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Some balanid cirripedes from the Korytnica Basin (Middle Miocene; Holy Cross Mountains, Central Poland)

ABSTRACT: The assemblage of the balanid cirripedes from the Korytnica Basin (Middle Miocene; Holy Cross Mountains, Central Poland) comprises the representatives of the two families, Archaebalanidae and Balanidae. The first is represented by *Solidobalanus* (*Solidobalanus*) *mylensis* (SEGUENZA), *Solidobalanus* (*Hesperibalanus*) sp.div., and *Actinobalanus actinomorphus* (MORONI). The family Balanidae is represented by the six species: *Balanus* (*Balanus*) *concavus* BRONN, *Balanus* (*Balanus*) *amphitrite* DARWIN, *Balanus* (*Balanus*) *trigonus* DARWIN, *Balanus* (*Megabalanus*) *tintinnabulum* LINNAEUS, *Balanus* (*Megabalanus*) *tulipiformis* ELLIS, and *Balanus* sp. The whole assemblage shows the greatest analogy to that of the Neogene of Italy.

INTRODUCTION

The studied barnacles of the family Archaebalanidae NEWMAN & ROSS, 1976, and Balanidae LEACH, 1817, come from the Middle Miocene (Badenian) deposits of the Korytnica Basin, southern slopes of the Holy Cross Mountains, Central Poland. They are relatively rare in the Korytnica Clays, as compared to other fossils, and they are recovered only at few localities situated in the littoral zone of the basin (BAŁUK & RADWAŃSKI 1967, 1977). The most frequent they are in the oyster lumachelle, that is a littoral facies of the clays, which is well exposed at Mt. Lysa (*see* BAŁUK & RADWAŃSKI 1967, 1977; DAWIDOWSKI 1974).

The balanids are also present in the *Heterostegina* sands overlying the Korytnica Clays (DAWIDOWSKI 1974, GUTOWSKI 1984) as well as in the marly sands exposed at Chomentów (RADWAŃSKI 1969, DAWIDOWSKI 1974), where complete crowns attached to large oyster shells were found besides loose plates (RADWAŃSKI 1969, Pl. 40).

The taxonomical diversity of the balanids from the investigated localities was studied by DAWIDOWSKI (1976), who relying mostly on the microscopic structure of the parietes distinguished the three balanid species: *Balanus concavus* BRONN, *Balanus mylensis* SEGUENZA, and *Balanus amphitrite* DARWIN.

The balanids in the Tertiary deposits of Poland, besides the Korytnica Basin, are known from the oyster limestone at the locality Kraków-Zwierzyniec (BIEDA 1931, RADWAŃSKI 1968). They were determined by BIEDA (1931) as *Balanus tintinnabulum* (L.), similarly as single specimens from Przegorzały near Cracow. The balanids were also found at Niechobrz (BIEDA 1931), in sandy sediments near Nawodzice (BAŁUK & RADWAŃSKI 1968), as well as in the Pińczów Limestones, and in marly-calcareous sediments in the vicinity of Busko (RADWAŃSKI 1969). The balanids at these localities have been not studied in detail.

Despite of their wide distribution in the Neogene deposits of Europe, the balanids are a relatively little studied group, due to their poor importance for stratigraphic purposes. The best studied balanid assemblages are those from the Miocene and Pliocene of Italy (SEGUENZA 1873-76; DE ALESSANDRI 1896, 1906; MORONI 1952, 1967; MENESINI 1965, 1966, 1971) and from Hungary and Bulgaria (KOLOSVÁRY 1962a, b).

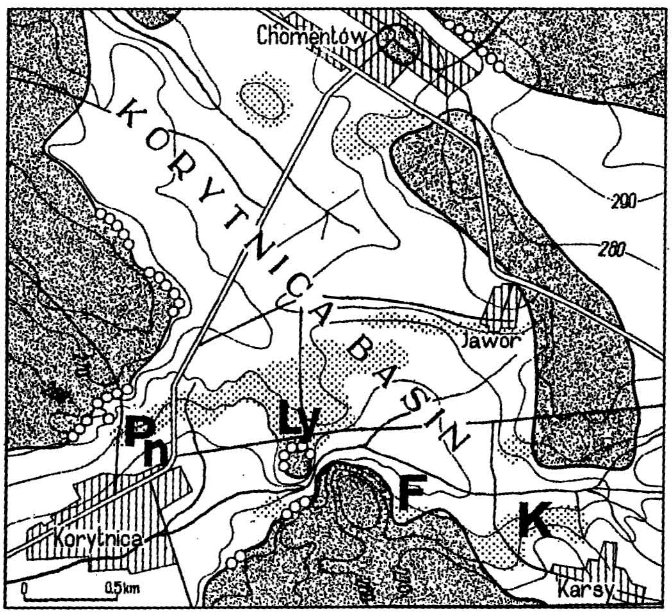


Fig. 1. Paleoenvironmental sketch of the Korytnica Basin, to show localities of the investigated assemblage of balanids: Ly — Mt. Lysa, Pn — Korytnica-Plebania, F — Korytnica-Forest, K — Karsy

Within the sketch indicated are: marine area of the basin during the Middle Miocene (Badenian) transgression (*blank*), present-day outcrops of the Korytnica Clays (*stippled*), preserved fragments of littoral structures (*circled*), and land or island areas along the seashore (*hachured*); adopted from BAŁUK & RADWAŃSKI (1977, Fig. 2)

REMARKS ON BALANID TAXONOMY

Throughout the whole their evolution the balanids displayed a rather low rate of changes, resulting in the formation of many groups of a more or less similar structure (FOSTER 1978). For this reason, the systematics of the balanids, especially in the fossil record presents difficulties not only in the distinction between species, but also in the establishing of philogenetic relations between the higher taxa. NEWMAN & *al.* (1969) presented a taxonomic study of the acorn barnacles in which they listed 12 subgenera belonging to the genus *Balanus* DA COSTA, 1778. This account did not solve, however, the disputable problems. For instance forms with different structure were considered as closely affined groups (e.g., the balanids with calcitic and organic bases). Some taxa, as *Balanus* (*Actinobalanus*) MORONI, 1967, were omitted, whereas *Balanus* (*Solidobalanus*) HOEK, 1913, still remained a controversial subgenus. According to MCLAUGLIN (*fide* FOSTER 1978), it is a synonym of *Balanus* (*Hesperibalanus*), while according to NEWMAN & ROSS (1976) a synonym of *Balanus* (*Bathybalanus*).

The present Author has used in this paper the systematics proposed by NEWMAN & ROSS (1976) who had presented a profound revision of the balanid systematics. The revision consists, among others, in separating the solid-wall balanids from the genus *Balanus*, and creating a new family Archaebalanidae. This family includes *Actinobalanus* MORONI, 1967, and *Solidobalanus* HOEK, 1913, the both raised to the rank of the genus. Within the latter the two subgenera have been distinguished: *Solidobalanus* (*Solidobalanus*) and *Solidobalanus* (*Hesperibalanus*). The species described earlier as *Balanus mylensis* SEGUENZA has been included by NEWMAN & ROSS (1976) to the subgenus *Solidobalanus*.

SYSTEMATIC ACCOUNT

The studied material composed primarily of isolated plates comes from four locations of the Korytnica Clays (*see* Text-fig. 1). Most specimens were obtained from the oyster shellbed exposed at Mt. Lysa. A relatively rich material, including three complete crowns, comes from the locality Korytnica-Plebania. Single plates were found at localities Karsy and Korytnica-Las.

Of all the balanid plates (*see* Text-fig. 2*A*), the opercular valves (*see* Text-fig. 3) were studied in most detail because their morphology is critical for the species determination.

Additional terms used for the description of the opercular test plates are: the basi-scutal, and the basi-tergal angle, meaning respectively the angles between the basal and tergal margins of the scutum, and between the basal and scutal margins of the tergum.

The descriptions of the parietes in general only complement this study, because of their small differentiation between species. In the microscopic structure of these plates, two types of microscopic structure are generally distinguished (*see* Text-fig. 4), corresponding to the solid and porous structures of the wall. The diagnoses of species based on the microstructure, as first used by DAVADIE (1963), were difficult to be applied in this study because of the marked obliteration of the internal structure by fossilization processes.

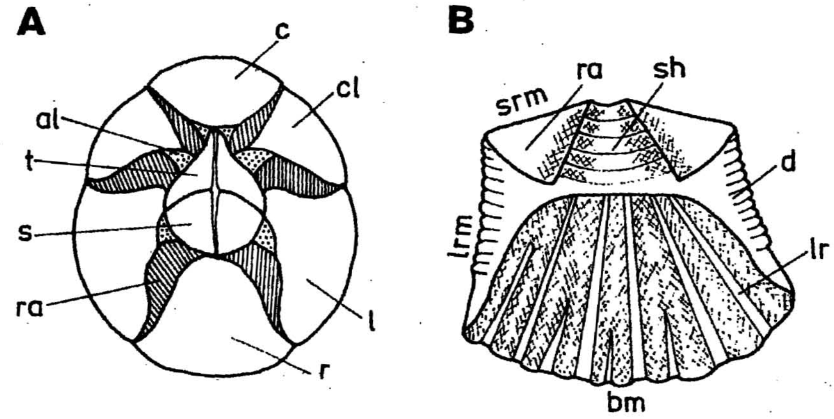


Fig. 2. Morphology of the parietes: **A** — position of plates in the crown, apical views; **B** — rostrum, inner views

c — carina, cl — carinolatus, l — latus, r — rostrum, s — scutum, t — tergum, al — ala, ra — radius, sh — sheath, d — denticles, lr — longitudinal rib, srm — superior radial margin, lrm — lateral radial margin, bm — basal margin

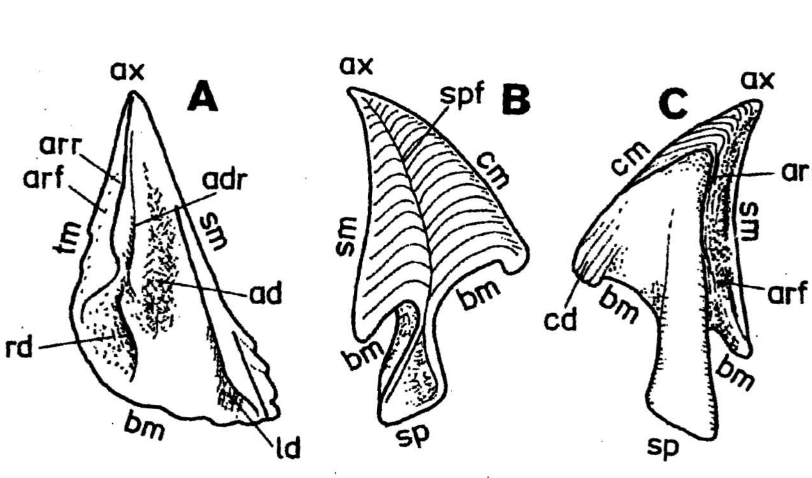


Fig. 3. Morphology of the opercular valves: **A** — scutum, inner view; **B** — tergum, outer view; **C** — tergum, inner view

ax — apex, tm — tergal margin, sm — scutal margin, bm — basal margin, cm — carinal margin, sp — spur, spf — spur furrow, arr — articular ridge, arf — articular furrow, adr — adductor ridge, ad — adductor muscle pit, ld — pit for lateral depressor muscle, rd — pit for rostral depressor muscle, cd — crest of depressor muscle

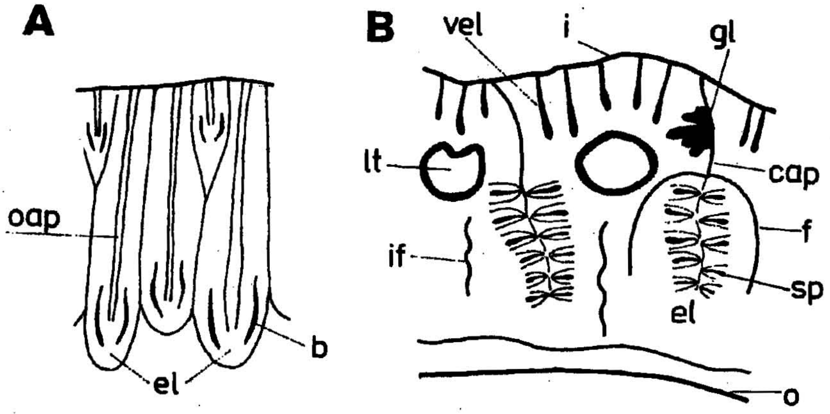


Fig. 4. Microscopic structure of the parietes: **A** — section trough the solid wall (*taken from* MORONI 1952), **B** — section trough the porous wall (*taken from* MENESINI 1965)

i — inner surface, o — outer surface, lt — longitudinal tube, el — epithecal lamella, vel — vestigital epithecal lamella, gl — glandular lamella, cap — close axial portion, oap — open axial portion, sp — secondary process, f — filet, b — band, if — inter laminate figure

The present Author used modern specimens from the Mediterranean for comparison when studying the species *Balanus* (*Megabalanus*) *tintinnabulum* LINNAEUS.

Order **Thoracica** DARWIN, 1854
Suprafamily **Balanomorpha** PILSBRY, 1916
Family **Archaebalanidae** NEWMAN & ROSS, 1976
Subfamily **Archaebalaninae** NEWMAN & ROSS, 1976

Genus *Solidobalanus* HOEK, 1913
Subgenus *Solidobalanus* HOEK, 1913

Solidobalanus (*Solidobalanus*) *mylensis* (SEGUENZA, 1873-76)
(Pl. 1, Figs 1-2, Pl. 2, Figs 1-2)

1873-1876. *Balanus mylensis* SEG; G. SEGUENZA, p. 87; Pl. 10, Figs 21-22.
1896. *Balanus mylensis* SEGUENZA; G. DE ALESSANDRI, p. 292; Pl. 1, Fig. 9a-d.
1965. *Balanus mylensis* SEGUENZA; E. MENESINI, pp. 117-120; Pl. 30, Figs 5-9; Pl. 35, Figs 3-8; Pl. 44, Figs 2-8; Pl. 45, Figs 1-2.
1966. *Balanus mylensis* SEGUENZA; E. MENESINI, p. 127; Pl. 26, Figs 8-9a; Pl. 31, Figs 5-7.
1976. *Balanus mylensis* SEGUENZA; S. DAWIDOWSKI, p. 496.

MATERIAL and OCCURRENCE: 350 scuta, 200 terga, several hundred parietes, and numerous fragments of bases from Mt. Lysa; 3 scuta, 1 tergum, 25 parietes from Korytnica-Plebania; 2 scuta, 2 terga, 11 parietes from Karsy; 2 scuta, 9 parietes from Korytnica-Las.

MEASUREMENTS: **Parietes** — mean height 14-15 mm, maximum height 18 mm; **scutum** — mean height 6-7 mm, maximum height 10 mm; mean width 5-6 mm, maximum width 8 mm; **tergum** — mean height 6-6.5 mm, maximum height 8 mm, mean width 4.5-5.5 mm, maximum width 7 mm.

DESCRIPTION: Parietes large, usually elongated, with irregular growth lines. Plate walls solid. Sheath of variable length (from 1/3 to 1/2 of the plate length), regularly coarsely striated. Inner surfaces of plates covered with variable numbers of long, straight or slightly wavy ribs of various width. Radii of variable width, predominantly narrow. Superior radial margin parallel or subparallel to the plate base. Lateral radial margins are coarsely toothed. The radial surfaces are covered with fine longitudinal and transverse lines.

The microscopic structure (Text-fig. 5) is very distinctive due to the lack of longitudinal tubes and the presence of epithecal lamellae with secondary processes. The epithecal lamellae are of various shapes: parallel-sided, trapezoidal, or club-shaped. They very in length, but do not form

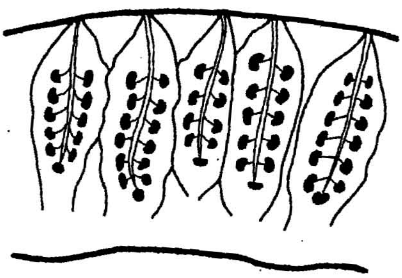


Fig. 5

Microscopic structure of *Solidobalanus* (*Solidobalanus*) *mylensis* (SEGUENZA); × 30

distinct generations. Axial portions are straight or slightly sinuous. In well shaped lamellae the axial portions are open. The secondary processes depart from the axial portion at various angles. The terminations of the secondary processes are crescent-shaped. The epithecal lamellae are surrounded by very distinct filets. The filets of adjacent lamellae coalesce or run parallel, close to one another.

Bases solid, thick. Deep pits occur at its margin. The upper surfaces of some plates are ornamented with fine radial striae.

Scuta with the tergal and scutal margins straight, the basal margin straight or convex-concave to a varying degree. The tergal margin usually of the same length as the basal margin, less commonly, somewhat shorter. Sharply pointed basi-tergal angle is usually slightly obtuse (100-105°). In extreme cases it is straight or more obtuse (*ca* 120°). The growth lines are flat, regular, not very wide.

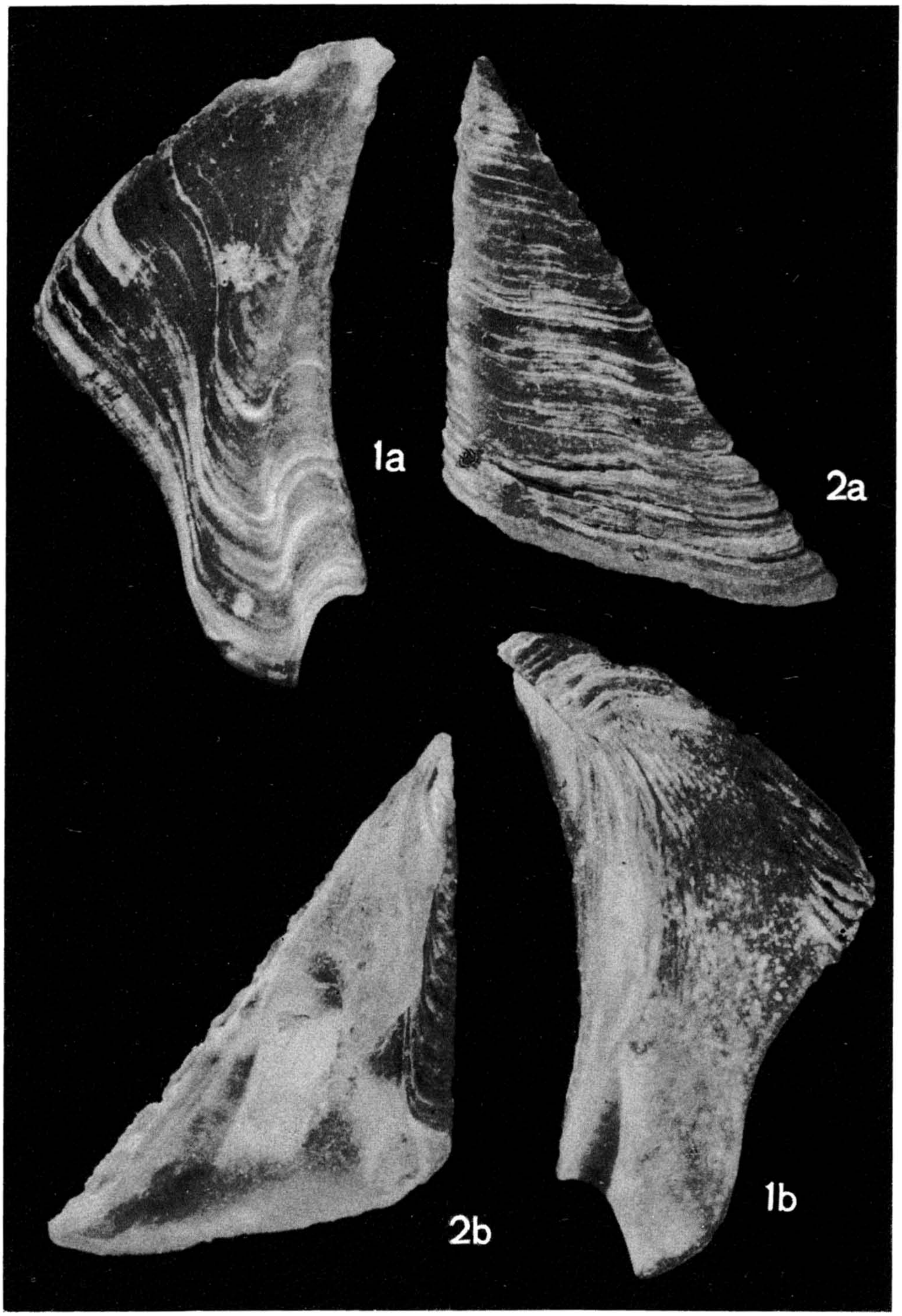
The development of the elements on inner surfaces of the scutum is very variable between the plates, correlative with their thickness. The common features of all scuta include: a high, long articular ridge (*ca* 2/3 of the tergal margin), the lack of an adductor ridge, rounded and centrally situated adductor muscle pit, non-developed pit for rostral depressor muscle, triangular pit for lateral depressor muscle, apical area with elongated or rounded nodes, arranged in lines radially arranged around the apex, scutal margin strongly bent inwards.

Two extreme types of the scutum may be distinguished, with intermediate forms present.

Type *1* — Scuta thin, with narrow articular ridge, slightly flattened in the apical part, inclined towards the tergal margin, with a narrow and shallow articular furrow, and with shallow and indistinct muscle pits (*see* Pl. 1, Fig. 2).

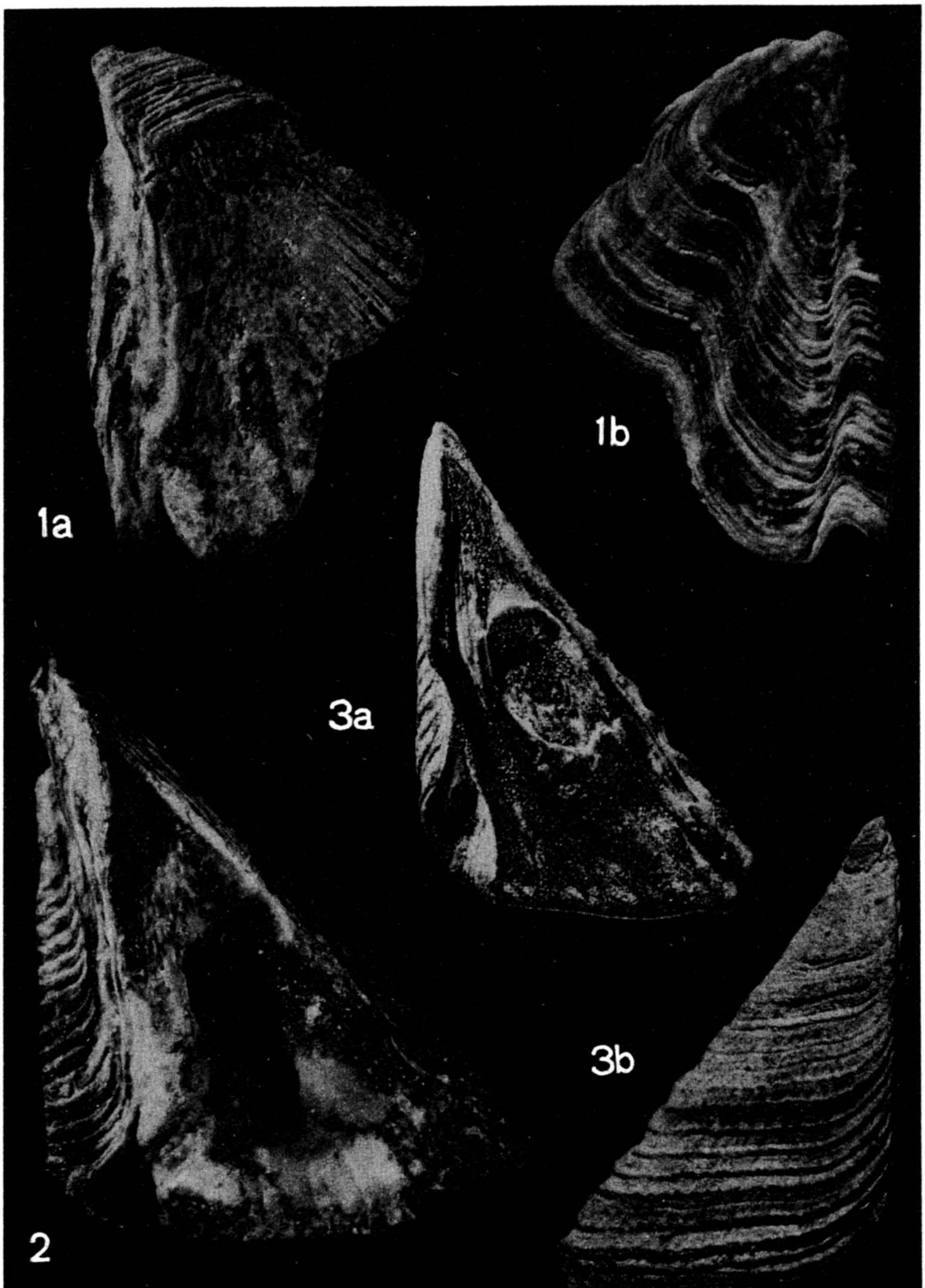
Type *2* — Scuta thick, with massive articular ridge, markedly widening in the apical part, nearly perpendicular to the plate surface, and having a wide and shallow articular furrow and very deep muscle pits (*see* Pl. 2, fig. 2).

Terga are also very variable, similarly as scuta. The characteristic common features include: ornamentation on the outer surface identical as on the scutum, wider and poorly individualized spur furrow, short spur, shifted towards the basi-scutal angle, long and moderately high articular



Solidobalanus (*Solidobalanus*) *mylensis* (SEGUENZA)

1 — tergum (*1a* outer, *1b* inner view), **2** — scutum (*2a* outer, *2b* inner view); × 30



1-2 — *Solidobalanus* (*Solidobalanus*) *mylensis* (SEGUENZA): 1 — tergum (*1a* inner, *1b* outer view), 2 — scutum (inner view); × 30

3 — *Balanus* (*Balanus*) *concavus* BRONN: scutum (*3a* inner, *3b* outer view); × 30

ridge, and long and shallow articular furrow. Similarly to scutum, two types can be distinguished, taking into account other structural elements:

Type *1* — Terga thin, crescentic, with scutal margin concave, carinal margin convex, the basal margin slightly concave-convex; fairly long and narrow spur (*ca.* 1/3 plate width), with arcuate articular ridge and rather not very wide articular furrow (*see* Pl. 1, Fig. 1).

Type *2* — Terga thick, triangular, with straight or slightly convex scutal margin and convex basal and carinal margins; with very short and wide spur (nearly 2/3 plate width), with straight or slightly arcuate articular ridge and wide articular furrow (*see* Pl. 2, Fig. 1).

REMARKS: The occurrence of the species *Solidobalanus* (*Solidobalanus*) *mylensis* (SEGUENZA) in the Korytnica Clays was recognized by DAWIDOWSKI (1976). In the oyster lumachelle at the Mt. Lysa this species is dominant in the balanid assemblage. Moreover, this species is known only from few Miocene and Pliocene localities in Italy. The plates from the Korytnica Basin differ however from the specimens described by SEGUENZA (1873-76) and DE ALESSANDRI (1896) in their complete lack of the adductor ridge on the scutum. The spur on the tergum is similar or narrower and shifted farther towards the basi-scutal angle.

The balanids from Italy have narrow radii, the basi-tergal angle ever obtuse, and their terga are close to triangular in shape (equivalent to type *2*). The collection from Korytnica includes additionally plates with fairly wide radii, scuta with straight basi-tergal angle, and crescentic terga (type *1*).

The microscopic structure of the plates from both localities is fully conformable. This structure deserves a special attention in this case. Besides the features characteristic of the solid-wall balanids (*i.e.*, the lack of longitudinal tubes, open axial portions) it has also an element typical of the genus *Balanus*, viz. the secondary processes.

Subgenus *Solidobalanus* (*Hesperibalanus*) PILSBRY, 1916

Solidobalanus (*Hesperibalanus*) sp. div.
(Pl. 3, Figs 1-3)

MATERIAL and OCCURRENCE: 2 scuta, 2 terga, 3 crowns, 2 parietes, 4 bases from Korytnica-Plebania; 1 scutum from Mt. Lysa.

MEASUREMENTS: Parietes — mean height 5 mm; basis — mean dimension 5 mm; scutum — height 3.3 mm, 2.1 mm, 1.8 mm; width 2.0 mm, 1.2 mm, 1.0 mm; tergum — height 3.0 mm, 2.0 mm; width — 2.0 mm, 1.3 mm.

DESCRIPTION: Crown conical. Orifice smooth, rhomboidal. Parietes solid, massive with irregular, longitudinal undulations (6-7 on a rostrum). Growth lines form additional swellings on the surface of the undulations. Microscopic, pointed papillae are visible on well preserved fragments of the plate surface. Sheath long, of *ca* 2/3 of the plate length, finely striate. Projecting septa with poorly developed secondary processes are visible in the basal parts of the plates. The septa pass gradually to straight or slightly sinuous ribs, extending to the sheath margin. Radii massive, narrow, slightly widened in the upper part, with the superior radial margin subparallel to the plate base. Lateral radial margin has coarse denticles. Fine transverse lines are present on the surface of the radii.

The microscopic structure (Text-fig. 6) is characteristic of the plates with solid wall. Axial portions are open without secondary processes. The axial portions are straight with arcuate terminations. Bands are lacking.

Base irregularly concave, probably due to the balanid attachment to skeletons of living corals. It is built of two thin layers; radially arranged septa of varying thickness and narrow tubes of rectangular transverse section occur between them.

Scuta have straight scutal and tergal margins. The basal margin is convex, slightly concave near the scutal margin. The basi-tergal angle is nearly straight with a rounded apex. Growth lines flat, of variable width (mostly wide), form rounded denticles on the scutal margin. The apex is bent outwards. Articular ridge is high, slightly longer than a half of the tergal margin, strongly inclined towards this margin. It widens in the apical part. Articular furrow wide and moderately deep.

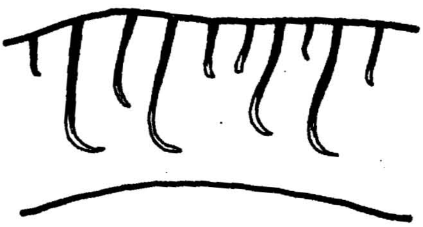


Fig. 6
Microscopic structure of *Solidobalanus* (*Hesperibalanus*) sp. div.; × 30

Adductor ridge short, low, subparallel to the articular ridge. Adductor muscle pit large and deep, depressor muscle pit not visible. Apical surface of the plate rough.

Terga have straight carinal and scutal margins, while the basal is concave-convex, oblique to the spur. Spur furrow nearly indistinguishable. Spur short, narrow, shifted towards the basi-scutal angle. Articular margin high, long, strongly convex towards the scutal margin in the apical part, and the middle part bent in the opposite direction. Articular furrow wide and rather deep. Depressor muscle crest in form of short and narrow ribs. Apical zone wide, covered with coarse ribs.

REMARKS: The distinctive features of the structure of the described parietes which indicate its attribution to the subgenus *Hesperibalanus* PILSBRY, 1916, are the denticles on lateral radial margins, solid walls (*see* NEWMAN & *al.* 1969), and incipient secondary processes in the lower parts of septa (*see* PILSBRY 1951). The structure of the studied opercular valves also conforms the diagnosis of this subgenus.

Especially typical is the position of the adductor ridge between the articular ridge and adductor muscle pit. The specimens from the Korytnica Basin have porous base. In the type species of this subgenus — *Balanus hesperius* PILSBRY, 1916 — the base is solid, typical of the whole group, according to PILSBRY (1916). In the later diagnoses of this subgenus (NEWMAN & *al.* 1969, NEWMAN & ROSS 1976) the details of the base structure were not taken into account. Porous base is characteristic of the genus *Actinobalanus* MORONI, 1967, a group of balanids also belonging to the family Archaebalanidae NEWMAN & ROSS, but the parietes of this genus differ from those of the subgenus *Solidobalanus* (*Hesperibalanus*) PILSBRY in having smooth lateral radial margins.

The microscopic structure of the studied plates is close to that of the species *Balanus* (*Hesperibalanus*) *parahesperibalanus* MENESINI, 1971 (*see* MENESINI 1971, Pl. 4, Figs 1-8), described from the Eocene of Italy, whose axial portions are also straight, with arcuate terminations.

This species differs from the specimens from the Korytnica Basin in having toothed orifice, shorter sheath, and narrower radii, as well as poorer developed adductor ridge on the scutum and a longer spur on the tergum.

The described opercular valves are approximate to the modern species *Balanus hesperibalanus* PILSBRY, 1916 (*see* PILSBRY 1916, p. 193, Pl. 49, Figs 1a-c, 7a-b), from the coasts of North America. The differences in the structure of tergum are unnoticeable, while scuta differ in the lack of the characteristic ornamentation in the apical part of the plate, consisting of irregular processes projecting above the upper margin of the adductor muscle pit. These scuta are very similar to the plates of *Balanus* (?*Hesperibalanus*) *cornwalli* ZULLO, 1966 (*see* ZULLO 1966, pp. 200-203, Fig. 2), from the late Eocene Cowlitz Formation of southern Washington, especially in the cross section of the articular ridge and adductor ridge. The terga of the last mentioned species are distinctly different, as they have arcuate articular ridge and the spur situated far away of the basi-scutal angle.

The described plates osculate with different species of the subgenus *Solidobalanus* (*Hesperibalanus*) but it is not unlikely that these plates represent a new species.

Genus *Actinobalanus* MORONI, 1967

Actinobalanus actinomorphus (MORONI, 1952)
(Pl. 3, Fig. 4)

1952. *Balanus (Hesperibalanus?) actinomorphus* n. sp.; M.A. MORONI, p. 73; Pl. 1, Figs 1, 5, 7, 8; Pl. 2, Figs 4-7.
1967. *Balanus (Actinobalanus* subgen. n.) *actinomorphus* MORONI; M.A. MORONI, pp. 923-928; Text-fig. 3; Pl. 70, Figs 1-2a.

MATERIAL and OCCURRENCE: 80 parietes, several fragments of bases from Korytnica-Plebania; 3 parietes from Karsy; 2 parietes from Mt. Lysa.

MEASUREMENTS: Parietes — mean height 4.5 mm; maximum height 7 mm.

DESCRIPTION: Parietes small, wide, less commonly slightly elongated. The outer surface with longitudinal undulations (3-5) which occur over the whole plate or only near its base. Growth lines narrow, poorly visible. Sheath long (*ca* 1/2 of the plate height), indistinctly finely striated.

Lower margin of sheath forms a projection extending along the lateral margins of the plate, and additionally reinforces the crown sutures. Long, well marked ribs occur on the inner surface of the plate. Radii narrow with superior radial margin oblique to the basal margin. Lateral radial margins smooth. The contact of the superior and lateral radial margins rounded. The surface of the radii covered with fine transverse lines.

Microscopic structure (Text-fig. 7) is characteristic of the plates with solid wall, *i.e.* the longitudional tubes are lacking, the epithecal lamellae have no secondary processes. The open axial portions of the epithecal lamellae are straight or slightly undulating. Two separate generations of

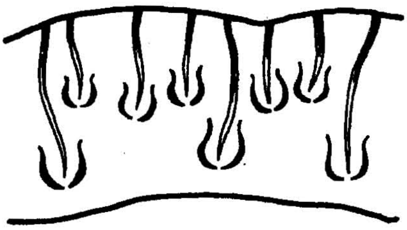
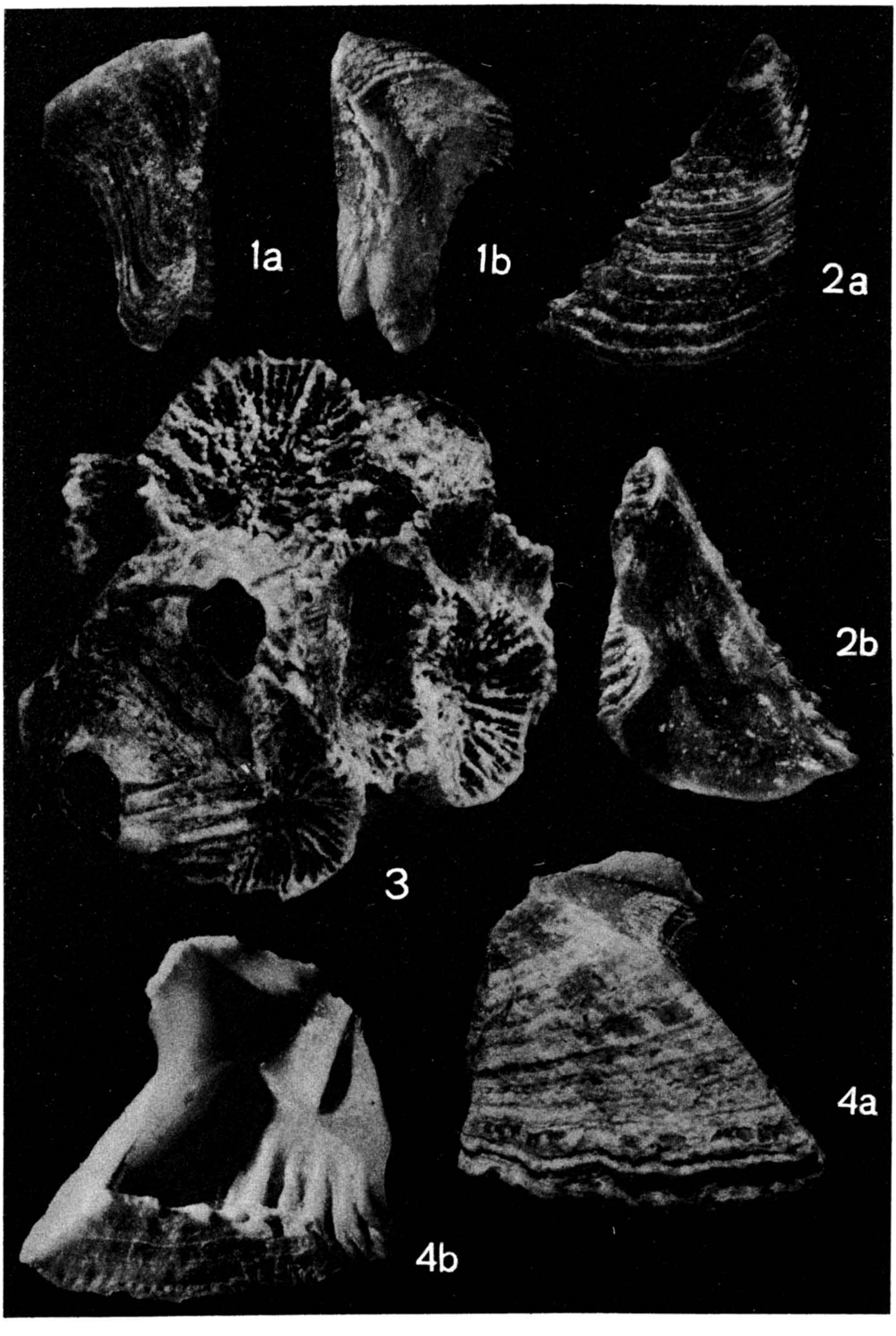


Fig. 7
Microscopic structure of *Actinobalanus actinomorphus* (MORONI); × 30

the epithecal lamellae are present — one to three shorter lamellae occur between the longer ones. The terminations of the lamellae closer to the outer surface of the plate are straight, parallel to the axial portion or turned outwards, while the terminations near the inner surface are turned towards the axial portion.

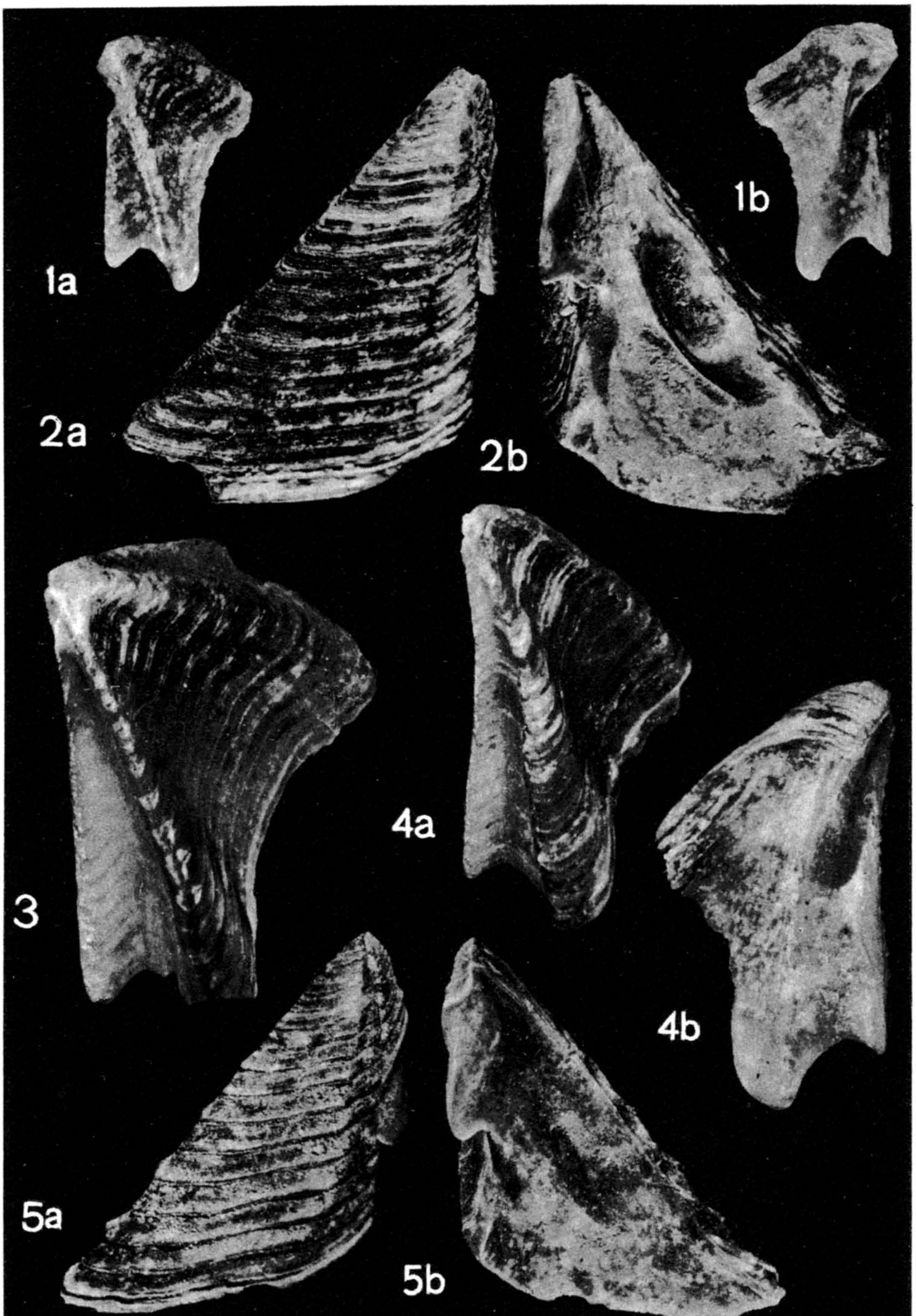
Base thick, porous, with thin, radially arranged septae separated by wide tubes, rectangular in cross section.

REMARKS: The species *Actinobalanus actinomorphus* (MORONI) was described from the Pliocene strata of Italy. The specimens from Korytnica Basin do not differ from the holotype, neither in the structure of the parietes nor in that of the base.



1-3 — *Solidobalanus* (*Hesperibalanus*) sp. div.: 1 — tergum (*1a* outer, *1b* inner view), × 15; 2 — scutum (*2a* outer, *2b* inner view), × 15; 3 — three crowns and two bases attached to coral colonies, × 30

4 — *Actinobalanus actinomorphus* (Moroni): carinolatus (*4a* outer, *4b* inner view), × 15



1-3 — *Balanus* (*Balanus*) *amphitrite stutsburi* DARWIN: 1 — tergum (*1a* outer, *1b* inner view), 2 — scutum (*2a* outer, *2b* inner view), 3 — tergum (outer view); × 30

4-5 — *Balanus* (*Balanus*) *amphitrite amphitrite* DARWIN: 4 — tergum (*4a* outer, *4b* inner view), 5 — scutum (*5a* outer, *5b* inner view); × 10

Balanus (Balanus) amphitrite DARWIN, 1854
Balanus (Balanus) amphitrite amphitrite DARWIN, 1854
(Pl. 4, Figs 4-5)

1854a. *Balanus amphitrite* var. *communis*; C. DARWIN, p. 240; Pl. 5, Fig. 2h, 21.
1873-76. *Balanus amphitrite* DARWIN; G. SEGUENZA, p. 82; Pl. 1, Fig. 6; Pl. 2, Fig. 2.
1895. *Balanus amphitrite* DARWIN; G. DE ALESSANDRI, pp. 286-287.
1931. *Balanus amphitrite* DARWIN; F. BIEDA, pp. 209-212; Pl. 3, Figs 1-8.
1963. *Balanus (Balanus) amphitrite amphitrite* DARWIN; C. DAVADIE, pp. 44-45; Pl. 21, Figs 1-2.
1965. *Balanus amphitrite* DARWIN; E. MENESINI, pp. 102-103; Pl. 9, Figs 1-4.
1976. *Balanus amphitrite* DARWIN; S. DAWIDOWSKI, p. 495.
1978. *Balanus (Balanus) amphitrite amphitrite* DARWIN; B.A. FOSTER, p. 109; Fig. 65b-c.

MATERIAL and OCCURRENCE: 24 scuta, 10 terga from Mt. Lysa; 6 scuta, 5 terga from Korytnica-Plebania.

MEASUREMENTS: **Scutum** — mean height 4-5 mm, maximum height 8 mm; mean width 4-5 mm, maximum width 7.5 mm; **tergum** — mean height 3-4 mm, maximum height 7 mm; mean width 2-3 mm, maximum width 5 mm.

DESCRIPTION: Scuta with outer surface flat or slightly concave, with wide growth bands which do not form denticles at the scutal margin. Plate margins straight. Basal margin slightly convex-concave on some plates. This margin is longer than the tergal margin. The basi-tergal angle varies from straight to slightly obtuse, with somewhat rounded apex. The articular ridge high, long (*ca* 2/3 of the length of the tergal margin). It is strongly inclined towards the tergal margin. This margin is markedly widened in the apical part. The lower termination of the ridge has a form of a hook-like process. The articular furrow is deep and moderately wide. The adductor ridge is short and thick. It is situated in the centre of the plate or is shifted towards the basal margin. The adductor muscle pit is oval; small on massive plates, and larger, shallower, with diffuse outline on thin specimens. The pit for the lateral depressor muscle is small of variable depth. Furrow-like pit for the rostral depressor muscle is fairly well developed. The apical part of the plate is rough.

Terga are relatively narrow, with the scutal margin straight or slightly concave, oblique to the spur. The spur furrow is wide, very shallow. Spur moderately wide, rather short. The termination of the spur gently narrowing and rounded. Articular ridge long, arcuate. Termination of the articulate ridge situated at the base of the spur, in its middle part. The articular furrow is deep, gradually widening along the whole scutal margin. The crest of the depressor muscle in form of a few long, narrow ribs. The apical zone wide, ornamented with thick, transverse ribs. Inner surface rough.

REMARKS: Opercular valves of *Balanus (Balanus) amphitrite amphitrite* DARWIN from the Korytnica Basin are identical with the specimens of this subspecies from Volhynia (*see* BIEDA 1931). The shape and relief of the described plates closely resemble respective skeletal elements of modern balanids described by DARWIN (1854a) as var. *communis*, and of the Pliocene forms from Italy, studied by MENESINI (1965).

The population studied by the present Author displays greater intraspecific variability as compared to those described by MENESINI (1965). Unlike the other comparable specimens of this subspecies, both modern (FOSTER 1978) and fossil (SEGUENZA 1873-76, DE ALESSANDRI 1896, DAVADIE 1963) the terga from the Korytnica Clays are wider, whereas the scuta do not show any significant differences.

The plates of this subspecies from the Korytnica Basin were described by DAWIDOWSKI (1976) as *Balanus amphitrite* DARWIN, without attribution to this subspecies. The species *Balanus (Balanus) amphitrite* DARWIN is cosmopolitan in the Miocene of Europe (KOLOSVÁRY 1962b, DAVADIE 1963).

Balanus (Balanus) amphitrite stutsburi Darwin, 1854 (Pl. 4, Figs 1-3)

1854a. *Balanus amphitrite* var. *stutsburi*; C. Darwin, p. 240; Pl. 5 Fig. 2i, 2m, 2n, 2o.
1952. *Balanus amphitrite stutsburi* Darwin; M.A. Moroni, pp. 72-73; Pl. 2, Fig. 8.
1963. *Balanus (Balanus) amphitrite stutsburi* Darwin; C. Davadie, p. 44.
1965. *Balanus pallidus stutsburi* Darwin; E. Menesini, pp. 104-106; Pl. 9, Figs 5-8.

MATERIAL and OCCURRENCE: 17 scuta, 5 terga from Mt. Lysa; 9 scuta, 2 terga from Korytnica-Plebania.

MEASUREMENTS: Scutum — mean height 4-5 mm, maximum height 6.5 mm; mean width 3-4 mm, maximum width 5 mm; tergum — mean height 2.5-3 mm, maximum height 7 mm; mean width 2.5 mm, maximum width 6.5 mm.

DESCRIPTION: Scuta with outer surface flat or slightly concave with distinct, rather wide growth bands. Scutal margin smooth, straight or slightly concave. The tergal margin straight, and the basal — straight or slightly concave-convex. Basal and tergal margins of nearly same length. The basi-tergal angle obtuse with a slightly rounded apex. Articular ridge high, half length of the tergal margin or somewhat longer, nearly perpendicular to the plate surface or slightly inclined towards the tergal margin. In the apical part it widens, and its margin is flattened. The termination of the ridge is sharply truncated more or less perpendicular to the plate surface.

The adductor ridge long, narrow, parallel to the scutal margin. The pit for the adductor muscle oval, variable in size. In extreme cases it is so large that it reaches to the scutal margin. The pit for the rostral depressor in form of a shallow furrow. The pit for the lateral depressor triangular, rather large, but moderately deep. The plate surface rough.

Terga wide, with scutal margin straight, and carinal rounded, with a wing-like convexity in the apical part. The basal margin is slightly concave-convex on one side of the spur, and concave on the other, near the scutal margin. The spur furrow is narrow and shallow. Spur narrow, fairly long, narrowing at the end, and shifted towards the basi-scutal angle. Articular ridge long, arcuate at the beginning, straight in the terminal part. Articular furrow deep, narrow in the apical part and very wide in the remaining part. The furrow extends along the whole scutal margin. The apical zone is small, with fine ribs. The plate surface covered with small tubercules in the apical part.

REMARKS: The discussed opercular valves, similarly as the plates of the preceding species *Balanus (Balanus) amphitrite amphitrite* Darwin, are closest to the specimens illustrated by Darwin (1854a), which display very differentiated forms of terga. Hence, while the scuta from the Korytnica Basin do not differ markedly from the other described scuta of *Balanus (Balanus) amphitrite stutsburi* Darwin, the terga are wider and have stronger bent carinal margin (*see* synonymy) as compared to the specimens from the Neogene of south-western Europe. This difference is especially marked in reference to the plates described by Moroni (1952).

Menesini (1965) questioned the attribution of the subspecies *Balanus (Balanus) amphitrite stutsburi* Darwin to the species *Balanus (Balanus) amphitrite* Darwin, and she described it as *Balanus pallidus stutsburi* Darwin. This taxon was considered by Newman & Ross (1976) as a synonym of *Balanus pallidus* Darwin. In the present Author's opinion, Menesini (1965) presented too narrow descriptions of the two species, thus erroneously stressing their distinction. According to Menesini (1965) the basi-tergal angle at scutum of *Balanus amphitrite* Darwin is exclusively straight, and in *Balanus pallidus stutsburi* Darwin strongly obtuse, and the muscle pits at *Balanus amphitrite* Darwin are always smaller and shallower than at *Balanus pallidus stutsburi* Darwin. The collection from the Korytnica Basin includes plates, of both subspecies, having the basi-tergal angles slightly obtuse. In the present Author's opinion a similar situation occurred in the population from Italy; described by MENESINI (1965). Most of the investigated plates of the subspecies *Balanus* (*Balanus*) *amphitrite amphitrite* DARWIN have in fact smaller and shallower muscle pits. However, on some plates these elements attain the same size and depth as on some scuta of *Balanus* (*Balanus*) *amphitrite stutsburi* DARWIN. The microscopic structure of parietes of both forms, presented by MENESINI (1965) also does not confirm their discrepancy.

The subspecies *Balanus* (*Balanus*) *amphitrite stutsburi* DARWIN is known from the Miocene of Italy, and from France, where it is especially numerous in the Tortonian strata (DAVADIE 1963). It has not hitherto to been reported from the Korytnica Basin.

Balanus (*Balanus*) *amphitrite* ssp. div.

MATERIAL and OCCURRENCE: 25 parietes, fragments of bases from Korytnica-Plebania; 6 parietes from Mt. Lysa; 3 parietes from Karsy.

MEASUREMENTS: Parietes mean height 5 mm, maximum height 12 mm.

DESCRIPTION: Parietes wide with smooth outer surface, with poorly discernible growth lines. Plate walls porous, with rounded tubes and thick septae. Sheath short, with regular fine lines. Ribs on the inner surface straight and thick. Radii narrow, widening in the upper part. Lateral radial margins oblique to the plate base. Small denticles occur on the lateral radial margin.

Microscopic structure (Text-fig. 8) is featured by longitudinal tubes fairly large, of varying cross-section rectangular, oval or nearly rounded. Epithecal lamellae trapezoid with closed axial portions, straight or slightly undulating. There are 5, less commonly 7, secondary processes in one lamella. Other details are not discernible.

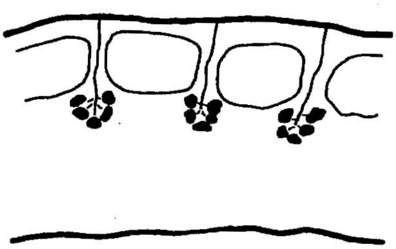


Fig. 8
Microscopic structure of *Balanus* (*Balanus*) *amphitrite* DARWIN; × 30

Bases thin, porous, with two transverse septae. Tube-like canals between the septae have small diameter.

REMARKS: The poorly discernible microscopic structure of the studied plates was useful in determining their attribution to the species *Balanus* (*Balanus*) *amphitrite* DARWIN; it could not serve, however, as a criterium to distinguish the subspecies.

Opercular valves of two kinds were identified in the studied material, so the parietes belong probably to at least these two groups *i.e.* to *Balanus* (*Balanus*) *amphitrite amphitrite* DARWIN (*see* DARWIN 1854a, p. 240, Pl. 5, Fig. 2e; BIEDA 1931, pp. 209-212, Pl. 3, Figs 22-24; DAVADIE 1963, pp. 44-45, Pl. 19, Figs 3-5; MENESINI 1965, pp. 102-103, Pl. 2, Figs 11-13, Pl. 15, Figs 1-3; FOSTER 1978, p. 109, Fig. 65a, Pl. 14a) and to *Balanus* (*Balanus*) *amphitrite stutsburi* DARWIN (*see* DARWIN 1854a, p. 240, Pl. 5, Fig. 2d; MORONI 1952, pp. 72-73; DAVADIE 1963, p. 44; MENESINI 1965, pp. 104-106, Pl. 2, Figs 14-16, Pl. 15, Figs 4-8).

Balanus (Balanus) trigonus DARWIN, 1854
(Pl. 5, Figs 1-4)

1854a. *Balanus trigonus*; C. DARWIN, pp. 223-224; Pl. 3, Fig. 7b-f.
1916. *Balanus trigonus* DARWIN; H.A. PILSBRY, pp. 111-114; Pl. 26, Figs 11, 12a, 13a.
1963. *Balanus (Balanus) trigonus* DARWIN; C. DAVADIE, pp. 58-59; Pl. 33, Figs 1a-2b.
1978. *Balanus (Balanus) trigonus* DARWIN; B.A. FOSTER, pp. 113-114; Fig. 68b-c.

MATERIAL and OCCURRENCE: 40 scuta, 3 terga from Mt. Lysa.

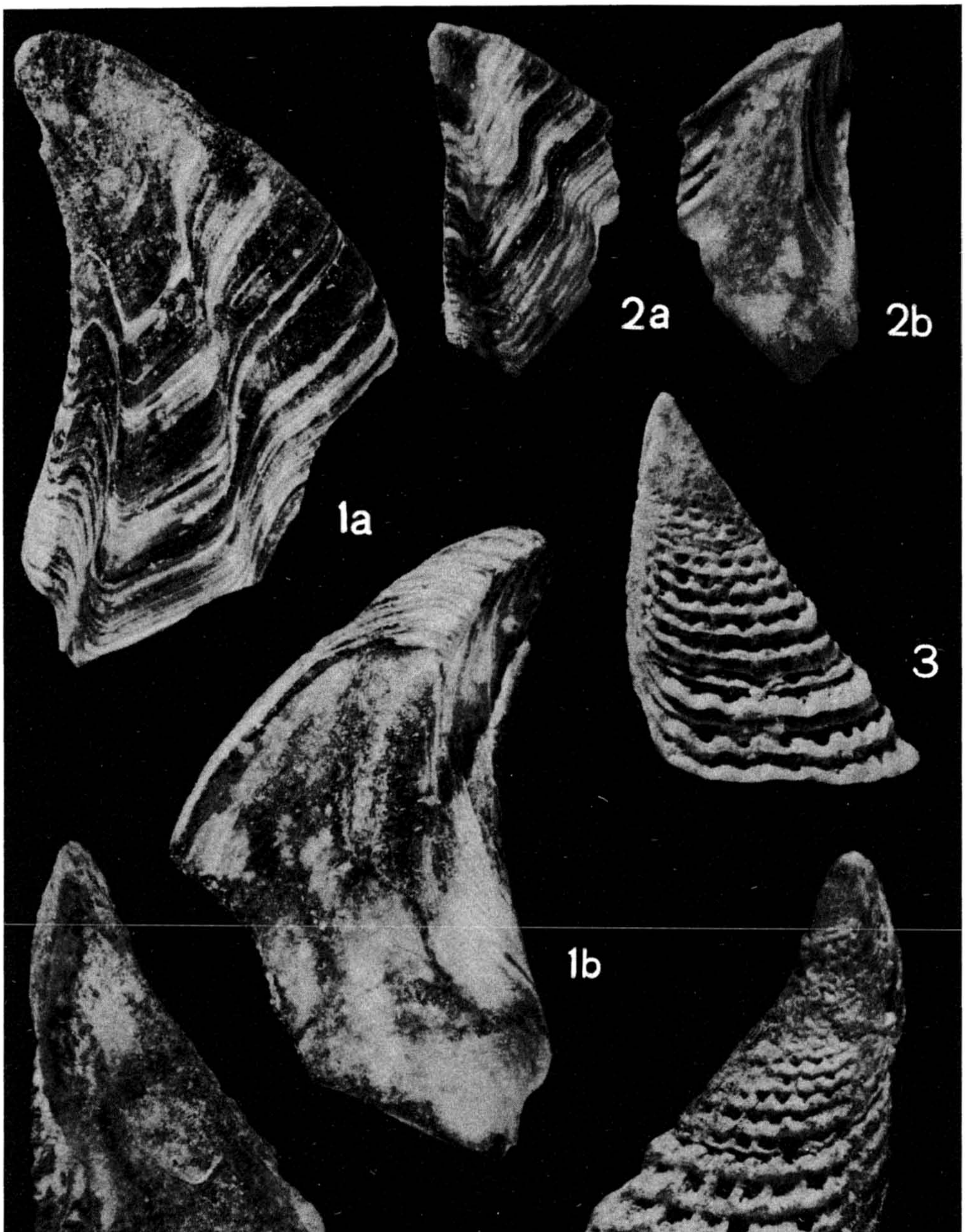
MEASUREMENTS: **Scutum** — mean height 4.5-5 mm, maximum height 7 mm; mean width 4-4.5 mm, maximum width 5 mm **tergum** — height 9 mm, 5 mm; width 6 mm, 3.5 mm.

DESCRIPTION: Scuta massive, with apex bent outwards. Tergal margin straight, scutal margin straight or slightly concave, basal margin straight or convex. The basi-tergal angle is almost straight with rounded apex. The projecting, ribbed growth bands are cut by ribs arranged radially with respect to the apex, and having 6, sporadically 7 rows of pits between them. These structures are absent on the tergal margin which is bent inwards. The articular ridge is moderately high, short, inclined towards the tergal margin, with its margin bent in the opposite direction. The ridge terminates with a small projection or is rounded. Articular furrow is shallow and moderately wide. Adductor ridge is short, arcuate, of various height on various plates. It surrounds the large, usually deep pit for the adductor muscle. Drop-shaped pit for the lateral depressor muscle is large and deep. The rostral depressor pit has a shape of irregular, elongated depression whose one end gets to the basi-scutal angle, and the second turns towards the middle part of the plate. The plate surface is rough.

Tergum with scutal margin concave, carinal convex, and basal nearly straight, oblique to the spur. Growth bands of variable width. Spur short, very wide (about half the plate width), shifted towards the basi-scutal angle. The end of the spur truncated. Articular ridge low, arcuate. Spur furrow very wide and shallow. The crest of the depressor muscle in form of a few (2-3) thick ribs. Apical zone with fine transverse ribs.

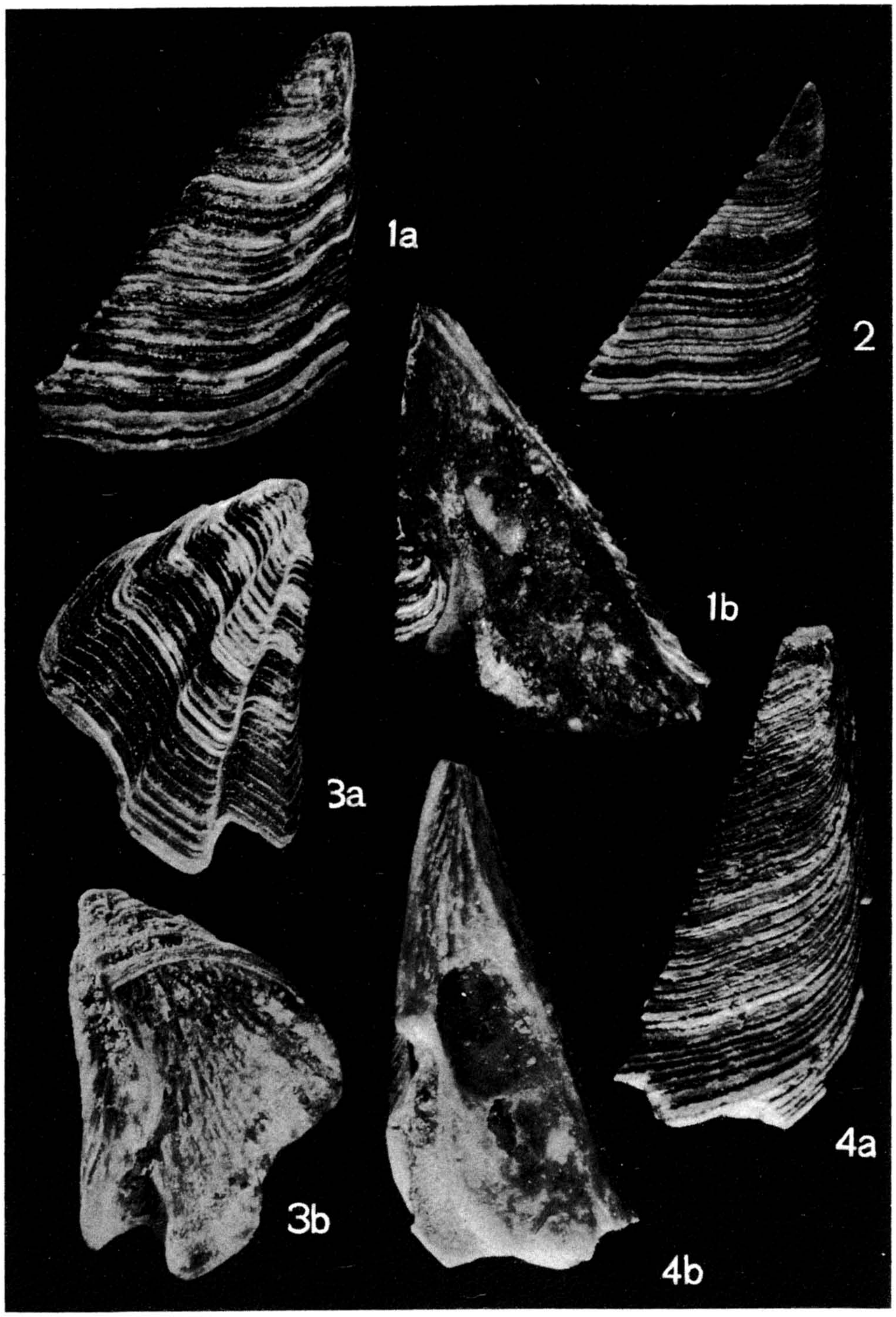
REMARKS: The specimens from the Korytnica Basin correspond to the described plates of this species, with respect to the structure of tergum and of the inner surface of the scutum, but greatest differences occur in the structure of the articular ridge. In most of the studied plates the termination of this ridge is identical as in the specimens studied by DARWIN (1854a) and PILSBRY (1916); some plates have ridges with gently rounded terminations, the most similar to the shape of this element on plates illustrated by DAVADIE (1963). The similarity to the last mentioned plates includes also the bending of the edge of the articular ridge towards the scutal margin. The ridge on the plates from the Korytnica Basin is higher. The scuta from the Korytnica Clays differ from the plates from other localities in having ribbed growth bands, which results in partial obliterating of the pit rows, and in the presence of an additional, seventh row of pits on some plates. Tergum in *Balanus (Balanus) trigonus* DARWIN is greater than scutum (*see* DARWIN 1854a, PILSBRY 1916), and this feature is also seen in the studied material.

The occurrence of *Balanus (Balanus) trigonus* DARWIN in Miocene sediments is known from the Tortonian of Hungary (*vide* DAVADIE 1963). The species has not hitherto been reported from the Korytnica Basin.



Balanus (*Balanus*) *trigonus* DARWIN

1 — tergum (*1a* outer, *1b* inner view), **2** — tergum (*2a* outer, *2b* inner view), **3** — scutum (outer view), **4** — scutum (*4a* outer, *4b* inner view); all × 10



1-2 — *Balanus* (*Megabalanus*) *tintinnabulum* LINNAEUS: 1 — scutum (*1a* outer, *1b* inner view), 2 — scutum (outer view); × 10

3 — *Balanus* sp.: tergum (*3a* outer, *3b* inner view); × 10

4 — *Balanus* (*Megabalanus*) *tulipiformis* ELLIS: scutum (*4a* outer, *4b* inner view); × 10

Subgenus *Balanus* (*Megabalanus*) HOEK, 1913

Balanus (*Megabalanus*) *tintinnabulum* LINNAEUS, 1767
(Pl. 6, Figs 1-2)

1854a. *Balanus tintinnabulum*; C. DARWIN, p. 194; Pl. 2, Fig. 1a, c, d.
1854b. *Balanus tintinnabulum*; C. DARWIN, p. 13; Pl. 1, Fig. 1c.
1873-76. *Balanus tintinnabulum* LINN; G. SEGUENZA, p. 438; Pl. 9, Fig. 1.
1896. *Balanus tintinnabulum* (LINNEO); G. DE ALESSANDRI, p. 270; Pl. 2, Fig. 4.
1916. *Balanus tintinnabulum* (LINNAEUS); H.A. PILSBRY, pp. 54-55.
1931. *Balanus tintinnabulum* L.; F. BIEDA, p. 207; Pl. 3, Figs 9-14.

MATERIAL and OCCURRENCE: 40 scuta from Mt. Lysa, 4 scuta from Korytnica-Plebania.

MEASUREMENTS: Scuta mean height 2-3 mm, maximum height 4 mm; width mean 1.5-2.5 mm, maximum width 3.5 mm.

DESCRIPTION: Scuta small, very variable in shape. Tergal margin straight, scutal margin straight or concave-convex, and the basal margin straight, convex or concave-convex. Basi-tergal angle nearly straight, with the apex rounded to a varying degree. Outer surface of plates from concave to convex. Growth bands thin, forming small denticles on the scutal margin. Articular ridge moderately high, strongly inclined towards the tergal margin. Its length varies from 3/4 to 2/3 of the tergal margin length, proportionally shorter ridges occur on greater plates. Articular furrow deep and narrow. Adductor ridge very variable in form on various specimens. It may be short, distinct, fused with the articular ridge, or may be not discernible at all. The adductor muscle pit usually large and deep. The lateral depressor pit large on most specimens, passing into the depression between the articular ridge and the adductor ridge (if the latter is developed). The rostral depressor pit is in form of a shallow and narrow furrow, parallel to the scutal margin.

REMARKS: The specimens hitherto not reported from the Korytnica Basin correspond to the general descriptions of this species, and they are most alike to the specimens distinguished by DARWIN (1854a) as var. *communis*, and to a scutum from Kraków-Zwierzyniec (BIEDA 1931). The plates from the Korytnica Clays are smaller when compared to average size of scutum in this species (10 mm). They also have longer articular ridges. These differences may be explained by the fact that these scuta belong to juvenile individuals, as suggested by the articular ridge length decreasing proportionally to the plate size with the age of an individual (*see* FOSTER 1978). The lack of adult forms in the studied collection suggests that this species did find favorable conditions in the Korytnica Basin. The colonization of the basin by this species was probably limited by the lack of an adequate substrate. The present-day colonies of *Balanus* (*Megabalanus*) *tintinnabulum* LINNAEUS settle on permanently submerged rocks, in zones of low water energy. For this reason, this species is very unevenly distributed, even on a small area (FOSTER 1978).

The species *Balanus* (*Megabalanus*) *tintinnabulum* LINNAEUS occurs, besides Poland, in the Miocene of Italy (SEGUENZA 1873-76, DE ALESSANDRI 1896, MENESINI 1966), France (DAVADIE 1963), and Brasil (BRITO 1972).

Balanus (Megabalanus) tulipiformis Ellis, 1758
(Pl. 6, Fig. 4)

1873-76. *Balanus tulipiformis* Ellis; G. Seguenza, p. 283; Pl. 9, Fig. 3, 3a.
1896. *Balanus tulipiformis* Ellis; G. de Alessandri, p. 272; Pl. 2, Fig. 5b-c.
1963. *Balamis (Megabalanus) tulipiformis* Ellis; C. Davadie, p. 30; Pl. 7, Fig. 2.
1965. *Balanus tulipiformis* Ellis; E. Menesini, p. 92; Pl. 8, Figs 1-2.
1966. *Balanus tulipiformis* Ellis; E. Menesini, p. 107.

MATERIAL and OCCURRENCE: 1 scutum from Mt. Lysa, specimen damaged in apical part and near the basal margin.

MEASUREMENTS: Scutum height *ca* 7.5 mm, width *ca* 3.5 mm.

DESCRIPTION: Plate strongly elongated, with straight margins (shape of the basal margin was determined from the course of the growth lines). Basi-tergal angle obtuse with strongly rounded apex. Growth bands thin, regular. Scutal margin without denticles. Articular ridge long (probably *ca* 2/3 of the tergal margin length), moderately high, bent towards the tergal margin. Articular furrow narrow and shallow. Adductor ridge not developed. Adductor muscle pit ovate, large and fairly deep. The pit for the lateral depressor very large and deep, *L*-shaped, with the corner cutting into the base of the articular ridge. This pit is separated from the remaining part of the plate by an arcuate swelling, extending from the articular ridge to the basal margin. The pit for the rostral depressor can not be described because of the damage. The apical surface of the plate covered with radially arranged, thin elongated elevations.

REMARKS: The attribution of this plate to the species *Balanus (Megabalanus) tulipiformis* Ellis is indicated by an elongated shape of the scutum, narrow growth bands which do not form denticles on the scutal margin, and unusually large and deep pit for the lateral depressor muscle. The scutum from the Korytnica Clays differs from the Neogene specimens of this species from Italy (Seguenza 1873-76; de Alessandri 1896; Menesini 1965, 1966) in its more elongated adductor muscle pit, slightly higher articular ridge and more rounded apex of the basi-tergal angle.

The species *Balanus (Megabalanus) tulipiformis* Ellis has not hitherto been noted from the Korytnica Basin, and undoubtedly it was a rare form.

Balanus sp.
(Pl. 6, Fig. 3)

MATERIAL and OCCURRENCE: 1 tergum from Mt. Lysa.

MEASUREMENTS: Tergum height 6 mm, width 5 mm.

DESCRIPTION: Tergum large, massive, of slightly convex outer surface. Plate margins of approximately equal lengths. Scutal margin almost straight, carinal slightly convex, and basal straight, perpendicular to the spur, turning towards the plate apex near the carinal margin. Growth bands distinct, wide. Spur *ca* 1/4 of the plate width, short, wedge-like, truncated at the end, parallel to the basal margin.

Spur furrow wide, very shallow, but with clear outline. Articular ridge long, arcuate, reaches to the basi-scutal angle. Articular furrow wide, rather deep. Plate apex ornamented with coarse ribs, bending arcuately near the carinal margin, getting to 2/3 its length. Inner surface covered with long crests arranged radially with respect to the apex, and fused with the depressor crests.

REMARKS: The plate shows some similarity to the tergum of *Balanus* (*Balanus*) *amphitrite obscurus* DARWIN, 1954, described by DAVADIE (1963, p. 45, Pl. 22, Fig. 1). According to NEWMAN & ROSS (1976), this is a synonym of the subspecies *Balanus* (*Balanus*) *venustus obscurus* DARWIN, 1954. The specimen from the Korytnica Basin has a shorter spur and greater apical zone. Moreover, the tergum described above has the spur with truncated termination, while in the specimens of *Balanus* (*Balanus*) *amphitrite obscurus* DARWIN the spur tip is rounded.

REMARKS ON BALANID ECOLOGY AND BIOGEOGRAPHY

The described balanid species from the Korytnica Basin support the hitherto existing data on the shallow water and normal salinity in this basin, as well as on its situation in the tropical and or subtropical zone. Modern barnacles of the genus *Balanus* are strongly related to the littoral zone of seas of normal salinity. Representatives of only a few species are sporadically encountered below the sublittoral zone (*see* FOSTER 1978). They are also rarely encountered in brackish environments, where only two species were found. On the other hand, such forms as *Balanus* (*Megabalanus*) *tintinnabulum* LINNAEUS, *Balanus* (*Balanus*) *amphitrite* DARWIN, *Balanus* (*Balanus*) *trigonus* DARWIN, prefer extremely shallow waters. These species are now cosmopolitan in all warm seas (DARWIN 1854a, PILSBRY 1916, FOSTER 1978), and *Balanus* (*Balanus*) *concavus* BRONN settles in the shores of California, Panama, Peru, Philippines and Australia (DARWIN 1854a, PILSBRY 1916, NEWMAN & ROSS 1976). The species *Balanus* (*Megabalanus*) *tulipiformis* ELLIS is confined to the Mediterranean basin (NEWMAN & ROSS 1976). The balanids from the families Archaebalanidae, i.e. *Solidobalanus* (*Solidobalanus*) *mylensis* (SEGUENZA) and *Actinobalanus actinomorphus* (MORONI), have hitherto been known only from the Neogene of Italy (SEGUENZA 1873-76; DE ALESSANDRI 1894, 1906; MORONI 1952, 1967; MENESINI 1965, 1966). The finding of these species in the Miocene of Poland proves an intense migration of balanids within the Neogene basins of Europe.

The uneven distribution of balanids in the Korytnica Clays is related, in the present Author's opinion, to the muddy bottom and rapid sedimentation. In such conditions balanids preferably attach to skeletons of living organisms, thus securing a stable position with respect to the sediment surface. In these conditions the crown debris is sporadically used (SCHÄFER 1972). This explains the occurrence of balanids at Mt. Lysa, where their bases occur on the right valves of oysters. The only complete crowns found, from the location Korytnica-Plebania, were preserved due to their partial overgrowing by coral colonies.

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PĄKLE Z BASENU KORYTNICY

(Streszczenie)

Przedmiotem pracy jest analiza zespołu pąkli występujących w iłach Basenu Korytnicy. Stwierdzono znacznie większą różnorodność gatunków niż było to dotąd znane (DAWIDOWSKI 1974, 1976).

Rodzaj *Solidobalanus* reprezentowany jest przez *Solidobalanus* (*Solidobalanus*) *mylensis* (SEGUENZA), znany jedynie z osadów miocenu i pliocenu Włoch, oraz *Solidobalanus* (*Hesperibalanus*) sp. div., takson znany z eocenu Włoch, jednakże typowy dla fauny północno-amerykańskiej zarówno współczesnej jak i kopalnej. Przedstawicielem rodzaju *Actinobalanus* jest gatunek *Actinobalanus actinomorphus* (MORONI), uważany uprzednio za endemit dla pliocenu Włoch.

Rodzaj *Balanus* reprezentowany jest przez 6 gatunków: *Balanus* (*Balanus*) *amphitrite* DARWIN, *Balanus* (*Balanus*) *concavus* BRONN, *Balanus* (*Megabalanus*) *tintinnabulum* LINNAEUS — gatunki kosmopolityczne w neogenie Europy, *Balanus* (*Balanus*) *trigonus* DARWIN, *Balanus* (*Megabalanus*) *tulipiformis* ELLIS — gatunki w stanie kopalnym związane z regionem Europy południowo-zachodniej, oraz *Balanus* sp. Powyższe gatunki współcześnie są formami typowo ciepłolubnymi, charakterystycznymi dla strefy litoralnej.
