An ostracod assemblage from late Visean shales of the Cracow area

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Late Visean ostracod assemblages from three regions of southern Poland strongly differ in contribution of species and specimens of the three main superfamilies. In the Cracow area, ostracods from the clays of Orlej are basically different from those from the limestone section of Czerna located only ten kilometers eastward but are similar to ostracods from the Lublin region. The kloedenellacean-bairdiacean dominant fauna of Czerna is representative of nearshore conditions, as opposed to the offshore Orlej bairdiacean-kirkbyacean fauna.

Key words: ostracoda, Early Carboniferous, Poland, paleoecology.

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Introduction

The Cracow area was an elevated structure in the Late Devonian and Early Carboniferous, with shallow-water limestones deposited in its central part. Westward it was bordered by deep-water environments of the developing Variscan Belt. Its proximity is expressed by the facies changes from shallow-water limestones into offshore clastics. Two areas with outcrops of late Visean rocks in the area represent two distinct facies. Near Czerna, 25 km NW of Cracow, a thick series of limestones is exposed, while near Zalas, 15 km W of Cracow, the same age strata are represented by shales. Both rock sequences are very fossiliferous and can be precisely dated by conodonts. This enables quantitative comparison of fossil assemblages from both facies.

The present paper is devoted to such an analysis of ostracod assemblages. New taxonomic identifications of ostracods from the Orlej quarry near Zalas (Fig. 1) will be compared with data from Czerna presented by Jeziorowska (1983). Another area in Poland, where Late Visean ostracods

are known, is the subsurface Lublin region (Woszczynska 1981) at the margin of the East European Platform.

The Orlej section represents a relatively thick, over 100 m in thickness, sequence of dark grey and black clay and sandy shales with only two intercalations of limestone beds. It is exposed out in the Orlej Quarry in the vicinity of Zalas, in the southern Cracow Upland (Fig. 1). This is the only argillaceous sequence of the Visean, with a paleontologically documented age, on the eastern fringe of the Upper Silesian Coal Basin (Belka 1982).

In the shales which under- and overlie the two limestone layers, very rich and well-preserved assemblages of micro- and macrofossils occur (Fig. 1B). Most numerous are brachiopods (Czarniecki 1955, 1956), gastropods (Gromczakiewicz-Eomnicka 1972), trilobites (Osmolska 1970), corals (Nowinski 1976; Kulicka & Nowiński 1978), nautiloids (Dzik 1984), fenestellid bryozoans, and pelecypods. Detailed geological studies of this section were made by Dżułyński (1955), Piłat (1957), and Czarniecki & Łydka (1958). The age of these beds was determined on brachiopod evidence as Late Visean by Czarniecki (1955, 1956). Conodonts from the limestone intercalations indicate the *Gnathodus girtyi collinsoni* Zone, which corresponds in age to the Visean/Namurian boundary (Belka 1982).

The collection is housed at the Institute of Paleobiology of the Polish Academy of Sciences, Warsaw (abbreviated ZPAL).

The Orlej ostracod assemblage

The described ostracod fauna occurs in the shales above the upper limestone intercalation (A) which are also richly fossiliferous. This assemblage consists of 31 species belonging to 21 genera, most of which are widespread and known from the Late Visean and/or Early Namurian in the Variscan Belt and East European Platform.

The characteristic elements of this fauna *Bairdiolites eleuatus* Robinson 1959, *Kirkbya quadrata* Robinson 1959, *Monoceratina youngiana* (Jones & Kirkby 1886), *Bairdia distracta* Eichwald 1857, and *Bairdia (C.) berniciana* (Robinson 1978) are known also from the Late Visean (P2 – late Brigantian) of the British Isles (Robinson 1978), whereas *Roundyella reticulosa* (Jones & Kirkby 1886), *Healdia cornigera* (Jones & Kirkby 1886) and *Microcheilinella subcorbuloides* (Jones & Kirkby 1885) are known from Late Visean and Early Namurian.

Asturiella cicatricosa Robinson 1978 and *Cribroconcha inflata* Robinson 1978 proposed by Robinson (1978) to be index species for the Early Namurian are probably conspecific with *Asturiella ucrainica* (Gurevitsch 1959) and *Cribroconcha gloriosa* (Gorak 1964), respectively, reported from the Donieck Basin (Gorak 1964) and Lvov Depression (Gurevitsch 1959), from the Late Visean and Early Namurian. Their ranges are thus consistent with the conodont dating of the Orlej section.

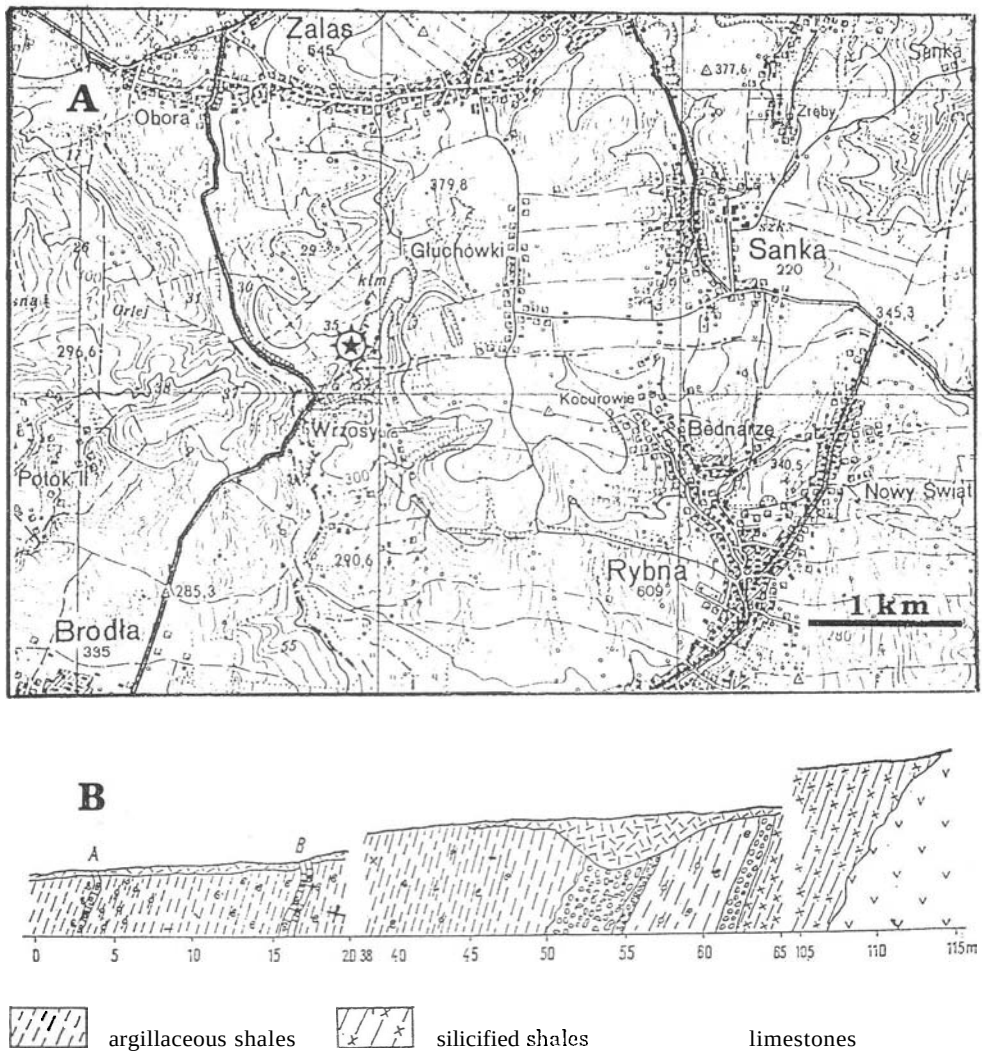


Fig. 1. ❑A. Location of the Orlej locality (marked with asterisk). OB. Schematic section of the Orlej Quarry with the Late Visean shales (after Czarniecki & Łydka 1958).

The ostracod assemblage of the Orlej shales consists of benthic genera, which are found in nearly all Carboniferous provinces, in marine shelf deposits of comparable age. The Orlej ostracod fauna is dominated by bairdiaceans and kirkbyaceans (Fig. 4). The dominant bairdiaceans are *Bairdia, Bairdiolites, Acratia, Bairdiocypris*, and *Microcheilinella* which represent together one third of the total identified species number. Dominant kirkbyaceans include *Polytylifes, Amphissites, Kirkbya, Roundyella*, and *Scrobicula;* represented by 9 species. Healdiaceans (*Healdia, Cribroconcha* and *Asturiella*) are also an important group of this assemblage. A few individuals of the palaeocopes *Coryellina, Tribolbina,* as well as the cladocopid *Discoidella* are also present.

The assemblage is rich in individuals. *Kirkbya quadrata, Bairdiolites elevatus* and *Bairdia (C.) berniciana* occur in great abundance, with instars common as well as adults. The fossil assemblage is thus apparently autochthonous. Paraparchitacean ostracods are practically absent from the Orlej assemblage, in contrast to their frequent occurrence in Variscan Europe in strata of comparable age, deposited in similar environments.

The dominance of species of Bairdiacea, Kirkbyacea and Healdiacea over those of the Kloedenellacea may reflect relatively open marine conditions. The Late Visean ostracod species from Orlej may be referred to the 'marine shallow offshore' assemblage of Bless (1983) or to the 'Thuringian assemblage' of Bandel & Becker (1975 p. 61; see also Bless in Dreesen *et al.* 1985: p. 332–336; Becker & Bless 1990). This type of assemblage is representative of basinal to shallow-marine low-energy environments.

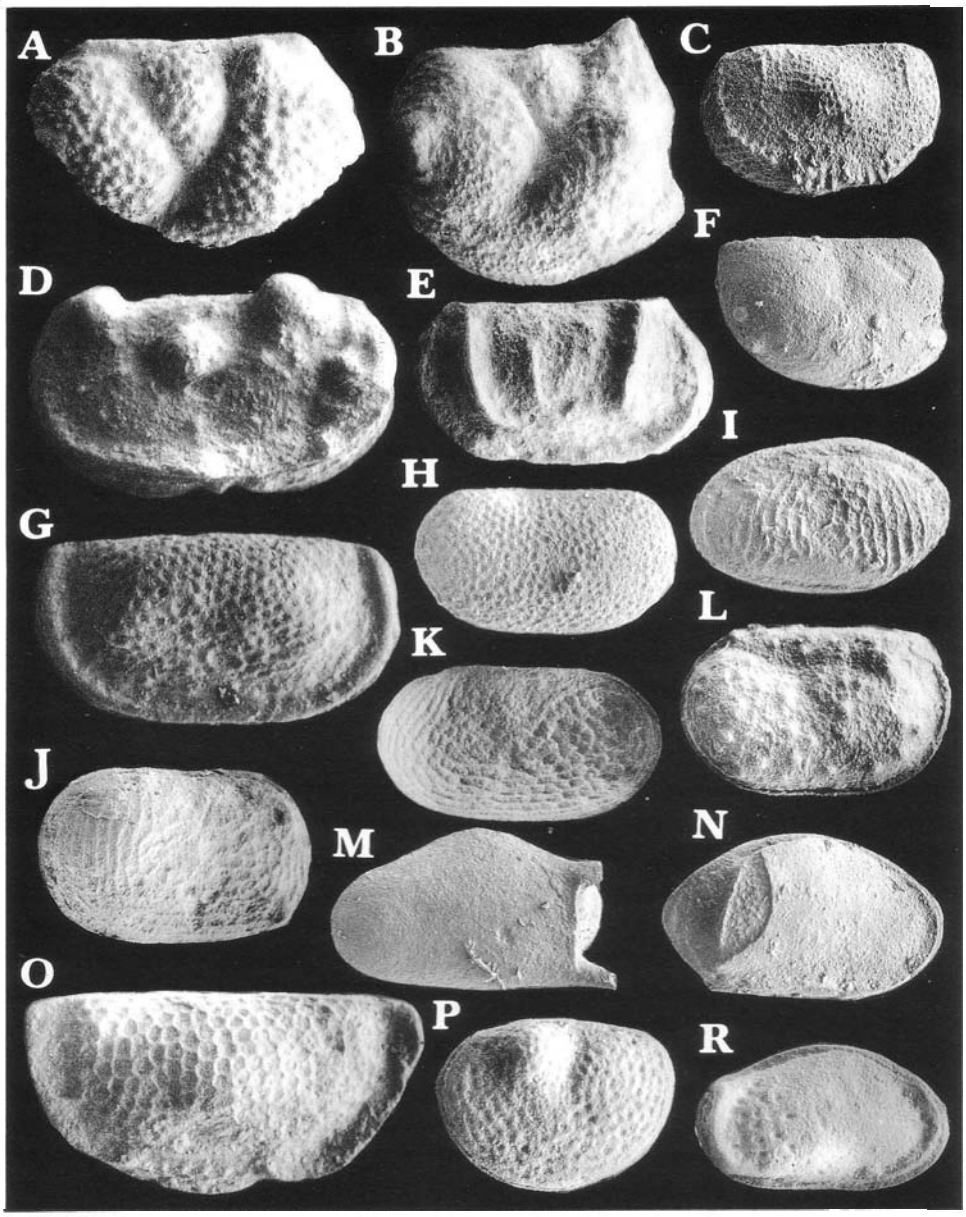
The Late Visean Carboniferous Limestone facies of Czerna in the Cracow area, is represented by thick-bedded limestones with marly intercalations (Alexandrowicz & Mamet 1973; Gromczakiewicz-Łomnicka 1974; Soboń-Podgórska 1975). From the marly intercalations an ostracod assemblage was extracted by Jeziorowska (1983). Although of almost the same age and located only a dozen kilometers apart, the Orlej and Czerna assemblages are very different in taxonomic composition (Figs 4, 5). This clearly reflects differences in depositional and paleoecological conditions.

The Jeziorowska's (1983) collection of 325 ostracod specimens from Czerna consists of 21 species. The Bairdiacea are represented by the genera *Bairdia, Bythocypris, Macrocypris,* and *Pontocypris.* The Paraparchitacea are represented only by one species, *Paraparchites subcircularis* Geis 1932, but in number of individuals it makes up to 32 percent of the assemblage. The Kloedenellacea are represented by *Glyptopleura, Knoxina, Jonesina,* and *Valleculella.* The assemblage is clearly dominated by kloedenellacean species which form at least half of the ostracod species; Bairdiacea form one third (Figs 4, 5). The dominance of Kloedenellacea may reflect the nearshore conditions in Czerna region. The presence of bairdiaceans suggests conections to a more-open marine environment.

In general, the Orlej section ostracod assemblage is of higher species diversity and ostracods are much more abundant. The differences in richness between Orlej and Czerna regions may be related to the types of sedimentary regime, open-marine during shaley sedimentation at Orlej, whereas in the Czerna region, conditions were shallow-water marine (cf. also Bełka 1982; Jeziorowska 1983).

The ostracod fauna from Orlej appers similar in its high-rank taxonomic composition to the Late Visean ostracod assemblage from the Lublin area in southern Poland as described by Woszczynska (1981). In the Lublin region, 26 species have been identified, of which bairdiaceans and kirk-

Fig. 2. ❑A–B. *Tribolbina* sp. A – right valve ZPAL O.XXIV/2 in lateral view; x *35.* B – right valve O.XXIV/1 in lateral view; x 40. OC. *Amphissites sp.* Left valve O.XXIV/7 in lateral view; × 40. OD. *Polytylites* sp. aff. *dorsoceratus* Blumenstengel 1975. Left valve O.XXIV/8 in lateral view:



x 60. ❑E. *Amphissites* tricostatus Blumenstengel 1975. Left valve O.XXIV/6 in lateral view: x 80. OF. Coryellina sp. Right valve O.XXIV/3 in lateral view; x 70. ❑G. Kirkbya *quadrata* Robinson 1959. Right valve O.XXIV/4 in lateral view; x 60. OH. *Roundyella reticulosa* (Jones & Kirkby 1886). Right valve O.XXIV/15 in lateral view; x 100. ❑I. *Graphiadactyllis* sp. Carapace O.XXIV/9 in right lateralview: x 100. ❑J. Scrobicutasp. aff. *reticulata* Posner 1951. Carapace O.XXIV/12 in left lateral view; x 110. OK. *Scrobicula* sp. Carapce O.XXIV/11 in left lateral view; x 100. OL. *Scrobicula? eresiformis* Zanina 1956. Carapace O.XXIV/14 in left lateral view: x 120. OM. *Healdia cornigera* (Jones & Kirkby 1886). Left valve O.XXIV/17; × 70. ON. Asturiella ucrainica (Gurevitsch 1959). Carapace O.XXIV/21 in right lateral view: × 70. OO. Kirkbyasp. Right valve O.XXIV/5; x 60. OP. Reticestussp. Rightvalve O.XXIV/16; x 130. OR. Cribroconcha gloriosa (Gorak 1964). Carapace O.XXIV/19 in left lateral view; × 100.

byaceans represent one third each and kloedenellaeans little more than ten per cent (Fig. 4). Unfortunatelly, Woszczyliska (1981) did not indicate the distribution of the ostracods in particular sections and it is unclear from which type of rock they were derived.

The three localities studied together give a facies picture for the Carboniferous of Poland which makes clear the position of landmasses and shorelines (Fig. 4).

The assemblage from Orlej is not unlike those from Late Visean/Early Narnurian assemblages of British Isles (Robinson 1959, 1978), Moscow Basin (Posner 1951; Gorak 1964), and the Lvov Depression (Gurevitsch 1959).

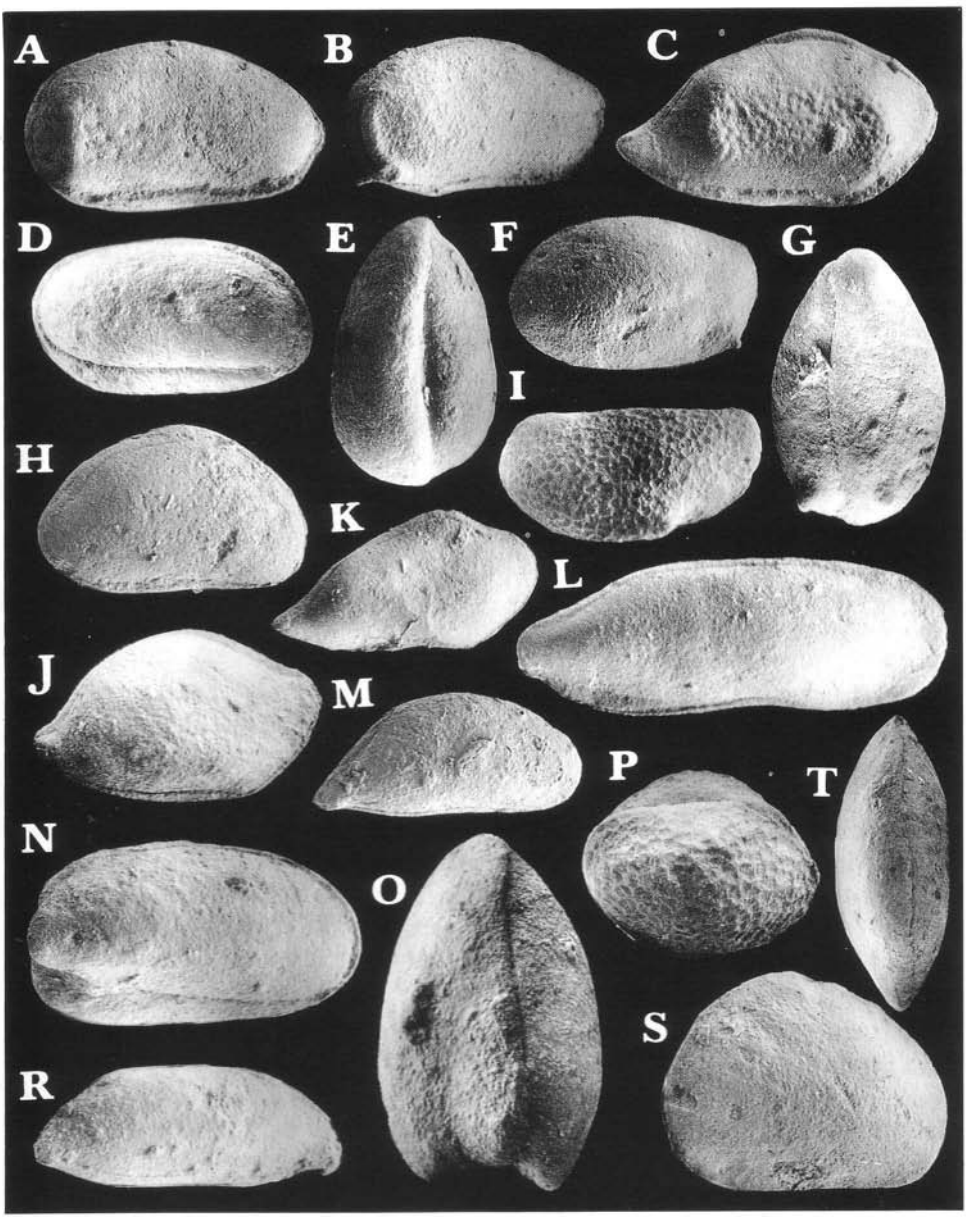
Studies carried out by different authors on Late Devonian and Carboniferous ostracod assemblages from northwestern Europe, Algeria, Spain, Morocco and Eastern Europe indicate that the presence or absence of certain ostracod forms is largely dependent upon the original depositional environment (Bandel & Becker 1975; Robinson 1978; Bless 1983; Bless *et al.* 1986,1988; Dreesen *et al.* 1985; Wang 1988a; Jones 1989; Becker & Bless 1990). Data from southern Poland corroborate this.

Identified ostracode species

***Tribolbina?* sp.** (Fig. 2A–B).— Three poorly preserved tecnomorphic valves have been found in Orlej. This species is most similar to the Late Permian *Tribolbina doescheri* Sohn 1978 from Greece (Sohn 1978), in having the anterior lobe split by a horizontal furrow, and narrow, pointed dorsal part to the anterior lobe. From *Tribolbina carnegiei* Latham 1932 from the Middle Visean of Scotland (Latham 1932), the species from Orlej differs in the presence of a posterolateral node on the posterior lobe and in having the central lobe not extending above midheight. With too few specimens (especially dimorphism cannot be identified), exact taxonomic identification is not possible.

***Coryellina* sp.** (Fig. 2F).— All four poorly-preserved specimens appear to be tecnomorphs which makes the taxonomic placement of the species difficult. This species is most similar in lateral outline and smooth surface to *Coryellina spinifera* Woszczyliska 1981 from the Late Visean of the Lublin Region, but differs in having a shallow sulcal depression. It is also similar to *Coryellina triceratina* (Posner 1951) from the Visean of the Moscow Basin and to *Coryellina ventricornis* (Jones & Kirkby 1886) from the Early Carboniferous of the British Isles (see Robinson 1978).

Fig. 3. ❑A. Bythocyproidea sp. Carapace ZPAL O.XXIV/20 in right lateral view; x 100. ❑B. Healdia? sp. Carapace O.XXIV/33 in right lateral view; x 100. ❑C. Bairdiolites *elevatus* Robinson 1959. Carapacee O.XXIV/25 in right lateral view; x 65. OD–E. Microcheilinella subcorbuloides (Jones & Kirkby 1886). D – carapace in left lateral view, E – dorsal view O.XXIV/34; x 100. OF–G. Microcheilinella sp. ex. gr. subcorbuloides (Jones & Kirkby 1886).



F – right valve in lateral view. G – ventral view O.XXIV/35; x 60. ❑H. *Bairdiocypris* sp. aff. *fomikhaensis* Buschmina 1968. Carapace O.XXIV/29 in right lateral view; x 40. 71. *Monoceratina youngiana* (Jones & Kirkby 1886). **Left** valve O.XXIV/28 in lateral view; x 100. ❑J. Bairdia *(Cryptobairdia)* bemiciana (Robinson 1978). Carapace O.XXV/22 in right lateral view; x 65. OK. Bairdia (Rectobairdia) sp. Carapace O.XXIV/24 in right lateral view; × 60. OL. Bairdia? *distracta* Eichwald 1857. Carapace O.XXIV/23 in right lateral view; x 60. OM. *Bairdianella protracta* (Zanina 1956). Carapace O.XXIV/26 in right lateral view: x 80. ON–0. *Triplacera?* sp. N – carapace in right lateral view, O – dorsal view O.XXIV/37; × 130. OP. *Discoidella* sp. Dorsal view O.XXIV/38; x 150. OR. Acratia *(Acratia)* sp. Carapace O.XXIV/27 in right lateral view; x 80. ❑S–T. *Silenites* cf. circumscisa (Jones & Kirkby 1879). S – carapace in left lateral view, T – dorsal view O.XXIV/31; x 55.

***Kirkbya quadrata* Robinson 1959** (Fig. 2G).— It is one of the most abundant species in the Orlej section. A few hundreds of specimens have been found. Specimens from Orlej slightly differ from the holotype in a slightly larger width of the carapace, especially in posterior part. This species is also similar to *Kirkbya pristina* Zanina 1956 from the Visean of the Moscow Basin (Zanina 1956); it differs from the latter in the lack of the small ridge in posterior part of the valve. The somewhat similar *K.* aff. *quadrata* was described from the Visean (V3b) of Australia (Jones 1989). *K. quadrata* has been widely reported from the P2 subzone (late Brigantian) of the North of England and Scotland (Robinson 1959, 1978), and also from the Late Visean of the Lublin region (Woszczyńska 1981).

***Kirkbya* sp.** (Fig. 2O).— Only a single valve of this species has been found. The specimen is somewhat similar in its lateral outline, reticulation and position of carinae to *Kirkbya lessnikovae* Posner 1951, from the Visean of the Moscow Basin, but lacks the spine at the posterior cardinal corner. It also resembles *Kirkbya* aff. *lessnikovae* described by Jones (1989) from the Bonaparte Beds (Visean) of Australia.

Amphissites tricostatus* Blumenstengel *1975 (Fig. 2E).— More than 40 poorly-preserved specimens have been collected. The outline and ornamentation of specimens from Orlej are identical with those of the holotype (Blumenstengel 1975: Pl. 1: 1–4). Previously this species was found in the Late Visean of Riigen and Hiddensee Island, Germany. This species is also similar to juvenile forms of *Amphissites urei* (Jones 1860) from the early Carboniferous of England and Scotland.

Amphissites sp. (Fig. 2C).— This is an abundant species in the Orlej section, more than 60 specimens were recovered. This species appears to have morphological similarities to with A. *centronotus* (Ulrich & Bassler 1906). It is also similar to A. *mosquensis* Posner 1951 from the Late Visean of the Moscow Basin. The preservation is rather poor and does not allow full description.

***Polytylites* sp. aff. *dorsoceratus* Blumenstengel 1975** (Fig. 2D).— This species is close to *P. dorsoceratus* from the Late Visean of Rügen (Blumenstengel 1975) but is also similar to specimens of *Polytylites* identified by Zanina (1956) as *Amphissites tricollinus* (Jones & Kirkby 1886). From other species of the genus, Orlej specimens differ in the equal size of the anterior and posterior node and in their rounded shape. Most specimens from Orlej are relatively poorly-preserved with the ornamentation indistinct, so more precise identification is impossible. 30 specimens have been found in the Orlej section.

***Reticestus* sp.** (Fig. 2P).— It is very similar to *Reticestus* sp. 1 described by Bandel & Becker (1975) from the Early Carboniferous (cu IIβ/γ) of the Carnic Alps. It is also very similar to *Reticestus* sp'. from the Late Devonian of the Holy Cross Mountains (Olempska 1979).

***Graphiadactyllis* sp.** (Fig. 2I).— The surface sculpture of this species resembles that in the late Tournaisian *Graphiadactyllis reticulocostata*

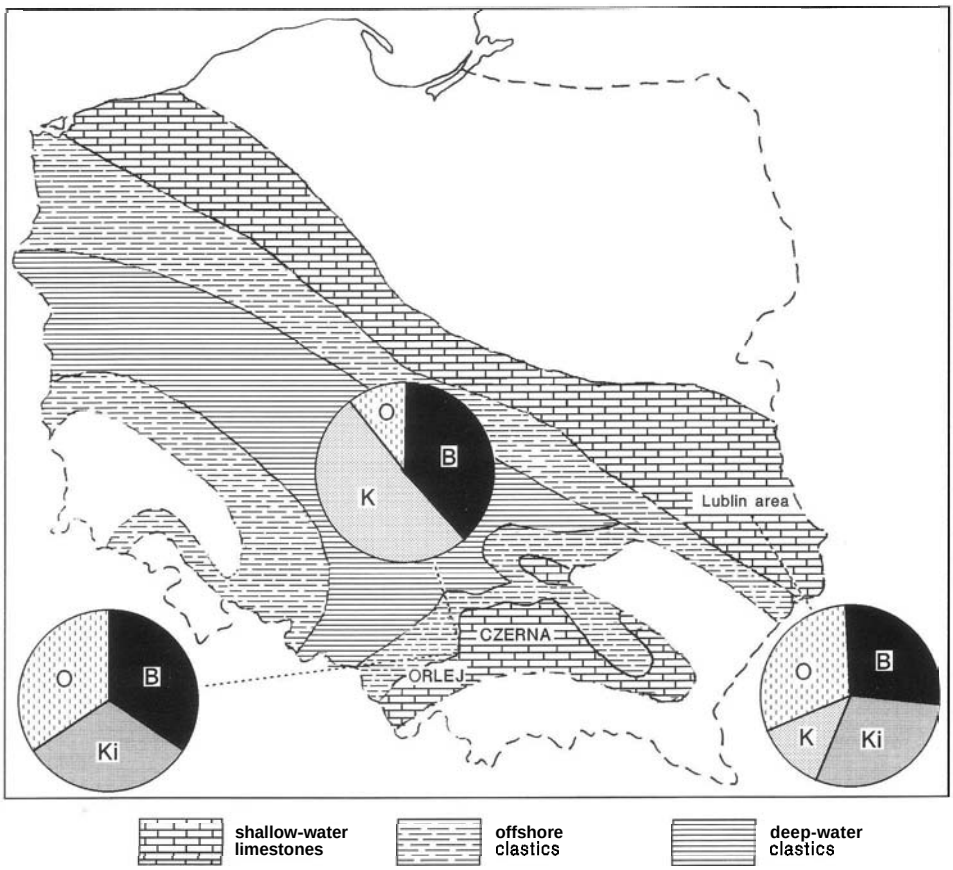


Fig. 4. Late Visean facies distribution (from Żakowa 1968, simplified), and taxonomic composition of ostracod assemblages in terms of per cent number of species of each main superfamily in the Late Visean of southern Poland. B – Bairdiacea, Ki – Kirkbyacea, K – Kloedenellacea, O – other superfamilies. Data from Czerna after Jeziorowska (1983) and from the Lublin region after Woszczyńska (1981)

Grundel 1975, but differs in having more asymmetrical outline of the carapace.

***Scrobicula* sp.** (Fig. 2K).—This is one of the most abundant species in Orlej, more than 200 specimens have been found. In the reticulate surface of a network of cells parallel in places to the outline of the valves it is most similar to Scrobicuh *foveolata* from the Visean of Moscow Basin (Zanina 1956), and also to Scrobicuh scrobicuhta (Jones, Kirkby, & Brady 1884) from which it differs slightly in the character of ornamentation.

Scrobicula* sp. aff. *reticulata* Posner *1951 (Fig. 2J).— The presence of two nodes in the posterior part of the valve makes it similar to that in S. *reticulata*, but the species differs in having more finger-print like ornament and more rounded cardinal corners. It is also similar in lateral outline and ornamentation to Scrobicula? aff. inaequalis Jones 1989 from

the Visean of Australia (Jones 1989) being distinct in having two nodes on each valve.

Scrobicula? *eresiformis* Zanina 1956 (Fig. 2L).— The species was reported from the Visean of the Moscow Basin (Zanina 1956), Lvov Basin (Gurevitsch 1959), and Lublin region (Woszczyriska 1981). Only three carapaces have been found in the Orlej section. They resemble some species of *Roundyella.*

Roundyella reticulosa (Jones & Kirkby 1886) (Fig. 2H).— This species is also somewhat similar to Roundyella *simplicissima* (Knight 1928) from the Carboniferous of North America but differs from it in lacking small spines on the lateral surface. In the central part of the specimens from Orlej a small muscle spot is visible. The species is also known from the early Carboniferous of Great Britain.

Healdia cornigera (Jones & Kirkby 1886) (Fig. 2M).— This species is widely distributed in the Visean-Namurian of British Isles (see Robinson 1959, 1978), Moscow Basin (Posner 1951), and Lublin region (Woszczyńska 1981). More than 100 specimens have been found in the Orlej section. Some variation is expressed in size of the posterior spines.

Cribroconcha gloriosa (Gorak 1964) (Fig. 2R).— Cribroconcha *inflata* Robinson 1978 from the Early Narnurian of British Isles (Robinson 1978) is probably conspecific. The species occurs in the Late Visean/Early Namurian of Donieck Basin (Gorak 1964).

Asturiella ucrainica (Gurevitsch 1959) (Fig. 2N).— This species known also from the Late Visean/Early Narnurian of Donieck Basin (Gorak 1964), Visean of Lvov Basin (Gurevitsch 1959), and the Late Visean of Lublin region (Woszczyriska 1981) appears conspecific with Asturiella cicatricosa Robinson 1978 from the Early Namurian of British Isles (Robinson 1978).

Bythocyproidea sp. (Fig. 3A).— More than 150 specimens have been found in the Orlej section. The gently arched dorsal margin of the carapace in specimens from Orlej is more similar to that of Bythocyproidea species than to Cribroconcha It posses poorly developed ridges in the posterior part of the valve. Probably the specimens from Orlej represent a new species.

Bairdia? *distracta* Eichwald 1857 (Fig. 3L).— This species is similar in lateral outline to Bairdia sp. cf. 92 of Becker & Bless (1974) from the Late Visean of Ardenno-Rhenish Massiv but differs in a more rounded anterior margin of the carapace. It is known from the Early Carboniferous of British Isles, Visean of the Moscow Basin (Posner 1951), Charauach Mountains (Buschmina 1970), Donieck Basin (Gorak 1967), Early Carboniferous of Guangxi, China (Wang 1988b), and the Lublin region in Poland (Woszczyriska 1981).

Bairdia (Cryptobairdia) berniciana (Robinson 1978) (Fig. 3J).— According to Bless et *al.* (1981) this species is more similar to Rectobairdia then to *Cryptobairdia* in having almost straight dorsum and distinct anterodorsal margin. B. *(C.)* berniciana is known from the Early Carbonife-

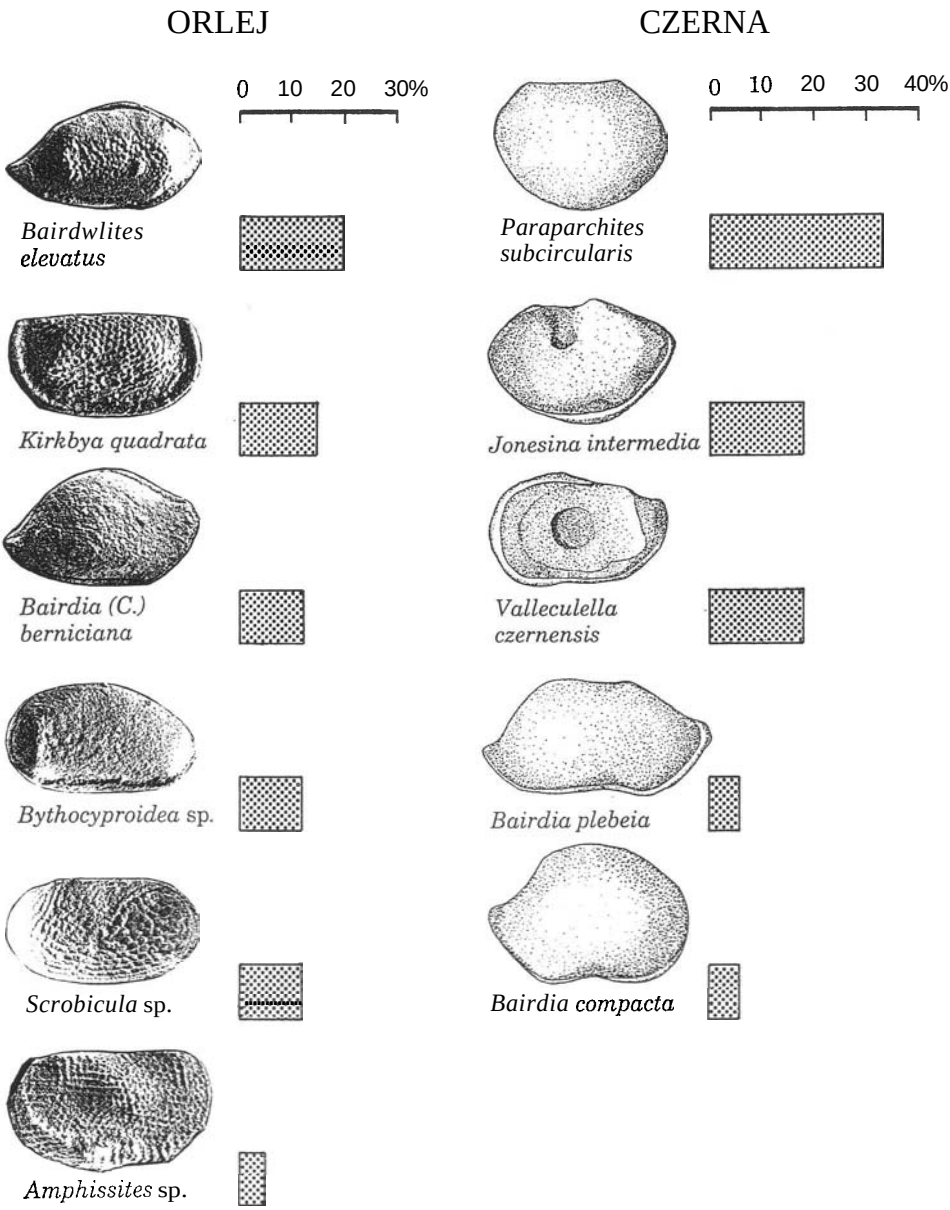


Fig. 5. Frequency distribution of the most common ostracode species in the latest Visean assemblages from clays of Orlej and marly limestones of Czerna (data from Jeziorowska 1983).

rous of the British Isles (see Robinson 1978), Late Visean of the Lublin region, Poland (Woszczyńska 1981), and was misidentified in the Lower Carboniferous of the Kuznieck and Kolyma Basins as *Bairdia brevis* by Buschmina (1968, 1975).

Bairdia *(Rectobairdia)*? sp. (Fig. 3K).— This species, rare in the Orlej section is similar to *Bairdia (Rectobairdia)* sp. aff. *romei* Lethiers 1974 from

the early Carboniferous of the Montagne Noire illustrated by Lethiers & Feist (1991: Pl. 5: 25–26).

***Bairdiolites elevatus* Robinson 1959** (Fig. 3C).— This is the most abundant species in Orlej; more than 250 specimens have been found. In Great Britain together with C. *gloriosa* and *Kirkbya quadrata* it is diagnostic for the P2 subzone of the late Brigantian (Late Visean; see Robinson 1978).

***Bairdianella protracta* (Zanina 1956)** (Fig. 3M).— This species is known from the Middle Visean of the Moscow Basin (Zanina 1956), Late Tournaisian of the Charauach Mountains (Buschmina 1970), and the Late Tournaisian of the Kuznieck Basin (Buschmina 1968).

Acratia (Acratia) sp. (Fig. 3R).— This species is similar in the shape of anterior and posterior margins to *Acratia zaniniana* Becker, Bless, & Sanchez de Posada 1977 from the Visean of the Moscow Basin, identified by Zanina (1956) as *Acratia rostrata*, but it differs in straight dorsal margin.

Bairdiocypris sp. aff. fomikhaensis Buschmina 1968 (Fig. 3H).— This species is alike *B. fomikhaensis* from the late Tournaisian of the Kuznieck Basin and Charauach Mountains (Buschmina 1968, 1970) but differs from the latter in a less-rounded posterior margin.

***Silenites* cf. *circumscisa* (Jones & Kirkby 1879)** (Fig. 3S).— The lateral outline of the carapace is similar to that in *Bairdocypris okensis* (Posner 1951) from the Visean of the Moscow Basin but differs in more rounded posterior margin. It is also similar to *Bairdiocypris rudolphi* (Kummerow 1939) from the Visean of the Rhenish Massif.

Healdia? sp. (Fig. 3B).— From other species of the genus this one differs in having a rather flat carapace in dorsal view and in an indistinct ridge in the posterior part of the carapace. From somewhat similar *Healdianella bispinosa* Gründel 1962 from the *Gattendorfia* Stage of Thuringia, the specimens from Orlej differ in the presence of an indistinct ridge in the posterior part of the valves.

Microcheilinella subcorbuloides (Jones & Kirkby 1886) (Fig. 3D, E).— This species is also known from the Visean of the British Isles (see Robinson 1978), early Carboniferous of the Moscow Basin (Posner 1951), Kuznieck Basin (Buschmina 1968), Kolyma (Buschmina 1975), and Donieck Basin (Gorak 1967).

Microcheilinella sp. ex. **gr. M subcorbuloides (Jones & Kirkby 1886)** (Fig. 3F–G).— In lateral outline this species is very similar to M. *subcorbuloides* but differs in having small spines in the posteroventral part of each valve. It is very similar to specimens illustrated by Robinson (1978: Pl. 6: 1) as M. *subcorbuloides*.

Monoceratina youngiana (Jones & Kirkby 1886) (Fig. 3L).— This species is known from the Late Visean of the British Isles (see Robinson 1978), Visean of the Moscow Basin (Posner 1951), and Late Visean of the Lublin region (Woszczyńska 1981).

Triplacera? sp. (Fig. 3N, O).— From typical *Triplacera* species this one differs in having short, thick, rounded spines in posteroventral part of the valves. It is also somewhat similar in its lateral outline to *Grammia zilimica* Kotschetkova 1980 from the late Tournaisian of the South Urals (Kotschetkova 1980).

Discoidella sp. (Fig. 3P).— This species is a little similar in its surface ornamentation to Discoidella *tuberculata* Wang 1988 from Wangyon Formation (Early Carboniferous) of Guangxi (Wang 1988b).

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Streszczenie

Z odsloniecia późnowizeńskich osadow w przekopie Orlej kolo Krakowa, opisano bogaty zespol ponad 30 gatunkow małżoraczków. Zespół ten porownany zostal z równowiekowym zespolem małżoraczków z pobliskiego odsloniecia w Czernej opisanym przez Jeziorowską (1983) oraz późnowizeńskimi malioraczkami obszaru Lubelszczyzny opracowanymi przez Woszczyńską (1981). Zespoły te rozniq się między sobą w proporcjach pomiędzy gatunkarni należącymi do trzech glownych nadrodzin małżoraczkow: Kloedenellacea, Kirkbyacea i Bairdiacea.

W rejonie Krakowa, małżoraczki z lupkow w Orleju różnią się zdecydowanie od zespolu opisanego z wapieni w Czernej, wykazują jednak podobienstwo do małżoraczków z regionu Lubelszczyzny. W odsłonięciu w Czernej dominujq gatunki z nadrodzin Kloedenellacea i Bairdiacea (Jeziorowska 1983), podczas gdy w odsłonięciu Orlej przeważają gatunki z nadrodzin Kirkbyacea i Bairdiacea. Zespol z Czernej jest charakterystyczny dla płytkowodnego (nearshore)srodowiska w przeciwienstwie do zespolu z odsloniecia w Orleju gdzie przewagą kirkbyidów i bairdidow wskazuje na srodowisko bardziej głębokowodne (offshore) (cf. Bless 1983; Becker & Bless 1990).

Zespol późno wizeńskich malzoraczkow z Orleja moina określić jako zespol typu „turyngijskiego", ktory zdefiniowany został przez Bandela & Beckera (1975)jako charakterystyczny dla srodowisk zarowno głęboko jak i płytkowodnych lecz o zdecydowanie niskiej energii srodowiska.