Studies on the Streptaxidae (Mollusca: Gastropoda Pulmonata) of Malawi 11. *Gulella fortidentata* (Smith), *G. nyikaensis* (Preston), and *G. cruciata* (Von Martens)[1]

A.C. van Bruggen

Netherlands Centre for Biodiversity Naturalis, P.O. Box 9517, NL-2300 RA Leiden, The Netherlands; dolf.vanbruggen@ncb.naturalis.nl

In 1899 the East African streptaxid *Ennea (Gulella) fortidentata* E.A. Smith, 1890, was wrongly incorporated by Smith in the Mollusca checklist of "British Central Africa" [now Malawi]. Preston showed in 1913 that Smith's material represents a new species, *E. nyikaensis* Preston (here figured for the first time), thereby deleting the former from the list. Now the real *Gulella fortidentata* has turned up in Malawi, considerably extending the range of the species. On the other hand, *G. nyikaensis* has not been found since its description – it is probably a local endemic still awaiting rediscovery. However, a doubtful lot from the Misuku Hills is discussed in detail. The somewhat similar *G. cruciata* (Von Martens, 1900) (described from a locality in Tanzania close to the Malawi border and here figured for the first time) is also new to the Malawi list and occurs in the Misuku Hills and on the Nyika Plateau.

Key words: Gastropoda, Pulmonata, Streptaxidae, *Gulella*, typification, Malawi, Tanzania, East Africa.

[1] For no. 10 in this series vide Bruggen, A.C. van, 2008. Studies on the Streptaxidae (Mollusca: Gastropoda Pulmonata) of Malawi 10. Description of *Gulella systemanaturae*, a new species from Dedza Mountain. – Zoologische Mededelingen, Leiden 82: 9-14.

Introduction

The East African streptaxid *Ennea fortidentata* was first introduced to the Malawi [" British Central Africa"] list by E.A. Smith (1899: 581) based on specimens from the Nyika Plateau in the north of the country. Smith writes s.n. "*Ennea (Gulella) fortidentata* Smith, var." as follows: "Generally a trifle stouter than the typical form from Mamboia, and without the minute parietal tooth above the columella." However, Preston (1913: 199-200) drew attention to this material, considering it to represent a new species, *Ennea nyikaensis*, by stating "Shell differing from *E. fortidentata* Smith in its larger and much broader form, the crenulation at the suture is also considerably finer, and it also lacks the small parietal denticle of that species." This implied removal of *E. fortidentata* from the Malawi list.

Gulella fortidentata may now once again be incorporated in the Malawi list based on new material. Recently Mr H.P.M.G. Menkhorst (Krimpen aan de IJssel) donated the mollusc material of his two trips to Malawi (1983, 1985) to the National Museum of Natural History, Leiden (abbreviated RMNH). This valuable material, which included a specimen of *G. fortidentata*, is complementary to the extensive holdings of mollusc material of this south central African country in the Leiden Museum. From time to time these specimens will be reported upon; reference is made here to a

first paper (Van Bruggen, 2009). The Menkhorst shell rekindled interest in the *G. fortidentata/nyikaensis/cruciata* complex, so that all relevant material in the Leiden Museum was re-examined. In addition specimens from The Natural History Museum (London: BM), the Manchester Museum (U.K.), the Museum für Naturkunde (Berlin: ZMB), and the Museum of Comparative Zoology, Harvard University (Cambridge, Mass., U.S.A.: MCZ) were examined. The abbreviation l/d stands for the ratio length/major diameter as an indication of the shape of the shell; l/d values are calculated from micrometer readings before conversion to mm.

Gulella fortidentata (E.A. Smith, 1890) (Figs 1-4, Table 1)

Ennea fortidentata E.A. Smith, 1890: 162, pl. 6 fig. 6 [here reproduced as fig. 1], [Tanzania] "Mamboia at an altitude of 4000 and 5000 feet (*Last*); Hkata (*Emin*)."; Von Martens, 1897: 21, [D.R. Congo] ". . . Bukende, westlich vom Issango-Fluss, 4/7.1891 und Bundeko, östlich von demselben, beides zwischen Ngesi und Mwutan-Nsige, Stuhlmann"; Kobelt, 1904: 222, pl. 27 fig. 14, [Tanzania] "Mamboya"; Kobelt, 1909: 54, [South Africa] Natal [sic!]: 160, [South Africa] Natal [sic!]; Trew, 1993: 37 [Tanzania]"Mamboia, central Africa, at an altitude of 4000-5000 feet (J.L. Last); Hkata, central Africa (E. Pasha)".

Gulella fortidentata. Pilsbry, 1919: 235, [D.R. Congo] "Semliki Valley: Bukende and Bundeko"; Verdcourt, 1953: 39, fig. 2b, [Tanzania] Pienaar's Heights; Verdcourt, 1962: 23, pl. III fig. 4, "K[enya] and T.T. [Tanganyika Territory]"; Verdcourt, 1963: 13 [errata]; Verdcourt, 1983: 235, "?SW, U[ganda], K[enya] (Elgon; Molo), T[anzania] (Nguru Mts., Pienaar's Heights)"; Richardson, 1988: 84; Verdcourt, 2006: 50, "?SW. U[ganda], K[enya] (Elgon; Molo), T[anzania] (Nguru Mts.; Pienaar's Heights)".

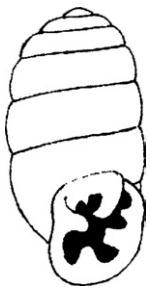
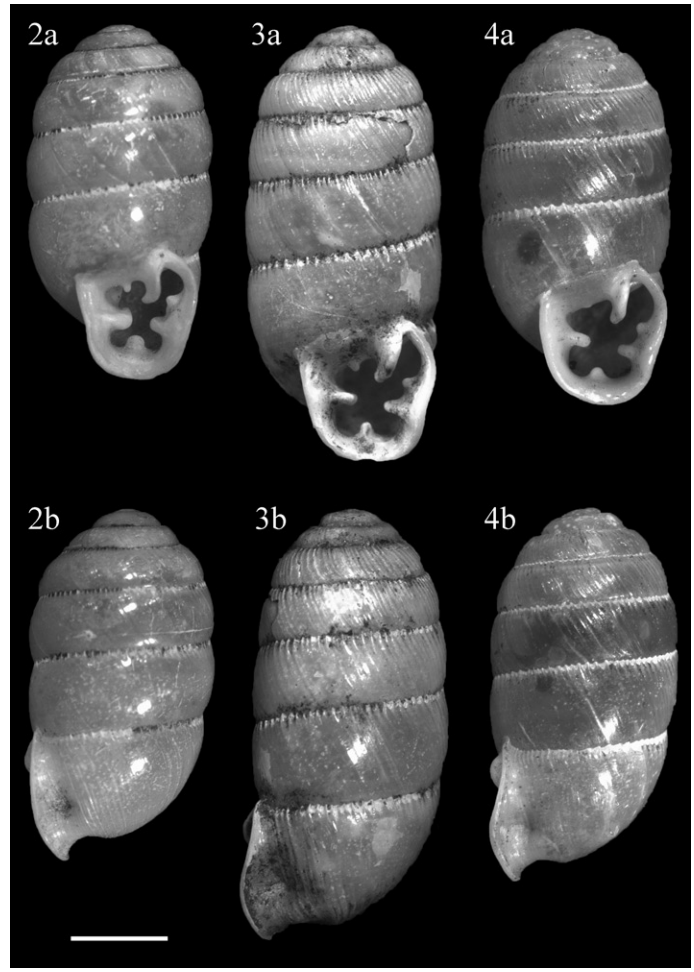


Fig. **1**. Original figure of *Ennea fortidentata* in Smith (1890: pl. 6 fig. 6, original figure 19 mm long), effective and characteristic, although only a simple outline drawing.

Gulella nyikaensis (Preston, 1913) sensu Van Bruggen, 1988: 11, [Zambia] "Kasama Rd. nr. R. Merayshu" and Mweru.

Gulella fortidentata is characterized by a medium-sized (i.e., under 10 mm), oblong-cylindrical smooth shell, with a smooth (or at most slightly pitted) apex, with crenellate suture and a closed umbilicus, and six-fold apertural dentition



Figs **2-4**. Shells of *Gulella fortidentata* (Smith, 1890). **2**, Malawi, Kasungu National Park (RMNH), actual length 7.3 mm; **3**, Uganda, Mt. Elgon (RMNH), actual length 8.6 mm; **4**, do., actual length 7.5 mm, note absence of small parietal denticle. Scale bar 2 mm. Photos Dr A.J. de Winter.

consisting of two parietal processes (i.e., a small mid-parietal process, which may be poorly developed or even completely absent, and the angular lamella), two labral processes (the labral complex corresponding to a noticeable depression behind the labrum), one basal process and a columellar lamella. In Verdcourt's (1962) notation the formula is: 2; 2; 1; 1 (in case the parietal denticle is absent: 1; 2; 1; 1, see fig. 4).

This species is now reinstated on the Malawi list on the strength of three new records in the Leiden Museum from central Malawi: (1) Lilongwe Dist., Lilongwe Nature Sanctuary, leaf litter, c. 1100 m, 10.XI.1984, leg. Dr. J.H. Seyani & H. Patel, don. H.M. Meredith (1 shell); (2) Ntchisi Dist., Ntchisi Mt. evergreen forest, lower slopes, leaf litter, c. 1500 m, V.1980, 36LXA 108232, leg./don. H.M. Meredith (1 very poor but characteristic specimen); (3) Kasungu Dist., Kasungu National Park, Solenje, cave paintings, c. 1100 m, VIII.1983, leg./don. H.P.M.G. Menkhorst (2008) (1 shell, fig. 2).

In addition there are seven East African shells of *G. fortidentata* in three lots in the Leiden museum, labelled as follows: (1) Uganda, Mt. Elgon, ex H.B. Preston, 1913 (with a note in Preston's handwriting "This is true E. fortidentata Smith. What has generally been distributed as this species from Nyassaland is false."), old catalogue no. 74a (1 shell); (2) Kenya/Uganda, Mt. Elgon, ex J.R. le B. Tomlin (1946) in Muséum National de l'Histoire Naturelle, Paris, via A.J. de Winter (1989) (2 shells); (3) Uganda, western slopes of Mt. Elgon, ex A.C. van Bruggen colln. (4 shells, figs 3-4). All three samples may derive from one and the same source, i.e. material procured from or through the dealer H.B. Preston.

The two records of *G. nyikaensis* for Zambia (Van Bruggen, 1988) have been found to refer to *G. fortidentata* rather than the former, which implies that in this enumeration one species is added to the Zambia list and one deleted.

Measurements of all material examined are shown in table 1: 7.0-9.2 × 3.8-4.2 mm, l/d [1.75] 1.88-2.18, length last whorl 3.7-4.4 mm, aperture height × width 2.5-3.1 × 2.5-3.0 mm, whorls >6-7 ¾. Metric data for *G. fortidentata* given by Verdcourt (1962: 23, line missing at the top of p. 23 later corrected

length × maj. diameter	l/d	length last whorl	aperture height × width	number of whorls	presence/absence parietal denticle	specimen
7.0 × 4.0 mm	1.75	3.7 mm	2.6 × 2.6 mm	6 ¾	-	BM: Zambia, Mweru, short and squat with poorly developed apertural dentition, subadult or somewhat abnormal?
-	-	3.7 mm	2.4 × 2.4 mm	-	+/-	RMNH: Malawi, Ntchisi Mt. (poor shell)
7.3 × 3.8 mm	1.93	3.9 mm	2.5 × 2.6 mm	6 ¼	+	RMNH: Malawi, Kasungu N. P.
7.5 × 3.9 mm	1.94	3.9 mm	2.7 × 2.5 mm	6 ½	-	RMNH: Uganda, Mt. Elgon, ex Van Bruggen, fig. 4
7.6 × 3.9 mm	1.97	3.9 mm	2.7 × 2.6 mm	6 ½	-	RMNH: Uganda, Mt. Elgon, ex Van Bruggen
7.7 × 3.9 mm	2	3.9 mm	2.7 × 2.6 mm	6 ½	+	RMNH: Malawi, Lilongwe
7.7 × 4.0 mm	1.94	3.7 mm	2.6 × 2.6 mm	6+	+/-	RMNH: Kenya/Uganda, Mt. Elgon, ex Tomlin
7.9 × 3.7 mm	2.1	4.0 mm	2.7 × 2.6 mm	6 ¼	+	RMNH: Kenya/Uganda, Mt. Elgon, ex Tomlin
8.0 × 4.2 mm	1.88	4.4 mm	3.1 × 2.7 mm	6 ¾	+	BM: Zambia, Kasama Rd.
8.2 × 4.1 mm	2	4.4 mm	3.0 × 2.7 mm	6 ¼	+	RMNH: Kenya, Mt. Elgon, ex Preston
8.5 × 4.0 mm	2.12	4.2 mm	2.7 × 2.7 mm	6 ¾	-	BM: Zambia, Mweru
8.5 × 4.0 mm	2.12	4.4 mm	2.9 × 2.9 mm	6 ¾	+/-	RMNH: Uganda, Mt. Elgon, ex Van Bruggen
8.5 × 4.1 mm	2.06	4.0 mm	2.6 × 2.6 mm	6 ¾	-	BM: Zambia, Mweru
8.6 × 4.0 mm	2.15	4.1 mm	2.7 × 2.5 mm	6 ¾	+	RMNH: Uganda, Mt. Elgon, ex Van Bruggen, fig. 3
9.2 × 4.2 mm	2.18	4.4 mm	3.0 × 3.0 mm	7 ¾	-	BM: Zambia, Mweru

Table **1**. Measurements of shells of *Gulella fortidentata* (Smith) in BM and RMNH examined for this paper.

in Verdcourt, 1963: 13) are 8.4-9.0 × 3.8-4.5 mm, l/d 2.00-2.21. Considering the above metric data, it appears that *G. fortidentata* is subject to fairly considerable variation in the size and shape of the shell: 7.0-9.2 × 3.8-4.5 mm, l/d 1.88-2.21. As regards apertural dentition, the small more or less mid-parietal process varies from well-developed to poorly developed to completely absent, contributing to the general picture of a variable taxon. In the 15 specimens examined (table 1), the small parietal denticle is present in 6 shells, is poorly developed in 3 shells, and is completely absent in 6 shells, i.e. in 9 of the 15 shells there is some form of parietal denticle and in 6 there is no trace of such a process.

Thus, *G. fortidentata* is now known from three rather different localities in south-central western Malaŵi, i.e. the Lilongwe Nature Sanctuary (*Acacia-Combretum* savanna), the Ntchisi Forest (*Pouteria* montane rainforest and *Newtonia* mid-altitude forest), and the Kasungu National Park (*Brachystegia-Julbernardia* woodland). The following seemingly complete, though somewhat patchy, distribution data are now available for this taxon. It ranges from the (far eastern) D.R. Congo through (southern and eastern) Uganda, (central-western) Kenya and (central-eastern) Tanzania southward to northeastern Zambia and (central) Malaŵi. The new localities in Zambia and Malaŵi constitute a noticeable extension southwestward of the range of this taxon. All known records are from >1000 m.s.m.
Thus, *Ennea fortidentata* was introduced to the Malaŵi list in 1890, removed in 1913, to return in 2009 after more than a century, but this time as a properly vindicated taxon.

Gulella nyikaensis (Preston, 1913) (Figs 5-7, Table 2)

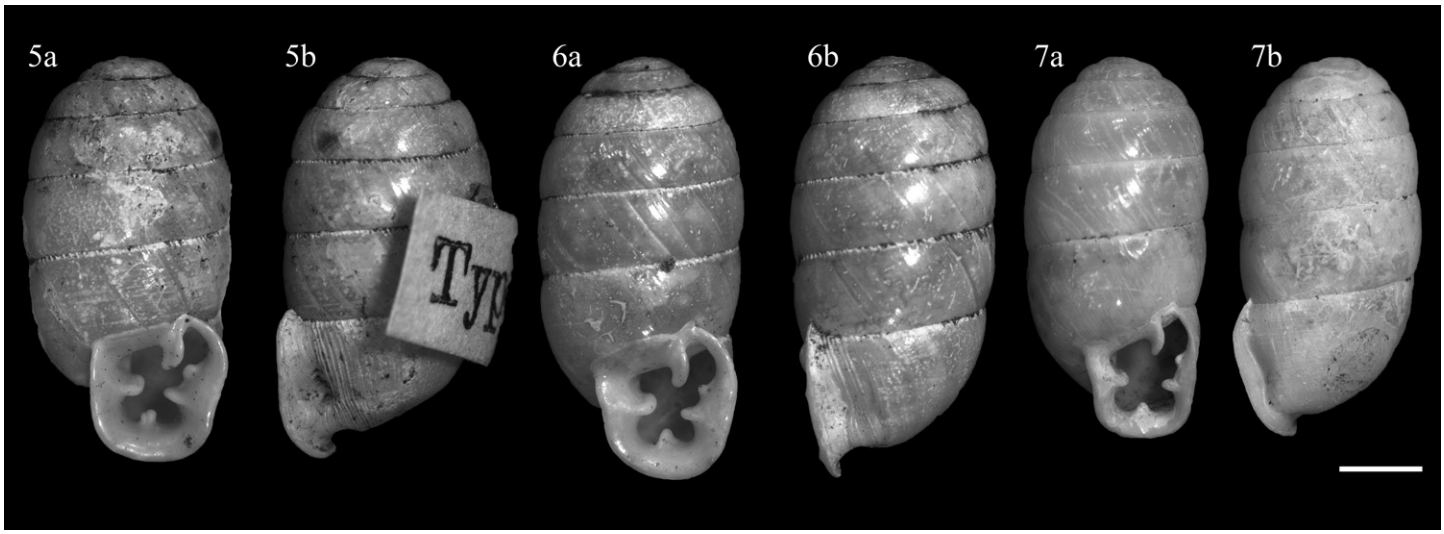
"*Ennea fortidentata* Smith, var." – Smith, 1899: 581, "Nyika Range, 7000 feet".

Ennea nyikaensis Preston, 1913: 199, "Nyika Range".

Gulella nyikaensis. Van Bruggen & Meredith, 1984: 161, Malaŵi; Richardson, 1988: 84, as a synonym of *G. fortidentata*; NEC Van Bruggen, 1988: 11, Zambia = *G. fortidentata*, see above).

Initially material of *Gulella nyikaensis* was identified as belonging to *G. fortidentata*. Preston (1913) in introducing this new taxon simply referred to the specimens mentioned by Smith (1899: 581) as "*Ennea (Gulella) fortidentata* Smith, var."; these automatically became the syntypes of Preston's new taxon. Thanks to the efforts of Mr J. Ablett of the Mollusca Section of the Natural History Museum (London) these syntypes have recently been traced. Mr Ablett found a lot containing five specimens with a label that reads: "*Ennea fortidentata* Smith/Nyika Range, Nyasaland, 7000 ft./Pres. Sir H.H. Johnston/1897.12.31.68-75". The original register entry states that there are eight specimens although there are only five in the lot now. One shell actually has a small printed label with 'Type.' glued to it. This (obviously invalid because unpublished) lectotype designation undoubtedly is due to the efforts of the famous malacologist M. Connolly (1872-1947) who extensively worked on the African non-marine molluscs in what was then called The British Museum (Natural History). Here we accept Connolly's lectotype designation validating it by publication – the shell measures 9.4 × 4.7 mm (fig. 5, table 2). It appears that *G. nyikaensis* has never been figured, which omission is now remedied (figs 5-6). The type shell does not conform to Preston's measurements of 9.25 × 6.25 mm, aperture 4.0 × 3.25 mm. In fact, these metric data do not match any of the five shells left in the type series, particularly in view of the l/d which normally is around 2.00, but according to Preston's metric data the l/d of the type should be 1.41. Most likely the major diameter of the shell shown as 6.25 mm is a typographical error. The label should now be emended to: "*Ennea nyikaensis* Preston, lectotype and 4 paralectotypes, Nyika Range, Nyasaland [Malaŵi], 7000 ft., leg. A. Whyte, June 1896, pres. Sir H.H. Johnston, 1897.12.31.68-78" (see below).

Photos of a shell of 9.8 × 4.9 mm, l/d 1.98, from "Nyika, E. Africa" and correctly identified as *G. nyikaensis*, in the Melvill-Tomlin collection in the National Museum of Wales were submitted by Dr Ben Rowson. The specimen was obtained via the dealer Hugh Fulton. In size, shape and state of preservation it suspiciously looks like those in the type series of *G. nyikaensis*. As stated above, the original BM register entry states that there were eight specimens, but there are only five in the lot now. Would this be one of the missing shells? Would it have reached the Tomlin collection via the BM through e.g., Connolly and Fulton? For the time being it should be labelled as "paralectotype?". If, indeed, this is one



Figs **5-7**. Shells of *Gulella nyikaensis* (Preston, 1913), all from Malaŵi. **5**, Lectotype, "Nyika Range" (BM1897.12.31.68-78), actual length 9.4 mm, note the attached label in fig. 5b (label deleted in fig. 5a); **6**, Paralectotype, "Nyika Range" (BM1897.12.31.68-78), actual length 10.0 mm; **7**, *G.* cf. *nyikaensis*, Matipa, Wilindi Ridge (MCZ 298197a), actual length 8.9 mm. Scale bar 2 mm. Photos Dr A.J. de Winter.

of the missing type specimens, then there are two more shells of this lot to be traced in other collections.

The shell is medium-sized (i.e., under 10 mm), oblong-cylindrical, smooth, only with growth lines (thickening to costulae behind the labrum), the sutures are crenellate, the apex smooth, and the umbilicus closed; apertural dentition is five-fold (Verdcourt's formula 1; 2; 1; 1), i.e. a strong inrunning angular lamella (connected to peristome, forming a noticeable sinus), a small upper labral denticle, a larger lower labral denticle (lamella), the labral complex corresponding to a noticeable outside depression, a left-central basal denticle (lamella), and a columellar lamella in the form of a horizontal inrunning lamella above the middle of the columella. In the "Type." the basal process exhibits an indentation, prior to splitting into two components. Metric data of the type lot (table 2) may be summarized as 8.7-10.0 × 4.6-4.9 mm, l/d 1.89-2.11, length last whorl 5.0 mm, aperture 3.5-3.6 × 3.1-3.4 mm, whorls 6 ¼-7.

Three shells in a lot identified as *G. cruciata*, MCZ 298197: "[Chitipa Dist.] Matipa, Wilindi/Ridge, Misuku Mtns./6000 ft N. Nyasa Distr.", 30.IX.1948, leg. A. Loveridge, Acc. 532 (see below), are similar to the shells of the type series of *G. nyikaensis*. Metric data of this sample (now numbered MCZ 298197a, fig. 7) are 8.5-8.9 × 4.2 mm, l/d 2.00-2.09, last whorl 4.7-4.9 mm, aperture 3.1-3.2 × 2.6-2.7 mm, whorls 6 ¼-6 ½, which would fit into table 2 without trouble – real differences are slight and may be attributed to the fact that these shells clearly represent a population different from that from which the type series is derived. However, somehow a hint of doubt remains, reason why for the time being this lot has been labelled "*Gulella* cf. *nyikaensis*".

A shell in the Manchester Museum (G.C. Spence collln., EE5943) from 'Nyassaland' is shown in the early computer catalogue (Pettitt, Kaiser & Mather, 1979: no. 2248) s.n. "ENNEA LAEVIGATA (DHRN) < FORTIDENTATA SM? (SYN)". The box contains an additional printed number (i.e., 1028) and the labels do not reveal the name of the dealer. Spence died in 1946. At that time the main dealers selling African non-marine shells were Fulton (initially Sowerby and subsequently Sowerby & Fulton) and Preston. Indeed, both these names are abundantly present in the Spence catalogue and the handwriting on one of the labels points to-

length × maj. diam.	l/d	length last whorl	aperture height × width	number of whorls	specimen
8.7 mm (length only)	-	-	-	6 ¾-	middle one, back view
8.9 × 4.7 mm	1.89	5.0 mm	3.6 × 3.2 mm	6 ¾	last shell, i.e. first from right
9.4 × 4.7 mm	1.97	5.0 mm	3.5 × 3.1 mm	6 ¼+	"Type.", fig. 5
9.7 × 4.6 mm	2.11	5.0 mm	3.6 × 3.1 mm	6 ¾	first shell, i.e. first from left
10.0 × 4.9 mm	2.05	5.0 mm	3.6 × 3.4 mm	7-	separate shell, fig. 6

Table **2**. Measurements of shells in the type series of *Gulella nyikaensis* (Preston), BM 97.12.31.68-75: five shells of which one marked with a small printed label "Type.", one separate, other three pasted onto strip of black paper (one in the middle reversed, therefore measured in back view).

wards the former. The shell in question clearly does not belong to *Gulella laevigata* (Dohrn, 1865) or *G. fortidentata*. It measures 8.6 × 4.4 mm, l/d 1.73, has >6 ¾ whorls, with apertural dentition 1; 2; 1; 1, and, bar the low value of the l/d, generally agrees with the shells in the type series of *G. nyikaensis*. Again, for the time being, this is labelled "*Gulella* cf. *nyikaensis*".

It appears that no further material is available. Alexander Whyte (1834-1905), the naturalist employed by Sir H.H. Johnston (1858-1927) when administrator of British Central Africa (1889-1896), visited the Nyika Plateau in June 1896 (fide Dowsett-Lemaire & Dowsett, 2006: 5). Here, on his way to the Misuku Hills, he collected natural history specimens among which the syntypes of *Ennea nyikaensis*. It is as yet impossible to exactly localize these specimens – the Nyika Plateau is immense and contains numerous forest pockets of various sizes. Whyte may have reached the plateau from the east via Livingstonia Mission Station; modern entry is via a western approach alongside the border with Zambia. Ms. Hazel M. Meredith and her collectors have sampled quite a number of these forest pockets and so have the Loveridge party, the Belgian arachnologist Dr R. Jocqué, and the present author and his wife (Van Bruggen & Meredith, 1984: 158-159; Van Bruggen, 1993: 99-100; Van Bruggen, 2008: 353). *G. nyikaensis* is not represented in these collections, which implies that its distribution is rather limited and that the forest patches involved have not been sampled yet.

Gulella cruciata (Von Martens, 1900) (Figs 8-12, Table 3)

Ennea cruciata Von Martens, 1900: 179, "Bulongva"; [*Ennea (Gulella) cruciata*] Moellendorff & Kobelt, 1904: 237, "Bulogwa, Deutsch-Ost-Afrika."; Kobelt, 1909: 54, "Deutsch-Ostafrika"; Verdcourt, 1990: 276, "Tanzania, Bulongva"; Kabat & Boss, 1997: 190, "Bulongva, Deutsch-Ostafrika".

Gulella cruciata. Verdcourt, 1962: 18, "T.T.[Tanganyika Territory], Ukinga Mts."; Verdcourt, 1983: 235, "T[anzania] (Ukina [recte: Ukinga] Mts.); Richardson, 1988: 71; Verdcourt, 2006: 49, "T[anzania] (Ukinga Mts.)".

Ennea (Gulella) cristata. Kobelt, 1910: 160, "*cristata* Martens, M.-Ch. p. 237 . . . . . Deutsch-Ostafrika" [*cristata* is a lapsus for *cruciata* as no other species is treated on p. 237 in Moellendorff & Kobelt, 1904; "*crista* auct." is a further lapsus in Richardson on p. 71].

In Verdcourt's Key 9 to the East African *Gulella* (Verdcourt, 1962: 18), referring to smoothish shells with basically a four-fold apertural dentition, the Malaŵi material with this type of apertural dentition would key out to the following four taxa: *G. excruciata* Connolly, 1931, *G. newtoni* (Smith, 1890), *G. cruciata* (Von Martens, 1900), *G. aequidentata* (Smith, 1890). For various reasons (size, shape, sculpture, apertural dentition, range) the first two of these are not relevant to the present discussion. However, *G. aequidentata* and *G. cruciata* have both been recorded from the parts of Tanzania almost adjoining northern Malaŵi. The former indeed has an aperture with an equidentate pattern, and, in addition, the shell is

Figs **8-9**. Shells of *Gulella cruciata* (Von Martens, 1900), type material with two original labels, Tanzania, Ukinga Mts., Bulongwa (ZMB109958). **8**, Lectotype, actual length 8.5 mm; **9**, Paralectotype, actual length 8.5 mm. Photos Dr B. Rowson.

smaller; shells of this type are not represented in the Malaŵi material. However, there are Malaŵi shells that may be identified as *G. cruciata*. There are no similar taxa in central/eastern Africa fitting the characters employed in the above key recorded after Verdcourt's 1962 paper.

The following Malaŵi material was examined: – Chitipa Dist., Misuku Hills, Mughesse evergreen forest litter, c. 1900 m, 18.IX.1983, leg./don. H.M. Meredith (RMNH: 1, fig. 12); "Matipa, Wilindi/Ridge, Misuku Mtns./6000 ft N. Nyasa Distr.", 30.IX.1948, leg. A. Loveridge (MCZ 298197, Acc. 532, numerous shells, dupl. in RMNH – additional small label "Mwaulambo/Misuku Mtns./Nyasaland/A. Loveridge/30.IX. 1948", fig. 10); Rumphi Dist., "Valley at 5000 ft./Nyika Plateau", X-XI.1948, leg. A. Loveridge (MCZ 298201, 12 shells among which 1 juv., dupl. in RMNH, fig. 11); "Nyika Plateau/7000 ft", XI.48. A. Loveridge (MCZ 298205, 3 shells among which 1 juv.). All three MCZ samples were identified by Dr J.C. Bequaert as *G. nyikaensis* with a note stating "nr fortidentata but weaker sculpture" for MCZ 298197 and MCZ 298201. In addition, excellent photos of the type material of *G. cruciata* (figs 8-9) were available for comparison.

G. cruciata was described from Bulongwa in the Ukinga Mts. in Tanzania; the original specimens were collected by Fülleborn (Verdcourt, 1990) and it has never been recorded

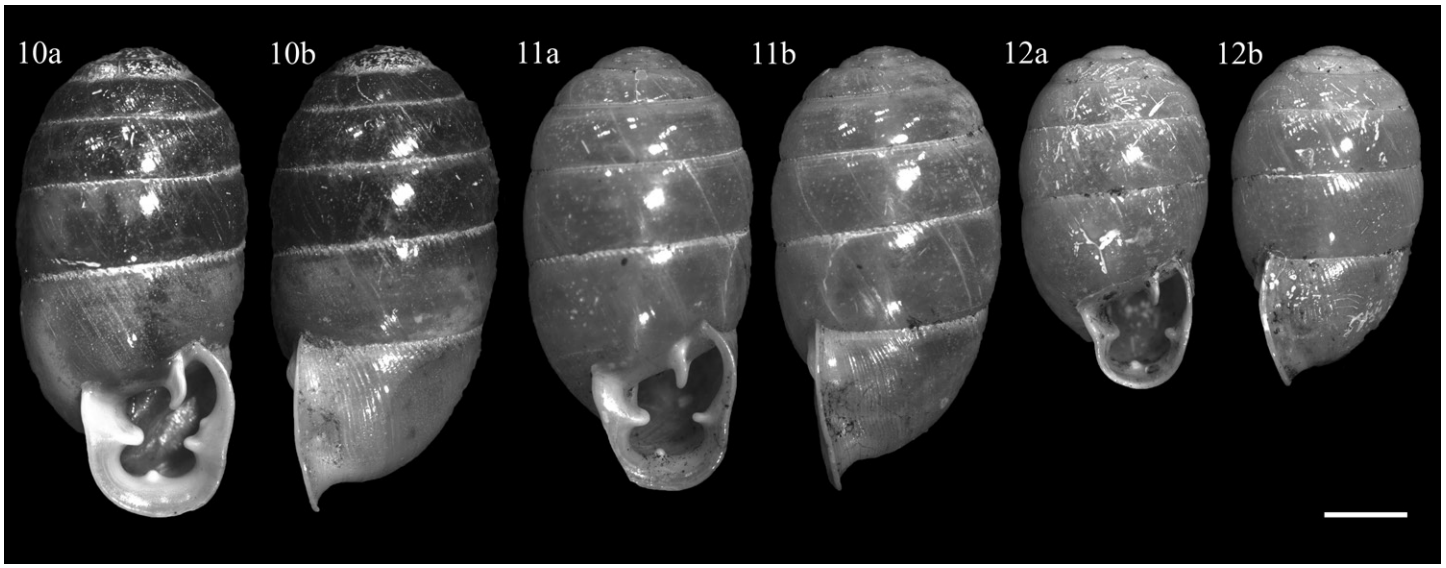
length × maj. diameter	l/d	length last whorl	aperture height × width	number of whorls	apertural dentition	specimen
8.0 × 4.5 mm	1.8	4.5 mm	3.0 × 2.7 mm	6 ¼	4-fold (labrum poorly developed: subadult?)	RMNH, fig. 12
8.5 × 4.2 mm	2	4.9 mm	3.2 × 2.7 mm	6 ¼	4-fold (teeth poorly developed: subadult?)	MCZ 298197
8.5 × 4.4 mm	1.92	4.8 mm*	3.1 × 2.6 mm*	6 to 6+*	4-fold	lectotype
						ZMB 109958
8.5 × 4.8 mm	1.77	4.8 mm*	2.8 × 2.6 mm*	6 to 6+*	4-fold (teeth poorly developed: subadult?)	paralectotype
						ZMB 109958
8.9 × 4.2 mm	2.09	4.7 mm	3.1 × 2.6 mm	6 ½	5-fold	MCZ 298197
8.9 × 4.2 mm	2.09	4.7 mm	3.1 × 2.6 mm	6 ½	5-fold	MCZ 298197
9.2 × 5.2 mm	1.76	5.2 mm	3.5 × 3.4 mm	6+	5-fold	MCZ 298197
9.6 × 5.6 mm	1.71	5.6 mm	3.7 × 3.5 mm	6	4-fold	MCZ 298201
9.6 × 5.6 mm	1.71	5.7 mm	3.9 × 3.4 mm	6-	5-fold	MCZ 298197
9.7 × 5.0 mm	1.95	5.2 mm	3.7 × 3.4 mm	6 ¼	5-fold	MCZ 298197
9.7 × 5.2 mm	1.86	5.5 mm	3.7 × 3.4 mm	6 ¼	5-fold	MCZ 298197
10.0 × 5.1 mm	1.95	5.9 mm	4.0 × 3.5 mm	6 ¼	4-fold	MCZ 298197
10.1 × 5.2 mm	1.93	5.6 mm	3.6 × 3.2 mm	6 ¼	4-fold	MCZ 298201
10.1 × 5.5 mm	1.82	5.4 mm	3.7 × 3.1 mm	6 ¼	4-fold	MCZ 298201
10.2 × 5.6 mm	1.82	5.9 mm	3.7 × 3.5 mm	6 ½	4-fold	MCZ 298205
10.4 × 5.5 mm	1.89	5.9 mm	4.0 × 3.5 mm	6 ¾	4-fold	MCZ 298201
10.5 × 5.2 mm	2	5.6 mm	3.7 × 3.5 mm	6 ½	5-fold	MCZ 298197
10.5 × 5.4 mm	1.95	5.6 mm	3.7 × 3.4 mm	6 ½	4-fold	MCZ 298201, fig. 11
10.7 × 5.1 mm	2.09	5.7 mm	4.0 × 3.6 mm	6 ¼	5-fold	MCZ 298197
10.9 × 5.2 mm	2.07	5.7 mm	3.9 × 3.5 mm	6 ¼	4-fold	MCZ 298197
10.9 × 5.4 mm	2.02	5.9 mm	4.1 × 3.7 mm	6 ½	5-fold	MCZ 298197
11.1 × 5.1 mm	2.17	5.9 mm	3.9 × 3.7 mm	6 ¼	5-fold	MCZ 298197, fig. 10
11.2 × 5.1 mm	2.19	6.0 mm	3.7 × 3.5 mm	6 ¾	5-fold	MCZ 298197
11.2 × 5.2 mm	2.14	6.2 mm	4.1 × 3.7 mm	6 ½	5-fold	MCZ 298197
11.6 × 5.4 mm	2.16	6.0 mm	4.3 × 3.7 mm	6 ¾	5-fold	MCZ 298197
11.7 × 5.6 mm	2.09	5.9 mm	4.4 × 3.7 mm	6 ¾	4-fold	MCZ 298205
12.2 × 5.4 mm	2.28	6.4 mm	4.4 × 3.7 mm	6 ½	5-fold	MCZ 298197

Table **3**. Measurements of shells of *Gulella cruciata* (Von Martens). Measurements with asterisk (*) have been calculated from photographs.

from elsewhere. In addition, this taxon has so far not been figured in the literature. According to the gazetteer (Anonymous, 1965) Bulongwa (Njombe Dist.) is situated at 9°20′S 34°03′ E in the Ukinga (also Kinga) Mts. between 2000 and 2300 m. This is NE of, and not all that far from, the Misuku Hills (Matipa: 9°39′S 33°26′E; Wilindi: 9°41′S 33°28′E) in Malaŵi.

Loveridge's Malaŵi localities (1948-1949; list of stations: Loveridge, 1953; book: Loveridge, 1954) are not always easily interpreted in the light of modern geography (cf. Atlas of Malawi, 1983). As regards his Nyika localities the student is referred to an earlier discussion (Van Bruggen, 2001: 31). In this it is made probable that the Loveridge party sampled the Mwenembwe-Kasaramba Forest complex on the eastern rim of the Nyika Plateau, particularly in view of the altitudes recorded, i.e. 5000 and 7000 ft.

The shell of *G. cruciata* is medium-sized (i.e., under 10 mm), oblong-cylindrical, smooth, only with more or less well-marked growth lines (thickening to costulae, particularly below the sutures and behind the labrum), the sutures



Figs **10-12**. Shells of *Gulella cruciata* (Von Martens, 1900) from Malaŵi. **10**, Matipa, Wilindi Ridge, actual length 11.1 mm (MCZ 298197); **11**, Nyika Plateau at 5000 ft., actual length 10.5 mm (MCZ 298201); **12**, Mughesse Forest, actual length 8.0 mm (RMNH). Scale bar 2 mm. Photos Dr A.J. de Winter.

are crenellate, the apex smooth, and the umbilicus closed. The apertural dentition is four- or five-fold, consisting of an angular lamella, a small upper labral denticle (which may be completely reduced), a mid-labral process corresponding to an outside depression, a mid-basal process and an inrunning mid-columellar lamella. In Verdcourt's (1962) notation the formula is: 1; 2; 1; 1 or, in case the upper labral denticle is absent: 1; 1; 1; 1. Metric data (table 3) may be summarized as

shell characters	***G. fortidentata***	***G. nyikaensis***	***G. cruciata***
length × maj. diam.	7.0-9.2 × 3.8-4.5 mm	8.7-10.0 × 4.6-4.9 mm	8.0-12.2 × 4.2-5.6 mm
l/d	[1.75] 1.88-2.21	1.89-2.05	1.71-2.28
formula apertural dentition	2; 2; 1; 1 or 1; 2; 1; 1	1; 2; 1; 1	1; 1; 1; 1 or 1; 2; 1; 1

Table **4**. Comparison of the shells of *Gulella fortidentata*, *G. nyikaensis* and *G. cruciata*. Verdcourt's (1962) notation has been used to show the apertural dentition.

8.0-12.2 × 4.2-5.6 mm, l/d 1.71-2.28, length last whorl 4.7-6.4 mm, aperture height × width 2.8-4.4 × 2.6-3.7 mm, number of whorls <6-6 ¾. Table 3 also shows that four-fold and five-fold apertural dentition in the 27 specimens examined is about equally represented: dentition 4-fold, n = 13; dentition 5-fold, n = 14.

G. cruciata is new to the Malaŵi list thereby losing its status as a restricted endemic in the Ukinga Mts. in Tanzania.

Conclusions

Table 4 shows that the differences between the shells of *G. fortidentata*, *G. nyikaensis* and *G. cruciata* are seemingly slight. There is a considerable overlap in metric data. Mean/average values for shell length show *G. fortidentata* to be the smallest taxon (8.1/8.0 mm, n = 14), *G. nyikaensis* to be intermediate (9.2/9.1 mm, n = 8), and *G. cruciata* to have the largest shells of this trio (10.1/10.1 mm, n = 27). The presence of a second parietal process is characteristic for *G. fortidentata*; at the same time this is the smallest taxon. Shells with a four-fold dentition are likely to be *G. cruciata*; in addition

comparatively very large and slender shells also seem to belong to the latter. Studies on the relationships of these three taxa must await anatomical and DNA data.

Specimens of the above taxa may be hidden in collections under the names *G. planidens* (Von Martens, 1892) and/or *G. laevigata* (Dohrn, 1865); both are in the same size and l/d range and have similar types of apertural dentition. The shell of *G. planidens* is easily distinguished from those of the various taxa under discussion by e.g., its filiform sutures and the upper labral process being about equal in size to the lower one; in *G. laevigata* the upper labral process is clearly bifid (Van Bruggen & Van Goethem, 1997: 21-22, figs 52-53).

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