Early Frasnian ostracods from the Arche quarry (Dinant Synclinorium, Belgium) and the *Palmatolepis punctata* Isotopic Event

JEAN-GEORGES CASIER and EWA OLEMPSKA

Ostracods from the Arche quarry at Frasnes are analysed. Twenty-seven species are recognised in the Chalon Member and in the very base of the Arche Member of the Moulin Liénaux Formation. Three new species: *Scrobicula gracilis*, *Microcheilinella archensis*, and *Bairdia* (*Rectobairdia*) *chalonensis*, and one subspecies *Plagionephrodes laqueus praelaqueus*, are proposed. The fauna is in the *Favulella lecomptei* Zone based on metacopid ostracods and belongs to the Eifelian Mega-Assemblage. Ostracods are indicative of a regressive trend from a moderately deep poorly oxygenated marine environment below fair weather wave base to very shallow well oxygenated and agitated environments. Comparison of the ostracod fauna present in the Arche quarry with faunas described from the Frasnes railway section and from the Lion quarry shows that ostracods did not suffer a crisis during the *Palmatolepis punctata* Conodont Zone and close to the Early–Middle Frasnian boundary.

Key words: Ostracoda, *Palmatolepis punctata* Event, palaeoecology, Dinant Synclinorium, Frasnian, Belgium.

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Introduction

In 2002, as part of a joint program of the Belgian National Foundation for Scientific research (FNRS) and the Polish State Committee for Research (KBN), it was decided to investigate the ostracod succession across the *Palmatolepis punctata* Isotopic Event in Poland (EU), Nevada (USA), and the type region for the Frasnian Stage (Belgium, EU). The results of the two first studies (Poland, Nevada) were reported in a special issue of Acta Palaeontologica Polonica (Casier et al. 2006; Głuchowski et al. 2006), but the study of ostracods present in Belgium has been postponed. The distribution of ostracods was insufficiently known close to the Early–Middle Frasnian boundary in the Dinant Synclinorium, and consequently it was decided to investigate two classic sections: the access path to the Arche Quarry and the Frasnes railway section. The latter section was a subject of studies, which results have just been recently published (Casier and Olempska 2008).

The goal of this paper is to establish an inventory of a rich and well preserved ostracod fauna present in the Chalon Member exposed in the access path to the Arche quarry. This member of the Moulin Liénaux Formation belongs to the *Pa. transitans* Zone (Boulvain et al. 1999), the last Early Frasnian conodont zone. Some rare ostracods present in the extreme base of the Arche Member of the same formation are also reported. Another goal of this study is to establish whether or not these ostracods suffered from a biotic change across the *Pa. punctata* Isotopic Event in the type region.

Institutional abbreviation.—IRScNB, Royal Belgian Institute of natural Sciences, Brussels, Belgium.

The Early–Middle Frasnian boundary and the *Palmatolepis punctata* Isotopic Event

The Early–Middle Frasnian boundary has been fixed recently at the base of the *Pa. punctata* conodont Zone by the Subcommission on Devonian Stratigraphy (SDS Business Meeting, Leicester, 2006). In the Dinant Synclinorium, the first occurrence of *Pa. punctata* is observed in the upper part of the Chalon Member of the Moulin Liénaux Formation (Boulvain et al. 1999). Recently Yans et al. (2007) demonstrated an abrupt and high-amplitude negative carbon isotopic excursion (δ¹³C shift of -7‰) in the *Pa. punctata* Zone, corresponding probably to a world-wide perturbation in the earth-ocean system. Yans et al. (2007) suggested that this
event is related to a catastrophic release of oceanic methane hydrate. They also suggest that, among other possibilities, an impact may have contributed to that carbon isotopic excursion. In the Pa. punctata Zone the Alamo Event is responsible for the deposition of a huge megabreccia in the eastern part of the Great Basin, Nevada (Sandberg and Warme 1993) caused by a marine impact (Morrow et al. 2005). The presence of entomozoid ostracods belonging to the Frankinella latesulcata Zone in the Alamo Breccia of the Tempiute Mountains in Nevada (Casier in Sandberg et al. 1997), in the Belgian Dinant Synclinorium (Bultynck et al. 2001) and in the Algerian Sahara (Casier 1983) was used by Casier et al. (2006) as evidence for the existence of a hypoxic event in the Pa. punctata Zone. These ostracods belong to the Myodocopid Mega-Assemblage and are indicative in the Devonian of hypoxic water conditions. Evidence of expanding anoxic conditions during the Pa. punctata Zone are also supported by geochemical and palynological investigations in the Kowala quarry, Holy Cross Mountains, Poland (Marynowski et al. 2008).

Geological setting

The Arche quarry (GPS: N 50°04'14"; E 4°29'57") is located 800 m southwest of Frasnes (Fig 1). The quarry is the stratotype for the base of the Moulin Liénaux Formation (Boulvain et al. 1999) and also the stratotype for its lower member, the Chalon Member. The Chalon crops out along the access path to the Arche quarry. The Chalon Member is composed of shales containing nodules and thin beds of argillaceous limestones that increase in number and in thickness upward. Above the Chalon, the 120-thick Arche Member is represented by a large bioherm with stromatactis, corals and stromatoporoids. The extreme base of the Arche Member develops in the upper part of the Chalon Member and consequently the top of that member, not visible along the access path to the quarry, has not been sampled. For the present study, only the Chalon Member (samples AR-06-1 to 28) and the extreme base of the Arche Member (samples AR-06-29 to 31) have been investigated for ostracods (Fig. 2).

Fig. 2. Lithologic sections of the Chalon Member and of the extreme base of the Arche Member exposed on the north-eastern side and on the south-eastern side of the access path to the Arche quarry.

Previous studies on ostracods from the Chalon Member

ptophyllus cf. materni (Bassler and Kellett, 1934) in the Chalon Member exposed in the access path to the Arche quarry.

From the same member in the Ermitage path at Boussu-en-Fagne, Casier (1977) mentioned *F. lecomptei*, *Adelphobolbina europaea* Becker and Bless, 1971, A. cf. parvulus, *Punctomosea weyanti* Becker, 1971 and *Cytherellina?* sp. B. Unfortunately the Ermitage path section has been covered by asphalt and is now inaccessible.

**Material and methods**

Thirty-one samples of approximately 500 g each and numbered AR-06-1 to 31 were extracted for the study, 20 on the northeast side of the access path, and 8 on the southwest side. The hiatus between these two sections is less than one meter. All the samples were crushed by a hydraulic press and samples collected from shales (AR-06-1 to 3) were directly sieved on 100 μm, 250 μm and 1600 μm mesh screens. The others were attacked with 99.8% glacial acetic, at nearly 90°C, for four days at a rate of eight hours a day. This hot acetolysis method has been described by Lethiers and Crasquin-Soleau (1988). The residues were sieved on the above mentioned screens. Then that part of the sample retained by the 1600 μm mesh screen was attacked by acid again and sieved on 250 μm and 1600 μm mesh screens only. The process was repeated for samples AR-06-22 to 27 but the residue was sieved on 250 μm and 1600 μm mesh screens only. About 825 carapaces, valves and fragments of ostracods identifiable at any taxonomic level were thus extracted.

Ostracods are absent or unidentifiable in the base of Chalon Member up to the sample AR-06-14. Their abundance is normal from sample AR-06-16 to sample AR-06-21, and also in the sample AR-06-25. They are abundant in samples AR-06-22, AR-06-23, and AR-06-26 to AR-06-28, and very scarce from sample AR-06-29 to sample AR-06-31.

A systematic list of identified ostracod taxa and their distribution in the access path section at the Arche quarry are reported in Appendix 1 and Table 1.

### Table 1. Distribution of ostracods in the access path to the Arche quarry. The boundary between the Chalon Member and the Arche Member is between samples AR-06-28 and 29.

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Systematic palaeontology

Class Ostracoda Latreille, 1802
Order Palaeocopida Henningsmoen, 1953
Suborder uncertain
Family Scrobiculidae Posner, 1951
Genus Scrobicula Posner, 1951

Type species: Cytherella? scrobiculata Jones, Kirkby and Brady, 1884.
Type locality: Not designated (East Kilbride, Lanarkshire or Robroystone, Lanarkshire), southern Scotland; Carboniferous Limestone series, Lower Carboniferous

Scrobicula gracilis sp. nov.

Diagnosis.—Small leperditoid carapace with a slim depression and with a finely wrinkled ornamentation.

Material.—Six carapaces and valves (samples AR-06-20 and AR-06-23). The description is also based on several specimens from the Nismes section (study in progress) and from the Frasnes railway section (Casier and Olempska 2008).

Description.—Small preplete carapace with a slightly convex dorsal border and a delicately curved or nearly straight ventral margin. The anterior and the posterior margins are regularly rounded, but the curvature of the last one is more accentuated. The greater length is at mid-height, and the greater height is at the anterior third of the carapace. Both cardinal angles (about 150°) located in the anterior and posterior sixth of the length. The left valve is larger than the right valve, and in right lateral view projects all along the free and dorsal margins. The carapace is biconvex in dorsal view, moderately wide, with the greatest width located just posterior of mid-length. The straight hinge line is in a slim depression. The finely wrinkled ornamentation and the muscle scar are only faintly visible. The inner wrinkles are concentric around a circular muscle scar; the exterior wrinkles follow the contour of the free margin and terminate against the dorsal border. The ornamentation is comparable to finger-print ornamentation observed in many entomozoid ostracods.

Remarks.—The species is easily distinguishable from the majority of species belonging to the genus Scrobicula by its elliptical contour in dorsal view. Where the finely wrinkled ornamentation is preserved, S. gracilis differs from all the species of genus Scrobicula. In Belgium the species is also present in the Pont d’Avignon Member, in the Sourd d’Ave Member and in the Chalon Member exposed in the Nismes section (study in progress). Paraparchites? sp. A figured by Casier and Olempska (2008) from the Frasnes railway section belongs also to the new species. In that section, S. gracilis is present in the Ermitage Member and also in the Bieumont and Boussu-en-Fagne Members of the Middle Frasnian Grand Breux Formation. The Paraparchitidae? sp. indet. recorded by Głuchowski et al. (2006) from the middle Wietrznia Beds (Pa. transitans Conodont Zone) of the Wietrznia quarry in the Holy Cross Mountains, Poland, belongs to S. gracilis.

Order Podocopia Sars, 1866
Suborder Metacopina Sylvester-Bradley, 1961
Family Ropolonellidae Coryell and Malkin, 1936
Genus Plagionephrodes Morey, 1935

Type species: Plagionephrodes uninodosus Morey, 1935. Clark’s Branch, Missouri, USA; upper Kinderhookian, Lower Mississippian.

Plagionephrodes laqueus praelaqueus ssp. nov.

Diagnosis.—A small subspecies of Plagionephrodes laqueus characterised by an ornamentation composed of an anterior vertical ridge and a posterior spur on each valve separated by some other irregular ridges in the middle part of the carapace.

Material.—126 valves and carapaces (samples AR-06-17, 18, 20-23, 25-28).

Description.—Small preplete carapace with a slightly curved dorsal border extending from the anterior two-seventh of the greatest length almost to the posterior extremity. The hinge line is straight. The ventral margin is straight or gently concave. Anterior margin largely rounded sometimes forming an obtuse angle with the dorsal border, or exceptionally slightly angular at the extremity. Posterior margin more rounded than the anterior, and curvature more accentuate ventrally. The greatest length is at mid-height, and the greatest height is at two-seventh of the carapace length. The left valve is larger than the right, and projects greatly all along the free and dorsal margins in right lateral view. The overlap is important along the ventral border. The contour of the left valve is quite different. Its greatest height is slightly shifted posteriorly, and the anterior extremity is acuminate. The ornamentation is more developed on the right valve, and is composed of a vertical ridge located at the anterior quarter of the valves and of a spur in the posterior quarter of the length at mid-height. Some other irregular ridges are present in the middle part of the carapace,
Fig. 3. Early Frasnian ostracods from the access path to the Arche quarry, Dinant Synclinorium, Belgium. 

sometimes extending from the upper part of the anterior ridge to the postero-ventral sector. A slightly crenulated marginal rim is visible all along the free border, but it is more developed close to the extremities. In dorsal view, the contours of valves are nearly straight between the anterior ridge and the posterior spur, which are prominent. The position of the posterior spurs corresponds to the greatest width. The anterior and the posterior borders are well rounded but the surface before the ante−
terior ridge and behind the dorsal spur is concave.

Remarks.—The new subspecies and Plagionephrodes laque−
eus laqueus (Matern, 1929) belong to the same phylogenetic
succession. P. laqueus laqueus is known from the Middle
Frasnian of Belgium and Bouloannais (France) (Becker 1971).
This species is larger and possesses a strongly developed orna−
mentation composed of ridges forming a “ö” letter of the
Greek alphabet, surmounted by a ridge parallel to the dorsal
border. Plagionephrodes inexpect Becker, 1971, also from the
Frasnian of the Dinant Synclinorium (Becker 1971), possesses
a spur in the dorsal sector only. In Belgium, P. laqueus prae−
laqueus is also known from the Chalon Member, from the
Sourd’Ave Member and from the Pont d’Avignon Member
in the Nismes section (study in progress). The P. laqueus
(Matern, 1929) specimen mentioned but not figured by Becker
(1971) from the access path to the Arche quarry belongs prob−
ably to the new subspecies.

Suborder Podocopina Sars, 1866
Family Pachydomellidae Berdan and Sohn, 1961
Genus Microcheilinella Geis, 1933
Type species: Microcheilus distortus Geis, 1932. Indiana (USA); Salem
Limestone, Upper Mississippian.

Microcheilinella archensis sp. nov.
Fig. 4F–J.

Etymology: After type locality.
Holotype: IRScNB n° b5083. Carapace. AR-06-23. Fig. 4G. L = 0.81
mm; H = 0.48 mm; W = 0.54 mm.
Type locality: Access path to the Arche quarry.
Type horizon: Chalon Member of the Moulin Liénaux Formation, Early
Frasnian, Devonian.

Diagnosis.—Wide Microcheilinella, very asymmetric, espe−
cially in the postero-ventral sector. Thin crest parallel to the
margin in the postero-ventral sector of the left valve and
more rarely of the right valve.

Material.—71 valves and carapaces (samples AR-06-20?,
22, 23, 25-28).

Description.—Relatively large species of Microcheilinella;
widest than high. Ventral and dorsal borders straight or very
slightly convex. Anterior and posterior borders angular with
the anterior extremity at third-height, and posterior extremity
at mid-height. Antero-dorsal, postero-ventral, and postero−
dorsal margins straight or slightly convex. Antero-ventral
margin convex. Greatest height slightly before mid-length,
and greatest length at half height. The left valve is larger than
the right but their contours are similar. In right lateral view,
Fig. 5. Early Frasnian ostracods from the access path to the Arche quarry, Dinant Synclinorium, Belgium. 


C. Bairdiacypris sp. D. Poorly preserved carapace in right (C1) and dorsal (C2) views. Sample AR-06-25. IRScNB n° b5088. 

D. Bairdiacypris sp. indet. Poorly preserved carapace in right (D1) and dorsal (D2) views. Sample AR-06-28. IRScNB n° b5089. 


F. Acratia evlanensis Egorov, 1953. Poorly preserved carapace in right lateral view. Sample AR-06-23. IRScNB n° b5091. 


N. Cryptophyllus sp. A. Valve in lateral (N1) and dorsal (N2) views. Sample AR-06-23. IRScNB n° b5099. Scale bars 200 μm.
of the left valve on the right is the greatest before the mid-
length. Surface of the valves finely pitted.

Remarks.—Bairdia (Rectobairdia) sp. A of Becker (1971)
from the Boussu-en-Fagne Member of the Grand Breux For-
mation exposed in the access path to the Lion quarry, at
Frasnes, may belong to or be very close to B. (R.) chalo-
enses. The morphology of the carapace is the same in the
two species except that the specimens collected by Becker
(1971) are smooth.

Discussion

Palaeoecology.—The ostracod fauna present in the Chalon Member and in the extreme base of the Arche Member ex-
posed in the access path to the Arche quarry belongs to the
Eifelian Mega-Assemblage. Due probably to a high sedi-
mentation rate (turbidite?) and (or) to the deepness, ostracods
seem to be absent in the first 4.5 m (up to sample AR-O6-15)
of the Chalon Member. However, in the upper part of the
Chalon Member (samples AR-O6-16 to 27) ostracods are
abundant and sometimes very abundant. In the top of the
Chalon Member, the greater abundance and diversity of
podocopid ostracod is indicative of a well oxygenated envi-
ronment. In the lower part of the interval productive of
ostracods P. laqueus praelaqueus is the most abundant spe-
cies. In the middle portion its great abundance is shared with
M. archensis, and finally in the upper part top of the Chalon,
this last species and B. (R.) chalonensis dominate the ostra-
cod fauna. This change in taxonomic composition and domi-
nance is probably due in part to the increase of the water mo-
tion related to the shallowing. This is also confirmed by
the increasing number of specimens belonging to Uchtovia ma-
terni Becker, 1971, and Cryptophyllus materni (Bassler and
Kellett, 1934).

The composition of the ostracod fauna reported by Becker
(1971) in the access path to the Arche quarry is quite different.
Becker recorded eight species, of which only five are recog-
nised in our study. We have not found Amphissites cf. par-
vulus, Hollinella (Keslingella) praecursor, or Acratia sp. A.
The near absence of podocopids in the fauna reported by
Becker (1971), which is composed almost exclusively of
metacopid and palaeocopid species, is significant. The greater
abundance of metacopids and palaeocopids compared to
podocopids indicates a deeper, poorly oxygenated calm envi-
ronment (Casier 1987). Consequently we surmise that his
fauna was collected in the lower part of the Chalon Member,
which would support our interpretation of a shallowing trend
observed in the upper part of that member.

In the base of the Arche Member ostracods are scarce but
that is generally the case in reefs. The rarity of ostracods in
that kind of environment is in great part related to the water
motion. Carapaces are frequently broken and (or) transported
basinward.

Previous studies on ostracods related to the Pa. punctata
Isotopic Event.—In Nevada some 26 taxa belonging to the

![Table 2. Ostracod species present in the Chalon Member of the access path to the Arche quarry (Palma-
tolepis transitans Conodont Zone), which are also
found by Becker (1971) and Casier and Olempska (2008)
in the Ermitage Member (Palma-
tolepis punctata Conodont Zone) of the Moul-
in Liénaux Formation or in the Bieumont Member (Palma-
tolepis hassi Conodont Zone) and Boussu-en-Fagne Member (Palma-
tolepis hassi and
Palma-
tolepis jamieae conodont zones) of the Grand Breux Formation.](http://app.pan.pl/acta53/app53-635.pdf)
Eifelian Mega-Assemblage and generally indicative of very shallow semi-restricted water conditions were identified, from the Late Pa. falsiovalis to the Early Pa. hassi conodont Zones (Casier et al. 2006). Because of the rarity and low diversity of ostracods in samples collected from the lower part of the lower member of the Devils Gate Limestone it was not possible to demonstrate conclusively an extinction event close to the Alamo Event Bed. Nevertheless the greater abundance and diversity of ostracods above this bed seems to indicate that the Alamo Event did not result in significant extinction of ostracod taxa in this shallow water setting.

In Poland we have analysed Early and Middle Frasnian ostracods from Wietrznia in the Holy Cross Mountains (Głuchowski et al. 2006). Twenty three ostracod species assigned to thirteen named genera were distinguished in the Wietrznia quarry. This ostracod assemblage also belongs to the Eifelian Mega-Assemblage, and changes from moderately diverse in its lower part to moderately abundant, diversified and of course characterised by different conodont zones. Consequently, we find no evidence that ostracod faunas suffered a crisis close to the Early–Middle Frasnian boundary. 

Finally, a pronounced ostracod change across the Early–Middle Frasnian transition has been documented by Evdokimova (2006) in the northwest part of the East European Platform. Evdokimova recognized more than 80 ostracod species belonging to the Eifelian Mega-Assemblage in the Sargaevo and Semiluki Horizons. However, the significant changes in ostracod content found there are related to the transition from relatively shallow well oxygenated and sometimes semi-restricted environments in the Sargaevo Horizons to deeper settings in the Semiluki Horizon where the ostracods are more abundant, diversified and of course characterised by different species. This important change of environments is not favourable to demonstrate an extinction event close to the Early and Middle Frasnian boundary in Poland.

Ostracods and the Pa. punctata Isotopic Event in the type region.—The abrupt $\delta^{13}$C isotopic excursion (from 5.85 to -1.2‰) observed in the Pa. punctata Zone by Yans et al. (2007) was measured in brachiopod shells extracted from the Ermitage Member, the uppermost member in the Moulin Liénaux Formation. Yans et al. (2007) think that the best explanation for the Pa. punctata Isotopic Event is a catastrophic release of oceanic methane hydrate triggered by Alamo (or other) impact, and (or) sudden initiation of a global warming. In order to appreciate the influence of the Pa. punctata Isotopic Event on ostracods, we have compared the fauna found in the access path to the Arche quarry (Pa. transiens Conodont Zone) with the faunas found in the Bioumont Member (Pa. hassi conodont Zone) and in the Boussu-en-Fagne Member (Pa. hassi and Pa. jamieae conodont zones) of the Grand Breux Formation (Table 2). These ostracod faunas are well known by the study of the Frasnian railway section (Casier and Olempska 2008) and of the access path to the Lion quarry (Becker 1971). Seventeen species (18 if we count some doubtful Punctomosea weyanti Becker, 1971) out of 25 species (we cannot count Acratia sp. indet. and Bairdiacypris sp. indet.) present in the Chalon Member of the access path to the Arche quarry are also present in the Bioumont or in the Boussu-en-Fagne Members of the Grand Breux Formation. Only Plagionephephodes laqueus is represented by another subspecies. With the exception of Microcheilinella archensis all the other species [Bairdiacypris sp. sensu Magne (1964), Bairdiacypris sp. C, Cryptophyllus sp. A, and Paraparchitidae? sp. indet 2] are known only by very rare or poorly preserved specimens. Consequently, we find no evidence that ostracod faunas suffered a crisis close to the Early–Middle Frasnian boundary.

Conclusions

The ostracod fauna present in the Chalon Member and in the extreme base of the Arche Member exposed in the access path to the Arche quarry belongs to the Eifelian Mega-Assemblage. In that section, ostracods are indicative of a regressive trend from a moderately deep, poorly oxygenated marine environment below fair weather wave base to shallow, well oxygenated and agitated environments. The studied section is entirely in the Favulella lecomptei Zone based on metacopid ostracods.

A comparison with faunas described from the Frasnian railway section (Casier and Olempska 2008) and from the access path to the Lion quarry (Becker 1971), shows that nearly all the ostracod species recognised in the Chalon Member of the Arche quarry, which belongs to the Pa. transiens Conodont Zone, are present in the Bioumont Member and in the Boussu-en-Fagne Member, which belong to the Pa. hassi and Pa. jamieae conodont zones. Consequently, we can state positively that ostracods do not suffer a crisis during the Pa. punctata Conodont Zone and close to the Early–Middle Frasnian boundary. That confirms that the changes observed close to that boundary in the Holy Cross Mountains in Poland (Głuchowski et al. 2006), in the Devils Gate section in Nevada (Casier et al. 2006) or in the northwest of the East European Platform (Evdokimova 2006) are related only to regional environmental changes. Referring to Sepkoski (1996) and McGhee (2001), Yans et al. (2007) noted also that the Early to Middle Frasnian interval is marked by very low extinction intensity in the world ocean.

An new analysis of carbon isotopes across the Pa. punctata Zone in the type region for the definition of the Frasnian stage is desirable even if the $\delta^{13}$C isotopic negative excursion is found in Poland (Yans et al. 2007) and in China (Ma et al. 2008). The high-amplitude negative carbon isotopic excursion detected by Yans et al. (2007) in brachiopod valves may have been amplified by a short hiatus or may be related to the collection. The brachiopods used for the isotopic analysis by
Yans et al. (2007) were collected in the Ermitage path at Boussu-en-Fagne, a section that has been inaccessible for several tens of years.

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References


Appendix 1

Systematic list of identified ostracod taxa

Order Palaeocopida Henningsmoen, 1953

Suborder Palaeocopina Henningsmoen, 1953
  Family Kirkbyellidae Sohn, 1961
    *Refrathella incompta* Becker, 1971 (Fig. 3A, B)
  Suborder Paraparchiticopina Gramm, 1975 in Gramm and Ivanov (1975)
    Family Paraparchitidae Scott, 1959
      Paraparchitidae? sp. indet. 2
  Suborder uncertain
    Family Scrobiculidae Posner, 1951
      *Scrobicula gracilis* sp. nov. (Fig. 3H–J)
  Suborder Platycopina Sars, 1866
    Family Kirkbyellidae Sohn, 1961
      *Refrathella incompta* Becker, 1971 (Fig. 3A, B)
  Suborder Paraparchiticopina Gramm, 1975 in Gramm and Ivanov (1975)
    Family Paraparchitidae Scott, 1959

Order Podocopida Sars, 1866

Suborder Metacopina Sylvester-Bradley, 1961
  Family Ropolonellidae Coryell and Malkin, 1936
    *Plagionephrodes laqueus praelaqueus* ssp. nov. (Fig. 3L–N)
    *Plagionephrodes ineptus* Becker, 1971 (Fig. 3O)
  Family Thlipsuridae Ulrich, 1894
    *Favulella lecomptei* Becker, 1971 (Fig. 4B)
  Family Quasillitidae Coryell and Malkin, 1936
    *Jenningsina lethiersi* Becker, 1971 (Fig. 4A)
  Family Bufinidae Sohn and Stover, 1961
    *Punctomosea weyanti* Becker, 1971
  Suborder Podocopina Sars, 1866
    Family Pachydomellidae Berdan and Sohn, 1961
      *Microcheilinella archensis* sp. nov. (Fig. 4F–J).
    Family Bairdiocyprididae Shaver, 1961
      *Bairdiacypris* sp. 5 sensu Magne (1964) (Fig. 4C)
      *Bairdiacypris* sp. C. (Fig. 4D, E)
      *Healdianella?* sp. B in Becker (1971) (Fig. 4K)
    Family Bairdiidae Sars, 1888
      *Bairdia* (Rectobairdia) *pafrathensis* Kummerow, 1953 (Fig. 4L)
      *Bairdia* (Rectobairdia) *chalonenensis* sp. nov. (Fig. 4M–O)
      *Bairdia* (Orthobairdia) sp. B in Becker (1971) (Fig. 5A)
      *Bairdiacypris* sp. B, aff. *B. martinae* Casier and Lethiers, 1997 (Fig. 5B)
      *Bairdiacypris* sp. D (Fig. 5C)
      *Bairdiacypris* sp. indet. (Fig. 5D)
      *Bairdiacypris* breuxensis Casier and Olempska, 2008 (Fig. 5E)
      *Schneideria groosae* Becker, 1971 (Fig. 5H)
    Family Acratiidae Gründel, 1962
      *Acratia evlanensis* Egorov, 1953 (Fig. 5F)
      *Acratia* sp. indet. (Fig. 5G)
  Suborder Podocopina Sars, 1866
    Family Cryptophyllidae Adamczak, 1961
      *Cryptophyllus materni* (Bassler and Kellett, 1934) (Fig. 5I–M)
      *Cryptophyllus* sp. A (Fig. 5N)