Observations on the Examination of SPONGE SAND, with Remarks on Collecting, Mounting, and Viewing FORAMINIFERA as MICROSCOPIC OBJECTS. By M. S. LEGG, A.I.A. (Read June 22, 1853.)

VARIOUS papers on the structure of the *Foraminifera* have been brought before the Society by Mr. Williamson and others, but the impression conveyed by those communications has been that the shells in question are not very easily obtained, and consequently they are likely to be passed over by microscopists from the want of specimens by which to study them.

Although the matter of this paper has no pretension to originality, I am induced to offer these remarks in compliance with a suggestion thrown out by a Member of our Council, that if Members would occasionally communicate facts, apparently unimportant in themselves, or new modes of manipulation under the general title of 'Microscopic Memoranda,' such remarks would contribute to diffuse a taste for the pursuit by facilitating the labours of those whose time and inclination admit of such researches.

Under this impression I now lay before the Society the result of my experiments on sponge sand, and the methods employed to bring the specimens more immediately within my reach without the labour of picking them out from an indiscriminate sample of the sand itself.

Having observed that there was some degree of uniformity in the magnitude of certain species of the *Foraminifera*, it occurred to me that by sifting the mass of sand through wires of different gauges important results would follow, and I therefore obtained some specimens of wire-gauze of 10, 20, 40, 70, and 100 wires to the inch, and, having also procured from a sponge merchant about a peck of the rubbish arising in sorting the sponges, I proceeded to separate the sand into parcels of different degrees of fineness.

In the first process (employing a gauze with 10 wires to the inch) I cleared the mass of clippings of sponge, small pebbles, &c., without obtaining any specimens of shells worth retaining.

In the second (20 wires to the inch) I obtained some very nice specimens of the *Orbiculina adunca* and *complanata*, but scarcely anything else; these specimens, of which the Members may recollect that Dr. Carpenter exhibited a series of very beautiful drawings at one of our *soirées*, were thus brought together, instead of being, as before, scattered through the mass, at intervals few and far between.

By means of the third gauge of wire-gauze, specimens of *Peneroplis*, and smaller specimens of *Orbiculina*, were brought together, with other species of *Foraminifera* of considerable variety of beauty and form, the result here obtained being very decided and characteristic of particular species; for, although the quantity retained after this process was comparatively small in relation to the original mass, yet the specimens were such as to afford an ample reward for the time and trouble incurred in obtaining them.

But the most surprising result was obtained by using the next quality of wire-gauze (that of 70 wires to the inch), the amount retained being much larger in quantity, and the proportion of shells to sand and other *débris* being such that sliders mounted indiscriminately from it yielded several very good objects in every instance.

From the above samples I was enabled to select, without difficulty, shells for microscopic observation; in the first two by the naked eye, and in the latter by using a hand magnifier, and removing them with the moistened point of a camel's-hair pencil.

The remaining portion of sand, forming probably 19-20ths of the original mass, will contain, as may easily be imagined, a very small comparative quantity of shells; but, nevertheless, it must not be thrown away. I again passed some of it through a gauze of 100 wires to the inch: the sample then retained yielded a fair quantity of shells by washing it in water, and thus other species characterized by their size were brought out by adopting the following process: having selected a dish of sufficient size and depth, and spread at the bottom of it a quantity of the sand, as much water was poured on it as would cover the whole to the depth of half an inch; after allowing the floating particles to settle, the dish was slightly raised at one end and gently agitated, so as to produce little eddies in the water. In a short time it was observed that small channels were formed in the sand of a whiter aspect than the other portions; allowing the water to settle gradually, the dish was slowly tilted at one end until the surface of the sand was exposed: the whiter particles being then carefully removed by means of a camel's-hair pencil, they were found to consist almost entirely of very minute shells; and the process being repeated a few times a large amount (microscopically speaking) was obtained for future examination.

In connexion with this subject I may venture a few remarks upon collecting, mounting, and viewing specimens of the *Foraminifera* as far as my experience has enabled me to speak.

When about four years ago I was staying at Weymouth

with my friend Mr. Woodward, in walking over the Small-mouth Sand, which is situate on the north side of Portland Bay, we observed the surface of the sand to be distinctly marked with white ridges, extending many yards in length, and parallel with the edge of the water. Upon examining portions of these we found that they consisted of *Foraminifera* in considerable abundance, and, upon scraping up a quantity of it carefully with a card, we obtained in a short time a bottleful of material which contained thousands and probably millions of these minute shells.

My friend Mr. Cocken, during a recent residence at Brighton, was very successful in obtaining a considerable quantity of the *Foraminifera* from the surface of the mud exposed by the receding tide in Shoreham Harbour; and here also the surface only should be taken, in order to have a large proportion of shells.

It is very well known to many of our Members that the ouze from the oyster beds yields a very fair proportion of *Foraminifera* and other materials for microscopic examination, and I am inclined to think from these evidences that the surface, and the surface alone, of sand or mud banks will yield satisfactory results. And I should recommend to all those who contemplate collecting for themselves, or employing others to do so for them, to take *only the surface*, being convinced that a few spoonfuls obtained in this way will yield more than a spadeful taken indiscriminately. My view of this is also confirmed by the large amount of shells in the sponge sand, for being taken from the sea-shores, that which is gathered up with them is such as occurs only on the surface. I think it also very probable that a locality sheltered from the direct action of the sea would be more favourable for finding these organisms than a bold shore exposed to all the violence of the wind and waves.

If these conjectures should be borne out by experience, it is to be hoped that the increased facilities of finding their habitats will lead to extended observations on their living economy, a subject rendered extremely interesting by the papers of Mr. Williamson and the writings of Dr. Carpenter and others, where the subjects of their structure and zoological position are very ably discussed.

The species of *Foraminifera* are so numerous that the mere mention of 575 species described by D'Orbigny as peculiar to the torrid zone, 350 species to the temperate zone, and 75 species to the frigid zone, sufficiently attests their abundance, and the samples of sand which have come under my own observation from the Caramatta Strait in the China Sea, from

Australia, and other localities, afford ample proof of numerous and beautiful forms.

After collecting these minute shells, two very important points are, mounting them for future examination, and viewing them so as to obtain their true structure. Much depends on the different genera, as to the most eligible mode; the simplest and most natural is that adopted by Mr. Marshall of placing them in cells made of perforated card, putting a piece of thin glass over and sealing it down, so that the objects roll about loosely, and are viewed as opaque objects by a side light; another mode, also adopted by the same gentleman, is placing the shells on a glass slip with a little very dilute gum water, which causes the shells to adhere sufficiently to the glass as to admit of the air being exhausted from them when mounted in Canada balsam. They may then be viewed either as opaque or transparent objects, but it will be observed that the texture of the shell which invests the segments of the animal is (as observed by M. d'Orbigny) very variable, but it almost always follows the different mode of growth upon which the orders of that author are founded. When the segments are closely packed together, the shell is opaque, of a close texture like porcelain, and without any indications of external porosity; when the segments are alternate without a spire, and when the spire is oblique, the shell is porous, and pierced over the last cells with a great number of little mouths, through which proceed the filaments, but which become obliterated when the animal no longer needs them; when the segments are in a straight line, when they are coiled upon the same spiral plane, or when they are alternate, and the shell inequilateral, their texture is almost as transparent as glass.

From the above description it will be evident that one single mode of illumination will not suffice for duly developing the structure of these shells, and I should therefore recommend that some be mounted loosely in a cell, so that all parts may be viewed as they roll over; and others be mounted in Canada balsam, and viewed by means either of the annular condenser of Mr. Shadbolt or the parabolic reflector of Mr. Wenham. By these means the difference in structure between the upper and under surfaces of the same species of shell is brought out, and that confusion avoided which occurs when direct light is transmitted.