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First record of Discinidae brachiopods from the Miocene of Hungary

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Abstract – Although Discinidae brachiopods are rare components of Neogene benthic assemblages, several records were published from the Miocene of the Central Paratethys (Poland, Ukraine, Czech Republic, Austria, and Bulgaria). However, until now discinid brachiopods have never been mentioned from Hungary. Recently, remains of one species, *Discradisca* cf. *polonica* (Radwańska et Radwański, 1984) were found at two Middle Miocene (Badenian) localities of the Bakony Mts. Two fragments were discovered in old washed samples (Pusztamiske Formation) from the Szabó sand pit of Várpalota in the collection of the Hungarian Natural History Museum, Budapest. The same species is much more numerous in a new material collected at Nyirád locality. Here hundreds of very eroded and fragmentary discinids were found in the Pusztamiske Formation, while the overlying Leitha Limestone Formation contains less, but sometimes more or less complete specimens. *D. polonica* seems to be restricted to shallow water environments. The Hungarian record is one of the most southern known occurrences of discinid brachiopods in the Central Paratethys (together with the very limited Bulgarian material). With 22 figures.

Key words – Badenian, Bakony Mts, Brachiopoda, Discinidae, *Discradisca*, Hungary, Miocene, Transdanubia

INTRODUCTION

Miocene benthic assemblages of the Central Paratethys are very diverse, but brachiopods belong to the rare constituents. Phosphatic brachiopods are even rarer, because most of the known brachiopods belong to calcitic-shelled Rhynchonelliformea. Phosphatic brachiopods are represented by lingulids and discinids in the Neogene. Lingulids were mentioned from several localities of the Central Paratethys, and according to the revision by Emig & Bitner (2005) all lingulid records of the Central Paratethys belong to a single species, *Lingula dregeri* Andreae, 1893. The first report on Miocene lingulid remains from Hungary was published recently by Bitner *et al*. (2012), and the above mentioned species was identified from the Badenian Leitha Limestone Formation of Budapest, Örs vezér square locality.

Discinids have more diverse records in the Central Paratethys. Dreger (1889) described *Discinisca scutellum* from the Vienna Basin on the basis of a single fragmentary dorsal valve, and the same specimen was re-illustrated without detailed discussion by Kroh (2003). *Discinisca leopolitana* was first mentioned by Łomnicki (1897) from the Middle Miocene of western Ukraine (Lviv) as *Discina* sp. (*leopolitana*); however, formal description and illustration was given only by Friedberg (1921), who regarded as author of this species (see also in Radwańska & Radwański 1984). A new species, *Discinisca carpathica* was erected by Čtyroký & Fejfar (1963) from the Miocene of the Czech Republic. Radwańska & Radwański (1984) introduced a new species, *Discinisca polonica* from the Middle Miocene Korytnica Clay in Central Poland. Later *D. leopolitana* was recorded from two additional localities, St. Margarethen (Vienna Basin, Austria) by Schmid *et al.* (2001) and Świniary (Holy Cross Mountains, Poland) by Radwański & Wysocka (2004). Kocsis *et al.* (2012) studied the geochemical composition of Neogene phosphatic lingulids and discinids from the North Sea Basin and the Central Paratethys, including some *D. leopolitana* from Huta Lubycka and Rybnica (Poland) and *D. polonica* from Korytnica (Poland). Dulai (2015) published Central Paratethyan Middle Miocene brachiopods from the collection of Naturalis Biodiversity Center (Leiden, the Netherlands), including *Discinisca leopolitana* from Monastyrz and Rybnica (Poland), and *Discradisca polonica* from Korytnica (Poland). Specifically unidentified *Discina* sp. was mentioned from Monastyrz and Huta Lubycka (Lublin Upland, Poland) by Popiel-Barczyk (1977, 1980), *Discinisca* sp. from Szydlów (Holy Cross Mts, Poland) by Dulai & Stachacz (2011), and *Discradisca* sp. from Yasen (Bulgaria) by Bitner & Motchurova-Dekova (2016) and from Brus-1 borehole (Carpathian Foredeep, Czech Republic) by Kopecká *et al.* (2018). Until now, discinid brachiopods have never been identified in the Miocene of Hungary.

GEOLOGICAL SETTINGS

The Paratethys was an epicontinental sea, which was isolated from the Tethys Ocean during the late Eocene (Rögl 1998). The Central Paratethys covered the area from the present-day Austria to Slovenia, Serbia, Bulgaria, Romania, Ukraine, Slovakia, Poland and Czech Republic. During the Badenian (16.4 to 13.0 Ma; Langhian to Middle Serravallian; Papp *et al.* 1978) the Central Paratethys had a stable marine connection with the Mediterranean in the present-day Slovenia (Kókay 1985; Rögl 1998). The thick Badenian marine deposits refer to a mixed siliciclastic and carbonate sedimentation (Kováč *et al.* 2007). Coralline algae and various invertebrates and vertebrates are abundant and diverse in these sediments, but brachiopods are generally rare.

Both studied localities are in the Bakony Mts (Transdanubian Range, Hungary) (Fig. 1). The protected Szabó sand pit is situated at the SW part of Várpalota, near the Rákóczi residential area. The section consists of several metres thick yellow or grey littoral sand (Pusztamiske Formation) full of resedimented mollusc shells (lido facies; Kókay 2007). The age of the sand is Lower Badenian (upper Lagenidae Zone; Kókay 2007). The diverse molluscs are well-preserved, sometimes with original colours. More than 400 mollusc species were identified in several papers and monographs (e.g., Strausz & Szalai 1943; Strausz

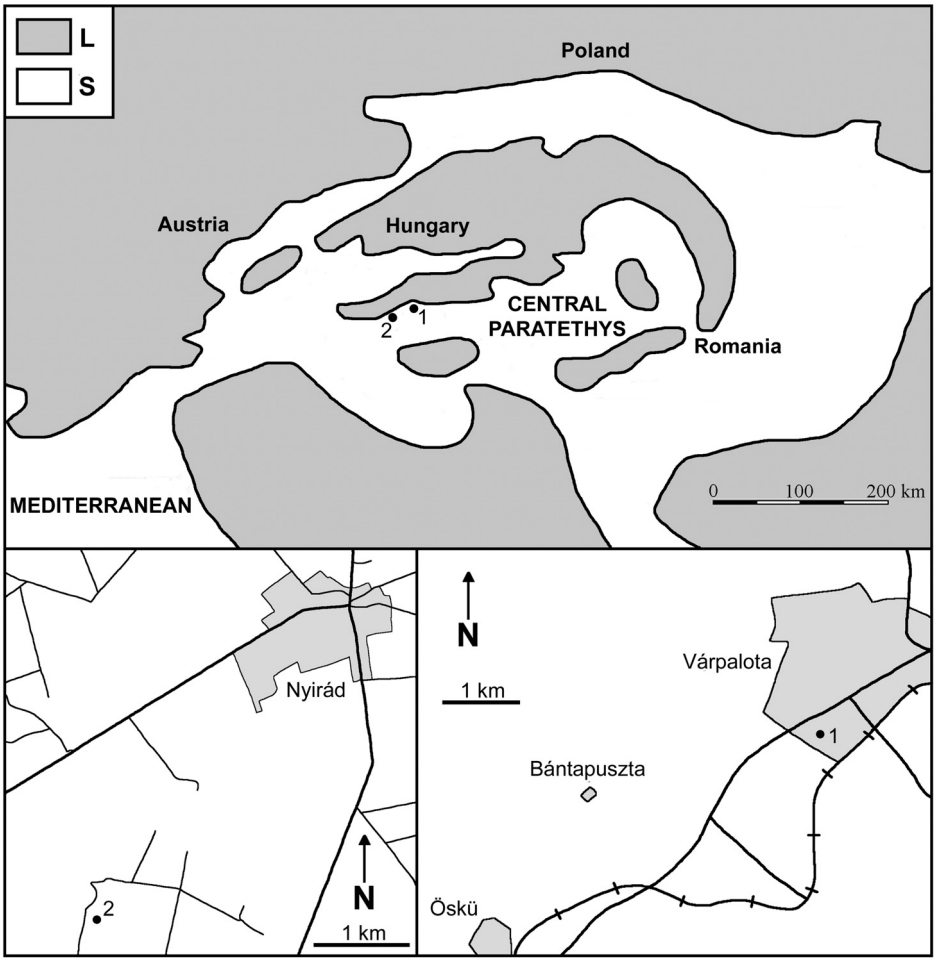


Fig. 1. Location of the studied localities. Palaeogeographic sketch map of the Central Paratethys (modified after Moissette *et al.* 2006) and geographic position of the localities (modified after Kókay 1988 and Szabó & Kocsis 2016). 1 = Várpalota, Szabó sand pit, 2 = Nyirád, abandoned gravel pit, L = land, S = sea

1954; Kecskeméti-Körmendy 1961, 1962*a*, *b*; Kókay 1988). The lower part of the section contains nearly 100 species of benthic foraminifers (Kókay 2007). Bryozoa fauna of the sand was investigated by Moissette *et al.* (2006, 2007), and on the basis of 15 species they interpreted the locality as representing the sediments deposited in a shallow-water environment on a terrigenous platform. The sands correspond to a beach environment where skeletal remains from various depth intervals accumulated (Moissette *et al.* 2007). Although these layers are very fossiliferous, until recently brachiopods were not recorded from this locality. Dulai (2015) mentioned single *Joania cordata* specimen on the basis of a sample in Naturalis Biodiversity Center (Leiden, the Netherlands), collected by Arie W. Janssen in Szabó sand pit in 1979.

Nyirád locality is an abandoned gravel pit about 3 km SW from Nyirád, close to the road from Nyirád to Sümeg. The fossils were collected by Márton Szabó, and they are from the eastern side of the quarry, where two fossil-bearing Middle Miocene formations can be found: Pusztamiske Formation and Leitha Limestone Formation (Szabó & Kocsis 2016, figs 2–3). The Lower Badenian Pusztamiske Formation, known from the Devecser-Nyirád Basin, is built up of coarse- and fine-grained marine sediments. The sediments consist of abrasional gravel, conglomerate, shallow water glauconitic sand, sandstone, silt, marl and corallinacean limestone lenses (Selmeczi 1996). The pebbly deposits contain several very fragmentary fossils (pectinid and ostreid molluscs, echinoderm spikes, foraminifers, bryozoans, cirriped fragments, chondrichthyan and osteichthyan teeth, and various bone elements of marine mammals; Selmeczi *et al.* 2002; Szabó & Kocsis 2016). A stratigraphical investigation of these layers yielded Lagenidae-*Orbulina* benthic foraminifera assemblage and refers to NN5 nannozone (Kercsmár *et al.* 2015). The Pusztamiske Formation is overlain by Leitha Limestone Formation with a gradual transition (see simplified section of the locality in Szabó & Kocsis 2016, Fig. 3C). This shallow water corallinacean limestone is widespread in the Central Paratethys. Generally it is very fossiliferous, e.g., the Nyirád washed samples contain several invertebrates, e.g., foraminifers, molluscs (gastropods, bivalves, scaphopods), echinoderms, bryozoans, decapods, worm tubes, and brachiopods. Brachiopods, other than discinids, will be discussed in a separate paper.

MATERIAL AND METHODS

Two fragmentary discinid specimens of Várpalota, Szabó sand pit were found in the old palaeontological collection of the Hungarian Natural History Museum, Budapest. A detailed, bed-by-bed collection was accomplished at the protected locality by Anna Kecskeméti-Körmendy, who studied the mollusc fauna of the fossiliferous Lower Badenian sand (Kecskeméti-Körmendy 1961,

1962*a*, *b*). Although she worked in the Geological Institute of Hungary, some of her washed samples were deposited in the Hungarian Natural History Museum.

Most of the studied specimens are from the abandoned gravel pit of Nyirád. The samples were collected recently by Márton Szabó with the main purpose to study fish teeth and marine mammal bones of the locality (Szabó & Kocsis 2016).

All of the studied specimens are deposited in the palaeontological collection of the Hungarian Natural History Museum, Budapest (inventory numbers: INV 2018.31.–2018.40.).

SYSTEMATIC PALAEONTOLOGY

Phylum Brachiopoda Duméril, 1806
Subphylum Linguliformea Williams, Carlson, Brunton, Holmer et Popov, 1996
Class Lingulata Gorjansky et Popov, 1985
Order Lingulida Waagen, 1885
Superfamily Discinoidea Gray, 1840
Family Discinidae Gray, 1840
Genus *Discradisca* Stenzel, 1964
Type species – *Orbicula antillarum* d'Orbigny, 1845

Discradisca cf. *polonica* (Radwańska et Radwański, 1984) (Figs 2–22)

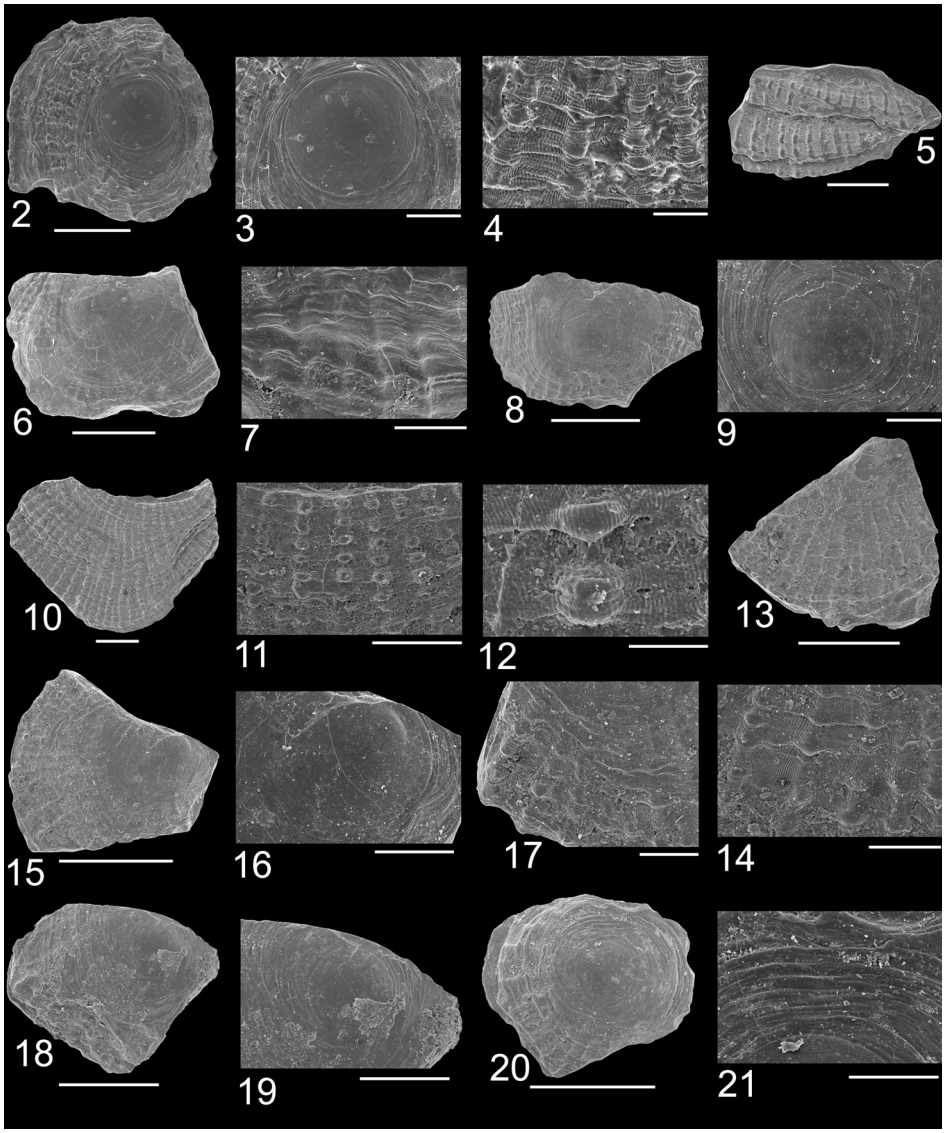
1984 *Discinisca polonica* sp. n. – Radwańska & Radwański, pp. 254–258, text-figs 1–3, pl. 1, figs 1–6, pl. 2, fig. 1.
2015 *Discradisca polonica* (Radwańska & Radwański) – Dulai, pp. 192, pl. 1, figs 5–10.

Material – Várpalota, Szabó sand pit, Pusztamiske Formation (2 fragments); Nyirád, gravel pit, Pusztamiske Formation (200 fragments), Leitha Limestone Formation (1 dorsal valve, 7 fragments).

Remarks – Except for one specimen, the studied brachiopods are rather fragmentary, but some of them give useful information on the larval shell and the ornamentation of the dorsal valve (Figs 2–21). The only complete dorsal valve from the Leitha Limestone Formation of Nyirád is fully covered by a celleporid bryozoan colony. Therefore, the larval shell and the ornamentation is not observable, however, this specimen is informative for the size, the outline and general shape of the dorsal valve (Fig. 22). After combining these available data, the studied material reliably can be identified as *D.* cf. *polonica*.

The organo-phosphatic shells are nearly black in the case of the Várpalota specimens, while reddish brown in the Nyirád samples. The outline of the com-

plete shell is nearly circular (Fig. 22), but irregular or broken at some places. The irregularly circular outline is also suggested by some of the illustrated fragments (e.g., Figs 2, 13, 15). Radwańska & Radwański (1984) mentioned some rectangular or even polygonal specimens; however, in the case of the Hungarian material the fragmentary preservation prevents to confirm this feature. The diameter of the complete dorsal valve is about 5.5 mm (similar to the largest one mentioned by Radwańska & Radwański 1984). According to the complete



valve and the more or less concentric growth lines of the fragments (e.g., Figs 2, 20), the apex is in central or nearly central position. Both the complete specimen and the fragments refer to low-conical shape. The diameter of the completely smooth, circular larval shell is about 0.47–0.53 mm (Figs 3, 9, 20), slightly larger than in the case of Korytnica specimens (both Radwańska & Radwański 1984 and Dulai 2015 mentioned 0.4 mm; however, in the latter case it is 0.45 mm on Pl. 1, Fig. 6). In some cases three different growth stages can be differentiated on the dorsal shells: the completely smooth larval shell, the post-larval shell characterized by dense growth lines and the adult part of the shell, where the radial ribs appeared (e.g., Figs 2, 8, 20). The external ornamentation of dorsal valves is characterized by numerous radial ribs. The number of ribs cannot be identified exactly on the fragments or on the Bryozoa-covered complete valve. However, the density of ribs is well comparable with the Korytnica specimens. The characters of ribs are also very similar to Radwańska & Radwański's (1984) description. Well defined swells formed at the intersections of ribs and growth lines which give a beaded appearance for the ribs (e.g., Figs 2, 4, 5, 7, 13, and 14). In some cases the beaded character of ribs is especially strong, even without definite growth lines (e.g., Figs 10–12). The ribs never bifurcate, but some new ribs can be seen intercalated at various growth stages (see Fig. 10). Interspaces are wider than ribs (Fig. 11). Unfortunately, the interior of the single complete valve is not well-preserved enough to identify precisely the muscle scars (see horseshoe-shaped white part on Fig. 22).

Although the specimens are rather fragmentary in the coarse-grained Pusztamiske Formation, the number of fragments is considerable, as it was not very

Figs 2–21. *Discradisca* cf. *polonica* (Radwańska et Radwański, 1984). – **2–4.** Várpalota, Szabó sand pit, 680–690 cm, INV 2018.31. – **2.** External view of dorsal valve. – **3.** Detail of the smooth larval shell. – **4.** Detail of the ribbed ornamentation. – **5.** Várpalota, Szabó sand pit, 520–530 cm; External view of dorsal valve fragment, INV 2018.32. – **6–7.** Nyirád, Pusztamiske Formation, INV 2018.33. – **6.** External view of dorsal valve. – **7.** Detail of growth lines and radial ribs. – **8–9.** Nyirád, Pusztamiske Formation, INV 2018.34. – **8.** External view of dorsal valve. – **9.** Detail of the smooth, circular larval shell and the post-larval shell ornamented by dense growth lines. – **10–12.** Nyirád, Pusztamiske Formation, INV 2018.35. – **10.** External view of dorsal valve. – **11.** Detail of ornamentation of beaded radial ribs. – **12.** Beads within a radial rib and radial micro-ornamentation on and around beads. – **13–14.** Nyirád, Pusztamiske Formation, INV 2018.36. – **13.** External view of dorsal valve. – **14.** Detail of external ornamentation with capillate micro-ornamentation. – **15–17.** Nyirád, Pusztamiske Formation, INV 2018.37. – **15.** External view of dorsal valve. – **16.** Detail of larval shell. – **17.** Detail of the rare and irregular ornamentation. – **18–19.** Nyirád, Pusztamiske Formation, INV 2018.38. – **18.** External view of dorsal valve. – **19.** Detail of the larval and post-larval shell. – **20–21.** Nyirád, Pusztamiske Formation, INV 2018.39. – **20.** External view of dorsal valve. – **21.** Detail of post-larval shell with dense and irregular concentric growth lines. Scale bars represent 1 mm (5, 6, 8, 10, 13, 15, 18, 20); 0.5 mm (2, 11, 19); 0.25 mm (9, 16); 0.2 mm (3, 7, 14, 17, 21); 0.1 mm (4, 12)

common in the Korytnica Basin either. Despite the systematic washing, Radwańska & Radwański (1984) mentioned only a few dozens of dorsal valves, while the three samples of Naturalis Biodiversity Center in Leiden contained nearly 200 fragments (Dulai 2015).

This is the first record of this species outside of Poland, as it was originally described from the Korytnica Basin by Radwańska & Radwański (1984) and recently it was mentioned from the same area by Dulai (2015). A similar ribbed discinid was described also from the Vienna Basin by Dreger (1889) on the basis of a single, fragmentary dorsal valve (*Discinisca scutellum*, see also in Kroh 2003). It is smaller in size and has fewer ribs than *polonica*, but the fragmentary, even more damaged condition than originally illustrated by Dreger (1889) make the real revision and comparison very difficult. The third ribbed discinid from the Miocene of the Central Paratethys is *Discinisca carpathica* described by Čtyroký & Fejfar (1963); however, it is easily distinguishable on the basis of the significantly larger size, and much numerous fine ribs. The fourth and most widely distributed Central Paratethyan discinid is *Discinisca leopolitana*, which

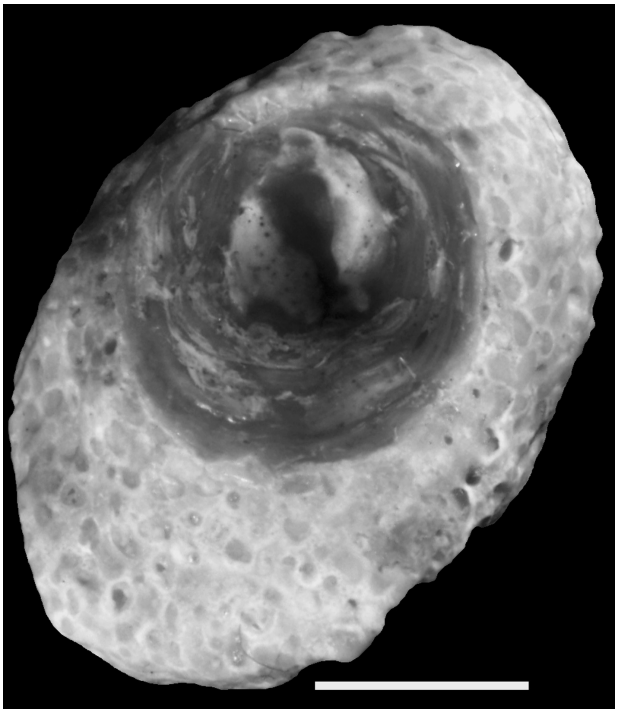


Fig. 22. *Discradisca* cf. *polonica* (Radwańska et Radwański, 1984). Internal view of a more or less complete dorsal valve covered by celleporid bryozoan colony. Nyirád, Leitha Limestone Formation, INV 2018.40. Scale bar: 3 mm

is ornamented only by concentric growth lines (Łomnicki 1897; Friedberg 1921; Schmid *et al.* 2001; Radwański & Wysocka 2004; Dulai 2015). A similar discinid species, *Discradisca multiradiata* (de Morgan, 1915) is known also from the Miocene of France (Dollfuss & Dautzenberg 1901; de Morgan 1915; Dulai 2013; Bitner & Cahuzac 2013); however, it has more numerous (80–100) fine, beaded ribs, and its apex is situated more regularly in central position. The generic attribution of the species *polonica* to *Discradisca* was discussed in detail by Dulai (2013) and Bitner & Cahuzac (2013).

D. polonica seems to be restricted to shallow water environments: it was described from the littoral deposits of the Korytnica Basin (Radwańska & Radwański 1984), and both Hungarian localities also refer to shallow habitats in the palaeoenvironmental reconstructions (e.g., Moissette *et al.* 2007; Selmeczi 1996). The shape variability and irregularity was interpreted by Radwańska & Radwański (1984) as adaptation to the high-energy environment of the shore zone.

Distribution – Middle Miocene (Badenian): Korytnica (Poland), Várpalota and Nyirád (Hungary).

DISCUSSION

Although Discinidae brachiopods were recorded several times from the Central Paratethys, until now they have never been mentioned from Hungary. Recently several fragmentary specimens were discovered at two Middle Miocene (Badenian) localities of the Bakony Mts (Transdanubian Range). The preservation of the brachiopods is rather poor and fragmentary. The surface of the single complete dorsal valve is covered by a celleporid bryozoan. Despite the fragmentary preservation, several specimens show radial ribbing, and only the larval shell is completely smooth. On the basis of the size, outline and shape of the complete valve, and the characters of ribbed ornamentation on several fragments, these brachiopods are identifiable with the species *Discradisca* cf. *polonica*.

This is the first record of the family Discinidae in the Miocene of Hungary, and it is one of the most southern occurrences of discinids within the Central Paratethys. The only more southern point of their Central Paratethyan distribution is NW Bulgaria, where Bitner & Motchurova-Dekova (2016) have found only two *Discradisca* sp. fragments. Fossil discinids are also very rare in the Neogene of the Mediterranean. The first record was published only recently by Bertolaso *et al.* (2009), when some Pliocene (Piacenzian) *Discinisca* sp. were found in the upper bathyal clays of Quattro Castella (Emilia, Italy). At the moment it is difficult to decide, whether this distributional pattern refers to palaeoenvironmental preferences of Neogene discinids or only to collecting bias. Discinids

are generally small-sized, and therefore collecting bias most probably plays important role in their knowledge. However, it is also worth mentioning that discinids are more common in the Neogene of the North Sea Basin. A separate paper is in preparation on the discinid brachiopods of the famous Dutch Winterswijk-Miste locality, where the very limited brachiopod material is represented by three different discinid species (Dulai *et al.* in prep.). The distributional pattern of European Neogene discinid brachiopods will be discussed in that paper.

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