

## Notes on Buliminidae, 5<sup>1</sup>

### On the systematic position of Arabian Buliminidae (Gastropoda Pulmonata), with the description of a new genus

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It is argued that the Chondrulinae are of a polyphyletic origin: the penial appendix of the Buliminidae has been lost independently in at least six different lineages. The Azorean species, which in contrast to the Canarian Buliminidae lack a penial appendix, are assigned to *Macaronapaeus*. *Spelaeoconcha* is removed from the Buliminidae; its systematic affinities within the Pupilloidea remains however unclear. A new division of the Buliminidae into two subfamilies is given: Bulimininae and Eninae. The former is mainly characterised by the presence of a penial caecum and contains the genera *Buliminus*, *Pene*, *Paramastus* (with the subgenera *Paramastus* s. str. and *Cyrenaesus*) and the here described *Mordania* (with the monotypic subgenera *Mordania* s. str. and *Iranopsis*). The systematic position of the four Arabian Buliminidae is discussed. The two south-western species *hedjazicus* and *sabaeanus* belong to *Paramastus* whereas the two south-eastern taxa *omanensis* and *jousseumei* are classified within *Mordania* and *Pseudonapaeus*, respectively. The last two species are of turanian origin.

Key words: Gastropoda, Pulmonata, Buliminidae, systematics, *Iranopsis*, *Macaronapaeus*, *Mordania*, *Paramastus*, *Pseudonapaeus*, *Spelaeoconcha*, Oman, Arabia, Iran, Azores.

## INTRODUCTION

In his taxonomic revision of the southern Arabian Buliminidae ('Enidae'), Mordan (1986) arranged the 16 recognised species into three subfamilies, viz. Chondrulinae, Eninae and Cerastinae. Subsequent research by Mordan (1992a-b) revealed that the Cerastinae should be considered a distinct family. The recent Buliminidae (which includes the hitherto used subfamilies Chondrulinae and Eninae) and Cerastidae both have an entirely old-world distribution. The Buliminidae are palaeartic and oriental in range, whereas the Cerastidae are mostly limited to the southern hemisphere (Mordan, 1992b: figure 1). The only areas of distributional overlap between the Cerastidae

<sup>1</sup> Bank, R.A., & H.P.M.G. Menkhorst, 1992. Notizen zur Familie Enidae, 4. Revision der griechischen Arten der Gattungen Ena, Zebrina, Napaeopsis und Turanena (Gastropoda Pulmonata: Pupilloidea). - Basteria 56: 105-158.

and Buliminidae are in southwest Arabia and parts of India and Sri Lanka (Mordan, 1992b: 3).

In southern Arabia, the number of Buliminidae is rather limited: only four species are recorded. They were placed by Mordan (1986) in the genera *Paramastus* Hesse, 1933 (*hedjazicus* Bourguignat, 1882 and *sabaeanus* Bourguignat, 1876), *Imparietula* Lindholm, 1925 (*jousseau mei* Smith, 1894) and *Mastus* Beck, 1837 (*omanensis* Smith, 1894). Following Forcart (1940), the genera were placed within the subfamilies Eninae (genera *Paramastus* and *Imparietula*) and Chondrulinae (genus *Mastus*). Forcart (1940: 124-126) reviewed the division of the Buliminidae into subfamilies; his conclusion, that the family can be divided into two subfamilies on the basis of the presence or absence of a penial appendix (Eninae and Chondrulinae, respectively), has been followed by many authors. However, both Gittenberger (1978: 11-12; 1983: 339) and Bank (1985: 41) pointed out that within the Buliminidae, the penial appendix has been independently lost several times. As a consequence, the so-called Chondrulinae are of a polyphyletic nature.

In this paper, the division into subfamilies by Forcart (1940) is again challenged; a new division in subfamilies is given as an alternative. The systematic position of the four southern Arabian Buliminidae, living at the fringe of the range of the family, is reconsidered. For one of them, a new genus is established.

#### SYSTEMATICS OF THE FAMILY BULIMINIDAE

The reproductive organs of the Buliminidae can easily be distinguished from those of the Cerastidae by (1) the presence of a clump of culs-de-sac above the seminal vesicle (Mordan, 1984: 126) and (2) the presence of a third groove ('serous canal'), in addition to the sperm duct and oviduct, in the spermoviduct (Mordan, 1984: 126). In the Cerastidae both the clump of culs-de-sac and the serous canal are missing. Furthermore (3), the Cerastidae possess a brown spongy tissue that lines the atrium and part of the vagina; this structure is missing in the Buliminidae (Mordan, 1984: 126). Only in *Buliminus glabratus* Mousson, 1861, a black connective tissue ensheathing the entire female system from albumin gland to vagina, has been reported (Heller, 1975: 39). It remains to be investigated, whether this is homologous to the brown spongy tissue seen in the Cerastidae. Bank (1985: 42) reported that, with respect to the genital organs, another difference (4) exists between the Cerastidae and Buliminidae, namely the insertion of the penial retractor at either the penis (Buliminidae) or the epiphallus (Cerastidae). It turned out, however, that there are exceptions: in *Rachistia* Connolly, 1925 (Cerastidae) the penis retractor inserts at the penis and not at the epiphallus (Mordan, 1992b: 4) whereas in *Edouardia* Gude, 1914 and *Amimopina* Solem, 1964 (Cerastidae) the penis appendix is branched, inserting both at the epiphallus and penis (Mordan, 1992b: 4, 6).

The subdivision of the Buliminidae into two subfamilies, Eninae and Chondrulinae, which is based on respectively the presence or absence of a penial appendix, cannot be accepted. As described below, the penial appendix has been independently lost in at least six groups.

(1) The more than 50 described taxa of the Macaronesian archipelagos of the Azores and Canaries are currently provisionally grouped within the genus *Napaesus* Albers, 1850. Although all Canarian species possess a penial appendix (Krause, 1895; Wagner, 1928; Odhner, 1931; Hesse, 1933; Henriquez, Ibáñez & Alonso, 1993), whereas the Azorean species do not exhibit this character (Backhuys, 1975; De Frias Martins, 1989),

the taxa are more closely related to each other than to any of the taxa of the remaining Palearctic Region. Backhuys (1975: 113), who first noted the absence of a penial appendix in the Azorean taxa, already rejected the relationship of the Azorean enids with the Chondrulinae. So far, no group name was available for the Azorean species. The taxon *Macaronapaeus* Kobelt, 1899, which was introduced for both the Canarian and Azorean enid species, still lacks a type species. We here designate *Bulimus hartungi* Morelet & Drouet, 1857 (type locality: Santa Maria, Azores) as the type species of *Macaronapaeus*; consequently, the Azorean species should bear the name *Macaronapaeus*. Because of this designation, there is no need for the creation of a new name. It is a matter of opinion, whether or not *Napaeus* and *Macaronapaeus* should be treated as genera or subgenera. Based on the presence or absence of a spermathecal diverticulum, *Napaeus* has been divided into the subgenera *Napaeus* s.str. and *Napaeinus* Hesse, 1933. This anatomical feature is by no means correlated with shell characteristics (Odhner, 1931: 58) or with other anatomical features of the genital tract (Henriquez, Ibáñez & Alonso, 1993: 162). Thus, the presence or absence of a diverticulum does not reflect natural affinities. *Napaeinus* should therefore be considered a synonym of *Napaeus*. The systematic significance of the presence or absence of a diverticulum is probably very low. For example, within the genus *Mastus* it can be present or absent, even in taxa living on the same island (e.g. the Greek islands Macaronissos and Crete - Mylonas & Vardinoyannis, 1989, and Maassen, 1995). In addition, the Azorean enids also possess or lack a diverticulum (Backhuys, 1975: 112). We treat *Macaronapaeus* as a subgenus of *Napaeus*; the close relationship between the Azorean and Canarian taxa is thus reflected in its nomenclature.

(2) We consider *Cyrenaesus* Heller, 1971, a subgenus of *Paramastus*. All *Cyrenaesus* species lack a penial appendix; they are restricted to the Cyrenaica (northern Libya). A relationship of *Cyrenaesus* with *Mastus* (as proposed by Heller, 1971: 273) is out of the question because of the presence of a penial caecum in *Cyrenaesus* (absent in *Mastus*), the absence of an epiphallar caecum (present in *Mastus*) and the long epiphallar flagellum (short in *Mastus*). *Paramastus* and *Cyrenaesus* are, apart from the lack of a penial appendix in *Cyrenaesus*, both anatomically and conchologically very similar to each other. Treating both groups as separate genera results in a nomenclature that would lose its present informative content concerning a close (i.e. sister-group) relationship.

(3) *Adzharia* Hesse, 1933. The affinities of this enigmatic, monotypic, taxon are uncertain. A close relationship with other enid taxa that have lost their penial appendix is rather unlikely, because of the peculiar structure of the epiphallus of *Adzharia* and the missing penial retractor.

(4) *Senaridenta* Schileyko, 1978. The shell of this monotypic taxon (type species *nachicevanjensis* Hudec, 1972) is difficult to separate from *pupoides* Krynicki, 1833, and *lamellifera* Rossmässler, 1858. The last two species have a penial appendix (Schileyko, 1984: 371-375); *lamellifera* is the type species of both *Bollingeria* Forcart, 1940, and *Tokatia* Hudec, 1972 (see Bank & Hovestadt, 1991: 9), whereas *pupoides* is the type species of *Improvisa* Schileyko, 1978. The three monotypic taxa *Bollingeria*, *Improvisa* and *Senaridenta* seem to be closely related to each other, not only with respect to their anatomy but also with regard to their shell and distribution. This group of species has more affinities with e.g. *Euchondrus* O. Boettger, 1883, than to the taxa mentioned under (5).

(5) *Chondrula* Beck, 1837, *Mastus* Beck, 1837, *Eubrephulus* A.J. Wagner, 1928, and *Meijeriella* Bank, 1985, are closely related to each other. None of these genera possess a penial appendix.

(6) *Mordania* gen. nov. For a discussion of this genus and its two subgenera see below under 'Arabian Buliminidae: the taxon *omanensis*'.

From the above data it is clear that the systematics of the Buliminidae should be reconsidered. Schileyko (1984) divided the family into eight subfamilies. Having studied the Palaearctic Buliminidae for years now, we are of the opinion that two subfamilies can be recognized, namely Bulimininae and Eninae. Some of the remaining subfamilies of Schileyko (1984) can be considered tribes within the Eninae; their interrelationships are a topic for a future paper.

The Bulimininae (type genus *Buliminus* Beck, 1837) consist of the genera *Buliminus*, *Pene* Pallary, 1929, *Paramastus* (with the subgenera *Paramastus* s.str. and *Cyrenaesus*) and *Mordania* spec. nov. (see below). They are characterized in the first place by the presence of a penial caecum (missing in a few species only) (which is absent in the Eninae) and the presence of a long to relatively long epiphallar flagellum (exception: *Mordania*, where it is missing) (mostly short or, sometimes, missing in the Eninae). In addition, all Bulimininae lack an epiphallar caecum (present in many Eninae), are in the possession of a spermathecal diverticulum (present or absent in Eninae), have a dextral shell (dextral or sinistral in Eninae), and do not have parietal, palatal, or basal apertural denticles (exception: *Buliminus glabratus*) (present or absent in Eninae). The presence of a penial caecum is a character that the Bulimininae shares with the Cerastidae and several other Pupilloidea. The same applies for the absence of an epiphallar caecum. We consider these character states as plesiomorphic.

*Spelaeoconcha* Sturany, 1901, a troglobitic genus known from Bosnia (former Yugoslavia), has been placed within the Buliminidae by Wagner (1928: 318-320); he has been followed by e.g. Zilch (1959: 193) and Maassen (1989). Wagner (1928: 319-320, plate 15 fig. 110) described and figured the genital apparatus of *S. paganettii polymorpha* A.J. Wagner, 1914. If belonging to the Buliminidae, the genus should be placed within the Bulimininae, as a well developed penial caecum is present. However, there is (1) no epiphallar flagellum present (which is present in *Buliminus*, *Pene* and *Paramastus*) and (2) a diverticulum is missing (present in all genera of the Bulimininae). In addition (3), *Spelaeoconcha* is geographically rather isolated from the other Bulimininae. We have the impression, that we are not dealing with a taxon of the Buliminidae at all. Although *Spelaeoconcha* is without doubt a representative of the Pupilloidea, its placement within one of the established families is rather difficult. The genital organs resemble those of *Lauria* Gray, 1840 (Lauriidae) (e.g. Steenberg, 1925: plate 9) and *Spelaeodontorcula* Gittenberger, 1985 (which belongs to the Argnidae - see Hausdorf, 1996: 10), but in both cases the shell is completely different. Clearly, the affinities of *Spelaeoconcha* remain to be elucidated.

#### ARABIAN BULIMINIDAE: THE TAXA *HEDJAZICUS* AND *SABAEANUS*

Having outlined the classification of Buliminidae into two subfamilies, we can now turn our attention to the Arabian Buliminidae. Mordan (1986: 222) placed the taxa *hedjazicus* and *sabaeanus* in *Paramastus* s.str., but stated that *Cyrenaesus* (which he wrongly spelled *Cyrenaicus*), a subgenus of *Paramastus* (see above), is a possibility as well. Both *hedjazicus* and *sabaeanus* belong to the genus *Paramastus* indeed, but without knowing the anatomy (after its original description by Bourguignat in 1882 and 1876, respectively, they were never collected again) the subgeneric position remains obscure. We provisionally place both taxa into *Paramastus* s.str., which is mainly based on zoogeographical grounds. We treat *hedjazicus* as a separate species (and not as a subspecies of *episomus* Bourguignat, 1857, as was done by Zilch, 1951: 42, and Mordan, 1986: 222), since there is a distributional gap between *episomus* and *hedjazicus* of around 1200 km.

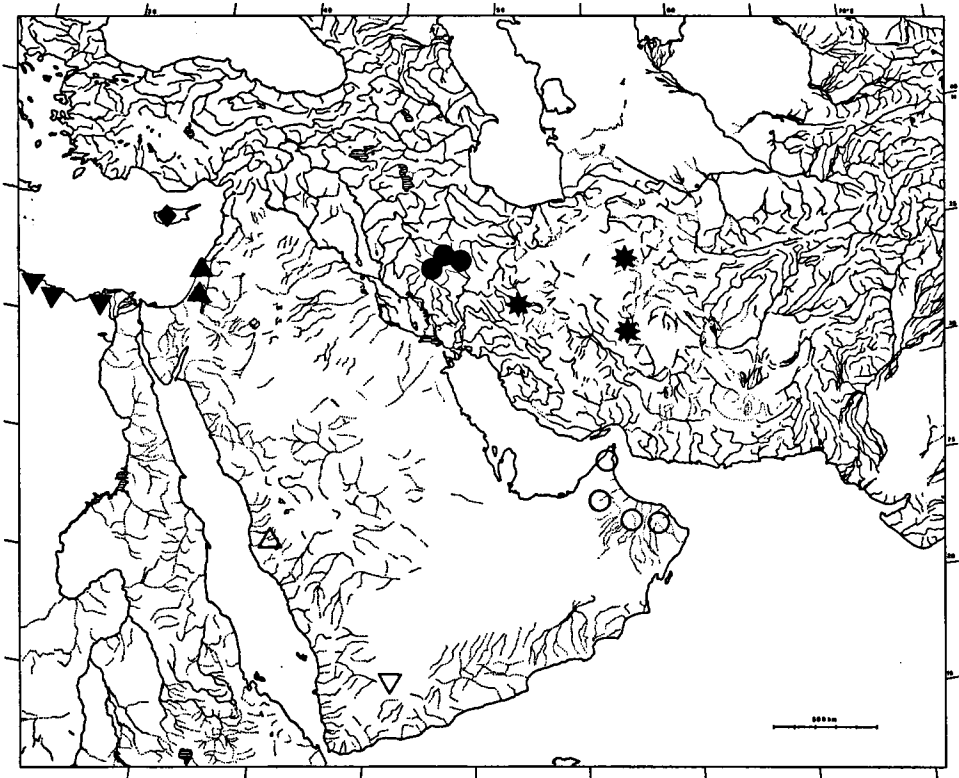


Fig. 1. Distribution map of *Mordania*, *Paramastus* s.str. and *Pseudonapaeus oxianus*. Black triangles, upside down - *P. gaillyi*; black triangles - *P. episomus*; diamond - *P. cyprius*; open triangle, upside down - *P. sabaeanus*; open triangle, - *P. hedjazicus*; black dots - *M. carduchus*; circles - *M. omanensis*; stars - *P. oxianus* (only the three Iranian localities mentioned in the text are shown).

The distribution of the genus *Paramastus* is summarized in fig. 1. The following *Cyrenaesus*-taxa are known: *dernensis* Zilch, 1951; *edentatus edentatus* Sturany, 1908; *edentatus zilchi* Brandt, 1958; *forcarti* Zilch, 1951; *kaltenbachi* Zilch, 1951; *kuiperi* Zilch, 1960. All species are restricted to the Cyrenaica (northern Libya). In this paper, the following taxa are considered species of *Paramastus* s.str.: *cyprius* Zilch, 1951 (nomen novum for *attenuatus* Mousson, 1854) (Cyprus); *episomus* Bourguignat, 1857 (synonym: *pseudepisomus* Bourguignat, 1857) (Israel and Lebanon); *gaillyi* Westerlund, 1887 (Egypt/Libya: several localities along the Mediterranean coast between Alexandria and Tobruk); *hedjazicus* Bourguignat, 1882 (Saudi Arabia: between Jeddah and Mecca); *sabaeanus* Bourguignat, 1876 (Yemen: ancient ruins Saba near Ma'rib = 130 km E. Sana). Since the anatomy of the last three species is unknown, its placement within *Paramastus* s.str. is only provisionally. At this stage, their identity with *Cyrenaesus* cannot be excluded. Species that we exclude from *Paramastus* are *goettingi* Forcart, 1961 (which belongs to a new genus - Hausdorf, unpublished results), *spratti* L. Pfeiffer, 1846 (which is most probably a species of *Zebrina* Held, 1838), and *oligogyrus* O. Boettger, 1898 (which we consider a species of the genus *Mastus*

Beck, 1837). These three taxa, all restricted to Turkey, were provisionally placed under *Paramastus* by Forcart (1940 and 1961).

It should be noted that none of the Bulimininae, the subfamily to which *Paramastus* belongs, are in the possession of an epiphallar caecum. Hesse (1933: 180-181, fig. 20) described and figured the anatomy of *Paramastus cyprius* under the name *Ena episomus*. The large epiphallar caecum (sensu Hesse) of *cyprius* is actually the epiphallar flagellum; the structure which Hesse designated as the epiphallar flagellum is most probably a misinterpretation. This misinterpretation might be caused by the fact, that in *Paramastus* the first part of the vas deferens is often thicker than its remaining part (see figs. 12-14 of Heller, 1971, for *episomus* and fig. 5 of Brandt, 1958, for *dernensis*). A subadult specimen of *P. cyprius* from "Akamas, Neohorio, march 1990, leg. M. Sanetra, coll. Neubert" could be investigated anatomically. The genital organs are very small and it is likely that they are not completely mature (only the male part could be investigated). The penis, epiphallus and penial appendix agree very well with that of *P. episomus* (Heller, 1971: fig. 12-14), thus substantiating our opinion with regard to the misinterpretations of Hesse. A penial papilla could not be traced.

#### ARABIAN BULIMINIDAE: THE TAXON *OMANENSIS*

This study was stimulated by the assignment of *Buliminus omanensis* E.A. Smith, 1894 to *Mastus* by Mordan (1986: 210-214). This confinement evoked some contradiction

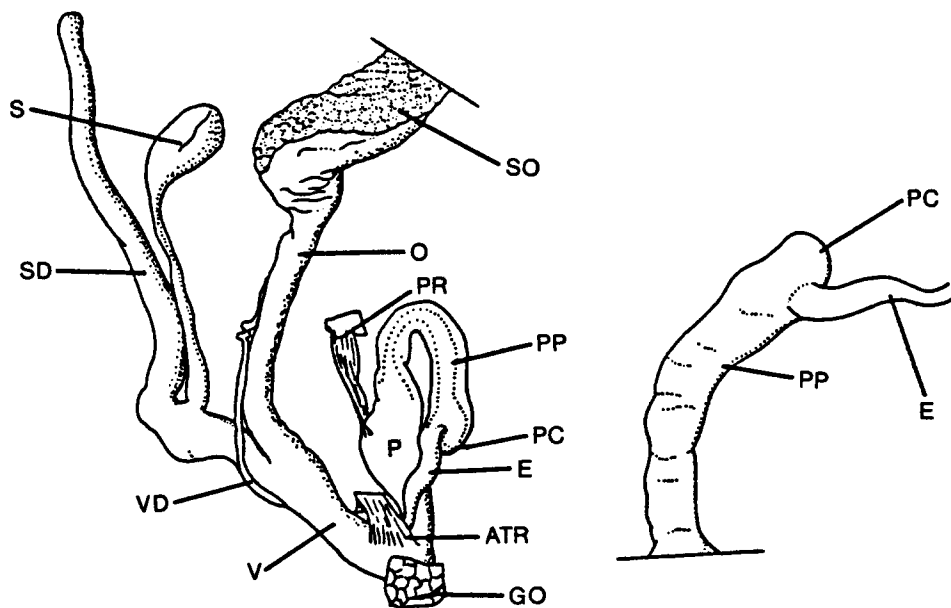


Fig. 2. Genital system of *Mordania omanensis* (after Mordan, 1986: fig. 7 - modified). Abbreviations: ATR = atrial retractor muscle; E = epiphallus; GO = genital orifice; O = oviduct; P = penis; PC = penial caecum; PP = penis, proximal part; PR = penis retractor; S = spermatheca; SD = spermathecal diverticulum; SO = spermoviduct; V = vagina; VD = vas deferens.

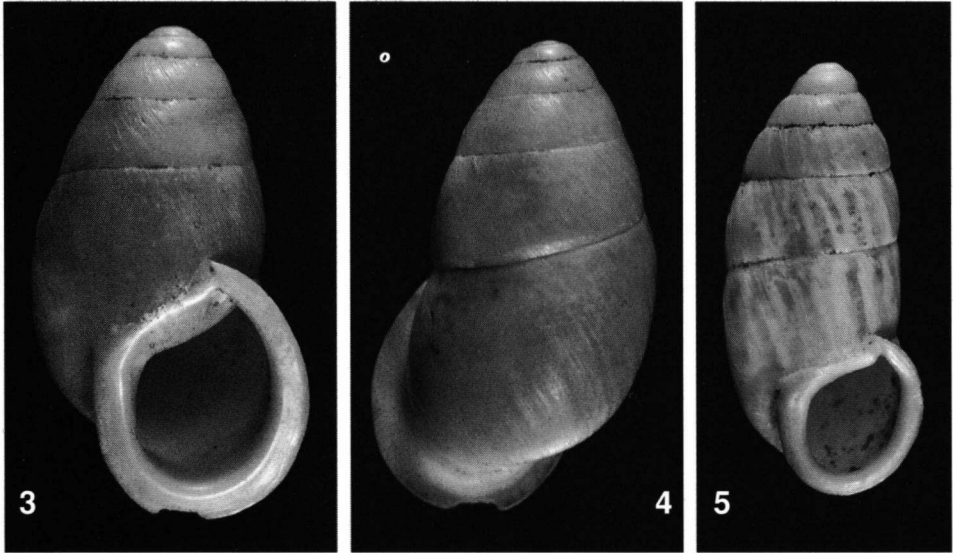


Fig. 3-5. Shells of *Mordania omanensis* and *Pseudonapaesus jousseaumei*. 3-4, *Mordania omanensis*, Oman, Oasis of Buraini (I. & H. Pauscher leg., I-1993) (height 16.9 mm, 6.25 whorls). 5, *Pseudonapaesus jousseaumei*, Oman, Fanja (= west of Mascat) (I. & H. Pauscher leg., I-1993)(height 10.7 mm, 7.0 whorls). Both shells in coll. Neubert.

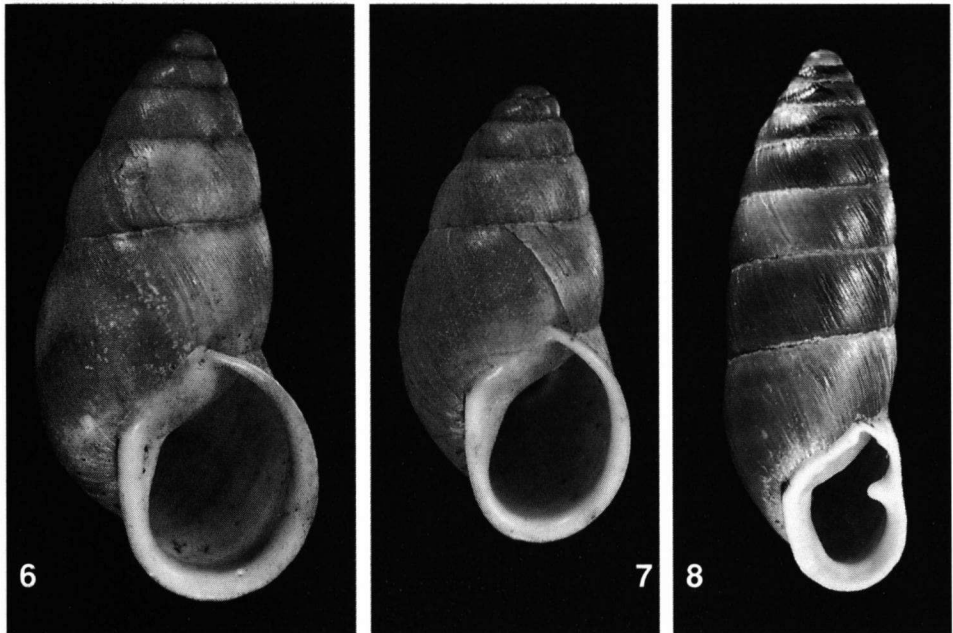


Fig. 6-8. Shells of *Mordania carduchus* and *Imparietula leucodon*. 6-7, *Mordania carduchus*, Iran, prov. Bakhtaran Kuh-e-Alvand, Gendj-Nameh, 2355 m alt. (coll. J. de Morgan 935, Museum National d'Histoire Naturelle Paris) (fig. 6: height 18.3 mm, 5.1 whorls; fig. 7: height 14.6 mm; 4.8 whorls). 8, *Imparietula leucodon*, Turkey prov. Trabzon, 7 km SW. Maçka, H.P.M.G. Menkhorst leg. & coll., 9-VIII-1992 (height 17.5 mm, 8.2 whorls)

as the speciose genus *Mastus* is only known from the central and eastern Mediterranean area. The genital anatomy was figured by Mordan (1986: fig. 7, our fig. 2), a second specimen was investigated by the authors. In our opinion, the anatomical details of *omanensis* have been misinterpreted by Mordan several times. The "epiphallus" sensu Mordan represents the proximal part of the penis. The "epiphallar flagellum" sensu Mordan represents a small globular penial caecum. The distal part of the vas deferens sensu Mordan is clearly thickened and is decorated with internal septa and thus represents the epiphallus. There are no pilasters or any other structures inside the proximal part of the penis. The epiphallus has no caecum and passes without a flagellum into the vas deferens. Consequently, *omanensis* differs considerably from *Mastus*: in this genus an epiphallar caecum and flagellum is present whereas a penial caecum is lacking (Maassen, 1995). The same misinterpretation was made by Forcart (1962: 54, plate 4 fig. 3) investigating the anatomy of *Bulimus carduchus* Von Martens, 1874. He identified the penial caecum as an epiphallar caecum; the distal part of the epiphallus is actually the proximal part of the penis whereas the proximal part of the epiphallus is actually the epiphallus. Like in *omanensis*, the epiphallus passes without a flagellum into the vas deferens. Forcart (1962: 54) classified *carduchus* within the genus *Zebrina* Held, 1838. In this genus, like in *Mastus*, an epiphallar caecum and flagellum are present whereas a penial caecum is lacking.

The taxa *omanensis* and *carduchus* are closely related to each other as illustrated by their shell structure (figs. 3-4, 6-7) and morphological details of the genital organs. As outlined above, there are basic differences between *Mastus* and *Zebrina* and the species discussed. Due to the presence of a penial caecum, both species belong to the Bulimininae. A unique combination of characters, renders it impossible to classify *omanensis* and *carduchus* in one of the existing genera, making it necessary to establish a new genus.

### **Mordania** gen. nov.

Diagnosis.- A genus from the Bulimininae as defined in this paper. The shell is medium sized pupiform (shell height 14-24 mm; maximum shell width 7-12 mm; 5-7 whorls) with a rounded and considerably expanded aperture. A well developed penial papilla is present. The penis is bipartate with a long, elongate, proximal part; the penial caecum is located near the insertion of the epiphallus. The epiphallus is short, its lumen is septated. The epiphallus passes without a flagellum into the vas deferens.

Type species.- *Buliminus omanensis* E.A. Smith, 1894 (by designation).

Derivatio nominis.- The genus is named in honour of Dr. Peter B. Mordan (The Natural History Museum, London), to acknowledge his phylogenetic research of the Buliminidae/Cerastidae.

Notes.- The genus *Mordania* differs from all other Bulimininae by the absence of a epiphallar flagellum and the bipartite penis (due to the presence of a well developed penial papilla).

### **Mordania (Mordania)** s. str.

Diagnosis.- As for *Mordania*. The peristome is strongly reflected and flared and may spread over the parietal wall. The penial appendix is missing.

Notes.- Only the type species is known, which is distributed in northern Oman.



**Mordania (Iranopsis)** subgen. nov.

Diagnosis.- As for *Mordania* s.l. The peristome is weakly reflected; the penial appendix is present.

Type species.- *Bulimus carduchus* Von Martens, 1874 (by monotypy).

Derivatio nominis.- The name of the subgenus is based on the fact, that its type species inhabits Iran (mountainous area of the provinces Bakhtaran and Hamadan).

Notes.- *M. carduchus* has so far been recorded from a single exact locality, namely Taq-i-Knist near Bakhtaran (Forcart, 1962: 54; Biggs, 1962: 69). We discovered in the rich collection of J. de Morgan (Museum National d'Histoire Naturelle, Paris) samples from three more localities, namely (1) prov. Bakhtaran (= 'Kermanshah'), Taq-e-Bostan (= 10 km NE. Bakhtaran), 1480 m; (2) same province, pass Teng-é-Tir (located between Hulilan and Zardal), 1180 m; (3) prov. Hamadan, Kuh-e-Alvand, Gendj-Nameh, 2355 m. In addition, we have a sample from Bisotun (prov. Bakhtaran) (coll. Neubert).

ARABIAN BULIMINIDAE: THE TAXON *JOUSSEAUMEI*

E.A. Smith described in 1894 under the name *Buliminus jousseumei* a snail that turned out to be widely distributed in the northern Oman mountains, from the summit of Jabal Akhdar (2980 m) to synanthropic lowland habitats down to 100 m (Mordan, 1986: 217-218, map 10). Based on characters of the reproductive system, Mordan (1986: 222, fig. 11) assigned *jousseumei* to *Imparietula* Lindholm, 1925. So far, the anatomy of the type species, *leucodon* L. Pfeiffer, 1846, is unknown. Only a single drawing, the one that accompanied the original description, of the shell was known. This drawing has been copied several times by subsequent authors. Here we present a photograph of a shell collected by H.P.M.G. Menkhorst, who rediscovered *leucodon* near Maçka (Vil. Trabzon, Turkey). The figure of Schütt (1996: 98) belongs to the taxon *lasitanicus* Lindholm, 1914, and not to *leucodon*. Based on shell characteristics we assign, apart from the type species, *brevior* Mousson, 1876, *pelidne* Biggs, 1946, and *allenai* Gittenberger, 1967, to *Imparietula*. All species are restricted to the northeastern part of Turkey, with the exception of *brevior*, which is also known from Armenia, Georgia and along the border of NW.-Iran. Most other species that are classified with *Imparietula*, such as *seductilis* Rossmässler, 1837, *blanda* L. Pfeiffer, 1853, *armeniaca* Mortillet, 1854, and *tetradon* Mortillet, 1854, are actually representatives of *Pseudochondrula* Hesse, 1933 (Schileyko, 1984: 289-292; Bank, unpublished observations).

The species of *Imparietula* are conchologically quite distinct from *jousseumei* (compare figs. 5 and 8), a fact that was already noted by Mordan (1986: 222). The shape of the shell, its colour pattern (transparent pale brown with irregular opaque white streaks becoming progressively thicker towards the aperture) as well as the anatomy of *jousseumei* agree very well with taxa those of the speciose genus *Pseudonapaeus* Westerlund, 1887. This genus is mainly distributed in the mountains of Central Asia. Many species, formerly classified as *Subzebrinus* Westerlund, 1887, have been assigned to *Pseudonapaeus* by Schileyko (1984). *Subzebrinus* has become a monotypic genus; its type species, *labiellus* Von Martens, 1881, is known from SE.-Kazakhstan. The only difference between *Subzebrinus* and *Pseudonapaeus* is the spermathecal diverticulum: it is absent in the former whereas it is present in *Pseudonapaeus* (for the anatomy of *labiellus* see Schileyko, 1984: fig. 185). Based on this character, *jousseumei* should be classified as a *Subzebrinus* (for the morphology of the reproductive system of *jousseumei* see Mordan, 1986: fig. 11).

Such a classification seems unlikely, considering the large geographical gap between Oman and SE.-Kazakhstan. It is more likely, that we are dealing with a loss of the diverticulum in two different lineages. We believe that, like in *Napaeus*, *Macaronapaeus* and *Mastus*, the presence or absence of a spermathecal diverticulum does not reflect natural affinities (see under 'Systematics of the Buliminidae'). We consider, as a consequence, *Subzebrinus* and *Pseudonapaeus* as identical taxa. Both names were introduced by Westerlund (1887: 66). As first revisors, we prefer the name *Pseudonapaeus* because it is more commonly used; *Subzebrinus* should be considered its synonym. We would like to stress that Ancey (1905: 262) already classified *jousseumei* as a *Subzebrinus* species.

The affinities between the *Pseudonapaeus* taxa are unknown; a comprehensive taxonomic revision of *Pseudonapaeus* is far beyond the scope of this paper. We refer here to Schileyko (1984), Uvalieva (1990) and Matekin (1959) for discussions concerning the variability of the many taxa. The wide-spread *P. oxianus* (Von Martens, 1876) has been found in Iran opposite Oman, the closest localities with respect to Oman being west of Esfahan (Starmühlner & Edlauer, 1957: 468), Ozbah-Kuh I (57°E 34°40'N) (Starmühlner, 1961: 98) and Kerman (Solem, 1979: 28).

*Pseudonapaeus* is a representative of the Eninae. It is the only representative of the Eninae reported from Arabia; *Mordania* and *Paramastus* belong to the Bulimininae. Thus, both subfamilies of the Buliminidae are known from Arabia. *Mordania* and *Pseudonapaeus* are examples of turanian influence in eastern Arabia. The opposite Iranian coast is close, and the area known as Arabian Gulf today is a recent geological structure dating from the late Pleistocene. Both areas were during these times separated by a river (pre Schatt el-Arab), which is no general dispersal barrier for terrestrial molluscs. Both Buliminidae support the close relationship of the southern Iranian and the eastern Arabian faunas; other examples are the distributional patterns of *Hemiscorpius* Peters, 1862 (scorpions) (Vachon & Kinzelbach, 1987: fig. 5), *Uromastyx* Merrem, 1822 (reptiles) (Jocher, 1987: 260) and *Cyprinion microphthalmum* (Day, 1880), *Garra persica* Berg, 1913, and *Garra barreimiae* Fowler & Steinitz, 1956 (fishes) (Krupp, 1983). The zoogeographical relationships of the malacofauna of the Arabian Peninsula will be discussed elsewhere in detail (Neubert, manuscript in preparation).

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