (Weaver) ( $\times 1.6$ ), holotype (U.W. 28) (C.A.S. 7575). Figured originally, 286, pl. 1, fig. 9.....	440
Fig. 17. <i>Searlesia dira</i> Reeve subsp. <i>miocenica</i> Etherington ( $\times 1$ ), holotype (U.C. 32005). Figured originally, 140, pl. 12, fig. 18.....	441
Fig. 18. <i>Searlesia dira</i> Reeve subsp. <i>miocenica</i> Etherington ( $\times 1.3$ ), paratype (U.C. 32006). Figured originally, 140, pl. 12, fig. 11.....	441
Fig. 19. <i>Searlesia branneri</i> Clark and Arnold ( $\times 0.7$ ), holotype (U.C. 30068). Figured originally, 50, pl. 30, fig. 3b.....	442
Fig. 20. <i>Searlesia branneri</i> Clark and Arnold ( $\times 0.7$ ), holotype (U.C. 30068). Figured originally, 50, pl. 30, fig. 3a.....	442
Fig. 21. <i>Bruclarkia oregonensis</i> (Conrad) ( $\times 1$ ), hypotype (C.A.S. 159). Figured originally as holotype of <i>Agasoma oregonense</i> by Anderson and Martin, 5, pl. 4, fig. 3a.....	444
Fig. 22. <i>Bruclarkia oregonensis</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 31991).....	444

## PLATE 87

	PAGE
Fig. 1. <i>Bruclarkia acuminata</i> (Anderson and Martin) ( $\times 1$ ), paratype (U.C. 30210). Figured by Clark and Arnold, 50, pl. 29, fig. 3a.....	442
Fig. 2. <i>Bruclarkia acuminata</i> (Anderson and Martin) ( $\times 1$ ), holotype (C.A.S. 157). Figured originally, 5, pl. 5, fig. 4a.....	442
Fig. 3. <i>Bruclarkia acuminata</i> (Anderson and Martin) ( $\times 1.5$ ), paratype (U.C. 30083). Figured originally, 50, pl. 29, fig. 1a.....	442
Fig. 4. <i>Bruclarkia acuminata</i> (Anderson and Martin) ( $\times 1$ ), paratype (U.C. 30084). Figured originally, 50, pl. 29, fig. 2.....	442
Fig. 5. <i>Bruclarkia thor Tegland</i> ( $\times 2$ ), paratype (U.C. 32181). Figured originally, 272, pl. 12, fig. 10.....	445
Fig. 6. <i>Bruclarkia yaquinana</i> (Anderson and Martin) ( $\times 1$ ), holotype (C.A.S. 161). Figured originally, 5, pl. 4, fig. 5a.....	444
Fig. 7. <i>Bruclarkia columbiana</i> (Anderson and Martin) ( $\times 1.2$ ), holotype (C.A.S. 155). Figured originally, 5, pl. 5, fig. 6a.....	443
Fig. 8. <i>Bruclarkia columbiana</i> (Anderson and Martin) ( $\times 1$ ), hypotype (U.C. 32442).....	443
Fig. 9. <i>Bruclarkia thor Tegland</i> ( $\times 3$ ), holotype (U.C. 32174). Figured originally, 272, pl. 12, fig. 9.....	445
Fig. 10. <i>Thais precursor</i> Dall ( $\times 1$ ), hypotype (U.S.N.M. 328330). Figured originally by Reagan as <i>Purpura canaliculata</i> Dusal, 230, pl. 3, fig. 27....	447
Fig. 11. <i>Thais precursor</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153995). Figured originally, 101, pl. 4, fig. 4.....	447
Fig. 12. <i>Thais lima</i> (Martyn) ( $\times 1$ ), hypotype (U.S.N.M. 338329).....	446
Fig. 13. <i>Thais lima</i> (Martyn) ( $\times 1$ ), hypotype (U.C. 32004). Figured by Etherington, 140, pl. 12, fig. 17.....	446
Fig. 14. <i>Sistrum hawaii</i> Howe ( $\times 1$ ), holotype (C.A.S. 576). Figured originally, 166, pl. 8, fig. 1.....	450
Fig. 15. <i>Thais clallamensis</i> (Reagan) ( $\times 1$ ), holotype (U.S.N.M. 328327). Figured originally, 230, pl. 3, fig. 25.....	448
Fig. 16. <i>Sistrum hawaii</i> Howe ( $\times 1$ ), holotype (C.A.S. 576). Figured originally, 166, pl. 8, fig. 1. Duplicate of pl. 87, fig. 14.....	450

(740)





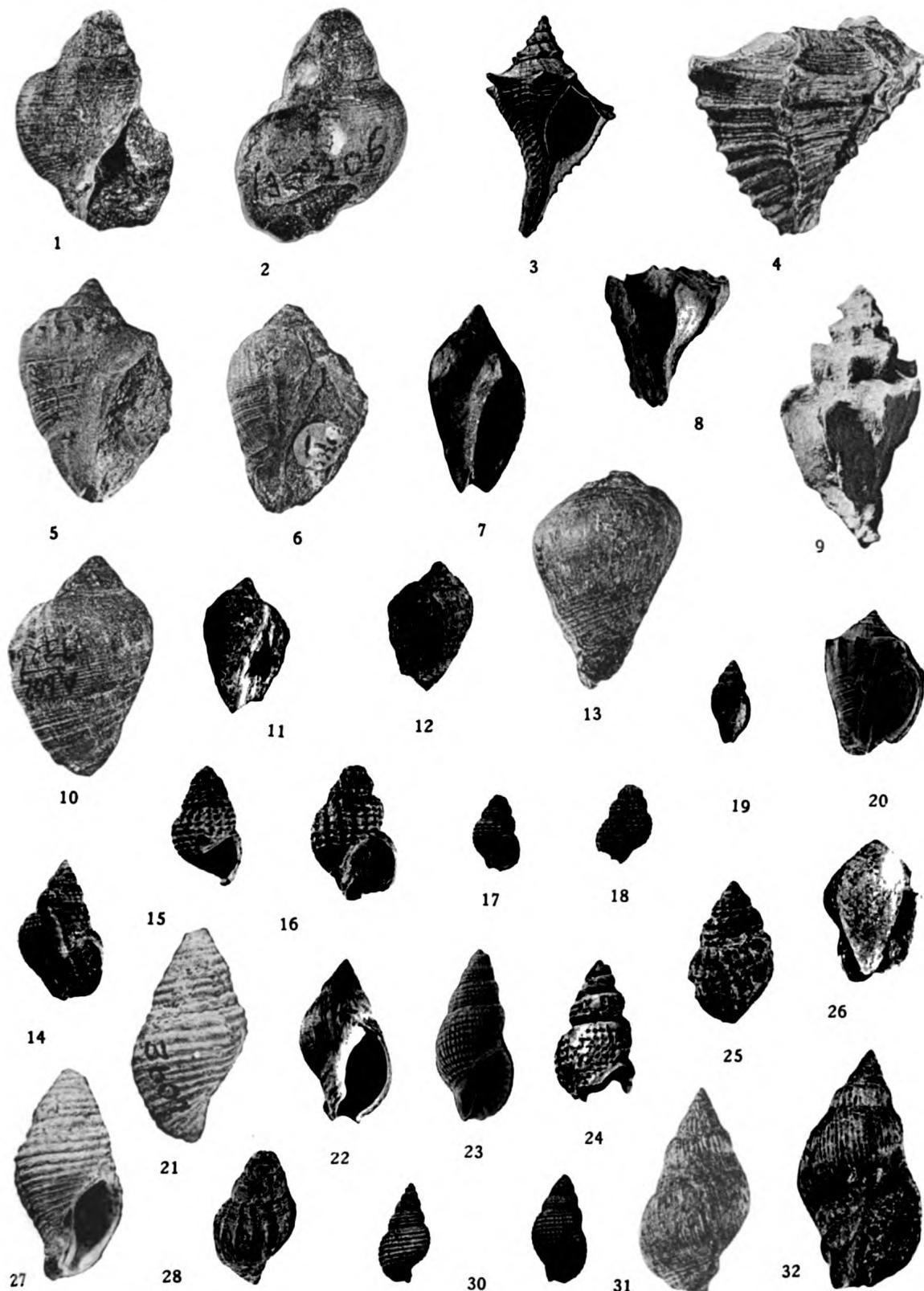
## PLATE 88

	PAGE
Fig. 1. * <i>Thais neahemensis</i> Anderson and Martin ( $\times 1$ ), holotype (C.A.S. 183). Figured originally, 5, pl. 6, fig. 3.....	449
Fig. 2. * <i>Thais neahemensis</i> Anderson and Martin ( $\times 1$ ), holotype (C.A.S. 183). Figured originally, 5, pl. 6, fig. 3.....	449
Fig. 3. <i>Thais imperialis</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 153897). Figured originally, 101, pl. 7, fig. 1.....	448
Fig. 4. <i>Thais cornwalli</i> Clark and Arnold ( $\times 1$ ), syntype (U.C. 30229). Figured originally, 50, pl. 31, fig. 1.....	450
Fig. 5. <i>Rapana perrini</i> Clark and Arnold ( $\times 2$ ), holotype (U.C. 30211). Figured originally, 50, pl. 31, fig. 7.....	451
Fig. 6. <i>Thais cornwalli</i> Clark and Arnold ( $\times 1$ ), syntype (C.A.S. 579). Figured originally, 50, pl. 31, fig. 3.....	450
Fig. 7. <i>Thais lamellosa</i> (Gmelin) ( $\times 1.5$ ), hypotype (U.S.N.M. 328364). Figured originally by Reagan, 230, pl. 6, fig. 59b.....	447
Fig. 8. <i>Purpura perponderosa</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 107778). Figured originally, 101, pl. 2, fig. 2.....	452
Fig. 9. <i>Murex cowlitensis</i> Weaver ( $\times 1$ ), holotype (U.W. 33) (C.A.S. 7595). Figured originally, 286, pl. 1, fig. 7.....	455
Fig. 10. <i>Purpura foliata</i> Martyn ( $\times 1$ ), hypotype (U.S.N.M. 328373). Figured originally by Reagan, 230, pl. 6, fig. 65.....	452
Fig. 11. <i>Urosalpinx</i> sp. Effinger ( $\times 2$ ), holotype (U.C. 33596). Figured originally, 138, pl. 46, fig. 19.....	454
Fig. 12. <i>Urosalpinx</i> sp. Effinger ( $\times 2$ ), holotype (U.C. 33596). Figured originally, 138, pl. 46, fig. 26.....	454
Fig. 13. <i>Urosalpinx tejonensis</i> (Weaver) ( $\times 1.5$ ), holotype (U.W. 30) (C.A.S. 321). Figured by Dickerson, 121, pl. 8, fig. 5b.....	453
Fig. 14. <i>Urosalpinx hannibali</i> Dickerson ( $\times 1.8$ ), holotype (C.A.S. 334). Figured originally, 121, pl. 8, fig. 5b.....	453
Fig. 15. <i>Murex cowlitensis</i> Weaver ( $\times 1$ ), holotype (U.W. 33) (C.A.S. 7595). Figured originally, 286, pl. 1, fig. 7.....	455
Fig. 16. <i>Murex sopenahensis</i> Weaver ( $\times 1$ ), holotype (U.W. 32) (C.A.S. 495). Figured originally, 286, pl. 1, fig. 8.....	456
Fig. 17. <i>Murex packardi</i> Dickerson ( $\times 1$ ), holotype (C.A.S. 333). Figured originally, 121, pl. 9, fig. 6a.....	455
Fig. 18. <i>Murex packardi</i> Dickerson ( $\times 1$ ), holotype (C.A.S. 333). Figured originally, 121, pl. 9, fig. 6b.....	455
Fig. 19. <i>Murex coosensis</i> Turner ( $\times 2$ ), holotype (U.C. 33179). Figured by Turner, 274, pl. 15, fig. 25.....	454

\*See note, page 449.

PLATE 89

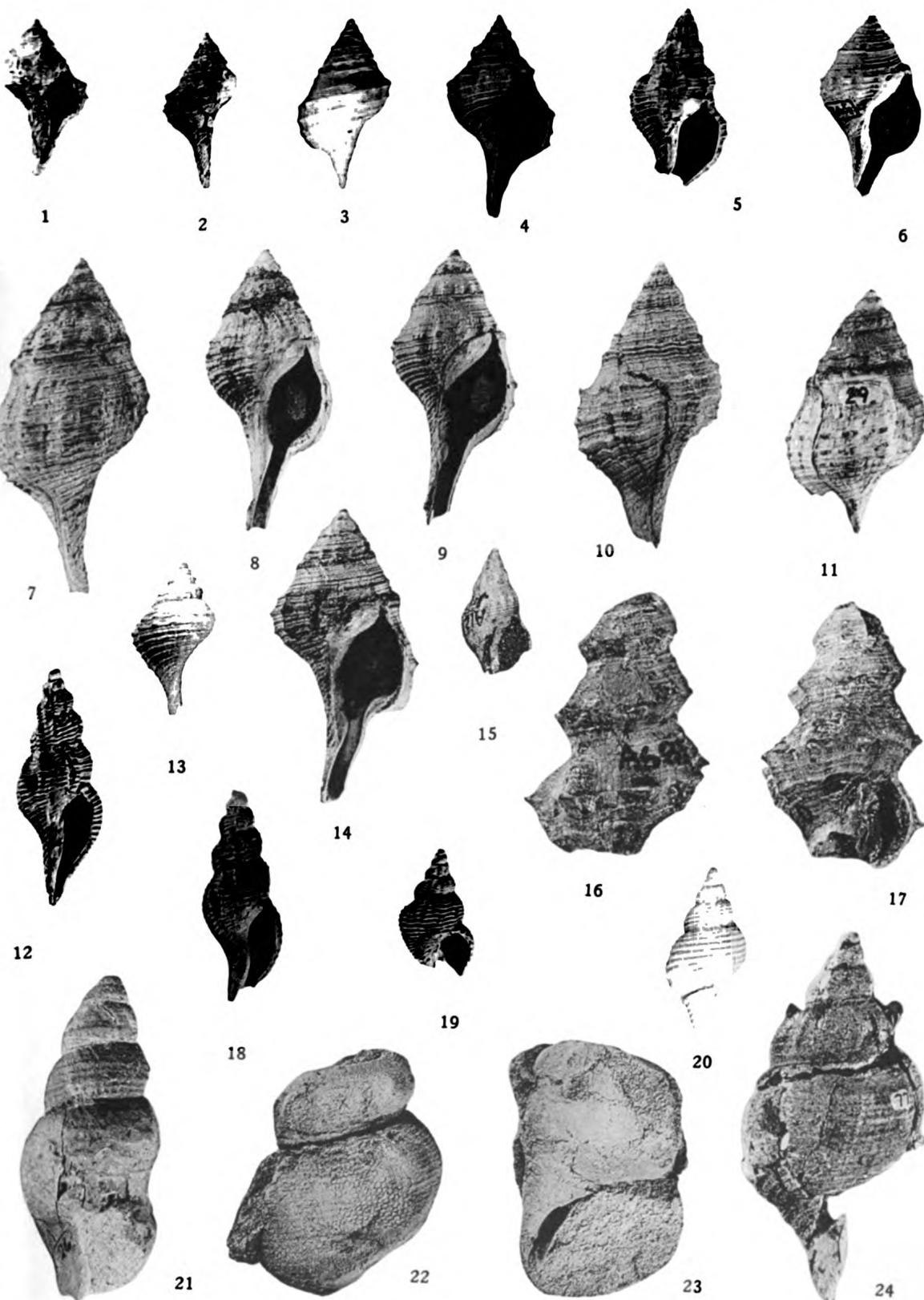
	PAGE
Fig. 1. <i>Buccinofusus turneri</i> n. sp. ( $\times 1.8$ ), holotype (U.C. 33206). Figured originally, 274, pl. 15, fig. 10.....	440
Fig. 2. <i>Buccinofusus turneri</i> n. sp. ( $\times 2$ ), holotype (U.C. 33206). Figured originally, 274, pl. 15, fig. 10.....	440
Fig. 3. <i>Murex sopenahensis</i> Weaver ( $\times 1$ ), hypotype (U.W. 32-B) (C.A.S. 495-B).....	456
Fig. 4. <i>Murex sopenahensis</i> Weaver ( $\times 1.5$ ), hypotype (U.W. 32-A) (C.A.S. 495-A).....	456
Fig. 5. <i>Pseudoliva dilleri</i> Dickerson ( $\times 1$ ), holotype (C.A.S. 248). Figured originally, 120, pl. 12, fig. 1a.....	458
Fig. 6. <i>Pseudoliva dilleri</i> Dickerson ( $\times 1.5$ ), topotype (U.C. 33268). Figured by Turner, 274, pl. 18, fig. 8.....	458
Fig. 7. <i>Pseudoliva kirbyi</i> Clark ( $\times 2.5$ ), hypotype (C.A.S. 307). Figured originally, 121, pl. 7, fig. 1b.....	457
Fig. 8. <i>Murex calamitus</i> Hanna ( $\times 2$ ), holotype (C.A.S. 412). Figured by Dickerson, 123, pl. 30, fig. 3b.....	457
Fig. 9. <i>Murex calamitus</i> Hanna ( $\times 2$ ), hypotype (U.C. 33615). Figured originally by Effinger, 138, pl. 47, fig. 32.....	457
Fig. 10. <i>Pseudoliva dilleri</i> Dickerson ( $\times 1.5$ ), topotype (U.C. 33268). Figured by Turner, 274, pl. 18, fig. 8.....	458
Fig. 11. <i>Pseudoliva dilleri</i> Dickerson ( $\times 1$ ), topotype (U.C. 33679). Figured by Turner, 274, pl. 18, fig. 7.....	458
Fig. 12. <i>Pseudoliva dilleri</i> Dickerson ( $\times 1$ ), topotype (U.C. 33679). Figured by Turner, 274, pl. 18, fig. 7.....	458
Fig. 13. <i>Pseudoliva umquamensis</i> Turner ( $\times 1.3$ ), syntype (U.C. 33175). Figured originally, 274, pl. 18, fig. 10.....	459
Fig. 14. <i>Nassarius arnoldi</i> (Anderson) ( $\times 3$ ), hypotype (U.C. 32012). Figured originally, 140, pl. 12, fig. 15.....	461
Fig. 15. <i>Nassarius andersoni</i> (Weaver) ( $\times 2$ ), holotype (U.W. 75) (C.A.S. 538). Figured originally, 286, pl. 6, fig. 56.....	461
Fig. 16. <i>Nassarius andersoni</i> (Weaver) ( $\times 2$ ), hypotype (U.C. 32015). Figured by Etherington, 140, pl. 12, fig. 4.....	461
Fig. 17. <i>Nassarius andersoni</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 32015). Figured by Etherington, 140, pl. 12, fig. 16.....	461
Fig. 18. <i>Nassarius andersoni</i> (Weaver) ( $\times 1.2$ ), hypotype (U.C. 32015). Figured by Etherington, 140, pl. 12, fig. 4.....	461
Fig. 19. <i>Amphissa decepta</i> (Etherington) ( $\times 1$ ), holotype (U.C. 32055). Figured originally, 140, pl. 14, figs. 6, 11.....	460
Fig. 20. <i>Pseudoliva volutaeformis</i> Gabb ( $\times 1$ ), hypotype (U.C. 15410).....	459
Fig. 21. <i>Latirus eocenica</i> (Weaver) ( $\times 2.7$ ), hypotype (U.C. 33593). Figured by Effinger, 138, pl. 47, fig. 30.....	472
Fig. 22. <i>Molopophorus bretzi</i> (Weaver) ( $\times 1.2$ ), holotype (U.W. 39) (C.A.S. 500). Figured originally, 286, pl. 2, fig. 21.....	464
Fig. 23. <i>Tritia (Antillophos) dumblei</i> (Anderson) var. <i>chehalisensis</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 32010). Figured by Etherington, 140, pl. 12, fig. 22.....	463
Fig. 24. <i>Tritia (Antillophos) dumblei</i> (Anderson) var. <i>chehalisensis</i> (Weaver) ( $\times 1.8$ ), holotype (U.W. 108) (C.A.S. 564). Figured originally, 286, pl. 5, fig. 70.....	463
Fig. 25. <i>Nassarius lincolensis</i> (Anderson and Martin) ( $\times 2.2$ ), holotype (C.A.S. 167). Figured originally, 5, pl. 7, fig. 14b.....	462
Fig. 26. <i>Pseudoliva packardi</i> Van Winkle ( $\times 6$ ), holotype (U.W. 144) (C.A.S. 7607). Figured originally, 275, pl. 7, fig. 16.....	460
Fig. 27. <i>Latirus eocenica</i> (Weaver) ( $\times 2.7$ ), hypotype (U.C. 33593). Figured by Effinger, 138, pl. 47, fig. 31.....	472
Fig. 28. <i>Molopophorus californicus</i> Clark and Woodford subsp. <i>lonsdalei</i> Turner ( $\times 1.7$ ), holotype (U.C. 33244). Figured by Turner, 274, pl. 15, fig. 8.....	464
Fig. 29. <i>Tritia (Antillophos) dumblei</i> (Anderson) var. <i>chehalisensis</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 32008). Figured by Etherington, 140, pl. 12, fig. 6. Figure present on plate, but number lacking.....	463
Fig. 30. <i>Tritia (Antillophos) dumblei</i> (Anderson) var. <i>chehalisensis</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 32008). Figured by Etherington, 140, pl. 12, fig. 6.....	463
Fig. 31. <i>Molopophorus antiquatus</i> (Gabb) ( $\times 2$ ), hypotype (U.C. 33246). Figured by Turner, 274, pl. 15, fig. 11.....	463
Fig. 32. <i>Molopophorus antiquatus</i> (Gabb) ( $\times 2.2$ ), hypotype (U.C. 33246). Figured by Turner, 274, pl. 15, fig. 11.....	463



## PLATE 91

	PAGE
Fig. 1. <i>Whitneyella gabbi</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 413). Figured originally, 123, pl. 30, fig. 4a.....	475
Fig. 2. <i>Whitneyella gabbi</i> (Dickerson) ( $\times 1$ ), holotype (C.A.S. 413). Figured originally, 123, pl. 30, fig. 4b.....	475
Fig. 3. <i>Whitneyella gabbi</i> (Dickerson) ( $\times 0.8$ ), hypotype (U.C. 33595). Figured by Effinger, 138, pl. 47, fig. 34.....	475
Fig. 4. <i>Whitneyella gabbi</i> (Dickerson) ( $\times 1$ ), hypotype (U.C. 33594). Figured by Effinger, 138, pl. 47, fig. 33.....	475
Fig. 5. <i>Whitneyella washingtoniana</i> (Weaver) ( $\times 1$ ), hypotype (C.A.S. 493). Cowlitz formation .....	475
Fig. 6. <i>Whitneyella lincolnensis</i> (Van Winkle) ( $\times 1$ ), hypotype (C.A.S. 508)	476
Fig. 7. <i>Whitneyella washingtoniana</i> (Weaver) ( $\times 1.3$ ), hypotype (U.W. 501). Cowlitz formation .....	475
Fig. 8. <i>Whitneyella washingtoniana</i> (Weaver) ( $\times 1.5$ ), hypotype (U.W. 501). Cowlitz formation .....	475
Fig. 9. <i>Whitneyella washingtoniana</i> (Weaver) ( $\times 1.2$ ), hypotype (U.W. 503). Cowlitz formation .....	475
Fig. 10. <i>Whitneyella washingtoniana</i> (Weaver) ( $\times 1.4$ ), syntype (U.W. 29-A) (C.A.S. 7565-A). Figured originally as <i>Hemifusus washingtoniana</i> , 286, pl. 2, fig. 11.....	475
Fig. 11. <i>Whitneyella washingtoniana</i> (Weaver) ( $\times 1.4$ ), syntype (U.W. 29). (C.A.S. 7565). Figured originally, 286, pl. 2, fig. 12.....	475
Fig. 12. <i>Whitneyella buwaldana</i> (Dickerson) ( $\times 2$ ), holotype (C.A.S. 346). Figured originally as <i>Fasciolaria buwaldana</i> , 121, pl. 11, fig. 2b.....	477
Fig. 13. <i>Whitneyella lincolnensis</i> (Van Winkle) ( $\times 1$ ), topotype (U.C. 32182). Figured originally by Tegland, 272, pl. 12, fig. 13.....	476
Fig. 14. <i>Whitneyella lincolnensis</i> (Van Winkle) ( $\times 0.7$ ), holotype (U.W. 143) (C.A.S. 7564). Figured originally, 275, pl. 7, fig. 10.....	476
Fig. 15. <i>Whitneyella markleyensis</i> (Clark) ( $\times 1$ ), paratype (U.C. 30868). Figured originally, 56, pl. 2, fig. 28.....	477
Fig. 16. <i>Fusinus merriami</i> Dickerson ( $\times 2$ ), hypotype (U.C. 33220). Figured by Turner, 274, pl. 17, fig. 8.....	479
Fig. 17. <i>Fusinus merriami</i> Dickerson ( $\times 2$ ), hypotype (U.C. 33220). Figured by Turner, 274, pl. 17, fig. 8.....	479
Fig. 18. <i>Fusinus willisi</i> (Dickerson) ( $\times 2$ ), holotype (C.A.S. 345). Figured originally, 121, pl. 11, fig. 1b.....	480
Fig. 19. <i>Fusinus gesteri</i> Dickerson ( $\times 2$ ), holotype (C.A.S. 429). Broken. Figured originally, 123, pl. 31, fig. 4.....	479
Fig. 20. <i>Fusinus gesteri</i> Dickerson ( $\times 2.4$ ), hypotype (U.C. 33601). Figured by Effinger, 138, pl. 47, fig. 16.....	479
Fig. 21. <i>Fusinus empireensis</i> Anderson and Martin ( $\times 1$ ), holotype (C.A.S. 185). Figured originally, 5, pl. 5, fig. 7.....	480
Fig. 22. <i>Fusinus (Priscofusus) sanctacrucis</i> (Arnold) ( $\times 2$ ), paratype (S.U. 5418).....	486
Fig. 23. <i>Fusinus (Priscofusus) sanctacrucis</i> (Arnold) ( $\times 2$ ), paratype (S.U. 5418) .....	486
Fig. 24. <i>Fusinus montesanoensis</i> (Weaver) ( $\times 1$ ), holotype (U.W. 77) (C.A.S. 7562). Figured originally, 286, pl. 6, fig. 58.....	481

(744)





## PLATE 92

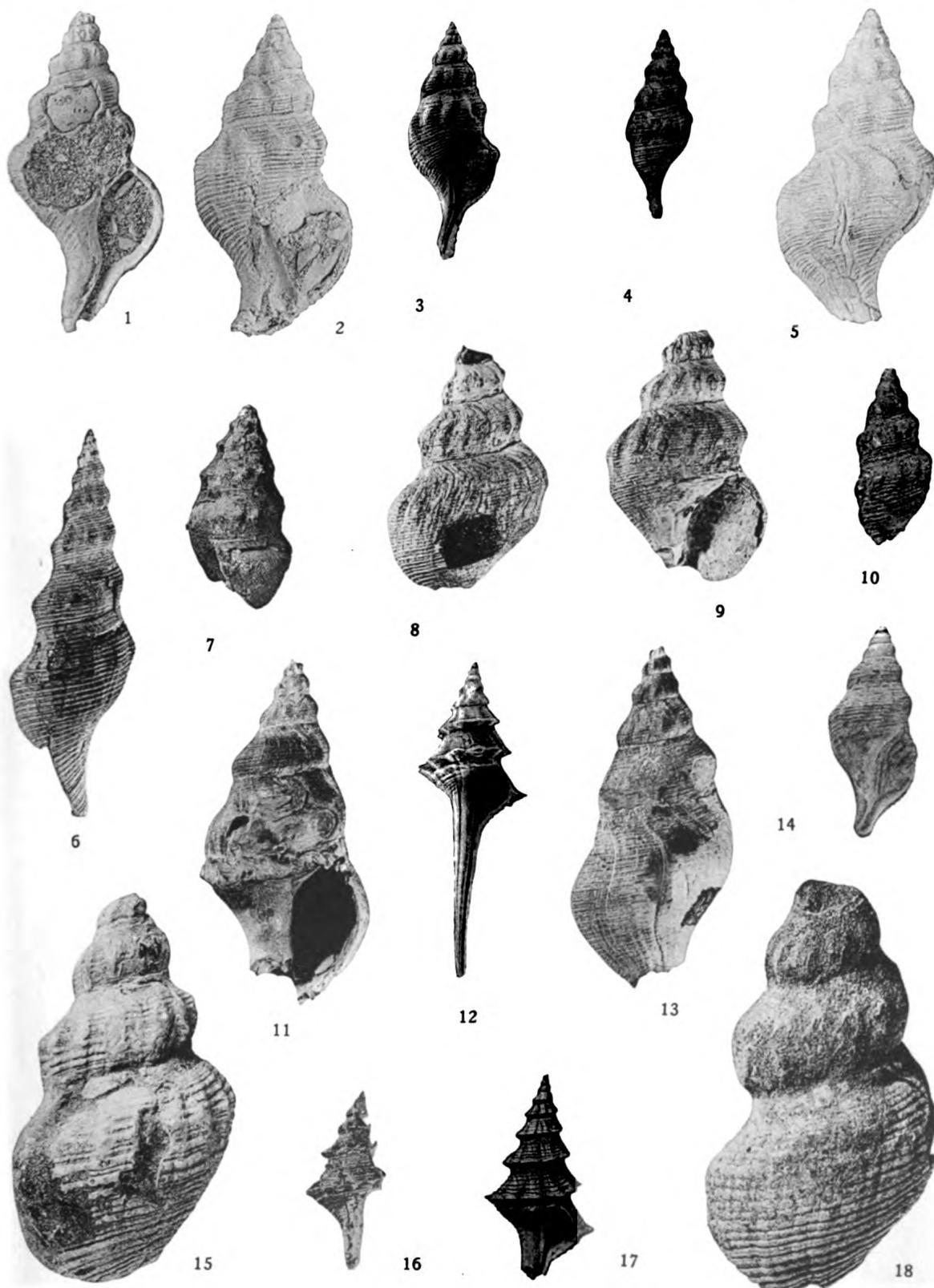
	PAGE
Fig. 1. <i>Fusinus (Priscofusus) corpulentus</i> (Conrad) ( $\times 1$ ), holotype (U.S. N.M. 3551). Conrad type. Figured originally, 68, pl. 20, fig. 4.....	482
Fig. 2. <i>Fusinus (Priscofusus) oregonensis</i> (Conrad) ( $\times 1$ ), paratype (U.S. N.M. 3535). Conrad type. Figured originally, 68, pl. 20, fig. 10.....	484
Fig. 3. <i>Fusinus (Priscofusus)</i> sp. indet. Dall ( $\times 1$ ), holotype (U.S.N.M. 3544) .....	483
Fig. 4. <i>Fusinus (Priscofusus) oregonensis</i> (Conrad) ( $\times 1$ ), holotype (U.S. N.M. 3517). Conrad type. Figured originally, 68, pl. 20, fig. 11.....	484
Fig. 5. <i>Fusinus (Priscofusus)</i> sp. indet. Dall ( $\times 1$ ), holotype (U.S.N.M. 3544). .....	483
Fig. 6. <i>Fusinus (Priscofusus)</i> sp. indet. Dall ( $\times 1$ ), holotype (U.S.N.M. 3544). .....	483
Fig. 7. <i>Fusinus (Priscofusus) chehalensis</i> (Weaver) ( $\times 1$ ), hypotype (C.A.S. 507-B) .....	485
Fig. 8. <i>Fusinus (Priscofusus) chehalensis</i> (Weaver) ( $\times 1$ ), hypotype (C.A.S. 551). Figured by Weaver, 275, pl. 4, fig. 48, as <i>Drillia hecoxi</i> (Arnold) .....	485
Fig. 9. <i>Fusinus (Priscofusus) chehalensis</i> (Weaver) ( $\times 1$ ), hypotype (U.W. 80-A) (C.A.S. 7545-A) .....	485
Fig. 10. <i>Fusinus (Priscofusus) geniculus</i> (Conrad) ( $\times 1$ ), holotype (U.S. N.M. 3552). Conrad type. Figured originally, 68, pl. 20, fig. 3.....	482

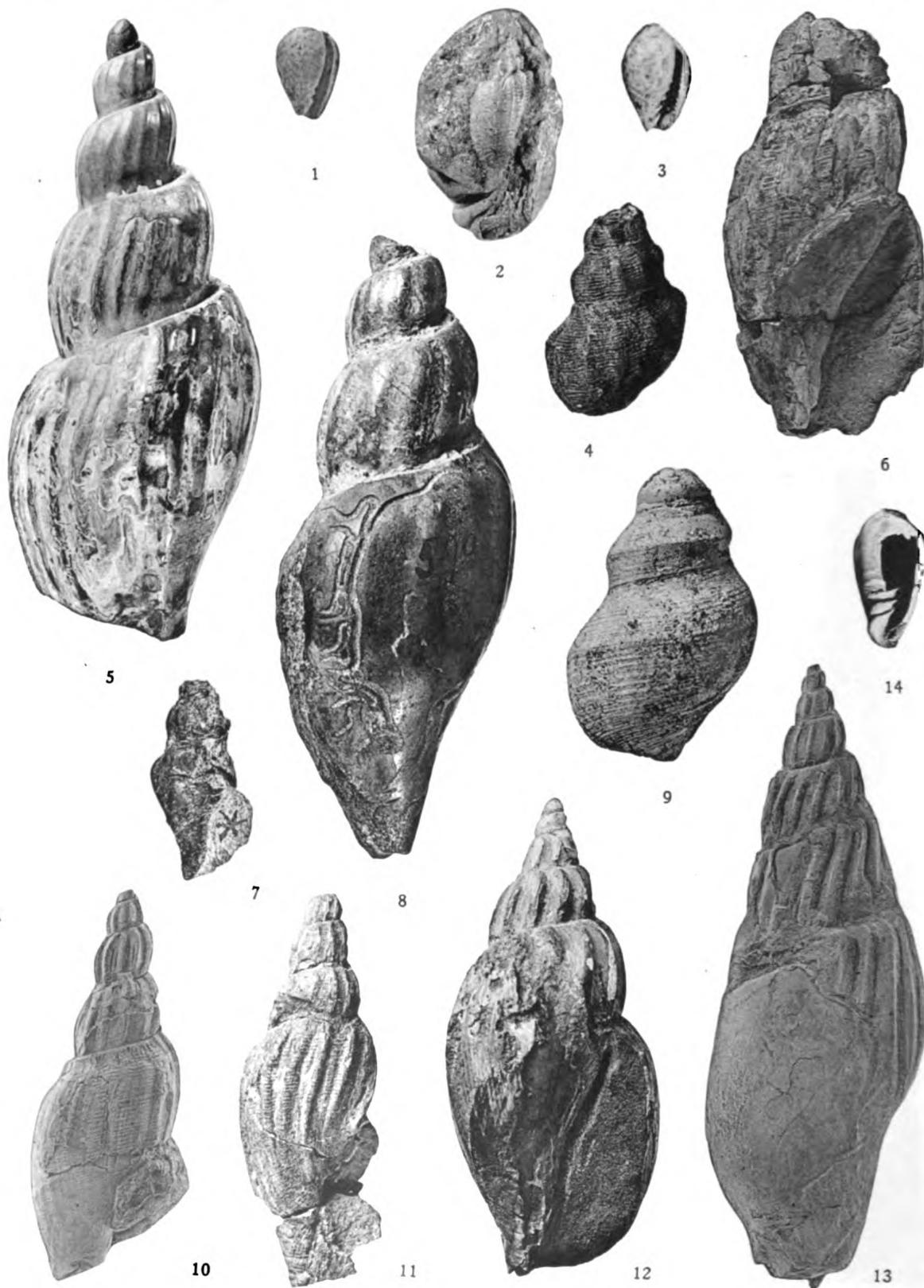
(745)

## PLATE 93

	PAGE
Fig. 1. <i>Fusinus (Priscofusus) hannibali</i> Clark and Arnold ( $\times 1$ ), holotype (U.C. 30069). Figured originally, 50, pl. 30, fig. 2.....	484
Fig. 2. <i>Fusinus (Priscofusus) hannibali</i> Clark and Arnold ( $\times 1$ ), cotype (U.C. 30070). Figured originally, 50, pl. 30, fig. 1a.....	484
Fig. 3. <i>Fusinus (Priscofusus) stewarti</i> Tegland ( $\times 1$ ), holotype (U.C. 32238). Figured originally, 272, pl. 12, fig. 4.....	486
Fig. 4. <i>Fusinus (Priscofusus) stewarti</i> Tegland ( $\times 1$ ), paratype (U.C. 32240). Figured originally, 272, pl. 12, fig. 5.....	486
Fig. 5. <i>Fusinus (Priscofusus) hannibali</i> Clark and Arnold ( $\times 1$ ), cotype (U.C. 30070). Figured originally, 50, pl. 30, fig. 1b.....	484
Fig. 6. <i>Fusinus (Priscofusus) chehalensis</i> (Weaver) ( $\times 1$ ), hypotype (U.W. 80-B) (C.A.S. 7545-B).....	485
Fig. 7. <i>Fusinus (Priscofusus) medialis</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 3532). Conrad type. Figured originally, 68, pl. 20, fig. 1.....	483
Fig. 8. <i>Fusinus (Priscofusus) lincolensis</i> (Anderson and Martin) ( $\times 0.9$ ), holotype (C.A.S. 211). Figured originally, 5, pl. 6, fig. 8.....	487
Fig. 9. <i>Fusinus (Priscofusus) lincolensis</i> (Anderson and Martin) ( $\times 0.9$ ), holotype (C.A.S. 211). Figured originally, 5, pl. 6, fig. 8.....	487
Fig. 10. <i>Fusinus (Priscofusus) stewarti</i> Tegland ( $\times 1$ ), paratype (U.C. 32239). Figured originally, 272, pl. 12, fig. 7.....	486
Fig. 11. <i>Fusinus (Priscofusus) carlsoni</i> (Anderson and Martin) ( $\times 1.2$ ), holotype (C.A.S. 212). Figured originally, 5, pl. 5, fig. 2a.....	488
Fig. 12. <i>Fulgurofusus washingtoniana</i> (Weaver) ( $\times 1$ ), hypotype (U.C. 15478). Cowlitz formation.....	490
Fig. 13. <i>Fusinus (Priscofusus) carlsoni</i> (Anderson and Martin) ( $\times 1.2$ ), holotype (C.A.S. 212). Figured originally, 5, pl. 5, fig. 2a.....	488
Fig. 14. <i>Fusinus (Priscofusus) stewarti</i> Tegland ( $\times 1$ ), paratype (U.C. 32241). Figured originally, 272, pl. 12, fig. 8.....	486
Fig. 15. <i>Fusinus (Priscofusus) coosensis</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 107783). Figured originally, 101, pl. 2, fig. 3.....	489
Fig. 16. <i>Fulgurofusus washingtoniana</i> (Weaver) ( $\times 1.1$ ), paratype (C.A.S. 497). Figured originally, 286, pl. 2, fig. 10.....	490
Fig. 17. <i>Fulgurofusus washingtoniana</i> (Weaver) ( $\times 1$ ), hypotype (U.W. 570) .....	490
Fig. 18. <i>Fusinus (Priscofusus) coosensis</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 107783). Figured originally, 101, pl. 2, fig. 3.....	489

(746)





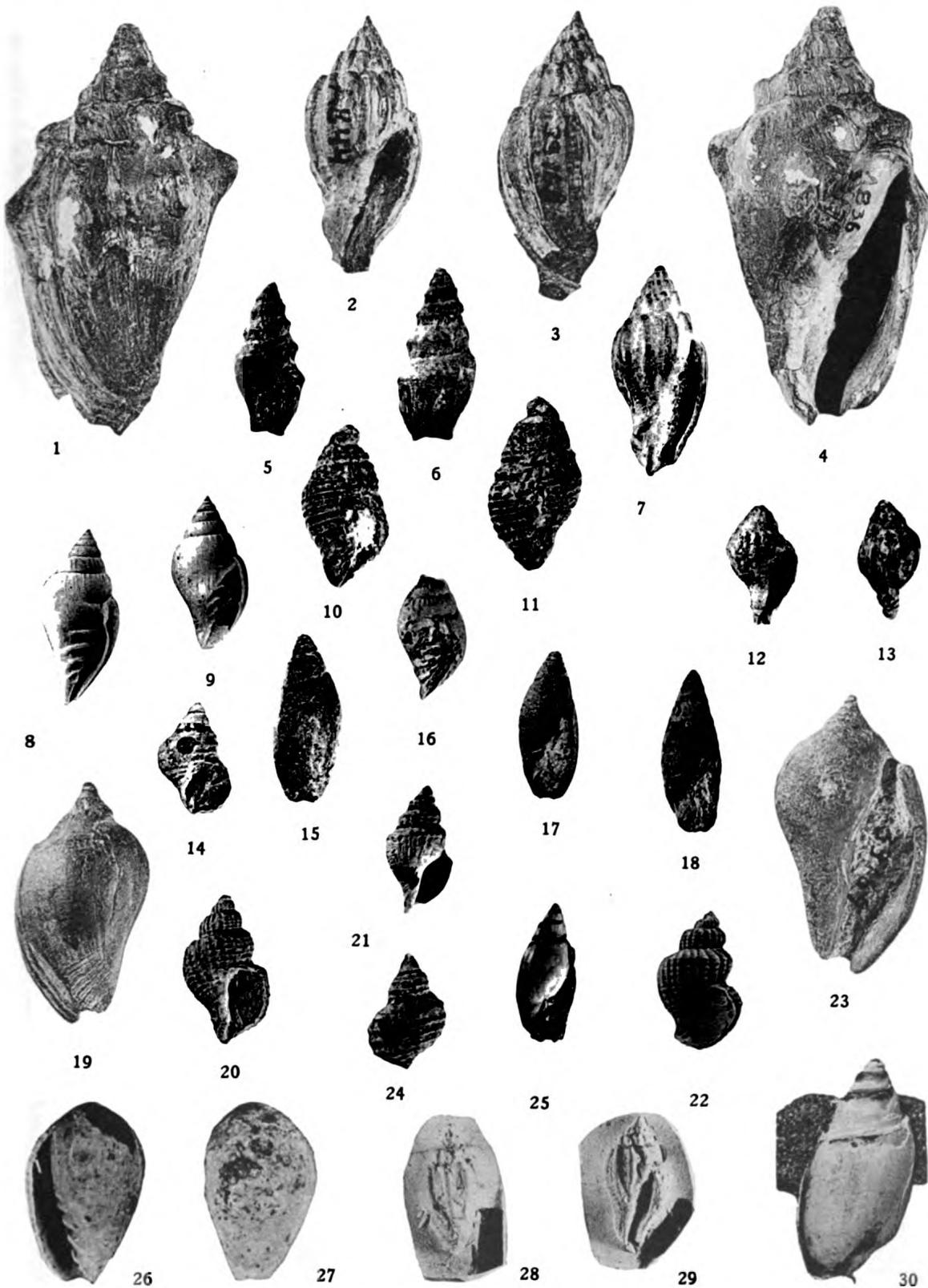
## PLATE 94

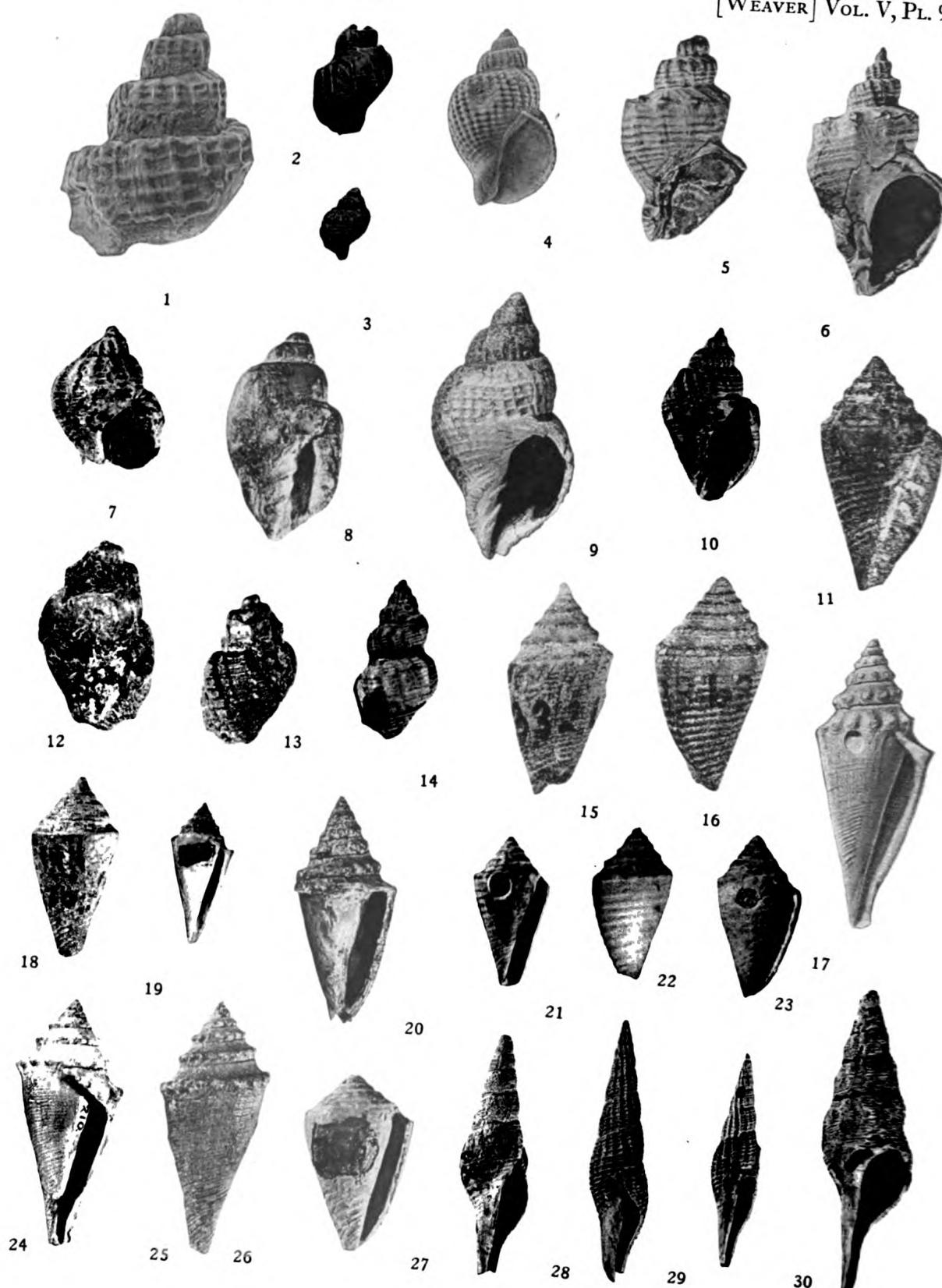
	PAGE
Fig. 1. <i>Marginella shephardae</i> Tegland ( $\times 2$ ), holotype (U.C. 32208). Figured originally, 272, pl. 10, fig. 22.....	494
Fig. 2. <i>Volutocorbis oregonensis</i> Turner ( $\times 1.2$ ), holotype (U.C. 33223). Figured originally, 274, pl. 18, fig. 16.....	493
Fig. 3. <i>Marginella instabilata</i> Hanna ( $\times 9$ ), hypotype (U.C. 33604). Figured by Effinger, 138, pl. 47, fig. 13.....	494
Fig. 4. <i>Fusinus (Priscofusus) coli</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 107783). Figured originally, 101, pl. 4, fig. 2.....	489
Fig. 5. <i>Miopleiona indurata</i> (Conrad) ( $\times 1$ ), hypotype (U.S.N.M. 112409) ..	491
Fig. 6. <i>Miopleiona weaveri</i> Tegland ( $\times 1$ ), paratype (U.C. 32248). Figured originally, 272, pl. 11, fig. 3.....	492
Fig. 7. <i>Streptochetus</i> sp. Turner ( $\times 0.7$ ), holotype (U.C. 33680). Figured by Turner, 274, pl. 17, fig. 14.....	490
Fig. 8. <i>Miopleiona indurata</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 5908). Conrad specimen .....	491
Fig. 9. <i>Fusinus (Priscofusus) cammani</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 153909). Figured originally, 101, pl. 4, fig. 12.....	488
Fig. 10. <i>Miopleiona weaveri</i> Tegland ( $\times 0.7$ ), holotype (U.C. 32243). Figured originally, 272, pl. 11, fig. 1.....	492
Fig. 11. <i>Miopleiona weaveri</i> Tegland ( $\times 1$ ), hypotype (U.S.N.M. 110428). Figured originally by Dall, 101, pl. 18, fig. 6.....	492
Fig. 12. <i>Miopleiona oregonensis</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153894). Figured originally, 101, pl. 18, fig. 3.....	492
Fig. 13. <i>Miopleiona indurata</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 15490). Blakeley formation .....	491
Fig. 14. <i>Persicula chehalisensis</i> n. sp. ( $\times 3.0$ ), holotype (U.C. 12541).....	495

## PLATE 95

	PAGE
Fig. 1. <i>Lyria coquillensis</i> Turner ( $\times 0.9$ ), holotype (U.C. 33174). Figured originally, 274, pl. 18, fig. 12.....	495
Fig. 2. <i>Lyria andersoni</i> Waring ( $\times 1.3$ ), hypotype (U.C. 33168). Figured by Turner, 274, pl. 18, fig. 5.....	496
Fig. 3. <i>Lyria andersoni</i> Waring ( $\times 1.4$ ), hypotype (U.C. 33168). Figured by Turner, 274, pl. 18, fig. 5.....	496
Fig. 4. <i>Lyria coquillensis</i> Turner ( $\times 0.9$ ), holotype (U.C. 33174). Figured originally, 274, pl. 18, fig. 12.....	495
Fig. 5. <i>Mitra cretacea</i> Gabb var. Turner ( $\times 2.5$ ), holotype (U.C. 33221). Figured by Turner, 274, pl. 15, fig. 9.....	497
Fig. 6. <i>Mitra cretacea</i> Gabb var. Turner ( $\times 2.5$ ), holotype (U.C. 33221). Figured by Turner, 274, pl. 15, fig. 9.....	497
Fig. 7. <i>Lyria andersoni</i> Waring ( $\times 1$ ), hypotype (U.C. 15790). Figured by Clark and Vokes, 55, pl. 1, fig. 17. From Domengine at Coalinga.....	496
Fig. 8. <i>Mitra washingtoniana</i> Weaver ( $\times 2$ ), hypotype (U.C. 15499).....	497
Fig. 9. <i>Mitra washingtoniana</i> Weaver ( $\times 2$ ), holotype (C.A.S. 357). Figured originally, 286, pl. 2, fig. 16.....	497
Fig. 10. <i>Mitra douglasensis</i> Hendon ( $\times 2$ ), holotype (U.C. 33632). Figured by Turner, 274, pl. 15, fig. 6.....	497
Fig. 11. <i>Mitra douglasensis</i> Hendon ( $\times 2$ ), holotype (U.C. 33632). Figured by Turner, 274, pl. 15, fig. 6.....	497
Fig. 12. <i>Harpa crescentensis</i> Weaver and Palmer ( $\times 3$ ), holotype (U.W. 206) (C.A.S. 7576). Figured originally, 301, pl. 11, fig. 21.....	498
Fig. 13. <i>Harpa crescentensis</i> Weaver and Palmer ( $\times 3$ ), holotype (U.W. 206) (C.A.S. 7576). Figured originally, 301, pl. 11, fig. 21.....	498
Fig. 14. "Cancellaria" <i>landesi</i> Van Winkle ( $\times 2.5$ ), holotype (U.W. 145) (C.A.S. 7550). Figured originally, 275, pl. 7, fig. 17.....	502
Fig. 15. <i>Olivella mathewsonii</i> Gabb var. <i>umpquaensis</i> Turner ( $\times 2.2$ ), holotype (U.C. 33650). Figured by Turner, 274, pl. 18, fig. 14.....	501
Fig. 16. <i>Mitra washingtoniana</i> Weaver ( $\times 2$ ), hypotype (U.W. 38) (C.A.S. 499).....	497
Fig. 17. <i>Olivella mathewsonii</i> Gabb var. <i>umpquaensis</i> Turner ( $\times 2.2$ ), holotype (U.C. 33650). Figured by Turner, 274, pl. 18, fig. 13.....	501
Fig. 18. <i>Ancilla gabbi</i> Cossmann ( $\times 2$ ), hypotype (U.C. 33243). Figured by Turner, 274, pl. 18, fig. 6.....	500
Fig. 19. <i>Cryptochorda californica</i> (Cooper) ( $\times 1$ ), hypotype (U.C. 33243). Figured originally by Dickerson, 120, pl. 12, fig. 4a.....	499
Fig. 20. <i>Cancellaria wynoochensis</i> Weaver ( $\times 0.8$ ), holotype (U.W. 114) (C.A.S. 563-A). Figured originally, 295, pl. 4, fig. 53.....	503
Fig. 21. <i>Cancellaria washingtonensis</i> Weaver ( $\times 3$ ), holotype (U.W. 115) (C.A.S. 558). Figured originally, 295, pl. 5, fig. 77.....	503
Fig. 22. <i>Cancellaria wynoochensis</i> Weaver ( $\times 1$ ), topotype (U.C. 32021). Figured by Etherington, 140, pl. 14, fig. 5.....	503
Fig. 23. <i>Cryptochorda californica</i> (Cooper) ( $\times 1.4$ ), hypotype (U.C. 33169). Figured by Turner, 274, pl. 18, fig. 15.....	499
Fig. 24. "Cancellaria" <i>landesi</i> Van Winkle ( $\times 2.5$ ), holotype (U.W. 145) (C.A.S. 7550). Figured originally, 275, pl. 7, fig. 17.....	502
Fig. 25. <i>Olivella pedroana</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 32022). Figured originally by Etherington, 140, pl. 14, fig. 10.....	501
Fig. 26. <i>Marginella instabilata</i> Hanna ( $\times 10$ ), holotype (C.A.S. 427). Figured originally as <i>M. pacifica</i> Dickerson, 123, pl. 31, fig. 2.....	494
Fig. 27. <i>Marginella instabilata</i> Hanna ( $\times 10$ ), holotype (C.A.S. 427). Figured originally, 123, pl. 31, fig. 2.....	494
Fig. 28. <i>Lyria andersoni</i> Waring ( $\times 1$ ), plastoholotype (S.U. 4816).....	496
Fig. 29. <i>Lyria andersoni</i> Waring ( $\times 1$ ), plastoholotype (S.U. 4816).....	496
Fig. 30. <i>Olivella pedroana</i> (Conrad) ( $\times 1$ ), hypotype (U.S.N.M. 328326). Figured by Reagan, 230, pl. 3, fig. 24.....	501

(748)





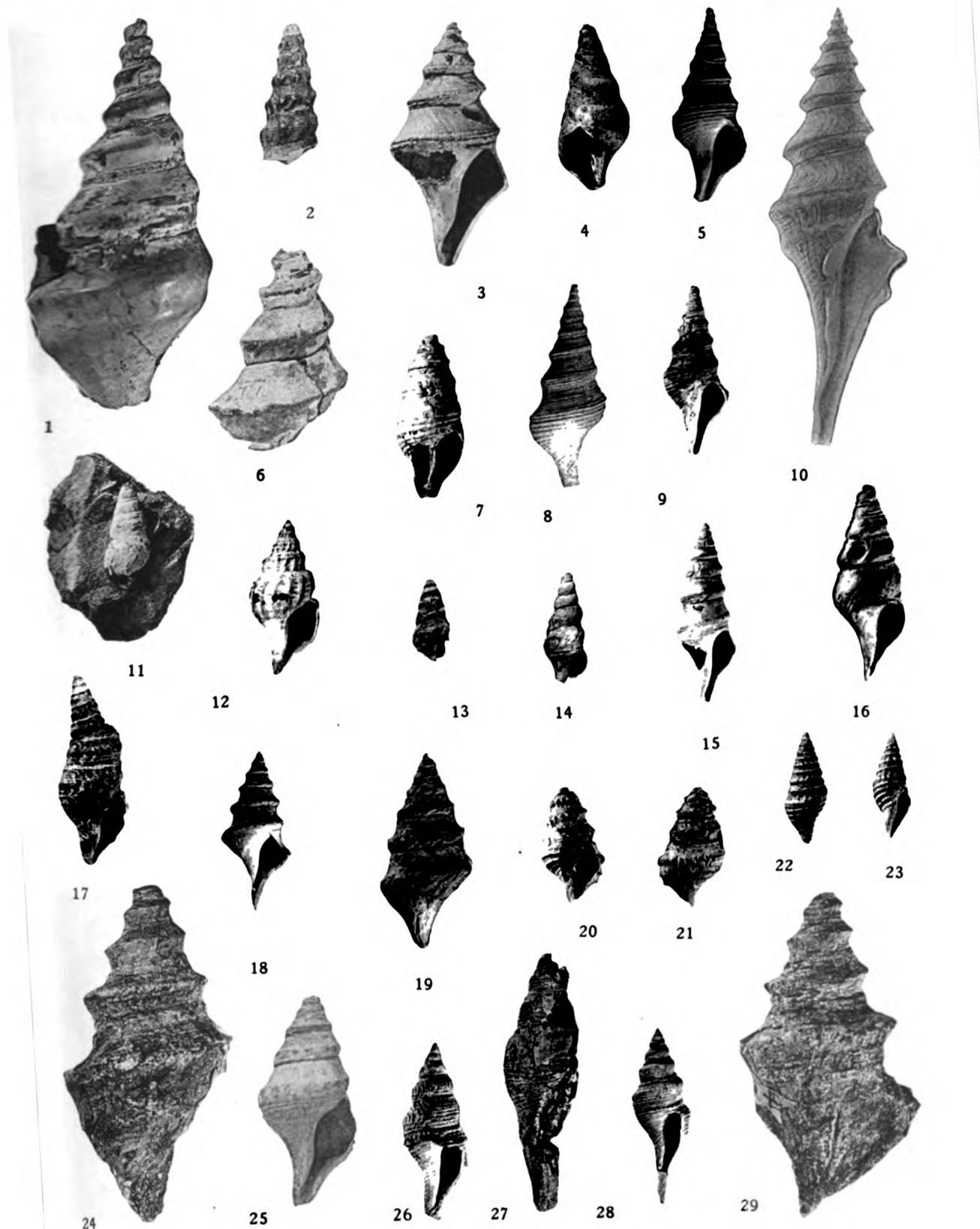
## PLATE 96

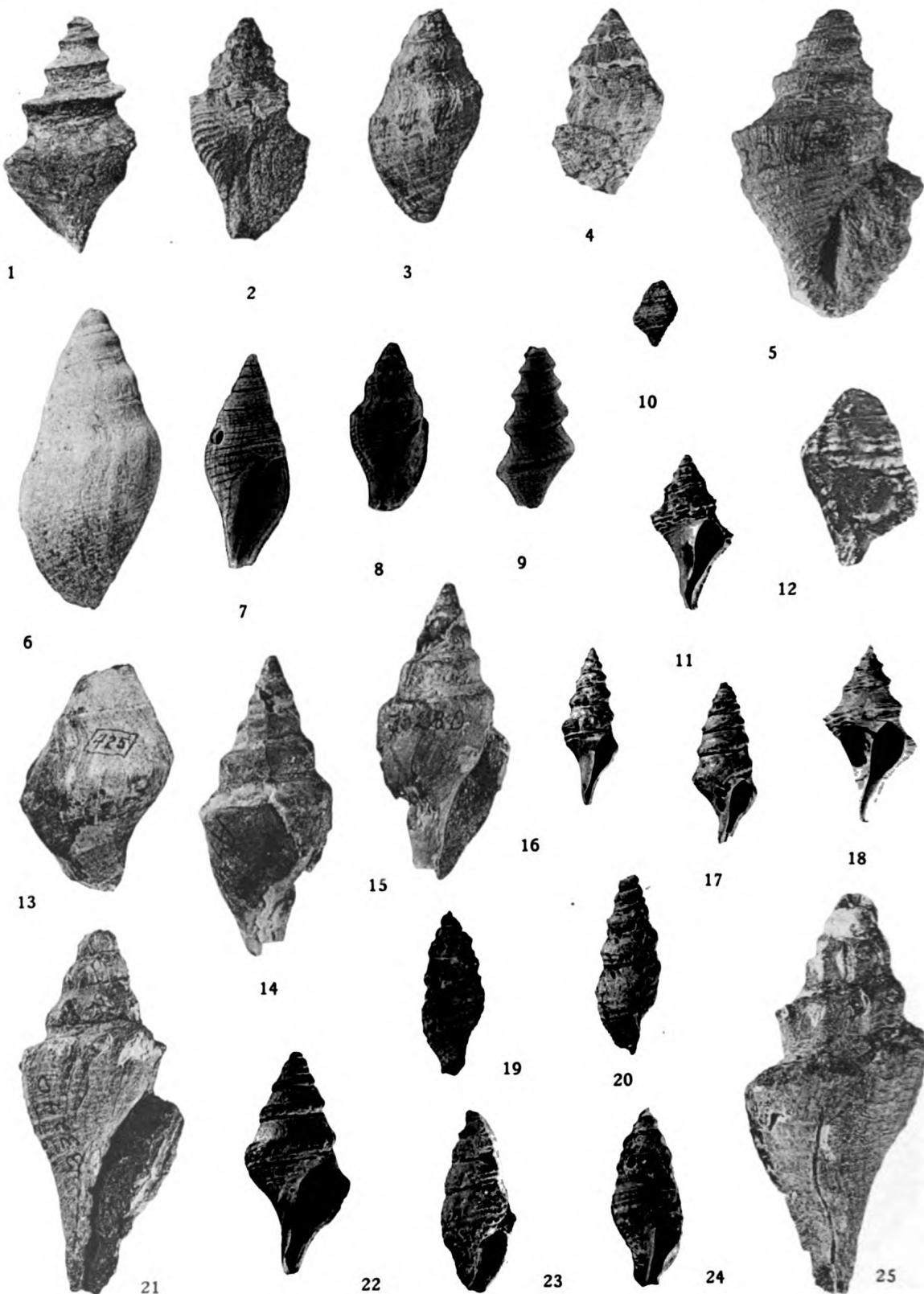
	PAGE
Fig. 1. <i>Cancellaria</i> sp. indet. Etherington ( $\times 1$ ), holotype (U.C. 32036). Figured originally, 140, pl. 13, fig. 11.....	505
Fig. 2. <i>Cancellaria vetusta</i> Gabb ( $\times 1$ ), hypotype (U.C. 32060). Figured by Etherington, 140, pl. 14, fig. 2.....	504
Fig. 3. <i>Cancellaria vetusta</i> Gabb ( $\times 1$ ), hypotype (U.C. 32033). Figured by Etherington, 140, pl. 14, fig. 23.....	504
Fig. 4. <i>Cancellaria weaveri</i> Etherington ( $\times 1$ ), holotype (U.C. 32017). Figured originally, 140, pl. 14, fig. 17.....	505
Fig. 5. <i>Cancellaria condoni</i> Anderson ( $\times 1$ ), holotype? (C.A.S. 67). Figured by Anderson and Martin, 5, pl. 8, fig. 8b.....	506
Fig. 6. <i>Cancellaria condoni</i> Anderson ( $\times 1$ ), hypotype (C.A.S. 197). Figured originally by Anderson and Martin, 5, pl. 8, fig. 8d.....	506
Fig. 7. <i>Cancellaria rotunda</i> Anderson and Martin ( $\times 1.6$ ), holotype (C.A.S. 205). Figured originally, 5, pl. 8, fig. 4a.....	506
Fig. 8. <i>Cancellaria sanjosei</i> Anderson and Martin ( $\times 1.8$ ), holotype (C.A.S. 207). Figured originally, 5, pl. 6, fig. 2a.....	507
Fig. 9. <i>Cancellaria oregonensis</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 107788). Figured originally, 101, pl. 2, fig. 7.....	507
Fig. 10. <i>Bonellitia (Admetula) paucivaricata</i> (Gabb) ( $\times 2$ ), hypotype (U.C. 15534). .....	508
Fig. 11. <i>Conus warreni</i> Hendon ( $\times 2$ ), holotype (U.C. 33635). Figured by Turner, 274, pl. 15, fig. 3.....	510
Fig. 12. <i>Bonellitia (Admetula) paucivaricata</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 33239). Figured by Turner, 274, pl. 96, fig. 12.....	508
Fig. 13. <i>Bonellitia (Admetula) paucivaricata</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 33239). Figured by Turner, 274, pl. 96, fig. 12.....	508
Fig. 14. <i>Admete clatskaniensis</i> Anderson and Martin ( $\times 2.5$ ), holotype (C.A.S. 209). Figured originally, 5, pl. 8, fig. 3a.....	509
Fig. 15. <i>Conus remondii</i> Gabb subsp. <i>comstockensis</i> Turner ( $\times 3$ ), holotype (U.C. 33215). Figured by Turner, 274, pl. 15, fig. 5.....	509
Fig. 16. <i>Conus warreni</i> Hendon ( $\times 2$ ), holotype (U.C. 33635). Figured by Turner, 274, pl. 15, fig. 4.....	510
Fig. 17. <i>Conus vaderensis</i> Weaver and Palmer ( $\times 1$ ), hypotype (C.A.S. 335)....	511
Fig. 18. <i>Conus hornii</i> Gabb var. <i>umpquaensis</i> Hendon ( $\times 2.1$ ), holotype (U.C. 33656). Figured by Turner, 274, pl. 15, fig. 1.....	510
Fig. 19. <i>Conus vaderensis</i> Weaver and Palmer ( $\times 1$ ), hypotype (C.A.S. 351). Figured by Dickerson as <i>Conus remondii</i> Gabb, 121, pl. 11, fig. 7.....	511
Fig. 20. <i>Conus cowlitzensis</i> Weaver ( $\times 1$ ), holotype (U.W. 41) (C.A.S. 502). Figured originally, 286, pl. 2, fig. 20.....	511
Fig. 21. <i>Conus ruckmani</i> Dickerson ( $\times 2$ ), holotype (C.A.S. 431). Figured originally, 123, pl. 31, fig. 6a.....	512
Fig. 22. <i>Conus ruckmani</i> Dickerson ( $\times 2$ ), hypotype (U.C. 33624). Figured by Effinger, 138, pl. 47, fig. 27.....	512
Fig. 23. <i>Conus ruckmani</i> Dickerson ( $\times 2$ ), hypotype (U.C. 33624). Figured by Effinger, 138, pl. 47, fig. 28.....	512
Fig. 24. <i>Conus vaderensis</i> Weaver and Palmer ( $\times 1.5$ ), holotype (U.W. 210) (C.A.S. 7539). Figured originally, 301, pl. 12, fig. 7.....	511
Fig. 25. <i>Conus vaderensis</i> Weaver and Palmer ( $\times 1.5$ ), holotype (U.W. 210) (C.A.S. 7539). Figured originally, 301, pl. 12, fig. 8.....	511
Fig. 26. <i>Conus weaveri</i> Dickerson ( $\times 2$ ), holotype (C.A.S. 356). Figured originally, 121, pl. 11, fig. 10.....	512
Fig. 27. <i>Exilia weaveri</i> Dickerson ( $\times 1.8$ ), holotype (C.A.S. 410). Figured originally, 123, pl. 30, fig. 1a.....	514
Fig. 28. <i>Exilia dickersoni</i> (Weaver) ( $\times 0.9$ ), syntype (C.A.S. 498). Figured originally, 286, pl. 3, fig. 29.....	513
Fig. 29. <i>Exilia dickersoni</i> (Weaver) ( $\times 1$ ), hypotype (C.A.S. 335). Figured by Dickerson, 121, pl. 9, fig. 9.....	513
Fig. 30. <i>Exilia lincolnensis</i> Weaver ( $\times 1.4$ ), holotype (U.W. 116) (C.A.S. 468). Figured originally, 295, pl. 4, fig. 50.....	514

## PLATE 97

	PAGE
Fig. 1. <i>Aforia clallamensis</i> (Weaver) ( $\times 0.8$ ), holotype (U.W. 117) (C.A.S. 555). Figured originally, 295, pl. 4, fig. 59.....	516
Fig. 2. <i>Exilia mclellani</i> Tegland ( $\times 1$ ), holotype (U.C. 32170). Figured originally, 272, pl. 10, fig. 19.....	515
Fig. 3. <i>Aforia packardi</i> (Weaver) ( $\times 1.8$ ), holotype (U.W. 122) (C.A.S. 473). Figured originally, 295, pl. 5, fig. 64.....	517
Fig. 4. <i>Antiplanes perversa</i> (Gabb) ( $\times 1$ ), hypotype (U.S.N.M. 110383). Figured by Dall, 101, pl. 5, fig. 5.....	517
Fig. 5. <i>Spirotropis winlockensis</i> Effinger ( $\times 2$ ), holotype (U.C. 33607). Figured originally, 138, pl. 46, fig. 16.....	520
Fig. 6. <i>Aforia clallamensis</i> (Weaver) subsp. <i>wardi</i> (Tegland) ( $\times 0.8$ ), paratype (U.C. 32204). Figured originally, 272, pl. 10, fig. 6.....	516
Fig. 7. <i>Sauvadriilla thurstonensis</i> (Weaver) ( $\times 1.8$ ), holotype (U.W. 121) (C.A.S. 472). Figured originally, 295, pl. 5, fig. 79.....	519
Fig. 8. <i>Spirotropis winlockensis</i> Effinger ( $\times 2$ ), holotype (U.C. 33607). Figured originally, 138, pl. 46, fig. 12.....	520
Fig. 9. <i>Spirotropis winlockensis</i> Effinger ( $\times 2$ ), hypotype (C.A.S. 428). Figured originally by Dickerson as <i>Surcula dickersoni</i> Weaver, 123, pl. 31, fig. 3b.....	520
Fig. 10. <i>Aforia clallamensis</i> (Weaver) subsp. <i>wardi</i> (Tegland) ( $\times 1$ ), hypotype (U.C. 14961). From locality (U.C. A-1636).....	516
Fig. 11. <i>Antiplanes impecunia</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 153912). Figured originally, 101, pl. 4, fig. 3.....	518
Fig. 12. <i>Lora tabulata</i> (Carpenter) ( $\times 3$ ), hypotype (U.S.N.M. 328357). Figured by Reagan, 230, pl. 5, fig. 50, as holotype of " <i>Bela fidicula</i> " Gould.	519
Fig. 13. <i>Spirotropis washingtonensis</i> Etherington ( $\times 1$ ), paratype (U.C. 32044). Figured originally, 140, pl. 14, fig. 22.....	521
Fig. 14. <i>Spirotropis washingtonensis</i> Etherington ( $\times 1$ ), holotype (U.C. 32042). Figured originally, 140, pl. 14, fig. 34.....	521
Fig. 15. <i>Spirotropis dickersoni</i> (Weaver) ( $\times 1.8$ ), holotype (U.W. 120) (C.A.S. 471). Figured originally, 295, pl. 5, fig. 66, as <i>Turris dickersoni</i> .....	521
Fig. 16. <i>Spirotropis dickersoni</i> (Weaver) ( $\times 2$ ), topotype (U.C. 15964).....	521
Fig. 17. <i>Gemmula fasteni</i> Weaver and Palmer ( $\times 3$ ), holotype (U.W. 208) (C.A.S. 7556). Figured originally, 301, pl. 12, fig. 4.....	524
Fig. 18. <i>Spirotropis kincaidi</i> (Weaver) ( $\times 1.2$ ), holotype (U.W. 119) (C.A.S. 470). Figured originally, 295, pl. 5, fig. 67, as <i>Turris kincaidi</i> .....	522
Fig. 19. <i>Spirotropis kincaidi</i> (Weaver) ( $\times 1$ ), topotype (U.C. 15963).....	522
Fig. 20. <i>Gemmula barksdalei</i> n. sp. ( $\times 1$ ), holotype (U.C. 15934).....	523
Fig. 21. <i>Gemmula barksdalei</i> n. sp. ( $\times 1$ ), holotype (U.C. 15934).....	523
Fig. 22. <i>Gemmula fasteni</i> Weaver and Palmer ( $\times 3$ ), topotype (U.W. 208-A). 524	524
Fig. 23. <i>Gemmula fasteni</i> Weaver and Palmer ( $\times 3$ ), topotype (U.W. 208-A). 524	524
Fig. 24. <i>Surculites mathewsonii</i> (Gabb) ( $\times 1.1$ ), hypotype (U.C. 33631). Figured by Turner, 274, pl. 15, fig. 10.....	526
Fig. 25. <i>Spirotropis kincaidi</i> (Weaver) ( $\times 2$ ), hypotype (U.C. 32175). Figured by Tegland, 272, pl. 10, fig. 12.....	522
Fig. 26. <i>Hemipleurotoma pulchra</i> (Dickerson) ( $\times 1$ ), hypotype (U.C. 15950). Locality (U.C. 7169). .....	525
Fig. 27. <i>Hemipleurotoma pulchra</i> (Dickerson) ( $\times 1.5$ ), hypotype (U.C. 33235). Figured by Turner, 274, pl. 17, fig. 17.....	525
Fig. 28. <i>Hemipleurotoma pulchra</i> (Dickerson) ( $\times 1.5$ ), holotype (C.A.S. 338). Figured originally, 121, pl. 10, fig. 4a.....	525
Fig. 29. <i>Surculites mathewsonii</i> (Gabb) ( $\times 1.1$ ), hypotype (U.C. 33631). Figured by Turner, 274, pl. 15, fig. 10.....	526

(750)





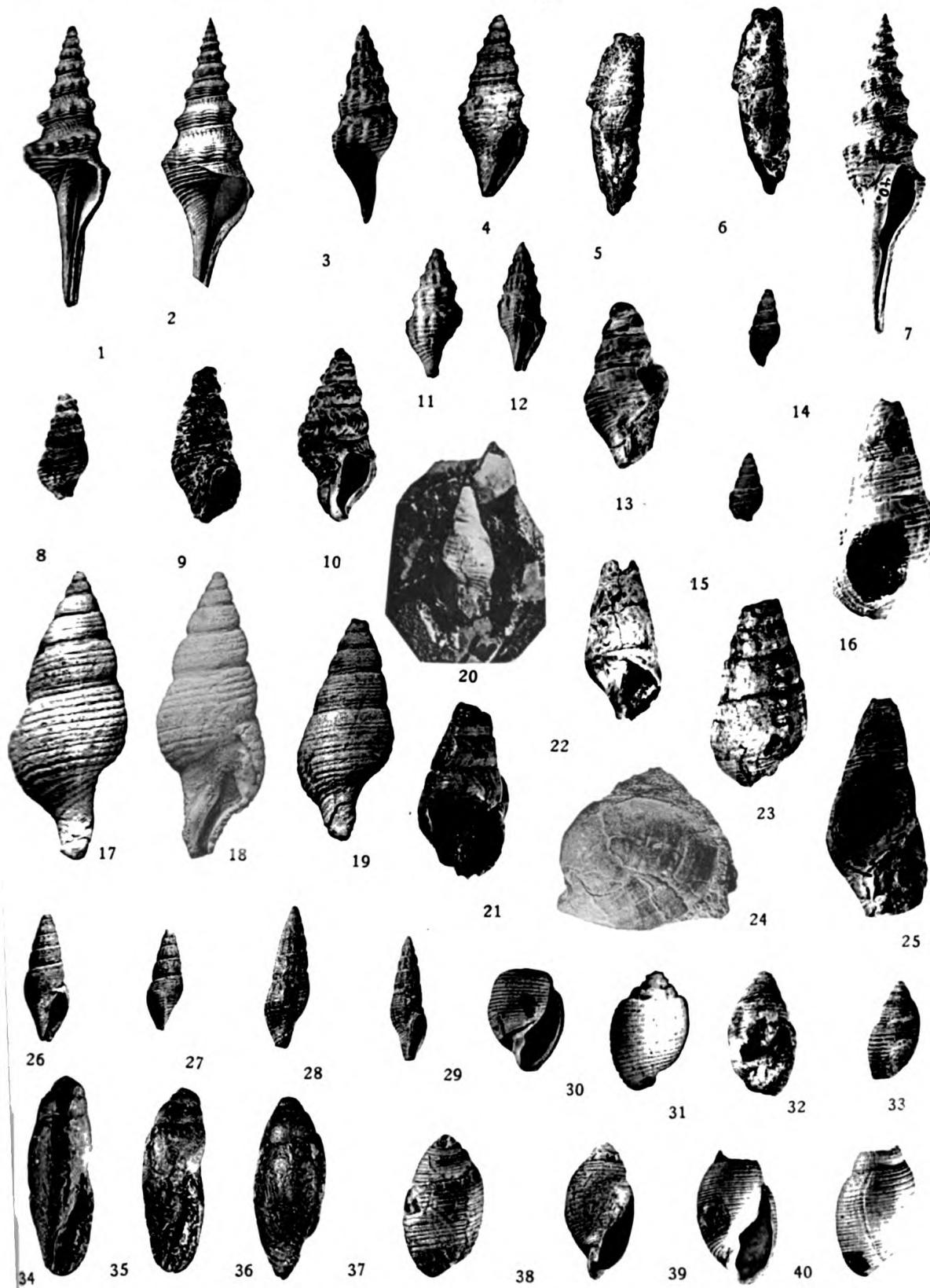
## PLATE 98

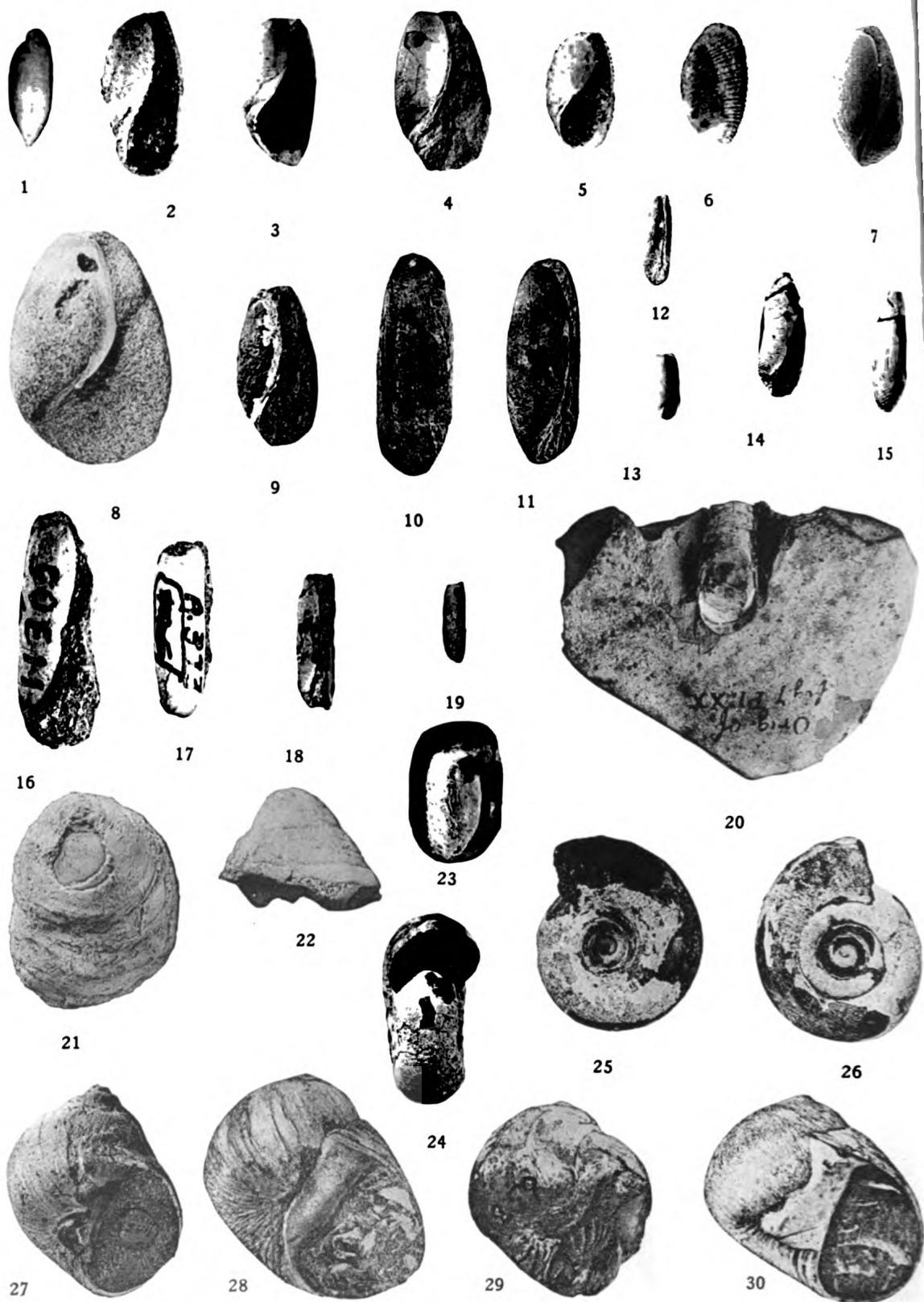
	PAGE
Fig. 1. <i>Surculites matthewsonii</i> (Gabb) ( $\times 0.7$ ), hypotype (U.C. 33631). Figured by Turner, 274, pl. 15, fig. 10.....	526
Fig. 2. <i>Megasurcula wynoocheensis</i> (Weaver) ( $\times 1.5$ ), syntype (U.W. 68 (C.A.S. 469). Figured originally, 295, pl. 5, fig. 65.....	527
Fig. 3. <i>Megasurcula gabbiana</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 153910). Figured originally, 101, pl. 4, fig. 1.....	529
Fig. 4. <i>Megasurcula condonana</i> (Anderson and Martin) ( $\times 1.8$ ), holotype (C.A.S. 214). Figured originally, 5, pl. 7, fig. 8.....	530
Fig. 5. <i>Surculites matthewsonii</i> (Gabb) ( $\times 2.2$ ), hypotype (U.C. 33209). Figured by Turner, 274, pl. 17, fig. 6.....	526
Fig. 6. <i>Megasurcula remondii</i> (Gabb) ( $\times 1$ ), hypotype (U.S.N.M. 153911). Figured by Dall, 101, pl. 4, fig. 8.....	528
Fig. 7. <i>Megasurcula carpenteriana</i> (Gabb) ( $\times 1$ ), hypotype (U.C. 32041). Figured by Etherington, 140, pl. 14, fig. 31.....	527
Fig. 8. <i>Megasurcula wynoocheensis</i> (Weaver) ( $\times 1$ ), topotype (U.C. 32024). Figured by Etherington, 140, pl. 14, fig. 25.....	527
Fig. 9. <i>Hemipleurotoma borgenae</i> (Tegland) ( $\times 1$ ), holotype (U.C. 32172). Figured originally, 272, pl. 10, fig. 9.....	525
Fig. 10. <i>Megasurcula condonana</i> (Anderson and Martin) ( $\times 0.6$ ), hypotype (U.C. 32062). Figured by Etherington, 140, pl. 14, fig. 20.....	530
Fig. 11. <i>Nekewis washingtoniana</i> (Weaver) ( $\times 1$ ), hypotype (C.A.S. 341).....	531
Fig. 12. <i>Megasurcula condonana</i> (Anderson and Martin) ( $\times 2.2$ ), hypotype (U.C. 32062).....	530
Fig. 13. <i>Megasurcula etheringtoni</i> n. sp. ( $\times 1.3$ ), holotype (U.C. 32038).....	530
Fig. 14. <i>Turricula cooperi</i> (Dickerson) subsp. <i>umpquaensis</i> Turner ( $\times 1.2$ ), holotype (U.C. 33230). Figured by Turner, 274, pl. 17, fig. 3.....	532
Fig. 15. <i>Turricula cooperi</i> (Dickerson) subsp. <i>umpquaensis</i> Turner ( $\times 1.2$ ), holotype (U.C. 33230). Figured by Turner, 274, pl. 17, fig. 3.....	532
Fig. 16. <i>Turricula washingtonensis</i> (Weaver) ( $\times 1$ ), hypotype (C.A.S. 545).....	533
Fig. 17. <i>Turricula washingtonensis</i> (Weaver) ( $\times 1$ ), syntype (C.A.S. 560). Figured originally, 295, pl. 4, fig. 45.....	533
Fig. 18. <i>Nekewis washingtoniana</i> (Weaver) ( $\times 1$ ), hypotype (C.A.S. 341-A)....	531
Fig. 19. <i>Turricula worcesteri</i> (Van Winkle) ( $\times 3$ ), holotype (U.W. 146-A) (C.A.S. 7555-A). Figured originally, 275, pl. 7, fig. 21.....	533
Fig. 20. <i>Turricula worcesteri</i> (Van Winkle) ( $\times 3$ ), paratype (U.W. 146) (C.A.S. 7555).....	533
Fig. 21. <i>Turricula crenatospira</i> (Cooper) ( $\times 1.2$ ), hypotype (U.C. 33240). Figured by Turner, 274, pl. 17, fig. 9.....	532
Fig. 22. <i>Turricula washingtonensis</i> (Weaver) ( $\times 1.5$ ), topotype (U.C. 32175)...	533
Fig. 23. <i>Turricula worcesteri</i> (Van Winkle) ( $\times 3$ ), paratype (U.W. 146) (C.A.S. 7555).....	533
Fig. 24. <i>Turricula worcesteri</i> (Van Winkle) ( $\times 3$ ), holotype (U.W. 146-A) (C.A.S. 7555-A). Figured originally, 275, pl. 7, fig. 21.....	533
Fig. 25. <i>Turricula crenatospira</i> (Cooper) ( $\times 1.2$ ), hypotype (U.C. 33240). Figured by Turner, 274, pl. 17, fig. 9.....	532

(751)

## PLATE 99

	PAGE
Fig. 1. <i>Turridula (Pleurofusia) cowlitzensis</i> (Weaver) ( $\times 1$ ), holotype (U.W. 40) (C.A.S. 7544). Figured originally, 286, pl. 3, fig. 30.	534
Fig. 2. <i>Turridula (Pleurofusia) cowlitzensis</i> (Weaver) ( $\times 1$ ), paratype (U.W. 40-A). Figured originally, 286, pl. 3, fig. 36.	534
Fig. 3. <i>Turridula (Pleurofusia) ornata</i> (Dickerson) ( $\times 1.8$ ) holotype (C.A.S. 337). Figured originally, 121, pl. 10, fig. 3.	535
Fig. 4. <i>Clavatula arnoldi</i> (Van Winkle) ( $\times 10$ ), hypotype (U.C. 33608). Figured by Effinger, 138, pl. 47, fig. 24.	535
Fig. 5. <i>Pseudomelatoma kernensis</i> (Anderson and Martin) ( $\times 2$ ), hypotype (U.C. 32054). Figured by Etherington, 140, pl. 14, fig. 32.	536
Fig. 6. <i>Pseudomelatoma kernensis</i> (Anderson and Martin) ( $\times 2$ ), hypotype (U.C. 32054). Figured by Etherington, 140, pl. 14, fig. 32.	536
Fig. 7. <i>Turridula (Pleurofusia) cowlitzensis</i> (Weaver) ( $\times 1$ ), holotype (U.W. 40) (C.A.S. 7544). Duplicate of pl. 99, fig. 1.	534
Fig. 8. <i>Thesbia antiselli</i> (Anderson and Martin) ( $\times 1$ ), hypotype (U.C. 32045). Figured by Etherington, 140, pl. 14, fig. 18.	538
Fig. 9. <i>Thesbia antiselli</i> (Anderson and Martin) ( $\times 1.5$ ), hypotype (U.C. 32045). Figured by Etherington, 140, pl. 14, fig. 16.	538
Fig. 10. <i>Thesbia antiselli</i> (Anderson and Martin) ( $\times 1.5$ ), holotype (C.A.S. 226). Figured originally, 5, pl. 7, fig. 2a.	538
Fig. 11. <i>Clavatula arnoldi</i> (Van Winkle) ( $\times 2.5$ ), hypotype (U.C. 33609). Figured by Effinger, 138, pl. 47, fig. 26.	535
Fig. 12. <i>Clavatula arnoldi</i> (Van Winkle) ( $\times 2.5$ ), hypotype (U.C. 33609). Figured by Effinger, 138, pl. 47, fig. 26.	535
Fig. 13. <i>Thesbia columbiana</i> (Anderson and Martin) ( $\times 3$ ), holotype (C.A.S. 231). Figured originally, 5, pl. 7, fig. 4a.	537
Fig. 14. <i>Thesbia workensis</i> (Etherington) ( $\times 1$ ), paratype (U.C. 32049). Figured originally, 140, pl. 14, fig. 28.	538
Fig. 15. <i>Thesbia workensis</i> (Etherington) ( $\times 1$ ), paratype (U.C. 32050). Figured originally, 140, pl. 14, fig. 12.	538
Fig. 16. <i>Thesbia ocoyana</i> (Anderson and Martin) ( $\times 2$ ), holotype (C.A.S. 228). Figured originally, 5, pl. 7, fig. 1a.	539
Fig. 17. <i>Thesbia muirensis</i> (Clark and Arnold) ( $\times 2$ ), cotype (U.C. 30254). Figured originally, 50, pl. 30, fig. 5b.	539
Fig. 18. <i>Thesbia muirensis</i> (Clark and Arnold) ( $\times 2$ ), cotype (U.C. 30254). Figured originally, 50, pl. 30, fig. 5a.	539
Fig. 19. <i>Thesbia muirensis</i> (Clark and Arnold) ( $\times 2$ ), holotype (U.C. 30067). Figured originally, 50, pl. 30, fig. 6.	539
Fig. 20. <i>Thesbia workensis</i> (Etherington) ( $\times 1.8$ ), holotype (U.C. 32047). Figured originally, 140, pl. 14, fig. 30.	538
Fig. 21. <i>Thesbia ocoyana</i> (Anderson and Martin) ( $\times 2$ ), hypotype (U.C. 32052). Figured by Etherington, 140, pl. 14, fig. 21.	539
Fig. 22. <i>Thesbia ocoyana</i> (Anderson and Martin) ( $\times 2$ ), hypotype (U.C. 32052). Figured by Etherington, 140, pl. 14, fig. 21.	539
Fig. 23. <i>Thesbia ocoyana</i> (Anderson and Martin) ( $\times 3$ ), hypotype (U.C. 32052). Figured by Etherington, 140, pl. 14, fig. 21.	539
Fig. 24. <i>Megistostoma caminoensis</i> M. A. Hanna ( $\times 1.3$ ), hypotype (U.C. 33688). Figured by Turner, 274, pl. 20, fig. 15.	541
Fig. 25. <i>Thesbia ocoyana</i> (Anderson and Martin) ( $\times 2$ ), holotype (C.A.S. 228). Figured originally, 5, pl. 7, fig. 1a.	539
Fig. 26. <i>Clavus (Crassispira) fryei</i> (Weaver and Palmer) ( $\times 3$ ), paratype (U.W. 209-A) (C.A.S. 7554-A).	540
Fig. 27. <i>Clavus (Crassispira) fryei</i> (Weaver and Palmer) ( $\times 2.5$ ), paratype (U.W. 209-A) (C.A.S. 7554-A).	540
Fig. 28. <i>Clavus (Crassispira) fryei</i> (Weaver and Palmer) ( $\times 3.2$ ), holotype (U.W. 209) (C.A.S. 7554). Figured originally, 301, pl. 11, fig. 25.	540
Fig. 29. <i>Clavus (Crassispira) fryei</i> (Weaver and Palmer) ( $\times 3$ ), holotype (U.W. 209) (C.A.S. 7554). Figured originally, 301, pl. 11, fig. 25.	540
Fig. 30. <i>Acteon parvum</i> Dickerson ( $\times 1.8$ ), holotype (C.A.S. 401). Figured originally, 123, pl. 29, fig. 12a.	543
Fig. 31. <i>Acteon parvum</i> Dickerson ( $\times 2$ ), hypotype (U.C. 33613). Figured by Effinger, 138, pl. 47, fig. 2.	543
Fig. 32. <i>Acteon moodyi</i> Dickerson ( $\times 2$ ), hypotype (U.C. 33222). Figured by Turner, 274, pl. 15, fig. 15.	542
Fig. 33. <i>Acteon moodyi</i> Dickerson ( $\times 1.5$ ), hypotype (U.C. 33222). Figured by Turner, 274, pl. 15, fig. 15.	542
Fig. 34. <i>Acteon umpquaensis</i> Turner ( $\times 2$ ), holotype (U.C. 33210). Figured originally, 274, pl. 17, fig. 4.	541
Fig. 35. <i>Acteon umpquaensis</i> Turner ( $\times 1.8$ ), holotype (U.C. 33210). Figured originally, 274, pl. 17, fig. 4.	541
Fig. 36. <i>Acteon umpquaensis</i> Turner ( $\times 1.7$ ), holotype (U.C. 33210). Figured originally, 274, pl. 17, fig. 4.	541
Fig. 37. <i>Acteon boulderana</i> Etherington ( $\times 2.2$ ), holotype (U.C. 32057). Figured originally, 140, pl. 14, fig. 9.	542
Fig. 38. <i>Acteon chchalisensis</i> (Weaver) ( $\times 2$ ), topotype (U.C. 15548).	543
Fig. 39. <i>Acteon chchalisensis</i> (Weaver) ( $\times 2.2$ ), holotype (U.W. 123) (C.A.S. 474). Figured originally, 295, pl. 4, fig. 55.	543
Fig. 40. <i>Acteon chchalisensis</i> (Weaver) ( $\times 2.2$ ), holotype (U.W. 123) (C.A.S. 474). Figured originally, 295, pl. 4, fig. 55.	543





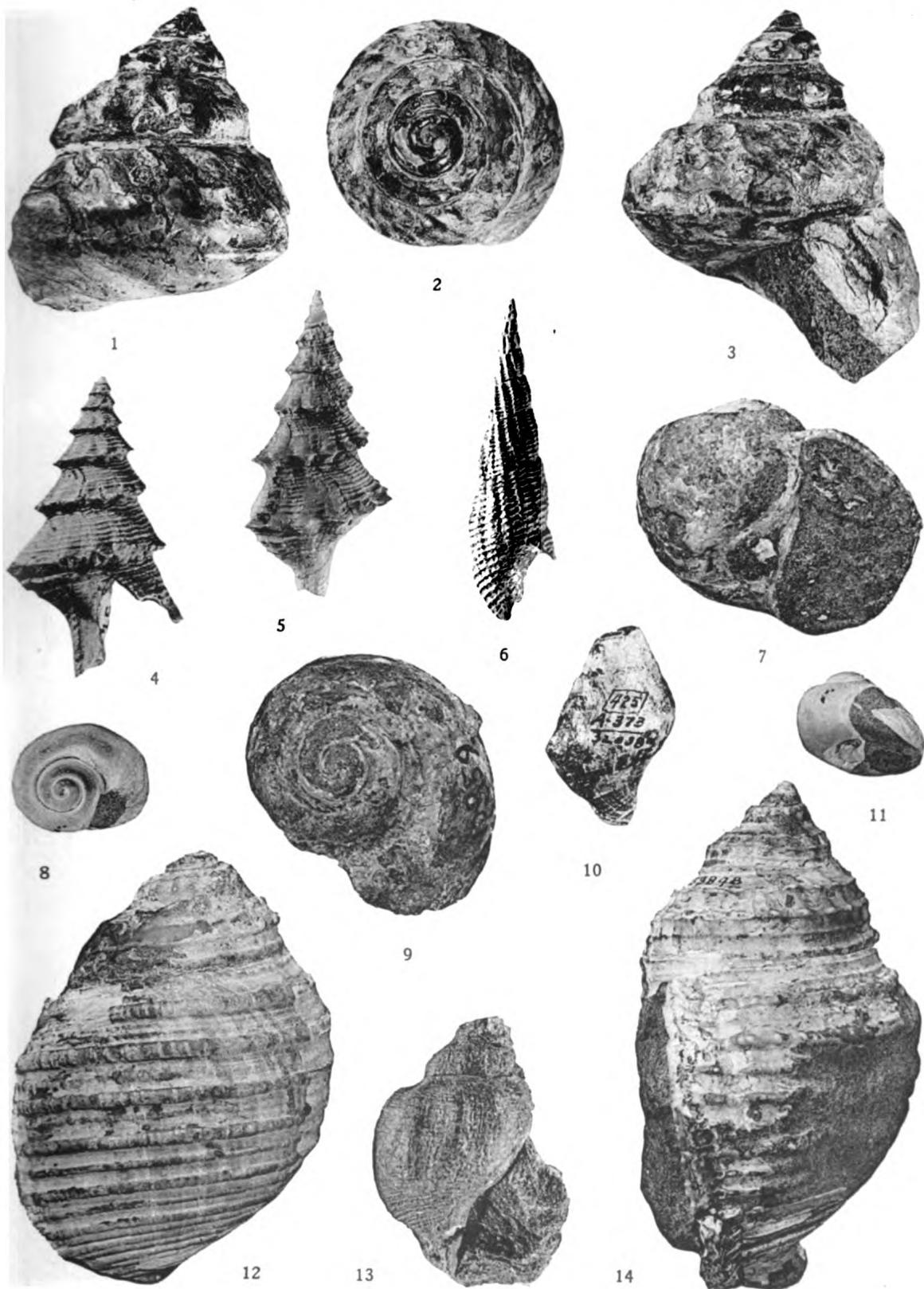
## PLATE 100

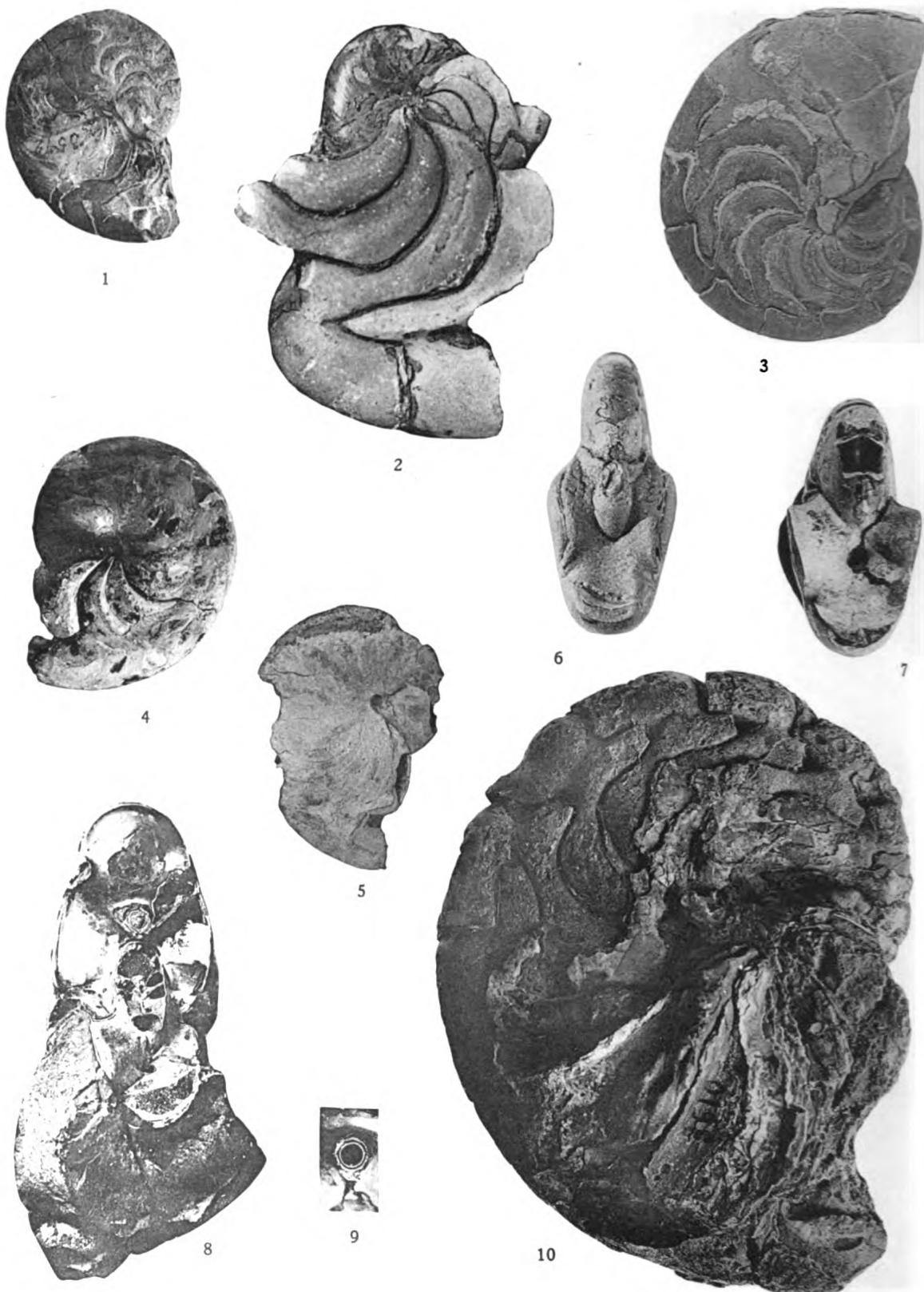
	PAGE
Fig. 1. <i>Volvulella tabori</i> Effinger ( $\times 6$ ), holotype (U.C. 33612). Figured originally, 138, pl. 47, fig. 11.....	544
Fig. 2. <i>Scaphander costatus</i> (Gabb) ( $\times 2$ ), hypotype (U.C. 33219). Figured by Turner, 274, pl. 17, fig. 16.....	545
Fig. 3. <i>Scaphander washingtonensis</i> Weaver ( $\times 1.3$ ), holotype (U.W. 124) (C.A.S. 475). Figured originally, 295, pl. 5, fig. 68.....	545
Fig. 4. <i>Scaphander washingtonensis</i> Weaver subsp. <i>gordoni</i> Tegland ( $\times 1.8$ ), holotype (U.C. 32209). Figured originally, 272, pl. 10, figs. 1, 2.....	546
Fig. 5. <i>Scaphander washingtonensis</i> Weaver subsp. <i>goodspeedi</i> Effinger ( $\times 5$ ), holotype (U.C. 33611). Figured originally, 138, pl. 47, fig. 14.....	546
Fig. 6. <i>Scaphander washingtonensis</i> Weaver subsp. <i>goodspeedi</i> Effinger ( $\times 5$ ), holotype (U.C. 33611). Figured originally, 138, pl. 47, fig. 14..	546
Fig. 7. <i>Scaphander jugularis</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 32058). Figured by Etherington, 140, pl. 14, fig. 7.....	546
Fig. 8. <i>Scaphander conradi</i> Dall ( $\times 2$ ), holotype (U.S.N.M. 154137). Figured originally, 101, pl. 6, fig. 3.....	547
Fig. 9. <i>Scaphander oregonensis</i> Dall ( $\times 2$ ), holotype (U.S.N.M. 154136). Figured originally, 101, pl. 5, fig. 7.....	548
Fig. 10. <i>Cylichnina tantilla</i> (Anderson and Hanna) ( $\times 1.8$ ), hypotype (U.C. 33172). Figured by Turner, 274, pl. 20, fig. 9.....	548
Fig. 11. <i>Cylichnina tantilla</i> (Anderson and Hanna) ( $\times 1.8$ ), hypotype (U.C. 33172). Figured by Turner, 274, pl. 20, fig. 9.....	548
Fig. 12. <i>Cylichnina tantilla</i> (Anderson and Hanna) ( $\times 0.7$ ), hypotype (U.C. 33172). Figured by Turner, 274, pl. 20, fig. 9.....	548
Fig. 13. <i>Cylichnina turneri</i> Effinger ( $\times 3$ ), holotype (U.C. 33619). Figured originally, 138, pl. 47, fig. 3.....	549
Fig. 14. <i>Cylichnina tantilla</i> (Anderson and Hanna) ( $\times 2.8$ ), holotype (C.A.S. 958). Figured originally, 6, pl. 7, fig. 9.....	548
Fig. 15. <i>Cylichnina tantilla</i> (Anderson and Hanna) ( $\times 2.8$ ), holotype (C.A.S. 958). Figured originally, 6, pl. 7, fig. 8.....	548
Fig. 16. <i>Haminoea petrosa</i> (Conrad) ( $\times 5$ ), topotype (U.C. 11305).....	549
Fig. 17. <i>Haminoea petrosa</i> (Conrad) ( $\times 3$ ), topotype (U.C. 11305).....	549
Fig. 18. <i>Haminoea petrosa</i> (Conrad) ( $\times 1.8$ ), hypotype (U.C. 32059). Figured by Etherington, 140, pl. 14, fig. 13.....	549
Fig. 19. <i>Haminoea petrosa</i> (Conrad) ( $\times 1$ ), hypotype (U.C. 32059). Figured by Etherington, 140, pl. 14, fig. 13.....	549
Fig. 20. <i>Dentalium conradi</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 3481 in part). Figured originally by Conrad as <i>Teredo substriatum</i> , 68, pl. 20, fig. 7a .....	267
Fig. 21. <i>Gadinia reticulata</i> Sowerby subsp. <i>sookensis</i> Clark and Arnold ( $\times 0.5$ ), cotype (U.C. 30234). Figured originally, 50, pl. 35, fig. 4.....	550
Fig. 22. <i>Gadinia reticulata</i> Sowerby subsp. <i>sookensis</i> Clark and Arnold ( $\times 0.5$ ), holotype (U.C. 30085). Figured originally, 50, pl. 35, fig. 3..	550
Fig. 23. <i>Haminoea petrosa</i> (Conrad) ( $\times 2$ ), holotype (U.S.N.M. 3607). Conrad type, figured as <i>Bulla petrosa</i> , 68, pl. 19, fig. 8.....	549
Fig. 24. <i>Segmentina durhami</i> Hanna and Hertlein ( $\times 2.6$ ), holotype (C.A.S. 5620). Figured originally, 157, pl. 21, fig. 5.....	551
Fig. 25. <i>Segmentina durhami</i> Hanna and Hertlein ( $\times 2.6$ ), holotype (C.A.S. 5620). Figured originally, 157, pl. 21, fig. 3.....	551
Fig. 26. <i>Segmentina durhami</i> Hanna and Hertlein ( $\times 2.6$ ), holotype (C.A.S. 5620). Figured originally, 157, pl. 21, fig. 4.....	551
Fig. 27. <i>Natica (Tectonatica) oregonensis</i> (Conrad) ( $\times 1$ ), hypotype (U.S.N.M. 153914). Figured originally by Dall, 101, pl. 4, fig. 7.....	331
Fig. 28. <i>Polinices (Polinices) hornii</i> (Gabb) ( $\times 1$ ), lectotype (P.A.N.S. 4214). Figured by Stewart, 289, pl. 30, fig. 15.....	335
Fig. 29. <i>Polinices (Neverita) globosa</i> (Gabb) ( $\times 1.5$ ), holotype (M.C.Z. 27859). Reproduction from Stewart, 289, pl. 28, fig. 6.....	339
Fig. 30. <i>Polinices (Neverita) secta</i> (Gabb) ( $\times 1.5$ ), holotype (P.A.N.S. 4212). Reproduction from Stewart, 289, pl. 30, fig. 17.....	341

## PLATE 101

	PAGE
Fig. 1. <i>Turcicula columbiana</i> Dall ( $\times 1$ ), hypotype (U.W. 350) (C.A.S. 7780). Rear view .....	292
Fig. 2. <i>Turcicula columbiana</i> Dall ( $\times 1$ ), hypotype (U.W. 350) (C.A.S. 7780). Posterior view .....	292
Fig. 3. <i>Turcicula columbiana</i> Dall ( $\times 1$ ), hypotype (U.W. 350) (C.A.S. 7780). Front view .....	292
Fig. 4. <i>Fulgurofusus washingtoniana</i> (Weaver) ( $\times 1.9$ ), holotype (U.W. 34) (C.A.S. 7559). Figured originally, 286, pl. 2, fig. 10.....	490
Fig. 5. <i>Fulgurofusus washingtoniana</i> (Weaver) ( $\times 1.5$ ), hypotype (U.W. 504). Locality (U.W. 232).....	490
Fig. 6. <i>Exilia dickersoni</i> (Weaver) ( $\times 1$ ), syntype (U.W. 35). Figured originally, 286, pl. 14, fig. 124.....	513
Fig. 7. <i>Polinices (Neverita) inezana</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 12539) .....	342
Fig. 8. <i>Polinices (Neverita) inezana</i> (Conrad) ( $\times 1$ ), hypotype (U.S.N.M. 153988) .....	342
Fig. 9. <i>Polinices (Neverita) inezana</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 12539). Top view.....	342
Fig. 10. <i>Megasurcula etheringtoni</i> n. sp. ( $\times 1$ ), holotype (U.C. 32038).....	530
Fig. 11. <i>Polinices (Neverita) inezana</i> (Conrad) ( $\times 1$ ), hypotype (U.S.N.M. 153988) .....	342
Fig. 12. <i>Galeodea oregonense</i> (Dall) ( $\times 1$ ), holotype (U.S.N.M. 153895). Figured by Dall, 101, pl. 7, fig. 7.....	409
Fig. 13. <i>Buccinofusus turneri</i> n. sp. ( $\times 2.2$ ), holotype (U.C. 33206). Figured originally, 274, pl. 15, fig. 10.....	440
Fig. 14. <i>Phalium (Bezoardica) turricula</i> Dall ( $\times 1$ ), holotype (U.S.N.M. 153898). Figured originally, 101, pl. 4, fig. 6.....	410

(754)





## PLATE 102

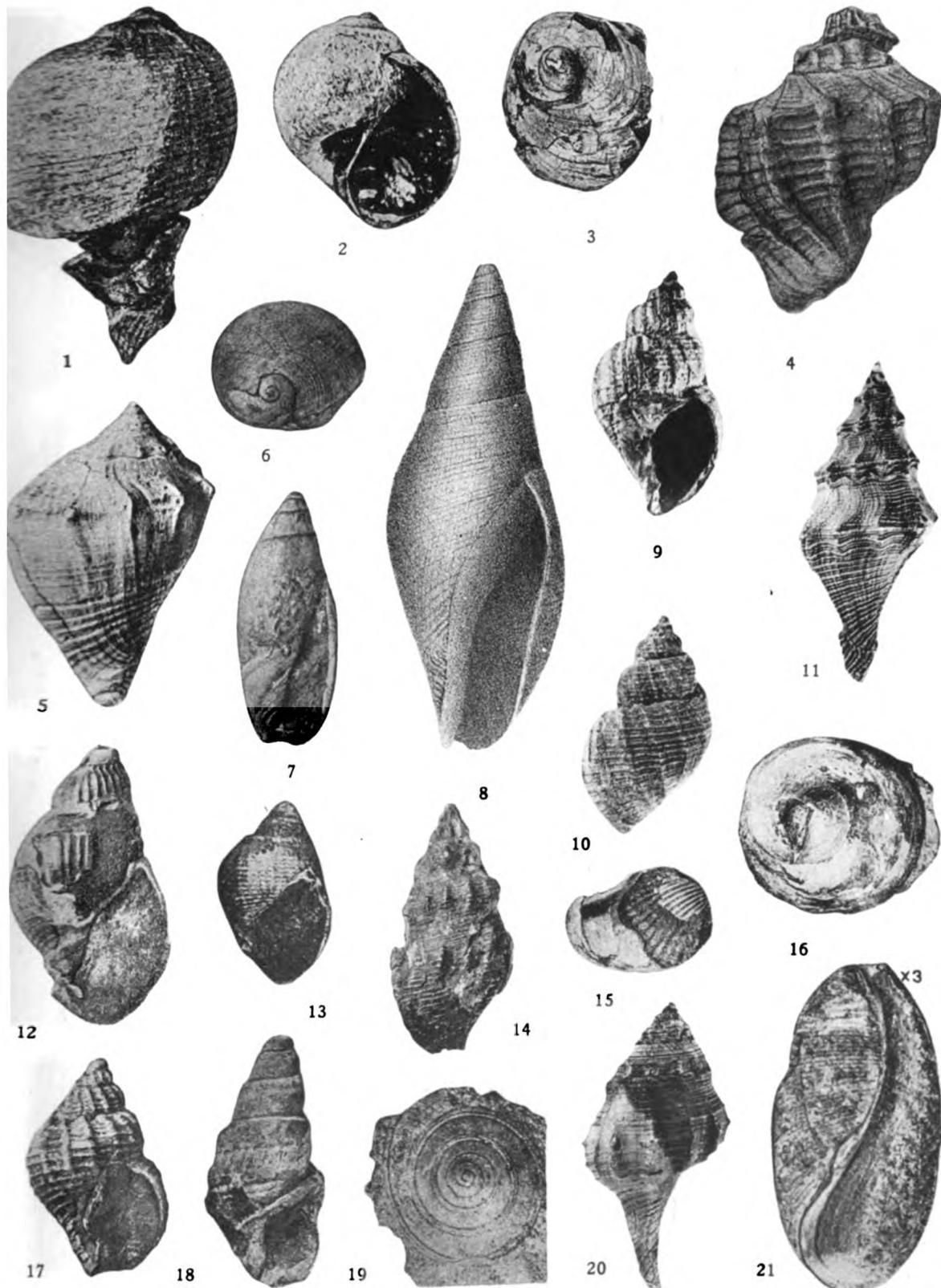
	PAGE
Fig. 1. <i>Aturia angustata</i> (Conrad) ( $\times 1$ ), hypotype (U.S.N.M. 3572). Astoria, Oregon. (Not a type—collected later.).....	551
Fig. 2. <i>Aturia angustata</i> (Conrad) ( $\times 1$ ), hypotype (C.A.S. 5221). Locality (U.C. 1818). Lincoln formation, Porter, Washington. Figured by Schenck, 243, pl. 72, fig. 1.....	551
Fig. 3. <i>Aturia angustata</i> (Conrad) ( $\times 1$ ), hypotype (C.A.S. 5219). Locality (C.A.S. 175). Astoria formation, Knapton, Washington. Figured by Schenck, 243, pl. 69, fig. 2.....	551
Fig. 4. <i>Aturia angustata</i> (Conrad) ( $\times 1$ ), paratype (U.S.N.M. 3534). Cotype of Conrad from Astoria, Oregon, but not previously figured.....	551
Fig. 5. <i>Aturia angustata</i> (Conrad) ( $\times 1$ ), hypotype (U.W. 367). Upper Oligocene. Restoration Point (U.W. 13), Washington.....	551
Fig. 6. <i>Aturia angustata</i> (Conrad) ( $\times 1$ ), hypotype (S.U. 180). Locality (S.U.N.P. 254). Green Creek, southwest Washington. Lincoln formation .....	551
Fig. 7. <i>Aturia angustata</i> (Conrad) ( $\times 1$ ), paratype (U.S.N.M. 3534). Cotype of Conrad from Astoria, Oregon, but not previously figured.....	551
Fig. 8. <i>Aturia angustata</i> (Conrad) subsp. <i>grandior</i> Schenck ( $\times 0.5$ ), holotype (S.U. 524). Locality (S.U.N.P. 207). Vance Creek, Washington. Oligocene. Figured by Schenck, 243, pl. 73, fig. 1.....	552
Fig. 9. <i>Aturia angustata</i> (Conrad) subsp. <i>grandior</i> Schenck ( $\times 2$ ), holotype (S.U. 524). Enlargement ( $\times 1$ ), of the siphuncle of fig. 8.....	552
Fig. 10. <i>Aturia angustata</i> (Conrad) ( $\times 1$ ), holotype (U.S.N.M. 3610). Astoria formation at Astoria, Oregon (Conrad type). Figured originally, 68, pl. 20, fig. 5.....	551

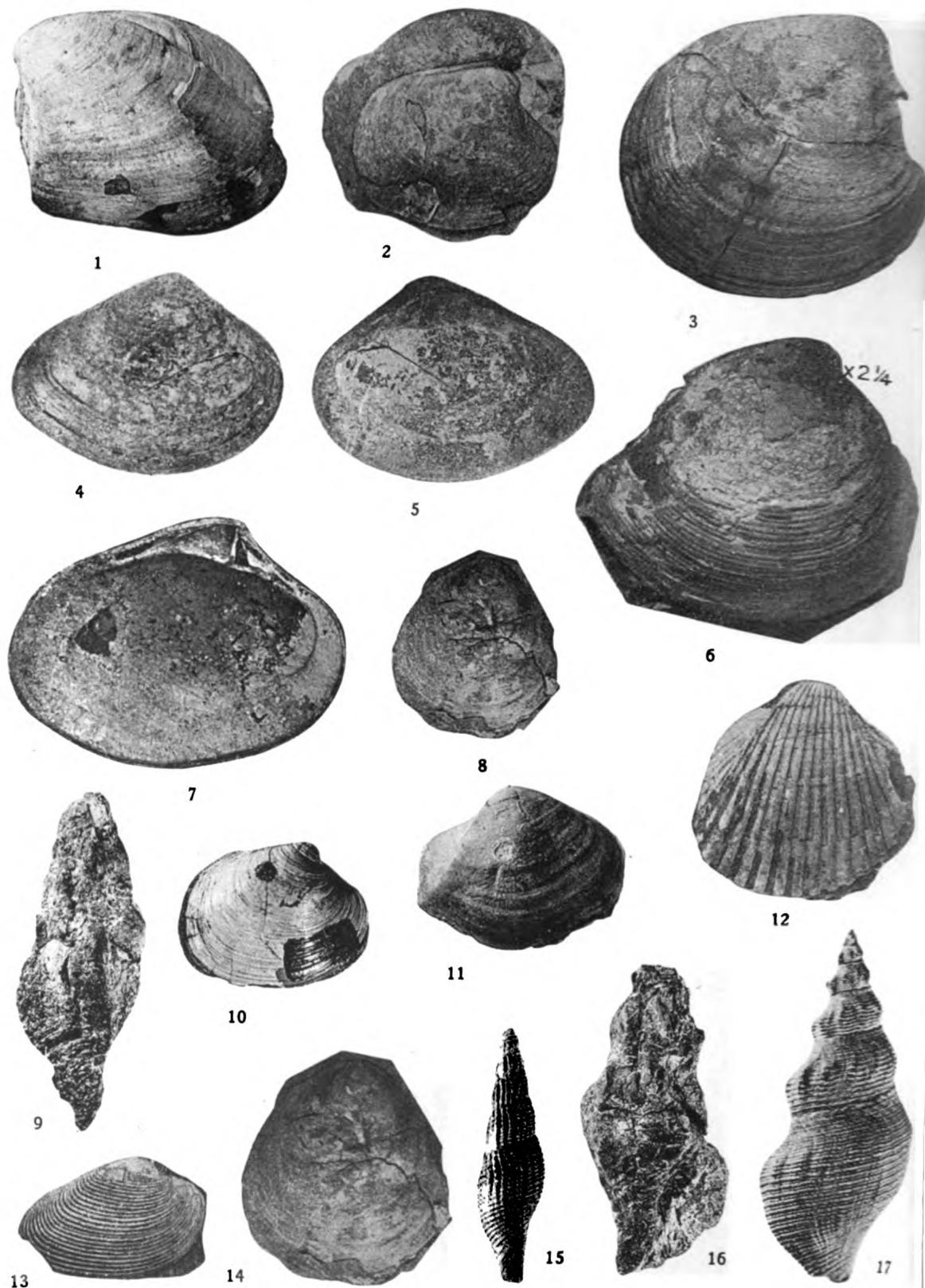
(755)

## PLATE 103

	PAGE
Fig. 1. <i>Ficus modestus</i> (Conrad) ( $\times 1$ ), holotype of <i>Ficus pyriformis</i> Gabb (P.A.N.S. 4325). Reproduction of Stewart's figure, 266, pl. 31, fig. 2....	395
Fig. 2. <i>Polinices (Euspira) nuciformis</i> (Gabb) ( $\times 1.5$ ), lectotype (P.A.N.S. 4213). Reproduction from Stewart, 266, pl. 30, fig. 16.....	342
Fig. 3. <i>Calyptraea diegoana</i> (Conrad) ( $\times 0.6$ ), lectotype (U.S.N.M. 4235). Reproduction from Stewart, 266, pl. 27, fig. 15.....	351
Fig. 4. <i>Cancellaria vetusta</i> Gabb ( $\times 2$ ), lectotype (P.A.N.S. 4295). Reproduction from Stewart, 266, pl. 31, fig. 1a.....	504
Fig. 5. <i>Pseudoliva volutaformis</i> Gabb ( $\times 1.5$ ), lectotype (P.A.N.S. 4201). Reproduction from Stewart, 266, pl. 29, fig. 7.....	459
Fig. 6. <i>Sinum obliquum</i> (Gabb) ( $\times 1$ ), lectotype (P.A.N.S. 4215). Reproduction from Stewart, 266, pl. 30, fig. 7a.....	350
Fig. 7. <i>Olivella matthewsonii</i> Gabb ( $\times 2.2$ ), lectotype (P.A.N.S. 4202). Reproduction from Stewart, 266-A, pl. 29, fig. 13.....	500
Fig. 8. <i>Megasurcula carpenteriana</i> (Gabb) ( $\times 1$ ), lectotype (U.C. 11996). Reproduction from Gabb, 144, pl. 5, fig. 8.....	527
Fig. 9. <i>Bonellitia (Admetula) paucivaricata</i> (Gabb) ( $\times 1.7$ ), holotype of "Admete (Bonellitia) stantoni" (Dickerson) (U.W. 207) (C.A.S. 7551). Figured originally by Weaver and Palmer, 301, pl. 11, fig. 5.....	508
Fig. 10. <i>Bonellitia (Admetula) paucivaricata</i> (Gabb) ( $\times 1.7$ ), holotype of "Admete (Bonellitia) stantoni" (Dickerson) (U.W. 207) (C.A.S. 7551). Figured originally by Weaver and Palmer, 301, pl. 11, fig. 1.....	508
Fig. 11. <i>Nekemias washingtoniana</i> (Weaver) ( $\times 1.5$ ), holotype (U.W. 37) (C.A.S. 7563). Rear view of specimen figured by Weaver, 286, pl. 1, fig. 5.	531
Fig. 12. <i>Molopophorus antiquatus</i> (Gabb) ( $\times 2.2$ ), holotype (P.A.N.S. 4198). Reproduction of Stewart, 266, pl. 28, fig. 4.....	463
Fig. 13. <i>Latirus eocenica</i> (Weaver) ( $\times 1$ ), holotype (U.W. 23) (C.A.S. 489). Figured originally, 286, pl. 3, fig. 22.....	472
Fig. 14. <i>Fusinus (Priscofusus) sanctaeccrucis</i> (Arnold) ( $\times 1$ ), hypotype (U.C. 32207). Figured by Tegland, 272, pl. 12, fig. 3.....	486
Fig. 15. <i>Crepidula pileum</i> (Gabb) ( $\times 1.5$ ), lectotype (P.A.N.S. 4221). Reproduction from Stewart, 266-A, pl. 29, fig. 3.....	356
Fig. 16. <i>Calyptaca inornata</i> (Gabb) ( $\times 1.0$ ), holotype (P.A.N.S. 4339). Reproduction of Stewart's figure, 266-A, pl. 32, fig. 10.....	354
Fig. 17. <i>Bonellitia (Admetula) paucivaricata</i> (Gabb) ( $\times 2.2$ ), lectotype (P.A.N.S. 4194). Reproduction of Stewart, 266-A, pl. 29, fig. 5.....	508
Fig. 18. <i>Loxotrema turrita</i> Gabb ( $\times 1$ ), lectotype (P.A.N.S. 4228). Reproduction of Stewart, 266-A, pl. 26, fig. 4.....	374
Fig. 19. <i>Architectonica cognata</i> Gabb ( $\times 2$ ), lectotype (P.A.N.S. 4224). Reproduction of Stewart, 266-A, pl. 28, fig. 8.....	363
Fig. 20. <i>Whitneyella lincolensis</i> (Van Winkle) ( $\times 1.3$ ), holotype (U.W. 143) (C.A.S. 7564). ....	476
Fig. 21. <i>Scaphander costatus</i> (Gabb) ( $\times 3$ ), lectotype (P.A.N.S. 4338). Reproduction of Stewart, 266-A, pl. 27, fig. 5.....	545

(756)





## PLATE 104

	PAGE
Fig. 1. <i>Thyasira disjuncta</i> (Gabb) ( $\times 2$ ), lectotype (M.C.Z. 15017). Reproduction of Stewart, 267, pl. 15, fig. 1.....	143
Fig. 2. <i>Pitar quadratus</i> (Gabb) ( $\times 1$ ), lectotype (P.A.N.S. 4464). Reproduction of Stewart, 267, pl. 7, fig. 9.....	180
Fig. 3. <i>Venerupis (Protothaca) staleyi</i> (Gabb) ( $\times 1$ ), neotype (P.A.N.S. 4490). Reproduction of Stewart, 267, pl. 15, fig. 4.....	170
Fig. 4. <i>Crassatellites merriami</i> Weaver ( $\times 1$ ), holotype (U.W. 93) (C.A.S. 456). Reproduction of figure, 295, pl. 1, fig. 7.....	123
Fig. 5. <i>Crassatellites merriami</i> Weaver ( $\times 1$ ), holotype (U.W. 93) (C.A.S. 456). Reproduction of figure, 295, pl. 1, fig. 8.....	123
Fig. 6. <i>Pelecyora aequilateralis</i> (Gabb) ( $\times 2.2$ ), lectotype (M.C.Z. 15039). Reproduction of Stewart, 267, pl. 8, fig. 13.....	194
Fig. 7. <i>Crassatellites corallitzenensis</i> Weaver ( $\times 1$ ), holotype (U.W. 7). Reproduction of figure, 286, pl. 4, fig. 40. (On page 123, <i>hypotype</i> should read <i>holotype</i> .) .....	123
Fig. 8. <i>Pododesmus inornata</i> (Gabb) ( $\times 1.2$ ), paratype (P.A.N.S. 4442). Reproduction of Stewart, 167, pl. 4, fig. 40.....	101
Fig. 9. <i>Streptochetus</i> sp. Turner ( $\times 1$ ), holotype (U.C. 33680). Figured by Turner, 274, pl. 17, fig. 14.....	490
Fig. 10. <i>Pitar (Katherinella) arnoldi</i> (Weaver) ( $\times 1.2$ ), holotype (U.W. 96) (C.A.S. 459) .....	185
Fig. 11. <i>Thracia trapezoides</i> Conrad ( $\times 1$ ), holotype (U.S.N.M. 3604). Figured originally, 68, pl. 17, fig. 6a.....	117
Fig. 12. <i>Loxocardium (Schedocardia) brewerii</i> (Gabb) ( $\times 1$ ), lectotype (P.A.N.S. 4560). Reproduction of Stewart, 267, pl. 12, fig. 6.....	153
Fig. 13. <i>Microcallista (Costacallista) conradiana</i> (Gabb) ( $\times 1$ ), holotype (P.A.N.S. 4561). Reproduction of Stewart, 267-A, pl. 12, fig. 3.....	172
Fig. 14. <i>Pododesmus inornata</i> (Gabb) ( $\times 1.5$ ), paratype (P.A.N.S. 4442). Reproduction of Stewart, 267-A, pl. 8, fig. 4.....	101
Fig. 15. <i>Exilia dickersoni</i> (Weaver) ( $\times 1$ ), syntype (U.W. 35-B).....	513
Fig. 16. <i>Streptochetus</i> sp. Turner ( $\times 1$ ), holotype (U.C. 33680). Figured by Turner, 274, pl. 17, fig. 14.....	490
Fig. 17. <i>Fusinus (Priscofusus) chehalensis</i> (Weaver) ( $\times 1$ ), hypotype (U.W. 80-E). .....	485

## NEW NAMES

- Echinorachnius blancoensis* var. *etheringtoni* n. var., page 6.  
*Solemya (Acharax) willapaensis* n. sp., page 21.  
*Yoldia clallamensis* n. sp., page 48.  
*Poromya teglandae* n. sp., page 121.  
*Pachydesma crowderi* n. sp., page 190.  
*Goniobasis coombsi* n. nom., page 375.  
*Cymatium etheringtoni* n. sp., page 413.  
*Gyrineum mackini* n. sp., page 424.  
*Neptunca telgandae* n. nom., page 427.  
*Buccinofusus turneri* n. sp., page 440.  
*Molopophorus effingeri* n. nom., page 465.  
*Persicula chehalisensis* n. sp., page 495.  
*Gemmula barksdalei* n. sp., page 523.  
*Megasurcula etheringtoni* n. sp., page 530.

(758)

## INDEX

Synonyms are indicated in *italics*; new combinations and new names in **bold face type**; names of families, superfamilies, orders, phyla, in **SMALL CAPITALS**; numbers in bold face indicate the page on which the description occurs.

- abrupta**, *Malletia*, **52**, 53  
**Acar**, **70**  
**Acharax**, **18**  
**Acila**, (genus) **22**; (subgenus) **32**  
    (*Truncacila*) *blancoensis*, **31**; pl. 6, figs. 13, 15  
    (*Truncacila*) *conradi*, **29**; pl. 4, fig. 3; pl. 6, figs. 10, 11, 12, 18; pl. 8, figs. 4, 10  
    *conradi*, **31**  
    (*Truncacila*) *decisa*, **22**; pl. 6, figs. 1, 4, 8; pl. 7, figs. 8, 9  
    (*Truncacila*) *empirensis*, **30**; pl. 6, figs. 6, 7, 16  
    (*Acila*) *gettysburgensis*, **29**, **32**; pl. 7, figs. 1, 2, 3, 4; pl. 8, fig. 1  
    *lajollaensis*, **23**  
    (*Truncacila*) *nehalemensis*, **24**; pl. 6, fig. 9  
    (*Truncacila*) *nelsoni*, **27**; pl. 6, fig. 5; pl. 7, fig. 21  
    *packardi*, **26**  
    (*Truncacila*) *packardi*, **26**; pl. 4, fig. 4; pl. 5, figs. 9, 10; pl. 8, fig. 32  
    (*Truncacila*) *pudgetensis*, **28**; pl. 6, fig. 3  
    (*Truncacila*) *shumardi*, **25**, **28**, **29**; pl. 7, figs. 5, 6, 7, 11; pl. 8, figs. 2, 5  
**Acmaea**, **279**  
    *clarki*, **282**  
    *dickersoni*, **283**, **284**; pl. 63, fig. 23; pl. 64, fig. 2  
    *geometrica*, **279**; pl. 62, fig. 4  
    *hannibali*, **280**; pl. 62, fig. 18  
    *mitra*, **279**, **281**  
        subsp. *sookensis*, **281**; pl. 62, fig. 3  
    *oakvillensis*, **283**; pl. 63, fig. 30; pl. 64, fig. 3  
    *ocititia*, **279**; pl. 62, fig. 6  
    *persona*, **281**  
        subsp. *vancouverensis*, **281**, **283**; pl. 62, figs. 2, 7  
    *simplex*, **279**, **282**, **283**; pl. 62, fig. 10; pl. 63, fig. 25; pl. 64, fig. 1  
    *victoriana*, **280**, **282**; pl. 62, figs. 1, 8, 11  
**ACMAEIDAE**, **279-284**  
**Acrilla**, **323**  
    *acuminata*, **323**  
    (*Ferminoscala*) *aragoensis*, **324**; pl. 67, fig. 9  
    (*Ferminoscala*) *becki*, **325**, **326**; pl. 67, fig. 14  
    (*Ferminoscala*) *berthiaumei*, **324**; pl. 67, figs. 12, 13  
    (*Ferminoscala*) *dickersoni*, **324**, **325**, **326**; pl. 67, figs. 7, 8, 21  
    *ferminiana*, **323**  
    (*Ferminoscala*) *lincolnensis*, **325**, **326**; pl. 67, fig. 6  
    (*Undiscala*) *olympicensis*, **327**; pl. 67, fig. 15  
    (*Undiscala*) *washingtonensis*, **327**; pl. 67, fig. 22  
**Acteon**, **541**  
    *boulderana*, **542**, **543**; pl. 99, fig. 37  
    *chehalisensis*, **542**, **543**, **544**; pl. 99, figs. 38, 39, 40  
    *moodyi*, **542**; pl. 99, figs. 32, 33  
    *parvum*, **543**; pl. 99, figs. 30, 31  
**Acteon**—*continued*  
    *tornatilis*, **541**  
    *umpquaensis*, **541**; pl. 99, figs. 34, 35, 36  
**Acteocina** *chehalisensis*, **543**  
**ACTEOCINIDAE**, **544**  
**ACTEONIDAE**, **541-544**  
*acuminata*, *Bruclaria*, **442**; pl. 87, figs. 1, 2, 3, 4  
*acuta*, *Nuculana*, **43**  
*acutilineata*, *Lucina*, **143**, **145**; pl. 34, figs. 8, 11, 16  
*acutirostrata* var. ?, *Spisula*, **232**; pl. 52, fig. 6; pl. 54, fig. 3  
**Admete**, **509**  
    *clatskaniensis*, **509**; pl. 96, fig. 14  
    *crispa*, **509**  
        (*Bonellia*) *stantoni*, **508**  
*aequilateralis*, *Pelecyora*, **194**, **195**; pl. 45, fig. 9; pl. 46, figs. 3, 6; pl. 104, fig. 6  
*aequisulcatum*, *Phalium* (*Bezoardica*), **409**, **411**; pl. 81, fig. 2  
**Aforia**, **516**  
    *clallamensis*, **516**; pl. 97, fig. 1  
        subsp. *wardi*, **516**; pl. 97, figs. 6, 10  
    *packardi*, **517**, **526**; pl. 97, fig. 3  
**Agasoma** *acuminatum*, **442**  
    *columbianum*, **443**  
        (*Trophosycon*) *kernianum*, **396**  
    *oregonense*, **444**  
    *yaquinanum*, **444**  
*albaria*, *Spisula* (*Mactromeris*), **235**, **238**, **239**; pl. 57, figs. 5, 10  
**ALBUNEIDAE**, **560**  
**Alectryon** *newcombei*, **467**  
*alienensis*, *Trichotropis*, **389**; pl. 76, fig. 17  
*alkiensis*, *Nuculana*, **40**; pl. 8, fig. 13  
*alockamanensis*, *Pecten* (*Plagioctenium*), **89**; pl. 17, fig. 5  
*altum*, *Pseudocardium* *densata* var., **245**; pl. 60, fig. 7  
**Alvania**, **362**  
    *acutilirata*, **362**  
    *lettana*, **362**; pl. 73, figs. 10, 15, 16, 17, 18, 19  
    *vinosula*, **363**  
**Amaurellina**, **344**  
    (*Euspirocrommium*) *clarki*, **345**; pl. 70, figs. 10, 18  
    *hendoni*, **345**; pl. 70, figs. 12, 13, 16, 17  
    *moragai lajollaensis*, **345**  
    *spirata*, **344**  
**Amauroopsis**, **347**  
    *alveata*, **345**  
    *andersoni*, **346**  
    *blakeleyensis*, **347**, **348**; pl. 71, fig. 10  
    *oregonensis*, **347**, **348**; pl. 71, figs. 7, 11  
    *umpquaensis*, **346**  
**Amblopus** *olequaensis*, **375**, **377**, **377**  
    *plicifera*, **377**  
    *virginicus*, **377**

- americana*, Ranina, 556  
*Amphissa*, 460  
  *descepta*, 460; pl. 89, fig. 19  
  *eocenica*, 472  
*ampla* var. *chrysia*, Panope (*Panomyia*), 263; pl. 60,  
  fig. 1  
*Ampullina*, 346  
  (*Crommium*) *andersoni*, 346; pl. 71, figs. 1, 2, 3, 4  
  *depressa*, 346  
  *gabbi*, 347  
  *hannibali*, 348  
  (*Amauroopsis*) *oregonensis*, 347  
  *sookensis*, 347; pl. 71, figs. 5, 6  
*Anadara*, 71  
  (*Anadara*) *devincta*, 71, 72; pl. 12, fig. 16; pl. 13,  
  figs. 4, 8  
  var. *montereyana*, 72, 73, 74; pl. 13, figs. 1, 5  
  var. *montesanoana*, 74; pl. 13, fig. 10  
  *microdonta*, 72; pl. 12, fig. 14  
  (*Anadara*) *obispoana*, 74; pl. 11, fig. 5; pl. 13, fig.  
  16; pl. 26, fig. 7  
  (*Anadara*) *trilineata*, 71; pl. 12, figs. 11, 19, 20  
*Anatina*, 244  
  *leana*, 117  
  *pellucida*, 244  
  *roseburgensis*, 244; pl. 57, fig. 8  
*Ancilla*, 500  
  (*Oliverato*) *californica*, 499  
  *fishii*, 470  
  *gabbi*, 500; pl. 95, fig. 18  
*Ancillaria bretzi*, 464  
  *candida*, 500  
  *elongata*, 500  
  *fishii*, 470  
*Ancistrolepis clarki*, 427  
  *landesi*, 427  
*andersoni*, *Ampullina* (*Crommium*), 346; pl. 71, figs. 1,  
  2, 3, 4  
*Glycymeris*, 59; pl. 10, figs. 5, 11  
*Lyria*, 495, 496; pl. 95, figs. 2, 3, 7, 28, 29  
*Macoma*, 211; pl. 49, fig. 9; pl. 52, fig. 7  
*Macrocallista*, 174; pl. 40, figs. 4, 5, 6, 12, 14; pl.  
  46, fig. 14  
*Nassarius*, 461; pl. 89, figs. 15, 16, 17, 18  
*Terebellum*, 392; pl. 76, fig. 28  
*Turritella*, 364, 365; pl. 73, fig. 12  
*angloniana*, *Molopophorus*, 470, 471; pl. 90, figs. 14, 15,  
  16, 18, 23  
*angustata*, *Aturia*, 551, 552; pl. 102, figs. 1, 2, 3, 4, 5,  
  6, 7, 10  
*angustifrons*, *Marcia*, 191; pl. 45, figs. 1, 2, 3, 4  
  var. *brevilineata*, *Marcia*, 191; pl. 45, fig. 7  
*ANNELIDA*, 3-5  
*ANOMALODESMACEA*, 117-123  
*Anomia*, 12, 100  
  *ephippium*, 100  
  *mcconiglensis*, 100; pl. 22, figs. 4, 5  
*ANOMIIDAE*, 100-101  
*Anorthoscutum*, 8  
  *interlineatum*, 9  
*Anorthoscutum*—continued  
  *oregonense*, 8; pl. 3, fig. 14  
    *major*, 10  
    var. *quaylei*, 9, 10; pl. 3, figs. 10, 11  
    var. *semigibbosus*, 10; pl. 4, fig. 2  
*ANTHOZOA*, 1-3  
*Antigona olympidea*, 169  
  *vancouverensis*, 182  
*Antiguamya*, 254  
*Antillophos*, 462  
*Antiplanes*, 517  
  *impecunia*, 518; pl. 97, fig. 11  
  *muirensis*, 539  
  *perversa*, 517; pl. 97, fig. 4  
  *thurstonensis*, 519  
*antiquatus*, *Molopophorus*, 463; pl. 89, figs. 31, 32; pl.  
  103, fig. 12  
*antiselli*, *Thesbia*, 537, 538; pl. 99, figs. 8, 9, 10  
*Apolymetis*, 220  
  *rostellata*, 221  
  *vancouverensis*, 221; pl. 50, fig. 17  
*Aporrhais* (*Aporrhages*) *quillayutensis*, 452  
*apta*, *Galeodea*, 406, 408; pl. 79, figs. 12, 13; pl. 80,  
  figs. 1, 3, 5  
*aragoensis*, *Acrilla* (*Ferminoscala*), 324; pl. 67, fig. 9  
*Lucina* (*Here*), 146; pl. 27, fig. 15; pl. 35, fig. 12;  
  pl. 38, fig. 4  
*Pachydesma*, 188, 189; pl. 44, figs. 18, 19, 20; pl.  
  46, figs. 1, 4, 7; pl. 47, fig. 2  
*aragonia*, *Tellina*, 202, 204; pl. 48, fig. 22  
*Venericardia*, 137, 138; pl. 28, figs. 2, 3, 4, 5; pl.  
  32, figs. 3, 4, 5, 6, 10, 11  
*Arca*, 65, 66  
  *antiquata*, 71  
  *barbatia*, 67  
  *columbiana*, 153  
  (*Barbatia*) *cowlitzensis*, 67  
*devincta*, 72, 73, 74  
*montesanoana*, 74  
  (*Anadara*) *devincta*, 72  
*glycymeris*, 54  
*grodata*, 70  
*gurita*, 75  
  (*Barbatia*) *landesi*, 69  
*(Arca) merriami*, 66; pl. 11, fig. 8; pl. 12, figs.  
  6, 7, 8, 9, 12, 15  
*(Scapharca) microdonta*, 72  
*modioliformis*, 68  
*montereyana*, 73  
*noae*, 65  
*nucleus*, 34  
*obispoana*, 74  
*rostrata*, 36  
*trilineata*, 73  
  (*Arca*) *trilineata*, 71  
  (*Scapharca*) *trilineata*, 71  
  (*Arca*) *washingtoniana*, 66, 67; pl. 12, fig. 5  
*ARCACEA*, 53-77  
*Architectonica*, 363  
  *blanda*, 364; pl. 73, fig. 7  
  *cognata*, 363; pl. 73, fig. 20; pl. 103, fig. 19

- Architectonica—continued**  
*(Stellaxis) cognata*, 363  
*compressa*, 364  
*hornii*, 363
- ARCHITECTONIDAE**, 363-364
- ARCIDAE**, 54-75
- arctata*, Macoma, 206, 208, 212; pl. 49, figs. 3, 5, 12; pl. 59, fig. 15  
var. *wynoocheensis*, Macoma, 208, 209; pl. 49, fig. 8
- arenaria* var. *japonica*, Mya, 253; pl. 59, fig. 18
- Argobuccinum**, 417  
*cammani*, 417; pl. 83, fig. 1  
*(Fusitriton) cammani*, 417  
*coosense*, 418; pl. 83, fig. 2  
*(Fusitriton) coosense*, 418  
*dilleri*, 420; pl. 83, fig. 6  
*goodspeedi*, 421; pl. 83, figs. 9, 10, 11  
*mathewsonii*, 420, 421; pl. 83, figs. 3, 4  
*oregonense*, 418, 420; pl. 83, fig. 15  
*(Fusitriton) oregonense*, 418  
*pacificum*, 419; pl. 83, fig. 5  
*sylviae*, 422; pl. 83, fig. 7  
*vancouverense*, 420, 421; pl. 83, figs. 8, 12
- arnheimi*, Macoma *inquinata* var., 214; pl. 49, fig. 13
- arnoldi*, Clavatula, 535; pl. 99, figs. 4, 11, 12  
*Hipponix*, 355; pl. 72, fig. 8  
var. *ornata*, Hipponix, 355; pl. 72, fig. 11  
*Mya (Antiguamya)*, 254; pl. 59, figs. 2, 6, 14  
*Nassarius*, 461, 462; pl. 89, fig. 14  
*Pitar (Katherinella)*, 185; pl. 44, figs. 1, 2, 3, 4, 5, 6, 7, 8, 12; pl. 104, fig. 10  
*Spisula (Mactromeris) albaria* subsp., 240; pl. 57, fig. 7  
*Tegula (Chlorostoma)*, 289
- ARTHROPODA**, 553-560
- asper*, Raninoides, 557
- Astarte mathewsonii*, 125  
*perrini*, 127
- astori*, Macoma, 213; pl. 49, fig. 14
- astoriana*, Hemithyris, 12; pl. 1, fig. 12
- Astraea*, 296  
*(Pachypoma) inaequalis*, 297; pl. 63, figs. 2, 24  
*precursor*, 297  
*(Pachypoma) precursor*, 297
- Athleta*, 459
- Aturia*, 551  
*angustata*, 551, 552; pl. 102, figs. 1, 2, 3, 4, 5, 6, 7, 10  
subsp. *grandior*, 552; pl. 102, figs. 8, 9
- Axinaea (Limopsis) sagittata*, 54
- B**
- bainbridgensis*, Cancer, 555  
*Cochlodesma*, 117; pl. 25, fig. 1; pl. 29, fig. 2
- bairdii*, Neptunea, 429; pl. 85, figs. 2, 3
- Balanophyllia*, 1  
*blakeleyensis*, 2; pl. 1, figs. 4, 5  
*cf. variabilis*, 1; pl. 1, figs. 1, 2, 3
- Balanus*, 553  
*tintinnabulum* var. *coosensis*, 553; pl. 4, fig. 1
- bandonensis*, Callianassa, 559
- Barbatia*, 67  
*andersoni*, 53, 54  
*(Barbatia) cowlitzensis*, 67; pl. 12, fig. 13  
*gabbi*, 53, 54  
*(Obliquarca) landesi*, 68, 69; pl. 12, fig. 18  
*merriami*, 54, 66  
*(Obliquarca) morsei*, 69; pl. 12, fig. 4  
*(Acar) reinharti*, 70; pl. 13, figs. 6, 7, 11, 13  
*(Obliquarca) suzzalloi*, 68, 69; pl. 11, fig. 7; pl. 12, fig. 10
- barksdalei*, Gemmula, 523, 758; pl. 97, figs. 20, 21
- Bathytoma carpenteriana*, 528  
*condonana*, 530  
*gabbiana*, 529
- Batissa*, 133  
*dubia*, 133, 134; pl. 31, fig. 3  
*newberryi*, 133, 134; pl. 31, fig. 6  
*tenebrosa*, 133
- becki*, Acrilla (*Ferminoscala*), 325, 326; pl. 67, fig. 14
- Bela exarata*, 519  
*fidicula*, 519
- bella*, Lima, 97, 98; pl. 21, fig. 3
- Benoistia*, 387  
*umpquaensis*, 387; pl. 76, figs. 11, 12
- bentsonae*, Cantharus, 433; pl. 85, figs. 4, 5
- berthiaumei*, Acrilla (*Ferminoscala*), 324; pl. 67, figs. 12, 13
- Bezoardica*, 409  
*areola*, 409
- bicarinata*, Siphonalia, 435, 436; pl. 85, figs. 11, 19  
subsp. *monospina*, Siphonalia, 436; pl. 85, figs. 10, 14
- bigranulata*, Persephona, 555
- bilineata*, Sassis, 416; pl. 82, figs. 8, 11, 12, 15
- biplicatus* var. *quadranodosum*, Molopophorus, 469
- bisculpta*, Chione, 167, 168; pl. 40, figs. 2, 3
- bisculpturata*, Spisula, 233, 234; pl. 54, fig. 7
- bisecta*, Thyasira, 142; pl. 34, figs. 5, 6
- Bittium*, 386  
*eschrichtii*, 386; pl. 76, fig. 9  
*(Stylium) eschrichtii*, 386  
*howardi*, 385  
*washingtoniana*, 383
- blakei*, Pseudoperissolax, 415; pl. 82, figs. 13, 17
- blakeleyensis*, Amaurosis, 347, 348; pl. 71, fig. 10  
*Balanophyllia*, 2; pl. 1, figs. 4, 5
- Turritella*, 372; pl. 74, figs. 15, 17
- blancoensis*, Acila (*Truncacilia*), 31; pl. 6, figs. 13, 15  
*Echinarachnius*, 5, 7; pl. 3, figs. 1, 2, 3, 4  
var. *etheringtoni*, *Echinarachnius*, 5, 6, 758; pl. 3, figs. 7, 8
- blanda*, Architectonica, 364; pl. 73, fig. 7
- Blepharipoda*, 560  
*brucei*, 560
- bodegensis* subsp. ?, Tellina, 202, 203; pl. 48, figs. 11, 17
- Bonellitia*, 508  
*(Admetula) paucivaricata*, 508; pl. 96, figs. 10, 12, 13; pl. 103, figs. 9, 10, 17
- Boreoscala*, 313

- borgenae*, Hemipleurotoma, 525; pl. 98, fig. 9  
*Borsonella*, 523  
  *nuncapatia*, 523  
*boulderana*, Acteon, 542, 543; pl. 99, fig. 37  
*Brachidontes*, 113  
  *cowlitzensis*, 113  
*BRACHIOPODA*, 12-18  
*Brachysphingus clarki*, 468  
  *sinatus*, 468  
*bramkampi*, Turrilella, 366; pl. 74, fig. 13  
*Branchioplax*, 554  
  *washingtoniana*, 554  
*branneri*, Searlesia, 442; pl. 86, figs. 19, 20  
*bravinderi*, Opalia (Opalia), 322; pl. 67, figs. 17, 18  
*bretzi*, Molopophorus, 464, 466; pl. 89, fig. 22  
*brevidens*, Corbicula, 131; pl. 29, figs. 6, 12  
*brevilineata*, Marcia angustifrons var., 191; pl. 45, fig. 7  
*brewerii*, Loxocardium (Schedocardia), 153; pl. 35, figs. 15, 16, 18; pl. 38, figs. 1, 9; pl. 104, fig. 12  
  var. *oldroydi*, Loxocardium (Schedocardia), 154; pl. 36, fig. 7; pl. 38, figs. 2, 12  
*Brisaster*, 11  
  *maximus*, 11; pl. 4, fig. 5  
  *townsendi*, 11  
*Brissus fragilis*, 11  
*brucei*, Blepharipoda, 560  
*Bruclickia*, 442  
  *acuminata*, 442; pl. 87, figs. 1, 2, 3, 4  
  *columbiana*, 443; pl. 87, figs. 7, 8  
  *oregonensis*, 444; pl. 86, figs. 21, 22  
  *thor*, 445; pl. 87, figs. 5, 9  
  *yaquinana*, 444; pl. 87, fig. 6  
*BUCCINIDAE*, 457-460  
*Buccinofusus*, 440  
  *diegoensis*, 440  
  *turneri*, 440, 758; pl. 89, figs. 1, 2; pl. 101, fig. 13  
*Buccinum arcularia*, 461  
  *clallamensis*, 448  
  *corrugatum*, 460  
*dalei*, 431  
*echinatum*, 450  
*geversianum*, 401  
*harpa*, 498  
*lamellosum*, 447  
*lima*, 446  
*mississippiensis*, 462  
*stromboides*, 499  
*trunquebaricum*, 432  
*Bulla hydatis*, 549  
  *jugularis*, 546  
*lignaria*, 544  
*petrosa*, 549  
*umbilicata*, 548  
*Bullia (Molopophorus) anglonana*, 470  
  *buccinoides*, 470  
  (*Molopophorus*) *striata*, 463  
*bunkeri*, Marcia (Mercionia), 183, 192; pl. 45, fig. 5; pl. 47, figs. 8, 11  
*Bursa vancouverensis*, 421  
  *washingtoniana*, 412  
*Busycon blakei*, 414, 415  
*buwaldana*, Mytilus, 104; pl. 23, fig. 7; pl. 26, fig. 1  
  subsp. *coensis*, Turrilella, 370; pl. 74, fig. 20  
*Whitneyella*, 477; pl. 91, fig. 12
- C**
- calafia*, Venericardia hornii subsp., 134, 135; pl. 28, figs. 6, 7; pl. 31, figs. 4, 5  
*calamus*, Murex, 457; pl. 89, figs. 4, 8, 9  
*Calappa*, 555  
  *lanensis*, 555  
*CALAPPIDAE*, 555-556  
*calcarea*, Macoma, 206, 212; pl. 49, fig. 11  
*californiana*, Pitar, 177; pl. 40, figs. 10, 13; pl. 41, figs. 15, 16, 17, 18, 19; pl. 47, figs. 6, 12  
*californica*, Cryptochorda, 499; pl. 95, figs. 19, 23  
*Pholididea*, 265  
*californicus* subsp. *lonsdalei*, Molopophorus, 464; pl. 89, fig. 28  
*Callianassa*, 558  
  *bandonensis*, 559  
  *clallamensis*, 559  
  *cowlitzensis*, 558  
  *knapptonensis*, 558  
  *oregonensis*, 559  
  *porterensis*, 559  
  *twinensis*, 559  
  *umpquaensis*, 558  
*CALLIANASSIDAE*, 558-560  
*Callistoma*, 286  
  *cammani*, 288, 289, 290; pl. 63, figs. 3, 9  
  *delezinensis*, 287; pl. 64, fig. 5  
  *mea*, 286, 287; pl. 62, fig. 12  
  *pacificum*, 286, 297; pl. 62, fig. 16  
*Callista sulcataria*, 178  
*tellinaria*, 187  
*Callocallista arnoldi*, 185  
*Calpitaria*, 178  
*Calyptraea*, 351  
  *diegoana*, 351, 352; pl. 71, figs. 16, 20; pl. 103, fig. 3  
  *excentrica*, 351, 352  
*filosa*, 353  
*inornata*, 354; pl. 72, figs. 2, 6; pl. 103, fig. 16  
  (*Trochita*) *inornata*, 354  
*mammillaris*, 353, 354  
  subsp. *vancouverensis*, 353, 354; pl. 72, figs. 5, 7  
*(Galerus) mammillaris* subsp. *vancouverensis*, 353  
*sookensis*, 353; pl. 72, figs. 1, 3, 4  
*washingtonensis*, 352; pl. 71, figs. 19, 22  
*CALYPTRAEIDAE*, 351-355  
*caminensis*, Megistostoma, 541; pl. 99, fig. 24  
*cammani*, Argobuccinum, 417; pl. 83, fig. 1  
*Calliostoma*, 288; pl. 63, figs. 3, 9  
*Fusinus (Priscofusus)*, 488, 489; pl. 94, fig. 9  
*Campeloma*, 347  
*Cancellaria*, 502  
  *candei*, 462  
  *condoni*, 506; pl. 96, figs. 5, 6

**Cancellaria**—continued  
*irelaniana*, 496  
*landesi*, 502; pl. 95, figs. 14, 24  
*oregonensis*, 388, 505, 507; pl. 96, fig. 9  
*paucivaricata*, 508  
*rotunda*, 502, 506; pl. 96, fig. 7  
*sanjosei*, 507; pl. 96, fig. 8  
*stantoni*, 508  
*vetusta*, 504; pl. 96, figs. 2, 3; pl. 103, fig. 4  
*(Calcarata) vetusta*, 504  
*washingtonensis*, 503, 506; pl. 95, fig. 21  
*weaveri*, 504, 505; pl. 96, fig. 4  
*(Crawfordina) weaveri*, 505  
*wynoochensis*, 503, 504, 505; pl. 95, figs. 20, 22  
*(Calcarata) wynoochensis*, 503

**CANCELLARIIDAE**, 502-509

**cancellata**, *Platydon*, 250; pl. 58, fig. 3

**Cancer**, 555  
**bainbrigdensis**, 555

**CANCRIDAE**, 555

**Cantharus**, 432, 435  
*bentsonae*, 433; pl. 85, figs. 4, 5  
*(Calicantharus) californicus*, 434  
*cowlitzensis*, 432, 433, 433  
*(Eocantharus) cowlitzensis*, 432  
*globularis*, 432  
*merriami*, 434; pl. 85, figs. 9, 13  
*(Calicantharus) merriami*, 434  
*perrini*, 433; pl. 85, fig. 8

**carbonicola**, *Potamides*, 378; pl. 75, figs. 15, 19

**CARDIACEA**, 153-231

**CARDIIDAE**, 153-162

**Cardiomya**, 122  
*comstockensis*, 122; pl. 25, fig. 20; pl. 26, fig. 16  
*dolabraeformis*, 122

**Cardita**, 141  
*arata*, 141  
*planicosta*, 134, 135  
*subtenta*, 140  
*sulcata*, 141

**Carditamera**, 141

**CARDITIDAE**, 141-142

**Cardium brewerii**, 153, 154  
*cooperii*, 159  
 var. *lorenzanum*, 160  
*(Cerastoderma) coosense*, 158  
*(Cerastoderma) corbis*, 157  
*edule*, 156  
*eugenense*, 162  
*formosum*, 153  
*hatchetigbeense*, 153  
*lincolnensis*, 156, 161  
*linteum*, 159  
*lorenzanum*, 160  
*meekianum*, 156, 158  
*modestum*, 153  
*oldroydi*, 154  
*olequahensis*, 155  
*(Cerastoderma) scapoosense*, 158  
*semi-asperum*, 159  
*solida*, 231

**Cardium**—continued  
*sookensis*, 159  
*rubrum*, 151  
*weaveri*, 161  
*carlsoni*, *Fusinus (Priscofusus)*, 488; pl. 93, figs. 11, 13  
*carmanahensis*, *Chione*, 167; pl. 39, figs. 4, 9, 10  
*Crassatellites*, 128; pl. 29, fig. 14  
*Limopsis*, 75; pl. 13, figs. 12, 14  
*Pilumnoplax*, 553  
*carpenteriana*, *Megasurcula*, 527, 529; pl. 98, fig. 7; pl. 103, fig. 8  
**CASSIDIDAE**, 402-412  
*Cassidaria tuberculata*, 402  
*washingtoniana*, 425  
*castacana*, *Tellina*, 198; pl. 51, fig. 2  
*castor*, *Venericardia*, 138, 139; pl. 34, figs. 1, 2, 3  
*cathcartensis*, *Macrocallista*, 176, 177; pl. 40, figs. 7, 8, 9, 11  
*caudata*, *Sanguinolaria*, 219; pl. 50, fig. 2  
**CEPHALOPODA**, 551-553  
*Cerastoderma*, 156  
*coosense*, 157, 158; pl. 36, fig. 12  
*corbis*, 157, 158; pl. 35, fig. 17; pl. 38, fig. 8  
*meekianum*, 156, 158  
*scapoosense*, 158; pl. 35, figs. 19, 20  
*sookensis*, 159; pl. 37, figs. 4, 5  
*Cerithidea newcombei*, 384  
**CERITHIIDAE**, 375-387  
*Cerithiopsis*, 381  
*alternata*, 382  
*excelsa*, 381, 382; pl. 76, fig. 1  
*fasteni*, 385, 386; pl. 76, fig. 8  
*howardi*, 385; pl. 76, fig. 10  
*merriami*, 382, 384; pl. 76, fig. 6  
*newcombei*, 384; pl. 76, fig. 7  
*oregonensis*, 370, 381  
*preussi*, 381, 382; pl. 75, figs. 20, 24, 27  
*vaderensis*, 381, 384; pl. 76, fig. 2  
*washingtoniana*, 383; pl. 76, figs. 3, 4, 5  
*Cerithium excelsum*, 382  
*mediale*, 483  
*muricoides*, 387  
*Cernina*, 348  
*(Eocernina) hannibali*, 348; pl. 71, figs. 8, 9, 21, 23  
*Chama*, 151  
*grunskyi*, 151; pl. 35, figs. 9, 10, 13  
*lazarus*, 151  
*pacifica*, 151  
**CHAMACEA**, 151  
**CHAMIDAE**, 151  
*chehalensis*, *Acteon*, 542, 543, 544; pl. 99, figs. 38, 39, 40  
*Chione ensifera* var., 163, 164, 165; pl. 37, fig. 2; pl. 39, fig. 1  
*Ficus (Trophosycon)*, 397  
*Fusinus (Priscofusus)*, 485, 488; pl. 92, figs. 7, 8, 9; pl. 93, fig. 6; pl. 104, fig. 17  
*Glycymeris*, 61; pl. 10, figs. 9, 10  
*Nuculana*, 39, 40; pl. 8, figs. 11, 15, 16, 17  
*Persicula*, 495, 758; pl. 94, fig. 14

- chehalensis*—continued  
*Tritaria* (*Antillophos*) *dumblei* var., 463; pl. 89,  
 figs. 23, 24, 29, 30  
*Yoldia*, 45, 46; pl. 8, figs. 35, 36, 37, 38
- Chione*, 162  
*bisculpta*, 167, 168; pl. 40, figs. 2, 3  
*carmanahensis*, 167; pl. 39, figs. 4, 9, 10  
*cathcartensis*, 176  
*chehalensis*, 165  
*ensifera*, 163, 164, 168; pl. 37, fig. 9; pl. 39, figs.  
 2, 3  
*(Chione)* *ensifera*, 164, 165  
*ensifera* var. *chehalensis*, 163, 164, 165; pl. 37,  
 fig. 2; pl. 39, fig. 1  
*kennicottii*, 164  
*montesanoensis*, 166; pl. 38, fig. 11  
*parapodema*, 163, 164; pl. 37, figs. 6, 7  
*securis*, 162, 169; pl. 36, figs. 8, 9, 13; pl. 37, fig.  
 8; pl. 39, fig. 15  
*staleyi*, 171  
*vancouverensis*, 168; pl. 39, figs. 5, 6, 11; pl. 40,  
 fig. 1
- Chlamys*, 82  
*Chlorostoma*, 289  
*arnoldi*, 289  
*chrysis*, *Panope* (*Panomya*) *ampla* var., 263; pl. 60,  
 fig. 1
- Chrysodomus bairdii*, 429  
*clallamensis*, 429  
*clarki*, 427  
*gettysburgensis*, 430  
*imperialis*, 448  
*lincolnensis*, 431  
*liratus*, 430  
*nodiferus*, 444  
*packardi*, 430  
*postplanatus*, 430
- CIRRIPIEDIA**, 553
- Cirsochilus*, 300  
*washingtonianus*, 300; pl. 63, figs. 15, 31
- Cirsotrema*, 311  
*clallamense*, *Epitonium* (*Cirsotrema*), 311; pl. 65, fig.  
 2; pl. 67, figs. 26, 27  
*clallamensis*, *Aforia*, 516; pl. 97, fig. 1  
 subsp. *wardi*, *Aforia*, 516; pl. 97, figs. 6, 10  
*Callianassa*, 559  
*Ficus* (*Trophosycon*), 396, 397, 398; pl. 77, fig. 7  
*Neptunea*, 429  
*Pecten* (*Propeamussium*), 94, 95; pl. 17, figs. 3, 6  
*Solen*, 225; pl. 53, figs. 3, 8  
*Thais*, 448; pl. 87, fig. 15  
*Yoldia*, 48, 758; pl. 9, fig. 13
- clarki*, *Amaurellina* (*Euspirocrommium*), 345; pl. 70,  
 figs. 10, 18  
*Melanella*, 302, 303; pl. 63, fig. 6  
*Molopophorus*, 468, 470, 471; pl. 90, fig. 12  
*Natica* (*Tectonatica*), 332; pl. 67, fig. 25  
*Pedalion*, 77; pl. 13, fig. 9  
*Pitar* (*Lamelliconcha*), 183; pl. 42, figs. 1, 2, 3, 4,  
 5, 6, 7, 8, 9
- clarki*—continued  
*Pteria*, 77, 78; pl. 11, fig. 4; pl. 14, figs. 11, 12  
*Siphonalia*, 437; pl. 86, fig. 14  
*Solena*, 228; pl. 53, fig. 11  
*Venericardia hornii* subsp., 135; pl. 27, figs. 7, 9,  
 10, 17, 18; pl. 32, fig. 2; pl. 33, fig. 6
- Clathrodrilla* (*Moniliopsis*) *antiselli*, 538  
*(Moniliopsis) fryei*, 540  
*(Moniliopsis) ocoyana*, 539  
*(Moniliopsis) workensis*, 538
- Clathrus*, 310  
*clatskanensis*, *Admete*, 509; pl. 96, fig. 14
- Clavatula*, 535  
*arnoldi*, 535; pl. 99, figs. 4, 11, 12  
*coronata*, 535  
*Clavella* *gravida*, 442  
*Clavilites californicus*, 417  
*Clavus*, 540  
*flammulatus*, 540  
*(Crassispira) fryei*, 540; pl. 99, figs. 26, 27, 28, 29  
*clemomensis*, *Pecten* (*Plagioctenium*) *andersoni* subsp.,  
 89, 90; pl. 19, figs. 3, 5
- Cochlea corbis*, 157  
*Cochlodesma*, 117  
*bainbridgensis*, 117; pl. 25, fig. 1; pl. 29, fig. 2  
*Codakia muirensis*, 148
- COELENTERATA**, 1-3
- cognata*, *Architeconica*, 363; pl. 73, fig. 20; pl. 103,  
 fig. 19
- coli*, *Fusinus* (*Priscofusus*), 489; pl. 94, fig. 4
- Columbella descepta*, 460  
*columbiana*, *Bruclickia*, 443; pl. 87, figs. 7, 8  
*Gari*, 215, 216, 217, 218; pl. 50, figs. 1, 3; pl. 51,  
 fig. 12  
*Lucina*, 145; pl. 34, figs. 13, 14, 15, 17  
*Solena*, 227, 229; pl. 51, fig. 6; pl. 52, fig. 4; pl.  
 53, figs. 10, 12  
*Thesbia*, 537; pl. 99, fig. 13  
*Turcicula*, 291, 292; pl. 63, fig. 1; pl. 101, figs.  
 1, 2, 3  
*Volsella*, 112; pl. 25, fig. 15
- columbianum*, *Pecten* (*Chlamys*), 84; pl. 15, fig. 3; pl.  
 16, fig. 1
- Cominella eocenica*, 472  
*complicata*, *Corbula*, 259; pl. 59, figs. 8, 10; pl. 61, figs.  
 15, 21
- Compsomyax*, 193  
*comstockensis*, *Cardiomya*, 122; pl. 25, fig. 20; pl. 26,  
 fig. 16
- Comus remondii* subsp., 509; pl. 96, fig. 15  
*Turritella andersoni* subsp., 365; pl. 74, fig. 4
- Conchoecetes disjuncta*, 143  
*condonana*, *Megasurcula*, 530; pl. 98, figs. 4, 10, 12  
*condoni*, *Cancellaria*, 506; pl. 96, figs. 5, 6  
*Epitonium* (*Boreoscala*), 314; pl. 65, figs. 12, 13,  
 16, 17  
 var. *eugenense*, *Epitonium* (*Boreoscala*), 315, 316;  
 pl. 65, figs. 14, 20; pl. 66, figs. 1, 2  
 var. *hadlockense*, *Epitonium* (*Boreoscala*), 315,  
 316; pl. 66, fig. 3

**condoni—continued**

- subsp. *janerobertsae*, *Epitonium (Boreoscala)*, 318; pl. 66, figs. 6, 15
- Margarites (Lirularia)*, 290; pl. 62, figs. 17, 19
- var. *oregonense*, *Epitonium (Boreoscala)* 316; pl. 65, figs. 18, 19; pl. 66, fig. 4
- var. *quimperense*, *Epitonium (Boreoscala)*, 317; pl. 66, figs. 5, 14
- subsp. *refulleri*, *Epitonium (Boreoscala)*, 319; pl. 66, fig. 11
- var. *townsendense*, *Epitonium (Boreoscala)*, 317; pl. 66, figs. 9, 10
- Thracia*, 119; pl. 25, fig. 10; pl. 29, fig. 15
- var. *woodmanense*, *Epitonium (Boreoscala)*, 317, 318; pl. 66, figs. 7, 8
- conradi*, *Acila (Truncacilia)*, 29; pl. 4, fig. 3; pl. 6, figs. 10, 11, 12, 18; pl. 8, figs. 4, 10
- Dentalium*, 267; pl. 100, fig. 20
- Scaphander*, 545, 547; pl. 100, fig. 8
- Solen curtus* var., 227; pl. 53, fig. 7
- conradiana*, *Microcallista (Costacallista)*, 172, 173, 174; pl. 41, figs. 5, 6; pl. 46, fig. 11; pl. 104, fig. 13
- CONIDAE**, 509-513
- Conus**, 509
  - cowlitzensis*, 511, 512; pl. 96, fig. 20
  - hornii*, 510, 511, 512
    - var. *umpquaensis*, 510; pl. 96, fig. 18
  - marmoreus*, 509
  - remondii*, 510, 511, 512, 513
    - subsp. *comstockensis*, 509; pl. 96, fig. 15
  - ruckmani*, 510, 512, 513; pl. 96, figs. 21, 22, 23
  - vaderensis*, 511, 512; pl. 96, figs. 17, 19, 24, 25
  - warreni*, 510; pl. 96, figs. 11, 16
  - washingtonensis*, 512
  - weaveri*, 512; pl. 96, fig. 26
- coombsi*, *Goniobasis*, 375, 758; pl. 75, figs. 6, 7, 11, 12
- cooperi* subsp. *umpquaensis*, *Turridula*, 532; pl. 98, figs. 14, 15
- cooperii*, *Yoldia (Portlandia)*, 50; pl. 9, fig. 19
- coosense*, *Argobuccinum*, 418, 420; pl. 83, fig. 2
- Cerastoderma*, 157, 158; pl. 36, fig. 12
- Epitonium (Boreoscala)*, 320; pl. 66, fig. 16
- coosensis*, *Balanus tintinnabulum*, 553; pl. 4, fig. 1
- Eoscutella*, 7; pl. 3, figs. 12, 13
- Fusinus (Priscofusus)*, 489; pl. 93, figs. 15, 18
- Murex*, 454; pl. 88, fig. 19
- Pecten (Patinopecten)*, 92; pl. 18, figs. 1, 2; pl. 21, figs. 2, 5
- Solena*, 229; pl. 52, fig. 16; pl. 53, fig. 13
- Spisula (Mactromeris) albaria* subsp., 242; pl. 56, fig. 3; pl. 57, figs. 2, 11
- Turritella buwaldana* subsp., 370; pl. 74, fig. 20
- Whitneyella*, 473, 474; pl. 90, fig. 26
- coquillensis*, *Lyria*, 495, 496; pl. 95, figs. 1, 4
- Corbicula**, 129
  - brevidens*, 131; pl. 29, figs. 6, 12
  - cowlitzensis*, 129; pl. 30, fig. 9
  - eufaulaensis*, 129
  - fluminalis*, 129
  - olequahensis*, 130, 132; pl. 30, figs. 10, 11

**Corbicula—continued**

- oregonensis*, 130; pl. 27, fig. 1; pl. 29, fig. 8
- pugetensis*, 131; pl. 30, fig. 15
- sookenensis*, 133; pl. 27, fig. 4; pl. 30, figs. 12, 13, 14; pl. 38, fig. 14; pl. 39, fig. 7
- willisi*, 132; pl. 30, figs. 16, 17; pl. 31, fig. 1
- corbiculatum*, *Gyrineum*, 424; pl. 84, figs. 1, 3
- CORBIDAE**, 152-153
- corbis*, *Cerastoderma*, 157, 158; pl. 35, fig. 17; pl. 38, fig. 8
- Corbis**, 152
  - washingtoniana*, 152; pl. 37, figs. 1, 3
- Corbula**, 255
  - complicata*, 259; pl. 59, figs. 8, 10; pl. 61, figs. 15, 21
  - cowlitzensis*, 255; pl. 59, fig. 9; pl. 61, figs. 7, 8, 10
  - dickersoni*, 256, 257, 259; pl. 61, figs. 13, 16, 17, 20
  - dilata*, 259
  - evansana*, 260
  - granulata*, 121
  - hornii*, 257, 258; pl. 59, figs. 7, 17; pl. 61, fig. 5
    - (*Caryocorbula*) *hornii*, 257
  - parilis*, 256, 259; pl. 59, fig. 16
  - stillwaterensis*, 258
  - sulcata*, 255
  - torreyensis*, 259; pl. 61, fig. 12
- CORBULIDAE**, 255-261
- costatus*, *Scaphander*, 545, 548; pl. 100, fig. 2; pl. 103, fig. 21
- cowlitzense*, *Cymatium*, 412, 413, 423; pl. 81, figs. 7, 8, 10, 13; pl. 82, figs. 1, 4
- cowlitzensis*, *Barbatia (Barbatia)*, 67; pl. 12, fig. 13
- Callianassa*, 558
- Cantharus*, 432, 433
- Conus*, 511, 512; pl. 96, fig. 20
- Corbicula*, 129; pl. 30, fig. 9
- Corbula*, 255; pl. 59, fig. 9; pl. 61, figs. 7, 8, 10
- Crassatellites*, 123, 124; pl. 104, fig. 7
- Ficopsis*, 399; pl. 77, figs. 3, 5, 6, 8, 9, 11
- Gari*, 215; pl. 49, fig. 16
- Murex*, 455; pl. 88, figs. 9, 15
- Nerita*, 294, 295; pl. 63, fig. 11
- Nuculana*, 36, 37; pl. 7, figs. 10, 18; pl. 8, figs. 27, 29
- Opalia (Rugatiscalpa)*, 323; pl. 67, fig. 16
- Pecten (Chlamys)*, 83, 85; pl. 11, figs. 1, 2; pl. 14, fig. 9
- Tellina*, 198; pl. 51, fig. 13; pl. 57, fig. 12
- Turboella*, 361; pl. 73, fig. 9
- Turridula (Pleurofusus)*, 534; pl. 99, figs. 1, 2, 7
- Volsella (Brachidontes)*, 113; pl. 26, fig. 4
- Cowlitzia**, 390
  - washingtonensis*, 390
- cornwalli**, *Pecten (Chlamys)*, 85; pl. 16, figs. 2, 3, 5
  - Thais*, 450; pl. 88, figs. 4, 6
- coronata**, *Trichotropis*, 388
- corpulentus**, *Fusinus (Priscofusus)*, 482, 484; pl. 92, fig. 1

- Crassatella dalli*, 124  
*gibbosula*, 123  
*perrini*, 127  
*uvasana* subsp. *mathewsonii*, 125
- Crassatellites**, 123  
*carmanahensis*, 128; pl. 29, fig. 14  
*collina*, 125  
*cowlitzensis*, 123, 124; pl. 104, fig. 7  
*dalli*, 124; pl. 29, figs. 1, 7  
*lincolnensis*, 128; pl. 26, figs. 9, 11, 14, 15; pl. 29,  
 figs. 10, 11; pl. 30, fig. 3  
*merriami*, 123; pl. 104, figs. 4, 5  
*perrini*, 127; pl. 26, figs. 12, 13, 17, 18  
*semidentata*, 125  
*sinuatus*, 123  
*stillwaterensis*, 126; pl. 27, figs. 2, 3, 5, 6; pl. 29,  
 figs. 9, 13; pl. 31, fig. 2  
*uvasana*, 125  
 subsp. *mathewsonii*, 125; pl. 26, fig. 8; pl. 29,  
 fig. 4; pl. 61, fig. 18  
*washingtoniana*, 126; pl. 30, figs. 1, 2, 4, 5, 6, 7, 8
- CRASSATELLITIDAE**, 123-129
- Crassispira*, 540  
*crenospira*, *Turricula*, 532; pl. 98, figs. 21, 25
- Crenella*, 115  
*porterensis*, 115; pl. 25, figs. 3, 14  
*washingtonensis*, 115, 116; pl. 25, fig. 4
- Crepidula*, 356  
*dickersoni*, 356  
*fornicata*, 360  
*inornata*, 356  
*(Spirocrypta) pileum*, 356  
*pileum*, 356, 357; pl. 72, figs. 10, 16; pl. 103, fig. 15  
 var. *dickersoni*, 356, 357; pl. 72, figs. 14, 17  
*praerupta*, 359, 359; pl. 73, figs. 1, 2, 3  
*princeps*, 358, 359; pl. 73, figs. 4, 13, 14  
*(Crepidula) rostralis*, 359; pl. 72, figs. 13, 15  
*sookensis*, 357; pl. 72, figs. 9, 12, 18  
*stillwaterensis*, 357  
*ungana*, 360; pl. 73, fig. 5
- CREPIDULIDAE**, 356-360  
*crescentense*, *Epitonium (Sthenorytis)*, 321; pl. 67,  
 fig. 2  
*crescentensis*, *Eratopsis*, 393; pl. 76, fig. 21  
*Ficopsis remondii* var., 399; pl. 77, fig. 10  
*Galeodea*, 403; pl. 78, figs. 4, 5  
*Glycymeris*, 58; pl. 10, figs. 20, 21; pl. 11, fig. 12;  
 pl. 38, fig. 10  
*Harpa*, 498; pl. 95, figs. 12, 13  
*Solariella*, 293; pl. 63, fig. 27  
*Venericardia*, 137, 138; pl. 32, figs. 8, 9; pl. 33,  
 figs. 1, 2; pl. 38, fig. 7  
*cretacea* var., *Mitra*, 497; pl. 95, figs. 5, 6  
*crowderi*, *Pachydesma*, 190, 758; p. 46, fig. 8
- CRUSTACEA**, 553-560  
*Crypta (Spirocrypta) pileum*, 356  
*Cryptochorda*, 499  
*californica*, 499; pl. 95, figs. 19, 23  
*Cryptogemma borgenae*, 525
- Cryptomya**, 251  
*oregonensis*, 252; pl. 59, fig. 4  
*ovalis*, 253  
*quadrata*, 252  
 subsp. *vancouverensis*, 207, 251; pl. 49, fig. 1;  
 pl. 59, fig. 13  
*washingtoniana*, 252; pl. 59, fig. 5
- Cucullaria (Porterius) gabbi*, 53  
*Cuma biplicata* var. *quadranodosum*, 469  
*curtus*, *Solen*, 226  
*CUSPIDARIIDAE*, 122  
*Cyathodonta*, 117  
*Cyclostoma acutum*, 362  
*Cylichna costata*, 545, 548  
*oregona*, 549  
*Cylichnina*, 548  
*tantilla*, 548, 548, 549; pl. 100, figs. 10, 11, 12, 14,  
 15  
*turneri*, 549; pl. 100, fig. 13
- CYMATIIDAE**, 412-426  
**Cymatium**, 412  
*cowlitzense*, 412, 413, 423; pl. 81, figs. 7, 8, 10, 13;  
 pl. 82, figs. 1, 4  
*etheringtoni*, 413, 758; pl. 82, figs. 2, 3, 10  
*pacificum*, 414; pl. 82, fig. 9  
*(Linatella) pacificum*, 414  
*washingtonianum*, 412, 413, 423; pl. 81, figs. 6,  
 9, 11, 12
- Cypreae**, 394  
*oakvillensis*, 394; pl. 76, figs. 29, 30  
*tigris*, 394
- CYPRAEIDAE**, 394-395  
**Cypraeogemmula**, 394  
*liliputana*, 394  
*warneri*, 394; pl. 77, fig. 2
- Cyrena brevidens*, 131  
*Cythera (Trigonella) crassatelloides*, 188  
*oregonensis*, 191  
*Cytherea concinna*, 183  
*hatchetigbeensis*, 193  
*newcombei*, 193  
*oregonensis*, 181  
*proxima*, 172  
*vancouverensis*, 182
- D**
- dalli*, *Crassatellites*, 124; pl. 29, figs. 1, 7  
*Galeodea*, 404; pl. 78, figs. 8, 9  
*Lucina (Here)*, 146; pl. 35, fig. 5  
*Molopophorus*, 466, 469; pl. 90, fig. 8  
*Myadesma*, 250; pl. 58, figs. 4, 7, 8; pl. 61, figs.  
 6, 11  
*Natica (Tectonatica)*, 330; pl. 67, fig. 30  
*Pitar*, 181, 184; pl. 43, figs. 1, 2, 3, 4, 5, 8, 11  
*Solemya (Acharax)*, 20, 21; pl. 4, figs. 6, 7, 8; pl.  
 5, figs. 4, 5, 6, 7, 8  
**DECAPODA**, 553  
*decisa*, *Acila (Truncacilia)* 22; pl. 6, figs. 1, 4, 8; pl.  
 7, figs. 8, 9  
*Delectopecten*, 96

*delezinensis*, *Calliostoma*, 287; pl. 64, fig. 5  
*Delphinula cancellata*, 301  
  *striata*, 300  
*Dendraster* (*Calaster*) *oregonensis*, 8  
  (*Calaster*) *oregonensis gibbosus*, 9  
*densata* var. *altum*, *Pseudocardium*, 245; pl. 60, fig. 7  
*Dentalium*, 266  
  *conradi*, 267; pl. 100, fig. 20  
  *elephantinum*, 266  
  *petricola*, 267  
  *porterensis*, 268; pl. 61, fig. 19  
  *stramineum*, 267  
*descepta*, *Amphissa*, 460; pl. 89, fig. 19  
*devincta*, *Anadara* (*Anadara*), 71, 72; pl. 12, fig. 16;  
  pl. 13, figs. 4, 8  
*diabloti*, *Semele*, 222; pl. 50, fig. 15; pl. 52, fig. 13  
*dichotomus*, *Mytilus*, 107; pl. 23, fig. 14; pl. 26, fig. 10  
  *Septifer*, 115; pl. 25, fig. 6  
*dickersoni*, *Acmaea*, 283, 284; pl. 63, fig. 23; pl. 64,  
  fig. 2  
  *Acrilla* (*Ferminoscala*), 325, 326; pl. 67, figs. 7,  
  8, 21  
*Corbula*, 256, 257, 259; pl. 61, figs. 13, 16, 17, 20  
*Crepidula pileum* var., 356, 357; pl. 72, figs. 14, 17  
*Exilia*, 513, 514; pl. 96, figs. 28, 29; pl. 101, fig.  
  6; pl. 104, fig. 15  
*Glycymeris sagittata* var., 55, 59; pl. 11, figs. 9, 10,  
  13, 14  
*Spirotropis*, 521; pl. 97, figs. 15, 16  
*diegoana*, *Calyptarea*, 351, 352; pl. 71, figs. 16, 20; pl.  
  103, fig. 3  
*dilleri*, *Argobuccinum*, 420; pl. 83, fig. 6  
  *Melanella*, 303; pl. 63, fig. 7  
  *Pseudoliva*, 458, 459; pl. 89, figs. 5, 6  
  *Pyramidella* (*Syrnola*), 306  
  *Thracia*, 119; pl. 29, fig. 3  
*diminuta*, *Neptunea*, 428; pl. 85, fig. 1  
*Diodora*, 284  
  *stillwaterensis*, 284; pl. 63, fig. 20; pl. 64, figs. 4,  
  7, 12  
*Dione angustifrons*, 191  
*Diplodonta dalli*, 146  
  *parilis*, 149  
*dira* subsp. *miocenica*, *Searlesia*, 441; pl. 86, figs. 17, 18  
*directa*, *Volsella*, 108; pl. 23, fig. 6; pl. 25, fig. 2  
*DISCINIDAE*, 14  
*Discinisa*, 14  
  *lugubris*, 14  
  *oregonensis*, 14; pl. 2, fig. 16  
*disjuncta*, *Thyasira*, 143; pl. 34, fig. 7; pl. 104, fig. 1  
*diversilineata*, *Turritella*, 373; pl. 74, fig. 19  
*Docoglossa*, 279  
*Dolium petrosum*, 405, 405  
*Donax stultorum*, 188  
*Dosinia bunkeri*, 192  
  *staleyi*, 170  
*douglasensis*, *Mitra*, 497; pl. 95, figs. 10, 11  
*drakei*, *Goniobasis*, 376; pl. 75, fig. 13  
*Drillia antiselli*, 538  
  *chehalensis*, 485, 486  
  *columbiana*, 537

*Drillia*—continued  
  *hecoxi*, 485  
  *kennicottii*, 519  
  *ocoyana*, 539  
  *ornata*, 535  
  *penicillata*, 536  
*DROMIIDAE*, 556  
*dubia*, *Batissa*, 133, 134; pl. 31, fig. 3  
*dumblei* var. *chehalensis*, *Tritaria* (*Antillophos*),  
  463; pl. 89, figs. 23, 24, 29, 30  
*duprei*, *Yoldia* (*Portlandia*), 46; pl. 7, fig. 16; pl. 9,  
  fig. 9  
*durhami*, *Segmentina*, 551; pl. 100, figs. 24, 25, 26  
  
**E**  
*carlturneri*, *Epitonium* (*Boreoscala*), 313; pl. 65, figs.  
  9, 15  
*Echinarachnius*, 5  
  *blancoensis*, 5, 7; pl. 3, figs. 1, 2, 3, 4  
    var. *etheringtoni*, 5, 6, 758; pl. 3, figs. 7, 8  
  *fairbanksi*, 7  
  *newcombei*, 6; pl. 3, figs. 5, 6  
  *vaquerensis*, 8  
*ECHINODERMATA*, 5-11  
*ECHINOIDEA*, 5-11  
*effingeri*, *Epitonium* (*Gyroscala*), 310; pl. 64, figs. 25, 33  
  *Molopophorus*, 465, 758; pl. 90, figs. 2, 3  
*Ectinochilus*, 390  
  (*Vaderos*) *elongata*, 391; pl. 76, fig. 22  
  *macilenta*, 392  
  (*Macilentes*) *macilenta* subsp. *oregonensis*, 392; pl.  
  76, figs. 25, 26, 27  
  (*Cowlitzia*) *washingtonensis*, 390; pl. 76, figs. 18,  
  19, 20, 23, 24  
*egberti*, *Phalium* (*Izeardica*), 410, 411; pl. 81, fig. 4  
*Elimia schencki*, 379  
*elongata*, *Ectinochilus* (*Vaderos*), 391; pl. 76, fig. 22  
*emacerata*, *Tellina*, 206; pl. 48, figs. 18, 20  
*empirensis*, *Fusinus*, 480; pl. 91, fig. 21  
*empirensis*, *Acila* (*Truncacila*), 30; pl. 6, figs. 6, 7, 16  
*ensifera*, *Chione*, 164, 168; pl. 37, fig. 9; pl. 39, figs. 2, 3  
*eocenica*, *Glycymeris*, 56, 57; pl. 10, figs. 2, 3, 8  
  *Latirus*, 472, 473; pl. 89, figs. 21, 27; pl. 90, figs.  
  13, 20, 22; pl. 103, fig. 13  
*Pinnixia*, 553  
*Pitar* (*Lamelliconcha*), 180, 184; pl. 39, figs. 8, 13;  
  pl. 47, figs. 7, 9  
*Upogebia* (*Upogebia*), 560  
*Eocernina*, 348  
*Eomeretrix*, 186  
  *martini*, 186; pl. 42, figs. 14, 16, 18, 19, 20; pl. 46,  
  fig. 9, 12, 13; pl. 47, figs. 1, 3  
*Eoscutella*, 7  
  *coosensis*, 7; pl. 3, figs. 12, 13  
*EPITONIIDAE*, 310-328  
*Epitonium*, 310  
  *aragoensis*, 324  
  (*Cirsotrema*) *clallamense*, 311; pl. 65, fig. 2; pl.  
  67, figs. 26, 27  
  *communis*, 310

- Epitonium*—continued  
*commutatum*, 310  
*(Arctoscala) condoni*, 314  
*(Boreoscala) condoni*, 314, 316, 324; pl. 65, figs. 12, 13, 16, 17  
*var. eugenense*, 315, 316; pl. 65, figs. 14, 20; pl. 66, figs. 1, 2  
*var. hadlockense*, 315, 316; pl. 66, fig. 3  
*subsp. janerobertae*, 318; pl. 66, figs. 6, 15  
*var. oregonense*, 316, 318; pl. 65, figs. 18, 19; pl. 66, fig. 4  
*var. quimperense*, 317, 318; pl. 66, figs. 5, 14  
*subsp. refulleri*, 319; pl. 66, fig. 11  
*var. townsendense*, 317; pl. 66, figs. 9, 10  
*var. woodmanense*, 317, 318; pl. 66, figs. 7, 8  
*(Boreoscala) coosense*, 313, 320; pl. 66, fig. 16  
*(Sthenoritys) crescentense*, 321; pl. 67, fig. 2  
*(Boreoscala) earlturneri*, 313; pl. 65, figs. 9, 15  
*(Gyroscala) effingeri*, 310; pl. 64, figs. 25, 33  
*expansum*, 321  
*greenlandicum*, 313  
*(Cirsotrema) howei*, 312, 320; pl. 65, fig. 8  
*(Boreoscala) insecuritum*, 313; pl. 65, fig. 11; pl. 67, figs. 10, 11  
*(Boreoscala) keaseyense*, 319; pl. 66, fig. 12  
*subsp. schencki*, 320; pl. 66, figs. 13, 17, 18  
*merriami*, 384  
*oregonense*, 316  
*(Catenoscala) oregonense*, 316  
*pretiosum*, 310  
*(Opalia) rugiferum*, 321  
*(Arctoscala) saundersi*, 312  
*(Cirsotrema) saundersi*, 311, 312; pl. 64, figs. 31, 32; pl. 65, figs. 3, 4, 5, 6, 7, 10  
*varicosum*, 311  
*washingtonensis*, 325, 327  
*(Boreoscala) washingtonensis*, 313  
*(Clathrus) weaveri*, 310; pl. 65, fig. 1  
*Eratopsis*, 393  
*barrandei*, 393  
*crescentensis*, 393; pl. 76, fig. 21  
*Ervilia*, 243  
*oregonensis*, 243; pl. 56, fig. 4  
**ERYCINACEA**, 151-153  
**ERYCINIDAE**, 151-152  
*eschrichtii*, *Bittium*, 386; pl. 76, fig. 9  
*etheringtoni*, *Cymatium*, 413, 758; pl. 82, figs. 2, 3, 10  
*Echinarachnius blancoensis* var., 5, 6; pl. 3, figs. 7, 8  
*Loxocardium (Schedocardia)*, 155, 156; pl. 35, fig. 21  
*Megasurcula*, 530, 758; pl. 98, fig. 13; pl. 101, fig. 10  
*Pitar (Katherinella) arnoldi* subsp., 186; pl. 44, figs. 9, 10, 13  
*Eucrate*, 554  
*martini*, 554  
*Eudolium oregonense*, 409  
*petrosum*, 405, 406, 407, 408  
*eugenense*, *Epitonium (Boreoscala) condoni* var., 315, 316; pl. 65, figs. 14, 20; pl. 66, figs. 1, 2  
*Nemocardium*, 162; pl. 36, fig. 10  
*Pseudocardium*, 244, 245, 247; pl. 57, fig. 4  
*eugenensis*, *Raninooides*, 557  
*Solena*, 230; pl. 53, figs. 14, 15  
*Volsella*, 110, 111; pl. 24, fig. 8  
*eugenia*, *Tellina*, 196, 201; pl. 48, figs. 5, 8  
*Eulima clarki*, 302  
*hiltoni*, 307  
*smithi*, 302, 303, 305, 306  
*washingtoni*, 303, 305  
*Eulimella dilleri*, 303, 306  
*Eumorphocorytes*, 558  
*naselensis*, 558  
**EPSAMMIDAE**, 1-2  
*Euspira*, 342  
*nuciformis*, 342  
*Euspirocrommium*, 344  
*evansana*, *Corbula*, 260  
*excelsa*, *Cerithiopsis*, 382; pl. 76, fig. 1  
*Exilia*, 513  
*dickersoni*, 513, 514; pl. 96, figs. 28, 29; pl. 101, fig. 6; pl. 104, fig. 15  
*lincolnensis*, 514, 515; pl. 96, fig. 30  
*mcellani*, 515; pl. 97, fig. 2  
*pergracilis*, 513  
*weaveri*, 513, 514, 515; pl. 96, fig. 27
- F**
- Fasciolaria bilineata*, 416  
*buvaldiana*, 477  
*gabbi*, 475  
*washingtoniana*, 531, 531  
**FASCIOLARIIDAE**, 472-491  
*fasteni*, *Cerithiopsis*, 385, 386; pl. 76, fig. 8  
*Gemmula*, 524; pl. 97, figs. 17, 22, 23  
*fax*, *Galeodea*, 404, 406; pl. 79, figs. 9, 10, 11  
*Ferminoscala*, 323  
*fettkei*, *Ostrea idriaensis* var., 80; pl. 14, figs. 8, 10, 14, 15  
*Potamides*, 379; pl. 75, figs. 18, 21, 22, 26  
**FIBULARIIDAE**, 5-7  
**FICIDAE**, 395-401  
*Ficopsis*, 398  
*cooperi*, 400  
*cowlitzensis*, 399; pl. 77, figs. 3, 5, 6, 8, 9, 11  
*hornii*, 399  
*meganosensis*, 401  
*var. packardi*, 400; pl. 77, fig. 14  
*packardi*, 400  
*remondii*, 398, 399; pl. 77, fig. 12  
*var. crescentensis*, 399; pl. 77, fig. 10  
*ficus*, *Mytilus*, 103; pl. 23, fig. 11  
*Ficus*, 395  
*(Trophosycon) chehalensis*, 397  
*(Trophosycon) clallamensis*, 396, 397, 398; pl. 77, fig. 7  
*communis*, 395  
*dussumier*, 395

- Ficus**—continued  
*modestus*, 395, 397, 398; pl. 77, fig. 1; pl. 103, fig. 1  
*pyriformis*, 395, 396  
*(Trophosycon) restorationensis*, 397; pl. 77, fig. 13  
*(Trophosycon) wynoochensis*, 397, 398; pl. 77, fig. 4
- fishii**, *Molopophorus*, 468, 470, 471; pl. 90, figs. 9, 10, 11
- FISSURELLIDAE**, 284-285
- Fissurella stillwaterensis*, 284
- flagleri**, *Macoma indentata* subsp., 211; pl. 49, fig. 10
- foliata**, *Purpura*, 451, 452; pl. 88, fig. 10
- fresnoensis**, *Glycymeris*, 59; pl. 11, fig. 11  
*Nuculana*, 41; pl. 7, figs. 15, 17, 22; pl. 8, figs. 14, 23, 24
- Frieleia** *halli*, 12
- fryei**, *Clavus (Crassispira)*, 540; pl. 99, figs. 26, 27, 28, 29
- fulgidus**, *Raninoides*, 557
- Fulgurofusus**, 490  
*washingtoniana*, 490; pl. 93, figs. 12, 16, 17; pl. 101, figs. 4, 5
- FUNGIDAE**, 2
- Fusinus**, 479  
*(Priscofusus) cammani*, 488, 489; pl. 94, fig. 9  
*(Priscofusus) carlsoni*, 488; pl. 93, figs. 11, 13  
*(Priscofusus) chehalensis*, 485, 488; pl. 92, figs. 7, 8, 9; pl. 93, fig. 6; pl. 104, fig. 17  
*(Priscofusus) coli*, 487, 489; pl. 94, fig. 4  
*(Priscofusus) coosensis*, 489; pl. 93, figs. 15, 18  
*(Priscofusus) corpulentus*, 482, 484; pl. 92, fig. 1  
*empireensis*, 480; pl. 91, fig. 21  
*(Priscofusus) geniculus*, 482, 484; pl. 92, fig. 10  
*gesteri*, 479, 480; pl. 91, figs. 19, 20  
*(Priscofusus) hannibali*, 484, 485; pl. 93, figs. 1, 2, 5  
*(Priscofusus) lincolnensis*, 487, 488, 490; pl. 93, figs. 8, 9  
*(Priscofusus) medialis*, 483; pl. 93, fig. 7  
*merriami*, 479; pl. 91, figs. 16, 17  
*montesanoensis*, 481; pl. 91, fig. 24  
*(Priscofusus) nodiferus*, 483  
*(Priscofusus) oregonensis*, 484; pl. 92, figs. 2, 4  
*(Priscofusus) sanctaerucis*, 486, 487; pl. 91, figs. 22, 23; pl. 103, fig. 14  
*(Priscofusus)* sp., 483; pl. 92, figs. 3, 5, 6  
*(Priscofusus) stewarti*, 486; pl. 93, figs. 3, 4, 10, 14  
*willisi*, 480; pl. 91, fig. 18
- Fusus antiquus**, 427  
*californicus*, 417  
*cinereus*, 453  
*corpulentus*, 482  
*dickersoni*, 513  
*geniculus*, 481, 482  
*intortus*, 490  
*mathewsonii*, 526  
*montesanoensis*, 481  
*oregonensis*, 444  
*quercolis*, 490  
*(Hemifusus) remondii*, 398  
*sanctaerucis*, 486  
*(Priscofusus) stanfordensis*, 444  
*terebralis*, 440
- Fusus**—continued  
*washingtoniana*, 490  
*willisi*, 480
- G**
- gabbi**, *Ancilla*, 500; pl. 95, fig. 18  
*Glycymeris*, 62; pl. 10, fig. 18  
*Molopophorus*, 466, 469; pl. 90, figs. 4, 6  
*Pelecyora*, 194; pl. 45, fig. 16; pl. 46, fig. 15  
*Porterius*, 53, 54; pl. 9, figs. 7, 10, 11, 14; pl. 11, fig. 3
- Turcica**, 288; pl. 63, fig. 4  
*Whitneyella*, 475, 477; pl. 91, figs. 1, 2, 3, 4
- gabbiana**, *Megasurcula*, 529; pl. 98, fig. 3
- Gadinia**, 550  
*afra*, 550  
*reticulata*, 550  
*subsp. sookensis*, 550; pl. 100, figs. 21, 22
- GADINIIDAE**, 550
- Galeodea**, 402  
*apta*, 406, 408; pl. 79, figs. 12, 13; pl. 80, figs. 1, 3, 5  
*crescentensis*, 403; pl. 78, figs. 4, 5  
*dalli*, 404; pl. 78, figs. 8, 9  
*echinophora*, 402  
*fax*, 404, 406; pl. 79, figs. 9, 10, 11  
*oregonense*, 409; pl. 81, fig. 1; pl. 101, fig. 12  
*petrosa*, 404, 405; pl. 79, figs. 5, 6, 7  
*rex*, 407, 408; pl. 80, figs. 2, 4, 6  
*susanac*, 402; pl. 78, figs. 2, 3  
*suterrensis*, 402, 403; pl. 78, figs. 6, 7  
*tri-tuberculata*, 403, 404, 406; pl. 78, figs. 10, 11, 12, 13, 14, 15; pl. 79, figs. 1, 2, 3, 4, 8  
*tuberculata* var. *crescentensis*, 403  
*tuberculiformis*, 403
- Galerus excentricus**, 351, 352
- galianoi**, *Polinices (Euspira)*, 344; pl. 70, figs. 11, 14
- Gari**, 215  
*columbiana*, 215, 216, 217, 218; pl. 50, figs. 1, 3; pl. 51, fig. 12  
*cowlitzensis*, 215; pl. 49, fig. 16  
*hornii*, 215, 216, 218; pl. 50, fig. 13; pl. 51, fig. 3  
*subsp. umpquaensis*, 218; pl. 50, fig. 10; pl. 51, fig. 9  
*martini*, 215; pl. 49, fig. 17  
*obscura*, 217; pl. 50, fig. 7  
*olequaensis*, 216; pl. 52, figs. 1, 2  
*vulgaris*, 215  
*gastonensis*, *Pachydesma*, 189; pl. 44, fig. 17; pl. 51, fig. 1
- GASTROPODA**, 279-553
- Gemmula**, 523  
*barksdalei*, 523, 758; pl. 97, figs. 20, 21  
*fasteni*, 524; pl. 97, figs. 17, 22, 23
- generosa**, *Panope*, 261, 262, 263; pl. 60, figs. 2, 4
- geniculus**, *Fusinus (Priscofusus)*, 482, 484; pl. 92, fig. 10
- geometrica**, *Acmaea*, 279; pl. 62, fig. 4
- gesteri**, *Fusinus*, 479, 480; pl. 91, figs. 19, 20
- Polinices (Polinices)**, 336; pl. 68, fig. 19

- gettysburgensis, *Acila* (*Acila*), 32; pl. 7, figs. 1, 2, 3, 4; pl. 8, fig. 1
- gibsonensis*, *Tellina*, 200; pl. 52, fig. 5
- glidensis*, *Turritella andersoni* subsp., 365; pl. 73, fig. 11
- globosa*, *Polinices* (*Neverita*), 339; pl. 68, figs. 21, 24; pl. 69, figs. 5, 6; pl. 100, fig. 29
- Globularia hannibali*, 349
- Glycymeris*, 54
- andersoni*, 59; pl. 10, figs. 5, 11
  - chehalensis*, 61; pl. 10, figs. 9, 10
  - conradi*, 63
  - crescentensis*, 58; pl. 10, figs. 20, 21; pl. 11, fig. 12; pl. 38, fig. 10
  - eocenica*, 56, 57; pl. 10, figs. 2, 3, 8
  - var. *tejonensis*, 57; pl. 10, fig. 12
  - fresnoensis*, 59; pl. 11, fig. 11
  - gabbi*, 62; pl. 10, fig. 18
  - grewingki*, 62, 65; pl. 10, fig. 19
  - hannibali*, 55
  - kelsoensis*, 56
  - larvata*, 62, 63; pl. 10, fig. 16
  - migueliana*, 60
  - perrini*, 58, 64; pl. 11, fig. 17; pl. 12, fig. 2
  - sagittata*, 54, 55, 56; pl. 9, figs. 17, 18; pl. 11, fig. 15
  - var. *dickersoni*, 55, 59; pl. 11, figs. 9, 10, 13, 14
  - var. *kelsoensis*, 56; pl. 10, fig. 1; pl. 11, fig. 16
  - tenuimbricata*, 63, 65; pl. 12, fig. 1
  - vancouverensis*, 60; pl. 10, figs. 4, 7, 15
  - winlockensis*, 61; pl. 10, figs. 6, 13
  - wishkahensis*, 60, 61, 65; pl. 10, figs. 14, 17
- GONIPLACIDAE**, 553-554
- Goniobasis*, 375, 376
- coombai*, 375, 376, 758; pl. 75, figs. 6, 7, 11, 12
  - drakei*, 376; pl. 75, fig. 13
  - hannibali*, 375, 377; pl. 75, figs. 8, 9, 10
  - kettlemanensis*, 378
  - olequaensis*, 375, 376, 377; pl. 75, fig. 14
  - olequaensis hannibali*, 375
  - olequaensis olequaensis*, 377
  - olequaensis*, 375, 376, 377
  - sookensis*, 377; pl. 75, figs. 16, 17
- goodspeedi*, *Argobuccinum*, 421; pl. 83, figs. 9, 10, 11
- Spisula* (*Mactromeris*) *albaria* subsp., 243; pl. 56, fig. 7
- gorrelli*, *Palchomola*, 556
- grandior*, *Aturia angustata* subsp., 552; pl. 102, figs. 8, 9
- Graptocarcinus*, 556
- sp.*, 556
- grewingki*, *Glycymeris*, 62, 65; pl. 10, fig. 19
- griesensis*, *Odostomia*, 308; pl. 64, figs. 26, 27, 28
- Ostrea*, 81; pl. 15, figs. 1, 2
- Taras*, 150; pl. 35, figs. 7, 14
- grunskyi*, *Chama*, 151; pl. 35, figs. 9, 10, 13
- Pecten* (*Chlamys*), 84; pl. 14, fig. 5
- Gyrineum*, 422
- var. *corbiculatum*, 424; pl. 84, figs. 1, 3
  - goodspeedi*, 421
  - kewi*, 423; pl. 83, fig. 14
- Gyrineum*—continued
- mackini*, 424, 758; pl. 84, figs. 2, 9
  - mediocre*, 423, 424; pl. 83, fig. 13
  - var. *corbiculatum*, 424
  - sylviaensis*, 422
- Gyroscala*, 310
- H**
- hadlockense*, *Epitonium* (*Boreoscala*) *condoni* var., 315, 316; pl. 66, fig. 3
- Haminea petrosa*, 549
- Haminoea*, 549
- petrosa*, 549; pl. 100, figs. 16, 17, 18, 19, 23
  - hannai*, *Sistrum*, 450; pl. 87, figs. 14, 16
  - Venericardia*, 138, 139; pl. 33, figs. 3, 4, 8, 10
  - hannibalanus*, *Pilumnoplax*, 554
  - hannibali*, *Acmaea*, 280; pl. 62, fig. 18
  - Cernina* (*Eocernina*), 348; pl. 71, figs. 8, 9, 21, 23
  - Fusinus* (*Priscofusus*), 484; pl. 93, figs. 1, 2, 5
  - Goniobasis*, 375, 377; pl. 75, figs. 8, 9, 10
  - Lucina*, 144, 145; pl. 34, figs. 9, 10, 12, 18
  - Mytilus*, 104; pl. 23, fig. 9
  - Nucula*, 34; pl. 6, fig. 14; pl. 7, figs. 19, 20
  - Spisula* (*Hemimactra*), 238; pl. 56, figs. 2, 6, 9
  - Urosalpinx*, 453, 454; pl. 88, fig. 14
  - Venericardia*, 138, 139; pl. 33, figs. 11, 14
- Harpa*, 498
- clarkii*, 499
  - crescentensis*, 498; pl. 95, figs. 12, 13
  - mutica californiensis*, 499
- HARPIDAЕ**, 498-499
- Helix* *haliotoides*, 349
- margarita*, 290
  - vivipara*, 360
- Hemifusus arnoldi*, 535
- cowlitzensis*, 399
  - lewisiana*, 449
  - lincolensis*, 476
  - remondii*, 398
  - sopenahensis*, 437
  - tejonensis*, 453
  - washingtoniana*, 475
  - washingtonianus*, 473
- Hemimactra*, 237
- Hemipleurotoma*, 525
- borgenae*, 525; pl. 98, fig. 9
  - pullchra*, 525; pl. 97, figs. 26, 27, 28
- Hemithyridia*, 12
- sp. A., 12; pl. 2, figs. 12, 13, 14, 15, 17
  - astoriana*, 12; pl. 1, fig. 12
  - psittacea*, 12
  - sp. 13; pl. 2, fig. 7
- hendersonianus*, *Zanthopsis*, 554
- hendoni*, *Amaurellina*, 345; pl. 70, figs. 12, 13, 16, 17
- hiltoni*, *Odostomia*, 307; pl. 64, figs. 18, 19, 29
- HIPPONICIDAE**, 355
- Hipponix*, 355
- arnoldi*, 355; pl. 72, fig. 8
  - var. *ornata*, 355; pl. 72, fig. 11
  - ornata*, 355

- H**omalopoma, 297  
 pacifica, 297, 298; pl. 63, figs. 16, 19  
 sp., 299  
 umpquaensis, 299; pl. 64, figs. 20, 21  
 vancouverensis, 299; pl. 63, figs. 5, 12  
 wattsi, 298, 299; pl. 64, figs. 11, 14
- HOMOLDAE**, 556  
*hornii* var. *umpquaensis*, *Conus*, 510; pl. 96, fig. 18  
*Corbula*, 257, 258; pl. 59, figs. 7, 17; pl. 61, fig. 5  
*Gari*, 215, 216, 218; pl. 50, fig. 13, pl. 51, fig. 3  
*Polinices* (*Polinices*) 335; pl. 68, figs. 1, 2, 3; pl. 100, fig. 28  
*Venericardia*, subspecies of, 134, 135  
*hotsoni*, *Polinices* (*Polinices*), 338; pl. 69, figs. 1, 2  
*howardi*, *Cerithiopsis*, 385; pl. 76, fig. 10  
*Sanguinolaria*, 219; pl. 50, fig. 11  
*howei*, *Epitonium* (*Cirsotrema*), 312; pl. 65, fig. 8  
*Myadesma*, 251; pl. 58, fig. 2  
*Hyalina* (*Cystiscus*) *instabilata*, 494  
*Hydrobia*, 362  
*ponatis*, 362; pl. 73, fig. 6
- I**
- iani*, *Phalium* (*Bezoardica*), 411; pl. 81, fig. 5  
*idriaensis*, *Ostrea*, 78; pl. 15, fig. 5  
*impecunia*, *Antiplanes*, 518; pl. 97, fig. 11  
*imperialis*, *Thais*, 448; pl. 88, fig. 3  
*impressa*, *Nuculana*, 42; pl. 4, figs. 9, 10; pl. 8, fig. 31  
*inaequalis*, *Astraea* (*Pachypoma*), 297; pl. 63, figs. 2, 24  
*indentata* subsp. *flagleri*, *Macoma*, 211; pl. 49, fig. 10  
*indurata*, *Miopleiona*, 491; pl. 94, figs. 5, 8, 13  
*inezana*, *Polinices* (*Neverita*), 342; pl. 70, fig. 15; pl. 101, figs. 7, 8, 9, 11  
*inornata*, *Calyptraea*, 354; pl. 72, figs. 2, 6; pl. 103, fig. 16  
*Pododesmus*, 100, 101; pl. 104, figs. 8, 14  
*inquinata* var. *arnheimi*, *Macoma*, 214; pl. 49, fig. 13  
*insculpta*, *Portunites*, 555  
*insecuritum*, *Epitonium* (*Boreoscala*), 313; pl. 65, fig. 11; pl. 67, figs. 10, 11  
*instabilata*, *Marginella*, 494; pl. 94, fig. 3; pl. 95, figs. 26, 27
- J**
- janerobertsae*, *Epitonium* (*Boreoscala*) *condoni* subsp., 318; pl. 66, figs. 6, 15  
*japonica*, *Mya arenaria* var., 253; pl. 59, fig. 18  
*jollaensis*, *Tellina*, 197; pl. 48, fig. 3  
*jugularis*, *Scaphander*, 546; pl. 100, fig. 7
- K**
- kamakawaensis*, *Tellina*, 201; pl. 48, fig. 7; pl. 51, fig. 7  
*karquinezensis* cf., *Thracia*, 119, 120; pl. 25, fig. 19; pl. 26, fig. 5  
*Katherinella*, 185  
*keaseyense*, *Epitonium* (*Boreoscala*), 319; pl. 66, fig. 12  
*Kellia twinensis*, 151; pl. 35, fig. 8
- kelsoensis*, *Glycymeris sagittata* var., 56; pl. 10, fig. 1; pl. 11, fig. 16  
*Volsella*, 112; pl. 24, fig. 1  
*kernensis*, *Pseudomelatoma*, 536; pl. 99, figs. 5, 6  
*kewi*, *Gyrineum*, 423; pl. 83, fig. 14  
*kincaidi*, *Solariella*, 294; pl. 63, fig. 29  
*Spirotropis*, 522; pl. 97, figs. 18, 19, 25  
*Tellina*, 203, 204; pl. 48, fig. 16  
*kirbyi*, *Pseudoliva*, 457; pl. 89, fig. 7  
*knapptonensis*, *Callianassa*, 558
- L**
- Laevicardium* (*Cerastoderma*) *corbis* var. *coosense*, 158  
 (*Cerastoderma*) *meekianum*, 156  
*lahondaensis* var. *stantoni*, *Tegula* (*Chlorostoma*), 290; pl. 62, figs. 13, 15  
*Lamelliconcha*, 183  
*lamellosa*, *Thais*, 447; pl. 88, fig. 7  
*landesi*, *Barbatia* (*Obliquarca*), 68, 69; pl. 12, fig. 18  
*Cancellaria*, 502; pl. 95, figs. 14, 24  
*Neptunea*, 427; pl. 84, figs. 7, 12  
*Pecten* (*Chlamys*), 82, 83n.; pl. 14, figs. 4, 6, 7  
*Pseudocardium* 248; pl. 60, figs. 5, 8  
*lanensis*, *Calappa*, 555  
*Laqueus*, 17  
*californicus*, 17  
 var. *vancouverensis*, 17  
 aff. *vancouverensis*, 17; pl. 2, figs. 5, 6  
*larvata*, *Glycymeris*, 62, 63; pl. 10, fig. 16  
*Latirus*, 433, 472  
*auranticus*, 472  
*cocenica*, 472, 473; pl. 89, figs. 21, 27; pl. 90, figs. 13, 20, 22; pl. 103, fig. 13  
*(Peristernia) cocenica*, 472  
*roseburgensis*, 473; pl. 90, figs. 21, 28  
*Leda acuta*, 43  
*alaformis*, 37  
*alkiensis*, 40  
*chhalensis*, 39  
*cowlitzensis*, 36  
*fresnoensis*, 41  
*gabbi*, 37  
*lincolnensis*, 38  
*merriami*, 37  
*oregona*, 49  
*subimpressa*, 42  
*vaderensis*, 37  
*washingtonensis*, 38  
*whitmani*, 44  
*willamettensis*, 41
- Leptothyra vancouverensis*, 299  
*lettana*, *Alvania*, 362; pl. 73, figs. 10, 15, 16, 17, 18, 19
- LEUCOSTIIDAE**, 555  
*Leucosyrinx clallamensis*, 516  
*clallamensis wardi*, 516  
*lewisiana*, *Parvisipho*, 440; pl. 86, fig. 16  
*Potamides*, 379; pl. 75, fig. 23  
*lewisiatus*, *Raninooides*, 557  
*lima*, *Thais*, 446; pl. 87, figs. 12, 13

- Lima, 97**  
**bella, 97, 98; pl. 21, fig. 3**  
**oakvillensis, 98; pl. 21, fig. 1; pl. 22, fig. 7**  
**(Radula) oakvillensis, 98**  
**oregonensis, 99; pl. 22, figs. 2, 6**  
**(*Plagiostoma*) *oregonensis*, 99**  
**packardi, 99; pl. 23, fig. 15**
- LIMIDAE, 97-99**
- LIMNAEIIDAE, 551-553**
- Limnoria, borings of, 4**
- LIMOPSIDAE, 75-77**
- Limopsis, 75**  
**carmanahensis, 75; pl. 13, figs. 12, 14**  
**nitens, 75; pl. 13, fig. 15**
- lincolnensis, Acrilla (*Ferminoscala*), 326; pl. 67, fig. 6**
- Crassatellites, 128; pl. 26, figs. 9, 11, 14, 15; pl. 29, figs. 10, 11; pl. 30, fig. 3**
- Exilia, 514, 515; pl. 96, fig. 30**
- Fusinus (*Priscofusus*), 487; pl. 93, figs. 8, 9**
- Molopophorus, 467; pl. 90, fig. 7**
- Nassarius, 462; pl. 89, fig. 25**
- Nemocardium, 161; pl. 36, fig. 6**
- Neptunea, 431**
- Olequahia, 426; pl. 84, figs. 4, 5, 13**
- Ostrea, 80, 81; pl. 14, figs. 1, 2, 3**
- Solen, 225, 226; pl. 53, figs. 2, 4, 5, 6**
- Tellina, 199; pl. 48, fig. 2**
- Whitneyella, 476; pl. 91, figs. 6, 13, 14; pl. 103, fig. 20**
- linteum, Nemocardium, 159; pl. 38, fig. 3**
- Liomesus, 431**  
**sulculatus, 432; pl. 85, figs. 6, 7**
- Liotia, 301**  
**weaveri, 301; pl. 63, figs. 13, 18**
- Lirularia, 290**
- Littorina, 328**  
**mountsoloensis, 328, 330**  
**oligocenica, 328; pl. 63, fig. 22; pl. 67, fig. 19**  
**petricola, 329; pl. 67, fig. 20**  
**sookensis, 329; pl. 67, figs. 23, 24, 29**
- LITTORINIDAE, 328-330**
- Ionsdalei, Molopophorus californicus subsp., 464; pl. 89, fig. 28**
- Lora, 519**  
**miona, 519**  
**tabulata, 519; pl. 97, fig. 12**
- lorenzanum, Nemocardium, 160; pl. 35, fig. 22; pl. 36, figs. 3, 5**
- lorenzoensis subsp. arnoldi, Macoma, 207; pl. 48, fig. 19**
- Loripes parilis, 149**
- Loxocardium, 153**  
**(Schedocardia) brewerii, 153, 154; pl. 35, figs. 15, 16, 18; pl. 38, figs. 1, 9; pl. 104, fig. 12**  
**var. oldroydi, 154; pl. 36, fig. 7; pl. 38, figs. 2, 12**  
**(Schedocardia) etheringtoni, 155, 156; pl. 35, fig. 21**  
**(Schedocardia) olequahensis, 155, 156; pl. 36, fig. 11**
- Loxotrema, 374**  
**turrita, 374; pl. 75, figs. 1, 2, 3; pl. 103, fig. 18**
- Lucina, 143**  
**acutilineata, 143, 145; pl. 34, figs. 8, 11, 16**  
**(*Myrtea*) *acutilineata*, 143**  
**annulatus, 145**  
**(Here) aragoensis, 146; pl. 27, fig. 15; pl. 35, fig. 12; pl. 38, fig. 4**  
**columbiana, 145; pl. 34, figs. 13, 14, 15, 17**  
**contracta, 144**  
**(Here) dalli, 146; pl. 35, fig. 5**  
**hannibali, 144, 145; pl. 34, figs. 9, 10, 12, 18**  
**meganosensis, 147**  
**muirensis, 148; pl. 27, fig. 12; pl. 35, fig. 1**  
**packi, 137; pl. 34, fig. 19; pl. 38, fig. 13**  
**parilis, 42**  
**roseburgensis, 147; pl. 27, fig. 11; pl. 35, figs. 3, 4**  
**washingtonensis, 147, 148; pl. 27, fig. 16; pl. 35, fig. 2**
- LUCINIDAE, 143-149**
- Lunaria cowlitzensis, 343**  
**hornii, 335, 336**  
**nuciformis, 342**  
**oregonensis, 331**  
**pallida, 331**  
**lutmani, Venericardia hornii subsp., 135; pl. 28, fig. 1; pl. 32, fig. 1**
- Lutraria (*Cryptodon*) *nuttallii*, 249**
- Lyria, 495**  
**andersoni, 495, 496; pl. 95, figs. 2, 3, 7, 28, 29**  
**coquillensis, 495, 496; pl. 95, figs. 1, 4**
- M**
- macilenta subsp. oregonensis, Ectinochilus (Macilento), 392; pl. 76, figs. 25, 26, 27**
- Macilento, 392**
- mackini, Gyreneum, 424, 758; pl. 84, figs. 2, 9**
- Macoma, 206**  
**andersoni, 211; pl. 49, fig. 9; pl. 52, fig. 7**  
**arctata, 206, 208, 212; pl. 49, figs. 3, 5, 12; pl. 59, fig. 15**  
**arctata var. wynoocheensis, 208, 209; pl. 49, fig. 8**  
**(*Psammacoma*) *arctata*, 208, 209**  
**astori, 213; pl. 49, fig. 14**  
**calcarea, 206, 212; pl. 49, fig. 11**  
**edentula, 213**  
**indentata, 211**  
**subsp. flagleri, 211; pl. 49, fig. 10**  
**(*Rexithacrus*) *indentata* *flagleri*, 211**  
**inquinata, 214**  
**var. arnheimi, 214; pl. 49, fig. 13**  
**lorenzoensis, 207, 208, 210**  
**subsp. arnoldi, 207; pl. 48, fig. 19**  
**molinana, 212; pl. 49, fig. 15**  
**montesanoensis, 209; pl. 49, fig. 18**  
**nasuta, 207, 212, 213**  
**snohomishensis, 208; pl. 49, fig. 2**  
**sookensis, 207, 252; pl. 49, fig. 4**  
**tenera, 206**  
**twinensis, 210; pl. 49, figs. 6, 7; pl. 55, fig. 1**  
**wynoocheensis, 209**

- Macrocallista**, 174  
*andersoni*, 174; pl. 40, figs. 4, 5, 6, 12, 14; pl. 46, fig. 14  
*cathcartensis*, 176, 177; pl. 40, figs. 7, 8, 9, 11  
*(Costacallista) conradiana*, 172  
 var. *meganosensis*, 173  
*hornii*, 179  
*meganosensis*, 173  
*newcombei*, 193  
*pittsburghensis*, 175, 176; pl. 32, fig. 7; pl. 41, figs. 4, 7, 10, 14  
*vaderensis*, 187  
*weaveri*, 176; pl. 41, figs. 1, 2, 3  
*williamsoni*, 173, 174; pl. 39, fig. 12; pl. 43, fig. 6
- Mactra** (*Spisula*) *albaria*, 239  
 (*Spisula*) *arnoldi*, 240  
*exoleta*, 248  
*hemphilli*, 248  
*packardi*, 231
- MACTRACEA**, 231-266
- MACTRIDAE**, 231-243
- Mactromeris**, 239
- Malletia**, 52  
*abrupta*, 52, 53  
*chehalensis*, 45  
*chilensis*, 52  
*pacifica*, 53  
*packardi*, 44
- mammillaris* subsp. *vancouverensis*, *Calyptraea*, 353, 354; pl. 72, figs. 5, 7
- Mangilia tabulata*, 519
- Mangilia kernensis*, 536
- Marcia**, 190  
*angustifrons*, 191; pl. 45, figs. 1, 2, 3, 4  
 var. *brevilineata*, 191; pl. 45, fig. 7  
*(Mercimonia) angustifrons*, 191  
*(Mercimonia) bunkeri*, 183, 192; pl. 45, fig. 5; pl. 47, figs. 8, 11  
*oregonensis*, 191  
*quadrata*, 180
- marcusana*, *Mursia*, 556
- Margarita** (*Turcicula*) *imperialis*, 291  
*lirulata*, 290
- Margarites**, 290  
*(Lirularia) condoni*, 290; pl. 62, figs. 17, 19  
*lirulatus*, 291  
*pupillus*, 291
- Marginella**, 493  
*instabilata*, 494; pl. 94, fig. 3; pl. 95, figs. 26, 27  
*pacifica*, 494  
*shepardae*, 494, pl. 94, fig. 1
- MARGINELLIDAE**, 493-496
- markleyensis*, *Whitneyella*, 477, 478; pl. 82, figs. 14, 16; pl. 91, fig. 15
- martini**, *Eucrate*, 554  
*Gari*, 215; pl. 49, fig. 17  
*Neritina*, 296; pl. 63, fig. 10
- Mathilda**, 309  
*umpquaensis*, 309; pl. 64, figs. 34, 35
- mathewi**, *Molopophorus anglonana* var., 471; pl. 90, figs. 17, 19
- mathewsonii*, *Crassatellites uvasana* subsp., 125; pl. 26, fig. 8; pl. 29, fig. 4; pl. 61, fig. 18
- Argobuccinum*, 420, 421; pl. 83, figs. 3, 4
- Mytilus* (*Mytiloconcha*), 102, 103, 106; pl. 23, figs. 1, 10
- Olivella*, 500; pl. 103, fig. 7
- Surculites**, 526; pl. 97, figs. 24, 29; pl. 98, figs. 1, 5
- maximus*, *Brisaster*, 11; pl. 4, fig. 5
- mcgonigleensis*, *Anomia*, 100; pl. 22, figs. 4, 5
- mcellani*, *Exilia*, 515; pl. 97, fig. 1
- mea*, *Calliostoma*, 286, 287; pl. 62, fig. 12
- medialis*, *Fusinus* (*Priscofusus*), 483; pl. 93, fig. 7
- mediocre*, *Gyrineum*, 423, 424; pl. 83, fig. 13
- meekianum*, *Cerastoderma*, 156, 158
- meganosensis*, *Microcallista* (*Costacallista*) *conradiana* var., 173; pl. 41, fig. 9; pl. 55, fig. 4
- Megasurcula**, 527  
*carpenteriana*, 527, 529; pl. 98, fig. 7; pl. 103, fig. 8  
*condonana*, 530; pl. 98, figs. 4, 10, 12  
*cooperi*, 527  
*etheringtoni*, 530; pl. 98, fig. 13; pl. 101, fig. 10  
*gabbiana*, 529; pl. 98, fig. 3  
*remondii*, 528; pl. 98, fig. 6  
*wynoocheensis*, 527; pl. 98, figs. 2, 8
- Megathura**, 285  
*californica*, 285  
*crenulata*, 285  
*vancouverensis*, 285; pl. 62, figs. 5, 9
- Megistostoma**, 541  
*caminoensis*, 541; pl. 99, fig. 24  
*gabbianum*, 541
- Melanella**, 302  
*clarki*, 302, 303; pl. 63, fig. 6  
*dilleri*, 303; pl. 63, fig. 7  
*dufresnii*, 302  
*oldroydi*, 302  
*sp.*, 302
- MELANELLIDAE**, 302-304
- Melania** *olivula*, 375  
*packardi*, 380  
*vaderensis*, 381
- MELANIIDAE** (see *Thiaridae*), 374
- Mercimonia bunkeri*, 192
- Meretrix californiana*, 177  
*gabbi*, 194  
*hornii*, 179  
*olequahensis*, 130  
*pittsburghensis*, 175, 176  
*tejonensis*, 178  
*uvasana*, 178
- merriami*, *Arca* (*Arca*), 66; pl. 11, fig. 8; pl. 12, figs. 3, 6, 7, 8, 9, 12, 15
- Cantharus*, 434; pl. 85, figs. 9, 13
- Cerithiopsis*, 384; pl. 76, fig. 6
- Crassatellites*, 123; pl. 104, figs. 4, 5
- Fusinus*, 479; pl. 91, figs. 16, 17
- Nuculana*, 36, 37; pl. 8, figs. 21, 30
- Spisula*, 233; pl. 52, figs. 11, 12; pl. 54, fig. 10
- Tellina*, 203, 204; pl. 51, figs. 4, 8; pl. 60, figs. 9, 11
- Mesalia lincolnensis*, 326

- MESODESMATIDAE, 243-255**
- Metis alta*, 221  
*vancouverensis*, 221
- Metula remondii*, 528
- Microcallista*, 172  
*(Costacallista) conradiana*, 172, 173, 174; pl. 41, figs. 5, 6; pl. 46, fig. 11; pl. 104, fig. 13  
*var. meganensis*, 173; pl. 41, fig. 9; pl. 55, fig. 4
- microdonta*, *Anadara*, 72; pl. 12, fig. 14
- miocenica*, *Searlesia dira* subsp., 441; pl. 86, figs. 17, 18
- Miopleiona*, 491  
*indurata*, 491, 492, 493; pl. 94, figs. 5, 8, 13  
*oregonensis*, 492; pl. 94, fig. 12  
*weaveri*, 491, 492; pl. 94, figs. 6, 10, 11
- mitra* subsp. *sookensis*, *Acmaea*, 281; pl. 62, fig. 3
- Mitra*, 496  
*cretacea*, 497  
*var. 497*; pl. 95, figs. 5, 6  
*douglasensis*, 497; pl. 95, figs. 10, 11  
*tessellata*, 496  
*washingtoniana*, 497; pl. 95, figs. 8, 9, 16
- MITRIDAE, 496-498**
- modestus*, *Ficus*, 395, 397, 398; pl. 77, fig. 1; pl. 103, fig. 1
- Modiola ornata*, 107
- Modiolus columbianus*, 112  
*(Brachydontes) cowlitzenensis*, 113  
*directus*, 108  
*eugenensis*, 111  
*inflatus*, 110  
*kelsoensis*, 112, 113  
*(Brachydontes) olequahensis*, 114  
*porterensis*, 111  
*pugetensis*, 109  
*restorationensis*, 109  
*sookensis*, 110  
*sulcata*, 113  
*trinominata*, 110
- molinana*, *Macoma*, 212; pl. 49, fig. 15
- MOLLUSCA, 18-551**
- MOLLUSCOIDEA, 12-18**
- Molopophorus*, 463  
*anglonana*, 470, 471; pl. 90, figs. 14, 15, 16, 18, 23  
*var. mathewi*, 471; pl. 90, figs. 17, 19  
*antiquatus*, 463; pl. 89, figs. 31, 32; pl. 103, fig. 12  
*biplicatus* var. *quadranodosum*, 469  
*bramkampi*, 465  
*bretzi*, 464, 466; pl. 89, fig. 22  
*californicus*, 464  
*subsp. lonsdalei*, 464; pl. 89, fig. 28  
*clarki*, 468, 470, 471; pl. 90, fig. 12  
*dalli*, 466, 469; pl. 90, fig. 8  
*effingeri*, 465; pl. 90, figs. 2, 3  
*fishii*, 468, 470, 471; pl. 90, figs. 9, 10, 11  
*gabbi*, 466, 469; pl. 90, figs. 4, 6  
*lincolnensis*, 467; pl. 90, fig. 7  
*newcombei*, 467; pl. 90, fig. 5  
*stephensi*, 465; pl. 90, fig. 1
- Monoceros engonatum*, 432
- Monodonta wattsi*, 298, 299
- monospina*, *Siphonalia bicarinata* subsp., 436; pl. 85, figs. 10, 14
- montereyana*, *Anadara* (*Anadara*) *devincta* var., 72, 73, 74; pl. 13, figs. 1, 5
- montesanoana*, *Anadara* (*Anadara*) *devincta* var., 74; pl. 13, fig. 10
- montesanoensis*, *Chione*, 166; pl. 38, fig. 11
- Fusinus*, 481; pl. 91, fig. 24
- Macoma*, 209; pl. 49, fig. 18
- Semele*, 224; pl. 52, fig. 8
- moodyi*, *Acteon*, 542; pl. 99, figs. 32, 33
- Morio tuberculatus*, 404  
*var. tri-tuberculatus*, 404, 405
- morsei*, *Barbatia* (*Obliquarca*) 69; pl. 12, fig. 4
- mountsoloensis*, *Littorina*, 328, 330
- muirensis*, *Lucina*, 148; pl. 27, fig. 12; pl. 35, fig. 1
- Thesbia*, 539, 540; pl. 99, figs. 17, 18, 19
- Mulinia densata*, 244  
*eugenensis*, 244  
*newcombei*, 247  
*olympica*, 248  
*oregonensis*, 246  
*undilifera*, 247  
*yaquinensis*, 245
- Murex, 454**
- argus*, 417  
*calamitus*, 457; pl. 89, figs. 8, 9
- colus*, 479
- coosensis*, 454; pl. 88, fig. 19  
*(Alipupura) coosensis*, 454
- cowlitzenensis*, 455; pl. 88, figs. 9, 15
- femorale*, 412
- gyrinus*, 422
- packardi*, 455; pl. 88, figs. 17, 18
- reticulatus*, 386
- sopenahensis*, 456; pl. 88, fig. 16; pl. 89, figs. 3, 4
- tribulus*, 454
- tubercularis*, 381
- vaughani*, 457
- MURICIDAE, 451-457**
- Mursia, 556**
- marcusana*, 556  
*yaquinensis*, 556
- Mya, 253**
- abrupta*, 262  
*arenaria*, 253  
*var. japonica*, 253; pl. 59, fig. 18  
*(Mya) arenaria* var. *japonica*, 253  
*(Antiguamyia) arnoldi*, 254, 258; pl. 59, figs. 2, 6, 14
- (Platydon) cancellata*, 250
- glycimeris*, 261
- intermedia*, 253
- japonica*, 253
- nitens*, 243
- pernula*, 36
- truncata*, 253, 253; pl. 59, fig. 12
- Myadesma, 250**
- dalli*, 250; pl. 58, figs. 4, 7, 8; pl. 61, figs. 6, 11
- howei*, 251; pl. 58, fig. 2
- MYTILACEA, 102-117**

**MYTILIDAE**, 102-116**Mytilus**, 102

- bifurcatus, 107
- bilocularis, 114
- buwaldana, 104; pl. 23, fig. 7; pl. 26, fig. 1
- californicus, 103
- decussatus, 115
- dichotomus, 107; pl. 23, fig. 14; pl. 26, fig. 10
- edulis, 102, 104
- fucus, 103; pl. 23, fig. 11
- hannibali, 104; pl. 23, fig. 9
- hirunda, 77
- inezensis, 107
- (Mytiloconcha) mathewsonii, 102, 103, 106; pl. 23, figs. 1, 10
- modiolus, 108
- sammamishensis, 102; pl. 25, fig. 12; pl. 26, fig. 6
- snohomishensis, 102; pl. 23, fig. 8; pl. 26, fig. 3
- stillaguamishensis, 103; pl. 23, fig. 12
- stillwaterensis, 107; pl. 25, fig. 13; pl. 26, fig. 2
- (Mytiloconcha) vancouverensis, 105; pl. 24, fig. 4; pl. 25, fig. 8
- washingtonensis, 105; pl. 23, fig. 4
- watersi, 106; pl. 25, fig. 11

**N****naselensis**, *Eumorphocystes*, 558**Nassa** *andersoni*, 461

- antiquata*, 463
- arnoldi*, 461
- chehalensis*, 463
- eocenica*, 472
- lincolnensis*, 462
- newcombei*, 467
- perpenquisi*, 461
- sp., 467

**NASSARIIDAE**, 461**Nassarius**, 461

- andersoni*, 461; pl. 89, figs. 15, 16, 17, 18
- (*Hima*) *andersoni*, 461
- arnoldi*, 461, 462; pl. 89, fig. 14
- (*Hima*) *arnoldi*, 461
- (*Uxita*) *arnoldi*, 461
- lincolnensis*, 462; pl. 89, fig. 25

**nasuta**, *Macoma*, 207, 212, 213**Natica**, 330

- (*Tectonatica*) *clarki*, 332; pl. 67, fig. 25
- closa*, 330
- (*Cryptonatica*) *consors*, 330, 333
- (*Natica*) *dalli*, 331, 333
- (*Tectonatica*) *dalli*, 330; pl. 67, fig. 30
- elongata*, 344
- fluctuata*, 348
- gesteri*, 336
- glaucoinoides*, 342
- hannibali*, 348, 348
- (*Cryptonatica*) *hannibali*, 348
- helicoidea*, 347
- inezana*, 342
- lincolnensis*, 337, 337

**Natica**—continued

- multipunctata* var. *consors*, 331
- (*Tectonatica*) *oligocenica*, 334; pl. 67, fig. 28
- (*Tectonatica*) *oregonensis*, 331, 337; pl. 100, fig. 27
- recluziana*, 341
- (*Tectonatica*) *saxea*, 332; pl. 68, fig. 4
- tectula*, 330
- (*Tectonatica*) *teglandae*, 333; pl. 68, figs. 5, 6, 7
- washingtonensis*, 337
- (*Natica*) cf. *weaveri*, 333
- (*Natica*) *weaveri*, 333
- (*Tectonatica*) *weaveri*, 333; pl. 68, figs. 8, 9, 13

**NATICIDAE**, 330-351**Naticina** *obliqua*, 350**NAUTILOIDEA**, 551-553**Nautilus** *angustatus*, 551

- lacustris, 551

**Neoera** *gouldiana*, 122**neahensis**, *Pecten* (*Plagioctenium*), 90; pl. 17, fig. 2**nehaleensis**, *Acila* (*Truncacilia*), 24; pl. 6, fig. 9

- Thais*, 449, 450; pl. 88, figs. 1, 2

**Neilo** *abrupta*, 52

- oregona*, 49

**Nekewis**, 531

- nehaleensis*, 449n.

- washingtoniana*, 531; pl. 98, figs. 11, 18; pl. 103, fig. 11

**nelsoni**, *Acila* (*Truncacilia*), 27; pl. 6, fig. 5; pl. 7, fig. 21**Nemocardium**, 159

- eugenense*, 162; pl. 36, fig. 10
- lincolnensis*, 156, 161, 162; pl. 36, fig. 6
- linteum*, 159; pl. 38, fig. 3
- lorenzanum*, 160; pl. 35, fig. 22; pl. 36, figs. 3, 5
- weaveri*, 161; pl. 36, figs. 1, 2

**NEOTREMATA**, 14-18**Neptunea**, 427

- bairdii*, 429; pl. 85, figs. 2, 3
- callamensis*, 429
- (*Neptunea*) *clarki*, 427
- diminuta*, 428; pl. 85, fig. 1
- landesi*, 427; pl. 84, figs. 7, 12
- lincolnensis*, 431
- maxfieldi*, 448
- packardi*, 430
- postplanata*, 430; pl. 85, fig. 12
- (*Sulcosiphon*) *postplanata*, 430
- tabulatus*, 429
- teglandae*, 427, 428, 758; pl. 84, figs. 8, 14

**NEPTUNEIDAE**, 427-446**Nerita**, 294

- cowlitzensis*, 294, 295; pl. 63, fig. 11
- exuvia*, 294
- littoralis*, 328
- pulliger*, 296
- triangulata*, 295
- var. *oregonensis*, 295; pl. 64, figs. 10, 13
- vitellus*, 330
- washingtoniana*, 295; pl. 64, fig. 8

**NERITIDAE**, 294-296

- Neritina, 296**
- martini, 296; pl. 63, fig. 10*
  - nevadanus var. fucanus, Pecten (Vertipecten), 87; pl. 19, fig. 7; pl. 20, fig. 1*
  - Neverita, 339**
    - globosa, 339*
    - inezana, 342*
    - josephina, 339*
    - nomlandi, 340*
    - secta, 341*
    - weaveri, 340, 341*  - newberryi, Batissa, 133, 134; pl. 31, fig. 6*
  - newcombei, Cerithiopsis, 384; pl. 76, fig. 7**
    - Echinarachnius, 6; pl. 3, figs. 5, 6*
    - Molopophorus, 467; pl. 90, fig. 5*
    - Pododesmus, 100; pl. 23, figs. 2, 3, 5*
    - Pseudocardium, 247; pl. 58, figs. 6, 9, 12*
    - Venerella (Compsomyax), 193; pl. 42, fig. 17; pl. 43, fig. 9; pl. 45, figs. 6, 8, 15, 17, 18*  - newcombi, Yoldia, 47; pl. 9, fig. 5**
  - nitens, Limopsis, 75; pl. 13, fig. 15**
  - nodiferus, Fusinus (Priscofusus), 483**
  - nomlandi, Polinices (Neverita), 340; pl. 69, figs. 8, 9, 12**
  - Nucella canaliculata, 446**
    - lima, 446*
    - quillayutea, 447*  - nuciformis, Polinices (Euspira), 342; pl. 70, figs. 1, 2; pl. 103, fig. 2**
  - var. cowlitzensis, Polinices (Euspira), 343; pl. 69, figs. 10, 11, 13, 14, 15, 16, 17, 18, 19**
  - Nucula, 34**
    - abrupta, 52*
    - acuta, 43*
    - arctica, 44*
    - castrensis, 22*
    - (Acila) castrensis, 29, 33*
    - conradi, 29*
    - (Acila) conradi, 25, 29, 31*
    - (Acila) cordata, 24*
    - cuneiformis, 35*
    - decisa, 22, 23, 25*
    - (Acila) decisa, 25, 26*
    - decussata, 35*
    - divaricata, 22, 29, 32*
    - gettysburgensis, 32*
    - (Acila) gettysburgensis, 32*
    - hannibali, 34; pl. 6, fig. 14; pl. 7, figs. 19, 20*
    - myalis, 44*
    - (Acila) nelsoni, 27*
    - (Acila) packardi, 26*
    - parkei, 38*
    - (Acila) pugetensis, 28*
    - (Acila) shumardi, 25, 26*
    - (Acila) stillwaterensis, 22*
    - townsendi, 35*
    - washingtonensis, 34, 35, 37, 41; pl. 8, figs. 3, 8*  - nuculana, Tellina, 205; pl. 48, fig. 21**
  - Nuculana, 36**
    - acuta, 43*
    - alkiensis, 40; pl. 8, fig. 13*

**Nuculana—continued**

    - astoriana, 42*
    - chehalensis, 39, 40; pl. 8, figs. 11, 15, 16, 17*
    - cowlitzensis, 36, 37; pl. 7, figs. 10, 18; pl. 8, figs. 27, 29*
    - fresnoensis, 41; pl. 7, figs. 15, 17, 22; pl. 8, figs. 14, 23, 24*
    - gabbi, 36, 37*
    - impressa, 42; pl. 4, figs. 9, 10; pl. 8, fig. 31*
    - merriami, 36, 37; pl. 8, figs. 21, 30*
    - ochsneri var. elmana, 39, 40; pl. 7, figs. 12, 13, 14; pl. 8, figs. 6, 7, 12, 19, 22*
    - oregona, 49*
    - parkei subsp. coosensis, 38; pl. 7, fig. 23; pl. 8, fig. 25*
    - vaderensis, 37; pl. 8, fig. 28*
    - washingtonensis, 38; pl. 8, figs. 18, 20, 26*
    - whitmani, 44; pl. 9, fig. 12*
    - willamettensis, 41*

**NUCULANIDAE, 36-53**

**NUCULIDAE, 22-36**

**nuncapatia, Borsonella, 523**

**nutallii var. pajaroanus, Schizothaerus, 249; pl. 58, fig. 10**

**Nyctilochus hornii, 417**

    - kewi, 423*
    - washingtoniana, 425*

**O**

**oakvillensis, Acmaea, 283; pl. 63, fig. 30, pl. 64, fig. 3**

**Cypraea, 394; pl. 76, figs. 29, 30**

**Lima, 98; pl. 21, fig. 1; pl. 22, fig. 7**

**Terebratulina, 14, 15; pl. 1, fig. 8**

**obispoana, Anadara (Anadara), 74; pl. 11, fig. 5; pl. 13, fig. 16; pl. 26, fig. 7**

**Obliquarca, 68**

**obliquum, Sinum, 350, 351; pl. 71, fig. 13; pl. 103, fig. 6**

**obruta, Tellina, 199, 205, 206; pl. 48, figs. 12, 13, 14, 15**

**obscura, Gari, 217; pl. 50, fig. 7**

**occidentalis, Terebratalia, 16; pl. 2, fig. 4**

**occidentis, Sinum, 351; pl. 71, fig. 15**

**ochsneri var. elmana, Nuculana, 39, 40; pl. 7, figs. 12, 13, 14; pl. 8, figs. 6, 7, 12, 19, 22**

**ocitatis, Acmaea, 279; pl. 62, fig. 6**

**ocoyana, Thesbia, 539; pl. 99, figs. 16, 21, 22, 23, 25**

**octoforis, Serpula, 3; pl. 1, fig. 13**

**Odostomia, 306**

    - griesensis, 308; pl. 64, figs. 26, 27, 28*
    - hiltoni, 307; pl. 64, figs. 18, 19, 29*
    - (Evalea) hiltoni, 307*
    - (Evalea) orfordensis, 309*
    - packi, 305*
    - (Evalea) pleioregona, 308*
    - winlockiana, 306; pl. 64, figs. 23, 24, 30*

**oldroydi, Loxocardium (Schedocardia) brewerii var., 154; pl. 36, fig. 7; pl. 38, figs. 2, 12**

**olequaensis, Goniobasis, 377; pl. 75, fig. 14**

- olequahensis**, *Corbicula*, 130, 132; pl. 30, figs. 10, 11  
*Gari*, 216; pl. 52, figs. 1, 2  
*Loxocardium* (*Schedocardia*), 155; pl. 36, fig. 11  
*Solariella*, 293; pl. 64, figs. 6, 9  
*Volsella* (*Brachidontes*), 114; pl. 25, fig. 16  
**Olequahia**, 425  
*lincolnensis*, 426; pl. 84, figs. 4, 5, 13  
*washingtoniana*, 425, 426; pl. 84, figs. 6, 10, 11  
**oligocenica**, *Littorina*, 328; pl. 63, fig. 22, pl. 67, fig. 19  
*Natica* (*Tectonatica*), 334; pl. 67, fig. 28  
*Oliva* *purpura*, 500  
**OLIVIDAE**, 500-502  
*Olivella*, 500  
*mathewsonii*, 500, 501; pl. 103, fig. 7  
*var. umpquaensis*, 500, 501; pl. 95, figs. 15, 17  
*pedroana*, 501; pl. 95, figs. 25, 30  
*Oliverato californica*, 499  
*olympiana*, *Yoldia*, 46; pl. 9, figs. 1, 2  
*olympica*, *Pseudocardium*, 248; pl. 57, fig. 9; pl. 58, fig. 11  
*olympicensis*, *Acrilla* (*Undiscala*), 327; pl. 67, fig. 15  
*olympidea*, *Venus* (*Chione*), 169; pl. 39, fig. 14  
*Opalia*, 321  
*australis*, 321  
*(Opalia) bravinderi*, 322; pl. 67, figs. 17, 18  
*(Rugatiscala) cowlitzensis*, 323; pl. 67, fig. 16  
*levesquei*, 333  
*(Opalia) rugifera*, 321, 324; pl. 67, fig. 1  
*undosa*, 327  
*(Opalia) wishkahensis*, 322; pl. 67, figs. 3, 4, 5  
**oregona**, *Yoldia* (*Portlandia*), 49; pl. 9, figs. 8, 16  
**oregonense**, *Anorthoscutum*, 8, 9; pl. 3, fig. 14  
*Argobuccinum*, 418; pl. 83, fig. 15  
*Epitonium* (*Boreoscala*) *condoni* var., 316; pl. 65, figs. 18, 19; pl. 66, fig. 4  
*Galeodea*, 409; pl. 81, fig. 1; pl. 101, fig. 12  
*Pseudocardium*, 246; pl. 58, figs. 1, 5  
**oregonensis**, *Amauroopsis*, 347, 348; pl. 71, figs. 7, 11  
*Bruclarkia*, 444; pl. 86, figs. 21, 22  
*Callianassa*, 559  
*Cancellaria*, 505, 507; pl. 96, fig. 9  
*Corbicula*, 130; pl. 27, fig. 1; pl. 29, fig. 8  
*Cryptomya*, 252; pl. 59, fig. 4  
*Dendraster*, 8  
*gibbosus*, *Dendraster* (*Calaster*), 9  
*Discinisca*, 14; pl. 2, fig. 16  
*Ectinochilus* (*Macilentes*) *macilenta* subsp., 392; pl. 76, figs. 25, 26, 27  
*Erilia*, 243; pl. 56, fig. 4  
*Fusinus* (*Priscofusus*), 484; pl. 92, figs. 2, 4  
*Lima*, 99; pl. 22, figs. 2, 6  
*Mioleiona*, 492; pl. 94, fig. 12  
*Natica* (*Tectonatica*), 331; pl. 100, fig. 27  
*Pecten* (*Patinoppecten*), 93; pl. 19, fig. 2; pl. 22, fig. 1  
*Pitar*, 181; pl. 42, figs. 12, 13, 15, 21  
*Scaphander*, 545, 547, 548; pl. 100, fig. 9  
*Siphonalia*, 439; pl. 86, fig. 12  
*Spisula* (*Mactromeris*) *albaria* subsp., 241; pl. 56, figs. 1, 5, 8  
*Tellina*, 201, 205, 560
- oregonensis**—continued  
*Trichotropis*, 388; pl. 76, fig. 13  
*Trophon*, 401; pl. 78, fig. 1  
*Turritella*, 370; pl. 74, fig. 12  
*Umpquaia*, 434, 435; pl. 85, figs. 15, 16, 18, 20  
*Volutocorbis*, 493; pl. 94, fig. 2  
*Whitneyella*, 474; pl. 90, figs. 24, 27, 30  
*ornata*, *Hipponix* *arnoldi* var., 355; pl. 72, fig. 11  
*Turricula* (*Pleurofusia*), 535; pl. 99, fig. 3  
**orfordensis**, *Odostomia* (*Evalea*), 309  
**OSTRACEA**, 78-82  
**Ostrea**, 78  
*columbiana*, 78, 79  
*edulis*, 78  
*ephippium*, 77  
*fettkei*, 80  
*griesensis*, 81; pl. 15, figs. 1, 2  
*hybrida*, 93  
*idriaensis*, 78; pl. 15, fig. 5  
*var. fettkei*, 80; pl. 14, figs. 8, 10, 14, 15  
*lima*, 97  
*lincolnensis*, 80, 81; pl. 14, figs. 1, 2, 3  
*maxima*, 82  
*sookensis*, 82; pl. 14, figs. 13, 16  
*titan*, 81, 82  
*(Crassostrea) titan*, 81  
**OSTREIDAE**, 78-82  
**P**  
*Pachychilus drakei*, 376  
*Pachydesma*, 188  
*aragoensis*, 188, 189; pl. 44, figs. 18, 19, 20; pl. 46, figs. 1, 4, 7; pl. 47, fig. 2  
*crowderi*, 190, 758; pl. 46, fig. 8  
*gastonesis*, 189; pl. 44, fig. 17; pl. 51, fig. 1  
*weaveri*, 188, 190; pl. 44, figs. 11, 14, 15, 16, 21; pl. 46, figs. 2, 5, 10  
*Pachypoma*, 296  
*pacifica*, *Homalopoma*, 297, 298; pl. 63, figs. 16, 19  
*pacificum*, *Argobuccinum*, 419; pl. 83, fig. 5  
*Calliostoma*, 286; pl. 62, fig. 16  
*Cymatium*, 414; pl. 82, fig. 9  
*packardi*, *Acila* (*Truncacila*), 26; pl. 4, fig. 4; pl. 5, figs. 9, 10; pl. 8, fig. 32  
*Aforia*, 517, 526; pl. 97, fig. 3  
*Ficopsis*, *meganensis* var., 400; pl. 77, fig. 14  
*Lima*, 99; pl. 23, fig. 15  
*Murex*, 455; pl. 88, figs. 17, 18  
*Neptuna*, 430  
*Potamides*, 380; pl. 75, fig. 25  
*Pseudoliva*, 460; pl. 89, fig. 26  
*Spisula*, 231, 232; pl. 54, figs. 2, 4  
*Yoldia* (*Portlandia*), 44; pl. 8, figs. 33, 34  
*packi*, *Lucina*, 147; pl. 34, fig. 19; pl. 38, fig. 13  
*Siphonalia*, 435; pl. 85, fig. 17  
*Palehomola*, 556  
*gorrelli*, 556  
*Palliolium*, 96  
*(Delectopecten) peckhami*, 96; pl. 11, fig. 6; pl. 21, fig. 4  
*(Delectopecten) vancouverensis* subsp. *sanjuanensis*, 96; pl. 17, fig. 4

- Pandora, 120**  
*vanwinkleae*, 120, 121; pl. 25, fig. 18  
*washingtonensis*, 120, 121; pl. 25, fig. 21
- PANDORIDAE, 120-121**
- Panopaea generosa*, 262
- Panope, 261**  
*ampla*, 263  
*(Panomyia) ampla* var. *chrysia*, 263; pl. 60, fig. 1  
*generosa*, 261, 262, 263; pl. 60, figs. 2, 4  
*(Panope) generosa*, 262  
*ramonensis*, 263; pl. 59, fig. 11  
*snohomishensis*, 261, 262, 263; pl. 59, figs. 3, 19
- Paphia landesi*, 141  
*(Tapes) staleyi*, 170  
*(Protothaca) staleyi* var. *hannibali*, 171
- Parallelodon (*Porterius*) andersoni**, 53
- PARALLELODONTIDAE, 53-54**
- Parapholas californica*, 265
- parapodema*, Chione, 163, 164; pl. 37, figs. 6, 7
- parilis*, Corbulia, 256, 259; pl. 59, fig. 16  
*Taras*, 149; pl. 35, fig. 6; pl. 36, fig. 4
- parkei*, Nuculana, 38; pl. 7, fig. 23; pl. 8, fig. 25
- Parvisiphon, 440**  
*lewisiiana*, 440; pl. 86, fig. 16
- parvum*, Acteon, 543; pl. 99, figs. 30, 31
- Patella, apertura, 284**  
*chinensis*, 351  
*cornucopia*, 355  
*fornicata*, 356  
*geometrica*, 279  
*noachina*, 285  
*subquadrata*, 279
- Patinopecten, 90**  
*patula* var. *oregonia*, Siliqua, 230; pl. 54, fig. 1  
*paucivaricata*, Bonellitidae (*Admetula*), 508; pl. 96, figs. 10, 12, 13; pl. 103, figs. 9, 10, 17  
*peckhami*, Palliolum (*Delectopecten*), 96; pl. 11, fig. 6; pl. 21, fig. 4
- Pecten, 82**  
*(Plagioctenium) alockamanensis*, 89; pl. 17, fig. 5  
*(Plagioctenium) andersoni* subsp. *clemonensis*, 89, 90; pl. 19, figs. 3, 5  
*bowersi*, 86  
*branneri*, 84  
*caurinus*, 90  
*(Propeamussium) ceciliae*, 94  
*(Propeamussium) clallamensis*, 94, 95; pl. 17, figs. 3, 6  
*(Chlamys) columbianum*, 84; pl. 15, fig. 3; pl. 16, fig. 1  
*(Patinopecten) coosensis*, 92; pl. 18, figs. 1, 2; pl. 21, figs. 2, 5  
*(Chlamys) cornwalli*, 85; pl. 16, figs. 2, 3, 5  
*(Chlamys) cowlitzenensis*, 83, 85; pl. 11, figs. 1, 2; pl. 14, fig. 9  
*(Chlamys) fucanus*, 87  
*gibbus* var. *circularis*, 88  
*(Chlamys) grunskyi*, 84; pl. 14, fig. 5  
*hindsii* var. *strategus*, 88  
*incomparabilis*, 96  
*islandicus*, 82, 83, 86
- Pecten—continued**  
*(Chlamys) landesi*, 82, 83n.; pl. 14, figs. 4, 6, 7  
*(Plagioctenium) neahensis*, 90; pl. 17, fig. 2  
*nevadanus*, 86, 87, 88  
*(Vertipecten) nevadanus* var. *fucanus*, 87; pl. 19, fig. 7; pl. 20, fig. 1  
*nevadanus* var. *perrini*, 87  
*(Patinopecten) oregonensis*, 93; pl. 19, fig. 2; pl. 22, fig. 1  
*peckhami*, 94, 96  
*(Pseudamusium) peckhami*, 96  
*pedroanus*, 94  
*(Pseudamusium) pedroanus*, 96  
var. *vancouverensis*, 96  
*porterensis*, 84  
*(Chlamys) porterensis*, 87  
*(Vertipecten) porterensis*, 87; pl. 16, fig. 4; pl. 19, figs. 1, 4, 8  
*(Patinopecten) propatulus*, 91; pl. 19, fig. 6; pl. 20, fig. 2  
*stanfordensis*, 95  
*(Pseudamusium) vancouverensis*, 96  
subsp. *sanjuanensis*, 96  
*(Pseudamusium) vanwinkleae*, 93; pl. 15, fig. 4  
*ventricosus*, 88  
*(Chlamys) washburnei*, 86; pl. 17, fig. 1  
*(Propeamussium) waylandi*, 95; pl. 22, fig. 3
- PECTINACEA, 82-102**
- PECTINIDAE, 82-97**
- Pectunculus eocenica*, 56  
var. *landesi*, 56, 57  
*nitens*, 75  
*tejonensis*, 57
- Pedalion, 77**  
*clarki*, 77; pl. 13, fig. 9
- PEDALIONIDAE, 77**
- pedroana*, Olivella, 501; pl. 95, figs. 25, 30
- Pelecyora, 193**  
*aequilateralis*, 194, 195; pl. 45, fig. 9; pl. 46, figs. 3, 6; pl. 104, fig. 6  
*cf. gabbi*, 194; pl. 45, fig. 16; pl. 46, fig. 15  
*victoriana*, 195; pl. 45, figs. 13, 14
- PELECYPODA, 18-266**
- penita*, Pholadidea, 265
- PERIPLOMATIDAE, 117**
- Perissolax blakei*, 415
- Perponderosa, Purpura, 452**; pl. 88, fig. 8
- perrini*, Cantharus, 433; pl. 85, fig. 8  
*Crassatellites*, 127; pl. 26, figs. 12, 13, 17, 18  
*Glycymeris*, 58, 64; pl. 11, fig. 17; pl. 12, fig. 2
- Rapana*, 451; pl. 88, fig. 5
- Perse markleyensis*, 477
- Persephona, 555**  
*bigranulata*, 555
- Persicula 495**  
*chehalensis*, 495, 758; pl. 94, fig. 14  
*variabilis*, 495
- persona** subsp. *vancouverensis*, Acmaea, 281, 283; pl. 62, figs. 2, 7
- perversa**, Antiplanes, 517; pl. 97, fig. 4
- petricola**, Dentalium, 267  
*Littorina*, 329; pl. 67, fig. 20

- petrosa**, *Galeodea*, 404, 405; pl. 79, figs. 5, 6, 7  
*Haminoea*, 549; pl. 100, figs. 16, 17, 18, 19, 23
- Phacoides** *acutilineatus*, 143  
*columbianum*, 145  
*(Lucinoma) hannibali*, 144  
*muirensis*, 148  
*turneri*, 149
- Phaenomya**, 260  
*vaderensis*, 260, 261; pl. 61, fig. 14
- Phalium**, 409  
*(Bezoardica) aequisulcatum*, 409, 411; pl. 81, fig. 2  
*(Bezoardica) egberti*, 410, 411; pl. 81, fig. 4  
*glaucum*, 409  
*(Bezoardica) iani*, 411; pl. 81, fig. 5  
*(Semicassis) iani*, 411  
*(Bezoardica) turricula*, 410; pl. 81, fig. 3; pl. 101, fig. 14
- Phelsumaster parma**, 5
- PHILINIDAE**, 541
- PHOLADIDAE**, 264-265
- Pholadidea**, 264  
*californica*, 265  
*(Parapholas) californica*, 265  
*loscombia*, 264  
*penita*, 265  
*(Pholadidea) penita*, 265
- Pholas californica**, 265  
*crispatus*, 264  
*papyraceus*, 264  
*penita*, 265
- pileum**, *Crepidula*, 356, 357; pl. 72, figs. 10, 16; pl. 103, fig. 15
- pilobryi**, *Ranellina*, 417; pl. 82, fig. 7
- Pilumnoplax**, 553  
*carmanahensis*, 553  
*hannibalanus*, 554
- Pinnixia**, 553  
*eocenica*, 553
- PINNOTHERIDAE**, 553
- Pisiana clallamensis**, 448
- Pitar**, 177  
*(Katherinella) arnoldi*, 185, 186; pl. 44, figs. 1, 2, 3, 4, 5, 6, 7, 8, 12; pl. 104, fig. 10  
subsp. *etheringtoni*, 186; pl. 44, figs. 9, 10, 13  
*californiana*, 177, 178; pl. 40, figs. 10, 13; pl. 41, figs. 15, 16, 17, 18, 19; pl. 47, figs. 6, 12  
*(Lamelliconcha) clarki*, 183; pl. 42, figs. 1, 2, 3, 4, 5, 6, 7, 8, 9  
*dalli*, 181, 184; pl. 43, figs. 1, 2, 3, 4, 5, 8, 11  
*(Lamelliconcha) eocenica*, 180, 184; pl. 39, figs. 8, 13; pl. 47, figs. 7, 9  
*mathewsonii*, 182  
*oregonensis*, 181; pl. 42, figs. 12, 13, 15, 21  
*(Pitaria) oregonensis*, 181  
*quadratus*, 180; pl. 47, fig. 4; pl. 104, fig. 2  
*stocki*, 183; pl. 39, fig. 16; pl. 47, figs. 5, 10  
*tumens*, 185  
*(Calpitaria) uvasanus*, 178; pl. 47, fig. 13  
subsp. *coquillensis*, 178, 179; pl. 41, figs. 8, 11  
subsp. *duprei*, 178, 179, 184; pl. 41, figs. 12, 13  
*vancouverensis*, 182; pl. 43, figs. 7, 10, 12
- Pitaria** (*Katherinella*) *arnoldi*, 185  
*californiana*, 177  
*(Lamelliconcha) clarki*, 183  
*(Pitaria) dalli*, 181  
*(Lamelliconcha) eocenica*, 184  
*martini*, 186  
*stocki*, 183
- pittsburghensis**, *Macrocallista*, 175, 176; pl. 32, fig. 7; pl. 41, figs. 4, 7, 10, 14  
*Spisula*, 235, 236; pl. 54, fig. 9; pl. 61, figs. 1, 4  
*Tellina*, 200; pl. 48, fig. 4
- Placunonomia inornata**, 101
- Plagiocardium** (*Schedocardia*) *brewerii*, 153
- Plagioctenium**, 88
- Platydon**, 250  
*cancellata*, 250; pl. 58, fig. 3
- pleioregona**, *Odostomia (Evalea)*, 308
- Pleorocera bitaeniata**, 377
- Pleurotoma archimedis**, 525  
*bottoe*, 540  
*(Surcula) carpenteriana*, 527, 527  
*(Borsonia) dalli*, 523  
*gemmata*, 523  
*(Surcula) perversa*, 517, 517  
*washingtoniana*, 533
- Pododesmus**, 100  
*decipiens*, 100  
*inornata*, 100, 101; pl. 104, figs. 8, 14  
*macrochisma*, 101  
*newcombei*, 100; pl. 23, figs. 2, 3, 5
- Polinices**, 334  
*albus*, 334  
*(Euspira) blakeleyensis*, 348  
*(Euspira) galianoi*, 344; pl. 70, figs. 11, 14  
*(Lunatia) galianoi*, 344  
*(Polinices) gesteri*, 336; pl. 68, fig. 19  
*(Neverita) globosa*, 339; pl. 68, figs. 21, 24; pl. 69, figs. 5, 6; pl. 100, fig. 29  
*(Polinices) hornii*, 335; pl. 68, figs. 1, 2, 3; pl. 100, fig. 28  
*(Euspira) hotsoni*, 338  
*(Polinices) hotsoni*, 338; pl. 69, figs. 1, 2  
*(Neverita) inezana*, 342; pl. 70, fig. 15; pl. 101, figs. 7, 8, 9, 11  
*lewisii*, 338  
*(Lunatia) lewisii*, 344  
*lincolnensis*, 337, 338  
*(Neverita) nomlandi*, 340; pl. 69, figs. 8, 9, 12  
*(Euspira) nuciformis*, 342, 343; pl. 70, figs. 1, 2; pl. 103, fig. 2  
var. *cowlitzensis*, 343; pl. 69, figs. 10, 11, 13, 14, 15, 16, 17, 18, 19  
*(Neverita) recluziana*, 341, 342  
var. *vancouverensis*, 340; pl. 70, figs. 5, 6, 9  
*(Euspira) rectus*, 336  
*(Polinices) rectus*, 336; pl. 68, figs. 15, 20  
*(Neverita) secta*, 341; pl. 70, figs. 3, 4, 7, 8; pl. 100, fig. 30  
*(Ampullina) sookensis*, 347  
*(Euspira) victoriana*, 335

**Polinices—continued**

- (*Polinices*) *victoriana*, 335; pl. 68, figs. 10, 11, 12, 14  
 (*Polinices*) *washingtonensis*, 337, 338; pl. 68, figs. 18, 23  
*var. lincolnensis*, 336, 337; pl. 68, fig. 22; pl. 69, figs. 4, 7  
 (*Neverita*) *weaveri*, 340, 341; pl. 68, figs. 16, 17; pl. 69, fig. 3  
*pontis*, *Hydrobia*, 362; pl. 73, fig. 6  
*Poromya*, 121  
*anatinoides*, 121  
*teglanidae*, 121, 758; pl. 25, fig. 23  
**POROMYACIDAE**, 121-122  
*Potamides*, 378  
*carbonicola*, 378; pl. 75, figs. 15, 19  
*fettkei*, 379; pl. 75, figs. 18, 21, 22, 26  
*lamarckii*, 378  
*lewisiana*, 379; pl. 75, fig. 23  
*packardi*, 380; pl. 75, fig. 25  
*porterensis*, *Callianassa*, 559  
*Crenella*, 115; pl. 25, figs. 3, 14  
*Dentalium*, 268; pl. 61, fig. 19  
*Pecten (Vertipecten)*, 87; pl. 16, fig. 4; pl. 19, figs. 1, 4, 8  
*Turritella*, 372; pl. 74, fig. 5  
*Volsella*, 111; pl. 24, fig. 2  
*Porterius*, 53  
*gabbi*, 53, 54; pl. 9, figs. 7, 10, 11, 14; pl. 11, fig. 3  
**PONTINIDAE**, 555  
*Fortunites*, 555  
*insculpta*, 555  
*triangulum*, 555  
*postplanata*, *Neptunea*, 430; pl. 85, fig. 12  
*praecursor*, *Pyramidella*, 305; pl. 64, fig. 22  
*praerupta*, *Crepidula*, 359; pl. 73, figs. 1, 2, 3  
*precursor*, *Spisula (Hemimactra)*, 237; pl. 55, fig. 5  
*Thais*, 447; pl. 87, figs. 10, 11  
*preussi*, *Cerithiopsis*, 381; pl. 75, figs. 20, 24, 27  
*princeps*, *Crepidula*, 358, 359; pl. 73, figs. 4, 13, 14  
*Priscofusus*, 481  
*cammani*, 488  
*medialis*, 483  
*nodiferus*, 444, 483  
*oregonensis*, 484  
*propatulus*, *Pecten (Patinopecten)*, 91; pl. 19, fig. 6; pl. 20, fig. 2  
*Propeamussium*, 94  
*Protothaca*, 170  
*Psammobia columbiana*, 216  
*cowlitzensis*, 215  
*martini*, 215  
*obscura*, 217  
*olequahensis*, 216  
*Psephaea prevostiana* var. *oregonensis*, 492  
*Pseudamusium*, 93  
*Pseudocardium*, 244  
*densata* var. *altum*, 245; pl. 60, fig. 7  
*eugenense*, 244, 245, 247; pl. 57, fig. 4

**Pseudocardium—continued**

- gabbi*, 244  
*var. altus*, 245  
*var. elongatus*, 245  
*var. robustum*, 245  
*var. undiliferum*, 247  
*landesi*, 248; pl. 60, figs. 5, 8  
*newcombei*, 247; pl. 58, figs. 6, 9, 12  
*olympica*, 248; pl. 57, fig. 9; pl. 58, fig. 11  
*oregonense*, 246; pl. 58, figs. 1, 5  
*undiliferum*, 247; pl. 60, fig. 6; pl. 61, fig. 9  
*yaquinense*, 244, 245; pl. 57, fig. 6  
**Pseudololiva**, 457, 499  
*dilleri*, 458, 459; pl. 89, figs. 5, 6, 10, 11, 12  
*packardi*, 460; pl. 89, fig. 26  
*inornata*, 457, 458, 459  
*kirbyi*, 457; pl. 89, fig. 7  
*plumbea*, 457  
*umpquaensis*, 459; pl. 89, fig. 13  
*volutaeformis*, 458, 459; pl. 89, fig. 20; pl. 103, fig. 5  
**Pseudomelatoma**, 536  
*kernensis*, 536; pl. 99, figs. 5, 6  
**Pseudoperissolax**, 414  
*blakei*, 415; pl. 82, figs. 13, 17  
*trophonoides*, 415; pl. 82, figs. 5, 6  
**Pseudotoma carpenteriana**, 527  
*condonana*, 530  
*remondii*, 528  
*wynocheensis*, 527  
*Pteria*, 77  
*clarki*, 77, 78; pl. 11, fig. 4; pl. 14, figs. 11, 12  
*pellucida*, 78  
**PTERIACEA**, 77-78  
**PTERIIDAE**, 77-78  
*pugetensis*, *Acila (Truncacila)*, 28; pl. 6, fig. 3  
*Corbicula*, 131; pl. 30, fig. 15  
*Teredo*, 266; pl. 60, fig. 12  
*Volsella*, 109; pl. 23, fig. 13  
*pulchra*, *Hemipleurotoma*, 525; pl. 97, figs. 26, 27, 28  
*Pullastra hannibali*, 171  
*Puncturella*, 285  
*sp.*, 285; pl. 62, fig. 14  
*Purpura*, 451  
*foliata*, 451, 452; pl. 88, fig. 10  
*(Purpura) foliata*, 452  
*lapillus* var. *quillayutea*, 447  
*lima*, 446  
*perponderosa*, 452; pl. 88, fig. 8  
*Pyramidella*, 305  
*(Syrnola) dilleri*, 306  
*praeccursor*, 302, 305; pl. 64, fig. 22  
*vaderensis*, 305; pl. 64, figs. 15, 16, 17  
*(Syrnola) vaderensis*, 305  
**PYRAMIDEILLIDAE**, 304-309  
**PYRENIDAE**, 460  
*Pyrgolampros*, 304  
*mioperplicatus*, 304  
*Pyrula modesta*, 395

## Q

- quadranodosum*, *Molopophorus biplicatus* var., 469  
*quadrata* subsp. *vancouverensis*, *Crytomyia*, 251; pl. 49,  
 fig. 1; pl. 59, fig. 13  
*quadratus*, *Pitar*, 180; pl. 47, fig. 4; pl. 104, fig. 2  
*quaylei*, *Anorthoscutum oregonense* var., 9, 10; pl. 3,  
 figs. 10, 11  
*quimperense*, *Epitonium (Boreoscala) condoni* var.,  
 317; pl. 66, figs. 5, 14

## R

- ramonensis*, *Panope*, 263; pl. 59, fig. 11  
*Ranella (Priene) cammani*, 417  
 (*Priene*) *corbiculata*, 424  
*cowlitzensis*, 413  
*mathewsonii*, 420  
 (*Priene*) *oregonensis*, 418  
 (*Priene*) *pacifica*, 419  
*washingtoniana*, 412  
*Ranellina*, 416  
*maclurii*, 416  
*pilsbryi*, 417, 474; pl. 82, fig. 7  
*Ranidina*, 558  
*willapensis*, 558  
*Ranina*, 556  
*americana*, 556  
**RANINIDAE**, 556-558  
*Raninooides*, 557  
*asper*, 557  
*eugenensis*, 557  
*fulgidus*, 557  
*lewisianus*, 558  
*vaderensis*, 557  
*washburnei*, 557  
*Rapana*, 451  
*bezoor*, 451  
*perrini*, 451; pl. 88, fig. 5  
*reagani*, *Semele*, 221; pl. 50, figs. 5, 6  
*Yoldia*, 52; pl. 9, fig. 6  
*recluziana* var. *vancouverensis*, *Polinices (Neverita)*,  
 340; pl. 70, figs. 5, 6, 9  
*rectus*, *Polinices (Polinices)*, 336; pl. 68, figs. 15, 20  
*refulleri*, *Epitonium (Boreoscala) condoni* subsp., 319;  
 pl. 66, fig. 11  
*reinharti*, *Barbatia (Acar)*, 70; pl. 13, figs. 6, 7, 11, 13  
*remondii* subsp. *comstockensis*, *Conus*, 509; pl. 96,  
 fig. 15  
*remondii*, *Ficopsis*, 398, 399; pl. 77, fig. 12  
 var. *crescentensis*, *Ficopsis*, 399; pl. 77, fig. 10  
*Megasurcula*, 528; pl. 98, fig. 6  
*restorationensis*, *Ficus (Trophosycon)*, 397; pl. 77,  
 fig. 13  
*Volsella*, 109, 110, 111; pl. 24, figs. 10, 11  
*reticulata* subsp. *sookensis*, *Gadinia*, 550; pl. 100, figs.  
 21, 22  
*rex*, *Galeodea*, 407, 408; pl. 80, figs. 2, 4, 6  
*Rhynchonella*, 13  
*washingtoniana*, 13; pl. 2, figs. 8, 9, 10, 11  
**RHYNCHONELLIDAE**, 12-13

## Rimella

- canalifera*, 392  
 var. *elongata*, 390, 391  
*macilenta*, 392  
*oregonensis*, 392  
*simplex*, 390  
*(Cowlitzia) washingtonensis*, 390  
*Rissoa lettana*, 362  
**RISSOIDAE**, 361-363  
*rockensis*, *Turbanilla (Pyrgolampros)*, 304; pl. 63,  
 fig. 17  
*roseburgensis*, *Anatina*, 244; pl. 57, fig. 8  
*Latirus*, 473; pl. 90, figs. 21, 28  
*Lucina*, 147; pl. 27, fig. 11; pl. 35, figs. 3, 4  
*Rostellaria indurata*, 491  
*rostralis*, *Crepidula (Crepidula)*, 359; pl. 72, figs. 13, 15  
*rotunda*, *Cancellaria*, 506; pl. 96, fig. 7  
*ruckmani*, *Conus*, 510, 512, 513; pl. 96, figs. 21, 22, 23  
*Rugatiscala*, 323  
*rugifera*, *Opalia (Opalia)*, 321; pl. 67, fig. 1  
*rushi* var. *aragoensis*, *Spisula*, 233; pl. 52, figs. 9, 17;  
 pl. 54, fig. 6

## S

- sagittata*, *Glycymeris*, 54, 55, 56; pl. 9, figs. 17, 18; pl.  
 11, fig. 15  
*sammamishensis*, *Mytilus*, 102; pl. 25, fig. 12; pl. 26,  
 fig. 6  
*Yoldia*, 48, 49; pl. 9, fig. 3  
*sanctaecrucis*, *Fusinus (Priscofusus)*, 486, 487; pl. 91,  
 figs. 22, 23; pl. 103, fig. 14  
*Sanguinolaria*, 219  
*caudata*, 219; pl. 50, fig. 2  
*howardi*, 219; pl. 50, fig. 11  
*nuttalli*, 220  
*townsendensis*, 220; pl. 50, fig. 8  
*(Nuttalina) townsendensis*, 220  
**SANGUINOLARIIDAE**, 215-221  
*sanJosei*, *Cancellaria*, 507; pl. 96, fig. 8  
*Sassia*, 416  
*bilineata*, 416; pl. 82, figs. 8, 11, 12, 15  
*saunderi*, *Epitonium (Cirsotrema)*, 311, 312; pl. 64,  
 figs. 31, 32; pl. 65, figs. 3, 4, 5, 6, 7, 10  
*saxea*, *Natica (Tectonatica)*, 332; pl. 68, fig. 4  
*Sasicava arnoldi*, 254  
**SAXICAVIDAE**, 261-264  
*Saxidomus gibbosus*, 193  
*newcombei*, 193  
*Scalaria acuminata*, 323  
*pretiosa*, 310  
*Scaphander*, 544  
*conradi*, 545, 547; pl. 100, fig. 8  
*costatus*, 545, 548; pl. 100, fig. 2; pl. 103, fig. 21  
*(Mirascapha) costatus*, 545  
*jugularis*, 546; pl. 100, fig. 7  
*oregonensis*, 545, 547, 548; pl. 100, fig. 9  
*washingtonensis*, 545, 546, 546; pl. 100, fig. 3  
 subsp. *goodspeedi*, 546; pl. 100, figs. 5, 6  
 subsp. *gordoni*, 546; pl. 100, fig. 4  
**SCAPHANDRIDAE**, 544-550  
**SCAPHOPODA**, 266  
*scapoosense*, *Cerastoderma*, 158; pl. 35, figs. 19, 20

- scapoosensis*, *Spisula (Mactromeris) albaria* subsp., 240, 241; pl. 57, figs. 1, 3  
*Schedocardia*, 163  
*schencki*, *Epitonium (Boreoscala) keaseyense* subsp., 320; pl. 66, figs. 13, 17, 18  
*Thracia*, 118, 119; pl. 25, figs. 5, 22  
*Schizaster*, 10  
 sp., 10; pl. 3, fig. 9  
*studeri*, 10  
*Schizothaerus*, 249  
*nuttallii*, 249  
 var. *pajaroanus*, 249; pl. 58, fig. 10  
*pajaroanus*, 249  
*scissurata* var. *strigata*, *Yoldia*, 51; pl. 9, figs. 15, 20  
*scopulosum*, *Sinum*, 349, 350; pl. 71, figs. 12, 14, 17, 18  
*Scutella* *blancoensis*, 5, 6, 32  
*coosensis*, 7  
*interlineata*, 8  
*newcombei*, 6  
*(Echinorachnius) oregonensis*, 8
- SCUTELLIDAE**, 7-11  
*Searlesia*, 441  
*branneri*, 442; pl. 86, figs. 19, 20  
*dira*, 441, 442  
 subsp. *miocenica*, 441; pl. 86, figs. 17, 18  
*secta*, *Polinices (Neverita)*, 341; pl. 70, figs. 3, 4, 7, 8; pl. 100, fig. 30  
*securis*, *Chione*, 162, 169; pl. 36, figs. 8, 9, 13; pl. 37, fig. 8; pl. 39, fig. 15  
*Segmentina*, 551  
*armigera*, 551  
*durhami*, 551; pl. 100, figs. 24, 25, 26  
*Semele*, 221  
*diabloti*, 222; pl. 50, fig. 15; pl. 52, fig. 13  
*gayi*, 221, 222  
*montesanoensis*, 224; pl. 52, fig. 8  
*reagani*, 221; pl. 50, figs. 5, 6  
*sylviaensis*, 223, 224; pl. 50, fig. 14; pl. 52, figs. 3, 15; pl. 60, fig. 10  
*vancouverensis*, 222, 223; pl. 50, figs. 9, 12, 16
- SEMELIDAE**, 221-224  
*semigibbosus*, *Anorthoscutum oregonense* var., 10; pl. 4, fig. 2
- Septifer*, 114  
*bifurcatus*, 107  
*dichotomus*, 107, 115; pl. 25, fig. 6
- Seraphs andersoni*, 392
- Serpula*, 3  
*octoforis*, 3; pl. 1, fig. 13  
 sp., 4; pl. 61, fig. 22
- shepardae*, *Marginella*, 494; pl. 94, fig. 1
- shumardi*, *Acila (Truncacila)*, 25, 28, 29; pl. 7, figs. 5, 6, 7, 11; pl. 8, figs. 2, 5
- sicarius*, *Solena*, 229; pl. 53, fig. 16
- Siderastrea*, 2  
*mendenhalli*, 2  
*vancouverensis*, 2; pl. 1, figs. 7, 14
- Sigarctus scopulosus*, 331, 349
- Siliqua*, 230  
*nuttallii*, 230  
*patula* var. *oregona*, 230; pl. 54, fig. 1
- simplex*, *Acmaea*, 282, 283; pl. 62, fig. 10; pl. 63, fig. 25; pl. 64, fig. 1
- sinuata* var. *aragoensis*, *Whitneyella*, 473; pl. 90, figs. 25, 29
- Sinum*, 349  
*obliquum*, 350, 351; pl. 71, fig. 13; pl. 103, fig. 6  
*occidentis*, 351; pl. 71, fig. 15  
*scopulosum*, 349, 350; pl. 71, figs. 12, 14, 17, 18
- Siphonalia*, 435  
*bicarinata*, 435, 436; pl. 85, figs. 11, 19  
 subsp. *monospina*, 436; pl. 85, figs. 10, 14  
*cassidariaeformis*, 435  
*clarki*, 433, 437; pl. 86, fig. 14  
*oregonensis*, 439; pl. 86, fig. 12  
*packi*, 435; pl. 85, fig. 17  
*sopenahensis*, 433, 437; pl. 86, figs. 1, 2, 3, 4, 5, 6, 7, 8, 15  
*sutterensis*, 433, 436, 437  
*washingtonensis*, 438; pl. 86, figs. 9, 10, 11, 13
- Sistrum*, 450  
*album*, 450  
*hannai*, 450; pl. 87, figs. 14, 16
- snohomishensis*, *Macoma*, 208; pl. 49, fig. 2  
*Mytilus*, 102; pl. 23, fig. 8; pl. 26, fig. 3  
*Panope*, 261, 263; pl. 59, figs. 3, 19
- Solariella*, 293  
*crescentensis*, 293; pl. 63, fig. 27  
*kincaidi*, 294; pl. 63, fig. 29  
*maculata*, 293  
*olequahensis*, 293; pl. 64, figs. 6, 9
- Solatia solat*, 508
- soledadensis*, *Tellina*, 196, 199; pl. 48, fig. 1
- Solemya*, 18  
*australis*, 18  
*(Acharax) dalli*, 20, 21; pl. 4, figs. 6, 7, 8; pl. 5, figs. 4, 5, 6, 7, 8  
*johsoni*, 18  
*ventricosa*, 18, 20, 21  
*(Acharax) ventricosa*, 18, 21, 22; pl. 5, figs. 1, 2, 3  
*willapaensis*, 20  
*(Acharax) willapaensis*, 21, 758; pl. 6, figs. 2, 17
- Solen*, 225  
*cincinnatus*, 225; pl. 53, figs. 3, 8  
*clarki*, 228  
*columbianus*, 227  
*curtus*, 226  
*(Plectosolen) curtus*, 226  
 var. *contradi*, 227, 227; pl. 53, fig. 7  
*eugenensis*, 230  
*lincolnensis*, 225; 226; pl. 53, figs. 2, 4, 5, 6  
*novacula*, 228, 229  
*obliquus*, 227  
*parallelus*, 226  
*radiatus*, 230  
*sanguinolentis*, 219  
*sicarius*, 229  
*townsendensis*, 225; pl. 53, figs. 1, 9  
*(Plectosolen) townsendensis*, 225  
*vagina*, 225

- Solena**, 227  
*clarki*, 228; pl. 53, fig. 11  
*columbiana*, 227, 229; pl. 51, fig. 6; pl. 52, fig. 4;  
 pl. 53, figs. 10, 12  
*(Eosolen) columbiana*, 227  
*coosensis*, 229; pl. 52, fig. 16; pl. 53, fig. 13  
*(Eosolen) coosensis*, 229  
*eugenensis*, 230; pl. 53, figs. 14, 15  
*lorenzianum*, 230  
*parallelus*, 228  
*sicarius*, 225, 229; pl. 53, fig. 16
- SOLENIDAE**, 225-230
- SOLEMONYCIDAE**, 18-22
- sookensis*, *Acmaea mitra* subsp., 281; pl. 62, fig. 3  
*Ampullina*, 347; pl. 71, figs. 5, 6  
*Calypteraea*, 353; pl. 72, figs. 1, 3, 4  
*Cerastoderma*, 159; pl. 37, figs. 4, 5  
*Corbicula*, 133; pl. 27, fig. 4; pl. 30, figs. 12, 13,  
 14; pl. 38, fig. 14; pl. 39, fig. 7  
*Crepidula*, 357; pl. 72, figs. 9, 12, 18  
*Gadinia reticulata* subsp., 550; pl. 100, figs. 21, 33  
*Goniobasis*, 377; pl. 75, figs. 16, 17  
*Littorina*, 329; pl. 67, figs. 23, 24, 29  
*Macoma*, 207; pl. 49, fig. 4  
*Ostrea*, 82; pl. 14, figs. 13, 16  
*Spisula* (*Hemimactra*), 238; pl. 55, figs. 2, 3, 6, 7  
*Terebratella*, 16; pl. 1, figs. 9, 10  
*Volsella*, 110, 112; pl. 24, figs. 3, 5, 6, 7  
*sopenahensis*, *Murex*, 456; pl. 88, fig. 16; pl. 89, figs.  
 3, 4  
*Siphonalia*, 433, 437; pl. 86, figs. 1, 2, 3, 4, 5, 6, 7,  
 8, 15
- Sphaenidae**, 251
- SPHAERIIDAЕ**, 129-141
- Spirotropis*, 520  
*carinata*, 520  
*dickersoni*, 521; pl. 97, figs. 15, 16  
*kincaidi*, 522; pl. 97, figs. 18, 19, 25  
*(Antiplanes) perversa*, 518  
*washingtonensis*, 521; pl. 97, figs. 13, 14  
*winlockensis*, 520; pl. 97, figs. 5, 8, 9  
*(Spirotropis) winlockensis*, 520
- Spisula*, 231  
*acutirostrata*, 232  
 var., 232; pl. 52, fig. 6; pl. 54, fig. 3  
*albaria*, 236, 240, 241, 242, 243, 249  
*(Hemimactra) albaria*, 242  
*(Mactromeris) albaria*, 235, 238, 239; pl. 57, figs.  
 5, 10  
 subsp. *arnoldi*, 240; pl. 57, fig. 7  
 var. *coosensis*, 242; pl. 56, fig. 3; pl. 57,  
 figs. 2, 11  
 subsp. *goodspeedi*, 243; pl. 56, fig. 7  
 subsp. *oregonensis*, 241; pl. 56, figs. 1, 5, 8  
*scapoosensis*, 240, 241; pl. 57, figs. 1, 3  
*bisculturata*, 233, 234; pl. 54, fig. 7  
*brevirostrata*, 239  
*catilliformis*, 238  
*(Hemimactra) hannibali*, 238; pl. 56, figs. 2, 6, 9  
*merriami*, 233, 234, 235; pl. 52, figs. 11, 12; pl.  
 54, fig. 10
- Spisula merriami*—continued  
 var. *longifrons*, 234; pl. 52, figs. 10, 14; pl.  
 54, figs. 11, 13  
*ovalis*, 239  
*packardi*, 231, 232; pl. 54, figs. 2, 4  
 var. *yokamensis*, 232; pl. 54, figs. 5, 8  
*pittsburgensis*, 235, 236; pl. 54, fig. 9; pl. 61, figs.  
 1, 4  
 subsp. *frustra*, 236; pl. 54, figs. 12, 15, 17  
*polynyma*, 239  
*(Hemimactra) precursor*, 237; pl. 55, fig. 5  
*rushi*, 233  
 var. *aragoensis*, 233; pl. 52, figs. 9, 17; pl.  
 54, fig. 6  
*(Hemimactra) sookensis*, 238; pl. 55, figs. 2, 3,  
 6, 7  
*twinensis*, 237; pl. 55, fig. 8  
*veneriformis*, 236; pl. 54, figs. 14, 16; pl. 61, figs.  
 2, 3  
*staleyi*, *Venerupis* (*Prototaca*), 170; pl. 39, fig. 17;  
 pl. 104, fig. 3  
*stantoni*, *Tegula* (*Chlorostoma*) *lahondaensis* var., 290;  
 pl. 62, figs. 13, 15  
*Stephanotrochus*, 3  
 sp., 3; pl. 1, fig. 6  
*stephensi*, *Molopophorus*, 465; pl. 90, fig. 1  
*stewarti*, *Fusinus* (*Priscofusus*), 486; pl. 93, figs. 3, 4,  
 10, 14
- Sthenorytis*, 321  
*stillaguamishensis*, *Mytilus*, 103; pl. 23, fig. 12  
*stillwaterensis*, *Corbula*, 258  
*Crassatellites*, 126; pl. 27, figs. 2, 3, 5, 6; pl. 29,  
 figs. 9, 13; pl. 31, fig. 2  
*Crepidula*, 357  
*Diodora*, 284; pl. 63, fig. 20; pl. 64, figs. 4, 7, 12  
*Mytilus*, 107; pl. 25, fig. 13; pl. 26, fig. 2  
*stocki*, *Pitar*, 183; pl. 39, fig. 16; pl. 47, figs. 5, 10  
*stramineum*, *Dentalium*, 267  
*Stramonita petrosa*, 404, 405  
*Strephona pedroana*, 501  
*Strepsidura lincolnensis*, 426  
*oregonensis*, 439  
*packi*, 435  
*washingtonensis*, 438  
*whitneyi*, 474  
*Streptochetus*, 490  
 sp. 490; pl. 94, fig. 7; pl. 104, figs. 9, 16
- STROMBIDAE**, 390-393
- Strombiformis*, 303  
*glaber*, 303  
*reticulatus*, 386  
*washingtoni*, 303, 306; pl. 63, fig. 26
- Strombus canalis*, 390  
*Suavodrillia*, 519  
*thurstonensis*, 519; pl. 97, fig. 7  
*subtenta*, *Venerocardia*, 139, 140; pl. 27, figs. 8, 13, 14;  
 pl. 33, figs. 5, 7, 9, 12; pl. 34, fig. 4
- sulculatus*, *Liomesus*, 432; pl. 85, figs. 6, 7  
*Surcula* (*Surculites*) *annosa*, 526  
*circinata*, 516  
*cowlitzensis*, 534  
*crenatospira*, 532  
*dicksoni*, 520  
*washingtoniana*, 531

**Surculites, 526**

- (*Megasurcula*) *carpenterianus*, 528
- (*Megasurculites*) *condonanus*, 530
- mathewsonii*, 526; pl. 97, figs. 24, 29; pl. 98, figs. 1, 5
- (*Clinura*) *washingtonianus*, 531
- wynooccheensis*, 527
- susanae*, Galeoidea, 402; pl. 78, figs. 2, 3
- sutterensis*, Galeoidea, 402, 403; pl. 78, fig. 6, 7
- suzzalloi*, Barbatia (Obliquarca), 68, 69; pl. 11, fig. 7; pl. 12, fig. 10
- Sycotyphus oyoyanus*, 396
- oregonensis*, 444
- sylviae*, Argobuccinum, 422; pl. 83, fig. 7
- sylviae*, Semele, 223, 224; pl. 50, fig. 14; pl. 52, figs. 3, 15; pl. 60, fig. 10

**T**

*tabori*, Volvulella, 544; pl. 100, fig. 1

*tabulata*, Lora, 519; pl. 97, fig. 12

*tantilla*, Cylichnina, 548, 549; pl. 100, figs. 10, 11, 12, 14, 15

*Tapes conradiana*, 172

- quadra*, 180
- staleyi*, 170
- washingtoniana*, 172

*Taras*, 149

- antiquatus*, 149
- griesensis*, 150; pl. 35, figs. 7, 14
- harfordi*, 149
- parilis*, 149; pl. 35, fig. 6; pl. 36, fig. 4
- sp., 150; pl. 35, fig. 11

*Tectonatica*, 330

- dalli*, 333

*teglandae*, Natica (Tectonatica), 333; pl. 68; figs. 5, 6, 7

*Neptunea*, 427, 428, 758; pl. 84, figs. 8, 14

*Poromya*, 121, 758; pl. 25, fig. 23

*Tegula*, 289

- (*Chlorostoma*) *arnoldi*, 289
- elegans*, 289
- (*Chlorostoma*) *lahondae*, 290
- var. *stantoni*, 288, 290; pl. 62, figs. 13, 15

(*Chlorostoma*) *stantoni*, 290

*tejonensis*, Glycymeris eocenica var., 57; pl. 10, fig. 12

*Urosalpinx*, 453, 454; pl. 88, fig. 13

*TELEODESMACEA*, 123-266

*Tellina*, 196

- aragonia*, 202, 204; pl. 48, fig. 22
- arctata*, 208
- bodegensis* subsp., 202, 203; pl. 48, figs. 11, 17
- (*Peronidia*) *bodegensis* subsp., 202
- calcarea*, 212
- castacana*, 198; pl. 51, fig. 2
- cowlitzensis*, 198; pl. 51, fig. 13; pl. 57, fig. 12
- emacerata*, 206; pl. 48, figs. 18, 20
- eugenia*, 196, 201; pl. 48, figs. 5, 8
- flexuosa*, 142
- gari*, 215

**Tellina—continued**

- gibsonensis*, 200; pl. 52, fig. 5
- hornii*, 218
- howardi*, 219
- inaequivalvis*, 120
- inquinata*, 214
- jollaensis*, 197; pl. 48, fig. 3
- kamakawaensis*, 201; pl. 48, fig. 7; pl. 51, fig. 7
- kincaidi*, 203, 204; pl. 48, fig. 16
- lincolnensis*, 199; pl. 48, fig. 2
- (*Moerella*) *lincolnensis*, 199
- longa*, 198
- lorenzoensis*, 207
- merriami*, 203, 204; pl. 51, figs. 4, 8; pl. 60, figs. 9, 11
- meyeri*, 200,
- nasuta*, 213
- nuculana*, 205; pl. 48, fig. 21
- (*Moerella*) *nuculana*, 205
- (*Moerella*) *obrupta*, 205
- obruda*, 199, 205, 206; pl. 48, figs. 12, 13, 14, 15
- (*Moerella*) *obruda*, 205
- oregonensis*, 196, 201, 205, 560
- pittsburghensis*, 200; pl. 48, fig. 4
- proficia*, 221
- radiata*, 196
- remondii*, 197
- reticulata*, 221
- soledadensis*, 196, 199; pl. 48, fig. 1
- townsendensis*, 196; pl. 45, figs. 10, 11, 12; pl. 50, fig. 4; pl. 51, figs. 5, 10, 11
- vancouverensis*, 202; pl. 48, figs. 6, 9, 10; pl. 59, fig. 1
- TELLINIDAE**, 196-215
- TELOTREMATA**, 12-13
- temblorense*, Yoldia, 50; pl. 9, fig. 4
- tenuimbricata*, Glycymeris, 63, 65; pl. 12, fig. 1
- Terebellum**, 392
- andersoni*, 392; pl. 76, fig. 28
- subulatum*, 392
- Terebratalia**, 15
- aff. *occidentalis*, 16; pl. 2, fig. 4
- transversa* var. *caurina*, 15; pl. 2, figs. 2, 3
- cf. *transversa* *caurina*, 15
- transversa* subsp., 15; pl. 2, fig. 1
- Terebratula**, 16
- sookensis*, 16; pl. 1, figs. 9, 10
- TEREBRATELLIDAE**, 15-18
- Terebratula australis**, 16
- caurina*, 15
- nitens*, 12
- transversa*, 15
- TEREBRATULIDAE**, 14-16
- Terebratulina**, 14
- oakvillensis*, 14, 15; pl. 1, fig. 8
- unguicula* var. B, 15; pl. 1, fig. 11
- TEREDIDAE**, 266
- Teredo**, 266
- navalis*, 266
- pugetensis*, 266; pl. 60, fig. 12
- sp., 266
- substriata*, 266
- substriatum*, 267

- Thais, 446**  
*(Nucella) canaliculata*, 447  
*clallamensis*, 448; pl. 87, fig. 15  
*cornwallii*, 450; pl. 88, figs. 4, 6  
*imperialis*, 448; pl. 88, fig. 3  
*(Straminata) imperialis*, 448  
*lamellosa*, 447; pl. 88, fig. 7  
*(Nucella) lamellosa*, 447  
*lima*, 446; pl. 87, figs. 12, 13  
*(Nucella) lima*, 446  
*nehalensis*, 449, 450; pl. 88, figs. 1, 2  
*neritoides*, 446  
*precursor*, 447; pl. 87, figs. 10, 11  
*(Nucella) precursor*, 447
- THAISIDAE, 446-451**
- Thesbia, 537**  
*antiselli*, 537, 538; pl. 99, figs. 8, 9, 10  
*columbiana*, 537; pl. 99, fig. 13  
*muirensis*, 539, 540; pl. 99, figs. 17, 18, 19  
*ocoyana*, 539; pl. 99, figs. 16, 21, 22, 23, 25  
*workensis*, 538; pl. 99, figs. 14, 15, 20
- Thiara markleyensis, 380**  
*calaf*, 380
- THIARIDAE (Melaniidae), 374**
- thor**, *Bruclarckia*, 445; pl. 87, figs. 5, 9
- Thracia, 117**  
*condoni*, 119; pl. 25, fig. 10; pl. 29, fig. 15  
*corbuloidea*, 117  
*dilleri*, 119; pl. 29, fig. 3  
*cf. karquinezensis*, 119, 120; pl. 25, fig. 19; pl. 26, fig. 5  
*schencki*, 118, 119; pl. 25, figs. 5, 22  
*trapezoidea*, 117  
*trapezoides*, 117, 118; pl. 25, fig. 7; pl. 29, fig. 5; pl. 104, fig. 11
- THRACIIDAE, 117-120**
- thurstonensis**, *Suavodrillia*, 519; pl. 97, fig. 7
- Thyasira, 142**  
*bisecta*, 142; pl. 34, figs. 5, 6  
*disjuncta*, 143; pl. 34, fig. 7; pl. 104, fig. 1
- THYASIRIDAE, 142-143**
- tintinnabulum var. coosensis**, *Balanus*, 533; pl. 4, fig. 1
- titan**, *Ostrea*, 81, 82
- Tivela crassatilloides, 240**  
*gastonensis*, 189  
*inezana*, 189  
*weaveri*, 188
- Tivelina, 187**  
*vaderensis*, 187; pl. 42, figs. 10, 11
- torreyensis**, *Corbula*, 259; pl. 61, fig. 12
- townsendense**, *Epitonium (Boreoscala) condoni* var., 317; pl. 66, figs. 9, 10
- townsendensis**, *Sanguinolaria*, 220; pl. 50, fig. 8
- Solen**, 225; pl. 53, figs. 1, 9  
*Tellina*, 196; pl. 45, figs. 10, 11, 12; pl. 50, fig. 4; pl. 51, figs. 5, 10, 11
- townsendi**, *Nucula*, 35
- Trachydolium dalli, 408**
- transversa** var. *caurina*, *Terebratalia*, 15; pl. 2, figs. 2, 3
- subsp.**, *Terebratalia*, 15; pl. 2, fig. 1
- trapezoides**, *Thracia*, 117, 118; pl. 25, fig. 7; pl. 29, fig. 5; pl. 104, fig. 11
- triangulata** var. *oregonensis*, *Nerita*, 295; pl. 64, figs. 10, 13
- triangulum**, *Portunites*, 555
- TRICHTROPIDAE, 387-390**
- Trichotropis, 387**  
*alienensis*, 389; pl. 76, fig. 17  
*bicarinata*, 387  
*coronata*, 388  
*(Iphinoe) coronata*, 388  
*lajollaensis*, 387  
*oregonensis*, 388; pl. 76, fig. 13  
*(Iphinoe) cf. unicarinata*, 389, 390; pl. 76, figs. 14, 15, 16
- Triforis martini, 383**  
*washingtoniana*, 383
- Trigonococilix cuneus, 76**
- trilineata**, *Anadara (Anadara)*, 71; pl. 12, figs. 11, 19, 20
- Trinacria, 76**  
*willipaensis*, 76; pl. 13, figs. 2, 3
- trinominata**, *Volsella*, 110; pl. 24, fig. 9; pl. 25, fig. 9
- Tritaria, 462**  
*dumblei*, 463  
*(Antillophos) dumblei* var. *chehalensis*, 463; pl. 89, figs. 23, 24, 29, 30
- Triton appenninicum, 416**  
*oregonense*, 418
- Tritonium diegoensis, 440**  
*nana*, 537  
*(Priene) oregonensis*, 418  
*paucivaricatum*, 508  
*sopenahensis*, 437
- tri-tuberculata**, *Galeoda*, 403, 404, 406; pl. 78, figs. 10, 11, 12, 13, 14, 15; pl. 79, figs. 1, 2, 3, 4, 8
- Trivia scabriuscula, 394, 395**
- TROCHIDAE, 286-294**
- Trochita diegoana, 351**  
*inornata*, 354
- Trochus argyrostomus, 289**  
*conulus*, 286  
*dolabratus*, 305  
*imperialis*, 296  
*inaequalis*, 296, 297  
*perspectivus*, 363
- Trophon, 401**  
*calamitus*, 457  
*costifer*, 441  
*gabbianus*, 401  
*kernensis*, 401  
*magellanicus*, 401  
*oregonensis*, 401; pl. 7, fig. 1
- trophonoides**, *Pseudoperissolax*, 415; pl. 82, figs. 5, 6
- Trophosycon, 396**  
*clallamensis*, 396
- Truncacila, 22**
- truncata**, *Mya*, 255; pl. 59, fig. 12
- TURBINIDAE, 296-301**

- Turbo cimex**, 362  
*clathrus*, 310  
*parvus*, 361  
*plicatus*, 306  
*quaricarinatus*, 309  
*sanguinea*, 297  
*scalaris*, 310  
**Turboella**, 361  
*cowlitzensis*, 361; pl. 73, fig. 9  
*elegans*, 361  
**turbanata**, *Turcicula*, 561  
**Turbonilla**, 304  
*oregonensis*, 304  
*(Pyrgolampros) rockensis*, 304; pl. 63, fig. 17  
*typica*, 304  
**TURBONILLIDAE**, 3  
**Turcica**, 288  
*caffea*, 289  
*gabbi*, 288; pl. 63, fig. 4  
*monilifera*, 288  
**Turcicula**, 291  
*bairdi*, 292  
*clarki*, 561  
*columbiana*, 19, 25, 291, 292, 561; pl. 63, fig. 1; pl. 101, figs. 1, 2, 3  
*turbanata*, 561  
*washingtoniana*, 291, 292, 561; pl. 63, figs. 8, 14, 28  
*turneri*, *Buccinofusus*, 440, 758; pl. 89, figs. 1, 2; pl. 101, fig. 13  
*Cylchinina*, 549; pl. 100, fig. 13  
**turricula**, *Phalium (Bezoardica)*, 410; pl. 81, fig. 3; pl. 101, fig. 14  
**Turricula**, 532  
*cooperi*, 532  
subsp. *umpquaensis*, 532; pl. 98, figs. 14, 15  
*(Pleurofusia) cowlitzensis*, 534, 535; pl. 99, figs. 1, 2, 7  
*crenatospira*, 532; pl. 98, figs. 21, 25  
*flammea*, 532  
*kincaidi*, 522  
*(Pleurofusia) ornata*, 535; pl. 99, fig. 3  
*washingtonensis*, 533; pl. 98, figs. 16, 17, 22  
*worcesteri*, 533; pl. 98, figs. 19, 20, 23, 24
- TURRIDAE**, 513-541  
**Turris campani**, 488  
*carlsoni*, 488  
*clallamensis*, 516  
*coli*, 489  
*coosensis*, 489  
*dickersoni*, 521  
*(Antiplanes) impecunia*, 518  
*kincaidi*, 522  
*lincolnensis*, 487, 523  
*monilifera*, 523  
*packardi*, 517  
*(Antiplanes) perversa*, 518  
*pulchra*, 525  
*thurstonensis*, 519  
*washingtonianus*, 533  
*worcesteri*, 533  
*wynoocheensis*, 527
- turrita**, *Loxotrema*, 374; pl. 75, figs. 1, 2, 3; pl. 103, fig. 18  
**Turritella**, 309, 364  
*andersoni*, 364, 365; pl. 73, fig. 12  
subsp. *comstockensis*, 365; pl. 74, fig. 4  
subsp. *glidensis*, 365; pl. 73, fig. 11  
*blakeleyensis*, 372; pl. 74, figs. 15, 17  
*bramkampi*, 366; pl. 74, fig. 13  
*buwaldana* subsp. *coosensis*, 370; pl. 74, fig. 20  
*diversilineata*, 373; pl. 74, fig. 19  
*eschrichtii*, 386  
*lawsoni*, 365  
*meganosensis*, 369  
subsp. *protumescens*, 369; pl. 74, figs. 14, 18  
*merriami*, 367, 369  
var., 369; pl. 74, fig. 10  
*olequahensis*, 368  
*oregonensis*, 370, 381; pl. 74, fig. 12  
*porterensis*, 372; pl. 74, fig. 5  
*terebra*, 364  
*uvasana*, 366, 366  
subsp. *hendoni*, 366, 367; pl. 74, figs. 1, 6  
var. A, 367; pl. 74, fig. 2  
var. B, 367; pl. 74, fig. 21  
subsp. *olequahensis*, 368; pl. 74, fig. 11  
subsp. *stewarti*, 366; pl. 74, fig. 9  
subsp. *hendoni*, 366, 367; pl. 74, figs. 1, 6  
var. A, 367; pl. 74, fig. 2  
var. *kincaidi*, 371; pl. 74, fig. 7  
*washingtoniana*, 368  
*weaveri*, 373
- TURRITELLIDAE**, 364-374  
**Turritellopsis**, 373  
*acicula*, 373  
*weaveri*, 373; pl. 75, figs. 4, 5  
*twinnensis*, *Callianassa*, 559  
*Kellia*, 151; pl. 35, fig. 8  
*Macoma*, 210; pl. 49, figs. 6, 7; pl. 55, fig. 1  
*Spisula*, 237; pl. 55, fig. 8
- U**
- umpquaensis**, *Acteon*, 541; pl. 99, figs. 34, 35, 36  
*Benoistia*, 387; pl. 76, figs. 11, 12  
*Callianassa*, 558  
*Conus hornii* var., 510; pl. 96, fig. 15  
*Gari hornii* subsp. 218; pl. 50, fig. 10; pl. 51, fig. 9  
*Homalopoma*, 299; pl. 64, figs. 20, 21  
*Mathilda*, 309; pl. 64, figs. 34, 35  
*Pseudoliva*, 459; pl. 89, fig. 13  
*Turricula cooperi* subsp., 532; pl. 98, figs. 14, 15  
*Umpquaia*, 434  
subsp. *oregonensis*, 434, 435; pl. 85, figs. 15, 16, 18, 20  
*undiliferum*, *Pseudocardium*, 247; pl. 60, fig. 6; pl. 61, fig. 9  
*Undiscala*, 327  
*unguicula* var. B, *Terebratulina*, 15; pl. 1, fig. 11  
*unganai*, *Crepidula*, 360; pl. 73, fig. 5
- UNGULINIDAE**, 149-151  
*unicarinata*, *Trichotropis (Iphinoe)*, 389, 390; pl. 76, figs. 14, 15, 16

- Upogebia**, 560  
 (Upogebia) eocenica, 560  
**Urosalpinx**, 453  
 hannibali, 453, 454; pl. 88, fig. 14  
*merriami*, 434  
*tejonensis*, 453, 454; pl. 88, fig. 13  
 sp. 454; pl. 88, figs. 11, 12  
*uvasana* subsp. matthewsonii, Crassatellites, 125; pl. 26, fig. 8; pl. 29, fig. 4; pl. 61, fig. 18  
*uvasanus*, Pitar (Calpitaria), 178; pl. 47, fig. 13

**V**

- vaderensis**, Cerithiopsis, 381; pl. 76, fig. 2  
*Conus*, 511, 512; pl. 96, figs. 17, 19, 24, 25  
*Nuculana*, 37; pl. 8, fig. 28  
*Phaenomya*, 260, 261; pl. 61, fig. 14  
*Pyramidella*, 305; pl. 64, figs. 15, 16, 17  
*Raninoides*, 557  
*Tivelina*, 187; pl. 42, figs. 10, 11  
*Turritella*, 371; pl. 74, fig. 8  
**Vaderos**, 391  
*vancouverense*, Argobuccinum, 420, 421; pl. 83, figs. 8, 12  
**vancouverensis**, Acmaea persona subsp., 281, 283; pl. 62, figs. 2, 7  
*Apolymetis*, 221; pl. 50, fig. 17  
*Calyptrea mammilaris* subsp., 353, 354; pl. 72, figs. 5, 7  
*Chione*, 168; pl. 39, figs. 5, 6, 11; pl. 40, fig. 1  
*Cryptomya quadrata* subsp., 207, 251; pl. 49, fig. 1; pl. 59, fig. 13  
*Glycymeris*, 60; pl. 10, figs. 4, 7, 15  
*Homalopoma*, 299; pl. 63, figs. 5, 12  
*Laqueus*, 17; pl. 2, figs. 5, 6  
*Megathura*, 285; pl. 62, figs. 5, 9  
*Mytilus* (*Mytiloconcha*), 105; pl. 24, fig. 4; pl. 25, fig. 8  
 subsp. *sanjuanensis*, Palliolium (*Delectopecten*), 96; pl. 17, fig. 4  
*Pitar*, 182; pl. 43, figs. 7, 10, 12  
*Siderastrea*, 2; pl. 1, figs. 7, 14  
*Semele*, 222, 223; pl. 50, figs. 9, 12, 16  
*Tellina*, 202; pl. 48, figs. 6, 9, 10; pl. 59, fig. 1  
**vanwinkleae**, Pandora, 120, 121; pl. 25, fig. 18  
*Pecten* (*Pseudamuseum*), 93; pl. 15, fig. 4  
*variabilis*, Balanophylilia, 1; pl. 1, figs. 1, 2, 3  
**Venerella**, 193  
 (*Compsomyax*) *newcombei*, 193; pl. 42, fig. 17; pl. 43, fig. 9; pl. 45, figs. 6, 8, 15, 17, 18  
*subdiaphana*, 193  
**Venericardia**, 134  
*aragonia*, 137, 138; pl. 28, figs. 2, 3, 4, 5; pl. 32, figs. 3, 4, 5, 6, 10, 11  
*(Leuroactis) aragonia*, 137  
*castor*, 138, 139; pl. 34, figs. 1, 2, 3  
*chehalensis*, 140  
*clarki*, 135  
*(Venericor)* cf. *clarki*, 136  
*crescentensis*, 137, 138; pl. 32, figs. 8, 9; pl. 33, figs. 1, 2; pl. 38, fig. 7  
*hannai*, 138, 139; pl. 33, figs. 3, 4, 8, 10

- Venericardia**—continued  
*hannibali*, 138, 139; pl. 33, figs. 11, 14  
*(Cyclocardia) hannibali*, 139  
*hornii*, 135  
 var. *aragonia*, 137  
 subsp. *calafia*, 134, 135; pl. 28, figs. 6, 7; pl. 31, figs. 4, 5  
 subsp. *clarki*, 135; pl. 27, figs. 7, 9, 10, 17, 18; pl. 32, fig. 2; pl. 33, fig. 6  
 subsp. *lutmani*, 135; pl. 28, fig. 1; pl. 32, fig. 1  
*imbricata*, 134  
*planicosta hornii*, 135  
*planicosta ionensis*, 137  
*planicosta merriami*, 137  
*subtenta*, 139, 140; pl. 27, figs. 8, 13, 14; pl. 33, figs. 5, 7, 9, 12; pl. 34, fig. 4  
**VENERIDAE**, 162-196  
*veneriformis*, Spisula, 236; pl. 54, figs. 14, 16; pl. 61, figs. 2, 3  
**Venerupis**, 170  
*hermonvillensis*, 193  
*(Protothaca) staleyi*, 170; pl. 39, fig. 17; pl. 104, fig. 3  
 var. *hannibali*, 170, 171; pl. 40, fig. 15  
*staminea*, 170  
*washingtoniana*, 172  
*ventricosa*, Solemya (Acharax), 18, 21, 22; pl. 5, figs. 1, 2, 3  
*Venus aequilateralis*, 194  
*(Chione) angustifrons*, 191  
*bisecta*, 142  
*brevilineata*, 191  
*(Chione) clallamensis*, 162  
*dysera*, 162  
*ensifera*, 164  
*fimbriata*, 152  
*gigantea*, 174  
*imbricata*, 134  
*lamellifera*, 164, 165  
*(Chione) olympidea*, 169; pl. 39, fig. 14  
*pajaroana*, 249  
*parapodema*, 164  
*perforans*, 170  
*pensylvanica*, 143  
*pinguis*, 190  
*(Chione) securis*, 162, 163  
 var. *ensifera*, 164  
*thaca*, 170  
*tumens*, 177  
*victoriana*, 195  
**VERMES**, 3-5  
*Vertipecten*, 86  
*vetusta*, Cancellaria, 504; pl. 96, figs. 2, 3; pl. 103, fig. 4  
*victoriana*, Acmaea, 282; pl. 62, figs. 1, 8, 11  
*Pelecyora*, 195; pl. 45, figs. 13, 14  
*Polinices* (*Polinices*), 355; pl. 68, figs. 10, 11, 12, 14  
**VIVIPARIDAE**, 360-361  
*Viviparus*, 306  
*fluviatorum*, 360

- Viviparus—continued**  
*subpurpureus*, 361  
*washingtonianus*, 361; pl. 73, fig. 8
- Volsella**, 108  
*columbiana*, 112; pl. 25, fig. 15  
*(Brachidontes) cowlitzensis*, 113; pl. 26, fig. 4  
*directa*, 108; pl. 23, fig. 6; pl. 25, fig. 2  
*eugenensis*, 110, 111; pl. 24, fig. 8  
*kelsoensis*, 112; pl. 24, fig. 1  
*(Brachidontes) olequahensis*, 14; pl. 25, fig. 16  
*porterensis*, 111; pl. 24, fig. 2  
*pugetensis*, 109; pl. 23, fig. 13  
*recta*, 108  
*restorationensis*, 109, 110, 111; pl. 24, figs. 10, 11  
*sookensis*, 110, 112; pl. 24, figs. 3, 5, 6, 7  
*trinomina*, 110; pl. 24, fig. 9; pl. 25, fig. 9
- Voluta** glabella, 493  
*nucleus*, 495  
*persicula*, 495  
*reticulata*, 502  
*tornatilis*, 541  
*volutaeformis*, *Pseudoliva*, 458, 459; pl. 89, fig. 20; pl. 103, fig. 5
- VOLUTIDAE**, 491-493
- Volutocorbis**, 493  
*limopsis*, 493  
*oregonensis*, 493; pl. 94, fig. 2
- Volvula** rostrata, 544
- Volvulella**, 544  
*tabori*, 544; pl. 100, fig. 1
- vulgaris**, *Zanthopsis*, 554

**W**

- Waldheimia grayi**, 16
- wardi**, *Aforia clallamensis* subsp., 516; pl. 97, figs. 6, 10
- warneri**, *Cypraeogemmula*, 394; pl. 77, fig. 2
- warreni**, *Conus*, 510; pl. 96, figs. 11, 16
- washburnei**, *Pecten (Chlamys)*, 86; pl. 17, fig. 1  
*Raninoides*, 557
- washingtonensis**, *Acrilla (Undiscala)*, 327; pl. 67, fig. 22  
*Calyptraea*, 352; pl. 71, figs. 19, 22  
*Cancellaria*, 503, 506; pl. 95, fig. 21  
*Crenella*, 115, 116; pl. 25, fig. 4  
*Ectinochilus (Cowlitzia)*, 390; pl. 76, figs. 18, 19, 20, 23, 24  
*Lucina*, 147, 148; pl. 27, fig. 16; pl. 35, fig. 2  
*Mytilus*, 105; pl. 23, fig. 4  
*Nucula*, 34, 35, 37, 41; pl. 8, figs. 3, 8  
*Nuculana*, 38; pl. 8, figs. 18, 20, 26  
*Pandora*, 120, 121; pl. 25, fig. 21  
*Polinices (Polinices)*, 337; pl. 68, figs. 18, 23  
*Scaphander*, 545, 546, 546; pl. 100, fig. 3  
*Siphonalia*, 438; pl. 86, figs. 9, 10, 11, 13  
*Spirotropis*, 521; pl. 97, figs. 13, 14  
*Turridula*, 533; pl. 98, figs. 16, 17, 22  
**washingtoni**, *Strombiformis*, 303; pl. 63, fig. 26  
**washingtoniana**, *Arca (Arca)*, 66, 67; pl. 12, fig. 5  
*Branchioplax*, 554  
*Cerithiopsis*, 383; pl. 76, figs. 3, 4, 5

- washingtoniana—continued**  
*Corbis*, 152; pl. 37, figs. 1, 3  
*Crassatellites*, 126; pl. 30, figs. 1, 2, 4, 5, 6, 7, 8  
*Cryptomya*, 252; pl. 59, fig. 5  
*Fulgurofusus*, 490; pl. 93, figs. 12, 16, 17; pl. 101, figs. 4, 5  
*Mitra*, 497; pl. 95, figs. 8, 9, 16  
*Nekewis*, 531; pl. 98, figs. 11, 18; pl. 103, fig. 11  
*Nerita*, 295, pl. 64, fig. 8  
*Olequahia*, 425, 426; pl. 84, figs. 6, 10, 11  
*Rhynchonella*, 13; pl. 2, figs. 8, 9, 10, 11  
*Turcicula*, 291; pl. 63, figs. 8, 14, 28  
*Venerupis*, 172  
*Whitneyella*, 475, 477; pl. 91, figs. 5, 7, 8, 9, 10, 11  
**washingtonianum**, *Cymatium*, 412, 413, 423; pl. 81, figs. 6, 9, 11, 12  
**washingtonianus**, *Cirrochilius*, 300; pl. 63, figs. 15, 31  
*Viviparus*, 361; pl. 73, fig. 8  
*watersi*, *Mytilus*, 106; pl. 25, fig. 11  
*wattsi*, *Homalopoma*, 298, 299; pl. 64, figs. 11, 14  
*waylandi*, *Pecten (Propeamussium)*, 95; pl. 22, fig. 3  
*weaveri*, *Cancellaria*, 504, 505; pl. 96, fig. 4  
*Cardita (Carditamera)*, 141; pl. 33, fig. 13; pl. 38, figs. 5, 6  
*Conus*, 512; pl. 96, fig. 26  
*Epitonium (Clathrus)*, 310; pl. 65, fig. 1  
*Exilia*, 513, 514, 515; pl. 96, fig. 27  
*Liotia*, 301; pl. 63, figs. 13, 18  
*Macrocallysta*, 176; pl. 41, figs. 1, 2, 3  
*Miopleiona*, 491, 492; pl. 94, figs. 6, 10, 11  
*Natica (Tectonatica)*, 333; pl. 68, figs. 8, 9, 13  
*Nemocardium*, 161; pl. 36, figs. 1, 2  
*Pachydesma*, 188, 190; pl. 44, figs. 11, 14, 15, 16, 21; pl. 46, figs. 2, 5, 10  
*Polinices (Neverita)*, 340, 341; pl. 68, figs. 16, 17; pl. 69, fig. 3  
*Turritellopsis*, 373; pl. 75, figs. 4, 5  
*Whitneyella*, 473  
*huwaldana*, 477; pl. 91, fig. 12  
*coosensis*, 473, 474; pl. 90, fig. 26  
*gabbi*, 475, 477; pl. 91, figs. 1, 2, 3, 4  
*lincolnensis*, 445, 476; pl. 91, figs. 6, 13, 14; pl. 103, fig. 20  
*markleyensis*, 477, 478; pl. 82, figs. 14, 16; pl. 91, fig. 15  
*var. collarus*, 478  
*oregonensis*, 474; pl. 90, figs. 24, 27, 30  
*sinuata*, 473  
*var. aragoensis*, 473; pl. 90, figs. 25, 29  
*washingtoniana*, 475, 477; pl. 91, figs. 5, 7, 8, 9, 10, 11  
*whitmani*, *Nuculana*, 44; pl. 9, fig. 12  
*willamettensis*, *Nuculana*, 41  
*willapaensis*, *Solemya (Archarax)*, 21, 758; pl. 6, figs. 2, 17  
*willapensis*, *Ranidina*, 558  
*williamsoni*, *Macrocallysta*, 173, 174; pl. 39, fig. 12; pl. 43, fig. 6  
*willipaensis*, *Trinacria*, 76; pl. 13, figs. 2, 3  
*willisi*, *Corbicula*, 132; pl. 30, figs. 16, 17; pl. 31, fig. 1  
*Fusinus*, 480; pl. 91, fig. 18

- w**inlockensis, *Glycymeris*, 61; pl. 10, figs. 6, 13  
*Spirotropis*, 520; pl. 97, figs. 5, 8, 9  
**w**inlockiana, *Odostomia*, 306; pl. 64, figs. 23, 24, 30  
**w**ishkahensis, *Glycymeris*, 60, 61, 65; pl. 10, figs. 14, 17  
*Opalia* (*Opalia*), 322; pl. 67, figs. 3, 4, 5  
**w**oodmanense, *Epitonium* (*Boreoscala*) condoni var., 317, 318; pl. 66, figs. 7, 8  
**w**orcesteri, *Turridula*, 533; pl. 98, figs. 19, 20, 23, 24  
**w**orkensis, *Thesbia*, 538; pl. 99, figs. 14, 15, 20  
**w**ynoocheensis, *Megasurcula*, 527; pl. 98, figs. 2, 8  
**w**ynoochenensis, *Cancellaria*, 503, 504, 505; pl. 95, figs. 20, 22  
*Ficus* (*Trophosycon*), 397, 398; pl. 77, fig. 4  
*Macoma arctata* var., 208, 209; pl. 49, fig. 8

**X**

- XANTHIDAE**, 554  
**Xylotrya**, borings of, 4

**Y**

- y**aquinana, *Bruclarkia*, 444; pl. 87, fig. 6  
**y**aquinense, *Pseudocardium*, 244, 245; pl. 57, fig. 6  
**y**aquinensis, *Mursia*, 556  
**Yoldia**, 44  
*astoriana*, 42  
*beringiana*, 52  
*chehalisensis*, 45, 46; pl. 8, figs. 35, 36, 37, 38  
*(Yoldiella) chehalisensis*, 45

**Yoldia**—continued

- clallamensis*, 48, 758; pl. 9, fig. 13  
*cooperii*, 50  
*(Portlandia) cooperii*, 49, 50; pl. 9, fig. 19  
*(Portlandia) duprei*, 46; pl. 7, fig. 16; pl. 9, fig. 9  
*impressa*, 42, 52  
*(Portlandia) impressa*, 42  
*montereyensis*, 52  
*newcombi*, 47; pl. 9, fig. 5  
*olympiana*, 46; pl. 9, figs. 1, 2  
*(Portlandia) oregonia*, 49; pl. 9, figs. 8, 16  
*(Cnesterium) oregonia*, 49  
*(Portlandia) packardi*, 44; pl. 8, figs. 33, 34  
*reagani*, 42, 52; pl. 9, fig. 6  
*sammamishensis*, 48, 49; pl. 9, fig. 3  
*scissurata*, 51  
*var. strigata*, 51; pl. 9, figs. 15, 20  
*strigata*, 51  
*(Cnesterium) strigata*, 51  
*temblorensis*, 50; pl. 9, fig. 4

**Z**

- Zanthopsis**, 554  
*hendersonianus*, 554  
*vulgaris*, 554  
**Zirfaea**, 264  
*gabbi*, 264  
*sp.*, 264; pl. 60, fig. 3













