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*I dedicate this work
to the memory of my late Wife, Jadwiga.*

AGRIOLIMACIDAE (GASTROPODA: PULMONATA) – A SYSTEMATIC MONOGRAPH

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Abstract. — The present paper represents the first attempt to revise all taxa that compose the family Agriolimacidae. It includes an extensive introduction characterizing the whole family with respect to anatomy, ecology, bionomics and distribution as well as instructions how to collect, dissect and preserve slug material. Each taxon from the rank of family to subspecies is provided with taxonomical data, a morphological description as well as information on bionomics, distribution, phylogeny and affinity; original keys are included. The index comprises 123 taxa of species rank and over 110 names regarded as synonyms. One species, namely *Deroceras (Deroceras) bistimulatum*, is described as new for science. The paper has been based on over 40-year-long field research of the author and his studies of both various museum material and own slug collection (the world's largest collection of Agriolimacidae deposited at the Museum of Natural History, Wrocław University) which has been built during that period. The text has been illustrated with 830 drawings, most of which made by the author himself, depicting both the external appearance and anatomical characters of particular species.



Key words. — Taxonomy, morphology, bionomics, distribution, classification, keys, Gastropoda, Pulmonata, Agriolimacidae of the world.

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INTRODUCTION

The family Agriolimacidae is the most speciose and the widest distributed slug family. As molluscs of entirely hidden shell, they are distinguished on the basis of external appearance and living habits, and called *Gastropoda terrestria nuda*. The name is informal, of no place in zoological systematics, nevertheless useful and therefore having its own equivalents in different languages: slugs in English, "Nacktschnecken" in German, "limaciens" in French, "babosas" in Spanish, "slizni" in Russian, "ślimaki nagie" in Polish, etc. The name slugs comprises nude (with externally invisible shell) land gastropods. The striking similarity between them, in spite of different origins, is accounted for by parallelism, whereas the similar appearance has been gained as an adaptation to similar way of living, which enables successful competition with snails having an external shell. The nudeness itself gives the slugs similar possibilities of moving, hiding etc. That is not only of ecological significance: the knowledge of those adaptations is useful in pest slug control, in material collecting and in carrying out research, maintaining the collection etc. One of the main reasons why the author got engaged in the study of slugs was that those animals had almost always been treated marginally by malacologists. There were only a few specialists in this group of invertebrates, and those scientists who devoted their energies to them usually studied different families often not related with one another and phylogenetically remote, though with one common character which is nudeness.

I have studied Agriolimacidae, first those occurring in Poland and then also others, for over 40 years. During that long period I have been gathering own material during frequently pursued field studies. My field research has been of paramount importance as it has enabled me to observe those slugs in natural conditions of various habitats and different zones of their ranges, and, which is equally important, has resulted in the world's largest collection of this group of animals. Having at my disposal representatives of most species known to science in my own collection, supplemented with specimens loaned from other museums, has made it possible for me to prepare the present monograph with the hope that it will facilitate further research in this realm rendering this group of animals better known.

I. GENERAL PART

I.1. History of research

Although the history of research on Agriolimacidae dates back to the beginnings of malacological study, as a systematic unit in the rank of separate family this group of molluscs appeared in the consciousness of systematicists as late as the 1930s. Originally, slugs were classified as differently termed snails "without a shell", then among Limacidae. New species of these molluscs were described in the whole history of the relevant study. Nevertheless, for a long time very few

of them were distinguished due to their lack of external characters that would allow identification. Most of the old descriptions take into account only the body shape, coloration and skin pattern. Nowadays at the base of systematics of all slugs lies anatomical examination, especially of the reproductive, alimentary and muscular systems as well as organs of pallial complex. A marked progress in the knowledge of Agriolimacidae took place as late as the end of the 19th century. The one to come to the fore was German zoologist Heinrich Simroth, the most distinguished expert in all *Gastropoda terrestria nuda*. We are indebted to him not only for his reliable descriptions and drawings, but first of all for his critical evaluation of morphological characters, their proper choice for the purpose of systematic considerations, setting in order the morphological terminology, and for his both numerous and voluminous papers which also deal with affiliation and distribution. For understandable reasons, not all the opinions and statements of this scholar have stood the test of time. It has turned out, for instance, that considering body coloration such a systematically essential character, which was typical of Simroth, is misleading. On the other hand, the importance of the remaining traits with which he used to distinguish between taxa from the level of family up to species is not only still acknowledged, but not many others have been added, although the number of recently described species, confirmed by zoogeographical study, research using biochemical methods or by discovery of certain new distinctive features, has been multiplied. Up to the present moment Simroth has remained a classic in this field of study, unrivalled in the whole world. The fact that he used not to keep his own collection is a heavy loss to science. There are relatively scarce specimens of the material he examined, mostly the types of the species he himself described, that have been preserved. Larger series of this material are available at three museums from which Simroth borrowed slug specimens for examination. These are the collection kept in Sankt Petersburg, comprising material from the territory of Russia, the Vienna collection, composed mainly of material from the Balkans and the former Turkey, and that of Berlin with a unique set of Agriolimacidae from Abyssinia (present Ethiopia).

For the development of research in the field, of crucial importance was the paper by Paul Hesse (1926) entitled "Die Nacktschnecken der palaearktischen Region", which, apart from being an attempt to put systematics into order, included a list of nearly all known names of genera and species, a vast part of these already regarded as synonyms. Owing to this paper, each consecutive malacologist had their work made enormously simplified. Although Hesse's knowledge of this group of invertebrates was practically based on literature, his synonymizations were in most part correct and his objectivity amazing. Regrettably, the author limited himself almost exclusively to names. It is a great pity that he did not provide his paper either with more comprehensive comments or a full list of references. After the publication of this masterpiece and the death of distinguished Simroth,

a period of almost complete stagnation in research on slugs, including Agriolimacidae, took place. A certain revival of malacological study was owed to a Hungarian, Janosz Wagner (he often published as Hans Wagner). Most his publications fell on the 1930s. Wagner concerned himself mainly with Hungary and the neighbouring countries, devoting an extensive monograph to that area (Wagner 1934–1935).

The research so far discussed pertained nearly exclusively to the Palearctic. A valuable complement to the knowledge of slugs, concerning North America, was a monograph by Pilsbry (1948). In spite of the fact that this malacologist occupied himself with studying different groups of molluscs, the fragment devoted to North-American Agriolimacidae is entirely professional. After World War II, starting from the 50s, the research on the family mentioned was nearly simultaneously developed by C. O. Van Regteren Altena (the Netherlands), H. E. Quick (Great Britain), Alexandru Grossu and Dochita Lupu (Roumania), Ilya M. Likharev (Russia) and myself (Poland). Van Regteren Altena left a series of publications, which, although not very much voluminous, represented a great scientific contribution. Somewhat later the group of slug researchers was joined by Dr Anton J. de Winter (the Netherlands), Dr Johan de Wilde (Belgium), Prof. Folco Giusti and Dr Giuseppe Manganelli (Italy), Dr W. Wolfgang Rähle and Heike Reise (Germany), Prof. Jose Castillejo, Dr Tereza Rodríguez, Dr Carlos Garrido and Dr Javier Iglesias (Spain), and Dr Maria Kosińska (Poland). All the malacologists mentioned devoted their usually numerous publications to Agriolimacidae, which has considerably enriched our knowledge of these slugs. At the moment I am preparing the present monograph for print, however, it is still far from being satisfactory. It may be illustrated by the fact that nearly each year new species are described, and, what is more, not only from "exotic" countries but also from Turkey or Greece. As far as bionomics is concerned, it is known in the case of a mere few species, most of them being completely unknown in this respect. The function of some organs, e.g. rectal caecum or certain appendages on reproductive organs, is unknown. The same concerns distribution ranges, which are barely known as well.

1.2. Morphology

Before I proceed to discuss the morphological characters typical of the family Agriolimacidae, I am going to give some attention to the morphology of *Gastropoda terrestria nuda* in general, as this group is distinguished not because of phylogenetic reasons but due to their morphological specificity. The origin of slugs is unknown. There are no paleontological data illustrating the process of "becoming sluggish" as referred to by Solem (1974). This process must have involved many systems; the shell, when undergoing reduction, was losing its role and functional importance. At the same time, its features do not reflect the far-reaching changes in the morphology of the soft body parts. Among

fossil evidence we find already reduced, flat, lenticular shells testifying to nudeness, but the scarcity of their characters hinders determination of the affinity with the fully developed shells of snails. The fossil shells differ in shape, being either symmetrical or not, which indicates that they have evolved from different types of ancestral shells. How this process worked is obscure. There are no intermediate fossil forms. In other, related, families forms are known in which the shell is to various extent hidden under the mantle folds; there are also families that include forms with shells reduced to various degree, up to full sluggishness. At present we can only speculate about the shell reduction process (Likharev and Wiktor 1979, 1980; Wiktor 1984).

In many extant slugs a tendency to shell reduction can be observed. In some the shell becomes thin and fragile, while in others it covers only the visceral sack and is too small to contain the whole animal. Based on morphological studies as well as bionomic and physiological observations of the contemporary slugs, one can attempt to examine the issue of becoming sluggish since there are numerous convincing proofs illustrating how the process was operating (see Likharev and Wiktor 1979, 1980; Wiktor 1984). The commonness of shell occurrence in all Mollusca testifies to the fact that this is a primary structure, its reduction or loss being of secondary nature. When simplified, the role of the shell in gastropods consists: in a. protection of the body against environmental factors; b. constituting a skeleton as it provides support for retractor muscles which act antagonistically relative to the muscular fibres pumping constitutional fluids that allow the functioning of the so-called "hydroskeleton". And thus the reduction of shell results in lessening of the body external protection against mechanical and chemical injuries, pollution etc. Simultaneously, it changes the whole mechanics of movements as the role of retractors undergoes evident reduction whereas the usage of constitutional fluids in making particular body parts firm or flabby increases. This system of hydroskeleton is particularly well-developed in body integuments. The loss or reduction of a heavy and hard shell brings definite advantages, i.e. material is saved, the weight of the body reduced, its elasticity increased, which, consequently, gives higher mobility and humidity, enables to enter tight crevices in which food may be found and which offer better protection, etc. As a result of these new adaptations, slugs become animals of entirely different ecological properties, use different habitats and occupy different ecological niches.

Under land conditions nudeness has found at least two applications: in the case of herbivorous forms, which have acquired a possibility to exploit new habitats and food resources that are difficult of access to snails; and in the case of predators, in which the reduction of shell allows large pieces of prey to be swallowed (Likharev and Wiktor 1979, Wiktor 1984). In the former situation, the reduced shell has remained in the anterior body part (Fig. 1), whereas in the latter it has undergone a shift backward in connection with the extension of the pharynx which is a hunting apparatus. Sluggishness has undoubtedly appeared a number of

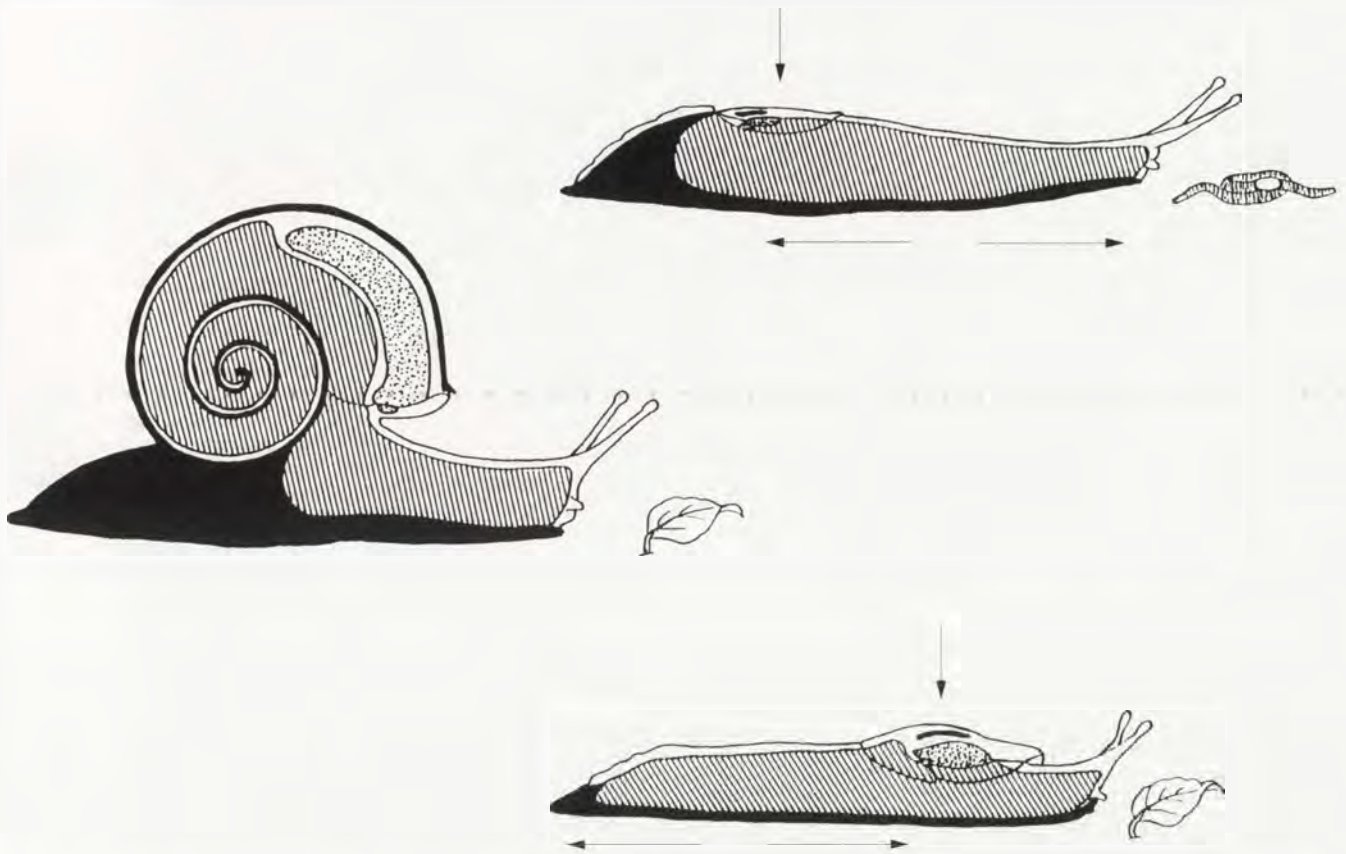


Fig. 1. Two main types of transformation of the snail into the slug. Top – predatory, bottom – herbi- and omnivorous. (After Likharev and Wiktor 1979)

times in the evolution of terrestrial gastropods independently in nonrelated and distant groups. It is a classic example of parallelism. This phenomenon is not extremely rare since out of over seventy families of Stylommatophora presently distinguished (the number differs depending on the malacologist), at least a dozen or so are represented exclusively by nude forms, which is slugs. What is more, some other families are composed both of snails with an external shell and completely nude forms (Likharev and Wiktor 1979, Wiktor 1984).

Agriolimacidae are herbivorous slugs displaying a tendency to polyphagy, and they are ranked with the first group above mentioned.

The reduction of shell in land gastropods has heavily affected not only their external appearance and the way they move but also the general topography of internal organs. The visceral sac, so characteristic of Gastropoda, which forms a kind of hump, flattens and plunges into the foot (Figs. 1–3). Everything undergoes a change: the proportions, topography and appearance of nearly all internal organs. The body lengthens, assuming a fusiform shape; the hump disappears; the mantle and all the accompanying organs (shell, pallial complex, muscles) get reduced; the original spiralization disappears giving way to a different type of the organs arrangement. The whole alimentary canal undergoes particular modification. The resultant lack of space forces

disappearance of spiralization of the ascending intestinal loop, instead of which two (in Limacidae even three) are formed. The loops of alimentary canal are situated horizontally along the body and are only inconspicuously twisted around the longitudinal axis of the animal, which has no counterpart in the spiralization of snail visceral sac.

Due to all those changes, Agriolimacidae show themselves as a distinct group, different from other terrestrial slugs with respect to numerous morphological characters for instance.

1.2.1. External morphology of Agriolimacidae

Agriolimacidae are fairly small terrestrial slugs, in extreme cases their size can be considered average. Most attain merely 30–35 mm in length and this is only when fully extended, for instance when crawling (after preservation in alcohol below 30 mm). These are only representatives of the genera *Krynckillus* and especially *Mesolimax* that can be larger. The last mentioned can be even as large as 53 mm in length, when alive probably reaching ca 70 mm. In all of them, during the life span the shell has no contact with the external world as it is entirely hidden in a closed cavity inside the mantle. Their body is more or less spindle-shaped, tapering backward. Most have a fairly thickset body (*Dero-ceras*, *Furcopenis*, *Megalopelte*, *Lytopelte*) (Fig. 4), and only the largest ones (*Krynckillus*, *Mesolimax*) are clearly

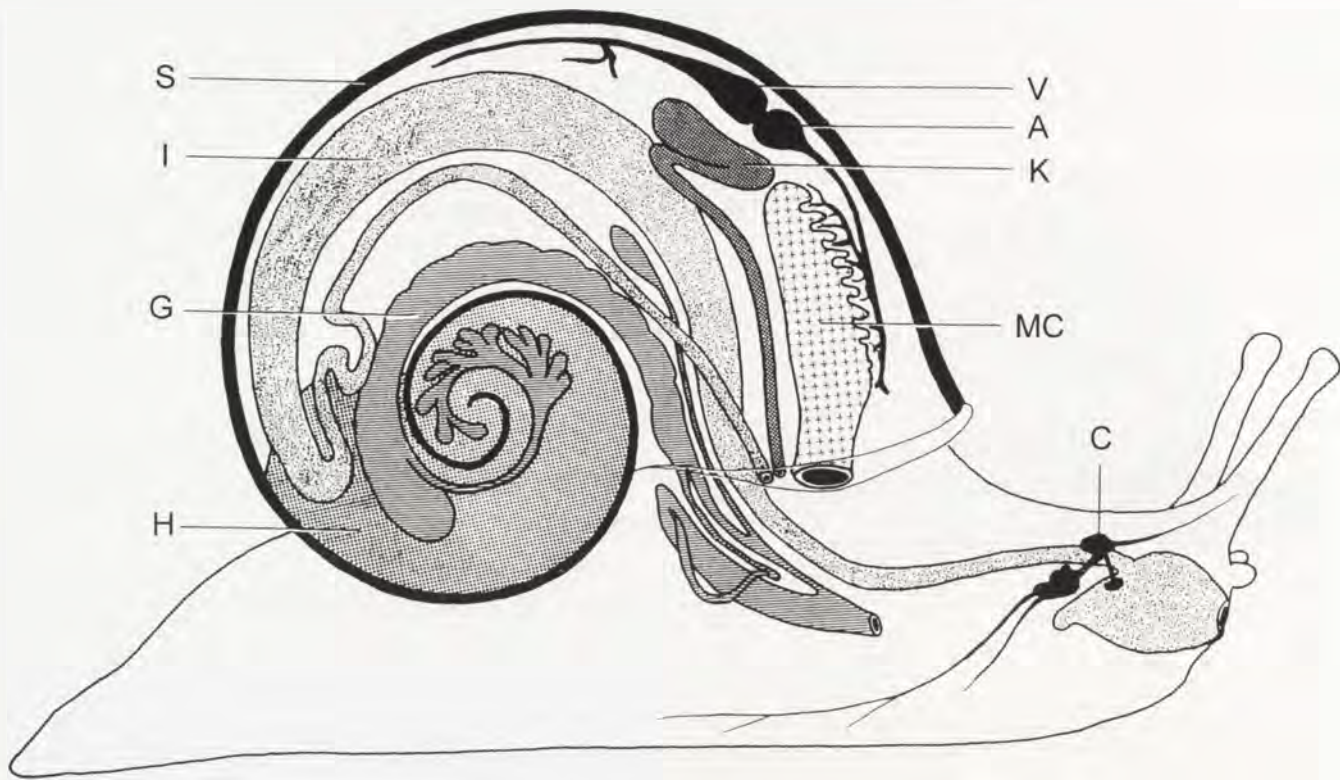


Fig. 2. Diagram of organ topography in pulmonate snails: A - heart auricle; C - central nervous system = brain; G - reproductive system; H - hepatopancreas = liver; I - intestine; K - kidney; MC - mantle cavity and lung; S - shell; V - ventricle. (After Wiktor 1984)

slender (Fig. 4), resembling in shape representatives of the closely related family Limacidae. The head is freely drawn out from under the mantle, but when the animal is irritated, it can be entirely retracted under the mantle, which in most species can be bent aside with energetic movements. Hiding of the head is presumably aimed at protection of its delicate organs from damage caused by a predator for instance. Between the head and the place where the mantle is accreted there is a nape, its border on the head side nondefinable. Except for *Megalopelte*, in which the whole of back is covered by this organ, the mantle occupies only the

anterior body section, its posterior margin reaching at most body half. The mantle is posteriorly accreted to the back and it is only in *Megalopelte* that it can be bent up from each side. In all the families other than the one mentioned, the size of the mantle is considerably smaller, the organ covering merely $\frac{1}{3}$ of the entire body length or even less (*Krynickillus*, *Mesolimar*). In all Agriolimacidae the mantle is oval in outline, nearly symmetrical as it only inconspicuously narrows anterad. In all, on the mantle right side pneumostom (spiraculum) is situated. Around it there is a circular plate (Figs. 4-5), distinguishable by a smooth

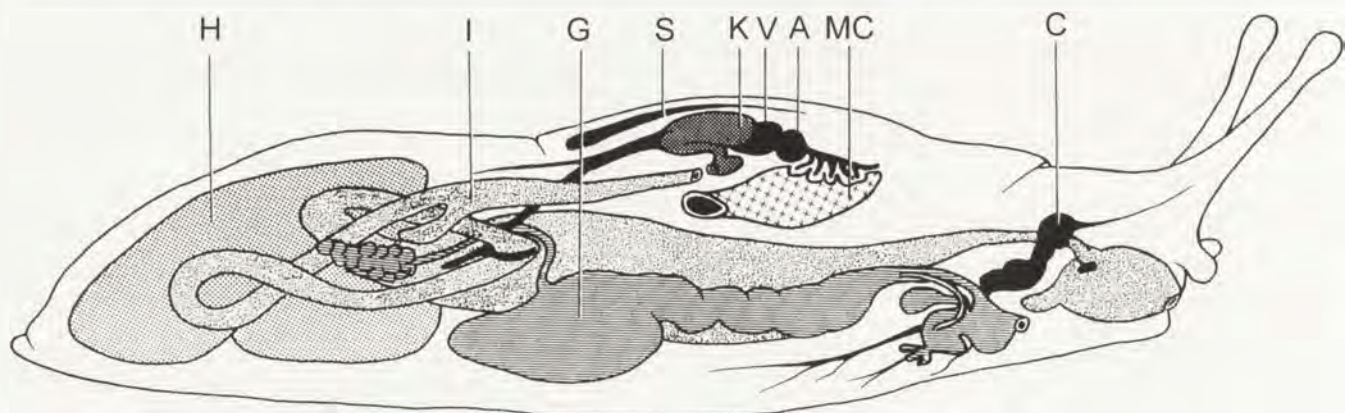


Fig. 3. Diagram of organ topography in *Agriolimar*: A - heart auricle; C - central nervous system = brain; G - reproductive system; H - hepatopancreas = liver; I - intestine; K - kidney; MC - mantle cavity and lung; S - shell; V - ventricle. (After Wiktor 1984)

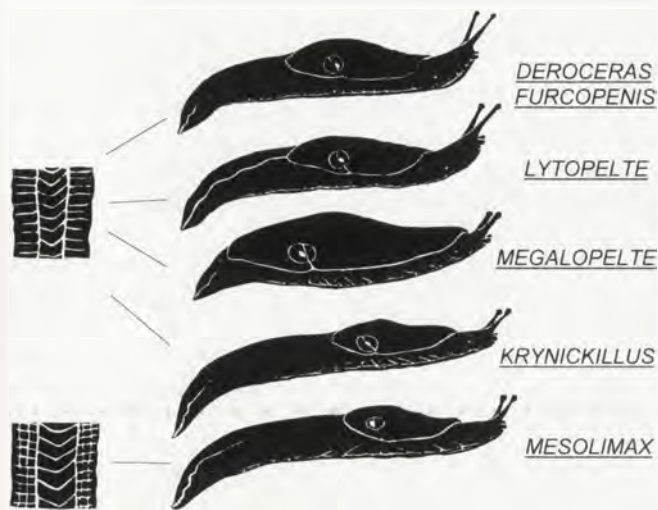


Fig. 4. External appearance of representatives of particular genera of Agriolimacidae, drawings on the left showing the arrangement of wrinkles on the sole surface. (Diagram – orig.)

surface and, most frequently, a paler colour. The plate is usually well visible, only in *Mesolimax* being poorly developed. In some species of the genus *Derocheras* and all *Krynickillus*, on the right side of mantle a poorly marked groove runs anterad from the rear end (Figs. 805–806). In *Derocheras*, if present, it becomes perceivable only after

preservation, reaching merely the plate around pneumostom. In *Krynickillus* the groove passes by the upper margin of the plate around spiraculum and, arching in the anterior section of mantle, reaches the line corresponding to the body axis. In live specimens the mantle's surface is covered by concentric mobile wrinkles. When the animal is dead, the wrinkles disappear completely, the surface of the mantle becoming smooth. More posterad there is a section referred to as the part beyond the mantle. In all Agriolimacidae it cuneately narrows posterad, being either more or less pointed at the end or, like in some *Derocheras*, assuming the shape of a fin as the hind end of the animal is conspicuously laterally constricted. In the latter case, the slug seen from a side makes an impression as if its posterior end were vertically truncated. It may be especially well-visible in preserved specimens when they are fully extended. A vestigial keel runs medially on back along the posterior body section (Figs. 4–5). It is short in all Agriolimacidae, except *Lytopelte*, covering at most half the distance between the rear end of the body and the posterior mantle margin. The sides and upper section of the whole part beyond the mantle are covered by moderately protruding wrinkles, between which there are furrows producing a reticulate pattern. The furrows are arranged longitudinally, only on sides gently descending towards the bottom. There are relatively few of them (in comparison with e.g. *Limacidae*). Between the medial line of the back and the pneumostom

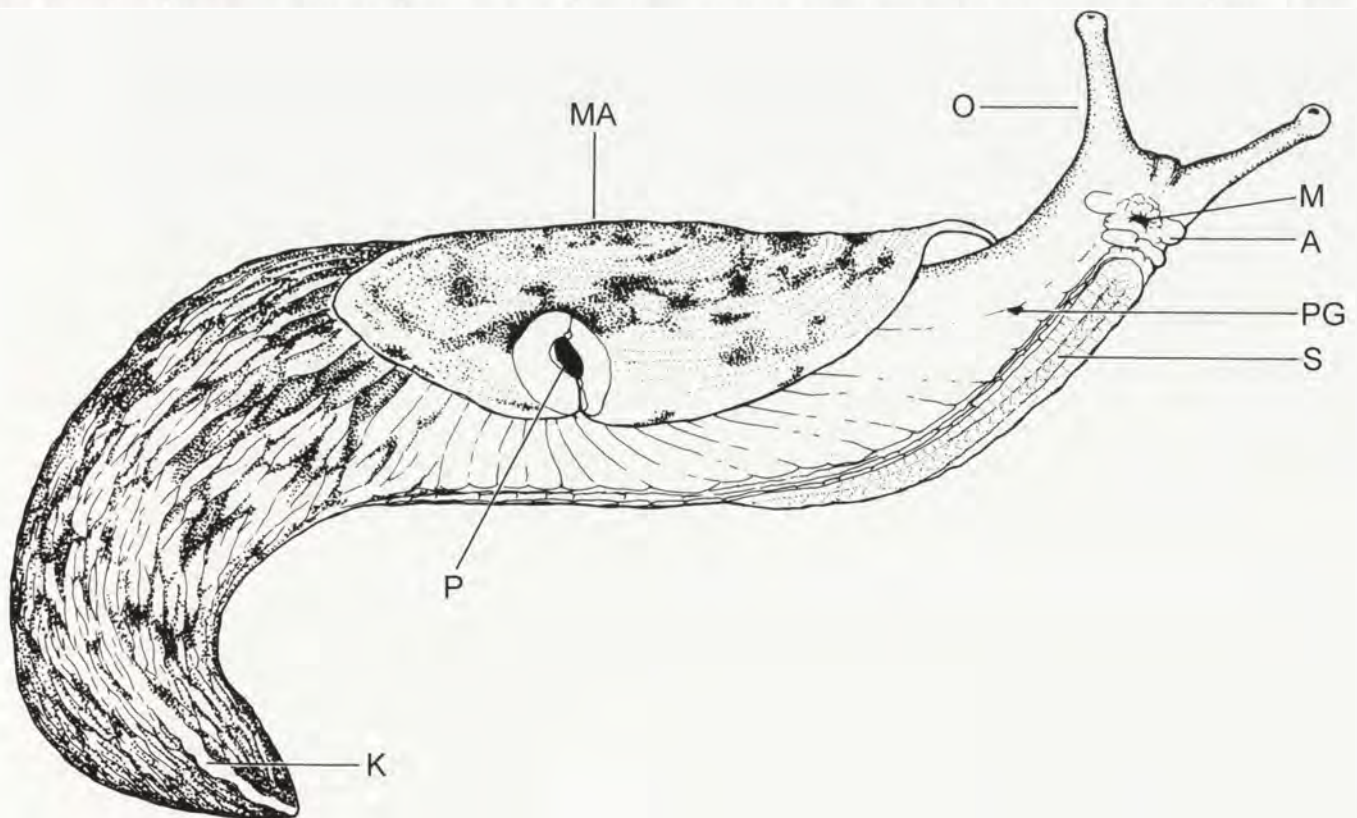


Fig. 5. External appearance of *Derocheras*: A – anterior tentacle; K – keel; M – mouth; MA – mantle; O – optic tentacle = ommatophore = ommatophorus; P – pneumostom; PG – porus genitalis = genital opening; S – sole. (Orig.)

their number exceeds ten (usually 12–15). In the case of Agriolimacidae the number of furrows does not seem of taxonomic importance. Above the foot margin, parallelling it, two longitudinal grooves run. Like in most other slugs, it is difficult to morphologically delineate the foot. The organ is flattened, ribbon-like, usually called a “sole”. Its muscular system is an important taxonomic character. It can be best observed in slightly wiped alcohol-preserved specimens. In oblique light, its surface structures are well-perceivable. In all Agriolimacidae, like in the whole superfamily Limacoidea, the sole is divided by two longitudinal grooves into a medial and two lateral zones (Figs. 4–5). An exception is the genus *Mesolimax*, in which the lateral zones are additionally divided longitudinally by two (*M. brauni*) or five (*M. escherichi*) shallower and more delicate furrows (Fig. 4). Irrespective of these longitudinal grooves, in all Agriolimacidae delicate transverse wrinkles occur on the sole. On the lateral zones they are arranged nearly regularly and at a right angle relative to the sole edge, whereas on the surface of the medial zone they are bent at an angle to resemble a wide letter V gapping anterad (Figs. 4–5). This is one of the distinctive features of the whole family Agriolimacidae.

1.2.2. General topography of internal organs

In chapter 1.2.1, devoted to external morphology, the difference in the topography of internal organs between slugs and snails has been pointed out (Figs. 2–3). Different arrangement within the viscera (= internal organs) is a consequence of the disappearance of the characteristic, spirally coiled visceral sac which in snails forms a kind of hump over the rest of the body. In slugs the viscera sink in a spindle-shapedly elongated body, called the cephalopodium, both the location of particular organs and proportions undergoing a change. No doubt, the ancestors of Agriolimacidae were dextral snails, which is testified to by the location of the pneumostom (also referred to as spiraculum). Like in snails, in its neighbourhood there are the anus (= anal opening) and excretory openings, situated in one aperture. The gonopore (opening of the reproductive system) is also on the right side. And thus, the openings of all these systems are located just like in dextral snails. I know no case of anomalous sinistrality in Agriolimacidae, so, if it occurs at all, it must be an exceptionally rare phenomenon not having been recorded by other specialists who have dissected thousands of slugs belonging to this family, either. (Considering the chirality of slugs and the location of the openings of several systems on the right, one should be very careful when attempting dissection and examination of internal organs; see p. 383).

As mentioned already, the spirally coiled visceral sac contains viscera which include a substantial part of alimentary system (the crop, stomach, intestine along with rectum and its caecum, digestive gland) and a considerable part of reproductive system (the spermoviduct, albumen gland, hermaphrodite duct and hermaphrodite gland). In slugs these organs are situated horizontally above the flattened

sole, and what in snails was situated in the spiral visceral sac in slugs belongs to the posterior, elongated body section beyond mantle (Figs. 2–3). The organs are partially twisted around the body axis, not mirroring, however, the spiral coiling of the visceral sac of their ancestors. The last convolution has presumably evolved quite independently as a result of “becoming sluggish”. In the process of topographic transformations within the viscera of Agriolimacidae, due to the shortage of space, the alimentary canal, which in snails constitutes a loop of one ascending and the other descending arm, has become coiled into two loops, one of them being displaced posterad relative to the other. This twisting of the alimentary canal is a new feature. It should be immediately emphasized, however, that the relative position of the loops, their length proportions, number (two or three), the presence of caecum and its location in the region of rectum vary between slug families and represent essential diagnostic characters at this taxonomic level.

The shift within the alimentary system is followed by changes in the course of the large blood vessels and the nerves which serve the organs concerned.

The muscular system undergoes a diametrical change. In snails it constitutes a composite bundle of muscular strands, whose contraction enables complex movements of different organs, their translocation relative to one another and, first of all, retraction of the whole body into the shell. It involves controlled compression of particular organs, the final contraction of the whole leading to the foot being folded in two. The latter is the last organ to be retracted into the shell. Emerging from the shell is a result of loosening of particular strands of the main retractor and simultaneous pumping of constitutional fluids into the body parts or organs being consecutively extended from the shell. In all slugs this main muscle undergoes profound reduction. Its role consists only in retraction of the soft body, tentacles and the whole head as well as in operating movements of the buccal mass. All the other movements of the body and its particular parts are caused by contraction of muscular fibres occurring in the body integuments, in which, not in the shell, they find their support. The system of stiffening ducts filled with constitutional fluids acts as a hydroskeleton on the same principle as the so-called turgor in plant tissues and performs the same skeletal function. The branching pattern of the head retractor muscle varies within Agriolimacidae. As seen in Figs. 11a–d, the muscle may branch differently even in the same species.

Nudeness implies sinking of the shell in the soft body parts. In Agriolimacidae the shell is entirely hidden in the mantle. This is probably a consequence of the gradual development of the mantle lobes as it is the case in e.g. Vitrinidae. The ultimate result is the accretion of the lobes to each other and complete enclosing of the shell in the mantle cavity. The plate-like shell of Agriolimacidae is situated in a cavity filled with liquid along with which and the muscled body integuments it provides support for the retractors of the head. They are no longer accreted to the shell (!) but only to the membrane (diaphragm) which

represents the wall separating the shell from the visceral and pulmonary cavities.

Very serious changes took place within the pallial complex. They little concern the topography (only the angle of the heart axis and aorta relative to the body axis is changed), while the shapes of particular organs of the complex have changed diametrically. The disappearance of the visceral sac and flattening of the mantle have brought about compression of organs as well as reduction of the size of pulmonary cavity and the space where the heart, system of pulmonary blood vessels, kidney, ureter and bladder are located. All these organs had undergone shortening, which was followed by the bean-shaped kidney archwise encircling the heart practically from three sides.

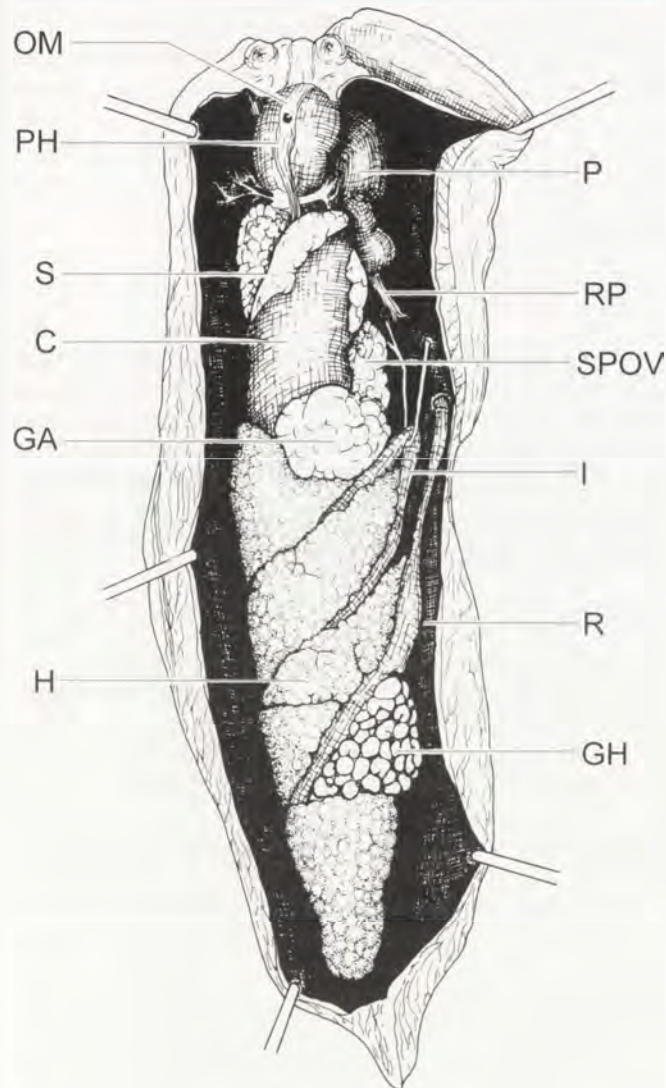


Fig. 6. Situs viscerum in *Deroceras sturanyi* seen when body integuments are drawn aside: BC – bursa copulatrix = spermatheca; C – ingluvies = crop; GA – glandula albuminalis = albumen gland; GH – glandula hermaphroditica = hermaphrodite gland; H – hepatopancreas = digestive gland = liver; I – intestinum = intestine; M – main retractor muscle; OM – optic tentacle = ommatophore = ommatophorus; P – penis; PH – pharynx = buccal mass; R – rectum and rectal caecum; RP – musculus retractor penis; S – glandulae salivales = salivary glands; SPOV – spermoviduct = spermoviductus. (Orig.)

Within the anterior body section, i.e. the head and neck as well as the pharynx, central nervous system, sensual organs, copulatory organs, etc., situated in this region, no essential topographic changes are noted compared to snails. Among the characters of diagnostic significance the relative position of the right ommatophore and its retractor muscle and the copulatory organs can be mentioned. In most Agriolimacidae the copulatory organs are situated parallel to the right ommatophore retractor instead of crossing it.

There still remains to discuss the changes pertaining to the foot. Contrary to snails in which it sometimes has to get retracted into the shell, in Agriolimacidae, like in other slugs, it cannot be folded in half, being just a flat ribbon.

The topography of the internal organs is illustrated in Figs. 6–7.

1.2.3. Shell

As mentioned already, the shell in Agriolimacidae has been significantly reduced to assume the shape of an asymmetrical (!) oval plate. It is slightly convex dorsally and inconspicuously concave ventrally. In the posterior shell section there is a nucleus, corresponding to the protoconch, i.e. embryonic shell, in snails. Except for *Mesolimax*, in which the body axis runs nearly medially along the shell, in

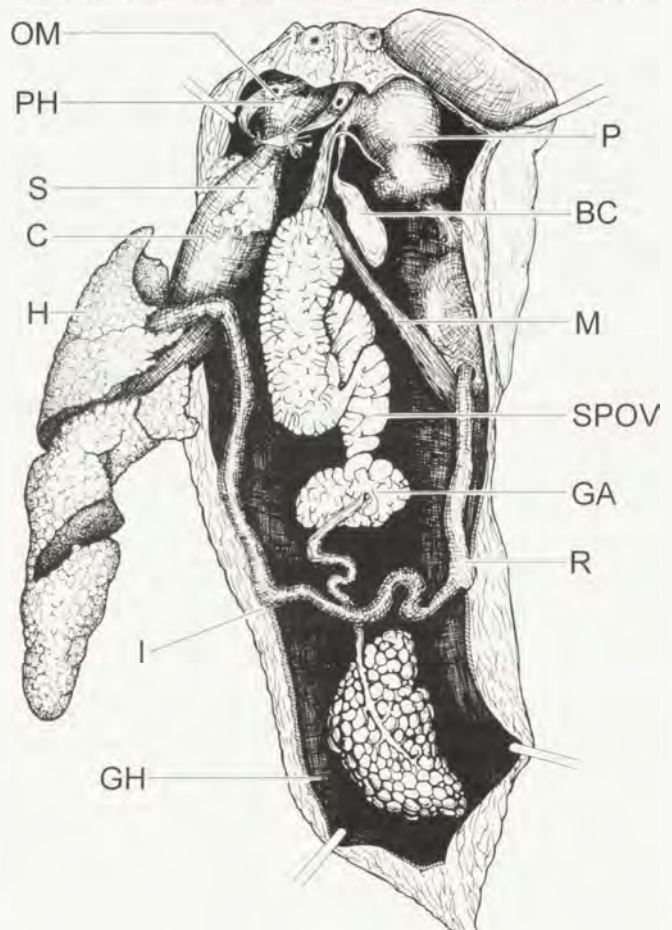


Fig. 7. Situs viscerum in dissected *Deroceras sturanyi* – for denotations see Fig. 6. (Orig.)

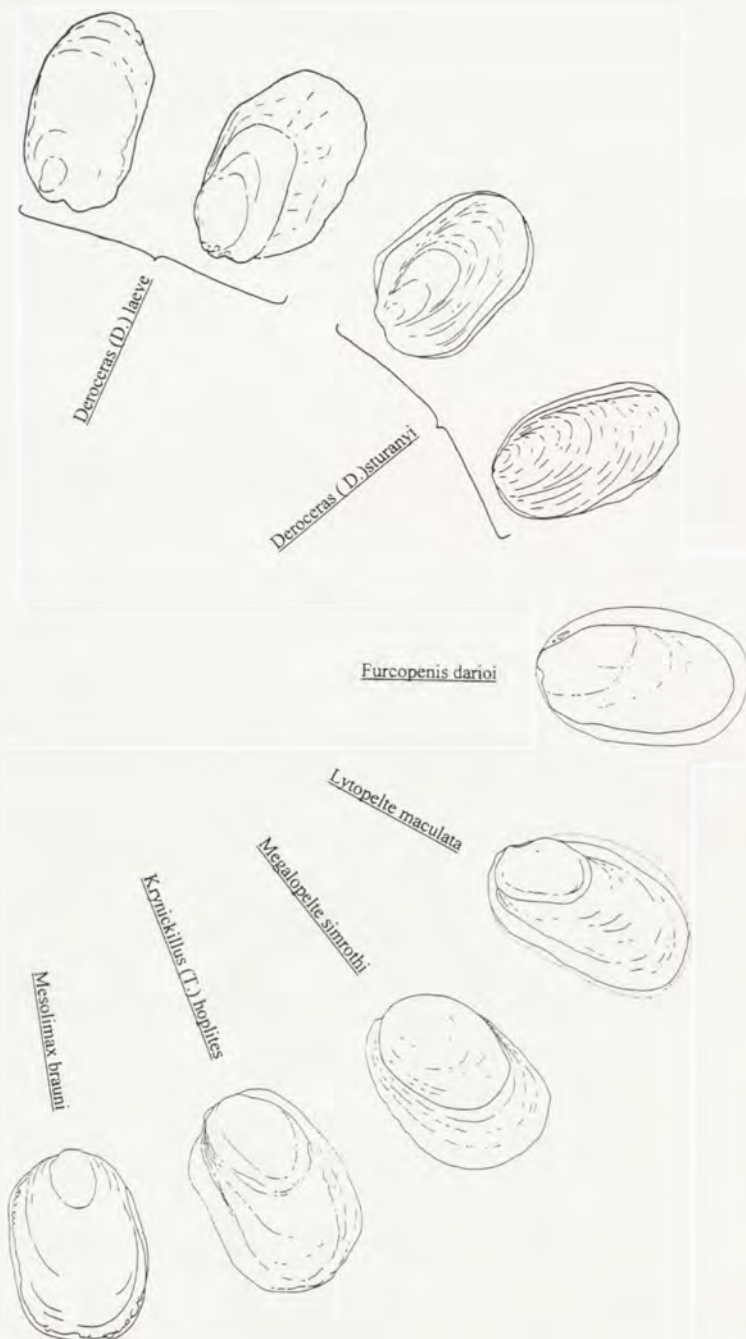


Fig. 8. Shell in representatives of particular genera. (Orig.)

all Agriolimacidae the nucleus is situated slightly to the left. With the growth of the slug's body, the shell increases at the edges, the effect of which are concentric growth lines visible on its upper surface. The increments are unequal: wider anterad and towards the right, where the shell grows faster. This irregularity of growth yields a result of the whole shell being asymmetrical. In the posterior part of the shell, on its ventral side there is a small protuberance which apparently represents a remnant of the lower part of the spirally coiled shell of their ancestors.

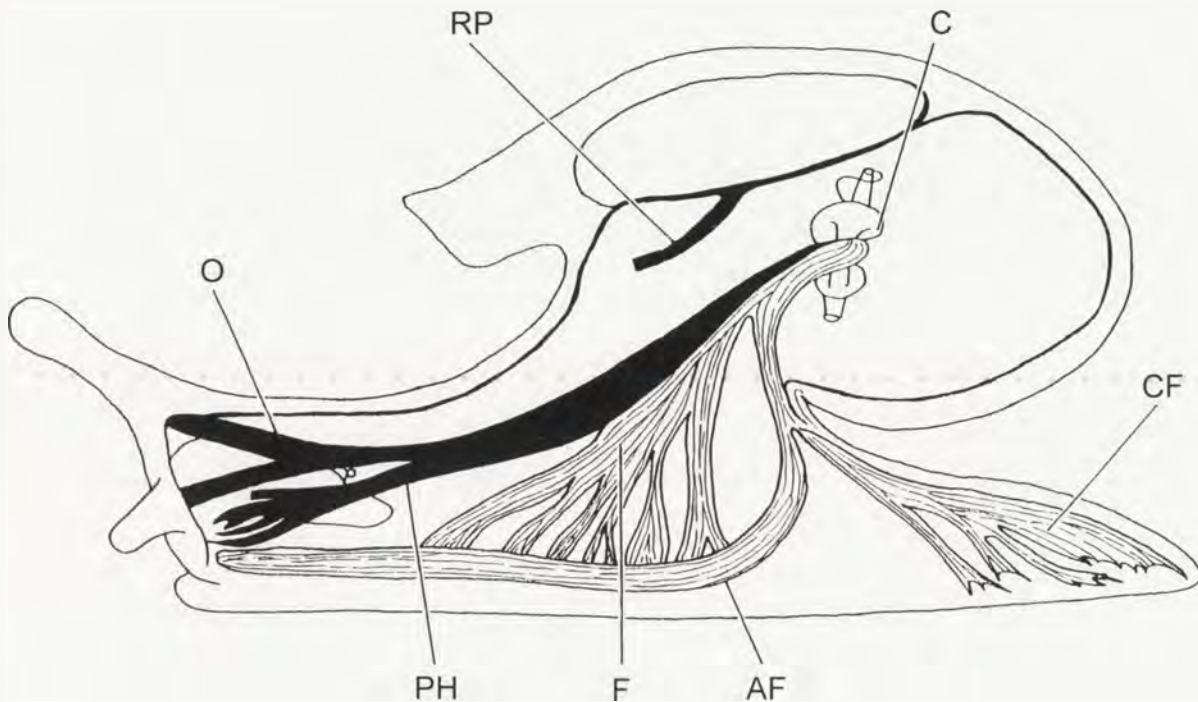
Neither the shape (Fig. 8) of the shell nor its other characters known are sufficient for identification, which means that the shell of Agriolimacidae is not always distinguishable from those of other slug families. Thus, the shell cannot be used to determine species. This is a serious difficulty when material of fossil or subfossil shells, not only of Agriolimacidae but of most slugs, is being interpreted (Reuse 1983).

The internal shell of Agriolimacidae is white. It is built of the same material as the shell of snails is, i.e. both conchiolin and crystalline calcium carbonate (calcite) (Fournie and Chétail 1982). Its function is limited to providing a skeleton and constituting a reservoir of calcium. The shell is not accreted to the walls of the cavity, but embedded in a liquid substance. In specimens long kept in alcohol (especially when the alcohol has not been changed a number of times) the shell corrodes and finally dissolves completely. Its marginal sections are the first to dissolve, only a conchiolin membrane remaining.

1.2.4. Muscular system

The "skeletal" musculature, i.e. the main retractor referred to as musculus collumellaris, which in snails finds its posterior support by accreting to the shell, in slugs loses its significance undergoing an enormous reduction (Fig. 10). In Agriolimacidae it is a muscle defined as a head retractor only, its function being limited exclusively to retraction of the head and tentacles into the cephalopodium (see p. 350). The muscle has a single insertion posteriorly, accreting to the diaphragm. An exception within the whole family of Agriolimacidae is the genus *Mesolimnaea*, in which the main retractor forks near its posterior insertion and is pierced through by rectum (Fig. 822). There are always several branches in the anterior section of this muscle, the strands dividing differently, usually in two more or less symmetrical offshoots. However, the branching pattern of the muscle is often variable within species, thus being an individual character (Fig. 11). Anyway, the main retractor always yields an even number of strands attached to the tentacles of the first and second pair, mouth lobes and to the pharynx.

The penial retractor (musculus retractor penis) is an independent and relatively big muscle. Posteriorly, it is inserted to the diaphragm, whereas anteriorly to the penis. Its anterior section may be forked, having two insertions on the penis or its accessory organs. The retractor retracts the genitalia (penis and stimulatory organs) that have been everted during the courtship and copulation. No doubt, the muscle participates in more complex movements of other copulatory organs as well.



9



10

Figs. 9–10. Diagrams of muscular system. 9 – In snails. 10 – In slugs. AF – anterior section of foot; C – shell columella; CF – caudal end of foot; F – foot; O – ommatophore; PH – pharynx = buccal mass; RP – retractor penis. (After Likharev and Wiktor 1979)

There also exists a system of smaller muscular strands or fibres like, e.g., retentors connecting the copulatory organs with the body integuments, muscular fibres between some internal organs, or a complex system of fibres responsible for changes in the pressure of body fluids in numerous cavities. Both in the upper regions of the body and in the foot (sole) the body integuments actually represent one large sack capable of controlled contraction. Owing to it, the body of a slug can bend, its particular sections getting concave etc. This is a dermal-muscular system ensuring high dexterity in movements which is far better developed in slugs than in snails. Moving on the ground is possible due to a combination of transferring waves of the sole transverse contractions (Figs. 12–13). In the mechanics of this type of movement the

role of mucus is of paramount importance. When the waves appear and disappear on the sole surface, the body rests on a "roll" or wave constituting an arch, whereas at the same time, owing to the contraction of other muscular fibres, the more anterior part of the sole rises above the ground and, contracting, moves anterad. In the subsequent phase of the movement another roll is formed, which touches the ground in a farther place, the formerly supporting roll rising and moving forward. This manner of moving resembles that of a caterpillar, although no limbs are involved. Between the sole surface and the substratum there is a layer of mucus which is produced in the foot anterior section. Thanks to the mucus, the whole sole is glued to the ground, and the changes in pressure between the appearing and disappear-

ing rolls or waves of the sole surface cause that the mucus pressure alternately changes as well. The arrangement of muscular fibres of the sole and the mechanics of their functioning makes only forward movement possible. A slug is not capable of moving backward, at most it can turn back. The sole movement bears resemblance to the peristaltic movement, but in this case it is mucus which is pumped backward between the sole surface and the ground. This type of movement enables a slug to crawl in different positions, also upside down, and on sharp objects, fringes, thorns, etc, without a threat that the sole might be injured. Friction is not a problem here since, contrary to what may seem, the sole does not actually slide against the ground but moves as if treading.

1.2.5. Alimentary system

The alimentary system in Agriolimacidae does not differ in its structure from those of other herbivorous and omnivorous pulmonate slugs. The mouth, situated in the head's fore-part, leads directly to the pharynx which is often called the buccal mass (Fig. 14). In the discussed family the mouth is a small-sized oval structure. Its upper part contains a cuticular jaw of oxygnathous type. It is brown-coloured, arcuate, with a distinct, gently rounded tooth situated medially (Figs. 15–16). Externally, only the cutting section of the jaw is visible, whereas its skeletal reinforcement penetrates deep into the issues of the pharynx arch, simultaneously serving as its stiffener. Inside pharynx there is the whole complex apparatus of radula. Like in other gastropods, it is equipped with its own muscular system and a stiffening cartilaginous plate, on which the proper radula with hundreds of teeth is situated. The teeth are set on a common ribbon-like membrane, which can move on the surface of the stiffening cartilaginous plate. Also the plate itself along with the radula can make movements which resemble those of a licking tongue. Such movements make it

possible to crumble food (algae and lichens) licked from the substratum, to rub off tissues of higher plants and simultaneously transport them into the pharynx and oesophagus. The radula serves other purposes as well. When a leaf fragment or other piece of food has been seized, it is pressed with the radula to the jaw blade and cut off. During licking the jaw leans against the surface licked, immobilizing the whole pharynx. Radular teeth (Fig. 17) in Agriolimacidae are of three types. A row of medial or central teeth runs along the whole radula in its middle. They are symmetrical and consist of a mesocone and two identical ectocones on its sides. From this radular axis, formed by the row of medial teeth, transverse rows of teeth run to the right and left. They include lateral and marginal teeth, although the border between them is difficult to define as they transform gradually. Like the central teeth, the lateral ones are composed of three – or only two towards the edge of the radula – cones. Their paracentral cone (closer to the radula axis) is called endoconus (endocone), whereas the external one is referred to as ectoconus (ectocone). In each transverse row the teeth become more and more asymmetrical going from the middle of the radula towards its margins. This results from the fact that the mesocone in each subsequent tooth only elongates, while the endocone undergoes both gradual diminution and lifting to finally join the mesocone. Contrarily, the more external a tooth, the lower situated and the smaller its ectocone which gradually disappears. Marginal teeth are those situated on the external margins of the radula. In Agriolimacidae their shape resembles a curved knife, their edges are smooth, top blunt. The marginal teeth in a more paracentral section usually have a vestigial ectocone preserved, their main blade being homologous with the mesocone. Towards the end of the radula the marginal teeth get gradually smaller, often having an irregular plate-like edge. In the past the radula was attributed a taxonomic importance. However, in the case of the family discussed no taxonomically important characters have been found in the

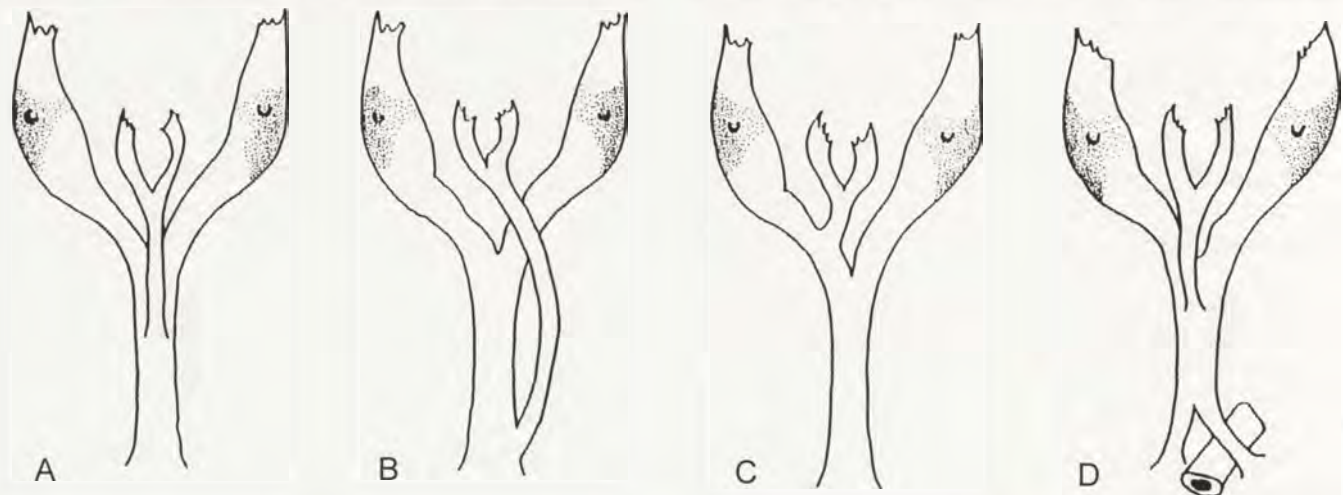


Fig. 11. Examples of different types of the main retractor muscle embranchment in Agriolimacidae: A – *Deroceras laeve*, *D. agreste*, *D. reticulatum*, *D. praecox*, *D. rodnae*; B – *Deroceras agreste*, *D. reticulatum*, *D. praecox*, *D. rodnae*; C – *Deroceras agreste*, *D. praecox*, *D. rodnae*, *D. (L.) moldavicum*; D – *Mesolimax brauni*, *M. escherichi*. (After Wiktor 1973, 1989)

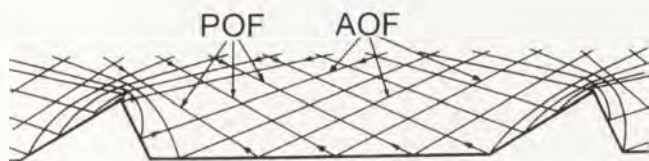


Fig. 12. Diagram presentation of the working mechanism of particular muscular strands in sole: AOF – strands causing the movement of a "contraction wave" on the sole surface; POF – strands responsible for raising of the sole surface. (After Jones 1973; slightly modified)

radula. The appearance of teeth is similar to that in many other Limacoidea, and even within Agriolimacidae this character does not provide a basis for identification of lower rank taxa (Jungbluth, Likharev, Wiktor 1981). The shape of the teeth in the anterior section of the radula changes with the wear of the cones. The radula regenerates in its posterior section, which is in the pocket where new teeth originate (radular pocket); the old, worn out, teeth in the anterior part come off. One can often find diagrams illustrating the number of teeth in a transverse row (C – central, L – lateral, M – marginal teeth) and the number of rows in the whole radula. For Agriolimacidae the formula is mostly the following:

M	L	C	L	M
24–144	13–19	1	13–19	24–144

×85–110

The most variable is the number of marginal teeth. Sometimes various anomalies in the structure of the radula are recorded. They concern the shape of teeth or different number of teeth on the right and on the left. Such an anomaly is usually a result of a defect in the part producing teeth and therefore the dissimilarity involves a whole longitudinal row of teeth and is observed along the entire radula.

Two ducts carrying the secretion of double lobular salivary glands (glandulae salivales) open to the pharynx on the dorsal side (Fig. 14).

From the pharynx, the food proceeds to a narrow and short canal called oesophagus (Fig. 14). It is surrounded by a ring of the central nervous system.

The next distinguishable section is the crop. It is a thick, almost straight canal, where the food is preliminarily processed, i.e. comminuted and partly digested. This process works thanks to the action of enzymes produced by the salivary glands and by the walls of the crop itself (a list of enzymes available in Runham and Hunter 1970). It is probably also affected by microorganisms. As a result of peristaltic movement, the food pellet is blended and shifted posterad to the shortest but very important section, which is the stomach. It is joined by two ducts leading from the hepatopancreas. The secretion of this huge gland is mixed with the food in the stomach. It is also in this organ that the food is sorted as a result of which the digestible portion of the food pellet is transferred to the hepatopancreas, where its particles are absorbed by cells capable of pinocytosis, whereas the remaining, useless, part moves to the subsequent sections of the alimentary canal. Ciliated epithelium,

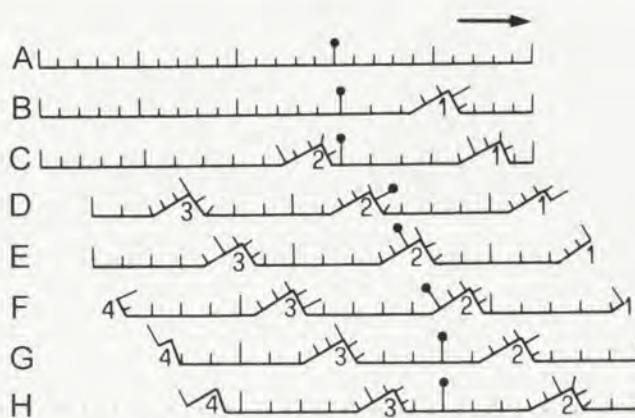


Fig. 13. Diagram presentation of the movement of a "contraction wave" on the sole surface. (After Jones 1973; slightly modified)

and also mucus cells, participate in all these processes, especially in the transport and sorting. In the roof of the stomach there is a system of folds, assuming the shape of the letter Y, some of which making up the so-called typhlosolis where faecal pellets are formed (Walker 1969, 1972). The hepatopancreas, also referred to as the liver, is a bipartite organ. Its anterior part is composed of 6 lobes, whereas the posterior one of 9. The gland is built of acini, the secretion of which is carried out by fine ducts that join to form two main ducts opening to the stomach. The ducts are lined with ciliated epithelium. They can also transfer their contents with peristaltic movements. The movement inside the ducts takes both directions, owing to which the food gets to the gland, the latter's secretion is transported to the stomach and unabsorbed remains removed through it. The histological structure of the hepatopancreas is complex. Four types of cells can be distinguished: a. secretory cells bulgy in shape, with a large vacuole and a basally located nucleus; b. cuboidal cells with numerous vacuoles originating during pinocytosis and green grains in the cytoplasm; c. narrow cells with a nucleus situated medially – their function is hardly known; d. trapezoidal calcareous cells. The last mentioned store up calcium in the form of granules. Calcium granules appear also in the intestine (Walker 1970). The so far discussed section of the alimentary canal in Agriolimacidae runs nearly straight and bends anterad in the region of the stomach thus forming an arm of the first, anterior, loop. The second arm represents the intestine. It runs anterad, bends over the aorta, and goes backwards providing the descending arm of the second, i.e. posterior, loop (Fig. 18). In all Agriolimacidae the latter reaches much more posterad than the anterior loop as it bends close to the posterior body end. It is an important character of the whole family distinguishing it, for example, from Limacidae, in which this is the first not the second loop that reaches more posteriorly. The last arm of the second, posterior, loop runs anterad again. Most frequently this section is referred to as the rectum. In some species of the genus *Deroceras*, more or less in the middle of the rectum there is a caecum of variable length. At times it nearly equals the length of the rectum, or

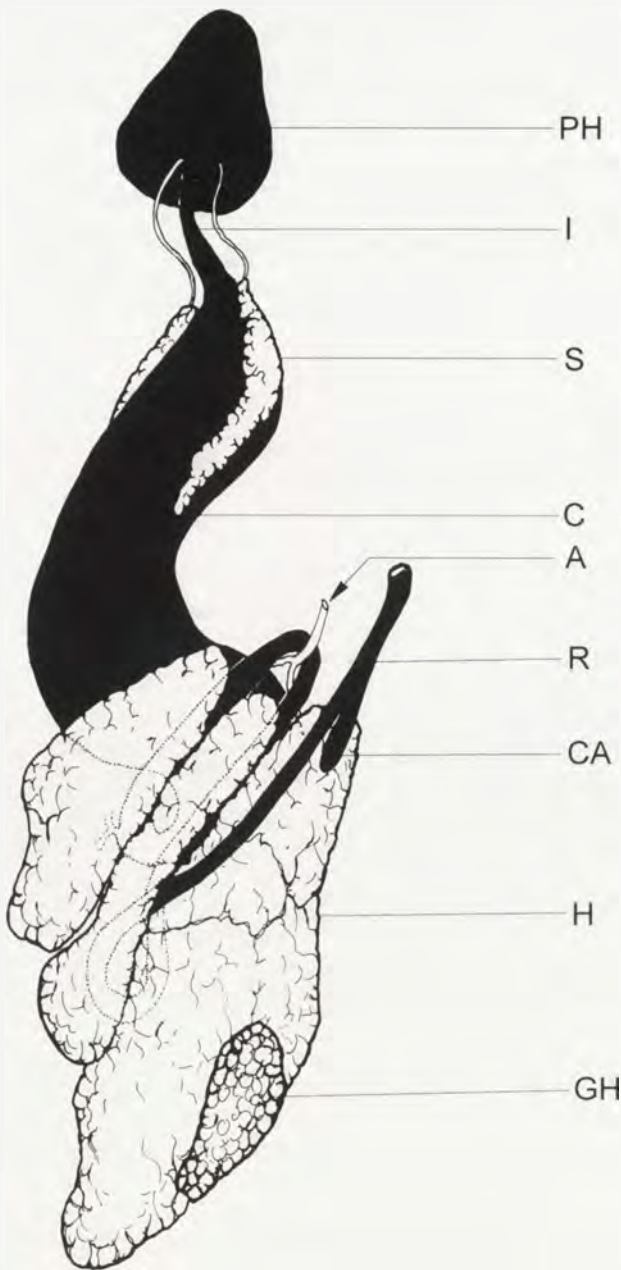


Fig. 14. Alimentary canal: A – aorta; C – crop; CA – caecum on rectum; GH – glandula hermaphroditica; H – hepatopancreas; I – oesophagus; PH – pharynx; R – rectum; S – glandulae salivales. (Orig.)

is merely a shallow pocket, or else just a barely perceivable dilation. The caecum is never filled with faeces. Inside it there is a transparent fluid. Histologically, this organ does not clearly differ from the rectum. The function of this blind appendix is unknown. Presumably, it is involved in water management or contains some substances that may repel enemies; the substance would be expelled through the anus when the slug is irritated. The whole alimentary canal is additionally twisted around the longitudinal body axis. In Agriolimacidae the twisting is not much pronounced. The anus is situated in a slit of the mantle somewhat above the

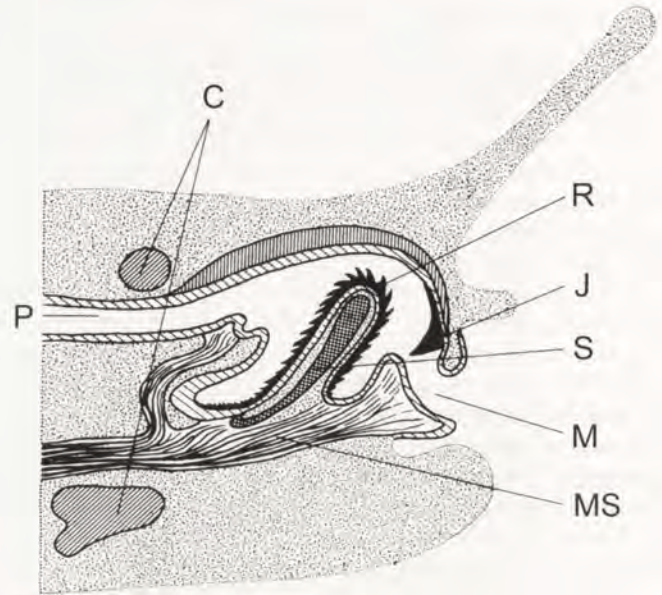


Fig. 15. Longitudinal cross-section through pharynx (=buccal mass): C – central part of nervous system; J – jaw; M – mouth; MS – muscles, P – oesophagus; R – radula; S – odentophore cartilage. (After Wiktor 1989)

pneumostom. The opening of the alimentary canal and that of the excretory system, strictly speaking the outlet of the bladder, join together to form one common opening.

1.2.6. Vascular and respiratory systems

Although in slugs the vascular system works like in snails, its role in locomotion and in all movements is much more essential, which is a result of reduction of the main retractor muscle. What is called the hydroskeleton the slugs owe to periodical shutting out the body fluids in cavities or vessels; when the muscular fibres are contracted, the pressure in the confined space causes stiffening of a whole body fragment. The blood-vascular system of slugs has been discussed by many authors (Runham and Hunter 1970, Duval and Runham 1981, Duval 1982), that of *Deroceras reticulatum* having been particularly thoroughly examined.

The main organ pumping the blood in vessels is the heart ventricle. Along with the auricle, it is enveloped by a stiff pericardium, which is filled with a fluid. The walls of the ventricle are abundantly muscled. Contractions of these muscles force blood into the aorta. Between the auricle and ventricle there are valves which prevent blood withdrawal. Supposedly, during the ventricle contraction the pressure in



Fig. 16. Jaw of the oxygnatic type: A – lateral view; B – frontal view. (After Wiktor 1989)

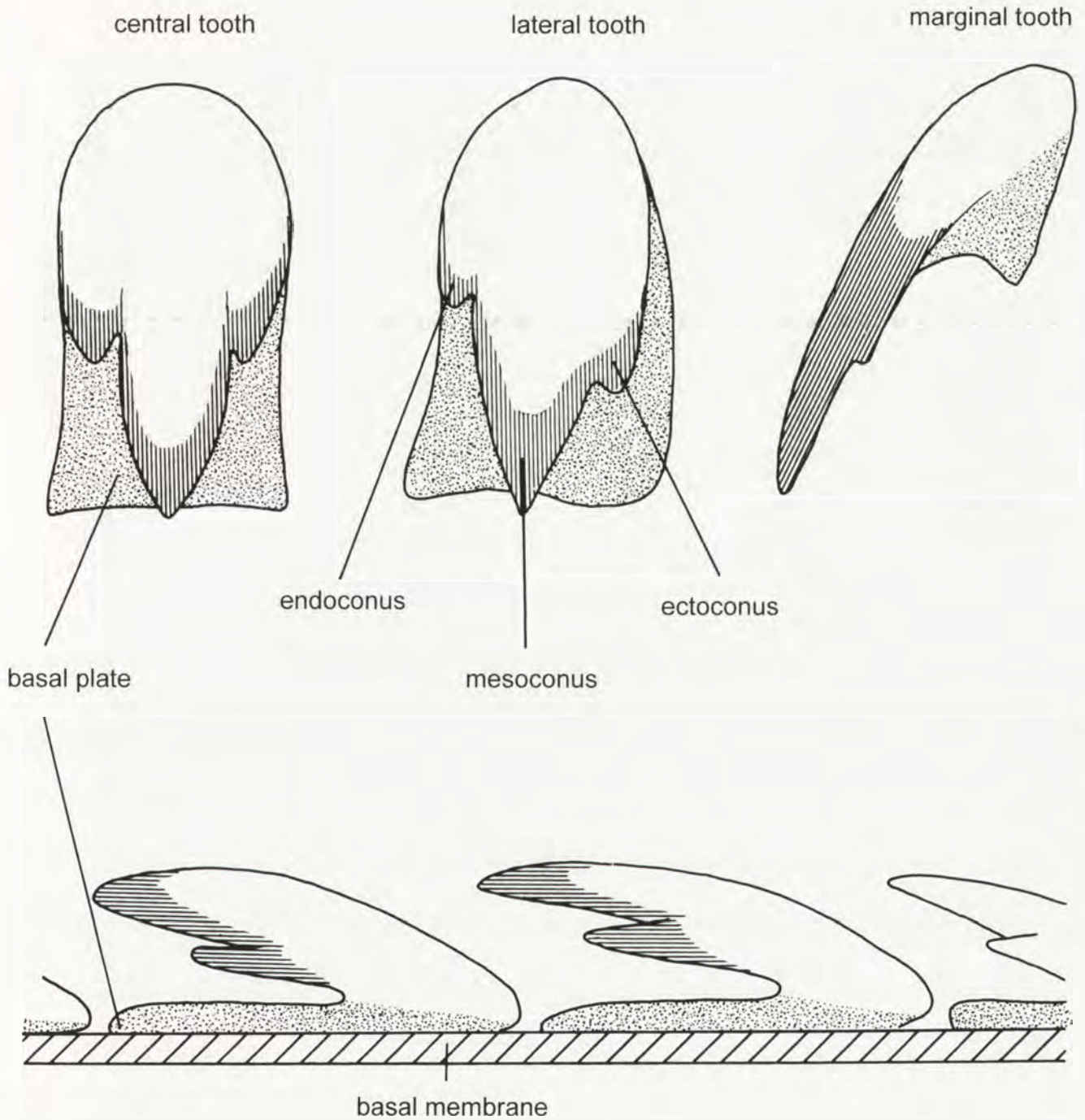


Fig. 17. Radular teeth in Agriolimacidae. (After Wiktor 1989)

the pericardium decreases which leads to "sucking in" of the peripheral blood by the auricle. The mechanism of the heart operation is not precisely known. There are no valves between the ventricle and aorta. Blood circulation in the whole body is possible not only thanks to the heart action: the flow of blood is also influenced by body contractions, and thus different groups of muscular fibres participate in pumping it. The blood pushed out of the heart gets into the main blood vessel called the main aorta or the aorta stem

which is the broadest vessel. In Agriolimacidae it is relatively long, running somewhat posterad. Only having crossed the alimentary canal, exactly at the border between the first and second intestinal loop, does this main vessel divide into the anterior and posterior aorta. Further embranchments vary depending on the species. The anterior aorta conveys blood, among others, to the head, copulatory organs, crop and foot, whereas the posterior one to the hepatopancreas, gonad and intestine (Fig. 19). Through a system of vessels of

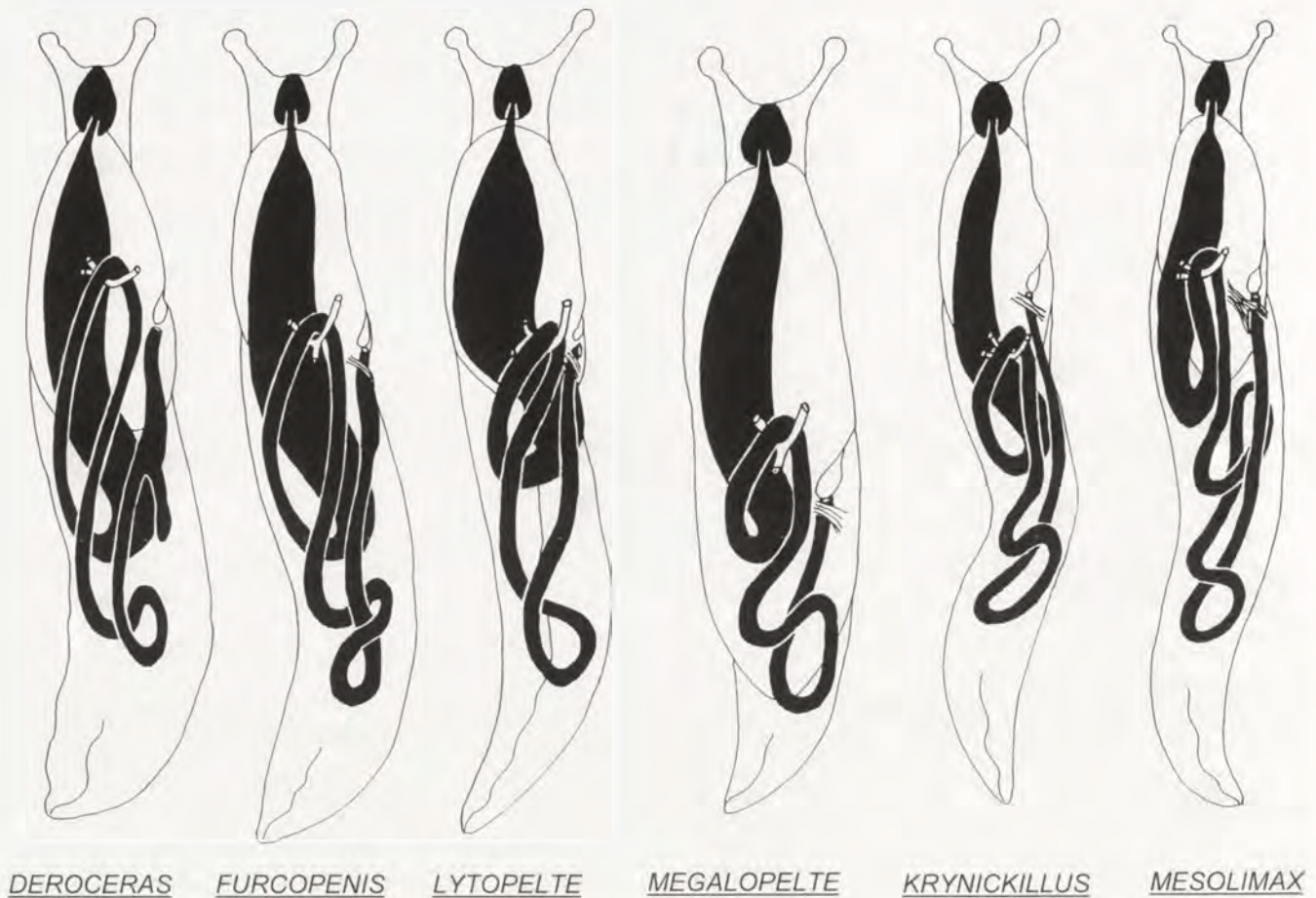


Fig. 18. Diagram presentation of the ways the alimentary canal twists in different genera of Agriolimacidae. (Orig.)

gradually decreasing lumen the blood runs into the system of spaces, directly suffusing the organs, and also to the system of lacunae in the skin. Further it gets into a large atrium which encompasses the pulmonary cavity, from which it flows to the dense system of vessels of the lung itself, where the main gas exchange takes place. From the pulmonary vessels the blood is collected by a short vessel opening directly to the heart auricle.

The lung is a single organ. It is located in the pulmonary cavity inside the mantle. The pulmonary cavity opens through the pneumostom. This opening is always situated on the right side of the body. It is well-muscled and can be closed or widely opened. During a body contraction the air is pushed out of the lung, getting inside the cavity during its dilation. The roof of the pulmonary cavity is amply provided with blood vessels. The lung is covered by glandular cells, the secretion of which maintains constant moisture in the entire organ. Although the lung is the main respiratory organ, in the case of small slugs, including most species of Agriolimacidae, it meets only ca 50% oxygen requirements. The whole skin, particularly in slugs where it is not covered by a shell, very intensely participates in gas exchange. The smaller the slug the larger its body surface relative to the

volume, the smaller proportionally its lung and the poorer the system of blood vessels of this organ.

Their low oxygen demand, especially at low temperatures, allows some species, e.g. *Deroceras laeve*, to stay under water and pursue normal activity for many hours. This constitutes an adaptation to protect those animals against drowning during spring thaws or heavy rains.

1.2.7. Pallial complex

The pallial complex comprises the organs connected with the mantle cavity. During the process of transformation of a snail into a slug, the body became spindle-shaped. The size of the mantle decreased markedly, all the organs situated in this region got compressed to occupy a small space. This concerns the lung, heart, excretory system (kidney and ureter), last fragment of the intestine, anus, space within which the vestigial shell is confined and additional structures (muscles, glands, etc.) that accompany all those organs. This whole system of organs is regarded as complex, for all of them move together as a kind of entity, and also all undergo partial reduction, deformation, shift etc. It has turned out that in all slugs, irrespective of their origin,

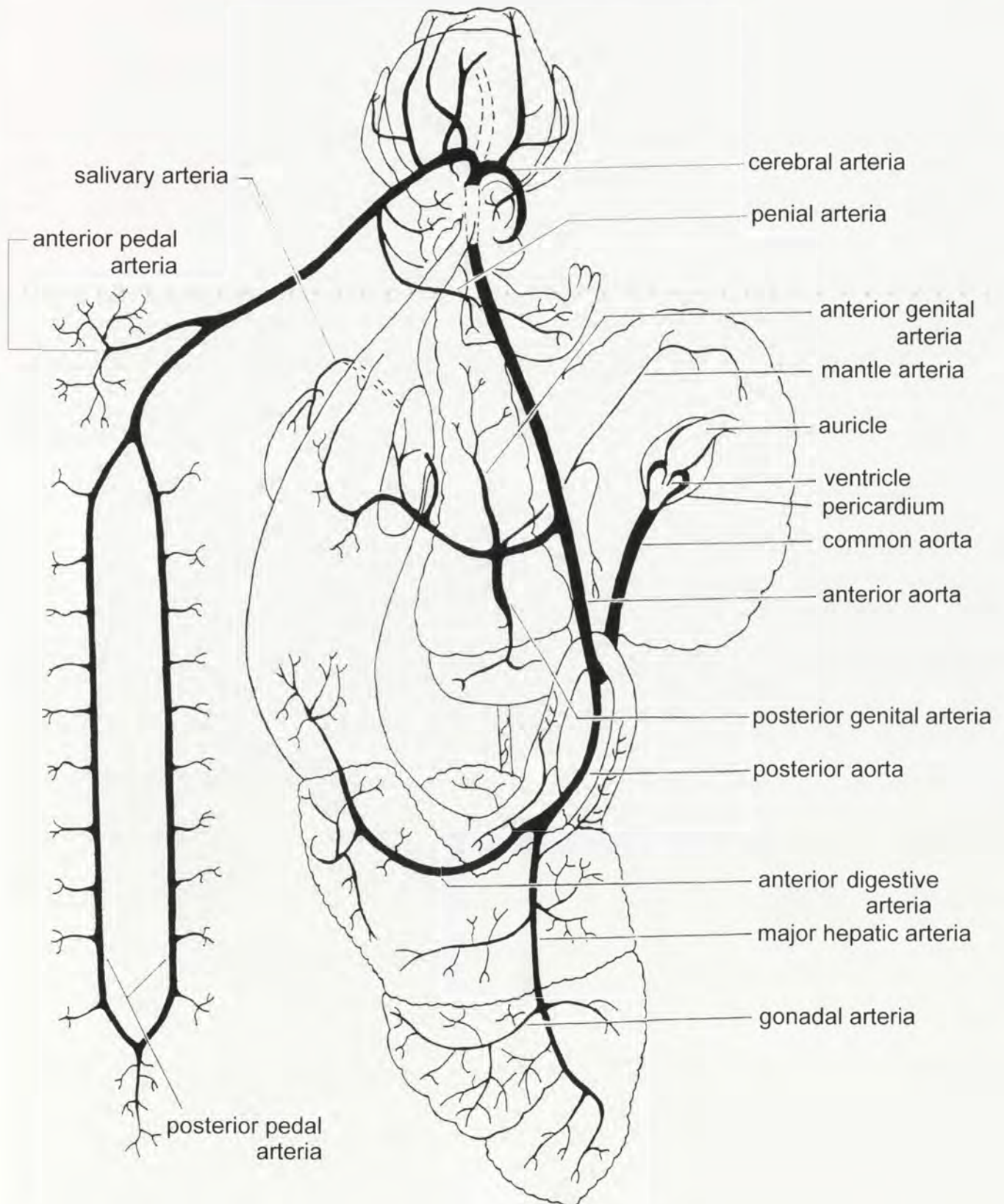
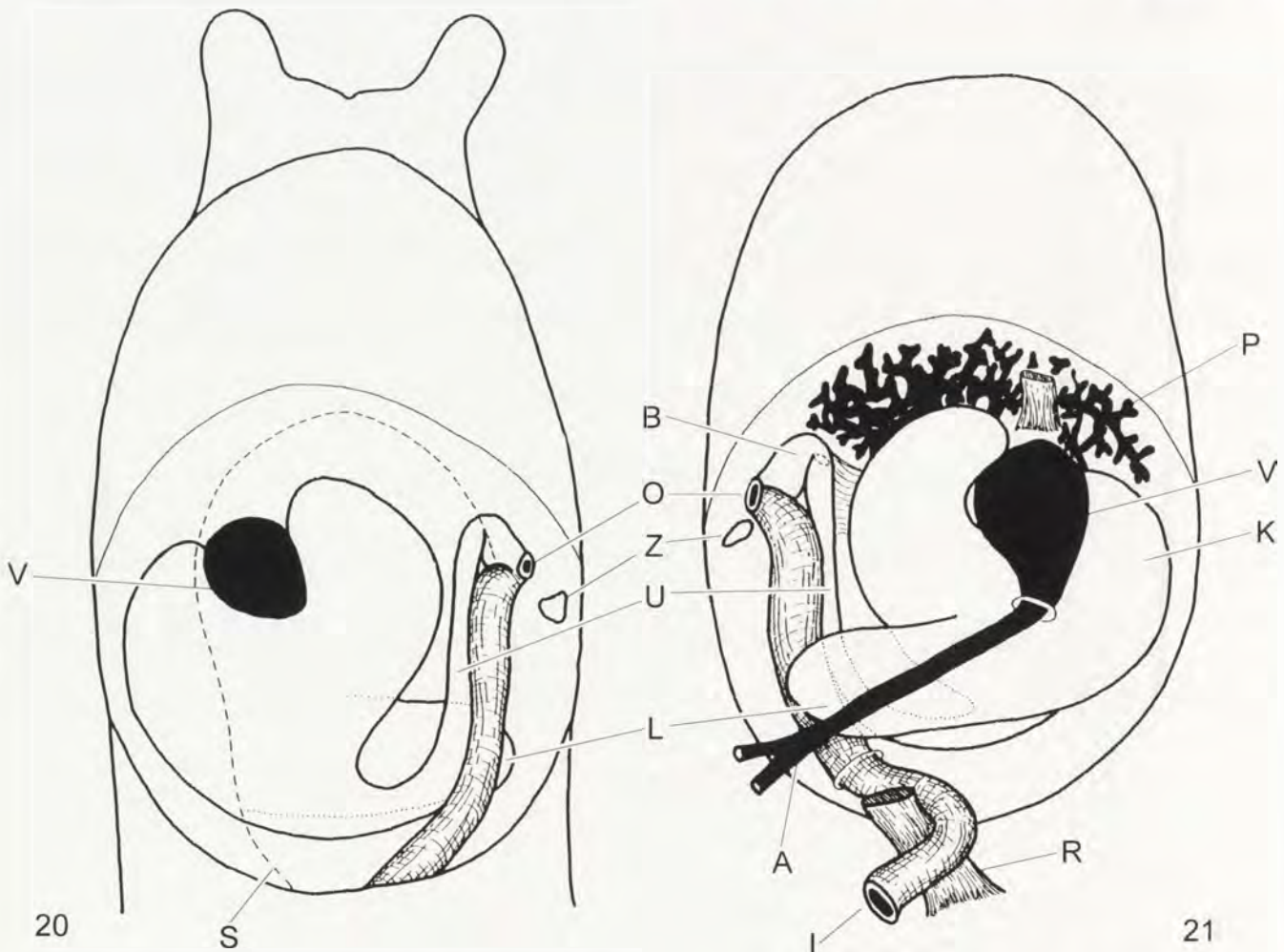


Fig. 19. Arterial vessels of *Deroceras reticulatum*. (After Duval and Runham 1981; slightly modified)

changes occurring within the pallial complex are similar. Obviously, in all the shell is reduced, becoming lamellar or lenticular, and buried inside the soft body parts. The mantle covers it also from the top and in this way the shell loses its protective role. As a stiff structure, the shell retains its skeletal function but it is considerably less important than in snails. The pulmonary cavity shortens, becomes shallow and dorso-ventrally flattened, thus assuming a circular shape. Having become dense, the network of blood vessels of the lung occupies a small space on the roof of the pulmonary cavity anterior part. The heart, its ventricle and auricle in particular, pericardium and main blood vessel undergo shortening, too. The kidney shortens becoming circular, semicircular or bean-shaped. Presumably, due to lack of space for such an important organ, a new structure, namely lobus, develops. The lobus is present only in some slugs. It represents a sort of second level of the kidney and is probably to increase the filtration surface. Both the primary and secondary ureters undergo considerable shortening. The latter opens to the bladder.

The structure and topography of particular organs of the pallial complex display numerous characters typical of the family and generic levels but they do not help in identification of particular species (Wiktor and Likharev 1980).

In Agriolimacidae the pallial complex is shifted to the posterior mantle regions. The long heart axis and the longitudinal body axis form an angle of ca 20° (Figs. 20–21). The widest angle between these two axes is recorded in *Megalopelte* (Fig. 22). The kidney surrounds the heart posteriorly and laterally, assuming the shape of a semicircle or a bean seed. Except for *Mesolimax*, in all the genera a large kidney lobe occurs. In *Deroceras*, *Lytlopelte*, *Furcopenis* and *Krynckillus* it narrows towards its free end (Fig. 22) whereas in *Megalopelte* it is widely rounded (Fig. 22), but in all those genera the lobe reaches as far as the secondary ureter and rectum. In *Mesolimax* there is no lobe (Fig. 22) and the kidney shape differs somewhat from that in other representatives of the family. In all Agriolimacidae the primary ureter tightly adheres to the kidney and is not visible during dissection, whereas the secondary ureter separates from the



Figs. 20–21. Pallial complex in *Deroceras praecox*. 20 – Dorsal view. 21 – Ventral view. A – heart; B – bladder; I – intestinum – rectum; K – kidney; L – kidney lobe; O – anus; P – pulmonary veins; R – cephalic retractor muscle; U – secondary ureter; V – heart ventricle; Z – pneumostom = spiraculum. (After Wiktor and Likharev 1980)

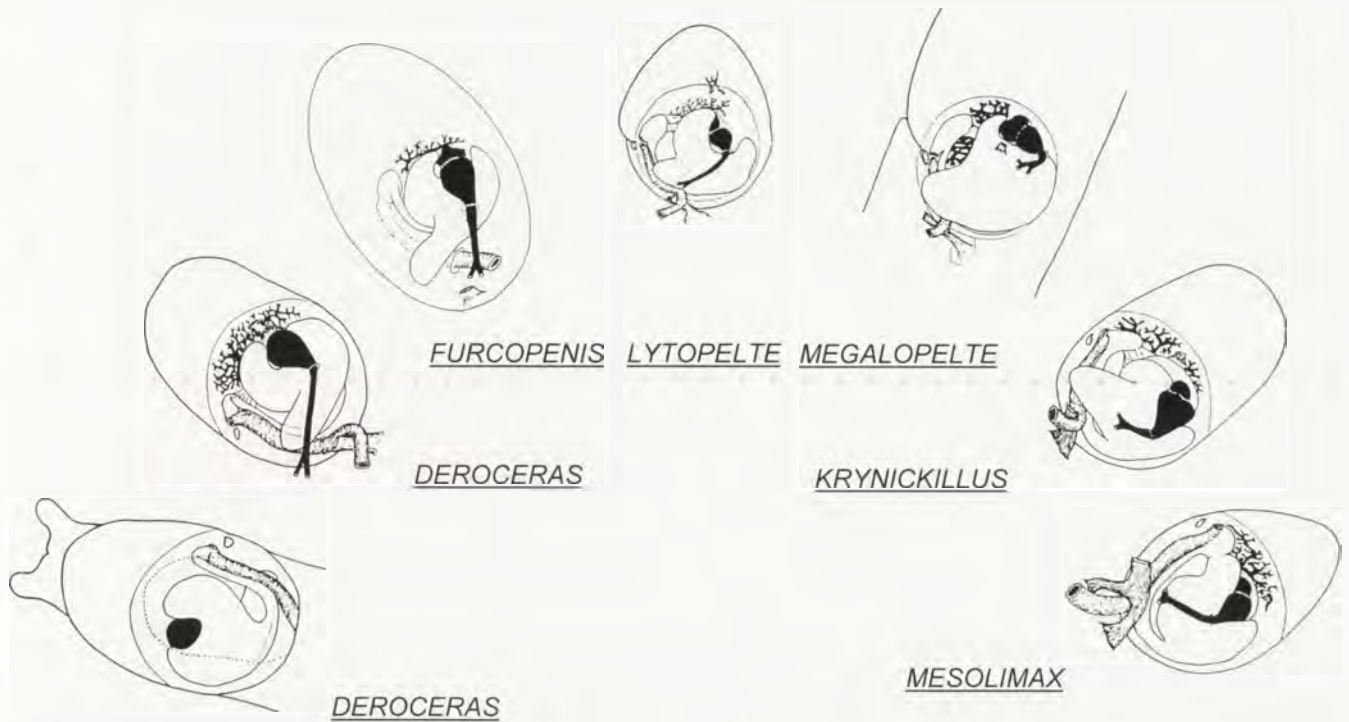


Fig. 22. Diagrams of pallial complexes in Agriolimacidae – ventral view except for the first which is dorsal. (Orig.)

kidney at its rear and runs with a gentle arch anterad opening to the bladder. The latter has a rounded but fairly variable shape. The excretory pore is situated in a slit above the pneumostom in the immediate neighbourhood of the anus. The network of blood vessels of the lung has a different appearance depending on the genus and species. The lung always occupies a small space in front of the kidney and sometimes on its right side (anatomically).

The whole pallial complex in all Agriolimacidae is very much alike in appearance. An exception is the genus *Mesolimax*, which, however, is markedly distinct not only in this respect.

1.2.8. Central nervous system (brain)

Like in other slugs, in Agriolimacidae the central nervous system undergoes strong ganglionization. Both the connectives and commissures are short and particular ganglia have a tendency to fuse with one another to such an extent that it is sometimes difficult to distinguish them. The central nervous system consists of three rings connected with one another. The largest one is represented by paired cerebral ganglia (ganglia cerebralia), connected by a commissure and situated over the oesophagus. The cerebral ganglia are connected with huge pedal ganglia (ganglia pedalia). The latter, tightly adherent to each other, are situated below the oesophagus. The second ring is formed by cerebral ganglia, united by connectives, and paired pleural ganglia (ganglia

pleuralia) semicircularly arranged below the oesophagus. The latter ganglia are connected each with one of the two parietal ganglia, between which there is a single visceral ganglion. The third ring is composed of the cerebral ganglia and two small buccal ganglia situated below the oesophagus but on the buccal mass (Fig. 23). Numerous nerves depart from all these ganglia, optic nerves (nervi optici) and those leading to the ommatophore retractor being particularly well-developed. Also, the nerve running to the region of the pneumostom departs from the cerebral ganglia. A whole series of nerves innervating the sole run from the pedal ganglia. The lateral walls of the pedal ganglia are adhered by statocysts that are filled with statolites which glitter on freshly dissected brains. In spite of their location, they are innervated by the cerebral ganglia. The nerves of internal organs and those of the pallial complex run from the lower part of the second ring. The pedal ganglia innervate mainly the sole. The central nervous system is not known well in particular Agriolimacidae. It seems, however, that its features are of minor taxonomic value. The one which has been more thoroughly investigated is the nervous system of *Deroceras reticulatum* (Figs. 24–25).

1.2.9. Reproductive system

Agriolimacidae are hermaphrodites. Their gonad produces gametes of both sexes, not simultaneously however. A tendency to protandry occurs. Some species are capable

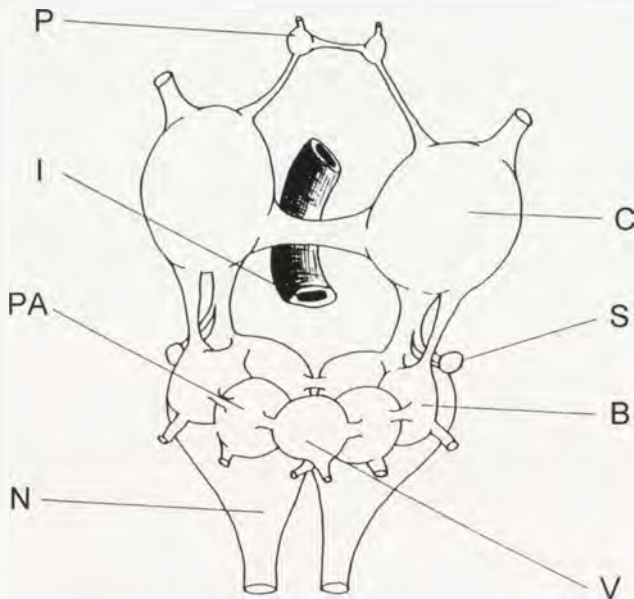


Fig. 23. Central nervous system (= brain) in Pulmonata: B – pleural ganglion; C – cerebral ganglion; I – oesophagus; N – pedal ganglion; P – buccal ganglion; PA – parietal ganglion; S – statocyst; V – visceral ganglion. (After Likharev and Wiktor 1980)

of uniparental reproduction by self-fertilization and parthenogenesis. This capability, however, seems to be typical only of a few species of *Deroceras*. It is unknown if slugs belonging to other genera of Agriolimacidae have it as well. The ability to reproduce uniparentally represents an enormous facilitation in extending the distribution range and establishing initial populations. Presumably, thanks to it, some species have spread world-wide. Populations originated from

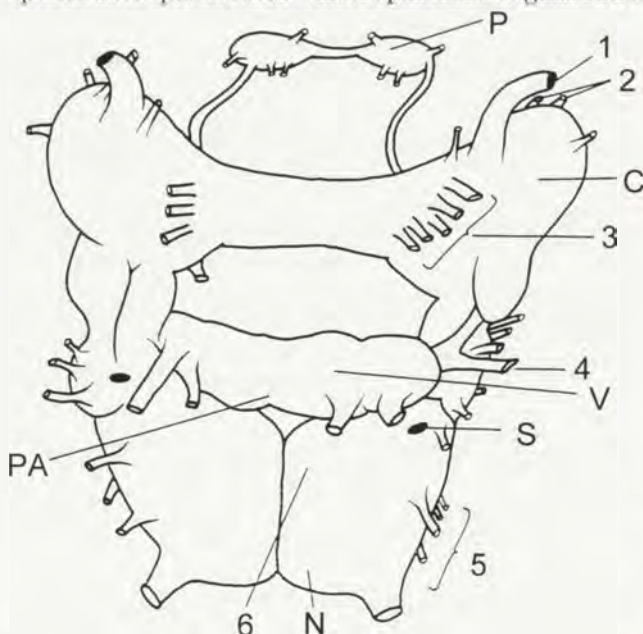


Fig. 24. Central nervous system (= brain) in *Deroceras reticulatum*: C – cerebral ganglion; N – pedal ganglion; P – buccal ganglion; PA – parietal ganglion; S – statocyst; V – visceral ganglion. (After Likharev and Wiktor 1980)

a single colonizer, which become clones with all genetic consequences, create tremendous difficulties to taxonomists.

Like the rest of the reproductive system, the gonad is of ectodermal origin (Laviolette 1950a, 1950b, 1954; Luchtel 1972a, 1972b; Kubrakiewicz 1985). It cannot be excluded, however, that also cells of mesodermal origin migrate into the developing reproductive system (Hochpöchler 1979, Runham 1982). Its ontogenetic development starts with formation of a concavity in the anterior part of the embryo. In the beginning it is a pocket, which further transforms into a blindly terminating canal. On this blind termination a protuberance which gives rise to the gonad appears.

In adult specimens the gonad (glandula hermaphroditica) is a relatively large organ, situated in the posterior part of the viscera. It differs from the liver in its colour and external structure, as the acini which build it look like a cluster of spherical bubbles (Figs. 6–7). When the slug is dissected, the gonad is most often easily noticeable for it usually lies between the lobes of the liver, only in a few species being hidden beneath them. In maturing specimens the gonad usually constitutes the terminal section of the viscera and is light creamy in colour. When it starts functioning, it gradually assumes a brown or even black colour. Simultaneously, it changes its position, shifting anterad to the region of rectum. In the phase of male sexual activity the gonad is conical in shape and particularly large, gradually decreasing in size with progressing development to finally become a small leaf-shaped structure. The gonad is built of round acini. In each of them both spermatozoa and ova are produced. Apart from pregonial and gonial cells, the gonad contains also trophic cells (trophocytes), which are the first to differentiate. Afterwards oocytes and then spermatocytes appear. Since the latter develop faster, the gonad first produces spermatozoa, which is a typical example of protandry. Later on, both male and female reproductive cells are produced simultaneously, and in the final stage of sexual activity only eggs. Spermatocytes and spermatozoa concentrate around huge trophocytes (the Sertoli cells). Oocytes are accompanied by small follicular cells, which surround them to form follicles. When an egg cell is mature, the follicle breaks and the egg is released.

Gamets pass through narrow ducts to a common hermaphrodite duct (ductus hermaphroditicus) which carries them anterad (Figs. 26–27). Sometimes male cells fill the duct, which is then swollen and white in colour. Most commonly the hermaphrodite duct is partly coiled, gradually broadening and winding between the liver lobes. In its anterior section the hermaphrodite duct joins a complex organ which more anteriorly turns into a spermoviduct (spermoviductus) and albumen gland (glandula albuminalis = glandula albuminea). In the same region an inconspicuous vesicular organ of vesica seminalis opens (Figs. 26–27). Starting from this point the reproductive organs divide into the female and the male part. Complex processes leading to fertilization of eggs take place in this transitional section. In the case of cross-fertilization an arriving ovum is awaited by spermatozoa obtained from the partner which are stored in

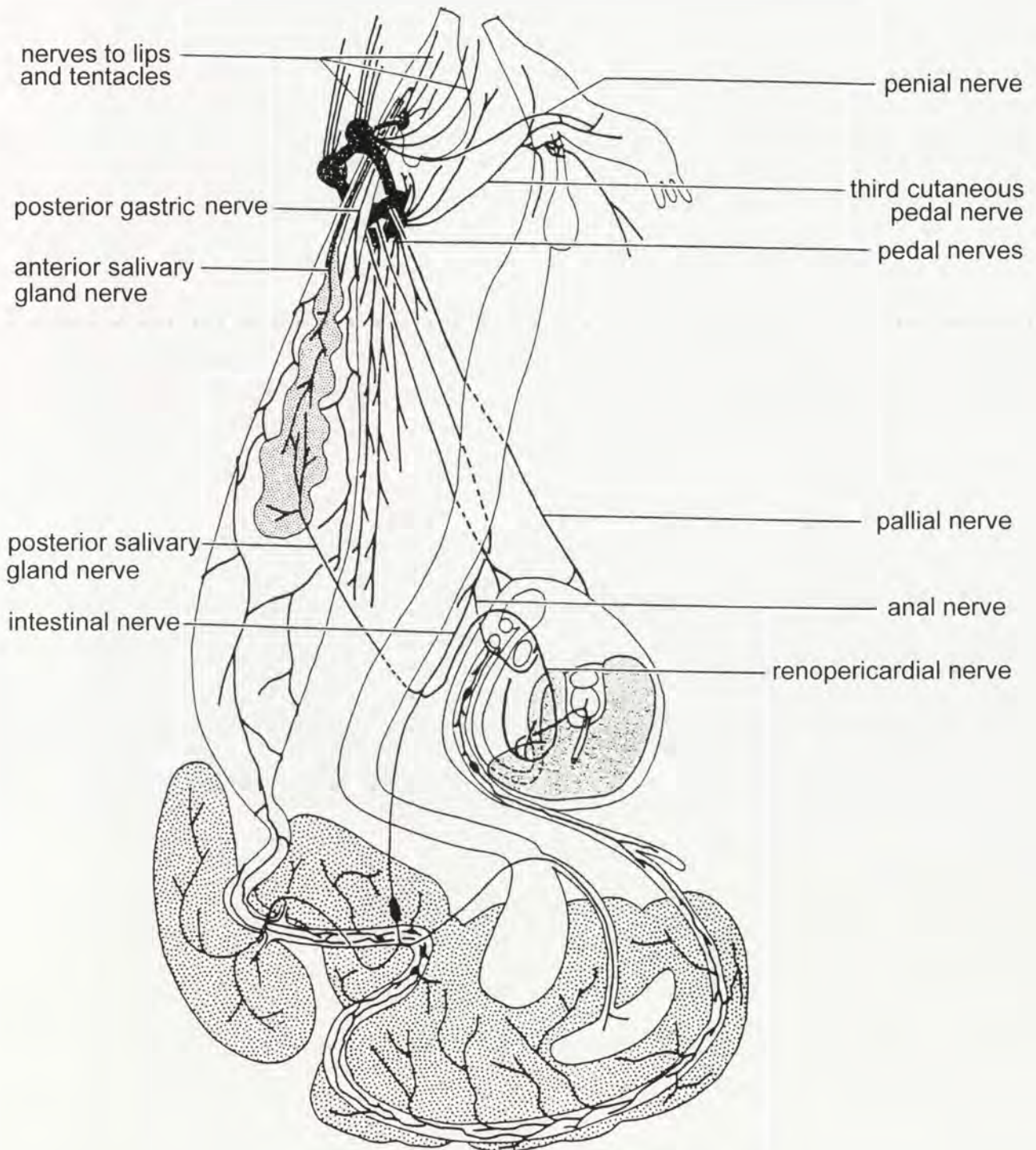
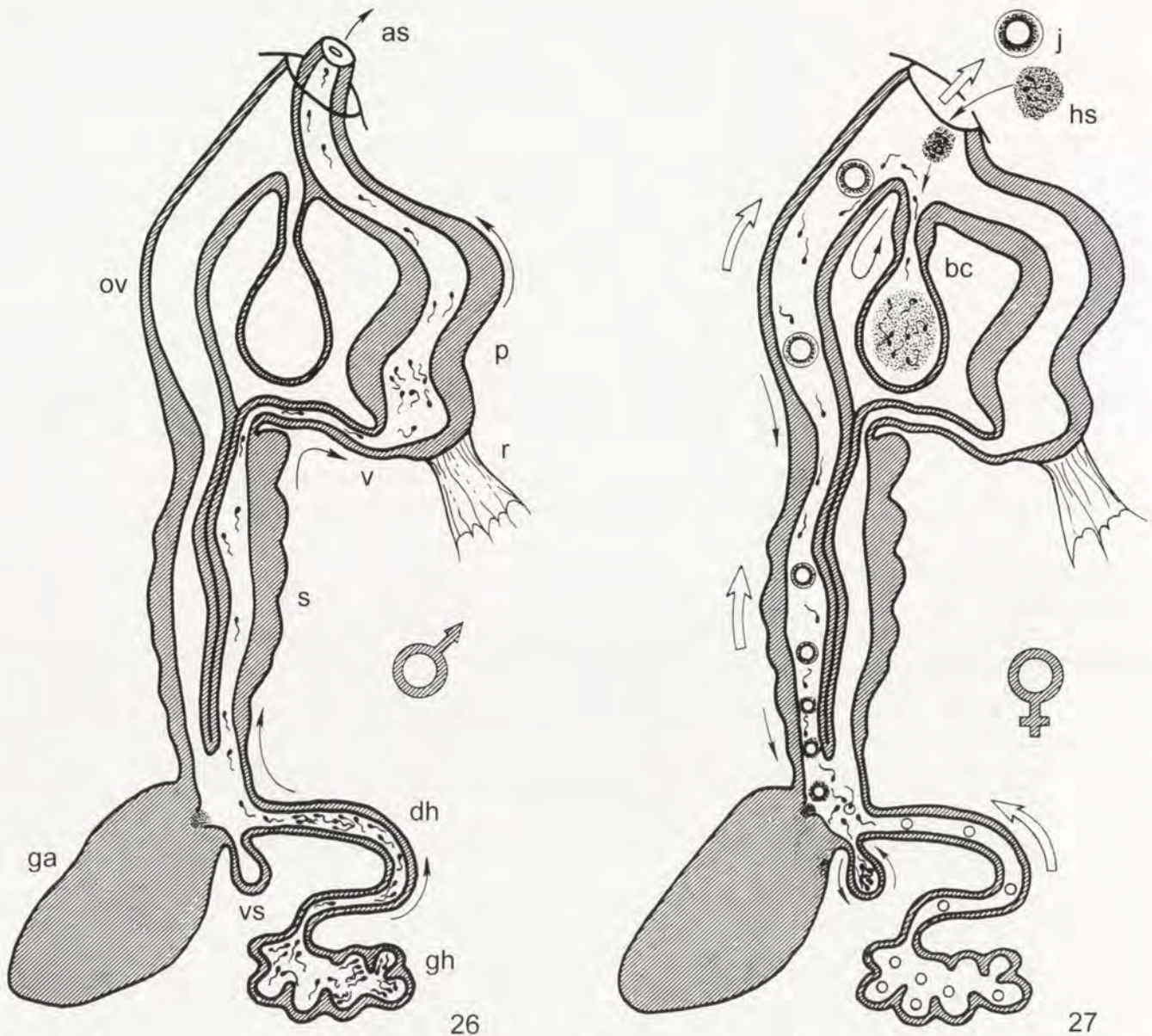


Fig. 25. Nervous system of *Deroceras reticulatum*. (After Walker 1969, Laryea 1970, Garner 1970 – from Runham and Hunter 1970)

vesicula seminalis. It is also in this transitional section that a fertilized egg (zygote) is surrounded with a secretion produced by the albumen gland which thus provides the egg with an envelope.

Seminal vesicle (vesicula seminalis) is not always well-visible during dissection. Its size and coloration depend on the extent to which it is filled with spermatozoa.

Glandula albuminalis is a lobular organ. Its size changes depending on the phase of sexual activity. When only male reproductive cells are produced, the albumen gland is still small. It reaches its maximum size in the phase during which ova are produced. This change in size is reverse relative to that of the gonad. This makes it easy to recognize the phase of sexual activity of the slug. The gonad being large and



Figs. 26–27. Reproductive system. 26 – The way of spermatozoa in the giver. 27 – The way of spermatozoa and ova in the receiver. as – penial opening through which spermatozoa of autosperm leave the reproductive system of the giver; dh – ductus hermaphroditicus; ga – glandula albuminalis; gh – glandula hermaphroditica; hs – sperm (heterosperm) from the partner; ov – oviductus; s – spermoviductus; p – penis; r – musculus retractor penis; vs – vesicula seminalis. (After Wiktor 1989)

glandula albuminalis small indicates that the individual is in its male phase of reproductive activity. When the situation is reverse, the slug is surely in the female or postclimacteric phase of reproduction.

Spermoviduct (spermoviductus) is a double duct, although it is not clearly visible from the outside. Its parts differ in the degree to which the wall surfaces, covered by glands, are folded. The male duct serves exclusively to carry away the slug's own spermatozoa (autosperm). This is the way they proceed to vas deferens and farther to penis through which they are transferred to the partner during copulation (Fig. 26). The glands of this section of the spermoviduct, though of varying types, are usually called prostate.

The female canal of spermoviduct is the way through which a zygote, enveloped with the secretion of glandula albuminalis, is removed. During this process the glands situated in the walls of this duct produce the other layers of egg envelopes and the coat. There are several layers of envelopes, which provide the embryo with nutritive material. Crystals of calcium, needed by the developing slug – e.g. – to build the protoconch which is the embryonic shell, are also deposited in the envelopes. To provide eggs with calcium involves a great effort. Sometimes even as much as 40% of the metabolized calcium, including that from the parental shell which is partly dissolved, is lost with eggs (Fournie and Chétail 1982). The female duct is also the way through which

spermatozoa coming from the copulation partner (allo-sperm) flow. They move unaided into the vesicula seminalis, and thus in the direction opposite to that taken by the eggs (Fig. 27).

Anteriorly each of the canals composing the spermoviduct separates from the other one, the male duct becoming vas deferens and the female duct – oviductus. Vas deferens is a thin canal which first runs anterad, and further, having bent, in the opposite direction along the penis. It opens into the latter organ usually near its hind end.

Both the external and internal structure of penis differ depending on the genus (Fig. 28). The organ is often pigmented, especially posteriorly. In most genera the penis assumes the shape of a fleshy bag with various swellings and protrusions, and is usually additionally equipped with various types of accessory organs. This bag-shaped penis occurs in *Deroceras*, *Furcopenis*, *Lytopenelte* and *Krynickillus*. In *Megalopelte*, when extended, the organ is tubular, posteriorly strongly narrowing, anteriorly bent; both parallel parts bound together by muscular fibres. In *Mesolimax* the penis is cylindrical, worm-like elongated, its appearance different than in other genera of Agriolimacidae. In all members of the family musculus retractor penis is present, and it is attached in the penis posterior part usually near the vas deferens outlet. The appearance of this muscle varies, but its posterior insertion is always single and situated beneath the vestigial shell. Only in *Mesolimax* the retractor muscle is pierced by the rectum, which results in the presence of two insertions. Anteriorly the muscle is fairly often branched, having two or more strands, but all those offshoots are attached to the penis or its accessory organs. Most commonly retractor penis attaches to the posterior penial wall, sometimes producing an offshoot also to the organ's anterior section. In *Furcopenis* one of the muscle's

branches is attached to the glands of an organ which occurs beside the proper penis. All genera have their genitalia anteriorly equipped with small strands of retentor muscles that connect them to the lateral body walls.

The accessory organs associated with penis include glands of various types. Some of them are situated in penial walls, some are clearly distinguishable as separate organs. The penial gland of the genera *Deroceras* and *Furcopenis* is particularly large and variedly shaped. Most commonly it is set apically, though usually asymmetrically. In some species it constitutes a small nodule whereas in others a whole system of tree-like branching twigs or a tuft of digitate finger-shaped processes. The penial gland gets everted during courtship and copulation. In *Lytopenelte* the penial gland seems to be stuck in the penial wall; in the remaining genera (*Megalopelte*, *Krynickillus*, *Mesolimax*) the organ is lacking.

In *Deroceras* there are often various types of pockets, swellings or appendices in the posterior section of penis. The walls of those protuberances hold glands, but their role is probably connected with courtship as well. The function of the narrower bent part of penis in *Megalopelte* is unknown. The stimulator-bearing anterior part of penis in the slugs (*Deroceras*, *Lytopenelte*) usually has a lateral swelling, which results in the organ being asymmetrical. It is particularly well-visible in *Deroceras samium* (Fig. 603). Most frequently this swollen lateral pocket has its surface granulated thanks to the glands occurring in the thus thickened penial wall. In *Furcopenis* there is a single or double additional structure, equipped with its own glands and own ducts on the apical end. The role of these glands and that of the muscular fibres connected with them is unknown. Finally, another exceptional additional accessory organ is the tubular membrane surrounding the penis along with vas

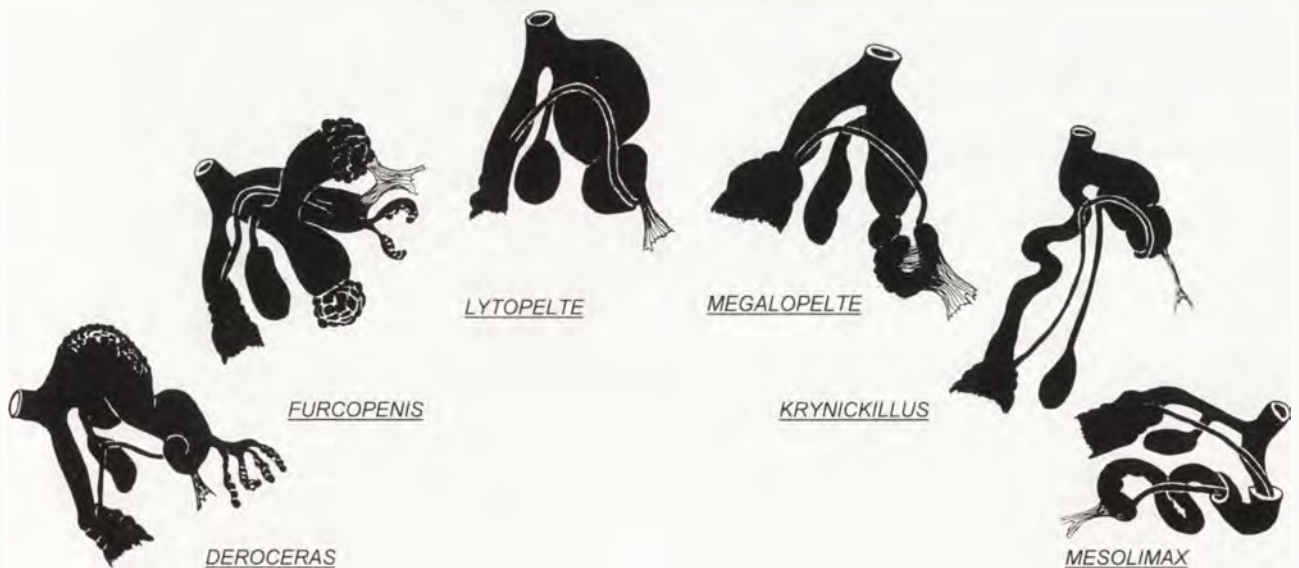


Fig. 28. Diagrams of copulatory organs in different genera of Agriolimacidae. (Orig.)

deferens in *Mesolimax*. Its function is unknown. It can only be presumed that the membrane plays some role during mating dance or copulation.

The structures inside the penis are also complex (Fig. 29). In *Deroceras* and *Lytopenelte* a major part of the internal penial walls and those of the stimulator is covered by fine striae resembling fingerprints; in all Agriolimacidae folding of various type occurs. Apart from that, many species have variously shaped stimulators inside penis, which get everted during courtship. In some members of *Deroceras* the stimulator assumes the shape of a cone or a rounded papilla, whereas in others it is fan-shaped (Fig. 29) or represents a double lobular structure. In *Deroceras* (but only subgenus *Liolytopenelte*) and *Lytopenelte* there is a hard conchiolin plate impregnated with calcium salts, which grows concentrically. It is probably homologous with the concentrically growing plate in the penis of *Krynckillus* (subgenus *Toxolimax*). In the additional organ adjoining the penis and present in *Furcopenis*, there is either a conical or funnel-shaped structure which seems to perform a function similar to that of a stimulator. However, its different location and the co-occurring glands may testify to a different origin: this organ does not necessarily have to be homologous with the stimulator of e.g. *Deroceras*. In *Megalopenelte* inside penis there are two longitudinal, medially connected folds (Fig. 799). In *Mesolimax* distinct stimulatory structures are lacking.

Oviduct (oviductus) (Figs. 26–27) is a thick tube without any additional structures occurring internally or distinguishable from the outside.

Spermatheca (= bursa copulatrix) (Figs. 26–28) is composed of a spermatheca duct and a container which is the spermatheca proper. The border between these two parts is usually clearly perceivable only when the spermatheca is expanded with the partner's sperm (allosperm). Then the walls of the container become thin, and remain such even when there is no sperm inside any longer. In juveniles the whole spermatheca is tubular. The organ does not only serve to collect allosperm, but it is also here that male gametes become mobile and proceed unaided towards the opening of ductus hermaphroditicus, the excess amount being absorbed. The spermatheca duct joins the penis near the latter's junction with the oviduct. An exception is the genus *Mesolimax*, where this duct is connected to the oviduct (!) at a certain distance from the atrium.

The genital atrium (atrium genitale) is a short canal or a kind of funnel, into which both the oviduct and penis open. The first to get everted during mating dance and copulation is the atrium, then the stimulator (if present), and finally the penis which transfers sperm in the form of a clot of spermatozoa-containing secretion. The clot gets glued to the everted genitalia of the partner, and after copulation is invaginated inside the receiver. Accessory organs such as the penial gland or appendices undergo eversion, too.

1.2.10. Mucus and its role

In Gastropoda mucus is closely related with the mechanics of movement, and also with the morphology and functioning of particular organs.

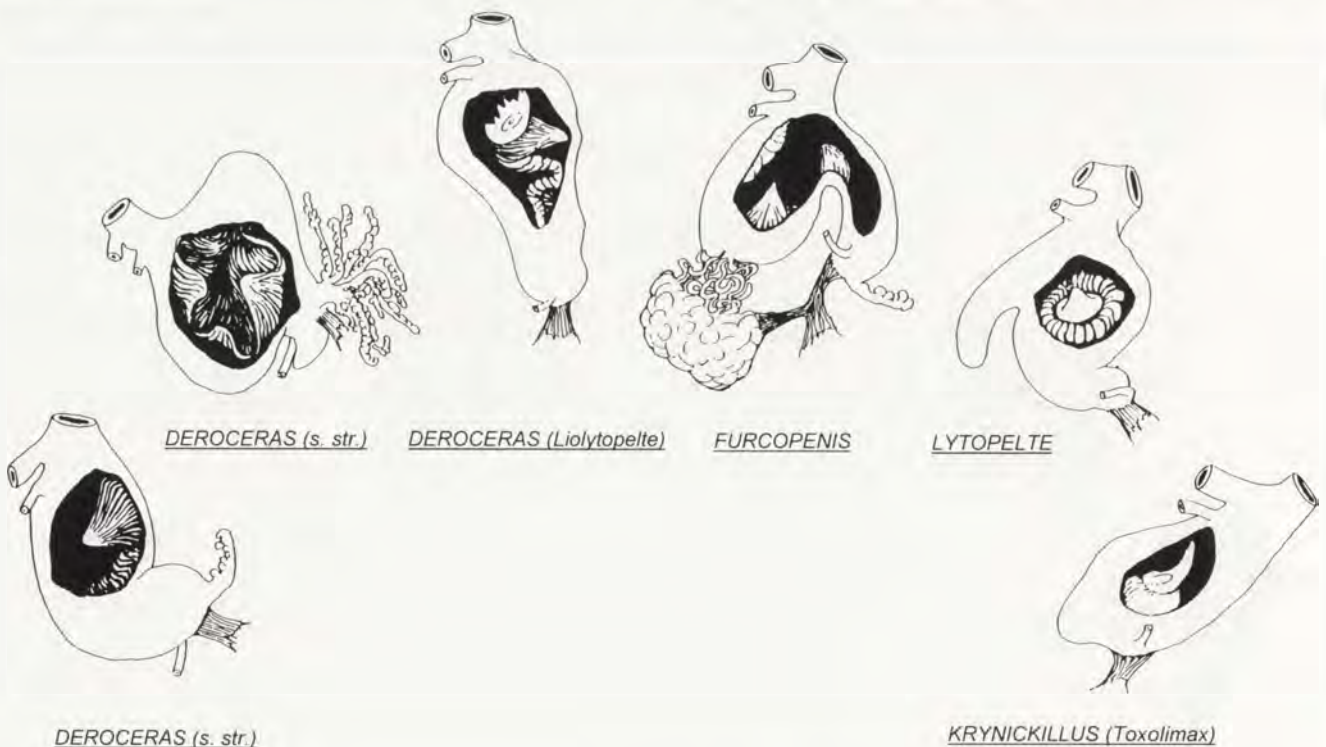


Fig. 29. Different types of stimulatory organs occurring in penis in Agriolimacidae. (Orig.)

The whole body of Agriolimacidae is covered by mucus. Keen observation of slugs in motion reveals that the mucus gets translocated along the whole body from its anterior part posterad. Having moved on the ground, a slug leaves a track. It results both from the mucus produced by the glands of the sole and also those situated in the skin of other body parts. Thanks to continual exchange and translocation of mucus, the skin is protected against getting dried or injured, simultaneously being incessantly cleaned, especially of fine particles of foreign bodies (soil and sand grains, dust). This transfer of mucus is an effect of the activity of the skin ciliary epithelium. The mucus is transferred posterad mainly through skin grooves, and at the posterior body end gets mixed with the sole secretion together yielding a track on the ground.

There are at least two kinds of mucus on the body surface. One is a thick secretion which covers the skin and protects it against drying, dirt, chemical factors etc. The other, similarly thick, mucus covers the sole and glues it to the ground. Both these secretions are colourless or slightly yellowish, but always transparent. When the slug is irritated, its body becomes covered by another type of secretion (more liquid) of protective or repellent character. In some species of *Deroceras* this substance is opaque, most commonly milky white.

The thickness of mucus varies between species of Agriolimacidae. In more agile slugs – as a rule, hygrophilous species – it is more liquid, often downright watery. It should be noted that mucus is of great importance for water balance of a slug. It both facilitates absorption of water from the environment and prevents its excessive loss.

1.3. Ecology and bionomics

1.3.1. Ecology

The ecological requirements of Agriolimacidae do not differ significantly from those of numerous snails inhabiting the same geographical zones. It bears evidence to the fact that nudeness not only does not pose an obstacle to living often under extreme habitat conditions but, on the contrary, it enables slugs to occur in habitats that are inaccessible to many snails. Sluggishness makes it possible to use a variety of hiding places which are well sheltered from external conditions, such as narrow rock crevices, soil cracks, chinks under stones, channels dug by other animals, tree bark peeling off, hollows of trees etc. Besides, slugs are more agile than snails. Thanks to these two adaptations, Agriolimacidae, like other slugs, can avoid being exposed to sudden changes of weather conditions or changes in air humidity during a day. It is also of crucial importance since they have to survive in milder microclimatic conditions the seasons that preclude activity. Under unfavourable environmental conditions, slugs find shelter in hiding places which they partly plug with mucus thus surviving drought periods, heat during a day, ground frost etc. They leave those places during condensation of mist and during rain, often returning to them before dawn.

1.3.2. Bionomics

Regrettably, available information on the ecology and bionomics of the family Agriolimacidae is very sparse. Slightly more is known of only few species of *Deroceras*, mainly *D. reticulatum* (very numerous authors), *D. sturanyi* (Kosińska 1980), *D. laeve* (scattered literature information), *D. praecox* and *D. rodnae* (Reise 1995), *D. panormitanum* (scattered data), *D. (Liolytopelte) caucasicum* (Uvalieva 1975, Rymzhanov and Schileyko 1991). These are the only slugs that have been more thoroughly investigated. Hardly anything is known about the other species, except for accidental observations made during field research. These data pertain mostly to the habitat, sometimes feeding or copulation.

Agriolimacidae are found in nearly all types of terrestrial habitats except for the nival zone in the mountains, deserts and saline environment. They are most common in open habitats such as meadows, idle land, cultivations, especially horticultural, rock rubble, neighbourhood of fresh water reservoirs and springs, etc. Some species have specialized to live in woodland, some occur in mountain habitats partly covered by shrubs and rock debris. Most frequently they choose humid and mesic, rarely dry, habitats. Some occur in wet and temporarily inundated habitats (*Deroceras laeve*). Nearly all are ground-dwellers and avoid climbing up tree trunks or other tall plants. The condition for their occurrence is a possibility to find hiding places protecting them from sun operation and getting dried.

Environments offering a wide variety of microhabitats are favourable for many species of Agriolimacidae. For that reason numerous slugs preferably colonize habitats destroyed or transformed by man, such as ruins of houses and old castles, cemeteries, gardens and parks, old rubbish dumps, glass-houses, vegetable warehouses, compost heaps etc.

A hindering barrier to their occurrence is without doubt friable sandy soil. Grains of dry sand stick to mucus irritating the skin, which results in excessive secretion of mucus etc. It must be for this particular reason that desert and semidesert areas are completely devoid of slugs. It is also impossible for slugs to bear high salinity of the substratum, both in maritime region and in the neighbourhood of desiccating lakes. Besides, they avoid acid soil and therefore they are absent e.g. from peatbogs.

These are zones of mild temperate climate close to warm, such as the Mediterranean, which are the most abundant in Agriolimacidae species. In this type of climate active slugs are encountered throughout a year. In zones with frosty winters or longer spells of seasonal drought only highly specialized species of short life cycles occur in general. They can survive the most unfavourable period only in the form of eggs. The most preferred substratum are heavy clay soils, especially those with a high calcium content. Such a substratum guarantees the possibility of hiding in the soil (even in a cultivated field). When the habitat offers other opportunities to hide, such as stones, wood pieces, ruins, drain-pipes,

composts, leaf litter etc, the character of the substratum is less important.

Temperature is a very significant factor. Slugs poorly tolerate overheating over 30–35°C, or cooling below –3°C or –3.5°C (Pinder 1969, Stephensen 1968). These temperatures seem to be lethal for all Agriolimacidae. It is also worth noting, however, that such extreme temperatures are rarely dangerous to slugs as they do not reach the animals' hiding places. Optimum temperatures for species occurring in Central Europe range between 10°C and 20°C, which is testified to by their activity (Lusis 1966, Smith 1966, Dmitrieva 1969, Pinder 1969, Runham and Hunter 1970, Kosińska 1980). The temperature optimum for foraging recorded for *Deroceras reticulatum* is 15–17°C, for egg-laying ranging between 10°C and 15°C. A longer period of temperature drop to 10°C results in cessation of the gonad growth. Eggs and embryos are markedly less susceptible to low temperatures than hatched slugs. Even a two-day period of temperature of –10°C causes no disturbance in the subsequent development of the embryo in *Deroceras reticulatum*, whereas young individuals die already after 48 hours when the temperature has fallen to –3.5°, a temperature of –4.5°C killing them after a mere 12 hours. Observations reveal that snails better tolerate chill than slugs.

Temperature certainly influences the rate of embryonic development. Higher resistance of the egg and embryo to low temperatures and the possibility to prolong the embryonic development when the air temperature is low are perfect advantages which help a slug survive winter. The longer the cold period, the longer the development takes, young slugs hatching with the start of spring. In the case of widely distributed slugs, which inhabit different climatic zones, the features mentioned enable them to adjust the life cycle to the local weather conditions. Where the vegetation season is longer, several generations can be produced per year, whereas in the regions where the "thermal summer" is shorter, slugs lay eggs only once. In *Deroceras agreste*, for instance, the development lasts for 3 weeks at a temperature of 20°C, extending to 4 weeks at 15°C, to 10 weeks at 10°C and as many as 98 days at 5°C (Carrick 1942).

Another factor incredibly important to slugs is air humidity and humidity of the substratum. Their body is more hydrated than that of snails, mucus being the only protection against intense evaporation. As emphasized already, the whole locomotion is dependent on the body fluids, their amount and translocations determining the pace of the animal's movements. In general, all slugs have a fairly wasteful water management. In order to prevent water loss by evaporation, they hide in narrow shelters, where the small space becomes quickly saturated with vapour. Slugs have an amazing ability to lose water and acquire it again (Künkel 1916, 1934; Kerkut 1959; Arias and Crowell 1963, Bayne 1968). Some can lose even as much as 80% body mass without any harm. *Deroceras reticulatum* can lose 1/2 its body weight with no permanent damage. Obviously, although having a chance to survive, an animal dried to such an extent cannot move without difficulty. Such a situation often

arises e.g. when a slug has failed to reach its shelter before daybreak. However, it can be saved from drying out by rain, dew or a substantial increase in air humidity. Slugs absorb water with the whole surface of their body like a sponge, thanks to which they can regain their ability to crawl. They usually avoid low humidity, moving preferably when it reaches 90%. That is why most of them are active only at night (Fig. 30). When it is misty or rainy, however, they display their ordinary activity also in the day-time, but still avoiding sun rays falling directly onto their body. When dew appears at night one can watch slugs leaving their hiding places and starting their active life with making up for the loss of water. It takes place during a "bath" in a dew drop which is absorbed through the skin, licked, or simply drunk (Kosińska 1980). Different species have varying requirements concerning humidity, which is associated with the mucus thickness. Hygrophilous forms (*Deroceras laeve*, *D. (L.) moldavicum*) have a more watery mucus whereas that of mesophilous species is distinctly thicker.

Drowning poses a serious danger to many species. It occurs during river floods, torrential rains, spring thaws etc. Yet, some slugs cope with it. I happened to catch with a net *Deroceras laeve* from the bottom of a water reservoir a few dozen centimetres in depth. It should be added, however, that it was in springtime and the water temperature was very low. The slug mentioned moves under water with great agility, easily resorting to flight onto leaves of grass for instance. Other *Deroceras* species do not have such capabilities in this respect and, not having succeeded to escape, they drown. Besides, eggs (e.g. of *Deroceras sturanyi*) sunk in water can still develop. Their development is only somewhat

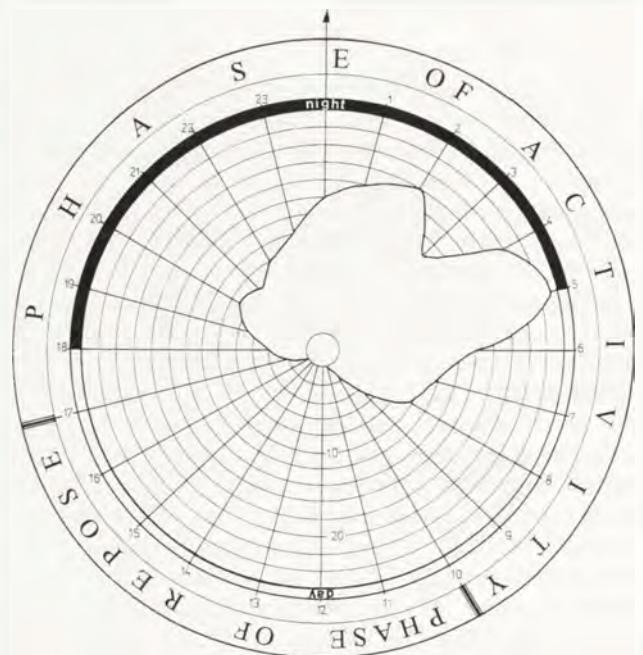


Fig. 30. Diurnal activity in *Deroceras sturanyi*. (After Kosińska 1980; slightly modified)

slower, the hatching juveniles emerging easily onto the surface (Kosińska 1980).

1.3.3. Life cycle

Although our knowledge of the life cycle in Agriolimacidae is fragmentary and concerns only some members of the genus *Deroceras*, it seems that in all species it is short, not exceeding a dozen or so months even under optimum conditions, e.g. in laboratory culture. This makes an interesting point as in natural conditions the life span is often determined by the onset of unfavourable season, i.e. with ground frosts lots of slugs die having previously laid eggs. In laboratory conditions their life can be prolonged by several months and their reproductive phase is extended as well. In such a situation slugs die "of old age", which under natural conditions may not happen or is exceptional. In general, Agriolimacidae live for about a year (Luther 1915, Kosińska 1980, Likharev and Wiktor 1980, Wiktor 1989). Under optimum conditions the embryonic development lasts for 2–3 weeks but this period can be increased to at least 227 days. The development threshold equals about 4°C. So far, various species are known to have their own specific rate of development, growth and maturation influenced by thermic conditions. The individual life span depends mainly on the living conditions of the slug (ample data and references on the issue available in South 1992).

Agriolimacidae (probably all) have an ability to adjust their life cycle to local environmental conditions. A close correlation between the rhythms of climatic seasons and active life seems to exist in all species. The stage to survive the most unfavourable period is the egg. When the conditions reach the critical state, adult slugs lay eggs and die. This happens so, for instance, in temperate climate during late autumn cooling and ground frost. The eggs are buried in soil or other hiding places, e.g. under stones. The rate of the embryonic development depends on the ambient temperature (see above).

Both eggs and the developing embryos more easily tolerate a drop in temperature than adult specimens. The same concerns water deficit, etc. It allows to adjust the periods of hatching and active life to favourable seasons and ensures greater comfort of living in better abiotic and trophic conditions. In more favourable geographical zones within the distribution range such a strategy also makes it possible to repeatedly lay eggs and sometimes to produce several generations within the vegetation season (Figs. 31–32). Hence, one or more generations of the same species within a vegetation season can be found. In the latter case slugs at different ontogenetic stages co-occur. In climatic zones of mild winter it often happens that young slugs appear in late autumn. If this is the case and the environmental conditions are favourable, the juveniles survive the winter and reach maturity in the spring. Thus, the life cycle may be dependent solely on the environmental thermics or, perhaps, also on the soil moisture, precipitation etc. The situation must be similar with the species inhabiting the

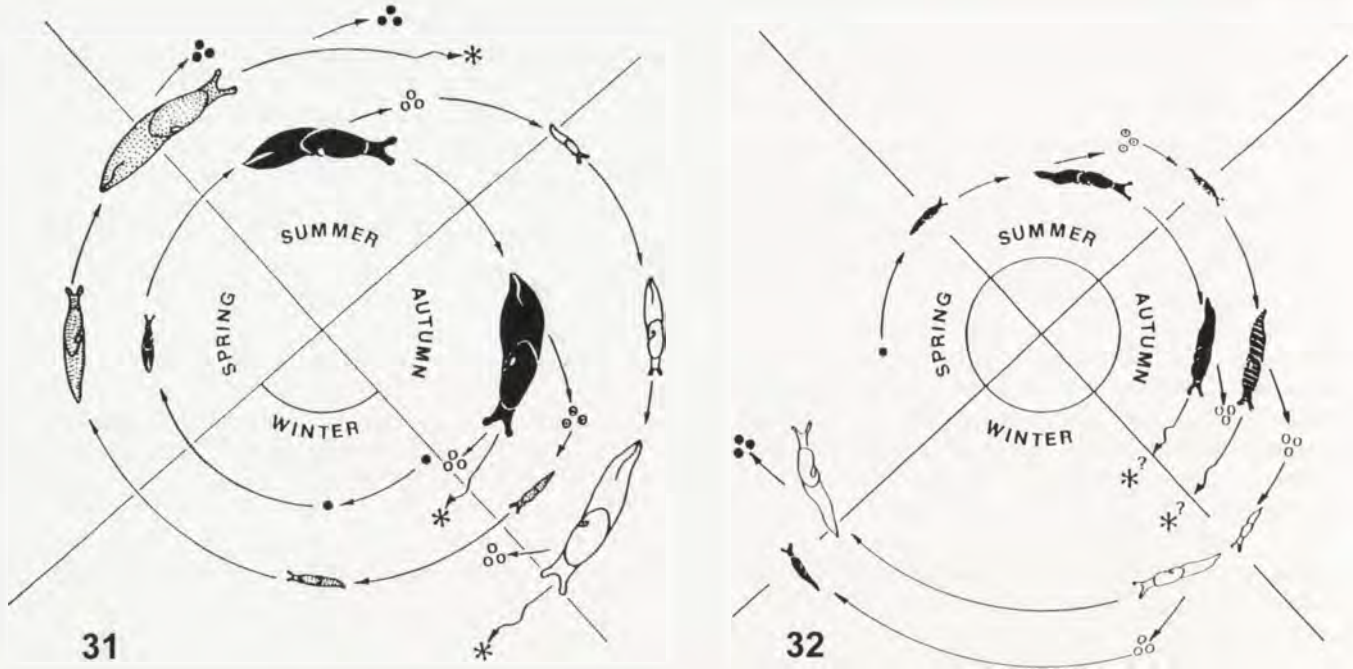
Mediterranean, but this it is not winter but dry summer that is the most difficult to survive.

Some species, however, clearly display seasonality of reproduction. It points out to the fact that reproductive seasonality is genetically encoded in all Agriolimacidae and only modified by environmental conditions. A great part, if not most, of the species reach maturity in summer, and at the end of this season and in autumn mature specimens are observed copulating and reproducing. Among the slugs whose life cycles are known *D. praecox* and *D. rodnae* are distinguishable (Wiktor 1989; Reise 1995, 1996a, 1996b). The former matures in spring and adult, reproducing, specimens are recorded as early as April. The situation is similar with the latter species but in this case, although adult individuals are encountered already in spring, the main phase of reproduction falls in late summer and autumn. Observations carried out by Welter-Shultes (1998) on the Greek island of Gavdos revealed that an endemic *D. gavdosensis* had a very short period of active life, adjusted to the most humid season; eggs are laid prior to a long drought and they are drought-resistant.

Another exceptional species is *D. laeve*, which under favourable conditions reproduces throughout the year irrespective of the season. Usually, individuals representing different ontogenetic stages co-occur during a whole year (Fig. 31). Moreover, *D. laeve* is the only species which, in favourable conditions, is able to complete its life cycle within a mere 6 weeks. At room temperature young slugs hatch after 14 days, and already after subsequent 4 weeks adult individuals lay eggs (Nicklas and Hoffmann 1981). This cycle can probably be shortened, and certainly extended considerably. This exceptional plasticity typical of *D. laeve* is undoubtedly the main reason behind the slug having the most extensive geographical range in the family and also an incredible predisposition to spread in various climatic zones where it lives as a synanthrope and is often introduced to.

1.3.4. Ontogeny

A fertilized egg, usually containing an embryo at early stages of development, leaves the reproductive tract. On an average, an embryo needs ca 3 weeks to develop, depending on temperature and species (see above). Like in all other gastropods, the cleavage is spiral. A few stages of development can be distinguished (Carrick 1938, South 1992). At early stages, following invagination, typical flame cells appear to perform the function of excretory organs. Further, a large endodermal lobe of liver develops, which serves to assimilate reserve material, i.e. protein. In subsequent stages a pulsing structure, called podocyst (= posterior sac = foot vesicle) appears. It is a sac which develops as a protuberance of the posterior part of the embryo. The pulsation of this organ and of the liver lobe ensures blood circulation in the embryo. The podocyst serves also as the embryo's respiratory organ. Its movements are well-visible through the egg envelopes. Gradually, an anterior sac (= visceral sac = hepatic lobe), with primordial viscera



Figs. 31–32. Life cycle. 31 – *Deroceras laeve*. 32 – *Deroceras reticulatum*. (After Wiktor 1989)

(liver, albumen gland etc), foot, mantle and tentacles can be distinguished within the embryo. In the following stages the podocyst undergoes gradual reduction, the embryo slowly assuming the appearance of an adult slug with an embryonic shell in the mantle, tentacles, foot etc (Runham and Hunter 1970, South 1992). With the development of the embryo the egg envelopes can change their colour and become turbid. Young slugs move for some time within the envelopes, then bite through them and get out. In some species, e.g. *D. laeve*, the hatching is synchronous and all slugs from the same clutch leave eggs within 1–2 hours (Nicklas and Hoffmann 1981). In others this can be extended to a longer period, even to a week (Luther 1915, Dmitrieva 1968, Uvalieva 1975, Kosińska 1980). The hatchlings remain for a certain time at the hatching place, gradually eating up the remains of egg envelopes. In the case of asynchronous hatching, the individuals that have hatched earlier often damage neighbouring eggs which still contain embryos or already formed juveniles. They probably treat other eggs as food. It is unknown whether this phenomenon has any selective significance. It may accelerate hatching of the young from the damaged eggs. If an egg contains a juvenile advanced in development, the individual leaves the envelopes as a “prematurely born child”. Since it has already been formed, it often succeeds to survive, despite being smaller than usual. If the envelopes still contain an embryo, the latter dies (Kosińska 1980). Sometimes two or a few embryos develop in one egg, which constitutes a kind of cocoon. It originates in two ways: either from a multinuclear egg or a few eggs having one envelope (Kosińska 1980 see below – reproduction). From such polyembryonic eggs-cocoons a few slugs

can hatch and, although they are smaller than usual, their further development is normal. They often hatch asynchronously: the largest sibling leaves the egg envelopes as first, thus making the others exposed to danger.

Young slugs grow quickly feeding on the same food as the adult ones and behave alike. Juveniles may differ in coloration from adult slugs. Spotting – if typical of the species – appears late, i.e. in maturing specimens. Sometimes juveniles are spotted whereas adults are entirely black. It seems, however, that the situation can sometimes be reverse. This results in a serious hindrance to field researchers and taxonomists as juvenile specimens of most species are completely indistinguishable. There are no other differences between an adult and a juvenile slug except those in coloration and size. The latter grows until the stage of sexual activity has been reached. The growth is stunted in the reproduction phase, which is probably humorally controlled, and the whole food the slug consumes is used for gamet production and for providing them with nutritive material. When the gonad has exhausted its reserves of gametes and the slug is still alive, a second phase of growth can occur. Such postclimacteric specimens sometimes attain a giant size (Kosińska 1980), but their behaviour is normal. The situation is similar as in the case of parasite-castrated snails, whose body and shell also grow to an unusually large size. In this second growth phase the gonad is tiny, chocolate or black in colour, while the albumen gland huge and white-coloured. Such slugs may sometimes lay eggs but nothing hatches from them (see below). Natural death is preceded but decreased mobility, cessation of feeding and gradual body diminution which is an effect of “slimming” as the lack

of a stiff skeleton leads to the whole slug becoming smaller. This is most frequently accompanied by a change of colour, the whole body getting darker.

1.3.5. Reproduction

Age at which sexual maturity is attained depends on the species. For example, in laboratory culture *D. laeve* lays eggs as early as after 4 weeks after hatching (Nicklas and Hoffmann 1981), whereas *D. rodnae* and *D. praecox* as late as after 180–210 days (Reise 1995). All Agriolimacidae are hermaphrodites. Outcrossing, in which spermatozoa come from a different specimen than ova, is a commonly recorded phenomenon. Some species, however, reproduce uniparentally. This type of reproduction was observed in *D. laeve* (McCracken and Selander 1980; Nicklas and Hoffmann 1981; Folz, Schaitkin and Selander 1982; Hoffmann 1983), *D. rodnae* and *D. praecox* (Reise 1996b). Slugs of the latter two species lay eggs earlier, i.e. at a younger age – if they have outcrossed, and later – when the reproduction is uniparental (Reise 1996b). This observation is indicative of uniparental reproduction being forced by lack of opportunities to copulate. Electrophoretic analysis of wild populations confirms that outcrossing is the common type of reproduction (Reise 1996b).

The structure of some natural populations points out to the possibility of self-fertilization existing alongside outcrossing. Another type of uniparental reproduction, namely parthenogenesis, commonly occurs in *D. laeve*. Moreover, it often repeats through many generations. In this species partial or complete reduction of penis is often observed (see p. 463). The presence or absence of male genitalia has been found to depend on the development conditions: temperature and photoperiod. Thus the environmental conditions may determine the mode of reproduction. Except for the ones mentioned, no other agriolimacid species has been reported to reproduce uniparentally.

Copulation is preceded by courtship. The two most commonly take place at night or after rain when both the air and soil humidity are high. Several phases can be distinguished in the whole process (Wiktor 1966; Kosińska 1980; Rodríguez 1985; Wiktor 1989; Rodríguez, Castillejo, Outeiro 1989; Reise 1995; Reise 1996b). It starts with recognition of the partner (Figs. 33–36). A slug which encounters another one or finds its mucus trail can get interested. Having approached the possible partner, the animal tries to lick its mucus, for instance from the posterior end of the crawling individual. This is surely aimed at recognizing the partner's species identity and its possible readiness to reproduce. The other individual can react to those licks with reciprocal interest, and then the two slugs taste each other's mucus usually assuming opposite positions, i.e. arching right, they reach with their mouth to the posterior end of the partner. They slowly move around one point, gradually covering the earth with mucus. This is the recognition phase. The effect is a mucus-coated surface which is going to be the stage of subsequent phases of mating dance and copulation. It may

happen that such an initial attempt is made by slugs representing different species which quit having recognized the mistake. Sometimes the "coquetted" individual does not respond to the courtship and escapes, or after the initial recognition phase retreats leaving the suitor. During this whole process, starting from joint preparation of mucus-covered surface, the slugs – at least *Deroceras* – nearly always remain in horizontal position. The partners make circles together for a longer time. It is usually as late as at this stage that the stimulators get everted, although sometimes it happens already in the initial phase of the encounter. Stimulator eversion may be simultaneous in both individuals, or delayed in one of them. Sometimes one of the mating slugs is observed to cease the dance as if leaving, but, making a circle, it returns to its partner. The "dancing" partners come so close to each other that their stimulators touch. It is unknown what happens at this stage, which is the longest one. Probably, apart from recognition, the slugs exchange substances stimulating the release of spermatozoa and their migration to penis. This would constitute the stimulation phase, which can last for several dozen minutes. The subsequent phase is very short, taking merely a minute, and this is the copulation proper which consists in mutual transfer of a sperm portion in the shape of a clot of thick jelly-like substance yellowish in colour (Fig. 33i). This is possible owing to abrupt eversion of the atrium and penis along with its gland, and other accessory organs if present. Then the slugs get together even tighter, sometimes rising, their skin covered by a milky white mucus. At this time the sperm clot gets glued to the everted organs of the partner, probably to the swollen atrium. According to Rymzhanov and Shileyko (1991), in *D. (L.) caucasicum* sperm sticks to the calcareous plate on the partner's stimulator, which is earlier cleaned by the slug. After the exchange of sperm, both partners remain motionless for some time, separating after a while. Before, they often eat the coagulated mucus coat on which the whole process took place. Later on, the copulatory organs with the sperm clot get retracted, that being the final phase. The duration of the whole process depends on ambient temperature. However, some observations (Gerhardt 1933, 1935, 1940; Wiktor 1960; Webb 1965; Kosińska 1980; Wiktor 1989; Rymzhanov and Shileyko 1991; Castillejo 1992; Reise 1995, 1996b) indicate that the duration of particular phases of courtship is species-specific. The courtship and its course, timing of its particular phases (Reise 1996b) probably prevent crossing of different species thus eliminating possible mistakes. At least, the literature does not report on the existence of interspecific hybrids. The course of courtship and copulation is known in a mere few species, and only in the genera *Deroceras* and *Furcopenis* (see Wiktor 1966 – *D. reticulatum*, Kosińska 1980 – *D. sturanyi*, Wiktor 1994 – *D. rethimnonensis*, Wiktor 1983 – *D. (L.) bureschi*, Rymzhanov and Shileyko 1991 – *D. (L.) caucasicum*, Rodríguez 1985 – *Furcopenis* sp.).

Eggs are laid after a few to several dozen days after copulation. As observed by Reise (1996b), *Deroceras*, at least some species, lay eggs repeatedly. Some can store

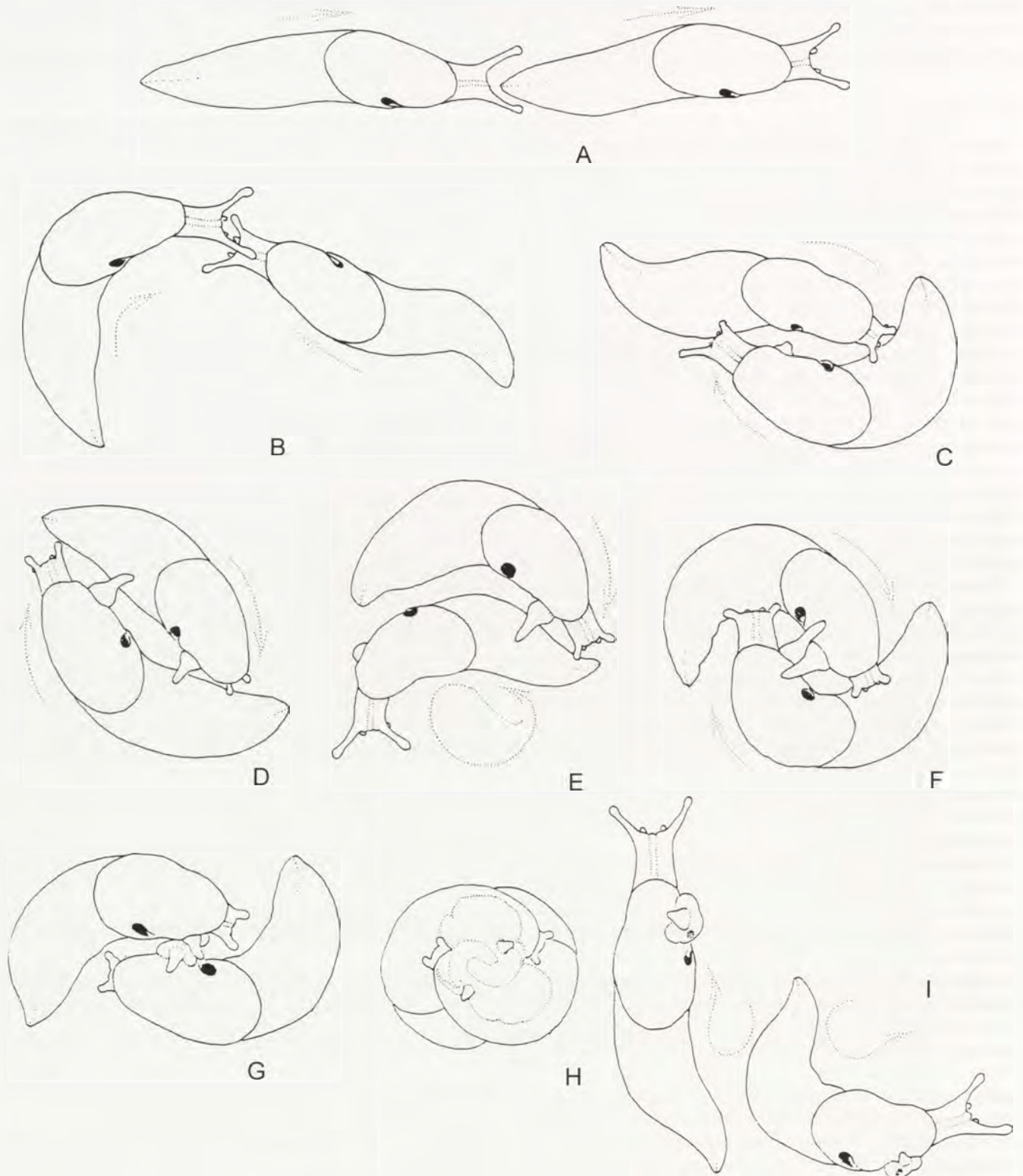


Fig. 33. Courtship and copulation in *Deroceras reticulatum*: A–B – recognition phase; C–G – courtship; H – copulation or exchange of sperm; I – disjunction of partners carrying away mucus clots containing sperm. (After Wiktor 1960)

allosperm, so each egg-laying need not be preceded by copulation. A slug is very careful when choosing a place for

laying eggs. Representatives of the genus mentioned most commonly lay eggs in the soil or detritus, less frequently

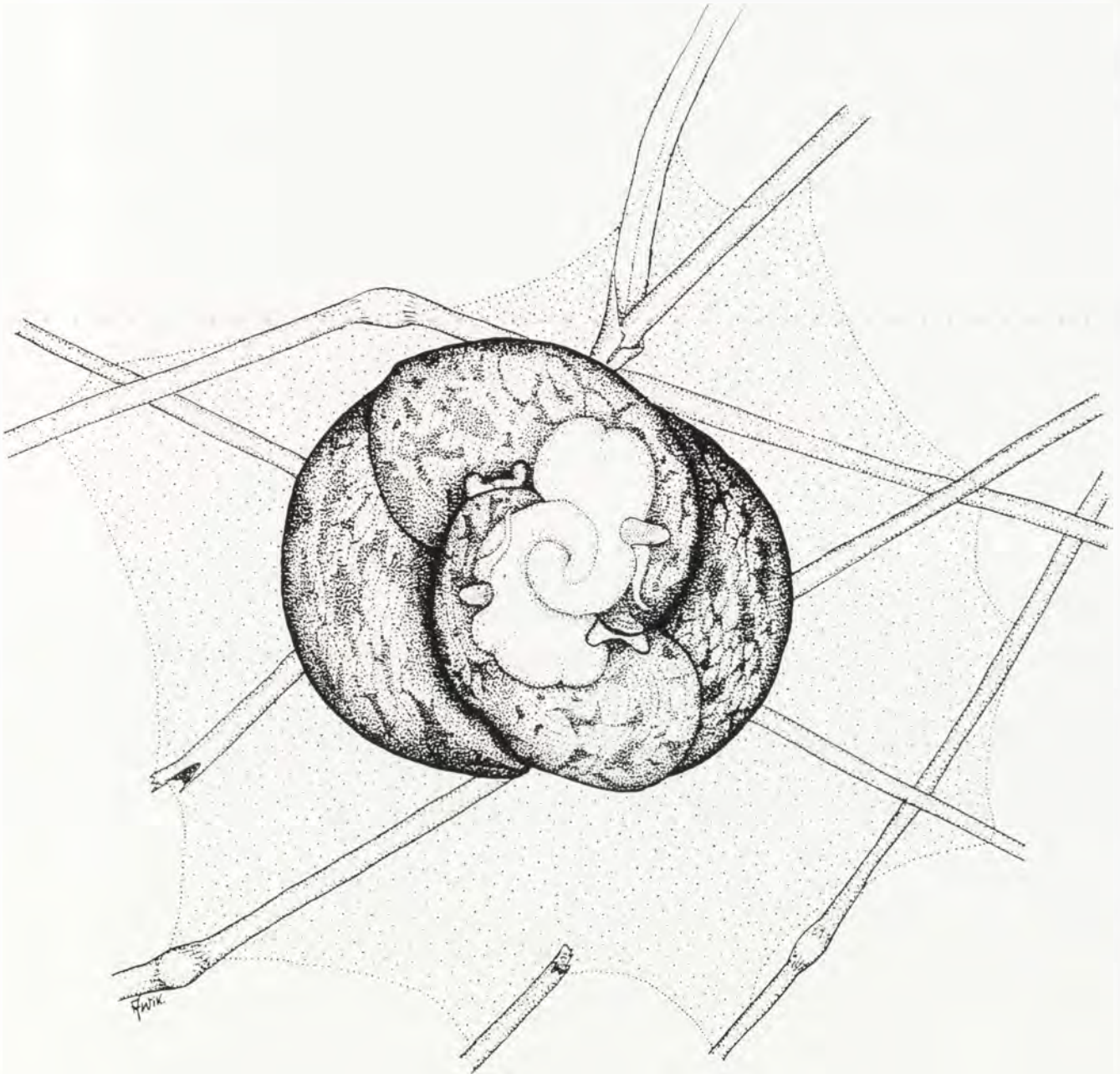


Fig. 34. Copulation (sperm exchange phase) in *Deroceras reticulatum*. (After Wiktor 1960)

under stones; nothing is known in this respect about species belonging to other genera. Having found a suitable location, a slug digs a hole with its head and the anterior section of foot, usually pushing aside soil particles. Eggs are always protected against sun operation. During egg laying the tentacles are invaginated, the animal being little susceptible to irritation or exposure to light. It takes a slug from several dozen seconds to a few minutes to lay an egg (Kosińska 1980). Most often an individual lays from a few to a dozen or so eggs, called a clutch, in one burrow. Clutches are usually laid at a few days' intervals. It is a rarer case that a slug lays

a mere one eggs or, crawling, "drops one no matter where". Eggs usually contain one zygote (Figs. 37–38). It happens, however, that there are 2–4 zygotes, each having its own protein envelope (!), in one external sheath, which results in a "compound egg". Each of the embryos from such eggs can develop normally, although they are usually smaller than individuals hatched from "single eggs". A slug is able to reproduce for a long time, but when it gets older, various anomalies appear. More and more of its eggs fail to develop normally, and also "eggs-cocoons" are laid, containing several zygotes in one external sheath and shared protein

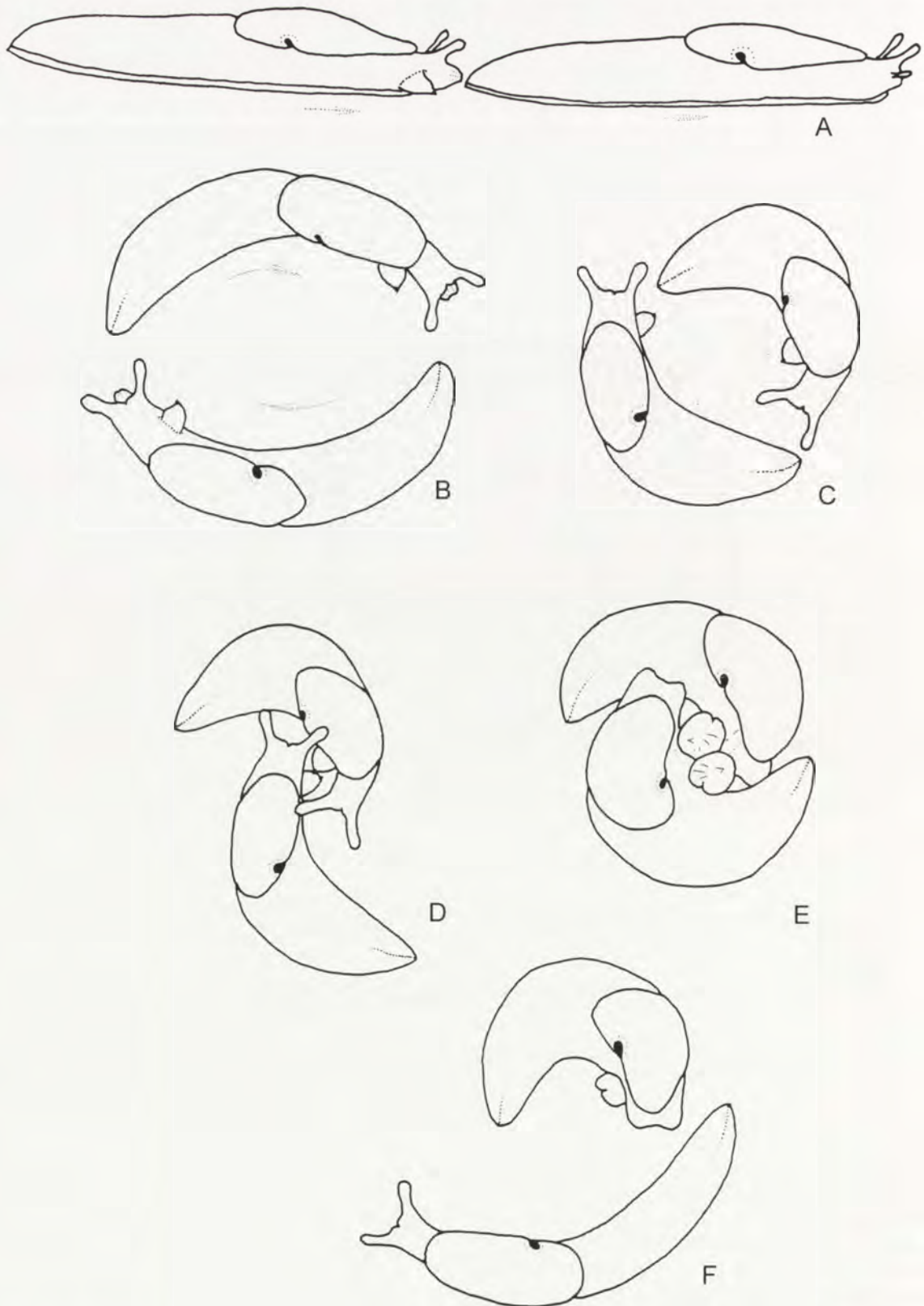


Fig. 35. Courtship and copulation in *Deroceras sturanyi*: A – recognition phase; B–D – courtship; E – copulation; F – separation of partners. (After Kosińska 1980)

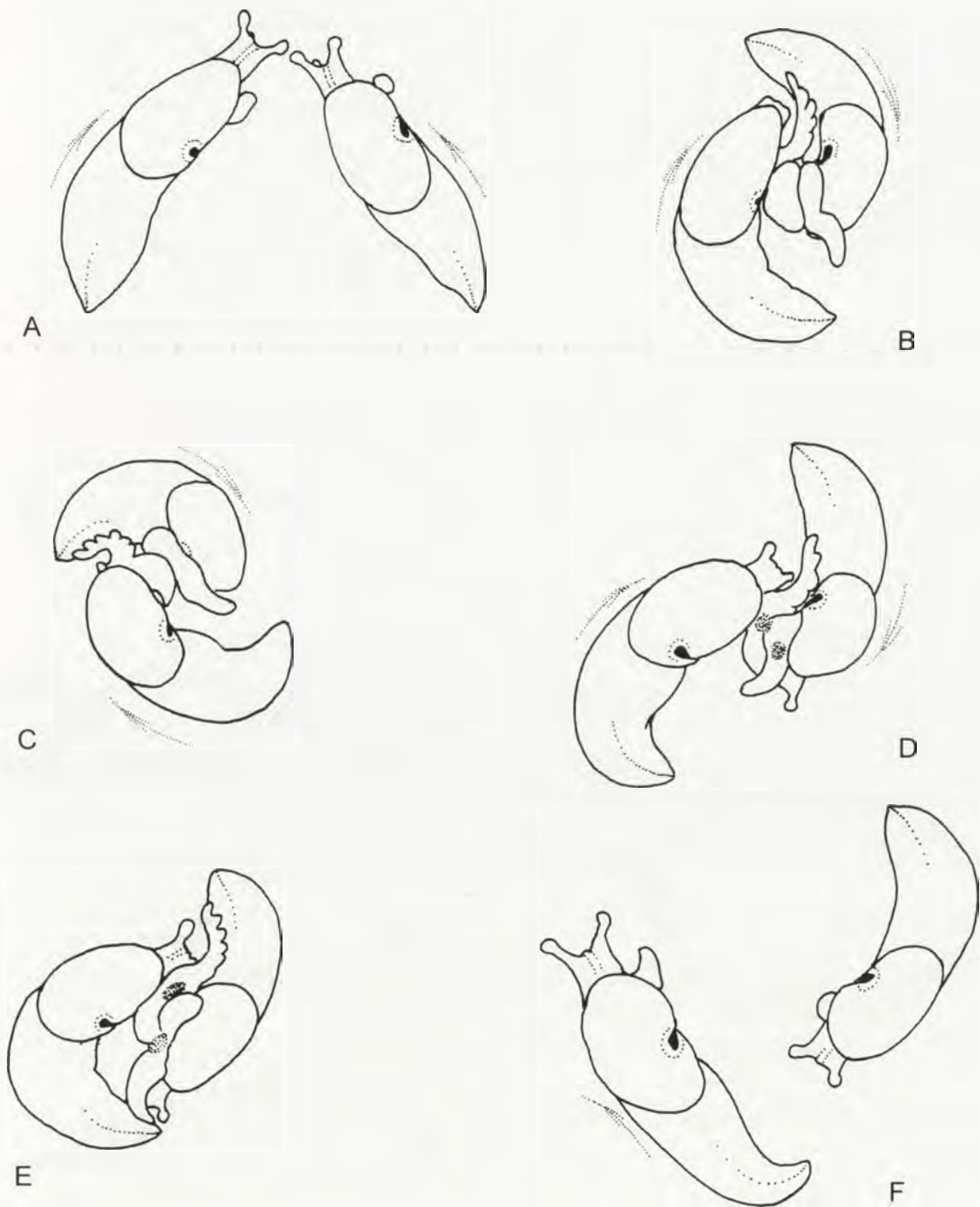


Fig. 36. Courtship and copulation in *Deroceras (Liolytopelte) bureschi*: A – recognition phase; B–C – courtship; D–E – phase immediately following the copulation; F – separation of partners. (After Wiktor 1983)

envelope (cf. compound eggs above). Sometimes only a cylindrical formation without embryos is produced. These are probably empty protein envelopes. The slugs incapable of uniparental reproduction sometimes lay eggs which have not been fertilized as they do not hatch (Carrick 1938, Kosínska 1980, Reise 1996b).

Eggs do not differ between species. They are transparent,

colourless or slightly whitish, with a somewhat cloudy embryo inside. The shape of eggs depends on their moisture. When fully hydrated, they are nearly spherical having two small conical protuberances on the sides. Sometimes, especially in the case of old specimens, eggs are connected with one another by these protuberances thus producing a chain which resembles a string of beads.

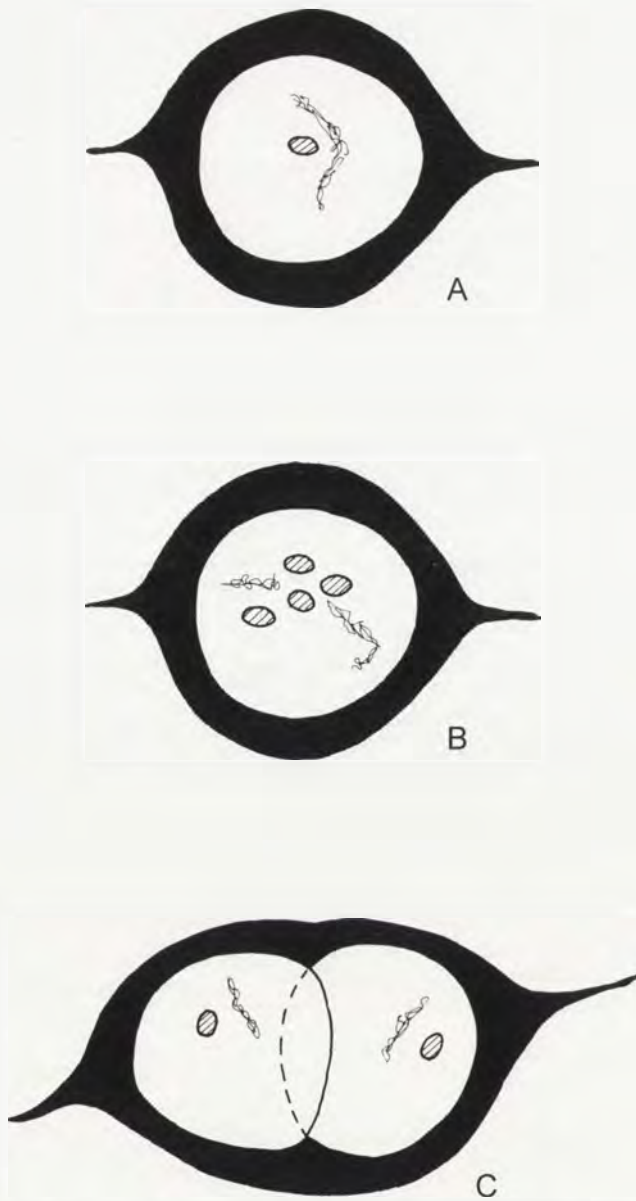


Fig. 37. Eggs of *Deroceras sturanyi*: A – an egg with a single zygote; B – an egg with four zygotes and a common envelope of protein mass; C – two monozygotic eggs with individual protein envelopes, closed together in a common external sheath. (After Kosińska 1980)

I.4. Distribution

Agriolimacidae have the most extensive distribution range of all slug families, but their representatives occur indigenously only in the northern hemisphere. Their range covers nearly whole Eurasia from the polar circle up to the Himalayas and Central America. In Africa it is delimited by the Sahara, although a few endemic *Deroceras* species inhabit Abyssinia (Ethiopia) (Fig. 39). The genus *Deroceras* is the only one found in the whole vast area of the family's range. Nearly everywhere within it, beside species of smaller ranges, "ubiquitous" *D. laeve* is found (!). The widest variety and highest number of *Deroceras* species inhabit the

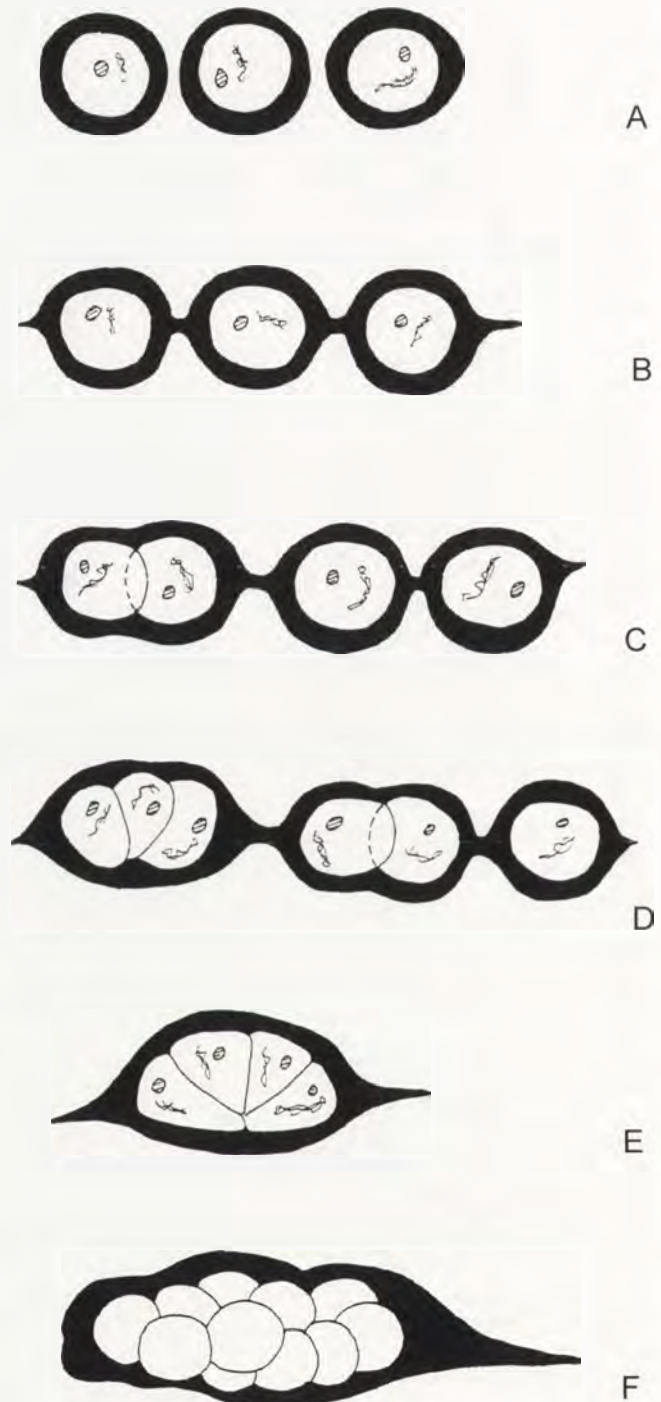


Fig. 38. Eggs of *Deroceras sturanyi*: A – properly developed eggs separated from one another; B – eggs connected like coral beads; C–D – eggs some of which have common external envelopes; E – eggs laid in the form of a cocoon; F – a cocoon containing only protein envelopes devoid of zygotes. (After Kosińska 1980)

Mediterranean region, especially the Balkans. The fauna of Greek *Deroceras* is exceptionally rich in endemics (Wiktor 1997, in print). In general, this genus is represented by nearly 120 species. Some of them seem to be in expansion, many are introduced. All the other genera comprise merely

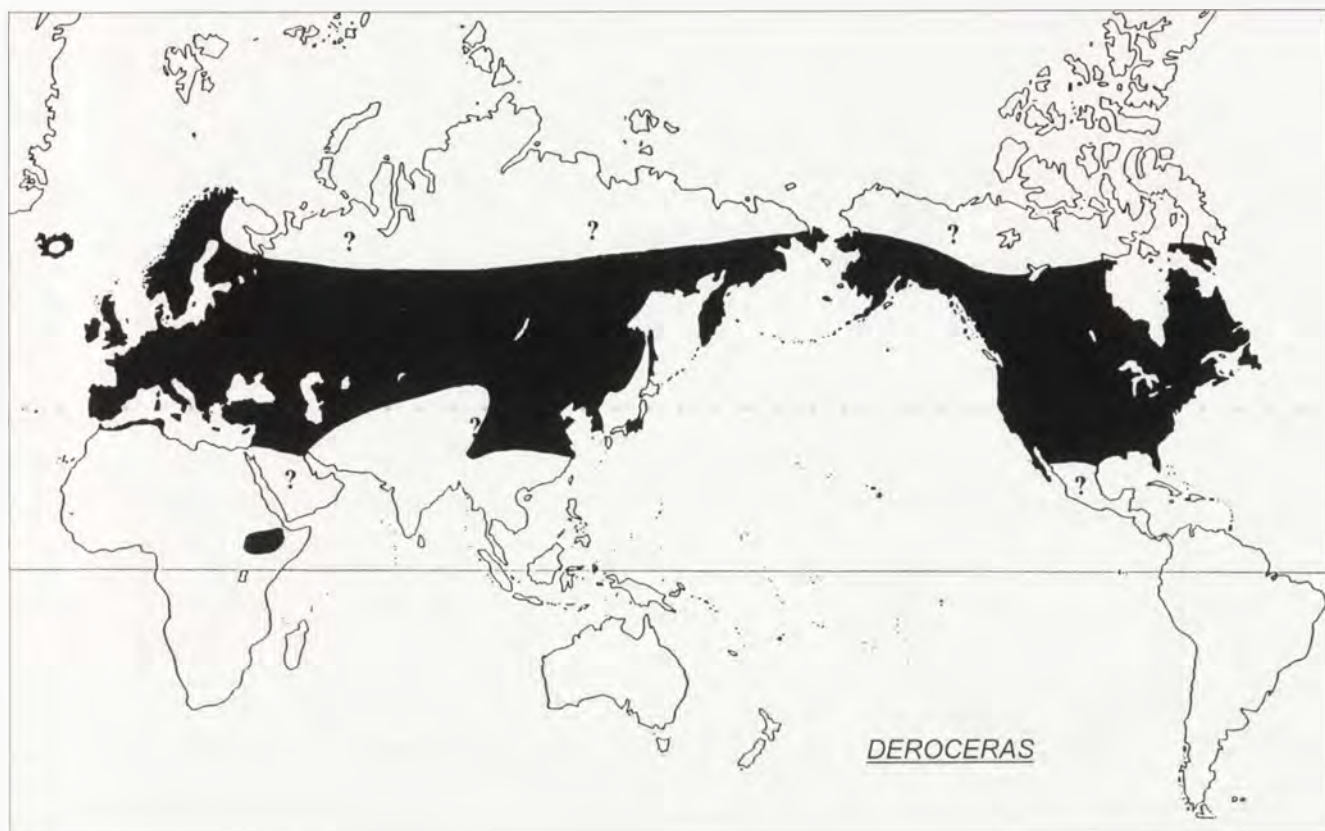


Fig. 39. Map of distribution range of the genus *Derocheras*. (Orig.)

1–5 species each and have small ranges. Their ranges lie within the area inhabited by *Derocheras*, which, in the main, is the only genus that can occur sympatrically with others. *Furcopenis* is an endemic genus of the north-western part of the Iberian Peninsula (Fig. 40). *Lytopenis* occurs in Central Asia and the Caucasus, possibly also in Iran and N Turkey (Fig. 41). *Megalopenis* inhabits the Black Sea coast in Turkey and Abkhazia (Fig. 42), *Krynickillus* is found in the Caucasus, N Iran, N Turkey and Bulgaria (Fig. 43), whereas *Mesolimnaea* recoded from SW Turkey (Fig. 44).

It is worth noting that *Derocheras* is the only genus occurring in the northern glaciation range. The distribution of all the remaining genera is limited to territories where the climatic influence of the Ice Age was slight and where the old pre-Pleistocene fauna has been preserved. During the glaciations most of these areas were refuges. Nowadays it is by no means possible to establish the original distribution range of the family. It was probably very wide already before the Pleistocene, certainly covering southern areas of the western Palearctic, which is the region where all the genera of Agriolimacidae still occur. Invasion of the northern part of the Palearctic, and probably also its eastern expanses and America, may be a result of migration during the interglacial periods or after the ultimate withdrawal of the continental northern ice-sheet. *Derocheras*, the most plastic genus with an enormous capability of speciation, has invaded this huge area relatively recently. Finally, it is also worth pointing out

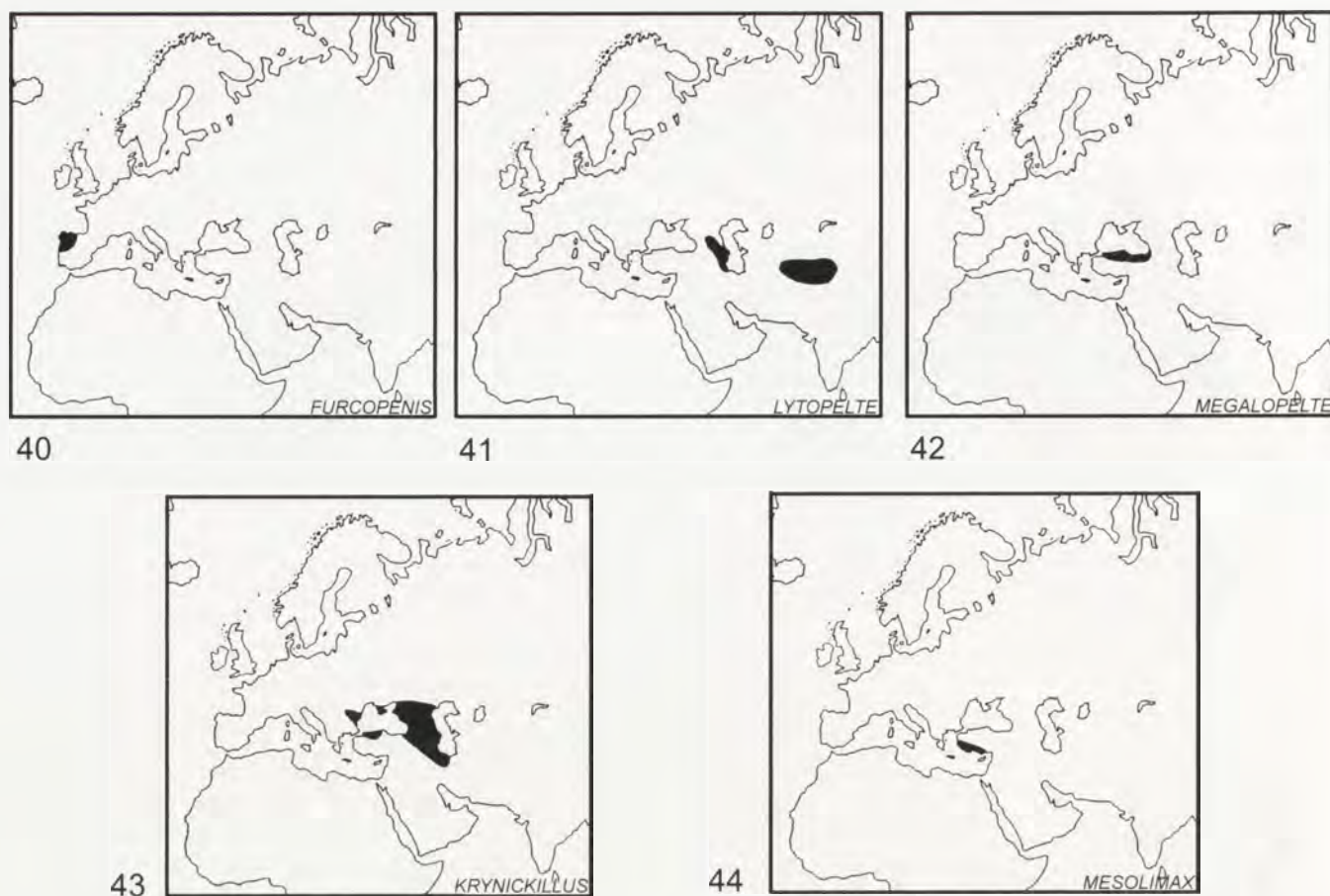
that, except for the Mediterranean sensu lato, i.e. including Asia Minor and the Black Sea region, everywhere the number of species is insignificant – just a few. It indicates that the historical centre of dispersal of the whole family was situated somewhere in the south-western Palearctic.

1.5. Methods

1.5.1. Collecting

The time of collection should obviously be chosen according to the climatic zone. Since probably all species have their life cycle lasting for about a year, one should plan the collection period so that to ensure the possibility of finding adult specimens. Young, sexually immature specimens are mostly unidentifiable. Since the egg is usually the stage which survives the period of the least favourable climatic conditions, the time of collection should overlap the season of reproduction which falls in a spell of increased precipitation and favourable temperature conditions. This pertains to the majority of species but there are some exceptions. In temperate climate, for instance, most species (such as *Derocheras agreste*, *D. reticulatum*) reach maturity in late summer, those which become mature in spring and early summer (e.g. *D. praecox*) being exceptions.

Neither is there any rule defining how to look for Agriolimacidae considering their various ecological adaptations. It is best to search for them after rain and a couple of



Figs. 40–44. Maps of distribution ranges. 40 – *Furcopenis*. 41 – *Lytopelte*. 42 – *Megalopelte*. 43 – *Krynickillus*. 44 – *Mesolimax*. (Orig.)

hours after dusk, especially when dew has appeared. During the day hours, when air humidity declines, slugs remain hidden under stones or wood pieces, in soil, detritus, leaf litter, rock crevices, etc. According to the hitherto acquired knowledge, all species live close to the ground or in the immediate neighbourhood of rocks, not climbing up trees and rarely crawling up tall herbs.

The collected slugs should best be put into boxes in which they could freely move and breathe. One should also put some leaves or leaf litter into these containers to ensure safety and suitable moisture for the specimens. When densely packed, slugs are irritated, secrete much mucus or even hurt one another. The leaves would help them to clean off the dirt stuck to the body and remain in a good condition for many hours. Since slugs are easily affected by high temperatures, the boxes should be protected against overheating. If we want to keep alive slugs for a couple of days, the best way is to leave them in a refrigerator at a temperature of over +4°C.

Collecting slugs, usually in difficult conditions, one should immediately provide the material with suitable labels. In order to avoid mistakes, labels should be put into the containers with slugs. Since paper is often eaten by slugs and a label attached outside the container easily comes off

or gets damaged, it is best to put it into a small test tube and insert the latter into the proper box. The safest way is to write with a soft pencil on thin cardboard. Such a label stands transport conditions: the paper does not soak up and the inscription does not get washed away even if for many hours carried in a rucksack.

When one wants to rear Agriolimacidae, the best way is to take some earth along with detritus from the site the specimens were collected. Thus they will be given some living comfort before their ecological requirements have been known. In order to offer them an opportunity to hide, the bottom of the terrarium should be carpeted with moist earth and a few pieces of rotting wood or broken flower-pots thrown into it. The suitable humidity as well as protection against sun and high temperature should be maintained. Almost all species eat lettuce and slices of fresh cucumber. When the culture is kept for a longer time, it is advisable to supplement the food with small bits of crushed egg shells.

1.5.2. Preservation

There are many methods of preservation to be employed depending on the purpose. I discuss ones that are the simplest but which guarantee that material fit for dissection

for taxonomic purposes will be obtained. In such a case it is necessary that preserved slugs long retain their softness and elasticity, and their muscles should be relaxed at the time of death and during preservation. Regrettably, none of the known preservation methods ensures that the colours, especially pure white, all shades of yellow and red, are retained and the coloration changes considerably. Melanophores with the dark pigment, melanine, are the ones which are preserved, often getting manifest only after preservation. Except for black-coloured forms, nearly all Agriolimacidae become dirty creamy after preservation, which makes them very much alike.

The simplest way to kill a slug when relaxed is to drown it in water. In order to do that, individuals cleaned of dirt and mucus should be placed in a test tube or jar so large that they could freely move and their muscles extend. The container should be filled with water, best boiled, and closed so that even a single air bubble has not remained inside. Slugs die within a few hours depending on temperature. The process can be accelerated by adding to water some drops of alcohol, an amount as small as not to provoke abrupt contraction of the body or intense secretion of mucus. The concentration of alcohol should not exceed 10%. One can also add a few menthol crystals (acting diastolically and bactericidally) or any substance which causes loosening of nonstriated muscles. However, such substances, e.g. barbiturates, are usually difficult to buy. A good effect can be achieved by using the $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ solution. In its crystalline form and solution this compound is red and partly colours tissues, but the coloration vanishes after some time. Some researchers recommend killing slugs with carbon dioxide in specially devised chambers.

When slugs are already dead, i.e. unresponsive to a touch, they should be washed of mucus with cold water. It is usually sufficient to rinse them repeatedly in the container they were killed in. For preservation ethyl alcohol, best its 70–75% solution, should be used. It is necessary to remember, however, that the preservation fluid should be changed several times at intervals of a few to a dozen or so days. The alcohol in which the slugs float gets diluted with the water from their bodies. Besides, various substances, e.g. from the alimentary system, get into it, and if the fluid is not changed, the specimens undergo maceration or putrefaction. In the case of large-sized slugs (which is rare in Agriolimacidae) it is advisable to cut the body integuments on the left or inject some preservation liquid into the body using a syringe. It is particularly important when it is hot and the putrefaction processes in the alimentary canal produce large amounts of gas which, inflating the whole body, deforms internal organs. Slug specimens can safely be kept only when the alcohol, exchanged several times, becomes colourless and completely devoid of suspended matter. Specimens preserved in such a way can be dissected even after 150 years.

Preserved slugs should be kept in dark which prevents them from complete fading.

It is a common practice at museums to preserve slugs in ethyl alcohol. Like every preservation liquid, it is responsible

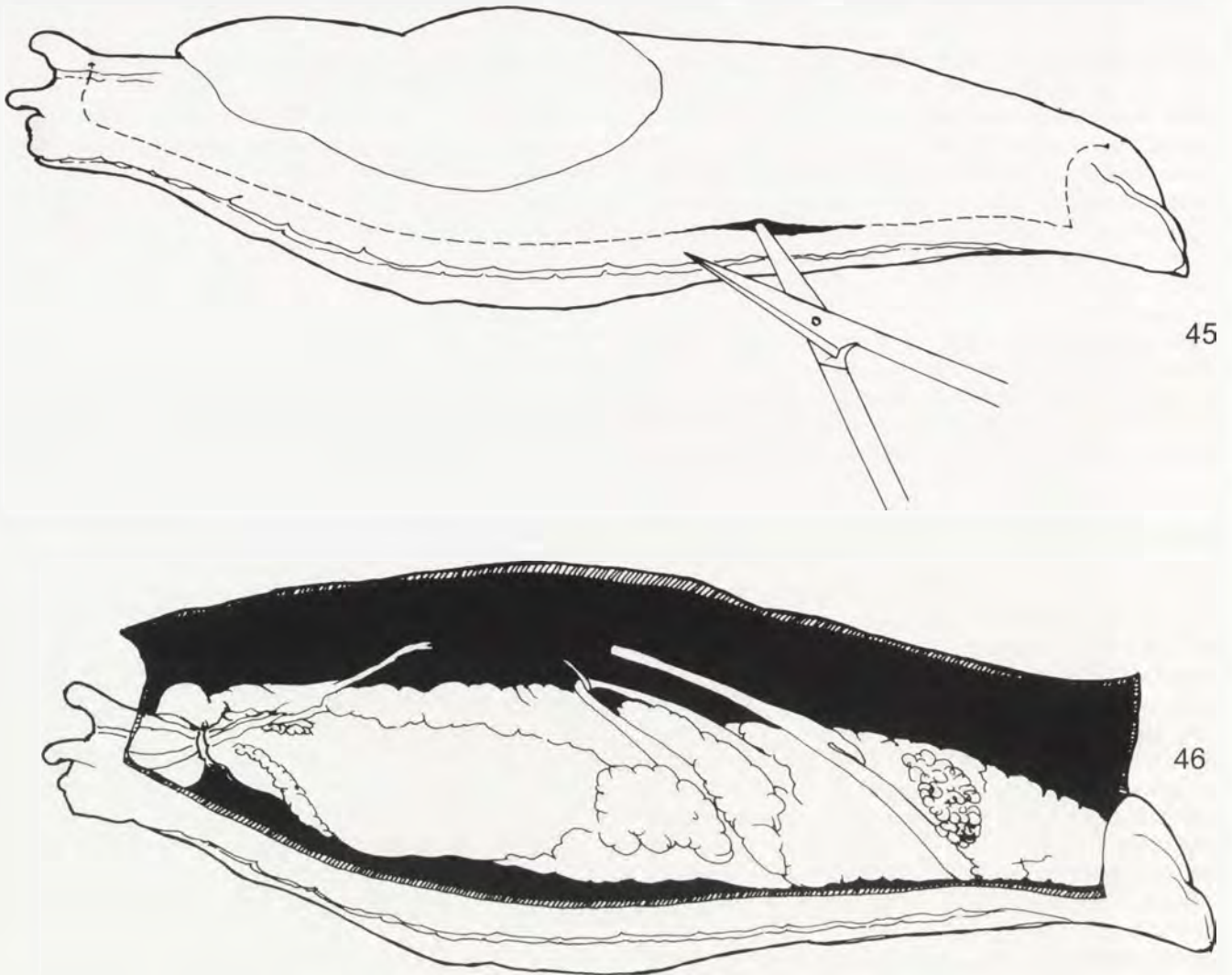
for certain deformations and artefacts. Such changes, however, are discussed in descriptions, specimens preserved alike being comparable with one another.

I warn against preservation in other fluids, formalin in particular. Slugs preserved in formalin are of no use for dissection. On the other hand, this fixative better saves the colours. Thus, formaline (4%) can be used if specimens are intended to serve the purpose of demonstrating external appearance exclusively.

1.5.3. Dissection

The equipment and tools necessary for dissection comprise the following: a stereoscopic microscope, two pairs of tweezers (the best are watch-maker's having sharp ends and a smooth internal surface), a small scalpel or a fragment of a safety razor set in a dissection needle holder, oculistic or nail scissors, entomological pins and minute pins, dissection pan. Black is the best colour to dissect on. One can pour a little paraffin mixed with beeswax (1:1) and an admixture of soot or black shoe polish onto the dissection pan. Dissection should always be performed in liquid, which enables to manipulate the utensils without them getting stuck to the specimen's organs, protects the latter against damages and prevents the glittering effect of reflection. The pan should be deep enough so that a slug being dissected be entirely submerged in the fluid. At the same time, its edges should be fairly low not to render operation with tools difficult.

Dissection should follow such a course so that the organs be least damaged. One should take a slug in the fingers and cut its body integuments along the foot margin necessarily (!) on the left (Fig. 45). Such cutting does not bring about any damage to taxonomically important organs. A slug should be cut along its whole length from the head up to the posterior end. Then the specimen should be placed with its back up on the dissection pan with paraffin and the margin of its foot pinned at two points at least. Next the slug's body integuments should be bent with tweezers to the right, thus revealing the viscera which look like peas embedded in a pod. Having bent the integuments aside, one should pin them (Fig. 46). In such a position practically all organs are available and easy to disclose. It is usually unnecessary to cut anything more for identification purposes: in order to be able to see the organs and make figures of the genitalia, intestine, brain, etc. one needs only to draw them aside. Also, the pallial system can be viewed from the bottom, and even without dissecting the membranes if the specimen is well-preserved. To dissect the shell, one can cut the mantle around it at the top or get to it from the bottom but this way damaging the pallial complex. The organ topography is more or less identical in all Agriolimacidae. For thorough study, it is usually more convenient to slightly loosen the twisted organs (Fig. 7). After examination one should return the organs to their original positions, unpin the body integuments from the paraffin in the pan and cover the viscera



Figs. 45–46. Dissection. 45 – Cutting of body integuments. 46 – Pinning to a dissection pan. (Orig.)

back with them. Specimens kept like that are not prone to damage when being taken out of the tube or when the preservation fluid is being exchanged, and – what is the most important – they can be used for other studies again in the future.

Preserved material should be dissected in the same liquid in which it has been kept (!).

Sometimes, for various purposes, fresh slugs, not preserved, are needed to be dissected. An advantage of such dissection is that their internal organs are differentiated by varying shades of colours, which renders their recognition easier. I recommend this method to beginners. Dissection can be performed downright in water, but after several dozen minutes organs get swollen, often disintegrating, and the specimens cannot be preserved. Such damages can be avoided when a physiological fluid (for invertebrates, e.g. ca 0.33% solution of common salt) is used.

Collected material is scientifically valuable only if

provided with a label, which constitutes its documentation. With a view to prevent possible mistakes, such a label should be placed inside (!) the container with slugs. It is best if it is written in indelible ink on tracing paper, or printed with a laser printer on durable paper. The label should at least include the following information: precisely defined collecting site with a specification of the country, province, or neighbouring locality if easier to find on a map; the name of the collector (legit) and date of collection. It is advisable to note ecological data. When a slug has been identified, another label should be added informing about the species name and that of the determiner (determinavit) and, recommendedly, the date of determination. Obviously, other useful information can be included, too. I warn against writing on labels, both those prepared in the field and the final ones, only numbers and keeping detailed information separately. It often leads to serious confusion or even errors which get to literature (!). The best way is to keep slugs in

test tubes plugged with cotton and put into tightly closed jars. One should pour preservation fluid into the jars with tubes and refill it from time to time.

II. ABBREVIATIONS OF THE MUSEUM'S NAMES

Caution!

If there is no mention of the place of deposit or the fate of the types, it means I do not know if they have been preserved.

- ANSP – Academy of Natural Sciences of Philadelphia (USA)
 BAN – National Natural History Museum of the Academy of Sciences, Sofia (Bulgaria)
 IZK – Zoological Institute, Ukraine Academy of Science, Kiev (Ukraine)
 FMNH – Field Museum of Natural History, Chicago (USA)
 MHNM – Museo Nacional de Ciencias Naturales, Madrid (Spain)
 MIZ – Museum and Institute of Zoology, Polish Academy of Sciences, Warsaw (Poland)
 MNHP – Muséum National d'Histoire Naturelle, Paris (France)
 MNHW – Museum of Natural History, Wrocław University, Wrocław (Poland)
 NHMG – Museum d'histoire naturelle, Geneve (Switzerland)
 NMGAB – Muzeul de istorie naturală "Griegori Antipa", Bucharest (Roumania)
 NMW – Naturhistorisches Museum, Wien (Austria)
 NMB – Naturhistorisches Museum, Basel (Switzerland)
 NNML – Nationaal Natuurhistorisch Museum of Leiden (= Rijksmuseum van Natuurlijke Historie) (The Netherlands)
 SMF – Naturmuseum Senckenberg, Frankfurt a/M. (Germany)
 SMT – Staatliches Museum für Tierkunde, Dresden (Germany)
 SSW – Naturhistoriska Riksmuseet, Stockholm (Sweden)
 ZAS – Institute of Zoology, Academia Sinica, Peking (= Beijing, China)
 ZIN – Zoologicheskij muzej, St. Petersburg (= Leningrad, Russia)
 ZMB – Museum für Naturkunde, Humboldt Universität, Berlin (Germany)
 ZMA – Zoologisch Museum Universiteit van Amsterdam (The Netherlands)

III. SYSTEMATIC REVIEW

Systematic list

(synonyms in brackets)

Fam. Agriolimacidae

Subfam. Agriolimacinae

Gen. *Deroceras*

Subgen. *Deroceras* s. str.

abessinicum (gimirranus)

adolphi

afar

agreste (agrestis, obliqua, bilobatus, pallidus, minutus, veranyanus, fedschenkoi, paradisiacus, pyenoblemmius, transecausicus, transecausicus v. coeciger, pojoritensis)

altaicum (buchar v. coeciger, altaicus transitorius, sibiriensis, stigmatoida)

altimirai (altimirai altimirai)

astypalaeensis

bakurianum (schemachensis, roseni)

sp. (cf. *bakurianum*)

barceum

berytensis (?Phoeniciaca, Pentheri, ?cyprius, ?Pallaryi, ?damascensis, ?Steindachneri, jordanicus, grossui)

bisacchianum

bistimulatum

boeoticum

boettgeri

"*Brunneri*"

bulgaricum

cazioti

chevallieri

christae

chrysorroyatissensis

concrementosum (-us)

cycladicum

?dallaii

deckeni

demirtensis

?dubium

ercinae

famagustensis

gardullanum (gofannus)

gavdosensis

giustianum

glandulosum

golcheri (?corsicus)

gorgonium

halieos

helicoidale

?hesperium

heterura

ikaria

ilium

johannae

karnaniensis

kasium

keaensis

kontanum

korthionensis

koschanum (-us)

kythirensis

laeve (*brunnaeus*, *gracilis*, *campestris*, *parvulus*, *weilandii*, *araneus*, *Krynickyillus* (*Malino*) *brunneus*, *montanus*, *ingersolli*, *hyperboreus*, *mentonicus*, *Hemphilli*, *globosus*, *Parkinsi*, *Bovenoti*, *berendti* v. *pictus*, *pseudodioicus*, *renschii*, *schulzi*, *pellucidus*, *monentolophus*)

lasithionensis lasithionensis

lasithionensis polylobatum

levisarcobelum (*altimirai levisarcobelum*)

libanoticum

limacoides

lombricoides (*immaculatus*, *immaculatus* v. *nigrescens*, *hispaniensis*)

lothari (*klemmi*, *dalmatinum*)

maasseni

malkini

melinum

minoicum

neuteboomi (*jaeckeli neuteboomi*)

?*nigroclypeatum*

nitidum (*Maltzani*, *hilbrandi*)

nyphoni

oertzeni (*libegoti*)

osseticum (*subagrestis* v. *minutus*)

??*padisii* (*padisii*)

pageti (*laconicum*, *saronicum*)

panormitanum (*queenslandicus*, *Pollonerae*, *Caruanae*, *Cecconii*, *ecconii* v. *silvatica*, ?*Scharffi*, *dubius*, *meridionale*)

parium

parnasium

planarioides (*rivanus*)

ponori

ponsonbyi

praecox

pseudopanormitanum

rethimnonensis

reticulatum (*tunicata*, *Drymonius*, ?*nicensis*, *simrothi*, *altenai*)

rhodensis

riedelianum

rodnae (*fatrense*, *juratum*)

samium

seriphium

sturanyi (*murinus*, *romanicus*)

subagreste (*agresticulus*, *Ananowi*)

tarracense (*altimirai tarracense*)

tauricum (*Dymczewiczi*, *ramosum*)

thersites

turcicum (*callatis*, *forcarti*, *schleschi*, *geticus*, *jaeckeli*, *dobrogicus*, *vranceanus*, *transsylvanicus*, *wiktori*, *pseudolytopelte*, *waldeni*, ?*padisii*, *bosnensis*, *hercegovinae*)

uataderensis

vascoana

zilchi

Subgen. *Liolytopelte*

bureschi (*herculana*, *olteniana*, *suboccidentalis*, *lotrensis*)

caucasicum (*caspius*, *grusina*, *caucasica armenia*, *hamatum*, *Dymczewiczi* s. *Simroth*)

kandaharensis

moldavicum (??*hydrobius*, ??*huculorum*)

occidentalis

trabzonensis

Nomina dubia

Agriolimax Absoloni

Agriolimax agrestopsis

Agriolimax Attemsi

Agriolimax crimense

Agriolimax fuscus

Agriolimax Horsti

Agriolimax Jickeli

Agriolimax kaffanum

Agriolimax Lábáni

Agriolimax Maggii

Agriolimax sardus

Genus *Furcopenis*

circularis

darioi

galleaciensis

geresensis

Genus *Lytopelte*

maculata (*longicollis*, *transeaspia*, ?*Boettgeri*)

Genus *Megalopelte*

simrothi

Genus *Krynickyillus*

Subgenus *Krynickyillus* s. str.

melanocephalus (*melanocephala*)

urbanskii

Subgenus *Toxolimax*

hoplites

Subfam. *Mesolimacinae*

Genus *Mesolimax*

brauni

escherichi

Incertae sedis

"*Agriolimax atoi* (*varians*)"

"*Krynickyillus cyrniacus*"

"*Agriolimax Drymonius*"

Limax (*Megalopelta*) *semitectus*

Family Agriolimacidae Wagner, 1935

Agriolimacidae Wagner, 1935: 174.

Deroceeratinae Magne, 1952: 30.

Deroceerasinae Hudec, 1972: 84.

Deroceerasidae: Bodon, Boato, Giusti 1982a: 53.

References: Likharev and Wiktor 1980: 123; Wiktor 1989: 100; Hausdorf 1998: 35.

Medium-sized slugs, usually below 60 mm in length. The posterior body end abruptly narrowed, pointed or laterally fin-shapedly flattened. Mantle situated in the anterior body section, most often covering more than 1/3 of the total length; in one case (*Megalopelte*) it covers as much as the entire body. The anterior section of mantle is free, i.e. not accreted to nape. In live individuals the surface of mantle is covered by concentric mobile wrinkles, which completely disappear after the animal's death. Pneumostom postmedial, exceptionally medial or even antemedial (e.g. *Mesolimax*). Keel short and clearly visible only in the posterior body end, *Lytopelte* being the only exception. Sole divided into three zones by longitudinal grooves. The lateral zones with transverse, i.e. running nearly perpendicularly to the longitudinal body axis, wrinkles. In the medial zone the wrinkles form a widely gaping letter V, its opening anterad. Posteriorly on back and body sides the skin wrinkles are relatively short and wide, their number between the medial line of back and pneumostom being usually ca 12–15.

Coloration uniform or the body is dark-spotted (never striped). The spots often make clusters, or the dark pigment concentrates along the skin grooves producing a net-like pattern.

Mucus colourless, often watery. In some species also a milky white secretion appears on irritation.

Shell, entirely hidden in mantle, is flat, thin and scale-shaped, its nucleus (representing the embryonic part) asymmetrically shifted posterad. It is only in *Mesolimax* that the nucleus is situated almost on the longitudinal axis; still it is also shifted backward.

Genitalia. Vas deferens thin, clearly delimited from penis. Penis mostly short and rounded, less frequently vermiform, always with one retractor. In many species penis equipped with penial gland and different kinds of accessory organs of the type of appendices, glands etc. Also in many species, inside penis there is a stimulator, sometimes additionally with a hard plate. No accessory organs occurring within the female part of genitalia. Bursa copulatrix (= spermatheca) oval or spherical, usually with a short spermatheca duct opening to penis (except for *Mesolimax*). Sperm transmitted in the form of gelly.

Eggs with soft and transparent envelopes.

Jaw oxygnatic, i.e. with one tooth in the middle.

Radula: central tooth with a large mesocone and smaller ectocones, lateral teeth also with three cusps, marginal teeth sabre- or dagger-shaped.

Alimentary canal forming two loops, which, to a small extent, are also twisted around the longitudinal body axis. Crop relatively long, constituting the first section of the first loop. The second loop is shifted posterad relative to the first

one. Roughly in the middle of the last intestinal arm, which is rectum, a short pocket-shaped caecum, never filling with faeces, may occur. The right lobe of digestive gland larger, representing the terminal section of viscera.

Heart situated in the right anterior quarter of pallial complex. Its longitudinal axis sometimes tilted even by 45° relative to that of body. Aorta long. Lung situated beneath heart. A bean-shaped kidney surrounds heart from its back and sides. Kidney ventrally equipped with a large lobe, *Mesolimax* being the only exception. Secondary ureter comes off kidney in its hind section and opens to an oval bladder. The main retractor has one common insertion attached to the membrane under the posterior margin of pallial complex. The muscle branches anterad in quite a varied way also within a species.

Slugs living on soil, some crawling on herbs and rocks but not up trees. They hide mainly under clods of earth, stones and wood pieces. Phytophagous or omnivorous.

The distribution range of the family covers nearly the whole Holarctic. Most species inhabit the Western Palearctic, their greatest abundance in the Mediterranean. Some of the species introduced over the whole globe, except for the Arctic and Antarctica.

The family Agriolimacidae is divided in two subfamilies with 6 genera and ca 120 species.

Key to identification of the genera of Agriolimacidae

1. Mantle covers nearly whole body (Fig. 795).
..... *Megalopelte* (p. 564)
- Mantle smaller, covering at most 1/2 body length. ... 2
2. Lateral sole zones divided by two or more longitudinally running grooves (Fig. 821). Large slugs, even up to 60 mm in length when preserved. Penis long, vermiform, partly enveloped along with vas deferens by a tubular membrane. Rectum piercing through the main retractor.
..... *Mesolimax* (p. 575)
- Lateral sole zones not divided by longitudinal grooves. Preserved slugs at most ca 46 mm in length, usually considerably smaller. Penis short, never enveloped by a tubular membrane. Rectum situated by the side of the main retractor. 3
3. Along the whole back, up to the mantle margin, there is a conspicuous keel (Fig. 787).
..... *Lytopelte* (p. 561)
- Keel present only on the posterior end of back, perceivable at most in 1/3 its length. 4
4. Body slender even if contracted. Its length after preservation usually ca 40 mm or slightly more. Mantle smaller, covering up to 1/3 entire body length. Penis oval, shortly cylindrical, without any external appendages (Fig. 810).
..... *Krynickillus* (p. 569)
- Body thickset when contracted. Mantle equalling, or often larger than, 1/3 entire body length. Penis usually with various external appendages (Caution! The two following genera externally indistinguishable from each other). 5

5. Penis narrow, anteriorly connected with one or two accessory bodies, each of which has cap- or papilla-shaped glands on the posterior wall (Figs. 774). No stimulator in the anterior section of penis; only in one species there is a spherical papilla in its posterior part. Rectal caecum lacking.

..... *Furcopenis* (p. 554)

–. Penis anteriorly asymmetrically distended, often with papillose or granular glands in the lateral wall of the distension. With few exceptions, the anterior section of penis containing stimulator or having folds. Stimulator in the form of a papilla, cone or fan-shaped plate. Rectum sometimes without caecum; when present, caecum is pocket-shaped or as a distinct blind process.

..... *Deroceras* (p. 388)

Subfamily *Agriolimacinae* Wagner, 1935

Agriolimacinae Wagner, 1935: 174.

Slugs mostly less than 50 mm long. Pneumostom clearly postmedial. Lateral sole zones having only transverse wrinkles. Penis short, usually bag-shaped, often with external appendages, inside with different stimulatory organs. No tubular membrane encircling penis and vas deferens. Musculus retractor penis running beside right tentacle. Kidney equipped with lobus.

The geographic distribution of one genus is as large as the range of the whole family, those of the other genera being small and restricted to the Western Palearctic.

The subfamily comprises the genera *Deroceras*, *Furcopenis*, *Lytopelte*, *Megalopelte* and *Krynickyllus*; altogether ca 110 species occurring in different regions of the Holarctic and in a part of Ethiopia.

Genus *Deroceras* Rafinesque, 1820

Deroceras Rafinesque, 1820: 10. Species typica: *Limax gracilis* Rafinesque, 1820 = *Deroceras laeve* (O.F. Müller, 1774).

Agriolimax Mörch, 1865: 378. Species typica: *Limax agrestis* Linnaeus, 1758 = *Deroceras agreste* (Linnaeus, 1758).

Limax Linnaeus, 1758: partim.

Limacella Brard, 1815: partim.

Krynickyllia Kaleniczzenko 1839: nomen nudum.

Krynickyllus Kaleniczzenko, 1851: partim.

Megalopelta Mörch, 1857: 282 pl. 10 fig. 7. Species typica: *Limax (Megalopelta) semilectus* Mörch (a scarcely known species).

Hydrolimax Malm, 1870: 79. Species typica: *Hydrolimax laevis* = *Limax laevis*.

Krynichia (sic!) Hazay, 1884: 329 as "*Krynichia Kaleniczzenko*" for *Krynichia brunnea* Draparnaud = *Krynichia laevis* Müller.

Chorolimax Westerlund, 1894: 163. Species typica: *Agriolimax agrestis* var. *norvegicus* Westerlund, 1894.

References: Hesse 1926: 21; Pilsbry 1948: 533; Wiktor 1973: 106; Likharev and Wiktor 1980: 125; Wiktor and Likharev 1980: 418 figs 8–11; Jungbluth, Likharev, Wiktor 1981: 17 figs 2–6; Wiktor 1989: 101; Wiktor 1996: 85.

Smallish slugs, their length after preservation not exceeding 45 mm. Body slender, sometimes more or less stout. Mantle covers slightly more than 1/3 of the body, its posterior margin reaching roughly body half. The anterior

section of mantle over nape can be easily bent upward. Pneumostom postmedial, surrounded by a kind of well distinguishable rounded plate of smooth surface. Keel limited to the posterior fragment of body. Between the medial line of back and pneumostom usually no more than 14 wrinkles. Skin thin, sometimes transparent enough for the internal organs to show through; in other species thick and non-transparent.

Coloration. General body colour from deeply black to snowy white, most often, however, dirty creamy. Some slugs are unicolour, some black-, blackish- or brown-spotted or -reticulated.

Mucus colourless, often watery. Apart from it, many species additionally produce a milky secretion when irritated.

Genitalia. Penis short, bag-shaped, spherical, oval, irregular and like. Posteriorly equipped with penial gland (with some exceptions). Besides, different types of distensions, pockets or appendices may occur, especially in the posterior section of penis. Musculus retractor penis laterally or, less frequently, apically accreted to penis; often branched. Inside penis different types of stimulatory organs (e.g. stimulator = sarcobellum) assuming the shape of a cone, fan, lobular structures, plicae etc, the surface of which is covered by a sculpture resembling fingerprints. Stimulator gets everted during courtship, and during the copulation itself both appendices and penial gland undergo eversion, too.

The terminal section of intestine, i.e. rectum, most commonly with a small caecum. In many species it is reduced to a different extent. Its length rarely reaches about 1/3 that of rectum; the organ is usually pocket-shaped and practically imperceivable in certain species. The terminal section of rectum always abruptly broadens.

Kidney equipped with a large lobus.

The representatives of the genus live in open habitats and forest, in averagely humid or wet environment. The life cycle completes itself within a period extending from a month to over ten months.

The genus is represented by two subgenera: *Deroceras* s. str. and *Lytopelte*.

Key to identification of *Deroceras* species

Caution! The key does not include species of unclear status, namely *Deroceras boettgeri*, *bulgaricum*, *dallaii*, *deckeni*, *dubium*, *heterura*, *kontanum*, *libanoticum*, *nigroclypeatum*, *padisi*, *ponori*, *rhodensis*, *uataderensis*, *zilchi*, and nomina dubia.

Characters discussed in the key pertain to alcohol-preserved slugs.

1. Caecum on rectum clearly longer than wide. 2
- . Caecum on rectum in the form of a pocket the length (depth) of which is roughly equal to or smaller than the width; or caecum completely lacking. 21
2. Stimulator inside penis in the shape of a cone. 3
- . Stimulator inside penis flattened – in the form of a laterally squeezed cone or a completely flat fold. 10
3. Posterior section of penis without appendices, only penial gland occurs. 4

- . Apart from penial gland, the posterior section of penis equipped with one or two processes of appendix character. 6
4. Penial gland single, in the shape of a nodule or unbranched process of smooth surface. A slug usually exceeding 30 mm, unicolorous, white, cream or brownish. Penis sack-shaped or with an inconspicuous constriction (Figs. 65–74). Mainly the western Palearctic.
..... *Deroceras (D.) agreste* (p. 397)
- . Penial gland covered by papillae, often branched or composed of a few knots. 5
5. Penial gland highly varying in appearance, large, in the shape of a single or a few branches covered by glandular papillae. Penis most frequently deeply laterally constricted. Vas deferens opens laterally close to the rear end of penis, nearly always on the side of body integuments (Figs. 560–579). A slug usually over 20 mm. Body nearly always patterned. Almost the whole of Europe, and – as introduced – different parts of the globe. Mostly a synanthropic living in open habitats.
..... *Deroceras (D.) reticulatum* (p. 507)
- . A species very similar to the preceding slug. Penis usually less significantly constricted. Penial gland of varied shape, most commonly small and made up of a number of knots or short processes. Vas deferens opens at the basis of penial gland on the side of penis and faces viscera (Figs. 669–697). A eurytopic species often found in forest, but also as a synanthrope. Usually less than 20 mm long. Occurring from Slovenia through nearly the whole Balkans up to Turkey.
..... *Deroceras (D.) turcicum* (p. 524)
6. On penis a long twisted appendix, which makes an impression that penis is forked at its 2/3. Penial gland composed of a few long, usually unbranched processes. Musculus retractor penis also forked, its one part attached to penis, the other to appendix (Figs. 446–450). Greek islands.
..... *Deroceras (D.) oertzeni* (p. 485)
- . Appendix different, always considerably smaller. 7
7. On penis a large tapering corrugated process (Figs. 640–643). Penial gland in the shape of a short small cylinder. Spermatheca larger than penis. Spain.
..... *Deroceras (D.) tarracense* (p. 519)
- . Appendix in the form of a cone with its top truncated or pocket-shaped. 8
8. Penial gland composed of two branches set on a very long common shaft (Figs. 546–557). Body most commonly blackish or grey, as if faded. Crete (Greece), Turkey.
..... *Deroceras (D.) rethimnouensis* (p. 505)
- . Penial gland different. 9
9. Penial gland assuming the shape of a branched tree (Figs. 652–668). Penis with a deep constriction, its posterior section with different types of distensions or a broad transverse appendix. Greece, Bulgaria.
..... *Deroceras (D.) thersites* (p. 521)
- . Penial gland composed of 5 unforked branches. Penis S-shapedly curved. Its posterior, bent, fragment forms a transversely situated pocket or simply an appendix, their surface gofferred (Figs. 503–506). Greece.
..... *Deroceras (D.) parnassium* (p. 494)
10. Stimulator in the shape of a laterally flattened cone. 11
- . Stimulator as a fold or flattened fan. 15
11. In the posterior part of penis two sideward directed swellings differing in size. On one of them a small penial gland in the shape of a hook-bent cone. In the dark pigmented specimens the posterior section of penis partly pigmented (Figs. 83–87). Spain, France.
..... *Deroceras (D.) altimirai* (p. 402)
- . The posterior end of penis different. 12
12. Penial gland resembling a fern leaf. Stimulator in the shape of an asymmetrical cone, its top and bottom pressed (Figs. 192–197). Turkey.
..... *Deroceras (D.) christae* (p. 426)
- . Penial gland different. 13
13. Penial gland single, long, unilaterally covered by glandular papille (Figs. 395–400). Hungary, Austria, Slovenia and N Italy.
..... *Deroceras (D.) lothari* (p. 474)
- . Penial gland different. 14
14. Penial gland represented by two separate tufts of branched processes. Stimulator in the shape of a flat narrow ligule (Figs. 182–191). France.
..... *Deroceras (D.) chevallieri* (p. 425)
- . Penial gland in the shape of a short process. Penial stimulator represented by a spoon-shaped fold. Penis can be sack-shaped in juveniles, in adult specimens being S-like bent. Retractor penis attached to penis with a fan-shaped extension (Figs. 75–82). Body most commonly dark-spotted or covered by a dark-coloured reticulum as the pigment is concentrated in skin grooves. Eastern Asia (Russia, the Tyan-Shan Mts., Mongolia, China).
..... *Deroceras (D.) altaicum* (p. 399)
15. Penis posteriorly spirally coiled like a snail's shell, with a short cone-shaped penial gland on the very end (Figs. 276–280). Turkey.
..... *Deroceras (D.) helicoidale* (p. 447)
- . The posterior penis section different. 16
16. Penis sack-shaped, posteriorly with two appendices, thus kidney-like (Figs. 295–298). A black slug up to 33 mm. Greece.
..... *Deroceras (D.) johanna* (p. 453)
- . The posterior section of penis different. 17
17. Penis elongated, with a lateral swelling. The posterior section of this organ with two lobular appendices directed posterad (Figs. 311–317). A black slug up to 52 mm in length. Greece.
..... *Deroceras (D.) keaensis* (p. 453)
- . Penis different. 18
18. Penis with a lateral swelling and a small pocked-shaped kind of appendix (Figs. 603–606). A black slug up to 40 mm long. Greek islands and Turkey.
..... *Deroceras (D.) samium* (p. 514)
- . Penis different. 19

19. The anterior section of penis oval, often laterally distended, the posterior one narrow, nearly cylindrical. Penial gland made up by a short common trunk and long undivided branches. Stimulator large, fan-shaped (Figs. 135–146). Caecum on rectum mostly long but – Attention! – sometimes nearly pocket-like. A large slug up to 32 mm. Lebanon, Cyprus, Turkey.
 *Deroceras (D.) berytensis* (p. 408)
- Penis different. 20
20. Penis large, approximating to 1/3 entire body length, S-like bent. Penial gland of 5 undivided branches (Figs. 218–220). Turkey.
 *Deroceras (D.) demirtensis* (p. 433)
- Penis of irregular shape with a large lateral distension and two curved appendices. Penial gland set on one of the appendices. Some of the processes of penial gland dichotomously branched (Figs. 273–275). Greece.
 *Deroceras (D.) halieos* (p. 447)
21. Caecum on rectum in the shape of a pocket whose length and width are roughly equal. 22
- Rectum lacking caecum or, at most, its terminal section widens abruptly. 57
22. Stimulator inside penis cone-shaped of more or less round base. 23
- Penial stimulator in the shape of a flattened cone or completely flat. 38
23. Penis posteriorly equipped with an appendix or, at least, large pocket-shaped swelling. 24
- There is neither an appendix nor a swelling in the posterior part of penis, but the organ is naturally extended with penial gland. The latter, roughly equalling 1/2 penis length, is a large, bent, gradually narrowing process of smooth walls. In some specimens on its very end there are vestigial glandular papillae (Figs. 50–57). France.
 *Deroceras (D.) adolphi* (p. 395)
24. The posterior section of penis with different types of distensions or a lateral pocket. 25
- Posteriorly penis equipped with an appendix in the shape of a digitate process. 31
25. The posterior end of penis resembles a hammer. Its one part is longer, sometimes goffered, and bent anterad, whereas the other is more rounded and transversely sticking out (Figs. 621–631). Body unicolour – from creamy to black. Europe.
 *Deroceras (D.) sturanyi* (p. 516)
- Penis posteriorly different. 26
26. Penial gland, situated on penis asymmetrically, in the form of a tuft of processes arranged in a circle (Figs. 259–268). A dirty creamy slug with a brownish tint, densely dark brown-black spotted. Malta and (?) Corsica.
 *Deroceras (D.) golcheri* (p. 443)
- Penial gland and penis different. 27
27. Penial gland single – undivided. Penis elongated, its posterior end with a bent deep pocket-like appendix (Figs. 423–428). Greek islands.
 *Deroceras (D.) melinum* (p. 476)
- Penial gland and penis different. 28
28. Penial gland with two unbranched processes joined directly with penis (Figs. 507–512). Penis of irregular shape, its posterior section usually with a lateral pocket. A unicolour, black or chocolate brown, slug. The Italian Alps.
 *Deroceras (D.) planarioides* (p. 494)
- Penis and penial gland different. 29
29. The anterior section of penis ovaly distended, the posterior narrow with a small transverse appendix. Penial gland as a tuft of 5 unbranched processes (Figs. 163–168). Greece.
 *Deroceras (D.) boeoticum* (p. 419)
- Penis and penial gland different. 30
30. Penis heavily distended anteriorly, its posterior section narrower and cylindrical (sometimes with a short, transversely set, conical appendix). The rear penial end without a distinct border turns into a large penial gland which is situated on the longitudinal axis of penis (Figs. 462–465). Greece.
 *Deroceras (D.) pageti* (p. 488)
- Penis elongated, gently posteriorly turning into a pocket-shaped, somewhat lateral, rounded appendix. Penial gland represented by a tuft of unbranched processes (Figs. 444–445). Skiatos Isl. (Greece).
 *Deroceras (D.) nyphoni* (p. 482)
31. Penial gland of varied appearance, composed of short irregularly shaped processes set in a line on the common base or directly on penial wall. Appendix large and twisted, constituting an extension of penis and roughly equalling this organ in size; the bent sections often connected together by a membrane. Retractor penis attached in the indentation between penis and appendix (Figs. 451–457). From the Caucasus up to Turkey.
 *Deroceras (D.) osseticum* (p. 486)
- Penial gland and penis different. 32
32. Penial gland situated laterally, short, consisting of three rounded lobular processes of smooth surface (Figs. 429–434). Penis dark-pigmented, with two swellings in the posterior part. Crete (Greece).
 *Deroceras (D.) minoicum* (p. 476)
- Penial gland and penis different. 33
33. Penis spherical only anteriorly. Its posterior section narrower, separated by a constriction, equipped with a short bent appendix and lanceolately narrowing penial gland of unilaterally corrugated surface (Figs. 292–294). The Caucasus region.
 *Deroceras (D.) ilium* (p. 451)
- Penis different. 34
34. Penis spherical. Appendix vermiformly tapering, often coiled. Penial gland with a long common trunk and a few undivided branches (Figs. 249–255). Sicily (Italy).
 *Deroceras (D.) giustianum* (p. 441)
- Appendix and penial gland different. 35
35. Penis spherical. Appendix cylindrical, truncated. Penial gland more or less as long as penis or even longer, built

- of 2–3 branches covered by papillae and situated on a common shaft (Figs. 127–138). Libya.
 *Deroceras (D.) barceum* (p. 406)
- Penis different. Penial gland shorter. 36
36. Slugs big, when preserved ca 45–47 mm, mostly unicolour – black, graphite or blackish, only sometimes dirty creamy and spotted. Penis irregular, elongated. One small, nodular or finger-like appendix. Crete (Greece).
 37
- Smaller slugs, up to 35 mm, mostly dirty creamy and spotted. Penis sack-shaped, without a clear medial constriction, posteriorly with two finger-shaped appendices directed posterad. Between the appendices there is a tuft of unbranched processes set on a common trunk, which constitutes penial gland. Retractor penis forked (Figs. 469–473). Caution! The diagnosis above mentioned pertains to the typical form. This slug is characterized by wide inter- and inrapopulational variability manifested in partial or complete reduction of one of the appendices (Figs. 475–496). The Mediterranean, often – as a synanthrope – introduced to other regions.
 *Deroceras (D.) panormitanum* (p. 488)
37. Penial gland composed of two long branches (Figs. 352–372). Crete (Greece).
Deroceras (D.) lasithionensis lasithionensis (p. 465)
- Penial gland consisting of 5–9 branches (Figs. 363–368). Crete (Greece).
 *Deroceras (D.) lasithionensis polylobatum* (p. 465)
38. Stimulator in the shape of a flattened cone. Penis irregular in shape, at the rear a big distended appendix transversely directed or bend anterad. Penial gland as a swelling with short knots (Figs. 409–420). Caution! In some specimens rectal caecum is pocket-like, whereas in others it is longer than wide. Turkey, Greece.
 *Deroceras (D.) malkini* (p. 475)
- Stimulator in the shape of a comb or completely flat fan, or else there are only folds occurring inside penis. ... 39
39. Stimulator in penis in the shape of a long crested structure, its whole base accreted to penial wall (Figs. 299–303). Penis with a small lateral appendix. Greece.
 *Deroceras (D.) karnaniensis* (p. 453)
- Stimulator different. 40
40. Stimulator completely flat, fan-shaped. 41
- Penis lacking stimulator, in the place of which there are only folds of penial walls. 56
41. Penis posteriorly equipped with two appendices or an appendix and a lateral distension. 42
- The posterior section of penis with a single appendix or clear distension, or else there is neither appendix nor distension, penial gland being then the only additional structure. 45
42. Penial gland single, situated laterally. Penis elongated with a hook-like appendix beside which an additional spherical distention occurs. One side of penis often with a dark blot. Spermatheca mostly dark-pigmented in the rear (Figs. 644–650). Crimea.
 *Deroceras (D.) tauricum* (p. 521)
- Penis different. 43
43. Penial gland conical or digital. Penis irregular in shape with different distensions. The posterior end of penis with two more or less distended pockets (Figs. 373–375). France and Spain.
 *Deroceras (D.) levisarcobelum* (p. 466)
- Penial gland composed of a few branches. Penis and appendices different. Spermatheca unpigmented. ... 44
44. Penis posteriorly with two appendices directed posterad. Penial gland made up by a common trunk and two branches divided into 4–8 smaller glandular offshoots. In penis two strongly flattened stimulators parallel to each other (Figs. 156–162). Greece.
 *Deroceras (D.) bistimulatum* (p. 414)
- The posterior part of penis with a cone-shaped appendix slightly bent anterad. The anterior penis section irregularly distended. On the opposite side relative to appendix and close to the vas deferens opening there is a small swelling. Penial gland of a common trunk and 4–5 unbranched processes. Stimulator lobe-shaped, set on a wide base. On the internal wall of penis opposite to stimulator a fold more delicately striated than the former organ (Figs. 89–95). The Greek island of Astypalea.
 *Deroceras (D.) astypalaeensis* (p. 402)
45. A single appendix or at least a distinct distension present in the posterior section of penis. 46
- Posterior section of penis lacking any appendices or a clear distension. 55
46. Penis with a large nearly spherical lateral swelling and a very large finger-like appendix (Figs. 290–291). A black slug up to 15 mm in length. The Greek island of Ikaria.
 *Deroceras (D.) ikaria* (p. 450)
- Penis and appendix different. 47
47. Appendix helically coiled and dark-pigmented. Penis divided in two parts: the anterior – broader and the posterior – narrower. Penial gland of 3–4 unbranched processes. Stimulator with a wide base (Figs. 531–539). The Sudetes and a part of the W Carpathian Mts.
 *Deroceras (D.) praecox* (p. 502)
- Appendix different. 48
48. Appendix as a kind of lateral, transversely situated pocket. Penis resembling that in the preceding species. Simulator on a narrow base (Figs. 591–598). European mountains and foothills from the E Carpathians up to France and Spain, but not the Sudetes.
 *Deroceras (D.) rodnae* (p. 512)
- Appendix in the form of a distension. 49
49. Penial gland composed of a few branches. 50
- Penial gland single, at most with a small lateral branch. 55
50. Penis anteriorly broadened, its posterior part elongated and equipped with a small lateral pocket-shaped appendix. Sometimes on the opposite side of the posterior section of penis an appendix-resembling protrusion. Stimulator tongue-shaped with a wide base (Figs. 541–545). Greece.
 *Deroceras (D.) pseudopanormitanum* (p. 502)

- Penis different. 51
51. Penis somewhat elongated, its anterior section distended and provided with granular glands. The posterior part of penis irregular, its one side distended. Stimulator small but fleshy, its free end broadened and perpendicularly cut (Figs. 401–407). Montenegro.
 *Deroceras (D.) maasseni* (p. 474)
- Penis different. 52
52. Penial gland represented by 4–6 noodle-like processes with poorly developed glandular papillae. The processes are directly connected with penial wall (Figs. 236–242). Ethiopia.
 *Deroceras (D.) gardullanum* (p. 436)
- Penial gland different. 53
53. Penis irregular in shape, its anterior section spherical, posterior narrowed. A small appendix, to which vas deferens opens. Penial gland consisting of two unbranched processes (Figs. 208–212). The Cyclades Archipelago (Greece).
 *Deroceras (D.) cycladicum* (p. 430)
- Penis and penial gland different. 54
54. Penis anteriorly oval or cylindrical, posteriorly deeply laterally constricted. Appendix large, transversely situated. Vas deferens opens apically to penis. Penial gland branched (Figs. 609–618). The Cyclades Archipelago (Greece).
 *Deroceras (D.) seriphium* (p. 514)
- Penis divided in two parts by a very deep indentation. Its anterior section very strongly distended and looking like a separate organ. Penial gland thick, undivided, constituting a prolongation of the narrow, i. e. posterior, part of penis (Figs. 499–502). Greek islands.
 *Deroceras (D.) parium* (p. 490)
55. A unicolour slug, pale or spotted, head and nape mostly evenly black. Stimulator narrowing at the base whereas its free section is symmetrically rounded like a fan (Figs. 635–639). Mainly the Northern Caucasus.
 *Deroceras (D.) subagreste* (p. 517)
- A species very similar to the preceding one but with a darker and denser spotting. Stimulator with a wide base and asymmetrical at its loose end, where a pointed, tongue-like narrowing structure clearly bent towards the base occurs (Figs. 99–126). Transcaucasia and Turkey.
 *Deroceras (D.) bakurianum* (p. 405)
56. Penial internal wall plicate and covered by striation resembling fingerprints. Penis posteriorly clavately distended. Penial gland consisting of 3–8 undivided branches set on a short trunk. Retractor penis single (Figs. 148–155). The Italian Alps.
 *Deroceras (D.) bisacchianum* (p. 414)
- Inside penis a long fold running along this organ. Penial gland as a lobe-shaped or cylindrical structure covered by glandular papillae. Retractor penis forked (Figs. 228–235). Cyprus.
 *Deroceras (D.) famagustensis* (p. 436)
57. The terminal section of rectum abruptly broadened at the place where in many other slugs caecum is situated.
 58
- Rectum lacking caecum or a distinct enlargement in its terminal part. 64
58. Appendix digitate. 59
- Appendix in the shape of an obtuse cone or absent.
 60
59. Penial gland in the form of laterally pressed cone. Penis oval. Appendix digitate, bent (Figs. 199–202). Sometimes rectal enlargement lacking. Cyprus.
 *Deroceras (D.) chryssorroyatissensis* (p. 428)
- Penial gland represented by a ball consisting of thin glandular threads which joins penis through a thick cylindrical shaft. Penis tubular, posteriorly tapering into a hook-like bent appendix. The appearance of stimulator unknown (Figs. 256–258). Ethiopia.
 *Deroceras (D.) glandulosum* (p. 441)
60. Penial gland single, at the most with an inconspicuous lateral offshoot or in the form of a nodule. 61
- Penial gland large, branched. 62
61. Penis oval. Penial gland large, noodle-shaped, single or sometimes bifurcated, with large papillae (Figs. 325–331). Body length up to 17 mm. Greek Kythira Isl.
 *Deroceras (D.) kythirensis* (p. 462)
- Penis usually elongated, without a constriction. In the place where penial gland normally occurs the surface of penis is inconspicuously wrinkled. Stimulator flattened, of a wide base and narrowed free end (Figs. 435–440). Greece.
 *Deroceras (D.) neuteboomi* (p. 478)
62. Penial gland as a short trunk divided into 3–4 long unbranched processes (Figs. 244–248). Greek Gavdos Isl.
 *Deroceras (D.) gavdosensis* (p. 438)
- Penial gland different. 63
63. Penial gland represented by a large cluster of numerous thin furcate processes which are tangled up and situated directly on penis. Penis constricted. Its posterior part narrowed, with a distinct appendix directed posterad (Figs. 269–272). The Greek island of Crete.
 *Deroceras (D.) gorgonium* (p. 445)
- Penial gland in shape of a tuft of numerous unfurcate vasiform processes not covered by papillae. Penis elongated and S-shapedly curved (Figs. 176–181). Corsica (France).
 *Deroceras (D.) cazioti* (p. 424)
64. Penial gland lacking (Figs. 338, 340, 342–343, 345). The posterior mantle margin reaching more or less half the body length. After preservation irregular spots occur on mantle. The aphallic form, which is frequently recorded in this species, sometimes makes whole populations, or the latter are composed of co-occurring aphallic and euphallic specimens. The Holarctic, and – as introduced – nearly the whole globe.
 *Deroceras (D.) laeve* (p. 462)
- Penial gland present. 65
65. Inside penis there are exclusively soft stimulatory structures. 67

- Inside penis, on stimulator there is a hard plate (Figs. 707, 734) (subgenus *Liolytopelte*). 80
66. Penis elongated, vermiform, sometimes coiled or twisted. Its anterior part with a small distension, the posterior section more or less cylindrical. Vas deferens opens approximately at 2/3 penis length. Retractor penis attached at half penis length. On the posterior end of penis single glandular papillae can occur (euphallic form). Caution! Partial or complete reduction of penis is often the case (Figs. 334–349). The posterior margin of mantle reaching roughly half the body length. Its geographical range covers nearly the whole Holarctic. Apart from that, the slug has been introduced almost worldwide, being recorded as a synthropo.
 *Deroceras (D.) laeve* (p. 462)
- Penis different. 67
67. Penial gland lacking. Penis cylindrically elongated, roughly at half its length joined by a specific cylindrical structure with its own muscles. Stimulator cylindrically conical (Fig. 324). Ethiopia.
 *Deroceras (D.) koschanum* (p. 460)
- Penial gland present. 68
68. Penial gland represented by a mamilla-like process. Penis anteriorly egg-shaped, posteriorly worm-like (Figs. 521–528). Gibraltar.
 *Deroceras (D.) ponsonbyi* (p. 495)
- Penis and penial gland different. 69
69. Apart from penial gland, which is hook-like bent anterad, there is a lateral swelling on the posterior end of penis (Figs. 581–587). Body spotted. Algeria.
 *Deroceras (D.) riedelianum* (p. 511)
- Penis different. 70
70. Penis irregularly elongated, with a few swellings, posteriorly nearly hammer-shaped. Penial gland represented by a large club-shaped process of smooth surface. Apart from large conical stimulator, a spirally twisted fold inside penis (Figs. 378–383). Ethiopia.
 *Deroceras (D.) limacoïdes* (p. 467)
- Penis and penial gland different. 71
71. Penial gland single. 72
- Penial gland consisting of a few branches. 73
72. Penial gland in the shape of an unbranched lobular structure with big papillae (Figs. 221–227). Penis divided by a constriction, its anterior and posterior part roughly equal in size. Spanish Cantabria
 *Deroceras (D.) ereinae* (p. 435)
- Penial gland of smooth surface devoid of glandular papillae. Penis different. 73
73. Behind the opening of vas deferens on the posterior end of penis there is a fragment separated from the main part by a constriction and looking as if attached. Spermatheca duct thick, often distended medially (Figs. 281–283). The American State of Oregon.
 *Deroceras (D.) hesperium* (p. 448)
- Penial gland noodle-shaped (Figs. 47–48). Ethiopia.
 *Deroceras (D.) abessinicum* (p. 394)
74. Penis posteriorly with different types of distensions or pockets. 75
- A finger-shaped appendix occurring in the posterior section of penis. 79
75. Inside penis, in the place of the typical stimulator, there is a U-shaped membraneous structure. Penis anteriorly nearly spherically distended and covered by glandular papillae, its posterior section narrow. Penial gland of 2–5 unbranched processes (Figs. 384–394). Portugal and Spanish Galicia and Asturia.
 *Deroceras (D.) lombricoïdes* (p. 470)
- Stimulator conical. 76
76. Penis anteriorly strongly laterally distended, its posterior section with one, more or less marked, lateral swelling. Penial gland large, single or composed of 1–4 branches. Stimulator in the shape of a flattened cone (Figs. 441–443). The Iberian Peninsula.
 *Deroceras (D.) nitidum* (p. 480)
- Penis different. 77
77. Penis irregular in shape. On its posterior section close to the outlet of vas deferens a conspicuous papilla. Penial gland composed of 4–5 short unbranched processes connected to penis without any distinct shaft (Figs. 318–322). Greek islands.
 *Deroceras (D.) korthionensis* (p. 458)
- Penis different. 78
78. Penis laterally deeply indented, with a lateral pocket in the posterior section. Penial gland large, represented by a short common trunk which is divided in two branches, the latter farther forking (Figs. 58–62). Ethiopia.
 *Deroceras (D.) afer* (p. 395)
- Penis oval, sometimes medially constricted. Penial gland repeatedly branched, composed of comparatively short flattened branches adherent to penial walls (Figs. 699–701). The W Pyrenees (Spain).
 *Deroceras (D.) vascoana* (p. 532)
79. Penis very small. Behind retractor insertion and penial gland there is a hook-like bent appendix larger than penis (Figs. 304–309). Kasos Isl. (Greece).
 *Deroceras (D.) kasium* (p. 453)
- Penis thin, with a huge appendix which, being hook-like bent, forms a triangle. Penial gland made up by a few unbranched processes (Figs. 203–205). Caution! The shape of stimulator unknown. Ethiopia.
 *Deroceras (D.) concrementosum* (p. 430)
80. The posterior part of penis dark-pigmented on the background of which two nodulous appendices occur. Penial plate resembling half a bivalve shell (Figs. 716–726). The Caucasus, Iran, Turkey, Crimea.
 *Deroceras (L.) caucasicum* (p. 538)
- Posteriorly, penis with neither a black blot nor two nodules. Penial plate of a different shape. 81
81. On the posterior end of penis, slightly laterally, a variedly long finger-shaped process of smooth surface. Retractor penis forked. The plate inside penis irregularly oval with

growth lines, its one end usually covered by fine papillae (Figs. 707–715). Bulgaria, Roumania.

- *Deroceras (L.) bureschi* (p. 536)
- . No long finger-shaped process present on the posterior end of penis. The hard plate of a different shape. 82
82. The posterior part of penis covered by papillae or with a few distensions. 83
- . The posterior part of penis smooth. 84
83. Penis posteriorly with big papillae. Penial plate oval, with an inconspicuous, more or less bent "ligule"; the whole having smooth margins (Figs. 744–749). Turkey. *Deroceras (L.) trabzonensis* (p. 544)
- . The posterior section of penis with fine papillae. The plate inside penis roughly circular, its margin crenated (Figs. 740–741). Roumania. *Deroceras (L.) occidentalis* (p. 543)
84. Penis posteriorly broadly rounded. Penial plate conically arched, with a somewhat crooked top (Figs. 727–729), its margins smooth. Kandahar. *Deroceras (L.) kandaharensis* (p. 541)
- . Penis pear-shaped. Its posterior, narrower, section sometimes slightly bent. Penial plate flat, semicircular, its less convex margin notched (Figs. 732–738). Roumania, Poland, (?) Ukraine. *Deroceras (L.) moldavicum* (p. 542)

Subgenus *Deroceras* s. str.

Limax subgenus *Deroceras* Rafinesque, 1820: 10.

Malino Gray, 1855: 178. Species typica: *Limax lombricoides* Morelet, 1845.

Hydrotilimax Malm, 1868: 79 (non Haldemann, 1842). Species typica: *Hydrotilimax laevis* = *Limax laevis*.

Arctolimax Westerlund, 1894: 163. Species typica: *Agriolimax hyperboreus* (Westerlund, 1876) = *Deroceras laeve* (Müller, 1774).

Agriolimax Mörch, 1865: 378. Species typica: *Limax agrestis* Linnaeus, 1758.

Plathystimulus Wiktor, 1973: 130. Species typica: *Deroceras subagreste* (Simroth, 1892).

References: Hesse 1926: 21; Pilsbry 1948: 532; Quick 1960: 163; Wiktor 1973: 106; Likharev and Wiktor 1980: 125; Wiktor and Likharev 1980: 418; Wiktor 1989: 101; Wiktor 1996: 85; Wiktor – in print.

Body of varied size, up to 45 mm in length. Mantle covering half the body length or less than that. Skin in some specimens thin, in others thick. Body evenly-coloured or spotted. Mucus colourless, but on irritation some species secrete also an additional cloudy milky-white liquid.

With a few exceptions, penial gland well-developed. Inside penis stimulators of different shape: conical, lobular, fan-shaped; entirely soft and devoid of calcified plates.

A distinct caecum usually present on rectum, but there are species whose caecum is pocket-shaped or lacking in which case the rectum is merely terminally broadened.

Representatives of the genus occur throughout the area inhabited by the family, i.e. nearly the whole Holarctic and a fragment of Ethiopia (Abyssinia).

Within the family Agriolimacidae the subgenus *Deroceras* is the most abundantly represented: at least 98 species known.

Comments. Two groups can be distinguished within the subgenus discussed. Species belonging to one of them have a conical stimulator whereas in those representing the other group the organ is strongly flattened. The difficulty consists in the fact that a few species have their stimulator in the shape of a strongly flattened cone. Originally, it seemed that the slugs with a flattened stimulator always have their caecum reduced to a great extent. It has turned out, however, that although such a correlation is very common, there are certain exceptions. And therefore, the distinction based on the cooccurrence of these two characters has proved unacceptable. The problem has already been discussed by Forcart (1965) and de Winter (1985).

Deroceras (Deroceras) abessinicum (Simroth, 1904)

Agriolimax abessinicus Simroth, 1904: 689 t. 39 figs 6–7, t. 41 figs 98–100. Locus typicus: Schubba Schenna (West – Kaffa = W Kaffa, Abyssinia = Ethiopia). Lectotypus: the specimen shown by Simroth (1904) in t. 41 fig. 100. ZMB no. 102 127. **Present designation.**

Agriolimax gimirranus Simroth, 1904: 691 t. 39 fig. 20, t. 41 figs 94–97. Locus typicus: Schenna Tschukke, West Kaffa, Abyssinia (= Ethiopia). Holotypus: ZMB no. 102 131. **Syn. nov.**

Dimensions: the length of the largest specimen (lectotype) 23 mm, body width ca 7 mm, mantle length 11 mm. Body coloration acc. to Simroth (1904) blackish (schwärzlich) or pale slate blue (blasser schiferblau), unicolour or with few black dots (Punkte). Sole light yellow. As visible in the figure (Simroth 1904 t. 39 fig. 6), the spotting is very characteristic, rarely found in *Deroceras*: there are dots both on mantle and beyond it.

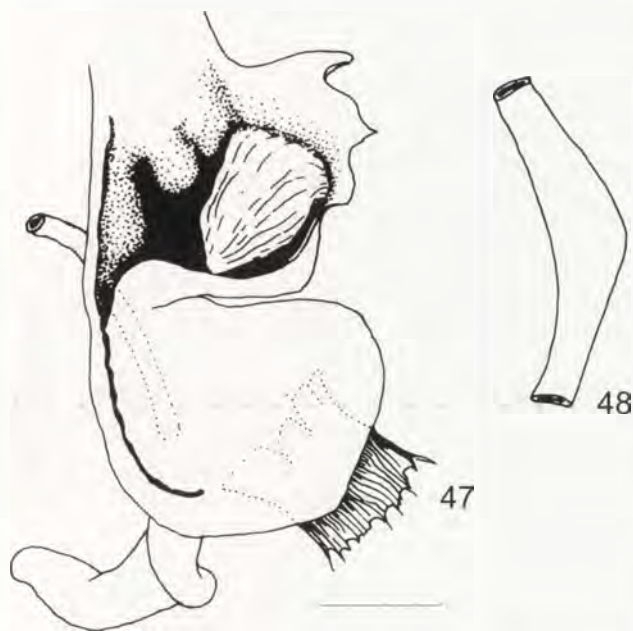
Genitalia (Fig. 47). Penis demonstrates the same characters in the two dissected specimens (the lectotype and a paralectotype). The organ consists of two more or less cylindrically oval parts separated by a lateral groove. The posterior section is joined by an undivided, i.e. unbranched, noodle-shaped penial gland, situated somewhat laterally. The gland lacks papillae (!). Musculus retractor penis short and wide, attached also slightly laterally to penis. The muscle widens fan-like, in the paralectotype dividing into a few short strands. Vas deferens opens laterally too, at the base of penial gland. Inside penis a fairly blunt conical stimulator, which is slightly different from the one illustrated by Simroth (1904).

Caecum on rectum lacking (Fig. 48).

Distribution. The species is known only from Ethiopia.

Comments. All syntypes (4) of *D. abessinicum* have been preserved. Two of them have been dissected, all have lost their original coloration and are now pale creamy, one specimen perceivably dark-dotted.

Only two specimens are partly dissected, which, judging by the figures, has been done by Simroth. The drawings, however, have been made without the use of a drawing apparatus. It is indicated by fig. 99 t. 41 showing penis from the side of body integuments. Retractor penis is not cut off (I have not cut it off either to leave the specimen intact). In this case, although it is possible to look under penis, the organ can be drawn only from one's memory.



Figs. 47–48. *Deroceras abessinicum*. 47 – Penis of the lectotype with stimulator visible inside. 48 – Rectum of a paralectotype with visible inconspicuous enlargement. (Orig.)

Simroth's drawings include the following inconsistencies: in reality stimulator is considerably broader and differently shaped, musculus retractor penis not as clearly forked as seen in the figure but it is widened and divided by a groove (in the other specimen the organ is divided in a few short muscular strands).

A. gimirranus – only one specimen, which is the holotype, is known. Simroth (1904) observed the similarity of this slug to *A. abessinicus* and *A. koschanus*. The author mentioned always paid much attention to body external coloration. *A. gimirranus* differs from *D. abessinicum* in coloration and comes from a different locality. When Simroth (1904) studied *A. gimirranus*, the holotype was pale grey, its upper section ochreous with red-brown infiltration (hell grau, oben ockerig, bezw. rothbraun angehaucht), and covered with clear black dots (Punkten) (at present the specimen is entirely faded). The author also notes whitish concretions showing through the skin. In my opinion, body coloration is a hardly reliable feature. What is important is the character of the pattern. Although the coloration of the two species mentioned differed, the pattern itself, composed of dots, was very similar. Concretions in skin, which Simroth regarded to be of high significance as well, are deposits (of calcium?) that in the case of other species are also present in some but absent from other individuals. For that reason they cannot be considered a taxonomically valid character. We know nothing of the distribution ranges of the two slugs mentioned, their different localities do not suffice for any interpretation, the more so that both were collected in Koffa. In my opinion, the two taxa do not differ from each

other with respect to the appearance of penis, penial gland, retractor penis and stimulator, and thus I do not see the point in distinguishing two species. Therefore, I synonymize the name *A. gimirranus* with *D. abessinicum*, a species described by Simroth on earlier pages of the same publication.

Deroceras (Deroceras) adolphi Wiktor, 1998

Deroceras adolphi Wiktor, 1998: 13 figs 1–9. Locus typicus: at the foot of Char de Ligué Mt. near St. Girons (Ariege, France). Holotypus: MNHW no. MP 668.

A large slug, i.e. up to 33 mm in length, cream-beige or whitish, dark spotted, especially on mantle. Over pneumostom there is an irregular blot (Fig. 49). Behind mantle the spots often produce a reticulate pattern. Skin thick.

Genitalia (Figs. 50–51, 53–57). Penis of irregular shape, with swellings. Adult specimens have a small transverse appendix in the rear part of penis. Penial gland is a large, bent, gradually narrowing process of smooth walls (!), the length of which roughly equals that of a penis half. In juveniles this organ may be shorter but is similarly shaped. It represents as if a penial extension. Inside it there is a longitudinal fold. Vas deferens opens nearly apically. Musculus retractor penis, forked in mature specimens, is laterally inserted to penis, its ramification running to the base of penial gland. In juvenile specimens this muscle does not branch, and is attached only to penis. Stimulator in the shape of a small cone having an obtuse, rounded top.

Caecum on rectum vestigial (Fig. 52).

Ecology. The slug was found in beech wood and other types of deciduous forest, on rock-debris, under stones, by streams.

Distribution. Up till now the species has been known only from the French province of Ariege (terra typica).

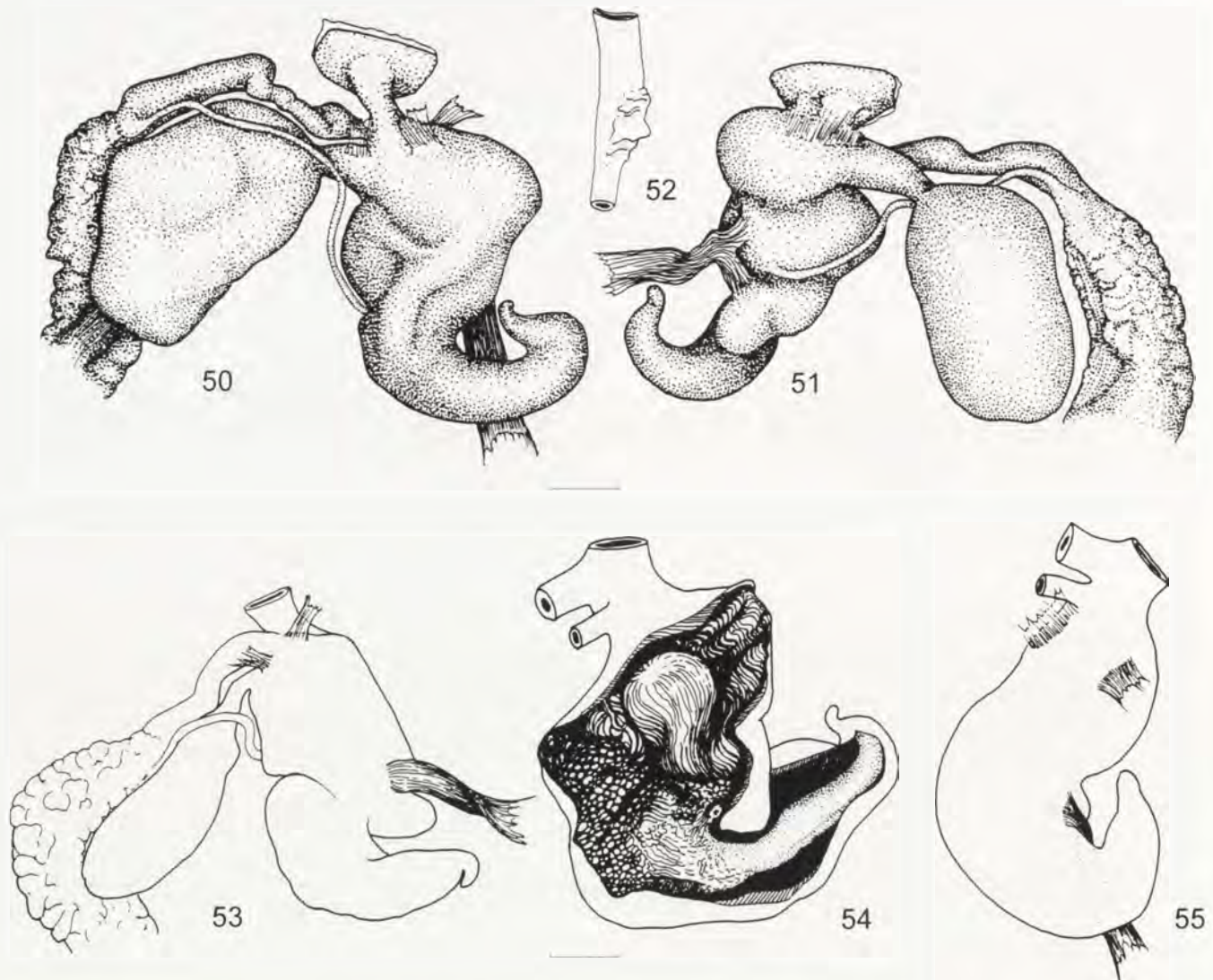
Deroceras (Deroceras) afer (Simroth, 1904)

Agriolimax afer Simroth, 1904: 676 t. 39 fig. 5, t. 41 figs. 56–63. Locus typicus: Gara Mulata, 2500–2700 m a.s.l. (Abyssinia = Ethiopia). Lectotypus: the specimen illustrated in t. 41 fig. 60 (Simroth 1904); ZMB no. 102 132. **Present designation.**

A large slug; in spite of having been contracted during preservation, it reaches up to 33 mm in length, 9 mm in



Fig. 49. *Deroceras adolphi* – lateral view of the holotype. (After Wiktor 1998)



Figs. 50–55. *Deroceras adolphi*. 50–51 – Copulatory organs of the holotype viewed from two different sides. 52 – Rectum of the holotype. 53 – Copulatory organs of a paratype from Moulis. 54 – Structures inside penis of the holotype. 55 – Penises of paratypes from Vallée de Bethmale. (After Wiktor 1998)

width, up to 12 mm in mantle. Lectotype 32.5 mm long. Skin thick. Coloration, according to Simroth (1904), dark brown. However, in the drawing the author shows distinct spotting on mantle. It can be inferred that in the now faded type specimens the dark pigment was once unevenly distributed on mantle, so this region at least must have been spotted. According to the figure, skin furrows in the remaining parts of the body were darker-pigmented. Since this is not visible now, it is possible that, when drawing the furrows, the illustrator just marked them darker.

Genitalia (Figs. 58, 60–61). Penis baggy, laterally deeply indented. The organ's posterior section broad, its one side markedly laterally distended. The enlargement constitutes a deep pocket comparable with appendix and probably homologous with it. A large penial gland situated on the apical end of penis. It is composed of a short common trunk which is divided in two branches, the latter farther forking. In total, the gland has four branches with distinct papillae on

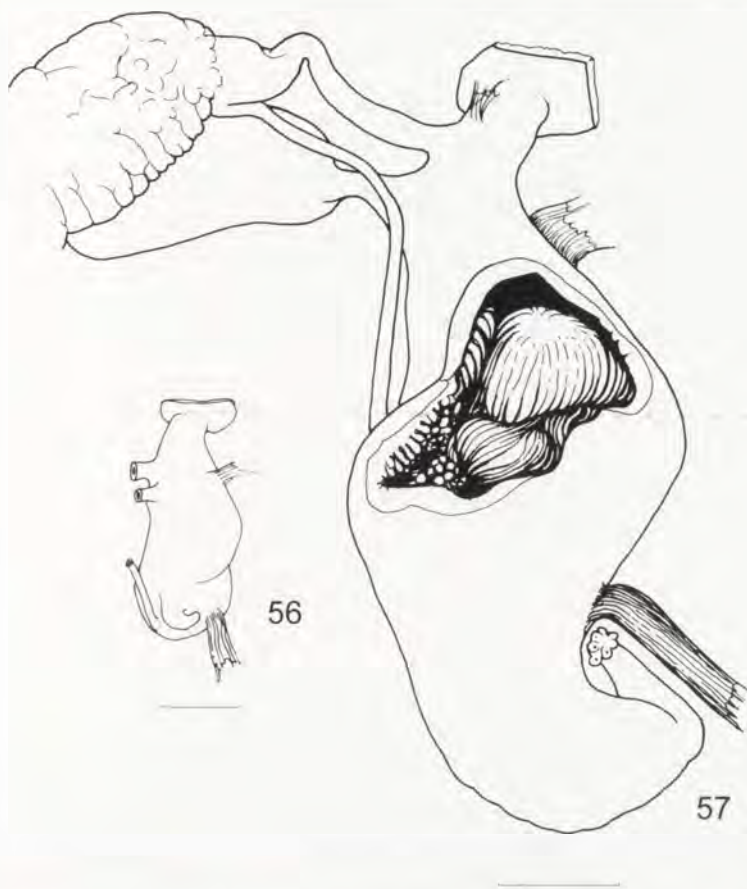
the surface. The gland is so formed in all, i.e. three, dissected specimens. Musculus retractor penis is laterally attached to the mentioned lateral pocket or appendix (Fig. 58). Its insertion is wide, membranaceous, divided into numerous fibres, some of which are inserted also at the base of penial gland. Vas deferens opens under the membranaceous part of retractor. Inside penis a wide, flat and symmetrical stimulator, its free end narrowed, margins curled up (Fig. 61).

No distinct caecum on rectum. In its place there is an inconspicuous bend and a fold (Figs. 59, 62).

Ecology. Unknown but the slug was found high in the mountains at an altitude over 2500 m a.s.l.

Distribution. The slug is known only from locus typicus in Ethiopia.

Comments. Simroth (1904) mentions that he had at his disposal two series of specimens of this slug. One of them, with the locality written on the label, comprised 7 specimens



Figs. 56–57. *Deroceras adolphi*. 56 – Penis of a small paratype from Vallée de Bethmale. 57 – Copulatory organs of a paratype from Mt. Lestelás. (After Wiktor 1998)

all of which have been preserved. From this series I have chosen the lectotype. The other series, of which two specimens have been preserved, have no information on the locality, although Simroth supposed the two had come from the same site.

In his description the author (Simroth 1904) draws attention to a shallow furrow that runs along mantle from its posterior end to pneumostom. Simultaneously he points out that he has observed it in all Abyssinian species. This character is not unique to this group of species: it occurs in many and its manifestation depends, in my opinion, mainly on the way of preservation. It is a fact that in some species the furrow is better perceivable than in others. This character seems to be of minor importance in taxonomy.

Deroceras (Deroceras) agreste (Linnaeus, 1758)

Limax agrestis Linnaeus, 1758: 652. Terra typica: Sweden.

Limacella obliqua Brard, 1815: 118 t. 4 figs. 5–6, 13–15 (after Hesse 1926: 97).

Limax bilobatus Férussac, 1819: 741. 5 fig. 2. Terra typica: environs of Paris (France).

Limax pallidus Schrenk, 1848: 143. Terra typica: Latvia? See also Hesse 1926: 97 and 137.

Krynickillus minutus Kaleniczenko, 1851: 224 t. 5 fig. 3. Terra typica: Sablam (province caucasicae).

Limax veranyanus Bourguignat, 1862: 30 t. 13 fig. 9. Terra typica: neighbourhood of Genoa (Genes – Piémont). Hesse (1926) regards this name as synonymous with *D. agreste*, which is questioned by Bodon, Boato and Giusti (1982), who think that the name is a synonym of a representative of *Limax*.

Limax (Agriolimax) Fedtschenkoi Koch et Heynemann, 1874 (nom. err.): 153 t. 6 fig. 6. Locus typicus: Schahimardan (Turkestan). Type: ZIN = *Agriolimax fedtschenkoi* (nom. emend. Simroth 1886 = *Agriolimax agrestis* var. *fedtschenkoi*: Simroth 1901. See Likharev and Wiktor 1980: 142)

Limax pycnoblennius Bourguignat, 1862: 31. Terra typica: Pyrénées.

Agriolimax transcausicus Simroth, 1901: 155 t. 16 figs. 18–30 map 6. Terra typica: Abkhazia, Georgia, Armenia. Syntypus: destroyed.

Agriolimax transcausicus var. *coeiger* Simroth, 1901: 155 text figs 8–9 t. 16 figs. 18–30. Terra typica: Transcaucasia (non *D. transcausicus* var. *simplex* Simroth, 1901, which is the name used by the author mentioned with regard to different juvenile *Agriolimacidae* of the Caucasus. See Likharev and Wiktor 1980: 145).

?*Agriolimax paradisiacus* Gambetta, 1932: 6. Terra typica: Parco Nazionale Gran Paradiso (Alps, Italy).

Deroceras pojoritensis Husanu, 1967: 92 figs. 7, 7a, 8. Locus typicus: Pojorita (Roumania). Typus: probably not designated. Lupu 1976: 11 = *agreste*.

References: Luther 1915: 1 figs. 5B–D; Hesse 1926: 97 (mentions numerous varietates); Quick 1960: 170 figs. 10B, G, 11D, I, K, M; Wiktor 1973: 121 figs. 45–46, 102–104, 107, 190–199, 241, 278–279; Godan 1979: 26; Likharev and Wiktor 1989: 142 figs. 84–91; Jungbluth, Likharev, Wiktor 1981: 21 t. 3 fig. 4; Kerney, Cameron, Jungbluth 1983: 195 t. 14 fig. 3 map 211; Wiktor 1989: 118 figs. 111–112, 115–125; Castillejo, Garrido, Iglesias 1995: 19.

Length: live slugs up to 40 mm, ca 35 after preservation. Mantle occupies ca 1/3 of the entire body length. Skin sculpture distinct (Figs. 63–64).

Coloration uniform: creamy, whitish or very pale coffee.

Mucus colourless, fairly thick. On irritation another mucus, milky white in colour, is also produced.

Genitalia (Figs. 65–72). Gonad shifted anterad, i.e. not forming the posterior end of viscera. Penis sack-shaped, in older specimens usually laterally narrowed, thick-walled and fleshy. On the surface of the anterior penis part there are no gladular papillae to be seen from the outside. Penial gland in the shape of a small conical nodule or finger-shaped process (never branched) of smooth surface. Vas deferens opens laterally close to penial gland. In the anterior part of penis there is a large, narrowly conical stimulator.

Rectum equipped with a well-developed caecum (Figs. 73–74), at least twice as long as wide, often simply long.

Bionomics. Most often the species is found in open habitats, such as meadows, pastures, mountain alps, but also in gardens, bush thickets, roadside ditches, less often on farmland. As a synthropo, it often occurs along with *D. reticulatum* or *D. sturanyi*. It is an eurytopic species, which is not found in masses. Predominantly, it chooses mesic habitats, occurring mainly in the lowlands, but recorded at least up to 2500 m a.s.l. The wintering stage is egg, the slug matures sexually in the second half of summer and in autumn. It seems to produce 1–2 generations yearly, depending on the duration of vegetation season. It can reproduce uniparentally as well. Its life cycle lasts about one



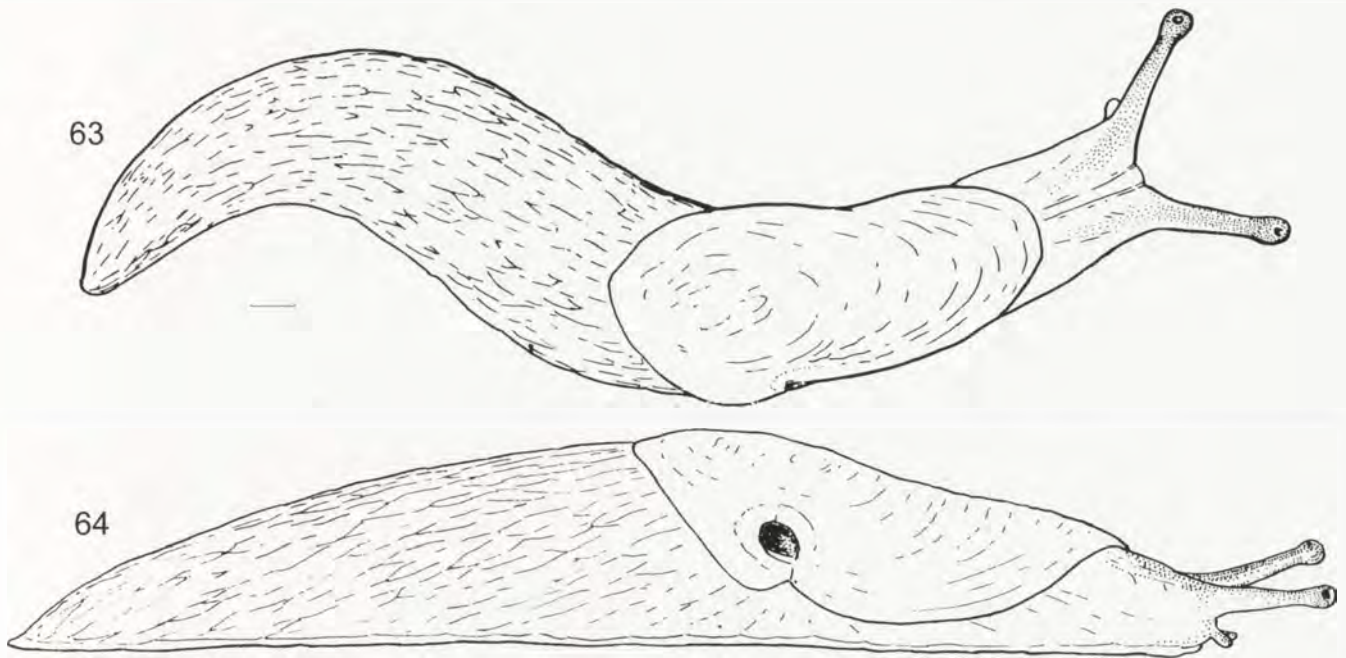
Figs. 58–62. *Deroceras afer*. 58 – Copulatory organs of the holotype. 59 – Rectum of the holotype. 60 – Penis of a paratype. 61 – Penial stimulator of the same paratype as in Fig. 60. 62 – Rectum of the same paratype as in Fig. 60. (Orig.)

year. *D. agreste* is a polyphagous phytophage, feeding on green parts of live plants, their dead remains, fruit, tubers etc.

Distribution. Not entirely known and it is difficult to establish where the species is indigenous and where it has been introduced. It probably inhabits whole Europe, undoubtedly whole Central Europe, the British Isles, Iceland

and Scandinavia, going as far as the Kola Peninsula, the Balkans, Crimea and Central Asia. In the Far East it spreads to Sakhalin and the Kuril Islands.

Comments. *D. agreste* is one of the longest known species and numerous reports on its occurrence probably concerned some other slugs. These are particularly juvenile specimens, not coloured yet, of different *Deroceras* species



Figs. 63–64. *Deroceras agreste* – specimens from Poland. 63 – Dorsal view. 64 – Lateral view. (After Wiktor 1973)

that are misidentified as the one discussed. Most pieces of information about its role as a pest actually concern *D. reticulatum*.

D. pojoritensis – the original description is unclear. Fig. 7 (in the text actually fig. 17 by mistake) depicts genitalia similar to those of *D. agreste*. Fig. 7a (Husanu 1967) is also unclear to me. Lupu (1976: 11) synonymizes this name with *A. transcausicus*, which is confirmed by Grossu (1983: 337). In my opinion, *D. transcausicum* sensu Lupu (1976) and Grossu (1983) represents *D. agreste*.

Deroceras (Deroceras) altaicum (Simroth, 1886)

Agriolimax altaicus Simroth, 1886a: 28 t. 1 fig. 14. Terra typica: Altai.
Agriolimax buchar var. *coeciger* Simroth, 1910: 523 t. 7 figs. 19–21. Terra typica: Tian-Shan and the environs of Lake Balhash (Kazakhstan). Syn-typ: ZIN (Simroth 1886 described two varieties of *A. buchar*: *coeciger*, which proved to be a juvenile *D. altaicum*, and *simplex*, the specimens of which are poorly preserved and indistinguishable – see Likharev and Wiktor 1980: 148).

Agriolimax sibiricus Waldén, 1956: 363 – a new name for *A. hyperboreus* sensu Simroth, 1901 (non Westerlund, 1876). Locus typicus: Jakutsk (Siberia). Typus: ZIN.

Agriolimax altaicus transitorius (Waldén, 1957): 355 figs. 5–15, 18, pl. 1 fig. 28.
Deroceras (Agriolimax) stigmatoida Chen et Gao, 1989: 408 figs. 1–5. Locus typicus: Minxian County, Gansu prov. (34°17'N, 104°25'E), China. Paratypus: ZAS. **Syn. nov.**

References: Uvalieva 1969: 53; Likharev and Wiktor 1980: 146 figs. 92–102.

Body length up to ca 30 mm. General coloration dirty cream, grey, yellow-brownish or blackish, at times with few darker spots which may also occur on mantle. In the posterior body section usually a discernible pattern thanks to the skin wrinkles being darker.

Mucus: not described.

Genitalia (Figs. 75–79, 82). Gonad usually hidden under

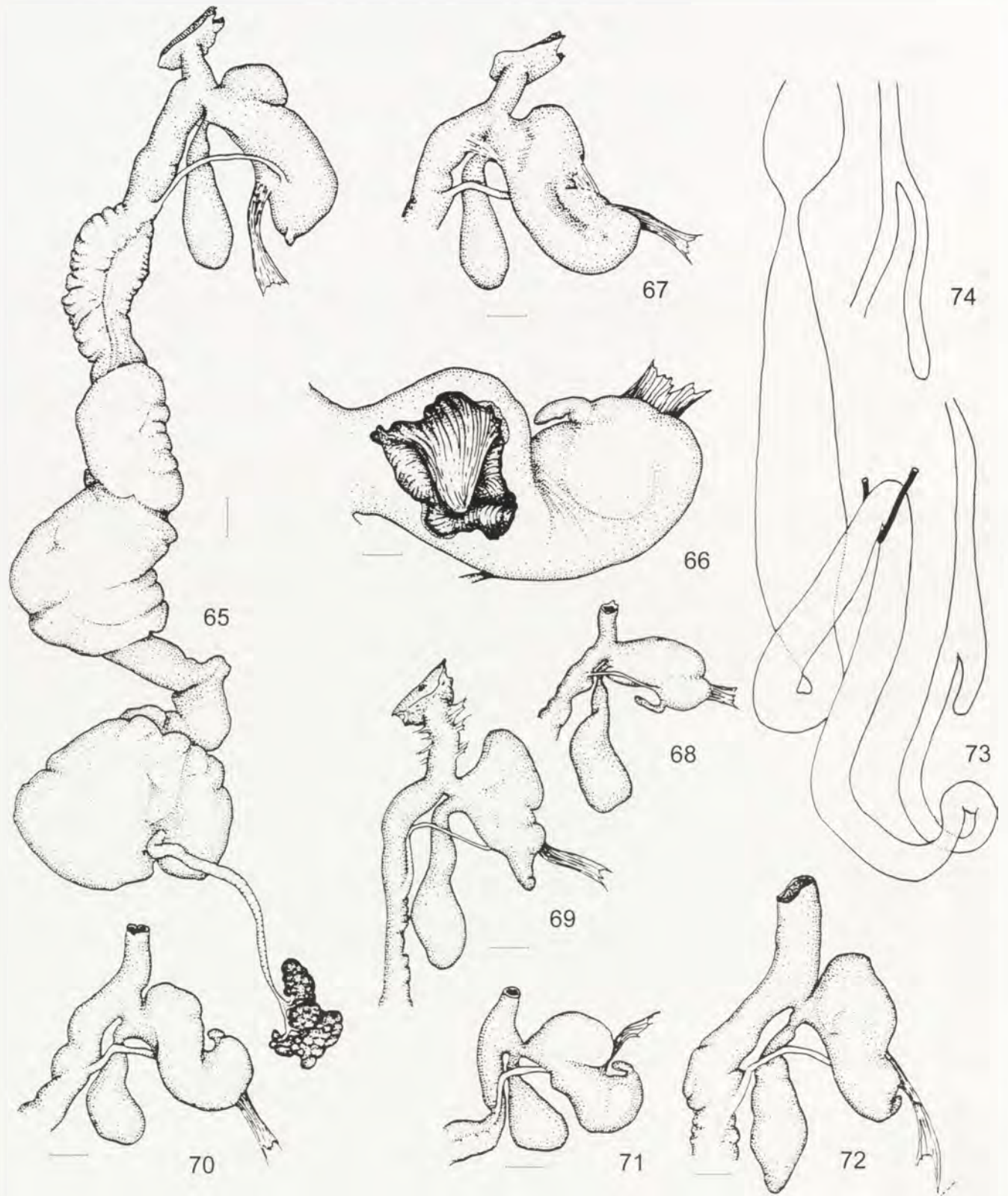
the lobes of liver and, like in *D. agreste*, does not reach the posterior end of viscera. Penis egg-shaped, in older specimens elongated, laterally constricted more or less in the middle. Penial gland small, broad, undivided, with a smooth surface, i.e. not covered by papillae, usually in the form of a bent hook, distorted cone or merely a nodule. Vas deferens opens near the penial gland's base. Musculus retractor penis single (sometimes with a small lateral offshoot), wide, attached laterally to the posterior penis section. Inside the latter organ a longitudinal fold. Spermatheca oval, gradually narrowing into spermatheca duct.

Caecum on rectum (Figs. 80–81) well-developed, at least twice longer than wide.

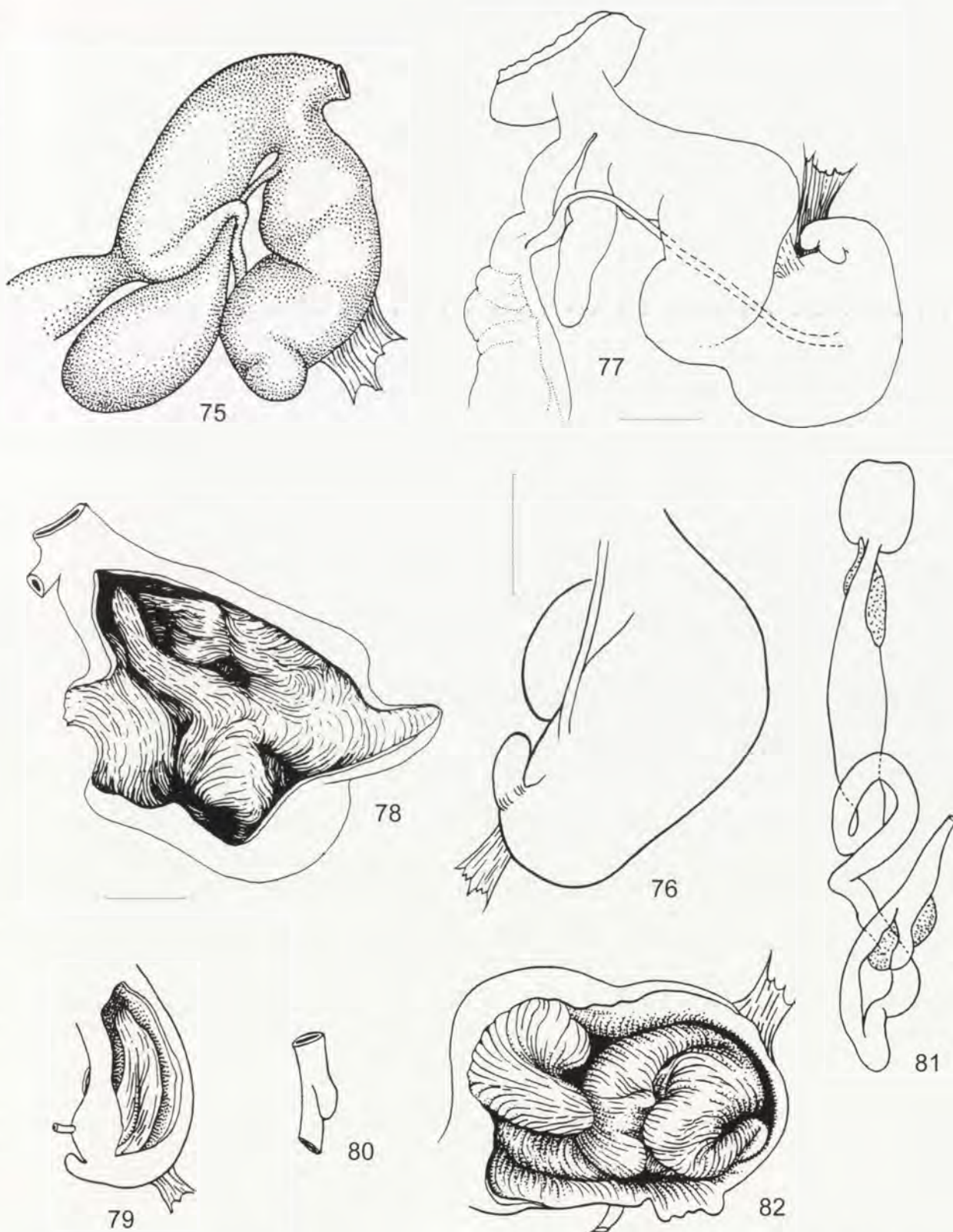
Ecology. Poorly known (Uvalieva 1969). In the Altai the species is found in all vertical zones from the steppe to the alpine zone. It shelters under stones, in leaf litter and rock crevices.

Distribution. Exclusively in Asia – from Kamchatka, Sakhalin, the Kuril Islands and the region of Primorskiy Kray, China to the Yangtse-Kiang River, large areas – if not the whole country – of Mongolia, environs of Lake Baikal in wide sense, the Sayan Mts, Altay Mts, Dshungarskiy Khrebet Mts and West Tyan-Shan Mts.

Comments. A slug very similar to *D. agreste*, both with regard to external appearance and anatomy. The distribution ranges of these two slugs partly overlap. The variability range within the species discussed is not known satisfactorily, and the area it inhabits is huge. As stated by Likharev and Wiktor (1980), it is difficult to ascertain whether *D. altaicum* and *D. agreste* are distinct species or subspecies. The former slug is smaller. Its penis is smaller too, penial gland usually more distended, stimulator different. Describing these characters creates difficulties. However, when the



Figs. 65–74. *Deroceras agreste* – specimens from Poland. 65 – Reproductive system. 66 – Penis with stimulator visible inside. 67–72 – Copulatory organs of different specimens. 73 – Alimentary system. 74 – Rectum with an especially long caecum. (After Wiktor 1973)



Figs. 75–82. *Deroceras altaicum*. 75 – Copulatory organs of the lectotype. 76 – Penis of the lectotype seen from the opposite sides. 77 – Copulatory organs of a specimen from Kanding County, Sichuan Prov., China. 78 – Internal structures of penis of the same specimen as in Fig. 77. 79 – Structures inside penis of a specimen from the Baikal region. 80 – Structures inside penis of *Agriolimax buchar* (= *D. altaicum*). 81 – Alimentary canal of a specimen from "Transbaikalia". 82 – Rectal caecum of a specimen from the Kamchatka Peninsula. (77–78 orig., the other after Likharev and Wiktor 1980)

two slugs are compared directly, the differences are quite obvious.

The synonyms have been established thanks to the types preserved in St. Petersburg (see Likharev and Wiktor 1980: 148) and ZAS.

Deroceras (Deroceras) altimirai Altona, 1969

Deroceras altimirai Altona, 1969a: 104 figs. 2a–f. Locus typicus: Garraf, prov. Barcelona (Spain). Holotypus: NNML no. 5237.

Deroceras altimirai: Castillejo *et al.* 1993: 175 figs. 9–16, 52; Altonaga *et al.* 1994: 118 map 130.

Deroceras altimirai altimirai Altona, 1969: de Winter 1986: 139 figs. 1–2, 36.

References: Castillejo *et al.* 1993: 175 figs. 9–16, 52; Altonaga *et al.* 1994: 118 map 130; Castillejo *et al.* 1995: 16 figs. 27–32.

Body length of live specimens 45 mm (Castillejo *et al.* 1993), after preservation up to 35–38 mm. General coloration creamy, yellow-sallow, in most cases darker on back, with or without a very delicate pattern composed of pigment concentrations. I also collected nearly black specimens (Peña Orel near Jaca, Spain) and so did Castillejo *et al.* (1993). Melanin is distributed in the form of concentrations of melanophores, which, however, do not produce distinct spots. Instead, body is as if sprinkled with a dark pigment (like in *Deroceras barceum* (Gambetta, 1925) or *D. chrysorroyatissensis* Rähle, 1984). The dark pigment is diffused on mantle, also on the plate around pneumostom. It is also present on the remaining part of back, including keel and the rest of back's medial section. Sole in light specimens dirty creamy, in dark ones sole edges sprinkled with the dark pigment (Fig. 83).

Mucus colourless. When irritated, the slug produces also a white secretion. According to Castillejo *et al.* (1993), the other mucus is less milky than in *D. reticulatum*.

Genitalia (Figs. 84–86). Glandula hermaphroditica does not reach the posterior end of viscera (Fig. 87). Copulatory organs, particularly penis, plainly small in relation to the body size (smaller than in the majority of species belonging to this genus). The anterior part of penis in the shape of a laterally swollen sack, with a well-developed glandular part of wall. In the posterior penis section two, different in size, swellings directed sideways. On the one that is somewhat smaller a tiny penial gland, in the shape of a hook-like cone, is situated. At its base there is the opening of vas deferens. An undivided musculus retractor penis inserts to penis between the above mentioned swellings. In the dark-pigmented specimens the posterior section of penis, especially its part directed towards body integuments, is pigmented. Inside penis stimulator in the shape of a large, somewhat laterally flattened cone. On its surface sparse, very distinct striae resembling fingerprints.

Caecum on rectum well-developed (Fig. 87).

Ecology. I collected the slug in mixed forest above 1000 m a.s.l.

Distribution. The distribution range requires a detailed study. The species is known from Catalonia, the environs of Barcelona, from Girona, Manresa, province Castellón

(Altona 1969, de Winter 1986, Castillejo *et al.* 1993), Huesca (Aragon), Benasque. It seems to be quite widely distributed in NW and W Spain (Altonaga *et al.* 1994). I myself collected this slug in the vicinity of Jaca in the Pyrenees, and de Winter (1986) in the French part of this mountain range (dept. Pyrénées Orientales, Hautes-Pyrénées, Haute-Garonne). In France *D. altimirai* occurs also in the environs of St. Giron, prov. Ariège (material at my disposal).

Comments. In de Winter's (1986) opinion, apart from the typical form, there is also a subspecies, namely *D. altimirai levisarcobelum* de Winter, 1986, which differs in its smooth-surfaced stimulator and in caecum, which is vestigial or completely lacking. According to Castillejo, Garrido, Iglesias (1993), these differences are so substantial that the two forms should be regarded as distinct species. Their arguments seem convincing and I am of the same opinion. See the description of *D. levisarcobelum* p. 466.

Deroceras (Deroceras) astypalaeensis Wiktor et Mylonas, 1992

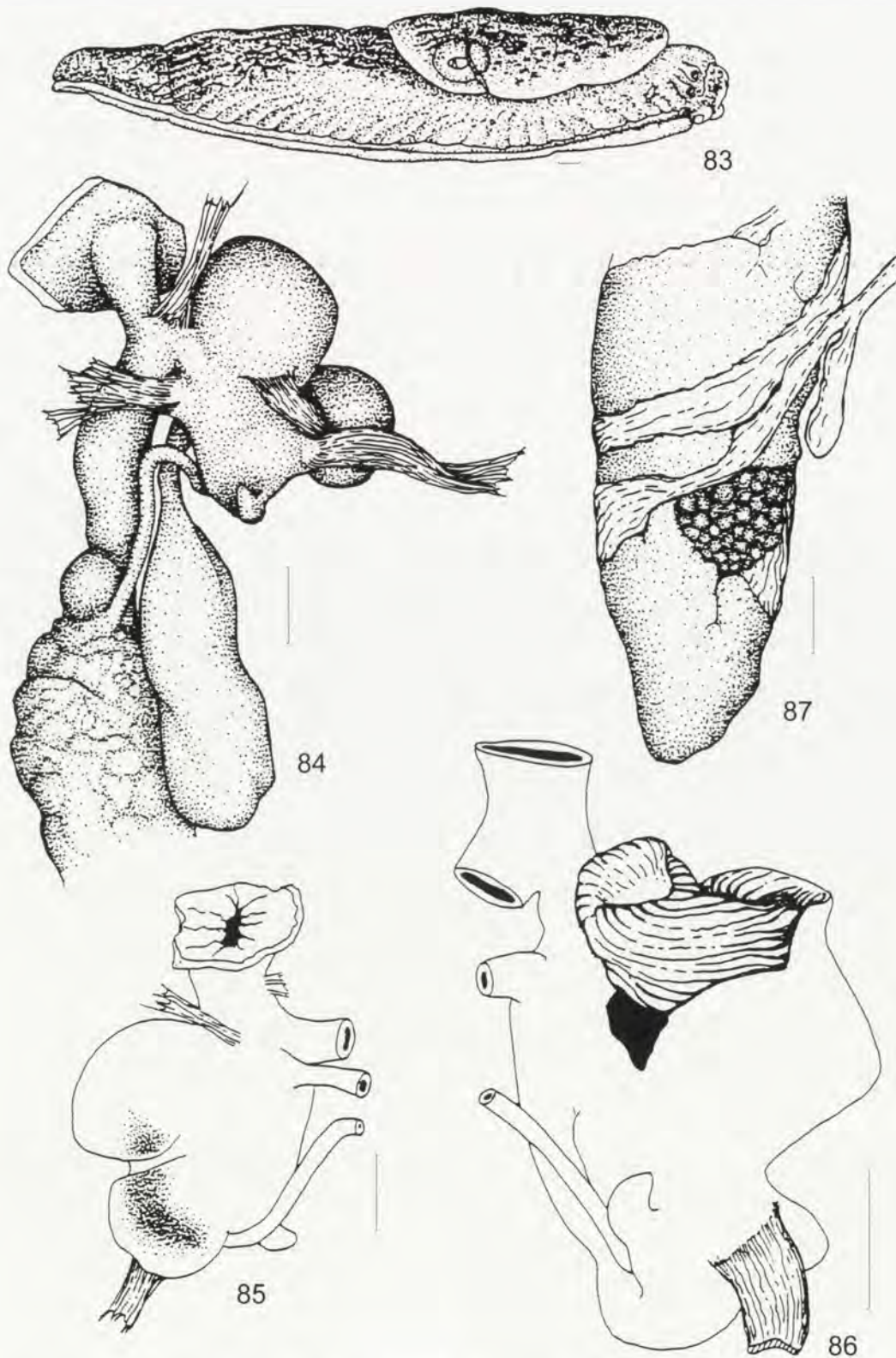
Deroceras astypalaeensis Wiktor et Mylonas, 1992: 1 figs. 1–8. Locus typicus: Agrilithi (Astypalaia = Astypalaea = Stampalia Isl., Dodekanese Archipelago, Greece). Holotypus: MNHW no. MP 630.

References: Wiktor – in print.

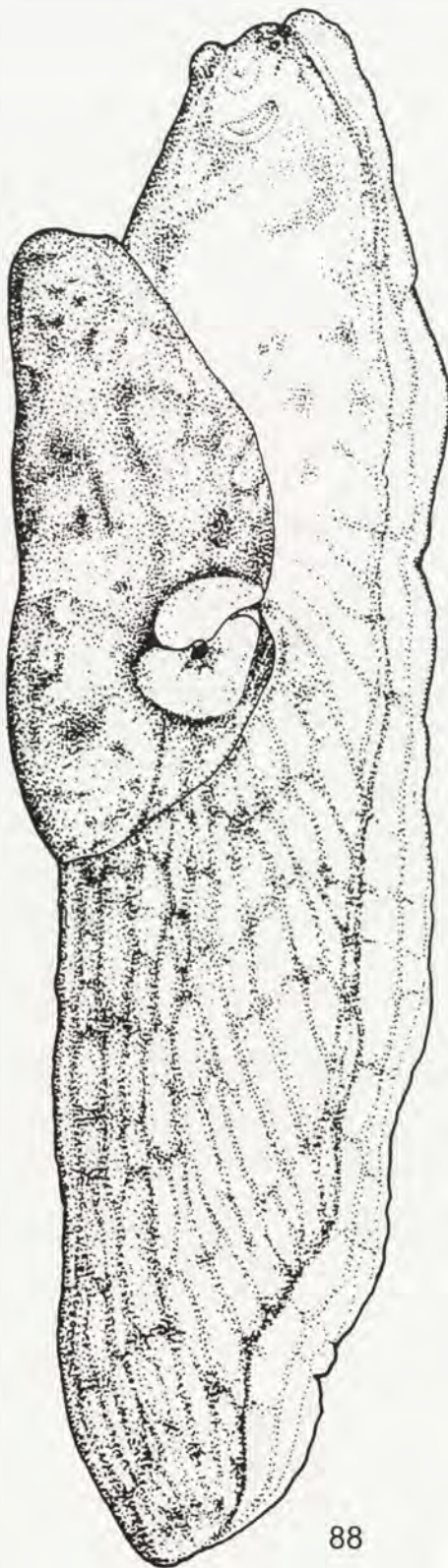
Body length less than 22 mm. General coloration dirty creamy with blackish spots on back, mantle and neck. In the posterior part of back spots form a net-like pattern. The medial section of back in some specimens devoid of spots (Fig. 88). Skin thin and limp.

Genitalia (Figs. 89–91, 93–95). The anterior section of penis irregularly distended. Its walls are partly covered by granular glands and partly transparent with stimulator showing through. More posterad there is a deep lateral penial pocket. The posterior fragment of penis narrow, laterally with a cone-shaped appendix slightly bent anterad and in the opposite direction than that of vas deferens (in order to make the appendix visible, penis should be turned round its axis). On the opposite side of the posterior penis section there is a small swelling, close to which a thin vas deferens opens. On the apical penis end, nearly on its axis, penial gland is situated. It is made up of a thick common trunk dividing into 4–7 unbranched processes covered by glandular papillae. Musculus retractor penis attached laterally to the posterior part of penis, more or less on its longitudinal axis. Posteriorly penis dark-pigmented, the surroundings of appendix in particular. Inside penis a strongly flattened lobe-shaped stimulator, set on a wide base. It is so large that it fills up not only the anterior penis part, but also the lateral pocket. On the internal penis wall opposite to the loose end of stimulator there is a thin fold more delicately striated than stimulator. When penis is everted, two separate structures appear: a wide fan-like stimulator with one side striated and an organ resembling a mushroom with a striated cap, which is probably the posterior part of penis (Figs. 94–95).

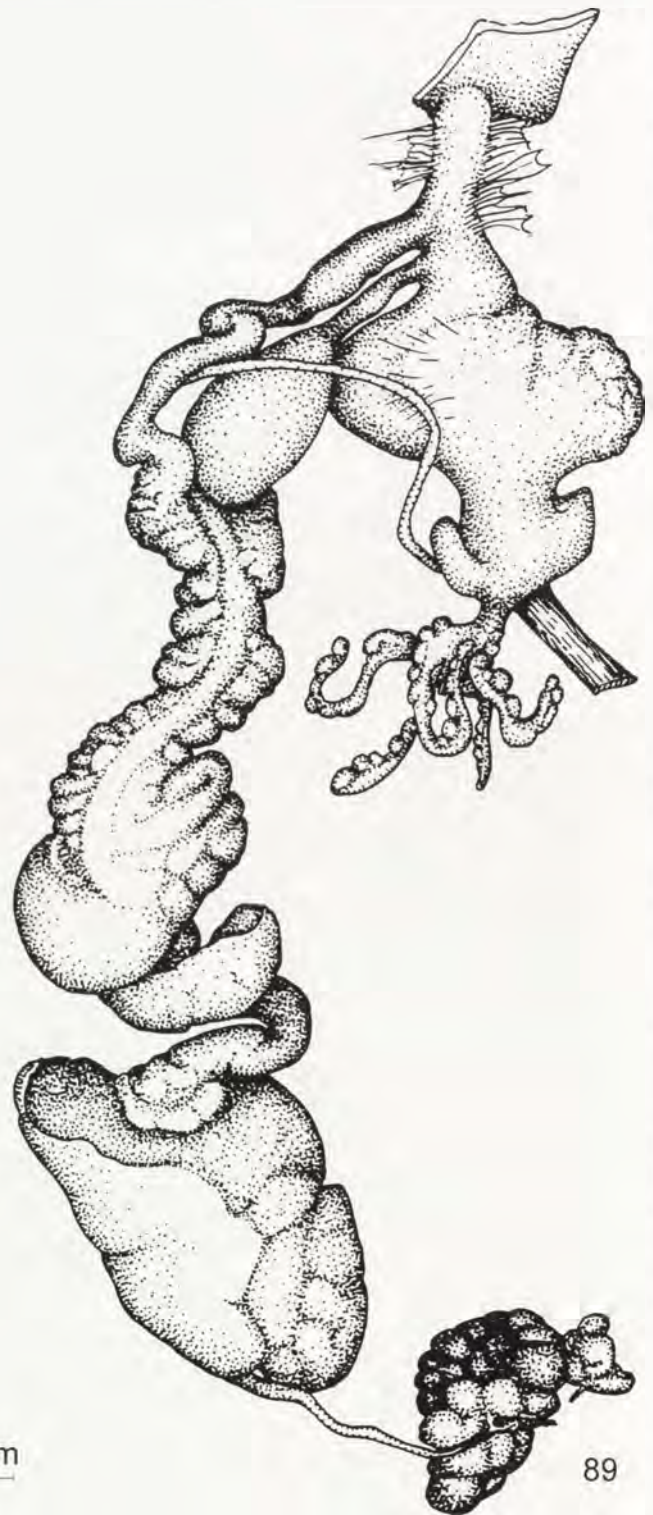
Caecum on rectum reduced to a shallow pocket (Fig. 92).



Figs. 83–87. *Deroceras altimirai*. 83 – Lateral view. 84 – Copulatory organs. 85–86 – Penises of two specimens. 87 – Posterior section of viscera with gonad (the darkest) and rectum along with caecum. (83 after Castillejo *et al.* 1995, 84–87 orig. – specimens from Peña de Oroel near Jaca)

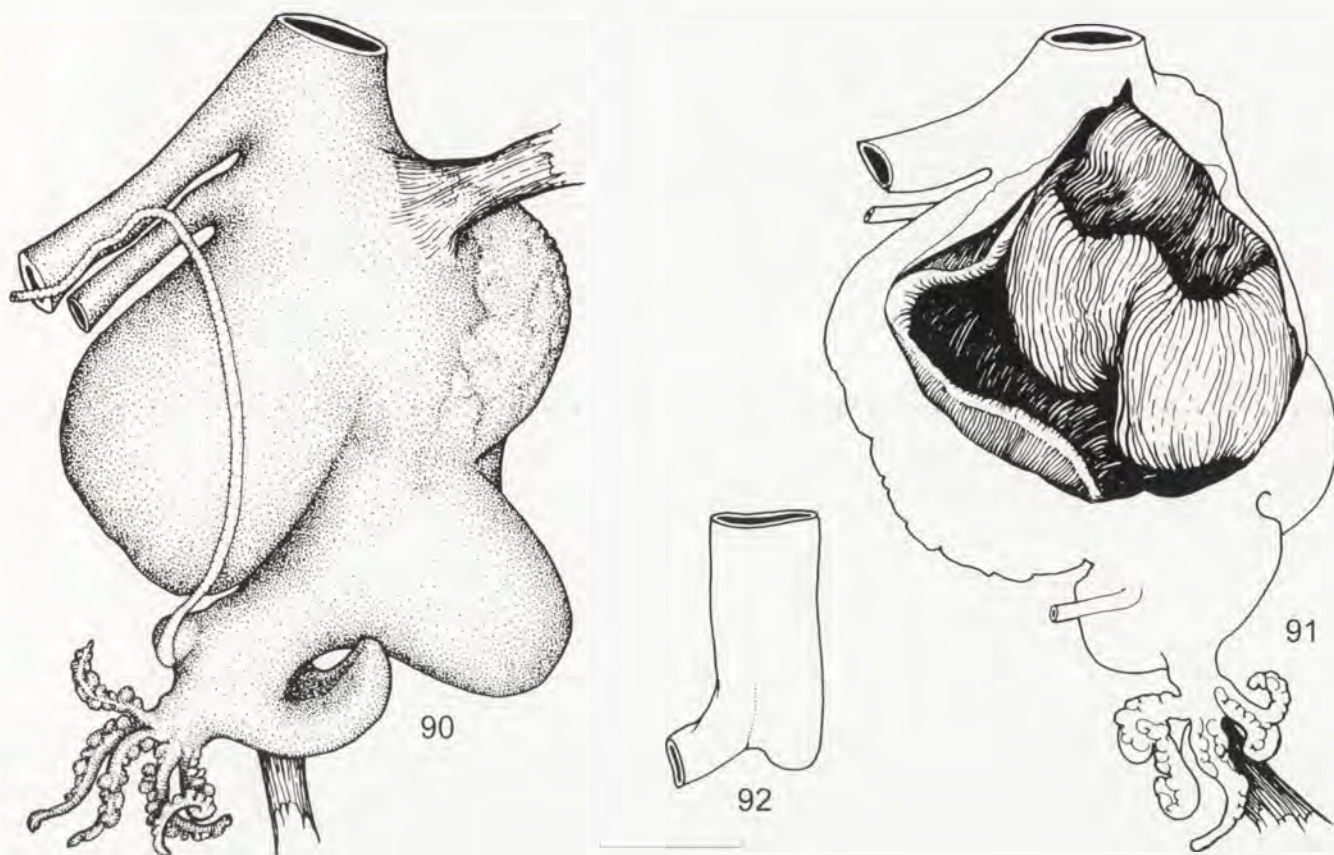


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Figs. 88–89. *Deroceras astypalaeensis*. 88 – Lateral view of a paratype from Agrilithi. 89 – Reproductive system of a paratype from Astypalaea. (After Wiktor and Mylonas 1992)



Figs. 90–92. *Deroceras astypalaeensis*. 90 – Penis of the holotype. 91 – Penis with visible stimulator of a paratype from Agrilithi. 92 – Rectum of the same paratype from Agrilithi. (After Wiktor and Mylonas 1992)

Distribution. The species has been known since recently, and exclusively from Astypalaia Isl. (Greece).

Comments. Considering the anatomy of penis, certain similarity of *D. astypalaeensis* to another species occurring in the Dodekanese Archipelago, namely *D. samium*, can be observed. The similarity consists in the presence of a lateral pocket of penis, short appendix, similar penial gland, broad stimulator and small caecum. However, *D. samium* is about twice bigger, entirely black, its lateral penial pocket is larger, appendix directed towards vas deferens and eversion of penis reveals only a single fan-shaped stimulator. Besides, this species has not been recorded from Astypalaia Island so far.

Another slug slightly resembling the one discussed is *D. bistimulatum*. It is also small and spotted, and its penis when everted shows a large flat stimulator with two distinct centres of striation on the surface. Penis itself, however, looks different as it has two appendices directed posterad. Stimulator and the fold opposite its loose end are nearly of the same size and identically ornamented. This species is recorded from the Chánia Mts near Volos in continental Greece.

Deroceras (Deroceras) bakurianum (Simroth, 1912)

Agriolimax bakurianus Simroth, 1912: 40 t. 3 fig. 34, t. 7 fig. 23. Locus typicus: Bakuriani near Borzom (Georgia). Lectotypus: ZIN.

Agriolimax schemachensis Simroth, 1912: 41 t. 3 fig. 35, t. 7 fig. 24. Locus typicus: Fit-dagh (= Fittag Mt. near Shemakha, Azerbaijan). Syntypus: ZIN.

Agriolimax roseni Simroth, 1912: 41 t. 3 fig. 36, t. 7 fig. 25. Terra typica: Turkey (Ardanué and Eznos-jaila near Oltu). Syntypus: ZIN.

References: Likharev and Wiktor 1980: 158 figs. 116–127; Wiktor 1994a: 13 figs. 22–26.

Body length up to 23 mm, that of mantle slightly exceeding 7 mm. Coloration varied. Body densely covered by big dark diffuse blots (particularly adult specimens) so that the slug creates the impression of being chocolate or black (Figs. 96–98). Some individuals from Turkey are lighter, their body covered by smaller spots. The dark pigment occurs in the region of head and neck, but also on sides and – obviously – on mantle, whereas keel and the medial part of back on the former's extension remain creamy. In juvenile specimens the dark pigment may produce a net-like pattern. Sole in especially dark individuals has lateral zones grey, often with clusters of dark spots. Its medial zone remains light.



Fig. 93. *Deroceras astypalaeensis* – stimulator of a paratype from Ag. Konstantinos. (After Wiktor and Mylonas 1992)

Genitalia (Figs. 99–105, 107). Gonad does not constitute the posterior end of viscera. Penis globular or oval, not constricted, at most with an inconspicuous lateral concavity. Penial gland mostly single, rarely bifurcate. It is shaped as a thick "noodle", usually bent, with few glandular papillae. The gland is connected with penis somewhat laterally or apically. Musculus retractor penis wide and single, i.e. unforked. It joins penis slightly below its apical end. Penis filled up with a huge flat stimulator. It has a wide base and is asymmetrical at its loose end as on one side there is a flat, tongue-like narrowing and pointed structure, clearly bent towards the stimulator base. It may give the impression as if there were an additional process on stimulator, or else it is merely an extension of the free edge of stimulator. In adult specimens the whole stimulator is usually dark grey or black. In specimens not entirely grown both penial gland and the appearance of stimulator may not show all the above mentioned characters.

Caecum on rectum short, pocket-shaped. It is not uncommon for it, however, to be fairly long, even twice as long as wide (Fig. 106).

Ecology. The slug inhabits mainly wet and mesophilous deciduous (beech, oak) and mixed forests, less frequently coniferous stands and river valleys.

Distribution. The species occurs in the Transcaucasia from Sochi and Batum to western Dagestan (up to Tlyrata). It is not recorded from the Talich Mts or Lenkoran lowlands. In the south it is found in Turkey along the Black Sea coast (vill. Trabzon, Ordu, Samsun, Kastamonu).

Comments. A species characterized by variability of external appearance and anatomy. It is most similar to *Deroceras subagreste*, which differs in the lack of spots or a smaller number of them, and in a blackish or black blot occurring on the posterior end of penis. Its musculus

retractor penis is forked. Stimulator, which is set on a narrow base, fan-shapedly broadens towards the loose end. The organ is asymmetrical and without any bent tongue-shaped structure, the whole of it being light in colour.

Deroceras sp. (cf. *bakurianum*)

In the NMW collection there is a series of 6 slugs with two labels, one of them reading: "Hamadan, 1970. Österr. Iranexp. 25.IV", the other: "*Deroceras reticulatum* (Müll.) det. Dr L. L. Forcart (verschleppt?)". Most certainly, these specimens do not belong to *D. reticulatum*. They resemble *D. bakurianum*, differing from this species in their definitely long rectal caecum (Figs. 117, 124, 126). It cannot be excluded that in the future these slugs will turn out to be a distinct, now unknown species.

Dimensions: body length up to 21 mm, width ca 4 mm, mantle length up to 7 mm. Skin soft and thin. Coloration uniform, in most specimens light creamy (this may be an effect of fading as the slugs were collected 29 years ago). One of the specimen has its back evenly brown-coloured. In some specimens remains of blackish colour perceivable on nape.

Genitalia (Figs. 110–114, 118–123, 125). Penis looks exactly like this organ in *D. bakurianum*. The similarity concerns the shape of penis, appearance of penial gland, situation of the outlet of vas deferens and retractor insertion. Inside penis there is a stimulator in the shape of a very broad completely flat fold. In its anterior part the "fingerprints" are arranged in the same way as in the conical stimulator, although this section of the fold is entirely flat. Somewhat more posterad the other part of the same fold is falciformly elongated and tongue-like terminating (Fig. 125). The stimulator resembles that occurring in *D. bakurianum*. No dark blot on penis.

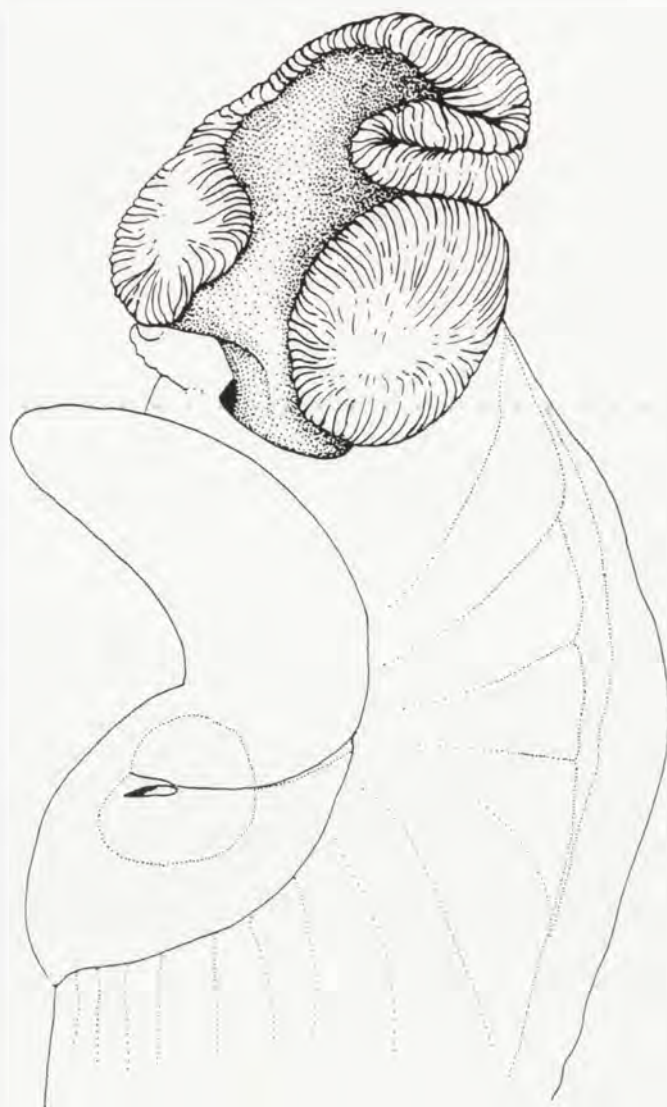
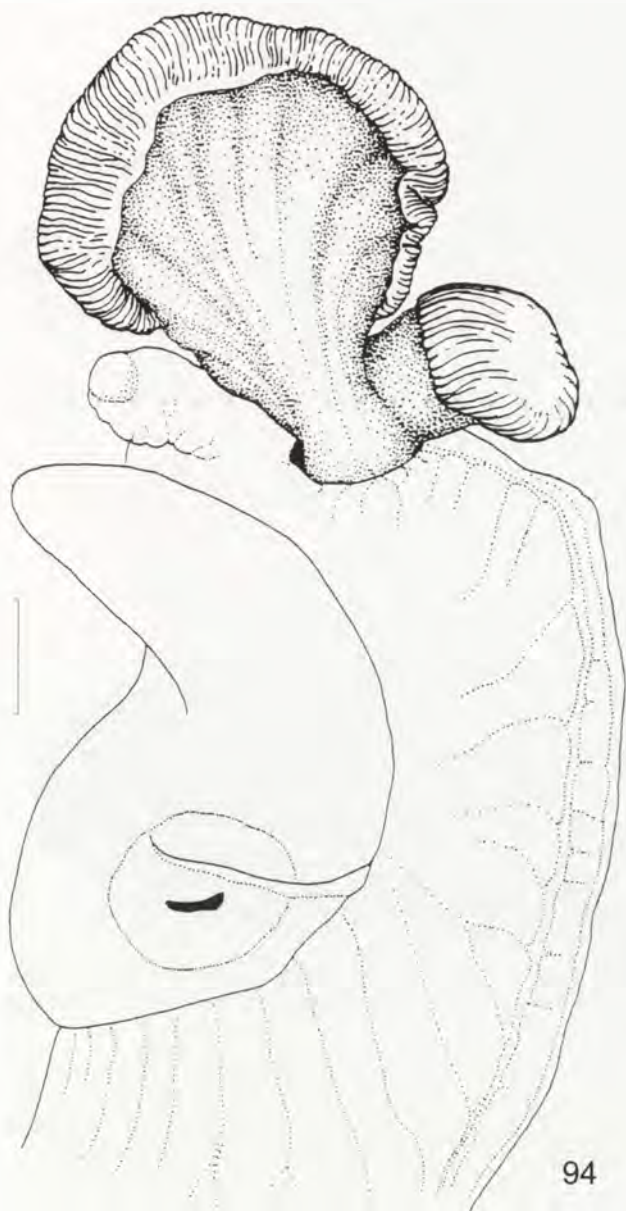
Caecum on rectum exceptionally long (!) (Figs. 117, 124, 126), reaching nearly the end of viscera, without parallel in other *Deroceras*. Yet, sometimes it is pocket-like.

Comments. Hardly anything is known about *Agriolimacidae* of this part of Iran. The slugs discussed above seem to be close to *D. bakurianum*. This species probably penetrates deep into eastern Turkey, but the localities in Hamadan are far more easterly, the air distance equalling ca 1000 km. The examined specimens differ morphologically from *D. bakurianum* in their long caecum, and also in coloration. It raises certain doubts if they represent this species. However, it is worth remembering that *D. berytensis*, for instance, comprises forms of varied lengths of caeca but very similar genitalia (see Wiktor 1994 and p. 408 of this paper).

Deroceras (Deroceras) barceum (Gambetta, 1925)

Agriolimacx barceus Gambetta, 1925: 7 figs. 1a–c. Terra typica: "parte orientale delle Cirenaiica" (Sidi Garbaa, Derna, altopiano di El Feteja). Neotypus: NNML.

References: Altena 1962b: 53 figs. 2–3a–e; Rähle 1984: 45 figs. 1a–f.



Figs. 94–95. *Deroceras astypalaeensis* – everted penis with its internal structures, different positions – a paratype from Chora. (After Wiktor and Mylonas 1992)

Body length up to 28 mm. Coloration dirty cream or brownish with darker (brown or blackish – my specimens were faded) melanophores, which do not form distinct dark spots: body is as if sprinkled. Such accumulations of melanophores occur both on mantle and back, but only along skin grooves.

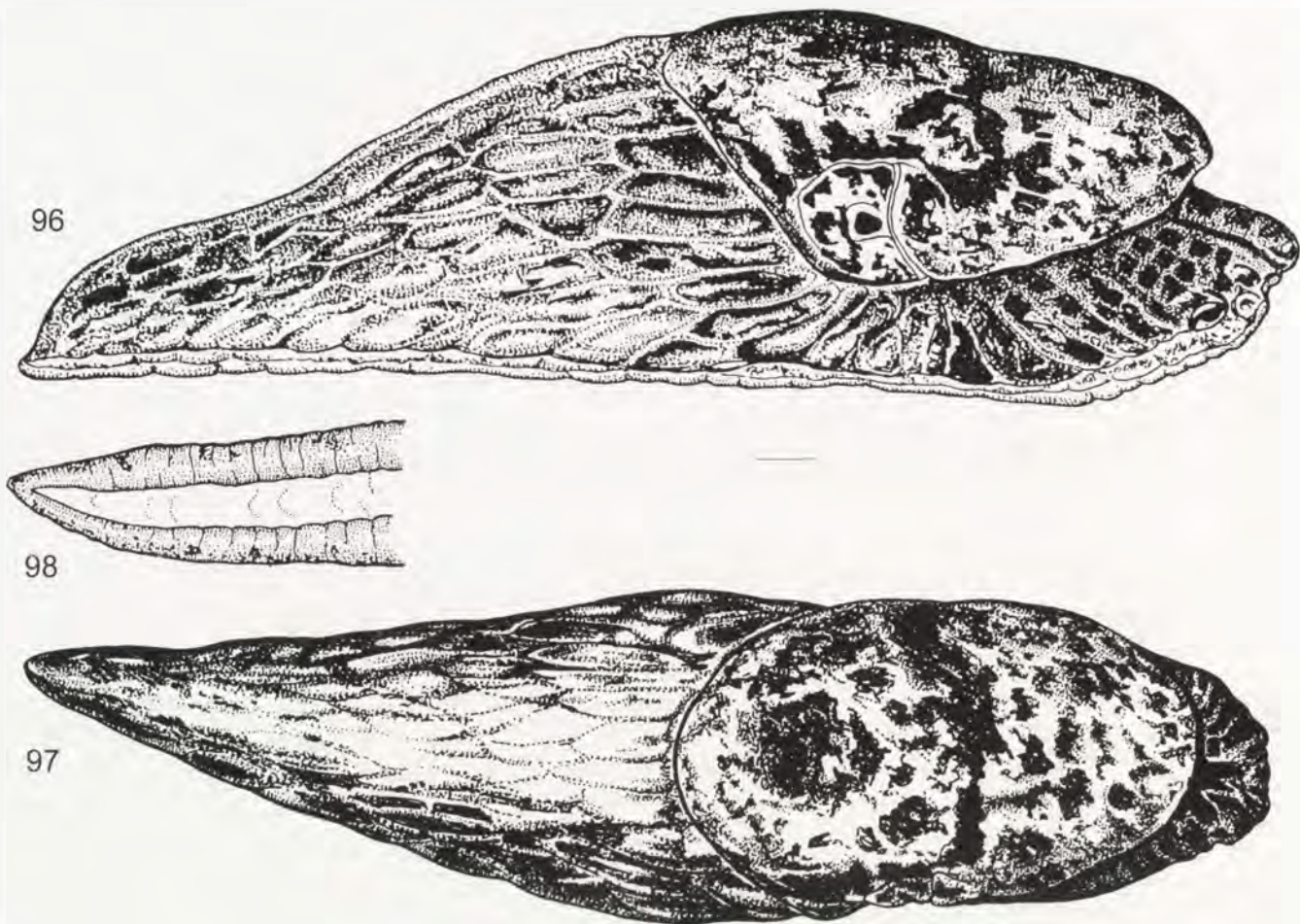
Genitalia (Figs. 127–129, 132–134). Penis strongly distended anteriorly, nearly spherical. One wall with plainly visible glands. The posterior penis section narrowed, in the shape of a cylindrical appendix of varied size. At its base, i.e. near the junction with the spherical part, a large penial gland composed of a few branches is laterally set. The longest branch may be longer than penis itself. A thin vas deferens opens laterally more or less in the middle of

appendix. This is also the place where musculus retractor penis is attached. This muscle is unbranched, but – as accreted to the walls of appendix – stretches as far as the spherical section of penis. Inside the latter's anterior part there is a fleshy, conical stimulator of striated surface.

Caecum on rectum (Fig. 130) in the shape of a vestigial, very shallow pocket.

Distribution. Cyrenaica (Libya).

Comments. A slug of a very characteristic coloration produced by melanophores which are not accumulated in distinct spots. Penis is typical by its large appendix and huge penial gland. In the first description (Gambetta 1925) there is a mention of 5 branches of penial gland clustered in two different groups. Like the specimens dealt with by Altena



Figs. 96–98. *Deroceras bakurianum* – a specimen from the environs of Batum (Georgia). 96 – Lateral view, 97 – Dorsal view, 98 – Posterior sole section. (After Likharev and Wiktor 1980)

(1962), those that I have examined have this gland composed of three branches: one longer and two shorter ones.

Rähle (1984) described *D. chrysorroyatissensis* from Cyprus, a slug bearing much similarity to *D. barceum* (see Comments p. 406).

Deroceras (Deroceras) berytensis (Bourguignat, 1852)

Limax Berytensis Bourguignat, 1852: 10 and 1853: 5 t. 1 figs. 5–7. Locus typicus: Beirut – “circa urbem Berytum” (Lebanon). Syntype: thoroughly dried up; NHMG. Neotypus: NNML.

?*Limax Phoeniciaca* Bourguignat, 1852: 9. Locus typicus: “Berytum” (Beirut).

?*Agriolimax* (s. str.) *Pentheri* Babor, 1905: 3 (Separata – Abdruck). Terra typica: Erciyas Dagi Mts (Lifos Mt. and Derwent near Tekir, Vil. Kayseri, Turkey). Lectotype: NMW no. 39449. See Wiktor 1994: 19 figs. 46–58.

?*Agriolimax cyprius* Simroth, 1906: 86. Terra typica: Cyprus Isl. Syntypus: presumably does not exist.

?*Agriolimax Pallaryi* Pollonera in Germain, 1911: 142. Terra typica: Lebanon (Amchit, Beirut). See also Germain 1921: 77 t. 2 figs. 5–6, t. 3 figs. 2, 5.

?*Agriolimax damascensis* Germain, 1911: 141; 1921: 73 pl. 2 fig. 2, pl. 3 fig. 4.

?*Agriolimax Steindachneri* Wagner, 1931: 196. Locus typicus: Samsun (Turkey). Lectotypus: NMW no. 16010. See Wiktor 1994: 22 figs. 59–62.

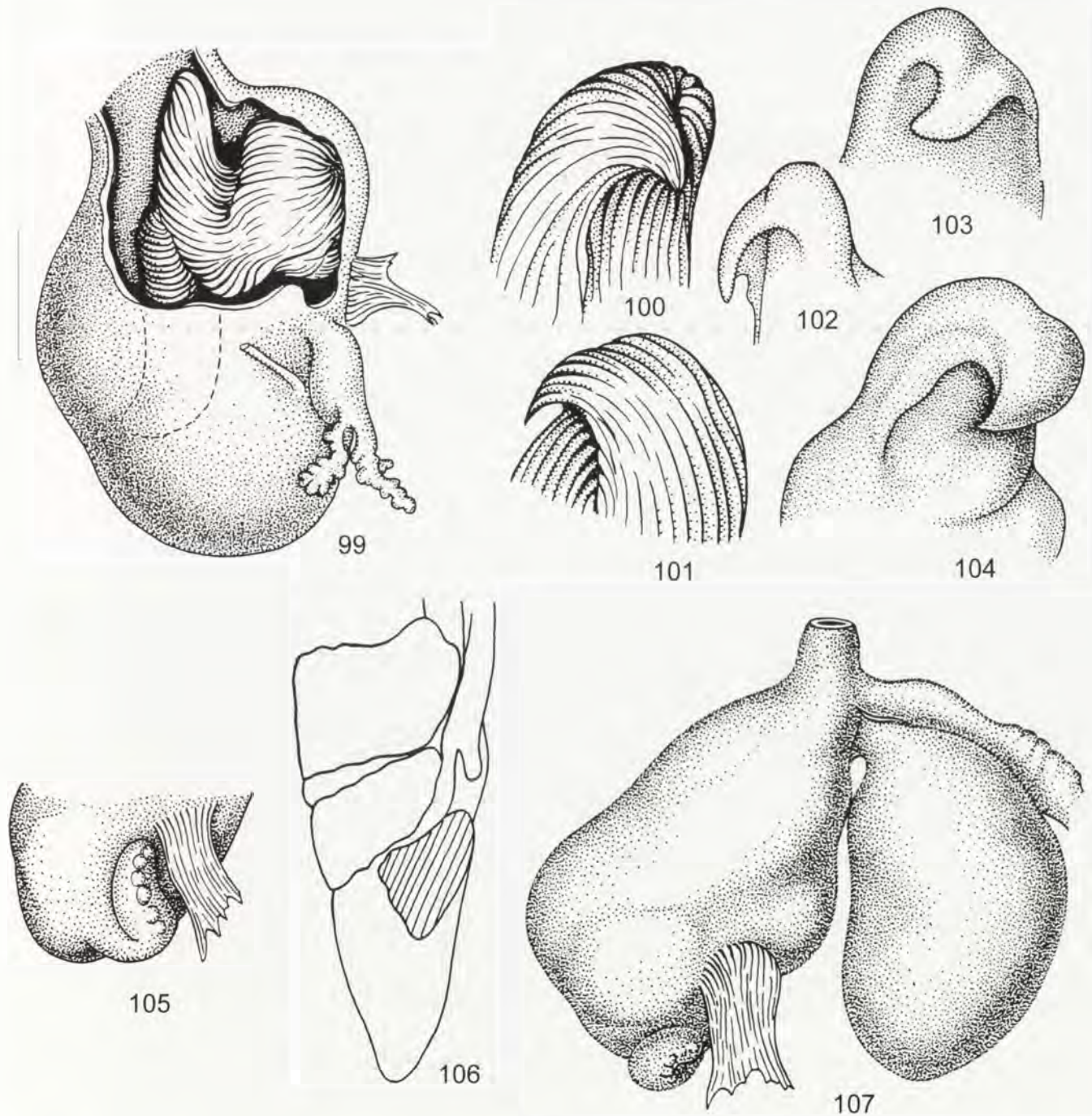
Agriolimax (Agriolimax) jordanicus Wagner, 1940: 285 fig. 1. Terra typica: above the Jordan River near the Sea of Galilee. Holotypus: probably non-existent.

Deroceras grossui Reischütz, 1975: 25 figs. 1–4. Locus typicus: Afyon Karahisar (by the road Karahisar-Isparta, Anatolia, Turkey). Holotypus: SMF no. 236606. **Syn. nov.**

References: Simroth 1889a: 15 figs. 5, 14–15; Wagner 1937: 385, figs. 7–9 (*D. Steindachneri*); Wiktor 1971: 272 figs. 5a–c; Likharev and Wiktor 1980: 187 figs. 195–199 (*D. (?) steindachneri*!) and 185 figs. 189–192 (*D. (A?) pentheri*); Rähle 1984: 48 figs. 2a–j (*D. cyprium*); Wiktor 1994: 16 figs. 37–62.

Length up to 32 mm. Coloration: back black or blackish, sides getting lighter and lighter downwards, or body mucky-grey with a blackish pigment concentrated in skin grooves. Mantle nearly evenly covered by small melanophores, which make it look slightly soiled. Sole in the black specimens with lateral zones blackish, the medial one being markedly lighter; in the mucky-grey specimens the whole of sole is light.

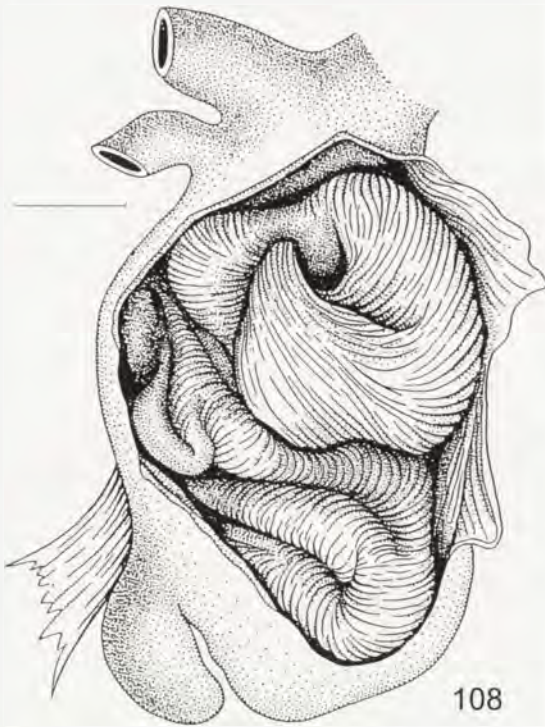
Genitalia (Figs. 135–137, 139–144, 146). In the dark specimens spermoviductus is dark as well. Penis oval, often laterally distended in its anterior section, which results in a lateral constriction and the whole organ being of varied



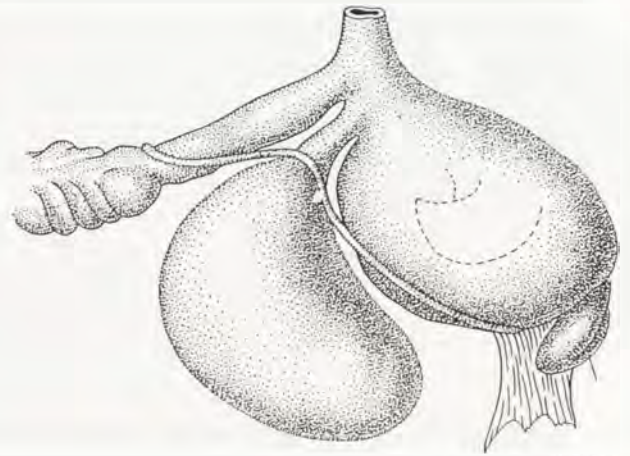
Figs. 99–107. *Deroceras bakurianum* – specimens from the environs of Batum (Georgia). 99 – Penis with partly visible stimulator. 100–104 – Stimulator in different positions. 105 – Posterior end of penis. 106 – Posterior end of viscera with visible gonad (hachured) and rectum along with its caecum. 107 – Copulatory organs. (After Likharev and Wiktor 1980)

irregular shape. The broadly distended anterior part is connected with a considerably narrower, nearly cylindrical, posterior one. A black blot often occurs at the posterior penis end. Penial gland composed of a common trunk and two undivided branches. Vas deferens opens laterally in the posterior section of penis. Similarly musculus retractor

penis is inserted. Inside penis a large, flat, fan-shapedly widening stimulator, which almost entirely fills up the organ mentioned. At its back stimulator is joined by a twisted fold, both structures having a distinct sculpture which resembles fingerprints. Spermatheca duct turns into spermatheca without any perceivable border.

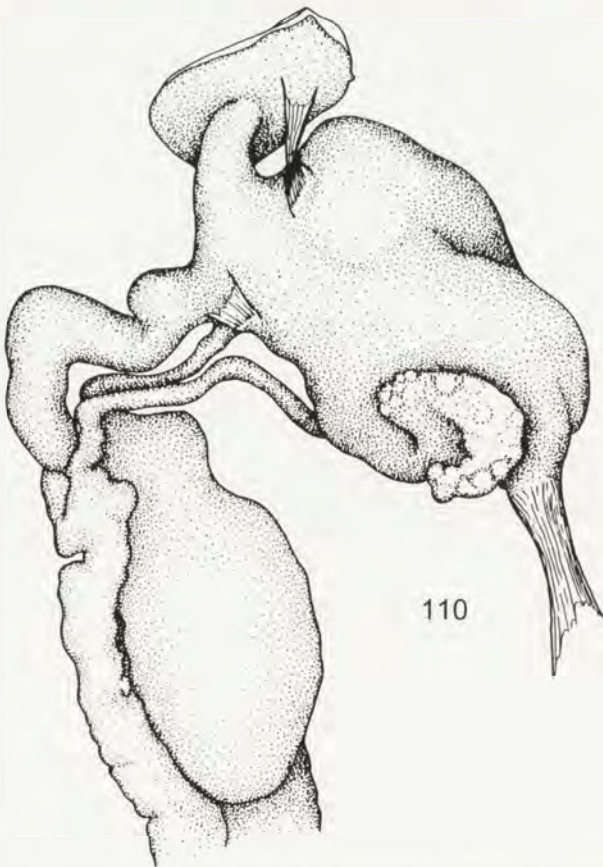


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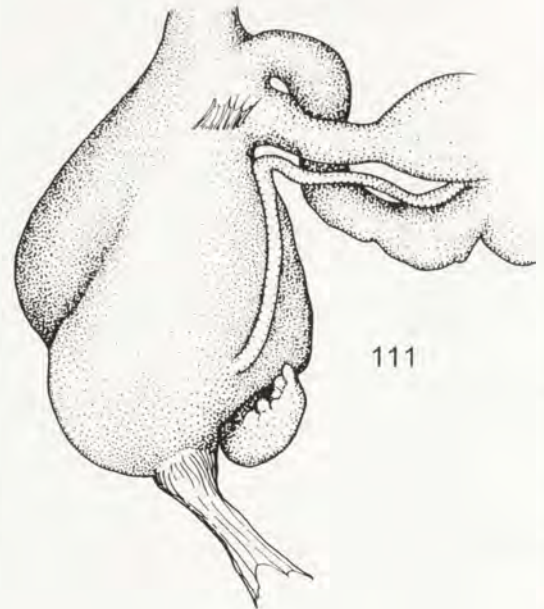


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Figs. 108-109. *Deroceras bakurianum* – specimens from the environs of Batum (Georgia). 108 – Structures inside penis. 109 – Copulatory organs. (After Likharev and Wiktor 1980)

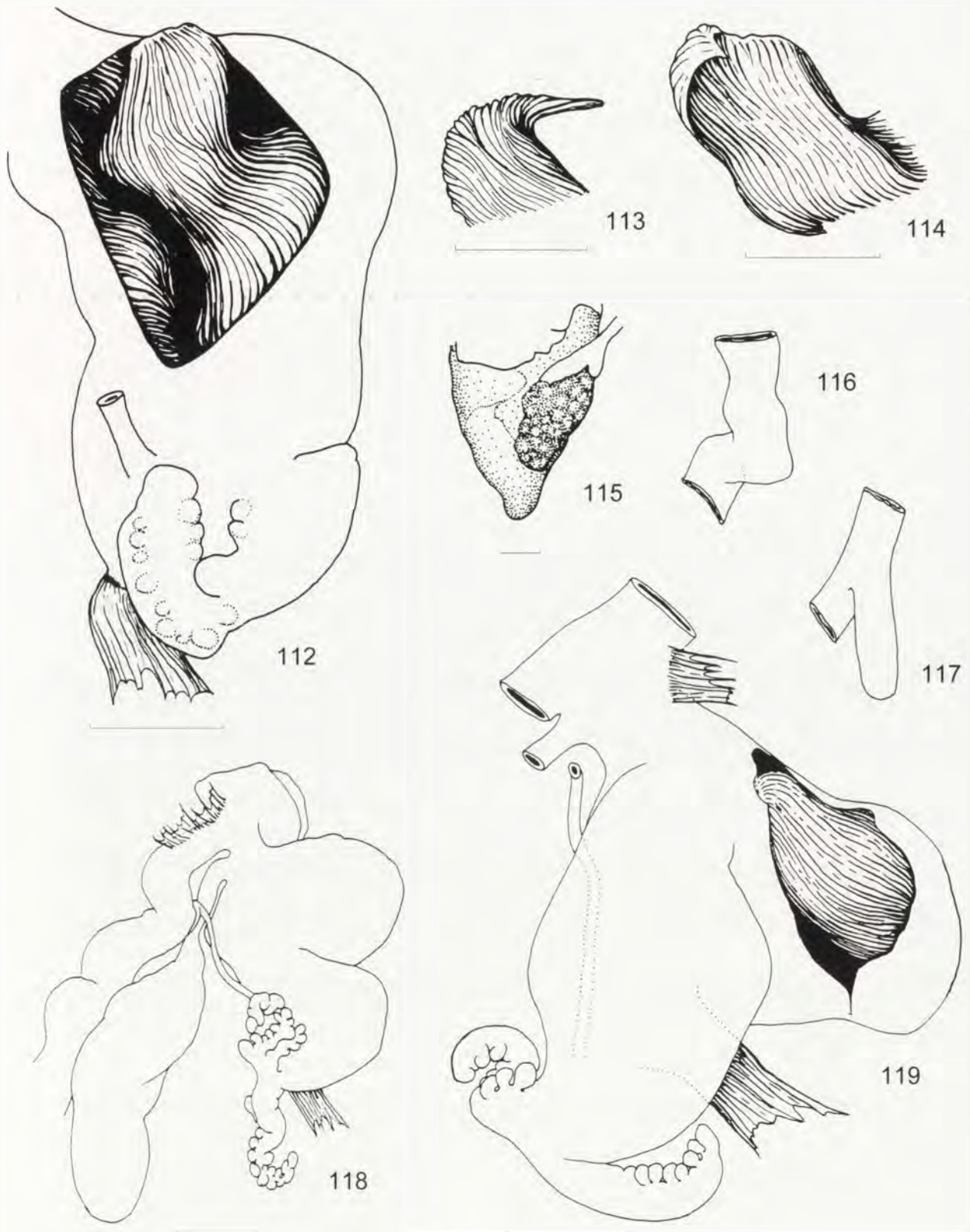


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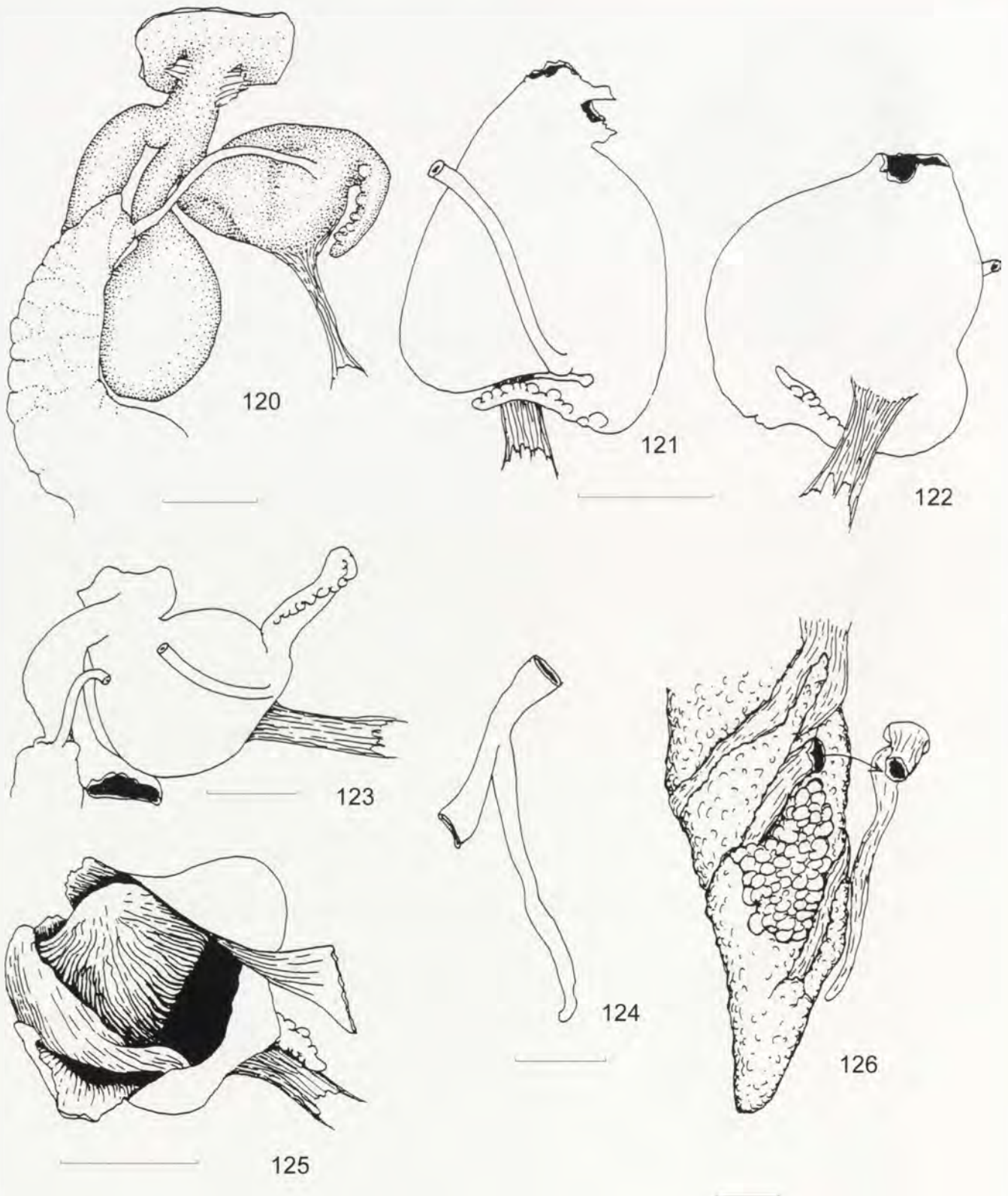


111

Figs. 110-111. *Deroceras cf. bakurianum* – copulatory organs of a specimen from Yenice (Turkey). (After Wiktor 1994)



Figs. 112–119. *Deroceras cf. bakurianum* from Turkey. 112 – Penis of a specimen from Yenice. 113–114 – Stimulator seen from different sides – a specimen from Yenice. 115 – Posterior end of viscera – a specimen from Yenice. 116–117 – Rectum and caecum of specimens from Ulubey. 118 – Copulatory organs of a specimen from Tekkeköy. 119 – Penis of a specimen from Tekkeköy. (After Wiktor 1994)



Figs. 120–126. *Deroceras* sp. (cf. *bakurianum*) from Hamadan (Iran). 120 – Copulatory organs. 121–122 – Penis of the same specimen viewed from two sides. 123 – Copulatory organs. 124 – Caecum of the same specimen as in Fig. 120. 125 – Stimulator inside penis of the same specimen as in Fig. 121. 126 – Posterior end of viscera – the same specimen as in Fig. 120. (Orig)



Fig. 127. *Deroceras barceum*: A – reproductive system; B – stimulator; C – penial gland. (After Gambetta 1925; slightly simplified)

Caecum on rectum most frequently very well developed (Figs. 138–145), often simply long, but in some specimens it is vestigial, merely pocket-like.

Distribution. Lebanon, Cyprus and vast areas of Turkey from Kayseri up to the Black Sea coast in the region of Samsun.

Comments. Although the types have been destroyed, I have had an opportunity to examine specimens collected in the environs of Beirut (near locus typicus), which can be entirely related to the description of the species.

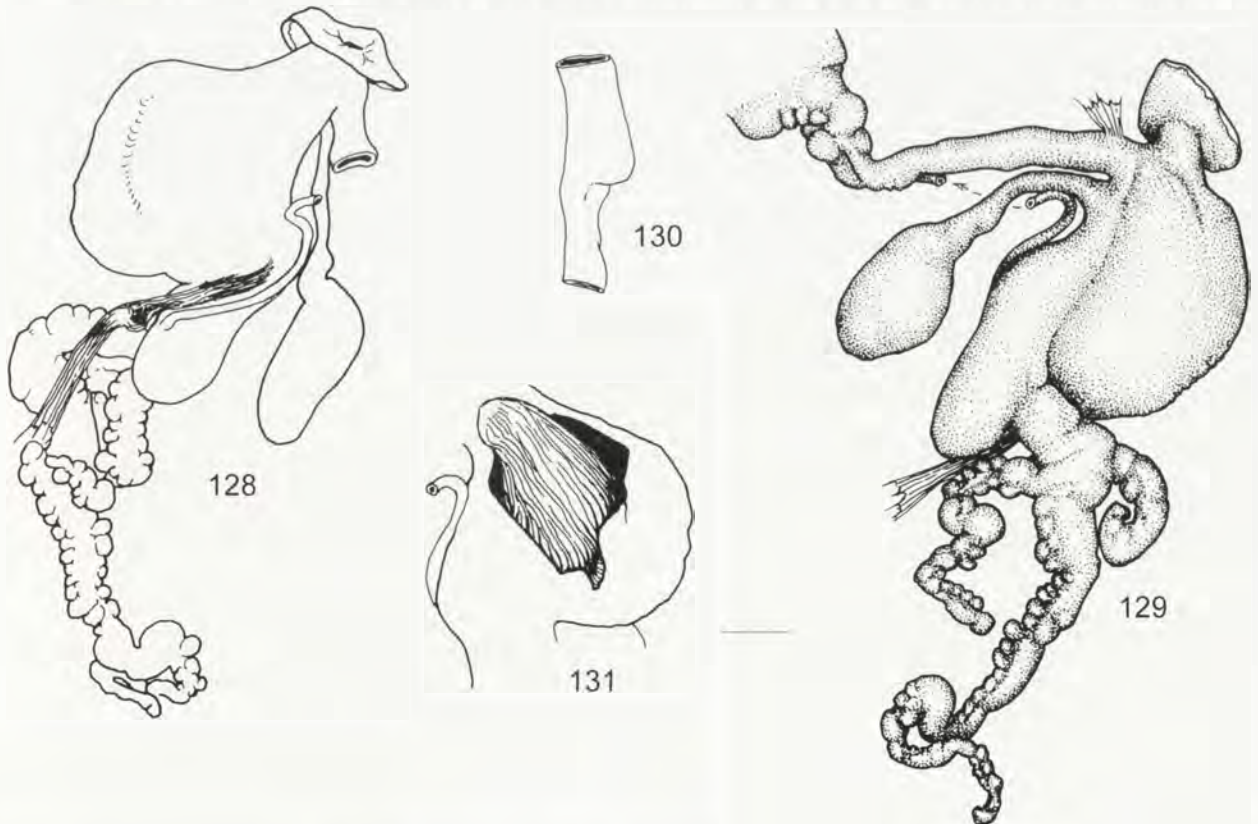
According to what I have established, this slug is characterized by a wide variability of the appearance of caecum on

rectum. Nevertheless, these differences seem to be of populational or individual character. Apart from typical forms with a simply long caecum, I have encountered individuals having their caecum short and vestigial, or merely a trace of it, but not different with respect to other features. This has made me synonymize *D. berytensis* with *D. pentheri*, *D. steindachneri*, *D. cyprium* and *D. grossui*. I discuss this problem more thoroughly in my paper on the slugs of Turkey (Wiktor 1994: 19), where drawings of the types of the first two mentioned synonymized names are available. Judging from the description and figures by Germain (1911, 1921), *Agriolimax Pallaryi* should be regarded as a synonym of *D. berytensis*, too.

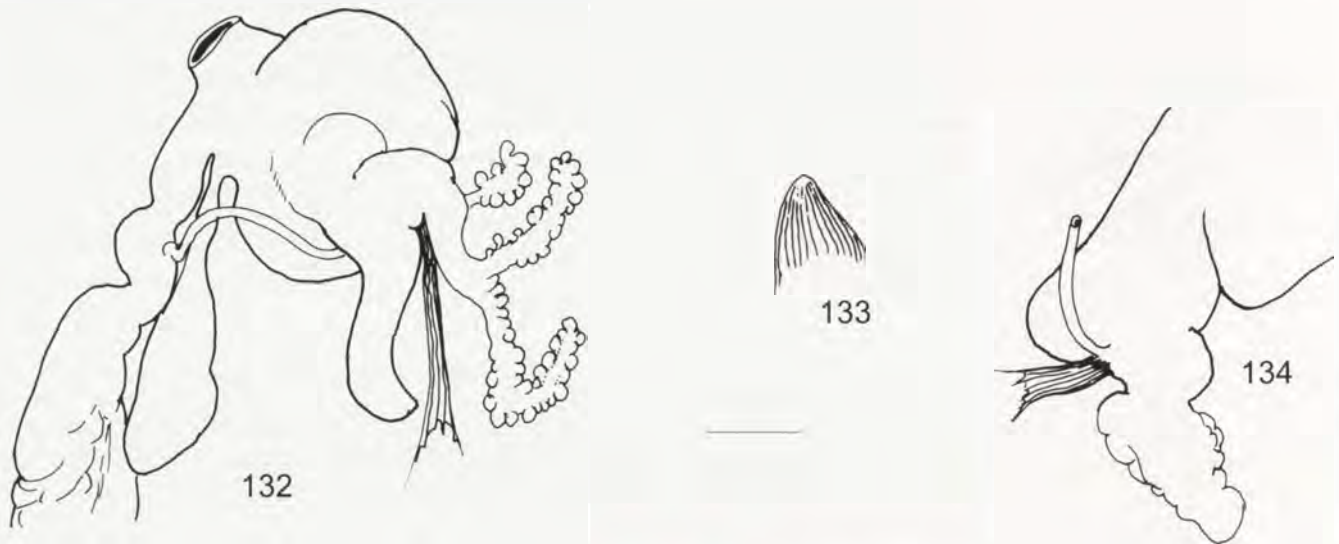
Among the synonyms of *D. berytensis* I also rank *Agriolimax damascensis*. Its first description (Germain 1911) discusses only the slug's external appearance, lacking any drawings. Another description by Germain (1921) includes figures which indicate that the author dealt with *D. berytensis* (I have not found the types; they are not kept in Paris).

In Rähle's (1984) opinion, the spotted slugs occurring on Cyprus should be considered as a distinct species, namely *D. cyprius*. This does not, however, seem justifiable as it is quite a common case in slugs that besides evenly black individuals spotted ones are also found.

The forms with a long caecum inhabit Lebanon, Cyprus and the Turkish region of Konya. The form having a caecum



Figs. 128–131. *Deroceras barceum* from Wadi Sudan, Cyrenaica. 128–129 – Copulatory organs seen from both sides. 130 – Rectum with caecum. 131 – Stimulator inside penis. (Orig.)



Figs. 132–134. *Deroceras barceum*. 132 – Copulatory organs of a specimen from Iamed, Cyrenaica. 133 – Stimulator of a specimen from Sidi Faliay near Messa, Cyrenaica. 134 – Posterior end of penis of a specimen from Sidi Faliay near Messa, Cyrenaica. (Orig.)

reduced to a different degree has been recorded from Cyprus and Turkey from Kayseri up to the Black Sea.

In this region of the world a number of unclear and similarly describable taxa have been found, like *Agriolimax nigroclypeata* Germain, 1911 or *Agriolimax (Agriolimax) jordanicus* Wagner, 1949 (see the notes to these species).

***Deroceras (Deroceras) bisacchianum* Bodon,
Boato et Giusti, 1982**

Deroceras bisacchianum Bodon, Boato et Giusti, 1982: 54 figs. 1A–E, 2A–G.
Locus typicus: Dolina di S. Lorenzo River valley (Rezzo, Italy). Holotype: Giusti's coll., Inst. Zool. Univ. Siena (Italy).

References: Boato, Bodon, Giusti 1982: 307.

Body length up to 33 mm. Coloration variable: "pale cream, with a more or less dense pattern of dark brown flecks and spots" (after Bodon *et al.* 1982), which are irregularly distributed and not concentrated in skin grooves (Fig. 147). Sole creamy.

Genitalia (Figs. 148–153). Penis elongated, irregular in shape or posteriorly clavately distended. The posterior penis part at times dark pigmented. Penial gland consisting of 3–8 unbranched glandular branches set on a short common trunk. No stimulator inside penis (!) or there is only an inconspicuous protuberance, defined by the authors of the species as "a small prominence [...], so as to simulate a reduced penial stimulator". Penial internal wall plicate and covered by striation resembling fingerprints. Spermatheca oval, along with spermatheca duct usually shorter than penis (!).

Caecum on rectum short but distinct (Figs. 154–155).

Habitat (after Bodon *et al.* 1982). It occurs in the lowlands and at low altitudes – up to 1300 m a.s.l. – in open and wooded habitats, mostly in "thermophilous wood-lands, such

as holm-oak woods or olive groves, but also in wet and cold ones, such as beech-woods".

Distribution. Ligurian Alps (Western Liguria, Italy).

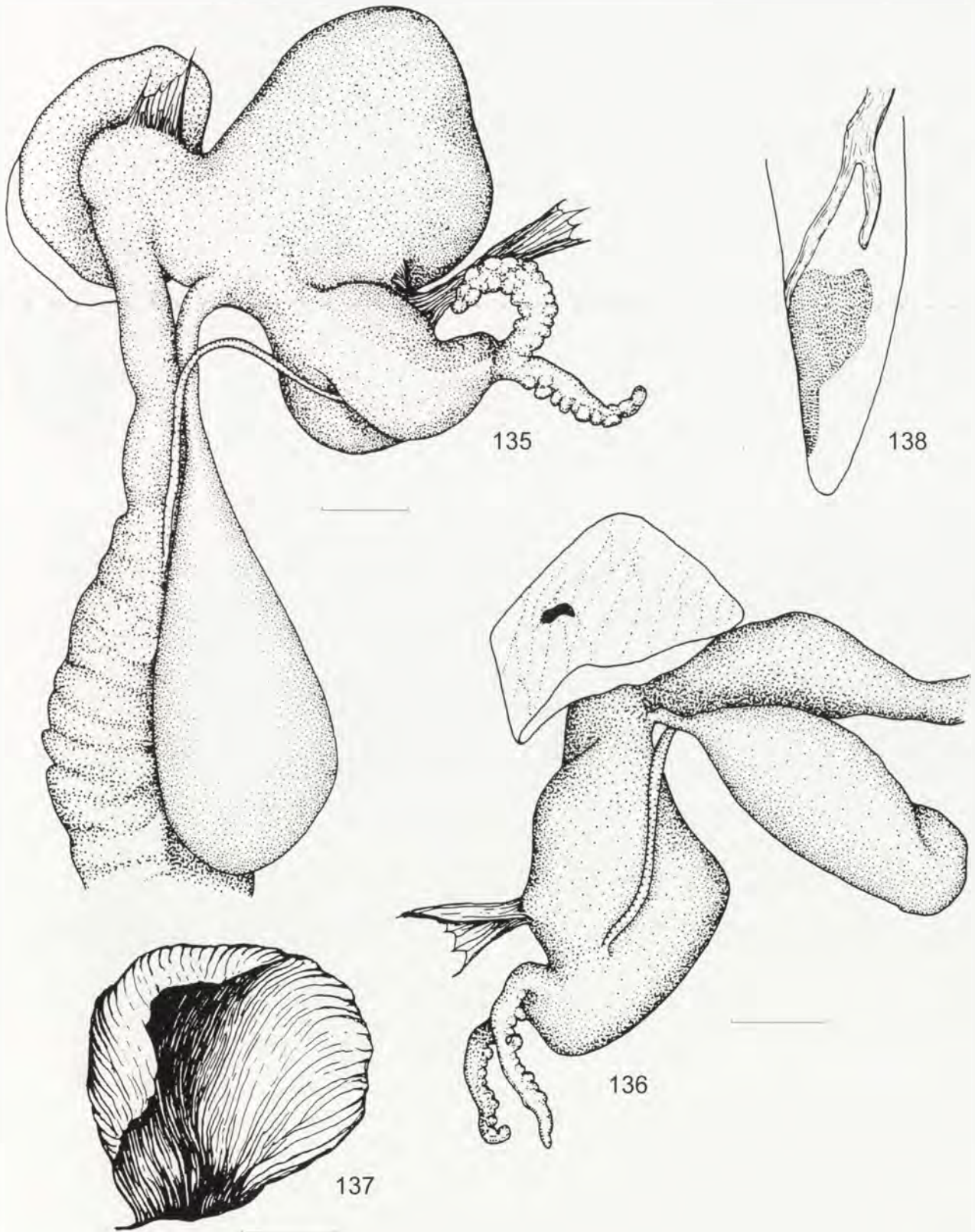
Comments. A species distinguishable by lack of proper stimulator inside penis, which is an exceptional character for *Deroceras*. The structures inside penis (thanks to Prof. Giusti's kindness I could examine the types) lack such a characteristic organ as stimulator, whereas the system of plicae observable in the posterior part of penis is better developed than in other species. It resembles that of *Krynickillus urbanskii* (see fig. 808), representing the only similarity, though. The external appearance, penial gland and rectal caecum unequivocally place the slug among *Deroceras*. Besides, I know from Prof. Giusti that, having described *D. bisacchianum*, he collected ample material to reveal that all characteristic features of the species remain highly stable, its distinctness giving way to no doubts.

***Deroceras (Deroceras) bistimulatum* n. sp.**

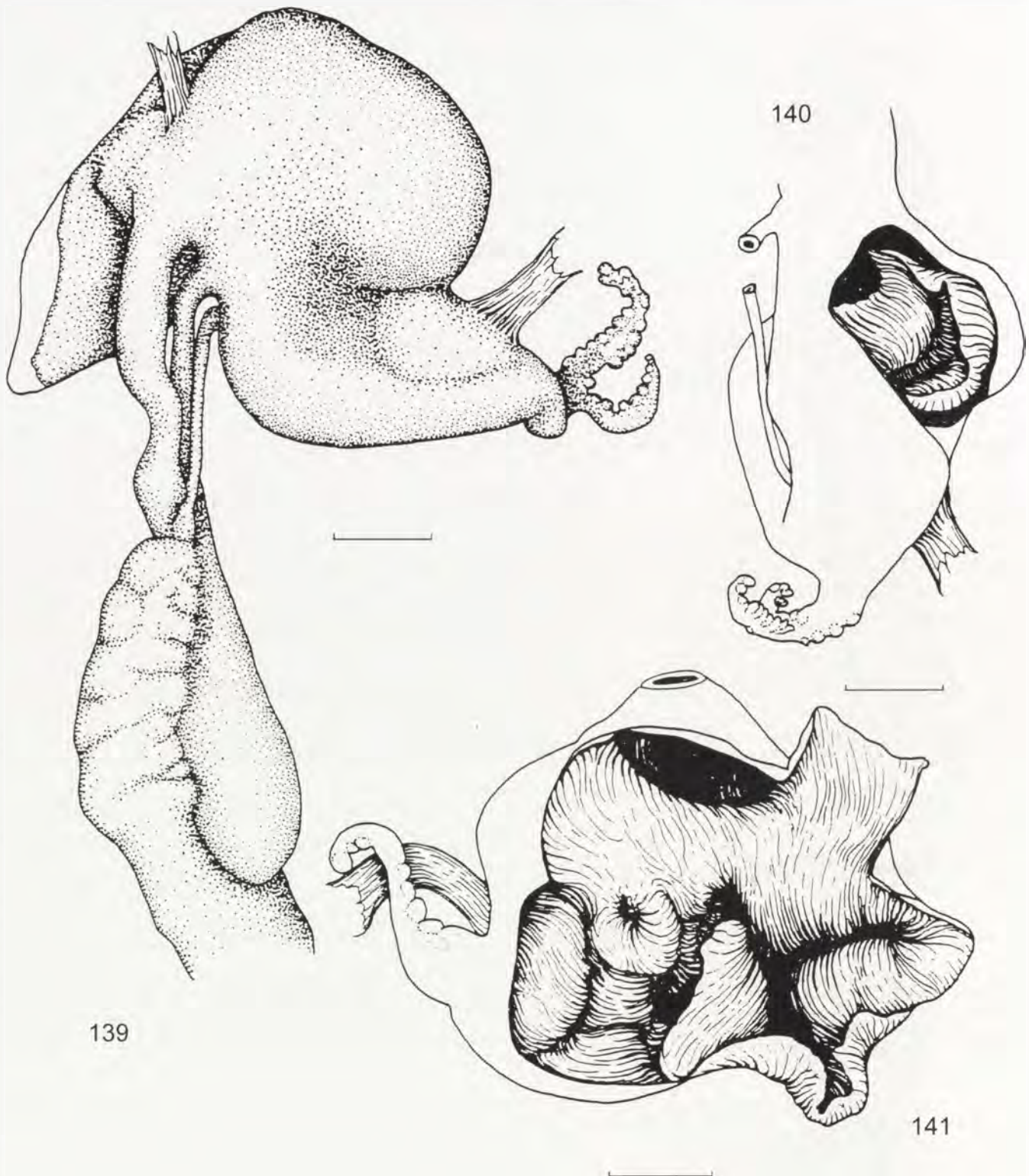
Holotypus and paratypi (20 specimens): come from one locality and were collected at the same time. Locus typicus: Greece, Thessalia, Pilio (= Pelion), Chania Mts, in the region of Chania village, 26 km NE of Volos, *Fagus* forest, quartzite rocks, under stones and litter, 1200–1300 m a.s.l., leg. A. Riedel, 15 April 1986. Holotypus no. MP 629 and 10 paratypi – MNHW, 10 paratypi – MIZ.

Etymology. The stimulatory organ being double is a unique character of this species; "bistimulatum" means having two stimulators.

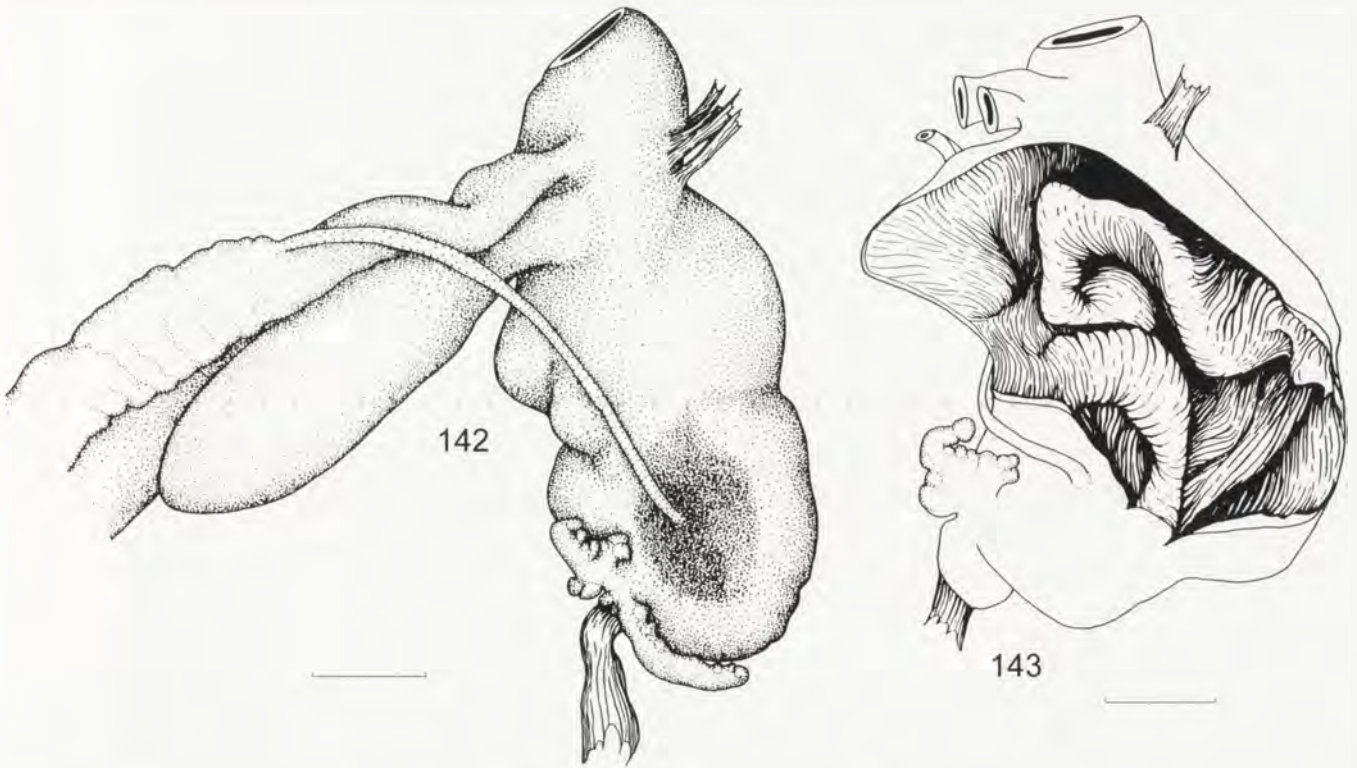
Diagnosis. A slug of medium size, unicolored or covered by a net-like pattern; brown creamy in colour. The posterior edge of mantle usually reaches half the body length. Penis of irregular shape, elongate, posteriorly with two small appendices between which a penial gland in the shape of a bundle of several processes is inserted. The stimulating organ



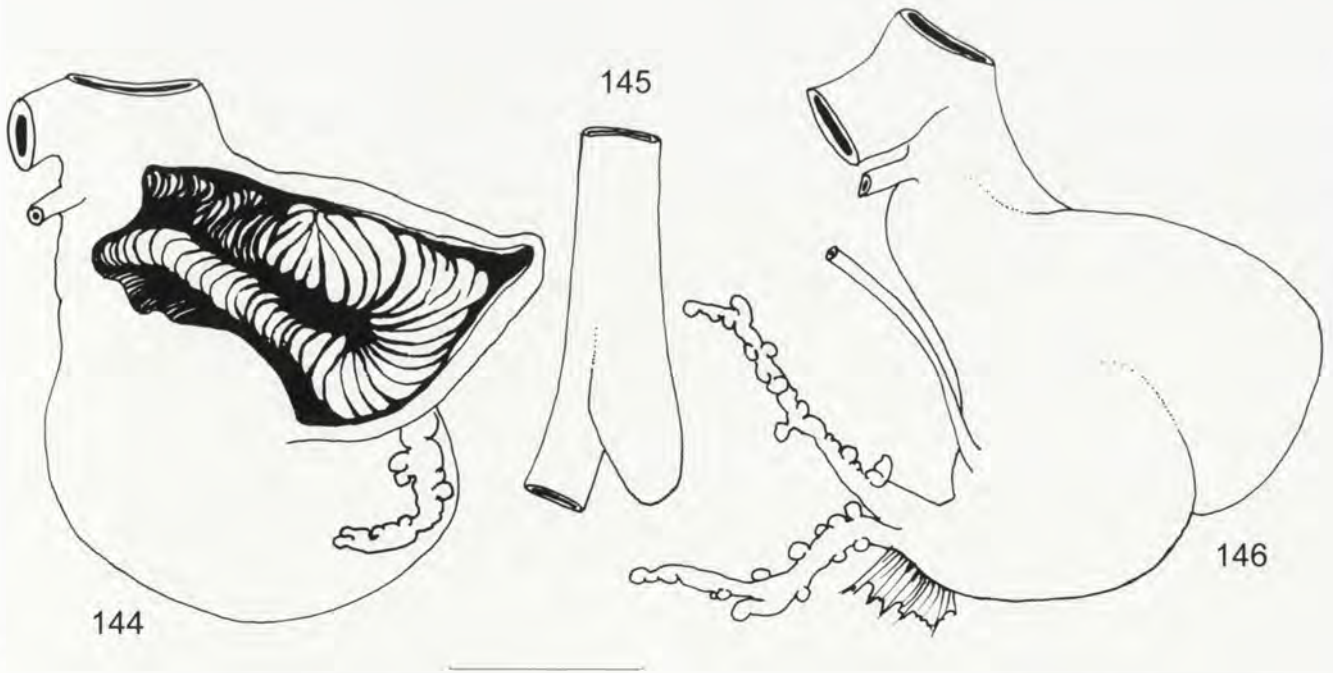
Figs. 135–138. *Deroceras berytensis* from Brummana near Beirut, Lebanon. 135–136 – Copulatory organs of two specimens. 137 – Stimulator. 138 – Posterior end of viscera with marked gonad and rectum. (After Wiktor 1994)



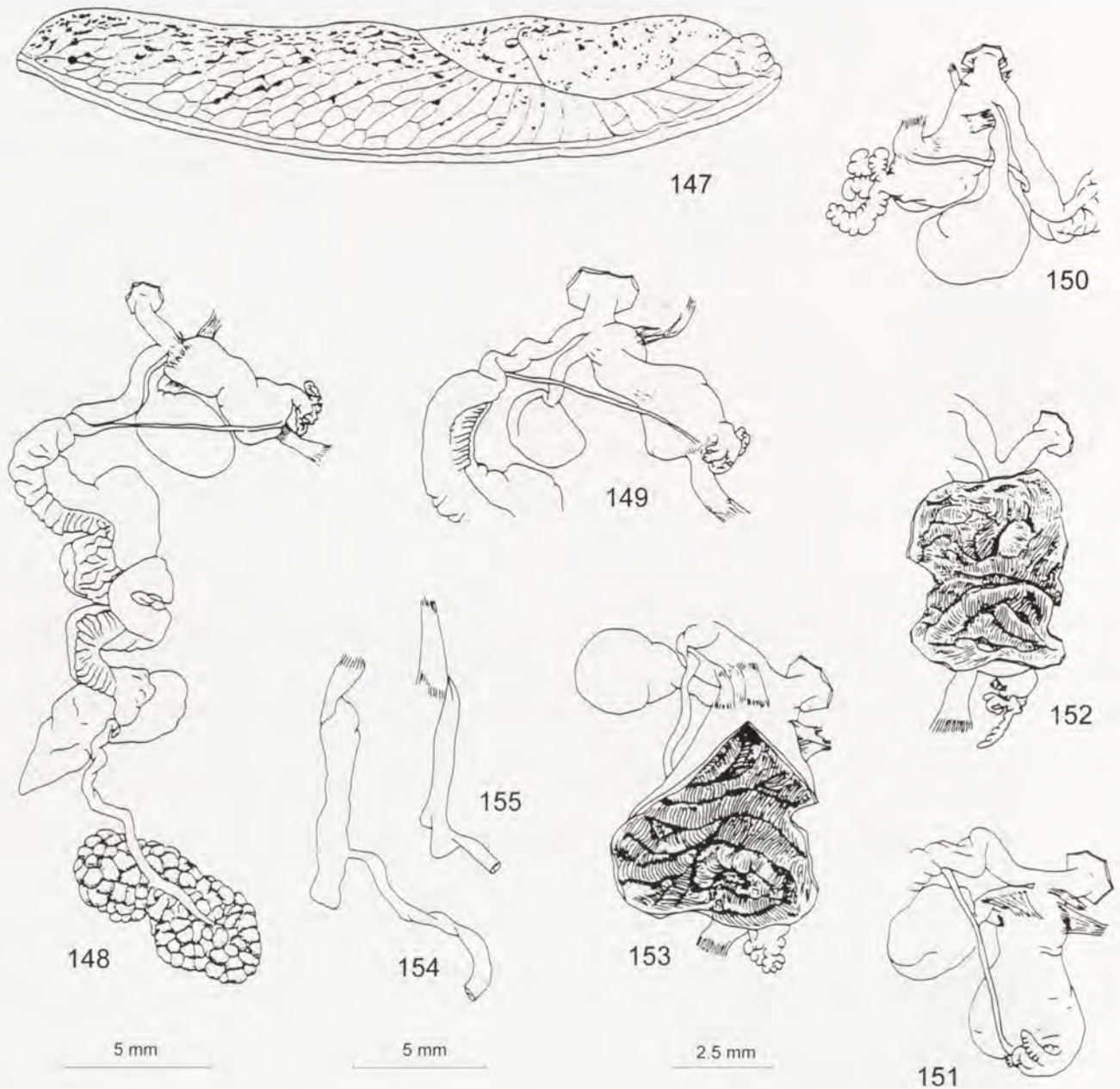
Figs. 139–141. *Deroceras berytensis* – specimens from Mersin, Turkey. 139 – Copulatory organs. 140 – Penis with visible stimulator. 141 – Structures inside penis. (After Wiktor 1994)



Figs. 142–143. *Deroceras berytensis* – specimens from Pinarbaşı, Turkey. 142 – Copulatory organs. 143 – Structures inside penis. (After Wiktor 1994)



Figs. 144–146. *Deroceras grossui* (paratype) = *berytensis*. 144 – Penis with visible stimulator. 145 – Rectum with caecum. 146 – Penis. (Orig.)



Figs. 147–155. *Deroceras bisacchianum* from Italy. 147 – Lateral view. 148 – Reproductive system. 149–151 – Copulatory organs of different specimens. 152–153 – Structures inside penis. 154–155 – Rectum. (After Bodon *et al.* 1982)

consists of two strongly flattened parts, hence two stimulators (!). One, external, part is slightly bigger and fan-shaped, sometimes with an elongate sharp ligular process in its posterior; the other, low, assumes the shape of a husk which can be bent aside. On rectum there is a slight distension or a shallow pocket.

Description. With respect to external appearance, this slug does not much differ from many other species (Fig. 156). Holotype's dimensions: length 19.5 mm, width 4.5 mm, mantle length 7 mm. Other specimens were of the same size or smaller. Body rather slender, its anterior section strongly elongated. The posterior edge of mantle reaches half the

body length or it ends in the posterior body part. Considering the fact that sometimes such a mantle dislocation may be an effect of preservation conditions, it cannot be stated for sure that it is a diagnostic feature (it should be noted that all specimens were simultaneously killed and preserved). Coloration of alcohol-preserved specimens is dirty-, brown- or greyish-cream. Most specimens have no pattern, their back and mantle somewhat darker. Some have an indistinct reticulate pattern in the posterior part of mantle as the grooves of the skin sculpture are slightly browner or greyer. The mantle in those specimens is darker, but not spotted. Skin is thin and soft. Inside it there are small crystals

(probably calcareous) which may produce streaks of white colour.

Genitalia (Figs. 157–160). Penis elongate, irregular, with a rather small narrowing in the middle. In its posterior there are two asymmetrical appendices. Usually, one of them is distinctly bigger. Between them there is the connection between penial gland and penis. The base of penial gland represents a short stem, usually divided in two branches, each of which splits into several processes. Thus, it makes quite a dense cluster consisting of 4–8 processes. Vas deferens is connected with penis at the base of one of the appendices. The main insertion of musculus retractor penis is situated more or less symmetrically between the two appendices and somewhat more anteriorly relative to their bases and the opening of vas deferens. Independently, membranous, smaller muscular strands run to the anterior section of penis, where they insert. Inside the anterior of penis two flat stimulators run parallel to each other (Fig. 158). The bigger one is fan-shaped, sometimes with a ligula-like, tapered process occurring on its external edge. The external surface of this stimulator is smooth, whereas the internal one covered by striae resembling human fingerprints. The other, smaller, stimulator lies on the internal side (i.e. the one adherent to pharynx) in the place where in other *Deroceras* a twisted fold often occurs. It has the shape of a husk or a high comb which can easily be tilted from the wall of penis. Both (internal and external) surfaces of this stimulator are covered by striation (“fingerprints”). Some individuals have their stimulators everted and in such a case both form one flat shield with two visible striation centres from which the striae run towards the edges (Fig. 160). The remaining parts of genitalia do not show any distinctive features.

Rectum is visibly widened near the end. In some specimens a flat pocket-like caecum occurs; in others such a pocket is lacking (Figs. 161–162).

Comments. Considering the structure of genitalia, *D. bistimulatum* resembles:

a. *D. panormitanum* (Lesson et Pollonera, 1882) (see p. 488) but this one has a conical stimulator;

b. *D. pseudopanormitanum* Wiktor, 1984 (see p. 502) but in this species the stimulator is single, completely flat and covered by striation on both sides;

c. *D. astypalaeensis* Wiktor et Mylonas, 1992 (see p. 402) but, apart from a stimulator, this slug has a fold in the place where there is a second stimulator in *D. bistimulatum*. When everted, the copulatory organs of the two species are entirely different (Figs. 94–95).

Deroceras (Deroceras) boeoticum Wiktor, 1984

Deroceras (Agriolimax) boeoticum Wiktor, 1984: 152 figs. 7–12. Locus typicus: Levadhia (Greece). Holotypus: MNHW no. MP 478.

References: Wiktor – in print.

Body length up to ca 30 mm. Coloration creamy, slightly darker on back and mantle. Under a higher magnification

dispersed fine concentrations of a darker pigment can be visible on skin, particularly on mantle.

Genitalia (Figs. 163–165, 168). The anterior section of penis ovally distended, whereas the posterior one is clearly narrower, shorter and equipped with a transverse conical appendix. Penis is apically joined by a tuft of 5 long unbranched processes of penial gland. Each of them is connected to penis separately, i.e. they are not set on a common shaft. Musculus retractor penis forked. Its one branch is attached to appendix while the other inserts to the broadened oval anterior section of penis. Vas deferens opens close to retractor insertion and the base of conical appendix. Stimulator inside penis cone-shaped (Fig. 168).

Caecum on rectum vestigial, in the shape of a poorly marked pocket or merely a protuberance (Figs. 166–167).

Distribution. The slug is known exclusively from Voitia (= Beotia), Thessaly (Greece) and one unconfirmed locality in Greek Macedonia, namely Loutráki (W of Arithia).

Comments. The species somewhat resembles *D. seriphium* Wiktor et Mylonas, 1981, but it is larger, its body unspotted, penial appendix smaller and stimulator conical (not flat).

It is also similar to *D. pageti* Grossu, 1972 (= *D. laconicum* Wiktor, 1984), which differs in its vas deferens opening into appendix, the appearance of penis that is more elongated posteriorly, and its penial gland that consists of two branches.

? *Deroceras (Deroceras) boettgeri* (Simroth, 1889)

Agriolimax Boettgeri Simroth, 1889a: 14 fig. 4. Terra typica: Crete (?Viano, Greece). Syntypi: probably do not exist.

References: Wiktor – in print.

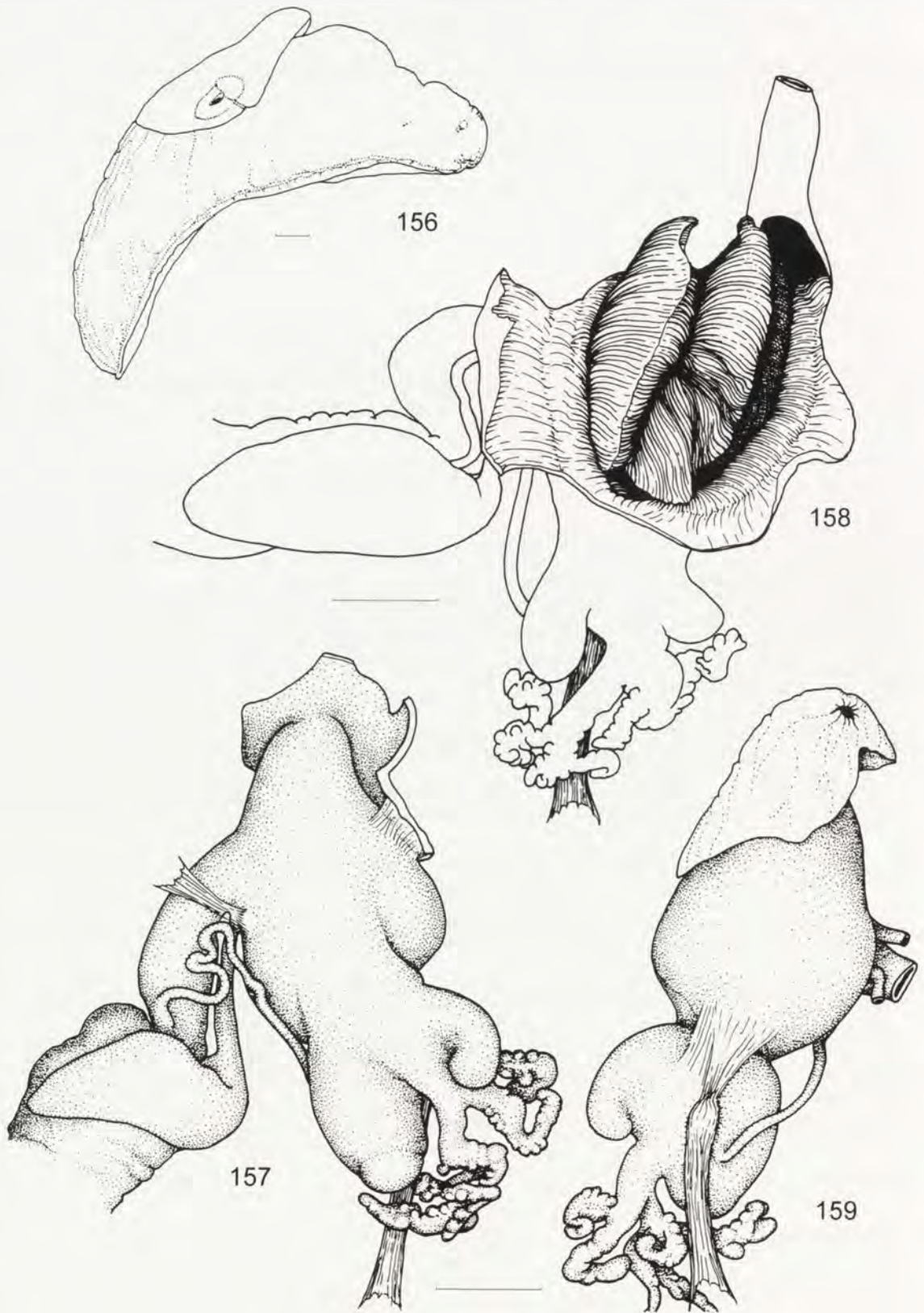
Simroth's (1889) description provides some essential though insufficient information. This is as follows: length at most 10 mm; the series of 5 specimens the author had at his disposal were sexually mature in spite of such a small size. Coloration yellow-grey (Gelbgrau), sometimes turning into red-brown (Rotbraune). On mantle contrasting, clearly delineated, round black spots, which in the posterior body part are blurred, now and again extending into lines.

Penial gland strongly branched (stark verzweigte). Stimulator inside penis narrow and long.

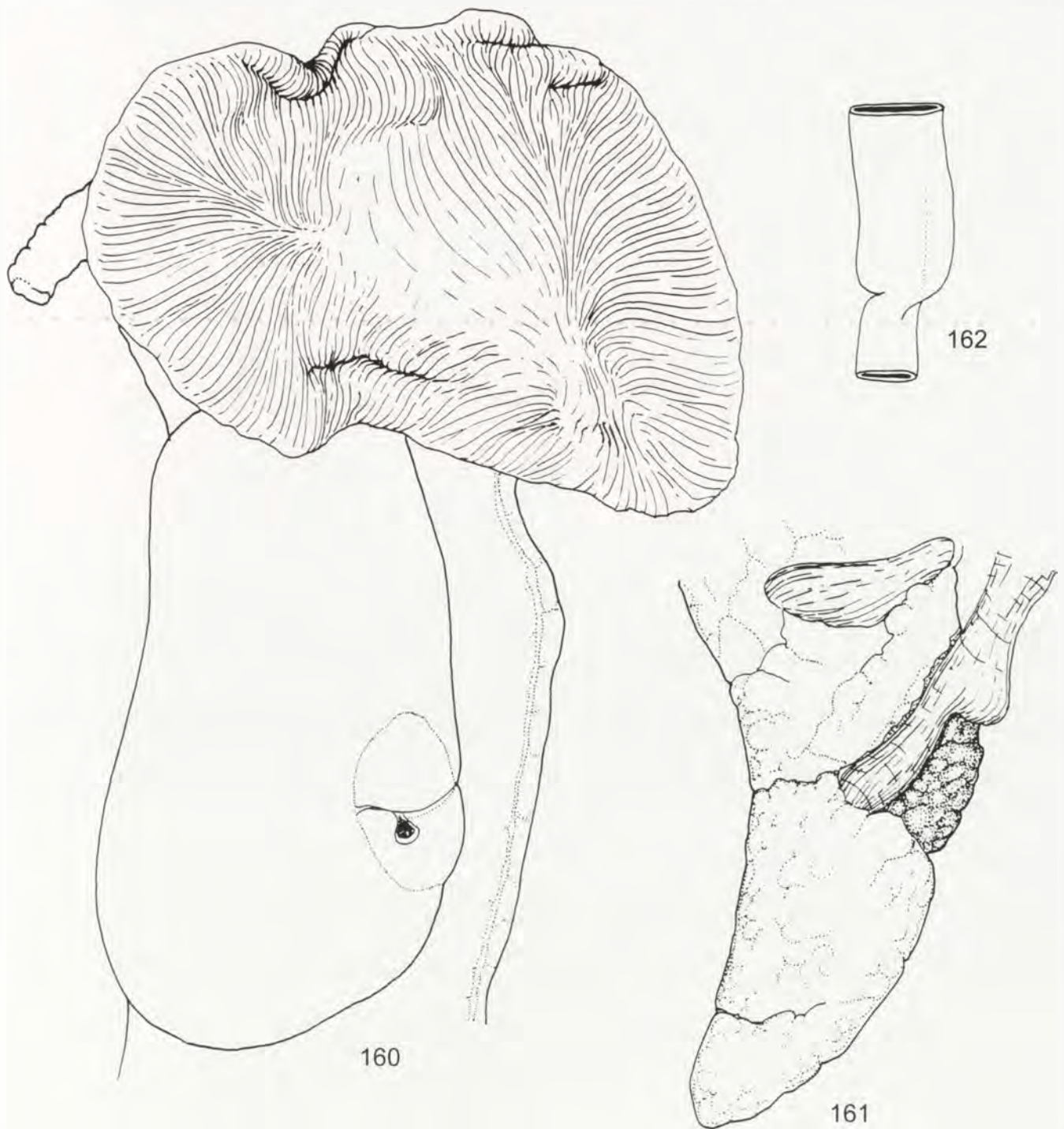
No caecum on rectum.

Comments. The taxonomic position of the species is unclear, its description laconic and the only drawing concerns solely its external appearance. Simroth (1889) compares this slug to *D. thersites* (Simroth, 1886). The author states that the two differ with respect to the body pattern, size and anatomy, not specifying, however, any anatomical distinctive characters. It is not certain if the few records of the species discussed were based on correct identification.

The slug should be further studied as it is unknown whether *D. boettgeri* is a species we still have scant information about or one which has been described under a different name. If the types were not possible to be found, it would not be easy to solve this issue.



Figs. 156–159. *Deroceras bistimulatum*. 156 – External appearance of the holotype. 157–159 – Genitalia (157, 159 – holotype, 158 – a paratype). (Orig.)



Figs. 160–162. *Deroceras bistimulatum* – paratypes. 160 – Anterior body section with everted stimulator. 161 – Posterior section of viscera. 162 – Rectum. (Orig)

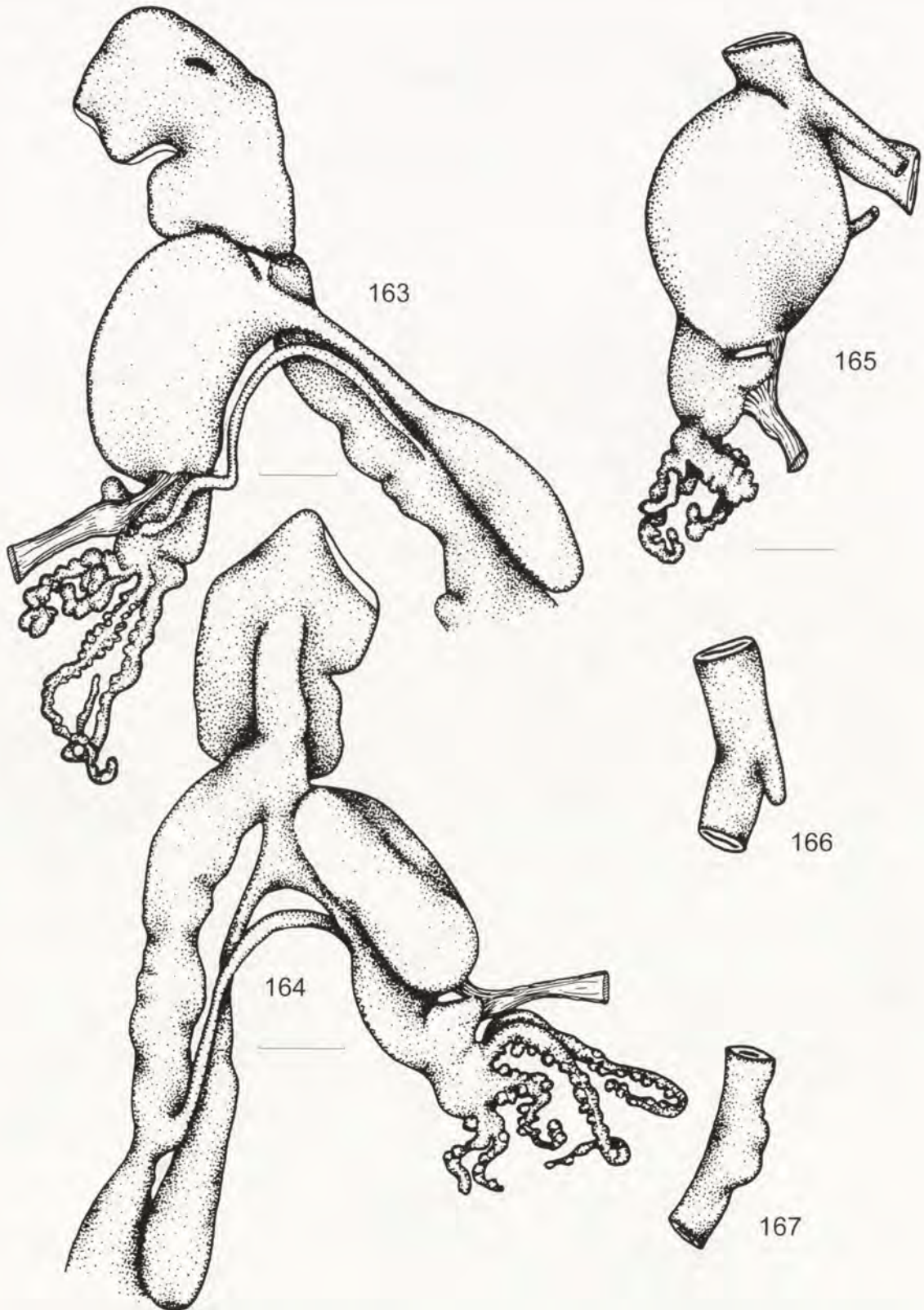
“*Agriolimax Brunneri* Wagner, 1931”

This name, found in literature, actually concerns *Lehmannia brunneri* (Wagner, 1931), a species from the family Limacidae – see Urbański and Wiktor 1968: 75.

? *Deroceras (Deroceras) bulgaricum* Grossu, 1969

Deroceras bulgaricum Grossu, 1969: 163 figs. 5 a–f. Locus typicus: Svilengrad (Bulgaria). Holotypus: MSF no. 194944.

Caution! The description and – especially – the figures by Grossu (1969) partly do not correspond with the actual



Figs. 163–167. *Deroceras boeoticum* – paratypes from Levadhia. 163–164 – Copulatory organs of the same specimen viewed from two sides. 165 – Penis. 166–167 – Rectum of two specimens. (After Wiktor 1984)

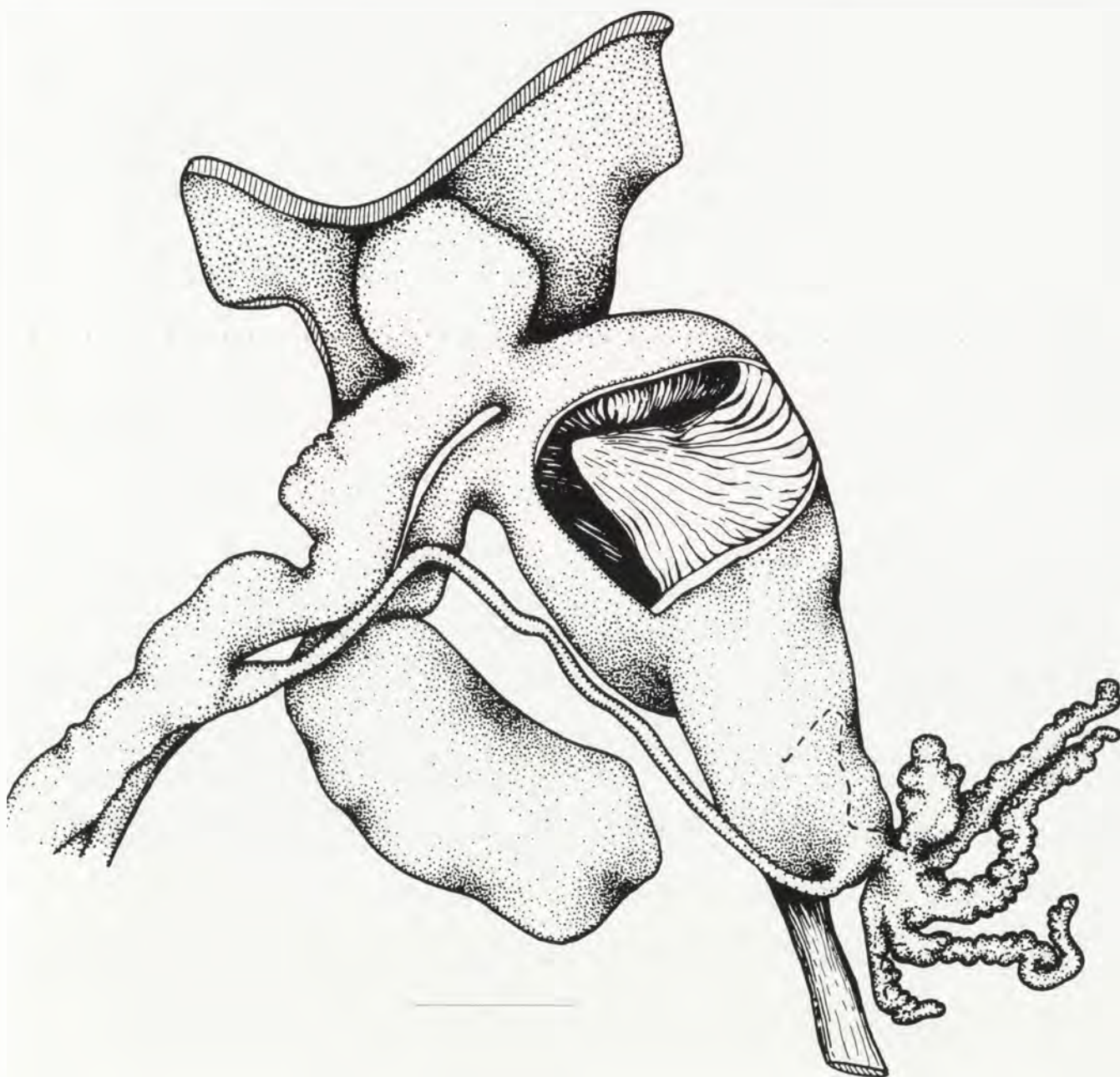


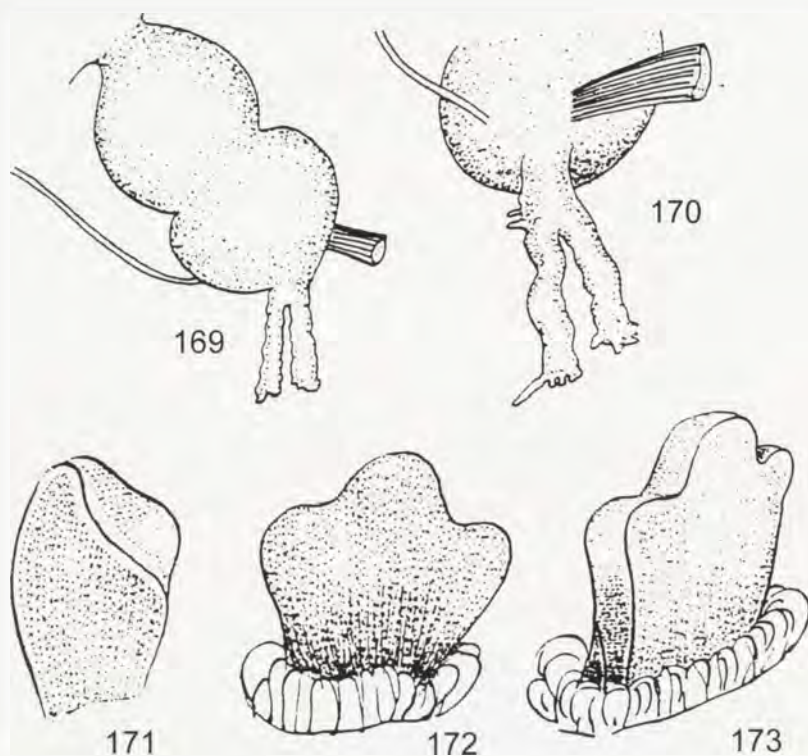
Fig. 168. *Deroceras boeoticum* – copulatory organs of the holotype. (After Wiktor 1984)

characters. For this reason I provide my own drawings and description based on my own study of the holotype. Regrettably, the holotype (the only specimen known) is in a bad condition: penis is torn off from the rest of genitalia, its anterior part and penial gland damaged, vas deferens broken. Moreover, it is impossible to establish the appearance of rectum as this organ has sustained damage, too.

According to Grossu, the holotype is 16 mm long (my measurement yields a length of 14 mm). Body uniformly grey.

Genitalia (Figs. 169–175). Penis more or less cylindrical

(Grossu defines its shape as "balgförmig"), medially slightly constricted, posteriorly with an inconspicuous swelling. Two branches of penial gland have been plucked off at their base, the third one, with three offshoots, preserved (acc. to Grossu, there should be only two branches: "gegabelt"). Retractor penis unforked. Stimulator sticks out of the torn off anterior part of penis. It is strongly contracted, somewhat flattened (but different from that in Grossu's drawing), with its free end broad and the medial part somewhat raised. I suppose that originally it might have had the shape of a low flattened cone.



Figs. 169–173. *Deroceras bulgaricum*. 169 – Penis. 170 – Posterior section of penis. 171–173 – Stimulator. (After Grossu 1969)

Rectum, acc. to Grossu, lacking.

Comments. It is only partly possible to reconstruct the appearance of anatomical characters as the holotype, the only known specimen, has suffered so much that some of the organs are completely missing, others being torn or damaged. Grossu's figures are freehand, made without any drawing device, and glaringly erroneous when compared with the preserved parts of genitalia (penial gland, stimulator). The description includes mistakes, too. Considering lack of any other specimens, it cannot be stated whether *D. bulgaricum* is a distinct species or, for instance, a junior synonym of *D. turcicum*. The problem can be solved only after a series of topotypes has been acquired and examined.

Deroceras (Deroceras) cazioti (Pollonera, 1896)

Agriolimax Cazioti Pollonera, 1896: 3 fig. 2. Locus typicus: Vizzavona (Corsica). Typus: probably does not exist.

References: Hoffmann 1926: 248 figs. 1A–B, 2.

Body size after Pollonera up to 39 mm. It is unknown, however, if this is the length of a live or preserved slug. According to Hoffmann (1929), preserved specimens are 19–20 mm long, and those I have examined are roughly of the same length (up to 19 mm). Coloration even, i.e. without spots. Back, mantle and the plate around pneumostom brown-blackish, sides getting paler and paler downward. Sole creamy.

Genitalia (Figs. 176–179, 181). Penis elongated, looking like an S-shapedly curved tube. Its walls hard and strongly muscled, partly with silky glittering (!). No glands perceivable in the wall to which stimulator is accreted in the anterior penis part (!), as it is often the case with other species. The posterior end of penis equipped with penial gland in the shape of a tuft of numerous (difficult to count) unfurcate vasiform processes not covered by papillae. In juveniles they are entangled and have one of their ends free. In adult specimens the processes are loop-shaped (!), the free end having probably got secondarily accreted to penis. They tightly adhere to one another and are enveloped by a membrane. Musculus retractor penis is attached to penis more or less half-way, at the place where also vas deferens opens. Inside penis a conical stimulator partly laterally accreted to penial wall.

There is no caecum on retum but merely a broadening and plication of the main canal (Fig. 189).

Ecology. Little known. The labels attached with the specimens I have had at my disposal say the slugs were collected under stones in a garden with trees, in a meadow

and forest at an altitude of 400–950 m a.s.l.

Distribution. So far known only from Corsica (Vizzavona and unpublished localities: NE of Tavera and Bocognano).

Comments. A poorly known species. The description by Pollonera (1896) is quite unclear. The drawing of the genitalia enclosed depicts a juvenile specimen, nevertheless with the typical characters.

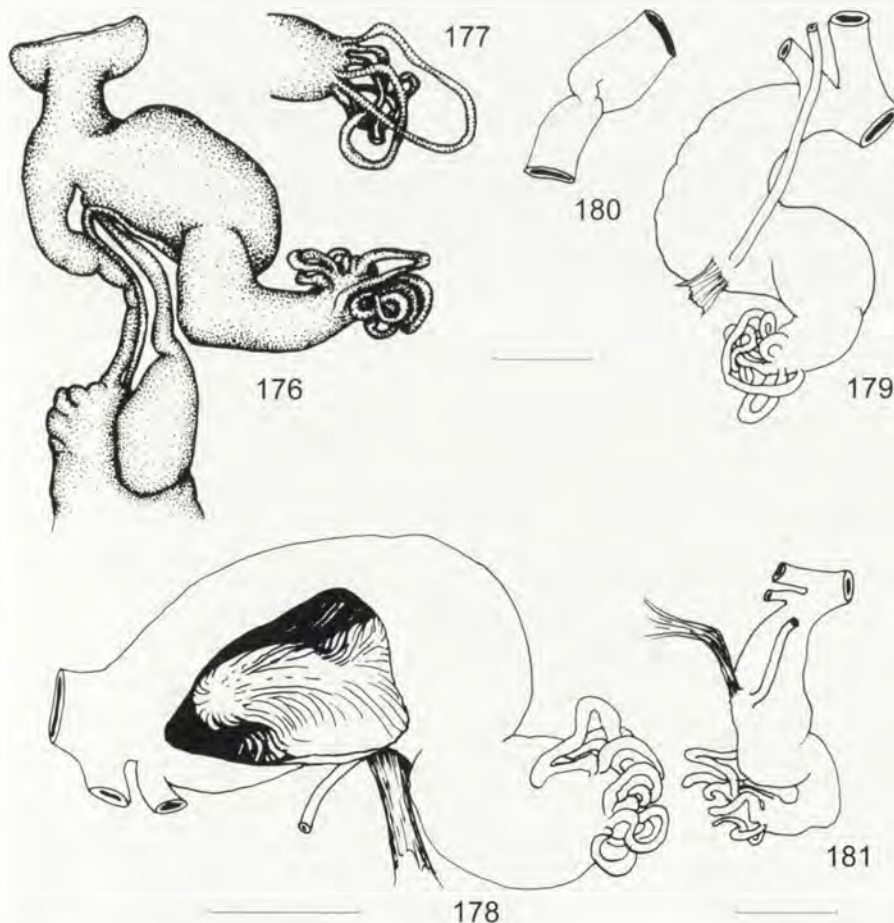
Hoffmann (1926) was the next to study this slug, providing his own drawings, which confirm the characters mentioned by Pollonera (1896). The former author comes to the conclusion that, when describing *Agriolimax corsicus*, Simroth (1900) was most probably dealing with *D. cazioti*. Although Simroth's description does not comprise any figure of the genitalia, it unequivocally indicates that the slug at disposal was a different species. At first Simroth (1900) describes *D. cazioti*, emphasizing that in this particular species penis is cylindrical, retractor attached at half-penis and penial gland digitate. When describing *A. corsicus*, the author states that its penis is clavate (Form einer kurzen Keule), or cone-shaped with two distensions between which retractor is inserted, and penial gland composed of very short tubes. And thus Hoffmann's (1926) argument for synonymizing *D. corsicum* with *D. cazioti* is not well-founded. Simroth certainly dealt with a slug other than *D. cazioti*.

When studying the material from Corsica, including specimens from Vizzavona (locus typicus of *D. cazioti*), collected by D.T. Holyoak, I found out that, apart from slugs



Figs. 174–175. *Deroceras bulgaricum* – penis of the holotype seen from two sides. (My own drawing)

displaying characters typical of *D. cazioti*, there was another species represented by the material, which did not



Figs. 176–181. *Deroceras cazioti* – specimens from Forêt Vizzavona, Corsica. 176 – Copulatory organs. 177 – Penial gland. 178 – Stimulator inside penis. 179 – Penis of the same specimen as in Fig. 176 seen from the other side. 180 – Rectum. 181 – Penis of a juvenile specimen. (Orig.)

differ externally from the one mentioned. Its genitalia corresponded with the description of *D. corsicum* (see Fig. 267). The one in question seems to be a small form of *D. golcheri* or *D. panormitanum*. The fact of the matter is that the description of *D. corsicum* lacks figures, and there are many doubts concerning both *D. golcheri* and *D. panormitanum* (see p. 433 and p. 488), which makes it impossible to satisfactorily solve this intricate problem.

Deroceras (Deroceras) chevallieri Altena, 1973

Deroceras chevallieri Altena, 1973a: 25 fig. 1. Locus typicus: les Salins près de Saint-Tropez (France). Holotypus: Laboratoire de Malacologie, Paris (no number!). Paratypus: Leiden.

References: de Winter 1986: 142 figs. 9–10.

According to Altena (1973), body length up to 21 mm, whereas in de Winter's (1986) opinion, even up to 31 mm. Coloration: blackish spotting, which in the part beyond mantle produces a reticulum, on a creamy background. The whole of back, including the extension of keel, spotted as well. Externally, the slug resembles other spotted *Deroceras* species.

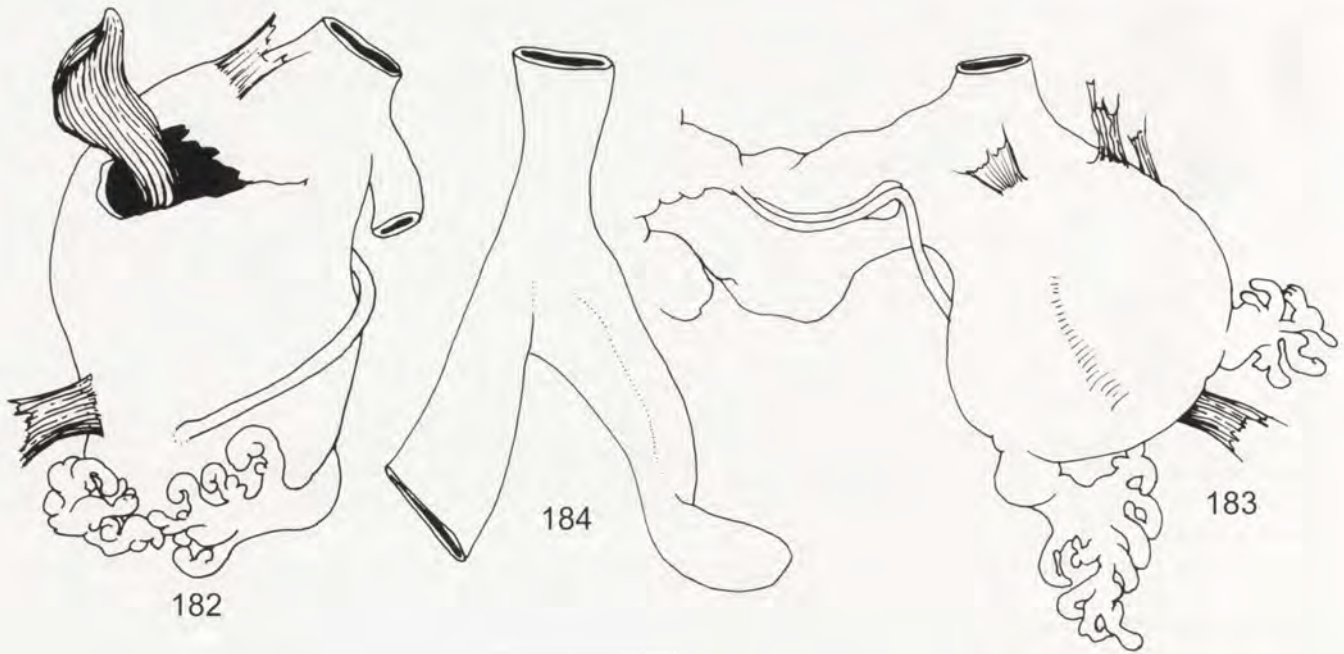
Genitalia (Figs. 182–183, 185–191).

Penis rounded in shape, its posterior end dark pigmented. Penial gland consisting of two separate tufts of branched processes. Vas deferens opens close to the bases of the tufts mentioned more or less on the line between them. A strong undivided musculus retractor penis inserted in the immediate neighbourhood of the junction vas deferens–penis. Spermatheca oval, well delineated from a thin spermatheca duct. Penial stimulator assuming the shape of a flat narrow ligule.

Rectum with a well-developed caecum (Fig. 184), which is so long that it nearly reaches the end of viscera.

Distribution. So far the species has been recorded only from France: the type locality (Saint-Tropez) and the north slope of Mont Ventoux in dept. Vaucluse (de Winter 1986).

Comments. With respect to external appearance the slug bears a great similarity to juvenile *D. reticulatum*. Altena (1973) compares it with *D. dallaii* Giusti, 1970. De Winter (1986) draws attention to certain essential differences between the specimens described by Altena (1973) and the ones at his disposal which are larger, their penial gland more branched, rectal caecum very long. The difference in the



Figs. 182–184. *Deroceras chevallieri* – a paratype. 182–183 – Penis viewed from two sides. 184 – Caecum on rectum. (Orig.)

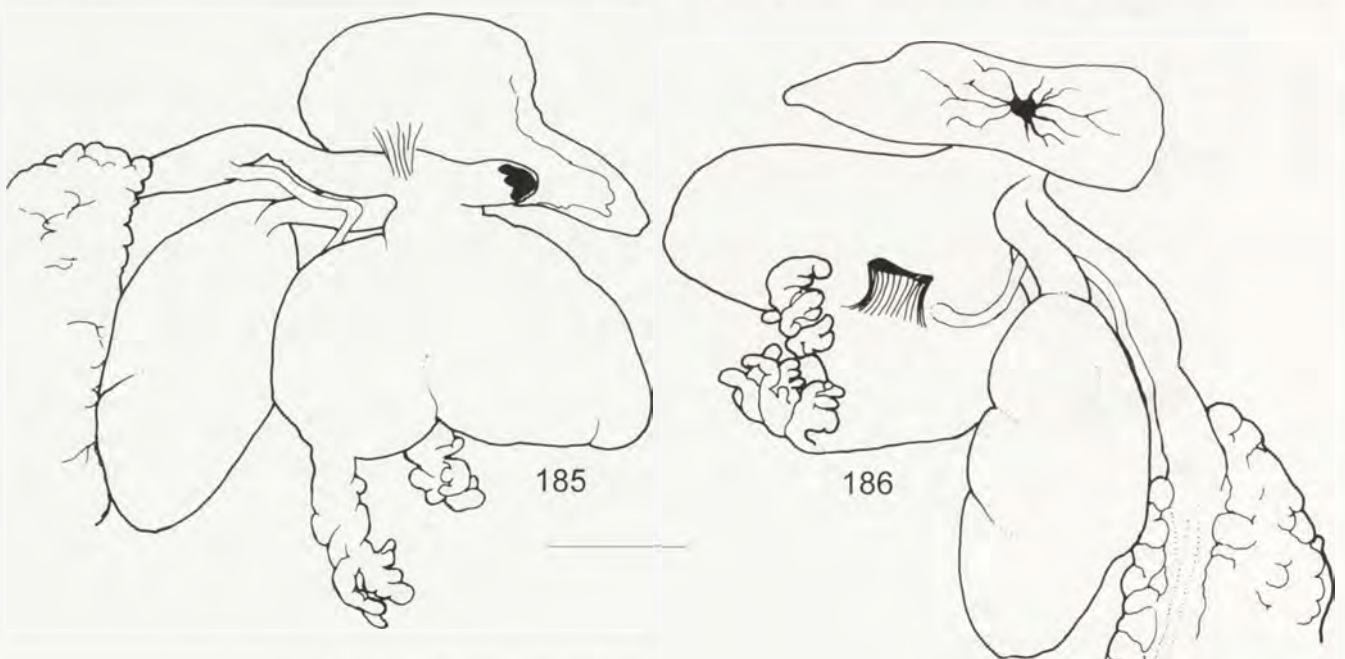
appearance of stimulator, which is "a large flat fold, with a blunt apex", is particularly obvious.

***Deroceras (Deroceras) christae* Rähle, 1998**

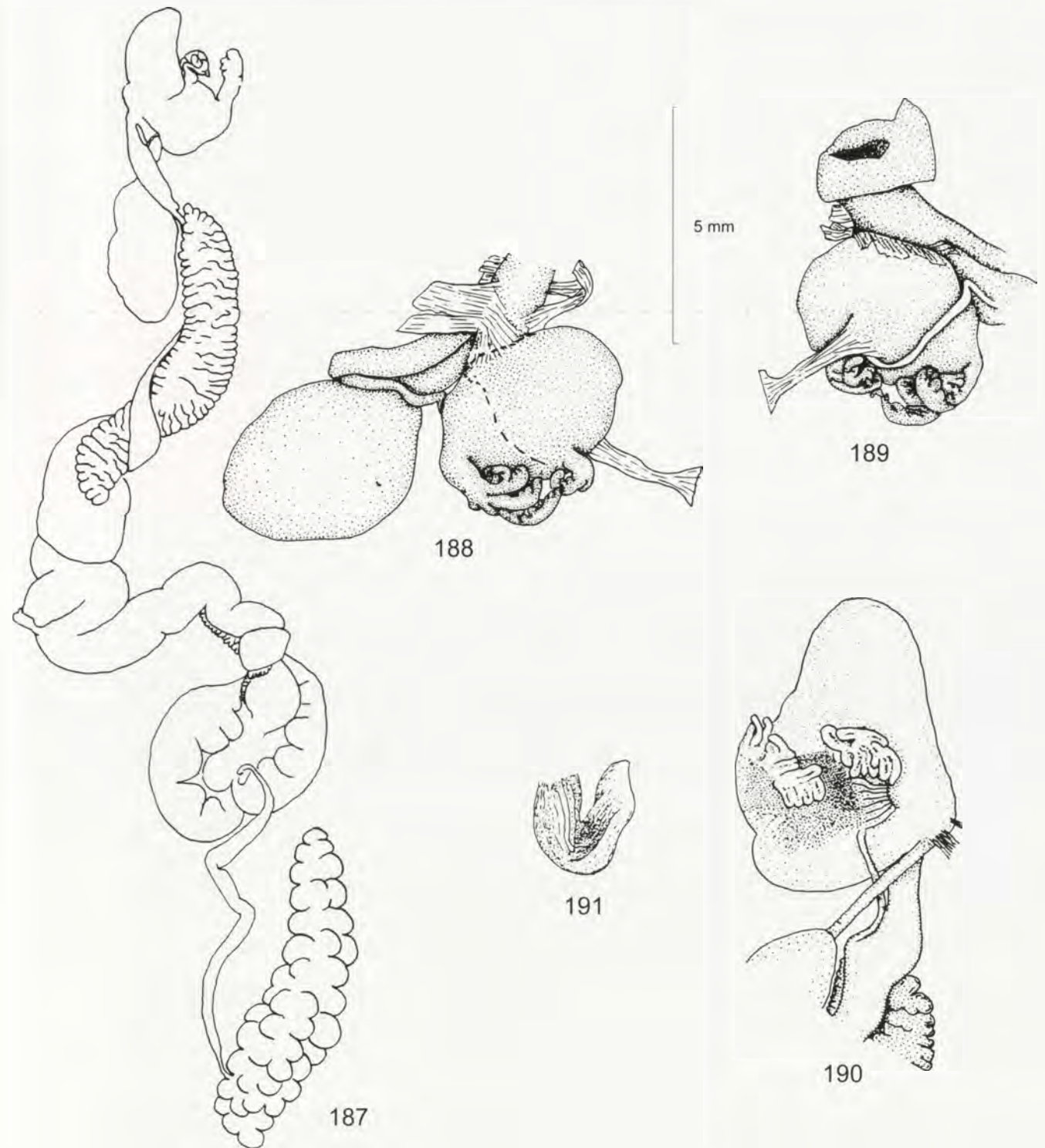
Deroceras (Deroceras) christae Rähle, 1998: 25 figs. 9–14. Locus typicus: Olympos, ca 60 km SSW of Antalya (UTM TF73), vil. Antalya, Turkey. Holotypus: SMT no. 39927.

Length up to 39 mm. Body light creamy with grey spotting on mantle, beyond which a darker reticulum is visible as skin grooves acquire more pigment. Sole pale, although its medial zone is slightly darker than the lateral ones.

Genitalia (Figs. 192–195). Penis deeply constricted, its anterior part heavily distended, the posterior narrower. Penial gland approximating to penis in length, flat, tapering towards the free end. Its glandular papillae are narrow, long, getting shorter and shorter towards the posterior end of the



Figs. 185–186. *Deroceras chevallieri* – copulatory organs of the holotype. (Orig.)



Figs. 187–191. *Deroceras chevallieri*. 187 – Genitalia. 188 – Copulatory organs. 189 – Penis. 190 – Copulatory organs. 191 – Stimulator. (187, 190–191 – types – after Altena 1973a; 188–189 after de Winter 1986)

gland (!). Rähle (1998) is right comparing the appearance of this gland to a fern leaf. Vas deferens opens close to the base of penial gland. Musculus retractor penis forked, its wider strand attached near the penial gland base, whereas the

other, narrower, to the anterior section of penis. Inside the latter organ a stimulator in the shape of a laterally pressed asymmetrical cone. Spermatheca oval, clearly delineated from spermatheca duct.

Caecum on rectum markedly long (Fig. 197).

Distribution. So far the slug has been known only from two localities where the types were collected, both in vilayet Antalya (Turkey).

Comments. The distinctive character is a huge penial gland resembling a leaf of fern. Compare *D. ercinae* p. 435.

Deroceras (Deroceras) chryssorroyatissensis

Rähle, 1984

Deroceras chryssorroyatissensis, Rähle, 1984: 45 figs. 1a-f. Locus typicus: Moni Khryssorroyatissa, 12 km N of Paphos (Cyprus). Holotypus: SMF no. 256367.

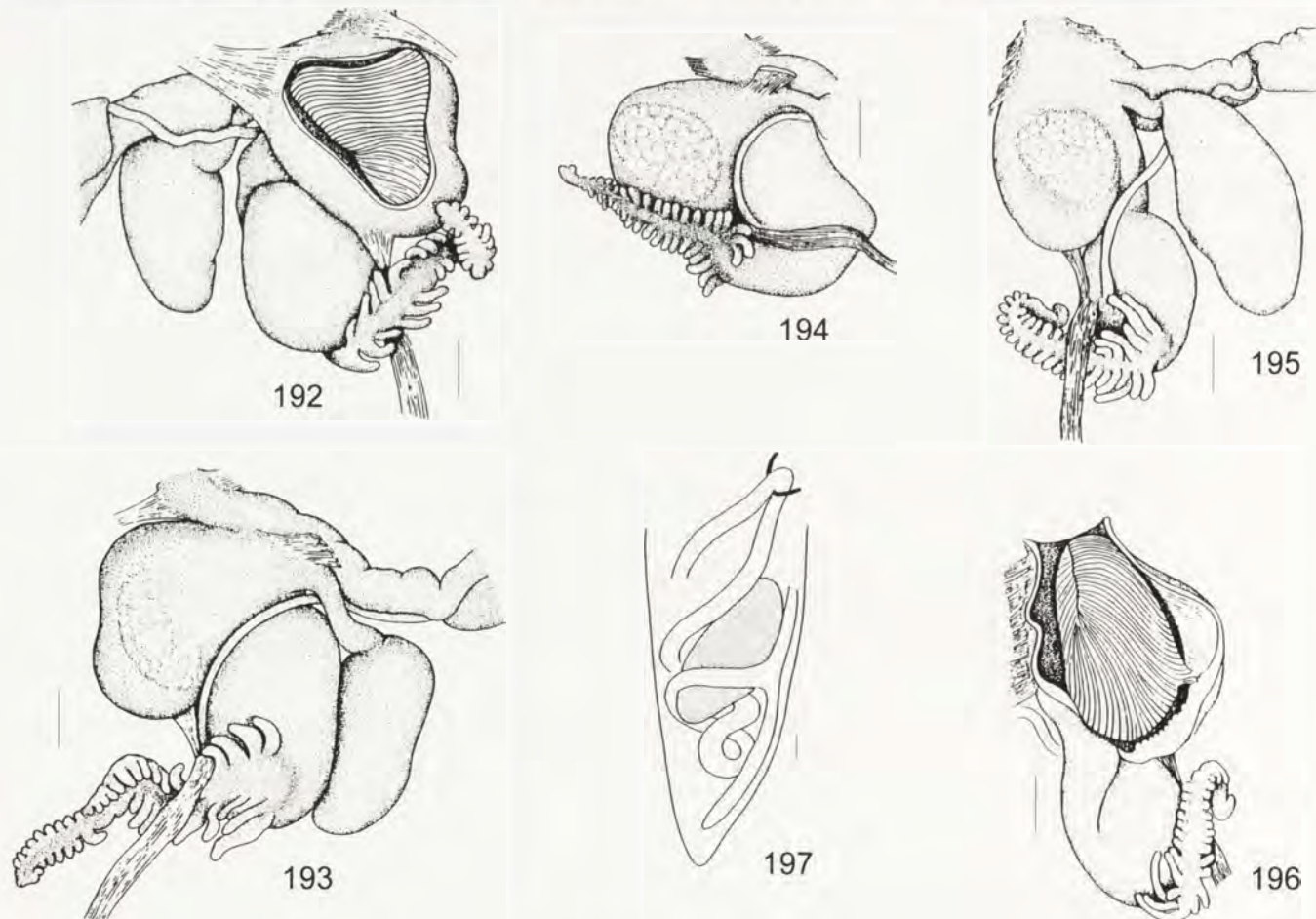
References: Rähle 1991: 146.

Body length ca 33 mm but smaller specimens may also be mature already. General coloration pale cream with very fine, nondiffuse, dark or simply black dots that are densely arranged. They seem to be single melanophores. They are more or less uniformly distributed both on head (!), nape (!), mantle and in the posterior part on back and sides. Only keel and its extension remain light or the dark spotting is sparser. Also on sides near sole and on the plate surround-

ing pneumostom the dots are scarcer. The spotting pattern in the whole series of specimens (at least the ones I have seen) is so characteristic that it may prove to be a constant feature differentiating this slug from other *Deroceras* regarding external appearance (!) (Fig. 198). Sole light. The colour of mucus unknown.

Genitalia (Figs. 199–201). Penis oval in general outline but its medial section is laterally, not strongly, constricted by a furrow. The anterior part of the organ is broader than the posterior one. On the rear end of penis there is a digital appendix directed posterad or bent, its surface smooth. Also in the posterior section of penis, and also slightly laterally, nevertheless on the opposite side relative to appendix, there is the junction with penial gland. Appendix and penial gland are roughly of the same length, both equalling about half that of penis. In all examined specimens penial gland is composed of two branches (!) set on a common trunk. Between appendix and penial gland there is the outlet of vas deferens and insertion of an unbranched musculus retractor penis. Inside the anterior fragment of penis a large conical slightly flattened stimulator is situated.

Rectum without caecum (Fig. 202), at the most with an inconspicuous distension instead.



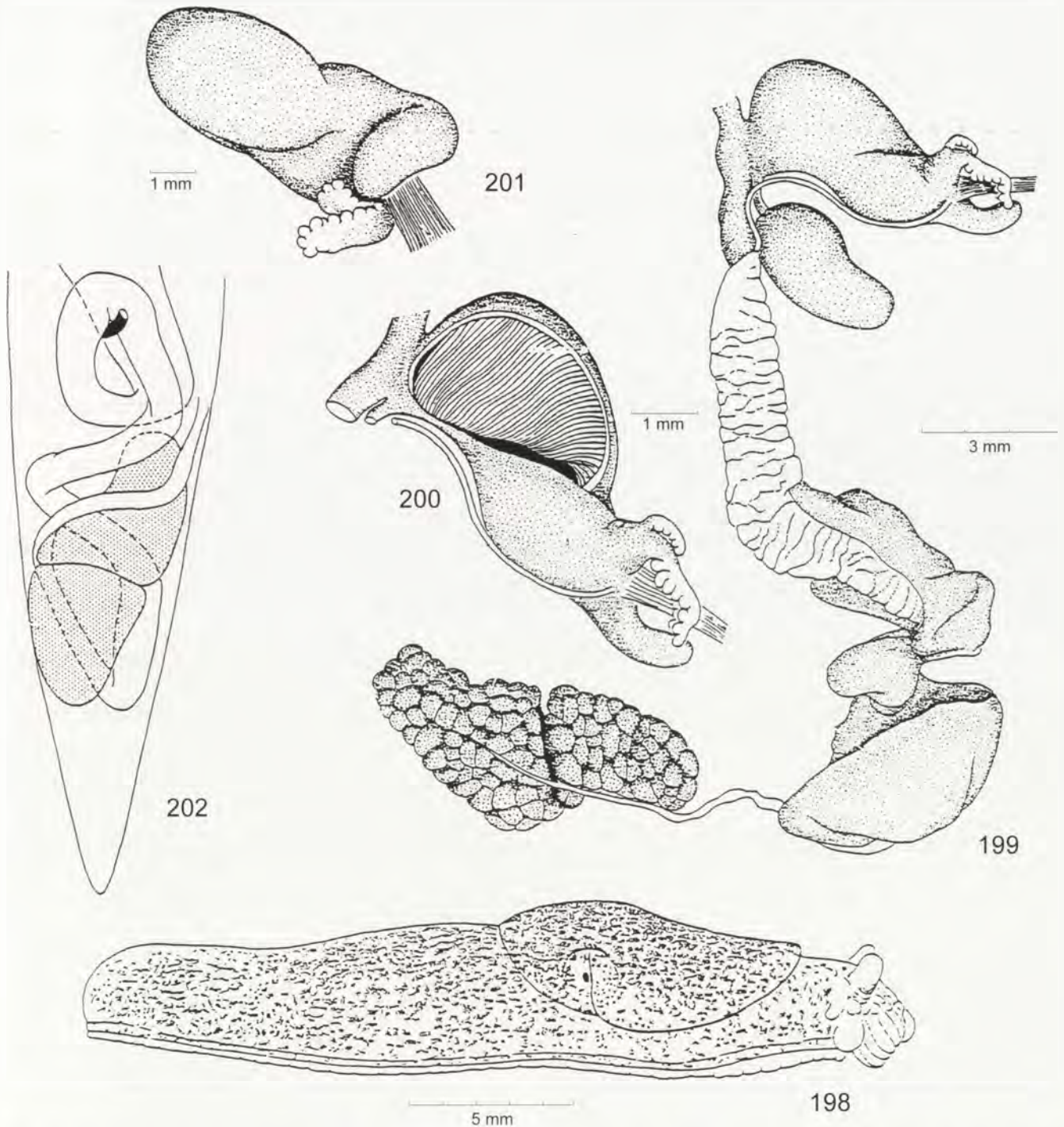
Figs. 192–197. *Deroceras christae*. 192–193 – Copulatory organs of the holotype. 194–196 – Copulatory organs of a paratype. 197 – Posterior section of viscera of the holotype. (After Rähle 1998)

Ecology. Still poorly known; the slug is found up to 900 m a.s.l. in the valley of a dried river, in olive groves and forest.

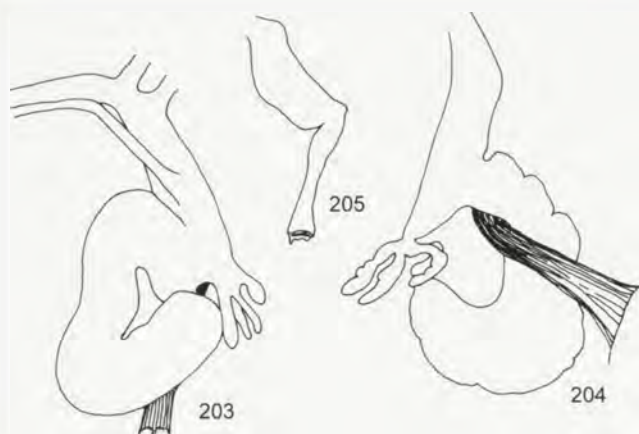
Distribution. Up until now the species has been known exclusively from Cyprus.

Comments. All the information about the slug I know is from Rähle (1984, 1991). I have only had an opportunity to examine the types deposited in SMF.

Deroceras chrysorroyatissensis seems to be highly similar to *D. barceum* from Cyrenaica (N Africa). At present



Figs. 198–202. *Deroceras chrysorroyatissensis*. 198 – Lateral view. 199 – Reproductive system. 200 – Penis with stimulator visible inside. 201 – Penises. 202 – Posterior end of viscera. (After Rähle 1984)



Figs. 203–205. *Deroceras concrementosum*. 203–204 – Penis of the holotype seen from two different sides. 205 – Rectum of the holotype. (After Simroth 1904)

it is difficult to decide about the relation between the two slugs; the names might prove to be synonymous. Though the description of *D. barceum* is quite laconic, still I have had some material from Cyrenaica. The specimens I have determined as *D. barceum* (I have failed to find the types): a. are slightly larger; b. I have little to say about the coloration for all specimens are faded, the remains of pigment yielding an unreadable pattern; c. the anterior penis section more distended, appendix of varied size: it may be short but in some specimens it is noticeably longer than that in the slugs from Cyprus; d. penial gland definitely larger in proportions and overall size, consisting of three branches (cf Figs and the description p. 406). The similarities concern: a. the shape of body; b. topography within penis; c. presence of appendix which, at least in the specimens from Cyprus, shows wide variability; d. location of the vas deferens entry and retractor insertion; e. appearance of penial stimulator and rectum. Now neither the variability range of *D. chryso-rotyatissensis* nor that of *D. barceum* is known. There exist two possibilities: either the slugs concerned represent two distinct species or make one and the morphological differences observed between them come within the range of populational variability.

Deroceras (Deroceras) concrementosum
(Simroth, 1904)

Agriolimax concrementosum Simroth, 1904: 687 t. 39 fig. 1, t. 41 figs. 66–69.
Terra typica: "Süd-Kaffa" (Abyssinia = Ethiopia). Holotypus: ZMB no. 102 128.

Body length 21 mm, width unmeasurable, mantle length 7.5 mm. Simroth (1904) drew attention to the fact that the slug was remarkably slim (besonders schlank) and hard. The author supposed the specimen had been too rapidly preserved, its hardness accounting for the slender shape. Coloration pale, upwardly reddish, anteriorly russet, posteriorly with a bluish hue (Die Grundfarbe is blass, oben rötlich, vorn ockerig, hinten bläulich angehaucht). Body spotted except for the foot. A white streak running alongside

the whole body length. It results from certain substances having been precipitated, referred to as concretions, which show through the skin.

Genitalia (Figs. 203–204). Penis cylindrical with a huge appendix (acc. to Simroth, "flagellum") which, being hook-like bent, forms a triangle. Penial gland consisting of three unbranched processes. Musculus retractor penis attached in the neighbourhood of the penial gland–penis junction. There is no information concerning penial stimulator. Inside appendix there are only folds present.

The terminal section of rectum has been preserved (Fig. 205) but lacks a typical caecum, intestine merely abruptly broadening.

No information on the ecology and distribution; there is only one specimen known.

Comments. I cannot add much to the description by Simroth (1904) as the holotype (the only existent representative of the species) is completely colourless, the copulatory organs lost. I base my opinion mainly on Simroth's (1904) description and figures. Judging by them, the slug described is obviously different by the presence of a huge appendix.

One should observe a certain similarity to *D. glandulosum*. The lack in the species discussed of glands characteristic of the one compared may indicate they have not been developed yet. We have no information about the retractor – whether it was bifurcate or single.

Deroceras (Deroceras) cycladicum
Wiktor et Mylonas, 1981

Deroceras (Platylimulus) cycladicum Wiktor et Mylonas, 1981: 190 figs. 25–31. Locus typicus: Allopronia (Sikinos Isl., Greece). Holotypus: MNHW no. MP 466.

References: de Winter and Butot 1985: 82; Wiktor – in print.

Length ca 22 mm. Body cream with indistinct black spots occurring both on mantle and beyond it, the dark pigment diffused along skin grooves. Unicolour, dark specimens are also encountered (Figs. 206–207).

Genitalia (Figs. 208–210). Penis of irregular shape, in its anterior section somewhat spherical, posteriorly narrowed. On the narrower part there is a small appendix, often dark-pigmented, to which vas deferens opens apically but asymmetrically. Musculus retractor penis inserts at the base of appendix. Penial gland mostly composed of two unbranched processes fused with their bases and with the wall of the narrowed, posterior, end of penis. This junction is situated on the opposite side relative to the appendix attachment. Inside penis a wide flat fan-like stimulator.

No typical caecum, rectum merely broadens abruptly in its terminal section (Figs. 211–212).

Distribution. The islands of the Cyclades Archipelago (Greece), namely Sikinos, Naxos, Thira and Ios.

? ***Deroceras (Deroceras) dallaii*** Giusti, 1970

Deroceras dallaii Giusti, 1970: 81 figs. 11a–c. 12. Locus typicus: Cala Gonone (Sardegna = Sardinia Isl., Italy). Holotypus: Giusti's coll., Siena (Italy).



Figs. 206–207. *Deroceras cycladicum* – holotype. (After Wiktor and Mylonas 1981)

Body length 22 mm. Coloration evenly blackish brown, back darker.

Genitalia (Figs. 213–215). Penis anteriorly laterally distended, posteriorly equipped with a well-marked appendix directed towards the body end. On the opposite side of the rear end of penis another extension of the organ, considerably smaller than the formerly mentioned appendix – this one may represent a second appendix which is partly reduced, at its end a multibranch penial gland. Most of the penial gland branches are undivided. Some of them are invaginated into penis. Presumably, the appendix on which penial gland is situated has also got partly invaginated along with penis. Between the obvious appendix and the base of penial gland there is the outlet of vas deferens. Musculus retractor penis is bifurcate, the thinner fork attached to the base of appendix, the thicker one close to that of penial gland. Inside penis a conical grey-pigmented stimulator.

The appearance of rectum and its caecum unknown.

Distribution. So far a single specimen (holotype) has been described. The test-tube it is kept in contains also another, tiny, slug, probably the same species.

Comments. I have had an opportunity to examine the holotype. The description and very detailed figures by Giusti (1970) are entirely correct. The alcohol-preserved parts of the holotype lack the terminal section of rectum and caecum. There is no mention of these organs in Giusti's description, either.

Based on the data available (the description by Giusti

(1970) and own study of the type), I have got the impression that *D. dallaii* is a junior synonym of *D. panormitanum*, a species famous for its enormous variability both with regard to external appearance and the shape of genitalia. *D. dallaii* differs only in its uniformly blackish coloration. Taking into account the almost certain fact that a part of its penial gland is invaginated, penis can fall within the wide variability range of *D. panormitanum*. Now that the variability ranges of slugs corresponding with the descriptions of *D. dallaii*, nor that of *D. panormitanum* from Sardinia, are unknown, I have to defer synonymization of the species concerned, leaving the problem for further, more thorough, study declared by Giusti.

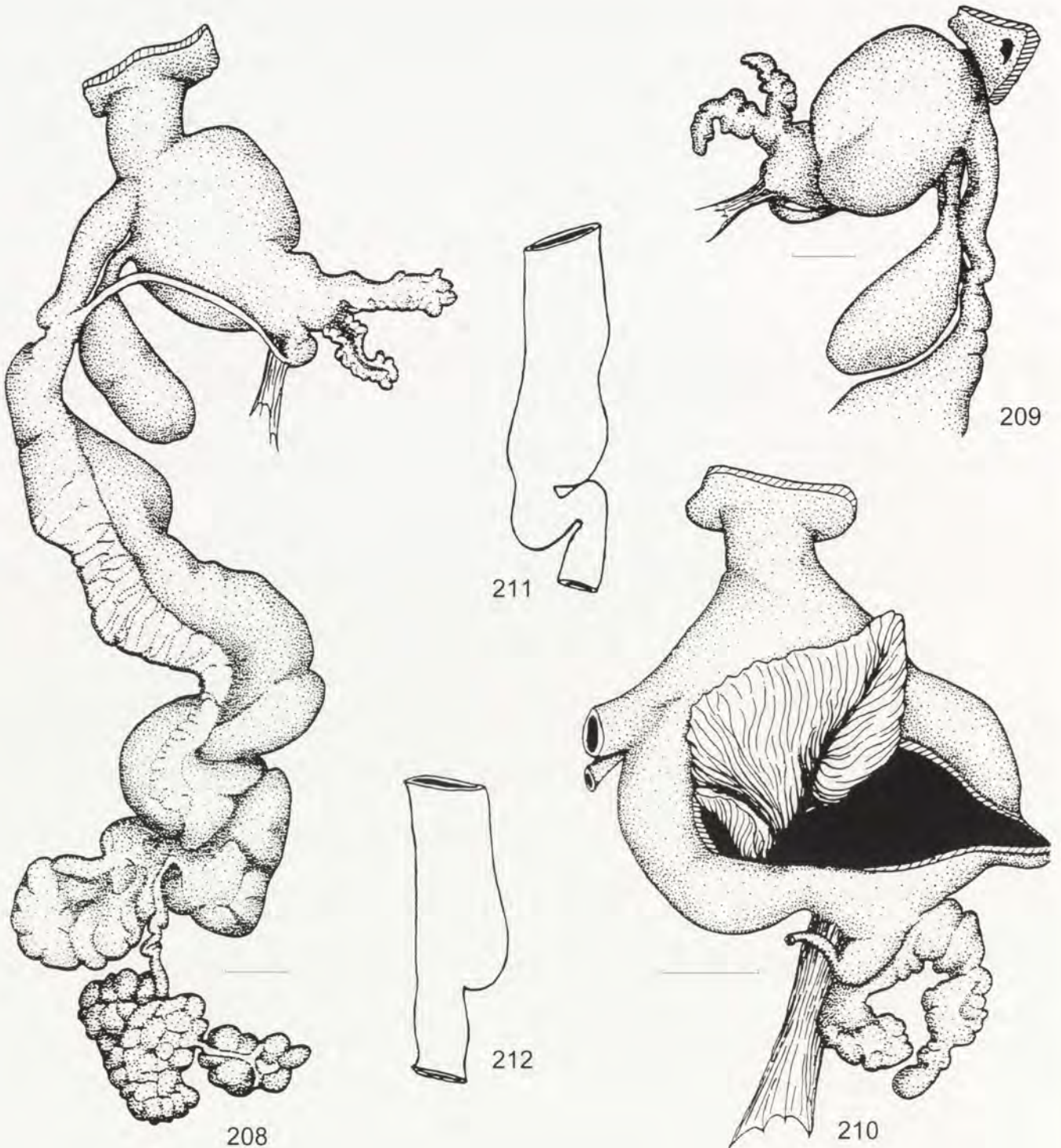
Deroceras (Deroceras) deckeni (Simroth, 1904)

Agriolimax deckeni Simroth, 1904: 690 t. 39 fig. 23, t. 42 figs. 107–109. Locus typicus: Schenna-Tschukke (West Kaffa, Abyssinia = Ethiopia). Holotypus: does not exist.

The information about the only specimen known is available in Simroth (1904).

The description does not include any mention of dimensions but the author states that the slug is large. The figure shows that the slug was ca 25 mm in length. It was evenly black.

Genitalia (Fig. 216). Penis spadicose. A small penial gland, situated on the apical end of penis, is composed of three branches set on a common trunk. External wall of



Figs. 208-212. *Deroceras cycladicum*. 208-210 - Reproductive system of a paratype from Allopronia. 211 - Rectum of a paratype from Allopronia. 212 - Rectum of a paratype from Koronos. (After Wiktor and Mylonas 1981)

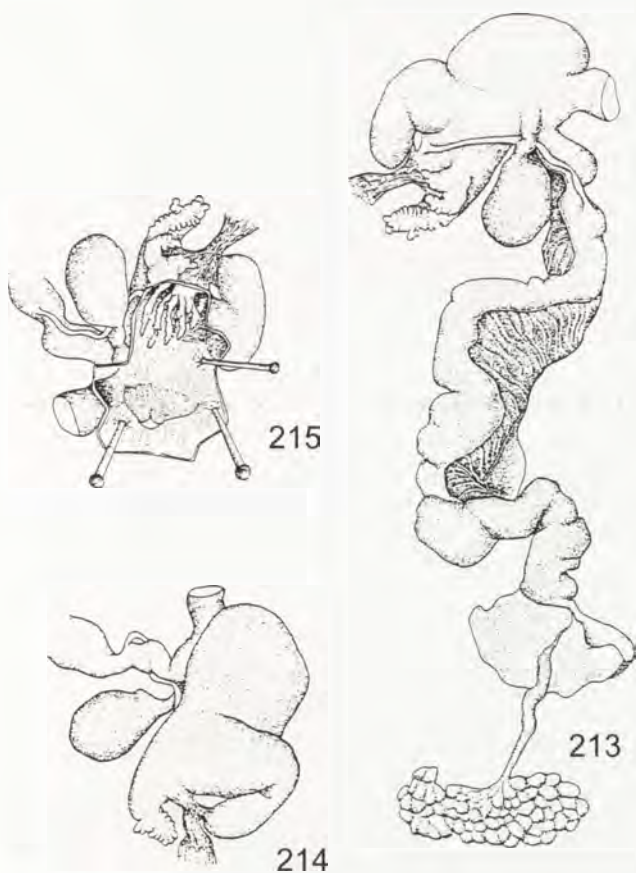
penis covered by glands. Retractor penis simple, undivided, attached nearly apically. At its base there is the opening of vas deferens. Inside penis a large fold (grosse Reizfalte).

Caecum on rectum lacking (Fig. 217).

Comments. The holotype of this species was deposited at the ZMB, but it has not been preserved till the present

moment (letter message from Dr. Mathiss Glaubrecht, a curator).

The information about this slug is very scant, insufficient to draw any conclusions. It seems, however, that *D. deckeni* may prove to be identical with *D. afer* for instance (cf. the drawings, dimensions, body coloration, stimulator).



Figs. 213–215. *Deroceras dattalii* – holotype. 213 – Reproductive system. 214 – Copulatory organs seen from the opposite side. 215 – Structures inside penis. (After Giusti 1970)

Deroceras (Deroceras) demirtensis Rähle, 1998

Deroceras demirtensis Rähle, 1998: 22 figs. 6–8. Locus typicus: Sedre valley SE of Alanya, 8 km from Demirtas towards Sapadere (UTM VF33), vil. Antalya, Turkey. Holotypus: SMT no. 39930.

Body length 33 mm. General coloration reddish brown on the background of which dark brown spotting is visible. The spots occur on head and mantle. They are also present on the ring encircling spiraculum, but the colour of this part is paler. Back behind mantle is devoid of spots, skin grooves distinguishable as a fine grey reticulum. Sole light creamy.

Genitalia (Figs. 218–220). Penis large, approximating to 1/3 of the entire body length, fleshy and S-shapedly bent. On its posterior end there is a penial gland composed of 5 undivided branches covered by glandular papillae and set on a common trunk. Vas deferens opens close to the base of penial gland. Musculus retractor penis forked. Its one strand is attached more or less at 1/3 penis length as seen from the organ's posterior end, the other inserting more anteriorly in the region of stimulator. Stimulator completely flat and very broad, internally covered by a very delicate striation, the striae on its external surface more pronounced. Spermatheca oval, difficult to delineate from spermatheca duct.

Caecum on rectum long (Fig. 220).

Distribution. The slug is known only from the type locality.

Comments. The species is distinguishable by its S-shapedly bent penis and, simultaneously, a long rectal caecum. Also the appearance of penial gland seems to show distinctive features, though its variability range is still unknown.

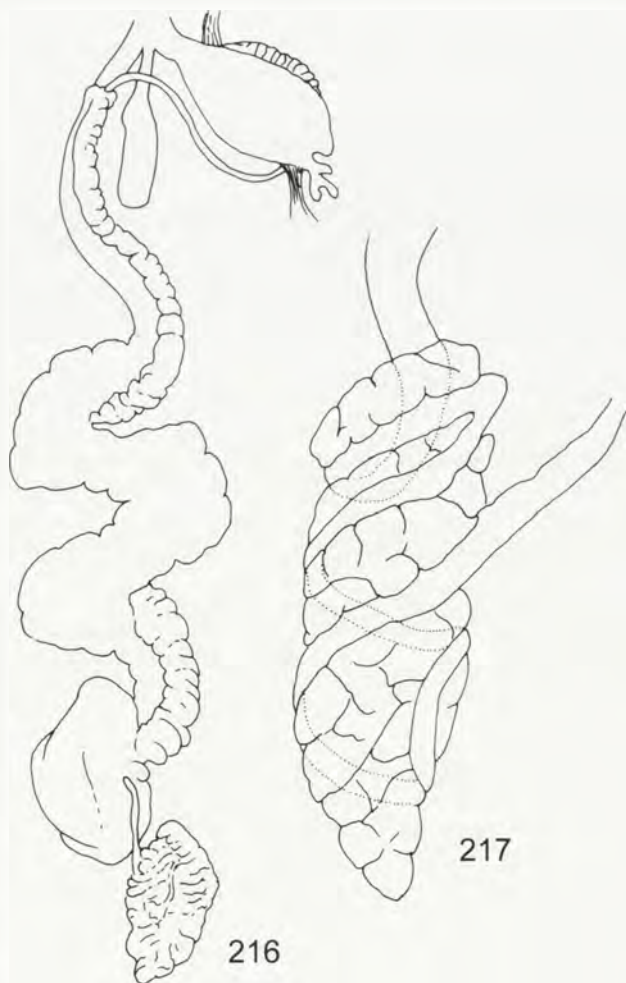
?*Deroceras (Deroceras) dubium* (Hoffmann, 1941)

Agriolimax dubius Hoffmann, 1941: 254 figs. 9–12. Locus typicus: Palermo (Sicily, Italy). Lectotypus: NHB no. 4641.

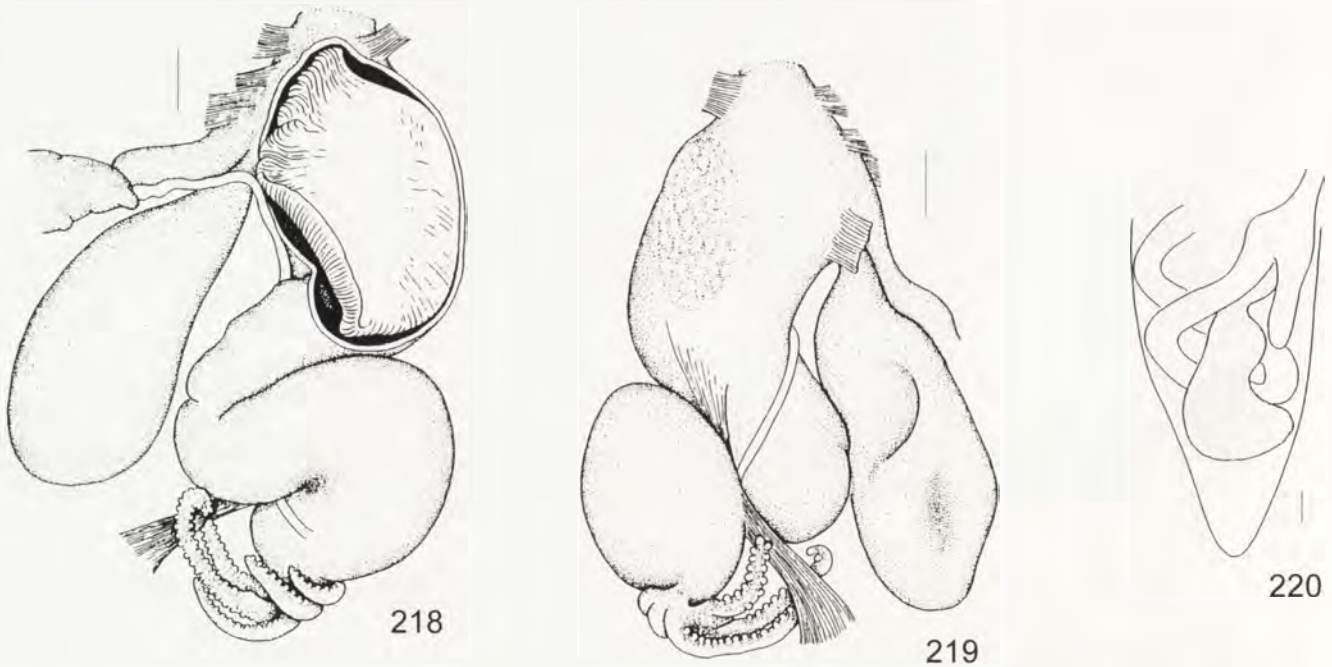
References: Giusti 1976: 219; Wiktor 1998: 17.

The taxonomic position of this slug is unclear to me.

The description by Hoffmann (1941) pertains to 4 specimens, probably representing two different species. The drawings he provides (Figs. 10A–B), which seem to illustrate juvenile specimens, show a marked similarity to *Deroceras panormitanum*. I have not seen these specimens and I do not know if they have been preserved. The two remaining



Figs. 216–217. *Deroceras deckeni*. 216 – Reproductive system. 217 – Posterior end of viscera. (After Simroth 1904)



Figs. 218–220. *Deroceras demirtensis* – holotype. 218–219 – Copulatory organs. 220 – Terminal section of viscera. (After Rähle 1998)

specimens were examined by Forcart, who designated the lectotype and paralectotype (housed in the NHB collection). I have no information if the latter malacologist have published anything about this slug. These two specimens are in a good condition and I have had an opportunity to examine them. I found them only after my own description of *Deroceras giustianum* (see p. 441) had appeared in print and that is why there is no mention of *D. dubium* in it.

The slugs Hoffman described under the name of *Agriolimax dubius* were 28–44 mm long, yellowish grey (probably faded). They had a very small rectal caecum (sehr kleine läppchenartige Falte), penis posteriorly equipped with two distensions (pockets), penial gland composed of 3 undivided branches set on a common trunk, and a large conical stimulator. The two specimens I have examined measure 41 and 27 mm. They have never been dissected nor their anatomy studied. Both have an entirely everted penis, with all its additional structures, and also stimulator, penial gland and probably appendix. Hoffman did not designate the holotype.

Beyond doubt, the lectotype and paralectotype of *D. dubium* belong to *Deroceras* s. str. They were probably a copulating pair (this is also suggested by Hoffmann).

Unfortunately, all anatomical characters that in the case of *Deroceras* are of utmost diagnostic importance have been described when in the natural position, which is invaginated inside the body. Those features concern the appearance of penis and its accessory organs, both external and internal. The everted organs are difficult to interpret and incomparable with what is situated inside penis in the "state of repose", unless one has at one's disposal both specimens with

invaginated and everted organs. The latter get swollen and change in shape, thus looking different.

The everted penises of the lecto- and paralectotype of *D. dubium* indicate the presence of a huge conical stimulator, thin penial gland equipped with three branches situated on a common trunk, at least one long appendix and one more structure difficult to define.

Comments. When discussing *A. panormitanus*, Hoffmann (1941 p. 252 figs 6A–B) mentions dark-coloured specimens with a bent appendix (referred to as "Blindsack"), which are shown in figs 6A–B. It follows from the drawings that the malacologist dealt either with atypical *D. panormitanum* or some other species bearing resemblance to *D. dubium* or *D. giustianum*.

Giusti (1976) ranks the name *A. dubius* among the synonyms of *D. panormitanum*. I used to share this view and therefore I decided to describe *D. giustianum*. After examination of the lectotype of *D. dubium*, however, I started to feel doubts about the relationship between the three slugs.

Having no opportunity to compare the copulatory organs of *D. dubium* and *D. giustianum* both in the form when they are everted and in the state of invagination, I leave the two names for future clarification if in the environs of Palermo there is one or two similar but distinct species of slugs.

We know well the anatomy of the species I have described, its characters being useful for diagnostic purposes. The situation with *D. dubium* is different, and the enormous variability range of *D. panormitanum* still causes difficulties to everybody. Now I can only recommend further

studies, leaving for the future the ultimate unequivocal decision concerning the nomenclature of the slugs in question.

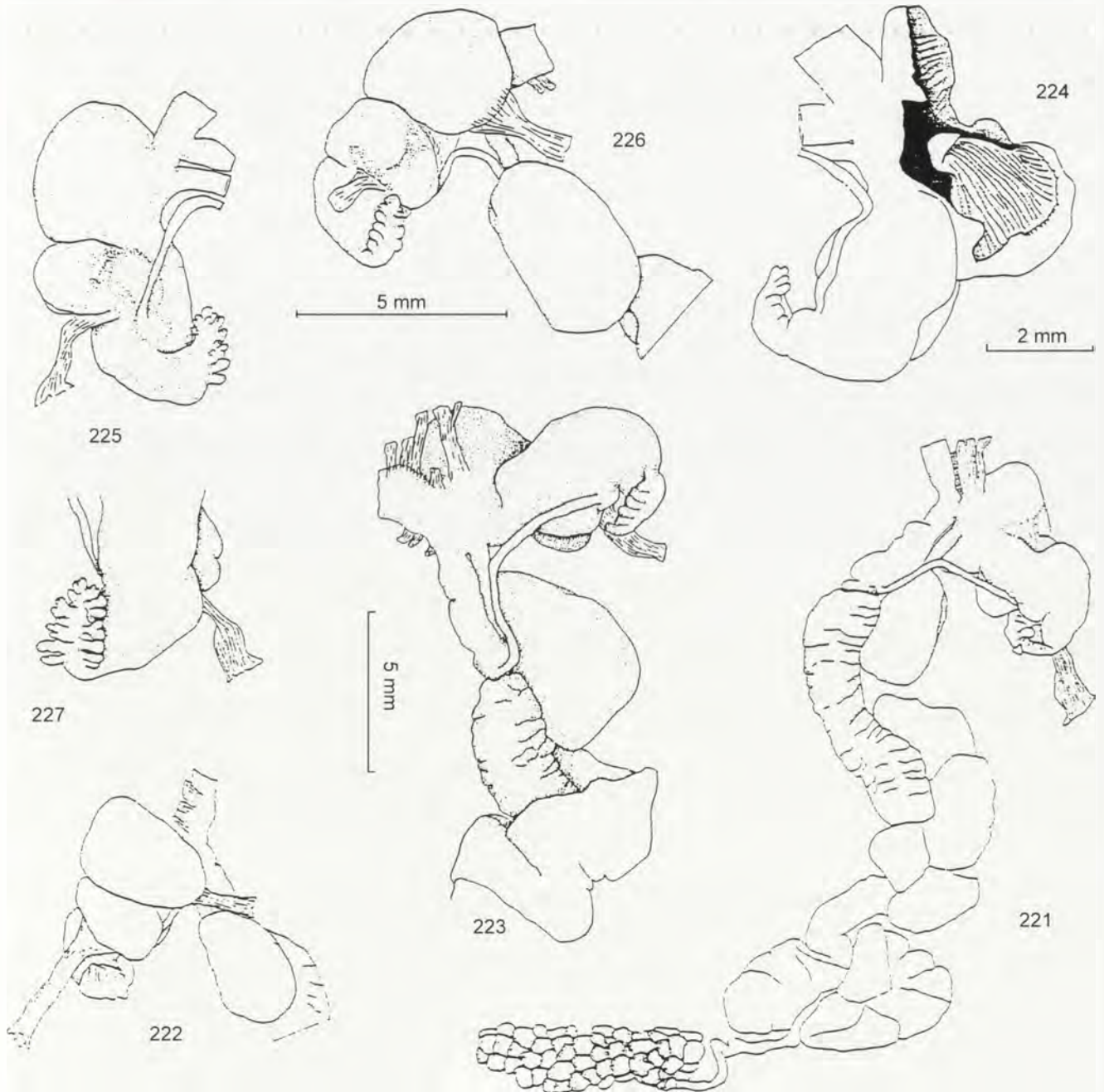
Deroceras (Deroceras) ercinae de Winter, 1985

Deroceras ercinae de Winter, 1985: 69 figs. 1–10. Locus typicus: Lago de Ercina in the Picos de Europa mountains (Spain). Holotypus: NNML no. 9122.

References: de Winter 1986: 146 fig. 36; Castillejo and Rodriguez 1991: 53 map 8; Castillejo, Garrido, Iglesias 1993: 177 figs 33–41, 52; Ondina, Rodriguez, Harmida 1994: 63 map 1; Altonaga et al 1994: 118 map 134; Castillejo, Garrido, Iglesias 1995: 19 figs 33–39.

Body length up to ca 30 mm. Coloration most often even but in some individuals there are sparse dark spots on mantle.

Genitalia (Figs. 221–227). Glandula hermaphroditica partly embedded in liver lobes. Penis divided in two parts by a constriction. In the posterior part of this organ there is a small lateral pocket. Penial gland, apically set, in the shape of an unbranched lobular structure with big glandular papillae occurring on both sides. Vas deferens and musculus retractor penis join penis at the base of penial gland. Stimulator inside penis conical.



Figs. 221–227. *Deroceras ercinae*. 221 – Reproductive system. 222–226 – Copulatory organs. 227 – Penial gland. (After de Winter 1985)

Caecum on rectum completely lacking.

Ecology. After de Winter (1985): the slug lives on limestone mountains around a lake in places with short herbs. It is found up to 1140 m a.s.l. (Altonaga *et al.* 1994).

Distribution. The species is a Cantabrian endemic occurring in a small area along the coast in the northern parts of the Cantabrian mountains more or less from Santander up to Asturia (Altonaga *et al.* 1994).

Comments. Compare with *D. nitidum* p. 480.

Deroceras (Deroceras) famagustensis Rähle, 1991

Deroceras famagustensis Rähle, 1991: 144 figs. 9–15. Locus typicus: Dipkarpaz (NE Cyprus). Holotypus: SMT no. 33689.

Body length up to ca 20 mm. Mantle unicolour, light brown-grey. Skin grooves in the posterior body section are clearly darker, producing a delicate pattern.

Genitalia (Figs. 228–235). Penis small in comparison with the body size, elongated, with a poorly marked constriction in the medial section. Apically and somewhat asymmetrically an unbranched penial gland joins penis. This is a thick, lobe-shaped or cylindrical structure, its both sides covered by glandular papillae. It is usually straight but its free end directed anterad. Musculus retractor penis is clearly forked (!). Its narrower end attaches to the anterior half of penis while the wider one is accreted at the base of penial gland. Vas deferens, half-spirally surrounding penis (!), opens at the penial gland base between the branches of retractor. Inside penis there is no typical stimulator (!), instead of which a long fold runs along this organ, accreted to its wall (!).

Caecum on rectum well-developed, in the form of a shallow pocket (Fig. 235).

Distribution. Up till now the species has been recorded only from a few localities in the eastern part of Cyprus.

Comments. The slug is distinct, first of all, by lack of a proper stimulator. Other distinctive features are as follows: thick unbranched penial gland, penis spirally girded by vas deferens (in most other *Deroceras* species the latter runs along penis), elongated shape of penis and a very characteristic bifurcation of musculus retractor penis. All these characters are visible and highly stable, as my examination of a large series of type specimens has allowed to establish.

Deroceras (Deroceras) gardullanum (Simroth, 1904)

Agriolimax gardullanus Simroth, 1904: 679 text fig. B, t. 41 figs. 64–65. Terra typica: Gidole and Gardulla, Abyssinia (= Ethiopia). Lectotypus: ZMB no. 102 124. **Present designation.**

Agriolimax gofanus Simroth, 1904: 680 t. 39 figs 24–25, t. 42 figs. 101–103. Locus typicus: Djala (Gofa). Lectotypus: ZMB no. 102 125. **Present designation.** Syn. nov.

Body dimensions: length up to 20–21 mm, width ca 4.5–6 mm, mantle length ca 6–8 mm. The coloration of the examined specimens is uniformly whitish; according to Simroth (1904), some of the specimens he named *A. gofanus* were evenly pale, others being spotted on mantle and below keel

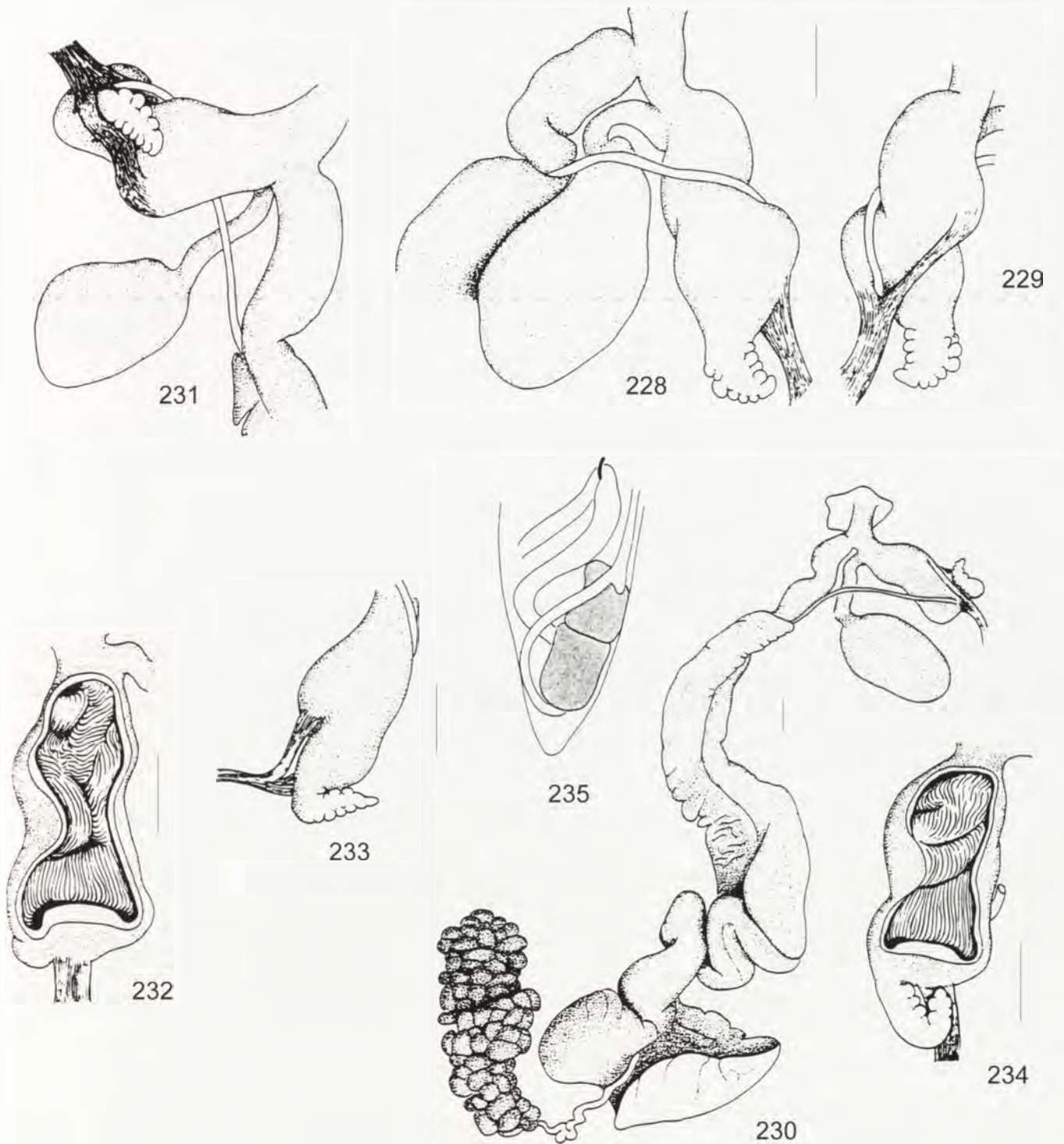
in the posterior body section (visible in Simroth's drawing – 1904 t. 39 figs 24–25). The spots were arranged in a reticulum. At present no spots are perceivable in the types. The specimens bearing the name *A. gardullanus* were unicolour: pale grey-brown (hell graubraun); only their back inconspicuously darker. There is nothing particular about the slug's body shape, skin sculpture etc.

Genitalia (Figs. 236, 238–242). Most frequently penis divided in two clearly distinguishable sections. One of them is strongly distended, its lateral wall covered by a thick layer of glands; this part contains stimulator. The other, anatomically posterior, section is narrower; to this one both musculus retractor penis and penial gland are attached. In one case (the lectotype of *D. gardullanum* – Fig. 236) there is no such clear division of penis in two parts, and the organ is egg-shaped. But another specimen from the same type series has its penis clearly divided in two sections by a deep constriction (Figs. 238–242). Sometimes there is a small nodule or swelling on the rear end of penis (Fig. 236). Penial gland composed of 4–6 thick noodle-like processes with poorly developed glandular papillae. The length of the processes differs from individual to individual. Some of them may be nearly as long as penis, or all, equal in length, are considerably shorter than the organ mentioned. The processes are either directly situated on penial wall, at most touching one another with the bases, or have a short common trunk. Some of the processes may be bifurcate. Musculus retractor penis wide. In some specimens, when it is not contracted, it is visibly forked, its one branch inserted directly to penis whereas the other is attached near the base of penial gland (Figs. 239–242). When the muscle is heavily contracted, no bifurcation is perceivable. In most of the specimens vas deferens is broken off. In the specimens where it has been preserved the organ opens into penis close to retractor insertion on the side of body integuments (!). Inside penis a huge flattened stimulator. As a matter of fact, it is one large concave fold, whose strongly elongated ligular free end (Figs. 236, 238, 239–240) corresponds to proper stimulator both with respect to location and appearance. This free section is most commonly multifolded or folded in two, its end nearly conical. The internal surface of the fold, especially its free end, i.e. the proper stimulator, are covered by thick structures resembling fingerprints. Spermatheca is damaged in most of the specimens. In one where it has been preserved, it is oval and set on a long spermatheca duct (Fig. 241).

Rectum. I have found it merely in one specimen of the type series of *D. gardullanum*; the organ is represented by a very shallow pocket (Fig. 237).

Distribution. To my knowledge, the descriptive types are the only known representatives of the species and thus the range covers exclusively loci typici in Abyssinia.

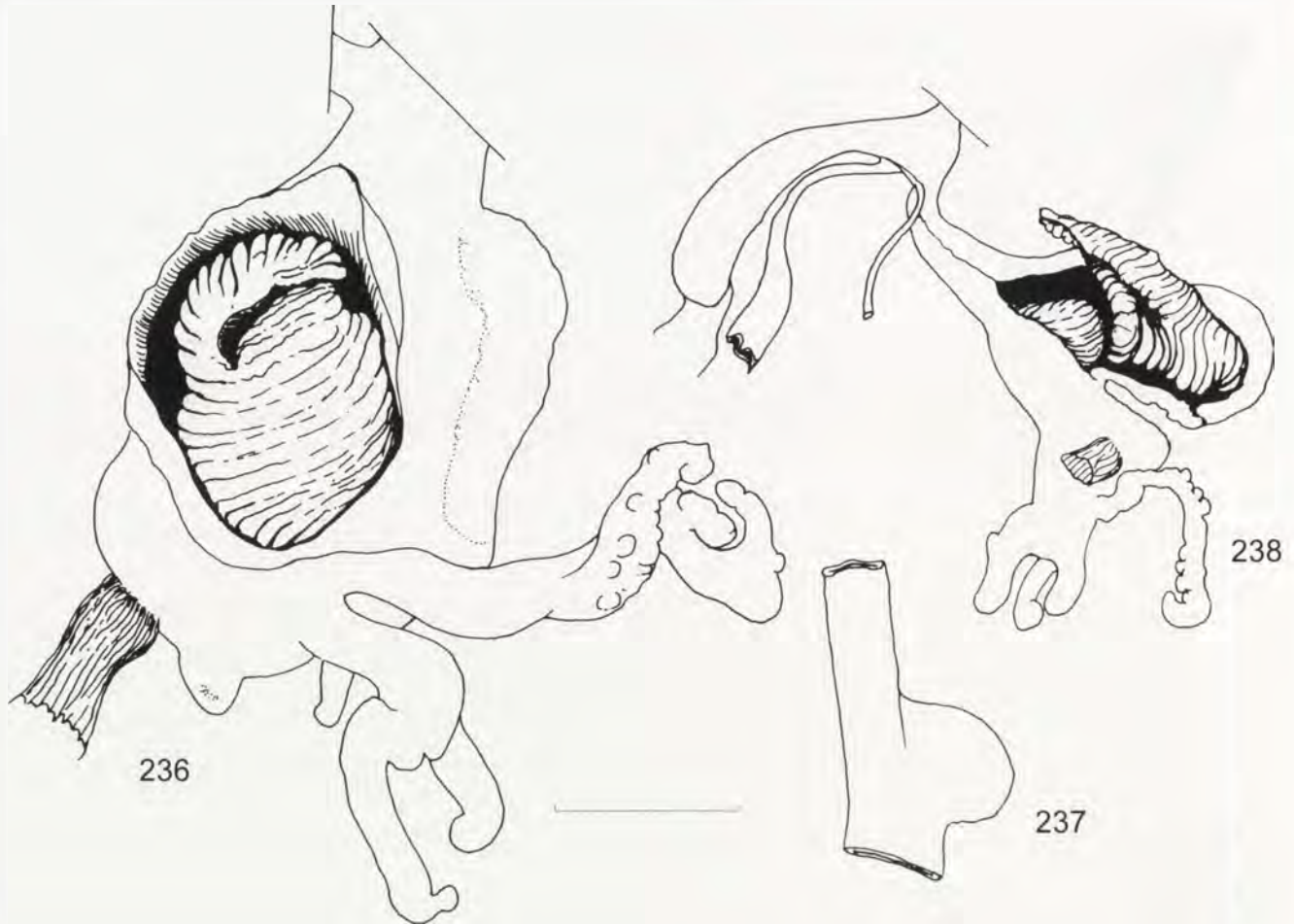
Comments. *Agriolimax gardullanus* – all the types, i.e. two roughly adult specimens (both dissected) and two juveniles, have been preserved. Now all of them are completely faded, a part of internal organs missing. As the lectotype, I designate the specimen drawn by Simroth (1904



Figs. 228–235. *Deroceras famagustensis*. 228–229 – Copulatory organs. 230 – Reproductive system. 231–234 – Different parts of genitalia. 235 – Posterior section of viscera. (228–229 – holotype, 230–235 – different paratypes). (After Rähle 1991)

t. 41 figs. 64–65). It should be pointed out, however, that both figures of this taxon are much simplified. The glandulous section of penial wall is now more homogeneous in structure and it is difficult to perceive the glands illustrated by

Simroth (fig. 65); the glands might have been destroyed (?). In comparison with penis, stimulator is larger. The other drawing (paralectotype) (Simroth 1904 text fig. B) shows stimulator inside the posterior section of penis. I have not



Figs. 236–238. *Deroceras gardullanum*. 236–237 – Penis and caecum on rectum of the lectotype. 238 – Copulatory organs of a paratype. (Orig.)

found such a structure in this specimen. What is more, this fragment of its penis has never been cut, but in the other one there is a fold, ending with a stimulator, like the one present in the lectotype I have designated.

Agriolimax gofanus – as the lectotype I designate the dissected specimen, probably the same which is depicted in Simroth's drawing (t. 42 fig. 101). It can be inferred from his paper that Simroth had 11 specimens at his disposal. At present the type series, deposited in Berlin, contains only 8 specimens (5 more or less grown and 3 juveniles). All the specimens are entirely faded.

Having examined the types of the two taxa, I have come to the conclusion that one species is concerned. The priority issues from the sequence of pages in the same publication (Simroth 1904) and falls to the name "*gardullanus*" (= *gardullanum*). Simroth himself had some doubts about the distinctness of the two taxa. He also pointed out to a small distance between the type localities of the two slugs. The division of penis into two clear parts or lack of this character frequently depends on the degree of genital

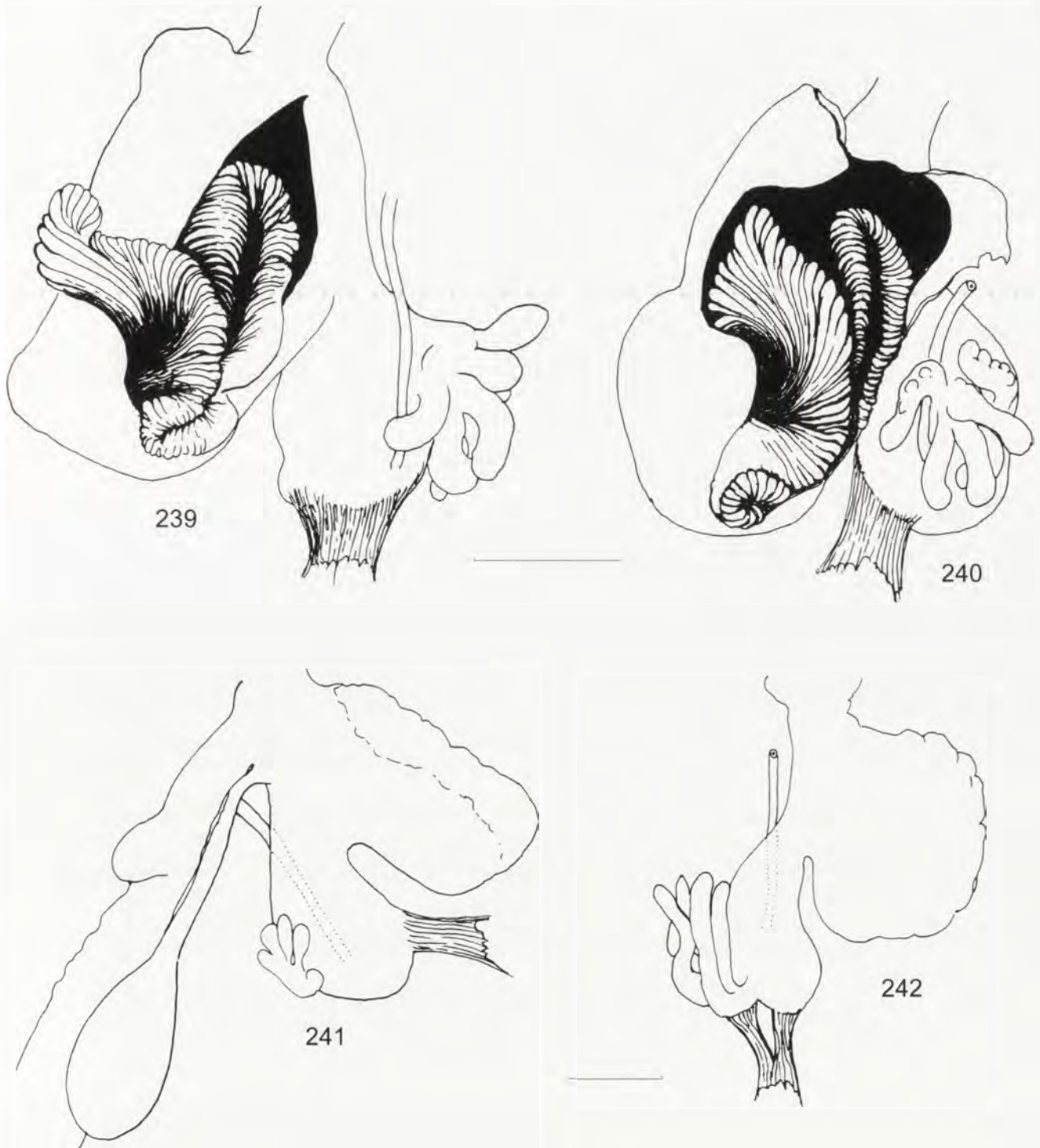
development or the means of preservation. The lateral gland-covered penial wall in the part containing stimulator is often so large that it makes the impression of being a separate section of penis. The features of coloration and presence of white lines in skin, to which Simroth paid particular attention, are hardly taxonomically useful in identification of species in the case of *Deroceras*.

Deroceras (Deroceras) gavidosensis

Wiktor, Vardinoyannis, Mylonas, 1994

Deroceras gavidosensis Wiktor, Vardinoyannis, Mylonas, 1994: 10 figs. 11–16 map 4. Locus typicus: between Karave and Kastri, Gavidos Isl. (= Nisos Gávdhos, Greece). Holotypus: MNHW no. MP 632.

Body length of live slugs up to 21 mm. General coloration after preservation dirty cream. On mantle black spots. On back and sides the dark pigment is concentrated along skin wrinkles, which results in a reticulate pattern (Fig. 243). Keel and its extension, i.e. only the medial section of back, devoid of the dark pigment. Welter-Schultes (1998) gives

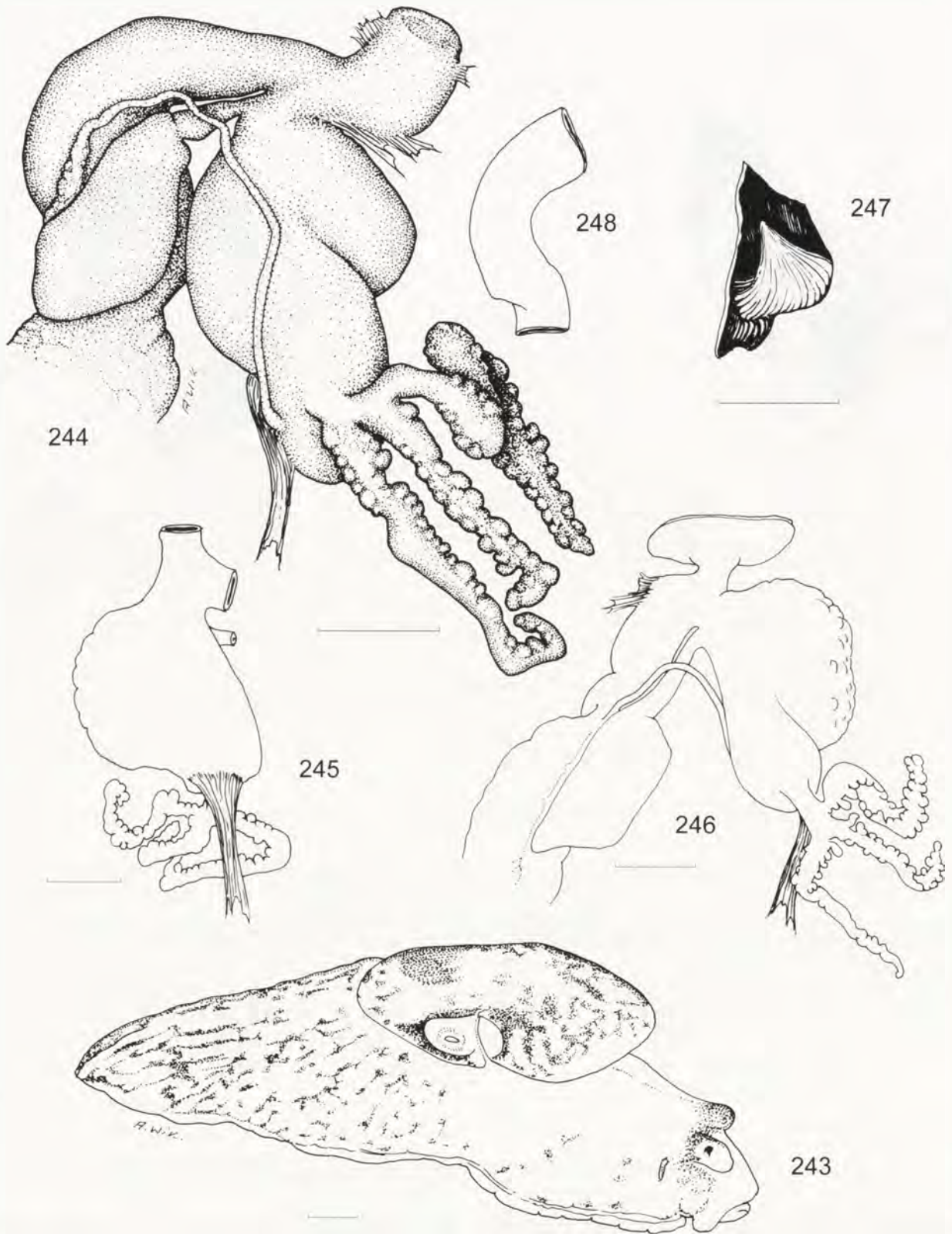


Figs. 239–242. *Agriolimax gofanus* = *Deroceas gardullanum*. 239–240 – Copulatory organs (lectotype of *A. gofanus*). 241–242 – Copulatory organs of paralectotypes, including a juvenile specimen (242). (Orig.)

a description of live slugs. They can attain a size of 30 mm. Their colour varies: from pale grey through ochreous and reddish brown to nearly black.

Genitalia (Figs. 244–247). Penis medially slightly constricted, irregular in shape, sometimes with lateral protuber-

ances. Penial gland, made up of a short trunk divided into 3–4 long unbranched processes, is nearly apically set. Vas deferens opens close to the opening of penial gland. Slightly more anterad there is the connection of penis and musculus retractor penis. Sometimes, however, the latter is almost



Figs. 243–248. *Deroceras gaudosensis*. 243 – External appearance. 244–246 – Copulatory organs. 247 – Stimulator. 248 – Rectum. (244, 247–248 – holotype, the remaining – paratypes; after Wiktor et al. 1994)

apically inserted. Inside penis a small conical stimulator, pale grey in colour.

On rectum merely an inconspicuous enlargement, i.e. proper caecum lacking (Fig. 248).

Ecology. According to Welter-Schultes (1998), the slug has an exceptionally short life cycle since it reaches maturity and lays eggs already after 30 days of life. Its life cycle is thus the shortest known in the genus *Deroceras*. The author mentioned maintains that this is an adaptation to the local climatic conditions, namely the wet season falling in winter and lasting very short. Only eggs can survive a period of drought.

Distribution. So far the slug has been known exclusively from the small island of Gavdos.

Deroceras (Deroceras) giustianum Wiktor, 1998

Deroceras giustianum Wiktor, 1998: 17 figs. 10–17. Locus typicus: Erice near Trapani (Sicily, Italy). Holotypus. MNHW no. MP 669. See Comments!

A very large, up to 43 mm long, comparatively thickset slug. Uniformly intensely black, but sides may be getting paler downwards (Fig. 249). The ring around pneumostome also lighter in colour. The lateral sole zones dark, the medial one creamy.

Genitalia (Figs. 250–254). Penis oval or spherical. In its posterior section a long, simply vermiform, tapering appendix (!). It may be spirally coiled, double-folded or twisted. Along its whole length there is an indistinct streak produced by a dark pigment. The rear end of penis is pigmented, too. Penial gland apically situated on penis. It is composed of a clearly distinguishable shaft and a few unbranched processes covered by poorly marked papillae. Vas deferens, opening into penis between retractor insertion and the base of appendix, is often crossed with the bent appendix as if holding it to penial wall. Musculus retractor penis not branched. Inside penis a long thin cone-shaped stimulator, its free end directed posterad.

On rectum a small and very shallow pocket (Fig. 255).

Distribution. Sicily, the environs of Erice, Calatafimi, Monte Pelegrino – Santa Rosalia.

Comments. Having found and examined the lectotype of *Deroceras dubium*, whose copulatory organs are known only in the state of evertion, I came to the conclusion that *D. dubium* and *D. giustianum* may be the same species (see *D. dubium* p. 433).

Deroceras (Deroceras) glandulosum (Simroth, 1904)

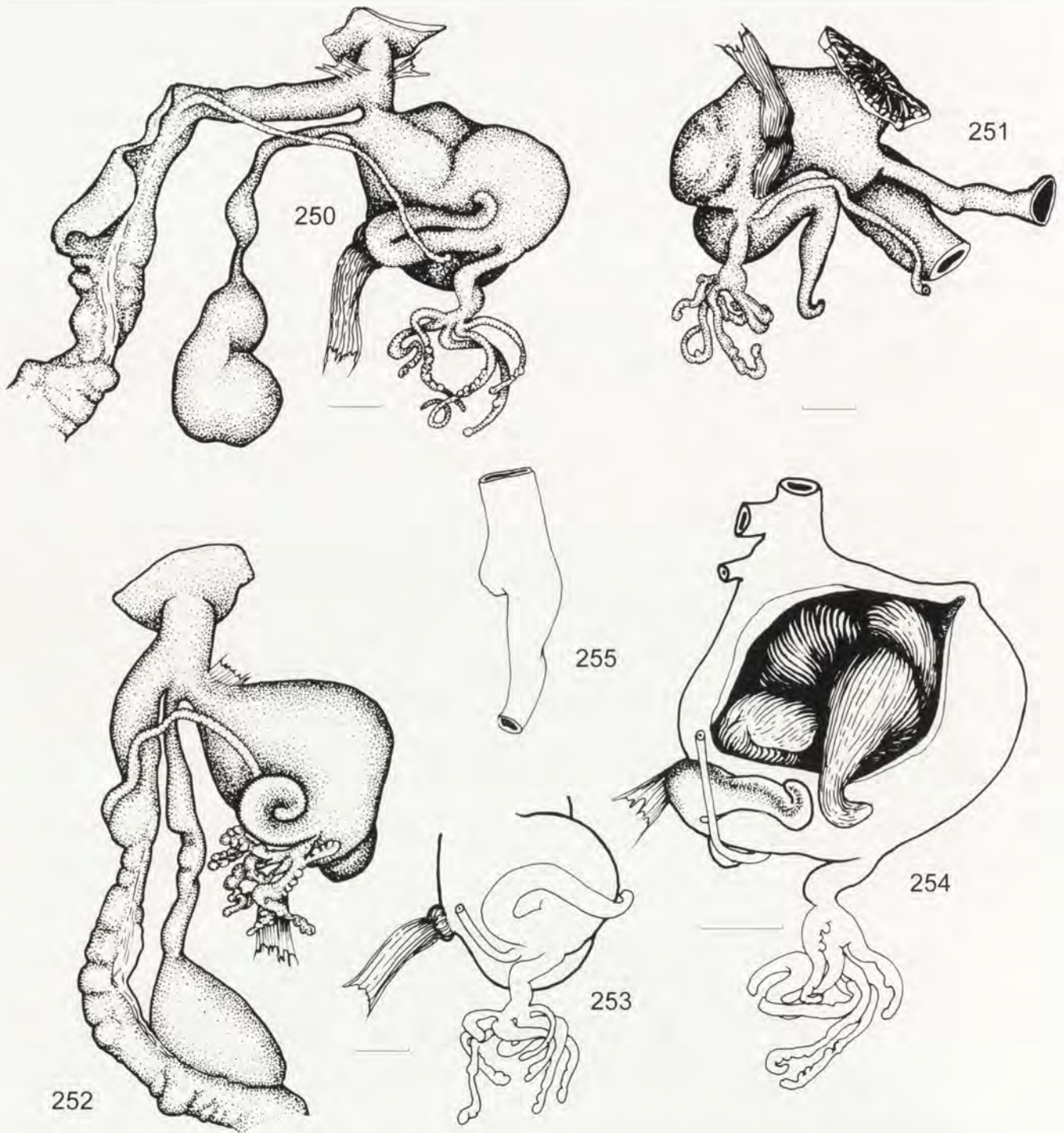
Agriolimax glandulosus Simroth, 1904: 681 t. 39 figs. 10–18, t. 41 figs. 81–92. Locus typicus: S of Kaffa (= Jimma), Abyssinia (= Ethiopia). Lectotypus: ZMB no. 102 126. Present designation.

Body dimensions: the largest specimen 35 mm in length, 7.5 mm wide, mantle length 13 mm. Lectotype's dimensions: 30 mm, ca 7 mm and 12 mm respectively. One of the paralectotypes, which is only 18 mm in length, has fully developed copulatory organs (Fig. 256). The types preserved are now completely faded, uniformly cream in colour. According to Simroth (1904), originally the particular specimens differed from one another in coloration and body pattern. They were brownish, or violet-blackish with a brown tint (braunlich oder schwarzlich violette, ins Braune gehendes Colorit). Some were unicolour, others with darker spots both on mantle and in the posterior body section.

Genitalia (Figs. 256, 258). Penis elongated, tubular, posteriorly tapering into a hook-like bent appendix. The whole of the organ is curved in the shape of the reversed letter S. The external surfaces of penis and appendix smooth. More or less in the place of the indistinct border between appendix and the rest of penis there is the connection with a specific penial gland unlike that in the other *Deroceras*. It is a ball composed of very thin glandular threads, which joins penis through a thick cylindrical shaft (!). Penis equipped with another accessory gland (!). It is also built of thin threads, which are lumped together, and



Fig. 249. *Deroceras giustianum* – external appearance of a paratype. (After Wiktor 1998)



Figs. 250–255. *Deroceras giustianum*. 250–252 – Copulatory organs. 253 – Posterior end of penis with its external structures. 254 – Stimulator inside penis. 255 – Rectum. (252 – a paratype, the other ones – holotype). (After Wiktor 1998)

opens into penis at its base next to the junction with atrium (!). This gland presumably corresponds to the glands which in many other *Deroceras* species build the wall of penis at the base of stimulator. As shown in Fig. 256, the gland is divided in two lobes. I do not know, however, whether it is its

original structure or the division is a result of dissection (performed probably by Simroth). Musculus retractor penis forked. Its one part is attached on the border between penis and its appendix, whereas the other inserts to the shaft of penial gland (!). Vas deferens, thin in comparison with

copulatory organs, opens on the border between appendix and penis, too. The walls inside penis are provided with various thickenings of very finely striated surface (the pattern of striae resembles fingerprints), but there is no stimulator or corresponding fold (!). Spermatheca – in the specimens in which it has been preserved – is narrowly oval and set on a thin and long spermatheca duct. Relative to the rest of genitalia, also oviductus seems to be long and thin.

Towards its end rectum abruptly broadens but it lacks not only caecum but even a distinguishable shallow pocket (Fig. 257).

Ecology. Unknown. Simroth (1904) notes that, judging from the map, the area inhabited by the species is mountainous in character.

Distribution. To my knowledge, the slug has so far been recorded only from the type locality.

Comments. Simroth does not mention how large the type series was. In the material I have been sent from Berlin there are 6 specimens (3 large and 3 smaller ones but the latter with their genitalia already developed). Of one specimen only body integuments, pharynx and a fragment of rectum have been preserved; the remaining specimens are nearly complete. I designate as the lectotype the specimen that, in all likelihood, is illustrated in Simroth's (1904 drawing t. 41 fig. 81).

The species is very clearly distinguishable within the whole genus, but only with respect to the shape of penis. The appearance of both ancillary glands (penial gland and the gland in the anterior part of penis) is different than in all the other *Deroceras* species. Other typical characters are

a forked retractor, of which one part is inserted to the base of penial gland, and lack of penial stimulator or a corresponding structure.

Considering the appearance of penis, and also its dark coloration and dimensions, *D. glandulosum* is very similar to recently described *D. adolphi* (see p. 395). This other species, however, does not have such additional glands connected with penis. Besides, its stimulator is roughly conical in shape.

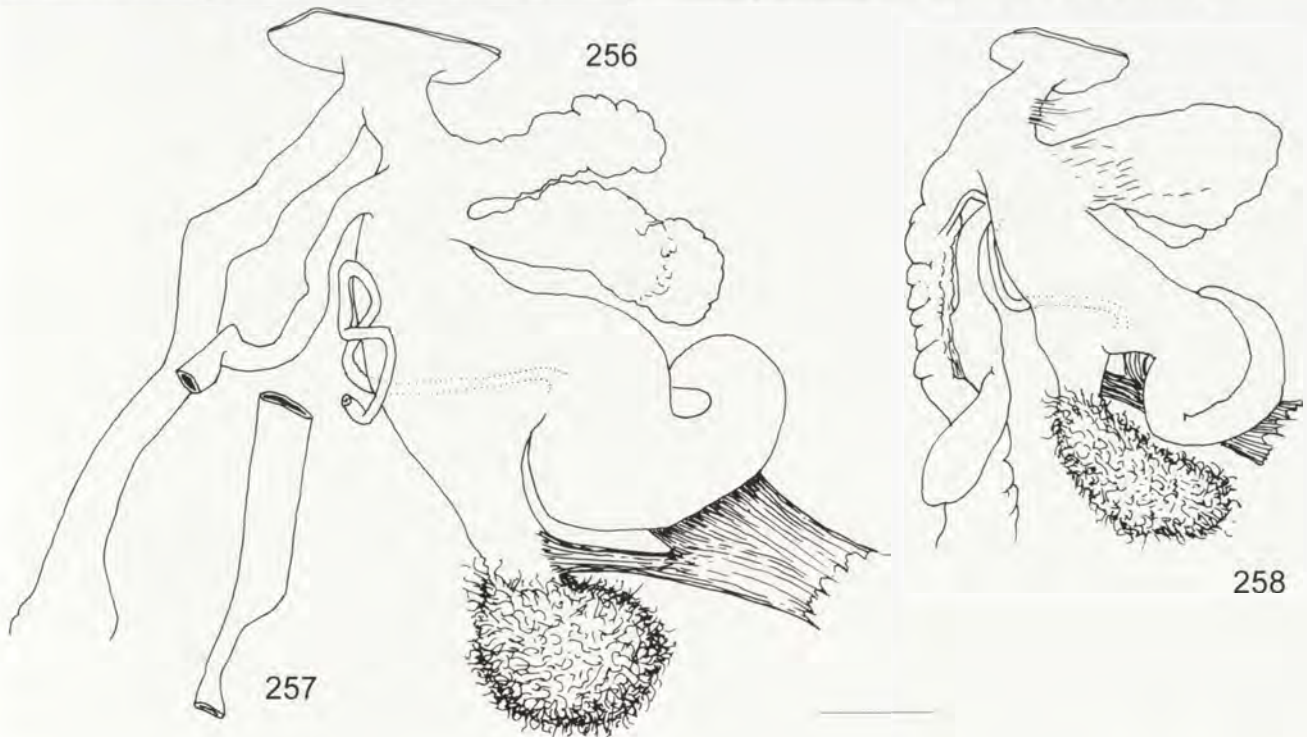
Deroceras (Deroceras) golcheri Altena, 1962

Deroceras golcheri Altena, 1962a: 49 figs. 1a–b. Locus typicus: gorge de Makluba (Malta). Holotypus: NNML no. 4788.

?*Agriolimax corsicus* Simroth, 1900: 102. Locus typicus: Fangothal bei Bastia (Corsica).

References: Hoffmann 1926: 248; Giusti 1976: 313 figs. 27A–C; Reischütz 1986: 143 map 25; Giusti, Manganelli, Schembri 1995: 288 figs. 241–242, 248–252.

A fairly large slug, up to 40 mm in length, the information confirmed by Giusti *et al.* (1995). Coloration of preserved specimens dirty creamy with a brownish tint, densely dark brown-black spotted. According to Giusti *et al.* (1995), live slugs are pale pink, grey or pinkish-violet. On mantle the fine dots are irregularly scattered, some fusing in larger concentrations of diffuse contours. On head, sides and back, also on the short keel and its extension, i.e. on mid-back, there are also tiny dots joined in aggregates. The dark pigment is more heavily accumulated in skin grooves. Sole without dots, creamy in colour. The colour of mucus unknown.



Figs. 256–258. *Deroceras glandulosum*. 256–257 – Copulatory organs and rectum of the lectotype. 258 – Copulatory organs of a paralectotype. (Orig.)

Genitalia (Figs. 259–260, 262–265, 267). Penis anteriorly distended, its one side with none too conspicuous layer of glands. The posterior part of the organ is somewhat narrower and irregularly shaped having several varied distensions but no definite processes of the type of appendices. A tuft of numerous (3–8) entangled processes, covered by fine papillae, constitutes penial gland, which is apically but asymmetrically situated on penis. The processes mentioned are arranged in a circle, so they are not lying flat as it is usually the case in many other *Deroceras* species. Musculus retractor penis branched in two or more strands, one of which is apically or nearly apically inserted on the opposite side of the rear end of penis relative to the latter's juncture with penial gland. Irrespectively, retractor produces a thin offshoot which is attached to penis at the base of penial gland. Vas deferens opens between the branches of musculus retractor penis. Stimulator inside penis dark, cone-shaped but clearly flattened. Spermatheca oval, set on a narrow spermatheca duct, sometimes its rear end dark-pigmented. In some specimens the apical end of penis is also dark pigmented (Fig. 262).

Rectal caecum vestigial, in the form of a barely marked recess or shallow lateral pocket. Sometimes rectum merely widens abruptly in its terminal section (Figs. 261, 266, 268).

Ecology. Now the slug is only known to occur on walls and under stones.

Distribution. So far the species has been recorded from Malta (Altena 1962, Giusti *et al.* 1995) and probably from Corsica (see Comments), the localities in Austria (Reischütz 1986) being doubtful.

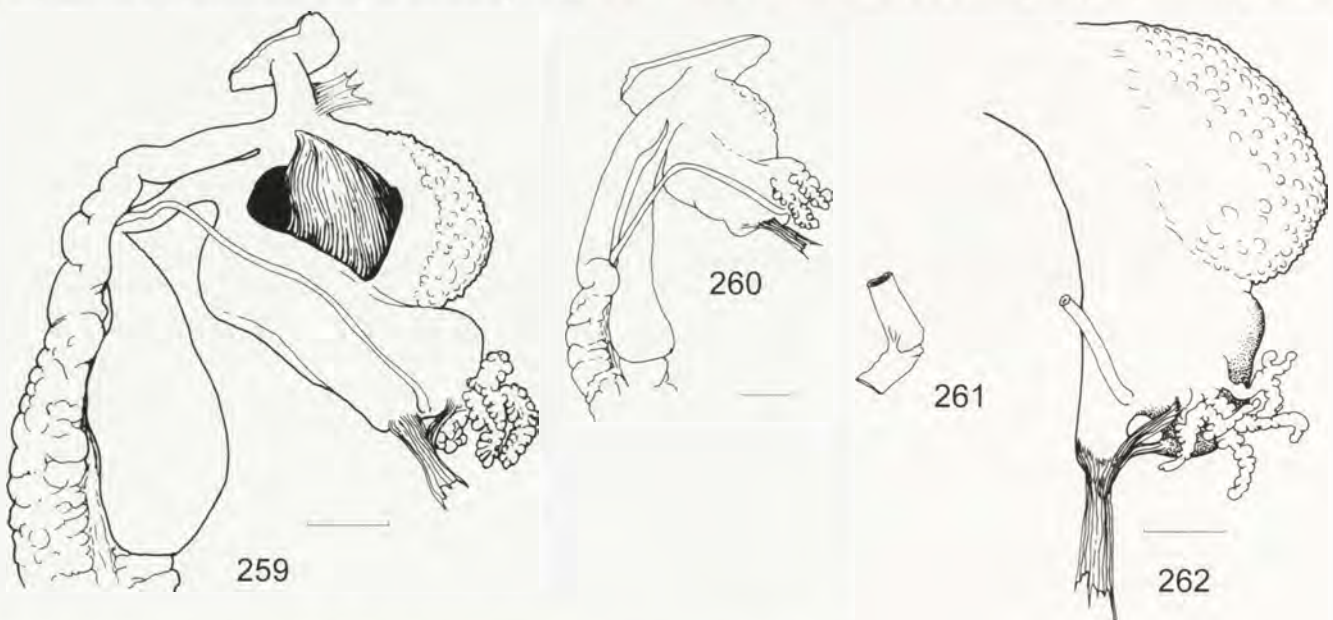
Comments. It is doubtful whether the discussed slug is a distinct species or not. It has been most thoroughly studied by Giusti, Manganelli and Schembri (1995), who provide many excellent figures illustrating its variability range. The

authors also state that the slug co-occurs with *D. panormitanum*, that being confirmed by the material I have had at my disposal. The specimens of *D. panormitanum* from the localities shared with *D. golcheri* are definitely of smaller size (at least by 1/3) and noticeably different coloration. As an important character of *D. golcheri*, Giusti *et al.* (1995) mention "the black, crescent-shape line bordering the upper pneumostomal margin". The specimens I have examined do not have such a clear blot. Judging by other species, however, this character seems to be of low stability. The two slugs concerned are similar anatomically. But it is important that although living in the same habitat (as sympatric) they differ both in size and external appearance, which is worth pointing out.

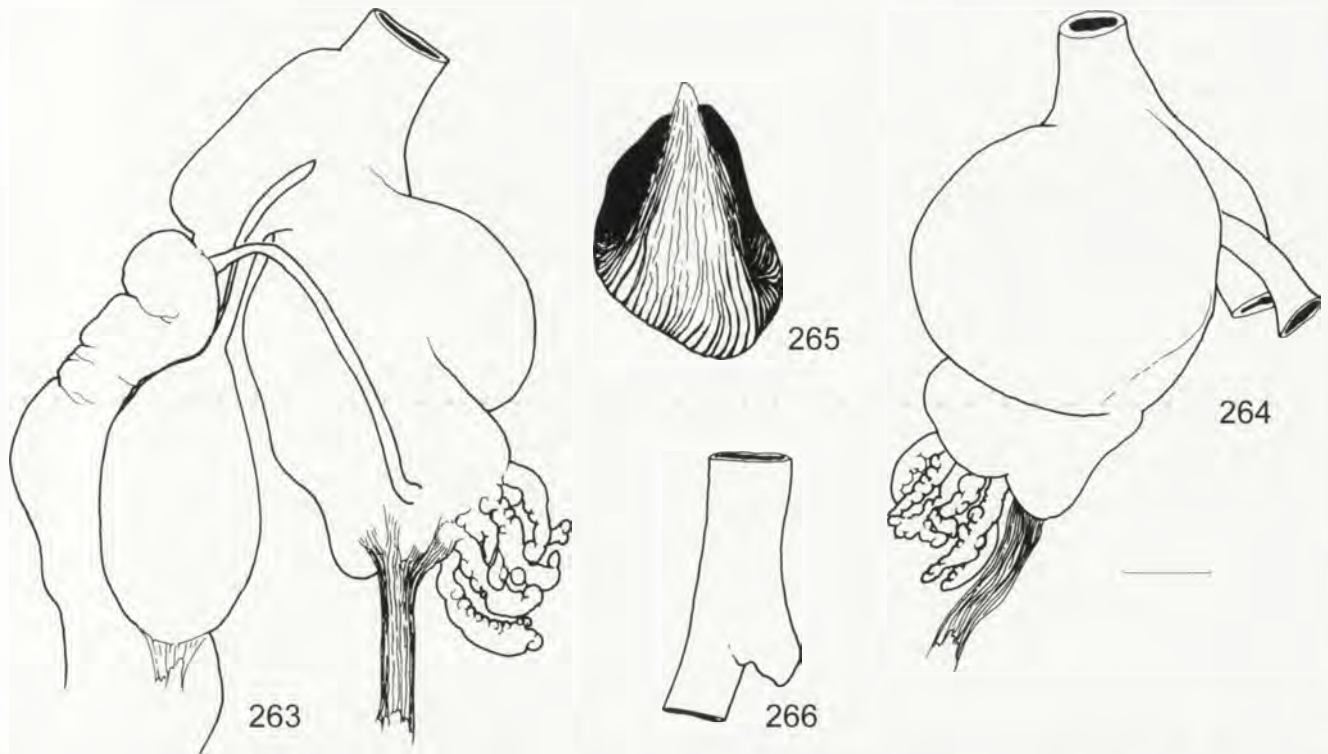
D. golcheri shows a striking similarity to some forms of *D. panormitanum*, a species which is exceptionally varied with respect to the structure of genitalia. This fact accounts for the especially great difficulties in identification, the more so that *D. panormitanum* occurs in numerous isolated populations both on islands and on the continent (see the description of this species and comments p. 488).

At present it cannot be authoritatively stated whether the resemblance between *D. golcheri* and *D. panormitanum* is a mere similarity or intraspecific morphological variability. *D. golcheri* never has any penial appendix, whereas in the other slug there are two such processes on penis, or at least one. In the specimens of *D. panormitanum* co-existing with *D. golcheri* in the same habitat penis is provided with one, but long, appendix (!).

The status of *Agriolimax golcheri* is unclear. The description by Simroth (1900) does not include any drawing, the characters mentioned possibly pertaining to several different species. Hoffmann (1926) synonymizes this name with *D. eazioti*, which is completely unjustifiable (see the



Figs. 259–262. *Deroceras golcheri*. 259–260 – Copulatory organs of two specimens from Malta. 261 – Rectum of the same specimen as in Fig. 260. 262 – Penis of a paratype from Garde de Makluba. (Orig.)



Figs. 263–266. *Deroceras golcheri* – a paratype from Garde de Makluba. 263 – Copulatory organs. 264 – Penis viewed from another side. 265 – Stimulator. 266 – Rectum along with caecum. (Orig.)

comments to *D. cazioti* p. 424). On Corsica there are slugs corresponding both with the description of *A. corsicus* and that of *D. golcheri* (Figs. 267–268). The name “*corsicus*” is older but it is unknown what slug it was actually referred to. The substantial doubt concerning *D. golcheri* – *D. panormitanum* makes it impossible to authoritatively take a decision.

Deroceras (Deroceras) gorgonium

Wiktor, Vardinoyannis et Mylonas, 1994

Deroceras gorgonium Wiktor, Vardinoyannis et Mylonas, 1994: 12 figs. 17–20 map 4. Locus typicus: 4–5 km from Sisses towards Aloides, Nomos Rethymnis, Crete Island (= Kriti, Greece). Holotypus: MNHW no. MP 633.

Body length up to 38 mm. Coloration dirty cream with blackish spots on mantle and body sides. No spots on the medial section of back.

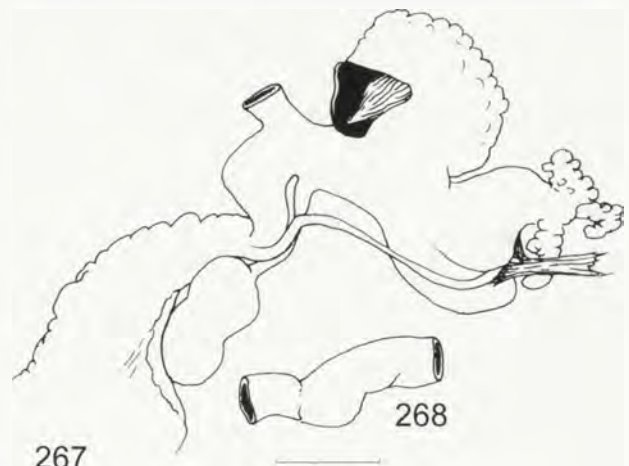
Genitalia (Figs. 269–271). Penis clearly constricted in its medial part. Lateral wall of its anterior section provided with visible glands. The posterior part of the organ narrowed, with a distinct oval appendix directed posterad. On the apical end of penis there is a very specific penial gland. It looks like a large cluster of numerous tangled thin processes that are set on a very short common shaft, or partly accreted with their bases and situated directly on penis. Vas deferens opens between the elongated fragment of penis and appendix. Musculus retractor penis bipartite, its one part joining the appendix base whereas the other inserted into the posterior penis section at the base of penial gland. Inside

penis a narrow cone-shaped stimulator. The posterior part of penis, stimulator and the membrane covering viscera dark-pigmented.

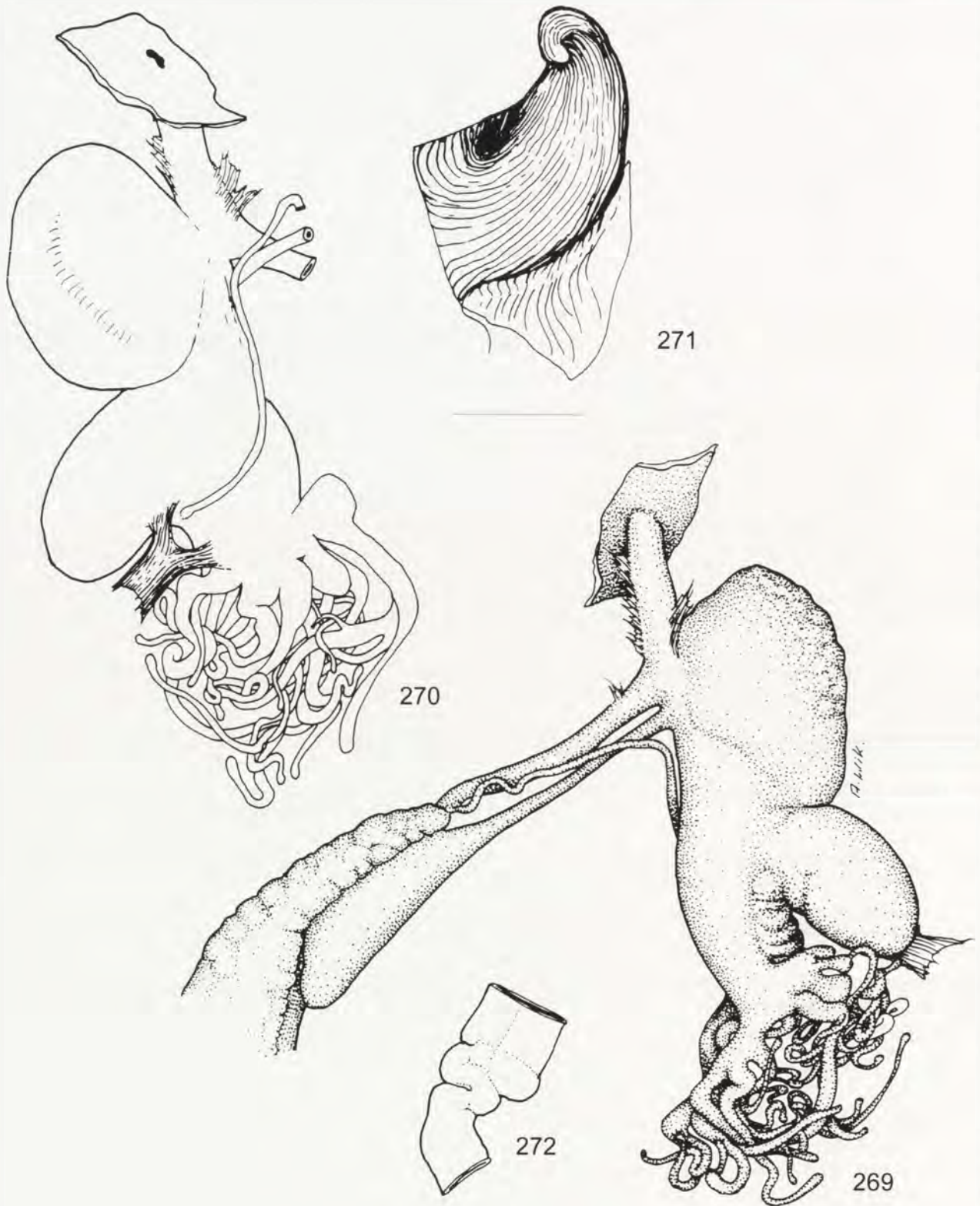
No caecum on rectum, but the latter’s final section abruptly widens (Fig. 272).

Distribution. Up until now the species has been recorded exclusively from Crete Isl.

Comments. The slug is different from all the other *Deroceras* species by the appearance of penial gland.



Figs. 267–268. *Deroceras* cf. *golcheri* from Corsica. 267 – Copulatory organs. 268 – Rectum. (Orig.)



Figs. 269–272. *Deroceras gorgonium* – holotype. 269 – Copulatory organs. 270 – Penis viewed from another side. 271 – Stimulator. 272 – Rectum.
(After Wiktor *et al.* 1994)

Deroceras (Deroceras) halieos de Winter et Butot, 1986

Deroceras halieos de Winter et Butot, 1986: 35 figs. 1–6. Locus typicus: near Simonos Petros Monastery (Atos, Chalkidiki, Greece, UTM KE65). Holotypus: ZMA no. 386003.

Body length up to 42 mm. "Body unicolorous, dark grey to nearly black; the ring around the swollen pneumostom is not or only trifle paler in colour" (de Winter and Butot 1986). Sole with the medial zone creamy and lateral ones greyish.

Genitalia (Figs. 273–275). Penis of irregular shape, with a large lateral distension comprising stimulator and two curved appendices ("caeca" acc. to the description by de Winter and Butot). A tuft of noncrenulated (!) processes of penial gland is set on one of the appendices. Some of the processes are dichotomously branched. Musculus retractor penis inserted between appendices, where there is also the entry of vas deferens. Stimulator flat, fan-shaped, on a very wide base.

Caecum on rectum long.

Ecology. The slug was collected in beech wood.

Distribution. Locus typicus is the only locality known.

Comments. According to de Winter and Butot (1986), the difference between the species discussed and *D. keaensis* consists in the former's lack of glandular thickening of external wall of penis, and longer processes of penial gland. The authors compare this slug also with *D. johannae*, from which it is different by a shorter rectal caecum and longer crenulated processes of penial gland. Nevertheless, the slug concerned may actually be a form of *D. keaensis*.

Deroceras (Deroceras) helicoïdale Rähle, 1998

Deroceras helicoïdale Rähle, 1998: 22 figs. 1–5. Locus typicus: Obaçay valley E of Alanya, ca 4 km N of Oba-Zentrum (UTM VF14) (Turkey, Vil. Antalya). Holotypus: SMT no. 39931.

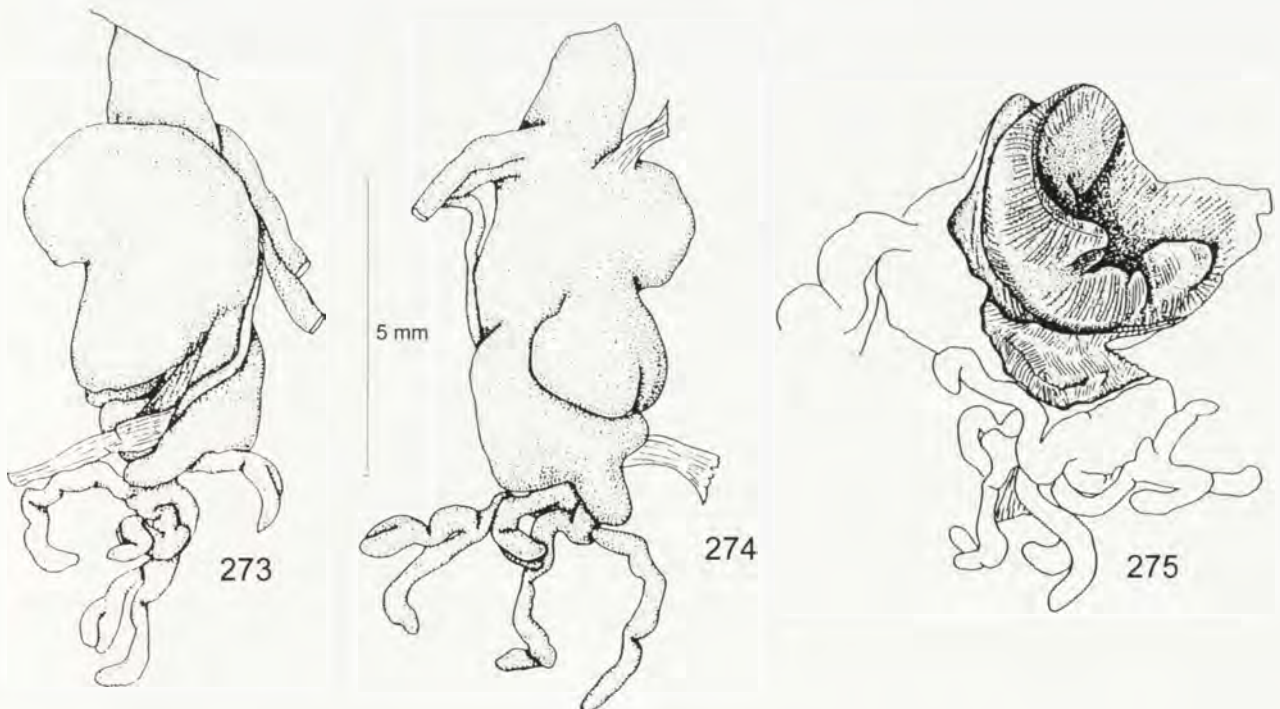
Body length up to 31.5 mm. Head reddish at the top, without spots. The whole of mantle covered by fine fusing dots, only the round plate around pneumostom left pale. Back grey-brown, even up to ochre, lighter than mantle. The dark pigment more concentrated in skin grooves and reaching as far as the foot margin. Sole pale. Skin thin.

Genitalia (Figs. 276–279). Gonad large, made up by three lobes. Penis fleshy, anteriorly inconspicuously distended, its one side with poorly marked glands. Penis not constricted, as it is often the case in *Deroceras*, but its posterior part is heavily elongated into a long process, which is spirally coiled like a snail's shell. The spiral consists of 3–4 coils, tapering toward the top. On the very end of this spirally twisted penial section there is a single small finger-shaped process, which is the penial gland. Vas deferens opens at the base of the spirally coiled appendix on its internal side. This is also here that a very strong musculus retractor penis is attached. In the anterior section of penis there is a large completely flat stimulator resembling a mushroom when everted. Spermatheca more or less spherical and, when filled, clearly distinguishable from a thin spermatheca duct.

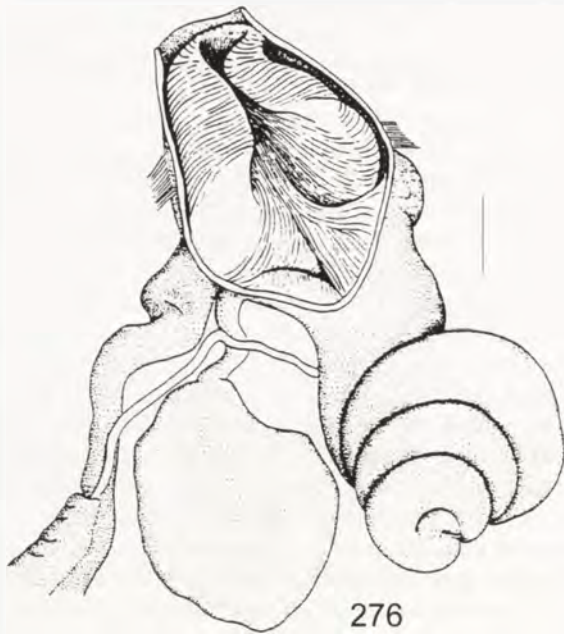
Caecum on rectum distinctly long (Fig. 280).

Nothing is known about the species ecology.

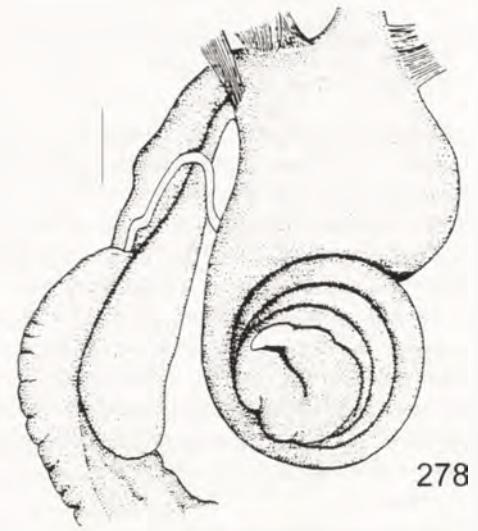
Distribution. So far the slug is known only from locus typicus.



Figs. 273–275. *Deroceras halieos*. 273–274 – Penis viewed from different sides. 275 – Stimulator. (After de Winter and Butot 1986)



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Figs. 276–280. *Deroceas helicoidale*. 276–277 – Copulatory organs of a paratype. 278 – Copulatory organs of the holotype. 279 – Lateral view of the holotype's penis. 280 – Intestine and gonad. (After Rähle 1998)

Comments. The shape of penis of this slug is absolutely exceptional in the whole family. No doubt, however, the species belongs to the genus *Deroceas*. An appendix constituting a prolongation of penis occurs also in *Deroceas laeve* but it is never coiled in the same way like in the species discussed. Besides, this other species has a small papilliform stimulator and a rectum completely devoid of caecum.

? *Deroceas hesperium* Pilsbry, 1944

Deroceas hesperium Pilsbry, 1944 (Nautilus 58): 16. See also Pilsbry 1948: 554 figs. 292f, 296 A–I. Locus typicus: Oswego, Oregon (USA). Holotypus: ANSP no. 112516a (shell).

I quote after Pilsbry (1948). Body length 16 mm. Coloration: mantle brown with small scattered spots, back elsewhere rather light with some faint brown spots. The medial section of sole slightly darker than its sides.

Genitalia (Figs. 281–283) penis long, cylindrical, with no constrictions. Penial gland “rather large”. As seen in the drawings, it constitutes a prolongation of penis, an inconspicuous constriction between the two organs. Vas deferens opens before the indentation, roughly at 2/3 penis length below the junction penis–“penial gland”. No information concerning retractor penis, the organ missing from the figures. Inside penis a low papilleceously conical stimulator. Spermatheca set on a well-delineated thick spermatheca duct.

Rectum without caecum.

Distribution. Oregon (USA)(after Pilsbry 1949).

Comments. I have had at my disposal only the shell of the holotype. The paratypes with soft parts have probably not been preserved.

Judging by the description, both of external appearance and the anatomy, it is nearly certain that Pilsbry actually dealt with *Deroceras laeve* (body dimensions, coloration, mantle spotting, the shape of penis, the way penis is connected with vas deferens, stimulator, lack of rectal caecum – see also the description of *D. laeve* p. 462). The distinctive character emphasized by Pilsbry is a thick spermatheca duct and a large penial gland. In specimens with their spermatheca empty spermatheca duct is often thicker than in others. The penial gland distinguished by Pilsbry looks like the terminal blind posterior section of penis in many specimens of *D. laeve*. Still, the fact that this remarkable scholar did not notice the similarity of the slug examined to this species, whose variability range he had discussed in such a detail on other pages of his monograph, gives way to doubts. Perhaps a direct comparison made him convinced about the distinctness of the slug concerned. If it were not for that, I would acknowledge *D. hesperium* as a synonym of *D. laeve* even without examination of the type. Having no opportunity to study the anatomy of *D. hesperium*, I leave the issue of possible synonymization for further research, at the same time drawing attention to the need to clear this problem up.

Deroceras (Deroceras) heterura Pilsbry, 1944

Deroceras heterura Pilsbry, 1944: 15 – after Pilsbry, 1948: *Deroceras (Krymickillus) heterura* – 560 figs. 292h (shell), 299a–d, 300A–G. Locus typicus: Sawyer Peak, Black Range, Grant County, New Mexico (32 11–N 107 15–W). Lectotypus: I have no information about it. Pilsbry (1948) mentions “Type 115226 A.N.S.P.”. In the ANSP collection there are: the shell of paralectotypus no. 371416 and whole paralectotypus no. A12333 which is entirely dried although kept in alcohol. I do not know who designated the lectotype.

I quote Pilsbry’s (1948) description. Body length ca 35 mm; the paratype was smaller. Width ca 3 mm. Body slender, back parallel to sole, the posterior end almost vertically truncated. Coloration: “The tripartite sole is cinnamon-buff colored, sides of the foot slightly darker, shading into dusky or saccardo’s umber color on the back and shield. (The dark color is seen under the lens to be due to a minute mottling of dusky brown on the mantle, and slight pigmentation of the rugae of the back...)”.

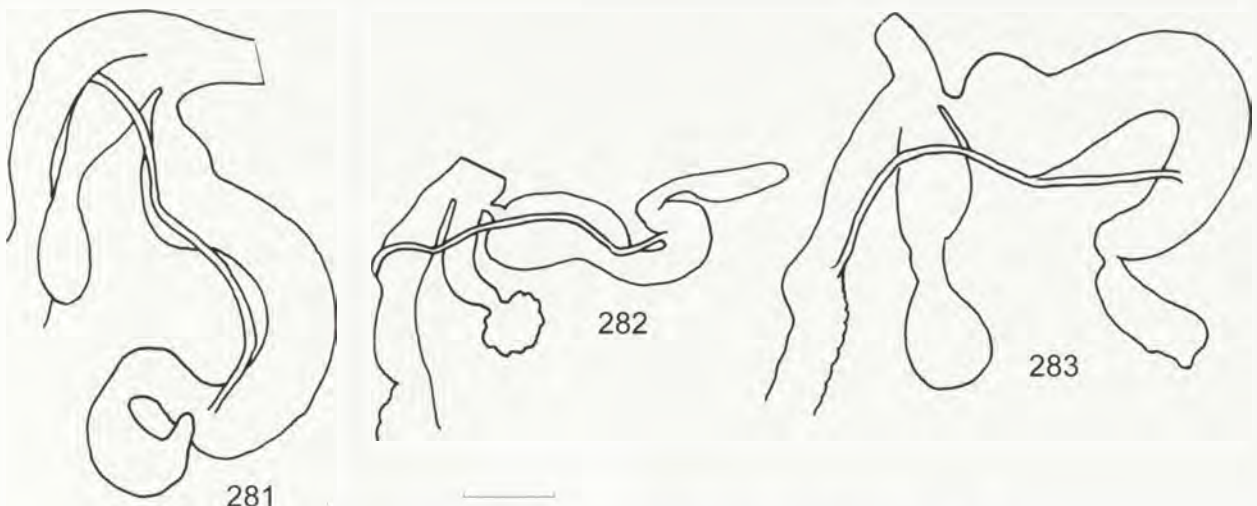
Genitalia (Figs. 284, 286–288). Penis elongated, cylindrical but narrowed at the end. The organ’s lateral wall thicker on one side. The occurrence of penial gland has not been established. Musculus retractor penis set apically or nearly so. Vas deferens opens laterally near retractor insertion. Inside penis neither stimulator nor fold has been found, internal walls only being covered by striae resembling fingerprints (Pilsbry 1948).

Rectum with a short caecum (Fig. 285), the specimen from the Mogollon Range lacking it however.

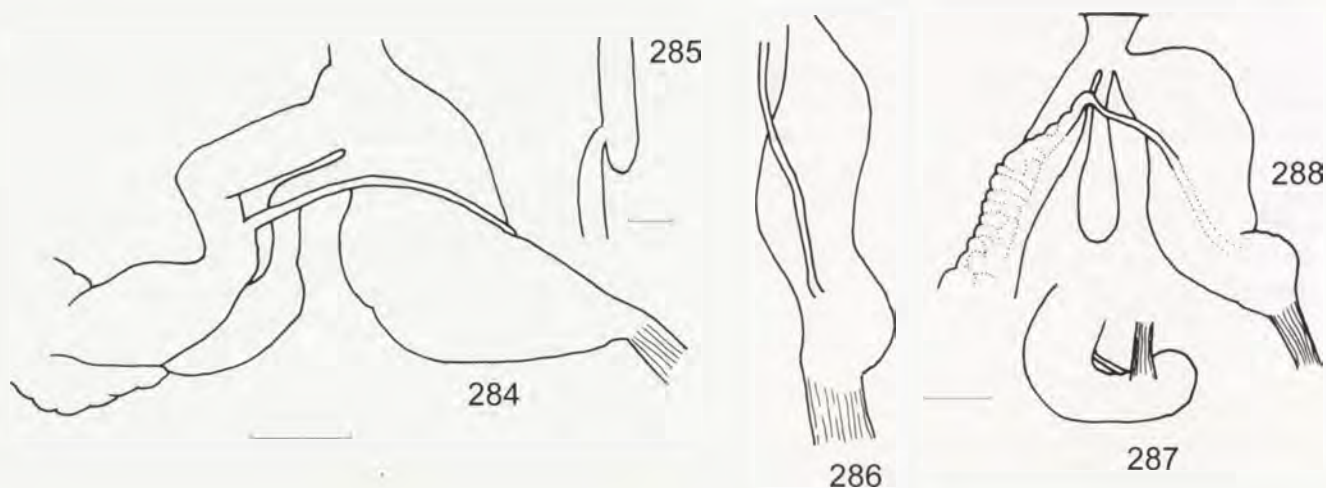
Distribution (acc. to Pilsbry 1948): USA, New Mexico: Black Range, south of Iron Creek, Morgan Creek, Sierra Co., Mogollon Range, Catron Co., Willow Creek and Silver Creek).

Comments. I have not had an opportunity to examine the soft parts of this slug. I have only seen the paralectotypes (a shell and a dried specimen).

I possess no information on who designated the lectotype and paralectotypes. Pilsbry (1948) mentions “type and paratype”.



Figs. 281–283. *Deroceras hesperium* – copulatory organs. (After Pilsbry 1947; simplified)



Figs. 284–288. *Deroceras heterura*. 284 – Copulatory organs. 285 – Rectum and caecum. 286–287 – Fragments of penis. 288 – Copulatory organs. (After Pilsbry 1947; simplified)

With certain doubts Pilsbry (1948) ranks this species among the genus *Krynockillus*. The reason for this is lack of stimulator inside penis. At the same time the malacologist ascertains the presence of rectal caecum in most specimens, which is not typical of Palearctic *Krynockillus*. The author reports, however, that he has not found caecum in a specimen from “farther west – Mogollon Range”.

The taxonomic position of *Deroceras heterura* is unclear to me. If all the characters noted by Pilsbry (1948) are present in all specimens, it is indicative of the slug being a distinct species. Its placement within the genus *Krynockillus* is neither clear nor justifiable.

Deroceras (Deroceras) ikaria Reischütz, 1983

Deroceras (Plathystimulus) ikaria Reischütz, 1983a: 23 figs. 1–5. Locus typicus: W of Chrysostomos (Ikaria Isl., Greece). Holotypus: SMT.

References: Wiktor – in print.

Body length up to 15 mm. A shallow groove can be observed on mantle, which runs from its posterior edge to pneumostom slightly bending in the rounded posterior mantle margin (Fig. 289). Mantle and back evenly deeply black. Head blackish. Sides anteriorly paler, even whitish. Sole black pigmented in its external margins, medially whitish. Reischütz (1983a), who described specimens immediately after preservation, notes bluish-black coloration.

Genitalia (Figs. 290–291). Penis with a large spherical lateral swelling and also large finger-shaped appendix. In the examined specimens the walls of appendix near its free end are thin and translucent (this may be an artefact resulted from the organ having been filled by gass before preservation, which is evidenced by the fact that hepatopancreas in this specimen is partly macerated and thus putrefaction processes must have taken place here). Vas deferens opens at the base of appendix. Penial gland composed of a bundle of unbranched processes set on a common, very

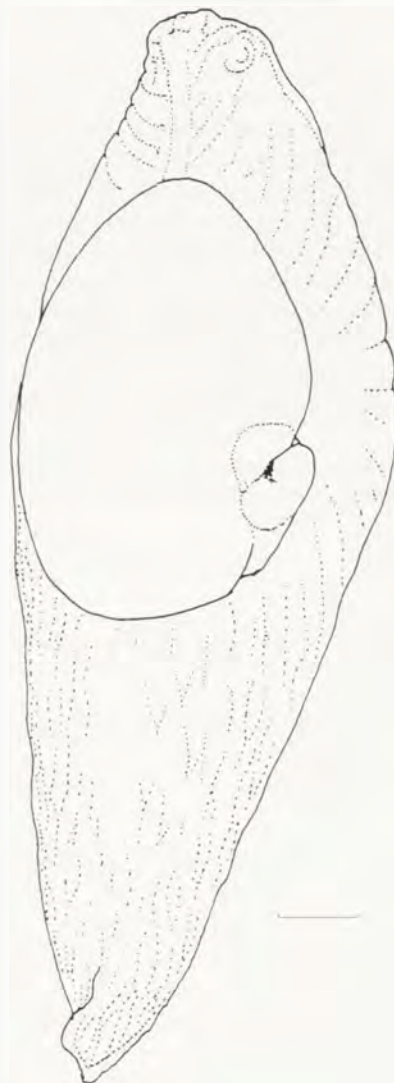
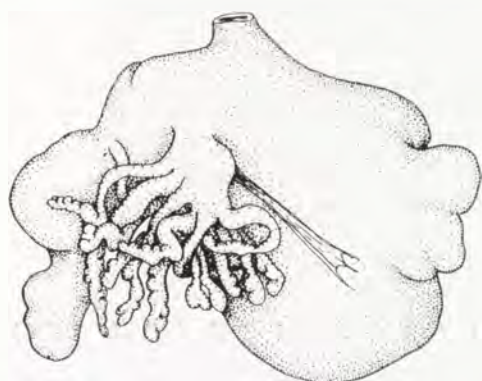


Fig. 289. *Deroceras ikaria*. (After Wiktor 1999)



290



291

Figs. 290–291. *Deroceras ikaria*. 290 – Penis of the holotype. 291 – Penis of the same specimen viewed from the opposite side with stimulator visible inside. (After Wiktor – in print)

short trunk. The latter organ joins the anterior part of penis, too. Retractor penis inserts near the outlet of penial gland. Stimulator in the shape of a wide fan. In penial wall close to the bases of stimulator and appendix there is a black pigment concentration. Spermatheca small and oval; the examined specimen has probably not copulated yet.

Rectal caecum scarcely visible; according to Reischütz (1983a), sometimes not perceivable at all or in the shape of a shallow pocket-like distension.

Distribution. So far the species has been known only from the type locality.

Comments. I have examined only the holotype and two paratypes. The three seem to be still immature, to which the size of glandula hermaphroditica testifies. I have made my own drawings since I have found, for instance, that the appearance of stimulator differs from what Reischütz (1983a) records.

As mentioned above, supposedly some of the characters found in the types are a result of deformation as those specimens were ill-preserved.

One should observe a striking similarity between *D. ikaria* and *D. samium*. This concerns not only the external appearance, i.e. coloration and the characteristic furrow in the posterior mantle section, but also most of the anatomical features. *D. ikaria* seems to attain smaller dimensions, at least at the corresponding stage of genital development. A larger appendix and an inconspicuous protuberances on the side of penis opposite appendix in *D. ikaria* are the only visible differences between the two species compared.

I have got the impression that *D. ikaria* will prove to be a synonym of *D. samium*. Today, however, not having at my disposal sufficient material from Ikaria Isl. which would allow to define the variability range, it is too early to pass judgements concerning this issue.

Deroceras (Deroceras) ilium (Simroth, 1901)

Agriolimax ilius Simroth, 1901: 159 t. 15 figs. 29–32. Locus typicus: "Berg Il in der Nähe von Wladikawkas" (Il Mt. = Sapiekaya buka near Odzhonikidze, Osetia, the Caucasus). Lectotypus: ZIN. Non *Deroceras ilius*: Grossu et Lupu 1959: 46 figs. 5a–b.

References: Likharev and Wiktor 1980: 139 figs. 77–83.

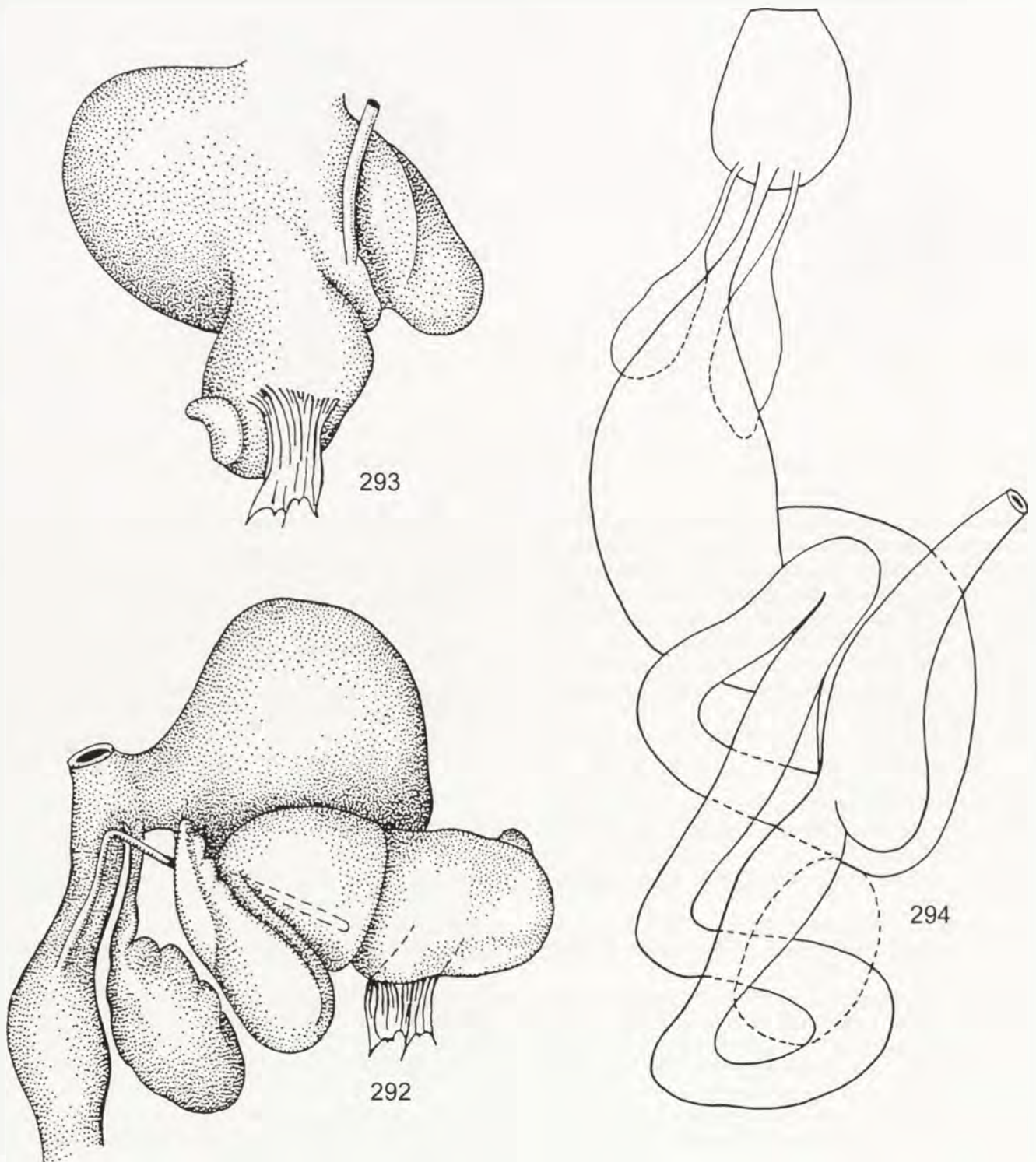
Body length up to 40 mm. Coloration of live slugs grey-pink, after preservation grey-yellow or dirty ochre, with comparatively big, dark, red-brown – at times nearly purple – spots both on mantle and back, except for the latter's medial section. Sides and sole pale, head grey.

Genitalia (Figs. 292–293). For the most part, gonad is covered by liver lobes. Penis anteriorly strongly distended, more or less spherical. The posterior part, separated by a constriction, is markedly narrower, at the loose end further narrowing abruptly into a short twisted appendix. Penial gland of a very peculiar shape. It is a fleshy, thin-walled and lanceolately narrowed structure, its side facing the wall of penis corrugated. Vas deferens opens laterally into the anterior, distended, part of penis. Musculus retractor penis short, attached somewhat laterally. It branches into three short strands, one of which is inserted approximately in the medial part of appendix, the second one at the base of the organ mentioned, while the third on the border between the anterior and posterior part of penis. Inside penis there is a narrow cone-shaped stimulator, its free end usually sticking in penial gland.

On rectum a shallow pocket of vestigial caecum (Fig. 294).

Ecology. The slug lives in mountain deciduous and mixed forests, in leaf litter and shaded places, often by streams.

Distribution. Abkhazia, the central and western parts of the north Caucasus.



Figs. 292–294. *Deroceras ilium*. 292 – copulatory organs. 293 – Penis. 294 – Alimentary canal. (After Likharev and Wiktor 1980)

Comments. The species discussed is similar to *D. osseticum* (Simroth, 1901), mainly with respect to external appearance, but differs in grey coloration of head and neck. The differences in the shape of penis are better visible. In *D. ilium* appendix is considerably smaller and

penial gland lanceolate, whereas in *D. osseticum* the former organ is almost as large as the rest of penis and the latter is more or less branched and of a totally different shape (see Figs. 454–456). There are also differences in the number and appearance of radular teeth (Likharev and Wiktor 1980).

Deroceras (Deroceras) johannae

de Winter et Butot, 1985

Deroceras johannae de Winter et Butot, 1985: 80 figs. 3–10. Locus typicus: 2 km W of Korthion along the road to Kochylou (UTM LB1883, Andros Isl., Greece). Holotypus: ZMA no. 385001.

References: Wiktor – in print.

Body length up to 33 mm. Back and mantle unicolour – dark grey, sides and the round plate around pneumostom slightly lighter.

Genitalia (Figs. 295–297). Penis sack-shaped, anteriorly broadened, its posterior section equipped with two appendices that are equal in size and, as defined by the authors of the original description, kidney-like. On one of them there is a tuft of unforked processes of penial gland. At the base of this appendix which is provided with penial gland there is the entry of vas deferens. Unbranched musculus retractor penis is apically inserted between penial appendices. Inside penis a huge wide completely flat semicircular stimulator.

Caecum on rectum well-developed (Fig. 298).

Distribution. Andros Isl. and two localities in Greek Macedonia (Wiktor – in print).

Comments. A slug very closely related to *D. keaensis*; it seems that the two names will have to be synonymized. Having compared the types of the two taxa, de Winter and Butot (1985) state that the two slugs are more or less of the same size and similar coloration, their rectal caeca are also similar. However, according to these authors, the shape of penis is different and there are also other differences which regard penial gland and stimulator. Further study will help to solve this problem but, in my opinion, the differences concerned come within the variability range of the same species, which my examination of rich material from Peloponnesus and the islands of Euboea, Kea and Andros indicates. According to the principle of priority, *johannae* should become a junior synonym of *keaensis*.

Deroceras (Deroceras) karnaniensis Wiktor, 1984

Deroceras (Plathystimulus) karnaniensis Wiktor, 1984: 160 figs. 23–27. Locus typicus: N of Mesolongion (= Mesolongiou, Karnania, Greece). Holotypus: MNHW no. MP 477.

References: Wiktor – in print.

Body length ca 25 mm. General coloration coffee-creamy, densely chocolate-spotted. In the posterior part of body the dark spots are arranged in a reticulum.

Genitalia (Figs. 299–301). Penis elongated, in adult specimens inconspicuously constricted in the middle. In the posterior penis section there is a small, laterally set appendix. Penial gland, situated on the apical end of penis, consists of 3–4 unbranched processes accreted at the base. Unforked musculus retractor penis joins penis at the base of appendix, where there is also the outlet of vas deferens. Stimulator inside penis in the shape of a long crested structure, its whole base accreted to penial wall.

Intestinal caecum like a barely visible fold on rectum (Figs. 302–303).

Distribution. Up until now the species has been known only from locus typicus.

Deroceras (Deroceras) kasium Rähle, 1993

Deroceras kasium Rähle, 1993: 111 figs. 1–8. Locus typicus: Arvanitochori Canyon (Kasos Isl., Greece). Holotypus: SMF no. 309783.

Body length up to ca 13 mm (after preservation), but also smaller specimens have their genitalia already developed. The colour of back ochreous or pale grey, on the background of which in the rear brown spots present. Mantle slightly darker. The dark pigment is also accumulated in skin grooves, which results in a reticulate pattern. The plate around pneumostom lighter than the rest of mantle but partly spotted as well (Fig. 304). Sole pale.

Genitalia (Figs. 305–309). Penis very small and non-constricted; appendix larger than penis itself. The latter is a hook-like bent structure with two slight unilateral constrictions on the surface of the bulging part, which divide the organ into three sections. The free end of appendix is bent anterad. It is not easy to establish what constitutes penis and what appendix. In my opinion, penis is the part which is connected with penial gland, retractor insertion marking the border between the two organs. Penial gland, situated apically on penis, is composed of 5–6 processes (some of them bifurcate), roughly equal in length, that are set on a very short common shaft. Musculus retractor penis forked: its one, larger, strand inserts on the border between penis and appendix, while the other accretes to the apical end of penis at the base of penial gland. In this muscular embranchment there is the opening of vas deferens. Penis in most part dark-pigmented, except for the area neighbouring with penial gland. Inside penis and its appendix there is a long twisted fold.

Caecum practically non-existent, in its place there is an inconspicuous rectal distension.

Distribution. So far the slug has been known only from the type locality.

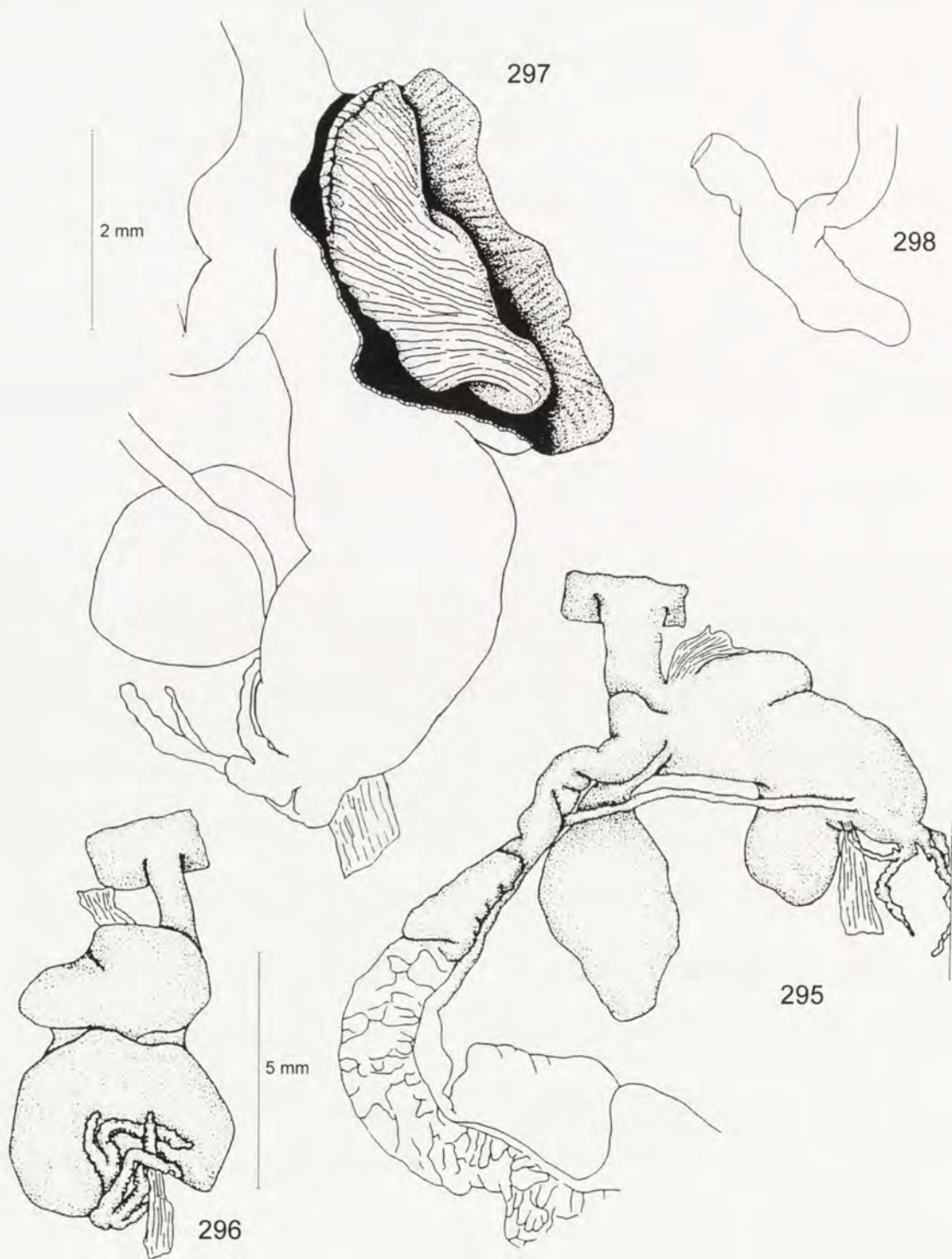
Comments. The slug is distinguishable by very small dimensions, and specific appearance of penis and its appendix. With regard to the shape of penis, the species resembles *D. samium*, and even more *D. ikaria*, differing from the former in size and from both in coloration and internal penial structures (see comments on *D. ikaria* p. 451). It is obviously different from other species, the ones occurring in the same region in particular.

Deroceras (Deroceras) keaensis Altena, 1973

Deroceras keaensis Altena, 1973c: 89 figs. 1A–C. Locus typicus: environs of the town of Kéa (Kéa Isl., Greece). Holotypus: MNHP. Paratypes: NNML. ?*Agriolimax berytensis* var. *andrios* Simroth, 1889a: 16. Terra typica: Andrios Isl. (Greece).

References: Reischütz 1983b: 139 figs. 4–5; de Winter and Butot 1985: 82 fig. 11; Wiktor – in print.

Body length up to 52 mm, but smaller individuals (even as small as 27 mm in length) may have fully developed reproductive organs. Body slim (Fig. 310). The posterior end

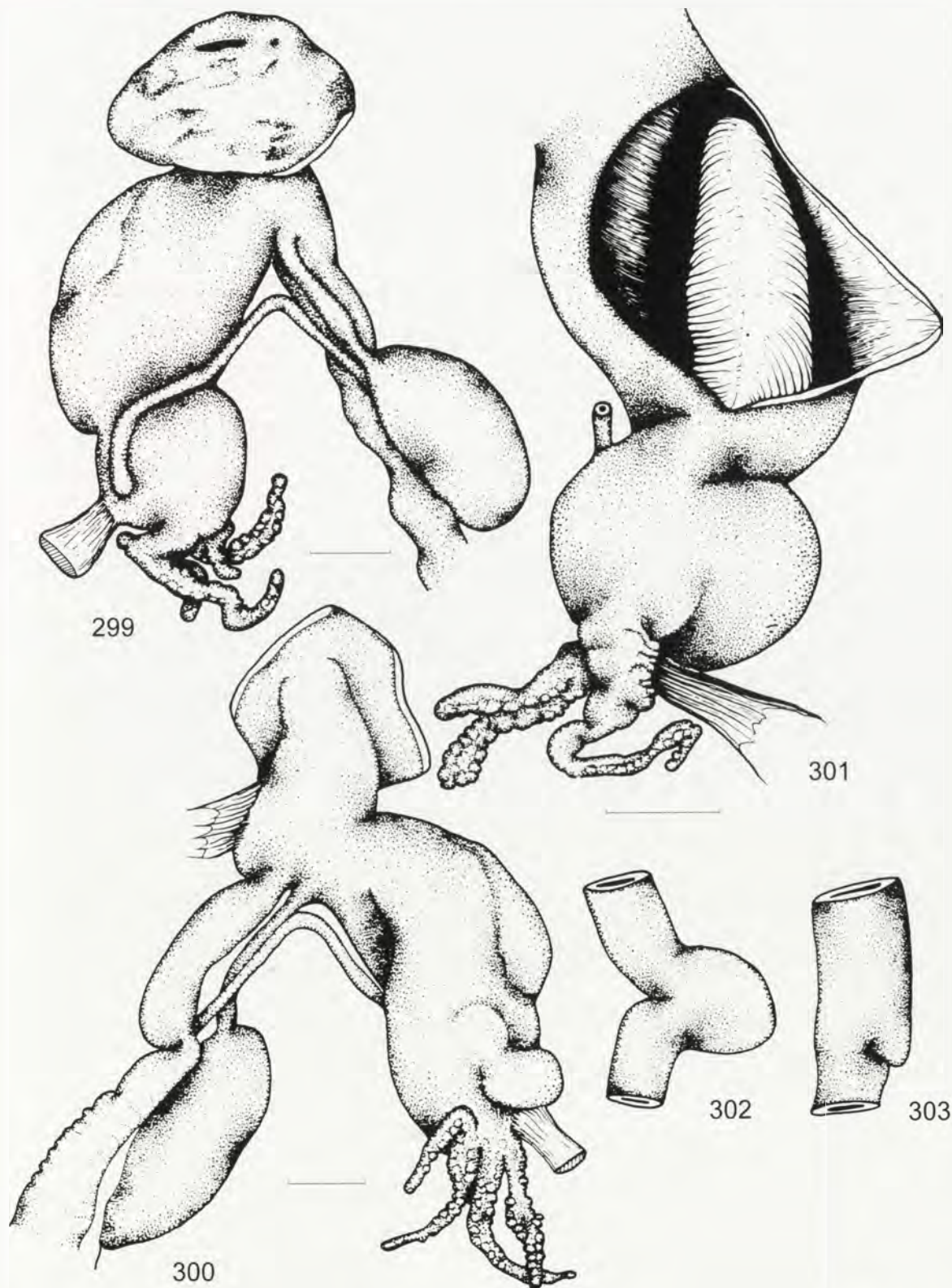


Figs. 295–298. *Deroceras johannae* – holotype. 295 – Copulatory organs. 296–297 – Penis. 298 – Rectum and caecum. (After de Winter and Butot 1985)

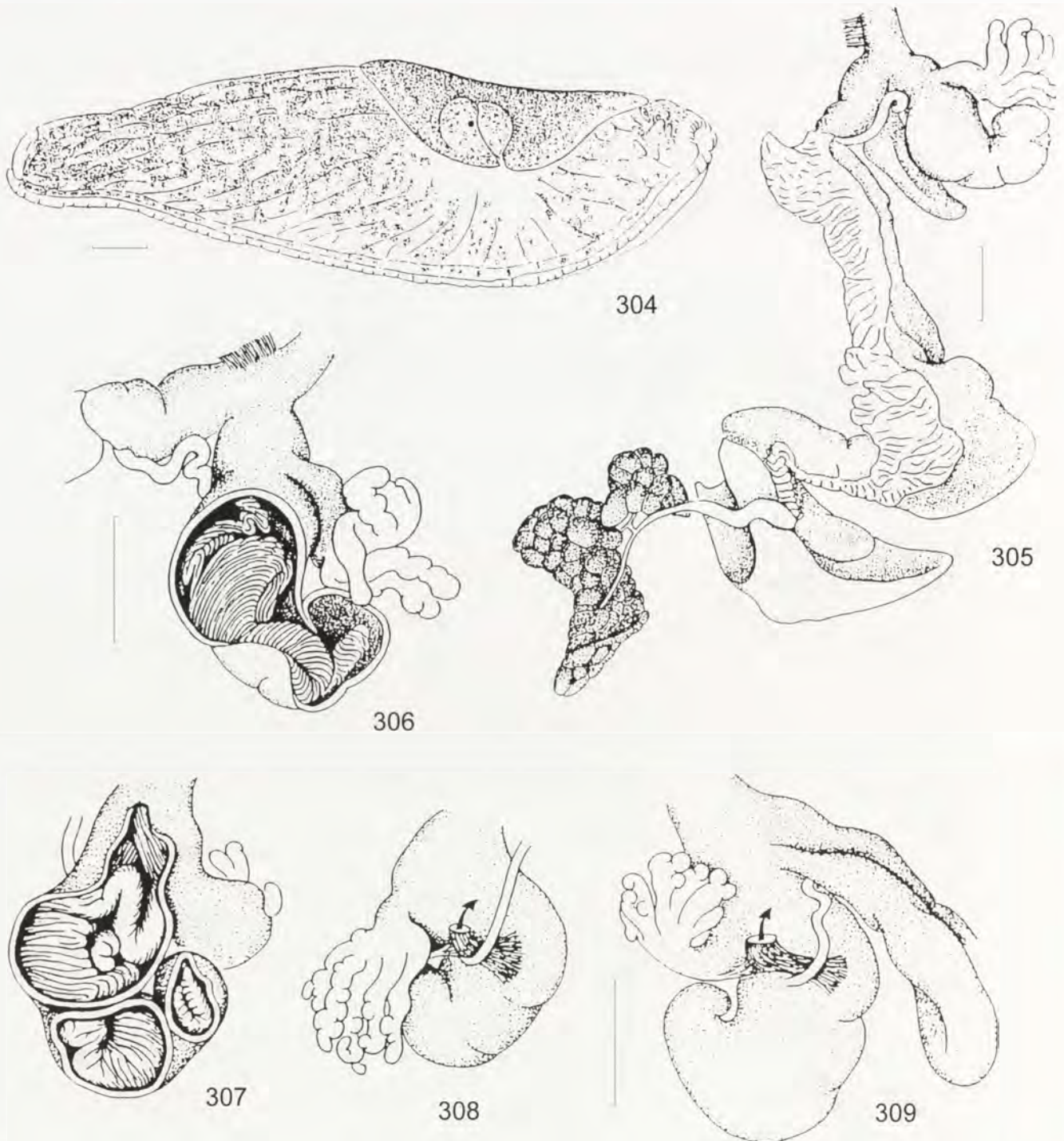
laterally fin-shapedly “bound”. The frontal part of mantle along 1/3 of its length can be bent aside, so it is not accreted. Coloration of head, mantle and back evenly dark grey. Sides somewhat lighter. Sole grey creamy; its lateral zones may be darker, i.e. grey.

Genitalia (Figs. 311, 313–317). Penis elongated, irregularly

shaped, anteriorly with a lateral swelling which has its lateral wall thickened and provided with glands. Most often penis is partly constricted roughly at 2/3 of its length. The posterior section of this organ is equipped with two appendices. Their appearance varies: they can make up a kidney-shaped structure or be two crescents directed posterad or sideward,



Figs. 299–303. *Deroceras karnaniensis*. 299–300 – Copulatory organs of the holotype. 301 – Penis with visible stimulator – a paratype. 302–303 – Recta of the holotype and a paratype. (After Wiktor 1984)



Figs. 304–309. *Deroceras kasiium*. 304 – Lateral view of the slug. 305 – Reproductive system of a paratype. 306–308 – Penises of different paratypes. 309 – Copulatory organs of the holotype. (After Rähle 1993)

or else they can markedly differ in shape, one of them being then more or less lobular. Vas deferens opens apically between appendices at the base of penial gland. The latter organ mentioned looks like a tuft of unbranched processes joined at the base into one short common shaft. Musculus

retractor penis divided at least in two strands, one of which is laterally attached to one of the appendices or at its base, while the other inserts more anteriorly, to the distended part of penis. There may also be a third branch of retractor, apically joining penis between its appendices. Stimulator

completely flat, folded, rectangular in shape, with a very wide base. Most commonly it is dark-pigmented.

Caecum on rectum well-developed (Fig. 312).

Ecology. Poorly known. The slug occurs in different types of habitat, hiding under stones.

Distribution. Up until now the species has been recorded only from Greece, where it is found in Attica, on the Peloponnesus Peninsula and the islands of Euboea, Ándros and Kéa.

Comments. A species related and similar to the one discussed is *D. samium*. The two clearly vicarize since *D. samium* has never been recorded either from the Cyclades

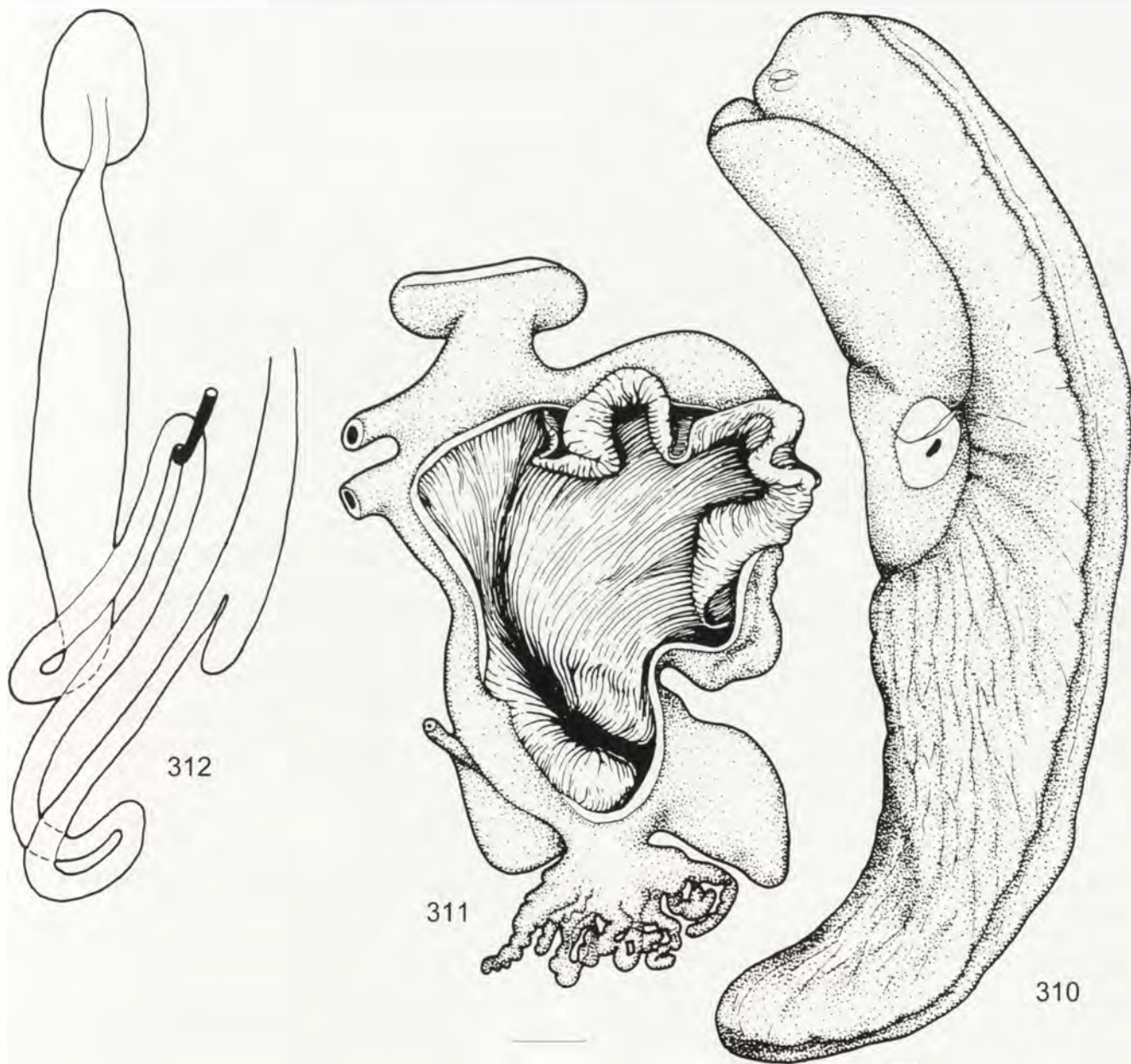
region or continental Greece and occurs in the Dodekanese Archipelago, on Aegean Isl. and in Turkey.

Simroth (1889a), who reported on the occurrence of *D. berytensis* on Euboea and Ándros, describing it as *D. berytensis* var. *andrios*, in all likelihood dealt with *D. keaensis*; *D. berytensis* is a distinct slug which does not occur in Greece (see data about this species p. 413).

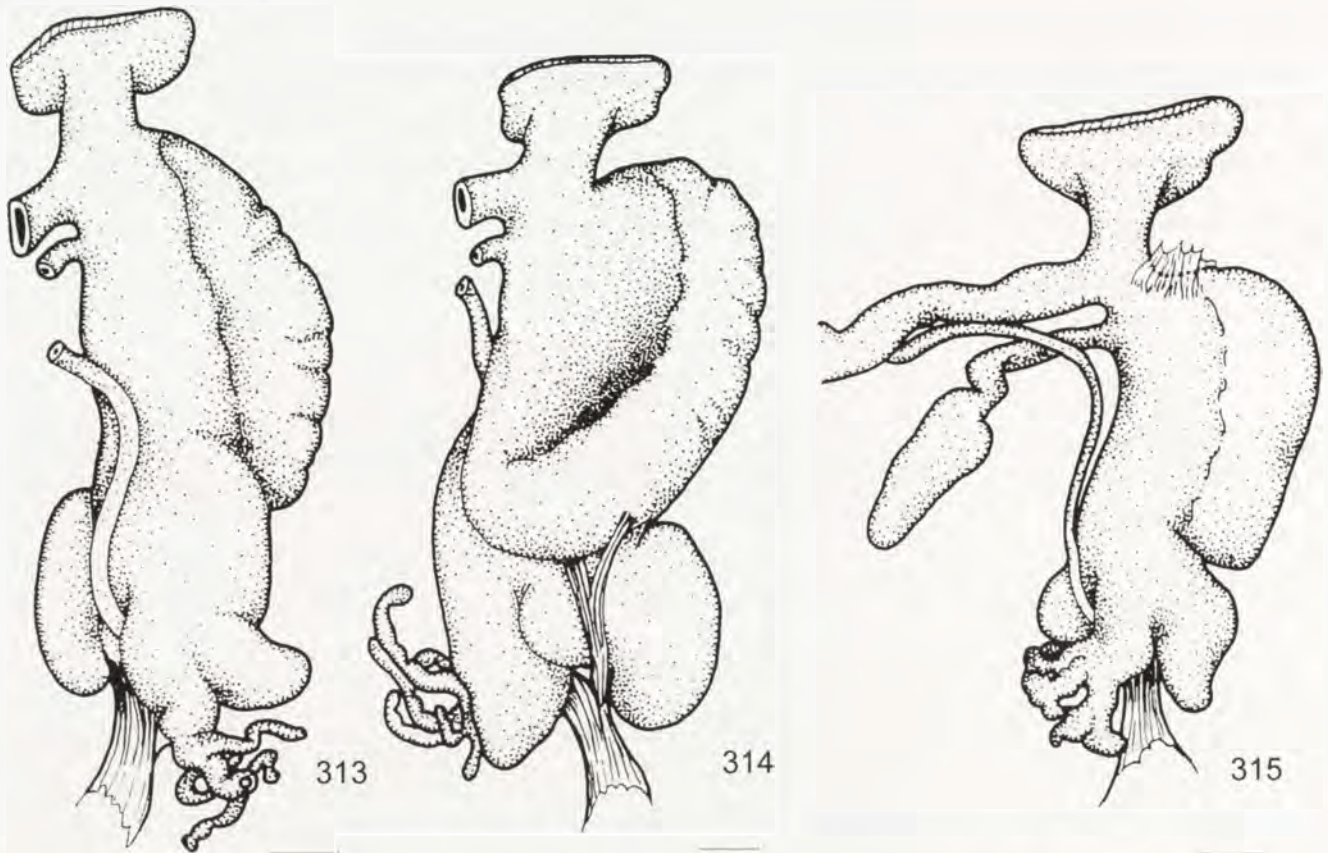
See also *D. halieos* and *D. johanna*e (p. 447, 453).

***Deroceras (Deroceras) kontanum* (Simroth, 1904)**

Agriolimax kontanus Simroth, 1904: 687 t. 39 fig. 19, t. 41 fig. 93. Terra typica: "Süd-Kaffa" (Abyssinia = Ethiopia). Holotypus: does not exist.



Figs. 310–312. *Deroceras keaensis* from Kea Isl. 310 – Lateral view of the slug. 311 – Penis with visible stimulator. 312 – Intestine. (After Wiktor 1999)



Figs. 313–315. *Deroceras keaensis*. 313–314 – Penis viewed from two sides – a specimen from Euboea Isl. 315 – Penis of a specimen from Kea Isl. (After Wiktor – in print)

The only information regarding the species is to be found in Simroth's paper (1904). The author probably had at his disposal only one specimen not entirely mature and in the male phase of genital development.

The description lacks data on body dimensions but the drawing indicates that the slug was ca 15–17 mm long. Its body was pale, uniformly brownish. No calcereous concretions occurred in skin.

Genitalia (Fig. 323). The information concerns only penis. The organ was oval, equipped with two glands. One of them was a typical penial gland composed of two distinct branches, one of which bifurcate, and two short little knots. Besides, the posterior end of penis bore some goffering seemingly of glandular character, too. Penial retractor unforked. Vas deferens opening at the base of penial gland. There is no information pertaining to the appearance of penial interior or stimulator.

The appearance of rectum not mentioned, either.

Nothing is known about the slug's ecology and distribution range.

Comments. The data on this slug are so incomplete that they are even difficult to comment upon.

The type used to be kept at the ZMB but has not been preserved till now. Such information has been imparted in

a letter by Dr. Mathias Glaubrecht, a curator of the ZMB collection.

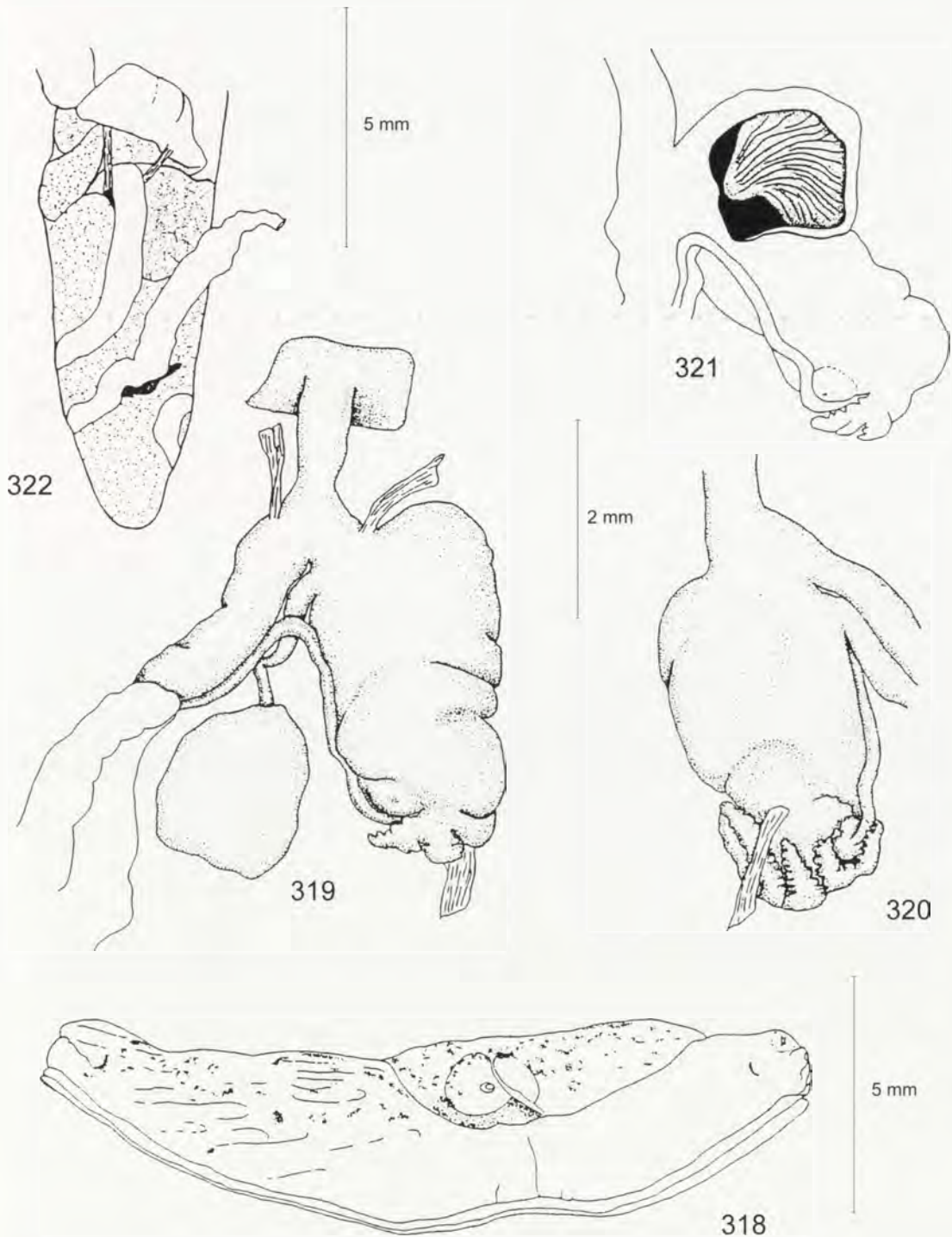
Deroceras (Deroceras) korthionensis
de Winter et Butot, 1985

Deroceras korthionensis de Winter et Butot, 1985: 82 figs. 12–16. Locus typicus: 2 km of Korthion along the road to Kochoyou (17 km SSE of Andros UTMLB1883, Andros Isl., Cyclades, Greece). Holotypus: ZMA no. Moll. 385003.

References: Wiktor – in print.

Body length up to 22 mm. Body pale brown or brownish with fine dark spots on mantle and dorsum. Sometimes unicolour, i.e. devoid of spots (Fig. 318), specimens are collected.

Genitalia (Figs. 319–321). In penis two parts can be distinguished: the anterior, usually broadened, comprising stimulator, and the posterior one that is more or less cylindrical, slightly narrower than the former. On the posterior section, close to the outlet of vas deferens there is a very conspicuous papilla. Penial gland composed of 4–5 unbranching processes accreted at the base, i.e. connected to penis without any distinct shaft. Musculus retractor penis



Figs. 318–322. *Deroceras korthionensis* – holotype. 318 – Lateral view of the slug. 319 – Copulatory organs. 320 – Penis viewed from another side. 321 – Stimulator inside penis. 322 – Terminal section of viscera with visible rectum. (After de Winter and Butot 1985)

unforked, laterally attached to the posterior section of penis. Stimulator inside penis small and cone-shaped. No caecum on rectum (Fig. 322).

Distribution. So far the slug has been known only from

the Greek islands of Ándros, Tinos, Náxos and Síros.

Comments. Penis may be similar in appearance to this organ in *D. turcicum* but clearly differs by its well-developed rectal caecum. De Winter and Butot (1985) compare



Fig. 323. *Deroceras kontanum* – penis. (After Simroth 1904)

D. korthionensis with a few other slugs, pointing out differences, the opinion of these authors can only be confirmed.

***Deroceras (Deroceras) koschanum* (Simroth, 1904)**

Agriolimax koschanus Simroth, 1904: 685 t. 39 fig. 15, t. 41 figs. 72–79.
Terra typica: “Süd-Kaffa” (= S Kaffa prov., Abyssinia = Ethiopia).
Holotypus: ZMB no. 102 130.

Body length 35 mm, width unmeasurable, mantle length ca 13 mm. According to Simroth (1904), the slug was yellow-grey (gelbgrau) as if dirty (etwas auschmutziges Aussehen). The dark spotting visible in the drawing (now the holotype is evenly white) finds no mention in the text.

Genitalia (Fig. 324). Simroth’s description includes many obscure points, and the author himself had difficulties in interpreting anatomical structure, too. Penis is cylindrically elongated, devoid of penial gland. Roughly at half its length penis is joined by a specific cylindrical structure (appendix?) equipped with a strand of muscles which was probably connected with penial retractor. In Simroth’s drawing (1904 t. 41 figs 74, 78) vas deferens has an apical opening. At present there are no traces whatsoever indicating this type of junction with penis. Inside the posterior section of penis a longitudinal fold. Stimulator cylindrically conical, not tongue-shaped (zungenförmig) as stated by the malacologist.

Intestine, according to Simroth (1904 t. 41 fig. 72), shows peculiar characters. It forms a short loop in the region of oesophagus. Rectal caecum absolutely lacking.

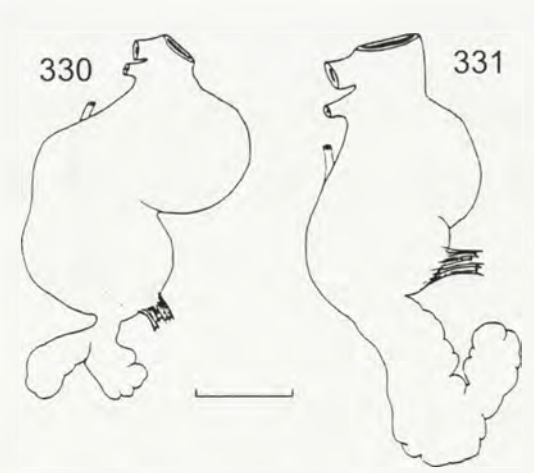
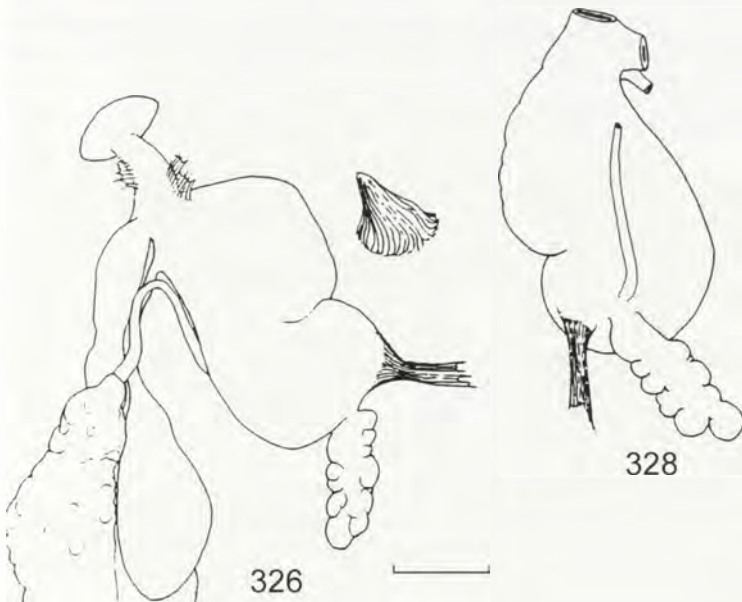
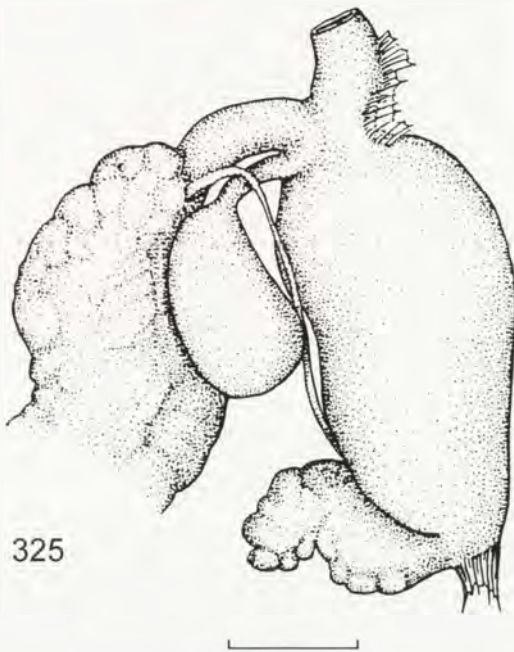
Distribution. The only locality known, not named



Fig. 324. *Deroceras koschanum* – penis of the holotype with visible stimulator. (Orig.)

precisely, is situated somewhere in province Kaffa in Abyssinia.

Comments. The slug is difficult to describe. Simroth (1904) had at his diaposal merely one specimen which has so far been the only known. It has not retained its original coloration and is nearly white. Of the viscera, the only preserved organs are: pharynx, fragments of intestine, main retractor and tentacles, and penis, which is severely torn and partly damaged.



Figs. 325–331. *Deroceras kythirensis*. 325 – Copulatory organs of the holotype. 326 – Copulatory organs of a paratype. 327 – Stimulator. 328 – Penis of a paratype. 329 – Rectum of the holotype. 330–331 – Penises of two paratypes. (After Wiktor et al. 1994)

Deroceras (Deroceras) kythirensis
Wiktor, Vardinoyannis, Mylonas, 1994

Deroceras kythirensis Wiktor, Vardinoyannis, Mylonas, 1994: 14 figs. 21–28.
Locus typicus: between Potamos and Agia Pelagia, Kythira Isl. (Greece).
Holotypus: MNHW no. MP 634.
References: Wiktor – in print.

Body length up to 17 mm. Coloration dirty creamy with a very intense, dense spotting. The dark chocolate-black spots are concentrated mainly in skin grooves. The dark pigment is also present on the plate-like ring surrounding pneumostom and on suprapedal groove.

Genitalia (Figs. 325, 328, 330–331). Penis oval, not constricted or, at most, with a slight one-sided indentation. Appendices lacking. Penial gland large as compared with penis, noodle-shaped, covered with big glandular papillae, mostly single but in some specimens bifurcate. It is apically situated on penis. Vas deferens opens near the base of penial gland. Musculus retractor penis attached more or less apically. Stimulator small, conical. In some specimens the posterior part of penis and stimulator are dark-pigmented.

No typical caecum, rectum merely abruptly widening in its posterior section (Fig. 329).

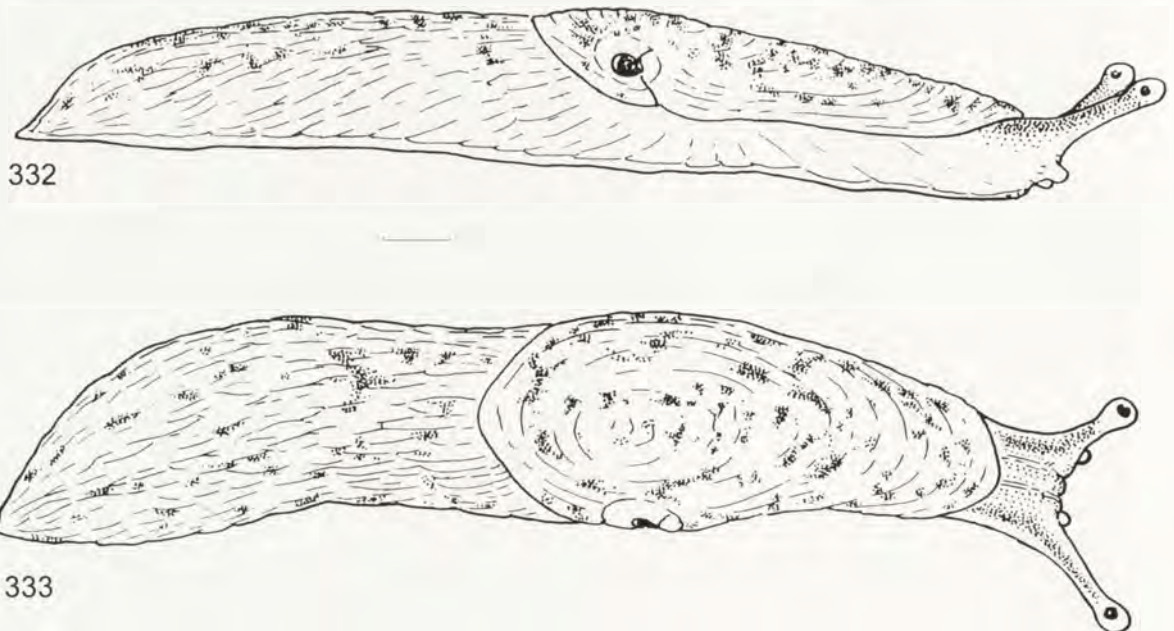
Distribution. Up until now the slug has been recorded only from Kythira Isl.

Deroceras (Deroceras) laeve (Müller, 1774)

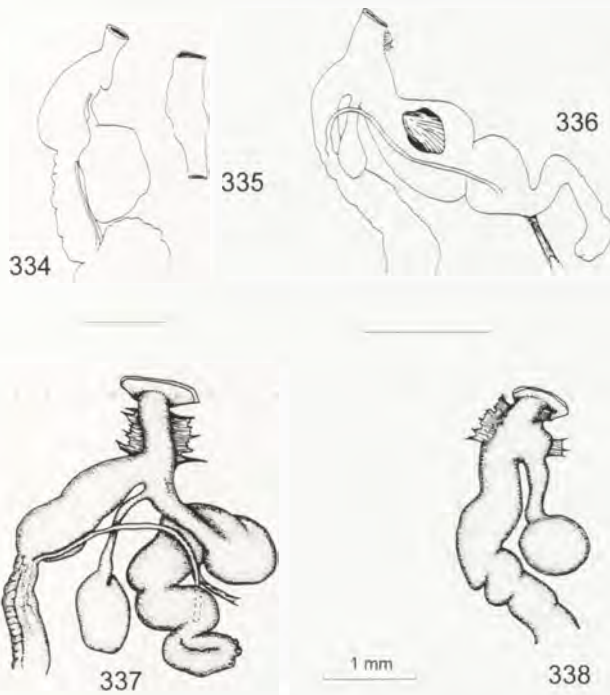
Limax laevis O. F. Müller, 1774: 1. Locus typicus: Frideriksdal (near Copenhagen, Denmark). Holotypus: probably non-existent.
Limax brunnaeus Draparnaud, 1801: 104. Terra typica: France. Typus: I have no information.
Limax gracilis Rafinesque, 1820: 10. Terra typica: Hendersonville, Kentucky, USA (after Pilsbry 1948).
Limax campestris Binney, 1842: 52. Terra typica: USA (after Pilsbry 1948).
Limax parvulus Normand, 1852: 8. After Hesse 1926.

Limax weinlandii Heynemann, 1862: 112. Terra typica: N America. See Pilsbry 1948: 539.
Limax araneus Gassies, 1866: 117 t. 1 fig. 1. Terra typica: France.
Krynickillus (Malino) brunneus Mabilie, 1868: 141. Terra typica: "Les environs de Paris" (France). Typus: probably does not exist.
Limax montanus Ingersoll, 1875: 130. Terra typica: USA (after Pilsbry 1948: 239).
Limax ingersolli Binney, 1875: 176. Terra typica: USA.
Limax hyperboreus Westerlund, 1876: 97. Locus typicus: Sopotschnoj Isl. on the Jenissei River. Typus: SSM. See Waldén 1956: figs. 23, 26.
? *Krynickillus mentonicus* Nevill, 1880: 103 t. 15 figs. 5, 8. Terra typica: ?? (in the opinion of Bodon, Boato, Giusti 1982, it is difficult to establish to what species this name was referred). Typus: in all likelihood, it does not exist.
Limax Hemphili Binney, 1890: 205 pl. I fig. 13 pl. II fig. 3. Locus typicus: Jurian City (California, USA).
Agriolimax globosus Collinge, 1896: 47 fig. 1. Locus typicus: Mauna Loa, Hawaii. See Quick 1960: 175.
Agriolimax Perkinsi Collinge, 1896: fig. II. Locus typicus: Lanai, Sandwich Isls. = Hawaii. See Quick 1960: 175.
Agriolimax Bovenoti Collinge, 1897: 295 fig. 9. Terra typica: Hawaii (Sandwich Isl.) (aphallic form).
Limax berendti var. *pictus* Cockerell, 1897: 176. After Pilsbry 1948.
Agriolimax pseudotoxicus Velichkovskiy, 1910: 64. See Likharev and Wiktor 1980: 132.
Agriolimax renschi Wagner, 1934b: 89 figs. 2–3 (aphallic specimen). Locus typicus: Rilski Monastir (Rila Mts, Bulgaria). Holotypus: ZMB no. 78336. See Wiktor 1983.
? *Deroceras momentolophus* Pilsbry, 1944: 16. Pilsbry 1948: 552 figs 294–295a–f. Locus typicus: Carbon Canyon, Orange Co., California (USA). Typus (?Holotypus): ANSP no. 180659 (shell).
Agriolimax schulzi Cvetkov, 1940: 115. Terra typica: Kazakhstan. See Likharev and Wiktor 1980: 132.
Agriolimax pellucidus Chen et Gao, 1979: 359 figs. 1–5. Locus typicus: Zhalaite Qi, Heilongjiang Province, China. Holotypus: ZAS. See Comments below.
See also *D. hesperium* p. 448.

References: Pilsbry 1948: 539 figs. 289–290 a–c; Waldén 1956: 349 figs. 1–4 pl. 1 figs. 23–27; Quick 1960: 172 figs. 11 A, B, E, F, N, 19; Wiktor 1973: 106 figs. 102, 105–106, 150–158, 238, 270–273 map 14; Likharev and Wiktor 1980: 129 figs. 47–54; Wiktor 1989: 104 figs. 73–74, 77–87 map 4.



Figs. 332–333. *Deroceras laeve* – lateral and dorsal views of the slug. (After Wiktor 1973)



Figs. 334–338. *Deroceras laeve*. 334 – Copulatory organs of an aphyllid specimen. 335 – Rectum of the same specimen as in Fig. 334. 336–337 – Copulatory organs of two ephyllid specimens. 338 – Copulatory organs of an aphyllid specimen. (334–335 after Wiktor 1996, 337–338 after Wiktor 1983, 336 after Wiktor – in print)

Body length usually not exceeding 22 mm, most frequently, however, even mature specimens are considerably smaller. Body nearly cylindrical, posterior end abruptly widened. Mantle strikingly large, its posterior edge covering half the body or even more. Skin thin. Wrinkles, which are well-visible in live specimens, after preservation may completely disappear. Coloration of live slugs ranging from dark chocolate to pale coffee. The unusually subtle spots on mantle are imperceptible with the unaided eye. This spotting, which is very characteristic, is better visible after preservation during the process of which the general coloration gets lighter becoming grey-brown of varied intensity and tone (Figs. 332–333). Mucus exclusively colourless, watery.

Genitalia (Figs. 334, 336–349). Partial or entire reduction of male copulatory organs is a common phenomenon in this species. In the specimens in which these organs are fully developed penis is elongated, vermiform, at times coiled or twisted (Figs. 337, 339, 344, 346–347). In its anterior section there is a small distension, the posterior part, markedly longer than the former, is more or less cylindrical. Vas deferens opens approximately at 2/3 penis length, and the part of penis behind the outlet is probably homologous with penial gland for at the very end of this section there are two or a few tiny glandular papillae. Retractor penis attached roughly at half penis length. In the distension of the anterior

part of penis there is a small stimulator resembling an obtuse papilla rather than a cone. Spermatheca egg-shaped, set on a relatively long, thin trunk. The tubular oviductus and atrium are unusually long when compared with these organs in other *Deroceras* species.

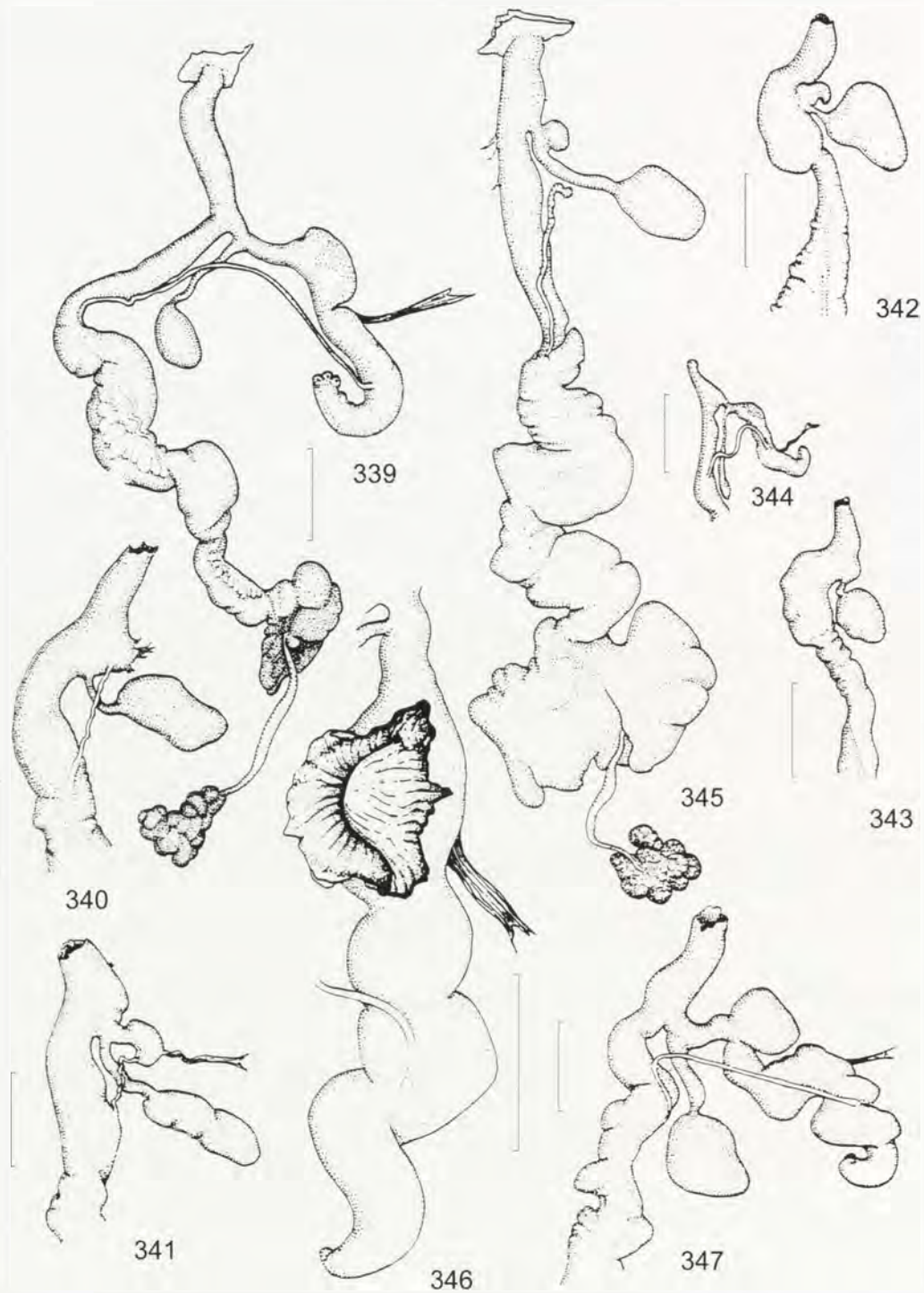
Forms with a developed penis, called ephyllid, are not found in some populations at all. In others all specimens are ephyllid. The specimens with penis are usually smaller and darker-pigmented. The reduction mainly concerns penis, which does not exist at all or is a mere vestige in the shape of a nodule, a shapeless process laterally joined by truncus bursae copulatricis. Sometimes vas deferens opens into this reduced penis. When the reduction of this organ is more advanced, vas deferens, blindly terminating, hangs loosely or the free section of this duct is lacking at all (Figs. 334, 338, 340, 342–343, 345). Specimens with their penis reduced are referred to as aphyllid.

Complete lack of caecum on the terminal section of intestine (Fig. 335).

Ecology. The slug inhabits different types of forest and open habitats, marshland, edges of rivers and lakes, areas degraded by human activity, glasshouses, damp cultivations etc, but mainly in the lowlands. It requires a highly wet environment, most often occurring in the neighbourhood of water in layers of detritus, under pieces of wood, lumps of earth, etc. Thermal conditions are of lesser importance to this species, thanks to which it is found not only in temperate climate but also in the tropics and subpolar zone. It can stand submergence in water, e.g. during river flooding, spring thaws, etc, especially when the temperature is not high. Then, not infrequently, it can be found active under water. Eggs do not die under water, either, and juveniles get out to the surface without difficulty. The slug's life cycle is very short, probably the shortest of the known species of the family, lasting less than a month when under favourable conditions. *D. laeve* is almost omnivorous, most preferably feeding on live and dead plant remains. It may be a pest, of glasshouses in particular. It is characterized by a great agility, crawling quickly and also moving under water very adroitly. It reproduces the whole year round, if only the weather conditions are favourable. Within the vegetation season it may produce a number of generations which live at the same time and on the same site (Fig. 31).

Distribution. The original distribution range of *D. laeve* seems to be the Palearctic, which is practically wholly inhabited by the species, from the subpolar zone up to its southern fringes, including China. Owing to its short life cycle and high ecological tolerance, the slug is extraordinarily susceptible to introduction. It can be encountered on all continents, except for Antarctic. It occurs quite locally but all over the globe, even on tropical islands such as New Guinea or others on the Pacific.

Comments. A slug of a widely varying body size, coloration and degree of reduction of male copulatory organs. It has spread throughout the world. Mainly for these reasons the species has been repeatedly described under different names. It still happens because it is difficult to imagine

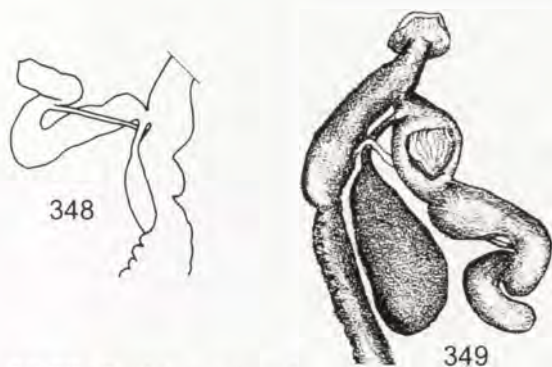


Figs. 339–347. *Deroceras laeve*. 339 – Reproductive system of an euphallic specimen. 340–343 – Copulatory organs with penis reduced to a different degree. 344 – Copulatory organs of a juvenile euphallic specimen. 345 – Copulatory system of a specimen with reduced penis and blindly terminating vas deferens. 346 – Stimulator in well-developed penis. 347 – Copulatory organs with fully developed penis. (After Wiktor 1973)

a Palearctic species to have been introduced to such unexpected places of the globe as in the case of *D. laeve*.

Identification of the aphallic forms may cause problems to an inexperienced malacologist. Then it would be useful to

find out if the mantle extends as far as to cover at least a half of the body, whether there are spots on the mantle and the rectum lacks caecum. Since aphallism in other species cannot be excluded, I recommend checking these characters



Figs. 348–349. Copulatory organs. 348 – *Deroceras momentolophus* (probably = *laeve*) (after Pilsbry 1945). 349 – *D. laeve* – a euphallic specimen from Hejningping, Changyang County, China. (Orig.)

especially when identifying single specimens from exotic localities, where the slug can be expected as introduced.

?D. momentolophus – I have had at my disposal only a dry shell labelled "Type". It follows from the descriptions and figures by Pilsbry (1944, 1948) that neither the slug's external appearance or its anatomy is different from those of *D. laeve* (Fig. 348). See also the comments on *D. hesperium* p. 449 and Figs. 350–351.

Deroceras (Deroceras) lasithionensis

Wiktor, Vardinoyannis, Mylonas, 1994

Deroceras lasithionensis Wiktor, Vardinoyannis, Mylonas, 1994: 16 – described as two subspecies differing mainly in the appearance of penial gland (see below).

A slug up to 47 mm long, evenly black, graphite-black or blackish. Skin soft and thin.

Genitalia. Penis of irregular shape with a small appendix in the shape of a nodule or finger-like process which is lateral or directed posterad. A dark blot present on the posterior end of penis. Penial gland large, approximating to half the length of penis, composed of 2–9 long, comparatively wide or simply lobular processes set directly on penis (!) or, at most, on a very short common shaft. Most often these processes do not branch, at the very most some of them having a short lateral offshoot. Inside penis a conical stimulator, frequently black-coloured. Musculus retractor penis unforked, attached more or less apically next to the entry of vas deferens and the junction between penial gland and penis.

Caecum on rectum short, often pocket-like.

Ecology. The slug is found in different habitats, e.g. in phreagaena, maquis, pine forest and old cultivations, near streams.

Distribution. The species has been recorded from the Greek islands of Crete, Karpathos and Paximadia.

Deroceras (Deroceras) lasithionensis lasithionensis

Wiktor, Vardinoyannis, Mylonas, 1994

Deroceras lasithionensis lasithionensis Wiktor, Vardinoyannis, Mylonas, 1994: 20 figs. 29–42 map 6. Locus typicus: 2–4 km S of Roussa Ekklisia (UTM MU29, Nomos Lasithiou, Crete Isl. Greece). Holotypus: MNHW no. MP 635.

This subspecies differs from the other one with respect to penial gland, which is here made up of merely two (!) long – roughly equal in length – processes. Exceptionally, there may be a small lateral twig present on one of them (Figs. 352–358, 362).

Ecology. The subspecies inhabits different types of habitat exclusively in the lowlands.

Distribution. *D. lasithionensis lasithionensis* occurs in the whole area occupied by the species, except for Paximadia Island. Most of its localities are concentrated in the western part of Crete. Although the distribution ranges of the two subspecies overlap, they do not presumably co-occur in the same habitats.

Deroceras (Deroceras) lasithionensis polylobatum

Wiktor, Vardinoyannis, Mylonas, 1994

Deroceras lasithionensis polylobatum Wiktor, Vardinoyannis, Mylonas, 1994: 22 figs. 43–52 map 6. Locus typicus: Moni Kapsa (UTM MU17, Nomos Lasithiou, Crete Isl. Greece). Holotypus: MNHW no. MP 636.

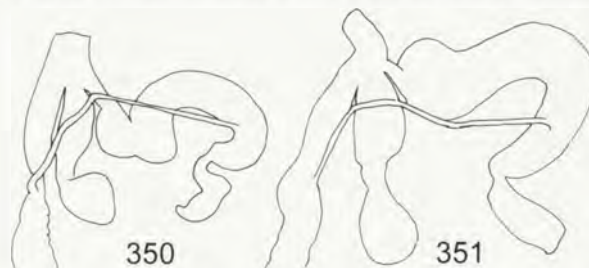
This one differs from the other subspecies in its penial gland consisting of 5–9 processes. Besides, the slugs that belong to this subspecies are somewhat smaller, usually not exceeding 40 mm in length (Figs. 363–369).

Ecology. The subspecies occurs in various habitats, not only in the lowlands but also in the mountains.

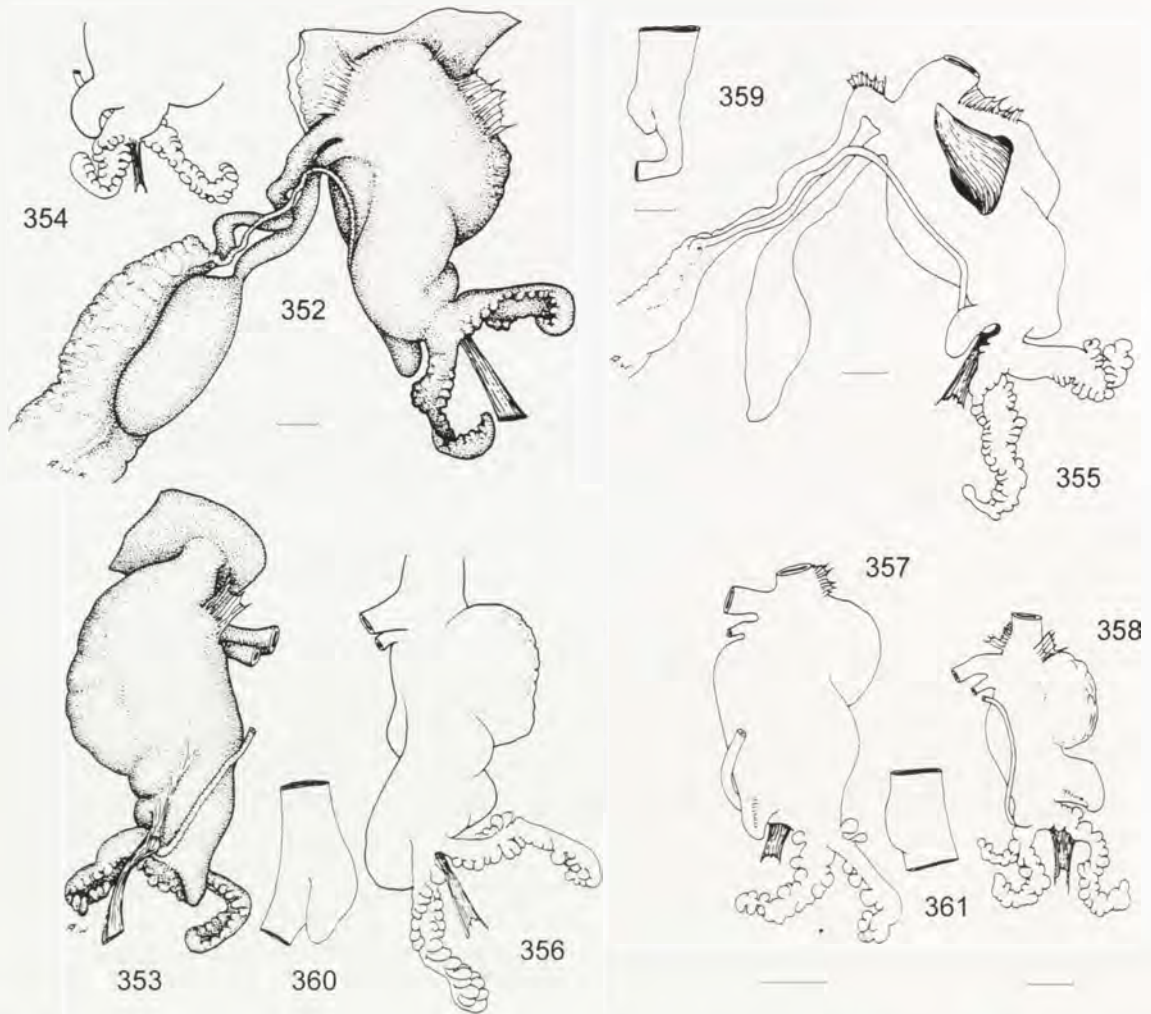
Distribution. The localities of the subspecies *polylobatum* are scattered within the whole range of the species. They do not make clear concentrations and their number is lower than that of the nominate subspecies localities. As mentioned above, despite their overlapping distribution ranges, the two subspecies do not occupy the same habitats.

Comments. The slug has been described very recently but on the basis of very ample material, which to a high degree allows to trace the range of morphological variability. The characters of the two subspecies distinguished are highly stable and there seem to be no transitional forms between them. The two have practically identical distribution ranges but, judging from the labels, they are reciprocally exclusive (I have not collected these slugs myself, and no special research on this problem has been conducted).

D. lasithionensis is similar to *D. rethimnonensis*, a species very common on Crete and occurring in the same habitats. *D. rethimnonensis* is very often, although not always, pale in colour, as if faded, a coloration I have never



Figs. 350–351. Copulatory organs of *Deroceras hesperium* (probably = *laeve*) (after Pilsbry 1945)



Figs. 352–361. *Deroceras lasithionensis lasithionensis*. 352–353 – Copulatory organs and penis alone of the holotype. 354 – Posterior end of penis. 355 – Copulatory organs. 356–358 – Penises of different specimens. 359 – Rectum of the holotype. 360–361 – Recta of different specimens. (After Wiktor et al. 1994)

observed in the species discussed. Both subspecies differ also in the appearance of penial gland, which in *D. rethimnonensis* is always forked, like in *D. lasithionensis lasithionensis*, but the two branches are set on a distinct and relatively long common shaft (!), and they are thin, not lobular. Besides, the stimulator in *D. rethimnonensis* is smaller compared with the size of penis, and the appendix, sometimes being merely a protuberance, is smaller as well.

Another species similar to the one under consideration is *D. nyphoni* but this slug is spotted, has a broad appendix, to which retractor penis inserts, a different penial gland and a smaller stimulator.

Deroceras (Deroceras) levisarcobelum de Winter, 1986

Deroceras allimiraï levisarcobelum de Winter, 1986: 141 figs. 3–8, 36.
Locus typicus: near Aigues-Juntas "along the D1", 15 km NW of Foix (UTM CH76, dep. Ariège, France). Holotypus: NML no. 9157.

Deroceras levisarcobelum: Castillejo, Garrido, Iglesias 1993: 176 figs. 23–32, 52.

References: Castillejo, Garrido, Iglesias 1995: 39 figs. 89–95.

Body length of live specimens up to 50 mm, preserved – up to 35 mm (Castillejo et al. 1993). Coloration pale brown, yellow-brown, at times orangish (nearly orange) with dark concentrations of melanophores which may yield diffuse brown spots, e.g. over pneumostom.

Genitalia (Figs 373–374). In de Winter's opinion (1986), gonad does not reach the posterior end of viscera, whereas acc. to Castillejo et al. (1993), it may constitute the posterior termination of visceral sack. The divergence between the descriptions must have stemmed from the fact that in juvenile, not fully mature, specimens the large gonad forms the posterior end of viscera, and later on, when it shrinks with the slug's maturation, it moves anterad (which is the case in many *Deroceras* species). This character seems to be important in certain species but it is difficult to observe on the basis of scant material. Medial section of penis without any constriction. Posterior end of penis provided with two, more or less distended, pockets. On one of them there is a tiny, conical or digital, bent penial gland. Between



Fig. 362. *Deroceras lasithionensis lasithionensis* – penis with visible internal structures. (After Wiktor *et al.* 1994)

the penial distensions mentioned musculus retractor penis is nearly apically inserted. In the neighbourhood of this insertion there is the entry of vas deferens. On penis other swellings may also occur (Caution! Penis is extraordinarily similar to that of *D. altimirai*). Inside penis a large, slightly flattened, blunt stimulator of smooth (not ornamented) surface (!). The surface of the remaining internal structures of penis may be covered by longitudinal striae differing with an individual.

Caecum on rectum (Fig. 375) very shallow, in the shape of a vestigial pocket. Acc. to Castillejo *et al.* (1993), caecum may be lacking at all.

Distribution. The slug occurs in France (dep. Ariège, Pyrénées Orientales) and Spanish Catalonia (environs of Lerida, Barcelona, Girona).

Comments. Due to *D. levisarcobelum* being highly similar to *D. altimirai*, de Winter (1986) described the former slug as a subspecies of the latter. Castillejo *et al.* (1993) rightly point out that *D. levisarcobelum* is different by two, taxonomically very useful, characters: 1. a tiny, vestigial caecum on rectum; 2. smooth, nonornamental surface of stimulator. Caution! With respect to external appearance of the body and penis, and probably, at least partly, distribution, the two slugs do not differ clearly.

Deroceras (Deroceras) libanoticum (Pollonera, 1909)

Agriolimax libanoticus Pollonera, 1909: 6 figs. 9–10. Locus typicus: "Sehtora e M. te Ermon" (Lebanon). Typus: I have failed to find it; probably non-existent.

The species is known exclusively from the description by Pollonera. The available information indicates that the slug

is smaller than *D. berytensis*, i.e. 12–13 mm in length, and brown-blackish in colour "colore brunoccio-narastro invece di nero ardesiaco". Sole uniformly pale.

Genitalia (Figs. 376–377). As illustrated in a figure, penis is divided by a deep constriction in two halves, lying nearly side by side. One of them is strongly distended, while the other slightly narrower and this one should be regarded as the posterior part of penis since penial gland is situated on it. The latter organ is single (!), fairly long, cylindrical, slightly bent, devoid of glandular papillae (!). Vas deferens probably (it is not well-visible in the figure) opens somewhat laterally. Musculus retractor penis unbranched, laterally attached to the narrower section of penis, nearly on the border between its two parts, i.e. deeply in the lateral constriction. It is unknown what is inside penis and what stimulator looks like. Spermatheca duct thin and clearly delimited from a strongly ovally distended spermatheca. The length of spermatheca along with spermatheca duct slightly exceeds that of penis.

Caecum on rectum probably lacking.

Comments. There have been no other records of the slug since it was described by Pollonera (1909). When describing the species, the author compares it with *D. berytensis*, from which it is to differ in its smaller size, paler body coloration, appearance of penis, penial gland and spermatheca. Looking at the figure in the paper by Pollonera (1909), however, one may observe that penis and spermatheca are highly similar in shape to these organs in *D. berytensis*. Body coloration is not an essential character. An important difference is the appearance of penial gland, which in the specimens of *D. berytensis* that I have examined is composed of two branches. It is uncertain whether *D. libanoticum* has no caecum. If so, this would be another significant difference between the two species concerned. We have no information about the stimulator in *D. libanoticum*, either. In the light of the current knowledge, it is difficult to authoritatively state whether *D. libanoticum* is a good species or this name should be rather synonymized with *D. berytensis* for instance. The latter is very likely to happen in the future, but no final position can be assumed until the internal structures of penis and variability range of penial gland have been examined as well as the presence of caecum established.

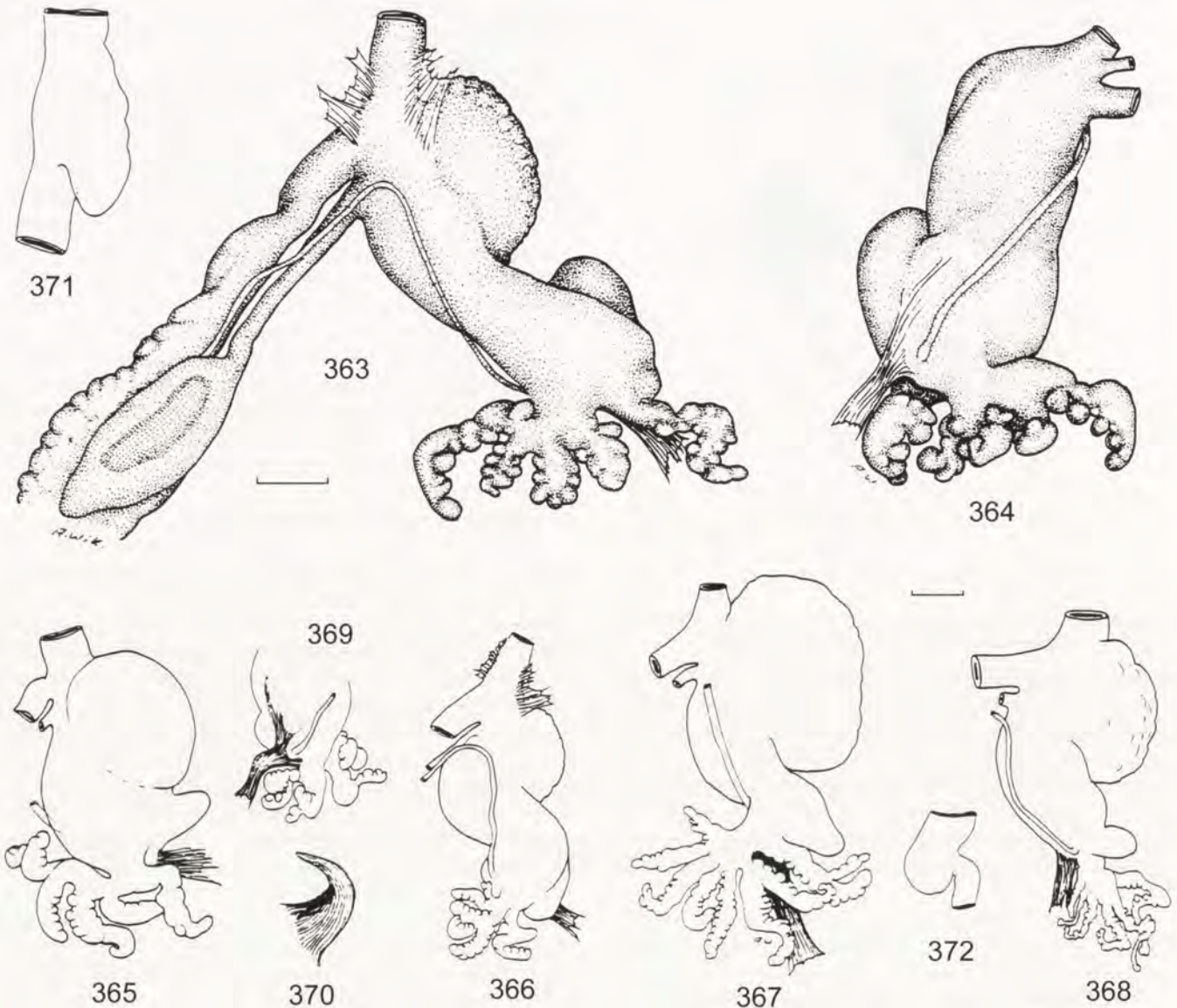
Germain (1921: 77) compares the species discussed with his *D. nigroclypeatum*, a taxon which also raises many doubts.

Deroceras (Deroceras) limacoides (Simroth, 1904)

Agriolimax limacoides Simroth, 1904: 694 t. 39 figs. 8–14, t. 42 figs. 110–114. Terra typica: Gardula and Abera, Djam-djam (Abyssinia = Ethiopia). Lectotypus: ZMB no. 102149. **Present designation.**

Since the types are dry (see Comments below), I quote the description after Simroth (1904), based on the text and figures.

Simroth does not provide dimensions. At present (having got dried) the largest specimen is ca 13 mm long. It resembles other *Deroceras* in shape. Around pneumostom there is

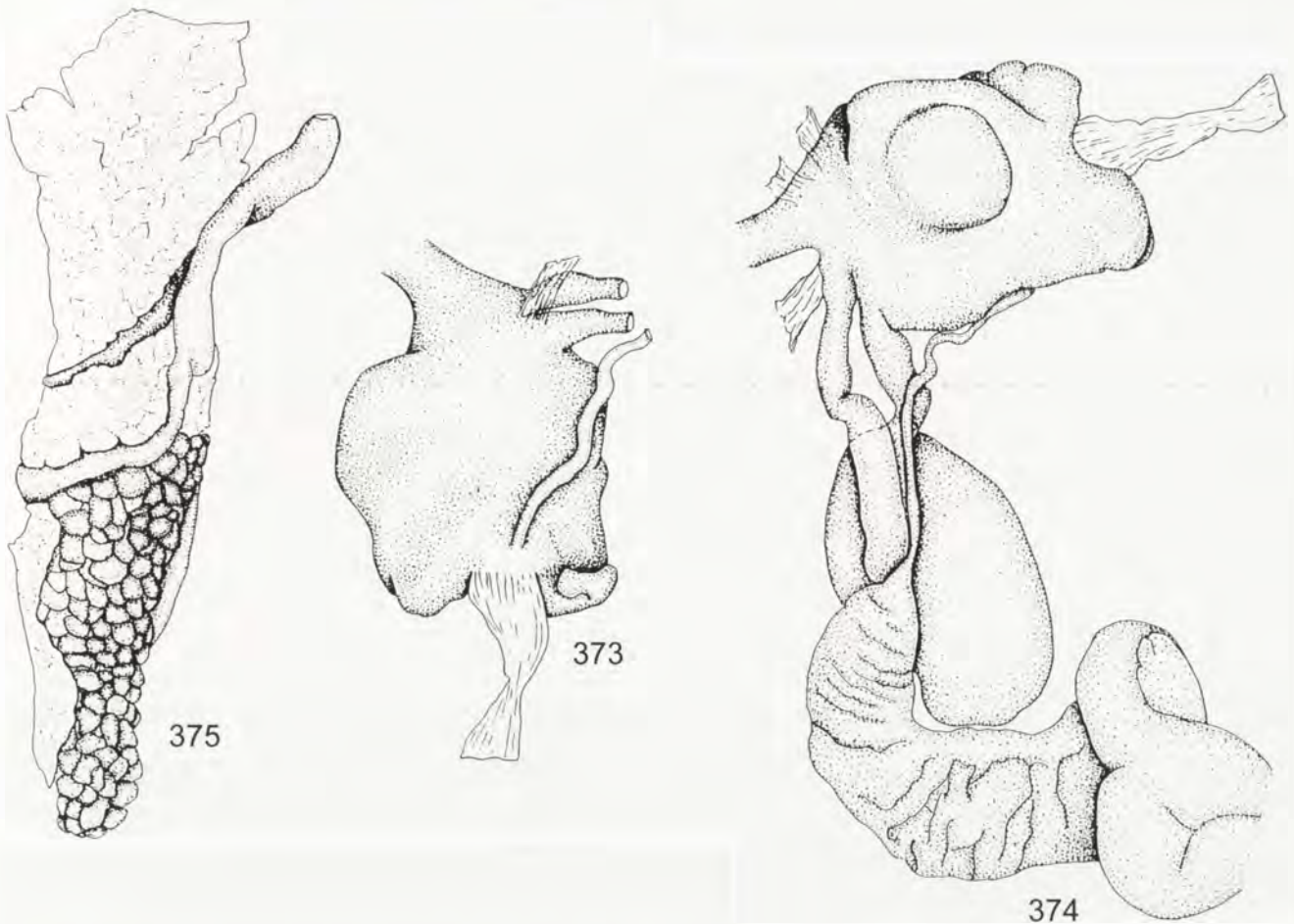


Figs. 363–372. *Deroceras lasithionensis polylobatum*. 363–364 – Copulatory organs and penis of the holotype. 365–368 – Penises of different specimens. 369 – Posterior end of penis. 370 – Stimulator. 371 – Rectum of the holotype. 372 – Rectum of a paratype. (After Wiktor *et al.* 1994)

a characteristic, particularly well-visible in *Deroceras* species, round plate (perceivable also in dried specimens). Coloration of some specimens evenly pale yellowish-grey with a slightly lighter streak along mid-back. Maturing slugs have stripes which are pale brown in juveniles, later becoming intensely brown. In the middle of mantle above shell dark spotting occurs, two dark bands beside it (!). In some specimens dark stripes are also present on the sides of keel and a light streak running medially along back as an extension of keel.

Genitalia (Figs. 378–379, 381–383). Penis irregularly elongated, cylindrical with a few swellings, posteriorly nearly hammer-shaped as it has two lateral pockets of different size. Penial gland in the shape of a large claviform process of smooth surface. Vas deferens opens laterally on an inconspicuous swelling. Musculus retractor penis later-

ally attached in the region of the smaller hammer-shaped pocket. Complex structures discernible inside penis. In the anterior part of penis (acc. to Simroth) there is a sunk tongue-shaped structure turning into stimulator (I suppose incorrectly named as such – see below). More posterad there is a spirally coiled fold which turns into another ligular stimulator (Reizplatte). In a partly dried specimen, whose structures have become transparent, it looks somewhat different than rendered by Simroth. It seems that only the latter organ, named "Reizplatte", is a proper stimulator. In the anterior section of penis only wall goffering is visible. Although now it is difficult to draw the internal structures of penis, I have tried to reconstruct the appearance of this organ in my freehand drawings (Figs. 381–382). When cut open, penial gland reveals a ledge-like fold which runs medially (Fig. 383).



Figs. 373–375. *Deroceras levisarcobelum*. 373 – Penis. 374 – Copulatory organs. 375 – Posterior section of viscera. (After de Winter 1986)

Alimentary canal typical of *Deroceras*, rectum devoid of caecum (Fig. 380).

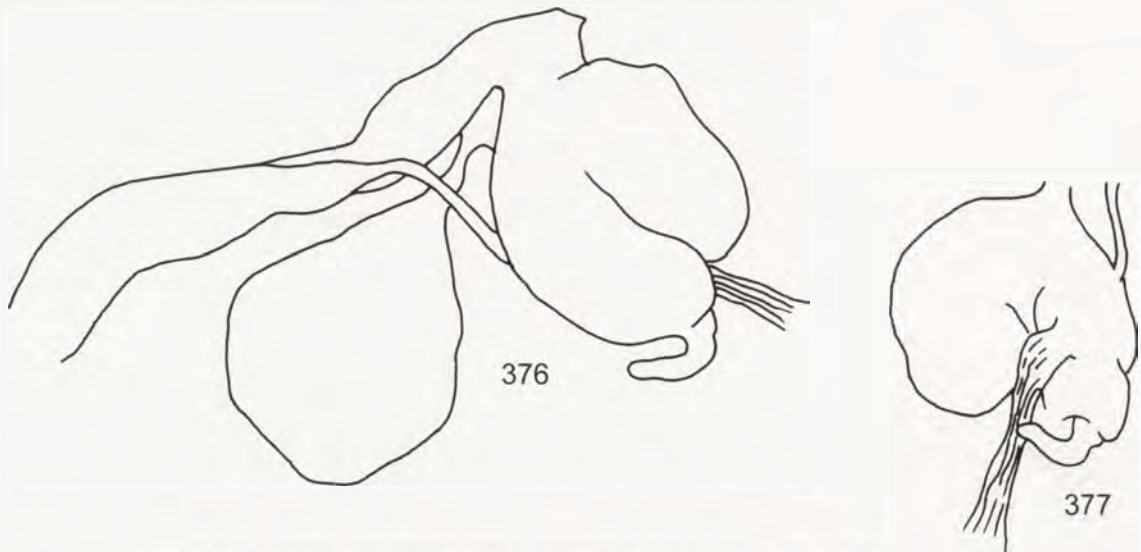
Distribution. The slug is known only from locus typicus.

Comments. Simroth's (1904) description pertains to 7 specimens collected by Neumann in Gardula and 1 specimen from Djam-djam. Six of those specimens (1 adult and 5 juveniles) are kept among the Berlin collection in one test-tube. The whole is provided with one label saying: (print "Zoologisches Museum Berlin") – "Agriolimax / limacoides Simr.*" coll. O. Neumann. All the specimens have been dried; now they are partly transparent, discoloured, but not completely hardened. The largest specimen is dissected, its penis opened. Most of the characters described and shown by Simroth in his figures are still well-visible. So, this one is probably the specimen illustrated in figure 114. Its genitalia have not been dissected, penis, which also occupies its usual place, is cut as seen in the drawing. I designate this specimen as the lectotype. It can be inferred from the text that it was collected in Djam-djam (Simroth 1904 p. 694). The other specimens are as follows: one dissected with primordial genitalia and 4 small quite young. The label (see above) does

not mention either the locality or the date of collection. It seems possible that all the specimens, of which two are missing, were put into one tube. The two may have been thrown away when already dried since their shrunk body integuments and dissected genitalia looked as rubbish. And thus the specimen that served Simroth for figures 110–112 is missing.

It is difficult and risky to attempt examination of the holotype again due to its condition. I have avoided further dissection and making my own figures with the use of a drawing device.

External appearance: now all the specimens preserved are discoloured, skin golden and transparent. No remains of the dark pigment have been retained but white precipitations (?Ca = calcium) inside skin are visible. The drawings of coloration demonstrate a great similarity to the coloration often recorded for *Lehmannia valentiana* (Férussac, 1823) (Limacidae). This one is a slug easily introduced, especially to warm climatic zones. Considering other characters (intestine, the crossing of ommatophore with retractor penis), the possibility of confusion with a representative of



Figs. 376–377. *Deroceras libanoticum*. 376– Copulatory organs. 377 – Penis. (After Pollonera 1909)

other families has been excluded by Simroth himself. It should be emphasized that, although coloration is not an essential character in the case of slugs of wide variability, the body pattern itself is of great significance. All Agriolimacidae are unicolour or spotted. I know no case of their body being striped. The discussed *D. limacoides* has a dark pigment concentrated in two streaks on mantle (!) and also on the sides of the medial line and keel. Simroth noticed similarity to *Lehmannia*, and thus what is seen in the figure is not a result of imprecision in drawing, but the slug is an exception within the family Agriolimacidae. Although it is a fact that concentration of spots on the sides of keel and the dorsal line, and also laterally on mantle, is common in *Deroceras*, it is never as manifest as in the species discussed.

In shape penis corresponds with a figure by Simroth (fig. 114), and thanks to the organ having got transparent, it turns out that inside there is only one flat ligular stimulator. The latter is situated in the posterior half of penis, in the region where the author placed a helical structure named "Reizplatte" (in fig. 114 marked with the letter Z).

Simroth (1914) comments on the non-typical appearance of this slug, emphasizing its similarity to *Limax*. He claims the slug concerned constitutes a link between two groups distinguished nowadays, namely Limacidae and Agriolimacidae. This interpretation, however, is hardly convincing in the light of the contemporary knowledge.

Deroceras (Deroceras) lombricoides (Morelet, 1845)

Limax lombricoides Morelet, 1845: 39 t. 3 fig. 4. Locus typicus: Monchique, Braga (Portugal). Typus: probably does not exist.

Agriolimax immaculatus Simroth, 1891: 286 t. 3 figs. 9–10, 17, 19. Terra typica: Portugal (Cintra = Sintra and other localities). Typus: probably does not exist.

Agriolimax immaculatus var. *nigrescens* Simroth, 1894c: 296 figs. A–D. Locus typicus: Portunhos (Gandra, ?Portugal).

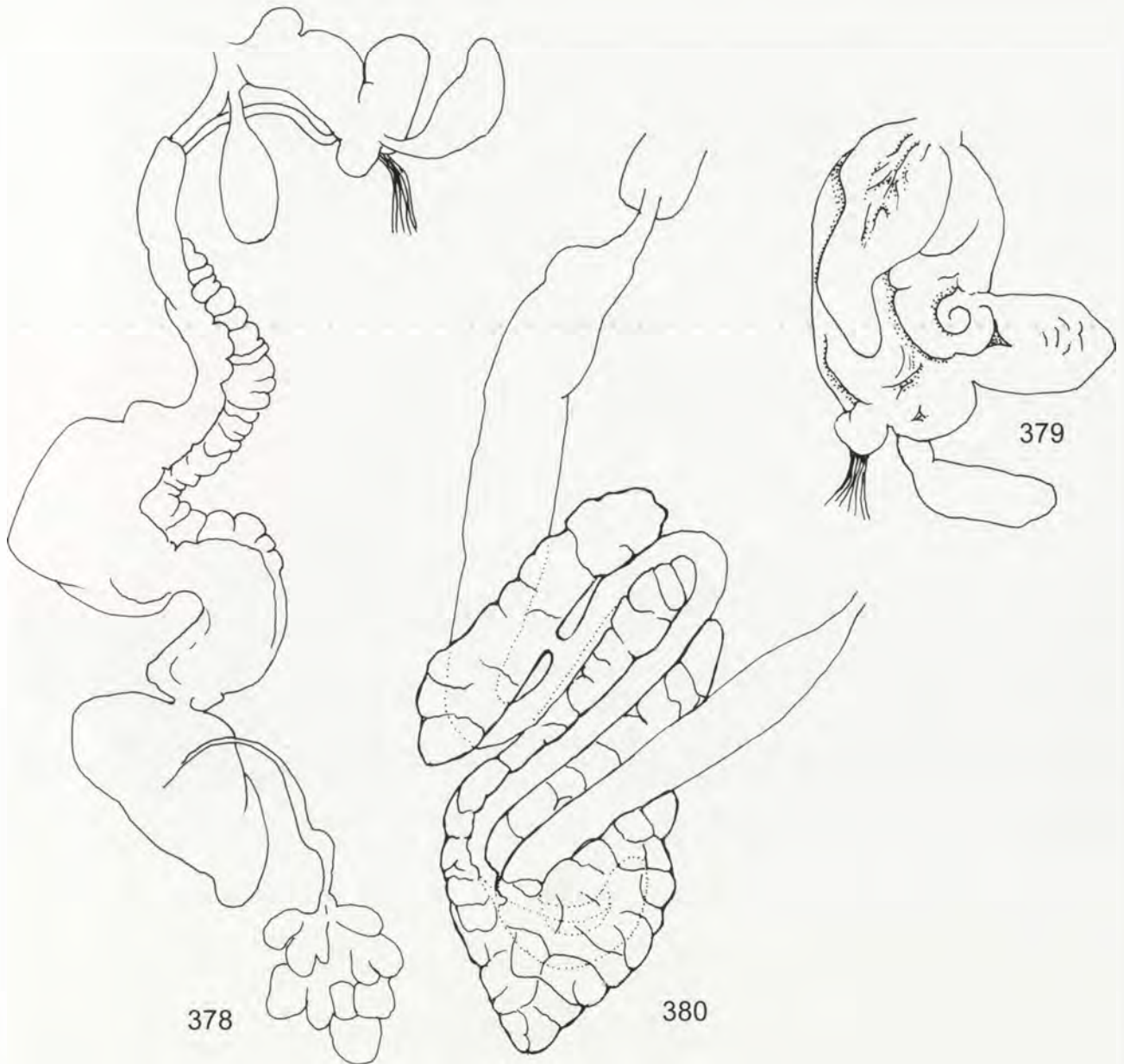
Deroceras (Plathystimulus) hispaniensis Castillejo et Wiktor, 1983: 11 figs. 26–32. Holotypus: MNHW no. MP 473. Locus typicus: Vidan (Galicia, Spain). See Wiktor and Castillejo 1987.

Deroceras lombricoides: corrected spelling being a derivative of the Latin name – see Comments.

References: Simroth 1891: 284 t. 3 figs. 8, 11–16, t. 8 map 1, t. 10 map 5; Castillejo, Diaz-Costin, Calvin, Mascato 1984: 117 figs. 1–14; Wiktor, Castillejo 1987: 13 figs. 1–3 photo 1; Castillejo, Rodríguez, Outeiro 1989: 236, 242 figs. 16–30; Rodríguez, Castillejo, Outeiro 1989: 95; Rodríguez, Hermida, Outeiro 1993: 38 figs. 1C–I 2A–B; Altonaga *et al.* 1994: 119 map 135; Castillejo, Garrido, Iglesias 1995: 27 figs. 55–59 and 36 figs. 79–83 (*D. hispaniensis*).

Body up to ca 23 mm in length (live individuals up to 40 mm (Castillejo *et al.* 1984)). General coloration coffee-creamy or reddish-creamy to blackish; mantle and back somewhat darker. In some specimens on mantle and back there are concentrations of a dark pigment, which may produce more or less distinct dots (Fig. 394). Sole creamy. Mucus colourless.

Genitalia (Figs. 384–386, 388–396). Penis composed of two differing parts: the anterior – nearly spherically distended with one lateral wall amply covered by glandular papillae (particularly in older specimens), and the posterior one which is clearly narrower, usually cylindrical. The latter is provided with a small, slightly laterally set, usually dark-pigmented appendix. Penial gland is apically situated on the opposite side of the cylindrical part of penis. It consists of a shaft on which there is a bundle of a few, most commonly 2–5, unbranched processes. Inside the anterior part of penis there is a wide, flat, simply membraneous structure in the shape of the letter U. Its edges are tucked and surface covered by comparatively wide striae resembling fingerprints. This organ, certainly an equivalent of stimulator in other species, is unusually delicate and easily damagable during preparation. Depending on which side penis opens, the organ formerly mentioned has a different appearance. When it is cut at the place of accretion with penis, one may get the impression that inside penis there are only thin folds accreted to walls. When penis is everted, the other organ has the shape of a ligular structure concave in the middle (Fig. 393).



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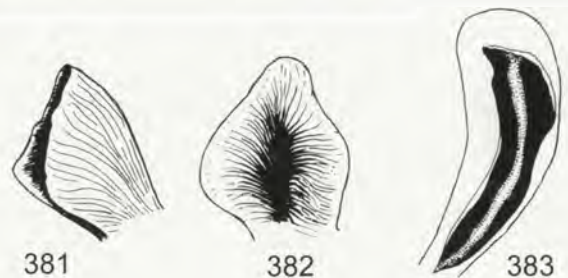
Figs. 378–380. *Deroceras limacoides*. 378 – Reproductive system. 379 – Penis with stimulatory structures visible inside. 380 – Reproductive system with visible rectum. (After Simroth 1904)

No distinct caecum on rectum; merely a very shallow pocket-like enlargement (Fig. 387).

Ecology. The slug inhabits various habitats, e.g. pine and oak woods, being found on rocks and in leaf litter (Castillejo *et al.* 1995).

Distribution. The species occurs nearly in whole Portugal (except for the country's southernmost area) and in Spain (Galicia and a substantial part of Asturia).

Comments. The original name was coined from the French "lombric" that is an earthworm, which the slug resembles in coloration. Hesse (1926) suggested that the

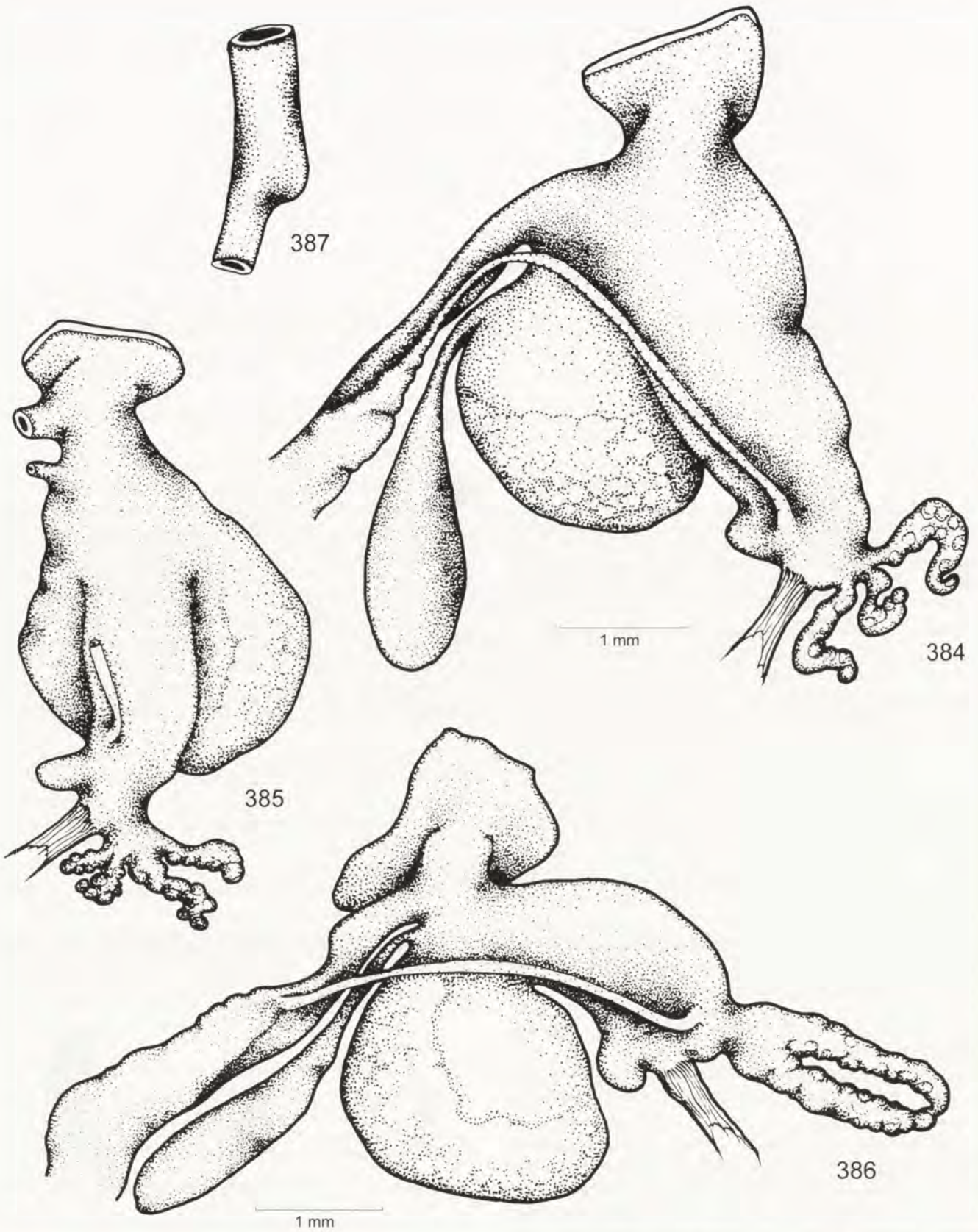


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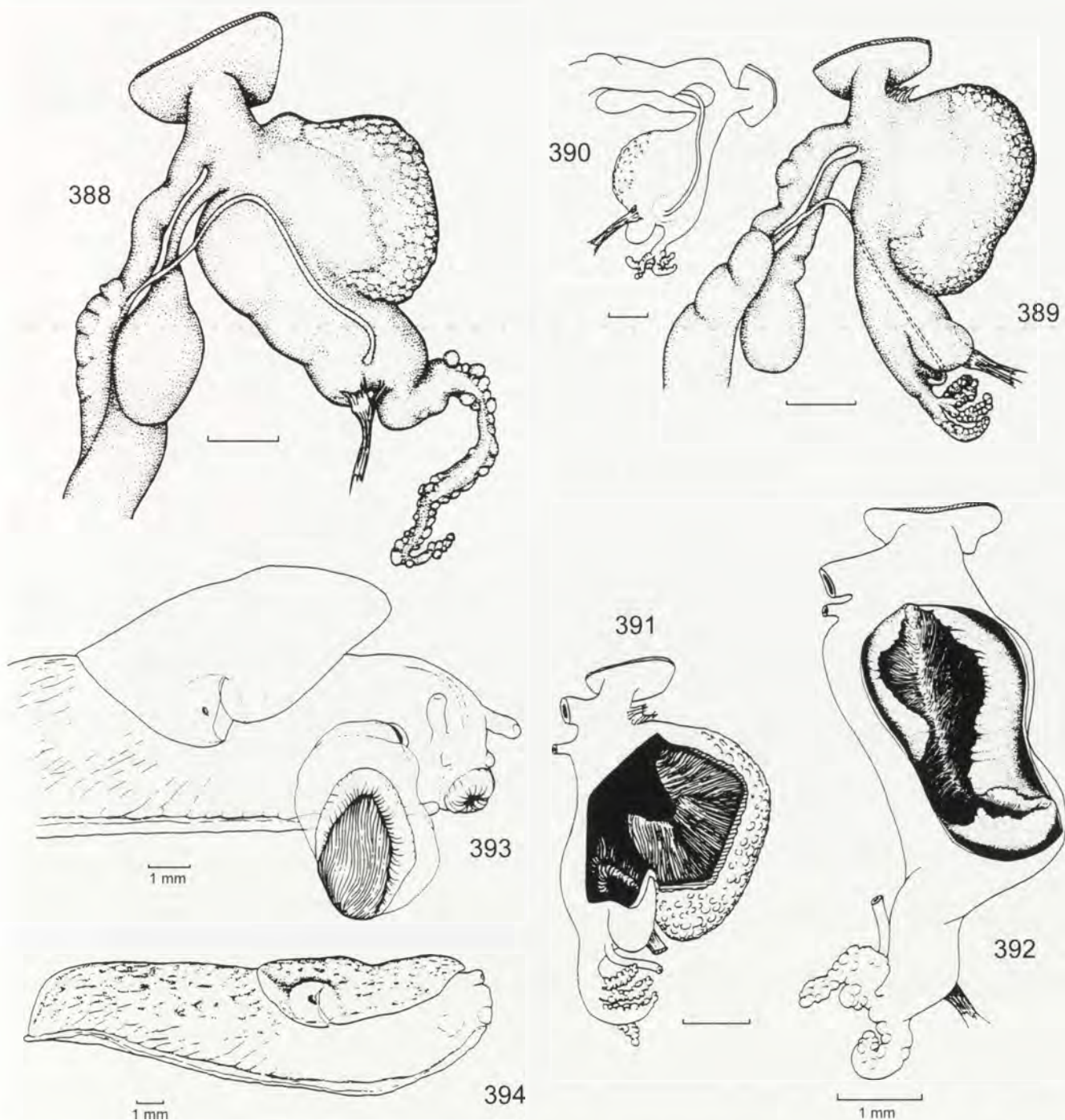
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Figs. 381–383. *Deroceras limacoides* – lectotype. 381–382 – Stimulator. 383 – Penial gland with ledge-like fold visible inside. (Orig.)



Figs. 384–387. *Deroceras lombricoides*. 384–386 – Copulatory organs. 387 – Rectum. (After Castillejo and Wiktor 1973 – as *D. hispaniensis*)



Figs. 388–394. *Deroceras lombricoides*. 388–390 – Copulatory organs. 391 – Penis with its internal structures. 392 – Stimulator inside penis. 393 – Everted stimulator. 394 – External view. (388–391 after Wiktor and Castillejo 1987; 392–394 after Castillejo and Wiktor 1983 – as *D. hispaniensis*)

name be corrected as *lumbricoides* in accordance with the spelling of the Latin equivalent “*lumbricus*”. Such changes, however, are not accepted by the code of zoological nomenclature (Castillejo and Wiktor 1987).

Morelet (1845) did not describe the anatomy of *D. lombricoides*, and the types are impossible to find. Simroth (1891) provided an anatomical description of a slug he recognized as *D. lombricoides*, which was, however,

collected in a different region than the material examined by Morelet. Simroth (1891) described another, similar species and named it *Agriolimax immaculatus*. In 1983, with Castillejo, I described *D. hispaniensis*. Later, after a more abundant material had been examined, it turned out that *D. immaculatus* and our *D. hispaniensis* are the same slug that Simroth designated as *D. lombricoides*, the three names being synonymized by Wiktor and

Castillejo (1987). Sill, for unknown reasons J. Castillejo and other Spanish authors continue to distinguish both *hispaniensis* and *lombricoides* (e.g. Castillejo and Rodríguez 1991; Castillejo, Garrido, Iglesias 1995).

Deroceras (Deroceras) lothari Giusti, 1971

Deroceras (Deroceras) lothari Giusti, 1971: 491 figs. 14A–D, 15A–D. Locus typicus: Mt. Terminolo (Central Appennines, Italy). Holotypus: F. Giusti's coll., Siena (Italy).

Deroceras klemmi Grossu, 1972: 642 figs. 2a–h. Locus typicus: Trieste (Boschetto, Italy). Holotypus: NHW no. 50598. See Reischütz 1978.

Deroceras dalmatinum Grossu, 1972: 647 fig. 5. Locus typicus: "Karst-doline" in the vicinity of Trieste (?Italy). Holotypus: NMW no. 50605. See Wiktor 1996.

References: Altena 1973: 85 figs. 1A–E; Reischütz 1978: 39 figs. 1–3; Wiktor 1996: 88 figs. 107–112.

Body length up to 36 mm. Body black or dirty creamy, mostly unicolour or with rare dark spots, which may be concentrated in skin grooves thus giving a reticulate pattern.

Genitalia (Figs. 395–398). Penis is not peculiar regarding the shape. In adult specimens it is divided by a constriction into two, roughly equal, parts. Penial gland single (!), i.e. not branched (exceptionally with a small lateral offshoot), long, covered by glandular papillae. Stimulator is neither a regular cone nor completely flat; it has a very wide base and can be defined as a flattened cone, its apex usually directed backward.

Caecum on rectum large (Fig. 399).

Ecology. Poorly known. The slug occurs mainly in open habitats like montane meadows up to ca 1500 m a.s.l.

Distribution. The hitherto known localities are distributed in a large area from Hungary through Austria and Slovenia to NE and central Italy. In the north the slug reaches S Germany, and Croatia in the south (Wiktor 1996).

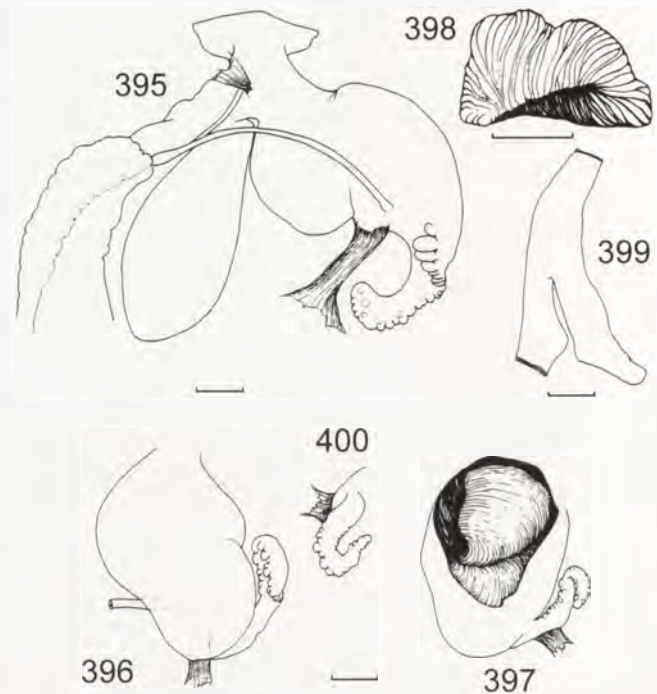
Comments. This species is similar both to *D. reticulatum* and *D. turcicum*, and probably for this reason it has been left out of account by former authors. In spite of the similarity, it seems to be a distinct species. Its specific morphological characters, particularly a single and relatively big penial gland and broad flattened stimulator, are stable characters showing small variability.

At times *D. lothari* may also be confused with *D. rodnae* but the resemblance concerns exclusively the external appearance. The latter species has a fan-shaped stimulator and a vestigial pocket-like rectal caecum.

The specimens Giusti had at his disposal were deep black. They had a small rectal caecum and an "arrow-head" stimulator. In correspondence Giusti confirms his opinion that the differences are essential enough to acknowledge *D. lothari* and *D. klemmi* as distinct species. A study of the distribution range of *D. lothari* should help to dissolve this question.

Deroceras (Deroceras) maasseni Wiktor, 1996

Deroceras maasseni Wiktor, 1996: 89 figs. 113–122 map 10. Locus typicus: 11 km N of Kolašin (Montenegro). Holotypus: NNML.



Figs. 395–400. *Deroceras lothari*. 395 – Copulatory organs. 396 – Penis. 397 – Penis with stimulator visible inside. 398 – Stimulator. 399 – Penial gland. 400 – Caecum on rectum. (After Wiktor 1996)

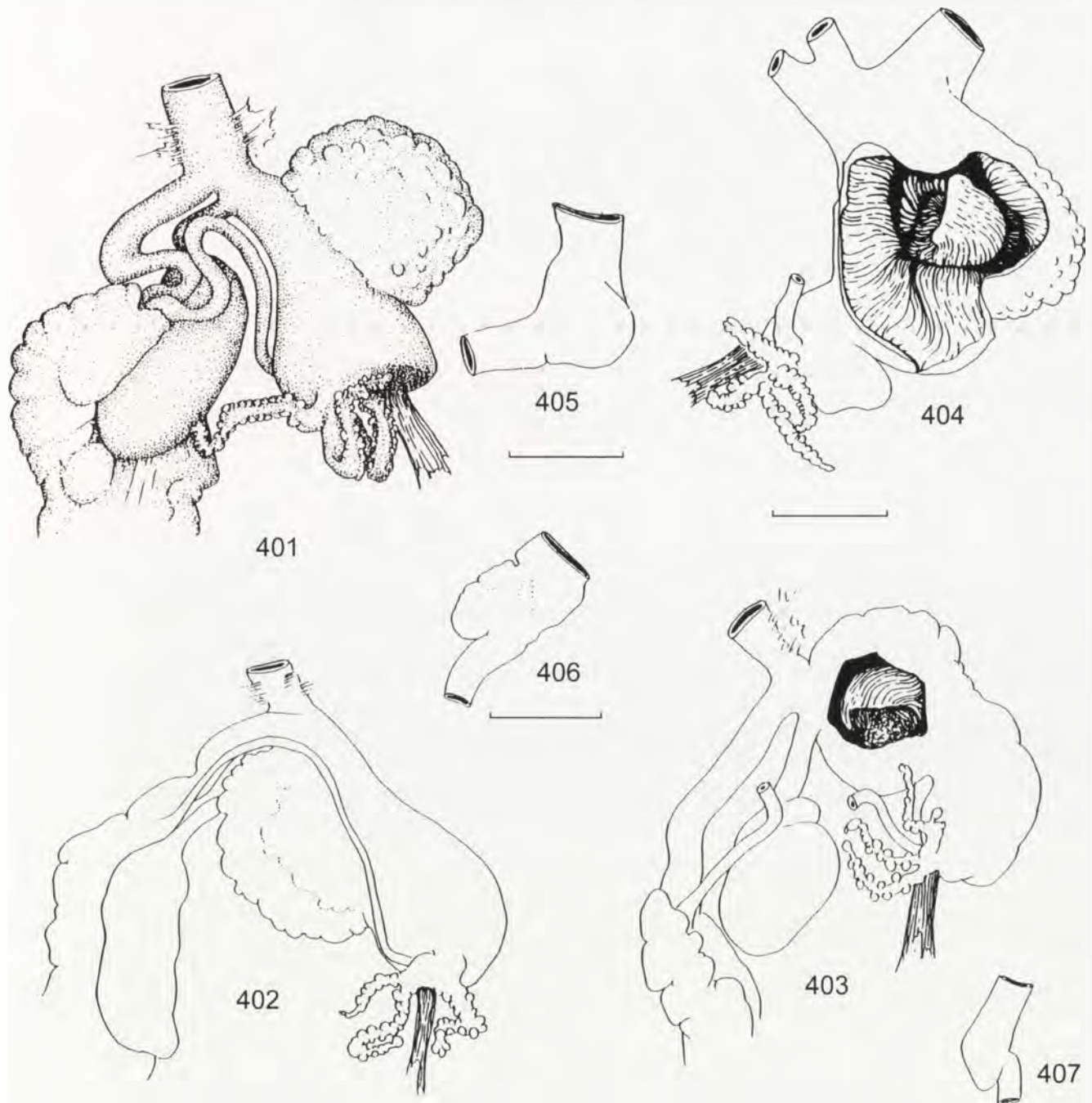
A small slug, merely up to 21 mm in length. Coloration: head, mantle and back evenly almost black, sides getting gradually lighter downwards, sole pale.

Genitalia (Figs. 401–404). Penis somewhat elongated, anteriorly distended, the wall of this part covered by granular glands. Lateral constriction of penis not deep. The posterior part of penis irregular, its one side distended, but without a distinct appendix. The rear end of penis dark-pigmented. Penial gland situated nearly apically, composed of 3–4 unforked processes accreted with bases and directly, without any distinct common shaft, joined to penis. The outlet of vas deferens and the insertion of an unbranched retractor are situated next to each other, near the connection between penial gland and penis. Inside penis a flat but fleshy (!) stimulator, its free end broad and as if perpendicularly cut.

Caecum on rectum (Figs. 405–407) in the shape of an inconspicuous but well-visible pocket. Only in one of the paratypes it is slightly longer than wide but it cannot be excluded that such a long caecum is an artefact (see Wiktor 1996).

Ecology. The slug was found near rivers, in the mountains at an altitude of 650–1150 m a.s.l.

Distribution. So far the species has been known only from the region of the Tara and Lim Rivers in Montenegro. Apart from the localities where the type specimens were collected (environs of Kolašin, Aluga, Dania Dobrilovina), the slug has also been recorded from W of Bradarevo, which is N of Bjelo Polje.



Figs. 401–407. *Deroceras maasseni*. 401 – Copulatory organs of the holotype. 402–403 – Copulatory organs of paratypes. 404 – Penis with visible stimulator. 405 – Caecum on rectum in the holotype. 406–407 – Rectal caeca of paratypes. (After Wiktor 1996)

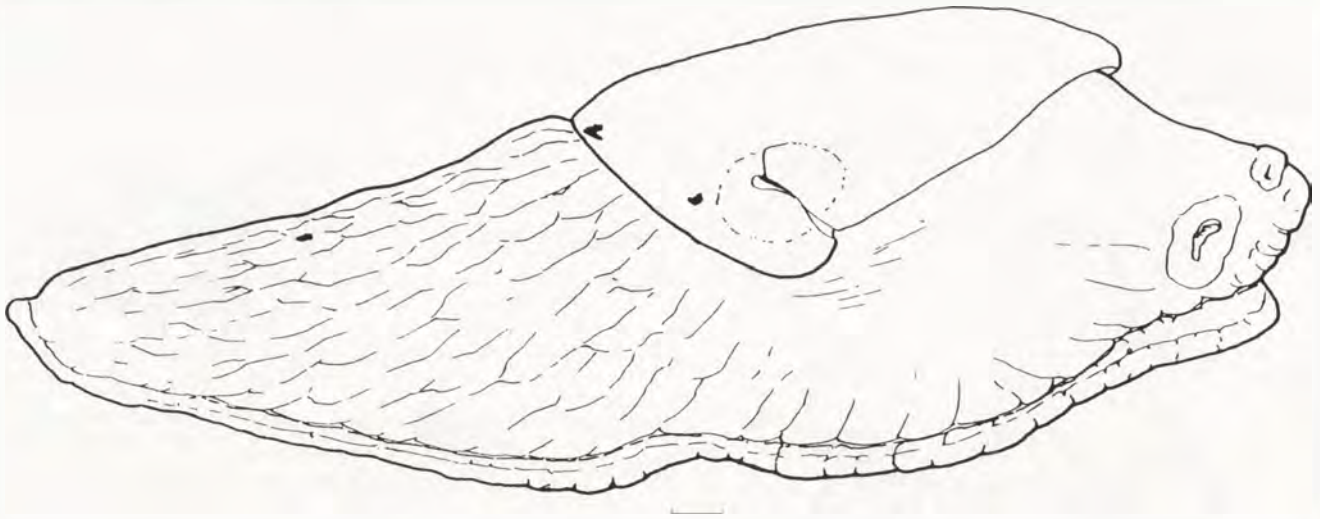
***Deroceras (Deroceras) malkini* Wiktor, 1984**

Deroceras (Deroceras) malkini Wiktor, 1984: 151 figs. 1–6. Locus typicus: Thymiana (Hios Isl., Greece). Holotypus: MNHW no. MP 475.

References: Wiktor 1994: 3 figs. 1–7; Wiktor – in print.

Length most commonly over 30 mm, skin thick, body thickset. Coloration whitish with very scarce dark tiny dots on mantle and back (Figs. 408, 414).

Genitalia (Figs. 409–411, 413–419). Penis irregular in shape, with various types of swelling. In its anterior part there is always a large lateral distension of smooth surface. More posterad, i.e. in the medial section, penis narrows getting more or less cylindrical. At the rear big lateral distensions occur, a larger one, transversely directed or bent anterad, has a smooth surface – it is an appendix. Most commonly there is also another, smaller swelling, of the opposite direction, with short knots or short processes which



Figs. 408. *Deroceras malkini* – lateral view. (After Wiktor 1984)

represent penial gland. This gland, widely varying in shape, creates the impression of being vestigial, its appearance unlike most other species of *Deroceras*. Both vas deferens and wide and strong musculus retractor penis laterally join penis at the base of appendix, where penial wall is usually dark-pigmented. Inside penis a large slightly flattened stimulator of a blunt top.

Caecum on rectum short but well-marked (Fig. 412).

Distribution. Not known in detail. The species occurs in Turkey (Vil. Bursa, Vil. Izmir, Vil. Aydin) (Wiktor 1996) and Greece, where it has been found on the island of Hios, in the Parnon Mts., on Peloponnesus, and in the region of Naousa in the continental part of the country (Wiktor – in print).

Comments. To date little has been known about this slug. The dispersion of its localities over an extensive and zoogeographically diversified area is a strange phenomenon difficult of interpretation. The species seems to be indigenous to Hios Isl. and the neighbouring territories of Turkey, whereas the localities on Peloponnesus and in the continental part of Greece may be a result of introduction.

Deroceras (Deroceras) melinum

Wiktor et Mylonas, 1981

Deroceras (Platystimulus) melinum Wiktor et Mylonas, 1981: 183 figs. 1–8. Locus typicus: Nychia (Milos Isl., Greece). Holotypus: MNHW no. MP 464.

References: Wiktor – in print.

Body length up to 24 mm. General coloration creamy, dark-spotted on mantle and beyond it. On sides the spotting yields a reticulum, whilst keel and mid-back are devoid of spots (Figs. 421–422).

Genitalia (Figs. 423–425, 427–428). Penis irregular in shape, elongated, with different swellings. On the posterior end of penis a bent appendix. Penial gland in the shape of a comparatively thick process covered by large glandular

papillae. Retractor penis attached on the rear end of penis at the base of appendix. Vas deferens opens in the immediate neighbourhood of retractor insertion. Stimulator flat, elongated, its one side sunk.

Caecum on rectum vestigial, in the form of a shallow pocket (Fig. 426).

Distribution. Up until now the species has been recorded only from the Greek islands of Milos, Kimolos and Polinos.

Deroceras (Deroceras) minoicum

Wiktor, Vardinoyannis, Mylonas, 1994

Deroceras minoicum Wiktor, Vardinoyannis, Mylonas, 1994: 25 figs. 53–58 map 7. Locus typicus: Nida plateau, Nomos Rethimnis, Crete (UTM LU09, Greece). Holotypus: MNHW no. MP 679.

Body length up to 19 mm. Skin thin. Body creamy with blackish spots.

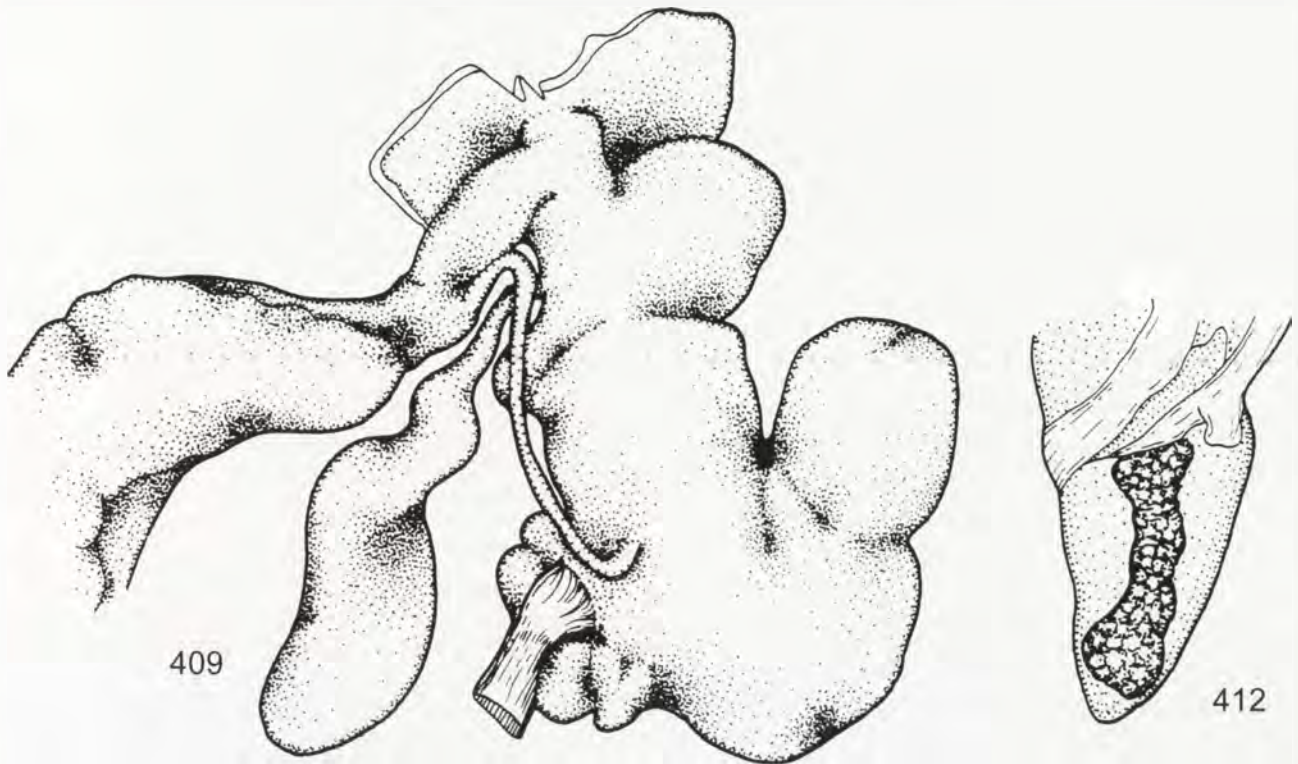
Genitalia (Figs. 429–432). Penis dark-pigmented, oval or medially constricted. Its posterior part broad, often even with two lateral swellings. Penial gland situated laterally. It consists of a short and thick trunk joined by three rounded lobular processes of smooth surface (no glandular papillae). Musculus retractor penis forked, the embranchment contains the outlet of vas deferens. Stimulator conical, dark pigmented.

Caecum on rectum practically non-existent, in its place there is an inconspicuous enlargement or a barely visible pocket-like concavity (Figs. 433–434).

Ecology. The only locality known is situated at an altitude of 1400 m a.s.l. The slug lives near springs on a site often covered by snow.

Distribution. So far the species has been recorded exclusively from the island of Crete.

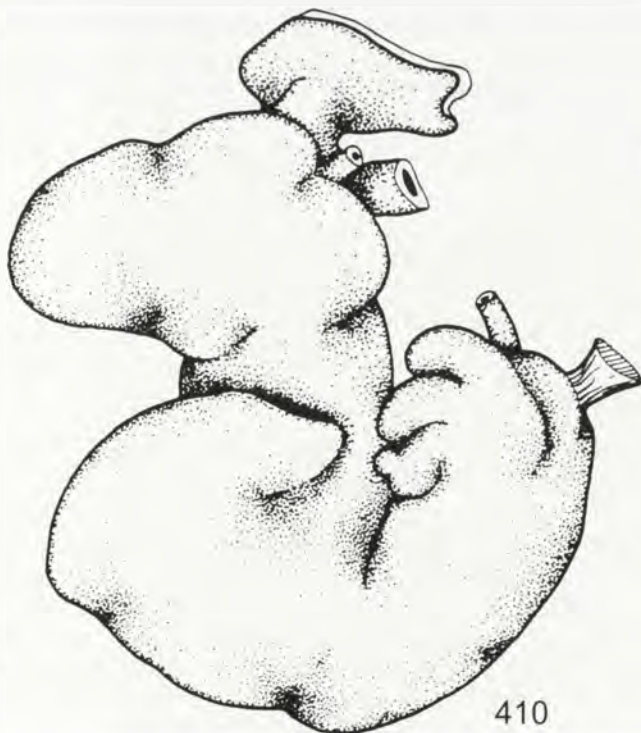
Comments. The specimens from Erimoupoli (9 specs.) and Cape Sidero (1 spec.) (both localities in Nomos Lassithion, Crete) and the one from the environs of Gonies



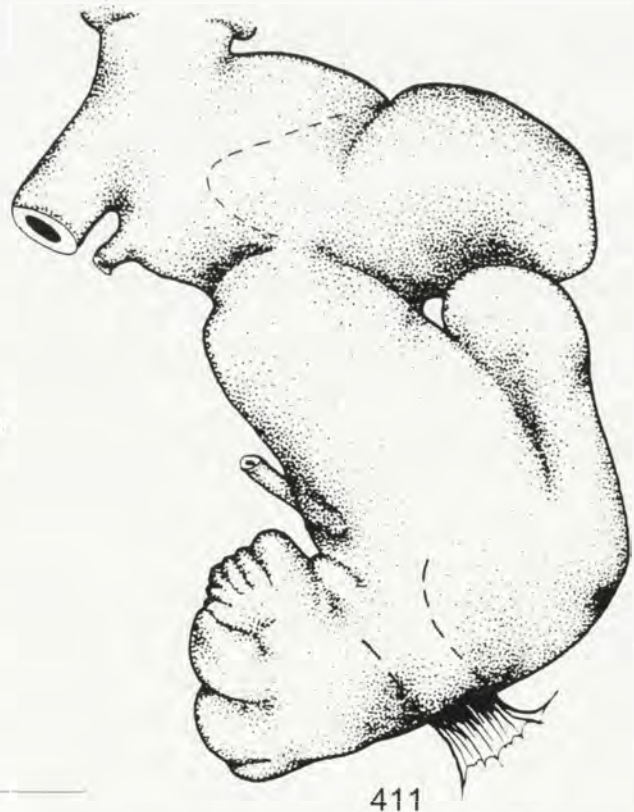
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Figs. 409–412. *Deroceras malkini* from Greece. 409–410 – Copulatory organs and penis seen from the opposite side. 411 – Penis of the holotype. 412 – Posterior end of viscera with visible rectal caecum. (After Wiktor 1984)



Fig. 413. *Deroceras malkini* from Greece – penis with visible stimulator. (After Wiktor 1984)

Asticoli (Nomos Iraklion) most probably represent *D. minoicum*, although they differ from the type specimens in their evenly ash grey-graphite coloration, the specimen from Gories Asticoli being the only one spotted. All of them have irregular lobe-shaped penial glands; the gland is sometimes merely a swelling, and, what is significant, assumes a different shape in different individuals (!). Besides, all these specimens have a very thin, nearly needle-like, and smaller stimulator though it is dark-pigmented like in the types of *D. minoicum*. At present we do not know the variability range of the species discussed. I have got the impression that it may be wide considering the tendency to strong reduction seen in many organs that are of vestigial character. Nevertheless, now it is difficult to decide whether my classifying the slugs from Erimoupoli, Capsidero and Gories Asticoli as *D. minoicum* is correct or whether they belong to some other, yet unknown, species.

Deroceras (Deroceras) neuteboomi Forcart, 1972

Deroceras jaeckeli neuteboomi Forcart, 1972: 112 fig. 3. Locus typicus: Lindos (Ródhos = Rhodes Isl., Greece). Holotypus: Rijksmus. Leiden.

References: Grossu 1969: 159 figs. 2a–g, Paget 1976: 744; Wiktor – in print.

A small slug, up to ca 12 mm in length. Coloration, acc. to Forcart (1972), of pale meat (hell fleischfarben), mantle and back heavily grey-spotted but keel and its extension, i.e. the very medial section of back, without spots. Beyond mantle the spots form a reticulum.

Genitalia (Figs. 435–437). Penis elongated or pear-shaped, devoid of lateral constriction (!). Only in the place where in most *Deroceras* species penial gland is situated the surface of penis is inconspicuously wrinkled (!). Musculus retractor penis insertion and vas deferens entry are situated close to each other, somewhat laterally on the rear end of penis. Stimulator flat with a wide base, in one specimen its free end is slightly sharpened whereas in others broad. Spermatheca along with spermatheca duct roughly equalling the length of penis.

No caecum; only a small rectal distension (Figs. 438–440).

Ecology. Unknown. The slug was collected at a stream.

Distribution. The species is known exclusively from the Greek island of Rhodes.

Comments. Forcart (1972) described the slug as a subspecies of *D. jaeckeli* Grossu, 1967. As I have found out, *D. jaeckeli* is a synonym of *D. turcicum* (see below), and the slug from Rhodes seems to be a good species distinct from *D. jaeckeli* = *turcicum*.

The drawing of genitalia by Forcart (1972) indicates that the author dealt with a juvenile specimen which had not copulated yet. This is evidenced by the small spermatheca. Forcart embedded genitalia in canada balsam. When preparations are made, different artefacts may be produced. The figure of the holotype seems to show such a preparation. I have not examined the holotype myself, my opinion being based on the topotypes that are at my disposal. Forcart (1972) draws attention to the fact that the gonad has been shifted as far as the region of mantle. My study of mere 4 specimens has not confirmed this (Wiktor – in print). Nevertheless, this character is not of great usefulness.

? *Deroceras (Deroceras) nigroclypeatum* (Germain, 1911)

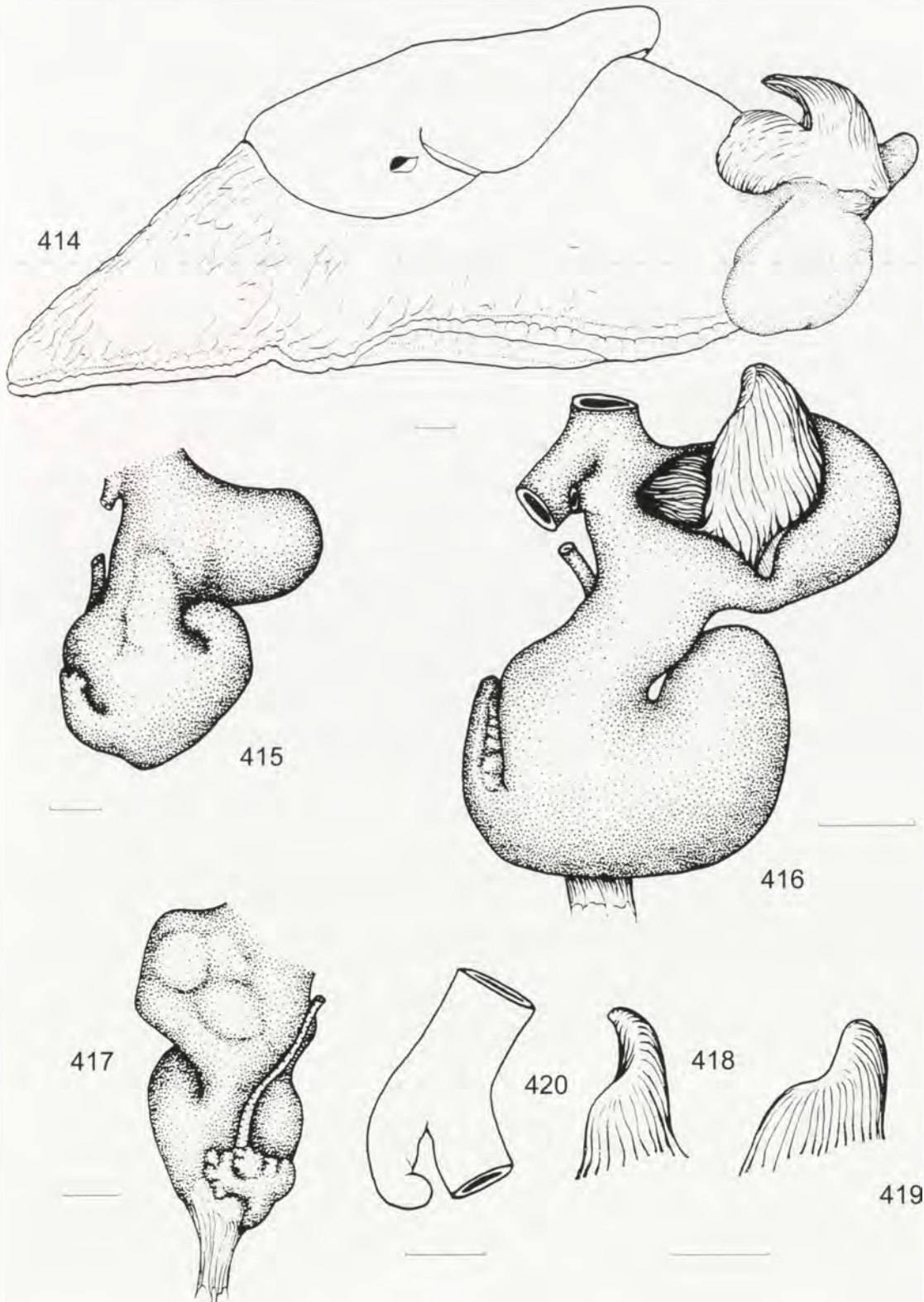
Agriolimax nigroclypeata Germain, 1911: 141 t. 2 fig. 3 and 1921: 75 fig. 3. Terra typica: NE of Damascus (Syria). Typus: I have got no information.

References: Wagner 1940: 286 fig. 2.

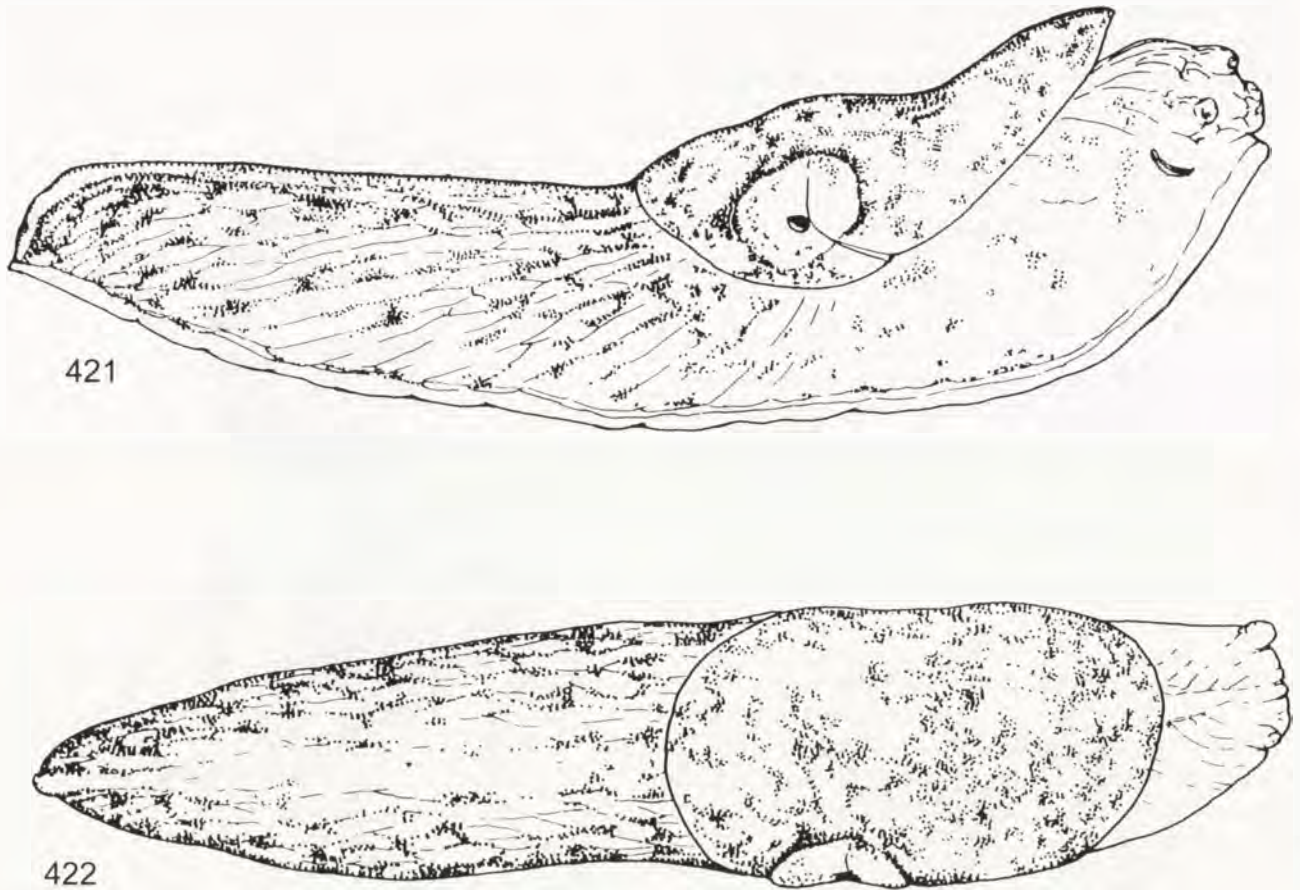
I quote the description after Germain (1911, 1921). Body length 17 mm, width 5 mm, mantle 7 mm long and 4 mm wide. Body coloration very dark blue-grey, back darker than sides. Sole unicolour, pale ochre-yellow. The species noticeably differs from *D. berytensis* in its smaller size and in the structure of genitalia, particularly penial gland which is enveloped in a transparent sheath lacking in the slug compared (!). *D. nigroclypeatum* is also smaller than *D. libanoticum*.

Intestine equipped with caecum (“L’intestin est muni d’un caecum”).

Comments. The status of this taxon is unclear. It also raised Wagner’s (1940) doubts. Judging from the description



Figs. 414–420. *Deroceras malkini* from Turkey. 414 – External appearance of a specimen with everted penis. 415–417 – Penises of different specimens. 418–419 – Stimulator viewed from different sides. 420 – Caecum on rectum. (After Wiktor 1994)



Figs. 421–422. *Deroceras melinum* – lateral and dorsal views. (After Wiktor and Mylonas 1981)

by Germain (1911, 1921), the only essential distinctive feature of this species is a membrane enveloping penial gland. I observed this character in some slugs, from Sicily for instance, that I recognized as *D. golcheri* but they had only a vestigial pocket in the place of caecum. Germain seems to have dealt with *D. berytensis*. This cannot, however, be unequivocally stated without a study of the types of *D. nigroclypeatum*, which I have failed to find, or thorough knowledge about the slugs of Syria.

Deroceras (Deroceras) nitidum (Morelet, 1845)

Agriolimax nitidum Morelet, 1845: 35. Locus typicus: "Lisbonne et ceux de Béja dans l'Alemtejo" (Portugal). Typus: I have got no information.

Agriolimax Maltzani Simroth, 1885: 225 and 329 t. VII fig. 18 (external view). Locus typicus: Algarve. Typus: probably non-existent.

Deroceras hilbrandi Altena, 1964: 44 figs 1A–F. Locus typicus: Sierra Nevada, La Maitena (Spain). Holotypus: RNHL no. 5192.

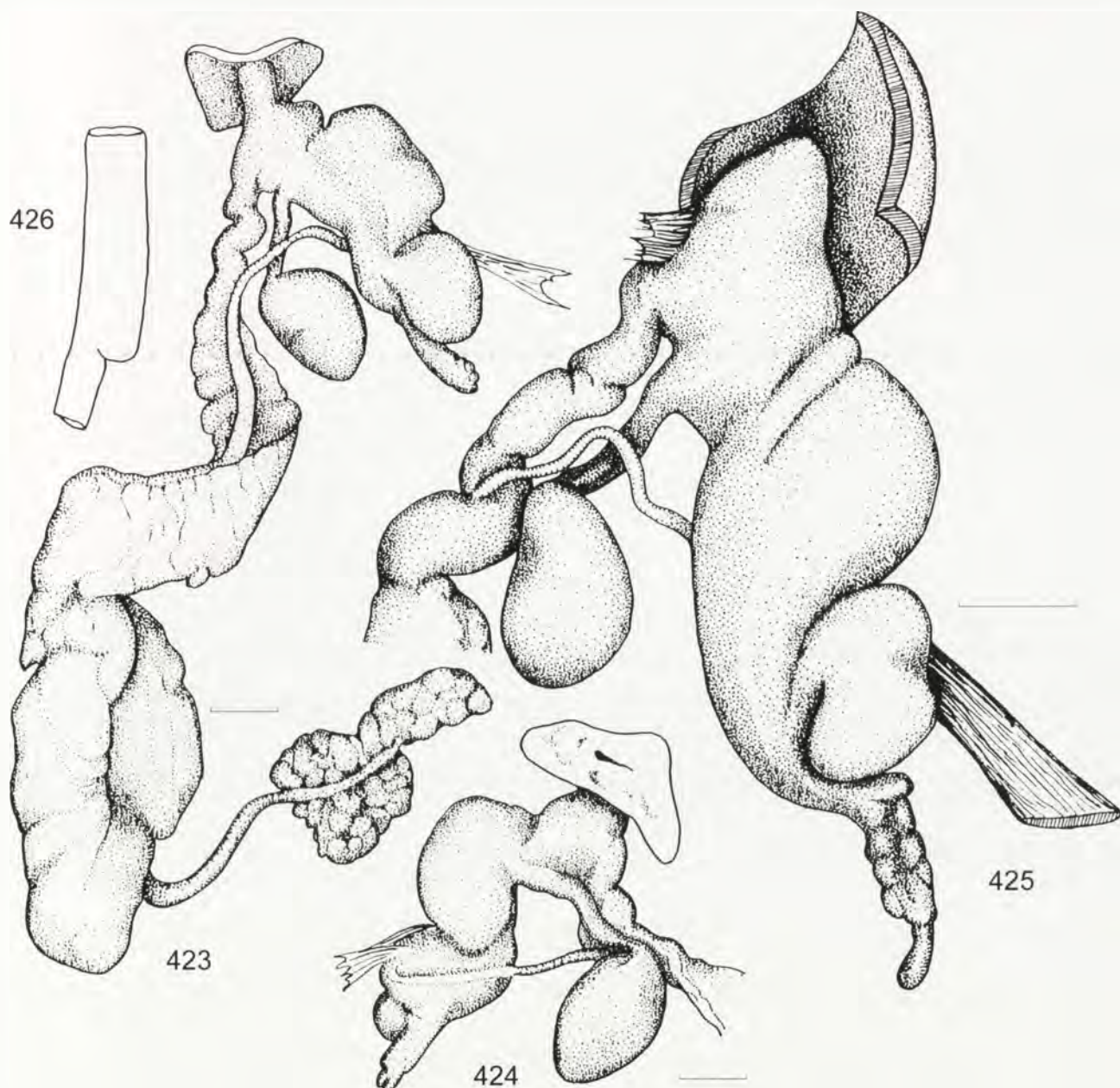
References: Simroth 1891: 290 (*Maltzani*); Rähle 1983: 191 figs. A–H; Wiktor and Castillejo 1987: 14 figs. 4–5; Castillejo and Rodríguez 1991: 51 map 5; Castillejo, Garrido, Iglesias 1993: 173 figs. 1–8, 52; Rodríguez, Hermida, Outeiro 1993: 38 figs. 1E–F, 3D; Castillejo, Garrido, Iglesias 1995: 13 figs. 15–20; Zamora and Gómez 1996: 154.

Body length up to 25 mm (live slugs up to 35 mm). Coloration from light brown, usually with dark spotting mainly on mantle, to evenly black. Body sides are usually paler and sole creamy white. Mucus colourless.

Genitalia (Figs. 441–443). Penis anteriorly strongly laterally distended. The wall of the distended part is amply covered with glands, its surface granulated. The posterior penis section is clearly narrower with one, more or less marked, lateral swelling. On the opposite side of the posterior penis end a large penial gland is situated. It has a thick base, farther narrowing into one long process covered by glandular papillae, or divided into 2–4 branches. Vas deferens opens laterally into the posterior part of penis. Musculus retractor penis most commonly forked, its one strand attached at the base of penial gland, the other to the lateral distension. Stimulator in the shape of a flattened cone.

Caecum on rectum lacking, acc. to Castillejo *et al.* (1995); in Altena's (1964) opinion, there is a vestigial caecum present.

Ecology. The slug inhabits damp habitats in different types of forest and brushwood like pinewood or groves of



Figs. 423–426. *Deroceras melinum*. 423 – Reproductive system of the holotype. 424–425 – Copulatory organs. 426 – Rectum. (After Wiktor and Mylonas 1981)

cork oaks, eucalyptus etc. (Castillejo *et al.* 1995). As observed by Zamora and Gómez (1996), it eats dead insects caught by an entomophagous plant, *Pinguicula vallisneriifolia*. The authors define the phenomenon as kleptoparasitic behaviour.

Distribution. The whole southern part of the Iberian Peninsula (Castillejo *et al.* 1995 map 20).

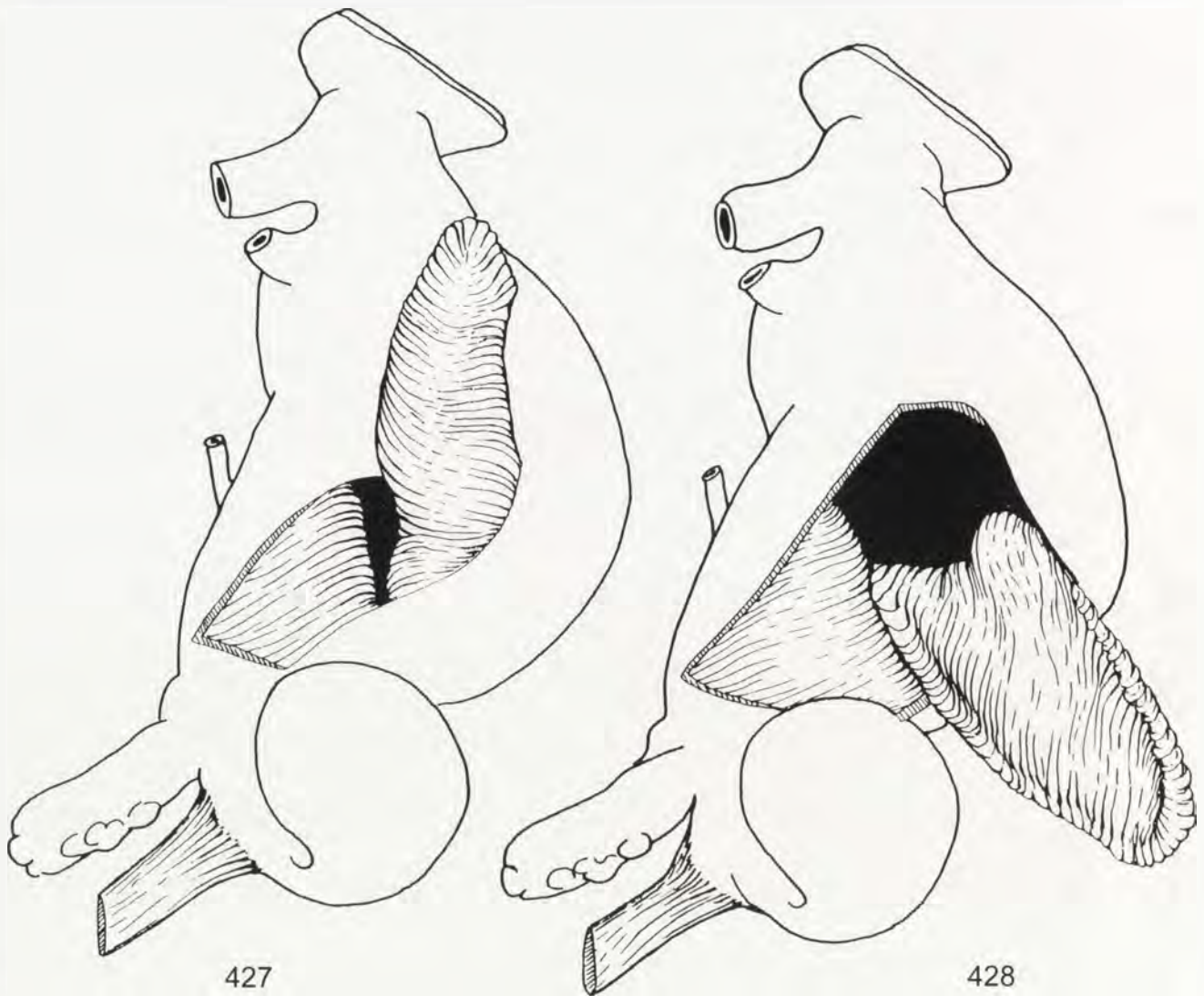
Comments. The description by Morelet (1845) is at least unclear. Besides, it is concerned only with the slug's external appearance.

When describing *Agriolimax maltzani*, Simroth (1885) compared it with similar *L. lombricoides* (= *lumbricoides*). The similarity concerns the external appearance, the

author providing a suitable drawing. However, there are no figures of the anatomy. According to Simroth, the species described lacks caecum. He compares the penis in *A. maltzani* with that of *D. agreste* (with *D. reticulatum* comprised), noting also the presence of a conical stimulator and papillae on penial gland.

Rähle (1983b) draws attention to the similarity between *D. maltzani* and *D. lothari*, even taking into consideration the possibility that this is the same species.

Wiktor and Castillejo (1987) treat *D. maltzani* as a distinct species which differs, first of all, in its single penial gland. A more detailed study on the variability of *D. nitidum* pursued by Castillejo and Rodríguez (1991) made these



Figs. 427–428. *Deroceras melinum* – stimulator inside penis shown from two sides. (After Wiktor and Mylonas 1981)

malacologists acknowledge *D. maltzani* as its synonym. This opinion seems to be justifiable and is expressed in later publications by Spanish teams.

The name *D. hilbrandi* has been synonymized by Castillejo, Garrido and Iglesias (1993), who provide convincing justification.

Besides, although Castillejo *et al.* (1995) maintain that rectal caecum is completely lacking, Altena (1964) records the presence of caecum in his *D. hilbrandi* and marks this organ in the drawing (fig. 1B).

***Deroceras (Deroceras) nyphoni* de Winter et Butot, 1986**

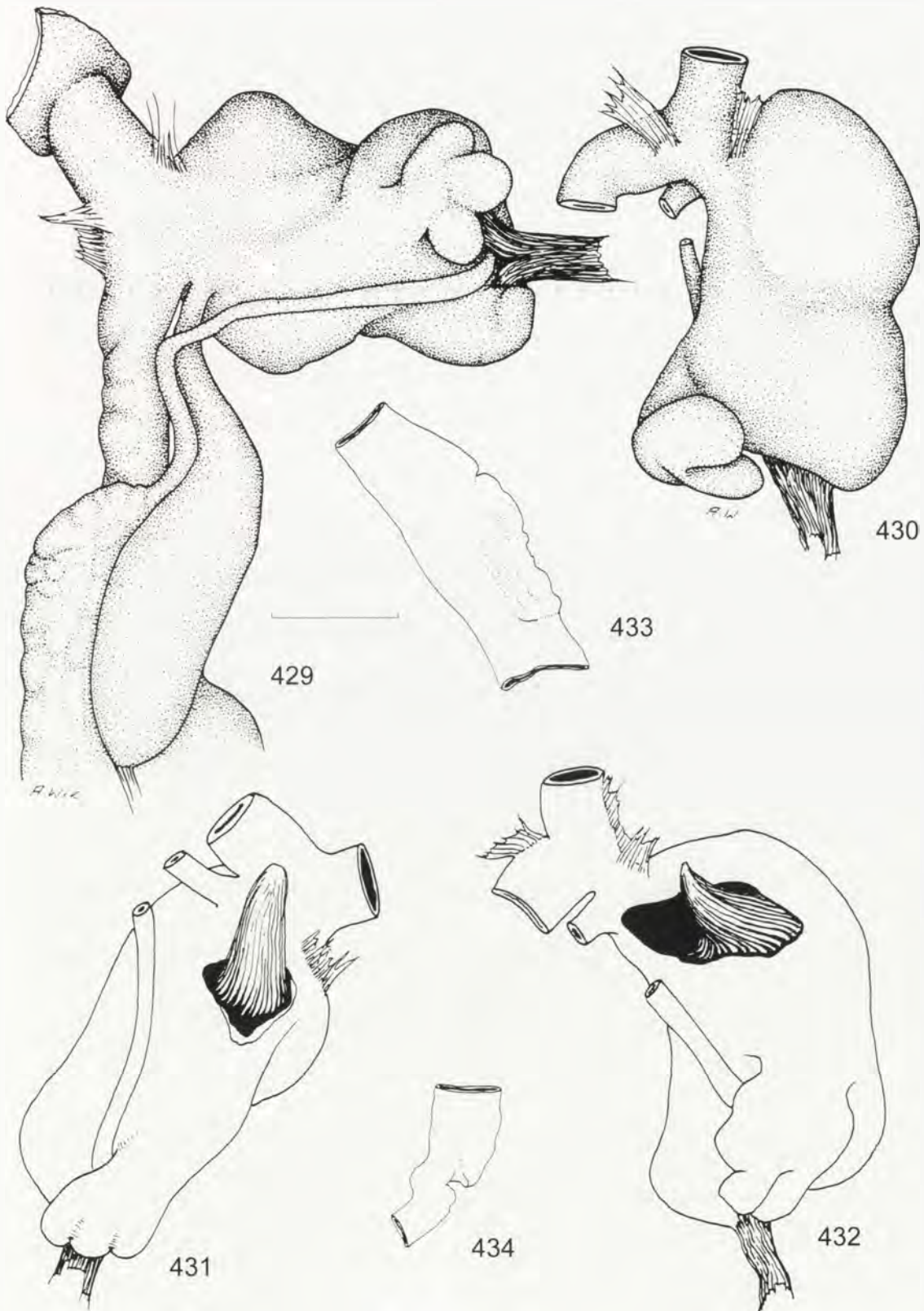
Deroceras nyphoni de Winter et Butot, 1986: 40 figs. 7–12. Locus typicus: S of Moni Evangelistria (Nomos Magnesia, Skiathos Isl., Greece). Holotypus: ZMA no. 356005.

References: Wiktor – in print.

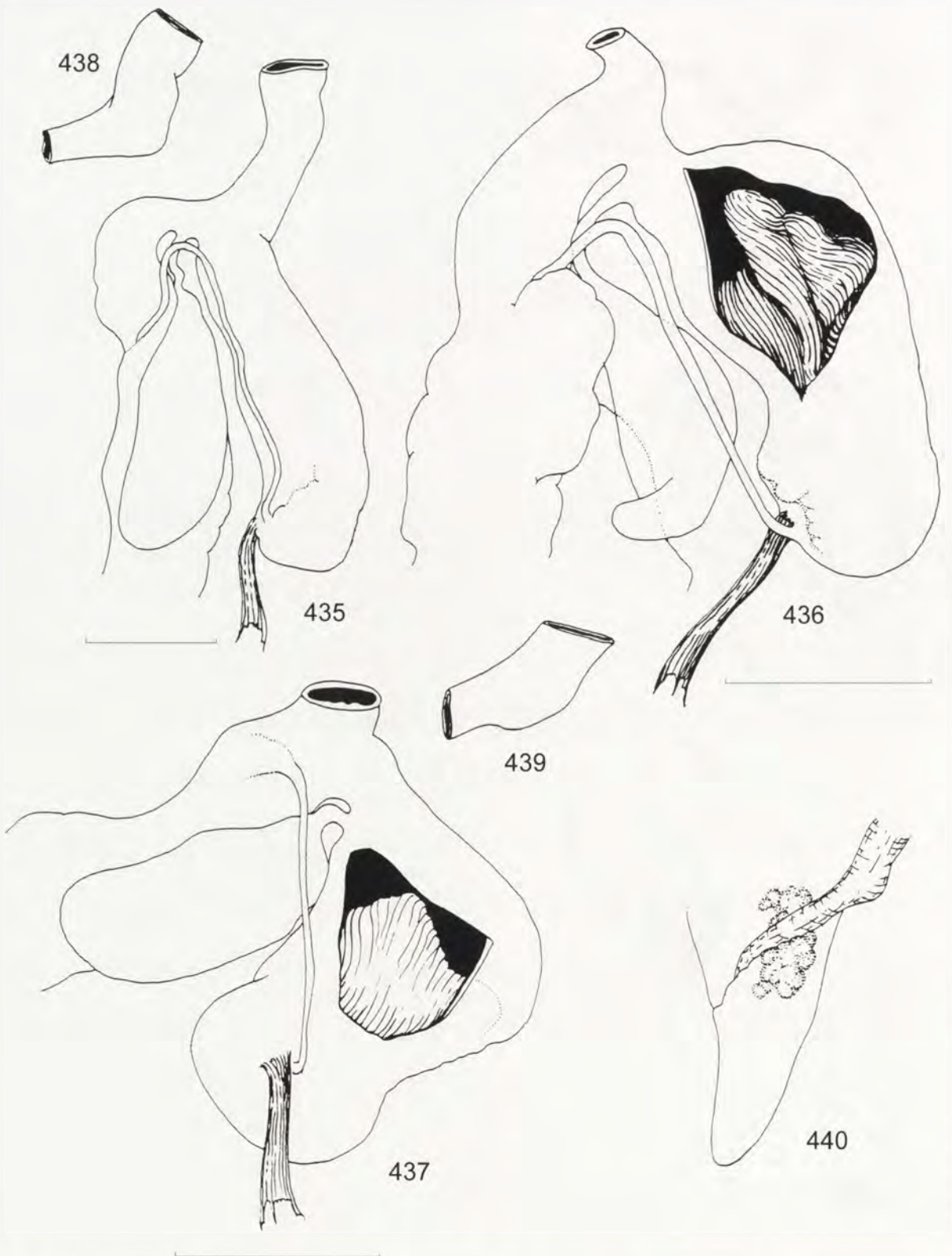
Body length 31 mm. Coloration mucky creamy or brown-creamy to dark grey with diffuse dark brown or blackish spots. No light streak in the middle of dorsum.

Genitalia (Fig. 444). Penis elongated, nearly cylindrical with a broad lateral appendix in its posterior part. Penial gland in the form of a tuft of unbranched processes (up to 9), set apically but asymmetrically on one side. Vas deferens opens also apically at the base of penial gland. Musculus retractor forked: one branch attached directly to penis, but on the opposite side relative to penial gland, the other insertion at the base of appendix. Stimulator in the shape of a short cone with a wide base.

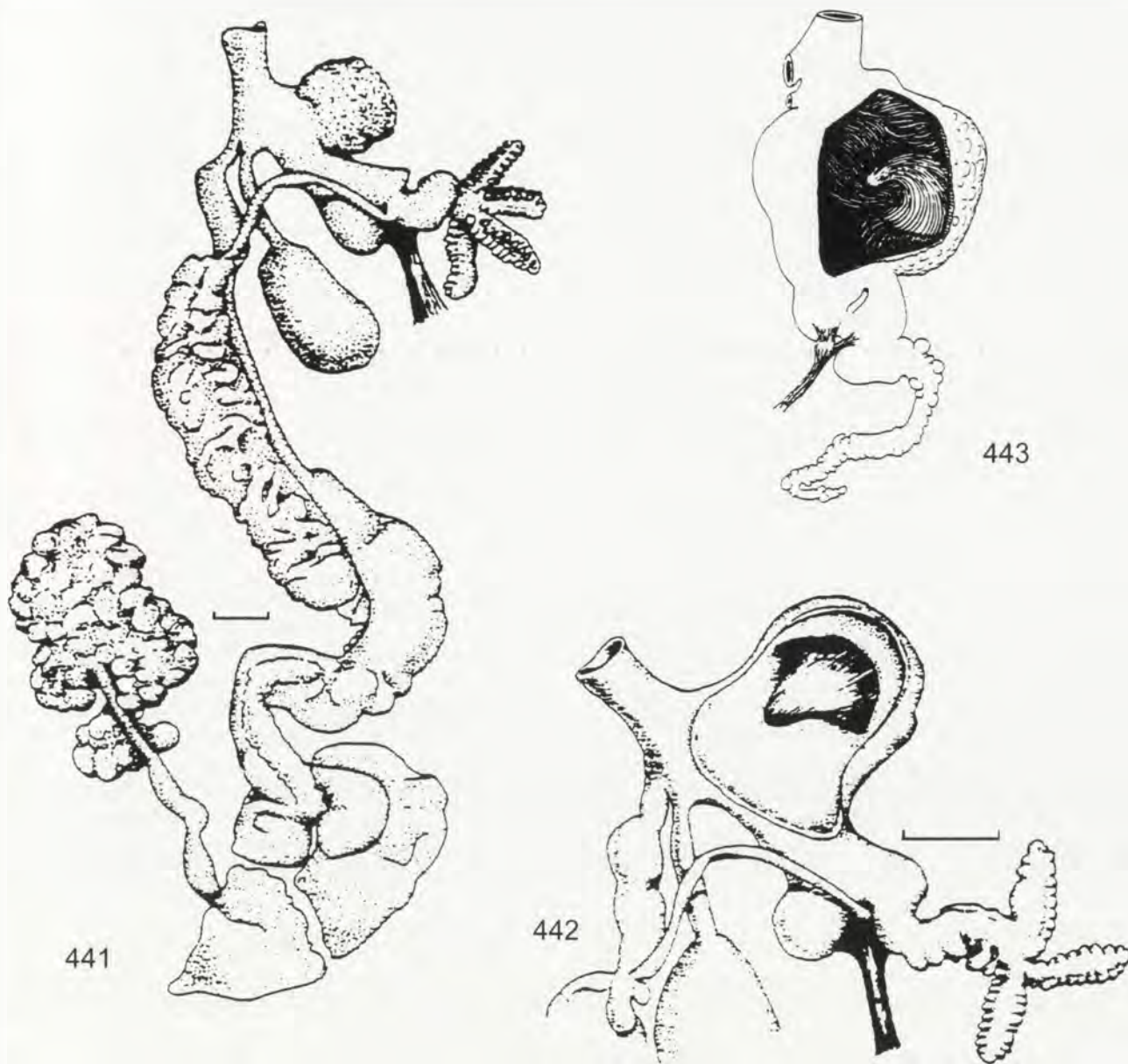
No distinct caecum on rectum; merely a small pocket-like enlargement.



Figs. 429–434. *Deroceras minoicum*. 429–430 – The holotype's copulatory organs and penis viewed from the other side. 431–432 – Stimulator inside penis in two paratypes. 433 – Rectum of the holotype. 434 – Rectum of a paratype. (After Wiktor *et al.* 1994)



Figs. 435–440. *Deroceras neuteboomi*. 435–437 – Copulatory organs. 438–439 – Rectum. 440 – Posterior section of viscera. (Orig.)



Figs. 441–442. *Deroceras nitidum*. 441 – Reproductive system. 442 – Copulatory organs. (After Casitillejo 1996)

Distribution. The slug is known only from the island of Skiathos (Greece).

Comments. The species bears some similarity to *D. korthionensis*.

***Deroceras (Deroceras) oertzeni* (Simroth, 1889)**

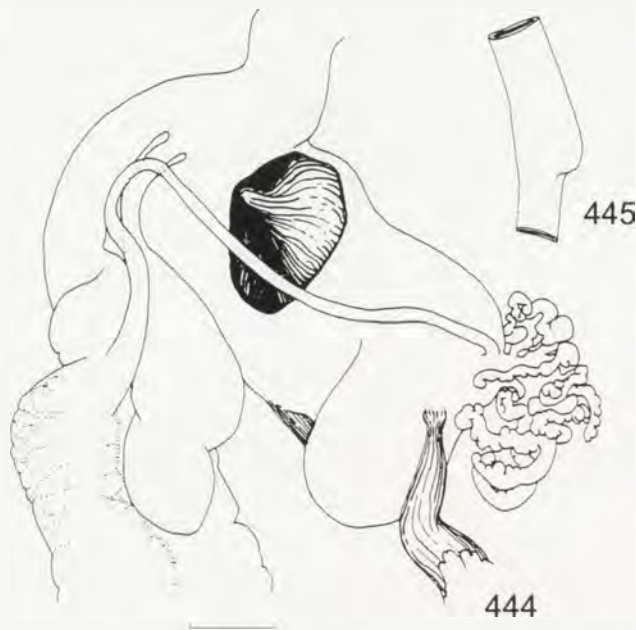
Agriolimax Oertzeni Simroth, 1889a: 17 figs. 3, 11–13. Locus typicus: Kowari Mt. (Andros Isl., Greece). Syntypi: probably do not exist.

Deroceras libegoti Reischütz, 1988: 350 figs. 2a–e, 3. Locus typicus: Therma (= Loutro, Samothráke Isl., Greece). Holotypus: NMW no. 84214.

References: Wiktor, Vardinoyannis, Mylonas 1994: 27 figs. 59–60; Wiktor – in print.

The largest specimens attain a length of 43 mm. The posterior body end perpendicularly fin-shapedly truncated. Uniform coloration of mantle, back and head: black or blackish; sides getting gradually lighter downwards. Sole creamy white.

Genitalia (Figs. 446–448, 450). Penis dark-pigmented, of complex structure. Its main part is strongly elongated, cylindrical in shape. Within the posterior part a roundish or oval lateral section is clearly distinguishable. At times it represents merely a heavy lateral distension. Roughly at 2/3 its length penis is joined by a long twisted appendix having a few swellings. This organ, like the posterior part of penis, varies in length depending on the individual. The two lengths



Figs. 444–445. *Deroceras nyphoni*. 444 – Copulatory organs. 445 – Rectum. (Orig.)

seem to increase with age. Appendix is so large that the whole makes the impression as if penis were bifurcate (!). On the apical end of the main penis section there is a tuft of long thin unbranched processes of penial gland. They are set directly on penis, which often narrows at the end, or there may be a kind of short common trunk of penial gland. The number of penial gland processes is 3–8. Vas deferens opens at the base of penial gland, i.e. laterally. Large musculus retractor penis is forked, its one strand attached to the main part of penis, immediately at the outlet of vas deferens, whereas the other to appendix in its posterior half or, in juveniles, near its rear end. Like inside appendix, in the anterior, laterally distended, fragment of penis striated folds are perceivable.

Caecum on rectum (Fig. 449) well-developed, its length varied between specimens. The organ is usually about twice as long as wide, but may be shorter, or, on the contrary, several times wider than long.

Distribution. Up until now the slug has been recorded from the Greek islands of Ándros, Tinos, Seriphos, Samothráke and Crete.

Comments. When examining the paratype of *D. libegoti* from the MIZ collection, I came to the conclusion that the specimen was an immature *D. oertzeni*. At present, however, it is difficult to ascertain whether the species is indigenous to Samothráke or introduced onto the island (Wiktor – in print).

Deroceras (Deroceras) osseticum (Simroth, 1901)

Agriolimax osseticus Simroth, 1901: 161 t. 14 figs. 22–26, map 6. Locustypicus: "Tkwibuli" (Tkwibuli, W Georgia). Lectotypus: ZIN.

Agriolimax subagrestis var. *minutus* Simroth, 1901: 158 t. 15 figs. 20–22 (pars).

References: Likharev and Wiktor 1980: 136 figs. 67–76; Wiktor 1994: 5 figs. 8–9.

Body length up to 40 mm. General coloration dirty creamy, grey-creamy or pale ochreous on the background of which there is a unique spotting pattern. The spots are black or blackish, large but of various size, sometimes fusing with one another. They occur on mantle and back, but the latter's medial section on the extension of keel remains light. The spotting, although difficult to describe, is so characteristic that the slugs attract immediate notice when among other representatives of the genus (Fig. 451). Another typical character observable in preserved specimens are white deposits of calcium inside skin but well-visible through it. They produce a pattern of white spots which may be arranged in longitudinal streaks.

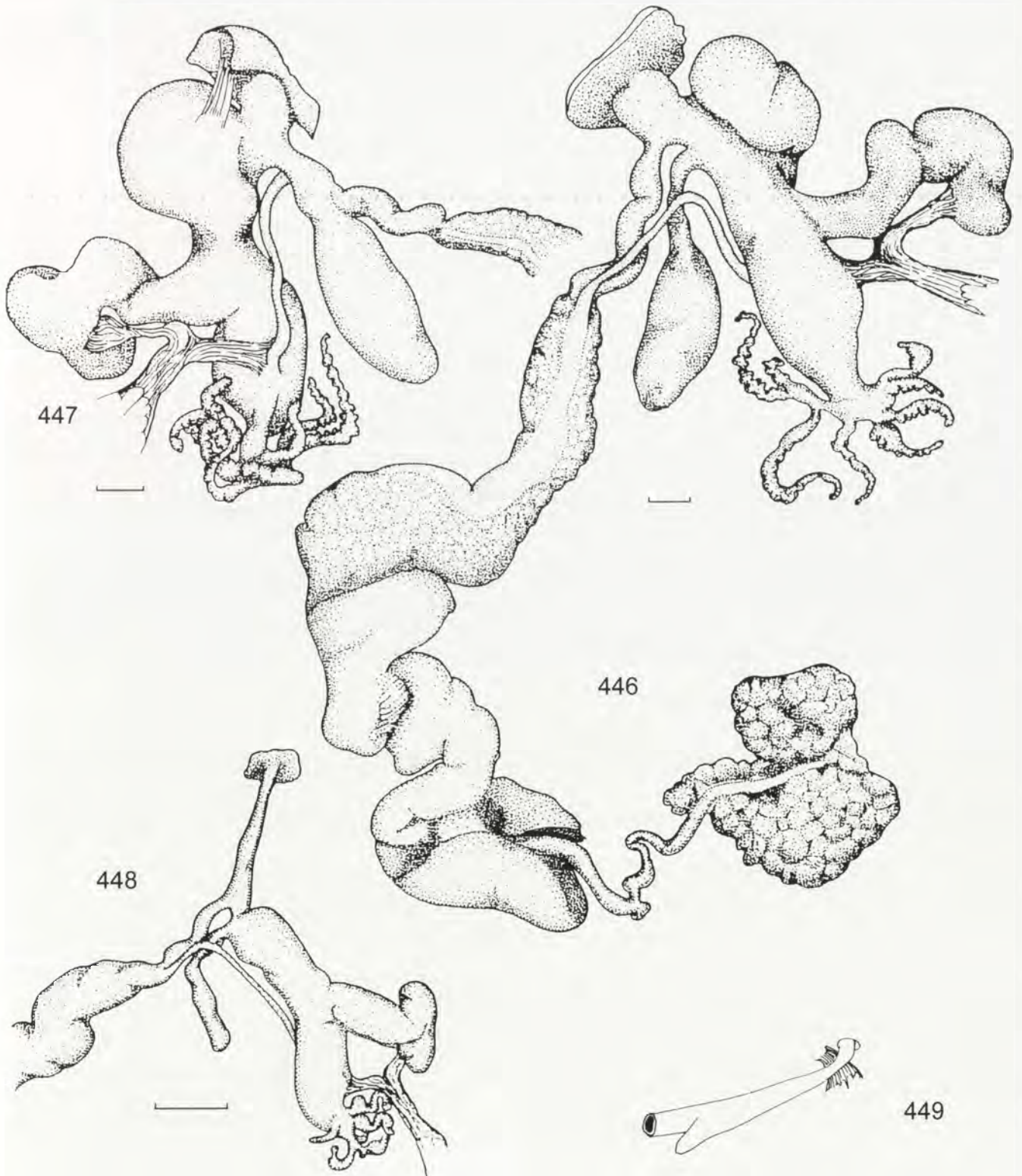
Genitalia (Figs. 452–456). Penis very large, occupying nearly 1/3 body length. Even though widely varied, its shape still diverges from the appearance of this organ in most species of *Deroceras*. It is more or less elongated, twisted, sometimes contracted to an oval. On its extension, and thus on its main axis, there is an appendix which is scarcely narrower and shorter than penis itself. It is usually bent, not infrequently folded in two, having a different shape depending on the individual. The bent parts of appendix are often connected together by a membrane. Penial gland, laterally set on penis, has a varying but characteristic appearance. It is composed of short, irregularly shaped processes set in a line on a common base or directly on penial wall. At the base of penial gland there is the opening of a thin and short vas deferens. Musculus retractor penis is branched, most commonly with three strands. The muscle is membranaceous, tightly adherent to penis. Its one insertion is situated close to penial gland, the second strand is attached to appendix and the third one at the latter's base. Inside penis there is a cone-shaped, but obtuse stimulator. Inside appendix a longitudinal fold.

Rectum long and straight with no typical caecum: at its place a shallow pocket (Fig. 457).

Ecology. The slug inhabits mainly deciduous and mixed forests (beech with an admixture of spruce or fir) and also open habitats of the subalpine zone. It hides under stones or in grass. In the region of Batum (= Batumi) it copulates and lays eggs in April and May. Both juveniles and sexually mature individuals live over winter.

Distribution. The species is known to occur in the western and partly the northern Caucasus (Teberda), western Transcaucasia up to Batum and Suramskij Hrebet. It has also been recorded (Wiktor 1994) from the region of Sürmene (Vil. Trabzon) in Turkey but may have only been introduced here.

Comments. With respect to external appearance and anatomical characters the species discussed slightly resembles *D. ilium*.



Figs. 446–449. *Deroceras oertzeni*. 446 – Reproductive system. 447–448 – Copulatory organs. 449 – Rectum. (Orig.)

?? *Deroceras (Deroceras) padisii* Lupu, 1969

Deroceras padisii Lupu, 1969: 434, 2 unnumbered figures. Terra typica: Apuseni Mts. (Roumania). Holotypus: NMGAB no. 13152.

I have failed to ascertain the status of this slug. Revising the information on the occurrence in Roumania of *D. caruanae* (Grossu and Lupu 1965), Lupu (1969) came to the conclusion that the slug concerned was actually a new, unknown, species, which she named *D. padisii*. Later she (Lupu 1971b) synonymized the names *D. transsylvanicus* and *D. pseudolytopelle* with *D. padisii*. In my opinion, the two taxa (*D. transsylvanicus* and *D. pseudolytopelle*) are synonyms of *D. turcicum*. I have got the impression that *D. padisii* will also prove to be synonymous with *D. turcicum*. Unfortunately, I have not managed to acquire for the purposes of examination the types of *D. padisii* deposited at the NMGAB, and the data in Lupu's (1969) paper along with the two figures included are unclear to me. On the other hand, the data and drawings of the slug available in the subsequent paper by this malacologist (Lupu 1971b) indicate that, in all likelihood, she dealt with *D. turcicum*. Since I have not succeeded to establish contacts with the Museum of Bucharest, I leave the problem of clearing up the status of *D. padisii* for further study.

Deroceras (Deroceras) pageti Grossu, 1972

Deroceras pageti Grossu, 1972a: 640 fig. 1. Terra typica: Taygetos Mts. (Greece). Holotypus: NMW no. 36025.

Deroceras (Agriolimax) laconicum Wiktor, 1984: 155 figs. 13–17. Locus typicus: Mistras (Peloponnesus, Greece). Holotypus: MNHW no. MP 476.

Deroceras saronicum Rähle, 1986: 130 figs. 1–6. Locus typicus: Palia Chora (UTM GG9180), Aiyina Isl. (Greece). Holotypus: NNML no. Moll. alk. 9180.

References: Wiktor – in print.

Body length up to 32 mm. Coloration of live slugs pinkish or grey, after preservation dorsum dirty creamy, greyish or blackish; sides whitish. Adult individuals are unicolor, juveniles – usually somewhat darker – sometimes with a still darker spotting.

Genitalia (Figs. 458–460, 462–463, 465). Penis heavily distended in its anterior part, usually asymmetrical. The posterior section of this organ is shorter, markedly narrower and cylindrical, sometimes with small swellings and a short, transversely set, conical appendix. Without a distinct border, the rear end of penis turns into a large penial gland, situated on the longitudinal axis of penis and apically connected with this organ. The gland, which constitutes a natural extension of penis, is very long, sometimes as long as penis itself (!). It consists of a long trunk and two, still longer processes that often have a few small and short offshoots each. Vas deferens opens on the top of a small cone-shaped appendix (!), which is a very typical character. A single retractor penis attached at the base of appendix. Inside penis a conical stimulator.

Caecum on rectum short but distinct (Figs. 461, 464).

Distribution. The slug is known exclusively from Greece: Peloponnesus (mainly its southern part) and the islands of Aiyina and Levkas.

Comments. The figures and description by Grossu (1972) are imprecise, which resulted in two synonyms coming into existence. It was a comparison of the types that enabled to synonymize the two junior names (see Wiktor – in print).

Deroceras (Deroceras) panormitanum
(Lessona et Pollonera, 1882)

Agriolimax panormitanus Lessona et Pollonera, 1882: 52 t. 1 fig. 5, t. 2 fig. 12. Locus typicus: Palermo (Sicily, Italy). Typus: I have no information.

?*Limax queenslandicus* Hedley, 1888: Proc. R. Soc. Qld. 5(4): 150 (after Altena and Smith 1975: 71).

Agriolimax Pollonerae (= *Pollonera*) Simroth, 1889b: 179 figs. a–c. Locus typicus: Palermo (Sicily, Italy). Typus: no information.

Agriolimax Caruanae Pollonera, 1891: 3 fig. 2. Terra typica: Malta. Neotypus (design. Giusti and Manganeli 1990): SMF no. 165018A. See Giusti and Manganeli 1990: 236.

Agriolimax Ceccanti Pollonera, 1896: 6 fig. 4. Locus typicus: Vallebrosa (Italy). Typus: no information.

Agriolimax ceccanti var. *ilvatica* Pollonera, 1905: 3 (after Giusti 1976: 219).

?*Agriolimax Scharffi* Simroth, 1910b: 326. Locus typicus: Rojatalle valley near La Giandola, (Alpes Maritimes, France). See Bodon, Boato, Giusti 1982: 54.

Deroceras meridionale Reygrobelle, 1963: 399 and 4 unnumbered figures. Terra typica: Bouches-du Rhône and Basses-Alps (France). Typus: no information.

References: Giusti 1973: 206, 1976: 218; Van Goethem 1974: 3 figs. 1–7, 10–14, 16, 19, 21–28, t. 1 figs. 1–6; Seixas 1978: 6 fig. 1; Wiktor 1983: 169 figs. 85–88; Van Goethem and de Wilde 1985: 305; Giusti *et al.* 1985: 98 figs. 6A–E, t. 6 figs. C–E; Giusti 1986: 57 figs. 1–3; de Winter 1988: 109; Giusti *et al.* 1995: 284 figs. 243–247; Wiktor, Vardinoyannis, Mylonas 1994: 28 figs. 61–65; Reise and Backeljau 1994: 71 fig. 2; Castillejo, Garrido, Iglesias 1995: 7 figs. 8–14; Wiktor – in print.

Body length up to ca 35 mm. Coloration varied: most frequently the general coloration is dirty creamy or pale brown nearly always with a dense dark spotting. Less commonly the slug is uniformly blackish (specimens from Bulgaria, Wiktor 1983), dark brown or chocolate. Reddish and violetish individuals are also found (Figs. 466–468). Sole of the dark-coloured forms has its lateral zones darker, the medial one pale. Mucus colourless and rare.

Genitalia (Figs. 469–483, 486–490, 493–495). Regarding the structure of penis and its appendages, the species is characterized by a great inter- and intrapopulation variability. Penis is irregular in shape, anteriorly unilaterally distended, the surface of the distended part abounding with glands. The posterior section of penis in the form I refer to as typical is slightly narrower and equipped with two, roughly equal in size, appendices directed posterad. Between them penis is nearly apically joined by penial gland which is made of a tuft of unbranched processes set on a common shaft. Musculus retractor penis bifurcate, its strands each inserted at the bases of appendices. Inside penis there is a cone-shaped stimulator.

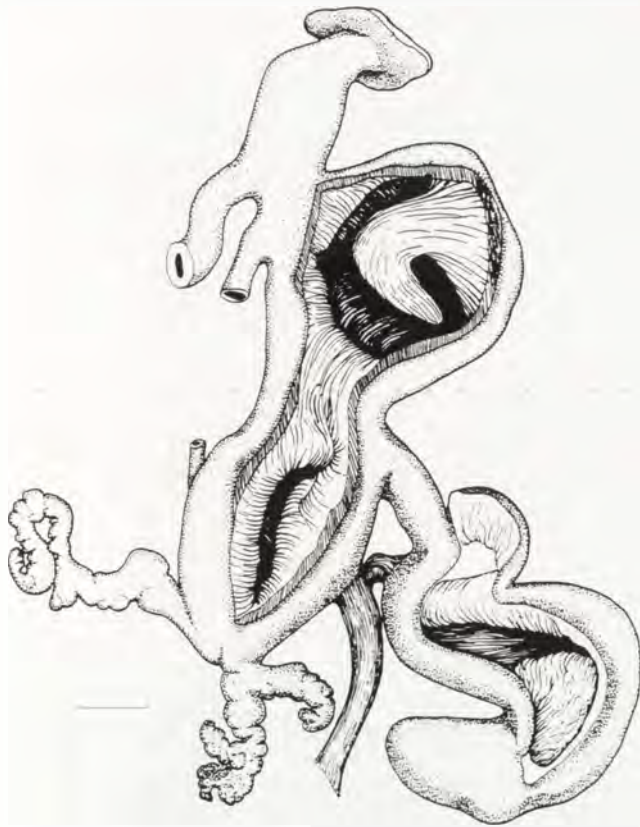


Fig. 450. *Deroceras oertzeni* – structures inside penis. (Orig.)

Apart from the typical form, one may encounter whole populations or single specimens having their appendices reduced to different degrees. The reduction may concern one of these processes which is then shorter or represents merely a distension. Both processes can also undergo reduction and then the posterior part of penis is irregularly shaped or resembles a kidney with its ends facing posterad. Penial gland may be of varied appearance as well. The number of processes may be reduced (sometimes even to a single one) but they are proportionally larger and broader instead. Musculus retractor penis usually retains its bifurcation but, in connection with the reduction of appendices, it may be affected by partial reduction too. As a result, it may be asymmetrical, or even single, its insertions being variously situated. In shape stimulator most commonly resembles a regular cone; only in black specimens from Bulgaria (Wiktor 1983) the organ is flattened having a wide apex.

Caecum on rectum always distinct but short (Figs. 484–485, 491–492, 496).

Ecology. *D. panormitanum* seems to be a lowland species. It inhabits widely varying habitats, both open ones and thickets of shrubs or different cultivations, preferably in the neighbourhood of rivers and springs. It hides under stones and pieces of wood.

Distribution. Presumably, *D. panormitanum* was originally a Mediterranean species. Thanks to its wide adaptive capabilities, the slug has spread over a vast area

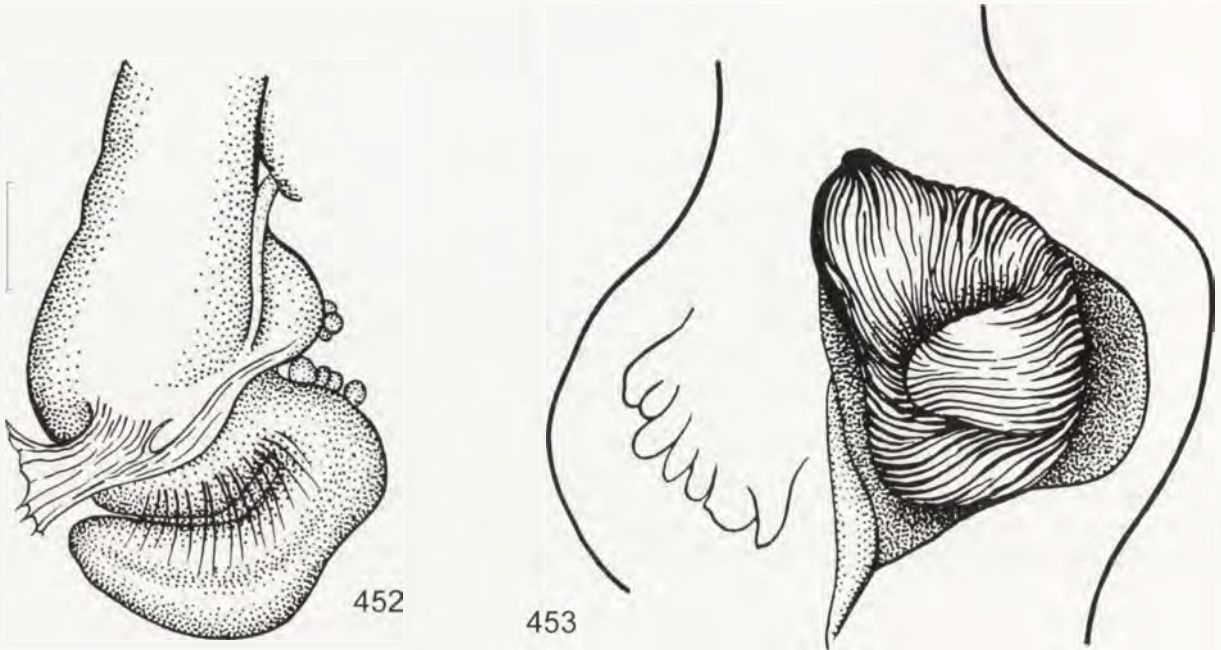
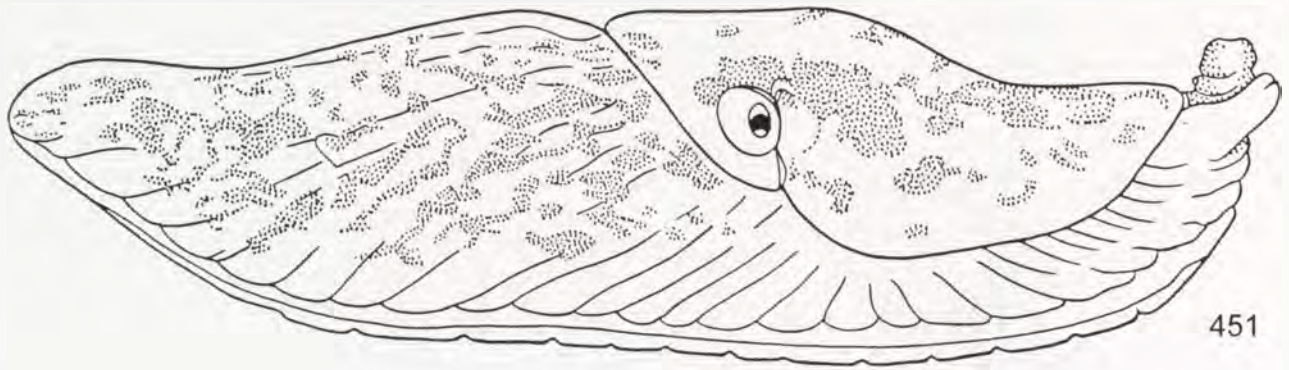
and is probably still in expansion as a synanthrope. It often occurs insularly and is found in unexpected places. Its continual distribution range covers areas of Europe adjacent to the Mediterranean Sea and the Mediterranean islands from Greece to Spain. In the latter country and France the species penetrates deep into the continent. It moves eastwards and, as a synanthrope, starts to colonize Central Europe. It also inhabits the British Isles and has some localities in Scandinavia.

Comments. *D. panormitanum* is an exceptionally variable slug. This problem is widely discussed by Giusti (1976, 1986), Giusti, Manganelli, Schembri (1995) or Van Goethem and de Wilde (1985). The great variability of the slug has brought about a clash of opinions concerning the synonymy and acknowledgement of one taxon or a complex of species. The issue is not easy due to *D. panormitanum* having spread to numerous isolated localities both on Mediterranean islands and the continent, where in many regions it has been introduced. Further research, e.g. biochemical, should be expected to settle the matter. On the basis of sole morphological studies, only enormous, both individual and populational, variability within one species seems to be concerned in this case.

The variability range of *D. panormitanum* is probably the highest in the whole family, exceeding even those of *D. reticulatum* and *D. turcicum*. It concerns penis and its different structures. Above I used the term "typical". It is difficult to establish, however, what a typical character is, the more so that different ones were considered typical when particular synonyms were being coined. If we assume there is a general tendency towards reduction of penial appendages, then the typical form will be that equipped with all the organs well-developed.

The variability pertains in the first place to appendices, that in the external appearance (size and coloration) being less pronounced. Most frequently the body is dirty creamy and dark-spotted but the slug can also be evenly coloured, i.e. blackish. One may find whole populations with both appendices being well-developed, and then penial gland is situated between them. When the appendices are reduced to various degrees, penial gland is often connected with a vestigial appendix. The appendices may also be reduced to inconspicuous swellings. Finally, the slugs occurring for instance on Sicily have one appendix practically entirely reduced whereas the other, when seen from the rear, forms a semicircular roll that at the same time constitutes the apical end of penis (Figs. 479–483, 486–490). In the posterior penis part a dark blot may be present. Penial gland has a varied number of branches, which are usually single, i.e. unbranched, and always arranged in a tuft. Musculus retractor penis may have one insertion or be forked, in the latter case its strands are attached to the bases of appendices.

Also the stimulator, which is always cone-shaped, assumes a different appearance. It may be a small cone, of a length scarcely exceeding the width of its base, and be directed anterad, or be (see Fig. 490) very narrow, nearly



Figs. 451–453. *Deroceras osseticum*. 451 – Lateral view of the slug. 452 – Penis. 453 – Stimulator inside penis. (After Likharev and Wiktor 1980)

equalling the length of penis and directed posterad, additionally having its end bent. The organ may be white or wholly blackish-pigmented.

In the Piryn Mts., Bulgaria, an isolated and very uniform population occurs. All the specimens there are evenly blackish. Their penis is provided with two bent appendices, penial gland has a digitate process and no papillae, stimulator always assumes the shape of a strongly flattened irregular cone (!) (Figs. 493–495).

See also Comments to *Deroceras golcheri* p. 444 and *Deroceras dallaii* p. 431.

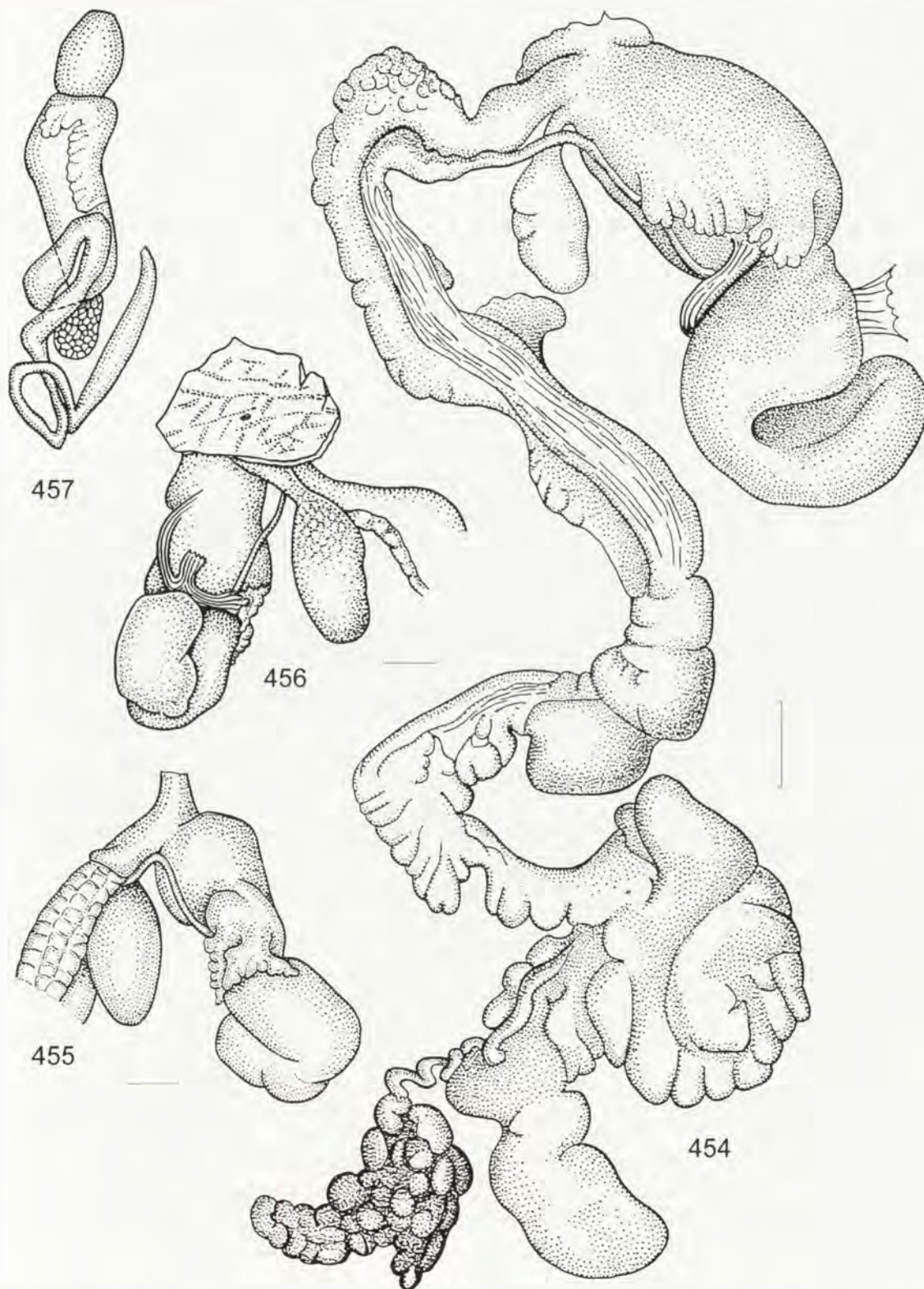
***Deroceras (Deroceras) parium* Wiktor et Mylonas, 1981**

Deroceras parium Wiktor et Mylonas, 1981: 187 figs. 19–24. Locus typicus: Ag. Pantès (Paros Isl., Greece). Holotypus: MNHW no. MP 465.

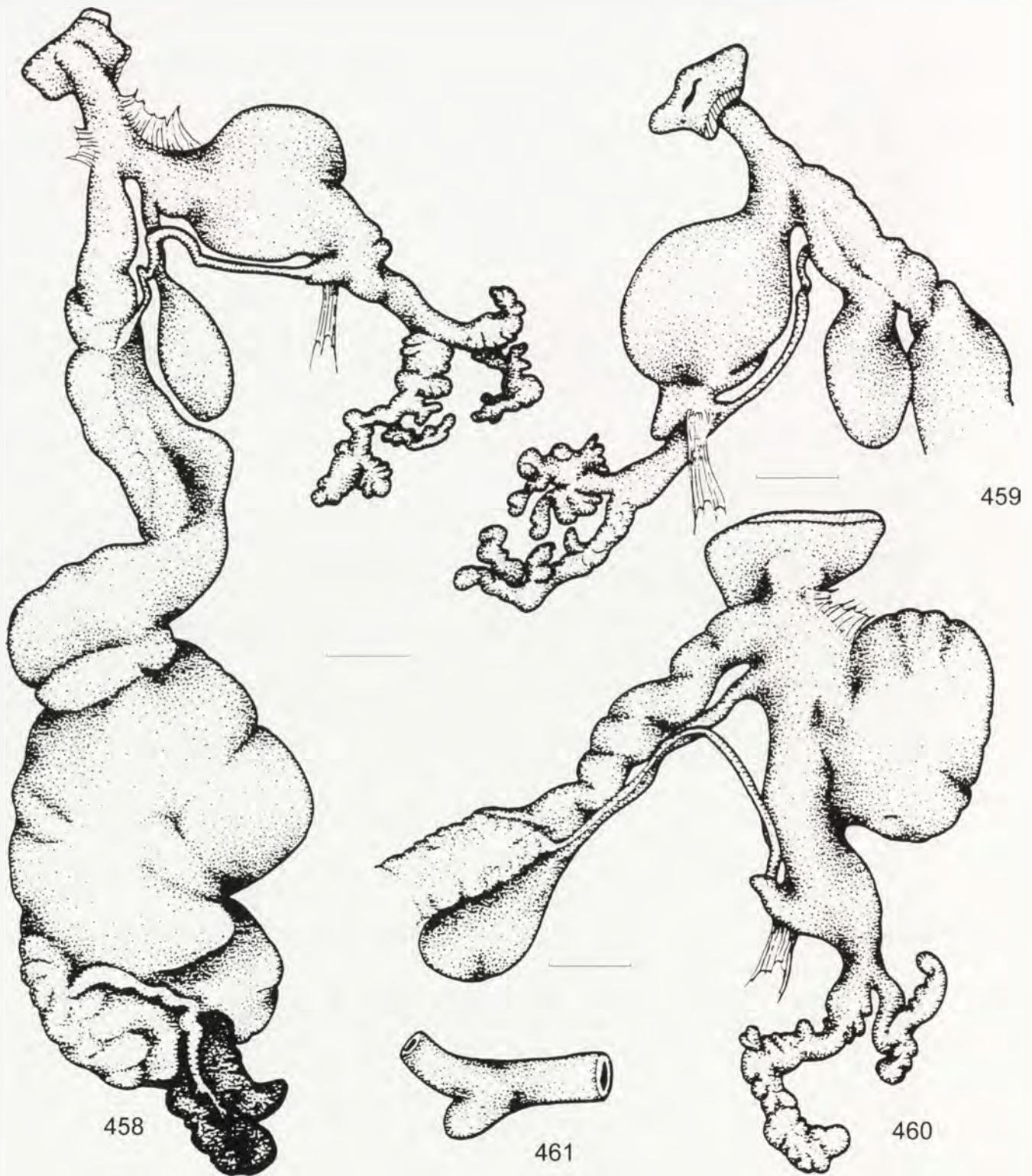
References: Wiktor 1999 – in print.

Body length up to 20 mm. Coloration from brownish creamy with dense chocolate-brown blurred spots to blackish with such a dense spotting that the slug makes the impression of being unicolour. Only the lower parts of sides are paler (Figs. 497–498). In dark specimens also the lateral zones of sole are dark.

Genitalia (Figs. 499–500, 502). Penis divided in two parts by a very deep lateral indentation. Anteriorly, its one side is very strongly distended, sometimes the distension looking like a separate additional organ. The rest of penis is narrow but with another, slight, lateral swelling. The narrow posterior part of penis continually, i.e. without a distinct border, turns into penial gland. The gland not only constitutes a prolongation of penis but is situated on its longitudinal axis. It is a thick, undivided organ with irregular, fairly



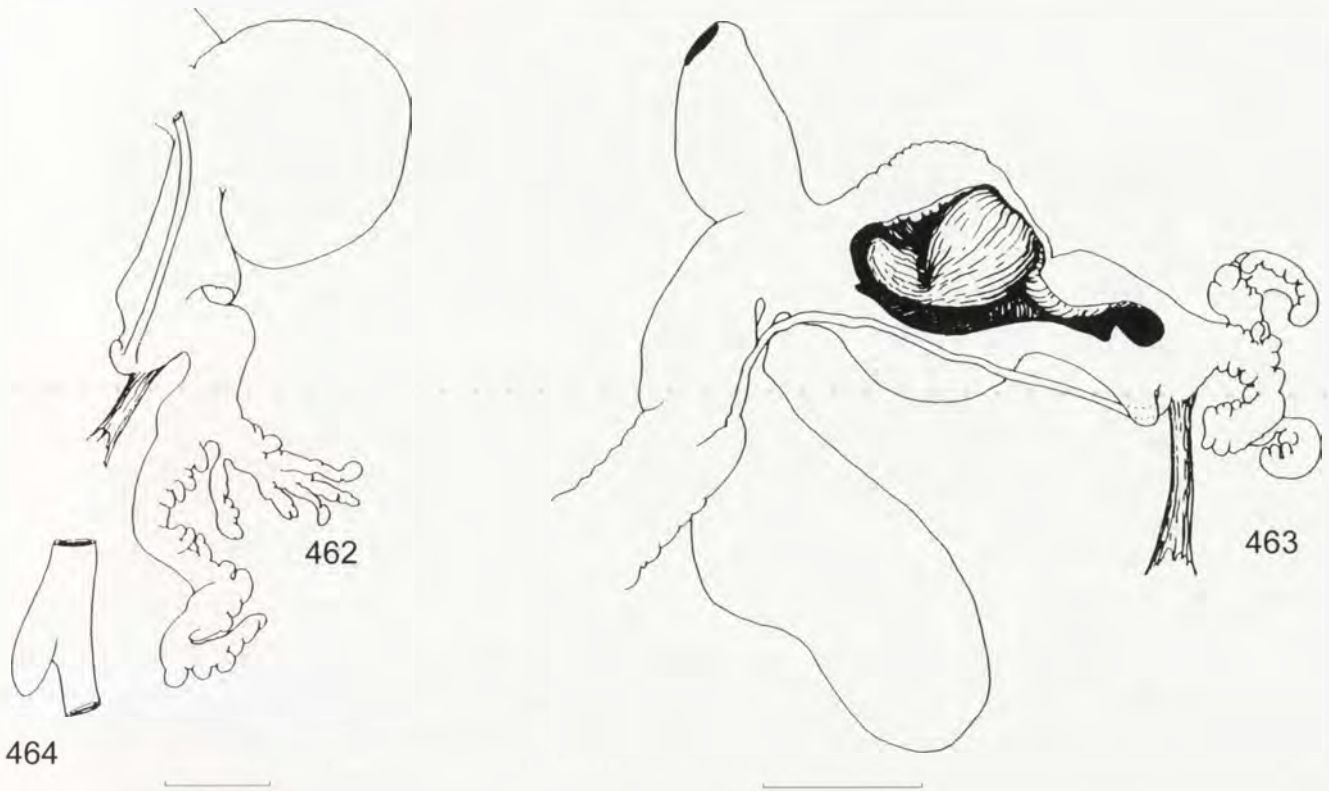
Figs. 454–457. *Deroceras osseticum*. 454 – Reproductive system. 455–456 – Copulatory organs. 457 – Alimentary canal. (After Likharev and Wiktor 1980)



Figs. 458–461. *Deroceras pageti*. 458 – Reproductive system. 459–460 – Copulatory organs. 461 – Rectum. (After Wiktor 1984 – as *D. laconicum*)

large papillae on the edges. Vas deferens opens at the base of penial gland. Unforked musculus retractor penis is

attached laterally to the posterior part of penis in the region of the above mentioned smaller swelling. In the anterior,



Figs. 462–464. *Deroceras pageti*. 462 – Penis of the holotype. 463 – Copulatory organs. 464 – Rectum of the holotype. (Orig.)

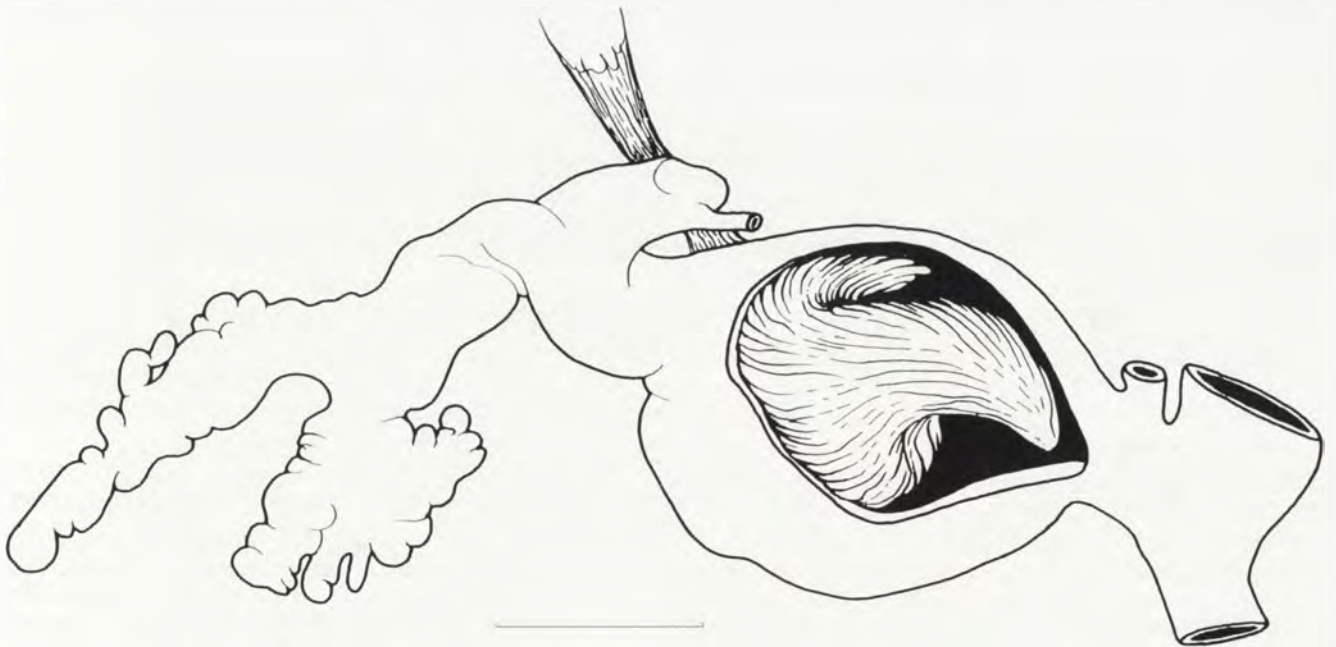
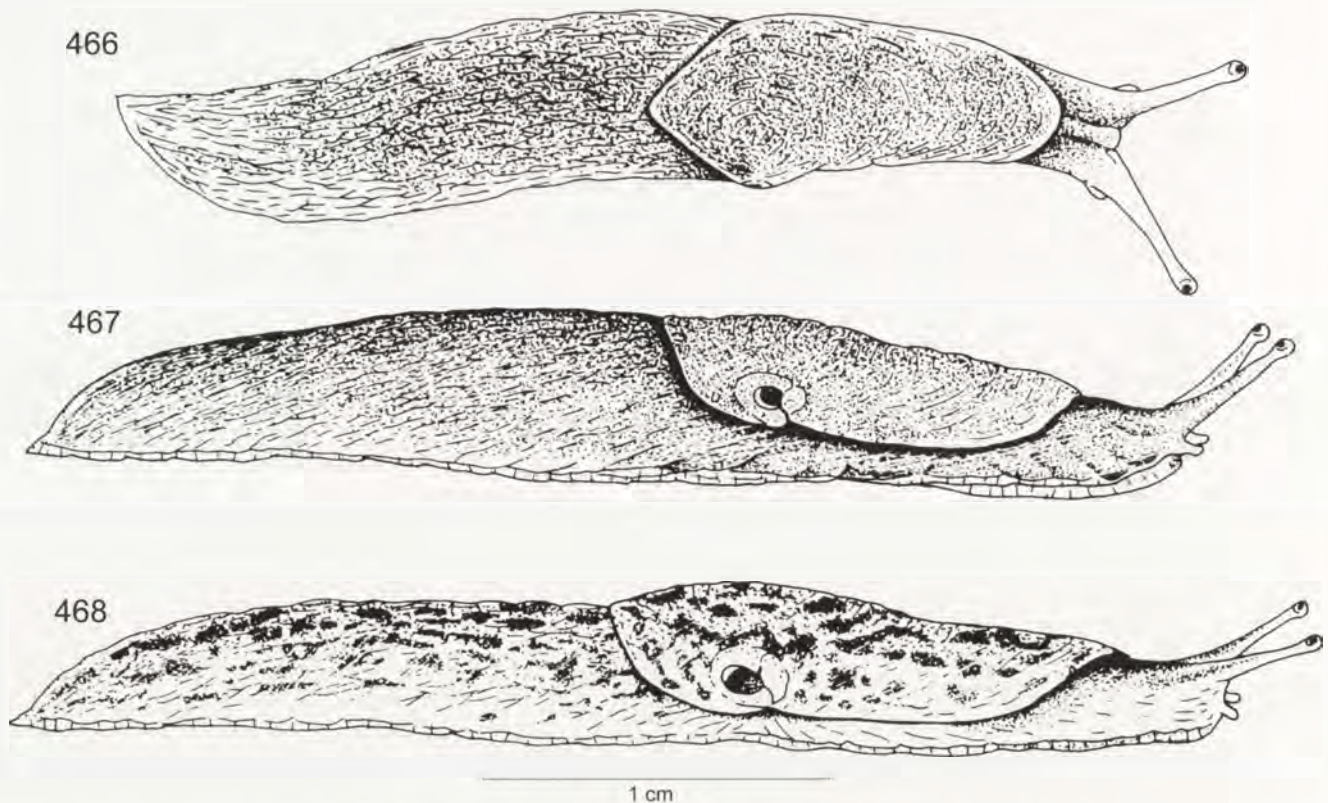


Fig. 465. *Deroceras pageti* – penis. (After Wiktor 1984 – as *D. laconicum*)



Figs. 466–468. *Deroceras panormitanum* – external views. (After Giusti *et al.* 1985)

distended, section of penis there is a huge, completely flat stimulator with two elongated ends, resembling the caudal fin of fish.

Caecum on rectum in the shape of a vestigial enlargement (Fig. 501).

Distribution. Greek islands of Paros, Naxos, Antiparos, Amorgos.

Deroceras (Deroceras) parnasium Wiktor, 1984

Deroceras (Agriolimax) parnasium Wiktor, 1984: 159 figs. 18–22. Locus typicus: N of vill. Arakhova (= Arahova, Parnassos Mts, Greece). Holotypus: MNHW no. MP 474.

References: Wiktor, Vardinoyannis, Mylonas 1994: 31 figs. 66–70; Wiktor – in print.

Length up to 28 mm. Body slender, its hind end vertically truncated. Skin thin and soft. Except for sole, the whole animal is evenly black or blackish. Sole's lateral zones grey, the medial one whitish.

Genitalia (Figs. 503–505). Penis S-shapedly curved. In its anterior part a lateral distension with clearly visible glands on the surface. The posterior, bent, fragment (the last section of the S) forms a transversely situated pocket or simply an appendix, their surface goffered (!). Penial gland consists of 3–5 short unbranched processes, accreted at the base and directly connected with penis. The gland is set more or less apically, i.e. on the posterior penis end. Vas

deferens opens laterally, more anterad relative to the goffered pocket. Retractor penis inserted somewhat laterally but at the apical end of penis, as close as the region of the lateral pocket. Inside penis a conical stimulator but there is no fold that in most *Deroceras* species runs posterad (!).

Rectal caecum well-developed (Fig. 506).

Distribution. The species has been known exclusively from Greece, recorded from Makedonia and Tessaly (Pilio and Parnassos Mts.) on the continent, and from Antikythira Isl.

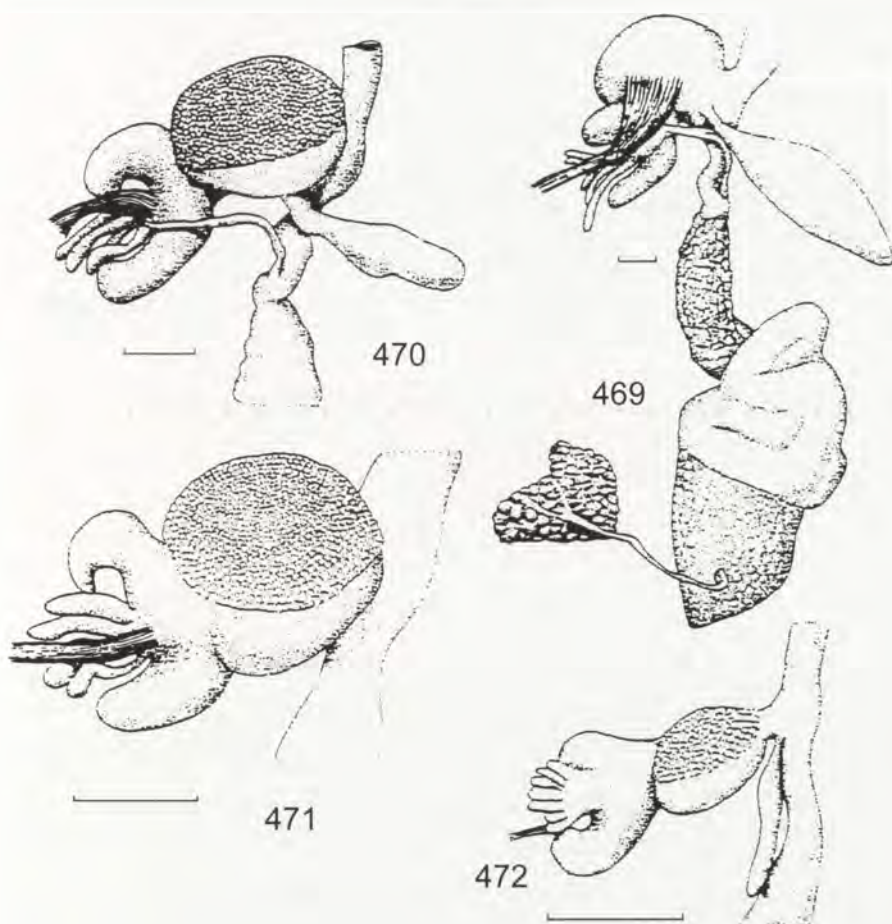
Comments. The variability range of this slug is unknown. Wiktor *et al.* (1994) draw attention to certain differences between the typical specimens and those from Antikythira Isl. The latter ones are slightly larger, paler (blackish), have a clear appendix and the posterior section of penis with a more pronounced goffering.

Deroceras (Deroceras) planarioides (Simroth, 1910)

Agriolimax planarioides Simroth, 1910b: 326 t. 24 figs. 21A–B. Terra typica: SE Alps (Riva – Trentino, Recoaro, Cansiglio – ?Alpi Veneziane, Italy). *Agriolimax rivanus* Wagner, 1931: 199 (no figures). Locus typicus: Riva, Strada ponale (?). Syntypus: NMW no. 19165.

References: Wagner 1936: 221 fig. 1; Allena 1967: 22 figs. 1a–c; Wagner 1937: 388 fig. 17; Wiktor and Milani 1995: 157 figs. 9–14.

Length up to 19 mm. Body slender, usually deeply black with a navy blue shade, or dark chocolate, sides becoming



Figs. 469–472. *Deroceras panormitanum* – genitalia of specimens from the Iberian Peninsula. (After Castillejo et al. 1965)

gradually lighter downwards. Sole in the mid-section creamy, the lateral zones being darker, i.e. blackish or brownish. Mucus colourless in a crawling slug, milky when the animal is irritated.

Genitalia (Figs. 507–510). Penis of irregular shape, anteriorly often distended. The posterior, narrower, part of the organ asymmetrical, usually with a lateral, pocket-shaped, most commonly transverse appendix of varied size. Penial gland connected with penis apically on the opposite side relative to appendix. The gland is composed of two, usually varying in size, unbranched processes accreted at the base and directly joining penis (without a shared truncus). Vas deferens opens laterally in the neighbourhood of penial gland, where a dark blot is often present. Inside penis a medium-sized conical stimulator.

On rectum a very shallow caecum (Figs. 511–512).

Ecology. A definitely hydrophilous slug, very agile, occurring near water – at springs, streams and other types of small mountain water reservoirs. It is recorded from an altitude of 800–1900 m a.s.l.

Distribution. Italian Alps (Prealpi Giulie, Carnia Trento, ?Trentino), south Tirol.

Deroceras ponori Lupu, 1972

Deroceras ponori Lupu, 1972a; 97 pl. V figs. 49–54. Locus typicus: Ponoare (Padiş – Roumanian West Carpathians). Holotypus: NMGAB no. 13190.

The description after Lupu (1972a).

Body stout, 20–30 mm in length. General coloration pale yellow with dark dots which may form a reticulum behind mantle. Sole unicolour. Mucus colourless.

Genitalia (Figs. 513–518). Penis oval, in some specimens medially constricted. Penial gland composed of 2–5 digitate branches, some of which in the shape of small buds. Each branch is separated from the other ones. Stimulator defined as triangular, which undoubtedly means “conical”.

Caecum on rectum large, constituting nearly a half of the whole length of viscera.

Distribution. According to the available information, the species is known only from locus typicus (Grossu 1983).

Comments. Regrettably, I have not examined the slug personally; I have failed to loan the types, my request left unanswered. Judging by the description, *D. ponori* will most probably have to be acknowledged as a synonym of *D. turcicum*. A similar opinion was expressed by Likharev and Wiktor

(1980). Lupu (1972a) maintains that the connection of penial gland processes immediately with penis is a character making the slug a distinct species. However, like the remaining characters discussed in the description, this one is observed in *D. turcicum* as well.

Deroceras (Deroceras) ponsonbyi (Hesse, 1884)

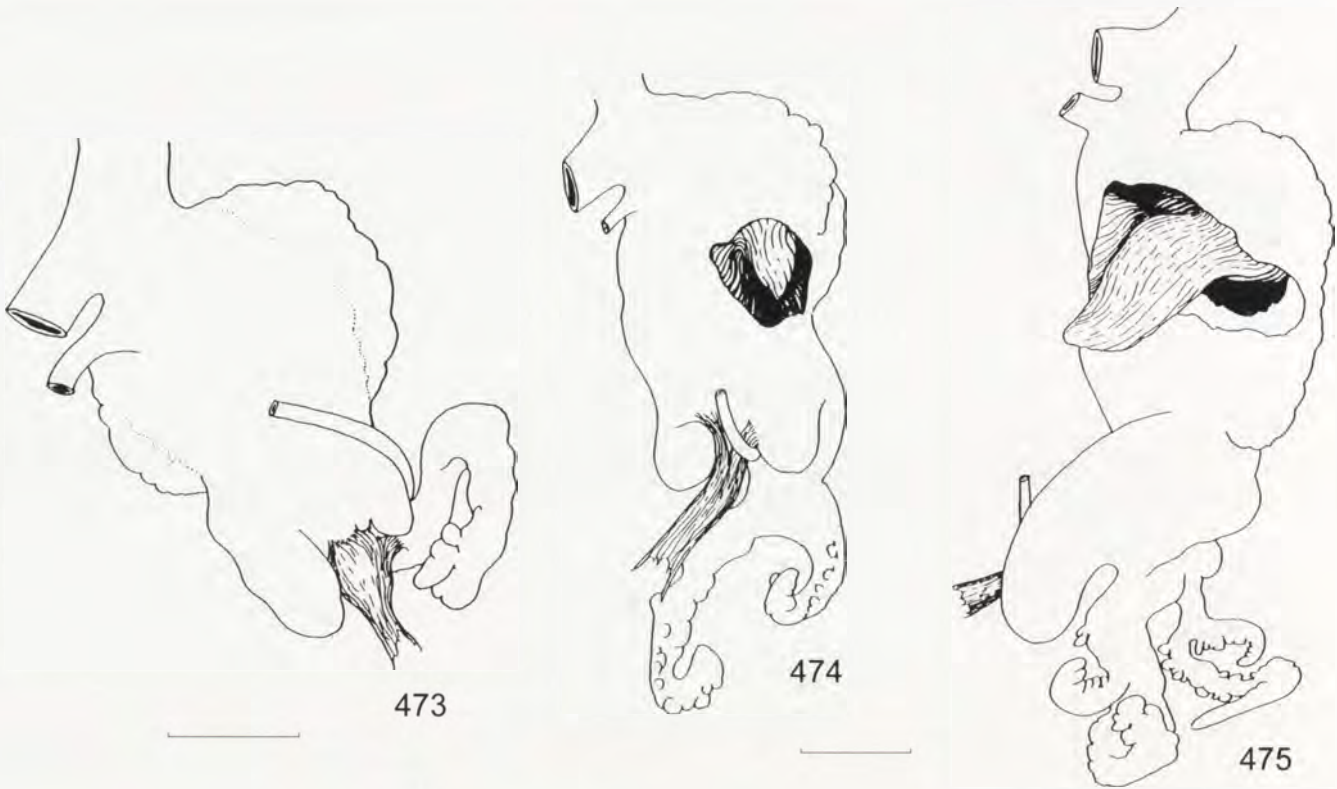
Limax (Agriolimax) Panormitanus Less. et Poll. var. *Ponsonbyi* Hesse, 1884: 12. Locus typicus: Gibraltar.

Deroceras (Malino) ponsonbyi: Norris 1977: 170 fig. 2.

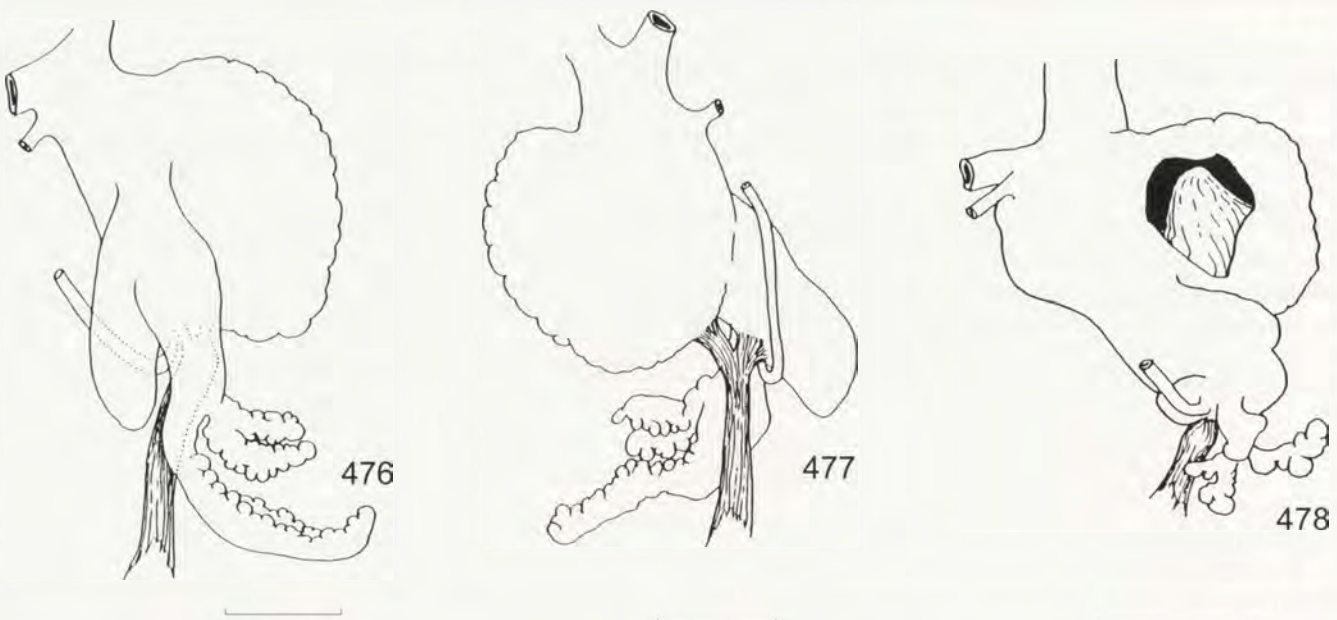
References: Wiktor 1983: 164; Castillejo, Garrido, Iglesias 1995: 14 figs. 21–26; Castillejo 1996: 25 figs. 1–9; Castillejo 1997: 165 figs. 3–4.

Hesse's (1884) description concerns a juvenile slug 14 mm long. The author compares it with *D. panormitanum* from Sicily, stating that the specimens from Gibraltar were paler in colour and covered by fine black dots. The anatomy is not discussed, however; there are no figures either. I have got no information about the types.

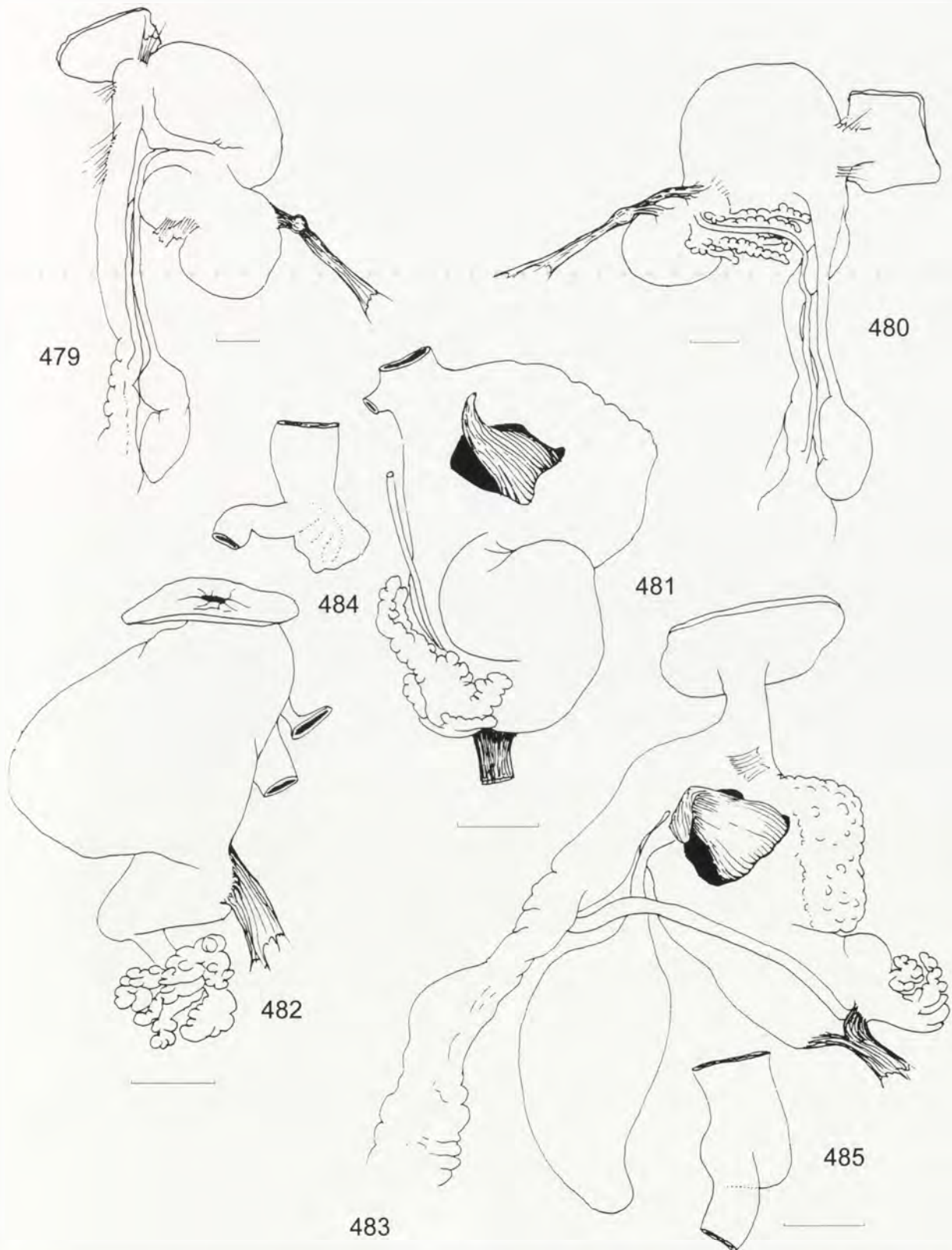
Norris (1977) mentions a slug from Gibraltar, calling it *D. ponsonbyi*. According to this malacologist, the species bears the following characters:



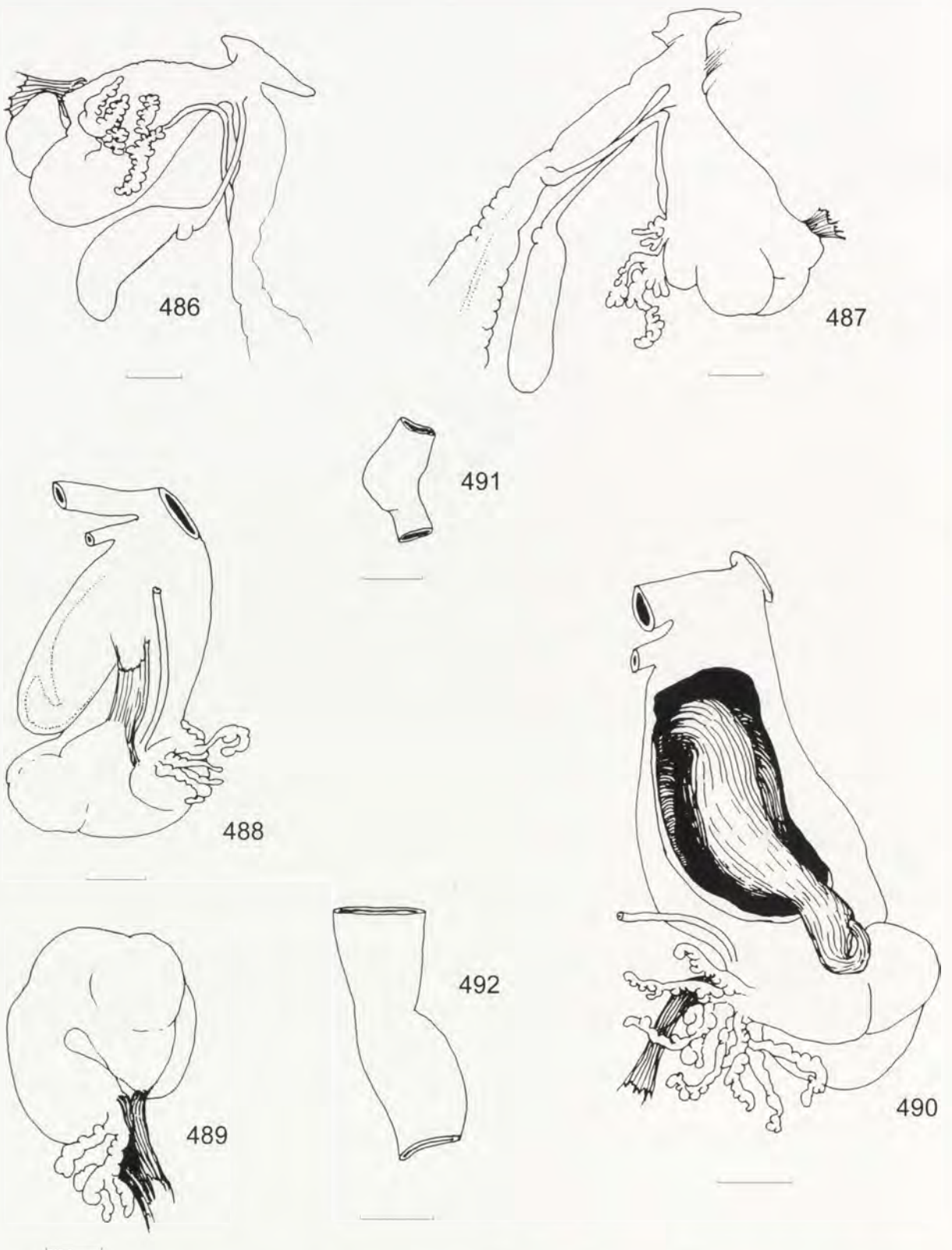
Figs. 473–475. *Deroceceras panormitanum* – penises of specimens from Greece. (Orig.)



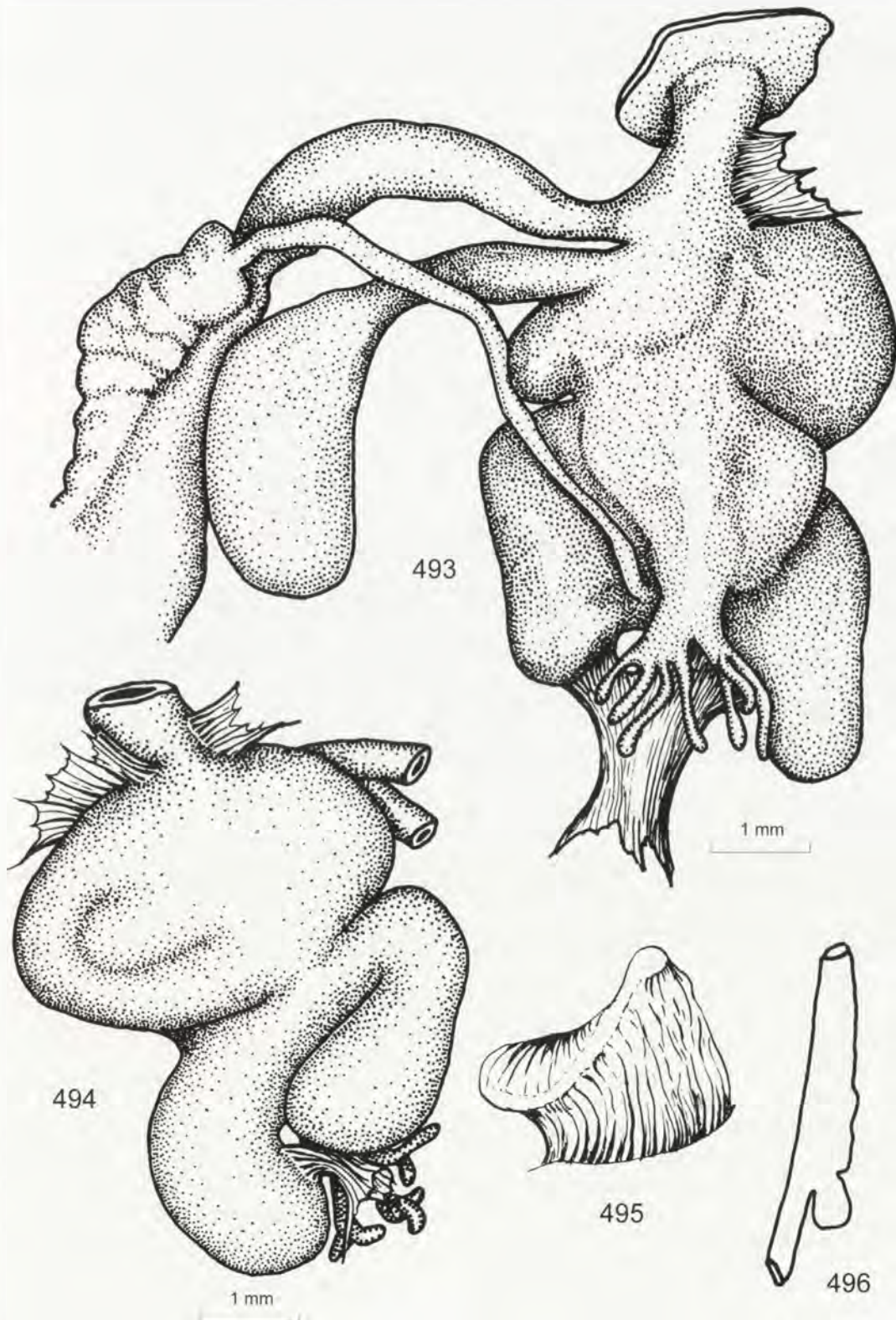
Figs. 476–478. *Deroceceras panormitanum* – penises of specimens from Greece. (Orig.)



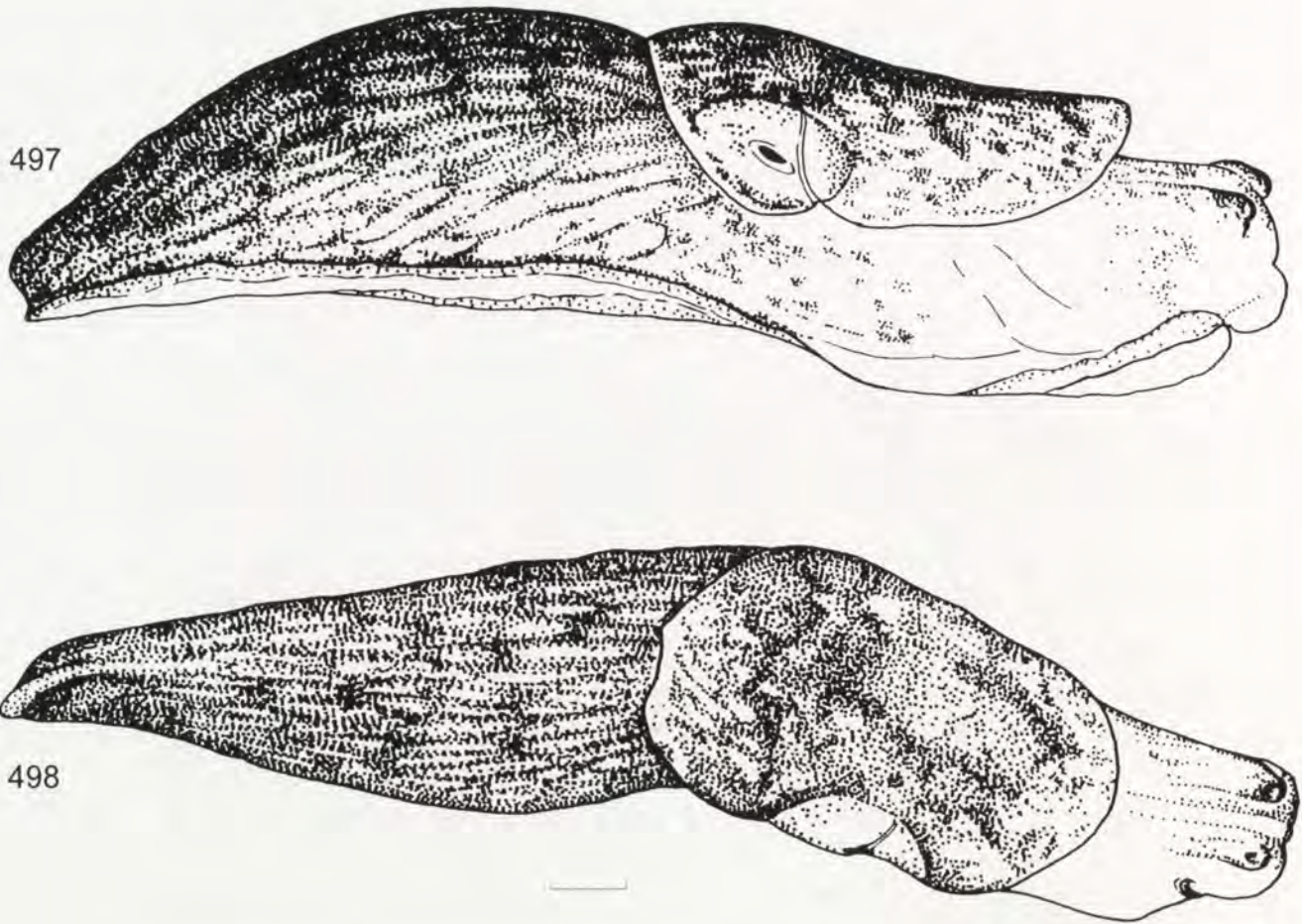
Figs. 479–485. *Deroceras panormitanum* from a few localities on Sicily. 479–480 and 482–483 – Genitalia viewed from two opposite sides. 481 – Penis. 484–485 – Recta of the same specimens as in Figs. 479 and 483. (Orig.)



Figs. 486–492. *Deroceras panormitanum* from a few Sicilian localities. 486–487 – Copulatory organs. 488–490 – Penis. 491–492 – Recum. (Orig.)



Figs. 493–496. *Deroceras panormitanum* from Bulgaria. 493 – Copulatory organs. 494 – Penis. 495 – Atypical, flattened, stimulator. 496 – Rectum. (After Wiktor 1983)



Figs. 497–498. *Deroceras parium* – external appearance of the holotype. (After Wiktor and Mylonas 1981)

Body length after preservation 20–30 mm (live slugs 30–35 mm). Externally, the slug resembles the pale mottled form of *D. caruanae* (= *panormitanum*) but it is larger. Its general coloration is buff-grey with numerous dark flecks on the body. According to Castillejo *et al.* (1995), the body is dark brown with fine dark dots (Figs. 519–520). Mucus colourless.

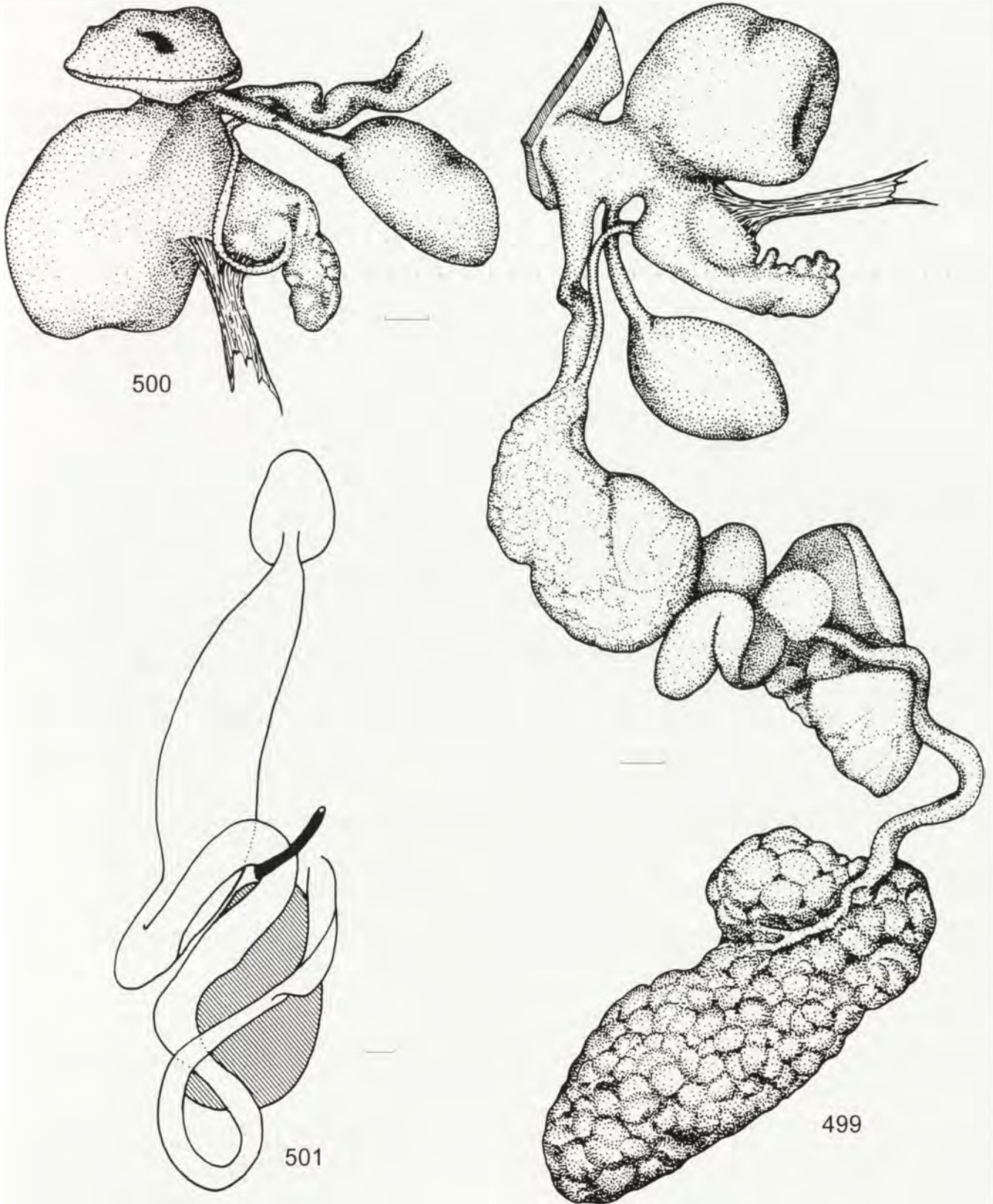
Genitalia (Figs. 521–525, 527). In the anterior part of penis an egg-shaped distension with a granular glandulous surface. Posteriorly the organ mentioned is wormiformly elongated, straight or hook-like bent. On the surface of this section of penis there are irregular concavities which have corresponding internal structures. At the rear of penis there is a small mamilla-like, as defined by Castillejo *et al.* (1995), process which presumably constitutes penial gland. According to Norris (1977), penial gland is lacking. At the very end of penis there is the opening of vas deferens. Retractor penis bifurcate: one insertion is situated near the outlet of vas deferens, the other on the anterior, distended, part of penis (!). In the anterior section of penis a small conical stimulator, which, according to Norris (1977), is pleated.

No caecum on rectum (Fig. 526).

Ecology. The slug occurs in damp places on waste ground and in gardens, always close to human habitations.

Distribution. The region of Gibraltar.

Comments. The description by Hesse (1884) is so laconic that it does not help with identification of the species. This opinion is shared by Castillejo *et al.* (1995). Having examined the material from Gibraltar, Castillejo (1996, 1997) came to the conclusion that the difference between the slugs he considered as the topotypes of *D. ponsonbyi*, the slugs, also from Gibraltar, acknowledged as *D. (Malino) ponsonbyi* by Norris (1977) and the Moroccan slugs I described under the name *D. riedelianum* (Wiktor 1983) may be a result of changes taking place in the process of ontogenesis. However, Castillejo does not discuss the variability range, and the figures he provides evidently reveal differences in the shape of penis, especially its appendix (which the author refers to as “diverticulum”), and musculus retractor penis. And thus we can only put forward suppositions, but as long as the variability ranges both of the slugs from Gibraltar and those from Morocco are unknown,



Figs. 499-501. *Deroceras parium*. 499 – Reproductive system of a paratype. 500 – Copulatory organs of the same specimen as in Fig. 499 seen from the other side. 501 – Alimentary canal. (After Wiktor and Mylonas 1981)

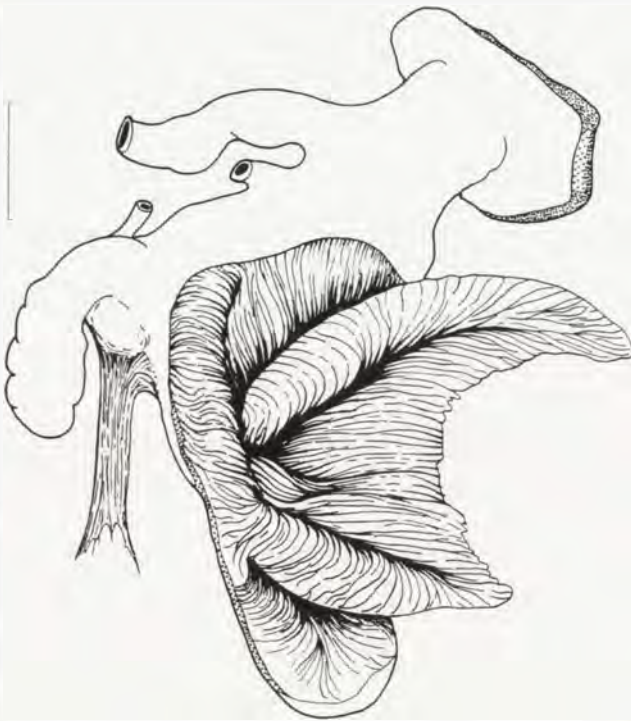


Fig. 502. *Deroceras parium* – stimulator inside penis of a paratype. (After Wiktor and Mylonas 1981)

I consider synonymization of *ponsonbyi-redelianum* as premature and the status of the slug Norris (1977) described as *D. (Malino) ponsonbyi* as unclear.

See also the comments to *D. riedelianum*.

Deroceras (Deroceras) praecox Wiktor, 1966

Deroceras praecox Wiktor, 1966: 449 figs. 1–10, 15–16 (not figs. 11–13!! – see Comments). Locus typicus: Pokrzywna (Opawskie Mts., Lower Silesia, Poland). Holotypus: MNHW no. MP 461.

References: Hudec 1967: 351 figs. 2, 4–5; Wiktor 1973: 131 figs. 49–50, 200–208, 243, 282–283; Wiktor 1989: 128 figs. 144–158; Reise 1995: 325 figs. 1a–f.

Body length ca 35 mm (live individuals up to 40 mm long). Body snowy white, less frequently creamy, covered by rare dark brown dots. Usually the dots do not fuse with one another (Figs. 529–530), being loosely scattered in the part beyond mantle irrespective of the skin sculpture (they do not produce a net-like pattern!!). Mucus colourless, but on irritation also milky white.

Genitalia (Figs. 531–537). Penis clearly divided in two parts. The anterior is broad, sometimes nearly rectangular in outline. The posterior section narrower, elongated, its end extended by a helically coiled appendix. This coiled section is usually unilaterally dark-pigmented. Penial gland, connected with penis at the base of appendix (!), consists of 3–4 long unbranched processes set on a common stem. With its main part musculus retractor penis is inserted laterally to penis at the base of appendix. Apart from that main inser-

tion, a thin strand of the muscle runs more anterad attaching to the anterior part of penis. Stimulator inside penis very flat, fan-shaped, with a wide base.

Caecum on rectum vestigial: in the form of a very shallow pocket (Figs. 536, 538–539).

Ecology. A forest species, inhabiting deciduous and mixed stands. It crawls on the undergrowth vegetation, sheltering mainly in soil and leaf litter. It occurs in low numbers, preferably in shadowy damp places in the neighbourhood of springs and streams. In the mountains it is found up to 1200 m a.s.l. Adult specimens are almost exclusively collected in spring and early summer (April–June). Detailed observations of sexual behaviour were carried out by Reise (1995).

Distribution. The species occurs in the western parts of the Carpathian and Sudete Mts. in Poland, Slovakia and the Czech Republic, in the Polish Lowland reaching as far as the Kraków-Wieluń Jura and the lowlands of Lower Silesia.

Comments. The species discussed is morphologically and ecologically very similar to *D. rodnae*, differing in its spirally coiled appendix, musculus retractor penis split in two, a wider base of flat penial stimulator, and also with respect to many aspects of its biology (spring-time reproduction period, mating dance, etc) and distribution range.

The similarity between the species described and *D. rodnae* is so remarkable that, when describing *D. praecox*, I acknowledged some paratypes from the Bieszczady Mts. (the eastern range of the Carpathians, Poland) as forms of the same species, which later turned out to be two distinct slugs, nearly simultaneously described. It has been confirmed by Reise's (1995) very careful study.

Geographically, the two species are mutually exclusive. They were recorded as sympatric only from Slavakia, which still requires further research. The wide range of *D. rodnae* encircles that of *D. praecox* from the east, south and west (see Wiktor 1973 map 18, Wiktor 1989 maps 9–10, Reise 1995).

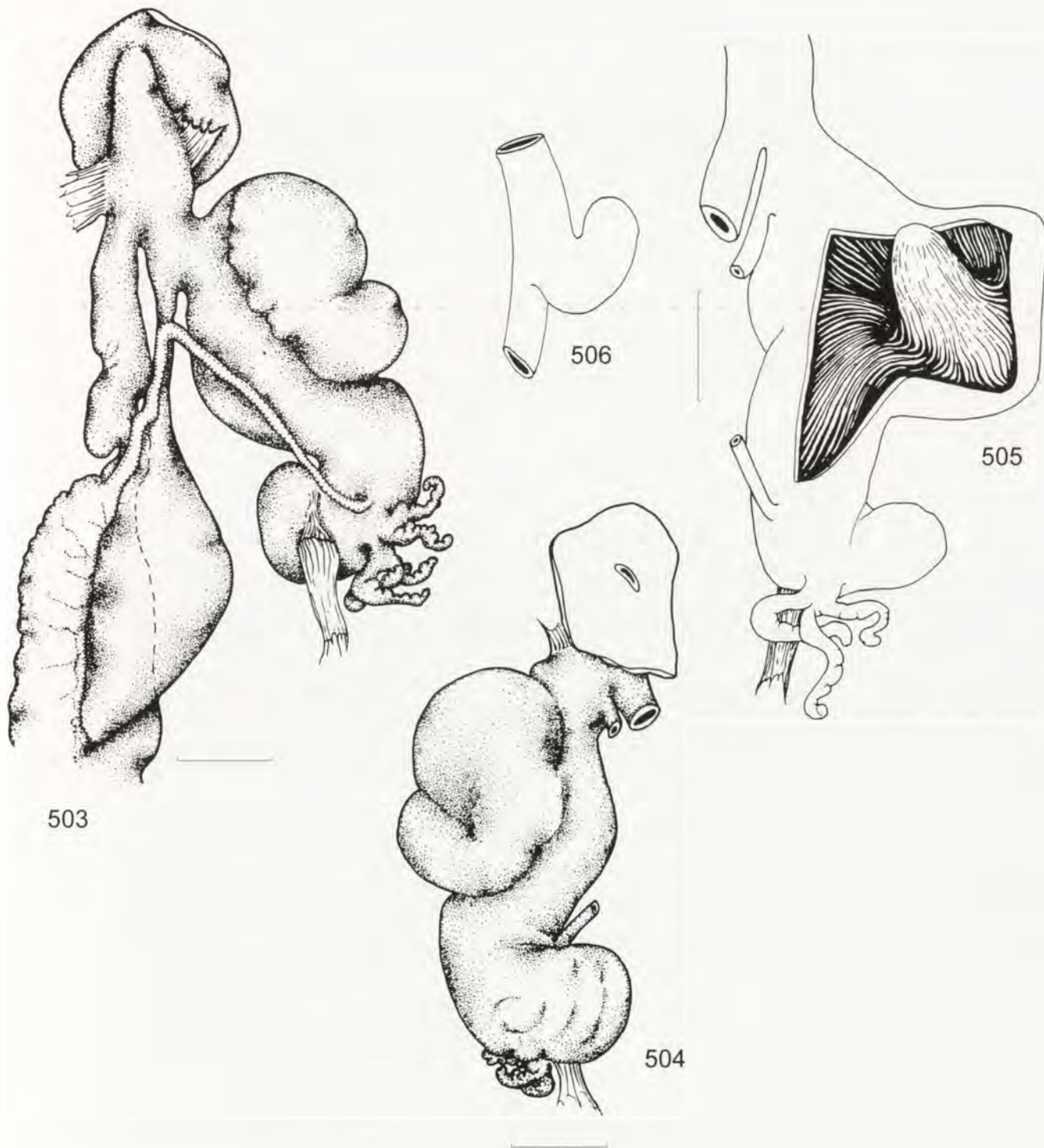
Deroceras (Deroceras) pseudopanormitanum Wiktor, 1984

Deroceras (Plathystimulus) pseudopanormitanum Wiktor, 1984: 162 figs. 28–33. Locus typicus: Tymfi (Tymfi Mts., NW Greece). Holotypus: MNHW no. MP 521.

References: Wiktor – in print.

Body length up to 18 mm. General coloration creamy coffee. On back and mantle dark spots, but the very medial section of back and the short keel are devoid of them (Fig. 540).

Genitalia (Figs. 541–544). Penis anteriorly broadened, sometimes with a large lateral pocket. The posterior part of the organ elongated and cylindrical, near its hind end a small lateral pocket-shaped appendix. In some specimens on the opposite side of the posterior fragment of penis there is an additional, less pronounced protrusion resembling also an appendix. Penial gland, almost apically situated, consists of 3–4 thin, usually unbranched processes set on a common



Figs. 503–506. *Deroceras parnasium*. 503–504 – Whole copulatory organs and penis alone viewed from the opposite side – holotype. 505 – Penial stimulator of a paratype. 506 – Rectal caecum of a paratype. (After Wiktor 1984)

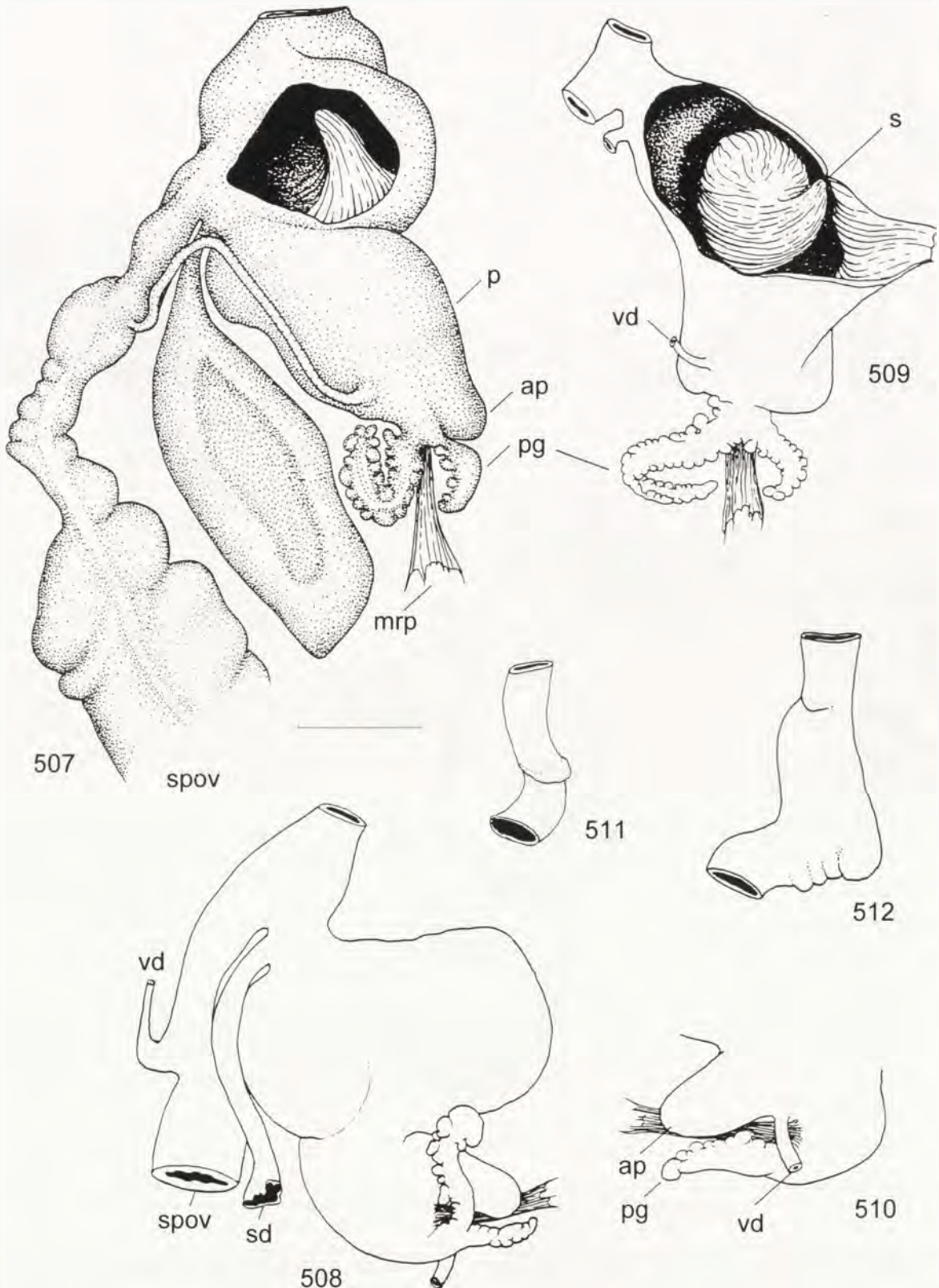
trunk. Vas deferens opens on the border between penis and its appendix. Inside penis a completely flat stimulator of wide base, which is wound in such a way that a small trough is formed inside.

Rectum lacking typical caecum (Fig. 545), in its place

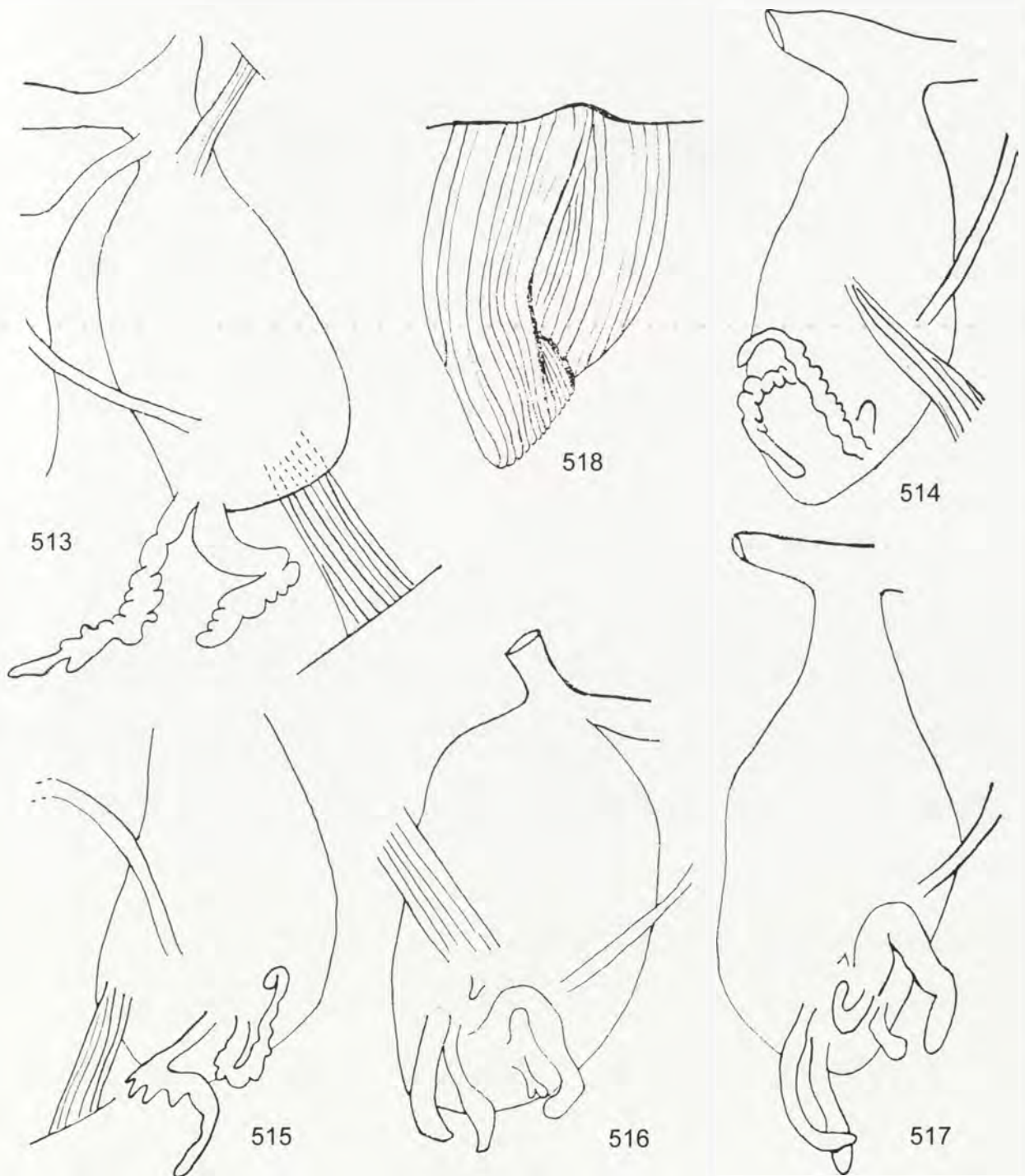
there is only a pocket-like enlargement.

Ecology. A forest species occurring in mixed stands, on various substratum, e.g. sandstone.

Distribution. So far the slug has been recorded only from the Tymfi Mts. (environs of Joannina) in NW Greece.



Figs. 507–512. *Deroceras planarioides*. 507–508 – Copulatory organs. 509 – Penis with its stimulator visible inside. 511–512 – Recta of two specimens. ap – appendix, mrp – musculus retractor penis, p – penis, pg – penial gland, sd – spermatheca duct, spov – spermoviductus, vd – vas deferens. (After Wiktor and Milani 1995)



Figs. 513–518. *Deroceras ponori*. 513–517 – Penises of different specimens. 518 – Stimulator. (After Lupu 1972)

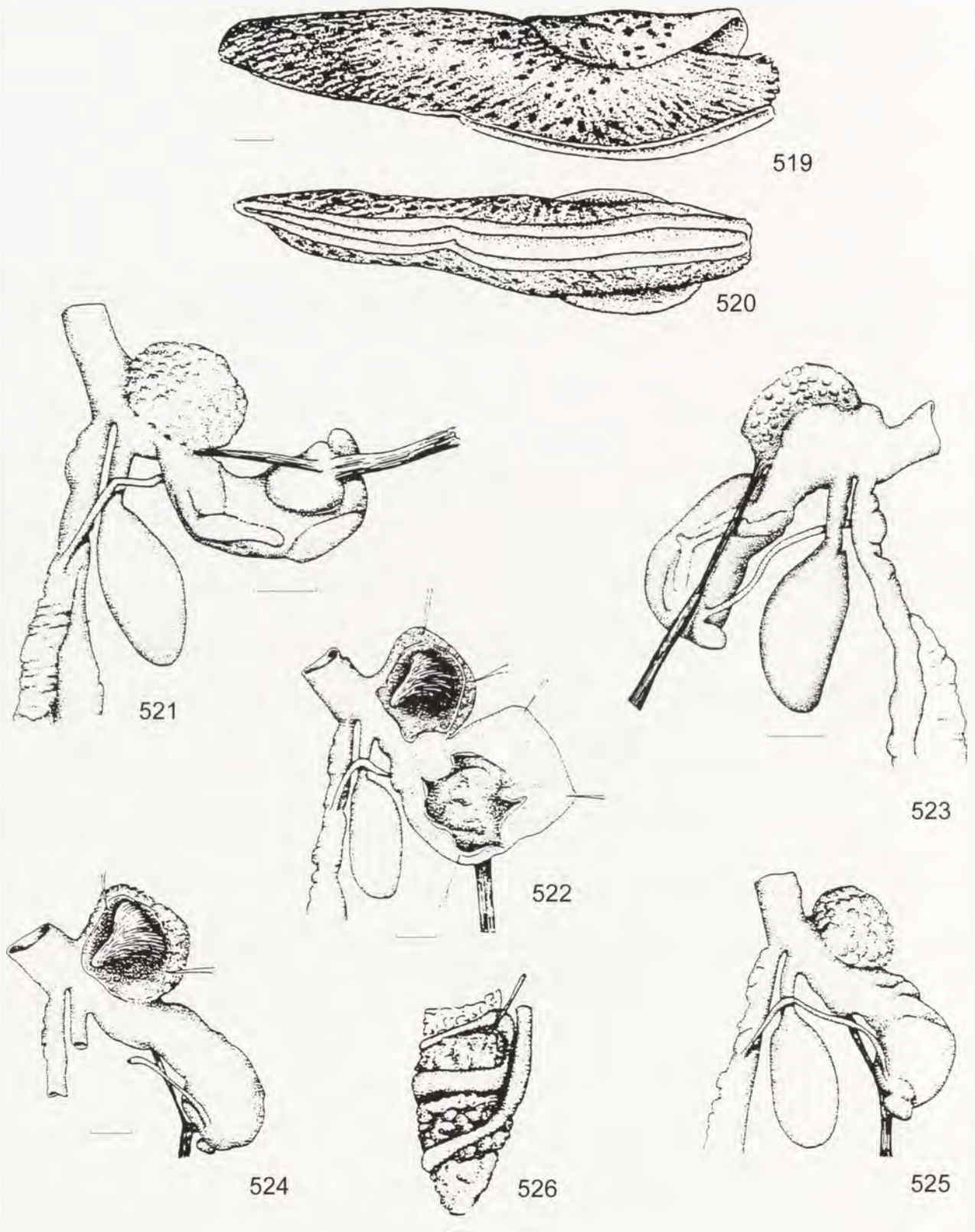
Comments. The slug is similar to *D. panormitanum* in external appearance and the shape of penis but has an evidently flat, completely different, stimulator.

Deroceras (Deroceras) rethimnonensis
de Winter et Butot, 1986

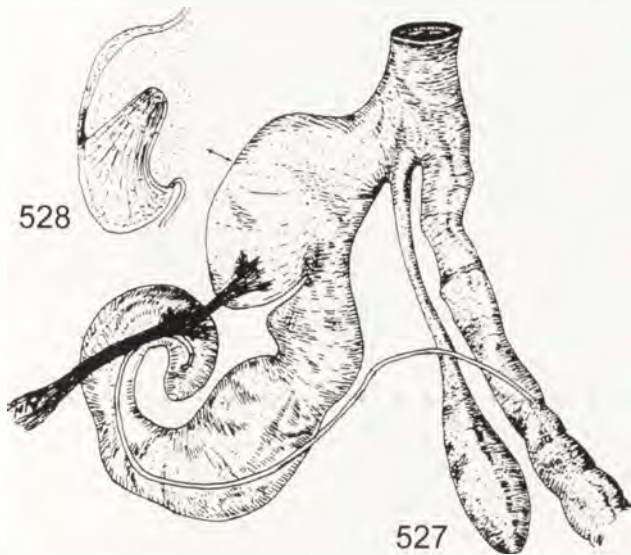
Deroceras rethimnonensis de Winter et Butot, 1986: 41 figs. 13–16. Locus typicus: Margarites (Crete Isl., Greece). Holotypus: ZMA no. 386008.

References: Wiktor 1994: 7 figs. 10–14 photos 1–4; Wiktor, Vardinoyannis, Mylonas 1994: 32 map 9; Wiktor – in print.

A large slug, attaining up to 40 mm in length, of a very soft and limp skin. Specimens preserved in alcohol are usually blackish or grey and look as if faded. Under a high magnification tiny granules of a dark pigment are discernible in skin. Most commonly back is darker than sides. Sole



Figs. 519–526. *Deroceras ponsonbyi*. 519–520 – External appearance. 521–525 – Copulatory organs. 526 – Posterior section of viscera. (After Castillejo 1996)



Figs. 527–528. *Deroceras ponsonbyi*. 527 – Copulatory organs. 528 – Stimulator. (After Norris 1977)

creamy. Some specimens have their back and mantle dark, as a matter of fact black, and only sides paler. Specimens clearly dark-spotted, especially on mantle, are also collected.

Genitalia (Figs. 546–549, 551–552, 555–556). Penis divided in two parts: the anterior one is broadened, its one side covered by granular glands; the other section is narrower, posteriorly with various distensions or pockets often resembling lateral appendices. Between these protuberances there is the outlet of penial gland. The organ is very characteristic as it is composed of a clearly long stem on which two (!), also long (!), branches are situated. They may have inconspicuous offshoots. Vas deferens is connected to a side of penis, most commonly at the base of the largest protuberance. Retractor penis usually with one lateral insertion in the posterior part of penis. Sometimes an additional small muscular strand, attached more anterad but also laterally, is present. Penis is very often black posteriorly. Inside this organ there is a large, narrowly conical stimulator, almost

always dark-pigmented. Its free end is usually directed posterad. Dark pigmentation is observable in other parts of genitalia as well, e.g. in spermoviductus and the membrane surrounding viscera.

Caecum long and thin (Figs. 550, 553–554, 557).

Ecology. The species occurs mainly in the lowlands, in the mountains not exceeding 1200 m a.s.l. It inhabits various habitats, both shaded by pine or maquis, and, as a synanthrope, in the neighbourhood of streams for instance.

Distribution. The species is collected on the whole of Crete (Greece), being probably the commonest slug of the island. *D. rethimnonensis* has also been recorded from Turkey (Wiktor 1994), but it should be found out whether the Turkish slugs have been introduced or are indigenous to this territory. Besides, as they are slightly different in the appearance of penis, they may prove to represent a distinct species.

Comments. There is another species externally resembling *D. rethimnonensis*, especially its black forms, that occurs on Crete, namely *D. lasithionensis*. It has been described in two subspecies, both differing from the slug discussed in the shape of penial gland, which, whether branched or not, never has a common trunk.

Another large Greek slug, for a change spotted, comparable with *D. rethimnonensis* is *D. thersites*. It has, in fact, penial gland set on a long trunk, but the latter further repeatedly divides which results in a structure resembling a tree with numerous twigs.

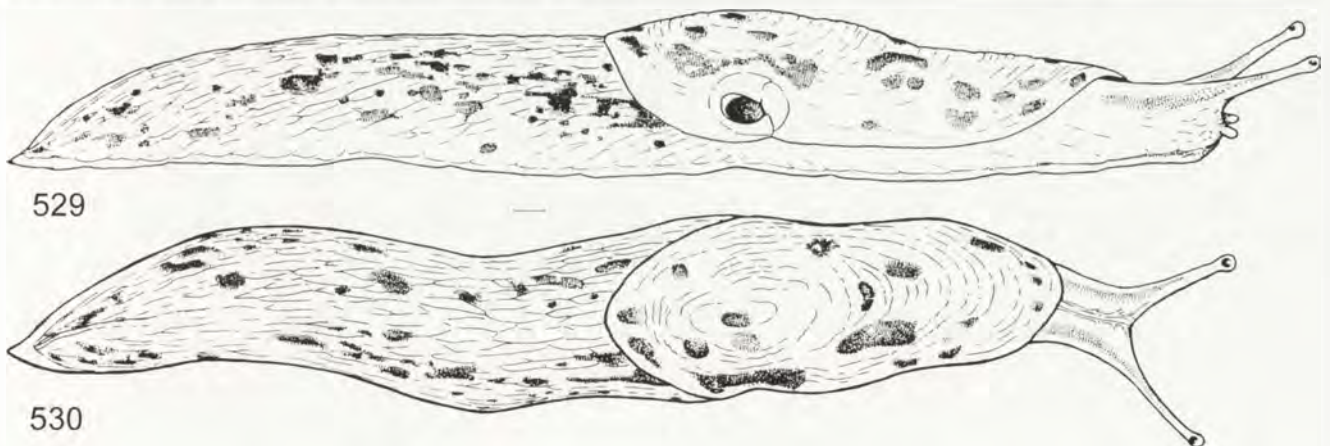
Deroceras (Deroceras) reticulatum (Müller, 1774)

Limax reticulatus O. F. Müller, 1774: 10. Locus typicus: Fridriksdal (Denmark). Typus: does not exist. See Altena 1969a: 103 fig. 1 – topotypes.

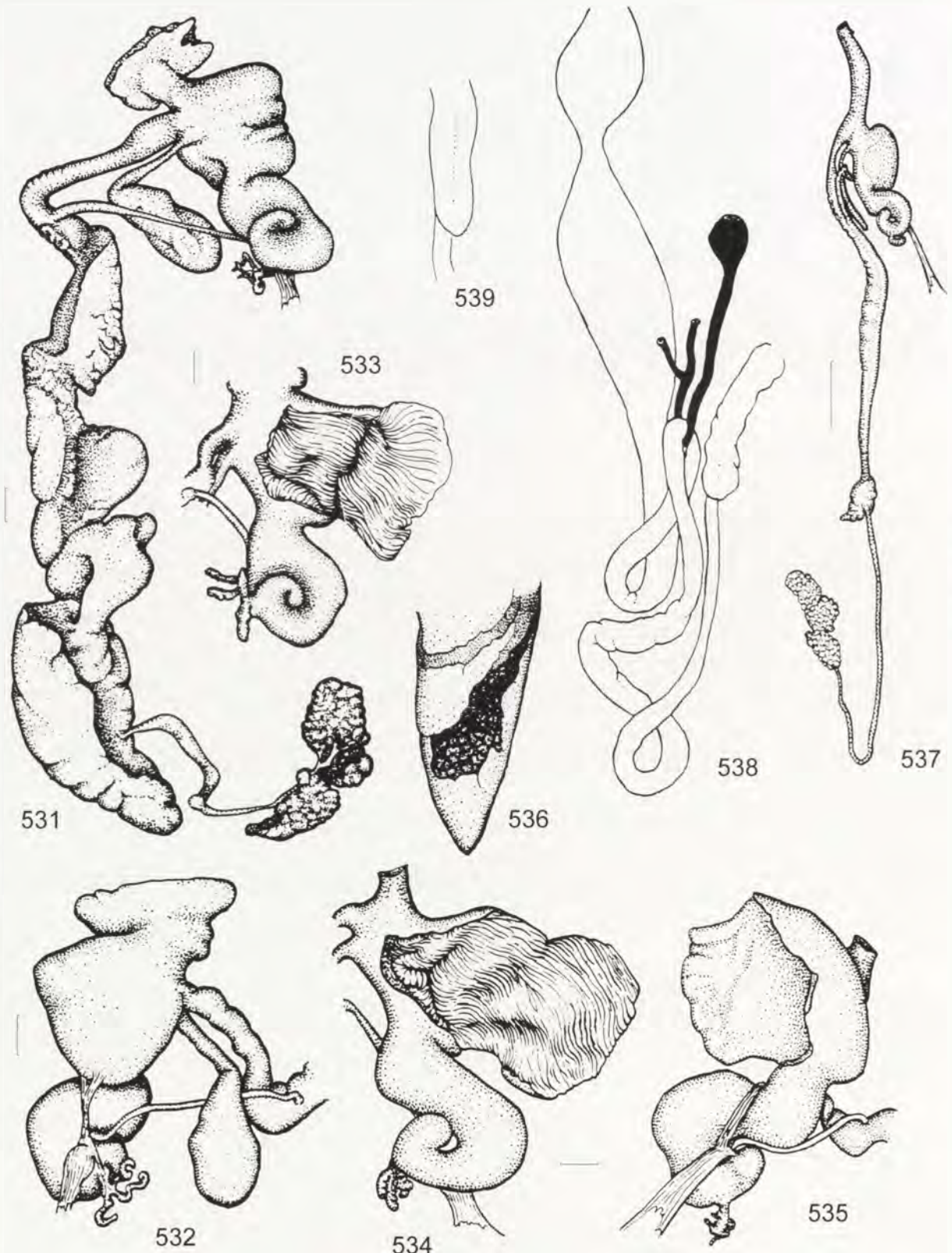
Limax tunicata Gould, 1841 (after Alonso, Ibáñez, Beech 1985: 102).

?*Agriolimax Drymonius* Bourguignat. See Simroth 1886b: 319 and Altena 1950: 17.

?*Limax (Krynockillus) nicensis* Bourguignat (in Nevill), 1880: 103 (by some malacologists, e.g. Lessona and Pollonera 1882a: 50 or Hesse 1926: 99, regarded as a synonym but acc. to Bodon, Boato, Giusti 1982: 54, it is impossible to establish what species was actually given this name). Typus: SMF no. 66901.



Figs. 529–530. *Deroceras praecox* – external appearance. (After Wiktor 1973)



Figs. 531–539. *Deroceras praecox*. 531 – Reproductive system. 532 – Copulatory organs viewed from the side of body integuments. 533–535 – Stimulator inside penis; notice that its one side is smooth (Fig. 535). 536 – Posterior end of viscera. 537 – Reproductive system of a juvenile specimen. 538 – Alimentary system. 539 – Caecum on rectum. (After Wiktor 1973)

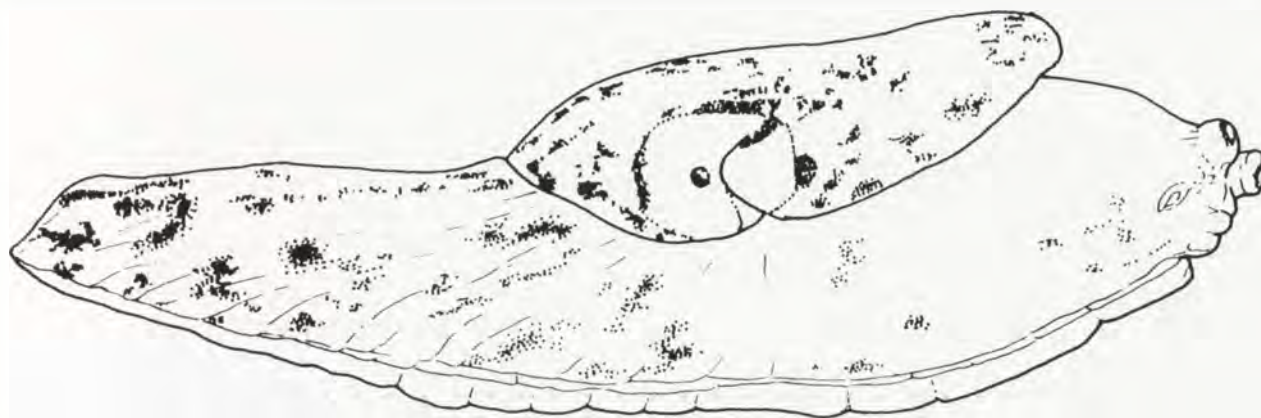


Fig. 540. *Deroceras pseudopanormitanum* – external appearance. (After Wiktor 1984)

Agriolimax simrothi Cockerell, 1893: 176. Terra typica: Canary Islands.

?Typus: SMF no. 66901. See also Altana 1950: 17.

Deroceras attenai Lupu, 1976: 10 pl. I figs. 1–9. Locus typicus: Bucharest (Roumania). Holotypus: MNGAB no. 13203 (I have not seen the types).

Caution! Often, especially in the 19th century, *D. reticulatum* was not distinguished from or confused with *D. agreste* and *D. turcicum*.

References: Luther 1915: 1 figs. 1B–D; Likharev and Wiktor 1980: 149 figs. 103–107; Wiktor 1989: 122 figs. 113–114, 126–143; Castillejo, Garrido, Iglesias 1995: 24 figs. 48–54.

Body length up to 25 mm (live slugs up to 45 mm). Skin thick. General coloration creamy, brown creamy or coffee on the background of which there are dark, blackish or black but of varied intensity, spots. In the part beyond mantle the dark pigment is concentrated in skin grooves, producing a reticulate pattern (Figs. 558–559). Mucus colourless, on irritation milky white.

Genitalia (Figs. 560–578). In adult specimens penis deeply laterally constricted, both parts can usually be inscribed in an oval. On the posterior end there is a large penial gland widely varying in shape. Most frequently it is made up of a few branches covered by glandular papillae and merged in a short common trunk. Sometimes penial gland is represented by a single process of both sides papillae-covered. Vas deferens opens laterally close to the rear end of penis, nearly always on the side of body integuments (!). Inside penis a large long conical stimulator.

Caecum on rectum long (Fig. 579).

Ecology. At present the species is almost exclusively known as a synanthrope. It avoids woodland, though may be found on forest margins. It occurs in various open habitats, e.g. in meadows, ditches, by roadsides, in ruins, near buildings, in gardens, parks, different types of cultivation. A mesophilous, lowland, eurytopic species. Its life cycle covers a few months and, living for about a year, the slug usually yields two generations. The wintering stage are eggs, sometimes juvenile specimens. The main reproductive phase falls in summer and autumn. The slug dies at the first frosts.

D. reticulatum is an omnivorous species, feeding mainly on fresh parts of plants, both leaves and fruit (e.g. berries),

tubers, seedlings etc. It is a dangerous pest of field and garden cultivations, for which reason the slug has been devoted many studies and ranks among the species whose biology is best known.

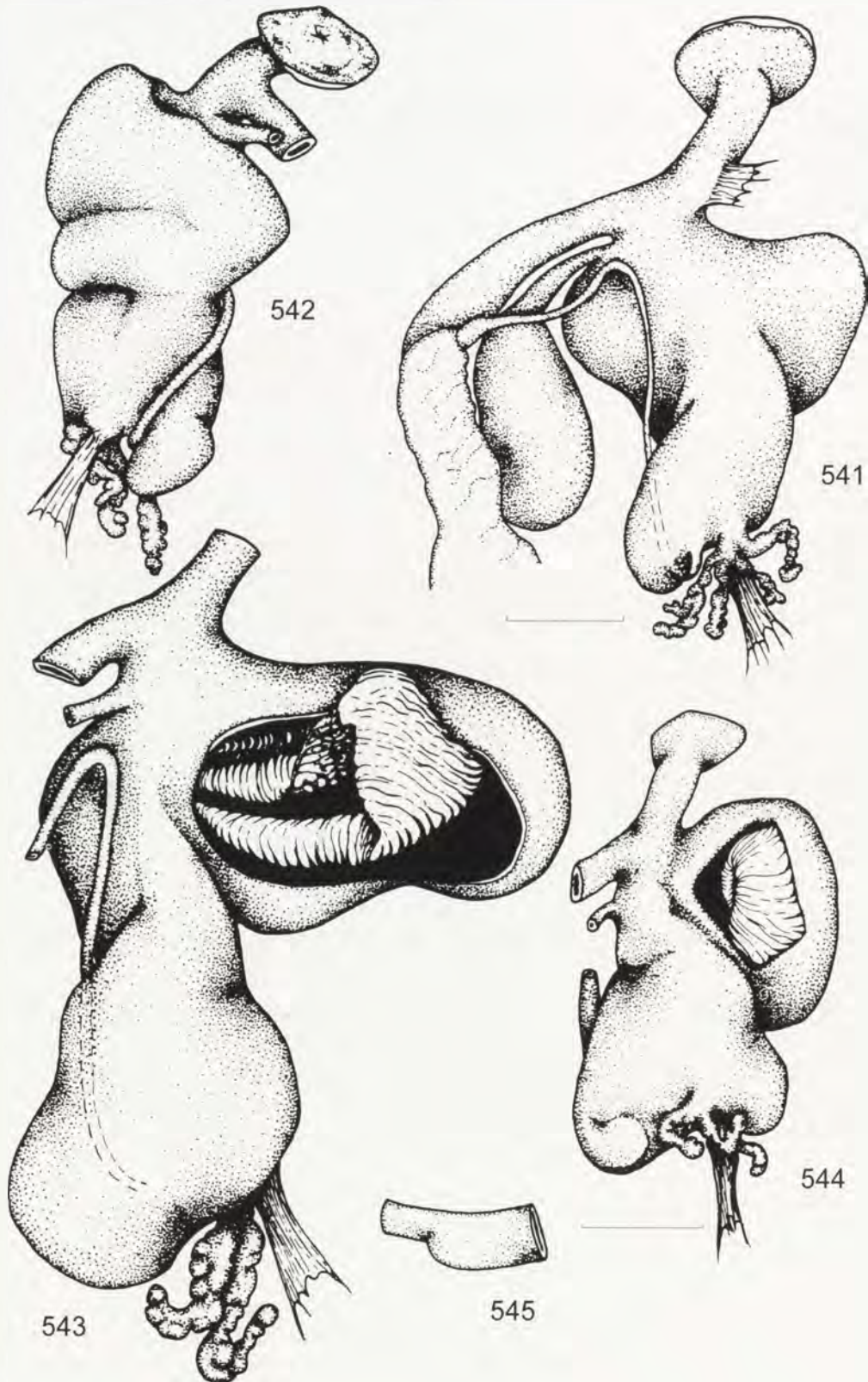
Distribution. It is difficult to establish where the original distribution range of *D. reticulatum* was; it must have been somewhere in Europe. Currently the slug occurs practically in the whole of this continent, but in its south-eastern part, particularly in the Balkans, is often found only as a synanthrope; in more natural habitats it gives way to other species. *D. reticulatum* has been introduced to different parts of the globe, e.g. North America, Peru, Tasmania, New Zealand, Central Asia.

Comments. The information about *D. reticulatum* found in literature is not fully reliable. In old papers the species was commonly not distinguished from *D. agreste* and nearly certainly confused with *D. praecox*, *D. rodnae*, and especially *D. turcicum*.

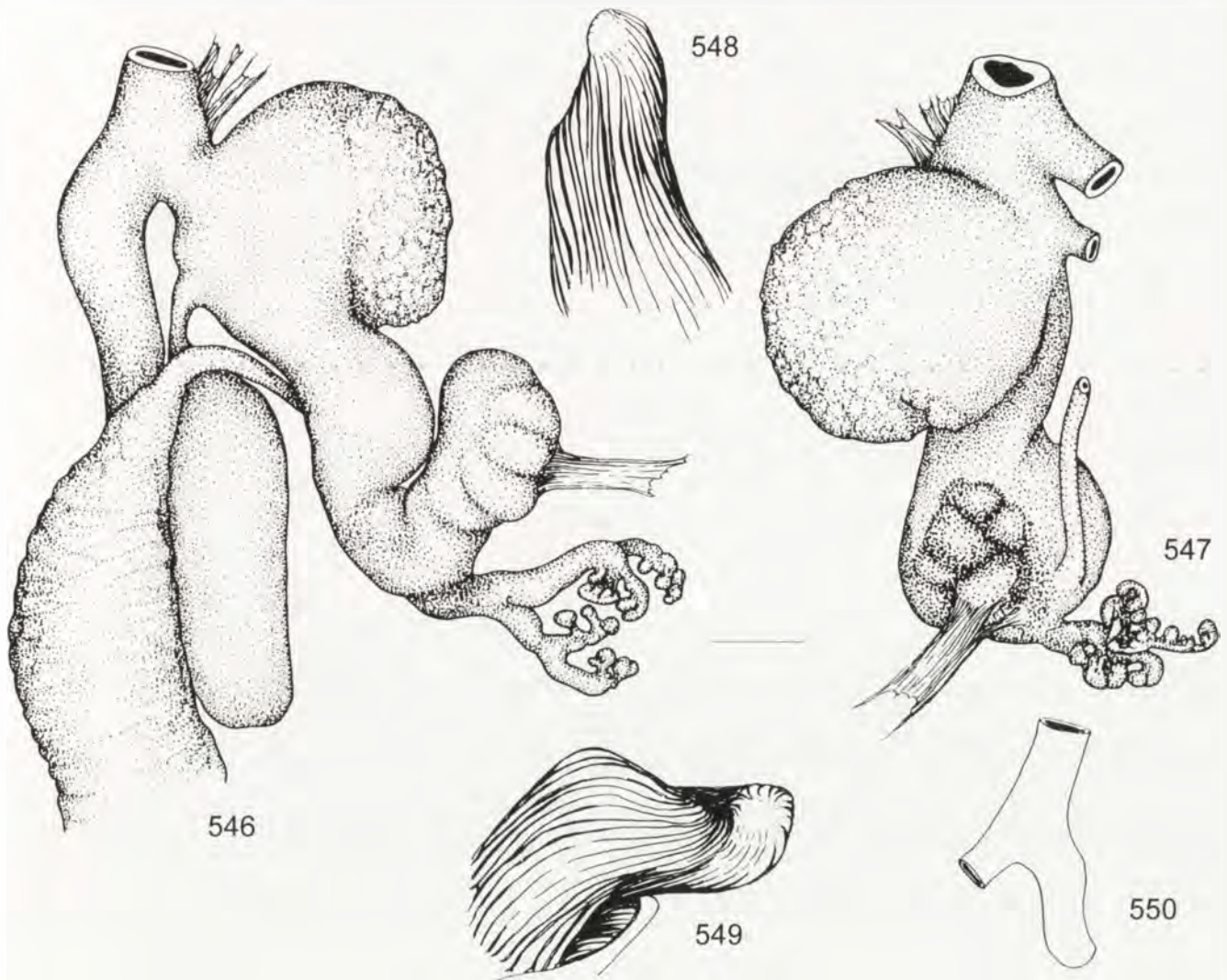
It can be easily distinguished from *D. praecox* and *D. rodnae* as the two have a vestigial caecum on rectum and a flat stimulator.

D. agreste differs from the slug discussed in its penial gland, which is smaller, unbranched and not papillae-covered, as well as in lack of spots on the body.

It is more difficult to differentiate *D. reticulatum* from *D. turcicum* as both species display immense variability, especially with regard to penis. In *D. turcicum*, which does not attain such a large size as the species discussed does, penis is somewhat different, although the difference is difficult to define precisely. Making a successful distinction between the two slugs requires experience, that being best obtained through examination of a series of specimens. In *D. turcicum* vas deferens usually opens on the side of viscera between two small distensions. Penial gland shows a tendency towards reduction, often assuming the shape of nodules or a tuft of short processes. It is also important that this slug is often found in forest, though, as also eurytopic, it may be synanthropic and occur amongst rock waste, rubble etc.



Figs. 541-545. *Deroceras pseudopanormitanum*. 541-542 - Copulatory organs and penis seen from the other side. 543 - The holotype's penis with its stimulator visible inside. 544 - Penis of a paratype. 545 - Rectum of the holotype. (After Wiktor 1984)



Figs. 546–550. *Deroceras rethimmonensis* from Turkey. 546 – Copulatory organs. 547 – Penis. 548–549 – Stimulator. 550 – Caecum on rectum. (After Wiktor 1994)

***Deroceras (Deroceras) rhodensis* Forcart, 1972**

Deroceras rhodensis Forcart, 1972: 114 fig. 4. Locus typicus: town Ródhos (= Rhodes, Rhodes Isl., Greece). Holotypus: NNML.

At present the species is known only from Forcart's (1972) description of 3 juvenile specimens.

Body length 15.5 mm (the slug presumably reaches larger dimensions). Coloration evenly grey.

Genitalia (Fig. 580). In the type specimens the genitalia are not fully developed. Penis is oval, flattened. In its posterior section two appendices of smooth surface and a short penial gland are situated. Stimulator conical, wide. Musculus retractor penis apically attached to penis.

Caecum on rectum short.

Distribution. Town Ródhos (=Rhodes, Rhodes Isl., Greece).

Comments. The status of this taxon is unclear. It may be a distinct species or represent juvenile specimens of a slug

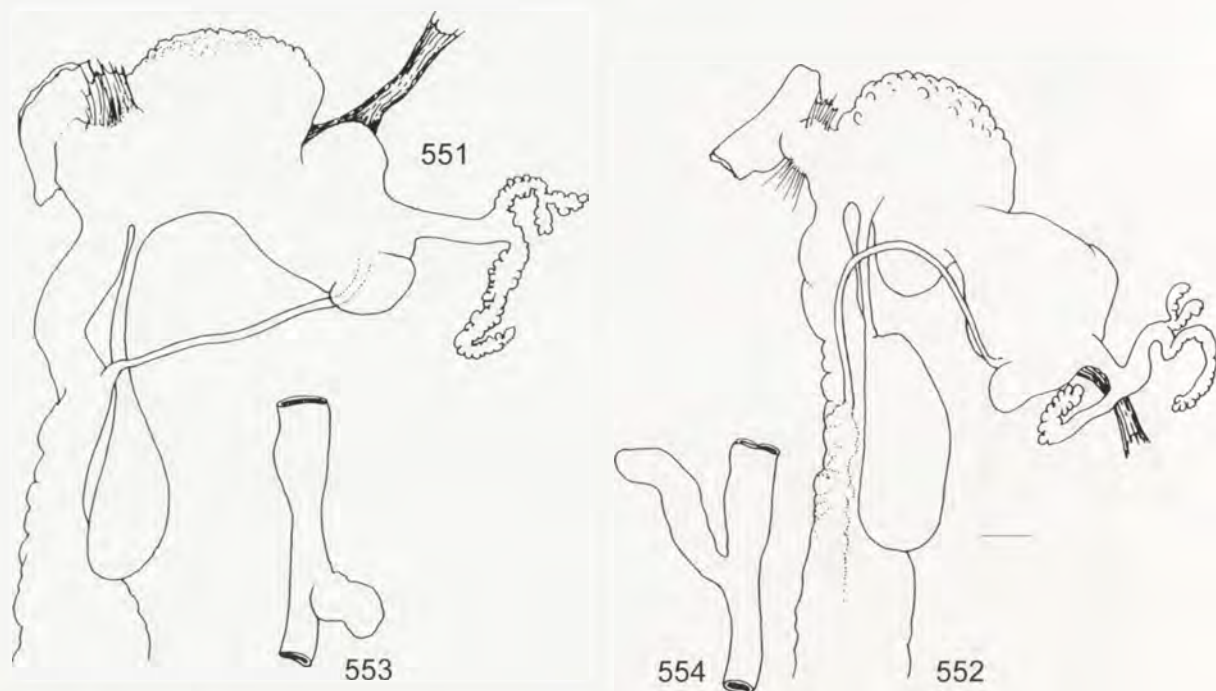
known under a different name. In the genus *Deroceras* juveniles often differ in coloration from adult individuals, the genitalia, particularly penis and penial gland, changing during maturation.

***Deroceras (Deroceras) riedelianum* Wiktor, 1983**

Deroceras (Deroceras) riedelianum Wiktor, 1983: 162 figs. 14–21. Locus typicus: Skikda (= Philippeville, Algeria). Holotypus: MNHW no. MP 470.

Body length up to 23 mm. Mantle accreted so far posteriorly that its anterior, free, fragment, roughly 2/3 of the whole length, can be tilted up. Coloration pale coffee with dark spotting both on mantle and the posterior body part (Fig. 588).

Genitalia (Figs. 581–586). Penis elongated, medially constricted, usually anteriorly enlarged. The posterior part equipped with one smooth-surfaced process bent anterad



Figs. 551–554. *Deroceras rethimnonensis* from Crete. 551–552 – Copulatory organs. 553–554 – Caecum on rectum. (Orig.)

which probably constitutes penial gland. On the opposite side of the rear end of penis there is an appendix-like distension. Vas deferens opens somewhat laterally between the process and the distension. Musculus retractor penis single, i.e. with one insertion to penis (!), situated also between the process and the distension but apically. Stimulator cone-shaped.

Caecum on rectum lacking (Fig. 587); only the terminal section of intestine abruptly broadens.

Ecology. The slug was collected in damp leaf litter of thick brushwood, in cork-oak forest, ruins and rock-debris.

Distribution. So far the only known are specimens of the type series from Algeria, collected in the environs of Skikda (= Philippeville) and Annaba (= Bône).

Comments. The species resembles *D. ponsonbyi* sensu Norris (see the notes on this species p. 500) described from Gibraltar. The similarity concerns the shape of penis and, especially, penial gland, which assumes the form of a process having a smooth surface. The essential difference is to be looked for in the appearance of musculus retractor penis which in *D. ponsonbyi* is bifurcate, its one insertion at the rear of penis and the other in the anterior part of the organ.

The shape of the posterior penis section in *D. riedelianum* may bring an association with similar structures observed in *D. sturanyi*. A closer comparison, however, will show obvious differences (see Figs. 621–629). Besides, *D. sturanyi* is not spotted and has a clearly perceivable, though very shallow, rectal caecum.

Having examined the material from Gibraltar, Castillejo (1996, 1997) came to the conclusion that *D. riedelianum* was a synonym of *D. ponsonbyi*. However, the slugs, which

the author acknowledged as topotypes of *D. ponsonbyi*, differ from *D. riedelianum* in the appearance of penial appendix (termed “diverticulum” by Castillejo) and in their forked musculus retractor penis. According to Castillejo (1996, 1997), the topotypes at his disposal may be juvenile forms, the typical characters described for the slugs from Morocco possibly manifesting themselves later in ontogenesis. It may be the case, yet the author’s statement is just a supposition, which, in my opinion, is insufficient to synonymize the two taxa concerned, at least at the current state of knowledge. Since the variability ranges of *D. ponsonbyi* sensu Castillejo, *D. ponsonbyi* sensu Norris and *D. riedelianum* from Morocco have not been established yet, I adhere to my opinion regarding Moroccan *D. riedelianum* as a distinct species (see Comments to *D. ponsonbyi* p. 500).

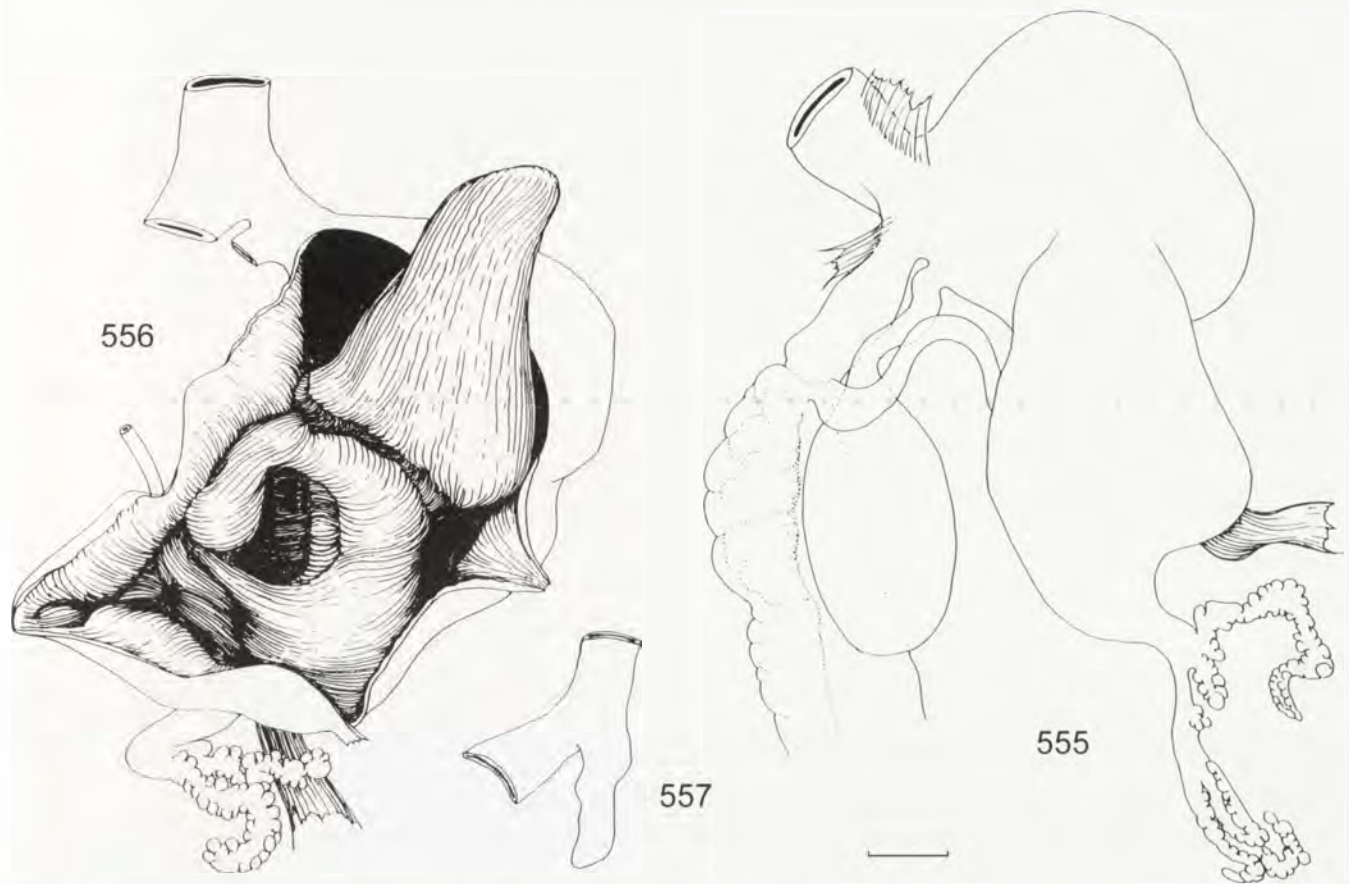
Deroceras (Deroceras) rodnae Grossu et Lupu, 1965

Deroceras rodnae Grossu et Lupu, 1965: 28 figs. 2a–c. Locus typicus: Monti Inău (Rodna Mts, Roumania). Holotypus: NMGAB no. 13135.

Deroceras (Platystimulus) fatrense Macha, 1981: 97 figs. 1–8. Locus typicus: 300 m S of the shelter-home “Chata pod Suchým” (Malá Fatra, Slovakia). Holotypus: Slovenské múzeum, Opava (Slovakia).

Deroceras (Platystimulus) juranum Wütrich, 1993: 123 figs. 1–2. Locus typicus: Combe Grede, near “La Corona”, Chasseral Nordhang (Kanton Bern, Switzerland). Holotypus: SMF no. 309794. See Reise 1996, 1997.

References: Schmidt 1971: 131 figs. 1–4; Wiktor 1973: 135 figs. 51–52, 209–214, 244, 284–285; Likharev and Wiktor 1980: 167 figs. 144–148; Bodon, Boato, Giusti 1982: 59 figs. 4A–L; Grossu 1983: 373 figs. 234A–D; Kerney, Cameron, Jungbluth 1983: 196 fig. 5 map 214; Wiktor 1989: 131 figs. 159–166; Reise 1995: 325 fig. 1; Reise 1996: 315; Reise 1997: 103 figs. 1–5.



Figs. 555–557. *Deroceras rethimmonensis* from Crete. 555 – Copulatory organs. 556 – Structures inside penis. 557 – Caecum on rectum. (Orig.)

Body length 32 mm (live slugs up to 45 mm). General coloration white (rarely), light creamy, dirty creamy or straw yellow. Mantle and back, except for the latter's medial section, nearly always dark brown- or blackish-spotted. The spotting may be arranged in a reticulate pattern. Individuals entirely devoid of spots are rare (Figs. 589–590). Mucus colourless but when the slug is irritated also a milky secretion of skin appears.

Genitalia (Figs. 591–597, 599–600). Penis irregular in shape, medially constricted (in older specimens), anteriorly regularly distended. The posterior part with different swellings, at the very end with a lateral distension, a kind of lateral pocket or transversely situated, short, broad and straight (not coiled!) appendix. Penial gland, consisting of a few branches set on a common trunk, apically connected with penis. Musculus retractor penis single, unforked. Stimulator completely flat, on a narrow base, with a gradually broadening free end.

Caecum on rectum vestigial: in the shape of a shallow pocket (Figs. 598, 601).

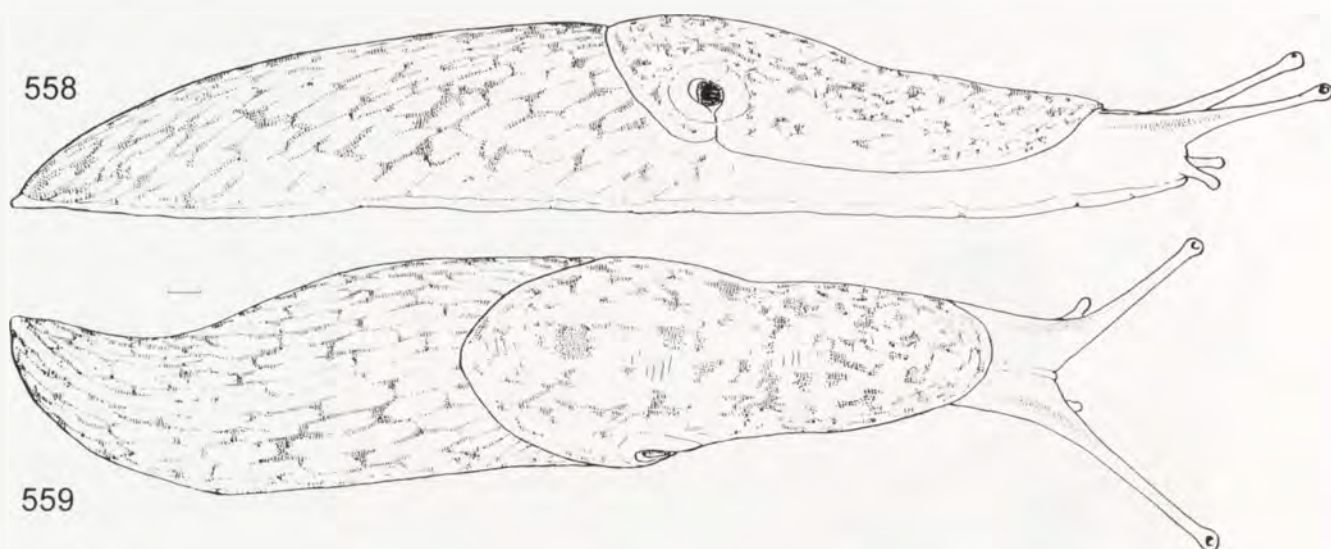
Ecology. A forest slug, occurring mainly in deciduous and mixed stands, particularly often found in dense tickets of herbs near springs. In Central Europe the main phase of its reproduction cycle falls in autumn; in warmer climate *D. rodnae* reproduces also in other seasons.

Distribution. The distribution range, still not known entirely, covers a vast area from the Eastern Carpathians, i.e. Ukraine and Roumania, through Slavakia, the Czech Republic, SE Poland, Hungary, Austria, Switzerland, S Germany, Croatia, France and probably Spain (see Comments).

Comments. The species is very similar to *D. praecox* which differs in its spirally coiled penial appendix, broader stimulator of a wide base, retractor penis with two insertions, body most often being white and rarer spots which do not produce a reticulum. Besides, this species has a spring-time reproduction period. The two slugs are mutually exclusive, their ranges not overlapping. Their bionomics is different, too (Reise 1996).

Two papers by Castillejo, Garrido, Iglesias, published in 1993 (Fig. 44) and 1995 (Fig. 62), include the same drawing of *D. rodnae*, in which rectal caecum is long, at the same time mentioning (1995 p. 30) that the slug has “a short rectal caecum”. This may be a mistake or the authors dealt with some other, similar species (!). I have got in my collection *D. rodnae* from Spain, whose rectal caecum is typical, i.e. in the shape of a very shallow pocket (!).

With the use of methods of laboratory culture and cross-breeding as well as electrophoretic analyses, Reise (1996, 1997) has revealed that *D. juranum* is only a Mendelian



Figs. 558–559. *Deroceras reticulatum* – external appearance. (After Wiktor 1973)

colour morph of *D. rodnae*. These results are fully confirmed by my own anatomical study. The preserved holotype of *D. juranum* is nearly black. Nevertheless, against this background still darker, completely black blots are visible both on mantle and the part beyond it.

Deroceras (Deroceras) samium Rähle, 1984

Deroceras (Platystimulus) samium Rähle, 1983a: 115 figs. 1–9. Locus typicus: Psili (Samos Isl., Greece). Holotypus: NNML no. 9108.

References: Bar and Butot 1986: 77; Wiktor 1994: 24 figs. 63–66; Wiktor – in print.

Body length up to 40 mm. Mantle and back uniformly black, sides in the anterior body section getting gradually lighter to become creamy to whitish (Fig. 602). Sole creamy but in some specimens its lateral zones are blackish.

Genitalia (Figs. 602–606). Penis very short with a huge lateral distension which is so large that it constitutes roughly 2/3 of the whole organ. The anatomically posterior part of penis, which in adult specimens is usually situated beside the distended, anatomically anterior part, is markedly narrower, bent and terminates with a pocket-shaped kind of appendix. Penial gland is made up of a tuft of 10–15 processes joined at the base and accreted to the apical end of penis more or less at the base of appendix. Just by the junction penis–penial gland, but already laterally, there is the entry of vas deferens. Stimulator flat, fan-like, very broad and so large that it nearly fills up the distended anterior part of penis.

Caecum on rectum well-developed, medium-sized.

Distribution. The Greek islands of Ródhos, Kos, Samos, Hios, Ikaria, Lesvos and the environs of Selçuk (Vil. Izmir) in Turkey.

Comments. Externally, the slug is similar to *D. keaensis*, which differs in its elongated penis, and the anterior

part of this organ being smaller and less conspicuously distended. Besides, its posterior penial section is of different shape and has two pockets of the type of appendices. The two species also have different distribution ranges and have never been found sympatrically so far (see Comments to *D. keaensis* p. 457).

There is a striking resemblance between *D. samium* and *D. ikaria*: the latter seems to be a miniature of the former slug. *D. ikaria* is likely to turn out to be a junior synonym of *D. samium* (see Comments to *D. ikaria* p. 451).

Deroceras (Deroceras) seriphium

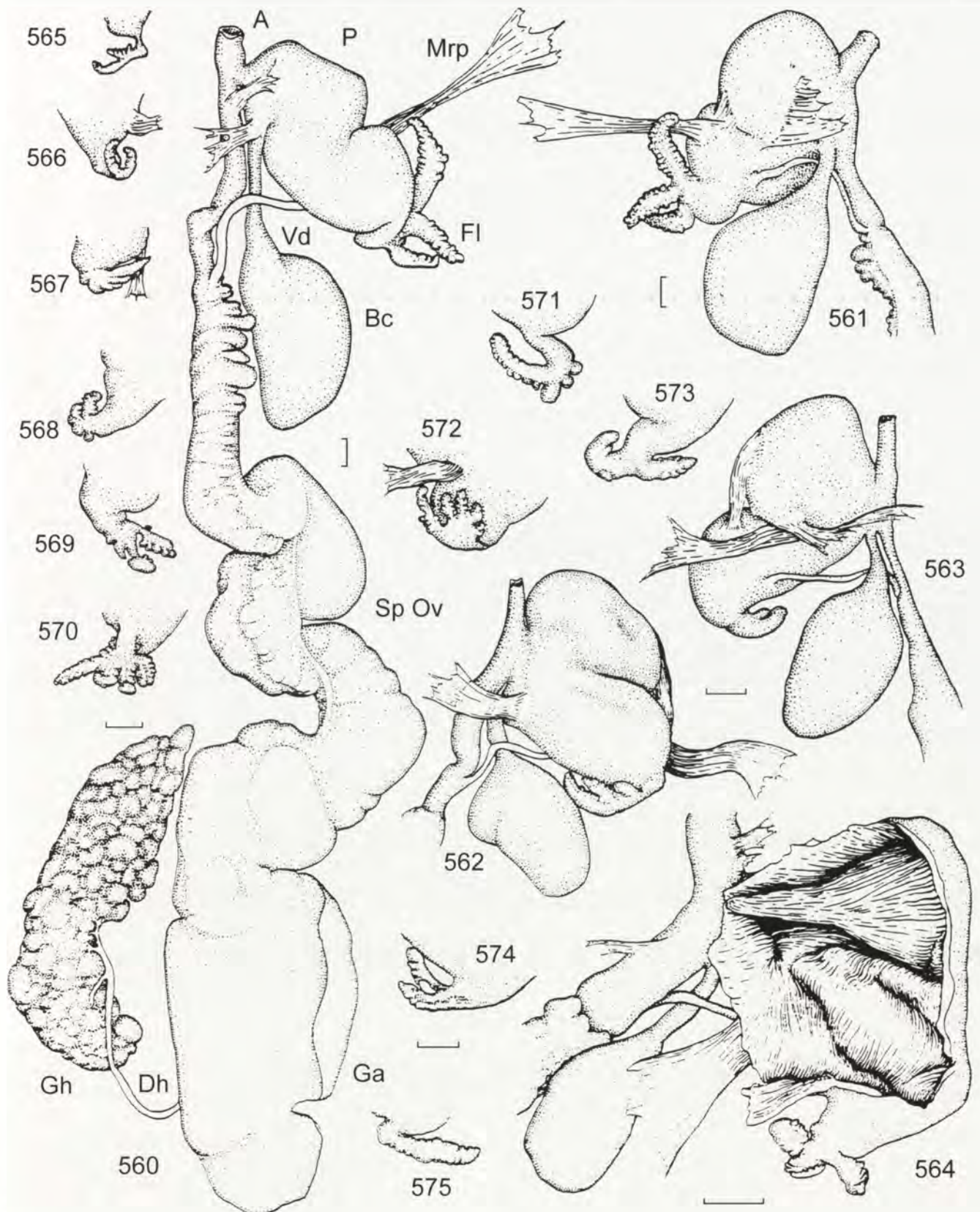
Wiktor et Mylonas, 1981

Deroceras (Platystimulus) seriphium Wiktor et Mylonas, 1981: 184 figs. 9–18. Locus typicus: Kentarchos (Sérifos = Seriphos Isl., Greece). Holotypus: MNHW no. MP 467.

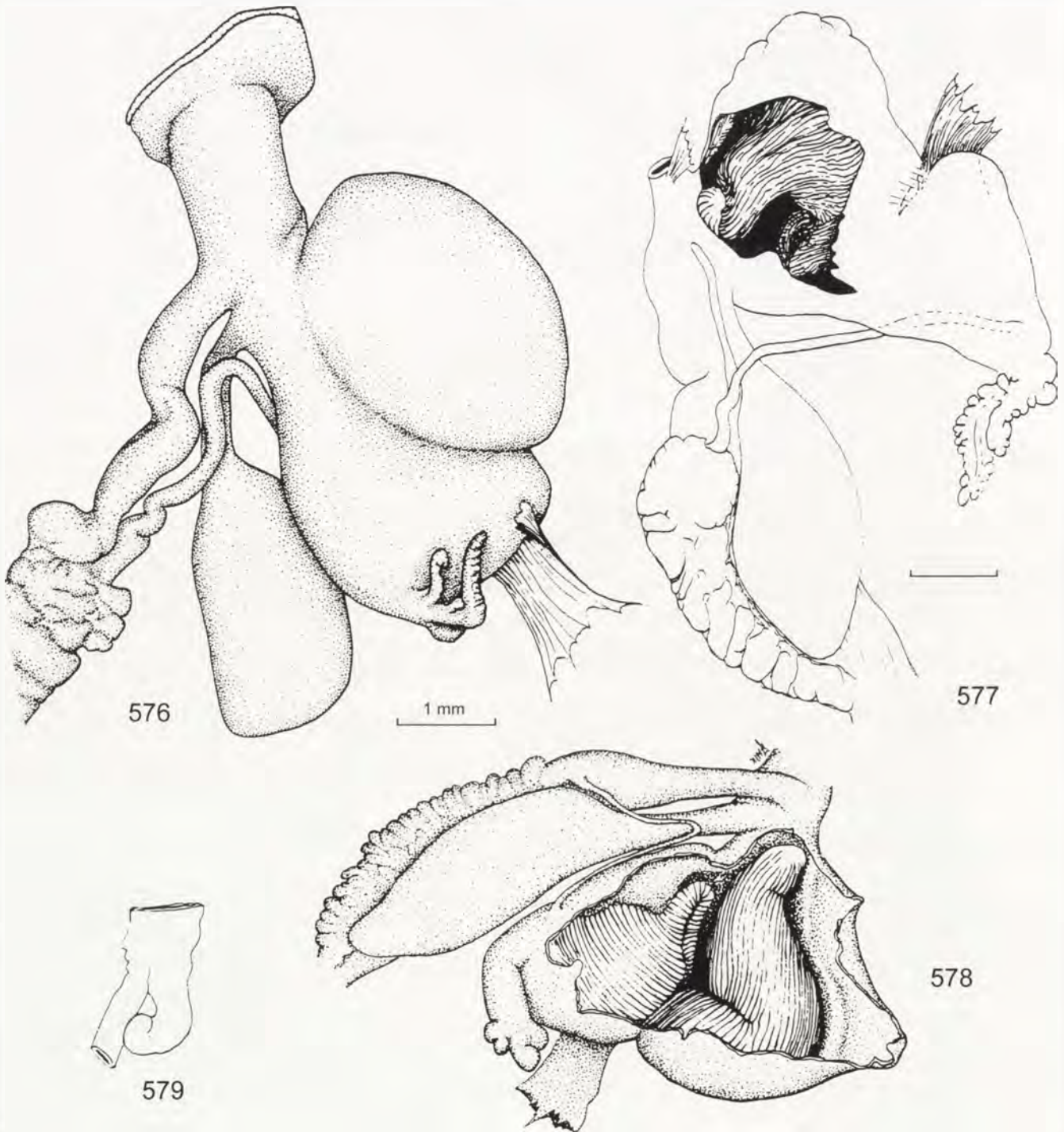
Body length up to 27 mm. General coloration creamy with blackish spotting both on mantle and back, except for the latter's medial section. Some specimens (from Kea Isl.) are almost uniformly creamy with only scarce spots on mantle (Figs. 607–608).

Genitalia (Figs. 609–611, 614–618). The anterior section of penis oval or cylindrical, distinctly longer than the posterior one. The lateral constriction deep, in the form of a crevice. The posterior penial section with a conspicuous, transversely situated appendix. Penial gland, set apically relative to the longitudinal axis of penis, is composed of a few thick, sometimes branching processes. Vas deferens opens almost apically at the base of penial gland. Musculus retractor penis bifurcate, its one strand attached below the vas deferens outlet, the other to the anterior fragment of penis. Stimulator large, flat, sometimes contracted, with its margins folded up.

Rectal caecum vestigial: in the shape of a shallow pocket (Figs. 612–613).



Figs. 560–575. *Deroceras reticulatum* from Poland. 560 – Reproductive system. 561–563 – Copulatory organs. 564 – Stimulator inside penis. 565–575 – Different types of penial gland. A – atrium, Bc – bursa copulatrix = spermatheca, Dh – ductus hermaphroditicus, Ga – glandula albuminalis, Gh – glandula hermaphroditica, Fl – penial gland, Mrp – musculus retracto penis, P – penis, SPOV – spermooviductus. (After Wiktor 1973)



Figs. 576–579. *Deroceras reticulatum*. 576 – Copulatory organs of a specimen from Bulgaria. 577 – Copulatory organs of a specimen from Yugoslavian Macedonia. 578 – Structures inside penis of a specimen from Poland. 579 – Caecum on rectum of the same specimen as in Fig. 577. (After Wiktor 1960, 1983, 1996)

Distribution. The species is recorded exclusively from the Cyclade Archipelago (Greece), i.e. Kea, Sérifos and Sifnos Isls.

***Deroceras (Deroceras) sturanyi* (Simroth, 1894)**

Agriolimax Sturanyi Simroth, 1894c: 393 t. 19 figs. 6–9. Locus typicus: Ochrida (= Lake Ohrid, Macedonia). Lectotypus: NMW no. 19494.

Agriolimax murinus Simroth, 1894c: 393 t. 19 figs. 10–11. Locus typicus: Ochrida (= Lake Ohrid, Macedonia). Holotypus: NMW no. 19439.

Deroceras romanicus Grossu et Lupu, 1959: 46 figs. 6a–f. Locus typicus: Sibiu (Roumania). Holotypus: SMF no. 161648/6.

References: Lupu 1972b: 91 figs. 25–39 (variability of penis); Wiktor 1973: 113 figs. 47–48, 159–165, 239, 274–275; Kosińska 1980: 113 (life history); Likharev and Wiktor 1980: 132 figs. 55–62; Wiktor 1983: 166 figs. 82–83; Wiktor 1996: 94 figs. 125–126.



Fig. 580. *Deroceras rhodensis* – copulatory organs. (After Altén 1972)

Body length in live specimens up to 46 mm, rarely even up to 60 mm, after preservation in alcohol ca 25 mm. Skin thin, limp, with internal organs showing through. Coloration even (Figs. 619–620): pale coffee, dark creamy, chocolate, sometimes black. Back usually darker in colour. After preservation the slug is usually from whitish- to blackish-coloured. Mucus colourless, watery.

Genitalia (Figs. 621–625, 628–630). Viscera, including reproductive organs, most commonly covered by a blackish membrane. Penis hammer-shaped, of a short medially broadened shaft, with two appendices differing in size and shape, usually bent anterad. One of the appendices is rounded, the other assuming various shapes: it may be hook-like bent or straight; both are gofferred (Fig. 629). The other appendix mentioned probably plays the role of penial gland. Vas deferens opens at the base of the larger appendix. Musculus retractor penis undivided, inserted laterally more or less between the two appendices. Inside penis a low conical stimulator.

Caecum represented by a shallow rectal enlargement or a vestigial pocket (Figs. 626–627, 631).

Ecology. A lowland mesophilous, or even hygrophilous, species, occurring in open habitats predominantly near water, in meadows, ditches, parks and cemeteries, ruderal environment. *D. sturanyi* belongs to slugs of the best known life history (Kosińska 1980). It reaches sexual maturity after ca 65 days, living ca 7 months.

Distribution. Originally, the species probably inhabited south-eastern Europe, particularly the region extending from Macedonia to Croatia and Hungary. It is easily introduced and, as a synanthrope, has invaded vast areas of Europe. It has been recorded from Turkey, Bulgaria, Roumania, Russia, Kazakhstan, Central Europe, Helgoland Isl. on the Baltic, the Netherlands and Germany. The slug can be expected also in other regions, especially of Europe.

Comments. The black form constitutes the majority of the population occurring by Lake Ohrid in Macedonia (within the former Yugoslavia). In the remaining parts of Europe the

pale one, from brown- to creamy-coloured, predominates, darker specimens being only exceptionally found.

Deroceras (Deroceras) subagreste (Simroth, 1892)

Agriolimax subagrestis Simroth, 1892a: 43; Simroth 1894a: 12 T. 17 figs. 5A–B. Locus typicus: Maykop. Syntypus: ZMB no. 45704 (2 dried and therefore not dissected spec.; there is no absolute certainty whether they are syntypes).

Agriolimax agresticulus Simroth, 1892a: 44; Simroth 1894a: 13 T. 17 fig. 6. Locus typicus: "Chamischky" (S of Maykop). See Likharev and Wiktor 1980: 154 and 158.

Agriolimax Ananowi Simroth, 1901: 159 t. 15 figs. 1–16. Locus typicus: Vladykavkaz (= Ordzhonikidze). Syntypus: ZIN. See Likharev and Wiktor 1980: 157.

Non *Deroceras subagrestis*: Grossu and Lupu 1959: 44 figs. 3a–c.

Non *Deroceras ananowi*: Grossu and Lupu 1959: 44 figs. 4a–b.

References: Likharev and Wiktor 1980: 154 figs. 111–115.

Body length up to 45 mm. Coloration, except for head, neck and the anterior part of sides, dark creamy or pale coffee; some specimens are white when alive. Body often covered by fairly sparse spots resembling splashes of a dark pigment. The spots often yield a reticulate pattern. Over pneumostome always a dark blot (!). Head, tentacles, nape, the neck section and the anterior part of sides evenly black or blackish (!) (Figs. 632–634). Sole creamy. In juveniles when irritated mucus turns milky.

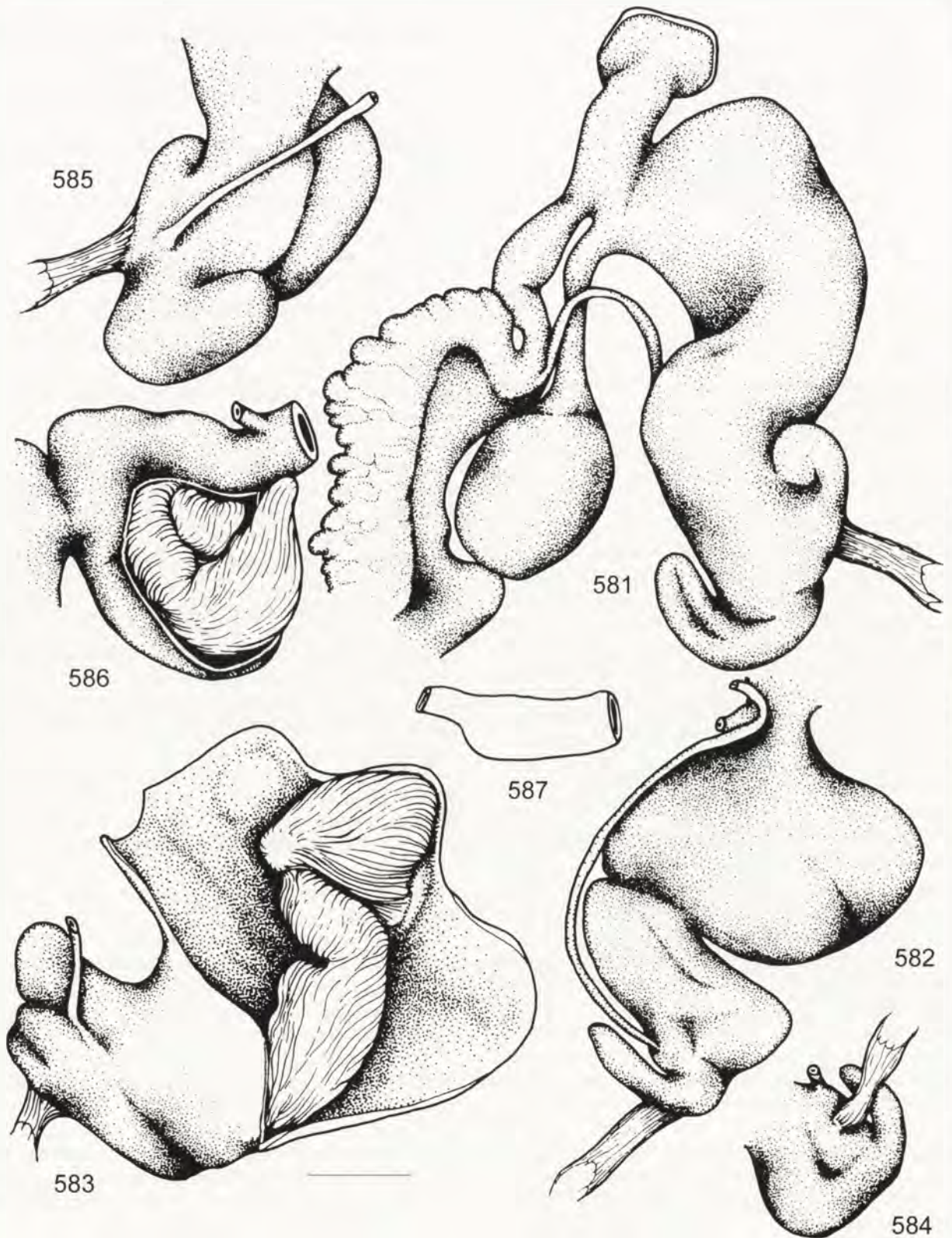
Genitalia (Figs. 635–638). Penis of varied appearance: roundish, pear-shaped or slightly constricted. Penial gland connected with penis more or less apically. Its shape also varies. Usually the gland is made up of a main branch with one or a few lateral offshoots at the base. In juveniles it is represented by a straight branch without appendages. Vas deferens opens to penis apically, too. Between vas deferens and the base of penial gland there is a black blot on penis (!). Musculus retractor penis is laterally attached to penis, roughly in the middle of this organ. An additional small muscular strand comes off the insertion and runs towards the rear of penis, where it is attached (!). Stimulator large, completely flat, fan-shaped, narrowing at the base, whereas its free section is semicircularly rounded (!) like in a fan.

In the place of caecum a vestigial pocket on rectum (Fig. 639).

Ecology. A species of woodland. Wintering as juvenile, the slug reaches maturity in spring and reproduces in this season and early summer. Later in the year only juvenile specimens are found, a part of which reach the male phase of genital development in the autumn.

Distribution. The northern Caucasus and forests of the Krasnodarskiy and Stavropol'skiy Kray, and also the foreland of Dagestan. The range extends southward to reach the region of Tuapse-Sochi and the ridge of the Great Caucasus (here it overlaps the range of relative *D. bakurianum*). As introduced, the species is known from gardens in the environs of Tashkent and glasshouses in the region of Sankt Petersburg and Rostov-na-Donu.

Comments. This slug is very similar to *D. bakurianum*, their distribution ranges partly overlapping. The two species



Figs. 581–587. *Deroceras riedelianum*. 581 – Copulatory organs. 582 – Penis. 583–584 – Structures inside penis. 585–586 – Posterior end of penis in different specimens. 587 – Rectum. (After Wiktor 1983)

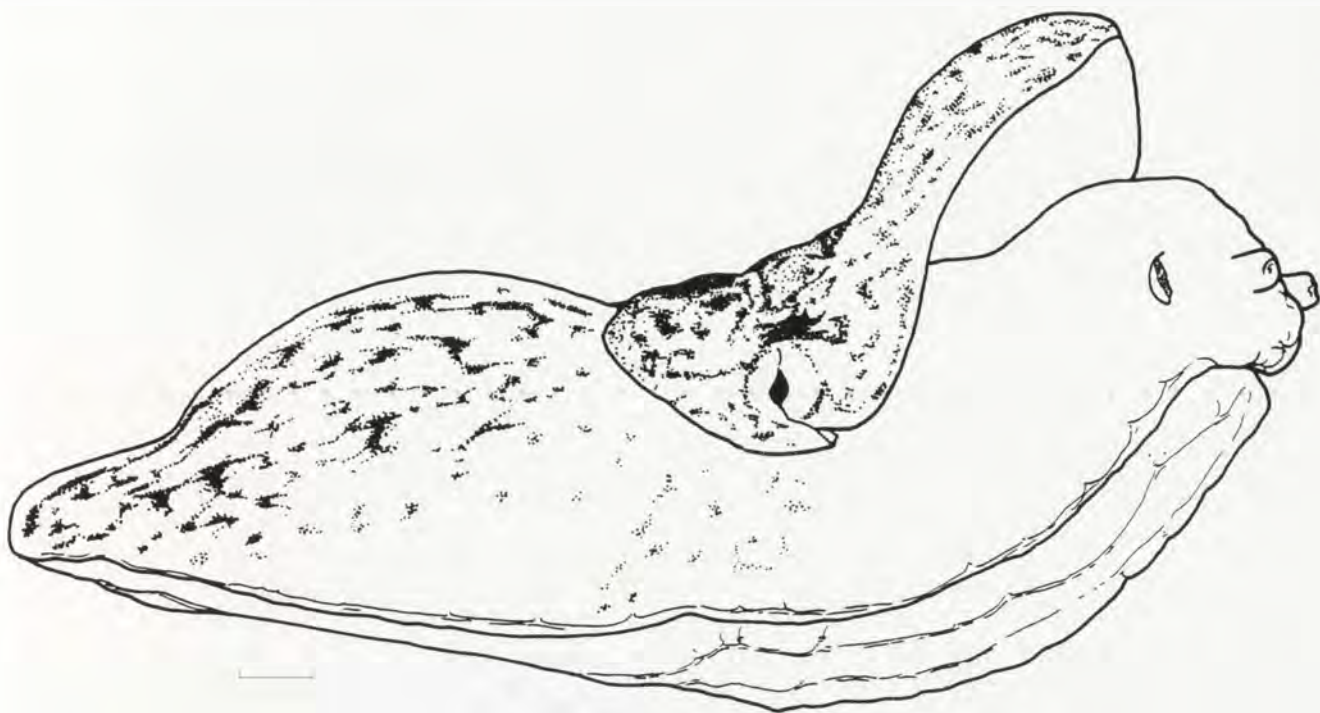


Fig. 588. *Deroceras riedelianum* – external appearance. (After Wiktor 1983)

differ mainly in the appearance of stimulator and penial retractor as well as in distribution (see Comments to *D. bakurianum* p. 406).

***Deroceras (Deroceras) tarracense* Altea, 1969**

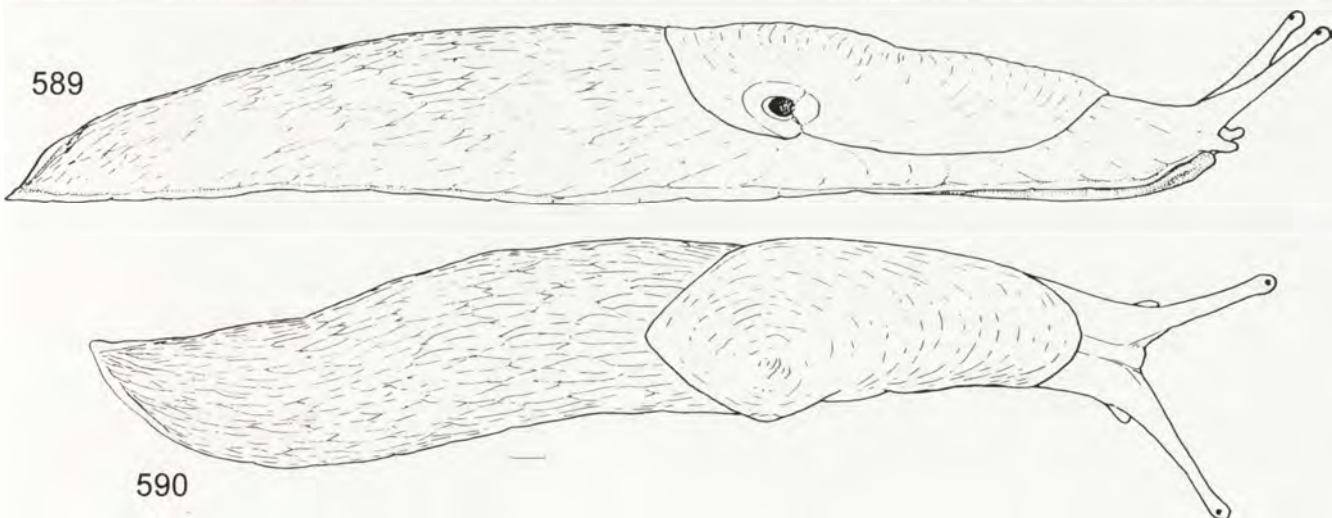
Deroceras tarracense Altea, 1969a: 106 figs. 3a–e. Locus typicus: Nola de Colleju, prov. Tarragona (Spain). Holotypus: NNML no. 5233.

References: de Winter 1986: 138; Castillejo, Garrido, Iglesias 1993: 175 figs. 17–22, 52; Castillejo, Garrido, Iglesias 1995: 30 figs. 66–72.

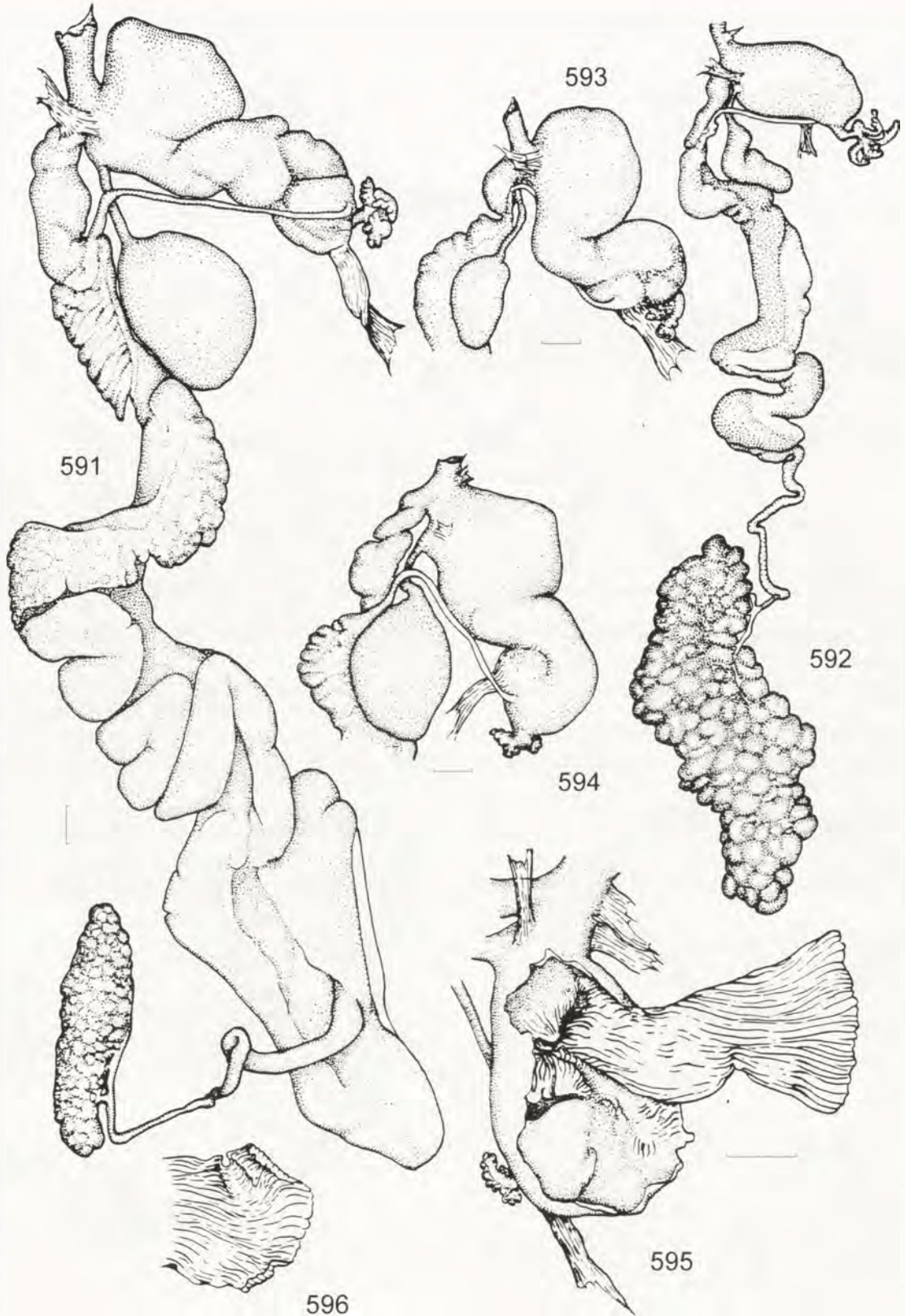
Length of live individuals up to 40 mm (Castillejo *et al.* 1993), after preservation 23 mm. Coloration brown of various

intensity, body covered by grey-brownish or blackish spots. Mucus colourless.

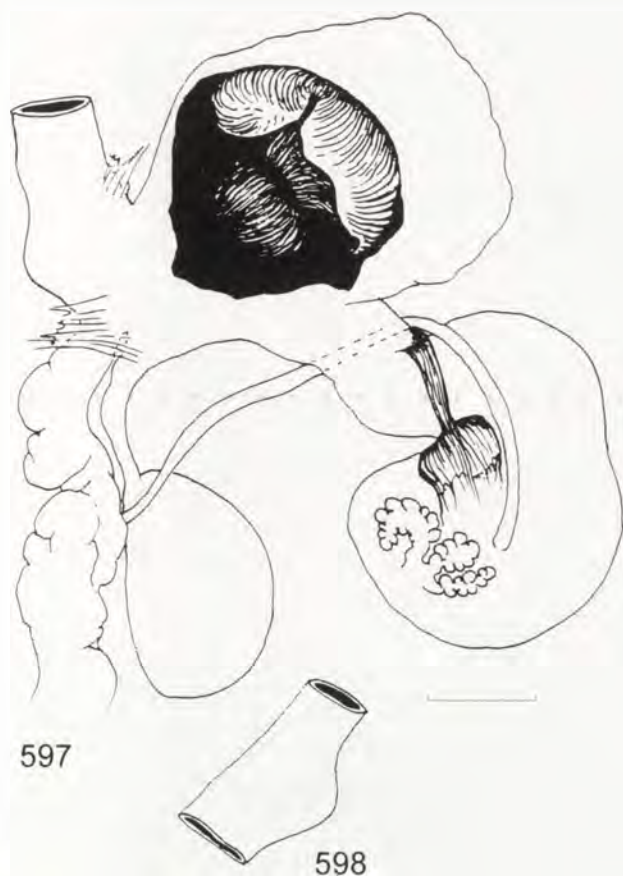
Genitalia (Figs. 640–642). Gonad does not reach the posterior end of viscera. Penis anteriorly equipped with a large appendix of transversely corrugated surface (!). This organ makes the slug distinguishable from the other species of the genus *Deroceras*. The posterior and the anterior part of penis are not separated from each other by a constriction. Near the hind end of the organ mentioned there are two inconspicuous lateral swellings. Roughly between them a small undivided digital penial gland is situated. Musculus



Figs. 589–590. *Deroceras rodnae* – external appearance. (After Wiktor 1973)



Figs. 591-596. *Deroceras rodnae* - specimens from Poland. 591-592 - Reproductive system in an adult and a juvenile specimen. 593-594 - Copulatory organs. 595 - Stimulator inside penis. 596 - Fragment of stimulator. (After Wiktor 1973)



Figs. 597–598. *Deroceras rodnae* from Croatia. 587 – Copulatory organs. 598 – Rectum. (After Wiktor 1996)

retractor penis is laterally attached to the larger of the swellings. Inside penis a conspicuous cylindrical fold (stimulator?), its end directed towards the appendix interior.

Caecum on rectum well-developed (Fig. 643).

Distribution. Up until now the species has been recorded only from province Tarragona in Spain (Altena 1969, Castillejo *et al.* 1993, 1995).

Comments. A slug bearing similarity to *D. altimirai* (see p. 402). In de Winter's opinion (1986), *D. tarracense* should be acknowledged as a subspecies of *D. altimirai* or regarded as a distinct species. Castillejo *et al.* (1993, 1995) treat the taxon concerned as a species, and I share this view.

D. tarracense is distinguishable mainly by a very specific appendix on the anterior section of penis, and also by the shape and location of stimulator.

Deroceras (Deroceras) tauricum (Simroth, 1901)

Agriolimax tauricum Simroth, 1901: 153 figs. 7a–b. Terra typica: Crimea. Typus: no information about its existence.

Agriolimax Dymczewiczii: Simroth, 1885: 224 and 329 t. 9 figs. 24XA, 25XB (non *Agriolimax Dymczewiczii* (Kaleniczenko, 1851)).

Deroceras ramosum Sklyar, 1975b: 79 fig. (not numbered). Locus typicus: ca 30 km NW of Alushta (Crimea, Ukraine). Holotypus: IZK.

Deroceras crimense: Hudec, 1972: 84 fig. 12. See Likharev and Wiktor 1980: 163.

References: Likharev and Wiktor 1980: 163 figs. 128–137.

Body length up to 35 mm. Coloration grey-yellowish with brown or blackish spotting varying in intensity from individual to individual. The spots are concentrated mainly in skin grooves. Sometimes they are so dense that the slug seems to be nearly black having lighter spaces visible only here and there. In the specimens that have intensely dark spots the nape section is dark and the dark pigment may infiltrate the lateral zones of sole. In the paler specimens the sole's lateral zones are scarcely darker than the medial one. A population comprises individuals of widely varying pigmentation, lighter specimens are most frequently larger.

Genitalia (Figs. 644–649). Penis elongated, variedly shaped, with enlargements or bulges. The posterior end of penis elongated to form a hook-like appendix beside which an additional spherical distension occurs. One side of penis often with a dark blot. Penial gland single, unbranched, situated laterally. Vas deferens opens between appendix and the spherical bulge. Next to this opening a strong unbranched musculus retractor penis is inserted. Stimulator large, flat, low, with a wide base. Spermatheca dark-pigmented in the rear.

There is no caecum or only a very shallow pocket discernible on rectum (Fig. 650).

Ecology. A forest species occurring also in parks and gardens, reproducing in spring from February to April.

Distribution. The forest and forest-steppe areas of Crimea.

Comments. Simroth (1885) used the name *A. Dymczewiczii* (Kaleniczenko, 1851) for a slug the anatomy of which he did not know. Also Kaleniczenko, when introducing this name, concerned himself solely with the slug's external appearance. After a more thorough study, Simroth (1901) decided he had been dealing with a new species and named it *A. tauricum*.

D. tauricum displays some similarity to *D. ilium* and *D. osseticum*, differing from both in stimulator (see the descriptions of the two species compared).

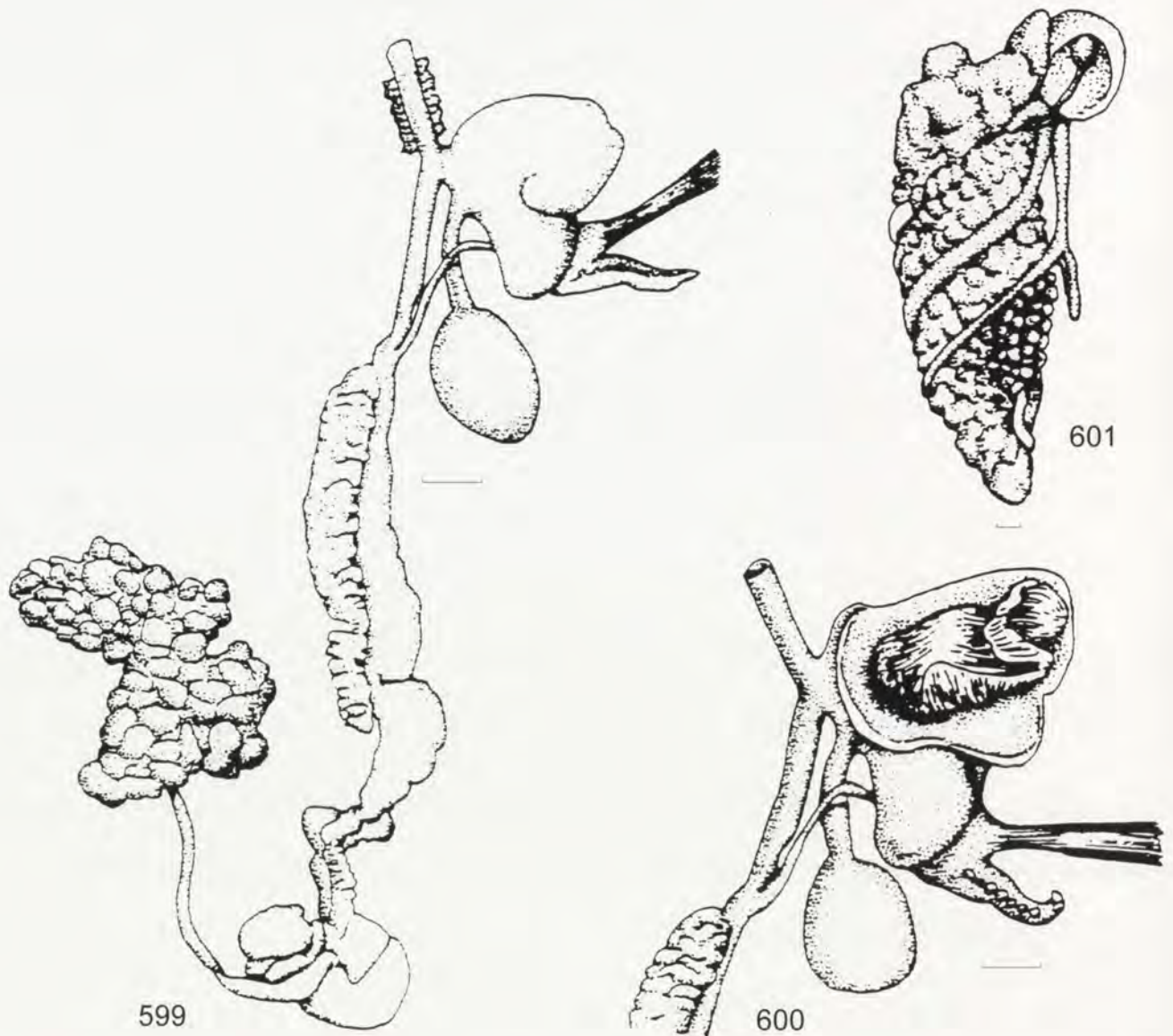
Deroceras (Deroceras) thersites Simroth, 1886

Agriolimax thersites Simroth, 1886b: 317 (as *Agriolimax Thersites* Heynemann et Koch) t. 10 figs. 5–7. Terra typica: Pireus (Greece). Lectotypus: SMF no. 155226.

References: Wagner 1934a: 54 figs. 5–6; Urbański and Wiktor 1968: 70 figs. 9A–G; Wiktor 1983: 178 figs. 96–101; Wiktor – in print.

A large, square-built slug, up to 35 mm in length. Skin thick. General coloration from creamy to pale brown with dark or chocolate spotting, especially on mantle. The medial section of back, i.e. the extension of keel, devoid of spots (Fig. 651). Some individuals are unicolour: they have no spots. Sole creamy.

Genitalia (Figs. 652–655, 657–659, 662–666). Penis divided by a deep constriction. The organ's anterior part usually asymmetrically laterally distended. The posterior section with different types of distensions, one of which resembles



Figs. 599–601. *Deroceras rodnae* from Spain. 599 – Reproductive system. 600 – Copulatory organs with visible stimulator. 601 – Posterior end of viscera with visible long caecum. (After Castillejo *et al.* 1995)

a broad transverse appendix; this region of penis often dark-pigmented. Penial gland, nearly apically situated, assumes the shape of a branched tree (!). It has a common trunk, farther repeatedly branching (!). There are most frequently two main branches dividing into smaller offshoots. Vas deferens opens laterally. Also laterally, musculus retractor penis attaches itself to the posterior section of penis. The muscle is not forked but from its main insertion an inconspicuous muscular strand runs anterad along penis. Stimulator large, conical, somewhat flattened, never pigmented in the specimens I have had at my disposal.

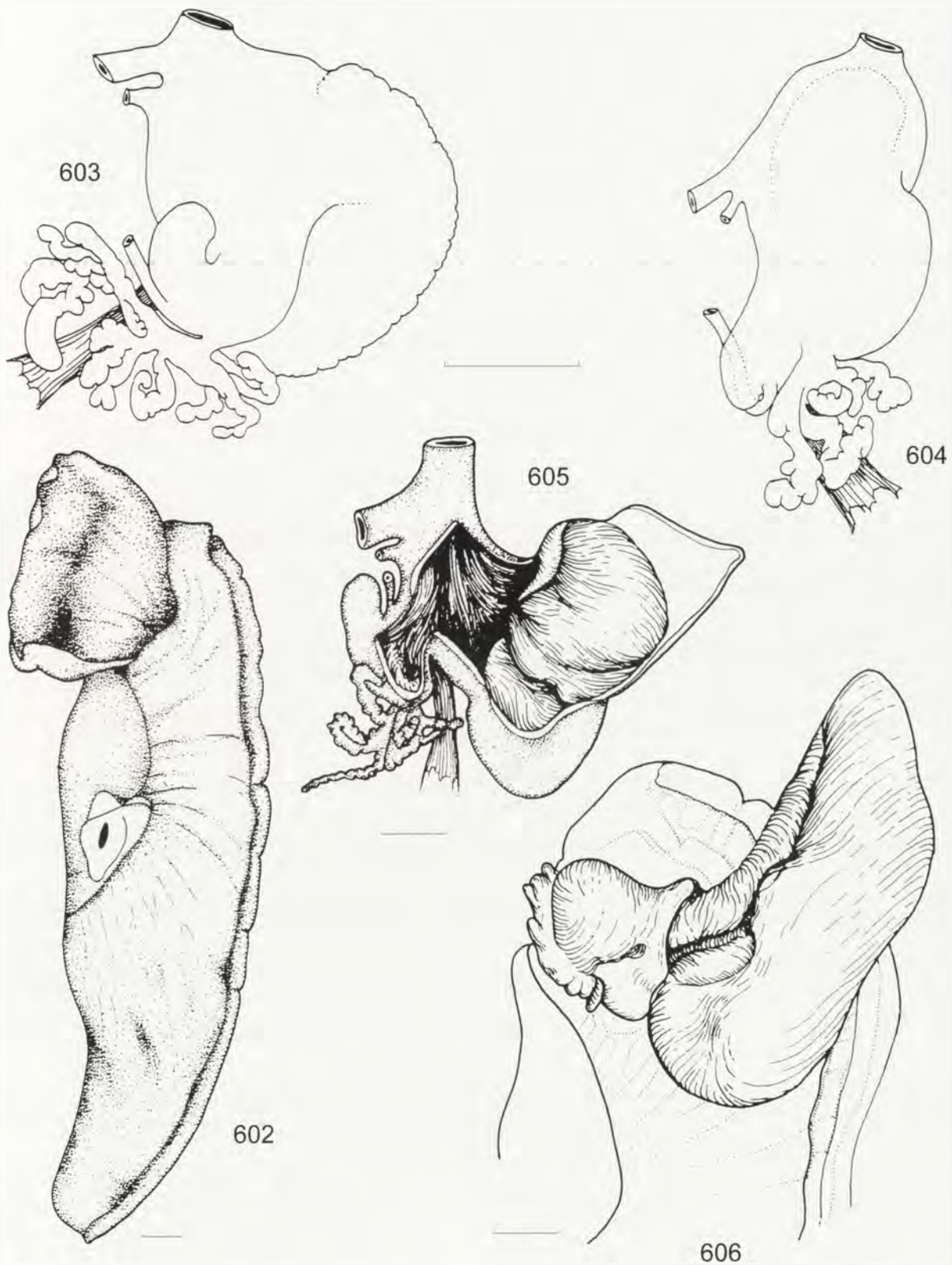
Caecum on rectum long (Figs. 656, 660–661, 667–668).

Distribution. The range is difficult to define. The species is known from scattered localities in Greece (its continental

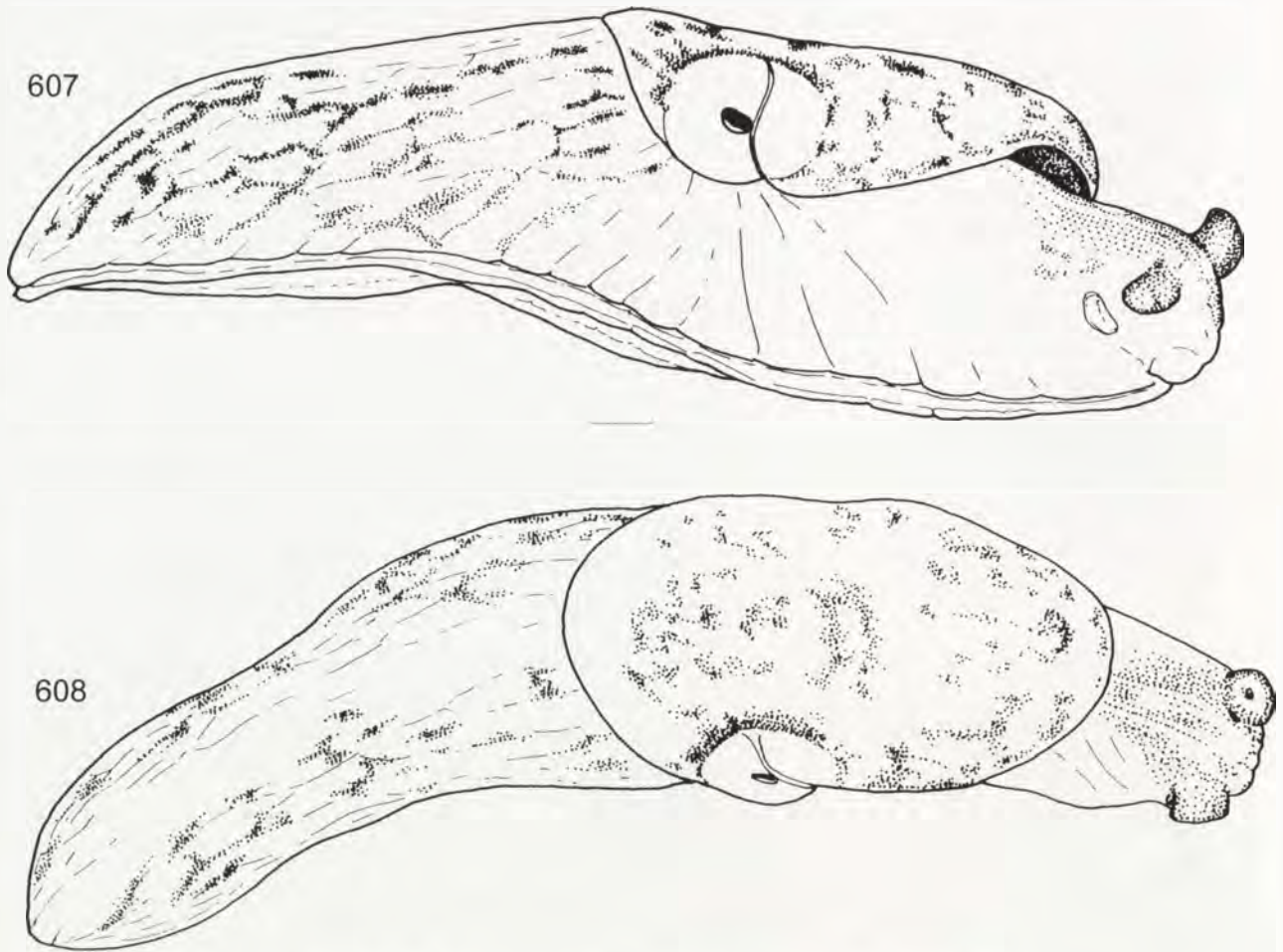
part and the islands of Egina, Chios and Crete) and Bulgaria. The dispersion of the localities and their character indicate that at least some of them are a result of introduction.

Comments. Sometimes the slug discussed resembles *D. rethimnonensis*, differing, however, in its thick skin, body spotting and, especially, repeated division of penial gland, and pale, unpigmented, stimulator. The shape of penis is different as well, but this is difficult to describe (cf. the descriptions and figures).

The reports on the occurrence of *D. thersites* in Roumania are doubtful and require confirmation. The description and drawings provided by Grossu (1972: 3 fig. 1 and 1983: 354 figs. 222a–f) evidently point out that the author dealt with some other species of slugs.



Figs. 602–606. *Deroceras samium*. 602 – Slug with its stimulator everted. 603–604 – Penises of two slugs. 605 – Stimulator inside penis. 606 – Anterior body section with everted penis. (Orig.)



Figs. 607–608. *Deroceras seriphium* – external appearance. (After Wiktor 1981)

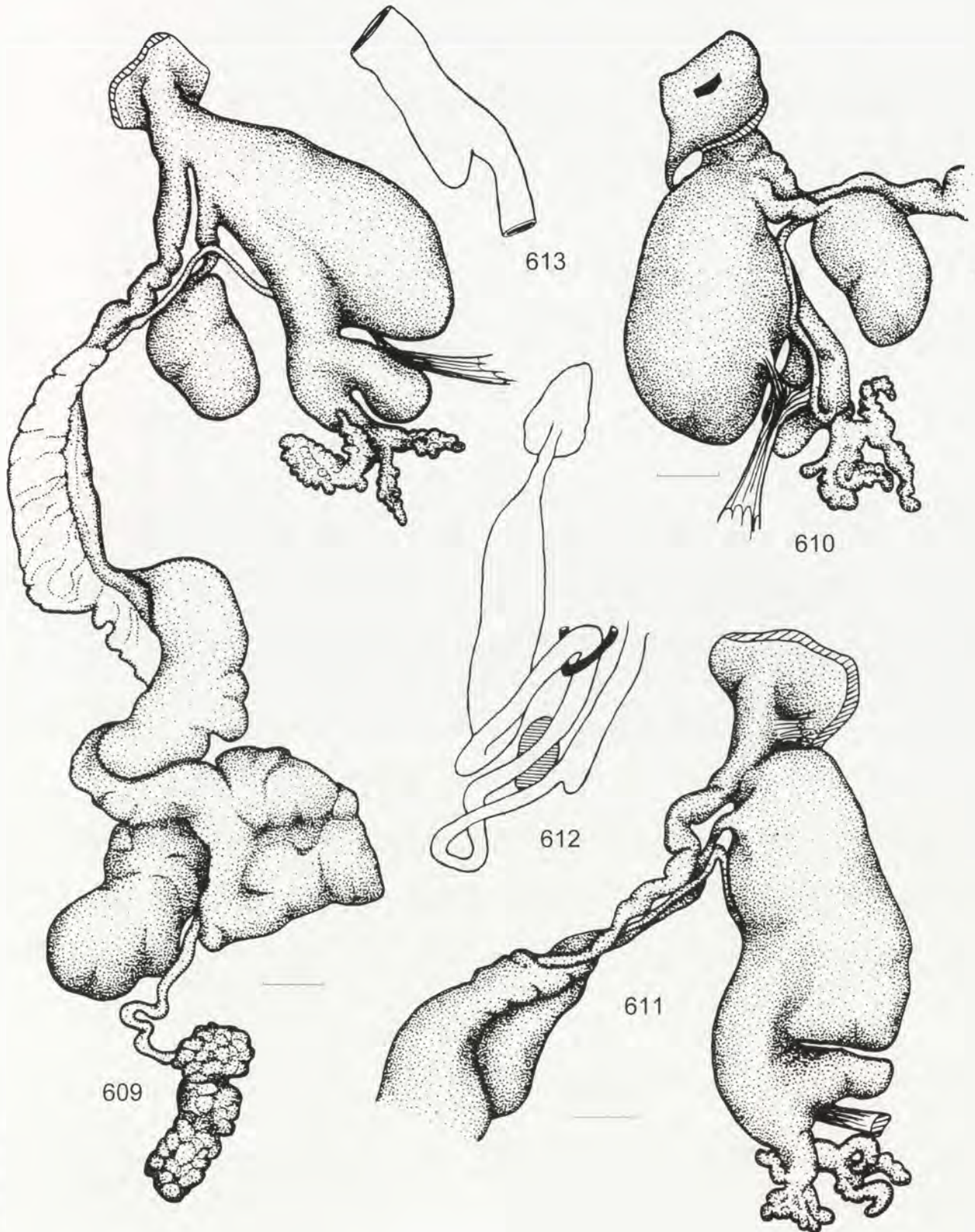
***Deroceras (Deroceras) turcicum* (Simroth, 1894)**

- Agriolimax turcicus* Simroth, 1894b: 392 t. 19 figs. 2–5. Locus typicus: Ochrida See (= Lake Ohrid, Macedonia). Holotypus: NMW no. 19491.
- ?*Deroceras forcarti* Grossu et Lupu, 1961a: 21 figs. 1–2. Locus typicus: Babadag (Dobruja, Roumania). Holotypus: Grossu's coll. (Bucharest) no. 13119. Paratypus: MNHW (from Chyma – the only specimen I have examined).
- Deroceras schleschi* Grossu et Lupu, 1961a: 23 figs. 3–5. Locus typicus: Ciucas Mts. (Bazău Mts., Roumania). Holotypus: NMGAB no. 13120. Paratypi: MNW.
- Deroceras callatis* Grossu et Lupu, 1963: 197 fig. 1, pl. III fig. 9. Locus typicus: Comorova, N of Mangalia (Roumania). Holotypus: NMGAB no. 13132. See figs. 687–689.
- Deroceras geticus* Grossu, 1969: 158 figs. 1a–e. Locus typicus: Comana, "Bezirk Teleorman in der walachischen Ebene" (Roumania). Holotypus: SMF no. 194946. **Syn. nov.**
- Deroceras jaeckeli* Grossu, 1969: 159 figs. 2a–g. Locus typicus: valley of the Topolog River (com. Tigveni, Arges, Roumania). Holotypus: Grossu's coll. (Bucharest) no. 1141. Paratypi: SMF no. 194947. **Syn. nov.**
- Deroceras dobrogiensis* Grossu, 1969: 160 figs. 3a–e. Locus typicus: Luncavița (Dobruja, Roumania). Holotypus: Grossu's coll. (Bucharest) no. 1142. Paratypus: SMF no. 194945/3 – 1 spec. from Jurilovica, N Dobruja (Roumania). **Syn. nov.**
- ?*Deroceras vranceanus* Grossu, 1969: 161 figs. 4a–g. Locus typicus: Vrancea (E Carpathian Mts, Roumania). Holotypus: Grossu's coll. (Bucharest) no. 1143.

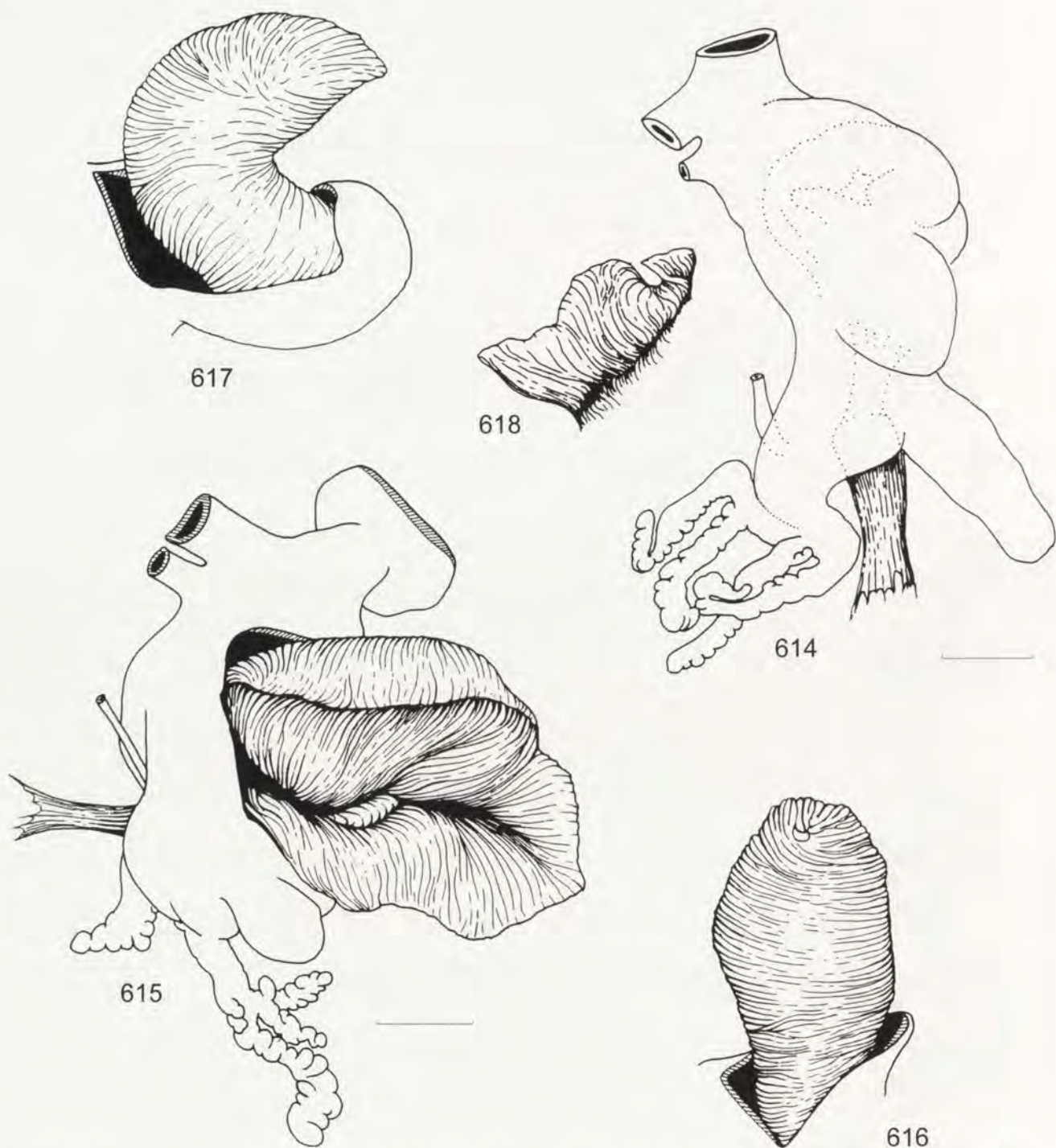
- ?*Deroceras transylvanicus* Grossu, 1969: 165 fig. 8. Locus typicus: Stina de Vale (W Carpathian Mts., Roumania). Holotypus: SMF no. 194948.
- Deroceras pseudolytopelte* Grossu, 1969: 167 figs. 9a–d. Locus typicus: Serisoara (W Carpathian Mts., Roumania). Holotypus: SMF no. 194948. **Syn. nov.**
- Deroceras wiktori* Grossu, 1969: 168 figs. 10a–i. Locus typicus: Orșova-Esalnița (Roumania). Holotypus: Grossu's coll. (Bucharest) no. 1147.
- ?*Deroceras waldeni* Grossu, 1969: 169 figs. 11a–i. Locus typicus: Jurilovica (Dobruja, Roumania). Holotypus: Grossu's coll. (Bucharest) no. 1148.
- Deroceras bosnensis* Grossu, 1972a: 643 figs. 3a–d. Terra typica: Bjelašnica pl. (Bosnia). Lectotypus: NMW no. 32333. See Wiktor 1996: 99 figs. 131–133.
- Deroceras hercegovinae* Grossu, 1972a: 645 figs. 4a–f. Terra typica: Bjelasica (it should be spelled "Bjelašnica") near Gacko (Herzegovina). Holotypus: NMW no. 77502. See Wiktor 1996: 99 figs. 134–135.
- Deroceras absoloni*: Grossu and Lupu 1959: 42 figs. 1a–e.
- Deroceras transcaucasicus*: Grossu and Lupu 1959: 42 figs. 2a–b.

References: Lupu 1972: pl. IV figs. 40–48 (variability of penis); Altena 1973: 86 figs. 2a–c (as *D. cf. forcarti*); Wiktor 1983: 172 figs. 89–93; Wiktor 1994: 10 figs. 15–21; Wiktor 1996: 97 figs. 129–130.

Usually a smallish slug up to ca 20 mm, dirty creamy or brown-creamy, densely covered with blackish or chocolate spots arranged in a reticulum. Keel and its extension, i.e. the medial section of back, without spots (Fig. 669). Mucus colourless. On irritation a milky white mucus is secreted as well.



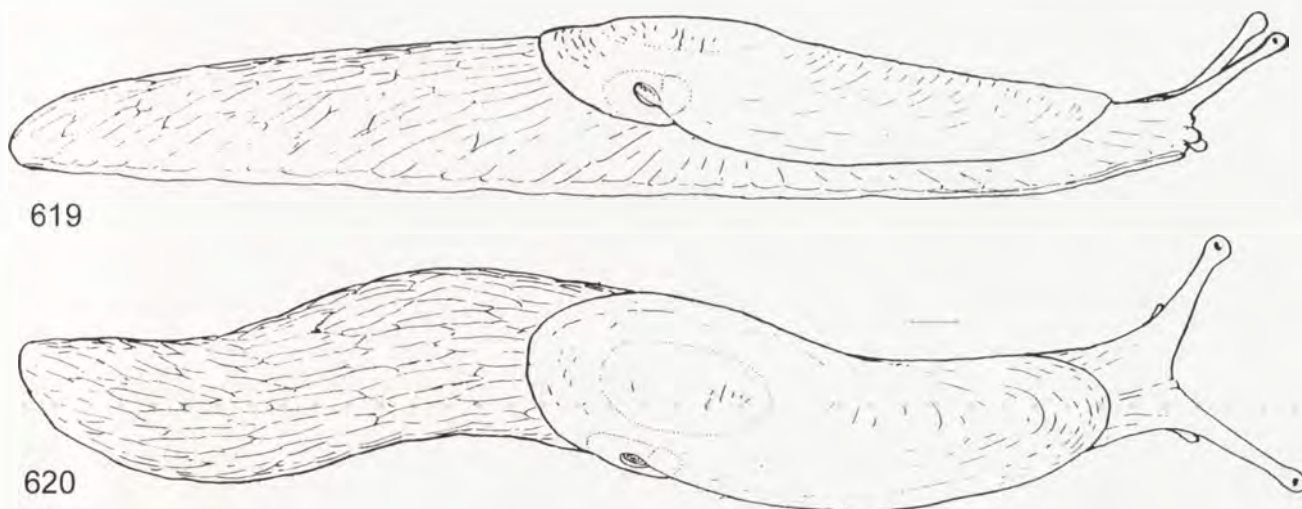
Figs. 609–613. *Deroceras seriphium*. 609–610 – Reproductive system and penis of the same specimen seen from the other side. 611 – Copulatory organs of the holotype. 612 – Alimentary system. 613 – Rectum. (After Wiktor and Mylonas 1981)



Figs. 614–618. *Deroceras seriphium*. 614 – Penis. 615 – Penis with unfolded stimulator. 616–618 – Different stimulators. (After Wiktor and Mylonas 1981)

Genitalia (Figs. 670–672, 674–679, 681–684, 687–688, 690–697). In adult specimens penis laterally constricted. The anterior fragment of the organ heavily distended, the posterior one narrower, usually with two distensions. Penial gland highly varied in shape, in most specimens showing a tendency towards significant reduction (!). Most commonly it is made up of a number of knots or represents a protuberance

covered by quite a few knots, or else it is composed of a few, usually short, processes set directly on penis or on a short common shaft. The gland is usually slightly laterally situated between the above mentioned swellings in the posterior section of penis. Vas deferens opens at the base of penial gland on the side of penis facing viscera and thus on the body axis (!). Retractor penis unforked. Stimulator conical.



Figs. 619–620. *Deroceras sturanyi* – external appearance. (After Wiktor 1973)

Caecum on rectum well-developed (Figs. 673, 680, 685–686, 689).

Ecology. A eurytopic slug, chiefly of forests, often found in great numbers particularly in beech and mixed woods. Not infrequently, as a synanthrope, it lives in parks, ruins, stone piles, gardens etc.

Distribution. A species presumably of Balkan origin, now occurring in Austria, Hungary, Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro, most probably also in Albania, certainly in Greece and Turkey.

Comments. A species creating considerable difficulties, which is evidenced by the number of synonyms. The tendency towards reduction of penial gland, with the simultaneous wide variability of this organ, is the main reason for these difficulties, especially when only a small series of specimens is available.

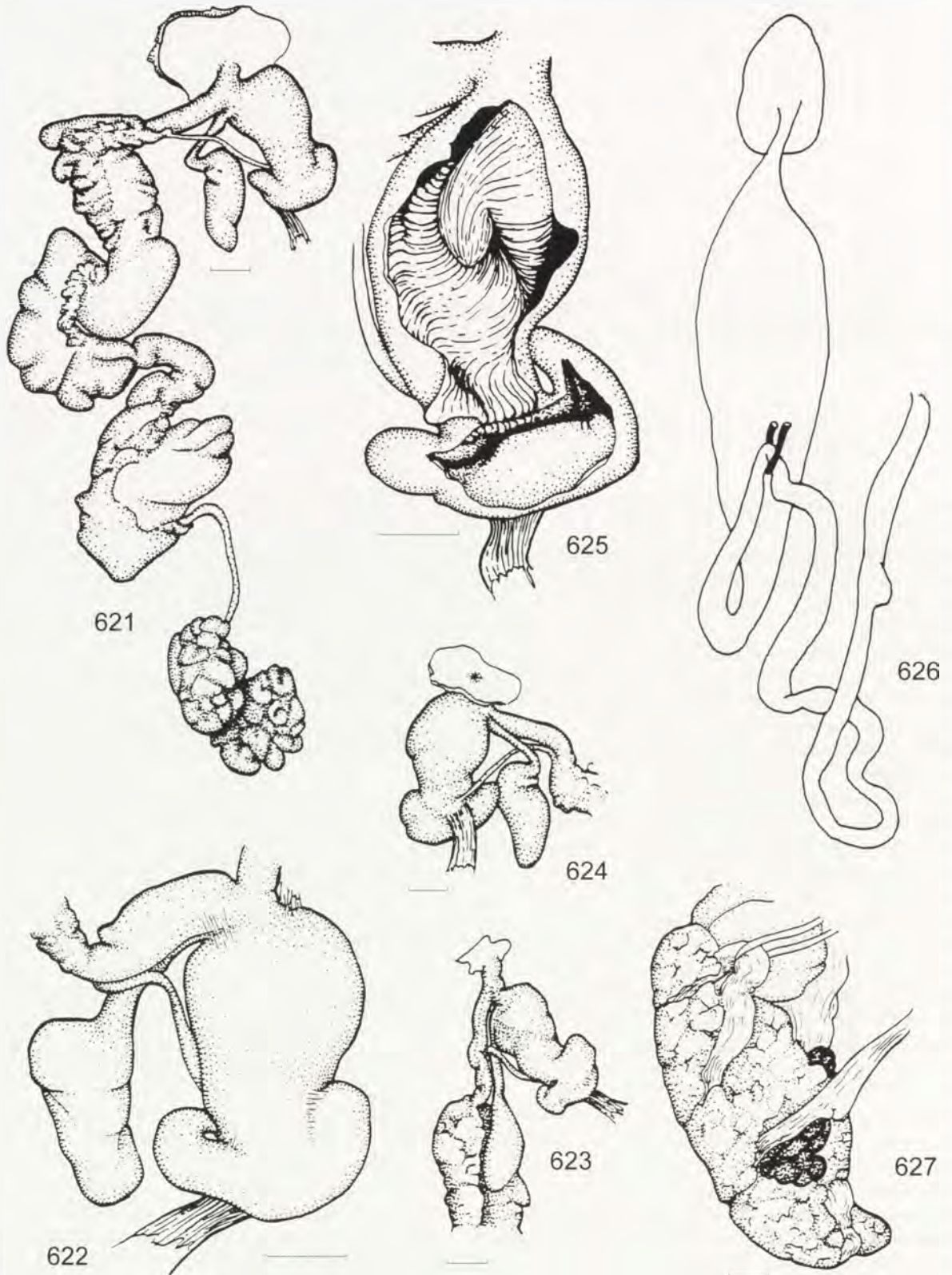
An apparent similarity is that to *D. reticulatum*. It pertains nearly to all characters of external appearance and anatomy. As far as external features are concerned, *D. turcicum* does not attain such a large size as the other slug does. With regard to the structure of genitalia, the main difference lies in the reduction of penial gland, although one may also collect individuals in which the organ is hardly smaller in proportion to penis than this is the case in *D. reticulatum*. An essential feature which is almost always observed in *D. turcicum* is the way vas deferens opens into penis, i.e. on the side of viscera, whereas in *D. reticulatum* the entry of vas deferens is always situated on the side of body integuments. Another difference is that the slug discussed occurs in forests, the type of habitat *D. reticulatum* avoids as a rule. The two species sometimes co-occur as synanthropes and then they can be sympatric. Nevertheless, their distribution ranges are different. Only *D. turcicum* is native to the Balkans, although it reaches as far as Hungary, Austria, Slovenia and Turkey.

D. schleschi – I have in my collection a specimen from Ciucaş, passed on by the authors, with a label saying "paratypus". The place where the slug was collected is the same as in the case of the actual types but the date is earlier (July 1955). The altitude at which the specimen was found is also different, i.e. 1500 m a.s.l., whereas the types were collected at an altitude of 700–1000 m a.s.l. The "paratype" has a tiny penial gland, other characters showing no difference when compared with those of *D. turcicum*.

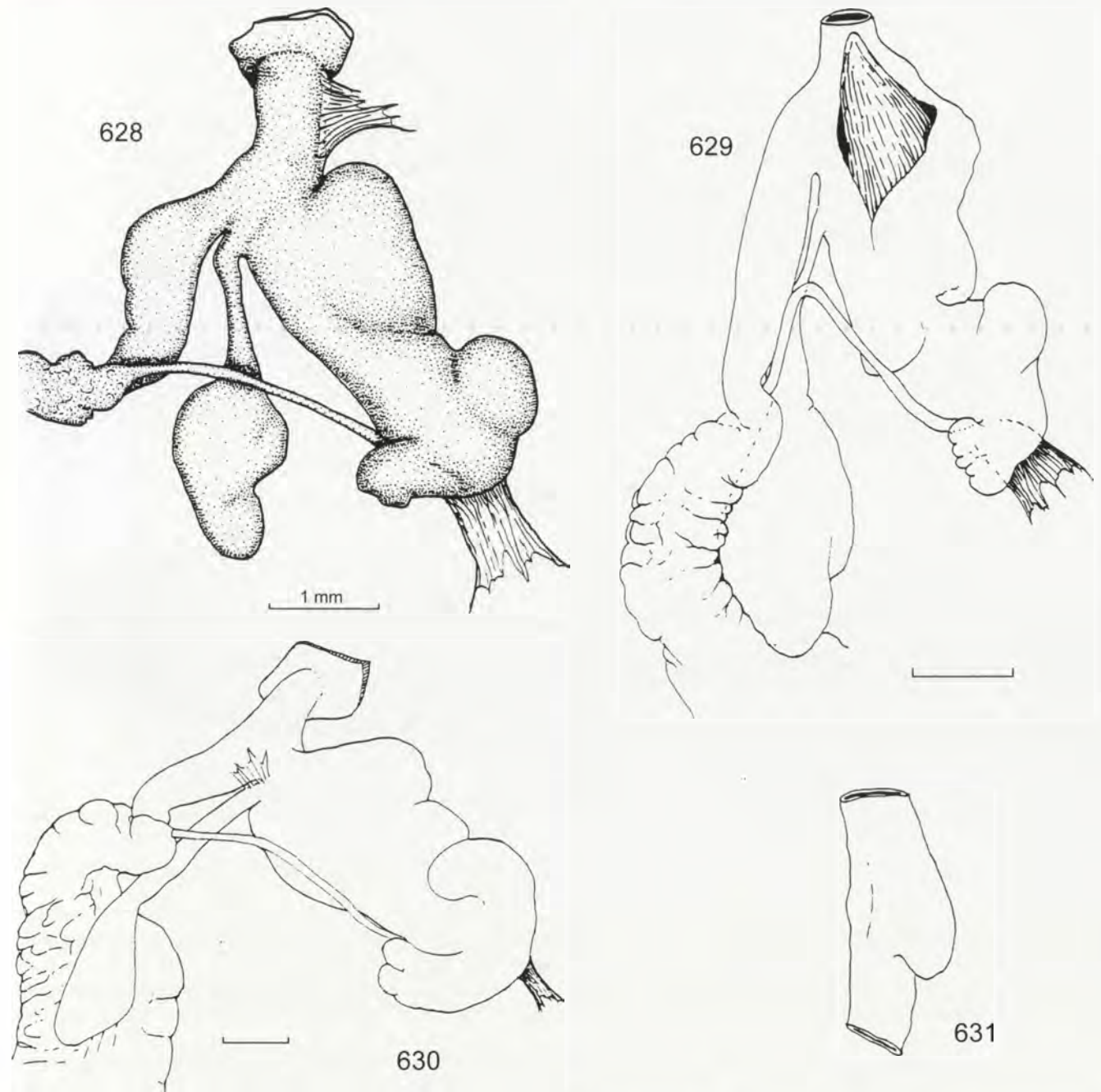
D. dobrogicus – I have examined the paratype from the SMF collection, which was earlier dissected by A. Grossu. The external appearance and structure of genitalia in this paratype (Fig. 695) are slightly different when compared with the holotype. Yet, the description and figures by Grossu (1969) have convinced me that the name is a synonym of *D. turcicum*.

D. vranceanum (emend. *vranceanus*) – I have not seen the types so far. Nevertheless, the description indicates that this is actually *D. turcicum*.

D. pseudolytopelte – I have examined the holotype and the only paratype (a tiny specimen) kept with it (Figs. 696–697). The external appearance of the holotype displays all the characters typical of *D. turcicum*. Even taking into consideration the enormous variability of *D. turcicum*, the penis in *D. pseudolytopelte* diverges slightly from those that I have observed in all the forms of the former species mentioned. The differences are as follows: a. a very deep constriction dividing penis in two parts, b. penial gland devoid of a common shaft. The holotype, which is the only specimen known, has been dissected with a cut on the right side, and that is why rectum is torn off, probably along with caecum. Penis is torn off the rest of genitalia and body integuments, which makes it impossible to determine its original location relative to alimentary canal. It is important considering the fact that, for instance, vas



Figs. 621–627. *Deroceras sturanyi* from Poland. 621 – Reproductive system. 622–624 – Copulatory organs. 625 – Structures inside penis. 626 – Alimentary canal. 627 – Posterior end of viscera. (After Wiktor 1973)

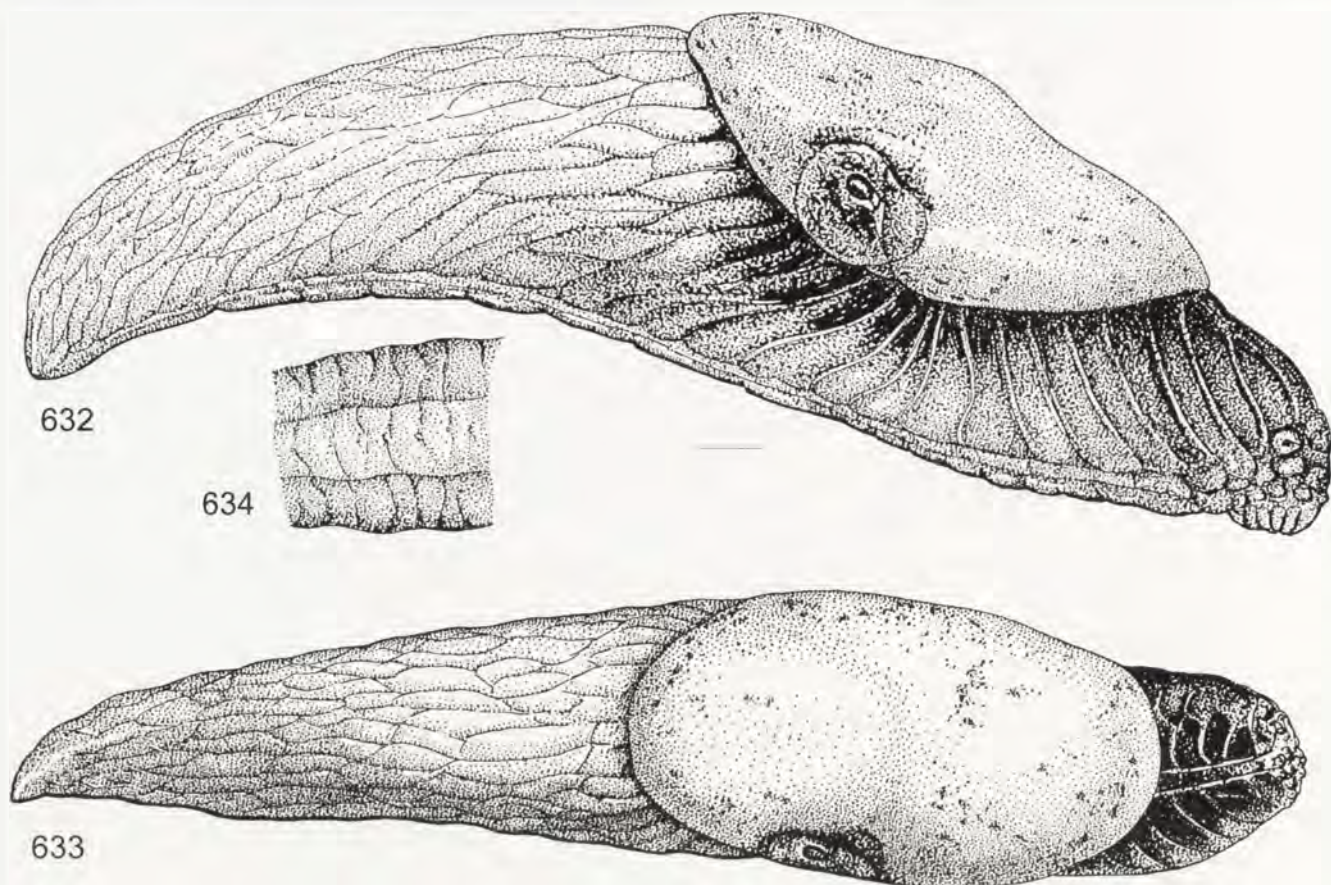


Figs. 628–631. *Deroceras sturanyi*. 628 – Copulatory organs of a specimen from Bulgaria. 629–630 – Copulatory organs of two specimens from Yugoslavian Macedonia. 631 – Rectum of a specimen from Yugoslavian Macedonia. (After Wiktor 1983, 1996 and orig.)

deferens in *D. turcicum* opens to penial wall on the side of alimentary canal, unlike in most other *Deroceras* species. Although I am almost positively sure that *D. pseudolytopelte* is actually *D. turcicum*, having at my disposal merely one specimen, I do not have absolute certainty about the synonymization and therefore I mark the former name with a question mark.

D. geticum (emend. *geticus*) – the holotype is faded (Figs. 693–694). At the moment I was examining it, the

specimen was pale creamy with barely perceivable traces of darker spots on mantle. The rest of body had already turned unicolour. According to Grossu's (1969) description, in the posterior body section thin brown lines occur on sides (!). Penis, stimulator, penial gland and rectal caecum depicted in the paper by Grossu (1969: figs. 1a–e) point out to the slug being *D. turcicum*. It is also evidenced (judging by Grossu's description) by lack of spots on mid-back and the fact that the slug occurs in forest.



Figs. 632–634. *Deroceras subagreste*. 632–633 – External appearance. 634 – Appearance of sole. (After Likharev and Wiktor 1980)

D. jaeckeli – I have examined two paratypes from the SFM collection. They are small and strongly contracted (Figs. 691–692). A careful study has revealed that, when describing the internal structures of penis, Grossu (1969) overlooked the small conical stimulator, wrongly regarding as this organ the fold running from stimulator towards the rear of penis. The fold is heavily twisted in the contracted and partly translucent penis. The conical stimulator is visible in both paratypes and the characters of external appearance, penial gland, caecum on rectum etc. indicate that the slug is *D. turcicum*, so synonymization of the two names is justifiable.

D. transylvanicus – I have examined the paratype no. 194952 from the SMF collection (Fig. 690). It is a juvenile coloured like *D. turcicum*. The specimen is dissected and partly damaged. Its penial gland is composed of three processes directly (without a common shaft) joining penis. Lupu (1971) synonymizes this name with *D. padisii*.

See also the descriptions of *D. padisii* p. 488 and *D. ponori* p. 495.

Deroceras (Deroceras) uataderensis (Simroth, 1904)

Agriolimax uataderensis Simroth, 1904: 678 t. 39 fig. 4, t. 41 figs. 70–71.
 Locus typicus: N margin of Lake Gandjule, Abyssinia (= Ethiopia).
 Holotypus: ZMB.

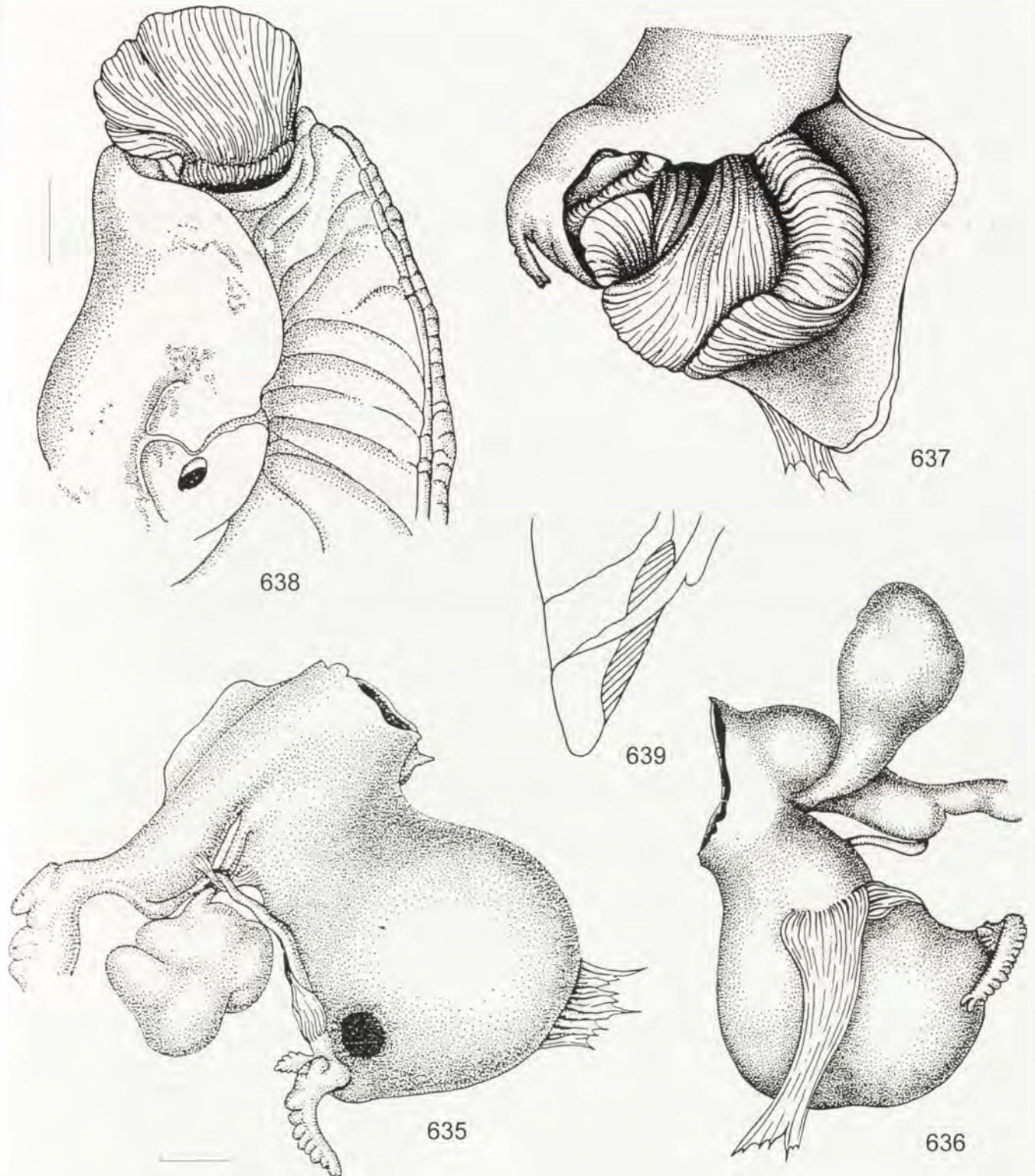
Body size: length 10.5 mm, width unmeasurable now. Coloration, according to Simroth, pale with a grey-brown tint in the upper section (blass, graubraun angeflogen). At present the holotype is entirely faded.

Genitalia (Fig. 698). Penis with a deep lateral constriction, posteriorly with a small lateral pocket (appendix). Penial gland relatively large, tree-shaped: on a shared trunk there are a few thin branches covered by glandular papillae. The broad musculus retractor penis unforked, attached between the outlet of penial gland and the lateral pocket of penis. Vas deferens of the holotype is torn off, so the place of its junction with penis is unknown. Inside the latter organ a flat, short and wide stimulator with its apex triangularly inconspicuously extended.

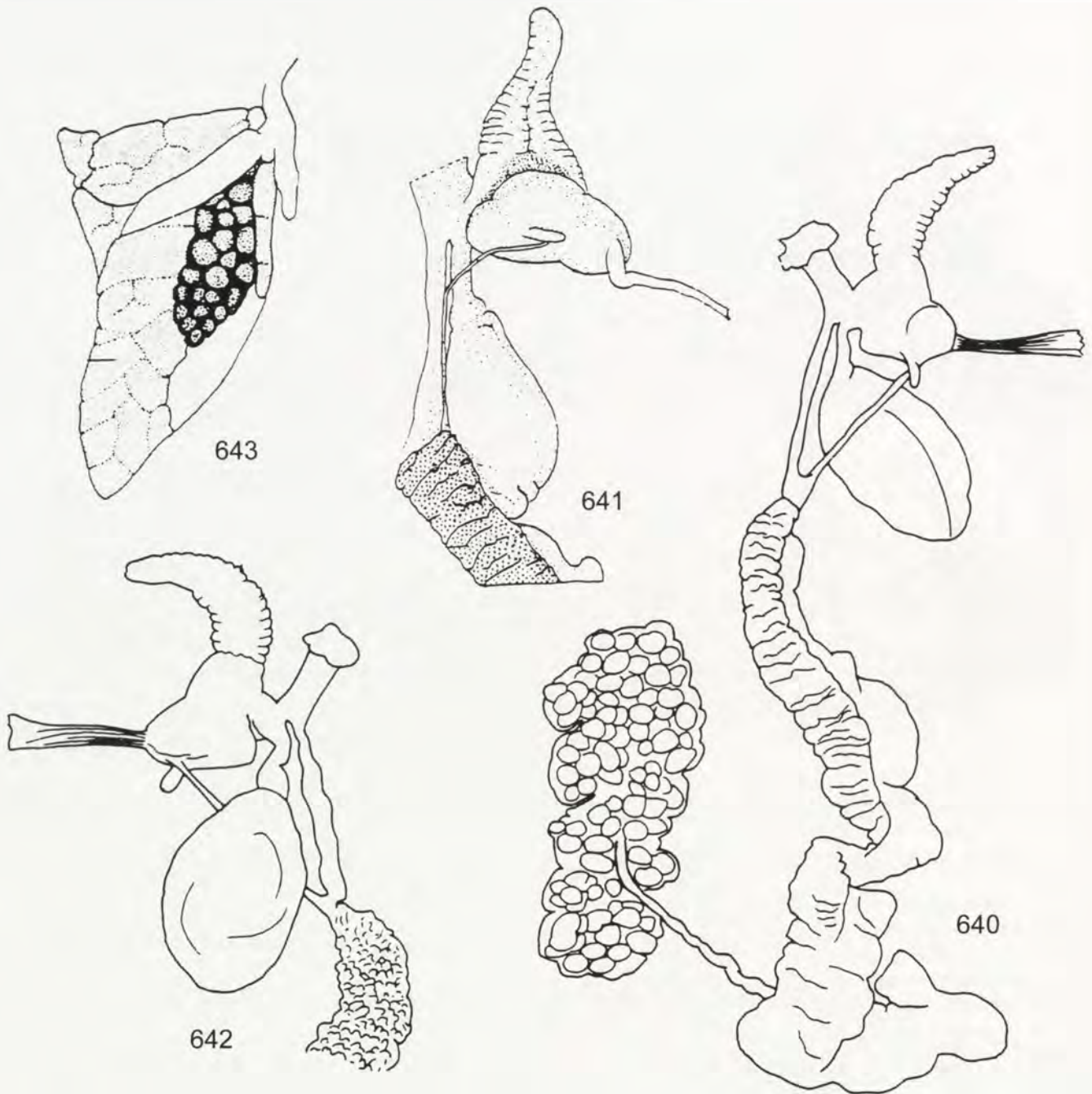
Simroth (1904) does not mention anything concerning rectum and caecum; I have failed to find the organs in the dissected holotype.

Distribution. The species has been recorded only from locus typicus, which is the southernmost locality of the family.

Comments. A very small slug, described on the basis of merely one specimen. To my knowledge, no one has ever collected it since then. In Simroth's (1904) opinion, the individual seems to be adult already, and certainly it is sexually mature. It cannot be excluded that it is identical



Figs. 635–639. *Deroceras subagreste*. 635–636 – Copulatory organs seen from two sides. 637 – Stimulator inside penis. 638 – Anterior body section with everted stimulator. 639 – Posterior section of viscera with visible rectum. (After Likharev and Wiktor 1980)



Figs. 640–643. *Deroceras tarracense*. 640 – Reproductive system. 641–642 – Copulatory organs. 643 – Posterior section of viscera. (After Castillejo *et al.* 1995)

with some other *Deroceras*. Having at one's disposal, however, only the facts known, it is impossible to establish it, and thus *D. uataderensis* should be considered as a good species.

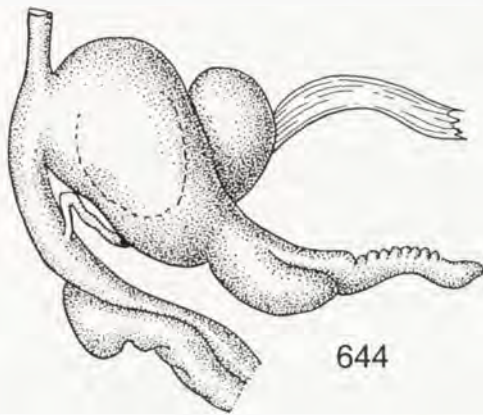
***Deroceras (Deroceras) vascoana* de Winter, 1986**

Deroceras vascoana de Winter, 1986: 143 figs. 11–16. Locus typicus: near Alto de Lizarrusti (13 km SW of Beasain, prov. Guipúzcoa, Spain). Holotypus: NNML no. 9161.

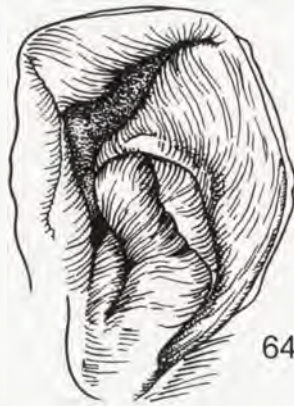
References: Castillejo, Garrido, Iglesias 1993: 178 fig. 52; Altonaga *et al.* 1994: 119 map 136; Castillejo, Garrido, Iglesias 1995: 32 figs. 73–78.

Body length up to ca 30 mm. Coloration uniform (without spots!); pale brown. Irritated slugs secrete a milky mucus.

Genitalia (Figs. 700–701). Penis oval, sometimes slightly medially constricted. Penial gland repeatedly branched, of comparatively short, flattened branches adherent to penial walls (!), situated asymmetrically but apically. Unforked musculus retractor penis apically connected with penis. Vas deferens opens near the rear end of the latter organ between the outlet of penial gland and retractor insertion. At the posterior end of penis a dark blot of pigment. Inside penis



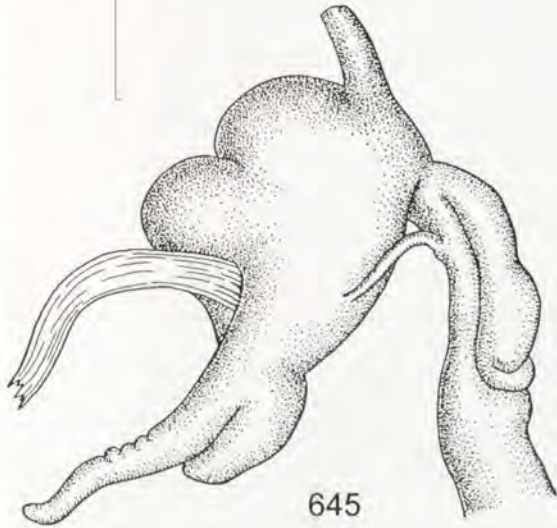
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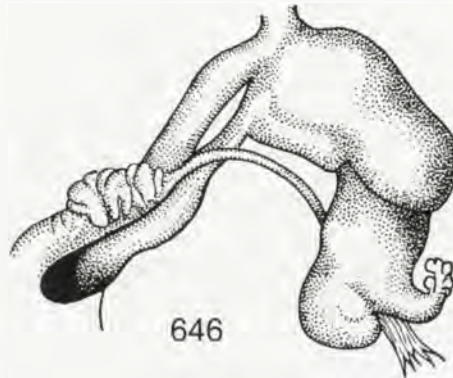
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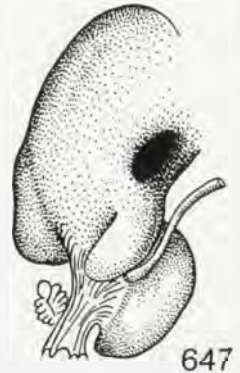
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Figs. 644–650. *Deroceras tauricum*. 644–646 – Copulatory organs. 647 – Penis. 648–649 – Stimulators. 650 – Posterior section of viscera with visible rectum and black gonad. (After Likharev and Wiktor 1980)

a small stimulator in the shape of an obtuse, sometimes somewhat flattened, cone.

Caecum on rectum lacking (Fig. 699).

Ecology. Unknown. The slug was collected in *Fagus* forest, at low altitudes.

Distribution. The species has been recorded only from the western Pyrenees and their foothills (Pais Vasco).

Deroceras (Deroceras) zilchi Grossu, 1969

Deroceras zilchi Grossu, 1969: 164 figs. 6a–g, 7a–f. Locus typicus: Cozla (S Banat Mts., Roumania). Holotypus: Grossu's coll. (Bucharest) no. 1144.

References: Wiktor: 1983: 184 fig. 107.

The systematic position of this species is unclear to me. Since I have not had an opportunity to examine the types,

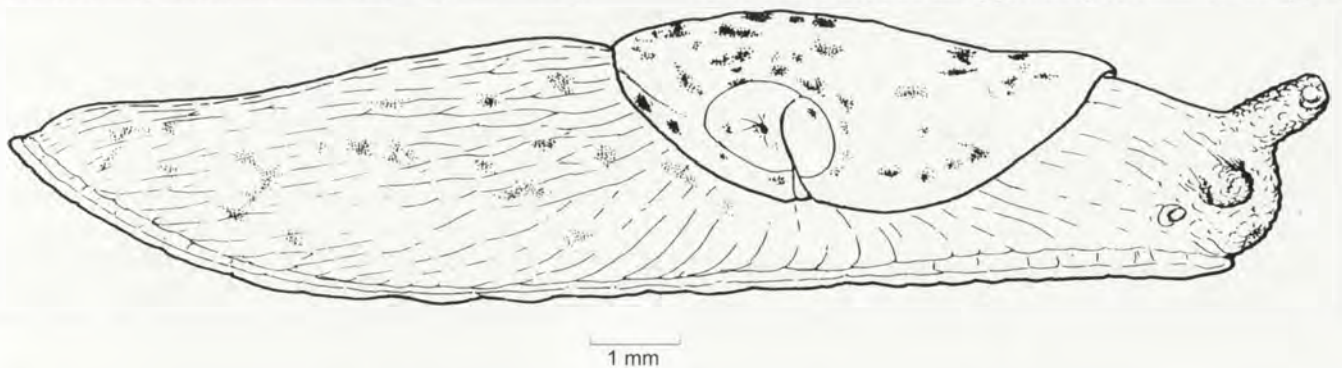
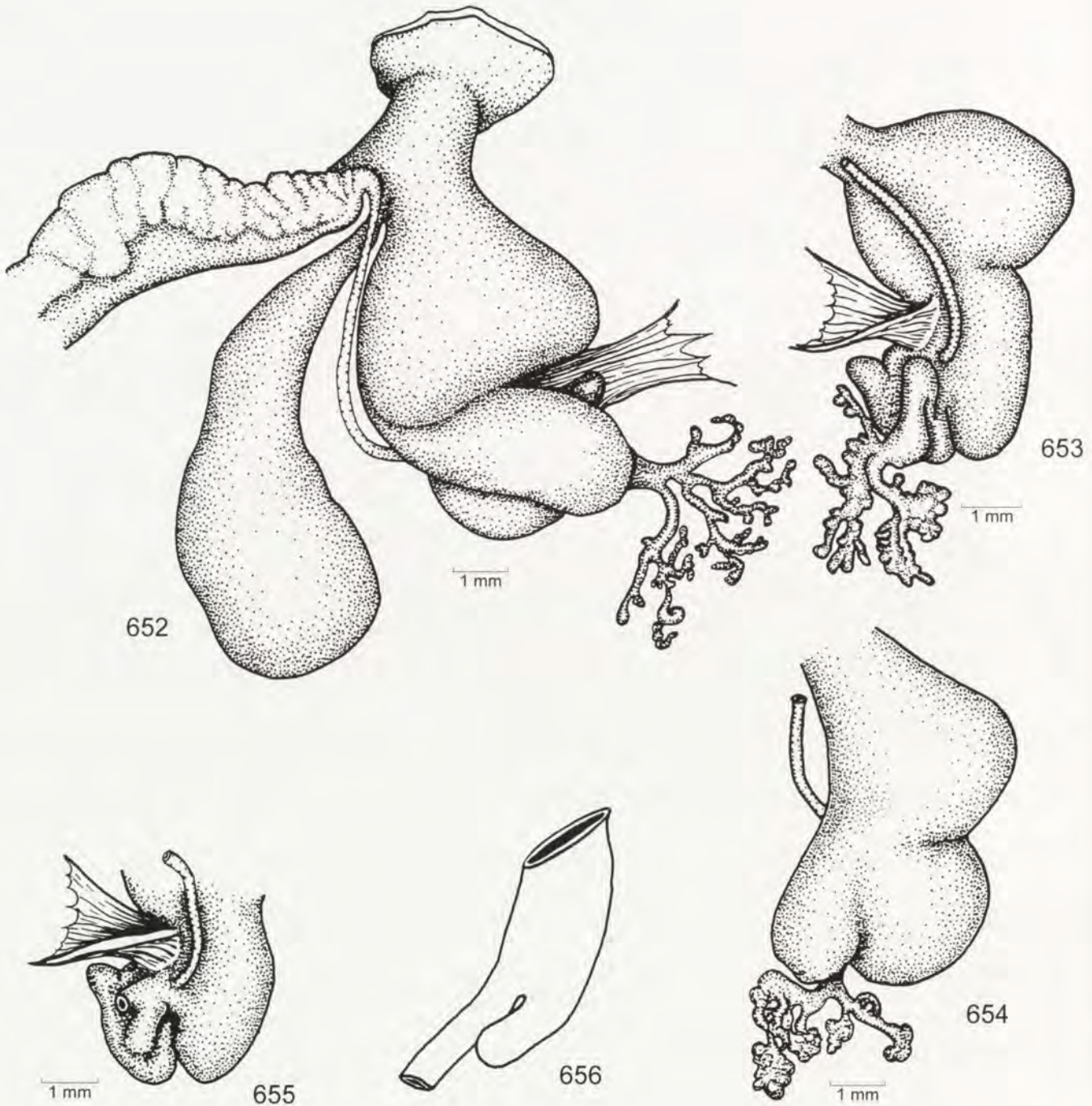


Fig. 651. *Deroceras thersites* – external appearance. (After Wiktor 1983)



Figs. 652–656. *Deroceras thersites*. 652 – Copulatory organs. 653–654 – Penises. 655 – Posterior end of penis. 656 – Rectum with caecum. (After Wiktor 1983)

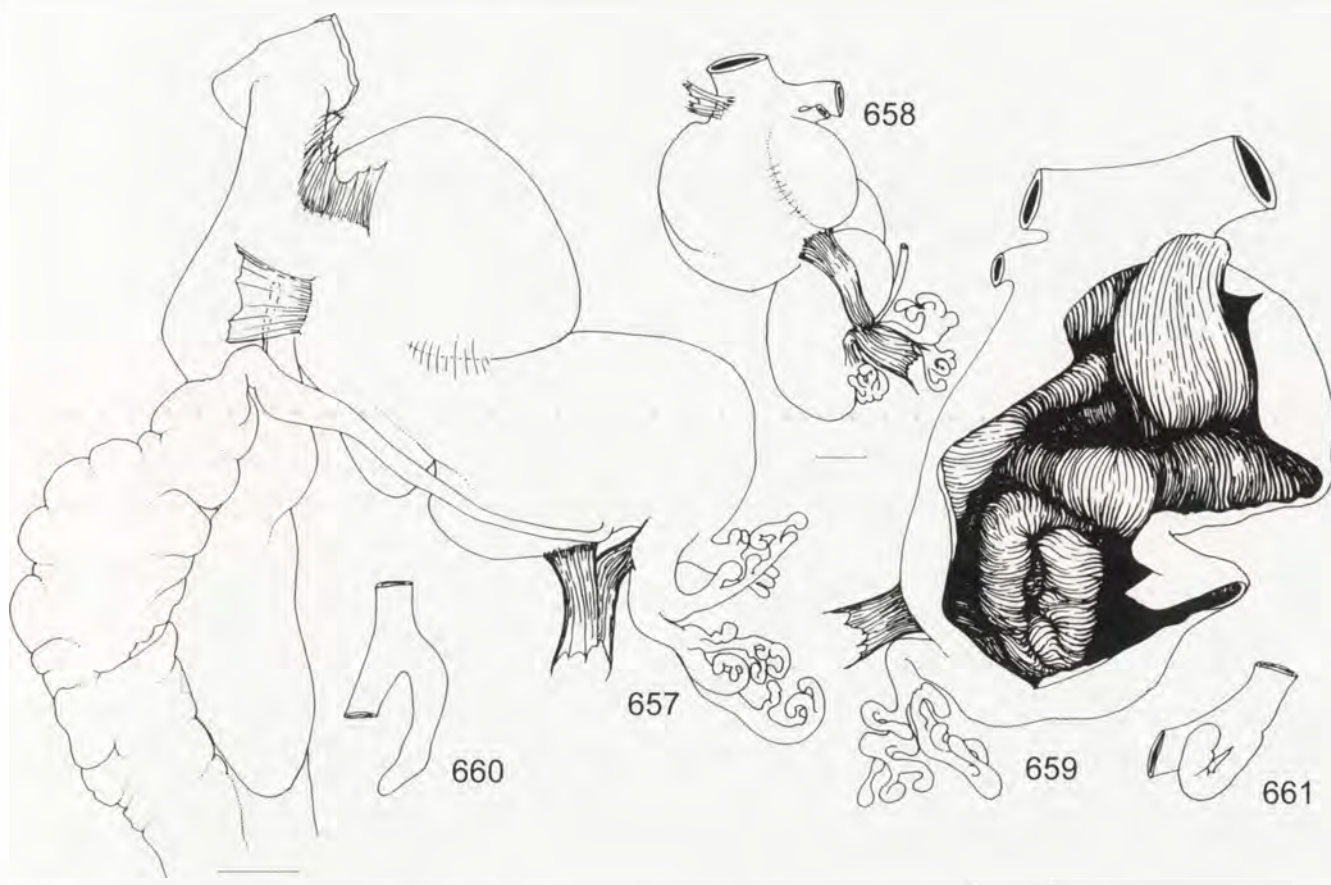
I quote the taxonomically useful information after Grossu (1969).

Body length 14 mm. Coloration dirty grey or pale yellowish. Skin thin.

Genitalia (Figs. 702–703). Penis baggy, inconspicuously medially constricted. Inside the posterior part of penis a small appendix (shown in figures but not mentioned in the text). Penial gland composed of 4 unbranched processes; in

one of the specimens one process is forked. All the processes, whose both sides are symmetrically covered by papillae, are set directly on penis. Retractor penis attached slightly laterally. Vas deferens opens at the base of penial gland. Stimulator flattened, ligula-shaped, its free end rounded, surface striated.

A shallow pocket present on rectum in the place of rectal caecum (Fig. 705).



Figs. 657–661. *Deroceras thersites*. 657 – Copulatory organs. 658 – Penis. 659 – Structures inside penis. 660–661 – Caecum on rectum. (Orig.)

Distribution. The species is known only from locus typicus and a doubtful locality in border-close regions of Bulgaria (see Comments).

Comments. I have failed to find new data on this slug. I have not managed to loan the types, either.

According to Grossu (1969), the distinctive character of this slug is the specific shape of its stimulator. The author does not mention the presence of an appendix, which, in my opinion, is an important feature. Grossu's drawings are freehand and they might be unreliable.

It follows from the description and drawings that Grossu dealt with juvenile specimens. It is evidenced by the proportions of glandula hermaphroditica and glandula albuminalis, and also by the appearance of stimulator (Figs. 702–703).

I collected a few slugs bearing similar characters to those of *D. zilchi* in close proximity to the Roumanian Banat Mts. in Bulgaria (Belogradchik, Lakatnik). The species needs to be further studied (Figs. 704–705).

Subgenus *Liolytopelte* Simroth, 1901

Liolytopelte Simroth, 1901: 174 as subgenus *Lytopelte* Boettger, 1886.

Species typica: *Lytopelte caucasica* Simroth, 1901.

References: Hesse 1926: 24; Grossu 1966: 57; Grossu 1970: 105 figs. 1–3; Wiktor 1973: 117; Altena 1975: 62; Wiktor and Likharev 1980: 418 fig. 11 (pallial complex); Jungbluth, Likharev, Wiktor 1981: 18 fig. 7 (radula); Likharev and Wiktor 1980: 169; Wiktor 1989: 114.

Body size: up to ca 40 mm in length. With its posterior edge, mantle usually extends as far as the body half. Keel poorly developed, restricted only to the posterior body end (like in the whole genus, it does not reach mantle). Skin soft and thin. Coloration evenly brown of different hues, in some species body spotted.

Mucus colourless and watery.

The posterior section of penis with different types of swellings, nodes or processes (a typical papillae-covered penial gland lacking). Inside penis there is a fold and conical stimulator, both covered by striae resembling fingerprints. Laterally on stimulator there is a hard, partly calcified, patle (!).

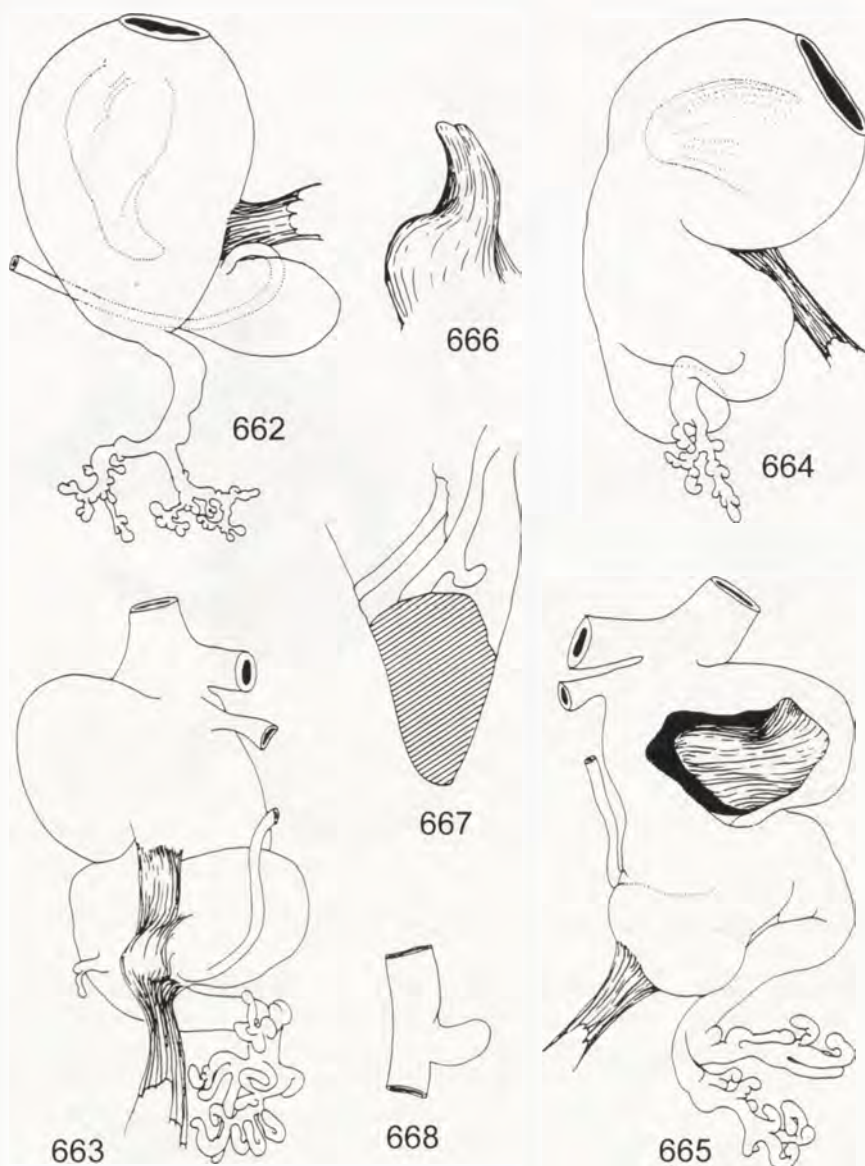
Rectum devoid of caecum or at the most with an inconspicuous sinuate enlargement.

Ecology. Hardly known; most species occur in humid habitats, usually near water, in forest, in the lowlands, reaching the subalpine zone in the mountains.

Distribution. The Balkans (Bulgaria), southern Carpathians (Roumania, Ukraine, up to SE Poland), Crimea, N Turkey, the Caucasus, N Iran, Kandahar.

The number of species known: 6.

Comments. The subgenus *Liolytopelte* differs from *Deroceras* s. str. mainly in its hard plate inside penis and lack of typical penial gland with papillae on the surface.



Figs. 662–668. *Deroceras thersites*. 662–665 – Copulatory organs. 666 – Stimulator. 667 – Posterior end of viscera. 668 – Rectum with caecum. (Orig.)

However, the distension and processes in the posterior part of penis are presumably homologous to penial gland.

The presence of a hard plate in penis makes the subgenus discussed similar to the genus *Lytopelte* (see p. 561). The difference between them concerns, first of all, keel, which in *Liolytopelte* is short while in the genus compared the keel is long.

The shape of the hard plate and its ornamentation constitute important species-specific characters.

Deroceras (Liolytopelte) bureschi (Wagner, 1934)

Agriolimax (Hydroilimax) Bureschi Wagner, 1934a: 55 figs. 7–9. Locus typicus: Peschtera “Mednik” bei Plakatinica (near Vratza = Mednik cave in the Iskur gorge, W of Elisena, Vratsanska Planina Mts. (Bulgaria). Typus: BAN.

Lytopelte herculana Grossu, 1964: 84 figs. 1A–C. Locus typicus: Băile Herculane (Roumania). Holotypus: Grossu’s coll. (Bucharest) no. 1055.

Lytopelte olteniana Grossu, 1964: 86 figs. 1A–C. Locus typicus: “valea Luncavâi comuna Vaideeni, raion Horezu, reg. Arge” (Roumania). Holotypus: Grossu’s coll. (Bucharest) no. 1058.

?*Deroceas (Liolytopelte) suboccidentalis* Grossu et Lupu, 1965a: 51 figs. 1–4. Locus typicus: Retezat Mts., a cave at an altitude of 1000–1800 m a.s.l. Holotypus: Grossu’s coll. (Bucharest) no. 1060. I have examined the paratype – SMF 176725/2.

Liolytopelte lotrensis Grossu, 1970: 108 figs. 3a–f. Locus typicus: Mălaia, Lotru valley in the S Carpathians (Roumania). Holotypus: Grossu’s coll. (Bucharest) – no number.

Deroceas ilius: Grossu and Lupu 1959: 46.

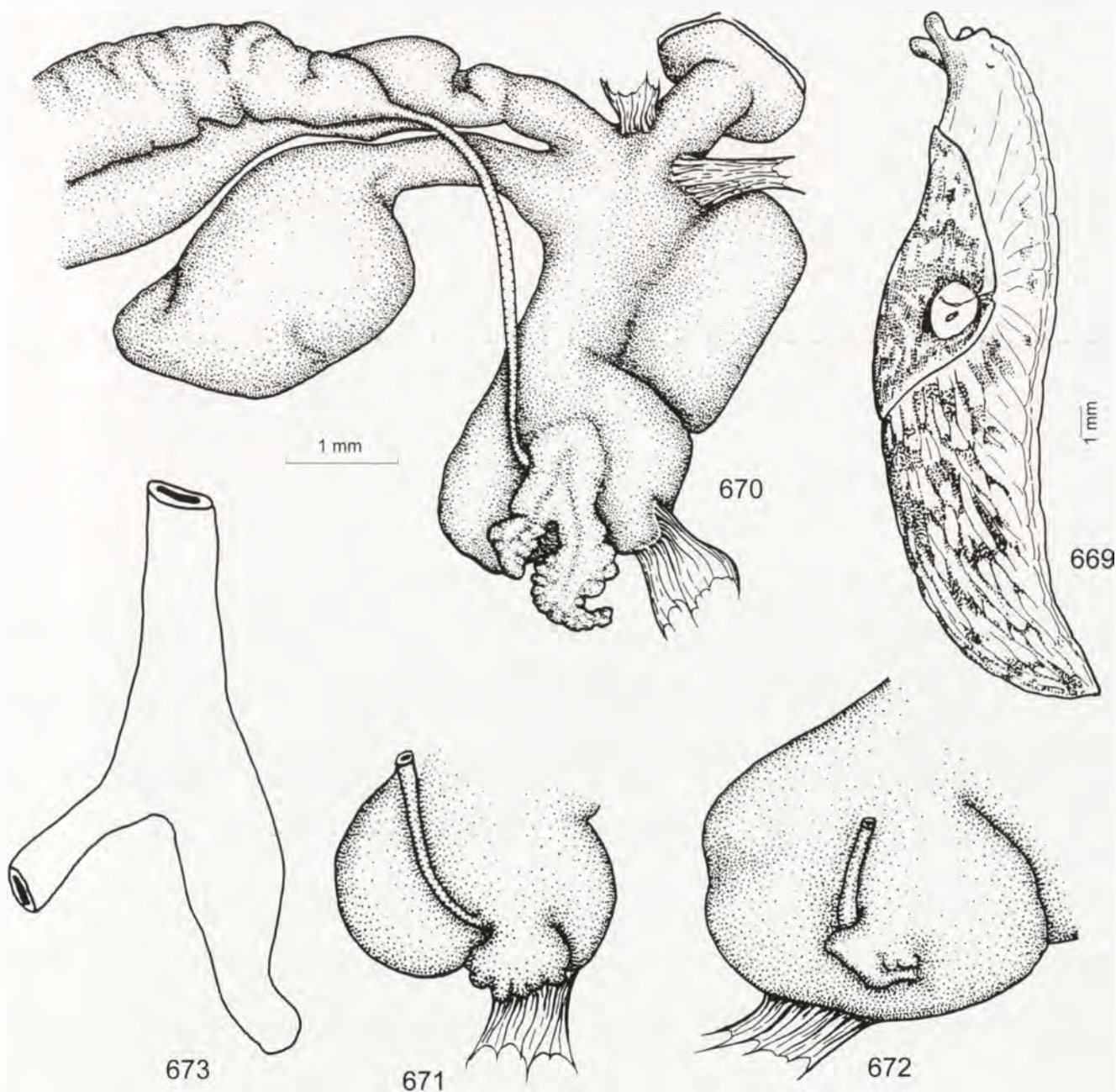
Lytopelte herculana: Hudec 1967: 349; Lupu 1972: 94.

References: Hudec 1967: 349; Urbański and Wiktor 1968: 62 figs. 6a–g; Grossu 1970: 107 fig. 2d; Likharev and Wiktor 1980: 174 figs. 158–162; Grossu 1983: 388–397 figs. 242–247; Wiktor 1983: 187 figs. 111–115a–f, map 28.

Body length up to ca 30 mm. Coloration dark coffee; unicolour or black-spotted (Fig. 706). The spots may be big, resembling ink splashes.

Genitalia (Figs. 707–708, 710–715). Penis of irregular shape, more or less oval, often asymmetrically laterally distended. Within the posterior section of the organ, which is always narrower, there are different swellings and goffering, and usually also a long single process (probably homologous with penial gland) which resembles a finger. The size of the process varies within a population depending on the individual. The external surface of this organ is smooth. Specimens, mostly juveniles, with a mere pocket-shaped enlargement and also some in which the finger-shaped process equals in length the

rest of penis can be encountered as well. When penis is everted, beside stimulator an organ of one side crenulated may be seen. This is probably the above mentioned digital process. Vas deferens opens laterally at the base of this process. Musculus retractor penis most commonly bifurcate, its one strand inserted to the posterior part of penis whereas the other laterally to the finger-like process. Inside penis, apart from a long fold, an inconspicuous stimulator occurs. On its side an irregular hard calcified plate often yellow-russet in colour. Its shape is fairly varied. It is usually oval or nearly round, not infrequently elongated. The plate may be centrally arched to form a clear prominence or have papillaceous nodules on one end. Growth lines or a distinct “nucleus” are usually discernible on its surface. Irrespective of the plate’s shape, its wholly smooth and uncrenated end



Figs. 669–673. *Deroceras turcicum* – specimens from Bulgaria. 669 – External appearance. 670 – Copulatory organs. 671–672 – Posterior section of penis with penial gland. 673 – Caecum on rectum. (After Wiktor 1983)

(Figs. 711–715) is a typical and, in my opinion, diagnostically essential character.

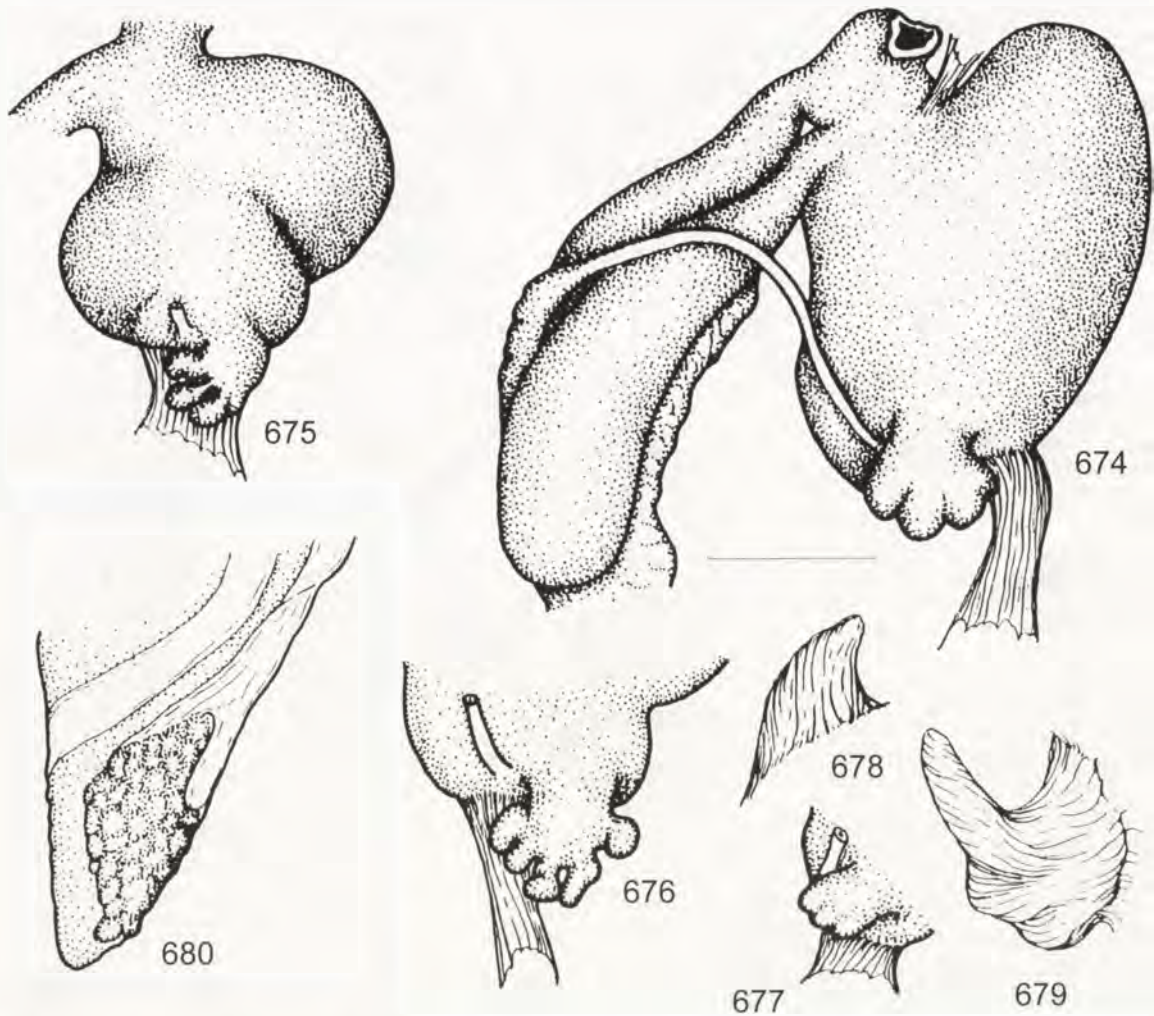
On rectum an inconspicuous shallow enlargement (Fig. 709).

Ecology. A very agile slug. It occurs, often in large numbers, in beech and hornbeam forests, especially in the neighbourhood of water; in the mountains up to 2000 m a.s.l. It hides in leaf litter, under stones and wood pieces. Adult individuals are collected in June, in which season copulation is observed. During mating dance, which is similar to that of

Deroceras s. str., the appendix a goffered-edged process gets everted (Fig. 36).

Distribution. The slug is recorded from Bulgaria (mountain ranges of W Stara Planina, Rodopi, Pirin and Rila) and SW Roumania (Grossu 1983 – under the names of synonyms). Besides, I have in my collection specimens from the regions of Rodna, Monte Apuseni (Vlădeasa) and Baia Mare (Gura Fintini).

Comments. Regrettably, I have not had an opportunity to examine the types of *D. (L.) herculana*, *olteniana* and



Figs. 674–680. *Deroceras tauricum* – specimens from Turkey. 674 – Copulatory organs. 675 – Penis. 676–677 – Penial gland. 678–679 – Stimulator. 680 – Posterior section of viscera. (After Wiktor 1994)

lotrensis. Nevertheless, I synonymize these names on the basis of Grossu's descriptions and freehand drawings, from which it follows that the characters mentioned come within the variability range of *D. (L.) bureschi*, a species I personally dealt with during my field research in Bulgaria, where I collected abundant material of over 220 slug specimens.

Deroceras (Liolytopelte) caucasicum (Simroth, 1901)

Lytopelte caucasicum Simroth, 1901: 171 t. 17 figs. 5–14 maps 6–7. Locus typicus: Lagodechi (in the valley of a lower tributary of the Alazani River, the former Georgian SSR). Lectotypus: ZIN.

Agriolimax caspius Simroth, 1901: 157 t. 16 figs. 31–34 map 6. Locus typicus: Sari Isl. on the Caspian Sea. Lectotypus: ZIN. See Likharev and Wiktor 1980: 169.

Lytopelte grusina Simroth, 1901: 173 t. 17 figs. 15–23 maps 6–7. Locus typicus: Tiflis (= Tbilisi, the former Georgian SSR). Holotypus: probably lost.

Lytopelte caucasicum armenia Akramovskiy, 1948: 37 figs. 1–3. Locus typicus: Gnishikin Wayke, Daralageze (N Armenia). Holotypus: ZIN.

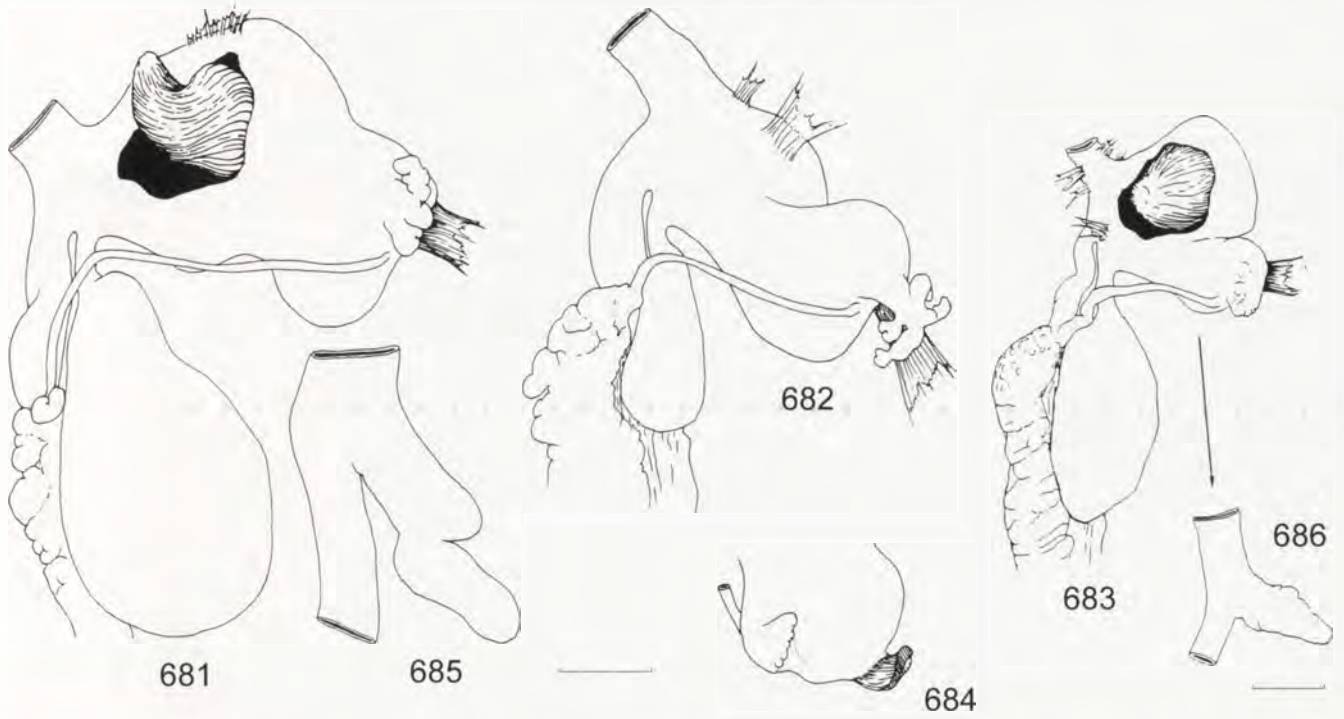
Deroceras (Liolytopelte) hamatum Sklyar, 1975a: 73 figs. 1–2. Locus typicus: 25 km NW of Alushta (Crimea, Ukraine). Holotypus: IZK.

Agriolimax Dymczewiczi (non Kaleniczenko): Simroth 1901: 151 t. 16 figs. 1–6. See Likharev and Wiktor 1980: 169.

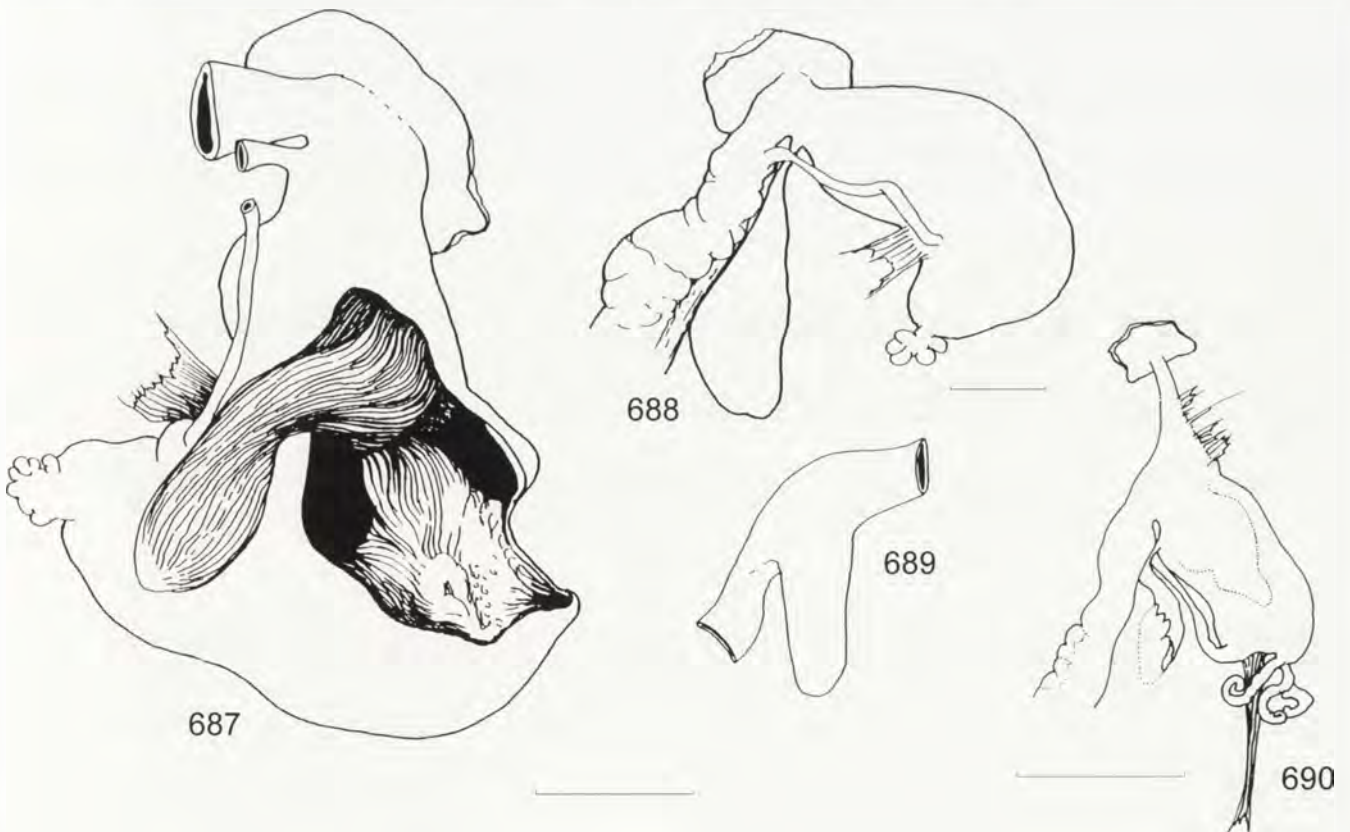
References: Likharev and Wiktor 1980: 169 figs 149–157; Wiktor 1994: 24 figs. 67–69.

Body up to ca 40 mm long. Coloration varied: from dirty white through grey-yellow, grey-pinkish to dark brown. Mantle and back slightly darker (Fig. 720). Tentacles, head and nape, also under mantle, blackish or black (!). Sole pale. Mucus colourless. The intensity of body coloration depends on the type of habitat. In shadowy environment the coloration is pale – whitish, whereas in open habitats it is darker. Juvenile individuals sometimes have their posterior mantle section spotted; with the process of maturation their body darkens and the spots melt away.

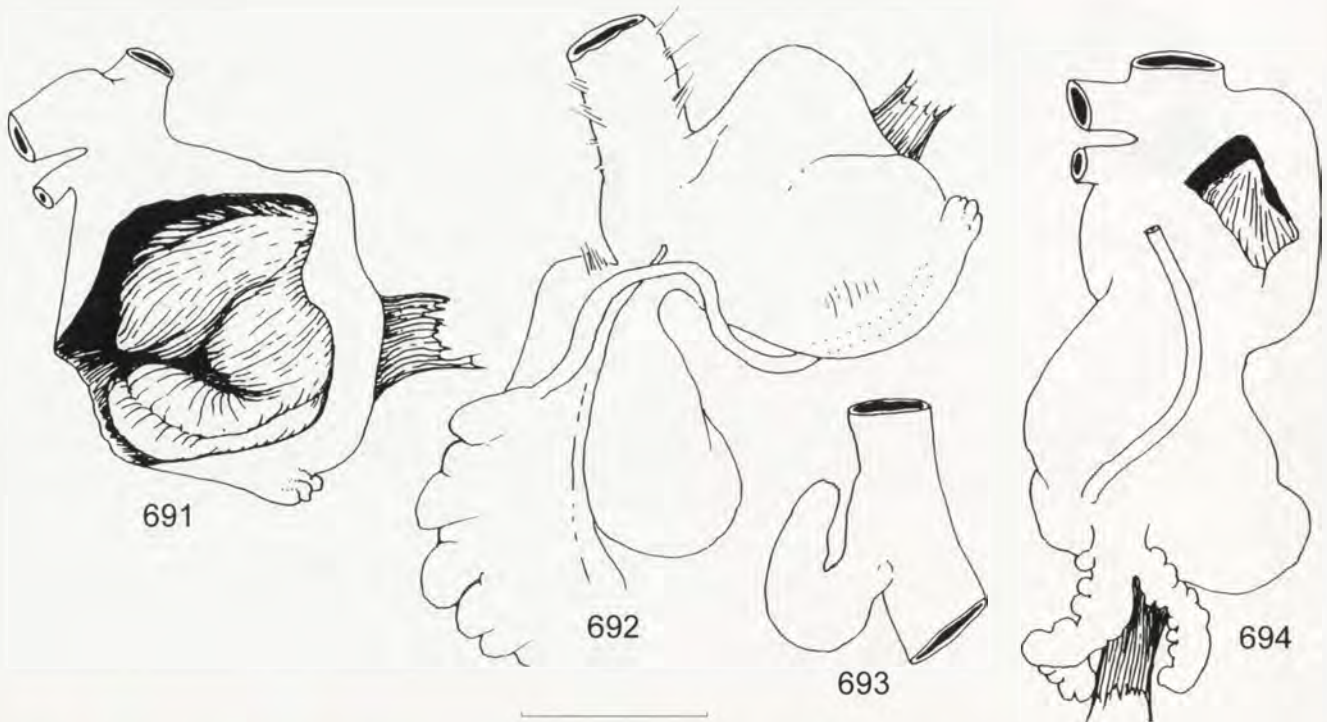
Genitalia (Figs. 716–717, 721–722, 723–724). Penis anteriorly asymmetrically distended. Its posterior part is somewhat narrower, more or less cylindrical in shape. On its rear end there are two nodulous appendices (!) between which vas deferens opens. The posterior fragment of penis is black; in each case a dark blot occurs there. Retractor penis divided in 2–4 strands some of which are attached to the posterior, narrower, fragment of penis, others to the



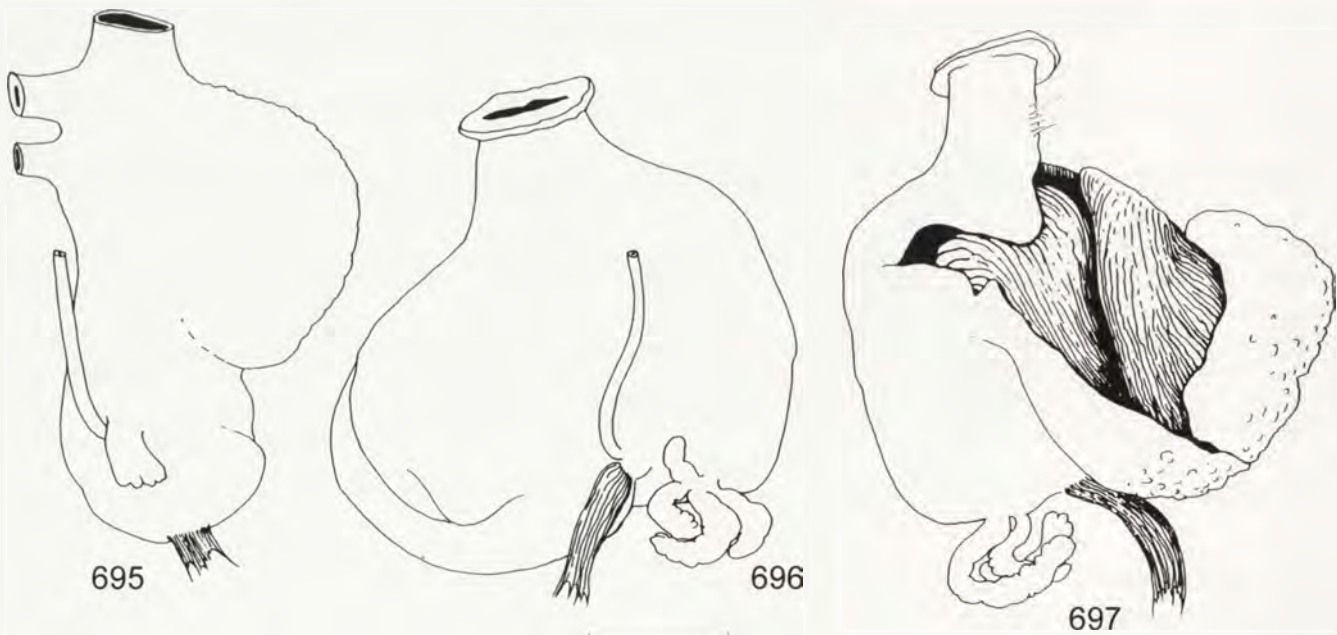
Figs. 681–686. *Deroceras turcicum*. 681–683 – Copulatory organs. 684–686 – Rectal caeca (681–682, 684–685 – specimens from Greece; 683 and 686 – a specimen from Bosnia). (After Wiktor 1996 and orig.)



Figs. 687–690. *Deroceras turcicum* – types described under the name of *D. callatis*. 678–688 – Copulatory organs of paratypes from Comorova. 689 – Caecum on rectum of a paratype. 690 – Caecum on rectum of a paratype from Stina de Vale. (Orig.)



Figs. 691–694. *Deroceras turcicum* – types described under other names. 691–692 – Penis and whole copulatory organs of the holotype of *D. jaeckeli* = *D. turcicum*. 693 – Caecum in the holotype of *D. geticus* = *D. turcicum*. 694 – Penis of *D. geticus* = *D. turcicum*. (Orig.)



Figs. 695–697. *Deroceras turcicum* – types described under other names. 695 – Penis of *D. dobrogicus* – paratypus no. 194945/3. 696–697 – Penis of the holotype of *D. pseudolytopelte*. (Orig.)



Fig. 698. *Deroceras uataderensis* – penis of the holotype. (Orig.)

organ's anterior section. Inside penis a conical stimulator. Beside it there is a hard plate of a very characteristic shape (Figs. 717–724) resembling a half of a bivalve shell (!).

On rectum there is a tiny pocket or merely a small enlargement (Figs. 718–719, 725).

Ecology. A hygrophilous species, preferably occurring on edges of water reservoirs (also those on semi-deserts and steppes), in wet meadows etc. Its life cycle varies depending on the region. In the region of Alma-Ata the species reproduces even three times within the vegetation period, and half-grown individuals are the wintering stage. In the Caucasus and Tadzhikistan the species survives winter also in the form of half-grown individuals as well as eggs, but it seems that here only one generation yearly matures and lays eggs. When in favourable conditions the slug causes severe damage to different cultivations, destroying even 50% of vegetable crops for instance.

Distribution. The Caucasus, especially its eastern part, northern Iran, Turkish areas on the Black Sea (Vil. Trabzon and Samsun), Crimea. The slug has been introduced to Central Asia – the region of Alma-Ata, Tashkent and Dushanbe.

Comments. As the name "*caucasicum*" was used by Simroth (1901) on farther pages relative to those mentioning "*caspius*" and "*grusina*", this one should be given priority. However, when synonymizing the numerous names used for the same species by Simroth, Likharev and Wiktor (1980) chose "*caucasica*" for this taxon was provided with the most

detailed description. Besides, its types had been preserved, and the name used by the author mentioned for the species typical of the genus *Liolytopelte*.

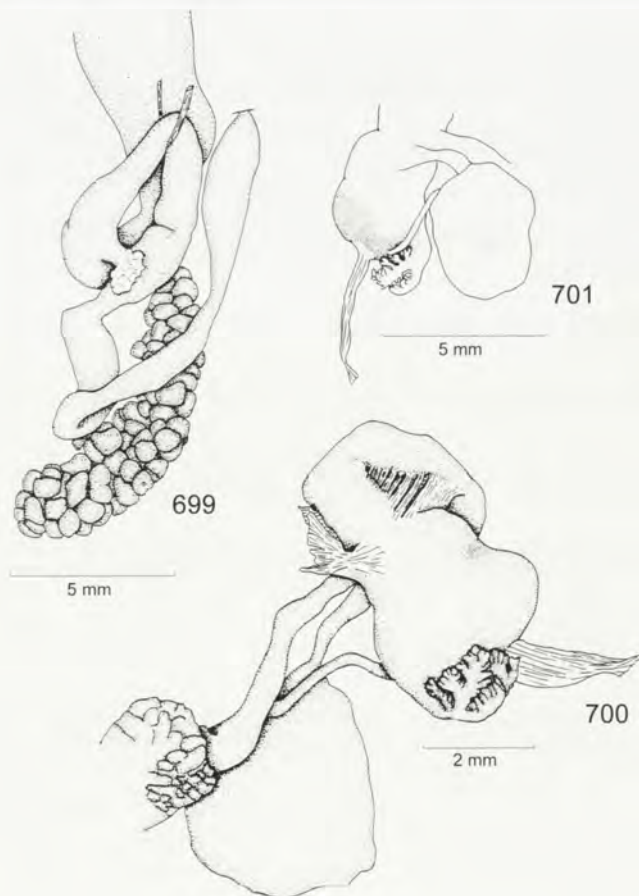
The coloration of body, especially the characteristic black-coloured head and nape, looks exactly like that of *Krynickillus melanocephalus* (see p. 570), which may result in mistakes when the two slugs are identified. They differ, however, in skin sculpture and, very markedly, in the structure of genitalia.

Deroceras (Liolytopelte) kandaharensis Altana, 1970

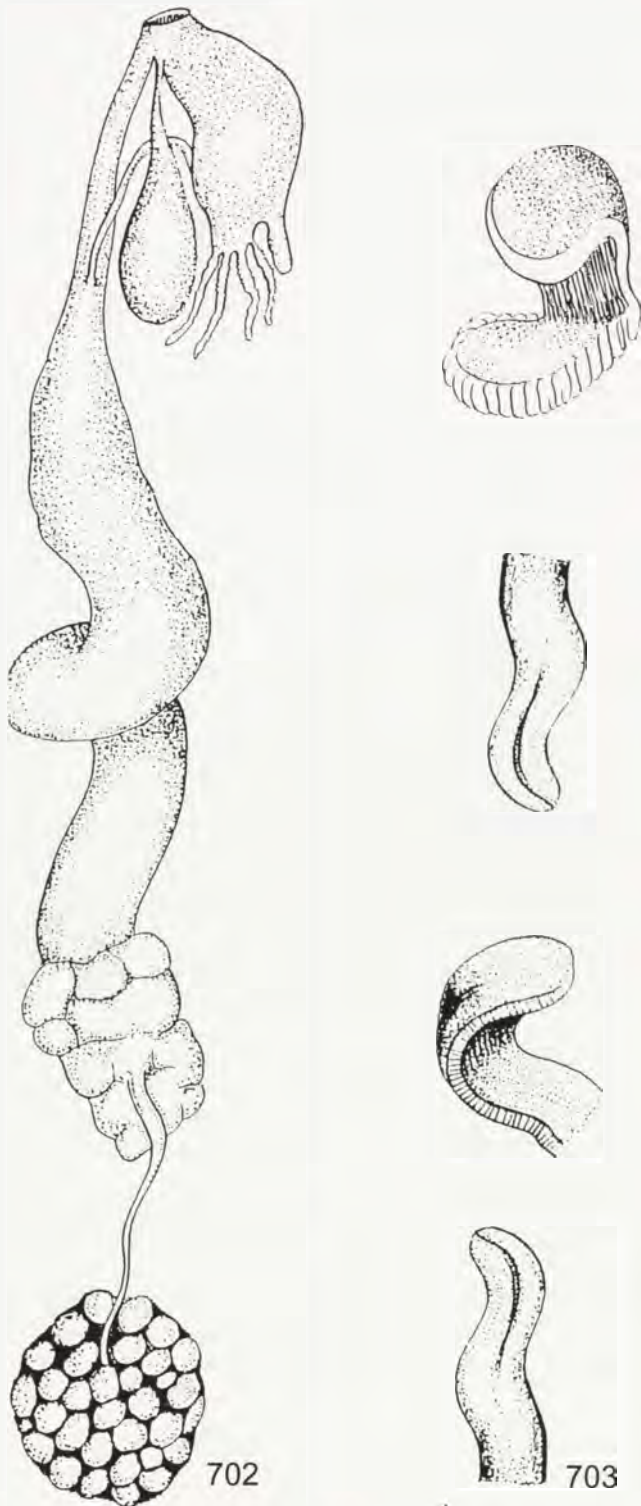
Deroceras kandaharensis Altana, 1970: 175 figs. 1a–e. Locus typicus: a cultivated garden in Baba Wali near Kandahar. Holotypus: FMNH no. 151672.

References: Altana 1975: 62.

Body length up to ca 30 mm. Keel limited to a part of back (Altana 1970). "Color yellowish white with some grey pigmentation on mantle. Dorsum with white line in middle that on posterior half edges an increasingly prominent keel. Pigmentation heaviest on sides of keel; neck and sole nearly white" (Altana 1970).



Figs. 699–701. *Deroceras vascoana*. 699 – Intestine and glandula hermaphroditica. 700–701 – Copulatory organs. (699–700 – holotype). (After de Winter 1986)



Figs. 702–703. *Deroceras zilchi* – holotype. 702 – Genitalia. 703 – Stimulator viewed from different sides. (After Grossu 1969)

Genitalia (Figs. 727–729). Penis egg-shaped or inconspicuously nearly symmetrically constricted, which results in an anterior and posterior part being distinguishable. There

are no additional accessory organs of the type of penial gland or appendix. Vas deferens opens laterally at the rear of the posterior penis section. Still more posteriorly a single (unforked) musculus retractor penis is inserted. Inside penis a strongly developed fold on which there is a hard plate conically arched, its base very wide, top bent (Figs. 728–729).

According to Altena (1970): “Intestinum poorly preserved, but caecum agreeing with that of *D. reticulatum*.”

Ecology. Unknown, except for the fact that the slug was collected in a garden.

Distribution. The only known locality is the one where the types were collected. Since the slug was found in a garden, it cannot be authoritatively stated whether it was there a synanthrope native to Kandahar or had been introduced from some other area.

Comments. I have had an opportunity to examine the types of this slug, but they have already been markedly faded and dissected. The specimens have a very thin and soft skin.

The species was originally described within *Deroceras* (Altena 1970). Later the same author (Altena 1975) transferred it within Simroth’s (1901) systematics to the genus *Lyttopelte* and subgenus *Liolyttopelte*. Retaining its rank as a subgenus, Likharev and Wiktor (1980) transferred *Liolyttopelte*, including *kandaharensis*, to the genus *Deroceras*. The main reason for that shift within the family was the short keel (like in *Deroceras*), which makes *Liolyttopelte* different from *Lyttopelte*.

Altena (1970, 1975) compares the species discussed with *D. buchar*. As proved by Likharev and Wiktor (1980), *D. buchar* is a synonym of *D. altaicum* (see also p. 399 of this monograph).

Likharev and Wiktor (1980) suppose that *D. kandaharensis* may be a synonym of *Lyttopelte maculata*. At present, however, having examined the types, I am prone to share the opinion of Altena (1975) and leave the species concerned within *Liolyttopelte*, retaining its distinctness, at least until a more thorough study of ample material has been pursued.

Deroceras (Liolyttopelte) moldavicum (Grossu et Lupu, 1961)

Lyttopelte (Liolyttopelte) moldavicum Grossu et Lupu, 1961: 28 figs. 1–2.

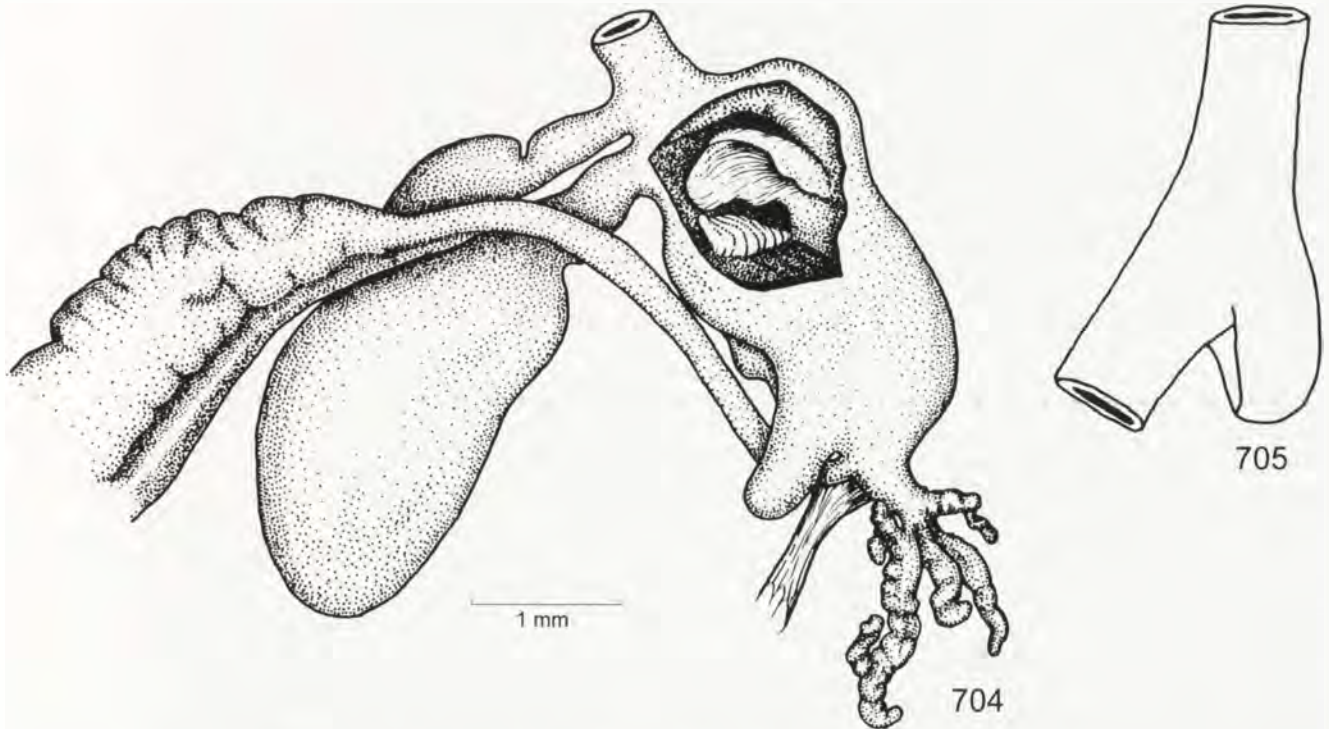
Locus typicus: Socevița (environs of Suceava, Roumania). Holotypus: MNGAB no. 13166. Paratypus (I have examined this specimen): SMF no. 163994/1.

?*Agriolimax huculorum* Babor et Frankenberger, 1914: 110 figs. 1–5. Terra typica: E Carpathian Mts. (Worochta, Hawerla, Ukraine).

?*Agriolimax (Hydrolimax) hydrobius* Wagner, 1943: 39 figs. A–B. Locus typicus: “Rodna-Borberek, Vörös-patak” (Transylvania).

References: Grossu 1970: 106; Wiktor 1973: 118 figs. 41–42, 104, 166–173, 240, 276–277; Likharev and Wiktor 1980: 176 figs. 163–172; Grossu 1983: 383 figs. 235a–f map 239; Wiktor 1989: 114 figs. 99–110 map 6.

Live individuals when crawling are 35 mm in length, preserved reaching merely a length of 23 mm. Coloration of live slugs violetish-brown, back darker than sides. Alcohol-preserved body steel grey or grey-violet in colour, sides whitish (Figs. 730–731). Mucus watery, colourless.



Figs. 704–705. *Derocheras* cf. *zilchi* – copulatory organs and rectum. (After Wiktor 1983)

Genitalia (Figs. 732–738). Penis pear-shaped, the narrower part directed posterad. The rear end of the organ may have inconspicuous swellings. Appendix lacking. Vas deferens opens apically. Musculus retractor penis single (unforked), attached apically or laterally to the posterior end of penis. Inside penis a large fold and a conical stimulator, on the latter's side a hard glossy transparent or whitish plate. It is more or less semicircular, its straight margin as if notched due to irregular indentations and sharp spikes between them.

Rectum not only lacking a vestigial caecum but even any enlargement of its terminal section.

Ecology. The species occurs in well-shaded and damp places, preferably immediately at streams in flood debris, beech woods or other deciduous stands, reaching at least 1000 m a.s.l. in the mountains. It matures (in Poland) in autumn.

Distribution. The eastern part of the Carpathian ridge from SE Poland (Bieszczady Mts.) up to NE Roumania (Moldavia, Transylvania, Rodna Mts.).

Comments. *A. huculorum* and *A. (H.) hydrobius* are older names probably pertaining to *D. (L.) moldavicum*. The two were described from the area inhabited by the slug discussed and collected in its favourable habitats. Since the types of *D. (L.) huculorum* and *hydrobius* are missing and there are no descriptions of the slugs' internal structures inside penis – no mention of the hard plate on their stimulators in particular, it does not seem justifiable to use any of the two older names.

Derocheras (Liolytopelte) occidentalis
(Grossu et Lupu, 1966)

Liolytopelte occidentalis Grossu et Lupu, 1966: 25 figs. 1–3. Locus typicus: Stinade de Vale, W Carpathians (Roumania). Holotypus: MNGAB no. 13138.

References: Grossu 1970: 106 figs. 1d, 2a; Grossu 1983: 386 figs. 240a–f, 241.

Body length 30 mm. Coloration yellowish-white with some grey pigmentation on mantle, some individuals without the grey pigment. Dorsum with a white line in the middle.

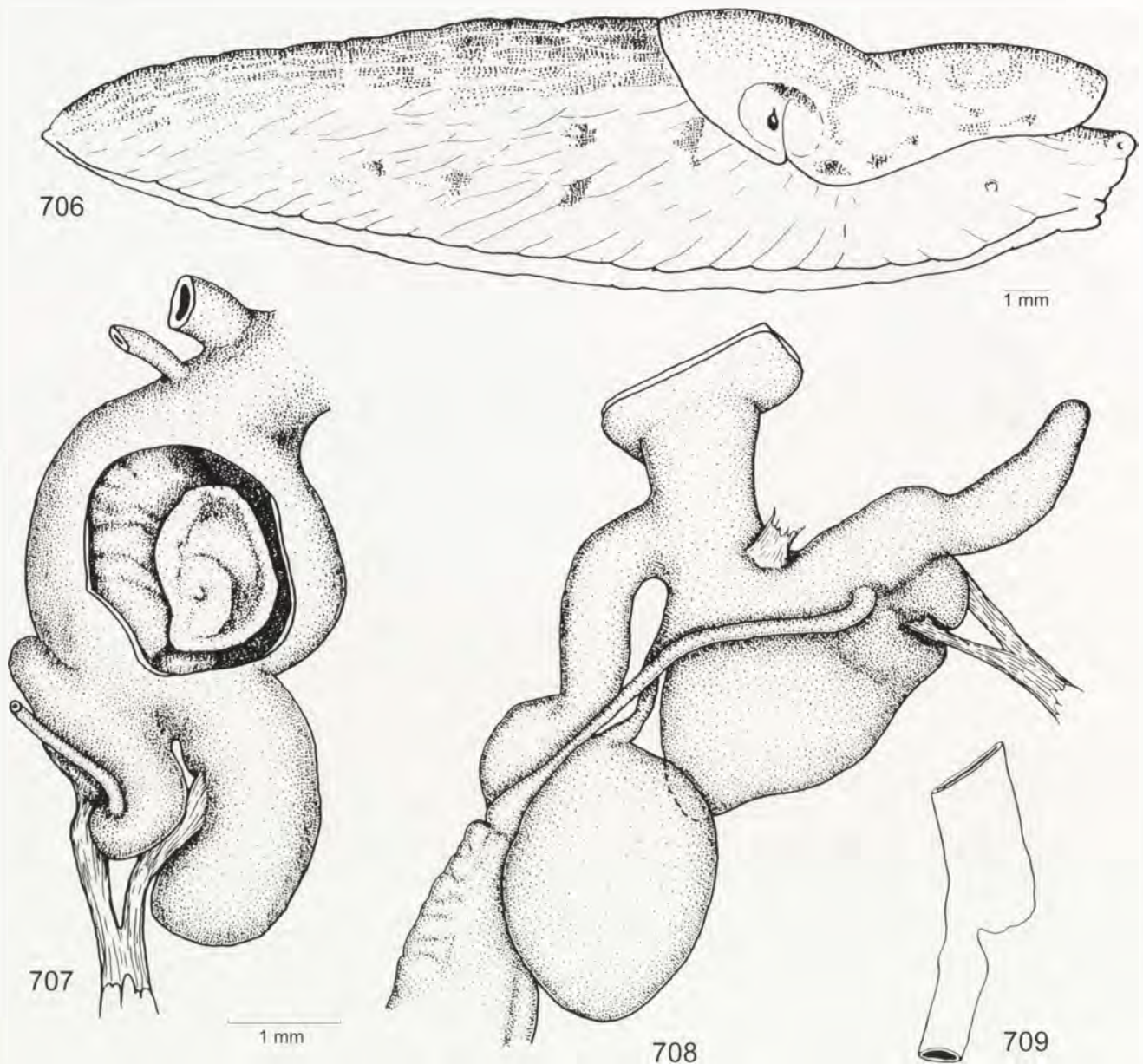
Genitalia (Figs. 740–741). Penis egg-shaped without any external accessory structures of the type of appendices or penial gland. Vas deferens opens somewhat laterally near the posterior end of penis. Just above this opening (closer to the rear of penis) there is the musculus retractor penis insertion. Inside penis a conical stimulator, on which there is a plate in the shape of a flattened cap with a jagged brim.

Caecum described as "agreeing with *D. reticulatum*".

Distribution. So far the slug has been known exclusively from locus typicus.

Comments. Altena (1970) compares the species discussed to *Derocheras buchar* (Simroth, 1910). For notes on this taxon see Likharev and Wiktor (1980: 146 and 148). *Agriolimax buchar* var. *coeciger* Simroth, 1910 is a synonym of *D. altaicum*. I have failed to establish what *D. buchar* var. *simplex* is.

Unfortunately, I have had no opportunity to examine *D. (L.) occidentalis*. It follows from the original description that this slug is similar to *D. (L.) bureschi*. Yet, they differ in the appearance of the plate on stimulator.



Figs. 706–709. *Deroceras (Liolytopelte) bureschi*. 706 – External appearance. 707 – Penis with a plate visible on its stimulator. 708 – Copulatory organs. 709 – Rectum. (After Wiktor 1993)

***Deroceras (Liolytopelte) trabzonensis* Wiktor, 1994**

Deroceras (Liolytopelte) trabzonensis Wiktor, 1994: 27 figs. 70–77. Locus typicus: Küçük (Vil. Trabzon, Turkey). Holotypus: MNHW no. MP 612.

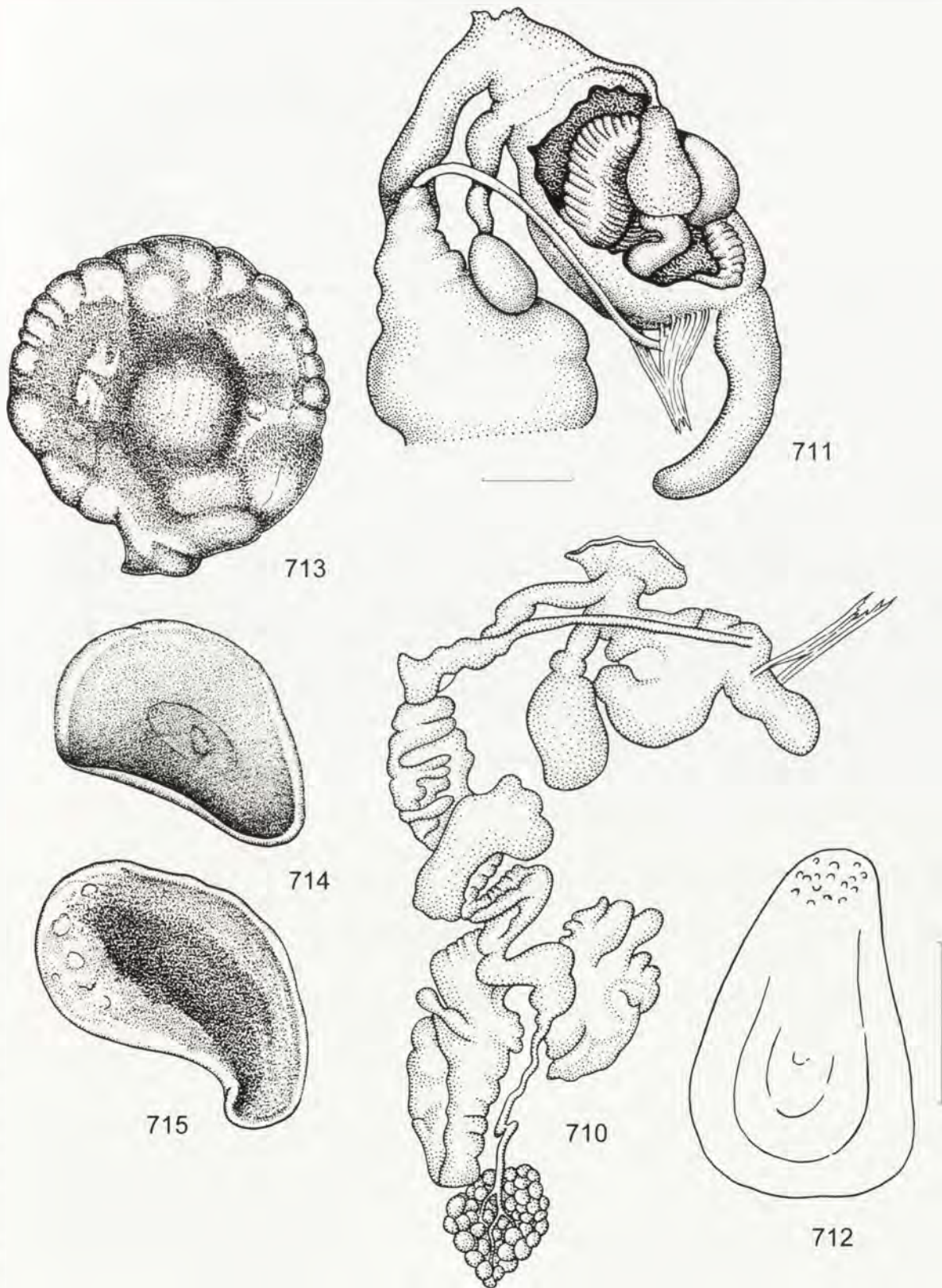
Body length up to ca 19 mm. Mantle large, constituting ca 1/3 slug's length; its posterior margin behind the middle. Coloration pale coffee with blackish spotting on this background. The medial section of back and the part of mantle above shell are devoid of spots (Figs. 742–743).

Genitalia (Figs. 744–749). Penis of irregular shape with its anterior part distended and nearly cylindrical, the posterior one narrower. On the hind end of penis a few nodular distensions. Besides, this fragment of penis is

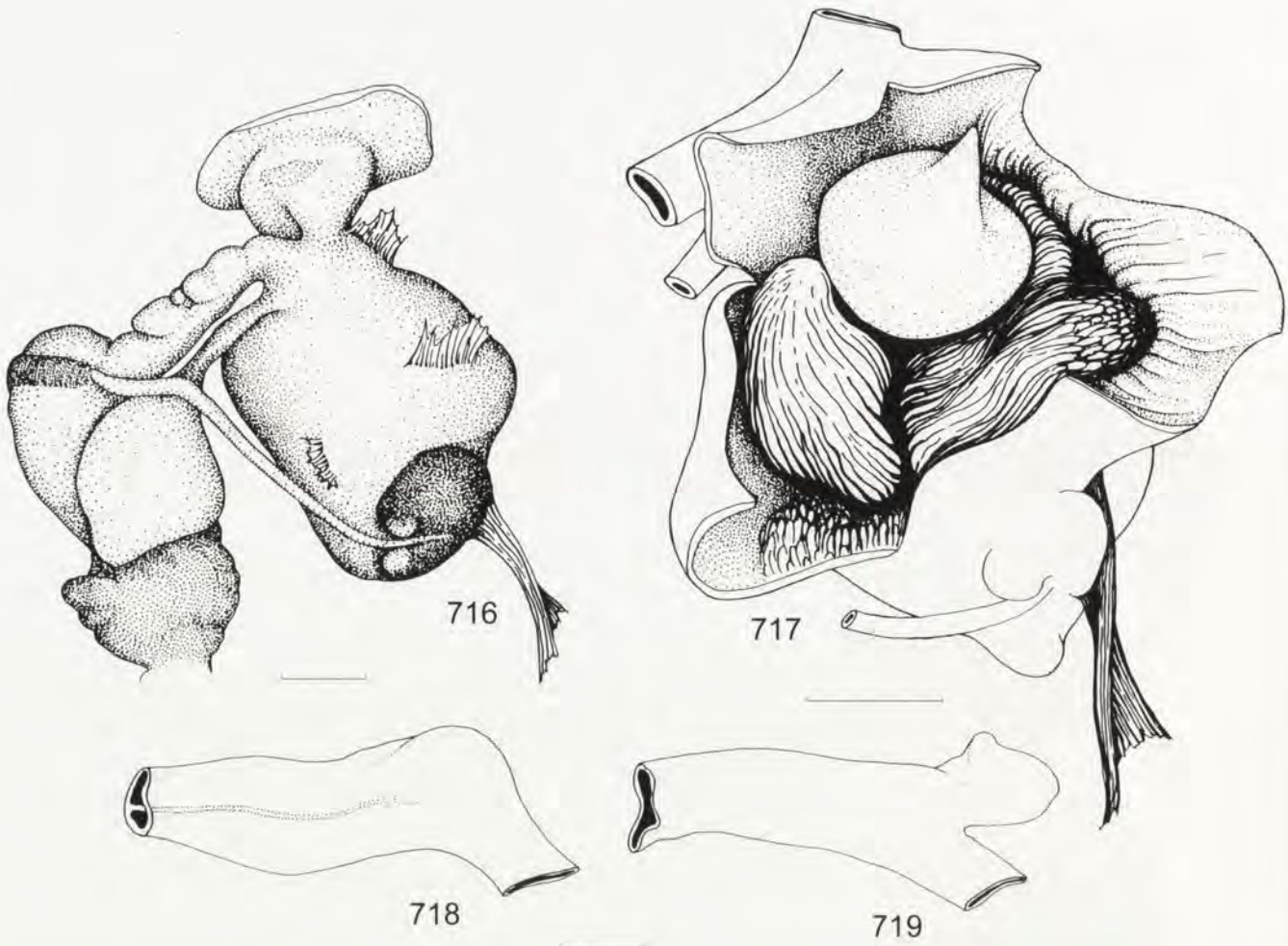
slightly darker-pigmented. Vas deferens opens apically. Musculus retractor penis insertion lateral. The muscle is unforked, although in some specimens, as a membrane, it runs anterad up to the border between the narrowed and the distended part of penis. Inside penis a long cylindrical stimulator covered by thick striae. On its top a relatively small hard plate. Its one side, on which nucleus is situated, is widened whereas the other ligularly narrowed.

Caecum on rectum lacking.

Distribution. Up until now the species has been recorded only from Turkey (Vil. Trabzon – the types; I have also got some material from Vil. Rize and Giersun that has not been taken into account in the hitherto published papers).



Figs. 710–715. *Deroceras (Liolytopelte) bureschi*. 710 – Reproductive organs. 711 – Copulatory organs with visible internal structures of penis. 712–715 – Plates on stimulator in different specimens. (After Likharev and Wiktor 1980)



Figs. 716–719. *Deroceras (Liolytopelle) caucasicum* from Turkey. 716 – Copulatory organs. 717 – Structures inside penis. 718–719 – Rectum in two specimens. (After Wiktor 1994)

Comments. See *Lytopelle maculata* (Comments p. 564).

Nomina dubia

Agriolimax Absoloni Simroth, 1916

Nomen dubium

Agriolimax Absoloni Simroth, 1916: 13 fig. 3. Locus typicus: unknown – Dalmatia or Herzegovina.

Deroceras absoloni: Wiktor 1996: 85.

The types are not known and nor is locus typicus. Later research has not confirmed the existence of slugs bearing the characters described by Simroth (1916). The systematic position of this taxon is completely unclear. It seems probable that the specimen concerned here was one poorly preserved or anomalous. Nothing remains but to classify it among nomina dubia (Wiktor 1996: 85).

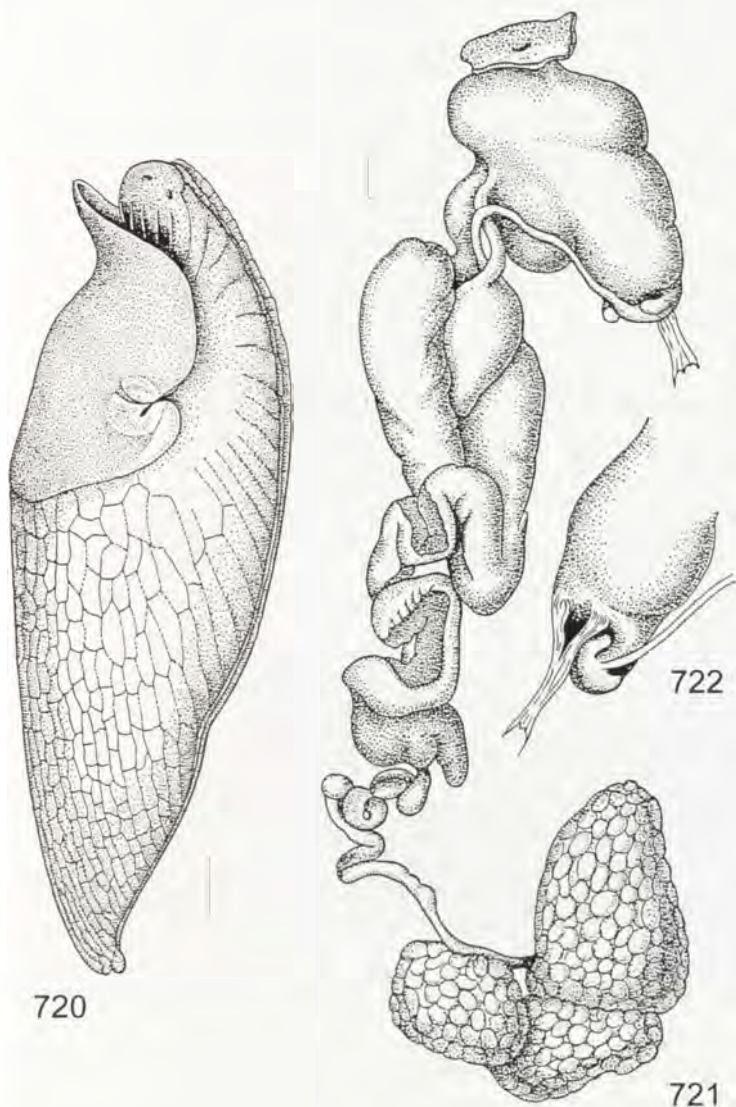
For the sake of completeness I quote the most important characters after Simroth.

Body size (after preservation in formalin!): length 18 mm, width – no data, mantle length 6.5 mm.

Coloration: yellow-grey (gelbgrau), the upper part and sole ochreous. The anterior part of a particularly bright colour: almost orange. On mantle, especially above pneumostom, traces of blackish or brownish infiltration.

Genitalia (Figs. 750–751). Gonad large, blackish-brown. Penis with a deep lateral constriction dividing this organ into two, roughly equal in size, parts (Säcke = sacks). The drawing (probably made without use of a drawing apparatus) shows a broad lobe-shaped stimulator. The text indicates that stimulator is a wide, poorly distinguished fold (Reizfalte), towards the penis posterior turning into a sharp swelling (scharfe Wülste). In one of the drawings, providing the lateral view of penis, vas deferens opening apically and retractor penis slightly laterally attached are visible. The other drawing of penis is unclear to me. Penial gland is lacking in both drawings, which is the only distinctive feature.

Caecum: no data.



Figs. 720–722. *Deroceras (Liotytopelte) caucasicum* from Dushanbe (Tadzhikistan).
720 – External appearance. 721 – Reproductive organs. 722 – Posterior end of penis.
(After Likharev and Wiktor 1980)

Ecology. No data.

Distribution. Dalmatia or Herzegovina.

Comments.

a. Simroth (1916) mentioned that the slug had been preserved in formalin. Such preservation is known to result in numerous deformations and some organs being difficult to perceive.

b. The statement that gonad was large indicates that the specimen might be a juvenile, in which case both penial gland and stimulator might not have been developed yet or were difficult to notice.

c. The existence of a slug having the characters described has found no confirmation (later mentions in literature are only quotations after Simroth).

Conclusion. In all likelihood Simroth dealt with a juvenile and, what is more, badly preserved slugs. Lack of the

type makes it impossible to unequivocally confirm the existence of such a species and, in my opinion, at the present state of knowledge it is not possible to synonymize the name *D. absoloni* either.

Agriolimax agrestopsis

Pollonera in Germain, 1911

Nomen dubium

Agriolimax agrestopsis Pollonera in Germain 1911b: 142. Locus typicus: Gebait near Beyrouth (Syria). Typus: probably does not exist.

References: Germain 1921: 68 pl. 3 fig. 1; Hesse 1926: 101.

The original description provides information about characters referable to lots of slugs. The only facts are as follows: length 32 mm, mantle length 13 mm, body sallow, yellow-grey, irregularly grey-blackish spotted on back, mantle darker. Foot unicolour.

There is no information on the anatomy, no drawings either. In a later publication by Germain (1921) there is a figure of genitalia but, unfortunately, the most essential features, i.e. the appearance of penial gland, retractor insertion or stimulator, have not been made visible. The description includes a statement that penis is circularly pear-shaped, equipped with a flagellum, as the author calls penial gland.

Intestine without caecum.

Germain (1921) compares *D. agrestopsis* with *D. agreste*. The basic difference between the two species is lack of caecum in the former slug, the other differences mentioned by the author being neither real nor clear. His (Germain 1921) drawing (fig. 1) does not show the slug's diagnostic features. Now it seems impossible to determine what species this malacologist dealt with.

***Agriolimax attemsi* Simroth, 1905**

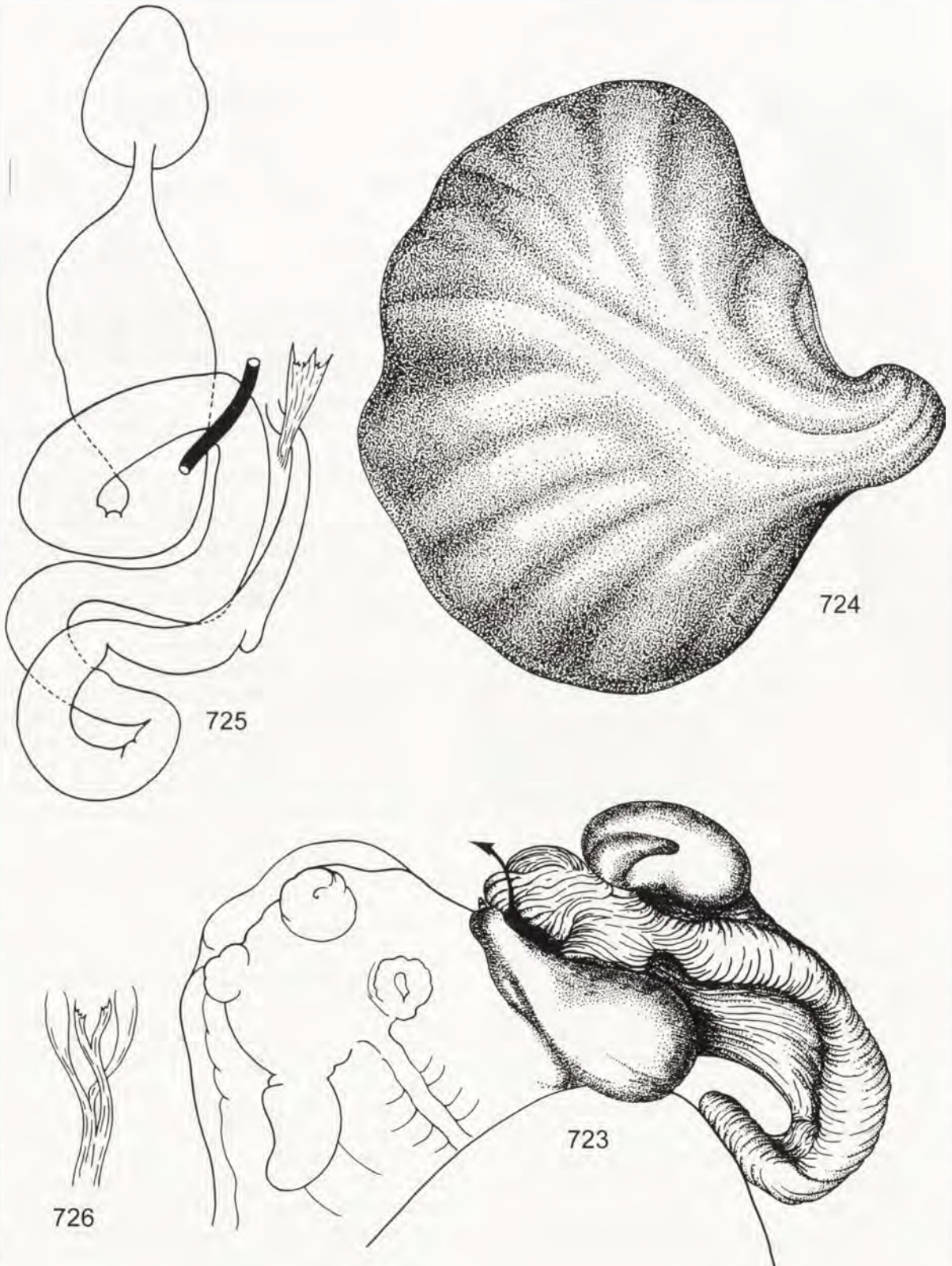
Nomen dubium

Agriolimax Attemsi Simroth, 1905 (1904): 18 figs. 16–18. Locus typicus: "Hochebene von Pantokrator" (Corfu = Kerkyra Isl., Greece). Holotypus: probably does not exist.

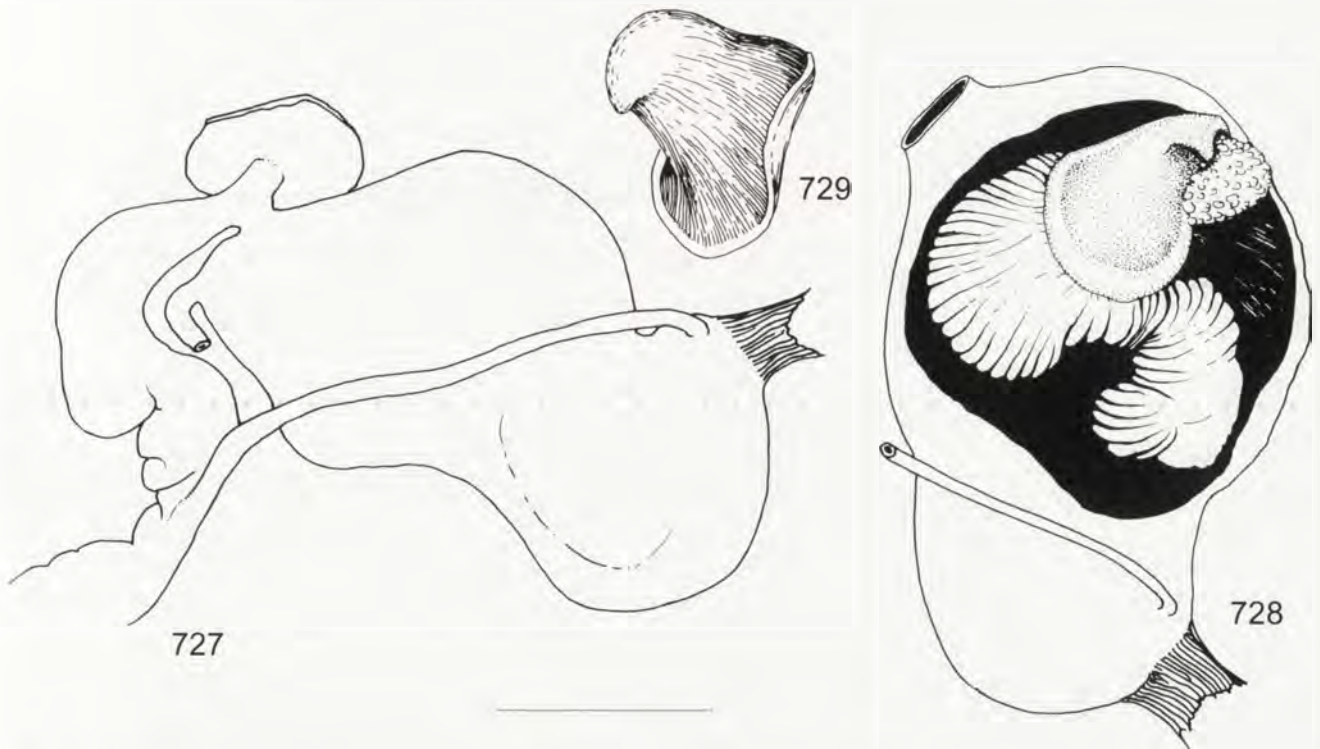
References: Hesse 1928: 17 t. 1 fig. 6; Wiktor 1986: 87; Wiktor – in print.

According to Simroth (1905), the slug is grey-brown with numerous fine dark spots.

Genitalia (Figs. 752–753). In the author's opinion, the specimen he described was mature. Its penis was ovably pear-shaped (kolbig-oval) in its anterior part whereas narrow, cylindrical, bent (sich knieformig umgibt), with 5 tubular processes (Schläuchen) of penial gland in the posterior one. Musculus retractor penis inserted in the anterior (dilated) penis part, in which there is a broad fold with its anterior end bent (eine breite Reizfalte mit umgeschlagenen vorderen Zipfel). It follows from the drawing that the latter is a stimulator, which is probably flat.



Figs. 723–726. *Deroceras (Liolytopelte) caucasicum* from Dushanbe (Tadzhikistan). 723 – Anterior body section with everted penis. 724 – Stimulator's plate. 725 – Alimentary canal. 726 – Main retractor muscles of head. (After Likharev and Wiktor 1980)



Figs. 727–729. *Deroceras (Liotylopelte) kandaharensis*. 727 – Copulatory organs. 728 – Penis with visible internal structures and a clot of sperm on stimulator. 729 – Stimulator's plate. (Orig.)

Rectum without caecum.

Distribution. The species was described from Corfu Isl. Later on, the name appeared in Hesse (1928), Jaeckel *et al.* (1958) – both cases concerned the former Yugoslavia.

Comments. The description is unclear; later mentions of the species (Hesse 1928, Jaeckel 1958) do not provide any essential information. When studying the slug fauna of the former Yugoslavia and Greece I did not encounter any slug bearing similar characters. Further investigations on Corfu are needed to dispel the doubts. It seems, however, that Simroth dealt with a specimen deformed during preservation.

Agriolimax crimense Simroth, 1901

Nomen dubium

Agriolimax crimense Simroth, 1901: 152 t. 16 figs. 7–12. Locus typicus: Salgir (Crimea). Syntypi: 2 dried specimens, ZIN.

According to Likharev and Wiktor (1980: 180 figs. 177–178), the taxonomic position of this slug remains unclear. The description concerned juvenile specimens, which in external appearance resembled *D. reticulatum* but had lateral sole zones darker, a flat stimulator inside penis and caecum on rectum in the shape of a shallow pocket. In order to ascertain the distinctness of this species or synonymize the name, further research is required.

It is worth mentioning that *D. tauricum* occurs in the region where the slug discussed was found (Simroth, 1901).

The report on *D. crimense* made by Hudec (1972) is false and actually concerns the other species mentioned (see Likharev and Wiktor 1980: 182).

Agriolimax fuscus Simroth, 1904

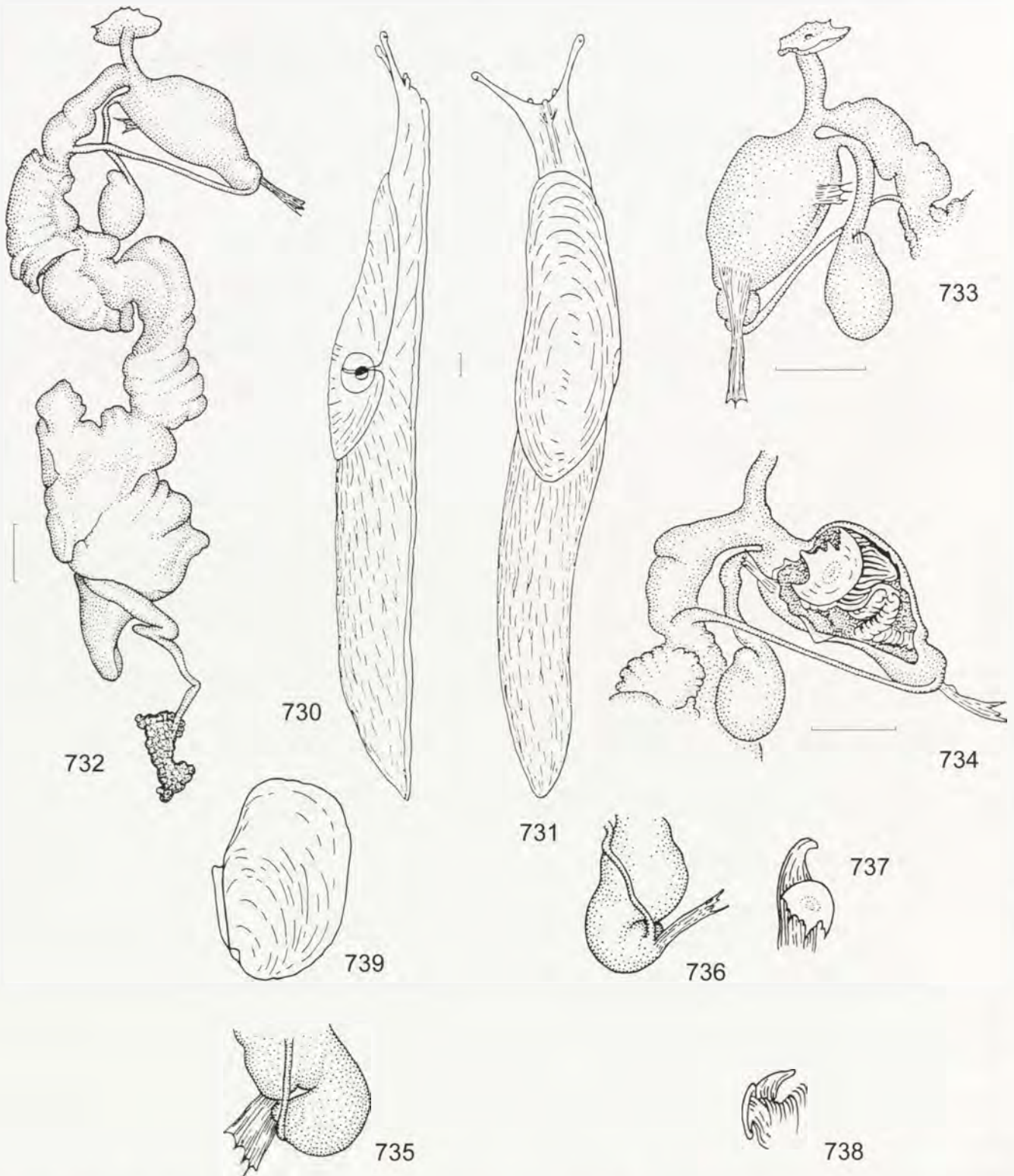
Nomen dubium

Agriolimax fuscus Simroth, 1904: 693 t. 39 figs. 104–106. Locus typicus: uncertain – probably Schoa or “Arusiland” (Abyssinia = Ethiopia). Holotypus: ZMB no. 102 134.

A small slug, ca 10 mm in length, mantle below 5 mm long, width unmeasurable. The slug was evenly coloured, orange-russet (orange oder fuchsroth), which was also the colour of internal organs (Simroth 1904).

Genitalia (Fig. 754). In the holotype, which is the only specimen preserved, copulatory organs are lacking. Therefore, I quote the description and figures by Simroth (1904). Penis divided in distinct parts by a deep lateral constriction. Penial gland composed of two branches set on a common trunk. Musculus retractor penis bifurcate. Vas deferens opens laterally at the level of the penial constriction. Inside penis a pear-shaped (birnförmiger) stimulator.

Comments. There is only one specimen known. Its copulatory organs have not been preserved. Judging by the figure, they may have been deformed during preservation. As Simroth indicates, it seems possible that the one concerned is an atypical specimen of *D. uataderensis* (see p. 530 and Fig. 698).



Figs. 730–739. *Deroceras (Liolytopelte) moldavicum*. 730–731 – External appearance. 732 – Reproductive system. 733 – Copulatory organs with visible stimulator's plate. 735–736 – Posterior penial sections of two specimens. 737–738 – Stimulator with its plate. 739 – Shell. (After Wiktor 1973)

Since the type locality is unknown, and the holotype deprived of its genitalia, it is now and will probably be impossible to ascertain the actual identity of the slug

described and to synonymize the name. The distinctive characters are small size and russet coloration. It seems possible, however, that this russet colour of the entire

Agriolimax Jickelii Heynemann

Nomen dubium

Agriolimax Jickelii Heynemann: Simroth 1886b: 317. Locus typicus: Makerka, E Africa.

All the data on this taxon I have managed to find come from Simroth (1886).

Simroth (1886) states: It is a small dark brown slug resembling *D. laeve* in habitus. The specimen (no mention of where it is deposited) is, unfortunately, very hard, examination of its entire anatomy rendered difficult. Gonad situated in the immediate neighbourhood of collar (Kragen – probably the mantle margin). Penis is an irregular elongated bag (plumper länglicher Sack) with a protuberance on its posterior end. Penial gland consisting of several processes. Retractor attached medially, not apically. Inside penis a blunt stimulator without any other folds. No rectal caecum but in the place where it usually occurs there is a bend.

Comments. I have failed to find out if the species was earlier described by Heynemann and where the description is available. It is possible that Simroth's is the only one, based only on Heynemann's suggestion that the concerned may be a new species. Simroth (1886b) recalls it without, however, mentioning the date of the possible first description or references. Besides, in the same paper the author describes another species new to science, the notation saying: "*Agriolimax Thersites* Heynemann und Koch n. sp." In the case of *Agriolimax Jickelii* the "n. sp." is lacking.

On the basis on Simroth's (1886b) description, I cannot decide if the discussed is a good species or some known slug introduced to Africa. There are no figures. Neither is there any information about the existence of the types.

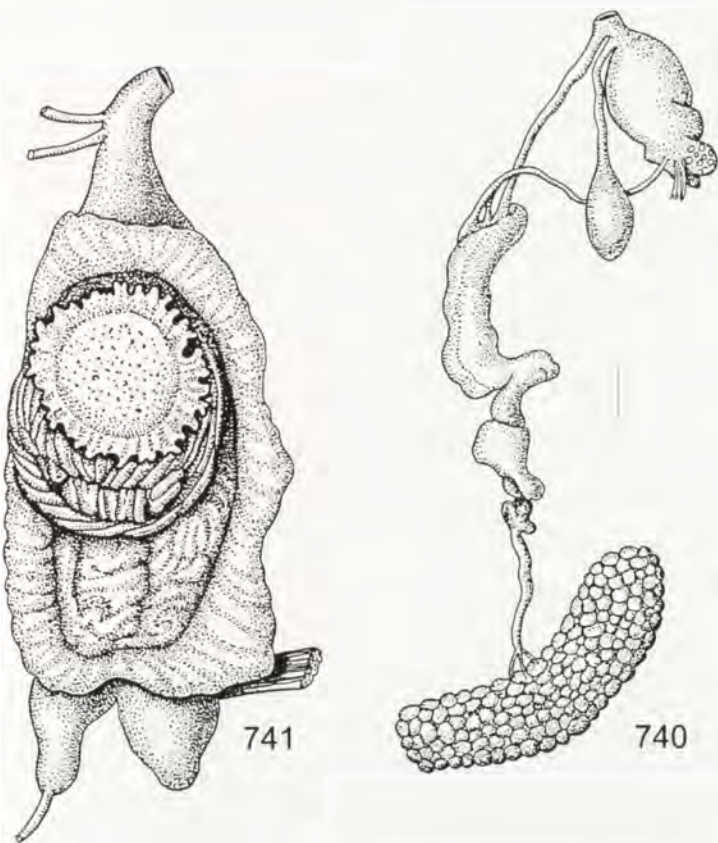
Agriolimax kaffanus Simroth, 1904

Nomen dubium

Agriolimax kaffanus Simroth, 1904: 689 t. 39 fig. 2. Locus typicus: Bukawori (Kaffa, Abyssinia = Ethiopia). Holotypus: ZMB no. 102129.

The species was described on the basis of only one juvenile specimen. Its genitalia are not developed: still germinal. The criterion for Simroth recognizing the slug as a new species was solely its external coloration. The slug was dark brown, its upper section blackish-hued (dunkler braunlich, oben schwarz angefliegen), with single big deep black spots. Besides, white concretions, less pronounced than in other *Deroce* species were visibly precipitated in skin. When describing this species, Simroth expressed an opinion that the slug concerned might be a local colour form.

Comments. Examination of the holotype does not clear up anything. The typical coloration has vanished along with the spots, the specimen being whitish. In my opinion, the characters mentioned did not justify description of a new species. Yet, the name has been introduced.



Figs. 740–741. *Deroceas (Liolytopelte) occidentalis*. 740 – Reproductive system. 741 – Penis with visible stimulator plate. (After Grossu and Lupu 1966)

animal, including the viscera, is a result of some pigment having been rinsed from a food item situated in the intestine or from the preservation fluid. The usefulness of this name should be regarded as doubtful, for which reason I consider it as nomen dubium.

Agriolimax Horsti Germain, 1911

Nomen dubium

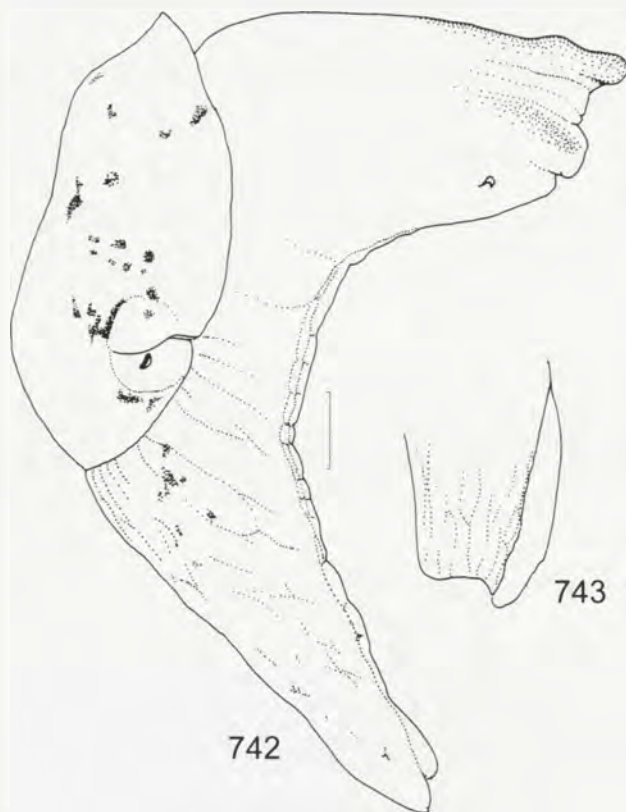
Agriolimax Horsti Germain, 1911a: 28. Locus typicus: Damascus (Syria). See also Germain 1921: 70 t. 2 fig. 1, t. 3 fig. 3.

Body length up to 25 mm. Mantle 9–10 mm long. Tentacles bluish grey, sole yellow or slightly ochreous. All the remaining characters mentioned in the description correspond to a great number of species.

Genitalia – Fig. 755.

Comments. On the basis of Germain's descriptions (1911, 1921), it is impossible to establish whether *Agriolimax Horsti* is a good species or the name is a synonym of some other slug, the second description hardly providing new information. The drawing (Fig. 755) indicates that the slug can be *D. berytensis*.

The types are probably non-existent; I have ascertained they are not kept in the Paris collection (MNHP).



Figs. 742–743. *Deroceras (Liolytopelte) trabzonensis*. 742 – External appearance. 743 – Posterior body end. (After Wiktor 1994)

The coloration seems to be much similar to that of *D. abessinicum* = *gimirranum*. The specimen concerned may be a juvenile form of this species (see *D. abessinicum* p. 394 and Simroth 1904 t. 39 figs. 2, 6, 20). At the present state of knowledge, it is impossible to establish whether *A. kaffanus* constitutes an existent species or the name is merely a synonym of some other slug.

Agriolimax Lábáni Wagner, 1931

Nomen dubium

Agriolimax Lábáni Wagner, 1931: 198. Locus typicus: "Mti. Sette Fratelli", 500–800 m a.s.l. (Prov. Cagliari, Sardinia Isl. Italy). Syntypus: it was kept in the NMW, but is probably lost now as the efforts to find it in the collection failed (oral information).

The description by Wagner (1931) is unclear, no drawing provided.

The author (Wagner 1931) had 6 specimens at his disposal. With respect to external appearance he compares his new species to *Agriolimax agrestis reticulatus*, while its anatomical structure to that of *Agriolimax sardus* (see Comments to this species p. 552). The description includes a few important pieces of information. And thus, according to Wagner, *A. Lábáni* reaches 18 mm in length. It is "fleischig-ockerig bis rötlich-grau" in colour. Penis "am Ende mit einer grossen Keule". Further the author states, "Es sind

keine Enddrüsen vorhanden, sondern wir finden bloss akzesorische Geschlechtsdrüsen am unetren Teile des Penisackes. Diese sind büschelig und vielfach verzweigt. In der Nähe dieser Drüsen mündet auch das Vas deferens ein, während noch weiter unten am Penisack ein langes, schmales, spitz ausgezogenes Organ zu finden ist, welches ebenfalls in der Nähe der Anhangsdrüsen befestigt wird". The author also states that he did not notice the presence of caecum on rectum or – more precisely – any rectal enlargement (Anschwellung).

Comments. Wagner's description is unclear to me. It is worth noting that a species I (Wiktor 1998) have recently described, namely *Deroceras giustianum*, also has a narrow pointed appendix on penis and penial gland composed of numerous processes, but, on the other hand, it is considerably larger, entirely black, its caecum vestigial and penial gland processes unbranched. Besides, *D. giustianum* occurs on the nearby island of Sicily.

Agriolimax Maggi Paravicini, 1896

Nomen dubium

Agriolimax Maggi Paravicini, 1896: 286. Terra typica: Castelmarte (Italy).

Body length up to 15 mm. Mantle covers 2/5 of the animal length. Coloration whitish yellow or grey. Mantle darker.

Anatomy unknown.

Comments. The slug is most probably one of the synonyms of *Deroceras agreste*.

Agriolimax sardus Simroth, 1886

Nomen dubium

Agriolimax sardus Simroth, 1886b: 319 t. 10 figs. VIIIa–b, Terra typica: N and S Sardinia (Sassari and Teulada). Typus: probably does not exist.

References: Simroth 1891: 288; Simroth 1910b: 324; Hoffmann 1926: 250 fig. 3; Bodon, Boato, Giusti 1982: 57.

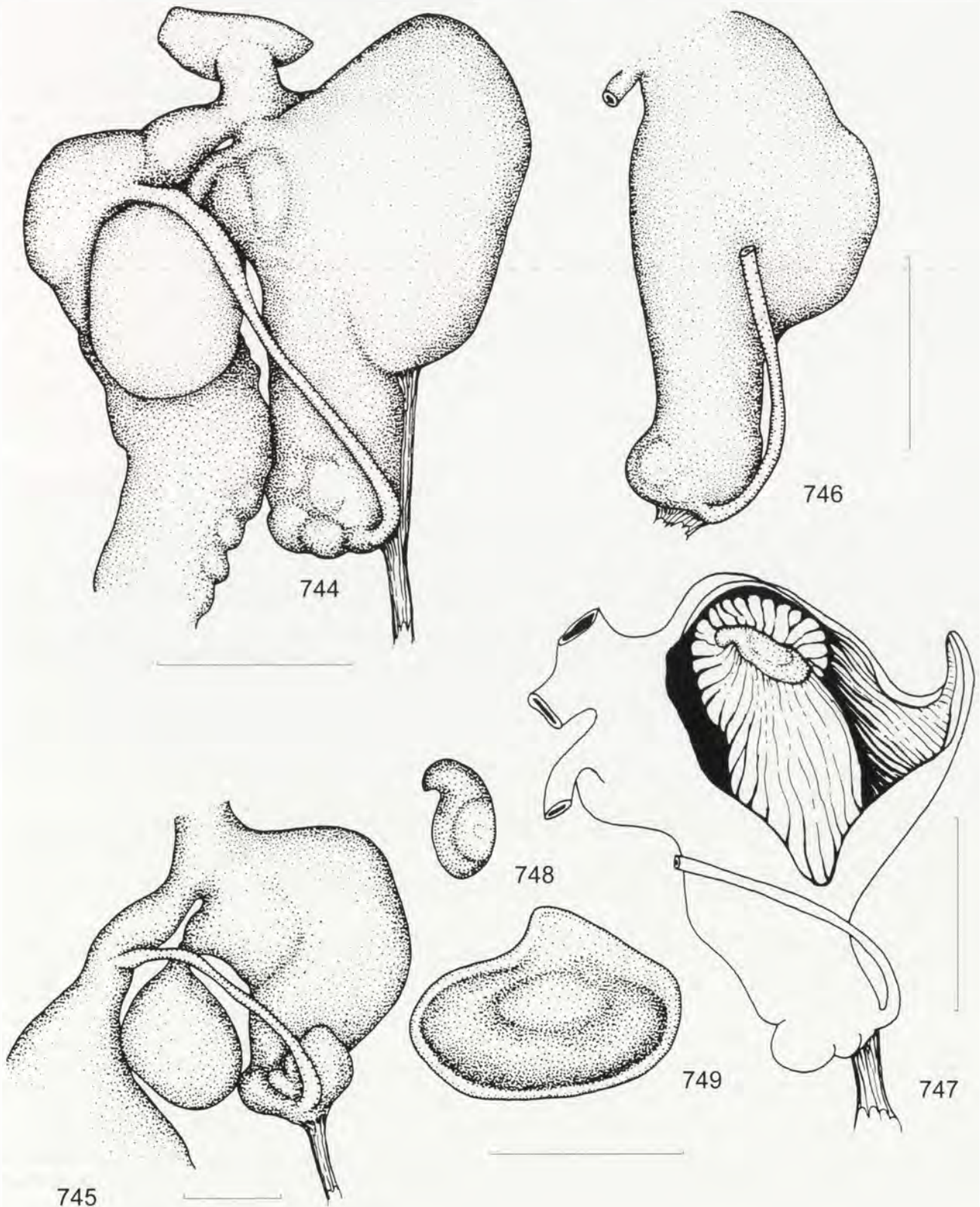
The status of this slug is unclear to me. I have not examined it myself, the authors who mention this name having failed to do it as well.

According to Simroth (1886b), the species attains a length of 10–20 mm. Its body is pale grey-coloured (hellgrau), upper sections darker, with dark spotting.

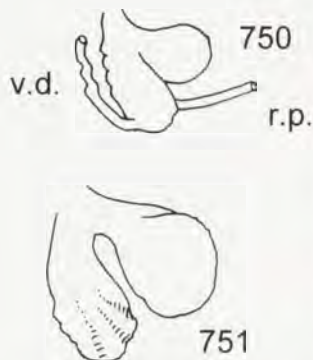
Genitalia. Penis elongated, without a constriction, with penial gland apically situated on its posterior end. The gland has a short shaft and 5 nodulous processes. Inside penis there is no stimulator, only two folds (Falten) are present, the anterior one of which is shorter and sharpened, resembling a stimulator (reizkörperartig zugespitzt).

Rectum lacking caecum; in its place an inconspicuous enlargement.

Comments. Simroth's very simplified figure (1886b t. 10 fig. 8a), repeated by Hoffman (1926), is freehand and plainly indicates that the author dealt with a juvenile specimen. This is evidenced by the appearance of spermatheca, small body size, probably not yet developed penial gland and stimulator, lack of penial constriction. We will probably never get to



Figs. 744–749. *Deroceras (Liolytopelte) trabzonensis*. 744–745 – Copulatory organs of the holotype and a paratype. 746 – Penis. 747 – Penis of the holotype with stimulator plate visible inside. 748–749 – Stimulator plates of a paratype and the holotype. (After Wiktor 1996)



Figs. 750-751. *Agriolimax Absoloni* - penis. (After Smroth 1916; slightly simplified)

know what slug Simroth actually examined. I have not succeeded to find the type. Both Simroth and Hoffmann compare the slug described with a few other species, the comparisons providing no new facts though. Simroth (1910) records this species from the S Alps but he does not introduce any new data concerning its anatomy.

Bodon *et al.* (1982) described *D. bisacchia-*

num from Italy. This slug has no stimulator and a light lateral constriction of penis. With respect to external appearance, the shape of penis and penial gland, the slug corresponds with Simroth's drawing of *A. sardus* (see p. 552). There are no grounds, however - at least before slugs from Sardinia have been more thoroughly studied - to synonymize the two names. Simroth may well have had at his disposal some other, already known, *Deroceras* species. Besides, the authors of *D. bisacchianum* knew Simroth's (1886b) description of *A. sardus*.

Genus *Furcopenis* Castillejo et Wiktor, 1983

Furcopenis Castillejo et Wiktor, 1983: 1. Species typica: *Furcopenis darioi* Castillejo et Wiktor, 1983.

Smallish slugs - up to ca 30 mm. Mantle covers ca 1/3 body length, its posterior margin reaching as far as the middle of the slug. Skin very thin. Externally, representatives of *Furcopenis* are indistinguishable from certain species classified with the genus *Deroceras*.

Coloration in different hues from creamy to brown, often irregularly spotted, but the spots are not arranged in a reticulum.

Mucus colourless.

Penis small, in the shape of a narrow bag. Its posterior section equipped with penial gland composed of 1-3 unfurcate processes. Beside penis, anteriorly connected with it, there is a large - larger than penis itself - single or double accessory organ with a granular gland on the apical end. No stimulator inside penis, at the most a longitudinal fold; whereas structures resembling stimulator may occur in accessory body. Musculus retractor penis bifurcate, its one branch attached to penis while the other to accessory organ.

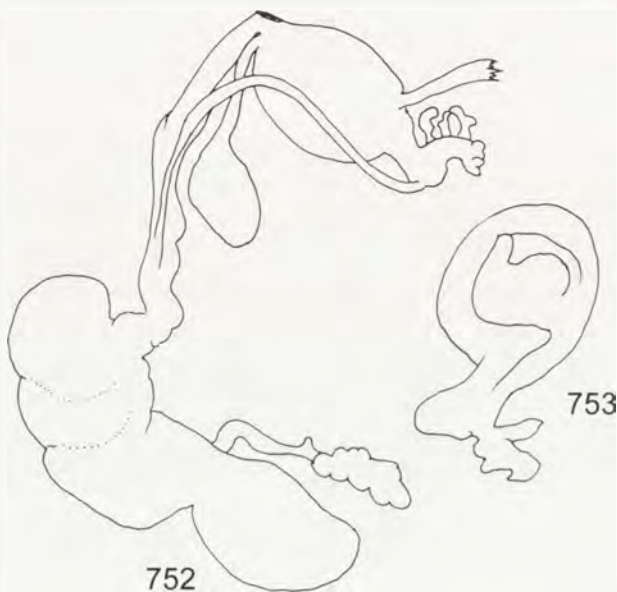
Rectum lacking caecum.

Kidney equipped with lobus.

Ecology and bionomics poorly known.

The distribution range comprises a small area of northern Portugal and Spanish Galicia.

There are 4 species known.



Figs. 752-753. *Agriolimax attemsi* - reproductive system and penis. (After Simroth 1905; slightly simplified)

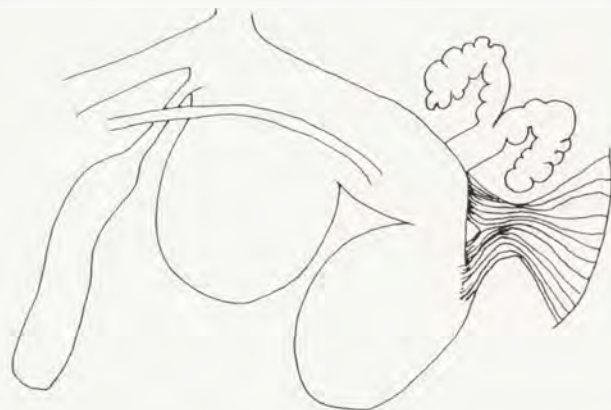


Fig. 754. *Agriolimax fuscus* - copulatory organs. (After Simroth 1903)

Key to identification of the species of the genus *Furcopenis*

1. The anterior part of penis is joined by two elongated accessory bodies, on the posterior ends of which glands, looking as if caps, are situated (Figs. 768-773).
 *Furcopenis darioi* (p. 555)
- Penis is joined by different accessory bodies. 2
2. The anterior section of penis connected with a heart-shaped accessory body, which is partly covered by fine granulate glands (Figs. 777-785). Inside the posterior part of penis a spherical papilla (Fig. 780).
 *Furcopenis geresiensis* (p. 557)
- A single elongated accessory gland joining the anterior part of penis. 3

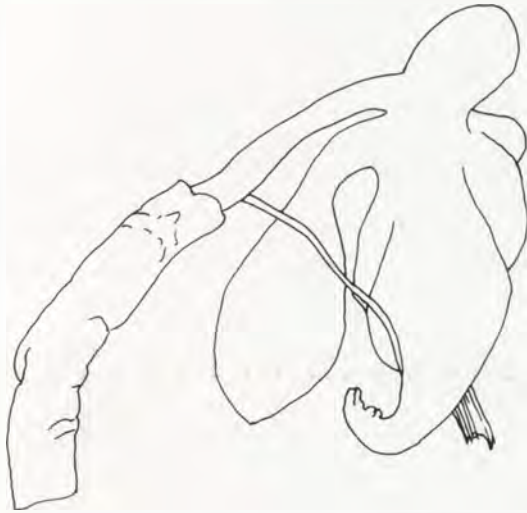


Fig. 755. *Agriolimax Horsti* – copulatory organs. (After Germain 1921)

3. The glands of the accessory body open into it through numerous entangled ducts. Inside the accessory body, in its posterior section, there is a conical structure (Figs. 774–775).

..... *Furcopenis gallaeciensis* (p. 555)

– The accessory body glands in the shape of an adherent cap. Posteriorly inside the accessory body a funnel-shaped structure is situated (Figs. 758–763).

..... *Furcopenis circularis* (p. 555)

Furcopenis circularis Castillejo et Mascato, 1987

Furcopenis circularis Castillejo et Mascato, 1987: 33 figs. 1–16. Locus typicus: Castéligo, near Puebla de Trives, Orense (Spain, UTM 29TPG33). Holotypus: MNHM.

Body length up to 29 mm. Coloration from pale to dark brown; body densely covered with irregularly occurring fine black dots. The dots do not merge with one another. Neither do they form a reticulum (Figs. 756–757). Mucus colourless and sticky.

Genitalia (Figs. 758–763). Penis smallish, spadiceous, its posterior end dark-pigmented. Penial gland in the shape of 1–3 unforked branches (Figs. 760–761). Beside the proper penis there is a large, usually larger than the organ mentioned, also spadiceous, accessory body. The two are joined with each other in the anterior section of penis. On the broadened posterior part of the accessory organ there is a large granular gland in the shape of a semicircular cap. The gland opens directly (!) into penis, lacking visible tubular ducts. Retractor penis forked. Its one branched attached somewhat laterally to penis, the other similarly to the accessory body. No stimulator but a longitudinal fold inside penis. Posteriorly inside the accessory organ, at the place where the cap-shaped gland is situated, there is a tubular structure hanging as if inward the cavity (Fig. 762).

Its surface is covered with striae resembling fingerprints. As observed by Castillejo and Mascato (1989), the structure performs the function of a stimulator. The remaining copulatory organs do not display distinctive characters.

Like in other representatives of the genus, rectal caecum is lacking.

Ecology. Barely known. Very agile animals (Castillejo 1997).

Distribution. So far the species has been known to occur only in Galicia (Spain) and northern Portugal (Castillejo 1997).

Comments. The species is similar to *F. gallaeciensis*, differing in lack of distinct tubular ducts that connect the cap-shaped gland with the accessory organ of penis, and in the presence of an orbicularly tubular structure (stimulator?) inside penial accessory body.

Furcopenis darioi, another slug bearing resemblance to *F. circularis*, is distinguishable by two accessory organs connected with penis. Both of them have glandular “caps” on the apical end.

Furcopenis darioi Castillejo et Wiktor, 1983

Furcopenis darioi Castillejo et Wiktor, 1983: 2 figs. 1–14. Locus typicus: Bosque los Cabaninos, los Ancares (Galicia, Spain, UTM 29TPH74). Holotypus: MNHW no. MP 471.

References: Castillejo 1997: 92 figs. 37–39.

Body length up to ca 20 mm (live individuals 30 mm). Coloration evenly chestnut brown. Skin very thin (Figs. 764–766). Mucus colourless.

Genitalia (Figs. 767–773). Penis small, anteriorly inconspicuously narrowed. Penial gland with 2–3 unbranched processes. Two (!) accessory bodies joining penis in its anterior section and roughly equalling this organ in size. Both are equipped with large granulated glands set in the form of caps onto the apical end. Musculus retractor penis branching into three insertions. One of them is attached to the apical end of penis, whereas the other two each to an accessory gland, i.e. to the surrounding membrane. Inside penis a kind of stimulator with a sculpture resembling fingerprints (Fig. 773). The internal wall of accessory bodies smooth. In each of them there is a longitudinal fold, but no other internal structures. When the genitalia are everted, the accessory bodies assume a horseshoe shape with two “testicles” (Fig. 766).

Rectum with no trace of caecum.

Ecology. Hardly known.

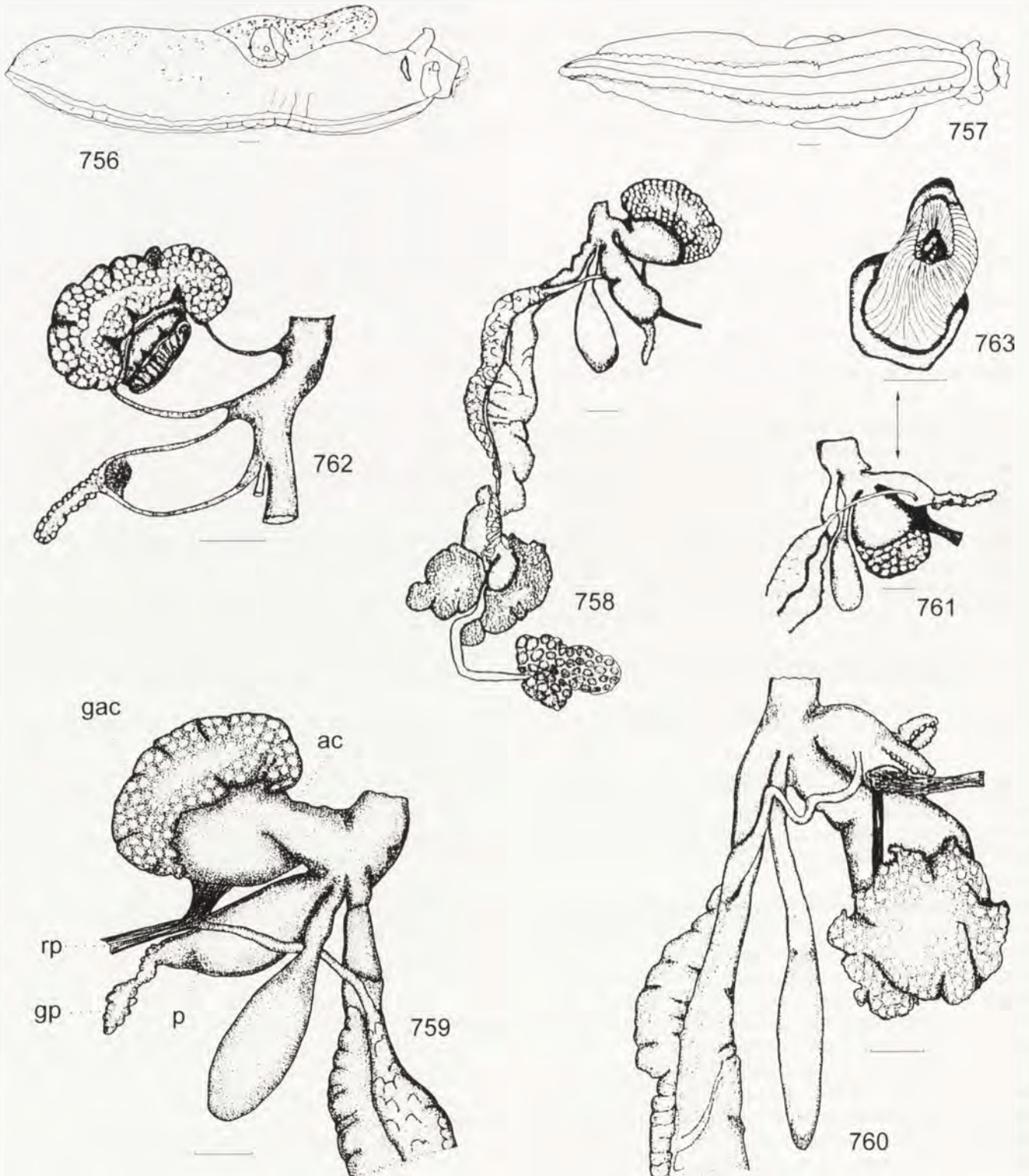
Distribution. Central and eastern Galicia, and the adjoining fragments of Asturias (Spain).

Comments. The slug is distinguishable by its uni-colouredness and two accessory glands the only internal structures of which are inconspicuous folds.

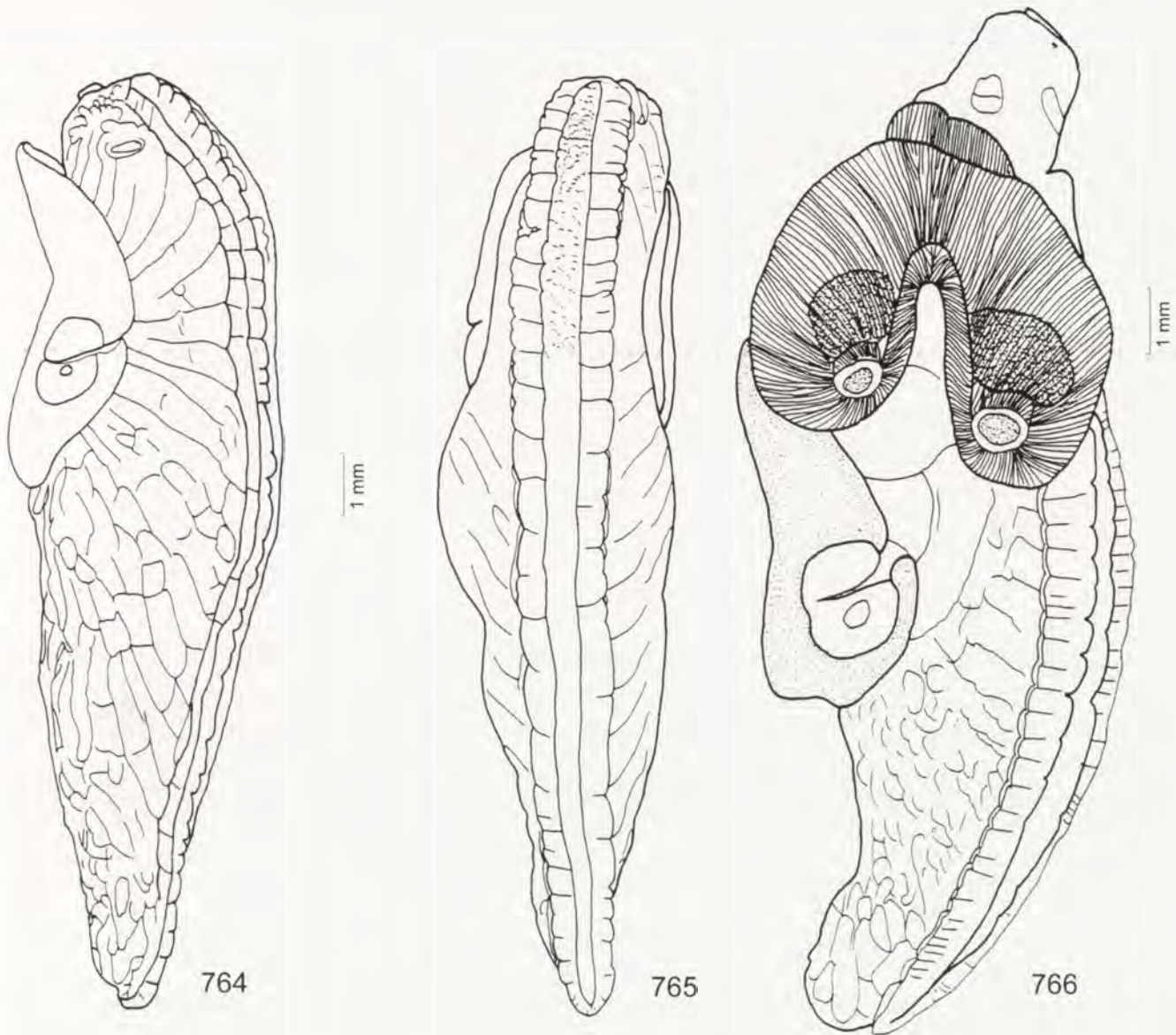
Furcopenis gallaeciensis Castillejo et Wiktor, 1983

Furcopenis gallaeciensis Castillejo et Wiktor, 1983: 8 figs. 15–25. Locus typicus: Barbanza, Sta. Eugenia (Galicia, Spain, UTM 29TNH02). Holotypus: MNHW no. MP 472.

References: Castillejo 1997: 97 figs. 40–42.



Figs. 756–763. *Furcopenis circularis*. 756–757 – External appearance. 758 – Reproductive system. 759–761 – Copulatory organs. 762 – Cross-section of copulatory organs. 763 – A tubular structure inside penial accessory body. (After Castillo and Moscato 1987)



Figs. 764–766. *Furcopenis darioi*. 764–765 – External appearance. 766 – External view with everted penis. (After Castillejo and Wiktor 1983)

Body size: ca 25 (live ca 35) mm in length. Skin very thin and transparent. Coloration dirty creamy, on back slightly darker up to chestnut. In some specimens delicate scarce dark dots occurring on back. Mucus colourless.

Genitalia (Figs. 774–775). Penis spadiceous. Penial gland in the shape of 1–3 unforked processes, situated apically on penis. The latter organ anteriorly joined by a single (!) large cylindrical accessory organ, which roughly equals the former in size or is even larger. On the accessory body apical end there is a large granular gland, the two connected by numerous coiled ducts (!). Musculus retractor penis forked. Its one branch inserting to the apical end of penis, the other attached to the membrane enveloping the gland of accessory body. Interior wall of penis smooth; stimulator lacking. A conical structure and a longitudinal fold inside the accessory body (Fig. 776).

No traces of caecum on rectum.

Ecology. Little is known about it, except that the slug lives in gardens and open habitats, sometimes as a synanthrope.

Distribution. Western Galicia (Spain).

Comments. The species distinctive characters are numerous coiled ducts connecting the accessory body with its gland, and a conical structure inside the former organ mentioned.

Furcopenis geresiensis

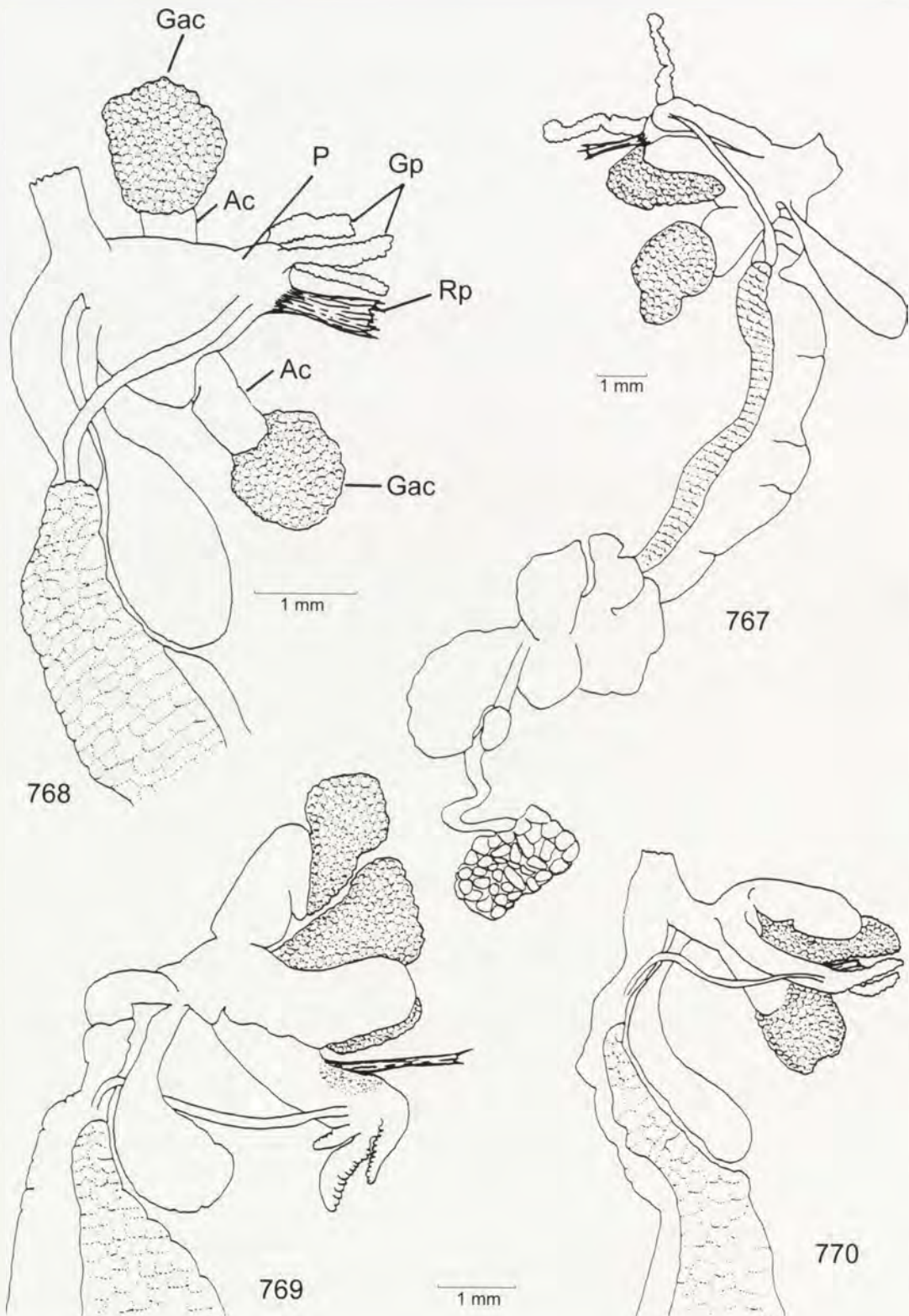
(Rodríguez, Castillejo et Outeiro, 1989)

Deroceras geresiensis Rodríguez, Castillejo et Outeiro, 1989: 95 figs. 1–42.

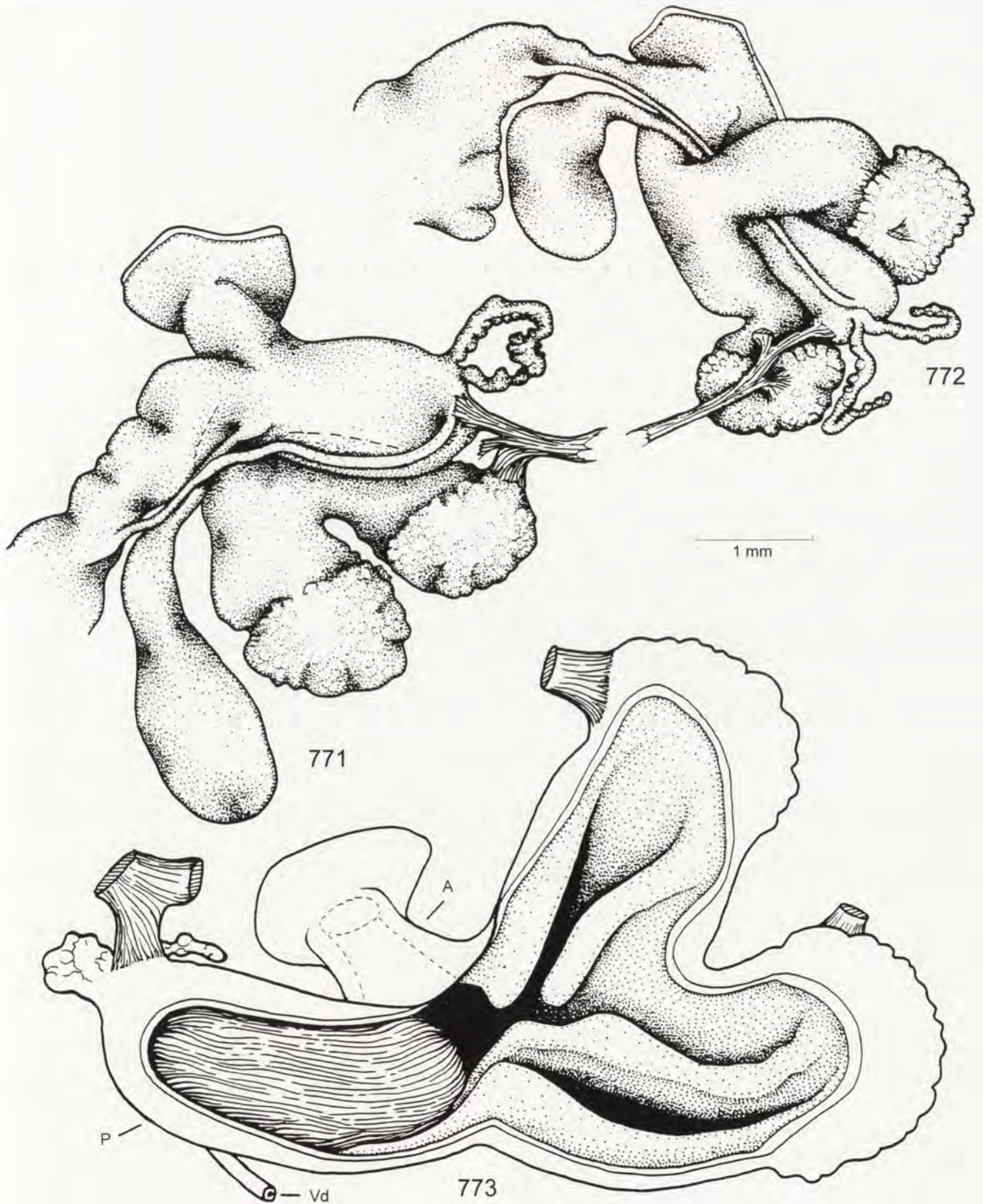
Locus typicus: Curral de Leonte, Serra de Geres (Portugal, UTM 29TNG72. Holotypus: MHNM.

Deroceras lombricoïdes (partim!): Simroth 1891: 284 t. 3 figs. 8, 11–16.

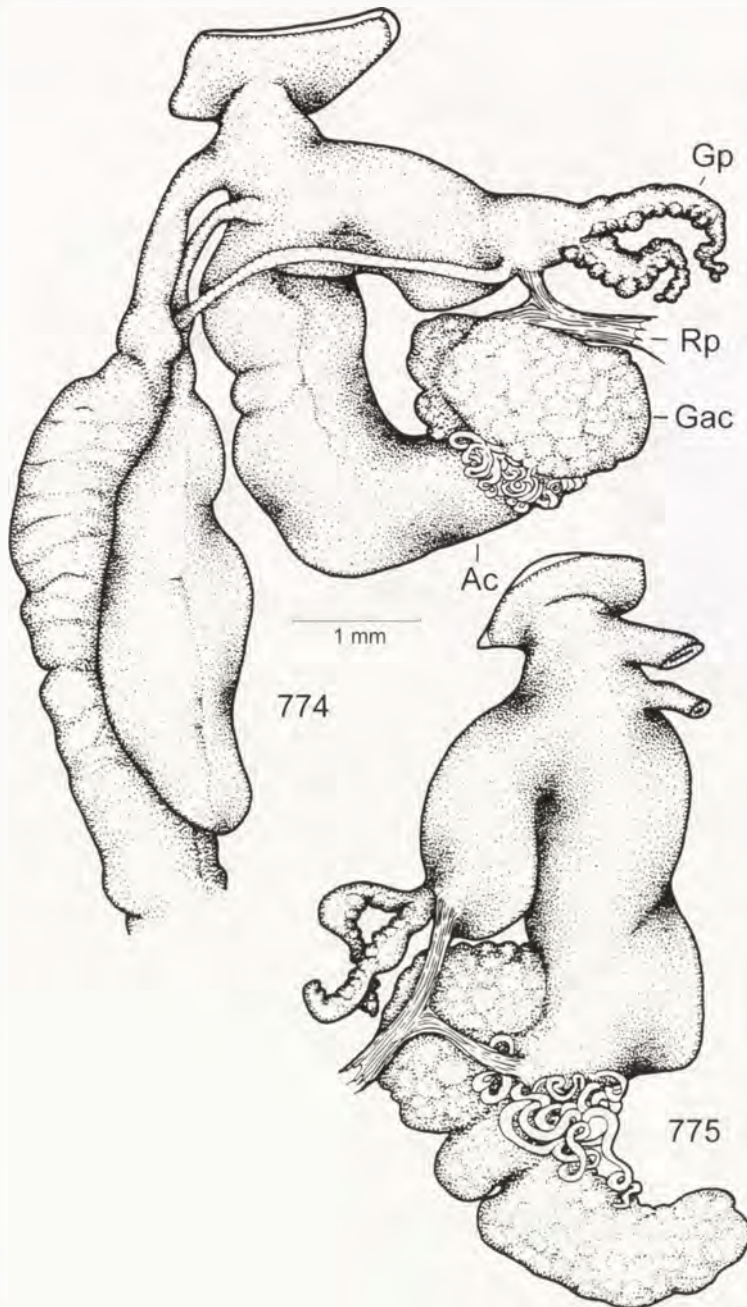
Deroceras (*P.*) *geresiensis*: Castillejo 1997: 88 figs. 34a–d.



Figs. 767–770. *Furcopenis darioi*. 767 – Reproductive system. 768–770 – Copulatory organs. (After Castillejo and Wiktor 1983)



Figs. 771–773. *Furcopenis darioi*. 771–772 – Copulatory organs of the holotype viewed from two opposite sides. 773 – Internal structures of penis and its accessory body. A – atrium; P – penis; VD – vas deferens. (After Castillejo and Wiktor 1983).



Figs. 774–775. *Furcopenis gallaeciensis* – holotype. Copulatory organs viewed from two different sides. Ac – accessory body, Gac – gland of accessory body, Gp – penial gland, Rp – musculus retractor penis. (After Castillejo and Wiktor 1983)

Body length up to ca 30 mm; the slugs I have examined are 24 mm long after preservation. Body creamy or dirty creamy, very delicately and irregularly spotted with blackish melanophores. On mantle they yield concentrations producing an irregular reticulum. In the part behind mantle the spots are scarcer and less distinct.

Mucus colourless (Rodríguez *et al.* 1989).

Genitalia (Figs. 777–780, 782–785). Penis narrow and tubular, anteriorly connected with a large heart-shaped accessory organ. Penis is as if inserted between the two

parts that compose the accessory body. Both parts have poorly perceivable granular glands embedded in their posterior wall. Penial gland made up of 2–3 branches accreted at the base. Musculus retractor penis inserted to penis nearly apically, its small fragment running more anterad and attaching to the above mentioned accessory organ. The outlet of vas deferens almost apical. Inside penis there is a spherical papilla, which, as follows from the figures by Rodríguez *et al.* (1989), does not undergo evertion, and thus it is unknown if this structure is homologous with stimulator. Inside the accessory body there are two ligula-shaped structures which form a reversed letter V. Spermatheca oval, its container markedly delineated from the spermatheca duct.

Rectum with no trace of caecum (Fig. 781).

Ecology. According to Rodríguez *et al.* (1989), the slug copulates in November. The course of this process, as described by the authors, is similar to that in *Deroceras*. During copulation only the accessory organ gets everted.

Distribution. The slug is known from northern Portugal and a few localities in north-western Spain. In the opinion of Rodríguez *et al.* (1989), all its localities are situated closer to the coast than those of *F. darioi*. Revising the paratypes of *F. geresiensis* from locus typicus, however, I found out that some of them were actually *F. darioi*. It seems that at least partly the ranges of the two species overlap.

Comments. With respect to external appearance the slug is indistinguishable from numerous *Deroceras* and other *Furcopenis* species. The authors (Rodríguez *et al.* 1989), ranked it with the genus *Deroceras*. Castillejo (1997) additionally placed this slug in the subgenus *Plathystimulus*. The appearance of penis and, especially, its heart-shaped accessory body, whose posterior walls are equipped with glands, indicate that the slug belongs to the genus *Furcopenis*. The geographical range and other characters, such as a thin skin, size, lack of rectal caecum, testify to this, too.

Among the specimens that I had been sent before the description was published, which were later acknowledged as paratypes, there were some representing *D. lombricoides*. At first glance they look exactly like *F. geresiensis*. They differ, however, in the presence of a spherical (not heart-shaped!) distension in the anterior section of penis. The lateral wall of the distension is equipped with glands which constitute one (not two!) concentration. What is more, penis lacks the spherical structure (!) typical of *F. geresiensis*.

D. darioi is also similar. This species differs in its accessory bodies, which are narrow and better distinguishable one from the other. In one of them a pointed organ is situated. Glands open to the accessory bodies through numerous entangled ducts.



Fig. 776. *Furcopenis gallaeciensis* – holotype. Internal structures of penis and its accessory body. (After Castillejo and Wiktor 1983)

Genus *Lytopenis* Boettger, 1886

Amalia (*Lytopenis*) O. Boettger, 1886b: 226. Species typica: *Amalia* (*Lytopenis*) *longicollis* O. Boettger, 1886 (= *Amalia maculata* Koch et Heynemann, 1874).

Agriolimax (*Platytoron*): Simroth, 1886b: 311. Species typica: *Agriolimax* (*Platytoron*) *maculatus* = *Lytopenis maculata* Koch et Heynemann, 1874.

Agriolimax (*Tropidolytopenis*) Simroth 1901: 174. Species typica: *Lytopenis maculata* (Koch et Heynemann, 1874).

Lytopenis s. str.: Hesse 1926: 25.

References: van Regteren 1975: 62; Likharev and Wiktor 1980: 195; Wiktor and Likharev 1980: 418 fig. 12 (pallial complex); Jungbluth, Likharev, Wiktor 1981: 21 fig. 9 (radula); Wiktor 1984: 27 figs. 70–77; Rymzhanov and Schileyko 1991: 80.

Length up to ca 35 mm. Body slender, spindle-shaped, similar to those of *Deroceras* species. Mantle inconspicuously longer than 1/3 of the entire body length, wholly in the anterior section, not reaching the posterior body half. The anterior section of mantle not accreted to nape and nearly half of it can be easily bent off. Pneumostom clearly post-

medial. Keel distinctly arched, reaching the posterior edge of mantle (!). Coloration pale brown or reddish grey, most commonly with a pattern of spots, often elongated, both on mantle and beyond it. Medially on mantle and along keel there runs a pale streak, beside which the body is darker-coloured and spotted. Skin relatively thick.

Mucus colourless.

Genitalia. Penis oval in general outline, with numerous distensions. There are no external accessory organs. Retractor penis inserts nearly apically, and somewhat more anteriorly there is the opening of vas deferens. Inside penis a large fold and stimulator with a hard calcified plate.

Rectum without caecum.

Ecology. A hygrophilous slug, most often living in the neighbourhood of water in forest but also in open habitats. It probably reproduces in autumn and spring. Life cycle of about a year.

Distribution. Central Asia, the Caucasus, Afghanistan, Iran.

Merely one species known.

Comments. A genus created for a slug with a hard plate inside penis. The plate is the reason behind some authors including into this genus also other slugs, which I classify as *Deroceras* (*Liolytopenis*). The internal structure of penis does not seem to be a decisive feature here (Likharev and Wiktor 1980). *Lytopenis* differs from *Deroceras* (*Liolytopenis*) in its keel which runs along the whole back, in a relatively thick skin, mantle smaller than the body half and a different, slenderer habitus. These characters appear to be essential enough for those slugs to form a distinct genus.

Keel is so strongly marked and conspicuous that, when describing the first species known, Boettger (1886) created a distinct subgenus, ranking it with the genus *Amalia* (= *Milax*, Milacidae) though.

Lytopenis maculata (Koch et Heynemann, 1874)

Amalia maculata Koch et Heynemann, 1874: in Martens 1874: 2 t. 1 fig. 4, t. 3 fig. 35; Koch and Heynemann 1874: 152 t. 6 fig. 5. Locus typicus: "prope Maracandam" (environs of Samarkand, Uzbekistan). Typus: I have got no information.

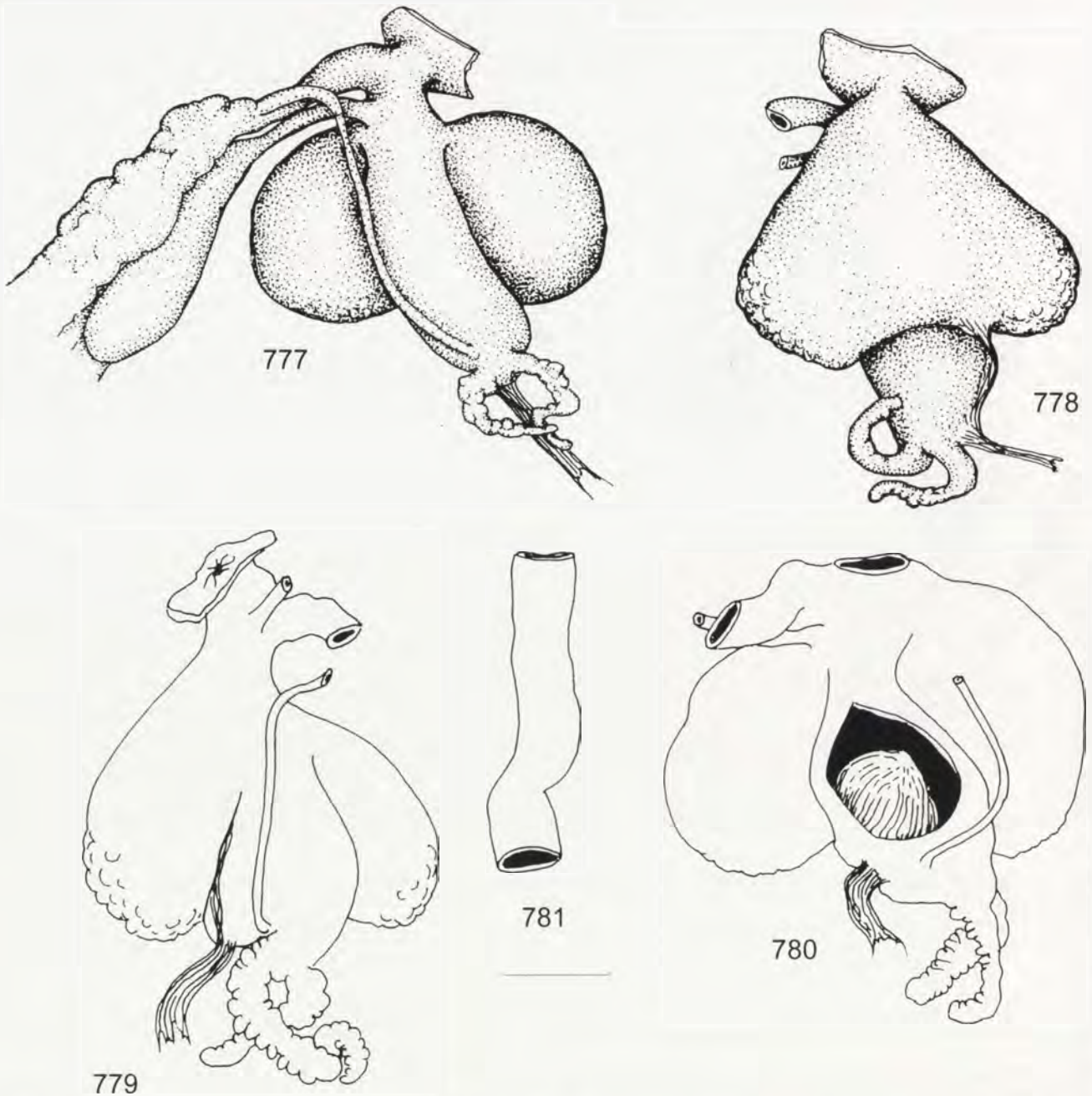
Amalia (*Lytopenis*) *longicollis* O. Boettger, 1886: 266 t. 2 figs. 1a–e. Locus typicus: Lenkoran. Typus: presumably does not exist.

Lytopenis transeaspia Rosen, 1892: 123. Locus typicus: Germab River valley near Schamhala in Chorasan (= Chorassan), Iran.

?*Lytopenis Boettgeri* Rosen, 1892: 124. See Likharev and Wiktor 1980: 200 and Simroth 1912: 44 t. 3 fig. 41.

References: Izzatullayev 1980: 95 figs. a–b; Likharev and Wiktor 1980: 196 figs. 219–225.

Body length up to ca 35 mm. A crawling slug has its body somewhat narrowed just behind mantle, being the widest in the posterior part, which is ca 2/3 of the whole length. Except for that, the slug externally resembles *Deroceras* species (Figs. 786–787). Skin wrinkles flattened. Keel, built of a few (2–3) rows of wrinkles, extends up to the posterior mantle margin, which is particularly well-visible when the body is contracted and in the case of the so-called hard preservation. Coloration varied but uneven: on a brown (of various shades) or reddish-grey background there is dark,

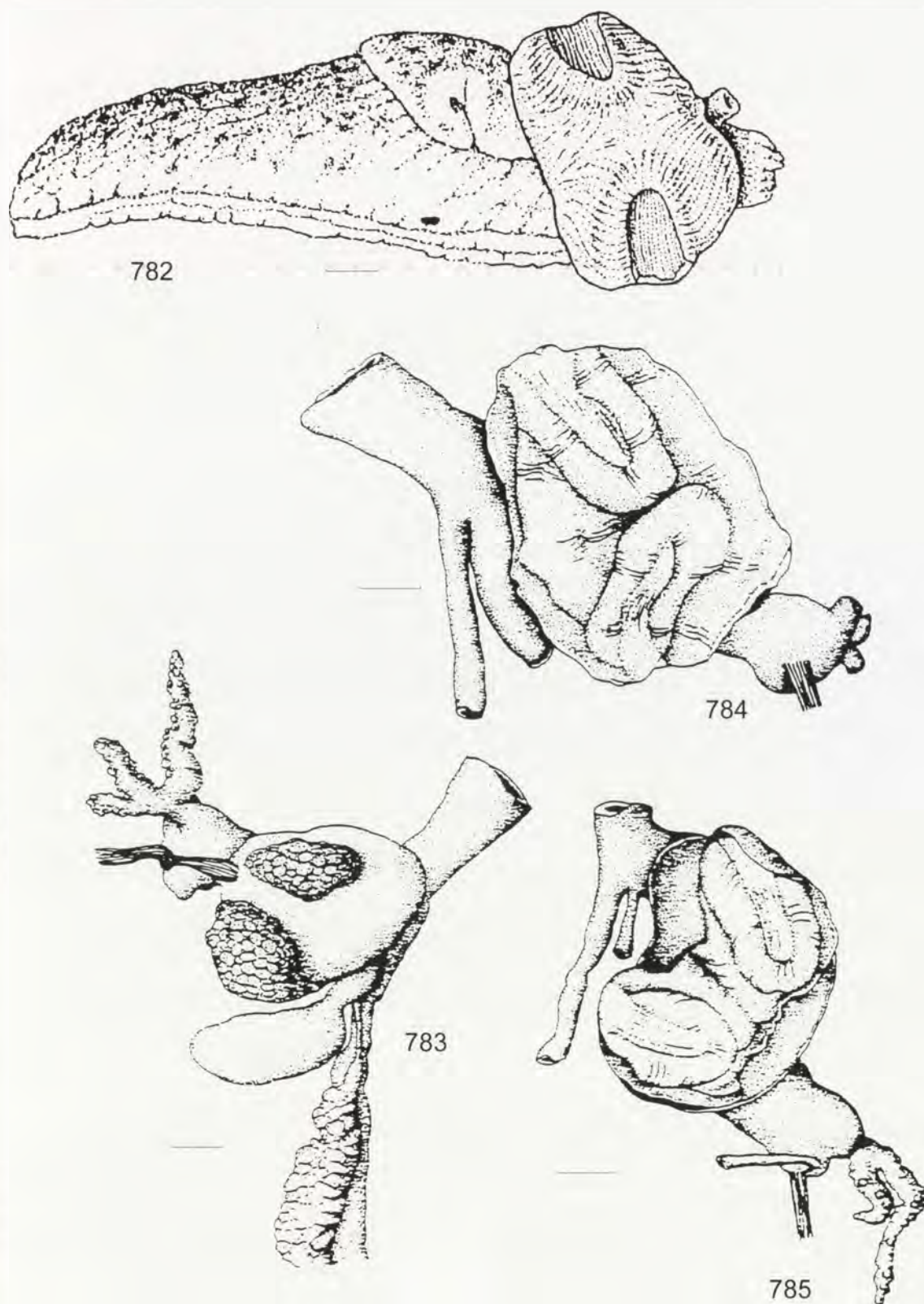


Figs. 777–781. *Furcopenis geresiensis* – paratypes from Curral de Leonte. 777 – Copulatory organs. 778 – Penis of the same specimen as in Fig. 777 viewed from the opposite side. 779–780 – Penis of the same specimen viewed from different sides and papilla inside it. 781 – Rectum. (Orig.)

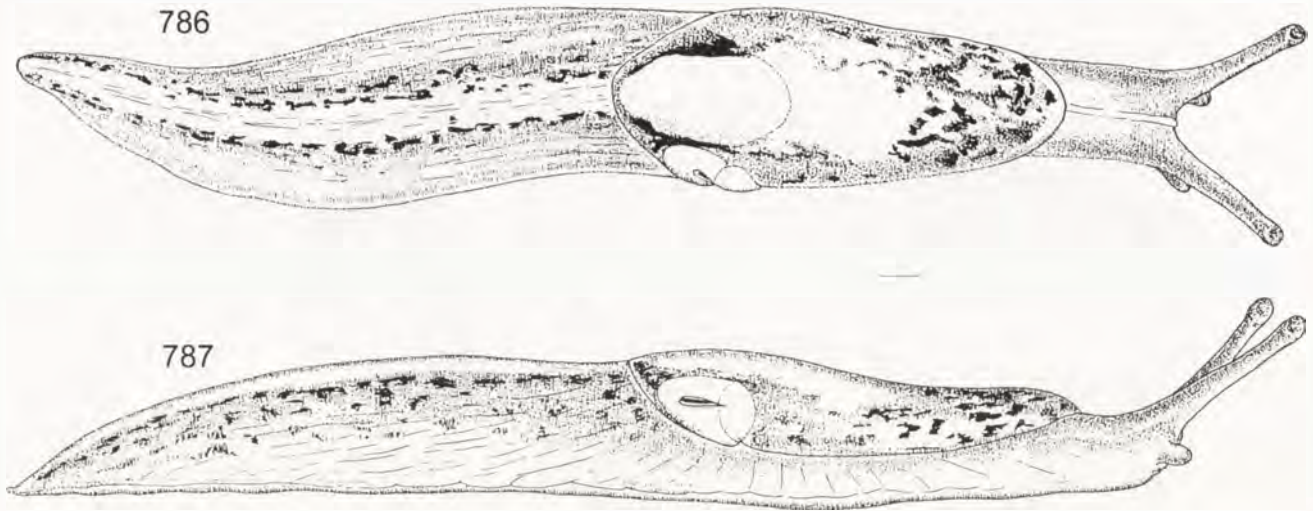
sometimes nearly black, spotting. The spots are irregular in shape, often elongated or simply turning into lines. On mantle they are anteriorly and laterally concentrated, in the posterior section fusing to yield a kind of a dark horseshoe. The medial section of mantle, particularly the part comprising vestigial shell, is pale and completely devoid of spotting. In the section beyond mantle the spots get concentrated, sometimes merging with each other on the sides of keel so that to produce a pale unicolourous band running medially along back. Head and tentacles blackish, sole creamy. It is

typical that the pattern appears already in juvenile specimens, only turning darker during the process of maturation. The coloration depends also on the type of environment. In open habitats the slugs are darker- and denser-pigmented, keel, the horseshoe blot and mantle (the form *longicollis* = *transcaspia*) greyer. Those individuals which live in well-shadowed places (e.g. forests) are of lighter coloration, their spotting sparser and less intense (forma typica).

Genitalia (Figs. 788–794). Penis sack-shaped, in its posterior part transversely constricted and thus divided into



Figs. 782–785. *Furcopenis geresiensis*. 782 – Slug with everted penis. 783 – Copulatory organs. 784–785 – Structures inside penis. (After Rodríguez *et al.* 1989)



Figs. 786–787. *Lytopenelte maculata* – external appearance. (After Likharev and Wiktor 1980)

two parts. The constriction is usually nearly symmetrical (not unilateral like in *Deroceas* species). The anterior and – especially – the posterior part of penis with various irregular distensions. Vas deferens opens into the posterior part of penis in the region of the constriction or more posterad. It is similar in the case of retractor insertion. Most often, however, the latter produces two offshoots, one of which inserts to the anterior section of penis whereas the other to the organ's posterior part (Fig. 789). Spermatheca oval on a well delineated spermatheca duct. Inside the anterior section of penis a large stimulator of coarse marked sculpture, situated on the oval plate, often with its medial part raised upward and arched. Its margins are turned up. A complex system of fine folds posteriorly inside penis.

Intestine loops like in *Deroceas*. On rectum there is even no trace of caecum.

Ecology. An agile animal, occurring most often in the neighbourhood of water and wet places. Most commonly found in forest, in somewhat shadowy sites. It hides in leaf litter and detritus. However, the slug inhabits also open habitats, by waters and irrigation appliances. It hides under stones and pieces of turf, in detritus etc. It lives for a year, yielding one generation. Judging by the material collected, the slug matures and reproduces late in the autumn, possibly also in the spring. In dry subtropical regions (e.g. in Central Asia), characterized by a long spell of summer drought, the slug buries itself deep into the earth or rock crevices to estivate (Likharev and Wiktor 1980). In Tadzhikistan the wintering stage are eggs and juveniles. The young slugs hatch mainly in April (Izatullayev 1980).

Distribution. Central Asia (Ferganski Ridge, the region of Samrakanda and Penozhikent, the environs of Duschanbe Pyandzha, W Kopeddag, the Caucasus (Lenkoran Lowlands, Talysh Foothills, Great Caucasus and Azarbaydzhan), Afghanistan (Herat – a garden, Karogh), probably also Iran (prov. Gilian, Mazendran).

Comments. The variability of coloration was the reason for *L. longicollis* and *L. transcaspia* being described as distinct species. A study of ample material made Likharev and Wiktor (1980) synonymize these names.

In all likelihood, also *L. boettgeri* should be acknowledged as such a “colour” synonym. The taxon has been described from an area where the typically coloured *L. maculata* occurs. Nevertheless, I have failed to find new specimens corresponding to the dark-coloured *L. Boettgeri*, which would enable to solve the problem.

The status of *D. (L.) kandaharensis* is also unclear. Likharev and Wiktor (1980) express the opinion that this name may be a synonym of *L. maculata*. However, my later studies on the type material of *D. kandaharensis* have convinced me that this is not the case and *kandaharensis* should be placed within *Deroceas (Liolytopenelte)* (see *Deroceas (Liolytopenelte) kandaharensis* p. 541).

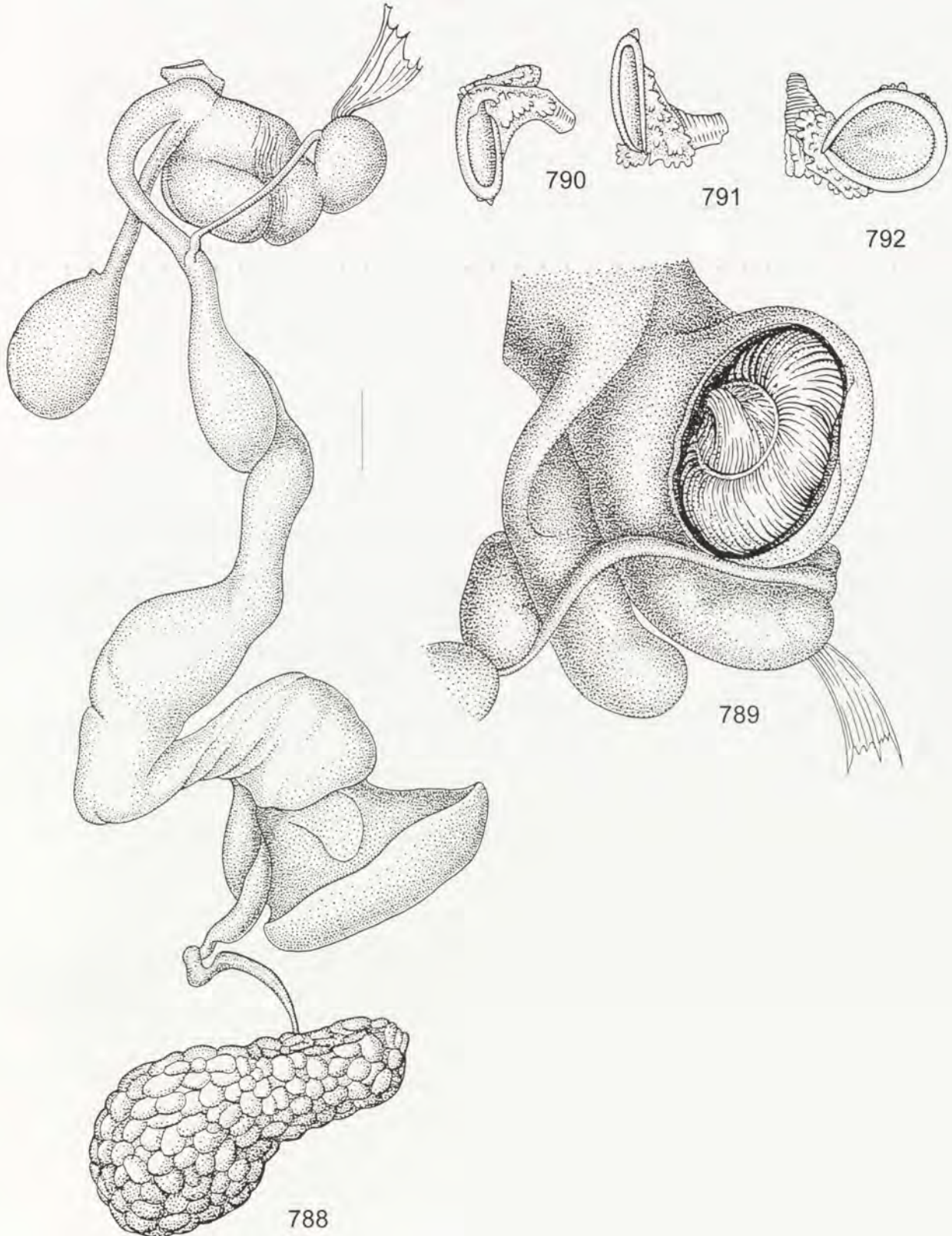
Genus *Megalopelte* Lindholm, 1914

Megalopelte Lindholm, 1914: 167. Species typica: *Megalopelte simrothi*, Lindholm, 1914.

References: Likharev 1957: 1253 figs. 1–2; Likharev and Wiktor 1980: 200; Wiktor and Likharev 1980: 418 fig. 14 (pallial complex); Jungbluth, Likharev, Wiktor 1981: 18 fig. 10.

Body length up to ca 25 mm. Body spindle-shaped, more or less in its 2/3 covered by mantle (!). The mantle margins can be easily bent aside from all the sides. Mantle occupies the medial part. Head and the very short, cuneately narrowed section behind mantle jut out from beneath of it. Pneumostom somewhat postmedial.

Penis consisting of two parts: a broader anterior section (when shrunk, assuming the shape of a pear) and an irregular posterior one, which is cylindrically elongated and



Figs. 788–792. *Lytopelte maculata* – specimens from Central Asia. 788 – Reproductive system. 789 – Penis with stimulator visible inside and a hard plate on the latter. 790–792 – Penial hard plate. (After Likharev and Wiktor 1980)

Megalopelte simrothi Lindholm, 1914

Megalopelte simrothi Lindholm, 1914: 168. Locus typicus: Dsansuul (Vil. Çoroh = Artvin, Turkey). Typus: no information about its preservation.

References: Likharev 1957: 1253 figs. 1–2; Likharev and Wiktor 1980: 202 figs. 226–235; Wiktor 1994: 34.

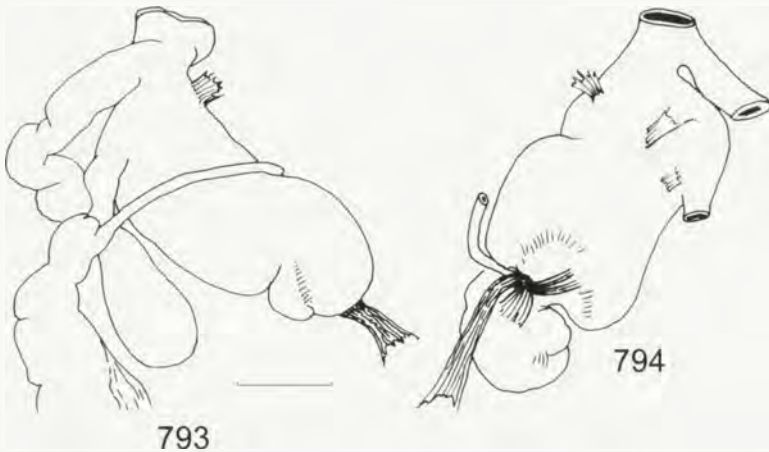
A smallish slug: ca 25 mm in length. Body spindle-shaped. A strikingly large mantle, which can cover nearly whole body when the animal is contracted and roughly its 2/3 when the slug is crawling. It is accreted only medially; its anterior, posterior and lateral margins can be tilted up. Pneumostom slightly beyond half-mantle. Coloration evenly chocolate-blackish (Fig. 795).

Genitalia (Figs. 796–799). Glandula hermaphroditica relatively large. Ductus hermaphroditicus long and thin. Spermooviductus comparatively long, too, its anterior section enlarged owing to a large prostate. Vas deferens thin and long. Penis anteriorly tubular, more posteriorly abruptly clavately broadening, its rear section considerably narrower and elongated, terminating with a bend. Vas deferens opens apically. A strong fan-shapedly widening musculus retractor penis attached laterally to the posterior, narrowed, part of penis. Stimulator lacking; inside penis there are folds forming the letter X (Fig. 799). Spermatheca small, oval, narrowing into a short spermatheca duct. The two are jointly ca three times shorter than penis. The free oviduct section thick, tubular. Atrium very short.

Intestine without caecum.

Ecology. See the description of the genus.

Distribution. Up till now the slug has been known only from Turkey (Vil. Bolu, Isparr, Samsun, Rize, İkizdere, Artvin). Besides, it has been recorded from Abkhazia. It probably occurs along the whole Asian and Caucasian coasts of the Black Sea.



Figs. 793–794. *Lytopelte maculata*. 793 – Copulatory organs. 794 – Penis seen from the opposite side. (Orig.)

bent anterad. Retractor penis fan-shapedly widened. No other appendages present. Stimulator lacking, too. Inside penis there are two folds medially accreted with each other.

Intestine coils into two loops. The first one has its second arm relatively short. The other loop is shifted far backward, its second arm, i.e. rectum, short as well. There is no caecum, not even any enlargement in the place where it might occur.

Ecology. Poorly known. The genus inhabits humid deciduous forests.

Distribution. The range is not thoroughly known. Slugs of the genus *Megalopelte* are recorded from the areas adjacent to the Black Sea: from Vil. Bolu (Abant Göl) in Turkey to the west to Georgia (Abkhazia – Batumi, Tkvarcheli) in the east.

So far there is only one species known.

Comments. The genus is easy to identify thanks to its huge mantle.

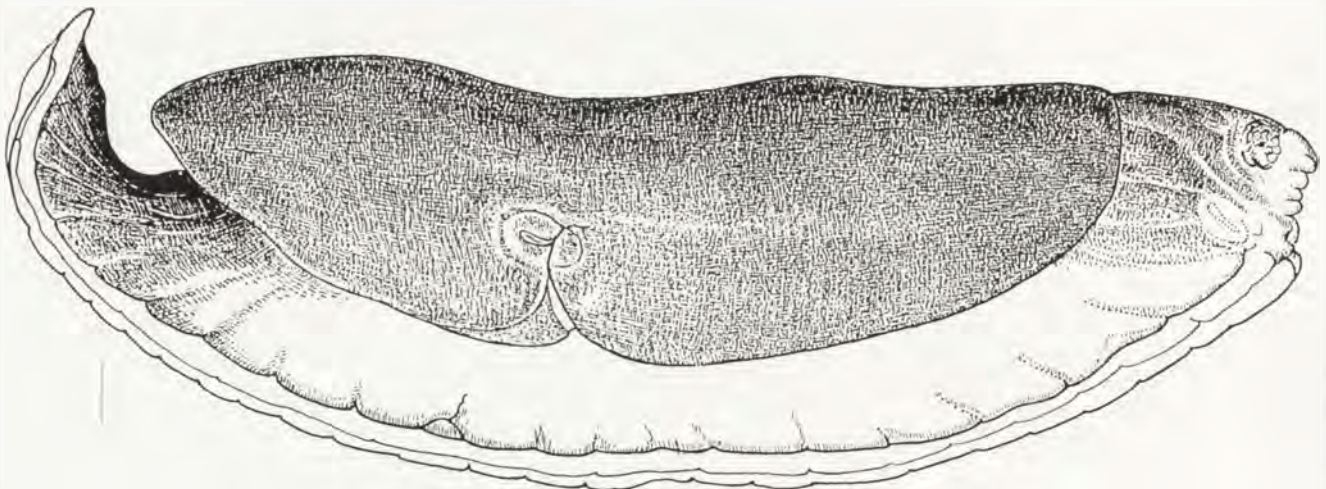


Fig. 795. *Megalopelte simrothi* – external view. (After Likharev and Wiktor 1980)

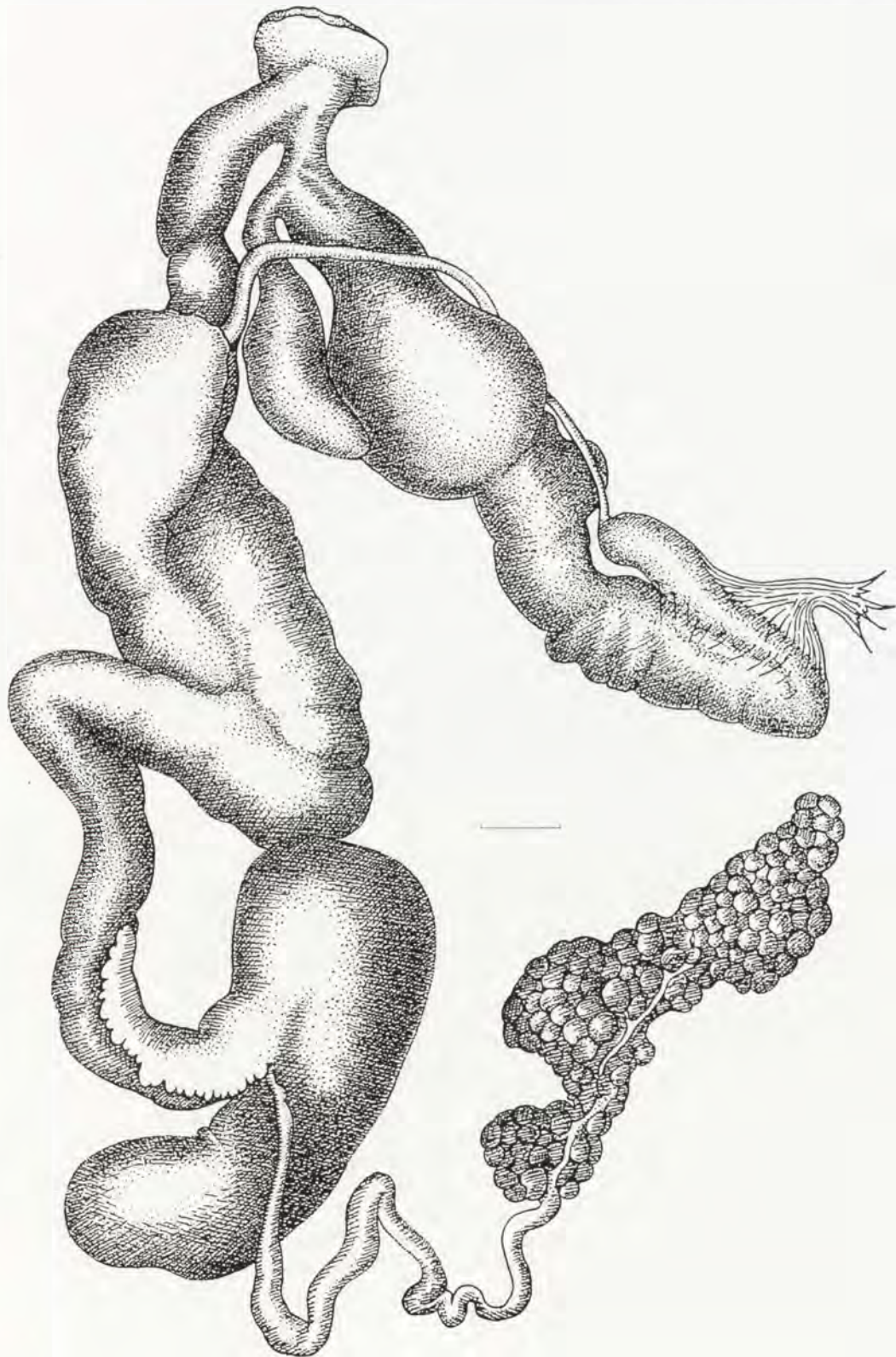


Fig. 796. *Megalopelte simrothi* – reproductive system. (After Likharev and Wiktor 1980)



Figs. 797–798. *Megalopelte simrothi*. 797 – Penis strongly contracted with its posterior part invaginated. 798 – Structures inside penis of the same specimen. (After Likharev and Wiktor 1980)

Genus *Krynickillus* Kaleniczenko, 1851

Krynickillus Kaleniczenko, 1851: 220. Species typica: *Krynickillus melanocephalus* Kaleniczenko, 1851.

References: Pilsbry 1948: 560; Wiktor 1971: 270; Likharev and Wiktor 1980: 190; Wiktor and Likharev 1980: 418 (pallial complex); Jungbluth, Likharev, Wiktor 1981: 21 fig. 8 (radula); Wiktor 1983: 190; Wiktor 1994: 30.

Slugs of medium size, up to ca 46 mm in length, which is fairly long for Agriolimacidae. Body slender (similar to Limacidae in habitus), posteriorly strongly narrowed. Mantle covering merely ca 1/3 entire body length. Nearly half of the anterior section of mantle can be bent aside. Pneumostom surrounded by quite a poorly marked shield. An inconspicuous shallow groove runs anterad from the back of mantle and on the right of it, disappearing towards its anterior part (Figs. 800, 805–807). The groove is well-visible when the animal is crawling; after preservation it may be difficult to perceive. Keel poorly arched, reaching nearly half the section behind mantle. Skin soft. Coloration evenly blackish brown, i.e. without spots. Nevertheless, the intensity of pigmentation of the particular body parts may be varied, up to black.

Mucus colourless.

Penis oval, shortly cylindrical, without external accessory organs. Vas deferens opens apically or laterally into the posterior penis section. Musculus retractor penis thin and unfurcate, inserted beside vas deferens opening. Spermatheca small, oval, set on a long spermatheca duct with which it is at least as long as penis, usually much longer.

Intestine forms two long loops. Rectum lacks any trace of caecum.

Ecology. Poorly known. Forest slugs usually found in small numbers, apparently living mostly in the mountains. They hide under stones and in leaf litter. Nothing is known about the life cycle.

Distribution. The Balkans and partly Roumania (Dobruja), Ukraine (mainly Crimea), almost the whole Caucasus, Turkey, N Iran.

Three species, classified among two subgenera (*Krynickillus*, *Toxolimax*), known.

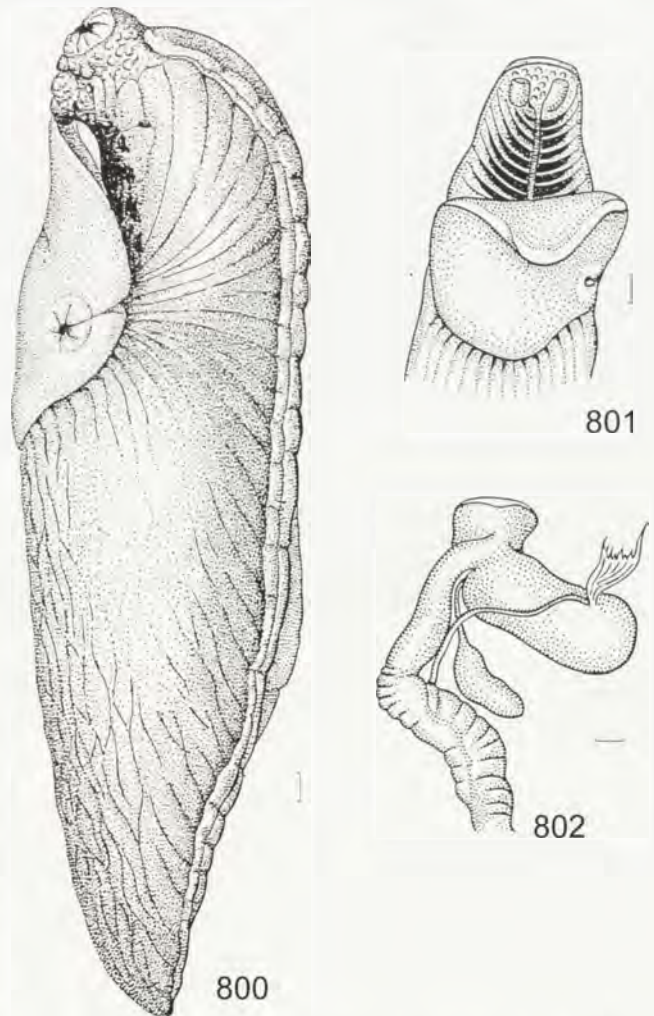
Key to identification of the species of the genus *Krynickillus*

1. A hard narrow plate situated inside penis (Figs. 816–817). Turkey.
 *Krynickillus (Toxolimax) hoplites* (p. 573)
- Inside penis only soft folds; no hard structures present (*Krynickillus* s. str.) 2
2. A grey slug, but its head and nape as well as the section below mantle deeply black (Figs. 800–801). Spermatheca along with its duct roughly equalling penis in length (Figs. 809–810). Crimea, the Caucasus, Turkey, Iran.

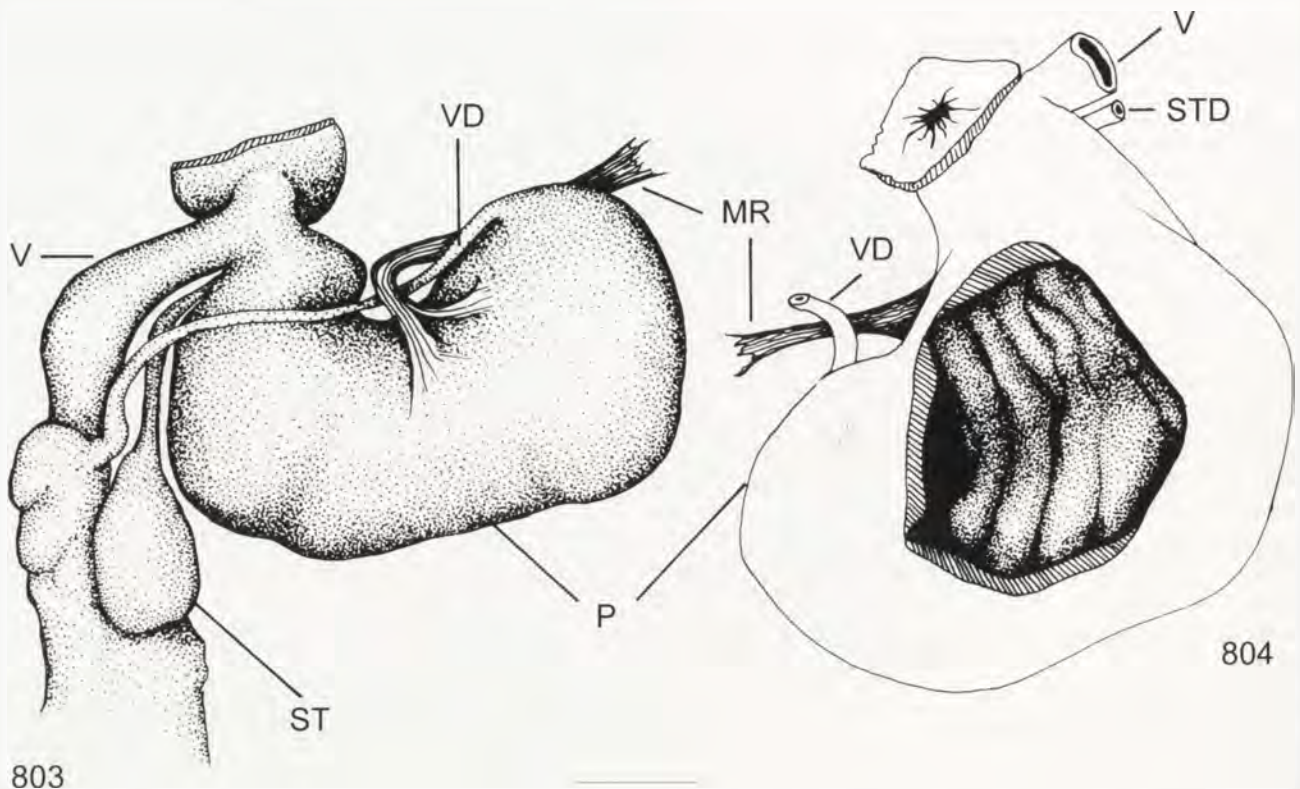
 *Krynickillus (Krynickillus) melanocephalus* (p. 570)
- A grey or blackish slug; head blackish but nape pale. Spermatheca on a long spermatheca duct, along with which it is at least twice longer than penis (Figs. 809–810). Bulgaria and Turkey.
 *Krynickillus (Krynickillus) urbanskii* (p. 570)



Fig. 799. *Megalopelte simrothi* – structures inside relaxed penis. (Orig.)



Figs. 800–802. *Krynickillus (Krynickillus) melanocephalus*. 800 – External appearance. 801 – Anterior body section with intensely pigmented nape. 802 – Copulatory organs. (After Likharev and Wiktor 1980)



Figs. 803–804. *Krynickillus (Krynickillus) melanocephalus*. 803 – Copulatory organs. 804 – Structures inside penis. MR – musculus retractor penis; P – penis; ST – spermatheca; STD – spermatheca duct; V – vagina; VD – vas deferens. (Orig.)

Subgenus *Krynickillus* s. str.

Soft folds discernible inside penis. Both stimulator and hard structures lacking.

The distribution range like that of the genus. Two species recorded.

Krynickillus (Krynickillus) melanocephalus Kaleniczenko, 1851

Krynickillus melanocephalus Kaleniczenko, 1851: 221 t. 5 fig. 2. Locus typicus: "Stauropol" (= Stavropol, Crimea, Ukraine). Typus: probably non-existent.

Megaspis melanocephala Kryn.: as a synonym mentioned by Simroth 1901: 154.

Agriolimax melanocephalus: Simroth 1901: 154.

Krynickia: acc. to Simroth 1901: 154, used as a synonym.

Deroceras melanocephalum: Akramovskiy 1976: 205.

Deroceras melanocephalum: Wiktor 1971: 269.

References: Simroth 1901: 154 t. 14 figs. 13–21; Likharev and Wiktor 1980: 191 figs. 202–207; Wiktor and Likharev 1980: 418 fig. 13 (pallial complex).

Body length up to 45 mm. Coloration dirty whitish, sometimes bluish grey. Mantle and back darker. Head, tentacles and nape (also its section under mantle) deep black (!)(Figs. 800–801). The colour of mucus unknown.

Genitalia (Figs. 802–803). Penis cylindrical, without distinctive features. Spermatheca along with spermatheca duct roughly equalling the length of penis.

Intestine without any unique characters as compared with other representatives of the genus.

Ecology. The slug is mainly a forest species, occurring chiefly in the neighbourhood of water; in the lowlands and subalpine zone.

Distribution. Nearly the whole Caucasian area, Crimea, Turkey (Vil. Çoroch) and Iran.

Comments. The species is anatomically similar to *K. urbanskii*, differing, first of all, in coloration, of its black head in particular. Besides, it is somewhat larger than the species compared, its skin thicker, distribution range different.

Krynickillus (Krynickillus) urbanskii (Wiktor, 1971)

Deroceras (Krynickillus) urbanskii Wiktor, 1971: 264 figs. 2A–E, 3A–F.

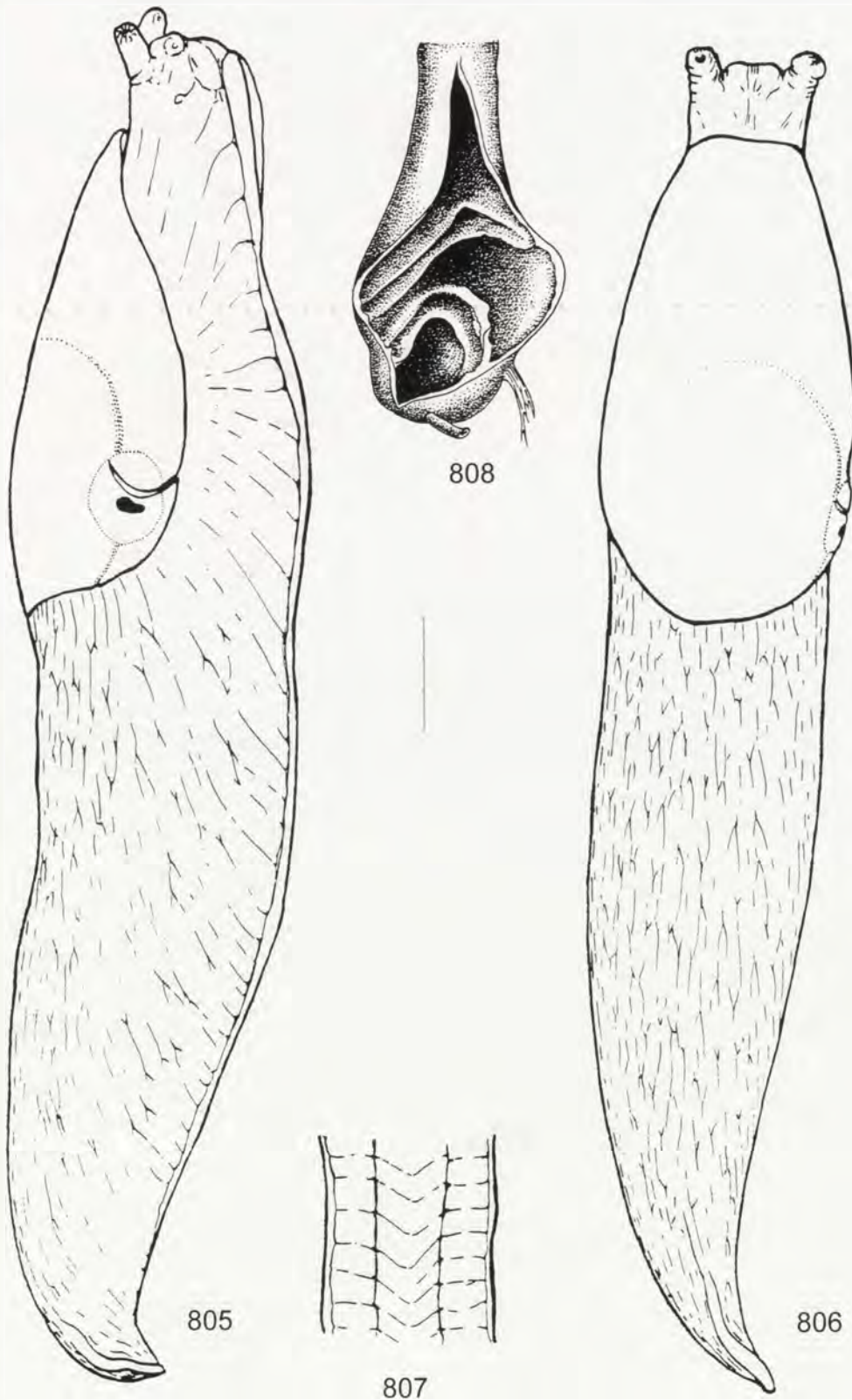
Locus typicus: Karlovo (Stara Planina Mts., Bulgaria). Holotypus: MNHW no. MP 455.

Deroceras melanocephalus (not "-um"): Grossu et Lupu 1957: 86 fig. 1.

Deroceras melanocephalum: Urbański and Wiktor 1968: 72 figs. 10A–D.

Krynickillus urbanskii: Rähle 1992: 7 fig. 2.

Body length up to 45 mm. Body slim with a delicately sculptured surface. Keel confined to ca 1/3 of the part beyond mantle (Figs. 805–808). Coloration grey-black with a slightly paler streak running medially along back both on keel and its extension. Sides getting gradually lighter downwards. Head and tentacles blackish (not black), nape whitish (!). Sole creamy. Mucus colourless, watery.



Figs. 805–808. *Krynickillus (Krynickillus) urbanskii*. 805–806 – External appearance. 807 – Arrangement of wrinkles on sole. 808 – Structures inside penis.
(After Wiktor 1971, Likharev and Wiktor 1980)

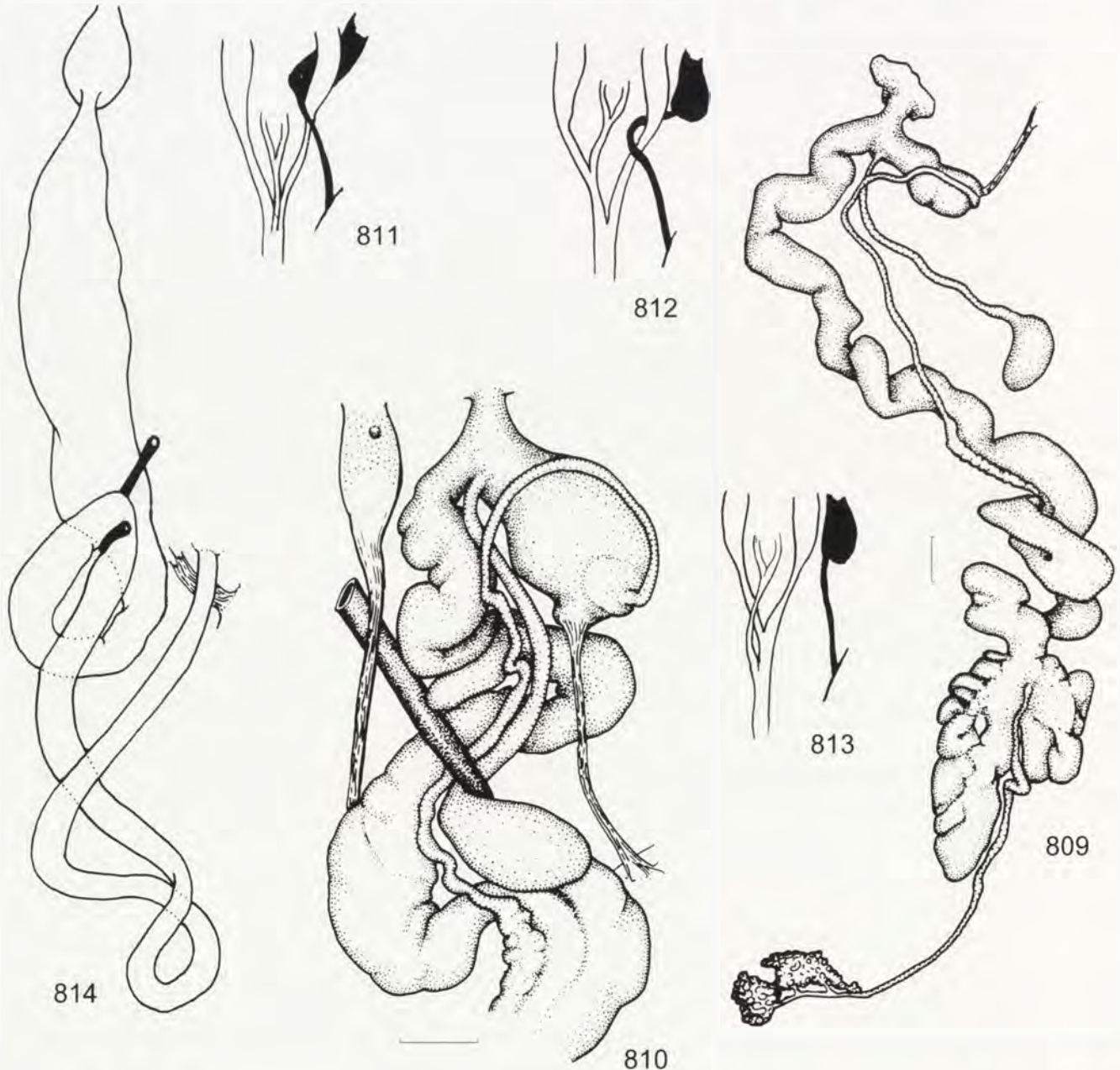
Genitalia (Figs. 808–810). Spermoviductus very long and thin. Copulatory organs in natural position heavily coiled. All their ducts, i.e. oviductus, vas deferens and spermatheca duct are clearly long and thin. Right tentacle and its retractor most often parallel to penis but in some specimens crossed with it (Figs. 811–813). Penis club-shaped or shortly cylindrical, not distinguishable by any typical characters. Inside its interior there are a few arching membraneous folds (Fig. 808). A small spermatheca along with a long spermatheca duct nearly twice longer than penis (!).

Intestine inconspicuously twisted around its axis, its second loop considerably longer than the first one (Fig. 814).

Ecology. A forest species occurring mainly in beech and hornbeam stands, also in brushwood. It hides in leaf litter and under wood pieces; often found on mushrooms. In Bulgaria I collected adult specimens only from August till October, earlier only juveniles.

Distribution. Bulgaria (W part of the Stara Planina Mts. and regions adjacent to the Black Sea), Roumanian Dobruja, Turkey (environs of Trabzun, Abant Gölü – SW Bolu, Araç-Kostamonu, N of Küre).

Comments. The slug discussed differs from *K. melanocephalus* in its slimmer and more delicate build, thinner skin, less prominent skin wrinkles, darker coloration of back



Figs. 809–814. *Krynockillus (Krynockillus) urbanskii*. 809 – Reproductive system. 810 – Copulatory organs in their natural location. 811–813 – Different situation of penis relative to the system of head retractors. (After Wiktor 1971)

and pale (not black) nape; within genitalia, in its long spermatheca duct and longer other ducts of copulatory organs. The ranges of the two slugs differ, too.

K. (K.) urbanskii is very similar to *K. (T.) hoplites* (see below). At the present state of knowledge, the two species can be distinguished only when adult specimens are dealt with. A decisive character is the presence of exclusively soft structures of the type of folds inside penis in the penis of *K. (K.) urbanskii* while in *K. (T.) hoplites* there is a hard calcified plate, bent aside to form a thorn.

Subgenus *Toxolimax* Simroth, 1899

Toxolimax Simroth, 1899: 37. Species typica: *Mesolimax (Toxolimax) hoplites* Simroth, 1899.

References: Simroth 1901: 135; Hesse 1926: 27; Likharev and Wiktor 1980: 208; Rähle 1992: 7 figs. 3–5.

Both the external appearance and anatomy very similar to those of the representatives of the type subgenus. Inside penis there is a hard (conchiolin?) narrow plate bent upwards, which assumes the shape of a thorn (!).

Merely one species known, which is found exclusively in Turkey.

Comments. The name *Toxolimax* was originally used in the rank of subgenus within the genus *Mesolimax*. The reason for that was the general habitus of the body and its size. Nevertheless, *Toxolimax* differs from *Mesolimax* with respect to many characters (e.g. the location of pneumostom, musculature of sole, shell, lack of a membrane surrounding penis and vas deferens) (see p. 575). Knowing only the description by Simroth (1899), Likharev and Wiktor (1980) decided that the taxon should be raised to the generic rank. However, my own study (Wiktor 1994), based on new material, made me transfer *Toxolimax* to the genus *Krynickillus* and thus preserve its original status. In my opinion, the situation here is analogous with that of *Deroceras* s. str. and *Liolytopelte*, where the basic difference between the two subgenera consists in the presence or lack of a hard stimulatory structure inside penis.

Krynickillus (Toxolimax) hoplites (Simroth, 1899)

Mesolimax (Toxolimax) hoplites Simroth, 1899: 37. Loces typicus: "Brussa" (= Bursa, Turkey). Syntypus: probably does not exist. *Toxolimax hoplites*: Likharev and Wiktor 1980: 209 figs. 243–245. *Krynickillus (Toxolimax) hoplites*: Wiktor 1994: 30 figs. 79–84.

References: Simroth 1901: 135 t. 13 figs. 8–15 (*M. (T.) hoplites*); Germain 1936: 90 figs. 6–7; Rähle 1992: 7 figs. 3–5; Wiktor 1994: 30 figs. 78–84.

Body length up to 46 mm. Body slender like in other representatives of the genus. Coloration of live individuals unknown; preserved specimens have their upper section nearly black. On the extension of short keel there is a paler streak reaching as far as mantle. Above shell there is a lighter blot on mantle. Sole and nape whitish. The colour of mucus unknown.

Genitalia (Figs. 815–817). Vas deferens thin and relatively long. Penis crossed with right ommatophore and its

retractor (!). Penis sack-shaped, devoid of any distinct protuberances or additional structures. Vas deferens opens somewhat laterally to its posterior part, and so is the comparatively wide retractor attached. Posteriorly penial wall is partly covered by striae resembling fingerprints. In the medial section of penis there is a hard plate, built probably of conchiolin, situated on lateral wall. It sticks out inward in the form of a slightly bent thorn, its free end directed anterad. In natural position this organ may be surrounded by a V-shaped fold making a kind of sheath. This hard plate develops relatively late in ontogenesis, lacking in juvenile individuals. Spermatheca small, pear-shaped, connected with a very thin spermatheca duct along with which it equals roughly 1.5 penis length. The free oviduct section is nearly twice as long as penis. Atrium tubular, thin, more or less twice narrower its length.

Intestine bears no typical characters which would make the species distinguishable within the genus (Fig. 818).

Distribution. So far the species has been recorded exclusively from the Turkish territories of Vil. Bursa (environs of the Ulu Dag Mts. = Ulu Dagħ) and Vil. Bolu (near Lake Abant).

Comments. Externally, preserved specimens seem indistinguishable from *K. urbanskii*. The criterion which allows unequivocal discrimination is a hard thorn-shaped plate present in *K. hoplites*. I have got the impression that there are also certain differences perceivable in the terminal section of genitalia. In *K. hoplites* both oviductus and vas deferens are shorter relative to the length of penis. These characters, however, should be confirmed on the basis of ampler material including specimens which represent different stages of ontogenesis.

Subfamily *Mesolimacinae* Hausdorf, 1998

Mesolimacinae Hausdorf, 1998: 62.

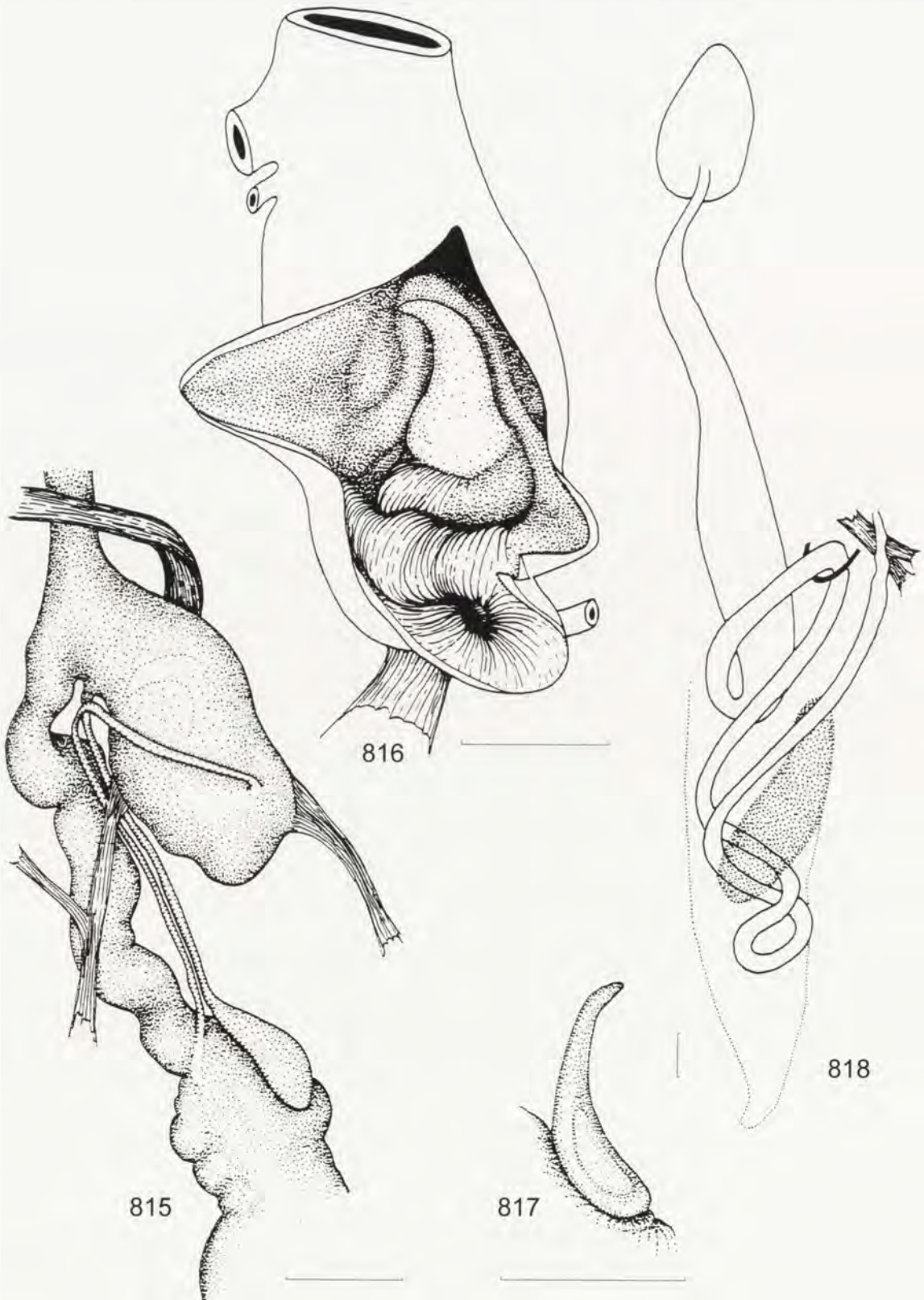
Slugs of a strongly elongated body and small mantle. Body length up to 60 mm. In external appearance these slugs highly resemble representatives of the family Limacidae. Apart from transverse wrinkles, the lateral sole zones are additionally divided by 2 or 5 longitudinal grooves on their whole length. Coloration from yellowish creamy to black. Longitudinal streaks may be present on mantle, and a darker reticulate pattern in the part behind it.

Penis vermiform without appendages or stimulator, but along with vas deferens enveloped in a membrane. Penis sometimes crossed by right tentacle retractor, or the two are parallel to each other. Spermatheca duct connected with the female part of genitalia.

Rectal caecum lacking, but the terminal section of rectum abruptly broadens. Rectum pierces through the posterior part of the main musculus retractor. Kidney devoid of lobus.

The distribution range covers exclusively the area of south-western Turkey.

Only one genus with two species known.



Figs. 815–818. *Krynickillus (Torolimax) hoplites*. 815 – Copulatory organs. 816 – Penis with its internal structures and hard plate. 817 – Penial hard plate. 818 – Alimentary canal and the location of gonad. (After Wiktor 1994)

Genus *Mesolimax* Pollonera, 1888

Mesolimax Pollonera, 1888: 8. Species typica: *Mesolimax brauni* Pollonera, 1888.

References: Simroth 1901: 133; Hesse 1926: 26; Wiktor 1971: 274; Likharev and Wiktor 1980: 204; Wiktor and Likharev 1980: 418 (pallial complex); Jungbluth, Likharev, Wiktor 1981: 18 (radula); Wiktor 1994: 34.

The characters typical of the genus overlap with those of the subfamily Mesolimacinae (see above).

Ecology. Unknown. Juvenile specimens are found in considerably greater numbers than adults. It allows both for a high mortality of juveniles and a relatively long life cycle. The size of sexually mature specimens widely varies and it is unknown what decides about the growth cessation (Wiktor 1994).

Distribution. Western and southern Turkey (from Izmir to Mersin, in the north up to Burdur, Isparta, Sultan Daglari Mts. = Sultan Dagh), and also the Greek island of Rhodes.

Comments. *Mesolimax* displays numerous characters that point out to its affiliation to the family Agriolimacidae. These are, first of all, the relative position of intestinal loops, transverse wrinkles on the lateral sole zones and V-shaped wrinkles on the medial one. At the same time the genus is distinguishable within the family by essential characters that are unique, namely longitudinal grooves on the lateral sole zones, a nearly symmetrical shell, vermiform penis, membrane enveloping penis and vas deferens, the connection of spermatheca with the female part of genitalia and the main retractor piercing through rectum. All the characters indicate the need to create a taxon higher than a genus. This has been demonstrated by Hausdorf (1998), whose opinion I share.

Mesolimax brauni Pollonera, 1888

Mesolimax brauni Pollonera, 1880: 8 pl. 2 figs. 19–23. Terra typica: Asia Minor. Typus: probably does not exist.

References: Germain 1936: 88 figs. 5, 7; Wiktor 1971: 274 figs. 1A–B; Forcart 1972: 112; Likharev and Wiktor 1980: 205 figs. 236–241; Wiktor and Likharev 1980: 418 fig. 15; Jungbluth, Likharev, Wiktor 1981: 21 fig. 11 (radula); Wiktor 1994: 34.

Body length up to 53 mm at least, the slug probably attaining a larger size. The size of an individual does not have to be directly related to sexual maturity. The largest specimens (53 mm) I examined had their copulatory organs still undeveloped. The lateral zones of sole divided into three sections by two longitudinal grooves (!). Coloration of varied intensity. Specimens alcohol-preserved are most often olive-brown, brownish of various shades to black. Mantle and back of the darkest colour, the former additionally with two blurred, still darker streaks. Keel and its extension paler. A dark reticulate pattern perceivable in the part beyond mantle (Figs. 819–821). Neither the colour of live animals nor that of mucus is known to me.

Genitalia (Figs. 823–824). Penis long, roughly equalling half the mantle, twisted. The tubular envelope surrounding penis and vas deferens comparatively short. Spermatheca duct connected with oviductus (!).

Alimentary canal – Fig. 822.

Ecology. Unknown. The slug hides under stones and in leaf litter.

Distribution. The Greek island of Rhodes and probably whole south-western Turkey (records come from Vil. Izmir, Antalya, Burdur, Isparta, Mersin = İçel, also from the Sultan Daglari Mts.). The information about the slug's occurrence in the Balkans and Caucasus is erroneous (Wiktor 1971, Likharev and Wiktor 1980).

Comments. The species differs from *M. escherichi* in the presence of two longitudinal grooves, which divide the sole lateral zones into three sections, in a longer penis and, most commonly, also pale coloration. Nevertheless, melanistic black-coloured forms are also encountered.

Mesolimax escherichi Simroth, 1899

Mesolimax Escherichi Simroth, 1899: 36. Terra typica: Sultan Dagh Mts. (=Daglari, Turkey. Typus: probably non-existent).

References: Simroth 1901: 133 pl. 13 figs. 1, 7; Germain 1936: 91 figs. 7–11; Wiktor 1971: 276 figs. 7A–D; Likharev and Wiktor 1980: 207 fig. 242; Wiktor and Likharev 1980: 418 fig. 15 (pallial complex); Wiktor 1994: 35.

Length up to 40 mm. Five longitudinal grooves dividing each lateral zone (!). Coloration evenly black. Sole margins also with a dark hue, the medial zone pale.

Genitalia (Fig. 825). Penis relatively short, more or less equalling 1/3 whole length of reproductive system. The organ is not coiled, at most bent. The membrane encircling penis and vas deferens longer than in *M. brauni*.

Ecology. Unknown. The slug seems to be rare, at least it is considerably less frequently found than *M. brauni*. In the case of the two *Mesolimax* species, most specimens collected are juvenile.

Distribution. The species is known only from Turkey: recorded from Vil. Antalya, Isparta and the Sultan Dagh Mts., the environs of Ankara and Dösemealti (=Yöniosmanli, N of Antalya).

Comments. See the notes on *M. brauni*.

Incertae sedis

“*Agriolimax atoi* (Hoffmann, 1941)”

Incertae sedis

Agriolimax atoi Hoffmann, 1941: 251 figs. 4–5. Locus typicus: Himi, Tajama pref., Japan. Typus: not preserved.

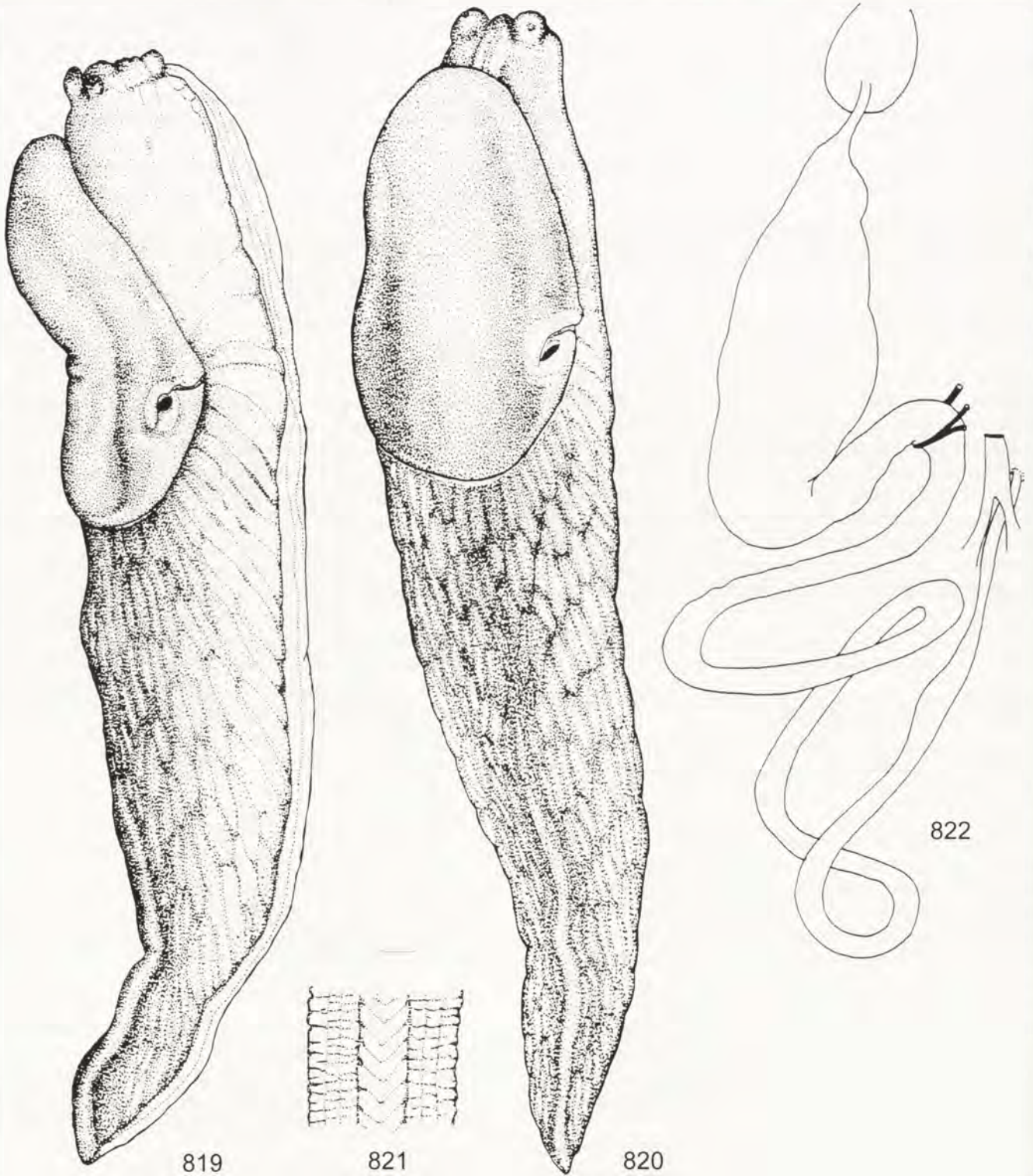
?*Limax varians* Adams, 1868 – see Comments.

References: Hoffmann 1941: 249–251.

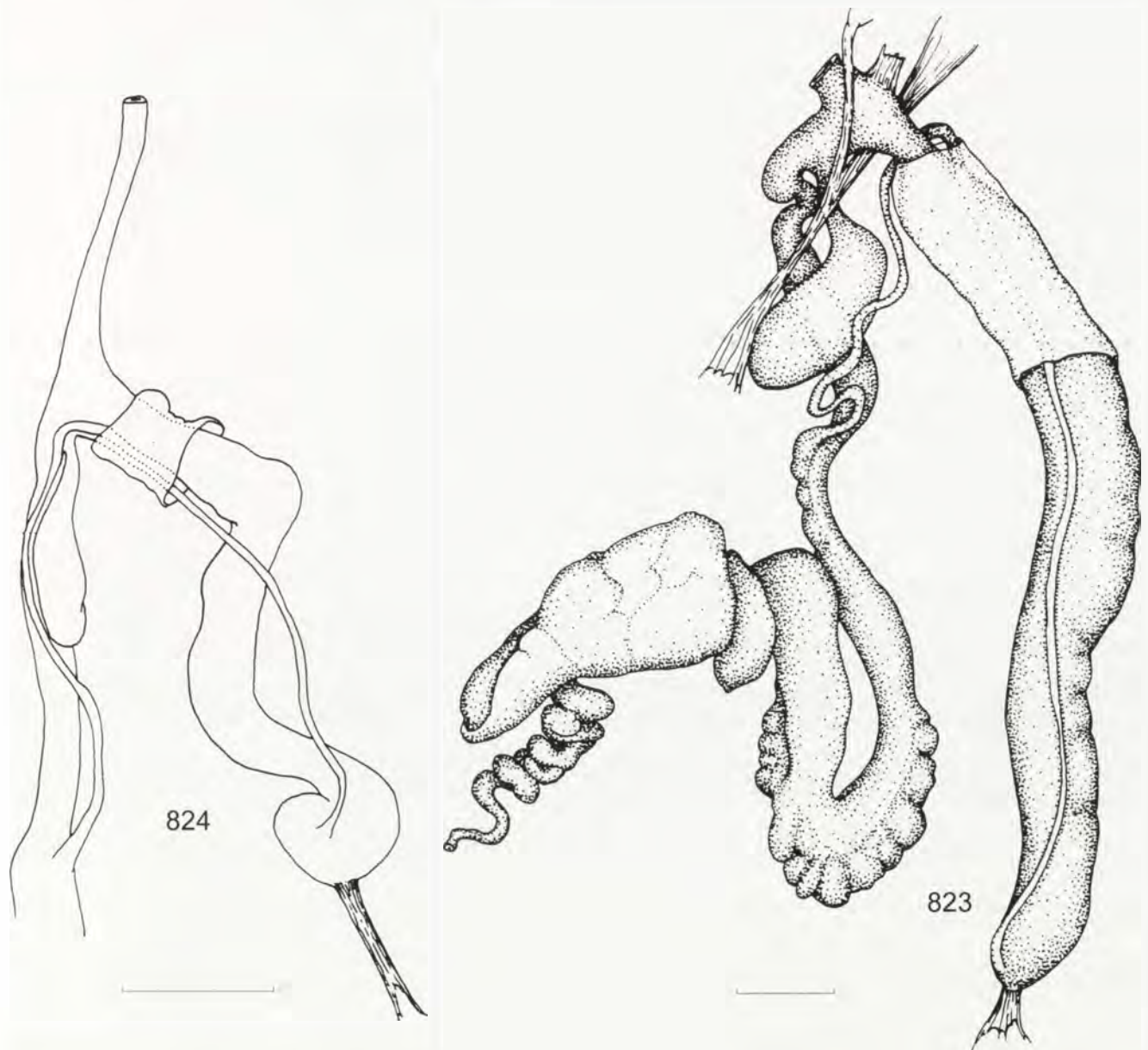
I quote Hoffmann's (1941) description, offering my own interpretation of the figures.

Slugs attaining up to 43 mm in length, 8 mm in width, mantle length equalling 14 mm. General habitus similar to that of *Limax* (!). Coloration black with the medial sole zone grey (grau).

Genitalia (Figs. 826–827). The upper section of copulatory organs does not exhibit any specific characters. Anteriorly penis equipped with a large elongated lateral appendix



Figs. 819–822. *Mesolimax brauni*. 819–820 – External appearance. 821 – Pattern of sole wrinkles. 822 – Alimentary canal. (Orig.)



Figs. 823–824. *Mesolimax brauni*. 823 – Reproductive system. 824 – Copulatory organs. (Orig.)

and huge penial gland that is also laterally set. The latter organ is made up of a thick, as thick as penis itself, shaft on which numerous unbranched processes devoid of glandular papillae are situated. At the rear of penis there is a long blind pocket as vas deferens opens laterally. Musculus retractor penis divides into three strands, one of which is attached to appendix, the second one inserts on the top of the penial pocket, while the third one to the shaft of penial gland. Penis lacking stimulator, whereas inside appendix there are some ledges forming a little trough.

Intestinum of the type of *Deroceras*, devoid of rectal caecum.

Comments. Both the external appearance and size, and a very specific structure of genitalia raise doubts about the justifiability of classifying this slug with the genus *Agriolimax* = *Deroceras*. Only further study may prove if it is actually a representative of Agriolimacidae.

The syntype of *Agriolimax atoi* is probably non-existent. Hoffmann worked in Jena and, to my knowledge, no slug bearing the name concerned, nor the other one used by the author mentioned, i.e. *A. varians*, has been preserved in the collection of this museum. Hoffmann's private collection has not been preserved either, at least in Jena (letter message from Dr. Dietrich von Knorre).

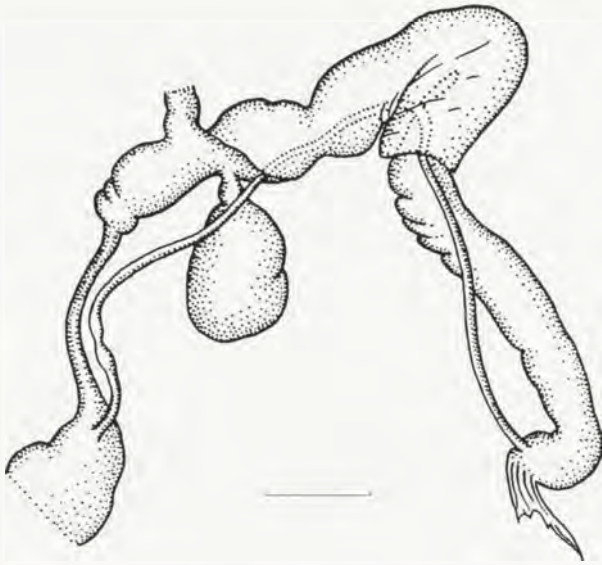


Fig. 825. *Mesolimax escherichi* – copulatory organs. (After Wiktor 1971)

Hoffmann described the species discussed on the basis of 3 specimens collected in Himi (Toyama prefecture, Japan) that he had obtained from Dr. Hajime Uchida from Tokyo. Having examined them, he ranked the slugs among *Dero-ceras*. From Japan, *D. agreste* had already been recorded, which was mentioned by Simroth (1911). Besides, *Limax varians* Adams, 1868 was described from this territory and the author of this species himself considered the possibility that the slug was identical with *D. agreste*. I have failed to reach the original description of *L. varians*; Hoffmann does not quote the publication by Adams in the references, providing only a diagnosis (see Hoffmann 1941: 250). It can be inferred from it that the name "*Limax varians*" should be acknowledged as a synonym of *D. agreste*. However, it is difficult to understand why the autor, maintaining "*vari-ans* = *agreste*", uses the name *vari-ans* for the slugs he has examined and found obviously different from *D. agreste*. At the same time he states that first slugs from locus typicus of *L. varians* should be examined and, if the supposition that they are identical with *D. agreste* has been confirmed, those he has dealt with ought to be designated as *Agriolimax atoi*.

"*Krynckillius cyrniacus* Mabille, 1868"

Incertae sedis

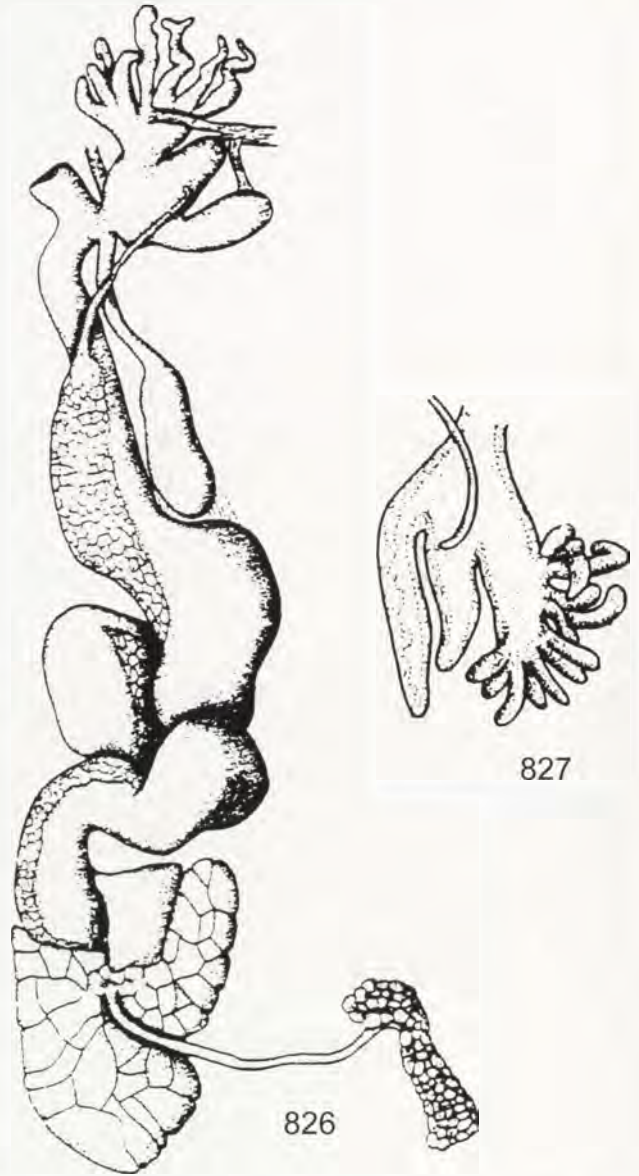
Krynckillius cyrniacus Mabille, 1868: 142. Terra typica: "les environs de Bastia Corse" (Corsica).

The description concerns only the external appearance, on the basis of which identification is impossible. The name is also mentioned by Pollonera (1896).

"*Agriolimax Drymonius*"

Incertae sedis

The combination "*Agriolimax Drymonius* Bourg." was used by Simroth (1886b: 319) for a slug Altena (1950: 17),



Figs. 826–827. "*Agriolimax varians*" (see *A. atoi* p. 575). 826 – Genitalia. 827 – Penis. (After Hoffmann 1941)

with certain doubts (the name provided with a question mark), identified as *Dero-ceras reticulatum*. In his other paper Simroth (1891: 288) repeats the name concerned, mentioning in the footnote that the slug had been described from Madeira as *Milax drymonius* by Bourguignat. Simroth comments that, since there are no *Amalia* (= *Milax*) species on the island, that slug described must have been an *Agriolimax*. What species the name actually pertained to is unknown. I just include it for the sake of completeness.

***Limax (Megalopelta) semitectus* Mörch, 1858**

Incertae sedis

Limax (Megalopelta) semitectus Mörch, 1858: 282 pl. 10 fig. 7. Terra typica: America.

The only information provided by the description is that the slug is 50 mm long, black, its mantle with concentric wrinkles. The figure shows that the mantle is large, its hind margin reaching the posterior body part. Everything points out to the slug being a representative of the genus *Deroceras*. The large size must pertain to a live animal when crawling. It is impossible to establish which of the presently known species was concerned. The one discussed is the type species for the name *Megalopelta* (non *Megalopelta* Lindholm, 1914).

IV. PHYLOGENETIC ANALYSIS

Agriolimacidae offer rather few morphological characters that could serve as a basis for phylogenetic inferences. Of external characters only the relative length of the mantle, the sole structure and the presence/absence of the plate around the pneumostom could be taken into consideration. Of internal characters, the structure of intestine (intestinal loops and caecum), penial retractor, penis with its appendages (penial gland, appendix, stimulator), symmetry/asymmetry of shell provide some phylogenetic information.

All the characters were polarized based on out-group comparison, the out-groups being the genus *Limax* and/or the family Limacidae. Synapomorphies of the whole family and autapomorphies were omitted from the analysis. The cladograms were generated with the programme Hennig86.

Synapomorphies of the whole family are: sole structure (V-shaped wrinkles on the central and transverse wrinkles on the lateral zones of the sole), presence of the plate surrounding the pneumostom and the second loop of intestine reaching farther posterad than the first.

Apomorphies of particular genera and subgenera are: genus *Deroceras*: stimulator present; subgenus *Deroceras* s. str. penial gland present; subgenus *Liolytopelte*: hard plate on stimulator; genus *Furcopenis*: penis provided with accessory bodies with their own glandular structures; genus *Lytopelte*: keel reaching posterior mantle margin; genus *Megalopelta*: mantle covering whole body length; penis with elongated posterior section; genus *Krynickillus*: penis sac-like, with no appendices or penial gland; subgenus *Krynickillus* s. str. only soft structures inside penis; subgenus *Toxolimax*: hard plate inside penis narrow and bent; genus *Mesolimax*: main retractor muscle perforated by intestine, symmetrical shell, penis surrounded by a tubular sheath; on the lateral zones of sole 2–3 longitudinal grooves.

When reconstructing phylogenetic relationships between the genera and subgenera within Agriolimacidae, the following transformation series were taken into account (Table 1).

The mantle (character 1 in the matrix): short, covering roughly 1/5 body length (0); longer, covering roughly 1/3 body length (1) and very long, covering whole body (2); the character was treated as ordered.

The penis (character 2 in the matrix) is long (0) or short (1).

Table 1

character \ taxon	1	2	3	4	5	6	7
<i>Deroceras</i>	1	1	1	1	1	0	0
<i>Liolytopelte</i>	1	1	1	1	1	1	0
<i>Furcopenis</i>	1	1	1	1	1	0	0
<i>Lytopelte</i>	1	1	1	1	0	1	0
<i>Megalopelte</i>	2	1	1	0	0	0	0
<i>Krynickillus</i>	1	1	1	0	0	0	1
<i>Toxolimax</i>	1	1	1	0	0	0	2
<i>Mesolimax</i>	0	0	0	0	0	0	0

The kidney (character 3 in the matrix) is either devoid of a lobe (0) or provided with a lobe (1).

The stimulator (character 4 in the matrix) is absent (0) or present (1). In those species in which it is present (character 6 in the matrix) it is either devoid of a hard plate (0) or bears a hard plate (1). Inside the penis of those taxa that are devoid of a stimulator (character 7 in the matrix) there may be no hard plate (0), a simple hard plate (1) or a narrow plate with its free end bent (2). The latter series was treated as ordered.

The penial gland (character 5 in the matrix) is either absent (0) or present (1).

The preferred cladogram of the shortest two, generated with hennig ie-algorithm, and the alternative, equally parsimonious, solution of the relationship between *Liolytopelte*, *Lytopelte*, *Deroceras* and *Furcopenis*, are shown in Fig. 828. The cladogram (larger diagram in Fig. 828) is

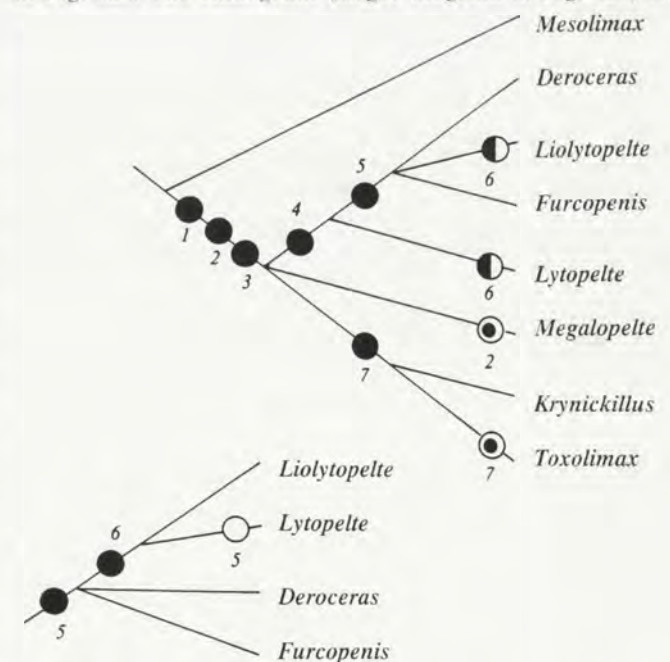


Fig. 828. Generic-level relationships of the Agriolimacidae (large cladogram) and an alternative interpretation of the relationships between *Liolytopelte*, *Lytopelte*, *Deroceras* and *Furcopenis* (small cladogram)

Table II. Character matrix for members of *Deroceas* s. str.

Species/character	1	2	3	4	5	6	7	8	9
<i>agreste</i>	0	0	1	0	1	1	0	0	0
<i>altaicum</i>	0	0	0	0	1	1	0	0	0
<i>altimirai</i>	0	0	2	0	1	1	0	0	0
<i>berytensis</i>	0	3	0	1	1	0	0	0	0
<i>chevallieri</i>	0	3	0	0	1	0	0	0	0
<i>christae</i>	0	3	2	0	1	0	0	0	0
<i>demirtensis</i>	0	3	0	1	1	0	0	0	0
<i>halios</i>	0	3	0	1	0	0	1	0	0
<i>helicoidale</i>	0	0	0	1	0	1	0	0	0
<i>johannae</i>	0	3	0	1	0	0	0	1	0
<i>keaensis</i>	0	3	0	1	0	0	0	0	1
<i>lothari</i>	0	0	0	1	1	2	0	0	0
<i>oertzeni</i>	0	3	1	0	0	0	0	0	0
<i>parnasium</i>	0	3	1	0	0	0	1	1	0
<i>rethimnonensis</i>	0	3	1	0	0	0	1	1	0
<i>reticulatum</i>	0	3	1	0	1	0	0	0	0
<i>samium</i>	0	3	0	1	0	0	1	1	0
<i>tarracense</i>	0	0	1	0	0	2	0	0	0
<i>thersites</i>	0	3	1	0	0	0	1	1	0
<i>turcicum</i>	0	3	1	0	1	2	0	0	0
<i>adolphi</i>	1	0	1	0	1	2	0	0	0
<i>astypalaeensis</i>	1	3	0	1	0	0	0	0	1
<i>bakurianum</i>	1	3	0	1	1	2	0	0	0
<i>barceum</i>	1	3	1	0	0	0	0	0	0
<i>bisacchianum</i>	1	2	0	0	1	0	0	0	0
<i>bistimulatum</i>	1	3	0	1	0	0	0	0	1
<i>boeoticum</i>	1	3	1	0	0	0	0	1	0
<i>cycladicum</i>	1	3	0	1	0	0	0	1	0
<i>famagustensis</i>	1	0	0	0	1	2	0	0	0
<i>gardullanum</i>	1	3	0	1	0	0	?	?	0
<i>giustianum</i>	1	3	1	0	0	0	0	0	0
<i>golcheri</i>	1	3	1	0	0	0	1	0	0
<i>heterura</i>	1	0	?	?	1	0	0	0	0
<i>ikaria</i>	1	3	0	1	0	0	0	0	0
<i>ilium</i>	1	0	1	0	0	2	0	0	0
<i>karnaniensis</i>	1	3	2	0	0	0	0	1	0
<i>lasithionensis</i>	1	3	0	0	0	0	0	0	0
<i>levisarcobelum</i>	1	0	0	1	0	2	1	1	0
<i>maasseni</i>	1	3	0	1	0	0	1	0	0
<i>malkini</i>	1	2	2	1	0	0	0	1	0
<i>melinum</i>	1	0	0	1	0	2	0	0	0
<i>minoicum</i>	1	2	1	0	0	0	1	0	0
<i>nyphoni</i>	1	3	1	0	0	0	0	1	0
<i>osseticum</i>	1	2	1	0	0	0	0	0	0
<i>pageti</i>	1	3	1	0	0	0	0	1	0
<i>panormitanum</i>	1	3	1	0	0	0	0	0	1
<i>parium</i>	1	0	0	1	1	2	0	0	0
<i>planarioides</i>	1	3	1	0	0	0	1	1	0
<i>praecox</i>	1	3	0	1	0	0	0	0	0
<i>pseudopanormitanum</i>	1	3	0	1	0	0	1	0	0
<i>rodnae</i>	1	3	0	1	0	0	1	0	0
<i>seriphium</i>	1	3	0	1	0	0	0	0	0
<i>sturanyi</i>	1	1	1	0	0	2	1	0	0
<i>subagreste</i>	1	3	0	1	1	2	0	0	0
<i>tauricum</i>	1	0	0	1	0	2	0	0	1
<i>cazioti</i>	2	3	2	0	1	0	0	0	0
<i>gardosensis</i>	2	3	1	0	1	0	0	0	0
<i>glandulosum</i>	2	0	?	?	0	2	0	0	0
<i>gorgonium</i>	2	3	1	0	0	0	0	1	0
<i>kythirensis</i>	2	0	1	0	1	2	0	0	0
<i>neuteboomi</i>	2	1	0	1	1	0	0	0	0
<i>chrysorroyatissensis</i>	3	3	2	0	0	0	0	0	0
<i>abessinicum</i>	3	0	1	0	1	2	0	0	0
<i>afcr</i>	3	3	0	1	0	0	0	1	0
<i>concrementosum</i>	3	3	?	?	0	0	0	0	0
<i>deckeni</i>	3	3	?	?	1	0	0	0	0
<i>ercinae</i>	3	0	1	0	0	2	1	0	0
<i>hesperium</i>	3	0	?	?	1	1	0	0	0
<i>kasium</i>	3	3	0	0	0	0	0	0	0
<i>korthionensis</i>	3	3	1	0	0	0	1	0	0
<i>koschanum</i>	3	0	1	0	0	0	0	0	0
<i>laeve</i>	3	0	0	0	0	0	0	0	0
<i>limacoides</i>	3	0	0	1	0	2	0	0	1
<i>lombricoides</i>	3	3	0	1	0	0	1	0	0
<i>nitidum</i>	3	3	2	0	1	2	0	0	0
<i>ponsonbyi</i>	3	0	1	0	1	1	0	0	0
<i>riedeltianum</i>	3	0	1	0	0	2	0	0	0
<i>vascoana</i>	3	2	1	0	1	0	0	0	0
<i>libanoticum</i>	?	0	?	?	1	2	0	0	0

Fig. 829. The first of the three shortest cladograms of the subgenus *Deroceas* s. str.

10 steps long, of CI = 0.90, RI = 0.75 and RC = 0.675. Character 6 (plate on the stimulator) shows a convergence while character 5 (penial gland) is a true synapomorphy of *Deroceas*, *Liolytopelte* and *Furcopenis*. In the alternative fragment of the cladogram (smaller diagram in Fig. 828), character 6 is a true synapomorphy of *Liolytopelte* and



Fig. 830. The second of the three shortest cladograms of the subgenus *Deroceras* s. str.

Lytopelte whereas character 5 undergoes reversal in *Lytopelte*. The convergence of character 6 is the more likely interpretation, because of the different structure of the stimulator plate in the two taxa.

The following transformation series served as the basis for reconstructing phylogeny of the members of the subgenus *Deroceras* s. str. (Table II; species of doubtful status or ones

for which no information on the characters used for phylogenetic considerations is available have been omitted from the matrix):

The caecum on rectum (character 1 in the matrix) is in some species long – longer than wide (0); in other it is shorter – as long as or shorter than wide (1); in some members of *Deroceras* the caecum is absent but the terminal part of rectum widens abruptly (2); finally there may be no caecum nor widening on the rectum (3); the character was treated as ordered.

The penial gland is either absent, or it may be present and then single or multiply branched, of various length. Since it was impossible to decide if the transformation series was linear or branched, it was split in two series. Character 2 was: penial gland absent (0); covered with numerous papillae (1); short, multiply branched (2); long, multiply branched (3); the character was treated as ordered. Character 6 was: penial gland absent (0); single tubercular (1); single finger-like (2); the character was treated as ordered.

Analogously, it could not be ascertained if the transformation series of the stimulator was linear or branched; I have succeeded only in establishing that the plesiomorphic condition was the stimulator in the form of folds. Consequently, the character was coded as two transformation series: one (character 3 in the matrix): stimulator in the form of folds (0); as a flattened cone (1); as a cone (2), being treated as ordered; and the other binary (character 4 in the matrix): stimulator in the form of folds (0); fan-shaped (1).

The characters related to the penial appendix were treated in the same way and for the same reason. The ancestral form of the appendix was most probably single, finger-like, and from this starting point the evolution proceeded in three directions. Hence there are the following transformation series. Series one (character 5 in the matrix): penial appendix single, finger-like (0); penial appendix absent (1). Series 2 (character 7 in the matrix): penial appendix single, finger-like (0); penial appendix pocket-like (1). Series three (character 8 in the matrix): penial appendix single, finger-like (0); penial appendix conical (1). Series four (character 9 in the matrix): penial appendix single (0); penial appendix multiple (1).

The shortest three cladograms of members of the subgenus *Deroceras* sensu stricto, generated with mhennig⁶⁶ option, are presented in Figures 829–830. Each is 80 steps long, of CI = 0.18, RI = 0.79 and RC = 0.14. Considering the number of taxa (79 species), they are short, but this seems to result from the low number of available characters rather than from their consistent distribution. The low values of the consistency index and rescaled consistency index testify to a high proportion of homoplastic evolution. Irrespective from the topology of the cladogram, all the characters show numerous instances of homoplasy: character 1 from 17 to 18, 2 from 7 to 8, 3 from 11 to 12, 4 from 6 to 7, 5 from 6 to 9, 6 from 6 to 7, 7 from 7 to 9, 8 from 4 to 6, 9 from 3 to 5.

In the first cladogram (Fig. 829) character 1 (caecum on rectum) shows 10 instances of progressive evolution and 8 reversals; character 2 (penial gland absent/multiple) –

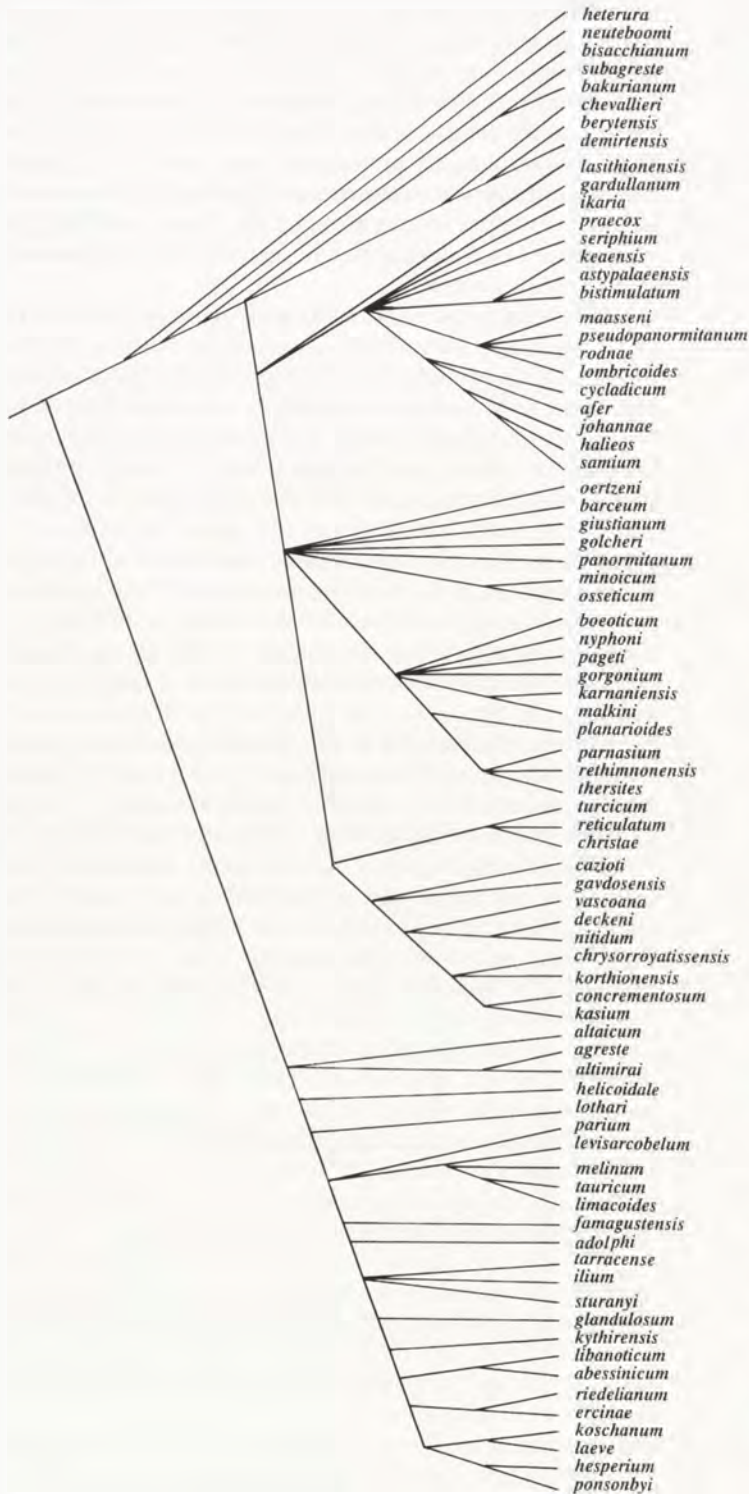


Fig. 831. The third of the three shortest cladograms of the subgenus *Deroceras* s. str.

4 instances of progressive evolution and 3 reversals; character 3 (stimulator folds/cone) – 7 instances of progressive evolution and 4 reversals; character 4 (stimulator folds/fan) – 5 instances of progressive evolution and 1 reversal; character 5 (penial appendix single/absent) – 1 instance of progressive evolution and 5 reversals; character 6 (penial

gland absent/single) – 4 instances of progressive evolution and 2 reversals; character 7 (penial appendix finger-like/pocket-like) – 7 instances of progressive evolution; character 8 (penial appendix finger-like/conical) – 5 instances of progressive evolution; character 9 (penial appendix single/multiple) – 3 instances of progressive evolution.

In the second cladogram (Fig. 830) character 1 (caecum on rectum) shows 13 instances of progressive evolution and 4 reversals; character 2 (penial gland absent/multiple) – 4 instances of progressive evolution and 3 reversals; character 3 (stimulator folds/cone) – 9 instances of progressive evolution and 3 reversals; character 4 (stimulator folds/fan) – 5 instances of progressive evolution and 1 reversal; character 5 (penial appendix single/absent) – 4 instances of progressive evolution and 6 reversals; character 6 (penial gland absent/single) – 4 instances of progressive evolution and 2 reversals; character 7 (penial appendix finger-like/pocket-like) – 7 instances of progressive evolution; character 8 (penial appendix finger-like/conical) – 5 instances of progressive evolution and 1 reversal; character 9 (penial appendix single/multiple) – 4 instances of progressive evolution and 1 reversal.

In the third cladogram (Fig. 831) character 1 (caecum on rectum) shows 11 instances of progressive evolution and 7 reversals; character 2 (penial gland absent/multiple) – 4 instances of progressive evolution and 4 reversals; character 3 (stimulator folds/cone) – 10 instances of progressive evolution and 1 reversal; character 4 (stimulator folds/fan) – 6 instances of progressive evolution and 1 reversal; character 5 (penial appendix single/absent) – 3 instances of progressive evolution and 6 reversals; character 6 (penial gland absent/single) – 4 instances of progressive evolution and 3 reversals; character 7 (penial appendix finger-like/pocket-like) – 9 instances of progressive evolution; character 8 (penial appendix finger-like/conical) – 3 instances of progressive evolution and 1 reversal; character 9 (penial appendix single/multiple) – 3 instances of progressive evolution.

Characters 1 (caecum on rectum) and 3 (stimulator folds/cone) are the most incongruent with all the proposed topologies, together accounting for ca 25 convergences and reversals. It can be thus concluded that they actually did undergo homoplastic evolution and are unreliable as a basis for phylogeny reconstruction. All the remaining characters (2 and 4–9) show less homoplasy but most of them (5–9) are not inclusive enough to delineate larger phylogenetic groups of species.

Although at present there are no data which could serve as a basis for the choice between the three cladograms, the following conclusions can be drawn.

1. The evolution of the subgenus *Deroce* s. str. displays numerous convergences and reversals, being to a large degree of mosaic character.
2. In the presented cladograms it is impossible to delineate groups associated with particular areas. However, rather many of the Greek endemics, in all the cladograms, are closely related.
3. Based on the characters employed in the analysis, the high number of species could not be divided into unambiguous groups. Probably, contrary to the remaining taxa of Agriolimacidae, the speciation and dispersal were very intense and led to invasion of large areas of the Palearctic without a clear differentiation into groups associated with particular regions. Each part of the present distribution area of *Deroce* s. str. seems to have been colonised more than once.
4. It is impossible to point unambiguously to the distribution centre of *Deroce* s. str., but because of its number of species, many of which are rather closely related, the area of S Balkans seems a likely candidate for the centre of origin and distribution.

V. ACKNOWLEDGEMENTS

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