PORTUGUESE SLUGS. II. DEROCERAS NITIDUM AND THE DEROCERAS LOMBRICOIDES GROUP OF FORMS. (GASTROPODA: PULMONATA: AGRIOLIMACIDAE)

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(Accepted for publication, 20th May 1989)

Abstract: Morelet and Simroth described four species of Portuguese agriolimacids: Deroceras nitidum (Morelet, 1845), Deroceras lombricoides (Morelet, 1845), Deroceras maltzani (Simroth, 1885) and Deroceras immaculatum (Simroth, 1891). On account of its anatomical similarity (rectum with no caecum, penis with caecum, terminal penial gland and posterior spheroid bulge), Wiktor and Castillejo considered that Deroceras hispaniensis Castillejo & Wiktor, 1983 is a synonym of D. lombricoides. Examination of 588 specimens of this group of forms, including paratypes and topotypes of D. hispaniensis, we conclude that D. nitidum and D. maltzani are the same species; and that the stimulators of the topotypes of D. lombricoides are horseshoe-shaped, those of D. immaculatum flat folds and those of D. hispaniensis ring-shaped. It is very difficult to distinguish between D. immaculatum and D. lombricoides on purely anatomical grounds, since stimulators with intermediate shapes have also been found. If the shape of the stimulator really is a taxonomically relevant characteristic, D. hispaniensis is a valid species.

Resumen: Morelet y Simroth describieron cuatro especies de Agriolimáctidos en Portugal: Deroceras nitidum (Morelet, 1845), Deroceras lombricoides (Morelet, 1845), Deroceras maltzani (Simroth, 1885) y Deroceras immaculatum (Simroth, 1891). Debido al parecido de la anatomía: recto sin ciego, con un abultamiento esferoidal posterior, ciego y glándula peniana terminal, Wiktor y Castillejo consideraron a Deroceras hispaniensis Castillejo & Wiktor, 1983 como sinónimo de D. lombricoides. Después de estudiar 588 ejemplares de este grupo de formas, de revisar paratipos y topotipos de D. hispaniensis, se llega a la conclusión que D. nitidum y D. maltzani son la misma especie, que el órgano estimulador de los topotipos de D. lombricoides tiene forma de herradura, el de los de D. immaculatum de pliegue plano y el de los de D. hispaniensis forma de anillo. Con criterios anatómicos puros es muy difícil separar D. immaculatum de D. lombricoides ya que se han encontrado órganos estimuladores intermedios, y si realmente el órgano estimulador tiene valor taxonómico, D. hispaniensis es buena especie.

INTRODUCTION

In the nineteenth century, four Portuguese agriolimacids were described whose genitalia all exhibited a caecum near a terminal or subterminal penial gland and a posterior glandular cap: Deroceras nitidum (= Limax nitidus) (Morelet, 1845); Deroceras lombricoides (= Limax lombricoides) (Morelet, 1845); Deroceras maltzani (= Agriolimax maltzani) (Simroth, 1885); and Deroceras immaculatum (= Agriolimax immaculatus) (Simroth, 1891). The same penial characteristics also occur in a species recently encountered in Galicia (Spain) and likewise found in Portugal, Deroceras hispaniensis Castillejo & Wiktor, 1983.

Morelet (1845) created the species name D. nitidum for agriolimacids he had collected in Lisbon and Beja, and D. lombricoides for those collected in Monchique and Braga. Both descriptions involved only external morphology. On reviewing the anatomy of these species, Simroth (1885, 1891) distinguished taxonomically between the Monchique and Braga

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specimens, reserving the name *D. lombricoides* (Morelet, 1845) for those from the hills around Braga and creating the name *D. maltzani* (Simroth, 1885) for those from Monchique. He also introduced the name *D. immaculatum* (Simroth, 1891) for a species found near Sintra for which he later published further anatomical details after encountering a dark variety at Portunhos (Simroth, 1893).

For many years the above species were ignored or their names treated as synonyms of others. Taylor (1907), for example, considered *D. lombricoides* (Morelet, 1845) to be identical to *D. laeve* (Müller, 1774) and completely overlooked Simroth's work. The same attitude was adopted by Nobre (1930, 1941), who failed to take *D. nitidum, D. maltzani* and *D. immaculatum* into account, and included *D. lombricoides* (Morelet, 1845) among the synonyms of *D. laeve* (Müller, 1774) (though adding that 'according to some naturalists it is hardly more than a variety of *A. agrestis*').

In creating the name *D. hispaniensis* for a species found in Spain, Castillejo and Wiktor (1983) stated that its genitalia resembled those of *D. lombricoides* as restricted by Simroth (1891) (*D. lombricoides* (Morelet, 1845, Partim!)), which Castillejo *et al.* (1984) redescribed on the basis of topotypes collected at Sameiro (Braga). Finally, on examination of part of the material used in the present study, Wiktor and Castillejo (1987) relegated *D. immaculatum* and *D. hispaniensis* to the status of synonyms of *D. lombricoides* and redescribed *D. maltzani* (Simroth, 1885), which had only shortly before been redescribed by Rahle (1983) on the basis of seven specimens collected at Barranco dos Pisos in the Algarve.

**MATERIAL**

Systematic, periodic sampling of Portuguese malacological fauna carried out between April 1983 and June 1986 by the soil biology group of the Biology Faculty, University of Santiago de Compostela (Spain) yielded 588 agriolimacids possibly belonging to the species mentioned above as described by Morelet and Simroth. Localities covering as much of Portugal as possible were sampled, including, where possible, those mentioned by Morelet (1845) and Simroth (1885, 1891, 1893). Most of the material examined has been deposited in the Department of Animal Biology of the University of Santiago, Spain. Specimens sent for confirmation by Dr. Wiktor (Wroclaw, Poland) and Dr. Giusti (Siena, Italy) are deposited in their private collections.

**HISTORICAL NOTES**

In order for the reader to understand the taxonomical problems of the species discussed in this article, we briefly review here the anatomical descriptions given by previous authors. The taxa are discussed in chronological order, but modern genus names are used.

**Deroceras nitidum** (Morelet, 1845)

*References:* Morelet, (1845), p. 35 (*Limax nitidus* sp. nov.); Simroth (1891), Pl. 3, fig. XVIII (*Agrilimax nitidus* Morelet).

Morelet (1845) described *D. nitidum* as 'glossy black' in colour and almost the same as *Milax gageae* (Draparnaud,1801) in size. Simroth (1891), who found this species in Abrantes and Calcihias, reported that 'the digestive tract is exactly the same as in *D. lombricoides*; the rectum has no caecum, but there is a suggestion of posterior separation. Penis with a short blind sac at its tip, penial gland with few ramifications, and a large stimulating organ.
Plate 3 from Simroth (1891) (in part).
whose position is shown in Figure XVIIIb of Plate 3’. According to the figure mentioned (Simroth (1891), Pl. 3, fig. XVIIIb), the stimulator has the shape of an elongated cone. He referred to this organ again when, in discussing D. maltzani, he says that ‘in the penis of this species there is a stimulating organ as long as that of D. nitidum’.

**Deroceras lombricoides** (Morelet, 1845, Partim!)  

Morelet (1845) described *D. lombricoides* as ‘very similar in colour and form to *D. agreste* (Linneo, 1758) ... the predominant colour is that of the earthworm ... Common in the neighbourhood of Monchique, and a darker variety inhabits the hills of Braga’.

Simroth (1891) writes ‘I assume the slugs from the north (the Braga hills) to be *D. lombricoides*, whose territory I extend to the following localities: Coimbra, Playa d’Espinho, Oporto, Mattosinhos and Gerês’. In discussing the internal anatomy of the species he says that he only notes distinctive characteristics ‘since the remainder coincide with the general structure of the genus. There is no appendix in the rectum ...’. As regards the genitalia, ‘the penis has a well-ramified penial gland like *D. agreste* [D. reticulatum], but it has no stimulating organ; nor is the penial gland normally at the distal [proximal] tip, but in front of a short terminal caecum where the vas deferens ends. Inside, instead of a stimulating organ, there is a high, comblike, many-pleated crooked fold whose variable position gives the penis widely differing outlines’.

Writing of copulation, he states that ‘they take up positions next to each other forming a circle; from the genital orifice they produce, as stimulating organ, a thick, flat triangular lip. With these lips they push each other’s backs vigorously, and from time to time they move round (Pl. 3, fig. XI)’. A few lines later he adds that he ‘found a pair of them in Oporto ... first they moved round slowly ... then they kept still ... again they came together ... again they moved round ...’, and that ‘during all this time the stimulating organ remained pressed against the mate ...’. Simroth quickly places these two *Deroceras* in alcohol, upon which they strongly retracted their stimulators, but on a different occasion he observed the evagination of ‘a kind of bare spoon that was round outside (Pl. 3, fig. XIV ...’). Most curiously, he states that ‘at the tip of the evaginated part (Pl. 3, fig. XIVa)’ can be seen ‘epithelial formations different from the remainder’ which he considers to be ‘peculiar stimulating structures’. Figs. XI and XII of Pl. 3 are said to correspond to different individuals; those represented in fig. XII of Pl. 3 had ‘only two small whitish vesicles that gripped each other hard’, and this is insisted on when he adds that ‘the orifices must correspond to these vesicles ...’.

**Deroceras maltzani** (Simroth, 1885)  
(= *D. lombricoides* (Morelet, 1845, Partim!))  

According to Simroth (1891), the specimens he collected near Monchique were grey or reddish-grey, with lightly mottled backs. He adds that ‘Morelet ... found them and characterized them correctly, but muddled them with *lombricoides* from northern Portugal ...’ Certainly, they both lack any caecum in the rectum, but in the penis there is a stimulating organ as large as in *nitidus*. He then notes that the proximal part of the penis features a slightly ramified penial gland near a caecum that he had not mentioned previously (Simroth, 1885). This description is almost exactly the same as his description of *D. nitidum*, the only difference being the colour of the body.

Rähle (1983) redescribed this species on the basis of 7 specimens collected by Jens
Hemmen in June 1983 at Barranco dos Pisoes (Monchique, Algarve). The genitalia of specimens from the Serra de Monchique were again portrayed by Wiktor and Castillejo (1987). The copula of two specimens from Gabo de Sao Vicente is described by Castillejo et al. (1987).

**Deroceras immaculatum** (Simroth, 1891)

*References:* Simroth (1891), p. 86, Pl. 3, figs. IX, X, XVII and IXX (*Agriolimax immaculatus* n. sp.).

According to Simroth (1891), this species is outwardly difficult to distinguish from *D. lombricoides*, since both have very similar colouration. He himself confessed to having 'mistaken it for the latter (*D. lombricoides*) when observing it in the wild, just as Morelet appears to have done', and he adds that *D. immaculatum* too is 'earthworm-coloured . . . or even black'. He presumably gave it the name *immaculatum* because, according to him, 'dorsal spots are always lacking'.

As regards internal anatomy, Simroth states that 'the differences with respect to *D. lombricoides* are few but constant. The penis has the same penial gland, but no terminal blind sac' (though in describing the variety *nigrescens* he does mention the existence of a penial caecum). Writing of the stimulator, or as he calls it, the 'fold', he states that it is 'considerably smaller; the figures (Pl. 3, figs. XVIIa, and b) show the maximum degree of development'. He then mentions that there is a suggestion of a caecum in the rectum, but no more, and closes his remarks on the rectal caecum opining that 'the existence or otherwise of a caecum in the rectum cannot be used to group the agriolimacids in two sub-genera'.

Simroth appears not have been completely convinced as to the validity of this species, for he emphasizes that 'since the differences between them are so slight, it might be feasible to consider *immaculatum* as just a variety of *lombricoides*; certainly the two are very homogeneous . . . but I nevertheless consider . . . that the differences in the penis rule out a cross between the two forms, which is sufficient to make *immaculatum* a slug that is constant within its circle of forms, i.e. a species apart'.

**Deroceras hispaniensis** Castillejo & Wiktor, 1983

*References:* Castillejo and Wiktor (1983), p. 11, Figs. 26–32 (*Deroceras* (*Plathystimulus*) *hispaniensis* n. sp.).

According to Castillejo and Wiktor (1983), the male part of the genitalia of this species has a caecum near the penial gland, a posterior spherical swelling and a membranous stimulator shaped like a U with the open end towards the anterior penis.

**RESULTS**

We here redescribe, under the appropriate name, each of the species which we consider may currently be distinguished; subgenera are not considered.

**Deroceras nitidum** (Morelet, 1845)

*Synonyms:* *Deroceras lombricoides* (Morelet, 1845, Partim!); *Deroceras maltzani* (Simroth, 1885).

*Description*

Length 35 mm live, 25 mm in 70° alcohol (Fig. 1). Body colour varying between light brown and all black. Body and sole mucus colourless.

*Organs in situ* (Fig. 2). The topography of the organs is the same as in other species of the genus. The conjunctive tissue about the visceral sac has black pigmentation in black
specimens and is colourless in brown ones. 

*Gentilavia* (Figs. 3–5). The ovotestis, hermaphrodite duct, oviduct, albumin gland and spermoviduct all conform to the typical topography of the genus. The proximal penis exhibits two caecum-like protuberances, one at the proximal end and one more centrally, near the insertion of the retractor muscle. Penial gland subterminal, with two festooned branches (sometimes just one). Distal penis with a spheroid protuberance covered by a cap of glandular appearance. Vas deferens short and narrow, oviduct shorter still. Copulatory sac ovoid, pyriform, with a short duct leading to the neighbourhood of the genital atrium. The stimulator located inside the distal penis is conical, pyramidal or a flattened cone and is normally greater in breadth than height (sometimes the vertex is blunt), but during copulation it is greater in height than breadth and has a ball-like tip.

*Copulation* (Figs. 6–14). During copulation, mating pairs stimulate each other in a distinctive fashion by presenting their stimulators one opposite the other (Figs. 6 and 10) and using them to stroke the mate’s flanks (Figs. 8, 9, 11), the two kinds of stimulus being repeated several times in turn before exchange of sperm takes place (Fig. 12). Immediately after sperm exchange, each individual begins slowly to chase its own tail; the penis can be seen to be completely evaginated, and each animal covers itself in a watery secretion before they finally move off in different directions (Figs. 13, 14). The photographs shown here were taken on December 4th 1984 at Cabo de Sao Vicente (Portugal). We have observed other copulations, likewise in Portugal, at Caldas de Monchique (4–XII–84) and Alferce (21–IV–85). We have observed no precopulatory courting behaviour because all three copulations were chanced upon when in progress.

*Material examined* (Fig. 15)


*Discussion*

There are good grounds for considering *D. malthzani* (Simroth, 1885) (= *D. lombricoides* (Morelet, 1845, Partim)) to be identical to *D. nitidum* (Morelet, 1845). Morelet (1845) found *D. nitidum* in the neighbourhood of Lisbon and Beja and described it as being the same colour as *M. gagates*, i.e. black. Simroth (1891) reported finding it in Alvega (Abrantes) and Cacilhas (Almada). Sampling of the Abrantes area has failed to locate *D. nitidum* (Morelet, 1845) but has afforded specimens of *D. lombricoides* (Morelet, 1845, Partim) (= *D. immaculatum* (Simroth, 1891)) whose stimulators projected partially towards the vagina; the

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*Numbers in brackets following each locality refer to the number of specimens studied.*

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only species found in the Serra da Arrábida, near Cacilhas, was *D. maltzani* (Simroth, 1885).

According to Simroth’s (1891) description of the two species, *D. nitidum* has a penis with ‘a short caecum at the tip, a little-ramified penial gland and, inside (the penis), a long stimulating organ whose position is shown in Fig. XVIIIb of Plate 3’. In describing *D. maltzani* he states that the penis contains ‘the same long stimulating organ as in *D. nitidum*, as well as a little-ramified penial gland at the tip’, and he goes on to add that there is also a penial caecum that he had not described previously. To our mind there is therefore no doubt that the two forms are one and the same species, since they have the same penial topography and identical stimulators, the only difference between them being the colour of the body.

It was quite probably their different colouration, together with the different altitudes at which he found them, that gave rise to Simroth’s confusion, since he states that ‘*D. maltzani* is a lighter type found in coastal mountains, and *D. nitidum* a black form belonging to meadows and fields’. For Simroth, all black *D. roccer* were, in the absence of further evidence, *D. nitidum*, though he might later assign them to some other species on examination of their internal anatomy. Thus on finding a black variety of *D. immaculatum* in Portunhos he wrote that ‘on account of the colour I was unsure whether it was *D. rocer* nitidum (Morelet, 1845) or *immaculatum*. Our own experience of the Monchique populations of *D. maltzani* (Simroth, 1885) is that melanism is induced by proximity to water; totally black individuals are found in the same area as others of a light brown colour depending on whether their local habitat is
Fig. 15. Map of localities in which *Deroceras nitidum* (Morelet, 1845) has been found. Scale 100 km.

wet or not. In the light of these considerations, Figs. XVIIIa and b of Simroth's (1891) Plate 3 may be recognized as agreeing perfectly with the drawings of *D. nitidum* published by Simroth himself (Simroth, 1891) and with the drawings of *D. malizani* published by Rähle (1983) and Wiktor and Castillejo (1987). We accordingly believe that *D. malizani* is identical to *D. nitidum*, and that its valid name, for reasons of priority, is *Deroceras nitidum* (Morelet, 1845).

It is worth pointing out that, at first sight, *D. immaculatum* (Simroth, 1891) can sometimes be taken for *D. nitidum*; we have found typical populations of *D. immaculatum* to contain specimens whose stimulator appeared to be more or less conical because it was folded
towards the vagina, which we attribute to intraspecific variation and/or to deformation caused by the contraction of the penial muscle during death by asphyxia.

**Deroceras lombricioides** (Morelet, 1845)

(= *Deroceras lombricioides* (Morelet, 1845, Partim!))

*Synonyms*: *Deroceras immaculatum* (Simroth, 1891).

**Description**
Length 30 mm live, 24–26 mm in 70° alcohol (Figs. 16, 21). Body brown, sometimes with dorsal spots that become darker and smaller in alcohol. Body and sole mucus colourless. *Organs in situ* (Figs. 17 and 22). The organs of the specimens studied exhibit the characteristic topography of the genus. Rectum with no caecum.

*Genitalia* (Figs. 18–20, 23–29). The ovotestis hermaphrodite duct, albumin gland and spermoviduct have the topography typical of the genus. Proximal penis broad and cylindrical, with a subterminal caecum; distal penis with a bulge or sphericoid mass of which the superior part is covered by a glandular structure in some specimens forms a crest and in others is horseshoe-shaped or forms an oval cap. Penial gland terminal, with 4–6 festooned branches of variable length. The short, subterminal retractor penis is inserted near the penial caecum. Vas deferens short, emerging between the penial gland and the retractor penis. The internal wall of the penis is covered in narrow striae and exhibits a fold giving rise to the subterminal anterior caecum. The stimulator is located in the sphericoid mass and its shape is related to that of the latter’s associated glandular covering; specimens with glandular structures in the shape of crests or oval caps have stimulators in the shape of a flat fold (Figs. 23, 25, 26), while those with horseshoe-shaped glandular structures have horseshoe-shaped stimulators too (Figs. 19 and 20). In both cases the stimulator is shrouded in fibrous projections from the base of the glandular structure.

**Material examined** (Fig. 31)


Discussion
The material that we have examined shows that Portugal still has populations of D. lombricoides (Morelet, 1845) (as restricted by Simroth 1891). The stimulator is like a comb folded upon itself many times, and when extended adopts a horseshoe shape (Fig. 20). In these specimens the distal spheroid bulge is covered by a structure of glandular appearance which, like the stimulator, is horseshoe-shaped (Fig. 19). These populations were found in northern Portugal and in Guarda (Serra da Estrela). There are likewise still Portuguese populations in which all the individuals have stimulators in the form of flat folds as in D. immaculatum (Simroth, 1891) (Figs. 21, 21a). However, in both the Serra do Gerês and the Serra da Estrela, where most individuals have clearly horseshoe-shaped stimulators, we have also found specimens with the extremes of the horseshoe so slightly marked as to result in a curved fold intermediate between the typical horseshoe of D. lombricoides (Morelet, 1845) and the flat fold of D. immaculatum (Simroth, 1891). Furthermore, the copula of D. immaculatum appears to be identical to that of D. lombricoides: on December 10th 1985, in the Serra do Caramulo, we observed a mating pair whose stimulators were clearly flat folds like those of Figs. 25, 26, 29, 30, and whose mating postures and behaviour were identical to those described for D. lombricoides by Simroth (1891, Pl. 3, fig. XI). We therefore consider that D. immaculatum should be considered a synonym of D. lombricoides (Morelet, 1845) (as restricted by Simroth 1891). The specimens on which Castillejo et al. (1984) based their re-description of D. lombricoides in fact had stimulators with shapes closer to the immaculatum flat fold than to the typical lombricoides horseshoe.

In Luso and Abrantes, in the territory of a population with characteristics typical of D. immaculatum (Simroth, 1891), we found specimens in which the stimulator looked conical (like that of D. nitidum (Morelet, 1845)) because it projected towards the vagina (Figs. 27, 28), either because of intraspecific variation or due to contraction of the penial muscle upon death by asphyxia.

Finally, it should be pointed out that when Simroth drew the genitalia and the copulation of D. lombricoides (Simroth, 1891, Pl. 3, figs. XI–XVI) he confounded two species. Figs. XI, XV and XVI of his Plate 3 represent D. lombricoides (Morelet, 1845) (as restricted by Simroth 1891), and Figs. XII–XIV a completely different species which his own figures and text show to have a copulation quite unlike that of D. lombricoides and genitalia characterized by having two glandular masses and two stimulators (Simroth, 1891, pp. 285–286). We ourselves have found individuals of this latter kind that fit Simroth’s description perfectly, and we have also observed their copulation, which is indeed totally different from that of D. lombricoides (Morelet, 1845); they are provisionally described below under the name Deroceras sp.
Figs. 16–20. *Deroceras lombricoides* (Morelet, 1845, Partim!)
Scale 1 mm.
21 and 21a: superior and inferior views of the evaginated stimulator of a specimen found copulating on December 10th 1985 in Pes de Pontes, Serra do Caramulo (UTM 29TNF70). 22–26: organs in situ, genitalia and stimulator of a specimen collected in Portunhos (UTM 29TNE35). Fig. 26 is the stimulator shown in Fig. 25 from a different angle. Scale 1 mm.

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**Deroceras hispaniensis** Castillejo et Wiktor, 1983

**Description**

Length 35 mm live, 23–27 mm in 70° alcohol. Body dark chestnut with small dots on the back. Body and sole mucus colourless.

**Genitalia** (Figs. 34–37). Topography of the ovotestis, hermaphrodite duct, albumin gland and spermoviduct typical of the genus. The penis comprises a globose distal part and a cylindrical proximal part with a dilation or caecum near the insertion of the retractor penis (Figs. 34, 35). Penial gland terminal, with two or three festooned branches, and of variable length (sometimes longer than the penis). The distal penis has a spheroid bulge capped by a glandular mass; the bulge may be joined to the anterior caecum by a band of muscle. The short vas deferens ends near the penial gland and the insertion of the retractor penis. Copulatory sac oval, with a short duct. Oviduct of average length. Internal wall of the penis covered with minute longitudinal striae. Membranous, annular, thin-walled stimulator housed in the distal bulge (Figs. 32, 33, 36, 37). The interior disc of the annulus exhibits a coarsely striated triangular area leading to a minute orifice through which the glandular cap may perhaps expel its secretions into the interior penis; these striations are perpendicular to the fine striae covering the rest of the interior penis, and are most easily seen in specimens in which the distal penis is evaginated on death by asphyxia (Figs. 32, 33).

**Material examined** (Fig. 38).

Mirador de Sao Silvestre (29TNG11, Viana do Castelo), 15–XII–85, leg. A. Outeiro (2).


Sao Salvador da Torre (29TNG32, Viana do Castelo), 16–XII–85, leg. T. Rodríguez (2).

**Discussion**

Wiktor and Castillejo (1987) and Giusti (personal communication) considered that *D.*
immaculatum (Simroth, 1891), D. lombricoides (Morelet, 1845) (as restricted by Simroth (1891)) and D. hispaniensis Castillejo et Wiktor, 1983 are probably all the same species. Though one of the present authors initially shared this opinion, examination of the additional specimens since captured has led us to the view that although these three forms are all similar as regards the external morphology of the penis, the morphology of their stimulators probably differentiates between D. hispaniensis on the one hand and D. lombricoides (including D. immaculatum) on the other.
Fig. 38. Map of localities in which *Deroceras hispaniensis* Castillejo et Wiktor, 1983 has been found. Scale 100 km.

Fig. 39. Possible distributions of the group of species discussed in this article. Scale 100 km.

32: specimen from Ponte de Lima (UTM 29TNG32) with the evaginated stimulator forming a cup with a different kind of epithelium at the bottom. 33: a detail of the specimen of Fig. 32. 34 and 35: genitalia. 36 and 37: stimulators of two different specimens *in situ*. Scale 1 mm.
The evidence for the identity of *D. lombricoïdes* (Morelet, 1845) (as restricted by Simroth (1891)) and *D. immaculatum* (Simroth, 1891) is twofold. Firstly, in *D. lombricoïdes* populations in the Serra da Estrela and the Serra do Gerês, in which horseshoe-shaped stimulators predominate, there are also individuals possessing stimulators with a less pronounced U like a slightly curved flat fold. Secondly, the behaviour of the mating pair of *D. immaculatum* (Simroth, 1891) that was observed on December 10th 1985 in the Serra do Caramulo was identical to that described by Simroth (1891, Pl. 3, fig. XI) for *D. lombricoïdes* (Morelet, 1845). It is therefore reasonable to consider these two forms provisionally as constituting a single species in which the shape of the stimulator ranges from a flat fold to a pronounced horseshoe shape. At an earlier stage of this species' evolution, all its individuals may have flat fold stimulators, or they may all have had horseshoe-shaped stimulators.

Though extension of the same reasoning as above might suggest that the annular stimulators of *D. hispaniensis* are likewise within the range of intraspecific variation of *D. lombricoïdes* (Morelet, 1845) (as restricted by Simroth (1891)), another feature of internal genital anatomy must also be taken into account. In *D. lombricoïdes* (Morelet, 1845) and *D. immaculatum* (Simroth, 1891), the glandular mass capping the spheroid bulge of the penis appears to communicate with the interior of the penis via numerous filaments surrounding the stimulator, whereas in *D. hispaniensis* the two regions communicate via a well-defined tongue-shaped structure located within the stimulatory ring and exhibiting a different texture and coarser striation than other areas (Figs. 36, 37). Since we have furthermore never come across specimens with stimulators intermediate between the horseshoe of *D. lombricoïdes* (Morelet, 1845) and the annulus of *D. hispaniensis*, we provisionally consider that *D. hispaniensis* is a valid species. A definitive decision on the relationships among *D. hispaniensis*, *D. immaculatum* (Simroth, 1891) and *D. lombricoïdes* (Morelet, 1845) must await the study of characteristics such as enzyme forms.

**Deroceras sp.**

**Synonyms:** *Deroceras lombricoïdes* (Morelet, 1845, Partim!, Ex parte Simroth, 1891).

**Description**

Length 30 mm live, 22 mm in 70° alcohol (Figs. 40 and 41). Body brown, dark on the back and lighter on the flanks and neck. Epidermis with irregular darker punctiform mottling. Sole whitish, divided in three areas. Body mucus colourless.

**Genitalia** (Figs. 43–48). Topography of the hermaphrodite duct, albumin gland and spermoviduct typical of the genus. In sexually mature specimens the ovotestis is composed of black acini. Proximal penis cylindrical, with a slight subterminal bulge. Penial gland terminal, divided in two or three branches of variable length with festooned borders. Distal penis thick, spheroid, with two more or less prominent structures of glandular appearance. Interior penial wall covered in fine longitudinal striae continuing into the spheroid bulge of the distal penis. The interior tectum of the posterior penis's spheroid mass features two tongue-shaped, more coarsely striated stimulators, the narrower part of each of which has an orifice communicating with the corresponding exterior glandular mass. Vas deferens short, of uniform cross-section, terminating near the penial gland and the insertion of the retractor penis. Retractor penis long, with one end inserted near the pallial complex and the other in the proximal penis, where the muscle branches towards the base of the posterior penis's spheroid mass. Copulatory sac oval, with a short duct. Oviduct free, as long or longer than the copulatory sac's duct. The two stimulators and the orifices by which the exterior glandular masses communicate with the interior penis can be clearly observed during copulation and when the penis is evaginated upon death by asphyxia. The stimulators are evident in sexually mature specimens, but immatures only exhibit two triangular areas with epithelial striation differing from that of the rest of the penis.
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Material examined

Discussion
In describing the copulation of *D. lombricoides* (Morelet, 1845) (as restricted by Simroth (1891)), Simroth (1891) states that the mating pair take up positions next to each other forming a circle, and that they produce, from the genital orifice, a thick flat triangular stimulator which they place against the mate’s back (Simroth, 1891, Pl. 3, fig. XI). Later, for another copulation observed in Oporto, he describes different behaviour in which the mating pair alternately circled round or kept still with the stimulator all the time pressed against the mate’s flank. The copulation of this latter pair is illustrated (Simroth, 1891, Pl. 3, fig. XII), but not their genitalia. He refers to these figures when he mentions that on being placed in alcohol, one of the pair evaginated a kind of ‘spoon’, a structure that was convex outside and concave inside and whose apex featured epithelial formations that were clearly distinct from the rest of the evaginated organ. He naturally assumed these formations to be stimulators, and that they communicate with two whitish vesicles that could be seen during copulation.

Comparison of Simroth’s illustrations with toptype of *D. lombricoides* (Morelet, 1845) (as restricted by Simroth (1891)) that we have collected in the Serra do Gerês has convinced us that the series of illustrations that purport to represent the species (Simroth 1891, Pl. 3, figs. XI–XVI) in fact represent two quite different species. Figs. XI, XV, XVIa and XVIIb do indeed show *D. lombricoides* (Morelet, 1845) (as restricted by Simroth (1891)), but Figs. XII–XIV show the different species whose penis was described by Simroth himself (1891, pp. 285–6) as having two glandular masses outside and two stimulators inside. It is this species that we provisionally refer to as *Deroceras* sp.

CONCLUSIONS

The group of species discussed here all have external coloration varying from light brown to black, colourless body mucus, a rectum with no caecum or with just a hint of one, a penis divided in a distal part with a spheroid bulge containing the stimulator(s) and a proximal part with a caecum and a penial gland that may be more or less ramified but is invariably festooned. Theoretically, it would be possible to subdivide this group on the basis of the shape of the stimulator, which is ring-shaped in *D. hispaniensis* Castillejo et Wiktor, 1983, horseshoe-shaped (with the gap facing the vagina) in *D. lombricoides* (Morelet, 1845) (as restricted by Simroth (1891)), a flat fold in *D. immaculatum* (Simroth, 1891) and a cone in *D. nitidum* (Morelet, 1845) (= *D. maltzani* (Simroth, 1885)). The problem resides in determining which anatomical characteristics are really valid for distinguishing between species. The current view that the stimulator is a specific determinant has led to many forms with identical penial topographies being separated because their stimulators are different. Indeed, this was Simroth’s argument for separating his *D. immaculatum* from *D. lombricoides* (Morelet, 1845).

Our recent research has discovered forms that are intermediate between *D. immaculatum* (Simroth, 1891) and *D. lombricoides* (Morelet, 1845) but no intermediates between the latter and *D. hispaniensis* Castillejo & Wiktor, 1983. Though the possibility that all three jointly make up a single polytypic species with considerable intraspecific variation exists and is currently being investigated in our laboratory by determining the genetic distances among the three forms, we therefore provisionally consider *D. immaculatum* (Simroth, 1891) to be a
Figs. 40–44. *Deroceras* sp. 40 and 41: specimens with the posterior penis evaginated. 42: organs *in situ*. 43 and 44: dorsal and ventral views of the genitalia. Scale 1 mm.
Figs. 45–48. *D. eustoma* sp. 45 and 46: dorsal and ventral views of the posterior genitalia. 47 and 48: interior distal penis, showing the two stimulators. Scale 1 mm.
synonym of *D. lombricoides* (Morelet, 1845) (as restricted by Simroth 1891), and that *D. hispaniensis* Castillejo et Wiktor, 1983 is a valid species. *D. maltzani* (Simroth, 1885) is clearly a later synonym of *D. nitidum* (Morelet, 1845), since the genitalia, the stimulators and the geographical distributions mentioned by Simroth (1891) are all identical.

With regard to the distributions of these forms, *D. nitidum* (Morelet, 1845) has only been found near the coast and then only south of the Tagus; *D. lombricoides* (Morelet, 1845) has been found with the stimulator in the shape of a flat fold in central and western Portugal and with a horseshoe-shaped stimulator in northern and western Portugal; *D. hispaniensis* Castillejo. & Wiktor, 1983 has only been collected in northern Portugal, near the Luso-Spanish border; and *Deroceras* sp. appeared in the Costa Verde region.

**ACKNOWLEDGEMENTS**

We wish to express our warmest thanks to Dr. Folco Giusti di Massa, for studying material we sent him and for critically reviewing the manuscript of this article, and to Dr. Andrzej Wiktor for offering his opinions on the species discussed.

**REFERENCES**


