DEPARTMENT OF THE INTERIOR UNITED STATES GEOLOGICAL SURVEY. PROFESSIONAL PAPER 59. CONTRIBUTIONS TO THE TERTIARY PALEONTOLOGY OF THE PACIFIC COAST. I. THE MIOCENE OF ASTORIA AND COOS BAY, OREGON

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PROFESSIONAL PAPER 59

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I. THE MIOCENE OF ASTORIA AND COOS BAY, OREGON

BY

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THE MIOCENE OF ASTORIA AND COOS BAY, OREGON.

By WILLIAM HEALEY DALL.

INTRODUCTION.

The object of the present memoir is not merely to describe and illustrate the fauna of a particular Tertiary horizon of the Pacific coast of the United States, although the larger portion of the work is devoted to that purpose. The literature of Pacific coast paleontology is scattered, much of it is inaccessible except in large libraries, and, though various worthy papers have appeared from time to time, no general revision of the nomenclature of the fossils has been made, and until recently the material for thorough monographic study has not existed anywhere. In the last few years large collections have been made under the auspices of the United States Geological Survey by members of its staff. These collections are now beginning to be sufficiently large for serious study, though, owing to the poor state of preservation so common in the Tertiary of the Pacific coast, this will prove a task much less easy and rapid than is possible with the well-preserved fossils of the Atlantic Tertiaries.

The work must proceed slowly and publication of the results will be possible only at intervals and, as it were, piecemeal. The present is the first of what I hope may prove a series of contributions to a better knowledge of the Tertiary faunas of the Pacific States.

I have aimed to describe and illustrate the Miocene fauna of the Empire formation of Coos Bay, Oregon, and the unfigured species of the Astoria group of Columbia River, and to revise and bring to date the systematic nomenclature of the species described or known from both localities. The description or illustration of a few species from other localities on the coast has been added when it seemed that these species would aid, by comparison or otherwise, in the elucidation of the fauna under consideration.

I have had the kind assistance of Dr. F. W. True, of the United States National Museum, in working up a remarkable fossil sea lion whose remains occur in the Coos Bay Miocene.

In view of the great difficulty in getting access to some of the early short papers on Pacific coast paleontology by T. A. Conrad and others, the text of a number of the more important of these papers has been included among the appendices to the main portion of the work. The student is thus enabled to consult a practically exact reprint of the originals. The text figures to the first paper ever printed on the invertebrate fossils of Oregon are also reproduced, as they have not been elsewhere refigured and the original paper is of great rarity.

In 1856 and 1863 the late Dr. Philip Pearsall Carpenter made reports to the British Association for the Advancement of Science "On the present state of our knowledge of the Mollusca of the northwest coast of America." These reports, published in 1857 and 1864, respectively, have been of the utmost value to students of the Tertiary and recent molluscan faunas of the coast. They not only analyzed the existing literature from the beginning, but systematized the data contained in it in a masterly way and at the cost of great labor. Since the death of Doctor Carpenter a large number of papers on the shells of this region, recent and fossil, have appeared, some of them in out of the way places. It was thought that a bibliography bringing the subject up to date—comprising all known papers issued since the publication of Carpenter's reports and including some titles omitted or imperfectly presented in the report of 1857 and the reprint of papers by Carpenter issued by the Smithsonian Institution in 1872—would be of value to students. Such a bibliography, gathering the titles to the output of some forty years of scientific activity, has been compiled and added to the series of appendices.

I have had the use of material and books belonging to the United States National Museum and of sundry specimens from the collection of Stanford University and the University of California; also the cooperation of Prof. W. B. Clark, of Johns Hopkins University; Dr. Ralph Arnold, of the United States Geological Survey, and many private correspondents on the Pacific coast, for which I desire to express my gratitude.

THE TERTIARY OF ASTORIA.

In Dana's report on the geology of the United States Exploring Expedition under Wilkes [a] he refers briefly to the Astoria Tertiaries as follows:

> The Tertiary rocks were first seen on the Columbia in the vicinity of Astoria. They occur along the shores of this river for 20 miles from the sea, though occasionally interrupted by basalt as at the settlement Astoria. * * * These sedimentary deposits, according to the reports of the officers of the *Vincennes*, prevail to the north of the Columbia and upon the shores of Puget Sound. They were observed by the writer 10 miles north of the Columbia in a stream emptying near Gray's Bay.
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> We have already stated that the Tertiary formation of Oregon occurs in various places from Puget Sound to San Francisco, along the * * * Straits of De Fuca, the Cowlitz, the lower Columbia, the Willamette Valley, and the Elk. * * * The thickness of this formation on the Columbia and Willamette is in many places 1,000 or 1,200 feet. As * * * the rocks had evidently been much removed by denudation it is probable that 1,500 feet is even too low an estimate for the whole height above the present sea level. The rocks of the formation are soft sandstones more or less argillaceous and schistose, and clay shales, either firm or crumbling, besides basaltic tufa or conglomerate.
>
> In many localities the argillaceous shale contains nodular concretions of limestone. These concretions are often very regularly spherical and vary from half an inch to 6 feet in diameter, though if

[a] Dana, J. D., Geology: U. S. Expl. Exped. 1838–1842, vol. 10, under command of Charles Wilkes, U. S. N., Philadelphia, 1849, pp. 626, 651, 652, 654, 657, 659.

exceeding a foot the form is more irregular. * * *. They are often very abundant, and as they fall out from the crumbling precipice the plain at foot becomes covered with these balls of stone.

The concretions often contain a fragment of wood, a fossil shell, a crab's leg or bones of fish. * * * Fossils rarely occur in the shales where these concretions are found, except they are inclosed in some of the concretions. No solid layer of limestone was observed in any part of the sandstone formation. These nodules occur along the Columbia, east of Astoria, in sufficient abundance to be procured and burnt for lime. They were also observed in the shale of Elk River.

The layers of sandstone and shale are generally horizontal. The sandstone continues to the water's edge on the north shores [of the Columbia], while on the south banks of shale at least 200 feet thick border the river. Above this height the shale is covered by the soil. * * *

The shale in the vicinity of Astoria contains numerous fossils. Those to the eastward are embedded in calcareous nodules and are consequently well preserved, while those in the cliffs down the river lie unprotected in the shale and have suffered from compression. The specimens collected include numerous shells of Mollusca, minute Polythalamia, besides the legs of a crustacean, an echinoderm, the remainder of four species of fish, and some cetacean vertebræ. * * *

The fossils of Astoria have been examined and described for this report by Mr. T. Conrad, and the following are his conclusions with regard to the age of the deposits:

"From the investigation of the fossils previously received from Mr. Townsend, I had arrived at the conclusion that they were of the geological era of the Miocene, and the specimens you sent confirm the opinion. I do not recognize, it is true, any recent species of the coast of California or elsewhere, but neither is there any shell of the Eocene period, nor has the group any resemblance to that of the Eocene. On the contrary, the forms are decidedly approximate to those of the Miocene period which occur in Great Britain and the United States. *Nucula divaricata*, for instance, closely resembles *N. cobboldiæ* (Sowerby) of the English Miocene, and *Lucina acutilineata* can scarcely be distinguished from *L. contracta* (Say), a recent species from the Atlantic coast and found in the Miocene beds of Virginia. *Natica heros*, a shell of similar range, is quite as nearly related to the *N. sarea*. A similar number of species might be obtained from some of the Miocene localities of Maryland or Virginia, and yet no recent species be observed among them. In the Eocene, and also in the Miocene strata, there are peculiar forms which obtain in Europe and America, and although the species differ, yet they are so nearly allied that this character alone, independent of the percentage of extinct forms, is quite a safe guide to the relative ages of remote fossiliferous rocks. On this foundation I speak with confidence when I assign the fossils of the Columbia River to the era of the Miocene."

These observations of Conrad, however liable to criticism in minor details, afford good evidence of his acuteness in recognizing the salient features of a fossil fauna and in referring it approximately to its proper place in the geologic column. Nevertheless, some years later he modified his opinion, and in a paper issued in 1865[a] he expressed himself as follows:

The fossil shells of the United States Exploring Expedition, collected at Astoria, and published in Dana's report on geology and paleontology, were referred by me to the Miocene period. A larger acquaintance with Tertiary fossils in general has led me to the conclusion that their position is in the older Eocene, and that they correspond in their horizon to the group of Shark River, Monmouth County, N. J., holding in common the *Aturia ziczac*. The shells of Shark River being in the form of casts, not sufficiently characteristic for comparison with those of Oregon, the *Aturia* is the only species that is certainly common to the two localities; but several of the Oregon species are almost identical with shells of the London clay of Bracklesham and Bognor.

This modification of Conrad's views in regard to the age of the Astoria group was doubtless due to his growing sense of the incongruity of the presence in an American Miocene formation of such forms as *Aturia*, *Miopleiona*, and *Tropho-sycon*. This feeling was to a certain extent justified, but the idea that the fauna of the miscellaneous concretions picked up at the foot of the Astoria bluff was not all derived from beds of a single age seems not to have occurred to him.

[a] Am. Jour. Conch., vol. 1, 1865, p. 159. See also Proc. Acad. Nat. Sci. Philadelphia, for 1865, p. 71.