

## 5. CHARACTERISATION OF INDIVIDUAL ELEMENTS

### 5.1 Gross Morphology

#### Adambulacral Ossicles (Plate 3, Numbers 1-5):

Adambulacral ossicles are rectangular elements with a pronounced distal abactinal extension. Well defined interadambulacral muscle depressions are present on both the distal and proximal surfaces (Plate 3, Numbers 5b, 5d). Four subcircular ambulacral - adambulacral articulation surfaces are present on the abactinal surface of each ossicle (Plate 2, Number 6).

Two rows of spines, running parallel to the adambulacral furrow, are borne on the adambulacrals (Figure 1). Spine bases are small, rounded knolls on the actinal surface (Plate 2, Number 6). The number of pedicellarial pits per adambulacral varies within any row from zero up to an observed maximum of three (Plate 3, Numbers 2-5). One or two pits per ossicle is most common. The pits are located proximally on the furrow surface of the ossicles (Figure 2).

Adambulacral ossicles from the arm tip (Plate 3, Numbers 1a, 1b) are of the same general shape as more proximal ossicles but many of the characteristics for example spine bases and pedicellarial pits, are less pronounced.

#### Ambulacral Ossicles (Plate 3, Numbers 6-9):

Ambulacral ossicles are elongate with a broad and tapering adradial portion (Plate 2, Number 4). The ambulacral - adambulacral articulation surfaces are deep-set, wings (Plate 2, Number 4) are broad and gently to moderately curved (Plate 3, Number 6c). The abactinal surface is slightly indented. Two distinctly different patterns of ambulacral - ambulacral articulation surfaces (Plate 2, Number 4) are present (Plate 3, Numbers 6a, 7). Adambulacrals from the arm tip are very similar to those more proximal (Plate 3, Numbers 8, 9).

#### First Ambulacral Ossicles (Plate 4, Number 2):

The first ambulacral ossicle is one of the largest elements in *A. planci* and is significantly different from the previously described ambulacral ossicle. The first ambulacral - first ambulacral articulation surface (Plate 2, Number 5) varies considerably between individual elements. A prominent ridge runs the length of the abactinal surface (Plate 2, Number 5). The wings, so evident in other ambulacrals, are greatly reduced. Two first ambulacral - oral ossicle articulation surfaces are present (Plate 2, Number 5).

Oral (Mount-Angle) Ossicles (Plate 4, Number 1):

The largest element in A. planci, the oral ossicle, is characterised by a prominent tapering proximal tip with numerous spine bases and a first ambulacral articulation bar (Plate 2, Number 3). The oral ossicle bears five to six large, blunt spines towards the oral cavity and four to six small, tapered spines distally (Figure 2). A large indentation accommodates the first adambulacral ossicle (Plate 2, Number 3). Two oral - first ambulacral articulation surfaces are present (Plate 2, Number 3).

Interbrachial Ossicles (Plate 4, Number 3):

A single anvil-shaped ossicle sits, supported by two stout stubs, between the arms in the arch formed by the first ambulacral and oral ossicles. The abactinal surface is angled sharply to fit the first interbrachial plate (Plate 2, Number 9). The neck is shorter, but thicker than the body (Plate 2, Number 9).

Interbrachial Plates (Plate 2, Number 12):

These elements vary in size and shape but are always flattened laterally. Articulation surfaces are very shallowly angled and typically ridged. In general, each side of the plate has one articulation surface.

Actinal Intermediate Ossicles (Plate 4, Numbers 4-9; Plate 7, Number 7):

Actinal intermediates are variable in size and shape but are essentially globose and spine-bearing. Those adjacent to the marginal ossicles (Plate 7, Number 7) tend to be larger and more tapered than ossicles closer to the adambulacrals. Articulation surfaces and skin and/or muscle attachment scars are readily apparent in this series (Plate 2, Number 10). A notch is often present in the actinal intermediate - actinal spine articulation surface (Plate 4, Numbers 6, 7).

Marginal Ossicles (Plate 4, Number 10):

Two rows of marginal ossicles are present in the arms of A. planci. They may be enlarged, spine-bearing elements but are more commonly discoid in shape (Plate 4, Number 10).

Secondary Abactinal Ossicles (Plate 5, Numbers 7-10;  
Plate 6, Numbers 1-11):

Secondary abactinals are highly variable in size and form but are generally rod- or plate-like. Those which are platey may resemble interbrachial plates. Articulation surfaces are straight-ridged or, more commonly, curve-ridged (Plate 2, Numbers 7, 8). Although most secondary abactinals are "spineless" some (Plate 6, Number 8) do bear small, unbarbed spines. Very little morphological difference appears to exist between the secondary abactinals of the arms and those of the disc.

Primary Abactinal Ossicles (Plate 7, Numbers 1-6, 8-10):

The most easily distinguished primary abactinals are long, narrow, conical ossicles with basal articulation surfaces (Plate 7, Numbers 1-5, 9-10). Less commonly, however, primary abactinals are incorporated into the meshwork of secondary abactinal ossicles and have dorsal and/or ventral articulation surfaces (Plate 7, Numbers 6, 8; Plate 2, Number 11). Primary abactinal ossicles are always spine-bearing.

Abactinal Spines (Plate 8, Numbers 2-3):

Abactinal spines are long and narrow and taper symmetrically to a sharp, barbed point. They are borne on both primary and secondary abactinal ossicles. Those borne on secondary abactinal ossicles are much smaller and insignificant in number compared with spines borne on primary abactinals. Abactinal spines are circular in cross-section. A basal bulge is often present (Plate 3, Number 2). Colouration is a uniform medium to dark mauve changing to a pale mauve at the base.

Under binocular microscope examination the framework is elongate although frequently fine and fairly indistinct.

Actinal Spines (Plate 8, Numbers 1, 4-8):

The majority of actinal spines taper only slightly along their length to a blunt, often grooved, rounded tip. They are flattened in cross-section, and are very often indented towards the tip on the side facing the distal part of the arm. (Plate 8, Numbers 1, 4). Spines borne on the actinal intermediates adjacent to the marginals may taper uniformly to a blunt point. Very small spines (Plate 8, Numbers 6, 8) line the adambulacral furrow on adambulacral ossicles and at the distal end of the oral ossicle (Figure 2).

Actinal spines are variable in colour, ranging from pale mauve to dark mauve and, rarely, an intense orange-red. The indented or distal surface is darker in colour than that which faces the body cavity and thus actinal spines are readily discernible from abactinal spines. In addition, actinal spines may contain a notch in their articulation surface.

Under binocular microscope the ultrastructure appears coarse, open and distinctly elongate.

Pedicellariae (Plate 8, Numbers 9-17):

Elongate and stout bivalved pedicellariae are situated in pedicellarial pits of adambulacral ossicles (Plate 3, Numbers 1-5) or in pedicellarial cups (Plate 8, Number 18) in skin on the dorsal surface.

### Other Elements

The madreporite (Plate 7, Number 11) is a delicate mushroom-shaped ossicle with a pattern superficially resembling brain coral on the dorsal surface. Subspherical granules (Plate 7, Number 12) are variable in shape, being subspherical to subelliptical. Encrusting granules (Plate 8, Number 19) are uniform in size and dome-shaped with an extended flat base.

### 5.2 Microstructure

The microstructure of A. planci is an open system in which the porosity may be as high as 50% (Bathurst, 1975). Within any one element, however, the mesh thickness, pore size, and hence, porosity, varies considerably from the representative examples shown in Plates 9-11.

In the majority of elements, the microstructure is very similar with fine calcite arranged in a subrounded to pentagonal pattern forming large pores. Pedicellariae retain this predominantly pentagonal structure but the presence of a series of ridges, terminating in blunt peaks (Plate 11, Number 4), gives the pedicles an overall elongate appearance. Abactinal and actinal spines do not generally have the pentagonal form. Their fabric is elongate, parallel to the long axis of the element (Plate 11, Number 1).

### 5.3 Chemistry

Electron microprobe analysis reveals the skeleton of A. planci to be composed of high magnesium calcite with 8.2 - 11.6 mole percent  $MgCO_3$ .