

**New *Odostomia* species (Gastropoda, Heterobranchia, Pyramidellidae) from the Miocene Pebas Formation of Western Amazonia (Peru, Colombia)**

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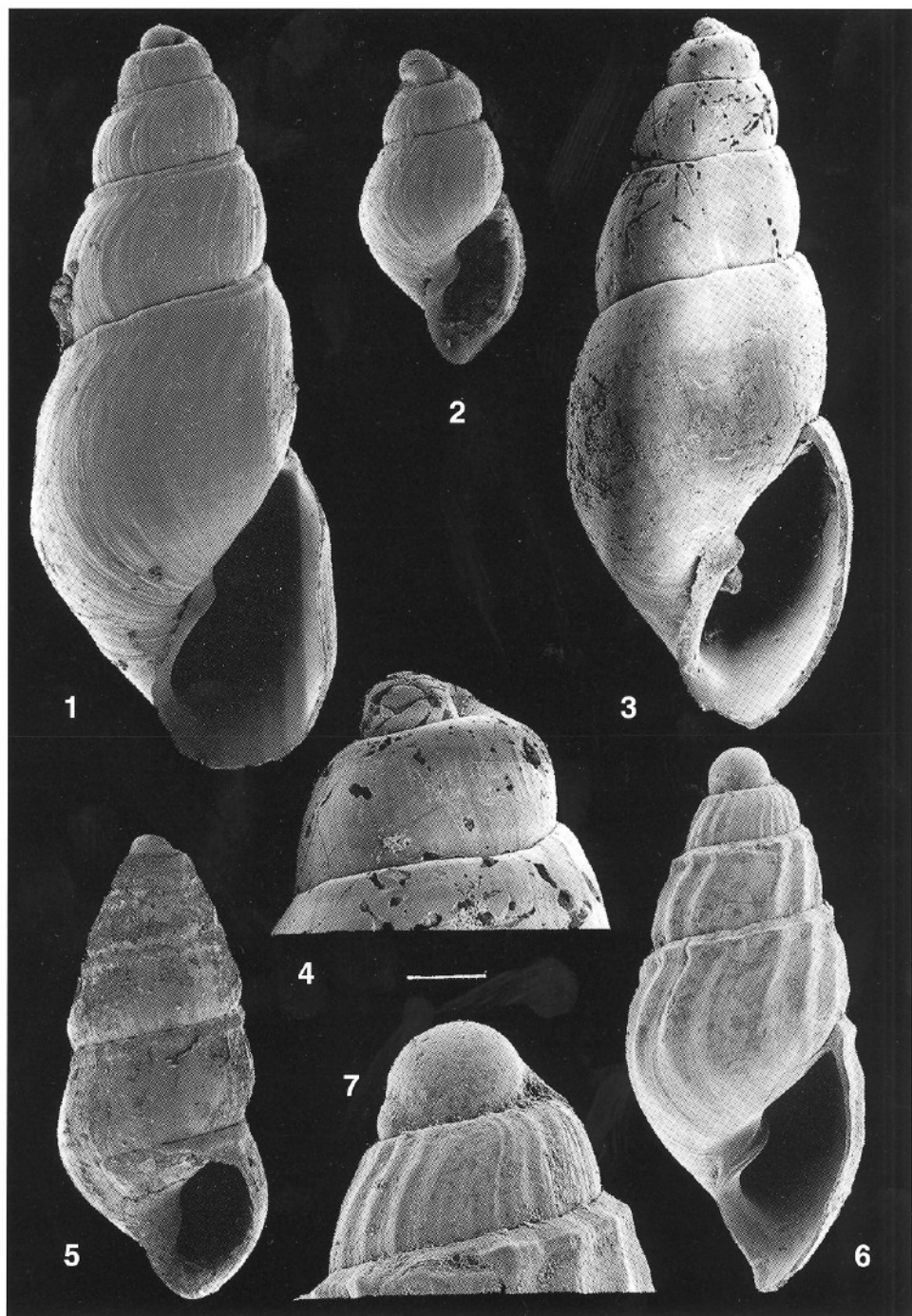
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*Odostomia nuttalli* spec. nov. and *O. cotuhensis* spec. nov. are described from the Miocene Pebas Formation of Peruvian and Colombian Amazonia. A third pyramidellid snail is also diagnosed. These species are indicators for marine influence in the late Middle to early Late Miocene of Western Amazonia. Some ecological implications are discussed.

Key words: Mollusca, Gastropoda, *Odostomia*, systematics, Miocene, Amazonia, Pebas Formation.

## INTRODUCTION

In Western Amazonia, Miocene fossiliferous deposits of the Pebas Formation crop out that contain an abundant molluscan fauna dominated by mostly extinct and endemic cochliopine hydrobiids and pachydontine corbulids. The Pebas fauna was reported first by Gabb (1869), and has puzzled many scientists since then. The environmental settings sustaining the Pebas fauna have been subject of debate since 1869, but more vigorously so since Nuttall (1990) published his seminal monograph on the non-marine Mollusca from Tertiary inland basins of NW South America (e.g. Hoorn, 1994; Räsänen et al., 1995; Hoorn, 1996; Marshall & Lundberg, 1996; Vonhof et al., 1998). Interpretations of the depositional environment for the Pebas Formation included terrestrial and flood-plain conditions, long lived lake settings and marine settings. Hoorn (1994) reported several layers containing mangrove pollen and benthic foraminiferal remains, indicating the (episodic) presence of marine influence during deposition of the Pebas Formation. Vonhof et al. (1998) analysed the fauna and isotope geochemistry of these 'incurSION'-layers. A mixture of typical (endemic) pebasian taxa (*Pachydon* spp., *Dyris* spp.) and (widespread) marine taxa (*Melongena* sp., *Nassarius* sp., barnacles, the foraminifer *Ammonia* sp.) was found, and a maximum paleosalinity of 3-5 psu was inferred from Strontium



Figs 1-7. Odostomiidae. Figs 1-4. *Odostomia* spec. 1-2, *O. mutalli* spec. nov.; Nuevo Horizonte, Peru; 1, holotype, RGM 445342, H 3.0 mm; 2, paratype, RGM 445343, H 1.1 mm. 3-4, *O. limnaeiformis* Cossmann, 1888, Auvers-sur-Oise, France; 3, shell, H 2.7 mm; 4, apex (scale bar 100  $\mu$ m); RGM 445347. 5, *O. cotuhensis* spec. nov., Nuevo Horizonte, Peru; holotype, RGM 445345, H 1.9 mm. Figs 6-7. Odostomiidae spec. indet., Porvenir, Peru; 6, shell, H 1.9 mm; 7, apex (scale bar 100  $\mu$ m); RGM 445341.

isotope ratios and abundances for these marine incursion levels. The levels that contained these marine indicators were also found to contain pyramidellid specimens of unknown affinity. These are described in this article.

All pyramidellid shells are deposited the Division of Cainozoic Mollusca, Nationaal Natuurhistorisch Museum Naturalis, Leiden, The Netherlands (formerly Rijks Museum van Geologie en Mineralogie), abbreviated RGM.

Abbreviations used in shell descriptions: H, height; HAP, height of aperture; W, width.

Localities: Nuevo Horizonte, Loreto, Peru; 73°25' W, 4°05' S; Level F70, outcrop in right wall (E-side) of the road Iquitos-Nauta, c. 50 m north of bridge in village; fossiliferous bed c. 2 m above surface of road, Miocene, Serravallian-Tortonian, Pebas Formation (F.P. Wesselingh leg., Sept. 1991). Porvenir, Loreto, Peru; 73°23' W, 4°15' S; Level F721, outcrop in left bank (W-side) of the Rio Amazonas, c. 250 m S. of northern end of village; fossiliferous interval at river level, Miocene, Serravallian-Tortonian, Pebas Formation (F.P. Wesselingh leg., Sept. 1996).

## SYSTEMATICS

### ***Odostomia nuttalli*** spec. nov. (figs 1-2)

Type material. — Holotype, RGM 445342: Nuevo Horizonte, level F70. Paratypes (type locality): RGM 445343/1 juvenile; 445344/>25 specimens.

Diagnosis. — Shell egg-shaped, with a well developed subsutural band and conspicuous sinuate growthlines.

Description. — Shell with four teleoconch whorls. The embryonic whorls are intorted and cannot be detected at the apex. The teleoconch whorls increase rapidly in size and are separated by a markedly incised suture. Just below this suture, at the adapical side of each whorl, there is a thickened spiral rib, which is more or less pronounced in different specimens. The growthlines are sinuous, with a tendency to be opisthocline on average. The aperture is relatively large, its height is approximately 2/5 of the shell height. A sinus is located at the adapical side of the outer lip corresponding to the subsutural ridge. The outer lip is evenly rounded; the basal part of the aperture is comparatively broad and slightly retracted. The inclined columella is rather straight and has a pronounced tooth. Sometimes a slight umbilical chink is present.

Dimensions. — H 2.5-3.0 mm, W 1.0-1.2 mm. Holotype: H 3.0 mm, W 1.2 mm.

Etymology. — Named after Mr. C.P. Nuttall, retired curator at the British Museum (Natural History), whose taxonomical work has contributed substantially to palaeontological research in the Amazon area.

Differentiation. — *Odostomia nuttalli* does not show close affinities with extant species known from the Pacific coast of South America. The few species mentioned by Skoglund (1972: 121), such as *O. mammillata* Carpenter, 1857, and *O. panamensis* Clessin, 1900, are quite different in shape. Bartsch (1924, 1926) in his work on the malacofauna of Ecuador does not mention any recent *Odostomia*. *Odostomia canaliculata* C.B. Adams, 1850, and *O. laevigata* d' Orbigny, 1842, are the only *Odostomia* species reported from the coast of Brazil (Rios, 1975: 142) as well as from the southern Caribbean coast of Colombia (von Cosel, 1986: 278), from the Yucatan peninsula (Vokes & Vokes, 1983: 32) and from

holocene shell ridges in Suriname (Altena, 1975: 68). Jung (1969: 568) cites *O. canaliculata* from the Pliocene Talparo Formation of Trinidad. Both *O. canaliculata* and *O. laevigata* differ from *O. nuttalli* spec. nov. by a much smaller last whorl and different apertural characters. Fossil *Odostomia* species are mentioned by Weisbord (1962: 462-465) from Venezuela. Some of these do not belong to the genus *Odostomia*, however, as axial (or spiral) sculpture is mentioned in the descriptions. *Odostomia antilleana* Weisbord, 1962, is most similar to our species but it has a very fine spiral sculpture which is not present in *O. nuttalli* and, moreover, the aperture and bodywhorl are much shorter in proportion to the total height of the shell. *Odostomia ingloria* Pilsbry & Johnson, 1917, from the Miocene of Santo Domingo, is smaller and its last whorl and mouth are proportionally smaller. None of these species have a spiral rib at the adapical side of the whorls. *Odostomia nuttalli* is also somewhat similar to *O. linnaeiformis* Cossmann, 1888, from the Bartonian (Eocene) of the Paris-Basin (figs 3-4). The general outline of that species is similar to *O. nuttalli*, but the adapical spiral rib, typical for the latter, is lacking in *O. linnaeiformis*. Based on the large time interval and geographic distance separating these species, as well as the difference in the subsutural spiral rib, we consider these taxa different species.

***Odostomia cotuhensis* spec. nov. (fig. 5)**

Type material. — Holotype, RGM 445345: Nuevo Horizonte, level F70. Paratypes (type locality): RGM 445346/7 specimens.

Diagnosis. — Shell cylindro-conical, rather thick-shelled, with obtuse top and lacking a pronounced columellar tooth.

Description. — Shell small, with four teleoconch whorls. Apical part obtuse, cylindro-conical. The embryonic whorls are intorted and hidden within the first teleoconch whorl. The four teleoconch whorls are somewhat convex and smooth except for a spiral rib at the adapical side. The whorls are separated by a well-defined suture. The growth-lines are straight and slightly opisthoclinal. The aperture is relatively small (apertural height less than one third of shell height). There is neither a tooth properly speaking, nor an umbilicus at the columella, but only a barely perceptible thickening. All specimens are corroded and damaged.

Dimensions. — H 1.5-1.9 mm, W 0.7-0.9 mm; holotype: H 1.9 mm, W 0.9 mm.

Etymology. — Named after the Rio Cotuhé in Southern Colombia, from which perimarine molluscs were collected.

Differentiation. — *Odostomia cotuhensis* is much smaller and more slender than *O. nuttalli*. The species have the presence of a subsutural ridge in common. There is some superficial resemblance with the Californian *O. orcutti* Bartsch, 1917, but that species has no spiral rib and its columella is "provided with a very strong, oblique fold" (Bartsch, 1917: 668).

The fossil *Odostomia bathyraphe* Pilsbry & Johnson, 1917, and *O. superans* Pilsbry & Johnson, 1917, both from the Miocene of Santo Domingo, have a more or less pronounced spiral thickening or rib at the abapical side of the whorls and a prominent columellar tooth. In these characters, they resemble the fossil *Orinella humboldti* Weisbord, 1962, from Venezuela. The latter also has a prominent suprasutural ridge. It is the type species of the subgenus *Cricolophus* Weisbord, 1962 (see the discussion below).

## Odostomiidae spec. indet. (figs 6-7)

A single specimen of a pyramidellid species belonging to the Odostomiidae was found in an outcrop at Porvenir, level F721. The shell is small and somewhat conical. The embryonic whorls have their axis at a right angle to the main shell axis. The 3 1/2 teleoconch whorls are slightly convex and separated by a well-incised suture. Just below the suture a spiral rib is present, bordering a small but well defined shoulder. The sculpture consists of fifteen rather sinuous axial ribs that are opisthoclinal on average. Weak spiral striae can be seen between the axial ribs. The mouth is relatively large, occupying just over half the total height of the shell. There is a strong tooth on the columella. An umbilicus is lacking. Its ornamentation resembles *Egila virginiae* van Regteren Altena, (1975: figs 29a,b), but that species has a completely intorted embryonic whorl and lacks a tooth on the columella.

As only one specimen was found we merely report its existence. The combination of the particular type of embryonic whorls and the axial sculpture makes it difficult to place this species in one of the genera of the Odostomiidae.

## DISCUSSION

It has been customary to place *Odostomia* species with a thickened spiral band or rib at the adapical side of the whorls in the (sub)genus *Cyclodostomia* Sacco, 1892 (van Aartsen & Corgan, 1999). Species with an abapical spiral rib are usually placed in *Eulimastoma* Bartsch, 1916 (which could well be synonymous with *Cricolophus* Weisbord, 1962). Especially our material from *Odostomia nuttalli* shows that these spiral ribs are sometimes only very weakly developed and so, for the moment we are not convinced that these sculptural details warrant a (sub)generic differentiation and place both *O. nuttalli* and *O. cotuhensis* in the genus *Odostomia* Fleming, 1813.

Taking into account that the overwhelming majority of the *Odostomia* species occur in fully marine waters, the inferred salinities at which the two species lived is very low (maximally 3.5 psu: Vonhof et al., 1998). However, the salinity inferences were based on very few measurements only, so that higher palaeosalinities cannot be ruled out.

The hosts of these parasitic snails is unknown. Hosts that are commonly used by *Odostomia* species, e.g. mytilid and ostreid bivalves, are lacking in the Pebas Formation deposits. Possible candidates are *Melongena woodwardi* (Roxo, 1924) and pachydontine corbulids that abound in the Pebas Formation. Apart from *Odostomia*, other snails containing apertural denticles occur in the Pebas Formation. The latter species, assigned to the genus *Toxosoma* Conrad, 1874 (Hydrobiidae, Cochliopinae) lack a heterostrophic protoconch and thus do not belong to the Pyramidellidae.

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