

**WHO SNAIL IDENTIFICATION CENTRE**  
**DANISH BILHARZIASIS LABORATORY**

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**A FIELD GUIDE**

to

**AFRICAN FRESHWATER SNAILS**

**4: SOUTH EAST AFRICAN SPECIES**



**1977**

## Preface

The present Field Guide to South-east African freshwater snails includes all those species known from Zambia, Rhodesia, Malawi and Mozambique. Not included are the many peculiar prosobranch snails endemic to Lake Tanganyika. The freshwater snails of South-east Africa are not well-known as only relatively small areas have been investigated thoroughly, for vast areas very little information is available. It is therefore likely that some snail species not included in the present Guide might occur in South-east Africa.

Complete acquaintance with technical terms, an ability to carry out a simple dissection and to produce a radula preparation are absolutely essential in order to achieve a reliable identification with the aid of this guide. Anyone unfamiliar with the terminology and procedures is referred to the "Introduction" which provides the necessary explanation and instruction. The dimensions given for each species are the height and the diameter of a full-grown shell of average size.

Snails which cannot be identified through the use of this guide or for which a confirmation of identification is desired can be sent to the address below. Such specimens should be sent either preserved in 70% alcohol or live between layers of damp, but not wet, cotton wool as sample post, and by air mail.

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## Prosobranchia

The freshwater prosobranchs are easily recognized by the presence of an operculum and by the structure of the radula, which in African species is either rhipidoglossate or more frequently taenioglossate.

## Key to the Prosobranch families

- |  |              |
|--|--------------|
| 1. Shell hemispherical consisting of few whorls. Spire small. Operculum calcareous, with apophyses. Radula rhipidoglossate.          | Neritidae    |
| Shell depressed, globose or higher. Operculum without apophyses. Radula taenioglossate.  | 2            |
| 2. Full-grown shell more than 10 mm high.  | 3            |
| Full-grown shell less than 10 mm high.   | 5            |
| 3. Operculum concentric.   | 4            |
| Operculum paucispiral or concentric with spiral nucleus.   | Thiaridae    |
| 4. Shell conical. Female viviparous (eggs or young in uterus!). Male with right tentacle enlarged and serving as a copulatory organ. | Viviparidae  |
| Shell depressed, globose or higher. Female oviparous. Male with a copulatory organ near the mantle border                            | Pilidae      |
| 5. Operculum calcareous, concentric around a spiral inner part. Lateral teeth without accessory plates.                              | Bithyniidae  |
| Operculum corneous and paucispiral. Lateral teeth with accessory plates.   | Assimineidae |

## 1. Family Neritidae

Shell strong, imperforate, hemispherical with a small spire. Aperture with semicircular outer lip and flat, expanded, thickened columellar margin. Operculum calcareous, paucispiral with projecting processes (apophyses) basally on the inner surface. Radula rhipidoglossate.

The species are living in fresh, brackish or salt water. In eastern Africa two species living in fresh or brackish water, both belonging to the genus *Neritina*.

Genus *Neritina* Lamarck

The East African species are found only in the coastal area.

## Key to the species

Shell dark with yellow spots and bands. The inner side of outer lip not orange. Spire somewhat projecting.

*N. natalensis*

Shell black with an orange band inside the outer lip. Spire not projecting.

*N. knorri*

1. *Neritina natalensis* Reeve Fig. 1

21 x 22 mm. Distributed in the coastal area from Natal to Somalia. Very variable in pattern.

2. *Neritina knorri* Recluz Fig. 2

18 x 23 mm. Known from the East-African coast from Kenya to Mozambique.

## 2. Family Viviparidae

In Africa two genera: *Neothauma* endemic in Lake Tanganyika and *Bellamyia* in most of the continent and also in southern Asia.

Genus *Bellamyia* Jousseaume

Shell medium sized to rather large, conical with convex, angular or carinate whorls. Operculum thin, corneous and wholly concentric. Females viviparous, normally with eggs and embryos in uterus. In males the right tentacle is enlarged and serves as a copulatory organ. In South-east Africa seven species are known. Three of these are endemic to Lake Malawi and three others to Lake Mweru and only one is generally distributed in all four countries.

## Key to the species

- |  |                      |
|--|----------------------|
| 1. The ultimate whorl is rounded or at most with an obtuse angle along the periphery.  | 2                    |
| All whorls with a distinct angle or keel along the periphery. (L. Mweru)               | 5                    |
| 2. Embryonic shell less than 6 mm high. Full-grown shell usually less than 30 mm high. | <i>B. capillata</i>  |
| Embryonic shell 8-14 mm high. Full-grown shell more than 30 mm high. (L. Malawi)       | 3                    |
| 3. Shell solid, 30-40 mm high. Basal margin evenly curved.                             | 4                    |
| Shell thin and fragile, until 55 mm high. Basal margin produced.                       | <i>B. ecclesi</i>    |
| 4. Shell usually light coloured, spire with flat whorls.                               | <i>B. robertsoni</i> |
| Shell usually of dark colour. Spire with convex whorls.                                | <i>B. jeffreysi</i>  |

5. The keel on the ultimate whorl disappears towards the aperture. Umbilicus completely closed. *B. crawshayi*

The keel on the ultimate whorl continues to the aperture. Umbilicus narrow. 6

6. The whorls are flat between suture and periphery. Full-grown shells 25-30 mm high. *B. pagodiformis*

The whorls are convex between suture and periphery. Full-grown shells up to 40mm high. *B. mweruensis*

1. *Bellamyia capillata* (Frauenfeld) Fig 3-5

28 x 19 mm (33 x 22 mm). The typical form has rounded or slightly angular whorls and delicate spiral lines are often present. The colour is usually a rather dark olive or brown. It is widely distributed in Eastern Africa south of equator. In the northern part of Zambia and in the middle Zambezi it is replaced by the following subspecies:

- a. *B. c. kalingwisiensis* (Smith). 24 x 17 mm. Smaller and with more angular whorls than the nominate form. Common in the Northern Province of Zambia. (Fig. 4).  
b. *B. c. sambesiensis* (Sturany). 30 x 22 mm. Broader than the typical form. Known from the Middle-Zambezi and some of its affluents. (Fig. 5).

2. *Bellamyia robertsoni* (Frauenfeld) Fig. 8

36 x 24 mm. The light colour and regularly conical spire are distinctive. It is restricted to Lake Malawi where it occurs from the shore and down to at least 285 feet.

3. *Bellamyia jeffreysi* (Frauenfeld) Fig. 10

37 x 27 mm. Easily separated from the preceding species by the darker colour and more convex whorls. Endemic to Lake Malawi, where it is found from the shore and down to 290 feet.

4. *Bellamyia ecclesi* (Crowley & Pain) Fig. 11

52 x 42 mm. The largest and most thin-shelled of the African *Bellamyia*. The new-born young have a shell 13-14 mm high. Known only from the southern part of L. Malawi, where it is found at depths from 90 to 260 feet.

5. *Bellamyia crawshayi* (Smith) Fig. 6

25 x 17 mm. The imperforate shell, less distinct peripheral keel and slightly convex sides of the spire separates this species from the following. Endemic to Lake Mweru.

6. *Bellamyia pagodiformis* (Smith) Fig. 7

27 x 20 mm. The straight sides of the spire separate this species from the two other species endemic to Lake Mweru, where it seems to be the most common.

7. *Bellamyia mweruensis* (Smith) Fig. 9

37 x 30 mm. The large size, strong peripheral keel and convex whorls are distinctive. Known only from Lake Mweru.

### 3. Family Piliidae

Shell medium to very large (more than 100 mm high), depressed, globose or higher. Mantle cavity divided into two rooms: one with a gill and the other one functioning as a lung. Operculum concentric. Worldwide distribution in tropical freshwater. In South-east Africa two genera.

#### Key to the genera

Shell sinistral, operculum corneous.	<i>Lanistes</i>
Shell dextral, operculum calcareous.	<i>Pila</i>

1. Genus *Lanistes* Monfort

The shell, but not the animal, is sinistral (hyperstrophy). The genus is distinctly African. In South-east Africa six species, one of which is divided into subspecies.

## Key to the species

- |   |                          |
|---|--------------------------|
| 1. Shell distinctly higher than wide.                               | 2                        |
| Shell wider than high.  | 7                        |
| 2. Height of aperture less than half the height of shell.           | 3                        |
| Height of aperture larger than half the height of shell.            | 4                        |
| 3. Umbilicus narrow, but distinct.                                  | <i>L. ovum procerus</i>  |
| Umbilicus completely closed.  | <i>L. ovum purpureus</i> |
| 4. The median cusp on the central teeth of radula angular.          | 5                        |
| The median cusp on the central teeth with evenly curved sides.      | 6                        |
| 5. Last whorl with evenly curved sides.                             | <i>L. ovum ovum</i>      |
| Last whorl with almost straight sides and an obtuse shoulder angle. | <i>L. ovum connollyi</i> |
| 6. Shell very heavy with coarse growth lines.                       | <i>L. solidus</i>        |
| Shell not heavy, usually with very fine growth lines.               | <i>L. ellipticus</i>     |
| 7. Small species, less than 25 mm high and with dark spiral bands.  | <i>L. neavei</i>         |
| Larger species without spiral bands.                                | 8                        |

- |   |                     |
|---|---------------------|
| 8. Shell up to 65 mm high and very heavy. Umbilicus closed. | <i>L. nyassanus</i> |
| Shell 30-40 mm high, thin and fragile. Umbilicus open.      | <i>L. nasutus</i>   |

1. *Lanistes ovum* Peters Fig. 12-16

A widely distributed and very variable species, which is divided into a number of subspecies. The following are found in South-east Africa.

a. *L. ovum ovum* Peters. Fig. 12

50 x 43 mm. The convex whorls, rather low spire and open umbilicus are distinctive. It is the most common form and is known from all four countries.

b. *L. ovum connollyi* (Pain) Fig. 13

46 x 39 mm. With more straight sides and somewhat shouldered whorls. Known only from the Zambezi above the Victoria Falls.

c. *L. ovum procerus* (Martens) Fig. 14

85 x 55 mm. The very large, high-spired and umbilicate shell separates this form from the typical ovum. It is not yet found within the area in question, but most likely it occurs near the Tanzanian border. A similar, but relatively wider form (105 x 80 mm) is known from the Upper Luapula.

d. *L. ovum bangweolicus* Haas Fig. 15

81 x 61 mm. A large thin-shelled form with shouldered whorls from Lake Bangweulu and adjacent areas.

e. *L. ovum purpureus* (Jonas) Fig. 16

55 x 37 mm. Resembling procerus in the shape, but it is imperforate and does not attain the same size. Restricted to the coastal area.

2. *Lanistes ellipticus* Martens Fig. 17

50 x 39 mm. The typical form is very narrowly umbilicated and has a straight columella. It is known from the Zambezi and some of its affluents. In Lake Malawi it is more openly umbilicated.

3. *Lanistes solidus* Smith Fig. 18

45 x 41 mm. The very heavy shell (it weighs 3-4 times as much as an ovum or ellipticus of equal size) and almost or completely closed umbilicus are distinctive. Endemic to Lake Malawi.

4. *Lanistes neavei* Melvill & Standen Fig. 19

22 x 23 mm. The small size, wide umbilicus and dark spiral bands separate this species from all other *Lanistes* species in South-east Africa. It seems to have a very restricted distribution: the Ndola area and the adjacent part of Zambia.

5. *Lanistes nyassanus* Dohrn Fig. 20

61 x 70 mm. The very low spire and heavy shell cannot be confused with other species. Young shells upto about 30 mm are rather thin and have narrow umbilicus. Endemic to Lake Malawi, where it has been found at depths from 40 to 90 feet.

6. *Lanistes nasutus* Mandahl-Barth Fig. 21

34 x 38 mm. The thin shell with a very high aperture and spout-like produced basal margin is unique among *Lanistes*. The umbilicus is wide and surrounded by a distinct angle. Known only from the southern part of Lake Malawi at depths from 150 to 270 feet.

2. Genus *Pila* Röding

The members of this genus are characterized by the large to very large globose shell and the calcareous, concentric operculum. They are distributed throughout tropical Africa and Asia. The genus is poorly represented in South-east Africa, from where but one species has been recorded and only a few times.

*Pila werneri* (Philippi) Fig. 22

Upto 127 x 125 mm and the largest African freshwater snail. A few immature specimens probably belonging to this species have been collected in Mozambique, but their identification is not quite certain.

## 4. Family Bithyniidae

The family is characterized by the calcareous operculum with a paucispiral inner part surrounded by a concentric outer part. Numerous species in fresh waters of the Old World. In Africa 9 genera, but only one of these is represented in South-east Africa.

Genus *Gabbiella* Mandahl-Barth

The shell varies in height from 2.5 to 9 mm and is of a lighter or darker horny colour. The aperture is fairly large, with a continuous, thickened and often dark peristome. The operculum, which in fullgrown specimens lodges to the peristome, has a spiral part occupying from 1/6 to 4/5 of the diameter. Central teeth with 3-4, seldom 5 basal denticles on each side. About 20 species are known from Africa and 4 of these have been recorded from South-east Africa.

## Key to the species

- |   |                      |
|---|----------------------|
| 1. Small umbilicate species, usually less than 4 mm high. | <i>G. kisalensis</i> |
| Full-grown shell imperforate and more than 4.5 mm high.   | 2                    |
| 2. Full-grown shell 4.5-6 mm high                         | 3                    |
| Full-grown shell 7-8 mm high                              | <i>G. zambica</i>    |

3. Shell horny brown. A species of streams. *G. balovalensis*  
Shell light yellow or pinkish. Endemic  
to Lake Malawi. *G. stanleyi*

1. *Gabbiella kisalensis* (Pilsbry & Bequaert) Fig. 23

3.3 x 2.7 mm. The small, globose and umbilicate shell separates this from the other species of South-east African *Gabbiella*. It is described from Upper Katanga and is known from several localities in Zambia, Rhodesia and Mozambique.

2. *Gabiella zambica* Mandahl-Barth Fig. 24

7.6 x 5.2 mm. By far the largest of the South-east African *Gabbiellae* and recognizable on the size alone. It is known from a single locality (Lundazi Tembwe) in eastern Zambia, but a wider distribution must be expected.

3. *Gabbiella balovalensis* Mandahl-Barth Fig. 25

4.5 x 3.0 mm. The imperforate, conical shell separates it from *G. kisalensis*, which occurs in the same area, the Balovalo district of western Zambia.

4. *Gabbiella stanleyi* (Smith) Fig. 26

4.6 x 3.3 mm. The shell has a more solid appearance and brighter colour than those of the preceding species and being endemic to Lake Malawi a confusion is unthinkable.

5. Family Assimineidae

Shell small, conical or ovate, usually umbilicate or perforate. Operculum corneous, paucispiral. The lateral teeth of radula with an accessory plate. The species are mainly estuarine or terrestrial, rather few live in freshwater. In South-east Africa two estuarine species belonging to two genera.

Key to the genera

The central teeth of radual almost as wide as long. The posterior margin of their basal plates well defined.

*Assimineae*

The central teeth of radual distinctly longer than wider, but the posterior margin of their basal plates ill defined.

*Eussoia*

1. Genus *Assimineae* Leach

The genus has a wide distribution, mainly in the tropics and comprises a great number of estuarine species, of which one is known from the area in question.

*Assimineae ovata* (Krauss) Fig. 27

6.7 x 4.2 mm. The shell is unicoloured or with one or two darker spiral bands ("*A. bifasciata*"). Estuaries from southern Mozambique to the Cape Province.

2. Genus *Eussoia* Preston

The genus is very similar to the preceding, but the radula is distinctive. It comprises a few true freshwater species from East Africa and the following estuarine species from Mozambique.

*Eussoia leptodonta* (Connolly) Fig. 28

4.5 x 3.0 mm. Known only from the estuary of Komati River, southern Mozambique.

6. Family Thiariidae

A large family of mainly freshwater snails, only a few are estuarine. The shell in most species is high ovate to turreted and fre-

quently sculptured. Operculum corneous, paucispiral or concentric with spiral nucleus. No copulatory organ. The family comprises a great number of genera, of which three are represented in East Africa. To these may be added 17 genera endemic to Lake Tanganyika and not dealt with here.

#### Key to the genera

- |  |            |
|--|------------|
| 1. Operculum concentric with spiral nucleus. Shell without transverse sculpture.                                   | Cleopatra  |
| Operculum paucispiral with nucleus near the basal margin. Shell usually with both transverse and spiral sculpture. | 2          |
| 2. Spire more than twice as high as aperture. Whorls evenly rounded, without shoulder angle.                       | Melanoides |
| Spire about 1.5 times as high as aperture or shorter. A distinct shoulder angle usually with spines is present.    | Thiara     |

#### 1. Genus *Cleopatra* Troschel

The shell medium sized, ovate, acuminate, smooth or with spiral sculpture. Operculum concentric with a small spiral nucleus. The genus is strictly African with several species on the continent and a few in Madagascar. In South-east Africa five species and two subspecies.

#### Key to the species

- |  |                      |
|--|----------------------|
| 1. Full-grown shell more than 22 mm high | <i>C. ferruginea</i> |
| Full-grown shell less than 20 mm high    | 2                    |
| 2. Shell imperforate.                    | 3                    |
| Shell narrowly umbilicate.               | <i>C. lesnei</i>     |

- |  |                         |
|--|-------------------------|
| 3. Shell with spiral keels at least on the upper whorls.               | 4                       |
| Shell without spiral keels.  | <i>C. nsendweensis</i>  |
| 4. The spiral keels also present on the ultimate whorl.                | 5                       |
| Spiral keels present on the upper whorls only.                         | <i>C. m. smithi</i>     |
| 5. 1-3 spiral keels. The whorls are flat between suture and periphery. | <i>C. johnstoni</i>     |
| 4-6 spiral keels. The whorls are convex.                               | <i>C. m. mweruensis</i> |

#### 1. *Cleopatra ferruginea* (Lea) Fig. 29

24 x 14 mm. The size, the smooth shell, and usually present darker spiral bands are distinctive. Common in the coastal areas of eastern Africa from Kenya to Zululand.

#### 2. *Cleopatra johnstoni* Smith Fig. 30

18 x 12 mm. Easily recognizable by the strong keel along the periphery and the flatness of the whorls above the keel. Known only from Lake Mweru and the lower Luapula.

#### 3. *Cleopatra mweruensis* Smith Fig. 31-32

The species is divided into two subspecies:

a. *C. m. mweruensis* Smith Fig. 31 with distinct spiral keels on all whorls. The average size is 15 x 8 mm. Endemic to Lake Mweru.

b. *C. m. smithi* (Ancey) Fig. 32. The spiral keels present only on the upper whorls. It is slightly larger (18 x 11 mm) and known from several rivers in Zambia.

#### 4. *Cleopatra lesnei* Germain Fig. 33

16 x 9 mm (18 x 11 mm). the umbilicate, slender shell is distinctive. Very little is known about this species, which has been found only twice: in the Sangadzi River in Mozambique and in a hot spring near Chirundu, Zambia.



5. *Cleopatra nsendweensis* (Dupuis & Putzeys) Fig. 34

18 x 10.5 mm, but often smaller. The complete absence of spiral lines or keels and the closed umbilicus are distinctive. Widely distributed in eastern Zaire and in Zambia. A smaller form living in the Zambezi above the Victoria Falls has been regarded as a distinct species, *C. morrelli* Preston, but represents at most a subspecies.

2. Genus *Thiara* Röding

Principally this genus is East Indian, but two species have a wide distribution along the coast of the Indian Ocean and one of them has been found in Mozambique.

*Thiara amarula* (Linnaeus) Fig. 35

35 x 17 mm. The characteristic shell cannot be confused with any other African species. It has a scattered distribution in the coastal area of eastern Africa from Somalia to Natal. The African specimens have usually been named *T. vouamica* (Bourguignat), but are not specifically different from *T. amarula* of the East Indies.

3. Genus *Melanoides* Oliver

The genus is widely distributed in the tropics of the World and comprises a great number of species. About thirty are known from Africa and most of these are restricted to Lake Malawi and the River Zaire drainage. They all have a high spire and usually strongly sculptured whorls. From South-east Africa 13 species are known.

## Key to the species

- |  |                       |
|--|-----------------------|
| 1. Species of streams and rivers, more rarely in stagnant water.         | 2                     |
| Species endemic to Lake Malawi or L. Mweru.                              | 4                     |
| 2. Shell up to 50 mm in height. Central teeth of radula with 9-11 cusps. | <i>M. tuberculata</i> |
| Shell less than 27 mm high. Central teeth with 5-7 large cusps.          | 3                     |

- |  |                             |
|--|-----------------------------|
| 3. Shell usually with strong, curved, transverse ribs. Central teeth with 7 cusps. Northern Barotseland. | <i>M. anomala</i>           |
| Shell usually without transverse ribs. Central teeth with 5 cusps.                                       | <i>M. victoriae</i>         |
| 4. Species of L. Malawi.   | 5                           |
| Species of L. Mweru.   | 12                          |
| 5. Full-grown shell more than 20 mm high.  | 6                           |
| Full-grown shell less than 20 mm high.   | 7                           |
| 6. A row of strong tubercles just below suture usually present. Sculpture coarse.                        | <i>M. nodicincta</i>        |
| Such a row not present. Sculpture much finer.  | <i>M. pergracilis</i>       |
| 7. Shell long consisting of 9-10 strongly sculptured whorls.   | <i>M. pupiformis</i>        |
| Shell shorter consisting of 6-8 whorls, sculpture less developed.  | 8                           |
| 8. Upper whorls with transverse ribs.  | 9                           |
| Upper whorls without transverse ribs.  | 11                          |
| 9. A row of tubercles below suture present.  | <i>M. turritispira</i>      |
| Such a row present.  | 10                          |
| 10. Spire evenly tapering, towards apex transverse ribs weak.  | <i>M. polymorpha</i>        |
| Spire suddenly tapering towards apex, transverse ribs strong.  | <i>M. magnifica</i>         |
| 11. Larger upto 18 mm high. Spire without sculpture, but often with reddish or brownish spots.           | <i>M. nyassana</i>          |
| Smaller 11-12 mm high, with spiral lines on the upper whorls and usually with a bead below sutures.      | <i>M. truncatelliformis</i> |

12. Shell almost cylindrical, with a tubercular bead below the sutures. M. crawshayi  
Shell with conical spire and without a tubercular bead. M. mweruensis

1. *Melanoides tuberculata* (Müller) Fig. 36-37

Up to 47 x 14 mm, but usually smaller. Very variable in the shape and sculpture of the whorls, and sometimes difficult to separate from other species, but always recognizable by the number of cusps (9-11) on the central teeth of radula. Its distribution in South-east Africa is peculiar: rather common in Mozambique and Rhodesia, abundant in Lake Malawi, but not recorded from Zambia.

2. *Melanoides anomala* (Dautzenberg & Germain) Fig. 38

23 x 9 mm. Also very variable in shape and sculpture and therefore difficult to separate from the preceding species, but the radula is distinctive. Its main distribution is in Katanga and in the area in question it is known only from a few localities in the northern part of Barotseland.

3. *Melanoides victoriae* (Dohrn) Fig. 39

23 x 7 mm. Rather similar to *M. anomala*, but usually more slender and with less developed transverse ribs. The central teeth of radula with only 5 cusps. It is common in the middle Zambezi and in some of the affluent rivers and is also known from Transvaal.

4. *Melanoides nodicincta* (Dohrn) Fig. 40

28.5 x 9 mm. The coarse sculpture and the row of strong tubercles just below the sutures are distinctive. When the sculpture is less pronounced, it may be difficult to separate it from *M. tuberculata* of the same size, but the central teeth have only 7 cusps. It is common in Lake Malawi from the shore and down to at least 90 feet.

5. *Melanoides pergracilis* (Martens) Fig. 41

25 x 7 mm. Very similar to *M. tuberculata*, but the shell is more slender and the aperture distinctly smaller than in *tuberculata* of same size. The radula is as in *nodicincta*, but relatively larger. Rather common in Lake Malawi at depths from 10 to 90 feet.

6. *Melanoides pupiformis* (Smith) Fig. 42

15 x 4.5 mm. The high-spined, almost cylindrical and strongly sculptured shell is distinctive. Radula similar to that of *pergracilis*. Endemic to Lake Malawi, but apparently rather uncommon, and possibly restricted to depths about 70 feet.

7. *Melanoides nyassana* (Smith) Fig. 43

17 x 6 mm. The sculpture is restricted to some spiral lines on the base of the shell. Central teeth of radula with 5 cusps. Endemic to Lake Malawi, but not common.

8. *Melanoides polymorpha* (Smith) Fig. 44

13 x 4.5 mm. A very variable species, difficult to characterize conchologically, but usually recognizable by the pointed apex, poorly developed sculpture and light colour. The central teeth of radula have 5 cusps as in the preceding species, but relatively larger. Endemic to and common in L. Malawi at moderate depths.

9. *Melanoides turritispira* (Smith) Fig. 45

19 x 7 mm. The transverse ribs on the upper whorls and the bead below the sutures which makes the whorls step-like, are distinctive. Radula relatively small with 7 somewhat divergent cusps on the central teeth. Endemic to Lake Malawi, where it lives at depths down to 15 feet.

10. *Melanoides truncatelliformis* (Bourguignat) Fig. 46

11 x 4.5 mm. The shape of the shell is similar to that of the preceding species, but the smaller size, more obtuse apex and lack of transverse ribs make it recognizable. Radula as in *M. nyassana*. Endemic to Lake Malawi and apparently rare.

11. *Melanoides magnifica* (Bourguignat) Fig. 47

10 x 4 mm. The size and shape of the shell and the costulate upper whorls are distinctive. The central teeth of radula have only three large cusps of almost equal size. Endemic to Lake Malawi and apparently rare.

12. *Melanoides crawshayi* (Smith) Fig. 48

20 x 12.5 mm. The almost cylindrical shell with a tubercular bead below the sutures separates it from the following species, which also is endemic to Lake Mweru. The central teeth of radula with 11-13 cusps of which the median one is much larger than the others.

13. *Melanoides mweruensis* (Smith) Fig. 49

23 x 9 mm. The convex whorls, more conical spire and the lack of a bead below sutures are distinctive. Radula as in *M. anomala*, from which it differs by the strongly developed spiral sculpture. Endemic to Lake Mweru.

## Pulmonata

The freshwater pulmonates can be separated from the prosobranchs by the absence of an operculum and by the radula which always has numerous small rather uniform teeth.

## Key to the Pulmonate families

- |   |                                    |
|---|------------------------------------|
| 1. Shell spirally coiled.   | 2                                  |
| Shell cape- or shield-shaped.   | Ancylidae                          |
| 2. Shell globose or higher.   | 3                                  |
| Shell discoid.  | Planorbidae, subfamily Planorbinae |
| 3. Shell dextral. Triangular tentacles.   | Lymnaeidae                         |
| Shell sinistral. Filiform tentacles.  | 4                                  |
| 4. Shell glossy. A pseudobranch is absent.  |                                    |
| Radula teeth in V-shaped transverse rows.   | Physidae                           |
| Shell usually dull. A pseudobranch is present. Radula teeth in slightly curved transverse rows. | Planorbidae, subfamily Bulininae   |

## 1. Family Physidae

The shell is sinistral, rather strong, ovate or acuminate and usually glossy. No pseudobranch, but mantle border frequently with prolongations functioning as gills. All radula teeth with several cusps and arranged in V-shaped transverse rows. Several species in North America, few in the Old World. In Africa only two, both introduced, one of which is found in South-east Africa.

Genus *Physa* Draparnaud*Physa acuta* Draparnaud Fig. 50

15 x 9 mm. Easily confused with some species of *Bulinus*, but distinguishable by the stronger shell with a more conical and pointed spire and twisted columella. The radula is unmistakable. Originally a Mediterranean species now common in many parts of eastern Africa from Egypt to South Africa. Known from Rhodesia and Mozambique.

## 2. Family Iymnaeidae

The thin shell, usually with a large body whorl, and the broad triangular tentacles are distinctive. Distributed throughout the world. In Africa one genus.

Genus *Iymnaea* Lamarck

Two species are known from South-east Africa.

## Key to the species

Shell without spiral lines.	<i>L. natalensis</i>
Shell with a distinct, regular spiral lines giving the shell a reticulate sculpture.	<i>L. columella</i>

1. *Iymnaea natalensis* Krauss Fig. 51

23 x 15 mm, but usually smaller. This well-known, widespread and common species acts as intermediate host of *Fasciola gigantica*.

2. *Iymnaea columella* Say Fig. 52

23 x 12 mm. Resembling a slender *L. natalensis* in size and shape, but always distinguishable by the distinct reticulate sculpture. Originally an American species but now found in many parts of the world and spreading. It is common in South Africa and also known from a few localities in Zambia and Rhodesia. Its invading a new territory usually starts from a botanical garden or an ornamental pool.

## 3. Family Planorbidae

## 1. Subfamily Planorbinae

All African species of this subfamily have a flat, discoid or lenticiform shell, apparently dextral because it is carried inverted so that the side corresponding to the apical side in other snail is

the lower side of a planorbid shell and the umbilical side of other snails is the upper side of a planorbid shell. In the descriptions the planorbid shell is regarded as dextral. The animal is always sinistral as anus, pneumostome and genital openings are placed on the left side. The subfamily has a worldwide distribution and is divided into several genera, of which six are known from South-east Africa and one more has been introduced recently.

## Key to the genera

- |   |   |                      |
|---|---|----------------------|
| 1. Large species more than 3 mm high.   | 2 |                      |
| Smaller species, less than 2 mm high.   | 3 |                      |
| 2. Shell less than 6 mm high. Whorls rounded or angular on both sides or flat on upper side. A prostatic duct and a penial gland are absent.                      |   | <i>Biomphalaria</i>  |
| Shell up to 14 mm high. Whorls very convex on upper side and angular on the underside and flat in the umbilicus. A prostatic duct and a penial gland are present. |   | <i>Helisoma</i>      |
| 3. Shell discoid, flat on both sides.   | 4 |                      |
| Shell lentiform, with a convex upper side and flat underside or convex on both sides.   | 6 |                      |
| 4. Shell very flat with 5 slowly increasing whorls. Verge with a small cap-like stylet. Shell relatively higher and in most cases with less than 5 whorls.        | 5 | <i>Afrogyrus</i>     |
| 5. Verge with long, well-developed stylet. The single East African species has a costulate shell.   |   | <i>Cyraulius</i>     |
| Verge with sclerotized tip, but without stylet. Shell not costulate.  |   | <i>Ceratophallus</i> |

6. Shell with internal septa. Segmentorbis  
 Shell usually without internal septa,  
 but sometimes with incomplete septa. Lentorbis

## 2. Genus *Helisoma* Swainson

The genus is American, but a single species has been introduced into greenhouses and botanical gardens in many parts of the world. In warmer climates it has usually gone wild and established colonies under natural conditions.

### *Helisoma duryi* (Wetherby) Fig. 53

13 x 25 mm. A native of Florida, now found in some ponds in Zambia. Recently introduced into some localities in East Africa as a potential biological control of *Biomphalaria* and *Bulinus*.

## 2. Genus *Biomphalaria* Preston

This genus comprises most of the larger planorbid snails in Africa and in Central and South America. With a few exceptions the species are of paramount medical importance as intermediate hosts of *Schistosoma mansoni*. Eleven species are known from Africa and four of these from South-east Africa.

### Key to the species

1. Full-grown shell consists of 4-5 whorls which are flat, rounded or angular on the upper side. Diameter of umbilicus not larger than height of last whorl. 2  
 Full-grown shell consists of 6 whorls which are flat on the upper side. Diameter of umbilicus distinctly larger than height of last whorl. *B. sudanica rugosa*

2. Whorls are flat or rounded on upper side. Colour of shell usually a yellowish grey. 3  
 Whorls with a distinct angle on upper side. Shell is bright reddish-brown. *B. angulosa*
3. The upper side of the slowly increasing whorls is flat. *B. rhodesiensis*  
 The upper side of more rapidly increasing whorls is rounded. *B. pfeifferi*
1. *Biomphalaria pfeifferi* (Krauss) Fig. 54  
 5 x 12.3 mm. Very variable in size and shape and many local forms have been described as distinct species, but it is impossible to regard them even as subspecies. It is common throughout tropical Africa and the most important intermediate host of *S. mansoni*. In South-east Africa it is widely distributed, but rare or absent in the coastal area and in the great Lakes.
2. *Biomphalaria rhodesiensis* (Mandahl-Barth) Fig. 55  
 4.1 x 13.4 mm. It is flatter and has more slowly increasing whorls than the preceding species, from which it also differs by the arrowhead shaped mesocone on the first lateral teeth. Nothing is known of its susceptibility to *S. mansoni*. It seems to be restricted to Zambia and the adjacent parts of Tanzania and Malawi.
3. *Biomphalaria angulosa* Mandahl-Barth Fig. 56  
 5.5 x 15 mm, but sometimes less high. The angular whorls and reddish-brown colour are distinctive. Known from some localities in Tanzania and Zambia, but not common. Locally intermediate host of *S. mansoni*.
4. *Biomphalaria sudanica rugosa* Mandahl-Barth Fig. 57  
 4 x 14.5 mm. The flat shell, narrowly coiled whorls and large umbilicus render it recognizable. It is known only from the Mansa-area and the adjacent part of Katanga. Locally intermediate host of *S. mansoni*.

3. Genus *Ceratophallus* Brown and Mandahl-Barth

Small planorbids in which the distal part of the verge is sclerotized. The species have been assigned to the genera *Anisus* and *Gyraulus*, but these possess a true stylet. Several species are known from East Africa, but only one of them is found in South-east Africa.

*Ceratophallus natalensis* (Krauss) Fig. 58

1.8 x 6.6 mm, but usually smaller. The largest of the *Ceratophallus* species and always identifiable by the large number of whorls slowly increasing in width. In the colling it is very similar to *Afrogyrus coretus*, but this is a much smaller species seldom exceeding 0.7 x 4.0 mm. A very common and often abundant species throughout eastern and southern Africa.

4. Genus *Afrogyrus* Brown and Mandahl-Barth

The genus comprises a few species from Africa and Madagascar. In East Africa only one.

*Afrogyrus coretus*. (Blainville) Fig. 59

0.7 x 4.0 mm with 4-4 1/2 slowly increasing whorls. Can be confused with *Ceratophallus natalensis*, but the much smaller size and flatter whorls are in most cases sufficient for a separation. In cases of doubt the copulatory organ must be examined. It is common in West Africa, and scarcer in eastern Africa, but it is found in all the countries from Sudan to Natal.

5. Genus *Gyraulus* Charpentier

The true *Gyraulus* are characterized by the rapidly increasing whorls, the presence of a prostatic duct and of a long stylet on tip of the verge. Only three species are known from Africa (Morocco and Algeria not included) and one of these is common in South-east Africa.

*Gyraulus costulatus* (Krauss) Fig. 60

1.5 x 6.5 mm, but usually smaller. The regular transverse costulation separates it from all the other small African planorbids. Widely distributed and usually common throughout tropical Africa.

6. Genus *Lentorbis* Mandahl-Barth

Shell is convex on the upper side and flat on the under side with deeply embracing whorls and a narrow umbilicus. Without internal septa or with rudimentary septa. The vergic sheath is large and there is no flagellum. Three species in Africa, two of which are known from South-east Africa.

## Key to the species

Colour of shell usually a glossy reddish brown.

*L. junodi*

Colour of shell pale yellow.

*L. carringtoni*

1. *Lentorbis junodi* (Connolly) Fig. 61

2.0 x 5.0 mm. Shell very similar in size and shape to *Segmentorbis angustus*, but usually without internal septa and slightly lower. Widely distributed in eastern Africa from Ethiopia to Natal, but not common.

2. *Lentorbis carringtoni* (Azevedo & al.) Fig. 62

1.8 x 5.0 mm. The pale colour and slightly wider umbilicus separates it from the preceding species. Known from a few localities in Malawi, Mozambique and Natal.

7. Genus *Segmentorbis* Mandahl-Barth

Shell with convex upper side and flatter under side, with deeply embracing whorls, umbilicate and always with internal septa.

Vergic sheath shorter than preputium, with a single flagellum or without flagellum. The genus comprises six species, all African, and two of these are known from South-eastern Africa.

#### Key to the species

- |   |                       |
|---|-----------------------|
| A blunt angle near the underside, which is almost flat. 4-9 sets of internal septae.        | <i>S. angustus</i>    |
| A sharp angle along the periphery. Underside more convex. Never more than 4 sets of septae. | <i>S. kanisaensis</i> |

#### 1. *Segmentorbis kanisaensis* (Preston) Fig. 63

1.2 x 4.6 mm. Flatter and more strongly carinate than the other species of the genus, with a distinct spiral sculpture and 3-4 septa. Known from most countries in tropical Africa and not rare in eastern Africa from Ethiopia to Natal and Transvaal.

#### 2. *Segmentorbis angustus* (Jickeli) Fig. 64

2.0 x 5.5 mm. With 4-9 sets of internal septa. The shell is usually reddish-brown and glossy, but sometimes colourless and hyaline. Widely distributed from Sudan to Natal and fairly common.

#### 2. Subfamily Bulininae

The shell is sinistral and in African species globose, ovate or higher. Closely related to the Planorbinae, but differing in the development of the copulatory organ, which is completely introverted when not in use. Distributed throughout Africa and southern Asia.

#### Genus *Bulinus* O. F. Müller

About 30 species are known from Africa and the East African Islands and of these 11 occur in South-east Africa. Some of them are of great medical and veterinary importance as intermediate hosts of schistosomes. While it is easy to recognize the genus, it is often difficult to identify the species because of the great variation and the lack of constant taxonomic characters. Apparently the species are in a state of evolution. The key below is based on typical specimens.

#### Key to the species

- |  |                     |
|--|---------------------|
| 1. The microsculpture consists of spirally arranged short transverse line or small dots. Columella with a fold ('truncate'). | 2                   |
| Microsculpture consists of transverse ribs or lines. A columellar fold is absent.  | 3                   |
| 2. Vergic sheath distinctly longer and much wider than preputium.  | <i>B. africanus</i> |
| Vergic sheath shorter and not wider than preputium.  | <i>B. globosus</i>  |
| 3. Spire shorter than aperture.  | 4                   |
| Spire as long as or longer than aperture.  | 10                  |
| 4. Mesocoines of the lateral teeth simply triangular.  | 5                   |
| Mesocoines of lateral teeth arrow-head-shaped.   | 8                   |
| 5. Full-grown shell more than 8 mm high.   | 6                   |
| Full-grown shell less than 7 mm high.  | 7                   |

6. Shell heavy and with very short spire. *B. nyassanus*  
Shell not heavy usually with a rather high conical spire. *B. tropicus tropicus*
7. Umbilicus closed by the narrow reflection of the columella margin. *B. tropicus depressus*  
Umbilicus not closed by the broad reflexion of the columella margin. *B. reticulatus*
8. Full-grown shell less than 6 mm high (L. Malawi). *B. succinoides*  
Full-grown shell more than 8 mm high. 9
9. First lateral teeth of full-grown specimens 20-25 microns long. Mesocone and endocone largely coalescent. Usually tetraploid. *B. truncatus*  
First lateral teeth of full-grown specimens 13-18 microns long. Mesocone and endocone less coalescent. Diploid. *B. natalensis*
10. Shell slender usually with a shoulder angle on the upper whorls. *B. forskalii*  
Shell broader without a shoulder angle on the upper whorls. 11
11. Vergic sheath much longer and wider than preputium. *B. scalaris*  
Vergic sheath only slightly longer than preputium. *B. canescens*
1. *Bulinus africanus* (Krauss) Fig. 65  
15 x 10 mm, but sometimes larger. The spire is frequently more pointed than in *B. globosus*, but the long and wide vergic sheath is the only reliable character. Important intermediate host of *S. haematobium*. Widely distributed in eastern Africa from Ethiopia to Natal. Intermediates between *africanus* and *globosus* (hybrids?) are known from some localities in Zambia and Rhodesia.

2. *Bulinus globosus* (Morelet) Fig. 66  
16 x 11 mm, but sometimes larger. The short and slender vergic sheath and the obtuse apex are distinctive. Widely distributed in Africa south of the Sahara and common in South-eastern Africa. Important intermediate host of *S. haematobium*.
3. *Bulinus tropicus* (Krauss) Fig. 67-68  
11-12 x 8-9 mm, maximum size 19.5 x 12.5 mm. Very variable, but usually with a rather pointed apex and broadly reflexed columellar margin (Fig. 67). The mesocone on the lateral teeth is simply triangular and aphylic specimens are extremely rare. Widely distributed in eastern Africa from Kenya and Uganda to South Africa. In northern Zambia the typical form is absent and instead a peculiar dwarfed form, *B. t. depressus* (Haas) fig. 68, is fairly common. The average size is only 7 x 5 mm and the reflexion of the columellar margin is narrow and the spire is lower.
4. *Bulinus reticulatus* Mandahl-Barth Fig. 69  
5.3 x 3.7 mm, maximum size 7.0 x 5.0. The small size, shouldered whorls, open umbilicus and broadly reflexed, not adnated columellar margin are distinctive. It has a scattered distribution from Ethiopia to South Africa and is found only in habitats completely dried up during the greater part of the year.
5. *Bulinus nyassanus* (Smith) Fig. 70  
11 x 10 mm. The low spire and wide and relatively heavy shell render this species easily identifiable. It is endemic to Lake Malawi, where it is found alive at depths from the shore and down to 80 feet. Empty shells have been dredged at much greater depths (about 300 feet).



6. *Bulinus natalensis* (Küster) Fig. 71

11.5 x 9.0, maximum size 15.0 x 10.7 mm. The typical form has a rather inflated shell with a low spire and twisted columella, but the shape of the shell is variable, sometimes almost cylindrical, sometimes more conical as in *B. tropicus*. The shape and size of the lateral teeth and chromosome numbers are distinctive. Aphallic specimens are frequent. Widely distributed in eastern Africa from Kenya and southwards. Insusceptible to *S. haematobium*.

7. *Bulinus truncatus* (Audouin) Fig. 72

Very little is known of the occurrence of this species in South-east Africa; With certainty it has been found in two localities only: Karonga in Malawi, and Bera Dam at Salisbury, Rhodesia. It is almost impossible to separate it from the preceding species on morphological characters, and the size of the radula teeth is difficult to use, because it depends on the size of the snail; but it is easy by enzym-electrophoresis. *B. truncatus* is normally tetraploid, but the Bera Dam population is diploid. Both the tetraploid and the diploid form are highly susceptible to the North-African strain of *S. haematobium*.

8. *Bulinus succinoides* (Smith) Fig. 73

5.5 x 4.2 mm. Endemic to Lake Malawi in shallow water down to about 15 feet. Easily separated from *B. t. depressus* (which does not live in L. Malawi) by the much larger radula teeth with arrow-head shaped mesocones on the first laterals.

9. *Bulinus forskalif* (Ehrenberg) Fig. 74

Average size 14 x 4 mm, but often smaller; maximum size 17 x 5 mm. The high-spined, slender shell usually with a shoulder angle on the upper whorls makes it easily recog-

nizable. The small copulatory organ separates it from the following species. It is a very variable and widely distributed species, common in most of Africa, especially in temporary waters, but apparently very rare in Zambia and Malawi. Insusceptible to *S. haematobium*.

10. *Bulinus scalaris* (Dunker) Fig. 75

11.5 x 4.4 mm, maximum size 12.7 x 5.0 mm. The relatively broader shell without a shoulder angle separates it from the preceding species. In cases of doubt the much larger copulatory organ is distinctive. Known from Ethiopia to Namibia, but with a very scattered distribution. In South-east Africa it is recorded from a single locality in Zambia.

11. *Bulinus canescens* (Morelet) Fig. 76

14.5 x 7.0 mm. It differs from *B. forskalii* in the absence of the shoulder angle and the greater width and from *B. scalaris* in the size and proportions of the copulatory organ and in the more regularly conical spire. It is described from Angola and is also known from Upper Katanga and from a single locality (Mazabuka) in Zambia.

## 4. Family Ancyliidae

The cap- or shield-shaped, uncoiled shell separates the members of this family from all other African freshwater snails. The family has a world-wide distribution and is represented in Africa by three genera, one of which is restricted to the Ethiopian highland. The two others are represented in South-east Africa.

## Key to the genera

Shell cap-shaped with radially punctate apex.	<i>Burnupia</i>
Shell shield-shaped. Apex radially striate.	<i>Ferrissia</i>

1. Genus *Burnupia* Walker

The shell is small, cap-shaped with radially punctate apex. Several species have been described from Africa, especially from South Africa. In South-east Africa three species.

## Key to the species

1. Tip of shell large and strongly bent overhanging the right margin.	<i>B. caffra</i>
Tip of shell small and not strongly bent, not overhanging the right margin.	2
Shell with fine, but distinct radial lines, esp. on the front part.	<i>B. verreauxi</i>
Radial lines absent.	<i>B. mooiensis</i>

1. *Burnupia caffra* (Krauss) Fig. 77

The shell is 3.8 mm high and 5.4 mm long. The large curved apex overhanging the margin is distinctive. Distributed in southern Africa from Katanga and Rhodesia to the Cape Province.

2. *Burnupia verreauxi* (Bourguignat) Fig. 78

The shell is 5.0 mm high and 7 mm long. It varies a good deal in shape, but is recognizable by the fine, but distinct radial striation especially on the front part of the shell. Rhodesia and South Africa.

3. *Burnupia mooiensis* (Walker) Fig. 79

The shell is 4 mm high and 6.8 mm long. It is lower and usually more regularly oval than the preceding species and it lacks radial striae. Its known distribution comprises Katanga, Rhodesia and Transvaal.

2. Genus *Ferrissia* Walker

The members of this genus are characterized by the small, shield-shaped shell with radially striate apex. Several species have been described from Africa, but most of them are ill-defined and their classification is unsatisfactory. Four species are known from South-east Africa.

## Key to the species

1. Posterior margin oblique and sides almost parallel.	<i>F. burnupi</i>
Outline of shell almost regularly ovale.	2
2. Shell with fine, but distinct radial lines.	<i>F. connollyi</i>
Shell without radial sculpture.	3
3. Shell forms a broad oval. Short diameter 5/7 of long diameter.	<i>F. natalensis</i>
Shell forms a narrower oval. Short diameter 4/7 of long diameter.	<i>F. equeefensis</i>

1. *Ferrissia burnupi* (Walker) Fig. 80

The shell is 2.2 mm high and 4.0 mm long and usually identifiable by the oblique posterior margin and the apex placed nearer the middle of the shell than in the following species. Rhodesia and South Africa.

2. *Ferrissia natalensis* Walker Fig. 81

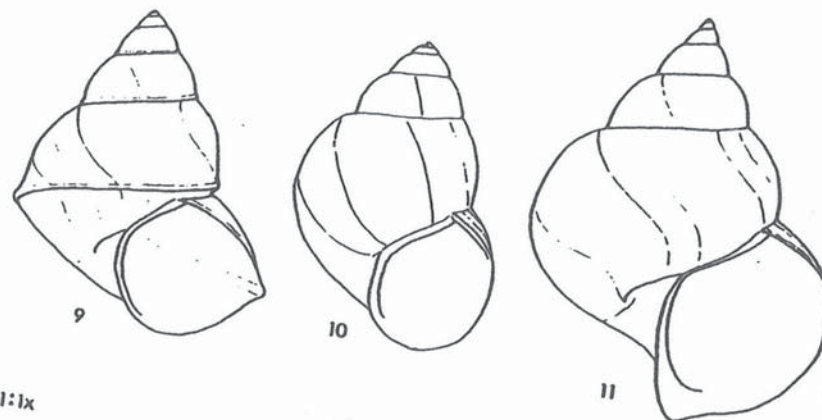
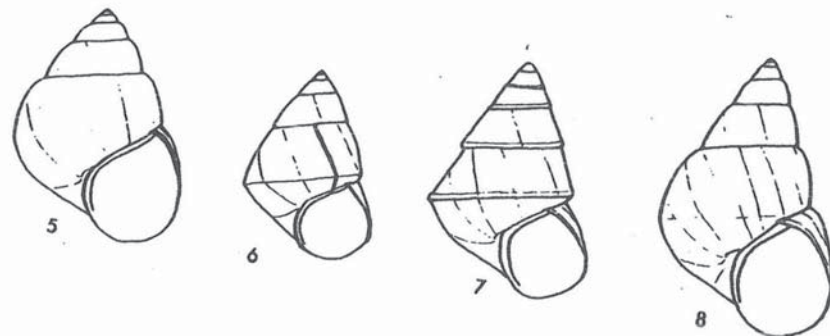
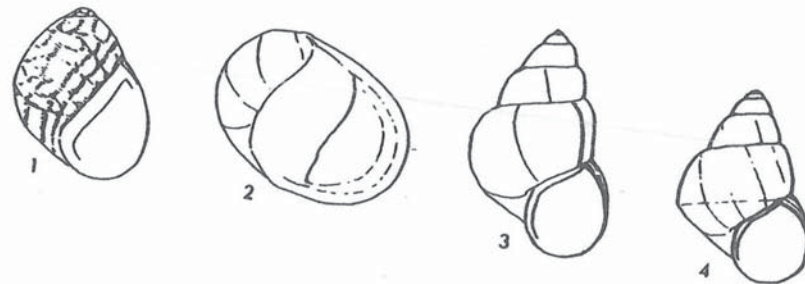
The shell is 3.0 mm high and 4.2 mm long and forms a broader oval than in the other species. It is known from Zambia, Rhodesia, Transvaal and Natal.

3. *Ferrissia connollyi* (Walker) Fig. 82

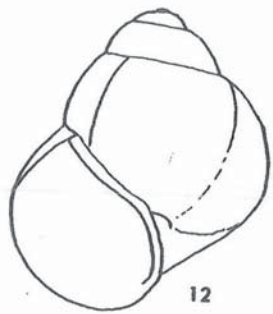
The shell is 2.2 mm high and 3.7 mm long and is recognizable by the delicate radial striae on the front part. It is common in Rhodesia and also known from Katanga and South Africa.

4. *Ferrissia equeefensis* (Walker) Fig. 83

The shell is 2.1 mm high and 3.7 mm long and forms a regular oval. Apex placed more posteriorly than in the preceding species. Recorded from Mozambique, Rhodesia and Natal.



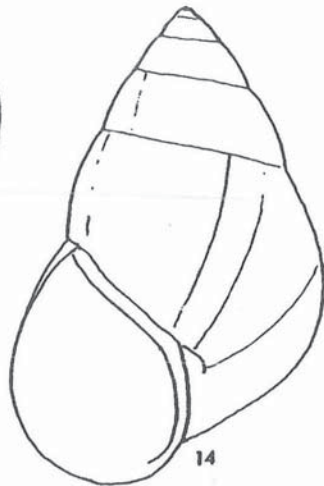
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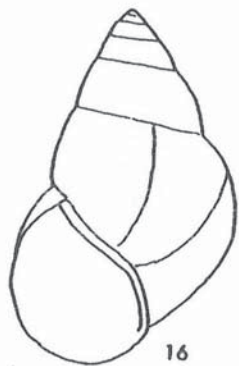
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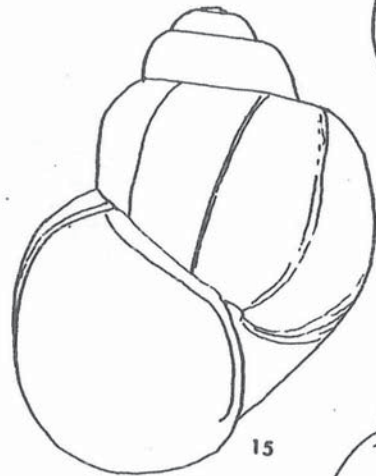
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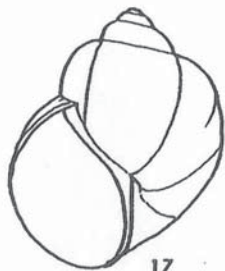
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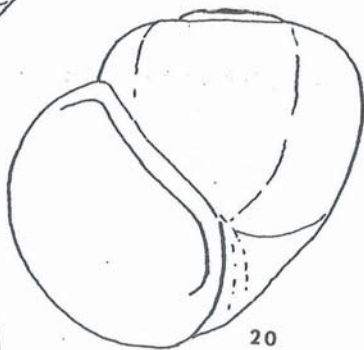
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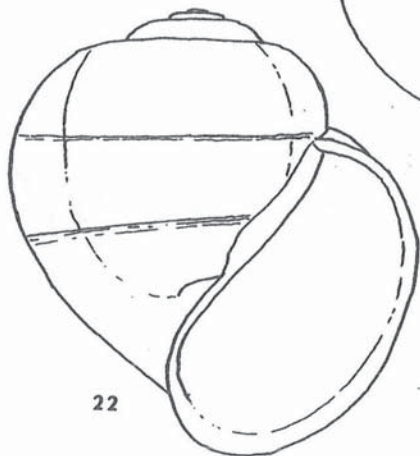
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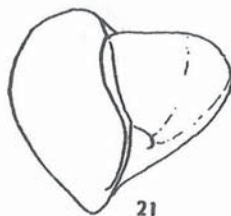
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12-22:  $\frac{2}{3}$ x

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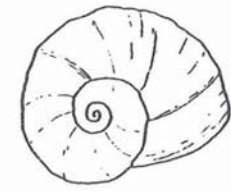
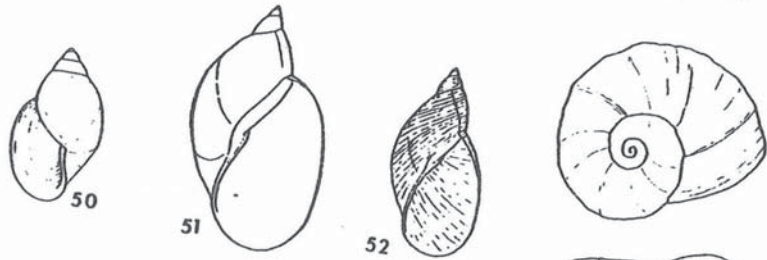
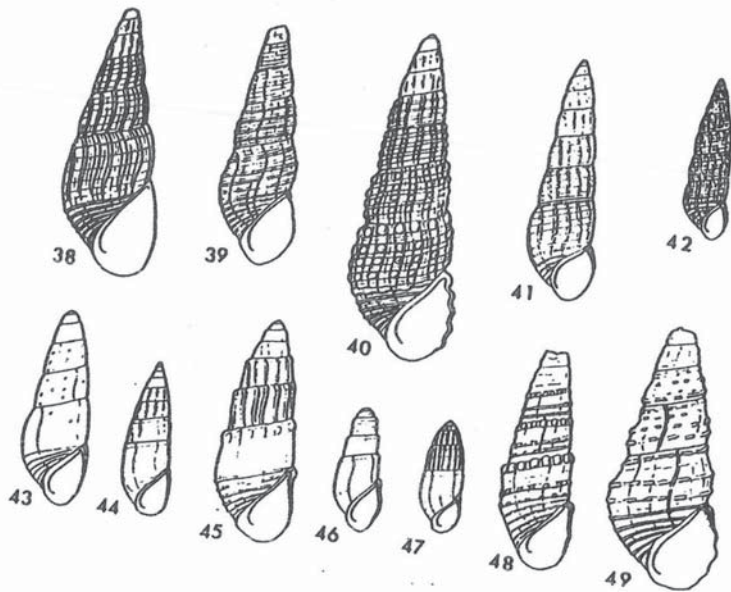


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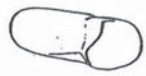
3-28: 3x 29-37:  $1\frac{1}{2}$ x



53



57



54



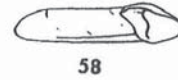
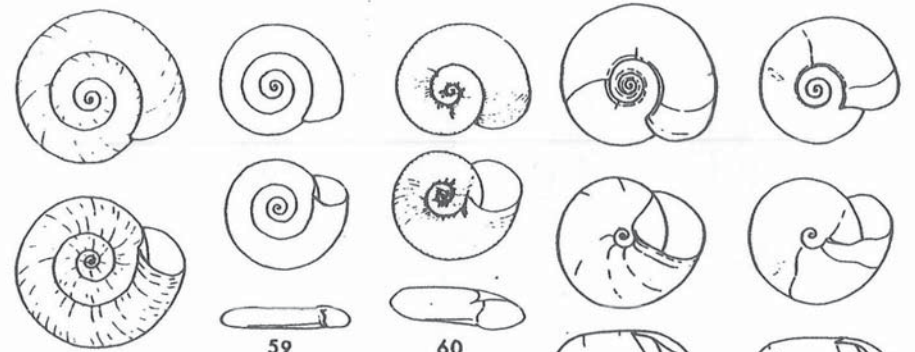
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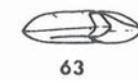
38-57: 1½x



58



63



64



72



78



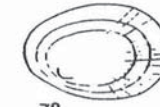
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79



74



80



81



75



76



82



83



83

58-64: 4x 65-76: 1½x 77-83: 3x