Givetian and Frasnian ostracod associations from the Holy Cross Mountains

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Variable bioclastic-biostromal-marly Posłowice facies within the Late Givetian open-shelf Jaźwica Member in the SW part of the Holy Cross Mts contain palaeocopid-podocopid ostracod associations of moderate diversity (18 species) dominated by *Microcheilinella fecunda* and *Fellerites tuimazensis*. More deep-water and stagnant environments of the Bolechowice micrite-marly facies, supported similarly differentiated (12 species) but less equitable associations with platycopids *Uchtovia refrathensis* and palaeocopids *Buregia jazwicensis* as a main component. Other late Givetian, and Frasnian reef and lagoonal microfaunas are mostly impoverished (at least in generic terms) and strongly predominated by podocopids, mostly *Bairdiocypris*. Late Givetian associations from the Kostomłoty basin are marked by the metacopid *Polyzygia symmetrica*, and the planktic entomozoid *Ungerella torleyi*. *Polenovula beckeri* sp. n., *Clavofabellina poslovicensis* sp. n., *Buregia jazwicensis* sp. n., and *Bairdia zbikowskae* sp. n. are proposed.

Key words: ostracods, taxonomy, paleoecology, Devonian, Poland.

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Introduction

Ostracod remains represent the most ubiquitous of the identifiable skeletal components in the stromatoporoid-coral Kowala Formation (see Racki 1993) of the southern Holy Cross Mountains. In contrast to the Middle Devonian faunas from more argillaceous strata of the northern (Łysogóry) region (Adamczak 1968, 1976), microfossils from the Givetian to Frasnian platform-to-reef limestones are still inadequately known. Except for one leperditiid species described by Gürich (1896), ostracods have been elaborated only from the Givetian *Stringocephalus* Beds at Jurkowice-Budy in the eastern part of the region (Olempska 1979). This is mostly the result

of difficulties in extracting an ostracod material from compact ('reef') deposits.

The present paper is aimed at describing the microfaunas from the Late Givetian lime-shaly complex of the Jaźwica Member, the only prominent open shelf intercalation within the essentially biostromal succession of the Kielce platform. A general review of biostratigraphy and ecology is given for the whole Kowala Formation, jointly with its overlying detrital strata, as well as for its Givetian lateral equivalents from the Kostomłoty transitional zone. Ostracod-bearing sections are located in the southwestern part of the Holy Cross Mountains (Fig. 1; see Racki 1993 for more details).

The senior author is responsible for taxonomy, the junior author for regional setting; other parts have been written jointly.

Material

The material under study comprises almost three thousand ostracod specimens; more than eighty per cent came from the Kowala Formation. Their preservation varies broadly; chiefly exfoliated internal molds and fragmentary carapaces have been obtained by washing of weathered limestone fragments in such sites as Jaźwica-Góra Łgawa, Jaworznia or Kadzielnia. Argillaceous sediments, especially of the Jaźwica Member and Szydłówek Beds, have yielded generally well preserved complete specimens. Only a few pyritized valves and moulds were found in acid resistant residues.

The collection examined is housed at the State Geological Institute in Kielce (abreviated PIG-OS).

Taxonomy

The chapter contains a taxonomical review of the most important ostracod species from the Jaźwica Member (Tab. 1 and Figs 2-5). Ostracods from other units of the Kowala Formation, mostly identified only to the generic level, are listed in the Tabs 2-3 and some of them are also illustrated (Fig. 7).

Order Palaeocopida Henningsmoen 1953
Family Primitiopsidae Swartz 1936
Parapribylites Pokorný 1950

Genus Parapribylites hanaicus (Pokorný 1950)

Fig. 2A.

Remarks.– Sexual dimorphism is well expressed among the six studied specimens. Females exhibit well developed perimarginal tubercles and posteroventral nodes that are situated at the level of the lowermost perimarginal tubercles. In males, adventral structures comprise poste-

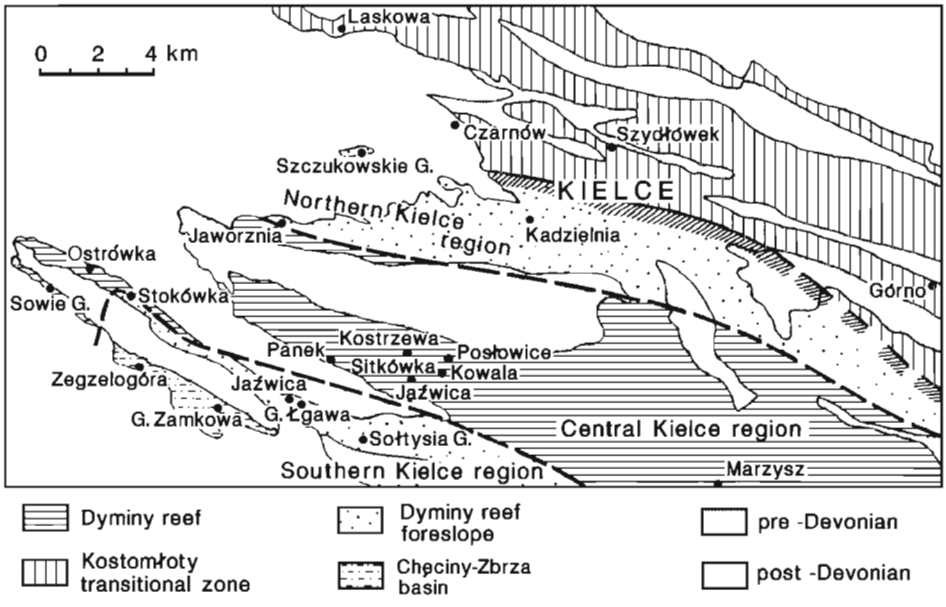

Fig. 1. Location of ostracode sites in the Holy Cross Mts, against early Frasnian paleogeography (Racki 1993: Fig. 2B); edge of the Kielce platform hatchured.

roventral nodes that are shaped as short, upraised thickened ribs or triangularly outlined spurs. In Poland the species has been found in the Late Givetian of the Holy Cross Mountains (Jaźwica Member: Jaźwica, Posłowice, Marzysz) and Pomerania (Żbikowska 1983). Known from the Early Givetian of the Rhenish Slate Mountains (Loogh to Rodert Formations: Becker 1965a, 1970, Upper Honseler to Bucheler Formations: Groos 1969; Becker 1965b), Ardennes (Coen 1985; Casier *in* Casier & Preat 1991), and Boulonnais (Milchau 1988), and the Eifelian to Givetian boundary beds of Moravia (Čelechovice Limestone: Pokorný 1950).

Family Buregiidae Polenova 1953
Genus *Buregia* Zaspelova 1953

Buregia jazwicensis sp. n.

Fig. 4B-E.

Holotype: PIG-OS OIII/28; Fig. 4C.

Type horizon: Jaźwica Member in Bolechowice facies, Late Givetian.

Type locality: Jaźwica Quarry (western exposure) near Bolechowice, Holy Cross Mountains, Poland.

Derivation of the name: After the type locality.

Diagnosis.– Carapace subrectangular in lateral outline. Anterior margin rounded, posterior obliquely truncate. Ventral margin slightly convex. Spines small; posterior spines are situated on the lower level than anterior ones. Cardinal angles distinct: posterior angle less obtuse than the anterior one. Surface smooth to finely punctate.

Material.– Ninety five specimens.

Tab. 1. Distribution and frequency of ostracods in the Late Givetian Jaźwica Member of the SW-part of Holy Cross Mts (see Fig. 1 for sites; GS – G. Sołtysia, GŁ – G. Łgawa, Jz – Jaźwica, GZ – G. Zamkowa, St – Stokówka, SG – Sowie G., Mz – Marzysz, Ps – Posłowice).

	Bolechowice						Posłowice	
	GS	GŁ	Jz	GZ	St	SG	Mz	Ps
Palaeocopida								
Parapribylites (P.) hanaicus	-	1	1	-	-	-	2	2
Polenovula beckeri	1	-	-	-	-	-	3	65
?Polenovula sp.	-	-	1	-	-	-	-	-
Clavofabellina poslovicensis	-	-	-	1	-	-	24	10
Amphissites sp. A	-	1	3	-	-	1	-	-
Fellerites tuimazensis	-	-	-	-	-	-	46	27
Hollinella antri	-	-	-	-	-	-	-	3
Primitiopsidae indet.	-	-	-	-	-	-	36	7
Buregia jazwicensis	1	24	16	-	37	27	-	-
Sulcatiella sp.	-	-	-	-	-	-	15	-
Platycopida								
Uchtovia refrathensis	-	12	18	87	225	-	-	2
Menoeidina sp.	-	-	-	-	-	-	10	-
Indivisia sp.	-	-	-	-	-	-	-	2
Knoxiella sp.	-	-	-	-	1	-	-	-
Bythocyproidea sp.	-	-	-	-	-	-	1	-
Metacopida								
Gerbeckites sp. A	-	-	-	-	-	-	5	-
Cytherellina sp.	-	-	-	-	-	-	1	-
Podocopida								
Microcheilinella fecunda	-	-	-	-	-	-	27	166
Microcheilinella sp.	-	-	-	-	-	-	9	-
Bairdiocypris aff. *rauffi*	-	4	-	-	-	-	-	-
Bairdiocypris sp.	1	-	1	-	-	-	36	13
Bairdia paffrathensis	-	-	-	-	-	-	21	-
Bairdia zbikowskae	10	10	14	-	16	3	-	-
Bairdia sp.	-	1	-	-	-	-	-	-
Acratia sp. A	-	-	-	-	1	-	5	-
Samarella laevinodosa	10	2	4	-	-	-	-	-
Baschkirina sp.	-	-	-	-	-	-	3	-
Schneideria sp.	-	-	-	-	-	-	4	-
No. of specimens	23	55	58	88	280	55	248	297
No. of species	5	7	8	2	5	4	17	10
Diversity index (Simpson's formula)	2.81	3.68	4.28	1.02	1.50	2.35	8.99	2.70

Description.– Medium-sized (length up to 1 mm) carapace subrectangular in lateral outline. Dorsal margin long, straight. Anterior border rounded, posterior slightly truncated. Ventral margin gently convex. Maximum convexity situated slightly behind the midlength. The right larger valve overlaps the left one along the entire free margin. A narrow list with fine spines in its anteroventral and posteroventral ends of each valve. The

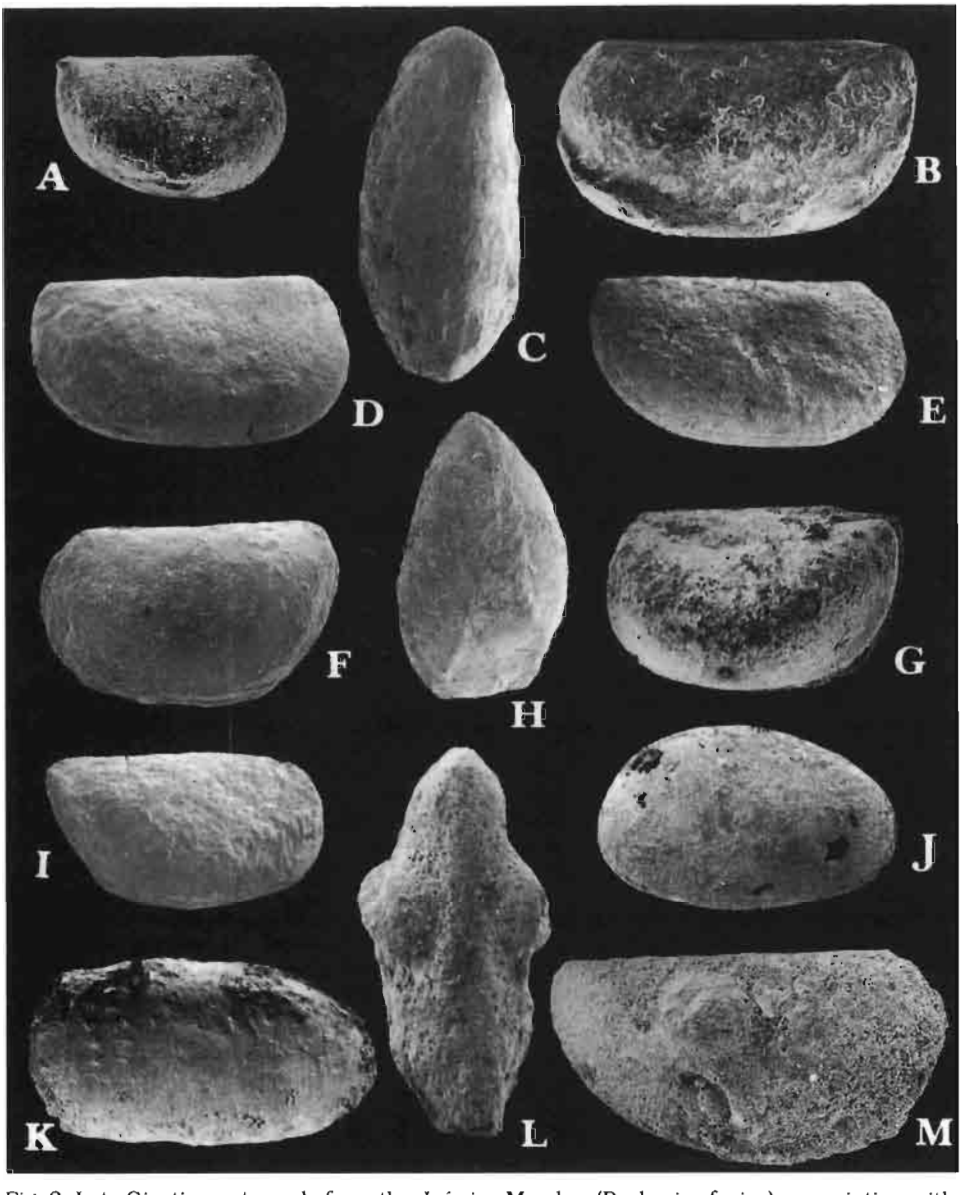

Fig. 2. Late Givetian ostracods from the Jaźwica Member (Posłowice facies); association with *Microcheilinella fecunda* and *Fellerites tuimazensis*. ❑A. *Parapribylites hanaicus* (Pokorný 1950), tecnomorphic carapace from right, PIG-O OIII/4; Marzysz. ❑B-E. *Polenovula beckeri* sp. n., tecnomorphic carapace from left (B) and top (C), PIG-OS OIII/7 (holotype; length L=0.93, height H=0.53, width W=0.45), and heteromorphic carapaces in right view (D-E), PIG-OS OIII/64-65; Posłowice; × 52 (B-C), × 42 (D), × 44 (E). ❑F-I. *Clavofabellina posłovicensis* sp. n., carapaces from left (F-G), ventral (H) and right (I); PIG-OS OIII/11 (G-H; heteromorph, holotype; L=0.75, H=0.45, W=0.43), OIII/10 (F), OIII/66 (I); Marzysz (F-H, × 52), Posłowice (I, × 44). ❑J. *Cytherellina* sp., right view, PIG-OS OIII/67; Marzysz; × 70. ❑K. *Bythocyproides* sp., right view, PIG-O OIII/12; Marzysz, × 95. ❑L-M. *Hollinella antri* Adamczak 1968, tecnomorphic carapace in right (H) and lateral (I) views; Posłowice; × 52.

anterior spines occur slightly higher than the posterior spines. Anterior spines are situated symmetrically on both valves, but posterior spines on the right valve is located somewhat higher than the posterior spine of the left valve. Maximum height in the posterior carapace part. Carapace subtriangular in transversal section. Posterior corner angle less obtuse than the anterior one. Surface smooth or closely covered with fine puncta.

Remarks.– *Buregia jazwicensis* sp. n. is similar to the variety of *B. jivensis* Shishkinskaya 1959, described from the Givetian *Stringocephalus* Beds by Olempska (1979) but differs by presence of an oblique termination of the posterior end, the maximum width of carapace placed in the posterior part, as well as by its smaller adult size. The new species bears some resemblance also to Late Frasnian *B. krestovnikovi* Polenova 1953 from Russia. The Polish Late Givetian form displays such specific characters as slight truncation of the posterior border, and less obtuse posterior cardinal angle.

Distribution.– Holy Cross Mountains, Late Givetian (Jaźwica Member: Jaźwica-Góra Łgawa, Stokówka, Sowie Górki, Góra Sołtysia).

Family Polenovulidae Martinsson 1960

Genus *Polenovula* Martinsson 1960

Polenovula beckeri sp. n.

Fig. 2B-E.

Polenovula sp. A; Becker 1970: pp. 59-60, Text-Fig. 8.

Holotype: PIG-OS O III/7; Fig. 2B-C.

Type horizon: Jaźwica Member (upper part) in Posłowice facies, Late Givetian.

Type locality: Small quarry on the Posłowice hill at Kielce (unit B_2), Holy Cross Mountains, Poland.

Derivation of the name: In honour of Professor Gerhard Becker, German investigator of the Devonian ostracods.

Diagnosis.– Carapace rectangular in lateral view, with the anterior margin rounded and the posterior end slightly obliquely truncate. Ventral margin weakly convex. Heteromorphs with dumpy carapace which is posteriorly expanded. No perimarginal structures.

Material.– Sixty eight carapaces.

Description.– Adult carapace medium in size (length L – 0.9-1.1 mm), subrectangular in lateral outline. Dorsal margin long, straight. Ventral margin slightly convex, subparallel to the dorsal one. Anterior margin semicircular, posterior one more gently truncated posteroventrally. Carapace is highest in its middle part. Surface covered with very delicate reticulation. A circular adductorial spot is situated in the middle of the central area, slightly above the midheight of the valve. Its diameter equals one-seventh of the valve height (0.08 mm in holotype). Carapace triangular in transverse section.

Heteromorphs with more convex carapace, widened in the posterior part. Tecnomorphs distinguished by relatively more narrowly outlined carapace.

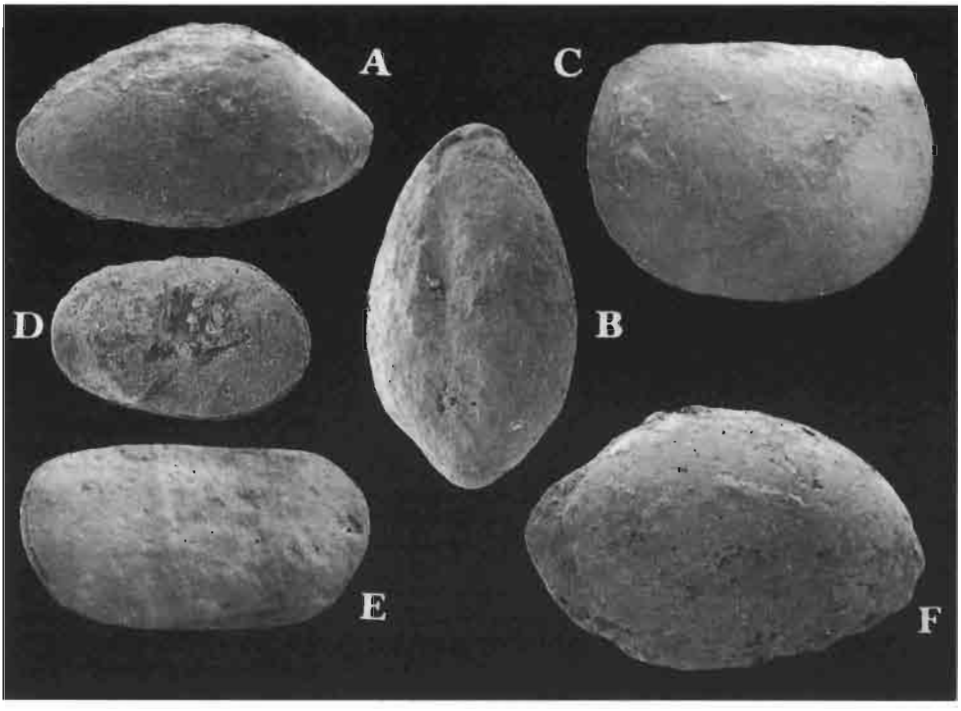

Fig. 3. Late Givetian ostracods from the Jaźwica Member (Posłowice facies); association with *Microcheilinella fecunda* and *Fellerites tuimazensis*. ❑A-B, F. *Microcheilinella fecunda* (Přibyl & Šnajdr 1950), carapaces from left (A), top (B) and right (F), PIG-O OIII/69-70; Marzysz (A-B), Posłowice (F); × 45 (C), × 43 (D), × 46 (F). ❑C. *Fellerites tuimazensis* (Rozhdestvenskaya 1959), carapace from right, PIG-OS OIII/19; Marzysz; × 43. ❑D. *Gerbeckites* sp. A., carapace from left, PIG-OS OIII/30; Marzysz; × 52. ❑E. *Indivisia* sp., right view, PIG-OSS OIII/71; Posłowice; × 50.

Remarks.– The new species is similar to *Polenovula ovata* (Kummerow 1953; Becker 1964, 1965b), but differs from it in having more narrowly rounded anterior margin, and a distinctive truncation of the postero-ventral margin.

Distribution.– Holy Cross Mountains, Late Givetian (Jaźwica Member: Posłowice, Marzysz, Góra Sołtysia); Eifel Mountains, Early Givetian (Cürten Formation: Becker 1970).

Genus *Clavofabellina* Polenova 1968

Clavofabellina poslovicensis sp. n.

Fig. 2F-I.

Holotype: PIG-OS OIII/11; Fig. 2G-H.

Type horizon: Jaźwica Member in Posłowice facies, Late Givetian.

Type locality: A trench dug on the lowhill, south of Marzysz, Holy Cross Mountains, Poland.

Derivation of the name: From the Posłowice suburb of Kielce, important as fossiliferous site in the Holy Cross Mountains.

Diagnosis.– Species of *Clavofabellina* characterized by massive, short carapace, uniformly rounded anterior margin and truncated posterior

margin. Females with perimarginal ridges, which are developed in the posterior parts of carapace and reach almost the midlength of ventral margin.

Material.– Thirty six carapaces.

Description.– Carapace small (L – 0.75-0.8 mm), subrectangular in lateral outline. Anterior margin rounded, posterior obliquely truncated. Dorsal margin long, straight, ventral margin slightly convex, subparallel to the dorsal one. An adventral structure is present in the posterior part of the carapace, connected with perimarginal ridges in posterior cardinal corner. Maximum height and width slightly behind the midlength of the carapace, both slightly reduced at its anterior end. When viewed dorsally, the carapace is ovally outlined, with narrowed anterior end and widened posterior end. Surface smooth.

Remarks.– *C. poslovicensis* sp. n. resembles strongly *Clavofabellina tenuis* (Adamczak 1968) from the late Emsian of the Holy Cross Mountains, and *C. abunda minor* Polenova 1968 from the Early Devonian of Salair. The new species is distinguished by a more inflated shape of the carapace and minute size. As compared with *C. tenuis*, females of *C. poslovicensis* differ also in their longer adventral structures in the ventral part that reaches almost to the midlength of the valve.

Distribution.– Holy Cross Mountains, Late Givetian (Jaźwica Member: Marzysz, Posłowice, Góra Zamkowa).

Family Hollinellidae Bless & Jordan 1971

Genus *Hollinella* Coryell 1928

Hollinella antri Adamczak 1968

Fig. 2L-M.

Remarks.– Only three specimens have been found at Posłowice. Recorded also from the Early Givetian of the Łysogóry Region (Skały Beds, Adamczak 1968), as well as from the Late Givetian of Pomerania (Żbikowska 1983) and Sauerland (Oberberge Beds, Groos 1969).

Family Amphissitidae Knight 1928

Genus *Amphissites* Girty 1910

Amphissites sp. A

Fig. 4F.

Remarks.– The examined 18 carapaces from Jaźwica, Góra Łgawa and Sowie Górki differ from typical representatives of the genus in weakly developed inner and ventral carina. They are close to *A. tener* Becker 1964 from the Early Givetian of Eifel (Cürten Formation), but are marked by longer dorsal margin. *A.* sp. A shows also some similarity to specimens described as *A.* cf. *parvulus* (Paeckelmann 1922) by Becker (1971a) from the Middle Frasnian of the Dinant Basin, but differ in completely reduced inner carina and only slightly outlined ventral carina.

Family Rozhdestvenskayitidae McGill 1966

Genus *Fellerites* Grundel 1962

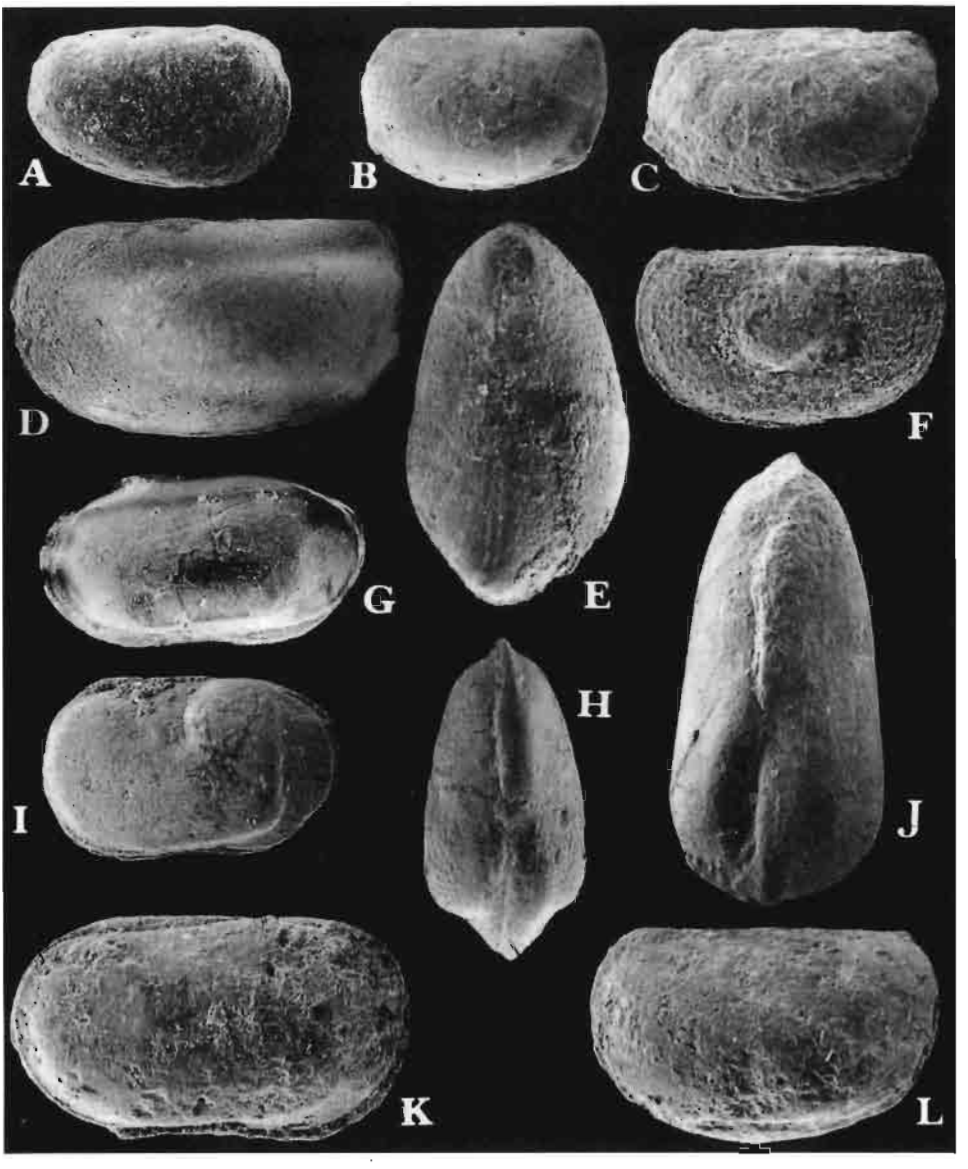

Fig. 4. Late Givetian ostracods from the Jaźwica Member (Bolechowice facies); association with *Buregia jazwicensis* and *Uchtovia refrathensis*. ❑A. *Samarella laevinodosa* Becker 1964, carapace from left, PIG-O OIII/53; Góra Sołtysia. ❑B-E. *Buregia jazwicensis* sp. n., juvenile carapace from left (B), and adult carapaces in left (C-D) and dorsal (E) views; PIG-OS OIII/28 (C; holotype, L=0.73, H=0.42, W=0.38),)III/59 (B), OIII/25 (D-E); Stokówka (B, D-E), Jaźwica (C). ❑F. *Amphissites* sp. A, carapace from left, PIG-OS OIII/15; Góra Łgawa. ❑G-K. *Uchtovia refrathensis* (Krömmelbein 1954), three juvenile carapaces in left (G, I) and dorsal (H) views, PIG-O OIII/24, Stokówka (G-H), PIG-OS OIII/56, Góra Łgawa (I); heteromorphic carapace from dorsum (J) and tecnomorphic carapace from right (K), PIG-OS OIII/21, Stokówka (J), Góra Łgawa, PIG-OS OIII/23 (K). ❑L. *?Polenovula* sp., tecnomorphic carapace from left, PIG-OS OIII/58; Jaźwica. All approximately × 52.

Fellerites tuimazensis (Rozhdestvenskaya 1959)
Fig. 3C.

Remarks.– Specimens from the Jaźwica Member (Marzysz, Posłowice) are very close to those described by Olempska (1979) from somewhat older Givetian strata (*Stringocephalus* Beds). All the Holy Cross Mountains populations differ from the typical representatives from the late Emsian to early Eifelian (Koiva and Biya horizons) of Bashkiria (Rozhdestvenskaya 1959) in having a shorter hinge margin. In the Holy Cross Mountains the species ranges from the earlier Givetian *Stringocephalus* Beds to Early Frasnian Sitkówka Beds (Jaźwica, sets C, H; Góra Łgawa, set J), and was also quoted from the Pomeranian Late Givetian (Żbikowska 1983).

Order Platycopida Sars 1866
Family Kloedenellidae Ulrich & Bassler 1908
Genus *Uchtovia* Egorov 1950

Uchtovia refrathensis (Krömmelbein 1954)
Fig. 4G-K.

Remarks.– The samples comprise both males and females, which are in good agreement with the broad concept of the species given by Coen (1985). Adult individuals have almost smooth valves with slightly outlined adductorial sulcus which is distinctly developed already in juveniles. The Late Givetian representatives of *U. refrathensis* from Pomerania exhibit more distinct adductorial sulcus (see Żbikowska 1983).

Distribution.– The rich examined material (381 carapaces) of *U. refrathensis* has been obtained from the Late Givetian to Frasnian strata [Jaźwica Member: Jaźwica-Góra Łgawa, Góra Zamkowa, Stokówka, Sowie Górki; also Sitkówka Beds (Jaźwica, sets E-F; Sitkówka-Kowala; Sowie Górki, set G) and Chęciny Beds (Zegzelogóra, Sitkówka-Kostrzewa)]. The species is known from the Givetian to Early Frasnian of the Rhenish-Ardenne Massif (Upper Plattenkalk Formation: Krömmelbein 1954; Trois Fontaines Formation, upper Fromelei nes to basal Nismes Formations: Coen 1985; Casier 1987b; Casier *in* Casier & Preat 1991), and from the Middle Givetian of the Bashkiria (Mulino subhorizon: Rozhdestvenskaya 1959).

Order Metacopida Sylvester-Bradley 1961
Family Healdiidae Harlton 1933
Genus *Gerbeckites* Żbikowska 1983

Gerbeckites sp. A
Fig. 3D.

Remarks.– *Gerbeckites* sp. A is similar to *G. pomeranicus* Żbikowska 1983, but differs in having considerably less convex dorsal margin, and higher and regularly rounded posterior margin. Four valves and 1 carapace have been found in the Holy Cross Mountains Late Givetian (Marzysz).

Order Podocopida Muller 1894
Family Pachydomellidae Berdan & Sohn 1961
Genus *Microcheilinella* Geis 1933

Microcheilinella fecunda (Přibyl & Šnajdr 1950)

Fig. 3A-B, F.

Remarks.– The studied Late Givetian specimens of *M. fecunda* from Marzysz and Posłowice are marked by asymmetrical posterior end of the carapace, as viewed dorsally, as well as by flattened, narrow left valve in contrary to regularly convex right valve. *M. fecunda* occurs too in the Early Givetian of the Łysogóry Region (Skały Beds: Adamczak 1976), Late Givetian of Pomerania (Żbikowska 1983), and the Eifelian Choteč Limestone of the Bohemia (Přibyl & Šnajdr 1950; Přibyl 1954).

Family Bairdiocyprididae Shaver 1961

Genus *Bairdiocypris* Kegel 1932

Bairdiocypris aff. *rauffi* Krömmelbein 1952

Fig. 5I-J.

Remarks.– Four carapaces from the Late Givetian of the southern Holy Cross Mountains (Góra Łgawa) are different from *Bairdiocypris rauffi* Krömmelbein 1952 from Germany in smaller sizes (length below 1.5 mm), less arcuate dorsal margin, more gently inclined anterodorsal border and broadly rounded anterior margin. This material bears the most affinity with *B. rauffi* from the Early Givetian of Skały Beds (Adamczak 1976), but is distinguished by more weakly bent anterior border, less inflated ventral margin and by location of the midheight of carapace in its middle part. *B. rauffi* is widespread in the Middle Devonian of the Hercynian Europe (Casier & Preat 1990).

Family Bairdiidae Sars 1888

Genus *Bairdia* McCoy 1844

Bairdia paffrathensis Kummerow 1953

Remarks.– The sample (21 carapaces) from Marzysz exhibits a wide population variability, similar to that discussed by Żbikowska (1983: p. 75). It is a common species known from the *Stringocephalus* Beds of Jurkowice-Budy (Olempska 1979), as well as from the Late Givetian of Pomerania (Żbikowska 1983), and the Middle Devonian and Frasnian of the Rheinish-Ardenne Massive (e.g. Junkenberg to Rodert Formations of the Eifel, Upper Honsel to Refrath Formations of the Bergisches Land: see summary in Becker 1971a, Trois Fontaines Formation, Fromelennes Formation through Frasnes Group: Coen 1985; Casier 1987b; Casier *in* Casier & Preat 1991), and the Givetian of Boulonnais (Blacourt Formation: Milhau 1988) and Volhynia (Pelcha Beds: *fide* Żbikowska 1983).

Bairdia zbikowskae sp. n.

Fig. 5A-E.

Holotype: PIG-OS OIII/44; Fig. 5A.

Type horizon: Jaźwica Member (Bolechowice facies), Late Givetian.

Type locality: Eastern Jaźwica (Góra Łgawa) Quarry near Bolechowice, Holy Cross Mountains, Poland.

Derivation of the name: In honour of Dr. Barbara Żbikowska, Polish ostracologist.

Diagnosis.– Carapace medium-sized, elongated (height/lenght ratio equals ca. 0.4), with almost parallel ventral and dorsal margins. Dorsal margin long, with gently inclined anterodorsal slope, and sharply truncated the posterodorsal one. Maximum width of carapace in its central part.

Material.– Fifty four carapaces.

Description.– Carapace length ranges from 0.8 to 1.2 mm, height/lenght ratio from 0.39 to 0.43. The anterior margin is rounded, slightly truncated in the anteroventral half, whereas the posterior end is pointed below the carapace midheight. Ventral margin is slightly medially concave. Maximum height, as well as maximum lenght and convexity is in the midlength. Carapace is compressed in the anterior and posterior ends.

Remarks.– *B. zbikowskae* sp. n. is close in the carpace shape to Late Givetian *Bairdia canigranulosa* (McGill 1961) from Canada, from which it differs in less inclined dorsal margin and more gently sloping ventrodorsal border. The lateral outline of the Polish species resembles also that of Givetian Russian *B. spinulosa* Polenova 1952 and *B. volatilis* Rozhdestvenskaya 1962, but is distinguishable from these by its straight and very long dorsal margin, and only slightly concave ventral border. *B. zbikowskae* sp. n. is similar in lateral outline to some variants of *B. paffrathensis* but differs in having slender shape of the carapace, subparallel dorsal and ventral margins, and weakly inclined posteroventral and anterodorsal margins.

Distribution.– Holy Cross Mountains, Late Givetian Jaźwica Member: Jaźwica-Góra Łgawa, Góra Sołtysia, Stokówka, Sowie Górki; also basal Szydłówek Beds: Czarnów, set B_1, and Sitkówka Beds: Jaźwica, sets C-F.

Genus *Acratia* Delo 1930

Acratia sp. A

Fig. 5G-H.

Remarks.– *Acratia* sp. A resembles strongly *A. samoilovae* Shishkinskaya 1959 from the Givetian of Russia. The Polish form is marked by more elongated shape (height/lenght=0.35, whilst in the Russian form the ratio equals 0.43), less sharply truncated anterodorsal border, and less excavated anteroventral margin. In addition, there is some similarity with the variety of *A. integra* Rozhdestvenskaya 1962 from the Givetian of Pomerania (Żbikowska 1983); the form described displays considerably less inflate dorsal margin and straight ventral border. Scarce material (6 carapaces) do not enables more proper taxonomic evaluation.

Distribution.– Holy Cross Mountains, Late Givetian Jaźwica Member: Stokówka, Marzysz, Jaźwica-Góra Łgawa.

Family ?Paraparchitidae Scott 1959

Genus *Samarella* Polenova 1952

Samarella laevinodosa Becker 1964

Fig. 4A.

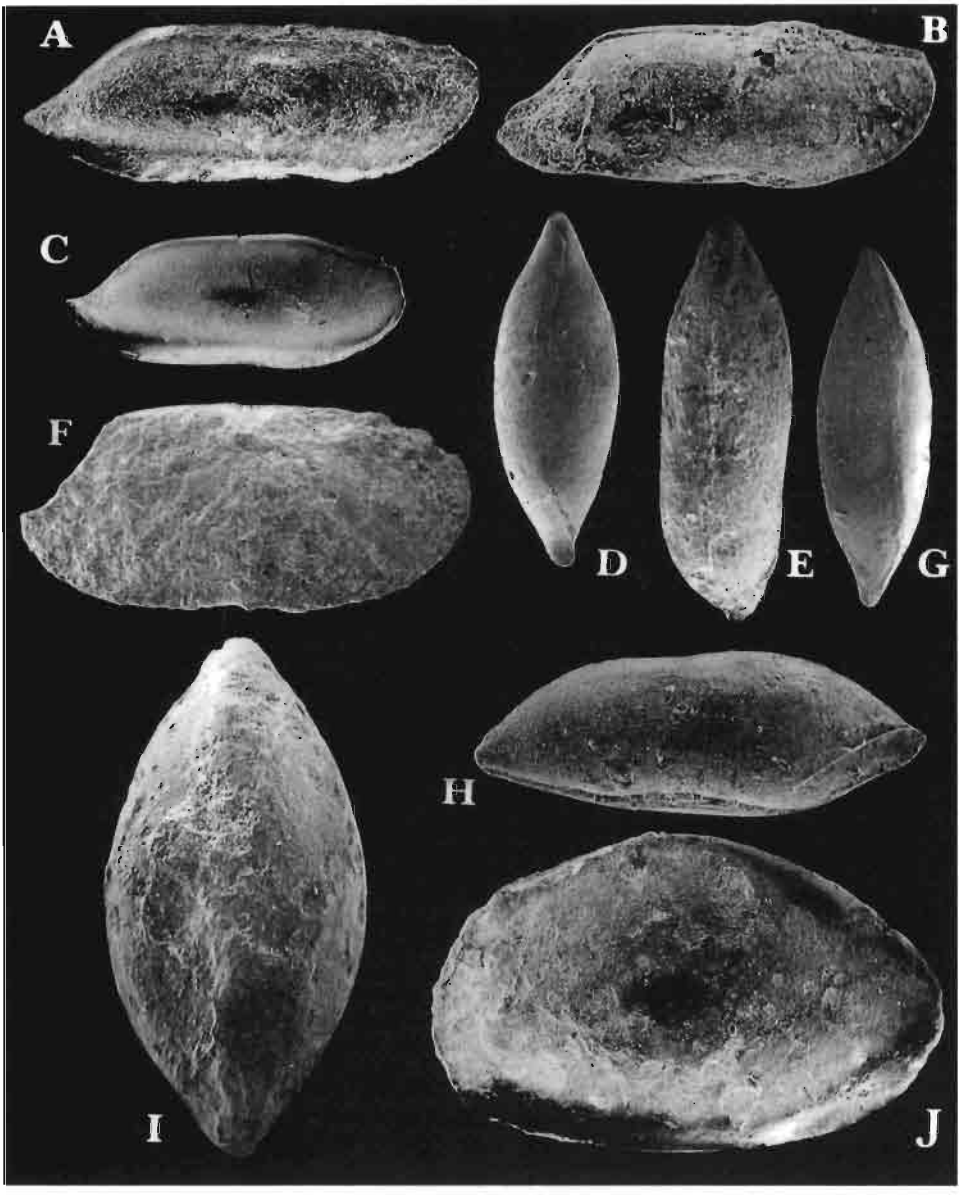

Fig. 5. Late Givetian podocopid ostracods from the Jaźwica Member (Bolechowice facies); association with *Buregia jazwicensis* and *Uchtovia refrathensis*. ❑A-E. *Bairdia zbikowskae* sp. n., carapaces in right (A-C) and dorsal (D-E) views; PIG-OS OIII/61 (A; holotype, L=1.15, H=0.45, W=0.33), OIII/47 (B), OIII/46 (C-D), OIII/44 (E); Góra Łgawa (A, E), Stokówka (B-D). ❑F. *Bairdia* sp., carapace in right view, PIG-OS OIII/63; Góra Łgawa. ❑G-H. *Acratia* sp .A., carapace from top (G) and left (H), PIG-OS OIII/49; Stokówka. ❑I-J. *Bairdiocypris* aff. *rauffi* Krömmelbein 1954, carapace in right (I) and dorsal (K) views, PIG-OS OIII/38; Góra Łgawa. All approximately × 52 except for B (× 70) and G (× 44).

Remarks.– The adult specimens examined differ from specimens of Becker (1964) in smaller size (less than 0.75 mm) and a more slender shape of the carapace. In the latter respect they better agree with stratigraphically older specimens of this species from Jurkowice-Budy (see Olempska 1979).

The Jaźwica Member (Góra Sołtysia, Jaźwica-Góra Łgawa) yielded 16 carapaces of the species from , but it was collected also from the Sitkówka Beds (Jaźwica, sets C and F) and Szydłówek Beds (Czarnów). *S. laevinodosa* was described from the Rhenish Early Givetian (Becker 1964).

Ostracod assemblages of the Jaźwica Member

The Jaźwica Member is a conspicuous Late Givetian horizon within the stromatoporoid-coral Kowala Formation of much correlative importance at least in the SW-part of the Kielce platform. This is a suite of variable, lime-argillaceous deposits marked by distinctive rich open-marine fossil assemblages (especially brachiopod-microcornid assemblage with *Crurispina*; Racki 1993), including conodont fauna with *Icriodus subterminus* indicating the *K. disparilis* to *M. falsiovalis* passage zonal interval.

Ostracod distribution in the Jaźwica Member (ca. 1100 specimens, Tab. 1) depends strongly on facies (Fig. 6). Wavy-bedded to nodular micritic-marly packages with sporadic ramose stromatoporoid layers, widespread in the SW-part of the region, occur in the six sampled sites. The Bolechowice facies have yielded variously ornamented species, the most numerous (66.5%) being the platycopid *Uchtovia refrathensis*, with *Buregia jazwicensis* next in abundance and limited to this particular association. This is thus an association strongly dominated by platycopids and palaeocopids containing several species well known from the Hercynian Europe. Of them, only the single one (*Samarella laevinodosa*) occurs also in the underlying *Stringocephalus* Beds of the Holy Cross Mountains.

Diverse lithologies of the Posłowice facies (marls, coral biostromes, echinoderm-spicule calcarenites, etc.) in the NE-part of the region supported ostracod assemblages mostly with the podocopids and palaeocopids and more equitable species distribution. The higher diversity of the fauna from Marzysz (see Simpson's indices in Tab. 1) is noteworthy. The two most frequent species, *Microcheilinella fecunda*, and *Fellerites tuimazensis*, are unknown from the Bolechowice domain. The 'facies filter' was evidently very effective and the similar differentiation is recorded also among conodonts of the formation. Affinities of the Posłowice-type microfauna with associations from the Łysogóry Region (Adamczak 1968, 1976; Malec in preparation) and Pomerania (Żbikowska 1983), are evidenced by both the marker species, *Bairdia paffrathensis* and *Hollinella antri*.

The available data suggest a strong control of the ostracod distribution by sediment property and energy level, also biotic factors, such as a proximity of the Posłowice-type association to charophyte meadows (Racki & Racka 1981). This results in evidently diachronous occurrences of

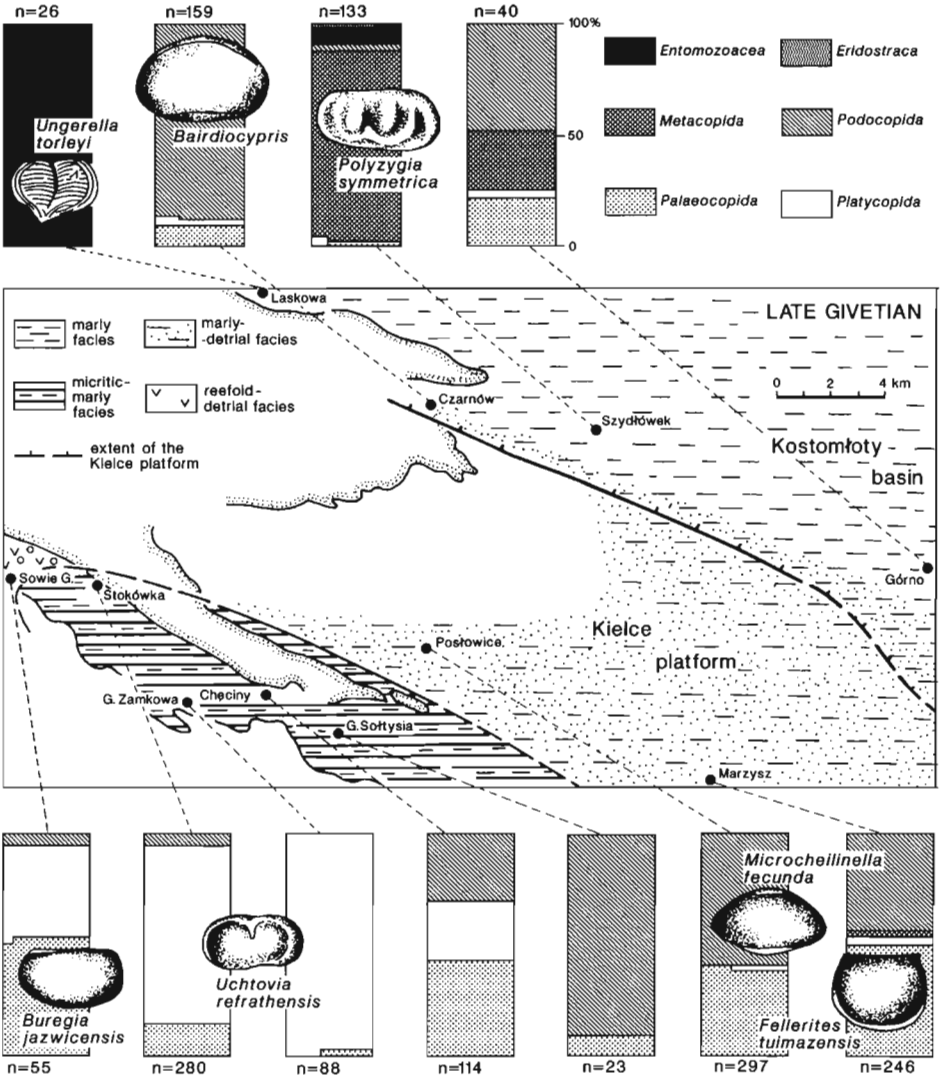

Fig. 6. Composition (in terms of orders) of the late Givetian ostracod faunas of the SW-part of the Holy Cross Mts, and their relationship to the major facies pattern (cf. Racki 1993). For details of taxonomy see Tabs 1 and 3; for localities see Fig. 1.

several species migrating together with their facies, e.g. those reported previously from the earliest Givetian Skały Beds of the Łysogóry Region.

If fit in earlier proposed Devonian ostracod habitat models, the association with *M. fecunda* and *F. tuimazensis* corresponds in its gross composition to the solitary coral biotope of Becker (1971b, 1973), and, to subtidal part of the IIIrd ecozone of Casier (1987a, b) belonging to the Eifelian Assemblage (*sensu* Becker & Bless 1990). The predominance of platycopids in the open marine microfauna with *U. refrathensis* remains some-

Tab. 2. Distribution and frequency of ostracods in the Jaźwica-Góra Łgawa section. For set subdivision see Racki (1993). The data are derived chiefly from the Góra Łgawa locality for the lower part, and from Jaźwica for the upper part.

	GIVETIAN						FRASNIAN			
	Stringoc. Beds	Jaźwica Mbr.	Sitkówka Beds						Kadzielnia Mbr.	*Phlogoid.* Level
			lower				upper			
	A	B	C	D	E	F	G	H	J	L
Palaeocopida										
Amphissites sp. A	-	4	-	-	-	-	-	-	-	-
Amphissites sp	2	-	4	-	-	-	-	-	-	1
Parapribylites hanaicus	-	2	-	-	-	-	-	-	-	-
Pribylites sp.	1	-	-	-	-	1	-	-	-	1
?Polenovula sp.	-	1	-	-	-	-	-	-	-	-
Fellerites tuimazensis	-	-	1	-	-	-	-	2	3	-
Hollinella sp.	-	-	-	-	-	-	-	-	1	-
Buregia jazwicensis	-	40	-	-	-	-	-	-	-	-
Primitiopsidae indet.	1	-	-	-	-	6	-	-	-	-
Palaeocopida indet.	2	-	-	-	-	1	-	-	-	-
Platycopida										
Cavellina sp.	115	-	-	-	2	-	-	-	-	-
?Cavellina sp.	14	-	-	-	-	2	-	-	1	1
Uchtovia refrathensis	-	30	19	1	4	1	-	1	-	-
Uchtovia sp.	1	-	-	-	1	-	-	-	-	-
?Jonesina sp.	1	-	-	-	-	-	-	-	-	-
?Knoxiella sp.	1	-	-	-	-	-	-	-	-	-
?Mennerites sp.	1	-	-	-	-	-	-	-	-	-
Indivisia sp.	-	-	-	-	2	-	-	-	-	-
Kloedenellidae indet.	8	-	6	-	-	-	-	-	-	-
Metacopida										
Cytherellina sp.	-	-	-	-	-	-	1	4	-	2
?Cytherellina sp.	2	-	5	-	2	1	-	-	2	-
Podocopida										
Orthocypris sp.	4	-	-	-	-	-	-	1	-	3
Bairdia zbikowskae	2	24	24	3	1	1	-	-	-	-
Bairdia sp.	2	1	2	1	1	2	1	15	3	-
Bairdiocypris cf. *rauffi*	-	4	-	-	-	-	-	-	-	-
Bairdiocypris sp.	8	1	46	1	48	7	14	100	3	-
Microcheilinella sp.	5	-	-	-	-	-	2	3	1	-
Acratia sp.	-	-	3	-	-	2	3	1	2	2
?Acratia sp.	1	-	-	-	-	-	-	-	-	-
Samarella laevinodosa	-	6	1	-	-	1	-	-	-	-
Podocopida indet.	4	-	-	-	-	-	-	-	-	-
No. of specimens	176	113	116	6	69	32	22	141	17	11

what peculiar as such associations are more common in some Devonian lagoonal environments (e.g. 'open lagoonal' Ist ecozone of Casier 1987a, b; Casier & Preat 1991). Possibly, this reflects a stagnant nature of biotopes of the Bolechowice facies what stimulated the survival of filter-feeding platycopids in diminished oxygen concentrations (Whatley 1991).

Other Givetian and Frasnian ostracod associations

Kielce Region.– We studied the Givetian bank deposits (*Stringocephalus* Beds) only at the Góra Łgawa, but ostracods from these strata were already studied by Olempska (1979) from the eastern Holy Cross Mountains. Only a few species, among others *Kegelites polonicus* Olempska 1979 and *Fabalicypris holuschurmensis* (Polenova 1955), were identified with certainty in the younger strata under study. The palaeocopid *Coeloenellina*, most abundant in the *Stringocephalus* Beds, has not been found in the higher Kowala Formation.

Our samples from Jurkowice-Budy point that the fauna of Olempska (1979) was recovered from different lithologies, also from reefoid (biostromal-biorudite) deposits (set E; see also Preat & Racki in press). Hence, a variety of bank-dwelling original associations (Fig. 9) seems to be included, in addition mixed due to higher energy events; this is suggested by the co-occurrence of echinoderm debris, trilobites and tentaculites with calcispheroids, charophytes, and diverse microproblematics. This unique site awaits strict ecologic evaluation.

The leperditicopid assemblage persisted in the Early to Middle Givetian calm muddy lagoons as demonstrated by thin sections (Leperditiid Assemblage of Racki 1993); this is a common biota in restricted parts of the Givetian vast carbonate platforms marked by cyclic depositional patterns (Casier & Preat 1991). The low-diversity *Cavellina* association has been identified in two samples from calcispheroid micrites of Góra Łgawa. This lagoon-dwelling platycopid fauna is widespread in Devonian carbonate-complexes (Becker 1971b; Coen 1985; Casier 1987a, b; Milhau 1988).

Variably abundant ostracod assemblages derived from the Sitkówka Beds, that include both latest Givetian biostromes and Frasnian reef-related strata, are invariably typified by a great abundance of undifferentiated podocopids, mainly *Bairdiocypris* (Tabs 2-3, Figs 8-10). This refers also to late Frasnian stromatoporoid-algal, detrital deposits of reef-cap type at Sitkówka-Bolechowice, as well as to biostromal strata of the earlier Givetian *Stringocephalus* Beds. Apparently, the podocopids were well adapted to cope with peculiar regimes of organic buildups (cf. Casier 1987a), including their low-energy coral variants, and even inhospitable vast *Amphipora* thickets. Likely, the chiefly medium-sized, smooth-shelled ostracods embraced mostly crawling (Siveter 1983; Becker & Bless 1990), both algae- and sediment-dwelling forms which occupied a variety of shelter niches (Neale 1965; Izuka & Kaesler 1985; Tabuki & Nohara 1990); some of them possibly fed on microbial mats, while others (e.g. *Orthocypris*; cf. Żbikowska 1983) burrowed into the mud substrate.

The remarkable diversity (14 genera) and equalized order participation are conspicuous characters of the back-reef association from Jaworznia, being connected with the occurrence of ornate platycopid *Mennerites* and the unique presence of Frasnian leperditiids. Also the abundant faunas from the early Frasnian Kadzielnia foreslope mud mounds display a broad

Tab. 3. Distribution and frequency of ostracods in the Givetian and Frasnian sites of the SW-part of Holy Cross Mts (Fig. 1 and 'Register of localities' in Racki 1993; ZG – Zegzelogóra, SK – Sitkówka-Kostrzewa, Kd – Kadzielnia, G – Sowie G., W – Sitkówka-Kowala, Sc – Szczukowskie G., Jw – Jaworznia, SJ – Sitkówka-Jaźwica, Pn – Panek, LG – Laskowa, Gn – Górno, Sz – Szydłówek, Cz – Czarnów).

	Kielce Region										Kostomloty area					
	L.Givet.		E.Frasnian			?	L.Frasnian				M.-L.Givetian					
	ZG	SK	Kd	SG	SW	Sc	Os	Jw	SJ	Pn	LG		Gn	Sz	Cz	
	A	C	A	G	B				B	B	A_2	B_1	A		B_1	B_2
Leperditicopida																
Leperditia sp.	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Palaeocopida																
Fellerites sp.	-	-	81	-	-	9	-	2	7	1	-	-	-	-	-	-
Amphissites sp.	-	-	4	-	-	-	-	4	-	2	7	-	1	1	3	-
Pribylites sp.	-	-	2	-	-	-	-	?2	-	-	-	-	-	-	-	-
Kegelites polonicus	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-
Coeloenellina sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tetrasacculus sp.	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Hollinella sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	2
Roundyella calceolae	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
Welleria aequiconvexa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-
Ctenoloculina sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Buregia sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Primitiopsidae indet.	4	1	2	-	-	-	-	28	-	-	-	-	-	-	-	-
Palaeocopida indet.	-	-	-	-	-	-	-	-	-	1	-	-	-	-	4	-
Platycopida																
Cavellina sp.	2	-	-	-	-	-	-	17	-	-	-	-	-	-	1	-
Uchtovia refrathensis	43	1	-	2	3	-	-	-	-	-	-	-	-	-	-	-
Uchtovia sp.	-	-	74	-	-	-	-	-	-	-	-	-	-	-	-	-
Knoxiella sp.	-	-	8	-	-	-	-	-	-	-	-	-	-	2	-	-
Mennerites sp.	-	-	-	-	-	-	-	34	-	-	-	-	-	-	-	-
?*Evlanella* sp.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Indivisia sp.	-	-	5	-	-	-	4	-	-	-	-	-	2	-	-	-
Platycopida indet.	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Metacopida																
Cytherellina sp.	-	-	?3	-	-	-	-	-	-	-	-	-	-	-	-	-
Polyzygia symmetrica	-	-	-	-	-	-	-	-	-	-	14	-	-	116	-	-
Jefina sp.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
Bufina sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Plagionephrodes cf. *lageus*	-	-	-	-	-	-	-	-	-	-	-	-	13	-	-	-
Podocopida																
Orthocypris sp.	5	-	9+?1	-	-	-	-	16	-	1	-	-	-	-	-	-
Bairdia zbikowskae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Bairdia sp.	-	2	103	-	7	6	6	7	6+?1	7	2	-	5	-	2	-
Bairdiacypris samsonowiczi	-	-	-	-	-	-	7	4	-	3	-	-	-	-	-	-
Bairdiocypris sp.	-	1	121	5	3	1	3	2	14	4	24	-	15	2	90	-
Acratia p. A	-	-	-	-	-	?1	-	-	-	-	-	-	-	-	-	-
Acratia sp.	16	-	35	-	-	-	-	16	-	-	1	-	-	-	-	-
Fabalicypris sp.	4	-	?3	-	-	-	1	2	14	-	-	-	-	-	3	-
F. holuschurmensis	-	-	-	-	-	-	8	-	2	-	-	-	-	-	18	-
Microcheilinella sp.	3	-	86	-	7	4	3	-	7	3	4	-	-	-	-	-
Pronipantex sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Samarella laevinodosa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-
Samarella sp.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Tricornina sp. A	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Podocopid indet.	6	-	8	-	-	-	-	3	-	-	-	-	?1	2	-	-
Myodocopida																
Ungerella torleyi	-	-	-	-	-	-	-	-	-	-	-	26	-	7	-	-
Eridostraca																
Cryptophyllus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-

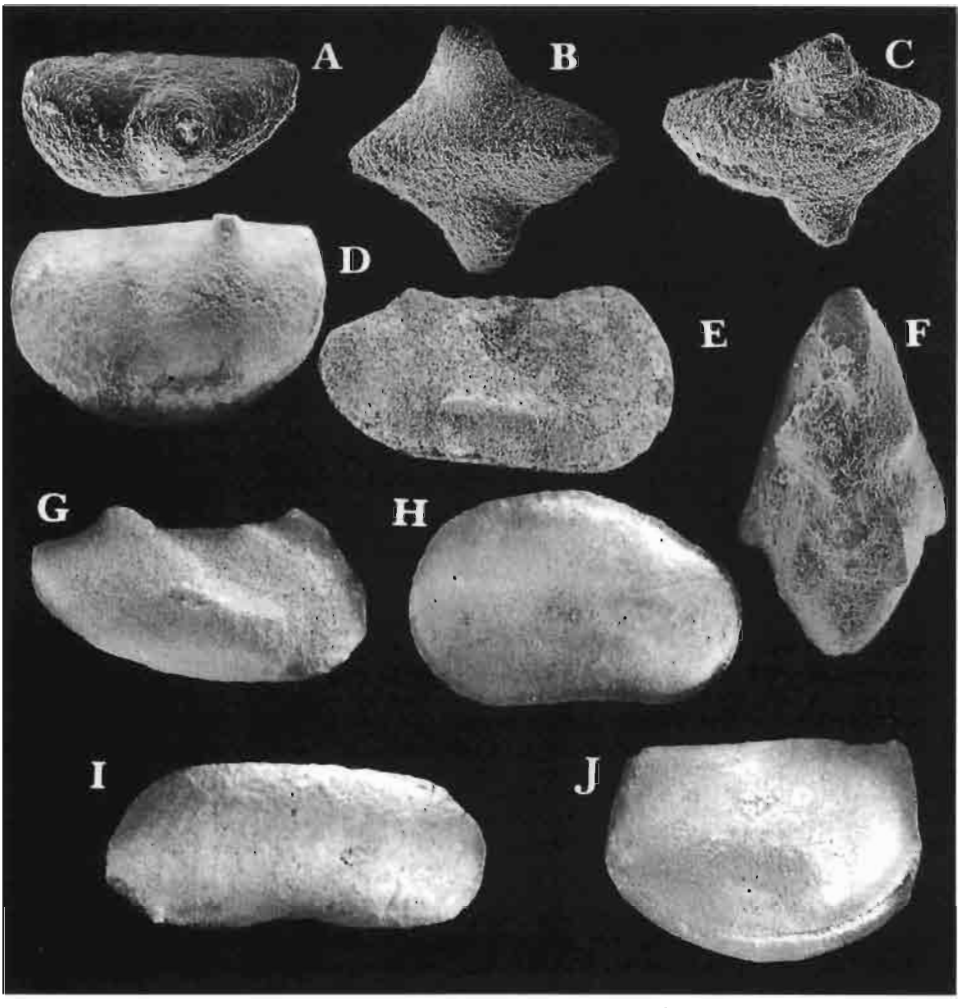

Fig. 7. Givetian (D, H) and Frasnian (A-C, E-G, I-J) ostracods from the Kowala Formation. ❑A-C. *Tricornina* sp. A, carapace from left (A), and dorsum (B), and other specimen in ventral view (C), PIG-OS OIII/72-73; Kadzielnia; × 40. ❑D. Palaeocopid genus indet., carapace from left, PIG-OS OIII/74; Jaźwica (set F); × 40. ❑E-G. *Mennerites* sp., three carapaces in right (E, G) and dorsal (F) views, PIG-O OIII/75-77; Jaworznia; × 50. ❑H. *Cavellina* sp., heteromorphic carapace from right, PIG-OS OIII/78; Góra Łgawa (set A); × 40. ❑I. *Fabalicypris* sp., right view, PIG-OS OIII/79; Ostrówka, × 50. ❑J. Palaeocopid genus indet., carapace from left, PIG-OS OIII/80; Jaworznia; × 56.

range of lateral variation suggestive of niche diversity. The material examined (above 500 specimens; Galińska 1984) shows local domination of platycopids and palaeocopids (Fig. 10).

The ostracod association from lacking macrofossils micrites of the Chęciny Beds that have originated within shallow semi-closed intershoal basin, appears to represent a slight modification (without *Buregia*) of the Bolechowice-type biofacies, with *Uchtovia refrathensis* in the main role.

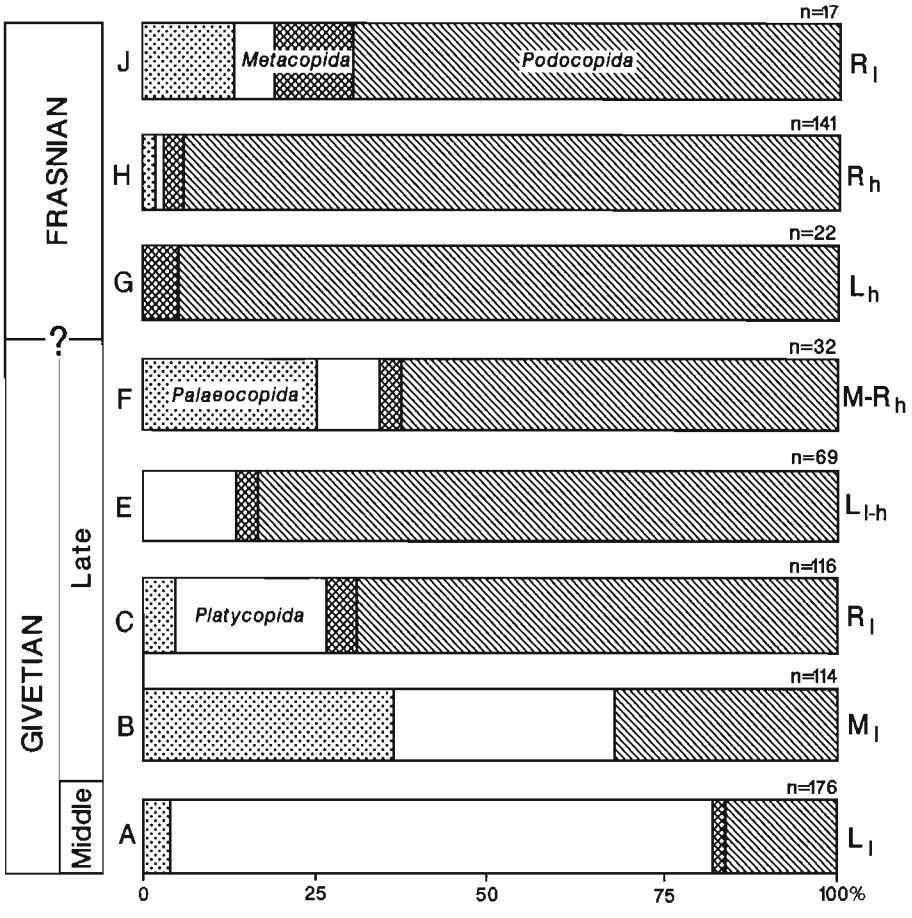

Fig. 8. Stratigraphic succession of the ostracod faunas (in terms of orders; Tab. 2) in the Jaźwica-Góra Łgawa section. Note a distinct shift from platycopid- to podocopid-dominated association. Facies types: L – lagoonal-peritidal, R – 'reef', M – open-shelf, l – law-energy, h – higher-energy.

The 'reef'-dwelling podocopid-rich faunas from the Holy Cross Mountains are difficult to compare with their stratigraphically older equivalents described by Becker (1971b); the latter are marked by many sculptured palaeocopids. According to Becker & Bless (1990), bairdiocypridaceans and bairdiaceans are common in offshore subassemblage of the Eifelian-type (e.g. Givetian near-reef microfauna of Ardennes; Coen 1985) as well as in some Thuringian (basinal) faunas. Nevertheless, they fit the IInd ecozone proposed by Casier (1987a) for shallow open-marine carbonate regimes in the Frasnian Paleotethys. Notably, Bairdiidae achieve their maximum diversity and incidence on the recent coral reefs, as summarized by Whatley & Watson (1988).

Kostomłoty area.– Late Givetian ostracod associations from the nearby deeper-water, oxygen-deficient Kostomłoty area are quite unlike to the

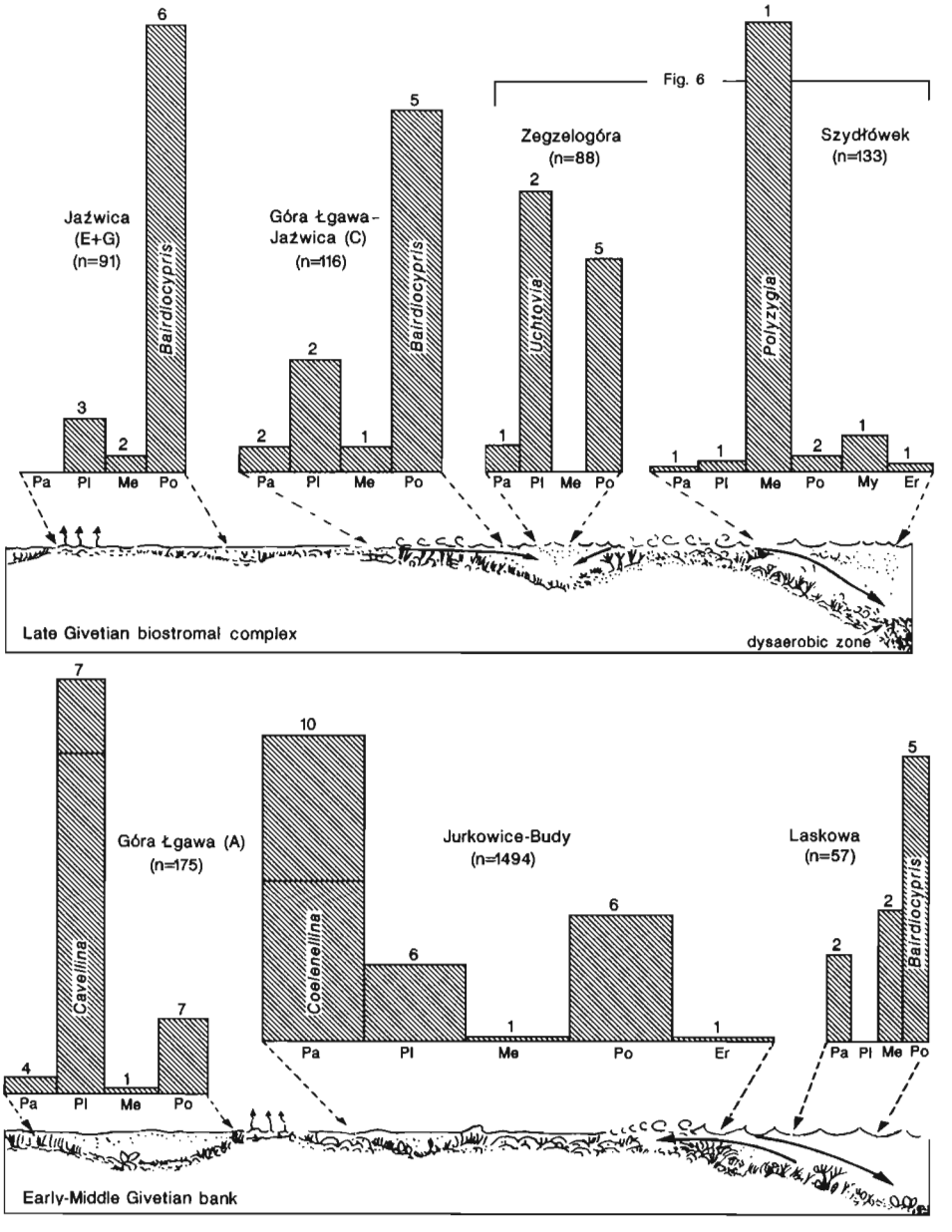

Fig. 9. Ostracod faunas (in terms of frequency of specimens representing orders and generic diversity; Tabs 2-3); data on Jurkowice from Olempska 1979 and their relationship to the Givetian platform facies (models after Racki 1993). Predominating genera indicated for particular sites.

roughly coeval Jaźwica Member faunas (cf. Racki *et al.* 1985: Pl. 10: 2, 4). They are characterized (Fig. 11) by metacopids (*Polyzygia, Plagionephrodes, Jefina*) and probably planktic entomozoids (*Ungerella*), indicative

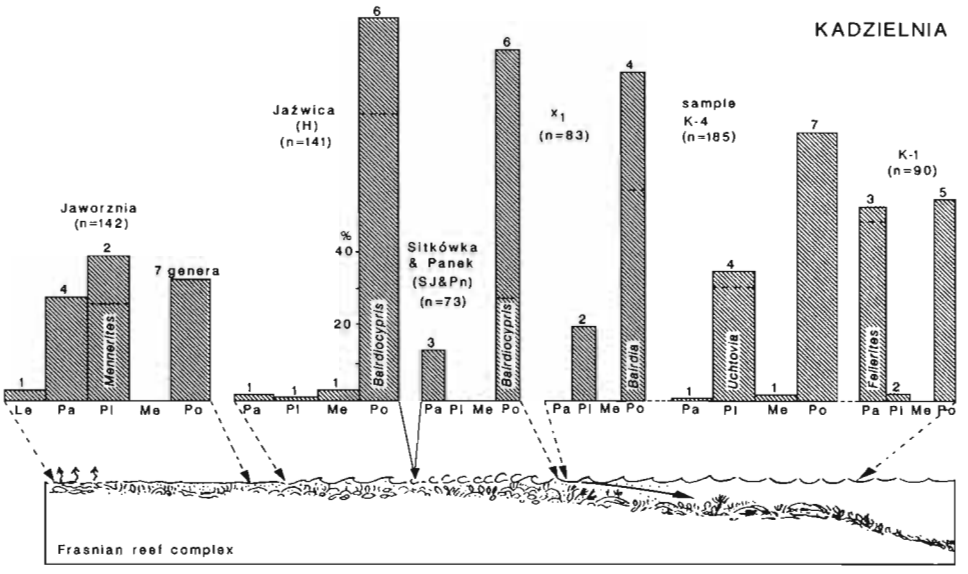

Fig. 10. Ostracod faunas (in terms of frequency of order abundance and generic diversity; Tab. 3) and their relationship to the Frasnian reef facies (see also Fig. 9). Three samples are given for the Kadzielnia locality to show range of taxonomic variability.

of the *Ungerella torleyi* Zone (see Gooday & Becker 1979). Exotic taxa from restricted shelf habitats are species of Eridostraca.

On the other hand, some typical species of the Bolechowice-type association (*Bairdia zbikowskae, Samarella laevinodosa*) occur in the Czarnów site. This podocopid-dominated fauna (with abundant *Bairdiocypris*) has been recovered from marly micrites with reef-builders, and resembles the above mentioned associations of the Sitkówka Beds.

Conclusions

Any ostracod analysis of the widespread Devonian carbonate complexes suffers of inadequate sampling. In effect of generally applied techniques of extraction they are usually (but see Coen 1985) focused on marly interbeds only (e.g. Becker 1971b). Present study shows that insight into broader lithofacies spectrum increases reliability of ecologic interpretations. Even high-energy portions of the reef appear suitable site for such studies, as shown by Izuka & Kaesler (1986) and Whatley & Watson (1988) for recent reef flats (but see also Tabuki & Nohara 1990). The distributional patterns of the microfaunas examined seem to be complex, and all comparative analysis of microfaunas from separate areas (see examples in Żbikowska 1983: pp. 17-18) should be preceded by accurate facies diagnosis.

The biostratigraphical importance of benthic ostracods appears very limited (cf. Coen 1985) despite many attempts to establish local biozonal

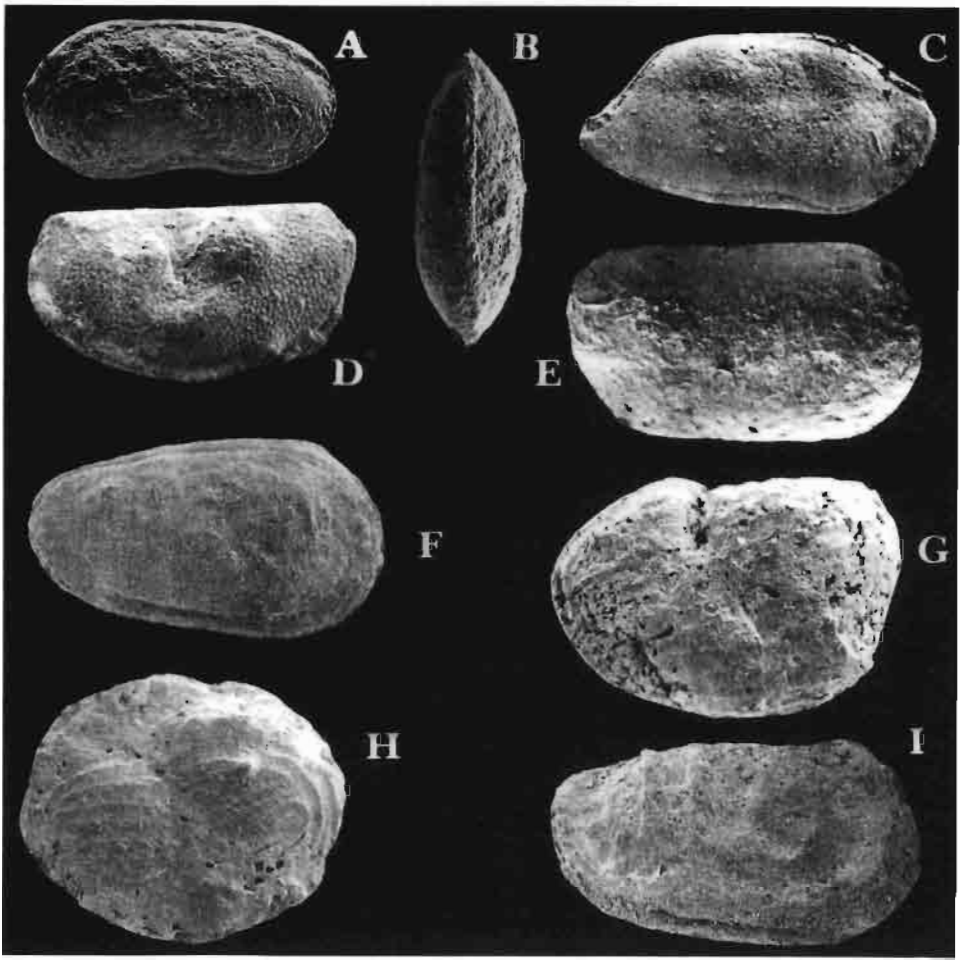

Fig. 11. Givetian ostracods from the Kostomłoty area; Laskowa Góra Beds (C-H) and Szydłówek Beds (A-B, G-I). ❑A-B. *Fabalicypris holuschurmensis* (Rozhdestvenskaya 1959), carapace in right (A) and dorsal (B) views, PIG-OS OIII/81; Czarnów (set B_1); × 40. ❑C. *Bairdia* sp., carapace in right view, PIG-OS OIII/82; Górno; × 50. ❑D. *Hollinella* sp., carapace from left, PIG-OS OIII/83; Górno; × 50. ❑E. Podocopid(?) genus indet; carapace from right, PIG-OS OIII/84; Górno; × 83. ❑F. *Plagionephrodes* cf. *laqueus* (Matern 1929), carapace from right, PIG-OS OIII/85; Górno; × 54. ❑G-H. *Ungerella torleyi* (Rabien 1954), carapaces from left (G; × 52) and right (H; × 42), PIG-OS OIII/90-91; Laskowa, set B_1. ❑I. *Polyzygia symmetrica* Gürich 1896, carapace in right view, PIG-OS OIII/95; Szydłówek; × 55.

schemes (e.g. Adamczak 1976). Only few species have proved to be stratigraphically useful (see review in Gooday & Becker 1979). The ostracods under study (see Tabs 1-3) may offer some possibilities of biostratigraphic correlation. Distinct assemblages seem to characterize different Givetian levels of the Kielce Region. This may be especially useful in restricted shelf deposits, usually devoid of any other fossils of correlative value. Ostracods played a leading role in the algae-dominated lagoonal

microbiotas (Racki 1993), and e.g. *Cavellina* and leperditicopids are typical of the Givetian (cf. also Malec *et al.* 1987), while *Mennerites* of higher Frasnian. Some euryfacies ostracod species may appear especially significant for the inferences, like late Frasnian *Bairdiocypris samsonowiczi* Olempska 1979. This species occurs from pelagic deposits with conodonts and entomozoids of Śluchowice (Olempska 1979) up to *Amphipora* facies at Jaworznia and Ostrówka (Tab. 3). This might examply an euryhaline form adapted to the high-stress, possibly of changing salinity biotope (Siveter 1983; Casier & Preat 1991).

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References

Adamczak, F. 1968. Palaeocopa and Platycopa (Ostracoda) from Middle Devonian rocks in the Holy Cross Mountains, Poland. *Stockholm Contributions in Geology* **17**, 1-109.

Adamczak, F. 1976. Middle Devonian Podocopida (Ostracoda) from Poland; their morphology, systematics and occurrence. *Senckenbergiana lethaea* **57**, 265-467.

Becker, G. 1964. Palaeocopida (Ostracoda) aus dem Mitteldevon der Sötenicher Mulde (N-Eifel). *Senckenbergiana lethaea* **45**, 43-113.

Becker, G. 1965a. Podocopida (Ostracoda) aus dem Mitteldevon der Sötenicher Mulde (N-Eifel). *Senckenbergiana lethaea* **46**, 367-441.

Becker, G. 1965b. Revision Kummerow'scher Ostracodenarten aus dem deutschen Mitteldevon. *Fortschrifte in der Geologie von Rheinland und Westfalen* **9**, 151-188.

Becker, G. 1970. Primitiopsacea (Ostracoda, Palaeocopida) aus dem Rheinischen Devon. *Senckenbergiana lethaea* **51**, 49-65.

Becker, G. 1971a. Ostracoda aus dem Mittel-Frasnium (Oberdevon) der Mulde von Dinant. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Sciences de la Terre* **47**, 1-82.

Becker, G. 1971b. Paleoecology of Middle Devonian ostracods from the Eifel Region, Germany. *Bulletin du Centre des Recherche de PAU-SNPA* **5**, supplément, 801-816.

Becker, G. 1973. Paläokologische Analyse einer Ostracoden Fauna aus dem Oberdevon von Belgien. *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen* **142**, 59-72.

Becker, G. & Bless, M.J.M. 1990. Biotope indicative features in Paleozoic ostracods: a global phenomenon. In: R. Whatley & C. Maybury (eds) *Ostracoda and Global Events*, 421-436. Chapman & Hall, London.

Casier, J.G. 1987a. Etude biostratigraphique et paléoécologique des ostracodes du récif de marbre rouge du Hautmont à Vodelée (partie supérieure du Frasnien, Bassin de Dinant, Belgique). *Revue de Paléobiologie* **6**, 193-204.

Casier, J.G. 1987b. Etude biostratigraphique et paléoécologique des ostracodes du sommet du Givétien et de la base du Frasnien à Ave-et-Auffe (bord sud du Bassin de Dinant, Belgique). *Bulletin de la Société belge de Géologie* **96**, 23-34.

Casier, J.G. & Preat, A. 1990. Sédimentologie et ostracodes de la limite Eifelian-Givetian à Resteigne (bord sud du Bassin de Dinant, Belgique). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Sciences de la Terre* **60**, 75-105.

Casier, J.G. & Preat, A. 1991. Evolution sédimentaire et ostracodes de la base du Givetien à Resteigne (bord sud du Bassin de Dinant, Belgique). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Sciences de la Terre* **61**, 157-177.

Coen, M. 1985. Ostracodes givétiens de l'Ardenne. *Mémoires de l'Institut géologique de l'Université de Louvain* **32**, 1-48.

Galińska, M. 1984. Opracowanie mikropaleontologiczne wapienia kadzielniańskiego z dewonu Kielc. *Unpublished MSc. thesis, Silesian University, Sosnowiec.*

Gooday, A.J. & Becker, G. 1979. Ostracods in Devonian biostratigraphy. *Special Papers in Palaeontology* **23**, 193-197.

Groos, H. 1969. Mitteldevonische Ostracoden zwischen Ruhr und Sieg (Rechtsrheinisches Schiefergebirge). *Göttinger Arbeiten zur Geologie und Paläontologie* **1**, 1-110.

Gürich, G. 1896. Das Paläozoikum des Polnischen Mittelgebirge. *Verhandlungen der Russischen Kaiserlichen Gesselschaft zu St. Petersburg II* , **32, 1-539.**

Izuka, S.K. & Kaesler, R.L. 1986. Biostratinomy of ostracode assemblages from a small reef flat in Maunalua Bay, Oahu, Hawaii. *Journal of Paleontology* **60**, 347-360.

Krömmelbein, K. 1954. Eine Ostracoden-Fauna aus der Riff-Einlagerung im Plattenkalk der Paffrather Mulde (Givetium, Bergisches Land). *Senckenbergiana* **34**, 247-258.

Kummerow, E. 1953. Über oberkarbonische und devonische Ostracoden in Deutschland und in der Volksrepublik Polen. *Geologie* **7**, 1-75.

Malec, J., Racki, G., & Racka, M. 1987. The leperditiid-charophyte assemblage from the Givetian of Dębnik and its stratigraphic value. *Acta Geologica Polonica* **37**, 51-59.

McGill, P. 1966. Ostracods of probable late Givetian age from Slave Point Formation, Alberta. *Bulletin of Canadian Petroleum Geologists* **14**, 104-133.

Milhau, B. 1988. Ostracodes du Givétien de Ferques (Dévonien moyen, Boulonnais France). *Biostratigraphie du Paléozoique* **7**, 479-491.

Neale, J.W. 1964. Some factors influencing the distribution of Recent British Ostracoda. *Pubblicazioni della Stazione Zoologica di Napoli* **33**, 247-307.

Olempska, E. 1979. Middle to Upper Devonian Ostracoda from the southern Holy Cross Mountains, Poland. *Palaeontologia Polonica* **40**, 57-162.

Pokorný, V. 1950. The ostracods of the Middle Devonian Red Coral Limestones of Čelechowice. *Sbornik Statniho Geologiceského Ustavu Ceskoslovenské Republiky* **17**, 580-630.

Polenova, E.N. (Поленова, Е.Н.) 1952. Остракоды верхней части живетского яруса Русской платформы. *Труды ВНИГРИ* **60**, 65-156.

Polenova, E.N. (Поленова, Е.Н.) 1953. Остракоды девонских отложений Центрального девонского поля и Средного Поволжа. *Труды ВНИГРИ* **67**, 1-157.

Polenova, E.N. (Поленова, Е.Н.) 1968. *Остракоды нижнего девона Салаира.* 151 pp. Наука, Москва.

Preat, A. & Racki, G. (in press) Small-scale cyclic sedimentation in the Early Givetian of the Holy Cross Mountains: comparative analysis with the Ardenne sequence. *Annales Societatis Geologorum Poloniae.*

Přibyl, A. 1954. A contribution to the study of the ostracods of Bohemian Devonian and their stratigraphical significance. *Sbornik Ustředniho Ustavu Geologického* **21**, 161-301.

Přibyl, A. & Šnajdr, M. 1950. On new Ostracoda from the Choteč Limestone - $g\gamma 2$ (Middle Devonian) of Holyne near Prague. *Sbornik Statniho Geologického Ustavu Ceskoslovenské Republiky* **17**, 101-179.

Racki, G. 1993. Evolution of the bank to reef complex in the Devonian of the Holy Cross Mountains. *Acta Palaeontologica Polonica* **37**, 87-182.

Racki, G., Głuchowski, E., & Malec, J. 1985. The Givetian to Frasnian succession at Kostomłoty in the Holy Cross Mts, and its regional significance. *Bulletin of Polish Academy of Sciences, Earth Sciences* **33**, 159-171.

Racki, G. & Racka, M. 1981. Ecology of the Devonian charophyte algae from the Holy Cross Mts. *Acta Geologica Polonica* **31**, 213-222.

Rozhdestvenskaya, A.A. (Рождественская, А.А.) 1959. Остракоды терригенной толщи девона Западной Башкирии и их стратиграфическое значение. In: Е.В.Чибрикова, А.А. Рождественская.

Материалы по палеонтологии и стратиграфии девонских и более древних отложений Башкирии, 117-247. Наука, Москва.

Rozhdestvenskaya, A.A. (Рождественская, А.А.) 1962. Среднедевонские остракоды западного склона Южноло Урала, Предуральского прогиба и платформенной части Башкирии. In: А.П. Тяжева, А.А. Рождественская, Е.В. Чибрикова. *Брахиоподы, остракоды и споры среднего и верхнего девона Башкирии*, 169-349. Издательство АН СССР, Москва.

Shishinskaya, A.F. (Шишкинская, А.Ф.) 1959. *Остракоды живетских отложений Саратовского Поволжья*. 68 pp. Издательство АН СССР, Москва.

Siveter, D.J. 1983. Habitats and modes of life of Silurian ostracodes. *Special Paper in Palaeontology* **32**, 71-85.

Tabuki, R. & Nohara, T. 1990. The Ostracoda of the Seikisei-sho area, Ryukyu Islands, Japan: a preliminary report on the ostracods from coral reefs in the Ryukyu Islands. In: R. Whatley & C. Maybury (eds) *Ostracoda and Global Events*, 365-373. Chapman & Hall, London.

Whatley, R. 1991. The platycopid signal: a means of detecting kenoxic events using Ostracoda. *Journal of Micropaleontology* **10**, 181-185.

Whatley, R. & Watson K. 1988. A preliminary account of the distribution of Ostracoda in recent and reef associated environments in the Pulau Serbiu or Thousand Island Group, Iava Sea. In: T. Hanai, N. Ikeya, & K. Ishizaki (eds) *Evolutionary Biology on Ostracoda*, 399-411, Kodansha, Tokyo.

Żbikowska, B. 1983. Middle to Upper Devonian ostracods from north-western Poland and their stratigraphic significance. *Palaeontologia Polonica* **44**, 3-108.

Streszczenie

Urozmaicona, detrytyczno-marglisto-biostromalna facja posłowicka w obrębie górnożyweckiego otwartomorskiego Ogniwa z Jaźwicy w południowo-zachodniej części Gór Świętokrzyskich wyróżnia się silniej zróżnicowaną (18 taksonów) asocjacją paleokopidowo-podokopidową, zdominowaną przez *Microcheilinella fecunda* i *Fellerites tuimazesis*. Natomiast bardziej głębokowodne, stagnujące biotopy, odpowiadające mikrytowo-marglistej facji bolechowickiej, były zasiedlone przez uboższą (12 gatunków) asocjację z platykopidami *Uchtovia refrathensis* i paleokopidami *Buregia jazwicensis* w rolach głównych. Inne późnożyweckie i frańskie rafowo-lagunowe mikrofauny są z reguły mało zróżnicowane rodzajowo i z bardzo dużym udziałem podokopidów, głównie z rodzaju *Bairdiocypris*; euryfacjalny gatunek *B. samsonowiczi* może być kluczem do korelacji wiekowej amfiporowych sekwencji lagunowych franu.

Żyweckie asocjacje z zachodniej części basenu łysogórskiego charakteryzują się obecnością metakopidów, przede wszystkim *Polyzygia symmetrica*, oraz planktonicznych entomozoidów *Ungerella torleyi*. Nowe gatunki *Polenovula beckeri* sp. n., *Clavofabellina poslovicensis* sp. n., *Buregia jazwicensis* sp. n. i *Bairdia zbikowskae* sp. n. zostały opisane z Ogniwa z Jaźwicy.