Lower Palaeozoic erratic favositids from the Island of Sylt, Germany

Jan H. Stel

Stel, J. H. Lower Palaeozoic erratic favositids from the Island of Sylt, Germany. – Scripta Geol., 97: 1-32, 6 figs., 14 pls, Leiden, December 1991.

Twelve species of favositids are described. They are derived from silicified boulders found in Pliocene (?) deposits of the Island of Sylt, Germany. *Paleofavosites* is the dominant genus in this material. Two new species are described, viz. *Paleofavosites oekentorpi* and *Favosites schuddebeursi*.

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Introduction

Favositids are characteristic of the Lower Palaeozoic. The Baltic outcrops are rich in these fossils and belong to the best studied areas in the world. Moreover, these fossils are well known as erratic boulders in northern Europe. In this paper erratic favositids are described from the Pliocene beds of the Island of Sylt, Germany. The material has been donated to the Nationaal Natuurhistorisch Museum (National Museum of Natural History), where it is stored under the registration numbers RGM 293 260 - 293 273.

Favositids are the skeletal remains of a probably extinct group of exclusively colonial organisms with controversial systematic affinities. The skeletons of favositids consist of slender tubes with many transverse partitions, the tabulae. Because of these tabulae favositids are mostly assigned to the tabulate corals, a name introduced by Edwards & Haime in 1849. The discovery of living sclerosponges that share architectural affinity with some groups within the Tabulata led to a renewed discussion about the evolutionary relationship of favositids (Stel, 1978a, 1980). At present this discussion is apparently finished in favour of a coral interpretation based on the discovery of fossilized polyp structures in favositids from the Llandoverian Jupiter Formation of Canada (Copper, 1985; Oekentorp & Stel, 1985).

Acknowledgements

The author wishes to thank Professor K. Oekentorp (Geologisches Institut der Westfälischer Wilhelms-Universität, Münster, Germany) for correcting the lists of synonyms, late Professor E.R. Klaamann (Germany) for discussions on the determinations and Professor G.J. Boekschoten (Vrije Universiteit, Amsterdam, The Netherlands) for support during this research at the former Geological Institute of the University of Groningen. Mr U. von Hacht (Hamburg, Germany) is acknowledged for providing the studied material from his extensive collection of silicified fossils from Sylt.

Structural elements

The form of the skeleton of favositids varies widely. It depends on the shape and arrangement of individual corallites. Single favositids do not occur as adult organisms. A colony may be laminar, domed, hemispherical, spherical, nodular, or irregular. It may have coarse or slender branches, which are either cylindrical or flat. The corallites may be polygonal, due to the fact that in ceroid colonies the corallites are closely pressed together and in contact on all sides (Thompson, 1917). In meandroid colonies the walls separate rows of confluent corallites. Meandroid colonies are described from paleofavositids with solenial growth. According to Coates & Oliver (1973) the meandroid growth form could be regarded as indicative of a higher level of integration compared to the ceroid growth form. These integration levels are based on both views about coloniality in Recent Scleractinia as well as the stratigraphic distribution of tabulates, rugose corals and heliolitids. According to Stel & Oekentorp (1976) this growth form is caused by geometrical conditions. Moreover, the intensity of this growth form is inversely proportional to the diameter of the corallite. I therefore do not believe that it is realistic to draw conclusions on the level of integration based upon the morphological arrangements of the corallites.

The overall diameter of favositid corallites varies from less than 1 mm to c. 7 mm. Flat tabulae, which mostly are horizontal or saucer-shaped are the only transverse skeletal element. The favositid organism partly or completely lived in the uppermost part of the colony. During growth the lowest part of the organism was cut off by the centripetal secretion of a tabulum. Centripetal growth is indicated by growth lines at the underside of the tabulae. Septal structures and pores developed in the uppermost compartment of the corallite.

There is an extensive literature about the wall structure in tabulates. Some authors are of the opinion that tabulates were aragonitic, just as the Recent anthozoans. Others concluded that a calcitic skeleton was secreted by the living organism. For detailed studies the reader is referred to the papers of Oekentorp (1972, 1980, 1984). The corallite wall actually is a double wall as it consists of the lateral skeletal deposits of neighbouring corallites.

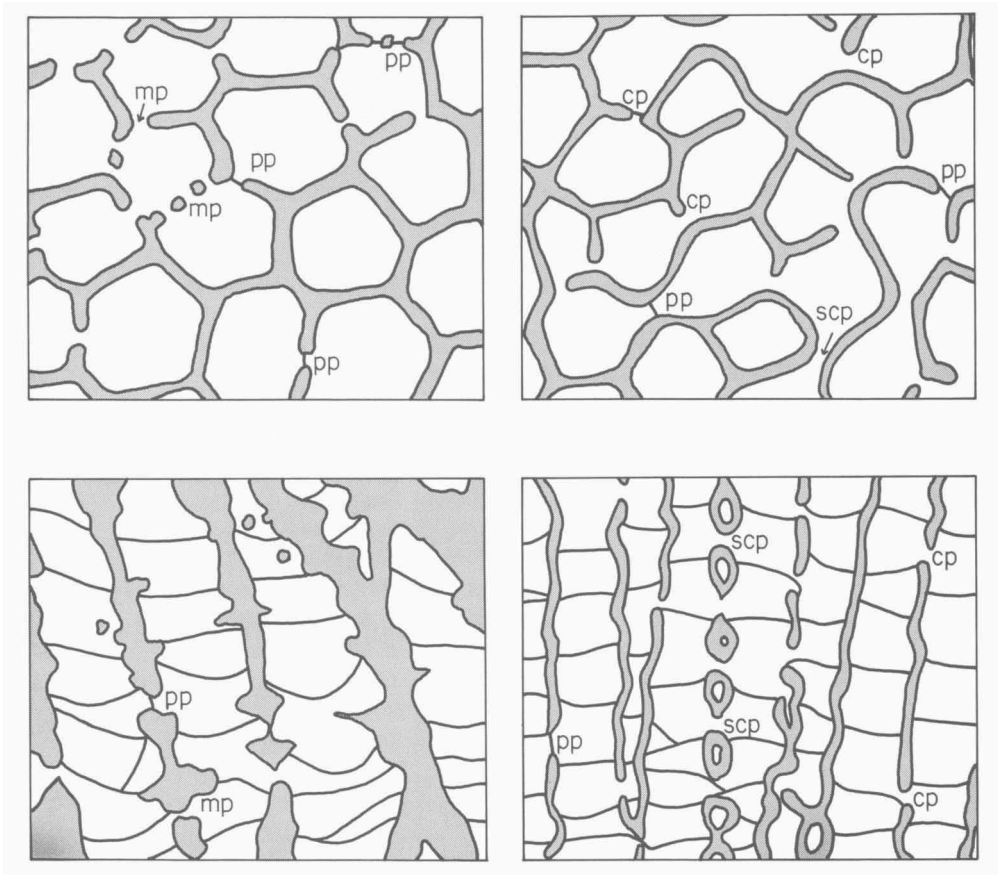


Fig. 1. Pores and related structures in favositids; cp = corner pore; mp = mural pore; pp = pore plate; scp = solenia-like corner pore.

Pores (Fig. 1) are the characteristic circular or ellipsoidal connections between adjacent corallites. The diameter of the pores is thought to be an important character at the species level. Schouppé and Oekentorp (1974) demonstrated that the number of rows of pores depends on the width of the corallite wall as well as on the growth modes of the colony. In stratigraphically older favositids such as paleofavositids, pores are only found at the corner of the corallite and are called corner pores. In stratigraphically younger favositids pores are situated in the corallite wall and are named mural pores. Oekentorp and Schouppé (1969) demonstrated that the alternation of pores in *Paleofavosites* caused a typical undulation of the corallite walls near the corner. The arrangement of pores has been widely used as a systematic characteristic at the generic level. *Mesofavosites*, showing both corner and mural pores, is a typical example of this. In literature another connective structure, the so-called solenia, has wrongly been used as a generic characteristic. Stel and Oekentorp (1976) demonstrated that these structures simply are funnel-shaped corner

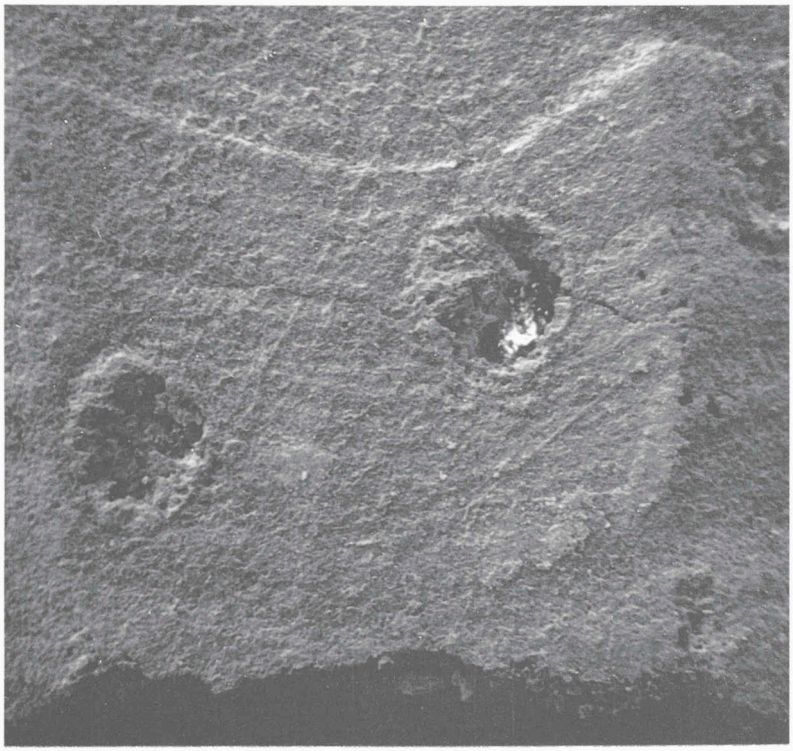


Fig. 2. Growth lines on the wall of a favositid. The lines near the right pore are bent downwards. Erratic boulder, Groningen, The Netherlands; RGM 243 723.

pores in paleofavositids. As a consequence *Multisolenia*, *Priscosolenia*, *Sparsisolenia*, and *Mesosolenia* are considered to be junior synonyms of *Paleofavosites*.

Oekentorp and Sorauf (1969) noted a relation between the pore development and the shape of the growth rings in the corallite wall of *Favosites gothlandicus* Lamarck. The arrangement of the growth rings indicated that a tissue connection developed in the lower part of the wall. During growth the connection was walled up and a pore was formed. Stel (1978a) showed that the development of pores is not limited to the lower parts of the corallite wall (Fig. 2).

Tabulae, from which the name Tabulata is derived, are more or less horizontal floors in the corallites. Several types are distinguished (Fig. 3). The morphology of the tabulae has been used as a generic feature by Sokolov (1962). The density of tabulae is mostly related to environmental conditions, and consequently is not important in systematics. A relation between the density of tabulae, the thickness of the corallite wall and the intensity of the expression of septal structures is sometimes suggested (Klaamann, 1962; Oekentorp, 1975). Stel (1978b) showed that, if the distance between the tabulae in *Favosites hisingeri* is large, thin walls, and few

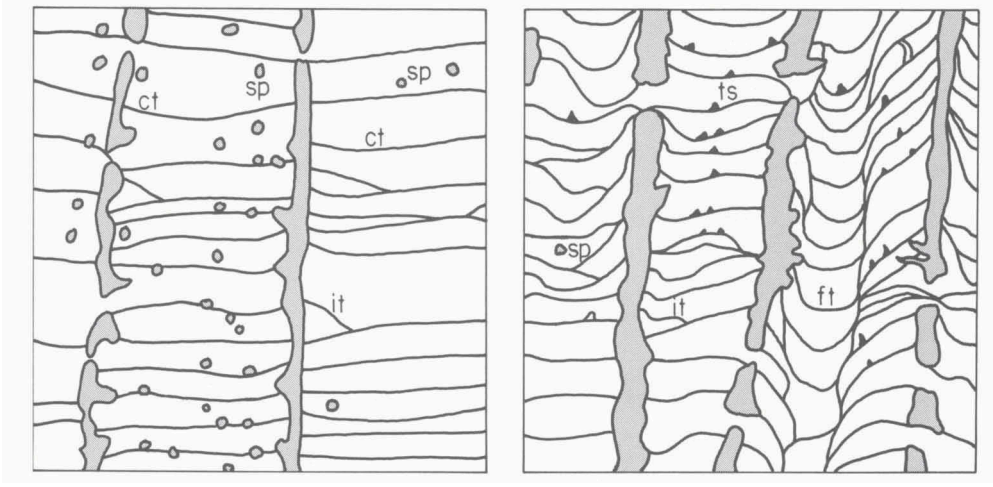


Fig. 3. Tabulae in favositids; ct = complete tabulum; ft = fundibular tabulum; it = incomplete tabulum; sp = spine; ts = tabular spine.

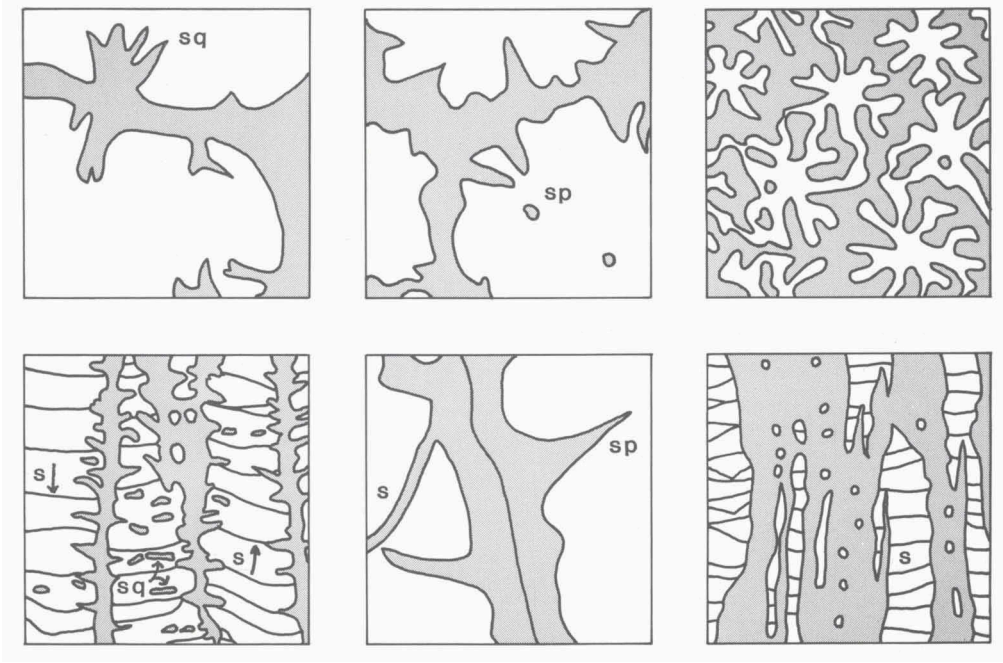
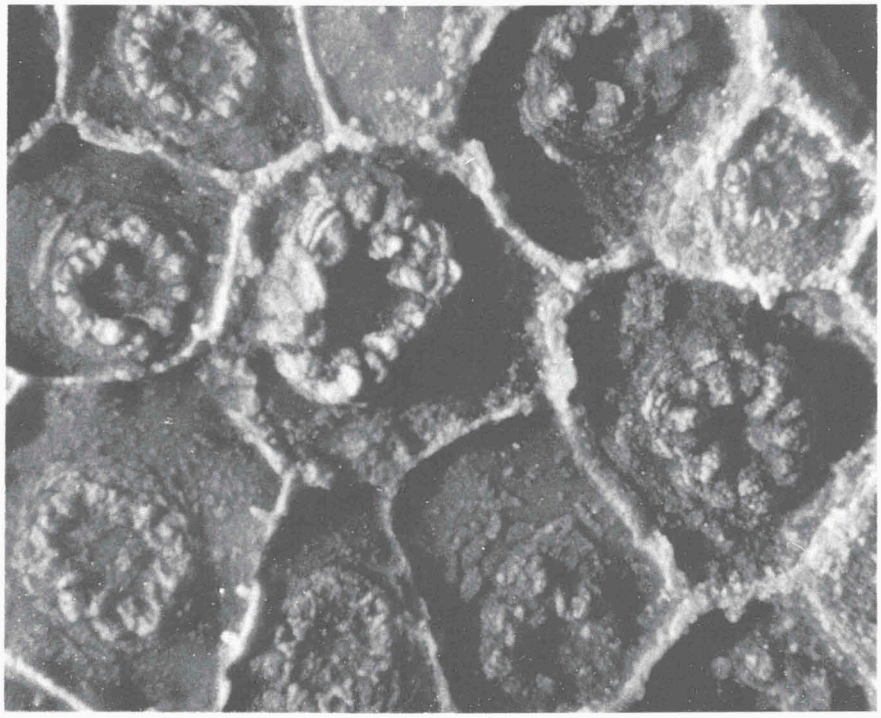


Fig. 4. Septal structures in favositids; s = septum; sp = spine; sq = squamulum.

Fig. 5. Favositid from the Silurian Jupiter Formation, Anticost Island, Canada. A. Fossilized 'polyps', × 25; B. SEM micrograph of polyp, showing radially and transversely wrinkled walls as in modern polyps (pictures by P. Copper).

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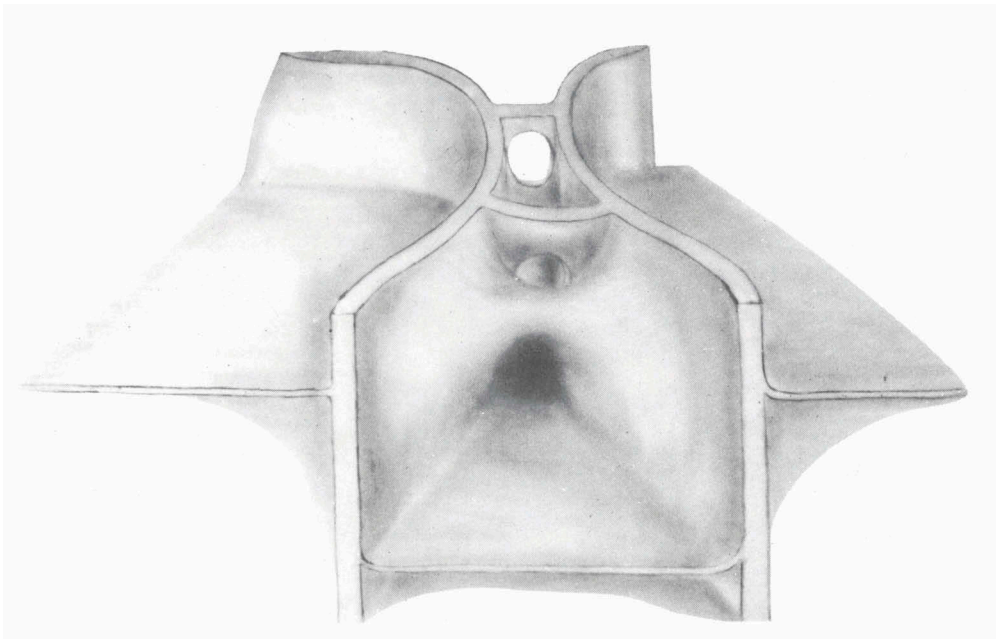


Fig. 6. Diagram of lateral increase in *Paleofavosites asper* (d'Orbigny, 1850) with a solenial growth habit.

or no septal spines occur. The reverse is also true: if the mutual distance is small, thick walls and large thick septal spines are found.

Radially arranged longitudinal elements in favositids are septa, spines and squamulae (Fig. 4). Continuous septa are an exception. There is no agreement about the presence of a fixed number of septal structures. In favositids spines are often seen. They are mostly directed obliquely upwards. Spines can expand laterally and form plates or squamulae. The occurrence of squamulae is sometimes used as a characteristic at the generic level.

An interesting recent discovery of well preserved polyps in favositids is described by Copper (1985). This material apparently shows evidence for 12-fold tentacles. Copper's illustrations (see also Fig. 5) are indeed easily leading to the conclusion that most Tabulata incontrovertibly belong to the Coelenterata and not to the Sclerospongia as suggested by Flügel (1976), Stel (1978a, 1980) and Kazmierzak (1984). Sofar, fossilized 'polyps' are known from two localities at the base of the upper Llandoverian Jupiter Formation, Anticosti Island, Canada. The lithology of the outcrops consists of sparsely fossiliferous shales and limestones and are comparable to the Visby Beds of Gotland. According to Dr P. Copper (pers. comm.) it is difficult to explain the special preservation of these favositids. There are no volcanic tuffs, no bentonites, no phosphatized layers, no black muds etc. in these outcrops. SEM-pictures of the 'polyps' show that the 'polyp' walls are wrinkled radially and transversely, like modern day retracted polyps (P. Copper, pers. comm.). Sofar, no 'polyps' are known from Gotland, although the Upper Visby Beds, having thin bentonite layers, are a promising research subject in this respect.

Oekentorp and Stel (1985) indicated that this does not answer the systematic positions of all tabulates. Forms as *Nodulipora* and *Desmidopora* as well as chaetetids are undoubtedly to be considered as sclerosponges.

It is reasonable to suppose that both sexual and asexual reproduction occurred in favositids. Sexual reproduction most likely led to free swimming larvae that usually settled upon a hard substratum and formed a protocorallite. However, little is known about these early life stages as protocorallites are rarely found. Colony development occurs by asexual reproduction. Lateral increase (Fig. 6) is widespread among favositids (Stel, 1978c, 1979).

Hard substrate trace fossils are frequently found in favositid colonies. Parasitic relationships are concluded in some cases.

Systematic descriptions

Class ANTHOZOA Ehrenberg, 1834
Subclass TABULATA Milne-Edwards & Haime, 1850
Order FAVOSITIDA Sokolov, 1962
Suborder FAVOSITINA Sokolov, 1950
Family FAVOSITIDAE Dana, 1846
Subfamily FAVOSITINAE Twenhofel, 1914

Genus *Paleofavosites* Twenhofel, 1914

Type species – *Favosites aspera* d'Orbigny, 1850 (see Oekentorp, 1976).

Diagnosis (revised after Oekentorp, 1976) – The colony is massive, convex, flat, or irregular in shape. The corallites are polygonal, strongly adjoined. The double wall is thin and straight. However, near the corner pores it can be rippled. Connecting structures (corner pores) are arranged in vertical rows at the corners of the corallites. In specimens with slender corallites, funnelshaped corner pores were developed because of the geometric conditions. The septal structure is developed as septal spines. Generally, the tabulae are flat.

Remarks – In the literature the occurrence of so-called solenia has wrongly been used as a generic characteristic. Stel and Oekentorp (1976) have demonstrated that these structures simply are funnel-shaped corner pores in paleofavositids having small corallites. As a consequence *Multisolenia*, *Priscosolenia*, *Sparsisolenia*, and *Mesosolenia* are considered junior synonyms of *Paleofavosites*. It is noted that the correct spelling, as given by Twenhofel (1914), of the genus is *Paleofavosites* instead of *Palaeofavosites*.

Distribution – Middle Ordovician-Lower Ludlow: Urals. Upper Ordovician-Lower Ludlow: Baltic, Podolia, Siberia, Kazakhstan, Kolyma Basin. Upper Ordovician-Ludlow: Western Europe, Australia, China, North America. Silurian: Central Asia. *Paleofavosites* is also found as erratic boulders in Germany, Poland and The

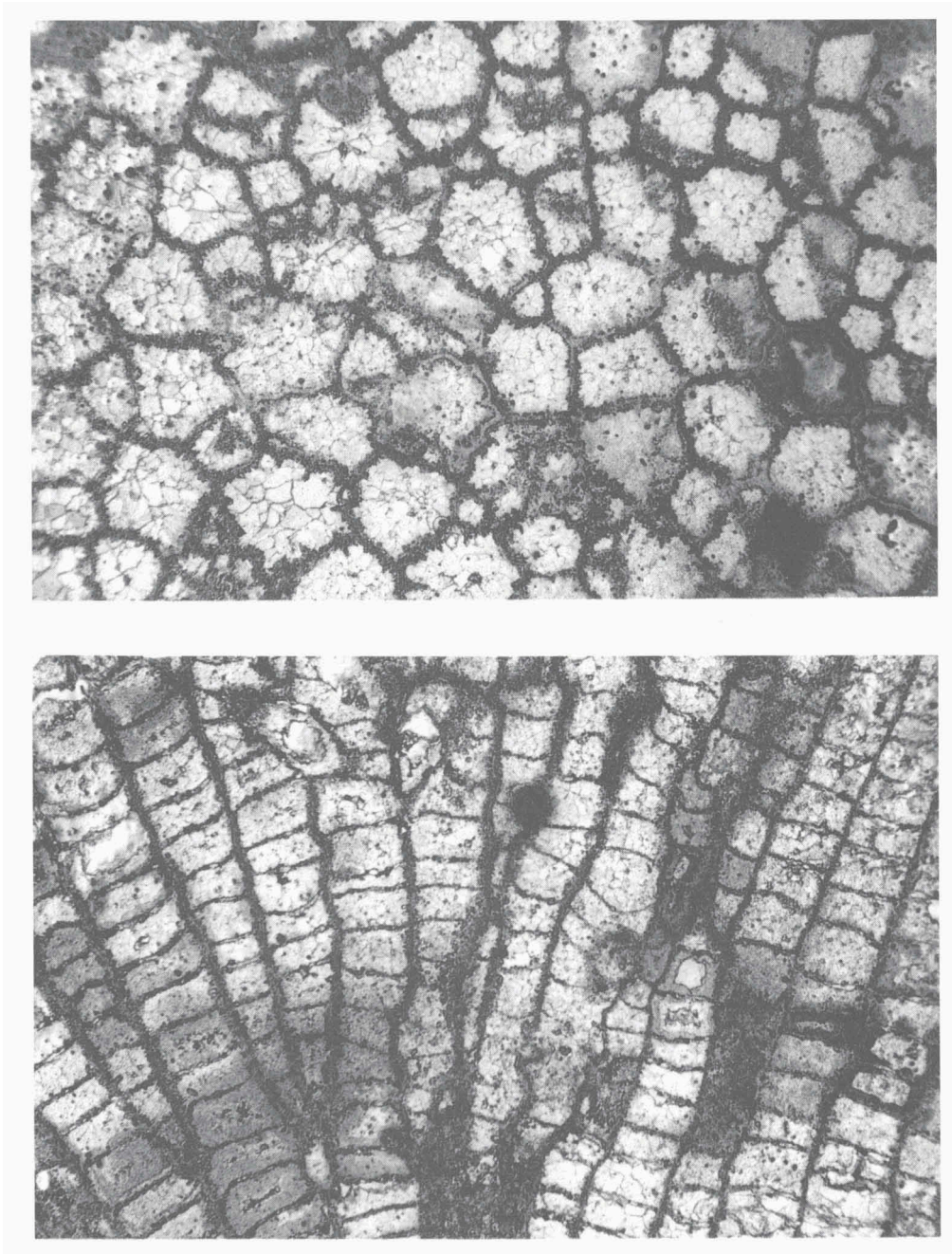


Plate 1

Paleofavosites paulus Sokolov, 1951. Silicified erratic boulder from Sylt, Pliocene; RGM 293 260, × 12.5; transverse section (upper), longitudinal section (lower).

Netherlands.

Paleofavosites paulus Sokolov, 1951
Pl. 1.

1951 *Palaeofavosites paulus* sp. nov. – Sokolov, pp. 30-31, pl. 9, figs. 4-7.
1964 *Palaeofavosites paulus* Sokolov – Klaamann, pp. 23-24, pl. 4, figs. 8-10.
1971 *Palaeofavosites paulus* Sokolov – Stel, p. 53, pl. 15.

Material – Erratic boulder from Sylt, collected by Mr U. von Hacht, RGM 293 260.

Description – Corallites polygonal, differentiated in size, 0.7-1.3 mm in diameter. Double wall straight, 0.06-0.12 mm thick. Small septal spines are found especially in the larger corallites. The dimensions of the corner pores are difficult to measure due to silicification. Tabulae flat; mutual distance 0.40-0.62 mm. On the average 5-9 tabulae are found at a 3 mm interval.

Remarks – Sokolov (1951) distinguished several varieties of *P. paulus*; this group is wide-spread in the Llandovery of the Baltic area. In his opinion this group includes colonies with well developed spines, straight walls and small (0.08 mm) pores (*P. paulus*) as well as colonies with less pronounced spines and much larger (0.24 mm) pores (*P. paulus* var. *raikuelaensis*) or with in a characteristic way undulating wall (*P. paulus* var. *dagoensis*). Klaamann (1964) concluded that it was impossible to differentiate between the varieties in this way and that, based upon a similar corallite size, unrelated favositids are assigned to *P. paulus*. Taking into account both the stratigraphic distribution and the morphological characteristics he concluded that these two varieties are better considered independent species. A third variety, *P. paulus tamsaluensis*, is incorporated in *P. paulus* as the so-called diagnostic characteristics are caused by the fossilisation processes. The loose bond of the walls allowing a colony to split easily along the individual corallites is a widespread feature in tabulates from the Tamsalu Stage.

In this paper I followed the interpretation of Klaamann mainly because of the influence of the stratigraphic distribution in his interpretation. According to Klaamann (1964) the colony shape of *P. paulus* is discoidal or platy. The size of the colony varies between 10-15 and 100 mm. The corallites are polygonal and slightly differentiated; the diameter is 0.7-1.3 mm. The double wall is straight with large septal spines. Normally the thickness of the double wall is 0.04-0.06 mm. However, a thickness of c. 0.1 mm is often found. Pores are small and have a diameter of c. 0.1 mm. Tabulae are thin, horizontal with a mutual distance of 0.4-1.0 mm. Colonies from the Juuru Stage show more pronounced spines. Colonies from the Tamsalu Stage have a larger corallite diameter and a more differentiated shape of the corallites. Colonies are most abundant in the Tamsalu reef facies.

Distribution – Estonia: Llandovery: Juuru, Tamsalu and Raikküla stages. Germany and The Netherlands: erratic boulders.

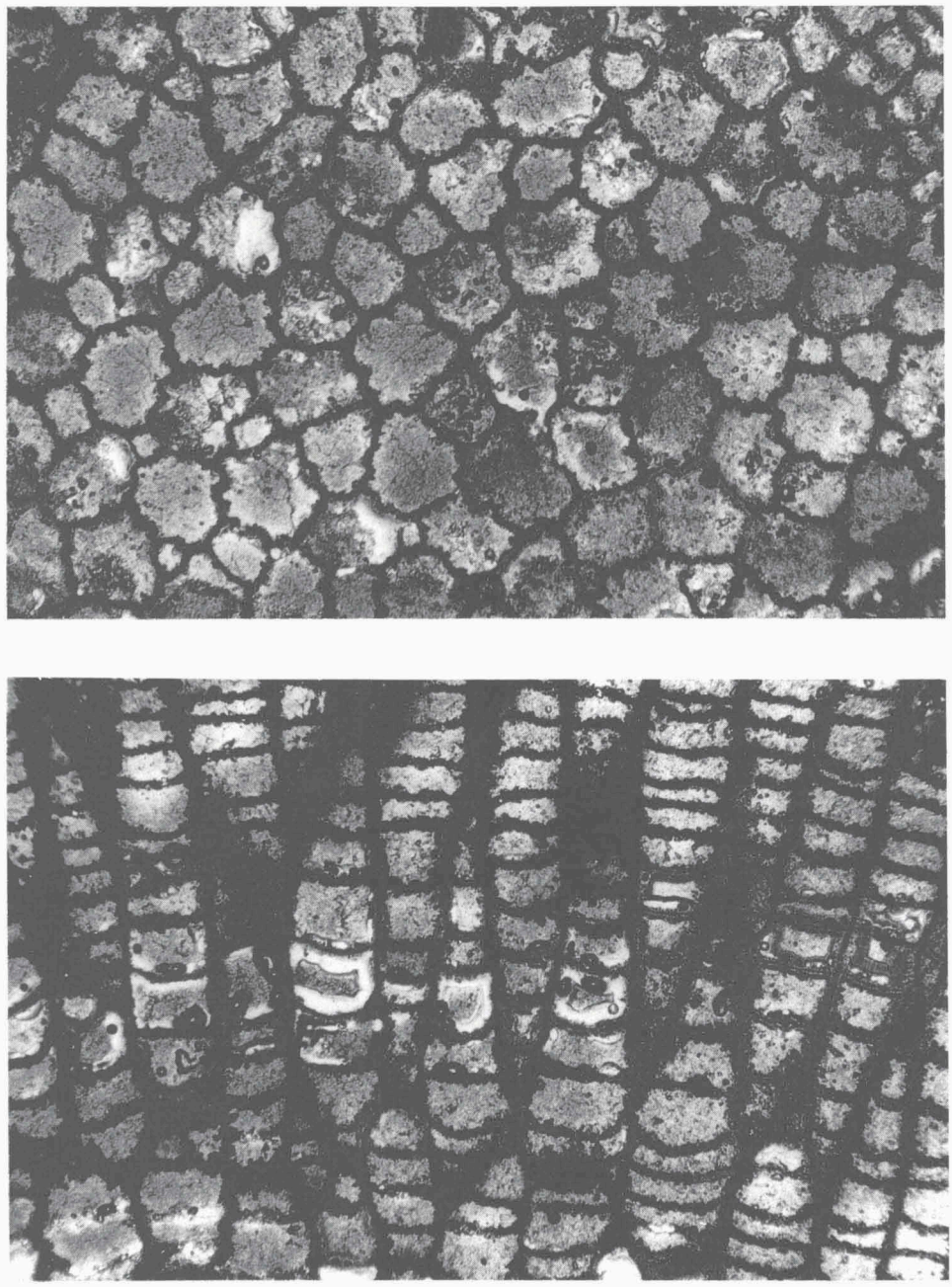


Plate 2

Paleofavosites dagoensis Sokolov, 1951. Silicified erratic boulder from Sylt, Pliocene; RGM 293 261, × 12.5; transverse section (upper), longitudinal section (lower).

Paleofavosites dagoensis Sokolov, 1951
Pl. 2.

1951 *Palaeofavosites paulus* var. *dagoensis* var. nov. – Sokolov, pp. 32-33, pl. 10, figs. 5-8.
1964 *Palaeofavosites dagoensis* Sokolov – Klaamann, pp. 24-25, pl. 4, figs. 11-12.

Material – Erratic boulder from Sylt, collected by Mr U. von Hacht, RGM 293 261.

Description – Corallites polygonal, differentiated in size, 1.0-1.4 mm in diameter. Double wall undulating in a characteristic way and sometimes showing small septal spines. Thickness 0.08-0.10 mm, occasionally up to 0.12 mm. Diameter of corner pores 0.07 mm. Tabulae flat; mutual distance 0.42-0.56 mm. On the average 6-8 tabulae are found at a 3 mm interval.

Remarks – *P. dagoensis* differs from *P. paulus* especially by the characteristic undulating wall. *P. dagoensis* is only known from the reef facies of the Tamsalu Stage (G-II-H), where it is abundant.

The specimen from Sylt has a corallite size which differs slightly from that given by Klaamann. However, the dimensions given under the description are the corallite sizes most often found. Due to the silicification process the pores are difficult to see and their dimensions are not so easy to measure. Therefore, the difference in size is neglected.

Distribution – Estonia: Llandovery, Tamsalu Stage (G-II-H). Germany: erratic boulders.

Paleofavosites mirus Sokolov, 1951
Pls. 3-4.

1951 *Palaeofavosites mirus* sp. nov. – Sokolov, pp. 40-41, pl. 15, figs. 3-7.
1951 *Palaeofavosites hystrix* Sokolov – Sokolov, pp. 36-38, pl. 13, fig. 4, pl. 14, figs. 1-2.
1951 *Palaeofavosites hystrix* var. *raikküensis* Sokolov – Sokolov, pp. 39-40, pl. 15, figs. 1-2.
1964 *Palaeofavosites hystrix* Sokolov – Klaamann, p. 28, pl. 7, figs. 1-2.
1967 *Palaeofavosites hystrix* Sokolov – Stasinska, pp. 69-70, pl. 17, fig. 3.

Material – Erratic boulder from Sylt, collected by Mr U. von Hacht, RGM 293 262-263.

Description – Corallites polygonal, uniform in size, 1.0-1.2 mm in diameter. Double wall straight, 0.08-0.10 mm thick. Diameter of corner pores 0.07 mm. Tabulae flat and arranged in differently spaced zone; mutual distance 0.53-1.45 mm. On the average 3-4 tabulae are found at a 3 mm interval.

Remarks – There are several favositids in the Llandoverian deposits of the Baltic area which resemble *P. mirus*. These are *P. paulus*, *P. dagoensis*, *P. limbergensis*, *P. hystrix*, and *P. alinquantulus*. The mutual difference is mainly based upon differ-

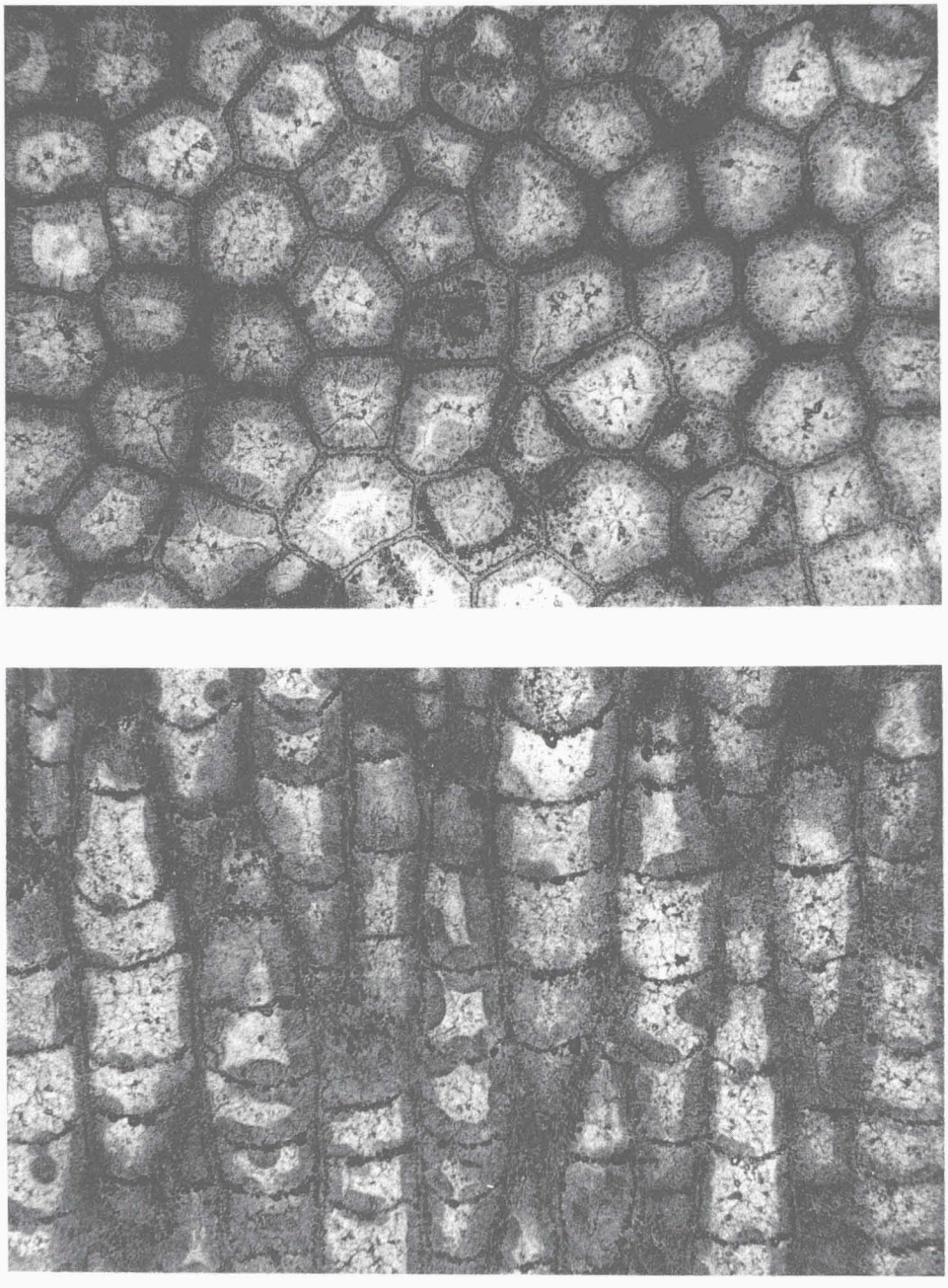
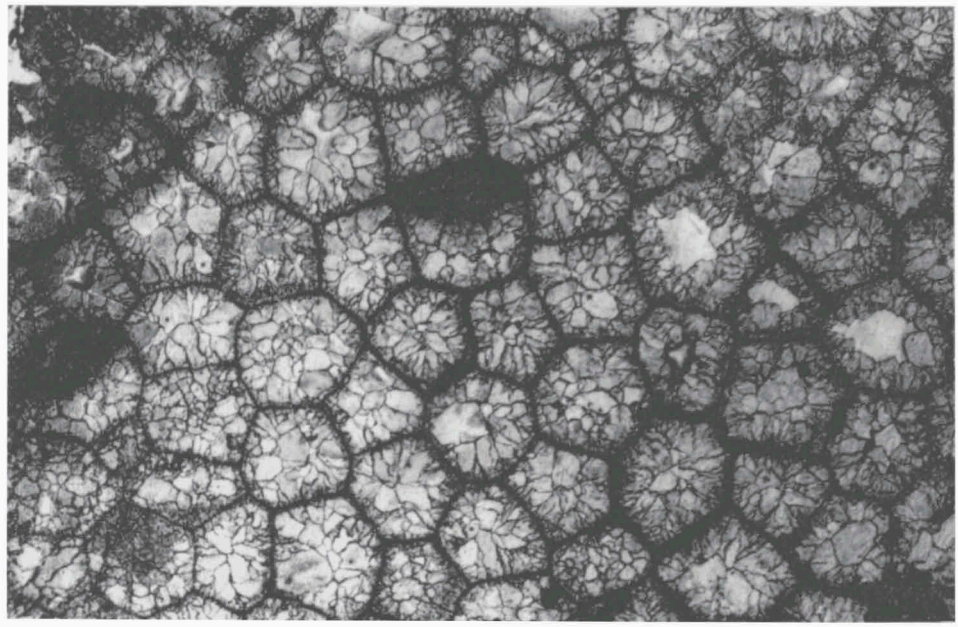


Plate 3

Paleofavosites mirus Sokolov, 1951. Silicified erratic boulder from Sylt, Pliocene; RGM 293 262, × 12.5; transverse section (upper), longitudinal section (lower).



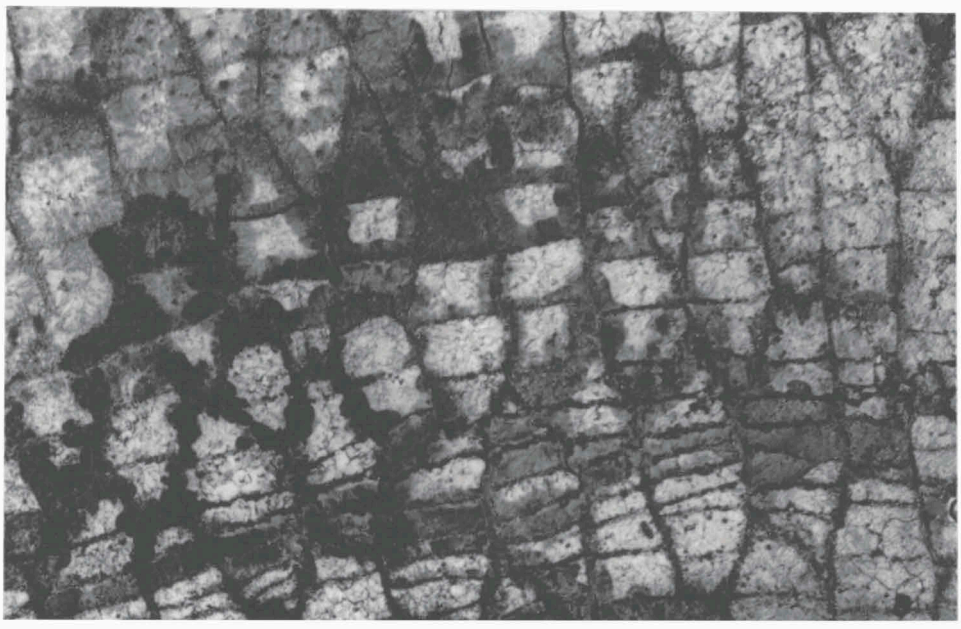


Plate 4

Paleofavosites mirus Sokolov, 1951. Silicified erratic boulder from Sylt, Pliocene; RGM 293 263, × 12.5; transverse section (upper), longitudinal section (lower).

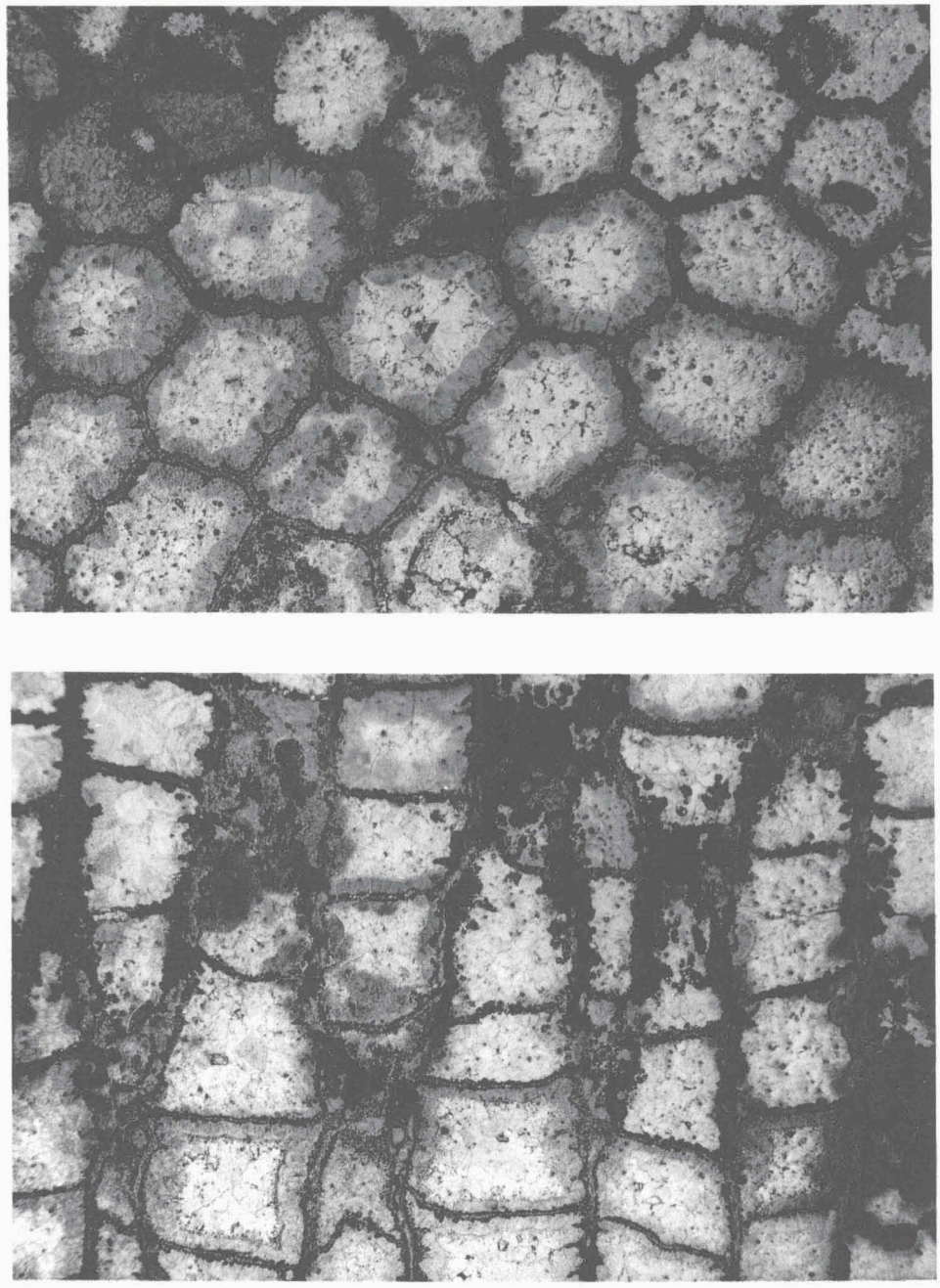


Plate 5

Paleofavosites primus Sokolov, 1951. Silicified erratic boulder from Sylt, Pliocene; RGM 293 264, × 12.5; transverse section (upper), longitudinal section (lower).

ences in pore diameter, tabulae distance and the intensity of the development of the septal spines. Based on the dimensions of the corallite the specimens from Sylt are assigned to *P. mirus*. The dimensions of *P. limbergensis* (0.6-1.7 mm.) differ considerably from the described specimens. The morphological differences with *P. hystrix* are very small and mainly concern the diameter of the pores and the weak development of septal spines. As the stratigraphic distribution is also similar, I consider both species as synonyms. The difference with *P. alinquantulus* concerns the development of broad septal spines. The dimensions of this species correspond very well with the specimen from Sylt. Because of the pronounced development of the septal spines in this species, this specimen is assigned to *P. mirus*, in which the development of spines varies. This erratic boulder is apparently derived from a part of a colony in which the development of spines is weak.

Distribution – Estonia: Llandovery, Tamsalu (G-II-H) and Raikküla (G-3) stages. Germany: erratic boulders.

Paleofavosites primus Sokolov, 1951
Pl. 5.

1951 *Palaeofavosites hystrix* var. *prima* var. nov. – Sokolov, p. 38, pl. 13, fig. 5; pl. 14, figs. 3-4.

Material – Erratic boulder from Sylt, collected by Mr U. von Hacht, RGM 293 264.

Description – Corallites polygonal, differentiated in size, 1.0-1.7 (2.0) mm in diameter. Double wall, undulating in a characteristic way and showing small, upwardly directed, septal spines. The thickness of the double wall varies between 0.12 and 0.20 mm. Diameter of corner pores c. 0.22 mm. Tabulae flat; mutual distance 0.64-1.02 mm. On the average 3-4 tabulae are found at a 3 mm interval.

Remarks – The specimen from Sylt slightly differs in the mutual distance between the tabulae from the specimens described by Klaamann (1964) and Sokolov (1951). In these colonies the tabulae are zonally arranged and their mutual distance is 0.4-1.2 mm. However, locally this distance only is 0.2-0.3 mm. *P. primus* slightly differs in corallite size from *P. hystrix* (1.0-1.5 mm) as well as from *P. mirus* (0.8-1.5 mm; dominant 1.0-1.4 mm).

Distribution – Estonia: Llandovery, Tamsalu (G-II) and Raikküla (G-3) stages. Germany: erratic boulder.

Paleofavosites schmidti Sokolov, 1951
Pl. 6.

1951 *Palaeofavosites schmidti* sp. nov. – Sokolov, pp. 26-27, pl. 6, figs. 4-5.
1961 *Palaeofavosites schmidti* Sokolov – Klaamann, pp. 121-123, pl. 10, figs. 1-8.
1964 *Palaeofavosites schmidti* Sokolov – Klaamann, pp. 5-6, pl. 1, figs. 1-3.

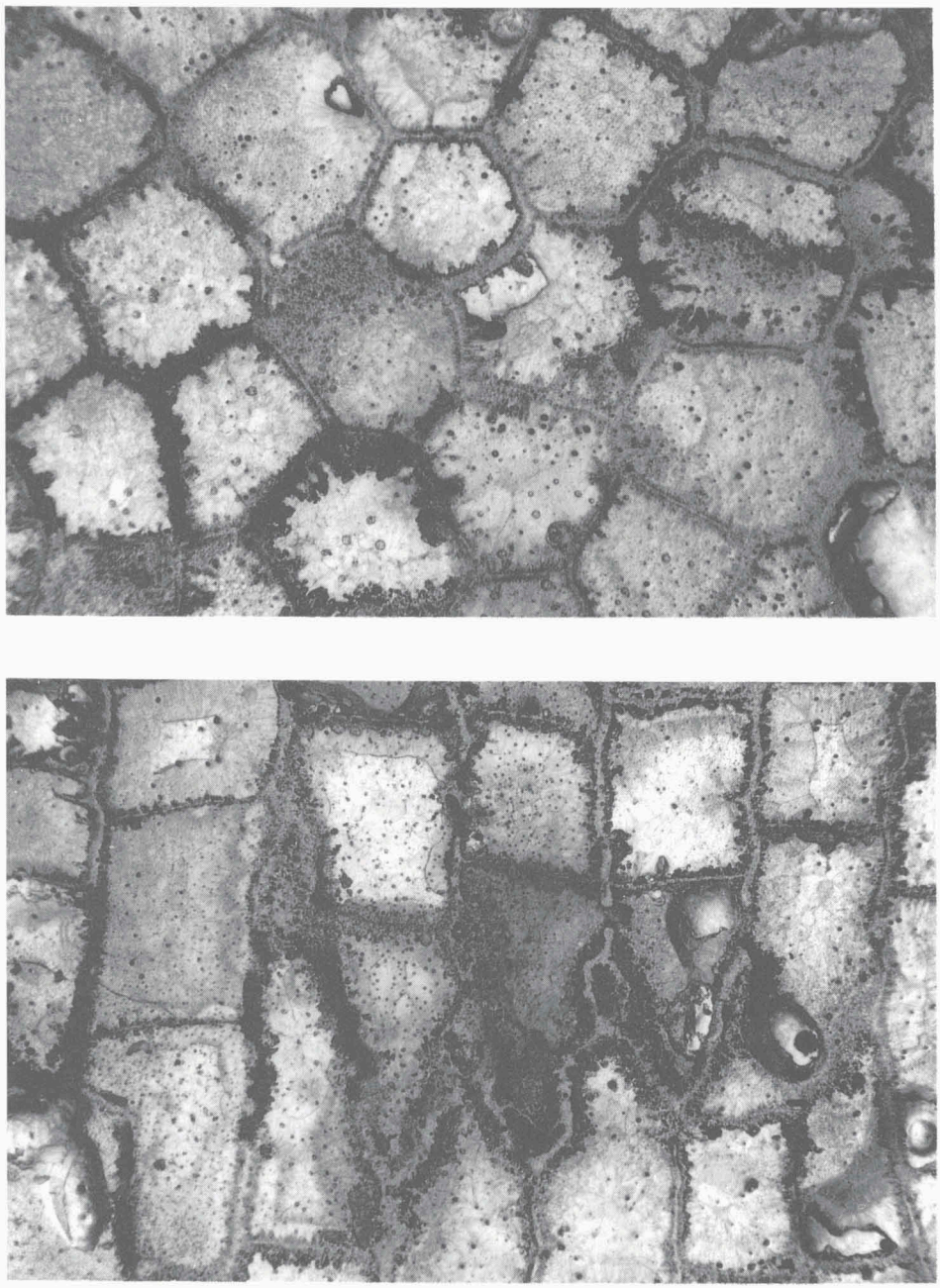


Plate 6

Paleofavosites schmidti Sokolov, 1951. Silicified erratic boulder from Sylt, Pliocene; RGM 293 265, × 12.5; transverse section (upper), longitudinal section (lower).

1967 *Palaeofavosites schmidti* Sokolov – Stasinska, pp. 71-72, pl. 16, figs. 2-5.
1971 *Palaeofavosites schmidti* Sokolov – Stel, p. 43, pl. 1.

Material – Erratic boulder from Sylt, collected by Mr U. von Hacht, RGM 293 265.

Description – Corallites polygonal, uniform in size, 1.4-2.0 mm in diameter. Double wall straight, sometimes slightly curved, 0.08-0.24 mm thick, occasionally up to 0.28 mm. Diameter of corner pores c. 0.20 mm. Tabulae flat; mutual distance 0.90-1.90 mm. On the average 2-4 tabulae are found at a 3 mm interval.

Remarks – According to Klaamann (1964) the size of the corallites in Late Ordovician colonies is somewhat smaller than in colonies from the Llandoverian. In the latter case the corallite-size is 1.6-2.3 mm. The morphological characteristics of the erratic boulder specimen from Sylt fit the description of the Ordovician species very well. The silicified specimen from Sylt differs from the one Stel (1971) described from Pleistocene deposits in Groningen, The Netherlands. However, the calcareous erratic boulders in this part of The Netherlands have a different and stratigraphically younger source area than the silicified erratic boulders. The specimen from Groningen perfectly meets the description of the Llandoverian material, described by Klaamann (1964).

Distribution – Estonia: Upper Ordovician, Wormsi, Pirgu (frequent) and Porkuni stages; Llandovery, Tamsalu and Adavere stages. Norway: Llandovery, series 6. Poland, Germany and The Netherlands: erratic boulders.

Paleofavosites karinuensis Sokolov, 1951
Pl. 7.

1951 *Palaeofavosites alveolaris* (Goldfuss) var. *karinuensis* var. nov. – Sokolov, pp. 23-24, pl. 5, figs. 1-2.
1964 *Palaeofavosites karinuensis* Sokolov – Klaamann, pp. 32-33.

Material – Erratic boulder from Sylt, collected by Mr U. von Hacht, RGM 293 266.

Description – Corallites polygonal, 2.0-3.4 mm in diameter, the dominating diameter being 2.5-3.4 mm. Double wall straight, 0.10-0.36 mm in longitudinal sections and 0.04-0.08 mm in transverse sections. Corner pores 0.06 mm in diameter. Tabulae flat; mutual distance 3.00-4.20 mm. On the average 1 tabulum is found at a 3 mm interval.

Remarks – The distance between the tabulae differs (1.5-2.5 mm) from those given by Klaamann (1964).

Distribution – Estonia: Llandovery, Raikküla Stage (rare). Germany: erratic boulder.

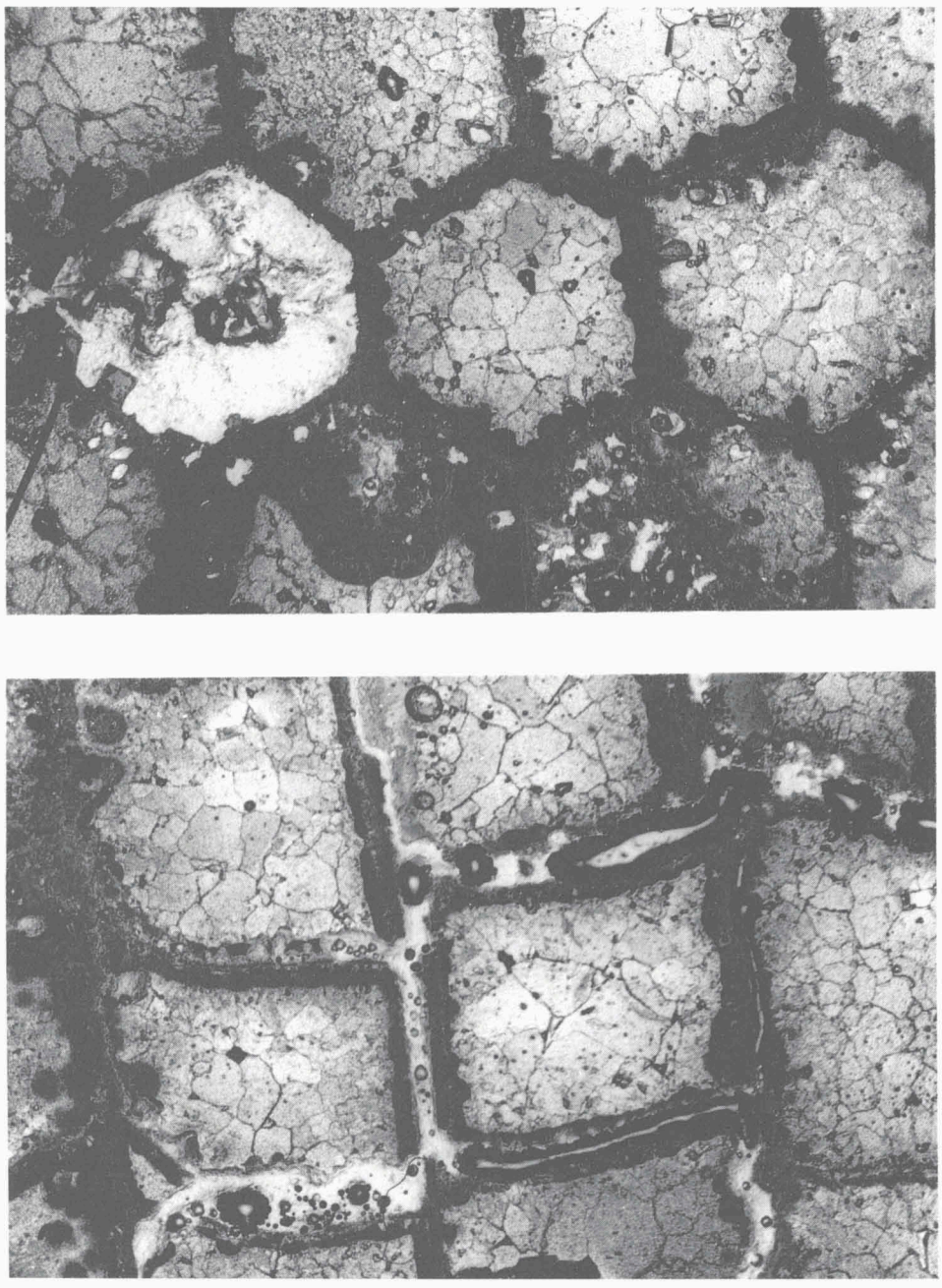


Plate 7

Paleofavosites karinuensis Sokolov, 1951. Silicified erratic boulder from Sylt, Pliocene; RGM 293 266, × 15; transverse section (upper), longitudinal section (lower).

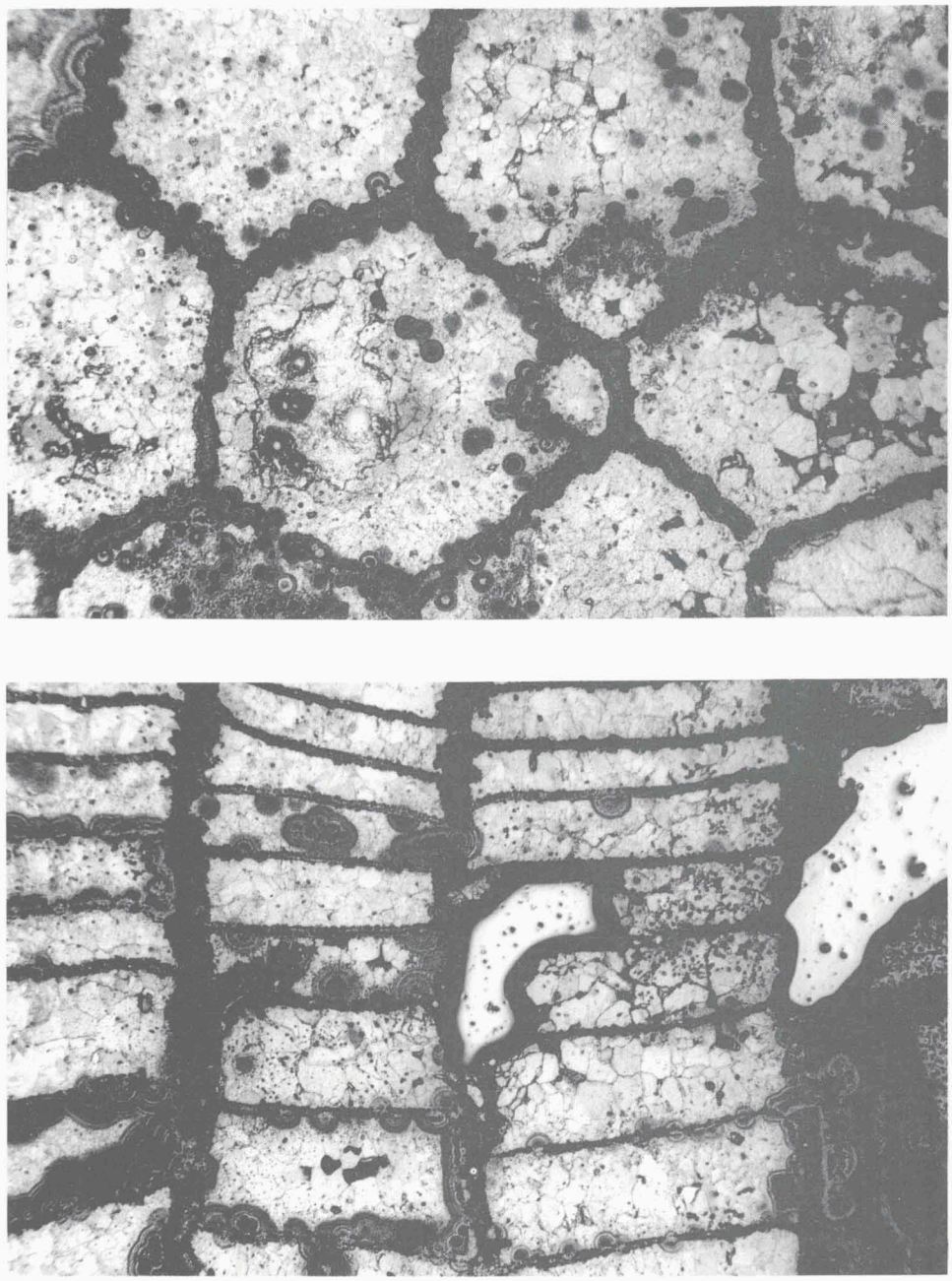
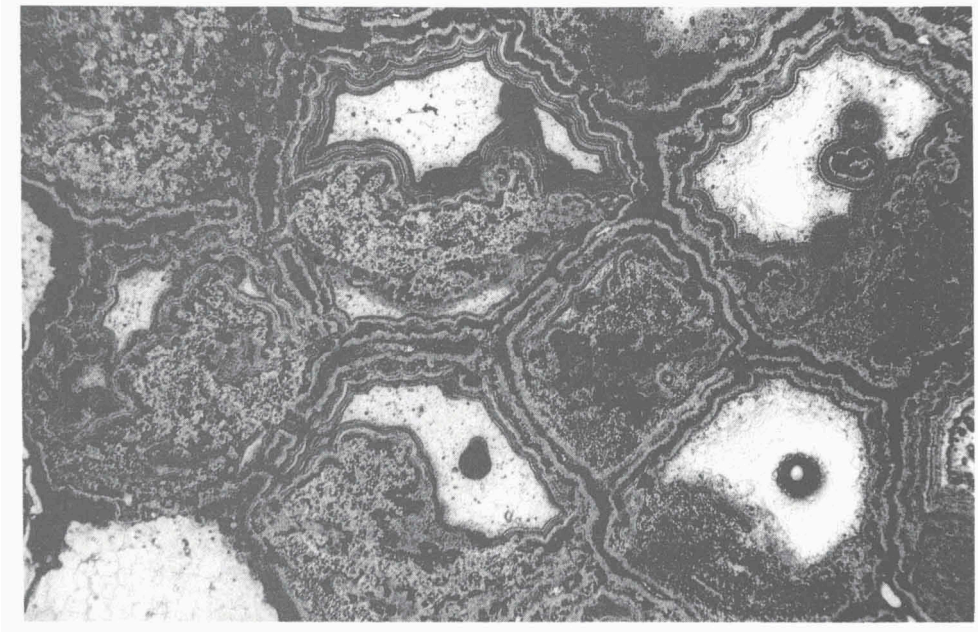


Plate 8

Paleofavosites abstrusus Klaamann, 1961. Silicified erratic boulder from Sylt, Pliocene; RGM 293 267, × 15; transverse section (upper), longitudinal section (lower).



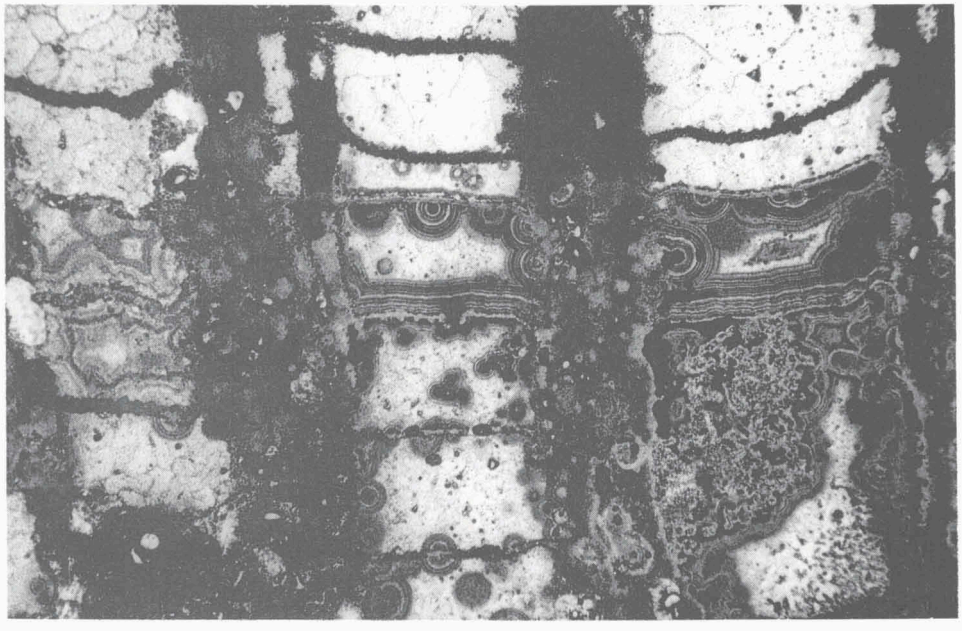


Plate 9

Paleofavosites abstrusus Klaamann, 1961. Same fossil as Pl. 8, more strongly silicified.

Paleofavosites abstrusus Klaamann, 1961
Pls. 8-9.

1961 *Palaeofavosites abstrusus abstrusus* sp. nov. – Klaamann, pp. 124-125, pl. 3, figs. 1-2.
1964 *Palaeofavosites abstrusus* Klaamann – Klaamann, pp. 9-11, pl. 1, figs. 6-8, pl. 2, figs. 1-2.
1967 *Palaeofavosites abstrusus* Klaamann – Stasinska, p. 66, pl. 14, fig. 2.

Material – Erratic boulders from Sylt, collected by Mr U. von Hacht, RGM 293 267-268.

Description – Corallites polygonal, 2.0-4.0 mm in diameter, mainly 3.0-4.0 mm. The double wall is straight and 0.16-0.28 mm, occasionally up to 0.40 mm, thick. Corner pores are 0.20-0.40 mm in diameter. Tabulae flat; mutual distance 0.75-1.50 mm. On the average 3-6 tabulae are found at a 3 mm interval.

Remarks – The erratic boulders from Sylt differ from the specimens described by Klaamann (1964) in the distance between the tabulae (0.5-2.4 mm.) and the lack of spines. However, in Estonian colonies spines are not always developed. The morphological characteristics are similar to the specimens described by Stasinska (1967).

Distribution – Estonia: Upper Ordovician, Pirgu (F-I-c) and Porkuni (F-II) stages (rare). Norway: Llandovery, substage 6ca. Germany: erratic boulders.

Paleofavosites alveolaris (Goldfuss, 1829)
Pl. 10.

1829 *Calamapora alveolaris* sp. nov. – Goldfuss, p. 75, pl. 26, fig. 1.
1839 *Favosites alveolaris* (De Blainville) – Lonsdale, pp. 681-682, pl. 15b, figs. 1-2.
1850 *Favosites aspera* d'Orbigny – d'Orbigny, p. 5.
1936 *Favosites alveolaris* Goldfuss – Lecompte, p. 66, pl. 11, fig. 4.
1937 *Palaeofavosites asper* (d'Orbigny) – Tchernychev, p. 82, pl. 5, fig. 4.
1941 *Palaeofavosites alveolaris* (Goldfuss) – Tchernychev, pp. 28-30, pl. 11, figs. 1-2.
1949 *Palaeofavosites alveolaris* (Goldfuss) – Sokolov, p. 81, pl. 7, figs. 1-2.
1951 *Palaeofavosites alveolaris* (Goldfuss) – Sokolov, pp. 22-23, pl. 4, figs. 3-5.
1955 *Palaeofavosites alveolaris* (Goldfuss); – Sokolov, pl. 11, fig. 1.
1964 *Palaeofavosites alveolaris* (Goldfuss) – Klaamann, pp. 8-9.
1967 *Palaoefavosites alveolaris* (Goldfuss) – Stasinska, p. 67, pl. 15, figs. 2, 3.
1971 *Palaeofavosites alveolaris* (Goldfuss) – Stel, pp. 52-52, pl. 14.
1976 *Paleofavosites alveolaris* (Goldfuss) – Oekentorp, pp. 173-178, pl. 20, figs. 4-8.

Material – Erratic boulder from Sylt, collected by Mr U. von Hacht, RGM 293 269.

Description – Corallites polygonal, slightly differentiated in size, 2.4-3.0 mm in diameter. Double wall straight, 0.10-0.20 mm thick. Due to the silicification process septal spines are not observed. Diameter of corner pores 0.12-0.20 mm. Tabulae flat. Mutual distance 0.84-1.70 mm. On the average 3 tabulae are found at a 3 mm

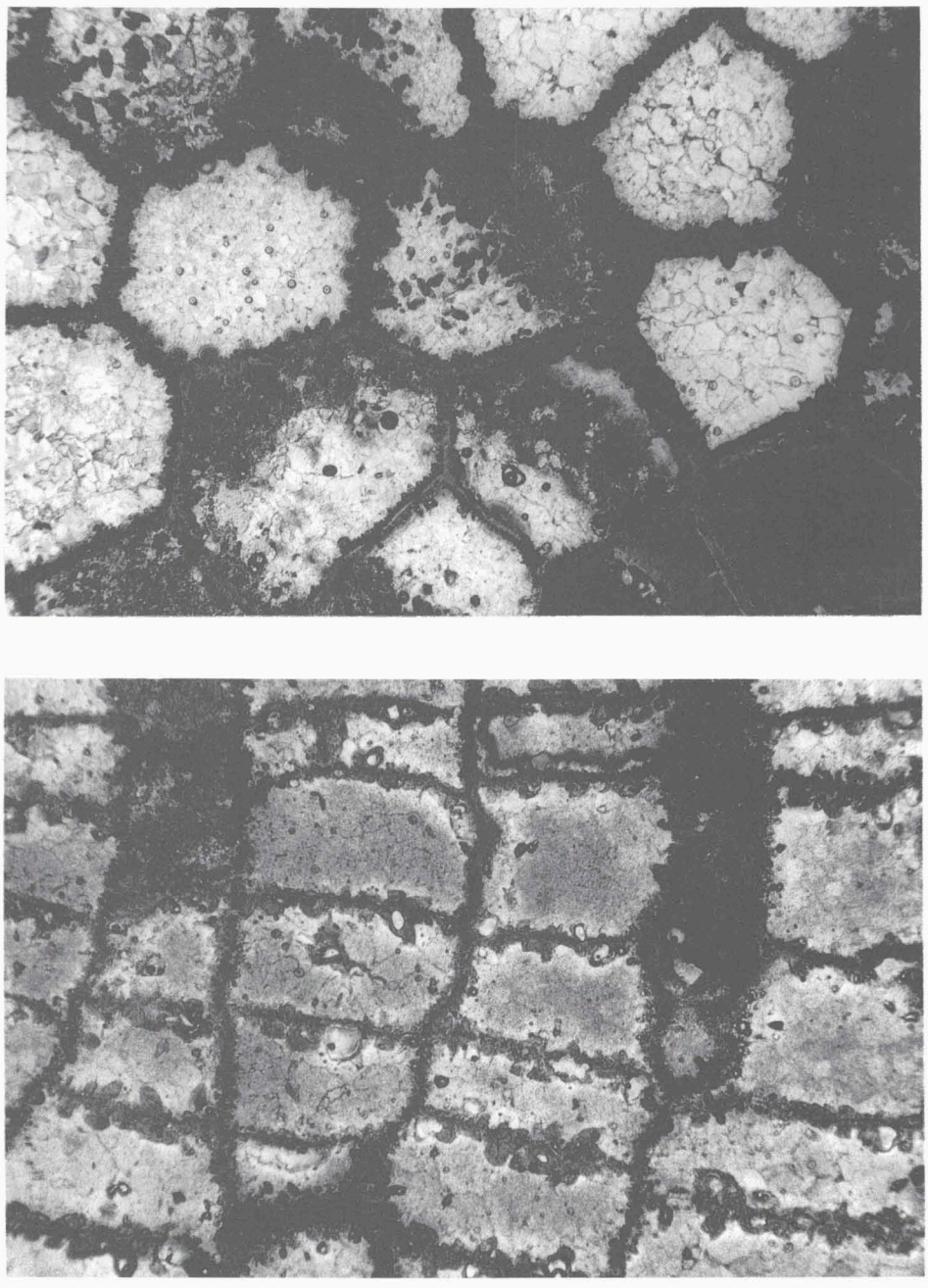


Plate 10

Paleofavosites alveolaris (Goldfuss, 1829). Silicified erratic boulder from Sylt, Pliocene; RGM 293 268, × 15; transverse section (upper), longitudinal section (lower).

interval.

Remarks – The holotype of *Paleofavosites alveolaris* is a Pleistocene erratic boulder from Groningen, The Netherlands and is derived from the Baltic area. For an up-to-date list of synonyms one is referred to Oekentorp's (1976) revision of *Paleofavosites*.
Distribution – Estonia: Llandovery: abundant in the Juuru and Tamsalu stages, uncommon in the Raikküla Stage. Norway: Llandovery: series 6. Germany and The Netherlands: erratic boulders.

Paleofavosites rugosus Sokolov, 1951
Pl. 11.

1951 *Palaeofavosites rugosus* sp. nov. – Sokolov, pp. 13-14, pl. 1, figs. 5-7.
1964 *Palaeofavosites rugosus* Sokolov – Klaamann, pp. 16-17, pl. 3, figs. 3-5.
1971 *Palaeofavosites rugosus*, Sokolov – Stel, pp. 51-52, pl. 13.
1976 *Paleofavosites rugosus* Sokolov – Oekentorp, pp. 178-184, pl. 20, fig. 9; pl. 21, figs. 1-6.

Material – Erratic boulder from Sylt, collected by Mr U. von Hacht, RGM 293 270.

Description – Corallites polygonal, differentiated in size, 2.0-2.8 mm in diameter. Double wall undulated, with many septal spines, 0.16-0.28 mm thick. Corner pores, difficult to recognise as a result of the silicification process, 0.08 mm in diameter. Tabulae flat; mutual distance 1.60-2.40 mm. On the average 2 tabulae are found at a 3 mm interval.

Distribution – Estonia: Upper Ordovician, Porkuni Stage (abundant). Germany and The Netherlands: erratic boulders (Pliocene?).

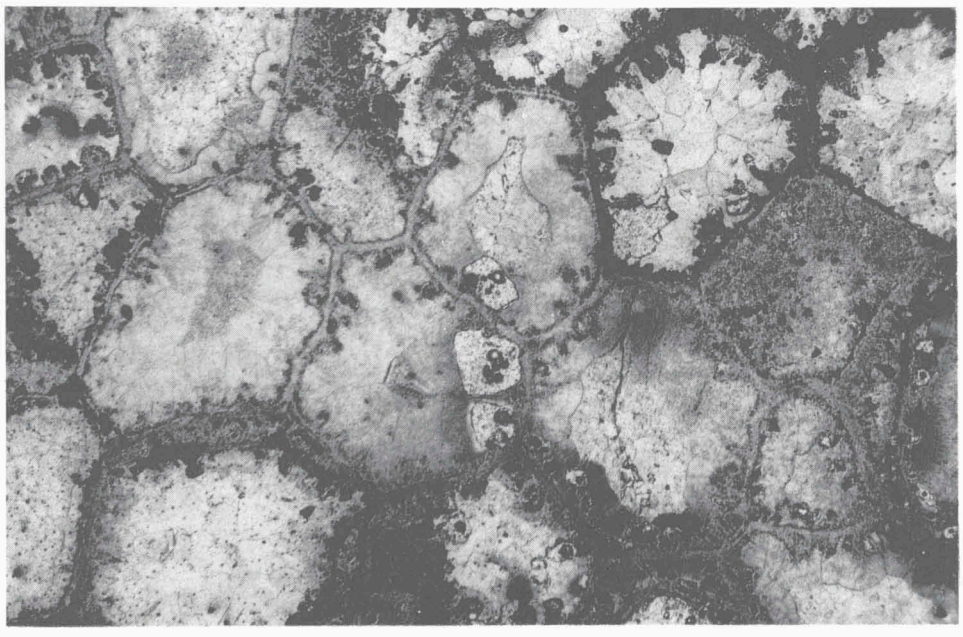
Paleofavosites haapsaluensis Klaamann, 1961
Pl. 12.

1961 *Palaeofavosites abstrusus haapsaluensis* subsp. nov. – Klaamann, pp. 125-126, pl. 3, figs. 3-5.
1964 *Palaeofavosites haapsaluensis* Klaamann – Klaamann, pp. 11-12, pl. 2, figs. 3-4.
1967 *Palaeofavosites haapsaluensis* Klaamann – Stasinska, p. 69, pl. 14, fig. 3.

Material – Erratic boulder from Sylt, collected by Mr U. von Hacht, RGM 293 271.

Description – Corallites polygonal, differentiated in size, 2.6-4.0 mm in diameter. Double wall, straight with short septal spines.The thickness of the double wall is 0.12-0.28 mm in longitudinal sections and 0.04-0.08 mm in transverse sections. Corner pores, diameter 0.10 mm. Tabulae flat, mutual distance 1.00-1.44 mm. As an average 3 tabulae are found at a 3 mm interval.

Remarks – The size of the corallites of *P. haapsaluensis* is more differentiated as the one of *P. abstrusus*.



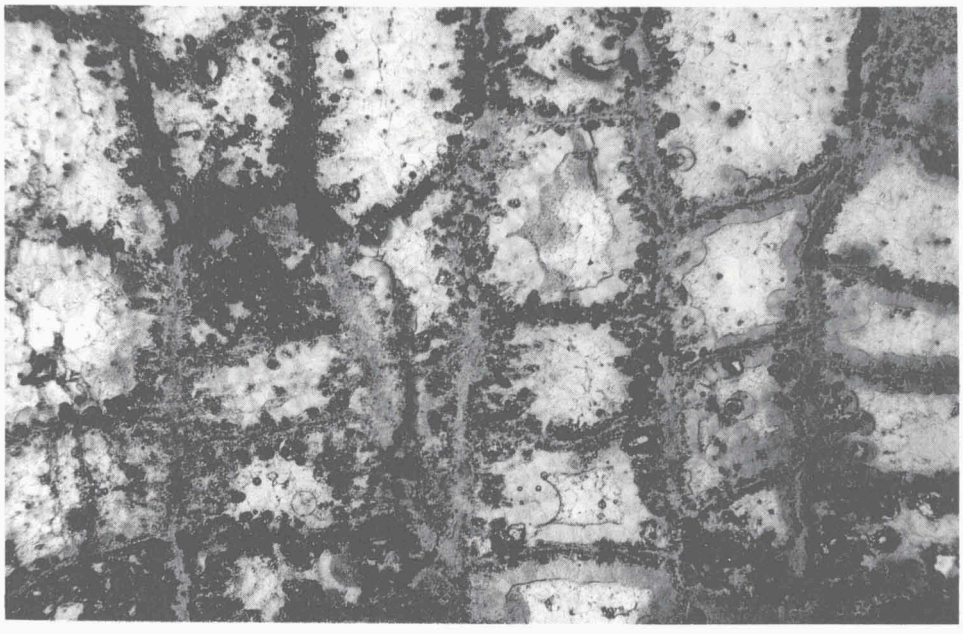


Plate 11

Paleofavosites rugosus Sokolov, 1951. Silicified erratic boulder from Sylt, Pliocene; RGM 293 269, × 15; transverse section (upper), longitudinal section (lower).

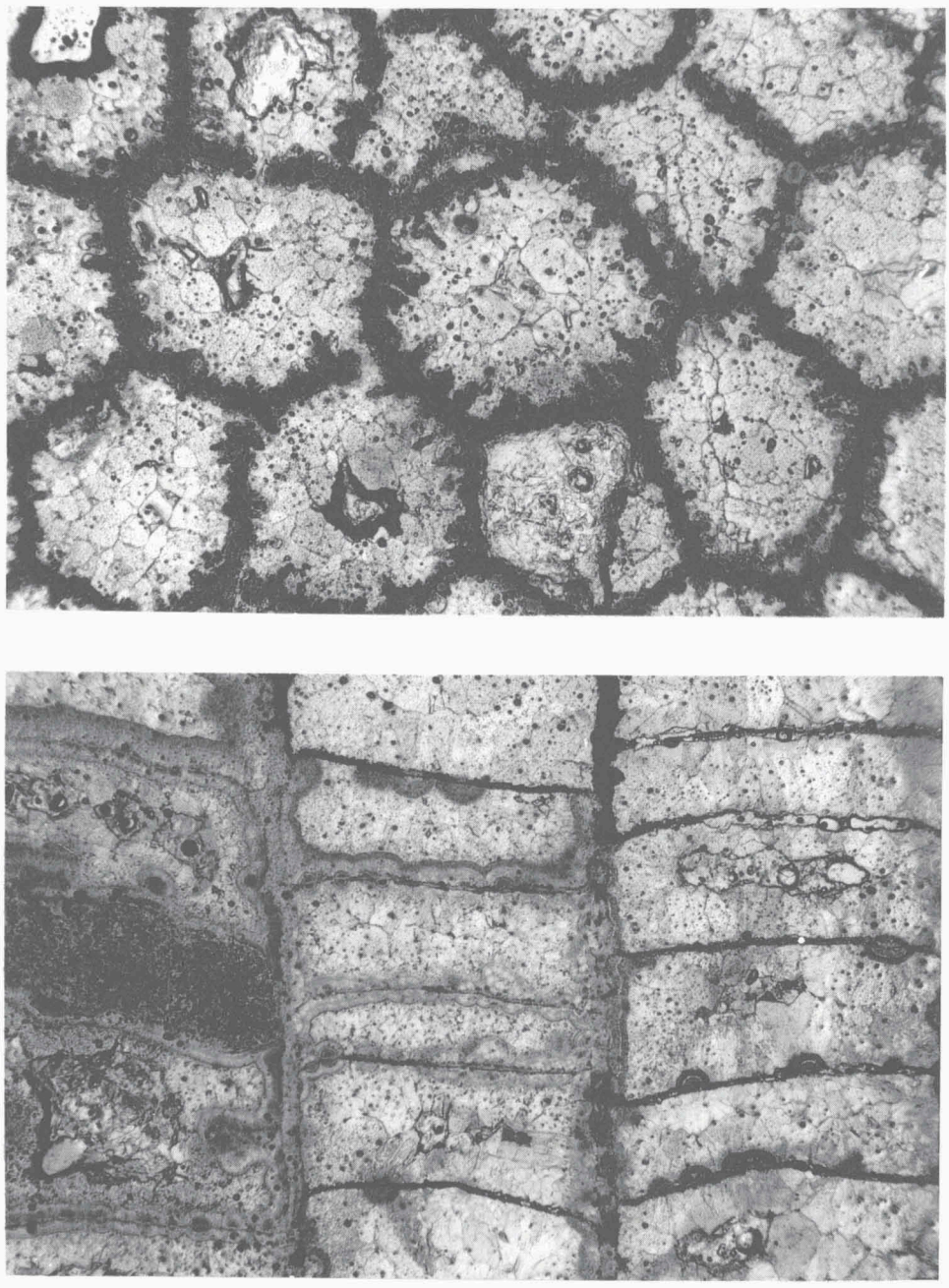


Plate 12

Paleofavosites haapsaluensis Klaamann, 1961. Silicified erratic boulder from Sylt, Pliocene; RGM 293 270, × 15; transverse section (upper), longitudinal section (lower).

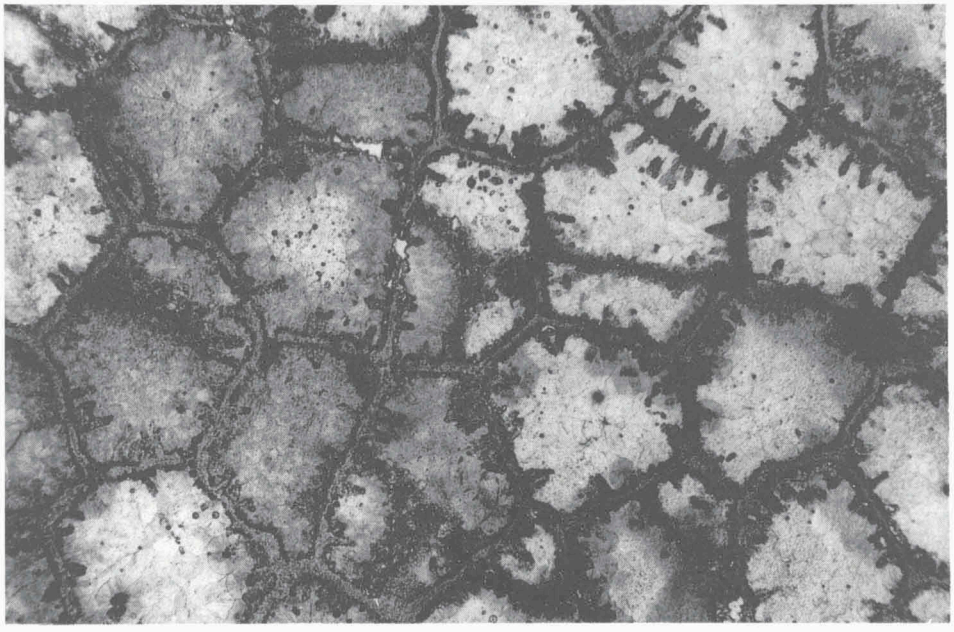


Plate 13

Paleofavosites oekentorpi sp. nov.. Silicified erratic boulder from Sylt, Pliocene; RGM 293 271, × 15; transverse section (upper), longitudinal section (lower).

Distribution – Estonia: Upper Ordovician; abundant in the upper part of the Pirgu Stage (F-I-c) and rare in the Porkuni Stage (F-II). Norway: Llandovery, substage 6ca. Germany: erratic boulder.

Paleofavosites oekentorpi sp. nov.
Pl. 13.

Holotype – Specimen RGM 293 272, figured on Pl. 13.
Type horizon – Erratic boulder, Pliocene.
Type locality – Sylt, Germany.
Derivation of the name – The species is named *oekentorpi*, in honour of my dear friend Professor Klemens Oekentorp.

Diagnosis – Corallites polygonal, 1.6-2.2 mm in diameter. Corner pores. Tabulae spaced 0.80-1.40 mm apart. Numerous septal spines.

Material – Type specimen only: erratic boulder from Sylt, collected by Mr U. von Hacht.

Description – Corallites polygonal, differentiated in size, 1.6-2.2 mm in diameter. Double wall straight or slightly curved with numerous septal spines. The thickness of the double wall is 0.20 mm in longitudinal sections and 0.08-0.14 mm in transverse sections. Corner pores 0.10-0.16 mm in diameter. Tabulae oblique, their mutual distance is 0.80-1.40 mm. On the average 3 tabulae are found at a 3 mm interval.

Remarks – *P. oekentorpi* is similar to *P. luxuriosus* Klaamann, *P. mysticus* Sokolov, *P. jaaniensis* Sokolov, and *P schmidti* Sokolov. It differs from the latter in the excessive development of the septal spines and the size of the corallite. *P. jaaniensis* and *P. mysticus* have smaller (1.2-2.0 mm) corallites and show differences in the arrangement and size of the pores and septal spines. The corallite diameter of *P. luxuriosus* (1.6-2.0 mm) is a little bit smaller than the one of *P. oekentorpi*. Also, the diameter of the pores is smaller and the distance between the tabulae is much larger.

Distribution – Germany: erratic boulder.

Subfamily FAVOSITINAE Dana, 1846

Genus *Favosites* Lamarck, 1816

Type species – *Favosites gothlandicus* Lamarck, 1816 (Milne Edwards & Haime, 1850, p. 60), Gotland, Silurian.

Diagnosis (after Klaamann, 1964) – Colony massive, semicircular, nodular, flat, or irregular. Composed of polygonal corallites with closely adjoining double walls and nearly always with distinct suture. Double walls pierced by vertical rows of pores.

Tabulae thin, complete, horizontal. Reproduction by lateral increase.

Distribution – Silurian: Baltic, USSR (Podolia, Siberia). Silurian-Middle Devonian: Urals, Timan, Kazakhstan, Central Asia, Salair, Verkhoyan, Kolyma Basin, Chukotka, Arctic. Silurian-Devonian: Western Europe, China, India, Korea, Australia, North America, Greenland. Lower-Middle Devonian: North America, Burma, Vietnam.

Favosites schuddebeursi sp. nov.
Pl. 14.

Holotype – Specimen RGM 293 273, figured on Pl. 14.
Type horizon – Erratic boulder, Pliocene.
Type locality – Sylt, Germany.
Derivation of the name – The species is named *schuddebeursi*, in honour of my old friend Mr P. Schuddebeurs, who stimulated my interest in geology when I was a kid.

Diagnosis – Corallites polygonal, differentiated, 2.0-3.6 mm in diameter. Mural pores c. 0.2 mm in diameter. Tabulae spaced 3.0-3.9 mm apart.

Material – Type specimen only: erratic boulder from Sylt, collected by Mr U. von Hacht.

Description – Corallites polygonal, differentiated in size, large corallites are the dominating ones, the overall diameter is 2.00-4.60 mm; the diameter most frequently found is 2.00-3.60 mm. The double wall is straight and has no septal spines. The thickness is 0.16-0.26 mm in longitudinal sections and 0.20-0.26 mm in transverse sections. Mural pores are 0.20-0.45 mm in diameter. Tabulae horizontal or slightly concave, mutual distance 3.08-3.87 mm. As an average 1-2 tabulae are found at a 3 mm interval.

Remarks – *F. schuddebeursi* is similar to *F. subfavosus* Klaamann, which is known from erratic boulders in limestone conservation from Poland and The Netherlands. However, the diameter of the corallite of *F. schuddebeursi* is larger. *F. schuddebeursi* is similar to *F. favosus* Goldfuss and *F. gothlandicus* Lamarck, from the Upper Llandovery of the Baltic. The most striking difference of *F. schuddebeursi* with the previously mentioned species is the diameter of the corallite.

Distribution – Germany: erratic boulder.

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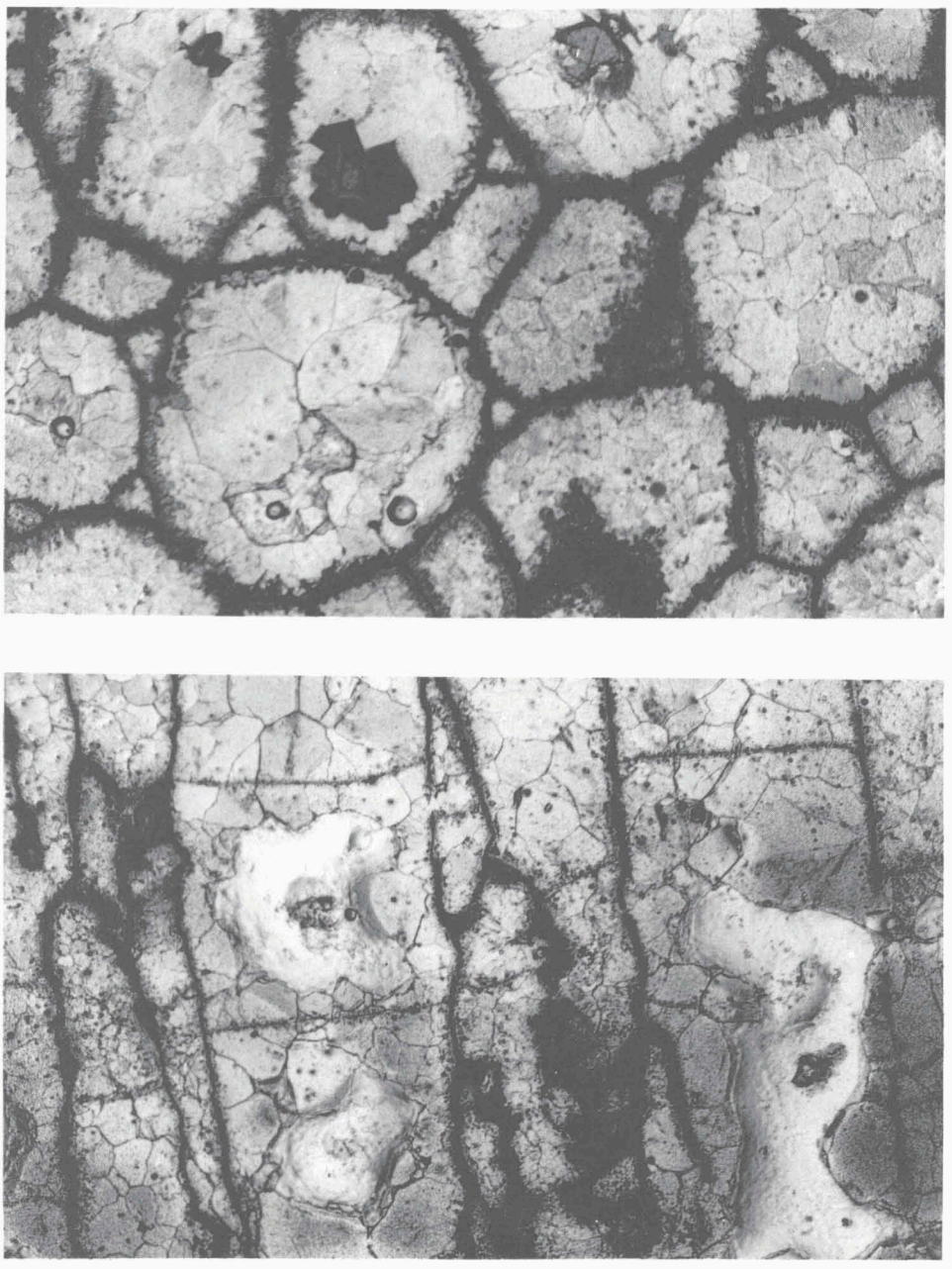

Plate 14

Favosites schuddebeursi sp. nov.. Silicified erratic boulder from Sylt, Pliocene; RGM 293 272, × 15; transverse section (upper), longitudinal section (lower).

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Manuscript received 20 March 1991.