STRUCTURE, GROWTH AND REGENERATION IN THE ASTROCOENIID SCLERACTINIAN CORAL, *ACROPORA FORMOSA*

Thesis submitted by
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ABSTRACT

Acropora formosa Oken, 1815, a fast growing member of the coral genus which dominates regions of dense coral growth throughout the Great Barrier Reef Province and in most reefs of the Indo-Pacific region has been studied with respect to its structure, functional morphology and histology.

The three dimensional lattice structure of the corallites which make up the openly branched colony is described. Aspects of the growth of the corallum including the manner of radial extension and the position of the growth points for longitudinal extension (the "trabecular tines") are investigated.

The anatomy and histology of the polyp is described, with particular reference to the relationship between the tissue and the skeleton, the structure of the mesenterial filaments, and the organisation of the musculature. An account is also given of the histochemistry of the gland cells. An attempt is made to relate these observations to various aspects of behaviour of the polyp and the possible evolutionary origins of the genus.

Diel expansion and contraction of the polyp is studied and the cellular mechanisms which effect such changes are analysed. The tissues over the trabecular tines are shown to interconvert between two distinct conformations depending upon the state of expansion of the polyp. Evidence is presented that re-orientation of the cells of the inner body wall at night creates a space into which the trabecular tines extend.

The pattern of cell division is studied by observing the incorporation of tritiated thymidine using autoradiographic techniques. A diel rhythm of DNA synthesis, and hence cell division, is demonstrated. This rhythm varies in magnitude on a seasonal basis. The significance of these observations in relation to skeletal growth is discussed. It is concluded that cell division keeps pace with skeletal growth, allowing extension in the trabecular tines to be fully accommodated. Maintenance of coral branches in darkness results in the disappearance of the diel pattern of DNA synthesis.

Infiltration of the characteristic, white tipped branch ends of A. formosa by zooxanthellae is studied and evaluated in terms of its effect on calcium carbonate deposition, and its possible significance to the nutritional balance of the colony. It is proposed that browning is part of a mechanism by which the metabolic resources of the colony are rationalised in response to changes in prevailing environmental conditions.

Histological studies have been made of the pattern of events involved in tissue repair and regeneration in severed branches. It is reported that the gastrodermis initiates the resealing of the tissues and contributes to the reformation of the epidermis before restoration of the mesoglea. The calicoblastic layer is the last to be repaired. The removal of cellular debris from repairing tissue is effected by amoebocytes, whilst the differentiation of interstitial cells at the wound edge appears to be responsible for the re-appearance of non-epithelial cell types in the reformed epidermis. The presence of zooxanthellae in the outer body wall immediately adjacent to the damaged tissue enhances the rate of repair.

Regeneration of axial and radial corallites after severance of a branch tip occurs very rapidly. A detailed description of regeneration, both of the tissues and the skeleton, is supplied, and the possible role of products of zooxanthellae photosynthesis discussed. The response to local infections of the cut surface by filamentous algae is also described.

To Rachel

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S. D. Meek

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