A C T A P A L A E O N T O L O G I C A P O L O N I C A
Vol. 21 1976 No 1

HALINA PUGACZEWSKA

TRIGONIIDAE OF THE DOGGER OF ŁĘCZYCA (CENTRAL POLAND)

Abstract. — From the Dogger deposits of Łęczyca near Kutno there are described 12 pelecypod species representing 3 genera: *Trigonia* Bruguiere, *Myophorella* Bayle, and *Vaugonia* Crickmay. One new species, *Trigonia crebraecostata* sp.n., is described. The results of studies on morphology, variability, development of shell, as well as on shell structure and microornamentation are given.

INTRODUCTION

A rich assemblage of Dogger pelecypods was gathered in the course of field works in the area of Łęczyca near Kutno in 1972. The assemblage comprises several trigoniids being the subject of the present study.

The trigoniid fauna was mentioned in some stratigraphic reports concerning this area (Znosko, 1957, 1958). Moreover, some other fossil groups were covered by palaeontological studies (Pugaczewska, 1961, 1971). The material gathered was primarily derived from lower and upper Upper Vesulian, the *Parkinsonia ferruginea* and *P. compressa* Zones. It comprises over a thousand specimens primarily representing more or less complete valves, suitable for morphological analysis on account of the typical ornamentation. The valves of mature individuals markedly predominate over valves of the juvenile and senile.

The valves of the representatives of the genus *Trigonia*, mostly found in clay deposits, are best preserved. The valves of *Myophorella* and *Vaugonia*, primarily derived from clay-sandy shales with siderites and from cocquinas, are usually less complete and it is more difficult to free them from rock.

The systematics proposed by L. McCormick and R. C. Moore (1969) and T. Kobayashi (1954) is accepted here.

Warm thanks are due to Professor Zofia Kielan-Jaworowska for critical reading of the manuscript. The photos were taken by Miss M. Czarnocka and Miss E. Mulawa and the figures were drawn by Mrs. K. Budzyńska, all from the Palaeozoological Institute of the Polish Academy of Sciences, Warsaw.

The following abbreviations are used in the systematic part: H — height, L — length, R — number of ribs, H/L — height index.

The material studied is housed in the Palaeozoological Institute of the Polish Academy of Sciences, Warsaw (abbr. ZPAL).

DIAGNOSTICALLY IMPORTANT MORPHOLOGICAL CHARACTERS AND BIOLOGY OF THE TRIGONIIDAE

The rich and variable ornamentation and complex internal morphology of trigoniid shell are of remarkable importance for their systematics. The most important generic features include: outline and size of shell, ornamentation and anterior adductor muscle scar; whereas the specific features include: height and location of umbo, location of maximum convexity of shell, character of hinge and size of pedal elevator muscle scar.

The shells of the genus *Trigonia* are usually more or less triangular in shape, almost so high as long. Those of the genus *Myophorella* are characterized by markedly elongated siphonal part, markedly convex anterior margin, and dissymmetric triangular outline, and those of the genus *Vaugonia* — ovate (and thus somewhat longer than high) or rounded.

The range of shell size, constant for a given genus, sometimes comprises 6 size intervals: juvenile individuals attaining less than 10 mm in size, very small — from 10 to 20 mm, small — 20 to 30 mm, medium-size — 30 to 50 mm, large — 50 to 100 mm, and giant individuals — over 100 mm in size (Savelev, 1958, *in*: Deschet, 1966). The material gathered comprises individuals ranging from very small to large in size.

The shells of *Trigonia* are characterized by concentric ribbing on flanks and radial, tuberculate striae on the area. Ornamentation consisting of concentric rows of tubercles is typical of the genus *Myophorella*, and V-shaped arrangement of the rows of tubercles — of the genus *Vaugonia*. The area is ornamented with horizontal ridges in *Myophorella* and *Vaugonia*. The height and spacing of ribs, number of radial striae on the area and number and outline of tubercles are of specific rank.

The muscle scar surface is smooth, flat to weakly concave in the trigoniids. The genus *Vaugonia* is the exception here as its representatives display anterior adductor muscle scar deep, elongated, with uneven, steplike depressed surface (pl. XX, figs 4—5) and usually translocated on anterior surface of hinge processus.

The size and outline of pedal elevator muscle scar are of specific importance. On the left valve of *Trigonia triangulare* (Goldfuss) and *T. costata* Sowerby the scar is observable on posterior side of the 2nd tooth. It is either fairly long, deeply incised, with a narrower end extending far into subumbonal area or markedly shorter, shallower, with the outline close to a triangle with a broad base (pl. XX, figs 2—3). Some authors (e.g., Deschet, 1966, p. 146), assume that this scar is typical of Tertiary and Recent forms only.

The height and location of umbo is of diagnostic value for some species. The umbo is prominent, sharp-pointed in *Trigonia triangulare* (Goldfuss), and low and rounded in *Myophorella franconica* (Lebküchner). It is somewhat shifted towards the anterior in *Myophorella clavellulata* (Strandt)

and submedial or situated somewhat closer to the posterior side of valves in *Trigonia incrassata* (Lebküchner).

Shell outline in frontal view is also a good specific criterion. It is cordate in *Trigonia triangulare* (Goldfuss), which shell is the thickest markedly above the mid-height, and ovate in *T. incrassata* (Lebküchner), which shell is the thickest at the mid-height (pl. XVI, figs 2*a*, 6*a*).

A massive, markedly convex hinge with a deep sinus beneath the main 2nd tooth is typical of *Trigonia costata* Sowerby, whereas a more slender

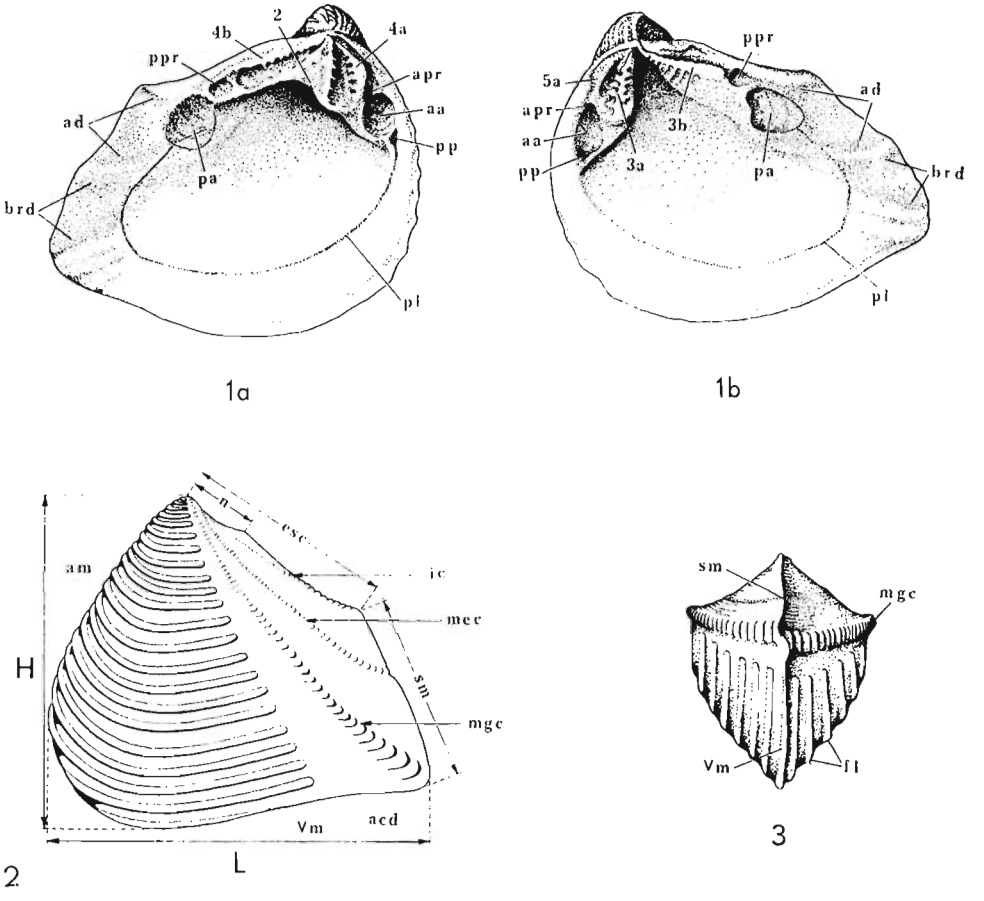


Fig. 1. Internal morphology of *Trigonia*; *a* left valve and *b* right valve. Hinge of the left valve; *4a* anterior lateral tooth, *4b* posterior lateral tooth, 2 main tooth. Hinge of the right valve: *3a* anterior tooth, *3b* posterior tooth, *5a* rudimentary anterior lateral tooth. Muscle scars of both valves: *aa* anterior adductor, *ad* anal depression, *apr* anterior pedal retractor, *brd* branchial depression, *pa* posterior adductor, *pl* pallial line, *pp* protractor pedis, *ppr* posterior pedal retractor.

Fig. 2. External morphology of *Trigonia* valve: *H* height, *L* length, *acd* ante-carinal depression, *am* anterior margin, *esc* escutcheon, *ic* inner carina, *mec* median carina, *mgc* marginal carina, *n* nymph (ligament fulcrum), *sm* siphonal margin, *vm* ventral margin.

Fig. 3. Posterior view of *Trigonia* shell: *fl* flank, *mgc* marginal carina, *sm* siphonal margin, *vm* ventral margin.

hinge with wider and shallower sinus is found in *T. triangularis* (Goldfuss) and *T. interlaevigata* Quenstedt.

Other morphological features of valves should be analysed along with the above mentioned features of high diagnostic value (see text-figs 1—3).

The variability in outline and ornamentation of shells of trigoniids undoubtedly resulted from differences in the mode of life of these pelecypods. Several hypotheses concerning this dependance in the case of fossil forms were revised in detail previously (see e.g. Lebküchner, 1932). Some of them are supported by the results of the studies of the present author. It is assumed that some species of the genus *Trigonia* (e.g. *T. triangulare* and *T. costata*) could be partly burried in soft bottom deposits as they are characterized by well-developed pedal elevator muscle scar. A strong pedal elevator muscle could ensure rising to the surface of bottom sediments and the concentric ribs on shell surface, when oriented perpendicular to the substratum, could act as some kind of slide-bars facilitating movements in the vertical (text-fig. 3).

The present author assumes that Jurassic trigoniids could move by leaps, similarly as Recent forms with rounded shells (Deschet, 1966, p. 51). Such well-rounded shells are found in the genus *Vaugonia*. A narrow, step-like depressed anterior adductor muscle scar, recently found by the author in some representatives of this genus, evidences a strong development of anterior adductor muscle. Assuming the movement of these animals by leaps this strongly developed muscle was highly efficient in rapid and tight closing of valves after every jump and pedal retraction.

It is not excluded that some Mesozoic trigoniids could attach themselves to the substratum with byssus for some time, as relict byssus apparatus is found in Recent trigoniids. However, the material available does not display any byssal incision, so it does not contribute to that problem.

THE MICROSTRUCTURE AND MICROORNAMENTATION OF TRIGONIID SHELLS

The microstructure of trigoniid shells was studied on radial and transversal thin sections. In the fossil material two layers are preserved: the external prismatic and internal nacreous layers. One of thin sections made in radial plane through valve of *T. triangulare* displayed a conchiolin periostracum wedge separating the prisms from each other, and marked in the form of dark-brownish lines (pl. XXIII, fig. 1*a*—*b*). The prismatic layer is especially thick at marginal carinae, where it consists of several rows of prisms (pl. XXIII, fig. 4) but usually it is much thinner than the nacreous layer. The prismatic/nacreous layer ratio equals 1 : 8, sometimes decreasing to 1 : 14 in the material studied, whereas it equals 1 : 10 at the average in the Recent material (Deschet, 1966). Radial thin section through juvenile valve displayed prismatic layer equal to nacreous layer in thickness at the

place where concentric rib passes (pl. XXIII, fig. 3). The thin section also displayed a thin, horizontal basal layer separating prismatic and nacreous layers (pl. XXIII, figs 2—5).

The microstructure of nacreous layers is well displayed by thin sections passing through ventral margin of valves (pl. XXIII, fig. 5). Pseudoprisms building the nacreous layer are set at the angle of about 45° to the basal layer. The pseudoprisms formed of alternating sheets of nacre and conchiolin leaflets are visible in the form of light and dark lines on the thin section (pl. XXIII, fig. 5; Deschet, 1966, pl. 5, fig. 5). The orientation of pseudoprisms becomes parallel to inner surface of the valve along with increase in distance from the basal layer towards the ventral margin.

The microornamentation of trigoniid shells was studied with the use of SEM at magnifications ranging from 150 to over 600 times. The valve surface is covered with prisms set in vertical and horizontal rows and closely adjoining one another. The prisms are hexagonal or, sometimes, pentagonal or quadrangular in outline. The arrangement of the prisms on flat valve surface resembles honey comb. The rows of prisms are somewhat wavy and the prisms are irregularly polygonal in outline on valve sides (pl. XXII, figs 2*a*, 3). When the valve surface is damaged the prisms have the appearance of irregularly rounded hummocks separated by narrow fissures and gaps after eroded-out prisms are sometimes visible (pl. XXII, fig. 1*a*—*b*). Such picture may be a source of valuable information about the size of individual prisms and the thickness of conchiolin periostracal wedges separating them.

Boss-like forms in the centre of every prism and concentric striation of bosses may be noted on well-preserved surfaces.

The microornamentation appears to be roughly the same in the genera *Trigonia, Myophorella* and *Vaugonia*. The prisms tend to be smaller in *Vaugonia*, whereas their arrangement and changes in their outline depending on convexity of surface appears to be the same.

SYSTEMATIC PART

Family **Trigoniidae** Lamarck, 1819
Subfamily **Trigoniinae** Kobayashi, 1954
Genus *Trigonia* Bruguière, 1789

Type species: *Venus sulcata* Hermann, 1781.
Diagnosis of the genus after L. R. Cox (1969, p. 478).

Trigonia costata Sowerby, 1815
(pl. XVII, figs 1—3, pl. XX, figs 3—4, pl. XXI, figs 2—3)

1898. *Trigonia costata* Sowerby; Greppin, p. 89, pl. 13, figs 1—4.
1932. *Lyriodon costatum* Sowerby; Lebküchner, p. 101, pl. 15, fig. 9; pl. 16, fig. 3.

1961. *Trigonia (Trigonia) costata* Sowerby; Sibiriakova, p. 112, pl. 15, figs 1—2 (with previous synonymy).

1965. *Trigonia costata* Parkinson; Cox, p. 74, pl. 11, figs 2a—b.

Material. — Ten well-preserved specimens, including 6 left valves (ZPAL Mo. IX/33, 69—72) and over 20 fragmentary specimens.

Dimensions (in mm):

H	L	R
7—37	6—38	8—21

Supplementary description. — External morphology. Valve 20 mm high is ornamented with 15—17 concentric ribs (12—15 according to Lebküchner); marginal carina 1.5 mm thick, median carina — 1 mm thick, and inner carina — 2 mm thick. Number of radial striae from area increasing mainly through intercalation. Ligament fulcrum usually 2×10 mm in size; ligament lamina usually 5 mm thick (pl. XXI, fig. 3).

Internal morphology. Main 2nd tooth large, convex, with depressed frontal surface, almost equally high as long, about 12—13 mm long; posterior part of upper tooth surface with a distinct boss, anterior part of the upper surface with deep, narrow furrow (pl. XVII, figs 1*a*—3*a*). Sinus beneath the tooth deep, wide. Anterior and posterior retractor muscle scars small, weakly depressed; the former subtriangular, the latter rounded. Anterior protractor muscle scar subtriangular, connected at its narrower end with pallial line. The maximum distance between the pallial line and valve margin, equalling one-third of valve height, at posteroventral margin (pl. XVII, fig. 1*a*). Posterior tooth surface displaying relatively shallow pedal elevator muscle scar with outline close to a triangle with broad base (pl. XX, fig. 3).

Growth changes of the valve. — Juvenile stages differ from adult in ornamentation, dimensions, outline of valve and adductor muscle scars. At the first growth stages two carinae, marginal and internal carinae, are observable in the form of fine, finely-denticulated striae. Valve, 2.5 mm high, displays 4 concentric riblets, median carina and first radial tread in the middle of area. Two subsequent treads originate on this surface through separation from internal carina. The first tread from anterior surface of area originates simultaneously with the second from the posterior surface of the area. The next two treads are formed successively on the anterior and posterior side of the first tread. In this stage the valve is 7 mm high and 6 mm long; the height index exceeds 1. The origin of radial ornamentation of area is preceded by concentric ornamentation consisting of fine transversal ridges. Adductor muscle scars, initially rounded and about 1 mm in diameters, increase up to 7—8 mm in size; the anterior scar becomes ovate and the posterior — roughly cordate in shape. The shell outline, subtriangular-ovate in the juvenile growth stage, becomes trapezoidal at the end of growth. There is some increase in the length of valves, and the height index does not exceed 0.9 in the final growth stage.

Remarks. — The Polish specimens are generally somewhat smaller than those from Germany (Lebküchner, 1932). The specimens from Tanganyika (Cox, 1965) are characterized by more convex anterior margin of valves, more depressed posterior margin, more numerous concentric ribs and they are shorter. These differences, however, fall in the limits of individual variability of the species. *Trigonia lineolata* Agassiz, 1840, is not included in the synonymy of this species because of a delicate construction of hinge of the latter, more similar to the hinge of *T. interlaevigata* Quenstedt, 1858.

Occurrence. — Poland: Vesulian (Łęczyca). Germany: Macrocephalenschichten. Switzerland: Upper Bajocian. England: Inferior Oolite. Tanganyika: Bajocian.

Trigonia triangulare (Goldfuss, 1834)

(pl. XVI, figs 1—5, pl. XX, figs 1—2, 6—7, pl. XXI, figs 1, 4, 10 pls XXII—XXIII)

1837. *Trigonia costata* Lam. var. *b*. Pusch, p. 58, pl. 7, figs 1ab.
1952. *Lyriodon triangulare* Goldfuss; Lebküchner, p. 98, pl. 14, fig. 12, pl. 15, figs 1—7, pl. 16, figs 1—2.
1933. *Trigonia* (*Lyriodon*) *subtriangularis* Wetz; Dacqué, p. 178, pl. 21, fig. 15.

Material. — Ten well-preserved specimens, including 4 shells, 3 left and 3 right valves (ZPAL MO. IX/24—27, 46) and about 80 fragmentary specimens.

Dimensions (in mm):

H	L	R	H/L
11—54	13—53	9—18	0.84—1.02

Supplementary description. — External morphology. Valve 20 mm high ornamented with 12—13 concentric ribs (12, 14—18 according to Lebküchner, 1932); marginal carina over 2 mm wide, median carina — 1 mm wide, and inner carina — 1.5 mm wide. Number of radial treads from area increasing mainly through dichotomy. Ligament fulcrum usually 2×6—8 mm in size; ligament lamina short, relatively wide; ligament furrow widening towards the posterior.

Internal morphology. Main 2nd tooth fine, almost equally high as long, about 7—8 mm long; posterior part of upper surface of the tooth with weakly projected boss and the anterior part with relatively wide furrow. Sinus beneath the 2nd tooth wide and shallow. Anterior and posterior pedal retractor muscle scars rounded, depressed, about 2 mm in size. Posterior adductor muscle scar cordate in outline (pl. XX, fig. 6). Siphonal tread separating branchial and anal depressions, may be noted on well-preserved specimen (pl. XX, fig. 6).

Growth changes primarily include an increase in value of the height index from 0.84 (juvenile forms) to 1.0 (mature forms). Area is smooth in the earliest growth stages; radial ornamentation first appears in posterior part of the area. Valve 7 mm high displays 3 radial treads on posterior part of the area and 1 radial tread on the anterior. Successive treads are formed on the anterior part on both sides of the first tread through intercalation, and on the posterior part — through dichotomous subdivision. Subsequent growth changes proceed in accordance with normal succession of growth process.

The variability is small, concerning some differences in size, depression of muscle scars, width of antecarinal field and width and height of tubercles on carinae.

Remarks. — The valves of *T. triangulare* analysed by the present author display several types of disturbances in concentric ornamentation: changes in thickness of ribs, wavy course and changes in density of ribbing, interrupted ribs and dichotomic subdivision of the ribs marked always only close to anterior valve margin. All these disturbances indicate reversible or irreversible disturbances of the whole or part of pallial line.

Occurrence. — Poland: Vesulian (Łęczyca). England: Inferior Oolite. Germany: "Parkinsoni-Clavellatenschichten", Oppelia fusca-Bank.

Trigonia interlaevigata Quenstedt, 1858

(pl. XVII, figs 6*a*—*b*, pl. XX, figs 8—9)

1834. *Lyriodon costatum* var. *triangularis* Goldfuss: p. 201, pl. 137, fig. 3d (non figs 3b, 3c).
1858. *Trigonia interlaevigata* Quenstedt: p. 503, pl. 67, figs 7—8.

1932. *Lyriodon interlaevigatum* Quenstedt; Lebküchner, p. 96, pl. 13, figs 9—12, pl. 14, figs 4—11.

Material. — Two left valves somewhat damaged and about 30 fragments (ZPAL MO. IX/73, 74).

Dimensions (in mm):

H	L	R	H/L
60—63	51—54	26	1.17

Supplementary description. — External morphology. Concentric ribs low, narrow; inter-rib spaces twice wider than the ribs. Valve 20 mm high ornamented with 13 ribs. Carinae low, narrow, slightly arcuate. The first tread equally high as the carinae and ornamented with rounded tubercles. In this species the area ornamented with radial treads originating mainly through intercalation in its anterior part and through dichotomous subdivision in the posterior. The treads are formed of ovate nodose tubercles. Ligament fulcrum narrow, long; its longer diameter, 7 mm, equalling about one-fifth of longer diameter of escutcheon.

Internal morphology. Hinge structure delicate; 2nd tooth as long as high, 9 mm long, with a narrow furrow delineated by high margins at its upper surface; typical boss is not developed but there is only some thickening of upper anterior surface of the tooth. Posterior adductor muscle scar about 10 mm in size, somewhat depressed along its upper margin (pl. XX, figs 8-9). Muscle scar surface cut by deeply incised line dividing it into anterior part and almost three times larger posterior part. Presumably to these areas were attached differently acting parts of the muscle — quick and catch parts of the muscle. Siphonal ledge well-developed, in the form of double line (pl. XX, fig. 9).

Growth changes of valve proceeding through normal increase in size of all the morphological and sculptural elements, except for the valve the most convex and the carinae the most arcuate at the initial growth stages.

Remarks. — The Polish specimens are most similar to those described from Germany by Quenstedt (1858). They differ from those described by Lebküchner (1932) in larger antecarinal field and less numerous radial treads on the area, but these differences fall into the range of individual variability of the species.

Occurrence. — Poland: Upper Vesulian (Łęczyca). Germany: the Parkinsonia Zone, "Clavallatenbank". Switzerland: the Oppelia aspidoides Zone.

Trigonia incrassata (Lebküchner, 1932)

(Pl. XVI, fig. 6a-c, pl. XVIII, fig. 6)

1932. *Lyriodon incrassatum* Lebküchner: p. 96, pl. 13, fig. 8; pl. 14, fig. 3.

Material. — Well-preserved shell representing mature growth stage and several valve fragments (ZPAL Mo. IX/77).

Dimensions (in mm):

H	L	R	H/L
53	49	22	1.08

Remarks. — The Polish specimens resemble in all their features those recorded from the area of Germany. *Trigonia incrassata* (Lebk.) resembles *T. triangulare* (Goldfuss) in shell outline, differing in several morphological features and sculpture.

Specific features	*T. incrassata*	*T. triangulare*
height (in mm)	53	54
length (in mm)	49	53
shell convexity (in mm)	36	30
transversal diameter of escutcheon	15	12
longitudinal diameter of escutcheon	30	32
number of concentric ribs	32	17
marginal carina	low, narrow, weakly arcuate, not tuberculated from the mid-height	high, wide, strongly arcuate; tubercles increasing in size, flattened at ventral margin
other carinae	low, not tuberculated from the mid-height	high, tuberculated
junction of concentric ribs with anterior margin of the shell	almost at the right angle, by ledges	by S-shaped riblets perpendicular to margin.

Occurrence. — Poland: Vesulian (Łęczyca). Germany: Dogger epsilon.

Trigonia latezonata (Lebküchner, 1932)
(Pl. XVIII, fig. 1*a-c*)

1932. *Lyriodon latezonatum* Lebküchner: p. 100, pl. 15, fig. 8.

Material. — Two slightly damaged shells representing mature growth stage and several fragments of valves: ZPAL Mo. IX/22, 23.

Dimensions (in mm):

H	L	R	L/H
50—70	56—75	18—23	1.07—1.12

Supplementary description. — Escutcheon 30—45 mm long and 14—17 mm wide. Ligament field 7—17 mm long in the specimens studied. Ligament laminae extremely short, 5 mm long. Ante-marginal field wide, 20 mm and over 25 mm wide in distal part of smaller and larger specimens, respectively.

Remarks. — The Polish specimens are similar to German specimens illustrated by Lebküchner (1932). The length index is similar equalling 1.08—1.09 for the latter.

Occurrence. — Poland: Vesulian (Łęczyca, the Parkinsonia ferruginea and P. compressa Zones). Northern Germany: the Parkinsonia zones.

Trigonia crebraecostata sp.n.
(Pl. XVIII, fig. 5)

Holotype: ZPAL Mo. IX/44; Pl. XVIII, fig. 5.

Type horizon: Upper Vesulian, the Parkinsonia ferruginea and P. compressa Zones.

Type locality: Łęczyca near Kutno, Central Poland.

Derivation of the name: *crebraecostata* — lat. *creber* = density, *costa* = rib; after relatively great density of uniformly arranged flank ribs.

Diagnosis. — Valve of small-medium size; umbo moderately prominent; marginal carina strongly curved; flank ornamented with relatively narrow (1 mm) and numerous (13) round-crested concentric ribs separated by intervals of almost the same width.

Material. — Seven fragmentarily preserved valves (including 5 right valves).

Dimensions of the holotype (in mm):

	H	L	R
ca	23	30	13

Description. — Umbo strongly bent towards the middle of shell, opistogyre, somewhat shifted towards the anterior. Maximum convexity, equalling 11 mm, above the mid-height. Anterior shell margin arcuate, posterior rectilinear, near umbo concave. Area and valve flank equal in length. Concentric ribs with distal parts somewhat bent, ending with a small swelling; horizontal ridges, with short rectilinear subumbonal sections and longer, arcuate ventral sections, come off the ribs at the boundary of antecarinal field. Carinae initially relatively high and narrow; distal part of marginal carina up to 2 mm high and 2 mm wide; tubercles marked on its surface are developed in the form of separate rings disappearing in the middle of its length; subsequent part of the carina nonuniformly rounded, cut by growth lines. Median carina ornamented with irregular elongated tubercles merging with one another which become flattened, quadrangle-plate-like in outline, set in imbricate pattern. The tubercles typical of the genus *Trigonia* are found only on inner carina. At the first stages of development the first radial tread comes off the inner carina. The tread seems closer to carina than to the treads proper in its ornamentation, height and width. In the second half and distal part of the tread the features typical of the carinae fade away and the tread does not differ any more from other treads from the area. The carinae are accompanied by furrows widening and shallowing towards distal part of valve. Number of treads increases up to 7 in posterior part and up to 5 in anterior part of the area. Escutcheon depressed in relation to inner carina, initially set at almost right angle to the carina and at progressively more obtuse angle. Escutcheon ornamented with numerous fine tubercles horizontally oriented close to umbo and radial elsewhere. Posterior margin of the escutcheon markedly thickened, in lower part higher and bent outwards. Escutcheon elliptical in outline; maximum transversal diameter — 5 mm (at the place where ligament fulcrum wedges out); longitudinal diameter — over 20 mm. Ligament fulcrum 8 mm long, consisting of short ligament lamina, 2 mm long, and wide furrow ornamented with oblique growth lines.

Remarks. — This species differs from all the species of the genus *Trigonia* in a number of features including: uniform concentric ribs, radial tread resembling carina in development, quadrangular outline of tubercles of median carina, wide area, and escutcheon with markedly thickened and elevated margin.

Occurrence. — Poland: Upper Vesulian (Łęczyca), the Parkinsonia ferruginea and P. compressa Zones.

Subfamily **Myophorellinae** Kobayashi, 1954
Genus *Myophorella* Bayle, 1878

Type species: *Trigonia nodulosa* Lmk., 1801

Diagnosis of the genus after L. R. Cox (1969, p. 483).

Myophorella clavellulata (Strand, 1928)
(Pl. XIX, figs 1*a-d*)

1932. *Clavotrigonia clavellulata* Strand (1928); Lebküchner, p. 62, pl. 4, fig. 6, pl. 5, figs 6-9, pl. 6, figs 1-4, text-fig. 34.
1955. *Trigonia* (*Clavotrigonia*) *clavellulata* Strand; Książkiewicz, p. 176.

Material. — Well-preserved shell of mature individual and several fragments of valves: ZPAL Mo. IX/43.

Dimensions (in mm):

H	L	H/L	R
46	66	0.69	18

Supplementary description. — External morphology. Valve 20 mm high ornamented with 10 concentric tuberculated ribs. At this height the carinae are extremely narrow: marginal carina is 0.6 mm wide and inner carina — about 1 mm wide, and a furrow (corresponding to siphonal ledge from the inner valve side) is marked instead of median carina. Ligament fulcrum and escutcheon lanceolate in outline. Transverse diameter of the fulcrum equals about 3 mm, and longitudinal diameter — 9 mm. Ligament lamina consists of wide, depressed posterior part and narrow, protruding, carina-like anterior part, anteriorly delineated by a narrow furrow (pl. XIX, fig. 1*a*).

Growth changes well-marked, involving gradual differentiation in shell morphology and increase in shell length during the last ontogenetic stages. The height index equals 1.0 and 0.69 in juvenile and adult forms, respectively.

Occurrence. — Poland: Vesulian (Łęczyca) and Bajocian (Bachowice). Germany: Lower-Middle Vesulian (Subfurcaten-Schichten — Parkinsoni Oolithen).

Myophorella franconica (Lebküchner, 1932)
(pl. XVIII, fig. 4)

1932. *Clavotrigonia franconica* Lebküchner, p. 71, pl. 7, figs 10—14, pl. 8, fig. 1 (vide synonymy).

Material. — External morphology. Small valves with low, weakly protruding, rounded, somewhat opistogyre umbo.

Internal morphology. Main, 2nd tooth about 4.5 mm high and long. A small depression visible on upper surface of the tooth. Sinus beneath the tooth wide and relatively deep. Lateral teeth well-developed; posterior tooth markedly lower than the anterior.

Remarks. — The Polish specimens are similar to those from Germany in size and style of sculpture. The internal morphology of these latter was not described by Lebküchner (1932).

Occurrence. — Poland: Middle Vesulian (Łęczyca — the Parkinsonia parkinsoni Zone). Germany: Lower Dogger.

Myophorella cf. *formosa* (Lycett, 1860)
(pl. XVIII, fig. 2)

Material. — Two fragments of right valves: ZPAL Mo. IX/54, 54a.

Remarks. — The largest representatives of *M. formosa* are 24 mm and 27 mm long, and are ornamented with up to 12 nodose ribs (Sibiriakova, 1961, p. 111). The valve fragments available display 6 to 8 concentric rows of tubercles. They are most similar to those described from the Bathonian of the Great Balkhan of the

USSR (Sibiriakova, *l.c.*, pl. 15, figs 10-11), characterized by similar sculpture, somewhat prosogyre, small umbos, and small size.

Occurrence. — Poland: Upper Vesulian (Łęczyca — the Parkinsonia ferruginea and P. compressa Zones).

Myophorella cf. *signata* (Agassiz, 1840)
(pl. XVIII, fig. 3)

Material. — Fragment of left valve: ZPAL Mo. IX/53.

Remarks. — The style of sculpture of this fragment of valve appears the most similar to that of young specimens from the Upper Bajocian of Bale area (Greppin, 1898, pl. 9, fig. 11). The adult specimens of *S. signata* are up to 80 mm high and 90 mm long (Lebküchner, 1932, p. 57).

Occurrence. — Poland: Upper Vesulian (Łęczyca) and Bajocian (Bachowice).

Subfamily **Vaugoniinae** Kobayashi, 1954
Genus *Vaugonia* Crickmay, 1930

Type species: *V. veronica* Crickmay, 1930.

Diagnosis of the genus after L. R. Cox (1969, p. 488).

Vaugonia V-costata (Lycett, 1850)
(pl. XIX, fig. 2, pl. XX, fig. 4)

1874. *Trigonia V-costata* Lycett: p. 66, pl. 13, fig. 5, pl. 15, figs 1-4.

Material. — Two left valves representing different growth stages and with damaged postero-ventral part: ZPAL Mo. IX/18, 19.

Dimensions (in mm):

H	L	R
28—30	15—22	12—14

Supplementary description. — Internal morphology (pl. XX, fig. 4). The inner surface of valves displays a lower part of anterior 3a tooth, anterior adductor muscle scar and weakly marked pedal protractor muscle scar. Attention should be paid to the mode of development of the anterior adductor muscle scar developed mostly on anterior surface of the tooth and incised into thin surface in the form of several deep cavities. On the larger specimen there are 10 such cavities, the central of which are larger and deeper than the remaining ones.

Remarks. — The style of sculpture of Polish specimens is the same as that of English forms (Lycett, 1874). The internal morphology is here discussed for the first time.

Occurrence. — Poland: Upper Vesulian (Łęczyca). England: Inferior Oolite.

Vaugonia compta (Lycett, 1863)
(Pl. XVII, figs 4-5, pl. XX, fig. 5)

1874. *Trigonia compta* Lycett: p. 70, pl. 15, figs 5-7, pl. 38, fig. 4.

Material. — Eleven well-preserved single valves, including 5 right valves (ZPAL Mo. IX/1—11) and several fragments of valves.

Dimensions (in mm):

H	L	R
18—42	18—44	9—23

Supplementary description. — Internal morphology. Hinge structure delicate. Main 2nd tooth 4 mm high and about 6 mm long. On the upper surface of this tooth in left valve there are marked a tubercle and, on anterior side of the tooth, a small depresion. Anterior adductor muscle scar well-developed, step-like depressed, situated at anterior surface of hinge margin somewhat extending on the valve surface; a weakly depressed pedal protractor muscle scar situated at the extension of the former and connected by its narrower ventral end with strongly incised pallial line (pl. XX, fig. 5). Arcuate siphonal ledge separating branchial and anal depressions visible in postero-ventral valve part (pl. XVII, fig. 5*a*). Two divergent 3a and 3b teeth preserved on right valve. The right tooth is almost perpendicular to inner valve surface, and the left tooth — parallel (pl. XVII, fig. 4*a*). Posterior adductor muscle scar with rounded outline, about 7 mm in diameter, with surface ornamented with concentric growth lines. Small, ovate posterior pedal retractor muscle scar visible at the base of posterior 3b tooth; transverse diameter of the scar equals about 2 mm, and the longitudinal — 3 mm. Surface of posterior adductor muscle scar is divided into larger posterior and smaller, anterior parts. Pallial line about 10 mm distant from ventral margin.

Remarks. — The Polish specimens are identical as the English in size, shell outline and style of sculpture. The internal morphology of the shells is here described for the first time.

Occurrence. — Poland: Upper Vesulian (Łęczyca). England: Aalenian-Bathonian.

Polska Akademia Nauk
Zakład Paleozoologii
Al. Żwirki i Wigury 93
02-089 Warszawa
April, 1975

REFERENCES

COSSMANN, M. 1912. Sur l'évolution des Trigonies. — *Ann. Paléont.*, **7**, 59—84.

COX, L. R. 1965. Jurassic Bivalvia and Gastropoda from Tanganyika and Kenya. — *Bull. Brit. Mus. (Nat. Hist.), Geol. Suppl.*, **1**, 1—213.

— 1969. Family Trigoniidae Lamarck, 1819. *In*: R. C. Moore (ed.), Treatise on Invertebrate Paleontology. Part N Bivalvia, **1**, 476—489, Kansas.

DACQUÉ, E. 1933. Wirbellose des Jura. *In*: G. Gürich (ed.), Leitfossilien. Lief. 7, **1**, 1—272, Berlin.

DEECKE, W. 1926. Über die Trigonien. *Palaeont. Ztschr.*, **7**, 65—101.

DESCHET, Y. 1966. Études sur des Trigoniidae cénozoïques. — *Trav. Lab. Paleont.*, **6**, 1—157, Orsay.

GOLDFUSS, A. 1834—1840. Petrefacta Germaniae. **2**, 1—312, Düsseldorf.

GREPPIN, E. 1869. Description des fossiles du Bajocien supérieur des environs de Bâle. — *Mém. Soc. Paléont. Suisse*, **25**, 53—126.

KOBAYASHI, T. 1954. Studies on the Jurassic Trigonians in Japan, part 1, Preliminary notes. — *Jap. Journ. Geol. Geogr.*, **25**, 1—2, 61—80.

— 1954. Studies on the Jurassic Trigonians in Japan, prt. 2, Prosogyrotrigonia and Trigoniinae. — *Ibidem*, **25**, 3—4, 155—175.
— 1955. The Myophorellinae from North Japan. Studies on the Jurassic Trigonians in Japan, part IV. — *Ibidem*, **26**, 1—2, 89—103.
— 1956. Some Jurassic trigonians from Central and West Japan. Studies on Jurassic trigonians in Japan, part V. — *Ibidem*, **27**, 1, 1—8.
KSIĄŻKIEWICZ, M. 1955. Jura i kreda Bachowic (The Jurassic and Cretaceous of Bachowice). — *Rocz. Pol. Tow. Geol.*, **24**, 2—3, 119—405.
LEBKÜCHNER, R. 1932. Die Trigonien des süddeutschen Jura. — *Palaeontographica*, **77**, 1—3, 1—119.
LYCETT, J. 1863. Supplementary Monograph on the Stonessfield Slate, Great Oolite, Forest Marble and Cornbrash. — *Palaeont. Soc.* [*Monogr.*], 1—129, London.
— 1874. A Monograph of the British fossil Trigoniae, 2. — *Ibidem*, 1—245.
McCORMICK, L. & MOORE, R. C. 1969. Outline of classification. *In*: R. C. Moore (ed.), Treatise on Intervertebrate Paleontology, N. 1, Mollusca 6, Bivalvia, 218—222, Kansas.
PUGACZEWSKA, H. 1961. Belemnoids from the Jurassic of Poland. — *Acta Palaeont. Pol.* 6, 2, 105—236.
— 1971. Jurassic Ostreidae of Poland. — *Ibidem*, **16**, 3, 195—311.
PUSCH, G. G. 1836—37. Polens Paläontologie. 1—218, Stuttgart.
ROMANOV, L. F. 1973. see РОМАНОВ Л. Ф.
QUENSTEDT, F. A. 1858. Der Jura, 1—842, Tübingen.
SIBIRIAKOVA, L. W. 1961. see СИБИРЯКОВА, Л. В.
TAYLOR, J. D., KENNEDY, W. J. & HALL, A. 1969. The shell structure and mineralogy of the Bivalvia. (Introduction. Nuculacea — Trigoniacea). — *Bull. Brit. Mus.* (*Nat. Hist.*). *Zoology*, Suppl. **3**, 1—125.
ZNOSKO, J. 1957. Zarys stratygrafii Łęczyckiego doggeru (Outline of stratigraphy of the Dogger in the Łęczyca area). — *Inst. Geol., Biul.* **125**, 1—144.
— 1958. Górny wezul jury łęczyckiej (The Upper Vesulian of the Jurassic in the Łęczyca Region). — *Ibidem*, **126**.
РОМАНОВ. Л. Ф. 1973. Юрские морские двустворчатые моллюски междуречья Днестр—Прут, 3—226, Изд. Штиинца, Кишинев.
СИБИРЯКОВА, Л. В. 1961. Среднеюрская фауна моллюсков Большого Балхана и ее стратиграфическое значение. — *Тр. ВСЕГЕИ*, н. с., **47**, 5, 3—233.

HALINA PUGACZEWSKA

TRIGONIIDAE Z DOGGERU ŁĘCZYCY (POLSKA CENTRALNA)

Streszczenie

Opisano 12 gatunków małżów z rodziny Trigoniidae z doggeru Łęczycy, w tym 1 nowy *Trigonia crebraecostata* sp.n., należących do 3 podrodzin i 3 rodzajów. Najliczniej reprezentowany jest rodzaj *Trigonia* (6 gatunków), mniej licznie rodzaj

Myophorella (4 gatunki) oraz rodzaj *Vaugonia* (2 gatunki). Wykazano po raz pierwszy odmienną, „schodkowatą" budowę odcisku mięśnia adduktora przedniego u przedstawicieli rodzaju *Vaugonia*. W badaniach nad wzrostem skorupek wykazano odmiennie wykształcone cechy w młodocianych i starszych stadiach wzrostu. Na cienkich szlifach radialnych i transwersalnych zaobserwowano w cienkiej warstwie pryzmatycznej wypustki konchiolinowe periostrakum przedzielające poszczególne pryzmy tej warstwy.

ГАЛИНА ПУГАЧЕВСКА

TRIGONIIDAE ИЗ ДОГГЕРА В РАЙОНЕ ЛЕНЧИЦЫ (ЦЕНТРАЛЬНАЯ ПОЛЬША)

Резюме

Описано 12 видов пластинчатожаберных моллюсков семейстма Trigoniidae из доггера в районе Ленчицы, в том числе один новый вид — *Trigonia crebrae-costata* sp. n., относящихся к 3 подсемействам и 3 родам. В наибольшем количестве представлен род *Trigonia* (6 видов), в меньшем количестве род *Myophorella* (4 вида) и род *Vaugonia* (2 вида). Впервые констатировано „ступенчатое" строение отпечатка мускула аддуктора у представителей рода *Vaugonia*. В исследовании роста раковин выявлены различия в формировании признаков юных и взрослых стадий роста. В радиальных и трансверсальных шлифах наблюдались в тонком призматическом слое конхиолиновые прослойки (периостракум), отделяющие призмы этого слоя.

EXPLANATION OF PLATES

All specimens represented in plates XVI—XXIII from Łęczyca near Kutno in Poland (Vesulian)

Plate XVI
Trigonia triangulare (Goldfuss)
(see also pls XX—XXIII)

Fig. 1. Right valve of young specimen in: *a* external, *b* internal views. ZPAL Mo. IX/46, × 2.

Fig. 2. Shell of adult specimen viewed from: *a* anterior, *b* posterior side, ZPAL Mo. IX/25.
Fig. 3. Left valve of adult specimen in: *a* external, *b* internal views. ZPAL Mo. IX/27.
Fig. 4. Right valve of adult specimen in: *a* external, *b* internal views. ZPAL Mo. IX/26.
Fig. 5. Shell of adult specimen in anterior view. ZPAL Mo. IX/24.

Trigonia incrassata (Lebküchner)
(see also pl. XVIII, fig. 6)

Fig. 6. Shell of adult specimen viewed from: *a* anterior side, *b* left valve, *c* right valve. ZPAL Mo. IX/77.
Figs 2-6 nat size.

Plate XVII
Trigonia costata Sowerby
(See also pls XX and XXI)

Figs 1-3. Three left valves of young (fig. 1) and adult specimens in: *a* internal, *b* external views. ZPAL Mo. IX/33, 71-72, fig. 1 × 3, figs 2-3 nat size.

Vaugonia compta (Lycett)
(see also pl. XIX)

Fig. 4. Right valve of adult specimen in: *a* internal, *b* external views. ZPAL Mo. IX/7, × 1.5.
Fig. 5. Left valve of adult specimen in: *a* internal, *b* external views. ZPAL Mo. IX/5, × 1.5.

Trigonia interlaevigata Quenstedt
(see also pl. XX)

Fig. 6. Left valve of adult specimen in: *a* internal, *b* external views. ZPAL Mo. IX/73, nat. size.

Plate XVIII
Trigonia latezonata (Lebküchner)

Fig. 1. Shell of adult specimen viewed from: *a* left valve, *b* anterior side, *c* posterior side. ZPAL Mo. IX/22, nat. size.

Myophorella cf. *formosa* (Lycett)
Fig. .2. Right valve in external view. ZPAL Mo. IV/54, × 1.5.

Myophorella cf. *signata* (Agassiz)
Fig. 3. The left valve in external view. ZPAL Mo. IX/53, × 1.5.

Myophorella franconica (Lebküchner)
Fig. 4. Left valve of adult specimen in external view. ZPAL Mo. IX/38, × 3.

Trigonia crebraecostata sp. n.
Fig. 5. Right valve in external view. ZPAL Mo. IX/44, × 1.5.

Trigonia incrassata (Lebküchner)
(see also Pl. XVI, fig. 6)
Fig. 6. The mode of area riblets arrangement on right valve of young specimen is visible. ZPAL Mo. IX/136, × 5.

Plate XIX

Myophorella clavellulata (Strand)

Fig. 1. Shell of adult specimen viewed from: *a* anterior side, *b* right valve, *c* posterior side, *d* umbonal part posteriorly. ZPAL Mo. IX/43, × 4.

Vaugonia V-costata (Lycett)
(see also pl. XX)

Fig. 2. Right valve of adult specimen in external view. ZPAL Mo. IX/19, × 1.5.

Plate XX

Trigonia triangulare (Goldfuss)
(see also pls XVI, XXI—XXIII)

Fig. 1. The cardinal tooth 2 of the left valve is visible. ZPAL Mo. IX/42, × 3.5.
Fig. 2. Elevator muscle scar on inner surface of cardinal tooth of left valve is visible. ZPAL Mo. IX/37, × ca. 1.5.

Trigonia costata Sowerby
(see also pls XVI and XXI)

Fig. 3. Elevator muscle scar on inner surface of cardinal tooth of left valve is visible. ZPAL Mo. IX/48, × 1.5.

Vaugonia V-costata (Lycett)
(see also pl. XIX)

Fig. 4. Anterior adductor muscle scar on the side surface of the 3a tooth of right valve is visible. ZPAL Mo. IX/18, × 2.5.

Vaugonia compta (Lycett)
(see also pl. XVII)

Fig. 5. Anterior adductor muscle scar in step-like form, as on fig. 4, of left valve is visible. ZPAL Mo. IX/5, × 2.5.
Fig. 6. The posterior adductor muscle scar of heart-like outline and little posterior retractor muscle scar on the right valve is visible. ZPAL IX. Mo/114, × 1.5.
Fig. 7. The side surface of the tooth 3a of the right valve is visible. ZPAL Mo. IX/47, nat. size.

Trigonia interlaevigata Quenstedt
(see also pl. XVII)

Fig. 8. The posterior adductor muscle scar and posterior retractor pedis muscle scar on the right valve are visible. ZPAL Mo. IX/72, × 1.5.
Fig. 9. On the left valve muscle scars are visible, also siphonal riblet separating anal and branchial depression ZPAL Mo. IX/74a × 1.5.
Fig. 10. The anterior adductor muscle scar and the little protractor pedis muscle scar on the right valve are visible. ZPAL Mo. IX/17, × ca 1.5.

Plate XXI

Trigonia triangulare (Goldfuss)
(see also pls XVI, XX, XXII, XXIII)

Fig. 1. Left valve of the shell. Scars of anterior adductor muscle and anterior retractor pedis muscle are visible. ZPAL Mo. IX/72, × 5.
Fig. 4. The shell in posterior view. The S-shaped commissure is visible. ZPAL Mo. IX/ /24, × 2.
Fig. 5. Irregularity of concentric ribs is visible. ZPAL Mo. IX/100.

Trigonia costata Sowerby
(see also pls XVI and XX)

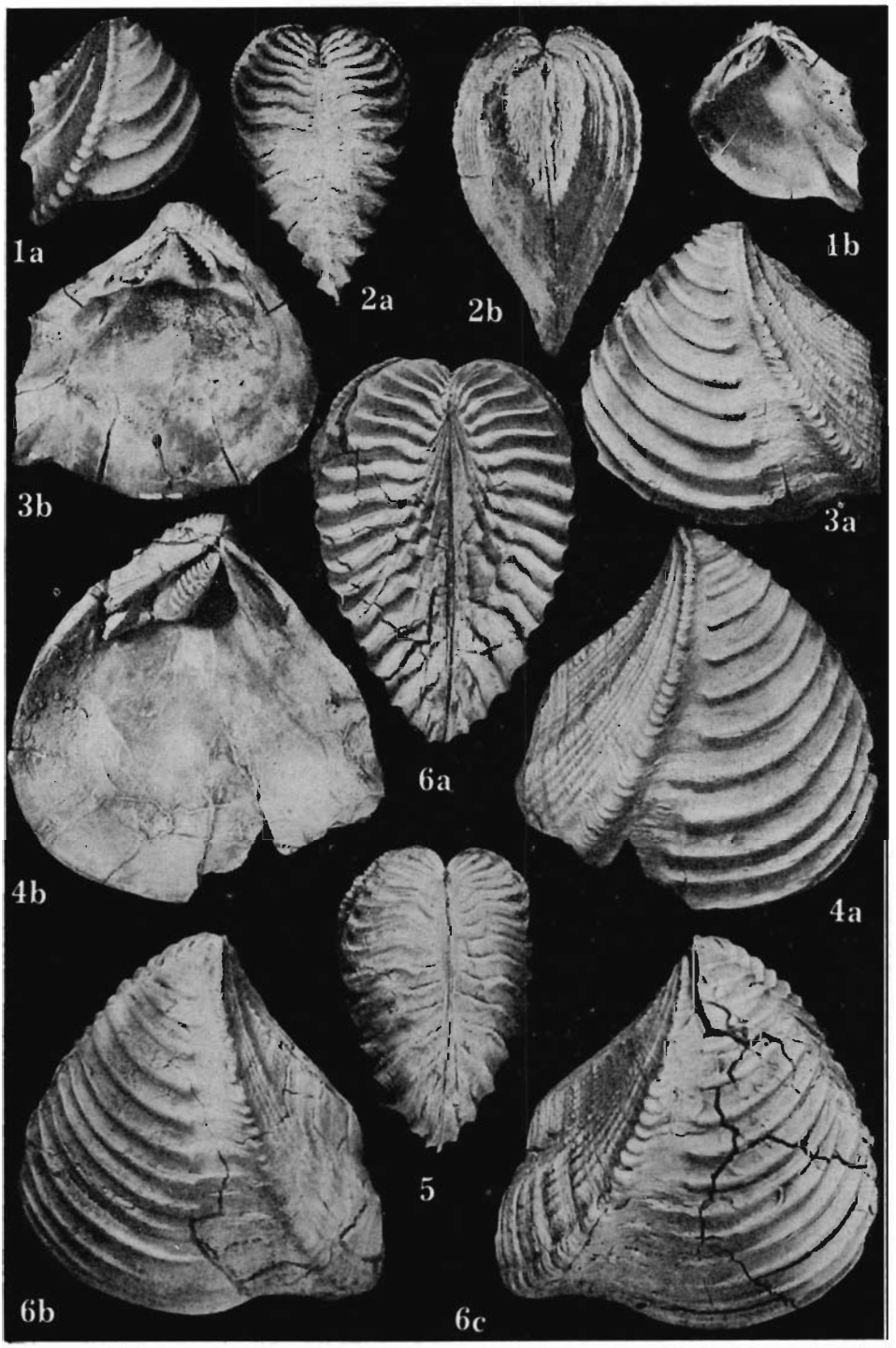
Fig. 2. Left valve of the shell. Scars of the anterior adductor muscle and anterior retractor pedis muscle are visible. The most convex tooth 2 is visible. ZPAL Mo. IX/71, × 1.5.
Fig. 3. Left valve. The ligament area is visible. ZPAL Mo. IX/69, × 4.

Plate XXII
Trigonia triangulare (Goldfuss)
(see also pls XVI, XX, XXI XXIII)

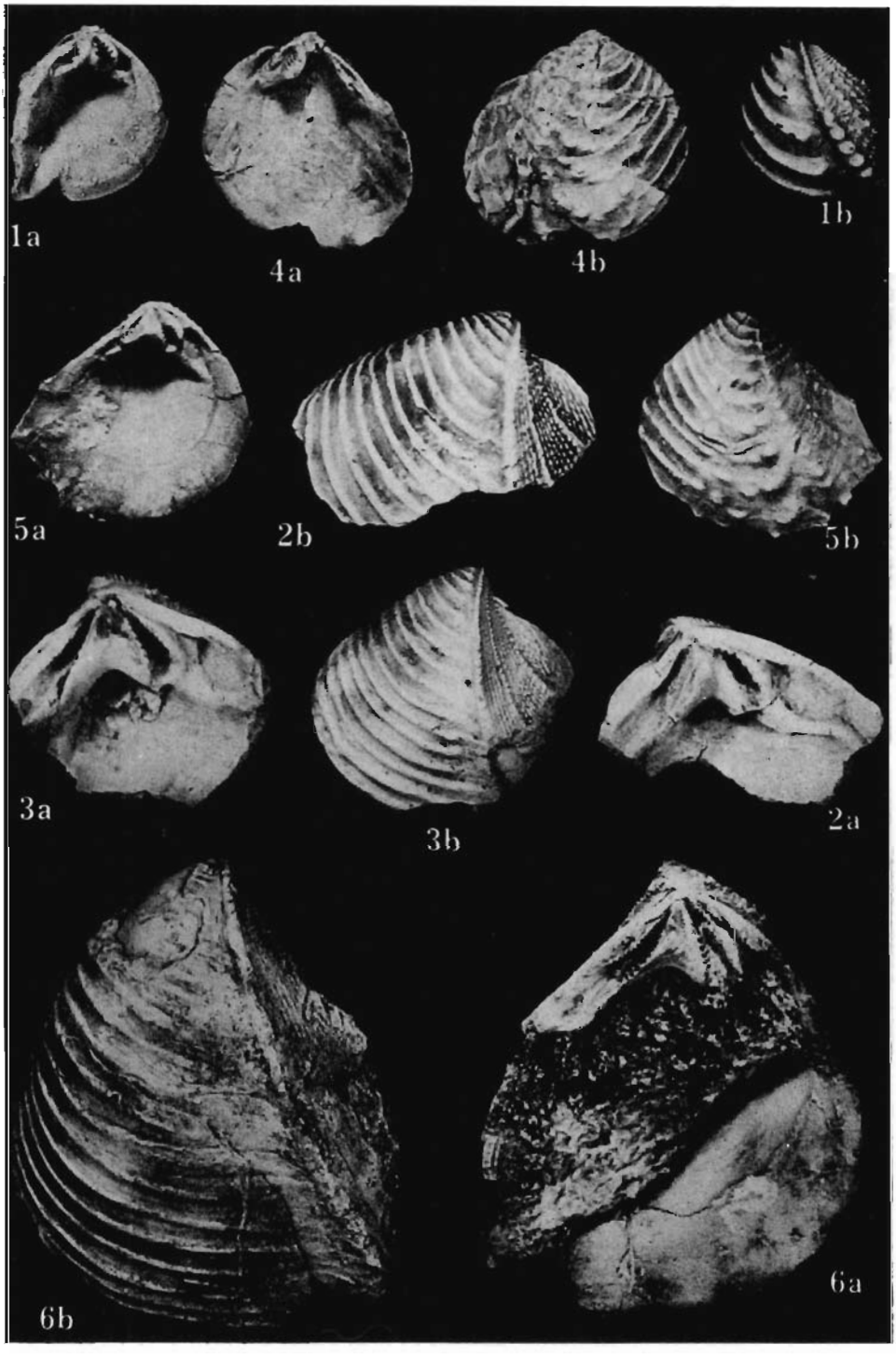
Fig. 1. The outer surface of the prismatic layer from the marginal part of the valve. The linear arrangement of the prisms is visible. In centre of the surface the little riblet of microornamentation is visible; some of polygonal prisms are destroyed. ZPAL Mo. IX/109, *a* × 150, *b* × ca 200.
Fig. 2. The outer surface of the prismatic layer from the middle part of the valve. The different outline of the prisms is visible. ZPAL Mo. IX/108, *a* × ca 160, *b* × 450, *c* × 600.
Fig. 3. The outer surface of the prismatic layer from the upper part of the concentric rib is visible. ZPAL Mo. IX/109, × 150.
Scanning electron micrographs

Plate XXIII
Trigonia triangulare (Goldfuss)
(see also pls XVI, XX—XXII)

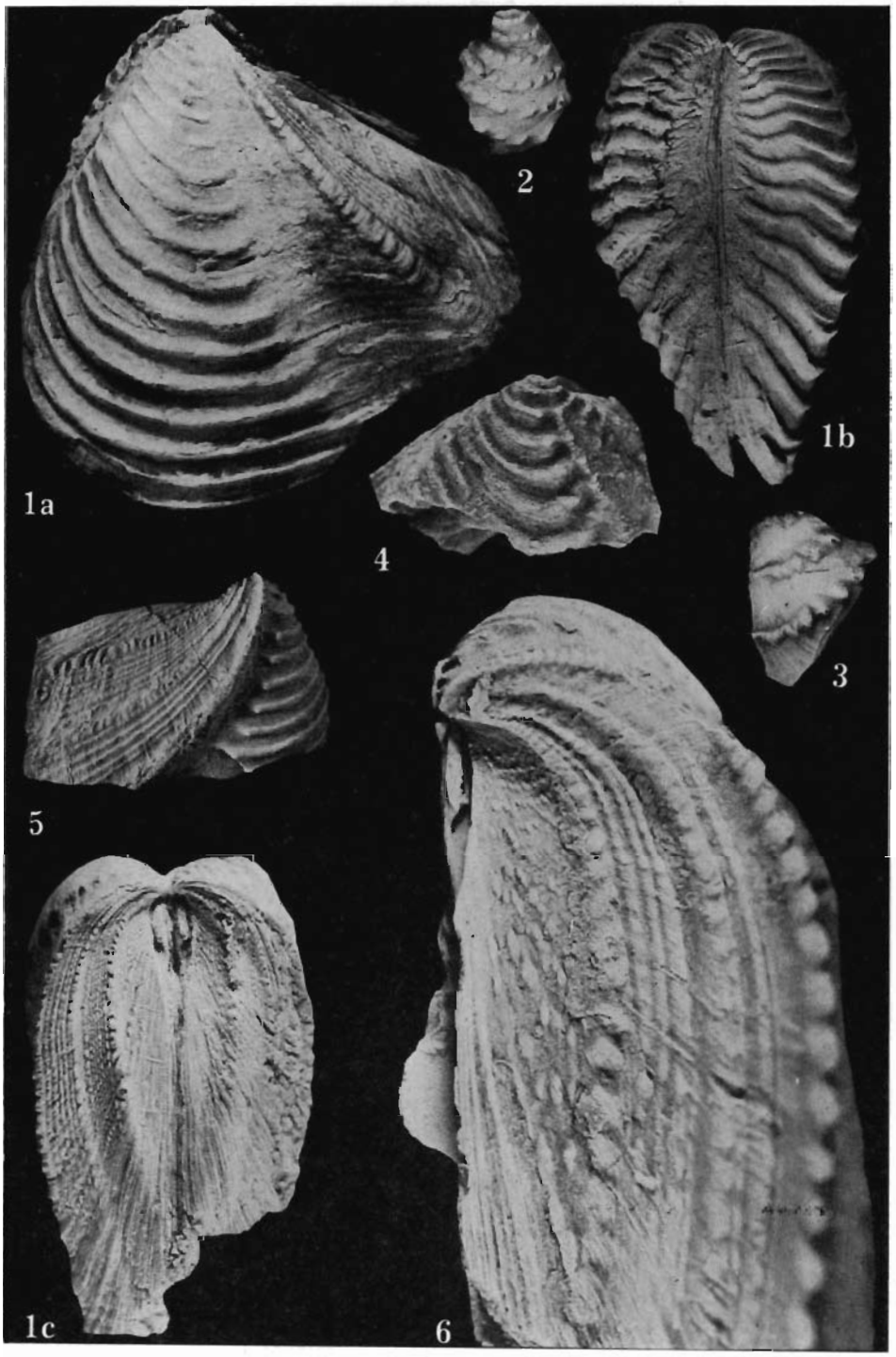
Fig. 1. Radial section of the outer prismatic layer showing the prisms separated by trace of conchioline. ZPAL Mo. IX/56, *a* × 145, *b* × ca 260.
Fig. 2. Transverse section of the area of the valve. The thin outer prismatic layer and thick aragonitic layer with growth lines are visible. ZPAL Mo. IX/68b.
Fig. 3. Radial section of the middle part of the young specimen. Two layers are separated by line-like dark basal layer. ZPAL Mo. IX/57.
Fig. 4. Transverse section of the area and marginal carina of the valve. The thickness under marginal carina increases by additional growth layer. ZPAL Mo. IX/68a.
Fig. 5. Radial section of the marginal part of the valve. In thick nacreous aragonite layer the numerous growth lines are visible. These lines are running nearly parallel in relation to inner margin of the valve. ZPAL Mo. IX/60.
Specimens on figs 2-5 × 10.



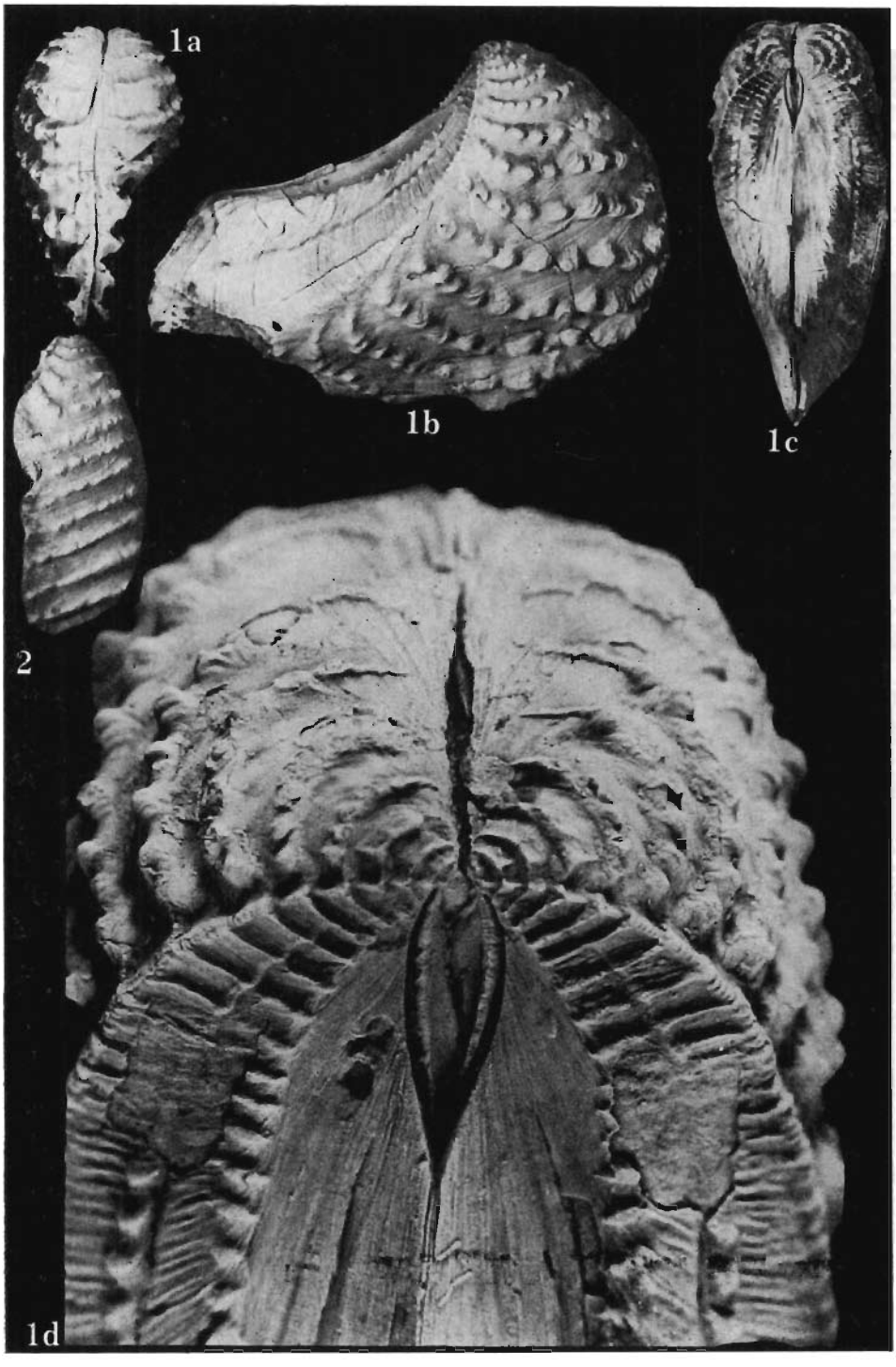
Phot. M. Czarnocka



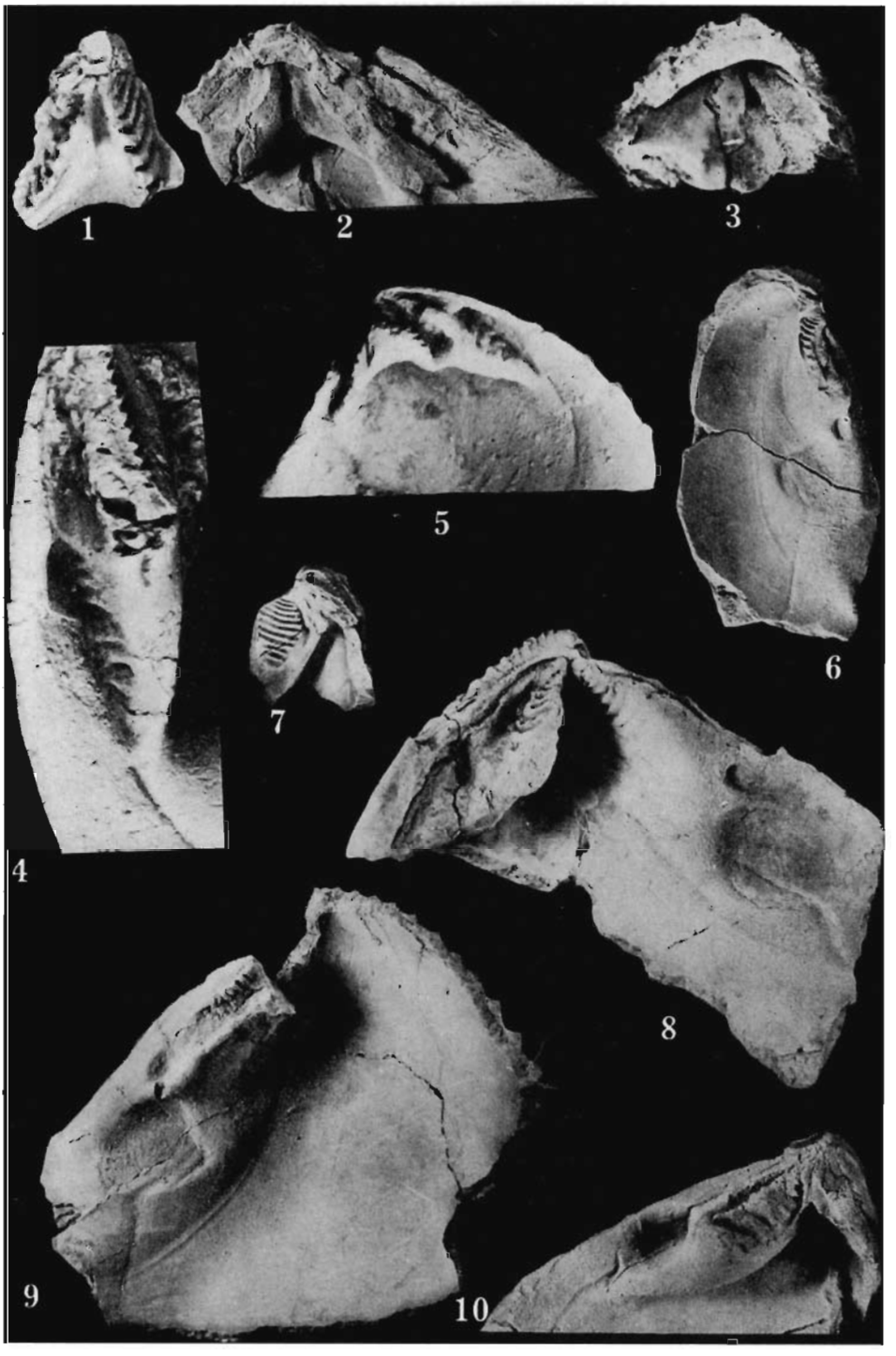
Phot. M. Czarnocka



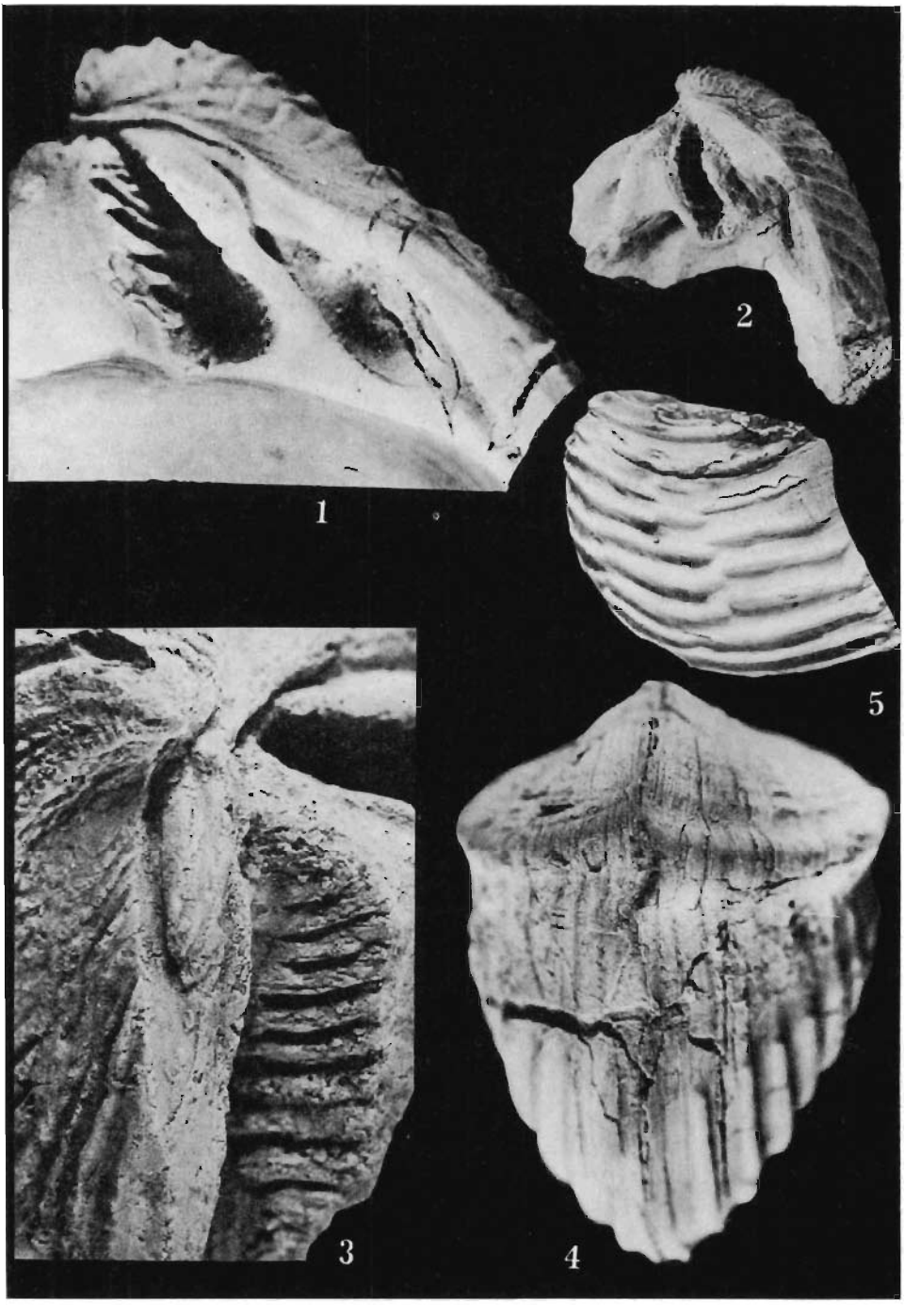
Phot. E. Mulawa



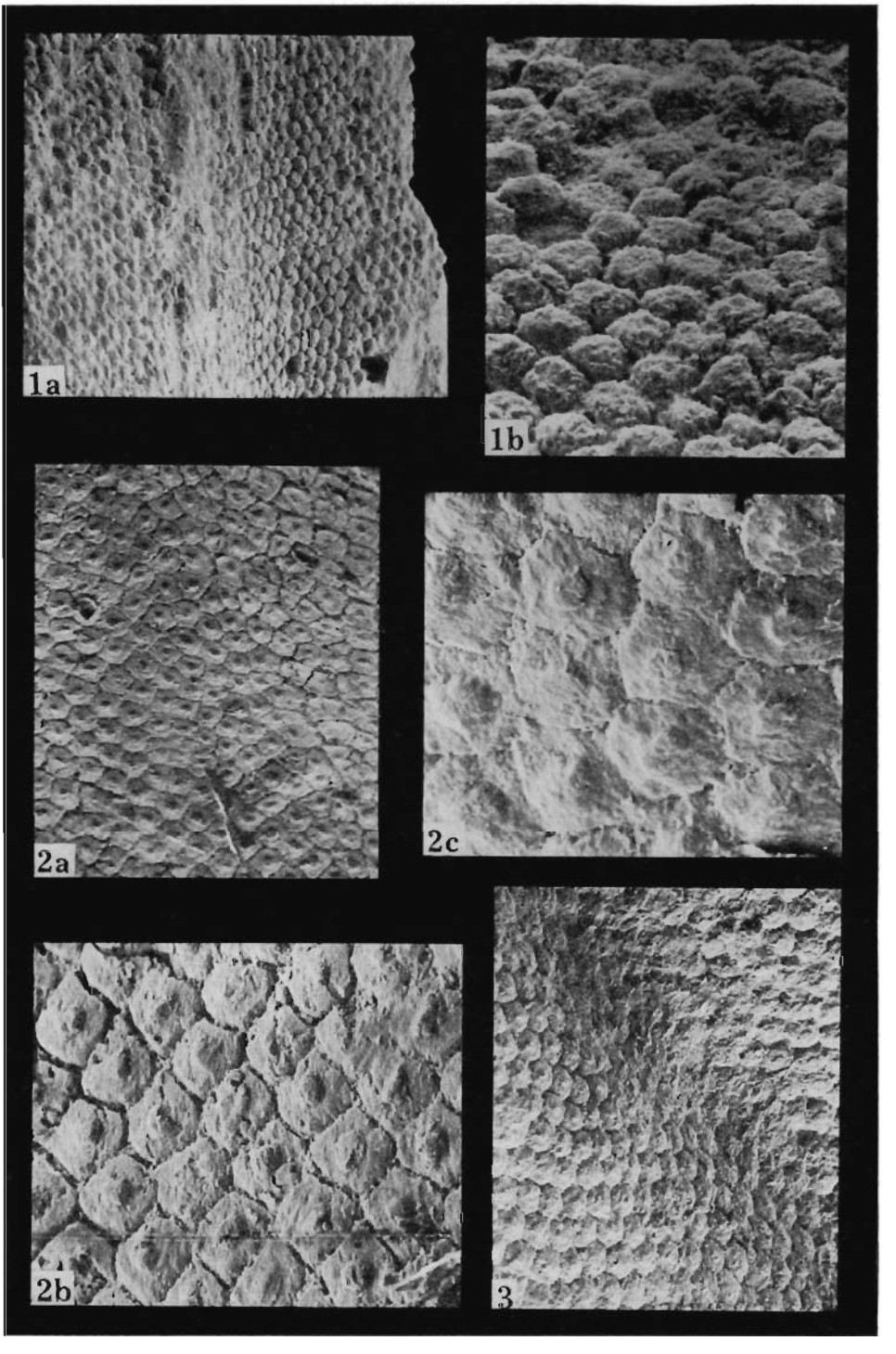
Phot. E. Mulawa

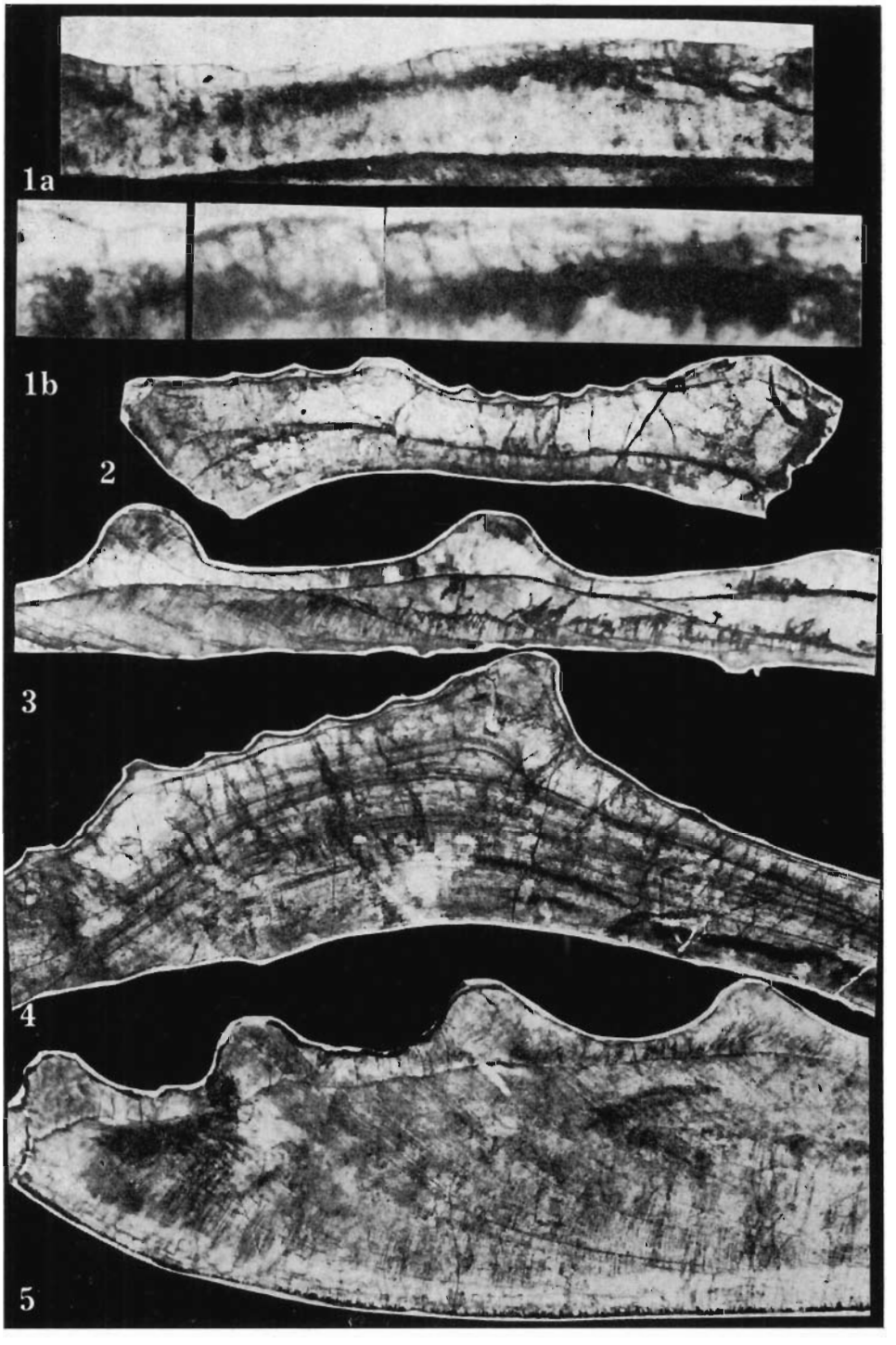


Phot. E. Mulawa



Phot. E. Mulawa


1a
1b
2a
2c
2b
3



Phot. M. Czarnocka