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On the distribution of *Schizosphaerella punctulata*
DEFLANDRE & DANGEARD and *Schizosphaerella astraea* n.sp.
in the Liassic section of Stowell Park Borehole
(Gloucestershire) and in some other Jurassic localities
in England

By SHIMON MOSHKOVITZ¹⁾

ABSTRACT

Schizosphaerella punctulata DEFLANDRE & DANGEARD has been regarded as the only species of the genus *Schizosphaerella*. In the present study, a new species, i.e. *Schizosphaerella astraea*, was found in some Early Liassic sections of England.

Distribution of *S. punctulata* and *S. astraea*, mainly in the Stowell Park Borehole (Gloucestershire), and in some other Jurassic localities in England is presented. Both species are described and illustrated by light microscope and scanning electron microscope.

RÉSUMÉ

Schizosphaerella punctulata DEFLANDRE & DANGEARD était considéré jusqu'à présent comme seule espèce du genre *Schizosphaerella*. Dans la présente étude, une nouvelle espèce, *S. astraea*, a été trouvée dans quelques sections du Lias inférieur d'Angleterre.

La répartition de *S. punctulata* et *S. astraea* dans le sondage de Stowell Park (Gloucestershire) et dans quelques autres localités d'Angleterre est présentée. Les deux espèces sont décrites et illustrées au microscope photonique et au microscope électronique à balayage.

Introduction

The schizosphaerellids, which are of unknown systematic position, are small (5-30 μm), calcitic, rounded microorganisms made of two sub-hemispherical valves, with numerous pores distributed on their surface. They populated in great numbers the Jurassic seas and are found especially in the Early and Late Liassic rocks of Europe. They were first described by DEFLANDRE & DANGEARD in 1938, under the name *Schizosphaerella punctulata* from the Lower Oxfordian section at Villers-sur-Mer (*Q. mariae* zone), Northern France. For a long time, the researches regarding their structure and morphology were carried out by means of the light microscope and it was only from the large and well-preserved specimens that the approximate arrangement of the ultrastructure could be reconstructed. The detailed ultrastructure was revealed only by means of the electron microscope (NOËL 1965, 1972; BERNOULLI & RENZ 1970; BLACK 1971; GRÜN et al. 1974; AUBRY & DEPECHE 1974).

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It was shown that there is a regular, parallel arrangement of small calcitic elements, associated with four, cross-like pattern and until now, this enigmatic group was regarded as a monospecific genus.

The present study brings new information on the ultrastructure pattern of a new species (*Schizosphaerella astraea*) and the distribution of the schizosphaerellids, mainly in the Stowell Park Borehole (Gloucestershire), and some other places in England.

Material and methods

In the present work, samples mainly from the Stowell Park Borehole (Gloucestershire), and from other places in England, were examined for their schizosphaerellid content as follows:

Table 1: *Examined samples from the Stowell Park Borehole*¹⁾.

Sample No. ²⁾	Depth	Age	Ammonite biozone	Presence of <i>S. punctulata</i>	Presence of <i>S. astraea</i>
IGSBj 1365	574'9"	Middle Toarcian	<i>H. bifrons</i>	X	
IGSBj 1429	666'5"	Middle Toarcian	<i>H. bifrons</i>	X	
IGSBj 1443 (GSI 4920)	682'	Middle Toarcian	<i>H. bifrons</i>	X	
IGSBj 1472	692'9"	Early Toarcian	<i>H. falciferum</i>	X	
IGSBj 1501	703'4"	Early Toarcian	<i>H. falciferum</i>	X	
IGSBj 1712	781'7"	Late Pliensbachian	<i>A. margaritatus</i>		
IGSBj 2032	906'2"	Early Pliensbachian	<i>P. davoei</i>		
IGSBj 2118	940'	Early Pliensbachian	<i>P. davoei</i>		
IGSBj 2475	1088'	Early Pliensbachian	<i>T. ibex</i>	X	X
IGSBj 2690 (GSIN 4921)	1146'	Early Pliensbachian	<i>T. ibex</i>	X	X
IGSBj 2731 (GSIN 4924)	1172'	Early Pliensbachian	<i>T. ibex</i>	X	X
IGSBj 3147 (GSIN 4922)	1263'7"	Early Pliensbachian	<i>U. jamesoni</i>	X	X
IGSBj 3557	1341'4"	Late Sinemurian	<i>E. raricostatum</i>	X	X
IGSBj 3572 (GSIN 4923)	1342'4"	Late Sinemurian	<i>E. raricostatum</i>	X	X
IGSBj 4428	1519'	Late Sinemurian	<i>A. obtusum</i>		
IGSBj 5097	1675'	Early Sinemurian	<i>A. semicostatum</i>	X	
IGSBj 5405	1747'5"	Early Sinemurian	<i>A. bucklandi</i>	X	X
IGSBj 5684	1873'5"	Early Sinemurian	<i>A. bucklandi</i>	X	
IGSBj 5851	1963'4"	Hettangian	<i>A. liasicus</i>		
IGSBj 5857	1965'	Hettangian	<i>A. liasicus</i>		

¹⁾ The stratigraphical position of the samples from Stowell Park Borehole was concluded from a geological report on the Llanbedr (Mochras Farm) Borehole (IVIMEY-COOK 1971, Fig. 17).

²⁾ IGS = Institute of the Geological Sciences, London. GSI = Geological Survey of Israel, Jerusalem.

Table 2: *Examined samples from other localities.*

Sample No. ¹⁾	Locality	Age	Ammonite biozone	Presence of <i>S. punctulata</i>	Presence of <i>S. astraea</i>
IGSDr 2452/Bk 29 (GSIN 4918)	Warboys, Hunts.	Oxfordian	<i>C. cordatum</i>	X	
IGSPe 598/Bk 15 (GSIN 4919)	Westbury Borehole, Wilts.	Early Oxfordian	<i>Q. mariae</i>	X	
G.M. 38392 (GSIN 2908)	Barrington, Somerset	Early Toarcian	<i>H. falciferum</i>	X	
B.M. (Nat. Hist.) C 36877 (GSIN 1735)	Broom Cliff, Dorset	Early Pliensbachian	<i>P. davoei</i>	X	X
B.M. (Nat. Hist.) C 25577 (GSIN 1778)	Lyme Regis, Dorset	Early Sinemurian		X	X

¹⁾ *IGS* and *G. M.* = Institute of the Geological Sciences, London. *B. M. (Nat. Hist.)* = British Museum (Natural History), London. *GSI* = Geological Survey of Israel, Jerusalem.

The samples were studied both by the light microscope (LM) and the scanning electron microscope (SEM). Examinations by the LM were carried by the usual suspension method and for the SEM, the rich samples were prepared according to the method proposed by AUBRY & DEPECHE (1974). It was noted however, that the resistance to the hexametaphosphate was much stronger in the case of the Late Liassic samples, that could withstand a prolonged boiling, whereas samples of the Early Liassic age showed a strong dissolution and therefore boiling was restricted in these cases to several minutes only. After boiling, the clean samples were diluted and some were mounted on special mounting slides for LM-SEM observations (MOSHKOVITZ 1978). SEM examinations were carried out with a Cambridge AS-2 at the Institute of Geological Sciences, South Kensington, London, where all the material from the Stowell Park Borehole is stored.

Systematics

The genus *Schizosphaerella* DEFLANDRE & DANGEARD is usually regarded as an *incertae sedis* group within the calcareous nannoplankton; it differs substantially from the Coccolithaceae by the greater size, the presence of two attached hemispherical valves and the arrangement of the ultrastructural elements. In some respects, *Schizosphaerella* is reminiscent of *Thoracosphaera* KAMPTNER, a genus which recently was transferred systematically to the calcareous dinoflagellates (FÜTTERER 1976, 1977), and it is possible that the representatives of the enigmatic group *Schizosphaerella* form also a part of the calcareous dinoflagellates.

Genus *Schizosphaerella* DEFLANDRE & DANGEARD 1938

Two sub-hemispherical, unequal valves, attached by a simple hingement. The ultrastructure of the wall is composed of numerous, elongated calcitic elements,

arranged either in a rectangular pattern (*S. punctulata*) or randomly (*S. astraea* n. sp.)

Schizosphaerella punctulata DEFLANDRE & DANGEARD 1938

(Pl. 1, Fig. 1-10)

- 1938 *Schizosphaerella punctulata* n. sp. – DEFLANDRE & DANGEARD, p. 115, Fig. 1-6.
 1961 *Nannopatina grandaeva* n. sp. – STRADNER (partim), p. 2, Fig. 1-4, 8 (non Fig. 5-6).
 1963 *Schizosphaerella punctulata* DEFLANDRE & DANGEARD. – STRADNER, Pl. 3, Fig. 1, 1a.
 1965 *Schizosphaerella punctulata* DEFLANDRE & DANGEARD. – NOËL, p. 170, Pl. 27, Fig. 6-8.
 1971 *Schizosphaerella punctulata* DEFLANDRE & DANGEARD. – BLACK, Pl. 3, Fig. a-c.
 1972 *Schizosphaerella punctulata* DEFLANDRE & DANGEARD. – NOËL, p. 121, Pl. 15, Fig. 2-4.
 1974 Schizosphère. – AUBRY & DEPECHE, p. 1-16, Pl. 1-6 (non Pl. 3, Fig. 7).
 1974 *Schizosphaerella punctulata* DEFLANDRE & DANGEARD. – GRÜN, PRINS & ZWEILLI, p. 314, Pl. 22, Fig. 4-6.
 1976 *Schizosphaerella punctulata* DEFLANDRE & DANGEARD. – MOSHKOVITZ & EHRLICH, p. 54, Fig. 7-15.

Description. – Two sub-hemispherical valves, usually bell- or cup-like in shape. The valves are attached one to the other by a simple hingement with a sub-peripheral groove. The ultrastructure of the wall is made of numerous calcitic elements (lathes and plates), arranged in a regular rectangular pattern. Detailed description of the morphology and ultrastructure is found in AUBRY & DEPECHE (1974).

Diagenesis. – In many altered specimens of *S. punctulata*, the original fundamental elements are completely lost, however, the disposition of the small recrystallized quadrilateral crystals within the original rectangular voids on the surface, enables to trace the principal arrangement of *S. punctulata*. Stages in the diagenetic processes are shown by SEM micrographs in Plate 1, Figures 7-10.

Stratigraphic distribution in the Stowell Park Borehole. – Early Sinemurian – Toarcian.

Stratigraphic remarks. – The definite earliest stratigraphic occurrence of *S. punctulata* is reported from the Hettangian (*S. angulata* zone) of Pinhay Bay, near Lyme Regis, Dorset (BLACK 1971). The species is widespread in the Early and Late Liassic rocks of Europe and Asia, where it sometimes constitutes a rock-forming element (BERNOULLI & RENZ 1970, BERNOULLI & JENKYNS 1970). It was also reported from the Middle and Late Jurassic of England and France; interestingly however, there is no mention until now of any true *Schizosphaerella* representatives from any of the Deep Sea Drilling Project Sites that penetrated Late Jurassic strata. The stratigraphic occurrence of this species was discussed by MOSHKOVITZ & EHRLICH (1976).

Schizosphaerella astraea n. sp.

(Pl. 2, Fig. 1-8)

- 1961 *Nannopatina grandaeva* n. sp. – STRADNER (partim), p. 2, Fig. 5-6 (non Fig. 1-4, 8).
 1974 Schizosphère. – In AUBRY & DEPECHE, Pl. 3, Fig. 7.
 1978 *Schizosphaerella* sp. – MOSHKOVITZ, Pl. 2, Fig. 1-2.

Derivation of name: Greek: aster = star.

Holotype: Plate 2, Figures 1-2, 4.

Type level: Early Pliensbachian (*T. ibex* zone), depth 1172', sample IGS Bj 2731.

Type locality: Stowell Park Borehole, Gloucestershire.

Depository: In the collection of the Paleontological Department, Geological Survey of Israel, Jerusalem (GSIN 1924, stub 89/P/15/4).

Description. – In LM, the two hemispherical valves are seen to be attached one to the other by a simple overlapping, the tips of the smaller, inner valve are somewhat curved, constricted and are pointed towards the walls of the bigger valve; the tips of the latter end sharply (Pl. 2, Fig. 1). The ultrastructure, as revealed by the SEM, is composed of numerous elongated crystallites, 0.3–0.5 μm in length. In well-preserved portions of the test, these elements are seen to be arranged in groups of six, five or four, radiating from a central knob, thus forming a star-like pattern. In some oblique views, it is seen that the crystallites form vertical plates and delimit triangular pores.

Dimensions of the holotype. – Diameter of the outer valve: 16 μm ; diameter of the inner valve: 13 μm ; height of the two valves (attached): 20 μm .

Remarks. – *S. astraea* n.sp. differs from *S. punctulata* by the simpler hinge which bears no sub-peripheral groove and by the arrangement of the radiating crystallites. It is probable that the forms mentioned by STRADNER (1961, p. 3) from the Liassic section, at Dorset (op. cit., Fig. 5–6), are similar to *S. astraea* since in his description, STRADNER writes that «Die im englischen Lias gefundenen Schalen und Gehäuse sind vereinzelt äquatorial etwas eingeschnürt und zeigen die feinen Poren nicht so deutlich und auch nicht so regelmässig angeordnet wie diejenigen aus dem deutschen Lias» (op. cit., p. 3).

Interestingly, the ultrastructure of *S. astraea* is reminiscent of that found in the calcareous dinoflagellate *Thoracosphaera tesserula* FÜTTERER, which also shows randomly oriented crystallites (FÜTTERER 1977, p. 715, Pl. 3, Fig. 1–2).

Diagenesis. – In many specimens, the ultrastructure of *S. astraea* has been obliterated but since the elongated bars delimit triangular pores (rather than rectangular ones) diagenesis proceeds accordingly (see Pl. 2, Fig. 5, 7, 8).

Stratigraphic distribution in the Stowell Park Borehole. – From the uppermost part of the *A. bucklandi* zone – Early Sinemurian, to the middle part of *T. ibex* zone – Early Pliensbachian. Many specimens of *S. astraea* are found especially in the *U. jamesoni* zone of the Early Pliensbachian.

Other places. – Specimens of *S. astraea* were found also in the Early Sinemurian and the Late Pliensbachian in the Dorset area.

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Plate 1

All specimens are from the Stowell Park Borehole, except for Figures 7 and 9.

Fig. 1-10

Schizosphaerella punctulata DEFLANDRE & DANGEARD

1: Assembled valves showing rectangular ultrastructure. Middle Toarcian (*H. bifrons* zone); IGS Bj 1443 (GSIN 4920); SEM $\times 3,750$.

2-3: Detached valves of two different specimens; same sample as in Figure 1; SEM $\times 3,750$.

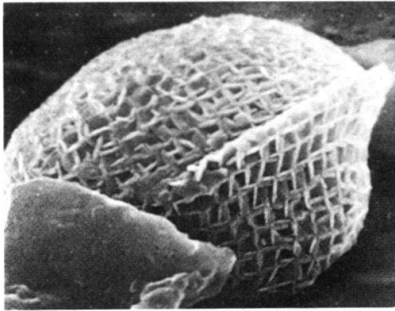
4-5: Assembled valves of different specimens. Early Pliensbachian (*U. jamesoni* zone); IGS Bj 3147 (GSIN 4922); LM $\times 2,800$.

6: Detailed view and arrangement of rectangular ultrastructure showing bars and plates. Same sample as in Figure 1; SEM $\times 8,000$.

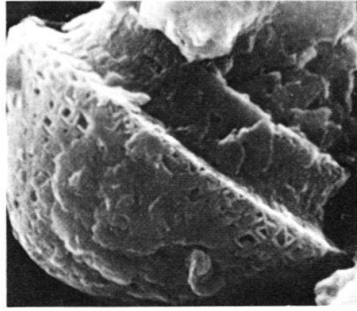
7: Inside view; partial alteration of test. Early Oxfordian (*Q. mariae* zone), Westbury Borehole, Wilts.; IGS Pe 598 Bk 15 (GSIN 4191, stub 120/0/16/4); SEM $\times 7,500$.

8, 10: Partial filling of voids by rectangular crystallites; same sample as in Figure 1; 8 = SEM $\times 22,500$; 10 = SEM $\times 7,500$.

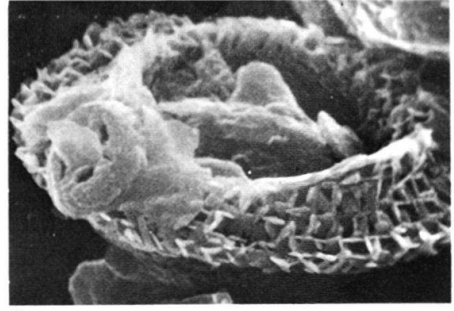
9: Complete alteration of ultrastructural elements and recrystallization; rectangular arrangement still preserved. Oxfordian (*C. cordatum* zone), Warboys, Hunts.; IGS Dr 2450 (GSIN 4918, stub 115/S/13/3); SEM $\times 7,500$.



1



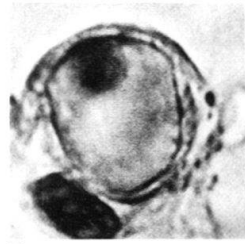
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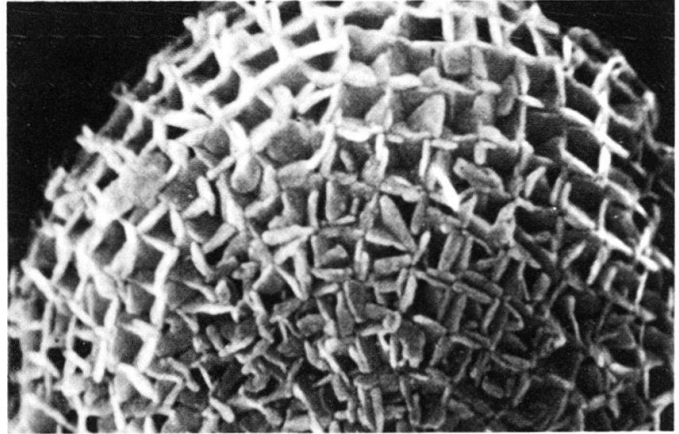
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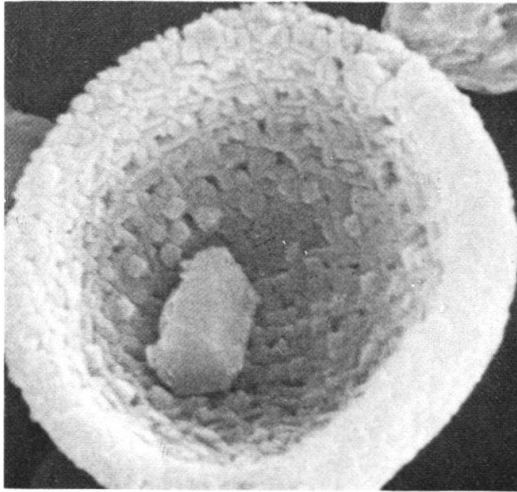
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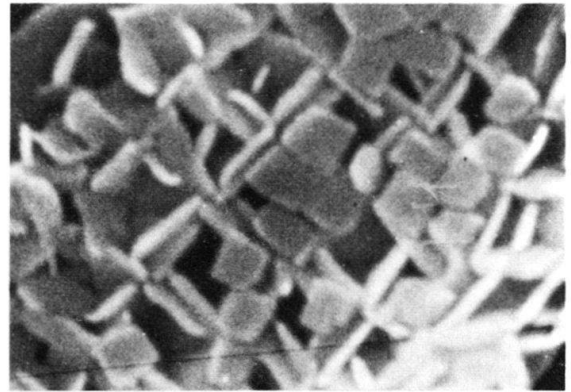
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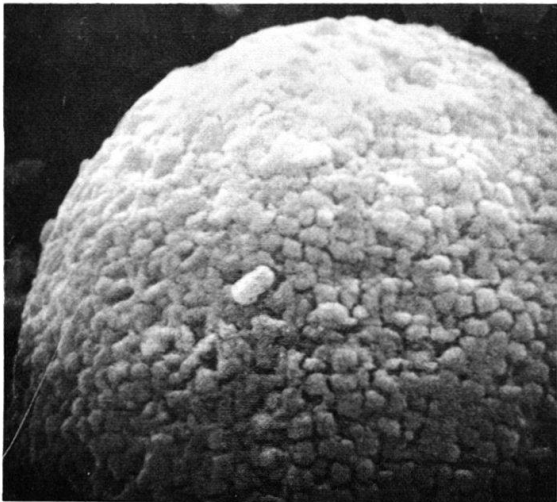
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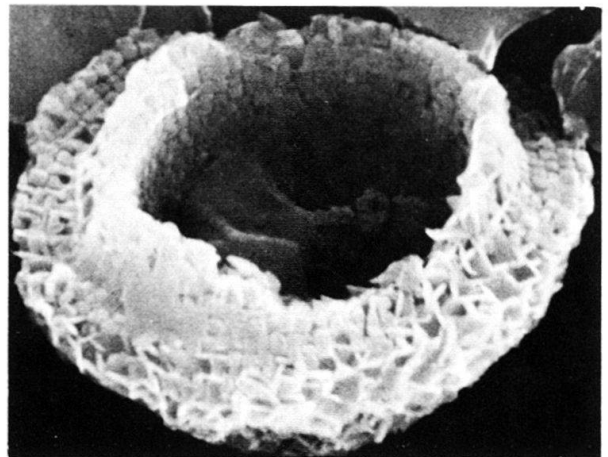
7



8



9



10

Plate 2

All specimens are from the Stowell Park Borehole, except for Figure 5.

Fig. 1-8

Schizosphaerella astraea n. sp.

1: Assembled valves. Holotype. Early Pliensbachian (*T. ibex* zone); IGSBj2731 (GSIN 4924, stub 89/P/15/4); LM \times 2,400.

2: Same specimen as in Figure 1; SEM \times 2,200.

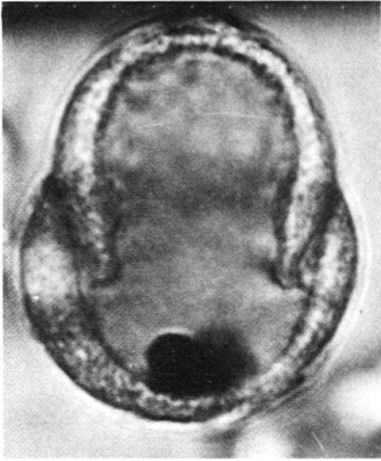
3: Another specimen. Same sample as in Figures 1 and 2; SEM \times 3,500.

4: Detailed view of ultrastructure. Holotype; SEM \times 8,000.

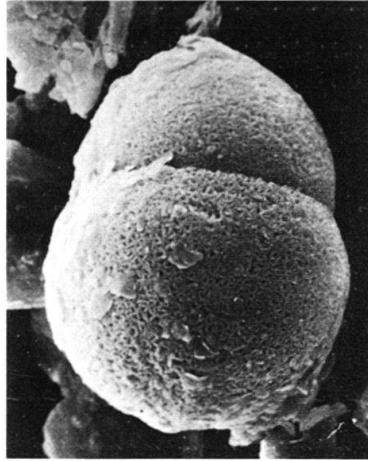
5: Detached valve, partly altered, showing asteroid arrangement of the elements. Early Pliensbachian (*P. davoei* zone), Broom Cliff, Dorset. B.M. (Nat. Hist.) C36877 (GSIN 1735, stub 320); SEM \times 7,500.

6: Detailed view and arrangement of elements. Late Sinemurian (*E. raricostatum* zone); IGSBj3572 (GSIN 4923, stub 104/G/15); SEM \times 15,000.

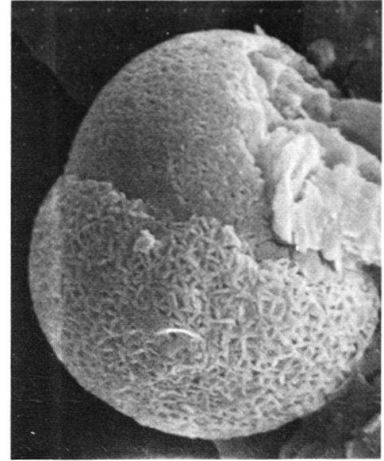
7-8: Diagenetic alteration of two different specimens of *S. astraea*. Same sample as in Figure 6; SEM \times 15,000.



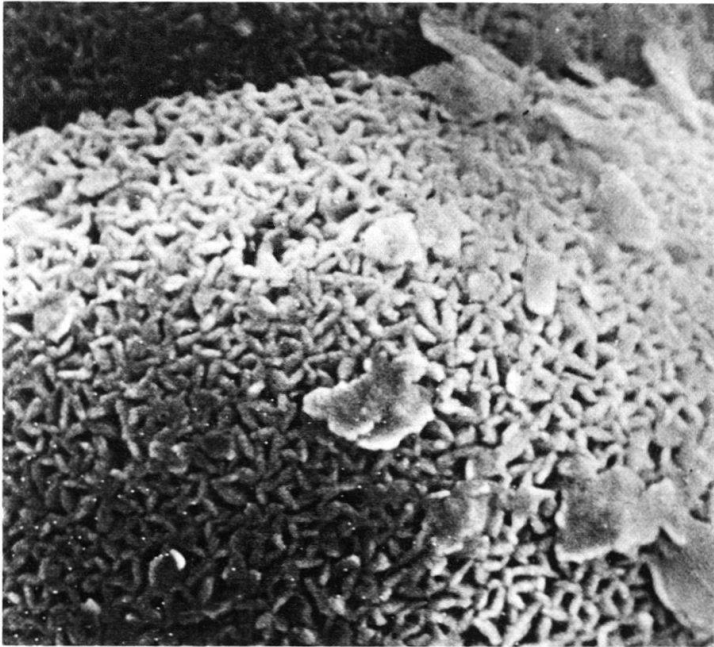
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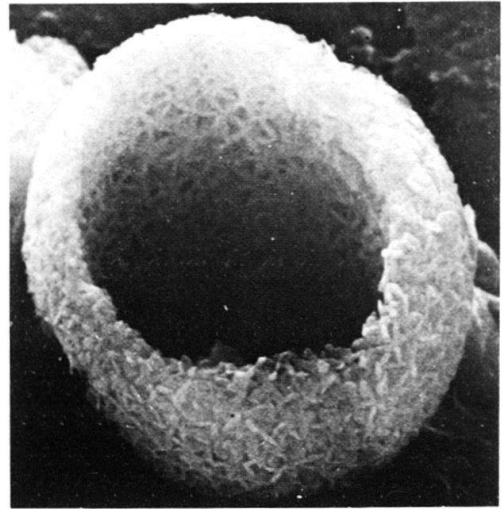
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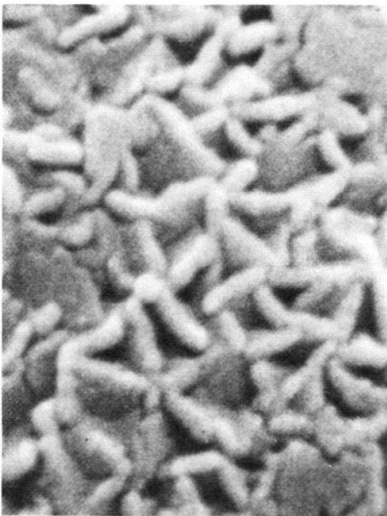
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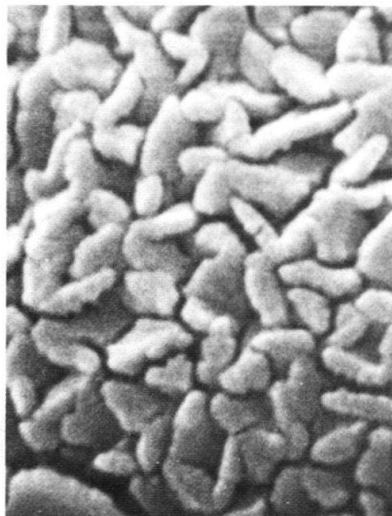
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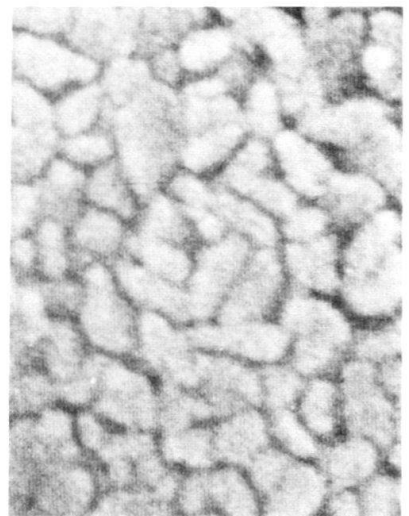
5



6



7



8

