OBSERVATIONS ON THE ASSOCIATES OF CRINOIDS AT WALTAIR COAST WITH SPECIAL REFERENCE TO MYZOSTOMES

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The associates of the crinoid *Tropiometra encrinus* Clark of Waltair coast have been enumerated and notes on protective colouration mentioned. Among these the anomuran *Galathea elegans* Adams and White, the aphroditid *Scalisetosus longicirrus* Schmarda, and several molluscs and myzostomes show striking adaptations in colour harmony.

Myzostoma gopalai Subramaniam, 1938 on *T. encrinus* and *M. striata* George, 1950 on *Lamprometra palmata* Clark have been encountered and the occurrence of strict host specificity in these interesting ectoparasites has been suggested. By a battery of histochemical tests it has been discovered that the myzostomes possess a significant laminated wall of collagen fibres in juxtaposition to the cutis of the dorsal body wall. This collagen wall forms an excellent bulwark against wave action in the turbulent intertidal environment. Such a layer is completely absent from the protected ventral side.

INTRODUCTION

Among the various relations and adaptations between species none perhaps can surpass that of crinoids and their bewildering variety of associates. The arborescent arms and exquisite colour pattern of crinoids have invited many an organisms for a lifetime stay from a stage of being a mere casual visitor through commensalism to parasitism. Hyman (1955) gave a short review of the interesting records of such protectively coloured associates of crinoids all over the world. It would appear that work in this direction dealing with crinoids of Indian coasts in scanty. In the present study our chief aim to investigate the interesting ectoparasitic myzostomes paved the way to examine other associates. Subramaniam (1938) described *Myzostoma gopalai* from *Tropiometra encrinus,* Clark and George (1950) described *Myzostoma striata* and recorded *M. adhaerena* Remscheid, 1918 from *Lamprometra palmata* Clark of Madras harbour. It was thought worthwhile to record here the occurrence of all the associates encountered and to bestow special emphasis on how *M. gopalai* and *M. striata* found on *T. encrinus* and *L. palmata* withstand the rather turbulent intertidal environment at Waltair.

MATERIALS AND METHODS

After carefully dislodging the crinoids from the rocks they were placed individually in polythene bags of sea-water. These bags were gently tied and immersed in a big bucket of water and brought to the laboratory as early as possible. They were examined in large petri dishes one after another under binocular microscope. The associates were picked and their colour pattern as well as that of the host crinoids noted. Myzostomes were fixed in alcoholic Bouin, Susa, formolicalcium or MFA, other animals were fixed in 5 per cent formalin or MFA. After usual procedures

of dehydration myzostomes were embedded in paraffin and cut at 5–10 thickness and stained according to the histochemical procedures given in Pearse (1960) in addition to the standard histological methods.

OBSERVATIONS

Host : *Tropiometra encrinus* Clark

Crustacea

Galathea elegans Adams and White (Anomura : Galatheidae)—Alcock (1902) described protectively coloured members of the genus *Galathea* living on crinoids trawled from 41 fathoms on way from Rangoon to the Coco islands. One *Galathea* was striped like a wasp with violet and blue, the other was white with pink spots. *Galathea* was also found by him hidden among the branches of the coelenterate *Spongodus pustulosa* on the coast of Gopalpur. The present specimens had deep brown and bright yellow stripes on the dorsal surface and similar coloured patches on the appendages (Fig. 1). It apparently occurs delicately poised on the crinoid (Fig. 2). The rostrum has seven small lateral teeth which is a characteristic features of this species. Tirmizi (1966) provided a key to the Indian Ocean species of the genus.

Elasmopus pectinicrus Bate (Amphipoda : Gammaridae)—It is diffuse brown violet, a common amphipod on almost every crinoid.

Pseudoanthessius sp. (Copepoda: Lichomolgidae)—This is a common copepod on every crinoid. It is more or less transparent with a slight brownish tinge and can be found moving dexterously on the arms of the host. Species of this genus are common commensals on various invertebrates. The present specimens belong to the group of the genus in which there occurs an indentation on the outer margin on the fourth endopodite (Ummerkutty 1961).

Polychaeta

Scalisetosus longicirrus Schmarda (Aphroditidae) (Fig. 3)—This is a graceful but fragile worm which is thrown into bits easily losing the elytra. The dorsal surface presents a pattern of two broad lateral bands of chequered violet brown. These coloured patches extend on to parapodia, prostomium and even tentacles. The elytra (*EL*) (Fig. 3) show two lateral regions of violet brown streaks—separated by a pale brownish band. This is a common species on crinoids (Fauvel 1953).

Nereis sp. (Nereidae)—This was collected only once. The specimen measures only 4 mm. The dorsal surface has transverse streaks of diffuse brown colour.

Mollusca

(Fig. 4)—Dark-coloured specimens of *Thias tissoti* (Petit) (*A*), *Pyrene zebra* Gray (*B*), and *Umbonium vestiarum* (*C*) on a deep violet crinoid; *Rissonia clathrata* (Adams) (*D*), and *P. zebra* (*EF*) on yellow brown crinoid have been encountered.

Myzostomida

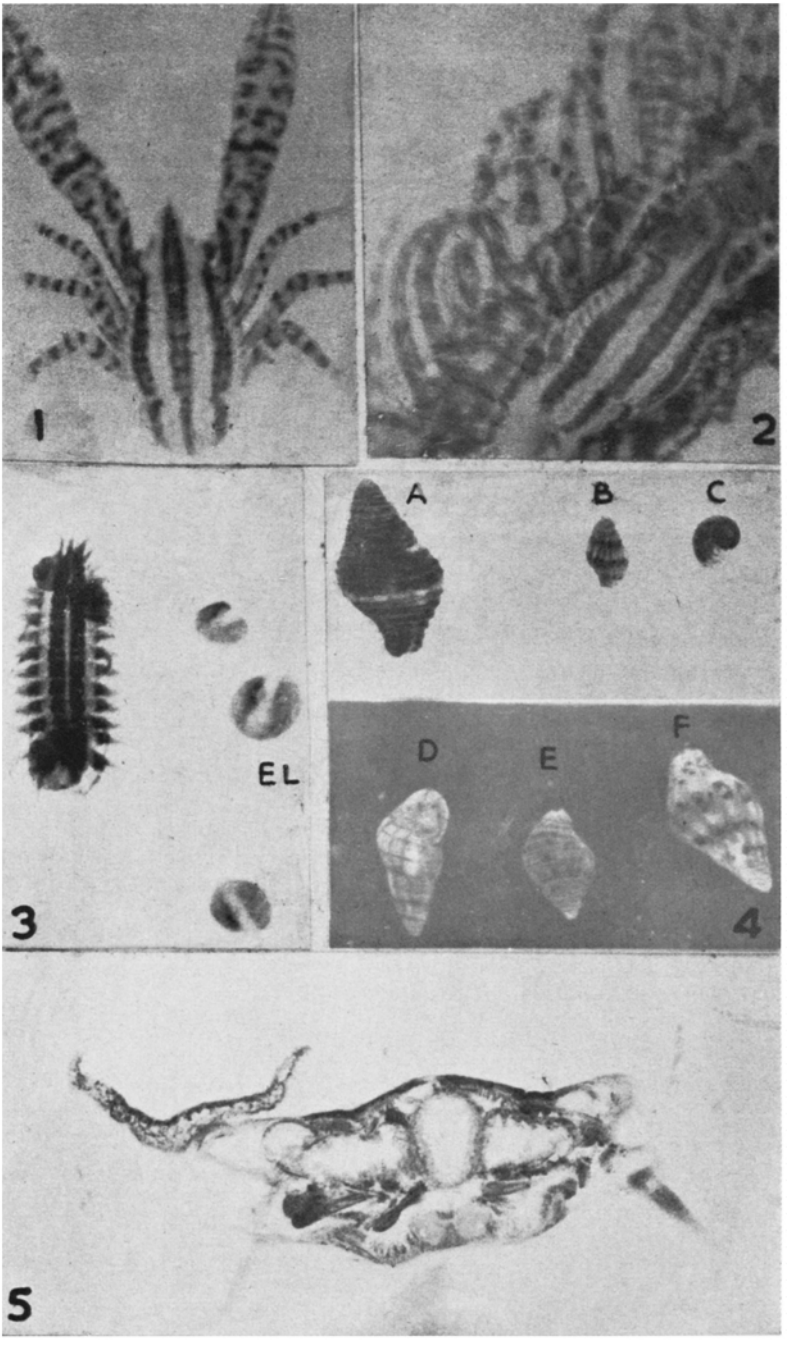
Two species of myzostomes namely, *Myzostoma gopalai* Subramaniam (1938) on *T. encrinus* and *M. striata* George (1950) on *Lamprometra palmata* occur on

this coast. *T. encrinus* with ten arms is a more abundant form occurring in a multitude of colour patterns ranging from plain dull yellow to deep violet. A more common one has brown and bright yellow or orange yellow stripes. *M. gopalai* specimens occurring on these show striking variations of brown, yellow, orange yellow or violet banding patterns (Figs. 7,8). *L. palmata* with thirty or forty arms is a rare species on this coast and it is found to harbour *M. striata* only.

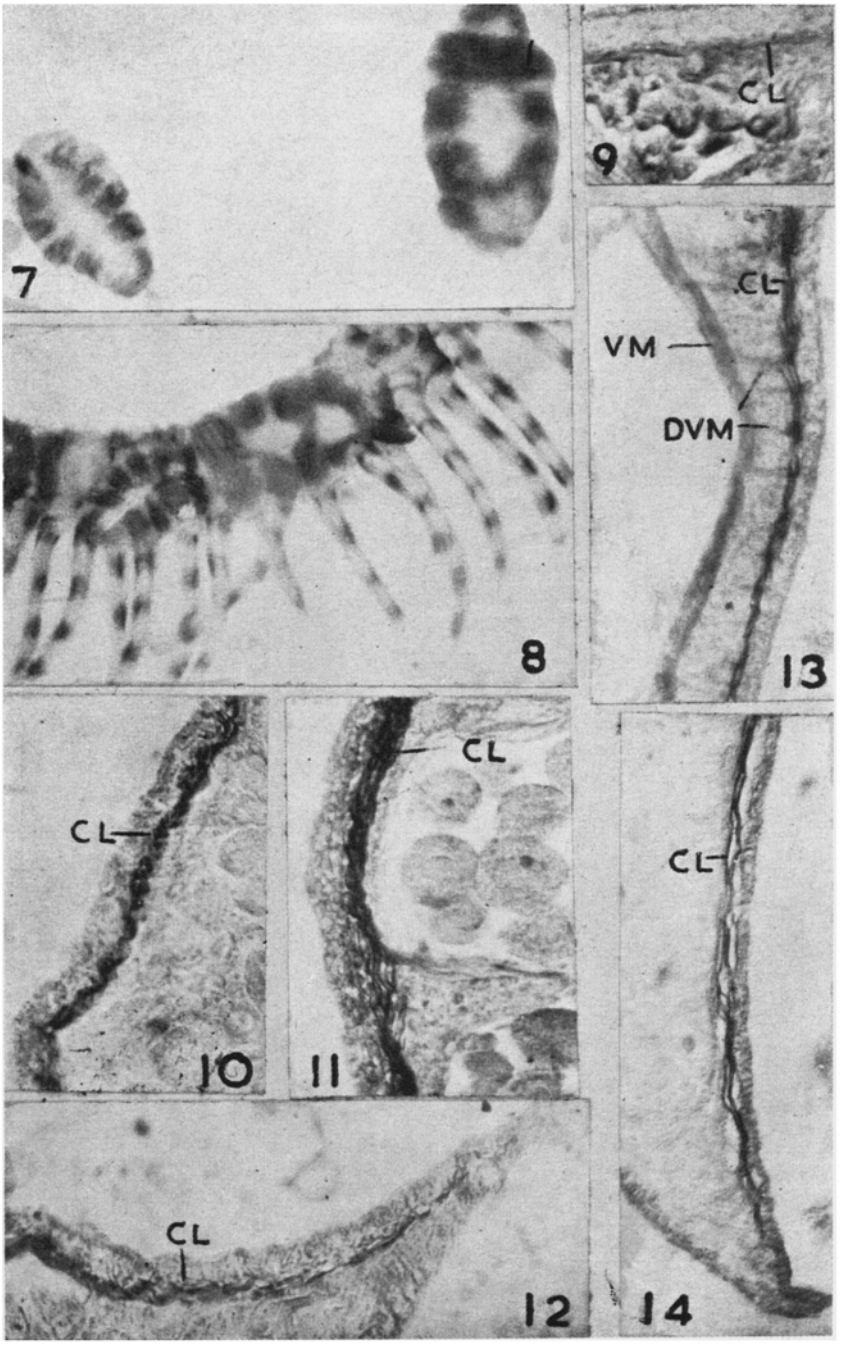
When disturbed the myzostomes move more or less in the fashion of a miniature tortoise. The most interesting adaptation to life in the intertidal environment is the architecture of the dorsal body wall (Fig. 6). The externalmost layer is a short region of the cuticle (*C*) which appears to be a part of the clear cellular epidermis (*EP*). Beneath the epidermis is a spongy layer designated as cutis (*CT*) by Graff (1877). The cutis is apparently well developed on the dorsal side only. It is followed by a characteristic layer (*CL*) formed of bundles of fibres. This layer has been called 'Hautmuskelschausches' or dermal muscle layer by Graff. In selectively stained sections it has been found that on the dorsal side the organisation and nature of this so-called dermal muscle layer are quite different from its counterpart on the ventral side. On the dorsal side, it is conspicuously thicker at the middle gradually becoming thinner laterally and finally tapering off to vanishing point (Fig. 13). In azan preparations (Figs. 10, 13) the fibres take a deep blue colour while the ventral layer of muscles (*VM*) as well as the dorso-ventral muscles (*DVM*) appear pinkish being typical muscle fibres. The dorsal thick layer is strongly PAS positive (Figs. 11,12) a reaction which is not abolished even after saliva digestion. With chrome haematoxylin–phloxin technique the fibres appear brownish while the ventral and dorso-ventral muscles stain red. In iron haematoxylin preparations this dorsal layer stained deep blue-black while the typical muscle fibres appear pale bluish. They are alcian blue negative and in formol-calcium fixed and post-chromed material they are Sudan Black B negative. Because of these reactions especially the PAS positivity even after saliva digestion, aniline blue positivity and birefringence it was surmised that the fibres could be collagenous. Thus the specific Van Gieson's staining technique was applied and the fibres stained characteristically red (Fig. 14) which undoubtedly confirms that this thick dermal layer is mainly a collagen wall and is neither reticulin nor a simple dermal muscle layer. On the ventral side in the corresponding position beneath the epidermis there is a typical muscle layer which is negative to the collagen tests mentioned above and there does not seem to be a conspicuous cutis comparable to that on the dorsal side. In *M. striata* the dorsal collagen layer (Fig. 12) is relatively thicker than it is in *M. gopalai* (Fig. 11). The ventral muscle layer appears to continue into a thin dorsal layer which lies almost indistinguishably enmeshed in the conspicuous laminated collagen wall.

Discussion

The most comprehensive account on the habits, anatomy and histology of the genus *Myzostoma* has been given by Graff (1877). According to him both on the dorsal and ventral sides of myzostomes a dermal muscle layer of more or less uniform thickness in any one species occurs close to the epidermis. However, he recognized that the thickness of the layer is of importance in the systematic determination of



FIGS. 1–5.



FIGS. 7–14.

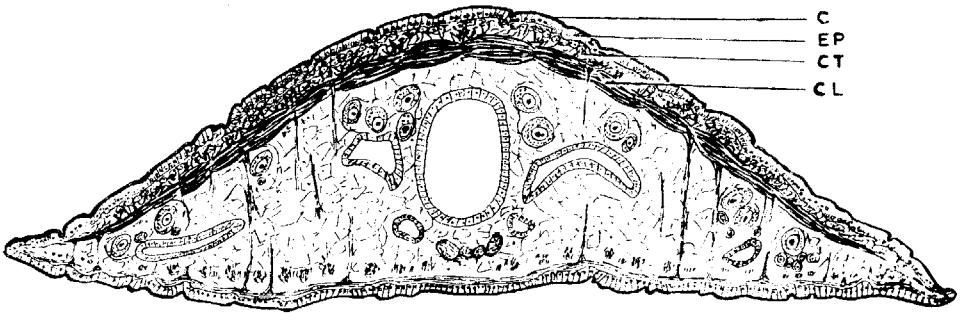


FIG. 6.

myzostomes. For example he stated that in *M. glabrus* Leuckart the layer is twice as thick as in *M. cirriferum* Leuckart. In the figures of these species, he has depicted the 'dermal muscle layer' as a uniformly thick band on the dorsal side continuous with that on the ventral side. In the present study it is revealed for the first time that the ectoparasitic soft-bodied myzostomes living on intertidal crinoids have a thick laminated wall of collagen fibres on the dorsal side and not on the ventral side. The layer is conspicuous and thicker at the dorsal midbody diminishing in thickness laterally and completely absent on the protected ventral side. Its position on the ventral side is occupied by a typical muscle layer.

In many animals both vertebrates and invertebrates the collagen fibres of the tegument are arranged in complex geometrical plywood-like arrays. Chapman (1953) has shown the chemical nature of the mesoglea in Coelenterata to be collagenous and it plays a role as a base for muscles and as a register of rapid body movements caused by body musculature and those enforced by the environment. Harkness (1961) stated that in invertebrates relatively little is known beyond the occurrence of collagen. In a general way it has been said that it is found in softer species such as worms for mechanical strength of the tegument. In the acquatic frog tadpole a laminated arrangement occurs in the dermis but after metamorphosis it is replaced by a more randomly arranged pattern of collagen as seen in land vertebrates (Gross 1963). It is clear that the occurrence and orderly arrangement of collagen in the integument depend on the habitat and not on the phyletic status of the animal. The soft-bodied myzostomes studied in the present investigation furnish us, in a dramatic way, the best example known as yet of the specific location and significance of collagen as a bulwark against impounding wave action in the intertidal region. That there may be species differences in the relative thickness of this collagen layer is brought out by the variations observed in *M. gopalai* and *M. striata.* It is clear that there occurs strict host-specificity in these species. Whether this as also the variations in the thickness of the collagen wall are due to the differing ecology of the host crinoids remain to be explored.

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