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TERTIARY FAUNAL HORIZONS OF WESTERN WASHINGTON

by
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INTRODUCTION

The formations of Washington west of the summit of the Cascades are almost entirely of Cenozoic age with the exception of the central core of the Olympic Peninsula, the San Juan Islands and portions of the western slope of the Cascade Mountains. The surface exposures consist largely of sands, gravels and clays of glacial or fluviatile origin and were deposited during the Quaternary epoch. However, in many places exposures of the older Tertiary rocks occur projecting through the poorly consolidated sands and gravels.

Because of the isolated occurrence of exposures of Tertiary formations it is often extremely difficult to determine the stratigraphic relationships of one outcrop to another. Many of the deposits formed contemporaneously in different areas

exhibit marked variations in lithologic character. Faulting and sometimes folding are often concealed so that structural relations in many cases cannot be solved. As a result of these difficulties it becomes very necessary to secure all the palaeontological evidence possible to aid in working out the geologic history of the western portion of the state and to correlate this history with that of other regions to the north and south along the Pacific Coast.

During the last eight years detailed studies have been made by the writer in those areas where formations of Tertiary age are exposed. The stratigraphic relations have been determined wherever possible. An especial effort has been put forth to make extensive collections of fossils and in every case to record exactly where these collections occur within the stratigraphic sections. Among the more recent collections from the lower Oligocene formations many news species occur and are described in this report. A list of localities at which Tertiary fossils have been collected is included as well as faunal lists of all species within the Tertiary of western Washington.

STRATIGRAPHY

During the past fifteen years investigations on the geology and palaeontology of the Tertiary formations of the Pacific Coast have been carried on with considerable zeal. Because of the economic relationship of these deposits as well as the excellent exposures in the field the major portion of this work has been done in California. Up to the present time there has been lack of agreement among many of the workers in the Coast Ranges of California as to how the deposits should be classified and correlated with one another. This condition gives promise of settlement in the near future and presumably a standard can be developed which can be used as a basis for correlation up and down the Pacific Coast. Until such a time has arrived it would seem undesirable to make definite correlations between the deposits and their contained faunas in the north with those in California. Suggestions as to apparent close relationships might well be recorded. Bearing these conditions in mind it would appear to be a wise policy to carry on detailed investigations in restricted areas and place the results upon record so that at a later date they may be available for generalizations. The main purpose of this paper is to bring together the results obtained up to date from studies in western Washington as a basis for more detailed studies in the future.

The Tertiary formations of western Washington consist of shales, sandstones and conglomerates of marine, estuarine and brackish water origin together with intercalated lavas and tuffs. These attain a total maximum aggregate thickness of thirty-four thousand feet, all of which, however, is not represented at any one locality. These materials were formed during the Eocene, Oligocene, lower Miocene and upper Miocene epochs. They have been subjected to deformational movements and in certain areas sharply folded and sometimes faulted. A considerable portion of their original volume has been removed by erosion. That which remains is for the most part deeply buried beneath deposits of glacial drift.

EOCENE

Igneous and sedimentary deposits of Eocene age occur in the western foothills of the Cascade Mountains, in southwestern Washington, in portions of the Puget Sound Basin and around the margins of the Olympic Peninsula. The sedimentary deposits within the western Cascade Mountains are almost entirely of fluviatile and estuarine origin. Those in southwestern Washington are predominatingly marine. The intervening area extending from Puget Sound to the vicinity of Portland, Oregon, contains alternating deposits of marine and brackish water origin together with bands of fresh water shales. Basalts and basaltic tufts are commonly intercalated with all these phases.

In King and Pierce counties Eocene sedimentary formations attain a thickness of at least ten thousand feet. They consist of non-marine sandstones, shales and conglomerates together with carbonaceous shales and coal seams which have been more or less intensely folded. Fossil plant remains occur within these deposits but no marine molluscan remains are known. A few brackish water fossils have been found, several species of which occur associated with the marine and brackish waters faunas in southwestern Washington. Strata containing marine fossils occur between South Seattle and Renton and are characteristic of the upper Eocene or Tejon of California. These strata are directly interbedded with the estuarine deposits occurring to the eastward near Coal Creek and Franklin. Upon the evidence afforded by the occurrence of fossil bearing marine Tejo strata interbedded with the purely estuarine phase as well as the presence of typical Eocene fossil floras, the brackish water deposits of the western foothills of the Cascade Mountains are correlated with the typically marine Eocene deposits of southwestern Washington.

The most complete section of the Eocene in western Washington occurs in southern Lewis County along Olequah Creek and Cowlitz River. The lower portion of this section, as exposed along Stillwater Creek to the southwest of Vader and as far south as Olequah, is of marine origin. Stratigraphically above the base these strata grade into those of brackish water origin and finally into those containing a fresh water fauna. Still higher in the section they revert back to a brackish water condition and finally to a marine. They continue as marine deposits to the top of the section. The total thickness of the section as measured from Olequah to Winlock is approximately 4,000 feet. Stratigraphically below the base of this measured section there are approximately 6,000 feet of sediments and intercalated basalts.

The marine faunas occurring within the measured section are typically upper Eocene and are very similar to the Tejon of California. The uppermost beds as exposed about one and one half miles east of the town of Vader on Cowlitz River at fossil localy No. (1) are possibly the equivalent of the Rimella simplex[1] Zone of the Tejon of California. The strata exposed between Vader and Olequah are

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[1]Dickerson, R. E. Note on the Faunal Zones of the Tejon Group, Univ. Calif. Publ. Bull. Dept. Geol., Vol. 8, pp. 17-25, 1914.

certainly older than those one and one half miles east of Vader as determined by detailed stratigraphic measurements.

A list of all known species occurring in the Eocene of western Washington as well as the localities at which they occur may be referred to in the accompanying tables.

OLIGOCENE

Deposits formed during the Oligocene epoch are for the most part of marine origin. They attain a maximum aggregate thickness of nearly 15,000 feet in the Cape Flattery section. In the Puget Sound Basin and in southwestern Washington they range in thickness from 1,000 to 10,000 feet. Marine fossils are abundant within the Oligocene deposits and constitute several faunal zones.

There does not seem to be sufficient evidence to divide the strata of the Oligocene into a series of formations. Possibly future studies may make such a procedure desirable. At the present time three distinct faunal zones can be recognized and the deposits in which these faunas occur are referred to as the Clallam formation. The faunal zones beginning with the oldest are the Molopophorous lincolnensis Zone, the Turritella porterensis Zone and the Acila gettysburgensis Zone. The corresponding sedimentary deposits containing these zones may be referred to as the Lincoln, Porter and Blakeley horizons. The term horizon is used in the sense of a deposit formed at a particular time and identified by distinctive fossils. The faunas occurring in each of the following zones are distinct and many of the species do not range into the zones below or above.

Molopophorous lincolnensis Zone—The type section in which this fauna occurs is situated in Thurston County along the banks of the Chehalis River between five and ten miles west of the city of Centralia and west of the mouth of Lincoln Creek. Strata of equivalent age occur on Porter Creek to the west, stratigraphically below the Porter Horizon or Turritella porterensis Zone. Lithologically the deposits are composed of somewhat massive sandy shales and shaly sandstones moderatly consolidated.

The most characteristic species of this zone are: *Acila schumardi, Cardium lorenzanum* (Arnold), *Crassatellites washingtonensis* Weaver, *Glycymeris chehalisensis* n. sp., *Leda washingtonensis* n. sp., *Pitaria dalli* n. sp., *Macrocallista pittsburgensis* Dall, *Dentalium substramineum* Conrad, *Calyptraea excentrica* (Gabb), *Exilia dickersoni* Weaver, *Exilia lincolnensis* n. sp., *Hemifusus washingtonensis* Weaver, *Drillia hecoxi* (Arnold), *Natica lincolnensis* n. sp., *Molopophorous lincolnensis* n. sp., *Strepsidura washingtonensis* n. sp., and *Turris thurstonensis* n. sp.

Several species occurring in this faunal Zone also occur in the typical Tejon fauna near Vader. The following species have been noted in common: *Crassatellites washingtonensis* Weaver, *Leda gabbi* Conrad, *Solen parallelus* Gabb, *Dentalium substramineum* Gabb, *Calyptraea excentrica* (Gabb), *Exilia dickersoni* Weaver, *Hemifusus washingtonensis Weaver,* and *Strepsidura washingtonensis* n. sp.

The following species are common to the Molopophorous lincolnensis Zone and the Turritella porterensis Zone: *Cardium lorenzanum* (Arnold), *Crenella porterensis* Weaver, *Dentalium substramineum* Gabb, *Drillia hecoxi* (Arnold), and *Natica washingtonensis* n. sp.

Such forms as *Marcia oregonensis* Conrad, *Phacoides acutilineatus* Conrad, *Thyasira bisecta* (Conrad), and *Thracia trapezoidea* Conrad are entirely absent from the Molopophorous lincolnensis Zone, although they are among the most characteristic species in the Turritella porterensis Zone at Porter. The fauna as a whole is distinct from the Tejon fauna below as well as the Turritella porterensis Zone above.

Turritella porterensis Zone—The starta in which this zone is typically represented are located in Chehalis County in the region where Porter Creek joins Chehalis River. Fossiliferous marine strata occur along the bluffs of Chehalis River both east and west of the town of Porter. These faunas are distinctly different from the underlying Molopophorous lincolnensis Zone as well as the Acila gettysburgensis Zone of the Puget Sound region. The most common species occurring in this zone are: *Cardium lorenzanum* (Arnold), *Crenella porterensis* Weaver, *Malletia chehalisensis* Arnold, *Marcia oregonensis* (Conrad), *Thracia trapezoidea* Conrad, *Thyasira bisecta* (Conrad), *Phacoides acutilineatus* (Conrad), *Drillia hecoxi* (Arnold), *Exilia lincolnenses* n. sp., and *Turritella porterensis* Weaver.

Those forms which are commmon to this Zone as well as to the Molopophorous lincolnensis Zone have already been mentioned. Many of the species occurring in this zone are very common in the Acila gettysburgensis Zone and it is possible that the extreme lower portion of the stratigraphic section exposed at the entrance to the Bremerton Navy Yard may be the equivalent of the upper beds at Porter. However, such species as *Acila gettysburgensis* Reagan, *Macrocallista vespertina* (Conrad), *Modiolus directus* Dall, *Panope generosa* (Gould), *Eudolium petrosum* Conrad, *Turcicula washingtoniana* Dall and *Turritella porterensis* Weaver which are very characteristic of the Acilia gettysburgensis Zone are entirely absent from the *Turritella porterensis* Zone.

Acila gettysburgensis Zone—The type section of the Acila gettysburgensis Zone is to be found within the strata outcropping at the entrance to the Bremerton Navy Yard. Excellent exposures containing marine fossils occur at the south end of Bainbridge Island and also on the opposite shore to the south. The deposits consist of interbedded massive conglomerates and medium grained sandy shales possessing a thickness of at least 9,000 feet. The lowermost exposed strata outcrop at Orchard Point and the highest on the north shores of Blakeley Harbor. Detailed stratigraphic surveys show that the conglomerates at Orchard Point are below the sandstones and shales at Beans Point on Bainbridge Island and that the beds at Beans Point are about two thousasd feet below the fossiliferous strata at Restoration Point. The fauna occurring in the lower portion of the Bremerton

Inlet section are identical with those at the well known locality just north of Restoration Point.

This faunal zone is represented within the city limits of Seattle, Newcastle Hills, Cathcart near Snohomish and along the Strait of Juan de Fuca from a point two miles west of Gettysburg westerly to a point half way between Twin River and Pysht. The conglomerates and overlying shales exposed along the north portion of Cape Flattery and along the Strait of Juan de Fuca easterly to the mouth of Sekiu River also contain faunas belonging to this zone.

The species which are most commonly and abundantly found within this zone are *Acila gettysburgensis* Reagan, *Macrocallista vespertina* (Conrad), *Marcia oregonensis* (Conrad), *Modiolus rectus* Dall, *Panope generosa* (Gould), *Phacoides acutilineatus* (Conrad), *Spisula albaria* (Conrad), *Solemya ventricosta* Conrad, *Tellina oregonensis* Conrad, *Thracia trapezoidea* Conrad, *Thyasira bisecta* (Conrad), *Crepidula praerupta* Conrad, *Eudolium petrosum* Conrad, *Miopleiona indurata* Conrad, *Turcicula washingtoniana* Dall and *Turritella blakeleyensis* Weaver.

LOWER MIOCENE

At the close of the Oligocene epoch there appears to have been a predominately upward movement of the sea floor over a large part of western Washington. The present site of the Puget Sound Basin may have become a land area insomuch as no deposits of lower Miocene age are known to occur within it. Marine deposits of this age occur along the north shore of the Olympic Peninsula between Clallam Bay and Pysht. In this region they possess a thickness of at least 5,000 feet and consist largely of coarse grained massive sandstones, conglomerates and minor amounts of shales. Strata of the same age occur in Wahkiakum County on the Alockaman River about twelve miles north of the town of Cathlamet, as well as in portions of the Grays Harbor region. The faunas within these deposits have a very close relationship to the Arca montereyana Zone of California. The strata containing them may be the equivalent of the Monterey Formation of California. It is possible, however, that the Lower Miocene strata of Washington may represent a greater or less geologic range than the deposits do in California which are commonly referred to as the Monterey Formation. Temporarily only a suggested correlation is made and the strata containing the Arca montereyana fauna in Washington will be referred to as the Wahkiakum Horizon.[2]

A complete list of the species occurring within the Arca montereyana Zone may be found in the faunal lists of the Post-Tejon accompanying this report. The following species are most characteristic of this zone: *Arca montereyana* Osmont, *Chione securis* Shumard, *Diplodonta parilis* Conrad, *Pecten propatulus* Conrad, *Pecten fucanus* Arnold, *Tellina arctata* Conrad, *Panope generosa* (Gould), *Phacoides acutilineatus* (Conrad), *Spisula albaria* (Conrad), *Tellina oregonensis* Con-

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2Weaver, C. E., "A Preliminary Report on the Tertiary Palaeontology of Western Washington," Bull. 15, Wash. Geol. Surv., pp. 19, 1912.

rad, *Venericardia quadrata* Dall, *Chione olympidea* Reagan, *Chione clallamensis* Reagan, *Ficus clallamensis* Weaver, *Crepidula praerupta* Conrad, *Fusinus stanfordensis* (Arnold), *Polynices saxea* (Conrad), *Sinum scopulosum* Conrad, *Dentalium conradi* Dall and *Aturia angustata* Conrad.

UPPER MIOCENE

There is ample evidence in Washington that there occurred during the middle Miocene the most marked crustal movements since the close of the Jurassic. The upper Miocene strata are everywhere unconformable upon the older rocks. The great unconformity of the middle Miocene is not confined to the state of Washington alone, but is just as well defined in Oregon and California. Near the close of the lower Miocene epoch the larger part of western Washington appears to have been elevated above sea level and the older Tertiary sediments more or less folded. Early in the upper Miocene two new embayments were developed. One of these occupied a part of the Grays Harbor region and the other covered a small area near the mouth of the Quillayute River in southwestern Clallam County. In the former area at least 5,000 feet of sediments accumulated and in the latter about 1,000 feet. These deposits consist for the most part of coarse grained brownish sandstones and conglomerates together with minor amounts of shales and sandy shales.

These sediments may be the equivalent of the Empire Formation of Oregon and the San Pablo of California. It is impossible with present evidence to determine whether they represent more or less. These deposits have formerly been referred to by the writer as the Montesano formation but if at some later time there is direct proof that they are the equivalent of the Empire formation, the present name can be dropped and the term Empire be adopted for the upper Miocene of both Oregon and Washington. There is very little variation in the character of the contained faunas from the base to the top of the formation. The faunas, however, occurring at the mouth of Queniult River may represent a slightly higher zone. The term Yoldia strigata Zone is applied to the faunas occurring within this formation from the persistent occurrence of this most common species.

The following species are most characteristic of this zone: *Arca trilineata* Conrad, *Cardium meekianum* Gabb, *Macoma astori* Dall, *Mulinea alta* Weaver, *Mulinea undulifera* Weaver, *Pecten coosensis* Schumard, *Solen sicarius* Gould, *Yoldia strigata* Dall, *Argobuccinum cammani* Dall, *Chrysodomus imperiallis* Dall, *Phalium aequisulcatum* Dall, *Sinum scopulosum* and *Scutella gabbii* Rémond. All of the species occurring within this zone are entirely marine types.

All of western Washington with the possible exception of the Strait of Juan de Fuca appears to have been a land area. No marine deposits are known to occur within the state younger in age than those at the mouth of Queniult River with the exception of late Pleistocene beach sands about the shores of Puget Sound. The history of the Pliocene in western Washington must be sought in terms of diastrophism and erosion.

FAUNAL LOCALITIES IN WESTERN WASHINGTON

1

One and one half miles east of Vader, Lewis County, on the west bank of Cowlitz River in massive sandy shales of marine origin, situated in Section 27, Township 11 North, Range 2 West. Tejon series, upper Eocene. Old locality 3003.

2

On Olequah Creek about one mile above the junction of Olequah and Stillwater creeks, back of the old Cantwell place, in Section 29, Township 11 North, Range 2 West. Tejon series, upper Eocene. Old locality 3002.

3

On a small creek about one third mile from its junction with Brinn Creek, under an old bridge, in Section 25, Township 11 North, Range 3 West. Tejon series, upper Eocene. Old locality 3001.

5

In Lewis County at a ledge just above the junction of Olequah and Stillwater creeks at Vader in Section 32, Township 11 North, Range 2 West. Upper Eocene. Old locality 3004.

6

In Lewis County one mile west of junction of Stillwater and Olequah creeks on the former in Section 30, Township 11 North, Range 2 West. Upper Eocene. Old locality 3005.

7

On Coal Creek, Cowlitz County, one and one half miles north from Inman Polson Logging Company's store.

8

In Coal Creek, Cowlitz County, one mile north from Inman Polson Logging Company's store, in brackish water shales, in Section 35, Township 9 North, Range 3 West. Old locality 3007.

9

In Northern Pacific Railway cut one hundred feet east of Seattle Brewing & Malting Company's brewery at Georgetown, South Seattle, in Section 20, Township 24 North, Range 4 East. Oligocene. Old locality 3008.

10

About one thousand feet south of Alki Point, West Seattle, in Oligocene shales outcropping at the waters edge in Section 15, Township 24 North, Range 3 East. Old locality 3009.

11

At northeast corner of rock outlier at Duwamish station in Section 10, Township 23 North, Range 4 East. Tejon series, upper Eocene. Marine sandstone. Old locality 3010.

12

In Northern Pacific Railway cut one half mile north of Cathcart Station, Snohomish County, in Section 6, Township 27 North, Range 6 East. Locally known as Fiddlers Bluff. Oligocene. Old locality 3011.

13

In marine sandstones on north side of Restoration Point, Kitsap County, opposite Seattle, in Section 12, Township 24 North, Range 2 East. Oligocene. Old locality 3012.

14

On the south fork of Ostrander Creek two hundred feet south from a point where the logging road crosses, which is 1130 feet from the town of Ostrander. In Section 12, Township 8 North, Range 2 West, in brackish water upper Eocene shales.

18

In Cowlitz County in Coal Creek 6500 feet up creek from Inman Polson Logging Company's store. In Section 35, Township 9 North, Range 3 West. Upper Eocene. Old locality 135.

20

In Cowlitz County 13,000 feet up Coal Creek from wagon bridge crossing. Upper Eocene. Old locality 136.

21

In Cowlitz County 14,000 feet up Coal Creek from wagon bridge crossing. Upper Eocene. Old locality 137-B.

22

On east side of Ilwaco Point in Section 4, Township 9 North, Range 11 West, in shales which are interbedded with basalts. At traverse station 32.

23

In bluff on north side of Columbia River one half mile east of the town of Ilwaco in Section 34, Township 10 North, Range 9 West. Probably Oligocene.

24

At Knappton, Pacific County, on north side of Columbia River in bluff back of cook house of Knappton Lumber Mill in Section 8, Township 9 North, Range 9 West. Oligocene. Old locality 139.

25

In Pacific County in bank of Nasel River two and one half miles east of the town of Nasel in Section 11, Township 10 North, Range 9 West. Oligocene. Old locality 140.

27

In Pacific County 700 feet up Alder Creek from its junction with the east fork of Nasel River in Section 15, Township 11 North, Range 8 West, in a fine dark colored tuffaceous shale interbedded with tuffs and basalts. Oligocene. Old locality 151.

28

In Pacific County 12,000 feet up Hull Creek from the hotel at town of Gray's River in Section 6, Township 10 North, Range 7 West. Oligocene. Old locality 154.

29

In Pacific County 15,000 feet up Hull Creek from the hotel at town of Gray's River in Section 6, Township 10 North, Range 7 West. Oligocene. Old locality 155.

30

Sea cliff between Point Grenville and Taholah in Section 13, Township 21 North, Range 13 West. Upper Miocene.

31

In railway cut, O.-W. R. R. & N. Co. one half mile west of Lincoln Creek Station, Lewis County, in Section 36, Township 15 North, Range 3 West. Oligocene. Old locality 181.

32

West of the county wagon bridge over Lincoln Creek in sandy shale, near Lincoln Creek Station. Old locality 180.

33

Six thousand feet east of Helsing Junction on the O.-W. R. R. & N. Co. in Thurston County. Eocene. Old locality 182.

34

In Pacific County on grays River two miles beyond its junction with Blaney Creek in Section 19, Township 11 North, Range 6 West, in a dark tuffaceous shale. Oligocene. Old locality 158.

35

In Pacific County on Nemah River at wagon bridge crossing, four miles east of Nemah post office in Section 33, Township 12 North, Range 8 West. Shales interbedded with basalt. Old locality 167.

36

Exposure at old wagon road trestle along Willapa River at the town of Willapa. In Section 22, Township 14 North, Range 7 West. Oligocene. Old locality 170.

37

In Pacific County at Northern Pacific Railway bridge below Lebam Station in Section 6, Township 12 North, Range 7 West. Oligocene. Old locality 175.

38

At bridge over Chehalis River northwest of Pe Ell station at power station in Section 34, Township 13 North, Range 5 West. Old locality 176.

39

One mile northwest of Pe Ell station in Lewis County on west side of Chehalis River, in Section 33, Township 13 North, Range 5 West. Old locality 177 A.

40

In Northern Pacific Railway cut 67 miles north of Portland.

41

In bank of small creek below Booth's house near junction with Stillwater Creek, in Section 25, Township 11 North, Range 3 West.

42

In railway cut O.-W. R. R. & N. Co. two thousand feet east of the Oakville wagon bridge over Chehalis River, in Section 1, Township 15 North, Range 5 West. Upper Eocene. Old locality 184.

43

In the bluff of Lankner Creek, Chehalis county, 16,000 feet up from the O.-W. R. R. & N. crossing in Section 25, Township 17 North, Range 6 West. Oligocene. Old locality 185.

44

In the bluff of Lankner Creek, Chehlais County, 18,000 feet up from the O.-W. R. R. & N. Co. crossing in Section 25, Township 17 North, Range 6 West. Oligocene. Old locality 187.

45

In the bluff of Lankner creek, Chehalis County, 25,000 feet up from the O.-W. R. R. & N. Co. crossing in Section 33, Township 17 North, Range 6 West.

46

In Chehalis County in O.-W. R. R. & N. Co. cut at culvert 38 east, 24,000 feet west from South Elma, in Section 7, Township 17 North, Range 6 West. Upper Miocene. Old locality 263.

47

Chicago, Milwaukee & St. Paul Railway cut 1000 feet south from O.-W. R. R. & N. Co.'s track in Section 29, Township 17 North, Range 8 West. Lower Miocene.

49

In Section 25, Township 16 North, Range 8 West, on North River, Chehalis County. Lower Miocene.

50

In the banks of Wynoochee River, Chehalis County, 35,000 feet north of Otter Post Office and 12,000 feet south of Reinkens' farm in Section 22, Township 19 North, Range 8 West. Upper Miocene.

51

500 feet north of locality 50 on Wynoochee River, Chehalis County.

52

In bluff on Wishkah River, northwestern part of Aberdeen, at a point where road to Grand Forks first reaches river after leaving Aberdeen in Section 9, Township 17 North, Range 9 West. Upper Miocene. Old locality 711.

53

Wahkiakum County in west bank of Alockaman River in Section 35, Township 10 North, Range 5 West. Lower Miocene. Old locality number 210. **Area trilineata** abundant in nodules.

54

400 feet south of locality number 53 in west bank of Alockaman River. Fossils abundant. Lower Miocene. Old locality 211.

56

In bank of creek in N. W. ¼ of Section 6, Township 9 North, Range 5 West, in Wahkiakum County. Oligocene. Old locality 213.

57

In bluff on branch of Wilson Creek in Section 36, Township 10 North, Range 6 West, Wahkiakum County. Oligocene. Old locality 214.

58

Nasel River. On Pentler's ranch, one mile west of point where wagon road crosses to south side. Oligocene.

59

On Fossil Creek near log dam in east part of Section 10 and west part of Section 11, Township 10 North, Range 6 West, in Wahkiakum County. Oligocene. Old locality 29.

60

Bluff on Chehalis River along O.-W. R. R. & N. Co. track at milepost 37, about four miles west of South Elma, in Section 11, Township 17 North, Range 7 West. Upper Miocene. Old locality 50.

61

Vance logging road at old milepost in coarse grained sandstone in Section 28, Township 18 North, Range 6 West. Upper Miocene. Old locality 51.

63

East branch of Clements logging road south of Montesano in Chehalis County in the Northwest ¼ of Section 28 Township 17 North, Range 7 West. Lower Miocene. Old locality 54.

64

East branch of Clements logging road one half mile east of where county wagon road crosses, in Section 27, Township 17 North, Range 7 West. Lower Miocene. Old locality 55.

65

On east branch of Clements logging road one half mile east of where county wagon road crosses in Section 29, Township 17 North, Range 7 West. Lower Miocene. Old locality 56.

66

On east branch of Clements logging road, one mile west of county wagon road intersection in Section 29, Township 17 North, Range 7 West. Lower Miocene. Old locality 57.

67

Bluff on Chehalis Logging Company road one mile west of Montesano in Section 6, Township 17 North, Range 7 West. Lower Miocene. Old locality 58.

68

Logging railway cut on Sylvia Creek in a conglomerate of upper Miocene age, in Section 32, Township 18 North, Range 7 West. Old locality 59.

69

Along logging railway in cut on Sylvia creek, one half mile north of locality 68 in conglomerates. Upper Miocene.

70

500 feet north of junction of north branch of east fork of Wilson Creek in Wahkiakum County on former, in Section 36, Township 10 North, Range 6 West.

71

Two miles up middle fork of Skamokawa River from junction with main river in Wahkiakum County, Section 32, Township 10 North, Range 6 West. Oligocene. Old locality 216.

72

Wahkiakum County, on McDonald Creek, two miles above its junction with the middle fork of Wilson Creek, in Section 28, Township 10 North, Range 6 West. Oligocene. Old locality 217.

73

Station 31 on Nasel River traverse line, Pacific County, Section 6, Township 10 North, Range 8 West. Oligocene. Old locality 223.

74

Station 34, Nasel River traverse line, Pacific County, in Section 6, Township 10 North, Range 8 West. Oligocene. Old locality 224 a.

75

Station 73, Nasel River traverse line, Pacific County, in Section 25, Township 11 North, Range 9 West. Oligocene. Old locality 229.

76

Station 16, Nasel River traverse line, Pacific County, in Section 6, Township 10 North, Range 8 West. Oligocene. Old locality 231.

77

Station 22, Nasel River traverse line, Pacific County, in Section 6, Township 10 North, Range 8 West. Lower Miocene. Old locality 233.

80

1600 feet above first railroad bridge on Willapa River below Holcomb in Section 25, Township 13 North, Range 8 West. In Oligocene shales. Old locality 240.

81

One half mile up Green Creek from Willapa River in Pacific County in Section 26, Township 13 North, Range 8 West. Oligocene. Old locality 241.

82

1200 feet above highway bridge near mouth of Green Creek. Old locality 242.

83

7050 feet up Green Creek from Willapa River, Pacific County. Oligocene. Old locality 243.

84

7750 feet up Green Creek from Willapa River, Pacific County. Oligocene. Old locality 244.

85

8250 feet up Green Creek from Willapa River, Pacific County, in Oligocene shales. Old locality 245.

86

8880 feet up Green Creek from Willapa River, Pacific County in Oligocene shales. Old locality 246.

87

11,350 feet up Green Creek from Willapa River, Pacific County, in Oligocene shales. Old locality 247.

90

In bluff north side Chehalis River 2240 feet west of Porter station along Northern Pacific Railway track. Oligocene. Chehalis County in Section 21, Township 17 North, Range 5 West. Old locality 260.

92

On North River branch of Chicago, Milwaukee & St. Paul Railway grade 3000 feet north of point where wagon road goes up Vesta Creek, near Chamber's farm, Chehalis County, Section 25, Township 16 North, Range 8 West. Lower Miocene. Old locality 265.

93

22,000 feet up Wynoochee River from Otter Post Office, in S. W. ¼ of Section 5, Township 18 North, Range 8 West. Upper Miocene. Old locality 270.

94

Bluff back of Lincoln School in Hoquiam, Chehalis County. Poorly preserved specimens of **Scutella Gabbi.** Upper Miocene.

96

28,000 feet up Falls Creek from Brooklyn in Pacific County, in Section 10, Township 15 North, Range 6 West. Old locality 281.

97

In Section 34, Township 15 North, Range 7 West, in a small creek entering North River just north of Chehalis-Pacific County line. Lower Miocene. Old locality 282.

98

Bluff on Willapa River, between Holcomb and the railroad bridge west of town in Section 36, Township 13 North, Range 8 West. Oligocene. Old locality 283.

99

On Wishkah River wagon road one mile north of Aberdeen in Section 4, Township 17 North, Range 9 West. Upper Miocene. Old locality 191.

100

On wagon road cut up Wishkah River road one and one half miles below Wishkah Post Office in Section 11, Township 18 North, Range 9 West. Old locality 192.

101

One mile beyond Wishkah Post Office in bank of river in Section 35, Township 19 North, Range 9 West. Upper Miocene. Old locality 193.

102

Station 837 Neah Bay-Cape Flattery traverse. About one half mile west of Kaitlab Point in the cliffs. Oligocene.

103

At station 996, Neah Bay-Cape Flattery traverse. About one mile west of Kaitlah Point in the sea cliffs. Lower Miocene.

105

About 200 feet east of Slip Point light house, west of Clallam Bay on coast line. Lower Miocene. Old locality 92.

109 to 109

At base of cliff, Slip Point, east of Clallam Bay on coast. Lower Miocene. Old locality 92 A.

111

Mouth of Maxfield Creek in southwest ¼ of northwest ¼ of Section 28, Township 28 North, Range 14 West. Old locality 94.

112

Southeast ¼ of northwest ¼ of Section 16, Township 28 North, Range 14 West. Old locality 95.

113

20 feet east of line of Lot 1, Section 27, Township 28 North, Range 14 West.

114

Northeast ¼ of northwest ¼ of Section 27, Township 28 North, Range 14 West. Old locality 96.

115

In brown sandstone on Soleduck River bluff about center of Section 20, Township 28 North, Range 14 West. Old locality 97.

117

Station 161, Wishkah River traverse. In bank of river in Section 30, Township 20 North, Range 8 West, Chehalis County. Upper Miocene. Old locality 2032.

118

Middle fork of Wishkah River 300 feet south of locality 117 in bank of river. Upper Miocene. Old locality 2033.

119

Middle fork of Wishkah River 1200 feet south of locality 117 in bank of river. Upper Miocene. Old locality 2033A.

120

Middle fork of Wishkah River 100 feet south of locality 117 in bank of river. Upper Miocene. Old locality 2034.

121

Middle branch of Wishkah River in east central part of Section 31, Township 20 North, Range 8 West. Upper Miocene. Old locality 2035.

122

Middle branch of Wishkah River, 800 feet west of locality 121. Upper Miocene. Old locality 2036.

123

Middle branch of Wishkah River in south central part of Section 36, Township 20 North, Range 9 West. Upper Miocene. Old locality 2037.

124

Middle branch of Wishkah River 1000 feet southwest of locality 123. Upper Miocene. Old locality 2038.

125

Middle branch of Wishkah River in southwest ¼ of Section 1, Township 19 North, Range 9 West. Upper Miocene. Old locality 2039.

126

One and one half miles north of Hoquiam on road to Copalis in a cut on west side of road, in Section 34, Township 18 North, Range 10 West. Upper Miocene. Old locality 901.

128

At Survey Stake 388 on North River branch of Chicago, Milwaukee & St. Paul Railway in Chehalis County in Section 29, Township 17 North, Range 8 West. Lower Miocene. Old locality 903.

129

In south bank of south fork of Stillaguamish River in Section 11, Township 30 North, Range 6 East, Snohomish County. Oligocene.

130

On west bank of Wilson Creek, Pacific County, one mile west of Willapa Post Office, in Section 21, Township 14 North, Range 8 West. Oligocene.

131

Logging railroad cut one mile west of Montesano, Chehalis County, in Section 1, Township 17 North, Range 8 West. Lower Miocene.

132

North River branch of Chicago, Milwaukee & St. Paul Railway, 300 feet south and up hill from culvert 38 of O.-W. R. R. & N. Co. track in Section 29, Township 17 North, Range 8 West. Lower Miocene. Old locality 1000.

133

North River branch of Chicago, Milwaukee & St. Paul Railway, 200 feet to the southwest from locality 132.

135

Railway cut on North River branch of Chicago, Milwaukee & St. Paul Railway in the northeast ¼ of the northwest ¼ of Section 29, Township 17 North, Range 8 West. Lower Miocene. Old locality 1008.

136

Railroad cut 300 feet west of locality 135. Lower Miocene. Old locality 1009.

137

Bluff in wagon road along east side of Wynoochee River one mile south of Bitter Creek in Section 35, Township 18 North, Range 8 West. Lower Miocene.

138

In bank of Wynoochee River along wagon road 600 feet north of station 137. Lower Miocene.

140

Cut in south side of "Think of Me" hill in East Aberdeen, Chehalis County. Upper Miocene.

141

Northern Pacific Railway cut 3000 feet east of locality 140, Aberdeen.

142

Northern Pacific Railway cut 270 feet east of locality 141, Aberdeen.

144

Stratum 20 feet stratigraphically above that at locality 142 in the Northern Pacific Railway cut east of Aberdeen.

145

In cut at Aberdeen, Chehalis County, at corner Summit and Chehalis streets.

146

Survey stake 110 on Chicago, Milwaukee & St. Paul Railway at Cosmopolis, Chehalis County, in section 23, Township 17 North, Range 9 West. Upper Miocene.

147

Railroad cut on Chicago, Milwaukee & St. Paul Railway track 400 feet east of locality 146.

148

Ocean bluff one mile north of Point Grenville in Section 13, Township 21 North. Range 13 West. Upper Miocene.

151

Log dam number 35 on the west fork of Wishkah River in Section 35, Township 20 North, Range 9 West. Upper Miocene. Old locality number 100.006.

152

100 feet south of locality 151 in canyon of West branch of Wishkah River.

154

North side of Restoration Point, Kitsap County. Oligocene.

155

Small creek emptying into Coal Creek, King County in Section 23, Township 24 North, Range 5 East. Oligocene.

156

Southeast quarter, Section 13, Township 24 North, Range 5 East, one mile west of Lake Sammammish, King County. Oligocene.

157

One mile east of locality 156 in Section 14, Township 24 North, Range 5 East. Lower Miocene.

158

One fourth mile north of Woodman's station on shore of Port Discovery Bay in Section 5, Township 29 North, Range 1 West. Oligocene.

159

300 feet north of locality 158 on east shore of Port Discovery Bay.

160

Bluff at Porter Station in N. P. Railroad cut in Section 22, Township 17 North, Range 4 West. Oligocene.

161

In wagon road cut one half mile east of Porter in Section 27, Township 17 North, Range 4 West. Oligocene.

162

On western shore, Port Townsend Bay, in Section 36, Township 30 North, Range 1 West. Oligocene.

163

On western shore Port Townsend Bay in Section 36, Township 30 North, Range 1 West. Oligocene.

164

At Restoration Point, Kitsap County.

165

Oak Bay on western shore just south of ship canal spit, in Section 7, Township 29 North, Range 1 East. Oligocene.

166

600 feet west of Porter station in Northern Pacific Railway cut, Section 22, Township 17 North, Range 5 West. Oligocene.

167

Wagon road cut on Wilson Creek, Pacific County, in Section 21, Township 14 North, Range 8 West. Oligocene.

168

Old embankment along Willapa River at trestle in Section 27, Township 14 North, Range 8 West, one half mile south of Willapa Post Office, Pacific County. Oligocene.

169

Oakville quarry, in sandstone overlying basalt, one mile west of Oakville, Chehalis County, on Northern Pacific track. Section 19, Township 16 North, Range 4 West. Oligocene.

170

Half Moon Creek, Pacific County, in Section 34, Township 13 North, Range 7 West.

172

Street cut Columbia City, Seattle, at 50th Avenue South, and one and one half blocks south of Ferdinand Street. Oligocene.

173

Street grade Columbia City, Seattle, corner 42nd Street and Juneau Street. Oligocene.

176

Bank of small stream entering Satsop River from west, in Section 23, Township 18 North, Range 7 West. Upper Miocene.

174

Bank of small stream entering Satsop River from west, in Section 23, Township 18 North, Range 7 West. Upper Miocene.

175

Bank of small stream entering Satsop River from west, in Section 23, Township 18 North, Range 7 West. Upper Miocene.

177

Ocean Cliff south from Hoh River in Section 32, Township 26 North, Range 13 West. Probably upper Miocene. Jefferson County.

178

Bluff along south shore of Strait of Juan De Fuca in Clallam County, one and one half miles west of Twin Post Office, Section 22, Township 31 North, Range 10 West. Oligocene.

179

1000 feet west of mouth of West Twin River in Section 22, Township 31 North, Range 10 West. Oligocene.

180

Oak Bay, Jefferson County, in cliff in north half of Section 18, Township 29 North, Range 1 East. Oligocene.

181

Cape Elizabeth, Chehalis County, Section 34, Township 21 North, Range 13 West. Upper Miocene.

182

600 feet south of Keyhole at Cape Elizabeth, Chehalis County. Upper Miocene.

185

One and one fourth miles north of Point Grenville, Chehalis County, Washington, in Section 25, Township 21 North, Range 13 West. Upper Miocene.

187

Cut along street car track in north end of Columbia City, Seattle. Oligocene.

188

King coal mine north of Issaquah, King County, in Section 22, Township 24 North, Range 7 West. Upper Miocene.

189

Conglomerate bank along Silvia Creek, Chehalis County, in Section 32, Township 18 North, Range 7 West. Upper Miocene.

192

Columbia City, Seattle, from hill six blocks west of City Hall. Oligocene.

193

Bluff north side of mouth of Raft River, Chehalis County, Section 21, Township 23 North, Range 13 West. Upper Miocene.

194

At culvert 38, in bluff along O.-W. R. R. & N. Co. track, 14 miles west of South Montesano, Chehalis County. Upper Miocene.

195

Section 25, Township 10 North, Range 9 West. Oligocene. Pacific County.

196

Two miles west of Winlock, Lewis County, in bank of a creek in Section 20, Township 12 North, Range 2 West. Oligocene.

197

Three fourths mile north of Point Grenville, Chehalis County, Washington. Upper Miocene.

199

Cut in left hand branch of Clemment's logging road three fourths mile west of wagon road intersection in Section 20, Township 17 North, Range 7 West.

200

Cut in Northern Pacific Railway one mile east of railroad bridge over Wishkah River at Aberdeen, Chehalis County. Upper Miocene. Old locality number 412.

201

One and one half miles north of Point Grenville in cliffs along ocean.

202

One and three fourth miles north of Point Grenville in cliffs along ocean.

203

500 feet west of railway station at Porter in cut of Northern Pacific Railway, Chehalis County. Former locality 406.

204

Cliff along shore line in northwest ¼, Section 15, Township 22 North, Range 13 West. Upper Miocene. North of Cape Elizabeth.

205

East center portion of Section 9, Township 22 North, Range 13 West, north of Cape Elizabeth. Upper Miocene.

206

Exposure on Germany Creek, Cowlitz County, in Section 12, Township 9 North, Range 4 West. Oligocene.

207

Cut back of Olympia Foundry, South Seattle, King County, in a bluff along east side of Duwamish Valley. Oligocene. North half, Section 20, Township 24 North, Range 4 East.

209

Bluff in main branch of Wishkah River in Section 27, Township 19 North, Range 9 West. Upper Miocene.

215

In Section 29, Township 17 North, Range 8 West, in cut on North River branch of Chicago, Milwaukee & St. Paul Railway.

218

Denny Renton mine Number 2, Second level, in Section 3, Township 22 North, Range 7 East. In brackish water phase of Eocene at Taylor.

219

Denny Renton Coal mine Number 6, at Taylor, King County, in Section 3, Township 22 North, Range 7 East. In brackish water phase of Eocene.

220

One half mile east of Duwamish in a small creek at a point where a well has been sunk, in northwest ¼, Section 11, Township 23 North, Range 4 East. Eocene brackish water strata.

221

Fossil ledge above Franklin wagon bridge in Green River in section 10, Township 21 North, Range 7 East. Brackish water Eocene.

222

Cut in Northern Pacific Railway track, one mile south of Duwamish Station, King County, in Section 14, Township 23 North, Range 4 East. Brackish water Eocene.

224

Section 5, Township 18 North, Range 6 West, in logging road cut, Chehalis County. Upper Miocene, coarse grained cross bedded sandstone.

226

One mile up Olequah Creek above Winlock in Lewis County. Section 29, Township 12 North, Range 2 West. Eocene.

228

Railroad cuts one mile north of Cathcart Station along Northern Pacific Railway. In Section 31, Township 28 North, Range 9 East. Oligocene.

229

Cuts along road and in Wynoochee River banks one mile south of junction with Bitter Creek in Section 35, Township 18 North, Range 8 West. Lower Miocene. Collection of August, 1913. Old locality Number 102.

230

A cut in the north river branch of Chicago, Milwaukee & St. Paul Railway about two miles beyond its junction with the O.-W. R. R. & N. Co. Lower Miocene. Chehalis County. Collected July, 1913.

231

Olequah Creek about three fourths of a mile north of Vader, just south of big bend in creek. A small band of fossils. In Section 29, Township 11 North, Range 2 West. Marine Eocene.

232

West bank and cliff of Cowlitz River, one thousand feet below bend and below locality 233, in Section 28, Township 11 North, Range 2 West. Marine Eocene.

233

West bank and cliff of Cowlitz River at bend in Section 28, Township 11 North, Range 2 West. Fossils in an excellent state of preservation. Marine Eocene.

234

A narrow band of strata in Olequah Creek about three fourths of a mile north of Vader just south of big bend in creek. About eight feet stratigraphically above locality 231. In Section 29, Township 11 North, Range 2 West. Marine Eocene.

235

West bank of the mill pond of the O'Connell Lumber Company up Olequah Creek one half mile above depot at Winlock in Section 28, Township 12 North, Range 2 West. Oligocene. Occurs in residual patches.

236

Stillwater Creek, Lewis County, 2200 feet above its junction with Olequah Creek in Section 30, Township 11 North, Range 2 West. Eocene.

237

Olequah Creek one fourth mile above Vader Station in east bank of creek just north of point where small creek enters Olequah Creek from the east. In Sction 29, Township 11 North, Range 2 West. Eocene.

238

On Olequah Creek three fourths of a mile north of Vader Station in bend just north of anticlinal axis, about five hundred feet south of locality 231. Section 29, Township 11 North, Range 2 West. Eocene.

239

Northeast quarter of Section 25, Township 11 North, Range 2 West, on east side of Cowlitz River three fourths of a mile above ferry on Mr. Greece's farm. Oligocene.

240

East bank of Olequah Creek about one third mile below its junction with Stillwater Creek and just below Northern Pacific Railroad bridge. In Section 32, Township 11 North, Range 2 West. Eocene.

241

Bank of Stillwater Creek about one and one half miles above junction with Olequah Creek in Section 30, Township 11 North, Range 2 West. Marine Eocene.

242

Between localities 233 and 232 in bank of Cowlitz River in Section 28, Township 11 North, Range 2 West. Eocene.

243

Coal Creek, Cowlitz County, at the main camp of the Inman Polson 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, in Section 27, Township 9 North, Range 3 West. Eocene.

244

Bank of Coal Creek, Cowlitz County, about one half mile below Inman-Polson Company's store. Oysters. Section 11, Township 8 North, Range 3 West, near center of section. Eocene.

245

Bank of Coal Creek, Cowlitz County, about one fourth mile down stream from Inman Polson Company's store. An oyster bed about twelve inches thick. In northeast corner of Section 11, Township 8 North, Range 3 West. Eocene.

246

East bank of Coal Creek about one fourth mile below school house in a small sandy ledge at foot of cliff. In Section 35, Township 9 North, Range 3 West, near center of Section. Eocene.

247

Coal Creek, Cowlitz County, about one and one half miles below Inman Polson Company's store at the old dam in the extreme southwest ¼ of Section 11, Township 8 North, Range 3 West. Eocene.

248

Coal Creek, Cowlitz County, about one and one fourth miles down stream below Inman Polson Logging Company's store on the east bank in the canyon. In southeast ¼ of southeast ¼ of Section 10, Township 8 North, Range 3 West.

249

Coal Creek, Cowlitz County, about one and one fourth miles down stream below Inman-Polson Logging Company's store on the west bank of the creek in the canyon and opposite locality 248. Mostly oysters. In Section 10, Tonwship 8 North, Range 3 West. Eocene.

250

Alockaman River in Wahkiakum County about one half mile above the forks on the east fork. A small ledge at the waters edge at the foot of a 30 foot cliff. Near boundary line between Sections 25 and 24, Township 10 North, Range 5 West. Lower Miocene.

251

Alockman River in Wahkaikum County near the center of the southeast ¼ of Section 26, Township 10 North, Range 5 West, on the Clinton Olmstead homestead. Oligocene.

255

In Railroad cut on the O.-W. R. R. & N. Co. one fourth mile north of Lincoln Creek Station in Section 26, Township 15 North, Range 3 West. Oligocene.

256

In Railroad cut on O.-W. R. R. & N. Co. one mile north of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West. Oligocene.

257

North bank of Columbia River, two hundred feet west of the mouth of Sisson Creek in Wahkiakum County in Section 6, Township 9 North, Range 8 West. Oligocene.

258

One half mile west of Twin Postoffice, Clallam County, in sea cliff in Section 27, Township 31 North, Range 10 West. Oligocene.

259

Two miles west of Gettysburg, Clallam County, in sea cliff in northwest ¼, Section 29, Township 31 North, Range 9 West. Oligocene.

261

Cliff on north shore of Columbia River about one half mile east of Knappton, Pacific County. Fossils occur in nodules. In Section 9, Township 9 North, Range 9 West. Oligocene.

262

One and one eighth miles west of Lincoln Creek Station in bluff along O.-W. R. R. & N. Co. in Lewis County. In Section 26, Township 14 North, Range 3 West. Oligocene.

263

Bluffs along bend in Cowlitz River in Section 28, Township 11 North, Range 2 West. Marine upper Eocene.

264

Bluff on south side of Bear River, Pacific County, on line between Sections 20 and 21, Township 10 North, Range 10 West. Oligocene.

265

Bluff on east side of Shoalwater Bay, Pacific County in Section 29, Township 11 North, Range 10 West. Oligocene.

267

East shore of Port Discovery Bay in Jefferson County in Section 5, Township 29 North, Range 1 West. Oligocene.

268

South shore Strait of Juan de Fuca in Clallam County, about three miles west of Piller Point, in Section 32, Township 31 North, Range 12 West. Lower Miocene.

269

Shore of Strait of Juan de Fuca in Clallam County one mile and a half west of the coal mine in Section 23, Township 32 North, Range 12 West. Lower Miocene.

270

Cliff south shore of Strait of Juan de Fuca in Clallam County in Section 21, Township 32 North, Range 12 West. Lower Miocene.

271

Cliff south shore of Strait of Juan de Fuca in Clallam County in Section 22, Township 31 North, Range 9 West, about one thousand feet west of locality 258. Lower Miocene.

272

Cliff south shore of Strait of Juan de Fuca in Clallam County in Section 19, Township 31 North, Range 9 West. About one mile west of locality 259. Lower Miocene

273

Cliff south shore of Strait of Juan de Fuca in Clallam County, in Section 24, Township 31 North, Range 10 West, about one half mile east of east fork of Twin River and just east of rocky bluff. Lower Miocene.

274

Cliff south shore of Strait of Juan de Fuca in Clallam County in Section 21, Township 31 North, Range 10 West. Lower Miocene.

276

Old Washington Geological Survey collection of 1902 from Cowlitz County, in Section 11, Township 9 North, Range 2 West. Eocene. Former locality 3.

277

Old Washington Geological Survey collection of 1902 from Cowlitz County in Section 25, Township 9 North, Range 2 West. The Pecten locality east of Castle Rock. Eocene. Former locality 2.

278

Old Washington Geological Survey collection of 1902 from Cowlitz County in Section 13, Township 9 North, Range 2 West. Eocene. Former locality 4.

279

Old Washington Geological Survey Collection of 1902 from Cowlitz County on Arkansas Creek, three miles west of Castle Rock. Eocene. Former locality 5. Pectens are common.

280

Old Washington Geological Survey collection of 1902. From Lewis County in Chehalis hill one fourth mile southeast of hotel. Eocene. Former locality 6.

281

Old Washington Geological Survey collection of 1902 in Lewis County on Olequah Creek, one mile up creek from Winlock. Former locality 7.

282

Old Washington Geological Survey Collection of 1902 in Cowlitz County twelve miles west of Kelso. Eocene. Former locality 8.

283

Old Washington Geological Survey Collection of 1902 in Cowlitz County twelve miles west of Kelso. Eocene. Former locality 9.

285

One mile west of Oakville, Chehalis County, in Section 19, Township 16 North, Range 4 West. Oligocene.

288

From falls on Scantogrèse Creek near Castle Rock in S. E. ¼, Section 18, Township 9 North, Range 2 West. Eocene.

289

Near an old coal prospect in Section 31, Township 10 North, Range 2 West. Eocene.

290

Near Pecten locality in Section 24, Township 9 North, Range 2 West. Eocene.

291

Near Winlock, Lewis County, in Section 28, on Olequah Creek in bluff near junction of west branch of Olequah Creek west from mill pond. Oligocene.

292

West branch of Olequah Creek one half mile above junction of main creek. Oligocene.

293

North end of big slide on N. P. Railway cut one half mile north of Tenino in Thurston County in Section 17, Township 16 North, Range 1 West. Oligocene.

294

McClarity ranch on south bank of Stillwater Creek one mile west of Vader in Section 30, Township 11 North, Range 2 West. Eocene.

295

One and one half miles north of Vader in Lewis County in bed of Olequah Creek at milepost 73 on Northern Pacific Railway in Section 20, Township 11 North, Range 2 West. Eocene.

296

On Booth Ranch two and one quarter miles up Stillwater Creek from junction with Olequah Creek in Section 24, Township 11 North, Range 3 West. Eocene.

297

On Olequah Creek one eighth mile north of Railway station at Vader in Section 29, Township 11 North, Range 2 West. Eocene.

298

Three fourths mile west of Vader on Stillwater Creek in Section 30, Township 11 North, Range 2 West. Eocene.

299

Rock bluff in N. P. Railway cut 2850 feet south of mile post 76 and three fourths mile north of Olequah Railway station in Section 4, Township 10 North, Range 2 West. Eocene.

300

Banks of Olequah Creek at the old Cantwell place north of Vader in Section 20, Township 11 North, Range 2 West. Eocene.

304

The west end of rock island west of Point Glover quarry near entrance to Bremerton Inlet in Section 8, Township 24 North, Range 2 East. Oligocene.

305

At Beans Point south end of Bainbridge Island in Section 14, Township 24 North, Range 2 East. Middle Oligocene.

FAUNAL LISTS AND GEOGRAPHICAL DISTRIBUTION

Eocene

	LIST OF SPECIES	1	2	3	4	5	6	7	8	11	17	17	18
	Pelecypoda												
1	Avicula pellucida *Gabb*	*											
2	Barbatia morsei *Gabb*					*							
3	Cardium breweri *Gabb*	*				*	*	*				*	
4	Cardium cooperi *Gabb*	*				*							
5	Cardium olequahensis *Weaver*												
6	Corbula hornii *Gabb*	*											
7	Corbula n. sp.	*											
8	Crassatellites washingtonensis *Weaver*					*							
9	Crassatellites grandis *Gabb*	*				*							
10	Crassatellites merriami n. sp.												
11	Crassatellites dalli n. sp.												
12	Crassatellites cowlitzensis *Weaver*												
13	Crassatellites compacta *Gabb*	*				*							
14	Cyrena brevidens *White*		*	*						*			*
15	Corbicula cowlitzensis *Weaver*								*				
16	Corbicula eufaulaensis *Weaver*								*				
17	Diplodonta polita (*Gabb*)	*											
18	Glycimeris sagittata (*Gabb*)							*					
19	Glycimeris eocenica (*Weaver*)												
20	Glycimeris eocenica var landesi (*Weaver*)												
21	Leda vaderensis *Dickerson*	*											
22	Leda gabbi *Conrad*	*		*				*					
23	Leda n. sp.	*											
24	Meretrix hornii *Gabb*	*				*		*					
25	Meretrix uvasana *Conrad*	*					*						
26	Meretrix ovalis *Gabb*					*		*					
27	Meretrix olequahensis *Weaver*												
28	Meretrix longa? *Gabb*												
29	Marcia quadrata (*Gabb*)	*				*		*					
30	Marcia conradana (*Gabb*)	*				*	*	*					
31	Macrocallista andersoni *Dickerson*	*											
32	Macrocallista vaderensis *Dickerson*	*											
33	Modiolus ornatus *Gabb*	*				*	*	*					
34	Ostrea idriaensis *Gabb*	*		*		*		*			*	*	
35	Ostrea olequahensis *Weaver*	*										*	
36	Ostrea fettkei *Weaver*	*		*									
37	Pecten cowlitzensis *Weaver*												
38	Pecten landesi *Arnold*												
39	Placunanomia inornata *Gabb*							*					
40	Psammobia hornii (*Gabb*)	*											
41	Semele diaboli *Dickerson*	*											
42	Solen parallelus *Gabb*	*		*		*	*	*			*		
43	Septifer dichotomus *Gabb*							*					
44	Thracia dilleri *Dall*	*		*									
45	Tellina sutterensis *Dickerson*	*											
46	Tellina longa *Gabb*												
47	Tellina hornii *Gabb*					*							
48	Tellina ooides? *Gabb*												
49	Tellina cowlitzensis n. sp.												
50	Teredo sp.	*											
51	Unio transpacifica *Arn & Hann*	*											
52	Venericardia planicosta *Gabb*	*		*		*	*	*					
	Gasteropoda												
53	Amauropsis alveata *Conrad*	*											
54	Ancillaria bretzii *Weaver*	*											
55	Ambloxus olequahensis *Arn & Hann*												
56	Amphissa eocenica (*Weaver*)	*											
57	Amphissa packardi (*Weaver*)	*											
58	Bursa washingtoniana (*Weaver*)	*	*										
59	Bursa cowlitzensis (*Weaver*)	*											
60	Brachysphingus clarki *Weaver*	*					*						
61	Calyptraea excentricus *Gabb*	*											
62	Crepidula pilea *Gabb*	*											
63	Cylichna costata *Gabb*	*											
64	Cancellaria stantoni *Dickerson*	*											
65	Conus hornii *Gabb*	*				*							
66	Conus remondi *Gabb*	*											
67	Conus Weaveri *Dickenson*	*											
68	Conus cowlitzensis *Dickerson*	*											
69	Cantharus perrini *Dickerson*	*											
70	Drillia ornata *Dickerson*	*											
71	Exilia dickersoni (*Weaver*)	*											
72	Exilia lincolnensis n. sp.												
73	Exilia perkinsiana (*Cooper*)	*											
74	Ficus mamillatus *Gabb*	*				*		*					
75	Fasciolaria buwaldana *Dickerson*	*											
76	Fasciolaria washingtoniana *Weaver*	*				*	*	*					

	20	21	41	42	222	223	217	231	295	232	233	234	235	236	237	238	240	241	242	243	244	245	246	247	248	249	275	275	276	277	278	279	281	282	283
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	LIST OF SPECIES	1	2	3	4	5	6	7	8	11	17	17	18
77	Fusinus lewisensis *Weaver*	*											
78	Fusinus washingtoniana *Weaver*	*											
79	Fusinus willisi *Dickerson*	*											
80	Ficopsis remondi *Gabb*					*		*		*			
81	Ficopsis cowlitzensis (*Weaver*)	*				*	*						*
82	Galeodea tuberculata (*Gabb*)	*				*		*					
83	Hemifusus tejonensis *Weaver*	*											
84	Hemifusus sopenahensis *Weaver*	*						*					
85	Hemifusus lewisensis *Weaver*	*											
86	Hemifusus washingtonensis *Weaver*	*											
87	Lunatia cowlitzensis *Dickerson*	*											
88	Lunatia nuciformis *Gabb*							*					
89	Lunatia hornii *Gabb*	*											
90	Mitra washingtoniana *Weaver*	*											
91	Murex sopenahensis *Weaver*	*											
92	Murex cowlitzensis *Weaver*	*											
93	Murex packardi *Dickerson*	*											
94	Melania packardi *Dickerson*	*											
95	Melania fettkei *Weaver*	*	*										
96	Melania lewisiana *Weaver*	*	*										
97	Melania vaderensis *Dickerson*	*											
98	Monodonta wattsi *Dickerson*	*											
99	Neverita secta *Gabb*	*											
100	Neverita martini *Dickerson*	*											
101	Nerverita weaveri *Dickerson*	*											
102	Nerita cowlitzensis *Dickerson*	*											
103	Naticina obliqua *Gabb*	*											
104	Nyctilochus washingtoniana (*Weaver*)	*											
105	Niso polito *Gabb*	*											
106	Olivella mathewsoni *Gabb*												
107	Olivella n. sp.		*										
108	Pachynilus drakei *Arn & Hann*												
109	Pseudolivia volutaeformis *Gabb*	*											
110	Pseudolivia inornata *Dickerson*	*											
111	Rimella simplex *Gabb*	*											
112	Rimella elongata (*Weaver*)	*				*							
113	Surcula washingtoniana (*Weaver*)					*							
114	Surcula cowlitzensis *Weaver*	*											
115	Siphonalia bicarinata *Dickerson*	*											
116	Turris monolifera *Cooper*	*				*							
117	Turris pulchra *Dickerson*	*											
118	Turritella uvasana *Conrad*	*		*		*	*	*		*			
119	Turritella	*											
120	Turritella	*											
121	Triforis washingtoniana *Dickerson*	*											
122	Urosalpinx *Dickerson*	*											
123	Vipiparus wasingtoniana *Arn & Hann*												
124	Dentalium stramineum *Gabb*	*				*	*	*					
125	Cadulus pusillus (*Gabb*)	*											
126	Nautilus sp.	*											
127	Aturia mathewsoni *Gabb*	*											
128	Rhynchonella washingtoniana *Weaver*	*											
129	Brachyuran remains	*											
130	Fish teeth	*											

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Oligocene and Lower Miocene

	LIST OF SPECIES	9	10	12	13	24	25	29	43	44	45	53	54	56	57	59	63	65	66	67	70	71	73	74	77	80
	Pelecypoda																									
1	Acila shumardi *Dall*	*							*																	
2	Acila gettysburgensis *Reagan*	*																								
3	Acila conradi *Meek*												*	*								*				
4	Anomia subcostata *Conrad*																									
5	Arca trilineata *Conrad*											*	*							*						
6	Arca montereyana *Osmont*											*	*			*	*	*								
7	Cardium lorenzanum (*Arnold*)		*																							
8	Cardium coosensis *Dall*																									
9	Cardium lincolnensis n. sp.																									
10	Cardium vaqueroensis *Arnold*																									
11	Chione securis (*Shumard*)												*													
12	Chione clallamensis *Reagan*																									
13	Chione olympidea *Reagan*																									
14	Chione cathcartensis *Weaver*			*	*																*					
15	Chione temblorensis *Anderson*																									
16	Callocallista arnoldi n. sp.																									
17	Crenella porterensis *Weaver*				*																					
18	Crassatellites washingtonensis *Weaver*																									
19	Crassatellites cowlitzensis *Weaver*																									
20	Crassatellites lincolnensis n. sp.																									
21	Crenella washingtonensis n. sp.																									
22	Glycimeris chehalisensis n. sp.																									
23	Leda washingtonensis n. sp.										*															
24	Leda lincolnensis n. sp.																									
25	Leda chehalisensis *Weaver*																									
26	Leda oschsneri *Anderson*																			*						
27	Macrocallista pittsburgensis *Dall*																									
28	Macrocallista vespertina *Conrad*			*	*																*					
29	Marcia oregonensis *Conrad*		*	*	*						*						*		*	*		*				*
30	Macoma secta *Conrad*																			*						
31	Macoma nasuta *Conrad*																									
32	Macoma calcaria *Gmelin*		*																							
33	Macoma clallamensis *Reagan*																									
34	Macoma wynoocheensis *Weaver*																									
35	Modiolus directus *Dall*		*																							
36	Modiolus inflatus *Dall*																									
37	Malletia chehalisensis *Arnold*								*																	
38	Mytillus mathewsoni *Gabb*																									
39	Mytillus sammammishensis *Weaver*																									
40	Mytillus snohomishensis *Weaver*																									
41	Nucula washingtonensis n. sp.																									
42	Ostraea veatchii *Gabb*																									
43	Ostraea lincolnensis n. sp.																									
44	Ostraea idraensis *Gabb*																									
45	Panope generosa (*Gould*)			*																						
46	Pandora washingtonensis n. sp.																									
47	Pitaria dalli n. sp.																									
48	Pecten propatulus *Conrad*						*						*													
49	Pecten fucanus *Arnold*																									
50	Pecten peckhami *Gabb*									*																
51	Pecten porterensis *Weaver*																									
52	Pecten alockamanensis *Weaver*											*	*													
53	Phacoides actutilineatus (*Conrad*)		*	*	*	*	*	*					*												*	*
54	Phacoides annulatus *Reeves*																									
55	Solemya ventricostata *Conrad*			*				*																		
56	Solen curtus *Conrad*								*							*	*		*			*				
57	Solen lincolnensis n. sp.																									
58	Solen parallelus *Gabb*																									
59	Spisula albaria (*Conrad*)				*								*	*	*	*					*					
60	Spisula catilliformis *Conrad*																									
61	Tapes staleyi *Gabb*											*														
62	Tellina obruta *Conrad*												*	*								*				
63	Tellina lincolenensis n. sp.																									
64	Tellina oregonensis *Conrad*																									
65	Tellina arctata *Conrad*																									
66	Tellina conjesta *Conrad*																									
67	Tellina nuculana *Dall*	*		*																*						
68	Tellina nevadensis *Anderson*																		*	*		*				
69	Thracia trapezoidea *Conrad*			*	*																					
70	Thracia oregonensis *Dall*																									
71	Thyasira bisecta (*Conrad*)		*	*			*																			
72	Venericardia subtenta (*Conrad*)	*		*																*						
73	Venericardia chehalisensis *Weaver*									*																
74	Yoldia oregona *Shumard*																									
75	Yoldia impressa *Conrad*	*	*	*																*						
76	Yoldia submontereyensis *Arnold*											*	*													
77	Yoldia sammammishensis *Weaver*																									

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	Scaphapoda																									
78	Dentalium stramineum *Gabb*																									
79	Dentalium conradi *Dall*		*	*	*		*						*	*	*		*		*	*	*		*	*		*
80	Dentalium porterensis *Weaver*																									
	Gasteropoda																									
81	Acteocina chehalisensis n. sp.																									
82	Ampullina oregonensis *Dall*																									
83	Brachysphingus clarki *Weaver*																									
84	Bittium lincolnensis n. sp.																									
85	Calyptraea excentrica (*Gabb*)																									
86	Calyptraea washingtonensis n. sp																									
87	Calyptraea filosa (*Gabb*)											*	*													
88	Calyptraea inornata (*Gabb*)																									
89	Cancellaria wynootchensis n. sp.																									
90	Cancellaria washingtonensis n. sp.																									
91	Cancellaria condoni *Anderson*											*	*													
92	Cancellaria dalliana *Anderson*											*	*													
93	Chrysodomus washingtonensis n. sp.																									
94	Chrysodomus packardi n. sp.																									
95	Chrysodomus clallamensis *Weaver*																									
96	Crepidula princeps *Conrad*												*													
97	Crepidula praerupta *Conrad*											*	*													
98	Caliostoma delazinensis *Weaver*								*																	
99	Chlorastoma arnoldi *Weaver*								*																	
100	Drillia chehalisensis (*Arnold*)								*																	
101	Cylichnella petrosa *Conrad*								*																	
102	Epitonium washongtonensis n. sp.																									
103	Epitonium condoni *Dall*																									
104	Epitonium rugiferum *Dall*																									
105	Exilia lincolnensis n. sp.																									
106	Exilia dickersoni *Weaver*																									
107	Eudolium petrosum (*Conrad*)	*	*		*						*															
108	Fusinus stanfordensis (*Arnold*)												*													
109	Fusinus corpulentus (*Conrad*)																									
110	Ficus wynootchensis n. sp.																									
111	Ficus chehalisensis n. sp.																									
112	Ficus oregonensis *Conrad*																									
113	Ficus clallamensis *Weaver*																									
114	Hemifusus washingtonensis *Weaver*																									
115	Molopophorous gabbi *Dall*														*						*					
116	Molopophorous biplicata (*Gabb*)																*	*								
117	Molopophrous lincolnensis n. sp.																									
118	Miopleiona indurata *Conrad*																									
119	Mesalia lincolnensis n. sp.																									
120	Nassa chehalisensis n. sp.																									
121	Nassa andersoni *Weaver*																									
122	Nassa arnoldi *Anderson*																									
123	Natica oregonensis *Conrad*	*			*						*	*	*	*	*	*	*		*	*	*					
124	Natica washingtonensis n. sp.																									
125	Natica lincolnensis n. sp.																									
126	Natica lewisii (*Gould*)																									
127	Natica olympidii *Reagan*																									
128	Natica saxea *Conrad*																									
129	Olivella pedroana *Conrad*																									
130	Phalium aequisulcatum *Dall*																									
131	Pisania clallamensis *Weaver*																									
132	Scaphander washingtonensis n. sp.																									
133	Schaphander oregonensis *Dall*																									
134	Strepsidura oregonensis *Dall*														*											
135	Strepsidura californica *Arnold*																									
136	Sinum scopulosum *Conrad*																									
137	Turris perissolaxoides *Arnold*																									
138	Turris thurstonensis n. sp.																									
139	Turris packardi n. sp.																									
140	Turris dickersoni n. sp.																									
141	Turris kincaidi n. sp.																									
142	Turris clallamensis n. sp.																									
143	Turris wynoocheensis n. sp.																									
144	Turcicula washingtonensis *Dall*	*	*		*																					
145	Turritella oregonensis *Conrad*																									
146	Turritella porterensis *Weaver*																									
147	Turritella blakeleyensis *Weaver*				*																					
148	Turritella newcombei *Merriam*	*	*	*																						
149	Brachyuran remains																									
150	Aturia angustata *Conrad*		*										*													
151	Foraminfera sp.																									
152	Sharks teeth																									
153	Hemithyris astoriana *Dall*																									
154	Terebratula oakvillensis *Weaver*																									
155	Terebratalia occidentalis *Dall*	*		*																						

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Upper Miocene

	LIST OF SPECIES	30	46	52	60	61	68	93	94	96	99	100	101	111	112	115	117	118
	Pelecypoda																	
1	Arca trilineata *Conrad*		*		*		*											*
2	Cardium corbis *Martyn*						*									*		
4	Cardium coosensis *Dall*										*							
4	Cardium meekianum *Gabb*													*				
5	Chione securis *Shumard*	*		*	*		*				*			*			*	
6	Chione bisculpta *Dall*						*				*							
7	Chione chehalisensis *Weaver*						*											
8	Chione montesanoensis *Weaver*						*											
9	Cryptomya oregonensis *Dall*						*											*
10	Cryptomya washingtonensis *Weaver*						*											
11	Diplodonta parilis *Conrad*		*		*	*	*			*								
12	Glycimeris gabbi *Dall*						*											
13	Leda Chehalisensis *Weaver*																*	*
14	Leda sp					*												
15	Macoma secta *Conrad*						*											
16	Macoma nasuta *Conrad*					*	*											
17	Macoma montesanoensis *Weaver*					*	*											
18	Macoma calcarea *Gmel*	*																
19	Macoma piercei *Arnold*						*											
20	Mactra coalingensis *Arnold*		*		*		*		*		*			*		*		
21	Modiolus directus *Dall*						*											
22	Mytillus condoni *Dall*					*												
23	Mytillus mathewsoni *Gabb*						*											
24	Mulinea alta *Weaver*					*	*				*							
25	Mulinea undulifera *Weaver*						*											
26	Mulinea landesi *Weaver*					*	*											
27	Marcia oregonensis *Conrad*																	*
28	Nucula conradi *Meek*			*			*				*		*	*				
29	Panope generosa *Gould*																	
30	Phacoides acutilineatus (*Conrad*)													*				
31	Phacoides annulatus *Reeve*			*														
32	Pecten coosensis *Shumard*																	
33	Pecten propatulus *Conrad*																	
34	Solen sicarius *Gould*		*			*	*											
35	Solen conradi *Dall*		*															
36	Spisula albaria *Conrad*		*	*	*		*			*						*		*
37	Spisula catilliformis *Conrad*																	
38	Semele montesanoensis *Weaver*						*											
39	Thracia trapezoidea *Conrad*						*											
40	Thracia oregonensis *Dall*		*															
41	Tellina kincaidii *Weaver*						*											
42	Tellina merriami *Weaver*						*											
43	Tapes staleyi *Gabb*		*			*	*											
44	Venericardia castori *Dall*							*										
45	Yoldia submontereyensis *Arnold*	*																
46	Yoldia strigata *Dall*		*		*									*				
	Gasteropoda																	
47	Argobuccinum cammani *Dall*																	
48	Argobuccinum coosensis *Dall*																	*
49	Bathytoma gabbina *Dall*						*											
50	Bathytoma bogachielli *Reagan*						*							*				
51	Buccinium bogachielli *Reagan*						*							*				
52	Calyptraea filosa *Gabb*						*											
53	Chrysodomus imperiallis *Dall*						*							*				
54	Chrysodomus bairdi *Dall*						*											
55	Chrysodomus giganticus *Reagan*													*				
56	Columbella gauspata *Dall*		*															
57	Crepidula princeps *Conrad*		*		*		*										*	*
58	Calliostoma stantoni *Arnold*																	
59	Cymatium pacificum *Dall*						*											
60	Eulima smithi *Reagan*													*				
61	Eulima washingtonensis *Reagan*													*				
62	Epitonium rugiferum *Dall*						*											
63	Fusinus montesanoensis *Weaver*						*											
64	Gyrineum sylviaensis *Weaver*						*											
65	Gyrineum medorce var corbiculatum *Dall*						*											
66	Liomesus sulcatus *Dall*						*											
67	Nassa andersoni *Weaver*				*													
68	Nassa arnoldi *Anderson*	*	*															*
69	Neptunia maxfieldi *Reagan*						*							*				
70	Olivella pedroana *Conrad*				*									*		*		
71	Polynices galianoi *Dall*						*											
72	Polynices clausa B & S	*	*	*	*		*							*		*	*	
73	Phalium aequisulcatum *Dall*						*		*									*
47	Ranella marshalli *Reagan*													*				
75	Sinum scopulosum *Conrad*		*															
76	Thais etchegoinensis *Arnold*		*															
77	Turris coosensis *Dall*																	
78	Turris perversa *Gabb*																	
79	Scutella gabbii *Remond*						*		*									
80	Dentalium conradi Dall																*	*
81	Teredo sp																	

	119	120	121	123	124	125	126	132a	132	140	141	142	144	145	146	147	148	151	152	163	174	181	182	185	189	193	194	197	200	201	202	209	210	211	215
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DESCRIPTION OF NEW SPECIES

Pelecypoda

GENUS NUCULA LAMARCK

NUCULA WASHINGTONENSIS n. sp.

Plate III, Figures 27, 28 and 29

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 radiating 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.

Occurrence—At locality 230 (University of Washington Palaeontological Collection) situated in a railway cut on the North River branch of the Chicago, Milwaukee & St. Paul Railway about two miles south of its junction with the Grays Harbor branch in Section 29, Township 17 North, Range 8 West.

Horizon—Lower Miocene; Arca montereyana Zone.

GENUS LEDA SCHUMACHER

LEDA WASHINGTONENSIS n. sp.

Plate III, Figures 25 and 26

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; palial sinus short.

Dimensions—Altitude 8 mm.; longitude 20 mm.; thickness 7 mm.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile west and north of Lincoln Creek Station in Section 27, Township 15 North, Range 8 West. In this region the bluffs extend above and below the railway track and for a distance along the track of about one mile. Specimens are exceedingly abundant and in an excellent state of preservation.

Horizon—Lowermost Oligocene which in this report is referred to as the Porter Horizon or Molopophorous lincolnensis Zone.

Leda lincolnensis n. sp.

Plate III, Figures 23 and 24

Description—Shell of moderate size and thickness. Beaks more nearly central than in case of *Leda washingtonensis*. Shell relatively higher and anterior end more broadly rounded than posterior. Surface of shell sculptured by prominent flat topped concentric ribs with interspaces about one and one-half times as wide. Lunule elongate and lanceolate, fairly deep and of about same width as escutcheon; escutcheon deeply impressed and sculptured. Hinge line with 25 anterior V-shaped teeth; interior of chondrophore slightly grooved; palial sinus short.

Dimensions—Altitude 10 mm.; longitude 20 mm.; thickness 8 mm.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile west and north of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene which in this report is referred to as the Porter Horizon or Molopophorous lincolnensis Zone.

genus GLYCIMERS da costa

Glycimeris chehalisensis n. sp.

Plate III, Figures 34 and 35

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 and 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.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile west and north of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene which in this report is referred to as the Porter Horizon or Molopophorous lincolnensis Zone.

GENUS OSTRAEA LINNAEUS

OSTRAEA LINCOLNENSIS n. sp.

Plate I, Figures 5 and 6

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.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

GENUS CRENELLA BROWN

CRENELLA PORTERENSIS n. sp.

Plate III, Figures 41 and 42

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 al-

most equilateral showing faint crenulations near the beaks but none on margins of shell. Beaks are strongly recurved.

This species was named and figured but through error the description was omitted in a report previously published.[3]

Dimensions—Altitude 13 mm.; longitude 18 mm.; thickness 9 mm.

Occurrence—At locality 256 (University of Washington Paleontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

Crenella washingtonensis n. sp.

Plate III, Figure 40

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.

Description—Altitude 3 mm.; longitude 2 mm.; thickness 2 mm.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one-fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

genus PANDORA brug

Pandora washingtonensis n. sp.

Plate II, Figures 19 and 20

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

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[3]Weaver, C. E., "A Preliminary Report on the Tertiary Palaeontology of Western Washington," Bull. 15, Wash. Geol. Surv., pp. 94, 1912.

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.

Dimensions—Altitude 8 mm.; longitude 12 mm.; thickness 3 mm.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

GENUS CRASSATELLITES KRUGER

CRASSATELLITES LINCOLNENSIS n. sp.

Plate III, Figures 31, 32 and 33

Description—Shell heavy, small, sub-quadrate in outline and equivalve; 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 evry slightly concave; anterior end sharply but evenly rounded; posterior dorsal margin straight and sloping downwards at an agle of 10°; posterior end sharply truncate and making an angle with the posterior dorsal slope of 120°; 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.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

CRASSATELLITES MERRIAMI n. sp.

Plate I, Figures 7 and 8

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 arcurate; 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; palial line simple; posterior lateral tooth large and anterior cardinal well developed.

Dimensions—Altitude 19 mm.; longitude 30 mm.; thickness 10 mm.

Occurrence—At locality 241 (University of Washington Palaeontological Collection) on Stillwater Creek about one half mile above junction of Olequah and Stillwater creeks and one fourth mile below crossing of county road in Section 25, Township 11 North, Range 3 West.

Note—This species bears a close resemblance to *Crassatellites cowlitzensis* Weaver. It is, however,, more attenuated posteriorly, thinner, higher and external sculpture less well developed.

Horizon—Tejon formation; upper Eocene.

Crassatellites dalli n. sp.

Plate II, Figures 15, 16, 17 and 18

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 downwards 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; palial line simple.

Note—This species is extremely common in the Tejon Eocene of Lewis and Cowlitz counties. It is most often associated with a fauna chiefly made up of *Ostraea idraeensis* and *Venericardia planicosta.* The specimens are usually excellently preserved so that all portions of the shell may be readily studied. This species is named in honor of Dr. W. H. Dall of the U. S. National Museum, whose

investigations have made known the general character of the Tertiary faunas of the Pacific Northwest.

Dimensions—Altitude 64 mm.; longitude 77 mm.; thickness 38 mm.

Occurrence—At locality 241 (University of Washington Palaeontological Collection) on Stillwater Creek about one mile above junction of Olequah and Stillwater creeks in Section 25, Township 11 North, Range 3 West.

Horizon—Upper Eocene; Tejon formation.

GENUS CARDIUM LINNEUS

CARDIUM LINCOLNENSIS n. sp.

Plate III, Figures 36 and 37

Description—Shell small, sub-quadrate 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.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

GENUS CALLOCALLISTA A. ADAMS

CALLOCALLISTA ARNOLDI n. sp.

Plate II, Figure 13

Description—Shell of medium size, thin and sub-quadrate 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 slowing down from 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 grove 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; palial sinus deep and extending in one-third the length of the shell.

Dimensions—Altitude 18 mm.; longitude 22 mm.; thickness 10 mm.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

GENUS PITARA ROMER

PITARIA DALLI n. sp.

Plate I, Figures 1, 2, 3 and 4

Description—Shell of medium size, inflated and ovate to sub-quadrate; 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° to a point one-fourth the length of the shell from the posterior end; from this point it becomes more sharply rounded and slopes at an angle of 45° to the posterior end which 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; palial 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.

Occurrence—At locality 256 (University of Washinton Palaeontological Collection) in railway cuts on the O.-.W R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

GENUS TELLINA LINNEUS

TELLINA LINCOLNENSIS n. sp.

Plate III, Figure 30

Description—Shell small, moderately convex and sub-rectangular 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 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.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

TELLINA COWLITZENSIS n. sp.

Plate II, Figure 14

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 anterior 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.

Occurrence—At locality 248 (University of Washington Palaeontological Collection) one and one-fourth miles down stream from the Innman-Polson Logging Company's Store in a gray sandstone in bank of Coal Creek, Cowlitz County, Section 11, Township 8 North, Range 3 West.

Horizon—Upper Eocene; Tejon formation.

GENUS SOLEN LINNEUS

SOLEN LINCOLNENSIS n. sp.

Plate II, Figures 9, 10, 11 and 12

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; palial sinus broad but short.

This form differs from *Solen parallelus Gabb* in that it is much shorter and the anterior end is much more obliquely truncated.

Dimensions—Altitude 19 mm.; longitude 62 mm.; thickness 11 mm.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

Gasteropoda

GENUS EPITONIUM BOLTEN

EPITONIUM WASHINGTONENSIS n. sp.

Plate IV, Figures 46 and 47

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°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

GENUS CALYPTRAEA LAMARCK

CALYPTRAEA WASHINGTONENSIS n. sp.

Plate III, Figure 44

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 *Calyptraea 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°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

GENUS NATICA SCOPOLI

NATICA WASHINGTONENSIS n. sp.

Plate V, Figures 73, 74, 75 and 76

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 simliar 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. This form is much narrower and elongate than *Lunatia oregonensis* Conrad.

Dimensions—Altitude of shell 14 mm.; altitude of spire 3 mm.; maximum diameter of shell 11 mm.; angle of spire 60°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

NATICA LINCOLNENSIS n. sp.

Plate V, Figures 71 and 72

Description—Shell very high, elongate-ovate and with five whorls; spire highly elevated but not so much as in the case of *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; umbillical opening large; aperture semi-oval; many specimens show distinct color banding.

Dimensions—Altitude of shell 30 mm.; altitude of spire 5 mm.; maximum diameter 24 mm.; angle of spire 100°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

GENUS MESALIA GRAY

MESALIA LINCOLNENSIS n. sp.

Plate V, Figure 85

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; longitundinal 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°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

GENUS FICUS BOLTEN

FICUS WYNOOCHENSIS n. sp.

Plate III, Figures 38 and 39

Description—Shell of moderate size; sub-pyriform and evenly rounded; whorls five; body whorl large; spire very low; surface of body whorl ornamented by thirty 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°.

Occurrence—At locality 229 (University of Washington Palaeontological Collection) in shaly sandstone in the east bank of Wynooche River one half mile below the mouth of Bitter Creek in Section 35, Township 18 North, Range 8 West.

Horizon—Lower Miocene; Arca montereyana Zone.

Ficus chehalisensis n. sp.

Plate V, Figure 84

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°.

Occurrence—At locality 229 (University of Washington Palaeontological Collection) in shaly sandstone in the east bank of Wynoochee River one half mile below mouth of Bitter Creek in Section 35, Township 18 North, Range 3 West.

Horizon—Lower Miocene; Arca montereyana Zone.

genus NASSA lamarck

Nassa chehalisensis n. sp.

Plate V, Figures 69 and 70

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 recticulated 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°.

Occurrence—At locality 230 (University of Washington Palaentological Collection) in sandy shale in railroad cut two miles south of the junction of the North

River branch of the Chicago, Milwaukee & St. Paul Railway with the main Grays Harbor branch, in Section 27, Township 17 North, Range 8 West.

Horizon—Lower Miocene; Arca montereyana Zone.

GENUS CHRYSODOMUS SWAINS

CHRYSODOMUS LINCOLNENSIS n. sp.

Plate V, Figure 86

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 callused; 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°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

CHRYSODOMUS PACKARD. n. sp.

Plate IV, Figures 57 and 58

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 prominenet 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 botttomed 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°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

GENUS STREPSIDURA SWAINS

STREPSIDURA WASHINGTONENSIS n. sp.

Plate V, Figures 81, 82 and 83

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 callused, 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.

Note—This species is close to *Strepsidura oregonensis* Dall. It differs in that

all specimens have a much 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 end of canal. Each whorl of the spire is about twice as high as in the case of *Strepsidura oregonensis.*

It differs from *S. californica* in the character of the finer ornamentation and the longitudinal ribbing.

Dimensions—Altitude of shell 34 mm.; altitude of spire 12 mm.; maximum diameter of shell 21 mm.; angle of spire 60°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

Strepsidura lincolnensis n. sp.

Plate IV, Figures 62 and 63

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 callused 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 columela.

Dimensions—Altitude of shell 41 mm.; altitude of spire 10 mm.; maximum diameter of shell 26 mm.; angle of spire 65°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

GENUS MOLOPOPHOROUS GABB

MOLOPOPHOROUS LINCOLNENSIS n. sp.

Plate IV, Figures 60 and 61

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 smooth; inner 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°.

Occurrence—At locality 256 (University of Washington Paleontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

GENUS CANCELLARIA LAMARCK

CANCELLARIA WYNOOTCHENSIS n. sp.

Plate IV, Figures 51, 52 53 and 54

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 channelel; 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 callused; canal short and slightly deflected outwards; two rather distinct plications are present on the lower end of the collumela; 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°.

Occurrence—From shaly sandstone in east bluff of Wynoochee River one-half mile below mouth of Bitter Creek in Section 33, Township 18 North, Range 8 West. At locality 229 (University of Washington Palaeontological Collection).

Horizon—Lower Miocene; Arca montereyana Zone.

Cancellaria washingtonensis n. sp.

Plate V, Figures 77 and 78

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° 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 collumela; 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°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W .R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

genus EXILIA

Exilia lincolnensis n. sp.

Plate IV, Figures 49 and 50

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°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

GENUS TURRIS BOLTEN

TURRIS CLALLAMENSIS n. sp.

Plate IV, Figure 59

Description—Shell large and solid with nine or ten whorls which are moderately inflated; each whorl is sharply angulated by well defined carniae 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°.

Occurrence—At locality 258 (University of Washington Palaeontological Collection) one half mile west of Twin River, Clallam County, in Section 22, Township 31 North, Range 10 West.

Horizon—Lower Miocene; Arca montereyana Zone.

TURRIS WYNOOCHEENSIS n. sp.

Plate V, Figure 65

Description—Shell small and solid with five and one-half whorls, each of which is sharply angulated; spire of about same length as body of whorl; body

whorl sculptured with nine distinct revolving ribs below the angle and within the interspaces there is a fine revolving thread; between the last upper revolving rib and the angulated portion of the whorl there are five closely set very inconspicuous revolving threads; between the angle and suture there are ten similar lines; this ornamentation is crossed by numerous closely set lines of growth which conform to the slightly developed posterior sinus; on the angle of each whorl there are thirteen prominent nodes which disappear above and eblow. Aperture moderately wide; outer lip sharp; inner lip slightly callused; canal slightly extended with well defined sinus at the end; upper margin of each whorl developed into a collar which partly covers the suture; angle of the body whorl very close to the suture.

Dimensions—Altitude of shell 23 mm.; altitude of spire 11 mm.; maximum diameter of shell 8 mm.; angle of spire 37°.

Occurrence—At locality 229 (University of Washington Palaeontological Collection) in shaly sandstone on the east bluff of Wynoochee River one half mile below mouth of Bitter Creek in Section 35, Township 18 North, Range 8 West.

Horizon—Lower Miocene; Arca montereyana Zone.

Turris kincaidi n. sp.

Plate V, Figure 67

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 a 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°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

Turris dickersoni n. sp.

Plate V, Figure 66

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 wi h 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°.

Occurrence—At locality 256 (University of Washington Paleontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

Turris thurstonensis n. sp.

Plate V, Figures 79 and 80

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 callused 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°.

Occurrence—At locality 256 (University of Washington Palaeontological Col-

lection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

Turris packardi n. sp.

Plate V, Figure 64

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 sub-pyriform; 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°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

genus ACTEOCINA gray

Acteocina chehalisensis n. sp.

Plate IV, Figures 55 and 56

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-channeled 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°.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 27, Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorous lincolnensis Zone.

GENUS SCAPHANDER MONTF.

SCAPHANDER WASHINGTONENSIS n. sp.

Plate V, Figure 68

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.

Occurrence—At locality 256 (University of Washington Palaeontological Collection) in railway cuts on the O.-W. R. R. & N. Co. one fourth mile northwest of Lincoln Creek Station in Section 26. Township 15 North, Range 3 West.

Horizon—Lowermost Oligocene; Molopophorus lincolnensis Zone.

PLATES

EXPLANATION OF PLATE I

All figures approximately natural size

Fig. 1. *Pitria dalli* n. sp. An inner view of specimen of left valve.....p. 41

Fig. 2. *Pitaria dalli* n. sp. An outer view of specimen of left valve.....p. 41

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All figures approximately natural size

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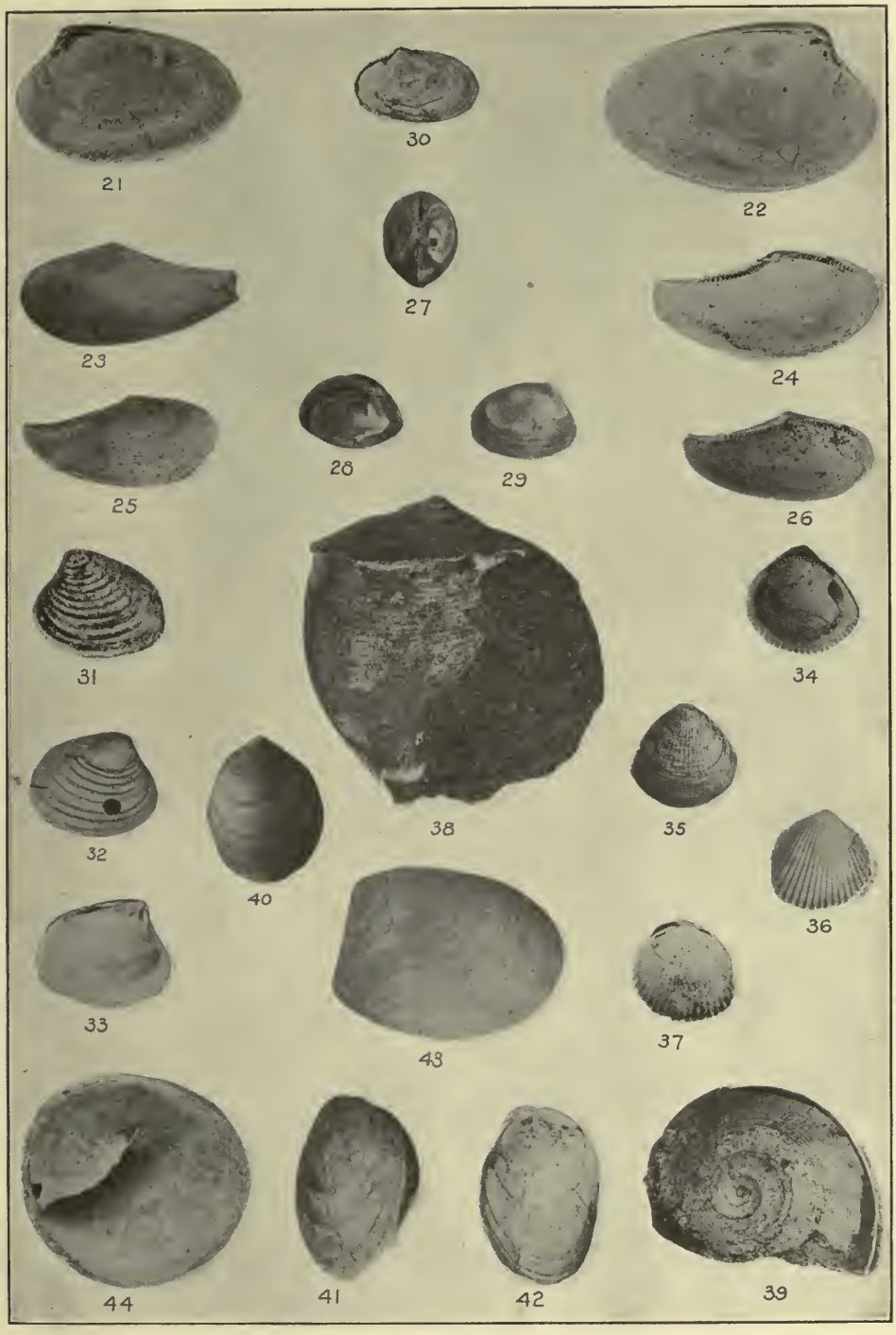
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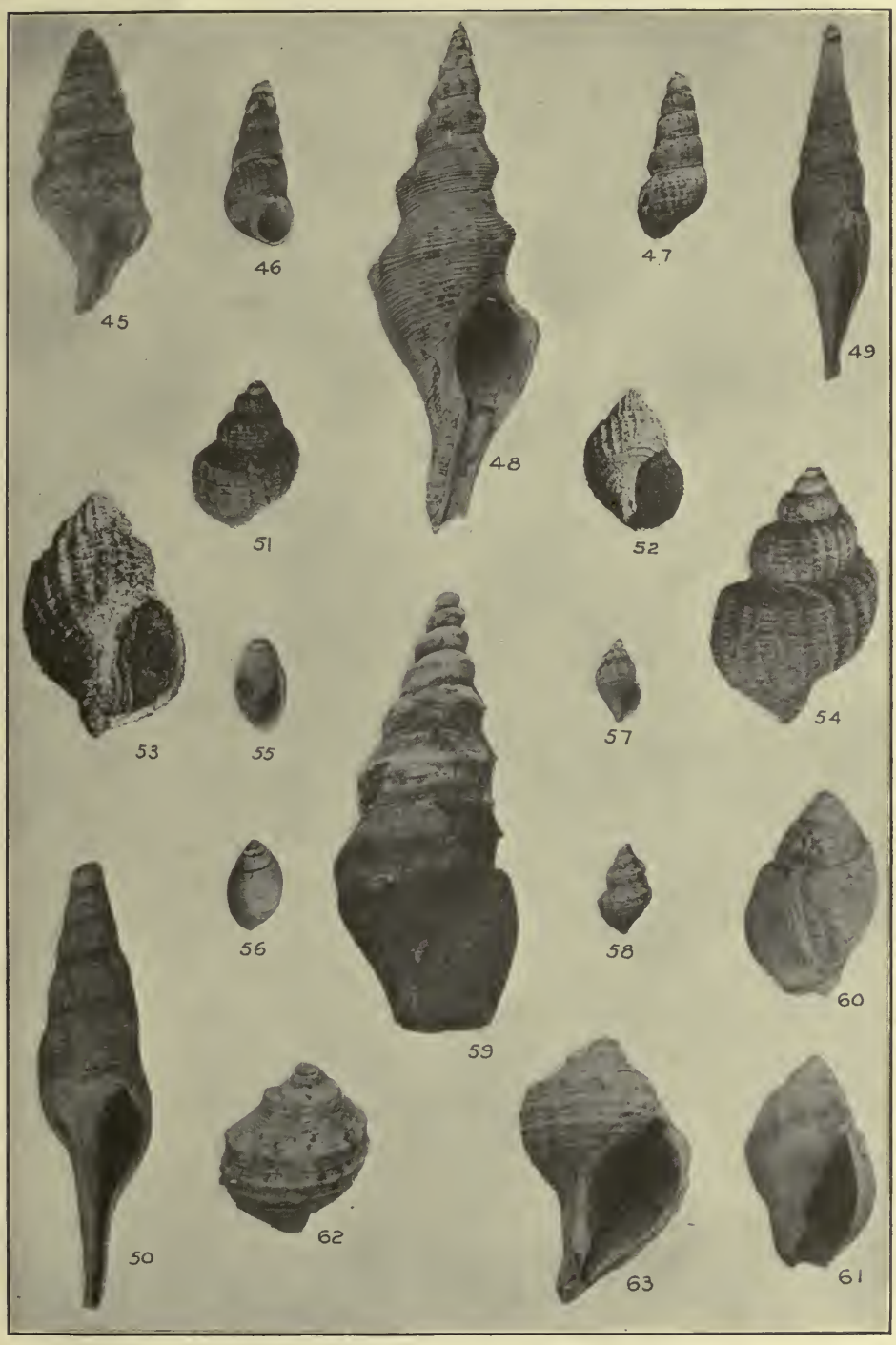
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EXPLANATION OF PLATE V

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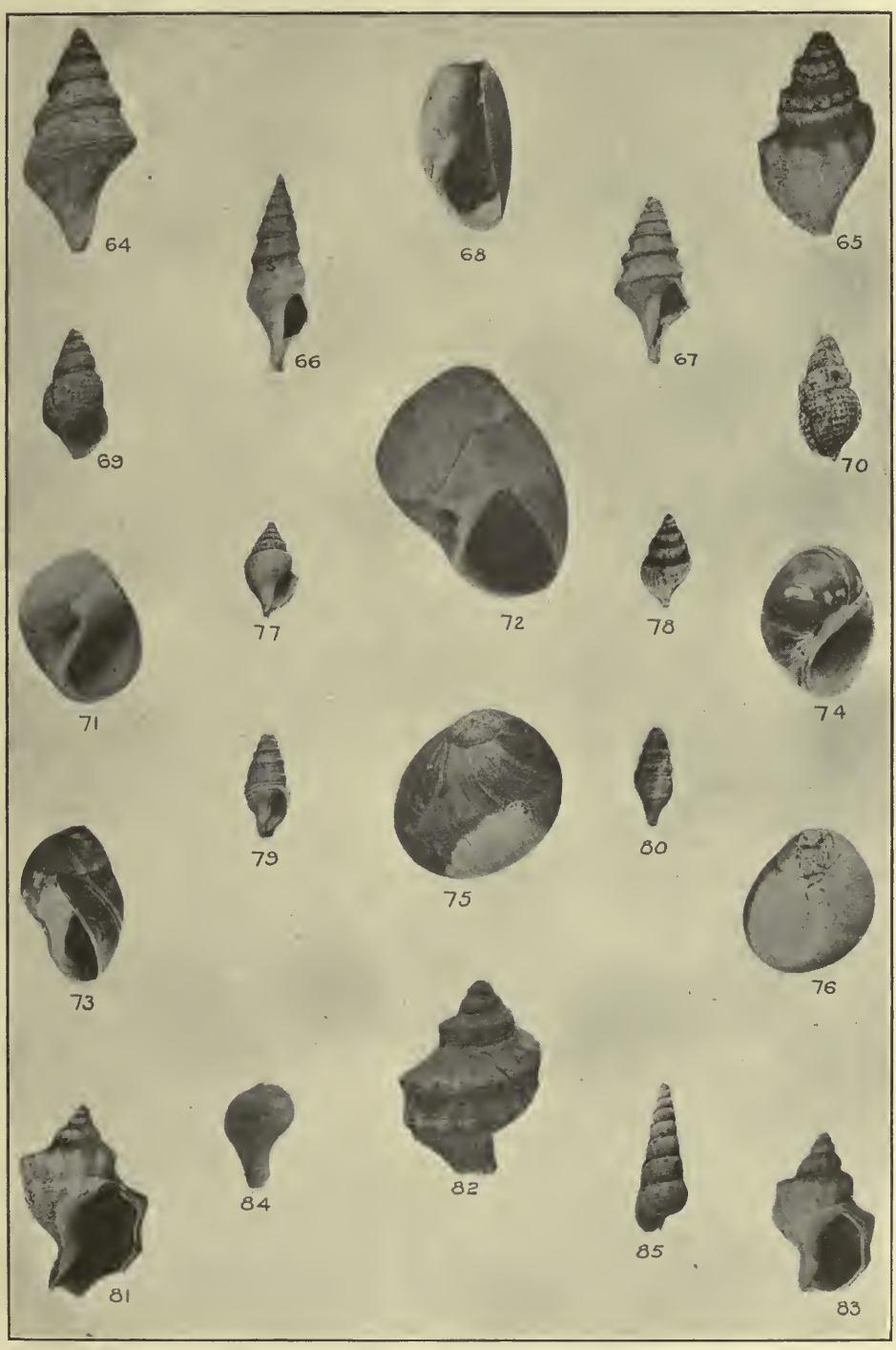
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