DISCINID BRACHIPODS FROM THE KOPANINA FORMATION (SILURIAN) OF AMERIKA QUARRIES NEAR MOŘINA, BARRANDIAN, CENTRAL BOHEMIA

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A b s t r a c t. Rare, remarkably well preserved discinid brachiopods from the Kopanina Formation (Ludlow, Silurian) are described and figured. A new genus Ivanothele, with the type species Ivanothele mordor n. sp. is established, a new species of Orbiculoidea is described and two poorly preserved species are briefly noted.

Brachiopoda, Discinoidea, taxonomy, Silurian, Bohemia

Despite being widely reported from Ordovician, Silurian and Devonian strata, discinids are a poorly known group of lingulate brachiopods. New data on the morphology, taxonomy and evolutionary history of discinids has been presented by Bassett (1986), Holmer (1987) and Havlíček (1994) providing a basis for the revision of known species as well as the discrimination of new taxa.

The Silurian sequence in Central Bohemia is rich in discinid brachiopods. Barrande (1848, 1879) figured 23 species of discinids of Silurian age, but Havlíček et Mergl (1988) only revised a few of these species.

Bohemian discinids in the Barrandian area are generally preserved as isolated, exfoliated and commonly neanic shells. However, in the lower part of the Kopanina Formation (Ludlow) remarkably well-preserved specimens have been recovered. These shells come from tuffaceous limestones outcropping in Amerika quarries near Mořina („Na rešnách“, „Liščí lom“) and are commonly complete, with conjoint valves. They have well-preserved external layers of the shell and often belong to adult or gerontic specimens. All specimens come from the rich benthic assemblage of a shallow-water environment associated with numerous gastropods, corals, crinoids, brachiopods, bivalves and other invertebrate groups (Horný 1955, Kříž 1986, Havlíček et Štorch 1990). Discinids are a relatively rare component of the assemblage, and other lingulate brachiopods are completely absent. Articulate brachiopods are represented by the genera Isorthis, Dicoelosia, Skenidioides, Sufetirhynchia, Morinorhynchus, Kirkidium, Meristina, Howellella, and Janius (full list of species see Havlíček et Štorch 1990). Calcareous-shelled „inarticulate“ brachiopods are less common, and only the species Gasconsia transversa and Craniops vulcanus have been described (Mergl 1986, 1989).

Terminology used herein follows that of Rowell (1965). The material is deposited in the J. Bouška’s collection of the Geological Survey, Prague, and a single valve of Ivanothele is deposited in the paleontological collection of the District Museum of Rokycany.
Superfamily Discinoidea GRAY, 1840
Family Discinidae GRAY, 1840
Subfamily Orbiculoideinae SCHUCHERT et LEVENE, 1929

Genus Orbiculoidea D'ORBIGNY, 1847

Type species: Orbicula forbesi DAVIDSON, 1848

Orbiculoidea karlstejnensis n. sp.
Pl. I

Type horizon: Ludlow, Lower Kopanina Formation, tuffaceous limestone, layer with Encrinuraspis storchii.
Type locality: Barrandian, Mofina, quarry Amerika („Na rešnách“).
Material: Two complete shells, one ventral and one dorsal valve.
Description: Shell thin, 13 mm in length, and subequally convex. Ventral valve depressed, conical, elongately ovoid in outline, 120% as long as wide, with maximum width at midlength. Lateral margins less curved than posterior and anterior margins. Ventral apex located slightly posterior of centre of valve. Posterior slope straight and sloping evenly, anterior slope less steep than posterior slope in lateral view, with weakly concave profile immediately in front of the apex. Pedicle track is a long, narrow and shallow slit with the base formed by a flat listrium. Pedicle track has uniform width along the entire length, extending from the apex toward the posterior margin. Pedicle foramen small, 0.7 mm in diameter, situated near posterior margin. In the largest ventral valve, the foramen is located 1 mm anterior of the posterior margin.
Dorsal valve widely and asymmetrically conical, with apex in posterior third of valve. Dorsal valve is approximately as high as ventral valve. The steeper posterior slope and gentle anterior slope are slightly convex in lateral side view.

External ornament with regular concentric, low rugellae of uniform size, arranged at regular intervals. Rugellae about 30-50% as wide as interspaces, with crests 0.25-0.30 mm apart. Rugellae evenly curved anteriorly and laterally, but an obscure triangular sector of the posterior slope possesses weakly curved rugellae. This area is as about a quarter as wide as the valve. Interspaces are widely U-shaped, shallow, covered by weak concentric growth lines. Dorsal valve with 8-9 poorly defined, broad and evenly widening radial plications in anteromedian sector of valve. Narrow strip between posterior margin and pedicle foramen with same ornament as adjacent parts of the valve.

Interior: Ventral interior is devoid of distinct muscle impressions or palpal markings. A set of radial intervascular ridges is distinct anteromedianly. Dorsal valve interior with poorly defined slender median ridge extending anteriorly from the apex approximately to midlength.
Comparison: The new species with its elongate-oval outline is similar to Barrande's (1879) species Discina Bohemica from the Lower Devonian of the Koněprusy area. Unlike the new species, D. bohemia has a shorter pedicle track and fine concentric ornament. Other discinids from the Silurian of Bohemia figured by Barrande (1879) have more circular outlines and are usually smaller in size.
Occurrence: Type locality only.

Orbiculoidea (?) spp.
Pl. IV, figs. 4,5

Remarks: Two additional species of discinids are present in the collections, but lack of specimens makes comparison with other Bohemian discinids difficult. The first species (pl. IV, fig. 4) is characterized by a dorsal valve with high, posteriorly located apex and steep posterior slope. Internally, the species is distinguished by its deeply impressed muscles anterior of the apex.
The other species (pl. IV, fig. 5) contrasts with other discinids from the locality by its very delicate concentric ornament and flat dorsal valve.

**Ivanothele** n. gen.

**Type species:** *Ivanothele mordor* n. sp.

**Diagnosis:** Shell of medium size, with moderately conical ventral valve. Ventral apex pointed and slightly curved laterally forming an irregularly shaped valve; dorsal valve flat to slightly concave, with submarginal apex. Pedicle foramen close to apex, pedicle track short, closed by minute listrium. Pedicle tube long, curved, open immediately near the posterior margin. Ornament consists of rather coarse, high, concentric rugellae.

**Comparison:** *Ivanothele* can be distinguished from *Orbiculoides* D'Orbigny by the irregular shape of the ventral valve, and the flat to weakly concave, almost operculum-like, dorsal valve. The type species *Orbiculoides forbesi* (DAVIDSON) has a subcentrally located dorsal apex and a much longer pedicle track, while *Ivanothele* has a dorsal apex in a submarginal position and a pedicle track with a minute listrium.

**Ivanothele mordor** n. sp.

Pl. II; pl. III; pl. IV, figs. 1-3

**Holotype:** Complete shell, figured in pl. III, fig. 4, deposited in the paleontological collection of the Museum of Rokycany under No. MR 1996/27.

**Type horizon:** Ludlow, Lower Kopanina Formation, tuffaceous limestone, layer with *Encrinurus* sp.

**Type locality:** Barrandian, Mořina, quarry Amerika („Na rešnách”).

**Material:** Six complete shells, two ventral valves and one dorsal valve.

**Description:** Shell, 17 mm in length in the largest specimens available, somewhat irregular in a shape.

Ventral valve moderately high, asymmetrically conical, some 55% as high as long. Shell subcircular in outline, the L/W ratio decreases during ontogeny; the neanic shells are 93% as long as wide, the shells of large adult specimens are 85-87% as long as wide. Anterior, lateral and posterior margins evenly curved, with commissure rectimarginate. Ventral apex pointed, located in posterior third of the valve. During ontogeny, the ventrally directed apex progressively changes anteroventrally eventually becoming laterally directed. In lateral view, the posterior slope is steeply sloping and slightly convex, the anterior slope is straight to concave near the apex but slightly convex anteriorly. Pedicle track elongate, about 2 mm long and 0.7 to 0.8 mm wide, with small but distinct listrium. Pedicle foramen small, 0.6 mm wide, elongate oval.

Dorsal valve circular and flat in small specimens, but slightly to moderate concave in adults. Apex located in 40% of the valve length anterior of the posterior margin. Neanic shell up to 1 mm in diameter weakly convex, larval shell moderately convex, resting obliquely on postlarval shell.

Ornament consists of coarse, regular concentric rugellae separated by slightly broader, flat interspaces. The size of rugellae in juvenile shell rapidly increases with moderate to large sized shells having 2-3 rugellae per 1 mm. The rugellae run parallel to the margin along the entire length, with new rugellae only rarely originating by intercalation. Rugellae often contain minute irregularities, filled by layers with growth lines which curve backwards and are wrinkled.

Interior of ventral valve with long pedicle tube, irregularly curved and running toward the posterior margin. The tube dissapears at approximately one third of the posterior slope. Dorsal valve interior poorly known, with convergent, undifferentiated pair of muscle scars, located laterally and anterolaterally to the apex. Proximal trunks of slender vacula media extend from the visceral area.

**Comparison:** The slightly irregular shell shape of the new species is unlike any other described discinid from the Silurian or Devonian of Central Bohemia. Specimens from the Silurian of Bohemia assigned by Barrande (1879, pl. 100, figs. II: 5-11) to *Discina maetis* EICHWALD of
comparable age belong to the genus Orbiculoidea D'ORBIGNY and can be compared with the
type species Orbicula forbesi DAVIDSON.
Holmer (1987) redescribed two orbiculoid species from the Ordovician of Sweden; both species
(Orbicula orbiculoideae and Orbiculoidea) were assigned with
some reservation to Orbiculoidea by Holmer (1987) and are very similar to the genus Ivanothele.
Both Swedish species also have a short pedicle track, submarginal ventral and dorsal valve apices,
a high ventral valve with identical lateral profile, and a tendency toward asymmetry of the ventral
apex. As in Ivanothele mordor n. sp., the Swedish species also possess rather coarse concentric
rugellae. However, unlike I. mordor n. sp. both Swedish species have more posteriorly located
apices and the asymmetry of their ventral valves is less significant.
Remarks: Asymmetry in phosphatic-shelled brachiopods is rarely developed. Deviation from
bilateral symmetry in lingulate brachiopods is so far known only from the family Eocomulidae
(genera Eocomulus, Undiferina, Otariella) and is rare in some genera of Trematidae (Psychopeltis,
Schizocrania). To the author's knowledge, no distinctly asymmetrical species of discinid brachiopods have previously been reported. The loss of symmetry is usually related to a cementing or
encrusting habitat in different groups (craniids, orthotetids, numerous productidinids, lissakypids,
davidsoniids in brachiopods; ostreids, anomids etc. in bivalves). Specimens of Ivanothele without
preserved cicatrix at the ventral apex may have been attached by a functional pedicle, and asymmetry
is closely related to the type of the substrate (? algae, rocks), or to aid anchoring of the asymme-
trical conical ventral valve in a soft substrate. The presence of both right- and left- „handed"
specimens is noteworthy (pl. II, figs. 4a and 5).
Occurrence: Type locality only.

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EXPLANATION OF PLATES:

All material comes from tuffaceous limestones of the lower Kopanina Formation in the locality Močina, quarry Amerika („Na rešnách“).

Pl. I
*Orbiculoidea karstefjennis* n. sp.
1 - complete shell of moderate size, holotype, dorsal (a), ventral (b) valves and lateral view (c) with dorsal valve above, JB 18a, all x5.
2 - incomplete shell, dorsal (a) and ventral (b) valves, JB 18b, x5.
3 - ventral valve, internal mould with partly preserved shell (b) and detail of posterior slope (a), JB 05a, x5 (b), x10 (a).
4 - dorsal valve, internal mould, JB 05b, x5.

Pl. II
*Ivanothela mordor* n. sp.
1 - complete shell, internal mould of dorsal valve, JB 06a, x5.
2 - complete shell, exfoliated dorsal valve, JB 06b, x5.
3 - complete, partly exfoliated shell, lateral view, ventral valve above, JB 06c, x5.
4 - complete shell, exfoliated ventral valve, posterior (a), ventral (b), and lateral (c) views, JB 16, x5.
5 - complete shell, exfoliated ventral valve showing pedicle tube, posterior view, JB 06d, x5.

Pl. III
*Ivanothela mordor* n. sp.
1 - ventral valve, side (a) and ventral (b) views, JB 14b, x5.
2 - complete shell, dorsal valve, JB 06c, x5.
3 - dorsal valve, JB 14A, x5.
4 - complete shell, holotype, dorsal (a), ventral (b) valves and side view (c) with ventral valve above, MR 1/96/27, x5.

Pl. IV
*Ivanothela mordor* n. sp.
1 - ventral valve, detail of ornamentation, JB 14b, x10.
2 - small ventral valve, oblique view, JB 06e, x5.
3 - complete shell, ventral valve, JB 06a, x5.

*Orbiculoidea (?)* spp.
4 - dorsal valve, internal mould, JB 15, x5.
5 - exterior of dorsal valve, JB 04a, x10.
DISCINIDNÍ RAMENONOŽCI Z KOPANINSKÉHO SOUVRSTVÍ Z LOMŮ AMERIKA
U MOŘINY, BARRANDIEN, STŘEDNÍ ČECHY.

Pozoruhodně zachovalý materiál brachiopodů ze spodní části kopaninského souvrství umožnil rozlišit celkem čtyři druhy discinidních brachiopodů. Dva z nich jsou dva ponechány v otevřeném systematickém postavení, jeden je popsán jako nový druh rodu Orbiculoidia a zbývající druh je typovým druhem nově stanového rodu Ivanothele. Ivanothele mordor n. sp. je druh pozoruhodný ztrátou bilaterální symetrie misk. Během růstu docházelo k přetáčení vrcholu břišní misky do strany a vzniku asymetrického vzhledu. Všechny studované misky druhu Ivanothele mordor n. sp. jeví různý stupeň asymetrie. Tato asymetrie odráží morfologické přizpůsobení tvaru podkladu během růstu nebo lepší udržení stability na písčitém dně, na rozdíl od četných skupin ramenonožců a mlžů, u kterých asymetrie spíše odráží přísný způsob života s cementací jedné z misk ke podkladu.
Mergl: Discinid brachiopods...
M. Mergl: Discinid brachiopods...