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ORTHID BRACHIOPODS FROM THE UPPER VISEAN
(CARBONIFEROUS) OF THE ŚWIĘTOKRZYSKIE MTS., POLAND

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Enteletid (four species) and rhipidomellid (one species) brachiopods from the Gałęzice region, SW Świętokrzyskie Mts., have been described. Dominating genus *Schizophoria* is represented by *S. (Schizophoria) resupinata*, *S. (S.) keyserlingiana*, *S. (Paraschizophoria) woodi*, *S. (Par.)* sp. A, *S. (Pocockia) linguata*, *S. (P.)* cf. *gibbera*. Six known morphological "varieties" or "forms" of *S. (S.) resupinata* have been described. They probably come from diverse environments. Most specimens collected belong to *S. (S.) resupinata* (Martin) forma *typica* and represent all stages of its ontogeny. The brachiopods have been collected from organodetrritic limestones and calcareous-clayey deposits of the *Gontatites crenistria* and *G. striatus* zones. It is suggested that only *S. (S.) resupinata* f. *gigantea* may be stratigraphically characteristic of the Upper Visean of Europe.

Key words: brachiopods, taxonomy, stratigraphy, Upper Visean, Świętokrzyskie Mts., Poland.

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INTRODUCTION

A part of a rich brachiopod collection is described from the Upper Visean of the Gałęzice syncline, SW part of the Świętokrzyskie Mts (= Holy Cross Mts.) (fig. 1A). In the central part of the region rare *Schizophoria* (*S.*) sp. specimens have been found (Żakowa 1962) which are not here discussed.

Czarnocki (1916) and Kwiatkowski (1959) mentioned that the Upper Visean of Gałęzice locality contained one taxon, *Schizophoria* (*S.*) *resupinata* (Martin). In the material studied, the species occurs first of all in its typical form and only rarely in a few other forms known from Western Europe as "varieties" or subspecies. The present paper for the first time describes and illustrates all these forms from Poland. From other orthid taxa described here, viz. *Rhipidomella michelini*, *S. (Schizophoria) keyserlingiana*, *S. (Paraschizophoria) woodi*, *S. (Pocockia) linguata*, the last two species have not been recorded in Poland till now.

The paper adopts the taxonomy of the genus *Schizophoria* proposed by Bond (1941) and Pocock (1968), later precised by Lazarev (1967), and based on differences in shell ornamentation, shape and, partly, on internal structure. Taxonomical identifications and comparative studies of the material from Gałęzice have been based mainly on external features. Unfortunately the attempts to use the method of transverse serial sections did not bring any results, due to infilling of shells with coarse calcite crystals.

The species described are of little use for the stratigraphy of the Carboniferous. Only *S. (Schizophoria) resupinata* forma *gigantea*, in its most typical development, has been known as limited to the Upper Visean in West and Central Europe. Further studies are needed to resolve the problem of stratigraphical value of the other forms of *S. (S.) resupinata* (see Pocock 1968).

The collection described is housed at the museum of the Geological Survey of Poland, Świętokrzyskie Branch, Kielce (abbreviated OS).

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Abbreviations: W — maximum width, W1 — width of the hinge line, L — length, H — thickness of the brachial valve, * approximation after reconstruction.

Lengths (L), measured on the pedicle valve, brachial valve, or on the shell, have been regarded as equal, since the differences, if any, are very small, just as in the case of width (W) and width of the hinge line (W1).

Specimen size is determined in conventional way (Muir-Wood and Cooper 1960): small up to 20 mm wide, medium-sized — 20—50 mm wide and large — wider than 50 mm.

The density of costae in *Schizophoria* has been counted per 1 mm at the distance of 10 mm from the beak (umbo), if not stated otherwise.

LOCATION OF THE SECTIONS AND THEIR STRATIGRAPHICAL POSITION (fig. 1, table 1)

The orthid collection here investigated comes from some tens of the Upper Visean sites (fig. 1). Twenty-six of them (one natural outcrop, 16 trenches, 9 ditches) are situated (1) on the bed faces of the organo-detritic limestone in the NW and SE parts of the Gałęzice syncline, (2) three others are boreholes (Gałęzice IG 3—5: G3—G5 in fig. 1B) from the NW, SE and the middle part of this syncline.

(1) Sites are within the geological sections marked a—e and Todowa Grząba hill (TG) on the figure 1. The orthids were collected from the sites:

- section a — the outcrop and trenches VIII and IX;
- section Todowa Grząba hill — trenches XX—XXIII;
- section b — trenches II, IV, V;

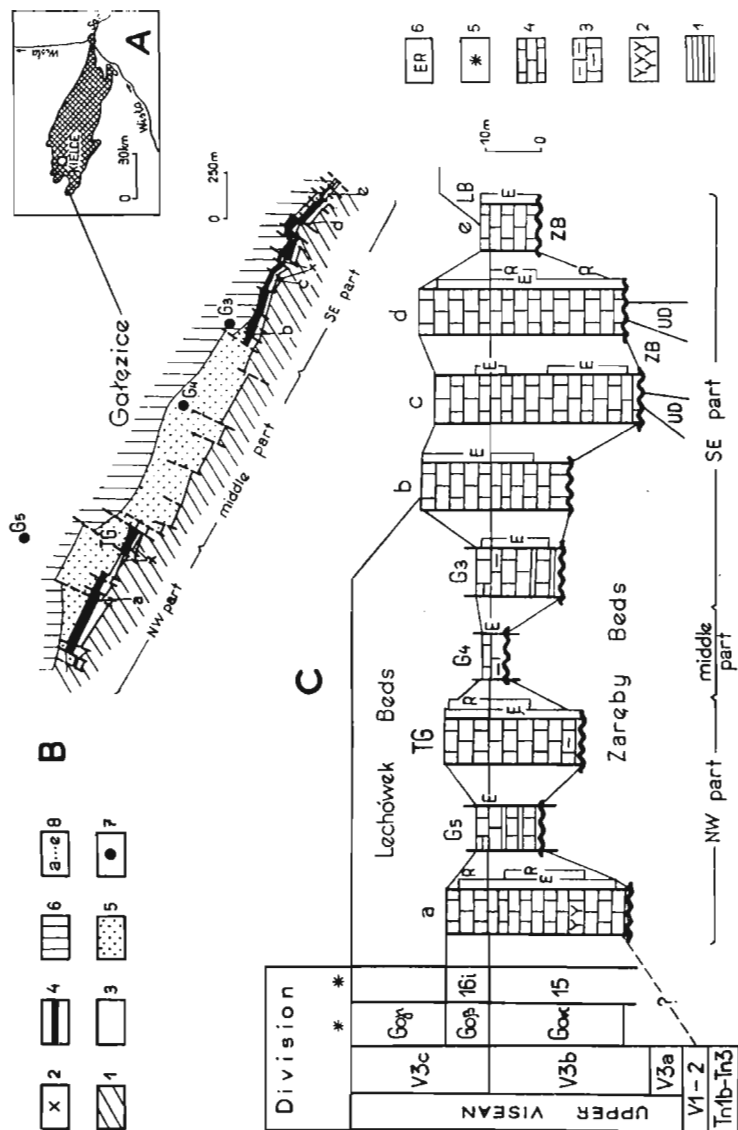


Fig. 1. Distribution and stratigraphy of the Carboniferous in the Gatożyce syncline, SW Świętokrzyskie Mts.: A. Sketch map of the Paleozoic. B. Geological map of the Gatożyce region (original): 1 Givetian, 2 Famennian, 3 Zareby Beds—mainly Tournaisian, 4 Upper Visean limestones of the *G. crenistria* Zone and *G. striatus* Zone, 5 Upper Visean clastic deposits of the *G. granosus* Zone, Lechówek Beds, 6 Permian, 7 G3, G4, G5: boreholes Gatożyce IG3, IG4, IG5, 8 location of the sections in question, TG Todowa Grząba hill section. C. Correlation of: 1 claystones, 2 pyroclastic sediments, 3 marls, 4 limestones, 5 documented biostratigraphical zones, 6 enteletid (E) and rhipidomellid (R) sites, LB Lechówek Beds, ZB Zareby Beds, UD Upper Devonian (Famennian); G3—G5 and TG—as in Fig. 1B.

Table 1

Stratigraphic distribution of orthid brachiopods in Upper Visean deposits from the Gałęzice syncline

Stratigraphy Taxa		Zones													Total number of specimens
		Go α , 15		Go β , 161		Go α , 15			Go β , 161						
		north-west part				middle part		south-east part							
		a	Todowa Grząba Hill		a	G4	b	c	d	e		d	c	b	
G5			G5	G3						G3					
<i>Schizophoria</i> / <i>Schizophoria</i> / <i>resupinata</i> f. <i>typica</i>	307	407	832	49		10	41	16	130	15	5	18	6	8	1835
<i>S. /S./ resupinata</i> f. A	3														3
<i>S. /S./ resupinata</i> f. <i>dorsosinuata</i>	3	1	15	1					4						24
<i>S. /S./ resupinata</i> f. <i>gigantea</i>	2	1	22										1		26
<i>S. /S./ resupinata</i> f. <i>lata</i>	3	3	17	1				2							26
<i>S. /S./ resupinata</i> f. <i>pinguis</i>	58	30	51	1			3		14	4		5			166
<i>S. /S./ resupinata</i> f. <i>rotundata</i>	17	18	45	1			4	2	8	1		5			101
<i>S./S./ keyserlingiana</i>	2		3												5
<i>S./S./ div. sp. ind.</i>	132	214	352	24	2	20	24	7	24	4	1	1	1	2	808
<i>S. /Paraschizophoria/ sp. A</i>			1												1
<i>S. /Par./ woodi</i>	2		2												4
<i>S. /Pocockia/ cf. gibbera</i>	1		1				1								3
<i>S. /Poc./ linguata</i>		1								1					2
<i>Rhipidomella michelini</i>	5	6	17	4						3					35

a, b, c, d, e: sections; G3, G4, G5: boreholes Gałęzice IG3, IG4, IG5. Other explanations in the text.

section c, distinguished in the vicinity of the Besówka hill — trenches VI, XIII, XV;

section d — trenches XIV, XIVa and ditches 22, 23, 26—29, 31, 83;

section e, situated in the farthest SE extremity of the Gałęzice syncline — trench XII and ditch 16.

The limestone is the thickest in the section c, up to 36 m (fig. 1C).

For details on the sites, layers sequence and symbols of the studied layers see: Żakowa 1976: figs 1, 4, 5, 8, 13; Jurkiewicz and Żakowa 1978: fig. 1, and for the general correlation of the sections also in other papers by the present author (e.g., Żakowa 1985: fig. 1, 1986: fig. 1).

(2) In the boreholes, the orthids have been found in limestones of the calcareous-clayey series, 4—11 meters thick. In the borehole Gałęzice IG 3 such series occurs at the depth of 160.50—185.45 m in Gałęzice IG 4 at 99.10—103.30 m and in Gałęzice IG 5 at 347.70—359.00 m (Łydka and Żakowa 1975: figs. 2—4). Figure 1C and table 1 show the correlation of geological columns of the boreholes and sections a—e.

The stratigraphic position of the brachiopod-yielding sediments has been determined at the *Goniatites crenistria* and *G. striatus* zones as well as incomplete 15 and 16i foraminiferal zones (Czarniecki 1973, Żakowa 1974, Jurkiewicz and Żakowa 1978). In general, the orthids occur within the whole biostratigraphic interval discussed, their range, however, varies vertically (fig. 1C). The Upper Visean deposits in question lie (dislocation contact) mainly on clayey-siliceous sediments (Zareby Beds), belonging mostly to the Tournaisian. The uppermost unit of the Upper Visean, i.e. Lechówek Beds, as a rule is sedimentologically continuous with underlying limestones or the calcareous-clayey series.

The brachiopod-yielding limestones from the sections mentioned are mainly coarse-grained organodetritic sediments. Their characteristics is as follows (according to Kuleta in: Jurkiewicz and Żakowa 1978): bio-sparrudites, sporadical biosparites, containing variable amounts of corals, crinoids, brachiopods and other macro- and microfauna. Rare micrite intercalations contain, most often foraminifera. In limestones occur lithoclasts of the Famennian limestones with conodonts, as well as phosphorite concretions and mudstone clasts from Zareby beds. The detritic nature of sediments as well as preservation state and distribution of allochems in the sections indicate active bottom currents of variable intensity. It is considered that organic components came from various ecological zones, their transport was short and deposition without any sorting (Fedorowski 1971, Nowiński 1976, Żakowa 1985, 1986, 1988). Bełka and Skompski (1988) have come to the conclusion that the Upper Visean limestones from Gałęzice are submarine fans formed by gravitational grain flow, and deposited at considerable depth.

MATERIAL

About 97% of the collection, which includes over 3000 orthid specimens, come from outcrops, most of them from Todowa Grząba hill (about 68% of all specimens, table 1), half of the collection having been completed in the trench no. XXI. Orthids occur there in a few fossiliferous layers. Found in large accumulations, they represent various stages of growth.

Shells, especially those of small and medium size, are relatively well preserved and their external features are observable. The shells are filled with calcite crystals.

In the material examined brachial valves dominate. Their interiors are rarely preserved and always incomplete. Pedicle valve interiors are preserved rarely, usually as internal moulds.

Many specimens are found as isolated valve fragments, sometimes as shell fragments. Such specimens make about 26% of the collection (table 1). They have been determined as *Shizophoria* (*Schizophoria*) div. sp. indet. and excluded from the systematic description. One specimen, determined as *S.* (*Paraschizophoria*) sp. A has been described to show this rare and interesting element of the assemblage studied.

The orthids in question belong to the families Rhipidomellidae and Enteletidae. Rhipidomellidae are represented by only a few specimens of *R. michelini* (Léveillé). Enteletidae are represented by four species of the genus *Schizophoria*, belonging to three subgenera: *S.* (*Schizophoria*), *S.* (*Paraschizophoria*) and *S.* (*Pocockia*). The most frequent is *S.* (*S.*) *resupinata* — about 60% of the collection. These are mainly specimens of forma *typica* representing all ontogenetic stages. Five other known forms of this taxon, i.e. *dorsosinuata*, *gigantea*, *lata*, *pinguis* and *rotundata*, have also been recognized, as well as forma A, represented by few specimens. The collection contains a small number of *S.* (*S.*) *keyserlingiana* (de Koninck), *S.* (*Paraschizophoria*) *woodi* Bond, and *S.* (*Pocockia*) *linguata* Quenstedt. Apparently, these species were not frequent in the Gałęzice region.

MORPHOLOGICAL VARIABILITY OF
SCHIZOPHORIA (*SCHIZOPHORIA*) *RESUPINATA* (MARTIN)

(fig. 2—10)

The species has been known for its great morphological plasticity. Demanet (1921—1923, 1934) recognized in *S.* (*S.*) *resupinata* five “varieties” — *dorsosinuata*, *gigantea*, *lata*, *pinguis* and *rotundata* basing on the external morphological features as the main criteria. These were, shape, size and outline of the shell, differences in dorsal and ventral sulci, convexity of the brachial valve as well as in some ornamentation characters (presence or absence of concentric growth rugae).

Bond (1941), while redefining the British and Belgian species of Carboniferous *Schizophoria*, discriminated diagnostic features and ecology dependent features. As diagnostic he considered the density of costae, the character that was further used by Lazarev (1976) in his division of the genus *Schizophoria*. All morphological features taken into account

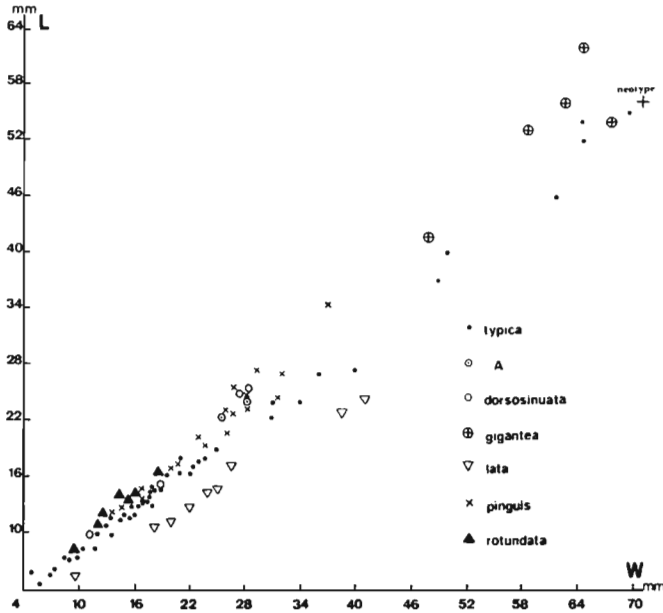


Fig. 2. *Schizophoria (S.) resupinata* Martin. Correlation between maximum width (W) and length (L) among distinguished forms.

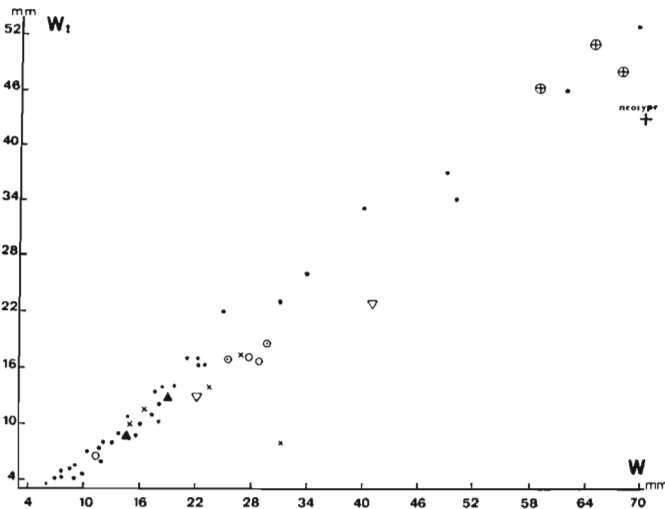


Fig. 3. *Schizophoria (S.) resupinata* (Martin). Correlation between maximum width (W) and width of hinge line (W1) among distinguished forms. For explanation see fig. 2.

by Demanet were, according to Bond, environment dependent. Bond concluded that combinations of morphological features resulted in peculiar forms within *S. (S.) resupinata*, corresponding to the "varieties" of Demanet. He presented the multidirectional morphological variability of *S. (S.) resupinata* in the scheme of radiation spectra (Bond 1941: figs. 33—34). It was based on the specimens coming from one site and horizon (the Upper Visean of England) and supplemented with data on var. *dorso-sinuata* and *rotundata* from Demanet's papers.

Pocock (1968) recognized *S. (S.) resupinata* as morphologically strongly variable species. She stressed close similarity of "varieties" in their

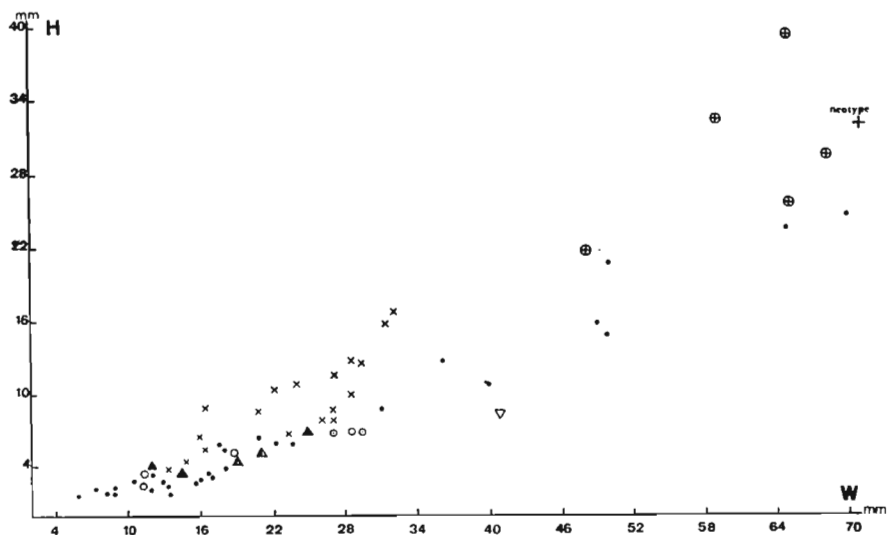


Fig. 4. *Schizophoria* (*Schizophoria*) *resupinata* (Martin). Correlation between width (W) and height (H) among distinguished forms. For explanation see fig. 2.

internal structures and small details differentiating their muscle fields. She recognized the transitional stages between the "varieties" and stated a lack of other forms than those described by Demanet. Lazarev (1976) suggested that Demanet's varieties should be considered as morphs.

The present author agrees that all "varieties" by Demanet fall within the wide spectrum of intraspecific variability of the species. Therefore, she has adopted for them an informal, neutral term — *forma*.

In the material from Gałęzice there are specimens corresponding to all known forms as well as of some other type designated here *forma A*. No other forms have been found. Specimens determined as *forma pinguis*, however, have been divided into four sub-forms. It is possible that they occur among *S. (S.) resupinata* described from Western Europe but have not yet been recognized there.

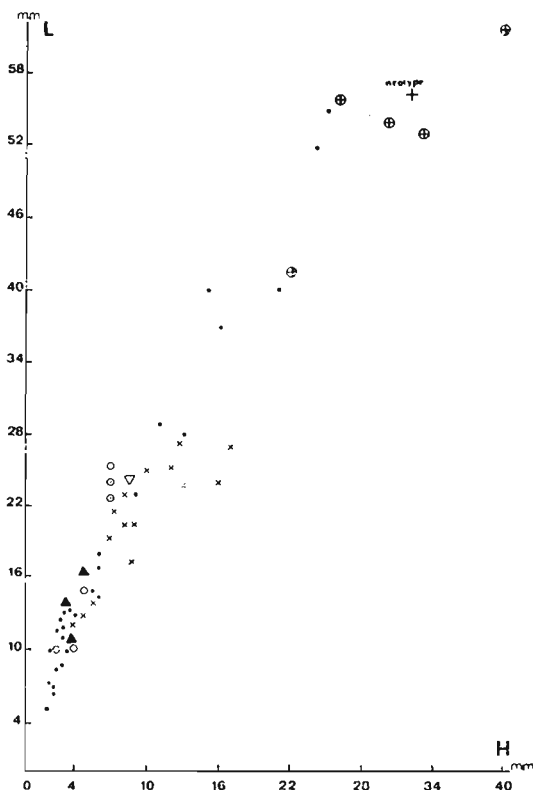


Fig. 5. *Schizophoria (S.) resupinata* (Martin). Correlation between length (L) and height (H) among distinguished forms. For explanation see fig. 2.

The correlation diagrams (figs. 2—5) for all forms from Gałęzice do not differ from those by Pocock (1968) and Martínez-Chacón (1979). At similar, sometimes analogous measurements points, there are specimens with characteristic differentiating features. This can be clearly seen in Gałęzice material, i.e. in *f. lata* and large specimens of *f. typica* as far as shell outlines are concerned (W and L dimensions plotted on fig. 2), and in *f. gigantea* and *f. pinguis*—in their characteristic brachial valve convexity (W and H, L and H dimensions plotted on figs. 4—5). No essential differences can be seen in $W:W_1$ ratios in the ontogeny of *f. typica* (except for large specimens) as well as in other forms, except *f. lata* and *f. gigantea* (tables 4 and 5, fig. 3).

The correlation diagrams, and especially variability spectra of shell outlines and shapes (figs. 6—8) confirm the opinion on the morphological plasticity of *S. (S.) resupinata* and indicate morphogenetic trends and tail forms. There is an interesting tendency to increase the brachial valve convexity in particular directions of the morphological variability distribution (fig. 7). It may result in similar morphology of extreme forms



Fig. 6. *Schizophoria (S.) resupinata* (Martin). Variability of shell shape in brachial valve view.

of diverse directions. As the spectra for Gałęzice material and those of Bond deal with the Upper Viséan specimens and have been constructed according to the same method (comp. Bond 1941: figs. 33, 34), their results can be compared. There is no doubt that the problem of morphological variability of *S. (S.) resupinata* needs further examination and for this purpose specimens from different Carboniferous profiles ought to be studied.

The specimens of f. *gigantea* from Gałęzice differ considerably from large specimens of f. *typica* corresponding to the neotype (see p. 105). This, as well as their co-occurrence, may indicate that f. *gigantea* represent a separate form and not an ontogenetic stage. It is worth of mention that the histogram (fig. 9) as well as frequency distribution curve (fig. 10) show two distinct peaks. This indicates that f. *gigantea* as well as large brachiopods of f. *typica* could represent taxonomically separate units, different from other forms.

Other forms than *typica* are not frequent in Gałęzice (table 1), similarly as in Western Europe (Pocock 1968). They make only 15.8% of the species representation. Among them the most frequent are f. *pinguis* — 7.6% and f. *rotundata* — 4.6% of the specimens. The remaining forms, *dorsosinuata*, *gigantea* and *lata* make only 1.1—1.2% of all specimens of

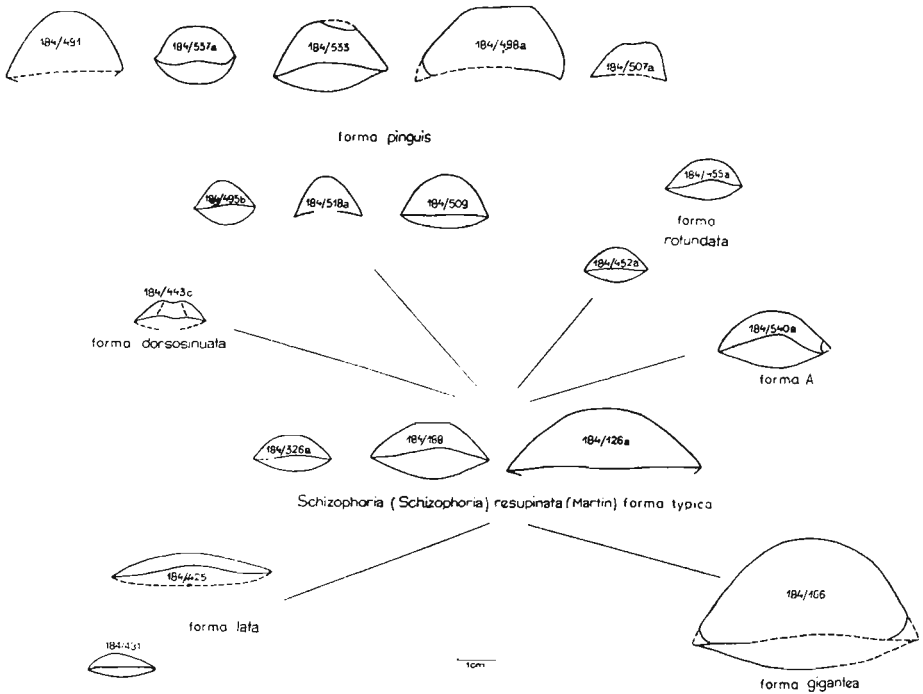


Fig. 7. *Schizophoria (S.) resupinata* (Martin). Variability of shell shape in anterior view.

the species. Figure 9 does not present exact quantitative relations as it is based on a chosen number of best preserved specimens from the collection (249). In any way, most numerous are specimens f. *typica* less than 20 mm wide (10—20 mm). The frequency diagram (based on 1835 specimens, fig. 10), quite regularly falling down for specimens up to 50—55 mm wide, rises again as the frequency of large specimens (corresponding to the neotype) grows. These specimens, 60—65 mm wide, make about 3.8% of all f. *typica* representation. The data presented in fig. 10 have been based on the whole collection of f. *typica* specimens from Gałęzice and, therefore, they do not fully correspond to the histogram (fig. 9).

Diversification of ecological conditions was considered responsible for development of all morphological variability up to development of extreme forms (see Bond 1941) and this seems true also for Gałęzice. Unfortunately, due to allochthonous character of the fauna accumulation, it is rather impossible to distinguish and characterize ecological zones within the Upper Visean basin of Gałęzice. Due to this "ecological disorder" specimens of f. *typica* occur in the same beds with forms considered as coming from different environment, for example, with f. *gigantea* (large shells with exceptionally convex brachial valves) which is believed to represent shallow shelf waters favourable for benthos. As in the whole

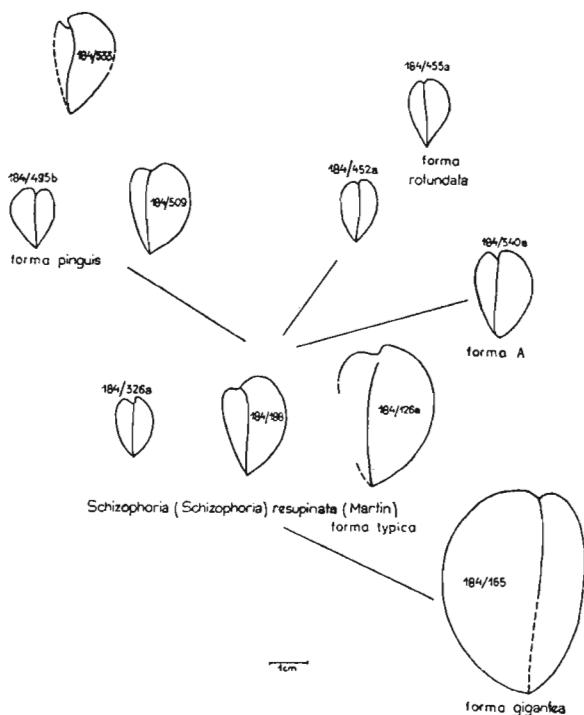


Fig. 8. *Schizophoria (S.) resupinata* (Martin). Variability of shell shape in lateral view.

its geographic range, i.e. Western and Central Europe, f. *gigantea* is known only from the Upper Visean, this may indicate that such environments were common at the time. It is probable that similar condition influenced diversification of f. *pinguis* (specimens of sub-forms 1—2, see description). The appearance of f. *dorsosinuata*, on the other hand, is connected, according to Bond (1941) with unfavourable, oscillating ecological conditions causing development of variable concentric shell ornamentation. The material from Gałęzice contains transitional forms between various types of morphology.

The literature presents different opinions on the stratigraphical value of the morphs. For example Parkinson (1954) estimated morphs as having different stratigraphical ranges, Bond (1941) denied their utility for zonation of Lower Carboniferous, Pocock (1968) maintained that Demanet's varieties reappear in various stratigraphical horizons, and only f. *dorsosinuata* is characteristic of the deposits from the Tournaisian/Visean boundary. The material from Gałęzice, collected only from limestones of two goniatite zones (p. 95) does not provide any significant information on the stratigraphical value of forms concerned. It proves, however, that f. *dorsosinuata* ranges up to the Upper Visean.

DESCRIPTIONS

Family *Enteletidae* Waagen, 1884Genus *Schizophoria* King, 1850

Type species: Conchyliolithus (Anomites) resupinatus Martin, 1809, Lower Carboniferous, England.

Subgenus *Schizophoria (Schizophoria)* King, 1850

Diagnosis (after Lazarev 1976, slightly shortened): Shell biconvex, brachial valve more convex than pedicle one. Pedicle valve often flattened antero-laterally, sometimes resupinate, usually with a sulcus, which may have a median fold. The ventral muscle field triangular or cordate; lateral diductors attached to the valve or dental plates. Dental plates divergent, parallel in cross-section. Dorsal muscle fields transversely elongated.

Remarks.—The original diagnosis gives no data on ornamentation, which consists of thin costae, often thickened alternately; costal density is 3–5; growth lines are clearly marked.

Schizophoria (S.) resupinata (Martin, 1809)

Remarks.—The synonymy of the species (e.g. Demanet 1934; Pocock 1968; Martínez Chacón 1979; Tazawa 1981, 1984) comprises forma *typica* and all morphological varieties known so far (*dorsosinuata*, *lata*, *gigantea*, *pinguis*). The species of such range was quoted, rarely illustrated or described from Poland, from the following areas: Świętokrzyskie Mts. (Gałęzice), Miechów Through (borehole Węgrzynów IG 1, after Jurkiewicz and Zakowa 1973), Western Sudetes (Jabiów, Wałbrzych, Konradów, Jugów, Sokolec, Czerwieńczyce, Srebrna Góra, Nowa Wieś, partly after Paeckelmann, 1930), Silesia-Cracow Upland (Szklarka, Raclawka and Czernka valleys, after Jarosz, 1909, 1926 and Zajączkowski 1975; Upper Silesia Coal Basin), Lublin Coal Basin (boreholes: Niedrzwica 3, Chełm, Husynne IG 1, Teptiuków IG 1, ?Abramów 1, partly after Korejwo 1960, 1974 and Bojkowski 1966), Western Pomerania (boreholes: Babilon 1, after Korejwo 1975; Brda 1, after Matyja 1976).

The present author limited the synonymy of *f. typica* exclusively to specimens of this type described or illustrated from Poland; the occurrence corresponds to the synonymy. As far as the other forms are concerned, their complete synonymies have been here given.

The description concern only Polish specimens coming from Gałęzice.

Schizophoria (S.) resupinata (Martin, 1809) *f. typica*

(pl. 1: 1–5; pl. 2: 1–5; pl. 3: 1–4; figs. 2–10; table 2)

1930. *Orthis (Schizophoria) resupinata* (Martin); Paeckelmann: 158, pl. 9: 7–8; pl. 13: 6–9.
 1953. *Schizophoria resupinata* (Martin); Zakowa: 15, pl. 3: 3.
 1966. *Schizophoria resupinata* (Martin); Zakowa: 56, pl. 14: 6.
 1968. *Schizophoria resupinata* (Martin); Korejwo and Teller: pl. 3: 4.
 1972. *Schizophoria resupinata* (Martin); Bojkowski: pl. 1: 13.

Material. — 1835 specimens (6—75 mm wide): 181 mostly complete shells with interareas and here and there preserved internal structure, 615 pedicle valves often with interareas, sometimes damaged on postero-lateral ends and in anterior parts, 2 casts and 4 moulds of pedicle valves, 1 fragment of pedicle valve interior, 1009 mostly incomplete brachial valves often with interareas, and rarely with traces of internal structure, 12 brachial valves interiors, 11 fragments of valves; OS-184/102—164, OS-184/175—418, OS-75/621, OS-75/628c, OS-75/640a—b, d, OS-75/655a—b, OS—75/681, OS-75/702a, c—e, OS-76/376a—c, OS-76/377a, c, OS-76/387a—b, OS-76/375c, OS-76/393, OS-77/375b, OS-77/579b, d, OS-77/588a.

Description. — Shells as a rule dorsibiconvex, transversely elliptical in outline (juveniles often shortened), widest at the mid-length, postero-lateral ends distinctly rounded, hinge line usually rather wide. Ventral (up to 2 mm) and dorsal (up to 1.8 mm) interareas in specimens 17—19 mm wide are slightly narrower than it could be inferred from the general tendency of growth changes. Less than 20 mm wide brachial valves are proportionally less convex than larger ones.

Table 2

Measurements:

Specimen No. OS-184/	W mm	W ₁ mm	L mm	H mm	W:L	W:W ₁	W:H	L:H	Remarks
367c	6.0	3.8	5.0	1.5?	1.20	1.58	4.00?	3.33?	brachial v.
323a	7.5	5.0	6.3	2.2	1.19	1.50	3.41	2.86	„
405a	9.0	4.2	7.0	2.2	1.29	2.14	4.09	3.18	„
350b	9.0	5.5	7.2	2.0	1.25	1.64	4.50	3.60	„
409e	10.5	7.0	8.8	3.0?	1.19	1.50	3.50?	2.93?	„
409d	11.8	7.5	10.0	3.5?	1.18	1.57	3.37?	2.86?	„
350a	12.0	8.0	10.0	2.2	1.20	1.50	5.45	4.55	„
367b	13.0	8.0	11.0	3.0	1.18	1.63	4.33	3.66	shell
249d	14.5	10.8	11.6	—	1.25	1.34	—	—	„
323b	15.5	9.0	12.8	2.8	1.21	1.72	5.54	4.57	„
367a	16.0	10.0	12.0	3.0	1.33	1.60	5.33	4.00	„
315a	16.8	—	13.4	3.4	1.25	—	4.94	3.94	„
249c	17.4	11.0	13.4	—	1.30	1.58	—	—	„
331a	17.8	10.6	14.6	6.0	1.22	1.68	2.97	2.43	„
363a	18.0	10.2	13.0	4.0	1.38	1.76	4.50	3.25	„
310a	18.0	12.0	15.0	5.5	1.20	1.50	3.27	2.73	brachial v.
249a	19.5	14.0	15.4	—	1.27	1.39	—	—	shell
2481	21.0	17.0	18.0	—	1.17	1.24	—	—	pedicle v.
248a	22.2	16.5	17.0	6.0	1.31	1.35	3.70	2.83	shell
303a	23.0	16.4	17.5	—	1.31	1.40	—	—	pedicle v.
290	23.8	—	18.0	6.0	1.32	—	3.97	3.00	shell
188	31.0	23.0	23.0	9.0?	1.35	1.35	3.44?	2.56?	brachial v.
184a	34.0	26.0	24.0?	—	1.42?	1.31	—	—	pedicle v.
176a	36.0	—	28.0	13.0	1.29	—	2.77	2.15	brachial v.
196a	40.0	33.0	29.0	11.0?	1.38	1.21	3.64?	2.64	„
126a	49.0	37.0	37.0	16.0	1.32	1.32	3.06	2.31	„
145a	50.0	34.0	40.0	15.0	1.25	1.47	3.33	2.66	„
130a	62.0	46.0	46.0	—	1.35	1.35	—	—	pedicle v.
114a	65.0*	—	52.0	24.0	1.25	—	2.71	2.17	brachial v.
124a	70.0	53.0	55.0	25.0	1.27	1.32	2.80	2.20	„

Pedicle valves the most convex in postero-median part. Anterior commissure rectimarginate in small shells, weakly curved in specimens 20–30 mm wide (rarely 12–16) mm, widely uniplicate in specimens over 30 mm wide. Thin costae irregularly and alternately thickened; density in adults 3–4 and usually 4 in small shells. Growth lines variably expressed, most common in the anterior part of shell.

Remarks.—The morphology and ornamentation of large shells from Gałęzice (45–75 mm wide, e.g. pl. 1: 1, 2, pl. 2: 3) are identical with those of the neotype (see Bond 1941: 289, pl. 21: A–C). The brachial valves of our specimens, however, are usually a little less convex, flattened at the middle, thus differing from *f. gigantea*. Large shells have the same size and shape, and muscle fields features as in *S. nuda* George et Ponsford (George and Ponsford 1938: 224, pl. 5: 1–5, figs. 1–5).

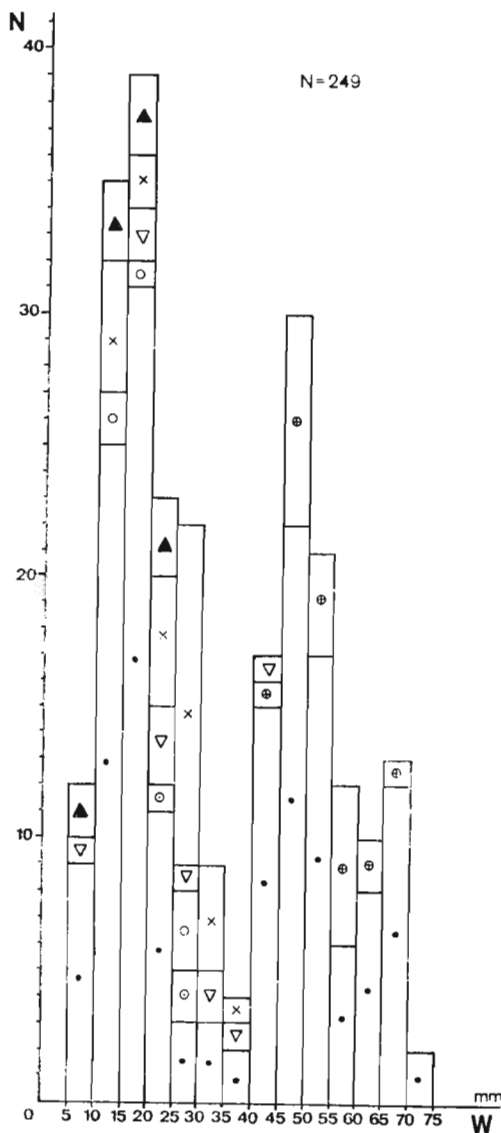


Fig. 9. *Schizophoria* (*S.*) *resupinata* (Martin). Frequency distribution of maximum shell width (W). The histogram based on the selected specimens, N = 249 specimens. For explanation see fig. 2.

It confirms Pocock's opinion (1968) that the taxa are conspecific. Muscle fields are best preserved in large valves. Unfortunately, in no valves they are complete and for this reason it was impossible, among others, to take measurements for comparison with data in literature.

The interiors of pedicle and brachial valves of large specimens from Gałęzice resemble in structure those from Toula and Steshovo horizons from Moscow Syneclise (compare Lazarev 1969: pl. 10: 1—4, fig. 1; 1976: pl. 2: 3, pl. 3: 2—5, pl. 4: 1—2, fig. 58). Dental plates diverging at about 65° and brachiophore plates usually at nearly 70° . The height of median septum of brachial valve is variable: it rises anteriorly and is the most elevated at its middle. Traces of *vascula media*, *vascula myaria* and muscle scars do not differ from those of the specimens from Soviet Union and Great Britain. The serial cross sections provide no new information on the internal structure.

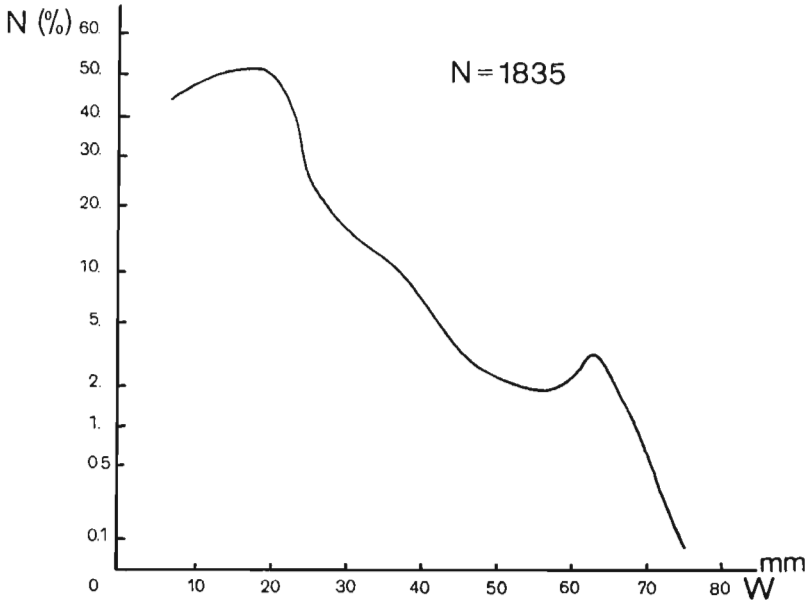


Fig. 10. *Schizophoria (S.) resupinata* (Martin), f. *typica*. Frequency distribution of maximum shell width (W). The number of specimens in per cent on a logarithmic scale; the curve based on all measured specimens in the collection, N = 1835 specimens.

Occurrence. — Cosmopolitan. Uppermost Famennian-Upper Carboniferous. Upper Viséan: Poland — Świętokrzyskie Mts. (Gałęzice), Western Sudetes (Jablów, Jugów, Sokolec), Lublin Coal Basin (borehole Niedrzwica 3); Lower Namurian: Poland — Silesia-Cracow Upland (Upper Silesia Coal Basin).

Schizophoria (S.) resupinata (Martin, 1809) f. *dorsosinuata*
(pl. 1: 6—8; pl. 2: 6—7; figs. 2—9; table 3)

1934. *Schizophoria resupinata* (Martin) var. *dorsosinuata* Demanet: 53, pl. 3: 14—15.

1961. *Schizophoria resupinata* Martin var. *dorsosinuata* Demanet; Pareyn: 211, pl. 26: 9—11.

1968. *Schizophoria resupinata* (Martin) *dorsosinuata* Demanet; Brunton: 11, pl. 2: 7—37, figs. 1—4 (with synonymy).

Material. — 24 specimens (10—30 mm in width): 2 a little damaged shells, 22 brachial valves some of them incomplete but with preserved interarea; OS-184/437-450.

Description. — Shell small or of medium size, rounded quadrate in outline, biconvex with uniplicate anterior commissure, slightly biplicate in gerontic specimens. Pedicle valve acute umbo projecting over a straight and relatively short hinge line; anterior part slightly concave. Brachial valve with well developed dorsal sulcus beginning near the umbo, widened anteriorly and ending in a tongue-like manner at the anterior margin. Costae thin; costal density 4. Very distinct and dense growth lines in the anterior part.

Table 3

Measurements:

Specimen No. OS-184/	W mm	W ₁ mm	L mm	H mm	W:L	W:W ₁	W:H	L:H	Remarks
446	11.5	6.5?	10.0	2.5?	1.15	1.77?	4.60?	4.00	shell
448a	11.6	6.5	10.0	3.5?	1.16	1.78	3.31?	2.86?	„
449	19.0	—	15.0?	5.0?	1.27?	—	3.80?	3.00?	brachial v.
437	28.6	16.8	25.5	7.0	1.12	1.70	4.09	3.64	„

Remarks. — The internal structure has not been examined. Dorsal sulcus, exceptionally distinct concentric ornamentation and shell outline allow us to include the specimens into f. *dorsosinuata*. In external features the specimens examined are comparable with those from Belgium, large specimens from Ireland and the ones described from England as cf. *dorsosinuata* (George and Ponsford 1938) as well as some Spanish ones (e.g. Martín-Chacón 1979: pl. 3: 9). Our specimens seem to be slightly longer. The W:W₁ ratio differs from the ones observed in other forms, especially in f. *gigantea* and adult specimens of f. *typica* (tables 2 and 4, fig. 3).

Occurrence. — Upper Tournaisian: Belgium. Upper Tournaisian-Lower Visean: England, Ireland (after Pocock 1968). Upper Visean: Ireland, Poland — Świętokrzyskie Mts. (Gałęzice), Lublin Coal Basin (borehole Husynne IG 1, after Bojkowski 1966). Namurian: ?Spain, North America.

Schizophoria (*S.*) *resupinata* (Martin, 1809) f. *gigantea*

(pl. 4: 1—2, pl. 5: 1—2, figs 2—9; table 4)

1934. *Schizophoria resupinata* (Martin) var. *gigantea* Demanet; Demanet: 60, pl. 4: 12—13.

1962. *Schizophoria gigantea* Litvinovitch: 179, pl. 1: 3.

1969. *Schizophoria gigantea* Litvinovitch; Litvinovitch et al.: 128, pl. 1: 13—14.

Material. — 26 specimens (45—70 mm in width): 1 a little damaged shell, 25 brachial valves some of them incomplete; OS-184/165-174.

Table 4

Measurements (brachial valves):

Specimen No. OS-184/	W mm	W ₁ mm	L mm	H mm	W:L	W:W ₁	W:H	L:H
171	48.0	—	41.6	22.0	1.15	—	2.18	1.89
168a	59.0	46.0	53.0	33.0	1.11	1.28	1.79	1.61
166	63.0	—	56.0	26.0	1.13	—	2.42	2.15
167	65.0*	51.0	62.0	40.0	1.05	1.27	1.63	1.55
165	68.0	48.0	54.0?	30.0	1.26?	1.42	2.27	1.80?

Description.—Shell large, nearly semi-elliptical, strongly dorsibiconvex with very slightly marked uniplicate anterior commissure. The pedicle valve, from its mid-length to the anterior end, is slightly concave medially, while slightly convex in the umbonal part, with small umbo. Brachial valve strongly and uniformly convex, semi-circular in transverse and longitudinal profiles, with quite steep sides and wide, inflated umbo. Costae thin; costal density 4 and 3 at 20 and 30 mm from the ventral and dorsal umbos respectively. Delicate growth lines in the umbonal part visible only under strong magnification.

Remarks.—The valve size and W:L and W:H ratios, indicating an exceptionally strong convexity and semi-circular shape of the brachial valve, are characteristic of this form. The W:W₁ index is close to that in *f. typica*. The specimens from Gałęzice and Belgium have transverse and longitudinal profiles identical to those of specimens coming from Kazakhstan and described by Litvinovitch (1962) and differ only in having growth rugae in the umbonal part. Their development might be caused by local ecological conditions (compare Bond 1941).

Occurrence.—Upper Viséan: Belgium, England (after Pocock 1968), Poland—Świętokrzyskie Mts. (Gałęzice). Upper Viséan-Lower Namurian: USSR (Kazakhstan).

Schizophoria (S.) resupinata (Martin, 1809) *f. lata*
(pl. 3: 8; pl. 4: 3–6; pl. 5: 3; figs 2–7, 9; table 5)

1934. *Schizophoria resupinata* var. *lata* Demanet; Demanet: 50, pl. 3: 6–7 (with synonymy).

?1965. *Schizophoria* cf. *resupinata* var. *lata* Demanet; Jerzykiewicz, 122, pl. 1: 3.

Material.—26 specimens (10–41 mm in width): 1 damaged shell, 17 incomplete and complete pedicle valves with interareas and rare traces of internal structure, 8 damaged brachial valves; OS-184/419-436.

Description.—Shell small or medium sized, transversely elliptical with rectimarginate anterior commissure at a juvenile stage, and slightly uniplicate at gerontic stage. Pedicle valve with shallow and anteriorly broad ventral sulcus, umbonal part slightly convex, antero-lateral parts wide; narrow interarea with triangular delthyrium (the apical angle about 92°) and distinctly divergent dental plates. Brachial valve slightly and uniformly convex. Costae thin, their density 3–4.

Remarks.—Considerably transversely elongated shell with broad ventral sulcus is typical of *f. lata*. The specimens from Gałęzice are comparable with those

Table 5

Measurements:

Specimen No. OS-184/	W mm	W ₁ mm	L mm	H mm	W:L	W:W ₁	W:H	L:H —	Remarks
431	9.8	—	5.8	—	1.69	—	—	—	shell
422	18.0	—	11.0	—	1.64	—	—	—	pedicle v.
428a	20.0	—	11.5*	—	1.74	—	—	—	„
419	22.0*	13.0*	13.0	—	1.69	1.69?	—	—	„
426a	24.0x	—	14.8x	—	1.62?	—	—	—	„
427a	26.6	—	17.6	—	1.51	—	—	—	„
430	38.5	—	23.0	—	1.67	—	—	—	brachial v.
425	41.0	23.0?	24.5	8.5?	1.67	1.78?	4.82?	2.71?	„

described from Belgium, and are similar to some specimens of *S. resupinata* described from the Ostrava Coal Basin (Řehoř and Řehořova 1972). The W:W₁ index is close to ones in other forms except f. *gigantea* and specimens of f. *typica* with W over 40 mm (compare tables 2 and 4).

Occurrence.—Upper Tournaisian-Lower Visean: Belgium. Upper Visean: England (after Pocock 1968), Poland—Świętokrzyskie Mts. (Gałęzice), Western Sudetes (?Konradów, Sokolec, ?Jugów—after Żakowa 1966). Lower Namurian: ?Czechoslovakia.

Schizophoria (S.) resupinata (Martin, 1809) f. *pinguis*
(pl. 6: 1—10; pl. 7: 1—4; figs. 2—9; table 6)

1934. *Schizophoria resupinata* var. *pinguis* Demanet: 59, pl. 4: 9—11.

1938. *Schizophoria pinguis* Demanet; George and Ponsford: figs 8—9.

1966. *Schizophoria resupinata* (Martin) cf. var. *gibbera* (Portlock); Żakowa: pl. 14: 7.

Material.—166 specimens (13—37 mm in width): 27 almost complete shells with interareas and sporadic internal structure, 2 pedicle valves, 137 here and there damaged brachial valves often with interareas and traces of internal structure; OS-184/487-539.

Description.—Shell small to medium sized, strongly and variably dorsibiconvex, narrowed posteriorly with relatively short hinge line, widest in its anterior part, with rounded postero- and antero-lateral ends and anterior commissure variable in shape during the ontogeny. Pedicle valve occasionally slightly concave anteriorly, rather regularly and strongly convex in juveniles; median septum, dental plates and *vascula media* well visible. Brachial valve often with strongly incurved umbo. According to variable convexity of the brachial valve four subforms may be here distinguished: 1 strongly inflated with a slight flattening at the middle (e.g. pl. 7: 3, pl. 6: 1, 3, 7, 8, 10, fig. 7), 2 regularly convex and from circular (e.g. pl. 7: 4, fig. 7) to subtriangular in transverse profil (e.g. pl. 7: 2, pl. 6: 5, 6, fig. 7), 3 irregularly inflated, often assymetrical (e.g. pl. 6: 2, 4, 9, fig. 7), and 4 relatively small, convex. Costae thin, costal density 3—4; growth lines well marked in the anterior part.

Remarks.—Anterior commissure is rectimarginate in small and variably expressed uniplicate in medium sized specimens. The form in question has been distinguished according to the criteria adopted by Demanet (1934), i.e. the shape

and outline of shell as well as the convexity of brachial valve. The Gałęzice valves, however, are often a little less convex than in specimens from Belgium, England and those of *S. resupinata* from Spain (Martínez Chacón 1979), which, according to the present author, can be compared with the form in question (*ibidem*, pl. 2: 9—12). Other features are convergent in all the specimens mentioned. It should be stressed that the specimens from our subform 1 are particularly similar to Belgian and English specimens, and especially to the extreme form in the

Table 6

Measurements:

Specimen No. OS-184/	W mm	W ₁ mm	L mm	H mm	W:L	W:W ₁	W:H	L:H	Remarks
532	13.5	—	12.2	3.8	1.21	—	3.55	2.95	shell
531a	15.0	10.0	13.0	4.6	1.15	1.50	3.26	2.83	„
510a	16.4	11.4	14.6	—	1.12	1.44	—	—	„
507a	16.5	—	—	9.0	—	—	1.83	—	brachial v.
537a	20.8	—	17.6	8.8	1.18	—	3.36	2.00	shell
488a	22.0	—	—	10.5	—	—	2.10	—	brachial v.
509	23.0	14.0	20.2	7.0	1.14	1.64	3.29	2.89	shell
494b	23.6	14.0	19.5	6.8	1.21	1.69	3.47	2.87	„
490a	26.0	—	20.6	9.0	1.26	—	2.89	2.29	„
494a	26.7	17.4	23.0	8.0?	1.16	1.53	3.34?	2.88?	„
512	27.0*	—	25.4	12.0	1.06	—	2.25	2.12	brachial v.
539a	27.0	—	23.0	8.0	1.17	—	3.38	2.88	shell
493b	28.5	—	25.0	10.0	1.14	—	2.85	2.50	brachial v.
491	28.5	—	23.8	13.0	1.20	—	2.19	1.82	„
533	29.2	—	27.6	12.8	1.06	—	2.28	2.16	shell
495a	31.3	8.0?	24.5	16.0	1.28	3.91?	1.96	1.53	„
521	32.0	—	27.0	17.0	1.19	—	1.88	1.59	brachial v.
498a	37.0?	—	34.5	—	1.07?	—	—	—	„

morphological variability spectrum by Bond (1941, fig. 34—specimen No. B. 54146); it concerns first of all, our specimens of medium size. The Gałęzice specimens from the subform 2 are identical in shape to the intermediate form of the spectrum (*ibidem*—specimen No B. 2480), but they are usually smaller.

Occurrence.—Upper Tournaisian—Visean: Belgium, England (partly after Pocock 1968). Upper Visean: Poland—Świętokrzyskie Mts. (Gałęzice), Western Sudetes (Sokolec). Lower Namurian: Spain.

Schizophoria (S.) resupinata (Martin, 1809) f. *rotundata*
(pl. 7: 5—6; figs. 2—9; table 7)

1934. *Schizophoria resupinata* var. *rotundata* Demanet; 51, pl. 3: 9—13; fig. 10 (with synonymy).

Material.—101 specimens (6—25 mm wide): 21 mostly a little damaged shells, some of them with interareas and internal structure, 22 incomplete pedicle valves, 58 mostly damaged brachial valves with rarely preserved internal structure; OS-184/451-486.

Table 7

Measurements:

Specimen No. OS-184/	W mm	W ₁ mm	L mm	H mm	W:L	W:W ₁	W:H	L:H	Remarks
453a	9.6	—	8.2	—	1.17	—	—	—	shell
485a	12.0	—	11.0	4.0	1.09	—	3.00	2.75	„
451	13.0	—	12.0	3.9	1.08	—	3.33	3.08	brachial v.
452a	14.5	8.5	14.0	3.6	1.04	1.71	4.03	3.89	shell
483	16.0	—	14.0	—	1.14	—	—	—	„
455a	19.0	12.8	16.6	5.0	1.14	1.48	3.80	3.32	„
455d	21.3	—	—	5.0	—	—	4.26	—	brachial v.
461a	25.0	—	—	7.0	—	—	3.57	—	„

Description.—Shell small, rounded, biconvex, with a relatively short hinge line. Pedicle valve relatively strongly convex, in larger specimens slightly concave anteriorly. Costae thin; costal density 4. Growth lines poorly visible.

Remarks.—Anterior commissure rectimarginate in shells up to 18 mm wide and slightly uniplicate in larger specimens, rounded outline (see W:L index), and usual lack of ventral sulcus are typical of the form. Interareae as well as the structure of dental and brachiopore plates (examined in cross sections) do not differ from those in *f. typica*.

Occurrence.—Uppermost Famennian-Tournaisian: Poland—Western Pomerania (boreholes: Babilon 1 after Korejwo 1975, Brda 1 after Matyja 1976). Middle Tournaisian-Lower Visean: Belgium, Democratic Republic of Germany (after Knüpfer and Weyer 1967 and Hoffmann *et al.* 1975). Upper Visean: Poland—Świętokrzyskie Mts. (Gałęzice), Western Sudetes (Sokolec, Jugów after Żakowa 1966).

Schizophoria (S.) resupinata (Martin, 1809) *f. A*

(pl. 3: 6—7; figs. 2—9; table 8)

Material.—3 specimens (20—30 mm in width): almost complete shells with interareae and traces of ventral muscle fields; OS-184/540.

Table 8

Measurements:

specimen No. OS-184/	W mm	W ₁ mm	L mm	H mm	W:L	W:W ₁	W:H	L:H
540b	26.6*	17.0	22.5*	7.0	1.14?	1.50	3.66	3.21
540a	29.4	18.5	23.9	7.0?	1.23	1.59	4.20?	3.41?

Description.—Shell medium sized, rounded quadrate in outline, widest at its mid-length, biconvex or dorsibiconvex, with slightly marked uniplicate anterior commissure. Pedicle valve relatively strongly convex in its umbonal part, with an acute umbo, and becoming slightly concave anteriorly. Dental plates divergent. Brachial valve strongly and regularly convex, with distinctly inflated wide umbonal

part, slightly flattened at the middle, and with relatively steep sides. Costae thin; costal density 3—4. Growth lines in the anterior and side parts of the shell.

Remarks.—The ventral and dorsal interareas do not differ from those in *f. typica*. The specimens in question differ from *f. typica* in steeper sides, more convex brachial valve, slightly different outline of the anterior commissure and shorter hinge line. In morphology, the specimens are closest to *f. pinguis*, and in outline to small specimens of *f. gigantea*. They resemble the former in their wide hinge margin and anterior commissure but differ from it in less steep sides and less convex brachial valve. Specimens of forma A seem to fall within the range of morphological variability set by Bond (1941: figs. 33, 34, with extreme form represented by the specimen B 2522).

Occurrence.—Upper Visean: Poland—Świętokrzyskie Mts. (Gałęzice).

Schizophoria (S.) keyserlingiana (de Koninck, 1843)

(pl. 4: 3; pl. 8: 7; table 9)

1934. *Aulacophoria keyserlingiana* (de Koninck); Demanet: 60, pl. 4: 14 (with synonymy).
 1958. *Aulacophoria keyserlingiana* (de Koninck); Żakowa: 66, pl. 3: 4.
 1966. *Aulacophoria keyserlingiana* (de Koninck); Żakowa: 58, pl. 14: 3.
 1949. *Schizophoria keyserlingiana* (de Koninck); Schwarzbach: 23, pl. 1: 1.
 1976. *Schizophoria (Schizophoria) keyserlingiana* (de Koninck); Lazarev: fig. 60.

Material.—5 specimens (18—30 mm in width): incomplete, probably slightly deformed brachial valves with traces of interareas; OS-184/541-543.

Table 9

Measurements:

Specimen No. OS-184/	W mm	W ₁ mm	L mm	H mm	W:L	W:W ₁	W:H	L:H
543a	28.8?	—	26.5	—	1.08	—	—	—
543b	29.0	20.0	26.0	11.8	1.12	1.45	2.26	2.20

Remarks.—Specimens rather strongly convex. Dorsal sulcus beginning just from below the umbo, deeply incised, with distinctly curved sides and widening anteriorly. Well marked growth lines in the anterior part. Costal density 4—5 (at the distance of 20—30 mm from the umbo, only 3—4); costae often thickened. Morphology and ornamentation are close to those in specimens from Belgium, the Sudetes and Rhenish Slate Mts.

Occurrence.—Upper Tournaisian-Visean: Belgium, FRG, USSR (Fergana). Upper Visean: Poland—Świętokrzyskie Mts. (Gałęzice), Western Sudetes (Witków, ?Marciszów, after Żakowa 1956a—b; Wałbrzych, Sokolec, Jugów, Czerwieńczyce, partly after Paeckelmann 1930), Lublin Coal Basin (boreholes Strzyżów). ?Lower Visean: Poland—Silesia-Cracow Upland (Raclawka valley, after Jarosz 1909). Lower Namurian: ?England (after George 1932), USSR-Ural, North Africa (after Pareyn 1961).

Subgenus *Schizophoria (Paraschizophoria)* Lazarev, 1976

Type species: *Schizophoria woodi* Bond, 1941, Lower Carboniferous (Visean—D₁ horizon), England (designated by Lazarev 1976).

Diagnosis (after Lazarev 1976 slightly shortened): Shell inflated with brachial valve more convex, longitudinal profile oval or circular. Concentric rugae always present. Ventral muscle field triangular, narrow. Dental plates parallel in cross section, gradually diverging with increasing distance from the umbo. Cardinal process trilobate, dorsal muscle field elongated.

Remarks.— In the diagnosis, Lazarev does not mention thin or very thin, rarely thickened costae.

Schizophoria (Paraschizophoria) woodi Bond, 1941

(pl. 8: 1–2; table 10)

1968. *Schizophoria woodi* Bond; Pocock: 86, pl. 18: 8; figs. 16–19 (with synonymy).

1976. *Schizophoria woodi* Bond; Lazarev: pl. 6: 2; fig. 64.

Material. — 4 specimens (17–33 mm in width): brachial valves damaged anteriorly with traces of hinge lines and internal structure preserved; OS-184/544–547.

Description. — Brachial valve usually of medium size, semi-spherical in shape; umbo and umbonal part not distinct; sides rounded. Adductor scars poorly visible. Traces of median septum and brachiophore plates diverging at about 40°. Costae thin, spine bases and thickenings lacking; costal density 6 or 5 when measured at the distance of 30–40 mm from the umbo. Growth lines poorly marked, visible in the anterior part, curved backwards.

Table 10
Measurements (brachial valves):

Specimen No. OS-184/	W mm	L mm	W:L
544	17.3	19.0	0.91
545	20.0	21.0	0.99
546	27.0	25.0	1.08
547	32.6	32.6	1.00

Remarks. — Although pedicle valves have not been found, characteristic shape and ornamentation of the brachial valves enabled specific determination of the specimens. According to Bond (1941) an angular uniplicate anterior commissure is characteristic of the species. Most specimens from Gałęzice are morphologically similar (see W:L index) to the specimens specified by Bond (1941: fig. 37) as “normal variation”, and similar in shape to those illustrated by Pocock (1968: middle form on fig. 19) as well as Demanet (1934: pl. 4: 1). Only one Gałęzice specimen (OS-184/544), due to its slightly ovate outline (W:L index), is close to “laterally compressed variation” according to Bond and Pocock.

Occurrence. — Upper Tournaisian-Visean: Belgium. Upper Visean: Great Britain, Poland — Świętokrzyskie Mts. (Gałęzice). Lower Namurian: USSR (Urals).

Schizophoria (Paraschizophoria) sp. A

(pl. 8: 3)

Material. — One damaged shell with traces of interareas, OS-184/548.

Measurements: W — 26.5 mm, W1 — 16.0 mm, L — 22.4 mm, H — 8.0 mm, W:L — 1.18, W:W1 — 1.65, W:H — 3.31, L:H — 2.80.

Description.—Shell of medium size with convex valves, anterior commissure uniplicate nearly subangular or quadrate uniplicate. Pedicle valve most convex in its umbonal part, elongated in a tongue-like manner anteriorly with poorly marked antero-median concavity. In longitudinal profile brachial valve more rounded than the pedicle one. Interareas narrow. Costae thin, sometimes divided, thickenings or spine bases lacking; costal density 6.

Remarks.—Morphology and ornamentation indicate that the specimen belongs to the subgenus *S. (Paraschizophoria)*. From the species described by Lazarev (1976) it differs in longitudinal and transverse profiles, pedicle valves size and, possibly, in the anterior commissure development.

Occurrence.—Upper Visean: Poland—Świętokrzyskie Mts. (Gałęzice).

Subgenus *Schizophoria (Pocockia)* Lazarev, 1976

Type species: Atrypa (Porambonites) gibbera Portlock, 1843, Lower Carboniferous (Visean), Ireland (designation by Lazarev 1976).

Diagnosis (after Lazarev 1976): Shell strongly convex, with geniculated anterior commissure of pedicle valve. Ventral muscle field very narrow (enteletic) with parallel borders. Bases of dental plates parallel, in transverse section reaching the valve floor. Cardinal process trilobate. Dorsal muscle field elongated. Costae relatively thin; density 6—7.

Schizophoria (Pocockia) cf. gibbera (Portlock, 1843)

(pl. 8: 4—5)

Material.—Three brachial valves 18—30 mm wide damaged anteriorly; OS-184/549-551.

Description.—Brachial valve up to medium sized, semicircular in transverse section, strongly convex at the middle, thus forming a fold particularly distinct in the posterior region. Umbo incurved and projecting. Costae thin and equal; density 6.

Remarks.—The specimens, in their transverse and longitudinal profiles, the shape of umbo and fold, strongly correspond to the brachial valves of *S. (P.) gibbera* described from the Lower Carboniferous of Ireland, England and Belgium (McCoy 1844: 124, pl. 18: 9, Bond 1941: 295, pl. 22: figs A-D, H; Demanet 1934: 55, pl. 4: 4 non 1—3; Pocock 1968: 69, pl. 18: 3, figs. 5—7).

Occurrence.—Upper Visean: Poland—Świętokrzyskie Mts. (Gałęzice).

Schizophoria (Pocockia) linguata (Quenstedt, 1871)

(pl. 8: 6; table 11)

1968. *Schizophoria linguata* (Quenstedt); Pocock: 72, pl. 18: 4—5, figs. 8—11 (with synonymy).

Material.—2 pedicle valves; OS-184/552-553.

Description.—Pedicle valve medium sized, geniculated, quadrate with distinct acute and slightly projecting umbo; concentric fold broken by sulcus, anterior margin unisulcate. Antero-lateral parts of the valve with growth lines following the shape of the sulcus. Costae poorly developed; costal density 6.

Table 11
Measurements (pedicle valves):

Specimen No. OS-184/	W mm	L mm	W:L
552	26.0	24.0	1.08
553	26.0	25.5	1.02

Remarks.—Shape of the shell and presence of concentric fold and ventral sulcus are characteristic of the species. Though the specimens differ from those described by Bond (1941: 297, pl. 22: E, fig. 36) in lower density of costae, but in their transverse section they correspond to the pedicle valve of his "high form". In their morphology, they are similar to the pedicle valve from Belgium (Demagnet 1934: pl. 4: 7) as well as to the gerontic pedicle valve described by Pocock (1968: fig. 11, b).

Occurrence.—Upper Tournaisian: Belgium. Upper Tournaisian-Visean: England (frequent in Asbian-Brigantian). Upper Visean: ?FRG, Poland—Góry Świętokrzyskie Mts. (Gałęzice).

Family **Rhipidomellidae** Schuchert, 1913, emend. Lazarev, 1970

Genus *Rhipidomella* Oehlert, 1890

Type species.—*Terebratula michelini* Léveillé, 1835, Lower Carboniferous, Belgium.

Rhipidomella michelini (Léveillé, 1835)

(pl. 3: 5; pl. 7: 7; table 12)

1934. *Rhipidomella michelini* (Léveillé); Demagnet: 37, pl. 2: 1—9 (with synonymy).
 1968. *Rhipidomella michelini* (Léveillé); Brunton: 17, pl. 3: 1—25; fig. 5.
 1974. *Rhipidomella michelini* (Léveillé); Kalashnikov: 21, pl. 3: 7—9 (with synonymy).
 1979. *Rhipidomella michelini* (Léveillé); Martínez Chacón: 63, pl. 3: 12—15; pl. 4: 1—15; figs. 6—7 (with synonymy).

Material.—Thirty five specimens (5—22 mm in width): 19 partly damaged shells of different size, 6 incomplete pedicle valves, 10 partly damaged brachial valves; OS-185/1-18.

Remarks.—The examined shells are small, semicircular or rounded triangular, slightly dorsibiconvex with rectimarginate anterior commissure. Small ventral umbo rising higher than the dorsal one. Ventral area concave, low and narrow. Growth lines visible only in the anterior part of the valve. Costae thin of a rounded profile, 5/2 mm (i.e. equal to minimum number quoted). The hinge line, slightly curved, is wider than in specimens from USSR (compare Sarytcheva and Sokolskaya 1952: pl. 1: 7; Litvinovitch *et al.* 1969: pl. 1: 9—10; Nalivkin and Foteva 1973: pl. 1: 2—5; Lazarev 1976), analogous to specimens known from Belgium and Ireland. The smallest specimens from Gałęzice are morphologically similar to Irish and Spanish ones. Larger specimens are closer to the Belgian ones, though they are usually slightly wider anteriorly. Internal structure not preserved.

Table 12

Measurements:

Specimen No. OS-185/	W mm	W ₁ mm	L mm	H mm	W:L	W:W ₁	W:H	L:H	Remarks
4b	5.0	2.0	4.6	—	1.09	2.50	—	—	brachial v.
9	6.0	2.2	5.8	—	1.03	2.73	—	—	shell
18a	6.5	2.5	6.0	1.2	1.08	2.60	5.42	5.00	„
12	6.0	2.5	5.5	—	1.09	2.40	—	—	„
14	7.0	2.8	6.5	1.8	1.08	2.30	3.89	3.61	„
6	9.0	3.5	8.0	1.6	1.13	2.57	5.63	5.00	„
3b	10.0	—	9.0	—	1.11	—	—	—	„
5	15.0	—	13.0	—	1.15	—	—	—	brachial v.
3a	16.5	6.0	14.0	—	1.18	2.75	—	—	shell
11a	17.5	—	17.0	—	1.03	—	—	—	„
15	18.0	7.0	16.0	3.0	1.13	2.57	6.00	5.33	„
1	21.2	7.0	18.0	3.0	1.18	3.03	7.07	6.00	„
8	21.6	8.5	18.8	—	1.15	2.54	—	—	brachial v.

Occurrence. — Cosmopolitan, Uppermost Famennian-Upper Carboniferous. Uppermost Famennian? — Tournaisian: Poland — Silesia-Cracow Upland (Stradlina Szklarska and Raclawka valleys, after Jarosz 1909, 1926), Western Pomerania (boreholes Rzeczenica 1, Brda 1, after Matyja 1976). Upper Visean: Poland — Świętokrzyskie Mts. (Gałęzice), Western Sudetes (Jablów, Wałbrzych, Konradów, Sokolec, Jugów, after Paeckelmann 1930, Żakowa 1958, 1966, Jerzykiewicz 1965).

REFERENCES

- BELKA, Z. and SKOMPSKI, S. 1988. Mechanizm sedymentacji i pozycja facjalna wapienia węglowego w południowo-zachodniej części Gór Świętokrzyskich. — *Przeł. Geol.*, **8**, 442—449.
- BOJKOWSKI, K. 1966. Charakterystyka faunistyczna osadów karbonu lubelskiego. W: Osady karbońskie w Zagłębiu Lubelskim. — *Pr. Inst. Geol.*, **44**, 55—82.
- 1972. Charakterystyka karbonu górnego Górnośląskiego Zagłębia Węglowego. W: Karbon Górnośląskiego Zagłębia Węglowego. — *Ibidem*, **61**, 89—134.
- BOND, G. 1941. Species and variation in British and Belgian Carboniferous Schizophoriidae. — *Proc. Geol. Assoc.*, **52**, 285—303.
- BRUNTON, C. H. C. 1968. Silicified brachiopods from the Visean of Country Fermanagh (II). — *Bull. Brit. Mus. (Nat. Hist.)*, *Geology*, **16**, 1—70.
- CZARNIECKI, S. 1973. Goniatyty wapienia węglowego z Gałęzic. — *Rocz. Pol. Tow. Geol.*, **43**, **2**, 227—248.
- CZARNOCKI, J. 1916. Kilka słów o odkryciu utworów karbońskich w Górach Świętokrzyskich. — *Spraw. Pos. Tow. Nauk. Warsz.*, **8**, 952—975.
- DEMANET, F. 1921—1923. Le Waulsortien de Sosoye et des rapports faunistiques avec le Waulsortien d'âge Tournaisien supérieur. — *Mém. Inst. Géol. Univ. Louvain*, **2**, 37—286.
- 1934. Les brachiopodes du Dinantien de la Belgique. Premier volume: Atrēmata, Neotremata, Protremata (pars). — *Mém. Mus. Royal d'Hist. Nat. Belgique*, **61**, 1—116.

- FEDOROWSKI, J. 1971. Aulophyllidae (Tetracoralla) from the Upper Visean of Sudetes and Holy Cross Mountains. — *Palaeont. Polonica*, 24, 1—137.
- GEORGE, T. N. 1932. Brachiopoda from the Cayton Gill Beds. — *Trans. Leeds Geol. Assoc.*, 5, 1—2, 37—48.
- and PONSFORD, D. R. A. 1938. Notes on the morphology of *Schizophoria*. — *Ibidem*, 5, 3—4, 227—245.
- HOFFMANN, N., LINDERT, D., WEYER, D. and ILLERS, K. H. 1975. Zum Unterkarbon-vorkommen auf der Insel Rügen und Hiddensee. — *Ztschr. Geol. Wiss., Jhg.* 3, 7, 851—873.
- JAROSZ, J. 1909. Stratygrafia wapienia węglowego w okręgu krakowskim. — *Bull. Acad. Sci.*, 4, 689—706.
- 1926. Obecny stan badań nad stratygrafią dewonu i dolnego karbonu w okręgu krakowskim. — *Rocz. Pol. Tow. Geol.*, 3, 115—190.
- JERZYKIEWICZ, T. 1965. Nowa fauna kulmowa z Konradowa koło Wałbrzycha. — *Acta Geol. Polonica*, 15, 217—238.
- JURKIEWICZ, H. and ŻAKOWA, H. 1973. Karbon dolny. W: Profile głębokich otworów wiertniczych Instytutu Geologicznego. Węgrzynów IG 1, 7, 22—27, 38—40.
- 1978. Glony i otwornice z wizenu górnego synkliny gałęzickiej. — *Pr. Inst. Geol.*, 85, 1—72.
- [KALASHNIKOV, N. V.] КАЛАШНИКОВ, Н. В. 1974. Раннекаменноугольные брахиоподы Печорского Урала. — Коми фил. инст. геол АН СССР, 1—200.
- KNÜPFER, J. and WEYER, D. 1967. Vorläufige Mitteilung über das Unterkarbon der Insel Rügen. — *Ber. deutsch. Ges. Geol. Wiss.*, 12, 185—192.
- KOREJWO, K. 1960. Wyniki wiercenia w Chełmie. Karbon. — *Biul. Inst. Geol.*, 165, 23—42, 60—64, 101—107, 160—164.
- 1974. Karbon struktury Abramowa. — *Acta Geol. Polonica*, 24, 631—661.
- 1975. Utwory najniższego dinantu z profilu Babilon 1 (Pomorze Zachodnie). — *Ibidem*, 25, 451—504.
- and TELLER, L. 1968. Stratygrafia karbonu zachodniej części niecki lubelskiej. — *Ibidem*, 18, 153—176.
- KWIATKOWSKI, S. 1959. Wapień węglowy Gałęzic. — *Biul. Inst. Geol.*, 159, 5—51.
- [LAZAREV, S. S.] ЛАЗАРЕВ, С. С. 1969. Сосудистая система у брахиопод *Schizophoria* и *Orthotichia* — *Палеонт. жур.*, 2, 66—72.
- 1976. Морфология и развитие брахиопод надсемейства Энтелетацеа. — Изд. Наука, 1—167.
- [LITVINOVITCH, N. V.] ЛИТВИНОВИЧ, Н. В. 1962. Каменноугольные и пермские отложения Западной части Центрального Казахстана. — Изд. МГУ, 4, 1—388.
- [—, AKSENOVA and RAZINA] —, АКСЕНОВА, Г. Г., РАЗИНА, Т. П. 1969. Стратиграфия и литология отложений нижнего карбона Западной части Центрального Казахстана. — Изд. Недра, 1—448.
- LYDKA, K. and ŻAKOWA, H. 1975. Środowiska sedymentancji karbonu Gałęzic. — *Biul. Inst. Geol.*, 283, 101—150.
- MARTÍNEZ CHACÓN, M. L. 1979. Braquipodos carboníferos de la Cordillera Cantábrica (Orthida, Strophomenida y Rhynchonellida). — *Inst. Geol. Espana*, 96, 1—291.
- MATYJA, H. 1976. Biostratigraphy of the Devonian-Carboniferous passage beds from some selected profiles of NW Poland. — *Acta Geol. Polonica*, 26, 489—539.
- McCOY, F. 1844. Synopsis of the Carboniferous fossils of Ireland. 1—207.

- [NALIVKIN, D. V. and FOTEVA, N. N.] НАЛИВКИН, Д. В., ФОТЕВА, Н. Н. 1973. Брахиоподы пограничных отложений турнейского и визейского ярусов Западного склона Урала. — *Изд. Наука*, 1—118.
- MUIR-WOOD, H. and COOPER, G. A. 1960. Morphology, classification and life habits of the Productoidea (Brachiopoda). — *Mem. Geol. Soc. Amer.*, **81**, 1—447.
- NOWIŃSKI, A. 1976. Tabulata and Chaetetida from the Devonian and Carboniferous of southern Poland. — *Palaeont. Polonica*, **35**, 1—125.
- PAECKELMANN, W. 1930. Die Brachiopoden des deutschen Unterkarbons. 1 Teil: Die Orthiden, Strophomeniden und Chonetiden des mittleren und oberen Unterkarbons. — *Abh. Preuss. Geol. L.-A., N. F.*, **122**, 143—326.
- PAREYN, C. 1961. Les massifs carbonifères du Sahara Sud-Oranais. — *Publ. Centre Rech. Sahar.*, II, Paléontologie stratigraphique, 1—244.
- PARKINSON, D. 1954. Quantitative studies of brachiopods from the Lower Carboniferous reef limestone of England. — *J. Paleont.*, **28**, 367—381.
- ПОЦОК, Y. P. 1968. Carboniferous schizophoriid brachiopods from Western Europe. — *Palaeontology*, **11**, 1, 64—93.
- ŘEHOŘ, F. and ŘEHOŘOVA, M. 1972. Makrofauna uhonosného karbonu československé části hornoslezské pánve. — *Ostravske Muz.*, 1—140.
- [SARYTCHEVA, T. G. and SOKOLSKAYA, A. N.] САРЫЧЕВА, Т. Г., СОКОЛЬСКАЯ, А. Н. 1952. Определитель палеозойских брахиопод Подмосковной Котловины. — *Тр. Палеонтол. инст. АН СССР*, **38**, 1—303.
- SCHWARZBACH, M. 1949. Die Fauna des Bug-Karbons, ihre stratigraphische und paläogeographische Bedeutung. — *Palaeontographica*, **97**, A, 1—74.
- TAZAWA, JUN-ICHI, 1981. An early Carboniferous brachiopod fauna from the Karoyama Formation in the Kikatami Mountains, Northeast Japan. — *Bull. Saito Ho-on Kai Mus. Nat. Hist. Res.*, **49**, 63—78.
- 1984. Early Carboniferous (Visean) brachiopods from the Hikoroichi Formation of the Kikatami Mountains, Northeast Japan. — *Trans. Proc. Palaeontol. Soc. Japan, N. S.*, **133**, 300—312.
- ZAJĄCZKOWSKI, W. A. 1975. Stratygrafia i litologia wapieni dinantu w Czernej koło Krzeszowic. — *Biul. Inst. Geol.*, **282**, 273—326.
- ŻAKOWA, H. 1956a. Fauna kulmowa z Witkowa na Dolnym Śląsku. — *Ibidem*, **98**, 5—76.
- 1956b. Fauna kulmowa z Marciszowa na Dolnym Śląsku. — *Ibidem*, **98**, 77—124.
- 1958. Biostratygrafia utworów morskich dolnego karbonu z obszaru Wałbrzycha Miasta na Dolnym Śląsku. — *Pr. Inst. Geol.*, **19**, 1—211.
- 1962. Warstwy z Lechówka w synklinie łagowskiej. — *Kwart. geol.*, **6**, 3, 373—402.
- 1966. Poziom *Goniatites crenistria* Phill. w okolicy Sokolca i Jugowa u podnóży Gór Sowich (Sudety środkowe). — *Pr. Inst. Geol.*, **43**, 1—197.
- 1974. *Goniatitina* from the Upper Visean (Gałęzice syncline, Holy Cross Mts.). — *Rocz. Pol. Tow. Geol.*, **44**, 1, 3—30.
- 1976. Wybrane problemy karbonu Gałęzic w świetle najnowszych badań. — *Biul. Inst. Geol.*, **296**, 5—50.
- 1985. Upper Visean gigantoproductoid brachiopods from the Góry Świętokrzyskie, Poland. — *Rocz. Pol. Tow. Geol.*, **55**, 1—2, 105—126.
- 1986. Brachiopods of the family Semiplanidae Sarytcheva, 1960 from the Upper Visean of Poland. — *Biul. Inst. Geol.*, **355**, 49—70.
- 1988. Ramienionogi rodziny Dictyoclostidae Stehli, 1954 z utworów wizenu górno-gałęzickiego. — *Biul. Inst. Geol.*, **358**, 45—71.

HALINA ŻAKOWA

ORTIDY (BRACHIOPODA) Z WIZENU GÓRNEGO GÓR ŚWIĘTOKRZYSKICH

Streszczenie

Opisano ortidy z poziomów *Goniatites crenistria* i *G. striatus* synkliny gałęzickiej. Zbadano ponad 3000 okazów zebranych z 26 stanowisk usytuowanych na wychodniach wapieni organodetrytycznych oraz z wkładek wapieni z serii wapienno-iłwcowej z 3 otworów wiertniczych (fig. 1, tabela 1). Punkty badawcze leżą w obrębie 6 przekrojów geologicznych. Najwięcej okazów zebrano ze wzgórza Todowa Grząba (około 68% kolekcji), głównie z przekopu XXI. W materiale przeważają skorupki ramieniowe. Około 800 źle zachowanych okazów oznaczono jako *Schizophoria* (*Schizophoria*) div. sp. ind. i wyłączono z opisu paleontologicznego. Na pozostałych okazach cechy zewnętrzne są dobrze widoczne, zwłaszcza na muszlach małych i średniej wielkości (zwykle z interareami i detyrium). Rzadko obserwowano budowę wewnętrzną (niekompletne pola mięśniowe), również w szlifach poprzecznych, co wiąże się z silnym przekrystalizowaniem materiału.

Opisane brachiopody należą do 2 rodzin: Rhipidomellidae (nieliczne okazy jednego gatunku — *R. michelini*) i Enteletidae (4 gatunków z 3 podrodzajów *Schizophoria*; Tabela 1, pls 1—8). Autorka przyjęła koncepcję podziału rodzaju *Schizophoria* według Lazareva (1976), który w znacznym stopniu oparł się na wynikach badań Bonda (1941) i Pocock (1968).

Pod względem ilościowym dominuje kosmopolityczny gatunek *S. (Schizophoria) resupinata* (Martin) do którego należy około 60% okazów kolekcji. Inne gatunki należą do rzadkich elementów taksonomicznych w badanym zespole ortidów. Wymieniony gatunek to przede wszystkim okazy formy *typica*, reprezentujące wszystkie stadia ontogenetyczne. Przeważają okazy małe, o szerokości poniżej 20 mm (fig. 9—10). Ponadto występują przedstawiciele pięciu innych, znanych w literaturze „odmian” tego gatunku tj. *dorsosinuata*, *gigantea*, *lata*, *pinguis* i *rotundata* (Demant 1921—1923, 1934). Opisano je w niniejszej pracy jako odmiany morfologiczne określone terminem forma, mieszczące się w szerokim spektrum zmienności wewnątrzgatunkowej (fig. 2—9). Kilka okazów wydzielono jako forma A i zróżnicowano okazy forma *pinguis* na 4 podformy. W materiale z Gałęzic występują przejścia pomiędzy formami, co może świadczyć o stopniowej adaptacji tych brachiopodów do zachodzących zmian środowiskowych. Formy inne niż *typica* stanowią zaledwie 15,8% sumy okazów zaliczonych do gatunku i należą do rzadko występujących, podobnie jak w Europie zachodniej. Przyczyn ich powstania upatrywano w zmianach warunków ekologicznych (Bond 1941), co w badanych utworach Gałęzic jest niemożliwe do prześledzenia z uwagi na przemieszanie fauny. Tu często, w tych samych ławicach wapieni, występują obok siebie przedstawiciele forma *typica* oraz pozostałych opisanych form.

Okazy forma *gigantea* wyraźnie różnią się od dużych okazów *S. (Schizophoria)*

resupinata) (Martin) forma *typica*, tj. odpowiadającym neotypowi (Bond 1941) i konspecyficznym z *Schizophoria nuda* George et Ponsford (George, Ponsford 1938). Ze względu na to, oraz na występowanie wymienionych dużych form autorka odrzuca możliwość uznawania forma *gigantea* za jedno ze stadiów rozwoju ontogenetycznego forma *typica*.

Opisane gatunki występują w całym karbonie lub w karbonie dolnym. Jedynie *S. (Schizophoria) resupinata* (Martin) forma *gigantea*, w swej najbardziej klasycznej postaci, znana jest w Europie zachodniej i środkowej tylko z utworów wizenu górnego. Może to być pewną wskazówką stratygraficzną, a poza tym może sugerować występowanie w tym czasie optymalnych warunków środowiskowych dla rozwoju bentosu.

EXPLANATION OF PLATES 1—8

Numbers of tranches and layers correspond to those in Żakowa (1976) and Jurkiewicz and Żakowa (1978)

Plate 1

Schizophoria (S.) resupinata (Martin) f. *typica*

- 1ab, 2ab. Pedicle valves of different size in *a* ventral and *b* anterior views. OS-184/122, OS-184/130a, trench XXI, bed 5, *G. striatus* Zone.
3. Internal mould of a fragmentarily preserved ventral muscle field; traces of dental plates and median septum visible. OS-184/133b, trench XXI, bed 5, *G. striatus* Zone.
4. Brachial valve interior with traces of brachiophore plates, median septum, adductor scars and *vascula media*. OS-184/127b, trench XXI, bed 5, *G. striatus* Zone.
5. Ventral interarea, $\times 1.5$. OS-184/184a, trench VIII, bed 2, *G. crenistria* Zone.

Schizophoria (S.) resupinata (Martin) f. *dorsosinuata*

6. Brachial valve in dorsal view. OS-184/449, trench XIVa, bed 5, *G. crenistria* Zone.
7. Brachial valve in anterior view. OS-184/443a, trench XXI, bed 5, *G. striatus* Zone.
8. Anterior commissure of a brachial valve. OS-184/437, trench IX, bed 7, *G. striatus* Zone.

All specimens in natural size excepting illustrated in fig. 5

Plate 2

Schizophoria (S.) resupinata (Martin) f. *typica*

- 1a—e. Shell in 5 positions: *a* dorsal, *b* ventral, *c* anterior commissure, *d* posterior and *e* side. OS-184/188, outcrop, bed 4, *G. crenistria* Zone.
2. Ornamentation of a pedicle valve, approx. $\times 5$. OS-184/200a, trench XXI, bed 5, *G. striatus* Zone.
- 3a—c. Brachial valve in 3 positions: *a* dorsal, *b* posterior and *c* side. OS-184/124b, trench XXI, bed 5, *G. striatus* Zone.
- 4, 5. Fragments of two brachial valve interiors; in dorsal muscle field traces of brachiophore plates, median septum, adductor scars, *vascula media* and *vascula myaria* preserved. OS-184/143a, trench XX, bed m; OS-184/121k, trench XXI, bed 6; *G. striatus* Zone.

Schizophoria (S.) resupinata (Martin) f. *dorsosinuata*

- 6a—c. Shell in 3 positions: *a* dorsal, *b* anterior commissure and *c* posterior. OS-184/448a, trench XIVa, bed 1; *G. crenistria* Zone.
7. Ornamentation of a brachial valve, ca $\times 6$. OS-184/443b, trench XXI, bed 5, *G. striatus* Zone.
- All specimens in natural size excepting illustrated in figs 2 and 7

Plate 3

Schizophoria (S.) resupinata (Martin) f. *typica*

- 1a—e, 2a—e, 3a—e, 4a—e. Four shells of different size in 5 positions: *a* dorsal, *b* ventral, *c* anterior commissure, *d* posterior and *e* side. OS-184/350c, b, a, trench XXI, bed 5; OS-184/310a, trench IX, bed 8, *G. striatus* Zone.

Rhipidomella michelini (Léveillé)

- 5a—e. Shell in 5 positions: *a* dorsal, *b* ventral, *c* anterior commissure, *d* posterior and *e* side. OS-185/3a, trench VIII, bed 1J, *G. crenistria* Zone.

Schizophoria (S.) resupinata (Martin) f. *A*

- 6a—e. Shell in 5 positions: *a* dorsal, *b* ventral, *c* anterior commissure, *d* posterior and *e* side. OS-184/540a, outcrop, bed 4, *G. crenistria* Zone.
7. Strongly damaged shell viewed ventrally with internal mould of the ventral muscle field; dental plates, median septum and adductor scars preserved. OS-184/540c, outcrop, bed 4, *G. crenistria* Zone.

Schizophoria (S.) resupinata (Martin) f. *lata*

8. Pedicle valve in ventral view. OS-184/427a, trench XXI, bed 5, *G. striatus* Zone.

All specimens in natural size

Plate 4

Schizophoria (S.) resupinata (Martin) f. *gigantea*

- 1a—d. Shell in 4 positions: *a* dorsal, *b* ventral, *c* posterior and *d* side. OS-184/165, trench VIII, bed 1G, *G. crenistria* Zone.

Schizophoria (S.) resupinata (Martin) f. *lata*

2. Brachial valve in dorsal view. OS-184/425, trench XXI, bed 7, *G. striatus* Zone.
4. Shell viewed from the pedicle valve, ca. $\times 2$. OS-184/431, trench XX, bed h, *G. crenistria* Zone.
5. Pedicle valve with internal mould of the ventral muscle field; traces of dental plates and median septum preserved. OS-184/422, outcrop, bed 4, *G. crenistria* Zone.

Schizophoria (S.) keyserlingiana (de Koninck)

- 3a—c. Damaged brachial valve viewed: *a* anteriorly, *b* posteriorly and *c* in a detail with ornamentation (ca. $\times 6$) OS-184/543a, trench XXI, bed 5, *G. striatus* Zone.

All specimens in natural size excepting illustrated in figs. 3c and 4

Plate 5

Schizophoria (S.) resupinata (Martin) f. *gigantea*

- 1a—c, 2a—c. Two brachial valves in: *a* dorsal, *b* posterior and *c* side views. OS-184/428c, trench XXI, bed 5, *G. striatus* Zone.

Schizophoria (S.) resupinata (Martin) f. *lata*

- 3ab. Pedicle valve viewed from *a* ventral side and *b* interarea (ca. $\times 1.5$). OS-184/428c, trench XXI, bed 5, *G. striatus* Zone.

All specimens in natural size excepting illustrated in fig. 3b

Plate 6

Schizophoria (S.) resupinata (Martin) f. *pinguis*

- 1a—d. Shell in 4 positions: *a* ventral with partly visible ventral muscle field, *b* anterior commissure, *c* posterior and *d* side. OS-184/494a, trench VIII, bed 1G, *G. crenistria* Zone.
- 2a—c. Shell in: *a* dorsal, *b* ventral and *c* anterior commissure views. OS-184/533, trench XIV, bed 17, *G. crenistria* Zone.
- 3a—c. Shell in 3 positions: *a* dorsal, *b* anterior commissure and *c* posterior. OS-184/539a, trench XII, bed A, *G. crenistria* Zone.

- 4, 5. Two brachial valves in posterior view. OS-184/507a, trench XXI, bed 8; OS-184/518a, trench XX, bed r, *G. striatus* Zone.
- 6ab. Shell viewed from *a* anterior commissure and *b* posterior OS-184/531a, ditch 22, *G. striatus* Zone.
- 7ab. Shell in: *a* anterior commissure and *b* dorsal views. OS-184/537a, trench XIVa, bed 1, *G. crenistria* Zone.
- 8a—c. Shell in 3 positions: *a* ventral with internal mould of the ventral muscle field, *b* anterior commissure and *c* posterior. OS-184/495a, trench VIII, bed 1G, *G. crenistria* Zone.
- 9ab, 10ab. Two brachial valves of different size in: *a* dorsal and *b* posterior views. OS-184/498a, outcrop, western part; OS-184/488a, trench IX, bed 5, *G. crenistria* Zone.

All specimens in natural size

Plate 7

Schizophoria (S.) resupinata (Martin) f. *rotundata*

1. Ornamentation of a brachial valve, ca.×6 OS-184/524, trench XXIII, bed 8, *G. striatus* Zone.
- 2a—e, 3a—e, 4a—e. Three shells of different size in 5 positions: *a* dorsal, *b* ventral, *c* anterior commissure, *d* posterior and *e* side. OS-184/495d, c, trench VIII, bed 1G, *G. crenistria* Zone; OS-184/509, trench XXI, bed 5, *G. striatus* Zone.

Schizophoria (S.) resupinata (Martin) f. *rotundata*

- 5a—e, 6a—e. Two shells of different size in 5 positions: *a* dorsal, *b* ventral, *c* anterior commissure, *d* posterior and *e* side. OS-184/452a, trench VIII, bed 1G; OS-184/455a, outcrop, bed 4, *G. crenistria* Zone.

Rhipidomella michelini (Léveillé)

- 7a—e. Shell in 5 positions: *a* dorsal, *b* ventral, *c* anterior commissure, *d* posterior and *e* side. OS-185/6, trench XXI, bed 13, *G. crenistria* Zone.

All specimens in natural size excepting illustrated in fig. 1

Plate 8

Schizophoria (Paraschizophoria) woodi Bond

- 1a—d, 2a—d. Two brachial valves in: *a* dorsal, *b* anterior, *c* posterior and *d* side views. OS-184/547, OS-184/546, trench XXI, bed 5, *G. striatus* Zone.

Schizophoria (Paraschizophoria) sp. A

- 3a—d. Damaged shell in: *a* dorsal, *b* anterior commissure, *c* posterior and *d* side views. OS-184/548, trench XX, bed t, *G. striatus* Zone.

Schizophoria (Pocockia) cf. gibbera (Portlock)

4ab, 5ab. Two damaged brachial valves in *a* side and *b* posterior views. OS-184/549, trench VIII, bed 1B; OS-184/551, trench II, bed 13, *G. crenistria* Zone.

Schizophoria (Pocockia) linguata (Quenstedt)

6a—c. Pedicle valve in 3 positions: *a* anterior, *b* side and *c* ventral. OS-184/552, trench XXII, bed 2, *G. crenistria* Zone.

Schizophoria (S.) keyserlingiana (de Koninck)

7a—c. Damaged brachial valve in: *a* dorsal, *b* anterior and *c* posterior views. OS-184/543b, trench XXI, bed 5, *G. striatus* Zone.

All specimens in natural size

