

# Revisionary notes on *Negulus* O. Boettger, 1889, a genus of minute African land snails (Gastropoda Pulmonata: Vertiginidae)

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Key words: Gastropoda; Pulmonata; Vertiginidae; *Negulus*; Africa; St. Helena Is.; taxonomy.

The genus *Negulus* is reviewed; only four Recent species, restricted to continental Africa, are recognized. The genus is extinct in Europe, being only recorded from Tertiary deposits. A key to the shells of the Recent species (all figured) is supplied. The anatomy is as yet unknown. A sinistral shell of *N. abyssinicus* is described from among a series of paralectotypes in the Leiden Museum, the first such abnormality in the genus (figured). A fair amount of shell material has become available (among which some historical specimens) so that metric data may be compared with greater confidence. Recent occurrence is established/confirmed for Eritrea, Ethiopia, Sudan, Kenya, Tanzania, Zaïre, Zambia, Malaŵi, and Bioko (Fernando Poo). The small size of the shell necessitates sampling forest leaf litter, a technique that has not been widely applied in Africa; undoubtedly the genus occurs much more widely in the Afrotropical Region. *Pupa obliquicostulata* from St. Helena Is. is removed from the genus because of the presence of apertural dentition.

## Introduction

The discovery of specimens of the land snail genus *Negulus* in Malaŵi (Van Bruggen, 1993: 101) and of some notes by the late Dr William Adam accompanied by relevant material in the Brussels Museum, prompted this concise review of available data on this genus of minute land snails in Africa.

For museum collections the following abbreviations have been used: BM for The Natural History Museum [formerly British Museum (Natural History)] in London; IRSNB for Institut Royal des Sciences Naturelles de Belgique in Brussels; MRAC for Musée Royal de l'Afrique Centrale, Tervuren, Belgium; NMWC for National Museum of Wales, Cardiff, Wales, U.K.; RMNH for National Museum of Natural History (formerly Rijksmuseum van Natuurlijke Historie), Leiden; SMF for Forschungsinstitut/Naturmuseum Senckenberg, Frankfurt am Main; ZMB for Zoologisches Museum der Humboldt-Universität, Berlin. HMM stands for Ms Hazel M. Meredith leg. The abbreviation l/d represents the ratio length/major diameter of shells as an indication of the shape; l/d values have been calculated from micrometer readings and may therefore differ slightly from those calculated from the dimensions in mm.

Assistance by museum staff is gratefully acknowledged: Dr J.L. van Goethem (IRSNB), Dr R. Janssen (SMF), Dr P.B. Mordan and Mr F. Naggs (BM), and Mr F. Puy-laert (MRAC). Figs. 1-3 have been copied from Adam (1957: 2, figs. 1-3) with the permission of Dr van Goethem; these drawings represent the professional hand of Mrs J.

van Meldereren-Sergysels. Figs. 4-5 were drawn by H. Heijn, formerly staff artist of Leiden University. Dr P. Tattersfield (Stockport, U.K.) has kindly contributed some valuable material, ultimately to be deposited in the Cardiff Museum (NMWC). The manuscript has been criticized and improved by Ms H.M. Meredith (Newquay, U.K., formerly Zomba, Malaŵi) and by Dr and Mrs G.F. Mees (Busselton, W.Australia, formerly Leiden); the former has also contributed most of the Malaŵi material. Ongoing research on the terrestrial molluscs of Malaŵi has been subsidized by the Koninklijke Nederlandse Akademie van Wetenschappen (Amsterdam), W.O.T.R.O.-N.W.O. (Netherlands Foundation for the Advancement of Tropical Research, The Hague), and the Van Tienhoven Stichting tot Internationale Natuurbescherming (Amsterdam).

### Vertiginidae

#### *Negulus* O. Boettger, 1889<sup>1</sup>

*Negulus* O. Boettger, 1889: 268; Pilsbry, 1921: 101; Pilsbry, 1926: 231; Pilsbry, 1934: 148, 150; Thiele, 1931: 504; Adam, 1953: 730; Zilch, 1959: 145; Parkinson, Hemmen & Groh, 1987: 67; Abbott, 1989: 213; Vaught, 1989: 80; Esu, Girotti & Kotsakis, 1993: 105.

Type species by original designation: *Pupa reinhardtii* Jickeli, 1874.

The original diagnosis of *Negulus*, published in a journal not easily available in many libraries (Boettger, 1889: 268), reads verbatim: "T. perforata aut oblonga, peculiariter striata vel costulata; apex obtusus. Anfr.  $4\frac{1}{2}$ - $5\frac{1}{2}$  convexi, suturis profundis disjuncti, ultimus  $\frac{2}{5}$ - $\frac{1}{3}$  altitudinis aequans. Apert. sat magna oblonga, altior quam latior, edentula; perist. incrassatum, leviter expansum, marginibus conniventibus, columellari subconcano." This is translated by Pilsbry (1921: 101) as follows: "Shell perforate, either cylindrical or oblong, peculiarly striate or costulate; [very small: 2 to 2.5 mm. long]; apex obtuse. Whorls  $4\frac{1}{2}$  to  $5\frac{1}{2}$ , convex, parted by a deep suture, the last  $\frac{2}{5}$  to  $\frac{1}{3}$  the length. Aperture rather large, oblong, higher than wide, toothless; peristome a little thickened, slightly expanded, the margins converging, columellar margin somewhat concave." Zilch's important manual (1959: 146) describes the genus as "Gehäuse eizylindrisch; Apex stumpf; 4-6 stark gewölbte Umgänge, durch tiefe Naht getrennt, mit axialen Rippenstreifen; durchbohrt offen oder geritzt genabelt; Mündung ziemlich weit, eiförmig; Mundränder nicht verbunden, etwas erweitert und schwach verdickt; ungezähnt." This may be translated as "Shell ovate-cylindrical; apex obtuse; 4-6 noticeably convex whorls, separated by a deeply incised suture, with axial costulation; umbilicus open and deep or rimate; aperture comparatively wide, ovate; inner and outer lips not connected, slightly expanded and weakly incrassate; toothless." Apart from the edentate aperture and other characters, the limited number of whorls is also diagnostic for the genus.

<sup>1</sup>Boettger in his original description does not dwell upon the etymology of the name *Negulus*. The Latin word *Negulus* is the diminutive of *negus*, which word does not exist in the Latin language. *Negus* is derived from the Amharic, the official language of Ethiopia, and refers to the title taken by the rulers of that country. In coining the new name, at the same time displaying his wry sense of humour, Boettger probably wanted to refer to both the diminutive size of the shells and the country of origin of the then known Recent species of *Negulus*.

Vaught (1989: 80) considers *Pronesopupa* Iredale, 1913, *Edentulipupa* Pilsbry & Cooke, 1920, and *Sericipupa* Pilsbry & Cooke, 1920 (all Hawaiian endemics, except for *Pronesopupa* which is also known from the Kermadec and Marquesas Is.), subgenera of *Negulus*. Zilch (1959: 146) considers *Pronesopupa* a separate genus with *Edentulopupa* and *Sericipupa* as subgenera. In view of the fossil record of both *Negulus* (Tertiary of Europe: Eocene-Middle or Late Pliocene, fide Zilch, 1959; Esu, Girotti & Kotsakis, 1993) and *Pronesopupa* (Pleistocene of Hawaii, fide Zilch, 1959) and also the Recent distribution, Zilch's classification is obviously more realistic than, and therefore preferable to, that of Vaught.

The Recent representatives of *Negulus* appear to be restricted to the African continent. The sum total of the knowledge of the genus is limited to a discussion of the shells in a few pages in Pilsbry (1921: 101-104, pl. 5) and in Adam (1957: 2-3, figs. 1-3); the soft parts and the radula have never been described, a condition that cannot yet be remedied.

The map depicting the general distribution in Africa (fig. 8) shows the limited number of scattered localities for the few known species. The available records refer to only eight countries, viz. Malaŵi (eight localities), Zambia (one do.), Tanzania (one do.), Kenya (two do.), Zaire (one do.), Sudan (one do.), Ethiopia (one do.), Eritrea (one do.), and Bioko (Fernando Poo, one do.). Like many other taxa with minute shells, species of *Negulus* are only found where the top soil (leaf litter) of forest types of vegetation is sampled, a procedure that so far has been little applied throughout Africa. However, the genus has not (yet) been recorded from Gabon (Dr A.J. de Winter, Wageningen, personal communication), Angola (RMNH, Dr A. de Barros Machado material), and Madagascar (Dr K.C. Emberton, Philadelphia, U.S.A., personal communication), where a number of potentially suitable localities has been sampled for minute land snails in the above manner.

#### The problem of *Pupa obliquicostulata*

Pilsbry (1920: 104) includes *Pupa obliquicostulata* E.A. Smith, 1892, an extinct taxon from Sugarloaf Quarry on St. Helena Is. in the Atlantic Ocean, in the genus *Negulus*, although drawing attention to his doubts about this classification. Crowley & Pain (1977: 547-548, figs. 189c-d), who for some reason or other insist on consistently calling it *Pupa obliquicostata*, keep it in *Pupa* and show noticeable apertural dentition in their figures. This alone would exclude the St. Helena taxon from *Negulus*. The fact remains, however, that both the original description and the figures are quite explicit in this respect (Smith, 1892: 268, "intus haud dentata", p. 269: "no teeth within the aperture"; pl. XXII fig. 21). Crowley & Pain (loc. cit.) give no particulars about their figures beyond the name, but do state "Specimens examined: None." and "Since we have seen no specimens, we prefer to leave the species in *Pupa* s.l."

The five syntypes of Smith's taxon, collected by Captain W.H. Turton (BM 1892.2.24.120-124) and all in (very) poor condition, are glued onto a strip of black paper. The far right specimen most resembles Smith's figure (pl. XXII fig. 21), although the apical part is now lost; it does not show any outwardly visible processes in the aperture. Therefore this is designated **lectotype**. In the other, obviously conspecific, specimens internal lamellae and processes are visible where the aperture is damaged.

The figures of Crowley & Pain (figs. 189c-d) show at least a six-fold, if not even seven-fold, apertural dentition, which cannot be seen in any specimen of the type series. For the time being, what they have depicted remains a mystery. However, the conclusion relevant to the present paper is that *Pupa obliquicostulata* Smith, 1892, from St. Helena Is. cannot be classified with the genus *Negulus* because of the presence of apertural dentition.

### Key to the Recent species

The following shell characters are used to distinguish the species of *Negulus*. (1) Size, one species being noticeably larger than the others. (2) Number of whorls, one species always having more whorls at the same size than the others. (3) Convexity of the whorls, which varies from comparatively flat to markedly convex. (4) Sculpture of the whorls; this varies from weakly striate to costulate. (5) Umbilicus, which varies from almost completely closed to wide open.

It appears that only four taxa have been recognized in Africa (Pilsbry, 1921; Adam, 1957). The differences are fairly subtle, but comparison of the shells at least shows the existence of four discrete units, here termed species. These may be distinguished as follows (see also figs. 1-4):

- 1a. Shell 2.2-2.6 mm high with at most 5 whorls, which are noticeably costulate and convex, umbilicus open (Ethiopia, Eritrea) ..... *N. reinhardti*
- b. Shell 1.9-2.2 mm high with  $4\frac{1}{2}$ - $5\frac{3}{4}$  whorls, which are striate or at most weakly costulate, less convex, umbilicus open or almost closed (Ethiopia, Central Africa) ..... 2
- 2a. Shell cylindrical, with more than 5 whorls, almost smooth and moderately convex, umbilicus open (Ethiopia, S. Sudan) ..... *N. abyssinicus*
- b. Shell more tapering, with at most 5 whorls, striate to weakly costulate, fairly convex to flattish, umbilicus open to almost closed ..... 3
- 3a. Whorls flattish, striate-costulate, umbilicus almost closed (Kenya, N. Tanzania) .....  
..... *N. kenianus*
- b. Whorls fairly convex, at most striate, umbilicus open (E. Zaire, E. Zambia, Malaŵi, Bioko) ..... *N. ruwenzoriensis*

This key should only be used for full-grown specimens and with due care because it is based on only 9 adult shells of *N. ruwenzoriensis*, 8 of *N. abyssinicus*, 12 of *N. reinhardti*, and 5 of *N. kenianus*. For comparative details as regards metric data see also table 5.

### Notes on the Recent species

*Negulus reinhardti* (Jickeli, 1874)  
(figs. 3, 8, tables 1, 5)

*Pupa Reinhardti* Jickeli, 1874: 122, pl. 5 fig. 12 ("in der abyssinischer Provinz Hamaszen bei Mekerka an den Ufern des Toquer an Felsen, die von Moos bedeckt waren.", lectotype ZMB 22511a, vide Kilius, 1969).

*Pupa reinhardti*; Boettger, 1889: 269; [*Pupa reinhardti* (*Isthmia*)] Kobelt, 1909: 73; Kiliyas, 1969: 251 (lectotype ZMB 22511a + 3 paralectotypes ZMB 22511b).

*Isthmia reinhardti*; Bourguignat, 1883: 116.

*Negulus reinhardti*; Pilsbry, 1921: 102; Pilsbry, 1934: 153; Bacci, 1951: 44; Adam, 1957: 2, fig. 3; Zilch, 1959: 146, fig. 490 (syntype SMF 4736/5; recte, paralectotype).

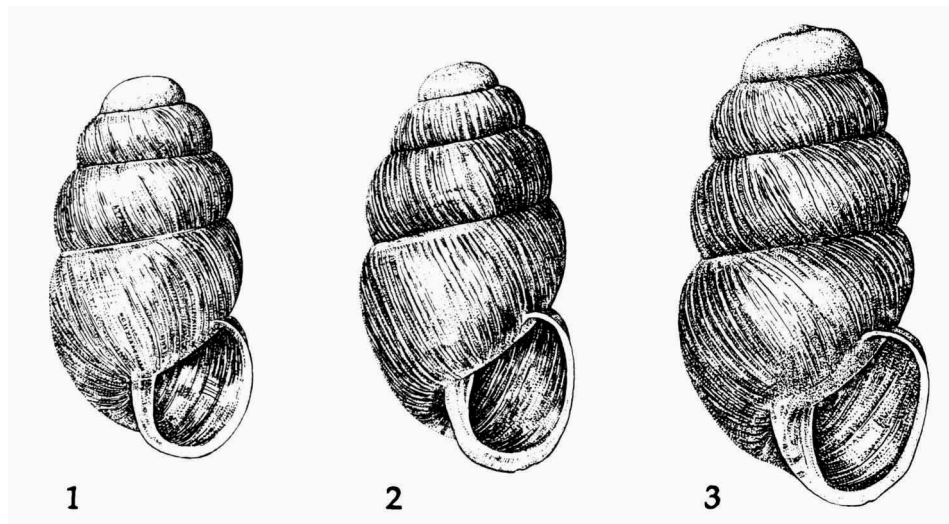
Jickeli (1873) in his travelogue describes the various localities and the molluscs he collected. In his formal description of *Pupa reinhardti* he (Jickeli, 1874) refers to p. 40 of this itinerary in vol. 20 of the *Malakozoologische Blätter* of which the first part covers pp. 1-20 and the second part pp. 109-151. Jickeli most likely refers to a reprint of his paper with new pagination; the new p. 40 would be p. 128 in vol. 20 of the journal. On this page there is no mention of this species of *Pupa*, although another (*P. fontana*) is recorded. No altitude is given in the original description nor in the itinerary; however, other species were collected at the same site, probably together with *P. reinhardti*, and the altitude recorded for these is "7995 F." At that time one 'Fuss' in most of Germany equalled 0.28 m, so that the species was collected at about 2238 m a.s.l.

The locality is not easily traced on modern maps. According to the gazetteer (Ethiopia, etc., 1950), the Hamasen district is situated at 15°20'N 38°40'E in Eritrea, once again an independent state. However, the Toquer River (alternative spelling Toquor and Toquar) does not feature in the gazetteer. The only name that shows some similarity is Tonqua (= Tonquò), a stream at 13°32'N 38°54'E in Ethiopia and, therefore, somewhat distant from the Hamasen district. The name Mekerka is also not shown in this geographical index. Therefore it is difficult to decide whether the locality is in Eritrea or Ethiopia; on the map (fig. 8) it has been indicated on the border of the two countries involved. So far this species is only known from its type locality.

The species has been summarily discussed and adequately depicted by Adam

Table 1. Measurements of paralectotype series of *Negulus reinhardti* from the type locality (BM, SMF, IRSNB), for details see text. The data for the IRSNB shell are taken from Adam (1957); the specimen figured by Zilch (1959, fig. 490, SMF) is indicated by an asterisk. The bottom specimen is taken to be subadult. For further details see text.

museum	length × maj.diam.	l/d	length last whorl	aperture height × maj.diam.	number of whorls
IRSNB	2.6 × 1.3 mm	2.00	1.4 mm	0.9 × 0.8 mm	5
SMF	2.4 × 1.3 mm	1.84	1.4 mm	0.7 × 0.8 mm	4 <sup>3</sup> / <sub>4</sub>
SMF*	2.4 × 1.2 mm	2.08	1.4 mm	0.8 × 0.7 mm	> 4 <sup>3</sup> / <sub>4</sub>
SMF	2.4 × 1.2 mm	2.00	1.4 mm	0.8 × 0.7 mm	4 <sup>3</sup> / <sub>4</sub>
SMF	2.3 × 1.2 mm	1.97	1.3 mm	0.8 × 0.7 mm	> 4 <sup>3</sup> / <sub>4</sub>
SMF	2.3 × 1.2 mm	1.92	1.3 mm	0.7 × 0.7 mm	> 4 <sup>1</sup> / <sub>2</sub>
SMF	2.2 × 1.2 mm	1.89	1.4 mm	0.8 × 0.7 mm	4 <sup>3</sup> / <sub>4</sub>
SMF	2.2 × 1.2 mm	1.82	1.3 mm	0.8 × 0.8 mm	4 <sup>3</sup> / <sub>4</sub>
BM	2.2 × 1.2 mm	1.80	1.3 mm	0.7 × 0.7 mm	4 <sup>3</sup> / <sub>4</sub>
SMF	2.2 × 1.2 mm	1.84	1.3 mm	0.8 × 0.7 mm	> 4 <sup>1</sup> / <sub>2</sub>
BM	2.2 × 1.2 mm	1.77	1.2 mm	0.7 × 0.7 mm	4 <sup>3</sup> / <sub>4</sub>
SMF	2.2 × 1.2 mm	1.75	1.2 mm	0.7 × 0.7 mm	4 <sup>1</sup> / <sub>2</sub>
SMF	2.0 × 1.2 mm	1.73	1.2 mm	0.7 × 0.7 mm	4 <sup>1</sup> / <sub>4</sub>



Figs. 1-3. Shells of three Recent species of *Negulus*. 1, *N. ruwenzoriensis* Adam, 1957, holotype (IRSNB); 2, *N. kenianus* (Preston, 1912), lectotype (MRAC 18394); 3, *N. reinhardti* (Jickeli, 1874), paralectotype (IRSNB). After Adam, 1957, figs. 1-3; Mrs J. van Melderren-Sergysels del.

(1957: 2-3, fig. 3, "paratype", recte paralectotype, IRSNB). Obviously the original material from the type locality (all to be considered syntypes, but since Kiliass' lectotype designation in 1969, paralectotypes) has been widely dispersed (specimens recorded to be present in at least BM, IRSNB, SMF, ZMB). The following paralectotype material has been examined: 1 (BM, A.E. Salisbury colln., Acc. no. 2172; original label in a German hand, ex auctore?); 2 (BM, A.E. Salisbury colln., Acc. no. 2172, ex H.C. Fulton); 5 (SMF 4736/5, O. Boettger colln., 'Normalsammlung'; among these is the shell figured by Zilch, 1959, fig. 490); 1 (SMF 51680/1, O. von Moellendorff colln.); 2 (SMF 51681/2, O. Reinhardt colln.); 2 (SMF 206403/2, S.H. Jaeckel colln.). The measurements of all these are shown in table 1 and may be summarized as 2.2-2.6 × 1.2-1.3 mm, l/d 1.75-2.08, length last whorl 1.2-1.4 mm, aperture 0.7-0.9 × 0.7-0.8 mm, whorls 4½-5, n = 12.

Obviously *N. reinhardti* is the species with the largest shell in the genus and also the most coarse costulation; in addition, the whorls are noticeably convex.

*Negulus abyssinicus* (Von Martens, 1869)  
(figs. 4-6, 8, tables 2, 5)

"*Pupa (Pupilla) edentula* Drap. var. *minor*" Von Martens, 1866: 96 ("Südliches Abyssinien").

*Pupa edentula*; Morelet, 1868: 40.

*Pupa abyssinica* "Reinhardt in litt." Von Martens, 1869: (157) 160 ("Südliches Abyssinien", lectotype ZMB

8581a, vide Kiliass, 1969); Jickeli, 1874: 123, pl. 5 fig. 13; [*Pupa abyssinica (Isthmia)*] Kobelt, 1909: 73.

*Pupa abyssinicus*; Kiliass, 1969: 249 (lectotype ZMB 8581a + 3 paralectotypes ZMB 8581b).

*Isthmia abyssinica*; Bourguignat, 1883: 117.

*Negulus abyssinicus*; Pilsbry, 1921: 103, pl. 5 figs. 19-21; Pilsbry, 1934: 153; Bacci, 1951: 44.

*Pupa abessynica*; Boettger, 1889: 269.

"*Pupa (Vertigo (?) abyssinica*"; Nevill, 1878: 196 (Ethiopia, Adigrat).

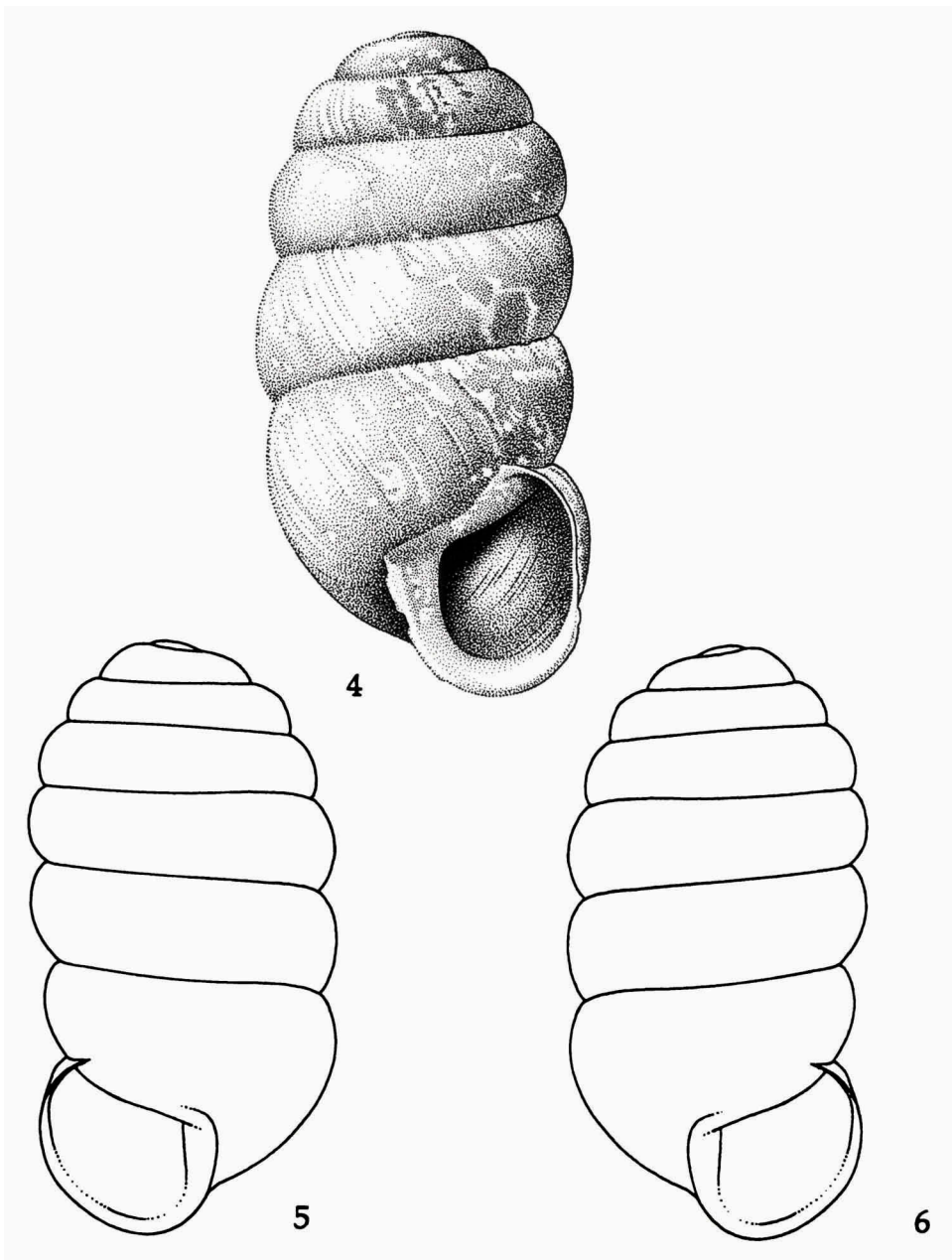
The exact type locality is unknown, but Von Martens (1866: 92) states in his paper that he discusses specimens "welche Th. Heuglin 1864 im Gebiet des weissen Nils, hauptsächlich im südlichen Abyssinien gesammelt hat." The famous German ornithologist and traveller Theodor von Heuglin (1824-1876) joined the adventurous upper class Dutch ladies Tinne of The Hague, Holland, on their explorations on the White Nile in 1863-1864. Various data available on Von Heuglin's travels (e.g., Von Heuglin, 1865), indicate that the type locality is not in Ethiopia, but in the Sudan. The White Nile (Bahr el Jebel, beyond Malakal called Bahr el Abiad), springing from Lake Edward in Uganda, traverses the southern Sudan northward and is joined by the Blue Nile (Bahr el Azraq) near Khartoum. The latter has its source in Lake Tana in the highlands of Ethiopia. Of course, the borders between Ethiopia and the Sudan were poorly delimited at the time of Von Heuglin's travels in the second half of the last century and may probably merely be considered in terms of spheres of influence. In the 1860s the Sudan was under Egyptian influence, while the emperor Theodore II during his reign (1855-1868) was trying to bring the Ethiopian feudal lords under his suzerainty, laying the foundations for his Abyssinian empire. The type locality cannot be traced and therefore restricted at the moment, because no details are known.

There is no mention of molluscs in Von Heuglin's itinerary (Von Heuglin, 1865) nor any details about shells sent to the Leiden Museum or elsewhere. There is some correspondence from Von Heuglin to H. Schlegel (director of the Leiden Museum 1858-1884; see also Gijzen, 1938) in which "Conchylien" are mentioned, but this does not supply any relevant information. A list, captioned "Heuglin 1865", enumerates in detail material bought by the Leiden Museum from Heuglin, totalling "111 Vögel/7 Säugethiere/Conchylien" [111 birds/7 mammals/shells]. The molluscs are described as "4 kleine Glasröhren mit Conchylien . . . 5" [4 small glass tubes with shells at Hfl. 5]. Perhaps the position is summed up best by Cave & Macdonald (1955: 408), who state: ". . . and finally in 1863 he [Von Heuglin] joined Madam Tinné's [sic, recte Tinne's] expedition to the Bahr el Ghazal, where from Meshra 'er Req and Wau, expeditions were made further afield, particularly southwards, apparently almost as far as the Congo border." There are ranges of hills and complexes of mountains in the southern parts of the Sudan that are potentially suitable for species of *Negulus*; the altitude here varies from 800-3000 m a.s.l. Some of these may have been sampled by Von Heuglin. Therefore the only fact that is certain, is that the type locality of *N. abyssinicus* is somewhere in S. Sudan.

The only exact locality for the species is Adigrat in Ethiopia (14°17'N 39°27'E). This is first mentioned by Nevill (1878), but has been overlooked by Boettger (1889) and Pilsbry (1921); however, it is recorded by Bourguignat (1883). The Adigrat specimens were collected by the famous geologist/conchologist Dr W.T. Blanford, F.R.S. (1832-1905), who was seconded by the Government of India to accompany Napier's punitive expedition (see e.g. Moorehead, 1963: 203-272) against the self-same emperor Theodore in 1867-1868 (Blanford, 1870)<sup>2</sup>. Blanford records a height of 8000 ft. = c. 2400 m a.s.l. for Adigrat.

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<sup>2</sup>Nevill writes literally "18 Adigrat; coll. W.T. Blanford, Esq." This material, probably still in the Indian Museum (Calcutta), is not mentioned in Blanford's treatise on the geology and zoology of Ethiopia (Blanford, 1870). Although a number of land molluscs are discussed, also in the itinerary, there is no mention of this species. Obviously the material was only later properly identified.



Figs. 4-6. Shells of *Negulus abyssinicus* (Von Martens, 1869), '[southern] Abyssinia' [recte: S.Sudan] (paralectotypes, RMNH 56856). 4,  $2.2 \times 1.1$  mm; 5, outline of sinistral shell,  $1.9 \times 1.0$  mm; 6, mirror image of fig. 5. H. Heijn del.



Table 2. Measurements of a paralectotype series of *Negulus abyssinicus* from '[southern] Abyssinia' (recte: S. Sudan, RMNH, SMF; sin. = sinistral shell), for details see text.

museum	length × maj.diam.	l/d	length last whorl	aperture height × maj.diam.	number of whorls
RMNH	2.2 × 1.1 mm	1.97	1.1 mm	0.7 × 0.6 mm	5 <sup>3</sup> / <sub>4</sub>
SMF	2.1 × 1.1 mm	1.94	1.1 mm	0.7 × 0.6 mm	> 5 <sup>1</sup> / <sub>4</sub>
RMNH	2.1 × 1.0 mm	2.06	1.1 mm	0.7 × 0.7 mm	5 <sup>1</sup> / <sub>2</sub>
RMNH	2.0 × 1.1 mm	1.78	1.1 mm	0.7 × 0.7 mm	5 <sup>1</sup> / <sub>2</sub>
RMNH	1.9 × 1.1 mm	1.75	1.1 mm	0.7 × 0.6 mm	5 <sup>1</sup> / <sub>2</sub>
RMNH	1.9 × 1.1 mm	1.75	1.1 mm	0.7 × 0.6 mm	5 <sup>1</sup> / <sub>4</sub>
RMNH	1.9 × 1.1 mm	1.77	1.1 mm	0.7 × 0.7 mm	5 <sup>1</sup> / <sub>4</sub>
RMNH	1.9 × 1.0 mm	1.97	0.9 mm	0.7 × 0.6 mm	6 <sup>1</sup> / <sub>2</sub> sin.

As mentioned above, some of Von Heuglin's material is in the Leiden museum. There is a sample of ten shells (six adults, one sinistral adult, three juveniles) s.n. *Negulus abyssinicus*, simply labelled "Abyssinië", undoubtedly paralectotypes (RMNH 56856). In addition another paralectotype was studied: SMF 5050/1, "Jickeli ex Heuglin u. Steudner". For shell measurements see table 2. The material is fairly uniform, having the following metric data: 1.9-2.2 × 1.0-1.1 mm, l/d 1.75-2.06, last whorl [0.9-]1.1 mm, aperture 0.7 × 0.6-0.7 mm, whorls >5<sup>1</sup>/<sub>4</sub>-5<sup>3</sup>/<sub>4</sub> [-6<sup>1</sup>/<sub>2</sub>] (n = 7; data of sinistral specimen, where aberrant, between square brackets, makes n = 8).

The sinistral specimen is in so far abnormal, that it has three-quarters of a whorl more than the largest normal adult specimen in the sample; otherwise, only the length of the last whorl is slightly less than that of all other shells. This is the first case of a sinistral specimen in the genus *Negulus*. At first sight the sinistral shell recalls sinistral forms of *Truncatellina*, e.g. *T. pygmaeorum* Pilsbry & Cockerell, 1933 (vide Van Bruggen, 1994). A close comparison of the above sinistral shell with material of that species and other Afrotropical *Truncatellina* material, however, reveals such a close similarity to the other Von Heuglin specimens, that it undoubtedly represents a sinistral individual of *N. abyssinicus*. In view of the slightly aberrant shell, it seems prudent to specifically exclude the sinistral specimen from the series of paralectotypes.

*N. abyssinicus* is characterized by the highest number of whorls in the genus, which are almost smooth and moderately convex.

*Negulus kenianus* (Preston, 1912)  
(figs. 2, 8, tables 3, 5)

*Alaea keniana* Preston, 1912: 189, pl. 31 fig. 6 (Kenya [formerly British East Africa], "Mt. Kenia, at an altitude of from 6000 to 9000 ft.", lectotype ('holotype') MRAC); Schouteden, 1936: 501 (lectotype designation).

*Negulus kenianus*; Pilsbry, 1926: 103; Pilsbry, 1934: 153; Adam, 1957: 2, fig. 2; Verdcourt, 1983: 208.

This species has also been discussed and adequately figured by Adam (1957: 2-3, fig. 2; here also fig. 2). The dimensions of the lectotype (MRAC 18394; NOT holotype, see lectotype designation by Schouteden, 1936; there is also a paralectotype in BM) are

Table 3. Measurements of *Negulus kenianus*. The MRAC specimen is the lectotype; for further details see text.

museum	length × maj.diam.	l/d	length last whorl	aperture height × maj.diam.	number of whorls
MRAC	2.2 × 1.1 mm	1.93	1.4 mm	0.8 × 0.7 mm	4 <sup>3</sup> / <sub>4</sub>
NMWC	2.1 × 1.0 mm	2.00	1.3 mm	0.7 × 0.7 mm	4 <sup>1</sup> / <sub>2</sub>
NMWC	1.9 × 1.0 mm	1.90	1.2 mm	0.6 × 0.6 mm	4 <sup>1</sup> / <sub>2</sub>
NMWC	1.9 × 1.0 mm	1.82	1.1 mm	0.7 × 0.6 mm	4 <sup>1</sup> / <sub>2</sub>
SMF	1.9 × 1.0 mm	1.94	1.2 mm	0.7 × 0.6 mm	4 <sup>3</sup> / <sub>4</sub>

2.2 × 1.1 mm, l/d 1.93, length last whorl 1.4 mm, aperture 0.8 × 0.7 mm, 4<sup>3</sup>/<sub>4</sub> whorls.

The following material was examined: Kenya, Mt. Kenya, Naro Moro Gate (Mt. Kenya National Park), forest floor litter, 3500 m a.s.l., 22.VIII.1993, leg. P. Tattersfield, 5 (NMWC); Tanzania, Mt. Meru, "Dickicht bei Farm Momella" (bush near Momella Farm, now Momella Lodge), 1700 m a.s.l., 22.II.1937, leg. K.L. Pfeiffer, 1 (SMF 109212/1). The measurements of the specimens examined (see table 3) may be summarized as 1.9-2.2 × 1.0-1.1 mm, l/d 1.82-2.00, last whorl 1.1-1.4 mm, aperture 0.6-0.8 × 0.6-0.7 mm, whorls 4<sup>1</sup>/<sub>2</sub>-4<sup>3</sup>/<sub>4</sub>, n = 5.

The shell of this species is characterized by a somewhat tapering, striate-costulate, shell with flattish whorls and an almost completely closed umbilicus. The whorls are slightly less convex than in *N. ruwenzoriensis*.

In addition to the (inexact) type locality and another site on Mt. Kenya, this species is now also known from Mt. Meru (for a time known as 'Socialist Peak') in northern Tanzania (new record), not far from the southern border of Kenya.

With some doubt two more shells from the Kiptaberr-Kapkanyar Forest (1°10'N 35°13'E), near Kaibibich, Cherangani Hills, Kenya, collected on 9.VIII.1993 by Dr P. Tattersfield (NMWC), are identified with this species. The shells differ considerably as regards size and, up to a degree, also shape, but are otherwise characteristically similar, exhibiting flattish, finely striated whorls and an almost completely closed umbilicus. The measurements (not incorporated in table 3) are the following: 2.5 × 1.2 mm, l/d 2.00, length last whorl 1.4 mm, aperture 0.7 × 0.6 mm, 5<sup>1</sup>/<sub>4</sub> whorls; 1.8 × 1.0 mm, l/d 1.81, last whorl 1.1 mm, aperture 0.7 × 0.6 mm, 4<sup>1</sup>/<sub>4</sub> whorls. The second specimen is obviously subadult as witnessed by its limited number of whorls. In running down the above key, the largest shell keys out to *N. kenianus*, if size as a character is ignored. Very little material of this species has been examined and the knowledge of its variability is therefore limited. For the time being, both specimens are labelled as *N. cf. kenianus*.

*Negulus ruwenzoriensis* Adam, 1957  
(figs. 1, 7-8, tables 4, 5)

*Negulus ruwenzoriensis* Adam, 1957: 2, fig. 1 (Zaire, Parc National des Virunga [formerly Parc National Albert], Kerere, "entre Mahungu (3.300 m) et Kiondo (4.300 m)", holotype and paratype in IRSNB); Van Bruggen, 1988: 6 (Zambia, "Chowo Forest"); Van Bruggen, 1993: 101 ("the species appears to

be widely distributed in Malaŵi from Mt. Mulanje in the south to as far north as the Nyika Plateau forests").

"*un Negulus*"; Ortiz de Zárate Lopez & Ortiz de Zárate Rocandio, 1959: 4.

The Malaŵi collections in the Leiden Museum (RMNH) encompass a limited amount of material of *Negulus*, all apparently belonging to a single taxon. In December 1984 some specimens were compared to the holotype of *N. ruwenzoriensis* in the Brussels Museum in the company of the late Dr Adam and found to agree well.

The dimensions of the Malaŵi shells (a total of six undamaged adult shells and a further three in poor condition, among which a subadult specimen) may be summarized as 1.9-2.1 × 0.9-1.0 mm, l/d 1.97-2.09, length last whorl 1.1-1.2 mm, aperture 0.6-0.7 × 0.5-0.6 mm, 4<sup>3</sup>/<sub>4</sub>-<5 whorls, n = 9 (table 4). The only published measurements available so far (Adam, 1957: 3) are those of the holotype: 2.05 × 1.03 mm, l/d 1.99, length last whorl 1.25, aperture 0.72 × 0.65 mm, 4<sup>3</sup>/<sub>4</sub> whorls. It is evident that the holotype completely fits into the Malaŵi series.

The species appears to be distributed throughout Malaŵi (fig. 7), albeit nowhere common. The localities (all material in RMNH) are enumerated from south to north and include one from Zambia, just W. of the border with Malaŵi on the Nyika Plateau: (1) Thyolo Dist., Thyolo Mt., evergreen forest litter, 1450 m a.s.l., 23.iii.1982, HMM; (2) Mulanje Dist., Mt. Mulanje, *Widdringtonia* leaf litter near underground stream near Sombani Hut, c. 2080 m a.s.l., 29.v.1983, HMM; (3) Chiradzulu Dist., Mt. Chiradzulu, fairly dense evergreen forest litter at the southern end of the ridge, c. 1700 m a.s.l., 8.iv.1984, HMM; (4) Zomba Dist., Zomba Plateau, Chingwe's Hole, evergreen forest litter, c. 1900 m a.s.l., 4.iii.1983, HMM; (5) ibidem, "10 bags leaf litter", 30.xii.1985, HMM; (6) Dedza Dist., Mt. Dedza, evergreen forest litter, c. 2000 m a.s.l., iv.1980, leg. Dr S. Blackmore; (7) Dedza Dist., Mulunduni Mt., evergreen forest litter, 2000 m a.s.l., 27.xi.1983, leg. Dr R.J.

Table 4. Measurements of *Negulus ruwenzoriensis* from various localities in Malaŵi (M, numbers refer to localities mentioned in the text), Fernando Poo (FP), and Zaire (Z, holotype). Shells with less than 4 1/2 whorls are considered juvenile or subadult. For further details see text.

locality	length × maj.diam.	l/d	length last whorl	aperture height × maj.diam.	number of whorls
FP	2.2 × 1.2 mm	1.87	1.3 mm	0.8 × 0.7 mm	4 <sup>3</sup> / <sub>4</sub>
FP	2.1 × 1.1 mm	1.88	1.2 mm	0.7 × 0.7 mm	4 <sup>3</sup> / <sub>4</sub>
M7	2.1 × 1.0 mm	2.09	1.2 mm	0.7 × 0.6 mm	< 5
Z	2.0 × 1.0 mm	1.99	1.2 mm	0.7 × 0.6 mm	4 <sup>3</sup> / <sub>4</sub>
FP	2.0 × 1.0 mm	1.93	1.2 mm	0.7 × 0.6 mm	4 <sup>1</sup> / <sub>2</sub>
M4	1.9 × 1.0 mm	1.97	1.1 mm	0.6 × 0.6 mm	4 <sup>3</sup> / <sub>4</sub>
M2	1.9 × 0.9 mm	2.00	1.1 mm	0.7 × 0.6 mm	4 <sup>3</sup> / <sub>4</sub>
M5	c.1.9 × 0.9 mm	c. 2.07	1.2 mm	0.7 × 0.5 mm	-
M6	1.7 × 0.9 mm	1.93	1.0 mm	0.6 × 0.5 mm	4 <sup>1</sup> / <sub>2</sub>
M5	1.7 × 0.9 mm	1.87	1.1 mm	0.6 × 0.5 mm	4 <sup>1</sup> / <sub>4</sub>
M1	c.1.7 × c. 1.0 mm	c. 1.75	-	-	-
M9	1.7 × - mm	-	-	-	-
M1	1.6 × 0.9 mm	1.67	-	-	4 <sup>1</sup> / <sub>4</sub>

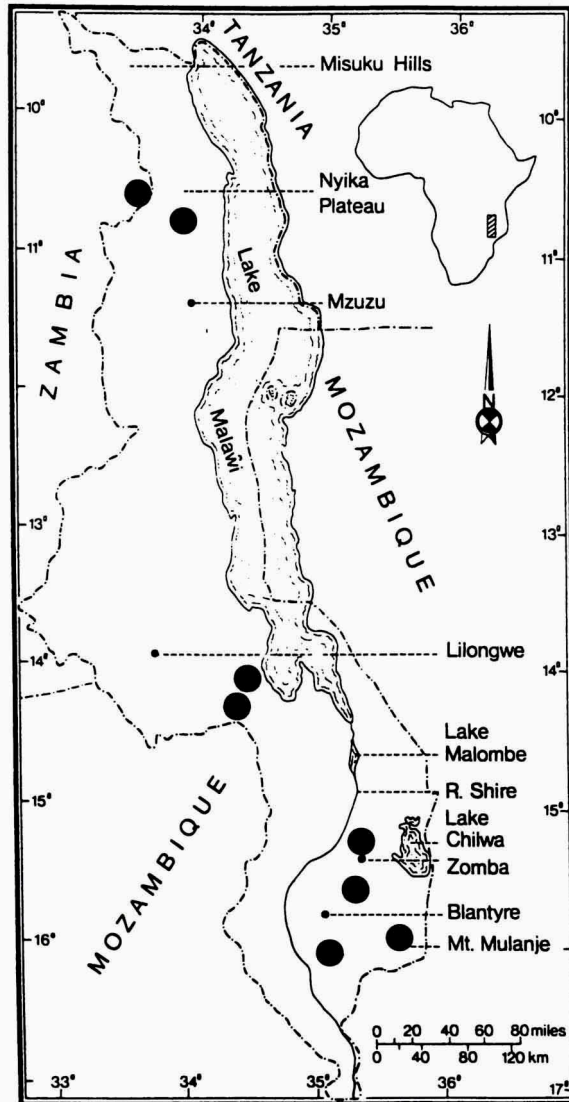


Fig. 7. Distribution of *Negulus ruwenzoriensis* in Malaŵi.

Dowsett; (8) Rumphu Dist., Nyika Plateau, Nyika National Park, evergreen forest Kasaramba road 9 km S. of Chelinda Bridge turn, under bark, c. 2450 m a.s.l., 4.iv.1987, HMM (a juv. shell of 0.9 mm height, cf. *Negulus* spec.); (9) ZAMBIA, Isoka Dist., Nyika Plateau, Nyika National Park, Chowo Forest, evergreen forest litter ("8 bags of leaf litter", Meredith in litt., 8.xi.1993), c. 2180 m a.s.l., 4-5.iv.1987, HMM.

The hypsometrical range in Malaŵi appears to be c.1450-c.2450 m a.s.l.

The Spanish malacologist Dr A. Ortiz de Zárate Lopez (1886-1964) of Najera (Logroño) had extensively corresponded with Dr William Adam (1909-1988), at that time chief of

Table 5. Metric data in mm of the known Recent species of *Negulus*, from data in present paper and quoted literature sources. N.B. The sinistral shell of *N. abyssinicus* (bottom specimen in table 2) is in so far aberrant that the length of the last whorl is 0.9 mm (shown below between brackets) and it reaches 6 1/2 whorls (not shown below). For further details see text.

	<i>reinhardti</i>	<i>abyssinicus</i>	<i>kenianus</i>	<i>ruwenzoriensis</i>
length × maj.diam.	2.2-2.6 × 1.2-1.3	1.9-2.2 × 1.0-1.1	1.9-2.2 × 1.0-1.1	1.9-2.2 × 0.9-1.2
l/d	1.75-2.08	1.75-2.06	1.82-2.00	1.87-2.09
length last whorl	1.2-1.4	(0.9)-1.1	1.1-1.4	1.0-1.3
aperture height × maj.diam.	0.7-0.9 × 0.7-0.8	0.7 × 0.6-0.7	0.6-0.8 × 0.6-0.7	0.6-0.8 × 0.5-0.7
number of whorls	4 <sup>1</sup> / <sub>2</sub> -5	>5 <sup>1</sup> / <sub>4</sub> -5 <sup>3</sup> / <sub>4</sub>	4 <sup>1</sup> / <sub>2</sub> -4 <sup>3</sup> / <sub>4</sub>	4 <sup>1</sup> / <sub>2</sub> -<5
n	12	8	5	9

the invertebrate division of the Institut Royal des Sciences Naturelles de Belgique. The former submitted material of terrestrial gastropods from the West African island of Fernando Poo (nowadays known as Bioko) for the latter's opinion. In a letter of 20.ix.1960 Adam writes as regards some *Negulus* specimens: "La taille est très variable d'après les trois spécimens que vous m'avez envoyés, mais je ne vois vraiment aucun caractère qui permet de distinguer votre matériel du *Negulus ruwenzoriensis*." The specimens in question are labelled as follows; "Pico de St. Isabel. Antonio Ortiz de Zárate Rocandio leg. I-1945. Entre 1350 y 2350 m sobre el mar", "Échange avec Mr le Dr A Ortiz de Zarate I.G. 22.064". The dimensions of these three shells are 2.0-2.2 × 1.0-1.2 mm, l/d 1.87-1.93, length last whorl 1.2-1.3 mm, aperture 0.7-0.8 × 0.6-0.7 mm, 4<sup>1</sup>/<sub>2</sub>-4<sup>3</sup>/<sub>4</sub> whorls, n = 3 (see table 4). As regards measurements the specimens fit well into the general pattern of the species. Compared to the type specimen, they agree well enough; compared to the Malaŵi shells, they appear to be somewhat larger and less slender with a slightly more limited number of whorls. In view of the enormous distance between the localities involved, this is to be expected. Metric data of the species may now be summarized as 1.9-2.2 × 0.9-1.2 mm, l/d 1.87-2.06, length last whorl 1.1-1.3 mm, aperture 0.6-0.8 × 0.5-0.7 mm, 4<sup>1</sup>/<sub>2</sub>-<5 whorls, n = 13.

The few available records indicate that *N. ruwenzoriensis* is widely distributed in tropical Africa (fig. 8). The southern limits of both the species and the genus are probably somewhere just north of the Zambezi River, the southernmost Malaŵi record being only about 100 km due north of this mighty stream.

The shell of *N. ruwenzoriensis* has fairly convex whorls with little sculpture (at most striate, i.e. showing fairly prominent growth striae) and an open umbilicus.

Obviously these minute snails are mountain dwellers, the hypsometrical range being >800-c.4000 m a.s.l. The limited data for the four species are, *N. ruwenzoriensis* c.1450-c.4000 m a.s.l., *N. kenianus* c.1700-c.3000 m a.s.l., *N. abyssinicus* >800-c.2400 m a.s.l., and *N. reinhardti* c.2200 m a.s.l.

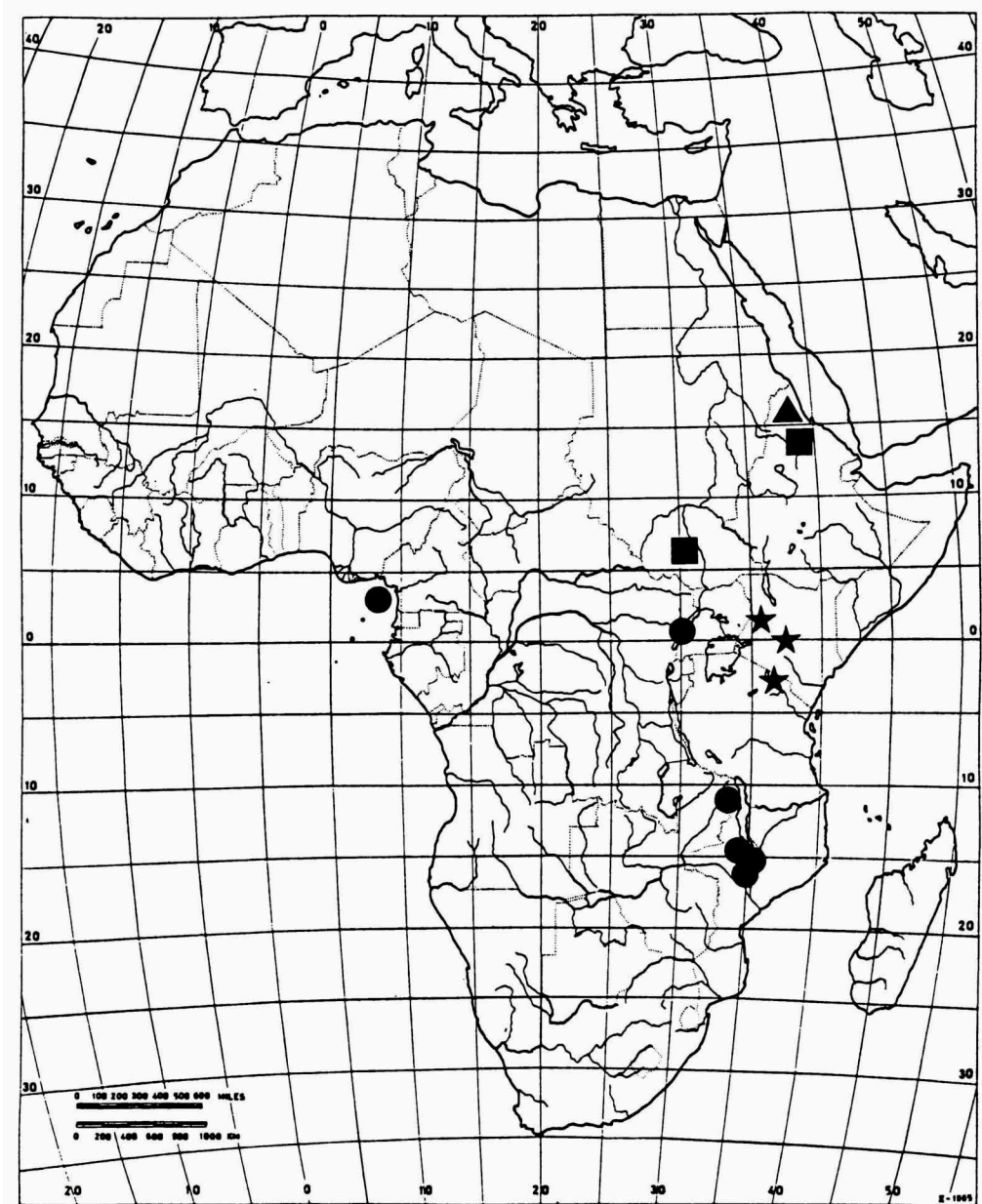


Fig. 8. Recent distribution of the genus *Negulus*; *N. ruwenzoriensis* (dots), *N. kenianus* (stars; the top one refers to the doubtful specimens from the Cherangani Hills in Kenya, see text), *N. abyssinicus* (squares), and *N. reinhardti* (triangle). *N. reinhardti* is only known from its type locality. Various extinct species are recorded from the Tertiary of Central Europe.

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