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# Observations on the genus Mastus from Crete (Greece), with descriptions of twelve new species (Gastropoda Pulmonata: Buliminidae)

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In challenging the view that only two species of the genus *Mastus* occur in Crete, it is demonstrated that this genus is very speciose on the island instead. An identification key is presented and 12 new species are described, emphasizing that several more await description. Conchologically these species may be almost indistinguishable, but the structure of the genitalia enables their identification. In several areas more than a single *Mastus* species is represented.

Key words: Gastropoda, Pulmonata, Buliminidae, *Mastus*, taxonomy, Greece, Crete.

## INTRODUCTION

During a trip to the Greek island of Crete, in April 1987, a considerable number of shells as well as living specimens belonging to the genus *Mastus* Beck, 1837, were collected. Examination of this material provided such interesting results, that four more collecting trips were made, viz. in April 1990, October 1991, October 1992, and January 1993, in order to collect additional material. Some further research material was provided by a number of colleagues.

Since the description of the two nominal taxa *Bulimus olivaceus* and *B. cretensis* by L. Pfeiffer (1846), there has always been disagreement in the literature about the taxonomic status of the Cretan *Mastus* taxa. Most often only a single species, *M. cretensis*, was accepted as valid and *M. olivaceus* was considered a variety or at best a subspecies of it. Heller (1976) was the first to consider *M. cretensis* and *M. olivaceus* specifically different, s.n. *M. pupa cretensis* and *M. olivaceus*, respectively. In his material he noticed that these two taxa occur together at several localities without intermediates.

Anatomical studies by the present author show the existence of conspicuous differences in genital structures between many *Mastus* populations, which differences are only partly associated with obvious conchological characters. Because these anatomical characters proved to be very uniform within and sometimes between populations, and because some forms were found sympatrically with others without intermediates, it was concluded that they represent different species, nearly all of which turned out to be unnamed.

This paper deals with only a part of the actually available material. In addition to the twelve new species described hereafter, a considerable number of still other *Mastus* species appears to exist on the island. These are not dealt with here, because sufficient material for anatomical studies is not yet available. Some of these taxa belong to a separate complex, closely related to *Mastus cretensis*. These forms will be dealt with elsewhere.

General distribution and ecology. — Of all the species of the genus *Mastus*, *M. pupa* (Linnaeus, 1758) has the largest distribution: Spain (Sacchi, 1965; Seddon & Tat-

tersfield, 1992), Algeria (Bourguignat, 1864, terra typica), Italy including the isles of Sicily, Malta and Lampedusa (Alzona, 1971), Tunisia (Letourneux & Bourguignat, 1887). The islands in the Aegean area are inhabited by a greater number of species. This group is being studied by Dr. R.A. Bank; the results will be published soon.

A small number of species is also known from Turkey (fide Forcart, 1940): *M. rossmaessleri* (L. Pfeiffer, 1846), *M. carneola* (Mousson, 1863), *M. etuberculata* (Frauenfeld, 1867), and *M. pontica* (Retowski, 1887). Some other members of the genus are known from Russia [fide Shileyko, 1984: *M. caucasica* (L. Pfeiffer, 1854) and *M. bielzi* (Kimakowicz, 1890)], Rumania [fide Grossu, 1987: *M. bielzi* (Kimakowicz, 1890), *M. transsylvanicus* (Kimakowicz, 1890), *M. venerabilis* (L. Pfeiffer, 1855), and *M. alpicola* (Kimakowicz, 1890)], and Bulgaria [fide Damjanov & Likharev, 1975: *M. rossmaessleri* (L. Pfeiffer, 1846) and *M. carneola* (Mousson, 1863). Mordan (1986: 210) classified also *Buliminus omanensis* Smith, 1894, with *Mastus*. However, because of striking anatomical and conchological differences, I prefer to consider this species from Oman not congeneric. This is in line with biogeographical considerations as well. Probably, a new genus has to be introduced for it.

The Cretan species live on and in the ground under stones or wood, or hidden in rock crevices. Especially during the dry and hot season, the animals seek protection well hidden in the soil, sometimes up to 30 cm deep. In spring, when the weather is far more humid, specimens were collected with full-grown shells but with their genitalia as yet undeveloped. Hence, all material collected from April until the second half of October cannot be used for anatomical investigations. The mating season starts at about the second half of October after the first rains and lasts until the end of February, as evidenced by the presence of spermatophores.

The 1 or the 10 km-grid UTM code is given with all localities mentioned.

Conchological characters. — It is hardly possible to give a conchological key, as the shells of the Cretan *Mastus* species generally possess only few, if any, unequivocally diagnostic characters. The shells are dextral and vary in shape from long and very slender to short-ovoid. The outer and the inner lip are usually connected by a more or less prominent callus. In many species a well pronounced tubercle is present in the upper right corner of the aperture. In several species this tubercle is obsolete, however. The shell colour varies considerably, from whitish to dark brown. In several species the surface of the shell is almost smooth; in others, the whorls are regularly striate, granulate or even malleate.

The apical whorls are convex, whereas the lower ones are convex to almost flat. In most species the shells have a somewhat indented suture; when the growth-lines are thickened at their upper ends, the suture becomes crenulated.

Apart from size-differences there is not much variation in shell characters within a single population, but among presumed species, these characters may vary considerably.

Anatomical characters. — According to Forcart (1940: 241) there are no differences in general structure of the genitalia between species of the genera *Chondrula* Beck, 1837, and *Mastus* Beck, 1837. These two taxa are separated only on the basis of conchological characters. Species of *Chondrula* have shells with several well-developed teeth in the aperture, while in *Mastus* there is only a single more or less obsolete tubercle in the upper right (if dextral) or left (if sinistral) corner of the aperture.

Some general remarks concerning those parts of the genitalia that are used in this paper will not be repeated in the various species descriptions, which can be relatively short and, therefore, more diagnostic. The terminology is for the greater part after Gittenberger & Menkhorst (1991).

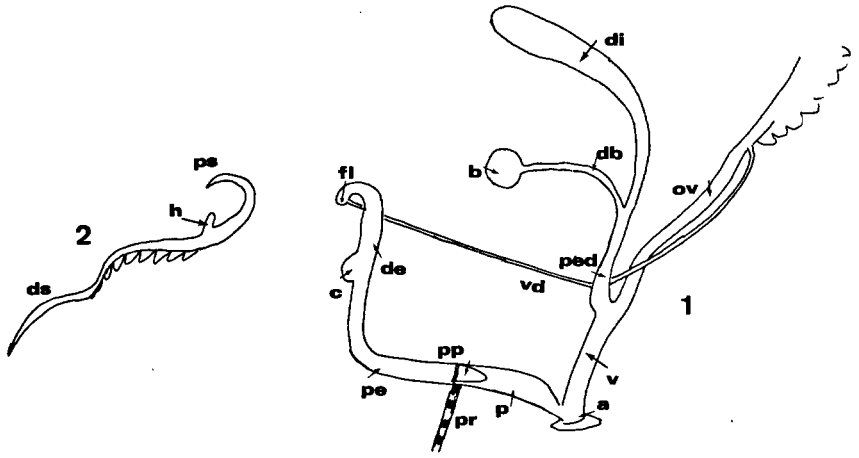
In all Cretan *Mastus* species studied, an atrium is hardly present. Within the penis there is a perforated papilla or verge, which occupies most of the lumen when full-grown. In all Cretan species but one, this verge is tapering ovally, only in *M. gittenbergeri* nov. spec. is it very flat. A short retractor muscle inserts laterally on the penis, at its distal end. The epiphallus is composed of two parts, separated by an epiphallic caecum. In most species the proximal and the distal epiphallus have a different lumen structure. In several species the lumen of the distal epiphallus shows some transverse folds (septa) close to the caecum. In most cases these septa can be seen from the outside in specimens made transparent. In one species (*M. riedeli* nov. spec.) the septa are situated near the caecum in the proximal epiphallus. The caecum can vary from flat and obsolete to very big, twice as long as the epiphallus is wide at this place (*M. abundans*). Usually the proximal epiphallus is more slender than both the penis and the distal epiphallus. Maybe the relative length of the distal part of the epiphallus varies with age or sexual activity of the individuals in question.

In the species studied there are two types of spermatheca. In the first type there is both a real bursa and a diverticulum. In the second type the bursa is missing; its function is apparently taken over by the diverticulum. I do not agree with Mylonas & Vardinoyannis (1989: 162), who claim that the absence of a bursa is not a taxonomically important character. In the species from Crete at least, it is not a case of simple absence. As a matter of fact, only in those species without any septa in the proximal part of the distal epiphallus, the bursa is missing.

The morphology of the spermatophores was found to be an important taxonomic character in this group. Only in a few cases, if there are obvious diagnostic other characters, a new species is described without data on the spermatophores. These provide information on the lumen structure of the epiphallus and flagellum (see below). Also in other groups of pulmonates, for example in milacid slugs (Wiktor, 1987), spermatophores have been found to provide excellent diagnostic characters.

In specimens of nine of the twelve new species studied, I could find spermatophores, sometimes several, sometimes only some fragments. In these Cretan species a spermatophore consists of a distal and a proximal part, separated by definition by the branching-off site of a big hook, corresponding with the shape of the lumen in the caecum. The distal part is formed in the distal epiphallus and shows all kinds of ornamentation. The proximal part, formed in the proximal epiphallus, is smooth in most cases, curved and much shorter than the distal part.

Two species groups can be distinguished on the basis of the structure of the genitalia. In the first group, the spermatheca has no bursa, and the spermatophore has no spines but only a number of longitudinal laminae along the entire length of its distal part. The second group contains species with a spermatheca provided with both a diverticulum and a bursa, whereas the spermatophore has spines. Most probably the spermatophores are produced only shortly before or during courtship, because only in one case a spermatophore (not yet completed and very fragile) was found inside an epiphallus (in *M. butoti*). Probably this specimen was disturbed just before or during mating. The majority of the undamaged spermatophores were found in the diverticulum of the spermatheca. In the bursa itself, only some fragments were found. Some snails had




Figs. 1, 2. Schematic representation of the genitalia (1) and a spermatophore (2) of *Mastus* species. Abbreviations: A, atrium; B, bursa of spermatheca; C, epiphallian caecum; DB, duct of the bursa; DE, distal epiphallus; DI, diverticulum; DS, distal part of the spermatophore; FL, epiphallian flagellum; H, "hook" of the spermatophore; OV, oviduct; P, penis; PED, pedunculus; PE, proximal epiphallus; PP, penis papilla; PR, penis retractor muscle; PS, proximal part of the spermatophore; SOD, spermoviduct; V, vagina; VD, vas deferens.

apparently mated several times within a short period of time, because their spermathecae contained several more or less complete spermatophores, one of which was undamaged and apparently fresh, and the others partly dissolved.

Remarks on the geographic names used. — The spelling of the geographic names indicating the collecting localities is taken from the "Touristmap Crete", 1:80.000, issued in five parts by Harms Verlag, Erlenbach, Germany (1989-1993). On these maps some names differ from those used on other maps. The most important examples are: Lenika (Ellinika), Sunias (Skinias), Xero Chorio (Xirohorio), Palekastro (Palaeokastro) and Stalida (Stalis). However, this is the most complete series of detailed Cretan maps which are both readily available and very useful for an accurate description of the collecting site.

Provisional results. — As mentioned above, it was hardly possible to characterize the species only by their shells. However, as there are clear specific anatomical differences, it is possible to identify at least a number of the species when alcohol-preserved material of full-grown animals is available. Apart from this, shell characters can be interpreted better as soon as anatomical data have enabled species recognition.

On the basis of the genital anatomy, the species described below can be assigned to two clusters, characterized by either the presence or the absence of a well-developed true bursa of the spermatheca. Species of the second cluster were so far only found in the eastern part of Crete.

This study indicates that apart from the already described *M. cretensis* and *M. olivaceus*, there are at least twelve other *Mastus* taxa, which I consider distinct species. These species are characterized and formally described in this paper.

As the identification of *Mastus* species requires specimens with fully developed genitalia, which are found only in late autumn and winter, shells and alcohol-preserved immature specimens from a great number of localities have to remain unnamed.

Abbreviations. — For collections the following abbreviations are used: BU, L. J. M. Butot (Bilthoven); HE, J. Hemmen (Wiesbaden); IZPAN, Instytut Zoologniczy, Polska Akademia Nauk (Warszawa); KI, K. Kittel (Wiesthal); MA, W. J. M. Maassen (Duivendrecht); NE, W. H. Neuteboom (Heemskerk); RNMH, Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie) (Leiden); SU, P. Subai (Aachen); ZMA, Zoölogisch Museum, Universiteit van Amsterdam. Shell height, H; breadth, B. Sample numbers are followed by the number of specimens in the sample, either shells or, when alc. is added, animals preserved in alcohol 70%.

Acknowledgements. — We wish to thank L. J. M. Butot Bilthoven), Prof. Dr. E. Gittenberger (Leiden), J. Hemmen (Wiesbaden), W. H. Neuteboom (Heemskerk), Prof. Dr. A. Riedel (Warszawa), and P. Subai (Aachen), who enabled me to study the material in their collections. A special debt of gratitude I owe to Dr. R.A. Bank, who made the photographs and both Dr. A. J. de Winter and Prof. Dr. E. Gittenberger for useful comments and corrections on the manuscript.

## SYSTEMATIC PART

It is possible to identify the known species provisionally, using the following key (after anatomical characters).

### Key to the Cretan species of *Mastus*

1. Spermatheca bursa present ..... 2
   Spermatheca bursa absent ..... 11
2. Penis retractor muscle inserting at the distal end of the penis ..... 3
   Penis retractor muscle inserting more proximally ..... 5
3. Penis papilla flat ..... *M. gittenbergeri* nov. spec.
   Penis papilla pointed ..... 4
4. Epiphallus short; at least some septa are visible in its distal part *M. butoti* nov. spec.
   Epiphallus long; its distal part without distinct septa ..... *M. sitiensis* nov. spec.
5. Distal part of the epiphallus without distinct septa ..... 6
   Distal part of the epiphallus with such septa ..... 8
6. Caecum inserting halfway the length of the epiphallus *M. ierapetrana* nov. spec.
   Caecum inserting more distally ..... *M. itanosensis* nov. spec.
7. Genitalia small and very slender (fig. 13) ..... *M. sphakiota* nov. spec.
   Genitalia much larger and robust ..... 8
8. Bursa duct thick, almost as broad as the pedunculus ..... *M. procax* nov. spec.
   Bursa duct slender ..... 9
9. Bursa duct at least as long as the bursa itself ..... 10
   Bursa duct short ..... *M. hemmeni* nov. spec.

10. Caecum clearly visible, epiphallus long and slender ..... *M. olivaceus* (L. Pfeiffer)
    Caecum indistinct, epiphallus compact ..... *M. violacea* nov. spec.
11. Proximal epiphallus with septa ..... *M. riedeli* nov. spec.
    Proximal epiphallus without septa ..... 12
12. Epiphallic caecum very large (fig. 23) ..... *M. abundans* nov. spec.
    Epiphallic caecum more or less normal ..... 13
13. Genitalia very small; distal epiphallus very compact (fig. 26) *M. subaii* nov. spec.
    Genitalia very large; distal epiphallus less compact ..... *M. cretensis* (L. Pfeiffer) complex

## SPECIES DESCRIPTIONS

### 1. - **Mastus gittenbergeri** nov. spec.
figs. 3, 4, 35, 49

Type material (all from Crete, Nomos Lasithiou). — Holotype: 2 km N. of Elounda, LV80 (RMNH 57064). Paratypes: locus typicus (MA/76, 21, 6, 43, 11 slides [nos. 604/606, 979/981, 1073/1077], 5 alc., 9 alc.; RMNH 57081/5, 57082/5, 9427/9 alc.; ZMA 39005/5); N-side Elounda, LV80 (RMNH 57080/7); 1 km S. of Elounda, LV80 (MA/27, 2 slides [nos.1078/1079], 3 alc.); 2 km S. of Elounda, near Lenika, LU89 (MA/29, 5 slides [nos.1080/1084], 9 alc.; RMNH 9428/6 alc.); 1 km E. of Lenika, rocky hill, E. of the road, LU89 (RMNH 57079/7); 1 km SW. of Lenika, LU89 (RMNH 57078/1); 2.8 km S. of Elounda, hill, LV80 (HW/5, 2); 1.7 km SW. of Lenika, LU89 (BU/3); 1 km Lenika to Elounda, LV80 (BU/4; SU/6); Lenika near Elounda, LU89 (IZPAN/2); Elounda, LV80 (NE/1).

Other material. — Nomos Lasithiou, 7 km S. of Elounda, LU89 (BU/1, 7).

Diagnosis. — Shell slender, of average size, with a somewhat granular texture. The very flat penis papilla is unlike that in any other *Mastus* species studied.

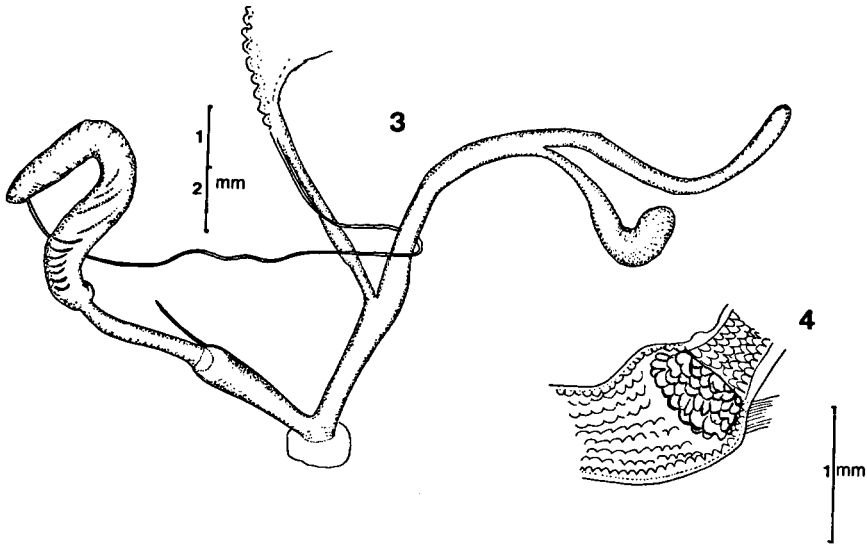
Shell. — Shell of average size, slender, with 6-7 whorls, separated by a slightly indented suture. Apical whorls convex, the lower ones more flattened. Aperture broadly rounded, taking up to c. 30% of the total shell height. A small, inconspicuous, angular denticle present. The shell is shining, light pale-brown, sometimes nearly colourless and transparent; the surface is covered with regular, somewhat granular striae.

Dimensions: H 11.7-15.3 mm; B 4.7-5.4 mm. Holotype: 14.9 × 5.2 mm.

Genitalia. — The genitalia are compact, not slender. The pedunculus of the spermatheca is at least twice as wide as the oviduct; there is both a bursa and a diverticulum. The bursa is not well separated from its duct. The diverticulum has about the same length as the pedunculus. The penis is about as long as the vagina. The penis retractor muscle inserts at the distal end of the penis. The distal part of the epiphallus is much broader than the proximal part. A caecum is weakly developed. The lumen structure of the distal part of the epiphallus, near the caecum, is composed of about six to eight conspicuous septa and three to four longitudinal folds. The lumen of the proximal epiphallus has regular small papillae. The penis papilla is small, very flat and composed of small tubercles. The flagellum is very short and rounded. The vas deferens is very thin and equally broad over its entire length.

The spermatophore is unknown.

Derivatio nominis. — This species is named in honour of my friend, Prof. Dr. Edmund Gittenberger. He allowed me to study the entire material of the genus *Mastus*




Figs. 3, 4. *Mastus gittenbergeri* nov. spec., 2 km N. of Elounda. 3, genitalia; 4, detail of the penis papilla.

kept in the Nationaal Natuurhistorisch Museum, Leiden, the majority of which was collected by himself.

Observations. — This appears to be the only *Mastus* species known with a flat penis papilla. It can be reported with certainty from a very restricted area between Plaka in the north and Aghios Nikolaos in the south. Alcohol material could be studied only from the coastal area; the distribution more inland is still unclear. Several kilometres north of the type locality of *M. gittenbergeri*, a large number of populations are known of a conchologically very similar species, *M. abundans*. Anatomically these two species can be separated easily, because in *M. abundans* the spermatheca is not provided with a true bursa.

South of the range of *M. gittenbergeri*, from the neighbourhood of Aghios Nikolaos, two additional, distinct species with small shells are known. These have to remain unnamed until more material is available for study.

## 2. - **Mastus butoti** nov. spec.
figs. 5-7, 35, 47

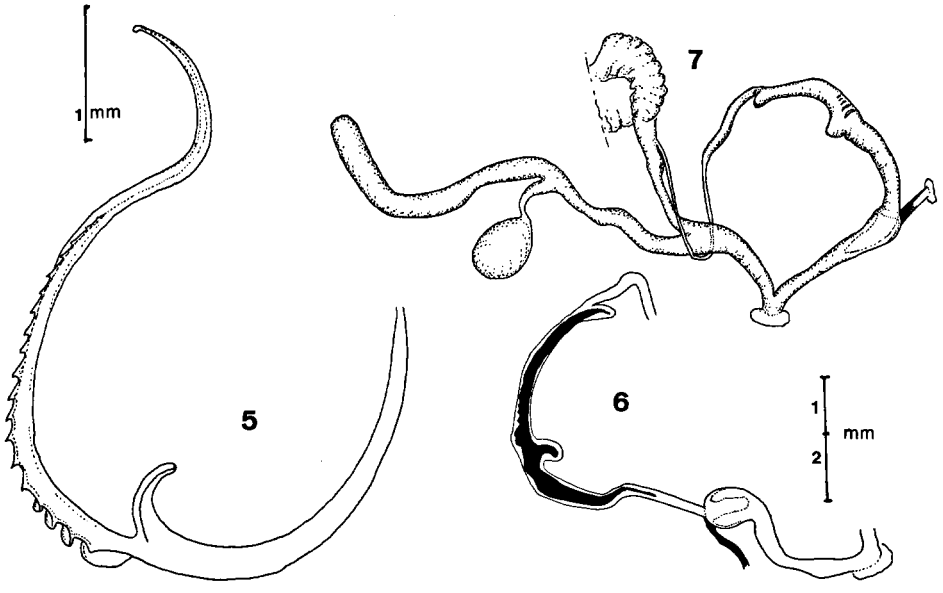
Type material (all from Crete, Nomos Irakliou). —Holotype: Tobrouk Beach, E. of Iraklion, LV31 (RMNH 57065). Paratypes: locus typicus (BU/33, 1 slide; MA/33, 1 slide [no. 967], 1 alc., 1 spermatophore; RMNH 57077/5); 1.8 km E. of Iraklion, LV31 (BU/2); 1.2 km E. of Iraklion, LV31 (BU/6); 1.4 km S. of Tobrouk Beach to "Military camp", LV30 (BU/12); Vathianos Kampos, LV31 (MA/1, 6); 1 km W. of Vathianos Kampos, LV31 (HW/25; MA/45, 15 alc., 2 slides [nos. 1037/1038]; RMNH 57083/5, 9429/5 alc.); 2 km W. of Vathianos Kampos, LV31 (MA/1, 2 alc.); 2 km E. of Hani

Kokkini, LV31 (MA/4, 7, 4 alc., 2 slides [nos. 1041/1042]); Amnissos near Ag. Ioannis, LV31 (MA/73, 3 slides [nos. 797/799], 3 alc.; RMNH 57084/5; ZMA 394004/5; IZPAN/3); Prassas, LV31 (MA/5, 1 slide [no. 796]); 5 km W. of Gournes, LV31 (SU/5; BU/3); Gournes, along the "New Road", LV41 (MA/7, 8); W. of Gouves, hill SW. of Hotel Marina, LV41 (BU/36); Kato Gouves, between Hotel Marina and "Main Road", LV41 (BU/22); waste dump, S. of Gouves, 0.5 km N. of exit to Skotino, LV40 (BU/5); Skotino, LV40 (MA/6, 5 alc., 2 slides [nos. 1039/1040]); NE. of Gouves, LV41 (BU/4); 2 km W. of Limin Hersonisou, LV51 (MA/12, 7, 3, 3 slides [nos. 968/969, 1043], 2 alc., 6 alc.; RMNH 9431/6 alc., 9414/1 spermatophore); along beach W. of Limin Hersonisou, LV51 (MA/9, 1 alc.).

Other material (all from Crete, Nomos Irakliou): 5 km W. of Apostoli (9 km W. of Kastelli), LU49 (MA/10); Ano Archanes, Mt. Jouchtas, 200 m alt., LV30 (MA/9); Ano Archanes, Mt. Jouchtas, 500 m alt., LV30 (MA/2, HW/1, RMNH/1).

Diagnosis. — Shell ovoid, small, with a malleate surface; aperture small. Spermatheca with both a bursa and a diverticulum; penis retractor muscle inserting at the distal end of the penis; epiphallus short.

Shell. — Shell small, ovoid, with 6.5-7.0 whorls, separated by somewhat indented sutures. The apical whorls convex, the lower ones more or less flattened. Surface of the protoconch whorls smooth, the adjoining ones more or less malleate, shining and provided with strong but rather irregular striae. The shell is widest at the body whorl. Aperture small, measuring c. 1/3 of the total shell height, only a little higher than wide (3.6 x 3.1 mm). Outer and inner lip connected by a callus. Most specimens with a small tubercle in the upper right corner of the aperture.




Figs. 5-7. *Mastus butoti* nov. spec. 5, spermatophore, 2 km W. of Limin Hersonisou; 6, penis with spermatophore (black) inside, Skotino; 7, genitalia, Tobrouk Beach.

Dimensions: H 9.2-12.4 mm; B 4.1-4.8 mm. Holotype: 10.4 × 4.5 mm.

Genitalia. — Spermatheca with a relatively long diverticulum, which is about as long as the oviduct; its bursa is rounded and connected with the pedunculus by a much thinner duct. The vagina is shorter than the penis. The penis retractor muscle is attached to the distal end of the penis. The epiphallus is about 1.5 times as long as the penis. About half-way the epiphallus a prominent caecum is situated. The lumen structure of the epiphallus has a complicated pattern of folds and papillae. Laterally of the distal part of the epiphallus, just opposite the caecum, there are a number of more or less prominent septa, corresponding to the spines on the spermatophore. On the other side of the distal epiphallus the lumen structure is composed of several longitudinal folds. The proximal epiphallus contains small papillae for about 2/3 of its length; the most proximal third, contacting the penis, has several longitudinal folds, which are devided into small lamellae. Where it enters the epiphallus, the vas deferens is dilated and has a lumen structure of very small papillae.

Two spermatophores, from specimens collected at different localities, could be studied. These turned out to be rather similar. They are c. 7 mm long and divided into a proximal and a distal part by a big hook; this large protrusion is apparently moulded within the caecum. The distal part bears a row of about 18 conspicuous spines; the initial spines are blunt, whereas the following ones are increasingly smaller and more acute towards the end. The proximal part of the spermatophore is much shorter, circular on cross-section and devoid of any ornamentation.

Derivatio nominis. — This species is named after my friend, the Dutch malacologist L.J.M.Butot (Bilthoven), who collected many samples of *Mastus* on Crete and over a long period of time allowed me to study these.

Observations. — This species is limited to the coastal area between Iraklion in the west and Limin Hersonisou in the east. Conchologically very similar populations are known from the hinterland. Shells from that area are not considered paratypes, however, because no alcohol-preserved specimens were available.

At 2 km W. of Limin Hersonisou this species lives sympatrically with both *M. subaii* and a species of the *M. cretensis*-complex. However, *M. butoti* is rather scarce at this locality, where *M. subaii* in very common.

Conchologically, *M. butoti* is most similar to *M. sitiensis*, which differs anatomically by a longer epiphallus, the caecum not being situated half-way the epiphallus, and another ornamentation of the spermatophore. *M. sitiensis* has a larger shell, the aperture of which has no tubercle.

### 3. - **Mastus sitiensis** nov. spec.
figs. 8, 9, 35, 40

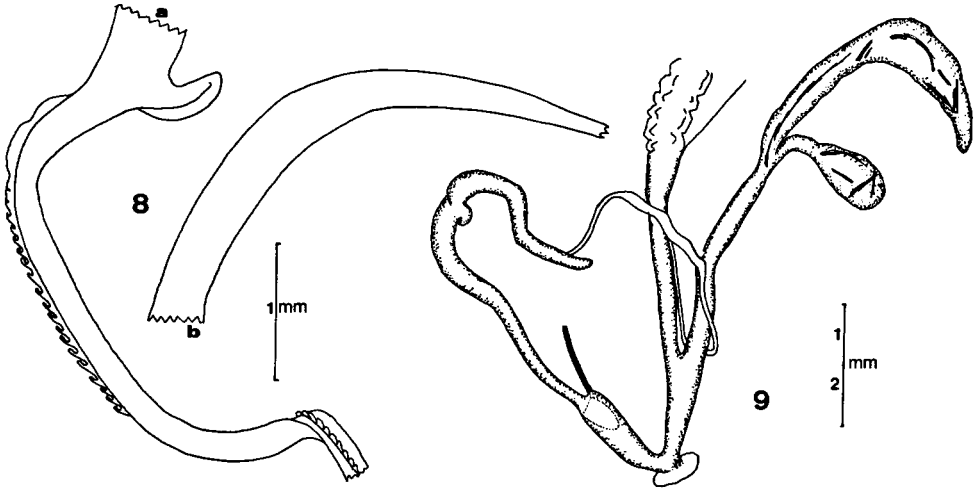
Type material (all from Crete, Nomos Lasithiou). — Holotype: 5 km E. of Agia Fotia, E. of Sitia, MU29 (RMNH 57066). Paratypes: locus typicus (MA/39, 8 alc., 5 slides [nos. 1135/1139], 1 spermatophore; RMNH 57085/5, 9426/9 alc., 9424/1 spermatophore; IZPAN/2; ZMA 394006/2); Sitia, MU19 (IZPAN/24, 2 alc.); 1 km NE. of the castle of Sitia, MU19 (HW/6); near Bay of Sitia, MU19 (RMNH 52136/2); Petras, 2 km E. of Sitia, MU19 (MA/18); hills, 3 km E. of Sitia, MU19 (MA/10); Agia Fotia, MU29 (MA/12, 4 alc., 6 slides [nos. 1126/1131]); 1 km E. of Agia Fotia, MU29 (MA/7); 7 km E. of Sitia, MU29 (HW/5); 3 km E. of Agia Fotia, MU29 (MA/1); Monastir Toplou, MU29 (IZPAN/50, 3 alc.; MA/7, 1 slide [no. 1132]); ruin opposite

Monastir Toplou, MU29 (MA/2; NE/2); 1 km S. of Monastir Toplou, MU29 (MA/13, 1 slide [no. 863]); 1 km W. of Monastir Toplou, MU29 (MA/2); 3 km W. of Palekastro, MU39 (SU/3; BU/10; MA/4); Palekastro, MU39 (IZPAN/3); 2 km S. of Palekastro, MU39 (RMNH 57121/2); 1 km N. of Palekastro, MU39 (MA/24, 5 alc., 2 slides [nos. 1133/1134], 1 spermatophore; RMNH 57086/5, 9425/5 alc.).

Other material (all from Crete, Nomos Lasithiou): 1 km from Roussa Ekklisia to Krioneri (= 6 km SSE. of Sitia), MU29 (HW/1); 0.5 km from Krioneri to Pal. Mitato (= 8 km SSE. of Sitia), MU29 (HW/1); 3 km from Karidi to Adravasti (= 12 km SE. of Sitia), MU28 (HW/13); 3 km from Kimouriotis to Monasir Faneromenis (4 km W. of Sitia), MU19 (HW/3); 1 km E. of Handras, W. of Ziros, MU1882 (RMNH/3); 1 km ENE. of Handras, W. of Ziros, MU18 (HW/3); Akrotiri Faneromenis, 5 km WSW. of Sitia, MU1495 (RMNH/1); E. of Hamezi (8 km WSW. of Sitia), MU1093 (RMNH/2); Papagiannades, W. of Handras, MU18 (SU/1); 1 km N. of Maronia, S. of Sitia, MU19 (MA/3); 1 km S. of Maronia, MU19 (HW/4); 1 km Piskokefalo to Ahladia, S. of Sitia, MU19 (HW/1); 3.5 km Piskokefalo to Ahladia, S. of Sitia, MU19 (HW/1); 3 km ESE. of Kato Zakros, MU3284 (RMNH/1); N-side of Kato Zakros, MU3284 (RMNH/2, HW/4, MA/1, 11, 4; NE/1); 2 km N. of Kato Zakros, MU28 (MA/3); S-side of Kato Zakros, MU3284 (RMNH/1); 0.5 km S. of Xerokambos, MU2977 (RMNH/4); 1 km SW. of Xerokambos, MU37 (HW/6); 2 km NE. of Xerokambos, MU2979 (RMNH/2); 7 km SSW. of Zakros, MU2678 (RMNH/1); 4 km SSE. of Ziros, MU2279 (RMNH/3); 9 km W. of Xerokambos, MU27 (NE/6); Nea Presos, 14 km S. of Sitia, MU18 (KI/1).

Diagnosis. — Shell of average size, elongate ovoid, fragile, with a fine spiral sculpture; aperture without a tubercle. Spermatheca with both a bursa and a diverticulum; penis retractor muscle inserting distally on the penis; epiphallus long, producing a spermatophore with a row of little, flattened spines.

Shell. — Shell more or less fragile and somewhat translucent, of average size, ovoid, with 5.5 to 6.5 worls. The apical worls convex, the lower ones flattened. Shell surface




Figs. 8, 9. *Mastus sitiensis* nov. spec., Agia Fotia. 8, spermatophore; 9, genitalia.

irregularly striate, hardly malleate and rather dull. In some populations, fine spiral lines can be observed on the shells under high magnification. Shells of shady and humid places are darker (more or less brown) than those of sunny and dry localities, which are lighter corneous brown. In all specimens, a tubercle is absent in the upper right corner of the aperture; only in shells from sunny, dry places there may be a thickening at that place.

Dimensions: H 10.7-14.0 mm; B 5.1-6.0 mm. Holotype: 13.4 x 5.6 mm.

Genitalia. —Compared to the size of the shell, the genitalia are fairly small. The vagina is about as long as the penis. The spermatheca is provided with both a diverticulum and a bursa. The duct of the bursa is almost as broad as the pedunculus, which is as broad as the oviduct. The penis retractor muscle inserts at the distal end of the penis. The penis is slender, though clearly wider than the proximal part of the epiphallus. The distal part of the epiphallus has a lumen sculpture of several longitudinal folds. No septa-like structures could be found. The proximal part of the epiphallus is subdivided into two parts, with different lumen structures; the part near the caecum has a lumen surface with small papillae, whereas the other part, near the penis, has longitudinal folds. The vas deferens is swollen at some distance from its insertion on the epiphallus.

Three partly damaged spermatophores could be studied. They could be dissected from the pedunculus. The distal part possesses a long ridge, which bears a row of very small, flattened spines. The proximal part is short, circular and regularly curved.

Derivatio nominis. — This species is named after the city of Sitia. Its locus typicus is only few kilometres east of this town.

Observations. — *M. ierapetrana*, *M. itanosensis* and *M. riedeli* are conchologically most similar. The shell of *M. ierapetrana* is more slender and smaller, and its surface is more conspicuously malleate. This species differs anatomically clearly from *M. sitiensis*; in *M. ierapetrana* the penis retractor muscle inserts clearly more proximally on the penis and the spermatophore has a long row of very fine, sharp and erect spines. *M. itanosensis* and *M. riedeli* cannot be separated conchologically, but there are sufficient anatomical features to separate these two species from *M. sitiensis*. *M. itanosensis* has a retractor muscle inserting more proximally on the penis; compared with *M. sitiensis* its genitalia are very slender. *M. riedeli* has a spermatheca without a bursa, and a strikingly different spermatophore.

There are many samples of shells from the neighbourhood of the type locality of this species. These samples are listed under "other material", because no material was available for anatomical research.

In a large sample from the Monastir Toplou I found, together with 50 typical specimens of *M. sitiensis*, a number of more slender, solid shells with at least an indication of a tubercle in the aperture (IZPAN/25). These shells have been separated and cannot be considered paratypes. They might represent the species as discussed under *M. itanosensis*.

### 4. - **Mastus itanosensis** nov. spec.
figs. 10, 35, 46

Type material (all from Crete, Nomos Lasithiou). — Holotype: Ruins of Itanos, 9 km N. of Palaeokastro, MV30 (RMNH 57067). Paratypes: locus typicus (SU/1; MA/6, 23, 26, 7 slides [nos. 982/983 & 1143/1147], 4 alc., 7 alc.; RMNH 57087/5, 9416/6 alc.;

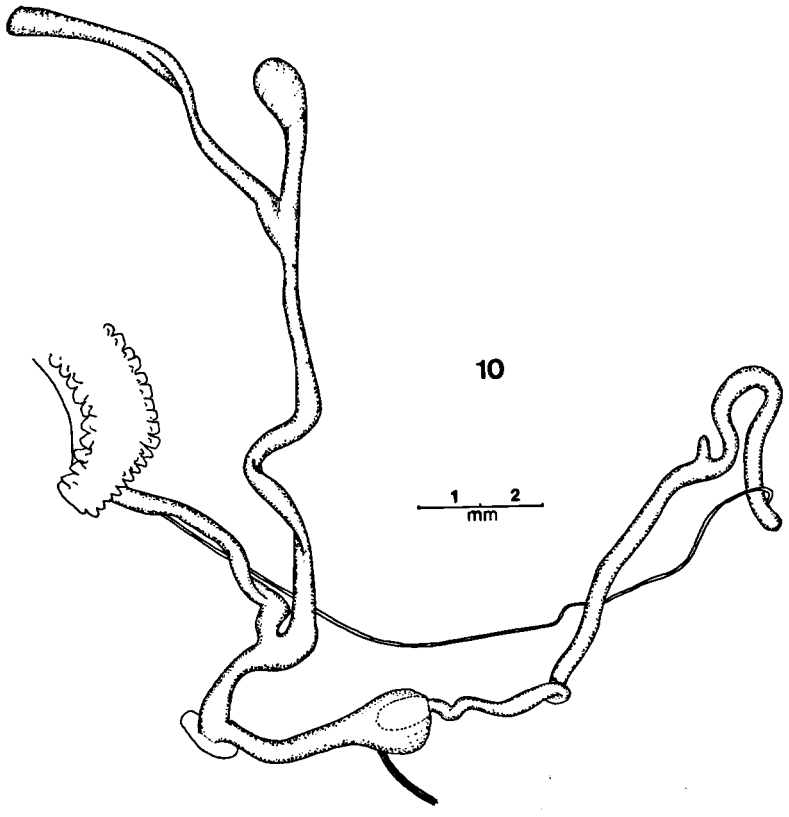



Fig. 10. Genitalia of *Mastus itanosensis* nov. spec., Itanos.

IZPAN/1; NE/1); Vai Finikodasos, MV30 (HW/4; MA/2, 4, 3 slides [nos. 1140/1142], 3 alc.; KI/1).

Diagnosis. — Shell of average size, with a large body whorl and an acute, conical spire. Spermatheca with both a bursa and a diverticulum; penis retractor muscle inserting proximal of the distal end of the penis; epiphallus with an extremely long proximal and a very short distal part.

Shell. — Shell of average size, with a large body whorl and a gradually tapering spire, with 5.5-6.5 whorls. The initial whorls are convex and separated by a deep suture; the body whorl is somewhat flattened. The shell is provided with fine growth lines on the upper whorls, whereas on the lower whorls these fine striae alternate with some pitted, irregular, more prominent lines. The surface is shining, pale olive-brown. The aperture is broadly rounded below, its height is 33-40% of the total shell height. In most specimens the parietal callus is more or less obsolete and an angular denticle is not always present.

Dimensions: H 10.9-12.8 mm; B 4.2-4.7 mm. Holotype: 11.2 x 5.3 mm.

Genitalia. — The genitalia are very slender. The spermatheca is provided with both a bursa and a diverticulum. The diverticulum is much longer than the bursa and, apart from its most distal part, about as wide as the bursa duct and the pedunculus. The bursa is not clearly separated from its duct. The vas deferens is long and very thin; nowhere it is widened. The penis is clearly longer than the vagina. The penis retractor muscle inserts proximal of the thickened distal end of the penis. The lumen of the distal epiphallus is provided with a great number of small transverse lamellae, arranged in some longitudinal folds. Opposite the caecum, the lumen wall of the epiphallus has only small papillae without any septa; these papillae become arranged into some longitudinal folds towards the penis. The penis papilla is elongated oval. The epiphallus is very long and slender, much narrower than the penis. The well-developed caecum is situated at about 1/3 from the distal end. The flagellum is short and rounded.

Spermatophores are unknown.

Derivatio nominis. — The epithet *itanosensis* is derived from the name of the type locality, the antique city of Itanos.

Observations. — Close to the range of *M. itanosensis*, *M. sitiensis* and *M. ierapetrana* occur, and, at some distance, *M. riedeli* and *M. abundans*. Conchologically it is not possible to separate all these species from each other with certainty, but there are enough anatomical features to do this without problems (see the key).

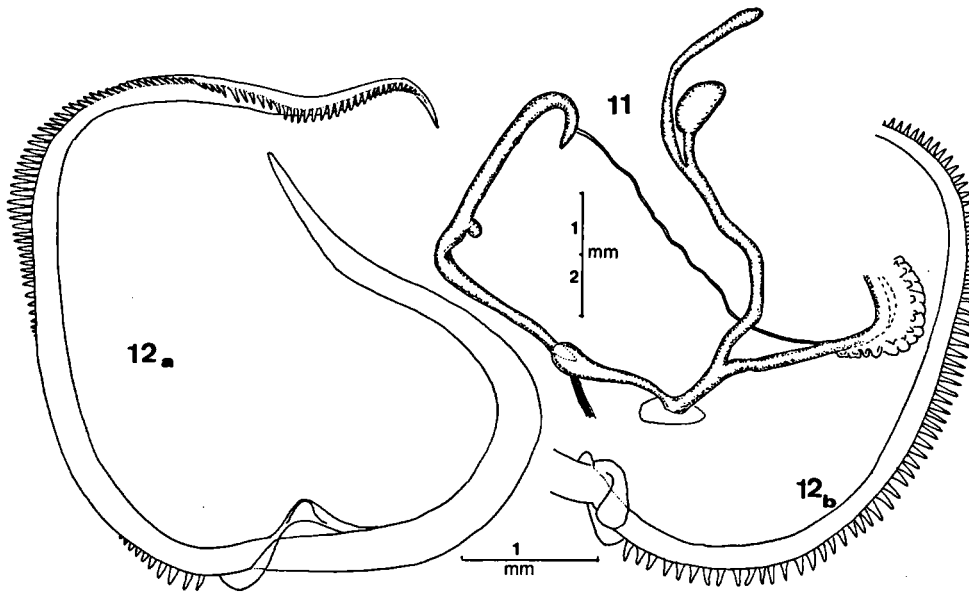
*M. itanosensis* apparently has a very restricted range, with only two localities known at the moment. At it type locality it occurs sympatrically with a species with larger, more slender shells, with more clearly flattened whorls and a prominent angular tubercle. Further to the north only this second species is present in samples collected by L. J. M. Butot and P. Subai. As no alcohol-preserved material is available for study, this species will not be discussed in this paper.

### 5. - **Mastus ierapetrana** nov. spec.
figs. 11, 12, 35, 45

Type material (all from Crete, Nomos Lasithiou). — Holotype: 5 km E. of Ferma, E. of Ierapetra, LU97 (RMNH 57068). Paratypes: locus typicus (MA/66, 8 alc., 3 slides [nos. 1160/1162]; RMNH 57089/5, 9433/9 alc., 9417/1 spermatophore; IZPAN/2; ZMA 394007/2); Ferma, E. of Ierapetra, LU97 (MA/4); 7 km E. of Ierapetra, LU97 (MA/6, 1 alc., 1 slide [no. 1156]); 6 km E. of Ierapetra, LU97 (MA/20); 4 km E. of Ierapetra, LU87 (MA/29, 5 alc., 3 slides [nos. 1157/1159]; RMNH 57088/5, 9432/ 3 alc.); Gra Ligia, LU87 (IZPAN/1 alc.); Koutsounari, 7 km E. of Ierapetra, LU97 (KI/62; MA/6).

Diagnosis. — Shell small, ovoid to slender spindle-shaped. Genitalia very slender; spermatheca with both a bursa and a diverticulum; penis retractor muscle inserting proximal of the distal end of the penis; distal epiphallus without septa; spermatophore with a long row of very sharp and small spines.

Shell. — Shell small; with 5.5 whorls in small specimens and up to 7.0 whorls in the largest ones. The shells are more slender spindle-shaped in the population of the type locality and more ovoid in populations more to the west. Usually the shells are pale corneous brown. In the upper right corner of the aperture there is either a very small tubercle or frequently no swelling at all. Most whorls are more or less flattened; the




Figs. 11, 12. *Mastus ierapetrana* nov. spec., 5 km E. of Ferma. 11, genitalia; 12a, b, spermatophore.

surface is irregularly striate and, especially on the last whorls, malleate. Fine spiral striae can be seen under a high magnification on the apical whorls.

Dimensions: H 10.5-13.5 mm; B 4.2-4.9 mm. Holotype: 11.9 x 4.5 mm.

Genitalia. — The genitalia are very slender. The vagina is shorter than the penis. The spermatheca is provided with both a diverticulum and a bursa; the pedunculus is as broad as the oviduct. The penis retractor muscle inserts proximal of the distal end of the penis. The caecum is situated approximately halfway the epiphallus. The lumen structure of the proximal epiphallus is divided into two parts; shortly proximal of the caecum there are little papillae, for one third of the length, whereas from there on, towards the penis, there are some longitudinal folds. In the distal epiphallus no septa could be observed. The flagellum is pointed at its end, not rounded as in most *Mastus* species.

The spermatophore is devided into two parts by a flat hook. Its proximal part is rounded and regularly curved, without any ornamentation, while the distal part shows at one side a long row of fairly long, sharp spines on a ridge. In the centre of this row the spines are much longer than at the ends. Apart from the spines, the distal part of the spermatophore does not show any structural elements.

Derivatio nominis. — The epithet *ierapetrana* is derived from the town Ierapetra, at the south-east coast of Crete, which is very close to the type locality, situated some kilometres to the east.

Observations. — This species is known from several localities from the coastal area near Ierapetra. For a discussion concerning the conchologically most similar species see under *M. itanosensis*.

The sample from Gra Ligia is problematic. Conchologically this sample looks like a mixture of *M. ierapetrana* and *M. riedeli*. The only specimen preserved in alcohol without doubt belongs to *M. ierapetrana*, while most shells are more like *M. riedeli*. Consequently, only this alcohol-preserved specimen is considered to belong to *M. ierapetrana*, whereas the rest of the sample is listed under *M. riedeli*, though not as type-material.

### 6. - **Mastus sphakiota** nov. spec.
figs. 13, 35, 44

Type material (all from Crete, Nomos Chanion). — Holotype: Anopolis, KV30 (RMNH 57069). Paratypes: locus typicus (MA/2, 1 slide [no. 1034]; SU/10; BU/4, 2 slides, 2 alc.; IZPAN/1); 3 km W. of Frangokastello, KU49 (MA/1); gorges at Aradena, 7 km WNW. of Hora Sfakion, 500 m alt., KV3201 (RMNH 57123/1); Loutro, 5 km W. of Hora Sfakion, E.-exposed rocks above the village, KU3398 (RMNH 57122/15; MA/2); 2.3 km Hora Sfakion to Imbros, KU49 (SU/1).

Other material: Crete, Nomos Chanion, Samaria gorge, just NE. of the lowest narrow part, 120 m alt., GE6905 (RMNH/1).

Diagnosis. — Shell small, very slender spindle-shaped. Genitalia very slender; spermatheca with both a bursa and a diverticulum; penis retractor muscle inserting proximal of the distal end of the penis; lumen of the distal epiphallus with several septa.

Shell. — Shell small, very slender, rather fragile, with 6.5-7.5 whorls, which are separated by a clearly indented suture. The initial whorls convex, the following ones less so, though not so conspicuously flattened as in most other Cretan species studied. Surface with prominent, irregular striae. The shells are pale brownish. The aperture is relatively small, 29-33% of the total shell-height. An angular tubercle is absent in all the specimens. The aperture is broadly rounded below.

Dimensions: H 10.0-12.7 mm; B 4.0-4.3 mm. Holotype 12.0 × 4.1 mm.

Genitalia. — The genitalia are very slender. The spermatheca is provided with both a bursa and a diverticulum. The duct of the bursa is longer than the bursa itself and the diverticulum is much longer than bursa duct and bursa together. The pedunculus is clearly longer than the diverticulum and as broad as the oviduct. The distal epiphallus is somewhat shorter and slightly narrower than the proximal epiphallus. The caecum is clearly discernible. Only two or three septa were observed in the distal part of the epiphallus, near the caecum. Apart from these septa, the lumen of this part of the epiphallus has some longitudinal folds; the proximal part is provided with some rows of small papillae. The penis is long and slender, longer than the vagina. The penis papilla is small and conical. The flagellum is small and rounded. The vas deferens is a very thin duct, enlarged and internally furnished with small papillae at the insertion on the epiphallus.

Spermatophores are unknown.

Derivatio nominis. — This species is named after its range, in the middle of the country of the Sfakiot people.

Observations. — Anatomically most similar are *M. itanosensis* and *M. ierapetrana*, which are also distributed along the south coast. However, these species have more ovoid, less slender shells, and there are sufficient anatomical features to separate them from *M. sphakiota*. Both *M. itanosensis* and *M. ierapetrana* do not possess any clearly discernible septa in the proximal part of the epiphallus. See also the identification key.

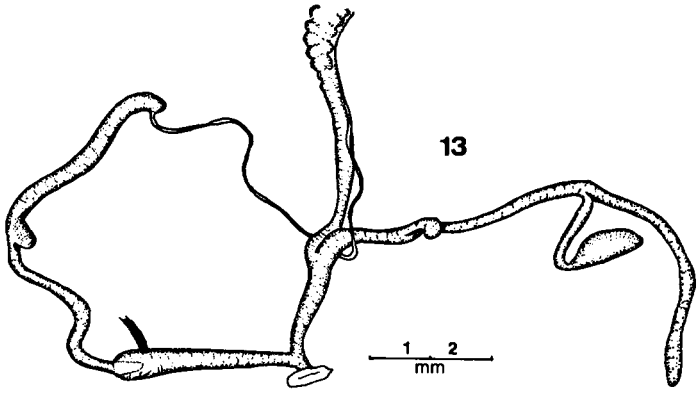



Fig. 13. Genitalia of *Mastus sphakiota* nov. spec., Anopolis.

There are few other *Mastus* taxa with shells as slender as those of *M. sphakiota*, but these are not discussed here, because of the lack of material preserved in alcohol. In particular an unnamed species from the neighbourhood of Aghios Nikolaos is extremely similar conchologically; it only differs by the presence of a very prominent tubercle in the upper right corner of the aperture.

*M. sphakiota* is known from only a small area along the south-coast, west of Hora Sfakion.

### 7. - **Mastus procax** nov. spec.
figs. 14, 15, 35, 39

Type material (all from Crete, Nomos Rethimnis). — Holotype: Lambini, NW. of Spili, don. J. Hemmen, KV70 (RMNH 57070). Paratypes: locus typicus (MA/8, 5 slides [nos. 961-963, 894-895], 5 alc.; HW/8; RMNH 9418/5 alc., 1 spermatophore [on slide]; IZPAN/1); 1 km S. of Akoumia, SE. of Spili, KU79 (MA/1, 1 slide [no. 867]); 4 km S. of Akoumia to Melambes, KU89 (SU/4); 3 km from Agia Gallini to Melambes, KU88 (SU/1); 4 km from Agia Gallini to Melambes, KU88 (MA/1, 29, 2 slides [nos. 864-865]; HW/4; RMNH 57090/5; ZMA 394008/2); 3.3 km W. of Agios Ioannis, 6.3 km NNE. of Melambes, KU8994 (RMNH 57119/1); 1.6 km from junction road Timbaki-Agia Gallini direction Agios Paraskevi, 5.7 km E. of Melambes, KU9190 (RMNH 57120/1); Agia Gallini, KU88 (SU/3; BU/2); 2 km S. of Spili, KU79 (MA/4); 1 km S. of Melambes, KU88 (MA/8).

Other material (all from Crete, Nomos Rethimnis): E. of Kerames, S. of Spili, KU79 (RMNH 52143/6).

Diagnosis. — Shell large, slender ovoid and broad. Genitalia robust. Spermatheca with both a bursa and a diverticulum; penis retractor muscle inserting proximal of the distal end of the penis; distal epiphallus with several septa.

Shell. — Shell rather variable in length, slender ovoid, relatively broad, with 5.5-6.5 rather convex whorls. All whorls increase quickly in width and, as a consequence, full-

grown shells look like juvenile specimens. Most shells have a distinct but weak callus and, in most cases, in the upper right corner of the aperture only a thickening instead of a real tubercle. The shell surface is covered with prominent growth lines and somewhat malleate; in several fresh shells fine spirals are visible. The colour is light brown.

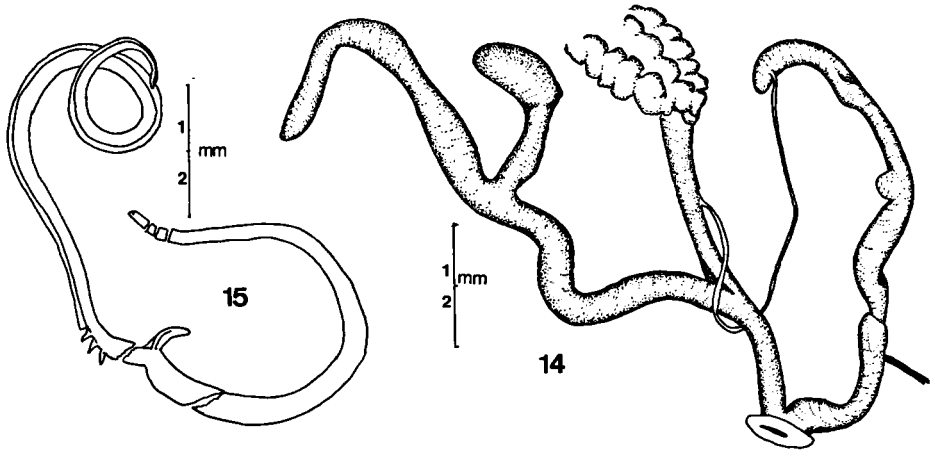
Dimensions: H 12.0-16.0 mm; B 5.5-7.0 mm. Holotype 14.1 × 6.2 mm.

Genitalia. — The genitalia are very robust, with broad ducts. The pedunculus of the spermatheca is as broad as both the vagina and the oviduct. The spermatheca has both a diverticulum and a bursa. The diverticulum is much longer than the bursa and its duct together. The bursa duct is about as broad as the pedunculus. The vas deferens is strikingly short. The vagina and the penis are about equally long. The penis retractor muscle inserts proximal of the distal end of the penis. A well developed caecum is situated at the middle of the epiphallus. In the distal part of the epiphallus, just above the insertion of the caecum, about 6-8 septa can be seen. The lumen structure of the epiphallus consists of two different structures: in the proximal part some rows of papillae can be found, while in the distal part, apart from the septa, several longitudinal folds are situated. The flagellum is rounded, short. The penis papilla is small and conical.

Only a single, partly damaged, spermatophore could be found in the diverticulum. Its proximal part is smooth and curved, whereas the distal part has one ridge along its entire length, with some spines near the big hook.

Derivatio nominis. — This species is named after the somewhat peculiar shape of the shell.

Observations. — The closest relatives are without doubt *M. hemmeni*, *M. violacea* and *M. olivaceus*, all geographically close as well. *M. olivaceus* has smaller, more slender shells, and differs anatomically by the more slender genitalia, with a long and thin duct of the spermatheca bursa, and the caecum inserting far more distally. *M. hemmeni* has somewhat larger shells, which are also more slender; anatomically this species differs by the short and thin duct of the bursa and by the different ornamentation of the spermatophore. *M. violacea* differs from *M. procax* by the very slender, large, dark shell,




Figs. 14, 15. *Mastus procax* nov. spec., Lambini. 14, genitalia; 15, spermatophore.

provided with a prominent tubercle in the upper right corner of the aperture; anatomically it differs by the long, thin duct of the spermatheca bursa, and a different ornamentation of the spermatophore.

West of the range of *M. procax* another species, *M. sphakiota*, is found. Conchologically the latter species differs clearly from *M. procax* by the much smaller and more slender shells. From east of the range of *M. procax* some samples are available of another species (near Phaestos and Matala). Because only a few shells and no alcohol-material are available, this material will remain unnamed until more specimens have been collected.

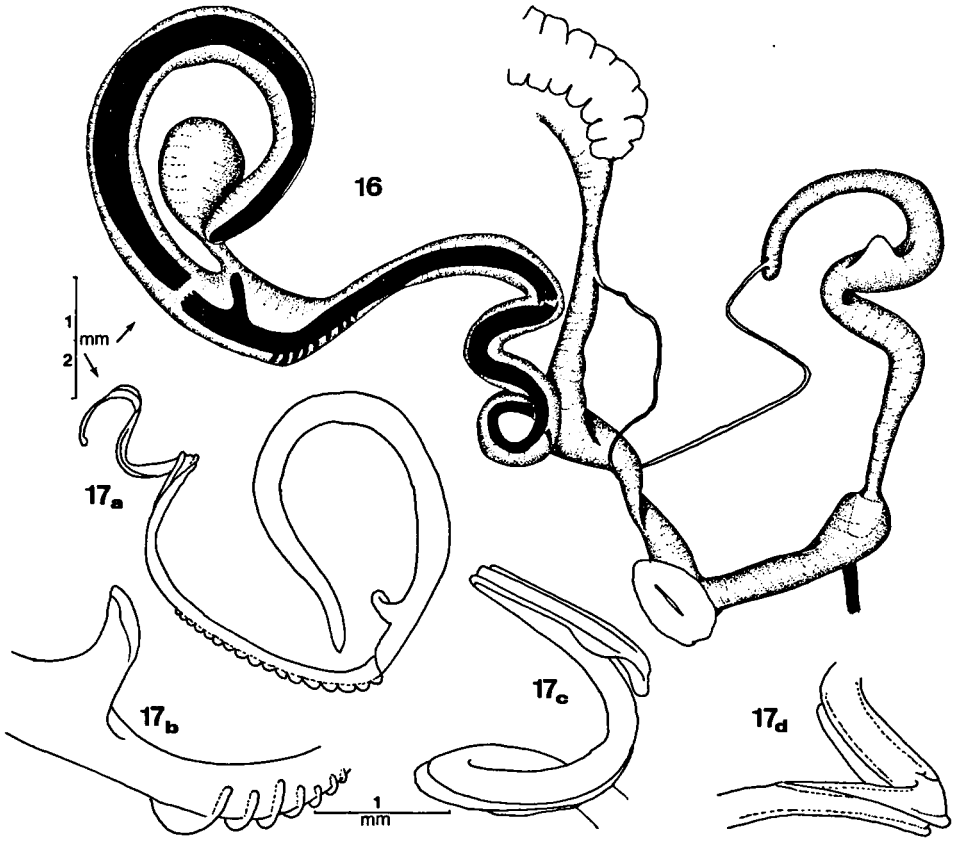
### 8. - **Mastus hemmeni** nov. spec.
figs. 16, 17, 36, 38

Type material (all from Crete, Nomos Rethimnis). — Holotype: W. of Orthes, S. of Perama, KV91, don. J. Hemmen (RMNH 57071). Paratypes: locus typicus (MA/5, 5 slides [nos. 958-960, 996-997], 1 alc.; HW/3; RMNH 9434/2 alc., 9419/spermatophore; IZPAN/1); little ravine, N. of Orthes, KV91 (MA/1); W.-edge of Livadia, SE. of Perama, 580 m alt., KV91 (RMNH 57091/13; MA/2); 1.6 km along the road from Monastir Arkadiou direction south, KV8408) (RMNH 57124/3); Monastir Arkadiou, KV80 (MA/1); ravine, N. of Monastir Arkadiou, KV81 (MA/6); 1 km NW. of Mourtsana, along the main-road, 0.4 km E. of road to Agia, KV9714 (RMNH 57125/1); NW. of Melidoni near cave-entrance, KV9417 (SU/2; RMNH 57127/1); 2.0 km along the road from Agios Ioannis direction Rethimnon, KV91 (RMNH 57128/2); 1 km N. of Perama, KV91 (MA/4).

Other material (from Crete, Nomos Irakliou): Palaeokastron, W. of Iraklion, 2 km E. of Rogdia, LV2115 (HW/3; MA/8, 3, 4 slides [nos. 898-899, 964-965], 4 alc.; RMNH/1); 1 km W. of Gazi, 8.5 km W. of Iraklion, LV10 (RMNH/3); 7.3 km along dirt-track from Ag. Irini to Gonies, 900 m alt., LV1102 (RMNH/1); 4.0 km SE. of Gonies, LV1405 (RMNH/1); 0.9 km from junction with road Tilissos- Gonies direction Moni, LV1906 (RMNH 1); 4.7 km NW. of Rogdia, LV1618 (RMNH/1).

Other material (from Crete, Nomos Rethimnon): 9 km W. of Rethimnon, along river Petres, KV61 (MA/15, 6 slides [nos. 871-875, 1035], 3 alc.; BU/2,]; SU/7, 1 slide); entrance cave near Gerani, KV61 (MA/4; RMNH/3 fragm.); Simonelli, 5 km W. of Rethimnon, KV61 (RMNH/1); 1 km along road from Prassies to Rethimnon, KV71 (RMNH/1); Xirohorio (= Xero Chorio), S. of Rethimnon, KV71 (MA/2; IZPAN/5); Rethimnon, KV71 (IZPAN/19); 6 km S. of Rethimnon direction Armeni, KV61 (SU/1); 2 km S. of Prassies, KV71 (MA/1); 3 km W. of Gonies, LV10 (MA/1); 10.2 km along dirt-track from Kalivos direction Mt. Psiloritis, 1260 m alt., KV90 (RMNH/1); 9.0 km along dirt-track from Kalivos direction Mt. Psiloritis, 1120 m alt., KV90 (RMNH/5).

Other material (from Crete, Nomos Chanion): 0.3 km E. of Hania, KV3234 (RMNH/1); rocky ravine between Almirida and Plaka, KV4726 (RMNH/2); 6 km NE. of Tsivaras, along coastal road, KV4827 (RMNH/1); 5 km E. of Vafes, along "New Road", KV4816 (RMNH/1); Kalives, KV42 (IZPAN/ 33); 1 km E. Georgioupoli, KV51 (MA/2); 2 km W. of Georgioupoli, KV51 (MA/1); Limni Kourna 6 km W. of Episkopi, KV51 (SU/12, 2 slides); MA/5, 4 slides [nos. 736-737, 1036]; BU/4); Sternes, N. of Souda, KV43 (SU/1); 0.8 km W. of Kefalas, N. of Georgioupoli, KV42 (BU/6; SU/19); 2 km E. of Neo Horio, KV42 (MA/1); 2 km S. of Askifos, KV40 (MA/1); 2 km S. of Topolia, SE. of Kastelli, GE4322 (RMNH/2); Katsamatados, S. of Topolia, GE42




Figs. 16, 17. *Mastus hemmeni* nov. spec., Orthes. 16, genitalia, with spermatophore (black) inside the diverticulum; 17a, spermatophore; 17b-d, spermatophore at different views.

(MA/7, 3 slides [nos. 601-603]); 2 km N. of Kakopetros, S. of Kolimvari, GE52 (MA/3); 2 km S. of Kakopetros, GE42 (MA/2); 0.2 km E. of the Phalasarna ruins, GE3332 (RMNH/3); 1 km N. of Kolimvari, GE53 (MA/3); 2.5 km E. of Phalasarna, GE32 (SU/3); 6 km N. of Platanos, SW. of Kastelli, GE32 (BU/2); Monastir Gonies, N. of Kolimvari, GE53 (IZPAN/14); Afrata, GE54 (BU/1; SU/1); Platanos, SW. of Kastelli, GE32 (BU/1; SU/6); 7.6 km N. of Therisso, GE72 (SU/3); ravine, 4 km N. of Therisso, GE72 (MA/4; BU/8; SU/14); Meskla, S. of Hania, GE62 (BU/1).

Diagnosis. — Shell large, very solid, spindle-shaped, with a prominently sculptured surface. Spermatheca with both a bursa, with a short, thin duct, and a diverticulum; penis retractor muscle inserting proximal of the distal end of the penis; spermatophore with transverse lamellae.

Shell. — Shell large, spindle-shaped, with 6.5-7.0 moderately convex whorls, which are separated by a strongly indented suture. Apertural base somewhat narrowed,

instead of broadly rounded; the aperture measures 33-37% of the total shell height. Shell corneous brown; the surface is prominently striate and malleate. Most specimens possess a clear but weak parietal callus; only a few have a marked angular tubercle.

Dimensions: H 15.9-18.7 mm; B 6.5-7.0 mm. Holotype 18.4 × 7.0 mm.

Genitalia. — The penis is somewhat shorter than the vagina. The spermatheca is provided with both a bursa and a diverticulum; the duct of the bursa is short and very narrow as compared to the pedunculus and the diverticulum. The caecum is well-developed and situated distally of the middle of the epiphallus. The penis retractor muscle inserts proximal of the location of the penis papilla. The most proximal beginning of the epiphallus is much more narrow than the middle; in the distal part the lumen is provided with longitudinal folds. There are several clearly discernible septa near the caecum. The penis papilla is short and conical, not much longer than broad.

Three spermatophores could be studied, one of which in situ in the diverticulum. In all specimens the distal part of the spermatophore has a series of spines and is provided with two longitudinal folds, running to its end; the proximal part below the hook, which corresponds with the caecum, is smooth, curved and devoid of any ornamentation.

Derivatio nominis. — This species is named after my friend J. Hemmen (Wiesbaden), who discovered it and provided me with many samples of *Mastus*, partly well preserved in alcohol.

Observations. — The differences between *M. hemmeni* on the one hand and *M. violacea*, *M. procax* and *M. olivaceus* on the other, are discussed under *M. procax*. Clear conchological differences between these species and members of the *M. cretensis* complex could not be found, but it is not difficult to separate the two species groups from each other after anatomical features. *M. cretensis* s. s. has a spermatheca with only a diverticulum, probably taking over the function of the bursa. Unfortunately our material was not preserved well enough to enable a more detailed study of the lumen structure.

Many *Mastus* samples from the entire western part of Crete are available, both shells and alcohol-preserved material. However, these samples (see under "Other material") should not be regarded as type material, because there are some vague conchological as well as anatomical differences between these populations. Most probably they belong to a group of very closely related species. I refrain from describing these forms in more detail here, as long as there are no data concerning the structure of the spermatophores.

Samples with conspicuous specimens are known from: 10.2 km along dirt-track from Kalivos to Mt. Psiloritis, 1260 m alt., KV90 (RMNH/1); 9.0 km along dirt-track from Kalivos to Mt. Psiloritis, 1120 m alt., KV90 (RMNH/5). These two samples are characterized by very large, slender shells, measuring 23-25 × 7.3-7.8 mm. These are the largest *Mastus* shells I saw from Crete.

### 9. - *Mastus olivaceus* (L. Pfeiffer, 1846)
figs. 18, 36, 41

*Buliminus olivaceus* L. Pfeiffer, 1846: 124, pl. 5 fig. 6. Locus typicus "insula Candia (Spratt in coll. Cuming)", restr. nov. by the selection of a neotype: Greece, Crete, Nomos Chanion, Levka Ori, just N. of the mountain cabin "Katafigio Kallergi", 1600 m alt. Syntypes could be traced in neither the British Museum (Natural History), London, nor the Senckenberg Museum, Frankfurt am Main.

Material (all from Crete, Nomos Chanion). — locus typicus, Levka Ori, just north of the mountain cabin "Katafigio Kallergi", 1600 m alt., GE6715 (RMNH 57072/

neotype, 10, 1 slide; MA/3, 1 slide); Levka Ori, Mt. Gingolos, near the "gate", 1750 m alt., GE60 (MA/2).

Diagnosis. — Shell slender, of average size. Spermatheca with both a bursa, with a narrow and long duct, and a diverticulum; penis retractor muscle inserting proximal of the distal end of the penis; epiphallus slender, with a distinct caecum and with septa in the distal part.

Shell. — Shell of average size, slender, elongate ovoid, with 6 to 7 whorls, separated by a somewhat indented suture. The initial whorls are convex, the following ones more flattened, with an indented suture. Shell surface strongly, irregularly striate; the lower whorls more or less malleate. The initial whorls have some delicate spiral lines. In most specimens an angular tubercle is absent. The shells of the only two live-collected snails are light-brown.

Dimensions: H 12.6-14.5 mm; B 5.0-5.4 mm. The neotype measures 12.9 × 5.4 mm.

Genitalia. — The spermatheca is provided with both a diverticulum and a bursa. The diverticulum is clearly longer than the bursa and its duct together. The bursa is clearly distinguishable from its long and thin duct. The pedunculus is about as broad as the oviduct and the vagina. The penis is clearly longer than the vagina and much broader than the epiphallus. The epiphallus is much longer than the penis; its distal part is much shorter than the proximal part. There is a distinct caecum. In the distal part of the epiphallus, near the caecum, several septa are discernible. The penis retractor muscle inserts proximal of the distal end of the penis. Unfortunately, the lumen structure could not be studied in detail. The animals were kept too long in boiled water and maceration had already started.

The spermatophore is unknown.

Observations. — In his original description, L. Pfeiffer (1846) compared this species with *Bulimus* (*Ena*) *subtilis* and *B.* (*E.*) *obscura*, not with *B. cretensis*, which was described on the same page, just before *B. olivaceus*. Dr. R. A. Bank, while looking for type specimens of terrestrial molluscan species from Greece in the Senckenberg Museum (Frankfurt am

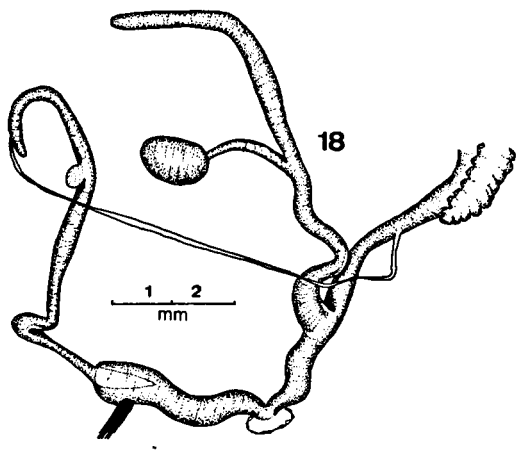



Fig. 18. Genitalia of *Mastus olivaceus* (L. Pfeiffer), near "Katafigio Kallergi".

Main), did not find syntypes of *M. olivaceus*. According to Zilch (1967: 39), the Pfeiffer collection most probably has been destroyed in the 1940/1945 war.

In the British Museum (Natural History), where the Cuming collection, containing material of L. Pfeiffer, is kept, syntypes of *M. olivaceus* could not be found. Only three syntypes of *M. cretensis* are present. However, on the small box containing these syntypes, a note is found: "olivaceus Pfr. Candia, 6500 feet (Spratt)". As a matter of fact, Spratt collected at 6500 feet in the White Mountains (= Levka Ori), in particular the alpine *Metafruticicola zonella* (L. Pfeiffer, 1847). Most probably he found that species and *M. olivaceus* at the same locality. It is known now that *Metafruticicola zonella* and a small *Mastus* species occur together at high altitudes on some mountains north of the Samaria Gorge (Kallergi Mt. and Gingolos Mt.). Specimens of these species were collected in that area by both Prof. Dr. E. Gittenberger and myself. To stabilize the nomenclature of the Greek *Mastus* species, it is necessary to define *M. olivaceus* unequivocally. This we did by selecting a neotype (see above) and, as a consequence, also a (restricted) type locality.

For a comparison of *M. olivaceus* with its nearest relatives, *M. hemmeni*, *M. procax* and *M. violacea*, see the discussion under *M. procax*. At several places at lower altitudes within the Omalos area, a few specimens have been collected, which probably do not belong to *M. olivaceus*. There are some differences with the specimens from the type locality in both shell characters (whorls are more flattened, colour is darker) and anatomical features (duct of the bursa shorter and thicker, distal part of the epiphallus as long as the proximal part).

Material: 0.4 km NE. of Omalos near cave entrance, 1050 m alt., GE6415 (RMNH/2; MA/1; SU/2); 4 km N. of Omalos, 790 m alt., GE6318 (RMNH/3; MA/6, 1 slide).

### 10. - **Mastus violacea** nov. spec.
figs. 19, 20, 36, 37

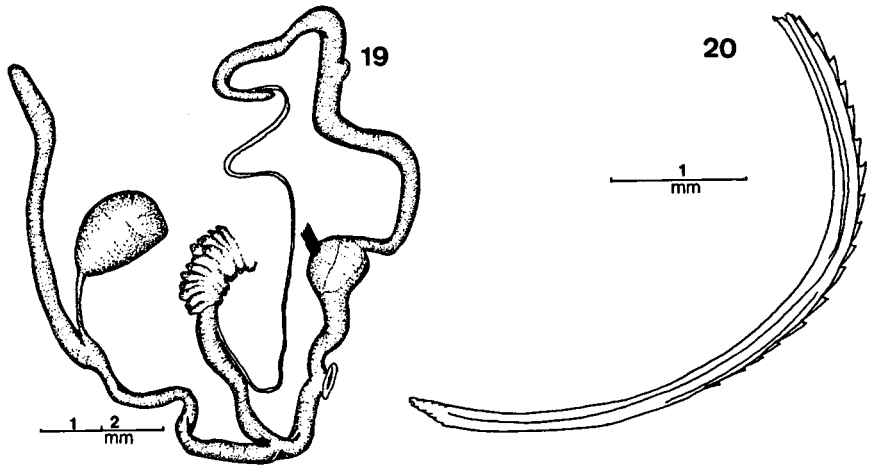
Type material. — Holotype: Crete, Nomos Rethimnis, 2 km E. of Sisses along the "New Road", LV02 (RMNH 57073). Paratypes: locus typicus (MA/9, 2, 1 alc., 2 slides [nos. 1148-1149], 1 slide with spermatophore; RMNH 57092/2, 9435/1 alc., 1 slide with spermatophore; IZPAN/1).

Other material: Nomos Rethimnon, 4 km along the "New Road" from Sisses to Rethimnon, LV01 (RMNH/1); 1.5 km along road N. of Sisses, LV01 (RMNH/1).

Diagnosis. — Shell very dark brown, large and slender, with a prominent angular tubercle. Spermatheca with both a bursa, with a long, thin duct, and a diverticulum; penis retractor muscle inserting proximal of the distal end of the penis; epiphallus robust, with septa in the distal part; spermatophore with a row of small spines.

Shell. — Shell large, subcylindrical with a conical apical part, with 7-8 whorls, separated by a somewhat indented suture. The initial whorls are convex and gradually increase in width; the final ones are strongly flattened and about equally broad. The shell is dark purple-brown, finely striate on the upper whorls, and somewhat malleate and irregularly striate on the lower ones. In fresh specimens, under high magnification, some very fine spiral striae can be seen on the upper whorls. The aperture is relatively small, measuring about 1/3 of the total height of the shell; it is narrow-elliptical (in frontal view) and oblique. Parietal callus very prominent, with a distinct angular tubercle in the upper right corner.

Dimensions: H 16.0-18.4 mm; B 5.6-6.2 mm. Holotype: 18.4 × 6.2 mm.




Figs. 19, 20. *Mastus violacea* nov. spec., 2 km E. of Sisses. 19, genitalia; 20, spermatophore.

Genitalia. — Only two specimens were investigated, one of which adult. The genitalia are very small and fragile, as compared with the large shell. The spermatheca is provided with both a diverticulum and a clearly delimited, large bursa with a very thin duct. The vagina is shorter than the penis. The penis retractor muscle inserts proximal of the distal end of the penis. The more or less obsolete caecum is situated in the distal half of the epiphallus. The lumen structure of the epiphallus was partly destroyed because maceration had already started. However, just above the insertion of the caecum, in the distal part of the epiphallus, a number of prominent septa could be observed.

Only two fragments of the distal part of the spermatophore were found in the diverticulum of the adult specimen. This part of the spermatophore bears a number of small, sharp, triangular spines, situated on a lateral ridge, next to an additional, simple, small lamella.

Derivatio nominis. — This species is given the epithet *violacea* after its dark purple-brown shell.

Observations. — For a comparison of *M. violacea* with its nearest relatives, *M. hemmeni*, *M. procax* and *M. olivaceus*, see the discussion under *M. procax*. This new species is only known from several localities within a small area, where it was found together with the recently described *Albinaria violacea* Schilthuizen & Gittenberger, 1990, a species with shells which have a very similar dark colour.

### 11. - **Mastus riedeli** nov. spec.
figs. 21, 22, 36, 42

Type material. — Holotype: Nomos Lasithiou: near main-road exit to Gdohia, 7 km W. of Mirtos, LU67 (RMNH 57074). Paratypen: Nomos Lasithiou: locus typicus (MA/3, 10, 3 alc., 4 slides [nos. 1151/1154]; RMNH 57093/5, 9420/3 alc., 9421/1

spermatophore; IZPAN/1); 2 km E. of exit to Riza, LU67 (MA/2); 1 km S. of Sikologos, LU67 (RMNH 57118/2); 1 km E. of the exit to Sikologos, LU67 (MA/5, 1 slide [no. 759]).

Other material: Nomos Lasithiou: 0.2 km W. of Anatoli, LU77 (BU/5); 1 km N. of Anatoli, LU77 (MA/1); 4 km N. of Anatoli, LU78 (HW/1); 7.5 km S. of Anatoli, LU77 (BU/1); 1 km S. of Kalamafka, LU78 (MA/1). Nomos Irakliou: Martha, NW. of Ano Viannos, LU58 (MA/1); Panagia, NW. of Ano Viannos, LU48 (MA/1); Gra Ligia, LU87 (IZPAN/35).

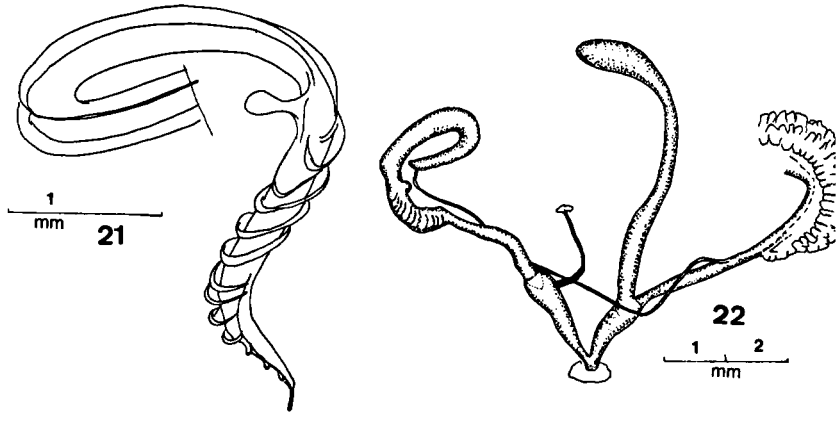
Diagnosis. — Shell fairly small, slender ovoid with an angular tubercle. Spermatheca without a true bursa; penis retractor muscle inserting proximal of the distal end of the penis; proximal epiphallus, near the caecum, with some prominent septa; spermatophore with a distinctive sculpture.

Shell. — Shell fairly small, slender ovoid, with 6-7 whorls, separated by a somewhat indented suture. The whorls are not clearly flattened, even the lower ones are moderately convex. The surface is irregularly striate and more or less clearly malleate. Under high magnification, an indistinct spiral sculpture can be observed, especially on the upper whorls. The parietal callus usually forms an angular tubercle in the upper right corner of the aperture. Fresh shells are medium brown.

Dimensions: H 11.5-14.5 mm; B 5.0-5.4 mm. Holotype 13.2 × 5.3 mm.

Genitalia. — The penis is somewhat longer than the vagina. The spermatheca has no true bursa and is about as long as the epiphallus; its distal end, homologous with the end of the diverticulum, is clearly widened, bursa-like. At the junction with the vagina, the pedunculus is somewhat wider than the oviduct. The caecum is situated at the middle of the epiphallus; in the proximal part of the epiphallus, near the small caecum, the epiphallus is swollen and the lumen is provided with about 10 prominent septa here. The vas deferens is very thin and has the same width over its entire length. The penis retractor muscle inserts proximal of the distal end of the penis. The penis papilla is small, conical.

Only a single, partly damaged, spermatophore could be studied. Its distal part has two prominent, lateral lamellae. The proximal part has about 12 very conspicuous, flat,




Figs. 21, 22. *Mastus riedeli* nov. spec., Gdohia. 21, spermatophore; 22, genitalia.

transverse ridges, corresponding to the septa mentioned above; these ridges recall the buckets of a dredging-machine.

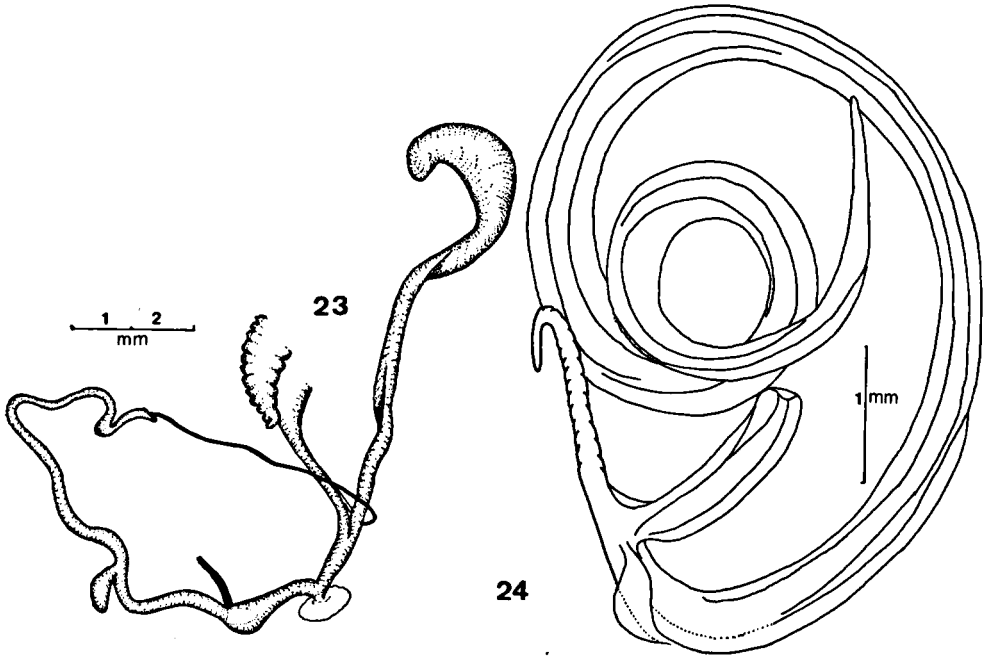
Derivatio nominis. — The epithet *riedeli* is given in honour of my friend Prof. Dr. Adolf Riedel, who allowed me to study the entire *Mastus* material from the IZPAN.

Observations. — As far as known, *M. riedeli* has a very small range. From the same area *Albinaria purpurea* Reitsma, 1988, was described. From the coastal area west of the type locality no *Mastus* species are known, but from localities situated more inland, some samples of *Mastus* shells are available. These are listed under "other material". More eastward along the coast a very different species, *M. ierapetrana*, is found in large populations. A problematic sample from Gra Lygia is discussed under *M. ierapetrana*.

## 12. - **Mastus abundans** nov. spec.
figs. 23, 24, 36, 48

Type material (all from Crete, Nomos Lasithiou). — Holotype: 1 km E. of Sunias (= Skinias), LV80 (RMNH 57075). Paratypes: locus typicus (MA/102, 4 slides [nos. 1089/1092], 25 alc., 1 spermatophore; RMNH 57101/5, 9436/15, 9415/spermatophore; IZPAN/3); Vrouhas, near the windmills on top of the hill, LV80 (MA/83, 39, 25, 16 slides [nos. 760/765, 978, 1085-1088, 1107-1111], 2 alc., 4 alc., 12 alc.; RMNH 57098/5; ZMA 394010/5); S-side Vrouhas, LV80 (RMNH 57113/64; NE/6); Plaka, LV80 (RMNH 57111/3); 0.5 km S. of Plaka, LV80 (MA/2, 1 slide [no. 1102], 2 alc.); 1 km S. of Plaka, LV80 (HW/1; MA/45, 3 slides [nos. 1099/1101], 6 alc.; RMNH 57103/5); 1 km N. of Plaka, LV80 (MA/494, 4 slides [nos. 1119/1122], 18 alc., 1 spermatophore; RMNH 57099/5); 1.5 km NE. of Plaka, LV80 (RMNH 57107/5, 57106/1); 2 km N. of Plaka, LV80 (MA/7, 28); 2.4 km N. of Plaka, LV80 (RMNH 57108/3); 3 km N. of Plaka, LV80 (MA/18, 27, 3 slides [nos. 1116/1118], 11 alc.; HW/11); 4 km NE. of Plaka, LV80 (RMNH 57105/3; MA/13, 2 slides [nos. 976/977], 1 alc.); 5 km N. of Plaka, LV80 (RMNH 57109/1); 6 km N. of Plaka, LV80 (HW/59); 1 km S. of Vrouhas, LV80 (MA/31, 4 slides [nos. 1112/1115], 12 alc.; RMNH 57095/5); 0.3 km W. of Vrouhas, LV80 (RMNH 57112/11); 1 km W. of Vrouhas, LV80 (HW/2); 2 km W. of Vrouhas near Selles, LV80 (MA/13, 91, 4 slides [nos. 1103/1106], 30 alc.; 57094/5, 9412/15 alc.); 1 km W. of Kato Loumas, LV71 (MA/39, 2 slides [nos. 766/767]; RMNH 57102/5); N. of Sunias, LV81 (RMNH 57114/9; MA/3 slides); 1 km N. of Ag. Georgios, LV81 (HW/19); 2 km E. of Finokalia, LV70 (MA/28, 2 alc., 1 spermatophore); Papoulos (= Patsopoulos) S. of Finokalia, LV70 (MA/24, 2 slides [nos. 1093/1094], 10 alc.; RMNH 571005/5); 0.7 km N. of Dilakos, LV70 (HW/2); Dilakos S. of Finokalia, LV70 (MA/67, 2 slides [nos. 1095/1096], 4 alc., 1 spermatophore; RMNH 57096/5, 9437/15 alc.; 9422/spermatophore); 1 km E. of Koudoumalos, LV71 (MA/26, 1 slide [no. 769]); Peninsula Spinalonga, LV80 (RMNH 57110/3; HW/2, 52; BU/71, 1 slide, 10; SU/9; MA/19, 165, 24 alc.; RMNH 57097/5, 9413/15 alc.); Little Spinalonga, LV80 (RMNH 57104/4; HW/1; MA/66, 1 slide [no. 742], 1 alc.).

Other material (all from Crete, Nomos Lasithiou): 1.5 km N. of Agios Antonios, LV70 (RMNH/6); between Tsampi and Agios Antonios, LV70 (RMNH/1); 1 km N. of Monastir Arethiou, LV70 (RMNH/3); Monastir Arethiou, LV70 (HW/3); 2 km S. of Nofalias, LV70 (MA/19, 3 alc., 2 slides [nos. 1097/1098]); 3 km S. of Nofalias, LV70 (MA/4); 1 km NE. of Karidio (3 km SE. of Nofalias), LV8007 (RMNH/22); 2 km S. of Karidio (7 km ENE. of Neapolis, LV7905 (RMNH/3); 2 km Nofalias to Amigdalea,




Figs. 23, 24. *Mastus abundans* nov. spec., 1 km E. of Sunias (= Skinias). 23, genitalia; 24, spermatophore.

LV70 (HW/1); near entrance of the Spilia Milatos, 1.5 km E. of Milatos, LV7107 (RMNH/4; HW/2).

Diagnosis. — Shell fairly small, spindle-shaped, with a more or less granular texture. Spermatheca without a true bursa; penis retractor muscle inserting at the distal end of the penis; epiphallus with a very large caecum and without septa; spermatophore with a long and sculptured spine.

Shell. — Shell fairly small, spindle-shaped, with 6-7 whorls, separated by an indented suture. The whorls are flattened, exept for the more convex apical ones. The shell surface is more or less granular, sometimes also somewhat malleate. The parietal callus usually shows a tubercle in the upper right corner of the aperture. The colour of the shell varies from light corneous brown to whitish; however, most specimens are light brown.

Dimensions: H 11.3-14.5 mm; B 4.5-5.0 mm. Holotype 12.8 x 4.6 mm.

Genitalia. — The spermatheca is not provided with a true bursa, but the distal end of the diverticulum has the shape of a bursa. At their junction, the pedunculus and the oviduct are about equally broad. The caecum is very prominent and much longer than the epiphallus is wide. The penis retractor muscle inserts at the distal end of the penis. The penis is about as long as the vagina. The lumen of the epiphallus lacks the kind of septa found in the other *Mastus* species from Crete that could be studied. The length of the distal part of the epiphallus is rather variable in the material studied. This might depend upon age or sexual activity. The penis papilla is long, much longer than broad,

tapering and provided with small papillae, arranged in regular, longitudinal rows.

Six spermatophores could be studied, from specimens belonging to different populations, and no differences could be found between them. The distal part of the spermatophore is fairly long, curved, with two whorls, and ornamented by several strong longitudinal lamellae. The spermatophore possesses a very prominent spine, which is provided with several lamellae. The proximal part is small, not smooth but with a regular wavy ribbing.

Derivatio nominis. — The epithet *abundans* is given because this species is very common within its range.

Observations. — With *M. riedeli*, *M. subaii* and *M. cretensis*, *M. abundans* belongs to a species group, characterized by a spermatheca without a true bursa, the lumen of the distal part of the epiphallus with longitudinal folds only, and a spermatophore with only longitudinal ridges on the distal part and a wavy ribbing on the proximal part. The shells of these species have a more or less granular texture.

*M. abundans* can be separated anatomically from *M. subaii* by its very prominent caecum, the slenderness of the epiphallus and the longer spermatophore which has a different ornamentation. It differs from *M. riedeli* by the absence of the very prominent septa in the proximal part of the epiphallus and by the place of insertion of the penis retractor muscle.

There is some material from several localities south and southwest of the distribution area of *M. abundans*. However, as alcohol-material is not available to confirm their identity, these are not considered paratypes.

### 13. - **Mastus subaii** nov. spec.
figs. 25, 26, 36, 43

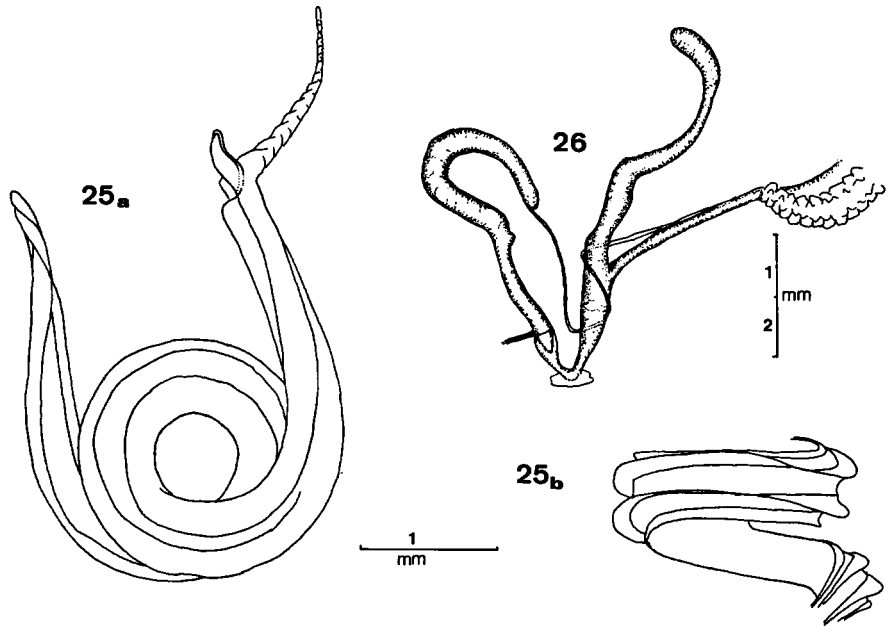
Type material (all from Crete, Nomos Irakliou). — Holotype: 2 km W. of Limin Hersonisou, LV51 (RMNH 57076). Paratypes: locus typicus (MA/96, 61, 18, 7 slides [nos. 730/733, 889/892], 10, 4, 8 alc., 1 spermatophore; RMNH 57117/5, 9423/1 spermatophore; IZPAN/3); between Limin Hersonisou and Stalida near camping, LV50 (BU/10, 5; SU/8, 19, 2 slides; MA/107, 4 slides [nos. 876/879], 3 alc.; RMNH 57116/5; zma 394009/5; NE/3); 0.5 km E. of Limin Hersonisou, LV50 (MA/24, 25 alc.; RMNH 9439/15 alc.); S. of Limin Hersonisou, along main road, LV50 (BU/32); 0.6 km E. of Stalis, LV50 (BU/5); near beach, W. of Limin Hersonisou, LV51 (MA/96, 4 slides [nos. 889/892], 12 alc.; RMNH 57115/5, 9438/5 alc.); about 1 km SE. of Limin Hersonisou LV50 (MA/42).

Diagnosis. — Shell small, spindle-shaped with an angular tubercle; surface granular. Spermatheca without a true bursa; epiphallus with a small caecum; spermatophore short and compact, with four longitudinal ridges.

Shell. — Shell small, spindle-shaped, with 6 to 7 whorls, separated by an indistinctly indented suture. The initial whorls fairly convex, the body-whorl clearly more flattened. Surface dull; the lower whorls are very fine granular and striate. The parietal callus usually forms a small tubercle in the upper right corner of the aperture.

Dimensions: H 10.6-12.9 mm; B 4.4-5.0 mm. Holotype 11.4 x 4.4 mm.

Genitalia. — The spermatheca is not provided with a true bursa, but the distal end of the diverticulum has the shape of a bursa. At the junction of pedunculus and oviduct, the pedunculus is much broader than the oviduct. The distal part of the epiphallus is longer than the proximal part, and fairly compact. The lumen of the distal part of the




Figs. 25, 26. *Mastus subaii* nov. spec. 25a, b, spermatophore, from two sides, 2 km W. of Limin Hersonisou; 26, genitalia, between Limin Hersonisou and Stalida, near camping.

epiphallus is provided with only about six longitudal folds. The caecum is very small. The penis retractor muscle inserts at the distal end of the penis. The penis papilla is short, not much longer than broad and provided with longitudinally arranged papillae. Two identical spermatophores could be studied. The proximal part is very short and provided with a regular, wavy ribbing. The distal part has two high lamellae and two smaller ones.

Derivatio nominis. — The epithet *subaii* is given in honour of my friend Peter Subai, who supplied me with samples of various *Mastus* species, well preserved in alcohol.

Observations. — For a discussion concerning the anatomically similar species *M. riedeli* and *M. abundans*, see under *M. abundans*.

At two localities west of Limin Hersonisou, this species was found sympatrically with *M. butoti*. *M. subaii* is much more abundant here. The two species can be differentiated by their anatomy and by the differences in the structure of the shell surface. At the same two localities, a third, much larger, *Mastus* species occurs, belonging to the *M. cretensis* complex.

## 14. - *Mastus cretensis* (L. Pfeiffer, 1846) s.l.
figs. 27-34

*Buliminus cretensis* L. Pfeiffer, 1846: 124-125, pl. 5 fig. 8. Locus typicus: "insula Candia". Three syntypes in British Museum (Natural History), London.

It is remarkable that it is at the moment impossible to give a redescription of this *Mastus* species, which gave its name to all Cretan species combined, unquestioned, for nearly a century and a half. Shells of *M. cretensis* are quite large (the three syntypes measure H 18.0-18.8 mm). Such specimens occur at several localities sympatrically with other, much smaller ones that are certainly specifically distinct.

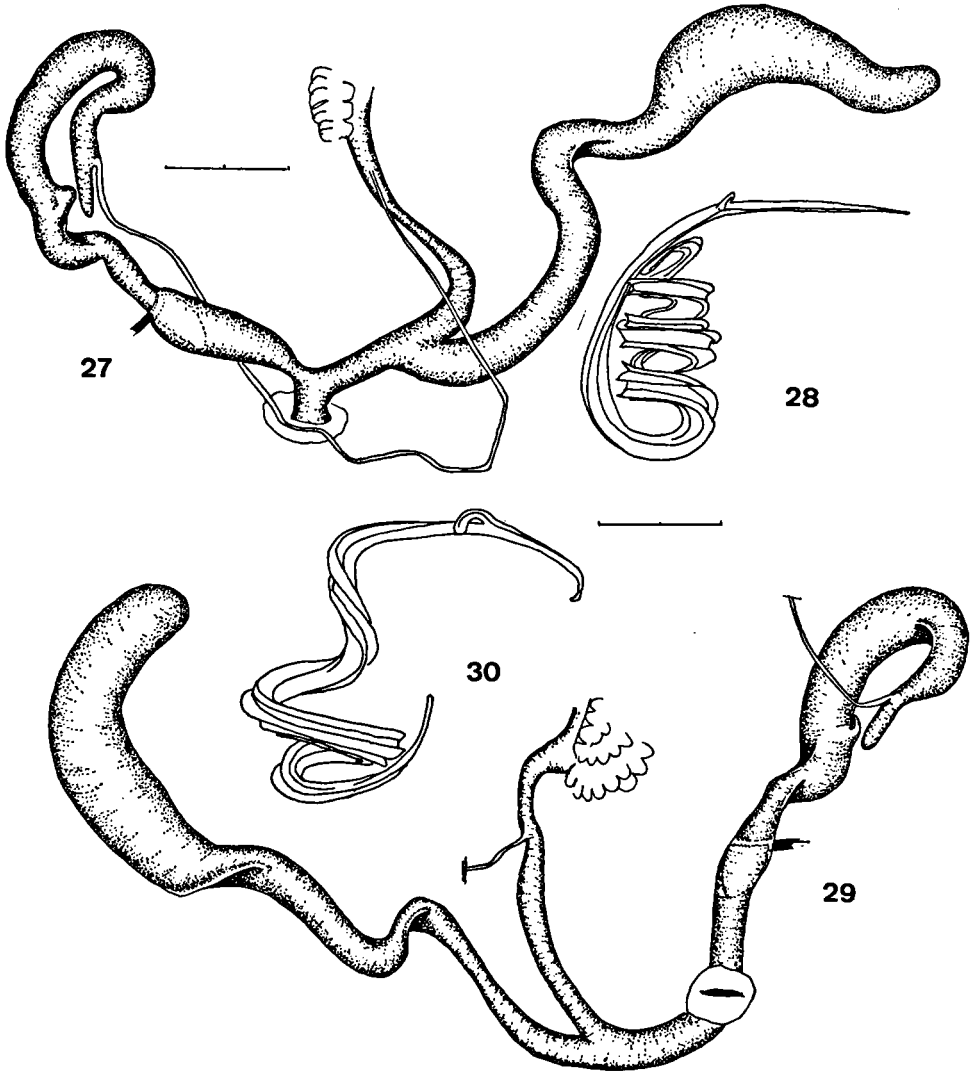
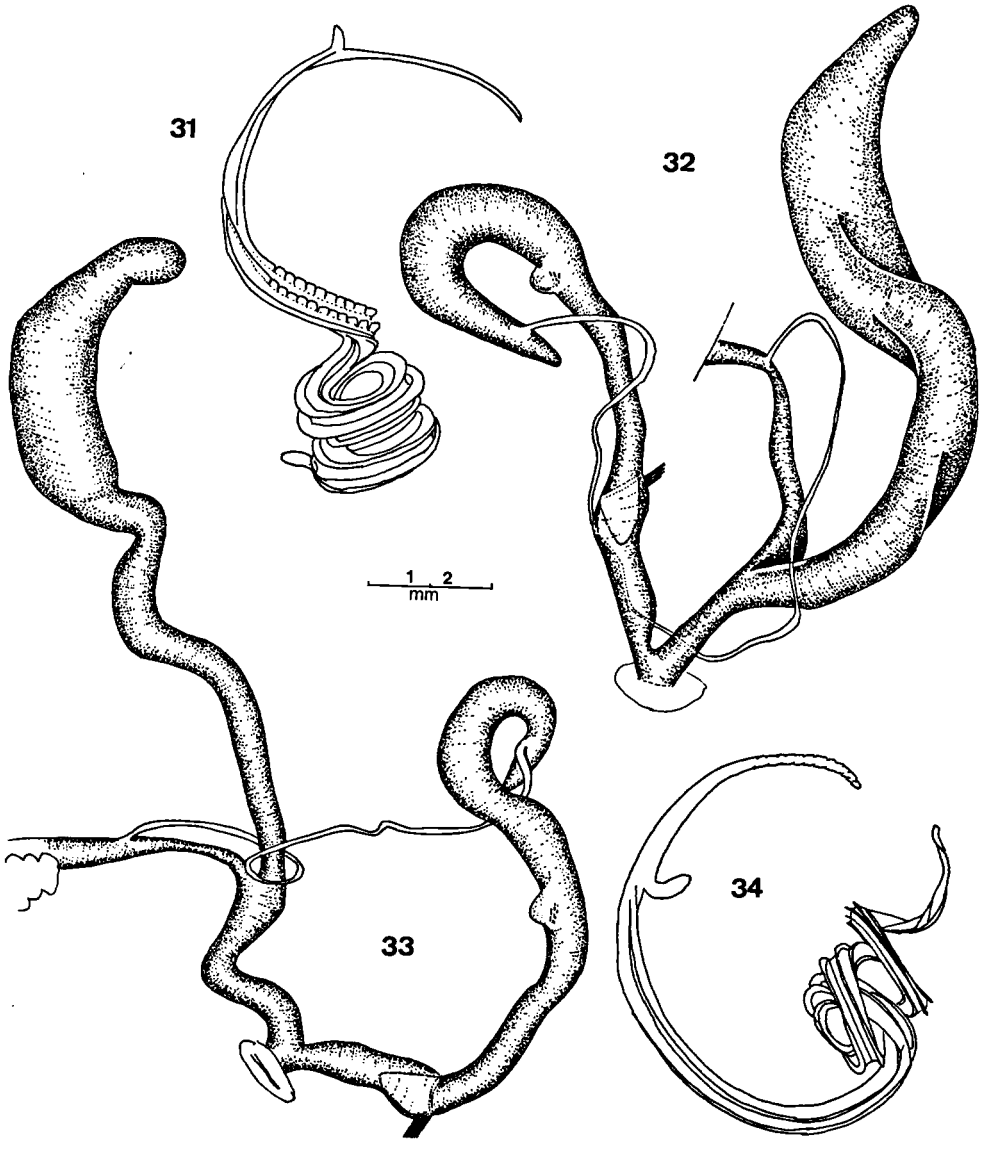
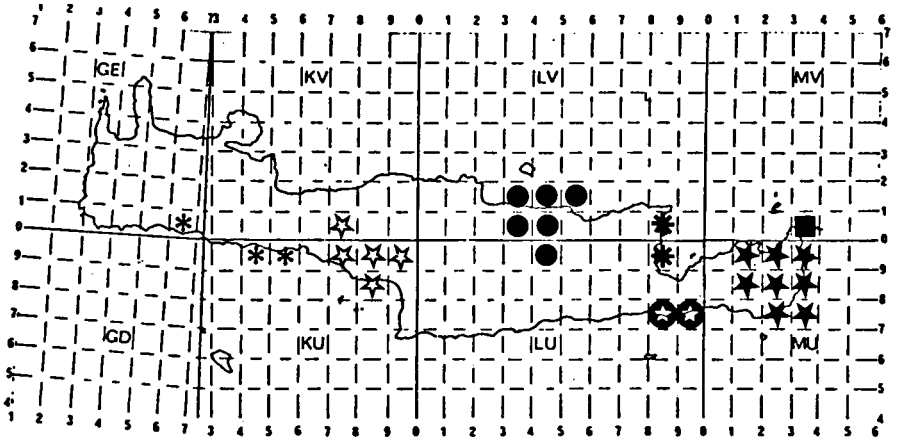



Fig. 27-34. *M. cretensis* (L. Pfeiffer) complex, genitalia and spermatophores of specimens from different localities. 27, 28, antique ruins of Malia; 29, 30, Kroustos; 31, 32, Tholos; 33, 34, Tsampi.


31
32
1 2
mm
33
34

Heller (1976) indicated "Candia" as the locus typicus, which should be considered to apply not to the city of Candia (= Iraklion), but to the island of Crete as a whole. Pfeiffer mentioned only the "insula Candia". However, east of Iraklion near Amnissos and Vathianos Kampos, shells could be collected, which agree very well with both the orginal description and the syntypes and thus could represent the true *M. cretensis*. No specimens with spermatophores could be found, however, and as a consequence, a redescription cannot be supplied yet. This is particularly so, because it seems that next to the species *M. cretensis*, there might be a number of very similar additional, still

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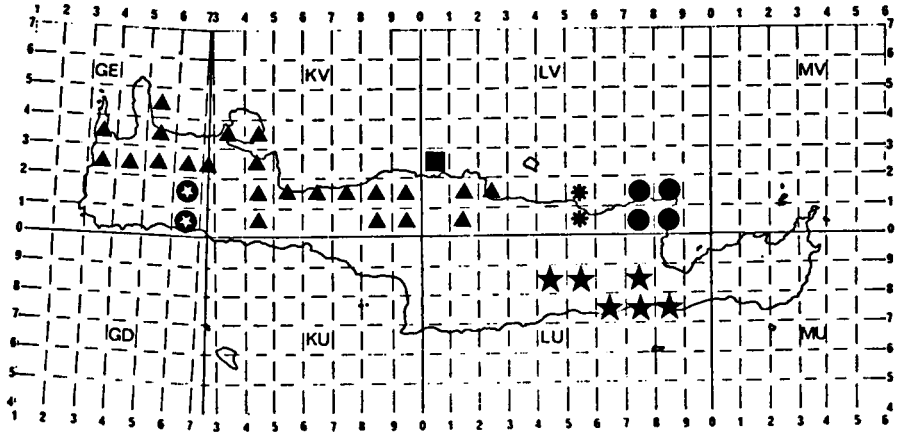


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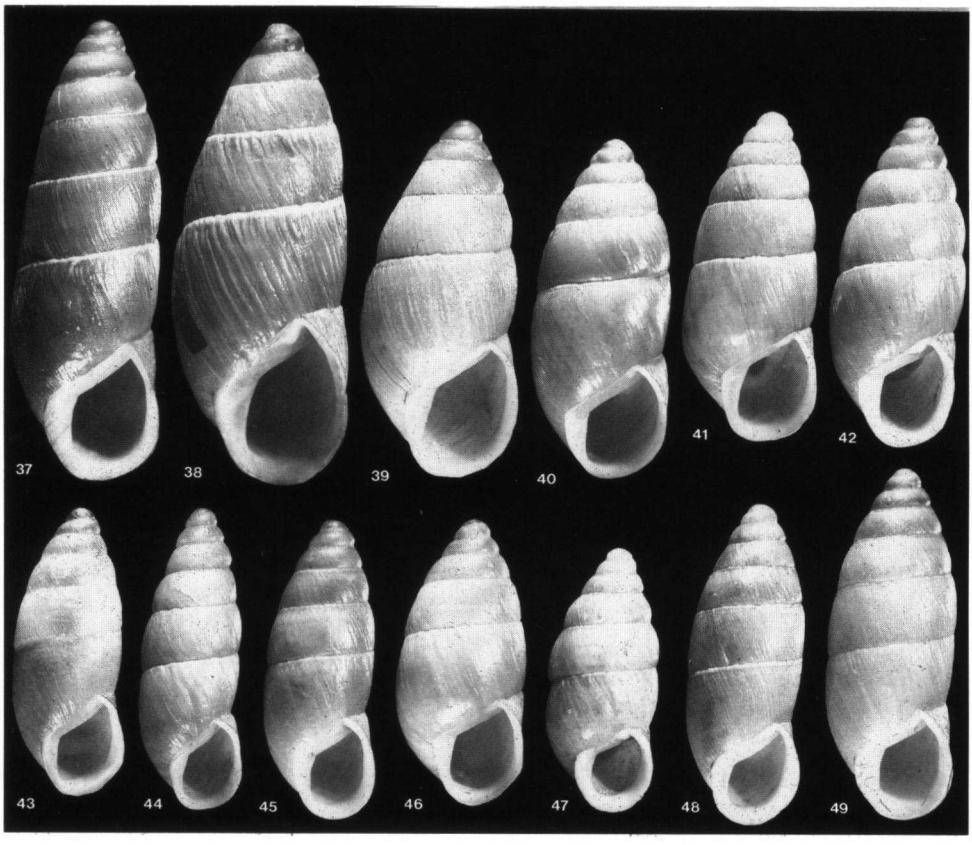
Figs. 35, 36. Maps of Crete, with the distribution of (35) *Mastus gittenbergeri* (8-pointed star); *M. butoti* (black dot); *M. sitiensis* (5-pointed star, black); *M. itanosensis* (square); *M. ierapetrana* (star in black dot); *M. sphakiota* (6-pointed star); *M. procax* (5-pointed star, open) -- (36) *Mastus hemmeni* (triangle); *M. olivaceus* (star in black dot); *M. violacea* (black square); *M. riedeli* (5-pointed star); *M. abundans* (black dot); *M. subaii* (8-pointed star).




Figs. 37-49. *Mastus* spec. from Crete. 37, *M. violacea* nov. spec., holotype (RMNH 57073), Nomos Rethimnon, 2 km E. of Sisses (actual height 18.8 mm); 38, *M. hemmeni* nov. spec., holotype (RMNH 57071), Nomos Rethimnon, Orthes (actual height 18.8 mm); 39, *M. procax* nov. spec., holotype (RMNH 57070), Nomos Rethimnon, Lambini (actual height 14.6 mm); 40, *M. sitiensis* nov. spec., holotype (RMNH 57066), Nomos Lasithiou, 5 km E. of Agia Fotia (actual height 13.8 mm); 41, *M. olivaceus* (L. Pfeiffer), neotype (RMNH 57072), Nomos Chanion, near mountain-cabin "Katafigio Kallergi" (actual height 13.4 mm); 42, *M. riedeli* nov. spec., holotype (RMNH 57074), Nomos Lasithiou, near main-road exit to Gdohia, SE. of Ano Viannos (actual height 13.6 mm); 43, *M. subai* nov. spec., holotype (RMNH 57076), Nomos Irakliou, 2 km W. of Limin Hersonisou (actual height 11.8 mm); 44, *M. sphakiota* nov. spec., holotype (RMNH 57069), Nomos Chanion, Anapolis near Hora Sfakion (actual height 12.3 mm); 45, *M. ierapetrana* nov. spec., holotype (RMNH 57068), Nomos Lasithiou, 5 km E. of Ferma, E. of Ierapetrana (actual height 12.2 mm); 46, *M. itanosensis* nov. spec., holotype (RMNH 57067), Nomos Lasithiou, ruins of Itanos (actual height 11.6 mm); 47, *M. butoti* nov. spec., holotype (RMNH 57065), Nomos Irakliou, Tobrouk Beach, E. of Iraklion (actual height 10.7 mm); 48, *M. abundans* nov. spec., holotype (RMNH 57075), Nomos Lasithiou, 1 km E. of Sunias (actual height 13.1 mm); 49, *M. gittenbergeri* nov. spec., holotype (RMNH 57064), Nomos Lasithiou, 2 km N. of Elounda (actual height 14.5 mm).

undescribed taxa. Within what is called here the *M. cretensis*-complex, there is much variation in shell shape, as well as in anatomical characters. The shell surface varies from very rough, malleate and dull, to smooth and shining. In several populations the epiphallus is very slender, with only simple longitudinal folds in its lumen. However, elsewhere, it may be very compact and short, with more complicated lumen folds.

In general, the structure of the spermatophores may be considered species-specific. From several localities, the spermatophores of conchologically very similar populations, tentatively classified with the *Mastus cretensis*-complex, could be studied. In doing so, more or less clear differences were found between these populations. This might be considered indicative of distinct species being involved. Several examples are figured (figs. 27-34) to give a first impression of the range of variation. The relationships between most of the populations are still very unclear. Much more material, well preserved in alcohol and collected in the right season is necessary to unravel the *M. cretensis*-complex.

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