

Guide to the Brackish and Fresh Water Gastropods of Fiji



Alison Haynes

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INTRODUCTION

The purpose of this publication is to provide an identification guide to the non-marine molluscs of Fiji for the amateur naturalist, the student or the professional biologist. The fauna consists of 39 species in 7 families. Keys, descriptions and habitat and distribution information are given. All freshwater gastropods and those from brackish water which are not found exclusively in mangrove areas are included in this publication.

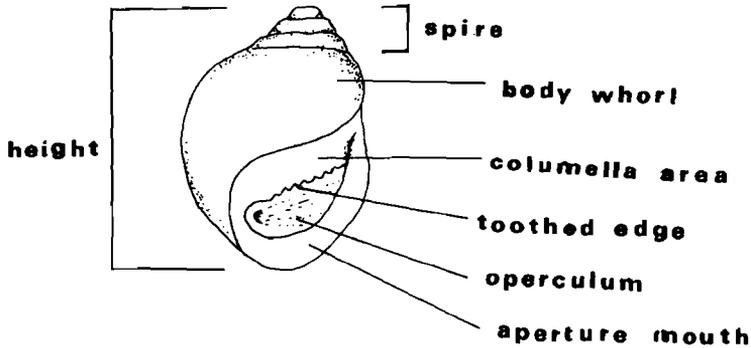
Most species found in Fiji also inhabit parts of Asia and other Pacific Islands. Two endemic species of Fijian freshwater snails are known. Both inhabit fast flowing streams in the interior of Viti Levu. These are Fluviopupa pupoidea (Hydrobiidae) which belongs to a genus that is found on New Caledonia, Vanuatu, Rapa Island, Lord Howe Island as well as Fiji (Hubendick, 1952; Ponder, 1982) and Fijidoma maculata (Thiaridae) which is monospecific and appears to have no close relatives (Morrison, 1954).

The most useful references to Pacific Island non-marine aquatic molluscs are either in French (Germain, 1932; Franc, 1956) or German (Reich, 1937; Starmühlner, 1970, 1976). Germain (1932) gives detailed distribution data for the Fijian non-marine molluscs but does not describe the species. He lists 47 freshwater species, at least 10 of which are considered synonyms by later workers. The species accepted here follow Starmühlner (1976) whose work on the taxonomy and anatomy of Pacific Island non-marine molluscs is probably the most significant in the field.

The guide is constructed in two parts - a key to families and a key to the species in each family. Once an unknown snail has been placed in a family, its species can be established by working through the species key for that family.

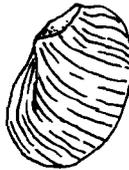
The terminology used in the key is shown in the following figures.

FIG. A



The sculpture on the surface of the shell is often important in identification. 'Ridged' describes prominent straight parallel raised lines.

FIG. B



RIDGED

'Wrinkled' describes the effect when the ridges are wavy and joined.

FIG. C



WRINKLED

Height is measured from the apex to the base (Fig. A.). When the spire is completely or partially covered by the body whorl, length is given instead of height.

KEY TO FAMILIES

Authorities for families are: PROSOBRANCHIA - W. Wenz (1938) modified by Golikov & Starobogatov (1975) to create a new family Septariidae. PULMONATA - A. Zilch (1959).

1 Shell tall, turret shaped or disc shaped 2

- Shell spherical with a low spire or the spire completely covered by the body whorl. 5

2 Shell left handed (sinistral) i.e. the aperture opens to the observer's left or disc shaped

PLANORBIDAE

- Shell right handed (dextral) i.e. the aperture opens to the observer's right. 3

3 Shell more than 5 mm high.

THIARIDAE

- Shell less than 5 mm high 4

4 Shell conical with a blunt apex, narrow body whorl, shiny, horn coloured.

HYDROBIIDAE

- Shell conical with a sharp apex, fat body whorl, pink-brown coloured, eroded white

ASSIMINEIDAE

5 Columella area present and aperture semicircular. Shell may have spines. Operculum visible in live snails.

NERITIDAE

- No columella area and no visible operculum. Shell limpet shaped. 6

6 Shell yellow, thin, smooth, transparent and less than 5 mm long.

FERRISSIDAE

- Shell brown or yellow with a black or purple pattern of lines or triangles. Up to 40 mm long.

SEPTARIIDAE

FAMILIES, WITH KEYS TO THEIR SPECIES

PLANORBIDAE

This worldwide pulmonate family has only two species established in Fiji, although the European large ramshorn, Planorbarius corneus, has been found in the lily pond at Suva Grammar School.

KEY TO PLANORBIDAE

1 Shell turret shaped and sinistral (left-handed)

Physastra nasuta (Morelet)

Plate 1, Fig. 1

(Grows to 20 mm high and is very variable in shape and colour. Found in ponds, ditches and fast flowing streams in Viti Levu and Vanua Levu.

Distribution: New Caledonia, Vanuatu, Tonga, Cook Islands, Fiji).

- Shell flat and disc shaped.

Gyraulus montrouzieri (Gassies)

Plate 2, Fig. 2

(Horn coloured shell not more than 5 mm in diameter. Lives in ponds, usually on water plants in Viti Levu.

Distribution: New Caledonia, Fiji).

THIARIDAE

These are mainly African, Asian and Pacific operculate freshwater snails. According to Morrison (1956) all members are parthenogenetic and ovoviviparous. However, those species which are found near or in brackish water produce veliger larvae instead of fully developed young adults. This family has 10 species in Fiji.

KEY TO THIARIDAE

- 1 Shell with a small sharp spire and a large spherical body whorl.

Fijidoma maculata (Mousson)

Plate 1, Fig. 3

(Shell fawn with red-brown zig-zag or broken lines. Grow up to 12 mm high. Found only in the headwaters of the Lami and Rewa rivers, Viti Levu.

Distribution: Fiji).

- Shell much taller than broad, often turret shaped. 2

- 2 Shell squat with deep sutures and with deep vertical ridges or spines.

Thiara spp. 3

- Shell tall with shallow sutures and no spines 6

- 3 Shell large (45 mm high), broad, solid and black consisting of 2-3 whorls with spines

Thiara amarula (Linné)

Plate 2, Fig. 4

(Apex eroded. Found on sand or gravel within a few kilometers of the sea in Viti Levu and Ovalau.

Distribution: East Africa, Mediterranean, Asia, Pacific Islands).

- Shell less than 30 mm high, black or olive-brown with red stripes or flecks, ridged or with spines. 4

- 4 Solid black shell composed of 3-6 whorls with short spines.

Thiara bellicosa (Hinds)

Plate 2, Fig. 5

(Has strong spiral ridges. Aperture obliquely oval with a small sharp spine near the upper edge. Grows to 30 mm high. Apex eroded. Found on mud in fresh water affected by the tide in Viti Levu and Vanua Levu.

Distribution: New Guinea, Solomon Is., Fiji).

- Olive brown shell with red-brown stripes or flecks. 5

- 5 4-8 whorls with vertical ridges and spines. Large body whorl, sharp apex with few or no red brown flecks.

Thiara scabra (Müller)

Plate 2, Fig. 6

(Grows 28 mm high. Found on gravel and stones from a few kilometres from the sea to well inland. Found on Viti Levu and Vanua Levu.

Distribution: Indo-pacific).

- 4-8 whorls, ridged with red brown vertical stripes.
Body whorl slender, apex usually eroded.

Thiara terpsichore (Gould)

Plate 2, Fig. 7

(A tall shell up to 28 mm high, apex usually eroded. Found within a few kilometres of the sea on Viti Levu and Ovalau.

Distribution: Samoa, Fiji).

- 6 Shells very tall with an acute apex, body whorl slender and whorls straight sided. 7
- Shells moderately tall, body whorl rotund and whorls with convex sides. 8
- 7 Shell olive brown with many red-brown vertical stripes or flecks especially below the sutures.

Melanoides plicaria (Born)

Plate 3, Fig. 8

(Upper whorls with vertical ridges and body whorl with transverse striations near the aperture. 9-18 whorls, reaching 90 mm high. Found in brackish and freshwater near the mouth of rivers and streams on Viti Levu, Vanua Levu, Taveuni, Ovalau.

Distribution: Indo-pacific).

- Shell olive brown with smooth unpatterned whorls.

Melanoides aspirans (Hinds)

Plate 3, Fig. 9

(Often covered in a black encrustation and with the upper whorls eroded to leave only 3 or 4 whorls. Found in brackish and freshwater

near the mouth of rivers. Grows to 74 mm high in Viti Levu, Ovalau, Taveuni.

Distribution: Bismarck Archipelago, Solomon Is., Vanuatu, New Caledonia, Samoa, Fiji).

- 8 Shell brown to olive with red-brown vertical stripes and flecks.

Melanoides tuberculata (Müller)

Plate 3, Fig. 10

(The upper whorls have a trellis pattern of crossing spiral and transverse ridges. Often has black encrustation and an eroded apex. Grows to 38 mm high. Widely distributed in ditches, ponds, rivers and streams on Viti Levu, Vanua Levu, Ovalau, Taveuni.

Distribution: S. Europe, Middle East, Africa, Asia, Pacific Is.).

- Shell brown, but adults with black encrustation. No red-brown stripes. 9

- 9 Shell smooth or with spiral lines.

Melanoides lutosa (Gould)

Plate 3, Fig. 11

(Inside of aperture white. Grows to 28 mm high. Found in fresh-water streams and rivers in strong current well inland in Viti Levu, Vanua Levu.

Distribution: Samoa, Fiji).

- Upper half of each whorl with strong vertical ridges, lower half with spiral lines.

Melanoides arthurii (Brot)

Plate 3, Fig. 12

(Inside of aperture pale brown. Found in streams and ditches on sand and mud near the sea. Grows to 48 mm high. Found on Viti Levu, Kadavu.

Distribution: N. Guinea, N. Caledonia, Solomon Is., Admiralty Is., Samoa, Tahiti, Fiji).

HYDROBIIDAE

A family of small prosobranch gastropods found in fresh and brackish waters. There is only one species in Fiji.

Fluviopupa pupoidea Pilsbry

Plate 4, Fig. 13

(Shell shiny, horn coloured but sometimes with black encrustation. Has 4-5 whorls and grows to 3.2 mm high. Found in inland streams of Viti Levu.

Distribution: Fiji).

ASSIMINEIDAE

Small prosobranch snails found in brackish water or in water influenced by the tide.

Assiminea crosseana Gassies

Plate 4, Fig. 14

(Shell 3.5 mm high with 5 whorls, the last very stout. Operculum transparent. Found on water hyacinth and in brackish water on Viti Levu.

Distribution: N. Caledonia, Fiji).

NERITIDAE

More freshwater gastropods in Fiji belong to the prosobranch family Neritidae than to any other. The family contains marine, freshwater and terrestrial species. Some freshwater species are found only near river and stream mouths while others have become established as far as 48 km upstream.

KEY TO NERITIDAE

- 1 *Columella* area very large, extending downwards and sideways.
Aperture small with a concave upper edge.

Neritina auriculata Lamarck

Plate 4, Fig. 15

(Shell shape variable sometimes with the columella area extended sideways into 'wings'. Grows to 23 mm long. Lives in the current near river and stream mouths on Viti Levu, Vanua Levu, Taveuni, Kadavu.

Distribution: Asia, Pacific Islands).

- *Columella* area less extensive. Aperture large and semicircular.

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- 2 Columella area with an acute slope, edge toothed with one large projection towards the upper aperture edge.

Clithon spp. 3

- Columella area large and flat. Aperture edge finely toothed or smooth.

Neritina spp. 8

- 3 Shell with deeply ridged or wrinkled surface, often with spines. 4

- Shell smooth or finely ridged. No spines. 7

- 4 Shells without spines.

Clithon rarispina (Mousson)

Plate 4, Fig. 16

(Shell olive with dark spots or dashes. Columella area and aperture mouth yellow-grey. Operculum yellow-orange with black stripes, nucleus yellow-orange and outer border orange. Found at the mouth of streams in brackish water. Reaches 18 mm long. Found on Ovalau.

Distribution: Java, N. Guinea, Fiji).

- Shells with spines 5

- 5 Shell ridged

Clithon diadema souleyetana (Recluz)

Plate 5, Fig. 17

(Whorls often angular, with spines. Shell colour brown-black with a few yellow flecks. Columella white-grey, aperture mouth white or faintly yellow. Operculum white to grey with a yellow nucleus. Found near river and stream mouths on Viti Levu, Vanua Levu, Ovalau. Grows to 20 mm long.

Distribution: Asia, Pacific Islands).

- Shell with a wrinkled appearance. 6

- 6 Spines long and thin, projecting backwards.

Clithon spinosus (Budgin)

Plate 5, Fig. 18

(Shell fawn with brown fine triangular pattern and wide dark bands. Columella white becoming orange-brown on the upper edge. Inside aperture mouth white-yellow. Operculum black and white with yellow nucleus and orange border. Found near river and stream mouths in Viti Levu. Grows to 20 mm. Distribution: Tahiti, Fiji).

- Spines short and stout or absent.

Clithon corona (Linné)

Plate 5, Fig. 19

(Shell with a red-brown pattern on a cream-fawn background. Columella orange at the upper edge, turning white towards the lower edge. Aperture mouth bright orange. Operculum yellow-pink, with a grey nucleus and a horn-red border. Found from the mouth to several kilometres upstream. Upstream snails are usually without spines. Grow to 30 mm. Found on Viti Levu, Ovalau, Taveuni, Kadavu. Distribution: Asia, Pacific Islands).

7 Shell spherical, less than 10 mm long with variable patterns on a yellow background.

Clithon oualaniensis (Lesson)

Plate 5, Fig. 20

(Shell shiny with a variable pattern of wavy stripes or triangles or some combination of these. Columella white turning yellow-orange on the upper edge. Aperture mouth white. Operculum blue-black with yellow nucleus and horn border. Found in brackish water at the mouth of streams on Viti Levu, Ovalau, Taveuni. Distribution: Asia, Pacific Islands).

- Shell oval, olive-brown with black stripes becoming broken lines on larger shells.

Clithon olivaceus (Récluz)

Plate 6, Fig. 21

(Columella area cream to yellow with a red-brown zone on the upper edge and with a channel at its upper corner. Aperture mouth

green-yellow. Operculum black and pink with a yellow-orange border. Found in freshwater, its range extending well inland on Ovalau, Taveuni and Kadavu. Grow to 25 mm.

Distribution: Asia, Pacific Islands).

8 Shell with a rounded projecting spire which is often eroded. 9

- Shell without a visible spire because the body whorl more or less encloses it. 11

9 Shell thick and dark with fine yellow zig-zag lines.

Neritina turrita (Gmelin)

Plate 6, Fig. 22

(Columella area yellow to orange with 5-7 strong teeth on its edge. Aperture mouth yellow. Operculum cream-orange with a black nucleus. Found in brackish water usually in mangrove areas on Viti Levu. Grows to 20 mm.

Distribution: Bismarck Archipelago, Solomon Is., Fiji).

- Shell thin and shiny

10

10 Columella area white with a red or orange stain on the upper edge.

Neritina variegata (Lesson)

Plate 6, Fig. 23

(Colour brown with black zig-zag or network pattern. Columella edge with 6-10 teeth. Aperture mouth white. Operculum black, or in young snails black and pink, with a white nucleus.

Found in fast flowing streams or Taveuni, Ovalau, Vanua Levu, Kadavu. Grows to 28 mm.

Distribution: Asia, Pacific Islands).

- Columella area red or orange-red.

Neritina turtoni (Récluz)

Plate 7, Fig. 24 .

(Shell shiny, colour variable but usually yellow to orange-red with black zig-zag bands. Columella edge with many teeth. Aperture mouth orange-red. Operculum smooth milk white to flesh coloured. Found in brackish to freshwaters near the mouth of slow flowing rivers on Viti Levu. Grows to 26 mm.

Distribution: Asia, Pacific Islands).

- 11 Shell less than 6 mm long, yellow to brown but usually covered with a black encrustation.

Neritilia rubida (Pease)

Plate 7, Fig. 25

(Shell rounded. Columella area grey-white and shiny, edge straight without teeth. Operculum yellow with a wide orange border. Found on water weed in rivers on Viti Levu.

Distribution: Asia, Pacific Islands).

- Shell more than 6 mm long.

12

- 12 Upper edge of the columella area drawn out into a sharp spine.

Neritina squamipicta Récluz

Plate 7, Fig. 26

(Last whorl enveloping all the spire. Shell brown with a black network or triangular pattern. Columella area grey-white turning orange at the sides, edge finely toothed and nearly straight. Aperture mouth yellow. Operculum with black and yellow radial stripes and a red-brown border. Grows to 15 mm. Found near the mouths of rivers and streams in Viti Levu and Vanua Levu.

Distribution: Asia, Pacific Islands).

- Upper edge of the columella area flat or with a canal at its corner.

13

- 13 Columella area bright red to purple

Neritina petiti Récluz

Plate 8, Fig. 27

(Shell brown-black with deep growth striations. Aperture mouth red. Operculum pink with black radial stripes and a dark red border. Grows to 45 mm. Found in fast flowing streams on Viti Levu, Vanua Levu, Ovalau.

Distribution: Asia, Pacific Islands).

- Columella area blue-black, yellow orange or some combination of these colours.

14

- 14 Columella area blue-black, with an orange tinge at the edges.

Neritina pulligera (Linné)

Plate 9, Fig. 28

(Shell green-brown with a black network pattern on young snails. Columella area edge toothed. Aperture mouth yellow-orange. Operculum with grey and yellow radial stripes and a red-brown border. Grows to 38 mm. Found in fast flowing streams and rivers in Viti Levu, Vanua Levu, Ovalau. Distribution: Asia, Pacific Islands).

- Columella area yellow or orange

15

- 15 A distinct canal or 'ear' at the upper corner of the columella area

Neritina canalis Sowerby

Plate 9, Fig. 29

(Columella area yellow becoming orange at the upper edge. Shell often covered with egg cases. Aperture mouth yellow-orange. Operculum pale orange with black stripes and a red-brown border. Grows to 20 mm. Found in fast flowing streams on Taveuni, Kadavu.

Distribution: N. Guinea, Bismarck Archepeligo, Solomon Is., Vanuatu, Tahiti, Fiji).

- Columella area flat without a canal

16

- 16 Columella area entirely yellow and very extensive.

Neritina macgillvrayi (Reeve)

Plate 10, Fig. 30

(Shell brown-black with strong growth striations. Aperture mouth yellow. Operculum yellow-orange with orange border. Columella edge without teeth. Grows to 20 mm. Found in fast flowing streams on Viti Levu.

Distribution: Bismarck Archipeligo, Solomon Is., N. Caledonia, Samoa, Fiji).

- Columella area yellow-orange turning red at the upper edge.

Neritina porcata Gould

Plate 10, Fig. 31

(Shell olive-brown with a dark network pattern. Columella edge with 12-16 fine teeth. Grows to 20 mm. Operculum with yellow and grey radial stripes and a red-brown border. Found in fast flowing streams on Vanua Levu, Kadavu.

Distribution: Admiralty Is., Solomon Is., Vanuatu, Samoa, Fiji).

FERRISSIDAE

This is a family of small pulmonate freshwater limpets. There is only one species in Fiji.

Ferrissia noumeensis (Crosse)

Plate 10, Fig. 32

(Shell fragile, transparent yellow but sometimes covered in a black encrustation. Found on water weed in ponds, streams and rivers on Viti Levu.

Distribution: N. Caledonia, Tahiti, Fiji).

SEPTARIIDAE

Some authorities place the genus Septaria in the family Neritidae but others think that they are sufficiently different to merit a family of their own. I follow Golikov and Starobogatov (1975). These prosobranch limpets live in brackish and fresh waters in tropical regions. Six species have been found in Fiji.

KEY TO SEPTARIIDAE

1 Shell bright yellow, narrow with pink-purple radial lines

Septaria lineata compressa (Guillou)

Plate 11, Fig. 34

(Grows to 20 mm. Found in still water near the mouth of the Rewa river, Viti Levu).

- Shell yellow-brown or dark brown. May have a black pattern.

- 2 Shell yellow-brown, smooth or faintly striated with a dark pattern. 3
- Shell dark brown with strong growth striation. Pattern absent or faint. 6
- 3 Shell yellow-brown with a fine pattern of triangles or spots 4
- Shell yellow-brown with a large bold pattern of lines, triangles or net. 5
- 4 Shell delicate with a prominent apex at the edge of the shell.

Septaria lineata (Lamarck)

Plate 11, Fig. 33

(Shape variable, septum (see Plate 11, Fig. 33) straight. Grows to 25 mm. Found on plants or wood in still water near river mouths on Viti Levu and Vanua Levu.

Distribution: Asia, Pacific Islands).

- Shell stout, extending well outside a prominent apex.

Septaria luzonica (Récluz)

Plate 11, Fig. 36

(Shell shallow and broad with a fine pattern of spots or triangles. Septum narrow with a concave edge. Grow to 25 mm. Found near the mouths of rivers on the western side of Viti Levu.

Distribution: Asia, Pacific Islands).

- 5 Shell shallow and variable in width. Septum (see Plate 11, Fig. 33) straight or slightly convex.

Septaria porcellana depressa (Linné)

Plate 12, Fig. 37

(Shell shape variable but with a bold pattern of dark wavy stripes, zig-zags, nets or triangles. Septum flat, relatively narrow with a yellow tinge. Grows to 30 mm. The most widespread species of Septaria in Fiji. Range extends from brackish water to well upstream in fast flowing streams on Viti Levu, Vanua Levu, Ovalau, Taveuni, Kadavu.

Distribution: Asia, Pacific Islands).

- Shell deep and relatively narrow. Septum with a wide projection in the middle.

Septaria suffreni (Récluz)

Plate 11, Fig. 35

(Shell with a pointed summit and with variable dark network patterns. Muscle impressions at the sides of lip on the septum are striking. Grows to 28 mm. Found in fast flowing streams on Viti Levu, Vanua Levu, Kadavu.

Distribution: Vanuatu, Samoa, Fiji).

- 6 Shell narrowest at septum end.

Septaria borbonica (Bory de St. Vincent)

Plate 13, Fig. 38

(Shell deep and widest in the middle. Septum short and straight. Shell eroded on the under surface instead of at the end as in other Septaria species. The only species with 2 projections of equal length on the operculum. Grows to 30 mm. Found in fast flowing streams on Vanua Levu, Taveuni, Kadavu.

Distribution: Asia, Indian Ocean Is., Solomon Is., Fiji).

- Shell widest in the region of the septum.

Septaria macrocephala (Guillon)

Plate 13, Fig. 39

(Shell shallow and relatively narrow. Summit extending well beyond the septum if not eroded. Grows to 26 mm. Septum long, straight and narrow. Found in fast flowing streams on Vanua Levu, Taveuni, Kadavu, Ovalau.

Distribution: New Britain, N. Caledonia, Vanuatu, Tahiti, Samoa, Fiji).

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P L A T E SPLATE 1

- Fig. 1 Physastra nasuta a) from sago swamp. b) from Wainimala river.
- Fig. 3 Fijidoma maculata a) dorsal b) ventral c) older shell with reduced markings.

PLATE 2

- Fig. 2 Gyraulus montrouzieri.
- Fig. 4 Thiara amarula
- Fig. 5 Thiara bellicosa
- Fig. 6 Thiara scabra
- Fig. 7 Thiara terpsichore

PLATE 3

- Fig. 8 Melanoides plicaria
- Fig. 9 Melanoides aspirans
- Fig. 10 Melanoides tuberculata
- Fig. 11 Melanoides lutosa
- Fig. 12 Melanoides arthurii

PLATE 4

- Fig. 13 Fluviopupa pupoidea
- Fig. 14 Assiminea crosseana
- Fig. 15 Neritina auriculata a) dorsal b) ventral.
- Fig. 16 Clithon rarispina

PLATE 5Fig. 17 Clithon diadema souleyetanaFig. 18 Clithon spinosaFig. 19 Clithon coronaFig. 20 Clithon oualaniensisPLATE 6Fig. 21 Clithon olivaceusFig. 22 Neritina turritaFig. 23 Neritina variegataPLATE 7Fig. 24 Neritina turtoniFig. 25 Neritilja rubidaFig. 26 Neritina squamipictaPLATE 8Fig. 27 Neritina petitiPLATE 9Fig. 28 Neritina pulligeraFig. 29 Neritina canalisPLATE 10Fig. 30 Neritina macgillvrayiFig. 31 Neritina porcataFig. 32 Ferrissia noumeensis a) dorsal b) side view

PLATE 11

Fig. 33 Septaria lineata

Fig. 34 Septaria lineata compressa

Fig. 35 Septaria suffreni

PLATE 12

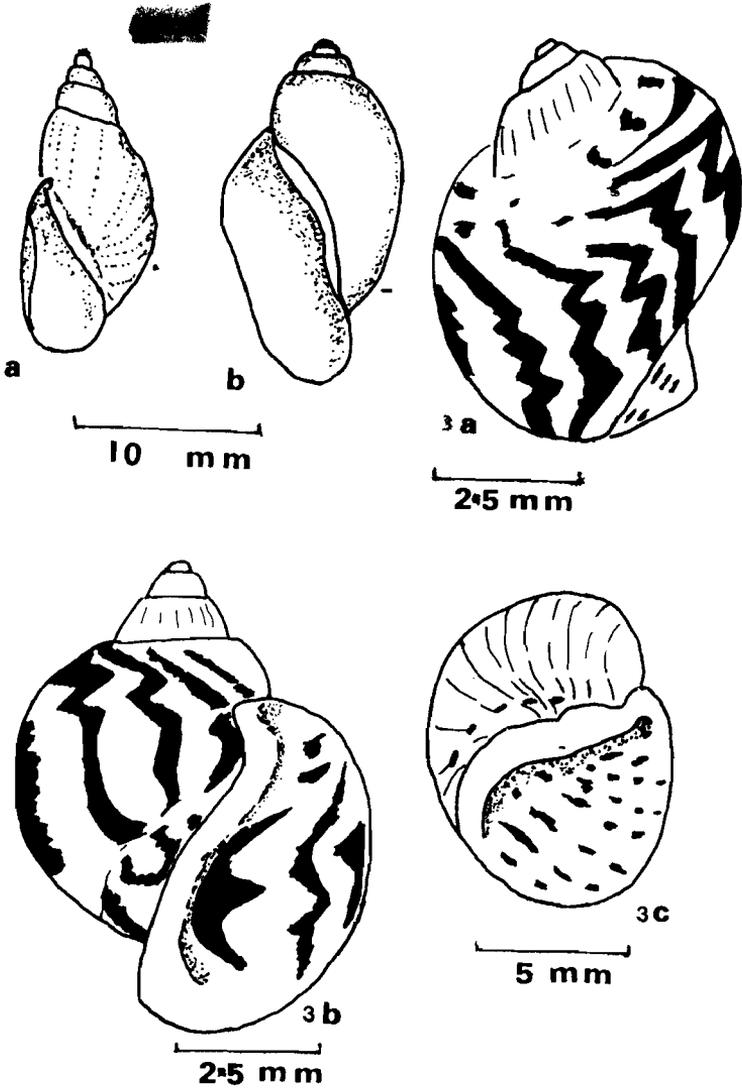
Fig. 36 Septaria luzonica

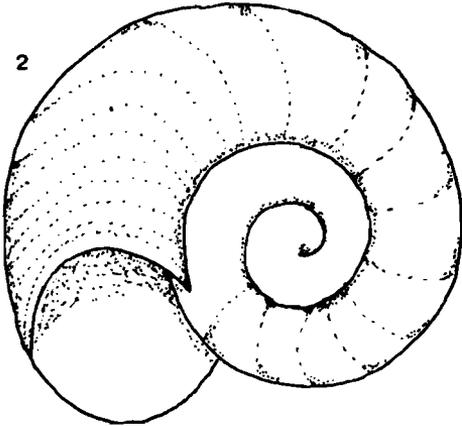
Fig. 37 Septaria porcellana depressa

PLATE 13

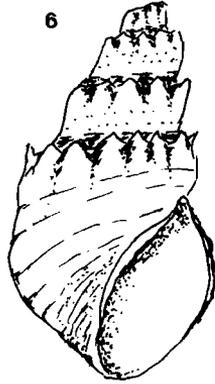
Fig. 38 Septaria borbonica

Fig. 39 Septaria macrocephala

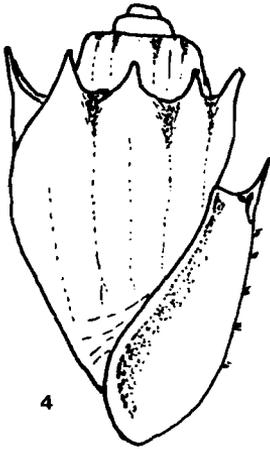




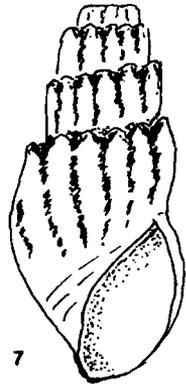
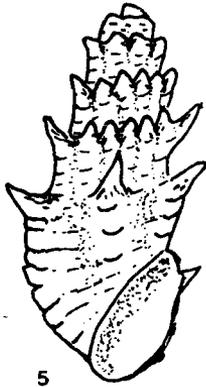
1 mm



5 mm

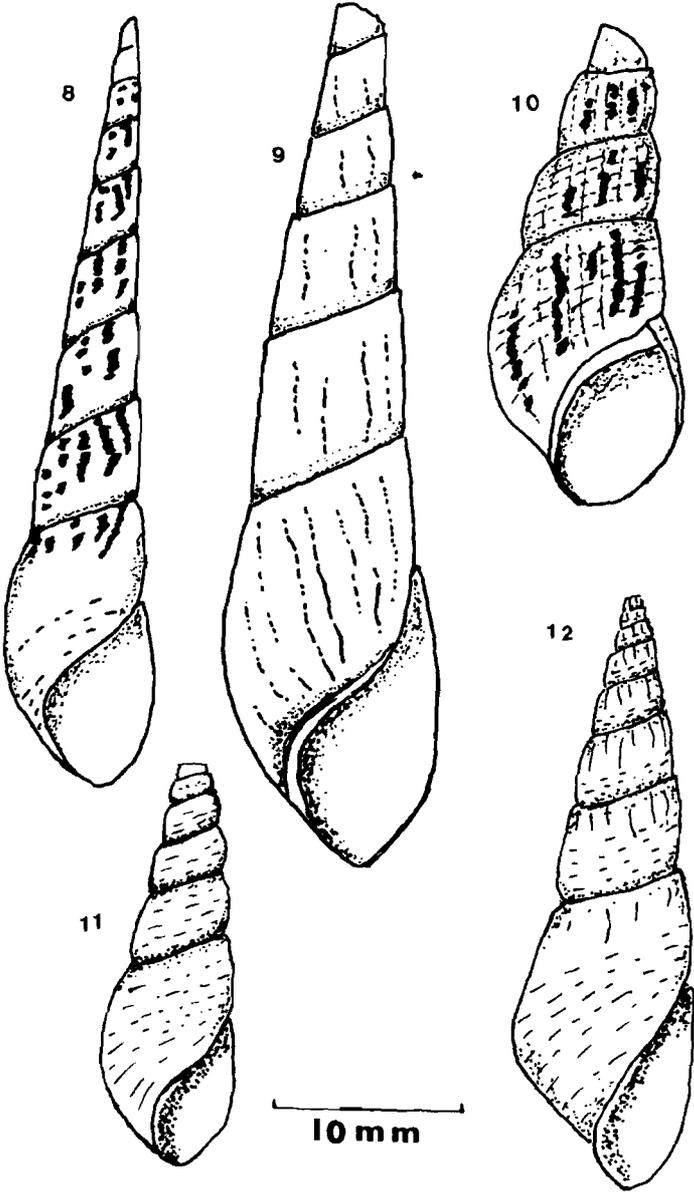


10 mm



5 mm

Plate 3



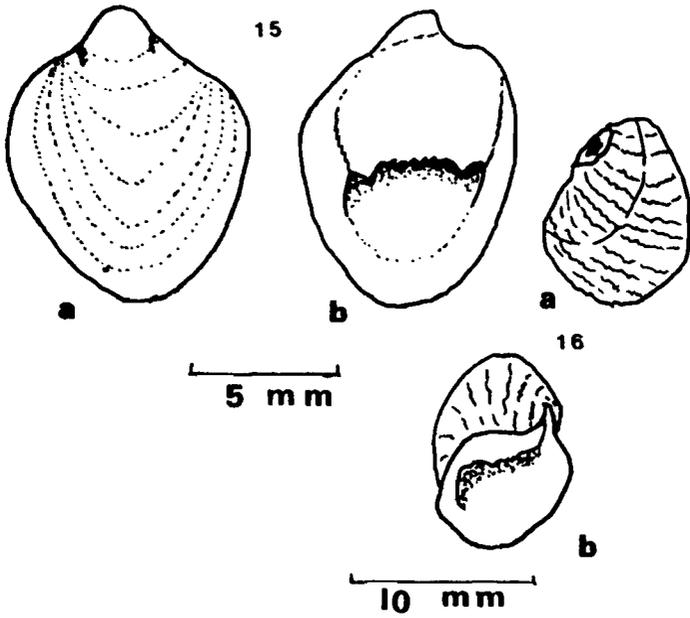
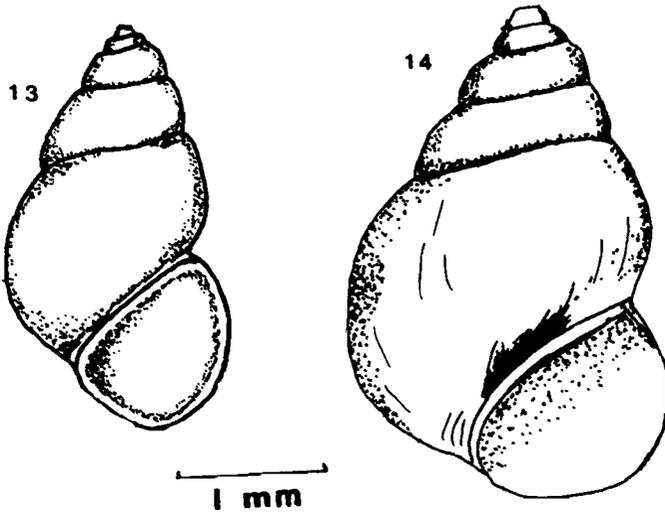
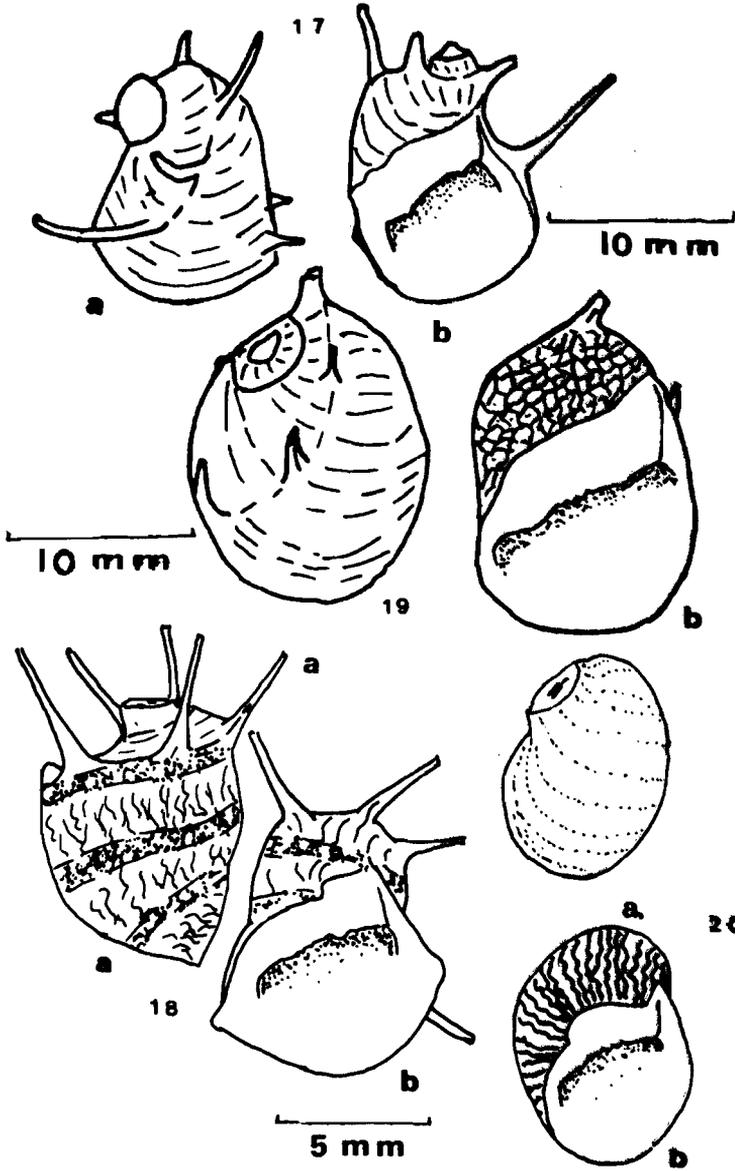
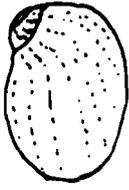


Plate 5

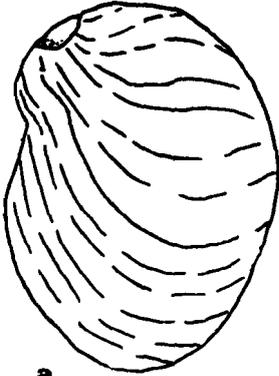




a 22

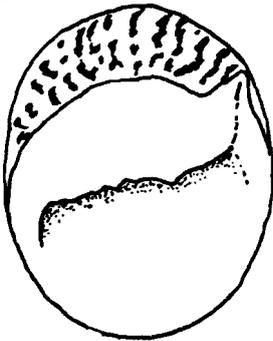


b

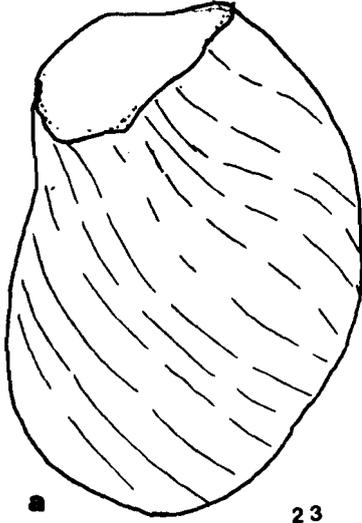


a

21

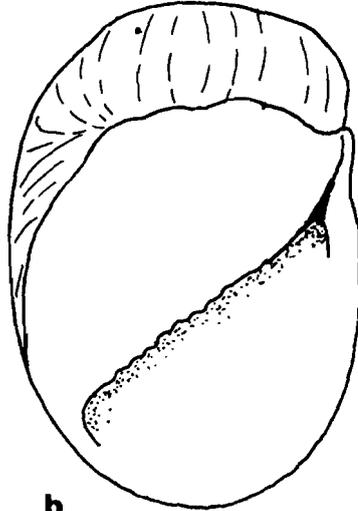


b



a

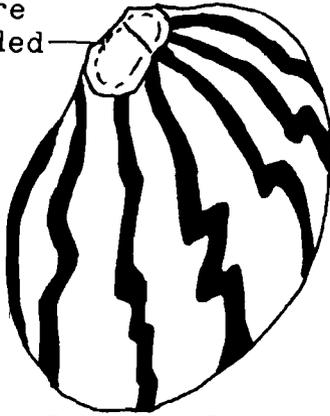
23



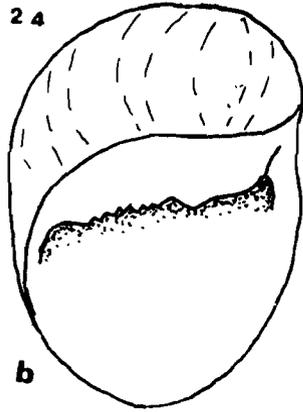
b

10 mm

spire
eroded

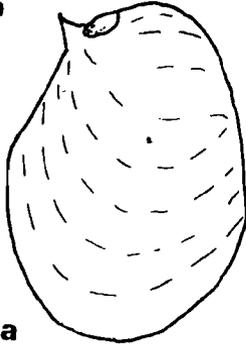


24

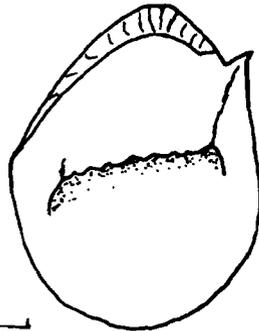


a

b



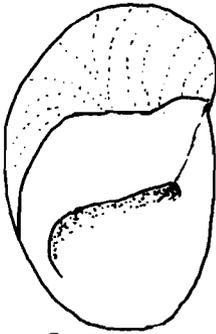
26



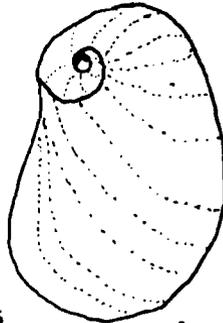
a

b

10 mm



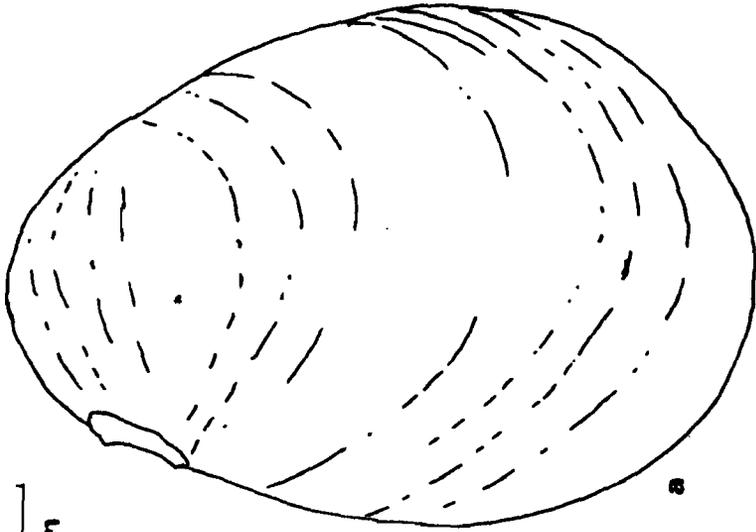
25



a

b

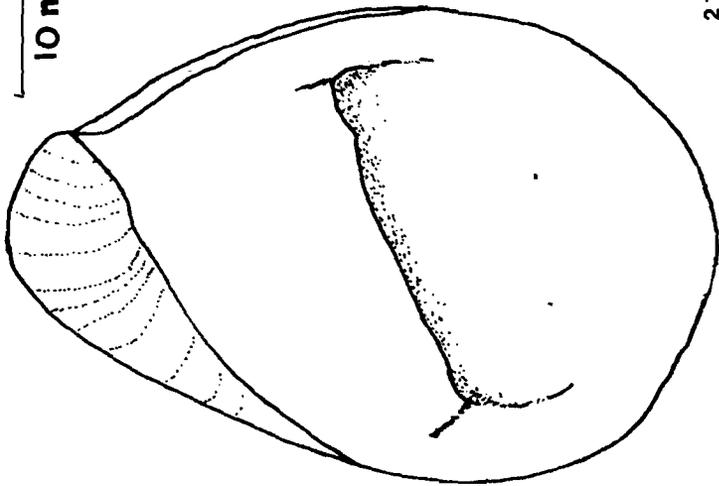
2 mm



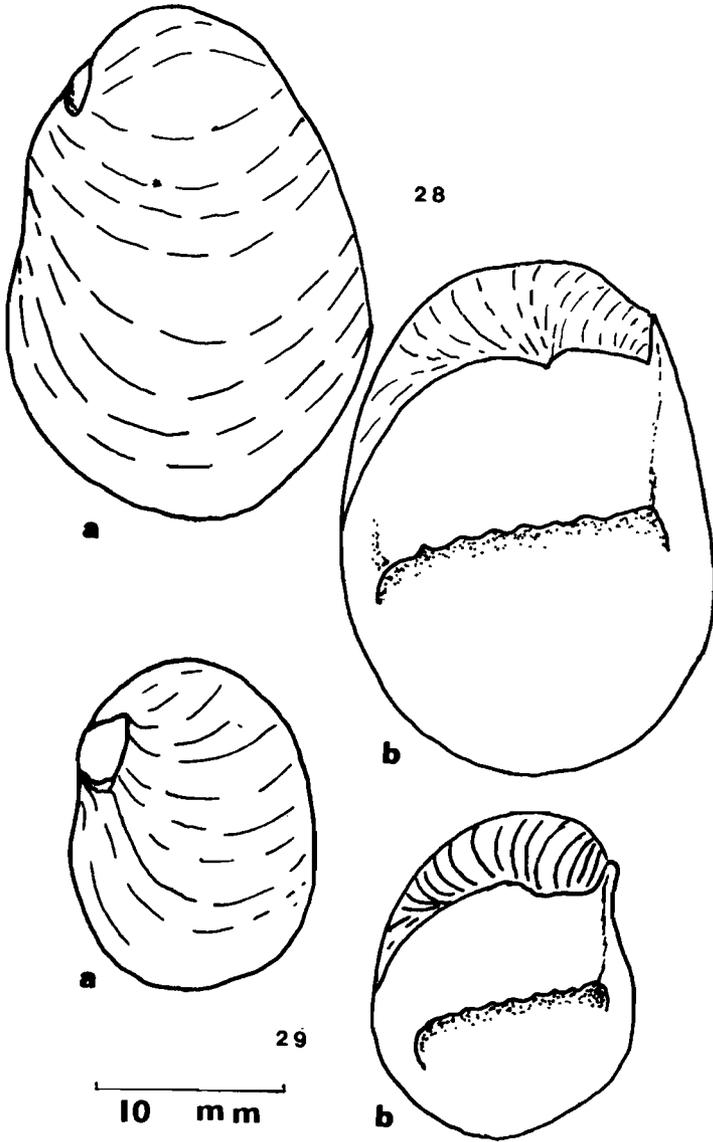
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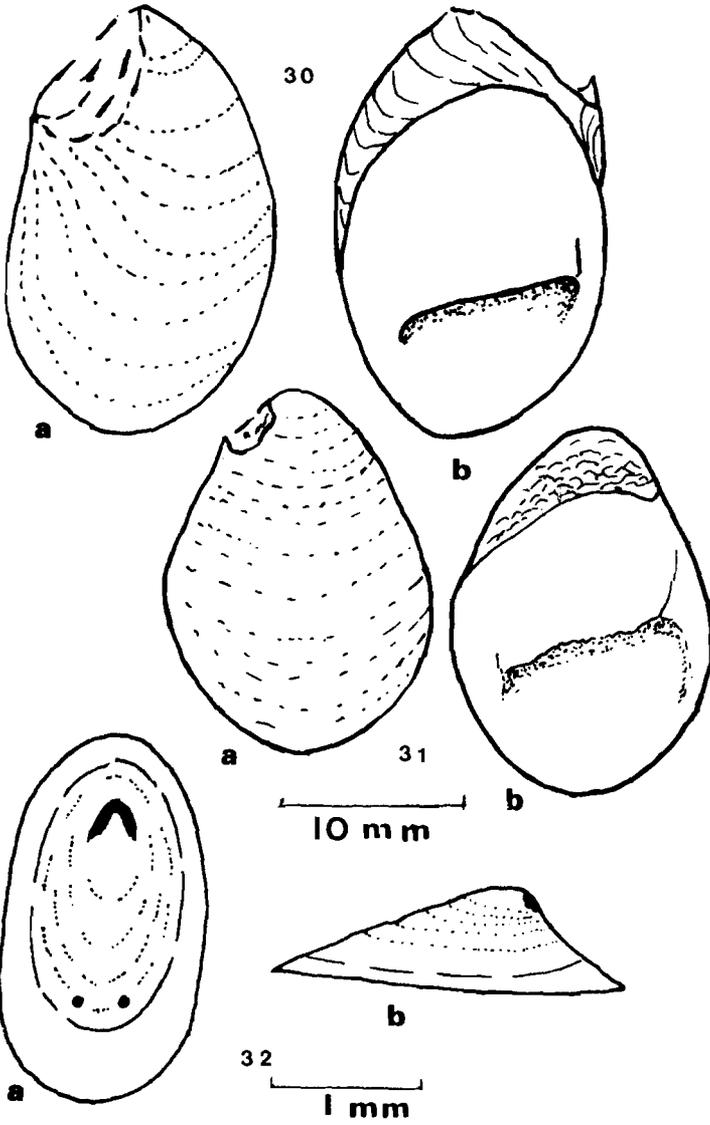
10 mm

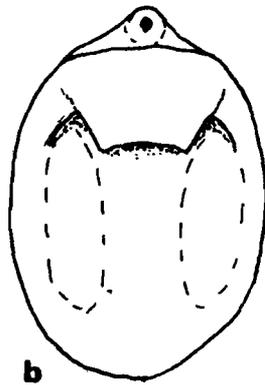
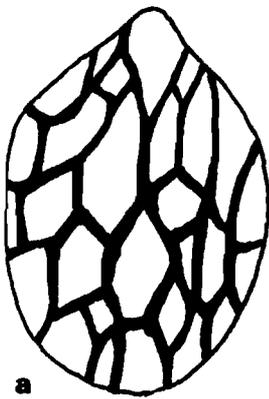
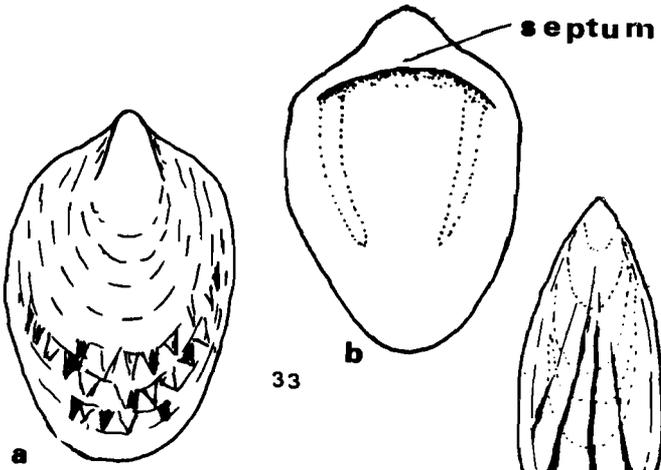
27



b

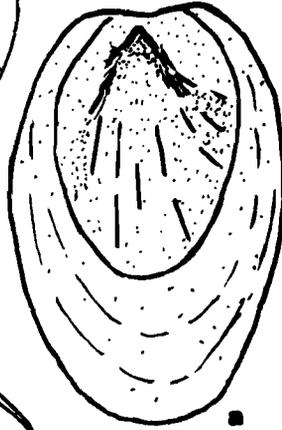
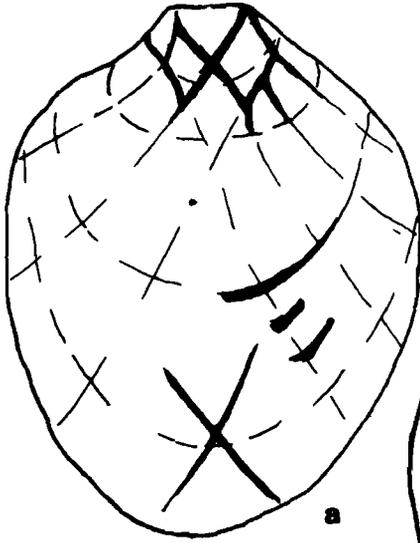






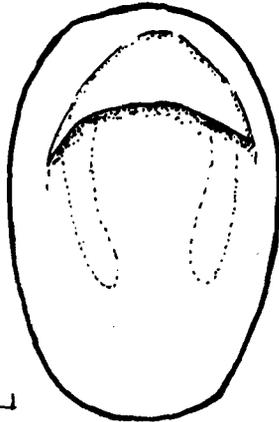
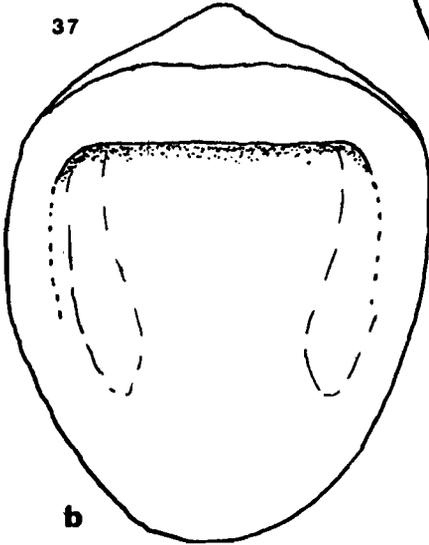
35

10 m m

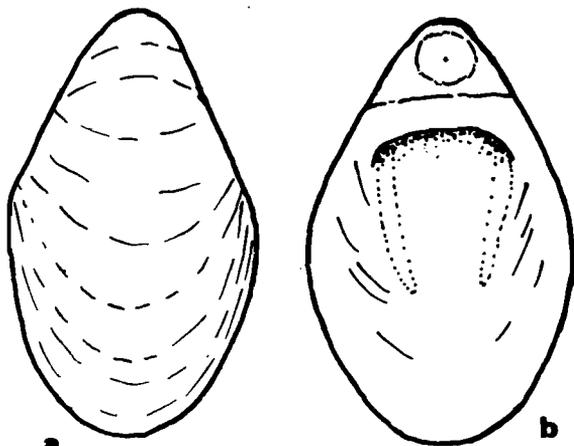


37

36

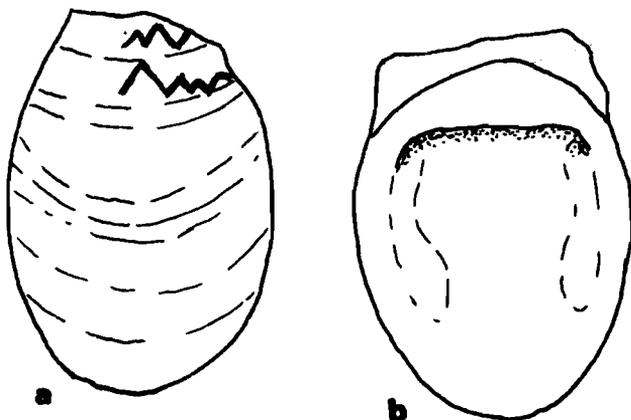


10 m m



38

10 m m



39