Studies on the Streptaxidae (Mollusca: Gastropoda Pulmonata) of Malaŵi 9. Description of *Gulella streptostelopsis*, a new *Streptostele*-like species of *Gulella*[1]

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Bruggen, A.C. van. Studies on the Streptaxidae (Mollusca: Gastropoda Pulmonata) of Malaŵi 9. Description of *Gulella streptostelopsis*, a new *Streptostele*-like species of *Gulella.*
Zool. Med. Leiden 81 (1), 8.vi.2007: 1-9, figs 1-6, table 1.— ISSN 0024-0672.
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Key words: Gastropoda; Pulmonata; Streptaxidae; *Gulella*; *Streptostele*; taxonomy; Malaŵi; East Africa.
Gulella streptostelopsis spec. nov. is described from a series of localities of mainly between 1000 and 1500 m a.s.l. in Malaŵi south of about 11°S. The minute, almost smooth, shell (length 2.0-2.4 mm) resembles that of the genus *Streptostele* (hence the name), but is characterized by three-fold apertural dentition and just under six whorls. This taxon may represent a new genus; pending studies on the anatomy no new generic name is proposed.

Introduction

This series is devoted to the description of the plethora of species of the pulmonate gastropod family Streptaxidae in Malaŵi (for No. 8 vide Van Bruggen & De Winter, 2003). Among the many taxa of the very diverse genus *Gulella* L. Pfeiffer s.l., 1865, in Malaŵi and elsewhere, there is a species with a shell that shows a remarkable similarity to that of the streptaxid genus *Streptostele* H. Dohrn, 1866. The new species is described and discussed below. All material except for one specimen was obtained for the National Museum of Natural History by Ms H.M. Meredith (Newquay, U.K.; formerly Malaŵi) and her co-workers in the period 1975-1988. Surprisingly the species was not encountered among the material assembled by Dr R. Jocqué and Mr W.N. Gray (vide Van Bruggen & Meredith, 1984: 159), nor in that of the three collecting trips of A.C. & W.H. van Bruggen (1988, 1990, 1993).

The following abbreviations have been used: alc. for material in alcohol; l/d for the ratio length/major diameter of shells (this ratio is calculated from micrometer readings and may therefore differ from that calculated when these measurements are first converted into mm); lw for length of last whorl in front view; leg. M for leg. Ms H.M. Meredith; BMNH for The Natural History Museum, London [British Museum (Natural History)]; IRSNB for Institut Royal des Sciences Naturelles de Belgique, Brussels; MRAC for Musée Royal de l'Afrique Centrale, Tervuren, Belgium; RMNH for National Museum of Natural History, Leiden (Nationaal Natuurhistorisch Museum; formerly Rijksmuseum van Natuurlijke Historie).

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[1] For no. 8 in this series vide Bruggen, A.C. van & A.J. de Winter, 2003. Studies on the Streptaxidae (Mollusca: Gastropoda Pulmonata) of Malaŵi 8. A revision of *'Marconia' hamiltoni* (Smith), the largest local streptaxid, with the description of a new genus.— Zool. Verh. Leiden 345: 59-78, figs. 1-21.

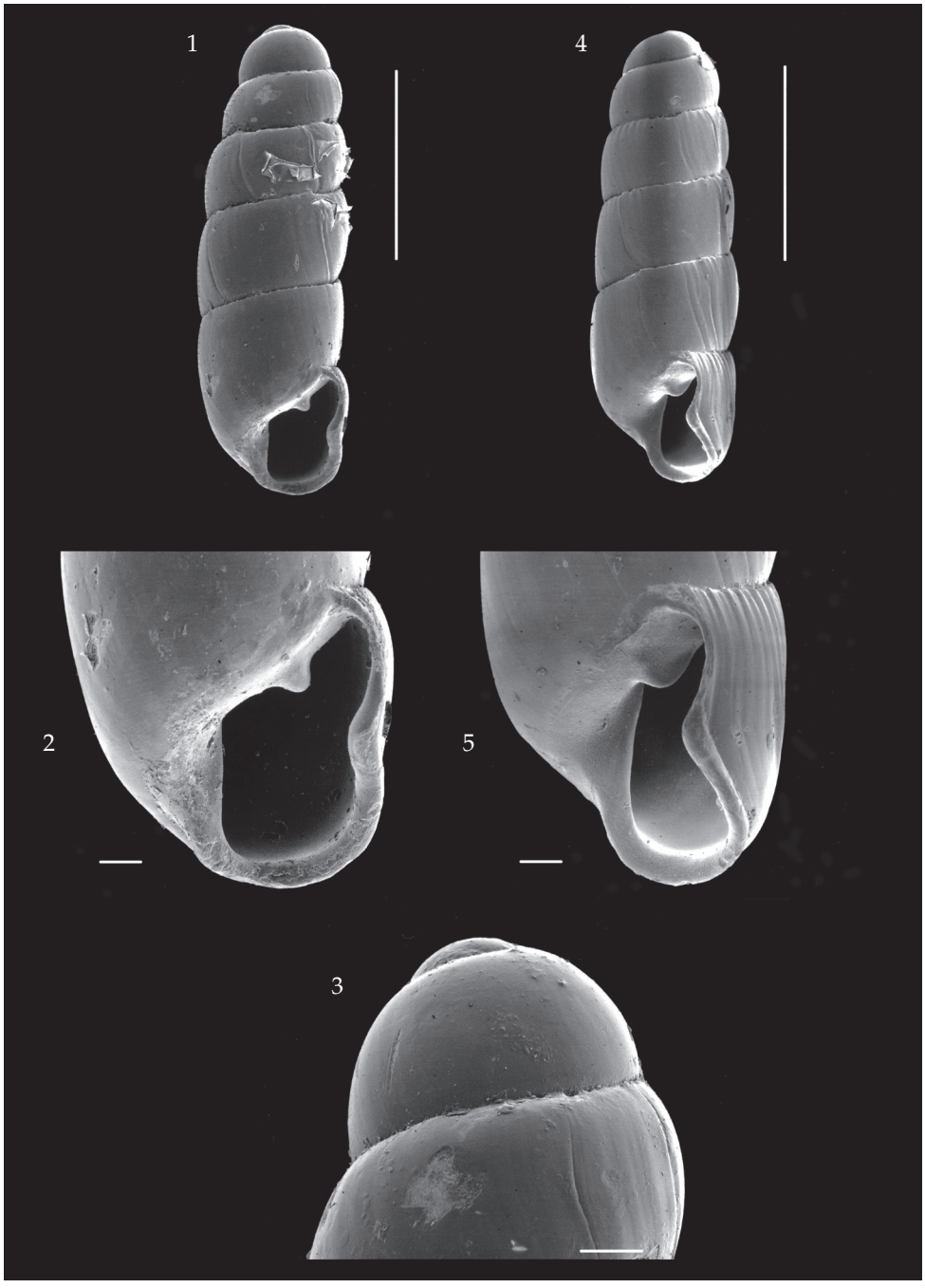
Description

Gulella streptostelopsis spec. nov.
(figs 1-6)

Material examined. All material has been derived from leaf litter samples; damaged, subadult and juvenile shells have been expressly excluded from the type material. Localities have been enumerated from south to north (fig. 6).— **Malaŵi**: (1) Thyolo Dist., Thyolo, Mwalantungi Estate, litter streamhead forest, c. 1100 m, 31.viii.1982, leg. J. Chapman (RMNH 92683, 2 paratypes); (2) Thyolo, Namingombo River, riverine forest litter, c. 1200 m, 8.vi.1980, leg. M (RMNH 92684, 2 paratypes, 2 juv.); (3) Thyolo Mountain Forest on Satemwa Tea Estates, submontane forest remnant, leaf litter, 1300 m, 17.i.2002, leg. K.-D. B. Dijkstra (RMNH 92685, 1 paratype); (4) Blantyre Dist., Blantyre, Soche Mt., submontane litter NE. side, 1400 m, 27.viii.1982, leg. J. Chapman (RMNH 92686, 1 paratype); (5) Blantyre, Soche Mt., leaf litter sites nos. 3-5, 1300-1450 m, 12.iii.1983, leg. M (RMNH 92687, 2 paratypes, 1 juv.); (6) Chiradzulu Dist., Lisau evergreen forest litter, c. 1300 m, ii.1981, leg. J. Chapman [RMNH 92688, 9 paratypes (among which shells shown in figs 1-5; 2 paratypes deposited in IRSNB), 1 subad., 1 juv.; also alc.]; (7) Chiradzulu Dist., Lisau evergreen forest litter, c. 1300 m, 3.i.1982, leg. H. Patel (RMNH 92689, 2 paratypes, 1 damaged shell, 1 subad.); (8) Mulanje Dist., Chigwankhalu Hill, near Malaŵi-Mozambique border just S. of Lake Chilwa, *Brachystegia* litter, 800-900 m, early May 1983, leg. H. Patel (RMNH, 1 juv.); (9) Zomba Dist., Mpita Forest near Thondwe, leaf litter, c. 1100 m, 10.ii.1982, leg. M (RMNH, 1 damaged adult); (10) Zomba Dist., Zomba, Mulunguzi bridge, *Newtonia* riverine forest litter, c. 1000 m, 22.iii.1986, leg. M (RMNH 92690, 2 paratypes, 3 subad., 1 damaged subad.); (11) Zomba, Mulunguzi bridge, riverine forest litter, c. 1000 m, 15.xi.1986-25.iii.1987, leg. P. Kamkodo (RMNH 92691, 5 paratypes, of which 1 deposited in MRAC); (12) Zomba-Namitembo road, Namitembo River riverine forest litter, c. 1000 m, 24.iv.1984, leg. M (RMNH 92692, 4 paratypes, 1 juv.); (13) Zomba, forest road, *Ficus* gulley litter, c. 1100 m, 10.viii.1986, leg. M (RMNH 92693, 12 paratypes, of which 2 deposited in BMNH); (14) Zomba Plateau, below Mulunguzi Dam, riverine forest litter, c. 1450 m, 15.xi.1986-25.iii.1987, leg. P. Kamkodo, **type locality** (RMNH 92681, **holotype**; RMNH 92682, 4 paratypes); (15) Zomba Plateau, riverine forest litter below Williams Falls, c. 1500 m, 15.xi.1986-25.iii.1987, leg. P. Kamkodo (RMNH 92694, 1 paratype); (16) Machinga Dist., Chikala Mt., Liwonde, c. 1550 m, 10.xii.1981, leg. J. Chapman (RMNH 92695, 2 paratypes, 1 juv., also alc.); (17) Chikala Mt., saddle on West side, evergreen forest litter, 800-1300 m, c. 2.xii.1982, leg. H. Patel (RMNH 92696, 2 paratypes, 1 subad.); (18) Lilongwe Dist., Dzalanyama submontane forest litter, 1600 m, 17.iii.1984, leg. Dr R.J. Dowsett (RMNH 92697, 1 paratype, 1 subad., 1 juv.); (19) Mangochi Dist., Mangochi Mt., riverine forest litter below Skull Rock, c. 1200 m, 19.iv.1987, leg. M (RMNH 92698, 1 paratype, 2 juv.); (19a) Mangochi Mt., leaf litter near summit, c. 1500 m, 19.vii.1987 (Meredith, in litt., 28.x.2001); (20) Ntchisi Dist., Ntchisi evergreen forest litter, c. 1500 m, iii.1980, leg. M (RMNH, 1 juv.); (21) Mzimba Dist., S. Viphya, Chikangawa Rest House, riverine forest litter, c. 1700 m, vii.1980, leg. M (RMNH 92699, 1 paratype); (22) Nkhata Bay Dist., Viphya, riverine forest litter near Ntungwa, c. 1550 m, 10.vi.1984, leg. M (RMNH 92700, 1 paratype); (23) Kaningina Forest Reserve off Nkhata Bay road, riverine forest litter, c. 1100 m, 5.vi.1986, leg. M (RMNH 92701, 2 paratypes, 1 subad.); (24) Mzimba Dist., Lunyangwa Forest Reserve, riverine forest litter, c. 1300 m, 3.vi.1986, leg. M (RMNH 92702, 1 paratype).

Diagnosis.— A minute species of *Gulella* s.l., with more or less tapering, almost smooth, shell about three times as long as wide and with three-fold apertural dentition consisting of single angular, labral and columellar processes.

Description.— Shell (figs 1-5) small to minute, clavate, more or less tapering, greatest width well below the middle, always more than two-and-a-half times as long as wide, transparent when fresh to whitish when worn. Umbilicus completely closed. Spire produced, slightly tapering or sides at most subparallel, not convex, apex flattened, obtusely conical to mamillate. Whorls five-and-a-half to just under six, hardly



Figs 1-5. S.E.M. photographs of two paratypes (nos. 23 and 38 of table 1, both loc. no. 6; RMNH) of *Gulella streptostelopsis* spec. nov. 1, shell, length 2.37 mm (no. 38); 2, aperture of do.; 3, apex of do.; 4, shell, length 2.21 mm (no. 23); 5, side view of aperture of do. Scale bars 1 mm for figs 1 and 4, 100 µm for figs 2, 3 and 5. S.E.M. photographs by J. Goud (RMNH).

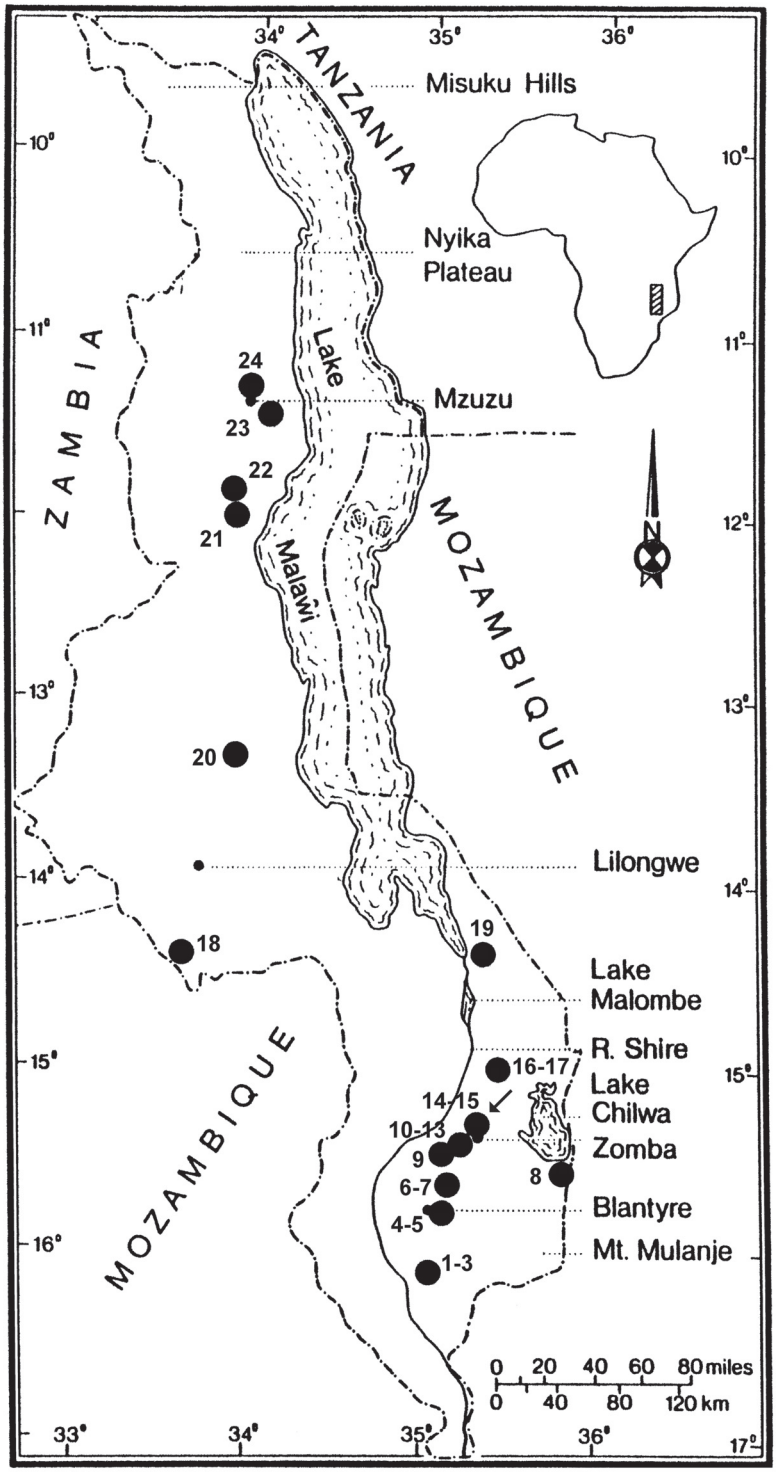


Fig. 6. Map of Malaŵi showing the distribution of *Gulella streptostelopsis* spec. nov. For numbers refer to 'Material examined'. The arrow indicates the type locality.

convex, superficially smooth but under high magnification with faint spiral sculpture and growth lines, growth lines turning to weak costulation behind the labrum (fig. 5). Sutures somewhat impressed, fairly shallow, simple and filiform. Aperture (fig. 2) subovate, sometimes distinctly squarish at base, peristome slightly incrassate and reflected, aperture not or hardly obstructed by three-fold dentition: a small angular process (usually a mere swelling), somewhat distant from and therefore not connected with apex of labrum so that there is no sinus; opposite the angular denticle there is an upper labral process in the form of a thickening of the labrum, which process does not correspond to a depression behind the labrum; finally, a very faint thickening of the lower columella may be interpreted as a columellar process.

Measurements of shell: 2.00-2.37 × 0.75-0.81 mm, l/d 2.62-3.17, lw 0.87-1.00 mm, aperture height × major diameter 0.56-0.62 × 0.44-0.50 mm, 5½->5¾ whorls. Holotype shell 2.31 × 0.78 mm, l/d 2.96, lw 1.00 mm, aperture 0.69 × 0.44 mm, >5¾ whorls. Mean values 2.18 × 0.78 mm, l/d 2.89, lw 0.93, aperture 0.59 × 0.47 mm, average values 2.19 × 0.75 mm, l/d 2.92, lw 0.94, aperture 0.59 × 0.44 mm (n = 38).

Animal so far undescribed.

Distribution (fig. 6).— So far only known from Malaŵi, scattered throughout the country south of 11ºS and mainly between 1000 and 1500 m a.s.l.

Derivatio nominis.— The epithet *streptostelopsis* (latinized Greek for *Streptostele*-like) refers to the likeness to shells of the streptaxid genus *Streptostele*. The kindred epithet *streptosteloides* already exists in the family under discussion. The original combination was *Opeas streptosteloides* Von Martens, 1897, but this taxon appears to be a streptaxid, now named *Streptostele streptosteloides* (Von Martens, 1897) (vide Verdcourt, 2006; Richardson, 1988; Kabat & Boss, 1997). In view of the similarity of the names and probable causes for confusion in possibly closely allied genera the epithet *streptostelopsis* is proposed here.

Discussion

The new species is generally easily recognized because of its small size and *Streptostele*-like shell. Zilch (1960: 567-568) has summarized the knowledge of *Streptostele* on the generic/subgeneric level; in 1959 Venmans had added the subgenus *Textostele*, which is not covered in Zilch's overview. Schileyko (2000: 802-807) has included anatomical data where available. It is difficult to find characters to reliably separate *Streptostele* and *Gulella*. Repeatedly attention has been drawn to the poor delimitation of the genera in the Streptaxidae (e.g., Van Bruggen & Van Goethem, 1997: 6-7, for *Gulella*); regrettably anatomical data are still very scarce and do not materially assist here. Generally *Streptostele* species appear to have costulate shells with no, or very poorly developed, apertural dentition. Also, the number of whorls at times may be quite high (i.e., 7-10), although a few nominal species may have numbers of whorls as low as in the above-described new species (e.g., *Streptostele jaeckeli* Venmans, 1959). For the time being the new taxon has been classified with *Gulella*, which genus in itself may be a polyphyletic unit.

A search of the literature for possibly related taxa has so far proved in vain. Pilsbry (1919), the main text on Congo land molluscs, provides no lead. The subgenus *Silvigulella* Pilsbry, 1919, characterized by a clavate shell with the greatest width well below the

middle, has a costulate shell. Subsequent publications on Congo streptaxids (mainly Van Bruggen & Van Goethem, 1997, 1999) are of no assistance either. A scrutiny of Verdcourt's East African *Gulella* key (1962) and subsequent papers (covered in his 2006 checklist of East Africa, but see next paragraph) comes no nearer in supplying possible candidates for relationship to or at least similarity with *G. streptostelopsis* spec. nov. Finally, Connolly (1939), particularly the overview of the southern African species on pp. 19-23, also does not lead anywhere. The same applies to southern African species of *Gulella* described since.

Recently Verdcourt (2004: 311-312, figs 14-17) described *Gulella eoryi* from Mt. Meru in northern Tanzania. The shell of this taxon looks somewhat like that of *G. streptostelopsis* spec. nov. However, the shell of *G. eoryi* shows more ribbing, a deep umbilicus and "At the back of the aperture a sloping arcuate lamella well away from the peristome corresponds to a deep furrow on the outside of the shell". This immediately makes the similarity of the two taxa entirely superficial.

The next question to be discussed is whether *G. streptostelopsis* spec. nov. might be classified with one of the known subgenera of *Gulella* sensu lato. These have been discussed in some detail by Zilch (1960: 569-573). Vaught (1989) and Millard (1997), simply enumerating generic/subgeneric names, give slightly differing versions, both incorporating *Sphincterocochlion* Verdcourt, 1985. Schileyko (2000: 808-820) treats all subgenera including anatomical data where available. Such data will eventually lead to a division of what is now called *Gulella* and it is confidently expected that many subgenera will be elevated to genus rank. A few of the subgenera of *Gulella* are seemingly well defined and these usually encompass only a limited number of species. On the other hand, many of the other subgenera are very broadly characterized and contain large numbers of nominal taxa. It appears that the present new species cannot be classified with any of the extant subgeneric units in *Gulella* so that the matter must be left in abeyance. Some alcohol material of the new taxon is available and should be properly evaluated, but this would involve micro-anatomy which is outside the competence of the present author. *G. streptostelopsis* spec. nov. might well represent an as yet unknown genus in the Streptaxidae.

The shell of *G. streptostelopsis* spec. nov. is subject to some variation in dimensions as shown by table 1. The abundant material allowed for a check on clinal variation. However, it appears that there is no discernible geographical pattern in the measurements of the shell of the new species. Both small and large shells derive from southern populations and to a slightly lesser degree this also applies to northern populations. As regards size it is not always easy to decide what shells are really adult, vide loc. 5 in table 1 (shells nos. 20 and 25). This sample consists of three shells, (a) a juvenile, 2.0 mm long and with 5 ¼ whorls, but with developed apertural teeth and reflected labrum; (b) a subadult, 2.21 mm long and with <5¾ whorls (no. 20 in table 1) with poorly developed dentition and labrum; (c) an adult, 2.25 mm long and with 5¾ whorls (no. 25 in table 1) with properly developed dentition and labrum.

Finally attention should be drawn to the distribution of *G. streptostelopsis* spec. nov. It is so far only known from Malaŵi, scattered throughout the country south of 11ºS between 800 and 1600 m, but mainly between 1000 and 1300 m a.s.l. First of all, this almost certainly is not a Malaŵi endemic. As shown on the map (fig. 6) many localities are sufficiently close to the borders of at least Zambia and Mozambique to predict occurrence in those countries, particularly as suitable habitat is available there.

Table 1. Measurements in mm of 38 shells of *Gulella streptostelopsis* spec. nov. from throughout its range. The holotype is no. 36; figured paratypes are nos. 23 and 38. The numbers in the seventh column refer to the localities enumerated under 'Material examined'.

no.	shell length × maj. diam.	l/d	lw	aperture height × maj. diam.	number of whorls	loc.	additional data
1	2.00 × 0.75	2.67	0.93	0.56 × 0.44	>5½	19	-
2	2.06 × 0.72	2.87	0.87	0.56 × 0.44	<5½	14	-
3	2.06 × 0.75	2.75	1.00	0.62 × 0.44	<5½	6	labrum reflected, teeth poorly developed
4	2.09 × 0.75	2.79	0.93	0.56 × 0.44	5½	22	-
5	2.09 × 0.75	2.79	0.93	0.59 × 0.44	5½	21	-
6	2.12 × 0.72	2.96	0.93	0.56 × 0.44	>5½	7	fairly poor specimen
7	2.12 × 0.75	2.83	0.87	0.56 × 0.44	5½	23	-
8	2.12 × 0.75	2.83	0.93	0.56 × 0.44	5½	11	subad. with epiphragm
9	2.12 × 0.75	2.83	0.93	0.59 × 0.44	5½	10	-
10	2.12 × 0.75	2.83	0.93	0.62 × 0.44	5½	12	-
11	2.12 × 0.75	2.83	0.93	0.62 × 0.50	5½	14	-
12	2.12 × 0.81	2.62	0.93	0.56 × 0.44	5¼	24	-
13	2.15 × 0.75	2.88	0.93	0.56 × 0.44	<5½	6	teeth barely developed
14	2.15 × 0.75	2.87	0.93	0.56 × 0.44	5½	16	-
15	2.18 × 0.75	2.92	0.93	0.56 × 0.44	5½	11	subad. with epiphragm
16	2.18 × 0.75	2.92	0.93	0.56 × 0.44	5½	6	teeth poorly developed
17	2.18 × 0.75	2.92	0.93	0.56 × 0.44	5½	15	-
18	2.18 × 0.75	2.92	0.93	0.56 × 0.44	>5½	13	-
19	2.18 × 0.75	2.92	0.93	0.56 × 0.44	<5¾	16	-
20	2.21 × 0.75	2.96	0.93	0.56 × 0.44	<5¾	5	subad.? teeth poorly developed
21	2.21 × 0.75	2.96	0.93	0.59 × 0.44	>5½	2	-
22	2.21 × 0.75	2.96	0.96	0.56 × 0.44	5½	17	aperture blocked by dirt
23	2.21 × 0.75	2.96	0.96	0.62 × 0.44	<5¾	6	figs 4-5
24	2.21 × 0.75	2.96	0.96	0.62 × 0.44	5¾	12	-
25	2.25 × 0.75	3.00	0.93	0.62 × 0.44	5¾	5	-
26	2.25 × 0.75	3.00	0.96	0.56 × 0.44	5¾	18	-
27	2.25 × 0.75	3.00	0.96	0.62 × 0.44	5¾	12	-
28	2.25 × 0.81	2.89	1.00	0.62 × 0.44	5¾	4	-
29	2.28 × 0.75	3.04	0.93	0.56 × 0.44	>5¾	23	-
30	2.28 × 0.75	3.04	0.93	0.59 × 0.44	5¾	13	-
31	2.28 × 0.75	3.04	0.93	0.62 × 0.44	5¾	2	-
32	2.31 × 0.75	3.08	0.93	0.56 × 0.44	>5¾	17	aperture blocked by dirt
33	2.31 × 0.75	3.08	0.93	0.62 × 0.44	>5¾	13	-
34	2.31 × 0.75	3.08	1.00	0.62 × 0.44	5¾	6	-
35	2.31 × 0.75	3.08	1.00	0.62 × 0.44	5¾	1	subad.? teeth poorly developed
36	2.31 × 0.78	2.96	1.00	0.69 × 0.44	>5¾	14	**holotype**
37	2.31 × 0.81	2.85	1.00	0.62 × 0.50	5¾	10	-
38	2.37 × 0.75	3.17	1.00	0.62 × 0.50	>5¾	6	figs 1-3

Is there a pattern to be discerned in the distribution of the species under discussion? There is an indication for this because so far *G. streptostelopsis* spec. nov. was not found in the Mt. Mulanje complex in the south of Malawi, and also not on the Nyika Plateau and in the Misuku Hills in the north, all areas well searched for micro-molluscs. Ms H.M. Meredith and her co-workers throughout the years 1975-1988 have extensively

worked these areas by sampling the leaf litter of many forests in and around Mt. Mulanje, the Nyika National Park (including the Chowo Forest just over the border with Zambia), and the Misuku Hills. Dr R. Jocqué (MRAC) has also worked on leaf litter on the Nyika Plateau and the present author and his wife have done the same on the Nyika Plateau and in the Misuku Hills in 1990. All this leads to the albeit preliminary conclusion that absence here might reflect a genuine distribution pattern. Such a conclusion would generate two questions. Would the new species reach its northern limits here, and, if so, what does delimit its distribution?

Correspondence with Ms Meredith on this subject leads to an interesting observation. She writes: "What does stand out, though, is that it is a species of riverine/lowland forest/submontane forest distribution. It is interesting to see Chapman's [i.e. Chapman & White, 1970] descriptions on pages 141, 153 and 161/2. This does not, however, explain why we have not found it on some of the lower slopes of Mulanje, or the Misukus. The submontane forests on the Nyika are on the slopes that haven't been properly studied – we have all looked in the more easily accessible montane forests of the plateau." (Meredith, in litt., 28 October 2001).

Acknowledgements

Acknowledgements are due in first instance to Ms H.M. Meredith for supplying the material, contributing data on the localities, and carefully criticizing the manuscript. Mr J. Goud of the Mollusca section (RMNH) deserves credit for the S.E.M. illustrations (figs 1-5), expertly enhanced by P.A. van Mulken (Biology Section, Leiden University). Numerous visits to the mollusc departments of the Natural History Museum (London), the Institut Royal des Sciences Naturelles de Belgique (Brussels), and the Musée Royal de l'Afrique Centrale (Tervuren, Belgium) have always been of great value – the cooperation of our colleagues Drs P.B. Mordan (BMNH), J.L. Van Goethem (IRSNB) and F. Puylaert & R. Jocqué (both MRAC) has been invaluable. Dr C.O. Dudley (University of Malaŵi, Zomba) is acknowledged for assistance with geographical problems.

Field work in Malaŵi of the present author (1988, 1990, 1993) has been mainly financed by Leiden University, the Koninklijke Nederlandse Akademie van Wetenschappen (Royal Netherlands Academy of Arts and Sciences, Amsterdam), WOTRO/NWO (Wetenschappelijk Onderzoek in de Tropen, The Hague), and the Stichting tot Internationale Natuurbescherming (Foundation for International Conservation, Van Tienhoven Stichting, Amsterdam).

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Received: 30.xi.2006
Accepted: 18.xii.2006
Edited: E. Gittenberger & C. van Achterberg