Zootaxa 3754 (3): 239–276
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3754.3.2
http://zoobank.org/urn:lsid:zoobank.org:pub:9E645014-5464-4E7C-8D4A-0B3B52A5AA53

Lost and found: The Eocene family Pyramimitridae (Neogastropoda) discovered in the Recent fauna of the Indo-Pacific

YURI KANTOR[1], PIERRE LOZOUET[2], NICOLAS PUILLANDRE[3] & PHILIPPE BOUCHET[4]

[1]*A.N.Severtzov Institute of Ecology and Evolution, Russian Academy of Sciences, Leninski prosp. 33, Moscow 119071, Russia. E-mail kantor.yuri1956@gmail.com*
[2]*Muséum National d'Histoire Naturelle, 55, Rue Buffon, 75231, Paris, France. E-mail lozouet@mnhn.fr*
[3]*Muséum National d'Histoire Naturelle, UMR7205 ISyEB, 43 rue Cuvier, 75005, France. E-mail puillandre@mnhn.fr*
[4]*Muséum National d'Histoire Naturelle, 55, Rue Buffon, 75231, Paris, France. E-mail pbouchet@mnhn.fr*

Abstract

Most neogastropod families have a continuous record from the Cretaceous or Paleogene to the Recent. However, the fossil record also contains a number of obscure nominal families with unusual shell characters that are not adequately placed in the current classification. Some of these are traditionally regarded as valid, and some have been "lost" in synonymy. One such "lost" family is the Pyramimitridae, established by Cossmann in 1901 for the Eocene genus *Pyramimitra*, and currently included in the synonymy of Buccinidae. Examination of several species of inconspicuous, small turriform gastropods has revealed a radula type so far unknown in Neogastropoda, and their shell characters identify them as members of the "extinct" family Pyramimitridae. Neither the radular morphology nor the anatomy reveal the relationships of this enigmatic, "living fossil" family. Molecular data (12S, 16S, 28S, COI) confirm the recognition of Pyramimitridae as a distinct family, but no sister group was identified in the analysis. The family Pyramimitridae Cossmann, 1901, is thus restored as a valid family of Neogastropoda that includes the genera *Pyramimitra* Conrad, 1865, *Endiatoma* Cossmann, 1896, ***Vaughanites* Woodring, 1928**, *Hortia* Lozouet, 1999, and ***Teremitra* new genus**. Pyramimitrids occur in the Recent fauna at bathyal depths of the Indo-Pacific from Taiwan to Madagascar and New Zealand, with three genera and nine species (all but one new).

Key words: living fossil, anatomy, radula, foregut, *Hortia, Teremitra, Vaughanites*

Introduction

The evolutionary history of the predatory/scavenger Neogastropoda is a classic example of a successful, post-Cretaceous radiation of marine snails. They are the most prolific group of marine predatory gastropods, including no less than 12,000 species (WoRMS). Currently, Neogastropoda are classified in 39 Recent families (including also fossil members) and seven exclusively fossil families (Bouchet & Rocroi 2005; with updates). Their phylogeny is far from resolved despite several recent attempts, including the use of molecular characters (e.g. Cunha *et al.* 2009; Oliverio & Modica 2010). Beyond the currently accepted families, a still larger number of nominal families have been established in Neogastropoda and subsequently sunken into synonymy: no less than 102 such family group names are listed by Bouchet & Rocroi (2005) in the synonymy of the 39 accepted Recent families. Some of these names were placed in synonymy based on different opinions in ranking (e.g., compare Tucker & Tenorio 2009 vs. Puillandre *et al.* 2011 for Conoidea), while others have been "lost" for decades in the graveyard of synonymy—for good or for weak reasons. One such "forgotten" family is the family Pyramimitridae, established by Cossmann (1901) for the fossil genus *Pyramimitra* Conrad, 1865. Also included by Cossmann (1901) in Pyramimitridae were *Nassarina* Dall, 1889 (now classified in the Columbellidae), and the fossil genera *Petrafixia* Cossmann, 1901, and *Pisanella* Koenen, 1865 (an Upper Eocene fossil genus classified with doubt by Beu & Maxwell (1987) in the Turbinellidae). The shell of *Pyramimitra* lacks any conspicuous characters; it is medium-sized (about 10 mm in length), has weak columellar plications and superficially resembles both Mitridae and Buccinoidea. Pyramimitridae was placed without discussion by Ponder and Warén (1988) in the synonymy of Buccinidae, and this opinion was followed by Bouchet and Rocroi (2005).

Accepted by M. deMaintenon: 27 Nov. 2013; published: 15 Jan. 2014

All fossil Pyramimitridae have a multispiral protoconch of 2.5–3.5 whorls, indicating planktotrophic larval development. Sculpture of axial ribs, appearing on the second or third whorl, is reminiscent of that observed in modern (and fossil) planktotrophic species of Fasciolariidae. By contrast, all but two Recent species possess a large, bulbous, paucispiral protoconch, indicating non-planktotrophic development that may be correlated with narrow geographical ranges. The exceptions are *Teremitra efatensis* and *Vaughanites? superstes* that have a multispiral protoconch and broad distributions extending from the Philippines to Fiji, and the Philippines to Papua New Guinea, respectively.

Acknowledgements

Work was conducted in Paris by Yu.I.K. under the MNHN visiting curatorship programme. He expresses his thanks to Virginie Héros, Barbara Buge, and Philippe Maestrati for assistance during his stays in Paris. Special thanks to Bruce Marshall from Te Papa Tangarewa (Wellington, New Zealand), whose knowledge of the New Zealand fauna and NMNZ collections brought to light three species of *Hortia*, all undescribed. We also want to thank our reviewers, Bruce Marshall and Jerry Harasewych from National Museum of Natural History, Smithsonian Institution (Washington, DC, USA) for valuable comments.

This work was partially supported by the grant of RFBR 11–04–01284–a 'Evolution of digestive system of carnivorous gastropods: testing of morphologically-based hypotheses by molecular data' (PI Yu. Kantor).

References

Aubry, U. (1999) *New Terebras and Ancient Verses*. L'Informatore Piceno, Ancona, 47 pp.

Beu, A.G. & Maxwell, P.A. (1987) A revision of the fossil and living gastropods related to *Plesiotriton* Fischer, 1884 (family Cancellariidae, subfamily Plesiotritoninae n. subfam.) with an appendix: Genera of Buccinidae Pisaniinae related to *Colubraria* Schumacher, 1817. *New Zealand Geological Survey Paleontological Bulletin*, 54, 1–140, 30 pls.

Bouchet, P. (1989) Systematics of *Plicoliva* with description of a new subfamily (Gastropoda: Volutoidea). *Archiv für Molluskenkunde*, 120, 1–10.

Bouchet, P., Heros, V., Lozouet, P. & Maestrati, P. (2008) A quarter-century of deep-sea malacological exploration in the South and West Pacific: Where do we stand? How far to go? Tropical Deep-Sea Benthos. Vol 25. *Mémoires du Muséum National d'Histoire Naturelle*, 196, 9–40.

Bouchet, P., Kantor, Yu.I., Sysoev, A. & Puillandre, N. (2011) New operational classification of the Conoidea (Gastropoda). *Journal of Molluscan Studies,* 77, 273–308.
http://dx.doi.org/10.1093/mollus/eyr017

Bouchet, P. & Rocroi, J.-P. (2005) Classification and nomenclator of gastropod families. *Malacologia,* 47, 1–397.

Boussac, J. (1911) Etudes stratigraphiques et paléontologiques sur le Nummulitique de Biarritz. *Annales Hébert*, 5, 1–96, 22 pls.

Bratcher, T. (1981) Four previously undescribed Indo–Pacific terebrids (Mollusca, Gastropoda). *Veliger*, 23, 329–332.

Chavan, A. (1952) A new fossil gastropod from the Middle Eocene of Ameki, Nigeria. *Proceedings of the Malacological Society of London*, 29, 80–82.

Conrad, T.A. (1848) Observations on the Eocene formation, and descriptions of one hundred and five new fossils of that period from the vicinity of Vicksburg, Mississippi, with an appendix. *Journal of the Academy of Natural Sciences at Philadelphia*, series 2, 1, 111–134.

Conrad, T.A. (1865) Catalogue of the Eocene and Oligocene Testacea of the United States. *American Journal of Conchology*, 1, 1–35.

Cossmann, M. (1883) Description d'espèces du terrain tertiaire des environs de Paris. *Journal de Conchyliologie*, 31, 153–174.

Cossmann, M. (1896) *Essais de paléoconchologie comparée*. 2. L'auteur et Comptoir de Géologie, Paris, 179 pp., 8 pls.

Cossmann, M. (1901) *Essais de paléontologie comparée*, 4. L'auteur et Société d'Editions Scientifiques, Paris, 293 pp., 10 pls.

Cossmann, M. & Lambert, J. (1884) Etude paléontologique et stratigraphique sur le terrain oligocène marin aux environs d'Etampes. *Mémoire de la Société Géologique de France*, 31, 3, 187 pp., 16 pls.

Cunha, R.L., Grande, C. & Zardoya, R. (2009) Neogastropod phylogenetic relationships based on entire mitochondrial genomes. *BMC Evolutionary Biology*, 9, 210.
http://dx.doi.org/10.1186/1471-2148-9-210

Dayrat, B., Tillier, A., Lecointre, G. & Tillier, S. (2001) New clades of euthyneuran gastropods (Mollusca) from 28S rRNA sequences. *Molecular Phylogenetics and Evolution*, 19, 225–235.
http://dx.doi.org/10.1006/mpev.2001.0926

Dockery, D. (1977) Mollusca of the Moddys Branch Formation, Mississippi. *Mississippi Geological Survey Bulletin*, 120, 1–212, 28 pls.

Folmer, O., Black, M., Hoeh, W., Lutz, R. & Vrijenhoek, R. (1994) DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology*, 3, 294–299.

Garvie, C.L. (1996) The molluscan macrofauna of the Reklaw Formation, Marquez Member (Eocene: Lower Claibornian), in Texas. *Bulletins of American Paleontology*, 111, 1–177.

Gougerot, L. & Le Renard, J. (1983) Clefs de détermination des petites espèces de gastéropodes de l'Éocène du Bassin parisien. XXII: Les genres *Coptochetus* et *Suessionia* Cossmann. *Cahiers des Naturalistes, new ser.*, 39, 1–9.

Huelsenbeck, J.P., Ronquist, F. & Hall, B. (2001) MrBayes: bayesian inference of phylogeny. *Bioinformatics*, 17, 754–755. http://dx.doi.org/10.1093/bioinformatics/17.8.754

ICZN (1999) *International Code of Zoological Nomenclature, 4th edition*. International Trust for Zoological Nomenclature, The Natural History Museum, London, 106 pp.

Jovelin, R. & Justine, J.-L. (2001) Phylogenetic relationships within the polyopisthocotylean monogeneans (Platyhelminthes) inferred from partial 28S rDNA sequences. *International Journal for Parasitology*, 31, 393–401.

Kantor, Y.I. (1988) On the anatomy of Pseudomelatominae (Gastropoda, Toxoglossa, Turridae) with notes of functional morphology and phylogeny of the subfamily. *Apex*, 3, 1–19.

Kantor, Y.I. (2002) Morphological prerequisites for understanding Neogastropod phylogeny. *Systematics, Phylogeny and Biology of the Neogastropoda*. *Bollettino Malacologico*, Supplement 5, 2–15.

Kantor, Y.I. & Bouchet, P. (2007) Out of Australia: *Belloliva* (Neogastropoda: Olividae) in the Coral Sea and New Caledonia. *American Malacological Bulletin*, 22, 22–73. http://dx.doi.org/10.4003/0740-2783-22.1.27

Kantor, Y.I., Strong, E.E. & Puillandre, N. (2012) A new lineage of Conoidea (Gastropoda: Neogastropoda) revealed by morphological and molecular data. *Journal of Molluscan Studies*, 78, 246–255. http://dx.doi.org/10.1093/mollus/eys007

Lea, I. (1833) *Contributions to geology*. Philadelphia: Carey, Lea & Blanchard, 227 pp.

Lozouet, P. (1999) Nouvelles espèces de gastéropodes (Mollusca: Gastropoda) de l'Oligocène et du Miocène inférieur d'Aquitaine (Sud-Ouest de la France). Partie 2. *Cossmanniana,* 6, 1–68, 20 pls.

Lozouet, P. (2004) The European Tertiary Neritiliidae (Mollusca, Gastropoda, Neritopsina): indicators of tropical submarine cave environments and freshwater faunas. *Zoological Journal of the Linnean Society,* 140, 447–467, 9 figs. http://dx.doi.org/10.1111/j.1096-3642.2003.00099.x

Lozouet, P. (2012) *Stratotype Stampien.* Muséum national d'Histoire Naturelle, Biotope, Méze, Paris, 464 pp.

Morton, A. (2012) A collection of Eocene and Oligocene fossils. Available from: http://www.dmap.co.uk/fossils/ (accessed 4 December 2013)

Oliverio, M. & Modica, M.V. (2010) Relationships of the haematophagous marine snail *Colubraria* (Rachiglossa: Colubrariidae), within the neogastropod phylogenetic framework. *Zoological Journal of the Linnean Society*, 158, 779–800. http://dx.doi.org/10.1111/j.1096-3642.2009.00568.x

Oppenheim, P. (1901) Die Priabonaschichten und ihre Fauna, im Zusammenhange mit gleichalterigen und analogen Ablagerungen vergleichend betrachtet. *Palaeontographica*, 47, 1–348, pl. 1–21.

Palmer, K.V.W. (1937) The Claibornian Scaphopoda, Gastropoda and Dibranchiate Cephalopoda of the southern United States. *Bulletins of American Paleontology*, 7, No. 32, Part I, Text, 1–548, Part II Plates, plates 1–90.

Palumbi, S. (1996) Nucleic Acids II: the polymerase chain reaction. *In*: Hillis, D., Moritz, C. & Mable, B.K. (Eds.), *Molecular Systematics*. Sinauer Associates, Sunderland (MA), pp. 205–247.

Ponder, W.F. (1970) Some aspects of the morphology of four species of the neogastropod family Marginellidae with a discussion on the evolution of the toxoglossan poison gland. *Journal of the Malacological Society of Australia*, 2, 55–81.

Ponder, W.F. & Warén, A. (1988) Classification of the Caenogastropoda and Heterostropha – A list of the family-group names and higher taxa. *Malacological Review, Supplement*, 4, 288–328.

Powell, A.W.B. (1966) The molluscan families Speightiidae and Turridae. *Bulletin of the Auckland Institute and Museum,* 5, 1–184.

Puillandre, N., Kantor, Y., Sysoev, A., Couloux, A., Meyer, C. & Rawlings, T. (2011) The dragon tamed? A molecular phylogeny of the Conoidea (Mollusca, Gastropoda). *Journal of Molluscan Studies,* 77, 259–272. http://dx.doi.org/10.1093/mollus/eyr015

Rambaut, A. & Drummond, A.J. (2007) Tracer v1.4. Available from: http://beast.bio.ed.ac.uk/Tracer (accessed 4 December 2013)

Spencer, H.G., Marshall, B.A. & Willan, R.C. (2009) Recent Mollusca. *In*: Gordon, D.P. (Ed.), *The New Zealand inventory of biodiversity. 1. Kingdom Animalia: Radiata, Lophotrochozoa, Deuterostomia.* Canterbury University Press, Christchurch, pp. 196–219.

Terryn, Y. (2007) *Terebridae. A Collectors Guide.* Conchbooks & Natural Arts, 57 pp, 65 plates.

Terryn, Y. & Holford, M. (2008) The Terebridae of Vanuatu with a revision of the genus *Granuliterebra* Oyama, 1961. *Visaya*, Supplement 3, 1–118.

Tucker, J.K. (2004) Catalogue of Recent and fossil turrids (Mollusca: Gastropoda). *Zootaxa*, 682, 1–1295.

Tucker, J.K. & Tenorio, M.J. (2009) *Systematic classification of Recent and fossil conoidean gastropods*. Conchbooks, Hackenheim, Germany, 296 pp.

Vinassa de Regny, P.E. (1898 ["1897"]) Synopsis dei molluschi terziari delle Alpi venete (Continuazione e fine della parte prima): IV. Zovencedo (Tufo glauconitico). — V. Monte Pulii, Caldiero, Bolca ecc. — Parte seconda: Strati oligocenici. — VI. Via degli Orti, Valle Orcagna, Priabona ecc. *Palaeontographia Italica*, 3, 145–200, pls 19–20 (6–7).

Wenz, W. (1943) Gastropoda. Allgemeiner Teil und Prosobranchia. *In*: Schindewolf, O.H. (Ed.), *Handbuch der Paläozoologie, Band 6, Gastropoda*. Teil 6, Lfg. 8, Berlin, Borntraeger, pp. 1201–1506.

Woodring, W.P. (1928) Miocene mollusks from Bowden, Jamaica. Part II. Gastropoda and discussion of the results. Contributions to the Geology and Palaeontology of the West Indies. *Carnegie Institution of Washington,* Publication No. 385*,* 1–564.

WoRMS Editorial Board (2013) World Register of Marine Species. Available from http://www.marinespecies.org (accessed 1 June 2013)

Wrigley, A. (1925) Notes on English Eocene and Oligocene Mollusca, with descriptions of new species. *Proceedings of the Malacological Society of London*, 16, 232–248.