A new species of *Pugilina* (Gastropoda, Caenogastropoda, Melongeninae) from the Lower Miocene Cantaure Formation of Venezuela

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The presence of the melongenid genus *Pugilina* in the tropical American Neogene to Recent assemblages is discussed, with comments on its fossil and Recent eastern Atlantic and European congeners. A new species is described from the lower Miocene Cantaure Formation of Venezuela. The Indo-Pacific species ascribed by most authors to *Pugilina* are here considered to be a different species group, for which we use the genus *Volegalea* Iredale, 1938.

Key words: Melongenidae, *Pugilina*, *Volegalea*, taxonomy, early Miocene, Cantaure Formation, Venezuela.

Introduction

Whilst reviewing the fasciolarids occurring in the lower Miocene Cantaure Formation of Venezuela (Landau & Vermeij, in prep), we came across a few shells in the collection that had been erroneously placed in this group, and which clearly did not belong here. These shells represent a new species of melongenid, of the genus *Pugilina* Schumacher, 1817. This genus is very poorly represented in the tropical American Neogene. We therefore take the opportunity to describe this new species, and comment on the occurrence of the genus in the central American fossil assemblages.

The Cantaure beds are rich in melongenids. Gibson-Smith & Gibson-Smith (1983) described *Melongena venezuelana* and *Torquifer barbascoana* from the Cantaure deposits, plus *M. venezuelana* and *M. candelariana* in the slightly younger La Candelaria Beds, situated close to Cantaure in the Paraguaná Peninsula. However, no species of *Pugilina* was discussed in their work.

Gibson-Smith & Gibson-Smith (1979) described the presence of 'upper' and 'lower' beds in the Cantaure Formation. The basal unit was defined by a breccia composed of blocks of granite with barnacle fragments and overlain by silty and gypsiferous shales with sandy levels (Hunter & Bartok, 1974). They also noted levels rich in mollusca within the lower unit. The upper level is more

sandy, but the transition between the two units is unclear. Dr. Emily Vokes, who has also visited the site, did not recognize the presence of an 'upper' and 'lower' bed (personal communication, BL). The gastropod assemblage found in the 'upper' and 'lower' beds is similar, with a predominance of filter-feeding turritellids in the 'upper' beds and a greater number of rocky-bottom dwellers in the 'lower' bed. These specimens of *Pugilina* were found in the 'lower' bed.

Material and Methods

The material described here is from the Panama Paleontology Project (PPP) collection and the Gibson-Smith collection, both housed in the Naturhistorisches Museum Basel (NMB colln), Switzerland, and the Bernard Landau collection, now deposited in the Naturhistorisches Museum Wien (NHMW colln), Vienna, Austria. The fossil shells were also examined under a UV light source.

Systematic part

Superfamily Buccinoidea Rafinesque, 1815
Family Melongenidae Gill, 1871 (1854)
Subfamily Melongeninae Gill, 1871 (1854)

Pugilina Schumacher, 1817

Type species. — *Pugilina fasciata* Schumacher, 1817 (= *Murex morio* Linnaeus, 1758), by subsequent designation (Herrmannsen, 1848: 354). Recent, eastern and western tropical Atlantic.

Pugilina paraguanensis spec. nov. (Figs 1-5)

Type series and dimensions. — Holotype NHMW 2013/0313/0001 (ex BL colln), height 146.8 mm, width 76.2 mm (Figs 1-3); paratype 1 NHMW 2013/0313/0002 (ex BL colln), height 103.9 mm, width 47.9 mm (Figs 4-5).
Other material examined. — One fragment of outer lip NMB H 19056, height 70.0 mm; 1 incomplete specimen, NMB H19060, height 68.0 mm.

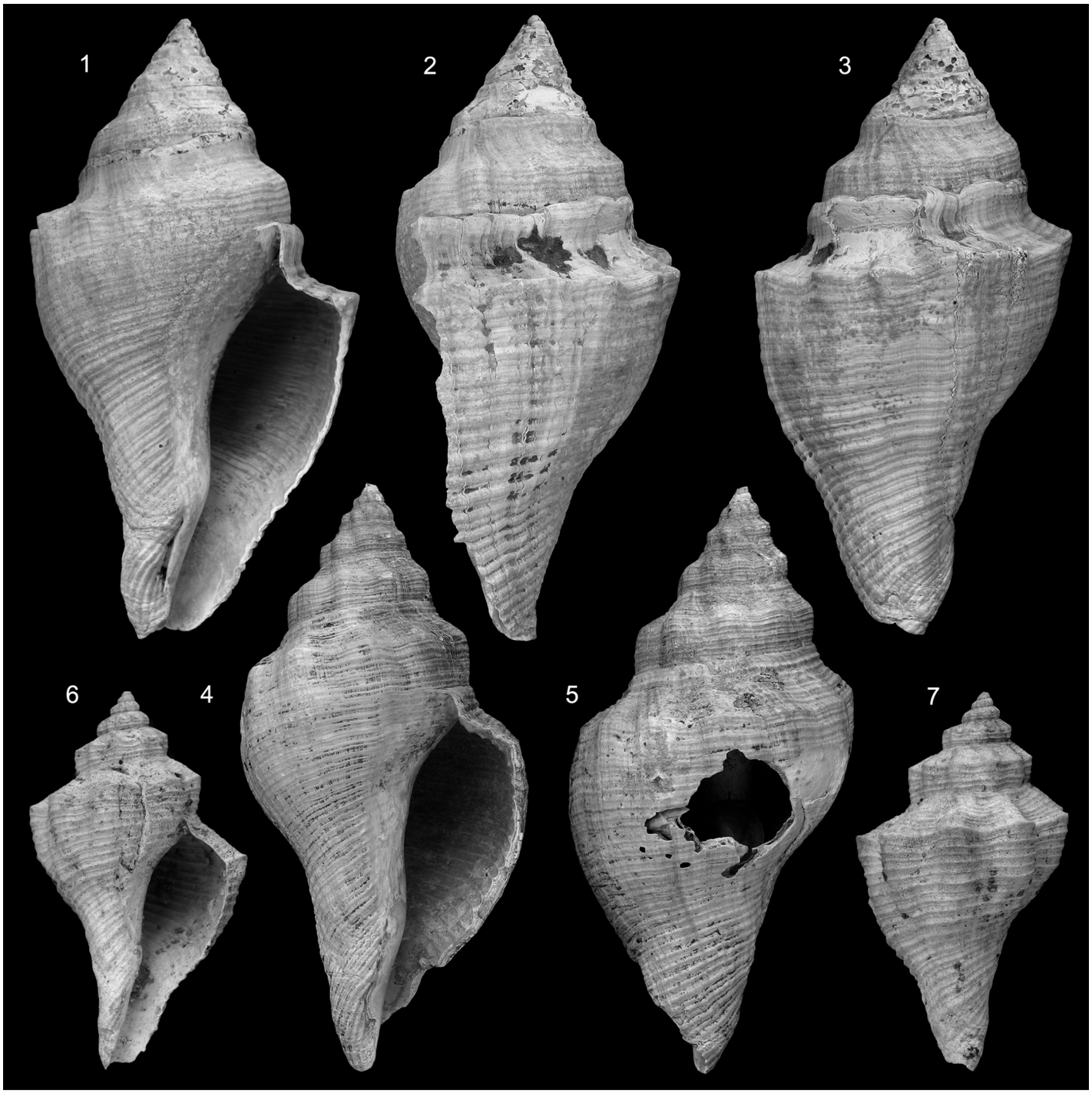
Etymology. — Named after the Paraguaná Peninsula, the geographical area in Venezuela where Cantaure is located.

Type locality. — Cantaure Formation (early Miocene: Burdigalian), lower shell bed, 1 km southwest of Casa Cantaure, about 10 km west of Pueblo Nuevo, Falcón, Venezuela (= locality GS12PGNA of Gibson-Smith & Gibson-Smith, 1979).

Diagnosis. — A large *Pugilina* species with a wide, fusiform shell shape, a sculpture of broad axial ribs weakening towards the aperture, forming weak tubercles at the shoulder, a spiral sculpture of fine irregular cords and threads, a simple outer lip, which is deeply lirate within, a smooth columella, which is thickened abapically, and a relatively short siphonal canal for the genus.

Description. — Shell large, broadly-fusiform, of medium thickness, spire medium-height, last adult whorl large. Protoconch not preserved. Teleoconch of about six whorls, with periphery at abapical suture. Spire whorls with broad sutural ramp becoming increasingly concave abapically, whorls roundly shouldered at the ramp outer edge, whorl profile convex below. Suture impressed, linear. Axial sculpture of nine low, broad, rounded, weakly prosocline ribs, each rib about double the width of each interspace. Spiral sculpture of close-set, irregular, narrow cords and threads. Last whorl 80% of total height with strongly concave sutural ramp, acutely angled at shoulder, moderately constricted at base, axial sculpture subobsolete, except at shoulder where ribs form short, spirally-elongate tubercles. Aperture 66% of total height, concave at sutural ramp, sharply angled at shoulder, weakly convex below. Anal sinus very deep, narrow. Outer lip simple, edge damaged, densely lirate within, the lirae developing a short distance from the lip margin, extending deeply within the aperture. Columella smooth, regularly concave, thickened abapically. Columellar

Figs 1-5. *Pugilina paraguanensis* spec. nov., Cantaure Formation (early Miocene: Burdigalian), lower shell bed, Casa Cantaure, Paraguaná Peninsula, Falcón, Venezuela; **1-3**, holotype NHMW 2013/0313/0001 (ex BL colln), height 146.8 mm, width 76.2 mm; **4-5,** paratype 1 NHMW 2013/0313/0002 (ex BL colln), height 103.9 mm, width 47.9 mm. **Figs 6-7.** *Pugilina antillarum* (Gabb, 1873), Baitoa Formation (early-middle Miocene), Arroyo Hondo, Rio Yaque del Norte, Dominican Republic, NHMW 2013/0313/0003 (ex BL colln), height 42.2 mm, width 24.2 mm.



and parietal area represented by depression on venter almost devoid of spiral sculpture, not thickened by callus adapically, relatively thickened columellar callus abapically. Siphonal process of medium length, relatively broad, canal open. Siphonal fasciole rounded, forming small umbilical chink, almost sealed by abapical columellar callus. Under UV light a colour pattern of three broad spiral bands is visible; adapical band placed at the shoulder, a second band just below it and a third band on the siphonal canal. Irregularly spaced fine coloured spiral lines are present between the broader colour bands.

Variability. — Only two shells are available, and there are important morphological differences between the two. The larger shell has weaker axial ribs and the sutural platform on the last whorl is more convex, especially on the last half whorl. These differences may well represent ontogenetic changes.

Discussion. — Vermeij & Wesselingh (2002) recognised two morphological groups within the post-Eocene Melongenidae, one represented in the Recent fauna by *Pugilina*, with species in the Atlantic and Indo-West Pacific regions and by *Hemifusus* Swainson, 1840 in southeast Asia, the second represented by *Melongena* Schumacher, 1817, *Volema* Röding, 1798, *Rexmela* Olsson & Harbison, 1953, and *Torquifer* Roth, 1981. According to Vermeij & Wesselingh (2002) species of the *Pugilina* group are characterised by having a relatively highspire, a relatively long siphonal protuberance, by the absence of an adapical notch in the outer lip of the adult shell, and by the presence of a single row of shoulder nodes or spines in most species.

Vermeij & Raven (2009) commented that inner side of the outer lip was lirate in the type species *P. morio* (Linnaeus, 1758), but smooth in most other species including all species of *Hemifusus*. A further difference is that in many species of *Melongena* there is a row of spines at the base, which is not present in *Pugilina* species.

Pugilina paraguanensis spec. nov. displays all the characters described above for genus *Pugilina*, including the lirate inner aspect of the outer lip. It differs from the Recent amphiatlantic *Pugilina morio* (Linnaeus, 1758) in having a stockier shell, the spire is less gradate than in *P. morio* and the siphonal canal is slightly shorter and wider than in *P. morio*. It is not possible to compare the character of the axial sculpture between the two species, as the number and strength of the axial ribs and shoulder tubercles is extremely variable in *P. morio*, with both strongly nodulose and completely smooth morphs coexisting. This extreme variability in shoulder sculpture is a character seen in almost all species of the family Melongenidae. The colour pattern enhanced under UV light is not unlike that seen in *P. morio* (Ardovini & Cossignani, 2004: 171, unnumbered figure left; Rios, 2009: fig. 619), but with more numerous and wider bands of colour.

The genus *Pugilina* is not speciose. In the tropical American Neogene the earliest member of the group is probably *P. turricula* (Dall, 1890), originally described as a smooth variety of *Melongena sculpturata* Dall, 1890. We have not seen this species, but the shell illustrated by Dall (1890: pl. 8 fig. 3; 1915: pl. 8 fig. 7) certainly displays the characters of the genus. Unfortunately, the aperture is filled with matrix obscuring the character of the inner aspect of the outer lip. *Pugilina turricula* differs from its tropical American congeners in having the sculpture on the penultimate whorl greatly reduced and obsolete on the last whorl which has a sharp shoulder devoid of tubercles. Only one further species is known, *P. antillarum* (Gabb, 1873) from the early Miocene Baitoa Formation of the Dominican Republic, which differs from *P. paraguanensis* in having a smaller shell and the siphonal fasciole is proportionately longer and more slender. The axial sculpture in *P. antillarum* is stronger than in *P. paraguanensis* and well developed on the last whorl, and the spiral sculpture consists of even finer spiral threads than in the Venezuelan species. Small tubercles develop at the shoulder on the axial cords in *P. antillarum*, which are sharper and smaller than in *P. paraguanensis*. The outer lip is lirate within, as in *P. morio* and *P. paraguanensis*. Interestingly, five specimens at hand (Figs 6-7; NHMW 2013/0313/0003-2013/0313/0004) from the Arroyo Hondo section of the Rio Yaque del Norte, Dominican Republic are all very similar, and do not show the sculptural variability discussed above.

Clench & Turner (1956: 164) included the early Miocene species *Melongena sculpturata* Dall, 1890 from the Chipola Formation of Florida in the genus *Pugilina*. However, this is not correct, as *M. sculpturata* has a depressed spire, strongly

globose last whorl and a row of spines at the base, all characters of the genus *Melongena*.

The post-Eocene record of the genus *Pugilina* is remarkably incomplete on both sides of the Atlantic. In the tropical American assemblages, apart from the single late Oligocene-early Miocene and two early Miocene species discussed above, there is no further record until that of *P. morio* in the Recent Caribbean, Lesser Antilles and Brazil (Abbott, 1974; Rios, 2009). We (BL) have searched extensively in numerous Pleistocene assemblages in Costa Rica, the Dominican Republic and Venezuela, and have not found *P. morio*.

In the eastern Atlantic fossil record, during the early Oligocene, Stampian, the genus is represented by *Pugilina polygonata* (Brongniart, 1823) in France and *P. aequalis* (Michelotti, 1861) in Italy. In the early Miocene Burdigalian it is represented by *P. pyrulata* (Bellardi & Michelotti, 1840) and *P. crassicostata* (Bellardi, 1873) (syntype illustrated by Ferrero Mortara *et al*., 1981: pl. 4 fig. 9), both from Turin Hills of Italy. All these eastern Atlantic fossil species have a lirate outer lip. The next record for the genus is in the Quaternary of Senegal (Dollfus, 1911: 25, pl. 14 figs 13-14) and the Recent coasts of West Africa from Mauritania south to Angola (Rolán, 2005). Therefore, both in the western and eastern Atlantic record, there is a hiatus for the genus from the middle Miocene to almost Recent times.

Following this discussion on the genus *Pugilina* in the Atlantic fossil and Recent assemblages, we can now review the remark made by Vermeij & Raven (2009) that species of the genus *Pugilina* usually have a smooth inner aspect to the outer lip. This is only true of the Indo-West Pacific species of the genus, as understood by Vermeij & Raven (2009).

All the fossil and Recent Atlantic species have prominent lirae extending deep within the outer lip. *Pugilina polygonata* (Brongniart, 1823) from the early Oligocene late Stampian of France also has lirae extending deep within the outer lip. In contrast, all the species from Malaysia and Indonesia discussed by Vermeij & Raven (2009) have smooth outer lips. It seems, therefore, that we are dealing with two separate species groups. The genus name *Pugilina* applies only to the Atlantic forms, but not the Indo-West Pacific group.

Iredale (1938) considered there to be some confusion as to what shell the name *Murex cochlidium* Linnaeus, 1758, referred to, which led to further confusion as to the authorship by Linnaeus or Lamarck. He resolved the problem by describing a new genus and erecting a new species name *Volegalea wardiana* to replace *Murex cochlidium*. *Volegalea wardiana* is now considered a junior synonym of *Murex cochlidium* (Wilson, 1994), but the genus name *Volegalea* is available for the Indo-Pacific '*Pugilina*' group, with *Murex cochlidium* as the type species by monotypy. Apart from the differences in sculpture within the outer lip, *Volegalea* species have heavier shells, the outer lip is much more robust, and parietal and columellar calluses are more strongly thickened than in species of *Pugilina*. In the genus *Volegalea* we include the following Recent species, *Volegalea cochlidium* and *V. dirki* (Nolf, 2007). *Fusus carnarius* Röding, 1798, is unusual in having a basal row of tubercles, which is well developed in most, but not all, specimens. It may be a *Volegalea* or a *Melongena* species.

In the fossil Miocene Indonesian/Malaysian assemblages we include *Volegalea rex* (Martin, 1895) and *V. madjalengkensis* (Martin, 1895), both of which might be synonyms of *V. cochlidium*; *V. ickei* (Martin, 1906); *V. erecta* (Vermeij & Raven, 2009); *V. ponderosa* (Martin, 1895); *Volegalea* sp. (Vermeij & Raven, 2009: figs 12-13) and possibly *Melongena (Pugilina) brevispina* Martin 1931. Several species have also been described from the Japanese Neogene. *Volegalea mimasakaensis* (Yokoyama 1929) (see Nakagawa, 2009: pl. 3fig. 13) definitely belongs to this genus, as may *Pugilina osawanoensis* Tsuda, 1959, and *Melongena sazanamii* Kanehara 1937. Nakagawa (2009) placed all these Japanese species in the genus *Pugilina*.

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