



## The brachiopod *Lingula* in the Middle Miocene of the Central Paratethys

CHRISTIAN C. EMIG and MARIA ALEKSANDRA BITNER

**In the Middle Miocene deposits of the Central Paratethys, lingulides, because of their low taphonomic potential, are very rare and difficult to identify. Two species of *Lingula*, *L. dumortieri* Nyst, 1843 and *L. dregeri* Andreae, 1893, have been recorded from the Badenian (Middle Miocene) of Poland. Re-examination of the specimens has shown that none of them can be referred to *Lingula dumortieri* (now *Glottidia dumortieri*). The rounded outline of the scar of the posterior adductor muscle and the lack of the septa indicate that all the specimens must be referred to the genus *Lingula*. Their valves appear to be slightly more convex than in other species of *Lingula* and closely resemble the Recent *L. tumidula* Reeve, 1841. We assign all the specimens of *Lingula* found in the Miocene of Poland to *L. dregeri*. Because our specimens are juveniles and some are broken we cannot adequately redescribe this species. *Lingula dregeri* was distributed in the Middle Miocene of the Central Paratethys (Austria, Poland, Ukraine, Romania), while *Glottidia dumortieri* occurs in the Pliocene of Northern Europe (Atlantic Province).**

### Introduction

Although articulate brachiopods are common in the Middle Miocene deposits of the Central Paratethys (Barczyk and Popiel-Barczyk 1977; Bitner 1990, 1993; Popiel-Barczyk and Barczyk 1990; Bitner and Pisera 2000), lingulides, because of their low taphonomic potential, are very rare and difficult to determine (Emig 1997). The lingulide specimens recorded in the Badenian (Middle Miocene) of the Korytnica Basin and Wójcza-Pińczów Range (Poland) have been referred to two species of *Lingula*: *L. dumortieri* Nyst, 1843 by Barczyk and Popiel-Barczyk (1977), and *L. dregeri* Andreae, 1893 by Popiel-Barczyk and Barczyk (1990). A re-examination of the specimens identified as *L. dumortieri* by Barczyk and Popiel-Barczyk (1977) led to the conclusion that these specimens do not belong to that species. Earlier Friedberg (1921) assigned the lingulides from the Middle Miocene of Podolia, Ukraine to *Lingula* aff. *dumortieri*. However, *L. dumortieri* Nyst was originally described from the Pliocene of Belgium, near Antwerp (Nyst 1843; Davidson 1874; Vincent 1893). It was also reported from the Pliocene of England by Davidson (1852). Chuang (1964) showed that this species must be assigned to *Glottidia* according

to the presence of the septa that characterize the genus. This identification is confirmed by Emig and Bitner (in press). *Glottidia dumortieri* is restricted to the Pliocene of the northern European Atlantic province.

*Institutional abbreviations.*—MZ, Museum of the Earth, Polish Academy of Sciences, Warsaw, Poland; ZPAL, Institute of Paleobiology, Polish Academy of Sciences, Warsaw, Poland.

### Material examined

The specimens assigned by us to *Lingula dregeri*, and originally referred to *L. dumortieri* by Barczyk and Popiel-Barczyk (1977) MZ VIII Bra-1204/1-2 (2 specimens) and MZ VIII Bra-1204/3-4 (5 specimens) have been re-examined (Table 1). Barczyk and Popiel-Barczyk (1977) indicated the length for these specimens from 6.0 to 8.5 mm and the width from 3.0 to 3.5 mm. Muscle scars were seen and described on three dorsal valves (Figs. 1, 2). From the Lublin Upland (Poland) (Fig. 3), *L. dumortieri* was cited by Jakubowski and Musiał (1977) and by Popiel-Barczyk (1977). Two specimens collected in this area by one of the authors (MAB), ZPAL Bp.54 have also been re-examined (Table 1; Fig. 1); these were cited as *Lingula* by Popiel-Barczyk (1980).

### Results

- No valve and valve fragment bears a septum: for this reason alone the specimens cannot be referred to *Glottidia dumortieri*. The absence of septa may be also seen in the figures by Barczyk and Popiel-Barczyk (1977: pl. 1: 8, 9) in their illustrations of *Lingula dumortieri*. The same applies to the description of Friedberg (1921) who referred the lingulide specimens from Podolia (Fig. 3) to *Lingula* aff. *dumortieri*. These specimens were lost during World War II.
- Because of the rounded outline of the scar of the posterior adductor muscle (Figs. 1, 2), the specimens must be referred to *Lingula* because in *Lingularia* this scar is heart-like in outline (see Biernat and Emig 1993). Furthermore after the early Palaeogene (Emig 2003; Emig and Bitner in press), only two lingulide genera are known: *Lingula* and *Glottidia*, while the youngest records of *Lingularia* (Biernat and Emig 1993; Smirnova and Ushatinskaya 2001) and of *Credolinguia* (Smirnova and Ushatinskaya 2001) are from the Cretaceous.

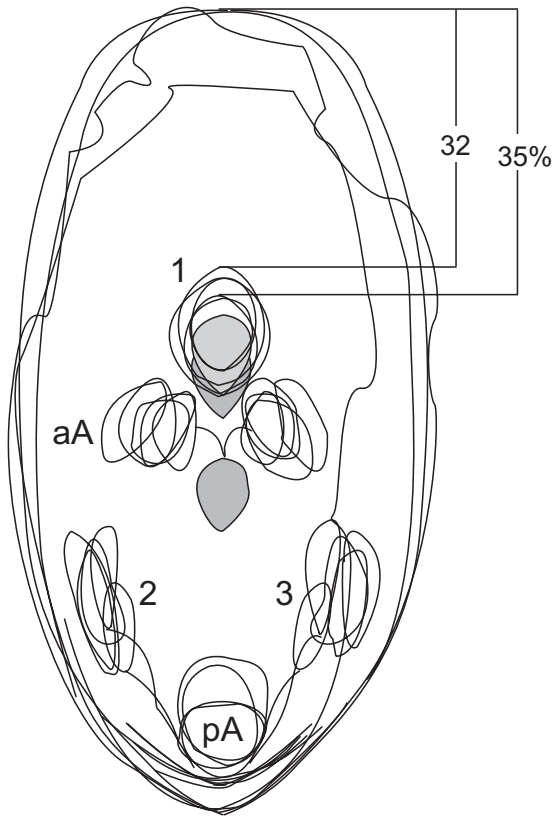


Fig. 1. Variability in musculature, established from 5 dorsal valves and in the valve outline of *Lingula dregeri*. The range of the lophophoral cavity is given in percentage. No data on ventral valves. The scars in grey represent the remnant of the motion of the anterior oblique muscles induced by the growth of the shell. Muscles: aA, anterior Adductor; pA, posterior Adductor; 1, Anterior Obliques; 2, Anterior Lateral Oblique + Median Lateral Oblique + Anterior Internal Oblique + Posterior Internal Oblique; 3, Anterior Lateral Oblique + Median Lateral Oblique + Median Internal Oblique (Emig 1982).

- Juvenile lingulide specimens, less than about 15 mm in length, as in the case of all the studied specimens, are often difficult to identify at species level because not all characters are completely developed. Consequently, several of these characters, i.e. the muscle arrangement and the umbonal shape, can be misinterpreted and may lead to an erroneous species attribution (Emig 1982). The juvenile state of our

shells is also demonstrated by the traces of a succession of anterior oblique muscle scars in the dorsal valve (Fig. 1) indicating that the valve grew rapidly during the early stages of the shell development (Emig 1997).

- Valve dimensions (see Table 1), although of no taxonomic value, are within the range of the measurements characterizing *Lingula*: that is  $W/L = 0.38-0.53$ ,  $H/L = 0.06-0.12$  and  $H/W = 0.14-0.25$  (from Biernat and Emig 1993, modified). The shells appear, however, to be slightly more convex than in the living species of *Lingula*, while in *Lingularia* the range is  $H/L = 0.12-0.23$  and  $H/W = 0.20-0.44$  (Biernat and Emig 1993). Unpublished data on *Lingula* show that there is no difference in valve ratios between young and adult specimens, these latter having generally a shell longer than about 20 mm. Friedberg's (1921) measurements (Table 1) probably record the lowest ratio among *Lingula*. The length of the lophophoral cavity (expressed as a percentage) is the distance between the distal limit of the anterior oblique muscle scars on the dorsal valve (Fig. 1, Table 1): the measurements in the juvenile specimens are similar to those of adult *Lingula* with a range of 24–35 % (Biernat and Emig 1993).
- From the partly visible scar of a main mantle canal in a dorsal valve, the shape of the main anterior mantle canals appears strongly curved as in *Lingula rostrum* (Shaw, 1798), *L. reevii* Davidson, 1880 and *L. tumidula* Reeve, 1841 (see Emig 1982). The muscle arrangement on the dorsal side (Fig. 1) is similar to that of *L. tumidula*. No observations were possible on ventral valves.

The paucity of specimens and their juvenile state, as well as the lack of complete ventral valves, do not permit a redescription of *Lingula dregeri*, a species reported from several localities in the Central Paratethys (Fig. 3). We suggest that the specimens examined here may belong to this species, originally described as *L. suessi* by Dreger (1889) from the Vienna Basin (Austria), and later by Friedberg (1930) from the Korytnica Basin (Poland). However, as the name *suessi* is preoccupied by an Upper Triassic species of the same genus, Andreae (1893) proposed its replacement by *dregeri*. Because the original description was very general, *L. dregeri* has been cited from several Miocene locations (Fig. 3). Specimens from Cagliari (Sardinia, Italy) were cited as *L. cf. dregeri* by Dreger (1911) but this identification remains questionable (see also data in Table 1).

Table 1. Dimensions (in mm) of the studied dorsal valves of *Lingula dregeri* (no complete ventral valve available), their ratios and the extension in percentage of the lophophoral cavity (see text). The first three specimens are housed in MZ collection, two next in ZPAL collection.

	Bra-1204/1	Bra-1204/3	Bra-1204/2	Bp.54/1	Bp.54/2	Friedberg 1921	Dreger 1911
Length	6.0	7.2	8.1	7.0	5.2	15	25
Width	3.1	3.7	3.5	3.6		5.5	18
Height	0.9	1.0	1.1	0.9			4
W/L	0.521	0.517	0.428	0.523		0.367	0.720
H/L	0.15	0.14	0.13	0.13			0.16
H/W	0.28	0.28	0.31	0.25			0.22
Loph. cav.	32%		35%	35%	33%		
Location	Korytnica Basin			Lublin Upland		Podolia	Sardinia
Species	<i>L. dregeri</i>			<i>L. dregeri</i>		<i>L. aff. dumortieri</i> = <i>L. dregeri</i>	<i>L. cf. dregeri</i>

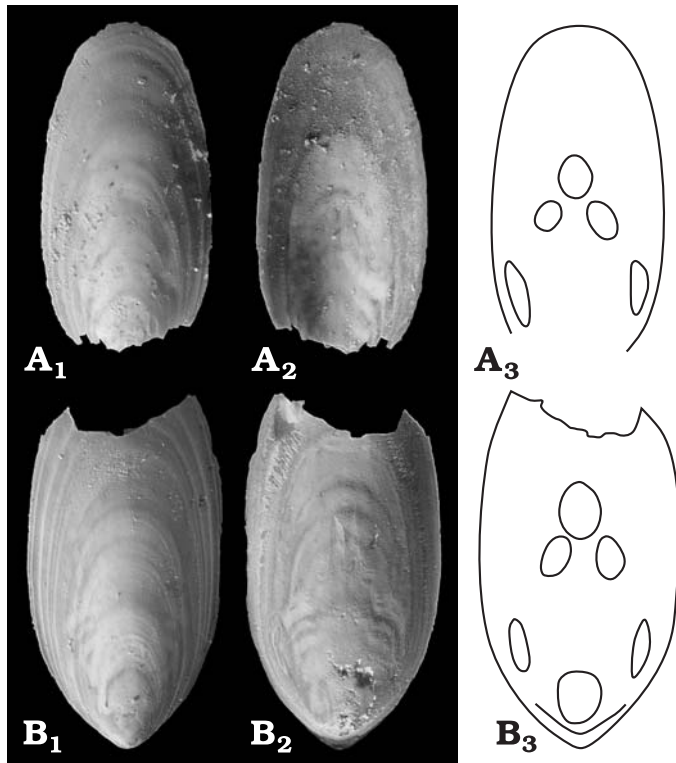


Fig. 2. External (A<sub>1</sub>, B<sub>1</sub>) and internal (A<sub>2</sub>, B<sub>2</sub>) views of two dorsal valves from the Korytnica Basin, with their muscles scars (A<sub>3</sub>, B<sub>3</sub>) as visible on the internal side of the valve (see also Fig. 1). A. MZ VIII Bra-1204/1. B. MZ VIII Bra-1204/2. All × 7.



Fig. 3. Geographical distribution of *Lingula dregeri* in the Miocene: 1, Korytnica Basin (Poland): Korytnica, Chomentów (Friedberg 1930; Barczyk and Popiel-Barczyk 1977; Gutowski 1984; Radwańska and Radwański 1984; and present data); 2, Wójcza-Pińczów Range (Poland) (Popiel-Barczyk and Barczyk 1990; and present data); 3, Lublin Upland (Poland): Huta Lubycka, Monastyrz, Długi Goraj (Popiel-Barczyk 1977, 1980; Jakubowski and Musiał 1977; present data); 4, Podolia (Ukraine): Obertasów near Złoczów (Friedberg 1921); 5–7, Vienna Basin (Austria): 5, Austränk (Dreger 1889); 6, Loretto (Dreger 1889); 7, St. Margarethen (Meznerics 1943; Schmid et al. 2001). A *Lingula* has been recorded in Lapugiu (Romania) by Bărbulescu and Rado (1984) in the Badenian (Miocene). The following localities are not indicated on the map: Cagliari, and vicinities: Sant Elias, Mirrionis island, San Michele hill, in Sardinia (Italy) (Dreger 1911).

The lingulide specimens from Podolia (Ukraine; Fig. 3) identified by Friedberg (1921) as *Lingula* aff. *dumortieri* have been attributed to *Lingula dregeri* Andreae, by Popiel-Barczyk and Barczyk (1990) based on size. Friedberg (1921) stated that the specimens he referred to *L. dumortieri* are similar in outline and ornamentation to *L. dregeri*.

Several occurrences of *L. dregeri* have been reported in the southern slopes of the Holy Cross Mountains and the Lublin Upland of Poland (Fig. 3), and the specimens identified as *L. dumortieri* by Barczyk and Popiel-Barczyk (1977) can be referred to *L. dregeri*. Consequently, we conclude that all the lingulide specimens from the Miocene of Poland belong to *Lingula dregeri*.

**Acknowledgments.**—This work was supported by the CNRS (France)–PAN (Poland) project 14481 (2003–2004). The specimens housed in the Museum of the Earth (Warsaw) were available through the courtesy of Dr. Barbara Studencka. The photographs were taken by Ms. Grażyna Dziewińska (Institute of Paleobiology, Warsaw) to whom we are very grateful. We thank Nestor J. Sander (USA) for the language improvement and comments to the earlier draft, as well as three anonymous referees.

## References

- Andreae, A. 1893. Die Brachiopoden des Rhät von Malsch. *Mitteilungen der Großherzoglichen Badischen Geologischen Landesanstalt* 3: 11–17.
- Bărbulescu, A. and Rado, G. 1984. Contributions à la connaissance des brachiopodes badéniens de Roumanie. *75 years of the Laboratory of Paleontology, special volume*, 173–183.
- Barczyk, W. and Popiel-Barczyk, E. 1977. Brachiopods from the Korytnica Basin (Middle Miocene; Holy Cross Mountains, Poland). *Acta Geologica Polonica* 27: 157–167.
- Biernat, G. and Emig, C.C. 1993. Anatomical distinctions of the Mesozoic lingulide brachiopods. *Acta Palaeontologica Polonica* 38: 1–20.
- Bitner, M.A. 1990. Middle Miocene (Badenian) brachiopods from the Roztocze Hills, south-eastern Poland. *Acta Geologica Polonica* 40: 139–157.
- Bitner, M.A. 1993. Middle Miocene (Badenian) brachiopods from coral reefs of north-western Bulgaria. *Acta Geologica Polonica* 43: 147–155.
- Bitner, M.A. and Pisera, A. 2000. Brachiopod fauna from the Middle Miocene deposits of Niechobrz, south-eastern Poland. *Tertiary Research* 20: 7–15.
- Chuang, S.H. 1964. The affinity of *Lingula dumortieri* Nyst with *Glottidia*. *Journal of Paleontology* 38: 155–157.
- Davidson, T. 1852. A Monograph of British Tertiary Brachiopoda. Part 1. *Monograph of the Palaeontological Society, London* 1852: 1–23.
- Davidson, T. 1874. On Tertiary Brachiopoda of Belgium. *Geological Magazine* 118: 150–189.
- Davidson, T. 1880. Report on the Brachiopoda dredged by the HMS Challenger during the years 1873–1876. *Report on the Scientific Results of the Voyage of the H.M.S. Challenger, Zoology* 1: 1–67.
- Dreger, J. 1889. Die tertiären Brachiopoden des Wiener Beckens. *Beiträge zur Paläontologie Oesterreich-Ungarns* 7: 179–192.
- Dreger, J. 1911. Miozäne Brachiopoden aus Sardinien. *Verhandlungen der kaiserlich-königlichen Geologischen Reichsanstalt* 6: 131–138.
- Emig, C.C. 1982. Taxonomie du genre *Lingula* (Brachiopodes, Inarticulés). *Bulletin du Muséum National d'Histoire naturelle de Paris, série 4 (Section A)* (3/4): 337–367.
- Emig, C.C. 1997. Ecology of inarticulated brachiopods. In: R.L. Kaesler (ed.), *Treatise on invertebrate Paleontology. Part H, Brachiopoda* revised, 1, 471–495. Geological Society of America, Boulder and University of Kansas Press, Lawrence.
- Emig, C.C. 2003. Proof that *Lingula* (Brachiopoda) is not a living-fossil, and

- emended diagnoses of the Family Lingulida. *Carnets de Géologie/Notebooks on Geology* Letter 2003/01: 1–8 (CG2003\_L01\_CCE).
- Emig, C.C. and Bitner, M.A. (in press). *Glottidia* (Brachiopoda: Lingulidae) from the Eocene La Meseta Formation, Seymour Island, Antarctica. *Palaeontology*.
- Friedberg, W. 1921. Les brachiopodes miocènes de la Podolie occidentale [in Polish]. *Prace Naukowe Uniwersytetu Poznańskiego, Sekcja Matematyczno-Przyrodnicza* 2: 1–20.
- Friedberg, W. 1930. Miozänstudien in Polen, Teil VI. *Kosmos serie A* 55: 357–381.
- Gutowski, J. 1984. Sedimentary environment and synecology of macrobenthic assemblages of the marly sands and red-algal limestones in the Korytnica Basin (Middle Miocene; Holy Mountains, Central Poland). *Acta Geologica Polonica* 34: 323–340.
- Jakubowski, G. and Musiał, T. 1977. Lithology and fauna from the Upper Tortonian sands of Monastyrz and Długi Goraj (Southern Roztocze – Poland). *Prace Muzeum Ziemi* 26: 63–126.
- Meznerics, I. 1943. Die Brachiopoden des ungarischen Tertiärs. *Annales Historico-Naturales Musei Nationalis Hungarici* 36: 10–60.
- Nyst, P.-H. 1843. Description des coquilles et des polypiers fossiles des terrains tertiaires de la Belgique. *Mémoires Couronnés et Mémoires des savants étrangers de l'Académie royale de Bruxelles* 17: 1–676.
- Popiel-Barczyk, E. 1977. A new locality of Miocene brachiopod fauna in Roztocze region [in Polish]. *Przegląd Geologiczny* 5: 246–248.
- Popiel-Barczyk, E. 1980. Brachiopod genus *Cryptopora* Jeffreys from the Miocene deposits of the Lublin Upland. *Acta Geologica Polonica* 30: 157–167.
- Popiel-Barczyk, E. and Barczyk, W. 1990. Middle Miocene (Badenian) brachiopods from the southern slopes of the Holy Cross Mountains, Central Poland. *Acta Geologica Polonica* 40: 159–181.
- Radwańska, U. and Radwański, A. 1984. A new species of inarticulate brachiopod, *Discinisca polonica* sp. n., from the Korytnica Basin (Middle Miocene; Holy Cross Mountains, Central Poland). *Acta Geologica Polonica* 34: 253–269.
- Reeve, L. 1841. On *Lingula*, a genus of brachiopodous mollusks. *Proceedings of the Zoological Society of London* 9: 97–101.
- Schmid, P.H., Harzhauser, M., and Kroh, A. 2001. Hypoxic events on a Middle Miocene carbonate platform of the Central Paratethys (Austria, Badenian, 14 Ma). *Annalen des Naturhistorischen Museums in Wien* 102A: 1–50.
- Shaw, G. 1798. *Naturalists Miscellany* 9: pl. 315.
- Smirnova, T.N. and Ushatinskaya, G.T. 2001. New lingulids (Brachiopoda) from the Lower Cretaceous of European Russia, with notes in the microstructure of their shells. *Paleontological Journal* 35: 387–395.
- Vincent, E. 1893. Contribution à la paléontologie des terrains tertiaires de la Belgique. Brachiopodes. *Annales de la Société royale malacologique de Belgique* 28: 38–64.

Christian C. Emig [christian.emig@com.univ-mrs.fr], CNRS-UMR 6540, Centre d'Océanologie, Chemin de la Batterie-des-Lions, F 13007 Marseille, France;

Maria Aleksandra Bitner [bitner@twarda.pan.pl], Instytut Paleobiologii, Polska Akademia Nauk, ul. Twarda 51/55, PL 00-818 Warszawa, Poland.