

# ZOOLOGISCHE MEDEDELINGEN

UITGEGEVEN DOOR HET

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE TE LEIDEN  
(MINISTERIE VAN CULTUUR, RECREATIE EN MAATSCHAPPELIJK WERK)

Deel 41 no. 20

22 december 1966

## NOTES ON LAND SLUGS, 11 ARIONIDAE, MILACIDAE AND LIMACIDAE FROM SOUTH AFRICA (MOLLUSCA, GASTROPODA PULMONATA)<sup>1)</sup>

by

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With 9 text-figures and 2 plates

### Abstract

New records of *Arion intermedius* Norm. are given.

All known data on the genus *Oopelta* Mörch have been compiled and supplemented by new observations, mainly on *O. nigropunctata* Mörch and *O. capensis* Poll. Of the former species the type specimens were examined and the external variation and anatomy were studied. A fine series of *O. capensis*, with notes on the living animals by Mr. van Bruggen, enabled the author to study that species in detail. The affinities of *Oopelta* are discussed and it is concluded that the genus should be maintained in a subfamily of its own, Oopeltinae Cockerell, 1891, in the Arionidae. It seems unlikely that the type locality of *O. nigropunctata* on the Gold Coast near Accra (Ghana) is autochthonous. The distributional area of *Oopelta* in South Africa strongly resembles that of some other so-called palaeogenic elements in the South African fauna.

The samples of *Milax* examined appeared to belong to *M. gagates* (Drap.) in its restricted sense. Therefore it seems likely that earlier records of this species from South Africa were correct. *M. capensis* (Krauss) probably is a synonym, and the same may even hold true for *M. ponsonbyi* (Collinge).

New records are given of *Limax flavus* L., *L. nyctelius* Bourg., *L. valentianus* Fér., *Deroceras reticulatum* (Müll.), *D. caruanae* (Poll.), and *D. laeve* (Müll.).

The interpretation of *Limax nyctelius* by Hugh Watson and others has been followed here, but attention is called to the fact that Simroth's different

1) No. 10: Notes sur les limaces, 10, see: J. Conchyl. 105 (4), 1966.

views on this Algerian species have never been definitely refuted. *Agriolimax kervillei* Germain is considered a synonym of *L. nyctelius* as interpreted by Watson et al.

*Deroceras caruanae* has only recently been recorded for the first time from South Africa by Van Bruggen, but possibly Connolly's "*Agriolimax laevis* (Müll.) var. *grisea* Taylor" is this species. "*Agriolimax (Hydrolimax) laevis* Müller, variété grise" of Abeloos and *Deroceras meridionale* Reygrobellet (a name preoccupied by *Agriolimax meridionalis* Doering) are considered synonyms of *D. caruanae*.

#### INTRODUCTION

Mr. A. C. van Bruggen, when curator of Mollusca of the Natal Museum, kindly sent me for identification a number of samples of slugs belonging to the three families mentioned in the title of this paper. Among these was an excellently preserved series of *Oopelta capensis* Pollonera, with notes on the living animals. When studying this material I became anxious to examine other species of this genus too, which was made possible by the loan of specimens from various other museums. Therefore, the subfamily Oopeltinae has been dealt with here as exhaustively as possible, while about the Arioninae, Milacidae and Limacidae only those remarks have been made to which the material examined gave rise.

I want to acknowledge my indebtedness to those persons who put at my disposal specimens belonging to the collections under their care. Dr. W. S. S. van der Feen — van Benthem Jutting and her successor Mr. H. E. Coomans allowed me to examine specimens of *Oopelta* belonging to the Zoologisch Museum of Amsterdam University (ZMA), which had already been reported upon by Forcart (1963). Dr. J. R. Grindley sent material from the South African Museum (SAM), Cape Town, which admittedly was in very poor condition, but treatment with trisodium phosphate made at least part of it recognizable. Dr. H. Lemche and Mr. J. Knudsen allowed me to dissect the holotype of *Oopelta nigropunctata* Mörch preserved for over a century in the Zoologisk Museum of Copenhagen (ZMK) and still in good condition. From Dr. O. Paget I received on loan three specimens belonging to the Naturhistorisches Museum in Vienna (NHMV).

According to Connolly the types of the species described by Collinge are in the University Museum of Zoology, Cambridge. I tried in vain to learn if these specimens are still in the collection of that institute.

The collections mentioned above will be referred to by the abbreviations given in brackets. Moreover LUM will indicate Lund University Museum, Sweden, to which belong a few samples sent with the Natal Museum

specimens by Mr. van Bruggen. NM will refer to the Natal Museum, Pietermaritzburg, and RNHL to the Rijksmuseum van Natuurlijke Historie, Leiden.

I am indebted to Prof. Dr. H. Boschma and Mr. A. C. van Bruggen for critically reading the typescript. The latter provided much useful information about localities at which samples had been collected.

#### SYSTEMATIC PART

##### Arionidae

##### Arioninae

#### **Arion intermedius** Normand, 1852

*Arion intermedius* - Connolly, 1939: 182 (with references to older literature on occurrence in South Africa); Quick, 1960: 125, fig. 4H (distal part of genitalia), map 5, pl. 1 fig. 7 (animal); Van Bruggen, 1964b: 162 (occurring in South Africa since 1898).

Material examined. — Cape Province: Cape Town, Table Mountain, ravine at Wynberg Cave at about 2400 ft., vegetable debris in indigenous bush, December 18, 1950, leg. P. Brinck and G. Rudebeck (Swedish S. Afr. Exp. 1950-1951, loc. 84): 1 specimen (LUM); Cape Peninsula, Hout Bay, Skoorsteenkop, January 28, 1951, leg. P. Brinck and G. Rudebeck (Swedish S. Afr. Exp. 1950-1951, loc. 161): 2 specimens (LUM); Cape Town, indigenous forest above Kirstenbosch Botanic Gardens, 1000 ft., September 17, 1965, leg. A. C. & W. H. van Bruggen: 1 specimen (NM).

The specimens from Hout Bay are too poorly preserved and the others are too small to allow of dissection, but the external features are characteristic enough for identification. This is a European species which has been introduced into several other parts of the world.

##### Oopeltinae

#### **Oopelta** Mörch

*Arion* - Gray, 1855: 52 (partim).

*Oopelta* Mörch, in Heynemann, 1867: 191 (type species by monotypy: *Oopelta nigropunctata* Mörch); Binney, 1879: 362; Fischer, 1880-1887: 466 (1883); Heynemann, 1885: 240, 242, 294; Sturany, 1898: 538; Simroth, 1902: 33; Heynemann, 1906: 59; Simroth, 1907: 793, 798 (distribution); Pollonera, 1909: 10; Simroth, 1910: 140; Simroth & Hoffmann, (1908-) 1928: 301 (mandible), 325 (radula), 377 (kidney), 445 (lung), 623, 1118 (transfer of sperm), 1226, 1237 (systematic position), 1264 (distribution), pl. 23 fig. 3 (lung venation and shell sack [of *O. polypunctata*!] after Simroth, 1910); Thiele, 1935: 1106 (no shell), 1139 (distribution); Connolly, 1939: 184; Pilsby, 1948: 661, 665; Van Bruggen, 1964a: 50.  
*Oopelte*, Heynemann, 1906: 24 (distribution map).

**Oopelta aterrima** (Gray)

*Arion aterrimus* Gray, 1855: 55 (South Africa).

"*Arion*" *aterrimus* - Cockerell, 1890: 387 (redescription of type; may belong to *Oopelta*); Cockerell, 1891: 222.

? *Oopelta aterrimia* [sic] - Cockerell, 1893: 189.

*Oopelta aterrima* - Melvill & Ponsonby, 1898: 172; Collinge, 1901: 230, 235; Heynemann, 1906: 59; Simroth, 1910: 141; Connolly, 1912: 124; Connolly, 1939: 186.

Type material. — The type is in the British Museum (Natural History). As long as its anatomy has not been studied, it is impossible to be sure that none of the following species is a synonym of *O. aterrima*.

**Oopelta nigropunctata** Mörch

*Oopelta nigropunctata* Mörch in Heynemann, 1867: 191 (Litus guineense ad colonias quondam danicas [i. e. Christiansborg, a Danish trading-station and fort on the Gold Coast near Accra (at present in Ghana), established 1659 and sold to Great Britain in 1850]); Heynemann, 1867: 192 (description of radula), pl. 2 fig. 1, 2 (elements of radula); Fischer, 1880-1887: 467 (1883); Heynemann, 1885: 293, 295, 323; Cockerell, 1891: 222; Cockerell, 1893: 189; Melvill & Ponsonby, 1898: 172; Collinge, 1900: 5 (Cape Town), 8, pl. 1 fig. 7, 8 (animal), pl. 2 fig. 16 (genitalia); Collinge, 1901: 231, 235, 236, pl. 14 fig. 6 (alimentary canal), fig. 11, 11a, 12 (penis, with internal structure); Heynemann, 1906: 59; Simroth, 1907: 794 ("Cape flats", Berge liet [recte Bergvliet]); Pollonera, 1909: 10; Simroth, 1910: 140; Connolly, 1912: 125 (exclusive of reference to figures by Simroth, 1910!; Sir Lowry's Pass); Connolly, 1939: 184, 658, pl. 14 fig. 8 (animal, after Collinge); Forcart, 1963: 106 (Visser's Hok N. Cape Town [Prof. Engel kindly informed me that Visser's Hok is the name of a farm on the silted up Diep River, about 12 miles north of Cape Town]).

not *Oopelta nigropunctata* - Sturany, 1898: 589 (see: *Oopelta polypunctata* Collinge and *O. capensis* Pollonera).

*Oopelta micropunctata* [sic] - Thiele, 1931: 604.

Type material. — The holotype and two paratypes (pl. 1 fig. 1-7) are in the collection of the Zoologisk Museum at Copenhagen. From the holotype the buccal mass is missing and the mantle shield has been removed and opened. So this must be the specimen in which Heynemann established the absence of an internal shell and of which he studied and figured the radular teeth. Further dissection revealed that the distal part of the genitalia (fig. 1), and especially the shape of the penis, agrees with the description and figures given by Collinge of these organs in South African material attributed to *O. nigropunctata*.

Other material examined. — Cape Town: 3 specimens (SAM, 5476). These animals are in poor condition. One of them had been dissected before I examined them and the penis had been opened. Apparently this is the specimen after which Collinge (1901) figured the inner structure

of the penis. — Tulbagh: 1 specimen (SAM, 11307). The specimen is in poor condition, but the external and internal characters that still can be verified confirm the identification on the label. — Visser's Hok, N. of Cape Town, September 6, 1938, H. Engel leg.: 2 specimens (ZMA), mentioned by Forcart. — Milberton [recte Milnerton], September 6, 1938, L. D. Brongersma leg.: 6 specimens (RNHL). — Experimental Station Elzenburg [recte Elsenburg] near Stellenbosch, October 10, 1938, H. Engel leg.: 2 specimens (ZMA), already identified by Forcart, but not mentioned in his paper. — Kleiheuvel, Bredasdorp, August 21, 1964, J. S. Taylor leg.: 1 specimen (NM). — Durbanville, Malmesbury, August 17, 1964, J. S. Taylor leg.: 4 specimens (NM).

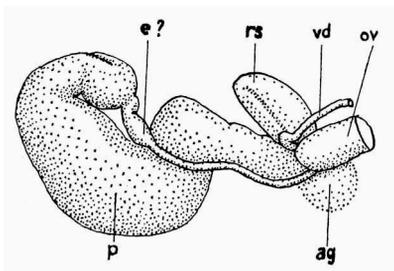


Fig. 1. *Oopelta nigropunctata* Mörch, holotype, distal part of genitalia. —  $\times 6$ . Abbreviations see p. 296.

External characters. — In the holotype and the two paratypes the black spots on the mantle are hardly or no more visible. The colour of these animals is dark brownish grey all over, with some irregular black spots on the sides. The specimens from Durbanville and from Milnerton have the same ground colour, the spots on the mantle are more or less obvious and there are no black spots on the sides. The animals from Visser's Hok, Elsenburg and Bredasdorp are much lighter, their ground colour is creamy white to light fulvous, and the black spots on the mantle are very obvious. In most specimens these spots are large and few in number (fig. 2a), but the animal from Bredasdorp has numerous little dots on the mantle (fig. 2b). the genital orifice is situated just behind the right tentacles (fig. 2c). There is no caudal mucus gland.

Anatomy. — The shell sack contains numerous small granules, which may form concretions (fig. 3d). They dissolve at once in diluted muriatic acid and presumably consist of calcium carbonate. The kidney surrounds the pericardium as in *Arion*, while the penial retractor muscle is inserted just behind the kidney (fig. 3c). The pedal gland is shorter than half the length of the pedal sole (fig. 3c).

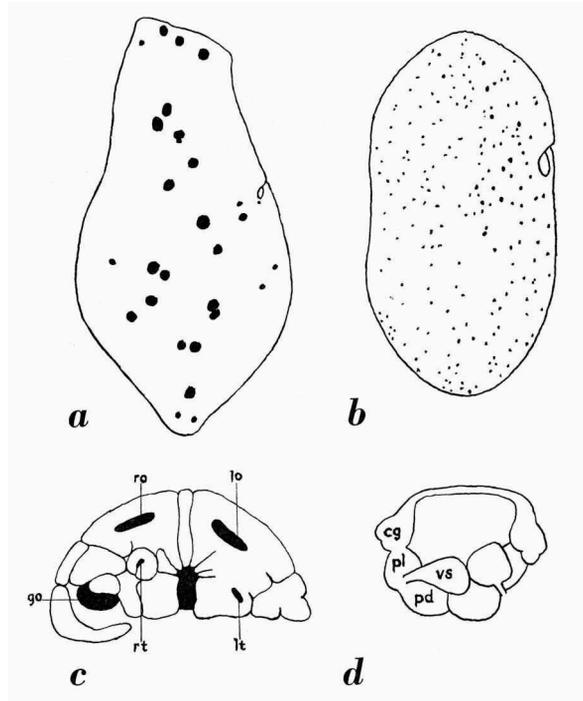


Fig. 2. *Oopelta nigropunctata* Mörch. a, spots on mantle, normal pattern (Elsenburg near Stellenbosch); b, spots on mantle in specimen from Bredasdorp; c, head from below (Bredasdorp); d, central nervous system (Milnerton). — a, b,  $\times 2\frac{1}{2}$ ; c, d,  $\times 5$ . Abbreviations see p. 296.

There is no long and posteriorly unpaired buccal retractor muscle. Just as Simroth found in *Oopelta polypunctata* its function must have been taken over by the short paired retractor muscles on both sides of the buccal mass. These belong to a complex of protractor and retractor muscles which I did not compare in detail with Simroth's description of that complex in *Oopelta polypunctata*. Contrary to what Simroth found in the latter species the retractor muscles of the small tentacles are branches of those of the ommatophores. The latter have a thin side branch inserted in the inner wall of the side of the head. The tentacular retractor muscles are rather short and their posterior insertion in the body wall is situated where the inner wall of the foot sole passes into that of the side of the body (fig. 3c). The retractor muscle of the right ommatophore passes between the penis and the oviduct (fig. 3a, b, c).

The central nervous system agrees with what Simroth found in *Oopelta polypunctata*. It is characterized by the long cerebral commissure and by its obvious asymmetry (fig. 2d).

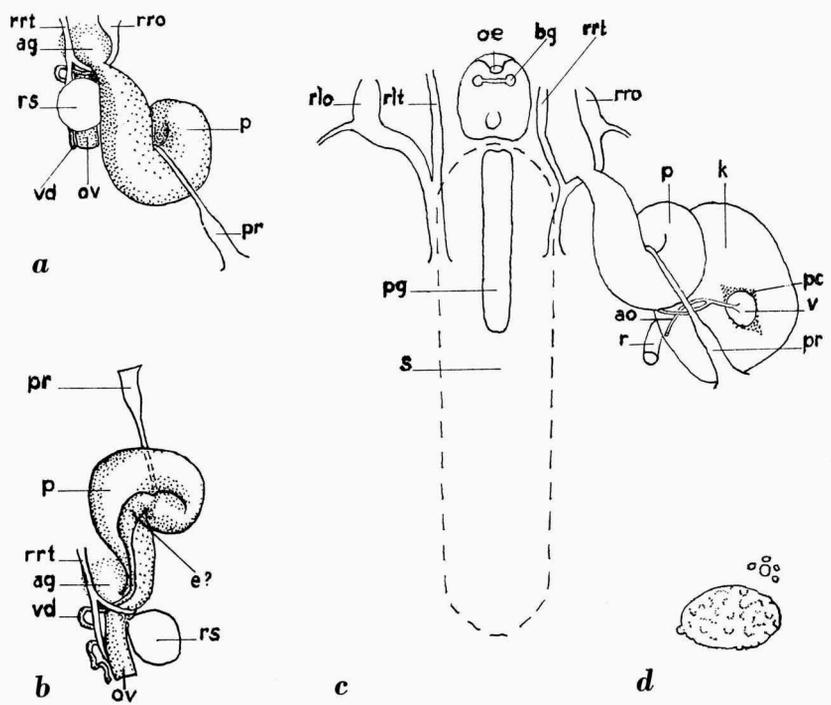


Fig. 3. *Oopelta nigropunctata* Mörch, from Milnerton. a, distal part of reproductive organs in situ; b, the same with the penis tipped over forward after the retractor muscle has been cut off at its posterior insertion, and with the receptaculum seminis turned to the right; c, tentacular retractor muscles, buccal mass, pedal gland, penis and pallial organs; d, granules and concretion from shell sack. — a-c,  $\times 2$ ; d,  $\times 7$ . Abbreviations see p. 296.

As already stated by Mörch the jaw is oxygnathous. In the radula of a specimen from Milnerton I found 97 rows of teeth and 40 teeth to the left of the central one in the 65th row from behind. This is slightly less than in the radula studied by Heynemann who figures the 42nd tooth as the last marginal. As to the shape the teeth agree with those in Heynemann's figure. I also found no clear-cut difference between laterals and marginals, while the cusps in the extreme marginals are rudimentary (fig. 4a).

The genitalia have been well described by Collinge (1900, 1901). I only want to call attention to one detail. Before entering the penis (Collinge's "sperm duct") the vas deferens is dilated over a short distance; this might be an epiphallus (fig. 1, 3b). Although no true spermatophore was ever found in any specimen of *Oopelta*, the short sausage-shaped sperm mass (cylindrical with convex ends, length 4, width  $1\frac{1}{2}$  mm) which I found in the receptaculum seminis of one specimen of *Oopelta nigropunctata* might be a sort of "protospermatophore" formed in the distal dilated part of the vas deferens.

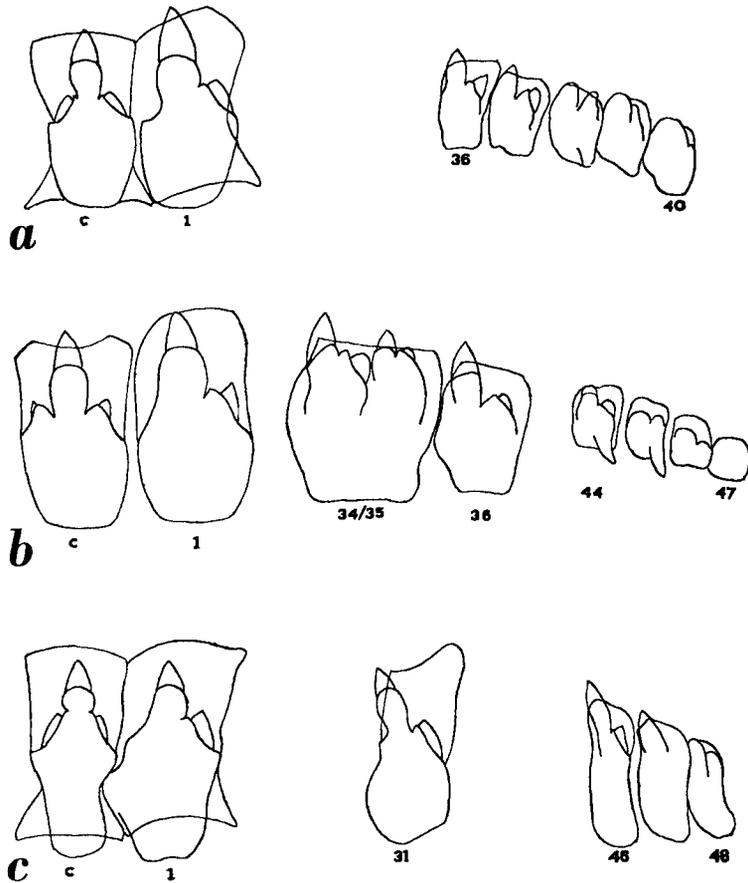


Fig. 4. Representative teeth of the radula. a, *Oopelta nigropunctata* Mörch, from Milnerton; b, *O. polypunctata* Collinge, from Albany District; c, *O. capensis* Pollonera, from Wilderness. —  $\times 340$ . Abbreviations see p. 296.

Distribution (see fig. 9). — Gold Coast near Accra (Mörch); Cape Town (Collinge); Bergvliet, Cape Flats, (Simroth); Sir Lowry's Pass (Connolly); Visser's Hok N. of Cape Town (Forcart); Milnerton (RNHL); Elsenburg near Stellenbosch (ZMA); Kleiheuvel, Bredasdorp (NM); Malmesbury, Durbanville (NM); Tulbagh (SAM).

#### ***Oopelta flavescens* Collinge**

*Oopelta flavescens* Collinge, 1900: 6 (Kalk Bay), 8, pl. 1 fig. 9, 10 (animal), pl. 2 fig. 17 (genitalia); Collinge, 1901: 231 (Caledon; Swellendam; Kogmans Kloof, mountain side near Ashton), 235; Heynemann, 1906: 59; Simroth, 1910: 141; Connolly, 1912: 125; Connolly, 1939: 185.

Type material. — The species was based on four specimens in the South African Museum. According to Connolly the type is in the Cambridge Museum. I consider three specimens from the type locality in the South African Museum (No. 5484) to be syntypes. They are in very poor condition, so I did not even try to dissect them.

Other material examined. — Storms Vlei, Swellendam Div.: 2 specimens (SAM, No. 7000). These animals are in poor condition. What can be seen of the anatomy does not contradict the identification on the label. Although the identification may be Collinge's, that author's locality record 'Swellendam' is not based on these specimens, because they have another sample number. — Diep River, Cape Div.: 4 specimens (SAM, No. 11152). These animals are also in poor condition, but what can be seen of the anatomy in one of them does not contradict the identification on the label.

Distribution (see fig. 9). — Kalk Bay, Caledon; Swellendam; Kogmans Kloof, mountain side near Ashton (Collinge); Storms Vlei, Swellendam Div.; Diep River, Cape Div. (SAM).

### ***Oopelta granulosa* Collinge**

*Oopelta granulosa* Collinge, 1900: 6 (Calvinia Div., Nieuwoudtville [recte Nieuwoudtville]), 8, pl. 1 fig. 11, 12 (animal), pl. 2 fig. 18 (genitalia); Collinge, 1901: 231 (Hot Springs, Montague), 235; Heynemann, 1906: 59; Simroth, 1910: 141; Connolly, 1912: 125 (Sir Lowry's Pass); Connolly, 1939: 185.

not *Oopelta granulosa* - Forcart, 1963: 106 (see *Oopelta capensis* Pollonera).

Type material. — The species was based on three specimens in the South African Museum. According to Connolly the type is in the Cambridge Museum.

Material examined. — Calvinia and/or Bokkeveld, Clanwilliam: 2 specimens (SAM, No. 5490); Calvinia: 3 specimens (SAM, No. 5491); Gift Berg, SE of Van Rhijnsdorp [recte Vanrhijnsdorp], R. M. Lightfoot, Sept. 1911: 5 specimens (SAM, No. 5737); Hot Springs, Montague: 1 specimen (SAM, No. 6989). All specimens are in poor condition, but what can be seen of the external and internal characters confirms the identification on the labels. With sample no. 5490 there are two labels. If the second does not belong to it, these animals might be syntypes. It seems unlikely that the specimens of sample no. 5491 are syntypes, because the genitalia are still in situ in all three specimens, and Collinge must have extracted these organs in order to figure them. Sample no. 6989 was mentioned by Collinge in 1901.

Distribution (see fig. 9). — Nieuwoudtville, Calvinia Div.; Hot Springs, Montague (Collinge); Sir Lowry's Pass (Connolly);? Bokkeveld, Clanwilliam (SAM); Gift Berg, SE of Vanrhijnsdorp (SAM).

**Oopelta polypunctata** Collinge

- Oopelta nigropunctata* [non Mörch] - Sturany, 1898: 589 (Albany Distrikt, partim).  
*Oopelta polypunctata* Collinge, 1901: 232 (Caledon Div., Zonder End [presumably Riviersonderend]), 235, 236, pl. 14 fig. 3, 4 (animal), 5 (alimentary canal), 7 (genitalia), 8, 9, 10 (penis with internal structure); Heynemann, 1906: 59; Simroth, 1910, 141, 142-152 (Promontorium bonae spei), fig. 2 (everted genitalia), fig. 3 (at right: distal part of genitalia), 179, pl. 21 fig. 1 (mantle), 2 (pneumostome), 3-5 (alimentary system with details), 6-10 (genitalia with details), 11, 12 (retractor muscles), 13 (pallial organs), 14 (lung venation and shell sack), 16 (calcareous granules and concretions), 17 (central nervous system); Connolly, 1912: 126; Simroth & Hoffmann, (1908-) 1928: 522, 633, fig. 170, pl. 29 fig. 10, 11 (distal genitalia, figures after Simroth, 1910); Connolly, 1939: 186; Forcart, 1963: 106 (Port Elizabeth, Nature Reserve).  
*Oopelta* [*polypunctata*] - Simroth, 1902: 33-39 (anatomy).

Type material. — The species is based on specimens in the South African Museum. According to Connolly the type is in the Cambridge Museum. The specimens kept in the South African Museum with the label "*Oopelta polypunctata*, cotypes, Caledon Div." appeared to have completely disintegrated and should be considered lost.

Other material examined. — South Africa, leg. Penther: 2 specimens, Dr. Babor det.: *Oopelta nigropunctata* Mörch (NHMW, No. 42.272, partim). These are two specimens from a sample of three. Presumably Sturany's record of *O. nigropunctata* from the Albany District is based on this sample. — Nature Reserve, Port Elizabeth, September 19, 1938, leg. H. Engel: 1 specimen (ZMA). This is the specimen mentioned by Forcart. The genitalia have been removed and are lacking, so the identification could not be checked.

External characters. — In all three specimens examined black spots on the mantle as found in this species by Collinge and Simroth, are absent. In spirit the specimens are smaller than those of *O. capensis*.

Anatomy. — The anatomy of the species has been described by Collinge and, in more detail, by Simroth. Therefore it will suffice to record here the differences found between the specimens I examined and Simroth's description, and to add some notes on the mandible and radula, which he did not study.

According to Simroth the retractor muscle of the small tentacle is inserted separately from that of the ommatophore. I checked this character in one of the animals of the Vienna museum and found that on both sides the tentacular retractor muscle branches into a retractor muscle for the small tentacle and one for the ommatophore, just as is the case in *O. nigropunctata* and *O. capensis*. So Simroth evidently studied an aberrant specimen.

The jaw is oxygnathous as in other species of *Oopelta*. In the radula I counted 99 rows of teeth and 47 teeth to the left of the central one in the

31st row from behind. In each transversal row the teeth of the 34th and 35th longitudinal row to the left of the central tooth are grown together, which is, of course, a peculiarity of the specimen examined. The general shape of the teeth agrees with that of the radular teeth of *O. nigropunctata* (fig. 4b).

The genitalia of the Vienna specimens have reached full maturity as appears from the strongly developed glandular tissue of the spermooviduct and the large albumen gland. This may be the reason why the form of the stimulator sack (Simroth's "Pfeilsack") differs from those figured by Collinge and Simroth. In the Vienna animals it is shorter and thicker and the terminal appendix (Simroth's "Pfeildrüse") is wider than long and has the shape of a low blunt cone (fig. 5). The penis coecum is shorter and wider than in the specimen figured by Simroth, but for the rest the form of the penis agrees well with his description and figure, more so than with Collinge's.

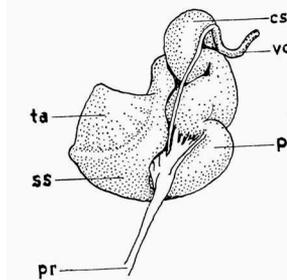


Fig. 5. *Oopelta polypunctata* Collinge, from Albany District, distal part of male genitalia. —  $\times 3$ . Abbreviations see p. 296.

The Vienna specimens were not well enough preserved for me to check Simroth's observation that the receptaculum seminis is only seemingly fixed some way up the free oviduct, but actually has a rather long duct fixed to the free oviduct by connective tissue.

Distribution (see fig. 9). — Albany District (Sturany); Zonder End [presumably Riviersonderend], Caledon Div. (Collinge); Cape Peninsula (Simroth); Nature Reserve, Port Elizabeth (Forcart).

### ***Oopelta capensis* Pollonera**

*Oopelta nigropunctata* [non Mörch] - Sturany, 1898: 589 (Albany Distrikt, partim).

*Oopelta capensis* Pollonera, 1909: 11 (Capo di Buona Speranza), 19, pl. fig. 1 (radular elements), 2 (mandible), 3, 4 (animal), 5 (alimentary canal), 6 (distal part of genitalia); Simroth, 1910: 141; Connolly, 1912: 125; Connolly, 1939: 186; Forcart, 1963: 106 (Groot River, E. Plettenberg Bay).

*Oopelta granulosa* [non Collinge]. - Forcart, 1963: 106 (Knysna).

*Oopelta* - Van Bruggen, 1964a: 52 (Wilderness), pl. 1, 2 (animal).

Type material. — The species was described after a specimen belonging to

the Zoological Museum of Turin University. The director of that museum, Prof. G. Bacci, kindly informed me (in litt.) that the types of slugs described by Pollonera and formerly kept in this museum must be considered lost.

Material examined. — South Africa, leg Penther: 1 specimen, Dr. Babor det.: *Oopelta nigropunctata* Mörch (NHMW, No. 42.272, partim). This is one specimen from a sample of three upon which Sturany presumably based his record of *O. nigropunctata* from the Albany District. — Groot Rivier, E. of Plettenbergbaai, September 19, 1938, leg. H. Engel: 1 specimen (ZMA); Knysna, September 1938, leg. A. D. J. Meeuse: 1 specimen (ZMA). This specimen was identified as *O. granulosa* by Forcart, but the well developed genital atrium, which appears to be the most important anatomical character of *O. capensis*, forced me to emend this identification. — Wilderness, July 26, 1963, leg. F. Goodliffe: 2 specimens (NM); Wilderness, August 7, 1963, leg. F. Goodliffe: 4 specimens (NM); Wilderness, August 8, 1963, leg. J. S. Taylor: 3 specimens (NM); Wilderness, August 20, 1963, leg. J. S. Taylor: 9 specimens (NM) + 4 specimens (RNHL).

The following are some notes made by Mr. van Bruggen on the living animals received in the Natal Museum.

“Two specimens from Wilderness, 20.VII.1963, leg. J. S. Taylor, ground colour greenish yellow, granules small and not very prominent, less numerous than in other specimens and not so well marked on dorsum, upper edge of foot not marked in different colour. Died and decomposed over the weekend on 9.IX.1963; not preserved. Set of photographs made by Laura Kelsall” (pl. 2 fig. 1, 2).

“Two specimens from Wilderness, 26.VII.1963, leg. F. Goodliffe, sent to Dr. Van Regteren Altena sub no. 16, two forms, ground colour greenish yellow, mantle covered with numerous dark reddish-brown granules, without visible pattern, on back and sides rows of dots and dashes in same colour, fringe of body much paler, upper edge of foot pale brown, footsole uniform dirty yellow, head ditto, tentacles (upper pair only) slightly darker. The slime channels are left uniformly dirty yellow between the rows of dots and dashes. Other phase has greenish grey basic colour, giving the general impression of a much darker animal. In both forms the footsole is of a uniform colour, viz., dirty yellow (first phase) or greenish grey (second phase). The living animal could stretch as long as 120 mm. at times. When the humidity was high typical flat wide foot fringe next to body — broad slugs! Killed and preserved early in September.”

“Four specimens from Wilderness, 7.VIII.1963, leg. F. Goodliffe, sent to Dr. Van Regteren Altena sub no. 17. One of these laid three eggs in the night of 21-22.VIII.1963 in the laboratory in Pietermaritzburg (petri dish

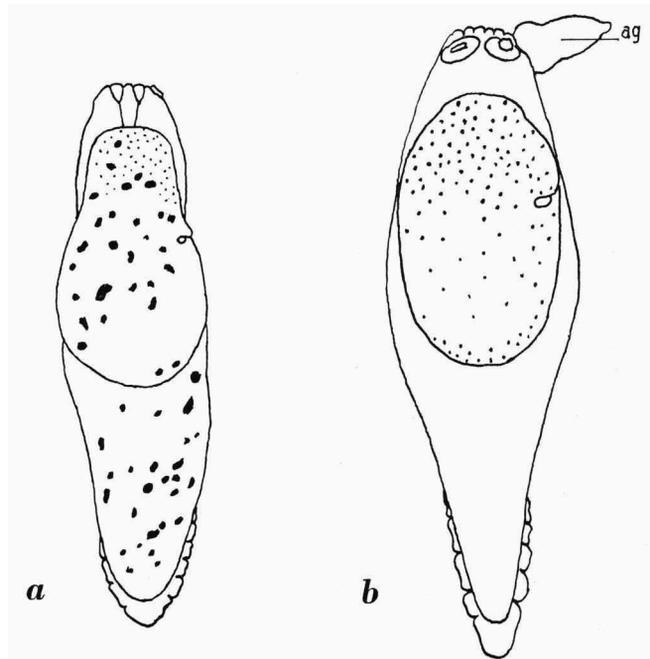


Fig. 6. *Oopelta capensis* Pollonera. a, from Groot River; b, with everted genital atrium, from Wilderness. — Both  $\times 1\frac{1}{2}$ . Abbreviations see p. 296.

“with only filter paper); on 22.VIII.1963 15 more eggs were laid during “the day, diameter when fresh 3-3.5 mm. Killed and preserved in August.”

“General remarks. All specimens lived well in petri dishes under laboratory “conditions; food consisted of filter paper, raw potatoes and carrots and “macaroni, soaked in water. The general impression is that darkness and “fairly low temperatures were preferred; two specimens succumbed during a “particularly warm weekend. Of course, the Pietermaritzburg climate is “utterly different from that of Wilderness in the SE Cape Province. All “specimens had a tough bluish green (turquoise is as near as can be) slime — “a most unusual colour which could be clearly seen in all petri dishes; some “specimens also left faint reddish marks on the fingers when handled.”

External characters. — Black spots on the mantle as in the type specimen figured by Pollonera are present only in the animal from Groot River, which moreover has dark spots on the sides of the back (fig. 6a). In the other specimens there are numerous little dark dots on the mantle (fig. 6b) and in some of them such dark dots are also found on the back and the sides. Probably these dots fade away when animals are kept in alcohol for a long time, as they are hardly visible in the specimen belonging to the Vienna

Museum. The ground colour is greyish creamy white in alcohol. Of the two specimens collected July 26, 1963, and described when living by Mr. van Bruggen, one is of a somewhat darker hue than the other, while in the lighter animal not only the mantle, but also the back and the posterior part of the sides bear small dark dots.

The situation of the genital orifice is the same as in *O. nigropunctata*, as is obvious in a specimen with everted genital atrium (fig. 6b). There is no caudal mucus gland.

Anatomy. — When opening the shell sack of one specimen, small granules were found as in *O. nigropunctata*, but no concretions. The kidney surrounds the pericardium and the penial retractor muscle is inserted behind the kidney (fig. 7b). The pedal gland does not reach the middle of the footsole.

There is no long and posteriorly unpaired buccal retractor muscle and the tentacular retractor muscles are like those in *O. nigropunctata*, except that I found no thin side branch in the retractor muscles of the ommatophores (fig. 7e).

The central nervous system agrees with that of *O. nigropunctata*.

The oxygnathous jaw has been figured by Pollonera. In the radula examined I found 106 rows of teeth and 48 teeth to the left of the central tooth in the 19th transversal row from behind. Pollonera did not mention the number of teeth he found in a transversal row, but as he states that the extreme marginals are not rudimental as found by Heynemann in *O. nigropunctata*, it seems warranted to suppose that the 31st tooth figured by him is one of the extreme marginals, the figure thus illustrating his point. The shape of the teeth in the radula I examined also markedly differs from Pollonera's figures. While these show teeth of the same general type as those found in *O. nigropunctata* and *O. polypunctata*, I found the teeth of *O. capensis* to be much longer and narrower than those of the other two species (fig. 4c).

No globular protrusion was found in the first fold of the alimentary canal, but for the rest this canal agrees with Pollonera's description and figure (fig. 7a, c).

The ovotestis is subglobular and lies more to the front than in *Arion* (fig. 7c). The hermaphrodite duct is coiled and of irregular width. I have been unable to find a bursa copulatrix, but in the specimen examined this may be hidden by the strongly developed albumen gland. In the same specimen the glandular tissues of the spermoviduct appeared to be well developed, showing the animal to be in the female stage (fig. 8a). The free oviduct, the rather long receptaculum duct and the vas deferens are folded back over the retractor muscle of the right ommatophore about the middle of the former

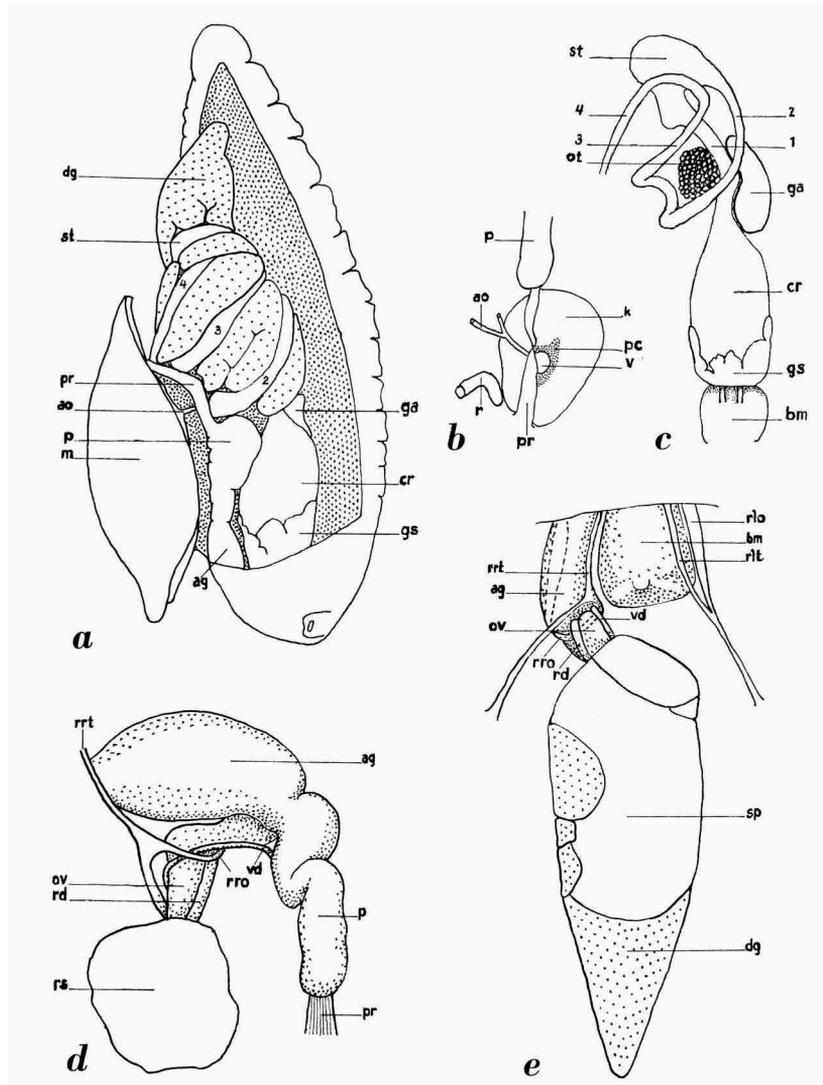


Fig. 7. *Oopelta capensis* Pollonera, from Wilderness. a, situs viscerum; b, pallial organs; c, alimentary canal with position of ovotestis and albumen gland; d, distal part of genitalia with right tentacular retractor muscles; e, diagram showing course of tentacular retractor muscles as seen from below. — a, c, e,  $\times 1\frac{1}{2}$ ; b, d,  $\times 3\frac{1}{2}$ . Abbreviations see p. 296; 1-4: first to fourth fold of alimentary canal.

two tubes; their distal parts run backward along the genital atrium with which they are connected by connective tissue (fig. 7d, e). The vas deferens enters the penis at its proximal end near the insertion of the penial retractor muscle; it has no distal dilated part reminding one of an epiphallus as is the

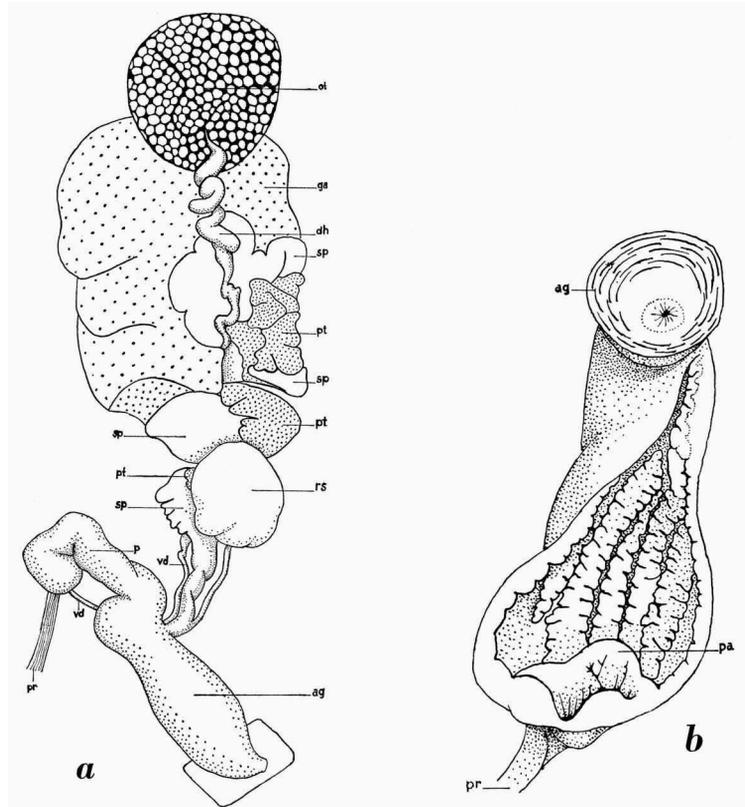


Fig. 8. *Oopelta capensis* Pollonera, from Wilderness. a, genitalia; b, penis opened and genital atrium cut through to show cross section. — a,  $\times 2\frac{1}{2}$ ; b,  $\times 5$ . Abbreviations see p. 296.

case in *O. nigropunctata*. Depending on the degree of contraction of the atrium the penis is about as long, or up to twice as long as the genital atrium. Its wall is rather thin and longitudinally folded inside. A papilla which surrounds the orifice of the vas deferens protrudes into the lumen of the penis from its proximal end. The genital atrium has a very thick muscular wall and a narrow lumen of which the epithelium is also longitudinally folded (fig. 8b).

Identification. — *O. capensis* as here understood differs from the other species of the genus by the well developed and massive genital atrium. No mention is made of this part of the genitalia in the original description of the species, but in Pollonera's figure a short genital atrium is clearly shown. Probably Pollonera did not disconnect the distal parts of the oviduct and receptaculum duct with the adjoining part of the vas deferens from the

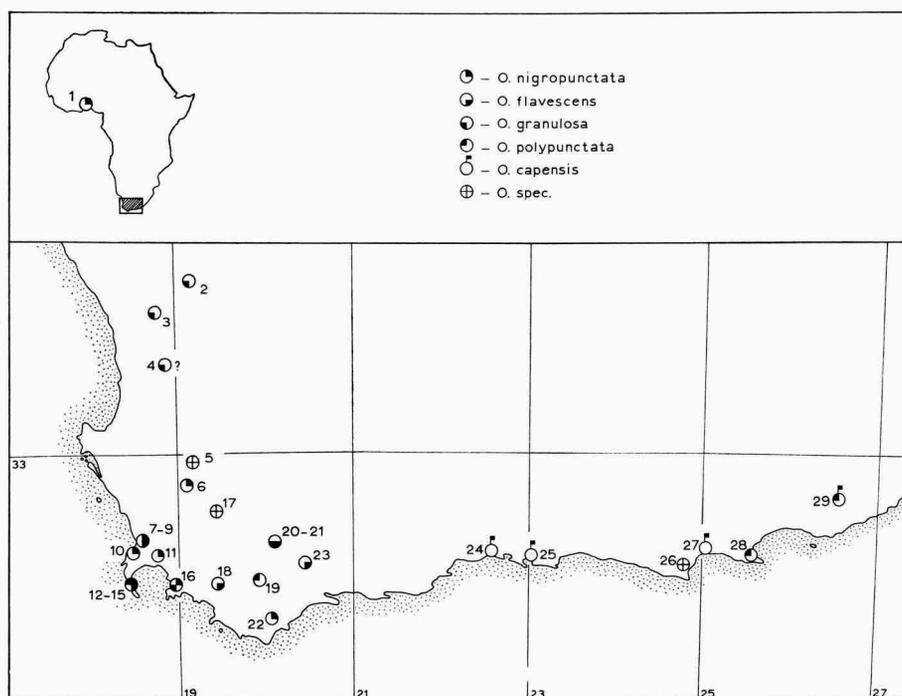


Fig. 9. Distribution of *Oopelta*. 1, Gold Coast near Accra; 2, Nieuwoudtville; 3, Vanrhijnsdorp; 4, Clanwilliam; 5, Great Winterhoek; 6, Tulbagh; 7, Visser's Hok and Diep River; 8, Durbanville; 9, Milnerton; 10, Cape Town; 11, Stellenbosch; 12, Cape Peninsula; 13, Bergvliet; 14, Simonstown; 15, Kalk Bay; 16, Sir Lowry's Pass; 17, Worcester; 18, Caledon; 19, Riviersonderend; 20, Montague; 21, Ashton; 22, Bredasdorp; 23, Swellendam; 24, Wilderness; 25, Knysna; 26, Oudebosch; 27, Groot River, E. of Plettenberg Bay; 28, Port Elizabeth; 29, Albany District.

proximal part of the genital atrium and, therefore, figured the atrium too short and the penis too long. It is on this assumption that my identification of the present material with Pollonera's species is mainly based. As the radula I examined differs considerably from Pollonera's description, I must admit that this identification is open to serious doubt. Unfortunately it is no more possible to check its correctness by examination of the type. As long as no specimens have been found agreeing better with Pollonera's species I prefer, therefore, not to give a new name to the form which Forcart was the first to identify as *O. capensis*.

Distribution (see fig. 9). — Albany District (Sturany); Cape of Good Hope (Pollonera); Groot River, E. of Plettenberg Bay (Forcart); Knysna (ZMA); Wilderness (NM, RNHL).

**Oopelta minor** Pollonera

*Oopelta minor* Pollonera, 1909: 12 (Capo di Buona Speranza), 19, pl. fig. 7 (alimentary canal), 8 (distal part of genitalia); Simroth, 1910: 141; Connolly, 1912: 125; Connolly, 1939: 187.

Type material. — The species was described after two specimens belonging to the Zoological Museum of Turin University. As has been explained under the discussion of the type of the previous species, these specimens should be considered lost.

Distribution. — Cape of Good Hope (Pollonera).

**Oopelta spec.**

*Oopelta spec.* - Semper, 1870: 111 (Java, Ceylon, Cap der guten Hoffnung; the localities unreliable as in other material from the Novara Expedition), pl. 16 fig. 29 (genitalia); Heynemann, 1885: 295 (Kap der guten Hoffnung); Collinge, 1900: 7 (*O. granulosa* juv.?, Great Winterhoek); Simroth, 1910: 139 (Kapland bei Simonstown), pl. 21 fig. 15 (lung venation and shell sack).

Material examined. — Tulbagh: 2 specimens in very poor condition (SAM, No. 5475). — Oudebosch, 1919, leg. K. H. Barnard: several specimens in poor condition (SAM, No. A6117). — Fairy Glen Kloof, Worcester, 1500-2000 ft, August 1929, leg. K. H. Barnard: 3 specimens in poor condition (SAM, No. 7582).

Remarks. — Semper's figure of the genitalia of one of the specimens he examined might represent *O. nigropunctata*. Of the three localities mentioned by Semper of course Cape of Good Hope must be the correct one.

The only importance of the references given above seems to be that some of the localities extend the known range of the genus as a whole (see fig. 9).

General remarks on *Oopelta*

Affinities. — The first species described which is now considered to belong to *Oopelta*, *O. nigerrima* (Gray), was originally classed with *Arion*. Ever since the genus *Oopelta* was created most authors approached it to *Arion*, whether they recognized the family Arionidae Gray, 1840, as Cockerell, Collinge, Simroth, Connolly, Thiele, Forcart, and Van Bruggen did, or not, like Binney and P. Fischer. Cockerell (1891: 222) established the Oopeltinae for the genus under discussion, which subfamily was accepted by those authors distinguishing subfamilies in the Arionidae.

Although originally the linking of *Oopelta* with *Arion* must have been based mainly on the, rather unessential, external resemblance, several anatomical characters support or at least do not contradict the view that these two genera, or rather *Oopelta* and the other Arionidae, are related.

This conclusion was already reached by Simroth (1910), who discussed the problem of the affinities of *Oopelta* at length. Unfortunately his paper, and the descriptions of the alimentary canal of *Oopelta* by Collinge and Pollonera, were overlooked by Pilsbry (1948: 665, footnote) who, therefore, thought that too little was known about *Oopelta* to include this genus in his discussion of arionid affinities.

In the following paragraphs I shall compare *Oopelta* with the other arionids, and more particularly with the two Palaearctic genera *Arion* Férussac (Simroth, 1885; Quick, 1960; and own observations) and *Anadenus* Heynemann (Godwin-Austin, 1882; Simroth, 1901). The characters which will be compared can be grouped in four categories.

(1) Characters which *Oopelta* shares with the other arionids. — They are: the kidney surrounding the pericardium; the radula which does not deviate fundamentally from what is found in other genera, and the alimentary canal which, with its four folds, is essentially similar to that of other arionids.

(2) Characters which *Oopelta* shares with either *Arion* or *Anadenus*. — Just as in *Arion* there is no shell, but the shell sack contains small granules which may form concretions. Moreover the first and second folds of the alimentary canal reach farther backward than the third and fourth do, while the contrary is the case in *Anadenus*. Contrary to what obtains in *Arion*, but agreeing with what is found in *Anadenus*, there is no caudal gland in *Oopelta*, a penis is present, the genital orifice lies just behind the tentacles, and (consequently) the retractor muscle of the right ommatophore crosses the distal genitalia by passing between the penis and the free oviduct.

(3) Characters which can be easily derived from those of *Arion* and/or *Anadenus*. — (a) The pedal gland reaches to almost the caudal end of the foot-sole in *Arion*, to about half the length of the animal in *Anadenus*, and to about  $\frac{2}{5}$  of the length of the pedal sole in *Oopelta*. (b) As compared with other arionids the tentacular retractor muscles of *Oopelta* are shorter and their posterior insertions have a latero-ventral position. When *Arion* is compared with other arionids it appears that its tentacular retractor muscles are somewhat shorter and that their posterior insertions have shifted sideward to gain a laterodorsal position. So the same trend is pursued farther in *Oopelta* than in *Arion*. (c) In *Oopelta* the first fold of the alimentary canal is clearly divided into a crop in front of and a stomach behind the entering of the ducts of the digestive gland. Such is not the case in *Anadenus*, but also seems a further step in the direction which is evolving in *Arion*. In "*Arion empiricorum*" [= *A. ater rufus* (L.)] such a division is hardly visible (Simroth, 1885, pl. 11 fig. 1), but nevertheless Simroth (1885: 232) distinguishes the two parts of the first fold and says that it could be a

question at issue which of the two is to be considered the stomach. In *Arion circumscriptus*, however, the separation is obvious (Pilsbry, 1948: fig. 364E) and the situation is virtually the same as in *Oopelta*.

(4) Characters by which *Oopelta* differs from all other arionids. — Unlike what is found in any other arionid a long and posteriorly unpaired buccal retractor muscle is lacking in *Oopelta*. Its function has apparently been taken over by short paired retractor muscles. I agree with Simroth that these probably are new formations, but I think that at least some of the buccal protractor muscles are homologous to those found in *Arion*. The long cerebral commissure is another feature distinguishing *Oopelta* from at least *Arion* and *Anadenus*. The oxygnathous jaw of *Oopelta* is a unique feature in the Arionidae. It probably induced Heynemann to compare *Oopelta* primarily with *Limax*, and made Melvill & Ponsonby class *Oopelta* in the Zonitidae.

The genital organs of *Oopelta* show such diversity that it is difficult to compare them for the genus as a whole with other arionids. The presence of a penis seems to be the only feature which can be used in one of the categories distinguished above. A genital atrium is hardly developed except in *O. capensis*, but in that species it is very different from that organ as found in *Arion*. In *O. capensis* the atrium has a thick muscular wall and a very narrow lumen, whereas the contrary is the case in *Arion*.

Simroth's discussion of the homologies of the distal genitalia of *Oopelta polypunctata*, and his derivation of them from the diallic condition in the Basommatophora is interesting, but highly speculative. Especially I doubt whether a stimulator sack or dart sack is a primitive character of the Stylommatophora, which seems to be a postulate of Simroth's reasoning. As the general structure of the genitalia of *Oopelta flavescens* and *O. granulosa* is nearer to that of these organs in *Anadenus*, it seems likely to me that it has changed less from the primitive condition in *Oopelta* than the more complicated genital organs of *O. polypunctata* and *O. capensis* did. Consequently I prefer to consider the stimulator sack of *O. polypunctata* and the large genital atrium of *O. capensis* as secondary additions which have developed convergently with such parts of the reproductive system in some other groups of Stylommatophora.

Anyhow, the great diversity of structure of the distal genitalia in *Oopelta*, which genus according to other characters certainly is a homogeneous group, points to its great antiquity and long isolation. These also appear from its distribution as to be dealt with in the next section. Affinity to the other Arionidae seems very probably and, therefore, I think that the Oopeltinae should be maintained as a subfamily of the Arionidae.

I agree, however, with Simroth when he states that the Oopeltinae might just as well be given family rank. As such a family on present evidence should be placed next to the Arionidae in the system, I see no reason for changing the status of the group. However, it should be borne in mind that the differences mentioned under (4) between Oopeltinae and other subfamilies, viz., the absence of a long and posteriorly unpaired buccal retractor muscle, the long cerebral commissure, and the oxygnathous jaw, are rather essential. Therefore, it seems likely that at least part of the similarities enumerated sub (1) and (2) are due to parallel or convergent evolution.

Distribution. — Except the type locality of *Oopelta nigropunctata*, viz., Gold Coast near Accra, all the localities in which specimens of *Oopelta* were found are in the Cape Province, South Africa. As *Oopelta* has never again been found on the Guinea Coast and the distributional area in South Africa practically coincides with that of a number of so-called palaeogenic elements in the South African fauna (cf. Stuckenberg, 1962: fig. 7), I am convinced that *Oopelta* does not belong to the autochthonous fauna of the Gold Coast. Anyhow, if this were the case, one would not expect the genus to be represented by a South African species in so remote a region. So either the specimens described by Mörch had been introduced with South African products, or the label was wrongly placed with the sample.

The distribution of the species of *Oopelta* is shown in figure 9. As a whole the genus occurs in a broad belt along the coast from Nieuwoudtville in the NW to the Albany District in the NE. In the central area four species occur of which *O. granulosa* extends farthest to the NW, while *O. polypunctata* has spread as far east as the Albany District. *O. capensis* seems to be confined to the eastern part of the distributional area of the genus, as it has not been found west of Wilderness. The restriction of the genus to an area characterized by several so-called palaeogenic elements belonging to diverse groups of animals (Stuckenberg, 1962) testifies to its antiquity.

#### Milacidae

##### **Milax gagates** (Draparnaud, 1801)

*Milax gagates* - Connolly, 1939: 180 (with references to older literature on occurrence in South Africa); Quick, 1960: 149, fig. 8A (genitalia), 8E (spermatophore), 8K (shell), 9A (radula), map 12, pl. 1 fig. 12 (animal); Van Bruggen, 1964b: 162 (occurring in South Africa since 1873, or even before 1848).

Material examined. — Cape Province: Amalienstein, 12 miles east of Ladismith, January 5, 1951, leg. P. Brinck and G. Rudebeck (Swedish S. Afr. Exp. 1950-1951, loc. 117): 3 specimens (LUM); Cape Peninsula, Table Mountain, Blinkwater Ravine, dense bush alongside fast running stream,

1000-2000 ft., July 5, 1951, leg. P. Brinck and G. Rudebeck (Swedish S. Afr. Exp. 1950-1951, loc. 351): ? 1 specimen juv. (LUM); East London, June 1964, leg. W. H. Archer: 5 specimens (NM).

This mediterranean species has been introduced into several parts of the world. Quick (1960: 155) pointed out that the occurrence of *M. gagates* in South Africa has not been proved, because it has for a long time not been distinguished from the closely related *M. insularis* (Lesson & Pollonera). The adult specimens I examined, however, certainly belong to *M. gagates*, and therefore it seems probable that the earlier records are correct.

It seems likely that *Milax capensis* (Krauss) is a synonym and even *M. ponsonbyi* (Collinge) might have been based on an abnormal specimen of *M. gagates*. No additional evidence of endemic species of *Milax* occurring in South Africa has been advanced since these two species were described, and the curious narrow distal part of the epiphallus (or proximal part of the penis?) in *M. ponsonbyi* rather seems an aberrant than a specific character. For references to these two nominative species see Connolly (1939: 181).

#### Limacidae

##### **Limax (Limacus) flavus** Linnaeus, 1758

*Limax flavus* - Connolly, 1939: 176 (with references to older literature on occurrence in South Africa); Quick, 1960: 184, fig. 14 (anatomy), map 20, pl. 2 fig. 22 (animal); Forcart 1963: 107 (Pretoria, in garden); Van Bruggen, 1964b: 162 (occurring in South Africa from before 1900).

Material examined. — Cape Province: Amalienstein, 12 miles east of Ladismith, January 5, 1951, leg. P. Brinck and G. Rudebeck (Swedish S. Afr. Exp. 1950-1951, loc. 117): 3 specimens (LUM). — Natal: Pietermaritzburg, Cordwalles School Grounds, January 8, 1963, leg. D. Brooks: 1 specimen (NM). — Transvaal: Pretoria, Hatfield, in garden, December 19, 1963, leg. H. K. Munro: 1 specimen (NM).

This is another mediterranean species which has been introduced into several other regions with a subtropical climate. Parasitic nematodes were found in the haemocoel of the animal from Pietermaritzburg.

##### **Limax (Limacus) nyctelius** Bourguignat, 1861

*Limax nyctelius* - Connolly, 1939: 176 (first records from South Africa); Quick, 1960: 200, fig. 17B, 17C (genitalia), 17E (radula); Forcart, 1963: 107 (Orange Free State, Bloemfontein; Natal, Zululand, Hluhluwe Game Reserve); Grossu & Lupu, 1963: 141 (in the hills and mountains of the Banat and Oltenia, Rumania, up to 1400 m); Van Bruggen, 1964b: 162 (occurring in South Africa since before 1939); Grossu & Lupu, 1965: 137 (Godetsch near Sofia, Bulgaria).

*Agriolimax kervillei* Germain, 1907: 154 (région d'Ain-Draham, Tunisie); Germain, 1908: 139, pl. 22 fig. 1-6 (animal), 7 (genitalia).

Material examined. — Natal: Pietermaritzbürg, garden of Natal Museum, February 15, 1960, January 8, 1963, August 24, 1964, September 11, 1964, under pot plants May 5, 1965, leg. A. C. van Bruggen: 6, 15, 7, 8, and 7 specimens (NM).

Bourguignat described this species after specimens from the neighbourhood of Algiers. His description relates to external characters and the form of the rudimental shell only. When identifying these South African animals with Bourguignat's species I followed the interpretation of the latter of Hugh Watson (in Connolly, 1939), which was accepted by Quick, Forcart, and Van Bruggen. Simroth (1885: 212, pl. 8 fig. 14, 15), however, appears to indicate another Algerian species by this name. He placed *L. nyctelius* in the section of *Limax* characterized by an alimental canal of six folds without a coecum, and his figure of the genitalia shows a short and not tortuous penis. Therefore he placed *L. nyctelius* near *L. tenellus* Müller, and Pollonera (1887: [3]) classed it in the subgenus *Malacolimax* Malm. By the long intestinal coecum and the morphology of the genitalia *L. nyctelius* as interpreted by Watson appears rather to be related to *L. flavus* L. and should, therefore, be placed in the subgenus *Limacus* Lehmann.

Though I prefer to follow Watson's views for the moment, I must admit that one day a thorough study of the Algerian land slugs may force us to abandon his interpretation of *L. nyctelius*. In that case the name *Limax kervillei* (Germain) would be available for the species under discussion. The reproductive organs figured by Germain do not belong to a juvenile specimen as that author thinks, because the glandular tissue of the spermoviduct is well developed. On the contrary, these organs appear to belong to an adult animal fixed suddenly, probably in alcohol of strong concentration. Consequently the penis is strongly contracted and folded back, which makes that the vas deferens seems to enter it near the middle. Unfortunately three syntypes of Germain's species, which I could study owing to the kindness of my colleague, professor E. Fischer-Piette of the Muséum National d'Histoire Naturelle at Paris, are not well enough preserved to allow of a verification of the essential anatomical characters.

In the collection of the Natur-Museum Senckenberg at Frankfurt am Main I found a large sample from eastern Algeria (Kobelt leg., SMF 165078) of which a dissected adult specimen shows the characters described and figured by Quick for *L. nyctelius*. That author examined specimens from Algeria, Egypt, Washington, D. C., and Royal Botanic Gardens, Edinburgh; "*Agriolimax kervillei*" is based on animals from Tunisia, and

recently Grossu & Lupu (1963, 1965) recorded the present species from Rumania and Bulgaria. It appears to be autochthonous in North Afrika and the Balkans, whereas it must have been introduced into the United States, Scotland and South Africa.

In alcohol specimens of this species have the mantle and back of a lighter colour than those of the next species. In young individuals the longitudinal bands on the mantle and back are more pronounced than in the adults. To distinguish these two species with certainty examination of the anatomy is necessary. For this purpose very careful dissection of young specimens is required, but even here the form of the still rudimental penis allows of a reliable identification.

### ***Limax (Lehmannia) valentianus* Férussac, 1823**

*Limax poirieri* - Quick, 1960: 197, fig. 17A (genitalia), 17D (radula), pl. 1 fig. 14 (animal).

*Limax valentianus* - Waldén, 1961: passim, fig. 1-7 (genitalia), 9-17 (radula), 19 (distribution), pl. 1 fig. 20-29 (animal); van Bruggen, 1964b: 162 (occurring in South Africa since 1961).

Material examined. — Cape Province: Port Elizabeth, near Fort Frederic, March 29, 1961, leg. J. S. Taylor: 1 specimen (NM); George, November 1963, leg. J. S. Taylor: 1 specimen (NM); East London, May 1964, leg. W. H. Archer: 1 specimen (NM); Cape Town, indigenous forest above Kirstenbosch National Botanic Gardens, 1000 ft., September 17, 1965, leg. A. C. and W. H. van Bruggen: 2 specimens (NM). — Natal: Pietermaritzburg, garden of Natal Museum, February 15, 1962 and March 24, 1964, leg. A. C. van Bruggen: 6 and 2 specimens (NM); Pietermaritzburg, Scottsville garden, November and December 2, 1964, leg. J. A. Pringle: 1 and 1 specimen (NM). — Transvaal: Kruger National Park, Skukuza, under stones, November 3, 1962, leg. Biologist K. N. P.: 1 specimen (NM).

Waldén ably described the specific characters and the geographical distribution of this species, of which he published the first record from South Africa. It is also a mediterranean species (autochthonous at least in Spain), which has been introduced into several other countries. Since Waldén published his paper it has also been found in the Netherlands (den Hartog & Sandee, 1962), and recently I could collect it in Menton, Alpes Maritimes, France.

As pointed out in the discussion of the previous species dissection is needed to separate it from *L. nyctelius*.

**Deroceras reticulatum** (Müller, 1774)

*Agriolimax reticulatus* - Connolly, 1939: 178 (with references to older literature on occurrence in South Africa); Quick, 1960: 164, fig. 10A (situs viscerum), 10F (rudimentary, shell), 11C (genitalia), 11G, 11H (retractor muscles), 11L, 11 O (radula), map 15, pl. 2 fig. 15 (animal).

*Deroceras reticulatus* [sic] - Van Bruggen, 1964b: 162 (occurring in South Africa since before 1898).

Material examined. — Cape Province: Knysna, December 18, 1938, leg. L. D. Brongersma: 3 specimens (RNHL); Cape Town, garden South African Museum, May 5, 1965, leg. A. C. van Bruggen: 3 specimens (NM); Cape Town, indigenous forest above Kirstenbosch National Botanic Gardens, 1000 ft., September 17, 1965, leg. A. C. and W. H. van Bruggen: 3 specimens (NM). — Natal: farm Redlands near Harding, under logs in grassland, February 1963, leg. O. Bourquin: 3 specimens (NM).

*D. reticulatum* is a Palaearctic species introduced into many other parts of the world. For a long time it has not been distinguished from another European species, *D. agreste* (L.). There can be little doubt that the older records of "*Agriolimax agrestis* L." in South Africa refer to the present species.

**Deroceras caruanae** (Pollonera, 1891)

*Agriolimax (Hydroilimax) laevis* [non] Müller, variété grise - Abeloos, 1945: 136 (near Poitiers).

*Agriolimax caruanae* - Quick, 1960, 175, fig. 10C (situs viscerum), 10E (retractor muscles and pallial organs), 10K (mating pair), 12A-N (anatomy), map 18, pl. 2 fig. 17 (animal).

*Deroceras (Malino) panormitanus* [non] (Lessona & Pollonera) - Forcart, 1960: 126 (Italy, province of Aquila, between Anversa and Villalago,  $\pm$  800 m), 136 (p.p., cf. Forcart, 1965: 112).

*Deroceras caruanae* - Waldén, 1960: 30, fig. 9 (radula), pl. 1 fig. 11, 12 (animal), 13-15 (anatomy); Altena, 1962: 48; Van Bruggen, 1964b: 162 (occurring in South Africa since 1963); Forcart, 1965: 112 (Italy, province of Catanzaro: Sila Piccola near Villaggio Mancuso, 1300 m, and Nicotera).

*Deroceras meridionale* Reygrobellet, 1963: 399 (diverses localités du Var, des Bouches du Rhône et des Basses-Alpes), 400 right fig. (genitalia).

Material examined. — Cape Province: George, in cabbage, July 20, 1963, leg. Mrs. E. Taylor: 1 specimen (NM); George District, September 1963, leg. B. L. Cairncross: 11 specimens (NM); Wilderness, September 1963, leg. J. S. Taylor: 2 specimens (NM); George, in cabbages, January 1964, leg. J. S. Taylor: 6 specimens (NM); Cape Town, indigenous forest above Kirstenbosch National Botanic Gardens, 1000 ft., September 17, 1965, leg. A. C. and W. H. van Bruggen: 7 specimens (NM).

*Deroceras caruanae* is a species from southwestern Europe which has been introduced into California and the Canary Islands. It seems unlikely that it is

autochthonous in its whole present distributional area in Europe. For instance, the Swedish localities mentioned by Waldén, which unfortunately I overlooked when discussing the distribution of the species in 1962, are probably inhabited by introduced populations.

The description of "*Agriolimax laevis*, variété grise" by Abeloos perfectly agrees with the present species and I consider *D. meridionale* Reygrobellet another synonym, notwithstanding the differences which the author points out in the note added to her paper (Reygrobellet, 1963: 402). The radular formula of her species appears to agree with those given by Waldén for Swedish specimens of *D. caruanae* (cf. Waldén, 1960: 34) and the colour is of little importance in distinguishing species of this genus. The name *Deroceras meridionale* is preoccupied by *Agriolimax meridionalis* Doering, 1874 (see: International Code of Zoological Nomenclature: 57, article 59b).

The largest known animals from South Africa attain a length of 23 mm in alcohol. *D. reticulatum* can reach larger dimensions, but it is impossible to distinguish spirit specimens of the two species with certainty without dissection. Both have a creamy white ground colour with dark cloudy spots on the mantle and back. In some spirit specimens of *D. caruanae* the subcutaneous connective tissue is black, which is visible through the transparent skin. I saw the same in living *D. caruanae* recently collected in La Mortola Inferiore, Liguria, Italy, and this character certainly induced Abeloos to consider this form as a grey variety of *D. laeve*. It seems possible that the animals recorded as "*Agriolimax laevis* (Müll.) var. *grisea* Taylor" by Connolly (1939: 179), of which the identification had not been based on anatomical characters, belong to the present species.

### ***Deroceras laeve* (Müller, 1774)**

*Agriolimax laevis* - Connolly, 1939: 179 (with references to older literature on occurrence in South Africa); Quick, 1960: 172, fig. 10D (situs viscerum), 10I (rudimental shell), 11A, 11B, 11E (genitalia), 11F (retractor muscles), 11N (radula), map 17, pl. 2 fig. 19 (animal).

*Deroceras laeve* - Forcart, 1963: 106 (Natal, Natal National Park; Pietermaritzburg, Scottburgh).

*Deroceras laevis* [sic] - Van Bruggen, 1964b: 162 (occurring in South Africa since before 1898).

Material examined. — Cape Province: Knysna, main forest, January 1911, leg. ? : 1 specimen (aph., NM); Jonkershoek, September 9, 1938, leg. L. D. Brongersma: 2 specimens (1 aph., 1 euph., RNHL); Cape Town, Botanic Gardens, in greenhouse, September 18, 1965, leg. A. C. and W. H. van Bruggen: 1 specimen (aph., NM). — Natal: National Park, 1938, leg. L. D. Brongersma: 9 specimens (1 aph., RNHL); Umhlali Beach, Chaka's Rock,

coastal bush, October 1954, leg. A. D. J. Meeuse: 2 specimens (1 euph., NM); Pietermaritzburg market, in lettuce, October 20, 1962, leg. Mrs. W. H. van Bruggen: 1 specimen (aph., NM); Pietermaritzburg, in flowers of York Avenue garden, November 7, 1964, leg. Mrs. W. H. van Bruggen: 1 specimen (euph., NM); Pietermaritzburg, December 1964, leg. Mrs. W. H. van Bruggen: 1 specimen (aph., NM); farm Redlands near Harding, under logs in grassland, February 1963, leg. O. Bourquin: 1 specimen (aph., NM). — Swaziland: Mhabane, November 1964, leg. R. F. Lawrence: 2 specimens (aph., NM). — Transvaal: Kruger National Park, Skukuza, under stones, November 3, 1962, leg. Biologist K. N. P.: 7 specimens (1 aph., NM).

At present this species is almost cosmopolitan and it is very difficult to know if it is autochthonous or not in a given locality. Its original area of distribution seems to include at least the Holarctic region and probably also the chain of mountains of Central America and the Andes. In South Africa it is probably an introduced species.

As to the reproductive organs *D. laeve* is dimorphous; euphallic specimens have the penis normally developed, while this organ is wanting or rudimentary in aphyallic animals. I dissected at least one specimen of each sample examined and it is indicated by the abbreviation euph. or aph. to which form the dissected animals belong.

In alcohol the animals are mostly of a darker colour than those of the two preceding species, viz., brown or nearly black. In the lighter coloured specimens the dark pigment is always more evenly dispersed over the mantle than in *D. reticulatum* and *D. caruanae*.

## Abbreviations used in the figures

ag: genital atrium	pd: pedal ganglion
ao: aorta	pg: pedal gland
bg: buccal ganglion	pl: pleural ganglion
bm: buccal mass	pr: penial retractor muscle
c: central tooth	pt: prostate
cg: cerebral ganglion	r: rectum
cr: crop	rd: receptaculum duct
cs: common stalk of penis and stimulator sack	rlo: retractor muscle of left ommatophore
dg: digestive gland	rlt: same of left small tentacle
dh: hermaphrodite duct	ro: right ommatophore
e?: epiphallus?	rro: retractor muscle of right ommatophore
ga: albumen gland	rrt: same of right small tentacle
go: genital orifice	rs: receptaculum seminis
gs: salivary gland	rt: right small tentacle
k: kidney	s: sole
lo: left ommatophore	sp: spermooviduct
lt: left small tentacle	ss: stimulator sack
m: mantle	st: stomach
oe: oesophagus	ta: terminal appendix
ot: ovotestis	v: ventricle
ov: oviduct	vd: vas deferens
p: penis	vs: visceral ganglion
pa: papilla	
pc: pericardium	

## REFERENCES

- ABELOOS, M., 1945. Sur les formes néoténiques et microphalliques d'*Agriolimax* (*Hydrolimax*) *laevis* Müller. — *Bull. Soc. Zool. France* **70**: 135-139.
- ALTENA, C. O. VAN REGTEREN, 1962. Notes sur les limaces, 6. A propos des limaces de l'île de Malte. — *Basteria* **26**: 47-53, 57, 1 fig.
- BINNEY, W. G., 1879. Note on the genera of slugs. Appendix to: On the jaws and lingual dentition of certain terrestrial mollusks. — *Bull. Mus. Comp. Zool. Harvard Coll.* **5**: 357-368.
- BRUGGEN, A. C. VAN, 1964a. South African slugs. — *African Wild Life* **18**: 49-54, fig. 1-11, pl. 1-2.
- , 1964b. The distribution of introduced mollusc species in Southern Africa. — *Beaufortia* **11**: 161-169, 3 fig.
- COCKERELL, T. D. A., 1890. Notes on slugs, chiefly in the collection at the British Museum. — *Ann. Mag. Nat. Hist.* (6) **6**: 380-390.
- , 1891. On the geographical distribution of slugs. — *Proc. Zool. Soc. London* **1891**: 214-226.
- , 1893. A check-list of the slugs. — *Conchologist* **2**: 168-176, 185-228.
- COLLINGS, W. E., 1900. On a collection of slugs from South Africa, with descriptions of some new species. — *Ann. S. Afr. Mus.* **2**: 1-8, pl. 1, 2.
- , 1901. On a further collection of South African slugs, with a check-list of known species. — *Ann. S. Afr. Mus.* **2**: 229-236, pl. 14.
- CONNOLLY, M., 1912. Revised reference list of South African non-marine Mollusca; with descriptions of new species in the South African Museum. — *Ann. S. Afr. Mus.* **11**: 59-306, pl. 2.
- , 1939. A monographic survey of South African non-marine Mollusca. — *Ann. S. Afr. Mus.* **33**: 1-660, fig. 1-58, pl. 1-19.
- FISCHER, P., 1880-1887. *Manuel de conchyliologie et de paléontologie conchyliologique*: i-xxiv, 1-1369, fig. 1-1138, frontisp., pl. 1-23, map.
- FORCART, L., 1960. Mollusken aus den Abruzzen mit taxonomischen Revisionen und anatomischen Beschreibungen. — *Verh. naturf. Ges. Basel* **71**: 125-139, fig. 1-12.
- , 1963. Slugs of South Africa. — *Proc. Mal. Soc. London* **35**: 103-110, pl. 11-12.
- , 1965. Rezenten Land- und Süßwassermollusken der süditalienischen Landschaften Apulien, Basilicata und Calabrien. — *Verh. naturf. Ges. Basel* **78**: 59-184, fig. 1-5, maps 1-4.
- GERMAIN, L., 1907. Liste des mollusques recueillis par M. H. Gadeau de Kerville, pendant son voyage en Khroumirie. — *Bull. Mus. Nat. Hist. Nat.* **13**: 154-158.
- , 1908. Étude sur les mollusques recueillis par M. Henri Gadeau de Kerville pendant son voyage en Khroumirie (Tunisie). In: H. GADEAU DE KERVILLE, *Voyage zoologique en Khroumirie (Tunisie)*: 129-298, pl. 22-30.
- GODWIN-AUSTIN, H. H., 1882. Land and freshwater Mollusca of India **1** (2): 19-65, pl. 5-12.
- GRAY, J. E., 1855. Catalogue of the Pulmonata or air-breathing Mollusca in the collection of the British Museum **1**: 1-192, fig. 1-5.
- GROSSU, A. V. & D. LUPU, 1963. *Limax nyctelius* en Roumanie. — *Arch. Moll.* **92**: 141-143, 2 fig.
- , 1965. Neue Beiträge zur Kenntnis der Verbreitung des *Limax nyctelius* in Europa (Gastropoda, Limacidae). — *Malak. Abh. Staatl. Mus. Tierk. Dresden* **2**: 135-138, 1 fig.
- HARTOG, C. DEN & A. J. J. SANDEE, 1962. *Milax gagates* en *Limax valentianus*, twee zeldzame naakte landslakken in Yerseke. — *Basteria* **26**: 83-85.

- HEYNEMANN, D. F., 1885. Die nackten Landpulmonaten des Erdbodens. — Jahrb. D. Malakoz. Ges. **12**: 236-330.
- , 1906. Die geographische Verbreitung der Nacktschnecken. — Abh. Senckenb. Naturf. Ges. **30**: 1-92, 9 fig., pl. 1, 2.
- HEYNEMANN, F. D., 1867. Oopelta Mörch. Neue Nacktschneckengattung. — Malakozool. Bl. **14**: 190-193, pl. 2 fig. 1, 2.
- MELVILL, J. C. & J. H. PONSONBY, 1898. A contribution towards a check-list of the non-marine molluscan fauna of South Africa. — Proc. Mal. Soc. London **3**: 166-184.
- PILSBRY, H. A., 1948. Land Mollusca of North America (north of Mexico) **2** (2): i-xlvi, 521-1113, fig. 282-585.
- POLLONERA, C., 1887. Intorno ad alcuni Limacidi europei poco noti. — Boll. Mus. Zool. Anat. Comp. Torino **2**: (24): (1-4), pl. 1.
- , 1909. Sul genere Oopelta. — Boll. Mus. Zool. Anat. Comp. Torino **24** (607): 10-13, 19, pl. fig. 1-8.
- QUICK, H. E., 1960. British slugs (Pulmonata; Testacellidae, Arionidae, Limacidae). — Bull. British Mus. Nat. Hist., Zoology **6**: 105-226, fig. 1-19, maps 1-23, pl. 1, 2.
- REYGRABELLET, D., 1963. Une nouvelle espèce de Limacidé, *Deroceras meridionale* n. sp. — Bull. Soc. Zool. France **88**: 399-402, 1 fig.
- SEMPER, C., 1870. Landmollusken. Reisen Arch. Philipp. C. Semper (2) **3**: i-iv, 1-337, pl. 1-27.
- SIMROTH, H., 1885. Versuch einer Naturgeschichte der deutschen Nacktschnecken und ihrer europäischen Verwandten. — Zeitschr. Wiss. Zool. **42**: 203-366, pl. 7-11.
- , 1901. Die Nacktschneckenfauna des russischen Reiches: i-xii, 1-321, fig. 1-17, pl. 1-26, maps 1-10.
- , 1902. Ueber Philomyciden und Arioniden. — Sitz.-ber. Naturf. Ges. Leipzig **28/29**: 32-45.
- , 1907. Die Aufklärung der südafrikanischen Nacktschneckenfauna, auf Grund des von Herrn Dr. L. Schultze mitgebrachten Materials. — Zool. Anz. **31**: 792-799, 1 fig.
- , 1910. Die Landschnecken der deutschen Südpolar-Expedition 1901-1903. — Deutsch. Südpol.-Exp. **12** (= Zool. **4**): 137-180, fig. 1-4, pl. 21.
- SIMROTH, H. & H. HOFFMANN, (1908-) 1928. Pulmonata. In: H. G. BRONN, Klassen und Ordnungen des Tierreichs **3** (2): i-xvi, 1-1354, fig. 1-561, pl. 1-44.
- STUCKENBERG, B. R., 1962. The distribution of the montane palaeogenic element in the South African invertebrate fauna. — Ann. Cape Prov. Mus. **2**: 190-205, fig. 1-7.
- STURANY, R., 1898. Catalog der bisher bekannt gewordenen südafrikanischen Land- und Süßwasser-Mollusken. — Denkschr. K. Ak. Wissensch. Wien (Mathem.-Naturw.) **67**: 537-642, pl. 1-3.
- THIELE, J., 1931. Handbuch der systematischen Weichtierkunde. **1** (2): 377-778, fig. 471-783.
- , 1935. Handbuch der systematischen Weichtierkunde **2** (2): 1023-1154, fig. 894-897.
- WALDÉN, H. W., 1960. Om ett par för Sverige nya, anthropochora landmollusker, *Limax valentianus* Férussac och *Deroceras caruanae* (Pollonera), jämte några andra, kulturbundna arter. — Göteborgs K. Vetensk. Vitterhets-Samh. Handl. (6B) **8** (8): 1-48, fig. 1-18.
- , 1961. On the variation, nomenclature, distribution and taxonomical position of *Limax* (*Lehmannia*) *valentianus* Férussac (Gastropoda, Pulmonata). — Ark. Zool. (2) **15**: 71-95, fig. 1-19, pl. 1.

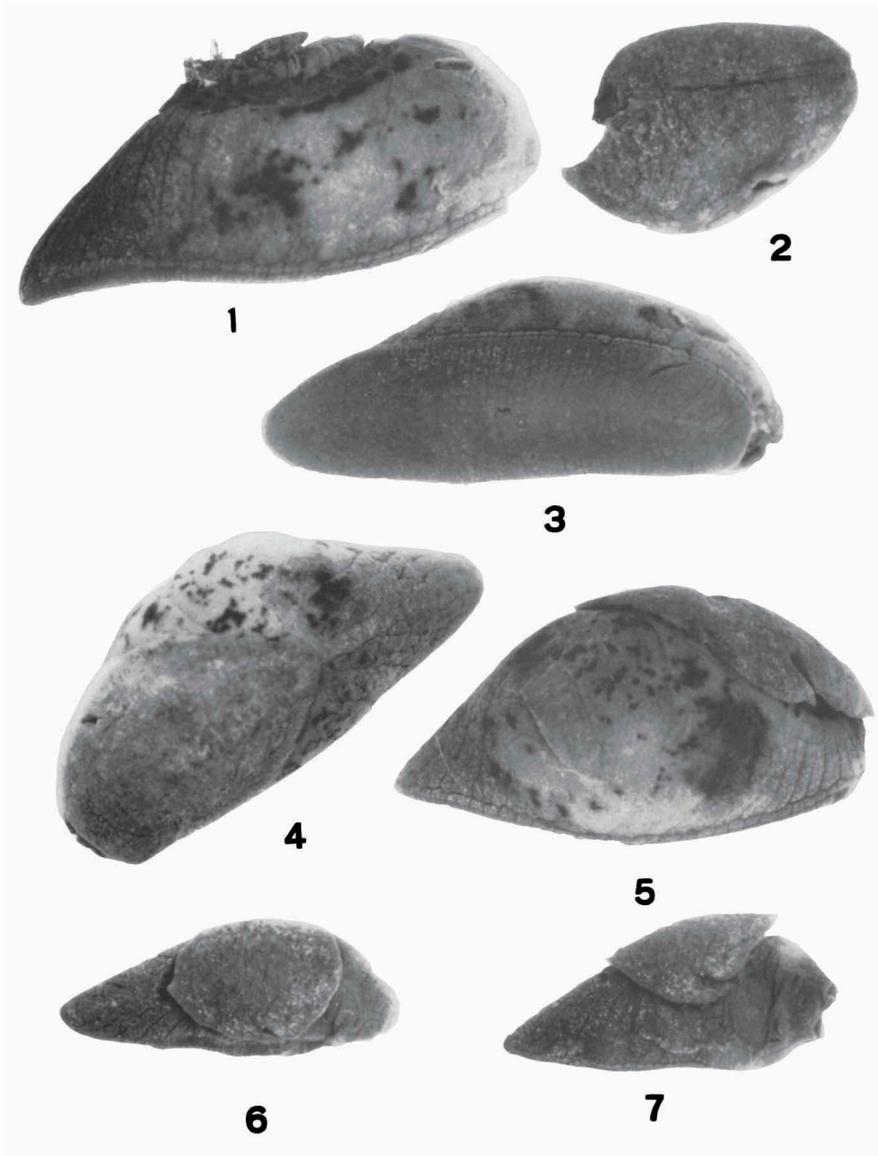


Fig. 1-7. *Oopelta nigropunctata* Mörch. 1, holotype, side view; 2, mantle of the same; 3, footsole of the same; 4, largest paratype from above; 5, side view of the same; 6, smallest paratype from above; 7, side view of the same. All slightly more than 3 X.  
H. F. Roman phot.



Fig. 1, 2. *Oopelta capensis* Pollonera, 1, living animal from below, with contractile waves passing over footsole; 2, side view of the same. Laura Kelsall phot., courtesy Natal Museum.