

**Notes on the non-marine molluscs of the island of Borneo 9. The genera *Cyclophorus*, *Leptopoma*, and *Craspedotropis* (Gastropoda Prosobranchia: Cyclophoridae)<sup>1</sup>**

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The species of the genera *Cyclophorus*, *Leptopoma*, and *Craspedotropis* (Cyclophoridae) occurring on Borneo are revised. The genus *Craspedotropis* is recorded from Borneo for the first time, including two new species (*C. juvenilis* and *C. andrei*), and one species previously included in *Jerdonia* (*C. borneensis*).

Key words: Gastropoda, Prosobranchia, Cyclophoridae, *Cyclophorus*, *Leptopoma*, *Craspedotropis*, taxonomy, Malaysia, Indonesia, Borneo.

## INTRODUCTION

The revision of the largest family of Bornean land snails, the Diplommatinidae, being completed in the previous instalment of the series (Vermeulen, 1996), the author has started a revision of the second largest family occurring on Borneo, the Cyclophoridae. The first results are presented in this paper. It provides a revision of the cyclophorid genera *Cyclophorus* Montfort, 1810 (4 taxa), *Leptopoma* Pfeiffer, 1847 (6 taxa), and *Craspedotropis* Blanford, 1864 (3 taxa). The first two include species with large or conspicuously coloured shells that were among the first to be collected on Borneo, now almost two centuries ago. They were also among the first to be described. Unfortunately, the descriptions and illustrations of these early names are often barely accurate enough to recognize the species, and, moreover, in some cases the type material has to be presumed lost, or was not accessible to the author. Yet it is expected that the synonyms listed below species such as *Cyclophorus perdix borneensis* (Metcalfe, 1851), *Leptopoma undatum* (Metcalfe, 1851), *L. pellucidum* (Grateloup, 1840), and *L. sericatum* (Pfeiffer, 1851) are largely accurate, and that at least no other valid species remain hidden under the synonymized names.

Access to the literature of this family is greatly facilitated by the various revisions and enumerations that have been published, the last of these being Kobelt (1902a, 1902b) and Gude (1921). Although these works are rather uncritical in many cases, they at least provide a fairly complete list of the nominal taxa recognized on Borneo and in surrounding areas.

References to material in the collection of the author are abbreviated as: V, followed by a collection number. Most of this material, including all holotypes of species described here will be deposited in the Nationaal Natuurhistorisch Museum (RMNH). If available, paratypes will be distributed to other institutes. For other collections the following abbreviations are used: BMNH, British Museum (Natural History), London; K, private collection

<sup>1</sup> For no. 8 in this series see Basteria 60: 87-138, 1996.

of Mr. K. Kittel (Germany); R, private collection of Dr. J. G. M. Raven (The Netherlands); UF, The Florida Museum of Natural History, Gainesville. After each reference to material seen by the author the number of specimens is given after a slash: /.

A few other abbreviations are used in the geographical references in the text, mainly derived from the Indonesian language: Bt. = bukit (hill); G. = Gunung (mountain); K. = Kalimantan (the name of the Indonesian part of Borneo, abbreviation only used in the names of the various provinces); Kpg. = Kampong (village); P. = Pulau (island); Sg. = Sungei (River).

The drawings were made by the author, with pencil, using a Wild M8 stereo microscope with camera lucida device.

## SYSTEMATIC PART

### *Cyclophorus* Montfort, 1810

Shell large (30-50 mm wide), solid, opaque, with a silky lustre, whitish to pale brownish or greenish yellow, usually marked with darker brown. Protoconch with well-spaced, thin radial riblets, and a fine spiral striation; transition towards the teleoconch clearly visible. Spire low conical or only slightly raised. Radial sculpture: growth lines mainly, sometimes with inconspicuous, spaced riblets close to the protoconch. Umbilicus open. Aperture circular to elliptic. Peristome thickened and reflected, angular edge without a sinus; peristome either simple, often consisting of thin, overlapping layers towards the outer margin, or double. Periostracum thin, smooth, without hairs or other appendages.

Operculum thin, entirely corneous, with many whorls, margins of the whorls not or hardly free, not raised.

Ecology. — Probably living on the forest floor (based on observations on extralimital species).

Distribution. — India to Japan, southwards to Papua New Guinea, Indonesia.

Notes. — Large genus, including about 200 species. Particularly well-represented from India to Indochina, and in The Philippines, relatively few species on the Sunda shelf.

### Key to the Bornean species of *Cyclophorus*

(check as large series of specimens as possible)

- 1a The last 3/4 whorl distinctly but obtusely shouldered towards the suture. Peristome double in fully adult shells, the inner protruding up to 7 mm from the outer ..... 1 - *Cyclophorus niahensis*  
 1b *Either* the last 3/4 whorl well-rounded, at most somewhat flattened towards the suture; *or* the last 3/4 whorl shouldered towards the suture, and peristome simple ..... 2  
 2a Spire depressed, apex only slightly raised. Suture channelled from the start of the teleoconch onwards. Spiral sculpture absent or nearly so ..... 2 - *Cyclophorus phlegethon*  
 2b Spire low conical. Suture depressed, but not channelled, or only slightly so in the last 1 1/2 whorl. Spiral sculpture present, fine, wavy, but easily wearing off in old specimens ..... 3  
 3a Peristome either simple, consisting of thin, overlapping layers towards the outer margin, or double, with the inner peristome protruding up to 2 mm from the outer. Umbilicus 7.5-9.0 mm wide ..... 3 - *Cyclophorus kinabaluensis*  
 3b Peristome simple, not consisting of thin layers towards the outer margin (except sometimes in the umbilical region) in fresh shells. Umbilicus 3.8-7.1 mm wide ..... 4 - *Cyclophorus borneensis*

1- *Cyclophorus niahensis* Godwin Austen, 1889 (fig. 1)

*Cyclophorus niahensis* Godwin Austen, 1889: 334; holotype ("Niah Hills") leg. Everett, BMNH 89.12.7.3.

Material seen. — SARAWAK. 4th Div.: Kakus Mts., S. of Bintulu (leg. Bryant, UF 268445/1, see note below); G. Subis (Batu Niah) (leg. Dorman et al., UF 196446/3, do., UF 196448/3; leg. Everett, BMNH/3, see also above); G. Subis, W. of Batu Niah (leg. Raven, R/6); Rumah Malang (leg. Lopez, R 1607/1); Materae (leg. Lim Chan Koon, V 5795/1). "North Borneo" (BMNH 1825/1). "Borneo" (RMNH/1).

Shell cream-coloured to pale brownish, with an irregular zig-zag pattern of darker brown, with a pale band at the periphery, with a wide band of dark (reddish) brown below and often above the periphery, partially dissolved into thin, more or less continuous spiral lines or not; umbilical region whitish to pale brown. Spire low conical. Whorls 4 1/4-4 7/8, the last 3/4 whorl distinctly, obtusely shouldered close to the suture, basally usually with a distinct, obtuse spiral ridge, periphery with a slight to distinct, obtuse edge. Suture depressed, somewhat channelled in the last 1 1/2 whorl. Spiral sculpture present, fine, wavy. Umbilicus 6.3-8.5 mm wide, not covered by the peristome. Peristome white, thickened and reflected, double, with the inner peristome protruding up to 7 mm from the outer. Height 22-30 mm, width 37-50 mm; height aperture 16.5-23 mm, width 18.5-28 mm.

Ecology. — Found in lowland forest on soils over limestone and sandstone/shale bedrock.

Distribution. — Borneo: Sarawak, 4th Div., Upper Tatau Valley, Batu Niah and surroundings, Middle Baram Valley.

Notes. — The only shell from the Tatau Valley (UF 268445), a sub-adult with a thin peristome, lacks the spiral ridge on the basal surface.

2- *Cyclophorus phlegethon* Godwin Austen, 1889 (fig. 2)

*Cyclophorus phlegethon* Godwin Austen, 1889: 335; holotype ("Molu Hills") leg. Hose, BMNH 1998011.

*Cyclophorus everetti* E. A. Smith, 1893: 343; syntypes ("Barit Mountain") leg. Everett, BMNH (not seen).

Material seen. — SARAWAK. 4th Div.: Bt. Pelamau (leg. Haegens, V 5613/1); G. Mulu area (leg. Everett, BMNH/1, see above); G. Mulu National Park, Tutoh valley, G. Benarat (leg. Wilford, UF 268448/2).

Shell whitish, but with an irregular zig-zag pattern of dark brown usually leaving only patches of the ground colour, with a row of pale spots at the periphery, with a wide band of darker brown below the periphery; umbilical region whitish to pale brown. Spire depressed, apex only slightly raised. Whorls 3 1/2-4, well-rounded, periphery with or without a slight, obtuse edge. Suture distinctly channelled from the start of the teleoconch onwards. Spiral sculpture absent or nearly so. Umbilicus 6.5-8.5 mm wide, not covered by the peristome. Peristome dull whitish or pale brownish, only slightly thickened and reflected except on the columellar side; either simple, or double with the inner peristome protruding up to 2 mm from the outer. Height 18.5-21 mm, width 34-41 mm; height aperture 15-18 mm, width 17.5-21 mm.

Ecology. — Found in forest on or near limestone outcrops. Recorded from lowland to up to 1200 m asl.

Distribution. — Borneo: Sarawak, 4th Div., G. Mulu area and surroundings.

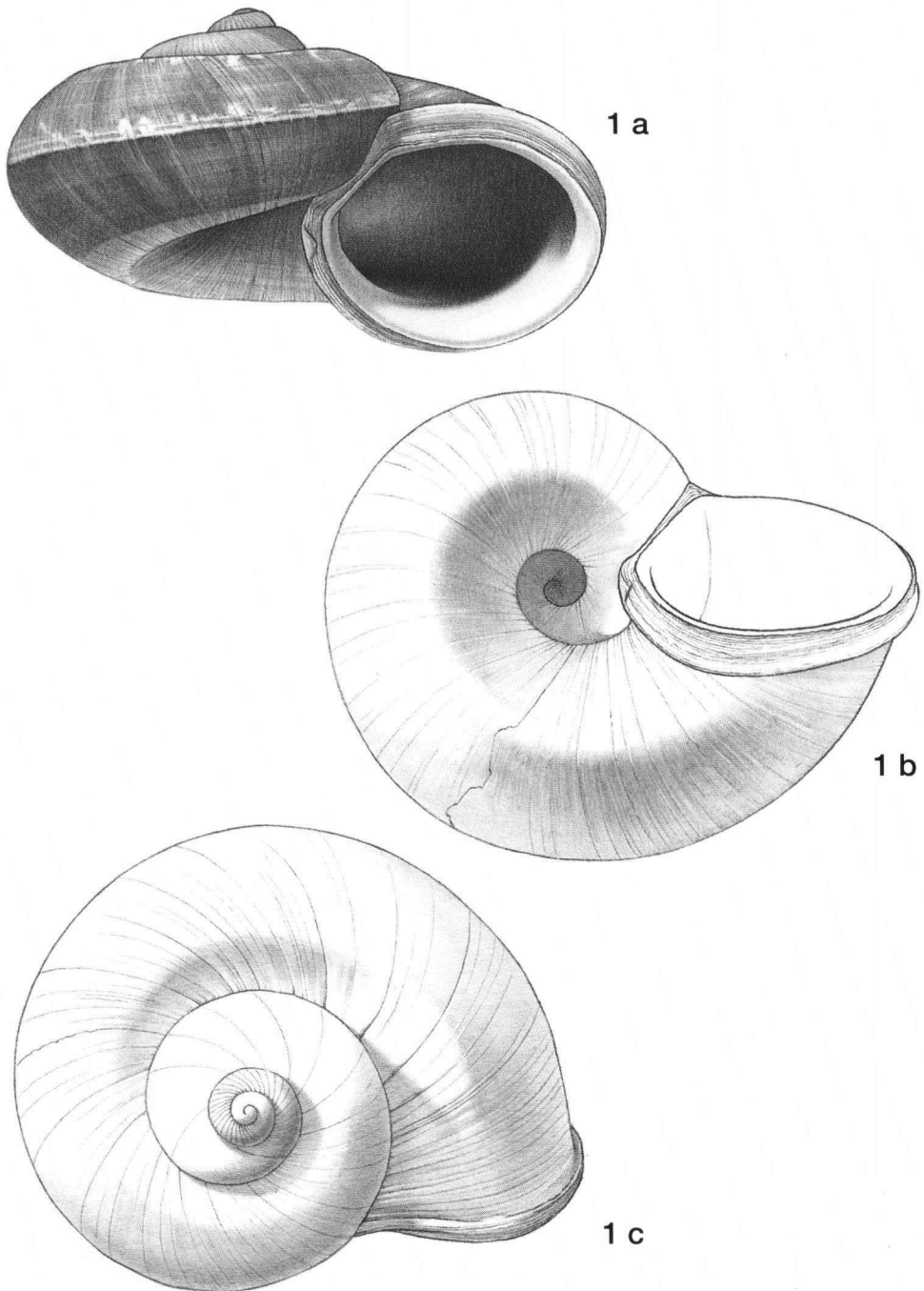
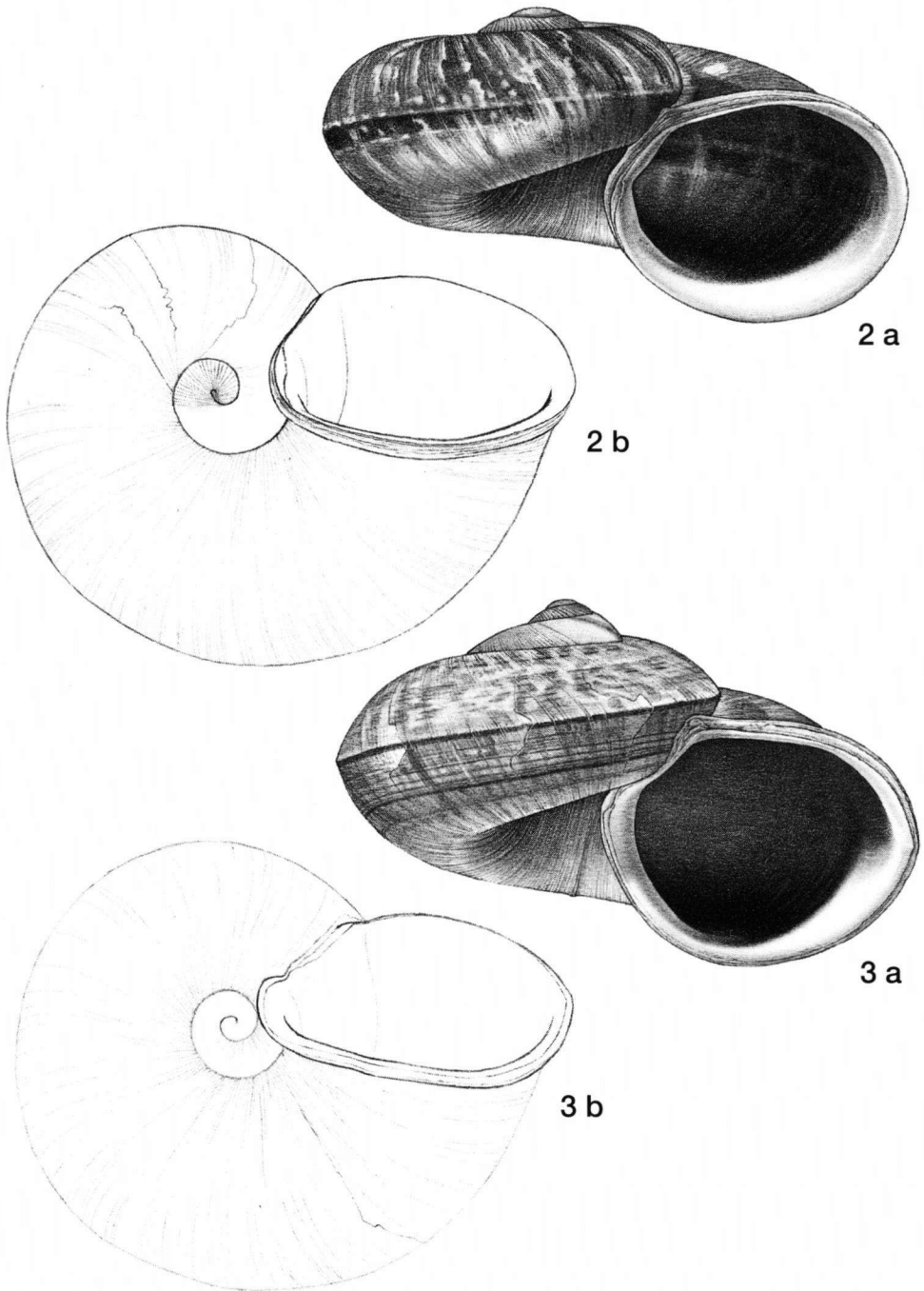


Fig. 1. *Cyclophorus niahensis* Godwin Austen, 1889; Sarawak, G. Subis (RMNH) (shell height 22 mm).



Figs. 2-3. *Cyclophorus* spec. 2, *C. phlegethon* Godwin Austen, 1889; Sarawak, Bt. Pelamau (V) (shell height 22 mm). 3, *C. kinabaluensis* E. A. Smith, 1895; Sabah, Bt. Gomantong (V) (shell height 30 mm).

3- *Cyclophorus kinabaluensis* E. A. Smith, 1895 (fig. 3)

*Cyclophorus kina-baluensis* E. A. Smith, 1895: 118; type ("Kina Balu, N. Borneo") BMNH (not seen).

Material seen. — SABAH. Sandakan Zone: Bt. Gomantong, 30 km S. of Sandakan (leg. Lee et al., UF 114724/6; V 1593/4). "Sabah" (leg. Beal-Maltbie, UF 242072/2). KALIMANTAN. Kalimantan Barat: G. Tilung (leg. Dutch Borneo exp. 1893-94, RMNH/1).

Shell white to pale yellowish or greenish brown, with an irregular zig-zag pattern of brown, often with a pale band at the periphery, with or without thin, more or less continuous spiral lines of darker brown above the periphery; below the periphery often with a band of darker brown partially dissolved similar, thin spiral lines; umbilical region whitish to pale brown. Spire low conical. Whorls 4 1/4-4 3/4, well-rounded, somewhat flattened towards the suture, periphery with a slight to distinct, obtuse to sharp edge. Suture depressed, but not or hardly channelled. Spiral sculpture present, fine, wavy, easily wearing off in old specimens. Umbilicus 7.5-9.0 mm wide, not covered by the peristome. Peristome white to reddish, thickened and reflected; either simple, consisting of thin, overlapping layers towards the outer margin, or double, with the inner peristome protruding up to 2 mm from the outer. Height 25-28 mm, width 43-47 mm; height aperture 18-21 mm, width 21-29 mm.

Ecology. — In forest on various soils; recorded are limestone and granodiorite bedrock. Recorded at sea level, probably at higher altitude in the Kinabalu area.

Distribution. — Borneo: Sabah, G. Kinabalu, N. and E. coast. Kalimantan, K. Barat, Kapuas basin.

4- *Cyclophorus perdix borneensis* (Metcalf, 1851) (fig. 4)

*Cyclostoma borneensis* Metcalfe, 1851: 71; holotype ("Borneo") (not seen).

*Cyclophorus borneensis*; Pfeiffer, 1852: 63.

*Cyclophorus cochraney* Godwin Austen, 1889: 334; holotype ("Niah Hills") leg. Everett, BMNH 1889.12.7.5.

*Cyclophorus cochraney* var. *ochraceus* Godwin Austen, 1889: 335; holotype ("Busan Hills") leg. Everett, BMNH 1889.12.7.6.

*Cyclophorus talboti* Godwin Austen, 1889: 335; holotype ("Busan Hills") leg. Everett, BMNH 1889.12.7.7.

*Cyclophorus perdix borneensis*; Van Benthem Jutting, 1959: 69. See also Rensch, 1934: 739.

Material seen. — SARAWAK. 1st Div.: Busau (leg. Beal-Maltbie, UF 242005/2; leg. Everett, BMNH/1, see above, type of *C. cochraney* var. *ochraceus*; do., BMNH/1, see above, type of *C. talboti*); quarry km 31.6 road Kuching-Bau (leg. Auffenberg, UF 183949/3); G. Pangga 3 km E.N.E. of Bau (V 2072/3); near Bau (leg. De Vogel, V 2640/2); 3 km S.W. of Taiton goldmine, near Bau (leg. Auffenberg, UF 183891/5); hill S. of Bau goldmine, 2.1 km S. of Bau (leg. Auffenberg, UF 183836/4); Bt. Jagoi near Bau (leg. Schuiteman, V 5474/1); G. Kapur 6 km S.E. of Bau (V 2044/3; do., 2045/7); Lobang Angin 2 km S.W. of Bau (V 2081/4); Fairy Cave approx. 8 km S.W. of Bau (leg. Dorman, UF 196306/2); G. Jambusan 4 km S.E. of Bau (V 2064/>10); G. Muan near kpg. Peninjau Lama, 22.5 km S.W. of Kuching (leg. Auffenberg, UF 183824/1; do., UF 183929/2); Hume Rock, 22.9 km S.E. of Kuching (leg. Auffenberg, UF 183998/1); Kpg. Beratok along road Kuching-Serian (leg. Auffenberg, UF 184003/5; do., UF 184026/10; V 2000/4); Semengoh Botanic Garden (leg. Rhea Warren, UF 28423/2; leg. De Vogel, V 2318/1); Kpg.

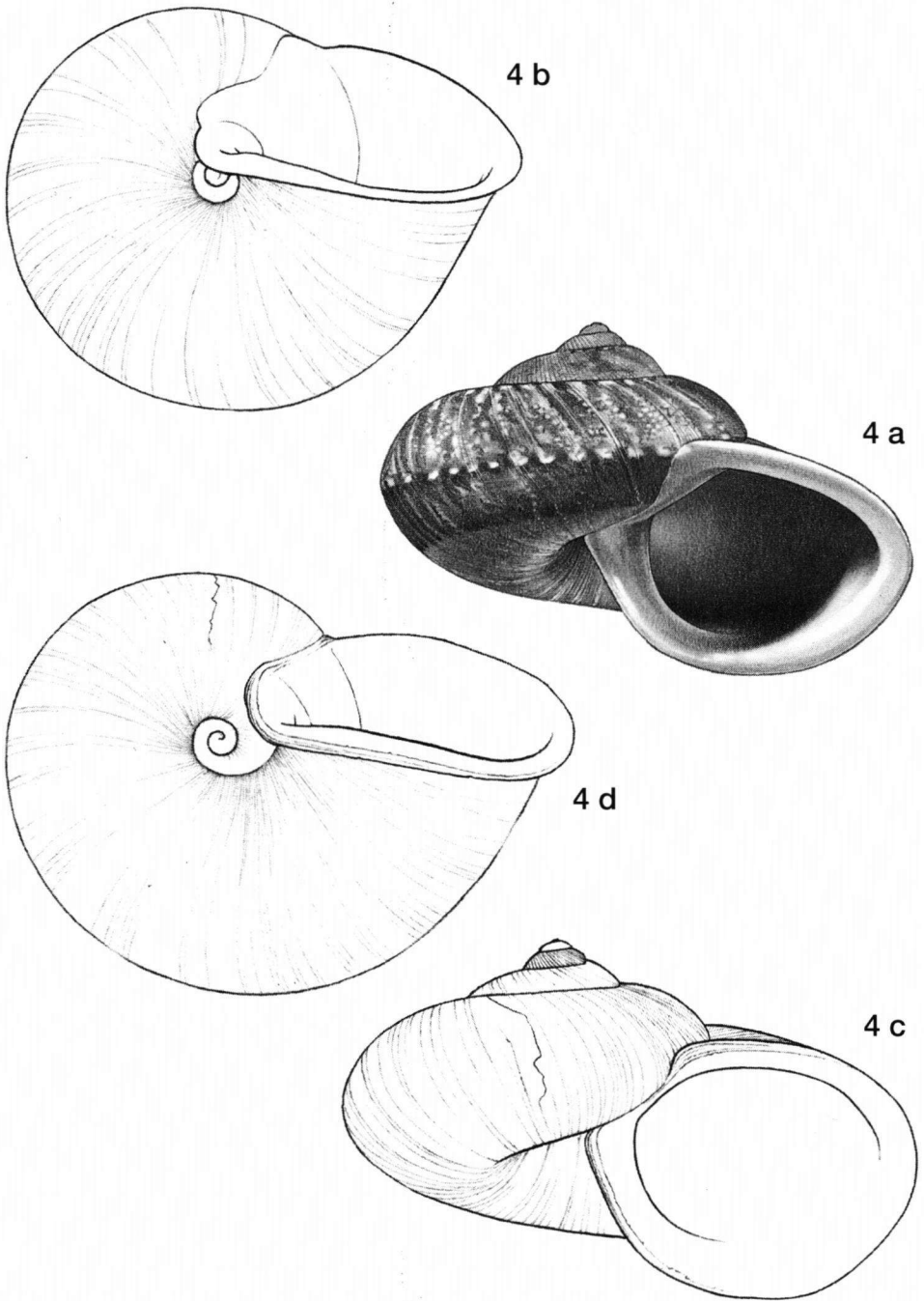


Fig. 4a-d. *Cyclophorus pernix borneensis* (Metcalf, 1851). a-b, Sarawak, G. Subis (V) (shell height 27 mm); c-d, Sarawak, G. Kapur 6 km SE. of Bau (V) (shell height 27 mm).

Tiang Bekap 10 km S.S.W. of Kpg. Beratok (leg. De Vogel, V 2593/1); G. Wah S. of Braang, 23 miles S. of Kuching (leg. Wilford, UF 268446/4); G. Gayu 23 miles S. of Kuching (leg. Wilford, UF 268450/3); Kpg. Segur Benuk, mile 21 Penrissen Road (leg. De Vogel, V 2558/5); G. Lelat 1 mile S.W. of Nyabet, 24 miles S.S.E. of Kuching (leg. Wilford, UF 268449/1); 7.5 km W.N.W. of Kpg. Piching, near Serian (V 1900/8); G. Selabor, W. of Kpg. Lobang Batu, 12.5 km S. of Tebakang (leg. Wilford, UF 268444/5; V 2034/>10). 4th Div.: G. Subis (Batu Niah) (leg. Dorman, UF 196442/3; do., UF 196443/2; do., UF 196445/5; leg. Everett, BMNH/1, see above; leg. Holzmark, UF 24830/4; do., UF 24831/5; do., UF 24832/4; do., UF 24833/5; do., UF 24834/4; do., UF 24835/5; leg. Sutton, UF 196405/1; leg. Wall, UF 268447/4; V 1580/>10); G. Subis, W. of Batu Niah (leg. Raven, R 1618/>10); G. Subis, 3 km W. of Batu Niah (leg. Raven, R/4); G. Subis, 4 km S. of Batu Niah (leg. Raven, R L 1674/10); Laogan Bunut, S. edge (leg. Raven, R L 1649/1). SABAH. West Coast Zone: G. Kinabalu (leg. Everett, UF 161689/3). KALIMANTAN. Kalimantan Barat: Liang Kubung (leg. Dutch Borneo exp. 1893-94, RMNH/1); Dadap Ketungau (do., RMNH/1); G. Sekedau (do., RMNH/1); G. Kenepai (do., RMNH/3); Sintang (do., RMNH/2); Sg. Sibau (do., RMNH/5); Pulau, Sg. Sibau (do., RMNH/1). Kalimantan Selatan: G. Siamang near Desah Liu, 30 km E. of Tandjung (V 3088/7); Jaro near Muara Uja, limestone escarpment W. of the village (V 3141/>10); limestone escarpments along road Benualawas-Limbangan (V 2905/1). Kalimantan Timur: Pt. ITCI logging concession (leg. Van Valkenburg & Galzin, V 4526/1). "Borneo" (RMNH/1).

Shell white to pale yellowish brown, usually (albino specimens occur) with an irregular zig-zag pattern of dark brown, often with a row of white spots below the suture and at the periphery, without any thin, continuous spiral lines, but with one wide band or two narrower bands of darker brown below the periphery; umbilical region white, usually with fewer brown markings than elsewhere. Spire low conical. Whorls 4 1/2-5, well-rounded, sometimes somewhat flattened or shouldered towards the suture, periphery with or without an obtuse to acute edge, or with a keel. Suture depressed, but not channelled, or only slightly so in the last 1 1/2 whorl. Spiral sculpture present, fine, wavy. Umbilicus 3.8-7.1 mm wide, sometimes partly covered by the peristome. Peristome white or cream-coloured, slightly to distinctly thickened and distinctly reflected, simple, not consisting of thin layers towards the outer margin (except sometimes in the umbilical region) in fresh shells. Height 19-29 mm, width 30-46 mm; height aperture 14-21 mm, width 16-28 mm.

Ecology. — Primary forest on various soils, most numerous on limestone bedrock. Also in secondary vegetation.

Distribution. — Borneo: widespread but in Sabah known from G. Kinabalu only. Also in W. Malaysia, and probably Singapore (see below).

Notes. — Next to the above subspecies, *Cyclophorus perdix* includes: *C. p. perdix* (Broderip & Sowerby, 1830) (Java to Bali), *C. p. tuba* (Sowerby, 1842) (Sumatra, W. Malaysia), *C. p. aquila* (Sowerby, 1843) (Singapore, W. Malaysia and possibly further North). Extraliminally, intermediates between the latter two and *C. p. borneensis* occur, rendering the range of the Bornean subspecies uncertain.

In spite of a considerable variability in shell colour, the number of riblets on the protoconch, presence/absence of a peripheral keel, and the width of the umbilicus, no further taxa can be distinguished within *C. p. borneensis*. Locally, states of these characters predominate, for instance at Batu Niah where most specimens display a comparatively narrow umbilicus. The surroundings of Batu Niah are inhabited by a form with a unusually sharp peripheral keel.



*Leptopoma* Pfeiffer, 1847

Shell medium sized (9.5-24 mm wide), thin, with a silky lustre, whitish to corneous, with or without colour markings. Protoconch smooth or with fine spiral ridges, transition towards the teleoconch unmarked. Spire conical. Radial sculpture: growth lines mainly. Spiral sculpture: striation, often combined with threadlike ridges. Umbilicus open, or partly or entirely covered by the peristome. Aperture about circular. Peristome simple, more or less thickened and reflected, angular edge without a sinus; Periostracum thin, smooth, without hairs or other appendages.

Operculum thin, entirely corneous, with many whorls, margins of the whorls neither free nor raised.

Distribution. — India to Taiwan, southwards to Australia, eastwards to the Pacific.

Notes. — Large genus, including over 100 species. Speciose in The Philippines, relatively few species on the Sunda shelf.

Specific delimitation is problematical in *Leptopoma* due to a general lack of reliable shell characters, and to morphologically intermediate forms between several nominal species. A marked variability in shell colouring within many species has caused further complications, because species names have been proposed mainly based on states of this character. Jonges (1980) studied the genitalia of various species of *Leptopoma* and found some differences; perhaps further anatomical research may lead to a better resolution of the genus into species.

The term 'lip', is used below to describe a thickened rim, often present on the inner edge of the reflected portion of the peristome.

Key to the Bornean species of *Leptopoma*

(check as large series of specimens as possible)

- 1a The first few whorls moderately convex, the others almost flat to slightly convex ..... 2  
 1b All whorls moderately to distinctly convex ..... 4  
 2a Palatal side of the peristome with a distinct lip that gradually increases in height towards the angular edge in fully adult specimens ..... 1 - *Leptopoma trochus*  
 2b Palatal side of the peristome without a lip; or peristome with a lip that gradually decreases in height towards the angular edge ..... 3  
 3a Periphery with a distinct keel that rather abruptly changes into a less conspicuous edge in the last 1/3-1/4 whorl, thus disrupting the curvature of the keel when the shell is observed from below .....  
 ..... 2 - *Leptopoma undatum*  
 3b Periphery with a moderately distinct keel that may gradually change into a less conspicuous edge towards the aperture, but without disrupting the curvature of the keel when the shell is observed from below ...  
 ..... 3 - *Leptopoma bourguignati*  
 4a (1) Reflected portion of the palatal peristome distinctly convex ..... 4 - *Leptopoma signatum*  
 4b Reflected portion of the palatal peristome flat or only slightly convex (lip, if present not taken into consideration) ..... 5  
 5a Periphery rounded (rarely angular), at most with a thread-like, inconspicuous keel. Spiral sculpture: above the periphery often with up to five inconspicuous, thread-like ridges similar to the peripheral keel but still weaker, below the periphery sometimes 1 such a ridge ..... 5 - *Leptopoma pellucidum*  
 5b Periphery rounded to angular, usually with a moderately distinct ridge. Spiral sculpture: above the periphery 3-6 rather distinct, thread-like ridges, below the periphery 1-2(-6) such ridges ..... 6 - *Leptopoma sericatum*

1- *Leptopoma trochus* Dohrn, 1862 (fig. 5)

*Leptopoma trochus* Dohrn, 1862: 182; type ("in Maligi insulae Mindanao") leg. Semper (not seen).

*Leptopoma geotrochiforme* E. A. Smith, 1895: 119; syntypes ("Mount Rabong, Sarawak") BMNH 94.4.21.128-9/2 & 94.7.20.85-6/2.

Material seen. — SARAWAK. 1st Div.: G. Rabong (BMNH/4, see above; BMNH 1825/1; RMNH/1); Kpg. Tiang Bekap 10 km S.S.W. of Kpg. Beratok (leg. De Vogel, V 2595/2).

Shell white, with or without translucent banding parallel to the growth lines. Whorls 5 1/4-5 5/8, the first few moderately convex, the others almost flat to slightly convex, but the last also slightly to moderately concave towards the periphery; periphery with a distinct keel that continues up to the peristome. Suture moderately depressed between the first whorls, elsewhere slightly depressed. Spiral sculpture: a fine striation, often combined with 3-5 slightly raised, inconspicuous ridgelets. Umbilicus narrow, largely or entirely covered by the peristome. Peristome white, on the palatal side usually slightly thickened and abruptly reflected, with a distinct lip that gradually increases in height towards the angular edge and then continues on the parietal side as a somewhat lower lip again. Height 15-19.5 mm, width 17-22 mm; height aperture 5.5-9.5 mm, width 9-12 mm.

Ecology. — Lowland forest on limestone soil.

Distribution. — Borneo: Sarawak, 1th Div. Also in The Philippines.

2- *Leptopoma undatum* (Metcalf, 1851) (fig. 6)

*Cyclostoma undatum* Metcalfe, 1851: 71; type ("Borneo") (not seen).

*Leptopoma undatum*; Pfeiffer, 1852: 113.

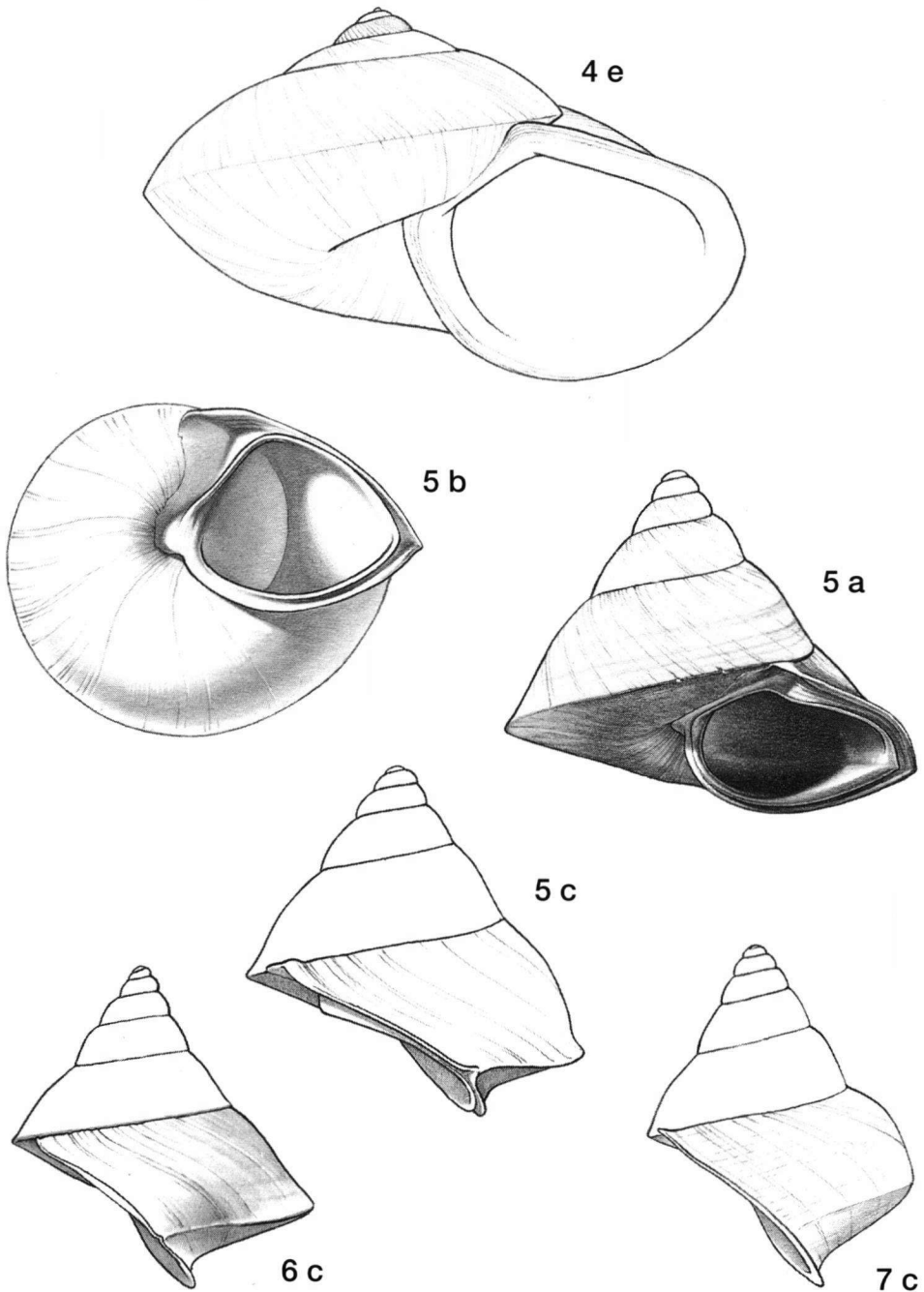
*Helix (Geotrochus) niahensis* Godwin Austen, 1891: 44; type ("Niah Hills") leg. Everett, BMNH (not seen).

*Leptopoma niahense*, E. A. Smith, 1895: 119.

*Leptopoma skerchlyi* E. A. Smith, 1895: 119; syntypes ("Mount Ambun, British North Borneo") leg. Skerchly, BMNH 95.1.16.1-2/2.

*Papuina niahensis*; Van Benthem Jutting, 1933: 58.

Material seen. — SARAWAK. 1st Div.: quarry km 31.6 road Kuching-Bau (leg. Auffenberg, UF 183947/2; do., UF 183986/1); G. Pangga 3 km E.N.E. of Bau (V 2150/2); 2-3 km S.W. of Bau (leg. Dorman, UF 196276/1); 1 km S. of Bau, S. edge of active gold mine (leg. Dorman, UF 196368/1); Bt. Jagoi near Bau (leg. Schuiteman, V 5473/3); Lobang Angin 2 km S.W. of Bau (V 2086/5); G. Muan near kpg. Peninjau Lama, 22.5 km S.W. of Kuching (leg. Auffenberg, UF 183825/2); Semengoh Botanic Garden (leg. De Vogel, V 2319/1). 4th Div.: G. Subis (Batu Niah) (leg. Dorman, UF 196452/1; V 1544/1); G. Subis, limestone quarry (leg. Raven, R/3); Lambir oil palm plantation (leg. Raven, R L1603/1); Lambir Hills (leg. Sleumer, RMNH/1); do., near canteen (leg. Raven, R 1586/1); do., near summit (leg. Raven, R 1588/1). BRUNEI. Temburong, Labi Road 13 km from S. Liang (leg. De Vogel, V2494). SABAH. Interior Zone: 5.5 km N.N.E. of Simatuoh, 9 km E. of Sepulot (leg. Dorman, UF 196516/1). West Coast Zone: G. Kinabalu National Park (RMNH/2); do., Headquarters area (V 1195/2); do., Silau-Silau trail (leg. Chan, V 3647/1; do., trail towards top (V 1440/1); do., Poring Hot Springs (leg. Kittel, K/1). Sandakan Zone: Tawai Mountains near Telupid (V



Figs. 4-7. *Cyclophorus* spec. and *Leptopoma* spec. 4e, *C. perdix borneensis* (Metcalf, 1851); Sarawak, Kpg. Beratok (V) (shell height 32 mm). 5a-c, *L. trochus* Dohrn, 1862; Sarawak, Kpg. Tiang Bekap (V) (shell height 15 mm). 6c, *L. undatum* (Metcalf, 1851), Sabah (RMNH) (shell height 15 mm). 7c, *L. bourguignati* Issel, 1874, syntype of *L. mitchellae* E. A. Smith, 1900, Sarawak (BMNH) (shell height 15 mm). See also figs. 6a-b, 7a-b.

1262/10); Batu Putih near road Lahad Datu-Sandakan, near Sg. Kinabatangan (V 1469/1); Bt. Gomantong, 30 km S. of Sandakan (leg. Lee et al., UF 114735/3; V 1598/2); Bt. Kipangi 2 mile N.E. of Sukau (leg. Lee et al., UF 114766/10). Tawau Zone: N.W. of road Lahad Datu-Sandakan crossing with Sg. Segama (V 1650/1); 'Kirk's Cave', 8 km N. of Lahad Datu (V 1247/1); Batu Tenggara, Segarong Hills 25 km E.S.E. of Kunak (V 1797/1). "British North Borneo" (BMNH/2, see above). "Sabah" (leg. Kavelaar, RMNH/>10). KALIMANTAN. Kalimantan Timur: 30 km W. of Balikpapan (leg. Van Balgooij, V 2455/1); surroundings Lempake (leg. WWF-IP Forest Fire Project 1998, V 5978/1). Material from elsewhere. Philippines. Palawan (leg. Ridsdale, V2317).

Shell white, usually with translucent banding parallel to the growth lines, sometimes with a transverse zig-zag pattern of pale brown most conspicuously present just below the suture. Whorls 5  $\frac{3}{4}$ -6  $\frac{1}{2}$ , the first few moderately convex, the others almost flat to slightly convex, but the last also slightly to moderately concave towards the periphery; periphery with a distinct keel that rather abruptly changes into a less conspicuous edge in the last  $\frac{1}{3}$ - $\frac{1}{4}$  whorl, thus disrupting the curvature of the keel when the shell is observed from below. Suture moderately depressed between the first whorls, elsewhere slightly depressed. Spiral sculpture: a fine striation, combined with up to 7 slightly raised, inconspicuous ridgelets. Umbilicus open, narrow, partly covered by the peristome. Peristome white, on the palatal side usually slightly thickened and abruptly reflected, and often with a slight to distinct lip that gradually decreases in height towards the angular edge; parietal side usually thin, but sometimes with a low ridge as a continuation of the lip on the palatal side. Height 14-21 mm, width 14-24 mm; height aperture 7-12 mm, width 8-15 mm.

Animal green, shining through the shell; shell, therefore, looking green with white (opaque) patches in living specimens.

Ecology. — Primary and secondary forest on various soil types, even in kerangas and peat swamp forest on wet, acid soils. Also found in oil palm plantations, in coastal shrubland, on sand dunes, as well as in montane forest at up to 3000 m asl. Observed living on vegetation.

Distribution. — Borneo: probably widespread and fairly common, not found in Kalimantan Selatan. Also in The Philippines: a record from Palawan (see above), and probably elsewhere but known under a different name.

Notes. — Variable in size and the ratio height/width. In some thick-shelled specimens the peripheral keel on the last whorl is shallowly and obtusely serrate.

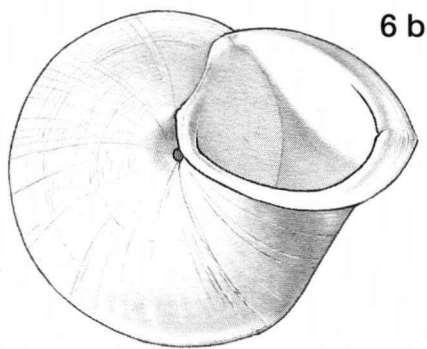
### 3- *Leptopoma bourguignati* Issel, 1874 (fig. 7)

*Leptopoma bourguignati* Issel, 1874: 65; syntypes ("Territorio di Sarawak") leg. Doria & Beccari, MCSNG/2 (not seen).

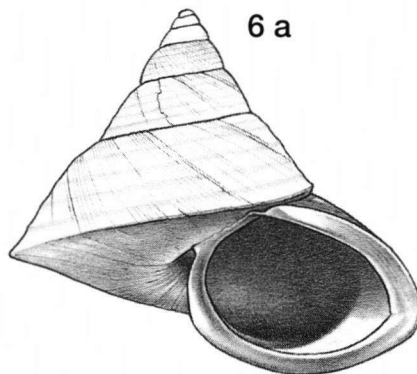
*Leptopoma (Trocholeptopoma) mitchellae* E. A. Smith, 1900: 42; syntypes ("Sarawak, North Borneo") BMNH 1900.1.15.1-2/2.

Material seen. — SARAWAK. 1st Div.: Bako N.P. (V 1436/1). "Sarawak, North Borneo" (BMNH/2, see above).

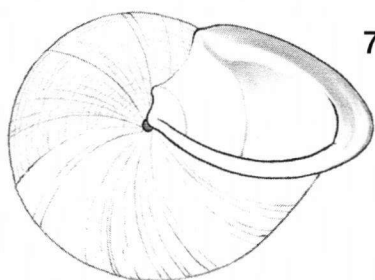
Shell white, with translucent patches or banding obliquely crossing the growth lines. Whorls 5  $\frac{3}{4}$ -5  $\frac{5}{8}$ , the first few moderately convex, the others slightly convex, but the last also usually slightly concave towards the periphery; periphery with a moderately distinct keel that may gradually change into a less conspicuous edge towards the ap-



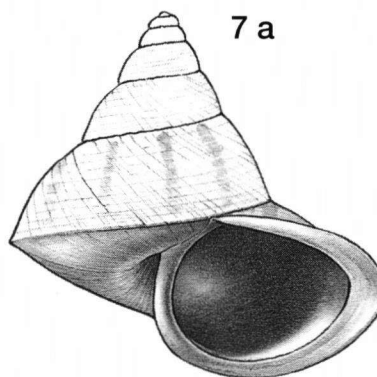
6 b



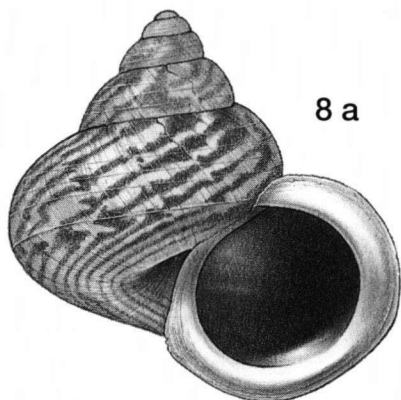
6 a



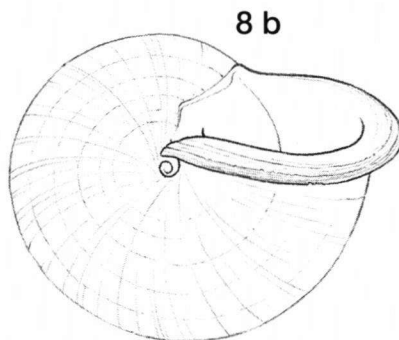
7 b



7 a



8 a



8 b

Figs. 6-8. *Leptopoma* spec. 6, *L. undatum* (Metcalf, 1851), Sabah (RMNH) (shell height 18 mm).  
 7, *L. bourguignati* Issel, 1874, syntype of *L. mitchellae* E. A. Smith, 1900, Sarawak (BMNH) (shell height 15 mm).  
 8, *L. signatum* Pfeiffer, 1856, syntype, "Borneo" (BMNH) (shell height 10.5 mm).

erture, but without disrupting the curvature of the keel when the shell is observed from below. Suture moderately depressed, except close to the aperture. Spiral sculpture: a fine striation, combined with up to 9 slightly raised, inconspicuous ridgelets. Umbilicus open, narrow, partly covered by the peristome. Peristome white, on the palatal side not thickened and gradually to abruptly reflected and without a lip; thin on the parietal side. Height 14-21 mm, width 14-24 mm; height aperture 7-12 mm, width 8-15 mm.

Ecology. — One record from podzolic forest on wet, acid soils on sandstone bedrock, at 50 m asl.

Distribution. — Borneo: Sarawak, 1th Div.

Notes. — Looks like thin-shelled, not entirely adult *L. undatum*, and is easily confused with that species. The regularly rounded periphery of the last whorl of *L. bourguignati* offers the best diagnostic character.

#### 4- *Leptopoma signatum* Pfeiffer, 1856 (fig. 8)

*Leptopoma signatum* Pfeiffer, 1856: 338; syntypes ("Borneo") leg. Cuming, BMNH 1998014/3.

*Cyclostoma signatum* Pfeiffer, 1858: 71.

Material seen. — "Borneo" (leg. Cuming, BMNH/3, see above).

Shell corneous, without translucent banding, with an oblique, somewhat zig-zag pattern of brown colouring. Whorls 5-5 1/8, convex, periphery rounded, with a thread-like, rather distinct ridgelet. Suture depressed. Spiral sculpture: some inconspicuous striation, above the periphery also with 4-5 rather inconspicuous, thread-like ridges, below the periphery with 1-3 such ridges. Umbilicus open, narrow, partly covered by the peristome. Peristome white, on the palatal side slightly thickened, rather gradually to rather abruptly reflected and then distinctly convex, without a lip, abruptly narrowing towards the angular edge. Height 10-10.5 mm, width c. 10 mm; height aperture 5.5-6 mm, width 5.5-6.5 mm.

Notes. — Differs from *L. sericatum* in having a strongly reflected, convex peristome, abruptly narrowing towards the angular edge, and in having oblique brown markings on the shell.

The syntype specimens from the Cuming collection are the only shells available. Frequent mistakes in the labelling of the Cuming collection makes their provenance somewhat uncertain.

#### 5- *Leptopoma pellucidum* (Grateloup, 1840) (fig. 10)

*Cyclostoma vitrea* Lesson, 1831: 346; type ("Nouvelle Guinée") (not seen). Not *Cyclostoma vitrea* Draparnaud, 1801; see Forcart, 1952: 85.

*Cyclostoma pellucida* Grateloup, 1840: 169; type ("Philippines, Manille") (not seen).

*Leptopoma vitreum*; Pfeiffer, 1847: 108.

*Leptopoma pellucidum*; Pfeiffer, 1847: 108.

*Cyclostoma bicolor* Pfeiffer, 1852b: 145; syntypes (locality unknown. A label with the specimens states "Borneo") leg. Cuming, BMNH 1998012/3.

*Leptopoma bicolor*; Pfeiffer, 1852: 104.

*Leptopoma lowi* Pfeiffer, 1855: 210; type ("Isle of Labuan") leg. Low, BMNH (not seen).

*Leptopoma bicolor anastomaticum* Von Martens, 1908: 278. Type ("Samarinda") (not seen).

Material seen. — SARAWAK. 4th Div.: G. Subis (Batu Niah) (leg. Dorman et al., UF 196485/2; V 1535/2, see note 3 below). BRUNEI. "Brunei" (leg. v.d. Poll, RMNH/6). SABAH. Kudat Zone: P. Banggi, southernmost point (V 1446/7). Sandakan Zone: Bt. Gomantong, 30 km S. of Sandakan (leg. Lee et al., UF 114722/3; V 1597/6); Bt. Kipangi 2 mile N.E. of Sukau (leg. Lee et al., UF 114757/1). Tawau Zone: N.W. of road Lahad Datu-Sandakan crossing with Sg. Segama (V 1651/>10); 'Kirk's Cave', 8 km N. of Lahad Datu (V 1251/4); Batu Tenggara, Segarong Hills 25 km E.S.E. of Kunak (V 1800/>10); Bt. Pababola, Segarong Hills 25 km E.S.E. of Kunak (V 1751/4). KALIMANTAN. Kalimantan Selatan: Batu Apoh, approximately 35 km N.E. of Martapura (V 3328/1; leg. Lamb & Mackinnon, V 2461/1); Beramban, approximately 13 km E. of Rantau (V 3756/1); Bt. Pagat, limestone hill 8 km S.E. of Barabai (V 3783/2); G. Siamang near Desah Liu, 30 km E. of Tandjung (V 3083/1); G. Buleh, 4 km E. of Muara Uja (V 3687/10); Jaro near Muara Uja, limestone escarpment W. of the village (V 3188/>10); 7 km N. of Kintap (V 3666/1); limestone escarpment W. of km 6 road Benualawas-Batulicin (V 3406/5); limestone escarpments along road Benualawas-Limbangan (V 2843/>10). Kalimantan Timur: Samarinda (leg. v. Roon, RMNH/3); Batu Butuk, near Muara Komang along main road Banjarmasin-Balikpapan (V 3518/>10); G. Melihat, foot of S. facing slope, between river and main road Banjarmasin-Balikpapan (V 2955/>10); road Bontang-Sanggata, 6 km N. of junction with road into Kutei National Park (leg. Van Valkenburg & Galzin, V 4518/>10); Kutei National Park (leg. WWF-IP Forest Fire Project 1998, V 5932/1); Pt. ITCI logging concession (leg. Van Valkenburg & Galzin, V 4527/1); Sangkulirang area, G. Sekarat (leg. Van Valkenburg & Galzin, V 4504/2; do., V 4530/3); surroundings Lempake (leg. WWF-IP Forest Fire Project 1998, V 5976/3). "Borneo" (leg. Cuming, BMNH/3, see above; leg. Schwaner, RMNH/2).

Shell white to corneous, sometimes with a pale brownish-purple apex, with or without translucent banding parallel to the growth lines as well as following the most prominent spiral sculpture; often with a transverse zig-zag pattern of brown colouring, or with thin, brown spiral bands following the most prominent spiral ridges, a few of these sometimes fused to wider colour bands; shells with combined transverse and spiral colour patterns also occur. Whorls (4 3/8-)-5-5 1/2, convex, periphery rounded (rarely angular, see note 3, below), at most with a thread-like, inconspicuous ridgelet. Suture depressed. Spiral sculpture: a fine striation, above the periphery often with up to five ridgelets, similar to the peripheral ridgelet but weaker, below the periphery sometimes one such a ridgelet. Umbilicus open, narrow, at most partly covered by the peristome. Peristome white, on the palatal side usually slightly thickened, abruptly reflected but then about flat, with or without a slight lip, gradually narrowing towards the angular edge; parietal side usually thin. Height 10.2-16 mm, width 10.2-16 mm, shell often slightly higher than wide; height aperture 5.8-9.2 mm, width 6.2-9.5 mm.

Ecology. — Forest on limestone soil. No certain records from other bedrock types on Borneo. Extraliminally observed living on the forest floor as well as on vegetation.

Distribution. — Borneo: widespread but not known from Sarawak, the 4<sup>th</sup> Division excepted. Extralimital range unknown due to uncertain taxonomy, material assigned to *L. pellucidum* and its synonym *L. vitreum* (excluding forms with distinct spiral sculpture, which are included here in *L. sericatum*) is known from Taiwan southwards to Papua New Guinea, as well as from Indonesia, Malaysia and Indochina.

Notes. — *Leptopoma pellucidum* constitutes an unresolved species complex; extreme variability occurs in size, spiral sculpture and colouring. Specific names have been proposed for various forms throughout its range. Unequivocal distinction between these

forms, however, appears impossible because intermediates exist, and because the states of the above characters occur in almost every possible combination. A broad species concept has been applied here, although this is unsatisfactory because some forms are restricted to a small part of the range of the species.

Bornean *L. pellucidum* differs from *L. sericatum* mainly in the spiral sculpture. Where occurring together, the two forms can usually be separated unequivocally, but intermediate specimens occur occasionally. Because of the distributional pattern the forms cannot be given subspecific rank. Therefore, they are provisionally classified as separate species here.

A population at G. Subis (Batu Niah, the only known from Sarawak) differs from *L. pellucidum* elsewhere on Borneo in having more slender shells and an angular periphery. Because they are morphologically enclosed within the species complex, they have not been given taxonomic rank.

#### 6- *Leptopoma sericatum* (Pfeiffer, 1851) (fig. 9)

*Cyclostoma sericatum* Pfeiffer, 1851: 244; syntypes ("North Borneo") leg. Taylor, colln. Cuming, BMNH 1998013/5).

*Leptopoma sericatum*; Pfeiffer, 1852: 108.

*Leptopoma wallacei* auct. Godwin Austen, 1889: 337. Material ("Borneo") colln. Hungerford (BMNH, not seen). Not *Cyclostoma (Leptopoma) wallacei* Pfeiffer, 1857, from the Aru Islands.

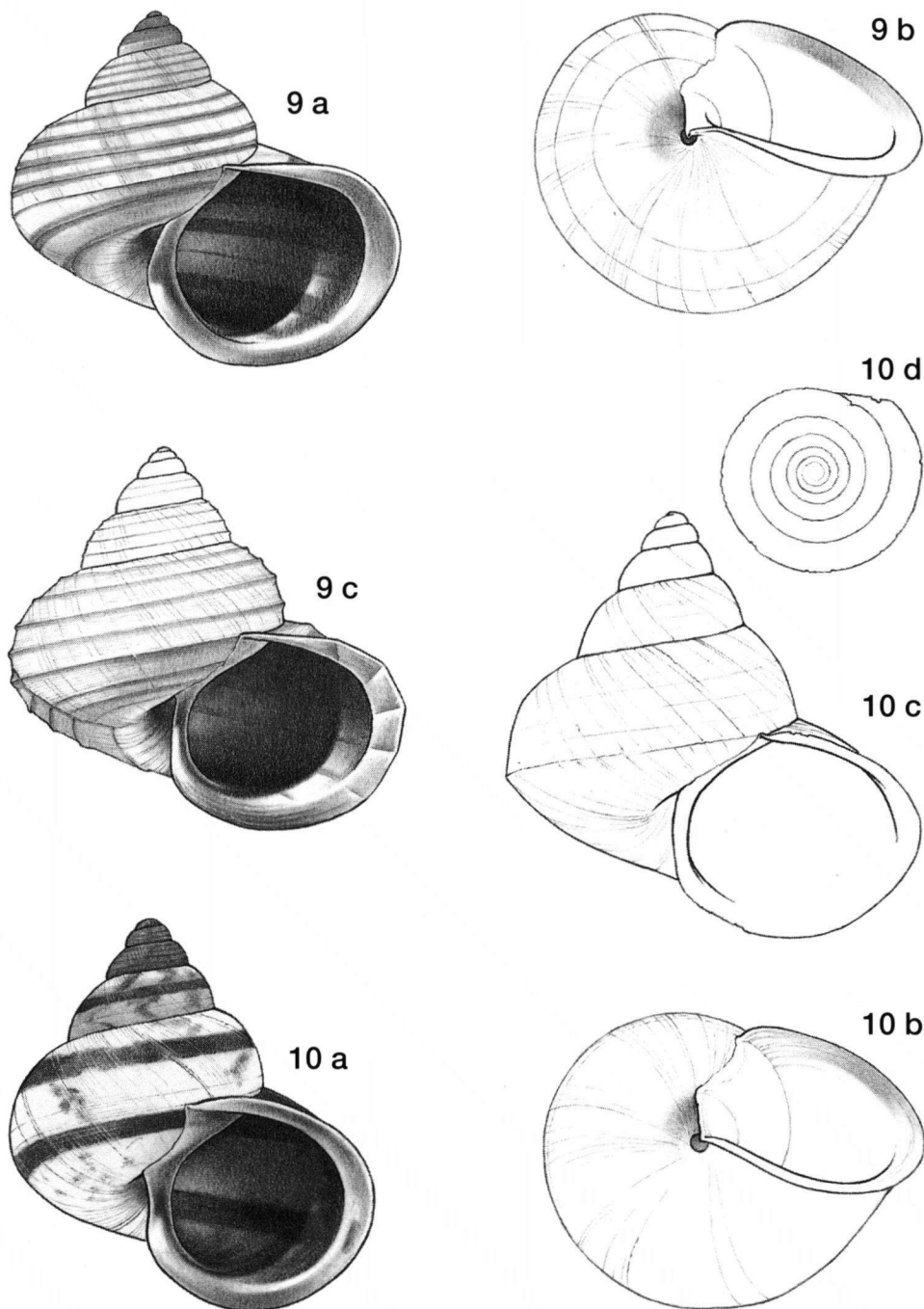
*Leptopoma sericatum* var. *baramense* Kobelt, 1897: 29; lectotype ("Baramfluss") leg. Kükenthal, SMF 126429 (not seen).

*Leptopoma (sericatum* var.) *baramense*; Kobelt, 1902b: 409.

*Leptopoma sericatum baramense*; Zilch, 1954: 153.

Material seen. — SARAWAK. 1st Div.: near Bau (leg. Lim Chan Koon, V 5803/4; leg. De Vogel, V 2625/1); 2-3 km S.W. of Bau (leg. Dorman, UF 196277/1); G. Kapur 6 km S.E. of Bau (V 2245/6); Kpg. Tiang Bekap 10 km S.S.W. of Kpg. Beratok (leg. De Vogel, V 2572/2); G. Selabor, W. of Kpg. Lobang Batu, 12.5 km S. of Tebakang (V 2092/3). 4th Div.: G. Subis (Batu Niah) (leg. Dorman et al., UF 196415/1; do., UF 196453/1; do., UF 196484/1; V 1536; V 1543; leg. Schuiteman, V 5456); do., W. of Batu Niah (leg. Raven, R L1628/>10); do., 4 km S. of Batu Niah (leg. Raven, R L1662); Lambir Hills (leg. Raven, R/1); G. Pala near Batu Bulang, near G. Mulu National Park (leg. Schuiteman, V 5400/2); G. Mulu National Park, near National Park entrance (leg. Ball, V 2674/2); do., trail to G. Mulu (leg. Schuiteman, V 4236/3); do., Sg. Melinau Paku headwaters, G. Api (leg. Schuiteman, V 5659/2). BRUNEI. Temburong, Labi Road 13 km from Sg. Liang (leg. De Vogel, V 2492/3). SABAH. Interior Zone: Lian Cave 12 km N. of Keningau (V 1130/1); Batu Punggol S.E. of Sepulot (leg. Dorman, UF 196629/5; V 1899/2); 0.6 km S. of Kpg. Simatuoh, on Simatuoh Creek (leg. Dorman, UF 196743/1); hill 3 km ENE. of Simatuoh, 0.5 km E. of Sg. Sapulot (leg. Dorman, UF 196595/1); 1 km S.E. of Simatuoh, 10 km S.E. of Sepulot (leg. Dorman, UF 196567/6); 5.5 km NNE. of Simatuoh, 9 km E. of Sepulot (leg. Dorman, UF 196517/2); Pun Batu approximately 30 km W. of Sepulot (V 1297/5). West Coast Zone: P. Tiga (RMNH/2); P. Gaya (leg. Kittel, K/1); G. Kinabalu National Park, Headquarters area (leg. Kittel, V 4802/1); do., Silau-Silau trail (leg. Kittel, K/4); do., Liwagu (leg. Kittel, K/6); do., Carson Falls (leg. Kittel, K/1). Sandakan Zone: Bt. Gomantong, 30 km S. of Sandakan (leg. Lee et al., UF 114713/1; do., UF 114722/





Figs. 9-10. *Leptopoma* spec. 9, *L. sericatum* (Pfeiffer, 1851); a-b, Sarawak, G. Subis (V) (shell height 12 mm); c, Sabah, G. Madai 40 km SSW. of Lahad Datu (V) (shell height 13 mm). 10, *L. pellucidum* (Grateloup, 1840); a-b, Sabah, NW. of road Lahad Datu-Sandakan crossing with S. Segama (V) (shell height 13 mm); c-d, Sarawak, G. Subis (V) (shell height 16 mm); d, operculum.

1; V 1595/1); Sukau, Sg. Mananggol (leg. Chan, V 4238/1; Bt. Kipangi 2 mile N.E. of Sukau (leg. Lee et al., UF 114757/>10); Kinabatangan Valley (leg. Chan, V 5596/1). Tawau Zone: Kirk's Cave', 8 km N. of Lahad Datu (V 2520/2); G. Madai, 40 km S.S.W. of Lahad Datu (V 1710/8); G. Baturong, 50 km W.S.W. of Lahad Datu (leg. Dorman, UF 196778/2; do., UF 196791/4; V 1839/6). "North Borneo" (leg. Taylor, colln. Cuming, BMNH/5, see above; colln. Venmans 5401, RMNH/2). KALIMANTAN. Kalimantan Barat: Liang Kubung (leg. Dutch Borneo exp. 1893-94, RMNH/4); Dadap Ketungau (do., RMNH/2); Kalimantan Selatan: Nateh near Batu Tangga, approximately 18 km E. of Barabai (V 3019/1); G. Siamang near Desah Liu, 30 km E. of Tandjung (V 3084/>10); Jaro near Muara Uja, limestone escarpment W. of the village (V 3183/2); limestone escarpments along road Benualawas-Limbungan (V 2842/1). Kalimantan Timur: Kutei National Park (leg. WWF-IP Forest Fire Project 1998, V 5933/1); surroundings Merabu: Liang Belana (do., V 5942/1); surroundings Lempake (do., V 5977/3).

As the nominate subspecies, but also with a pinkish apex; without transverse zig-zag colour pattern, often with orange or pinkish brown thin spiral bands following the most prominent spiral ridges, the lowermost of these sometimes fused to wider colour bands. Whorls 4 3/8-5 1/8(-5 1/2), periphery rounded to angular, usually with a moderately distinct thread-like ridge. Spiral sculpture: a fine striation, above the periphery with 3-6 rather distinct, thread-like ridges, below the periphery 1-2(-6) such ridges. Height 9-15 mm, width 9.2-15.5 mm, shell often slightly wider than high; height aperture 5-8 mm, width 5-9.5 mm.

Animal red, tips of tentacles blackish (1 observation).

Ecology. — In primary forest on limestone soils, also in forest on soils over sandstone/shale bedrock, and granodiorite. Also found in disturbed vegetation, and in roadsides. Found in lowland conditions, but also in montane forest at about 1800 m asl. Observed living on the forest floor as well as on vegetation.

Distribution. — Borneo: widespread. Extralimital range unknown; *L. altum* Moellendorff, 1897, from Java, and *L. fultoni* Aldrich, 1898, from Sumatra, are possibly identical, as well as some species described from the Philippines.

Species excluded from the list of Bornean *Leptopoma*.

*Leptopoma duplicatum* auct.

*Leptopoma duplicatum* auct. Bock, 1881: 634; material ("Mindai") (not seen). Possibly not *L. duplicatum* Pfeiffer, 1856, of unknown origin.

*Leptopoma massena* auct.

*Leptopoma massena* auct. Bock, 1881: 634; material ("Mindai") (not seen). Probably not *Cyclostoma massena* Lesson, 1831, from New Guinea.

*Leptopoma subconicum* auct.

*Leptopoma subconicum* auct. Bock, 1881: 634; material ("Mindai") (not seen). Probably not *Cyclostoma subconica* Pfeiffer, 1862, probably from southern Vietnam.

Notes. The identifications of Bornean *Leptopoma* in Bock (1881: 634) are probably not correct: the species concerned either are not likely to occur on Borneo, or they are of doubtful provenance and taxonomic status. The shells are not available for study, and cannot be identified. At most, their identity can be inferred from checking properly identified material of the species listed above.

Both *L. duplicatum* auct., and *L. subconicum* auct., probably refer to shells combining thread-like spiral ridges with a brown colour pattern. They could be *L. signatum*, but also various species of the genus *Japonia*, in which this combination of characters is common.

*Leptopoma massena* auct. probably refers to a shell of *L. pellucidum*.

*Leptopoma tenebricosum* (Adams & Reeve, 1850)

*Cyclostoma tenebricosum* Adams & Reeve, 1850: 57. Type ("Balangbangan insulae Borneo") leg. Cuming (not seen).

*Leptopoma tenebricosum* Pfeiffer, 1852: 117.

*Cyclophorus tenebricosus* Pfeiffer, 1865: 96.

Note. — Identity uncertain. Could be either a *Leptopoma*, or a *Japonia*.

*Leptopoma whiteheadi* E. A. Smith, 1887.

*Leptopoma whiteheadi* E. A. Smith, 1887: 133; syntypes ("Northern Borneo") leg. Whitehead, BMNH 89.5.21.2-3/2.

Material seen. — "Northern Borneo" (BMNH/2, see above).

Note. - This is a *Japonia* species.

*Craspedotropis* Blanford, 1864

Shell very small (1.8-3.6 mm wide), thin, somewhat translucent, with a silky lustre, whitish to corneous, without colour markings. Protoconch finely rugose, transition towards the teleoconch unmarked. Spire conical to high conical. Radial sculpture: growth lines and fine riblets. Spiral sculpture: striation, often combined with ridges. Umbilicus open, not covered by the peristome. Aperture often with one or more edges. Peristome somewhat thickened but not reflected, simple; angular edge without a sinus. Periostracum thin, corneous, with or without hairs or other appendages.

Operculum thick, with many whorls, inner layer corneous, the margins of the whorls erect, the spiral cavity in between filled with calcareous matter or not.

Distribution. — India, Borneo.

Notes. — Three genera seem appropriate to include the species listed below: *Cyathopoma*, Blanford, 1861 (India to Africa), *Jerdonia* Blanford, 1861 (India mainly), and *Craspedotropis* Blanford, 1864 (India). According to Kobelt (1902), the first two have an operculum with calcareous elements, whereas the third has an entirely corneous operculum. *Cyathopoma* should differ from *Jerdonia* in having an operculum with free and erect margins. Gude (1921) is less explicit about the generic delimitations, but, judging from the species descriptions, follows Kobelt.

However, on investigation of material present in RMNH, *Craspedotropis cuspidata* (Benson, 1851), the type species of the genus, appears to have a corneous, multispiral operculum with thin, free and erect whorl margins. The spiral cavity in between the margins is partly filled with a layer of calcareous matter. This is fairly similar to *Cyathopoma*, and the only remaining distinction between the two genera then lies in the shape of the shell: *Craspedotropis* usually has a higher conical spire and has a distinct peripheral keel, or a number of equally distinct ridges. All in all, the distinctness of the three genera leaves much to be desired, and the inclusion of the species below in any of them is doubtful. The argumentation to choose *Craspedotropis* is as follows: *C. andrei*, is included because the shell shape is similar to that of *C. cuspidata*, the type of the genus. Unfortunately, the operculum of *C. andrei* is unknown. *Craspedotropis borneensis* has an operculum essentially similar to that of *C. cuspidata*, although it lacks the calcareous layer. The shell shape is reminiscent of Indian species later included in the genus: *C. bilirata* (Beddome, 1875), and *C. salemensis* (Beddome, 1875). *Craspedotropis juvenilis*, finally, is in fact fairly similar to *C. andrei*, except for the prominent peripheral keel of the latter. However, it would equally well fit in *Cyathopoma* as far as the shell is concerned. Again, the operculum is lacking in the only specimen available.

Next to the taxa listed below, the genus includes four species from India (Gude, 1921: 15), and probably one more from Bunguran Isl. off the NW. point of Borneo: *Cyathopoma tricarinatum* E. A. Smith, 1894.

Bornean *Japonia*, Gould, 1859 (is *Lagocheilus*, Blanford, 1864) have larger shells (the smallest about 4 mm high), usually have a reflected peristome with a sinus in the angular edge, and have an operculum without erect whorl margins. It is either entirely corneous, or it has a thin layer of calcareous matter on one side.

#### Key to the Bornean species of *Craspedotropis*

(check as large series of specimens as possible)

- 1a Ultimate whorl entirely without conspicuous ridges ..... 1- *Craspedotropis juvenilis*
- 1b Ultimate whorl with a distinct peripheral keel, or with various distinct spiral ridges ..... 2
- 2a Ultimate whorl with 9 about equally distinct spiral ridges ..... 2- *Craspedotropis borneensis*
- 2b Ultimate whorl with a single peripheral keel, all other spiral sculpture inconspicuous .....  
..... 3- *Craspedotropis andrei*

#### 1- *Craspedotropis juvenilis* spec. nov. (fig. 11)

Material seen. — SARAWAK. 4th Div.: G. Mulu National Park, Sg. Melinau Paku headwaters, G. Api (leg. Schuiteman, V 5430/1, holotype RMNH 59386).

Spire high conical. Whorls  $3 \frac{5}{8}$ , convex; periphery rounded. Suture depressed. Radial sculpture: inconspicuous growth lines, alternating with somewhat spaced riblets (c. 20/mm on the last whorl). Spiral sculpture: inconspicuous striation, alternating with fine ridgelets (c. 12 on the last whorl); shell with a very fine reticulate sculpture. Umbilicus narrow. Aperture slightly angular above, otherwise circular. Peristome with a thickened lip on the palatal side. Height 1.9 mm, width 1.8 mm; height and width aperture 0.95 mm. Periostracum greenish, smooth, without hairs or appendages.

Ecology. — Forest on limestone soil. Found at 1200 m asl.

Distribution. — Borneo: Sarawak, 4th Div., G. Mulu area only.

Notes. — The low whorl count gives this species an immature appearance. The peristome, however, is thickened, as in adult shells of most cyclophorids.

Its inclusion in *Craspedotropis* is somewhat doubtful, but, apart from the absence of a peripheral keel, the shell is more similar to *C. andrei* than to any other Bornean cyclophorid.

2- *Craspedotropis borneensis* (Godwin Austen, 1889) (fig. 12)

*Jerdonia ? borneensis* Godwin Austen, 1889: 345; holotype ("Busan Hills") leg. Everett, BMNH 1889.12.7.21/1.

Material seen. — SARAWAK. 1st Div.: Busau (leg. Everett, BMNH/1, see above).

Spire high conical. Whorls 5 1/2, convex. Suture depressed. Radial sculpture: growth lines and densely placed riblets (35/mm on the last whorl) which are most distinct close to the suture. Spiral sculpture: distinct, high ridges, 9 on the last whorl (6 regularly spaced on the lateral surface of the whorl, 2 on the basal surface, but at some distance from the lowermost lateral one, and 1 in the umbilicus); in between the ridges a fine striation that is least conspicuous near the suture. Umbilicus rather wide. Aperture more or less ovate, with a shallow sinus basally. Peristome with a slight lip on the palatal and the basal side, at some distance from the margin. Height 3.2 mm, width 1.6 mm; height aperture 1.2 mm, width 1.3 mm. Periostracum greenish, close to the suture raised to minute crests over the radial riblets, without further appendages.

Operculum corneous, free whorl-margins widened and flattened so that together they form a second corneous layer at some distance from the first. No calcareous matter present.

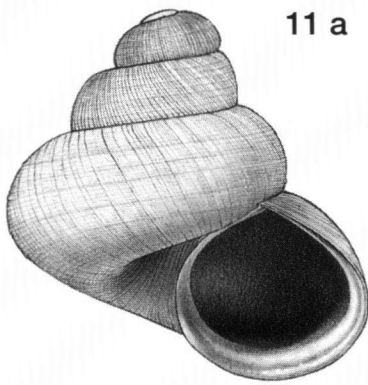
Ecology. — Forest on limestone soil. Lowland conditions.

Distribution. — Borneo: Sarawak, 1st Div., limestone ranges S.W. of Kuching.

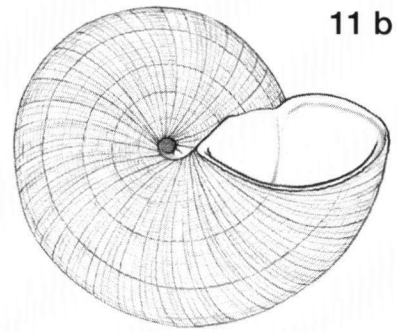
3- *Craspedotropis andrei* spec. nov. (fig. 13)

Material seen. — SARAWAK. 4th Div.: Bt. Pelamau (leg. Haegens, V 5614/1); G. Mulu National Park, Sg. Melinau Paku headwaters, G. Api (leg. Schuiteman, V 5431/2, including holotype RMNH 59385; do., V 5640/3).

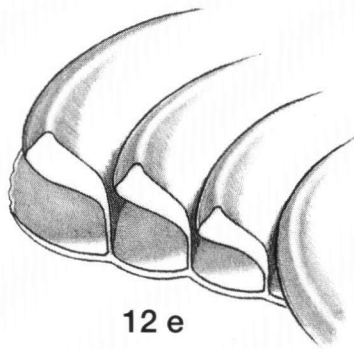
Spire conical. Whorls 4-4 1/4, the first few convex, the last almost flat to moderately convex, slightly concave towards the periphery; periphery with a distinct keel. Suture depressed. Radial sculpture: growth lines and densely placed to irregularly spaced riblets (15-25/mm on the last whorl) which are most distinct close to the peripheral keel. Spiral sculpture: inconspicuous striation, combined above the periphery with 4-5 slightly raised, somewhat more distinct ridges; below the periphery with 1-2 such ridges, one of these running close to the peripheral keel. Umbilicus rather wide. Aperture angular above and to the right. Peristome with a thickened lip on the palatal and basal side. Height 2.0-2.5 mm, width 2.8-3.6 mm; height aperture 1.0-1.1 mm, width 1.3-1.6 mm. Periostracum corneous, sometimes raised to a minute crest where radial riblets cross the spiral ridges, with rather deciduous, distinct, flat, obtuse appendages of c. 0.1 mm long on the peripheral keel.



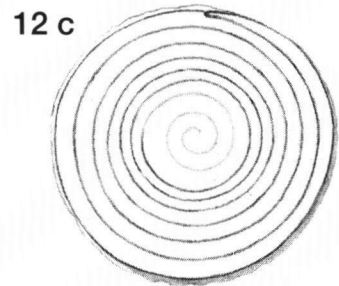
11 a



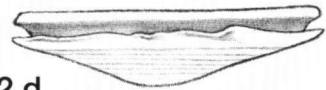
11 b



12 e



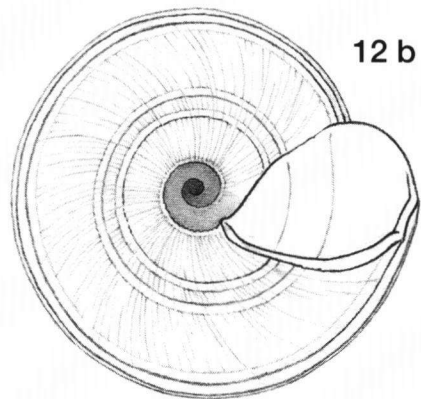
12 c



12 d



12 a



12 b

Figs. 11-12. *Craspedotropis* spec. 11, *C. juvenilis* spec. nov., holotype; Sarawak, G. Mulu area, G. Api (RMNH) (shell height 1,9 mm). 12, *C. borneensis* (Godwin Austen, 1889), holotype; Sarawak, Busau (BMNH); a-b, shell (height 3.2 mm); c-e, operculum; c, outside; d, lateral view; e, section through outer whorls.

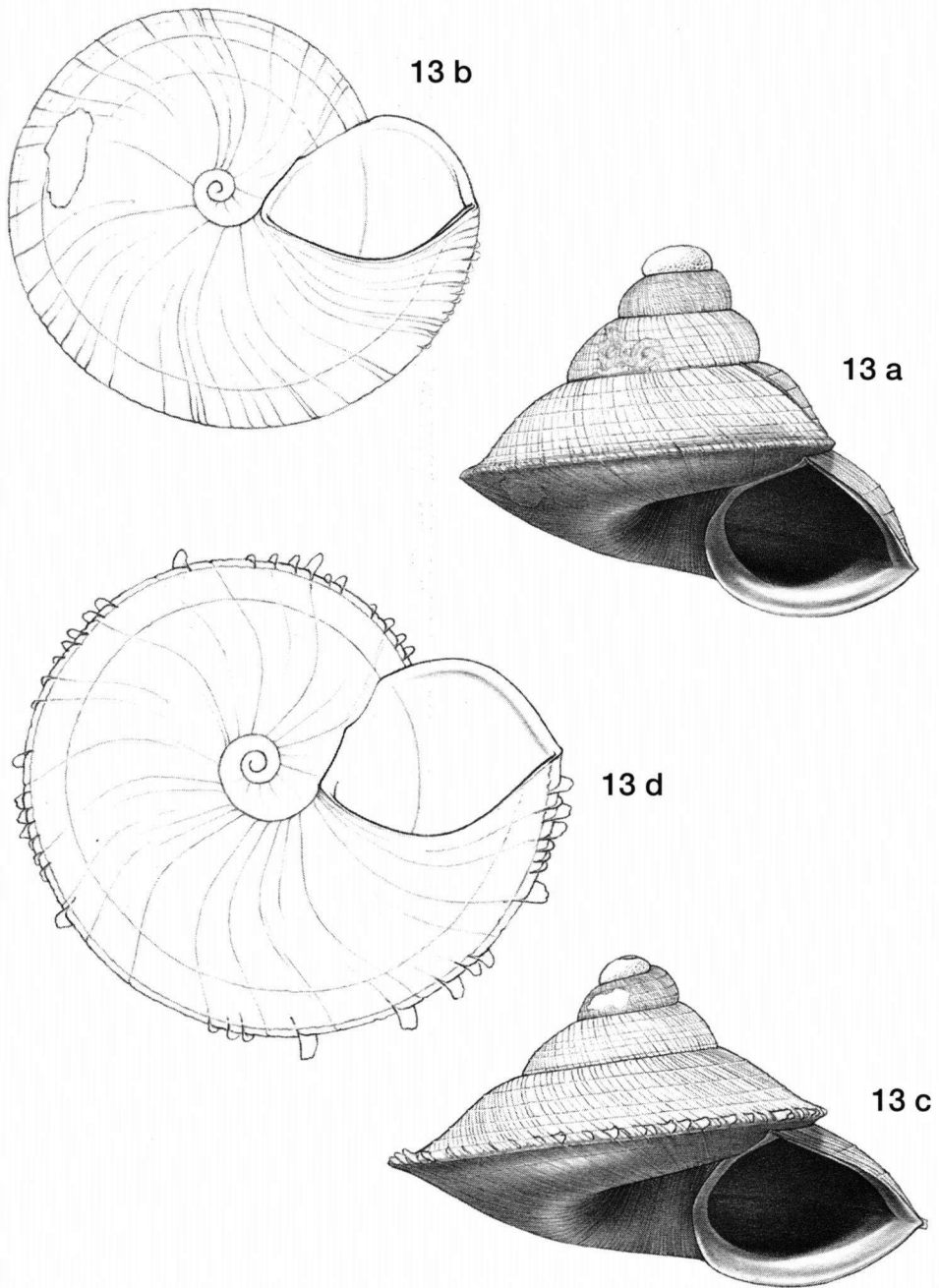


Fig. 13. *Craspedotropis andrei* spec. nov. a-b, holotype, Sarawak, G. Mulu area, G. Api (RMNH) (shell height 2.2 mm); c-d, paratype, Sarawak, Bt. Pelamau (V) (shell height 2.4 mm).

Ecology. — Forest on limestone soil. Found at 1200-1300 m asl.

Distribution. — Borneo: Sarawak, 4th Div., G. Mulu area and surrounding limestone hills.

Note. — Named in honour of Mr. André Schuiteman (Rijksherbarium, Leiden, the Netherlands), who collected the first specimens of this species, and whose collecting activities at 900-1200 m asl. in the Pinnacle area in the Mulu range revealed the extraordinary composition of the local snail fauna.

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