ABSTRACT: The Korytnica Clays yield a rich assemblage of the holothurian sclerites which contain 32 forms belonging to 4 families: Stichopitidae, Calclamnidae, Theelilidae and Synaptilidae. Eleven species are established new: *Calclamna cruciformis* sp. n., *C. tricorniculata* sp. n., *Calclammella clavata* sp. n., *C. deflandreae* sp. n., *C. korytnicensis* sp. n., *C. sanctacrucensis* sp. n., *C. trigonalis* sp. n., *Calclamnoidea tollmannae* sp. n., *Eocaudina lacrimaeformis* sp. n., *Mortensenites kielcensis* sp. n., and *M. multilaminaris* sp. n. The comparison of this assemblage with sclerites of Recent holothurians makes possible to assume that both burrowing and free moving (or seaweed clinging) species lived in the Korytnica basin.

INTRODUCTION

Holothurian sclerites of Miocene age in Europe are known only from a few localities. They were first recorded from the Burdigalian deposits of Saucats and Cestas in the Aquitanian Basin wherefrom Duvergier (1924) described 3 groups of sclerites corresponding to sclerites of the Recent holothurian genera *Psolus*, *Echinocucumis* and *Oneirophantaz* living in the Gironde Bay. Subsequently, holothurian sclerites were reported from the Tortonian deposits of Baden, Eisenstadt and Müllendorf in the Vienna Basin (Papp & Küpper 1953, Kristantollmann 1964). In Poland, they were found in the “Sarmatian” deposits (borehole Žrecze) of the Holy Cross Mts wherefrom Górka & Łuszczewska (1969) identified representatives of the genera *Eocaudina* (assigned by them to *Cucumarites* and *Calclamna* — cf. synonymy) and *Croneisites*.

The investigated material from the Korytnica Clays comes from the samples taken near village Karsy (*vide* Text-fig. 1; and Bałuk &
Radwański 1977, Text-fig. 2). The specimens from other sampling places are the subject of further investigations.

The recognized holothurian sclerite assemblage from the Korytnica Clays is relatively rich and well preserved, the surface of all specimens being glossy. It comprises 32 forms belonging to 4 families (cf. Table 1): Stichopitidae, Calcarnidae, Theeliidae and Synaptitidae. Sclerites are accompanied by numerous foraminifers as well as some ostracodes, radiolarians of the genus Cenosphaera, fragments of bryozoan colonies, sponge spicules and echinoid spines. A redepotted Upper Cretaceous material is represented i.a. by some foraminifers, and holothurian sclerites Achistrum and Eocaudina inaequiporus (Müller).

![Paleoenvironmental sketch of the Korytnica basin](image)

**Fig. 1.** Paleoenvironmental sketch of the Korytnica basin *(from: Baluk & Radwanski 1977, Text-fig. 2)*

Indicated are: marine area of the Korytnica basin during the Middle Miocene (Badenian) transgression (*blank*) and present-day outcrops of the Korytnica Clays (*stippled*); preserved fragments of littoral structures (*circled*); land or island areas along the seashore (*hachured*). Arrowed is the sampling place for the investigated assemblage of holothurian sclerites.

The taxonomy used in the present paper is that as offered by Frizzell & Exline (1966) in *Treatise on Invertebrate Paleontology* (Part U; Echinodermata 3, vol. 2).

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HOLOTHURIAN SCLERITES

Table 1
Holothurian sclerites from the Korytnica Clays

Cucumarites sp. A — Pl. 1, Fig. 13
Cucumarites sp. B — Pl. 3, Fig. 16
Calcclamna cruciformis sp. n. — Pl. 1, Figs 8–7
C. tricorniculata sp. n. — Pl. 1, Fig. 4
Calcclamella aquitanica Rioult — Pl. 2, Figs 7–9
C. irregularis (Schlumberger) — Pl. 1, Fig. 11 and Pl. 2, Figs 2–3
C. sinuosa Rioult — Pl. 2, Fig. 1 and Pl. 4, Fig. 11
C. clavata sp. n. — Pl. 4, Fig. 10
C. deflandreae sp. n. — Pl. 2, Figs 5–6
C. korytnicensis sp. n. — Pl. 1, Figs 8–10 and Pl. 2, Fig. 4
C. sanctacrucensis sp. n. — Pl. 3, Figs 11–15
C. trigonalis sp. n. — Pl. 2, Figs 10–14
Calcclamella sp. — Pl. 2, Fig. 15
Calcclamnoides gonata Kristan-Tollmann — Pl. 4, Fig. 7
C. tollmannae sp. n. — Pl. 4, Figs 5–6
Calcclamnoides sp. — Pl. 4, Fig. 8
?Calcclamnoides sp. — Pl. 4, Fig. 9
Elgerius sp. — Pl. 4, Fig. 12
Eocaudina girodensis (Rioult) — Pl. 4, Fig. 4
E. kuepperi (Deflandre-Rigaud) — Pl. 3, Figs 2–7
E. robusta (Deflandre-Rigaud) — Pl. 3, Fig. 10
E. spectosa (Deflandre-Rigaud) — Pl. 1, Fig. 1 and Pl. 3, Fig. 1
E. subtrigonalis Kristan-Tollmann — Pl. 3, Fig. 9
E. aff. variabilis (Rioult) — Pl. 3, Fig. 8
E. lacermaeformis sp. n. — Pl. 1, Fig. 3
Eocaudina sp. A — Pl. 2, Fig. 16
Eocaudina sp. B — Pl. 2, Fig. 17
Eocaudina sp. C — Pl. 1, Fig. 2
Mortensentites kielcensis sp. n. — Pl. 4, Fig. 15
M. multilaminaris sp. n. — Pl. 4, Figs 13–14
Theella cf. muellendorfensis Kristan-Tollmann — Pl. 1, Fig. 12
Cronotiites polonicus Górka & Łuszczewski — Pl. 4, Figs 1–3
Undetermined forms — Pl. 3, Figs 17–18.

SYSTEMATIC DESCRIPTION

Family Stichopitidae Frizzell & Exline, 1956
Genus CUCUMARITES Deflandre-Rigaud, 1952

Cucumarites sp. A
(Pl. 1, Fig. 13)

Material: Two damaged specimens (Coll. No. H–1).
Dimensions: Arm length 775 μ, arm width 150 μ, hole diameter 12 μ.

Description. — Sclerite with three long, narrow arms ovate in cross section. Holes uniform in diameter, elliptical, elongated along with the longer axis of arm, arranged in parallel rows slightly shifted in relation to one another. Periphery straight, gently rounded.

Remarks. — This form differs from other species of the genus Cucumarites in long, narrow arms and the arrangement and shape of holes.

Cucumarites sp. B
(Pl. 3, Fig. 16)

Material: Two damaged specimens (Coll. No. H–2).
Dimensions: Arm length 790 μ, arm width 156 μ, hole diameter 25–35 μ.
Description. — Sclerite massive, with three wide thick arms; arms ovate, with strongly extended ends in cross section. Holes large, circular, facing one another or somewhat shifted; arranged in 4 parallel rows on wider thicker arms, and in two parallel rows on the third one, narrower arm. Periphery flattened, undulated.

Remarks. — The forms differ from representatives of other species of the genus Cucumarites in size, differences in number of rows of holes on arms, and in flattened periphery.

Family Calclamnidae Frizzell & Exline, 1956
Genus CALCLAMNA Frizzell & Exline, 1966

Calclamna cruciformis sp. n.
(Pl. 1, Figs 5—7)

Holotype: The specimen presented in Pl. 1, Fig. 5; housed in the Author's collection.
Paratypes: Specimens presented in Pl. 1, Figs 6—7.
Type locality: Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.
Type horizon: Middle Miocene (Badenian).
Derivation of the name: Latin cruc — cross; after a cross-like arrangement of the holes.
Diagnosis: Plate flat, spindle-shaped, 9 holes arranged in the form of cross; longer cross axis composed of 7 holes (a in Text-fig. 2) and shorter cross axis (passing in the mid-length of the plate) made of 2 larger perforations (b in Text-fig. 2); holes loosely spaced (c in Text-fig. 2). Plate margin somewhat undulated.

Variability. — Variability concerning position of shorter cross situated in the middle (Pl. 1, Fig. 7) or one-third of the plate length (Pl. 1, Fig. 6).

Remarks. — The new species differs from all the previously described species of the genus Calclamna in plate outline and arrangement of perforations.

Calclamna tricorniculata sp. n.
(Pl. 1, Fig. 4)

Holotype: The specimen presented in Pl. 1, Fig. 4; housed in the Author's collection.
Type locality: Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.
Type horizon: Middle Miocene (Badenian).

Derivation of the name: Latin corniculum — tiny horn; after occurrence of three projections.

Diagnosis: Flat plate, with bilateral symmetry; central area with 3 holes; 3 projections of different length marked at opposite ends of the plate.


Dimensions: Length 250—275 µ, width 150—200 µ, hole diameter 8—35 µ, number of holes 6.

Description. — Flat plate; three elliptic holes of different size arranged radially in the central area (e in Text-fig. 2). On one end of the plate the central area passes into short upper projection (f in Text-fig. 2), and on the opposite end — into 2 longer projections (d in Text-fig. 2); a single circular hole marked on each projection. Periphery finely undulated.

Remarks. — The new species differs from the remaining species of the genus Calclamna in the development of 3 projections and the arrangement of holes on the plate.

Genus CALCLAMNELLA Frizzell & Exline, 1956

Calclamnella aquitanica Rioult, 1965

(Pl. 2, Figs 7—9)


Material: Ten, well preserved specimens (Coll. No. H—3).

Dimensions: Length 375—600 µ, width 175—225 µ, hole diameter 15—50 µ, number of holes 8—18.

Remarks. — The investigated specimens differ from the holotype (cf. Rioult 1965) in somewhat larger dimensions of the plate. The sclerites are similar to those of Recent holothurians of the species Holothuria vagabunda Selenka reported by Erwe (1913, Pl. 6, Fig. 13 a) in plate outline and arrangement of holes, differing in larger size of the plate and more ovate holes. Holothurians of the species Holothuria vagabunda Selenka occur along the coasts of western South America, Mozambique, Zanzibar, as well as Red Sea, Gulf of Aden, Tahiti, and Hawaii (Erwe 1913).

Calclamnella irregularis (Schlumberger, 1890)

(Pl. 1, Fig. 11 and Pl. 2, Figs 2—3)

1890. Priscopedatus irregularis sp. n.; M. Schlumberger, pp. 199—200, Text-figs 20—21.


1955. Calclamnella irregularis Schlumberger; D. L. Frizzell & H. Exline, Text-fig. 530, 4a, b.

Material: Seven, well preserved specimens (Coll. No. H—8).

Dimensions: Length 250—370 µ, width 100—150 µ, hole diameter 17—25 µ, number of holes 15—18.

Remarks. — The investigated specimens do not differ from the holotype (cf. Schlumberger 1890). Sclerites of Calclamnella irregularis (Schlumberger) are similar to those of Recent Holothuria polii Delle Chiaje (cf. Cherbonnier 1951, Pl. 7, Fig. 19; Strenger 1963, Pl. 180) from the coasts of the Mediterranean and Adriatic Sea, differing in much larger size.
Calclamnella sinuosa Rioult, 1965
(Pl. 2, Fig. 1 and Pl. 4, Fig. 11)

1965. Calclamnella sinuosa sp. n., M. Rioult, p. 170, Pl. 3, Fig. 3.
Dimensions: Length 275–300 µ, width 175–185 µ, hole diameter 12–37 µ, number of holes 8–10.

Remarks. — The investigated specimens do not differ from the holotype.

Calclamnella clavata sp. n.
(Pl. 4, Fig. 10)
Holotype: The specimen presented in Pl. 4, Fig. 10, housed in the Author’s collection.
Type locality: Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.
Type horizon: Middle Miocene (Badenian).
Derivation of the name: Latin clava — club; after a club-like appearance of the sclerite.
Diagnosis: Sclerite massive, club-shaped; perforations arranged in two rows, one of which continues up to the middle, and another one throughout the whole sclerite.
Material: Four, well preserved specimens (Coll. No. H-6).
Dimensions: Length 425 µ, width 100 µ, hole diameter 10–20 µ, number of holes 11–12.

Description. — Sclerite massive, thick, club-shaped. Holes small, elliptical, elongated along with the longer axis of sclerite, arranged in 2 parallel rows of different length; one row continues up to the middle, and another throughout the sclerite; holes very loosely spaced. Periphery slightly undulated.

Remarks. — The new species differs from all the hitherto described species of the genus in massive, club-shaped appearance of the sclerite and in arrangement of holes.

Calclamnella deflandreae sp. n.
(Pl. 2, Figs 5–6)
Holotype: The specimen presented in Pl. 2, Fig. 5; housed in the Author’s collection.
Paratype: The specimen presented in Pl. 2, Fig. 6.
Type locality: Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.
Type horizon: Middle Miocene (Badenian).
Derivation of the name: In honour of Dr. Marthe Deflandre-Rigaud, an outstanding student of the holothurian sclerites.
Diagnosis: Plate flat, perforated, elongate; holes circular, loosely spaced, arranged in two rows shifted in relation to one another; 5 holes in the lower, and at least one hole in the upper row; periphery incised.
Material: Five, well preserved specimens (Coll. No. H-7).
Dimensions: Length 400–425 µ, width 175 µ, hole diameter 12–25 µ, number of holes 6–8.

Description is the same as diagnosis.

Variability. — Variability concerning the shape of holes changing from circular (Pl. 2, Fig. 5) to subtriangular (Pl. 2, Fig. 6), as well as the number of holes in the upper row, ranging from one (Pl. 2, Fig. 5) to two (Pl. 2, Fig. 6).

Remarks. — The new species differs from all the hitherto described species of the genus in having not numerous holes arranged in two rows of different length. The representatives of the new species are similar to sclerites of Recent holothurians Holothuria pardaIs Selenka (cf. Cherbonnier 1951, Pl. 9, Figs 26–21) from the coasts of Hawaii Islands, differing in markedly larger size.
**Holotype:** The specimen presented in Pl. 1, Fig. 9; housed in the Author's collection.

**Paratypes:** Specimens presented in Pl. 1, Figs 8, 10.

**Type locality:** Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.

**Type horizon:** Middle Miocene (Badenian).

**Derivation of the name:** From the Korytnica basin, in the deposits of which the holotype was found.

**Diagnosis:** Plate flat; central area with large holes arranged in 2 parallel rows; side area with fine holes developed at the extension of these rows.

**Material:** Fourteen, well preserved specimens (Coll. No. H-8).

**Dimensions:** Length 375–525 μ, width 175–200 μ, hole diameter 12–50 μ, number of holes 8–18.

**Description.** — Plate flat, spindle-shaped. Central area (c in Text-fig. 3) with 4 large, circular to elliptical holes arranged in 2 parallel rows markedly shifted in relation to one another. Side areas (b in Text-fig. 3) a half narrower than the central area, are developed on the extension of diagonal of the latter; the side areas display small, elliptical holes arranged in two parallel rows slightly shifted in relation to one another. Periphery undulated.

![Fig. 3. Various shapes (A, B, C) of sclerites in the genus Calclamnella](image)

**Variability.** — Variability concerning (1) the appearance of side areas changing from elongate with numerous holes (Pl. 1, Fig. 9) to short, with less numerous holes (Pl. 1, Fig. 8), (2) the number of holes from the central area ranging from 4 (Pl. 1, Fig. 9) to 6 (Pl. 1, Fig. 10), and (3) a shift of side areas from sclerite margins towards the center.

**Remarks.** — The new species is similar to *C. fusiformis* Deflandre-Rigaud in sclerite outline and presence of central and side areas, differing in larger size and in the presence of holes on side areas.

**Calclamnella sanctacrucensis** sp. n.

(Pl. 3, Figs 11—15)

**Holotype:** The specimen presented in Pl. 3, Fig. 13; housed in the Author's collection.

**Paratypes:** Specimens presented in Pl. 3, Figs 11 and 13–15.

**Type locality:** Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.

**Type horizon:** Middle Miocene (Badenian).

**Derivation of the name:** Latin sanctacrucensis; after the Holy Cross Mts, the region where the Korytnica basin is situated.
Diagnosis: Plate flat, elliptical in outline; holes arranged on both sides of longitudinal axis of the plate; periphery deeply incised.

Material: Twelve, well preserved specimens (Coll. No. H-10).


Description. — Plate flat, elongate elliptical in outline; 4 large, elliptical to subtriangular holes arranged in the row on one side, whilst 2 others on the opposite side of longitudinal axis of the plate; 5 holes of various size marked on both ends of the axis; notches in the periphery deeply incised (f in Text-fig. 3).

Variability. — Variability concerning depth of incision of the periphery; the incisions being either gentle (Pl. 3, Figs 13–14) or narrow and deep (Pl. 3, Figs 11, 15). Variable is also the number of holes which decreases when the number of incisions becomes greater.

Remarks. — The new species is similar to the species Calcclamnella transversa Deflandre-Rigaud (cf. Deflandre-Rigaud 1962, Text-figs 14–15) known from the Oxfordian of France, in holes arranged on opposite sides of longitudinal axis of the plate and in deep incisions, differing in twice larger size of the plate and the occurrence of small holes on both ends of the longer axis. The representatives of C. sanctacrucensis sp. n. are similar to sclerites of Recent Holothuria pervicax Selenka (cf. Cherbonnier 1951, Pl. 113, Figs 8, 10) living along the coasts of Hawaii Islands, differing in markedly larger size, narrower axis and holes more ovate in outline.

Calcclamnella trigonalis sp. n.

(Pl. 2, Figs 10–14)

Holotype: The specimen presented in Pl. 2, Fig. 11; housed in the Author’s collection.

Paratypes: Specimens presented in Pl. 2, Figs 10 and 12–14.

Type locality: Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.

Type horizon: Middle Miocene (Badenian).

Derivation of the name: Latin trigon — triangle; after triangular outline of the sclerite.

Diagnosis: Plate flat, triangular in outline; holes arranged in 2 rows converging in the apical part of the plate.

Material: Eleven, well preserved specimens (Coll. No. H-13).


Description. — Plate flat, subtriangular in outline. Holes circular to elliptical, displaced in relation to one another, arranged in 2 rows converging in the plate apex; largest close to the base of the plate, decreasing in diameter towards the apex, generally loosely spaced. Periphery gently undulated.

Variability. — Variability concerning the plate outline changing from low and broad (Pl. 2, Fig. 10) to high and slender (Pl. 2, Fig. 14). Supplementary perforations (a in Text-fig. 3) present (Pl. 2, Fig. 12) in the lower part of the plate or missing (Pl. 2, Figs 10–11 and 13–14).

Remarks. — The new species differs from all the hitherto described species of the genus Calcclamnella in triangular outline and perforations arranged in 2 rows converging in the apical part of the plate.

Calcclamnella sp.

(Pl. 2, Fig. 15)

Material: One, well preserved specimen (Coll. No. H-12).

Dimensions: Length 300 μ, width 175 μ, hole diameter 25–50 μ, number of holes 7.
Description. — Plate flat, semicircular in outline. Holes elliptical, variable in size, arranged in two rows; one of the rows is bent stronger and displaced for about one-hole distance in relation to another. Periphery straight.

Remarks. — The investigated specimen differs from the representatives of all the species Calciamnella hitherto described in small number of perforations and one row of perforation strongly bent.

Genus CALCLAMNOIDEA Frizzell & Exline, 1956
Calciamnoidea gonia Kristan-Tollmann, 1964
(Pl. 4, Fig. 7)

Dimensions: Width 120 μ, hole diameter 15–23 μ, number of holes 14–20.

Remarks. — The investigated specimens do not differ from the holotype.

Calciamnoidea tollmannae sp. n.
(Pl. 4, Figs 5–6)

Holotype: The specimen presented in Pl. 4, Fig. 5; housed in the Author's collection.
Paratypes: The specimen presented in Pl. 4, Fig. 6.
Type locality: Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.
Type horizon: Middle Miocene (Badenian).
Derivation of the name: In honour of Dr. Edith Kristan-Tollmann, an outstanding student of the holothurian sclerites.

Diagnosis: Plate flat, with three short and broad arms; holes arranged in rows.

Material: Six, well preserved specimens (Coll. No. H—15).
Dimensions: Arm width 125 μ, arm length 100–125 μ, hole diameter 12–25 μ, number of holes 12–14.

Description. — Plate flat, with ends passing into arms roughly of the same length. Holes small, circular to elliptical, arranged in two parallel rows, somewhat shifted in relation to one another. Periphery gently incised.

Remarks. — The new species differs from all the hitherto described species of the genus Calciamnoidea in the development of three arms and the arrangement of holes on the arms.

Calciamnoidea sp.
(Pl. 4, Fig. 8)

Material: One, well preserved specimen (Coll. No. H—16).
Dimensions: Length 300 μ, width 120 μ, hole diameter 18–50 μ, number of holes 22.

Description. — Plate flat, reniform. Holes variable in diameter, circular to elliptical, arranged in 2–3 rows parallel to the plate periphery. Periphery broadly sinuated.

Remarks. — The specimen differs from the representatives of hitherto described species of Calciamnoidea in reniform holes and their arrangement.

?Calciamnoidea sp.
(Pl. 4, Fig. 9)

Material: One, well preserved specimen (Coll. No. H—17).
Dimensions: Length 800 μ, width 300 μ, diameter of holes 20–60 μ, number of holes 24.

Description. — Plate massive, subrectangular in outline, with biconvex central part. Holes circular to elliptical, variable in diameter, arranged in 2 longer
and 2 shorter rows; longer rows arcuately bent, parallel to the plate periphery and continuing throughout the plate; shorter rows are oriented obliquely to the longer ones. Periphery incised.

Genus *ELGERIUS* Deflandre-Rigaud, 1959

*Elgerius* sp.

(Pl. 4, Fig. 12)

**Material.** One, somewhat damaged specimen (Coll. No. H-18).

**Dimensions.** Length 200 μ, diameter of perforations 10–15 μ.

**Description.** — Plate very fragile, concave—convex, circular in outline; with central part strongly convex, made of a single layer. Perforations large, circular to elliptical, loosely spaced. Peripheral zone double-layered, with small perforations arranged in 2 rows roughly parallel to the margin. Periphery finely undulated.

**Remarks.** — The specimen differs from the representatives of hitherto described species of the genus *Elgeriuss* in the plate outline and character and arrangement of perforations in central and peripheral parts of the plate.

Genus *EOCAUDINA* Martin, 1952

*Eocaudina girondensis* (Rioult, 1965)

(Pl. 4, Fig. 4)

1965. *Cucumarttes girondensis* sp. n.; M. Rioult, pp. 172–174, Pl. 2, Fig. 8.

**Material.** Four damaged specimens (Coll. No. H-19).

**Dimensions.** Length 350 μ, width 150–275 μ, diameter of perforations 12–25 μ.

**Remarks.** — The specimens correspond exactly to the holotype.

*Eocaudina kuepperi* (Deflandre-Rigaud, 1961)

(Pl. 3, Figs 2–7)


1964. *Calculmnoide kupperi* (Deflandre-Rigaud); E. Kristian-Tollmann, p. 52, Pl. 4, Figs 1–6.


**Material.** Twenty, well preserved specimens (Coll. No. H-21).

**Dimensions.** Length 300–375 μ, width 150–250 μ, diameter of perforations 12–30 μ, number of perforations 15–27.

**Variability.** — Variability mainly concerning the plate outline changing from rectangular (Pl. 3, Fig. 4) to almost square (Pl. 3, Fig. 7), and the number of perforations in rows ranging from three (Pl. 3, Fig. 4) to five (Pl. 3, Fig. 7).

**Remarks.** — The investigated specimens do not differ from those described by Papp & Küpper (1953) from the Vienna Basin.

*Eocaudina robusta* (Deflandre-Rigaud, 1962)

(Pl. 3, Fig. 10)


**Material.** Eight incomplete specimens (Coll. No. H-22).

**Dimensions.** Length 500 μ, width c 300 μ, diameter of perforations 25–60 μ.
Remarks. — The investigated specimens do not differ from the representatives of the species described by Deflandre-Rigaud (1962) from the Oxfordian of France.

**Eocaudina speciosa** (Deflandre-Rigaud, 1959)
(Pl. 1, Fig. 1 and Pl. 3, Fig. 1)

1959. *Cucumarites speciosus* sp. n.; M. Deflandre-Rigaud, p. 192, Pl. 1, Fig. 4; Pl. 2, Fig. 6.  
*Dimensions*: Plate diameter 225–250 µ, diameter of perforations 20–25 µ, number of perforations 20–30.

Remarks. — The investigated specimens do not differ from the holotype of the species *Eocaudina speciosa* (Deflandre-Rigaud). The specimen is similar to that of *Cucumarites scaber* Deflandre-Rigaud (cf. Deflandre-Rigaud 1959, Pl. 1, Fig. B) in size and outline of plate as well as number and shape of perforations, differing in more uniform distribution of perforations and undulated plate margin.

**Eocaudina subtrigonalis** Kristan-Tollmann, 1964  
(Pl. 3, Fig. 9)

1964. *Eocaudina subtrigonalis* sp. n.; E. Kristan-Tollmann, p. 86, Pl. 6, Figs 1–2.  
*Dimensions*: Length 450 µ, width 500 µ, diameter of perforations 10–50 µ, number of perforations 88–40.

Remarks. — The investigated specimens differ from the holotype (cf. Kristan-Tollmann 1964) in more regular plate outline, being almost subtriangular.

**Eocaudina aff. variabilis** (Rioult, 1965)
(Pl. 3, Fig. 8)

1965. *Cucumarites variabilis* sp. n.; M. Rioult, p. 172, Pl. 3, Figs 8, 10.  
*Material*: Seven, well preserved specimens (Coll. No. H-25).  
*Dimensions*: Length 300 µ, width 200 µ, diameter of perforations 20–50 µ, number of perforations 8.

Remarks. — The investigated specimens are assigned to the species *Eocaudina variabilis* (Rioult) with reservation as they differ from the representatives of the species described from the Burdigalian of France by Rioult (1965) in less ovate plate outline and larger and more circular perforations.

**Eocaudina lacrimaeformis** sp. n.  
(Pl. 1, Fig. 3)

*Holotype*: The specimen presented in Pl. 1, Fig. 3; housed in the Author's collection.  
*Type locality*: Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.  
*Type horizon*: Middle Miocene (Badenian).  
*Derivation of the name*: Latin *lacrima* — tear; after a tear-like outline of the plate.  
*Diagnosis*: Plate tear-shaped; its central area bearing four larger and five smaller perforations; a snout-like projection displaying three perforations.

*Dimensions*: Length 300 µ, width 150 µ, diameter of perforations 10–30 µ, number of perforations 11–14.

*Description*. — Plate thick, tear-like in outline; its central area clearly pronounced, with 4 larger and 5 smaller perforations, and it gradually passes
into a snout-like projection with 3 perforations. This projection is of one-third of the whole plate length. All the perforations are round and loosely spaced. Periphery undulated.

Remarks. — The new species clearly differs from all the hitherto described species of the genus *Eocaudina* in a tear-like outline and massive appearance of the plate and arrangement of perforations.

*Eocaudina* sp. A  
(Pl. 2, Fig. 16)


*Description.* — Sclerite in the form of a flat, thin plate, irregularly rounded in outline. Perforations round and elliptical, varying in size; arranged in rows. Periphery finely undulated.

*Remarks.* — This badly preserved specimen is illustrated here, as it differs from all the remaining *Eocaudina* forms under description.

*Eocaudina* sp. B  
(Pl. 2, Fig. 17)

*Material*: One, well preserved specimen (Coll. No. H-26).

*Dimensions*: Length 380 μ, width 150 μ, diameter of perforations 20–50 μ, number of perforations 22.

*Description.* — Plate perforated, flat, elliptical in outline, somewhat elongated at one end. Perforations elliptical, small on both ends of plate, increasing towards the central part, arranged in a very dense network with alternating rows. Periphery undulated.

*Remarks.* — The investigated specimen differs from the representatives of all the hitherto known species of the genus in perforations arranged in very dense network.

*Eocaudina* sp. C  
(Pl. 1, Fig. 2)

*Material*: One, well preserved specimen (Coll. No. H-27).

*Dimensions*: Length 700 μ, width 375 μ, diameter of perforations 13–40 μ, number of perforations c 35.

*Description.* — Plate perforated, subrhomboidal in outline, with biconvex central part and flat peripheral part. Perforations circular or elliptical, variable in size, loosely and regularly arranged on surface of the plate. Periphery finely undulated.

*Remarks.* — The investigated specimen differs from the representatives of all the hitherto known species of the genus in size and outline of the plate and biconvex central part.

**Genus MORTENSENITES** Deflandre-Rigaud, 1952  
*Mortensenites kielcensis* sp. n.  
(Pl. 4, Fig. 15)

*Holotype*: The specimen presented in Pl. 4, Fig. 15; housed in the Author's collection.

*Type locality*: Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.

*Type horizon*: Middle Miocene (Badenian).
Derivation of the name: From Kielce, the main city of the Holy Cross region.

Diagnosis: Plate multilayered, subrectangular in outline; layers tightly packed; perforations closely spaced in the upper and loosely spaced in the lower layer.


Dimensions: Length 375 μ, width 210 μ.

Description. — Plate multilayered, subrectangular in outline; layers tightly packed. Perforations circular, elliptical, variable in size on the upper layer, very small and closely packed on the lower layer. Periphery incised.

Remarks. — The new species differs from all the hitherto described species of the genus Mortensenites in size and density of spacing of the perforations on the lower and upper layers of the plate.

Mortensenites multilaminaris sp. n.

(Pl. 4, Figs 13—14)

Holotype: The specimen presented in Pl. 4, Fig. 14; housed in the Author's collection.

Paratypes: The specimen presented in Pl. 4, Fig. 13.

Type locality: Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.

Type horizon: Middle Miocene (Badenian).

Derivation of the name: Latin multi — many, and lamina — layer; after multilayered structure of the plate.

Diagnosis: Plate perforated, multilayered, irregular in outline; layers loosely arranged; holes uniform in size throughout the plate.

Material: Six, well preserved specimens (Coll. No. H-29).

Dimensions: Length 200—425 μ, width 180—1375 μ, diameter of perforations 8—20 μ.

Description. — Plate perforated, highly irregular in outline. Layers more or less uniform in size, loosely arranged one above another. Perforations large, elliptical, densely and uniformly distributed in every layer; perforations from different layers somewhat shifted in relation to one another. Surface of external layers finely frosted. Periphery incised.

Remarks. — The new species differs from the species Mortensenites hemisphaericus described by Kristan-Tollmann (1964, Pl. 7, Fig. 3) from the Badenian of Austria in more numerous and more densely spaced perforations as well as in their shape.

Family Theeliidae Frizzell & Exline, 1956

Genus THEELIA Schlumberger, 1891

Theelia cf. muellendorfensis Kristan-Tollmann, 1964

(Pl. 1, Fig. 12)


Material: One, well preserved specimen (Coll. No. H-30).

Dimensions: Diameter 175 μ, number of spokes 6.

Remarks. — The investigated specimen differs from the holotype only in less undulated upper side of the rim.

Family Synaptitidae Frizzell & Exline, 1956

Genus CRONEISITES Frizzell & Exline, 1957

Croneisites polonicus Górka & Łuszczewska, 1969

(Pl. 4, Figs 1—3)

1969. Croneisites polonicus sp. n.; H. Górka & L. Łuszczewska, pp. 366—367, Pl. 68, Fig. 7, Pl. 69, Figs 1—6, 8, 10 and Pl. 70, Fig. 4.
Material: Twenty one, well preserved specimens (Coll. No. H-31).
Dimensions: Length 225–260 μ, width 175–200 μ, diameter of main perforations 50–70 μ, number of perforations 16.

Variability. — Variability concerning the outline of plate changing from hexagonal (Pl. 4, Fig. 1) to subrounded (Pl. 4, Fig. 3).

Remarks. — The investigated specimens do not differ from those described by Górka & Łuszczewska (1969) from the “Sarmatian” deposits of the Holy Cross Mts (borehole Żrecze). They are similar to those of Recent holothurians of the species Chondrocloea recta (Semper) (cf. Erwe 1913, Pl. 8, Fig. 26a) differing in larger size of the plate and less numerous and smaller holes in central part of the plate. The holothurians Chondrocloea recta (Semper) are confined to the coasts of SW Australia, New Guinea, Philippines, Timor and Ceylon (Erwe 1913).

Undetermined forms
(Pl. 3, Figs 17–18)


Description. — Plate flat, thin, somewhat bent, irregular in outline, with 2–3 small, circular to subtriangular completely developed holes and over a dozen circular pits. Periphery straight, sometimes slightly incised.

Remarks. — The investigated specimens markedly differ from all the fossil holothurian sclerites hitherto described in small plate thickness and small number of holes. They are similar to sclerites of Recent holothurians Thyone lechleri Lampert (cf. Ludwig 1868, Pl. 2, Fig. 26b, d, e, f), differing in more irregular outline of the plate and the development of pits.

REMARKS ON ECOLOGY

The reconstruction of synecological conditions of ancient marine sedimentary basins on the basis of holothurian sclerites is relatively difficult and deceptive. The majority of Recent holothurians are characterized by wide bathymetric and climatic ranges (Hyman 1955), being highly sensitive to changes in water salinity, and all of them confined to waters of normal salinity (Frizzell & Exline 1955). The described sclerites Calclamnella aquitanica Riout, C. deflandreae sp. n., C. sanctacrucensis sp. n., and Croneisites polonicus Górka & Łuszczewska are similar to sclerites of Recent holothurians distributed in tropical or subtropical seas (cf. Erwe 1913, Cherbonnier 1951). According to Frizzell & Exline (1955), various morphological forms of holothurian sclerites recorded in ancient deposits may be used for defining ecological types represented by then-living holothurians with some reliability. Consequently, the sclerites of circular outline (Theeliidae, Synaptitidae) that occur in the Korytnica basin should be ascribed to the holothurians burrowing in the sediments, whilst those of the type of perforated plates (Calclamnidae) and elongated perforated rods (Stichopitidae)
presumably belonged to the species either free moving on the sea bottom, or clinging to seaweed, such as kelp or marine grass.

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**REFERENCES**


SKLERYTY STRZYKÓW Z IŁÓW KORYTNICKICH

(Streszczenie)

Przedmiotem pracy jest charakterystyka bogatego i dobrze zachowanego zespołu sklerytów strzyków z ilów korytnickich (por. fig. 1). Zespół ten (por. tab. 1, fig. 2–3 oraz pl. 1–4) obejmuje 32 formy reprezentujące 4 rodziny: Stichopitidae, Calcilamnidae, Theeliidae oraz Synaptitidae. W obrębie tego zespołu stwierdzono występowanie 11 gatunków dla nauki nowych: Calclamna cruciformis sp. n., C. tricorniculata sp. n., Calclamnella clavata sp. n., C. deflandreae sp. n., C. korytnicensis sp. n., C. sanctacrucensis sp. n., C. trigonalis sp. n., Calclamnoidea tollmannae sp. n., Eocaudina lacrimaeformis sp. n., Mortensenites kielcensis sp. n., oraz M. multilaminaris sp. n. Stwierdzono także obecność kilku okazów (reprezentujących 2 gatunki) redeponowanych z osadów kredowych. Badany zespół mioceński jest niewątpliwie znacznie bogatszy niż poznany dotychczas z Basenu Wiedeńskiego (por. Papp & Küpper 1953, Kristan-Tollmann 1964). Porównanie tego zespołu ze sklerytami współczesnymi pozwala stwierdzić, że w basenie Korytnicy występowały dwa ekologiczne typy strzyków — zagrzebujące się w osadzie, oraz swobodnie poruszające się bądź przyczepione do wodorostów (głównie lub traw morskich). Kilka badanych form wykazuje ponadto duże podobieństwo do sklerytów strzyków żyjących dzisiaj w morzach tropikalnych bądź subtropikalnych.
1 Eocaudina speciosa (Deflandre-Rigaud), × 120; 2 Eocaudina sp. C, × 70; 3 Eocaudina lacrimaeformis sp. n., holotype, × 160; 4 Calclamna tricorniculata sp. n., holotype, × 180; 5–7 Calclamna cruciformis sp. n. (5 presents the holotype), × 120; 8–10 Calclamnella korytnicensis sp. n. (9 presents the holotype), 100; 11 Calclamnella irregularis (Schlumberger), × 180; 12 Theelia cf. muellendorfensis Kristan-Tollmann, × 270; 13 Cucumites sp. A, × 120
1 Calclamnella sinuosa Rioult; 2–3 Calclamnella irregularis (Schlumberger); 4 Calclamnella sp. n.; 5–6 Calclamnella deflandrei sp. n. (5 presents the holotype); 7–9 Calclamnella aquitanica Rioult; 10–14 Calclamnella trigonalis sp. n. (11 presents the holotype); 15 Calclamnella sp.; 16 Eocaudina sp. A; 17 Eocaudina sp. B. All figures X 100
1 Eocaudina speciosa (Deflandre-Rigaud); 2–7 Eocaudina kuepperi (Deflandre-Rigaud); 8 Eocaudina cf. variabilis (Rioult); 9 Eocaudina subtrigonalis Kristan-Tollmann; 10 Eocaudina robusta (Deflandre-Rigaud); 11–15 Calciamnella sanctacruccensis sp. n. (12 presents the holotype); 16 Cucumarites sp. B, × 90; 17–18 Undetermined sclerites. All figures × 100
1–3 Croneisites polonicus Górka & Łuszczewska: 1–2 convex side, 3 concave side, \( \times 175 \); 4 Eocaudina girondensis (Rioult), \( \times 100 \); 5–6 Calclamnoidea tollmannae sp. n. (3 presents the holotype), \( \times 180 \); 7 Calclamnoidea goniaia Kristan-Tollmann, \( \times 160 \); 8 Calclamnoidea sp., \( \times 120 \); 9 ?Calclamnoidea sp., \( \times 40 \); 10 Calclamnella clavata sp. n., holotype, \( \times 120 \); 11 Calclamnella sinuosa Rioult, \( \times 180 \); 12 Eigerius sp., \( \times 190 \); 13–14 Mortensenites multilaminaris sp. n. (14 presents the holotype); 15 Mortensenites kielcensis sp. n., holotype, \( \times 120 \)