XXV.—*Further Observations on Deep Soundings obtained by H.M.S. "Herald," Capt. Denham, R.N., F.R.S., employed on Surveying Service in the South-western Pacific; with an Account of the Examination of the Alimentary Matter of the* Salpæ *as bearing on the nature of the Materials composing the Sea-bottom.*

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[With a Plate.]

The following observations are intended as an appendix to a former paper, on the microscopic examination of the bottom obtained in two soundings taken in the Feejee group, from the respective depths of 1020 fathoms and 440 fathoms. To these positive soundings we can now add several others of much interest, the most important of which, however, was registered on the 30th May 1856, when, in latitude 30° 25′ S. and longitude 161° 57′ E., and about forty miles E. by S. of the reported position of the Lady Nelson Shoal, a deep cast was taken, bringing up bottom from a depth of 919 fathoms.

Unfortunately, the greater part of the materials had been washed away during the ascent of the lead through the water; and it was only with the help of the microscope that many Foraminifera, siliceous spicula of Sponges, and the fragments of the solid parts of more minute organisms were detected. Enough, however, was retained in contact with the arming of the lead, to prove that the bottom had been reached. Indeed, this microscopic test is often in requisition, for in several instances we have been enabled by its aid to pronounce with certainty, where the most scrupulous examination by unaided vision had failed to decide.

It may be mentioned here, that when the deep sounding in 1020 fathoms, above alluded to, was obtained, a double lead was employed, and the greater part of the matter which had been submitted to microscopic analysis was taken out from between the strands of the lashing, very little being at all visible on the arming. While these facts show how readily one may be deceived in a matter apparently so easily determined, they suggest the adoption of some simple apparatus, by means of which a reasonable quantity of those minute materials might be safely brought up from the bottom, both for inspection and preservation.

As legitimately connected with this subject, the examination of the alimentary matter of the *Salpæ* opens up some new and interesting facts, which prove the wide dispersion of numerous minute organisms, both animal and vegetable, hitherto supposed only to be found in shallow zones skirting the land.

Having ascertained, with a certain degree of precision, the

nature of the materials to be found in deep soundings off the coast of Australia, and in the neighbourhood of the South Sea Islands, it is a discovery of peculiar interest to find the same minute organic forms in vast numbers mixed up with the alimentary matter of Salpians and other pelagic animals, obtained in the open ocean far distant from those shores.

The presence of the siliceous spicula and the fenestrated cells of *Thalassicolla* with the embryonic shells of the pelagic Mollusca might be readily accounted for; but how minute bivalves, Foraminifera, and a great variety of Diatomaceæ, and even Desmidieæ, including the genus *Closterium*—and all apparently recent—could have been, as it were, casually inhaled, is not so easily explained. Such are the facts, however; and the means by which those bodies are so widely distributed seem inscrutable to us, unless it be ultimately determined that they are in great part purely pelagic examples of the orders and genera to which they belong. This appears to be the most consistent view of the matter, seeing that the agency of drift-weed, or any other fortuitous cause, would be quite inadequate to produce so vast a result, even so far as mechanical dispersion is concerned, not to complicate the question with the more important part of the problem, namely the preservation of the vitality and integrity of the beings under consideration.

Wherever the deep-sea lead plumbs the bottom, and, by simple inference, in those depths immeasurably below its exploring reach, geometrical atoms exist, far removed from the supposed source of their development. But when we know that identical or allied forms, with their living crust or contents, are being continually swallowed with the daily food of the Salpian and the Pteropod, at the surface of the ocean, we can easily perceive how, at the termination of their short existence, the less perishable parts may ultimately be distributed through the illimitable and unknown districts of the ocean-bed.

The alimentary matter of the *Salpæ* is composed of animal and vegetable elements in nearly equal proportions; and when the microscope reveals the calcareous shells of Foraminifera, the beautifully sculptured frustules of Diatomaceæ, keen siliceous needles, and the sharp armature of minute Crustacea, within an intestinal tube so tender and friable that it withers at the human touch,—one cannot help admiring the operation of those conservative properties with which its delicate tissues are endowed. Each atom yields to acute impressions as by an instinctive intelligence, evading injurious contact; and although a contractility of the tube is essential to the due performance of its functions, no evil thus befalls its integrity till the term of life is at an end.

The accompanying figures (Pl. VII.), which might be increased *ad infinitum*, sufficiently illustrate the character of the little bodies above noticed as occurring in the alimentary matter of *Salpæ*.

The Diatomaceæ appear to embrace many new genera, but some recent.

Gallionellæ (B), *Naviculæ* (C), and forms allied to *Pixidium* (D) will be readily recognized. The latter are composed of two valves. At fig. 1 (D) the separation of these valves is represented; but, from the want of symmetry exhibited by them, it would seem as though each pair originally formed one quarter of a quadrate body, dividing by crucial fission into four distinct portions.

Fig. 2 (D) is a simpler and more symmetrical form, with its soft contents remaining.

In fig. 3 (D), which is rather imperfect, the radiating ribs are beautifully branched and reticulated.

It is rather remarkable that the minute bivalves (fig. E) were generally found with the soft parts little changed, and the univalves (F) empty, as though the animals had been digested out of their shells.

The Foraminifer with long silky hair-like processes is deserving of particular observation. It is the species most usually taken at the surface of the ocean. One or two other forms with minute spherical gemmules are figured in the neighbourhood.

It appears to be much easier to establish a line of demarcation between the Desmidieæ and Diatomaceæ than between the latter and the Foraminifera.

With all our opportunities of observing living Foraminifera in the South-western Pacific, where they abound in the most diversified forms, we have never been able to discover their branched "pseudopodia," so called, or the slightest evidence of the crawling movement which they are reputed to exhibit, while we can vouch for the actual fixity of some. The soft contents of the Foraminifer are grosser than those of the Diatom. They each consist of a yellowish amber-tinted, or rich brown, more or less homogeneous or granular pulp, interspersed with fatty globules. The essential differences are yet to be detected by the accurate observer of both.

The connexion of the Foraminifera with the encrusting Corallines, through the genus *Orbiculina*, is worthy of further investigation.

Mr. Huxley's curious genus *Thalassicolla* would appear to be referable rather to the Diatomaceæ than the Foraminifera, but I must defer any observations on this subject to a future period.