NOTE ON THE FINE SKELETAL STRUCTURES IN SCLERACTINIA AND IN TABULATA

by

Makoto KATO

(with 1 Text-figure)

(Contribution from the Department of Geology and Mineralogy, Faculty of Science, Hokkaido University. No. 1069)

On the fine skeletal structures in Scleractinia

Scleractinia is a vast group including reef corals of recent time. Much knowledge on the ecology, physiology and so on of the recent Scleractinians has been accumulated up to the present by a number of research workers.

By deduction, biological aspects of fossil Scleractinians may be readily sought in these data on recent corals.

Being an extinct group, however, nothing definite has been ascertained as to the true biological aspects of Palaeozoic Rugosa, though many functional features or conditions of Scleractinia can be also attributed to Rugosa, since the former is the nearest ally to the latter. Hence, one must study in every detail the biology of the recent Scleractinia, for the thorough understanding of Palaeozoic Rugosa.

It is well known that in Scleractinia microstructure of coral skeleton has been taken as a clue to major divisions of the group. (VAUGHAN & WELLS, 1943: WELLS, 1956) Recent comprehensive work on Scleractinia by ALLOITEAU (1957) also gave importance to the microstructure in the classification of the said group.

For the sake of comparison with Palaeozoic corals, the writer also examined many thin sections of Scleractinians kept at the British Museum of Natural History. In consequence the writer is now inclined to think that there is no fundamental difference between Scleractinia and Rugosa in connection with their fine skeletal structures.

Some examples of fine skeletal structures in Scleractinia are shown in text-figure. Sketches and diagrams are based on the collections of the British Museum of Natural History.

ALLOITEAU (1957) found a new type of fine skeletal structure amongst Mesozoic Scleractinia, and gave the term " granular structure " to it. He made this type of structure together with two other types, lamellar and fibrous structures, the three elementary types of fine skeletal structures in Scleractinia. The writer, however, would disaggree with him in this regard. As stated already elsewhere (KATO, 1963), lamellar structure is nothing but an expression of growth lines within the coral skeleton, and further, so-called " granular structure " is also regarded as an effect of recrystallization of fine skeletal structure.

As a result of recrystallization, primary fibrous structure of skeletons may be destroyed to moire structure, in which are observable scattered granules of calcite

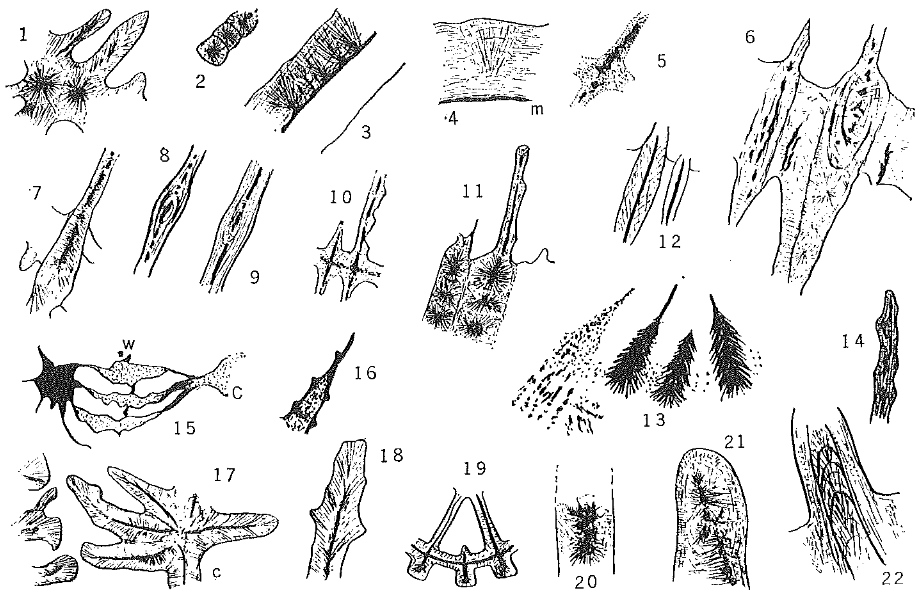

Fig. 1

Diagrams showing fine skeletal structures in some Scleractinian corals.

1. *Astrocoenia orbignyi* E. & H.—Turonian (An example of "fibrous" structure).
2. *Astraea* sp.—Pleistocene (A typical uni-trabecular septum).
3, 4. *Ceratotrochus* sp.—Pliocene (Fibro-lamellar type of septum. m—median dark line).
5. *Convexastraea* sp.—Jurassic (Rhabdacanthine septa like structure. Dark spots may be representing the remains of the centres of calcification after recrystallization).
6. *Heliastraea cavernosa cylindrica* (DUNCAN)—Miocene
7. *Madracis decactis* (LYMAN)—Pleistocene
8, 9. *Montlivaltia sp.*—low. Lias
10. *Montasraea* sp.—Miocene
11, 12. *Orbicella acropora* (L.)—Pleistocene (Figure 12 shows cleavage pattern in a septum).
13. *Stylina* sp.—Jurassic (Comparable to rhabdacanthine septa).
14. *Paracyathus caryophyllus* LAM.—Eocene (Fibro-lamellar)
15, 16. *Siderastraea* (*Siderofungia*) sp.—(w—wall, c—column. Figure 16 shows internal feature of a septum in cross section. Spots are not trabecular rods but only moire structure).
17, 18. *Stephanocoenia reussi* DUNCAN—Miocene (c—axial structure).
19. *Turbinolia* sp.—Eocene
20–22. *Stylophyllopsis mucronata* (DUNCAN)—low. Lias (There is a part of a septum in which fine structure is entirely lamellar).

or other carbonates. In this case, the centre of calcification may be left as a dark spot, or sometimes, the entire skeleton seems to be massive except for clear outlines of skeletons.

Even in *Corbariastraea renensis*, quoted by ALLOITEAU as a typical example of having granular structure, it is clear that lamellar structure remains within the skeleton. Rather concentric aspect of this lamellar structure suggests the dimunition of fibrous structure from the structure like in a form of *Heliastraea* shown in text-figure 6.

The term " granular " may be good for descriptive use, but does not indicate a genuine fine skeletal structure in Scleractinia.

So far as observed in cross sections, trabecular patterns are very much the same both in Rugosa and in Scleractinia. But in the latter group, later alteration of fine skeletal structure is rather common, owing presumably to the nature of calcium carbonate therein.

It is rather interesting to know that multi-trabecular type structure of septa is a very common feature amongst forms of Scleractinia.

The elongation of trabeculae often extends right cross the transverse sections of Scleractinian corals, owing to the nearly vertical dispositions of trabeculae. Accordingly dark spots representing centers of calcification in trabeculae are clearly seen in transverse sections. This character is more common in Scleractinia than in Rugosa.

There are two cases of so-called synapticulae. One of them is caused by the disorder in trabecular arrangement, and the other is the case in which trabeculae are laterally expanded to form swelling or nodes.

Lamellar structure is also distinct in Scleractinia accompanied by fibrous structure. Cleavage patterns are also detectable in Scleractinia.

There are cases in which septal construction is of rhabdoacanthine type. Pali structure is also comparable to axial lobes of Rugosa to some extent. So-called " Mullaille " is the same in structure as inner wall of Rugosa. And to make this " mullaille " a boundary the inclination of trabeculae is different both in inner and outer sides of the septa.

" Epitheca " is not fully studied in the present work, but is probably constructed simply of fibres.

In summary, histological features in Scleractinia do not reveal much difference from those of Rugosa, although there exist morphological as well as, possibly, functional differences or organs between these two major groups. So, it may be said that there is no big difference between the two in the mechanism of the skeletal formation itself.

On the fine skeletal structures in Tabulata

Now it may be as well to consider the fine skeletal structures of tabulate corals.

As far as the writer's observation goes, two major types of fine skeletal structures are also recognizable in Tabulata as in Rugosa. The fine skeletal structure in general is relatively simple in Tabulata, just like the simplicity of the internal structure of the group itself.

Roughly speaking the skeletons of Tabulata may be classified into three major parts, viz., tabulae, walls and septal spines. Among them tabulae and walls are the output of unilateral deposition (precipitation) in the writer's terminology and only septal spines are the result of segregation from cone-like folding of basal ectoderm of then living polyp.

However, walls actually sometimes consist of trabecular aggregation, and there are cases in which fibres are bundled in walls.

Usually fibres constructing walls are roughly perpendicular to the surface, and in many instances growth lines are observed cutting through these fibres. This fibro-lamellar structure of wall may be easily transformed into lamellar, according to the conditions of fossilization similar to cases in Rugosa.

CHUDINOVA (1959) separated Devonian Thamnoporoids into two groups based on the difference of lamellar and fibrous structure of walls. But these features are apparently not reliable criteria for separating Thamnoporoids or any other groups of Tabulata, since the difference of forms between them is only superficial as above stated.

The wall structure of Halysitid corals, studied by BUHLER (1955) and HAMADA (1957), is said to be two or three layered. But essentially they are aggregations of fibres perpendicular to the dark " epitheca ". They may also give massive or lamellar appearences, in which septal spines are embedded. Layers are only the result of a pause in growth of these fibres above mentioned.

Walls of *Sinopora* figured by KONISHI (1960) also gives similar example in this respect. For example so-called sclerenchymal deposits after the formation of " epitheca " makes two distinct layers. The circumstance is readily comparable to the case of dilation in Rogosa.

As to septal structure the writer does not know the presence of completely platy septa in Tabulata. Most of them are represented by rows of spines (acanthine septa) as in a rugosa, *Tryplasma*. Each one of them is nothing but a trabecula. Those acanthine septa (septal spines) sometimes fused together at their bases to form somewhat platy but denticulated septa (THOMAS and SMITH, 1954) in a *Halysites*.

Structures of horizontal partitions like tabulae are much the same with those of Rugosa, and they are fibrous-fibrolamellar-lamellar or massive., with dark lines at their basal portions.

The writer failed to observe good thin sections to reveal the fine structures of squamulae. However, it is rather supporsed that they are the results of some sort of modification of proper acanthine septa or septal spines, and not related genetically to tabulae.

In short fine skeletal structure of Tabulata is essentially not different from that of Rugosa. And wall structure is more important in Tabulata than the other characteristics. Many of them belong to fibro-normal type, represented by *Favosites*. Each corallite is separated from the other either by dark lines or light coloured, translucent layers at the middle of walls. In other words corallites are separated with each other in this type, although the communication between these corallites is suggested by the presence of mural pores.

Another type may be termed as trabecular, which is presumably a product of precipitation from invagination of common tissue between neighbouring corallites.

The following is a list of the result of my observation upon many genera of Tabulata, specimens of which are now stored at the British Museum of Natural History and Sedgwick Museum of Cambridge.

Abbreviation: A—fibro-normal wall structure
B—trabecular wall structure

Alveolites	A?	*Michelinia*	A
Angopora	B?	*Monilopora*	A
Aulopora	A	*Nyctopora*	B
Beaumontia	A	"*Pachypora*"	A
Calapoecia	B (cribriform)	*Palaeacis*	B
Chaetetes	B	*Planalveolites*	A
Cladochonus	A (lamellar)	*Propora*	B
Cladopora	A	*Protomichelinia*	A
Coenites	A	*Pseudofavosites*	A?
Cosmolithus	B	*Roemeria*	A
Diploepora	B	*Sarcinula*	B
Emmonsia	A	*Striatopora*	A
Favosites	A	*Syringopora*	A (lamellar)
Lichenaria	B	*Tetradium*	B
Lammotttia	B	*Tetrapora*	A
Lyopora	B	*Thecia=Laminopora*	B
Trachypora	A	*Vaughania*	A

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