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SOME HOLOTHURIAN SCLERITES FROM THE POLISH JURASSIC

Abstract. — Eight species (including a new one), assigned to 5 genera of the holothurian sclerites from the Jurassic of the Wieluń Upland and of the environs of Łuków are described. The suitability of sclerites for the local correlation of lithological units is shown and their palaeoecological significance is pointed out.

INTRODUCTION

The holothurian sclerites described in the present paper come mainly from the Upper Jurassic marly deposits (Upper Oxfordian and Lower Kimmeridgian) of the Wieluń Upland (Wierzbowski, 1966, p. 130, Fig. 1). The authors also found some sclerites in black clays of the Callovian at Łuków, Central Poland. The material collected is laid down in the collection of the Geological Institute (Micropalaeontological Laboratory) of the Polish Academy of Sciences and numbered ZNG/H/1-730.

GEOLOGICAL SIGNIFICANCE OF THE HOLOTHURIAN SCLERITES

The occurrence of the holothurian sclerites in the formations of different age in Poland was more than once mentioned in the geological literature. However, they have never become the subject of a more detailed study and they were never used for geological purposes.

The holothurian sclerites are of a certain importance in palaeoecological and stratigraphic considerations.

Apart from a small group of planktonic forms, most Recent holothurians are bottom dwellers, living on either a rocky substratum, or a muddy-sandy bottom and frequently burrowing in it. Definite morphological types of fossil sclerites are related with a character of sediment in which they were found. Sclerites, occurring in the form of hooks (e.g.

Achistrum) or wheels (e.g. *Theelia, Hemisphaeranthos*), were as a rule met with in clay or marly deposits which allows one to conclude that they belonged to forms burrowing in a soft bottom (Frizzell & Exline, 1955*a*). Since most sclerites under description belong precisely to these morphological types and occur in lithologically similar sediments, one may assume that these sclerites belonged to animals whose mode of life was the same as referred above.

A considerable amount of sclerites collected, which are well preserved, and a fairly uniform distribution of the sclerites in samples indicate that sclerites have been found in the same places where holothurians lived and that they have not been transported from other areas. This conclusion may, however, apply to the Wieluń Upland which a marked majority of the sclerites under description come from.

Recent holothurians are met with in different bathymetric conditions, but mostly they live at relatively small depths. They are almost entirely animals characteristic for seas of a normal salinity. These facts may be of some help for environmental reconstruction of the deposits under study.

The stratigraphic importance of the holothurian sclerites is relatively much greater than the palaeoecological one. Although definite forms of sclerites (genera, species) are more than once met with in formations different in age, they also may be of a certain importance for local correlations. The occurrence of numerous different types of sclerites, assuming their autochthonity, in lithologically similar units, directly following each other in the profile, may be correlated with a change of the environmental conditions, although frequently it is difficult to determine the character of these changes. The correlation of lithological units, based on a type of sclerites that occur within, may concern only relatively small areas.

Within the Upper Jurassic deposits of the Wieluń Upland, one may distinguish three marly units (lower, middle and upper) separated by zoogenic-chalky or platy limestones. The determined ammonite fauna allowed to assign the lower marly unit to the Upper Oxfordian (*Idoceras planula* zone), while the middle and upper ones to the Lower Kimmeridgian (Wierzbowski, 1966). Numerous holothurian sclerites, described in the present paper, come from the marly units of the Wieluń Upland. The numbers of samples, taken from individual units, were almost identical and the material was mostly sampled in bore-holes. The distance between extreme bore-holes amounted a dozen or so kms. Identical conditions of sampling of individual units and relatively small dimensions of the area under study (Wierzbowski, 1966, p. 130, Fig. 1), were the opportunities that allowed to present characteristics of marly units of the Wieluń Upland on the basis of genera and species of sclerites (Table 1).

Table 1

Occurrence of the holothurian sclerites in the Upper Jurassic marly units of the Wieluń Upland

Form	Lower marly unit	Middle marly unit	Upper marly unit
Rhabdotites mortenseni Defl.-Rig.	rarely	—	—
Priscopedatus guyaderi Rioult	—	numerous in single samples	
Achistrum issleri (Cron.)	v. numerous	v. numerous	v. numerous
Achistrum monochordata H., H. & L.	v. numerous	v. numerous	v. numerous
Theelia heptalampra (Bart.)	numerous	—	—
Theelia wartensis n. sp.	—	v. numerous	—
Hemisphaeranthos sieboldi (Schwag.)	v. numerous	rarely	numerous

The lower marly unit contains numerous sclerites of *Theelia heptalampra* and a great abundance of *Hemisphaeranthos sieboldi*, whereas *Rhabdotites mortenseni* are rarely recorded.

The middle marly unit is marked by the presence of *Theelia wartensis* n.sp., whereas *Hemisphaeranthos sieboldi* seldom occurs here. At the same time, a complete absence of *Theelia heptalampra* and *Rhabdotites mortenseni* may be stressed.

The upper marly unit contains numerous sclerites *Hemisphaeranthos sieboldi*, but lacks the forms of the genus *Theelia*. Likewise, no *Rhabdotites mortenseni* are present in this unit.

Sclerites of the genus *Achistrum* occur in all the units. No conclusions may be drawn concerning the significance of the sclerites *Priscopedatus guyaderi* which, in truth, occur abundantly but in single samples and different in age. In all probability, these latter sclerites, in contradistinction to the remaining genera and species, do not represent an autochthonous material and, consequently, cannot be used for the correlation of the Upper Jurassic marly units of the Wieluń Upland.

In contrast to the Upper Jurassic marly sediments, discussed above, the Callovian clay deposits at Łuków cannot be accurately characterized now on the basis of the sclerite material. The holothurian sclerites occur there occasionally and belong to only one genus, *Achistrum*, which is represented by two species: *Achistrum monochordata* and *Achistrum gamma*.

SYSTEMATIC PART

The classification of the holothurian sclerites based only on their morphology has an artificial character. There is also a natural classifica-

tion of complete specimens of holothurians (Frizzell & Exline, 1966) which, however, are very rarely found in a fossil state. In the material under description, only isolated sclerites are present and their division is in conformity with that recently given by Frizzell & Exline (1966). This classification is derived from a previous one by both these authors (Frizzell & Exline, 1955*b*) and takes into account only some modifications, introduced by Deflandre-Rigaud (1962).

In classifying isolated holothurian sclerites, Deflandre-Rigaud (e.g. 1950, 1952, 1962) and Rioult (1960) applied the units of division of "ordo--militaris" in conformity with Croneis' suggestion (1938). Like Frizzell & Exline (1955*b*, 1966), in description of sclerites the authors use normal taxonomic units from the rank of species to the familial rank including.

Family **Stichopitidae** Frizzell & Exline, 1955
Genus *Rhabdotites* Deflandre-Rigaud, 1952
(Type species: *Rhabdotites mortenseni* Deflandre-Rigaud, 1952)

Sclerites in the form of a simple or branching rod with knobs on their ends.

Rhabdotites mortenseni Deflandre-Rigaud, 1952
(Fig. 1 *A—D*)

1955. *Rhabdotites mortenseni* Deflandre-Rigaud; D. L. Frizzell & H. Exline, Monograph..., p. 66, Pl. 1, Figs. 12-13 (*earlier synonymy included*).

Material. — Seven well-preserved specimens.

Dimensions: Length from 0.575 to 1.1 mm, diameter from 0.085 to 0.135 mm.

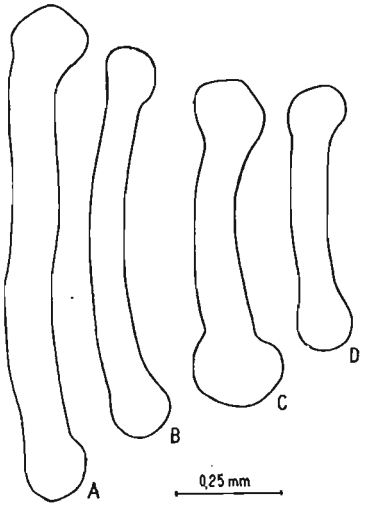

Fig. 1. — *Rhabdotites mortenseni* Defl.-Rig.; Upper Oxfordian, *Idoceras planula* zone, Wieluń Upland; *A* Stoczki, *B-D* Ważne Młyny (ZNG/H/4—7).

Description. — Sclerites in form of a simple rod, with knobs on both ends. Rod slightly, irregularly arched, circular in cross section. Diameter of rod approximately uniform along the entire length. Knobs, terminating the ends, uniform in size, subspherical, with smooth surface and diameter not too much exceeding that of rod.

Remarks. — The specimens collected are of a complete conformity with the sclerites *Rhabdotites mortenseni*. The only difference is marked in a smaller length of some of the specimens.

Occurrence. — *Rhabdotites mortenseni* is known from Malm of Germany (Württemberg). The specimens collected come from the Upper Oxfordian (*Idoceras planula* zone) of the Wieluń Upland (Gajęcice Stare, Stoczki, Ważne Młyny).

Family **Priscopedatidae** Frizzell & Exline, 1955

Genus *Priscopedatus* Schlumberger, 1890 emend. Deflandre-Rigaud, 1962

(Type species: *Priscopedatus pyramidalis* Schlumberger, 1890)

Sclerites perforate, variable in shape, circular, oval, polygonal or starlike, with four central holes, bearing a spire or a turret on one side. The outline of central holes is not related to the sclerite shape.

Priscopedatus guyaderi Rioult, 1959

(Fig. 2 *A-C*)

1959. *Priscopedatus guyaderi* Rioult; M. Rioult, Les vestiges microscopiques..., pp. 33—34, Fig. 5d.

Material. — About 70, in general well preserved, specimens.

Dimensions: Diameter 0.175 — 0.325 mm, mostly (in about 3/4 of all specimens) 0.2—0.275 mm.

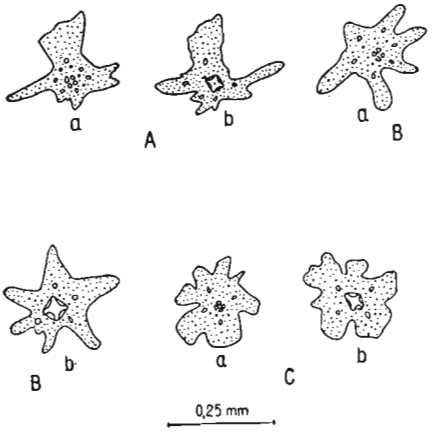

Fig. 2. — *Priscopedatus guyaderi* Rioult: *a-b* two sides of the same specimen; Lower Kimmeridgian, Wieluń Upland; *A, B Sutneria platynota*(?) zone, Prusicko-Góry, *C Ataxioceras hypselocyclum* zone, Dubidze (ZNG/H/19—21).

Description. — Sclerites perforate, shaped like irregular stars. Central part with four suboval holes, bearing a small turret on one side (Fig. 2 *A*—*C,b*). The remaining part of the sclerite irregularly perforate. Hole size decreasing towards the periphery.

Occurrence. — *Priscopedatus guyaderi* was described by Rioult (1959) from the Upper Oxfordian (*Decipia decipiens* zone) of Northern France. The specimens collected come from the Lower Kimmeridgian (*Sutneria platynota*(?) and *Ataxioceras hypselocyclum* zone) of the Wieluń Upland (Prusicko-Góry, Dworszowice Kościelne and Dubidze).

Family **Achistridae** Frizzell & Exline, 1955
Genus *Achistrum* Etheridge, 1881 emend. Frizzell & Exline, 1966
(Type species: *Achistrum nicholsoni* Etheridge, 1881)

Sclerites in the form of a hook consisting of a spear, shank and terminal loop (eye). Spear situated in a plane perpendicular to that of terminal loop.

Within the genus *Achistrum*, three morphological groups (I—III) had been distinguished on the character of the terminal loop, by Hodson, Harris & Lawson (1956). The fourth morphological type (group IV) had been distinguished by Hampton (1957). These groups were considered by Hampton (1958) as subgenera of *Achistrum*. He introduced the following subgeneric names: *Achistrum* (sensu stricto), *Spinrum*, *Cancellrum* and *Aduncrum*. The characteristics of these subgenera was presented by Hampton (1958) as follows:

Achistrum (= group I), (type species: *Achistrum nicholsoni* Ether.) — *Achistrum* with terminal loop empty;

Spinrum (= group II), (type species: *A. bartensteini* Friz. & Ex.) — *Achistrum* with terminal loop occupied by two thornlike processes;

Cancelirum (= group III), (type species: *A. gamma* H., H. & L.) — *Achistrum* with cross-bar in terminal loop;

Aduncrum (= group IV), (type species: *A. cordatum* Hampt.) — *Achistrum* with terminal loop replaced by two incurved, hooklike projections.

According to Rioult (1960), erecting of the subgenus *Spinrum* is not justified since it has been based on damaged specimens of the subgenus *Cancellrum*. On the other hand, the subgenus *Aduncrum* has recently been raised by Frizzell & Exline (1966) to the rank of a new genus *Aduncrum* within the family Achistridae.

The genus *Achistrum* may, therefore, be divided according to Rioult (1960) into the following two subgenera, based on the structure of the terminal loop:

1) *Achistrum* (*Achistrum*), (type species: *A. nicholsoni* Ether.) with terminal loop empty;

2) *Achistrum* (*Cancellrum*), (type species: *A. monochordata* H., H. & L.) with terminal loop containing thornlike processes or a simple, sometimes bifurcate, cross-bar.

The specimens collected, in which the interior of the terminal loop is visible, are assigned to both subgenera, referred to above.

Achistrum (*Achistrum*) *issleri* (Croneis, 1932)
(Fig. 3 *A-F*)

1960. *Achistrum (Achistrum) issleri* (Croneis); M. Rioult, Les sclérites d'Holothuries..., p. 139, Pl. 1, Fig. 1 (*earlier synonymy included*).

Material. — About 110 usually broken specimens with the interior of the terminal loop visible.

Dimensions: Length of complete specimens 0.375—0.6 mm.

Description. — Sclerites in form of a hook. Terminal loop empty, oval or subellipsoidal. Shank more or less arcuate. Terminal loop inclined to shank (Fig. 3 *F*). Spear broadly curved, situated in a plane perpendicular to that of the terminal loop.

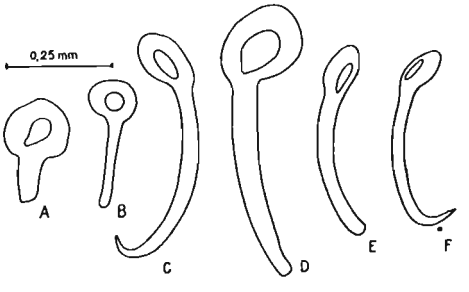

Fig. 3. — *Achistrum (Achistrum) issleri* (Cron.); Lower Kimmeridgian, *Sutneria platynota*(?) zone, Wieluń Upland, Prusicko-Góry (ZNG/H/159—164).

Remarks. — The specimens under description slightly differ from those of *A. issleri,* described by Frizzell & Exline (1955*b*), since their terminal loop is variable in shape and shank is usually arcuate. A lack of thornlike processes or cross-bars inside the terminal loop, as well as the shape of spear are, however, common characters. According to Rioult (1960), *A. issleri* — just like specimens under description — is characterized by a variable shape of terminal loop and, as can be concluded on the basis of figures, referred by Rioult (1960) to this species in the synonymy, also by a variable degree of the arcuation of shank.

Occurrence. — *Achistrum issleri* is known from the Jurassic of Germany, France and England. The specimens collected come from the Upper Oxfordian (*Idoceras planula* zone) and Lower Kimmeridgian (*Sutneria*

platynota(?) and *Ataxioceras hypselocyclum* zone) of the Wieluń Upland (Stoczki, Ważne Młyny, Prusicko, Prusicko-Góry, Brzeźnica Stara, Dworszowice Kościelne, Zakrzówek Szlachecki, Zamoście).

Achistrum (*Cancellrum*) *monochordata* Hodson, Harris & Lawson, 1956
(Fig. 4 *A-M*)

1960. *Achistrum (Cancellrum) monochordata* H., H. & L.; M. Rioult, Les sclérites d'Holothuries..., pp. 139—140, Pl. 1, Fig. 2 (*earlier synonymy included*).
1962. *Achistrum (Cancellrum) monochordata* H., H. & L.; B. N. Fletcher, Some holothurian..., p. 325, Figs. 6-7.

Material. — About 90, usually broken specimens, with the interior of terminal loop visible.

Dimensions: Length of complete specimens 0.45—0.6 mm.

Description. — Sclerites in form of a hook. Terminal loop variable in shape, round to ellipsoidal. The interior of terminal loop exhibits a simple (Fig. 4 *A-H*), thin cross-bar. The situation of the cross-bar within the terminal loop is variable. Sometimes, the cross-bar is almost fused to its

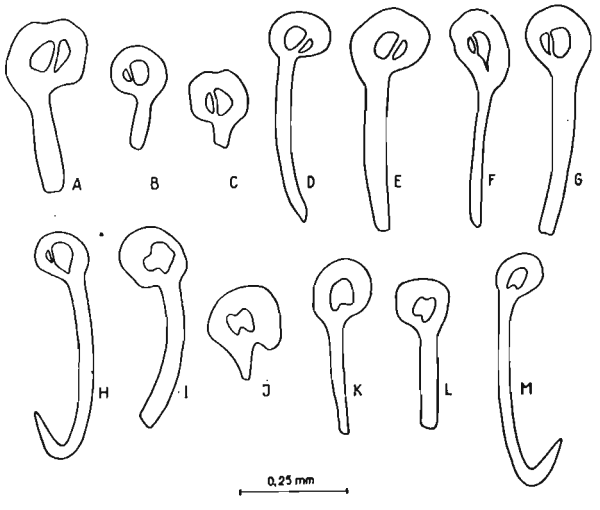

Fig. 4. — *Achistrum* (*Cancellrum*) *monochordata* H., H. & L.; *A-E*, *I-J* Lower Kimmeridgian, *Sutneria platynota*(?) zone, Wieluń Upland: *A-E* Brzeźnica Stara, *I* Dworszowice Kościelne, *J* Zakrzówek Szlachecki (ZNG/H/221—225, 246, 254); *F-H*, *K-M* Callovian, Łuków (ZNG/H/255—257, 213—215).

margin (Fig. 4 *H*). The thickness of cross-bar also variable. It is the thickest in the place where it joins the terminal loop and the thinnest in the middle. As a result, in some specimens, the cross-bar is damaged in the central part and only two small thornlike processes occur within the loop (Fig. 4 *I-M*).

Shank is variable in shape, in some specimens straight, in some others arcuate. Terminal loop usually more or less inclined to shank (Fig. 4 *D, H*). Spear sharp, broad, with a variable, mostly distinct, degree of arcuation. It is situated in a plane perpendicular to that of terminal loop.

Remarks. — The form of *Achistrum monochordata,* characterized by the presence of a simple cross-bar within terminal loop, has been first described by Hodson, Harris & Lawson (1956). The form *Achistrum bartensteini,* bearing two single thornlike processes within terminal loop, has been included by Rioult (1960) in the synonymy of *A. monochordata.* As mentioned above, these processes were formed by the damage of a cross-bar which originally was situated within the loop. A similar opinion was expressed by Summerson & Campbell (1958).

The character of shank and spear, as well as the degree of inclination of terminal loop to shank are, according to Frizzell & Exline (1955*b*), an important taxonomic feature of *A. bartensteini* which — in conformity with Rioult's view (1960) — the authors include in the synonymy of *A. monochordata.* The comparison of figures, depicting *A. monochordata* in Rioult's work (1960, Pl. 1, Fig. 2), with figures of other specimens assigned to this species, seems to indicate, however, that these characters are not of any major taxonomic value. Similar conclusions may be drawn on the basis of our material.

Occurrence. — *Achistrum monochordata* is known from the Devonian(?) to the Upper Jurassic of North America and Western Europe. The specimens collected come mostly from the Upper Oxfordian (*Idoceras planula* zone) and from the Lower Kimmeridgian (*Sutneria platynota*(?) and *Ataxioceras hypselocyclum* zone) of the Wieluń Upland (Stoczki, Zapole, Prusicko-Góry, Brzeźnica Stara, Dworszowice Kościelne, Zakrzówek Szlachecki, Dubidze, Błota Kruplińskie, Zamoście). A few specimens have also been found in the Callovian at Łuków.

Achistrum (Cancellrum) gamma Hodson, Harris & Lawson, 1956
(Fig. 5)

1956. *Achistrum gamma* H., H. & L.; F. Hodson, B. Harris & L. Lawson, Holothurian spicules..., p. 340, Fig. 12-13.
1957. *Achistrum gamma* H., H. & L.; J. S. Hampton, Some holothurian spicules..., p. 509, Fig. 5.
1958. *Achistrum (Cancellrum) gamma* H., H. & L.; J. S. Hampton, Subgenera..., p. 76, Fig. 3a (= 5 in text).
1962. *Achistrum (Cancellrum) gamma* H., H. & L.; B. N. Fletcher, Some holothurian..., pp. 323—324, Fig. 4.

Material. — Two broken specimens with the interior of terminal loop visible.

Description. — Sclerites in form of a hook, similar to those of *Achistrum monochordata*. The interior of terminal loop exhibits a bifurcate cross-bar.

Remarks. — The characteristic feature of the *Achistrum gamma* sclerites is a bifurcate cross-bar inside the terminal loop which damaging

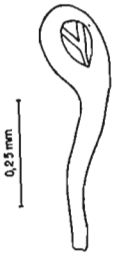

Fig. 5. — *Achistrum* (*Cancellrum*) *gamma* H., H. & L.; Callovian, Łuków (ZNG/H/280).

ought to involve presentation of three processes. According to Rioult (1960), the form *A. gamma* should be considered as a variety of *A. monochordata*. The separateness of the species *A. gamma* is, however, maintained by Frizzell & Exline (1966).

Occurrence. — *Achistrum gamma* is known from the Bathonian and the Oxfordian of England. The specimens collected come from the Callovian of Łuków.

Family **Theeliidae** Frizzell & Exline, 1955
Genus *Theelia* Schlumberger, 1890
(Type species: *Chirodota undulata* Schlumberger, 1888)

The generic name *Theelia* was introduced by Schlumberger in 1890. The later name *Chirodotites*, used by Deflandre-Rigaud in 1949 to term the same type of sclerites, is a synonym (Frizzell & Exline, 1955*b*; Kristan-Tollman, 1963).

Sclerites in form of a wheel, consisting of a central portion, spokes and an outer rim. Spokes, mostly 6—7, less frequently 8—12, join, on the lower side of sclerite, central portion with outer rim. On the upper side of sclerite, the inner margin of the rim is mostly denticulate. Teeth are shallow and do not reach the periphery of a specimen.

On the number of spokes and degree of denticulation of the outer rim, three morphological groups of sclerites were distinguished by Rioult (1960) within the genus *Theelia*, described however by him under the name of *Chirodotites* Defl.-Rig. According to Rioult, the characteristics of these groups are as follows:

I. *Microdentatum* (type species: *Theelia heptalampra* (Bart.)), number of spokes (6), 7, (8), number of teeth on the inner margin of 1/4 of outer rim, 35—50;

II. *Mesodentatum* (type species: *T. mortenseni* (Defl.-Rig.)), number of spokes (8), 9—10, (11), number of teeth on the inner margin of 1/4 of outer rim, 20—30;

III. *Macrodentatum* (type species: *T. crassidentata* (Defl.-Rig.)), number of spokes (7—8), 9—10, (11—12), number of teeth on the inner margin of 1/4 of outer rim, 12—16.

The forms collected by the authors belong only to the group *Microdentatum*.

Theelia heptalampra (Bartenstein, 1936)

(Fig. 6 *A-C*; Pl. I, Fig. 1)

1960. *Chirodotites heptalampra* (Bartenstein); M. Rioult, Les sclérites d'Holothuries..., pp. 142—143, Pl. 1, Fig. 21 (*earlier synonymy included*).

Material. — About 40 not well enough preserved specimens.

Dimensions: Diameter 0.15 to 0.375, mostly 0.225 to 0.3 mm (in about 3/4 of all specimens).

Description. — Sclerites rounded, more or less heptagonal, in form of a wheel, consisting of a central portion, spokes and an outer rim.

On the lower side of sclerites (Fig. 6 *A-C, a*), there are visible 7 spokes which join central portion with outer rim. Central portion not very large, with an irregular raised, seven-rayed star. Rays of star correspond to the position of spokes. Spokes distinctly convex, wide, slightly thinning towards the central portion and outer rim. Along each spokes, in its central part, there runs a small, narrow median ridge, joining the ray at the central portion of sclerite. Outer rim narrow, incurved. Small concavities visible in the place, where spokes join outer rim.

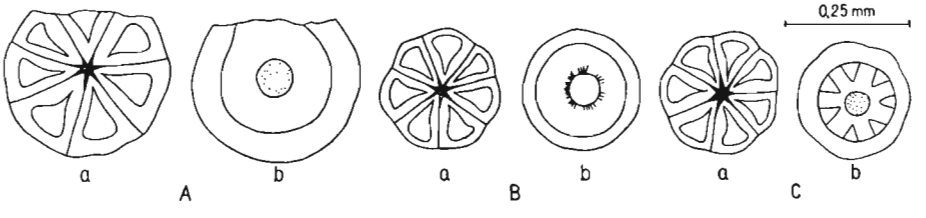

Fig.6. — *Theelia heptalampra* (Bart.): *a* lower side, *b* upper side; Upper Oxfordian, *Idoceras planula* zone, Wieluń Upland; *A* Ważne Młyny, *B* Gajęcice Stare, *C* Stoczki (ZNG/H/282, 283, 289).

On the upper side of sclerites (Fig. 6 *A-C, b*), there is a wide, distinctly incurved outer rim. In some, better preserved specimens, the inner margin of the rim is finely denticulate. The number of teeth is, however, difficult to recognize. The central portion, on the upper part of sclerites, is large and convex in the form of a boss. In some specimens, spokes

diverging from the central portion and covered by an elevated outer rim, are visible in the xylene.

Remarks. — A range of size of the sclerites described, somewhat more extensive than that given so far for *T. heptalampra*, is probably a result of a great number of individuals.

A slightly petaloid outline of spokes in specimens under description is similar in character to that in *Theelia atava* (Waag). The latter species has not, however, on the lower part of its central portion, a raised, seven-ray star, typical of *T. heptalampra*.

Theelia guembeli, described by Kristan-Tollman (1963) from the Triassic, differs from our specimens in thinner spokes and in the lack of a raised star on the lower side of the central portion of sclerites.

Occurrence. — *Theelia heptalampra* is known from the Lower Jurassic of Germany and France. The specimens collected come from the Upper Oxfordian (*Idoceras planula* zone) of the Wieluń Upland (Gajęcice Stare, Stoczki, Ważne Młyny).

Theelia wartensis n.sp.
(Fig. 7 *A-H*; Pl. I, Figs. 2-4)

Holotypus: Specimen No. ZNG/H/320; Fig. 7*B*; Pl. I, Fig. 2.
Stratum typicum: Lower Kimmeridgian, *Sutneria platynota*(?) zone.
Locus typicus: Dworszowice Kościelne, Pajęczno District.
Derivatio nominis: *wartensis* — after the Warta River.

Diagnosis. — Sclerites of small dimensions (diameter 0.125—0.25 mm), in form of a wheel, consisting of a central portion, six spokes and an outer rim. Central portion with an indistinct elevation in form of a six--rayed star, situated on the lower side of sclerites. Along each spoke there runs a narrow ridge which joins the ray of the star in the central portion of sclerites.

Material. — About 170 well preserved specimens.

Dimensions: Diameter 0.125—0.25, mostly 0.15—0.2 mm (in about 3/4 of all specimens).

Description. — Sclerites hexagonal in outline, in form of a wheel, with more or less rounded corners, consisting of a central portion, spokes and an outer rim.

On the lower side of sclerites (Fig. 7 *A-H, a*), there are visible 6 spokes entering the central portion and joining it with outer rim. Central portion small, concave, with an indistinct elevation in the form of a fairly irregular six-rayed star. Rays of star correspond to the position of spokes. Spokes distinctly convex, wide, slightly thinning towards the central portion and outer rim. Along each spoke, in its central part, there runs a small, narrow ridge, joining the ray of star in the central

portion of sclerite. Outer rim very narrow, incurved. Small concavities in the place where spokes join the outer rim.

On the upper side of sclerites (Fig. 7 *A-H, b*), there is a fairly wide, distinctly incurved outer rim. The inner margin of this rim is finely

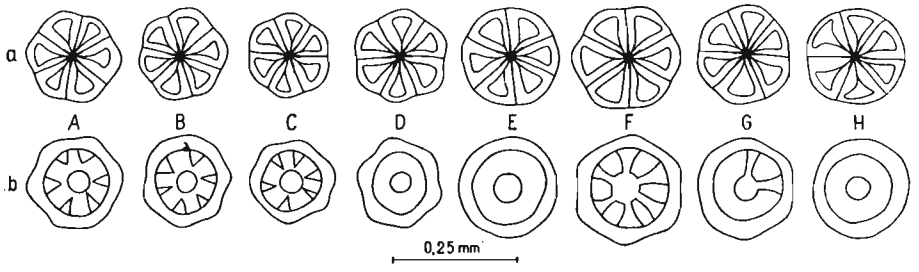

Fig. 7. — *Theelia wartensis* n. sp. (*B* holotype): *a* lower side, *b* upper side; Lower Kimmeridgian, *Sutneria platynota*(?) zone, Wieluń Upland; *A* Prusicko-Góry, *B-D* Dworszowice Kościelne, *E-H* Zakrzówek Szlachecki (ZNG/H/322, 320, 321, 376, 413—416).

denticulated. The number of teeth cannot, however, be recognized. Central portion large, bosslike, strongly raised. On the upper side of some specimens, there are visible spokes, radially diverging from the central portion and covered by a raised outer rim.

Remarks. — *Theelia wartensis* n.sp. is similar to *T. angulata* (Defl.-Rig.), but differs in smaller dimensions and presence — on the lower side of sclerites — of a raised star with small, narrow ridges, radially diverging along the spokes. In addition, all specimens of *T. wartensis* n.sp. have 6 spokes, whereas in *T. angulata* the number fluctuates from 5 to 6. The details of the structure of the upper side in *T. angulata* are unknown but, concluding on illustrations of this species, published by Deflandre-Rigaud (1950, p. 23, Figs. 26, 27), who called it *Chirodotites angulatus* Defl.-Rig., the central portion on the upper side seems to be considerable less raised than that in *T. wartensis* n.sp.

Since the species *T. angulata* has been erected by Deflandre-Rigaud (1950) only on the basis of illustrations of poorly preserved sclerites, presented in Terquem's and Jourdy's work and described by these authors as *Chirodota* sp., it seems quite possible that several characters of the structure of *T. angulata* might be overlooked and omitted. Under such circumstances, it may turn out that the differences between *T. wartensis* n.sp. and *T. angulata* are actually smaller than those, elucidated formerly.

The new species differs from *T. florida* (Terq. & Berth.) mainly in markedly smaller dimensions, amounting in the latter species up to 0.5 mm. Larger dimensions than those of *T. wartensis* n.sp. are also recorded in *T. stellifera* Zankl, which is also characterized by the presence of a three-rayed star on the lower side of the central portion

of sclerites (Zankl, 1966).

Occurrence. — *Theelia wartensis* n.sp. has been found in the Lower Kimmeridgian (*Sutneria platynota*(?) zone) of the Wieluń Upland (Prusicko-Góry, Brzeźnica Stara, Dworszowice Kościelne, Zakrzówek Szlachecki).

Genus *Hemisphaeranthos* Terquem & Berthelin, 1875 emend. Frizzell & Exline, 1966

(Type species: *Hemisphaeranthos costifera* Terquem & Berthelin, 1875)

The name *Myriotrochites* Defl.-Rig., 1949 is a synonym of the generic name *Hemisphaeranthos* Terq. & Berth., 1875 emend. Frizzell & Exline, 1955. The range of the generic name *Hemisphaeranthos* is much less extensive in use now (Frizzell & Exline, 1966).

Sclerites circular or elliptical, in form of a wheel, consisting of a central portion, spokes and an outer rim. Numerous spokes (usually 10—17) are contiguous and join, on the lower side of sclerite, central portion with the outer rim. On the upper side of sclerite, there is a hemispherical depression, bordered by a wide outer rim, whose margin is distinctly denticulate. Teeth may reach as far as the periphery of a specimen.

Hemisphaeranthos sieboldi (Schwager, 1865)

(Fig. 8 *A-C*)

1962. *Myriotrochites sieboldi* (Schwager); M. Deflandre-Rigaud, Contribution à la connaissance..., p. 93 (*earlier synonymy included*).

Material. — About 250 differently preserved specimens.

Dimensions: Diameter 0.15—0.385, usually 0.225—0.275 mm (in about 2/3 of all specimens).

Description. — Sclerites circular, in form of a wheel, consisting of a central portion, spokes and an outer rim. On the lower side (Fig. 8 *A-C, a*) of sclerites, there are visible 10—17 (mostly 10—14) contiguous

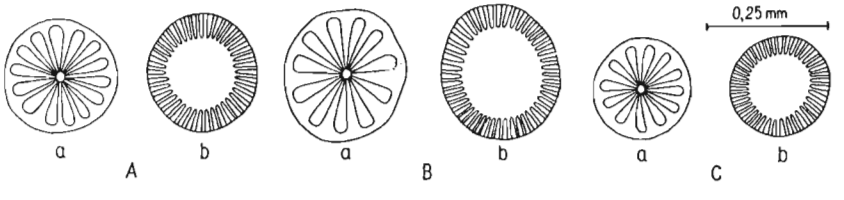

Fig. 8. — *Hemisphaeranthos sieboldi* (Schwag.): *a* lower side, *b* upper side; *A* Lower Kimmeridgian, *Ataxioceras hypselocyclum* zone, Wieluń Upland, Dubidze (ZNG/H/489); *B-C* Upper Oxfordian, *Idoceras planula* zone, Wieluń Upland, Ważne Młyny (ZNG/H/487, 488).

spokes, which join central portion with outer rim. Central portion very small, with a not very large button in the middle. Spokes, with straight sides, thinning towards the central portion. Outer rim not very wide on the lower side of specimens.

On the upper side of sclerites (Fig. 8 *A-C, b*), there is a hemispherical depression, bordered by an extensive outer rim, denticulate in a frill-like manner over its entire width. Teeth (30—46, mostly 31—39) are uniform in size. In some specimens, not very distinct spokes, diverging from a slightly marked central portion and hidden under a raised outer rim, may be observed in xylene.

Remarks. — The specimens collected are in both their appearance and dimensions considerably similar to those of *Hemisphaeranthos sieboldi* (Schwag.), described by Deflandre-Rigaud (1950) as *Myriotrochites sieboldi* (Schwag.) from the Oxfordian. Specimens, described by Deflandre-Rigaud (1950) as *Myriotrochites sieboldi* (Schwag.) from the Liassic differ from them to a considerable extent and, according to Rioult (1960), represent a new species, *Theelia rigaudae* (Rioult).

Occurrence. — *Hemisphaeranthos sieboldi* is known from the Oxfordian of Germany and France. The specimens collected come from the Upper Oxfordian (*Idoceras planula* zone) and Lower Kimmeridgian (*Sutneria platynota*(?) and *Ataxioceras hypselocyclum* zone) of the Wieluń Upland (Gajęcice Stare, Stoczki, Ważne Młyny, Zapole, Brzeźnica Stara, Dworszowice Kościelne, Dubidze, Błota Kruplińskie).

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Warszawa, Al. Żwirki i Wigury 93
April, 1966

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JADWIGA GARBOWSKA & ANDRZEJ WIERZBOWSKI

SKLERYTY HOLOTHUROIDEA Z UTWORÓW JURAJSKICH WYŻYNY WIELUŃSKIEJ I OKOLIC ŁUKOWA

Streszczenie

Opracowane skleryty Holothuroidea pochodzą w znacznej części z górno-jurajskich osadów marglistych (górny oksford i dolny kimeryd) Wyżyny Wieluńskiej (Wierzbowski, 1966, s. 130, fig. 1). Niewielka ilość sklerytów znaleziona została ponadto w ilastych utworach keloweju Łukowa. Opisano 8 gatunków należących do 5 rodzajów, w tym 1 gatunek nowy. W materiale występują wyłącznie skleryty izolowane, a ich podział przyjęty w niniejszej pracy zgodny jest z podziałem Frizzella i Exline'a (1966).

Z punktu widzenia geologicznego, skleryty Holothuroidea mogą mieć znaczenie w rozważaniach paleoekologicznych i stratygraficznych.

Pomijając niedużą grupę form planktonicznych, większość współczesnych strzykw — są to formy denne, żyjące bądź na twardym skalistym podłożu, bądź też

na dnie mulasto-piaszczystym, zagrzebując się przy tym często w mule lub piasku. W stanie kopalnym określone typy morfologiczne sklerytów wiążą się z charakterem osadu, w którym zostały znalezione. Skleryty o zarysie haczykowatym (np. *Achistrum*), bądź kolistym (np. *Theelia, Hemisphaeranthos*) były z reguły napotykane w obrębie utworów ilasto-marglistych; pozwala to wnioskować, że należały one do form zagrzebujących się w miękkim dnie (Frizzell & Exline, 1955*a*). Ponieważ większość opisanych tu sklerytów należy właśnie do tych typów morfologicznych i występuje w podobnych litologicznie osadach, można przyjąć, że skleryty te należały do zwierząt prowadzących taki tryb życia.

Współczesne strzykwy spotyka się w różnych strefach batymetrycznych, najczęściej jednak żyją na niewielkich stosunkowo głębokościach. Są one prawie wyłącznie zwierzętami charakterystycznymi dla mórz o normalnym zasoleniu.

Znaczenie stratygraficzne sklerytów Holothuroidea jest dużo większe, niż znaczenie paleoekologiczne. Jakkolwiek określone formy sklerytów (rodzaje, gatunki) spotyka się niejednokrotnie w utworach różnego wieku, mogą one mieć jednak znaczenie dla celów paralelizacji lokalnej. Występowanie często odmiennych typów sklerytów, przy założeniu ich autochtoniczności, w następujących bezpośrednio po sobie, podobnych litologicznie zespołach, może wiązać się ze zmianą warunków środowiska; charakter jednak tych zmian zazwyczaj trudno określić. Paralelizacja zespołów litologicznych na podstawie sklerytów, występujących w ich obrębie, dotyczyć może niewielkich stosunkowo obszarów.

W obrębie utworów górno-jurajskich Wyżyny Wieluńskiej wydzielić można trzy zespoły margliste: dolny, środkowy i górny, rozdzielone między sobą kompleksami organogenicznych wapieni kredowatych i wapieni płytowych. Fauna amonitowa pozwoliła zaliczyć dolny zespół marglisty do górnego oksfordu (poziom *Idoceras planula*), środkowy i górny — do dolnego kimerydu (Wierzbowski, 1966). Z zespołów marglistych Wyżyny Wieluńskiej pochodzą liczne skleryty Holothuroidea, opisane w niniejszej pracy. Jednolite warunki opróbowania poszczególnych zespołów oraz nieduże stosunkowo rozmiary badanego obszaru, pozwalają na przedstawienie charakterystyki zespołów marglistych Wyżyny Wieluńskiej na podstawie rodzajów i gatunków sklerytów występujących w ich obrębie.

Dolny zespół marglisty zawiera liczne skleryty *Theelia heptalampra* i bardzo liczne skleryty *Hemisphaeranthos sieboldi*. Rzadko występuje *Rhabdotites mortenseni*.

Środkowy zespół marglisty charakteryzuje się obecnością sklerytów *Theelia wartensis* n.sp. Natomiast *Hemisphaeranthos sieboldi* występuje rzadko, a jednocześnie brak jest całkowicie w obrębie tego zespołu sklerytów *Theelia heptalampra* i *Rhabdotites mortenseni*.

Górny zespół marglisty zawiera liczne skleryty *Hemisphaeranthos sieboldi*, natomiast brak w nim form z rodzaju *Theelia*. Nie występują również skleryty *Rhabdotites mortenseni*.

Skleryty z rodzaju *Achistrum* (*A. issleri*, *A. monochordata*) występują we wszystkich wymienionych zespołach. Natomiast skleryty *Priscopedatus guyaderi* napotkane zostały w dużych ilościach, jednak w próbach pojedynczych i różnego wieku.

W przeciwieństwie do omówionych uprzednio marglistych osadów górno-jurajskich Wyżyny Wieluńskiej, ilaste osady keloweju Łukowa nie mogą być obecnie dokładnie scharakteryzowane na podstawie materiału sklerytowego. W Łukowie skleryty Holothuroidea występują bowiem zupełnie sporadycznie i należą wyłącznie do jednego rodzaju *Achistrum*, reprezentowanego przez dwa gatunki: *Achistrum monochordata* i *Achistrum gamma*.

ЯДВИГА ГАРБОВСКА & АНДРЖЕЙ ВЕРЖБОВСКИ

НЕКОТОРЫЕ СКЛЕРИТЫ ГОЛОТУРИЙ ИЗ ЮРСКИХ ОТЛОЖЕНИЙ ПОЛЬШИ

Резюме

Изученные склериты голотурий происходят преимущественно из верхнеюрских мергелистых отложений (верхний оксфорд и нижний киммеридж) Велюньской Возвышенности (Wierzbowski, 1966, с. 130, фиг. 1). Часть материала найдена в келловейских аргиллитах окрестностей Лукова, центральная Польша. Описано 8 видов принадлежащих к 5 родам, в этом 1 вид новый. В материале находятся исключительно отдельные склериты, а их классификация в настоящей работе согласна с принятой Фриззеллом и Экслейном (Frizzell & Exline, 1966).

С геологической точки зрения, склериты голотурий могут иметь значение для палеогеографических и стратиграфических рассуждений.

Не учитывая небольшой группы планктонных форм, большинство современных голотурий это придонные формы, живущие или на твердом субстрате, либо на дне илисто-песчанистым и часто зарывающиеся в ил или песок. В ископаемом состоянии определенные морфологические типы склеритов связаны с характером осадков, в которых они найдены. Склериты крючко- (нп. *Achistrum*) или кругообразные (нп. *Theelia, Hemisphaeranthos*), как правило, были встречены в илисто-мергелистых осадках, что приводит к выводу, что это были формы зарывающиеся в мягкий грунт (Frizzell & Exline, 1955 *a*). Так как большинство описанных нами склеритов принадлежит именно к таким морфологическим типам и находятся оне в литологически похожих осадках, можно принять, что склериты эти принадлежали к животным ведущим именно такой образ жизни.

Современные голотурии встречаются в различных батиметрических зонах, но наиболее часто поселяют они относительно небольшие глубины. Это почти

исключительно животные характеристические для морей о нормальной засоленности.

Значение склеритов голотурий важнее для стратиграфии, чем для палеоэкологии. Хотя определенные формы склеритов (роды, виды) нередко встречаются в отложениях разного века, то однако могут оне иметь значение для местных параллелизаций. Распространение часто иных типов склеритов, принимая их автохтонизм в чередующихся друг за другом, литологически похожих комплексах, может иметь связь со сменой условий среды, хотя часто характер смен трудно определимый. Сравнение литологических комплексов на основании типа склеритов, находящихся в их пределах, может касаться относительно небольших районов.

В верхнеюрских отложениях Велюньской Возвышенности можно выделить три мергелистые комплексы: нижний, средний и верхний, разграниченные между собой органогенно-меловидными, а также плитчатыми известняками. Аммонитовая фауна разрешила причислить нижний мергелистый комплекс к верхнему оксфорду (горизонт *Idoceras planula*), а средний и верхний — к нижнему киммериджу (Wierzbowski, 1966). Из мергелистых комплексов Велюньской Возвышенности происходят обильные склериты голотурий, описанные в настоящей работе.

Одинаковые условия, в которых взяты были пробы из отдельных комплексов, и относительно небольшой размер изучаемого района, позволяют охарактеризовать мергелистые комплексы Велюньской Возвышенности на основании родов и видов находящихся в них склеритов.

Нижний мергелистый комплекс вмещает много склеритов *Theelia heptalampra* и очень много склеритов *Hemisphaeranthos sieboldi*. Редко находятся *Rhabdotites mortenseni*.

Средний мергелистый комплекс характеризуется присутствием склеритов *Theelia wartensis* n. sp. *Hemisphaeranthos sieboldi* появляется редко, одновременно совсем отсутствуют в этом комплексе склериты *Theelia heptalampra* и *Rhabdotites mortenseni*.

Верхний мергелистый комплекс содержит обильные склериты *Hemisphaeranthos sieboldi*, а отсутствуют в нем формы рода *Theelia*, а также склериты *Rhabdotites mortenseni*.

Склериты *Achistrum* (*A. issleri*, *A. monochordata*) выступают во всех обсуждаемых комплексах. Склериты *Priscopedatus guyaderi* встречены были в большом количестве но только в единственных пробах, разного возраста.

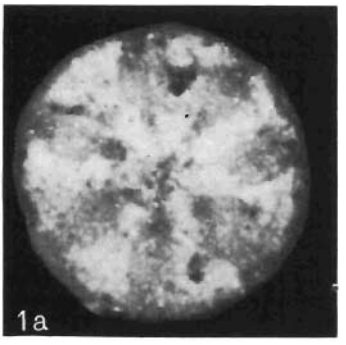
В противоположности к выше обсуждаемым верхнеюрским мергелистым отложениям Велюньской Возвышенности, аргиллистые келловейские осадки из Лукова не могут быть охарактеризованы на основании склеритового материала. Склериты голотурий находятся там только спорадически и принадлежат исключительно к одному роду *Achistrum*, представленному двумя видами: *Achistrum monochordata* и *Achistrum gamma*.

PLATE

Plate I

Fig. 1. *Theelia heptalampra* (Bart.): *a* lower side, *b* upper side; Upper Oxfordian, *Idoceras planula* zone, Wieluń Upland, Ważne Młyny; diameter 0.3 mm (ZNG/H/316).

Figs. 2-4. *Theelia wartensis* n. sp. (*2* holotype): *a* lower side, *b* upper side; Lower Kimmeridgian, *Sutneria platynota*(?) zone, Wieluń Upland; *2*, *3* Dworszowice Kościelne, diameter 0.2 mm; *4* Prusicko-Góry, diameter 0.225 mm (ZNG/ /H/320—322).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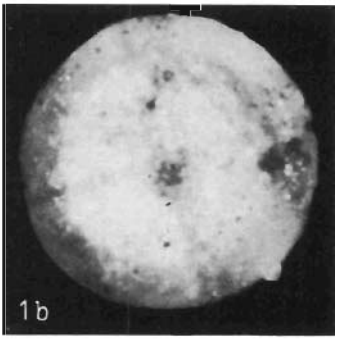
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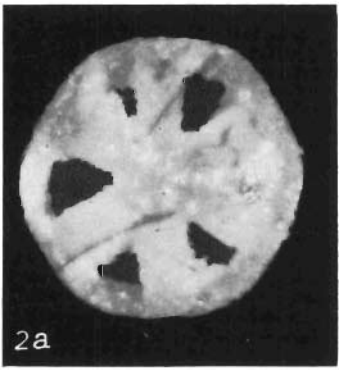
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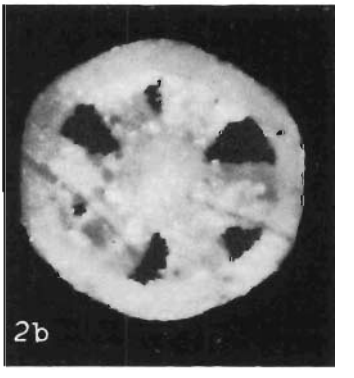
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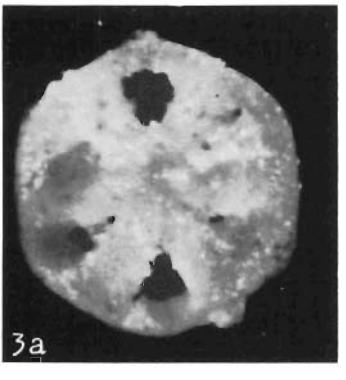
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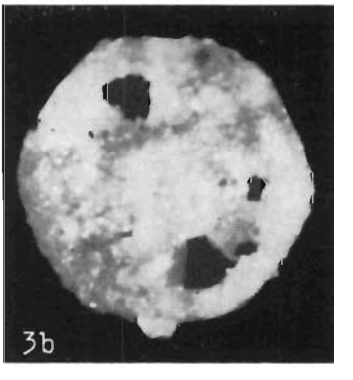
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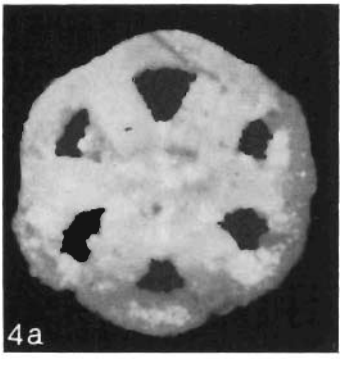
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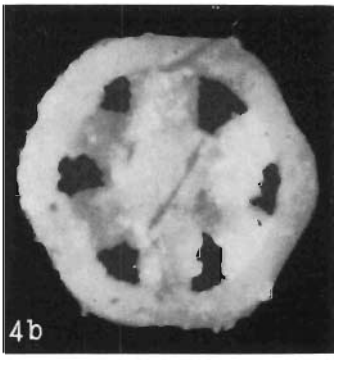
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