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LOWER FAMENNIAN BRACHIOPODS FROM THE HOLY CROSS MOUNTAINS, POLAND

Abstract. — The Lower Famennian brachiopods from the southern part of the Holy Cross Mountains (Góry Świętokrzyskie) are described. Two new species: *Orbiculoidea kadzielniensis* and *Tenuisinurostrum subcrenulatum* are proposed, the latter taxon considered as an index fossil. Remarks on the shell exterior and interior, growth changes and individual variations are included.

INTRODUCTION

The stratigraphy of the Famennian strata of the Holy Cross Mountains (Góry Świętokrzyskie) is based mainly on corals, conodonts, cephalopods and trilobites. The brachiopods here have, up to now, never been studied in detail, so their stratigraphical value is not defined. This was probably due, among others, to their unsatisfactory state of preservation and the scarcity of their occurrence. Although some of the brachiopods were mentioned by e.g. Gürich (1896, 1900, 1909), Samsonowicz (1917), Sobolev (1909, 1912*a*, 1912*b*), their descriptions were inadequate and often without illustrations. To fill this gap in our knowledge of the Lower Famennian brachiopods, the present author has undertaken some restudy of this group.

The described specimens come from a few localities in the southern part of the Holy Cross Mountains, collected by Dr. H. Osmólska (Jabłonna) and Prof. M. Różkowska (Zaręby, Kielce) between the years 1959—1962. They come from the Lower Famennian layers, corresponding to the upper "*crepida*" and lower "*quadrantinodosa*" zones (Wolska, 1967). It is, at present, the largest collection of Lower Famennian brachiopods from the above area, containing over 900 specimens, however, it is poor in species. Two new species are described. The remaining few inarticulate and articulate specimens are not assigned definite specific names owing to their unsatisfactory state of preservation. A rhynchonelloid,

Tenuisinurostrum subcrenulatum n. sp. which occurs "en masse" in Jabłonna and Kielce, in a limited range of time, can be considered as a useful index fossil. This is supported by the additional fact that *Tenuisinurostrum crenulatum* (Gosselet), type species of the genus *Tenuisinurostrum* Sartenaer, akin to our *T. subcrenulatum* n. sp., characterizes the Lower Famennian "*crenulatus*" zone in Belgium (Sartenaer, 1957*b*, p. 436; 1967, p. 17).

Acknowledgements

An acknowledgement is made to Prof. M. Różkowska (Palaeozoological Institute, Polish Academy of Sciences, Poznań Branch), and Dr. H. Osmólska (Palaeozoological Institute, Polish Academy of Sciences, Warszawa) for providing the present author with the Lower Famennian brachiopod material; to Dr. P. Sartenaer (Institut Royal des Sciences Naturelles de Belgique, Brussels) for his kindness in sending some specimens of *Tenuisinurostrum crenulatum* (Gosselet) from Belgium. The photographs are the work of Miss M. Czarnocka, the inking of the drawings of Mrs. K. Budzyńska, the thin sections, peels and some preparations of Miss D. Kościelska (all from the Palaeozoological Institute, Polish Academy of Sciences, Warszawa). To all these persons my thanks are due.

The here considered collection is deposited at the Palaeozoological Institute, Polish Academy of Sciences, Warszawa, for which the abbreviation Z. Pal. is used.

REMARKS ON LOWER FAMENNIAN EXPOSURES

The considered brachiopods come from two regions in the southern part of the Holy Cross Mountains (Fig. 1), which differ in their lithology and in the general faunal assemblage. They are: 1) Kielce—Łagów Synclinorium with cypridinic shales, intercalated by massive and nodulous limestones, fauna consists of corals (Różkowska, 1969), conodonts (Wolska, 1967), trilobites (Osmólska, 1958), some pelecypods, cephalopods, ostracods and brachiopods (Kadzielnia quarry at Kielce, Zaręby); 2) Gałęzice—Daleszyce Syncline with clymenid limestone, fauna of pelecypods, cephalopods, crinoids prevailing, numerous conodonts (Wolska, 1967) and trilobites (Osmólska, 1962), rare corals (Różkowska, 1969), poor and extremely rare brachiopods (Jabłonna).

Kadzielnia quarry. The brachiopods come from 3 exposures named by Różkowska: Beds I-III (Różkowska, 1969). Very rarely do they occur in exposures I and II, but are more numerous in III-d.

Exposure I comprises four complexes of layers consisting of calcareous concretions in marly shales, massive limestone with intercalations of

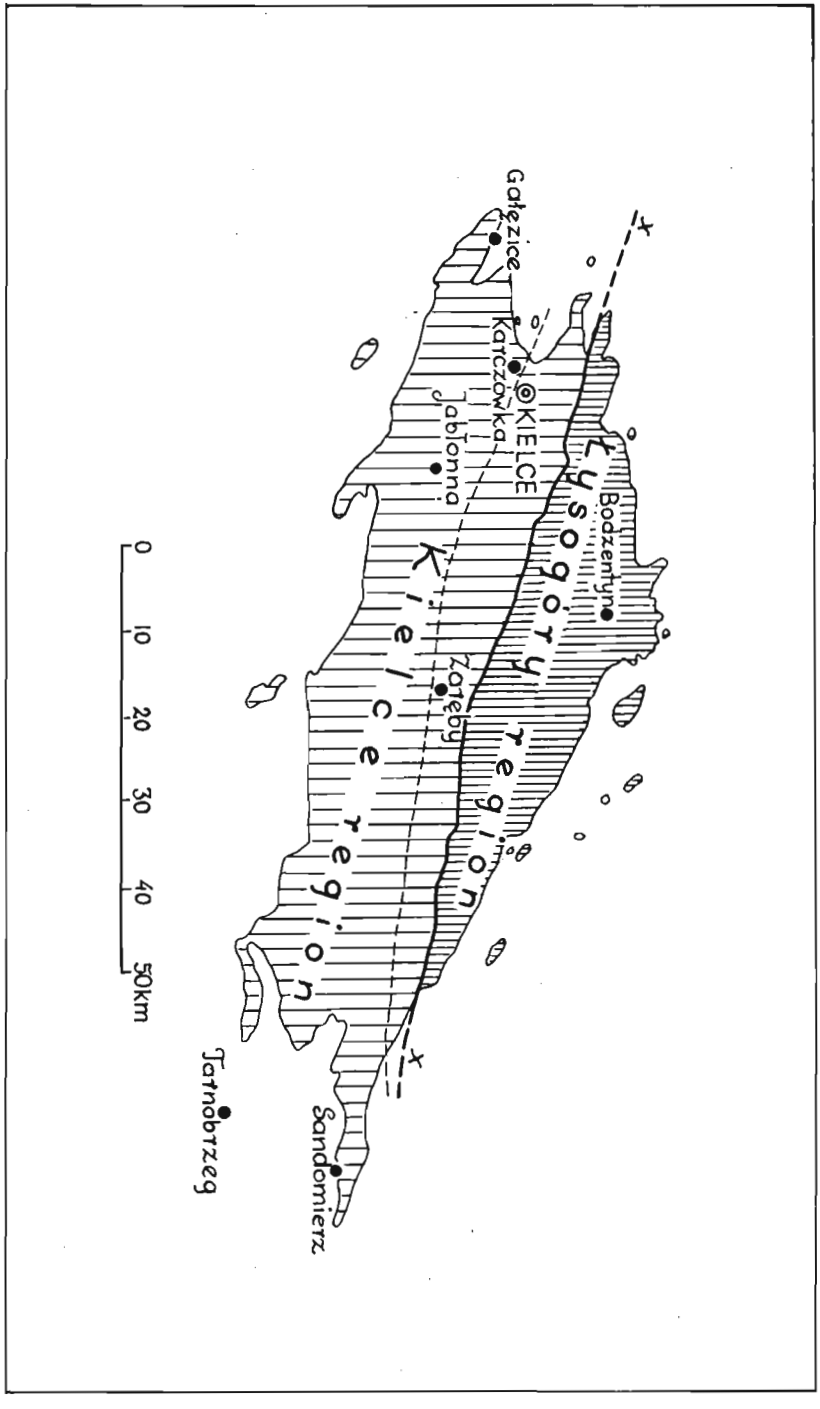

Fig. 1. — Map of the Holy Cross Mountains district. Range of Palaeozoic deposits and localities with brachiopod bearing beds marked (after Różkowska, 1969, Fig. 1).

dark, bituminous shales and limestone nodules. The brachiopods are sporadically represented by the inarticulate *Orbiculoidea kadzielniensis* n. sp. and a few articulate species *Tenuisinurostrum subcrenulatum* n. sp., *Cyrtospirifer* cf. *archiaci* (de Vern.), *Athyris* sp. They are accompanied by more numerous corals: *Amplexocarinia muralis* Soshkina, *Nalivkinella rariseptata* Różk., pelecypod *Posidonia venusta* Münster and by rare fragments of cephalopods *Cheiloceras* sp. and *Michelinoceras* sp.

Exposure II comprises the layers A-N composed of dark shales with or without calcareous concretions, marly shales, limestones. The brachiopods, also not numerous here, are: *Orbiculoidea kadzielniensis* n.sp. (layers M, N, D), *Lingula* sp. (layer F), accompanied rather abundantly by *Posidonia venusta* Münst., *Buchiola retriostrata* v. Buch, *Cyrtoceras* sp., *Michelinoceras* sp., *Tornoceras* sp. and *Tenuisinurostrum subcrenulatum* n. sp. (layer K) which is very rare, associated with corals *Kielcephyllum confluens* Różk., *Amplexocarinia muralis* Różk., cephalopods *Cheiloceras* sp., and *Michelinoceras* sp.

Exposure III is the largest (see Różkowska, 1969, Fig. 2) comprising about 50 thin layers of alternate deposits of thin-grained limestones and marly or weakly limy shales with or without nodules. This exposure directly overlies the organodetritic Upper Frasnian limestone. In the lower part of the Famennian, 3 distinct zones of conodonts were recognized (Wolska, 1967): "*crepida*" zone with e. g. *Palmatolepis crepida* Sanneman — layer 50; "*rhomboidea*" zone with e. g. *P. rhomboidea* Sanneman — layers 49-47; "*quadrantinodosa*" zone with e. g. *P. quadrantinodosa quandrantinodosa* Branson & Mehl, *P. glabra glabra* Ulrich & Bassler, *P. tenuipunctata* Sanneman, *P. glabra perlobata* Ulrich & Bassler, *P. glabra pectinata* Ziegler, *P. minuta minuta* Branson & Mehl — layers 46-38. In the remaining layers no conodonts were found and the stratigraphy is based on cephalopods and partly on trilobites. As to the brachiopods, there occurs mainly *Tenuisinurostrum subcrenulatum* n. sp., found as a great concentration of shells in a very limited area of the 30 cm thick layer (42) of marly gray shales, within the "*quadrantinodosa*" zone. It is accompanied here by unidentified crinoids and single specimens of *Trimerocephalus mastophtalmus* (Rhein.Richter). In the remaining layers single specimens of *Tenuisinurostrum subcrenulatum* n. sp., *Orbiculoidea kadzielniensis* n. sp., *Lingula* sp., *Lingulipora* sp. are scattered throughout the whole thickness of the exposure. Other groups represented are: corals, e. g. *Petraiella profunda* Różk., *Kielcephyllum densum* Różk., *Nalivkinella profunda* Różk., lacking in the layers 17-1 (Różkowska, 1969); trilobites — e. g. *Trimerocephalus caecus* (Gürich), layers 49, 47, 44; *T. mastophtalmus* (Reinh. Richt.), layers 42, 41, 12, 9, 5-3, *T. polonicus* Osmólska, layer 3; bivalves — *Posidonia venusta* Münst., repeated throughout the profile. The same applies to the ostracods, not identified; cephalopods — *Cheiloceras curvispina* Münster, layers 45, 32, 26-25; *Ch. globosum* Mün-

ster, layer 26; *Ch. ambrylobum* Sandb., layers 50, 48, 44; *Cheiloceras* sp., layers 43, 41-40, 36, 27, 23, 19, *Michelinoceras* sp., layers 50, 46-44, 25, 7; *Tornoceras simplex* v. Buch, layers 28, 26; *Cyrtoceras* sp., layer 50. In addition to the above, there are unidentified crinoids and worm tubes.

Zaręby near Łagów. Very rare are specimens of *Lingulipora* sp. and *Lingula* sp. occurring in mudstones, almost amorphous, in association with *Posidonia venusta* Münst., *Phacops granulatus* Münst., *Cyrtosymbole* (*C.*) *franconica* R. & E. Richter.

Jabłonna beds near Borków exposed by Osmólska in 1962, about 200 m from the road to Kaczyn, comprises 30 layers of organodetritic or recrystallized red-purple limestones. The brachiopods come from the base of the Lower Famennian (layers 13-16) probably slightly below the first appearance of the Famennian trilobites (oral communication from Dr. H. Osmólska) and are confined to thin layers of red marls intercalating with the massive limestones. They are represented by one species — *Tenuisinurostrum subcrenulatum* n. sp., with specimens of different size, occurring, as in the Kadzielnia quarry "en masse". On the basis of the conodonts (Wolska, 1967, Tab. 1), *T. subcrenulatum* n. sp. is confined mainly to the upper "*crepida*" and to the "*quadrantinodosa*" zones (?lower part), being associated with the conodonts, e. g. *Palmatolepis superlobata* Branson & Mehl ("*triangularis*" — "*quadrantinodosa*" zone), *P. tenuipunctata* Sanneman ("*crepida*" — "*quadrantinodosa*" zone), *P. glabra glabra* Ulrich & Bassler ("*crepida*" — "*quadrantinodosa*" zone), *P. minuta minuta* Branson & Mehl with a fairly wide range "*triangularis*" — "*quadrantinodosa*" zones). In addition, the conodont species are, to a great extent, almost identical to those of the Kadzielnia quarry (comp. p. 4).

The above review shows that: 1) the Lower Famennian brachiopods are, in comparison with the other fossils, a monotonous assemblage, constituting only a small part of the whole fauna in the considered exposures; 2) the brachiopods occur more abundantly in shale facies than in the limestone and, in general, are not very associated with the other fossil groups; 3) *Tenuisinurostrum subcrenulatum* n. sp. merits some mention as an additional example of a very "expansive" form creating a monospecific fossiliferous "bank", (like e. g. *Mutationella podolica* Kozł., *Peregrinella multicarinata* Lmck. (Kozłowski, 1929; Biernat, 1957). Probably, the environment favoured a great proliferation of this species, which quickly and almost exclusively took over a definite area on the sea bottom. The other groups could, perhaps, not withstand this competition, or the life conditions were not suitable for them. Hence, the other animals are not associated with the dominating *T. subcrenulatum* n. sp. or if they occur, they are scarce; 4) the *Tenuisinurostrum subcrenulatum* n. sp. bearing beds (Kadzielnia quarry, Jabłonna) constitute a fossil community ("life assemblage"), this being evidenced by shells of a wide range of growth

stages occurring together. This fossil assemblage could not be far removed, if at all, from its life area. This can be supported by the fact that shells are not disarticulated, evidence of comparatively freedom from turbulence and sorting during sedimentation.

MATERIAL

The most numerous of the inarticulates are specimens of *Orbiculoidea kadzielniensis* n. sp. (more than 40 specimens of pedicle or brachial valves), the others occurring very sporadically. They are all preserved as external or internal moulds of particular valves. This applies especially to orbiculoids, which are usually badly crushed, often preserved as fragments of valves (their apical parts usually preserved), with very small patches of an external "mat" shell layer preserving the surface concentric lines.

Of the articulates the best are preserved specimens of *Tenuisinurostrum subcrenulatum* n. sp. (from Kadzielnia quarry). The large and small shells of this species differ somewhat in the nature of their preservation. All shells are closed, and on an average, almost complete, retaining their original proportions, and to a great extent, the shell shape and outline, but not without deformations. Many of the larger shells (= adults) with advanced shell convexity and a developed tongue-like extension are, often, badly damaged mostly due to crushing, probably as a result of the compaction of the sediments. The young specimens (= flat), on the contrary, are better preserved, only slightly deformed, asymmetrical. Their small size and very limited shell convexity protected them from the effects of the compaction of the sediments. On the contrary, specimens from Jabłonna exposure are, in addition to deformations, very badly crushed, usually preserved as larger or smaller fragments of shell, and rarely of valves. In addition, the shells from Kadzielnia quarry are usually completely filled with matrix material, only rarely being recrystallized; those from Jabłonna are partly filled, mostly posteriorly, by matrix, the rest of the shell, which probably was uppermost at the time of burial, being recrystallized or forming geods, partially or completely filled with calcite crystals. Specimens, which occur in limestone, mostly adults, are also much less crushed. The few other articulate species which complete the Lower Famennian assemblage of brachiopods from the shaly limestone or shales (Kadzielnia quarry, exposures I, II, Zaręby) are found as fragmentary specimens of particular valves only, not suitable for exact identification (they are only cited or illustrated on Pl. III but not described). They are: *Nervostrophia* sp., *Productella* sp., *Cyrtospirifer* cf. *archiaci* (de Vern.), *Atrypa* sp., *Chonetes* sp. The specimens of *Tenuisinurostrum subcrenulatum* n. sp. were obtained from the soft rock by the washing method. The inarticulates and the remaining articulates could only be slightly

prepared mechanically with a needle. A short quantitative morphological study of *T. subcrenulatum* n. sp. has been undertaken to show the range of the individual variability and the growth changes.

DESCRIPTIONS

Superfamily **Discinacea** Gray, 1840
Family **Discinidae** Gray, 1840
Subfamily **Orbiculoideinae** Schuchert & Le Vene, 1929
Genus *Orbiculoidea* d'Orbigny, 1847

Type species: Orbicula forbesi Davidson, 1848, p. 334; Silurian (Wenlockian), England.

Orbiculoidea kadzielniensis n. sp.
(Pl. I; Pl. II, Figs 1-7; Text-figs. 2-6)

?1896. *Orbiculoidea excentrica* Gürich; G. Gürich, Das Paläozoicum..., p. 216 (*nomen nudum*).
1912. *Orbiculoidea excentrica* Gürich b?; D. Sobolev, O famenskom jaruse... (*nomen nudum*).

Type specimen: Z. Pal. Bp. XII/21c, figured on Pl. II, Fig. 6.
Type horizon: Lower Famennian, "*quadrantinodosa*" zone, layer 43, exposure III.
Type locality: Kielce (Kadzielnia quarry), Holy Cross Mountains, Poland.
Derivation of the name: kadzielniensis — found in the Kadzielnia quarry.

Diagnosis. — Shell subcircular, small, thick-shelled, wider than long, apexes very excentrically, pedicle groove very minute.

Material. — About 40 fragmentary specimens of single valves, the pedicle ones prevailing.

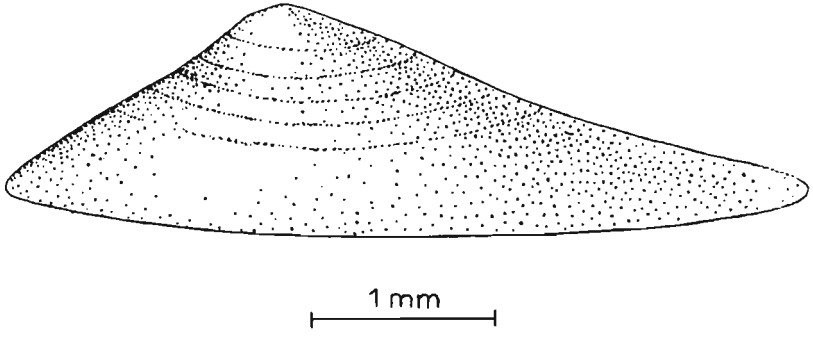

Fig. 2. — *Orbiculoidea kadzielniensis* n. sp. (Z. Pal. Bp. XII/21c), Kadzielnia quarry at Kielce, Exposure III, layer 33. Side view of pedicle valve.

Approximate measurements of 4 valves (in mm):

Z. Pal. Cat. No. Bp. XII	Whole length	Whole width	Length		Length pedicle groove
			ant. margin to apex	apex to post. margin	
21c pedicle valve, holotype exterior	9	10	6.7	3.3	1.2
1b brachial valve	8.6	?8	6.5	2.1	—
25a brachial valve	7	8	5.2	1.8	—
33 pedicle valve, interior	6.8	?8	5.0	1.8	0.9

Description. — Shell small, subcircular to circular in outline, posterior margin entire, slowly subconical in side view (Fig. 2), width usually exceeding the length, both apexes lying excentrally, the ventral one commonly more so, very close to the posterior margin, the distance from the later to apex slightly varying.

Pedicle valve gently convex, more elevated apically. Surface ornamentation consists of distinct concentric macrolines and microlines. The macrolines almost equal in thickness and height, 9-11 per 1 mm, are arranged regularly with intervals of slightly varying distance, their backs acutely thickened, separating furrows wider and correspondingly shallower, with moderately rounded bottoms. The microlines cover regularly both, the concentric macrolines and separating furrows, to about 30 per 1 mm, 5-8 between each two macrolines. The outline of concentric lines slightly changes with an increase in shell dimensions. The observed earliest concentric lines on the pedicle valve are almost round in outline, sometimes only slightly transversely elongated. With growing distance from the apex they gradually elongate anteriorly, running along a widely longitudinal--oval curvature. With the brachial valve it is slightly different. The concentric lines at the apex are somewhat elongate oval, becoming more circular with the shell enlargement. In addition to the above lines there occur concentric two colloured bands following the macrolines, alternat-

ely dark-brown and light, of varying width. This differentiation is, in all probability, connected with the degree of iron content in the sediment. It is possible that they may reflect, to some extent, the original colouring of the shell during the life.

Pedicle groove is, in comparison to the general shell size, minute, extending from the apex about half way or two-thirds to the posterior margin. It usually varies in length, a little only in width and depth. These being growth and to a lesser degree individual variations. The groove slit is lense-like, widening and only slightly deepening posteriorly, bearing along its bottom a median weak longitudinal ridge (= an external trace of the fusion of both walls of internal pedicle tube (Fig. 3*A*). Concentric lines, not continuing in the groove, are interrupted on both its lateral edges, which in this way are more accentuated.

Pedicle tube of slightly varying appearance is, sometimes, only discernible on the internal surface. It can be almost uniformly elevated on

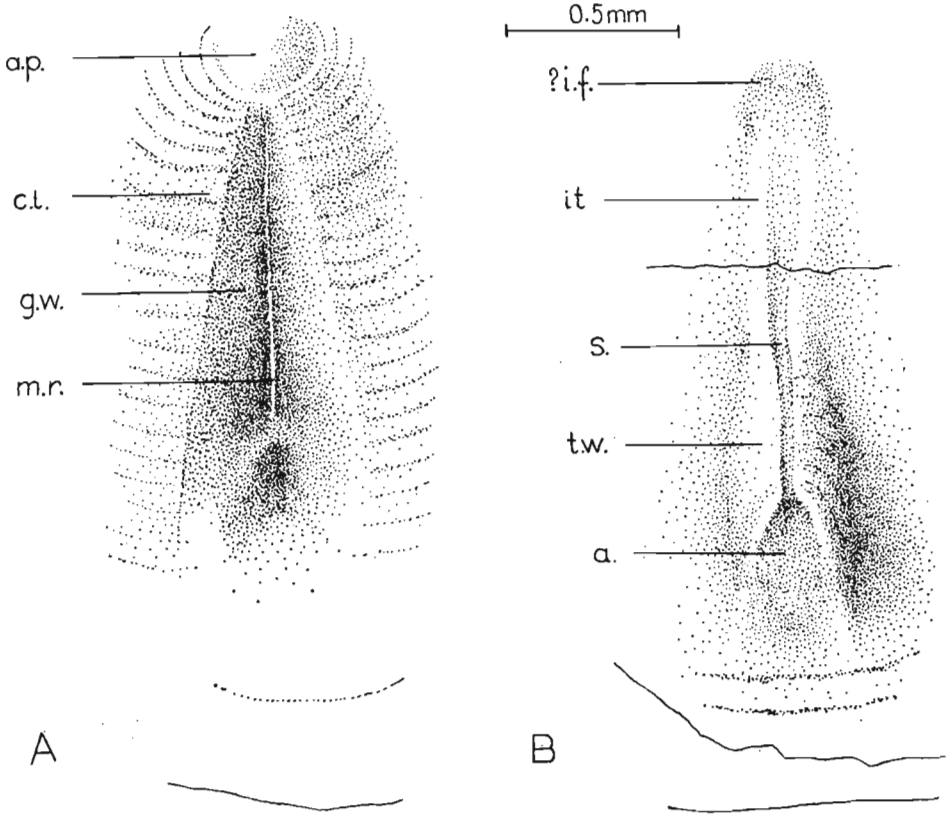

Fig. 3. — *Orbiculoidea kadzielniensis* n. sp., Kadzielnia quarry at Kielce. *A* pedicle groove (Z. Pal. Bp. XII/21e), Exposure I, layer 3; *a. p.* apical part, *g. w.* groove wall, *m. r.* median ridge; *c. l.* concentric lines. *B* pedicle tube (Z. Pal. Bp. XII/33), Exposure III, layer 33; *s.* suture of the tube, *t. w.* tube wall, *a.* aperture, *i. t.* incipient appearance of tube, *?i. f.* ?incipient foramen.

its whole length, or with growth it slightly but progressively enlarges in width, thickness and height, being almost flat apically, widening posteriorly from about one-third of its length. Both walls of tube usually remain, on their beginning part, separate, looking as slightly elevated shell thickenings. They probably almost correspond to the stage when the margins of the earlier pedicle slit become united, and the subsequent true tube and correspondent pedicle groove are about to be formed, leaving a distinct suture on the top of tube (Fig. 3*B*). In addition, on the younger halves of the tube and groove walls surfaces there are often steep-like thickenings, marks of the temporary arrested growth of the tube in length. At the apical end of the tube, there is, sometimes, a faint, rounded trace of the ?incipient pedicle foramen, which finally, after the posterior migration of the pedicle is a distinct aperture of slightly irregular outline (Fig. 3*B*). The edges of aperture are thickened, the lateral ones gradually fused with the valve floor, the upper edge, sometimes incised, this incision being final evidence of the progressing fusion of both walls of the tube. It is possible, that more adult valves do not preserve the traces of a suture and incision, these with time being obliterated by secreted shell substance.

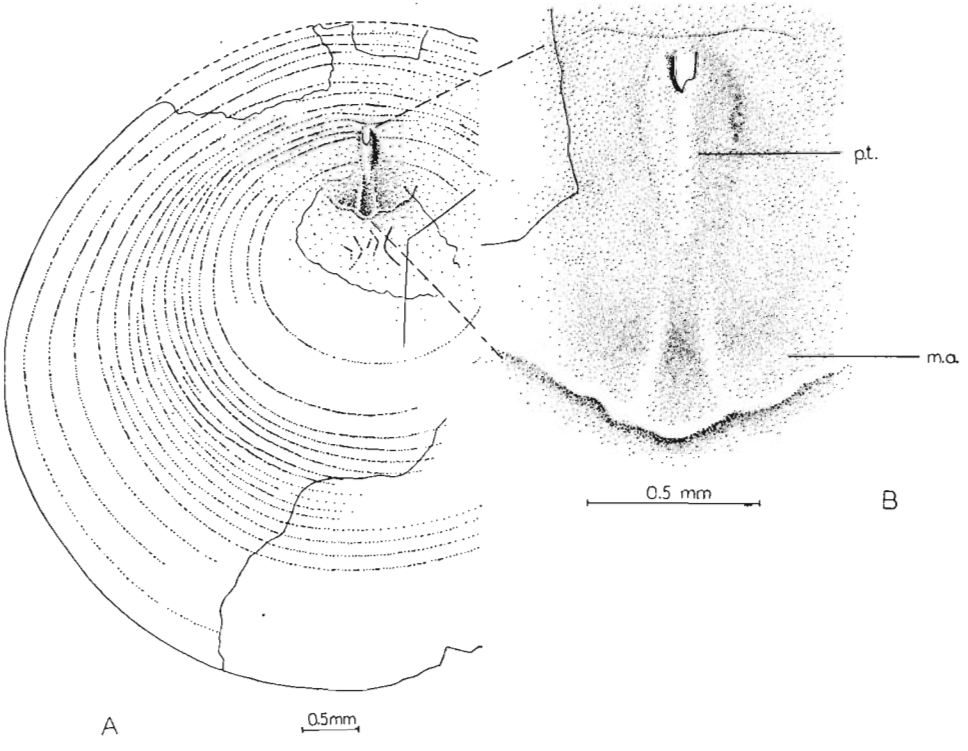

Fig. 4. — *Orbiculoidea kadzielniensis* n. sp. (Z. Pal. Bp. XII/33), Kadzielnia quarry at Kielce, Exposure III, layer 33. *A* ventral interior partly preserved, showing apical structure (partly exfoliated), *B* apical part enlarged: *p. t.* pedicle tube, *m. a.* muscle area.

Interior. — Ventral interior is very poorly seen. On the internal surfaces (Fig. 4), partly exfoliated, are preserved fragments of probably mantle canal system. This radiate series of furrows, probably of vascular nature, lies only within the inner lamellae of the shell and not interrupting the external shell ornamentation. It is, hence, a cause, that this canal system can be seen on the partly exfoliated interior. The sinuses are disposed around the small platform (?muscle platform), slightly elevating at its anterior end, and bounded by thickened ridge; this platform slowly lowers posteriorly in the median part of this platform, almost from the edge of the elevated ridge, a pedicle tube appears, progressively growing with age (comp. p. 42). The muscular impressions in orbiculoids are extremely faint and rarely discernible at all. In our specimens they are also not seen.

Dorsal interior not well known (Figs. 5, 6). There are discernible two, very divergent anteriorly ridges, starting from the environs of the dorsal apex and traces of muscles and pallial sinuses (Pl. I, Figs. 3-5). These later are, in general appearance, much like to those of *Lindströmella* Hall & Clarke (Hall & Clarke, 1892, Pl. 4*E*, Figs. 25—26) but differ, among others, in the outline, size, median ridge distinctly widening anteriorly (Fig. 5).

Remarks. — When comparing the illustrations of some Devonian and

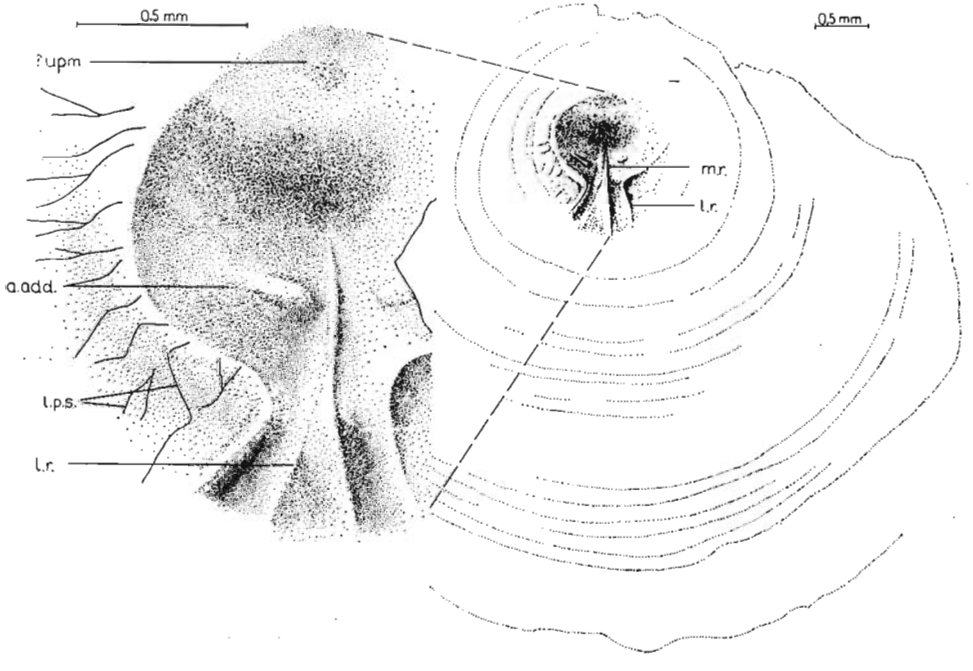

Fig. 5. — *Orbiculoidea kadzielniensis* n. sp. (Z. Pal. Bp. XII/37), Kadzielnia quarry at Kielce, Exposure III, layer 14. Partly exfoliated apical portion of the dorsal interior; *m. r.* median ridge, *l. r.* lateral ridge, *a. add* anterior adductor scar, *l. p. s.* lateral pallial sinuses, *?u. p. m.* ?unpaired posterior muscle.

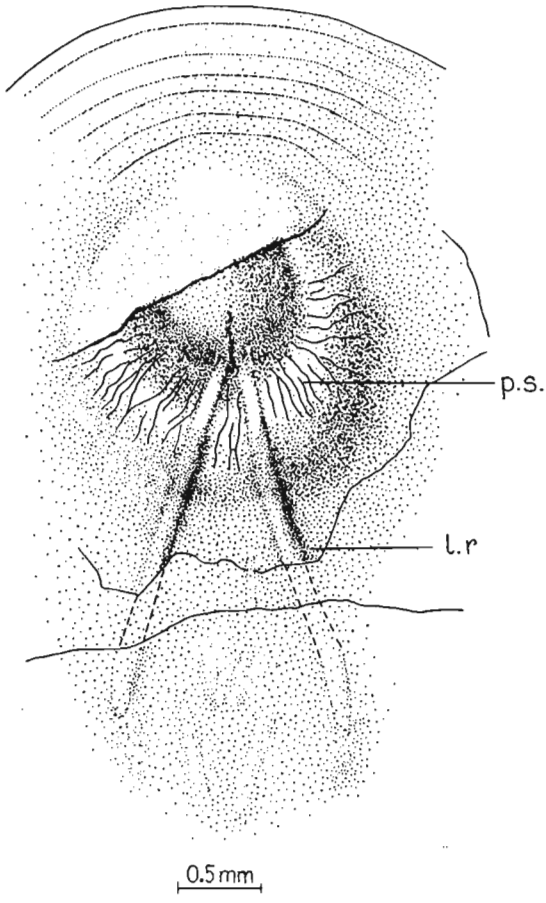

Fig. 6. — *Orbiculoidea kadzielniensis* n. sp. (Z. Pal. Bp. XII/1b), Kadzielnia quarry at Kielce, Exposure III, layer 14; brachial valve partly exfoliated, showing pallial sinuses, *p. s.* pallial sinuses, *l. r.* lateral ridges.

Carboniferous orbiculoids, it should be remembered that they are all much the same in external morphology, the distinctions being slight. No doubt, this is, to a great extent, due to the usually bad state of preservation of the specimens, unsuitable for study, and insufficient illustrations. In the case of the small collection from Kielce, all the specimens are tentatively regarded as belonging to one species. In spite of being badly damaged, it can be stated that they are all approximately of the same size and correspond to the adult age. In addition to the size, the other morphological features, such as: surface ornamentation, position of apexes and appearance of pedicle groove (of specific value for orbiculoids) are observable within all members of the species. *Orbiculoidea kadzielniensis* n. sp. is judged to be very close to *O. nitida* (Phillips). As to the latter form, it is, however, not well known and needs restudy. Judging from literature, its stratigraphical range and geographical distribution are fairly wide. *Orbicu-*

loidea kadzielniensis n. sp. is even closer, especially in the shell outline and appearance of both apexes, to specimens of *O. nitida* (Phill.) illustrated and described by Torley (1908, p. 39, Pl. 10, Fig. 7) and Paeckelmann (1913, p. 327) from Germany — Schleddenhofes at Iserlohn, Dorper Kalk. *Orbiculoidea nitida* figured by Davidson (1865, Pl. 20, Fig. 9) from the Devonian of England (Frankinurst quarry, Parish of Picton, Marwood beds of West Angle) is less rounded and the ventral apex less excentric than in *O. kadzielniensis* n. sp. Gürich (1896, p. 216) reported *O. nitida* (Phill.) from the Middle Devonian, Skały beds, of the Holy Cross Mountains, as very similar to the English form figured by Davidson (1865, Pl. 20, Fig. 9). Recently, Kościelniakowska (1966) mentioned this form from the Frasnian of the Trzcianki ravine in the Holy Cross Mountains. Judging from the illustrations given by Demanet (1934, Text-fig. 3, Pl. 1, Figs. 12-13), *O. nitida* (Phill.) from the Carboniferous (Tn_3, Tn_1) of Belgium, resembles our *O. kadzielniensis* n. sp. in the shell outline and position of the dorsal apex, the main difference being in the lack of the surface radial ornamentation in *O. kadzielniensis* n. sp. There is also some similarity to *O. tornacensis* Demanet (1934), but the later species differs in having less dense and less regularly distributed concentric macrolines. *Orbiculoidea kadzielniensis* recalls very much the Lower Devonian *O. falklandensis* Rowell (1965b, Pl. 2, Figs. 2-7) from the Horlick fm., Ohio range, Antarctica, differing a little in the shell outline, in having a slightly narrower and deeper pedicle groove and in the lack of radial fila. In addition, *O. excentrica* Gürich, (Gürich, 1896, p. 216) could be conspecific with *O. kadzielniensis* n. sp. judging from his extremely short description (= almost round in outline, apex very excentral, the pedicle groove slit-like and very short). Unfortunately, the first specific name is "nomen nudum" — no typical material of Gürich's species is preserved and no illustrations of the type specimen of *Orbiculoidea excentrica* are given by Gürich.

Family **Lingulidae** Moenke, 1838
Genus *Lingulipora* Girty, 1898

Type species: Lingula (Lingulipora) williamsana Girty; Upper Devonian, U.S.A.

Lingulipora sp.
(Pl. III, Figs. 6-8)

Horizon: Lower Famennian.

Locality: Kadzielnia quarry at Kielce, Holy Cross Mountains, Zaręby, exposure 1 (marls and marly shales).

Material. — Three internal moulds of single brachial valves.

Approximate dimensions (in mm):

Z. Pal. Cat. No. Bp. XII	Length	Width	Width posteriorly	Width anteriorly
1	3.8	3.1	1.4	2.3
2	3.7	3.1	?	?

Description. — Small, probably not adult, elongate-oval in outline, apex slightly pointed, anterior margin moderately rounded. Concentric microlines densely arranged, and the macrolines of wavy character, disposed in irregular intervals. Shell?punctate, punctae small, round, regularly spaced in a somewhat quincuncial pattern, preserved over the upper surface of the internal mould and on the inner surface of the shell (Pl. III, Fig. 6*a*).

Remarks. — The valves are poorly preserved, exposing two inner surfaces of probably pedicle valves and one brachial mould with exfoliated shell layer. The external outline, ornamentation and especially the punctate shell agree with those of *Lingulipora* Girty. Our specimens are close to those of *Lingulipora bowlensis* Mikrjukov reported from the Givetian of Bashkir, USSR (Gorjansky, 1960, Pl. 2, Fig. 3). The main differences are marked in the shell outline, which in the Famennian species is more oval, the lateral margins being more arched. A direct comparison shows that *Lingulipora* sp. from the Uppermost Devonian of Morocco (Ibel Tazout) [1] differs from the our form in being much larger, and the punctae are smaller and more densely disposed.

Genus *Lingula* Bruguière, 1797

?*Lingula* sp. cf. *L. koninckі* Schnur, 1851

(Pl. III, Figs. 9-10)

Type species: L. anatina Lamarck; Recent.
Horizon: Lower Famennian.
Locality: Zaręby, exposure marls, Holy Cross Mountains.

Material. — Two internal moulds of brachial valves.
Approximate dimensions (in mm):

Z. Pal. Cat. No. Bp. XII	Length	Width	Width posteriorly	Width anteriorly
31	9.6	3.8	1.0	3.0
32	7.4	3.4	1.0	2.8

[1] Few unidentified specimens of *Lingulipora* are, in the present author's collection, kindly offered by Dr. J. Drot, Institut de Paléontologie, Muséum d'Histoire Naturelle, Paris.

Description. — Small, narrowly and very regularly elongate-oval, lense-like in outline, widest at the midlength, acutely pointed posteriorly and to a slightly lesser degree anteriorly; lateral margins moderately arched, concentric macrolines slightly wavy in appearance, badly preserved; the macrolines observed on the lateral slopes, posteriorly.

Remarks. — No other features can be seen in the above form. The internal details are not preserved. One of the characteristic external features is the very narrowly elongate shell, which is judged to be of natural character, the preserved specimens do not show special traces of eventual deformations. The considered form is very similar to Schnur's *Lingula koninckí* (Schnur, 1851, p. 229, Pl. 43, Fig. 6) from the *Goniatites* layers at Büdesheim. The German species (unfortunately only a fragmentary specimen being figured) is also narrowly elongated anteriorly. Our form displays a shell outline very near that of the genus *Langella* Mendes (Rowell, 1965*a*, p. H263, Fig. 158.5). It is also close to *Barroisella* Hall & Clarke, only more narrowly outlined (Rowell, comp. 1965, p. H263, Fig. 158.2). It is really very near to *B. subspatulata* Meek & Worthen as is shown by the illustrations (Hall & Clarke, 1892, Pl. 2, Figs. 16-18).

Family **Camarotoechiidae** Schuchert & Le Vene, 1929
Subfamily **Camarotoechiinae** Schuchert & Le Vene, 1929
Genus *Tenuisinurostrum* Sartenaer, 1967

Type species: Camarophoria crenulata Gosselet, 1877, pp. 316-317, Pl. 4, Figs. 8a, b, 9c, d, Upper Devonian (Lower Famennian, Tranchée de Senzeilles), Belgium.

Species assigned: Tenuisinurostrum crenulatum (Gosselet), Belgium; *?Camarophoria elegans* Güirich, Poland; *Tenuisinurostrum subcrenulatum* n. sp., Poland; *Pseudoleiorhynchus ?zemoulensis* Drot, Morocco; *?Leiorhynchus kielcensis* Sobolev, Poland.

Remarks. — The generic assignment of the type species was somewhat controversal, as is seen from the synonymy (comp. Sartenaer, 1967). The species was treated as a member of *Camarophoria* King (= *Stenoscisma* Conrad), *Leiorhynchus* Hall and *Calvinaria* Stainbrook. This was, in all probability, due to its almost unknown interior (lately restudied by Sartenaer in 1967). Moreover, its exterior is confusing, due to its great simplicity, a common feature within palaeozoic rhynchonelloids. The morphological features of *Tenuisinurostrum crenulatum* (Gosselet) are very comparable with those of the mentioned genera, e. g. *Leiorhynchus* and *Calvinaria*. However, the very simple exterior of *Tenuisinurostrum* and equally simple interior (i. e. vestigial dorsal septum, small teeth, no dental plates — characteristic of the type species) make the genus *Tenuisinurostrum* a quite distinguishable taxon. Another valuable feature is its stratigraphical position. *T. crenulatum* (Goss.) is confined to the Lower Famennian (Sartenaer, 1967, pp. 5-6) of Belgium. This limited vertical ran-

ge also concerns the other known members of the genus *Tenuisinurostrum* — all cited from the Lower Famennian beds. *Tenuisinurostrum* Sartenaer is younger than *Leiorhynchus* and *Calvinaria* (Givetian, Frasnian) but older than *Stenoscisma* (Carboniferous, Permian).

In addition, to the genus *Tenuisinurostrum* can be assigned, in all probability, two species from the Holy Cross Mountains: *Camarophoria elegans* Gürich, described from the Upper Devonian of Karczówka (Gürich, 1896, p. 261, Pl. 7, Fig. 10) and *Leiorhynchus kielcensis* Sobolev from clymenid limestone of Kielce (Sobolev, 1912*b*, p. 4, Pl. 1, Fig. 1). The exterior of the mentioned taxons are, in general, of the type of *Tenuisinurostrum*. Unfortunately, their interior is not yet known.

Stratigraphical and geographical range. — Lower Famennian (western and ?eastern part of the Dinant Basin, Belgium; ?France; Poland, Holy Cross Mountains), "*crepida*" and "*quadrantinodosa*" zones — Jabłonna, Kielce, Karczówka?; Morocco, Syncline of Tindouf (Famennian II); ?USSR.

Tenuisinurostrum subcrenulatum n. sp.

(Pl. III, Fig. 1; Pls. IV. V; Text-figs. 7,8)

Type specimen: Z. Pal. No. Bp. XII/25; Pl. V, Fig. 2; Paratypes: Z. Pal. Bp. XII/20, 21, 24a, 24, 26; Pl. V, Figs. 1,3-6.

Type horizon: Marly shales, layer 42, Lower Famennian, "*quadrantinodosa*" zone.

Type locality: Kielce — Kadzielnia quarry, Holy Cross Mountains.

Derivation of the name: subcrenulatum — remind one of the *Tenuisinurostrum crenulatum* (Gosselet) in the external appearance.

Diagnosis. — Like *Tenuisinorostrum crenulatum* (Gosselet) but smaller, less globular, radial ornamentation extremely faint, sulcus very shallow, fold low.

Material. — About 230 specimens well preserved.

Approximate dimensions (in mm):

Z. Pal. Cat. No. Bp. XII		Length	Width	Thickness	Sulcus width	
					anteriorly	posteriorly
20,	holotype	13.4	15.5	7.5	10.0	5.8
21	paratypes	14.9	18.8	10.3	13.1	9.6
22		12.5	15.0	6.7	9.2	6.6
23		12.2	14.8	8.5	11.0	5.4
24		14.5	15.8	10.3	?9.7	6.3
25		12.5	14.5	9.0	9.3	5.3
26		12.3	15.2	8.7	9.4	6.2

Description. — Shell of median size, widest about midlength, moderately dorsi-biconvex, dorsi-plane to slightly dorsi-concave, in varying degree

widely pentagonal to subcircular in outline; the hinge and the antero-lateral angles rounded, anterior commissure uniplicate.

Pedicle valve. Beak small but well marked, acute, incurved, pedicle foramen comparatively minute, round, subapical, in gerontic specimens usually obscured; deltidial plates very small, often indistinct, area and ventral ridges poorly marked; shallow median sulcus starting about half valve length, the two bordering lateral foldings distinct, although not very high, to different degree divergent anteriorly.

Brachial valve. Beak not very conspicuous in adults, covered by the ventral one, median fold low, bordered by two, side shallow grooves — counterparts of ventral side foldings.

Ornamentation. — Surface radial ornamentation is poorly developed, one of the characteristics of the species. Besides the side ridges and furrows of moderate height and depth which border the ventral sulcus and dorsal fold, there are sometimes present, very faint and short radial ribs of almost equal width, 2-4 in the sulcus and generally 2 on the fold. Lateral ribs, usually present on the antero-lateral third of the shell, are always shorter and weaker than the median ones, as they are added very late in the growth process. Concentric growth macrolines, in general, rare, irregularly arranged, sometimes leaving thickened traces in the anterior third of the shell, usually better marked on the lateral slopes.

Interior — as in type specimen *Tenuisinurostrum crenulatum* (Gosselet).

Growth changes. — The collection includes representatives of three age groups differentiated on the basis of two main morphological features recognized to be an important element of growth. These are: 1) the development of radial ribs and 2) the morphogenesis of ventral sulcus and dorsal fold. These features appear late in the process of growth and, therefore, they never attain their full development in adults. However, the time of their first appearance and the small but consequent changes in their development really offer a good basis for recognition of these groups. They are: 1) the young (immature), comprising shells with a completely smooth surface, of very low shell convexity, antero-lateral margins rounded; these specimens constitute about one-fourth of the whole collection; 2) intermediate, with sulcus and fold differentiated, bearing a few very faint median ribs which appear always after the sulcus and fold are definitely formed and have a definite length, the shells are roundly-pentagonal in outline with beak truncated; the specimens are the most numerous in the collection; 3) the advanced adult group with the features of the former stage, but in their full development for the species; sulcus and fold, although growing remain always flat and shallow, steeply curving dorsally to form a tongue-like extension, the anterior commissure generally defined as somewhat of uniplicate to slightly sulciplicate type; in

addition, a few faint ribs at the shell commissure, laterally to the tongue extension usually appear. As they arise so late, they remain indistinct, expressed as comparatively broad and short plications. As a result, the final antero-lateral commissure can be very weakly zigzag, reminding one, to some extent, of Rudwick's subgroup B III (Rudwick, 1964, p. 151). The shell preserves, to a varying degree, its widely pentagonal outline, ventral beak strongly incurved, covering the dorsal one, ventral beak ridges obscured. The most distinct of these groups are: 1) the young, being stable in external morphology, the shell flat and smooth, and 2) the beginning phase of the second, intermediate stage. The appearing at this stage of the sulcus and fold enables to recognize, even visually, the immature (young) and the older individuals. For this reason, in the case of the considered collection, the average shell length in mm can be given, which approximately defines: a) the maximum observed shell size attained by the immature individuals, which is 5.3 mm of the shell length (the observed upper limits of length for this stage ranging from 3.4-5.3 mm), and b) the beginning phase for the second stage, intermediate, which usually ranges between 3.2 mm to about 5.7 mm of the shell length.

To generalize, the range of the shell length for the first differentiated group is comparatively great, and shell can attain almost one-third of the whole length of adults. The longest stage, basing on the considered morphological features, is the second one — intermediate, constituting almost two-thirds of the whole length of adult individual, ranging in the limits of about 3.5 to 14 mm of the shell length. The most indistinct is the beginning phase of the third stage, because of the gradual but slow changes in the appearance of the sulcus and fold. Characteristic of this stage is the tongue extension which reaches its full development (tongue moderate) towards the end of the adult growth period. This stage can start, approximately, in the limits of about 12.5 to 14.0 mm of the shell length. The possible maximum shell length for this stage is not known. In the considered collection it is about 17 mm. In addition, there occur subsequent changes in shell length and width during the growth and the relationship of shell length to width is perfectly direct (Fig. 7). As to the radial ribs including these on the lateral flanks of the shell, they appear late in the process of growth. This phenomenon occurs especially often within rhynchonellids. Kozłowski (1929, p. 146) considers this feature as arising independently in a number of different groups within articulate brachiopods.

Individual variability. — The degree of variation within the *Tenuisinurostrum subcrenulatum* n. sp. fossil community is rather limited and not distinct. This concerns all specimens in a particular growth stage, having been ascertained on the abundant collection at hand (230 specimens measured). This is, most likely, due to the great morphological simplicity

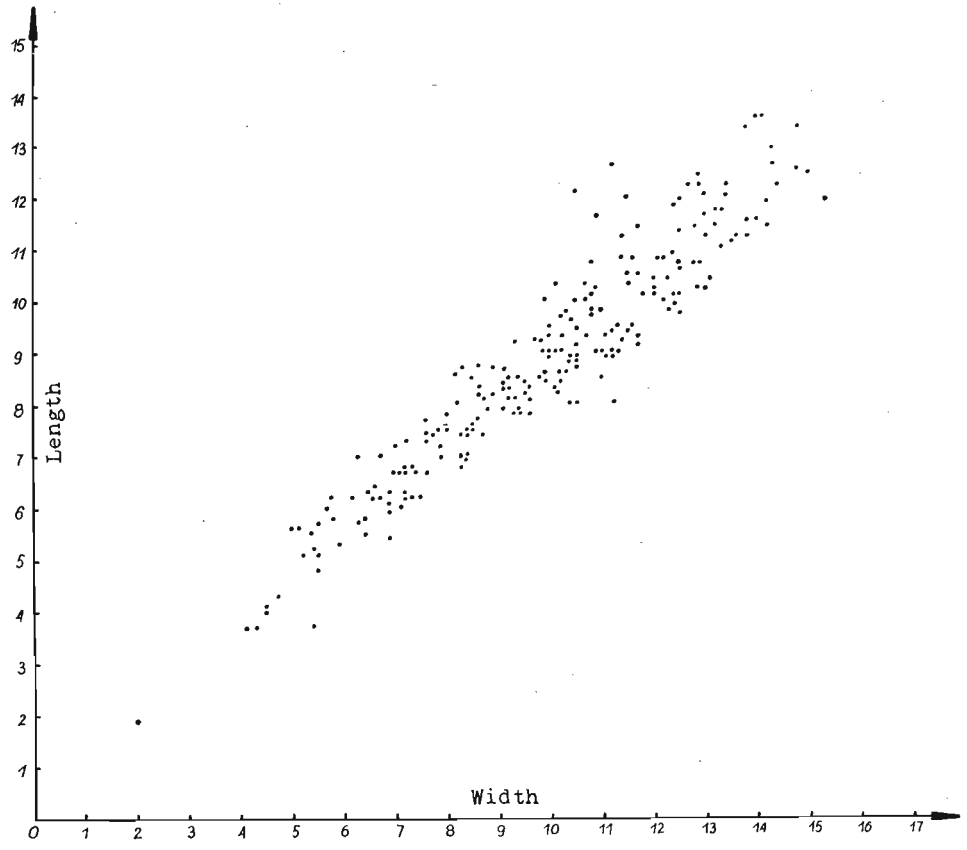

Fig. 7. — *Tenuisinurostrum subcrenulatum* n. sp., Kadzielnia quarry at Kielce, Exposure III, layer 42; scatter diagram of the relationship of length to shell width — the correlation during growth being direct.

of the species. Also the degree of bottom turbulence and other environmental factors are not without some influence.

In general, two quite distinct variants of the shell outline (of course with many intermediates) are observed in samples from Kielce and Jabłonna, but with a difference in the number of representatives for each variant. The shells can, in general, be a) widely pentagonal and b) narrowly pentagonal. In the first case, the ventral beak is less pointed and the hinge-line comparatively very widely, moderately arched. These shells predominate in the Kielce (Kadzielnia quarry) being in a minority in Jabłonna. In the second case, the beak is much narrower, hence more pointed, and the hinge-line slightly more arched. These shells predominate in Jabłonna, being less numerous in the Kadzielnia quarry at Kielce. As a rule, however, in both cases, the general pentagonal shell outline, characteristic of the species, is preserved.

The other morphological features, e.g. appearance of the fold and

sulcus and their size, vary only slightly and do not merit some mention (Fig. 8).

Remarks. — The described species is distinctive and easily recognizable from the other members of the genus. Sartenaer's descriptions and illu-

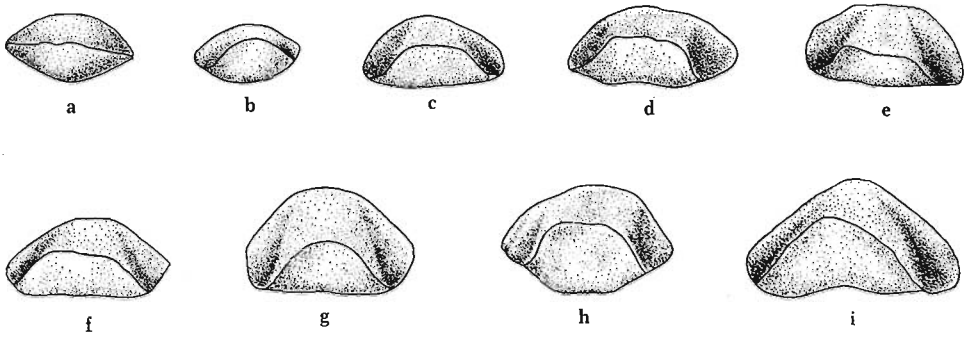

Fig. 8. — *Tenuisinurostrum subcrenulatum* n. sp. (Z. Pal. Bp. XII/75 a-i) Kadzielnia quarry at Kielce, Exposure III, layer 42; series of specimens of different size to show the appearance of anterior commissure.

strations of *Tenuisinurostrum crenulatum* (Gosselet), supplemented by the few Belgian species available for comparison, show its close similarity to *T. subcrenulatum* n. sp. The major differences between *T. subcrenulatum* and *T. crenulatum* are: a more flatter shell, very subdued radial ribs, smaller tongue and shell length in our species. *Pseudoleiorhynchus ?zemoulensis* Drot from the Famennian-zone II (Drot, 1964, p. 172, Pl. 23, Figs. 2-3) is very close to *T. subcrenulatum* n. sp. especially in the limited shell convexity, similarly low and subdued radial ribs, the shell size of Moroccan species is, however, larger and the ribs on the fold wider and more widening anteriorly. Externally *"Camarophoria" elegans* Gürich (1896, pp. 281-282, Pl. 7 Fig. 10) is of the type of *T. subcrenulatum* n. sp., but it differs in its slightly greater shell convexity, more elevated and more accentuated sulcus and fold (the tongue extensions being not well marked) with more distinct radial ribs which, according to Gürich, are 3-5 in number. Drot (1964, p. 172) mentioned some external similarity between Gürich's species and her *Pseudoleiorhynchus ?zemoulensis. Leiorhynchus kielcensis* Sobolev cited from the Upper Devonian of Łagów and Kielce — clymenid limestone (Sobolev, 1912*a*, 1912*b*, p. 4, Fig. 1) is very much like *to T. subcrenulatum* n. sp. The main differences according to very short description given by Sobolev (1912*b*, p. 4) are: the smooth shell surface and the accentuated convexity of both valves in *L. kielcensis*. The former feature differs the later species from *"Camarophoria" elegans* Gürich (Sobolev, 1912*a*, p. 10). Virtually, *Leiorhynchus kielcensis* Sobolev can correspond to the not very advanced, intermediate growth stage (comp. p. 49) of *Tenuisinurostrum subcrenulatum* n. sp., but with shell

convexity and tongue extension in their full development and without radial ribs.

The another question is, to what degree the features characteristic of *Leiorhynchus kielcensis* Sobolev are stable. It might be possible that e.g. the radial ribs, which are delicate in *Tenuisinurostrum subcrenulatum* n. sp., were also present in the Sobolev's species — but not observed. Unfortunately, there are not preserved specimens of Sobolev species, its interior is unknown, and the illustration of the discussed species is unsatisfactory, hence, at present, nothing can be explained.

In addition, it seems to be very probable, that *Glassia*? sp. cited by Sobolev (1912*a*, 1912*b*) represents the young — smooth, without sulcus and fold — stage of his cited rhynchonellids, e.g. *Leiorchynchus* sp.?.

Palaeozoological Institute
of the Polish Academy of Sciences
Warszawa, Żwirki i Wigury 93
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GERTRUDA BIERNAT

DOLNO-FAMEŃSKIE BRACHIOPODA Z GÓR ŚWIĘTOKRZYSKICH

Streszczenie

Zbadane w niniejszej pracy brachiopody (około 1000 okazów) pochodzą z kilku odsłonięć w Górach Świętokrzyskich: Kielce — kamieniołom Kadzielnia, Jabłonna, Zaręby, z warstw dolnego famenu odpowiadających poziomowi "*quadrantinodosa*".

Fauna brachiopodowa jest na ogół słabo zróżnicowana taksonomicznie, gatunki są niejednakowo licznie reprezentowane; kilka form reprezentowanych jest przez nieliczne fragmenty pojedynczych skorupek lub pojedyncze ośródki, co uniemożliwiło ich identyfikację gatunkową. Ogółem opisano 4 gatunki: 3 należące do Inarticulata i 1 do Articulata, w tym 2 nowe.

Z Inarticulata stosunkowo licznie występują orbikuloidy (kamieniołom Kadzielnia w Kielcach), reprezentowane przez jeden gatunek — *Orbiculoidea kadzielniensis* n.sp. Są one zachowane jako oddzielne skorupki muszli, najczęściej połamane lub pogniecione. Mimo tego stanu zachowania, udało się częściowo zbadać ich budowę wewnętrzną. Do rzadkich należą okazy rodzajów *Lingulipora* Girty i *Lingula* Burguière.

Z Articulata opisano jeden gatunek — *Tenuisinurostrum subcrenulatum* n.sp. Na uwagę zasługuje fakt, że gatunek ten: 1) występuje masowo w kamieniołomie Kadzielnia w Kielcach i w Jabłonnej, 2) ma wąski zasięg stratygraficzny (dolny famen — poziom *"quadrantinodosa"*) i ograniczony jest do niewielkiej miąższości warstw, np. w kamieniołomie Kadzielnia do warstwy 42, którą stanowią szare margliste łupki; sporadycznie występuje też w wapieniach pozostałej części profilu; w Jabłonnej znajduje się w marglach o czerwonawym zabarwieniu; 3) został uznany za gatunek przewodni dla dolnego famenu Gór Świętokrzyskich. Analogicznie, w Belgii, typowy gatunek tego rodzaju — *Tenuisinurostrum crenulatum* (Goss.) ograniczony jest w swym zasięgu pionowym do dolnego famenu, w obrębie którego wydzielony został nawet poziom *"crenulatus"*, jako wyraźne ogniwo stratygraficzne.

Należy dodać, że *Tenuisinurostrum subcrenulatum* n.sp. charakteryzuje się zaawansowaną symplifikacją morfologiczną w stadium dorosłym, co stanowi jedną z jego cech gatunkowych. Występowanie okazów powyższego gatunku różnego wieku osobniczego pozwoliło na poczynienie pewnych obserwacji dotyczących zmian wzrostowych. Na podstawie pojawiania się kilku cech morfologicznych (np. wentralna zatoka, dorsalny fałd, formowanie się linii komisury przedniej) wyróżniono 3 kolejne stadia wzrostowe, z których najbardziej charakterystycznym okazało się stadium młodociane o spłaszczonym profilu bocznym i gładkiej powierzchni.

ГЕРТРУДА БЕРНАТ

НИЖНЕФАМЕНСКИЕ БРАХИОПОДЫ СВЕНТОКШИСКИХ ГОР

Резюме

Работа посвящена результатам исследования брахиопод (около 1000 экземпляров), происходящих из слоев нижнего фамена, эквивалентных горизонту „*quadrantinodosa*", из следующих обнажений в Свентокшиских горах: карьер

Кадзельня в г. Кельце, Яблонна и Зарембы. Брахиоподовая фауна таксономически довольно однообразна, отдельные виды представлены в весьма неравном количестве. Некоторые формы представлены лишь в виде единичных створок или редких ядер, что не позволило определить их до вида. Всего описано 4 вида, три из которых относятся к Inarticulata, а один к Articulata; два вида новые.

Среди Inarticulata в довольно большом количестве встречены орбикулоиды (карьер Кадзельня в Кельце), принадлежащие одному виду — *Orbiculoidea kadzielniensis* n. sp. Они представлены обычно раздробленными или раздавленными отдельными створками раковин. Несмотря на плохую сохранность удалось частично изучить их внутреннее строение. Редко встречаются экземпляры рода *Lingulipora* Girty и рода *Lingula* Burguière.

Из Articulata описан один вид — *Tenuisinurostrum subcrenulatum* n. sp. В отношении этого вида необходимо отметить следующее: 1) он представлен в массовом количестве в карьере Кадзельня и в обнажении Яблонна; 2) характеризуется узким стратиграфическим распространением (нижний фамен — горизонт „*quadrantinodosa*") и приурочен к слоям небольшой мощности. В карьере Кадзельня его распространение ограничивается слоем 42, сложенным серыми мергелистыми сланцами; спорадически он встречается и в известняках остальной части разреза. В обнажении Яблонна этот вид приурочен к мергелям красноватого цвета; 3) этот вид признан руководящим для нижнего фамена Свентокшиских гор. В Бельгии типовой вид этого рода — *Tenuisinurostrum crenulatum* (Goss.) — в своем вертикальном распространении также ограничен нижним фаменом, в пределах которого даже выделен в качестве отчетливой стратиграфической единицы горизонт „*crenulatus*".

Следует отметить, что *Tenuisinurostrum subcrenulatum* n. sp. характеризуется сильным морфологическим упрощением в зрелой стадии, что является одним из его видовых признаков. Благодаря наличию экземпляров этого вида в разных стадиях развития можно было проследить некоторые закономерности в эволюции этого рода. На основании появления ряда морфологических признаков, таких как вентральный синус, дорсальная складка, формирование линии передней комиссуры, выделяются 3 последовательных стадии роста, из которых наиболее характерной оказалась юношеская стадия, отличающаяся сплюснутым боковым профилем и гладкой поверхностью.

PLATES

Plate I

Orbiculoidea kadzielniensis n.sp.

(Kadzielnia quarry at Kielce, Lower Famennian, "*quadrantinodosa*" zone, layer 14)

Figs. 1-2. Ventral view of two specimens (Z. Pal. Bp. XII/5b, 8); *Fig. 1* ×9, *Fig. 2* ×6.
Figs. 3-4. Dorsal view of two specimens (Z. Pal. Bp. XII/1b, 25a); *Fig. 3* ×4, *Fig. 5* ×5.
Figs. 5-7. Three dorsal interiors (Z. Pal. Bp. XII/18, 11, 12); *Figs. 5, 7* ×5, *Fig. 6* ×6.
Fig. 8. Dorsal interior showing a small fragment of ?muscle platform (Z. Pal. Bp. XII/37); approx ×12.

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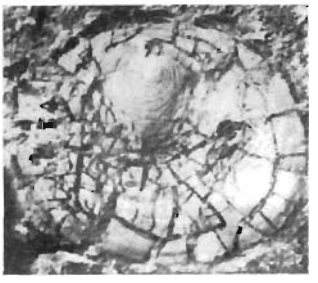

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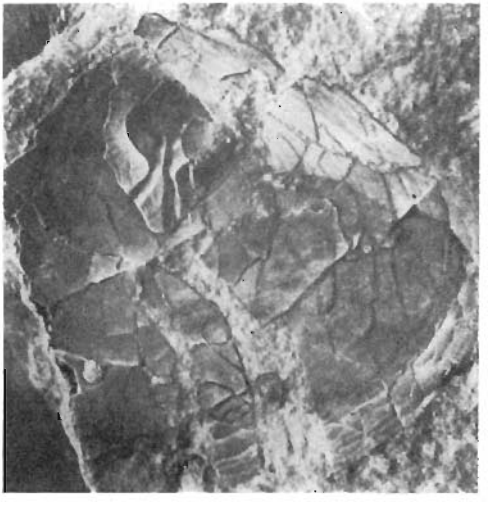

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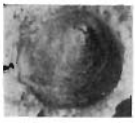

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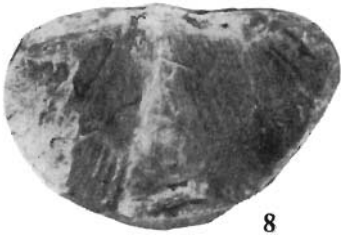

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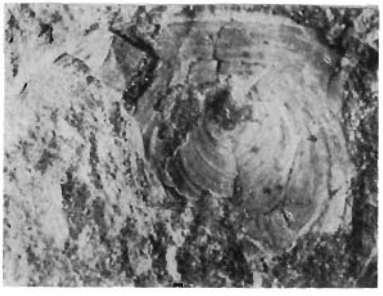

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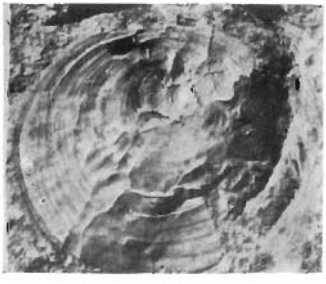

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Plate II

Orbiculoidea kadzielniensis n. sp.

(Kadzielnia quarry at Kielce, Lower Famennian, "*quadrantinodosa*" zone)

Fig. 1. Brachial valve (Z. Pal. Bp. XII/30), layer 30; ×3.

Figs. 2-3. Two dorsal interiors (Z. Pal. Bp. XII/31, 23b): *Fig. 2* — layer 31, *Fig. 3* — layer 29; ×5.

Fig. 4. Dorsal interior partly preserved (Z. Pal. Bp. XII/20b) from layer 29; approx. ×10.

Fig. 5 Ventral interior with marked pedicle tube (Z. Pol. Bp. XII/33), layer 33; approx. ×5.5.

Figs. 6-7. Two pedicle valves with preserved pedicle groove (Z. Pal. Bp. XII/21c, 34); Fig. 6 — type specimen; all approx. ×5.

Fig. 8. *Cyrtospirifer* cf. *?archiaci* (Vern.) (Z. Pal. Bp. XII/27), layer 7; nat. size.

Plate III

Tenuisinurostrum subcrenulatum n. sp.

(Kadzielnia quarry at Kielce, Lower Famennian, "*quadrantinodosa*" zone, layer 42)

Fig. 1. Adult specimen in: *a* dorsal, *b* ventral, *c* anterior views (Z. Pal. Bp. XII/22b); approx. ×2.

?Nervostrophia sp.

(Kadzielnia quarry at Kielce, Lower Famennian, layer 7)

Fig. 2. Fragment of the dorsal valve (Z. Pal. Bp. XII/32b); nat. size.

?Productella sp.

(Kadzielnia quarry at Kielce, layer II-O)

Fig. 3. Fragment of the dorsal interior (Z. Pal. Bp. XII/28b); nat. size.

Atrypa sp.

(Kadzielnia quarry, layer 8)

Fig. 4. Complete specimen in: *a* dorsal, *b* ventral views (Z. Pal. Bp. XII/37b); nat. size.

?Cyrtiopsis sp.

(Kadzielnia quarry at Kielce, layer 31)

Fig. 5. Fragment of ventral valve exterior (Z. Pal. Bp. XII/31c); nat. size.

Lingulipora sp.

(Kadzielnia quarry at Kielce, layer 14)

Fig. 6. Exfoliated dorsal valve showing punctae (Z. Pal. Bp. XII/4a); *Fig. 6* ×6, *Fig. 6a* approx. ×20.

Fig. 7. Interior of the dorsal valve (Z. Pal. Bp. XII/4c); ×8.

Fig. 8. Dorsal mould (Z. Pal. Bp. XII/4e); approx. ×5.

?Lingula sp. cf. *L. koninckі* Schnur

(Zaręby, layer 1e, Lower Famennian)

Figs. 9-10. Two dorsal moulds (Z. Pal. Bp. XII/31d, 32d); approx. ×5.

?Dignomia sp.

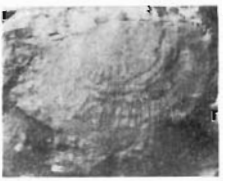
(Kadzielnia quarry at Kielce, layer 14)

Fig. 11. Dorsal interior (Z. Pal. Bp. XII/80); approx. ×15.

Fig. 12. Dorsal exterior (Z. Pal. Bp. XII/8e); approx. ×10.

1a

1b



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1c

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4a

11

9

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4b

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6a

12

10

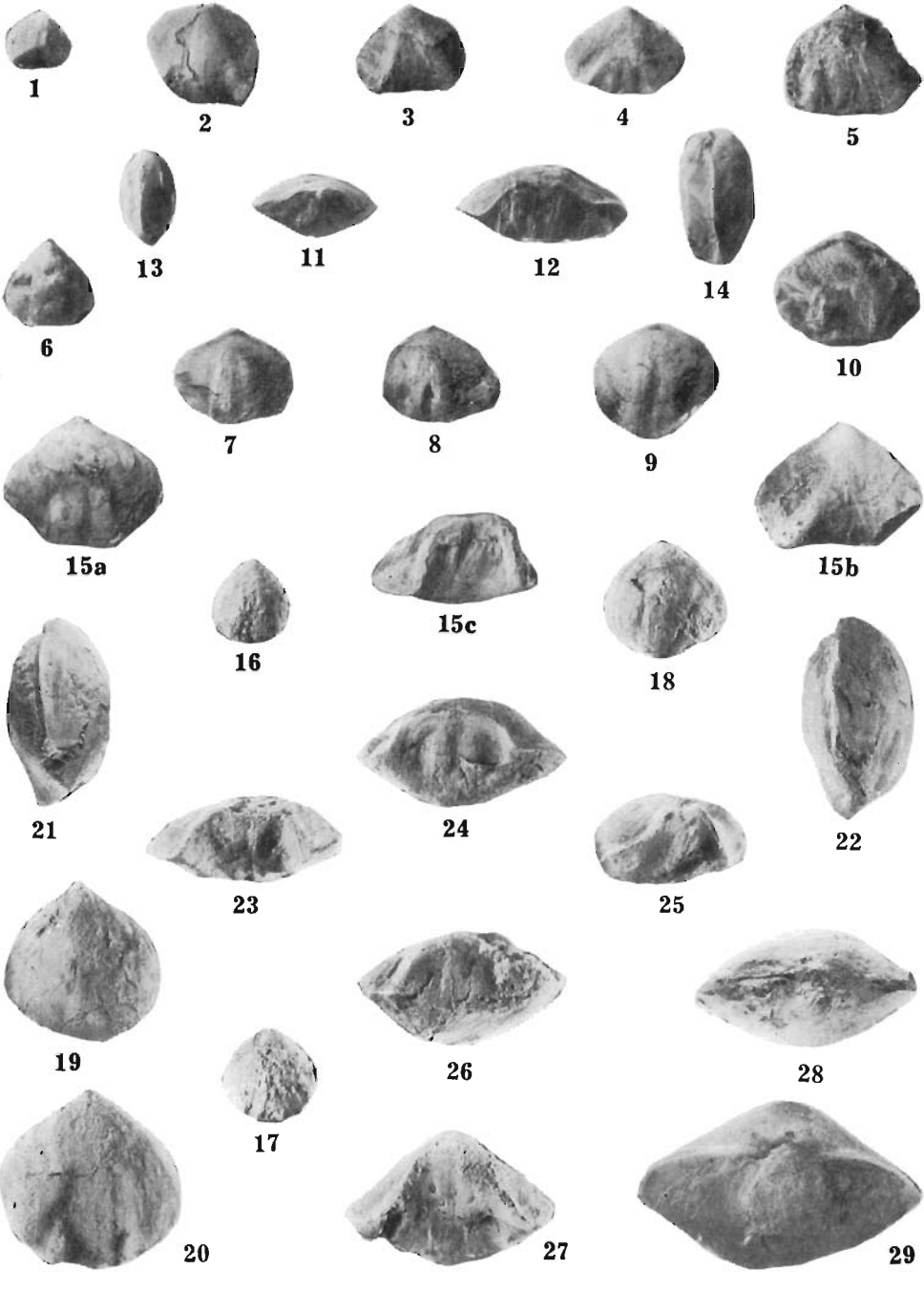
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Plate IV

Tenuisinurostrum subcrenulatum n. sp.
(Kadzielnia quarry at Kielce, Lower Famennian, "*quadrantinodosa*" zone, layer 42)

Figs. 1-5. Ventral valve view of 5 specimens of different size (Z. Pal. Bp. XII/1a-5a; approx. ×0.5.
Figs. 6-10. Dorsal view of few different specimens (Z. Pal. Bp. XII/6a-10a); approx. ×0.5.
Figs. 11-12. Anterior view of two specimens (Z. Pal. Bp. XII/11a-12a); approx. ×0,5.
Figs. 13-14. Side view of two specimens (Z. Pal. Bp. XII/13a-14a); approx. ×0.5.
Fig. 15. Adult specimen in: a dorsal, b ventral, c anterior views (Z. Pal. Bp. XII/15a); approx. ×0.5.
Figs. 16-20. Ventral view of five immature specimens (Z. Pal. Bp. XII/1, 2, 3, 5, 7); *Figs. 16-18* approx. ×2.5, *Figs. 19-20* approx. ×3.5.
Figs. 21-22. Side view of two specimens (Z. Pal. Bp. XII/21a, 22a); approx. ×2.5.
Figs. 23-27. Anterior view of five specimens to show appearance of sulcation (Z. Pal. Bp. XII/10, 8, 11, 9, 4); approx. ×2.
Figs. 28-29. Posterior view of two specimens (Z. Pal. Bp. XII/13, 6); approx. ×4.

Plate V

Tenuisinurostrum subcrenulatum n. sp.

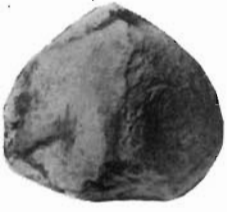
(Kadzielnia quarry at Kielce, Lower Famennian, "*quadrantinodosa*" zone, layer 42)

Figs. 1-6. Six different specimens in: *a* dorsal view, *b* ventral view, *c* posterior view, *d* lateral view (Z. Pal. Bp. XII/24a, 24, 25, 26, 20, 21); *Fig 2* type specimen, *Figs. 1, 3-6* paratypes, all approx. ×2.1.

1a

1c

1b

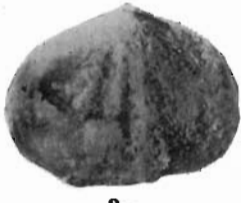


2a

2c

2b

4c



3a

3d

3b

4a

6b

4b

5a

6a

5b