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IV
TERTIARY AND PLEISTOCENE MOLLUSCA
FROM THE GALAPAGOS ISLANDS

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EDITOR'S NOTE

During 1905 and 1906 an expedition from the California Academy of Sciences spent 18 months in the exploration of the Galapagos Islands. Very large collections were made in several branches of natural history and the present report contains descriptions of the fossil Mollusca. Geology, paleontology and conchology were in charge of Mr. Ochsner and the material he assembled far exceeded in quantity and importance that secured in these branches by any previous or subsequent expedition. A preliminary notice giving a brief summary of the geological and paleontological results was published in 1924 by Dr. Dall.¹

Previous reports on the Expedition of 1905-1906 have been published as: Proceedings of the California Academy of Sciences, 4th Ser., Vol. I, Vol. II, Pts. 1, 2, Nos. 1-18.

Various circumstances have contributed to delay the publication of the final reports on the fossils and land shells until this time although the manuscript has been almost complete for several years. In the meantime both authors have died². The final preparation of the manuscript for the printer has been undertaken by Dr. G. Dallas Hanna and his part has been made possible through hearty cooperation of all interested persons; especially should be men-

¹ (Note on fossiliferous strata on the Galapagos Islands explored by W. H. Ochsner of the Expedition of the California Academy of Sciences in 1905-6. <Geol. Mag., Vol. 61, No. 723, 1924, pp. 428-9.)

² Dr. Dall in Washington, D. C., March 27, 1927, and Mr. Ochsner in Portland, Oregon, April 11, 1927.

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tioned the following, to all of whom the Academy is very grateful: Mrs. Hilda Carling Ochsner; Mr. Charles H. Shaw; Mr. Randolph V. Whiting and Mr. Henry F. Wrigley.

The actual descriptions of the fossils were drawn by Dr. Dall. Except for the necessary changing of four new specific names and the addition of fuller locality data from Mr. Ochsner's notes, this portion of the paper remains as submitted. All locality data and general notes were supplied by Mr. Ochsner. Most of this material is taken almost verbatim from his note books, written in the field. The sketch maps and sections are tracings from originals found in these note books, now deposited in the Academy. The original base map was the U. S. Hydrographic Office sailing chart of the Galapagos Islands.

It was the expressed wish of both Dr. Dall and Mr. Ochsner that the report on the fossils should appear under joint authorship.

The plates of fossils have been made from photographs taken by Dr. Hanna.

—*Editor*

INTRODUCTION

The fauna of the Galapagos Islands has been the subject of much discussion. The islands have been held by some to have been a part of the American continent, separated by subsidence of a connecting area; others have considered them to be a permanently isolated group formed by volcanic action and built from the depths of the ocean by volcanic ejections. Still another hypothesis is that they form the remnants of an outlying archipelago of a former Pacific continent now submerged below the sea.

A discussion of the recent fauna by eminent specialists has led to the conclusion that in large part it is of American derivation, modified by long isolation. This is especially true of the land animals, while the marine invertebrates, although predominantly of American affinities, also include a small proportion of forms now more characteristic of the Pacific islands to the westward and southward. However, the marine invertebrate fauna of Clarion Island, one of the nearest to the Galapagos, so far as yet explored, is of a strictly Indo-Pacific type and presents a strong contrast to the fauna of the Galapagos.

One of the most interesting and important of the discoveries made by the Academy's Expedition of 1905-1906 was the discovery of fossil Mollusca in several places.

Formerly it was supposed that the islands were wholly of volcanic origin, or at least destitute of fossil-bearing sedimentary rocks. The discovery of these not only affords a clue to

the minimum age of the Galapagos group, but also an indication of the sources from which its fauna has been derived.

It is known that about the end of the Oligocene period, or in the early Miocene, a movement in elevation of the earth's crust in the Panamic region resulted in the union of the continents of North and South America and the closing of the gap between them through which the Eocene marine fauna of the north and west shores of South America had previously extended.

It seems a reasonable hypothesis that, during the widespread volcanic activity of the Miocene, the Galapagos group, or its preexisting nucleus, underwent enlargement and elevation, a process which the discoveries made by the Academy's expedition show continued, perhaps intermittently, into Pleistocene time.³

The characteristics of the fossils collected are, with hardly an exception, typically American. The faunas are tropical, as might be expected, but there is nothing of a typical Indo-Pacific nature, although some of the species belong to groups widely distributed in tropical seas, both of America and elsewhere.

While most of the species belong to groups now represented in the Panamic fauna there are a few which recall forms now existing only on the Antillean side, and quite a number which belong rather to the subdivision of the Panamic fauna now existing in the Gulf of California, than to the warmer waters of the Gulf of Panama. The inference might be drawn from this that at the time the Galapagos fossil forms were living, the temperature of the local seas was somewhat cooler than at present.⁴

COLLECTING STATIONS

Albamarle Island.—About $1\frac{1}{4}$ miles northeast of the settlement of Vilamil, Albamarle Island, Locs. 802, 803 (C.A.S.). The locality is reached from the settlement by

³ Mr. Joseph R. Slevin of the department of herpetology of the Academy and who was a member of the 1905-1906 expedition, visited the islands again in December, 1927, and reports violent volcanic activity on Narborough Island on December 13.—*Editor.*

⁴ It is suggested from the present study that the fossils from Albamarle Island are Pleistocene in age while those from Indefatigable and Seymour are Pliocene.

4. *Conus indefatigabilis* Dall & Ochsner, new species

Plate 2, figure 4

Shell rather large, of about 10 whorls, the nucleus lost, the suture excavated, without spiral sculpture, the shoulder in the early whorls with a cord-like keel which becomes sharper in the later ones; the anal sulcus deep, the suture appressed, and the whorl between the shoulder and the suture sculptured with concentric lines in harmony with the sulcus; anterior portion of the whorl straight-sided, rapidly attenuated, a slight convexity near the shoulder; surface smooth except a few spiral sulci near the anterior end. Height, 57 mm.+; height of last whorl, 50 mm.+; maximum diameter at the shoulder, 34 mm.

Holotype: No 2905; *paratype*: No. 2906, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from lowermost horizon (zone A) on east shore of Indefatigable Island, Galapagos Group. Probably Pliocene.

This species is perhaps nearest to *Conus regularis* Sowerby living from the Gulf of California to Panama.

5. *Conus academicus* Dall & Ochsner, new species

Plate 2, figure 5

Shell of moderate size with an acute apex and slightly concave sides to the spire, with about eight whorls excluding the (lost) nucleus; suture distinct, not channelled or turrated; surface between the sutures axially sculptured with hardly curved, close-set incremental lines and very slightly excavated; shoulder rounded, surface in front of the shoulder two-thirds of the distance toward the anterior end smooth, slightly convex; the anterior third sculptured with distant grooves, the interspaces wider and smooth, the grooves becoming closer and more channelled anteriorly, about four on the body and six or seven more crowded on the region of the canal; aperture long and narrow, the inner lip smooth, the canal short, straight, and as wide as the aperture behind and hardly differentiated from it. Height of shell, 31 mm.; aperture, 25 mm.; maximum diameter at the shoulder, 16 mm.

Holotype: No. 2907; *paratypes*: Nos. 2908, 2909, Mus. Calif. Acad. Sci., collected by W. H. Ochsner and Joseph R. Slevin, November 17, 1905, from upper horizon (zone D), on **east shore of Indefatigable Island, Galapagos Group**. Probably Pliocene.

6. ***Conus loomisi*** Dall & Ochsner, new species

Plate 2, figure 6

Shell of moderate size, solid, with a slightly concave, acute spire, and about 12 whorls exclusive of the (lost) nucleus; suture distinct, whorls between the sutures excavated, marked only with concavely retractive incremental lines, corresponding to a sulcus at the aperture; shoulder well marked but rounded; body in front of the shoulder with slightly convex sides, constricted somewhat behind the canal; sculpture of the posterior half of the body obsolete, consisting of very narrow incised lines with much wider flat interspaces; on the anterior half of the body these lines gradually become wider excavated channels, numbering about eight on the canal, which in the adult has a marked siphonal fasciole, there being three or four more grooves; aperture narrow, wider anteriorly; canal deep, wide, very slightly recurved. Height, 44 mm.; height of last whorl, 38 mm.; diameter at shoulder, 22 mm.

Holotype: No. 2910; *paratypes*: Nos. 2911, 2912, Mus. Calif. Acad. Sci., collected by W. H. Ochsner, March 5, 1906. $1\frac{1}{4}$ miles northeast of Vilamil, Albemarle Island, Galapagos Group. Probably Pleistocene.

The recent shell which most nearly approaches this is *Conus lucidus* Mawe, which occupies the same region at present. This is a shorter and more stumpy shell with less conspicuous sculpture.

The species is named for Mr. Leverett Mills Loomis who was Director of the Museum of the California Academy of Sciences at the time the Galapagos Expedition was organized.

Several localities produced undeterminable cones, one large one especially which by its size and outline recalled *C. fergusoni* Sowerby, from the Gulf of Panama.

PLATE 2

- Fig. 1. *Terebra albemarlensis* Dall & Ochsner, new species. Holotype, No. 2894 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 85 mm.; p. 99.
- Fig. 2. *Terebra galapagina* Dall & Ochsner, new species. Holotype, No. 2897 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 35 mm.; p. 100.
- Fig. 3. *Terebra litorea* Dall & Ochsner, new species. Holotype, No. 2904 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 56 mm.; p. 101.
- Fig. 4. *Conus indefatigabilis* Dall & Ochsner, new species. Holotype, No. 2905 (C. A. S. type coll.) from zone A, Indefatigable Island; Pliocene; height, 57 mm.; p. 102.
- Fig. 5. *Conus academicus* Dall & Ochsner, new species. Holotype, No. 2907 (C. A. S. type coll.) from zone D, Indefatigable Island; Pliocene; height, 31 mm.; p. 102.
- Fig. 6. *Conus loomisi* Dall & Ochsner, new species. Holotype, No. 2910 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 44 mm.; p. 103.
- Fig. 7. *Cancellaria emydis* Dall & Ochsner, new species. Holotype, No. 2916 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 23 mm.; p. 105.
- Fig. 8. *Latirus galapaganus* Dall & Ochsner, new species. Holotype, No. 2918 (C. A. S. type coll.) from zone D, Indefatigable Island; Pliocene; height, 24 mm.; p. 107.
- Fig. 9. *Alectrion tropicalis* Dall & Ochsner, new species. Holotype, No. 2925 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 43 mm.; p. 109.
- Fig. 10. *Alectrion oldroydæ* Dall & Ochsner, new species. Holotype, No. 2926 (C. A. S. type coll.) from zone D, Indefatigable Island; Pliocene; height, 34 mm.; p. 110.
- Fig. 11. *Nerita oligopleura* Dall & Ochsner, new species. Holotype, No. 2937 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 14 mm.; p. 114.
- Fig. 12. *Turbo agonistes* Dall & Ochsner, new species. Holotype, No. 2939 (C. A. S. type coll.) from zone D, Indefatigable Island; Pliocene; height 25 to 31 mm.; p. 115.
- Fig. 13. *Tegula forbesi* Dall & Ochsner, new species. Holotype, No. 2941 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 21.5 mm.; p. 116.
- Fig. 14. *Phos cocosensis* Dall. (See Proc. U. S. Nat. Mus., Vol. 18, 1895, p. 11) Plesiotype, No. 2974 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 36 mm.; p. 96. •

Plate 2 continued on next page

PLATE 2—Continued from preceding page

- Fig. 15. *Turbo vermiculosus* Dall & Ochsner, new species. Holotype, No. 2938 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 34 mm.; p. 115.
- Fig. 16. *Turbo agonistes* Dall & Ochsner, new species. Paratype, No. 2940 (C. A. S. type coll.) from zone D, Indefatigable Island; Pliocene; height, 24 mm.; p. 115.
- Fig. 17. *Divaricella lucasana* Dall & Ochsner, new name. Paratype, No. 2968 (C. A. S. type coll.) from Albemarle Island, Pleistocene; height, 20 mm.; p. 122.
- Fig. 18. *Arca seymourensis* Dall & Ochsner, new species. Holotype, No. 2943 (C. A. S. type coll.) from Seymour Island, Pliocene; length, 35 mm.; p. 117.
- Fig. 19. *Pecten insulus* Dall & Ochsner, new species. Holotype, No. 2946 (C. A. S. type coll.) from zone D, Indefatigable Island; Pliocene; height, 17 mm.; p. 119.
- Fig. 20. *Pecten insulus* Dall & Ochsner, new species. Paratype, No. 2947 (C. A. S. type coll.) from zone D, Indefatigable Island; height, 21 mm.; p. 119.
- Fig. 21. *Divaricella lucasana* Dall & Ochsner, new name. Holotype, No. 2966 (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 18.6 mm.; p. 122.
- Fig. 22. *Pecten seymourensis* Dall & Ochsner, new species. Holotype, No. 2948 (C. A. S. type coll.) from Seymour Island; Pliocene; height, 57 mm.; p. 119.
- Fig. 23. *Strombus propegracilior* Dall & Ochsner, new species. Holotype, No. 2936 (C. A. S. type coll.) from zone B, Indefatigable Island; Pliocene; height, 80 mm.; p. 114.
- Fig. 24. *Divaricella lucasana* Dall & Ochsner, new name. Paratype, No. 2968B (C. A. S. type coll.) from Albemarle Island; Pleistocene; height, 20 mm.; p. 122.

