ANNALEN
VAN HET KONINKLIJK MUSEUM
VAN BELGISCH-CONGO
TERVUREN (BELGIË)

Reeks in 8°

Zoologische Wetenschappen
Deel 79

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(Mollusca-Achatinidae)

BY

T. E. CROWLEY & T. PAIN

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INTRODUCTION

These large terrestrial snails form a conspicuous element in the molluscan fauna of the Ethiopian region, enjoying a very extensive distribution in East Central Africa (see Map p. 16). Although closely related to *Achatina* by its soft anatomy, *Burtoa* differs from both *Achatina* and *Limicolaria* in the absence of oblique stripes. Unlike *Achatina* they are said never to climb trees, are rarely seen on plantations and are usually found crawling about singly in the forest trails. PILSBRY (1919.83) on the authority of H. LANG, states that at Yakuluku in the Belgian Congo near the Sudan border, *Burtoa* occur in such numbers that the officials had the natives collect the heavy shells to make lime to whitewash their homes. It is not eaten by the natives of the Ituri Forest, who believe it is responsible for certain diseases.

BURTOA have a strong superficial resemblance to certain *Strophocheilidae* of the subgenus *Megalobulimus,* a South American family belonging to the *Acavacea. Burtoa* and *Megalobulimus* seem to replace each other on their respective continents, where they occupy to some extent the same ecological niche, the shells of the two genera having become superficially similar through convergence.

No comprehensive account of the genus *Burtoa* has been attempted since the publication of PILSBRY's monograph in 1904, with the exception of the subspecies occurring in the Belgian Congo, which he dealt with in 1919, and which are further reviewed by RAEMAEKERS 1958. Many forms, particularly those described by BOURGUIGNAT (1889) from Tanganyika Territory have remained almost unknown. In all eighteen recent subspecies have been described by various authors, which number, as a result of careful comparative study we have been obliged to reduce to seven.

It is well to remember in this connection the somewhat inflexible nature of the principles of taxonomy as regards infraspecific groups. Variants may, and in the case of the *Achatinae* do, have extremely inconstant value and it is therefore to some extent a matter of opinion or subjective selection, what constitutes a subspecies. The official rules of nomenclature are so frozen that the only acceptable infraspecific names must be dubbed subspecies regardless of the true value of the groups they designate. Most widely distributed species show certain variations on a population basis, not necessarily correlated with geographic distribution or even with ecology, although they may sometimes be, or appear to be so. This is the case with *Burtoa nilotica.* As RAEMAEKERS (1958) has pointed

out, many of the past named subspecies have been found living together in various places. Aberrants also, may occasionally be found anywhere, but we have attempted to examine the variations of this species in the light of the areas they inhabit. These areas are in some cases very much more clearly defined than others and sometimes correspond to a marked ecological boundary : in others a broad intermediate zone can be located between the districts of two adjacent subspecies, in which the shells can be seen to partake of the character of both. In the past, many names have been given to a few shells of ill defined characteristics, greatly variable within the area they inhabit and it is best that these names be now forgotten.

In general terms, those subspecies of *Burtoa* which live in dense or wooded areas retain their periostracum throughout life, while those from the savannah or sandy regions appear usually to lose it with the onset of maturity.

ACKNOWLEDGMENTS

Specimens of *Burtoa* are by no means common in collections either public or private and the authors commenced their study with a feeling that examination of sufficient examples of this genus on which to form conclusions, might be a matter of considerable difficulty. In actual fact, the co-operation received from both Institutions and private individuals in three continents has been on a most remarkable scale. Many people have taken most unusual pains to answer difficult queries or to send material without stint; we have been privileged to receive type specimens from places both sides of the iron curtain. People have undertaken to search for shells, to spend valuable time in measuring specimens, checking references, providing photographs or looking up records. Without the generous help and co-operation of Dr. J. C. BEQUAERT (who has made us free of his own researches on the subject) and Prof. P. L. G. BENOIT, this revision would have been impossible. The authors consider themselves fortunate in having been able to study over seven hundred examples of *Burtoa* from many localities for the purpose of this monograph, and are deeply indebted to the following for this material : The Musée Royal du Congo Belge, Tervuren (Tervuren Mus.); The Museum of Comparative Zoology (Harvard College), Cambridge, Massachusetts (M.C.Z.); The Zoological Museum, Humboldt University, Berlin (Berlin Mus.); The British Museum (Nat. Hist.); The Senckenberg Institute, Frankfurt-on-Main; The Coryndon Museum, Nairobi; the Rhodes-Livingstone Museum, N. Rhodesia and the Natal Museum, Pietermaritzburg.

Also to Dr. B. VERDCOURT, Dr. G. MANDAHL-BARTH, Dr. A. ZILCH, Mr. C. T. HOLLIDAY, Mr. J. PRINGLE, M. E. BINDER, Dr. W. J. CLENCH, Dr. RUTH TURNER, Dr. K. H. BARNARD, Mr. A. E. SALISBURY; and to Mr. S. P. DANCE, Mr. C. P. SCASE and the Rev. H. E. J. BIGGS, for much helpful criticism and advice. For preparing for us photographs of BOURGUIGNAT 's types preserved in the Museum National d'Histoire Naturelle, Paris, we are indebted to Dr. E. FISCHER and M. J. GAILLARD, and for photographs of STURANY's type of *B. n. arnoldi*, we have to thank Dr. OLIVER PAGET. With the exception of that of *B. n. nilotica* (PFR.) which is the work of one of us (T.E.C.), the accompanying illustrations were prepared from photographs taken by Mr. J. A. WILLSON, to whom our grateful thanks are due. Through the kindness of Dr. R. KILIAS of the Zoological Museum at the Humboldt University, Berlin, we have received photographs, as well as study material, of VON MARTENS'type specimens.

Family **ACHATINIDAE**

Sub-family **Achatininae**

Genus **BURTOA** Bourguignat, March 1889

(Genotype *Bulimus niloticus* Pfr.)

Burtoa Bourguignat, March, 1889. Mollusques de l'Afrique Equatoriale, p. 88.
Burtopsis Bourguignat, March 1889. Mollusques de l'Afrique Equatoriale, p. 98.
Livinhacia Crosse, April 1889. Journ. de Conchyl., *37,* pl. 107.
Burtoa Pilsbry, 1904. Man. of Conch. (2), *16,* p. 298.
Curtiburtoa Jousseaume, 1911, Bull. Soc. Zool. France, *36,* p. 94.
Burtoa R. H. Raemaekers, 1958, Journ. de Conchyl., XCVIII, No. 2, p. 102, ff.

Characters.

The general shell characters are :

1) The bulimoid shape, the shell being higher than greatest width, with a relatively large and often capacious body-whorl and comparatively short spire;
2) A non-truncate columella, continuous with the base of the outer lip;
3) A simple outer-lip, even in adult shells, seldom expanded or thickened;
4) A small nepionic shell, decussately sculptured;
5) A relatively narrow or almost closed umbilicus;
6) Sculpture of small, unequal folds, cut into low oblong granules by impressed spiral lines.

Subfossil and Fossil Species.

Although shells of the family Achatinidae are known from the Upper Eocene or Oligocene of the Sudan and from the Miocene of Uganda and Kenya, fossil records of the genus Burtoa are extremely rare. C. R. Boettger (1947, Archiv. Fur Molluskenkunde. *76,* p. 95, pl. 2, fig. 5) figures and describes a specimen of *Burtoa* from deposits presumably of Pleistocene age occurring near the north-western shore of Lake Nyasa in Tanganyika Territory and refers it to the recent subspecies *B. n. emini* (Mts.) (= *B. n. benoiti* C. & P.). This locality is, however, far from the known range of the latter race and we should be inclined to refer this shell to *B. n. giraudi* (Bgt.).

From Tanganyika we have examined two shells, obtained in a subfossil condition at Williamson's diamond mines, Shinyanga, Usukama, and these also

we are unable to separate from *B. n. giraudi* (BGT.) which is the subspecies still living in the area.

The following new subspecies represents the oldest known occurrence of the genus *Burtoa*.

Burtoa nilotica verdcourti, n. subsp. — Pl. I, Figs. 1-2.

1914 *Burtoa* cf. *nilotica* NEWTON, Quart. Journ. Geol. Soc. Lond., *70,* p. 195, pl. 30, fig. 13.

This fossil subspecies has been taken from Miocene (Burdigalian) deposits in the Kavirondo district of Kenya.

The original material collected in 1912 by Dr. FELIX OSWALD at Kachuku in the North-east corner of Lake Victoria was reported on by R. BULLEN NEWTON (1914). It consisted of a specimen only 16 mm. long, which NEWTON considered as representing the summit portion of a much larger individual; there was also an internal cast of similar size. We have examined these specimens, now in the British Museum and are of the opinion that the former in particular (No. G. 23393), is in fact a complete though immature example of a *Burtoa*.

Through the kindness of Dr. B. VERDCOURT we received for study an adult and well preserved specimen obtained on the Kavirondo Gulf, from deposits of the same light coloured calcareous sandstone as the original material. In this shell the spire is somewhat short and convex but shows considerable signs of wear and the apex is missing so that little impression of the original shape can be gained. The spire and upper part of the body-whorl show distinct traces of the characteristic *Burtoa* sculpture consisting of small unequal folds cut into low oblong granules by weakly impressed spiral lines. The body whorl is somewhat elongated, three-quarters the total length, umbilicus very narrow but distinct, columella slightly curved, erect, aperture capacious, vertical, oblong; outer lip thin, slightly retracted near its upper insertion. No trace of periostracum or colour remain.

This holotype (No. 572/56) and many specimens are in the Coryndon Museum, Nairobi. Type locality Rusinga Site R3, Kavirondo, Kenya, in Miocene (Burdigalian) calcareous sandstone, collected by Dr. L. S. B LEAKEY.

Dr. VERDCOURT was able in addition to send us the four paratypes for examination and in each case the apex was preserved, a feature missing in the holotype, as previously mentioned. The apex appears appreciably narrower than in all recent subspecies of *Burtoa* or in Dr. OSWALD's examples. On two specimens traces of characteristic sculpture occur on the body whorl and spire, and on one of the three specimens having a visible columella, this is seen to be noticeably curved as in the recent subspecies *B. n. benoiti*. In no case is there any indication of a truncated columella, nor indeed does there seem any grounds for considering that the fossils form anything but another subspecies of *B. nilotica*.

One of the four paratypes lacked a portion of the body whorl and a number of eggs, in all probability those of the snail itself, were seen to be well preserved

therein. The sandstone filling the apertures of the fossils was noticed in one case to contain fragments of the brilliant black garnet peculiar to the island of Rusinga.

Measurements of Adult Shells (approx. : in mm.)

Length	Greatest Width	Aperture Length	Aperture Width	Remaining Whorls	
80	47	55	30	?	Holotype
85	51	53	33	6½	Paratype
72	42	47	27	6	»
68	44	40	26	5½	»
56	37	37	26	5½	»

ANATOMY OF BURTOA.

The anatomy of specimens identified as *B. n. nilotica* from Bukamo Island in Lake Victoria, has been well described by REYNELL (1906, 197) and POLLONERA has figured the genitalia and jaw of a form from west of the same lake, perhaps belonging to the same subspecies, which we consider should more correctly be referred to *B. n. crassa* (MTS.), since the nominate race of *nilotica* is unknown from Lake Victoria. PILSBRY (1919) has dissected *B. n. obliqua* (MTS.) (= *B. n. congoensis* C. & P.), and describes it as follows : « The penis with its enveloping sheath is very stout, 6.5 mm. in diameter. When the sheath is opened, the penis is seen to be slender, enlarging at the distal end, which projects from the sheath as in many *Achatinae*. The vas deferens penetrates the sheath above the middle becoming much smaller inside, where fibres and bands of the penial retractor are inserted upon it throughout its length. As noted by REYNELL, the penial retractor is inserted distally on the diaphragm.

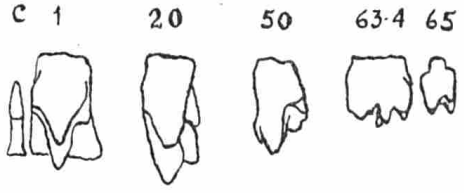
The vagina is much longer than in the form described by REYNELL, who gives the length as 10 to 15 mm. The spermatheca is recurved : at the apex is a little oval body about 2 mm. long; but probably this would disappear when the organs became functionally active.

Length of penis 24 mm.; of spermatheca and duct, 30 mm., of which the spermatheca occupies about 10 mm.; of the vagina, 33 mm;. of the shell 107 mm. ».

The divergence between the figures of REYNELL and PILSBRY would no doubt be due to the fact that they dealt with different subspecies.

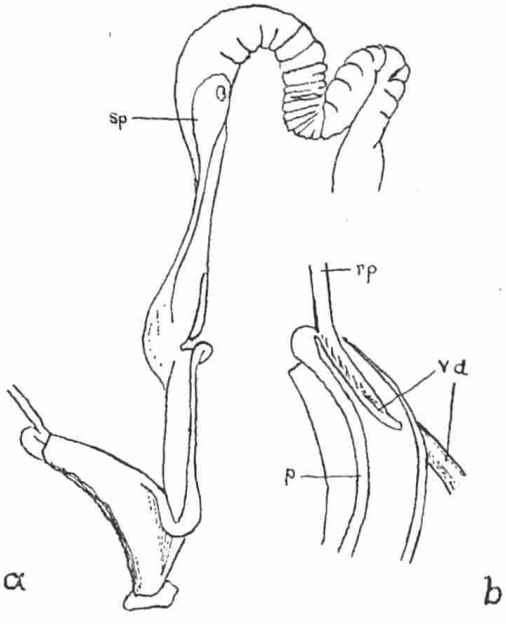
MEASUREMENTS.

We have followed the method used by BEQUAERT in his studies in the *Achatininae* (Bull. Mus. Comp. Zool. Harvard, *105*, 1950). All dimensions are measured to the half millimetre. The length (or height) is that of the longest vertical axis of the shell, from the tip of the spire to the basal edge of the outer lip. The greatest width is the largest diameter in front view, measured at right angles to the vertical axis, from the left margin of the body-whorl to the extreme



× 115

B. n. arnoldi Stur. Representative teeth from the radula. (After Connolly).



B. n. obliqua (Mts) Genitalia. (After Pilsbry). In b, the penis sheath opened: p, penis; rp, penial retractor; sp, spermatheca; vd, vas deferens.

outer edge of the outer lip. In the aperture, the length is the longest obtainable distance from the insertion of the outer lip on the parietal wall, to the basal edge of the outer lip. The width is measured at right angles to the length as the greatest distance from the inner edge of the columella to the outer lip or to the outer margin of the rim, if the latter is expanded. This seems to be the only practical method of determining the width of the aperture in *Burtoa* which do not show any particular outer accretions on the lip after full adult size is reached. When the lip thickens in old age, it is by additions to the inner layer of the margin and does not change the total width of the aperture.

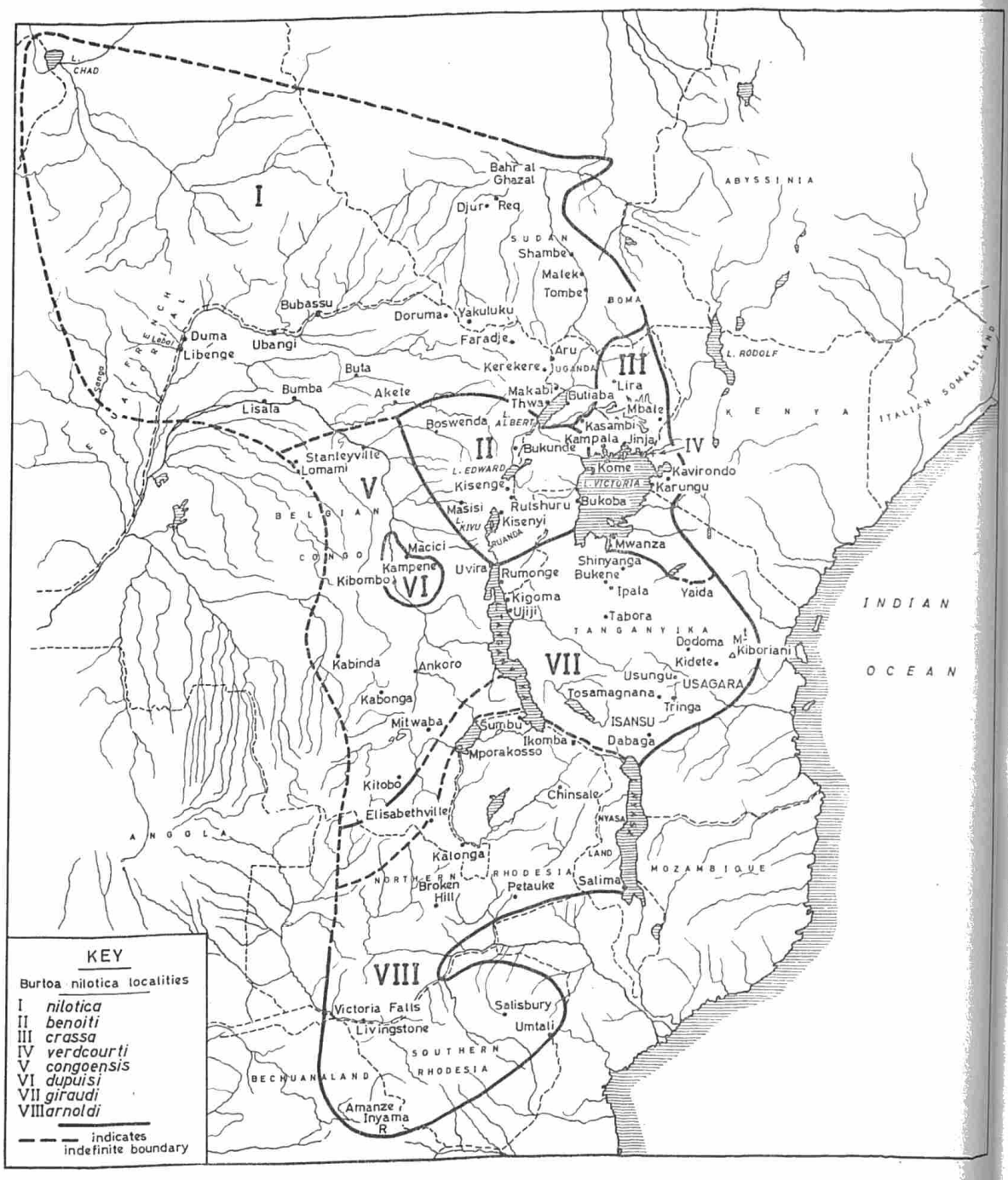
DISTRIBUTION — Map p. 16.

Burtoa was originally known only from the highlands of Central East Africa, until DUPUIS discovered its existence in the Rain Forest of the Upper Congo. It has since been found much farther westward; JOUSSEAUME described his *B. n. louisettae* from the Upper Sanga, and GERMAIN recorded examples from the « pays M'Bagba » and from Kanem, east of Lake Chad. Today *Burtoa* is known from the Sudan, south of 10° N. lat., throughout the region of the Great Lakes, in the Upper Congo, the Upper Sanga and Lake Chad, possibly also in certain parts of the Kasi drainage. The southern-most record is on the banks of the Amanze Inyama River in Matabele Land, about 22° S. lat. In East Africa these large snails avoid the coastal belt where *Achatina* is very abundant. The record of its occurrence at Kismayu on the East Coast quoted by LONGSTAFF (1914, Journ. Linn. Soc. Lond. Zool., p. 250) on the authority of H. B. PRESTON, would seem to us to be certainly erroneous. In Kenya, *Burtoa* has been known only from the region about Lake Victoria and records are very scanty. It enjoys a far wider distribution in Tanganyika Territory and many localities have been recorded, especially in the vicinity of Lake Tanganyika. It is apparently fairly abundant also, in the Rhodesias and in the south-eastern Belgian Congo.

TYPE MATERIAL.

It has been possible in many cases to examine the actual type specimens and every effort has been made to determine the present location of the remainder and to obtain photographs wherever possible, type specimens being preserved in the following institutions :

British Museum (Nat. Hist.)	*B. n. nilotica* (PFR.), (lectotype)
Berlin Zoological Museum	*B. n. emini* (MTS.), (syntypes)
	B. n. schweinfurthi (MTS.), (holotype)
Museum National	*B. n. sabasmia* (BGT.), (holotype)
d'Histoire Naturelle, Paris	*B. n. giraudi* (BGT.), (holotype)
	B. n. jouberti (BGT.), (holotype)
	B. n. reymondi (BGT.), (holotype)
Musée Royal	*B. n. benoiti* n. subsp. (holotype)
du Congo Belge, Tervuren	*B. n. congoensis* n. subsp. (holotype)
	B. n. dupuisi (PUTZ.), (holotype)


KEY
Burtoa nilotica localities
I nilotica
II benoiti
III crassa
IV verdcourti
V congoensis
VI dupuisi
VII giraudi
VIII arnoldi
indicates indefinite boundary
CHAD
SUDAN
ABYSSINIA
BOMA
UGANDA
L. RODOLF
KENYA
ITALIAN SOMALILAND
BELGIAN CONGO
L. EDWARD
L. ALBERT
L. VICTORIA
L. KIVU
RUANDA
TANGANYIKA
INDIAN OCEAN
NYASALAND
MOZAMBIQUE
RHODESIA
NORTHERN RHODESIA
SOUTHERN RHODESIA
BECHUANALAND
ANGOLA
Bahr al Ghazal
Djur
Req
Shambe
Maleka
Tombe
Bubassu
Doruma
Yakuluku
Duma
Libenge
Ubangi
Faradje
Aru
Kerekere
Buta
Bumba
Akele
Lisala
Makabi
Thwa
Butiaba
Lira
Mbale
Kasambi
Kampala
Jinja
Boswenda
Bukunde
Kome
Kavirondo
Karungu
Kisenge
Masisi
Rutshuru
Bukoba
Kisenyi
Stanleyville
Lomami
Macici
Kampene
Kibombo
Uvira
Rumonge
Kigoma
Ujiji
Mwanza
Shinyanga
Bukene
Ipala
Yaida
Tabora
Dodoma
Kiboriani
Kidete
Usungu
USAGARA
Tosamagnana
Tringa
ISANSU
Dabaga
Ikomba
Mporakosso
Sumbu
Mitwaba
Kabonga
Kabinda
Ankoro
Kitobo
Elisabethville
Chinsale
Kalonga
Broken Hill
Petauke
Salima
Victoria Falls
Livingstone
Salisbury
Umtali
Amanze
Inyama
R

Vienna Museum	*B. n. arnoldi* (STUR.), (holotype)
Turin Museum	*B. n. minor* (POLL.), (holotype)
Coryndon Museum, Nairobi	*B. n. verdcourti* n. subsp. (holotype)

Regarding the types of *obliqua, oblonga* and *crassa* of VON MARTENS 1895, the shells from which these subspecies were described may be in the Berlin Museum, but as neither holotype nor type locality were designated, they cannot be identified with certainty.

The present whereabouts of the remaining five described forms could not be traced in spite of extensive enquiries. That of *B. n. louisettae* (JOUS.) is not in Paris, neither are those of *B. n. bridouxiana* (BGT.), *B. n. pethericki* (BGT.), *B. n. lavigeriana* (BGT.) or *B. n. bourguignati* (GRAND.) (= *B. n. grandidieri* PILS.) (J. GAILLARD in litt., 1958). No *Burtoa* are contained in that part of BOURGUIGNAT's collection which is preserved in the Geneva museum (E. BINDER in litt., 1957); and all these must be considered lost.

KEY TO THE SUBSPECIES OF *BURTOA NILOTICA* (PFR.)

The following key is offered with reservations, since because of the variability of the subspecies, individual specimens may sometimes be found which contravene the following descriptions. Also, because these descriptions must necessarily to a certain extent be comparative, a general acquaintance with the genus is desirable. The key is applicable only to fully adult examples and should be read in conjunction with the following descriptions.

1. Shells normally without periostracum 3, 4
2. Shells normally with some periostracum 5, 8
3. Shell heavy, globose, tending to slight polish, wide in proportion to length ..... *arnoldi*
4. Shell not answering to the description in 3 above ..... *giraudi*
5. Mouth of shell set noticeably obliquely to the axis 6, 7
6. Shell small (normally below 100 mm.), thin, pale, blue inside mouth ..... *dupuisi*
7. Shell large (normally above 110 mm.), heavy ..... *congoensis*
8. Mouth of shell not noticeably oblique 9, 12
9. Shell small (normally below 95 mm.) 10, 11
10. Shell noticeably heavy, short-spired ..... *crassa*
11. Shell medium in weight, narrow; columella curved, spire long, whorls tumid, aperture relatively small ..... *benoiti*
12. Shell large (usually above 95 mm.), periostracum brown-streaked, persistent; aperture nacreous internally, pale blue or shining bluish-white, tending to transluscency ..... *nilotica*

Burtoa nilotica nilotica (PFEIFFER). Plate I, fig. 4. Plate II, figs. 6-7.

1861 *Bulimus niloticus* PFEIFFER, Proc. Zool. Soc. Lond., p. 24.
1862 *Bulimus niloticus* PFEIFFER, Malakoz. Blatt., *8*, p. 14.

1864 *Limicolaria (Bulimus) nilotica* DOHRN, Proc. Zool. Soc. Lond., p. 116.
1865 *Achatina (Limicolaria) nilotica* v. MARTENS, Malakoz. Blatt., *12,* p. 196.
1866 *Achatina (Limicolaria) nilotica* v. MARTENS, ibid., *13,* p. 94.
1868 *Bulimus niloticus* PFEIFFER, Mon. Helic., *6,* p. 86.
1868 *Bulimus niloticus* MORELET, Voyage WELWITSCH, p. 48.
1870 *Achatina nilotica* v. MARTENS, Malak. Blatt, *17,* p. 32.
1870 *Limicolaria nilotica* PFEIFFER, Novitates Conc., *4,* pp. 5-6, pl. 110, figs. 1, 2.
1873 *Achatina (Limicolaria) nilotica* v. MARTENS, Malak. Blatt., *21,* p. 38.
1874 *Achatina nilotica* JICKELI, Moll. N. O. Afr., p. 151.
1881 *Limicolaria nilotica* PFEIFFER & CLESSIN, Nomencl. Helic., p. 262.
1881 *Limicolaria nilotica* CROSSE, Journ. de Conch., *29,* pp. 138, 269.
1889 *Burtoa nilotica* BOURGUIGNAT, Moll. Afr. Equator., p. 89.
1889 *Livinhacia nilotica* CROSSE, Journ. de Conch., *37,* p. 109.
1891 *Achatina (Livinhacia) nilotica* v. MARTENS, Sitzungsber. Ges. Naturf. Fr. Berl., p. 14.
1893 *Livinhacia nilotica* KOBELT, Conch. Cab. (Edit. 2), p. 5, pl. 1, fig. 1.
1893 *Livinhacia nilotica* E. A. SMITH, Proc. Zool. Soc. Lond., p. 634.
1895 *Burtoa nilotica* E. A. SMITH, Proc. Malac. Soc. Lond., *1,* p. 323.
1897 *Limicolaria (Livinhacia) nilotica* v. MARTENS, Deutsch Ost. Afr., *4,* Beschalte Weichth., p. 94.
1897 *Limicolaria (Livinhacia) nilotica* var. *Schweinfurthi* v. MARTENS, ibid., p. 95.
1904 *Burtoa nilotica* PILSBRY, Man. of Conch. (2) 16, p. 300, pl. 27, fig. 5.
1904 *Burtoa nilotica* var. *Schweinfurthi* PILSBRY, ibid. [Exclusive of the synonymy of *B. pethericki* (BGT.)].
1906 *Burtoa nilotica* GERMAIN, Bull. Mus. Hist. Nat., Paris No. 3, p. 171.
1906 *Achatina (Burtoa) nilotica* PRESTON, Proc. Malac. Soc. Lond., *8,* p. 89.
1910 *Burtoa nilotica* GERMAIN, Bull. Mus. Hist. Nat. Paris, No. 4, p. 211.
1911 *Burtoa nilotica* J. THIELE, Wiss. Ergebr. D. Z. Afr. Exp. (1907-8), *3,* p. 204.
1911 *Burtoa louisettae* JOUSSEAUME, Bull. Soc. Zool. France, *36,* p. 94, fig.
1912 *Burtoa nilotica* GERMAIN, Bull. Mus. Hist. Nat. Paris, No. 7, p. 434.
1913 *Burtoa nilotica* GERMAIN, ibid., No. 5, p. 285.
1914 *Burtoa nilotica* LONGSTAFF, Journ. Linn. Soc. Lond., *32,* p. 250.
1919 *Burtoa nilotica* PILSBRY, Bull. Amer. Mus. Nat. Hist., *40,* p. 84.
1919 *Burtoa nilotica schweinfurthi* PILSBRY, ibid., p. 86.
1958 *Burtoa nilotica* RAEMAEKERS, Journ. de Conch., XCVIII, No. 2, p. 102.

(Certain references by GERMAIN (1906, Moll. Afrique Cent. Franç., p. 487 and DAUTZENBERG and GERMAIN 1914 : Rev. Zool. Afr., *4,* p. 30) have been ommitted from the above synonymy, since it is doubtful to which subspecies they actually refer).

Since the original description of *B. nilotica* is somewhat inadequate the following is based upon a typical specimen from Madi, Uganda :

« Shell large, acuminate-ovate, solid, covered with a fibrous dark-brown periostracum, streaked with darker lines. Whorls 6½, moderately convex rapidly increasing, spire broadly conoid, apex acute, suture impressed, crenulate. Apical whorls practically smooth, sculpture of small unequal folds, cut into low oblong granules by weakly impressed spiral lines commencing upon the second whorl, becoming much weaker below the periphery. Aperture subovate, very large, three-quarters the total length, columella straight, erect, inner margin narrowly reflexed over the umbilicus, which is very narrow, parietal calus moderately thick, peristome simple, not thickened or reflected. Interior of the aperture bluish-white, outer lip, columella and calus pink. »

The nominate race of *B. nilotica* is easily distinguished from other races by reason of its very large, somewhat elongated aperture, strong sculpture (especially on the upper half of the body whorl), and in live specimens, by the invariable presence of a well-preserved periostracum, especially on the lower whorls, although in common with the other races this is entirely missing from the first 2½ whorls in all the specimens seen. This subspecies shows considerable variation in thickness of the shell, the columella, calus and outer lip being considerably thickened in some very old examples.

BEQUAERT (in litt., 1958) points out that type localities of the nominate race and of var. *schweinfurthi* appear to be almost identical and this fact indicates the need to eliminate *schweinfurthi* from the list of valid subspecies. BEQUAERT states as follows :

« PFEIFFER in 1861 based typical *nilotica* on at least one of the specimens collected by PETHERICK at the « Sources of the White Nile », and sent to PFEIFFER by CUMING. This locality is, however, vague and if taken literally, misleading. PETHERICK never came anywhere near the true sources of the White Nile, which were totally unknown in 1861. It is nevertheless possible to determine fairly precisely the area where PETHERICK collected his specimens of *nilotica*.

« JOHN PETHERICK, for some years a merchant and British Consul at Khartoum made in the years 1853 to 1859 several journeys up the Nile and the Bahr-el-Ghazal, as related in his book « *Egypt, the Soudan and Central Africa* » (London, 1861). The map which he appended to this book is grossly inaccurate; PETHERICK believed that he had reached the equator whereas actually he never went further south than about 7° 30′ N. This is evident from the corrected map he published in 1869 in a later book, « *Travels in Central Africa and Explorations of the Western Nile Tributaries* », by Mr. and Mrs. PETHERICK, London 2 Vols. The courses of his earlier travels are also traced on this map, showing that they were confined to the basin of the Djur River. This is the region that should be regarded as the type locality of *B. nilotica* s. s.

« The specimens on which VON MARTENS based his var. *schweinfurthi* in 1897 had been collected by SCHWEINFURTH in precisely the same basin of the Djur River «... im gebiet des Ruk und Djur, Zuflüsse des Bahr-el-Ghasal »). Two of these specimens had been figured by PFEIFFER as *Limicolaria nilotica*

in 1870 (*Novit. Conch. Vol. 4, Pl. 110, fig. 1 and 3 only);* and Von Martens the same year (1870, *Malak Blatt., 17, p. 32),* gave for them the precise locality « Sheriba Ghattas », which is only slightly east of the Djur River in 7° 30′ N., 28° 30′ E.

« It should be noted that Pfeiffer's original description was based on an unusually large and slender specimen, the measurements being given as 118 mm. in length, 60 mm. in diameter, the aperture 67 mm. × 42 mm. This holotype was never figured and its present location is unknown. If Pfeiffer kept it, it probably went to Dohrn, and later to the Stettin Museum with the entire Pfeiffer collection. » (It is understood that all this material was destroyed in the late war.)

«... The two specimens at the B. M. which I examined some years ago (1933) are at best paratypes; it is not even certain that Pfeiffer ever saw them since Cuming might have kept them in his collection, sending only his largest specimen to Pfeiffer for the description. In any case they are part of the original lot collected by Petherick and therefore at least topotypes. They are smaller than Pfeiffer's holotype being respectively 98 mm. and 100 mm. long, as I measured them in 1933. Note that the largest specimen from Sheriba Ghattas described by Von Martens as var. *schweinfurthi* was 114 mm. long and 79 mm. in greatest width. Bourguignat seems to have been misled by his poor knowledge of Central African geography when he proposed his *Burtoa pethericki,* referring to it Pfeiffer's fig. 3 (1870, *Nov. Conch., 4, pl. 110),* which came from the Bahr-el-Ghazal and was later used by Von Martens for his var. *schweinfurthi.* However, Bourguignat described his *pethericki* from actual specimens from Tanganyika (« Contrée voisine du Nyanza Oukerewe (= Lake Victoria), notamment aux environs de Boma, dans le Mwere et de Msalala dans l'Uniamwezi, 2° 40′ S. to 5° 30′ S., and 31° 40′ E. to 33° 50′ E. »). As Pilsbry pointed out (1919, 87), the name *pethericki* must therefore be referred to some form of *B. nilotica* from Tanganyika : the location of his types is unknown. »

It might be of interest to note in passing that the activities of John Petherick are alluded to in no less a work than Jules Verne's *Five Weeks in a Balloon.*

Pilsbry (1919, 87) noted that there was little in the description to distinguish Jousseaume's *louisettae* from typical *schweinfurthi* and after examination of specimens we ourselves are quite unable to separate them. Jousseaume in his original description draws attention to the chestnut-coloured, black streaked periostracum and states that the spire is short, shorter than in any other race of *Burtoa.* Some of the more globose amongst the nominate race which we have examined likewise have a very short spire and Jousseaume's description would apply equally well to them.

Burtoa nilotica nilotica would appear therefore to have a very wide distribution extending from the Nile basin and Southern Sudan, between 5° and 10° N. latitude, westwards across French Equatorial Africa. One dead shell undoubtedly belonging to this race, was obtained at Nasarawa in Northern

Nigeria by Dr. BENNET and sent by him to the late Dr. DARTEVELLE (Tervuren Mus. No. 782097). It is somewhat immature, measuring 92 mm. in length. The locality is very far removed from the known range of the genus *Burtoa* and although there is no ecological reason why the genus should not occur as far west as this, corroborative evidence so far is entirely lacking.

Burtoa nilotica s. s. and var. *schweinfurthi* were described from the region of the Rek and Djur, tributaries of the Bahr-el-Ghazal in the Southern Sudan, and *louisettae* from the Upper Sanga in the French Congo. The so-called type set in the British Museum consists of two shells, the larger of which is much damaged; as concluded above, neither of these is the type, which must be regarded as lost.

We therefore regard the B. M. set as syntypes and select the smaller and more perfect of them as the lectotype.

Measurements of Adult Shells (in millimetres)

Length	Greatest Width	Aperture Length	Aperture Width	Whorls	
118	70	72	41.5	6½	Madi
117	80	71	45	6	Aketi
114	74	73	42.5	6½	Rek. (Type of *schweinfurthi*)
113	68	65	40	6½	Bahr-el-Ghazal
110	63	66	38	6½	S. W. Sudan
105	70	66	42.5	5½	Lake Albert
105	68	71	39.5	6	Libenge
103	68	65	41	5½	Lake Albert
103	61	62	36	5¾	Madi
103	66	63	36	5½	Djema
101	62	61	37	6	Aketi
100	60	62	39	5½	Djur (Lectotype)
100	67	65	39	5½	Aketi
100	60	56	34.5	6½	Boma plateau
98	60	56	35	6½	Bunyoro
97	54	57	34	5¼	Malek
96	59	56	36	5½	Malek
90	60.5	53	34.5	6	Aru

SPECIMENS EXAMINED :

SUDAN : Bahr-el-Gebel, Malek [LONGSTAFF-PAIN Coll.; B. M. (N. H.)]; Lake Shambe, Shiek Tombe, Kiro, Lado, [LONGSTAFF-B. M. (N. H.)]; Bahr-el-Ghazal (CONNOLLY-PAIN Coll.); S. W. Sudan (PITMAN-Coryndon Mus.); Region of the Rek and Djur (SCHWEINFURTH-Berlin Zool. Mus., type and paratype of *schweinfurthi* (MTS.); PETHERICK-CUMING Coll., B. M. (N. H.), Lectotypes); Nelichu, Boma plateau, Equatoria at 3700 ft. (J. G. MYERS-M.C.Z.).

UGANDA : Madi (HALE-CARPENTER-Coryndon Mus.); Kasambio, Bunyoro, CROWLEY Coll.); East and West sides of Kufu River, 31° 70′ E., 1° 32′ N. (G. H. E. HOPKINS-M.C.Z.); Mbale, Buguere (HOPKINS-M.C.Z.); Lira, Lango (HOPKINS-M.C.Z.).

BELGIAN CONGO : *Ubangi District* : Libenge (LÉONTOVITCH - Tervuren Mus., DEGNER - M.C.Z., SCHUBOTZ - Senckenberg); Duma (SCHUBOTZ - Senckenberg); Banzyville (DOLENGA - KOWALEWSKY - Tervuren Mus.); Mongupa (VERMEIREN - Tervuren Mus.); entre Gemena et Bosobolo (RAEMAEKERS - Tervuren Mus.); Gemena (RAEMAEKERS - Tervuren Mus.); Kwawa (WALLIN - Tervuren Mus.); Karawa (WALLIN - Tervuren Mus.); Eloko, Alberta near Bumba (DYKE-PAIN Coll.); Lisala (M.C.Z.). — *Uele District* : Aketi (PITMAN-PAIN coll., JOHNSON - Tervuren Mus.); Doruma (H. SCHOUTEDEN - Tervuren Mus. & M.C.Z., DE GRAER - Tervuren Mus.); Ibembo (HUTSEBAUT, DEHEYN - Tervuren Mus.); Buta (HUTSEBAUT - Tervuren Mus.); Dika, au sud Doruma (H. SCHOUTEDEN-Tervuren Mus.); Bambesa (BRÉDO, VRIJDAGH, STEYAERT-Tervuren Mus.), frontière du Soudan (A. PILETTE-Tervuren Mus.); Yakuluku (LANG & CHAPIN - M.C.Z. & Tervuren Mus.). — *Ituri District :* Kerekere (TURCO - Tervuren Mus.); Kawa (BRÉDO - Tervuren Mus.); Mahagi (PITMAN-PAIN coll.); Aru (PASTEELS - Tervuren Mus.); Faradje (H. SCHOUTEDEN - Tervuren Mus. & M.C.Z.); Kilo (THALMAN, BURGEON - Tervuren Mus.); Abimva (H. SCHOUTEDEN - Tervuren Mus.); Aba (Tervuren Mus.); Abock (CH. SCOPS - Tervuren Mus.); Ishwa (H. BRÉDO - Tervuren Mus.); Geti (RANDOUR - Tervuren Mus.); bord lac Albert (Tervuren Mus.).

Burtoa nilotica benoiti, n. subsp. Plate 2, fig. 8.

1897 *Limicolaria nilotica* var. *emini* V. MARTENS, Deutsch Ost Afr., *4,* Beschalte Weichth, p. 94, fig. on p. 96 (not of V. MARTENS 1891; in part *benoiti,* in part *giraudi).*

1904 *Burtoa nilotica* var. *emini* PILSBRY, Man. of Conch., *16,* p. 301, pl. 29, fig. 7 (not of V. MARTENS 1891).

1909 *Burtoa nilotica minor* POLLONERA, Moll. Spedizione el Ruwenzori; di S.A.R. Il Principe L. AMEDEO DI SAVOIA, Parte Scientifica, p. 197, pl. 19, figs. 5 and 6.

1919 *Burtoa nilotica emini* PILSBRY, Bull. Amer. Mus. Nat. Hist., p. 85, pl. 5, figs. 1 and 1a (not of V. MARTENS 1891).

1936 *Burtoa nilotica* GERMAIN, Bull. Mus. Hist. Nat., Paris, 2nd Ser., vol. *8,* No. 2, p. 153.

1958 *Burtoa nilotica emini* RAEMAEKERS, Journ. de Conch., XCVIII, No. 2, p. 102 (not of V. MARTENS 1891).

VON MARTENS' subspecies *emini,* of which neither holotype or type locality were designated by the author, was based upon specimens collected by STUHLMANN at Ipala (40° 30′ S., 32° 50′ E.), in Tanganyika Territory, in June 1890. VON MARTENS subsequently received shells from STUHLMANN, collected at Bukoba on the Western shore of Lake Victoria, May 1892, one of which he figured in 1897, p. 96, as representing *emini.* Ipala is undoubtedly near the middle of the

area inhabited by the very variable subspecies *giraudi* BGT.. and very far removed from the known range of the subspecies referred to *emini* by subsequent authors. Through the kindness of Dr. KILIAS we have been privileged to examine the three syntypes collected in 1890 and now preserved in the Berlin Museum. Of these only one is adult and this conforms almost exactly with the measurements given by VON MARTENS in his original description. This specimen is indistinguishable from subspecies *giraudi* and does not in any way resemble VON MARTENS' figure of 1897, nor the shells from the Belgian Congo subsequently referred to *emini* by PILSBRY. It seems evident therefore that the shells from Ipala must in fact be identified as *giraudi*, of which *emini* becomes a synonym; VON MARTENS' name is not therefore available for the more northerly race, for which we propose the name *benoiti*.

The shell of *B. n. benoiti* is narrowly umbilicate, rather thin but strong, cinnamon in colour, partly covered with a thin ochreous-tawny periostracum, streaked with chestnut brown. The sculpture is finer than in the other subspecies and extends over three whorls to the aperture. The columella is strongly curved, merging smoothly into the outer lip, the aperture is a little over half the total length. The outer lip is slightly retracted near its upper insertion. Parietal callus, columella and outer lip pale pink. Interior of the aperture pale blue, nearly white in some specimens.

This subspecies is narrower, has noticeably more tumid whorls and a more elongated apex than the other forms of *B. nilotica*. It comes nearest to *B. n. crassa* (MTS.), which has an adjacent geographical distribution, but the curved columella, more convex whorls and thinner shell serve to distinguish it.

Shells of subspecies *benoiti* obtained on Damba I., in Lake Victoria and now in the Coryndon Museum are considerably elongated, resembling a small form of *crassa* obtained in gardens in Jinja and differing only in respect of their being very much thinner, though somewhat larger and certainly adult. In spite of this indication however, we have nowhere seen any examples of both *benoiti* and *crassa* from the same locality and we favour the retention of both as valid subspecies.

Two specimens of *benoiti* taken alive on the volcano Nyamlagira, Belgian Congo, by J. H. HODGSON (M.C.Z. No. 99160) are albinos, the shell beneath the periostracum being white, including the columella and aperture, the latter being suffused with pale blue within. The lip is white. Specimens from Idjoi Island, Lake Kivu, are the largest yet examined; in these the columella is vertical, the shell almost imperforate. *B. n. benoiti* has been taken at a height of 5000 ft. near Karambi on the Congo-Uganda border by Dr. BEQUAERT, and at 5200 ft. at Boswenda, near Lulenga, Belgian Congo, by Dr. SCHOUTEDEN, which are the highest altitudes so far recorded for this genus.

There is nothing whatever in the description or figure to separate POLLONERA's subspecies *minor* from some small but adult *benoiti* we have examined from the Ruwenzori. *B. n. minor* was described from this region and *benoiti* from Rutshuru.

Measurements of Adult Shells (in millimetres)

Length	Greatest Width	Aperture Length	Aperture Width	Whorls	
95	58	56	32.5	6½	Kivu
94	55	50	31	6½	Mt. Kinangongo
93	59	49	34	6½	Rutshuru (holotype)
93	54	48	30	6½	Bukenda
92	54	47	30	6¼	Kisenyi
91	54	50	29	6¼	Damba Is.
90	55	49	31	6½	Rutshuru (paratype)
90	55	49	32.5	6½	Nyakabande
87	50.5	47	28	6½	Volcano Nyamlagira
87	50	44	26	6½	Kisenyi
82	48	45	26	6½	Karambi

SPECIMENS EXAMINED :

UGANDA : Damba Is., L. Victoria (Coryndon Mus.).

BELGIAN CONGO : *Kivu District* : lake Kivu, Idjwi Isl. (HENDRICKX - PAIN coll., LOVERIDGE - M.C.Z. & PAIN coll.); Rutshuru (J. GHESQUIÈRE - Tervuren Mus.); foot of Mt. Kinangongo, nr Kibati (J. BEQUAERT - M.C.Z.); Karambi, 5000 ft (J. BEQUAERT - M.C.Z.); Kirotshe (R. KOLP - Tervuren Mus.); Tshibinda (L. BURGEON - Tervuren Mus.); Boswenda (J. BEQUAERT - Tervuren Mus.); Mulungu (L. BURGEON, F. HENDRICKX - Tervuren Mus.); Katana (COLBACK, HOSTENS- Tervuren Mus.); chaîne du Mugira Nyankera (G. ROBERT - Tervuren Mus.); Kibati (H. SCHOUTEDEN - Tervuren Mus.); Butembo (J. WOLFS - Tervuren Mus.); volcan Nyamlagira (J. H. HODGSON - M.C.Z.).

RUANDA : Kisenyi (BASTIAENS - Tervuren Mus.); Terr. Nyanza, colline Bulima (POYER - Tervuren Mus.); Kirinda (Tervuren Mus.); Kibati (H. SCHOUTEDEN - Tervuren Mus.); Terr. Ngosi, colline Magwatu (VARKAS - Tervuren Mus.); Ruhengeri (COLBACK - Tervuren Mus.); Nyakabande (LOVERIDGE - M.C.Z.; PAIN coll.).

URUNDI : Usumbura (RAEMAEKERS - Tervuren Mus.); Imuramvya (Tervuren Mus.).

Burtoa nilotica crassa (VON MARTENS). Plate I, fig. 3.

1895 *Limicolaria nilotica* var. *crassa* VON MARTENS, Nachrichtsbl. d. Malak. Ges. *27*, p. 181.

1897 *Limicolaria nilotica* var. *crassa* VON MARTENS, Deutsch. Ost. Afr., *4*, Beschalte Weichth, p. 97, fig. on p. 96.

1904 *Burtoa nilotica* var. *crassa* PILSBRY, Man. of Conch., (2) *16*, p. 302, pl. 29, fig. 8.

1906 *Burtoa nilotica* REYNELL, Proc. Malac. Soc. Lond., *8*, p. 197 pl. 17, figs. 1-3 (anatomy).
1919 *Burtoa nilotica* GERMAIN, Bull. Mus. Hist. Nat. Paris, p. 640.

Shells of this subspecies are far thicker and heavier for their size than those of any other. The periostracum is usually preserved or partially so, in live specimens. This is golden brown in colour, with numerous dark streaks marking periods of growth. The nepionic whorls are smooth, the characteristic granular sculpture appears on the latter half of the third whorl. The spire is narrow and more produced than in other races; the aperture is three-quarters the total length, and of moderate width; suture impressed, crenulate. Columella almost vertical, umbilicus narrow but deep. The parietal calus, columella and outer lip are bright pink in colour, the interior of the aperture pale blue or, in a few specimens seen, almost white.

When he described his *B. n. crassa,* VON MARTENS (1895, 181) designated neither a holotype nor a type locality. It would appear however, that the only examples he possessed at the time (1895) were some collected in the Kavirondo district of Kenya by O. NEUMANN during the previous year. The only specimen preserved in the Berlin Museum under this locality and collector is a very stunted and weathered shell of very different measurements from those given by VON MARTENS in the original description; in addition, the locality itself is in doubt (KILIAS in litt. 1959). It seems impossible therefore, to determine what shells VON MARTENS actually had before him at the time of description.

The shell figured by VON MARTENS (1897, 96) is stated to be from Lake Victoria, collected by G. A. FISCHER, without more definite locality or date. There is no justification however, for assuming that this shell represented the type of *B. n. crassa* or was even in VON MARTEN's hands in 1895. The figured shell is preserved in the Berlin Museum.

In view of these facts, Kampala, Uganda is here designated as the type locality of *B. n. crassa* and a typical specimen from that district is figured herein (pl. I, fig. 3).

Crassa is the only subspecies so far recorded from Kenya Colony, and all those hitherto known to us from there are in a very dead condition. It appears confined almost entirely to the lakeside, if indeed, it still lives in this locality, which Dr. VERDCOURT considers very doubtful in view of the intensive cultivation of the area.

Measurements of Adult Shells (in millimetres)

Length	Greatest Width	Aperture Length	Aperture Width	Whorls	
97	60	57	34.5	6½	Kampala
97	60	53	35.5	6½	Entebbe
94	57	50	31.5	6½	Entebbe
91	60	52	33.5	6½	Kampala
89	62	52.5	33.5	6½	Kampala
83	52	47	29	5½	Jinja
81	48	43.5	26	5½	Jinja
80	58	47	30	6½	Kavirondo
79	50	45.5	28	5½	Maragoli
79	51	45	30	6½	Yaida Steppe
76	45	43.5	26	5½	Jinja

SPECIMENS EXAMINED :

UGANDA : Kampala (J. DEN DOOP - M.C.Z., PAIN Coll.); Jinja (CRIDLAND - Tervuren Mus., PAIN Coll.), Kisubi, near Entebbe (SCHWARTZ & AMBENON - M.C.Z., PITMAN - PAIN Coll.); Masindi (RAVEN - Tervuren Mus.); lake Victoria, Nipiravira - Tervuren Mus.).

KENYA : Maragoli, Kaimosi (ALLEN-TURNER - Coryndon Mus.); Kavirondo (NEUMANN - Berlin Mus.; possible paratype).

TANGANYIKA TERRITORY : Mwanza (Rev. K. H. SHORT - BIGGS Coll.); Yaida Steppe, Hohenlohe Graben (E. OBST - M.C.Z.).

Burtoa nilotica congoensis, n. subsp. Plate II, fig. 9.

1904 *Burtoa nilotica* var. *obliqua* PILSBRY, Man. of Conch. (2), *16,* p. 303, pl. 30, fig. 18 (Not of VON MARTENS 1895).

1913 *Burtoa nilotica* var. *obliqua* GERMAIN, Bull. Mus. Nat. Hist. Paris, p. 285 (Not of VON MARTENS 1895).

1913 *Burtoa nilotica* var. *obliqua* C. R. BOTTGER, Ann. Soc. Malac. Belgique *47* (1912), p. 94 (Not of VON MARTENS 1895).

1914 *Burtoa nilotica* var. *obliqua* DAUTZENBERG and GERMAIN, Rev. Bot. Zool. Afr., *4,* p. 32 (And p. 30 as *B. n. nilotica* PFR.) (Not of VON MARTENS 1895).

1919 *Burtoa nilotica obliqua* PILSBRY, Bull. Amer. Mus. Nat. Hist., *40,* p. 84, pl. 12, figs. 1 and 2 (Not of VON MARTENS 1895).

1958 *Burtoa nilotica obliqua* RAEMAEKERS, Journ. de Conch., XCVIII, No. 2, p. 102 (Not of VON MARTENS 1895).

VON MARTENS, in describing his *B. n. obliqua* designated no type locality but quoted various localities in the Usagara and other districts on the Eastern side of Lake Tanganyika — his figured shell being from Kidete (6° 40′ S., 36° 44′ E.) — all within the area now known to be inhabited by the very variable

B. n. giraudi (Bgt.). We have however, examined nearly fifty specimens identified as *B. n. obliqua,* sent to us by various institutions and these have without exception been labelled from Belgian Congo districts. We must conclude that the original description was based on a few oblique specimens of *giraudi* such as certainly occur amongst others in Tanganyika territory, and that Von Martens' *obliqua* is thus merely a synonym of the former species. This is confirmed by a close examination of photographs of one or two of Von Martens' shells which indicate that, like *giraudi,* they are entirely destitute of periostracum.

On the other hand by a notable coincidence, a well-marked subspecies certainly inhabits a large portion of the Congo basin whence no other race of *Burtoa* has been recorded, and this form agrees very well with Von Martens' description of his *obliqua.* For this hitherto unrecognised subspecies we propose the name *congoensis.*

This is by far the largest subspecies known and appears to be entirely confined to parts of the Belgian Congo. The shell is very variable in shape and is mainly distinguished by the rapid increase of the whorls, the last one inflated at or below the periphery, giving the shell an oblique, lengthened contour and making the aperture noticeably wide. The periostracum is usually well preserved and the colour is claret-brown copiously streaked with black, or sometimes wholly black.

The sculpture of small unequal folds cut into low oblong granules by impressed spiral lines, is strongly developed on the body-whorl above the periphery, becoming obsolete below. Suture strongly impressed, crenulate. Nepionic whorls smooth, the sculpture commencing about the middle of the third whorl. The umbilicus is fairly wide and deep, particularly in the very obtuse oblique examples. The strong columella often curved, projects outwards towards the base. The aperture is very wide, with a strongly flaring outer lip which however, though sometimes thickened within, is not reflected. It is joined to the columella by a thick calus which, with the outer lip and the columella, is bright pink becoming pale blue within the aperture.

The designated type specimen (No. 5072) together with numerous paratypes (Mus. nos 5050-5075) are at Tervuren Museum; type locality Belgian Congo, Haut-Lomami district, between Sampwe and Kikondja (Capt. Tonneau).

Pilsbry (1919, 85) on the authority of Dr. J. C. Bequaert states than when estivating, these snails bury themselves in termite hills, closing the aperture of the shell with a solid milky-white calcareous epiphragm.

Measurements of Adult Shells (in millimetres)

Length	Greatest Width	Aperture Length	Aperture Width	Whorls	
126	80	76	46	6½	Luashi
124	86	70	44.5	6¼	Kikondja (Paratype)
122	77	70	42	6¼	» »
121	78	65	42	6½	» »
120	80	69	42.5	6½	Ankoro
118	78	72	43	5¾	Kikondja (Holotype)
122	80	75	46	6½	Kabongo
113	75	73	45	6½	Stanleyville
111	84	64.5	46	5½	Stanleyville
113	73	65	42	6½	Kibao
110	72	68	44	6½	Mitwaba
105	67	64	38	6¼	Uvira

SPECIMENS EXAMINED :

BELGIAN CONGO : *Uele District* : Medje (H. SCHOUTEDEN - Tervuren Mus., LANG & CHAPIN - Tervuren Mus.). — *Stanleyville District* : Stanleyville (H. SCHOUTEDEN - Tervuren Mus. & M.C.Z., J. GHESQUIÈRE - Tervuren Mus.).. — *Kivu District* : Uvira (M. VERHAEGHE - PAIN Coll.). — *Lualaba District* : Kabongo (M. VERHAEGHE - PAIN Coll.); Kapiri (G. DE WITTE-Tervuren Mus.), Kanzenze (G. DE WITTE - Tervuren Mus.); Bukama (J. BEQUAERT - Tervuren Mus.); embouchure riv. Lufira dans le Lualaba (GREY - Tervuren Mus.); Katentania (VAN SACEGHEM - Tervuren Mus.); Luashi (FREYNE - Tervuren Mus.). — *Tanganika District* : Kibao nr Ankoro (J. BEQUAERT - PAIN Coll.); Kiambi (G. DE WITTE - Tervuren Mus.); Mulongo (Tervuren Mus.); Katompe (M. BEQUAERT - Tervuren Mus.). — *Haut Katanga District* : Mitwaba (M. VERHAEGHE - PAIN Coll.); Kalonga (M. VERHAEGHE - PAIN Coll.); Lukonzolwa (HISSETTE - Tervuren Mus.). — *Sankuru District* : riv. Lomami (LUTZ - Tervuren Mus.); Kabenga (Tervuren Mus.); Luputa (BOUVIER - Tervuren Mus.). — *Haut Lomami District* : between Sampwe and Kikondja (Capt. TONNEAU - Tervuren Mus.).

Burtoa nilotica dupuisi (PUTZEYS). Plate III, fig. 10.

1898 *Livinhacia dupuisi* PUTZEYS, Ann. Soc. Malacol. Belgique. Bull. Sciences, *33*, p. LXXXII, fig. 1.

1904 *Burtoa dupuisi* PILSBRY, Man. of Conch. (2) *16*, p. 306, pl. 23, fig. 47 (copy of original description and figure).

1914 *Burtoa nilotica* var. *dupuisi* DAUTZENBERG and GERMAIN, Rev. Zool. Afr., *4*, 31.

1919 *Burtoa nilotica dupuisi* PILSBRY, Bull. Amer. Mus. Nat. Hist., *40*, 87.

B. n. dupuisi is most readily recognized by its persistent straw-coloured periostracum, streaked with dark-brown lines. With the exception of a paratype

from the DUPUIS collection, which is far larger and heavier than the other adult examples seen, this subspecies has a comparatively thin shell. The characteristic granulose sculpture is well developed above the periphery, almost obsolete below. The spire is short, convex, the body-whorl moderately inflated specially below the periphery, giving the shell the appearance of a diminutive *congoensis*. The columella, pale-blue or pink in colour is thin, erect or slightly curved in the more widely umbilicate examples. It is joined to the outer lip by a thin, blue or pink, transparent calus. The umbilicus varies from moderate width, to a narrow chink in some examples seen. The aperture is three-quarters the total length, oblong-ovate, outer-lip thin, pale-blue or pink, the interior bluish-white, suffused with pink, which may appear as a band along the edge of the lip.

B. n. dupuisi is known only from the Rain-Forest of the Upper Congo and would appear to be a rare and local race. The type was described from the Forest of Macici in the Manyema.

Measurements of Adult Shells (in millimetres)

Length	Greatest Width	Aperture Length	Aperture Width	Whorls	
107	70	67	41	5½	Micici (Paratype)
92	60	60	35	5½	Kampene
86	55	55	34	5½	Kampene
84	52	50	30	5½	Kibombo
78	50	49	30	5½	Kampene

SPECIMENS EXAMINED :

BELGIAN CONGO : Maniema, Wasumba, Micici (holotype, DUPUIS - Tervuren Mus.); Kampene (E. MILLIAU) - Tervuren Mus.); Kibombo (J. BEQUAERT - Tervuren Mus.); Maniema district, route de Kabambare, riv. Luaye (E. MILLIAU - Tervuren Mus.); Maniema, Mwana Kusu (BOURGUIGNON - Tervuren Mus.).

Burtoa nilotica giraudi (BOURGUIGNAT). Plate I, fig. 5. Pl. III, fig. 11.

1880 *Achatina (Limicolaria) nilotica* E. A. SMITH; Proc. Zool. Soc. Lond., p. 345.
1885 *Bulimus giraudi* BOURGUINAT, Moll. du Lac Tanganyika, p. 12.
1885 *Bulimus reymondi* BOURGUIGNAT, Ibid., p. 13.
1885 *Limicolaria bourguignati* GRANDIDIER; Bull. Soc. Malac. de France, *2*, p. 157, pl. 7, fig. 1 (not *Limicolaria bourguignati* PALADILHE 1872, a species of *Opeas*).
1889 *Burtoa reymondi* (BOURGUIGNAT); Moll. de l'Afr. Equatorial, p. 92, pl. 4, fig. 1.
1889 *Burtoa bridouxiana* BOURGUIGNAT, ibid., p. 92, pl. 4, fig. 3.
1889 *Burtoa sabasmia* BOURGUIGNAT, ibid., p. 93, pl. 3, fig. 1.
1889 *Burtoa lavigeriana* BOURGUIGNAT, ibid., p. 96, pl. 4, fig. 2.

1889 *Burtoa giraudi* (BOURGUIGNAT), ibid., p. 98, pl. 5, fig. 1.
1889 *Burtoa jouberti* BOURGUIGNAT, ibid., p. 99, pl. 2, fig. 1.
1889 *Burtoa pethericki* BOURGUIGNAT, ibid., p. 195.
1891 *Limicolaria nilotica* var. *emini* E. VON MARTENS, Sitz. Ber. Ges. Naturf. fr., Berlin, p. 14.
1895 *Limicolaria (Livinhacia) nilotica* var. *oblonga* VON MARTENS, Nachrichtsbl. d. Mal. Ges., *27*, p. 181.
1895 *Limicolaria nilotica* var. *obliqua* VON MARTENS, ibid., p. 181.
1897 *Limicolaria (Livinhacia) nilotica* VON MARTENS, Deutsch Ost Afr., p. 97, fig. on p. 96.
1897 *Limicolaria nilotica* var. *obliqua* VON MARTENS, ibid.
1904 *Burtoa nilotica* var. *grandidieri* PILSBRY, Man. of Conch., (2), *16*, p. 303, pl. 26, fig. 16 (New name for *L. bourguignati* GRANDIDIER).
1904 *Burtoa nilotica* var. *reymondi* PILSBRY, ibid., p. 301-305, pl. 20, fig. 19; pl. 26, fig. 16; pl. 30, fig. 17; pl. 35, figs. 21 and 23.
1947 *Burtoa nilotica emini* C. R. BOTTGER, Arch. Fur. Moll., *76*, p. 95, pl. 2, fig. 5.

B. n. giraudi, the common subspecies over a vast area of Tanganyika Territory and the adjoining areas of N. E. Rhodesia and the S. E. Belgian Congo, is polymorphic to a degree, and it is not feasible to attempt to select any one shell as being typical of the race as a whole. Every intermediate form between elongated shells with a strongly curved columella and oblique aperture, to which BOURGUIGNAT gave the name *jouberti*, to short, globose examples like his types of *reymondi* and *giraudi* can be found in any reasonably large series. Similarly, attenuate forms as represented by VON MARTENS' *oblonga* can be found among most other distinguishable races. Practically all shells ascribable to the subspecies *giraudi* however are entirely devoid of periostracum; in about a hundred specimens examined we have seen one adult with most of its periostracum remaining and one with a partial covering.

Giraudi (BGT.) is the oldest name available for this subspecies, it having priority of a page over the same author's *reymondi*. The type locality was not designated at the time of description and Tabora, Tanganyika Territory, is now chosen.

Perhaps the least inconstant characters by which *giraudi* may be recognised are, the beautiful pink, sometimes almost red columella and outer lip, and the interior of the aperture which in fresh shells is bluish-white. Traces of periostracum are occasionally preserved on some adult *giraudi* along the suture and on the upper whorls. Preservation of the periostracum is usual on immature examples of all races irrespective of their appearance when adult, by which time it may have been completely removed, presumably by the action of sun and wind.

The strength of the external granulose sculpture varies considerably amongst individuals but it is usually obsolete below the periphery as in other

races. In the short and more globose examples the umbilicus is of moderate width, reduced to a narrow chink in elongated shells.

In Northern Rhodesia, at Mporokosso near Lake Mweru and other places, *B. n. giraudi* has been taken in company with the most southerly race, *B. n. arnoldi*; specimens are intermediate in character and there appears to be a « cline » in the area of contact.

The type of *B. n. oblonga* VON MARTENS (type locality south of Lake Victoria between Bukense and Ngome), is indistinguishable from specimens of the nominate race we have examined from the Southern Sudan, and oblong specimens can in fact occur in any of the subspecies. The type is referred here to *B. n. giraudi* by reason of its geographical locality.

Measurements of Adult Shells (in millimetres)

Length	Greatest Width	Aperture Length	Aperture Width	Whorls	
111	65	61	39	6½	Ujiji
110	75	67	44	6½	Kiboriani Range
105	61	62	36	6½	Tabora
103	65	58	38	6½	Iringa
103	61	56.5	34.5	5½	Mporokosso
101	67	52.5	36.5	6½	Tabora
100	60	57	35	5½	Elisabethville
99	65	57	37	5½	Mporokosso
98	65	60	37	6½	Shinyanga
97	61.5	56	36	6½	Ipala (Type of *emini* mts)
96	60	58	35	6	Lubumbashi
96	60	57	36	5½	Mt. Kiboriani
89	57	53	32	5½	Mporokosso
86	55	50	32	5½	Mporokosso
80	49	46	27	5½	Rumonge

SPECIMENS EXAMINED :

TANGANYIKA TERRITORY : 40 m. N. of Iringa (W. COLLEY - Coryndon Mus.); Kazima, Tabora (R. P. HESSE - Coryndon Mus.); Near Dodoma (P. ROBINSON - Coryndon Mus.); Olduvai Headwaters; Serengeti (P. J. GREENWAY - Coryndon Mus.); Nzubuka, Tabora (MENEGHETTI - Coryndon Mus.); Tabora (LOVERIDGE - Coryndon Mus., PAIN COLL., M.C.Z.); Mt. Kiboriani (HODGSON - H. E. J. BIGGS Coll.); Ujiji, (HORE - PAIN Coll.); Ipala, Ugogo (STUHLMANN - Berlin Mus. - syntypes of *emini* MTS.); Shinyanga (P. S. GLOVER - M.C.Z.); Iringa Plateau (BAILY WILLIS - M.C.Z.); Saranda, Dodoma (A. LOVERIDGE - M.C.Z.); Yaida, 1800 m., (L. KOHL - LARSEN - Senckenberg); Tosamagnana (C. BOTTGER - Senckenberg); Dabaga Muitu (Senckenberg); Kigoma, Usangu-Ebene (H. KNIPPER - Senckenberg); Kiboriani Range, 60 m. N. of Dodoma (BULLARD - BIGGS Coll.); WILLIAMSON'S Mines, Shinyanga, Usukama (Sub-fossil, PAIN Coll.).

NORTHERN RHODESIA : Mweru, Mantipa Mporokosso (J. BRÉDO - Tervuren Mus.).

BELGIAN CONGO : *Lualaba District* : Bunkeya (Tervuren Mus.). — *Tanganika District* : Moliro (J. PILETTE - Tervuren Mus.); Mpala (H. BOMANS - Tervuren Mus.). — *Haut-Katanga District* : Elisabethville (J. LEPERSONNE, G. DUBOIS, RICHARD - Tervuren Mus.); vallée Lubumbashi (L. STAPPERS, M. BEQUAERT - Tervuren Mus. & M.C.Z.); Kasenga (L. STAPPERS - Tervuren Mus.); Lukafu (G. DE WITTE - Tervuren Mus.); Kilwa (H. BRÉDO - Tervuren Mus.); Urua (Tervuren Mus.). — *Sankuru District* : Tshipama (J. DRION - Tervuren Mus.).

URUNDI : Rumonge (J. BOUILLON, LESTRADE - Tervuren Mus.); Kabezi (J. BOUILLON - Tervuren Mus.).

Burtoa nilotica arnoldi (STURANY). Plate III, figs. 12-13.

1898 *Livinhacia arnoldi* STURANY, S. Afr. Moll. p. 59, pl. 2, fig. 41.
1904 *Burtoa arnoldi* PILSBRY, Man. of Conch. (2) *16*, p. 307, pl. 26, fig. 14.
1907 *Burtoa nilotica* MELVILL and STANDEN, Manchester Memoirs *51* (No. 4), p. 11.
1938 *Burtoa nilotica* var. *arnoldi* CONNOLLY, Ann. S. Afr. Mus. *33*, p. 296.

The shell of this subspecies is very thick and solid, the height of the spire and width of the aperture show considerable variation, but all examples seen are nearly uniform cream or pale buff externally; even in live condition the periostracum is almost invariably missing. CONNOLLY (1938.296) reports having seen one example with traces of a thin dark brown one, a fine example kindly loaned to us by Mr. A. E. SALISBURY shows considerable traces of it on the body-whorl. The columella is nearly vertical, somewhat curved towards the base in very globose shells. It is joined to the outer lip by a heavy calus. Umbilicus very narrow, aperture subovate. The spire is broadly conoid, apical angle nearly 90°, apex very small, broadly subacute, whorls 6½ moderately convex, rapidly increasing, the earlier practically smooth, the latter showing typical granulation above the periphery, below which there is fairly strong very close vertical striae with little or no spiral sculpture. Columella, parietal calus and outerlip bright rose pink, aperture bluish-white within.

B. n. arnoldi represents the most southerly extension of the range of *Burtoa*, the banks of the Amanze Inyama River in Matabele land, about 22° S. lat., being the southern-most record. In northern Rhodesia however it appears to merge into the common, very variable and widely distributed race inhabiting Tanganyika Territory, for which the oldest available name is *giraudi* BGT. This author has described numerous subspecies, based on individual variants of this extremely polymorphic form (see under *B. n. giraudi*). It would seem from our examination of a considerable series from the region of Lake Mweru, that *arnoldi* is hardly separable from it. Nevertheless we have provisionnally retained *arnoldi* as a subspecies in order to draw attention to the occurrence, at any rate in the Rhodesias, of a striking and well marked race.

CONNOLLY (1925, *Non-marine Moll. of Portugese E. Afr., Trans. Roy. Soc. S. Afr., 12* (Part 3), pp. 105-220, pls. 4 to 8), does not mention the occurrence of *Burtoa* in Mozambique, and it does indeed appear that conditions in the low-lying valley of the lower Zambezi are unsuited to these height-loving snails.

CONNOLLY (1938, 296) retained *arnoldi* as a distinct subspecies but pointed out that WATSON and PEILE could find no special feature in the anatomy or radula to suggest a subspecific distinction from some of the Northern races.

Measurements of Adult Shells (in millimetres)

Length	Greatest Width	Aperture Length	Aperture Width	Whorls	
111	71	66	42	6½	N. E. Rhodesia
110	69	62	40	6½	Mweru
109	71	64	41.5	6½	Victoria Falls
107	67	60	40	6½	N. E. Rhodesia
106	73	63	41	6½	Petauke
105	70	64	40	6	Chitala River
104	74	65	41	6	Salisbury
100	65	61	39.5	6½	Mweru
92	65	55	36	6¼	Chinsale

SPECIMENS EXAMINED :

SOUTHERN RHODESIA : Victoria Falls (SOPER - PAIN Coll.); Umtali (Natal Mus.); Salisbury (OAKLEY - PAIN Coll., M.C.Z.); Issansuland (KOHL-LARSEN-Senckenberg).

NORTHERN RHODESIA : Mweru, Mporokosso (BRÉDO - Tervuren Mus.); Chinsale (PAIN COLL.); Broken Hill (M. CONNOLLY - M.C.Z.; Natal Mus.); Petauke (NEAVE-PAIN Coll.); N. E. Rhodesia (STANLEY RELIEF EXPEDIT. - A. E. SALISBURY Coll.); L. Bangwelu, Ikomba (Natal Mus.).

NYASSALAND : Chitala River, nr. Salima (A. LOVERIDGE - M.C.Z.).

BELGIAN CONGO : Lualaba Distr., Kapiri (DE WITTE - Tervuren Mus.).

CONCLUSION

This revision can be considered only as an interim one, since further information on the genus *Burtoa,* especially as regards the distribution of the various subspecies, can be expected as fresh, well localized material is obtained.

The authors would therefore be most grateful for the loan for study of any *Burtoa* collectors or museums may obtain in the future, or have already, with a view to publishing additional information as it becomes available. In this connection specimens can be sent to the authors, c/o The Dept. of Mollusca, British Museum (Nat. Hist.), Cromwell Road, London, S. W. 7.

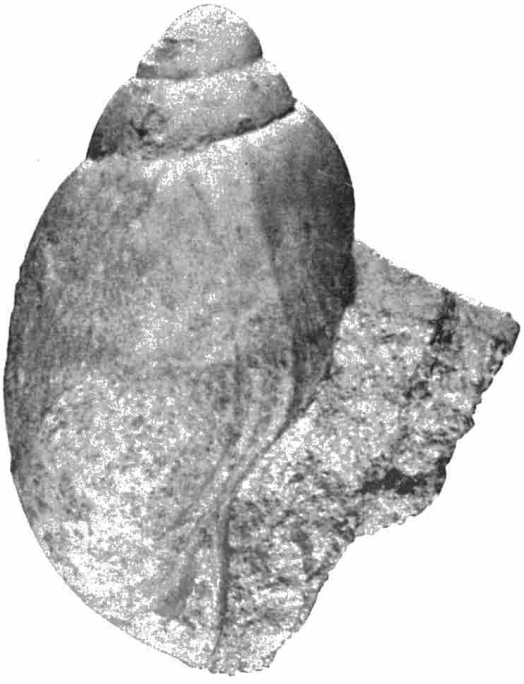
CONTENTS

PLANCHES

PLANCHE I

1. *Burtoa nilotica verdcourti* n. ssp., holotype.
2. *Burtoa nilotica verdcourti* n. ssp., paratype.
3. *Burtoa nilotica crassa* (MTS), Uganda: Kampala.
4. *Burtoa nilotica nilotica* (PFR), syntype.
5. *Burtoa nilotica giraudi* BGT., holotype.

(Photo C.N.R.S., reproduction autorisée).



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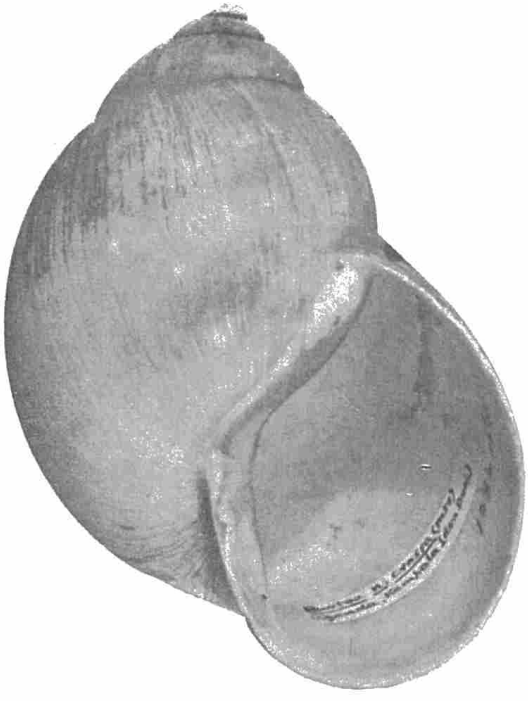

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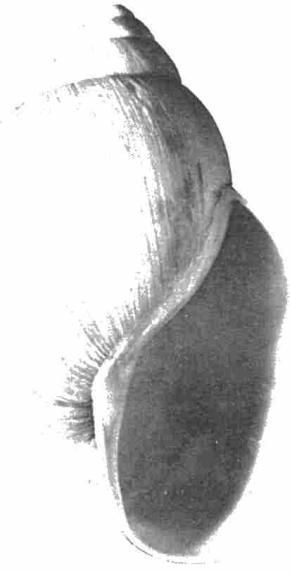

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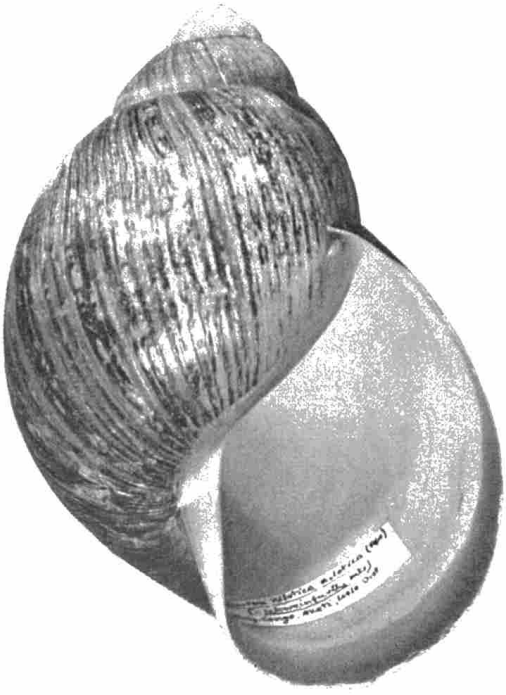
5

PLANCHE II

6. *Burtoa nilotica nilotica* (PFR), Belg. Congo: Aketi.
7. *Burtoa nilotica schweinfurthi* (MTS), holotype. (synonym of B.n. *nilotica*).
8. *Burtoa nilotica benoiti* n. ssp., holotype.
9. *Burtoa nilotica congoensis* n. ssp., holotype.



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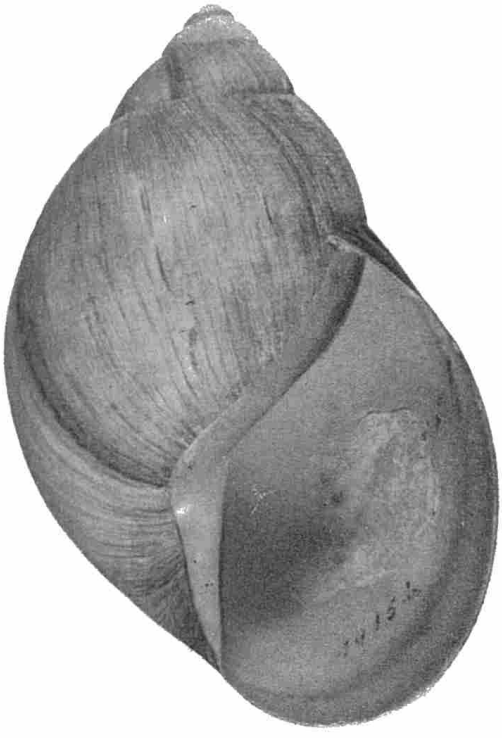

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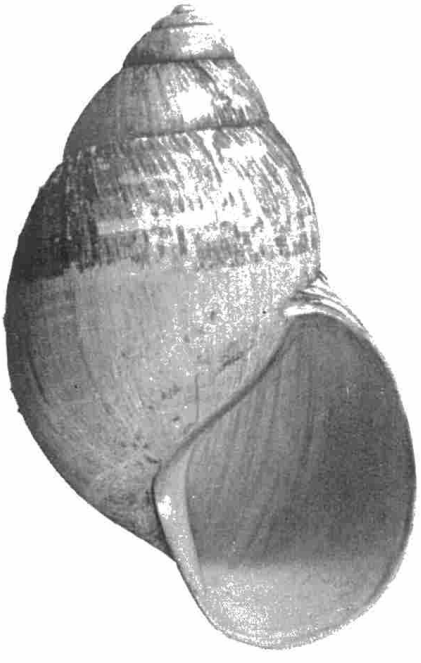

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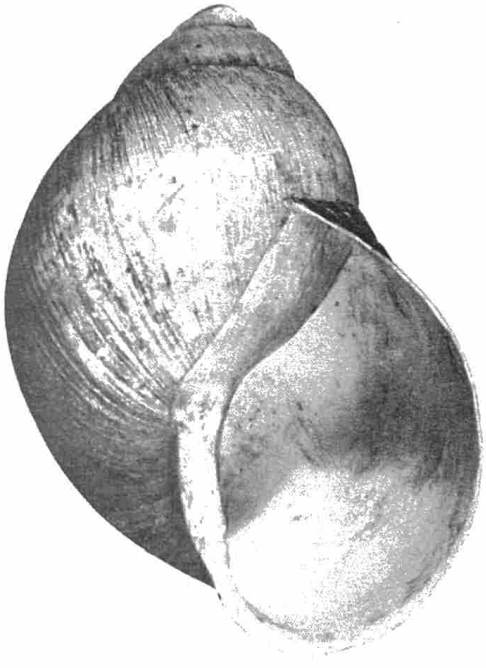
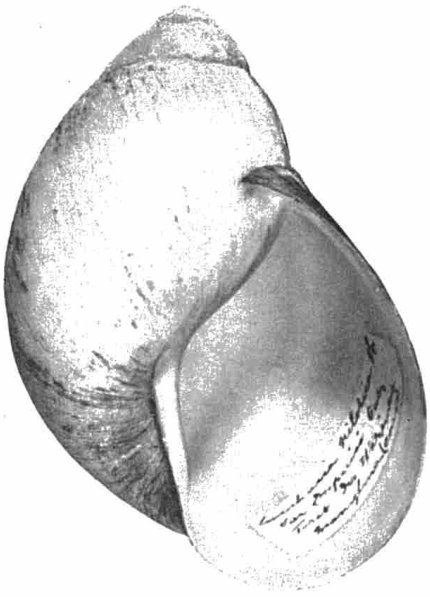


9

PLANCHE III

10. *Burtoa nilotica dupuisi* PUTZEYS, paratype.
11. *Burtoa nilotica emini* (MTS), holotype.
(synonym of B.n. *giraudi*).
12. *Burtoa nilotica arnoldi* STURANY, holotype.
13. *Burtoa nilotica arnoldi* STURANY, N.E. Rhodesia: Petauke.



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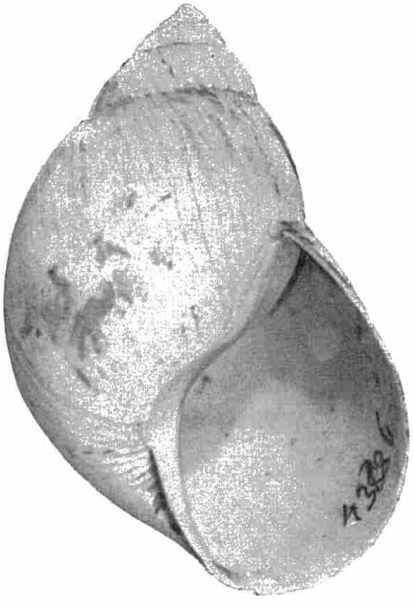

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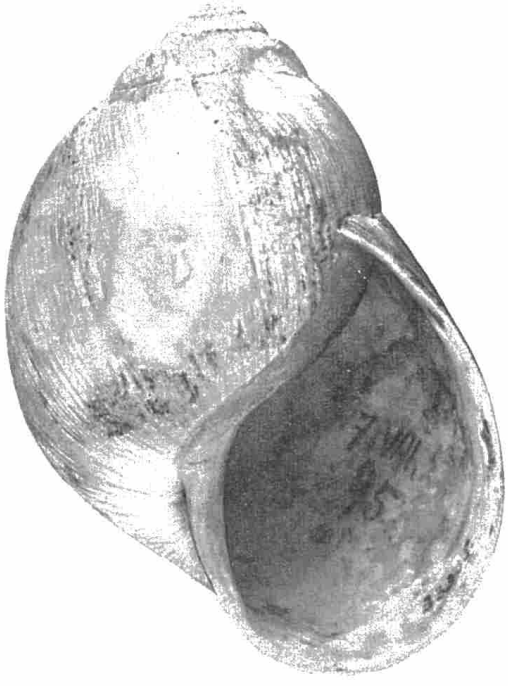

12

13

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