Conclusions

Although the Recent Lingulidae constitute a panchronic group, the evaluation of the bradytelic evolution of a rather poorly preserved group with a low potential for fossilisation is under development based on the recent descriptions of anatomical structures in the fossil taxa (BIERNAT and EMIG, 1993; JIN *et alii*, 1993; KOWALEWSKI and FLESSA, 1996; EMIG, 2002; ZHANG *et alii*, 2003). Albeit they have kept surficial aspects derived from ancestral life, species of *Lingula* show significant evolutionary differences and can no longer be considered as "living-fossils"! Consequently, the traditional opinions regarding *Lingula* must be rejected because the diagnoses of the Lingulidae given here are based on recent morphological findings and evolutionary novelties.

In conclusion, the notion of "living-fossils" is very probably erroneous. In fact such a concept appears more journalistic than scientific, for it is based for the most part on a unique characteristic maintained over time, like the lingulide shape and the coelocanth fin and scale pattern. In any event only a species can be referred to as a living-fossil – supra-specific taxa are excluded automatically.

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References

ARNAUD P.M., EMIG C.C. (1987).- La population, unité fonctionnelle de la biocoenose. *In*: Biologie des Populations.- *Actes du Colloque National du Centre National de la Recherche Scientifique*, Lyon 1986, pp. 69-72.

BABIN C., DELANCE J.H., EMIG C.C., RACHEBOEUF P.R. (1992).- Brachiopodes et Mollusques Bivalves : concurrence ou indifférence ?- *Géobios*, *Mémoire spécial*, Lyon, Vol. 14, pp. 35-44.

BIERNAT G., EMIG C.C. (1993).- Anatomical distinctions of the Mesozoic lingulide brachiopods.- *Acta Palaeontologica Polonica*, Warsaw, Vol. 38, n° 1/2, pp. 1-20.

EMIG C.C. (1982a).- Terrier et position des Lingules (Brachiopodes, Inarticulés).- *Bulletin de la Société zoologique de France*, Paris, Vol. 107, n° 2, pp. 185-194.

EMIG C.C. (1982b).- Taxonomie du genre *Lingula* (Brachiopodes, Inarticulés).- *Bulletin du Muséum national d'Histoire naturelle de Paris*, Paris, (4), Vol. 4, Section A, n° 3/4, pp. 337-367.

EMIG C.C. (1983a).- Sur les relations du panchronisme avec les conditions écologiques : le cas des Lingules (Brachiopodes, Inarticulés).- *Bulletin de la Société zoologique de France*, Paris, Vol. 108, n° 4, pp. 558-561.

EMIG C.C. (1983b).- Taxonomie du genre *Glottidia* (Brachiopodes, Inarticulés).- *Bulletin du Muséum national d'Histoire naturelle de Paris*, Paris, (4), Vol. 5, Section A, n° 2, pp. 469-489.

EMIG C.C. (1984a).- On the origin of the Lophophorates.- *Zeitschrift für zoologische Systematik und Evolutionforschung*, Frankfurt am Main, Vol. 22, n° 2, pp. 91-94.

EMIG C.C. (1984b).- Pourquoi les Lingules (Brachiopodes, Inarticulés) ont survécu à la transition Secondaire-Tertiaire.- *Bulletin du Comité des Travaux historiques et scientifiques*, *Section Sciences*, Paris, Vol. 6, pp. 87-94.

EMIG C.C. (1989).- Les lingules fossiles, représentants d'écosystèmes oligotypiques ?- *Atti 3° Simposio de Ecologia e Paleoecologia de Comunità bentoniche* (Catania, Italia, 1985), pp. 117-121.

EMIG C.C. (1997a).- Ecology of the inarticulated brachiopods. *In*: KAESLER R.L. (ed.), Treatise on Invertebrate Paleontology. Part H. Revised Brachiopoda.- Geological Society of America, Boulder, and University of Kansas, Lawrence, Vol. 1, pp. 473-495.

EMIG C.C. (1997b).- Biogeography of the inarticulated brachiopods. *In*: KAESLER R.L. (ed.), Treatise on Invertebrate Paleontology. Part H. Revised Brachiopoda.- Geological Society of America, Boulder, and University of Kansas, Lawrence, Vol. 1, pp. 497-502.

EMIG C.C. (2002).- Tools for linguloid taxonomy: the genus *Obolus* (Brachiopoda) as an example.- *Carnets de Géologie/Notebooks on Geology*, Maintenon, Article 2002/01, http://paleopolis.rediris.es/cg/CG2002_A01_CCE/index.html

HOLMER L.E., POPOV L.E. (2000).- Class Lingulata. *In*: KAESLER R.L. (ed.), Treatise on Invertebrate Paleontology. Part H. Revised Brachiopoda.- Geological Society of America, Boulder, and University of Kansas, Lawrence, Vol. 2, pp. 30-146.

JIN Y., HOU X., WANG W. (1993).- Lower

Cambrian pediculate lingulides from Yunnan, China.- *Journal of Paleontology*, Tulsa, Vol. 67, pp. 788-798.

KOWALEVSKI M., FLESSA K.W. (1996).- Improving with age: The fossil record of lingulide brachiopods and the nature of taphonomic megabiases.- *Geology*, Boulder, Vol. 24, n° 11, pp. 977-980.

ZHANG X., HOU X., EMIG C.C. (2003).- Evidence of lophophore diversity in Early Cambrian Brachiopoda.- *Proceedings of the Royal Society of London*, *Biological Sciences*, London, Biology Letter, DOI: 10.1098/rsbl. 2003.0013.

Table 1: Systematic part: Emended diagnoses directly derived from the original descriptions and diagnoses, to replace the diagnoses of HOLMER and POPOV (2000).

Subphylum **Linguliformea** WILLIAMS, CARLSON & BRUNTON, 1996
Class **Lingulata** GORYANSKY & POPOV, 1985
Order **Lingulida** WAAGEN, 1885
Superfamily **Linguloidea** MENKE, 1828

Family Lingulidae MENKE, 1828

Diagnosis:

Shell elongate oval to subrectangular, gently and subequally biconvex, subequivalved; lateral margins generally subparallel.

Ventral valve with wide triangular pedicle groove and lateral vestigial propareas.

Dorsal valve with posterior margin rounded, with a more or less developed median beak; anterior adductor and anterior oblique muscle scars closely spaced.

Asymmetrical muscle system with internal oblique muscles; unpaired posterior adductor muscle; pedicle nerve curving around posterior adductor muscle.

Mantle canal system bifurcate; *vascula lateralia* of both valves converging anteriorly to become subparallel; *vascula media* absent.

Long flexible pedicle; lophophore spirolophous, with apices of spires directed medially.

?Upper Devonian, Carboniferous-present

Only three genera have been retained in this family, because according to HOLMER and POPOV (2000) the other genera are *Apsilingula*, *Barroisella*, *Langella* and *Semilingula*, which remain only provisionally within this family.

Genus *Lingularia* Biernat & Emig, 1993 [1]

Diagnosis:

Shell elongate oval in outline, lateral margins subparallel, anterior margin broadly rounded. Valves weakly to strongly convex.

Ventral valve with triangular umbo formed by vestigial to small internal propareas, continuous with posterolateral margins and separated by deep pedicle groove; pair of narrow subparallel, V-shaped, grooves extends internally from the anterior adductor pair to posterior adductor where grooves join.

Dorsal valve with posterior margin rounded, narrow median beak sometimes present, and a narrow internal central ridge extending over about 1 millimetre posterior to anterior oblique muscle scars.

Posterior adductor scar heart-like in outline. Main ventral canals (*vascula lateralia*) shorter than dorsal canals.

Carboniferous-Cretaceous

[1] Complete description in Biernat and Emig (1993)

Figure 5: *Lingularia siberica* (from the Triassic of Northern Siberia) - shell length about 0.7 cm.

Genus *Lingula* Bruguière, 1797 [2]

Diagnosis:
Shell elongate oval or subrectangular in outline, lateral margins subparallel, anterior margin broadly rounded to straight.

Ventral valve with wide triangular pedicle groove and lateral vestigial propareas. Ventral visceral area extending to midvalve, with impression of pedicle nerve curving around unpaired posterior adductor muscle scar.

Dorsal valve with dorsal anterior adductor and anterior oblique muscle scars closely spaced, bisected by weak median septum; posterior margin rounded, with a median beak. Dorsal visceral area extending somewhat anterior to midvalve.

Main ventral and dorsal canals (*vascula lateralia*) ending at the same level.

?Cretaceous, Tertiary - present

[2] Complete description in Emig (1982b)

Figure 6: *Lingula anatina* (from Sumatra) - shell length about 4.5 cm.

Genus *Glottidia* DALL, 1870 [3]

Diagnosis:
Shell strongly elongate in outline, lateral margins subparallel to parallel, anterior margin broadly straight. Mantle canal system with papillae.

Ventral valve with a with wide pedicle groove and lateral vestigial propareas; two divergent septa, serving as places of attachment for oblique muscles and support of body wall; pedicle nerve curving around unpaired posterior adductor muscle. Ventral visceral area extending anterior to midvalve.

Dorsal valve with median septum extending from posterior adductor muscle to internal oblique muscles; posterior margin rounded, with a median beak. Dorsal visceral area extending anterior to midvalve.

Main ventral and dorsal canals (*vascula lateralia*) ending at the same level.

?Cretaceous, Tertiary - present

[3] Complete description in EMIG (1983b)

Figure 7: *Glottidia palmeri* (from the Gulf of California, Mexico) - shell length about 4.5 cm.