Shallow-Water Foraminifera of the Tortugas Region

Cushman Joseph Augustine

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Author: Cushman Joseph Augustine

DEPARTMENT OF MARINE BIOLOGY
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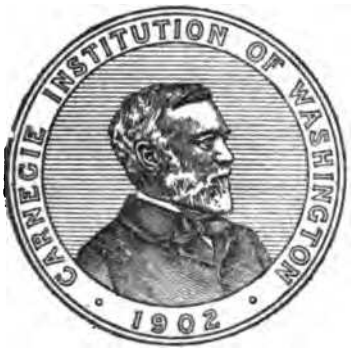
BY

JOSEPH AUGUSTINE CUSHMAN



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By Joseph Augustine Cushman.

INTRODUCTION.

The present paper gives the results of a study of collections made in the waters about the Tortugas Laboratory of the Carnegie Institution of Washington. The Dry Tortugas are a group of small keys well out from the Florida Coast; both in the lagoon which is formed by the group of islands and in the waters outside they afford a range of conditions of much interest. In general, the range of temperature was not great, due to the proximity of the mass of warm Gulf Stream water which sweeps by to the southerly side of the group. Within the limited area, however, varied ecological conditions were found which will be later noted and which seem to have a direct influence on the presence or absence of certain species in those places.

Collecting was done largely from the boats, the most satisfactory method that used with the *Darwin*. This is equipped with glass-bottomed wells, and it was possible in collecting on the reef areas to let the snapper down to within a short distance of the bottom, where in the clear water it could be easily seen at several fathoms; then, on passing over a suitable spot, free from corals, the gear was allowed to run and samples of the bottom were obtained before coral heads again came in the way. Collecting in the moat at Fort Jefferson on Garden Key and in shallow water on Long Key, as well as on the reefs and flats, was done by hand.

An opportunity was afforded of studying living forms. Results of these studies are also given here, some of them being of special interest as throwing light upon disputed problems.

I gratefully acknowledge the many courtesies shown me by Dr. Alfred G. Mayor, Director of the Tortugas Laboratory, in the carrying on of the work while at the Tortugas, and to the Carnegie Institution of Washington for the services of Mr. J. Henry Blake, who has so carefully drawn the figures on the plates in this report. The text-figures I have drawn myself.

The Tortugas region presents an ideal spot for studying the shallow-water tropical Foraminifera of this particular region. It is far removed from influence of shore conditions; the water is at all times warm and pure, so that ecological conditions that are present are constant. The shallow-water Foraminifera of the Gulf of Mexico

and Caribbean are very inadequately known. Except for d'Orbigny's classic work on the Foraminifera of the shore sands of Cuba and other West Indian Islands,[1] published in 1839, little has been published. Flint[2] in 1900 published on a few shallow-water samples from off Porto Rico. I have just published a paper on the Foraminifera obtained in a few samples from the north coast of Jamaica,[3] and a few short lists are given in Publication 213 of the Carnegie Institution of Washington, published in 1918. The present collection, therefore, is useful in giving information for a little-known region and the results have been interesting. Several genera are here recorded for the first time from the Atlantic, and the extension of ranges of others is considerable. A number of undescribed species were also obtained, as well as certain of the species originally described by d'Orbigny from the West Indian region and not since recorded.

An extension of the present work to include the deeper-water Foraminifera which occur in the adjacent region to the southward would undoubtedly prove of interest in the determination of the bathymetric ranges of many of the genera and species of the region. This would be of much use in the interpretation of the faunas of many of our Tertiary deposits of the Gulf Coastal Plain of the United States.

[1] D'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères."
[2] Flint, Bull. U. S. Fish Commission, 1900.
[3] Proc. U. S. Nat. Mus., vol. 59, 1921.

OBSERVATIONS ON LIVING SPECIMENS.

MOVEMENT.

Specimens belonging to several families were kept under observation at different times. It was found in all cases, where no injury to the animal had taken place, that pseudopodia were thrust out within 5 minutes of the time of contraction. This was true of *Iridia* and *Haliphysema* in the Astrorhizidæ, *Discorbis* in the Rotaliidæ, *Polystomella* in the Nummulitidæ, and *Quinqueloculina*, *Orbiculina*, and *Orbitolites* in the Miliolidæ.

One observation of much significance, in view of the widespread view that individuals of various species or even genera may unite, seems to entirely disprove this theory. In all cases where specimens of the same species even were brought near enough to have their pseudopodia touch there was a repellant rather than an attractive action. The same was true of specimens of different species and those of different genera. While specimens were under observation, they occasionally altered their course abruptly. In such cases it was often found that the pseudopodia of the specimen under observation had come into contact with those of another. In all such cases the first specimen changed its direction, usually rotated the test somewhat, and started off in a new course, often 90° from that in which it was at first traveling.

Portions of the same specimen, however, when separated by cutting, threw out pseudopodia rapidly, and when those of one part touched those of the other they quickly anastomosed and the two masses moved toward one another and coalesced.

The rate of movement of the protoplasm in the pseudopodia was recorded in *Iridia diaphana* and *Orbitolites duplex*. The unit of measurement in all experiments was 10 units of the micrometer scale, which on the slide represented about 0.2 mm. As in the movement of the whole test, there is apparently a rhythmic movement instead of a constant one. In one specimen of *Iridia diaphana* the movement along the more slender pseudopodia was as follows for the return current—the rate in seconds for the 0.2 mm.

8, 8, 8, 9.6, 7.5, 10.2, 8 seconds.

The average of movement in the slender pseudopodia was about 40 seconds per millimeter. In large coalesced pseudopodia it was slower, averaging about 60 seconds per millimeter.

One group of records shows the rhythmic character in 10 successive units of 0.2 mm. each:

10, 8, 7.8, 8.4, 9.2, 10, 9.4, 9, 8.2 seconds.

A series of measurements of the pseudopodia in *Orbitolites duplex* gave the following for 0.2 mm. units:

12.8, 8.8, 9.2, 14, 12, 7.8 seconds.