ULTRASTRUCTURE OF *ACROPORA*

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Corals belonging to the genus *Acropora* have a particular ultrastructure which differs from that of other scleractinians. The skeleton consists of three-dimensional, curved fans subdivided into parallel stripes. The stripes are composed of anhedral aragonite needles 0.5–1.0 μm in diameter and a few μm long. The curved fans radiate from an axis constructed of needles lying perpendicular to those of the fans. The stripes as well as the individual needles are enveloped by organic membranes. The surface structure consists of a scale-like pattern of needles covering the trabecular network.

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Acropora Oken 1815 is the most important and protean genus of hermatypic corals and is one of the most common constituents of the coral reefs of the Gulf of Elat (Loya, 1971). The material studied originates from the reef complexes at "Coral Beach" near the town of Elat and Ras el Burqa 40 km south of it. Many morphologically different forms were observed in the present material which certainly belong to different species of this genus, but specific distinction is as yet difficult (Wells, 1956). The morphology of *Acropora* was described by Vaughan & Wells (1943), Alloiteau (1952) and Wells (1956). The special nature of the ultrastructure of *Acropora* was observed during investigation of coral ultrastructure and early diagenesis (Spiro & Hansen, 1970; Spiro, 1971).

In the present study thin sections were studied under the petrographic microscope, and ultrastructures were investigated by means of scanning and transmission electron microscopes.

Ultrastructure

Thin sections studied under the petrographic microscope do not show the distinct picture of coralites built of well defined elements, but rather a perforate mass of trabeculae. Two types of areas can be distinguished.

Darker areas form patches and stripes which never occur near perforations and are surrounded by brighter areas in which crescent-shaped fan structures can be seen. The fans are built of smaller elements and envelop the perforations tangentially. Between crossed nicols these fans constitute an optical continuity. The darker, granular areas show lower birefringence than the lighter areas, suggesting a difference in optical orientation. The darker appearance might be due to higher concentration of organic material.

In the scanning electron microscope the trabecular network seems to be delicate near the polyp and more massive elsewhere (pl. 1, fig. 1). The surface is built of scale-like structures 15–20 μm high which are built of anhedral needles. These are up to 1 μm in diameter and are arranged parallel to each other (pl. 1, figs 2, 3). The trabeculae generally carry crystal clusters on their tips (possibly growth tips). In broken trabeculae their inner part is seen to be built of parallel needles arranged in the elongation of the trabeculae or to have a spherulitic structure (pl. 1, fig. 4), while only the surface is built in the scale pattern. The thin trabeculae lack this veneer altogether (pl. 1, fig. 2). Polished and etched surfaces show the fan system already described from thin sections: the perforations are surrounded by fans which are built of parallel stripes about 10 μm wide and composed of needles. The needles are parallel to each other and, as a rule, deviate in orientation from that of the stripes (pl. 2, figs 1, 2, 3). The boundaries of the stripes are marked by interruption of the needles though their orientation is the same throughout many adjacent stripes. The scales form the continuation of the stripes and no clear boundary can be seen at the base of each scale where it adheres to the stripe. In the central parts the stripe pattern disappears. Instead, bundles of needles occur with an orientation pependicular to that of the needles building the stripes (pl. 2, fig. 1). Even in thin elements (septa) the pattern of curling fans is still recognizable (pl. 2, fig. 4) but the central part lacks the perpendicular bundles, and the structure seems more spaceous. In older parts of the skeleton the scale-like surface structure is lacking and the surface appears smooth.

From these observations a sequence of events in the development of the coral skeleton can be suggested. First to form are the trabeculae, built of needles orientated either in the elongation of the trabeculae or arranged as spherulitic structure. This framework of trabeculae is then covered by the scale-like bundles of needles. These scales are aligned so as to form a continuous stripe, where the last formed scale forms the tip of the stripe. Adjacent stripes are arranged in a fan pattern. The voids are progressively filled, but the structure is still quite porous when secretion ceases.

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Dansk sammendrag

Koraller af slægten *Acropora* har en speciel skelet-ultrastruktur forskellig fra andre scleractinier. Skelettet består af 3-dimensionalt buede vifter, som er opdelt i parallelle bånd. Båndene er opbygget af anhedrale nåle 0,5–1,0 μm i diameter og nogle få μm lange. De buede vifter radierer fra en akse, der består af nåle, som står vinkelret på vifternes. Båndene i vifterne såvel som de enkelte nåle er omgivet af organiske membraner. Skelettets overflade har et skælmønster af nåle, som dækker det trabekulære netværk.

References

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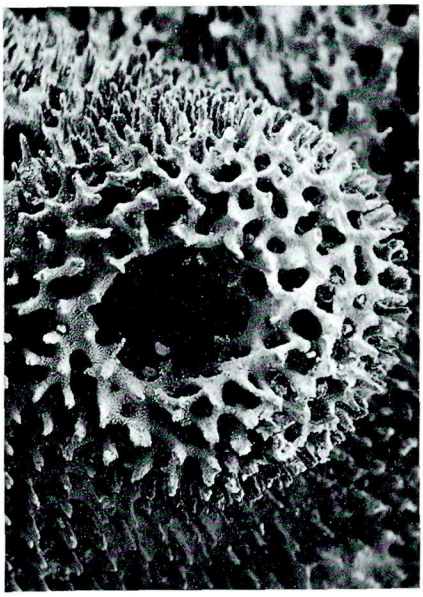
Plate 1 (all SEM micrographs)

Fig. 1. View of a polyp; the structure consists of a delicate framework of trabeculae, thinner and more spaced at the outer surface.

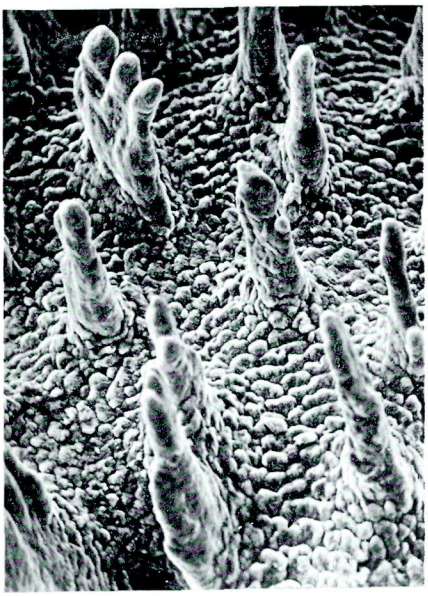
Fig. 2. A veneer showing a scale-like structure covers the trabecular framework. The thin trabeculae lack this veneer.

Fig. 3. The individual scales are built of anhedral needles arranged parallel to each other.

Fig. 4. A fractured trabecula; the inner part has a spherulitic structure which is covered by the scale-like veneer.

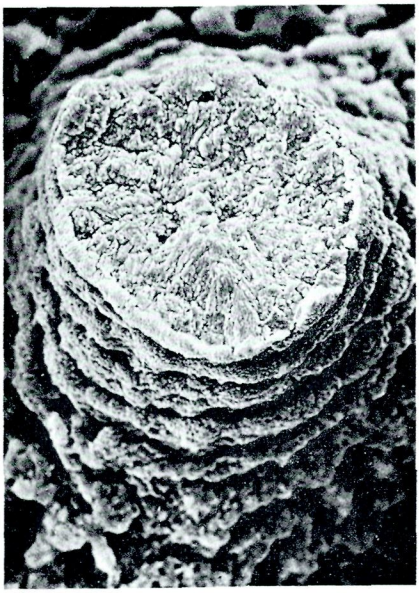


1 500 μm



2 50 μm

3 5 μm



4 15 μm

Plate 2 (all SEM micrographs)

Fig. 1. Polished and etched section. Parallel curved stripes of needles. The needles are oblique to the direction of the stripes, their orientation is constant throughout the section. A bundle of needles in orientation perpendicular to that of the stripes is seen at lower right.

Fig. 2. Polished and etched section. Sharp boundaries divide the stripes but the orientation of their needles is maintained throughout the structure.

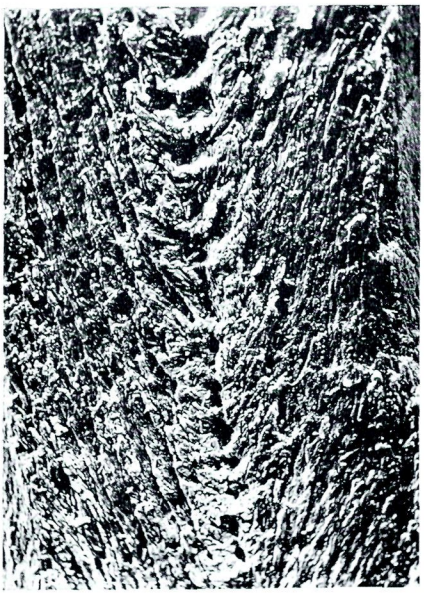
Fig. 3. Polished and etched section. Oblique section through the stripes, notice the orientation of the needles.

Fig. 4. Polished and etched section of a septum. Stripes of parallel needles deviate from the axis of the skeletal element. The central part has a more open structure.

1 20 μm

2 10 μm

3 10 μm



4 20 μm