TERTIARY FOSSILS DREDGED OFF THE NORTH-EASTERN COAST OF NORTH AMERICA.[1]

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The U. S. Fish Commission selected as its summer station for 1878 the port of Gloucester, Mass. During the season the fishermen were interested in the collecting work of the Commission and brought in many specimens from the various fishing banks. Among these were small masses of rock which had been tangled in the trawl and which contained numerous fossils. These were obtained from the Grand Banks, Banquereau, and George's Banks, and were the subject of a brief note by Professor A. E. Verrill in the same year.[2] The examination having been hasty, some of the determinations of species require revision. Having been requested to report on this material, it forms the basis of the present paper.

There can be little doubt that late Cretaceous and Tertiary fossiliferous deposits originally existed along the northeastern coast from Newfoundland southward, as far as the area of glaciation extended, though in most cases the only evidence remaining is the presence in the glacial débris of fragmentary portions of the original deposits. The only coast localities north of New York which have been found to contain Tertiary invertebrate material in undisturbed position are Gay Head, on Martha's Vineyard, where Miocene and traces of Pliocene strata have been reported,[3] and perhaps the mostly Pleistocene beds at Sankaty Head, Nantucket Island.[4]

On the other hand, from Continental glacial deposits have been obtained fossil remains of Cretaceous,[5] Eocene,[6] Miocene, and later age, those of the Pleistocene abundantly.

In 1885, dredgings of the U. S. Fish Commission off the Carolina coast included numerous casts of shells in a hard shaly matrix, mostly much water worn but with some recognizable species, among which *Pecten raveneli* Dall, a Pliocene

[1] By permission of the Director of the U. S. Geological Survey.

[2] This Journal, 2nd ser. 16, Oct. 1878, p. 323.

[3] Dall, W. H., this Journal, 48, Oct. 1894, pp. 297-301.

[4] Wilson, J. H., Journ. Geology, XIII, No. 8, Nov.-Dec., 1905, pp. 713-734.

[5] Verrill, this Journal, 47, Feb. 1894, p. 101; Hollick, Trans. New York Acad. Sci., XVI, Dec. 1896, pp. 11-16.

[6] Crosby, Proc. Boston Soc. Nat. Hist. 20, Feb. 5, 1879, p. 138.

species, was determined. This occurs in the Caloosahatchie marls of Florida.[7]

In 1892 Dr. H. A. Pilsbry obtained together with *Buccinum undatum, Urosalpinx cinereus,* and *Chrysodomus stimpsoni* of unusual dimensions, an extinct species which he named *Chrysodomus stonei,* all of which had been cast up on the New Jersey coast during severe gales from the southeast.[8] The latter species was subsequently obtained from the Miocene beds at Gay Head, Martha's Vineyard, thus establishing its age.[9]

It may be noted that both on the southeast coast of the United States and the Northwest coast of the continent where Pliocene beds occur in a definite relation to those of earlier and later age, the indications of the fauna are that the temperature at the time of deposition was notably warmer than in immediately earlier or later periods, and also that a freer communication existed between the Atlantic and Pacific Coasts than has obtained later. Thus we find in the Pliocene of Nome, Alaska, *Littorina palliata*[10] Say, our common New England periwinkle, not known living now west of the Atlantic, and in the Sankaty Head deposit, *Macoma incongrua* Martens, and *Serripes laperousei* Deshayes, only known living on the Alaskan coast.[11] Harmer has recently found traces of Pacific coast influence in the Pliocene of Iceland, including the genus *Searlesia,* as well as of the European North Sea fauna as previously shown by Mörch.[12] Both influences will be found in the faunas treated in the present paper.

The material studied was enclosed in a matrix of sandstone, usually very hard, with a multitude of fragments of shell sometimes almost forming a coquina rock; much of it represented only by casts or molds; the shelly matter when present in the majority of cases has the external coat removed. Molds of the bivalves show ravages of erosion, *Cliona* borings, and attached worm tubes. In short the difficulties of identification have been considerable and that of the species must in many cases remain doubtful. In general, however, the few exceptions are usually sufficient to determine the age, at least approximately.

[7] Trans. Wagner Free Inst. of Science, 3, p. 721, 1898.
[8] Nautilus, vol. 7, No. 6, p. 67, pl. III, figs. 1.-3, Oct. 1893. Proc. Acad. Nat. Sci. Phila. for 1892, p. 328.
[9] Nautilus, vol. 8, No. 7, p. 84, Nov. 1894.
[10] U. S. Geol. Survey, Prof. Paper 125 c, pp. 23-37, Jan. 1920.
[11] Journ. of Geology, XIII, No. 8, Nov.-Dec. 1905, p. 726.
[12] Geological Magazine, 8, No. 9, Sept. 1871, pp. 1-10.

Lot No. 4. Upper Cretaceous.

Parts of a boulder obtained by Captain Ludwig Olson of the schooner William Thomson, on the east part of Banquereau, Nova Scotia, at a depth of 200 fathoms. Innumerable crushed fragments in a flinty matrix.

Gryphaea vesicularis Lamarck.
Cyprimeria ? cf. *gabbi* Stephenson.
Crassatellites cf. *conradi* Whitfield.
Nucula sp. cf. *amica* Gardner, and *stantoni* Stephenson.
Solyma sp. cf. *lineolata* Conrad.
Veniella cf. *carolinensis* Conrad.
Corbula subgibbosa Conrad?
Striarca cf. *umbonata* Conrad.
Anchura sp. (perhaps new).
Turritella sp. (3 to 5 sparsely beaded spirals).
Morea cf. *reticulata* Stephenson.
Volutoderma? sp. (internal cast).

Lot 2. (Miocene or Pliocene.)

A boulder secured from Banquereau by Henry Crowell, and presented by Mrs. Mercy E. Davis.

Venericardia n. sp.
Gemma sp.?
Cyprina sp. fragment.
Cardium sp.
Antiplanes sp.? (Pacific genus).
Aurinia sp. cf. *mutabilis* Conrad (internal cast).
Mangilia sp.? fragment.
Mold of spire (of *Olivella?*).
Colus (*Aulacofusus*) small species.
Pyrula sp. fragment.
Alectrion (*Tritia*) sp. fragment.
Euspira, fragment.
Tachyrhynchus sp.
Fishbone?

Lot 1. (Pliocene?)

All from a single boulder obtained by Sidney Friend of Gloucester, Mass., from George's Banks.

Very large thin bivalve, not determinable.

Nucula cf. *expansa* Reeve.
Spisula n. sp.? like *procera* Solander, but the anterior end shorter.
Cyprina cf. *islandica.*
Cardium sp., decorticated fragment, like *ciliatum* Fabricius.
Cardium fragment, like *pinnulatum* Conrad.
Solen sp. (European type).
Print of fragment of a Pecten.
Astarte sp. n.? (decorticated).
Hinge mold of *Nucula* sp.
Angulus politus Say.
Fragment of indeterminable bivalve.
Small Lucinoid bivalve.
Acteon sp., fragment.
Lora sp.? young.
Ilyanassa isogramma Dall (Mio-Pliocene).
Alectrion (*Tritia*) *trivittatoides* Whitfield, Pliocene.
Pyrula harrisi Glenn?
Tachyrhynchus sp. (defective).
Fragment of Naticoid gastropod.
Small *Euspira* sp. with peripheral light and two brown spiral bands.
Colus (*Aulacofusus*) sp. cf. *spitsbergensis* Reeve.
Siphonal end of *Ancistrolepis* sp. (Pacific type).
Indeterminable gastropod.
Fish vertebra?

Lot 5.

Part of E. P. Sayward boulder from George's Banks. Received from D. W. Low of Gloucester, Mass.

Solen sp. (European type).
Cyprina sp., internal cast.
Aulacofusus sp., fragmentary impression.

Lot 6. (Pliocene?)

From a boulder secured by J. D. Lloyd, from George's Banks.

Venericardia n. sp.? *cf. nuculina* Wood, British Crag.
Venericardia n. sp.? like *borealis* Conrad, but with more and less prominent radial ribs.

Large species of *Isocardia,* nearest to the *I. ignolea* Glenn, of the Miocene, but probably new.

Semele? sp.

Cardium cf. *patuxentium* Glenn, Miocene.

Dentalium, fragment of a smooth species.

Lora sp.

Littorina sp.? fragment.

Euspira, fragment.

Opalia sp. Pacific type, almost identical with the *O. wroblewskii* Mörch (*borealis* Gould), of Alaska and British Columbia.

Fragment of *Echinus* test.

Lot 7.

Specimens from George's Banks obtained by W. M. Gaffney.

Indeterminable bivalves, perhaps *Astarte.*

Lot 8.

George's Banks, obtained by Captain Curtis.

Mya truncata Linné, variety with pallial sinus deeper than in the recent form. Also a small *Anomia* and an impression of a fragment of a large thin bivalve.

Lot 9. (Pleistocene?)

Boulder from George's Banks, obtained by James Mansfield's Sons, of Gloucester, Mass.

Fine impression of a *Panomya,* probably a new species, not the recent *norvegica.*

Lot 10.

Specimens of *Turritella,* close to *variabilis* var. *cumberlandiana* Conrad (Miocene), and said to be identical with one obtained by Captain Curtis from George's Banks.

Lot 11.

Supposed to be from George's Banks.

Partial cast of a Lucinoid bivalve.

Lot 12.

Supposed to be from George's Banks.

Mya truncata Linné, variety, cast, similar to the specimen in Lot 8.

Lot 13. (Eocene?)

Boulder from George's Banks, obtained by J. D. Lloyd of Gloucester, Mass.

Solen sp., small, of European type.

Indeterminable bivalve.

Internal cast of *Schizaster* sp., not one of those already known from the early Tertiary, but having the petals more widely triangular and shorter. Probably undescribed.

Lot 14.

From George's Banks, obtained by Smith and Oakes.

Fragment of a gastropod resembling *Paladmete*.

Lot. 15.

Fragments of a boulder from George's Banks, presented by Pettingell and Cunningham.

Angulus sp., cf. *productus* Conrad.

Nucula sp., like young *proxima* Say.

Fish bones.

It may be noted especially that the *Solen* which appears in several of these lots is a distinctly European type not represented in our recent fauna, and that the presence of a species of *Isocardia* different from any in our known fossil faunas, recalls the Icelandic Pliocene in which two or more species occur. The genus is not represented in American recent faunas.

I am under obligation to Dr. T. W. Stanton, U. S. G. S., for coöperation in identifying the Cretaceous material.

All of this material is now in the Peabody Museum of National History, Yale University.