Givetian and Frasnian ostracod associations from the Holy Cross Mountains

JAN MALEC & GRZEGORZ RACKI


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 jaźwicensis* 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 Kostomloty basin are marked by the metacopid *Polyzygia symmetrica* and the planktic entomozoid *Ungrella torleyi.* *Polenovula beckeri* sp. n., *Clavojabellina poslovicensis* sp. n., *Buregia jaźwicensis* sp. n., and *Bairdia zbikowskiae* sp. n. are proposed.

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

*Jan Malec, Oddział Świętokrzyski Państwowego Instytutu Geologicznego, ul. Zgoda 21, Kielce, Poland.*

*Grzegorz Racki, Katedra Paleontologii i Stratygrafii, Uniwersytet Śląski, ul. Będźińska 60, 41-200 Sosnowiec, Poland.*

**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 (Lysogóry) 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
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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 Jażwica 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 Kostomloty 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 Jażwica-Góra Łgawa, Jaworznia or Kadzielnia. Argillaceous sediments, especially of the Jażwica Member and Szydlówka 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 (abbreviated PIG-OS).

Taxonomy

The chapter contains a taxonomical review of the most important ostracod species from the Jażwica 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 Pokorny 1950

Genus Parapribylites hanaicus (Pokorny 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-
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, Posłowie, 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: Pokorny 1950).

Family Buregiidae Polenova 1953
Genus Buregia Zaspelova 1953

Buregia jaźwicensis 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 Jażwica Member of the SW-part of Holy Cross Mts (see Fig. 1 for sites: GS – G. Sołtysia, GŁ – G. Łgawa, Jz – Jażwica, GZ – G. Zamkowa, St – Stokówka, SG – Sowie G., Mz – Marysz, Ps – Posłowie).

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<td>?Polenovula sp.</td>
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<td><em>Schneideria</em> sp.</td>
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**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 (Poslowice facies); association with Microchelina jecunda and Fellerites tuimazensis. Q.A. Parapribylites hanai cus (Pokorny 1950), tecnomorphic carapace from right. PIG-O III/4: Marzysz. □B-E. Polenoula beckeri sp. n., tecnomorphic carapace from left (B) and top (C). PIG-OS III/7 (holotype; length L=0.93, height H=0.53, width W=0.45), and heteromorphic carapaces in right view (D-E). PIG-OS III/64-65: Poslowice: × 52 (B-C), × 42 (D), × 44 (E). □F-I. Clavofabellina poslovicensis sp. n., carapaces from left (F-G), ventral (H) and right (I); PIG-OS III/11 (G-H; heteromorphic, holotype; L=0.75, H=0.45, W=0.43). III/10 (F), III/66 (I): Marzysz (F-H, × 52). Poslowice (I, × 44). □J. Cytherellina sp., right view. PIG-OS III/67; Marzysz; × 70. □K. Bythocyproides sp., right view, PIG-O III/12; Marzysz, × 95. □L-M. Hollinella antri Adamczak 1968, tecnomorphic carapace in right (H) and lateral (I) views; Poslowice; × 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. jiwensis* Shishshinskaya 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. krestownikovi* 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 Górk, 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 Poslowice facies, Late Givetian.

Type locality: Small quarry on the Poslowice hill at Kielce (unit B2), 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 (Poslowice facies); association with *Microchelinella fecunda* and *Fellerites tuimazensis*. □A-B. *Microchelinella fecunda* (Příbyl & Šnajdr 1950), carapaces from left (A), top (B) and right (F), PIG-OIII/69-70; Marzysz (A-B). Poslowice (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-OIII/30; Marzysz: × 52. □E. *Indiwisia* sp., right view, PIG-OS OIII/71; Poslowice: × 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: Posłowiec, Marzysz, Góra Soltysia); Eifel Mountains, Early Givetian (Curten 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 Posłowiec facies. Late Givetian.

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

Derivation of the name: From the Posłowiec 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
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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 ovaly 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 (Skaly Beds, Adamczak 1968), as well as from the Late Givetian of Pomerania (Zbikowska 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 Gorki 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 Jażwica Member (Bolechowice facies): association with *Buregia jazwicensis* and *Uchtovia refrathensis*. ▲A. *Samarella laevinodosa* Becker 1964, carapace from left, PIG-O OIII/53; Góra Soltysia. ▼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), Jażwica (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, PI-G-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; Jażwica. All approximately ×52.
Fellerites tuimazensis (Rozhdestvenskaya 1959)
Fig. 3C.
Remarks.—Specimens from the Jaźwica Member (Marzysz, Posłowie) 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 Sitkówska Beds (Jaźwica, sets C, H; Góra Łągowa, 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 adductor sulcus which is distinctly developed already in juveniles. The Late Givetian representatives of U. refrathensis from Pomerania exhibit more distinct adductor 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 Łągowa, Góra Zamkowa, Stokówka, Sowie Górk; also Sitkówska Beds (Jaźwica, sets E-F; Sitkówska-Kowala; Sowie Górk, set G) and Checiny Beds (Zegzelogóra, Sitkówska-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 Fromelles 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 Posłowiec 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 (Skaly 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 Skaly 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 Marzyżs 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 Jurkówice-Budy (Olempska 1979), as well as from the Late Givetian of Pomerania (Żbikowska 1983), and the Middle Devonian and Frasnian of the Rheinisch-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 zbkowskiae 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/length 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/length 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 length and convexity is in the midlength. Carapace is compressed in the anterior and posterior ends.

Remarks.— B. zbikowskae sp. n. is close in the carapace 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 Szydlówek Beds: Czarnów, set B1, and Sitkówka Beds: Jaźwica, sets C-F.

Genus Acratia Delo 1930

Acratia sp. A
Fig. 5G-H.

Remarks.— Acratia sp. A resembles strongly A. samoilovaе Shishkinskaya 1959 from the Givetian of Russia. The Polish form is marked by more elongated shape (height/length=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 (Zbikowska 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 ?Paraparxchitidae 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*. QA-E. *Bairdia zbkowskae* 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).

QF. *Bairdia* sp., carapace in right view. PIG-OS OIII/63; Góra Łgawa. QG-H. *Acratia* sp. A., carapace from top (G) and left (H). PIG-OS OIII/49; Stokówka. QI-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 Sołtyśia, 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 Szydlówek 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 *Cruropsina*; Racki 1993), including conodont fauna with *Icriodus subterminus* indicating the *K. disparilis* to *M. falsiovalis* passage zonal interval.

Ostracod assemblages in the Jaźwica Member (ca. 1100 specimens, Tab. 1) depend 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 Posłowie 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 tilmazensis*, 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 Posłowie-type microfauna with associations from the Łysogóry Region (Adamczak 1968, 1976; Malec in preparation) and Pomerania (Zbikowska 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 Posłowie-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 Skaly 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-
what peculiar as such associations are more common in some Devonian lagoonal environments (e.g. ‘open lagoonal’ 1st 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. Žbikowska 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 Menerrites and the unique presence of Frasnian leperditiids. Also the abundant faunas from the early Frasnian Kadzielnia foreslope mud mounds display a broad

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<tr>
<th>Kielce Region</th>
<th>Kostomłoty area</th>
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<td>L.Givet.</td>
<td>E.Frasian</td>
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<td>Leperditicopida</td>
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<td>Leperditia sp.</td>
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<td>Palaeocopida</td>
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<td>Fellerites sp.</td>
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<td>Amphissites sp.</td>
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<td>Keletes polonicus</td>
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<td>Coelocollandina sp.</td>
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<td>Tetrasacculus sp.</td>
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<td>Hollinella sp.</td>
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<td>Primitiopsideae indet.</td>
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<td>Fabarlycpris sp.</td>
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<td>Microcheliellina sp.</td>
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<td>Pronipantex sp.</td>
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<td>Podocopid indet.</td>
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<td>tingerella torleyi</td>
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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 Checiny 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.
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 palaecopids. 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 IIInd 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
 roughly coeval Jazwica Member faunas (cf. Racki et al. 1985: Pl. 10: 2, 4). They are characterized (Fig. 11) by metacopids (Polyzygia, Plagione-phrodes, 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 Kadzienia 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
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 Olemska 1979. This species occurs from pelagic deposits with conodonts and entomozoids of Śluckowice (Olemska 1979) up to Amphipora facies at Jaworznia and Ostrówka (Tab. 3). This might example an euryhaline form adapted to the high-stress, possibly of changing salinity biotope (Siveter 1983; Casier & Preat 1991).

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Streszczenie

Urozmaicona, detrytyczno-marglisto-biostromalna facja poslowicka w obrębie górnozoisteckiego otwartomorskiego Ogniwa z Jaźwicy w południowozachodniej 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) asocjacje z platykopidami Uchtovia refrahathensis i paleokopidami Buregia jazwicensis w rolach górnych. Inne późnożyweckie i frailskie rafowo-lagunowe mikrofauny są, z reguły mało zróżnicowane rodzajowo i z bardzo dużym udziałem podokopidów, głównie z rodzaju Bairdiocypris: euryfacjonalny gatunek B. samsonowiczii może być kluczem do korelacji wiekowej amfiporowych sekwencji lagunowych franu.

Żyweczkie asocjacje z zachodniej części basenu łysogórskiego charakteryzują się obecnością metakopidów, przede wszystkim Polyzygia symetria, oraz planktonicznych entomozoïdów Ungerella torleyi. Nowe gatunki Polenovula beckeri sp. n., Clavojabellina poslovicensis sp. n., Buregia jazwicensis sp. n. i Bairdia zbikowskae sp. n. zostały opisane z Ogniwa z Jaźwicy.