

## Late Ordovician Ostracoda from Iran and their significance for palaeogeographical reconstructions

Oberordovizische Ostrakoden aus Iran und ihre Bedeutung für paläogeographische Rekonstruktionen

ROGER SCHALLREUTER (Greifswald), INGELORE HINZ-SCHALLREUTER (Greifswald), MARCO BALINI (Milano) & ANNALISA FERRETTI (Modena)

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### Abstract

The first record of Late Ordovician ostracods from Iran comes from the lowermost part of the Shirgesht Formation east of Anarak, central Iran. The fauna comprises more than 40 species of beyrichiopes and podocopes with a total of 17 new species and one new subspecies. Among the beyrichiopes the Binodicopa are represented with 10 species, the Palaeocopa occur with eight species. The Anarak fauna shows relations to both allochthonous and autochthonous sediments from Thuringia as well as to Baltica with the relations being closest to the fauna of certain calcareous clasts of the glaciomarine Lederschiefer of Thuringia. The clasts have been considered as pebbles or boulders from debris flows (SCHALLREUTER & HINZ-SCHALLREUTER 1998), but their origin remained unclear until now. Investigation of the Anarak ostracods proved to be most significant in terms of clarifying this question. The close relations between both faunas suggest that the Thuringian clasts came from the vicinity of Gondwanian Iran.

### Zusammenfassung

Aus dem zentralen Iran ist in einem Profil nördlich Anarak Oberordovizium, das diskordant auf metamorphen Gesteinen des Präkambriums lagert, aufgeschlossen. Bei den Sedimenten handelt es sich um rötliche, dünnbankige Siltsteine, in die partiell extrem dünne Kalklagen eingeschaltet sind. Die stratigraphische Einstufung in das Oberordovizium erfolgte an Hand silifizierter Ostrakoden, die anstelle der erwarteten Conodonten bei der Aufbereitung mit Ameisen- bzw. Salzsäure und anschließender Wasserstoffperoxid-behandlung gewonnen wurden. Das Ordovizium des Anarak-Profiles wird zur Shirgesht Formation gerechnet, deren Typuslokalität sich ca. 150 km westlich bei Tabas in den Derenjal Bergen befindet. Das Alter des dortigen Ordoviziums wird gegenwärtig nur mit Unter- bis Mittelordovizium angegeben, wobei die komplizierten tektonischen Verhältnisse weitere Untersuchungen erfordern. Jüngste Untersuchungen an Trilobiten (GHOBADI POUR, OWENS & POPOV 2006) aus der obersten Einheit (ob. Darriwillian) der Shirgesht Formation bei Tabas sprechen für ein mittelordovizisches Alter (Llanvirn). Das Oberordovizium bei Anarak lagert diskordant auf den präkambrischen Doshakh Metamorphiten. Ob es die Fortsetzung des Mittelordoviziums der Tabas Region darstellt, wobei entweder relativ kleinräumige tektonische Prozesse zum Fehlen der oberen bzw. unteren Einheiten des Ordoviziums an den jeweiligen Orten geführt haben oder die genannten Profile aus dem zentralen Iran zwei ursprünglich unterschiedlichen Terranes angehören, bedarf weiterer, detaillierter Untersuchungen.

Ostrakoden sind bisher nur aus unterlagernden Kalkbänken des unteren Darriwillian an der Typuslokalität untersucht worden (WILLIAMS et al. in GHOBADI POUR et al. 2006). Inwieweit das obere Darriwillian keine Ostrakoden enthält oder nur auf Makrofossilien, wie z.B. Trilobiten (s. GHOBADI POUR, OWENS & POPOV 2006) beprobt wurde, ist unbekannt.

Die Ostrakodenfauna des Anarak-Profiles ist sehr viel diverser mit einem eindeutig oberordovizischen Alter, während die Ostrakodenassoziation der Shirgesht Formation von Tabas charakteristische Elemente des Unter-/Mittelordoviziums aufweist.

Die Anarak Fauna zeigt bemerkenswerte Übereinstimmungen mit zeitgleichen sowohl autochthonen als auch allochthonen Vergesellschaftungen Thüringens, nämlich der Ostrakodenassoziationen der Kalkbank und der *Bairdiocypridella*-Kalkgerölle. Die stärksten faunistischen Übereinstimmungen gibt es zwischen der Anarak-Fauna und denjenigen der allochthonen *Bairdiocypridella*-Kalkgerölle mit sechs (? sieben) identischen Arten (*Postceratia posterocerata*, *Baltonotella angustovelata*, *Conodomyra conocerata*, *Tricornina haehneli*, *Bairdiocypridella bairdiaformis*, *Brevicornina brevis*, ? *Baldiscella anterobulbosus*).

Die autochthonen Faunen der Kalkbank sowie des oberen Erzhorizontes von Thüringen haben mit der Anarak-Fauna vier Arten sowie drei weitere Gattungen gemeinsam (*Duringia spinosa*, *Baldiscella anterionoda*, *Tricornina haehneli*, *Morphobealdia wiefeli*; *Brevicornina Kliphores*, *Dornbuschia*). Da es jedoch kaum Übereinstimmungen zwischen der Kalkbank-Fauna und der Fauna der *Bairdiocypridella*-Kalkgerölle gibt, wird zwischen Thüringen und dem Ursprungsort der *Bairdiocypridella*-Kalgerölle eine Faunenbarriere in Form einer Tiefsee angenommen.

Im Gegensatz zu den im Thüringer Lederschiefer gefundenen Dropstones, die durchweg sehr stark verkieselt sind und deren Ursprung in Armorica gesehen wird (SCHALLREUTER & HINZ-SCHALLREUTER 1998), ist bei den Kalkgerölle lediglich die Fauna verkieselt. Aus diesem Grund nahmen HINZ-SCHALLREUTER & SCHALLREUTER (1998) keinen glazialen Ursprung an, sondern leiteten die Kalkklasen von untermeerischen Schlammströmen aus einer relativ nahe gelegenen Region (s.a. Fig. 6) ab, was das Bild der vermuteten Existenz einer TiefseebARRIERE hervorragend ergänzt. Die hier aufgezeigten faunistischen Befunde und die daraus resultierenden paläogeographischen Schlussfolgerungen unterstützen die bereits von SCHALLREUTER & HINZ-SCHALLREUTER (1998) geäußerte Vermutung, daß Thüringen kein Teil Perunicas, sondern ein eigenständiger Mikrokontinent bzw. Terrane war.

## Introduction

In Iran Ordovician sedimentary successions are exposed in several structural units, as in the Cimmerian blocks (Alborz and central Iran) and in the Zagros. Notwithstanding the distribution of the outcrops, the knowledge of the successions is still rather incomplete.

The basic lithostratigraphical subdivisions of the Ordovician were defined only in the 1960's with the publication of the first series of geological maps of Iran, which were true milestones for the geological understanding of the country. Ordovician formations were recognized in the Kerman area (HUCKRIEDE et al. 1962), Shirgesht area (Tabas Block: RUTTNER et al. 1968), and the Alborz (GANSSE & HUBER 1962; ASSERETO 1966), while in the Zagros the first description of Ordovician units was much older (HARRISON 1930). This first wave of modern stratigraphical contributions, however, was not followed by significant improvements, and it is only in recent years that new palaeontological contributions have re-opened the discussion on bio-chronostratigraphical and paleobiogeographical correlations. At the present bio-chronostratigraphical and data are available only from four sites.

The Derenjal Mountains (central Iran, Tabas Block, Shirgesht area) are the most studied site, as trilobite, echinoderm, and ostracod bed-by-bed collected data are available (BRUTON et al. 2004, LEFEBVRE et al. 2005, GHOBADI POUR et al. 2006). The second site is BanestanShabdjereh area (NW of Kerman), where acritarchs, conodonts and trilobites were reported (REITZ & DAVOUDZADEH 1995, ZHEN et al. 2001, BRUTON et al. 2004), but no stratigraphic section is available. Two additional sites are Alam Kuh in central Alborz and Simeh-Kuh (Damgan area) in eastern Alborz, where respectively trilobites (BRUTON et al. 2004), and

bed-by-bed collected echinoderms (LEFEBVRE et al. 2005) were described.

Here we present new bed-by-bed collected ostracods, from a new site located in the Anarak area (central Iran, Yazd Block).

Lower Palaeozoic ostracods from Iran are poorly known as yet and their investigation started only recently. BASSETT et al. (1999: 484) were the first who mentioned ostracods from Unit B (Llandeilo – lower Caradoc) of the Katkoyeh Formation at Banestan, the hills east of Zarand, Kerman Region, south-eastern Iran. LEFEBVRE et al. (2005: 232) recorded ostracods from the Lashkarak Formation of Simeh-Kuh, eastern Alborz Range, northern Iran. Recently, WILLIAMS, VANNIER & MEIDL (in GHOBADI POUR et al. 2006) described the first ostracod fauna from the Middle Ordovician part of the Shirgesht Formation of Derenjal Range, north of the type area of the formation. The fauna came from the upper part of the Shirgesht Formation, a sequence of limestone mudstone interbeds underlying a thick sequence of upper Darriwillian sand- and siltstones. The fauna, found in an attempt to recover conodonts, consists of "some hundred specimens" and is silicified to varying degrees that prevented taxonomic assignment in particular of the numerous podocopes. The fauna comprises some eight species of which only three new species out of three palaeocope genera could be precisely determined. The associated trilobite *Nesuretinus* and brachiopod *Nicolella* suggest a late Middle Ordovician age.

The ostracods presented in this study came from a section of central Iran, east of Anarak, where the Shirgesht Formation is developed in a sandy to silty facies (text-fig. 1). Red limonitic siltstones from the lowermost part of the profile yielded silicified ostracods that are undoubtedly of Late Ordovician age.

## Geological and Stratigraphical setting

The type area of the Shirgesht Formation is in the Tabas area, east Iran where the formation has been formally defined by RUTTNER et al. 1968. This is the site of collection of all the fossils described up to now from the Shirgesht Formation: trilobites by BRUTON et al. (2004), echinoderms by LEFEBVRE et al. (2005), ostracods by WILLIAMS et al. in GHOBADI POUR et al. (2006).

The ostracodes described herein came from the Shirgesht Formation east of Anarak, Central Iran. Anarak (NE of Nain), located in central Iran, Yazd Block (Fig. 1A, 1B), is the main town of an historically important mining district where lead, zinc and copper mineralisation were exploited for hundreds of years. Palaeozoic rocks were already reported about 20–25 km ESE of Anarak by DAVOUDZADEH & AMIDI in 1975 (in DAVOUDZADEH et al. 1981: fig. 1), but it was only in 1984 that a stratigraphical

**Table 1:** Description of the Shirgesht Formation at section 5-6756 (from SHARKOVSKI et al. 1984: 25; see also Fig. 2A and 3A,C)

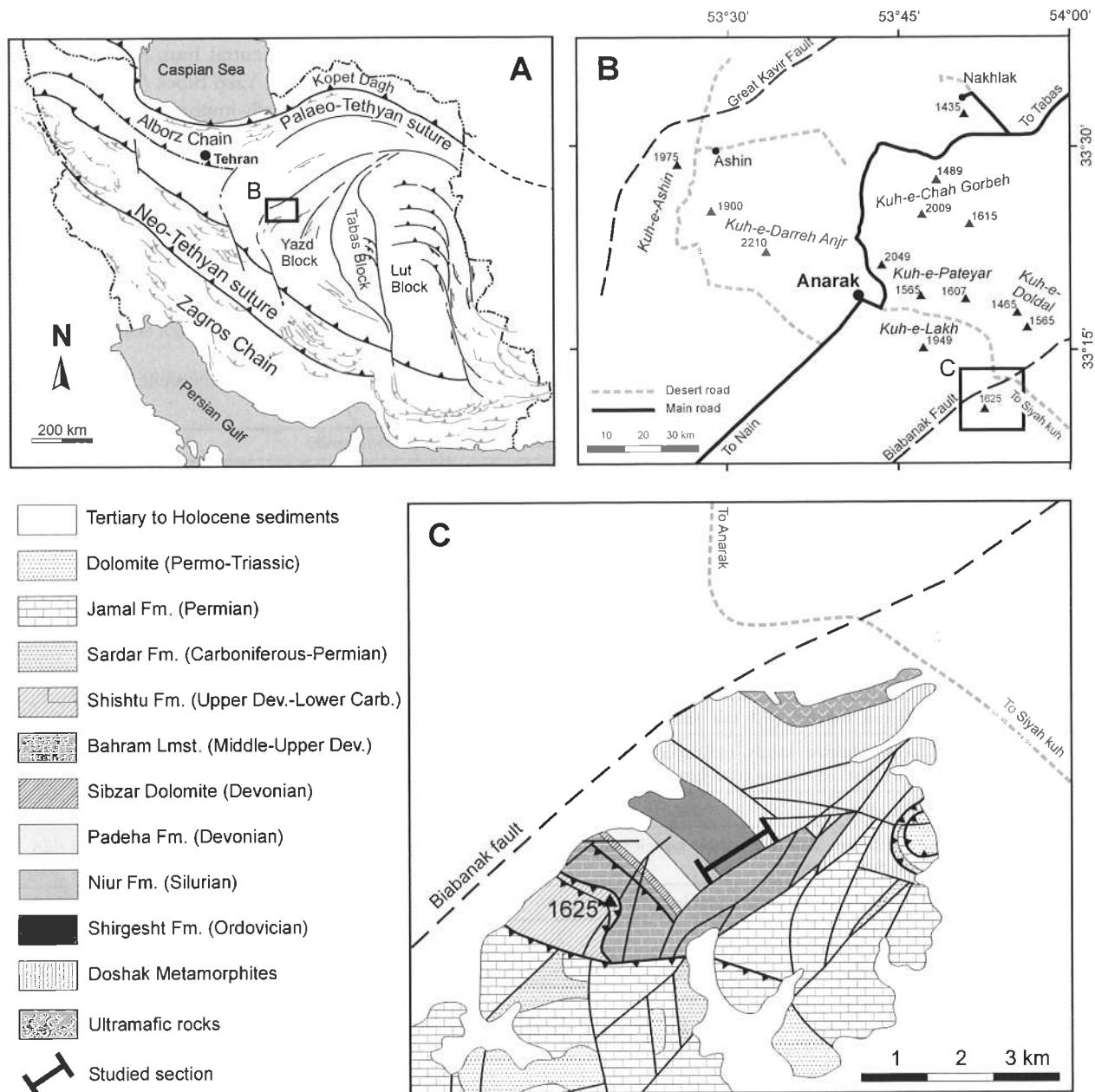
**Tab. 1:** Beschreibung der Shirgesht-Formation des Profils 5-6756 (nach SHARKOVSKI et al. 1984: 25; siehe auch Abb. 2A und 3A,C)

Top: Alternation of green mudstone and limestone of Niur Formation (Silurian), conformity
9) Sandstone, dark green, micaceous, in upper part with intercalations of violet-red sandstone and lenses of dark grey quartzite, brachiopods and pelecypods (?). 100 m.
8) alternation of violet-red and greenish-red, micaceous sandstones containing brachiopods. 78 m.
7) Sandstone violet-red, micaceous, with thin intercalations of yellowish limestone containing <i>Liospira</i> ex gr. <i>vitruvia</i> (Bill.), brachiopods and other fossils. 68 m.
6) Sandstone, green, micaceous, bedded, with thin intercalations of yellowish-grey limestone, containing brachiopods and other fossils. 52 m.
5) Sandstone, green-grey and violet-grey, flaggy micaceous, alternating with siltstone. 156 m.
4) Siltstone, violet-red, foliated, with thin sandstone intercalations. 125 m.
3) Limestone, reddish-brown, sandy, indistinctly bedded, and calcareous sandstone with Endoceratida and Orthoceratida, fam., gen. et sp. indet., as well as trilobites, brachiopods and cystoids. 38 m.
2) Sandstone, light grey. 11 m.
1) Tuffaceous gravelstone, and fine pebble conglomerate, brownish-red, with sandstone intercalations and occasional thin lenses of ignimbrite. 128 m.
Base: Doshakh metamorphites, supposed angular unconformity.

**Table 2:** Description of the stratigraphic section IR12 (WGS84 coordinates: 33°10'53,8" N – 53°53'37,2" E; see also Fig. 2B and 3B)

**Tab. 2:** Beschreibung des stratigraphischen Profils IR12 (WGS84 Koordinaten: 33°10'53,8" N – 53°53'37,2" E; siehe auch Abb. 2B und 3B)

Top
F) Alternation of red shales with thin bedded bioclastic sandy-silty limestones to silty marls. The red shales intervals are up to 1,4 m thick. The limestone-silty marl beds are up to 20-25 cm thick and are sometimes grouped in 40 cm thick limestone-silty marl packages. Occasionally very thin sandstone beds; 11.25 m.
– Cover, 3.8 m.
E) Microconglomerate, with quartz grains; 0.4 m.
– Cover, 1.2 m.
D) White quartzarenites, in the upper part with crossbedding; 4.0 m.
C) Light green sandstones; 1.5 m.
B) Red to green conglomerates, with volcanic pebbles; 7.6 m.
A) Poorly exposed red to violet conglomerates; 6 m.
Bottom



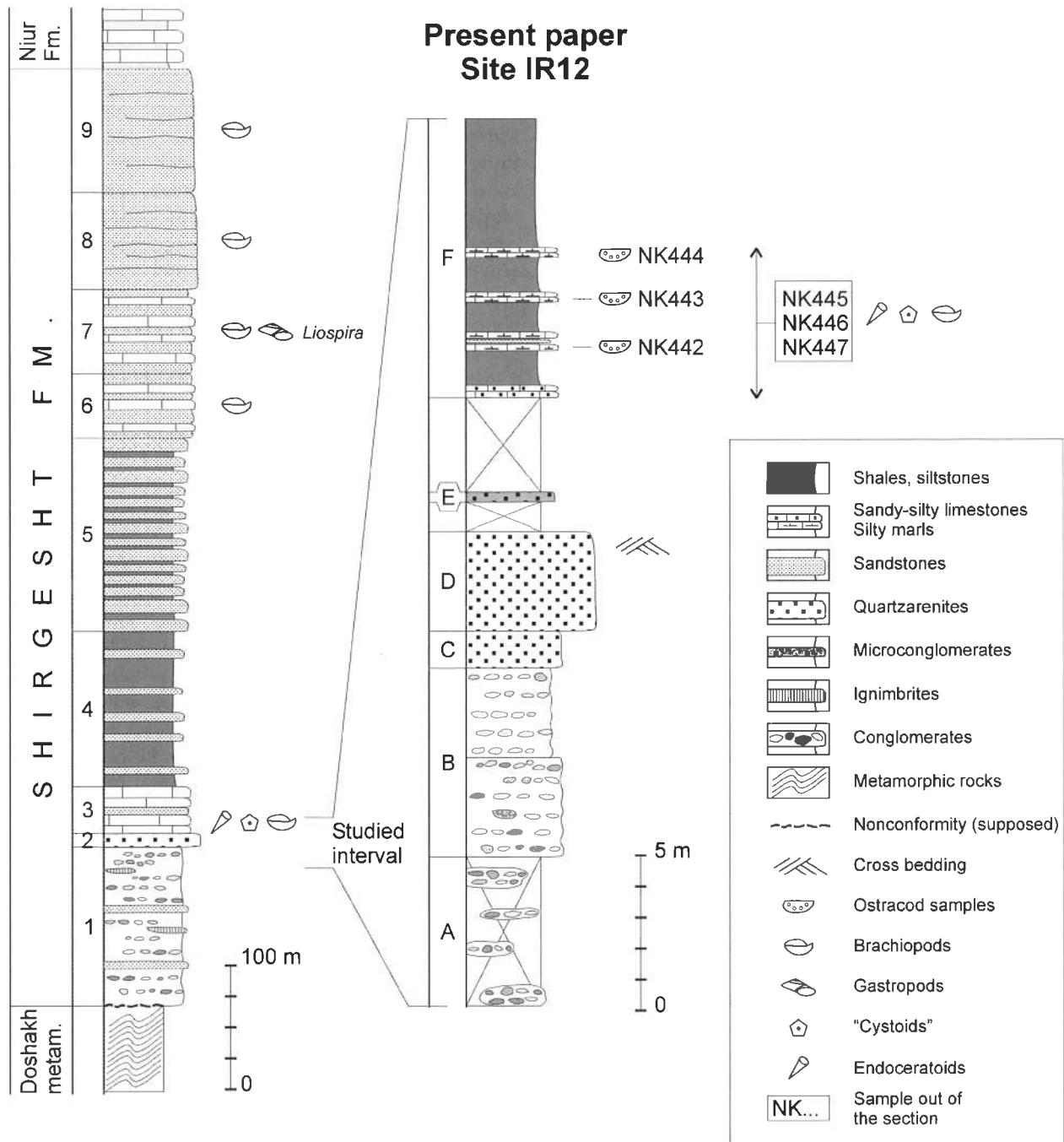
**Fig. 1:** Location map of the studied locality near Anarak, central Iran

A – Structural model of Iran, simplified from ALAVI et al. (1997). B – Road connections of the studied locality. C Geological map of the 1,625 elevation area (redrawn from SUSOV et al. 1984) showing the position of the stratigraphic section 5-6756

**Abb. 1:** Karte der Lokalität in der Nähe von Anarak, Zentraliran

A – Strukturmodell von Iran (vereinfacht nach ALAVI et al. 1997); B – Straßenverbindungen zur untersuchten Lokalität; C – Geologische Karte des Gebietes um die Höhe 1,625 (nachgezeichnet aus SUSOV et al. 1984) die Position des stratigraphischen Profils 5-6756 zeigend

**Sharkovski et al., 1984  
section 5-6756**



**Fig. 2:** Stratigraphic section of the Shirgesht Fm. at the elevation 1,625 near Anarak, central Iran  
A – Complete log of the Shirgesht Formation (from SHARKOVSKI et al. 1984, section 5-6756, p. 25); B – Studied interval exposed at Site IR12, with position of the samples

**Abb. 2:** Stratigraphisches Profil der Shirgesht Formation an der Höhe 1,625 in der Nähe von Anarak, Zentral-Iran  
A – Vollständiges Log der Shirgesht Formation (aus SHARKOVSKI et al. 1984, section 5-6756, p. 25; B – Das am Site IR12 untersuchte Intervall mit der Position der untersuchten Proben

analysis of the Palaeozoic succession was done in the framework of the mapping activities for the 1 : 100,000 and 1 : 250,000 sheets of the Geological Map of Iran, by a team of Russian geologists under contract by the Geological Survey of Iran. An almost complete section (5-6756, 2.4 km E-NE of 1,625 m elevation) covering the interval from the metamorphic rocks of the basement (Doshakh metamorphites) and to the Permian (Fig. 1C) was described (SHARKOVSKI et al. 1984). The overall succession is about 2,800 m thick and displays great similarities with the Palaeozoic succession exposed at the Derenjal Mountains (Shirgesht area: RITTNER et al. 1968) and in the Shotori range (Tabas area: STÖCKLIN et al. 1965). SHARKOVSKI et al. (1984) identified the same eight formations (Fig. 1C) which were dated on the basis of palaeontological determinations of a wide range of fossils, including cephalopods, gastropods, brachiopods, cnidarians, bryozoans and foraminifers. However such a rich and wide palaeontologic database has never been described or illustrated.

The section 5-6756 was visited in November 2004, by a team of stratigraphers, structural geologists and magnetostratigraphers with the purpose to sample biostratigraphically constrained sites for palaeopole analysis. Three sites (IR12, IR14 and IR13) were selected in the lower and lower-middle part of the Shirgesht Formation. Of the three sites, the lowermost (IR12) is fossiliferous and was sampled for conodonts and macrofossils.

The section 5-6756 of SHARKOVSKI et al. (1984) can be reached by car from Anarak along the desert road to Siyah kuh. The mountain without a name of 1,625 m elevation is clearly visible from some km distance, and is a good reference to locate the section 5-6756, whose lower part (Shirgesht Formation: Fig. 2A) is actually exposed on small hills and weakly cut small valleys (Fig. 3). The overall exposure of the Shirgesht Formation is not very good, but the section is not disturbed by tectonics, so that it is possible to move along strike from one outcrop to the next. The total thickness of the formation is 765 m (SHARKOVSKI et al. 1984: 25), and the unit is divided into nine lithologic intervals (text-fig. 2A, 3C; Appendix 1). The lithology is dominated by red to green sandstones and siltstones, with limestones restricted to specific intervals.

The site IR12 (WGS84 coordinates: 33°10'53,8" N – 53°53'37,2" E) is located at the best exposure of the lower part of the Shirgesht Formation (Fig. 3). There, a section was measured and described (Fig. 2B, see also Appendix 2). The lower part of interval F is rather fossiliferous. Endoceratoids, "cystoids", as well as badly preserved brachiopods and trilobites (samples NK445, NK446, NK447) were collected from floats, following the beds along strike. Three samples for conodonts which yielded

the silicified ostracodes were bed-by-bed sampled from the section: NK442, NK443 and NK444.

## Material and methods

The collected samples consist of red-coloured siltstones with partial intercalations of rather thin limestone layers. From sample nos. NK 442, NK 443, NK 444 (text-fig. 2) the calcareous parts were preferentially processed at Modena University using formic acid in order to find conodonts. Instead, silicified ostracodes were obtained and sent to Greifswald for further study. Unfortunately, the whole material was lost in the post, so that only photographs of part of that particular material remained (see also remarks in section Systematic Palaeontology). In a separate parcel, siltstone material was successfully sent to Greifswald and processed with oxygenated water. The residues were sieved with 3.0, 0.5, 0.2, and 0.06 mm mesh size, but only the median and fine fractions of sample NK 443 contained sufficient material for investigative purposes. Picking and sorting of these particular residues resulted in an assemblage of >2,000 specimens of which more than 150 individuals were prepared for SEM study. All specimens are documented as SEM stereo-pair micrographs, since many details are visible on illustrated material only by using this technique. Scale bars on the plates according to SEM data might not be exact in all cases and were checked by comparison with measurements under a binocular using a micrometer scale.

As was stated by WILLIAMS et al. (in GHOBADI POUR et al. 2006) for their material, silicification of the ostracodes is rather coarse so that especially some sculptural features of smaller specimens are lost. Apart from that, some ostracodes appear to be slightly distorted diagenetically which has resulted in a different L:H ratio which may be higher or lower compared to the normal form. The respective taxa, e.g., *Bairdiocypridella*, *Morphobealdia*, and *Brevibolbina*, therefore, may show more slender or higher shapes (Pl. 7 fig. 9, Pl. 9 fig. 5, Pl. 10 fig. 4).

As in other Late Ordovician ostracod faunas, the number of taxa is approximately the same between beyrichiocopes and podocopes, but podocene individuals outnumber by far beyrichicope specimens. However, the observed ratio between beyrichiocopes is largely dependent of the preparation technique. The partly heavily sculptured beyrichiocopes are more attached to the sediment by their sculpture and not as easy to remove from rock as smooth forms by mechanical preparation. Therefore, the percentage between simply sculptured taxa such as many podocopes and more or less strongly sculptured beyrichiocopes is a direct result of the preparation technique applied. Mechanical methods including physico-

chemical treatment favours the over-representation of smooth forms. Also, carapaces are more frequent than valves, because biconvex carapaces are more easily released from the rock than isolated valves.

The paper of MEIDLÁ (1996) serves as a good example for the effect of mechanical preparation. Concerning podocopes this technique permits the study of the important outer carapace characters like valve overlap and incorporated sculptures, but handicaps the observation of internal sculptures such as duplicature, stop-pegs, sulcaments, etc. which are likewise important. Modern methods like that presented, e.g. by SIVETER et al. (2003: 1749) might be helpful in this respect for future studies.

The Anarak fauna is compared with contemporaneous ostracods from Baltica which frequently came from glacial erratic boulders. It is suggested this rather long term be substituted by the term "geschiebe". This term comprises information about origin and transport of the respective material. By contrast, the commonly used terms "erratic boulder" or simply "erratic" are poorly defined since many kinds of non-glacial erratics exist.

The material described herein is housed at the Institute of Geography and Geology of Ernst Moritz Arndt University Greifswald under the series number GG 341. For numbers of the individual specimens see explanation of plates.

## Systematic Palaeontology

*Morphological terminology.* Use and application of morphological terms is outlined in Text-fig. 4 and tables 1–2 supplemented by a short glossary.

### Glossary.

d-line. Diagonal connection of the outermost anterior and posterior ends of a valve.

orientation. The straight-hinged forms are orientated according to the hinge-line, the podocopes normally according to the basis line except for podocopes with a long straight hinge-line (for example, *Steusloffina*, *Brevicornina*, *Neoscaphina*).

Outline. Concerning the position of the greatest height, also in podocene taxa orientated according to the basis line preplete, amplete and postplete outlines are distinguished.

Vecon. Short term for the "ventricular concavity" (HENNINGSMOEN 1965: 385) and "konkave Außenlinie des Ventralrandes" (HARTMANN 1963: 53). Typical for many podocopes (distinct only in smaller, mostly right, valves and weak to missing in overlapping valves). Fairly common in kirkbyocopes but very rarely in palaeocopes (SCHALLREUTER 1982: 103).

**Table 3:** Definition of size / **Tab. 3:** Größendefinition

< 0.50 mm	very small
0.50 – 1.00 mm	small
1.00 – 2.00 mm	median-sized

**Table 4:** Definition of shape (L:H ratio) after HINZ-SCHALLREUTER & SCHALLREUTER (1998: 19) and HINZ-SCHALLREUTER (2006: 362)

**Tab. 4:** Definition der Gestalt (L:H-Verhältnis) nach HINZ-SCHALLREUTER & SCHALLREUTER (1998: 19) und HINZ-SCHALLREUTER (2006: 362)

L : H	term
– 1.25	extremely high
1.25 – 1.45	very high
1.45 – 1.55	high
1.55 – 1.65	rather high
1.65 – 1.75	moderately high
1.75 – 1.85	moderately long
1.85 – 1.95	rather long
1.95 – 2.05	long
2.05 –	very long

Remark: The material of Plate 1 showing different ostracod species of the taxa described below was lost on the post from Italy to Germany (see also Material and methods). These ostracods were obtained from the more calcareous rock samples by formic acid and show better preservation than the ostracods gained from the almost purely siliciclastic rocks by using oxygenated water. Although this material cannot be viewed anymore, its illustration is used to supplement the specific documents.

Order BEYRICHIOCOPA POKORNÝ, 1954

Suborder PALAEOCOPA HENNINGSMOEN, 1953

Infraorder HOLLINOMORPHA HENNINGSMOEN, 1965

Superfamily Eurychilinoidea ULRICH & BASSLER, 1923

Family Eurychilinidae ULRICH & BASSLER, 1923 ULRICH & BASSLER, 1923

Subfamily Ampletochilininae SCHALLREUTER, 1975

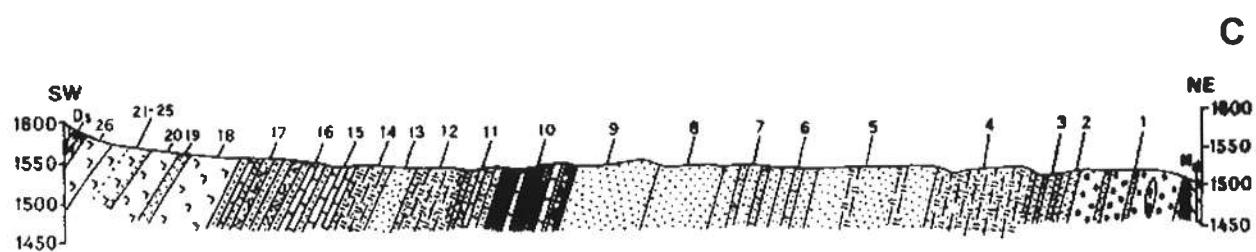
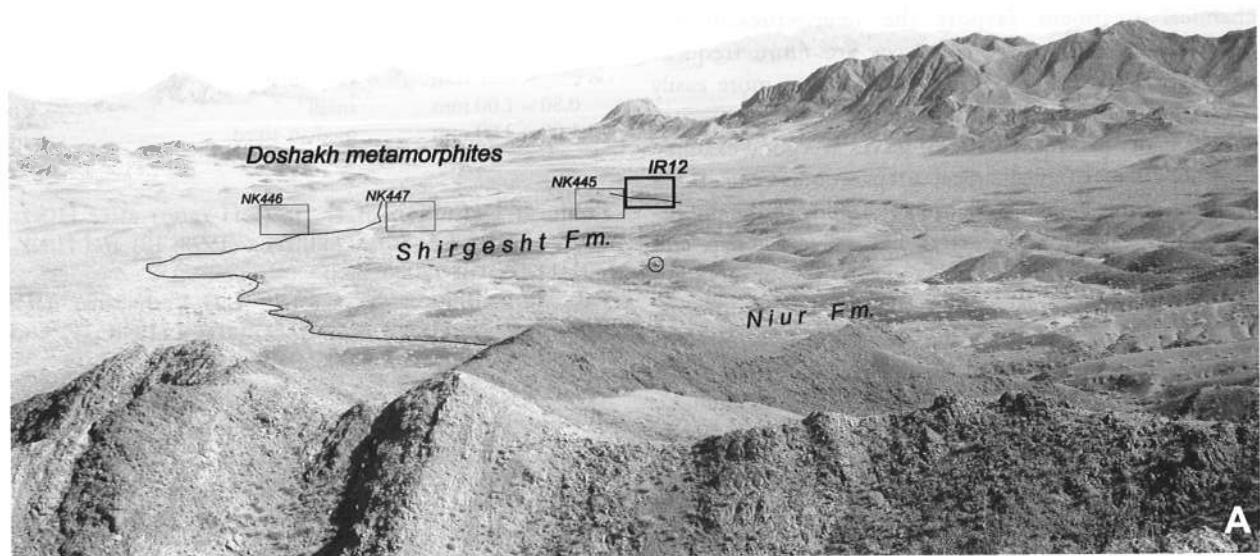
**Ampletochilina** SCHALLREUTER, 1969

**Ampletochilina?** sp. n.

Pl. 3 fig. 5

*Material.* One incomplete valve.

*Description.* The species is larger than 0.71 mm and characterized by an elongate shape, an amplete outline, and a muscle spot that is located in the ventral half of the valve and the outer surface is finely reticulated. A distinct velum is missing.



**Fig. 3:** **A** Landscape view of the lower part of the section 5-6756 (SHARKOVSKI et al. 1984) taken from a point close to the elevation 1,625 m, view towards E-NE. Despite for the very gentle morphology, the beds can be followed along strike for 1 to 2 km. The scale (white circle) is a 4-wheel drive vehicle. The black line on the left shows the trace that was probably followed by SHARKOVSKI et al. (1984) to describe the middle to upper part of the Shirgesht Formation (see Fig. C). The black box on the right shows the best exposure (IR 12) of the lowermost part of the Shirgesht Formation.

**B** Site IR12, general view of the outcrop, with the position of the ostracod samples NK442-444. Letters refer to lithologic intervals of Fig. 2.

**C** “Section of Paleozoic rocks in the area of 1,625 elevation” (= SHARKOVSKI et al. 1984: fig. 6). Shirgesht Formation (Ordovician): 1–9, Niur Formation (Silurian): 10–15.

**Abb. 3:** **A** Landschaftsbild des unteren Teils des 5-6756 (SHARKOVSKI et al. 1984) fotografiert von einem Punkt in der Nähe der Höhe 1,625 m gegen E-NE. Trotz der ruhigen Morphologie können die Schichten 1–2 km im Streichen verfolgt werden. Als Maßstab dient der weiß umrandete Landrover. Die schwarze Linie in der rechten Hälfte zeigt das wahrscheinlich von SHARKOVSKI et al. (1984) zur Beschreibung der Shirgesht-Formation verwendete Profil von Anarak, der rechte schwarze Kasten in der Mitte den besten Aufschluß (IR 12) der Shirgesht-Formation.

**B** Der Site IR12, Überblick über den Aufschluß mit der Position der Proben NK442-444. Die Buchstaben beziehen sich auf die der lithologischen Intervale in der Abb. 2.

**C** “Section of Paleozoic rocks in the area of 1,625 elevation” (= SHARKOVSKI et al. 1984: Abb. 6). Shirgesht-Formation (Ordoviz): 1–9, Niur- Formation (Silur): 10–15.

*Comparison.* The species resembles *A. granifera* SARV, 1962 by its elongate shape and ventral position of the muscle spot but this species possesses a distinct velar flange (SCHALLREUTER 1986b: pl. 1 fig. 8).

Family Oepikiidae JAANUSSON, 1957 emend. POKORNÝ, 1958

***Duringia*** SCHALLREUTER, 1984

***Duringia spinosa*** (KNÜPFER, 1968)

Text-fig. 4; Pl. 1 figs. 1–2, Pl. 2 fig. 1

- 1963 *Eurychilina* – BLUMENSTENGEL, HELMS, KNÜPFER & ZAGORA: 6
- 1968 *Eurychilina spinosa* n. sp. – KNÜPFER: 9, 10, 24, 25; pl. 4 figs. 1a–b
- 1970 *Eurychilina spinosa* KNÜPFER 1968 – JORDAN: 8
- 1973b *Piretia* ? *spinosa* (KNÜPFER 1968) – SCHALLREUTER: 89
- 1980 *Piretia* ? *spina* (Knüpfner, 1968) – QVALE: 94
- 1984a *Duringia spinosa* (Knüpfner, 1968) – SCHALLREUTER: 9–12; pls. 11, 10 and 11, 12
- 1984 *Duringia spinosa* – JONES: 15
- 1986a DURINGIA SPINOSA (KNUEPFER, 1968A) SCHALLREUTER, 1984 B; EURYCHILINA SPINOSA KNUEPFER, 1968 A – KEMPF: 324, 351
- 1986b – dto. – KEMPF: 557
- 1987 – dto. – KEMPF: 761, 501

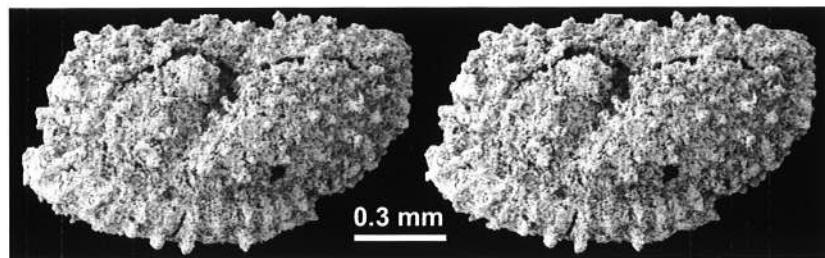
- 1987 *Duringia spinosa* (KNÜPFER, 1968) – SCHALLREUTER: 37
- 1996b *Eurychilina spinosa* KNÜPFER, 1968 = *Duringia spinosa* – SCHALLREUTER: 62
- 1996 *Eurychilina spinosa* KNÜPFER, 1968 – KEYSER & SCHÖNING: 44
- 1997 *Eurychilina spinosa* KNÜPFER, 1968 = *Duringia spinosa* – BLUMENSTENGEL & SCHALLREUTER: 14
- 1998 *Duringia spinosa* – SCHALLREUTER & HINZ-SCHALLREUTER: 347; Tab.1
- 2005 *Duringia spinosa* (KNÜPFER 1968) – BLUMENSTENGEL: 135

*Holotype.* Larval tecnomorphic right valve, Geological Institute, Bergakademie Freiberg, Sachsen no. 45/1024. Catalogue of KEYSER & SCHÖNING 1996: no.1502.

*Type locality.* Middle adit of the former iron-ore mine Gebersdorf, Thuringia; lat. 50° 32' N, long. 11° 17' E; limestone layer (Kalkbank) of the upper layer of the Upper Ore Horizon (Oberes Lager des Oberen Erzhorizontes = uppermost Caradoc, zone 13), Gräfenthal series. *Material.* Four valves (three on stubs).

*Definition.* SCHALLREUTER 1984a: 9.

*Remarks.* The holotype (L 0,79 mm) is a small larva. A fragment of a female with a strongly convex antrum (false brood pouch) was published by SCHALLREUTER for the first time in 1984a (pl. 11, 10 fig. 2). New material has delivered complete females which show the complete extension of the antrum (text-fig. 4).



**Fig. 4:** *Duringia spinosa* (KNÜPFER, 1968). Slightly distorted ♀ left valve (GG-341-1) in lateral view, L 1.20 mm. Limestone layer (Kalkbank) of the Upper Ore Horizon of the former open-pit iron-ore mine Wittmannsgereuth on the „Breiten Berg“ near Saalfeld, Thuringia (BLUMENSTENGEL et al. 1963: 5–7, fig. 1).

**Abb. 4:** *Duringia spinosa* (KNÜPFER, 1968). Leicht verzerrte linke ♀ Klappe (GG-341-1) in Lateralansicht, L 1.20 mm. Kalkbank des Oberen Erzhorizontes des ehem. Tagebaus Wittmannsgereuth auf dem Breiten Berg bei Saalfeld, Thüringen (BLUMENSTENGEL et al. 1963: 5–7, fig. 1).

Superfamily Hollinoidea SWARTZ, 1936  
Family Euprimitiidae HESSLAND, 1949  
Subfamily Euprimitiinae HESSLAND, 1949

#### *Iranomitia* gen. n.

*Derivation of name.* Combination of Iran + *Euprimitia*.

*Type species.* *Iranomitia cecus* sp. n.

*Definition.* Small. Outline rounded-square. Central sulcal depression (S2) with a muscle spot in its centre. Lateral surface in front of S2 slightly inflated. Tecnomorphs without velum. Dolon ridge-like. Lateral surface punctate.

*Comparison.* The type-species of *Euprimitia* ULRICH & BASSLER, 1923, *Primitia sanctipauli* ULRICH, 1894, is only poorly documented. The description and figures of SWAIN & CORNELL (1987: 109; pl. 6, figs. 2a–f) resemble the new genus. The S2 may be strong or developed as a shallow pit only. The figured male (Pl. 6 fig. 2d) lacks velum like *Iranomitia*. The female (Pl. 6 fig. 2a) is “provided with a narrow submarginal frill beginning near midheight on anterior end and extending to midventral region”. By contrast, *Iranomitia* has a velar ridge developed only ventrally and posteroventrally.

#### *Iranomitia cecus* sp. n.

Pl. 3 figs. 1–4

*Derivation of name.* Artificial letter combination, from centrosulcus.

*Holotype.* ♀ right valve GG-341-12a – Pl. 3 fig. 3.

*Material.* >20 valves (13 on stubs).

*Definition.* As for genus which is presently monotypic.

*Description.* Length between 0.48–0.54 mm, shape high to rather high (1.35–1.65). Weak sulcal depression in centre

or slightly in front of it with a ± distinct muscle spot just in its middle. Presulcal part of lateral surface slightly raised in comparison with postsulcal field and very indistinctly divided into a broad, flat preadductor node and a node anteroventrally of preadductor node. Dorsal margin straight or centrodorsally very slightly concave by an indistinct dorsal plica which is formed by elevations of the lateral surface only (distinct in Pl. 3 fig. 1). Lateral surface confluent with ventral surface (tecnomorphs) or forming ventrally a thick, indistinct, bulge-like ridge (females?). Shell of lateral surface punctate. One specimen is 0.66 mm long and more elongate (L : H 1,89); it may represent a male.

Subfamily Gryphiswaldensiinae SCHALLREUTER, 1968b

#### *Geshirtia* gen. n.

*Derivation of name.* Artificially formed from Shirgesht.

*Type species.* *Geshirtia ventrocostata* sp. n.

*Definition.* Small. Unisulcate, with S2 being rather flat. Preadductor node very broad. A dorsal ridge is lacking. The thick, ridge-like velum is rather high at the marginal surface and developed only ventrally. Velum indistinctly set off from the lateral surface. Surface punctuate.

*Comparison.* Concerning the prominent preadductor node *Geshirtia* is similar to *Gryphiswaldenia* SCHALLREUTER, 1965 and *Osiribolbina* SCHALLREUTER, 1998 but differs mainly by its thick velar ridge which is developed and indistinctly set off from the lateral surface. Apart from the velum *G. wilnoiensis* (NECKAJA, 1952) shows a ventrolateral ridge formed by a stronger ridge of the reticulation (SCHALLREUTER 1986b: pl. 2 fig. 4). *Osiribolbina* SCHALLREUTER, 1998 has a distinct but

smaller preadductor node than *Geshirtia* but also has a ventrolateral ridge above the velum (SCHALLREUTER 1998: fig. 1.3). The ventral ridge of *Geshirtia* might be homologous with this ridge (+ velar ridge?).

***Geshirtia ventrocostata* sp. n.**

Pl. 2 figs. 2–3

*Derivation of name.* After the ventral ridge.

*Holotype.* Right valve GG-341-3a – Pl. 2 fig. 2.

*Material.* Three valves on stubs.

*Definition.* As for the genus which is presently monotypic.

***Bolbarakia* gen. n.**

*Derivation of name.* Artificial combination of the genus name *Bolbina* and Anarak.

*Type species.* *Bolbarakia obliqua* sp. n.

*Definition.* Small. Domicilium broadest anteroventrally, flattening in dorsal and posterior directions. S2 developed as sulcal depression in front of and dorsal to centre. Preadductor node in front of S2, flat and indistinct. Velum ridge-like and extending from anterocentral to posteroventral regions parallel to and fairly far distanced to free margin. Velum indistinctly set off from the lateral surface and gradually disappearing at either end.

*Comparison.* The systematic position is presently questionable. The high position of the velum on the marginal surface is known from glossomorphitines. *Bolbarakia* has a velum paralleling the free margin, having a high position already in the anteroventral region and gradually disappearing posteroventrally. By contrast in the glossomorphitine genus *Huckea*, e.g., the velum that is fused with the histium and starts at the anterodorsal corner continuously diverges from the free margin. It is broadest and reaches its greatest height in the posteroventral region (SCHALLREUTER 1975: pl. 30 (9) figs. 1–3). The same refers to *Eolomatella* (SCHALLREUTER 1981: pl. 8, 130). In the new taxon the velum disappears continuously already in the posteroventral region. In contrast to these forms the new taxon has a high velar position in the anteroventral region.

*Bohuckea* SCHALLREUTER & KRÚTA, 2001 from the Letná Formation of Bohemia resembles *Bolbarakia* but differs by its continuous divergence between free margin and velum from the anteroventral region to the posteroventral region (SCHALLREUTER & KRÚTA 2001: pl. 3 figs. 7–8).

***Bolbarakia obliqua* sp. n.**

Pl. 3 figs. 6–9

*Derivation of name.* From Latin *obliquus* referring to the oblique decline of the lateral surface from anteroventral region towards the posterior cardinal corner.

*Holotype.* Right valve GG-341-15b – Pl. 3 fig. 9a–b.

*Material.* 12 valves (six on stubs).

*Definition.* As for genus which is presently monotypic.

**Family Tvaerenellidae JAANUSSON, 1957**

Subfamily Nodambichiliniae SCHALLREUTER, 1967b

***Bichilinoides* gen. n.**

*Derivation of name.* According to the similarity to *Bichilina* SARV, 1959.

*Species.* *Bichilinoides interrupta* sp. n. (type-species), *Laevanotella* sp. nov. WILLIAMS et al., 2001.

*Definition.* Small. Unisulcate, with the S2 being moderately long and extending ventrally until mid-height. Small preadductor node located in front of the ventral part of the S2. Another node is developed behind the dorsal part of the S2. Lateral surface surrounded by a flange-like ridge comprising the entire velum and the dorsal plica which is missing in the centrodorsal part dorsally of the S2. Plica projects more beyond the hinge-line anterodorsally than in the posterior half.

*Comparisons.* The new genus differs from *Bichilina* by the centrodorsal interruption of the circular crista and the node behind the dorsal part of S2.

*Dicranella* ULRICH, 1894 also possess two nodes on both sides of S2 but the nodes are spine-like (name!) and a dorsal plica is missing (SWAIN & CORNELL 1987: pl. 12 fig. 14).

*Laevanotella* MEIDLÁ, 1996 is nonsulcate and lacks nodes (MEIDLÁ 1996: pl. 8 figs. 1–3). This genus resembles *Bichilina* and is best placed within the Tvaerenellinae.

***Bichilinoides interrupta* sp. n.**

Pl. 2 figs. 6–7

*Derivation of name.* After the centrodorsal interruption of the dorsal plica.

*Holotype.* Right valve GG-341-6 – Pl. 2 fig. 6.

*Material.* >30 valves (four on stubs).

*Definition.* As for the genus which is presently monotypic.

*Comparison.* Sexual dimorphism in form of antral dimorphism has not been observed. In *Bichilina* the dimorphism is only weakly expressed and may be completely lost in *Bichilinoides*.

*Bichilinoides* sp. nov. (WILLIAMS et al., 2001) differs by its more distinct anterior node (preadductor node), by its nearly obsolete posterior node, the shorter distance between the preadductor node and the velum and the missing anterior part of the dorsal plica (WILLIAMS et al. 2001: fig. 3h).

Superfamily Tetradelloidea SWARTZ, 1936

Family Tetradellidae SWARTZ, 1936

Subfamily Glossomorphitinae HESSLAND, 1954

Tribe Glossomorphitini HESSLAND, 1954

**Vittella** SCHALLREUTER, 1964a

**Vittella pana** sp. n.

Pl. 1 fig. 4, Pl. 2 figs. 8–9

*Derivation of name.* After the large preadductor node (PAN).

*Holotype.* Dorsally incomplete tecnomorphic right valve GG-341-9 – Pl. 2 fig. 9.

*Material.* 6 tecnomorphic valves and one incomplete female valve (four on stubs).

*Definition.* At least up to 1.23 mm. Narrow S2 with distinct broad preadductor node. Posteroventral lobe relatively low, and terminating into a spine. Velum passing into a distinct plica anterodorsally. Outer surface granulose.

*Comparisons.* The species differs from all other species of the genus by the distinct dorsal plica which is generally rare in glossomorphitines. A posteroventral lobe with spine-like top is known from both *Vittella craspedota* and *V.? jemilandica* (SCHALLREUTER 1983: pl. 18(4) figs. 5–6, pl. 20 (6) figs. 7–8, 10–11).

Very similar is *Vittella ishibimica* (MELNIKOVA, 1986) (Erkevidaikian, early Caradoc; Kazakstan) (MELNIKOVA 1986; pl. 8 figs. 1–2) but differs by its minute preadductor node and a strong posteroventral lobe.

Infraorder PRIMITIOPSIOMORPHA SCHALLREUTER, 1986c

Superfamily Bubnoffiopoidea SCHALLREUTER, 1964b [nov.]

= Signetopsacea ABUSHIK, 1987

Family Bubnoffiopsidae SCHALLREUTER, 1964b

**Bollita** NECKAJA, 1973

**Bollita anarakensis** sp. n.

Pl. 1 fig. 8, Pl. 4 fig. 1

*Derivation of name.* After its occurrence at Anarak.

*Holotype.* Left valve GG-341-19a – Pl. 4 fig. 1.

*Material.* Two valves (on stubs).

*Definition.* At least up to 0.76 mm. S2 developed as a flat pit. L1–L3 (anterior lobe, preadductor node, and posteroventral lobe) more or less distinct. Posterocentrally and posteroventrally a steep ridge-like dolon present, nearly vertical to the dorsal margin.

*Comparison.* *Bollita bellis* NECKAJA, 1973 (= *Hillmeria maeandrica* SCHALLREUTER, 1985) differs strongly by the

lobation, the anteriorly longer dolon and the reticulation/punctuation (SCHALLREUTER 1998: fig. 1.4, 2)

Suborder BINODICOPA SCHALLREUTER, 1972b emend.

SCHALLREUTER, 1978a

Family Bolliidae BOUČEK, 1936

**Klimphores** SCHALLREUTER, 1966

**Klimphores granterionodus** sp. n.

Pl. 4 figs. 5–7

*Derivation of name.* Artificial combination of grandis, Latin great, anterior and nodus.

*Holotype.* Left valve GG-341-23a – Pl. 4 fig. 5.

*Material.* >10 valves (six on stubs).

*Definition.* At least up to 0.34 mm. Anterior node slightly larger than posterior node. A pseudovelum is not developed. No reticulation.

*Comparison.* *K. scanensis* SCHALLREUTER, 1980 also lacks a reticulation but the posterior node is distinctly larger than the anterior node (SCHALLREUTER 1980: pl. 5 fig. 1).

*Klimphores* nov.sp. VANNIER in VANNIER & VASLET, 1988 (Hanadir Mb., Qasim Fm., Llanvirn; central Saudi Arabia) is fairly similar in overall morphology, however, it is much larger (1.45 mm), characterized by a faint ridge with the free margin being slightly concave (VANNIER in VANNIER & VASLET 1988: 9; pl. 1).

**Bullaferum** QVALE, 1980

*Remarks.* SIDARAVIČIENĖ (1992: 164) considered *Bullaferum* a questionable synonym of *Laterophores* SCHALLREUTER, 1968c whereas MEIDLÁ (1996: 83) considers it as a distinct genus. *Laterophores* differs from *Bullaferum* mainly by the missing pseudovelum.

**Bullaferum granodus** sp. n.

Pl. 1 fig. 11

1967a *Laterophores* ? *tapaensis* (SARV, 1959) – SCHALLREUTER: 616

1969a „*Ulrichia*“ *tapaensis* SARV, 1959 – SCHALLREUTER: 204

1986b *Bullaferum iapaeense* (SARV, 1959) – SCHALLREUTER: 24 (1987: 224); pl. 5 [p. 25 (1987: 225)] fig. 4

1987 *Bullaferum tapaensis* (SARV, 1959) – SCHALLREUTER: 30

1989 *Bullaferum tapaensis* (Sarv, 1959) – VANNIER, SIVETER & SCHALLREUTER: 214; Taf.29 (S. 215) Fig. 2 [= SCHALLREUTER 1986a: Taf. 5 Fig. 4 (GPIMH 3409)]

- 1992 *Laterophores?* *tapaënsis* (Sary, 1959) – SIDARAVIČIENĖ: 165 (pars) [probably n. sp.]  
 1992 *Laterophores?* sp. A – SIDARAVIČIENĖ: 165, 246; table 2 (p. 216); pl. 41 fig. 6

**Derivation of name.** Constructed from *grandis* (Latin) great, and anterior nodus.

**Holotype.** Left valve, GG-400-3408 – SCHALLREUTER 1986b: pl. 5 fig. 4; VANNIER, SIVETER & SCHALLREUTER 1989: pl. 29 fig. 2 (L 0.69 mm).

**Type locality.** Braderup, Isle of Sylt, North Sea; geschiebe from the Kaolinsand (Plio-pleistocene).

**Stratum typicum.** Öjlemyr flint, Pirgu- (F1c) or Porkuni Stage (F2).

**Definition.** Length up to 0.97 mm. Anterodorsal node of anterior nodes group strong, comparable to both preadductor and anteroventral nodes.

**Comparison.** SIDARAVIČIENĖ (1992: 165) considered the specimen figured by SCHALLREUTER (1986: pl. 5 fig. 4) as *B. tapaense* as a presumably new species.

The type-species of the genus, *B. tapaense* (SARV, 1959) from F1aβ of Estonia, has only a very small anterodorsal node (SARV 1959: pl. 32 figs.8–12).

The holotype (L 1.19 mm) of *B. forneboensis* QVALE, 1980 from the uppermost Upper Chasmops Limestone of the Oslo-Asker District lacks an anterodorsal node (QVALE 1980: figs. 6, 7a). However, another specimen (QVALE 1980: fig. 7b) shows an anterodorsal node, but the preadductor node is elongate as in the holotype.

From Iran only the lost specimen of this species has been found (Pl. 1 fig. 11). It is very similar to the holotype and the specimen figured by SIDARAVIČIENĖ (1992: pl. 41 fig. 6).

Family Circulinidae NECKAJA, 1966

#### **Pseudobollia** SCHALLREUTER, 1968c

**Type-species.** *Bolla subaequata* ULRICH, 1894 (sensu KAY, 1934) = *Pseudobollia subaequata* SCHALLREUTER, 1968c (according to the ICZN art.11.10).

**Occurrence.** Until now the genus was known only from North America and Wales.

#### **Pseudobollia egregoides** sp. n.

Pl. 5 fig. 3

**Derivation of name.** After the similarity with *Pedomphalella egregia* with regard to the ventral weak portion of the pseudovelum.

**Holotype.** Left valve GG-341-28 – Pl. 5 fig. 3.

**Material.** One valve (on stub).

**Definition.** Posterior node more ventrally located than anterior node. Bulge-like pseudovelum paralleling free

margin between anterior and posterior nodes, ridge only weakly developed ventrally.

**Comparison.** *P. egregoides* is distinct from the type-species by the different ventralwards extent of the nodes and by the pseudovelar ridge that is much weaker and centroventrally rather than to either side (KAY 1934: pl. 44 figs. 6–16; SWAIN & CORNELL 1987: pl. 2 figs.1a–h).

In *P. obsoleta* JONES, 1987 (Llandeilo, Dryslwyn) the pseudovelum is invisible ventrally and only well developed posterodorsally (JONES 1987: pl. 28 figs. 5, 9).

#### **Herrigia** SCHALLREUTER, 1999

##### **Herrigia asiatica** sp. n.

Pl. 1 fig. 3, Pl. 4 fig. 8, Pl. 5 figs. 1–2

**Derivation of name.** After the occurrence in Asia.

**Holotype.** Right valve GG-341-27a – Pl. 5 fig. 1.

**Material.** >30 valves (nine on stubs).

**Definition.** Posterior node elongate and directed obliquely to the straight dorsal margin. Weak ridge extending parallel to free margin from anterior node to posteroventral region where it gradually disappears.

**Comparison.** In *H. gonyloba* (WARSHAUER & BERDAN, 1982) the posterior node is smaller than the anterior node but only weakly oblique to the dorsal margin; the co-marginal ridge is more distinct than in the new species but is not connected with anterior node, and terminates in the ventrocentral region (WARSHAUER & BERDAN 1982: pl. 3 figs. 13–15).

*H. melmerbyensis* (JONES, 1987) differs mainly by its spine-like posterior node (JONES 1987: pl. 24 figs. 10–11).

The type-species *H. besslandi* (HENNINGSMOEN, 1948) from the Black Tretaspis Shale of Sweden differs by its rounded posterior node and a more distinctly developed ridge (HENNINGSMOEN 1948: pl. 25 figs. 5–6).

*H. intermedia* (GAILITE, 1975) has a spine-like posterior node and a distinct ridge which ends abruptly in the posterior region (GAILITE 1975: pl. 2 figs. 1a–b)

#### **Pariconchoprimitia** SCHALLREUTER, 1980

##### **Pariconchoprimitia iranica** sp. n.

Pl. 4 fig. 4, Pl. 5 figs. 6–7

**Derivation of name.** After its occurrence in Iran.

**Holotype.** Left valve GG-341-4b – Pl. 5 fig. 6.

**Material.** >40 valves (five on stubs).

**Definition.** At least up to 0.61 mm. Outline subcomplete or very slightly postplete. Maximum convexity in posterior region, anteriorly less convex, and central regions rather flat.

*Comparison.* *P. conchoides* (HADDING, 1913) is distinctly postplete and has a relatively short straight hinge-line. The valves are equally convex between anterior and posterior ends. By contrast, the new species is characterized by different convex anterior and posterior regions that enclose a flat central part.

*P. coniqua* SCHALLREUTER, 1990b is fairly similar but differs by the straight posteroventral portion of the free margin (SCHALLREUTER 1990: pl. 7 fig. 1).

*Pariconchoprimitia* ? sp. (= *Primitiella* ? sp. MEIDL, 1996) is similar (MEIDL 1996: pl. 21 figs. 10–11) but MEIDL (1996: 107) mentioned R/L-overlap and a marginal ridge at the right valve.

Family Aechminidae BOUČEK, 1936

***Antiaeuchmina*** SCHALLREUTER, 1968c

***Antiaeuchmina*** sp. n.

Pl. 1 fig. 12

*Remarks.* The incomplete specimen figured on Pl. 1 fig. 13 certainly represents a new species of *Antiaeuchmina*. However, since it belonged to the material lost by post and remained the only representative so far, it is only briefly introduced in open nomenclature. Its main characteristic is the long, slender spine which makes it distinct from all other species of *Antiaeuchmina*. The spine in *A. blumenstengeli* PŘIBYL, 1979 from the Lederschiefer clast is only short (SCHALLREUTER 2005: pl. 5 figs. 5–6).

***Baldiscella*** DE GARCÍA, 1975

***Baldiscella anterionoda*** (KNÜPFER, 1968)

Pl. 6 figs. 9–10

- 1968 *Euprimitia* ? *anterionoda* n.sp. – KNÜPFER: 10, 24, 25; pl. 4 figs. 2a–c
- 1970 *Euprimitia* ? *anterionoda* KNÜPFER 1968 – JORDAN: 8
- 1986a EUPRIMITIA ? ANTERIONODA KNUEPFER, 1968 A – KEMPF: 349
- 1986b – dto. – KEMPF: 55
- 1987 – dto. – KEMPF: 501
- 1996b *Euprimitia* ? *anterionoda* KNÜPFER, 1968 – SCHALLREUTER: 62
- 1996 *Euprimitia anterionoda* KNÜPFER, 1968 – KEYSER & SCHÖNING: 44
- 1997 *Euprimitia* ? *anterionoda* KNÜPFER, 1968 – BLUMENSTENGEL & SCHALLREUTER: 14
- 2005 *Euprimitia* ? *anterionoda* KNÜPFER 1968 – BLUMENSTENGEL: 135
- ? 2005 *Antiaeuchmina* ? *anterobulbosa* (BLUMENSTENGEL,

1965) SCHALLREUTER, 1977; *Antiaeuchmina* ? *anterobulbosa anterobulbosa*; *Antiaeuchmina anterobulbosa* (BLUMENSTENGEL, 1965) – SCHALLREUTER: 291–292, 330; table 1 (p. 312); pl. 6 (p. 331) figs. 6, 8 (q. v. p. 291 for further synonymy)

*Holotype.* Right valve, Geological Institute, Bergakademie Freiberg, Sachsen no. 45/1025 – KNÜPFER 1968: pl. 4 fig. 2a–c. Catalogue of KEYSER & SCHÖNING 1996: no. 1498.

*Type locality.* As for *Duringia spinosa* (p. 301).

*Material.* Two valves on stubs.

*Definition.* Length up to 0.51 mm. Preadductorial node bulb-like, located in dorsal half close to straight hinge-line. Pseudovelum developed as a faint ridge-like bend extending from anterodorsal to posterodorsal corner.

*Comparisons.* The type species, *B. originalis* DE GARCÍA, 1975 from the Aguaditas Formation (Llanvirn/Llandeilo) of San Juan, NW-Argentina, is larger (1.00 mm), generally more elongate and has a more slender spine (SCHALLREUTER 1996a: pl. 2 figs. 1–3).

According to KNÜPFER (1968: 10) *Aechminaria anterobulbosa* BLUMENSTENGEL, 1965a differs from *B. anterionoda* by its anterodorsal bulb-like spine. In the holotype (L 0.54 mm) it projects beyond the hinge-line (BLUMENSTENGEL 1965: text-fig. 5, pl. 1 fig. 10; SCHALLREUTER 2005: pl. 6 fig. 8) contrary to another specimen (L 0.46 mm) from the same boulder where the node has a similar position as in the holotype of *B. anterionoda* (SCHALLREUTER 2005: pl. 6 fig. 6). The two specimens from Iran are very small (0.38 and 0.32 mm) and the node has an even more central position, which may suggest an ontogenetic shift of the node from a central to a more anterior position. The presently available material is however, insufficient to contribute to the question whether or not the two nominal species are synonymous.

***Postceratia*** SCHALLREUTER & HINZ-SCHALLREUTER, 1998

*Type species.* *Pseudulrichia posterocerata* BLUMENSTENGEL, 1965a.

*Definition.* Small to median-sized. Anterior node developed as a small node. Anterior of the latter is located a ± distinct bulb or ridge which may also incorporate the anterior node. Posterior node occurs as a spine in centro- or posterodorsal region.

*Comparison.* *Postceratia* differs from all aechminids by the presence of an anterior bulb. The posterior spine-like node changes from posterodorsal region in smaller larvae to the centrodorsal region in adults. This ontogenetic shift has not been observed on other aechminids.

**Postceratia posterocerata** (BLUMENSTENGEL, 1965)  
Pl. 1 figs. 5–7, Pl. 6 figs. 1–3

Synonym: *Parulrichia?* *tubulata* NECKAJA, 1966

- 1966 *Parulrichia?* *tubulata* Neckaja, sp. n. – NECKAJA: 32–33, 86; tab. 2; pl. 5 figs. 5, 10  
 1983 *Parulrichia?* *tubulata* Neckaja – ABUSHIK & SARV: 112, 133; tab. p. 103; pl. 3 fig. 3  
 1985 *Pseudulrichia tubulata* (Neckaja) 1966 – SZTEJN: 57, 72; tabs. 1–2; pl. 4 fig. 6  
 1986a PARULRICHIA? TUBULATA NECKAJA, 1966 A – KEMPF: 582  
 1986b – dto. – KEMPF: 615  
 1987 – dto. – KEMPF: 473  
 1987 *Postceratia posterocerata* BLUMENSTENGEL, 1965 – JONES: 86  
 1992 *Pseudulrichia tubulata* (Neckaja, 1966) – SIDARAVIČIENĖ: 166, 167, 246; tab. 2 (p. 216); pl. 42 figs. 1–3  
 1995a PSEUDULRICHIA TUBULATA (NECKAJA, 1966 A) SZTEJN, 1985 A – KEMPF: 196  
 1995b – dto. – KEMPF: 177  
 1995c – dto. – KEMPF: 95  
 1996 *Pseudulrichia?* *tubulata* (Neckaja, 1966) – MEIDL: 85; fig. 12, 14, 17, 19, 24 (faunal logs); tab. 9 (p. 208), pl. 16 fig. 3  
 1996 *Pseudulrichia tubulata* (Neckaja, 1966) – SIDARAVIČIENĖ: 25; figs. 3–4, 6–9, 11 (faunal logs); tabs. 7–8, 9 (p. 29), 10 (p. 32), 11 (p. 37)  
 2005 *Postceratia tubulata* (NECKAJA, 1966) – SCHALLREUTER: 292  
 2005 *Postceratia posterocerata* (BLUMENSTENGEL, 1965) SCHALLREUTER & HINZ-SCHALLREUTER, 1998 – SCHALLREUTER: 292, 328; table 1 (p. 312); pl. 5 (p. 329) figs. 1–4 (p. 292 further synonymy)

*Holotype.* See SCHALLREUTER 2005: 292.

*Material.* >20 valves (nine on stubs).

*Definition.* See SCHALLREUTER 2005: 292.

*Comparison.* In the largest specimens (=1.00 mm) the anterior bulb is very distinct and the spine is situated in the posterior centrodorsal region. In smaller valves (0.59–0.49 mm) the spine is located in the posterodorsal region close to or directly at the posterodorsal corner and the anterior bulb is weaker than in adult specimens to indistinct. In the Thuringian type specimens (0.47–0.71 mm) the bulb is rather weak. Apparently during ontogeny the spine moves towards the centrodorsal region and the anterior bulb becomes gradually stronger. It is strongly developed first in the last instars and adults. Therefore, the specimens of the Thuringian type series represent larvae only, as do all Baltic specimens described as *Po. tubulata*, although more than 100 specimens are known

from some localities (SZTEJN 1985: 72, SIDARAVIČIENĖ 1992: 166). The Baltic specimens for which the dimensions were given range between 0.42–0.69 mm length.

The anterior bulb of *Po. tubulata* is not recognizable on the figures of both the holotype and the paratype of NECKAJA (1966: pl. 5 figs. 5, 10) but NECKAJA (1966: 33) mentioned the anterior bulb (“vystup”), presumably the reason for placing the species originally in *Parulrichia*. The bulb is distinct in figures by ABUSHIK & SARV (1983: pl. 3 fig. 3), SIDARAVIČIENĖ (1992: pl. 42 fig. 1), and MEIDL (1996: pl. 16 fig. 3). The differences to the specimens of the type-series of *Po. conicerata* are so weak that *Po. tubulata* is regarded as synonym of *Po. conicerata*.

The older *Postceratia ventadorni* (VANNIER, 1986), Llandeilo, Massif Armorican, is characterized by a longer, more slender spine and a ridge-like, rather flat anterior protuberance that does not extend beyond the free margin (VANNIER 1986, pl. 8 figs. 1–2).

*Postceratia albacea* (SCHALLREUTER & LEHNERT, 1993) is more elongate and the spine (posterior node) is situated in the centrodorsal region. The anterior node is located at some distance from anterior end and developed as a small node in front of a weak sulcus. An anterior bulb is lacking (SCHALLREUTER & LEHNERT 1993: pls. 20, 110 and 112). *Occurrence.* Estonia: Oandu – Nabala (MEIDL 1996), Lithuania: Keila – Vormsi (SIDARAVIČIENĖ 1996), East Prussia: Oandu – Pirgu (SZTEJN 1985), Podolia: Molo-dovo Fm. (ABUSHIK & SARV 1983), Thuringia: Lederschiefer clast (BLUMENSTENGEL 1965a).

#### Family Spinigeritidae SCHALLREUTER, 1980

##### *Conchoprimitiella* SCHALLREUTER, 1980

*Conchoprimitiella discriminata* sp. n.  
Pl. 6 figs. 6–7

*Derivation of name.* Discrimen, from Latin: difference; after the different cardinal angles.

*Holotype.* Right valve GG-341-36 – Pl. 6 fig. 6.

*Material.* Seven valves (two on stubs).

*Definition.* At least up to 1.06 mm. Anterior cardinal angle > posterior cardinal angle. Strongest convexity anteriorly. Transverse profile flat-semicircular.

*Comparison.* The Baltic type species, *C. eremita* SCHALLREUTER, 1980 from the Sularp Shale (Late Ordovician) of Scania, has equally large cardinal corners and a rounded-triangular transverse profile (SCHALLREUTER 1980: pl. 4 fig. 4).

In *C. schnelsensis* SCHALLREUTER, 1990a from a Middle Ordovician Rogö Sandstone geschiebe of Hamburg the differences between the cardinal corners are much larger and the valves are posteriorly more strongly convex than anteriorly (SCHALLREUTER 1990a: figs. 6.1–2).

*C. dyfedensis* JONES, 1987 and *C. papilalata* JONES, 1987 from the Llandeilo and Caradoc of Dyfed (Wales) differ from the new species by the clearly postplete outline and their distinct fingerprint-like reticulation (JONES 1987: pl. 29 figs. 1, 5, 10–11, 13–20).

***Opisthoplax*** KUMMEROW, 1943

***Opisthoplax anarakensis* sp. n.**  
Pl. 6 fig. 8

*Derivation of name.* After its occurrence at Anarak.

*Holotype.* Right valve GG-341-16b – Pl. 6 fig. 8.

*Material.* A single valve on stub.

*Definition.* At least up to 0.50 mm. With relatively weak postplete outline. Anterior cardinal angle only little larger than 90°, posterior cardinal angle somewhat larger than anterior one. Posterior margin flattened.

*Comparison.* The species represents the first Ordovician species of the otherwise Silurian-Devonian genus. Both, the type-species *O. compressa* KUMMEROW, 1943 from the Graptolithengestein (“graptolithic rock” geschiebes of Northern Germany, Wenlock/Ludlow) and *O. gerhardi* SCHALLREUTER, 2000 from the Wenlock or early Ludlow of the Lindener Mark (Germany) have larger cardinal angles and very pronounced postplete outlines (KUMMEROW 1943: pl. 2 fig. 8; SCHALLREUTER 2000: figs. 5–6). In *O. subcompressa* ABUSHIK, 1968 and *O. gyratus* ABUSHIK, 1968 from the Early Devonian (Gedinnian) of Podolia both anterior and posterior margins are flattened (ABUSHIK 1968: pl. 1 figs. 7–10; 1971: pl. 3 figs. 1–5).

Suborder LEIOCOPA SCHALLREUTER, 1973a  
Family Aparchitidae JONES in CHAPMAN, 1901

***Baltonotella*** SARV, 1959

***Baltonotella angustovelata*** (BLUMENSTENGEL, 1965a)  
Pl. 4 figs. 2–3

2005 *Baltonotella angustovelata* (BLUMENSTENGEL, 1965)  
comb. n. – SCHALLREUTER: 299, 332; table 1  
(p. 312); pl. 7 (p. 333) figs. 1–4 (q. v. p. 301 for  
further synonymy)

*Holotype.* See SCHALLREUTER 2005: 299.

*Material.* >20 valves (three on stubs).

*Definition.* See SCHALLREUTER 2005: 299.

*Remarks.* The orientation is problematical because the species is nonsulcate and a muscle spot is not visible. Here the valve with the marginal ridge (Pl. 4 fig. 3) is considered as the left valve which is overlapped by the

larger right valve (Pl. 4 fig. 2) as in similar species. In the revision of the first author (2005) the species has been orientated vice versa according to the original orientation of BLUMENSTENGEL (1965).

*Comparisons.* See SCHALLREUTER 2005: 299.

Order PLATYCOPA Sars, 1866

Suborder KLOEDENELLOCOPA SCOTT in BENSON et al., 1961

Superfamily Kloedenelloidea ULRICH & BASSLER, 1908

Family Monotioleuridae GUBER & JAANUSSON, 1964

***Foveaprimitiella*** SCHALLREUTER, 1972a

***Foveaprimitiella* ? sp. n. A**  
Pl. 2 fig. 4

*Material.* A single valve on stub.

*Remarks.* The species differs from the type-species *F. dactyloscia* SCHALLREUTER, 1972 from Öjlemyrflint geschiebes by its higher shape, an amplete outline and by its irregularly tuberculate ornamentation instead of the typical fingerprint reticulation (SCHALLREUTER 1972: fig. 6).

Order PODOCOPA SARS, 1866

Suborder METACOPA SYLVESTER-BRADLEY in BENSON et al., 1961

Superfamily Bairdiocypridoidea SHAVER in BENSON et al., 1961

Family Balticellidae SCHALLREUTER, 1968d

Subfamily Steusloffininae SCHALLREUTER, 1984b

***Steusloffina*** TEICHERT, 1937

***Steusloffina nudaplex* sp. n.**  
Pl. 5 figs. 8–9

*Derivation of name.* Composed of nudus (Latin) naked and simplex (Latin) simple.

*Holotype.* Right valve GG-341-31 – Pl. 5 fig. 8.

*Material.* 9 valves (5 on stubs).

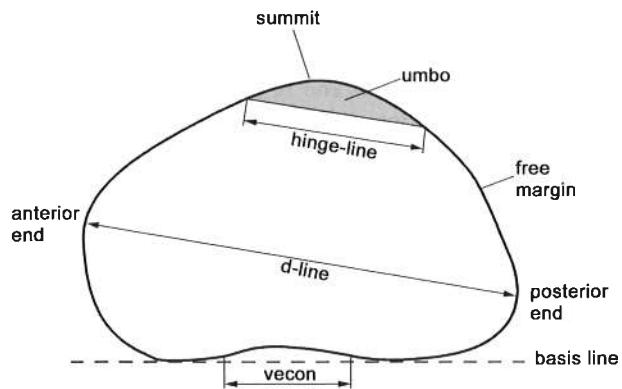
*Definition.* At least up to 1.05 mm. Centrolateral portion only very weakly inflated. A lateral spine is lacking.

*Remarks.* At least the right valve shows a feature that suggests the presence of a spine or stragulum similar to *Steusloffina cuneata* (SCHALLREUTER 1968d: fig. 13.1). WILLIAMS et al. (2001: fig. 2) mentioned *Steusloffina cuneata* from the Cautley Mudstone Formation, but the figured specimen (Fig. 3t) is considered herein as *Tricornina cf. baehnli* BLUMENSTENGEL, 1965a.

*Comparison.* *S. ampla* MELNIKOVA, 1986 from the Caradoc and Ashgill of Kazakhstan resembles the new species in

**Fig. 5:** Morphological terms used for podocope description

**Abb. 5:** Für die Beschreibung der Morphologie der Podocopa verwendete Termini



the missing lateral spine but differs by its stronger centrodorsal inflation (MELNIKOVA 1986: pl. 24 figs. 3–5). Larger specimens of *Steusloffina cuneata* show much stronger central inflation than the new species (SCHALLREUTER 1968d, figs. 12, 13.1, 3, 8).

Family Bairdiocyprididae SHAVER in BENSON & al., 1961  
= Longisculidae NECKAJA, 1966

**Bairdiocypridella** BLUMENSTENGEL, 1965a

Synonym: ? *Macrocyprides* SPIVEY, 1939

**Remarks.** In outline and mainly the presence of a “subvertical ridge” on “interiors of valves” which “probably represents median sulcus” (SWAIN et al. 1961: 371; see also SWAIN 1962: 740) *Macrocyprides trentonensis* (ULRICH, 1894) resembles *B.* (comp. Pl. 7 fig. 8 and SWAIN et al. 1961: pl. 50 fig. 5d or BURR & SWAIN 1965: pl. 6 fig. 33). The type-species of *Macrocyprides* SPIVEY, 1939, *M. clermontensis* SPIVEY, 1939 from the Maquoketa Shale (Upper Ordovician) of Iowa, seems to lack such a sulcament (SWAIN in BENSON et al. 1961: fig. 310A.9b) although SWAIN (1962: 740) mentioned it in the generic diagnosis. Based on the present state of knowledge *M. trentonensis* is assigned in *Bairdiocypridella*. Whether or not the latter is a younger synonym of *Macrocyprides* needs further investigation.

*Bairdiocypridella* also resembles in outline *Pullillites* but the type-species, *P. triangulum* ÖPIK, 1937, is posteriorly less pointed (ÖPIK 1937: pl. 13 fig. 25).

**Bairdiocypridella bairdiaformis** BLUMENSTENGEL, 1965a  
Pl. 7

2005 *Bairdiocypridella bairdiaformis* BLUMENSTENGEL, 1965;  
*Bairdiocypridella bairdiaformis* – SCHALLREUTER: 306–  
307, 340, 342; table 1 (p. 312); pl. 11 (p. 341)  
figs. 1–5, pl. 12 (p. 343) fig. 6 (q. v. p. 306 for  
detailed synonymy)

**Holotype.** Left valve – BLUMENSTENGEL 1965: pl. 2 figs. 29–30.

**Material.** >100 valves (16 on stubs).

**Definition.** At least up to 2.01 mm. Maximum height slightly before centre. Dorsal margin strongly convex, free margin slightly convex ventrally, right valve often with a vecon. Posterior end ventrally pointed.

**Remarks.** The species varies concerning shape and outline, and also the position of the sulcament seems to be variable. The shape values range <1.67 and >2.06 (Pl. 7 figs. 3–4; holotype 1.67). The posterior end is distinctly pointed in the holotype as well as in many specimens from Iran (e.g. Pl. 7 figs. 1–2). The anterior end is broadly rounded in the holotype comparable to Pl. 7 fig. 3. Other specimens are less broadly rounded having the anterior-most end inclined ventrally (Pl. 7 fig. 1). Furthermore, the posterodorsal margin may not be evenly curved but developed with an angle (Pl. 7 fig. 1) which is missing in the holotype.

The sulcament (interior adductor ridge) is placed in the holotype behind the summit of the dorsal margin (BLUMENSTENGEL 1965: pl. 2 fig. 29). This is in accord with the few specimens from Iran where this feature is not hidden by sediment particles stuck to the inner valve surface (Pl. 7 figs. 6–8). A single specimen, however, has the sulcament directly below the summit (Pl. 7 fig. 9). Since it is less pointed posteriorly, it may represent another species.

**Longiscula** NECKAJA, 1958

**Longiscula** sp. A  
Pl. 9 fig. 7

**Material.** A single valve on stub.

**Description.** Up to 1.21 mm. Shape rather long. Dorsal margin broadly convex, summit at about mid-length; anterior half more broadly rounded than posterior one. Posteriormost end near mid-height. Outer lateral surface finely porate.

*Comparison.* In the Baltic type-species, *L. arcuaris* NECKAJA, 1958, anterior and posterior halves of the valve are less symmetrical, the anterior end is more narrowly rounded than the posterior one with the latter not being pointed (NECKAJA 1958: pl. 3 fig. 1). *L. loknensis* NECKAJA, 1958 is more similar concerning lateral outline, but the outer surface is more sculptured and the posterior end may be more spine-like in its development (NECKAJA 1958: pl. 3 fig. 3; MEIDLÀ 1993: figs. 2.13–14).

In *Bairdiocypridella bairdiaformis* the dorsal margin is narrowly rounded, the posterior end more pointed and located closer towards the basis line.

***Longiscula venterconvexa* sp. n.**

Pl. 8 figs. 1–3

*Holotype.* Right valve GG-341-38b – Pl. 8 fig. 1.

*Material.* Three valves on stubs.

*Definition.* Up to 0.93 mm. Shape mostly rather long to long. Broadly convex dorsal margin and with summit being shifted slightly anteriorly. Convex ventral margin distinctly asymmetrical, without vecon. Anterior margin broadly rounded, posterior margin more narrowly rounded and pointed near ventral margin.

*Remarks.* Most species of *Longiscula* have a distinct vecon. Some similarity exists to *L. parrectis* NECKAJA, 1958 (NECKAJA 1958: pl. 3 fig. 5; MEIDLÀ 1993: fig. 1.9–15).

*Comparison.* The new species resembles *Bairdiocypridella bairdiaformis* but differs by its more elongate shape which occurs in *B. bairdiaformis* uncommonly (Pl. 7 fig. 9). Other differences refer the missing vecon (either valve) and the more broadly rounded dorsal margin.

***Longiscula posteroangulata* sp. n.**

Pl. 9 figs. 8–9, ? Pl. 11 fig. 7

*Holotype.* Left valve GG-341-55b – Pl. 9 fig. 8.

*Material.* Two valves on stubs.

*Definition.* Up to 1.16 mm (? 1.49 mm). Shape moderately long (to rather long?). Anterior and posterior halves of the valve almost symmetrical except for the angular development of the posteroventral region. Ventral margin straight to very weakly concave Centroventrally.

*Remarks.* The larger specimen is more elongate, more asymmetrical in lateral view and posteroventrally more pointed (Pl. 9 fig. 9). The material on hand is insufficient to decide whether these differences are the result of ontogenetical changes, intraspecific variation or species characters.

*Comparison.* The species resembles *L. parrectis* NECKAJA, 1958 but the posterior end is narrowly rounded in *L. posteroangulata* (op. cit.: pl. 3 fig. 5).

Similar is also the late Ordovician *L. praelonga* (STEUSLOFF, 1895) [= *L. porrecta* MEIDLÀ, 1993; SCHALLREUTER

& HINZ-SCHALLREUTER 2005: 604) which is, however, posteriorly more broadly rounded than the new species (MEIDLÀ 1993: figs. 2.5, 9).

***Longiscula* sp. D**

Pl. 1 fig. 14; Pl. 8 figs. 10–11

*Material.* Two valves on stubs.

*Description.* Up to 1.21 mm. Shape rather high to moderately long. Dorsal margin broadly convex and asymmetrically developed with a summit which is located more anteriorly. Anterior and posterior margins broadly rounded, posterior margin slightly narrower. Weak vecon.

*Comparison.* *L.* sp. A is more elongate and the posterior margin more pointed. *L. venterconvexa* lacks a vecon and

*L. posteroangulata* has an angular posteroventral extremity rather than a well-rounded free margin in this region.

***Longiscula* sp. E**

Pl. 8 figs. 7–8, Pl. 11 figs. 5–6

*Material.* Five valves on stubs.

*Description.* Up to 1.15 mm. Shape moderately long. Dorsal margin highly convex with summit at about mid-length. Both anterior and posterior margins equally and broadly rounded. No vecon.

*Comparison.* In *L.* sp. D the dorsal margin is somewhat asymmetrical by the slightly off-centre summit. Anterior and posterior margins are slightly narrower with their points of maximum lateral extension shifted towards the basis line.

***Elliptocyprites* SWAIN, 1962**

***Elliptocyprites* sp. A**

Pl. 8 fig. 11–12, Pl. 11 fig. 9

*Material.* Three valves on stubs.

*Description.* At least up to 1.12 mm. Shape long. Dorsal margin broadly convex with central summit. Both anterior and posterior margins equally and broadly rounded with their points of maximum lateral extent located near mid-height in the same distance.

**? *Platyrhomboides* HARRIS, 1957**

***Platyrhomboides* sp. A**

Pl. 8 fig. 5

*Material.* A single valve on stub.

*Description.* Length at least up to 0.53 mm. Shape long to very long. Dorsal margin long and nearly straight extending slightly oblique to basis line with greatest height in

posterior half. Anterior margin broadly rounded, posterior margin more narrowly rounded; maximum lateral extent near mid-height. Together with the lateral surface the narrow ventral surface forms a distinct, rounded bend.

**Remarks.** Internal views of *Platyrhomboides* species described from Baltica proved to represent homeomorphic characters of two different genera belonging to different suborders, e.g., *Inisylthere* (suborder Cypridocopa) with an inner lamella and *Revivylthere* (suborder Metacopa) with two stop-pegs in the left valve. Since the inner sculptures of the type-species of *Platyrhomboides* are unknown it is unclear which of the two genera *Platyrhomboides* is synonymous with. Because this is the same situation in the species from Iran it is placed in that genus.

#### *Olbianella* MEIDLÁ, 1996

##### *Olbianella* sp. A

Pl. 8 fig. 4

**Material.** Two valves (one on stub).

**Remarks.** The species is rather strongly convex with its maximum development in the dorsal half. Anterior and posterior margin are equally rounded with their maximum lateral extent just below mid-height.

**Comparison.** The type-species, *Olbia fabacea* PRANSKEVIČIUS, 1972, is less convex than the specimens from Iran and the maximum convexity seems to be more centrally located (MEIDLÁ 1996: pl. 22 figs. 8–10).

##### *Olbianella*? sp. B

Pl. 10 fig. 7

**Material.** Two valves (one on stub).

**Remarks.** The species is characterized by its striking lateral asymmetry with greatest height in anterior half. In this respect, the certain representatives known of the genus are nearly symmetrical. The specimen from Iran might therefore belong to another genus which, however, requires further study of more material.

#### *Parasclerites* SWAIN, 1962

##### *Parasclerites* sp. aff. *lamellosus* SWAIN, 1962

Pl. 10 figs. 8–10

**Material.** More than 50 valves (four on stubs).

**Remarks.** This rather common species resembles *P. lamellosus* SWAIN, 1962 which is of about the same size (SWAIN 1962: pl. 111 fig. 6).

##### *Parasclerites* sp. aff. *elongatus* SWAIN, 1962

Pl. 8 fig. 6

**Material.** A single valve on stub.

**Remarks.** This species is more elongate than *P. sp. aff. lamellosus* and resembles more the holotype of the type-

species *P. elongatus* SWAIN, 1962 but in *P. sp. aff. elongatus* the dorsal and ventral margins are less parallel to each other (SWAIN 1962: pl. 111 fig. 5b).

#### *Parasclerites* sp. A

Pl. 10 fig. 10, Pl. 11 fig. 8

Size at least up to 0.56 mm. Outline rounded-rectangular, dorsal and ventral margins (without vecon) nearly parallel to each other. Vecon weak. Anterior end closer to basis-line than posterior end.

Superfamily Tricorninoidea BLUMENSTENGEL, 1965b

Family Tricorninidae BLUMENSTENGEL, 1965 emend. SCHALLREUTER, 1966

#### *Tricornina* BOUČEK, 1936

##### *Tricornina haehneli* BLUMENSTENGEL, 1965a

Pl. 1 fig. 10, Pl. 5 fig. 10

1986 Ovornina (Tricornella) haehneli (Blumenstengel, 1965) – MELNIKOVA: 63

2005 *Tricornina haehneli* BLUMENSTENGEL, 1965 – SCHALLREUTER: 301–302, 334, 342; text-fig. 3; table 1 (p. 312); pl. 8 (p. 335) figs. 10–12, pl. 12 (p. 343) fig. 7 (p. 301 further synonymy)

**Material.** A single valve on stub.

**Definition.** See SCHALLREUTER 2005: 301.

**Remarks.** The specimen figured by MEIDLÁ (1996: pl. 21 figs. 2–3) as *Gotlandina caudica* seems to represent a new species of *Tricornina* which differs from *T. haehneli* by the flattened anterior and posterior margins.

The specimen figured by WILLIAMS et al. (2001: fig. 3) as *Steusloffina cuneata* is considered here as *Tricornina* cf. *haehneli*.

**Comparisons.** *T. ancoralis* (MELNIKOVA, 1986) (Dulankarinskian horizon, late Ordovician; Kazakhstan) differs mainly by the more pointed posterior half and the stronger ventrolateral spine (MELNIKOVA 1986: pl. 11 fig. 4).

**Occurrence.** Iran: upper Shirgesht Fm., Thuringia (Kalkbank, Lederschiefer clasts). Sardinia (unpubl.).

#### *Brevicornina* GRÜNDEL & KOZUR, 1972

**Definition.** Small. Outline tricorninid. Ends indistinctly flattened. Ventrolateral sculpture as a bend or ± broad ridge.

**Remarks.** *Brevicornina* has been defined for species with a tricorninid outline and a ventrolateral sculpture developed only as an indistinct bend (SCHALLREUTER 2005: 304). The relatively rich material of *B. brevis* from the sample NK 443 shows variation in the ventral sculpture that may

be developed as a bend, ridge or even a small flange. This variation suggests an extension of the definition of *Brevicornina*.

**Comparison.** *Brevicornina* now also includes species with a ventrolateral ridge. A ventrolateral ridge now recorded from *Brevicornina* is developed also in *Margoplanitia ventrocosta* (name!) but larval stages of the latter species have only a posteroventral spine as in the type-species of *Margoplanitia*, *Ovornina brevispina* (KNÜPFER 1968: Pl. 3 figs. 1–2). In adults of *M. ventrocosta* the ridge shows a weak cone-like protuberance posteroventrally, most likely the remainder of a larval spine (SCHALLREUTER 2005: pl. 8 figs. 1–2).

In contrast to *Margolanitia*, all ontogenetic stages of *Brevicornina* have the ventrolateral sculpture developed as a bend or ridge. This refers also to *Margolanitia wittmannsgereuthensis* SCHALLREUTER, 2005 which is therefore, assigned to *Brevicornina*.

*Steusloffina? caudica* NECKAJA, 1966 which was assigned by SIDARAVIČIENĖ (1992: 203) to *Gotlandina* seems to be another species of *Brevicornina*. The characteristic features for the new assignment are recognizable on SIDARAVIČIENĖ's figures (1992: pl. 53 figs. 5–7).

#### ***Brevicornina brevis* (BLUMENSTENGEL, 1965a)**

Pl. 1 fig. 9, Pl. 5 fig. 5, Pl. 10 figs. 1–6

2005 *Brevicornina brevis* (BLUMENSTENGEL, 1965) GRÜNDL & KOZUR, 1972 – SCHALLREUTER: 304, 334; table 1 (p. 312); pl. 8 (p. 335) figs. 7–9; (q. v. p. 304 for further synonymy)

Material: 50 valves (10 on stubs).

**Holotype.** See SCHALLREUTER 2005: 304

**Definition.** Up to 0.88 mm long. Lateral surface above the ventrolateral ridge or bend slightly convex.

**Remarks.** The variation in this species is rather great and apparently influenced by preservation. The variation refers to shape (L:H ratio; Pl. 10 figs. 4–5), outline, length and development of the ventrolateral sculpture (bend or a ± strong ridge) which handicaps comparison to some extent.

The specimen GG-341-56a (Pl. 10 fig. 1) is most similar to the holotype with the ventrolateral sculpture developed as a bend only. Between this specimen and a specimen with a broad ridge (Pl. 10 fig. 6) exist all transitions showing the extensive variation in this respect (Pl. 10 figs. 2–5). Most specimens have a tricorinid outline like the holotype, i. e. subamplete with the posterior end more pointed than the anterior end. Other features are outlined below.

With a L:H ratio of 2.60 one specimen (Pl. 10 fig. 4) distinctly exceeds normal shape, which may be the result

of weak diagenetic compression. The valve has an amplete outline with only slightly pointed posterior and with distinct ventrolateral ridge. Another, smaller specimen (Pl. 10 fig. 3) differs from typical representatives by a higher, less pointed posterior end resulting in a subamplete outline and the formation of a vecon in the left (l.) valve. Additionally a weak ventrolateral bend is developed. Whether or not these extreme variants represent two or more species requires detailed study of more material.

**Comparison.** *Brevicornina wittmannsgereuthensis* (SCHALLREUTER, 2005) differs from *B. brevis* mainly by its flat, less convex lateral surface (SCHALLREUTER 2005: fig. 4).

#### ***Neoscaphina* MELNIKOVA, 1982**

##### ***Neoscaphina pseudopennae* sp. n.**

Pl. 5 fig. 4

**Derivation of name.** Referring to the similarity to *N. pennae* SCHALLREUTER, 1996a.

**Holotype.** Left valve GG-341-29 – Pl. 5 fig. 4.

**Material.** A single valve on stub.

**Definition.** At least up to 0.78 mm. Distinctly postplete, inflated part of the domicilium amplete. Dorsal margin straight. Centroventral region straight and oblique to the dorsal margin. Anterior end only weakly flattened.

**Comparison.** The new species is very similar to *Neoscaphina pennae* (SCHALLREUTER, 1996a) from the Llanvirn/Llanello of Argentina but the latter species is characterized by a preplete inflated domicilium, a distinctly flattened anterior margin and a weakly developed vecon (SCHALLREUTER 1996a: pl. 6 figs. 1–3).

The type-species of *Neoscaphina*, *N. kazachstanica* from the Middle Ordovician of Kazakhstan is preplete with anterior and posterior sides distinctly flattened (MELNIKOVA 1982: pl. 7 figs. 10–11).

*Brevibolina brevis* which occurs together with *N. pseudopennae* is distinctly preplete and has a distinct ventrolateral ridge or bend.

#### Superfamily Healdoidea HARLTON, 1933

Family Healdiidae HARLTON, 1933

##### ***Morphohealdia* KNÜPFER, 1968**

##### ***Morphohealdia wiefeli restricta* ssp. n.**

Pl. 9 figs. 1–6

**Derivation of name.** From *restrictus* (Latin) withdrawn, referring to the distance between free margin and posterior ridge in lateral view.

**Holotype.** Left valve GG-341-49 – Pl. 9 fig. 1.

**Material.** One carapace and >80 valves (13 on stubs).

*Definition.* Posterior ridge developed at some distance from the posterior margin seen in lateral view.

*Description.* Shape (L:H ratio) variable, generally ranging between moderately to rather high. Outline distinctly pre-plicate, i.e. maximum height in anterior half. Hinge-line relatively long and straight, extending more or less obliquely to basis line and sloping down towards the latter. Hinge-line embedded in an epicleine dorsum. Cardinal angles obtuse with posterior angle slightly larger than anterior one. Anterior margin broadly rounded, posterior margin more narrowly rounded, d-line therefore slightly oblique to basis line. Vecon in left valve weak or missing, in most cases distinctly developed in right valve. Anterior and posterior sides bordered by a bulging inflated ridge. Left valve with a contact semifurrow at least posteroventrally. Stop-pegs have been not observed, which might be due to the coarse silicification or the domicilium often filled with sediment particles. Lateral surface coarsely punctate.

*Variation.* Some specimens exceed normal shape (Pl. 9 fig. 5), in few specimens the umbo is missing (Pl. 9 fig. 6a) and the posterior ridge may almost reach the posterior end (Pl. 9 fig. 6b).

*Comparison.* In the nominal subspecies the posterior ridge covers the free margin in lateral view and the punctuation is much coarser (BLUMENSTENGEL & SCHALLREUTER 1997: text-fig. 2 fig. 1). The type-species from the Kalkbank is not punctate like *M. wiefeli*.

Suborder CYPRIDOCOPA JONES in CHAPMAN, 1901  
emend. SCHALLREUTER, 1978b

= Bairdiocopina GRÜNDEL, 1967; Bairdiomorpha KOZUR, 1972

Superfamily Bairdioidea SARS, 1888

Family Beecherellidae ULRICH, 1894

#### *Dornbuschia* SCHALLREUTER, 1968a

##### *Dornbuschia dynamica* sp. n.

Pl. 2 fig. 5, Pl. 6 figs. 4–5

*Holotype.* Right valve GG-341-7b – Pl. 6 fig. 4.

*Material.* Six valves (four on stubs).

*Definition.* At least up to 0.46 mm long. Straight part of the dorsal margin relatively short. Narrow rounded anterior end in ventral half. Posterior end elongated and distinctly pointed.

*Comparison.* From *D. ostseensis* SCHALLREUTER, 1968a from Baltica and *D. germanica* KNÜPFER, 1968 (Kalkbank, Thuringia) the new species differs by its narrowly rounded anterior end and the more pointed posterior end (KNÜPFER 1968: pl. 5 figs. 1, 7). Apart from that *D. ostseensis* has a much longer straight dorsal margin (SCHALLREUTER

1968a: pl. 9 fig. 1). More similar is the type-species, *D. biddenseensis* SCHALLREUTER, 1968 from Backsteinkalk geschiebes (N Germany), but the posterior end is less pointed in that species (SCHALLREUTER 1968a: pl. 9 fig. 5–6).

Suborder CYTHEROCOPA GRÜNDEL, 1967 emend.  
SCHALLREUTER, 1979

Superfamily inc.

Family Conodomyridae SCHALLREUTER, 1977

#### *Conodomyra* SCHALLREUTER, 1968d

##### *Conodomyra conocerata* (BLUMENSTENGEL, 1965a)

Pl. 10 fig. 11

2005 *Conodomyra conocerata* (BLUMENSTENGEL, 1965) –  
SCHALLREUTER: 300, 330; table 1 (p. 312); pl. 6  
(p. 331) fig. 7 (q.v. p. 300 for further synonymy)

*Material.* >40 valves (two on stubs).

*Definition.* See SCHALLREUTER 2005: 300.

*Remarks.* The holotype of *C. conoceata* shows no reticulation, which probably is a preservational feature and results from silicification. The Anarak specimens are also silicified with accordingly variable to indistinct reticulation. The more or less centrally located pit represents the S2. The somewhat different development (weak to distinct) between the Thuringian and Anarak specimens is considered to result from preservation.

*Comparison.* *Conodomyra reticulata* sensu MELNIKOVA, 1986 (= *C. sp. n.*; SCHALLREUTER 2005: 301) from the Ashgill of Kazakhstan differs from *C. reticulata* and the species presented here by the strong, broad centroventral lobe (MELNIKOVA 1986: pl. 11 fig. 1).

There are some more species in the material (see Pl. 11) which could not be determined exactly at present because of lack of sufficient material.

#### Stratigraphical and palaeobiogeographical meaning of the ostracod fauna

##### Age of the fauna

The fauna consists of more than 40 species of which 17 are new and some other 12 species have been described in open nomenclature. Some of the yet known Anarak ostracods also occur in the autochthonous Thuringian Kalkbank Fauna (Table 5). Based on conodont determination the Kalkbank was stratigraphically correlated with

**Table 5:** Occurrences of the Anarak genera found outside of Iran**Tab. 5:** Vorkommen der im Profil von Anarak nachgewiesenen Gattungen außerhalb Irans

Genera	Iran	Thuringia Kalkbank Ore Horizon	Thuringia Clasts	Baltica	Avalonia (England, Wales)	Kazakhstan	Laurentia
<i>Ampletochilina</i>	? sp. n.			trapezoidea			
<i>Duringia</i>	<i>spinosa</i>	<i>spinosa</i>		? alembaeensis	<i>triformosa</i>	? <i>multispinosa</i>	
<i>Bichilinoides</i>	<i>interrupta</i>				sp. n.		
<i>Vittella</i>	<i>pana</i>			vittensis et al.		<i>ishimica</i>	
<i>Bollaferum</i>	<i>anarakensis</i>	<i>levis</i>		<i>bellis</i>			
<i>Klimphores</i>	<i>granterior nodus</i>			planns et al.	<i>digitatus</i>		
<i>Bullaferum</i>	<i>granodus</i>			<i>granodus</i>			
<i>Pseudobollia</i>	<i>egregoides</i>						subaequata
<i>Herrigia</i>	<i>asiatica</i>			<i>besslandi, intermedia</i>	<i>melmerbyensis</i>		<i>gonyloba</i>
<i>Piconchoprimitia</i>	<i>iranica</i>			<i>conchoidea, coniqua</i>	<i>Improba, oscillata</i>		<i>incompta</i>
<i>Antiaechnina</i>	sp. n.		<i>blumenstengeli</i>	<i>groenwalli, pseudovelata</i>	<i>macromicki</i>		
<i>Baldiscella</i>	<i>anterionoda</i>	<i>anterionoda</i>	? <i>anterobulbosa</i>				
<i>Postceratia</i>	<i>posteroerata</i>		<i>posteroerata</i>	<i>p. (tubulata)</i>	sp.		
<i>Conchoprimitiella</i>	<i>disciminata</i>			<i>schnellsensis, eremita</i>	<i>dysfedensis, papillata</i>		
<i>Baltonotella</i>	<i>angustovelata</i>		<i>angustovelata</i>	<i>limbata</i>	spp.	<i>limbata</i>	<i>berdanae</i>
<i>Steusloffina</i>	<i>nudaplex</i>			<i>cuneata</i>	<i>cuneata?</i>	<i>ampla</i>	
<i>Bairdiocypridella</i>	<i>bairdiaformis</i>		<i>bairdiaformis</i>				
<i>Longiscula</i>	sp. A et al.			<i>parrectis</i> et al.		<i>dulankarensis</i> et al.	
<i>Elliptocyprites</i>	sp. A, sp. B			<i>Revisylthere,</i>			<i>parallela</i>
<i>Platyrhomboides</i>	sp. A			<i>Imisylthere</i>			<i>quadratus</i>
<i>Olbianella</i>	sp. A, ? sp. B			<i>sabacea</i>			
<i>Parasclerites</i>	aff. <i>lamellosus</i> aff. <i>elongatus</i>	<i>lamellosus?</i>					<i>elongatus, lamellosus</i>
<i>Tricornina</i>	<i>haehneli</i>	<i>haehneli</i>	<i>haehneli</i>	sp. n.	<i>cf. haehneli</i>	<i>ancoralis</i>	
<i>Brevicornina</i>	<i>brevis</i>	<i>wittmannsgereenthensis</i>	<i>brevis</i>	<i>caudica</i>			
<i>Neoscaphrina</i>	<i>pseudopennae</i>			<i>kappkai</i>		<i>kazachstanica</i>	
<i>Morphohealdia</i>	<i>wiefeli dynamica inornata, wiefeli w.</i>						
<i>Dornbuschia</i>	<i>dynamica</i>	<i>germanica</i>		<i>biddenseensis, longissima longissima</i>			
<i>Conodomyra</i>	<i>conocerata</i>		<i>conocerata</i>	<i>reticulata, brevinodata</i>		sp. n.	

the basal *Ordovicicus* Zone in the early Ashgill (FERRETTI & BARNES 1997: 20). By contrast, HOTH & LEONHARDT in BEIER et al. (2001: tab. 1) correlated the Kalkbank with the Upper Caradocian *Pleurograptus linearis* Zone and the upper Iron Layer with the *Dicranograptus clingani* Zone.

Two species of the Anarak Fauna occur also in Baltica: *Postceratia posteroerata*, and *Bullaferum granodus*. *Postceratia posteroerata* has been reported in Baltica from the Keila to Pirgu (Late Caradoc/early Ashgill) under the name *Parulrichia* or *Pseudulrichia tubulata*. *Bullaferum granodus* is known from Öjlemyrflint geschiebes of both the Isle of Gotland

(Baltic Sea) and the Isle of Sylt (North Sea) which were correlated with the Pirgu- and Porkuni stages. The genera *Conodomyra* and *Dornbuschia* are known in Baltica from Johvi to Pirgu stages.

On account of these data the Anarak Fauna described herein is certainly of Late Ordovician age. Taking into account that the Anarak fauna is recorded at the base of the Shirgesht Formation, and that this unit is 756 m thick, this dating on ostracods opens the problem of the correlations with the Shirgesht Formation in the type area.

## Age of the Shirgesht Formation

Originally, the Shirgesht Formation at its type locality was considered as Middle Ordovician by RUTTNER et al. (1968: 33, 36; table 2). MÜLLER (1973: 9) was the first who recorded conodonts in the Shirgesht Formation and demonstrated “that several Upper Cambrian and Tremadocian zones are represented in the formation”. BRUTON et al. (2004: 111) investigated the respective trilobites and came to the conclusion that the “Shirgesht fauna is Tremadoc to probably Arenig”. They referred to the statement of BASSETT et al. (1999) “that the age of the upper unit of the Shirgesht Formation can be no younger than Arenig” (BRUTON et al. 2004: 119).

The ostracod fauna recorded by WILLIAMS et al. (in GHOBADI POUR et al. 2006: 551, 553) came from the “upper part of the Shirgesht Formation” in the Derenjal Mountains and is of “probably late Middle Ordovician” age. As shown in their fig. 2, the ostracods came from Unit B5 and B6 (lower Darriwillian) which is overlain by the thick unit B7 composed of sand- and siltstones of the upper Darriwillian. The latter contains trilobites of the subfamily Reedocalymeninae which indicate an upper Llanvirn age (GHOBADI POUR, OWENS & POPOV 2006: 55).

With regard to the complicated tectonics noted by BRUTON et al. (2004) and referred to by WILLIAMS et al. (in GHOBADI POUR et al. 2006), and the fact that the uppermost unit (B7) of the Shirgesht Formation at Tabas has not been investigated for ostracods, the following interpretations may be considered:

- a) the Ordovician of the Anarak Section is the upper continuation of the Shirgesht Formation at Tabas. Both regions underwent complicated tectonic processes that caused the loss of upper or lower part of the Ordovician at the respective sites.
- b) The Anarak Section does not belong to the Shirgesht Formation but represents a formation of its own from a separate terrane, suggesting that Central Iran is composed of several terranes. Support of this hypothesis is based on the close faunal relationships between the Anarak ostracods and those from Thuringia. On the contrary, ostracods from the type locality of the Shirgesht Formation recently described by Williams et al. (2006) document closer relations to Armorica.

Particularly the upper part of the Shirgesht Formation at Tabas requires more detailed investigation as to whether or not Late Ordovician sediments are definitely lacking. This information is crucial for recognition of the regional context between the Tabas and Anarak regions concerning palaeobiogeography and tectogenesis.

## Relations to other faunas

The ostracod fauna described recently by WILLIAMS et al. (in GHOBADI POUR et al. 2006) from the middle part of the Shirgesht Formation at Dahaned-Kolut is rather poor and shows relations to Baltica and Armorica only at the generic level. The Anarak Fauna is much more diverse and shows relations to different regions such as Thuringia, Baltica, Avalonia, Kazakhstan, and Laurentia. The closest relations do, however, exist to Thuringia.

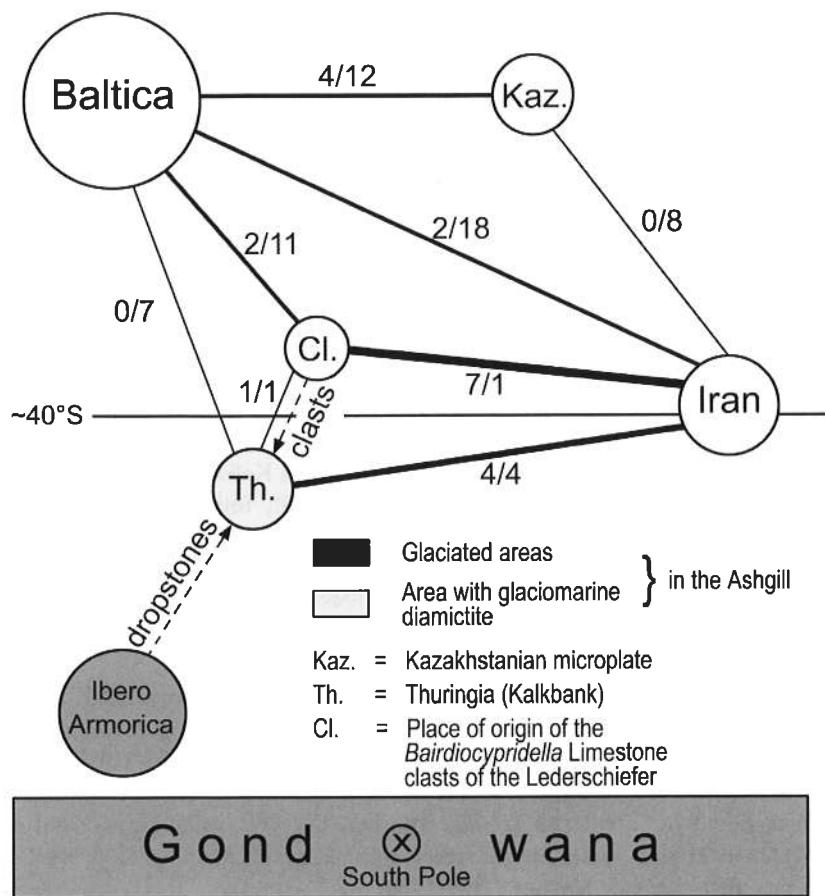
In general, Ordovician ostracod faunas are rather rare in Thuringia. Their documentation refers to both autochthonous and allochthonous occurrences. Only two autochthonous faunas are known so far. One comes from a limestone horizon called Kalkbank and was firstly described by KNÜPFER (1968), followed by SCHALLREUTER (1984a, 1986a, 2005) who investigated some elements of that particular fauna in detail. The other fauna documented by BLUMENSTENGEL & SCHALLREUTER (1997) is rather small and comes from the upper Iron-Ore Horizon.

By contrast, allochthonous Upper Ordovician ostracods were recorded by BLUMENSTENGEL (1965a) from a limestone clast of the Lederschiefer (Ashgill). This author described a rich fauna which was revised by SCHALLREUTER (2005). Another, but very small fauna from a quartzitic clast was published by SCHALLREUTER & HINZ-SCHALLREUTER (1998).

The Anarak Fauna shows relations to both autochthonous and allochthonous faunas of Thuringia. However, the taxonomic overlaps between the Anarak Fauna and those of the Lederschiefer clasts are greatest with a total of six (? seven) species (*Postceratia posterocerata*, *Balnotella angustovelata*, *Conodomyra conocerata*, *Tricornina haebneli*, *Bairdiocypridella bairdiaformis*, *Brevicornina brevis*, ? *Baldiscella* ? *anterobulbosa*). Four species and four genera of the Anarak Fauna also occur in the autochthonous Kalkbank and Upper Iron-Ore Horizon (*Duringia spinosa*, *Baldiscella anterionoda*, *Morphohealdia wiesfeli*, *Tricornina haebneli*; *Brevicornina Klimpfhoes*, *Parasclerites*, *Dornbuschia*).

A main difference between the clasts from the Lederschiefer and the Anarak Faunas is the presence of *Pseudulrichia bohemica* SCHMIDT, 1941 and *Thuratia reticulata* (BLUMENSTENGEL, 1965). *Pseudulrichia bohemica* is known only from Baltica (*P. b. norvegica* HENNINGSMOEN, 1954) and Bohemia (*P. b. bohemica*) so far. *Thuratia reticulata* is apparently endemic but was frequent in one of the studied boulders and completely missing in the other one that contained only a few ostracod specimens (SCHALLREUTER 2005: tab. 1).

Relations, even if not as close as to Thuringia, also exist between the Anarak Region and Baltica with 18 common genera and two species.



Although Kazakhstan and Iran are geographically very close today, the ostracod faunas from the Late Ordovician of both regions are rather different. Similarities exist only on the generic level documented by *Duringia*, *Vittella*, *Baltonotella*, *Steusloffina*, *Longiscula*, *Tricornina*, *Neoscaphina*, and *Conodomyra*.

Some relations exist also to England and Wales, mainly to the fauna of the Cautley Mudstone Formation described by WILLIAMS et al. (2001). Similarities comprise the occurrence of *Antiaechmina maccormicki*, *Bichilinoides* sp. n. (Laevanotella sp. nov. of WILLIAMS et al. 2001), *Postceratia* ? sp. (Pseudulrichia sp. B of WILLIAMS et al. 2001), *Tricornina* cf. *haehneli* (*Steusloffina cuneata* of WILLIAMS et al. 2001: fig. 3f), and *Dornbuschia longissima* (Podocope sp. 1 of WILLIAMS et al. 2001). Further relations are expressed by the common genera *Duringia*, *Klimphores*, *Herrigia*, *Pariconchoprimitia*, and *Baltonotella*.

Relations to Perunica are documented only by *Duringia* with *D. angustosulcata* SCHALLREUTER & KRÚTA, 2001 from the Letná Formation.

The co-occurrence of *Pseudobolla*, *Herrigia*, *Pariconchoprimitia*, *Baltonotella*, *Platyrbomboides*, *Elliptocyprites*, and *Para-*

*sclerites* in Laurentia and Anarak suggest at least some relations between these two regions.

### Palaeobiogeographical implications

As has been stated above, the closest relations occur between the Anarak Region and Thuringia. Thuringia has been considered by many authors as part of Perunica. ERDTMANN (1991: 28), e. g., described the "Thuringia-Fichtelgebirge Platform" as "an integral part of the Barrandian Platform at the time" (Ordovician) and also the recent palaeogeographical map presented by GHOBADI POUR et al. (2006: fig. 4) apparently follows this idea. However, in 1998 SCHALLREUTER & HINZ-SCHALLREUTER (1998: 323, 324, 347) already documented significant faunal differences to Perunica which suggest that Thuringia was a separate microcontinent or terrane rather than part of Perunica.

The Lederschiefer facies is a striking characteristic of the Late Ordovician in Thuringia. Known for more than a century, its content of boulders led to its original desig-

nation as "Gerölltonsschiefer" by ZIMMERMANN (1914). DEUBEL & NAUMANN (1929) interpreted these boulders as glacial dropstones, but the existence of a Late Ordovician glaciation did not become accepted before the second half of the last century with the identification of glacial striae in the Sahara and other glaciomarine diamictites (SCHALLREUTER & HINZ-SCHALLREUTER 1998: table 3).

The dropstones of the Lederschiefer are strongly silicified and sometimes glacially striated. Their place of original sedimentation may be very distant from their modern occurrence. They were speculated to come from North Africa, but convincing evidence is lacking. Two dropstones originate from Armorica which could be demonstrated by faunal comparisons (SCHALLREUTER & HINZ-SCHALLREUTER 1998; SCHALLREUTER 2003: 235).

Apart from heavily silicified dropstones, the Lederschiefer also contains some rare limestone pebbles. Since these are not silicified (except for the microfossils) they are assumed to originate from debris flows of adjacent areas – a scenario similar to what is known from giant boulders ("Riesengerölle") (SCHALLREUTER & HINZ-SCHALLREUTER 1998: 323–324). The fauna of these limestone clasts (*Bairdiocypridella* Limestone) show greatest conformity with the Anarak Fauna. Provided that the *Bairdiocypridella* Limestone clasts are not dropstones but originate from debris flows, their place of original sedimentation must have been not very distant from the place of origin.

The close relation between the faunas from Central Iran (Anarak) on one hand and the ostracod faunas of the Kalkbank and Upper Iron-Ore Horizon on the other hand suggest that Thuringia was located near Central Iran (Anarak) during Ordovician times, but not as close as the region from which the *Bairdiocypridella* Limestone originated (Fig. 6). The precise position of that particular region is unknown as yet. It is clear that the similarity between the Kalkbank Fauna and the *Bairdiocypridella* Limestone is less than that between the Kalkbank (Thuringia) and Central Iran (Anarak Region). This suggests a barrier possibly in the form of a deep sea between Thuringia and the regional source of the *Bairdiocypridella* Limestones which would also support the assumption of debris flows contemporaneous to the deposition of the Lederschiefer. Because of the occurrence of *Pseudohirchia bohemica norvegica* and other Baltic elements the *Bairdiocypridella* Limestone clasts must have originated from a region that was located closer to Baltica than Central Iran (Anarak) was. Based on the presence of dropstones within the Lederschiefer, Thuringia was placed near the drift ice border (~ 40°) by SCHALLREUTER & HINZ-SCHALLREUTER (1998: 323–324). By contrast, GOBADI POUR et al. (2006: fig. 4) considered East-Central Iran (Derenjal Mts.)

as part of Gondwana at its western border at 50° South in their palaeogeographic map.

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#### Korrekturen/Ergänzungen zu SCHALLREUTER 2005

Peter Lange, Orlamünde, verdankt der Verfasser folgende Hinweise (brfl. Mitt. 11.1.2006):

- Die Unsicherheit in der Zuschreibung der Abb. 1 (S. 285) auf HERMANN LORETZ ist unberechtigt. Die Abkürzung S. M. ist die seinerzeit allgemein benutzte Bezeichnung für das Herzogtum Sachsen-Meiningen.
- p. 328, 3. Zeile: rechte und linke vertauscht. 8<sup>th</sup> line: right and left exchanged

The author thanks Peter Lange, Orlamünde, for the following information (written communication 11.1.2006):

- The insecurity in assigning text-fig. 1 (p. 285) to Hermann LORETZ is not justified. The abbreviation S. M. refers to the generally used termination for Sachsen-Meiningen at that time.
- p. 338, 3. Zeile bzw. 9<sup>th</sup> line: statt (instead of) *Thuringobairdia* – *Thuringobliqua*

Eingereicht am 4.12.2006  
Angenommen am 21.12.2006

Addresses of the authors:

PD Dr. Roger Schallreuter, Prof. Dr. Ingelore Hinz-Schallreuter, Institut für Geographie und Geologie, Ernst Moritz Arndt-Universität, Friedrich Ludwig Jahn-Str. 17a, D-17489 Greifswald  
Roger.Schallreuter@uni-greifswald.de  
ihinz-s@uni-greifswald.de

Prof. Dr. Marco Balini, Dipartimento di Scienze della Terra „Ardito Desio“, Università degli Studi di Milano, Via Mangiagalli 34, I-20133 Milano  
marco.balini@unimi.it

Prof. Dr. Annalisa Ferretti, Dipartimento del Museo di Paleobiologia e dell'Orto Botanico, Via Università 4, I-41100 Modena  
ferretti@unimore.it

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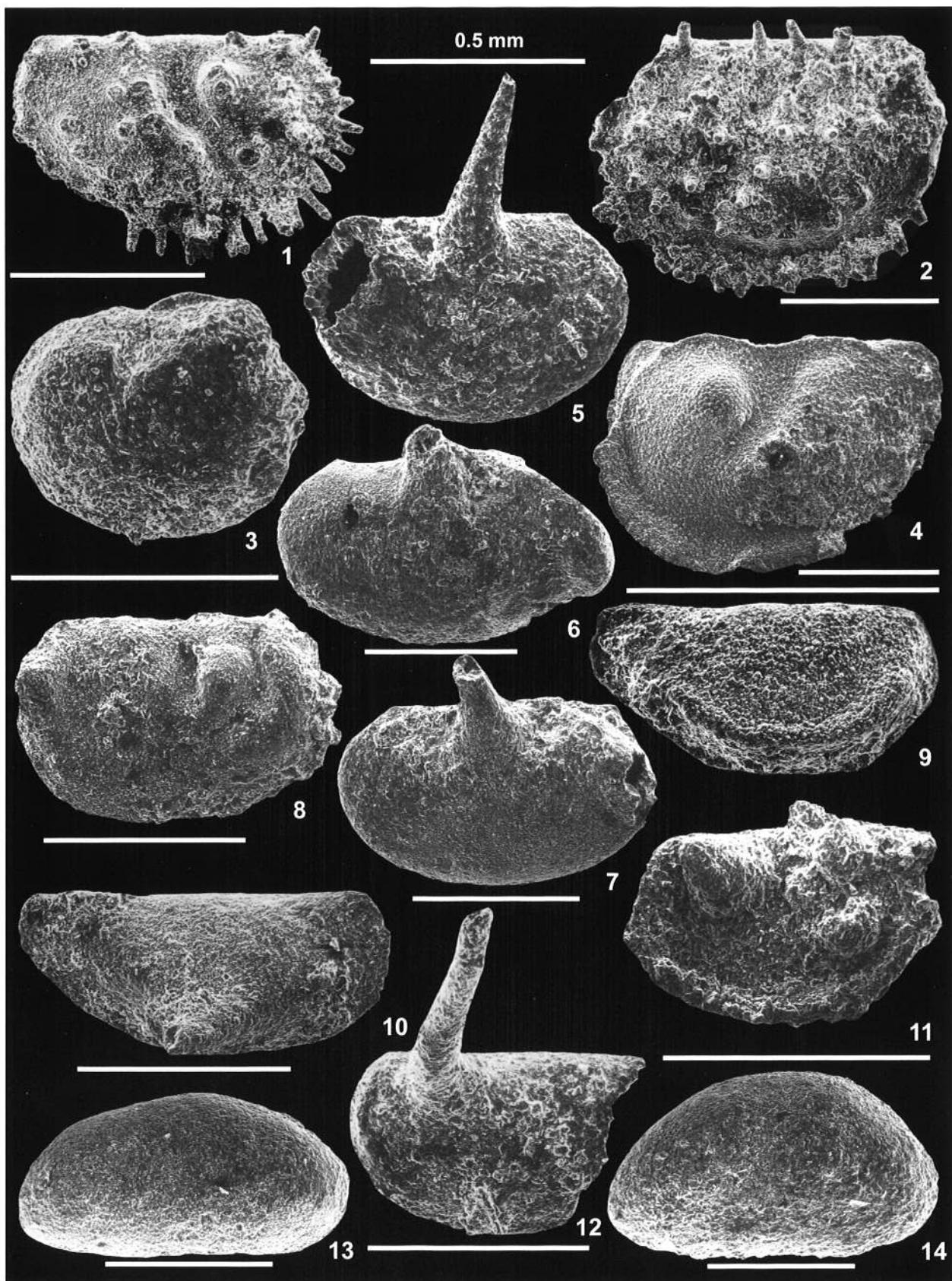
TAFEL 1 / PLATE 1

- 1–2 – *Duringia spinosa* (KNÜPFER, 1968), left and right valves, length (L) 0.84 (without spines) and 1.00 mm (without velum)  
3 – *Herrigia asiatica* sp.n. ?, left valve, L 0.56 mm  
4 – *Vittella pana* sp.n., left valve, L 1.23 mm  
5–7 – *Postceratia posterocerata* (BLUMENSTENGEL, 1965), left and two right valves, L 0.76, 1.11, and 0.96 mm  
8 – *Bollita anarakensis* sp. n., right valve, L 0.76 mm  
9 – *Brevicornina brevis* (BLUMENSTENGEL, 1965), right valve, L 0.56 mm  
10 – *Tricornina haehneli* BLUMENSTENGEL, 1965, right valve, L 0.87 mm  
11 – *Bullaferum granodus* sp.n., right valve, L 0.55 mm  
12 – *Antiaeckmina* sp.n., posteriorly incomplete left valve, L 0.67 mm  
13 – *Longiscula* ? sp., right valve, L 1.00 mm  
14 – *Longiscula* sp. D, right valve, L 1.12 mm. Length measurements after the SEM picture and scale

All specimens lost (including sample data).

- 1–2 – *Duringia spinosa* (KNÜPFER, 1968), linke und rechte Klappe, Länge (L) 0,84 (ohne Dornen) bzw. 1,00 mm (ohne Velum)  
3 – *Herrigia asiatica* sp.n. ?, linke Klappe, L 0,56 mm  
4 – *Vittella pana* sp.n., linke Klappe, L 1,23 mm  
5–7 – *Postceratia posterocerata* (BLUMENSTENGEL, 1965), linke und zwei rechte Klappen, 0,76, 1,11, bzw. 0,96 mm  
8 – *Bollita anarakensis* sp.n., rechte Klappe, L 0,76 mm  
9 – *Brevicornina brevis* (BLUMENSTENGEL, 1965), rechte Klappe, 0,56 mm  
10 – *Tricornina haehneli* BLUMENSTENGEL, 1965, rechte Klappe, L 0,87 mm  
11 – *Bullaferum granodus* sp.n., rechte Klappe, L 0,55 mm  
12 – *Antiaeckmina* sp.n., hinten unvollständige linke Klappe, L 0,67 mm  
13 – *Longiscula* ? sp., rechte Klappe, L 1,00 mm  
14 – *Longiscula* sp. D, rechte Klappe, L 1,12 mm. Exemplare verlorengegangen (zusammen mit der Information über die Probennummer)

Länge nach den Angaben auf den REM-Mikrographien



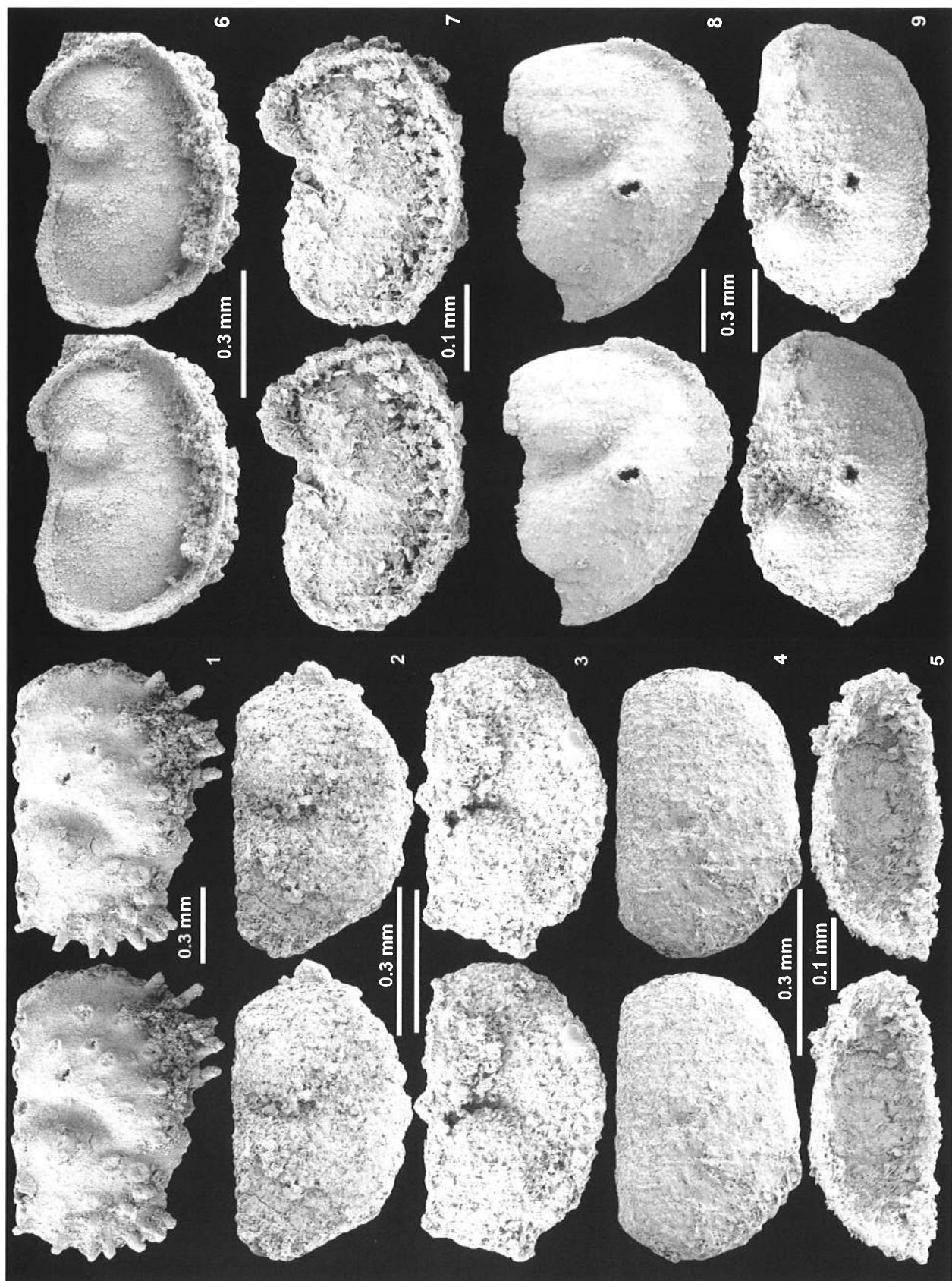
TAFEL 2 / PLATE 2

- 1 – *Duringia spinosa* (KNÜPFER, 1968), left valve (GG-341-2), L 1.12 (without spines)  
2–3 – *Geshirtia ventrocostata* gen. n. sp. n., holotype (GG-341-3a), right valve (2) and paratype (GG-341-3b), right valve (3), L 0.56 mm  
4 – *Foveaprimitiella* ? sp. n., left valve (GG-341-4a), L 0.54 mm  
5 – *Dornbuschia dynamica* sp. n., paratype (GG-341-5), left valve in internal view, L 0.42 mm  
6–7 – *Bichilinoides interrupta* gen. n. sp. n., holotype (GG-341-6), right valve, L 0.70 mm (6), and paratype (GG-341-7a), right valve of a young larva, L 0.33 mm (7)  
8–9 – *Vittella pana* sp. n., paratype (GG-341-8), tecnomorphic right valve, L 1.05 mm (8), and holotype (GG-341-9), tecnomorphic left valve, L 1.09 mm (9)

All lateral views except of fig. 5

- 1 – *Duringia spinosa* (KNÜPFER, 1968), rechte Klappe (GG-341-2), L 1,12 (ohne Dornen)  
2–3 – *Geshirtia ventrocostata* gen. et sp. n., Holotypus (GG-341-3a), rechte Klappe (2) und Paratypus (GG-341-3b), rechte Klappe (3), L 0,56 mm  
4 – *Foveaprimitiella* ? sp. n., linke Klappe (GG-341-4a), L 0,54 mm  
5 – *Dornbuschia dynamica* sp. n., Paratypus (GG-341-5), linke Klappe in Innenansicht, L 0,42 mm  
6–7 – *Bichilinoides interrupta* gen. n. sp. n., Holotypus (GG-341-6), rechte Klappe, L 0,70 mm (6) und Paratypus (GG-341-7a), rechte Klappe einer jungen Larve, L 0,33 mm (7)  
8–9 – *Vittella pana* sp. n., Paratypus (GG-341-8), tecnomorphe rechte Klappe, L 1,05 mm (8) und Holotypus (GG-341-9), tecnomorphe linke Klappe, L 1,09 mm (9)

Lateralansichten außer Fig. 5



TAFEL 3 / PLATE 3

1–4 – *Iranomitia cecus* sp. n.

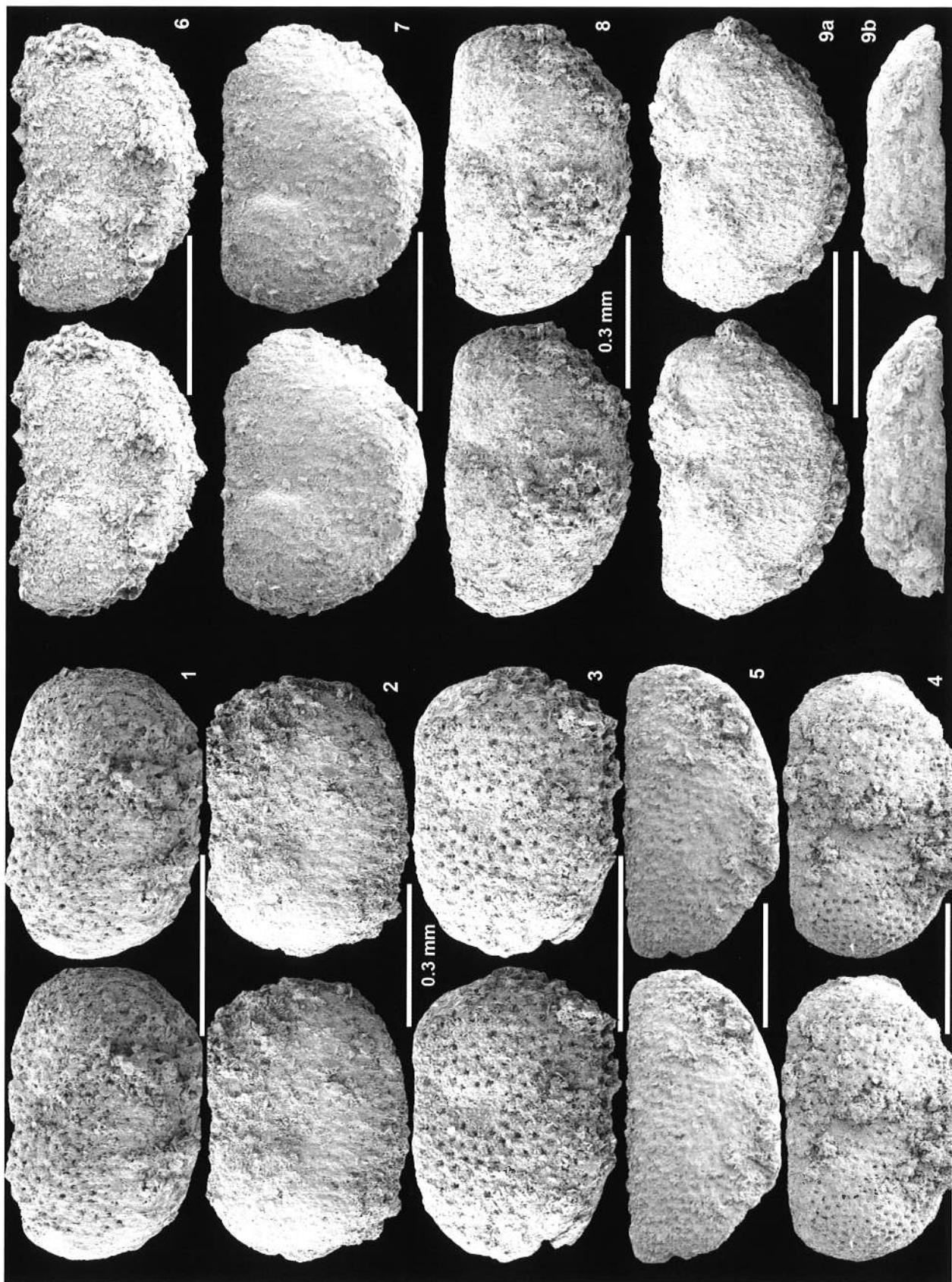
- 1 – Paratype (GG-341-10), tecnomorphic right valve, L 0.50 mm
- 2 – paratype (GG-341-11), female left valve, L 0.54 mm
- 3 – holotype (GG-341-12a), female right valve, L 0.49 mm
- 4 – male left valve (GG-341-13a), L 0.66 mm
- 5 – *Ampletochilina* ? sp.n., anteroventrally incomplete left valve (GG-341-14a), L 0.71 mm
- 6–9 – *Bolbarakia obliqua* gen. n. sp. n.
- 6 – paratype (GG-341-15a), left valve, L 0.54 mm
- 7 – paratype (GG-341-16a), left valve, L 0.49
- 8 – paratype (GG-341-17a), right valve, L 0.58 mm
- 9 – holotype (GG-341-15b), right valve, L 0.56 mm

Lateral views and anteroventral view (9b)

1–4 – *Iranomitia cecus* sp. n. 1 Paratypus (GG-341-10), tecnomorphe rechte Klappe, L 0,50 mm

- 2 – Paratypus (GG-341-11), linke ♀ Klappe, L 0,54 mm
- 3 – Holotypus (GG-341-12a), rechte ♀ Klappe, L 0,49 mm
- 4 – linke ? Klappe (GG-341-13a), L 0,66 mm
- 5 – *Ampletochilina* ? sp.n., anteroventral unvollständige linke Klappe (GG-341-14a), L 0,71 mm.
- 6–9 – *Bolbarakia obliqua* gen. n. sp. n.
- 6 – Paratypus (GG-341-15a), linke Klappe, L 0,54 mm
- 7 – Paratypus (GG-341-16a), linke Klappe, L 0,49
- 8 – Paratypus (GG-341-17a), rechte Klappe, L 0,58 mm
- 9 – Holotypus (GG-341-15b), rechte Klappe, L 0,56 mm

Lateralansichten und Anteroventralansicht (9b)



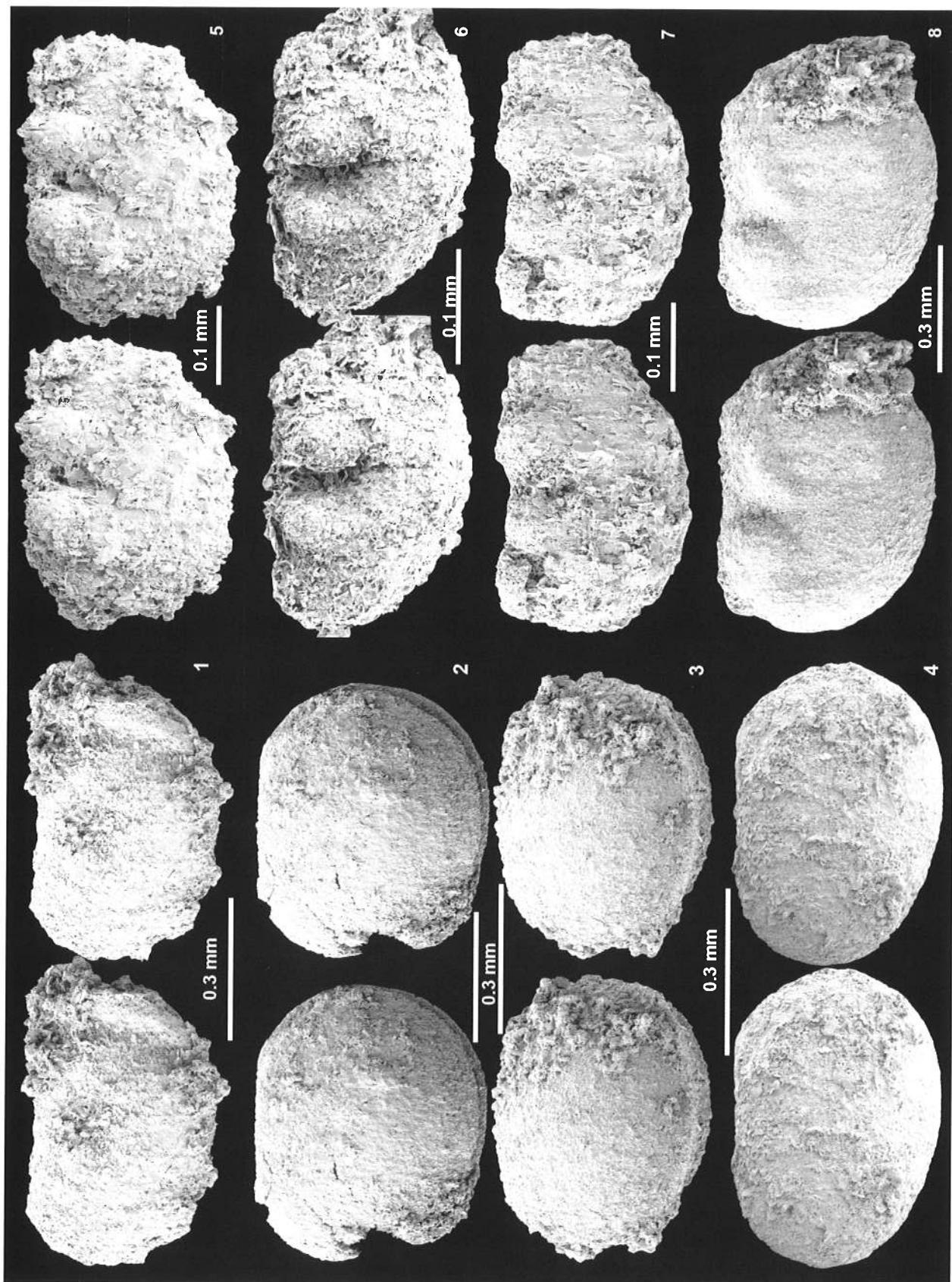
TAFEL 4 / PLATE 4

- 1 – *Bollita anarakensis* sp.n. Holotype (GG-341-19a), left ♀ valve, L 0.61 mm  
2–3 – *Baltonotella angustovelata* (BLUMENSTENGEL, 1965), right valve (GG-341-20), L 0.64 mm (2), and left valve (GG-341-21), L 0.55 mm (3)  
4 – *Pariconchoprimitia iranica* sp.n., paratype (GG-341-22a), left valve, L 0.56 mm  
5–7 – *Klimphores granterionodus* sp.n., holotype (GG-341-13b), left valve, L 0.34 mm (5), paratype (GG-341-24a), right valve, L 0.29 mm (6), and paratype (GG-341-25), left valve, L 0.33 mm (7). 8 *Herrigia asiatica* sp. n., left valve (GG-341-26a), L 0.70 mm

All lateral views

- 1 – *Bollita anarakensis* sp. n. Holotypus (GG-341-19a), linke ♀ Klappe, L 0.61 mm  
2–3 – *Baltonotella angustovelata* (BLUMENSTENGEL, 1965), rechte (GG-341-20) (2) und linke Klappe (GG-341-21) (3), L 0.64 und 0.55 mm  
4 – *Pariconchoprimitia iranica* sp.n., Paratypus (GG-341-22a), linke Klappe, L 0.56 mm  
5–7 – *Klimphores granterionodus* sp.n., Holotypus (GG-341-13b), linke Klappe, L 0.34 mm (5), Paratypus (GG-341-24a), rechte Klappe, L 0.29 mm (6), und Paratypus (GG-341-25), linke Klappe, L 0.33 mm (7). 8 *Herrigia asiatica* sp. n., linke Klappe (GG-341-26a), L 0.70 mm

Lateralansichten



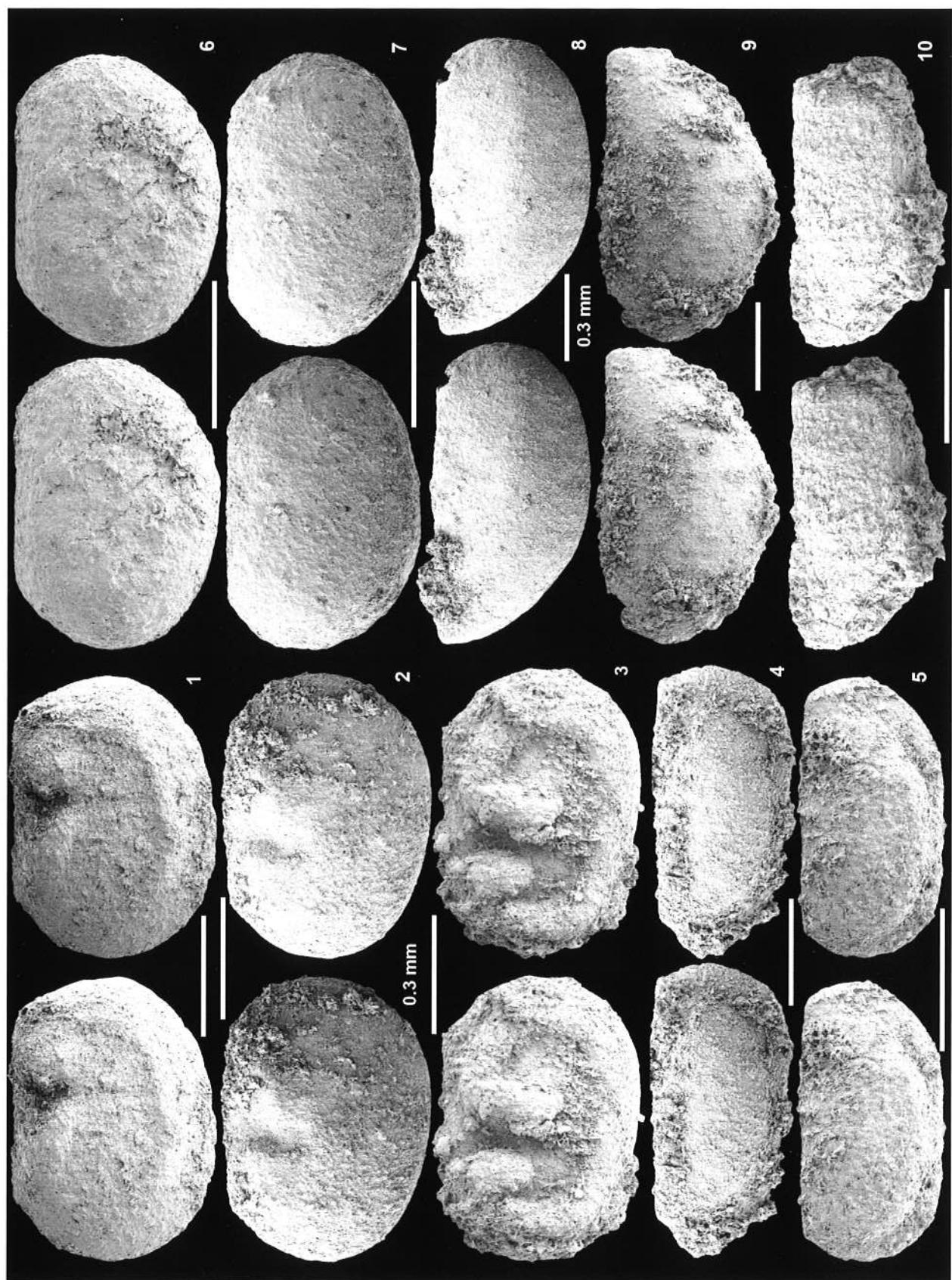
TAFEL 5 / PLATE 5

- 1–2 – *Herrigia asiatica* sp. n., holotype (GG-341-27a), right valve, L 0.71 mm (1), and paratype (GG-341-27b), left valve, L 0.71 mm (2)  
3 – *Pseudbollia egregoides* sp. n., holotype (GG-341-28), left valve, L 0.73 mm  
4 – *Neoscaphina pseudopennae* sp. n., holotype (GG-341-29), left valve, 0.78 mm  
5 – *Brevicornina brevis* (BLUMENSTENGEL, 1965), left valve (GG-341-30), 0.59 mm  
6–7 – *Pariconchoprimitia iranica* sp. n., holotype (GG-341-4b), left valve, L 0.61 mm (6), and paratype (GG-341-4c), right valve L 0.62 mm (7)  
8–9 – *Steusloffina nudaplex* sp. n., holotype (GG-341-31), right valve, L 1.05 mm (8), and paratype (GG-341-17b), left valve, L 1.02 mm (9)  
10 – *Tricornina haehneli* BLUMENSTENGEL, 1965, right valve (GG-341-32), L 0.52 mm

All lateral views

- 1–2 – *Herrigia asiatica* sp. n., Holotypus (GG-341-27a), rechte Klappe, L 0.71 mm (1) und Paratypus (GG-341-27b), linke Klappe, L 0.71 mm (2)  
3 – *Pseudbollia egregoides* sp. n., Holotypus (GG-341-28), linke Klappe, L 0.73 mm  
4 – *Neoscaphina pseudopennae* sp. n., Holotypus (GG-341-29), linke Klappe, 0.78 mm  
5 – *Brevicornina brevis* (BLUMENSTENGEL, 1965), linke Klappe (GG-341-30), 0.59 mm  
6–7 – *Pariconchoprimitia iranica* sp. n., Holotypus (GG-341-4b), linke Klappe, L 0.61 mm (6) und Paratypus (GG-341-4c), rechte Klappe, L 0.62 mm (7)  
8–9 – *Steusloffina nudaplex* sp. n., Holotypus (GG-341-31), rechte Klappe, L 1.05 mm (8) und Paratypus (GG-341-17b), linke Klappe, L 1.02 mm (9)  
10 – *Tricornina haehneli* BLUMENSTENGEL, 1965, rechte Klappe (GG-341-32), L 0.52 mm

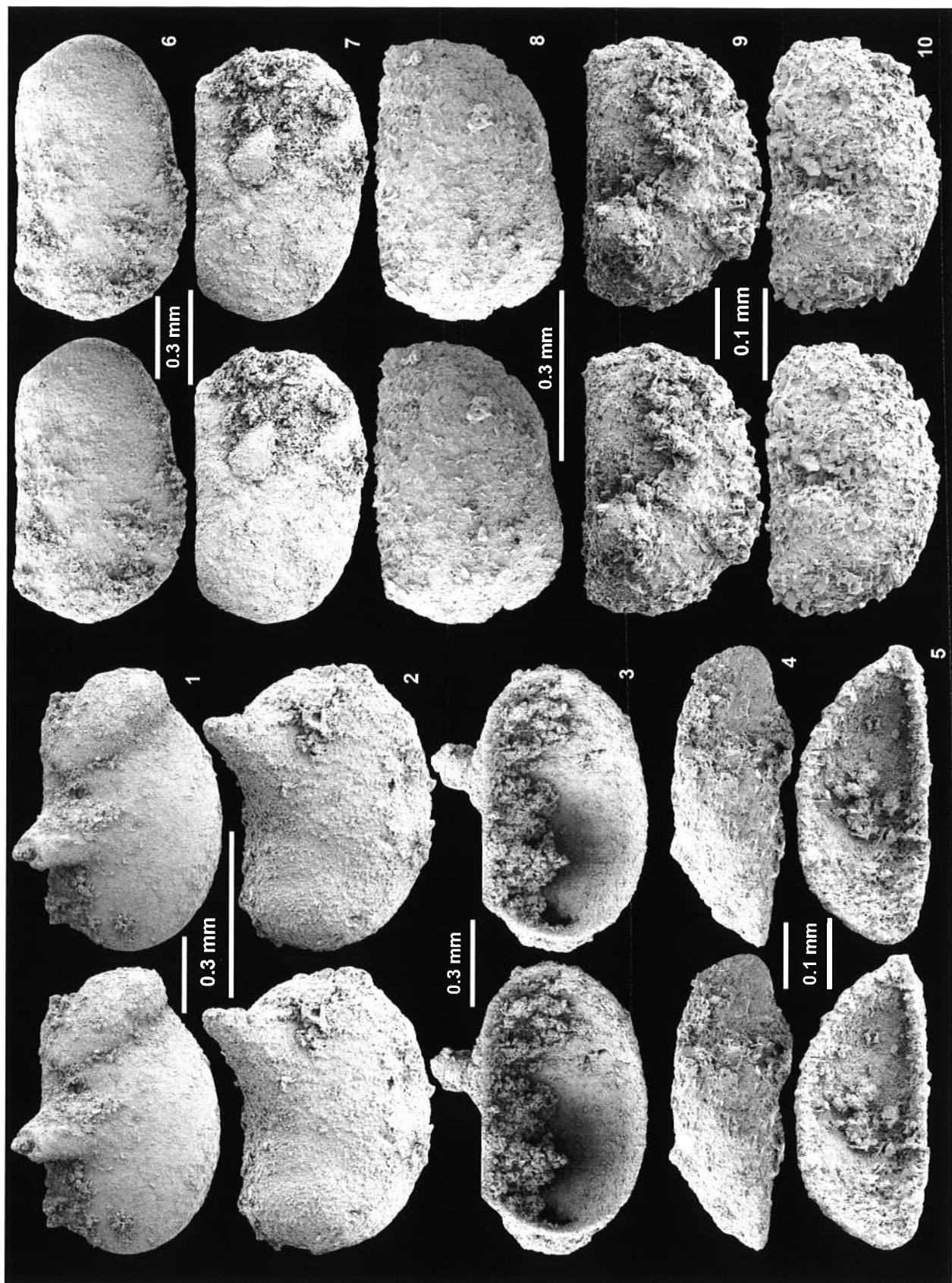
Lateralansichten



TAFEL 6 / PLATE 6

- 1–3 – *Postceratia posterocerata* (BLUMENSTENGEL, 1965), right valve (GG-341-33) in lateral view, L 1.17 mm (1), left valve (GG-341-34a) of young larva in lateral view, L 0.54 (2), right valve (GG-341-35) in internal view, L 0.95 mm (3)
- 4–5 – *Dornbuschia dynamica* sp.n., holotype (GG-341-7b), right valve in lateral view, L 0.46 mm (4), and right valve (GG-341-7c) in internal view, L 0.42 mm (5)
- 6–7 – *Conchoprimitiella discriminata* sp.n., holotype (GG-341-36), right valve, L 1.06 mm (6) and paratype (GG-341-13c), left valve, L 0.87 mm (7), in lateral views
- 8 – *Opisthoplax anarakensis* sp.n., holotype (GG-341-16b), right valve, L 0.50 mm, in lateral view
- 9–10 – *Baldiscella anterionoda* (KNÜPFER, 1968), two left valves (GG-341-13d; -37a), L 0.38 mm, and 0.32 mm, in lateral views

- 1–3 – *Postceratia posterocerata* (BLUMENSTENGEL, 1965), rechte Klappe (GG-341-33) in Lateralansicht, L 1.17 mm (1), linke Klappe (GG-341-34a) einer jungen Larve in Lateralansicht, L 0.54 (2), rechte Klappe (GG-341-35) in Innenansicht, L 0.95 mm (3)
- 4–5 – *Dornbuschia dynamica* sp.n., Holotypus (GG-341-7b), rechte Klappe in Lateralansicht, L 0.46 mm (4), und rechte Klappe (GG-341-7c) in Innenansicht, L 0.42 mm (5)
- 6–7 – *Conchoprimitiella discriminata* sp.n., Holotypus (GG-341-36), rechte Klappe, L 1.06 mm (6) und Paratypus (GG-341-13c), linke Klappe, L 0.87 mm (7), in Lateralansicht<sup>^</sup>
- 8 – *Opisthoplax anarakensis* sp.n., Holotypus (GG-341-16b), rechte Klappe, L 0.50 mm, in Lateralansicht
- 9–10 – *Baldiscella anterionoda* (KNÜPFER, 1968), zwei linke Klappen (GG-341-13d; -37a), L 0.38 mm, und 0.32 mm, in Lateralansicht.



TAFEL 7 / PLATE 7

*Bairdiocypridella bairdiaformis* BLUMENSTENGEL, 1965

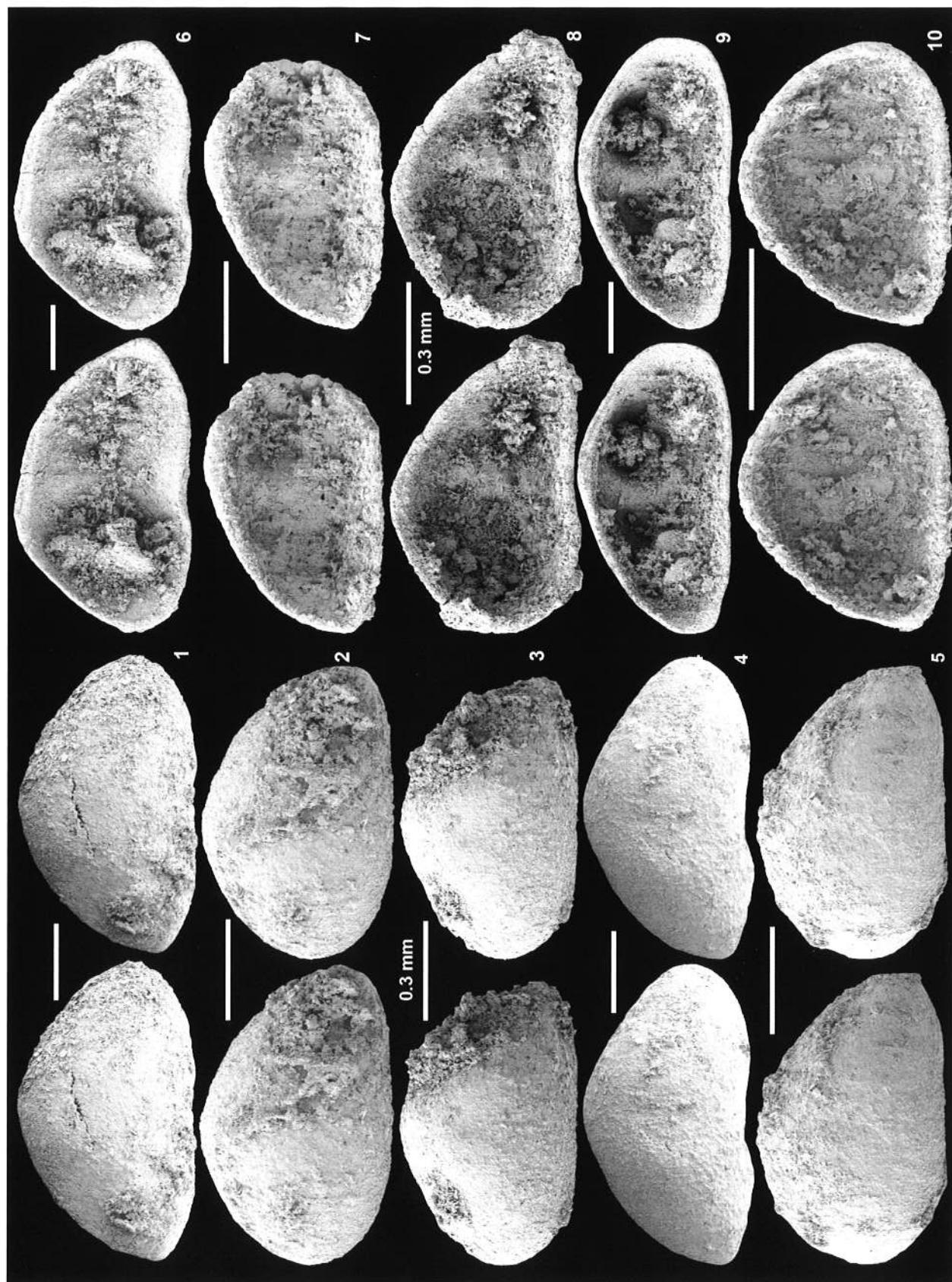
- 1 – right valve (GG-341-38a), L 1.20 mm
- 2 – left valve (GG-341-39a), L 0.90 mm
- 3 – left valve (GG-341-40a), L 0.87 mm
- 4 – right valve (GG-341-41a), L 1.15 mm
- 5 – left valve (GG-341-39b), L 0.83 mm
- 6 – right valve (GG-341-42) with sulcament behind summit, L 1.37 mm
- 7 – anteriorly incomplete left valve (GG-341-43) with sulcament slightly behind summit, L 0.76 mm, height 0.50 mm
- 8 – right valve (GG-341-44) with sulcament behind summit, L 0.72 mm
- 9 – elongate left valve (GG-341-45) with sulcament near summit, L 1.26 mm
- 10 – very high left valve (GG-341-46) of a young larva with questionable sulcament, L 0.54 mm

Figs. 1–5 lateral views, figs. 6–10 internal views.

*Bairdiocypridella bairdiaformis* BLUMENSTENGEL, 1965

- 1 – rechte Klappe (GG-341-38a), L 1.20 mm
- 2 – linke Klappe (GG-341-39a), L 0.90 mm
- 3 – linke Klappe (GG-341-40a), L 0.87 mm
- 4 – rechte Klappe (GG-341-41a), L 1.15 mm
- 5 – linke Klappe (GG-341-39b), L 0.83 mm
- 6 – rechte Klappe (GG-341-42) mit dem Sulcament hinter dem Gipfel, L 1.37 mm
- 7 – vorn unvollständige linke Klappe (GG-341-43) mit dem Sulcament etwas hinter dem Gipfel, L 0.76 mm, Höhe 0.50 mm
- 8 – rechte Klappe (GG-341-44) mit dem Sulcament hinter dem Gipfel, L 0.72 mm
- 9 – längliche linke Klappe (GG-341-45) mit dem Sulcament in der Nähe des Gipfels, L 1.26 mm
- 10 – sehr hohe linke Klappe (GG-341-46) einer jungen Larve mit fraglichem Sulcament, L 0.54 mm

Figs. 1–5 Lateralansichten, Fig. 6–10 Innenansichten



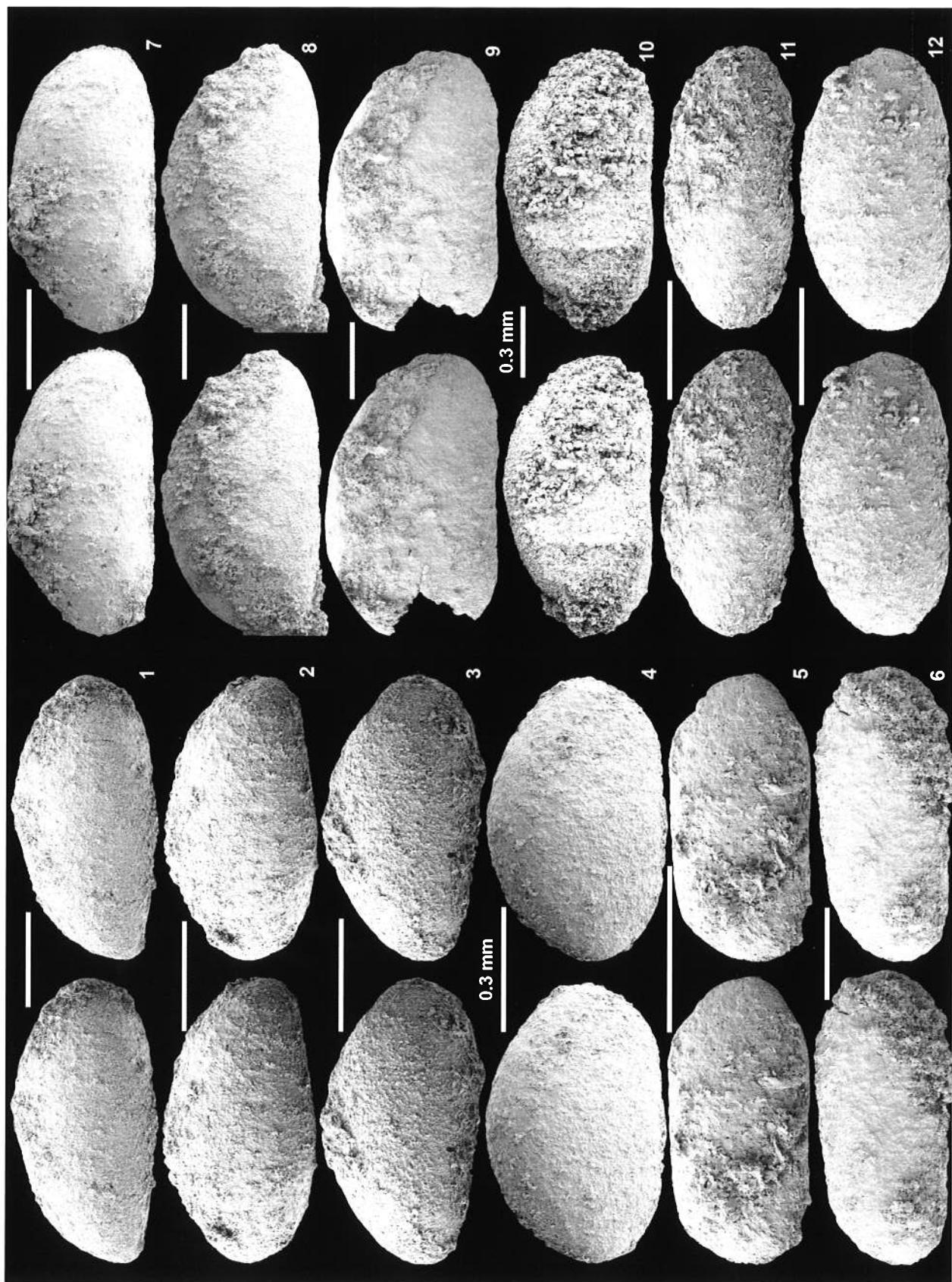
TAFEL 8 / PLATE 8

- 1–3 – *Longiscula ventroconvexa* sp.n., holotype (GG-341-38b), right valve (1), L 0.93 mm, paratype (GG-341-47a), left valve (2), L 0.54 mm, and paratype (GG-341-47b), right valve (3), L 0.53 mm  
4 – *Olbianella* sp. A, left valve (GG-341-14b), L 0.68 mm  
5 – *Platyrhomboides* sp. A, left valve (GG-341-47c), L 0.53 mm  
6 – *Parasclerites* sp. aff. *elongatus* SWAIN, 1962, right valve (GG-341-14c), L 0.98 mm  
7–8 – *Longiscula* sp. E, two left (?) valves (GG-341-47d, and -41c), L 0.86 mm, and 1.15 mm  
9–10 – *Longiscula* sp. D, anteriorly incomplete left valve (GG-341-47f), L 1.12 mm (9), and right valve (GG-341-41b), L 1.21 mm (10)  
11–12 – *Elliptocyprites* sp. A, left valve (GG-341-48a), L 1.12 mm (11), and right valve (GG-341-47e), L 0.74 mm (12)

All lateral views

- 1–3 – *Longiscula ventroconvexa* sp.n., Holotypus (GG-341-38b), rechte Klappe, L 0.93 mm (1), Paratypus (GG-341-47a), linke Klappe, L 0.54 mm (2), und Paratypus (GG-341-47b), rechte Klappe, L 0.53 mm (3)  
4 – *Olbianella* sp. A, linke Klappe (GG-341-14b), L 0.68 mm  
5 – *Platyrhomboides* sp. A, linke Klappe (GG-341-47c), L 0.53 mm  
6 – *Parasclerites* sp. aff. *elongatus* SWAIN, 1962, rechte Klappe (GG-341-14c), L 0.98 mm  
7–8 – *Longiscula* sp. E, zwei linke(?) Klappen (GG-341-47d, and -41c), L 0.86 mm, bzw. 1.15 mm  
9–10 – *Longiscula* sp. D, vorn unvollständige linke Klappe (GG-341-48a), L 1.12 mm (9), und rechte Klappe (GG-341-47f), L 1.21 mm (10)  
11–12 – *Elliptocyprites* sp. A, linke Klappe (GG-341-48a), L 1.12 mm (11), und rechte Klappe (GG-341-47e), L 0.74 mm (12)

Lateralansichten



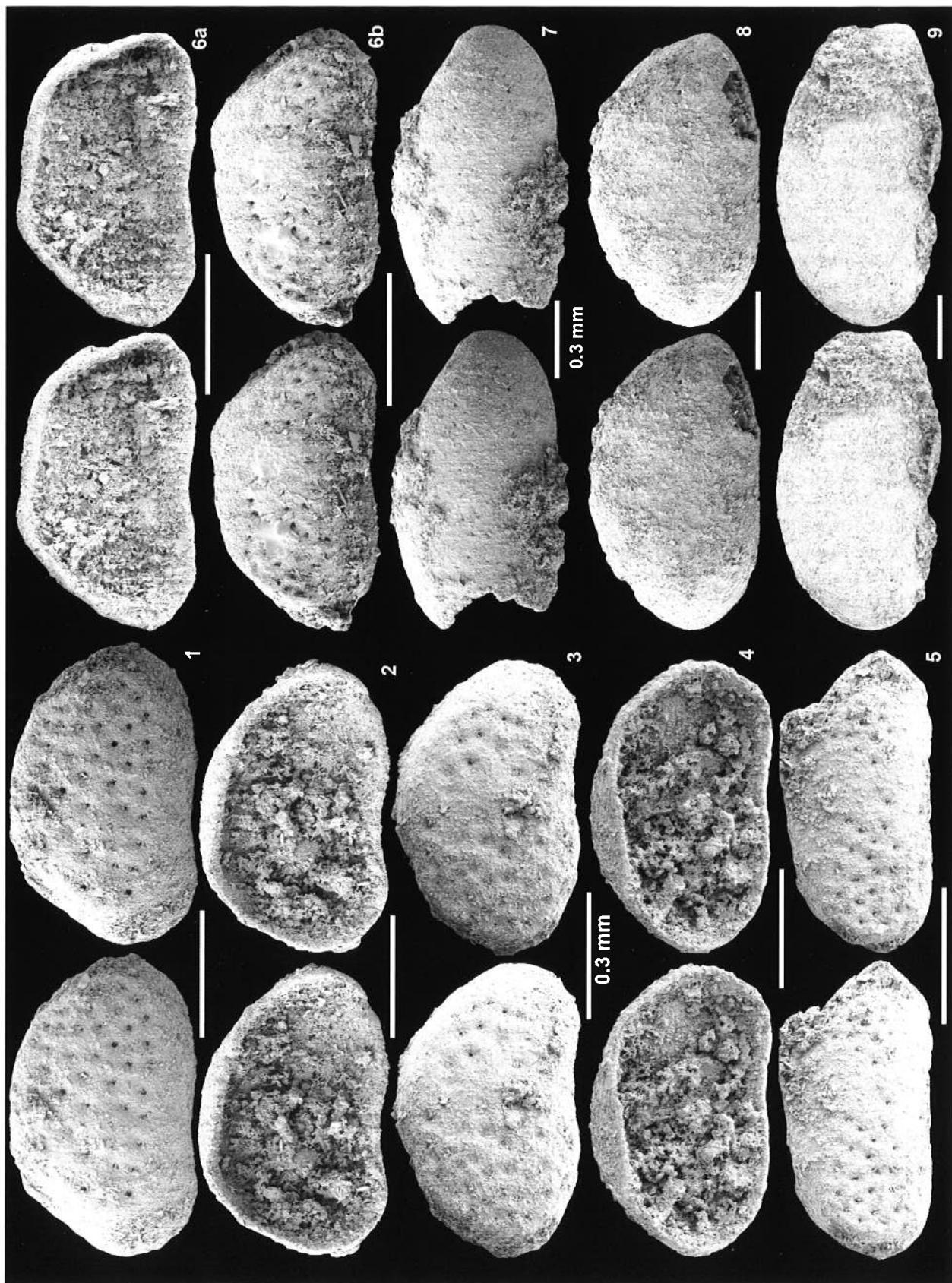
TAFEL 9 / PLATE 9

1–6 – *Morphohealdia wiefeli restricta* ssp. n.

- 1 – holotype (GG-341-49), left valve in lateral view, L 0.73 mm
- 2 – paratype (GG-341-50), right valve in internal view, L 0.71 mm
- 3 – paratype (GG-341-51a), right valve in lateral view, L 0.71 mm
- 4 – paratype (GG-341-52), left valve in internal view, L 0.74 mm
- 5 – right valve (GG-341-53a) in lateral view, elongate specimen, L 0.64 mm
- 6 – right valve (GG-341-54) in internal (6a) and lateral views (6b), L 0.67 mm
- 7 – *Longiscula* sp. A, left valve (GG-341-55a), L 1.21 mm, lateral view
- 8–9 – *Longiscula posteroangulata* sp.n., holotype (GG-341-55b), left valve, L 1.16 mm (8), and paratype (GG-341-41d), left valve, L 1.49 mm (9), lateral views

1–6 – *Morphohealdia wiefeli restricta* ssp. n.

- 1 – 1 Holotypus (GG-341-49), linke Klappe in Lateralansicht, L 0.73 mm
- 2 – Paratypus (GG-341-50), rechte Klappe in Innenansicht, L 0.71 mm
- 3 – 3 Paratypus (GG-341-51a), rechte Klappe in Lateralansicht, L 0.71 mm
- 4 – Paratypus (GG-341-52), linke Klappe in Innenansicht, L 0.74 mm
- 5 – rechte Klappe (GG-341-53a) in Lateralansicht, längliches Exemplar, L 0.64 mm
- 6 – rechte Klappe (GG-341-54) Innen- (6a) und Lateralansicht (6b), L 0.67 mm
- 7 – *Longiscula* sp. A, linke Klappe (GG-341-55a), L 1.21 mm, Lateralansicht
- 8–9 – *Longiscula posteroangulata* sp.n., Holotypus (GG-341-55b), linke Klappe, L 1.16 mm (8), und Paratypus (GG-341-41d), linke Klappe, L 1.49 mm (9), Lateralansicht



TAFEL 10 / PLATE 10

1–6 – *Brevicornina brevis* (BLUMENSTENGEL, 1965)

- 1 – left valve (GG-341-56a) with ventrolateral bend, L 0.54 mm
- 2 – left valve (GG-341-56b) with ventrolateral ridge, L 0.65 mm
- 3 – left valve (GG-341-57a) with subcomplete outline and ventrolateral bend, L 0.66 mm
- 4 – right valve (GG-341-58a) with elongate shape and ventrolateral ridge, L 0.60 mm
- 5 – left valve (GG-341-58b) with relatively high shape and ventrolateral ridge, L 0.67 mm
- 6 – right valve (GG-341-59) with ventrolateral flange, L 0.61 mm
- 7 – *Olbianella* ? sp. B, left valve (GG-341-60), 0.77 mm
- 8–9 – *Parasclerites* sp. aff. *lamellosus* SWAIN, 1962, right valve (GG-341-61a), L 0.68 mm (8), and left valve (GG-341-61b), L 0.50 mm (9)
- 10 – *Parasclerites* sp. A, left valve (GG-341-61c), L 0.54 mm
- 11 – *Conodomyra conocerata* (BLUMENSTENGEL, 1965), left valve (GG-341-62a), L 0.46 mm

All lateral views

1–6 – *Brevicornina brevis* (BLUMENSTENGEL, 1965)

- 1 – linke Klappe (GG-341-56a) mit ventrolateraler abgerundeter Kante, L 0.54 mm
- 2 – linke Klappe (GG-341-56b) mit ventrolateraler Rippe, L 0.65 mm
- 3 – linke Klappe (GG-341-57a) mit subcompletem Umriß und ventrolateraler Kante, L 0.66 mm
- 4 – rechte Klappe (GG-341-58a) mit langer Gestalt und ventrolateraler Rippe, L 0.60 mm
- 5 – linke Klappe (GG-341-58b) mit relativ hoher Gestalt und ventrolateraler Rippe, L 0.67 mm
- 6 – rechte Klappe (GG-341-59) mit ventrolateralem Flansch, L 0.61 mm
- 7 – *Olbianella* ? sp. B, linke Klappe (GG-341-60), 0.77 mm
- 8–9 – *Parasclerites* sp. aff. *lamellosus* SWAIN, 1962, rechte Klappe (GG-341-61a), L 0.68 mm (8), und linke Klappe (GG-341-61b), L 0.50 mm (9)
- 10 – *Parasclerites* sp. A, linke Klappe (GG-341-61c), L 0.54 mm
- 11 – *Conodomyra conocerata* (BLUMENSTENGEL, 1965), linke Klappe (GG-341-62a), L 0.46 mm

Lateralansichten



TAFEL 11 / PLATE 11

- 1–2 – *Pariconchoprimitia iranica* sp. n., paratypes (GG-341-22b – c), right valves, L 0.65 and 0.48 mm  
3 – Gen. n. sp. n. A, right (?) valve (GG-341-16c), L 0.48 mm  
4 – Gen. n. sp. n. B, left valve (GG-341-19b), L 0.53 mm.  
5–6 – *Longiscula* sp. E, left valves (GG-341-48b,d), L 0.96 and 0.82 mm  
7 – *Longiscula ventroconvexa* sp.n. ?, left valve (GG-341-48e), L 0.59 mm  
8 – *Parasclerites* sp. A, left valve (GG-341-48c), L 0.56 mm  
9 – *Elliptocyprites* sp. A, left valve (GG-341-61d), L 0.78 mm

All lateral views

- 1–2 – *Pariconchoprimitia iranica* sp. n., paratypes (GG-341-22b – c), rechte Klappen, L 0.65 and 0.48 mm  
3 – Gen .n. sp. n. A, rechte (?) Klappe (GG-341-16c), L 0.48 mm  
4 – Gen. n. sp. n. B, linke Klappe (GG-341-19b), L 0.53 mm  
5–6 – *Longiscula* sp. E, linke Klappen (GG-341-48b,d), L 0.96 and 0.82 mm  
7 – *Longiscula ventroconvexa* sp. n. ?, linke Klappe (GG-341-48e), L 0.59 mm  
8 – *Parasclerites* sp. A, linke Klappe (GG-341-48c), L 0.56 mm  
9 – *Elliptocyprites* sp. A, linke Klappe (GG-341-61d), L 0.78 mm

Lateralansichten

