

New Microscopic Details of Certain New Zealand Loricata

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Ocelli in *Eudoxochiton nobilis* Gray.

THE statement by Pilsbry, and quoted by Suter, that the "genus *Eudoxochiton* is sundered by lack of eyes in the valves &c." requires revision. These organs do exist in the genus, and although not so highly developed as in *Onithochiton*, where they are visible to the naked eye, the ocelli in *Eudoxochiton* are quite as advanced as in some of its congeners and therefore merit full recognition.

The eyes are oval in shape, projecting slightly above the general surface of the tegmentum, very minute, rounded at the upper end which is directed towards the apex of the valve, and tapering, goblet-fashion, towards the outer margin. They are arranged in quincuncial formation, and are present upon the lateral areas of the median valves, on the whole surface of the head valve, and on the post-mucronal area of the tail-valve. The eyes are more fully developed on the head-valve than are those of the intermediate valves. In the latter situation they appear usually as mere aggregations of blackish granular matter, but their position and regular arrangement, simulating those of *Levicoplax* and *Icoplax*, render their identification beyond dispute. On the head-valve each eye is accompanied by a single megalopore, which is seen in close proximity to its upper pole, a small canal connecting the two organs; and it is a significant fact that there are no megalopores found in any of the ocelliferous regions otherwise than in this same relationship. The micropores are very numerous, and are found strung along fine parallel lines which lie between the minute riblets composing the microscopic sculpture of all the valves of this genus (Fig. 1).

As Moseley observes: "The eyes are obviously homologous with the megal aesthetes, and as a comparatively late modification, some of the megal aesthetes have been modified into eyes in certain genera, whilst in chiton and other forms, the more primitive conditions, in which they all remain as organs of touch, has been retained."

It is certainly probable that the function of the micraesthetes is tactile, or rather that they constitute the means whereby the animal is sensitive to changes of temperature in the water, as indicated by the emergence of certain loricates during hot weather from the laminarian to the litoral zone. It is equally reasonable to assume that the megal aesthetes possess some degree of visual power even in the most primitive form in some genera, otherwise it is impossible to account for the fact that essentially non-ocelliferous loricates such as *Lepidopleurus* and *Ischnochiton* invariably avoid a strong light.

Note on the Sculpture of *Eudoxochiton nobilis* Gray and *E. huttoni* Pilsbry (Fig. 2).

Sculptured pits upon the valves of these species, hitherto unrecorded, have been observed by Mr. A. E. Brookes and the writer. They are triangular in shape and situated in the central areas, imme-

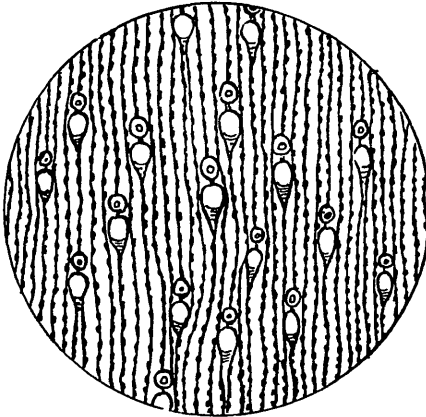


Fig. 1

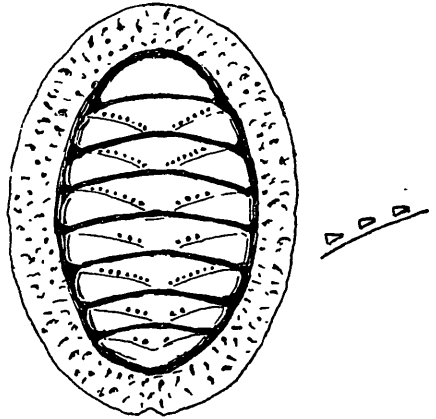


Fig. 2

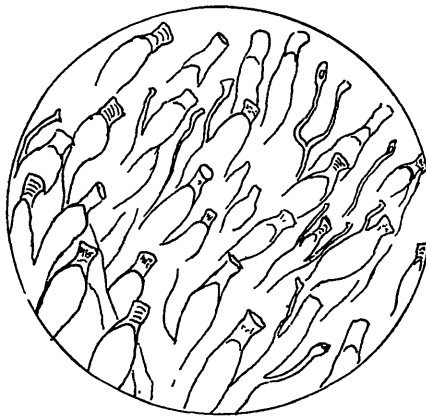


Fig. 3

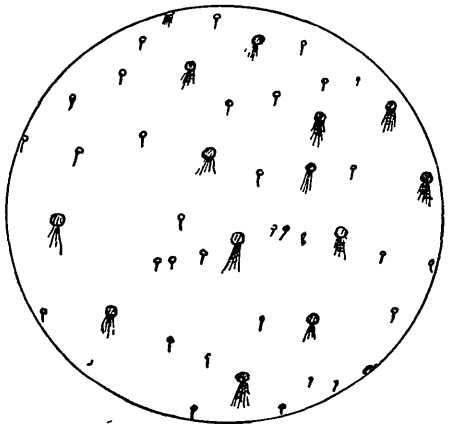


Fig. 4

- FIG. 1.—*Eudoxochiton nobilis* Gray. Ocelli with megalopores and micropores. $\times 230$.
 FIG. 2.—*Eudoxochiton huttoni* Pilsbry. 80 mm. $\times 47$ mm. Showing sculptured pits.
 FIG. 3.—*Pseudotonicia cuneata* Suter. Megalaesthetes and Micraesthetes. Decalcified and stained. $\times 230$.
 FIG. 4.—*Pseudotonicia cuneata* Suter. Megalopores and Micropores. Stained Methylene blue. $\times 230$.

diately anterior and parallel to the diagonal line, equally spaced and occurring on all the valves with the exception of the head valve. Frequently they are absent, but when present are rarely the same in number on both sides. Thirty specimens in all were examined, and in seventeen the pits were present. The remaining specimens, though for the most part free from lithothamnia, showed no trace of pitting, while in the entire series none was discovered upon the head-valve of any single specimen. Similar pits are sometimes present in *Levicoplax platessa* Gould, and always in *Icoplax empleurus* Hutton, which latter become shorter and shallower towards the median part of the valve. In *Eudoxochiton* they tend to become obsolete towards the margin, but their character indicates a marked affinity to *Levicoplax* and *Icoplax*, which taken together with the presence of eyes in all three genera, further confirms their generic relationship in the family Lepidochitonidae.

Diagnosis of nerve-terminals in the valves of *Pseudotonicia cuneata* Suter (Figs. 3 and 4).

Suter in his description of this species, states that in all the valves the whole surface is dotted or covered with minute eyes, though in the appended remarks he acknowledges that he might be mistaken as to the identity of these organs. Nor has this uncertainty been dispelled by Ashby in his recent paper "The Rediscovery of *Tonicia* &c." (*Trans. N.Z. Inst.*, vol. 58, 1927, p. 392 *et seq.*). The universal distribution alone of these organs should have suggested a more careful scrutiny, for it had already been pointed out by Moseley that the ocelliferous regions of the valves in loricates are in definite relation to the incisurae. Unfortunately Suter had only one specimen of this rare species at his disposal; but having myself the singular good fortune to collect ten specimens at Mount Maunganui, ample material has been available for an extensive examination.

The best method of demonstrating the nature of these sensory organs is to grind away the under-surface of a valve until sufficiently thin to be translucent, and to stain for one minute in an aqueous solution of methylene blue. Examined under the microscope by transmitted light and using a $\frac{3}{8}$ inch objective, the dots will be found to have distinctly taken up the stain. They are megalopores and micropores. The former are circular in outline and well defined, showing a smudge of stain like the tail of a comet, where the dye has penetrated into the capsule of the organ, the colour fading away in the depth of the tegmentum. The micropores, much smaller in size, are also circular in outline; the stain injecting the pore shows the minute neural canal for a short distance as a fine tapering thread. Viewed by reflected light the nerve-terminals appear as refractile convex dots, suggestive of ocelli to the casual observer. The great advantage of employing a staining reagent lies in the fact that the true eyes, such as are present in *Onithochiton*, *Schizochiton* and *Eudoxochiton* do not stain, the cornea being an impervious hyaline calcareous structure, whereas the easily identified megalopores and micropores in these genera always stain quite readily. Further details of these organs may be studied by decalcifying the shell in a 4% solution of nitric acid, as recommended by Moseley, and shaving

off a thin horizontal section of the tegmentum. When stained with methylene blue, the true nature can be determined with a $\frac{3}{8}$ inch objective. The megalaesthetes are elongated fusiform bodies produced at the distal end as a short obconic tube, which is closed at the upper extremity with a flattened circular disc. Beneath this disc is a small zone of fine granular matter or in some instances a few fine transverse lines. Many of the micraesthetes can be observed springing from the dilated bodies of the megalaesthetes, some singly, some branching in pairs from the same stem, while others again have independent fibres of their own which can be traced to the neural plexus lying in the plane between the articulamentum and the tegmentum. Though the micraesthetes often appear as small club-shaped bodies with a nucleus, the fully-developed organs have a flattened disc at the extremity, the whole resembling the seed-capsule of the common poppy.

Pseudotonicia cuneata has been obtained in Tauranga Harbour at depths varying from three to four fathoms; but one has been found on a small stone during warm weather late in the summer, immediately below low-water mark; another crawling half-submerged in wet sand at the same season; and three others upon one rock half buried in sand, also in the litoral zone. This rather singular choice of station militates against the idea of these animals possessing any marked degree of vision, but tends at the same time to strengthen the assumption that the sensory organs are associated with the perception of heat and cold. ●

Judging from the asymmetry of the head-valve photographed by Ashby as a plesiotype of the species, there is little doubt but that the specimen selected was abnormal, which is satisfactorily proved by the three specimens subsequently secured by Brookes, and all of the ten collected by the writer, possessing five slits in the head-valve and five corresponding radial ribs, arranged in perfect symmetry. This slitting of the head-valve and the total absence of eyes finally disposes of any necessity for the proposed subfamily of Pseudotonicinae.

LITERATURE CITED.

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