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RESULTS OF THE AUSTRIAN-CEYLONESE HYDROBIOLOGICAL MISSION 1970 OF THE 1ST ZOOLOGICAL INSTITUTE UNIVERSITY OF VIENNA (AUSTRIA) AND THE DEPARTMENT OF ZOOLOGY OF THE UNIVERSITY OF CEYLON, VIDYALANKARA CAMPUS, KELANIYA (SRI LANKA)

Part XVII: The Freshwater Gastropods of Ceylon

by

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(WITH 15 PLATES–PLATES II–XVI)

(1) Introduction

Sri Lanka (Ceylon), situated between the 6° and 9° N latitude and the 79° and 82° E longitude, is a detached part of the continental Deccan plateau of ancient crystalline rocks. The Central Highlands, at a general elevation of 1400m and 1800m, is surrounded by two peneplains, the lowland from the coast to 100m to 150m altitude and the upland from 150m to 500/700m altitude. The upland and highland are composed of crystalline Precambrian rocks. The greater part of the lowland is composed of very strongly metamorphic palaeozic rocks (Vijayan-series). In western Ceylon are also found the Tabbowa and Andigama basins with sedimentary rocks of Upper Jurassic age which form a part of the Gondwana system. In the northwest area of Jaffna is a thick belt of limestone from the Lower Miocene age. Lastly along the river valleys and along the coast there are Quaternary deposits (Cooray, 1967; Moormann & Panabokke, 1961; Brink, Andersson, 4 Cederholm, 1970/71; Weninger, 1972).

The climate of Ceylon shows only slight seasonal variations in temperature, air humidity and day length. In the highland the mean average temperature is about 15°C, in the upland about 24°C and in the lowland about 27°C. The yearly amplitudes of the air-temperatures vary between 1'8°C along the coast, 2'7° in the upland and 2'4°C in the highland. These narrow amplitudes are a result of the influence of the sea and of the cloudiness. The rainfall in the southwest of the island the " wet zone " is very high (between 2000 mm and 7000 mm in average), while in the " dry zone " there occurs a dry season lasting several months. Costa & Starmuhlmer, 1972 and Weninger, 1972 have already given reports about the physical and chemical conditions in the inland waters, specially the running waters in the upland and highland areas.

Due to their short courses, the brooks, torrents and the rivers of the up-and highlands have steep falls, on the average it is 15 p.m., but in the higher regions the falls rises to 50 p.m. These remarkable falls cause high current velocities in the up-and highland between 1m to 2m/sec. In the groove-like pools between the cascades and in the lower parts of the streams in the up-and lowland however the current reaches only a maximum of 30-50cm/sec.

The formation of the bottom in the running waters is a consequence of the velocity of the current. In the waterfalls and torrents of the high-and upland the bottom is formed of standing, smooth granitic rocks, interrupted by regions with larger and smaller boulders. On the banks and in the pools the bottom is covered by gravel and sand like in the rivers of the lower up-and lowland. In the lower regions of the rivers and streams the bottom is very frequently muddy.

The water temperatures in the running waters of Ceylon increased from the springs and torrents in the highland (between 1800m and 2000m altitude) from 15°C to 22°C and 25°C in the upland and between 25°C and 28°C in the lowland to the coast. The variation between highland waters and the streams near the coast is approx. 13°C. The amplitudes of water temperature changes between day and night is from 4°C-5°C in the highland to 3°C-4°C in the upland

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and only 1°C-2°C in the lowland and the coast. In the crystalline highland and upland the waters are extremly poor in electrolytes, specially poor is the content of CaO and MgO. The total hardness vary in the crystalline zone from 0'08° dH* to 2'35°dH. Otherwise in the regions of limestone of the Lower Miocene and the sediments of the Upper Jurassic the hardness of the waters shows values between 7°dH to 12'9°dH. Exact analysis of the investigated streams are given by Weninger, 1972.

The exploration of the non-marine molluscs of Ceylon was begun a long time back. The collection of shells was at all times very easy and pleasant for the collectors. But till the 20th century in most cases only the shells have been described by the conchologists. However, the shells of freshwater molluscs are very variable, depending on the ecological features of the local aquatic environment. The consequence of this was the description of numerous species of freshwater molluscs from Ceylon only from the shape of the shells, sometimes only from one shell. With the study of the shells of large populations and the anatomy of the soft body parts it was necessary to unite many " species ". Descriptions and figures of shells of freshwater gastropods from Ceylon have been made by Reeve, 1843-1878, Deshayes 1854, Dohrn, 1857 and 1858. Very important are the summaries of land-and freshwater shells by Hanley & Theobald, 1876 and Godwin-Austin, 1882-1920. Many descriptions and figures of shells are also to be found in several volumes of the " Conchylien-Cabinet " edited by Martini & Chemnitz, for example by Küster. 1862; Brot 1874, 1880; Clessin, 1886 and Kobelt 1909 and 1915. A list of the freshwater molluscs of British India, including Ceylon was published by Preston, 1915. Other contributions to the Malacology of Ceylon have been made by Collett 1897 and 1898. Recent studies of shells from Ceylon have been made by Satyamurthi, 1960. Sivalingam, 1949 studied the correlation of some freshwater snails of Ceylon to human schistomiasis. Hubendick, 1951 in his important study about the recent Lymnaeidae gave a revision of the Ceylonese species of *Lymnaea*. The same author in 1955 in his investigation about the phylogeny of the Planorbidae gave anatomical comments on *Indoplanorbis exustus*, ocurring also in Ceylon. The special literature concerning freshwater gastropods found in Ceylon is cited in the systematical part describing the different species.

In the following study are described the specimens collected by (1) Austrian Ceylonese Hydrobiological Mission 1970 (Costa & Starmühlner, 1972, Weninger, 1972), (2) Prof. Dr. H. H. Costa and students from the Vidyalankara Campus of the University of Ceylon, Department of Zoology, Kelaniya during 1971 and (3) Swedish Lund University of Ceylon Expedition in 1962, conducted by P. Brinck, H. Anderson and L. Cederholm (Report No. 35 of the Lund University Expedition to Ceylon, 1962)

(2) Material and Methods

The specimens of freshwater snails from the Austrian Ceylonese Mission 1970 were collected by the author qualitatively and quantitatively. The collections of Costa et. al., 1971 and from the Lund University Ceylon Expedition 1962 were taken only qualitatively. The quantitative samples were taken mostly from 1/16m² sometimes from 1/4m². However when the density of the population was very small the collection was counted on 1 m²—and more. The animals were preserved in alcohol 75% for anatomical studies and in Bouin's liquid for subsequent histological studies. The dissections of the snails were executed with a binocular Wild M5 and a drawing tube. For microanatomical and histological studies the snails were sectioned in paraffin and stained with Haemalaun-Eosin. The photographs of the shells were made by Kine-Exakta and the micro-photographs with Reichert Zetopan with KAM ES.

The freshwater gastropods in this study were collected from 100 different localities, mostly running waters, but some were also collected from stagnant waters like pools, irrigated paddy fields, swamps and water reservoirs (tanks). Listed from these localities are 31 species (and subspecies) 28 species are Streptoneura (=Prosobranchia), 3 species are Euthyneura-Pulmonata-Basommatophora. The freshwater bivalves from the cited collections were studied by G. Hadl (Zool. Inst. Univ. Vienna) and will be published elsewhere in this Journal.

* dH : German hardness degree.

List of Species

GASTROPODA

STREPTONEURA (PROSOBRANCHIA)

Archaegastropoda

Neritacea

Neritidae

(1) *Neritina* (*Neripteron*) *auriculata* LAMARCK, 1816

(2) *Septaria lineata* (LAMARCK, 1816)

Mesogastropoda

Cyclophoracea

Viviparidae

(3) *Bellamya dissimilis* (O.F. MÜLLER, 1774) var. *ceylanica* (DOHRN, 1857)

Ampullariidae

(4) *Pila globosa* (SWAINSON, 1822)

Rissoacea

Hydrobiidae

Lithoglyphinae

(5) *Tricula montana* (BENSON, 1842)

Stenothyridae

(6) *Gangetia burmanica* (PRASHAD, 1921)

Bulliminidae (=Bithyniidae)

(7) *Bulimus* (=*Bithynia*) *inconspicua* (DOHRN, 1857)

(8) *Bulimus* (=*Bithynia*) *stenothyroides* (DOHRN, 1857)

(9) *Mysorella costigera* (KÜSTER, 1852)

Synceridae (=Assimineidae)

(10) *Syncera* (=*Assiminea*) cf. *hidalgoi* (GASSIES, 1869)

(11) *Syncera* (=*Assiminea*) cf. *woodmasoniana* (NEVILL, 1880)

Cerithiacea

Thiaridae (=Melaniidae)

Melanopsinae

(12) *Faunus ater* (LINNÉ, 1758)

Paludominae

(13) *Paludomus* (*Paludomus*) *chilinoides* (REEVE, 1847)

(14) *Paludomus* (*Paludomus*) *inflatus* (BROT, 1880)

(15) *Paludomus* (*Paludomus*) *palustris* (LAYARD, 1854)

(16) *Paludomus* (*Paludomus*) *tanschauricus* (GMELIN, 1791)

(17) *Paludomus* (*Paludomus*) *tanschauricus* (GMELIN, 1791) subspec. *nasutus* (DOHRN, 1857)

(18) *Paludomus* (*Philopotamis*) *bicinctus* REEVE, 1852

(19) *Paludomus* (*Philopotamis*) *decussatus* REEVE, 1852

(20) *Paludomus* (*Philopotamis*) *nigricans* REEVE, 1847

(21) *Paludomus* (*Philopotamis*) *regalis* LAYARD, 1854

(22) *Paludomus* (*Philopotamis*) *sulcatus* REEVE, 1847

(23) *Paludomus* (*Tanalia*) *loricatūs* REEVE, 1847

(24) *Paludomus* (*Tanalia*) *neritoides* REEVE, 1847

(25) *Paludomus* (*Tanalia*) *solidus* DOHRN, 1857

Thiarinae

Thiareae

(26) *Thiara* (*Plotia*) *scabra* (MÜLLER, 1774)

(27) *Melanoides* (*Melanoides*) *tuberculata* (MÜLLER, 1774)

(28) *Melanoides* (*Stenomelania*) *torulosa* (BRUGUIÉRE, 1789)

EUTHYNEURA

Basommatophora

Lymnaeacea

Lymnaeidae

Lymnaeinae

(29) *Radix* (*Cerasina*) *luteola* (LAMARCK, 1822) var. *pinguis* (DOHRN, 1858)

Planorbidae

Bulininae

(30) *Indoplanorbis exustus* (DESHAYES, 1834)

Planorbinae

Planorbeae

(31) *Gyraulus* (*Gyraulus*) *convexiusculus* (HUTTON, 1849)

(3) List and Descriptions of the Stations

In this study are described the specimens of freshwater Gastropods collected in 1970 by the Austrian-Ceylonese Hydrobiological Mission, specimens collectd by Prof. Dr. H.H. COSTA et al. in 1971 and the specimens collected by the Swedish Lund University Expedition to Ceylon in 1962.

The stations of the collections are listed after the Provinces of Ceylon and are also listed by continuous numbers*. These numbers are also to be found in the systematical and anatomical part of this study. (Fig. 1).

3.1 SOUTHERN PROVINCE

Collection Austrian-Ceylonese Hydrobiological Mission 1970

No. 1. FC 7/g/12.11.1970 : Thanipita Dola, a tributary of the Nilwala Ganga, near Deniyaya ; torrent running through forest and tea plantations, partially with shadow . Alt. : 600m. ; Br. 3-5m ; D. 5-20cm. ; Curr. : 50cm/sec. (on cascades :1m./sec.), Gr. : pebbles, gravel, sand, some parts with boulders ; Te. :9^h : 25.1°C, 12^h: 27.3°C ; Che. : pH : 6, El_{20} : 35 —U. Siemens, Tot. H. : 1.2°C dH, Ca0 : 4 mg. /1. Species found : *Paludomus* (T.) *loricatus*, *Thiara* (*Pl.*) *scabra*, *Melanoides* (*M.*) *tuberculata*.

No. 2.—FC 8/c/13.11.1970 : Nagahaketa Dola, a tributary of the Nilwala Ganga, near Deniyaya; torrent running through forest and plantations, partially with shadow. Alt. : 500m. ; Br. : 8-10m. ; D. : 5-10cm. (some pools : 30-50cm); Curr. : 50cm-1m/sec., (in pools : 5-10 cm./sec.) ; Gr. : granitic boulders ; pebbles, gravel and sand ; Te. : 9^h : 24¹2°C) 10^{30} : 25'4° ; Che. : pH : 5·8, El_{20} : 35—U Siemens, Tot. H. : 1°dH, Ca0 : 2mg /1. species found : *Paludomus* (Ph., *sulcatus*, *Paludomus* (*T.*) *loricatus*, *Pludomus* (*T.*) *neritoides*.

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* Abbreviations : Alt : Altitude, Br. : Breadth, D. : Depth : Curr : Currency, Gr. : Ground, Te : Temperature Che. : Chemistry, El_{20} : Electrolytic conductivity (in U. Siemens), Tot. H. : Total Hardness (in°dH)

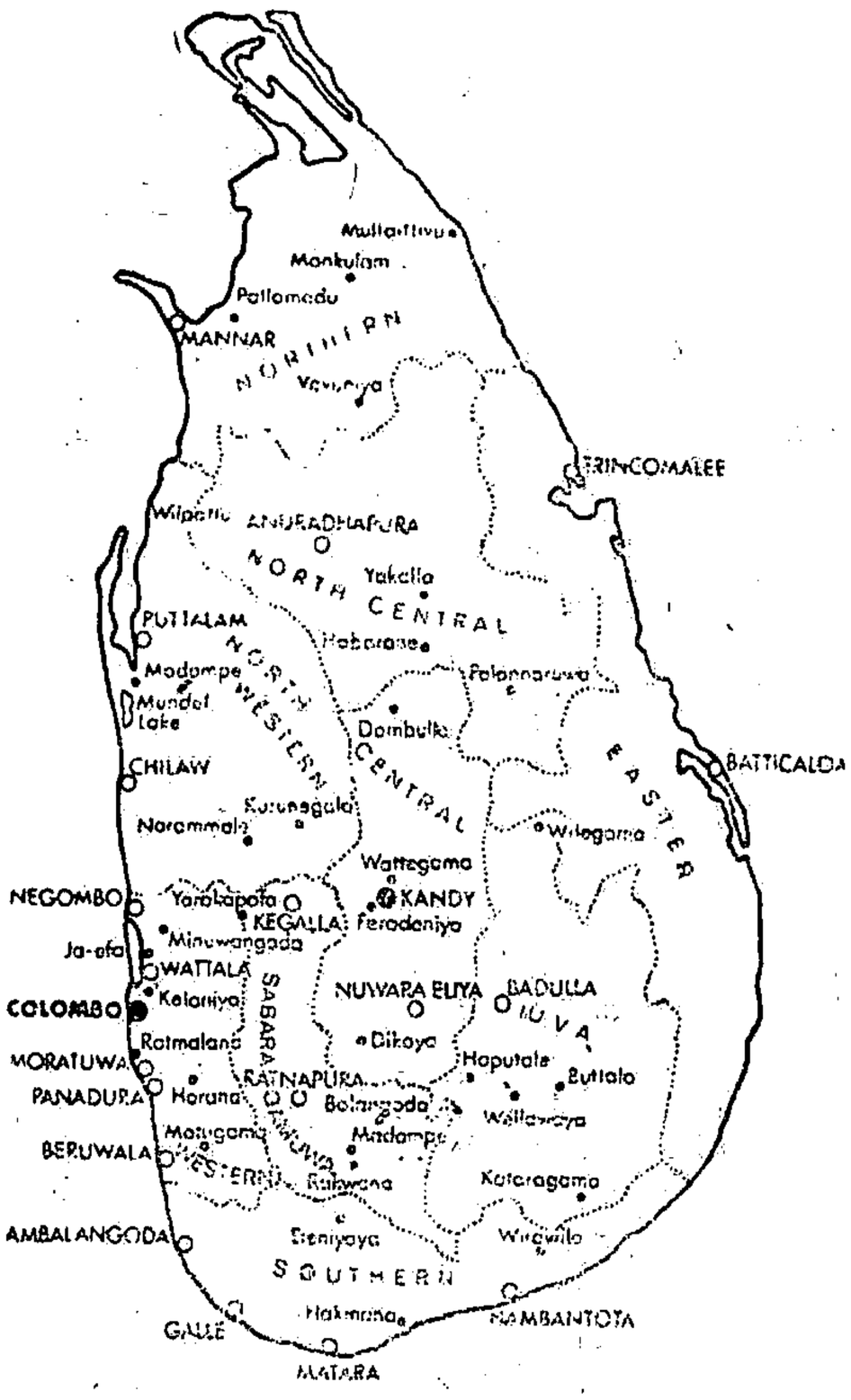


Fig. 1. Map of Sri Lanka (Ceylon), Indicating Provinces and Main Towns.

Collection COSTA et al., 1971

No 3 : Ambalangoda ; Species found : *Neritina* (*Neripteron*) *auriculata, Septaria lineata, Faunus ater, Paludomus* (*T.*) *loricatus.*

No. 4. Hakmana ; Species found : *Bellamya dissimilis* v. *ceylanica, Pila globosa, Thiara* (*Pl.*) *scabra, Melanoides* (*M.*) *tuberculata, Indoplanorbis exustus*

No. 5. Matara ; Species found : *Thiara* (*Pl.*). *scabra, Melanoides* (*M.*) *tuberculata.*

Collection Lund University Expedition 1962,

No. 6. Loc. 24/26.1.1962 : Gilcroft, 7.5 mls. SE of Ambalangoda ; Alt. : 10m, shallow cultivated valley (paddy fields) with central areas swampy, transversed by a muddy stream, surroundings cultivated, plantations. Species found : *Bulimus inconspicua, Melanoides* (*M.*) *tuberculata, Radix* (*C.*) *luteola* v. *pinguis, Indoplanorbis exustus, Gyraulus convexiusculus.*

No. 7. Loc. 33 : 1/29.1.1962 : Haycock Mountain, 21 mls. NNE of Galle ; Alt. : 325m ; ravine with fast-running stony stream, dense indigenous forest with a layer of leaves on the ground and soill rich in humus. Species found : *Paludomus* (*Ph.*) *regalis.*

No. 8. Loc. 169/22.3.1962 : Yoda Wewa at Tissamaharama ; Alt. : 20m. ; large water reservoir with much aquatic vegetation. Species found : *Bulimus inconspicua, Gyraulus convexiusculus.*

No. 9 : 12.7.1963 : coll. Dag. BILLE at Wirawila, 18mls. NE Hambantota. Species found : *Bulimus inconspicua, Mysorella costigera.*

3.2 WESTERN PROVINCE

Collection COSTA et al., 1971

No. 10. Kelaniya ; Species found : *Neritina* (*Neripteron*) *auriculata, Bellamya dissimilis* var. *ceylanica, Pila globosa, Bulimus inconspicua, Mysorella costigera, Radix* (*C.*) *luteola* var. *pinguis, Indoplanorbis exustus.*

No. 11. Horana, Species found : *Septaria lineata, Neritina* (*Neripteron*) *auriculata, Melanoides* (*δ Stenomelania*) *torulosa, Radix* (*C.*) *luteola* var. *pinguis, Indoplanorbis exustus.*

No. 12. Tholangamuwa near Warakapala ; Species found : *Neritina* (*Neripteron*) *auriculata, Septaria lineata.*

No. 13. Agalawatte : Species found : *Bellamaya dissimilis*, var. *ceylanica, Thiara* (*Pl.*) *scabra, Melanoides* (*M.*) *tuberculata.*

No. 14. Beruwala : Species found : *Pila globosa, Indoplanorbis exustus, Gyraulus convexiusculus.*

No. 15. Moratuwa : Species found : *Paludomus* (*T.*) *loricatus.*

No. 16. Minuwangoda ; Species found : *Melanoides* (*M.*) *tuberculata, Radix* (*C.*) *luteola* var. *pinguis, Indoplanorbis exustus.*

No. 17. Attanagalla : *Bellamaya dissimilis* var. *ceylanica, Pila globosa, Paludomus* (*P.*) *chilinoides, Melanoides* (*M.*) *tuberculata, Indoplanorbis exustus.*

No. 18. Ratmalana : *Pila globosa.*

No. 19. Panadura : *Pila globosa, Faunus ater, Melanoides* (*M.*) *tuberculata, Radix* (*C.*) *luteola* var. *pinguis, Indoplanorbis exustus.*

Collection Lund University Expedition 1962 :

No. 20. Loc. 7/11.1.1962 : Stream Ja-Ela, 10 mls. NNE of Colombo ; Alt. : 1-5m. in the stream *Azolla* ; surrounding cultivated area with paddy fields and coconuts. Species found : *Pila globosa, Indoplanorbis exustus.*

No. 21. Loc. 11 and 16 : II/14. and 31.1.1962 : Yakkala, 18mls. NE of Colombo ; Alt. : 25m. ; in wet grounds near stream for paddy fields ; Loc. 16 : II : outflowing stream. Species found : *Pila globosa, Indoplanorbis exustus.*

No. 22. Loc. 13 : I and 14 : V/17.1.1962 : Alawala, 26mls. NE of Colombo, 10mls. ENE of Yakkala ; Alt. 25m., 150m., and 200m. respectively ; hill with streams coming down in cascades ; 13 : I : stream in ravine sheltered by trees and bush, surroundings : dry, thin forest ; 14 : V : clayey, shallow river (Attangalu Oya) in a valley, shores with bush and palm trees. Species found : *Paludomus* (*P.*) *sulcatus*, P. (*T.*) *loricatus, Paludomus* (*T.*) *neritoides.*

No. 23. Loc. 17 : IV/21.1.1962 : Labugama, 24 mls. ESE of Colombo ; Alt : 100-150m. stony stream sheltered by dense forest, outflow from Kalutawawa Reservoir ; Species found : *Paludomus* (*T.*) *neritoides.*

3.3 SABARAGAMUWA PROVINCE

Collection Austrian-Ceylonese Hydrobiological Mission 1970

No. 24. FC9/d/17.11.1970 : Bodathpitiya Ela near Ratnapura, torrent coming from the Bodathpitiya falls casades changes with sectors of slight current in pools, surrounding forest and plantations, nearly no shadow at the borders Alt. : 500m. ; Br. : 5-30m. ; D. : 10-50cm. (in pools to 1m. and more) ; Curr. : cascades : 75cm/sec. to more than 1m/sec pools : 0-30 cm/sec ; Gr. : granitic rocks, boulders, pebbles and sand (on banks and in pools) ; Te. : 10^{30} : 26 C, 13^{h} 27'2°C ; Che. : pH : 6, El_{20} : 35 μ Siemens, Tot. H. : 1,1°dH, CaO : 2 mg/1. Species found : *Paludomus* (*T.*) *loricatus. Paludomus* (*T.*) *neritoides, Thiara scabra.*

No. 25. FC 10/d/18.11.1970 : Katugas Ela near Ratnapura, torrent with waterfalls in a narrow ravine, forest very shady. Alt. : 450m ; Br. : 1-10m ; D. : in cascades : 1 cm, in pools : 50cm-1m ; Curr. : in cascades : more than 1m/sec, pools : 30-50cm/sec ; Gr. : granitic rocks, boulders, in pools : gravel with sand ; Te. : 9^{30} : 25'1°C, 12^{h} : 25'3°C Che. : pH : 5·8, El_{20} : 29 u Siemens, Tot. H. : 0·6° dH, CaO : 2mg/1. Species found : *Paludomus* (*T.*) *neritoides.*

No. 26. FC 11/d/19.11.1970 : Rajanawa Dola near Ratnapura, torrent with waterfalls and pools, running through dense forest, very shady. Alt. : 250m ; Br. : 50cm-3m ; D. : in cascades : 1-3cm, in pools : 10-50cm ; Curr. : in cascades : more than 1m/sec., in pools : 0-20 cm/sec. ; Gr. : granitic rocks, boulders, gravel with sand ; Te. : 9^{h} : 24'6°C 12^{h} : 25'8° C, 13^{h} : 26'1°C ; Che. : pH : 5'8, El_{20} : 29 u Siemens, Tot. H. : 0'6° dH, CaO : 2 mg/1. Species found : *Paludomus* (*Ph.*) *sulcatus, Paludomus* (*T.*) *loricatus, Paludomus* (*T.*) *neritoides.*

No. 27. FC 12/d/20.11.1970 : Kalu Ganga before the town of Ratnapura, deep valley, running between forests an plantations. Alt : 60m ; Br. 20-30m. ; D. : up to 3m in the middle of the stream ; Curr. : in cascades more than 1m/sec on the banks : 0-30cm/sec ; Gr. : granitic boulders, gravel and on the banks with muddy sand ; Te. : 10^h : 26'1°C° 11^{30} : 26'6°C ; Che. : pH : 6'5, El_{20} : 46 μSiemens, Tot. H. : 1'2°dH, CaO : 6mg/1. Species found : *Paludomus (T.) loricatus, Paludomus (T.) neritoides, Thiara (Pl.) scabra.*

No. 28. FC 13/e/21.11.1970 : Upper reaches of Kalu Ganga near Malwala (in the region of Ratnapura), running through plantations, no shadow on the shores. Alt : 80m ; Br. : 15-20m ; D. : 30-50cm ; Curr. : 50-75cm/sec., in pools 5-10cm/sec. ; Gr. : granitic rocks, boulders, gravel, on the stones attached long water-plants floating in the current, banks, and pools with sand and mud ; Te. : 13^{30} : 26'7°C, 16^h : 26'3°C ; Che. : pH : 7'2, El_{20} : 41 μSiemens, Tot. H. : 1'15°dH, CaO : 6 38 mg/1, MgO : 3'6mg/1, SiO_2 : 9'7mg/1, Cl : 1'94 mg/1, NO_3 : O'094mg/1, NH_4 : 0'16mg/1, P_2O_5 : 0'12mg/1, Species found : *Paludomus (T.) loricatus. Paludomus (T.) neritoides.*

No. 29. FC 14/d/22.11.1970 : Upper reaches of the Kalu Ganga on the south flank of the Adam's Peak, near Carney Estate (region of Ratnapura), deep ravine, sheltered by dense primary forest, very shady. Alt : 300m ; Br. : 2-10m ; D. : in cascades : 1-3m, in pools : 30-50cm ; Curr. : in casades : 75cm/sec. and more than 1m/sec. in pools : 15-20cm/sec Gr. : granitic rocks and boulders of 1-3m in diameter, gravel, sand ; Te. : 10^h : 22'8°C, 12h : 23'8°C ; Che. : pH : 6'5, El_{20} : 14'6 μSiemens, Tot. H. : : O'25°dH, CaO : 1'12mg/1, MgO : 0'99mg/1, SiO_2 : 7'4mg/1, Cl : 1'6mg/1, NO_3 : 0'94mg/1, NH_4 : 0'21mg/1, P_2O_5 : 0'12mg/1. Species found : *Paludomus (T.) neritoides.*

No. 30. FC 15/d/23.11.1970 : Ira Handha Pana Dola, torrent and a tributary of Kalu Ganga (region of Ratnapura), running through plantations, no shadow. Alt. : 100m ; Br. : 2-4 ; D. : 10-20cm, in pools : 30-50cm ; Curr. : in cascades : more than 1m/sec, in pools 30-50cm/sec, Gr. : granitic boulders from 50cm to 2m in diameter, gravel, sand, Te. : 9^{30} : 18'7°C, 12^h : 20'7'C : Che. : pH : 6'7, $El._{20}$: 25'5 μSiemens, Tot. H. : 0'5°dH, CaO : 2'35 mg/1, MgO : 1'9mg/1, SiO_2 : 4'4mg/1, Cl : 1'6mg/1, NO_3 : 0'101mg/1, NH_4 : 0'08mg/1, P_2O_5 : 0. Species found : *Paludomus (T.) loricatus.*

No. 31. FC 24/d/7.12.1970 : Belihul Oya near the Belihul Oya Rest-House. A tributary of the Wallawe Ganga : surrounded by forest, on the shores no shadow. Alt : 650m ; Br. : 5-6m ; D. : 30-50cm, in pools : 50cm-1m ; Curr. , in cascades : 1m/sec, in pools : 0-30cm/sec ; Gr. : granitic rocks, gravel, sand ; Te. 15^h : 21'3°C, 17^h : 21'4°C ; Che. : pH : 6'6, El_{20} : 23 μSiemens, Tot. H. : 0'55° dH, CaO : 2'3mg/1, MgO : 23'mg/1, SiO_2 : 9mg/1, Cl : 1'42 mg/1, NO_3 : 0'123 mg/1, NH_4 : 0'03mg/1, P_2O_5 : 0'17mg/1. Species found : *Paludomus (T.) loricatus, Paludomus (T.) neritoides.*

No. 32. FC 25/d/8.12.1970 : Kirikatu Oya, torrent comming from the Horton Plains at World's End, near Belihuloya, no shadow. Alt : 700m ; Br. : 5 .8m ; D. : 20cm .1m ; Curr. ; 40-50cm/sec., in cascades : more than 1m/sec in pools : 0-20cm/sec ; Gr. : granitic rocks, boulders (1-3m in diameter), gravel sand ; Te. : 9^h : 18'8°C, 12^h : 19'6°C ; Che. : pH : 7'1, El_{20} : 34 μSiemens, Tot. H : 1°dH, CaO : 4'7mg/1, MgO : 3'8mg/1, SiO_2 : 11mg/1, Cl : 42mg/1, NO_3 : 0'071mg/1, NH_4 : 0'03mg/1, P_2O_5 :0'14mg/1. Species found : *Paludomus (T.) loricatus, Paludomus (T.) neritoides.*

No. 33. FC 30/c^1+c^2/10.12.1970 : We Ganga, a tributary of the Kalu Ganga, near Balangoda, running through a deep ravine, surrounded by forests and paddy fields, on the border pools with reeds, muddy and sandy bottom. Alt. : 0'0m ; Br. : 5-10m ; D. : in cascades : more than 1m/sec, pools : 0-30cm/sec. ; Gr. : granitic rocks, boulders, gravel, on the banks and shores : muddy sand, reeds and rushes ; Te. : 10^h : 24'7°C, 12^h : 25'6°C ; Che. : pH : 7'2, El_{30} : 89 μSiemens, Tot. H. : 2'35°dH, CaO : 15'6mg/1, MgO : 5'7mg/1, SiO_2 : 24'8mg/1, Cl : 14'82mg/1, NO_3 : 0'05mg/1, NH_4 : 0'04mg/1, P_2O_5 : 0'17mg/1. Species found : *Bulimus stenothyroides, Paludomus (P.) tanschauricus* subspec. *nasutus, Palumdomus (T.) neritoides, Thiara (Pl.) scabra, Melanoides (M.) tuberculata.*

No. 34.—FC34/a/26.12 1970: Bibili Oya. a tributary of the Kelani Ganga near Kitulgala, surrounded by forests, partially shady. Alt. : 80m; Br. 6-10m; D. 10-50cm; in pools : 1m; Curr. : 50cm-1m/sec; Gr. : granitic boulders (30cm to 2 m in diameter) gravel sand and on submerged rocks floating water-plants. Te. : 14^h : 25'4° 16^h : 25'8°c; Che. : ph :6, Tot. H. : 0'8°dH. Species found : *Paludomus (T.) neritoides.*

No. 35. FC 37/d/28.12.1970 : Kelani Ganga near the Rest House of Kitulgala no-shadow at the borders of the stream, surrounding : forest and plantations, influence of pollution from the Kitulgala town. Alt. : 60m; Br. : 30-40m; D. : 30-50cm; Curr. : 50cm-1m/sec; Gr. : granitic rocks gravel sand floating water-plants; Te. : 7^h : 24'3°, 9^h : 24'5°C, 11^h : 25'8°C 18^h : 26' 4°C, Che : pH : 6'65, El_{20} : 33' 5 μSiemens, Tot. H. : 0'71°dH, CaO : 4'48 mg/2 MgO : 1'84 mg/1, SiO_2 : 6'5 mg/1, Cl : 2'41 mg/1, NO_3 : 0'128 mg/1, NH_4 : 0'08 mg/1, P_2O_5 : 0'18 mg/1 Species found : *Paludomus (T.) loricatus Paludomus (T.) neritoides, Thiara scabra.*

Collection COSTA et al., 1971

No. 36. Kegalla; Species found : *Bellamya dissimilis* var. *ceylanica; Pila globosa, Paludomus* (*P.*) *chilinoides, Thiara scabra, Melanoides* (*M.*) *tuberculata, Indoplanorbis exustus.*

No. 37. Ratnapura ; Species found : *Pila globosa, Melanoides* (*M.*) *tuberculata.*

No. 38. Rakawna; Species found : *Paludomus* (*T.*) *loricatus.*

Collection Lund University Expedition 1962.

No. 39. Loc. 90. : II/2/18-21.1962 : Kuruwita ; 6 mls NNW of Ratnapura, Deerwood, slopes of Botiyagala Mountains. Alt. 300-350m. ravines with primary dense vegetation and fast running streams. Species found : *Paludomus* (*Ph.*) *sulcatus, Paludomus* (*T.*) *loricatus.*

No. 40. Loc. 93/20.2.1962 : Gilimale; 6 mls NE of Ratnapura. Alt.: 90m, stony stream in hillside cultivated area tea and rubber plantations Species found : Paludomus (*T.*) *loricatus.*

No. 41. Loc. 94/20.2.1962: Carney; 8 mls NE of Ratnapura. Alt.: 300m, foot hills of Adam's peak, above Carney primeval forest torrential, mountain river (see also No. 260!). Species found : *Paludomus* (*T.*) *neritoides.*

No. 42. Loc. 96/22.1.1962 : 5 mls NNW of Balangoda. A.t . : 725 m, mountain ravine upper parts with virgin forest, wet and dense; fast-running stream, surroundings: tea estate. Species found : *Paludomus* (*T.*) *neritiodes.*

No. 43. Loc . 106/1.3.1962: Kahawatta ; 15 mls SE of Ratnapura.Alt.: 150m, shallow valley, surrounded by tea plantations ; Species found : *Paludomus* (*T.*) *loricatus, Paludomus* (*T.*) *neritoides.*

No. 44. Loc. 110/2.3.1962: Karagal Oya; 3 mls ENE of Belihul Oya. Alt. : 600m ; stream from Ellamana Mountain (950m) passing a wet ravine with primary vegetation. Species found : *Paludomus* (*T.*) *neritoides.*

No. 45. Loc. 152/17.3.1962 : Kitulgala; 21 mls N of Ratnapura. Alt.:-60-150m, valley of the river Kelani Ganga; banks gravel and sand, small stream at 150m. Species found : *Paludomus* (*T.*) *neritoides.*

3.4. Central Province

Collection Austrian-Ceylonese Hydrobiological Mission 1970

No. 46. FC 21/c/2.12.1970 : Hakgala Dola, a small torrent in the Hakgala Gardens, near Nuwara Eliya, surroundings dense cultivated park-forest, very shady. Alt. : 170m ; Br.: 1m; D. : 1-5cm, in pools : 20-30cm ; Curr.: 50cm. 1m/sec, in pools :0-10cm/sec; Gr.: gravel and sand, artificial cascades; Te.: 11^h: 14'9°C, 13^h: 15 2°C, Che.: pH: 6'9, El_{20} 26 µSiemens, Tot.H. : O'65° dH, CaO : 2'6mg/1, MgO : 2'7 mg/1, SiO_2: 13'3 mg/1, Cl: 2'55mg/1, NO_3: 0'067 mg/1, NH_4: 0'2 mg/l P_2O_5 : 0'02 mg/1. Species found : *Paludomus* (*Ph.*) *nigricans.*

No. 47. FC 35/c/27.12.1970: Hal Oya near Ginigathhena (region of Kitulgala) a tributary of the Kelani Ganga, no shadow at the borders. Alt.: 650m, Br.: 1-5m; D.: 10-50cm in pools: to 1m Curr.: 30-50 cm/sec (Cascades: more than 1m/sec) in pools: 0-20 cm/sec; Gr.: granitic boulders (1-2m in diameter), gravel sand; T.: 9^h : 22'5°C, 11^h: 23'1°C Che: pH. 6'8, El_{20} : 36 µSiemens, Tot.H. : 0'82° dH, CaO : 5'15 mg/1, MgO : 2'16 mg/1, SiO_2 : 12'3 mg/1, Cl : 1'99 mg/1, NO_3 : 0'04 mg/1, NH_4: 0'03 mg/1, P_2O_5: 0'16 mg/1. Species found : *Paludomus* (*T.*) *neritoides.*

No. 48. FC 36/c/27.12.1970 : Rambukoth Oya near Pitawela, a tributary of the Kelani Ganga in a deep ravine, no shadow at the borders. Alt.: 625m ; Br.: 5-8m; D.: 5-30cm, in pools: 50cm; Curr.: 30—75 cm/sec, in cascades: more than 1m/sec.; granitic boulders (1-3m in diameter), gravel, sand.Te. : 13^h : 25'1°C; Che. : pH: 6'7; El_{20}: 18'7 µSiemens, Tot.H.: 0'36° dH, CaO: 0'89 mg/1; MgO: 1'9 mg/1, SiO_2 : 11'2 mg/1, Cl:1'7 mg/1, No_3: 0'037 mg/1, NH_4: 0'03 mg/1, P_2O_5:0'18 mg/a. Species found: *Paludomus* (*T.*) *neritoides.*

Collection COSTA et al. 1971

No. 49. Kandy; Species found: *Bellamya dissimilis* var. *ceylanica, Pila globosa, Paludomus* (*P.*) *chilinoides, Melanoides tuberculata, Radix* (*C.*) *luteola* var. *pinguis, Indoplanorbis exustus.*

No. 50. Peradeniya-River, near Kandy: Species found: *Paludomus* (*P.*) *chilinoides, Thiara* (*Pl.*) *scabra.*

Collection Lund University Expedition 1962.

No. 51. Loc. 9/12.1.1962: Kandy.Alt. 600m, sanctuary with indigenous vegetation muddy water reservoir. Species found :*Bellamya dissimilis* var. *ceylanica, Bulimus inconspicuares Melanoides* (*M.*) *tuberculata, Indoplanorbis exustus.*

No. 52. Loc 128/11.3.1962 : Udawela ; 8 mls E of Kandy, Alt. : 450m, exposed slow-flowing stream, a place forming pools, surroundings cultivated area. Species found : *Bulimus inconspicua, Paludomus (P.) chilinoides.*

No. 53. Loc. 134/12.3.1962 : Stream 2 mls E of Madugoda, 18 mls E of Kandy. Alt. 800m, small stream in shallow ravine in forest-clad mountain side. Species found : *Tricula montana, Bulimus inconspicua, Paludomus* (Ph.) *nigricans.*

No. 54. Loc. 135/12.3.1962 : Stream 20 mls E of Kandy. Alt. : 250m ; fairly fast-running is in bush and thin secondary forest. Species found : *Paludomus* (*P.*) *chilinoides, Paludomus* (*Ph.*) *bicinctus, Thiara* (*Pl.*) *scabra, Indoplanorbis exustus.*

No. 55. Loc. 148/16.3.1962 : 3 mls. NW of Hanguranketa, 10 mls E of Kandy. Alt : 575m; shallow ravine with slow—flowing stream in a coconut plantation. Species found : *Paludomus* (*P.*) *chilinoides, Thiara* (*Pl.*) *scabra.*

No. 56. Loc. 135/18.3.1962 : Rambukpoth Oya, 10 mls NW of Hatton. Alt. : 250m ; stream in steep ravine with bush and some indigenous vegetation (see also No. 47!). Species found : *Paludomus* (*T.*) *neritoides.*

No. 57. Loc. 161/19.3.1962 : Diyagama East, 9 mls SSE of Nuwara Eliya. Alt. : 1800m ; small stony stream in a recently cleared ravine at upper border of tea plantation. Species found : *Paludomus* (*Ph.*) *nigricans.*

No. 58. Loc. 162/19.-20.3.1962 ; Horton Plains ; 11 mls SSE of Nuwara Eliya. Alt. : 2000m ; stream at edge of remaining forest, bush and meadows. Species found : *Paludomus* (*Ph.*) *nigricans.*

3.5 Uva Province

Collection Austrian-Ceylonese Hydrobiological Mission 1970

No. 59. FC 26/8.12.1970 : Veli Oya, a tributary of the Walawe Ganga in the E of Belihul Oya, borders without shadow. Alt : 700m ; Br. : 10-15m ; D. : 20cm-1m ; Curr. : 50cm-1m/sec, in cascades : more than 1m/sec, in pools : 0-20cm/sec ; Gr. : granitic boulders (1-3m in diameter), gravel and sand ; Te. : 16^h : 21°C, 17^h : 20'8°C ; Che : pH : 7, El_{20} : 45 µSiemens, Tot. H. : 1'3°dH, CaO : 6'8mg/1, MgO : 4'4mg/1, SiO_2 : 13mg/1, Cl : 1'84mg/1, NO_3 : 0101mg/1, NH_4 : O, P_2O_5 : 0'1mg/1. Species found : *Paludomus* (*T.*) *neritoides, Thiara* (*Pl.*) *scabra, Melanoides* (*M.*) *tuberculata,*

No. 60. FC 27/c/9.12.1970 : Kuda Oya, a tributary of the Menik Ganga, near Buttala, surroundings forest, very shady. Alt. : 150m ; Br. 10-15m ; D. : 20cm-1m ; Curr : 30-50cm/sec, in cascades : 1m/sec ; Gr. : Gravel, sand and rarely rocks ; Te. : 11^h : 25'5°C ; Che. : pH : 7'7, El_{20} : 295 µSiemens, Tot. H. : 9'2°dH, CaO : 52mg/1, MgO : 28'9mg/1, SiO_2 : 28'8mg/1, Cl : 7'1 : mg/1, NO : 0'108mg/1, NH_4 : 0'02mg/1, P_2O_5 : 0'11mg/1. Species found : *Bulimus inconspicua, Paludomus* (*P.*) *chilinoides, Thiara* (*Pl.*) *scabra.*

No. 61. FC 28/c/9.12.1970 : Wetakei Ela, an affluent of the Kirindi Ganga, near Wellawaya, a small torrent with calcareous sinters on the stones and rocks, surroundings dense forest, very shady. Alt. : 200m, Br. 1-2m ; D. : 5-20cm, in pools : to 1m ; Curr. ; 30-50cm/sec., in cascades : 1m/sec ; Gr. : calcareous rocks, gravel, sand ; Te. : 14^h : 23'9°C ; Che. : pH : 8'3, El_{20} : 360 µSiemens, Tot. H. : 11'6°dH, CaO : 59'4mg/1, MgO : 40'8mg/1, SiO_2 : 54'8mg/1, Cl : 2'55mg/1 NO_3 : 0'101mg/l, NH_4 : 0'08mg/1, P_2O_5 : 0. Species found : *Paludomus* (*P.*) *tanschauricus* subspec. *nasutus,* Paludomus (*T.*) *solidus.*

No. 62. FC 29/c/9.12.1970 : Diyaluma-falls, coming from the Horton Plains at World's and and fall about 150m, a tributary of the Kirindi Ganga. Alt. : 500m ; Br. : 10m. ; D. : 1-3cm, in pools : to 50cm ; Curr. : more than 1m/sec ; Gr. : granitic rocks, boulders ; Te. : 17h : 20°C ; Che. : pH : 6'7, El_{20} : 34 µSiemens, Tot. H. : 0'8°dH, SiO_2 : 24'8mg/1. Cl : 2'4lmg/1, NO_3 : 0'35mg/1, NH_4 : 0'08mg/1, P_2O_5 : 0'06mg/l. Species found : *Paludomus* (*P.*) *tanschauricus* subspec. *nasutus, Paludomus* (*T.*) *neritoides.*

Collection COSTA et al., 1971 :

No. 63. Badulla ; Species found : *Paludomus* (*P.*) *chilinoides, Thiara* (*Pl.*) *scabra, Melanoides* (*M.*) *tuberculata, Indoplanorbis exustus.*

Collection Lund University Expedition 1962 :

No. 64. Loc. 119 : II/7.3.1962 : Westminster Abbey, 25 mls ESE of Bibile. Alt. : 250m ; stream sheltered by trees, secondary dry forest. Species found : *Paludomus* (*P.*) *chilinoides.*

No. 65. Loc. 121/7.3.1962 : Monaragala Mountain, 25mls E of Badulla. Alt. : 150m. ; slow-flowing stream with gravel bottom, surroundings by gardens and paddy fields. Species found : *Paludomus* (*P.*) *chilinoides.*

No. 66. Loc. 140/13.3.1962 : Yalakumbura ; 5 mls SSW of Bibile, Alt. : 450m, fast-running stream in fairly wet ravine, sheltered by bushes and trees, thick layer of debris. Species found : *Paludomus* (*Ph.*) *bicinctus, Paludomus* (*Ph.*) *decussatus.*

No. 67. Loc. 141/13.3.1962 : Adawatte, 7mls S of Bibile. Alt. : 600m ; a small stream cascading down mountain slope with remains of forest, surrounding tea estate. Species found : *Paludomus* (*Ph.*) *bicinctus.*

No. 68. Loc. 143 : I/14.3.1962 : Ury Estate; 6 mls SE of Badulla, Alt. : 1200m ; exposed stream in a shallow ravine with primary forest. Species found : *Paludomus* (*P.*) *tanschauricus* subspes. *nasutus*, *Paludomus* (*Ph.*) *bicinctus.*

No. 69. Loc. 166/21.3.1962 : Diyatalawa, 3 mls N of Haputale. Alt. : 1200m ; in a shallow depression of grassland, small streams and marshes. Species found : *Melanoides* (*M.*) *tuberculata*, *Radix* (*C.*) *luteola* var. *pinguis*, *Indoplanorbis exustus.*

No. 70. Loc. 167 : II/21.3.1962 : Wellawaya, 18 mls S Badulla. Alt. : 175–200m ; Radapola Oya, a large stream in dry area, sheltered by dense vegetation of bush and plants, shaded by scattered trees. Species found : *Paludomus* (*T.*) *solidus.*

3.6 Eastern Province

Collection Lund University Expedition 1962 :

No. 71. Loc. 125/8.3.1962 : Rambukkan Oya ; 25 mls NE of Bibile, Alt. : 25m ; a shallow river with sandy bottom and banks; partly open, partly covered by sedges. Species found : *Paludomus* (*P.*) *inflatus.*

No. 72. Loc. 139/13.3.1962 : Kokagala Mountain ; 20 mls N of Bibile. Alt. : about 50m ; sandy area, stream sheltered by bush and scattered trees. Species found : *Paludomus* (*P.*) *chilinoides.*

3.7 North-Central Province

Collection Austrian-Ceylonese Hydrobiological Mission 1970 :

No. 73. FC 31/15.12.1970 : Small canal near the temple of Isurumuniya, Anuradhapura ; water colour yellowish-brown, pollutted, open. Alt. ; 80m : Br. : 50cm ; Curr. : 30cm/sec. ; D. : 50cm ; Gr. : walls of concrete ; Temp : 11h : 26°C ; Chem : pH : 7, Tot. H. : 7° dH. Species found : *Paludomus* (*P.*) *tanschauricus.*

No. 74. FC 32/15.12.1970 : Small stream in a forest, crossed by the road between Habarane and Dambulla, W of Polonnaruwa, very shady. Alt. : 100m ; Br. : 1·5-3m ; D. : 10-50 cm ; Curr. : 30cm/sec. ; Gr. : sandy, on the borders are roots hanging and floating in the current ; Te. : 18h : 25·5°C, Che. : pH : 7·25, El_{20} : 605 µSiemens, Tot. H. : 12·9°dH, CaO : 50·9 mg/1, MgO : 56 mg/1, SiO_3 : 15 mg/1, Cl : 145·6 mg/1, NO_3 : 0·081mg/1, NH_4 : 0·22 mg/1, P_2O_5 : 0·18mg/1. Species found : *Paludomus* (*P.*) *chilinoides.*

No. 75. FC 33/17.12.1970 : Border of the Parakrama Tank near the Rest House at Polonnaruwa. Empty shells of *Bellamya dissimilis* var. *ceylanica*, *Thiara* (*Pl.*) *scabra*, *Melanoides* (*M.*) *tuberculata.*

Collection COSTA et al., 1971 :

No. 76. Wilpattu : Species found : *Bellamya dissimilis* var. *ceylanica*, *Bulimus stenothyroides*, *Gyraulus convexiusculus* var. *compressus.*

No. 77. Kala Oya ; Species found : *Thiara* (*Pl.*) *scabra.*

Collection Lund University Expedition 1962 :

No. 78. Loc. 47/2.2.1962 : Wilpattu National Park, intermediate zone, 29 mls NE of Puttalam. Alt. : 75m ; temporary stream in dry secondary scrubland, collected during rainy season. Species found : *Paludomus* (*P.*) *tanschauricus*, *Indoplanorbis exustus.*

No. 79. Loc. 48/2.2.1962 : Maradan Maduwa, Wilpattu National Park ; 23mls W of Anuradhapura. Alt. : 80m ; water reservoir with dense aquatic vegetation in a dry dense secondary forest. Species found : *Bulimus inconspicua*, *Mysorella costigera*, *Indoplanorbis exustus*, *Gyraulus convexiusculus* var. *compressus.*

No. 80. Loc. 50/4.2.1962 : Maha Bulankulama ; 7 mls SW of Anuradhapura. Alt. : 80m. : large stream (Talawa Oya) in open cultivated area (paddy fields, coconut and banana plantation), in pools with aquatic vegetation. Species found : *Bulimus inconspicua*, *Mysorella costigera*, *Melanoides* (*M.*) *tuberculata*, *Gyraulus convexiusculus.*

No. 81. Loc. 56 : Ib/8.2.1962 : Ritigala, Natural Reserve; 8 mls NW Habarana. Alt : 500m ; fast-running small stream which emerged as a rheocrene and came down in cascades under a canopy (isolated mountain, alt. 760m). Species found : *Paludomus* (*P.*) *chilinoides*, *Paludomus* (*P.*) *tanschauricus.*

No. 82. Loc. 67/11.12.1962 : 3 mls of S Minneriya. Alt : 100m ; ravine with small stream sheltered by bush and trees ; surroundings secondary, dense, fairly dry forest (Giritale Forest Reserve). Species found : *Paludomus* (*P.*) *chilinoides*, *Paludomus* (*P.*) *tanschauricus.*

No. 83. Loc. 99/11.2.1962 : 5 mls. E of Habarana. Alt. : 110m. ; shallow ravine in dense secondary forest, fairly dry ; stream (Talkote Oya) with sandy banks ; surroundings secondary dry forest. Species found : *Paludomus* (*P.*) *chilinoides.*

3.8 North-Western Province

Collection COSTA et al., 1971 :

No. 84. Kurunegala ; Species found : *Bellamya dissimilis* var. *ceylanica, Pila globosa, Paludomus* (*P.*) *chilinoides, Indoplanorbis exustus, Gyraulus convexiusculus.*

No. 85. Narramala ; Species found : *Pila globosa, Paludomus* (*P.*) *chilinoides, Melanoides* (*M.*) *tuberculata.*

No. 86. Batalagoda : Species found : *Bellamya dissimilis* var. *ceylanica, Bulimus inconspicua, Melanoides* (*M.*) *tuberculata, Radix* (*C.*) *luteola* var. *pinguis, Gyraulus convexiusculus.*

Collection Lund University Expedition 1962 :

No. 87. Loc. 36/31.1.1962 : Kadaimparu; 15 mls N of Negombo. Alt. : 1-5m; estuarine lagoon. Species found : *Faunus ater.*

No. 88. Loc. 37/31.1.1962 : Madampe; 20 m N of Negombo. Alt. : 5m ; old water reservoir with dense aquatic vegetation. Species found : *Bulimus inconspicua Radix* (*C.*) *luteola* var. *pinguis Indoplanorbis exustus.*

No. 89. Loc. 40/1.2.1962 :— Mundel Lake; 16 mls N of Chilaw. Alt. : 5m; brackish lagoon with exposed grazed shore. Species found : *Pila globosa. Bulimus inconspicua, Melanoides* (*M.*) *tuberculata, Indoplanorbis exustus.*

No. 90. Loc. 42/1.2.1962 : 5 mls NNE of Puttalam; Alt. 2-5m; marsh with dense vegetation, at places flooded by river. Species found : *Bulimus inconspicua.*

No. 91. Loc. 45/2.2.1962 : 10 mls E of Puttalam. : Alt. : 20m; marsh flooded by river after rain, surroundings: secondary dry scrub forest. Species found : *Radix* (*C.*) *luteola* var. *pinguis, Gyraulus convexiusculus* var. *compressus.*

No. 92. Loc. 52/7.2.1962 : Deduru Oya; 5 mls. NE of Kurunegala. Alt. : 120m ; river in open, shallow bed, bordered by scattered old trees, bottom and shores sandy, at places rock ; surroundings cultivated with coconut and paddy fields. Species found : *Thiara* (*P.*) *scabra.*

No. 93. Loc . 53/8.2.1962: Andapolakanda; 3 mls NE of Melsiripura. Alt. : 225m; small fast-running stream in ravine sheltered by old trees and a dense layer of species of Aracea ; Umbuwewa Hills with remains of dense indigenous forest. Species found : *Melanoides* (*M.*) *tuberculata.*

3.9. Northern Province

Collection Lund University Expedition 1962 :

No. 94. Loc. 73/13. 2. 1962: Paranthan; 32 mls SE of Jaffna. Alt.: 10m; temporary streams and pools at rainy season, surroundings: open low scrubland. Species found: *Paludomus* (*P.*) *tanschauricus.*

No. 95. Loc. 75/14.2.1962: 2 mls E of Mankulam. Alt.: 30m; shallow ravine with small stream, sheltered by dense bush and indigenous secondary dry forest at rainy season. Species found : Paludomus (*P.*) *tanschauricus.*

No. 96. Loc. 76/14.2.1962.7 mls E of Mankulam. Alt.: 31m; flooded swampy water reservoir (tank); surroundings: grazes and thin secondary dry forest. Species found: *Bulimus inconspicua, Mysorella costigera.*

No. 97. Loc 79/14.2.1962 : Nanthi Kadal lagoon; 3mls S of Mullaitivu. Alt.: 5m ; brackish, marsh and pools with freshwater inshore : paddy fields. Species found : *Bulimus inconspicua, Indoplanorbis exustus.*

No. 98. Loc. 82/15.2.1962: 2 mls E of Paraiyanalankulam, 20 mls W of Vavuniya. Alt.: 20m; small stream with sandy banks ; surroundings, dense secondary dry forest at places glades with grass and plants. Species found: *Paludomus* (*P.*) *tanschauricus.*

No. 99. Loc. 86/15.2.1962: Nay Aru at Pallamadu; 10 mls E of Mannar. Alt.: 5m; flooded river in open grass land, mainly salt meadow. Species found: *Gangetia burmanica, Syncera* (=*Assiminea*) *hidalgoi, Syncera* (=*Assiminea*) *woodmasoniana, Gyraulus convexiusculus* var. *compressus.*

3.10. *Collection from COSTA et al., without locality* (1971)

No. 100. Ceylon; Species found: *Paludomus* (*P.*) *palustris.*

4 SYSTEMATIC-ANATOMICAL PART

STREPTONEURA (=PROSOBRANCHIA)

Archaegastropoda

Neritacea

Neritidae

(1) *Neritina* (*Neripteron*) *auriculata* LAMARCK, 1826

Lit.:1816 *Neritina auriculata* (LAMARCK, Encycl. Meth. (Vers) Explic. Planches, pl.455, f.6)–1826/34 *Nerita auriculata* (QUOY & GAIMARD, Voy. de 1' Astrolabe, Zool. 3 : 198 ; pl.65, fs. 6-8)—1849 *Neritina subauriculata* (RÉCLUZ, in SOWERBY, Thes. Conch. 2 : 510, f. 138)—1856 *N. layardi* (REEVE, Conch. Icon. : f. 104, 105)—1856 *N.* (*rostrata* REEVE, Conch. Icon. : f. 151)–1862 *N. subalata* (RÉCLUZ, Rev. Zool., 1862 : 269)–1872 *N. subauriculata* var. *inaurita* (MÖRCH, J. de Conch., 1872 : 323)–1879 *N. auriculata* (MARTENS in MARTINI & CHEMNITZ, Syst. Conch. Cab., 2 (10) : 30 (with *subauriculata*, *rostrata* and *layardi* as synonyms) ; pl. 6, fs. 13-15 and 24-27)—1888 N. (*Neripteron*) *auriculata* (TRYON, Man. Conch. 10 : 73 (with *subalata*, *subauriculata*, var. *inaurita*, *rostrata* and *layardi* as synonyms) ; pl. 21, fs. 58-63)—1955 *N. auriculata* (BUTOT, Treubia, 23 (1):78, fs. 5a-c)—1956 *N. auriculata* (BENTHEM-JUTTING, Treubia, 23 (2) : 297, f.22)—1969 N. (*Neripteron*) *auriculata* (STARMÜHLNER, Malacologia 8 (1/2) : 56, fs. 58, 59)—1970 *N.* (*Neripteron*) *auriculata* (STARMÜHLNER, Cah. O. R. S. T. O. M., ser. Hydrobiol., 4 (3/4) : 35, fs. 12-15).

Localities. Southern Province: No. 3 (10 ind.) ; Western Province: No. 10 (12 ind.), No. 11(6 ind.) No. 12 (1 ind.).

Shell. All individuals of the subgenus *Neripteron* in the samples belong to *Neritina* (*Neripteron*) *auriculata*. After a letter of Mr. Henk H. MIENIS (Dept. of Zoology, Section Mollusca, the Hebrew University of Jerusalem, Israel), recognized specialist of Neritidae, all Ceylonese specimens of *auriculata* have generally been referred to the subspecies or infraspecies *layardi*, REEVE,1856. But in the opinion of Mr. MIENIS there is hardly any difference from *N. auriculata* s. str. from the Indo-Malayan Archipelago.

The semi-globar shell is with a flat base ; 1–1 1/2 whorls with growth striae in semi-circles, crossed by finer spiral lines. Colour brownish to olivaceous with darker brown or violet reticulations or flames, mostly on the oldest part; aperture large, half-moon shaped ; the broad peristome ends in two "wings" or "auricles" at the upper and lower columellar sides ; margin of columella a little arcuate in the middle and minutely toothed (20–23) ; yellowish-white. The indiviuals of No. 10 (Kelaniya) correspond to the var. *rostrata* REEVE, 1856 (Conch. Icon. : f. 151, figured also by TRYON, 1888 on pl. 21, fs. 61, 62) : the shell is smaller than by *auriculata* s. str. and var. *layardi*. Juvenile shells with well developed "wings", adult shells have only small "wings" (corrosion ?).

No. 10 Kelaniya Sizes (in mm) :	Adult shells (Fig. 2, Plate II)			Juvenile shells ; (Fig. 2, Plate II)	
Length :	17′8	15′6	15′4	12	12
Diameter :	11′2	10′4	10′3	10	9″4
Height :	8′1	7′6	6′8	5′3	5′4
Index L : D :	62′8%	66′6%	66′8%	83′3%	78″3 %
Index L. : H :	45′5%	48′7%	44′1%	44′1%	45%

The indices of Length : Diameter decreases from juvenile to adult shells. It shows that the 'wings' are smaller-in-relation—by adult shells than by juvenile shells. This variation in form and size depends on the surface of stones, where the snails are fixed.

No. 3 (Ambalangoda; Fig. 3, Plate II)

Sizes (in mm):

Length :	..	13	12'5	12	10'3
Diameter :	..	10	9'3	9'1	8'2
Height :	..	5'2	5'5	5	4'6
Index L : D :	..	76'9%	74'4%	75'8%	79'6%
Index L : H :	..	40%	44%	41'6%	44'6%

The specimens from No. 3 (Ambalangoda), No. 11 (Horana) and No. 12 (Tholangamuwa, near Warakapola) belong to the var. *layardi* REEVE, 1856 (Conch. Icon.: f. 104, 105, also figured by TRYON, 1888 on pl. 21, f. 63). These shells are much more broader like the juvenile shells of var. *rostrata* in consequence of the well developed "wings".

No. 11 (Horana ; Fig. 4, Plate II)

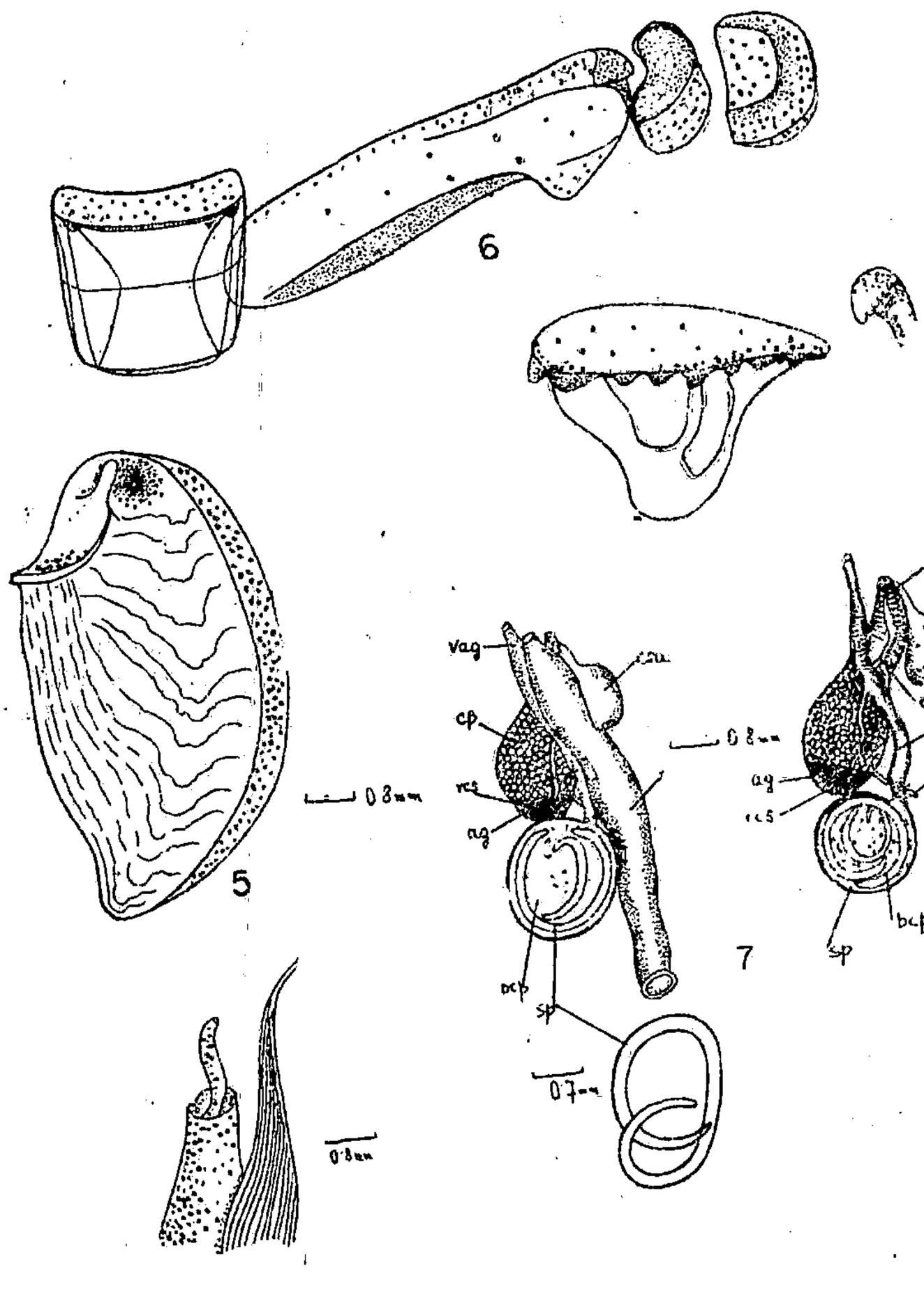
Sizes (in mm):

Length	..	12	10'3
Diameter	..	10'2	8'1
Height	..	4'5	4'2
Index L : D.	..	85%	78'6%
Index L : H.	..	37'5%	40'7%

. The sizes given are from the biggest specimens in the samples.

Operculum. Semilunar with a sinous columellar side and with right hand nucleus ; along the exterior edge is a narrow brown-horny margin. On the back side are two apophyses ; the lower one is conical with a rounded top and the upper one is sharp, sickle shaped and with an acute free top (sizes from an individual of No. 10 : 7'2mm ×4'16mm; Fig. 5).

Anatomical remarks. Descriptions of the anatomy of *Neritina* (*Neripteron*) *auriculata* (including var. *lecontei*, REEVE, 1855/56) are given by STARMÜHLNER 1969 and 1970. The radula of the specimens from No. 11 (Horana) shows a central-tooth more elongated than broad with a small cutting edge and without denticles. The first lateral tooth is very long and narrow, with two cusps on the outside, the 4th lateral tooth in the shape of a triangle with a broad cutting edge forming 8–10 denticles. The marginal-teeth are with 5–8 small denticles (Fig. 6).



Neritina (*Neripteron*) *auriculata* ; Fig. 5 : operculum ; Fig. 6 : radula teeth ; Fig. 7 : female reproductive system and spermatophore ; ág : albumen gland, bcp : bursa copulatrix, csa : crystal sac, cp : capsule gland, od : oviduct, r: rectum, rcs : receptaculum seminis, sp : spermatophore, vag : vagina; Fig. 8: tentacle, penis and penis sheath of male.

The female reproductive organs possess a big bursa copulatrix, filled with small, rolled up spermatophores(Fig. 7). The male shows a very twisted vas deferens conducting in a broad ductus ejaculatorious surrounded by the prostate gland. It opens in to a small penis covered by the penis sheath on the left side of the right tentacle (Fig. 8).

Ecological-biolological remarks : Neritina (*Neripteron*) *auriculata* settles in the lower parts of streams below the stones near the borders in a current between 20–50cm/sec. The snails tolerate slight brackish water in the mouths of the streams during high-tide. The eggs are found under stones, sometimes also on the shells of other water-snails. Their food consists of algae, growing on the stones.

Distribution : Coastal areas of the Indo-Pacific Islands : from Madagascar, Ceylon to the Malayan and Phillippine Islands and most of the Pacific Islands.

(2) *Septaria lineata* (LAMARCK, 1816)

Lit. : 1816 *Navicella lineata* (LAMARCK, Enc. Méth. (Vers) Expl., Planches : pl. 456, f. 2)—1816 *N. tesselaria* (LAMARCK, ibid. : f. 3, 4)—1822 *N. tesselata* (LAMARCK, Hist. Nat. Anim. s. Vert., 6 (2)/182)—1822 *N. lineata* (LAMARCK, ibid. : 182)—1827 *Septaria navicula* (FÉRRUSAC, Bull. Sc. Nat., 10 : 413)—1836 *Navicella compressa* (BENSON, J. Asiat. Soc. Bengal. 5 : 749)—1841 *N. entrecasteauxi* (RÉCLUZ, Rev. Zool., 1851 : 380)—1842 *N. clypeolum* (RÉCLUZ, Proc. zool. Soc., London, 1842 : 157)—1848 *N. maculifera* (MOUSSON, Mitth. naturf. Ges. Zürich, 1 : 268)—1849 *N. maculifera* (MOUSSON, Land-u. Süsswassermoll. Java : 85 ; pl.12, f. 13)—1850 *N. ambigua* (RÉCLUZ, J. de Conch., 1 : 376)—1850 *N. caerulescens* (RÉCLUZ, in SOWERBY, Thes. Conch., 2 : 550 ; pl. 118, f. 129)—1856 *N. Vari bilis* (REEVE, Conch, Icon., 9 : f. 8)—1856 *N. reticulata* (REEVE, ibid. : f. 20)—1856 *N. insignis* (REEVE, ibid. : f. 21)—1856 *N. pulchella* (REEVE. ibid. : f. 25)—1856 *N. eximia* (REEVE, ibid. : f. 26)—1856 *N. orientalis* (REEVE, ibid. : f. 33)—1858 *N. livesayi* (DOHRN, Proc. zool. Soc. London 1858 : 135)—1876 *N. compressa* HANLEY & THEOBALD, Conch. Ind. : 54, pl. 137, fs. 1;4 ; the synonym is after the authors probably *Patella aponogetonis* VAHL, 1798 (Skrift. Nat. Selskab., 4 (2) : 153 as young of *N. compressa* or *N. caerulescens*)—1876 *N. caerulescens* (HANLEY & THEOBALD, ibid. : 55; pl. 137, fs. 2, 3, 7a: var. f. 10)—1876 *N. reticulata* (HANLEY & THEOBALD, ibid. : 55 ; pl. 137, fs. 5, 6)—1876 *N. livesayi* (HANLEY & THEOBALD, ibid. : 55 ; pl. 137, fs. 8, 9)—1881 *N. tesselata* (MARTENS, in MARTINI & CHEMNITZ, Syst. Conch. Cab., 2(10a) : 37 ; pl. 7, fs. 8–17, pl. 8, fs. 1–9, including var. *oblonga*)—1888 *N. tesselata* (TRYON, Man. Conch., 10: 81 ; pl. 29f. 57 ; as synonyms are listed : *clypeolum* (f. 50–52), *recluzii, variabilis* (fs. 53, 54), *ambigua, atra, radiata,* var. *subrostrata, pulchella* (f. 56), (insignis (f. 55) var. *oblonga, maculata,* var. *compressa, entrecasteauxi* (f. 59), *reticulata* (f. 62), *eximia* (f. 61) var. *compressa* (f. 67), *livesayi, caerulescens* (f. 63–65), *plumbea, compressa, orientalis* (f. 66)—1888 *N. lineata* (TRYON, ibid. : 82 ; pl. 29, f. 58)—1897 *Septaria tesselata* var. *clypeolum* (MARTENS, in WEBER, Erg. Reise Nied. Ost.-Indien, 4 : 86)—1908 *S. tesselata* vars. *clypeolum, compressa* and *lineata* (HORST & SCHEPMANN, Cat. Syst. Moll. Mus. Hist. Nat. Pays—Bas, 3(3) : 435–436)—1914 *S. tesselata* vars. *clypeolum* and *oblonga* (LESCHKE, Mitt. naturhist. Mus. Hamburg. 31, 266)—1915 *S. reticulata* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 7 ; no. 13)—1915 *S. compressa* (PRESTON, ibid. : 7 ; no. 14)—1915 *S. caerulescens* (PRESTON, ibid. : 7 ; no. 15)—1915 *S. livesayi* (PRESTON, 8 ; no 16)—1935 *S. dravadica* (PRASHAD, Rec. Ind. Mus. Calcutta, 36 : 5)—1937 *S. tesselata* sic ! (RIECH, Arch. Naturg. (N.F.), 6 : 68)—1953 *Navicella lineata* (MERMOD, Rev. Suisse Zool., 60 : 133 ; f. 155 ; with *N. tesselata* : 134. f. 156)—1956 *Septaria lineata* (BENTHEM-JUTTING, Treubia, 23 (2) : 317 ; f. 4, 33)—1962 *S. livesayi* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12 : 52)—1962 *S. reticulata* (MENDIS & FERNANDO, ibid, : 52).

Localities. Southern Province : No. 3 (33 ind.) ; Western Province : No. 11 (7 ind.), No. 12 (2 ind.).

Shell. All shells found belong to *Septaria lineata* (LAMARCK, 1816). After the opinion of Henk H. MIENIS who also examined the specimens, it is apparent that those from No. 3 and No. 11 are very close to a form of *lineata,* which was described by LAMARCK in 1816 as *tesselaria.* They are somewhat broader than the "typical" *lineata.* As this is probably due to ecological factors (form of settling area!) it in not necessary to give them an intraspecific name. The same is found in the case with the animals from No. 11. These shells are however more slender than "typical". *lineata* this is due to the fact they are living on small waterplants. Such shells were described under several names like *entrecasteauxi* RECLUZ, *livesay* DOHRN, *picturata* GARRETT, but BENSON's name *compressa* is the oldest' However it is the opinion of MIENIS that it is not necessary to give an intraspecific name to these specimens.

The shells are symmetrical cap-like with the apex at the posterior side. Posterior margin straight, anterior rounded. The ground colour is yellowish-green, with longitudinal dark lines, near the border the lines dissolve to a reticulate pattern of flames or zigzag lines. The aperture is very large with a rather narrow, little concave septum.

No. 3 (Ambalangoda; var. *tesselaria* ; Fig . 9, 10, Plate III)

Sizes (in mm.):

Length	..	..	20'5	16'9	15'9	14'4	10'7
Diameter	..	..	13'3	10'5	10'2	9	6'4
Height	..	..	5'4	4.9	4'4	3'6	2'7
Index L : D	..	..	64'8%	63'2%	64%	62'5%	60%
Index L : H	..	..	25'8%	29%	27'6%	25%	25%

No. 11 (Horana; var. *tesselaria*, Fig. 11, 12, Plate II)

Sizes (in mm.)

Length	..	15'1	14'3	14
Diameter	..	10'1	9'7	9.6
Height	..	3'7	3'2	3
Index L : D :	..	66'8%	67'8%	68'5%
Index L : H	..	24'5%	22'3%	21'4%

No. 12 (Tholangamuwa var. *compressa*; Fig 13, Plate II)
Sizes (in mm.)

Length	11'1
Diameter ..	5'2
Height ..	2'5
Index L : D ..	46'8%
Index L:H : ..	22'5%

The sizes given are from the biggest specimens in the samples. In comparing the indices Length : Diameter of the shells from No. 3 and 11 with No. 12 the difference between the var. *tesselaria* and the var. *compressa* are seen. The var. *tesselaria* was found on stones and rocks, the slender var. *compressa* was found on the small leaves of water-plants.

Operculum. Irregularly squarish with two straight sides and two sides with pointed lobes. Along the shorter of the two straight sides there is a broad triangle with radiating ridges (No. 12 ; size 4 mm × 2.2 : mm, Fig. 14).

Anatomical remarks. Descriptions of the internal anatomy of *Septaria* were made by BOURNE, 1908 (Proc. Zool. Soc. London, 1908 : 810) and by STARMÜHLNER, 1969 and 1970 for *Septaria borbonica*. Radula with slender central tooth, cutting edge without denticles, the first lateral tooth elongate-rectangular, the 4th lateral tooth with a serrate cutting edge consisting of many small denticles (Fig. 15). The female reproductive system is very similar to *S. borbonica*. The spermatophores are long and slender (Fig. 16).

Ecological-biological remarks. Like *N.* (*Neripteron*) *auriculata* found in the lower parts of the streams, mostly not very far from the mouth. Only the specimens of No. 12 were from the inside of the lowland of the Western Province. The snails prefer strong to moderate current (50 cm-1m/sec) and are found settled on the surface of stones and rocks, sometimes on floating water-plants (No. 12). The eggs are deposited on stones or on the shells of other specimens. The snails feed on algae, growing up on the stones and water-plants.

Distribution. South-India, Ceylon, Malay Archipelago, Philippines, New Guinea, Western Australia and Pacific Islands.

Mesogastropoda

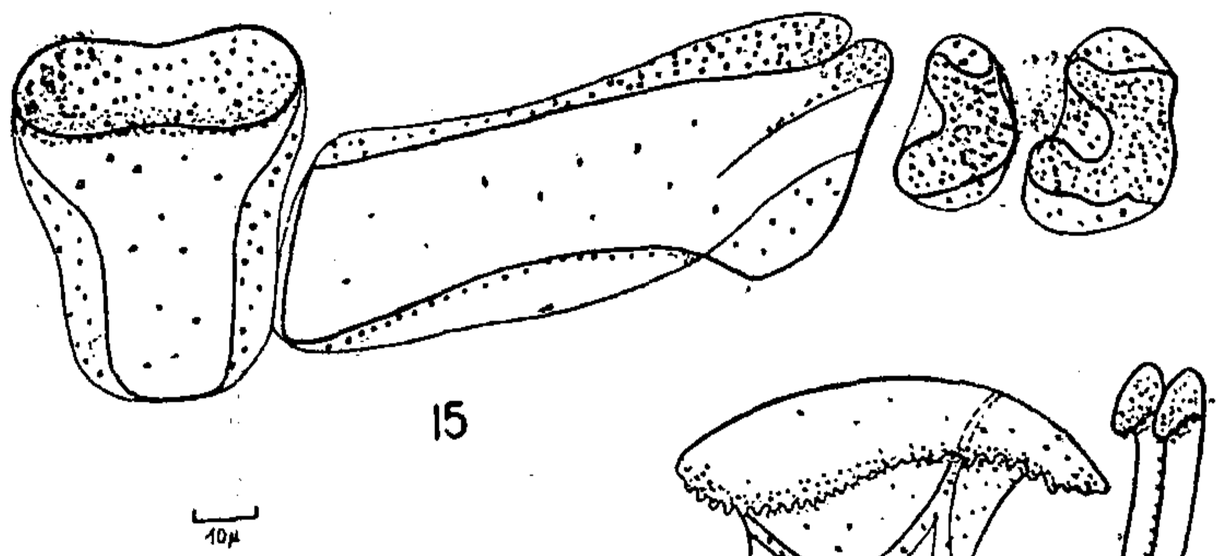
Cyclophoracea

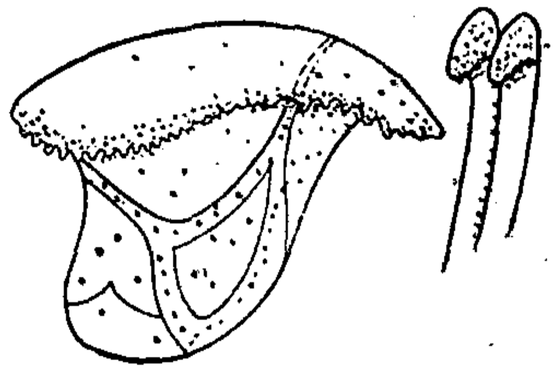
Viviparidae

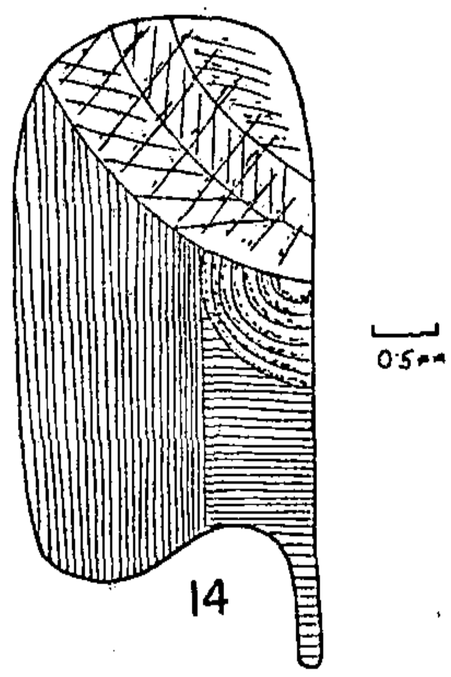
(3) *Bellamya dissimilis* (O.F. MÜLLER, 1774) var. *ceylanica* (DOHRN, 1857)

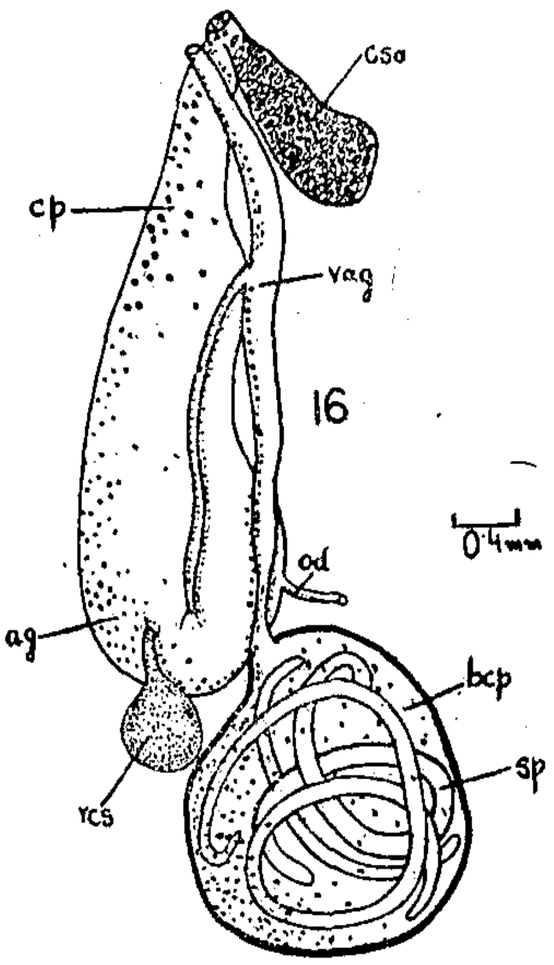
Lit. : 1774 *Nerita dissimilis* (MÜLLER, Vermium Hist. 2 : 184)- 1852 *Paludina remossi* (KÜSTER (not PHILIPPI) in MARTINI & CHEMNITZ, Syst. Conch. Cab. 1 (21) : 26; pl. 5, fs. 17, 18)-1857 *P. ceylanica* (DOHRN, Proc. zool. Soc. London, 25:123) - 1862 *P. variata* (FRAUENFELD, Verh. Zool. bot. Ges. Wien, 1862:1163)—*P. variata* (REEVE, Conch. Icon. : pl.6 f. 32)—1864 *P. ceylanica* (FRAUENFELD, Verz. in : Verh. zool. bot. Ges.

Wien, 1864: 585(25), No. 150-1876 *P.variata*) HANLEY & THEOBALD, Conch.Ind. : 33; pl.77, fs 1,2 var. *ecarinata*: 47; pl. 115, f.9)-1884 *P. dissimilis* var. *variata* subvar. *ceylanica* (NEVILL Handl. Ind. Mus. Calcutta, 2:29)-1909 *Vivipara dissmilis ceylanica* (KOBELT, in MARITINI & CHEMNITZ, Syst. Conch Cab. 2 (2,N.F.): 292; pl. 56, fs. 5-8)—1915 *V. ceylonica* (PRESTON, F.BR. Ind.(Freshw.Gastr. & Pelec.) : 89, no. 176)-1921 *V. dissimilis* (SEWELL, Rec. Ind Mus. Calcutta, 22 : 243)-1928 *V. ceylonica* (PRASHAD, Mem. Ind. Mus. 8 (4) : 153-251, pl. 19)-1928









Septaria lineata ; Fig. 14: operculum. Fig. 15: radula teeth, Fig. 16: female reproductive system and spermatophore ; abbreviations like in Fig. 7.

Paludina ceylonica (NEUMANN, Jen. Z. Naturw., 63(2):181-236)-1937 *Viviparus dissimilis* (ROHRBACH, Arch. Moll., 69 : 206-208)-1937 *V. ceylonicus* (ROHRBACH, ibid. : 206, 208)-1962 Bellamya ceylanica (MENDIS and FERNANDO, Fish . Res. Stn. Bull., 12:56, f.10).

Localities. Southern Province: No. 4 (5 ind.) ; Western Province : No. 10 (38 ind.) No. 13 (58 ind.), No. 17 (5 ind.), Sabaragamuwa Province : No. 36 (3 ind.) ; Central Province : No. 49 (3 ind.), No. 51 (10 ind.) ; North Western Province: No. 75(40 empty shells), No. 76 (9 ind.), No. 84 (2 ind.), No. 86(3 ind.)

Shell. According to NEVILL, 1884 (p. 27), KOBELT, 1909(p.292) and PRASHAD, 1928 (p. 163) *Bellamya ceylanica* belongs to the group of the Indian *B.dissimilis*. According to KOBELT, 1909 (p.284) this specific name is also a synonym of *B. remossi* (KÜSTER (not PHILIPPI), 1852). The same opinion has also been expressed by PRESTON, 1915 (P. 87) and ANNANDALE, 1921 (p.243). But KOBELT, 1909 states that *B.dissimilis* is not a well described species and FRAUENFELD 1864 (p.600) and REEVE, 1863 (pl.9, f.56) state that the locality of the type described by MÜLLER

is not known. His original description of 1774 was very short "*Nerita dissimilis* testa subovato acuminata, luteo-albescente, labro niger" NEVILL, 1884 takes as the type of *B. dissimilis* the shell, figured by HANLEY and THEOBALD, 1876 on pl.77 fs. 2,3 in the Conchologica Indica. KOBELT, 1909 did not agree with this opinion. He pointed out that MÜLLER 1774 gave the description of "labrum nigrum" for the type. This characteristic is typical for a form from South-India, described by FRAUENFELD, 1862 as *B. variata*. NEVILL 1884, places *variata* as a variation of B. *dissimilis*; B. *dissimilis* var. *variata* with subvar. *ceylanica*. After our studies of the shells and of the internal anatomy we agree with PRASHAD, 1928 that the form occurring in Ceylon is *Bellamya dissimilis* var. *ceylanica*.

The shell is ovately conical, rather solid, greenish-olive with 6 flatly-convex whorls, more or less flatly angled above and below (var. *ecarinata* of HANLEY and THEOBALD 1876 is a nearly ecarinate shell with rounded whorls and painted with a narrow, brownish, to blackish, subperipheral band on the last whorl). The whorls are everywhere closely spirally and linearly striated and punctured obtusely keeled at the angles . . The umbilicus is narrow bordered by a keel. The aperture is pyriformly broad-ovate, black edged and with black polished labrum (Fig. 17 Plate III)

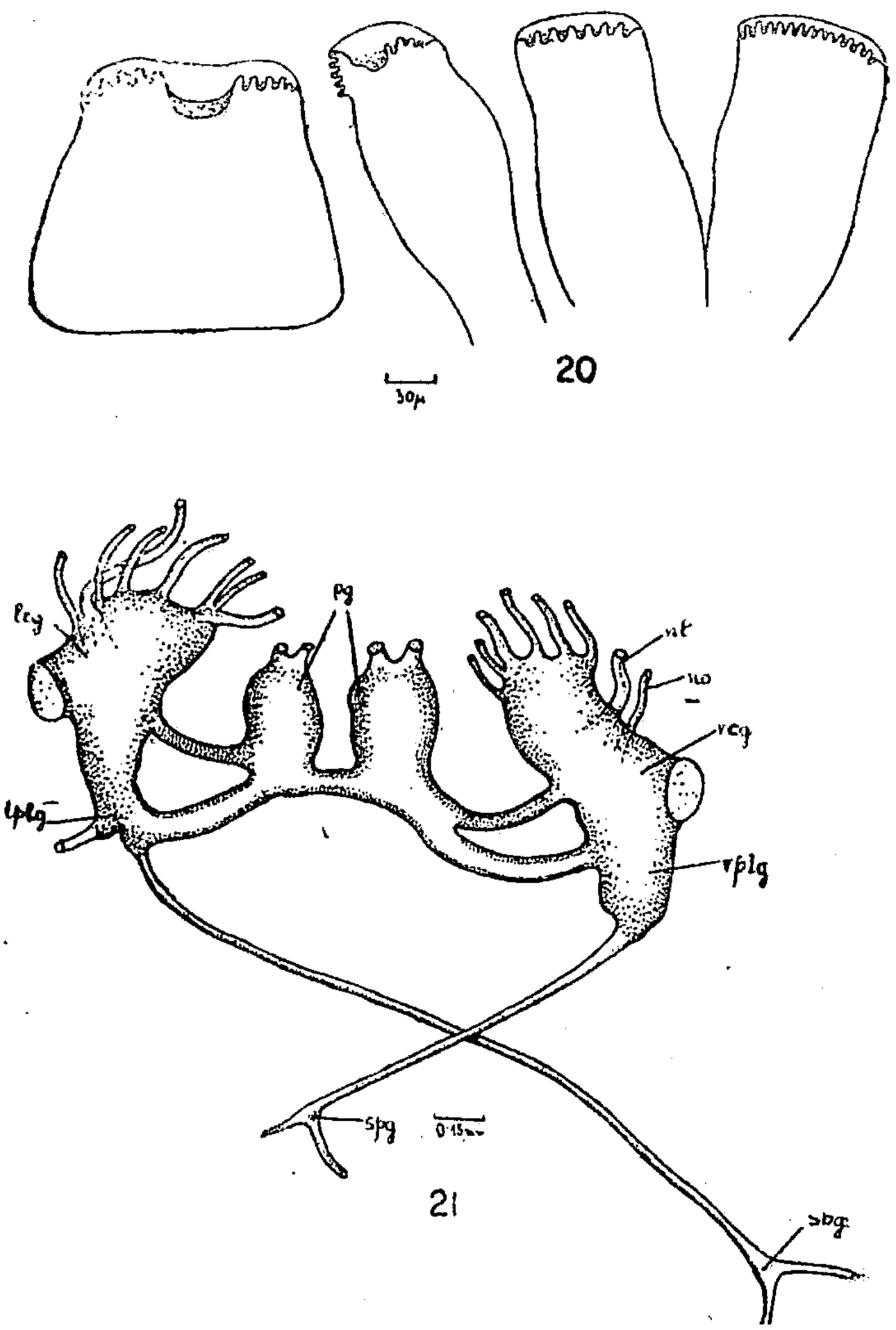
	Shell		Aperture	
Sizes (in mm):	Ht.	Diam.	Ht.	Diam.
No. 4 (Hakmana) Apex eroded	18′8	14′4	9′5	8
	18′5	14′5	10	8′5
No. 10 (Kelaniya)	21′4	17	11′5	10
	21′4	15′6	11′1	9′9
	19′4	15′2	10	8′5
No. 13 (Agalawatte) Apex eroded . .	26′2	17 8	12′2	10
	24′5	18′2	12′6	10′4
	24	18	12	10′2
No. 36 (Kegalla)	20	14′4	11′2	9
No. 49 (Kandy)	19′3	14′9	9′2	7′4
No. 51 (Kandy)	17	13	9′5	7′7
No. 75 (Parakrama Tank) (Fig.17) . .	26′3	19′1	12′8	11
	26	19	12′7	11
	25′4	19′3	13′3	11
	25	18′8	11′8	10′5
No. 76 (Wilpattu)	17	14	9′8	8
No. 84 (Kurunegala)	13′6	11	8	6′1

The sizes are for the biggest shells in the samples.

Operculum. Broad-ovate, horny, with a subcentral nucleus and concentrical growth-rings (No.72 Size: 11mm×9 mm ; Fig. 18, 19 (Plate III).

Anatomical remarks. Detailled anatomical descriptions of different species of the genus *Bellamya* with accounts of the anatomy of *B.dissimilis* and of the var. *ceylanica* are given by SEWELL, 1921 (Rec.Ind. Mus. Calcutta, 22:213-242), NEUMANN, 1928 (Jen.Z.Naturw., 63(2); 181-236) and ROHRBACH, 1937 (Arch. Moll.69: 177-218).

The radula of the specimens, investigated from our collections, possesses a central tooth with a trapezoid outline. The cutting edge bears one broad central denticle and 5 smaller denticles on either side (5–1–5). The lateral tooth consists of a quadrilateral portion with its base prolonged on one side. On the cutting adge are 4 small cusps on the inner portion, a big central denticle and 4 outside denticles (4–1–4). The inner and outer marginals possess 7, and 14 small denticles respectively. (Fig. 20). Nervous system : The cerebral ganglia are long-oval in outline and united by ashort but broad commissure. From the outside to the inner area escapes the n. opticus, n. tentacularis and 5 nerves to the region of



Bellamya dissimilis var. *ceylanica* ; Fig. 20: radula teeth ; Fig. 21: nervous system ; lcg : left cerebral ganglion, lplg : left pleural ganglion, nt : nervous tentacularis, no : nervous opticus, pg : pedal ganglia, spg : supraintestinal ganglion, sbg : subintestinal ganglion.

mouth and lips and the cerebrobuccal-connective. The pleural ganglia are approximated to the cerebral ganglia, being connected to them by very short connectives. The right pleural ganlion gives rise to the thick n. supraintestinalis, the left gives rise to the left pallial nerve and the long and slender n. subinestinalis. These nerves cross each other, and are separated by the oesophagus (Fig. 21). The sexes are separate and the females-like all Viviparidae are viviparous. From the ovarium in the upper whorls, extends a small oviduct to the posterior edge of the mantle cavity, Entering into the mantle cavity it extends in to a broad tube-receptaculum seminis, forming a loop with two sides. Into the smaller side

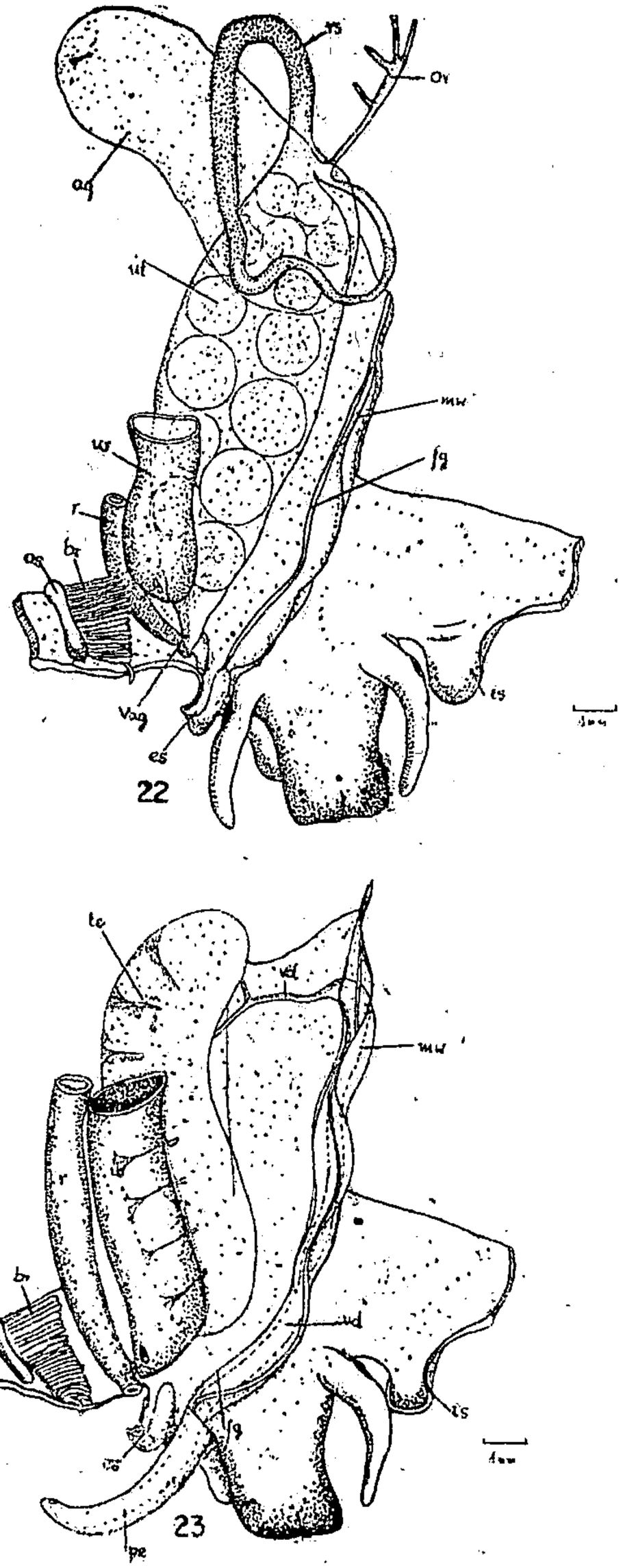


Fig. 22 : *Bellamya dissimilis* var *ceylanica* ; female reproductive organs ; ag : albumen gland, br : gill, es : exhalent siphon, fg : food groove, is : inhalant siphon, mw : mantle wall, os : osphradium, ov : oviduct, r : rectum, rs : receptaculum seminis, ur : ureter, ut : uterus, penis, vag : vagina, Fig. 23. male reproductive organs ; abbreviations as in Fig. 22: and pe : te : testis, v.d. Vas deferens.

opens the big albumen gland. The proximal part of the receptaculum section of the lower oviduct opens abruptly to the big uterus. In the uteri of mature females 10-14 embryos in different stages of development are always found. The uterus opens into a short vaginal papilla near the right (ex-halant) siphon of the mantle cavity (Fig. 22).

The testis of the male form a big bean-shaped complex of yellowish-reddish colour situated on the right part of the floor of the mantle cavity. The vasa efferentia-in two separate ducts-unite after rising from the posterior part of the testis to form vas deferens. It enters into the mantle wall in the centre of the floor of the mantle cavity and runs, surrounded by the glandular cells of the prostate, forward to the right tentacle. This tentacle is longer than the left tentacle and serve as a penis (Fig. 23).

Like all Viviparidae, the genus *Bellamya* is partially filter feeding. On the right side of the mantle wall lies a small groove with ciliar-and glandular cells (food-groove). The collected material (by ciliary feeding of the gill in connection with the hypobranchial gland) is carried down in the food groove to the propodial region in front of the snout, from where it may be raked into the gut by the radula (Fig. 24).

Ecological-biological remarks. *B. dissimilis* var. *ceylanica* inhabits sandy-muddy bottoms of stagnant waters like pools, ponds, water reservoirs (tanks) and also found living on the borders of slow-running streams in the lowland, where this species can be very frequent. The females are viviparous and bear young snails the whole year round. They feed on algae and debris covering the muddy bottom. Sometimes the snails filter the microplankton from the respiratory water currents.

Distribution. India, Burma (var. *ceylanica* : low-and upland of Ceylon).

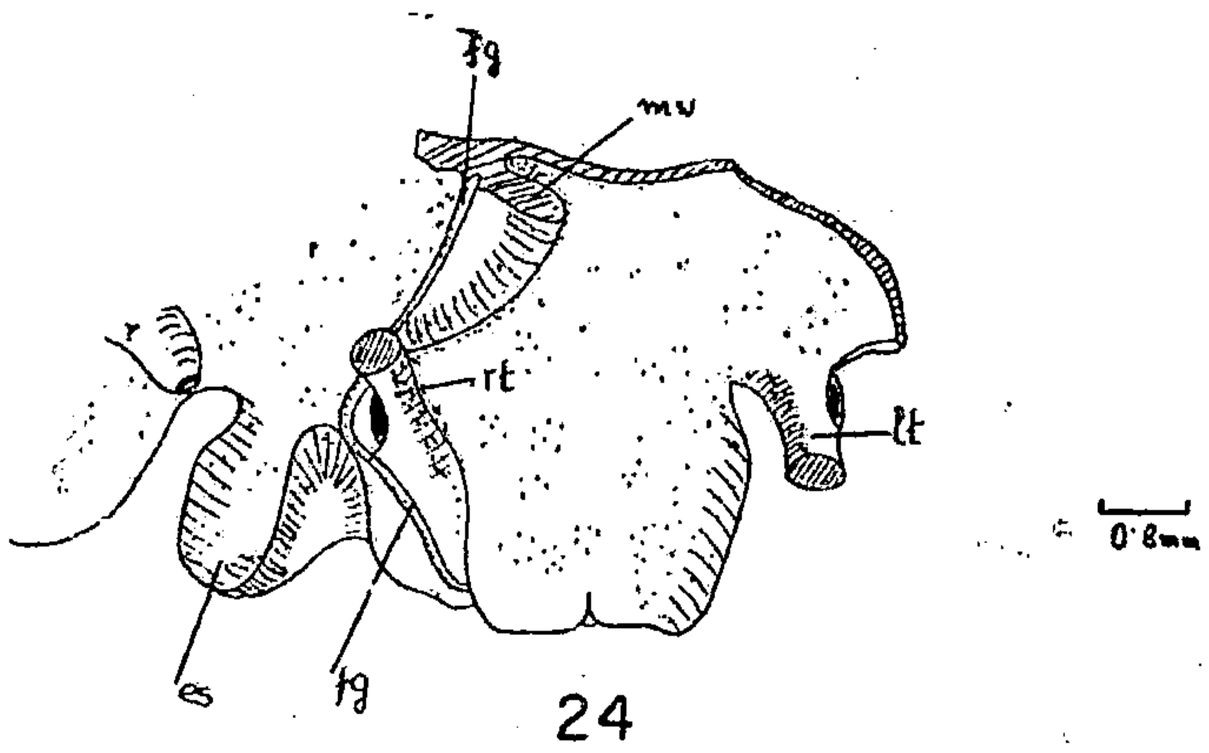


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Fig. 24: *Bellamya dissimilis* var. *ceylanica* ; exhalant siphon with lower part of the food groove ; lt : left tentacle (cut), rt : right tentacle (cut and lifted to show end of food groove or a lobe) ; other abb. as in fig. 22.

Ampulariidae.

(4) *Pila* (*Pila*) *globsa* (SWAINSON, 1822)

Lit. : 1822 *Ampullaria globosa* (SWAINSON, Zool. III. 1(2) : pl. 119)–1829 *A. carinata* (SWAINSON, ibid., 2(1) : pl. 9, non OLIVIER)–1851 *A. carinata* (PHILIPPI, in MARTINI & CHEMNITZ, Syst. Conch. Cab. 1 (20) : 8 ; pl. 1, f. 2)–1851 *A. globosa* (PHILIPPI, ibid. : 8 ; pl. 1, f. 3)-1856 *A. layardi* (REEVE, Conch. Icon. : pl. 6, f. 27)–1856 *A. globosa* (REEVE, ibid. : pl. 10, f. 46, 47, with var. *corrugata* SWAINSON and var. *pachystoma* BENSON)–1856 ? *A. doliloides* (REEVE, ibid. : pl. 16 f. 75)–1856 ? A. moesta (REEVE, ibid. : pl. 20, f. 92)–1856 *A. cinerea* (REEVE, ibid. : pl. 20, f. 94)–1858 ? *A. ceylanica* (DOHRN, Proc. zool. Soc. London 1858 : 135)–1858 ? *A. tischbeini* (DOHRN, ibid. :, 134) –1858 ? *A. woodwardi* (DOHRN, ibid. : 134)–1876 *A. cinerea* (HANLEY & THEOBALD, Conch. Ind. : 46, pl. 113, f. 1)–1876 *A. corrugata* (HANLEY & THEOBALD, ibid. : 46 ; pl. 113, f. 2)–1876 *A. globosa* (HANLEY & THEOBALD, ibid : 46 ; pl. 113, fs. 3–5 ; with var. *sphaerica* DESHAYES and var. *fasciata* HANLEY & THEOBALD)– 1876 *A. carinata* (HANLEY & THEOBALD,ibid. 4:6 ;p .l 114, f..1)–1876 *A. malabarica* (HANLEY & THEOBALD, ibid. : 46 ; pl. 114, f. 2)–1876? *A. tischbeini* (HANDEY & THEOBALD, ibid. : 46 ; pl. 114, f.3)–1876 *A. layardi* (HANLEY & THEOBALD, ibid. : 46; pl. 114, f. 4)—*A. paludinoides* (HANLEY & THEOBALD, ibid. : 47 ; pl. 114, fs. 5, 6)–1876

A. woodwardi (HANLEY & THEOBALD, ibid. : 47, pl. 115, f. 5)–1876? *A. moesta* (HANLEY & THEOBALD, ibid. : 47 ; pl. 115, f. 6)–1876 ? *A. ceylonica* (HANLEY & THEOBALD, ibid. : 47 ; pl. 115, f. 9, with var. *ecarinata*)–1877 *A. globosa* (NEVILL, Cat. Moll. Fasc. E. : 2, including the var. *corrugata* SWAINSON, *carinata* SWANISON, *incrassula* NEVILL, *minor* NEVILL, *longispira* NEVILL)–1884 *A. globosa* (NEVILL, Handle. Ind. Mus. Calcutta, 2 :1 ; including the var. *carinata* SWINSON, *corrugata* SWANISON, *fasciata* HANLEY & THEOBALD, *hepataria* REEVE, *incrassatula* NEVILL, layardi REEVE, *longispira* NEVILL, *malabarica* PHILIPPI, *minor* NEVILL, paludinoides PHILIPPI, *sinistrorsa* NEVILL, *virens* LAMACK after PHILLIPPI, 1851)–1884 ?*A doliloides* (NEVILL, ibid. : 7)–1884 ? *A moesta* (NEVILL, ibid. : 7)–1910 *A. globosa* (SOWERBY, Proc. mal. Soc. London, 9 : 58, no. 125, including the var. *cinerea* REEVE and *encaustica* REEVE)–1910? *avirens* var. *tischbeini* (SOWERBY, ibid. : 62)–1910 ?*A. alucinans* (SOWERBY, ibid. : 63)–1915 *Pachylabra globosa* (KOBELT, in MARTINI & CHEMNITZ, Syst. Conch. Cab., 1 (20), N.F. : 72 ; pl. 1, f. 3 ; var. f. 1, 2 and pl. 34, fs. 1–2; after NEVILL, 1884 are synonyms the var. *carinata* SWAINSON, *paludinoides* PHILIPPI, *corrugata* SWAINSON, *hepataria* REEVE, *layardi* REEVE, *malabarica* PHILIPPI and ?(*virens* LARMARCK) PHILLIPPI : after SOWERBY, 1910 (Proc. mal. Soc. London, 9: 62) *P. virens* is the type of some forms including *layardi* PHILLIPPI, *maura* REEVE, *paludinoides* PHILLIPPI and *tischbeini* DOHRN)–1915 P. *layardi* (KOBELT, ibid. : 73 ; pl. 34, f. 3,4)–1915 *P. hepataria* (KOBELT, ibid. : 74 ; pl. 34, f. 5, 6)–1915 ?*P. moesta* (KOBELT, ibid. : 75 ; pl. 34 f. 8)–1915 ?*P. doliloides* (KOBELT, ibid. : 75 ; pl. 34. f. 5, 6)–1915 *P. cinerea* KOBELT ibid. : 89 ; pl. 35, f. 9)–1915 ?*P. tischbeini*, (KOBELT, ibid. : 100, pl. 42, f. 1, 2)–1915 ?*P. alucinans* (KOBELT, ibid. : 104 ; pl. 43, f. 8)–1915 ?*P. woodwardi* KOBELT), ibid. : 105 ; pl. 43, f. 9)–1915 *Pila globosa* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 97, no. 188 ; including the var. *fascinata* HANLEY & THEOBALD, *incrassata* NEVILL, *minor* NEVILL, *sinistrorsa* NEVILL, and *sphaerica* HANLEY & THEOBALD)–1915 *P. carinata* (NEVILL, ibid. : 98, no. 190)–1915 *P. malabarica* (NEVILL ibid. : 98, no. 191)–1915 *P. layardi* (PRESTON, ibid. : 99, no. 192, with the var. *virens* (LAMARCK) PHILIPPI)–1915 ?*P. doliloides* (PRESTON, bid. : 101, no. 198)–1915 ?*P. moesta* (PRESTON, obid.. : 101, no. 199)–1915*P. cinerea* (PRESTON, ibid. : 101, no. 200)–1915 ?*P. tischbeini* (PRESTON, ibid. : 102, 203) 1915 ?*P. woodwardi* (PRESTON, ibid. : 102, no 203)—1915 *P. alucinans* (PRESTON, ibid. : 103, no. 204)–1923 *Pachylabra* (*Ampullaria*) *cinerea* (HAGLER, Acta Zool., 4 : 313)–1925 *Pila globosa* (PRASHAD, Mem. Ind. Mus. Calcutta, 8: 91)–1962? *P. alucinans* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12 : 57)–1962 *P. cinerea* (MENDIS & FERNANDO, ibid. : 57)–1962 ? *P. doliloides* (MENDIS & FERNANDO, ibid. : 57)–1962 *P. globosa* (MENDIS & FERNANDO, ibid. : 57, f. 8)–1962 *P. layardi* MENDIS & FERNANDO, ibid.: 57, f. 11)–1962 ?*P. moesta* (MENDIS & FERNANDO, ibid. : 57)–1962 P. *tischbeini* MENDIS & FERNANDO, ibid. : 57)–1962 ?*P. woodwardi* (MENDIS & FERNANDO, ibid. : 57).

Localities. Southern Province : No. 4 (12 ind.) ; Western Province : No. 10 (31 ind.), No. 14 (18 ind.), No. 17 (4 ind.), No. 18 (4) ind.), No. 19 (9 ind.), No. 21 (5 ind.) ; Sabaragamuwa Province : No. 36 (6 ind.) No. 37 (5 ind.) ; Central Province : No. 49 (3 ind.) ; North Western Province : No. 84 (16 ind.), No. 85 (1 ind.), No. 89 (6 ind.).

Shell. The types of the species of the genus *Pila* found in Ceylon have been described only after the shells. But ike in all species of Ampullariidae the shell of *Pila* is extremely variable in form. After examining the series of shells land the anatomy of the soft bodies it is now concluded that all species of *Pila* described from Ceylon belong to the variable Indian species *Pila* (*P.*) *globosa* (SWAINON, 1822).

In the collections of COSTA et al., 1971 and the Lund University Expedition 1962 *Pila* (*P.*) *globosa* was represented mostly by the var. *carinata*, described by SWAINSON, 1829 from Ceylon. At 2 localities (No. 17 (Attanagala) and No. 37 (Ratnapura) the shells are similar to the var. *moesta* (REEVE, 1856), the shells of No. 10 (Kelaniya) are closer to the var *layardi* (REEVE, 1856) and some shells of smaller sizes, also from No. 10 (Kelaniya) looks very similar to the var. *alucinans* (SOWERBY, 1910) and var. *tischbeini* (DOHRN 1858). But all these shell variations are connected by transitiona forms.

The shell of var. *carinata* is round, globose, thick, with 5 whorls like the var. *typica* of *P. globosa*, but it is more or less carinated near the suture; flatly angled at the upper part of the whorl so as to present a narrow shelf. The colour is yellowish-olive with narrower and broader bands, specially in young shells. In the older shells the bands disappear sometimes. Aperture ovate, adult shells with thickened lip, tinged with yellow (Fig. 25, Plate IV).

Sizes (in mm.):	Shell Ht.	Shell Diam.	Aperture Ht.	Aperture Diam.
No. 4 (Hakmana)	40	37	31'7	20
No. 14 (Beruwala)	46'5	42	35'2	23
No. 20 (Ja-Ela) (Fig. 25)	50	43'4	38	24'8
No. 21 (Yakkala) young specimens! ..	35'5	32	26	19
No. 36 (Kegalla)	52	47	41'5	27'5
No. 84 (Kurunegla)	40	37	32'1	19'5
No. 85 (Narramala) young specimens! ..	35'8	30'8	28'6	12'6
No. 89 (Mundel-Lake)	49'2	42'2	36	22

The shells of var. *moesta* are ovately globose narrowly umbilicated, the spire is rather exserted the whorls are sligthly flattened at the upper part then rounded and smooth the colour is dull olive encircled with narrow darker bands, the aperture is lunar-ovate the lip yellowish-white within.

Sizes (in mm.)	Shell Ht	Shell Diam.	Aperture Ht.	Aperture Diam.
No. 17 (Attanagalla)	33'5	28'3	24	14'7
No. 37 (Ratnapura)	36'4	31	26'3	17'5

The shells of var. *layardi* are rather compressly globose, 5 whorls narrowly flatly impressed round the upper part then rounded smooth, shining; umbilicus small contracted ; aperture ovate, whitish covered with an olive horny epidermis ; several darkbrown narrow and broad bands specially on young shells (Fig. 26, Plate IV.)

Sizes (in mm.):	Shell Ht.	Shell Diam.	Aperture Ht.	Aperture Diam.
No. 10 (Kelaniya) (Fig. 26)	44'6	40'6	33'4	21
	41	38	31	19'5

The juvenile shells of this locality (No. 10, Kelaniya) correspond to the small var. *alucinans* with altitudes between 23'5 and 28mm From the same area, but from another locality in Kelaniya are some smaller shells corresponding to the var. *tischbeini*: ovate-globose, solid, 5 whorls with impressed suture the upper part flatly angled, then rounded ; typical for these variations is a prominent riblike striation of the shell, formed by the growth lines; colour olive with some bands not very distinct (Fig. 27, Plate III).

Sizes (in mm):	Shell Ht.	Shell Diam.	Aperture Ht.	Aperture Diam.
No. 10 (Kelaniya) (Fig. 27).	33	28	24	17'2
	33	29	24'3	18'3
	32'5	28	25	17'5
	31'5	26'7	23'2	16'8

The sizes are from the biggest specimens in the samples.

Operculum. Ovate, outside horny, inside calcarous. Sizes : var. *carinata*: No. 4 : 27'7mm × 16mm, No. 14 : 34mm × 18mm, No. 20 : 35mm × 22mm, No. 21 : 25'1mm × 14'5mm, No. 36 : 35mm × 21'5mm, No. 84 : 30'2mm × 16'7mm, No. 89 : 33mm × 19mm ; var. *layardi* : No. 10 : 30'7mm × 17'7mm (Fig. 28,29, Plate IV) ; var. tischbeini : No. 10 : 22'4mm × 13'5mm (Fig. 30 ; Plate III) ; var. *moesta* : No. 17 : 22'2mm × 13'5mm.

Anatomical remarks. A detailled study of the anatomy of *Pila* (*P.*) *globosa* has been given by PRASHAD, 1925 and HAGLER, 1923 has studied Pila (*P.*) *cinerea* (REEVE, 1856) a species, which is considered by SOWERBY, 1910 to be also a variation of Pila (*P.*) *globosa*. A further anatomical study of a species of the genus *Pila* was also given by STARMÜHLNER 1969, who described the anatomy and histology of the Madagassian *Pila* (*P.*) *cecillei* (PHILIPPI, 1848) in comparison with the results of PRASHAD and HAGLER.

The radula of *Pila* (*P.*) *globosa* var. *carinata* from Ceylon is very similar to the figures of radulae given by ANNANDALE, 1921 (Rec. Ind. Mus. Calcutta 22:7) for *Pila* (*P.*) *globosa* (typica) from India and by STARMÜHLNER, 1969 (Malacologia 8(1/2) :126, f. 169) for *Pila* (*P.*) *cecillei* from Madagascar: the central-tooth is trapezoid in outline. The base is cut into on both sides. The cutting edge shows one broad central cusp and two lateral denticles on either side (2-1-2). The lateral tooth is from a a quadrilateral form prolonged on the base, the formulae of the denticles is 1-1-2, the inner and outer marginals have only two prominent cusps (Fig. 31).

Ecological-biological remarks. *Pila* (*P.*) *globosa* is found in the lowland and in the upland and is a typical in habitant of stagnant water, like the pools, ponds, water reservoirs (tanks), irrigated paddy fileds, sometimes also found living on the muddy borders of slow-running streams. They prefer waters with a dense growth of water-plants, like *Azolla* and other species. The species occurs also in slightly brackish waters of lagoons like in No. 89 (Mundel-Lake) If the water disappears in dry season the snails dig in to the mud or move on land to other places. *Pila* has a type of taenioglossa radula with strong cusps to feed on water plants cutting parts from the submerged stems and blades.

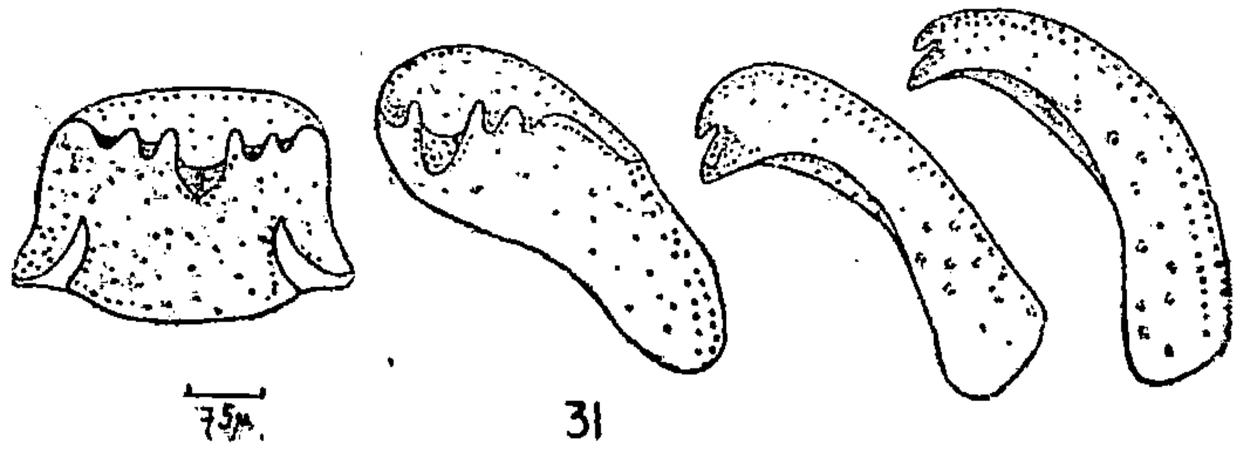


Fig. 31. *Pila globosa* ; radula teeth.

Distribution, India, Ceylon.

Rissoacea

Hydrobiidae

Lithoglyphinae

(5) *Tricula montana* BENSON, 1843

Lit. : 1843 *Tricula montana* (BENSON, J. Nat. Hist. Calcutta, 1843:467)-1862 *T. montana* (BENSON, Ann. Nat Hist. 1862:415-416)-1865 *T. montana* (STIMPSON, Smiths. Misc. Coll, 201 (I-III):1-59)-1876 *T. montana* (HANLEY and THEOBALD, Conch . Ind. : 62; pl. 155, f.1)-1884 *T. montana* var. *curta* (NEVILL, Handl. Ind. Mus. Calcutta, 2 : 62)-1915 *T. montana* (PRESTON, F. Br. Ind. (Freshw. Gastr. and Pelec.): 68, no. 136; with var. *curta* NEVILL)-1921 *T. montana* (PRASHAD, Rec. Ind. Mus. Calcutta, 22 (2,9) : 67, 69)-1924 *T. montana* (ANNANDALE, Amer. J. Hyg. (Mongr. Ser.) 3:247-279, f. 4A)-1928 *T. montana* (RAO, Rec. Ind. Mus. Calcutta, 30 (4) : 399-468)-1928 *T. montana* (THIELE, Handb. syst. Weichtierkde. : 145)-1938 *T. montana* (WENZ, Handb. Palãozool., Gastr., Pros. : 578, f. 1572) -1968 *T. montana* (DAVIS, Arch.Moll.98 (5/6):291-317).

Locality. Central Province: No.53 (1 ind)–First record for Ceylon.

Shell. Minute, conical-ovate, 6 whorls moderately rounded, suture impressed, smooth, colour olive-brown; apex blunt umbilicus narrow; aperture oblique-ovate but acutely pointed posteriorly, peristome continuously moderate reflexed, blackish (Fig .32, Plate III).

Sizes (in mm)	Shell Ht.	Shell Diam.	Aperture Ht.	Aperture Diam.
No. 53 (Madugoda) Fig 32, Plate III	3	1'25	1	0'8

Operculum. Horny, paucispiral.

Anatomical remarks. In the collection of the Lund University Expedition 1962 there was only one specimen of this species for which reason it was not possible to dissect the soft body part without destroying the shell. In the literature the radula is figured by ANNANDALE, 1924 (Amer.J. Hygiene (Monogr. Ser.), 3:247.279, text fig.4A) from a specimen from India.

The internal anatomy of species of *Tricula* from Thailand has been described by DAVIS, 1968 (Arch. Moll., 98 (5/6): 291317). The anatomy of *T. montana* is unknown.

Ecological-biological remarks. Known only from mountain-streams in India (Bhim-Valley on stems of water iris and Jhiri-Valley (N-Cachar) in Assam) and now from Central Ceylon. In No. 53 (Madugoda) at 800m. altitude in a small stream in forest-clad mountain side.

Distribution. India (Bhim-Valley), Assam (Jhiri-Valley); Central Ceylon.

Stenothyridae

(6) *Gangetia burmanica* (PRASHAD, 1921)subspec.?

Lit. : 1921 *Astenothyra burmanica* (PRASHAD and ANNANDALE, Rec. Ind. Mus., 22:135; pl. 16, fs.11-12).

Locality. Northern Province: No. 99(35 ind).

Shell. After a letter from Mr. H. SCHÜTT (Düsseldorf-Benrath; Germany), a recognized specialist for Rissoacea, the shells are attached to the Stenothyrid *Gangetia burmanica* described by PRASHAD,1921 from the coast of the Arakon-Mountains in Burma.

The specimens from Ceylon may be perhaps a new subspecies, but the material on adult specimens in the sample is too small to arrive at definitive conclusion.

The minute shells have creamy-white colour and are ovate with a bluntly apex; 6 whorls, suture deeply impressed somewhat canaliculate and only slightly oblique. The first whorls are very minute, the third a little more than half of the fourth while the penultimate whorl is more than twice as broad as the fourth. The body-whorl is large inflated and dorsal view trumpet-shaped. Aperture oblique-ovate, but acutely pointed posteriorly. Peristome continuous and only slightly thickened with a rather broad callus; on the body-whorl spiral pitted lines are marked (Fig. 33 Plate III).

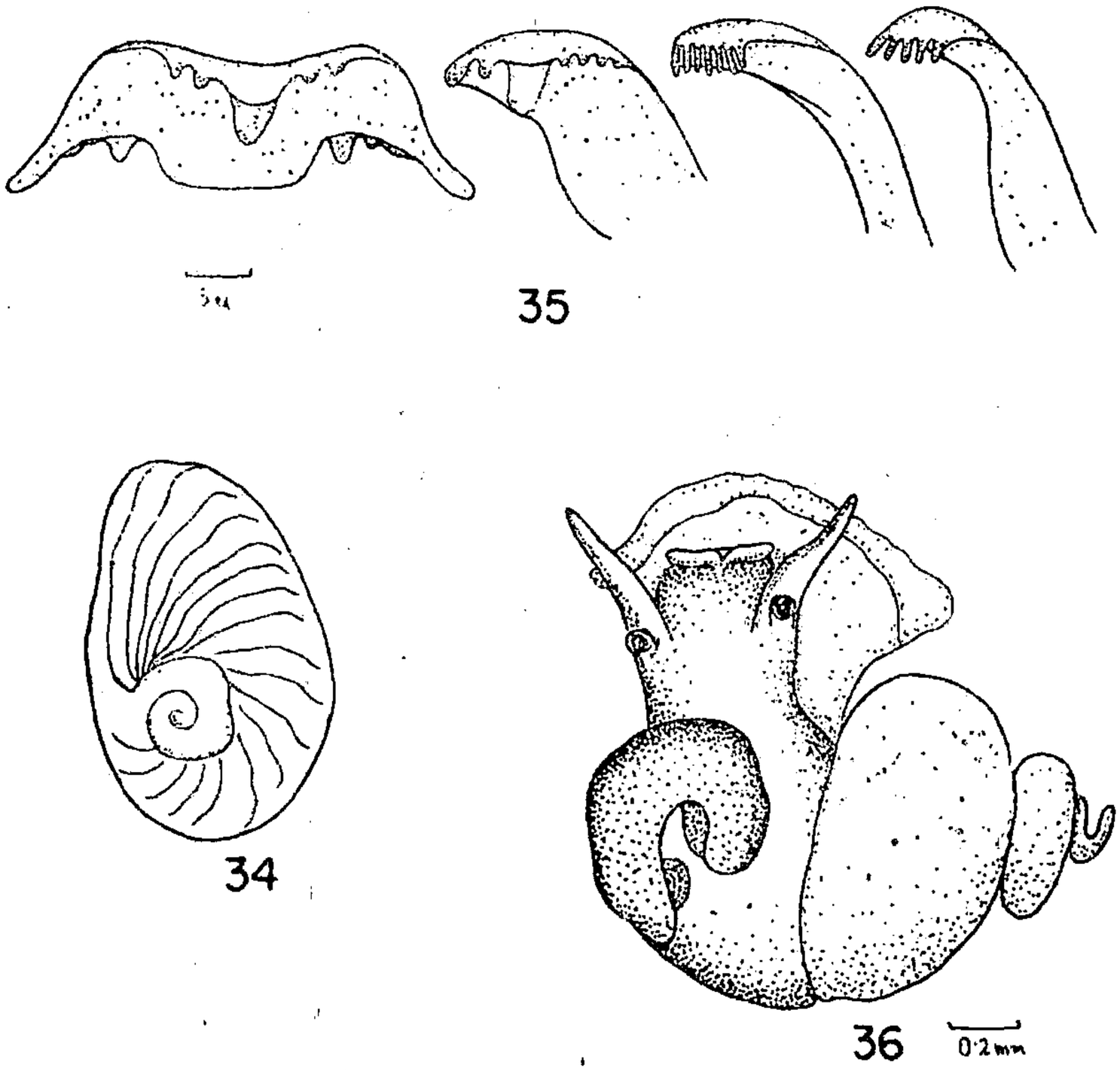
Sizes (in mm.):	Shell Ht.	Shell Diam.	Aperture Ht.	Aperture Diam.
No. 99 (Nay Aru) (Fig. 33 Plate, III.) ..	2'8	1'5	1	0'75

The sizes are from the biggest specimen of the sample. The type has an altitude of 1'5 mm and a diameter of 1 mm (PRASHAD, 1921: p. 136).

Operculum. Corresponds in outline with the aperture; thin, transparent, paucispiral with subcentral nucleus On the inner surface are the two diverging ridges which are very difficult to recognize (Fig. 34)l.

Anatomical remarks: Back and head of the soft body is greyish, the long and slender foot is lightly greyish and pointed behind. A few minute blackish spots are found on the mantle lobe. Proboscis is long and truncate, tentacles long and filiform, the eyes are situated on the outside of the bases of the tentacles (Fig.36). Radula: central-tooth form trapezoid outline with long slender prolongations on both sides of the base; the cutting edge with a prominent central cusp and two smaller denticles on either side (2-1-2), on the base 2-3 denticles on either side. The lateral-tooth with the denticles on either side. The lateral-tooth with the denticle-formula 2-1-4 and the inner and outer marginals with 7, resp. 5 small denticles (Fig 35).

The male with a thick, coiled penis in the middle of the neck; inside a single duct (Fig. 36).



Gangetia burmanica. Fig. 34 : exterior of operculum, Fig. 35 : radula teeth, Fig. 36 : male with the coiled penis behind the neck.

Ecological-biological remarks. The snails occur in slightly brackish water near the coast. The locality No. 33 (Nay Aru) in North Ceylon was a flooded river, crossing salt meadows. The animals feed on microscopic algae, like diatoms.

Distribution. Locus typicus: coast of the Arakon-Mountains in Burma, perhaps also on other similar biotopes on the coast of the Gulf of Bengal; North-Ceylon.

Buliminidae(=Bithyniidae)

(7) *Bulimus* (=*Bithynia*) *inconspicua* (DOHRN, 1857)

Lit. : 1857 *Bithynia inconspicua* (DOHRN, Proc.zool.Soc. London, 24:123)-1876 *B. inconspicua* (HANLEY and THEOBALD, Conch. Ind.:18; pl.37, fs. 5,6)-1915 *B. inconspicua* (PRESTON, F. Br. Ind. (Freshw.Gastr. and Pelec.):77; no.154)-1962 B. *inconspicua* (MENDIS and FERNANDO, Fish.Res. Stn., Bull., 12:56, f.12).

Localities. Southern Province:No. 6(6 ind.) No. 8 (24 ind.), No. 9 (5 ind.) Western Province: No. 10 (2 ind.); Central Province : No. 51(6 ind.), Nr. 52 (3 ind.), Nr. 53 (1 ind.); Uva Province: Nr. 60 (1 ind.); North-Central Province No. 79 (5 ind.), No. 80 (36 ind.) ; North-Western Province No. 86 (8 ind.), No. 88 (14 ind.), No. 89 (4 ind.), Nr. 90 (16 ind.); Northern Province: No. 96 (10 ind.) , No. 97 (3 ind.).

Shell. Oblong-conically, fragile, transparent, spire acute, 4-5 convex whorls, weak striated in spiral lines (lens !); white to brown; aperture oblong but acutely pointed posterior. In shape the shell of this species is nearly allied to the common European *B. tentaculata* but differing in sizes. The whorls are rounder and broader in proportion to the height and flatter than in *B. orcula* and the whole form is more conical. There are some shells with transitions to *B. stenothyroides*, but the typical *inconspicua* is smaller in size and more conical with a spire more elevated (Fig. 37, 38, Plate III)

Sizes (in mm.):	Shell Ht.	Shell Diam.	Aperture Ht.	Aperture Diam.
No. 6 (Gilcroft)	5'3	3'7	2'9	2.9
No. 8 (Yoda Wewa)	5'4	3'6	3	2'4
No. 9 (Wirawila)	5'4	3'8	3'1	2'5
No. 10 (Kelaniya)	5'6	3'6	3	2'4
No. 51 (Kandy)	5'3	3'7	3	2'3
No. 52 (Udawela)	5'2	4	2'7	2'2
No. 60 (Kuda Oya)	4'8	3'5	2'8	2'1
No. 79 (Wilpattu)	4'2	3'6	2'7	2'2
No. 80 (Maha Bulankulama) (Fig. 37) ..	5'3	3'7	3	2'3
No. 88 (Madampe)	4'5	3'3	2'3	1'8
No. 89 (Mundel Lake)	5'1	3'6	3	2'4
No. 90 (Puttalam) (Fig.38)	5	3'5	2'8	2'3
No. 96 (Mankulam)	5'1	3'6	2'6	2'1

The sizes are from the biggest specimens in the samples.

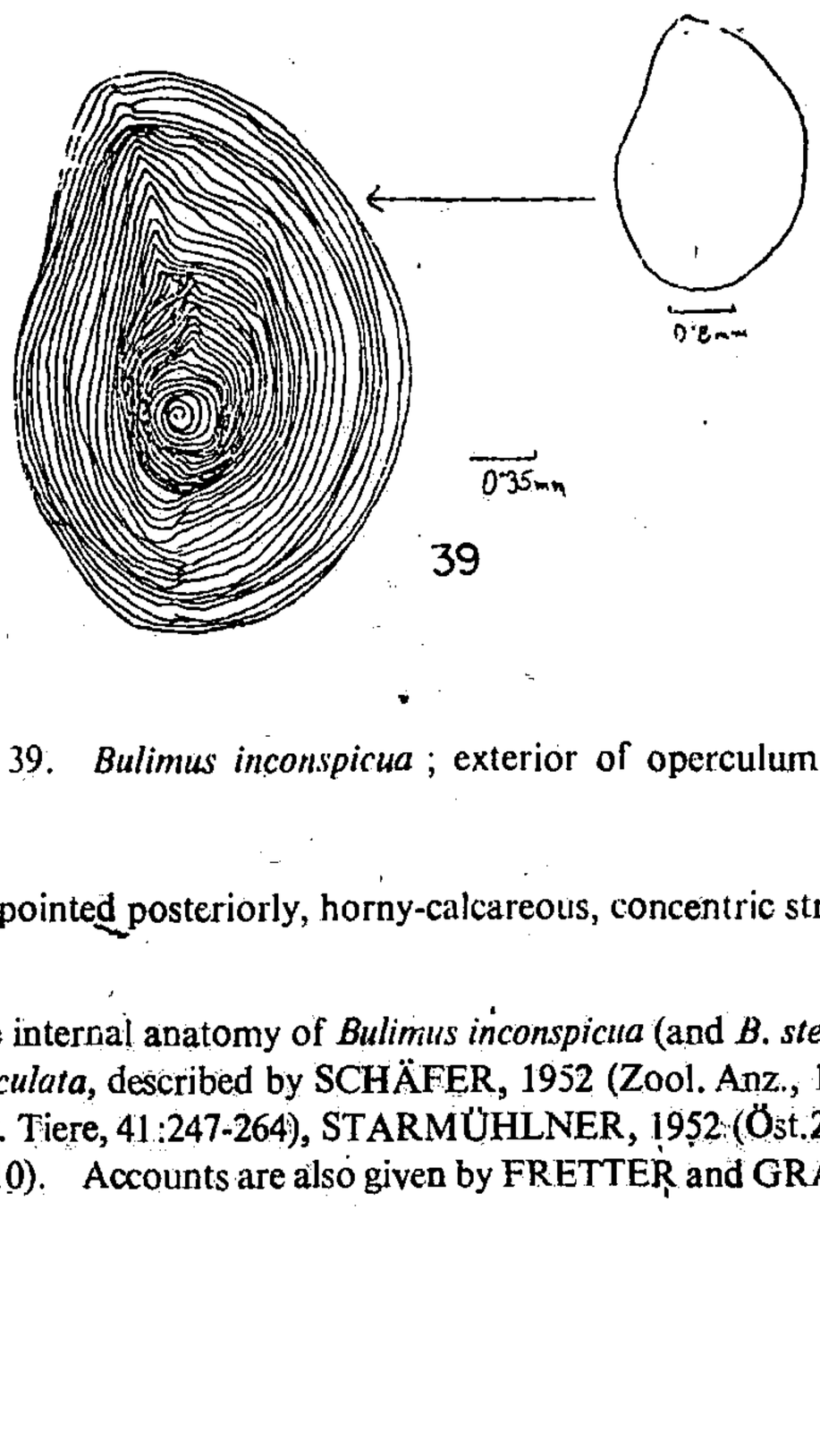


Fig. 39. *Bulimus inconspicua* ; exterior of operculum.

Operculum. Oblong-ovate, pointed posteriorly, horny-calcareous, concentric striatious (Sizes: No. 80:3mm × 2·2 mm; Fig.39).

Anatomical remarks. The internal anatomy of *Bulimus inconspicua* (and *B. stenothyroides*) is very similar to the common european species *B. tentaculata*, described by SCHÄFER, 1952 (Zool. Anz., 148:299-303), 1953a (Arch.Moll., 82:67-70), 1953b (Z. Morph. Ökol. Tiere, 41:247-264), STARMÜHLNER, 1952 (Öst.Zool.Z., 3:546) and LILLY, 1953 (Proc. malac. Soc. London, 30:87-110). Accounts are also given by FRETTER and GRAHAM. 1962 in the British Prosobranch Molluscs.

Between the dissected specimens of *B. inconspicua* and B. *stenothyroides* no differences are to be recognized. Some remarks on the internal anatomy are given below on *B. stenothyroides.*

Ecological-biological remarks. Bulimus inconspicua (and *stenothyroides*) inhabits swamps, pools, ponds, water reservoirs (tanks) and the borders of slow-running streams with muddy bottom, and which are rich with debris. They occur in Ceylon from the coast to the low-and upland (to 800m). The shells are mostly encrusted with mud and filiform algae. The snails feed on algae and organic matter. The genus *Bulimus* partially filters the respiratory water with the gills. (SCHÄFER, 1952, 1953 a, b, LILLY, 1953).

At one locality (No. 89, Mundel Lake, 16 mls. N of Chilaw) *B. inconspicua* was found in a brackish lagoon with exposed grassy shores.

Distribution : Coast, low and upland of Ceylon.

(8) *Bulimus* (=*Bithynia*) *stenothyroides* (DOHRN, 1857)

Lit: 1857 *Bithynia stenothyroides* (DOHRN, Proc. zool. Soc. London., 24 : 123)–1876 *B. stenothyroides* (HANLEY & THEOBOLD, Conch. nd. : 18 ; pl. 38, fs. 7, 10)–1884 *B. stenothyroides* and var. *biangulata* (NEVILL, Handl. Ind. Mus. Calcutta, 2 : 37) 1915 *B. stenothyroides* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 74, No. 174)–1962 *B. stenothyroides* (MENDIS & FERNANDO, Fish. Res. Stn. ; Bull., 12 : 56).

Localities. Sabaragamuwa Province : No. 33 (7 ind.) ; North-Central Province : No. 76 (14 ind.).

Shell. It is noted above that in the same populations are to be found transitions in the form of the shells betweeen the typical *B. inconspicua* and the typical *B. stenothyroides*. The latter is in the typical form bigger in size and more ovate, the last whorl is bulging and blowing up, the spire is shorter; the 4–5 whorls are convex, the colour is whitish to brownish transparent, smooth, under a lens fine spiral striations could be recognized. The aperture is oblong-ovate, but acutely pointed posteriorly. PRESTON, 1915 (p. 74) notes, that this species has some characters of a "*Stenothyra*" : the last whorl is-for a *Bulimus* (=*Bithynia*)-unusually great, the aperture is somewhat contracted, but the general aspect is that of *Bulimus* (=*Bithynia*) (Fig. 40,Plate V).

	Shell		*Aperture*	
Sizes (in mm.)	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 33 (We Ganga) (Fig. 40) ..	6'6 ..	5 ..	3'8 ..	2'8
No. 75 (Wilpattu) ..	5 ..	4 ..	3 ..	2

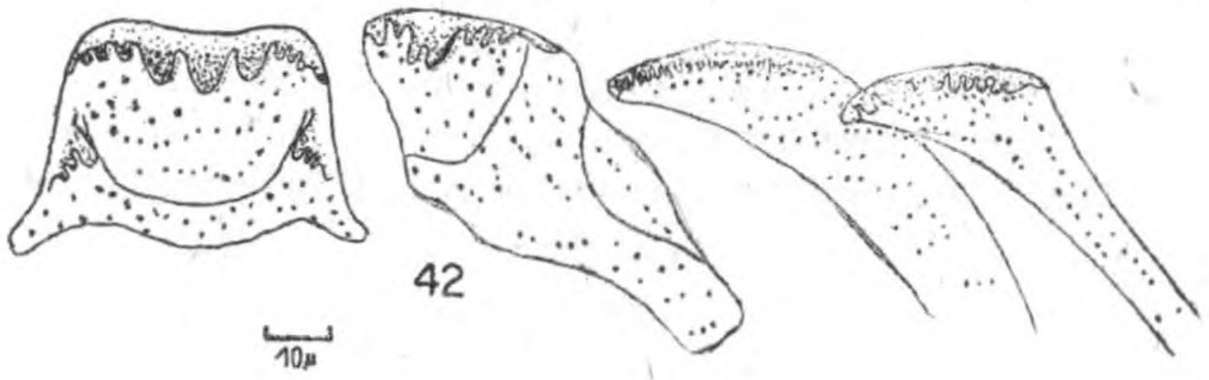
The sizes are from the biggest specimen in the samples.

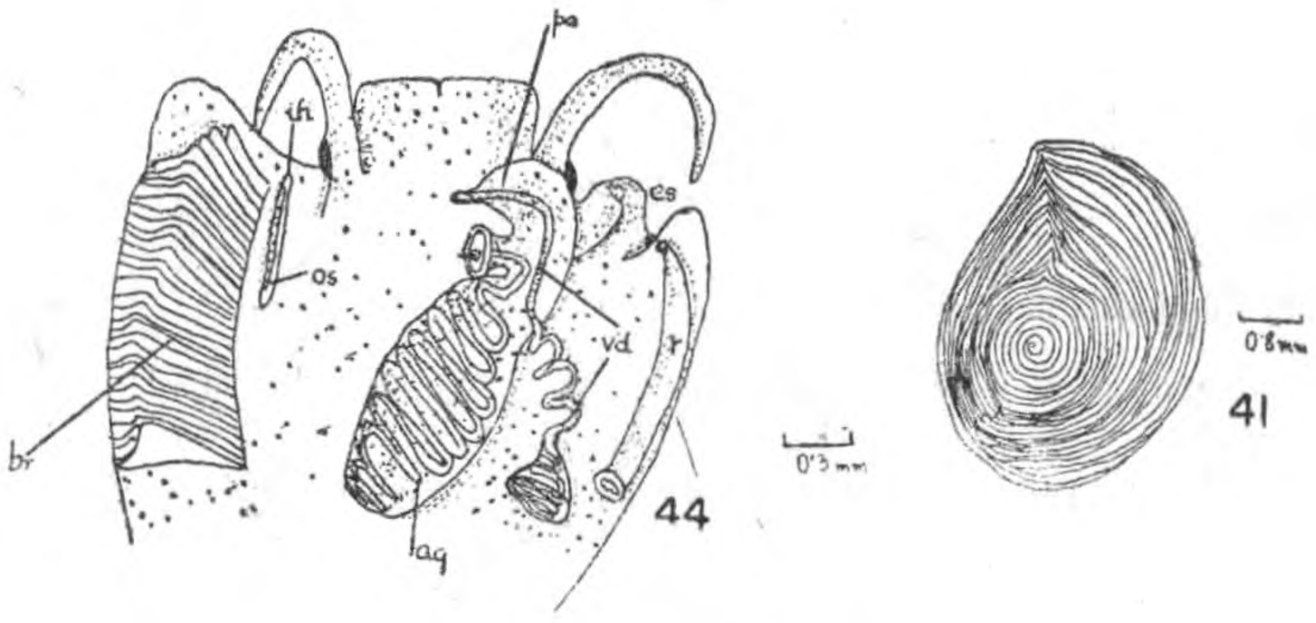
Operculum. Oblong-ovate, pointed posteriorly, horny-calcareous, concentric striated (Size No. 39 : 4 mm × 3'2 mm ; Fig. 41).

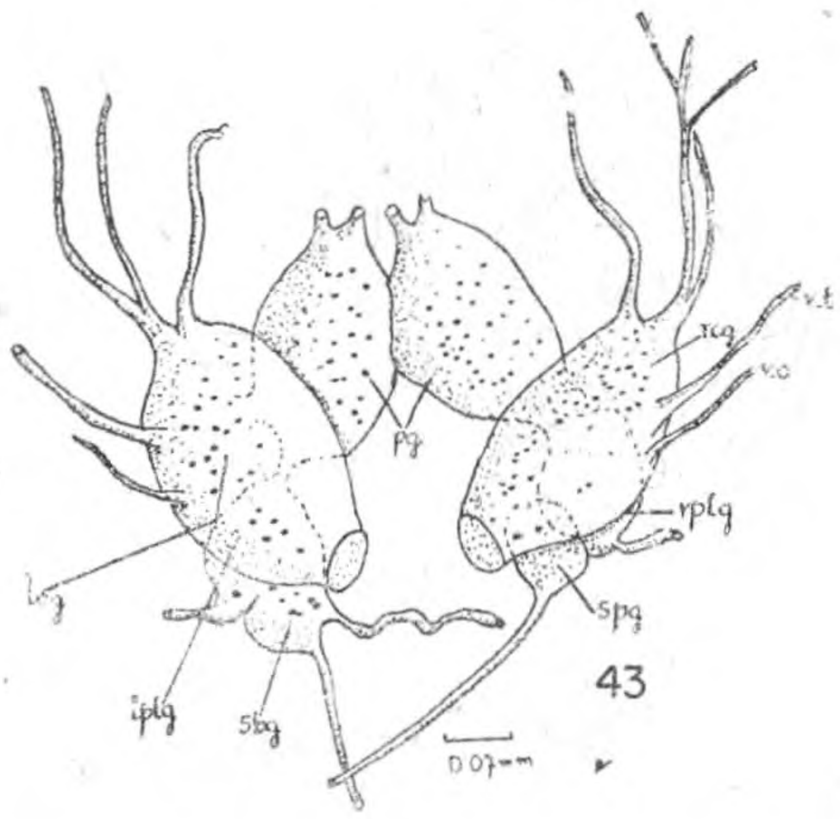
Anatomical remarks. Radula : central-tooth with trapezoid outline, prolonged on the base on either side, cutting edge with 3 central cusps and 3 smaller denticles on each side (3–3–3) ; on the base 3 small denticles on either side. The lateral with the denticle formula of 2–2–3, the central cusp is bifurcate. Inner and outer marginals with 17, resp. 11 denticles (Fig. 42). Nervous system : Big ovate cerebral ganglia, from the outside escapes the n. opticus, n. tentacularis the cerebro-buccal-connective and two ramified nerves to the mouth and lips (by the male also one to the penis). The pleural-and the sub-and supraintestinal ganglia are attached to the base of the cerebral ganglia. Cerebral and pleural ganglia are connected with thick, but very short connectives to the broad-ovate pedal ganglia (Fig. 43). The male possesses a prominent penis with an accessory gland, containing a long rolled up flagellum. In the penis duct is also the lower part of the vas deferens (Fig. 44).

Ecological-biological remarks. *B. stenothyroides* is found in similar biotopes like *B. inconspicua*, but this species was much more rare in the samples. In the locality No. 33 (We Ganga,), a branch of the Kalu Ganga, near Balangoda this species occur near the border of the stream on stones, covered with mud. The frequency was 3-5 ind./dm ² (!) in a current of 10–30cm/sec. Other ecological factors were : temperature : 24'7° to 25 6°C (10.12.1970), pH : 7'2, El_{20} : 89, μ Siemens, Total hardness : 2'35°dH, CaO : 15'6mg/1, Mg0 : 5'7mg/l.

Distribution.—South-India (Nilgiris Distr., Madras State) ; Ceylon.







Bulimus stenothyroides. Fig. 41 : exterior of operculum. Fig. 42 : radula teeth, Fig. 43 : nervous system, abb. as in fig. 21, Fig. 44 ; male with penis and accessory gland, br : gill, as exhalent siphon, ih : inhalent siphon, os : osphra-dium, pe : penis, r : rectum.

(9) *Mysorella costigera* (KÜSTER, 1852)

Lit.—1852 *Paludina costigera* (KÜSTER (non BECK) in MARTINI & CHEMNITZ, Syst. Conch. Cab. 1 (21) : 33 ; pl. 7, fs. 18, 19)–1852 *Valvata sulcata* (EYDOUX & SOULEYET, Voy. "BONITE", Zool., 2 : 517 ; pl. 31, fs. 19-21) 1876 *Bithynia costigera* (HANLEY & THEOBALD, Conch Ind. : 60 ; pl. 151, f. 10, after the authors it is possible that *Cyclostoma gradatum* PFEIFFER, 1854 (Zool. Proc. 1854 : 303) and *Turbo marginatus* CHEMNITZ are indentical with this species)–1884 *Bithynia costigera*' (NEVILL, Handl. Ind. Mus. Calcutta, 2 : 42, with var. *curta*)–1915 *B.* (?*Fossarulus*) *costigera* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 78, no 156)–1919*a Mysoria* (?*Fossarulus*) *costigera*

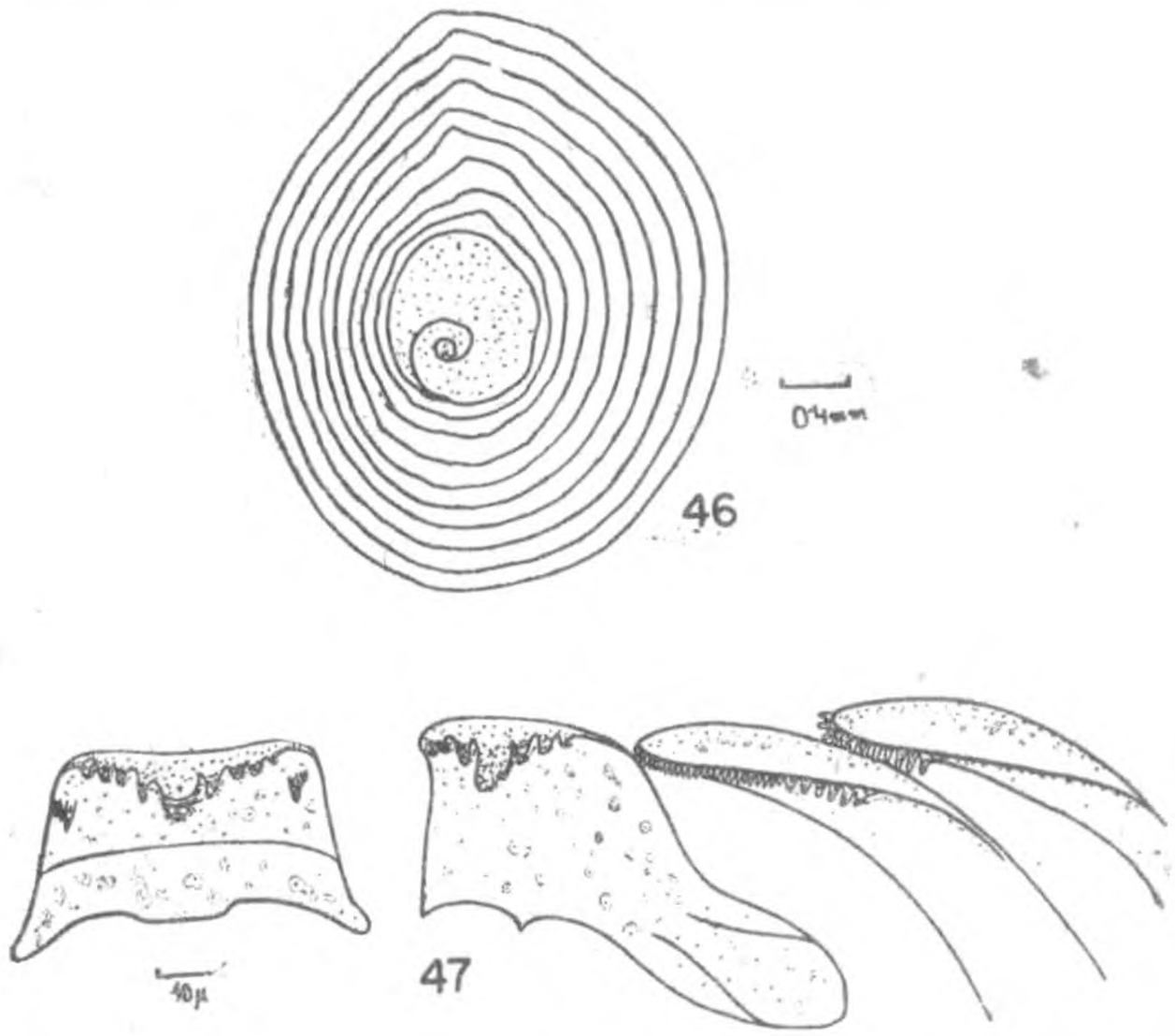
(GODWIN-AUSTIN, Rec.Ind. Mus. Calcutta, 16 : 209–213)–1919*b* *Mysorella costigera* (GODWIN-AUSTEN, ibid. : 431)–1928 *M. marginata* (CHEMNITZ) (THIELE, Zool. Jb. (Syst.), 55 : 355, f. 4)–1930 *M. costigera* (SESHAIYA, Rec. Ind. Mus. Calcutta, 32 : 1–28)–1931 *M. marginata* (CHEMNITZ) (THIELE, Handb. syst. Weichtierkde. : 155, fs. 127, 128)–1938 *M. costigera curta* (WENZ, Hand. Paläozool., Gastr., Pros. 593, f. 1626)–1962 *M. costigera* ((MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12 : 56).

Localities. Southern Province : No. 9 (1 ind.) ; Western Province : No. 10 (1 ind.) : North-Central Province : No. 79 (2 ind.), No. 80 (3 ind.) ; Northern Province : No. 96 (1 ind.).

Shell. Small, rigid, gyroform to conical-ovate, spire moderate elevated with 5-6 stairshaped deposed, convex whorls, prominent spiral edges, crossed by weaker vertical ridges ; the penultimate whorl bulging and blowing up ; umbilicus open. Aperture oblique-circular, slightly extended, peristome continuously thick (Fig. 45, Plate V).

	Shell		*Aperture*	
Sizes (in mm) :	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 9 (Wirawila) (Fig. 45)	7'3	6'3	4'2	3'5
No. 10 (Kelaniya)	7	5'6	3'7	3'3
No. 79 (Wilpattu)	5'8	4'6	3'4	3
No. 80 (Maha Bulankulama)	6'7	5	3'2	2'7
No. 96 (Mankulama)	6'9	5'5	3'4	3

The sizes are from the biggest specimens in the samples.



Mysorella costigera. Fig. 46 : exterior of operculum, Fig. 47 : radula teeth.

Operculum. Calcareous nucleus situated spirally, than concentrically (Size : No. 80:3'1mm × 2'6mm; Fig. 46).

Anatomical remarks. The internal anatomy of *M. costigera* has been described SESHAIYA, 1930 (Re.Ind.Mus. Calcutta, 32:-28) after specimens from India. Radula of an individual of No. 80: central tooth with one prominent central cusp and 4 denticles on either side (4-1-4), on the base of the trapezoid tooth on either side 3 fine basal denticles. The lateral tooth with the denticle formula of 3-1-3. The inner and outer marginals with a sawlike cutting edge formed by 25-30 resp. 12 very small denticles (Fig. 47).

Ecological-biological remarks. It is a rare species found in the stagnant waters of the lowland (pool, ponds, water reservoirs) with muddy bottom and dense vegetation. The shells are mostly eroded and covered with filiform algae.

Distribution.—India (Bengal, Bangalore) ; Ceylon.

SYNCERIDAE

(10) *Syncera* (=*Assiminea*) *cf. hidalgoi* (GASSIES, 1869)

Lit.—1869 *Hydrocena hidalgoi* (GASSIES, J. de. Conch., 17:18)-1882 *Assiminea granum* (MORELET, J. de Conch., 30:105; pl.4f.8)-1883*A. granum=hidalgoi* (MORELET, ibid., 31:208)-1887 *A. hidalgoi* BOETTGER, Jahrb.mal.Ges., 14:180)—1927 *Paludinella hidalgoi* (THIELE, Zool.Jb. (Syst), 53:118)-1956 *Syncera hidalgoi* (BENTHEM-JUTTING Treubia 23 (2) : 354, f. 67)-1961? *Assiminea hidalgoi* (SOLEM, Fieldiana, Zool., 41 (3) :433)-1970 *Paludinella hidalgoi* (STARMÜHLNER, Cah.O.R.S.T.O.M., sér. Hydrobiol., 4 (3/4): 59, fs. 51-54).

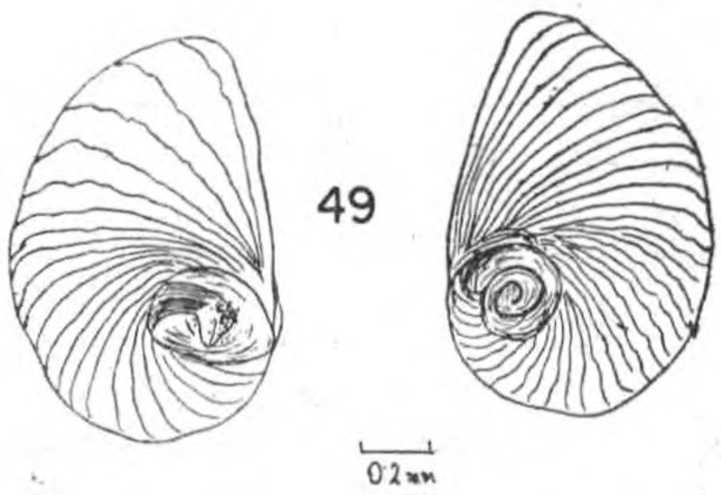
Locality.—Northern Province: No.99 (40 ind.).

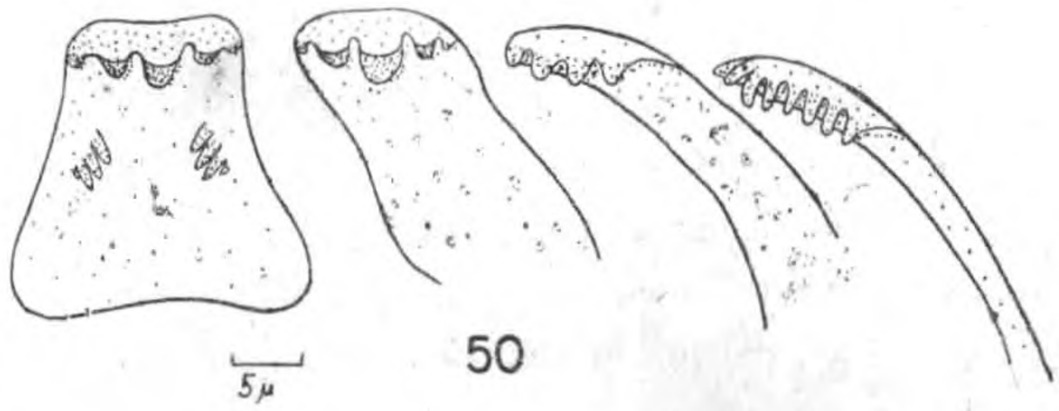
Shell..—The recorded shells from No. 90 probably belongs to *Syncera* (*Assiminea*) *hidalgoi* (GASSIES, 1869) : moderately conical, solid colour yellowish white to brown but somewhat shining and transparent finely sculptured by the growth lines, crossed by still more delicate spiral lines (lens 50 × !). The top is smooth, but whorls 2,3, and 4 with some raised spiral lines (clearly recogniz able on the shells form No. 99!). after the fifth whorl these lines fade away and there is no subsutural thread. The 6 whorls are rapidly increasing somewhat convex suture distinct but not deep periphery rounded. The narrow umbilicus is open. Aperture oblique-oval with rounded base and pointed top, the peristome is nearly continuous, the parietal side as callus against the previous whorl, exterior margin somewhat thickened, columellar margin thick, flattened and expanded (Fig. 48, Plate V).

			Aperture	
Sizes (in mm) :	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 99 (Nay Aru) (Fig. 48) ..	2′5 ..	2′1 ..	1′5 ..	1′2

The size is from the biggest specimen in the sample.

Operculum. Thin corneous paucispiral with excentrical nucleus, the inner surface with a small thin slightly curved apophyse, incisived on free end (Size:No. 99: 1′1mm × 0′8mm; Fig 49).





Syncera (*Assiminea*) cf. *hidalgoi* Fig. 49 : interior and exterior of operculum, Fig. 50 : radula teeth.

Anatomical remarks. The animals do not have-like all Synceridae =(Assimineidae)-true tentacles, but instead, two short stunted eyestalks in which are embedded the round black eyes. There are no gills and respiration is by means of a lung which opens to the right side of the mantle (see also ABBOT, 1948, Bull Mus. Comp. Zool., 100 (3) : 281-282). The central tooth of the radula is trapezoid in outline. On the cutting edge with one central cusp and two denticles on either side (2-1-2); on the base are 3-4 fine basal denticles. The lateral shows the denticle formula 2-1-2, the inner and outer marginal with 4, resp. 7-8 denticles (Fig 50). This type of radula found in the dissected specimens of No.99 differs from the drawing of the radula of *Paludinella hidalgoi* given by STARMÜHLNER 1970 (p. 60,f.52) from a specimen from New Caledonia. But the radula is very is similar to the drawing of a radula from *Syncera* (=*Assiminea*) *abbotti* (BRANDT, 1968, Arch.Moll., 98 (5/6) : 262-263, f, 32) from Thailand.

Ecological and biological remarks. At No. 99 (Nay Aru) found in brackish water of a flooded river, crossing a salt meadow near the coast. Lives associated with *Gangetia burmanica* and *Syncera* (=*Assiminea*) *cf. woodmasoniana.*

Distribution. Syncera (=*Assiminea*) *hidalgoi* is known from the brackish shores of the Indian and Pacific Ocean between Mauritius and New Caledonia.

(11) *Syncera* (=*Assiminea*) *cf wocdmasoniana* (NEVILL, 1880)

Lit. 1880 *Assiminea woodmasoniana* (NEVILL, J.Asiat. Soc. Bengal, 49: 163)-1881 A. *woodmasoniana* (NEVILL ibid., 50:pl.7,f.1)-1884 *A. woodmasoniana* (NEVILL, Handl. Ind.Mus. Calcutta, 2:69)-1887 *A. woodmasoniana* (BOETTGER Jahrb. mal.Ges., 14 : 211)-1956 *Syncera woodmasoniana* (BENTHEM-JUTTING, Treubia, 23 (2) : 352, f.66).

Locality. Northern Province: No. 99 (48 ind).

Shell.—Adult shells are attached to *Syncera* (=*Assiminea*) *woodmasoniana*, described from Lower Bengal by NEVILL 1880. They are high-conical and rather solid, the colour changes from yellowsih to chestnut-brown, the apical whorls are somewhat reddish. The surface is smooth and shining with oblique, darker growth lines and very delicate spiral lines (lens, 50x!). Near the periphery of the last whorl is in typical shells, described by NEVILL, 1880 and figured by BENTHEM-JUTTING, 1956, f. 66 a distinct raised spiral thread. But the shells from locality No. 99 bear the threads, below the periphery of the last whorl. Each succeeding whorl is pressed collar-like against the preceding whorl. Part of the previous whorl shines through, so that a false margin is formed along the suture. 7 whorls regularly increasing in diameter, form an ideal cone with nearly flat sides. Suture shallow, periphery rounded, only in immature shells bluntly angular. The apex is pointed, but not sharp, the base rounded. The umbilicus is nearly closed, the aperture is oblique oval with rounded base and pointed top. The parietal side of the continuous peristome is pressed against the penultimate whorl. The exterior margin is sharp, the columellar side is almost vertical, thicknene and flattended (Fig. 51, Plate V).

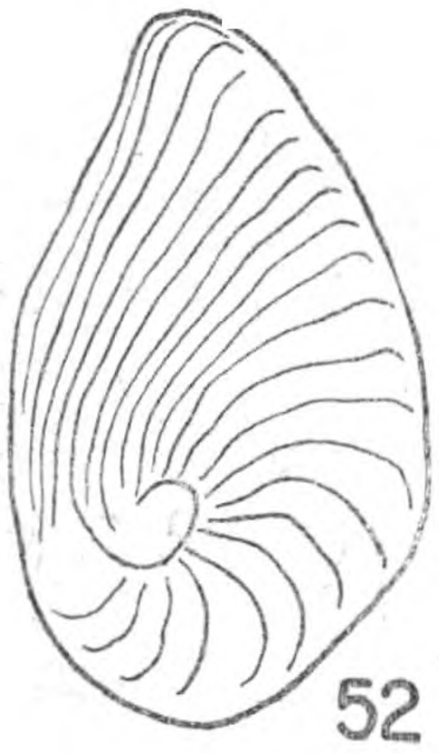
	Shell		*Aperture*	
Size (*in mm.*)	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 99 (Nay Aru) (Fig. 51) ..	3′2 ..	2 ..	1′3 ..	1

The sizes are from the largest shells in the sample.

Operculum. Thin, horny, oval with round base and a pointed top, paucispiral with excentrical nucleus (Size : No. 99 : 1′1mm, ×0′6,mm ; Fig. 52).

Anatomical remarks. 2 short stunted eyestalks with round eyes. The snout short and with blackish pigmentation. A deep oblique furrow in the flesh on each side of the body divides the head and body from the lower foot (Fig. 53). Radula : central tooth squarish with a long handle-shaped process at the lower margin ; the denticle-formula on the cutting edge is 2—1—2, also 2 very small basal denticles on either side of the base. The lateral has 3—1—3 denticles. The inner and outer marginals are with 7—8, and 20 denticles (Fig. 54) respectively.

The penis of the male is coiled and enlarged before the free end and consists of only one simple duct. (Fig. 55).



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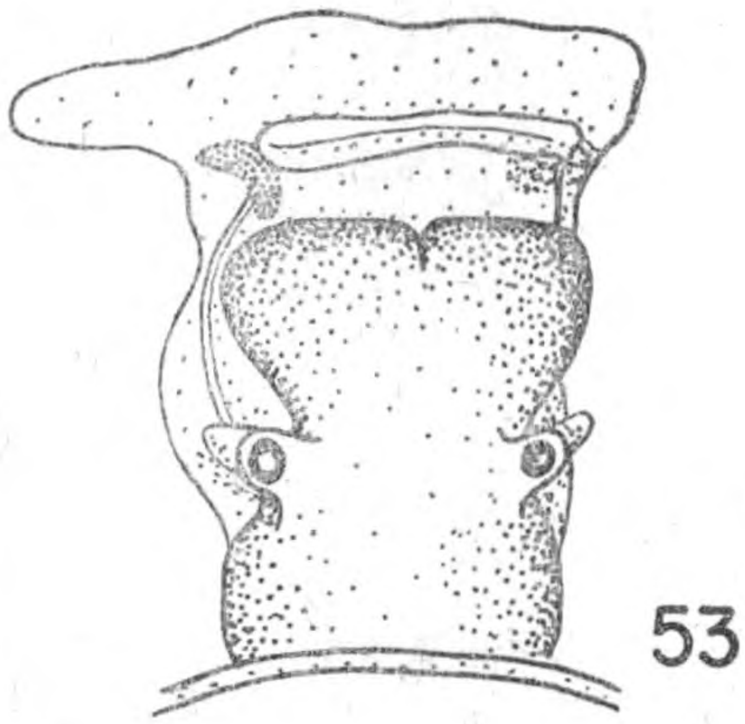

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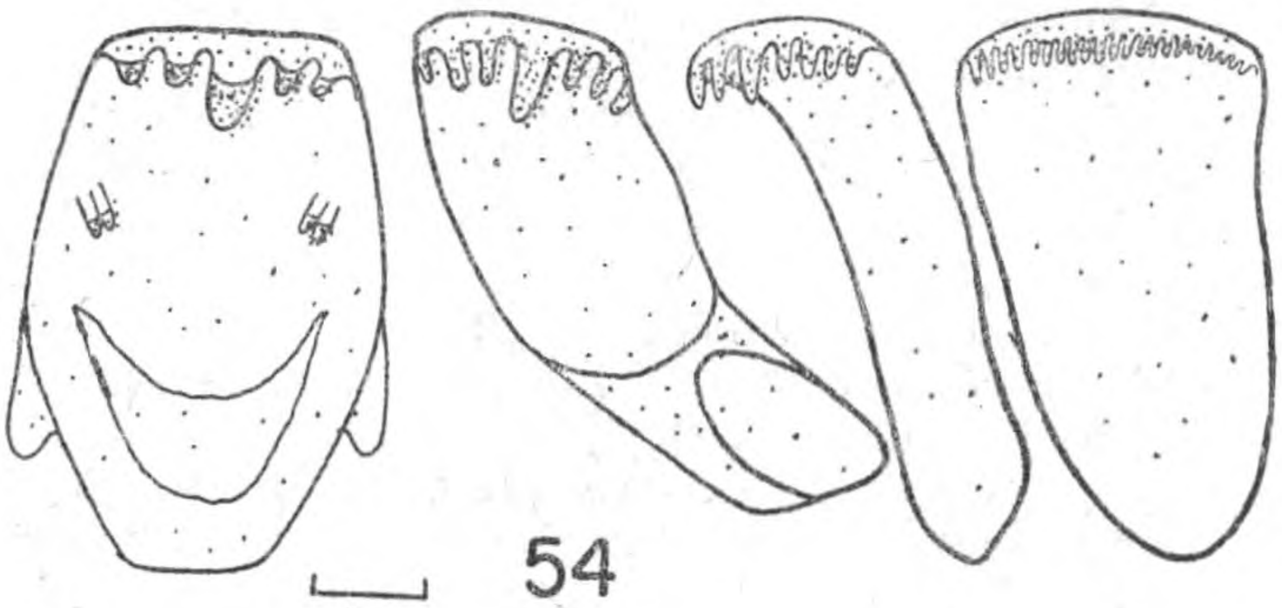

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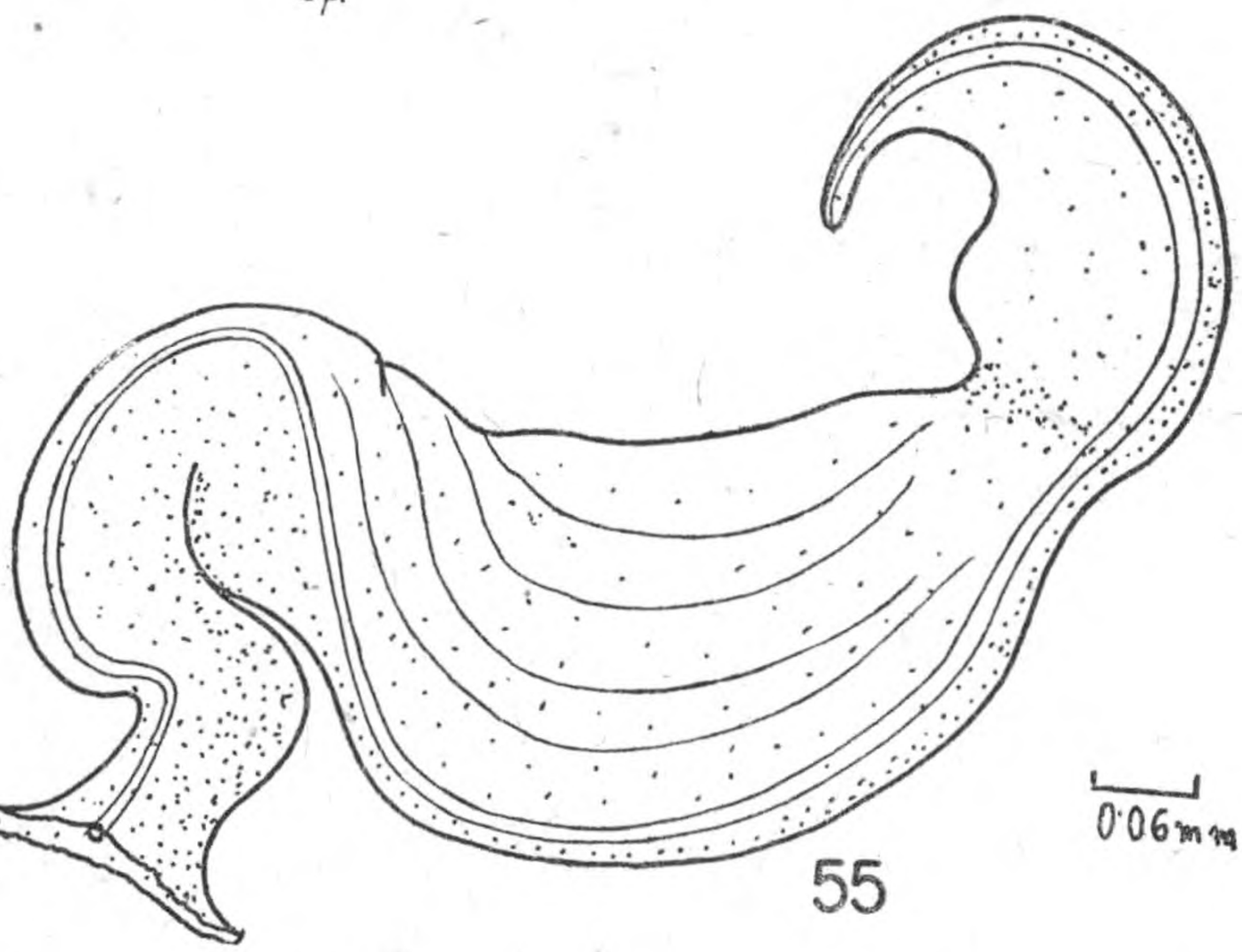

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Syncera (*Assiminea*) cf *woodmasoniana*. Fig. 52 : exterior of operculum, Fig. 53 ; Snout, eyestalks and oblique furrow in the flesh of each side of the body, Fig. 54 : radula teeth, Fig. 55 : penis.

Ecological and biological remarks :—The habitat of the snails from locality No. 99 (Nay Aru) was brackish water in a flooded river, crossing a salt meadow. The snails were found associated with *Syncera* (*Assiminea*) cf. *hidalgoi* and *Gangetia burmanica*.

Distribution.—Lower Bengal (Calcutta, Port Canning, Chandipal), Andaman Islands, Amsterdam Island in Djakarta Bay (Malay Archipelago). Probably first record for Ceylon.

Cerithiacea

Thiaridae (Melaniidae)

Melanopsinae

2. *Faunus ater* (Linné, 1758)

Lit. : 1758 *Strombus ater* (LINNÉ, Syst. Nat., End. 10 : 746)—1822 *Pirena terebralis* (LAMARCK, Hist. Nat, Anim. s. Vert., 6(2) : 169)—1848 *P. atra* (MOUSSON, Mitth. naturf. Ges. Zürich, 1 : 268)—1849 *P. atra* (MOUSSON. Land-u. Süssw. Moll. Java : 63 ; pl. 10, f. 1)—1856 *P. atra* (REEVE, Conch. Icon. : f. 5)– 1856 *P. picta* (REEVE, Conch. Icon. :f. 3)—1856 *P. pagodus* (REEVE, Conch. Icon—f. 4):1860 *P. atra* (ZOLLINGER, Nat. Tijd. Ned. Inst., 21: 318)—1874 *Faunus ater* (BROT, in MARTINI & CHEMNITZ, Syst. Conch Cab., 1 (24) : 410 ; pl. 44, f. 3 ; as synonyms are listed : *Nerita atra* MÜLLER, *Strombus atropurpureus* SCHROTER, *St. dealbatus* GMELIN, *Cerithium fluviatile* FÉRUSSAC, *Buccinum acicula* GMELIN, *Pirena acus* LESSON *Melanopsis princeps* LEA, *Faunopsis princeps* (LEA) GILL)—1884 *F. ater* (NEVILL, Handl. Ind. Mus. Calcutta, 2 : 217 ; with var. *perdecollata* : 218)—1888 *F. ater* (TENNISON WOODS, Proc. Linn. Soc. N. S. Wales, 3(2) : 1087)—1897 *F. ater* (MARTENS, in WEBER, Erg. Reise Nied. Ost—Ind., 4 : 191)—1899 *F. ater* (HORST & SCHEPMAN, Cat. Syst. Moll Mus. Hist. Nat. Pays—Bas, (13(2) : 267)—1914 *F. ater* (LESCHKE, Mitt. naturh. Mus. Hamburg. 31 : 258)—1915 *F. ater* (PRESTON, F. Br. Ind. (Freshw., Gastr. & Pelec.) : 9, no. 18, with *perdecollata* NEVILL and a list of synonyms)—1929 *F. ater* (BENTHEM-JUTTING, Treubia, 11 : 86)—1937 *F. ater* (BENTHEM-JUTTING-, Zool. Med. Mus. Leiden, 20 : 109)—1952 *Pirena terebralis* (MERMOD, Rev. Suisse Zool,. 59 : 78, f. 142)—1956 *Faunus ater* (BENTHEM-JUTTING, Treubia, 23(2) : 380, f. 78)—1962 *F. ater* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12 : 52, f. 5 ; with var. *perdecollata* NEVILL).

Localities. Southern Province : No. 3 (15 ind.) ; Western Province : No. 19 (3 ind.), North-Western Province : No. 87 (3 ind.).

Shell. High turreted with long and regular spire,thick ; colour dark-brown ; whorls flat with shallow suture and fine undulating growth striae crossed by a few strong and numerous fine spiral lines. Aperture vertical, broad-oval, with a distinct sinus at upper and lower end ; peristome outer margin with an incision at the upper corner, then protracts and recedes again towards the basal margins which are somewhat thickened and often with yellow reddish colour (Fig. 57, Plate VI).

The var. *perdecollata* NEVILL, 1884 is a form characterized by strong decollation, erosion of the surface and ironrust reddish colour of the peristome (Fig. 56, Plate VI.)

	Shell		*Aperture*	
Sizes (*in mm.*)	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 3 (Ambalangoda) var. *perde-*	69 ..	19 ..	18′5 ..	14
collata (Fig. 56, Plate VI) ..	64′5 ..	20′5 ..	18′5 ..	11
	66 ..	19 ..	18′8	12
No. 19 (Panadura) var. *perdecol-*	54 ..	18 ..	16 ..	11′5
lata ..	50′8 ..	17′7 ..	15 ..	11′2
..	50′3 ..	16 5 ..	15 ..	10
No. 87 (Kadaimparu) (Fig. 57, Plate VI)	66 ..	18 ..	16 ..	12
..	64 ..	17′8 ..	17 ..	12
	63′2 ..	18′2 ..	17′5 ..	10′5

The sizes are form the biggest specimens in the samples.

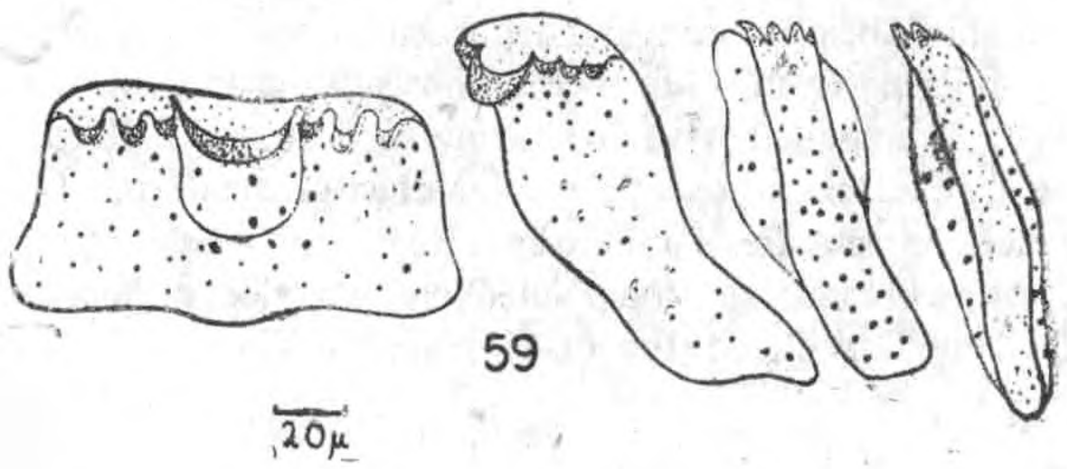
Operculum Horny, ovoid with the nucleus at the base, the growth striae are subspiral (Size:No.3:17mm × 12'5 mm ; Fig 58, Plate VI).

Anatomical remarks. Radula : Central tooth with broad trapezoid outline, on the cutting edge with a prominent broad central cusp and 3 small denticles on either side (3-1-3). The lateral tooth with the denticles formula 1-1-3, the inner and outer marginals with 3 resp.4 denticles ; both marginals have thin "wings" on either side (Fig. 59). This type of radula is very similar not only to the radula type of the genus *Melanopsis* (STARMÜHLNER, 1970 Cah. O.R.ST.O.M., sér. Hydrobiol., 4 (3/4) : 73, fs 88-90) but also to the radula type of the genus *Melanatria* (STARMÜHLNER, 1969, Malacologia 8(1/2):167, f.220).

The dissected female shows, like the genus *Melanopsis* (STARMÜHLNER, 1970, Cah.O.R.S.T.O.M., sér. Hydrolbiol. 4 (3/4) : 75, f. 92) and the genus *Melanatria* (STARMÜHLNER, Malacologia, 8 (1/2) : 176, f. 234) in the palliae cavity an open ciliated groove as oviduct separated by a fold from an other groove, the open duct of the receptaculum seminis (Fig. 60). The tentacles are long and slender and coloured with blackish and yellowish rings. The mantle edge possess many very small fringes.

Ecological-biological remarks.—In the coastal areas in fresh and slightly brackish water (No. 87, lagoon), living on mud flats which run dry during low tide. The females are oviparous.

Distribution.—On the coast of the Indo-Pacific area : Mauritius, Ceylon, (var. *perdecollata* : South and West Coast of Ceylon) Malay Archipelago, Philippines, New Guinea, New Ireland.



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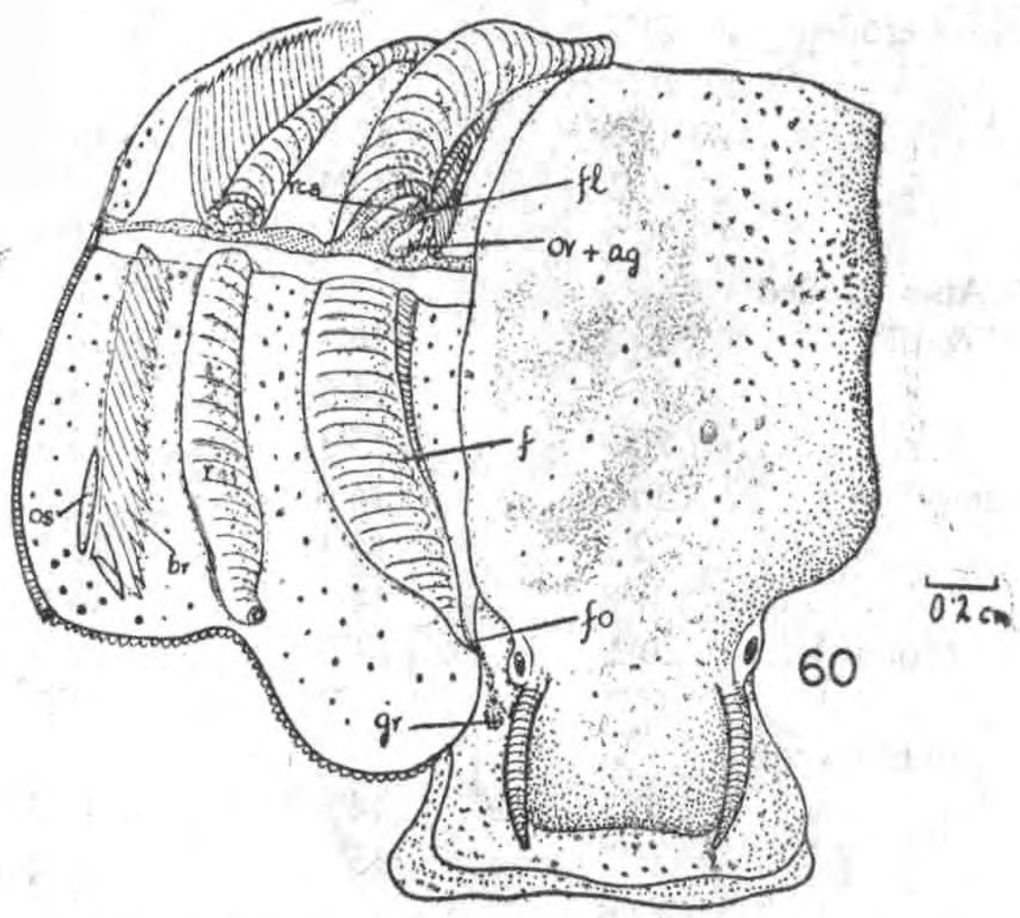

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Faunus ater. Fig. 59 : radula teeth. Fig. 60 : mantle cavity opened to show the lower parts of the open female ducts, a : albumen gland, br : gill, f: flange bordering edge of the left wall of the pallial oviduct, fl : fold, fo : female opening, gr : groove in the right side of the foot or : oviduct, r : rectum, res : receptaculum seminis.

Paludominae

(13) *Paludomus* (*Paludomus*) *chilinoides* REEVE, 1847

Lit. 1847 *Paludomus chilinoides* (REEVE Conch. Icon.: pl. 2, f. 7a; pl.3 f. 7b, 7c)-1850 Melania *zeylanica* (LEA, Proc. zool. Soc. London, 1850 : 194-195)-1852 *Paludomus phasianinus* (REEVE, Proc. zool.Soc. London, 1852: 127)-1852. *P. constrictus* (REEVE, ibid.: 129)-1854 *P. Reevis* (LAYARD Proc.zool.Soc. London 1854 : 89) (1854 *P.parvus* (LAYARD)

ibid.:90)-1857 *P. fulguratus* (DOHRN) Proc. zool. Soc. London, 1857:123)-1858 *P. pyriformis* (DOHRN) ibid. ; 1856:2 536)-1876 *P. laevis* (HANLEY and THEOBALD, Conch.Ind.:44; pl.108f.3)-1876 *P. parvus* (HANLEY and THEOBALD bid.:44; pl.108, f.7)-1876 *P. fulgurata* HANLEY and THEOBALD ibid.: 50 pl. 123, f. 1)-1876 *P. chilinoides* (HANLEY, & THEOBALD ibid. : 50; pl. 123, f.2)-1876 *P.pyriformis* (HANLEY & THEOBALD, ibid.: 51 ; pl. 125 fs. 2.31)-1876 *P. constricta* (HANLEY & THEOBALD ibid. 51 ; pl.126, fs 1-4)-1880 *P.chilinoides* (BROT in MARTINI & CHEMNITZ, Syst. Conch.Cab., 1(25):27; pl.2 fs. 5,6, pl. fs.8,8a, 9,10. 6,15; pl.7 fs.13,13a;as synonyms are listed: *constrictus* REEVE *fulguratus* DOHRN, *parvus* LAYARD, *phasianinus* REEVE *piriformis* DOHRN (=*pyriformis* DOHRN) and *zeylanica* LEA=1884 *P. chilinoides* (NEVILL Handl. Ind. Mus. Calcutta, 2:293; with var. *laevis* LAYARD)-1915 *P.constricta* (PRESTON, F.Br.Ind. (Freshw. Gastr. & Pelec.): 41, no. 68)-1915 P. chilinoides (PRESTON, ibid.:45, no. 78; as synonyms are listed: *phasianinus* REEVE and *parvus* LAYARD)- 1915 *P. ceylanica* (PRESTON, ibid.:46, no. 80)-1915 *P. fulgurata* (PRESTON, ibid. : 46, no. 81)-1915 *P. pyriformis* (PRESTON, ibid. : 51, no. 92)-1962 *P. chilinoides* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12:53, f. 3)-1962 *P. constrictus* (MENDIS & FERNANDO, ibid. : 53)-1962 *P. fulgurata* (MENDIS & FERNANDO, ibid. : 53)-1962 *P. laevis* (MENDIS & FERNANDO, ibid. : 53)-1962 *P. zeylanica* (MENDIS & FERNANDO, ibid.: 56, f.4).

Localities. Western Province: No. 17 (1 ind.); Sabaragamuwa Province: No. 36(48 ind.); Central Province: No. 49 (22 ind.), No. 50 (80 ind.), No. 52 (13 ind.), No. 54 (5 ind.), No. 55 (12 ind.); Uva Province: No. 60 (6 ind.), No.63 (49 ind.), No. 64 (9 ind.). No. 65 (77 ind.) ; Eastern Province: No. 72 (4 ind.), North Central Province: No. 74 (39 ind.), No. 81 (4 ind.), No. 82 (1 ind.), No. 83(1 ind.); North Western Province: No. 84 (1 ind.), No. 85 (26 ind.).

Shell. Ovate rather thin spire small, exserted, 5 whorls depressed round the upper part, smooth. The chief variation of form consists in the whorls being more or less depressed around the upper part, after the manner of a *Chilina*, with spire varying considerably in its elevation. Mostly the whorls of the apex are eroded and there remains only 2-3 whorls. Colour yellow-brown to olive, spotted or waved with one or more rows of dots. The markings are very variable, being sometimes oblique zigzag lines, extending over the whole surface of the whorls, sometimes sagittate or short zigzag spots in transverse series. Some specimens are of a uniform olive to dark green or the coloration is masked by a thick layer or black iron-oxide. Aperture broad-ovate, top pointed, base rounded, peristome continuous, at the parietal side as callus, thick and expanded. Umbilicus closed (Fig. 61-64, Plate V & VI).

	Shell		*Aperture*	
Sizes (in mm.) :	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 17 (Attanagala) Apex eroded	21'3	14'6	15'3	12
No. 36 (Kegalla)	20'1	12'8	13	10'4
Apex eroded	18'7	12'6	12	9
No. 49 (Kandy)	20'2	13'3	13'5	10'4
Apex eroded	20'3	14	14'4	11'5
No. 50 (Peradeniya) Apex eroded (Fig. 61-64 Plates V & VI)	24'3	16'3	16	11'5
No. 52 (Udawela)	21	14'6	13'6	10'2
No. 54 (20mls E of Kandy)	20	15'3	13'8	11
No. 55 (10mls E of Kandy)	20'5	14'6	13'5	10
No. 63 (Badulla)	22'5	14'3	13'5	10
Apex eroded	21'8	14	13'4	9'8
No. 65 (Monaragala Mount.)	20'2	14'3	13	10'1
Apex eroded	18'5	14'7	13'3	10'5
No. 72 (Kokagala Mount.) Apex eroded	20'3	14'8	13'3	10
No. 74 (Habarane)	24'7	15'7	15'4	12'5
	23'6	15'3	15'4	11
	22'1	14'2	13'8	11
	22	14	13'6	10
No. 81 (Ritigala) Apex eroded	23'8	15'4	15'1	11
No. 83 (Habarana)	19'2	13'5	12	9
No. 84 (Kurunegala)	20'2	13'1	12'2	9'3
No. 85 (Narrammala)	23'5	14'3	14'6	10'8
Apex eroded	21'7	14'1	14'2	10'6

The sizes are from the biggest specimens in the samples.

Operculum. Horny, ovoid; the outside border concave, base rounded ; nucleus submedian left ; subspiral, than concentrical growth striae. At the inner surface, the region of the nucleus is distinctly marked by stairlike deposited growth lines (Size: No. 50:9'5mm/10mm × 6/6'7mm Fig. 65, Plate V.)

Anatomical remarks. SESHAIYA, 1934 (Rec.Ind.Mus.Calcutta, 36:185-212, 15figs.) has given a detailed study on the anatomy of *Paludomus* (*Paludomus*) *tanschauricus* (GMELIN 1791). The internal antaomy of dissected specimens of *Paludomus* (*Paludomus*) *chilinoides* from Ceylon correspond with the results of SESHAIYA, 1934. Following are some accounts : Head tentacles and surface of the foot are darkbrown to olive with interspersed yellow spots arranged in transverse rows. The sole of the foot is of a light greyish colour and yellow spotted (Fig. 66, Plate VII).

The anterior part of the mantle has a broad greyish-white area behind the darker pigmented mantle edge. The mantle surface varies in colouration in different parts : in the male at the right side the male genital duct is of an orange colour, in the female the lower part of the oviduct is coloured greyish-white to creamy. Over the ctenidial region the mantle has a bluish-greenish apearence. On the lower end of the penultimate whorl is the pericardium and the termination of the style sac, as a translucent spot. In the female the ovary in the first and second whorl is composed of greyish tubes with interspersed yellow patches. In the male the corresponding whorls are occupied by the testis with an orange-reddish colour (Fig. 67, Plate VII).

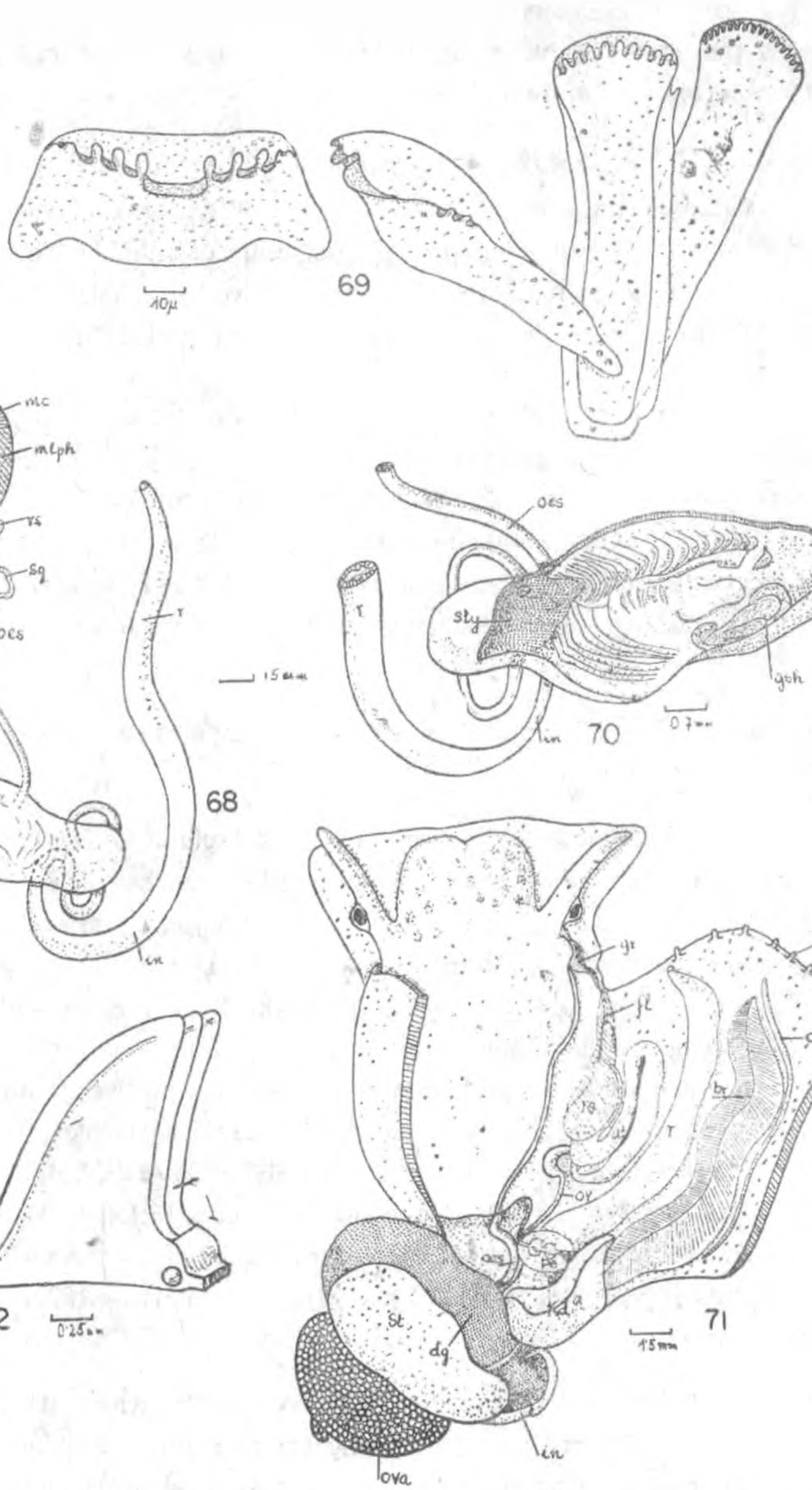
The mantle edge posseses 15-17 finger-like processes. If the snails are moving these processes are extended in to the water and project forwards (Fig. 66, Plate VII).

The digestive system begins with the mouth in the form of a vertical split at the end of snout. The buccal mass, including the oral cavity, the pharynx with radula and cartilages is pyriform and surrounded by the musculus circularis on the oral part and the musculus levator pharyngis on either side of the pharynx. The salivary glands are long, slender and somewhat coiled. They enter below the cerebral-commissure on the dorsal side of the pharynx where they open into the buccal cavity. The radula sac is short and slightly coiled (Fig. 68). Radula: central tooth with a broad trapezoid outline. The base protrudes in the middle, the cutting edge bears one broad central cusp and 3-4 denticles on either side (3/4-1-3/4). The quadrilateral lateral tooth with a prolonged base posses the denticles formula 2-1-3. The inner and outer marginals are somewhat spatulate in shape and bears 7-10, resp. 15-17 small denticles (Fig.69). This type of radula agrees with the radula of *Paludomus* (*P.*) *tanschauricus* described by SESHAIYA 1934, p.195, fig.7) and the radula of *Paludomus* (*P.*) *obesa* figured by ANNANDALE, 1919 (Rec.Ind.Mus. Calcutta, 16:139-152). The radulae of the genus *Paludomus*, subgenus *Paludomus* shows also a close resemblence to the radulae of the genus *Cleopatra* and its species in Africa and Madagascar (STARMÜHLNER, 1969 Malacologia 8(1/2): *C. colbeaui*: p.189, f. 247: *C. madagascariensis* and *C. grandidieri*: p. 204 fs. 266 and 270).

The oesphagus is long and slender and stretches in the floor of the mantle cavity to the bean-shaped stomach with the style sac. The stomach shows in the cavity some folds forming a major and minor typhlosole in front of the gastric shield (Fig. 70). The intestine, after coming from the stomach, forms two loops before the rectum enters into the right outside part of the mantle cavity (Fig. 68).

The kidney is greyish to yellow in colour and is situated at the apex of the body whorl. The anterior end projects into the mantle cavity and is triangular in shape. The aperture is placed on the right side. The pericardium, including ventricle and auricle, lies between kidney and style sac. (Fig. 71). The gill consists of about 200 lamellae. which are triangular in shape (Fig. 71, 72).

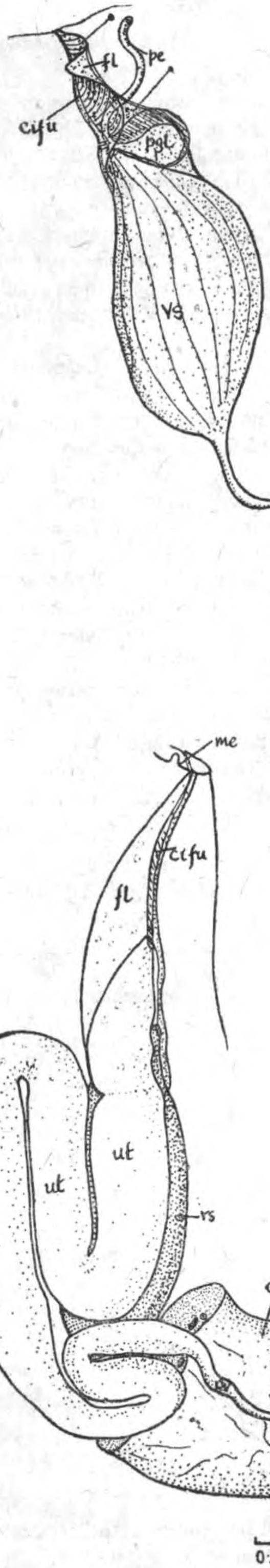
The nervous system agrees with the description and the figure of *Paludomus* (*P.*) *tanschauricus* given by SESHAIYA, 1934 (p. 200, f. 10). From the oval cerebral ganglia which are connected by a short, thick commissure, arises seven nerves (n. tentacularis, n. opticus, 3 n. labiali and the connective between cerebral and buccal ganglion). A further, very thin nerve goes to the statocyst. The pleural ganglia are very closely approximated to the cerebral ganglia, only connected by short connectives. From the right pleural ganglia arises the supraintestinal connective and the right pleural nerve. The subintestinal ganglion is attached to the left pleural ganglion. From this ganglion arises the left pallial nerve and



Paludomus (*Paludomus*) *chilinoides*. Fig. 68; digestive systems; in : intestine, mc : musculus circularis, mlph : musculus levetor pharyngis, oes : oesophagus, r : rectum, rs : radula sac, sg : salivary gland, St : stomach with crystal style sac) Fig. 69 ; radular teeth. Fig. 70 : Stomach and crystal style sac opened to show the folds in the cavity and the gastric shield ; gsh : gastric shield, in : intestine, oes : oesophagus, r : rectum, sty : styl sac Fig. 71 : Mantle cavity of female : br : gill, dg : digestive gland, fl : flap, gr : groove at the right side of the foot, in : intestine, kd : kidney, Fig. 72 : 3 lamellae of the gill.

then. columellaris. From the subintestinal ganglion arises the connective to the visceral ganglion crossing the supraintestinal connective from the right pleural ganglion to the supraintestinal ganglion. From the subintestional ganglion arises also a short nerve to the right side connecting with the right n. pallialis which is typical dialineurie (Fig. 73). The somewhat elongated pedal ganglia are connected by connectives of moderate length with the cerebral and pleural ganglia (Fig. 73).

In comparison with the nervous system of the genus *Cleopatra* (STARMÜHLNER, 1969; p. 196 f. 257, and p. 204, f. 271) the nervous system of *Paludomus* is very similar to it and confirms the close relationship of these two genera.



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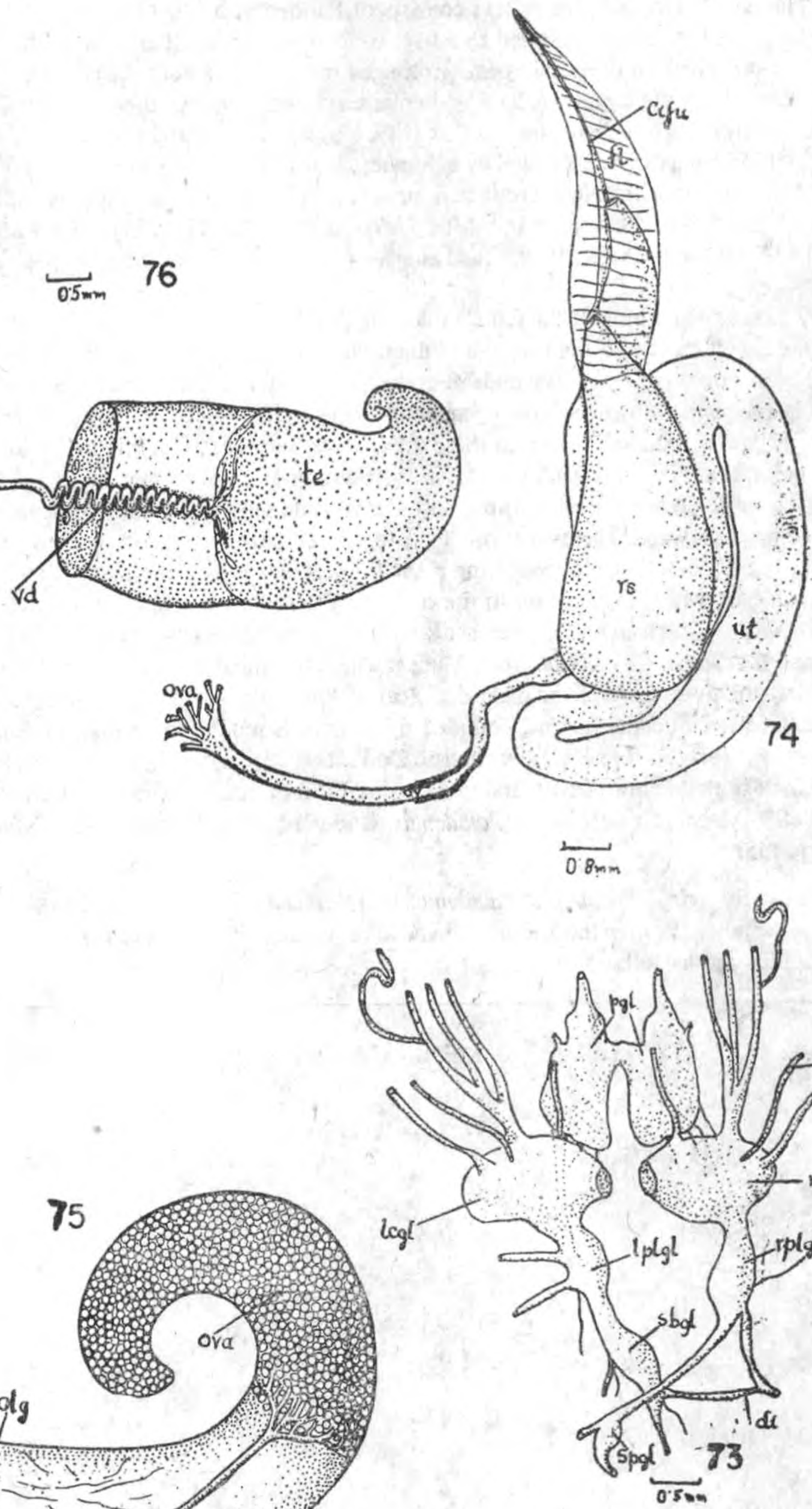

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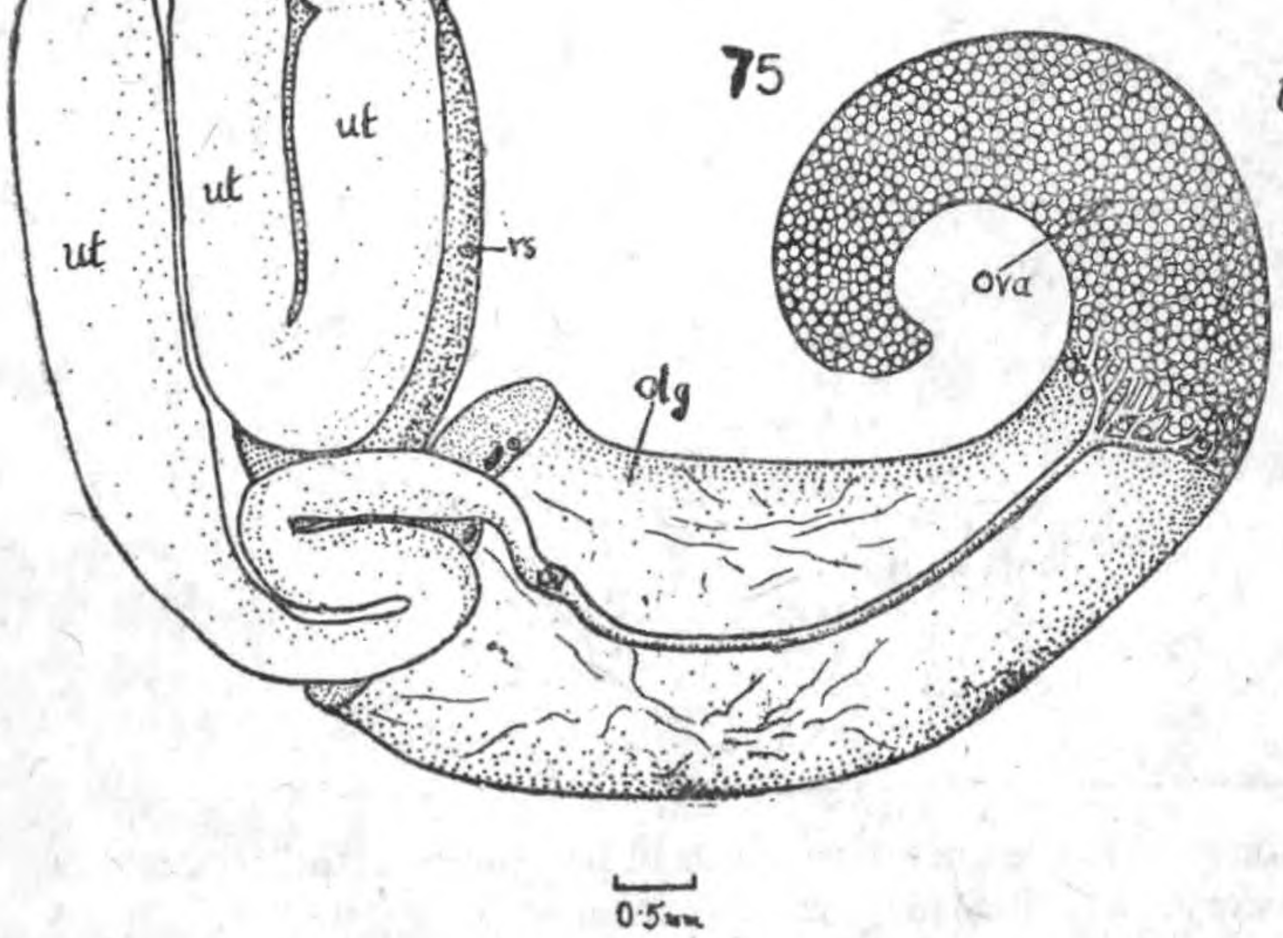

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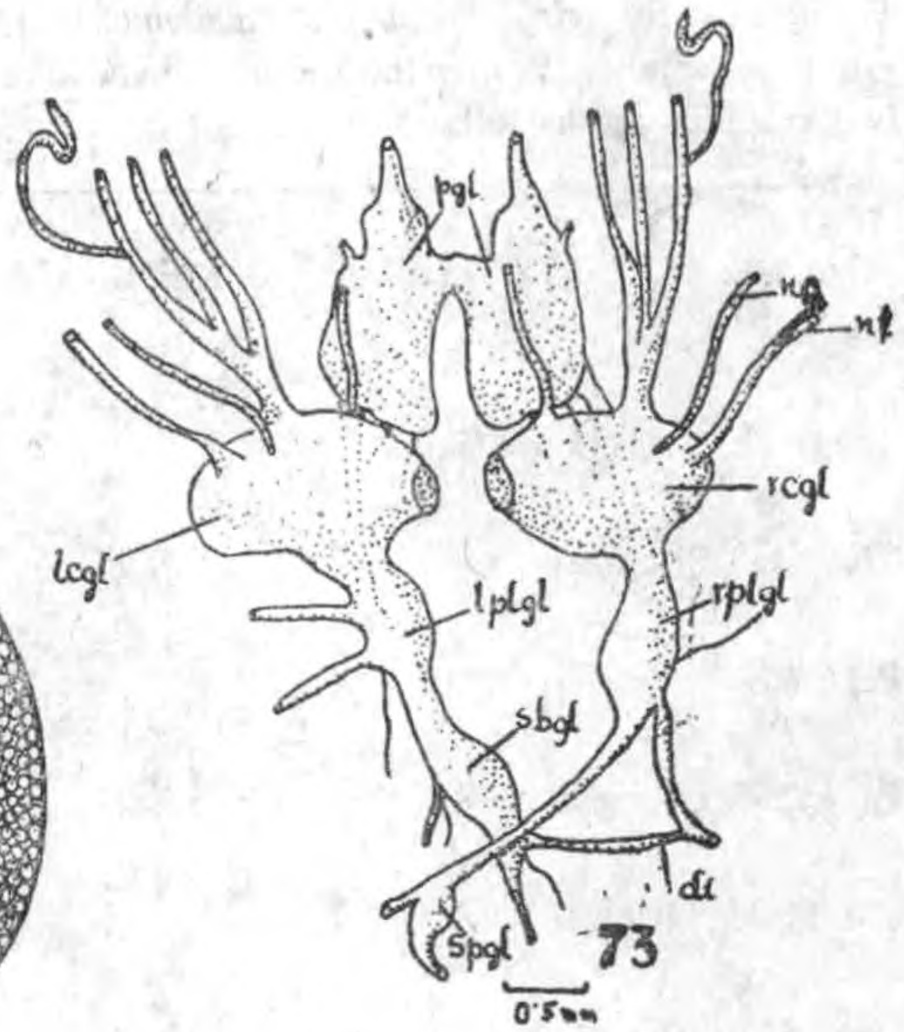

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Paludomus (*Paludomus*) *chilinoides*. Fig. 73: nervous system ; di : dialineuric. lcgl : left cerebral ganglion, lplgl : left pleural ganglion, no : nervus opticus, nt : nervus tentacularis, pgl : pedal=ganglia, rcgl : right cerebral ganglion, rplgl : right pleural ganglion, sbgl : subintestinal ganglion, spgl : supraintestinal ganglion. Fig. 74 : Reproductive system of a female, shown from the outside ; ci fu : ciliated furrow, covered by a fl : flap, ov : oviduct, Ova : ovary (lower part ; efferent ducts), rs : receptaculum seminis, ut : uterus with albumen gland in the upper part and the capsule gland in the lower part of the walls. Fig. 75 : Reproductive system of a female seen from inside ; abbreviations like fig. 74 and dg : digestive gland, me : fringed mantle edge. Fig. 76 : Reproductive system of a male, shown from inside ; ci fu : ciliated furrow, guarded by a fl : flap, pe : penis, pgl : penis gland, tes : testes, vd : vas deferens, vs : vesicula seminalis.

The female reproductive system consists of the ovary, oviduct, uterus, vagina, receptaculum seminis and in the lower part a ciliated furrow, guarded by a flap, conducting to a small groove on the right outside of the foot. The ovary consists of branched tubules. They are prolonged into small efferent ducts, which join in the oviduct. It runs on the columellear side of the digestive gland and enlarges on entering into the mantle cavity into a thick walled uterus. The last forms, on the right side of the mantle cavity, a s-shaped loop and passes into the vagina. Near the opening of the vagina in the ciliated furrow, guarded by a thin flap, is also the opening of the sac of the receptaculum seminis (Fig. 74,75). The formation of the female reproductive organs agrees with the description and figures of *Paludomus tanshauricus*, given by SESHAIYA, 1934 (Rec. Ind. Mus. Calcutta, 36 : 206–209, f. 14). They are also very similar to the conditions found by STARMÜHLNER, 1969, Malacologia 8 (1/2) : 196 f. 159) for the Madagassian species of the Genus *Cleopatra*.

The micro-anatomy of the female ducts of *Paludomus* is given for *Paludomus* (*Tanalia*) *neritoides*. (p. 153). There are no differences in the macro-and micro-anatomy of the reproductive system of the different species of the genus *Paludomus* examined. The male reproductive system consists of the testis, the vas deferens, the enlarged vesicula seminalis, the penis with an accessory gland and a ciliated furrow-like in the female-guarded by a thin flap. The testis consists of fine tubular follicles, from these ducts arises the vasa efferentia and lead to the vas deferens. The last runs on the columellar sides omewhat coiled, in the right part of the mantle cavity. Entering into the roof of the mantle cavity, the vasdeferens enlarges abruptly into the vesicula seminalis. These vesicula shows on the inside some furrows bordered by thick walls. These furrows allied to one ciliated furrow on the opening of the vesicula. Near these openings lies a sac-like glan dconducting a small duct-the penis-to the mantle border. The furrow is bounded by a thin, small flap, which overlaps on to the outside of the vesicula seminalis (Fig. 76). This again corresponds with the, of *Paludomus* (*P.*) *tanschauricus*, described and figured by SESHIYA, 1934 (p. 203.206, f. 12). In comparison wita the genus *Cleopatra*, C. *colbeaui* from Madagascar (after the description from STARMÜHLNER, (1969), p. 198.199) shows that the lower part of the male duct (called "prostata"-with glandular cells) opens into the posterior part of the mantle cavity and the furrow, bounded by a flap, is much longer than in *Paludomus*. There is also no penis in *Cleopatra*. BINDER, 1959 (Rev. Suisse Zool., 66 : 735) describes only a small male duct for *Cleopatra bulimoides* from Africa in the mantle cavity and gives no indication about a ciliated furrow. The micro-anatomy of the male reproductive system of a species of *Paludomus* is described and figured for *Paludomus* (*Tanalia*) *neritoides* in this study. (p. 153).

Ecological—Biological Remarks : Paludomus (*P.*) *chilinoides* is very frequent in slow to fairly fast-running streams with gravel and sandy bottom in the low and upland areas of Ceylon (up to 600 m). The physical and chemical data from two localities are as follows:—

No. 60 : KUDA OYA, a tributary of MENIK GANGA	No. 74 : a small stream between Habarane and Dambulla
Temp. : 25'5°C (11h, 9.12.1970)	25'5°C (18h, 15.12.1973)
Curr. : 30-50 cm/sec	30 cm/sec
PH : 7'7	7'25
El_{20} : 295 µSiemens	605 µSiemens
Tot. Hard. : 9'2°dH	12'9 dH
Ca0 : 52 mg/1	50'9 mg/1
Mg0 : 28'9 mg/1	56 mg/1

Both streams flow outside of the precambric granitic area and show much higher values in the conductivity, total hardness, content of Ca0 and Mg0 than the streams and rivers in the granitic region.

The frequency of the species in the locality No. 74 was as follows : At a current speed of 30 cm/sec : on sand : 2–3 ind./ 1/4m², on small stones, surrounded by sand and mud : 2–3 ind./ 1/16m² (=approx. 8–12 ind./1/4 m²).

The snails prefer stones and rocks emerging from the water surface and usually extend the anterior parts of their bodies out of water. On sandy bottom the animals usually come towards the water-edge of the stream and even crawl about outside the water. In an aquarium it could be observed that the animals crawl about outside the water and feel quite at home for some length of time provided that the air is humid. The snails are positively phototactile and move towards the light. In an aquarium, they disappear during the night into the upper layers of the sandy or gravelly bottom. They feed on diatoms and filamentous algae, growing on the stones and rocks. Fully grown specimens are to be met in abundance in the months between October and January. The shells of these specimens are mostly covered with filamentous algae and mud mixed with iron-oxide. In the aquarium, copulation was observed during the months of August-September. During copulation the male sits on the right side of the female (Fig. 77, Plate VII.).

It is stated by RAMANAN, 1900 (Non-marine Mollusca of Madras) that the females of *Paludomus* are oviparous, but we have never found ripe eggs in the uterus. We believe that the snails are ovivivíparous, this means that the young snails come out of the eggs after the eggs have passed the opening of the vagina and the ciliated groove from the anterior mantle cavity to the right part of the foot. But further observations are necessary.

Distribution : Low and upland of Ceylon.

(14) *Paludomus* (*Paludomus*) *inflatus* BROT, 1880

Lit: 1880 *Paludomus inflatus* (BROT, in MARTINI and CHEMNITZ Syst. Conch. Cab., 1(25): 44 ; pl. 18, f. 25, 26)—1884 ?*P. striatula* (NEVILL, Handl. Ind. Mus. Calcutta, 2 : 297)—1915 *P. inflata* (PRESTON, F. Br. Ind. (Freshw. Gastr. and Pelec.) : 49, no . 86)—1915 ?*P. striatula* (PRESTON, ibid. : 49, on . 87)—1962 ?*P. striatula* (MENDIS and FERNANDO, Fish. Res. Stn. Bull., 12 : 56).

Locality:—Eastern Province : No. 71 (2 ind.).

Shell:—There is some confusion in the literature concerning *Paludomus inflatus* and *striatulus*. The firset species, recorded after BROT, 1880 (p. 44) from South India (Travancore, Amerghat, Tinnevelley) has a globular elevated shell, moderately rigid ; the spire is elevated, but the apex is mostly eroded and it remains only as 3 steep-lik convex whorls. The penultimate whorl is abruptly enlarged and globular. Below the suture it is flat and then strongly arched ; the surface has distinct, unequal spiral furrows, olive with zigzag lines. The aperture is broad ovate, inside white with translucent zigzag-lines, top pointed, base blunt angled, the columella arched and thick, the callus on the parietal side distinct, the peristome on the outside sharp and arched.

Paludomus striatulus is recorded after NEVILL, 1884 (p. 297), from Ceylon. The author has not given any figures for this species, he states : " in BROT's pl. 7, fs. 7–8, in the Syst. Conch. Cab., 1 (25), 1880, *Paludomus isseli* from Borneo gives an exact representation of this new and rare Ceylon form ; the well developed, crowded, almost granulose spiral striation will at once distinguish it." But PRESTON, 1915 (p. 49) notes and we confirm this opinion that BROT's figures appear to depict a conically fusiform, solid, lightbrown form, with yellowish labrum and aperture. They do not, however, give any appearance of a spiral sculpture.

Therefore we belive that *Paludomus striatulus* is a synonym for *P. inflatus* from South India. Our shells, 2 specimens, not fully mature, correspond exactly with the description and figures of *Paludomus inflatus* given by BROT, 1880 Fig. 78 Plate VIII).

	Shell		*Aperture*	
Sizes (in mm.)	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 71 (Rambukkan Oya) (Fig. 78, Plate VIII) ..	11'6	8'5 ..	8	6

Anatomical remarks. No dissections were made. *Operculum :* Typical.

Ecological remarks. The two immature individuals were found by the Lund University Expedition 1962 in a shallow river with sandy bottom and banks ; partly open, partly covered by sedges in a secondary dry forest area.

Distribution. South-India (Travancore ; Amerghat ; Tinnevelley or Tirunelveli in Madras State) ; Eastern Ceylon.

(15) *Paludomus* (*Paludomus*) *palustris* LAYARD, 1854.

Lit. : 1854 *Paludomus palustris* (LAYARD, Proc. zool. Soc. London, 1854 : 89)—1876 *P. palustris* (HANLEY & THEOBALD, Conch. Ind. : 51 ; pl. 126, fs. 2, 3)—1880 *P. palustris* (BROT, in MARTINI & CHEMNITZ, Syst. Conch. Cab., 1 (25) : 42 ; pl. 8, fs. 27, 28)—1915 *P. palustris* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 47, no. 82)—1962. *P. palustris* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12 : 53).

Locality. In the collection of COSTA et al. 1971, but without particulars of the locality (No. 100). In the literature (PRESTON, 1915 : 47) is noted : the grassy margin of a tank near Anuradhapura (North-Central Province).

Shell. Ovate with exserted spire form 3-4 whorls, rounded, rather flat, spirally closed grooved with minute granular striae (lens) ; apex mostly eroded, colour yellow to brown with dark brown spots, frequently running in wavy lines (Fig. 79, Plate VII).

Sizes (in mm)	*Shell*		*Aperture*	
	Ht.	*Diam.*	*Ht.*	*Diam.*
Ceylon (Fig. 79, Plate VIII) ..	.. 15'2	.. 9'6	.. 10	.. 7
	14'7	.. 9'5	.. 9'5	.. 6'6

The sizes are from the biggest specimens in the sample.

Operculum. Typical for the genus *Paludomus*, subgenus *Paludomus*. No data for anatomical ecological and biological remarks are available. PRESTON, 1915 (p. 47) notes : grassy margin of a tank.

Distribution. After PRESTON, 1915 (p. 47) : Anuradhapura : North-Central Province of Ceylon.

(16) *Paludomus* (*Paludomus*) *tanschauricus* GMELIN, 1791.

Lit. 1791 *Paludomus tanschaurica* (GMELIN, in LINNÉ Syst. Nat. : 3655 (no 244) for the *Helix fluviatilis tanschaurensis* of CHEMNITZ, Conch. Cab., 9 : 174, f. 1246, 1247 (1243 ?))-1847 *P. spiralis* (REEVE, Conch. Icon. ; f. 15)—1850 *Melania modicella* (*Rivulina*) LEA, Proc. zool. Soc. London, 1850)—1852 *Paludomus acutus* (REEVE, Proc. zool. Soc., 1852: 127)—1862 *Paludina lutosa* (EYDOUX & SOULEYET, Voy. " Bonite", Zool., 2 : 550 ; pl. 31—fs. : 28—30)—1853/58 *Paludomus spurcus* (SOULEYET, in ADAMS, Gen. rec. Moll. ; pl. 36, f. 2)—1858 *Rivulina modicella* (ADAMS, Gen. rec. Moll. : Suupl. ; 2 : 623)—1859/62 *Paludomus spurcus* (CHENU, Man. Conch. : f. 2208)—1876 *P. acuta* (HANLEY & THEOBALD, Conch. Ind. : 50, pl. 123, f. 7)—1876 *P. lutosa* (HANLEY & THEOBALD, : 50.; pl. 123, & 6)-18-6 *P. tanschaurica* (HANLEY & THEOBALD ibid.: 50, pl. 123, f.8)—1880 *P. tanjoriensis* (BROT, in MARTINI & CHEMNITZ, Syst. Conch. Cab., 1 (25) : 40 ; pl. 8, fs.: O—23 ; as synonyms are listed : *Helix lanschaurica* GMELIN, *Helix tanschauriensis* (GMELIN) CHEMNITZ *Helix fluviatilis* DILLWYN, *Paludomus tanschaurica* GMELIN, *P. acutus* REEVE, *P. gracilis* PARREYSS, *Melania modicella* (LEA) ADAMS, *P. paludomus spiralis* REEVE, *Paludina lutosa* SOULEYET, *Paludomus lutosa* (SOUL.) HANLEY & THEOBALD, *P. nasutus* DOHRN, *P. spurcus* (SOUL. ADAMS)—1884 *Paludomus tanschaurica* (NEVILL, Handl. Ind. Mus. Calcutta, 2 : 294 ; with var. *kandapaensis* and *malabarica*)—1915 *P. tanchaurica* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 47, no. 83)—1915 *P. lutosa* (PRESTON, ibid. : 51, no 94)—1915 *P. acuta* (PRESTON, ibid. : 52, no 97)—1934 *P. tanschaurica* (SESHAIYA, Rec. Ind. Mus. Calcutta, 36 : 185—212).

Localities. North-Central Province : No. 73 (7 ind.), No. 78 (1 ind.), No. 81 (2 ind.), No. 82 (8 ind.) ; Northern Province : No. 94 (1 ind.), No. 95 (4 ind.), No. 98 (2 ind.).

Shell. Globular turret-like with 4-8 convex whorls the first whorls with remarkable keeled spiral-ridges in the older shells the apex is sometimes eroded. On the penultimate whorl are the spiral-ridges mostly dissolved. Colour yellow-brown with darkbrown spots mostly running in lines and waves. Aperture ovate, top-pointed (Fig. 80, Plate VIII)

Sizes (in mm.)	*Shell*		*Aperture*	
	Ht.	*Diam.*	*Ht.*	*Diam.*
No. 73 (Anuradhapura) (Fig. 80, Plate VIII)	15 ..	7'5 ..	7 ..	5
No. 78 (Wilpattu) Apex eroded ..	14'5 ..	8'7 ..	8 ..	6'5
No. 81 (Ritigala) Apex eroded ..	11 ..	7'4 ..	7 ..	5'2
No. 82 (Minneriya) Apex eroded ..	10'4 ..	7'6 ..	7 ..	5
No. 98 (Paraiyanalankulam Apex ..	14 ..	9'5 ..	8'2 ..	5'5
eroded	11 ..	6'6 ..	6'2 ..	4'2

The sizes are from the biggest specimens in the samples.

Operculum. Typical for the subgenus *Paludomus* s.str.

Anatomical remarks. SESHAIYA, 1934 (Rec.Ind.Mus.Calcutta 36:185-212 with 15 text figs, (gives a detailed study of the macro-and micro-anatomy of these species.

Ecological-biological remarks.—The species inhabits slow-flowing streams and canals. In No. 73 (Anuradhapura) the snails occur in a polluted canal moving on the sides at a speed of 30 cm./sec. In this locality the pH was 7 and the and the total hardness was F°dH. In locality No. 78 (Wilpattu) and No. 94 (Paranthan) the animals were found in temporary streams in dry secondary scrubland with water in the bed only during the rainy season,. The occurence of the snail in North Ceylon extends from the low to the upland in the Ritigala Nature Reserve in 500 m. altitude. RAMANAN, 1900 (Non-Marine Mollusca of Madras) and SESHAIYA, 1934 (p. 185) report that in South India the snails occur in clear, slow moving, shallow streams with a sandy bottom, where the animals usually come towards the water-edge of the stream and extend the anterior parts of their bodies out of water. The snails feel quite at home out of water for some length of time, and even crawl outside water. This behaviour give the snails the possiblity to leave dried out temporary streams—and to burrow in the mud. Fully grown specimens are found usually in November and December. The shells of these animals are mostly coated with encrustations of mud and algae. The food of the snails consists of diatoms and filamentous algae like *Spirogyra*. The females are ovivivíparous.

Distribution. Central India, Bombay, Madras, Hoogly, Pondycherry (after BROT, 1880, p. 41) mostly in the lowland. First record for (the Northern Provinces of) Ceylon.

(17) *Paludomus* (*Paludomus*) *tanschauricus* (GMELIN, 1791) subspec. *nasutus* DOHRN, 1857.

Lit. 1857 *Paludomus nasutus* (DOHRN, Proc. zool. Soc. London, 1857 : 123)–1876 *P. nasuta* (HANLEY & THEOBALD, Conch. Ind. : 50 ; pl. 124, f. 7)–1880 *P. tanjoriensis* var. *nasutus* (BROT, in MARTINI & CHEMNITZ Syst. Conch. Cab. 1 (25) : 41 ; pl. 8, f. 18)–1915 *P. nasuta* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 52, No. 95)-1962 *P. nasutus* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12 : 53).

Localities.—Sabaragamuwa Province : No. 33 (1 ind,) ; Central Province : No. 53 (8 ind.) ; Uva Province : No. 61 (75 ind.) : No. 62 (2 ind.), No. 68 (8 ind.).

Shell.—Highly conical, smooth, with obsolete furrows on the penultimate whorl, grooved and mostly carinated; on the upper whorls the ridges are not always well developed like in *tanschauricus* s. str. The apex is sometimes eroded, but never in specimens occurring in habitats with high total hardness and high content of CaO, like locality No. 61, Spire variable in height, sometimes concave acute, consiting of 7–8 whorls, when perfect, of which 2–3 are sometimes eroded. Sutures deep, those of the last whorl marginate. Typical for the subspec. *Nasutus* is a distinct impressed line after the suture (DOHRN, 1857 describes on p. 123 as : "ad suturam linea valde impressa"). Upper whorls angular, penultimate whorl ventricose, flattened above towards the mouth, usually marked with 2–5 linear obsolete furrows on the periphery. Colour darkbrown, spiral bands only to see on the inner side of the peristome which is continuous. The aperture is gibbous, ovate, pointed above, the outer lip sharp, columella callous (Fig. 81, Plate VIII).

Sizes (in mm.)	*Shell*		*Aperture*	
	Ht.	*Diam.*	*Ht.*	*Diam.*
No. 53 (Madugoda)	11′5 ..	7′7 ..	7′5 ..	5′4
No. 61 (Wetakei Ela) (Fig. 81, Plate VIII) ..	15′1 ..	8′2 ..	8′4 ..	6
	15 ..	8′4 ..	8 ..	6′2
	14′7 ..	8′4 ..	8′3 ..	5′4
	14′3 ..	7′9 ..	8′2 ..	5′8
No. 62 (Diyaluma Falls) Apex eroded ..	11′6 ..	7′4 ..	6′9 ..	4′9
	10′8 ..	7 ..	6′8 ..	4′8
No. 68 (Badulla) Apex eroded	14 ..	9′7 ..	9 ..	6′8
	12 ..	7′8 ..	7′5 ..	5

The sizes are from the biggest specimens in the samples.

Operculum. Typical for the subgenus *Paludomus* s. str.

Anatomical remarks. No dissections were made.

Ecological-biological remarks. The snails prefer the edges of fast-running streams in the up-and highland of the Central and Eastern parts of the mountains in South Ceylon. In the locality No. 61 the subspec. *nasutus* occurs in a calcareous stream (Wetakei-Ela, an affluent of the Kirindi Ganga) running through dense forest. The rocks and gravel in this stream are coated by calcareous sinter. The snails crawl on sandy bottom in the edges of the stream. The ecological factor of No. 61 were recorded on 9.12.1970 (14*h*) :

Temp. : 23′9°C	CaO : 59 4 mg/l
Curr. : 30cm/sec (edges of the stream)	MgO : 40′8 mg/l
pH : 8′3	SiO_2 : 54′8 mg/l
El_{20} : 360 µ Siemens	Tot. Hard. : 14′6°dH

The frequency of *Paludomus* (*P.*) *tanschauricus* subspec. *nasutus* on the borders of the Wetakei-Ela was 1–5 ind/ 1/16m², and were living together with young specimens of *Paludomus* (*Tanalia*) *solidus*. At the Locality No. 62 (Diyaluma Falls), the frequency was lower (pH : 6′7, El_{20} : 34µ Siemens, total hardness : 0′8′dH, Sio_2 : 24′8 mg/1). In this locality with very low hardness the apices of all shells were eroded like in all streams of the crystalline rocks in the highland with low content of CaO. In No. 68 the species occurs up to 1200 m. altitude.

Distribution.—The distribution of subspec. *nasutus* is only in the East and South East of the Central high and upland of Ceylon.

(18) *Paludomus* (*Philopotamis*) *bicinctus* REEVE, 1852

Lit. 1852 *Paludomus bicinctus* (REEVE, Proc. zool. Soc. London, 1852 : 129)—1852 *P. abbreviatus* (REEVE, ibid. : 127)—1876 *P. bicincta* (HANLEY & THEOBALD, Conch. Ind. : 50, pl. 123, f. 10)—1876 *P. abbreviata* (HANLEY & THEOBALD, ibid. : 51, pl. 125, f. 7)—1880 *Philopotamis bicinctus* (BROT, in MARTINI & CHEMNITZ, Syst. Conch. Cab., 1 (25) : 17 ; pl. 5, fs. 6–9, 11, 12, as synonym is *abbreviatus* listed)—1915 *Paludomus abbreviata* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 52, No. 96)—1915 *P. bicincta* (PRESTON, ibid. : 54, No. 102)—1962 *P. abbreviatus* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12 : 53)—1962 *P. bicinctus* (MENDIS & FERNANDO, ibid. : 53).

Localities. Central Province : No. 54 (9 Ind.) : Uva Province : No. 66 (14 ind.), No. 67 (1 ind.), No. 68 (30 ind.)

Shell. Oblong–globular, spire small with 3 whorls, apex mostly eroded and 2 whorls remaining, convex, the penultimate whorl big and ovate ; delicately striated, colour brown to olive. Aperture ovate, on the inner surface two broad, but indistinct chestnut–brown bands, base rounded, top pointed (Fig. 82, Plate VIII).

Sizes (in mm.)	*Shell*		*Aperture*	
	Ht.	*Diam.*	*Alt.*	*Diam.*
No. 54 (20 mls E of Kandy) (Fig. 82, Plate VIII)	17′5	14	12′9	9′8
No. 66 (Yalakúmbara)	12′7	9	10	7′2
Apex eroded	12′8	9′2	10′1	7′5
No. 67 (Adawatte) Apex eroded	12′7	9′7	9′2	8′8
No. 68 (6 mls SE of Badulla) Apex eroded	16′5	12′5	13	9′8

This sizes are from the biggest individuals in the samples.

Operculum. Horny, subtriangularly ovate, apex superior, paucispiral, nucleus sub-basal, dextral. The subgenus *Philopotamis* is based upon the characters of the operculum (see also *P.* (*Ph.*) *sulcatus* and *P.* (*Ph.*) *nigricans.*)

Anatomical remarks. No dissections were executed.

Ecological–biological remarks. Occuring in fast to fairly fast-running streams with cascades, surrounded by bush or forest with thick layers of debris. Between 250m. and 1100m in the eastern parts of the central up-and highland.

Distribution. Ceylon : Mountains of the eastern Central and Uva Province.

(19) *Paludomus* (*Philopotamis*) *decussatus* REEVE, 1852.

Lit.—1852 *Paludomus decussatus* (REEVE, Proc. Zool. Soc. London, 1852 : 127)—*P. decussatus* (HANLEY & THEOBALD, Conch. Ind: 50, pl. 123, f. 3)—1880 *Philopotamis decussatus* (BROT in MARTINI & CHEMNITZ, Syst, Conch, Cab., 1 (25) : 19 ; pl. 5, fs. 15-16)—1915 *Paludomus* (*Philopotamis*) *decussata* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 54, No. 100)—1962 *Paludomus decussatus* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12 : 53).

Locality.—Uva Province No. 66 (12 ind.).

Shell.—Allied to *P.* (*Ph.*) *bicinctus* but more acuminate-ovate and rigid ; apex decollated, spire with 3–4 whorls, moderate convex, delicate and indistinct striated in spiral and vertical lines (finely "decussated" surface) but could be only seen with a lense ; penultimate whorl ovate, convex; colour whitish-yellow to olive with indistinct, livid spiral-bands like in *bicinctus* seen on the inner surface of the peristome). Aperture ovate, top pointed (Fig. 83, Plate VIII).

Sizes (*in mm.*)	*Shell*		*Aperture*	
	Ht.	*Diam.*	*Ht.*	*Diam.*
No. 66 (Yalakumbura) (Fig. 83 Piate VIII)	14′2	9′5	8′6	6

The sizes are for the biggest specimen in the sample.

Operculum. Typical for the sub-genus *Philopotamis.*

Anatomical remarks. No dissections were executed.

Ecological-biological remarks. Occuring (No. 66) in a fast running stream with borders coated by debris at an altitude of 450m.

Distribution. Ceylon : uplands of the Uva Province.

(20) *Paludomus* (*Philopotamis*) *nigricans* REEVE, 1847

Lit. : 1847 *Paludomus nigricans* (REEVE, Conch. Icon. pl. 2, f. 6)—1859/62 *P. nigricans* (CHENU, Man. Conch. f. 2213)—1876 *P. nigricans* (HANLEY & THEOBALD, Conch. Ind: 50 ; pl. 124, f. 1)—1880 *Philopotamis nigricans* (BROT, in MARTINI & CHEMNITZ, Syst. Conch. Cab., 1 (25): 22; pl. 2, fs. 1, 2 ; pl. 6, fs. 5, 5a, 6, 6a,)—1884 *Paludomus* (*Philopotamis*) *nigricans* (NEVILL, Handl. Ind. Mus. Calcutta, 2 : 299 ; including var. *subgranulosa*)—1915 *P.* (*Ph.*) *nigricans* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 55, No. 105, including var. *subgranulosa* NEVILL)—1928 *P. nigricans* (THIELE, Zool. Jb. (Syst.), 55, 392, f. 51—1962 *P. nigricans* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12 : 53).

Loclalities. Central Province : No. 46 (202 ind.) No. 53 (8 ind.), No. 57 (2 ind.) No. 58 (3 ind.).

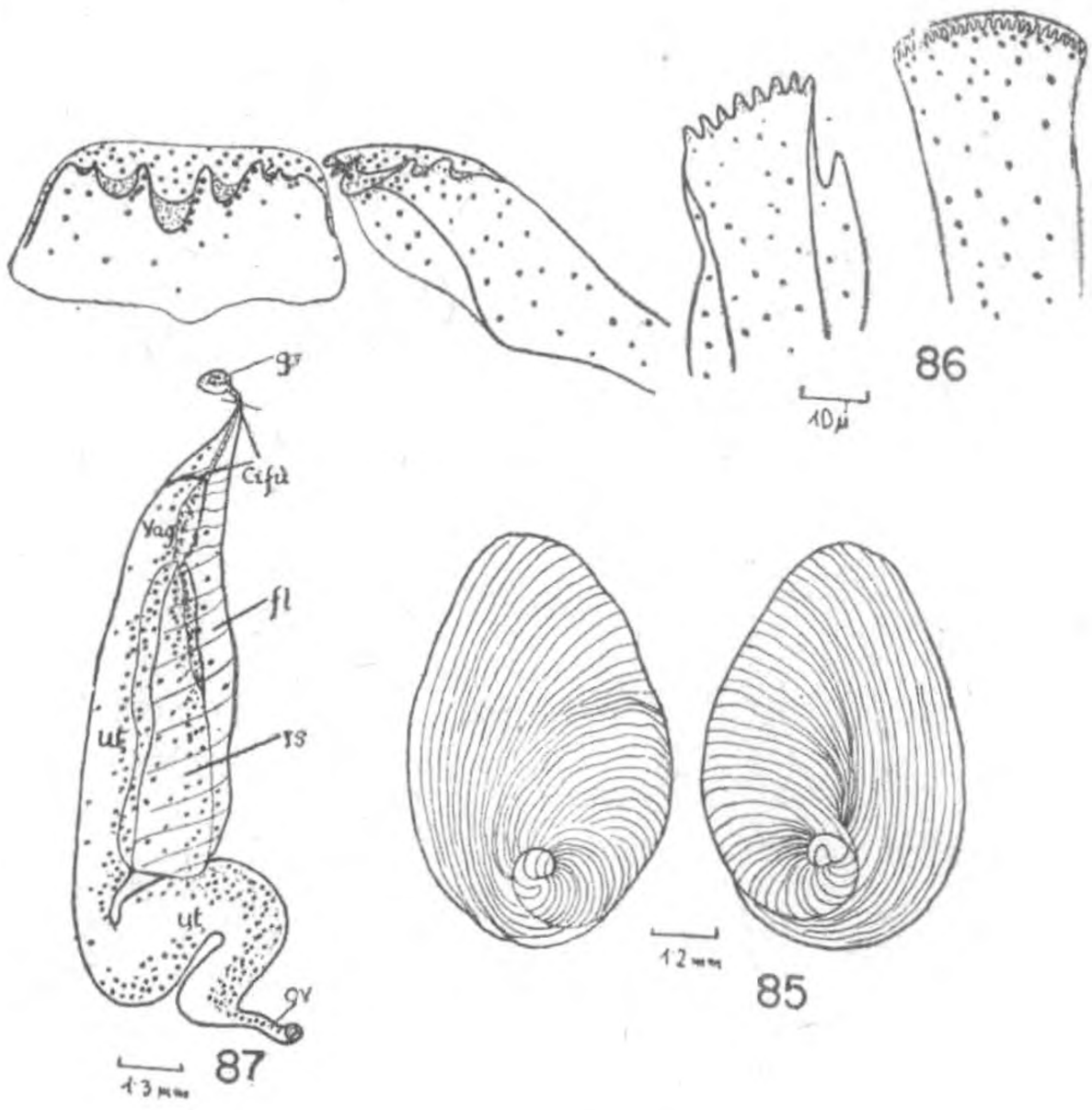
Shell. Ovate spire rather prominent exserted, 2–4 whorls but apex mostly eroded, in tie var. *typica* surface neatly smooth in the var. *subgranulosa* NEVILL (= var. β of BROT 1880, p. 23; pl. 6, fs. 6,6a with spiral and vertical striae, forming a delicate granulation. The observations of BROT 1880 and our observations show all transitions between smooth and subgranulated surfaces of the whorls in one population. Last whorl faintly angled towards the base. Colour blackish interior of the aperture is ovate, pointed and is bluish ; young specimens are reddish brown with chestnut-brown indistincet bands. These are not to be seen in adult specimens coated with darkbrown to blackish encrustations (mud and iron-oxide) (Fig. 84, Plate VII).

Sizes (*in mm.*) :	*Shell*		*Aperture*	
	Ht.	*Diam.*	*Ht.*	*Diam.*
No. 46 (Hakgala-Gardens (Fig.84 Plate VIII)	13′2	8′4	8	5.5
	12′7	8	7′2	5′2
No. 53 (Madugoda)	11′5	7′7	7′5	5′3
No. 57 (Diyagama East)	12′6	8′2	7′8	5
No. 58 (Horton Plains)	13′6	9′4	8′5	5′7

The sizes are for the biggest specimens in the samples.

Operculum. Typical for the subgenus *Philopotamis*, peculiar are the distinctly spiral growth striae (Size of a specimen of No. 46 : 7′9 mm × 5′4 mm, Fig . 85).

Anatomical remarks. Radula: The central tooth is broad-trapezoid on the cutting edge with one prominent central cusp and 2-3 lateral denticles on either side; the lateral tooth is quadrilateral prolonged with 2–1–1 denticles (see also THIELE, 1928, p. 392, f. 51), the inner and outer marginals with 8, resp. 21-23 small denticles (Fig.86).



Paludomus (*Philopotamis*) *nigricans*. Fig. 85 : exterior and interior of operculum, Fig. 86; radula teeth. Fig. 87: reproductive system of a female, shown from the outside, gr: groove on the left side of foot, vag : vagina , other abb. as : in fig. 74.

Reproductive system: The lower part of the female genitals are very similar to the investigated species of the subgenus *Paludomus* : the oviduct enlarges, after the entry into the right part of the mantle cavity, to a thickwalled uterus, forming a narrow S-shaped loop. This opens into a vagina in the ciliated furrow, guarded by a thin flap. The furrow guides to the right side of the foot in a small groove. Near the vagina opens also the sac-like receptaculum seminis (Fig. 87).

Ecological-biological remarks: Paludomus (*Ph.*) *nigricans* occurs in Ceylon exclusively in the cool brooks torrents and streams of the highland in the Central Province in altitudes between 8000m and 200m. The frequency of this species in locality No. 46 (Hakgala Dola in the Hakgala Gardens near Nuwara Eliya) was as follows :—

Near the borders of the brook on sandy bands (also outside of the water) with debris : 10-20 ind./1/16 m² (current : 0–20cm/ sec); on stones and rocks in a current between 30-50cm/sec: 15 ind./1/16m². The temperature in the highland-streams is around 15° C (2.12.1970 (13ʰ) ; 15′2° at No. 46). The pH in No. 46 was 6′9, the electrolytic conductivity: El_{20} : 26 µSiemens ; total hardness: 0′65° dH, CaO:2′6mg./1, MgO :2′7 mg/1. It could be stated that the species is a stenothermic form living in cool, very soft and slightly acidic water.

Distribution. Ceylon : Crystalline Highland of the Central Province.

(21) *Paludomus* (*Philopotamis*) *regalis* (LAYARD, 1854)

Lit. 1854 *Philopotamis regalis* (LAYARD, Proc. zool. Soc. London, 1854:93)-1855 *Ph. regalis* (LAYARD, Ann. Mag : 1855:193)-1868 *Ph. regalis* (BROT, Mater., 3:54; pl. 3mf. 15)-1876 *Paludomus regalis* (HANLEY and THEOBALD, Conch.Ind. 49 ; pl. 121, f. 10)-1880 *Philopotamis regalis* (BROT, in MARTINI and CHEMNITZ, Syst. Conch. Cab., (25) : 21 ; pl. 6, fs.1-4)-1915 *Paludomus* (*Philopotamis*) *regalis* (PRESOTN, F. Br. Ind. (Freshw. Gastr. and Pelec.): 55, no 104)-1962 *P. regalis* (MENDIS and FERNANDO, Fish. Res. Stn. Bull., 12: 56).

Localities. Southern Province: No. 7 (2 ind). PRESTON, 1915, p. 55 notes the locality as Western Province: Ciana Corale.

Shell. Oblong-ovate, spire exserted, short whorls rounded, depressed at the upper part, spirally corded with close-set slight ridges, longitudinally minutely striated and crowned with a single row of short, sharp, hollow angular spines, closely set. Colour yellowish olive painted with wavy, dark brown longitudinal lines. Aperture ovate top pointed (Fig. 88, Plate VIII).

The altitude of an immature shell of No. 7 (Haycock Mountains) is 8'5 mm.

Operculum. Typical for the subgenus *Philopotamis.*

Anatomical remarks. No dissections of the immature specimens were executed.

Ecological-biological remarks. The record is from a stony fast running stream at an altitude of 325m, surrounded by the dense indigenous forest of the Haycock Mountains.

Distribution. Ceylon Upland of the Southern and Western Province.

(22) *Paludomus (Philopotamis) sulcatus* REEVE, 1847

Lit. 1847 *Paludomus sulcatus* (REEVE Conch. Icon.: pl.2, f. 8a, pl.3 fs. 8b., 8c)-1855 *P. sulcatus* (LAYARD Ann. Mag. Nat. Hist., ser. 2,16: 134)-1876 *P. sulcata* (HANLEY and THEOBALD, Conch. Ind. :50; pl.122, f. 2)-1880 *Philopotamus sulcatus* (BROT, in MARTINI and CHEMNITZ, Syst. Conch. Cab., 1 (25):20; pl.2, fs. 7, 8; pl.5, fs. 17-20)-1884 *Paludomus (Phlilopotamis) sulcata* (NEVILL Handl. Ind. Mus. Calcutta, 2:22, with the subvar. *minor, contracta* and *compacta*)-1915 P. (Ph.) *sulcata* (PRESTON, F. Br.Ind. (Freshw. Gastr. and Pelec.): 53, no. 99, with the subvar. *minor* NEVILL *contracta* NEVILL *compacta* NEVILL)-1928 *P. sulcata* (THIELE, Zool. Jb. (Syst)., 55:392, f.54)-1938 *P. (Ph). sulcata* (WENZ Handb. Paläozool, Gastr., 1:704, f.2028)-1962 *P. sulcatus* (MENDIS and FERNANDO, Fish. Res. Stn. Bull., 12:56, with the var. *compactus* NEVILL, *contractus* NEVILL and *minor* NEVILL).

Localities. Southern Province. No. 2 (2 ind.), No. 7 (6 ind.); Western Province : No. 22 (3 ind.); Sabaragamuwa Province : No. 26 (12 ind.) No. 39 (1 ind.); Localities in the literature are after BROT, 1880 (p. 21) and PRESTON, 1915 (p. 53) mountain streams at Ratnapura, Uda Pusselawa, Peradeniya and Ambegammuwa.

Shell. Ovate with a prominent spire but mostly eroded; whorls 3-5, rounded, spirally very closely grooved, grooves and intermediate ridges very closely decussated with longitudinal striae. Colour yellowish to olive pointed here and there with black spots, sometimes forming vertical flames; Aperture subtrianguarly ovate, top pointed (Fig. 89, Plate IX).

	Shell		*Aperture*	
Sizes (in mm) :	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 2 (Nagahaketa-Dola, Nilvala Ganga)	19'7 ..	12'3 ..	13'1 ..	8'8
	18 ..	12 ..	12 ..	9'9
No. 7 (Haycock Mountains) ..	16 ..	12'8 ..	12 ..	9
	15'5 ..	10'3 ..	10'2 ..	7'3
No. 26 (Rajanawa Dola near Ratnapura) (Fig: 89, Plate IX) ..	22 ..	14 ..	13'4 ..	11'2
	19 ..	13'5 ..	13'2 ..	11'2
	17 ..	12'5 ..	12'4 ..	11'2
No. 39 (Kuruwita, 6mls NNW Ratnapura)	26'2 ..	18'3 ..	16'7 ..	13'3

The sizes are for the biggest individuals in the samples.

Operculum. Typical for the subgenus *Philopotamis* (founded by LAYARD, 1855 Ann.Mag. Nat. Hist., ser. 2, 16:134 on the type *Paludomus sulcata* REEVE and based upon the characters of the operculum) : horny, subtriangularly ovate, apex superior paucispiral, nucleus sub-basal and dextral (Sizes (No. 26) : 13mm × 11 mm; Fig. 90).

Anatomical remarks. One male from No. 26 was dissected and this showed the typical parts of the male reproductive system of the genus *Paludomus* : enlarged vesicula seminalis in the lower part of the male duct, a small penis with a sac-like gland and a ciliated furrow from the opening of the male duct to the outside of the right part of the mantle cavity. This furrow is like in the female of *Paludomus* covered by a thin flap. On the mantle edge of the dissected specimen were 19 finger-shaped processes. Radula: central tooth is broader than long, on the cutting edge with (2-3)-1(2-3) denticles, the prolongated lateral tooth with the formula 2-1-3 and the inner and outer marginals with 5-6, resp. 14-15 delicate denticles. Our observations agree with the figure of the radula, given by THIELE, 1928 (p. 392, fig. 54).

Ecological-biological remarks. Paludomus (*Philopotamis*) *sulcatus* inhabits moderately fast to fast-running mountain streams with gravel boulders and sand. In a current between 30cm. and 75 cm/sec we found on stones and rocks in No. 2 (Nagahaketa Dola): 1-2 ind./m² and in No. 26 (Rajanawa Dola): 1-3 ind/ 1/4m²=ca. 10 ind./m².

The temperature in these two streams ranges in November between 24° C and the 26° C, the pH: 5'8, El_{20}:29-35 μ Siemens, Total hardness: 0·6°-1° dH and CaO: 2mg/1. This species occurs in streams with low content of minerals and in very soft and slightly acidic water.

Distribution : Ceylon: Upland of the South West.

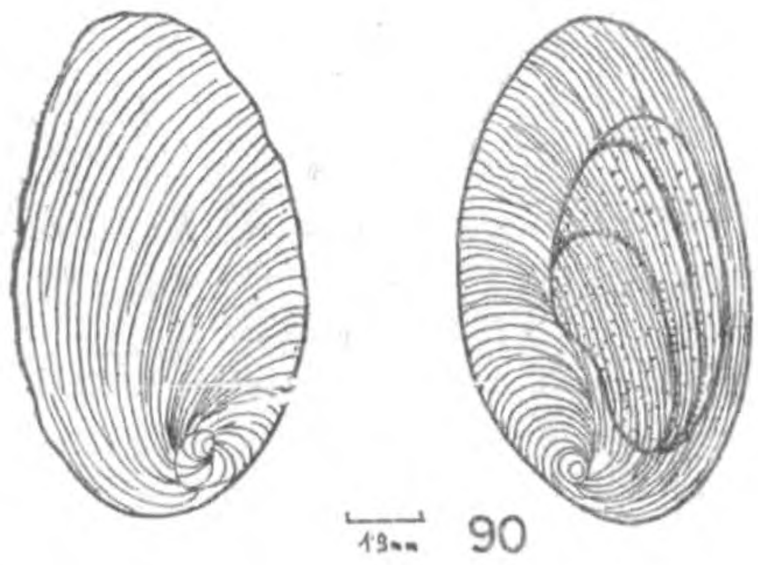


Fig. 90. *Paludomus* (*Philopotamis*) *sulcatus* ; exterior and interior of operculum.

(23) *Paludomus* (*Tanalia*) *loricatus* REEVE, 1847

Lit. 1847 *Paludomus loricatus* (REEVE, Conch. Icon.: pl. 1, fs. 1a, b,c.)-1847 *P. undatus* (REEVE ibid.: pl. 1, f.2)-1847 *P. pictus* (REEVE, ibid.:pl. fs. 10a, b.)-1847 *P. funiculatus* (REEVE, ibid.: pl.3. f.13)-1852 *P. layardi* (REEVE, Proc.zool.Soc. London, 1852: 128)-1852 *P. erinaceus* (REEVE ibid.: 128)-1852 P. *aereus* (REEVE, ibid.:128)-1854 *Tanalia loricata* (LAYARD Proc. zool. Soc. London, 1854 :91)-1854 *T. erinascens* (LAYARD, ibid.: 91)-1854 *T. similis* (LAYARD, ibid.:92)-1854 *T. funiculata* (LAYARD, ibid.:93)-1855 *T. erinascens* (LAYARD, Ann.-mag. Nat. Hist., ser. 2,16: 137)-1855 *T. similis* (LAYARD, ibid.:138)-T.*reevei* (LAYARD, ibid :138)-1855 *T. funiculata* (LAYARD, ibid.:138)-1857 *Paludomus skinneri* (DOHRN, Proce. zool. Soc. London, 1857 : 124)-1857 *P. distinguendus* (DOHRN, ibid.: 124)-1857 *P. nodulosus* (DOHRN ibid.:125)-1858 *P.torrenticola* (DOHRN, ibid., 1858:536)-1853/58 *Tanalia aculeata* (CHEMNITZ) (ADAMS, Gen. rec Moll.: pl. 36, f. 3)-1859/62 *T. loricata* (CHENU, Man. Conch.: f. 2215)-1859/62 *T. aculeata* (CHENU ibid.: f. 2216)-1859/62 T. undata (CHENU, ibid. : f.2218)-1876 *P.erinaceus* (HANLEY and THEOBALD, Conch Ind.: 49 ; pl. 121, f. 1.)-1876 *P. loricata* (HANELY and THEOBALD, ibid.: 49; pl. 121, f. 2.)-1876 *P. undatus* (HANLEY and THEOBALD, ibid.: 49; pl.121, f.3)-1876 *P. skinneri* (HANLEY and THEOBALD, ibid.:49; pl. 121, f.5)-1876 *P. similis* (HANLEY and THEOBALD) (ibid. 49 ; pl.121, f.4)-1876 *P.aereus* (HANLEY and THEOBALD, ibid.:49 ; pl.121, f.5)-1876 *P. layardi* (HANLEY and THEOBALD, ibid.: 49 ; pl.121, f. 4 4-1876 *P. similis* (HANLEY and ; THEOBALD, ibid. : 49; pl.122,f.1)-1876 *P. distinguenda* (HANLEY and THEOBALD, ibid.:50 ; pl.122, f.3) 1876 *P. picta* (HANLEY and THEOBALD, ibid.:50 ; pl.122, f. 7)-1876 *P. torrenticola* (HANLEY and THEOBALD ibid.: 50; pl. 124., f. 9)-1876 *P. funiculata* (HANLEY and THEOBALD, ibid.: 51; pl. 125, fs. 1, 4)-1876 *P. nodulosa* (HANLEY and THEOBALD), ibid.: 51; pl. 126, fs. 8, 9)-1880 *Tanalia loricata* (BROT, in MARTINI and CHEMNITZ, Syst. Conch. Cab., 1 (25): 2; pl.1, fs. 1-5; pl. 2, fs. 3, 4; pl 3, fs. 1-13; pl. 4, fs. 2-6, 6a, 8; pl.8 f, 2. In 4 variations are listed the following synonyms: Var. A: with "liris nodulis": *P. loricatus* REEVE and *loricata* (REEVE) HANLEY and THEOBALD *Tanalia loricata* (REEVE) CHENU, *T. aculeata* (GMELIN) BLANFORD (pro parte), *Paludomus undatus* REEVE, *Tanalia undata* (REEVE) CHENU, *T. aculeata* (GMELIN) BLANFORD (pro parte), *Paludomus undatus* REEVE *Tanalia undata* (REEVE) CHENU, *Paludomus layardi* (REEVE) *P. nodūlosūs* DOHRN, Var. B : with "liris elevatis squamoso-muricatis": *Tanalia acūleata* (CHEMNITZ) ADAMS, *Paludomus erinaceūs* REEVE *Tanalia erinascens* (REEVE) LAYARD, *Paludomus loricatus* REEVE var. Var. C: with "liris angūstioiribus, acutis, simplicibus,

in anfr. supremis saepe obsolete nodulosis": *Paludomus aereus* REEVE, *Tanalia aculeata* (GEMLIN) BLANFORD (pro parte), *Paludomus funiculatus* REEVE, *Tanalia reevei* LAYARD, *Paludomus reevei* (LAYARD) HANLEY and THEOBALD. Var. D : with "liris tenuibus, confertis, simplicibus saepe subgranoso-decussatis nonnunqam obsoletis": *Paludomus pictus* REEVE *P. distinguendus* DOHRN, *P. torrenticola* DOHRN *Tanalia similis* LAYARD, *Paludomus similis* (LAYARD) HANLEY and THEOBALD)-1884 *Paludomus* (*Tanalia*) *aculeata* (NEVILL Handl. Ind. Mus. Calcutta 2:301-303; with the var. *erinacea* REEVE *nodulosa* DOHRN *reevei* LAYARD and subvar. *minor*, *funiculata* REEVE, *picta* REEVE, *distingūenda* DOHRN, *torrenticola* DOHRN,)-1915 *Paludomus* (*Tanalia*) *loricata* (PRESTON, F.Br. Ind. (Freshw. Gastr. and Pelec.): 57, no.109; as synonyms are listed: *aerea* REEVE, layardi REEVE and *undata* REEVE)-1915 *P.* (*T.*) *erinacea* (PRESTON, ibid.: 57, no.110; as synonym is listed: *aculeata* CHEMNITZ var. *erinacea* REEVE)-1915 *P.* (*T.*) *nodulosa* (PRESTON, ibid.:57, no. 111; as synonym is listed: *aculeata* CHEMNITZ var. *nodulosa* DOHRN)-1915 *P.* (*T.*) *reevei* (PRESTON, ibid.: 58, no. 112; as synonyms are listed : *nodulosa* DOHRN var. *reevei* LAYARD and the subvar. *minor* NEVILL)-1915 *P.* (*T.*) *funiculata* (PRESTON ibid. : 58, no. 113; as synonyms is listed : *aculeata* CHEMNITZ var. *funiculata* REEVE)- 1915 *P.* (*T.*) *picta* (PRESTON ibid. : 58 No. 114 ; as synonym is listed : *acūleata* CHEMNITZ var. *picta* REEVE)-1915 , *P.* (*T.*) *distinguenda* (PRESTON, ibid.:59, no. 116 ; as synonym is listed : *aculeata* CHEMNITZ var. distinguenda DOHRN)- 1915 *P.* (*T.*) *torrenticola* (PRESTON, ibid. : 59, no. 117 ; as synonym is listed :. *aculeata* CHEMNITZ var. torrenticola DOHRN)-1915 *P.* (*T.*) *skinneri* (PRESTON, ibid.: 62, no .127)-1931 *P.* (*T.*) *loricata* (THIELE, Handb. syst. Weichtierkde.: 196, f. 184)- 1938 *P.* (*T.*) *loricata* (WENZ, Handb. Paläozool, Gastr(, 1:704, f. 2029)-1962 *Paludomus distinguendus* (MENDIS and FERNANDO, Fish. Res. Stn. Bull., 12:53)-1962 *P.erinaceus* (MENDIS and FERNANDO, ibid . :53)-1962 *P. loricatus* (MENDIS and FERNANDO, ibid.:53, f. 2)-1962 *P. funiculatus* MENDIS and FERNANDO, ibid.: 53)-1962 *P. nodulosus* (MENDIS and FERNANDO, ibid., 53)- 1962 *P. pictus* (MENDIS and FERNANDO, ibid.:53)-1962 *P. reevei* (MENDIS and FERNANDO, ibid.: 56)- 1962 *P. similis* (MENDIS and FERNANDO, ibid, : 56)-1962 *P. skinneri* (MENDIS and FERNANDO, ibid.: 56)-1962 *P. torrenticola* (MENDIS and FERNADO, ibid.: 56).

Localities. Southern Province : No. 1 (30 ind.), No. 26 (12 ind.), No. 3 (1 ind.) ; Western Province : No. 15 (12 ind.),No. 22 (8 ind) ; Sabaragamuwa Province : No. 24 (72 ind.), No. 26 (39 ind.), No. 27 (6 ind.), No. 28 (26 ind.), No. 30 (92 ind.), No. 35 (4 ind.), No. 38 (18 ind.), No. 39 (22 ind.), No. 40 (22 ind.), No. 43 (8 ind.).

Shell. Extremely varying in size, altitude of the spire and sculpture with all transitions. This variation in the shells was the reason for the descripions of many species after characteristics of the shells. The typical *loricatus* s. str. has an obovate shell with an exserted, but mostly eroded spire. 2-3 whorls slightly angularly or flatly depressed around the upper part. Spirally encircled with close-set squamate ridges (varying in the different variations). Colour chestnut, to blackbrown with vertical zigzag or flame-like, darkbrown bands, but mostly seen only on immature shells. Mature shells mostly coated by black encrustations. Aperture broad-ovate, top pointed, interior whitish-blue, columella and edge of the lip violet to purple-brown. Outside of the peristome is irregularly grooved.

BROT, 1880 (p. 2 -3) has created 4 variations of *P.* (*T.*) *loricatus* basing upon the sculpture of the shell :—

(*a*) Var. *typica* : with nodular ridges : *loricatus* s. str. (Fig. 91/A, 6 ; 92, 93 Plate IX). The description of thi type of shell is given above. This type includes also *aculeata* (GEMLIN) BLANFORD (pro parte), *undatus* REEVE, *ayardi* REEVE, *nodūlosa* DOHRN.

(*b*) Var. *erinaceus* REEVE (Fig. 91/A. 5 ; 94, 95, 96, 97 Plate VIII) : Obovate shell as in the form of *loricatus* s. str. but the spiral ridges show distinct thorn-like scales, specially in young specimens (Fig. 94, 95, Plate IX). This variation includes the var. *erinaceus* REEVE, *aculeata* (GMELIN) BLANFORD (pro parte), *erinascens* (REEVE) LAYARD, *loricatus* REEVE var. (f. la in Conch. Icon., 1847).

(*c*) Var. *funiculatus* REEVE (Fig. 91/A. 2, A.3, A. 4 ; 98, 99, 100; Plate IX & X) : Shell oblong-ovate, spire exerted, whorls rather depressed round the upper part, spirally corded with rather distant obtuse ridges, some times vertically striated with well-marked close-set striae. Colour dark yellow-brown, thickly marked with vertical, slanting, jet-brown wavy bands. This variation includes the var. *aereus* REEVE, *aculeata* (GMELIN) BLANFORD (pro parte), *funiculatus* REEVE and *reevei* LAYARD.

(*d*) Var. *pictus* REEVE (Fig. 91/A. 1. A. 2 ; 101, 102, 103, 104; Plate X): Shell oblong ovate, spire exserted, whorls spirally and vertically obtusely striated or grooved. Colour dark yellow to olive, profusely marked with vertical, wavy dark bands and lines, sometimes interrupted by fine transverse bands of the same colour. The dark markings of the shell show through at the aperture, specially in young shells, margin of the columella stained with brown. These variations includes the var. *pictus* REEVE, *distinguendus* DOHRN, *torrenticola* DOHRN and *similis* LAYARD. It is probable that also *Paludomus* (*Tanalia*) *hanleyi* DOHRN 1858 (Proc. zool. Soc. London 1858 : 535) figured by HANLEY & THEOBALD, 1876 (Conch. Ind. : 51 pl. 125, f. 10) and by BROT, 1880 (in MARTINI & CHEMNITZ, Syst. Conch.

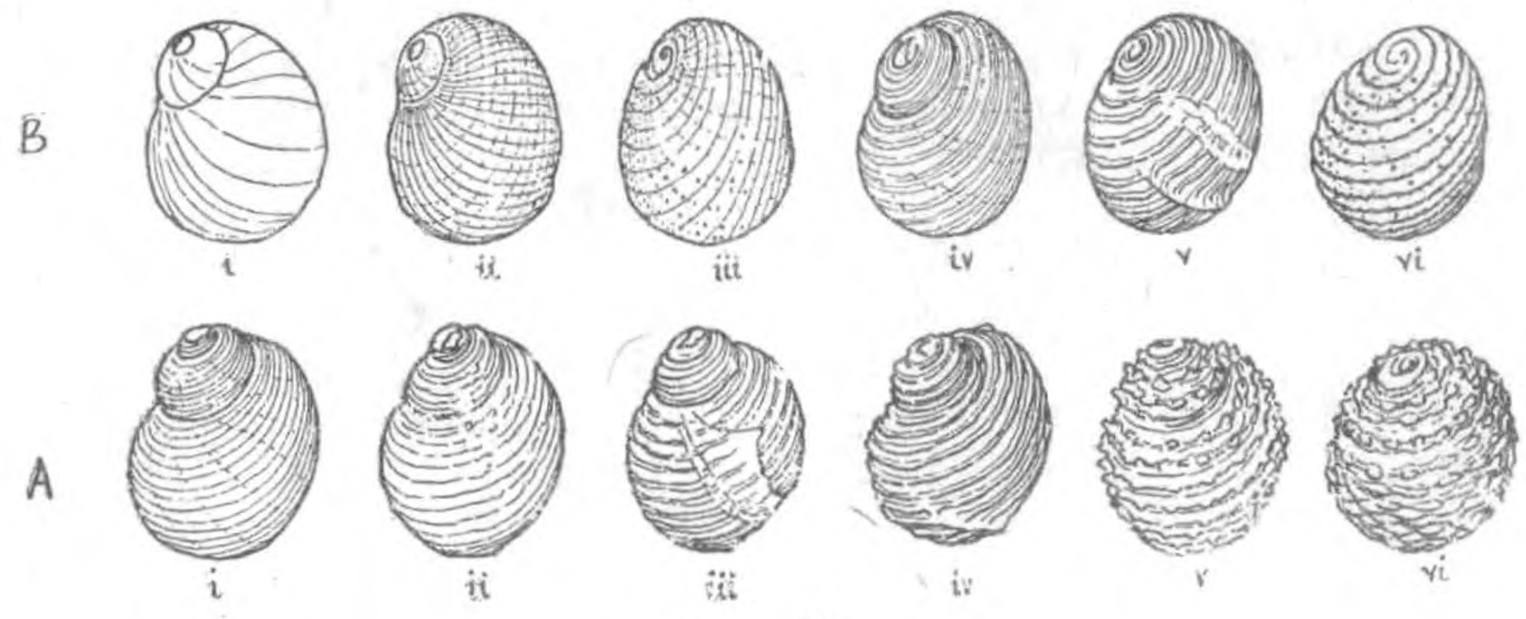


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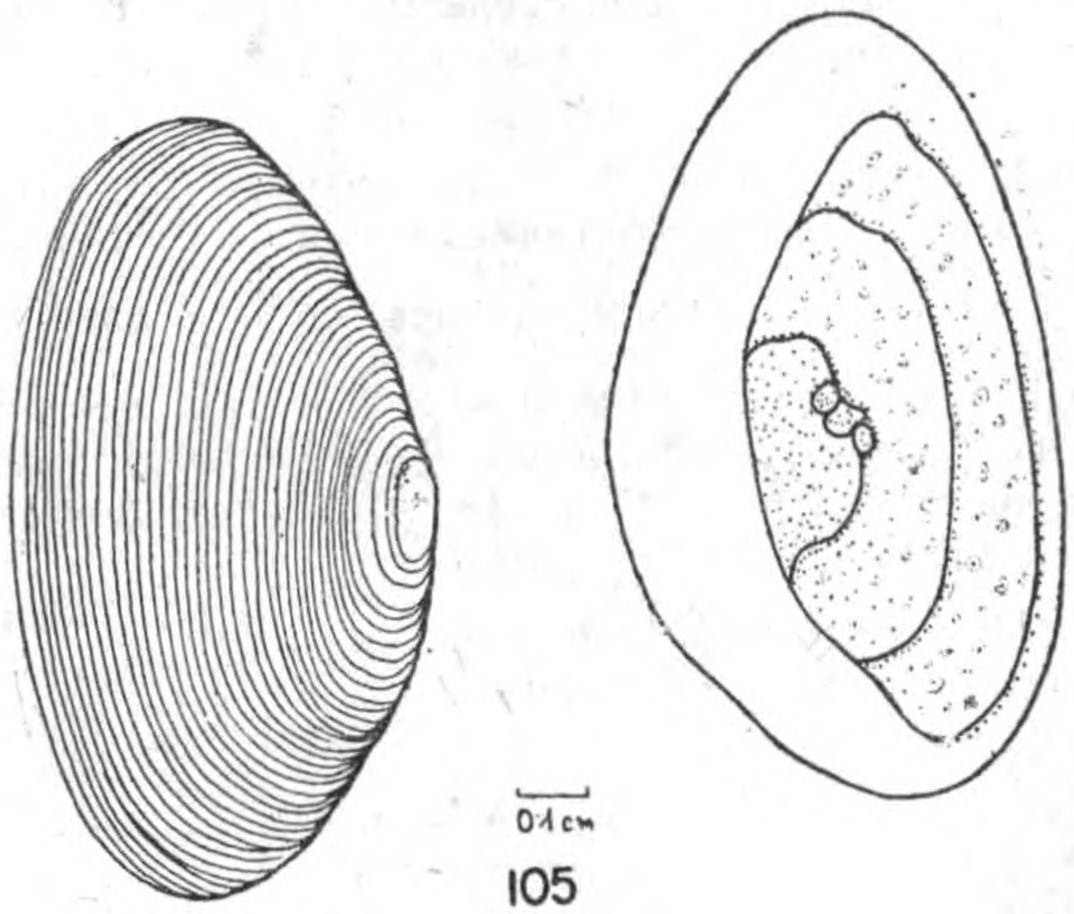
Fig. 91. Different variations with transitions in the shells of: A (lower row): *Paludomus* (*Tanalia*) *loricatus*: I: var. *pictus*, II: transition between var. *pictus* and *funiculatus*, III: var. *funiculatus*, IV: transition between var. *funiculatus* and var. *typica*, V: var. *erinaceus*, VI: var *typica* (*loricatus* s. str.). B (upper row) *Paludomus* (*Tanalia*) *neritoides*: I: var. *dilatatus*, II: var. *typica* (*neritoides* s. str.), III: var. *tennanti*, IV: transition between var. *dilatatus* and var. *typica* (*neritoides* s. str.), V: transition between var. *tennanti* and var *gardneri*, VI: var. *gardneri*.

Cab., 1 (25) : pl. 4, f. 9) belongs to *loricatūs*. Uncertain is also the position of *Paludomus sphaerica* DOHRN, 1857 (Proc. zool. Soc. London, 1857 : 124), figured by HANLEY & THEOBALD 187 (Conch. Ind. : 50; pl. 124, f. 8) and copies by BROT, 1880 (in MARTINI & CHEMNITZ, Syst. Conch. Cab. 1 (25) : pl. 4, f. 10). BLANFORD (Trans. Linn. Soc. L., 23) places these species as var. of his *Tanalia aculeata* (GMELIN), a species which is placed by BROT 1880 (p. 2) as synonym of *P.* (*T.*) *loricatus*. But BROT, 1880 (p. 12) is not certain whether this species, described only, after one shell from the collection of CUMING, is also to be placed in the subgenus *Tanalia*. The colouration of the shell is similar to *P.* (*P.*) *chilinoides* and the shell is perhaps an abnormality.

	Shell		*Aperture*	
Sizes (*in mm.*)	*Ht.*	*Diam.*	*Ht.*	*Diam*
No. 1 (Thanipita Dola) ..	28'4 ..	22'8 ..	20'6 ..	17
var. *funiculatus* (with transitions	26'8 ..	20'4 ..	18 ..	15'5
to var. *pictus*) (Fig. 101, Plate X)	25'9 ..	20'3 ..	19 ..	16'5
No. 2 (Nagahaketa Dola) ..	30'5 ..	27 ..	23'8 ..	19
var. *funiculatus* ..	30 ..	25'3 ..	22'5 ..	18'5
No. 15 (Moratuwa, var. *pictus*), ..	26'7 ..	19'5 ..	18 ..	14
No. 22 (Alawala) var. *funiculatus* ..	31'7 ..	24'2 ..	24 ..	18'3
	25 ..	21'3 ..	19'7 ..	15
No. 24 (Bodathpitiya Ela) var.	41 ..	34 ..	32 ..	28'5
typica (Fig. 92, Plate IX) ..	39 ..	30 ..	28 ..	24'5
	36'5 ..	27'3 ..	26'5 ..	22'5
	36 ..	27'5 ..	26'5 ..	22'5
No. 26 (Rajanawa Dola) var. *typica*	33'5 ..	27'2 ..	24 ..	21'5
(Fig. 93, Plate VI) ..	33'5 ..	27'8 ..	24'5 ..	22
No. 27 (Kalu Ganga) var.	40 ..	31'5 ..	31 ..	25
erinaceus (Fig. 96, Plate IX) ..	43 ..	32 ..	31 ..	25
	40'2 ..	31'5 ..	30 ..	25
No. 28 (Kalu Ganga, upper reaches)	40'2 ..	32'5 ..	31 ..	23'5
var. *typica* and *erinaceus* (Fig. 97,	34'2 ..	26'2 ..	24'5 ..	22'5
Plate IX)	38'8 ..	31 ..	29'8 ..	23'9
No. 30 (Ira Handha Pana Dola) var.	30'8 ..	24'5 ..	22 ..	19
funiculatus with transitions to	30'6 ..	24'3 ..	23'4 ..	19
var. *pictus* (Fig. 104, Plate X) ..	30 ..	24'8 ..	22 ..	19
No. 31 (Belihul Oya) ..	30'5 ..	23'5 ..	19'7 ..	16
var. *pictus*	27'6 ..	20'5 ..	19'2 ..	15'1
No. 32 (Kirikatu Oya) var. *funicu-*	28'8 ..	22'1 ..	20 5 ..	15'9
latus (Fig. 100, Plate X)	28 ..	22 ..	20'3 ..	15,8
	27 ..	21'8 ..	19 ..	15'9
	27'5 ..	20'5 ..	19 ..	15'8

	Shell		Aperture	
Sizes (in mm.)	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 35 (Kelani Ganga) ..	32′1 ..	28 ..	27 ..	21
var. *funiculatus* ..	33′8 ..	27′8 ..	25 ..	21
(Fig. 98, 99, Plate VIII)				
No. 38 (Rakwana) ..	19′1 ..	14′5 ..	13′6 ..	10′5
var. *pictus*	17′3 ..	13′2 ..	12′3 ..	9′6
(Fig. 102, 103, Plate X)				
No. 39 (Kuruwita) ..	26′3 ..	21 ..	18′5 ..	16′2
var. *funiculatus* ..	26′1 ..	21 ..	20′8 ..	16
	24′5 ..	20′5 ..	17′5 ..	15′3
No. 40 (Gilimale)				
var. *typica*	34′5 ..	31′4 ..	28 ..	23′3
(juv.=*erinaceus*)				
(Fig. 94, 95, Plate IX)				
No. 43 (Kahawatta) ..	15 ..	7 8 ..	11′5 ..	9′3
var. *pictus* juv.				

The sizes are from the bgiggest specimens in the samples.



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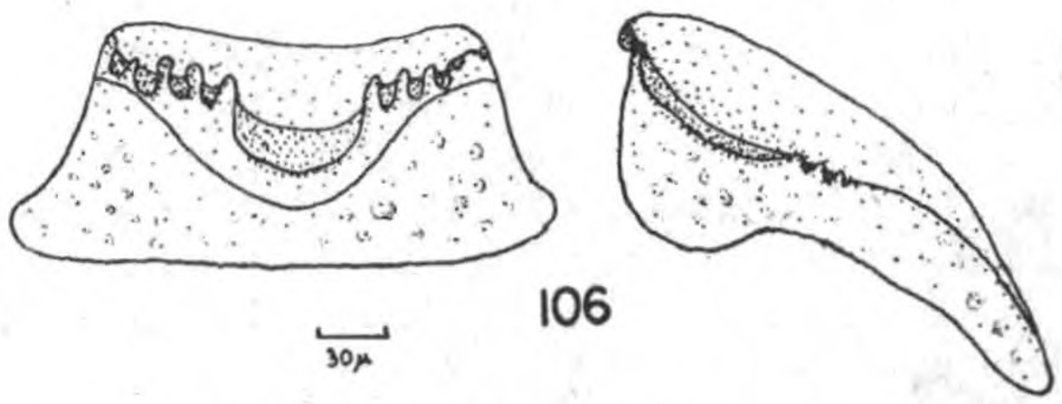

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Paludomus (*Tanalia*) *loricatus*. Fig. 105 : exterior and interior of operculum ; Fig. 106 : Radula teeth.

Operculum. The subgenus *Tanalia* is based, like other subgenus of *Paludomus*, upon the structure of the operculum : horny, subtriangularly ovate, apex lateral, lamellated, nucleus lateral and dextral (sizes of a specimen of No. 24 (var. *typica*) : 17′7mm × 12′3mm ; Fig. 105).

Anatomical remarks. The anatomy of *P.* (*T.*) *loricatus* shows no particular differences from the dissected specimens of *P.* (*T.*) *neritoides*, described in the following pages. The anatomy is also very similar to those of *P.* (*P.*) *chilinoides* and *P.* (*P.*) *tanschauricus*. Radula : central tooth broad-trapezoid, the cutting edge with one prominent, broad central

cusp and 4 smaller denticles on either side (4–1–4). The lateral possess a handle-like process on the broad convex base, cutting edge with one broad, convex central cusp, one prominent cusp on the inner side and 3 small denticles on the outside (1–1–3) (Fig. 106). The marginals like in *P.* (*T.*) *neritoides* are finely denticulated.

Ecological-biological remarks. *Paludomus* (*Tanalia*) *loricatus* is a typical inhabitant of the fast-running mountain streams in the upland of the crystalline mountains of South-west Ceylon (60–700m altitude). The snails prefer stones and rocks in a current between 30 and 100cm/sec, where they move near the water surface. Sometimes they crawl outside of the water on rocks emerging from the stream.

Their frequency varied in the different investigated localities :

No. 2 (Nagahaketa Dola) var. *funiculatus* : 1–2 ind/m²

No. 24 (Bodathpitiya Ela) var. *typica* : 1–3 ind/1/4m²

No. 26 (Rajanawa Dola) var. *typica* : 1–3 ind/1/4 m²

No. 32 (Kirikatu Oya) var. *funiculatus* : 3–5 ind/1/16m² (25–30 juv. ind/1/16m² on the border)

The physcio-chemical conditions of the streams with *P.* (*T.*) *loricatus* are as follows :

Temperature : Between 18°C and 27'3°C

pH : 5'8 to 7'1—El_{20} : 23 to 46 μSiemens—Total Hardness : 0'5 to 1'2°dH—CaO : 2 to 6'38mg/l.

The species occurs in slightly acid to neutral, very soft water with low content of minerals. They prefer the main parts of the mountain stream-systems, less the smaller affluents, where *Paludomus* (*Tanalia*) *neritoides*, the second species of the subgenus in the crystalline zone, dominates. But the distribution of these two very related species is overlapping.

The main parts of the bigger streams (like Kalu Ganga, Kelani Ganga) flow in deep and broad valleys mostly surrounded by cultivated areas and settlements. In these areas, the streams are sometimes slightly polluted :

NO_3: 0'071mg/l to 0'128mg/l–NH_4 : 0'03mg/l to 0'16mg/l P_2O_5 : 0'12mg/l to 0'18mg/l

But the occurence of *P.* (*T.*) *loricatus* in these regions shows that the species tolerate slight pollution, if however the current and turbidity of the flowing water is strong enough. Like all species of the genus *Paludomus* it seems that *P.* (*T.*) *loricatus* is also ovo-viviparous. The snails feed not only on algae, growing on stones and rocks, but also on organic debris, deposited between stones.

Distribution:—Ceylon : Crystalline Upland of South West.

(24) *Paludomus* (*Tanalia*) *neritoides*, REEVE, 1847

Lit.: 1847 *Paludomus neritoides* (REEVE, Coch. Icon: pl. 1, f. 3)—1847 *P. gardneri* (REEVE, ibid.: pl. 2, f. 9)—1847 *P. tennanti* (REEVE, ibid.: pl. 3, f.12)—1852 *P. dilatatus* (REEVE, Proc. zool. Soc. London, 1852 : 128)—1854 *P. gardneri* (LAYARD, Proc. zool. Soc. London, 1854 : 93–94)—1854 *Philopotamis thwaitesi* (LAYARD, ibid.)—1854 *Tanalia tennanti* (LAYARD, ibid.)—1854 *Gangia dilatata* (LAYARD, ibid.)—1855 *Paludomus gardneri* (LAYARD Ann. Mag. Nat. Hist., 1855 : 139)—1855 *Tanalia tennanti* (LAYARD, ibid.)—1855 *Philopotamis thwaitesii* (LAYARD, ibid.)—1855 *Gangia dilatata* (LAYARD, ibid.)—1857 *Paludomus cumingianus* (DOHRN, Proc. zool. Soc. London, 1857 : 124)—1857 *P. dromedarius* (DOHRN, ibid. 124)—1857 *P. swainsoni* (DOHRN, ibid.: 124)—1876 *P. melanostoma* THORP. MSS. (HANLEY & THEOBALD, Conch. Ind.: 49, pl. 121, fs. 8, 9)—1876 *P. tennenti* (error for *tennanti*) (HANLEY & THEOBALD, ibid. : 50, pl. 122, f. 5)—1876 *P. gardneri* (HANLEY & THEOBALD, ibid.: 50; pl. 122, f. 6)—1876 *P. neritoides* (HANLEY & THEOBALD, ibid.: 50; pl. 122, f. 8)—1876 *P. dromedarius* (HANLEY & THEOBALD, ibid.: 50 ; pl. 122 f. 9)—1876 *P. swainsoni* (HANLEY & THEOBALD, ibid.: 50; pl. 124, f. 6)—1876 *P. dilatatus* (HANLEY & THEOBALD, ibid.: 51; pl. 125, fs. 5, 6)—1876 *P. thwaitesii* (HANLEY & THEOBALD, ibid.: 51; pl. 125 fs. 8, 9)—1876 *P. cumingiana* (HANLEY & THEOBALD, ibid.: 51; pl. 126, fs. 5, 6)—1880 *Tanalia neritoides* (BROT in MARTINI & CHEMNITZ, Syst, Conch. Cab., 1 (25) : 6 ; pl. 1, fs. 6-11 ; pl. 4, fs. 11-14 ; pl. 8, f: 1 ; as synonyms are listed : *aculeata* (GMELIN) var. BLANFORD, *gardneri*, REEVE, *tennanti*, REEVE, *dilatatus* REEVE, *cumingianus* DOHRN, *dromedarius* DOHRN, *melanostoma* THORPE MSS., *swainsoni* DOHRN, and var. *globosa*)—1880 *T. thwaitesii* (BROT, ibid.: 9 ; pl. 5, fs. 1, 1a; probably a var. of *neritoides*)—1884 *Paludomus* (*Tanalia*) *neritoides* (NEVILL, Handl. Ind. Mus. Calcutta, 2 : 303, including var. *dilatata* REEVE (?), *gardneri* REEVE ; 304 : var. *globosa* BROT *thwaitesi* LAYARD (?), *tennanti* REEVE, *dromedarius* DOHRN)—1915 *P.* (*T.*) *swainsoni* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 59, No. 115)—1915 *P.* (*T.*) *neritoides* PRESTON, ibid.: 60, No.118, with var. *globosa* BROT)—1915 *P.* (*T.*) *dilatata* (PRESTON, ibid. 60, No. 119)—1915 *P.* (*T.*) *gardneri* (PRESTON, ibid.: 60, No.120)—1915 *P.* (*T.*) *cumingiana* (PRESTON, ibid.: 61, No. 121)—1915 *P.* (*T.*) *thwaitesi* (PRESTON, ibid.: 61, No. 122)—1915 *P.* (*T.*) *tennanti*

(PRESTON, ibid. 61. No.123)—1915 *P.* (*T.*) *dromedarius* (PRESTON, ibid.: 62, No. 124)—1915 *P.* (*T.*) *melanostoma* (PRESTON, ibid.: 63, No. 129)—1962 *P. dilatatus* (MENDIS & FERNANDO, Fish. Res. Stn. Bull. 12 : 53)—1962 *P. dromedarius* (MENDIS & FERNANDO, ibid.: 53)—1962 *P. gardneri* (MENDIS & FERNANDO, ibid.: 53)—1962 *P. hanleyi* (MENDIS & FERNANDO, ibid. 53, with var. *major* ?)—1962 *P. melanostomus* (MENDIS & FERNANDO ibid.: 53)—1962 *P. neritoides* (MENDIS & FERNANDO, ibid.: 53, f. 7 ; with var. *globosus* BROT)—1962 *P. swainsoni* (MENDIS & FERNANDO, ibid.: 56)—1962 *P. tennanti* (MENDIS & FERNANDO, ibid.: 56)—1962 ? *P. thwaitesi* (MENDIS & FERNANDO, ibid.: 56).

Localities. Southern Province : No. 2 (1 empty shell) ; Western Province : No. 22 (24 ind.), No. 23 (67 ind.) Sabaragamuwa Province : No. 24 (30 ind.), No. 25 (39 ind.), No. 26 (66 ind.), No. 27 (some ind.), No. 28 (3 ind.), No. 29 (21 ind.), No. 31 (2 ind.), No. 32 (102 ind.), No. 33 (135 ind.), No. 34 (1 ind.), No. 35 (6 ind.), No. 41 (1 ind.), No. 42 (appr. 200 ind.), No. 43 (12 ind.), No. 44 (1 ind.), No. 45 (1 ind.) ; Central Province : No. 47 (276 ind.), No. 48 (109 ind.) No. 56 (45 ind.),; Uva Province : No. 59 (many ind.), No. 62 (10 ind.).

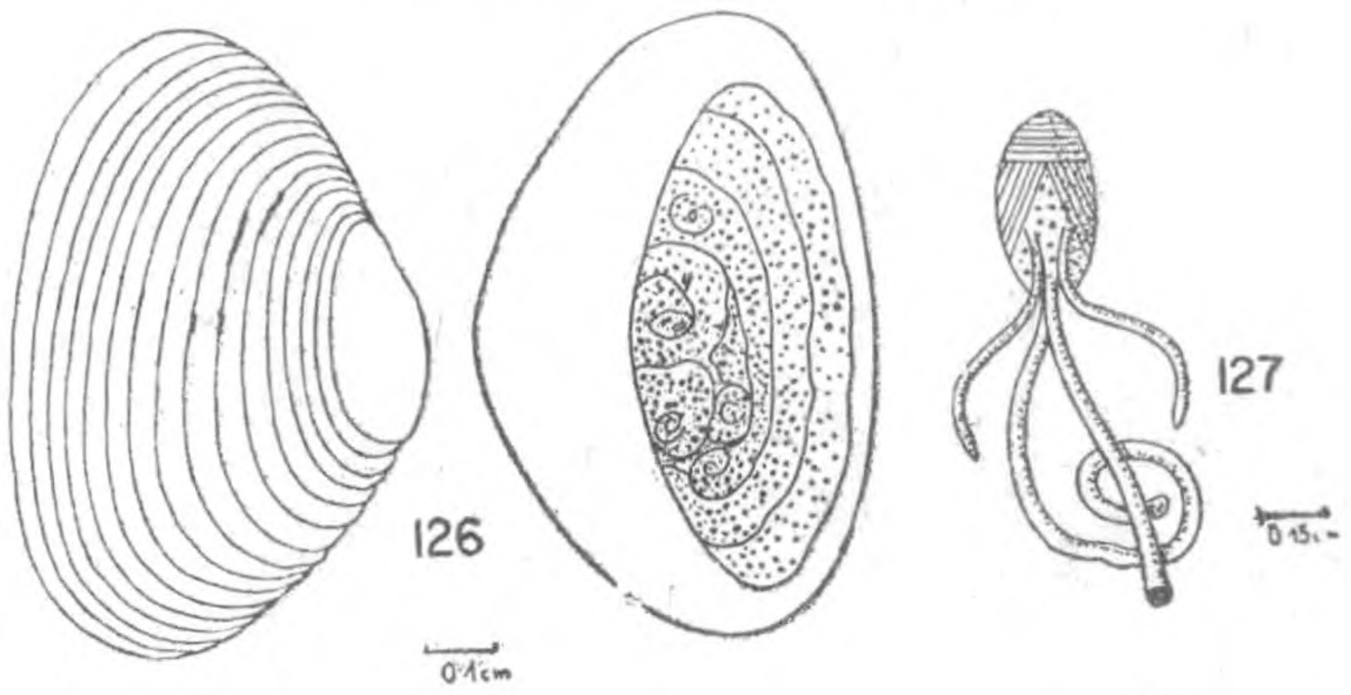
Shell. Oblong-ovate, spire varying from flatly depressed and enveloped by the big globular penultimate whorl (var. *gardneri* ; Fig. 91/B. 5, 6; 110, 111, 112, 113, Plate X, XI) to scarcely (var. *tennanti*; fig. 91/B.3, B. 5; 107, 119, 120; Plate X, XI) or little exserted (var. *neritoides typica* and var. *dilatatus* ; Fig. 91/B. 1, B. 4, 115-118, 121-126) If the spire is little exserted it is sometimes difficult to differentiate var. *dilatatus* from *P.* (*T*) *loricatus* var. *Pictus*. 2 1/2 whorls rounded and not-or scarcely-angular around the upper part ; apex mostly eroded. Obscurely ridged (var. *neritoides;* Fig. 91/B. 2, B. 4; 108, 109, 114-118, 121-125) var. *dilatatus* (Fig. 91/B. 1, B. 4; 115-118, 121-125, Plates XI and XII var. *tennanti* (Fig. 91/B. 3, B 5; 107, 119, 120 Plates X, XI) varying to very closely spiraled ridge. The ridges rather thin obtuse alternately larger (var. *gardneri*, Fig 91/B. 5, B. 6, 110-113 Plates X, XI). Colour olive, blackish-brown, and at an early stage of growth with a brilliant pattern of brown Zigzag painting in the interior of the aperture. The latter is rather large, columella and edge of the lip sometimes blotched here and there with blackish-brown or stained with purple-black.

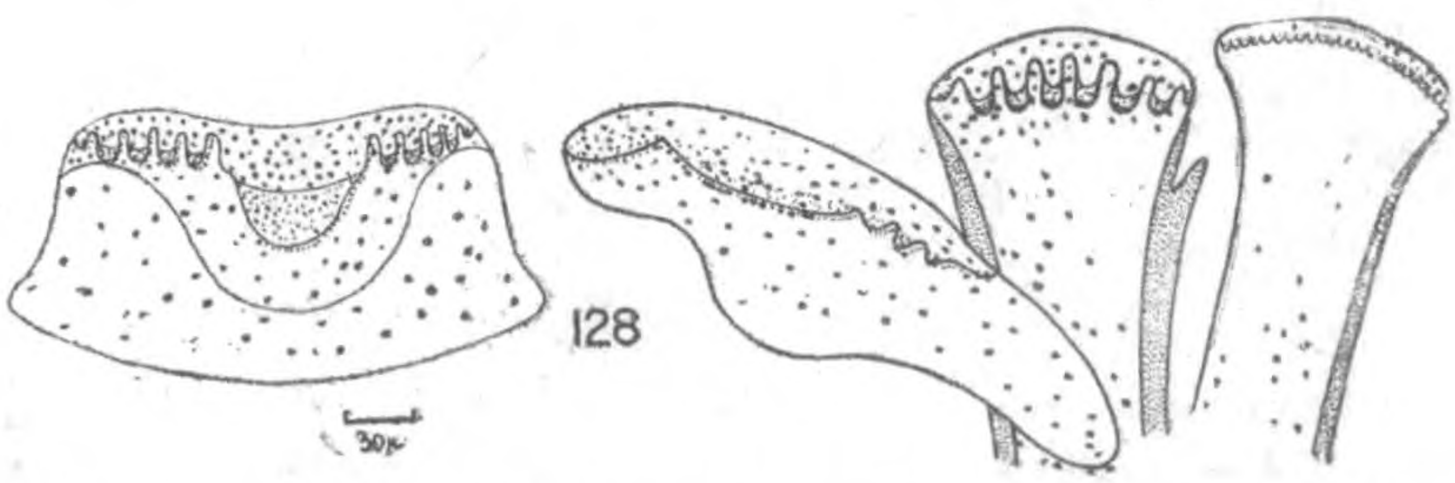
	Shell		*Aperture*	
Sizes (in mm) :	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 22 (Alawala) var. *typica* ..	22′8 ..	18′5 ..	18 ..	14′9
	20 ..	17 ..	16 ..	13′4
No. 23 (Labugama) var. *typica* ..	20′3 ..	16′5 ..	15′5 ..	12′5
	19′3 ..	15′9 ..	14′5 ..	12·2
No. 24 (Bodathpitiya Ela) var.	25′4 ..	24′6 ..	23′5 ..	18′3
tennanti with *transitions* to var.	22′5 ..	20′7 ..	22 ..	17′4
gardneri (Fig. 107, Plate X) ..	19 ..	18 ..	19 ..	15′8
No. 25 (Katugas Ela) var. *typica* ..	21′1 ..	15′5 ..	16′5 ..	14′2
	22 ..	15′9 ..	17′2 ..	14′7
	20′6 ..	15′3 ..	17 ..	14′2
	20′9 ..	15′8 ..	16′4 ..	14′2
	21′6 ..	15′6 ..	16′5 ..	14
No. 26 (Rajanawa Dola var.	22′3 ..	16′9 ..	17′5 ..	14′5
typica (Fig. 108 ; 109, Plate X) ..	22 ..	16′5 ..	17′5 ..	14′5
	21′5 ..	15′8 ..	16′4 ..	14′3
	20′1 ..	16 ..	17′4 ..	14′5
No. 27 (Kalu Ganga) var. *gardneri*	32′7 ..	31 ..	30′2 ..	26′5
(Fig. 110, 111, Plates X and XI)	32′6 ..	31′3 ..	29′7 ..	26
	32′2 ..	30 ..	29′8 ..	27′4
No. 28 (Malwala) var. *gardneri*	35′3 ..	32 ..	31′2 ..	27′5
(Fig. 112, 113, Plate XI) ..	34′4 ..	29′8 ..	29 ..	26′3
No. 29 (Carney) var. *typica* (Fig.	24 ..	19 ..	18 ..	15
114, Plate XI) ..	23′4 ..	20′6 ..	18′2 ..	15′5
No. 32 (Kirikatū Oya) var. *typica* ..	22′3 ..	18′4 ..	17″7 ..	15′5
	20 ..	17 ..	14′8 ..	12′9
	19′5 ..	16 ..	15 ..	12′8
No. 33 (We Ganga) var. *typica* with	27 ..	19 ..	20′7 ..	16′7
transitions to var. *dilatatus*	25 ..	18′5 ..	19′2 ..	16′9
	25 ..	18′6 ..	19 ..	15′2
(Fig. 115-118, Plate XI) ..	24′3 ..	17′7 ..	19′2 ..	17′4

Sizes (in mm) :	*Shell*		*Aperture*	
	Ht.	*Diam.*	*Ht.*	*Diam.*
No. 35 (Kelani Ganga) var. *tennanti*	28′2 ..	23′5 ..	24 ..	19
with transitions to var. *typica* Fig. 119,120, Plate XI)	26 ..	23′2 ..	22′6 ..	18′9
No. 42 (Balangoda) var. *typica* with	23′3 ..	17′5 ..	16′9 ..	13′8
transitions to var. *dilatatus* ..	22′8 ..	18 ..	16′9 ..	13′8
No. 45 (N of Ratnapura) var. *garneri* with transitions to var. *tennanti*	26′4 ..	22′4 ..	23′5 ..	19
No. 47 (Hal Oya) var. *typica* with	23 ..	19′8 ..	18′2 ..	14′6
transitions tovar. *dilatatus* (Fig.	21 ..	17 ..	16′3 ..	13′5
121-124 Plate XII ..	21′5 ..	17′3 ..	16′1 ..	14
No.48(Rambukpoth Oya)var.*typica*	23′3 ..	19 ..	18 ..	14′8
with transitions to var. *dilatatus*	22′5 ..	19 ..	17′3 ..	13′5
(Fig. 125 Plate XII). ..	22′5 ..	19 ..	17 ..	14
	22 ..	19 ..	17′2 ..	14′5
	22 ..	19 ..	17′2 ..	14′3
	21 ..	18 ..	16′5 ..	14
No. 56 (Rambukpoth Oya) var.	27 ..	23′5 ..	20 ..	16′8
typica	24′3 ..	21′4 ..	17′5 ..	16
No. 59 (Veli Oya) var. *typica* ..	19′6 ..	16′7 ..	16 ..	14
	19′6 ..	16′8 ..	15′2 ..	13

The sizes are from the biggest specimens in the samples.

Operculum. Typical for the subgenus *Tanalia* with lamellated lateral apex and lateral nucleus (Sizes of a specimen from No. 33: 12′5 mm × 8mm, from No. 48 : 11′5 mm × 9′3 mm; Fig . 126).





Paludomus (*Tantalia*) *neritoides*. Fig. 126: exterior and interior of operculum. Fig. 127 : buccal mass, oesophagus, radula sac and salivary glands. Fig. 128: radula teeth.

Anatomical remarks. Digestive system : The buccal mass is—like in *Paludomus* (*P.*) *chilinoides*—pyriform, the salivary glands are two long tubular and somewhat coiled structures. They lie closely pressed to the sides of the slender long oesophagus. The radula sac is, in the subgenus *Tanalia*, slender and much longer than in the species of the two other subgenera studied. The sac lies coiled below the oesophagus (Fig. 127). Radula : the teeth are similar to *P.* (*T.*) *loricatus* ; central tooth broad-trapezoid with one big central cusp and 4–5 lateral denticles on either side (4/5–1–4/5) Lateral tooth with a very broad, convex central cusp and one inner, resp. three denticles on the outside (1–1–3). Marginals with 7, resp. 20–22 very delicate denticles (Fig. 128). The species of the subgenus *Tanalia* possess an extremely long radula with denticles on the central and lateral teeth much stronger than in the species of the subgenera *Paludomus* s. str and *Philopotamis*. This explains the fact that *P.* (*Tanalia*) *neritoides* and *loricatus* live exclusevely on hard granitic bottom in the strong current like rocks and stones. The radula teeth have to scratch off the encrusted algae from the granite rocks. The species of the other two subgenera live more on sandy bottom.

Reproductive system : The external anatomy of the female and male reproductive system in the subgenus *Tanalia* is also very similar to the external anatomy of the reproductive system described for *P.* (*P.*) *chilinoides* and *transchauricus* (SESHAIYA, 1934, p. 206).

The female system consists of the ovary, the oviduct, the uterus, coiled in a double S-shaped loop, the vagina and the sac-like receptaculum seminis. A flap guards on one side the ciliated furrow, leading from the opening of vagina and receptaculum to right side of the anterior part of the foot in a small groove. Cross-sections of a female specimen from No. 32 (Kirikatu Oya) show some details of the micro-anatomy and histology of the female reproductive system in the genus *Paludomus* : Ovary: The tubules with egg-cells in development stage lies outside the tubules of the digestive gland (Fig. 129, Plate XIII). Uterus: The cavity is lined by columnar cells. In the upper part is the uterine wall which is very thick, as a consequence of the presence of subepithelial elongated gland masses, which are composed of groups of cells with ill definied cell-limits and round nuclei. These mucous-or albumen gland cells open between the ciliated epithelial cells in the upper cavity of the uterus. With Haemalaun-Eosin they are stained blue (Fig. 130, Plate XIII). In the lower part of the uterus the walls, as already stated, when, stained with H. E., gives a dark purple-violet colour and the histological structure, though really the same as that of the upper part of the uterus presents a different appearance (capsule gland ; Fig. 131, Plate 13). The cavity of the coiled lower part is roughly U-shaped and one limb of the cavity develops in its walls, on either side, glandular tissue similar to that seen in the upper part of the uterus (figs. 131, 132, Plate XIII). The gland masses open by narrow necks between the ciliated cells and each gland mass consists of gland cells arranged round a central lumen and appear like saccular glands opening into the uterine cavity between the ciliated epithelial cells (Fig. 130). The receptaculum seminis has in section, a broad sac-like lumen and its epithelium is thrown into processes. It is composed of glandular and ciliated cells stained with eosin, the nuclei are placed basally (Figs. 133, 134, Plate XIII). The external anatomy of the male reproductive organs of *P.* (*T.*) *neritoides* is also very similar to the condition described for *P.* (*P.*) *chilinoides* and *tanschauricus* (SESHAIYA, 1934, p. 203). It consists of the testis, the coiled vas deferens, an enlargement of the lower part, called vesicula seminalis and a small penis-like organ in connection with a sac-shaped gland. A deep ciliated furrow, guarded by a flap, conducts from the genital opening to the free mantle opening on the right side. This flap arises from the ventrolateral edge of the upper part of the vesicula seminalis. It is homologous to the flap guarding the genital groove in the less specialed forms of Thiaridae (STARMÜHLNER 1969, p. 180 and 1970, p. 77).

Cross-sections of a male from No. 33 (We-ganga) shows some details of the micro-anatomy : the testis surrounds the tubules of the digestive gland (Fgs. 135, 136, Plate XIV). The tubules of the testis are separated from one another by connetive tissue with blood spaces. Their walls are composed of sperm mother cells or spermatocytes. The spermatogonia project into the cavity of the tubule (fig. 136, Plate XIV). The seminal vesicle lying in the right part of the mantle cavity has a narrow lumen and is crescentic in section (Fg. 137, Plate XIV). The narrow cavity is lined by ciliated and glandular epithelium (Fig. 138, Plate XIV).

The penis shows in transverse sections, an elliptic outline and a small layer of circular muscles (fig. 142, Plate XIV). It is a narrow continuation of the glandular part of the vesicula seminalis (penis gland; Figs. 139–141, PlateXIV). The flap guarding the groove is lined on the side facing the groove by glandular and ciliated epithelium continuous with that of the groove.

Ecological-biological remarks. Paludomus (*Tanalia*) *neritoides* (and the varieties) is a typical inhabitant of the smaller effluents, torrents and brooks running in the mountainous up and highlands of South-West Ceylon. The snails crawl on the surfaces of stones and rocks, mostly just under the surface of the water. Sometimes they also move out of the water.

Frequencies from our quantitative samples are as follows :

Locality	*Current*	*Frequency*
No. 26 (Rajanawa Dola) No. 32 (Kirikatu Oya) No. 33 (We Ganaga, Balangoda) No. 47 (Hal Oya) No. 48 (Rambukpotha Oya) No. 59 (Veli Oya)	30cm. 1m/sec.	3 to 10 ind./1/16m²
No. 32 (Kirikatu Oya) .. No. 59 (Veli Oya) ..	0–30cm/sec. (border)	30–60 mostly young ind./1/16m²

We found these high frequencies, in 1970, only in populations of var. *neritoides typica* and var. *dilatatus*. The var. *tennanti* and specially the big, sculptured var. *gardneri* (only in bigger streams, like *P.(T.) loricatus*) have a lower frequency:

Locality	*Current*	*Frequency*
No. 24 (Bodathpitiya Ela) No. 27 (Kalu Ganga, Ratnapura) No. 28 (Kalu Ganga, Malwala) No. 31 (Belihul Oya)	50cm–1m/sec.	1 to 5 ind./1/4m²

The species *neritina* occurs like *loricatus* only in the crystalline up-and highland in the South-West in altitudes between 50m (valleys of the mountain streams) and 1700m. The temperature in these streams changes between 18'8°C (in the higher parts) and 27'2°C (in the open, bigger streams in the valleys with cultivated area). The average optimal temperature lies between 20° and 25°C.

All localities situated in this zone are composed of crystalline Precambrian rocks.

Chemistry of the waters is as follows :

pH : 5'8 to 6'7—El_{20} : 20 to 45 µSiemens in average (minimum : 14'6 µSiemens, maximum : 89 µSiemens)—Total hardness : 0'25°dH to 2'35°dH (average : about 0'8°dH)—CaO : 1'12mg/1 to 15'6mg/1 (average: 2.4mg/1)—MgO : 0'99mg/1 to 5'7mg/1 (average : 2mg/1). The waters of these streams, where *P. (T.) neritoides* occurs, are very soft, slightly acidic with very low content of minerals, specially CaO and MgO. The organic pollution of the streams is not important (NO_3 : 0'037mg/1 to 0'94mg/1 (average : 0'05.0'1mg/1) ; NH_4 : 0 03mg/1 to 0'21mg/1 ; P_2O_5 : 0—0'18mg/1).

No molluscs occur in the brooks and torrents of the crystalline highland when the content of CaO is below 1mg/1, the pH is below 5'8, the total hardness is below 0'25°dH and the elctrolytic conductivity is lower than 10 µSiemens.

In the soft, slightly acidic waters of the up-and highland streams the shells of *P. (T.) loricatus* and *neritoides* are almostly decollated and strongly eroded by the free dissolved aggressive CO_2.

Like all other species in the genus *Paludomus P. (T.) neritoides* seems also to be ovo-viviparous. Young specimens are found in November and December near the borders of the streams. The food consists of encrusted algae growing on the rocks (diatoms, blue and green algae).

Distribution. Ceylon : Crystalline up-and highlands of South West.

(25) *Paludomus (Tanalia) solidus* DOHRN, 1857

Lit. 1857 *Paludomus solidus* (DOHRN, Proc. zool. Soc. London, 1857 : 124)—1876 *P. solida* (HANLEY & THEOBALD, Conch. Ind. 50, pl. 122, f. 4)—1880 *Tanalia solida* (BROT, in MARTINI & CHEMNITZ, Syst. Conch. Cab., 1 (25) : 11 ; pl. 4, fs. 7, 7a, 7b)—1915 *Paludomus (Tanalia) solida* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 62, No. 125)—1962 *Paludomus solidus* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12 : 56).

Localities. Uva Province : No. 61 (265 ind.), No. 70 (5 ind.)

Shell.—Appearance of a young *P.* (*T.*) *loricatus* var. *funiculatus* ; globose-elevated with short pointed spire 5 whorls rounded, rapidly, regularly growing ; dense spiral cords with rather distant obtuse ridges and delicately striated vertically. Colour yellow-brown (specially in young shells), thickly marked with vertical, slanting, jet-brown wavy bands, specially seen on the inside of the aperture. The last is broad-ovate, top pointed, outer lip white with narrow fair-brown edge, columella arcuate, flat with a brown edge on the outside (Figs. 143,144, Plate XII).

	Shell		*Aperture*	
Size (in mm)	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 61 (Wetakei Ela)	20'7	14'8	14'2	11'5
(Figs. 143, 144)	18'6	13'5	12'8	10'7
No. 70 (Wellawaya)	17'5	12'8	12	9'8
	22 1	14'3	12'9	10'9

The sizes are from the biggest specimens in the samples.

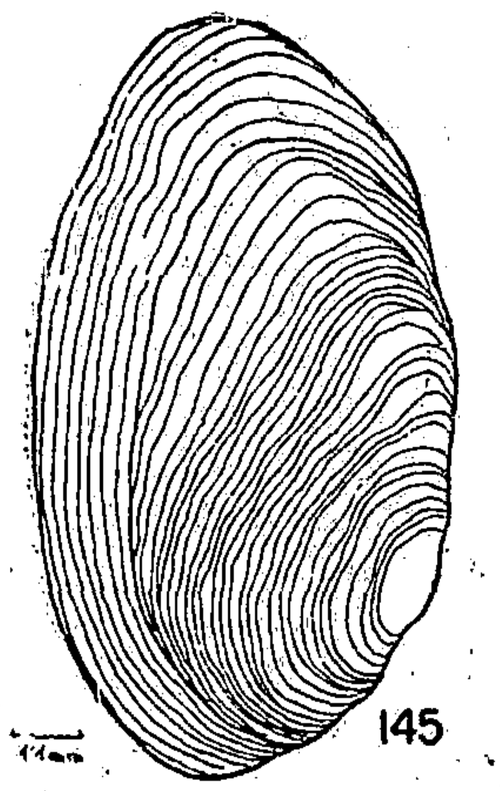


Fig. 145. *Paludomus Tanalia solidus* Exterior of operculum

Operculum.—Typical for the subgenus *Tanalia* : horny, blackish, nucleus dextral, lateral, subbasal, concentrically striated (Sizes of a specimen of No. 61 : 14mm × 11m ; fig. 145).

Anatomical remarks. No dissections were made.

Ecological and biological remarks. *P.* (*T.*) *solidus* is the representative of the subgenus *Tanalia* in the calcareous streams of some parts in the hilly region of the Uva Province (near Wellawaya). These streams flow over limestone formations.

Chemistry of No. 61 (Wetakei Ela, affluent of Kirindi Ganga) :

pH : 8'3	CaO : 59'4 mg/l
Conductivity : 360μ Siemens	MgO : 40'8 mg/l
Total Hardness : 11'6° dH	SiO_2 : 54'8 mg/l

These streams cross the typical dry forests of the Chloroxylon—ecosystem (after BRINCK et al., 1971). In the Wetakei Ela (No. 61) we found thick layers of calcarous sinter on the stones and rocks. The shells of *P.* (*T.*) *solidus* were not decollated and eroded.

Frequency in the Wetakei Ela (No. 61) :

Current : 30cm—1m/sec : 5 to 10 ind./1/16m²

Current : 0—30cm/sec. (border) : 40 to 60, mostly young ind./1/16m² (associated with *P.* (*P.*) *tanschauricus*, subspec. *nasutus*

The food consists of calcareous encrustated algae growing on the sinter of the rocks and stones.

Distribution. Ceylon : South-East of Uva Province.

Thiareae

(26) *Thiara* (*Plotia*) *scabra* (MÜLLER, 1774)

Lit. 1774 *Buccinum scabrum* (MÜLLER, Hist. Verm., 2 : 136)—1822 *Melania spinulosa* (LAMARCK, Hist. An. s. Vert., 6 (2) : 166)—1842 *M. granum* (VONDEM BUSCH, in PHILIPPI, Abb. & Beschr., *Melania*, 1 : 4 ; pl. 1, f. 7 (not 3)—1847 *M. scabrella* (PHILIPPI, ibid., 172 ; pl. 4, f. 13)—1850 *M. acanthica* (LEA, Proc. zool. Soc. London, 1850 : 194)—1858 *M. datura* (DOHRN, Proc.zool. Soc. London, 1858 : 135)—1859 *M. scabra* (REEVE, Conch. Icon., 12 : pl. 26, f. 183)—1859 *M. pugilis* (REEVE, ibid., pl. 26, f. 180)—1859 *M. pagoda* (REEVE, ibid. pl. 26, f. 182)—1859 *M. datura* (REEVE, ibid. pl. 28; f, 213)—1859 *M. granum* (REEVE, ibid. pl. 28; f. 219)—1874 *M. scabra* (BROT, in MARTINI & CHEMNITZ, Syst. Conch. Cab., 1(24) : 266 ; pl. 27, fs. 14, 15 ; as synonyms are listed : *spinulosa* LAMARCK, *doreyiana* LESSON, *denticulata* LEA, *tenuis* LEA)—1874 *M. granum* (BROT, ibid. : 270 ; pl. 27, f. 12)—1874 *M. myurus* (BROT, ibid. ; 271; pl. 28, f. 1)—1874 *M. elegans* (BROT, ibid. : 274 ; pl. 28, fs. 9, 9a)—1874 *M. acanthica* (BROT, ibid. : 278 ; pl. 28, f. 10)—1876 *M. scabra* (HANLEY & THEOBALD, Conch. Ind. : 31 ; pl. 73, fs. 1—4 ; var. *elegans* : fs. 5—7 ; *scabra*? var. *spinulosa* : 45 ; pl. 110, f. 7)—1876 *M. datura* (HANLEY & THEOBALD, ibid. : 31 ; pl. 73, f. 10)—1876 *M. acanthica* (HANLEY & THEOBALD, ibid. : 45 ; pl. 110, f. 10)—1884 *M. acanthica* (NEVILL, Handl. ind. Mus. Calcutta, 2 : 281 ; with the var. *roepstorffiana*, subvar. *brevispira*, subvar. *subscabra*)—1884 M. *scabra*, (NEVILL, ibid. : 283 ; with var. *myurus* BROT, *granum* VON DEM BUSCH : 285)—1915 *Tiara* (*Plotia*) *scabra* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 35 ; No. 60, with var. *elegans* BENSON)—1915 *T.* (*Pl.*) *acanthica* PRESTON ibid. : 35, No. 62 ; with the var. *roepstorffiana* NEVILL, subvar. *brevispira* NEVILL, subvar. *subscabra* NEVILL)—1931 *Melania* (*Plotia*)*scabra* (THIELE, Handb. Molluskenkde. : 200)—1934 *M. scabra* (RENSCH, Arch. Hydrobiol., Suppl., 13 : 234 ; with further synonyms)—1937 *M. scabra* (RIECH, Arch. Naturg. (N.S.), 6 : 41—48, 49—51 ; fs. 1—5)—1938 *Thiara* (*Plotia*) *scabra* (WENZ, Handb. Paläozool., Gastr. : 713, f. 2058)—1956 *Thiara scabra* (BENTHEM-JUTTING, Treubia, 23 (2) : 393, fs. 72, 88, with an extensive list of synonyms and literature)—1962 *Th. scabra* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12 : 53)—1962 *Th. acanthica* (MENDIS & FERNANDO, ibid. : 53, f. 9)—1962 *Th. datura* (MENDIS & FERNANDO, ibid. : 53).

Localities. Southern Province : No. 1 (1 ind.), No. 4 (6 ind.) ; No. 5 (3 ind.); Western Province : No. 13 (22 ind.); Sabaragamuwa Province : No. 24 (empty shell), No. 27 (1 ind.), No. 33 (33 ind.), No. 35 (1 empty) shell), No. 36 (167 ind.) No. 37 (14 ind.) ; Central Province : No. 50 (1 empty shell), No. 54 (1 ind.), No. 55 (3 ind.); Uva Province : No. 95 (ind.), No. 60 (6 ind.) ; No. 63 (96 ind.); North Central province : No. 75 (1 empty shell), No. 77 (33 ind.) ; North Western province : No. 92 (5ind.),

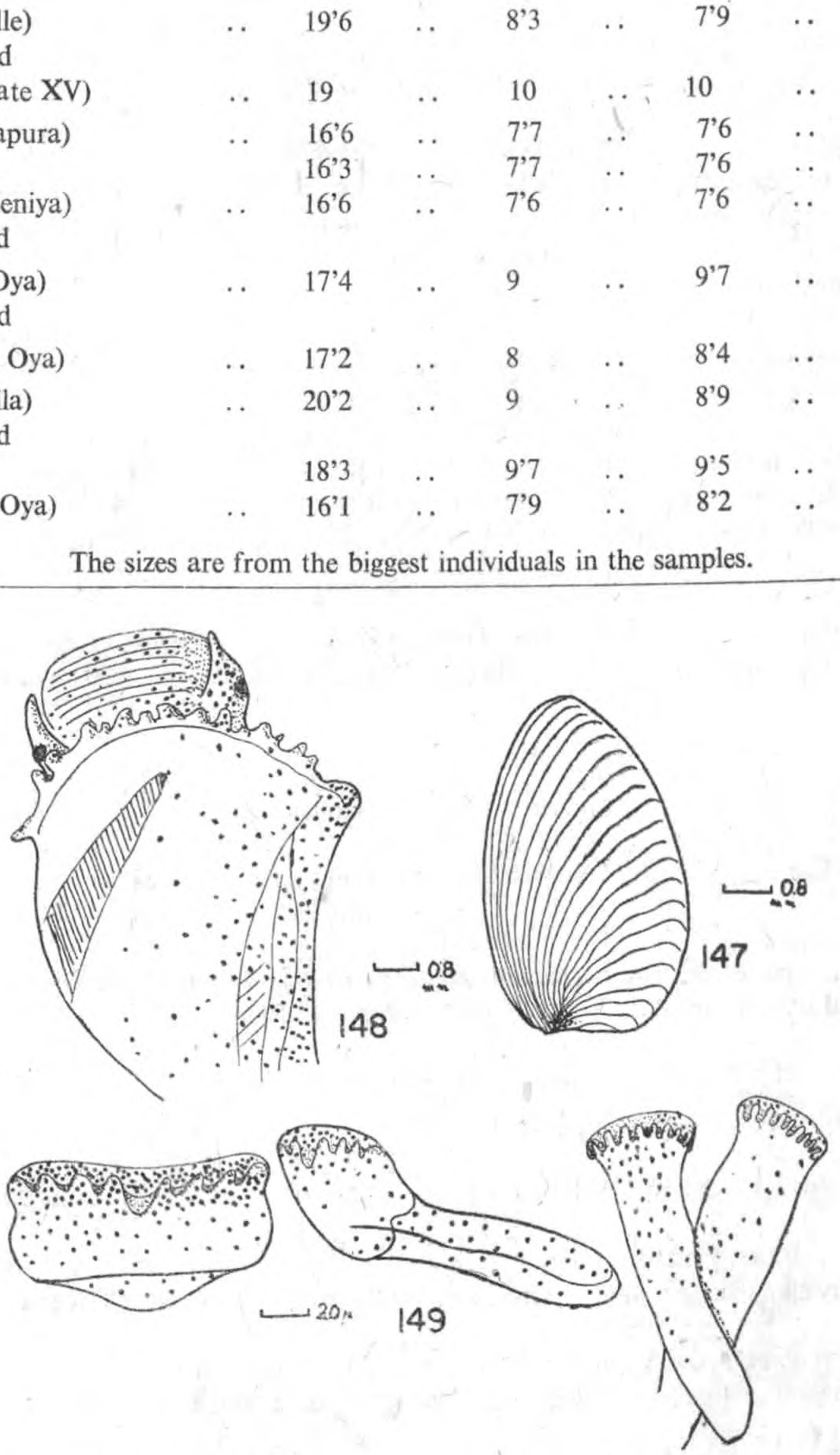
Shell. Elevated conical, with a high spire and large last whorl ; surface roughly striated in spiral direction, below the periphery, especially in the region of the umbilicus, the spiral striae form stronger ridges; the spiral striation is crossed by ribs in vertical direction. At about 1/3 of the distance between the suture and the periphery the axial ribs form-more or less-prominent spines, pointing obliquely outward ; these spines are of various strengths in different shells, varying between blunt knobs and sharp prickly needles, sepecially on young, immature shells. Fresh shells are somewhat transparent and shining, the surface is often eroded or coated with encrustations.

8—12 whorls, regularly increasing in size, descending step-like, with distinct suture ; the periphery is rounded below the row of spines, the top pointed, base rounded and the umbilicus closed ; apex often eroded.. Colour yellowish-brown to olive-brown, with irregular reddish-brown spots and flames; 2—3 spiral bands, but often absent.

Aperture almost vertical, oval and pointed above, rounded below ; peristome not continuous, the two ends are connected by a white callus against the penultimate whorl ; exterior margin sinuous, projecting forward with rounded curve in the middle, receding in the upper and lower part, basal margin somewhat channeled (Fig. 146, Plate XV).

	Shell		Aperture	
Sizes (in mm)	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 4 (Hakmana) Apex eroded	20	8'4	8'3	4'6
No. 5 (Matara) ..	17	7'3	7'4	4'2
No. 13 (Agalawatte)	22'2	10'3	11'3	6
Apex eroded ..	21'4	11'6	11	6'5
	19'3	9	8'8	5'6
	18	9'2	9	5
	17'3	8'1	7'6	4'4
No. 33 (We Ganga) Apex eroded	18'6	8'6	9	5
No. 36 (Kegalle) Apex eroded	19'6	8'3	7'9	4'7
(Fig. 146 plate XV)	19	10	10	6
No. 37 (Ratnapura)	16'6	7'7	7'6	4
	16'3	7'7	7'6	4'1
No. 50 (Peradeniya) Apex eroded	16'6	7'6	7'6	4'3
No. 59 (Veli Oya) Apex eroded	17'4	9	9'7	5'4
No. 60 (Kuda Oya)	17'2	8	8'4	4'7
No. 63 (Badulla) Apex eroded	20'2	9	8'9	4'7
	18'3	9'7	9'5	5'2
No. 77 (Kala Oya)	16'1	7'9	8'2	5

The sizes are from the biggest individuals in the samples.



Thiara (*Plotia*) *scabra*. Fig. 147 : exterior of operculum, Fig. 148 : snout, tentacles with eyes and fringed mantle edge, Fig. 149, radula teeth.

Operculum. Horny, oval, blackish-brown, the nucleus excentric at the left corner, the growth lines fanning out to the top and to the side of the operculum (Sizes from a specimen of No. 36 ; 8'3mm × 5'2mm ; Fig. 147).

Anatomical remarks. The anatomy of *Thiara* (*Plotia*) *scabra* was studied by RIECH, 1937 (Arch. Naturg (N. S.), 6 : 41.45, figures 1—5) on specimens from Pacific Islands. Our dissections confirm the results of RIECH 1937. Mantle edge with 15—20 fleshy papillae ; snout broad and short-truncated, proboscis transversely striated with strong, often V—shaped lines of jet-black ; eyes very near the base of the tentacles (Fig. 148).

Radula : Central tooth broad, on the base median triangular prolongated, one big central cusp and 3 denticles on either side (3—1—3). Lateral tooth of a quadrilateral portion with its base prolonged on one side, cutting edge with 1—1—3 denticles. The marginals being somewhat spathulate in shape and with 9—10, resp. 8—9 denticles (Fig. 149).

Alimentary system : The stomach has a typical style-sac with a relatively long club-shaped "crystalline style."

Nervous system : The ganglia are very close together (cerebral—, pedal—, pleural— and subintestinal—ganglia with short commissures connecting them. Only the supraintestinal—ganglion, connected with the right pleural—ganglion, lies separately on the floor of the left part of the mantle cavity.

Reproductive system : BENTHEM-JUTTING, 1956 (Treubia, 23 (2) : 364) states, that "as far as the Thiaridae have been investigated the animals are parthenogenetic, no males occur". But RIECH, 1937 (Arch. Naturg. (N.S.), 6 : 42, f. 1, and p. 45) gives a figure and a short description of a male of *Thiara* (*Plotia*) *scabra.* It is perhaps possible that RIECH has mistaken a young female without a developed brood-pouch. In his fig. 1 the "vas deferens" is very similar to the oviduct of the female in fig. 2.

From our dissections, we found the specimens collected from locality No. 36 to be all females : The ovary is surrounded by the digestive gland in the upper whorls. The oviduct runs, in the right part of the mantle cavity nearby the rectum, to a short distance before the mantle edge. Close to the opening of the oviduct, behind the base of the right tentacle opens a short glandular duct in the brood-pouch of the neck. The brood-pouch reaches in mature females from the radula-sac to the pericardium. We counted in mature specimens around 50 embryos in different stages of development. The shells of the bigger embryos possess 4 to 4¼ whorls ; the first whorls are smooth, from the third whorl begin two spiral ridges and two brown spiral bands.

Ecological-biological remarks. This species occurs in slow-running streams or near the border or in pools of fast-running streams. They are also found in ponds of the low-and upland between 60m and 700m altitude.

Frequency :

Locality	*Current*	*Ground*	*Frequency*
No. 33 (We Ganga)	.. 10–30cm/sec.	.. sand and stones, coated with mud and debris	5—6 ind./1/16m²

In this locality the species was associated with *Bulimus stenothyroides* and *Paludomus* (*P.*) *tanschauricus* subspec. *nasutus.* The ecological data for localities with *Th.* (*Pl.*) *scabra* is as follows :

Temperature : 21° to 27'2°C (optimum : 25°—26°C) pH : 6 to 7'7

Conductibility : 35 to 295 μ Siemens

Total Hardness : 1'1°dH to 9'2°dH ; CaO : 2 to 52 mg/1 MgO : 1'84 to 28'9 mg/1

These values indicate that the species is euryoec and occurs from slightly acidic and soft waters in the crystalline zone to neutral or slightly alkaline, hard waters in the zones of limestones, like in No. 60 (Kuda Oya) in South East Ceylon.

The females are viviparous and young snails leave the brood-pouch after 2—3 weeks. The animals feed on algae (diatoms, filamentous algae) and debris, growing or covering the mud, and stones.

Distribution. Widely distributed on the coasts and islands of the Indopacific and South—and South East Asia: East Africa, Mauritius, Seychelles, India, Burma, Malay Peninsula, and Archipelago, Philippines, Palau, Moluccas, New-Guinea, Bismarck Archipel, Solomon Islands, Fiji Islands.

(27) *Melanoides* (*Melanoides*) *tuberculata* (MÜLLER, 1774)

Lit: 1774 *Nerita tuberculata* (MÜLLER, Hist. Verm., 2 : 191)—1836 *Melania pyramis* (BENSON, J. Asiat. Soc. Bengal, 5)—1874 *Melania ornata* (BROT, in MARTINI & CHEMNITZ, Syst. Conch. Cab., 1 (24) : 173 ; pl. 21, f. 2)—1874 *M. moesta* (BROT, ibid. 180; pl. 21, f. 6)—1874 *M. inhonesta* (BROT, ibid. 206; pl. 23, f. 8)—1874 *M. crepidinata* (BROT, ibid. 238 ; pl. 25, f. 13)—1874 *M. javanica* (BROT, ibid. 238 ; pl. 26, f. 11)—1874 *M. tuberculata* (BROT, ibid. : 247 ; pl. 26, f. 11); as synonyms are listed : *Strombus costatus* SCHRÖDER, *Melania fasciolata* OLIVIER, *M. suturalis* PHILIPPI, *M. punctata* (LAMARCK) POITIEZ, *M. virgulata* FERUSSAC, *M. punctulata* GRATEL. in REEVE. ?*M. rothiana* MOUSSON, *M. rubropunctata* TRISTRAM, *M. beryllina* BROT, *M. tigrina* HUTTON, *M. layardi* DOHRN. *M. trunculata* LAMARCK *M. mauriciae* LESSON, *M. incontaminata, muricata, bisacrae* (all) PARREYSS in specim., ?*M. rivularis* PHILIPPI)—1874 *M. cylindracea* (BROT, ibid. : 252 ; pl. 26, f. 10)—1874 *M. malayana* (BROT, ibid. : 253 ; pl. 26, f. 5)—1874 *M. parreyssi* (BROT, ibid. : 254 ; pl. 27, f. 5)—1874 *M. unifasciata* (BROT, ibid. : 262 : pl. 27, f. 7)—1876 *M. layardi* (HANLEY & THEOBALD, Conch. Ind. : 31 ; pl. 73, fs. 8, 9)—1876 *M. tuberculata* (HANLEY & THEOBALD, ibid.: 32 ; pl. 74, fs, 1—4)—1876 *M. tigrina* (HANLEY & THEOBALD, ibid.: 44—45; pl. 110, fs. 1, 2)—1876 *M. pyramis* (HANLEY & THEOBALD, ibid. 45 ; pl. 110, fs. 3,4)—1884 *M. cylindracea* (NEVILL, Handl. Ind, Mus. Calcutta, 2 : 232)—1884 *M. unifasciata* (NEVILL, ibid. : 235)—1884 *M. nicobarica* (NEVILL, ibid. : 237 ; & with subvar. *canaliculata, gigantea*, var, *fusiformis, perstriatula* : 238)—1884 *M. tuberculata* (NEVILL, ibid. 239 ; with the variations *plicifera* : 241, *subcrebra* : 241, *layardi* : 242, *tigrina*,242, *orissaensis* : 243, *luteomarginata* : 244, *myadoungensis* : 245, subvar, *subplicifera* : 245)—1884 *M. rivularis* (NEVILL, ibid. : 247, with var. *subunifascialis*)—1915 *Tiara* (*Striatella*) *tuberculata* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 15—17, No. 28 ; with the var. *subcrebra* NEVILL, *layardi* (DOHRN) NEVILL, *tigrina* (HUTTON) NEVILL, *orissaensis* NEVILL, *luteomarginata* NEVILL, *myadoungensis* NEVILL, subvar. *subplicifera* NEVILL)—1915 *T.* (*St.*) *nicobarica* (REEVE) (PRESTON, ibid. : 19 ; No. 32, with the subvar. *canaliculata* NEVILL, *gigantea* NEVILL, var, *fusiformis* NEVILL, *perstriatula* NEVILL)—1915 *T.* (*St.*) *rivularis* (PRESTON, ibid. : 20, No. 34 ; with var. *subunifascialis* NEVILL)—1915 *T.* (*St.*) *pyramis* (PRESTON, ibid. : 20, No. 35)—1915? *T.* (*St.*) *sublutosa* NEVILL (PRESTON, ibid. : 17, No. 29)—1915? *T.* (*St.*) *turriculus* LEA (PRESTON, ibid. : 18—19, No. 30)—1915 ? *T.* (*St.*) *nevilli* BROT (PRESTON, ibid. : 18, No. 31 ; with the var. *andamanica*, subvar. *semilaevigata* NEVILL, *appressa* NEVILL)—1915 *T.* (*St.*) *crebra* LEA (PRESTON, ibid. : 20, No. 33 ; with subvar. *emaciata* NEVILL)—1931 *Melania* (*Melanoides*) *tuberculata* (THIELE, Handb. syst. Weichtierkde,: 201)—1937 *Melania tuberculata truncatula* (RIECH, Arch. Hydrobiol., Suppl. 13 : 55 ; with and extensive list of synonyms) —1938 *Melanoides* (*Melanoides*) *tuberculata* (WENZ. Handb. Palaeozool., Gastr. : 715, f. 2065)—1956 *Melanoides tuberculata* (BENTHEM-JUTTING, Treubia, 23, (2) : 412—418 ; fs. 69, 73, 91 ; with an extensive list of literature and synonyms)—1957 *Melanoides tuberculata* (STARMÜHLNER, Sitz.—Ber. österr. Akad. Wiss. (Math.—Nat.), Abt. 1, 166 (9/10) : 457—459 ; f. 13, pl. 2, f. k)—1962 *Melanoides tuberculata* (MENDIS & FERNANDO, Fish. Res. Stn. Bull 12 : 53, f. 6 ; with the var. *layardi* DOHRN, *subcrebra* NEVILL)—1969 *Melanoides* (*Melanoides*) *tuberculatus* (STARMÜHLNER, Malacologia, 8 (1/2) : 224—243 ; fs. 297—320)—1970 *Melaniodes tuberculatus* (STARMÜHLNER, Cah. O.R.S.T.O.M., sér. Hydrobiol., 4 (3/4) : 89—91 ; fs. 129—132).

Localities. Southern Province: No. 1 (1 ind.), No. 4 (5 ind.), No. 5 (114 ind.), No. 6 (8 ind.); Western Province: No. 13 (26 ind.), No. 17 (1 ind.), No. 19 (106 ind.) ; Sabaragamuwa Province : No. 33 (44 ind.), No. 36 (47 ind.), No. 37 (4 ind.) ; Central Province : No. 49 (16 ind.) No. 51 (4 ind.), Uva Province : No. 59 (1 ind.), No. 63 (4 ind.), No. 69 (11 ind.), North Central Province : No. 75 (2 empty shells), No. 80 (1 ind.) ; North Western Province : No. 85 (5 ind.) No. 86 (3 empty shells), No. 89 (6 ind.) No. 93 (2 ind.).

Shell. Extremely variable, many local forms have led collectors and conchologists to discriminate a profusion of "species, subspecies, varieties, subvarieties and forms"!

Turreted with high spire and moderately large last whorl, 10–15 whorls, regularly increasing in diameter, the first whorls are convex, the later ones more flattened, apex often eroded, a little distance below the distinct suture sometimes somewhat "shouldered", umbilicus closed ; whorls sculptured by spiral striae, well raised in the upper whorls, but flatter in the later ones, crossed by vertical striae which can even be developed as coarse, sometimes undulating ribs; shell often coated by mud or ferruginous encrustations ; colour straw-yellow or olive with darker red-brown dots and flames, either irregularly distributed or arranged in vertical rows. Many specimens possess a spiral band of the same colour in the umbilical region.

Aperture vertical-oval, pointed above round below ; peristome not continuous but connected by a thin callus against the penultimate whorl ; exterior margin sinuous protruding in the middle receding in top and basal region (Fig. 150-153, Plate XV).

	Shell		Aperture	
Sizes (in mm) :	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 4 (Hakmana) Apex eroded ..	22'2	8' 5	8	5
	22	7'5	7'4	4'7
No.5 (Matara) Apex eroded (Fig.150,	16'5	5	4'7	3'4
Plate XV)	15'8	5'8	5'5	3'5
No. 13 (Agalawatte) Apex eroded ..	28'7	9'7	9'7	6
No. 16 (Minuwangoda) Apex				
eroded	21	7'5	7'1	4'4
No. 17 (Attanagalla) Apex eroded ..	24'2	7'4	7'3	4'4
No. 19 (Panadura) Apex eroded ..	22'7	7'2	7	4'5
No. 33 (We Ganga) Apex eroded	24'8	9	9'5	5'7
(Fig. 151, Plate XV). ..	24	7'4	7'3	4'2
	23'2	8'8	9	5'2
	22'9	8'1	7'7	4'9
	22'9	7'2	7	4'4
	22'2	7	7	4'1
No. 36 (Kegalla) Apex eroded (Fig.	24'5	7'6	8	4'3
152, Plate XV). ..	23'5	9	8'5	4'8
	23'5	7'5	7'4	4'5
	22	6'9	7	4
	17'4	7'2	7'2	4
No. 37 (Ratnapura) ..	27'3	9'1	9	5'4
No. 49 (Kandy) Apex eroded (Fig.	29'5	8'8	9	5'6
153, Plate XV). ..	28	8'6	8'6	5
	27'7	9	9	5'2
	28	9'2	9'2	5'5
No. 51 (Kandy) Apex erroded ..	20'5	7'4	7'2	4
No. 63 (Badulla) Apex eroded ..	24'3	8	7'8	4'7
	23'6	9'2	9	5'5
No. 69 (Diyatalawa) Apex eroded ..	22'5	8'2	8	4'9
No. 75 (Polonnaruwa) ..	18'8	6'5	6'3	3'8
No. 85 (Narammala) Apex eroded	20'5	7'8	7'1	4'7
No. 89 (Mundel Lake) Apex eroded	21'8	7'3	7	4

The sizes are from the biggest specimens in the samples.

Operculum. Horny blackish-brown; nucleus excentric in the left corner; growth striae spread in a short spiral in vertical and lateral directions (Sizes of a specimen from No. 49: 8 mm × 5 mm).

Anatomical remarks. Anatomical details of this species have been described by RAMAMOORTHI, 1949 (Proc. Ind. Sci. Congr., 36 : 157) and 1950 (J. zool. Soc. India, 2:27), STARMÜHLNER, 1957 (Sitz. Ber. österr. Akad. Wiss. (Mathem.—Nat.) Abt.1,166(9/10) : 457—459; f. 13, pl. 2, f. k), STARMÜHLNER, 1969 (Malacologia, 8(1/2) :224—243 F. S. 297—320) and STARMÜHLNER, 1970 (Cah. O.R.S.T.O.M., sér, Hydrobiol., 4(3/4) : 89—91; fs. 129.132). The dissected specimens from Ceylon show no differences.

Ecological-biological remarks. Melanoides(M.)tuberculata is an euryoec species, found in Ceylon from the coast to low-and upland, in No. 69 (Diyatalawa) till 120m altitude. This species prefers stagnant waters, like pools, impoundments tanks, marshes, irrigated paddy fields, but occurs also on the borders and in pools of slow-running streams with muddy-sandy bottom. In such biotopes this species is found upto a current of maximal 30cm/sec, but prefers the slow current between 0—20cm/sec. The snail is very resistant against higher temperatures, organic pollution and also is found in slightly brackish waters (like in No. 89, Mundel Lake).

The frequency in flooded pools near the border of the We Ganga (No. 33 near Balangoda) was 10-15 ind./1dm², around 50-60 ind./1/16m² or 800—950 ind./m² !

The optimal temperatures for *M. (M.) tuberculata* are between 21° and 26° C.

Chemical conditions of the localities with *M. (M.) tuberculata* : pH : between 6 and 7'2 ; Conductivity : 35 to 89 μ Siemensi Total hardness : 1'2° dH to 2'3° dH ; CaO: 4 to 15'6 mg/1.

Melanoides (*M.*) *tuberculata* has a negative phototaxis and by day the snails mostly hide away under mud and bottom detritus. In the evening and night they come out and feed on algae and organic waste matter from animals. Sometimes they attack small live animals. like oligochaetes.

The females are viviparous and about 20–50 embryos are to be found in the brood-pouch of a mature female. BEMTHEM-JUTTING, 1956 (Treubia, 23 (2) : 365) states : "As a consequence of their parthegonicity one individual suffices to found a new colony. As no cross breeding takes place such a colony has a very homogenious genetical composition. If the ecological conditions remain practically the same during many generations an isolated colony can develop into a population of uniform individuals with an outspoken local or "insular" character. This procedure may help to explain the almost incredible variability of the members of the family Thiaridae, especially *Melanoides* (*M.*) *tuberculata*." MORRISON, 1954 (Proc. U. S. Nat. Mus., 103 : 374–375) writes : "There is required only one individual to start a new population or colony if it reaches a new freshwater locality by stream capture or by adventitious transportation. The resultant ability of these snails theoretically to spread more rapidly may partly explain their wider distribution in suitable habitats ....." and the present geographic distribution of the Thiaridae (especially *M.* (*M.*) *tuberculata*) argues for their greater ability to spread across oceanic areas on island stepping stones without the necessity for any continuous land bridges."

Distribution. North Africa, Asia Minor, Iran, India, Ceylon, Madagascar, Islands of the Indian Ocean, Burma, South China, Malay Peninsula and Archipelago, North Australia, New Guinea and the most Pacific Islands.

MARTENS, 1897 (in WEBER, Erg. Reise Nied. Ost. Indien, 4 : 59) tried to explain the wide distribution of the species from North Africa to the Pacific Islands by assuming that this species, which is common inhabitant of irrigated rice fields has been passively and unintentionally spread through human agency by inter-local, or even inter-continental transport of young rice plants.

(28) *Melanoides* (*Stenomelania*) *torulosa* (BRUGUIÈRE, 1789)

Lit: 1789 *Bulimus torulosus* (BRUGUIÈRE, Encycl. Meth. Vers., 1 : 332)—1791 *Helix crenata* (GMELIN, in LINNÉ, Syst. Nat., 13 : 3655)—1834 *Melania aculeus* (LEA, Trans. Phil. Soc. Philadephia (N.S.), 5 : 81 ; pl. 19, f. 72)—1834 *M. tirouri* (QUOY & GAIMARD, Voy. Astrolabe, Zool. 3 : 159 ; pl. 56, fs. 38, 39)—1838 *M. crenulata* (DESHAYES Hist. Nat. Anim. s. Vert. 2 (8) : 434)—1838 *M. tirouri* (DESHAYES, ibid. : 435)—1844 *M. semicancellata* (VON DEM BUSCH, in PHILIPPI, Abb. & Beschr., 1 (*Melania*) : 159 ; pl. 3, f. 2)—1844 *M. porcata* (JONAS, Z. f. Malak., 1 : 50)—1858 *M. confusa* (DOHRN) Proc. Zool. Soc. London, 1858 : 135)—1859 *M. crenulata* (REEVE, Conch. Icon., 12 : pl. 5, f. 26)—1859 *M. semicancellata* (REEVE, ibid. : pl. 8, f. 37)—1874 *M. crenulata* (BROT, in MARTINI & CHEMNITZ, Syst. Conch. Cab., 1 (24) : 114 ; pl. 14, fs. –a—f.)—1874 *M. semicancellata* (BROT, ibid. : 118 ; pl. 15, fs. 1, 1a–b)—1874 *M. obesula* (BROT, ibid. : 121 ; pl. 15, f.8)—1874 *M. aculeus* (BROT, ibid. : 122 ; pl. 15, f. 6)—1876 *M. confusa* (HANLEY & THEOBALD, Conch. Ind. : 31 ; pl. 72, f. 4)—1884 *M. crenata* (NEVILL, Handl. Ind. Mus. Calcutta, 2 : 225 ; with var. *confusa*, *tirouri* : 226)— 1884 *M. semicancellata* : 225)—1915 *Tiara* (*Radina*) *crenulata* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 11, No. 21 ; with var. *confusa* NEVILL, *tirouri* NEVILL : 12)—1956 *Melanoides torulosa* (BENTHEM-JUTTING, Treubia, 23 (2) : 410 ; fs. 92a–b ; with an extensive list of literature and synonyms)—1962 *M. crenulata* (MENDIS & FERNANDO, Fish. Res. Stn. Bull. 12 : 53 ; with var. *confusa* DOHRN).

Locality. Western Province : No. 11 (5 ind.)

Shell. Large, high-turrted with a great number of flat whorls and large body whorl ; the whorls of the spire with fine spiral lines, separating flat ridges continues but they are broader and less numerous ; the spiral ridges are broken up by transverse lines into 1–4 rows of nodules, which may even appear as vertical nodule ribs. The row of nodules immediately below the suture is generally the strongest and forms an elevated crown, below the nodules are much weaker, but the spiral ridges remain ; 12–14 little convex whorls, the penultimate concave and below the suture then convex again, umbilicus closed. Colour dark-olive to brown, the top whorls lighter than the later ones and often spotted with small brown spots or waves. Aperture vertical-pyriform, pointed above and rounded below ; peristome not continuous, but connected by a thick bluish-white callus against the penultimate whorl ; columellar side somewhat twisted and so much curved to the left side, that, on looking from the base, the penultimate whorls are visible inside ; basal margin slightly channeled, outer margin crenulated.

All five specimens from the collection of COSTA et al. 1971 are partially broken and with eroded apices (sizes in mm) : No. 11 (Horana) : 21'4 (alt.) and 10'6 (diam.)

Operculum. Horny, pear-shaped, almost black ; the nucleus is excentric, situated at the left basal corner ; the growth lines spread from the nucleus to the top and margins.

Anatomical remarks. After SESHAIYA, 1940 (Current Science, 9 : 331–332) the female has a brood-pouch. From the eggs slide veliger larvae into the water, where they complete their development. From the specimens of the collection no dissections were executed.

Ecological-biological remarks. Inhabit streams, but no observations were made on this species in Ceylon.

Distribution. India, Ceylon, Andaman-Islands, Malay Archipelago, Philippines, Solomon-Islands.

EUTHYNEURA

Basommatophora

Lymnaeacea

Lymnaeidae

Lymnaeinae

(29) *Radix* (*Cerasina*) *luteola* (LAMARCK, 1822) var. *pinguis* (DOHRN, 1858)

Lit : 1822 *Lymnaea luteloa* (LAMARCK, Hist. nat. Anim., s. Vert., 6 (2) : 16)–1822 *Limnaea ovalis* (GRAY SOWERBY, Gen. Rec. Foss. Shells, lpt. 7, *Limnaea :* pl. 178)-1834 *L. succinea* (DESHAYES, Voy. Belanger, Zool. :418) 1836 *Lymnaea butta* (error of typist for *bulla ;* BENSON, J . asiat. Soc. Bengal, 5:744 , after HUBENDICK, 1951 a nomen nudum)- 1837 *Lymnaeus cerasum* (TROSCHEL, in WIEGMANN's Arch.f.Naturg., 3:170)-1837 *L. nucleus* (TROSCHEL ibid. : 171)-1837 *L. impurus* (TROSCHEL, ibid.:172)-1841 *Lymnaea luteola* (DELESSERT, Rec. coqu. decr. pour. LAMARCK : pl. 30, fs . 5A-B)- 1858 *Limnaea pinguis* (DOHRN, Proc., zool.Soc. London, 26 : 134)- 1858 *L. tigrina* (DOHRN, ibid.: 134)-1862 *Limnaeus oliva* (KÜSTER, in MARTINI and CHEMNITZ, Syst.Conch.Cab., 1 (17b) : 31 ; no. 41, pl.5, fs.25-26)-1862 *L. succineus* (KÜSTER, ibid.:29 ; pl. 5, fs. 18-19)-1872 *L. pinguis* var. *strigata* (SOWERBY, in REEVE, Conch. Icon., 18:pl. 9, f. 18b.)-1873 L. *ovalis* (SOWERBY, ibid.: pl.9,f.59)-1873 *L. siamensis* (SOWERBY, ibid.; pl. 10, f. 63)-1873 *L. nucleus* (SOWERBY, ibid.: pl.10 f. 67)-1867 *Limnaea ovalis* (HANLEY and THEOBALD, Conch. Ind.: 30 ; pl.70, fs.2-3)-1973 *L. ovalis* var. *strigata* (HANLEY and THEOBALD, ibid.: 30 ; pl. 70, f. 4)-1873 *L. luteola* (HANLEY and THEOBLAD, ibid.:30 ; pl. 70, fs. 5-6)-1873 *L. pinguis* (HANLEY and THEOBALD, ibid.:30; Pl.70, 7, 10 ; var. :f. 8)—1873 *L. tigrina* (HANLEY and THEOBLAD, ibid.: XVI, foot-note 8)- 1877 *L. andersoniana* (NEVILL, J. asiat. Soc. Bengal, 46:26)-1878 L. *luteolus* (NEVILL, Handl. Ind. Mus. Calcutta, 1:233)-1881 *L. nucleus* (MARTENS, Conch. Mittheil., 1:82 ; pl. 15, fs. 8-9)-1881 *L. tigrina* (MARTENS, ibid.: 85 ; pl. 15. f. 5)-1881 *L. succinea* var. *impura* (MARTENS, ibid. : 86 ; pl. 15, f. 6)- 1886 *Limnaeus ovalis* CLESSING (KÜSTER and DUNKER) in MARTINI and CHEMNITZ Syst. Conch . Cab. 1 (17) 375 ; pl. 52 . f. 1; as synonyms are listed : *bulla* BENSON *variabilis* BENSON, *sulcata* TROSCHEL *lessoni*, DESHAYES, *cerasum* TROSCHEL : all teste SOWERBY and var. *zebra* KÜSTER : pl. 16, fs. 5-7; after HUBENDICK, 1951 (p. 192) *lessoni* DESHAYES, 1831 (Mag. de. Zool., 1 : no 16) is a species of " 1 ' Aüstralie" and after the same author (p. 205) is *sulcata* TROSCHEL, 1837 (WEIGMANN's Arch.f. Naturg., 3:167 as *Limnaeus*) the race *rufescens* of *auricularie* LINNÉ the species *variabilis* of BENSON is not listed in HUBENDICK's monograph about the genus *Lymnaea*)-1886 *L. nucleus* (CLESSIN (KÜSTER and DUNKER), ibid.: 378 ; pl. 50, f. 6)- 1886 *L. siamensis* (CLESSING (KÜSTER and DUNKER) ibid.: 380 ; pl. 50, f. 9)- 1915 Limmnaea Limnaea) ovalis (PRESTON F. Br. Ind. (Freshw. Gastr. and Pelec.) : 109, no. 212 ; with var. *nucleus* TROSCHEL) - 1915 *L.* (*L.*) *tigrina* (PRESTON, ibid.:110, no 213. with var. *minor* PRESTON)- 1915 L. (*Gulnaria*) *succinea* (PRESTON, ibid.: 112 no. 220 ; with var. *impura* TROSCHEL)- 1915 *L.* (*G.*) *pinguis* (—PRESTON ibid. : 113, no 222)-1915 *L.* (*G.*) *siamensis* (PRESTON, ibid.: 113. no 223)- 1919 *L. pinguis* (ANNANDALE, Rec. Ind. Mus. Calcutta, 16:144; f.5; pl.—5, f.4)-1925 *L. luteola* (ANNANDALE, ibid., 27: 106; race *siamensis* SOWERBY:107)-1925 *L. luteola* (ANNANDALE and RAO, ibid., 27 : 162 ; f. VI : 4, 5, 14, 15; p. 171 : f. XI : A. B, C, p. 179 : f.: XV : K. L, M, N; p. 183-189 with f. *typica* : 184, *f. ovalis* GRAY : 184 f. *australis* (=*pinguis* DOHRN) : 184, f. *impur* TROSCHEL : 185, f. *succinea* DESHAYES : 185, f. *siamensis* SOWERBY : 185)- 1951 *L. luteola* (HUBENDICK, Kungl. Svenska Vetenskapsakad. Handl., Fj. Ser. (1) : 43, f. 33-35; p. 46 (with *pinguis* DOHRN), 47 . f. 39, 49f, 40 (*pinguis*. DOHRN) ; p. 76, 79, f. 137 ; p. 180 : f. 178 ; 161 : f. 349a-i. p. 193; as synonyms are listed : p. 180 : *andersoniana* NEVILL, p. 183 : *cerasum* TROSCHEL, p. 190 *impura* TROSCHEL, p. 197 : *nucleus* TROSCHEL *oliva* KÜSTER, p. 198 *ovalis* GRAY, p. 199 : *pinguis* DOHRN p. 202 : *simaensis* SOWERBY, p. 204 : *strigata* SOWERBY, p. 205 : *succinea* DESHAYES, p. 206 : tigrina DOHRN)- 1958/60 *Radix* (*Cerasina*) *luteola* (WENZ and ZILCH, Handb. Palaeozool., 6 (2), Gastr.-Euthyn. : 94, f. 304)- 1962 *Lymnea pinguis* (MENDIS—FERNANDO, Fish Res. stn. Bull., 12:55, f. 15; as foot-note: after HUBENDICK 1951, *pingüis=luteola*) 1962. *ovalis*) MENDIS—FERNANDO, ibid. : 57) - 1962, *L. tigrina* (MENDIS—FERNANDO, ibid. : 58 ; with var. *minor* NEVILL).

Localities. Southern Province: No. 6 (3 ind.); Western Province : No. 11 (2 ind.), No. 16 (42 ind.), No. 19 40 ind.);Central Province : No. 49 (30 ind.); Uva Province: No. 69 (1 ind.); North-Western Province : No. 86 (65 ind.), No. 88 (1 ind.), No. 91 (1 ind.).

Shell. Varying in size shape and form has led the conchologists, like in many other freshwater Gastropods into naming a profusion of species, subspecies, varieties and forms : HANLEY and THEOBALD, 1876 note in the Conch. Ind. page XVI, footnote 8 : "*L. tigrina* DOHRN is just like a streaked form of BENSON's *L. bulla* (misprinted as *butta*), a mere name for the almost undescribed *L. limosa* (?) of HUTTON 1834 (J. asiat. Soc. Bengal, 3), chiefly belonging to a variation of *L. pinguis* DOHRN from Calcutta (Conch. Ind. : pl. 70, f. 8). After CLESSIN (in MARTIN and CHEMNITZ) Syst. Conch. Cab. 1 (17) : 375) the name L. *bulla* BENSOM is (like *variabilis* BENSON, *sulcata* TROSCHEL, *lessoni* DESHAYES, *cerasum* TROSCHEL and *zebra* KÜSTER) a synonym of *L. ovalis* GRAY.

ANNANDALE and RAO, 1925 (Rec. Ind. Mus. Calcutta, 27) state in their monograph about "Indian Limnaeidae" (on pages 183-186) that *L. luteloa* LAMARCK has 6 forms in India (including Burma and Ceylon) *typica* (*luteola* LAMARCK), *ovalis* GRAY, *australis* ANNANDALE and RAO (for *pinguis* DOHRN), *impura* TROSCHEL, *succinea* DESHAYES and *siamensis* SOWERBY.

HUBENDICK 1951 published a monograph about the "Recent Lymnaeidae" (in Kungl. Svenska Vetenskapakad. Handl., Fj. Ser. 3 (1) with extensive conchological and anatomical studies. He found that the so called "species"–*cerasum* TROSCHEL, *impura* TROSCHEL, *nucleus* TROSCHEL, *pinguis* DOHRN (occuring also in Ceylon), *siamensis* SOWERBY and *succinea* DESHAYES are really synonyms of *L. luteola* LAMARCK. According to HUBENDICK, 1951 probably *andersoniana* NEVILL, *oliva* KÜSTER, *ovalis* GRAY, *tigrina* DOHRN are also synonyms for the same species. In the collections from Ceylon we found exclusively the var. *luteola* DOHRN.

Radix (*Cerasina*) *luteloa* f. *typica* has 5-6 flat whorls, which are separated by a very shallow suture. HUBENDICK 1951 (p. 161) accentuates "that the outlines of the shell, from the apex to the middle of the body whorl, sometimes even to the middle of the aperture from nearly straight lines." The suture slopes very gradually. The columella is twisted to a greater or lesser extent and the columellar fold likewise pronounced. The inner lip is closely appressed to the body whorl and there is consequently no umbilical chink. The top of the shell is generally brown in colour. Generally smooth and often very glossy. Brown bands parallel to the peristome are relatively common. The columellar callus is not exceptionally well developed. In this form which occur in India, Burma and Andaman Islands, the shell size may vary from fairly large to very large size (ANNANDALE and RAO, 1925 : p. 184).

The var. *pinguis* DOHRN (f. *australis* ANNANDALE and RAO) occurs in India and also in Ceylon : it is a smaller form, than *typica* with much narrower and more elogated spire, with the suture more impressed and more sinuous and without any compression of the body -whorl. The whorls are less rounded. The shell is also thinner and as a rule, more polished than in the var. *typica* (Fig. 154*).

	Shell		*Aperture*	
Sizes (*in mm*) :	*Ht.*	*Diam.*	*Ht.*	*Diam.*
No. 11 (Horana)	14'8	8	11'4	6
No. 16 (Minuwangoda) ..	16'1	8'7	11'8	6'2
	15'6	8'5	11'6	6
No. 19 (Panadura) (Fig. 154 Plate XV*)	18'9	9'5	13'2	7'2
	16'9	9'2	13	7'8
	17'4	9	12'2	7'3
No. 49 (Kandy)	15'9	8'9	12'3	6'4
	15'9	8'9	11'7	6'7
No. 86 (Batalagoda) ..	12'5	7	9	5

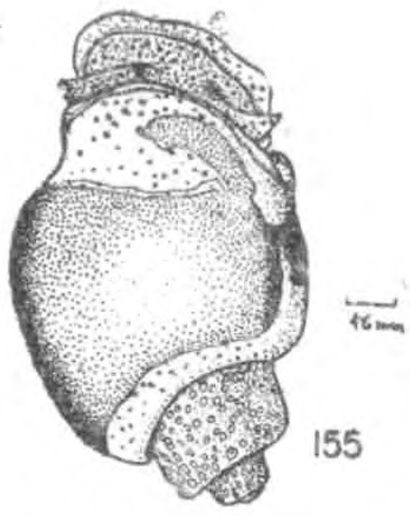
The sizes are from the biggest specimens in the samples.

Anatomical remarks. Detalis of the anatomy of Radix (*Cerasina*) *luteola* are given by ANNANDALE and RAO 1925 (jaws : p. 162, f. VI : 4,5, 14, 15; radula : p. 171, f. XI : A,B, C, ; genitalia : p. 179, f. XV : K, L, M, N,) and HUBENDICK, 1951 (shell and genitalia : p. 43 : f. 33, 34, 35; p. 46; p. 47 : f. 39; p. 46; p. 79 : f. 173 ; p. 80 : f. 187 ; shells : p. 161, f. 349*a* - i ; p. 161 ; radula : p. 107, f. 298 : 47).

The shell, radula, jaw and genitalia of var. *pingūis* are described and figured by ANNANDALE and PRASHAD, 1919 (p. 114, 145 ; f. 5 and pl. 5, f. 4). HUBENDICK 1951, has also examined the genitalia of the specimens of the var. *pingūis* from India . He gives the description on p. 46-48 with drawings of shells and genitalia on p. 49, f. 40. Animal with moderately broad foot (fig. 154*) and flat triangular tentacles. Eyes at the base of the tentacles. Head and tentacles are in life greyish-olive with fairly small dots. The mantle possess on the outside irregular darkblue to blackish patches flowing off into each other . The upper whorls are greenish-brown with the digestive gland shining through the thin skin (Fig. 155). Jaw : middle piece of the horny upper jaw broad slightly curved, coarse and dark brown ; the cutting edge nearly straight (Fig. 156).

* Marked fig. 165—Plate XV.

Radula : About 70 teeth on each row. Central tooth small, often distinctly asymmetrical and with two lobes. The laterals with 3 distinct cusps, sometimes the inner cusp is bifurcate ; the median cusp is much larger than the outer one. After the six to seven rows of laterals increases on the cutting edges of the marginals the number of denticles to four and five (Fig. 157). Our results from specimens from Ceylon agree with the description and figure, given by ANNANDALE and PRASHAD,1919 from a specimen of var. *pingūis* from Khandalla near Bombay. Nervous system : Like in Lymnaeidae the ganglia are very concentrated . The cerebral ganglia are ovate and connected by a very short and thick commissure. From the outside arises the n. tentacularis and the n. opticus. Following there are the ramified n. labialis and the connective to the buccal ganglia. On the right cerebral ganglion arises also the n. penis. Pedal-and pleural ganglia are very close to the cerebral ganglia, connected only by very short and thick connectives. They form with the parietal ganglia and the adbominal (or visceral) ganglion a ring around the oesophagus (Fig. 158).



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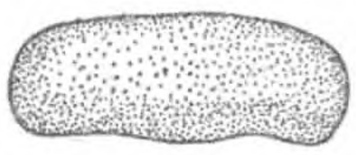

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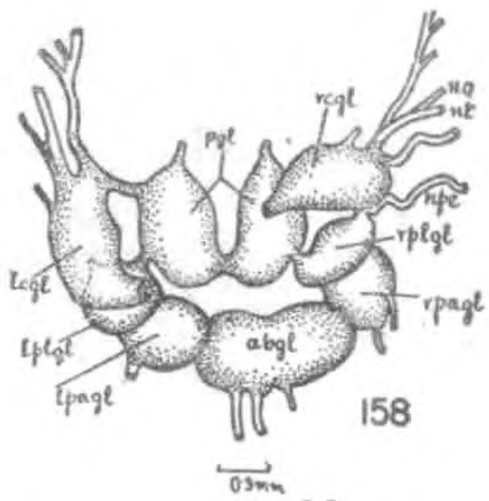

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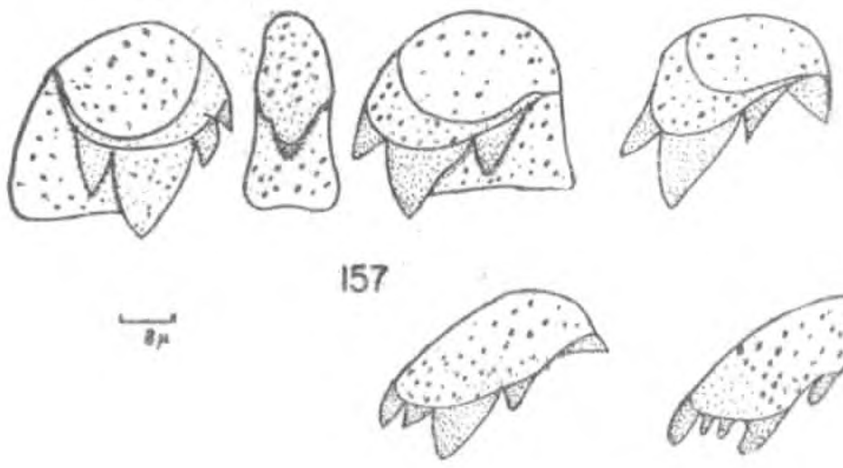

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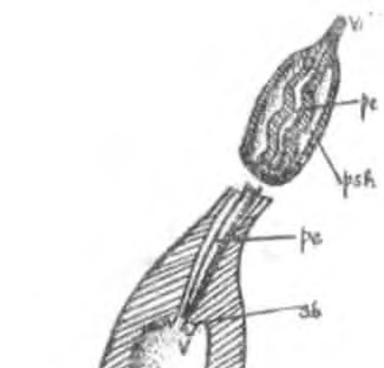

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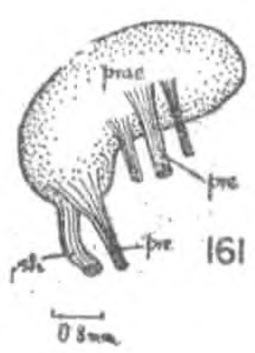

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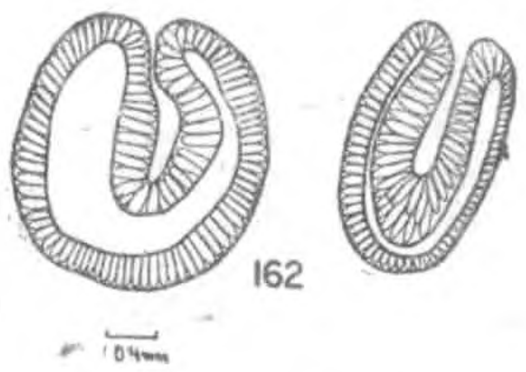

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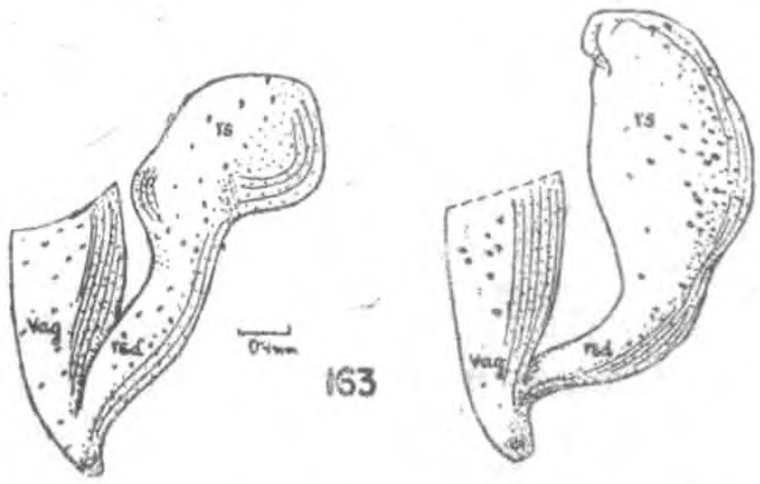

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Radix (*Cerasina*) *luteola* var. *pinguis*. Fig. 155: Soft body of the snail, Fig. 156: middle piece of the jaw, Fig. 157: radula teeth, Fig. 158: nervous system, agl: abdominal ganglion, lcgl: left cerebral ganglion, lpagl: left parietal ganglion lplgl : left pleural ganglion, no: nervus opticus, npe : nervus penis, nt : nervus tentacularis, pgl : pedal ganglion, rcg, right cerebral ganglion, rpagl : right parietal ganglion, rplgl: right parietal ganglion, Fig. 159: lower parts of the male duct ; psh : penis sheath, pshr : penis sheath retractor, pre : retraitor muscle of praeputium, prae : praeputium, vd : vas deferens (lower part, coming from the prost hatata gland. Fig. 160: longitudinal section of praeputium with penis and upper part of penis sheath, mp : muscular pillars of praeputium, pe : penis, sb : sarcobelum, ve : velum, other abb· as—Fig. 159, Fig. 161 : praeputitum with retractor muscles in the outside : abb. as—Fig. 159, Fig. 162 : Cross section of the prost hatata glands of two specimens from different localities in Ceylon. Fig. 163: Vagina walls spermathecal duct and spermatheca (=receptaculum seminis) of two specimens from different localities in Ceylon, rs : spermatheca (=receptaculum seminis), rsd : spermathecal duct, vag : vagina.

Genitalia : Figured and described for var. *pingüis* by ANNANDALE and PRASHAD, 1919 and HUBENDICK 1951 from specimens from India. The results of these authors show some differences, specially in the formation of the prostate and spermatheca with its duct. Like all Lymnaeidae, *R.* (*C.*) *luteola* var. *pingüis* is hermaphroditic. From a lobed hermaphrodite gland, situated in the upper whorls, runs a short hermaphrodite duct which divides in to a long slender vas deferens and a shorter oviduct. In the upper part of the oviduct opens a big albumen gland and a smaller accessory gland. In the male part of the genital ducts the slender vas deferens passes as coils and and in the lower part in the opening of the prostate gland. From here the vas deferens enters the penis sheath by a short duct. It coils within this proximal part of the sheath (Fig. 159). The penis reaches (in our dissected specimens) till the opening of the cavity of the penis sheath in the cavity of the praeputium, surrounded by a weakly developped sarcobelum and velum. The penis sheath of our specimens is as long or somewhat longer than the praeputium. The cavity of the praeputium is narrowed by lateral muscular pillars on either side (Fig. 160). On the proximal end of the praeputium arises, near the entrance of the vas deferens, the penis retractor muscle. Three smaller retractor muscles arises on the inner part of the praeputium. But the formation of these muscles vary in the different dissected specimens (Fig. 161).

The prostate glands of all the dissected specimens of var. *pingüis*, collected from different localities in Ceylon have in section only one large fold (Fig. 162). This situation is also seen in the figure given by ANNANDALE and PRASHAD, 1919 (p. 144, f. 5) for *pinguis* and in the figures given by ANNANDLE and RAO, 1925 (p. 179. f. XV : K, L,) for *luteola* var. *ovalis*. But HUBENDICK, 1951 states that he found in his material of *luteola* only one specimen with an unifold prostate (p. 79, f. 173). All other investigated specimens of *luteola* (*typica*) and *pingüis* have prostates with rather thin walls making some folds directed inwards (p. 43, f. 33. 34, 35).

There is also a difference between the results of HUBENDICK, 1951 on the one hand and ANNANDALE and PRASHAD, 1919 and our dissections on the other hand, concerning the spermatheca and the duct in var. *pinguis*. HUBENDICK, 1951 found that in *pingüis* (specimens from India) that distal female organs agree with the typical *luteola* : it means the spermaduct is long and slender, abruptly or gradually merging into the rounded spermatheca (*luteola*: p. 43, f. 33, 34 ; *pingüis* : p. 49, f. 40) ANNANDALE and PRASHAD 1919 describe (p. 145) and figure (p. 144, f. 5: sp. D., Sp.) the " spermal duct, although distinctly present, is much shorter than the spermatheca". ANNANDALE and RAO, 1925 figure (p. 179), f. XV: K the spermathecal duct of a specimen *L. luteola* f. *ovalis*-like HUBENDICK, 1951 in his figures long and slender.

In the dissected specimens from Ceylon the spermathecal duct was always distinctly developed, but short and thickened, as long or fairly longer than the spermatheca (Fig. 163). These results suggests that the Ceylonese populations of *R.* (*C.*) *luteola* var. *pinguis* are a distinct variation (or subspecies?) which separated and evolved for a longer time than the populations of the Indian Subcontinent (the separation between Ceylon and South-India is dated since the last Ice-Age).

Ecological-biological remarks. Occuring in stagnant waters, like pools, irrigated paddy fields, swamps, ponds and tanks and in slowly running freshwater with muddy bottom and dense vegetation. The localities lies between the coast and the low-and upland (till 1200m). The snails feed on diatoms, green filamentous algae and debris. Eggs are deposited in gelatinous strings on water plants, stones, etc.

Distribution. Radix (*Cerasina*) *luteola* with all variations : India, Burma, Siam, Andaman-Islands, Ceylon (—in this island only the var. *pingüis* seems to occur).

(30) *Indoplanorbis exustus* (DESHAYES 1834)

Lit. : 1834 *Planorbis exustus* (DESHAYES, in BELANGER, Voy. Ind.-Orient., Zool. 417 ; pl. 1, fs. 11–13)—1836 *P. indicus* (BENSON, J. asiat. Soc. Bengal, 5 : 473)—1876 *P. exustus* (HANLEY & THEOBALD, Conch. Ind. : 18 ; pl. 39, f. 10 ; pl. 40, f. 10)—1886 *P. coromandelicus* (CLESSIN (KÜSTER & DUNKER) in MARTINI & CHEMNITZ, Syst. Conch. Cab., 1 (17) : 43 ; pl. 6, fs. 20–22, 24–26 var.)—1886 *P. indicus* var. *exustus* (CLESSIN (KÜSTER & DUNKER), ibid. : 117 ; pl. 17, fs. 1–2)—1886 *P. eburneus* (CLESSIN (KÜSTER & DUNKER), ibid. : 226)—1915 *P. exüstus* (PRESTON, F. Br. Ind. (Freshw. Gastr. & Pelec.) : 115, No. 227 ; with var. *eburneus* GRAY, var. *brunneus* GRAY, var. *zonatus* DUNKER) 1921 *Indoplanorbis exüstüs* (GERMAIN, Rec. Ind. Mus. Calcutta, 21 : 26 ; pl. 1, fs. 4–9 ; pl. 4, fs. 11, 17–18 and text-f. : 1–11, 13–16 ; exhaustic account of variation and synonymy)—1921 *I. exustus* (ANNANDALE, PRASHAD & AMIN-UD-DIN, ibid. 22 : 529)— 1922 *I. exustus* (ANNANDALE & PRASHAD, ibid. 24 : 360)—1923 *I. exustus* (RAO, ibid. 25: 199)—1924 *L. exustus* (SEWELL, ibid., 26 : 535)—1933 *I. exustus* (BAKER, J. Morph., 55 : 1)—1939 *I. exustüs* (LARAMBERGUE, Bull. Soc. Zool. France, 64 ; 286)—1945 *I. exustus* (BAKER,

Moll. Fam. Planorbidae : 196–201 ; pl. 21, fs. 1–10; pl. 22, fs. 5–9 ; pl. 66, f. 1 ; pl. 79, fs. 33–35)—1955 *I. exustus* (HUBENDICK, Trans. zool. Soc. London, 28 (6)/488–489 ; fs. 86–88, 172b, 183)—1956 *I. exustus* (BENTHEM-JUTTING, Treubia, 23 (2) : 471, fs. 126, 135)—1962 *I. exūstūs* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12 : 58 ; f. 13).

Localities. South Province : No. 4 (1 ind.), No. 6 (7 ind.); Western Province : No. 10 (20 ind.), No. 11 (1 ind.), No. 14 (5 ind.), No. 16 (17 ind.), No. 17 (3 ind.), No. 19 (56 ind.), No. 20 (2 ind.), No. 21 (2 ind.); Sabaragamuwa Province: No. 33 (9 ind.), No. 36 (9 ind.); Central Province : No. 49 (57 ind.), No. 51 (1 ind.), No. 54 (1 ind.); Uva Province : No. 63 (3 ind.), No. 69 (19 ind.); North Central Province : No. 76 (16 ind.), No. 79 (1 ind.); North Western Province : No. 84 (24 ind., No. 86 (11 ind.), No. 88 (4 ind.), No. 89 (1 ind.); Northern Province : No. 97 (2 ind.).

Shell. Discoidal with a slight tendency to be pseudodextral, moderatelly large, the base much less concave or almost flat ; periphery rounded, narrowly and irregularly striated by the growth lines ; last whorl occasionally of irregular shape mostly with inflations and constrictions ; 4–5 whorls, rapidly increasing in diameter, the last whorl very large and dilated towards the aperture often bell-shaped and slightly ascending. Corneous, often with reddish-brown vertical streaks and irregular intervals. Aperture broad sickle-shaped and little oblique, the peristome rounded without angle, sharp and not continuous; often coated by mud and reddish ferruginous encrustations, a thin, filmy callus against the penultimate whorl and sometimes with a thickened interior ridge along the free margin (Fig. 164, 165; Plate XVI).

Sizes (in mm) :	*Shell* Diam.	*Shell* Ht.	*Aperture* Ht.
No. 4 (Hakmana)	10'5	5'5	6'4
No. 6 (Gilcroft)	10'6	5	5'9
No. 10 (Kelaniya)	11'5	5	5'5
No. 11 (Horana)	11'4	5'5	6'3
No. 14 (Beruwala)	13	5'9	7
No. 16 (Minuwangoda)	13'2	5'3	6
No. 17 (Attanagalla)	12	5'3	6'2
No. 19 (Panadura)	10'5	5'6	6'4
	10'7	5	5'8
No. 20 (Ja-Ela)	9	4'9	5'3
No. 21 (Yakkala)	9'1	4'5	5'2
No. 33 (We Ganga)	12'5	4'5	6'4
No. 36 (Kegalle)	11	5	5'6
No. 49 (Kandy) (Fig. 164, 165; Plate XVI)	15'7	7	7'9
No. 51 (Kandy)	8'8	5	5'6
No. 54 (E of Kandy)	10'4	4'7	5'2
No. 63 (Badulla)	10'6	5	5'9
No. 69 (Diyatalawa)	12'5	5'6	7
No. 76 (Wilpattu)	9'5	5'6	6'3
No. 79 (Wilpattu)	10'4	5'5	5'9
No. 84 (Kurunegala)	12	5'3	6'1
No. 86 (Batalagoda)	9'7	5	6'3
No. 88 (Madampe)	13	5'6	7'7
No. 89 (Mundel Lake)	13'2	5'6	7

The sizes are from the biggest individuals in the samples.

Anatomical remarks. ANNANDALE et al. 1921, (Rec. Ind. Mus. Caluctta, 22:529), RAO. 1923 (Rec. Ind. Mus. Calcutta, 25 :199), BAKER, 1933 (Moll. Fam. Planorbidae: 196-201, with pl. 21, fs. 1-10; pl. 22, fs. 5-9; pl. 79, fs. 33-35), LARAMBERGUE, 1939 (Bull. Soc. zool. France ; 64:286) and HUBENDICK, 1955 (Trans. zool. Soc. London, 28 (6):. 488-489 ; fs. 86-88 , 172 b and 183) have studied and given details of the internal anatomy of *Indoplanorbis exustus*-

External morphology : Foot relatively broad and short, head very broad and the lower margin expanded and flattened ; one pair of long cylindrical tentacles (contracted in preserved specimens). The eyes are at the inner base of the tentacles. The outside of the mantle shows irregular bluish-black patches flowing off into each other. In the upper

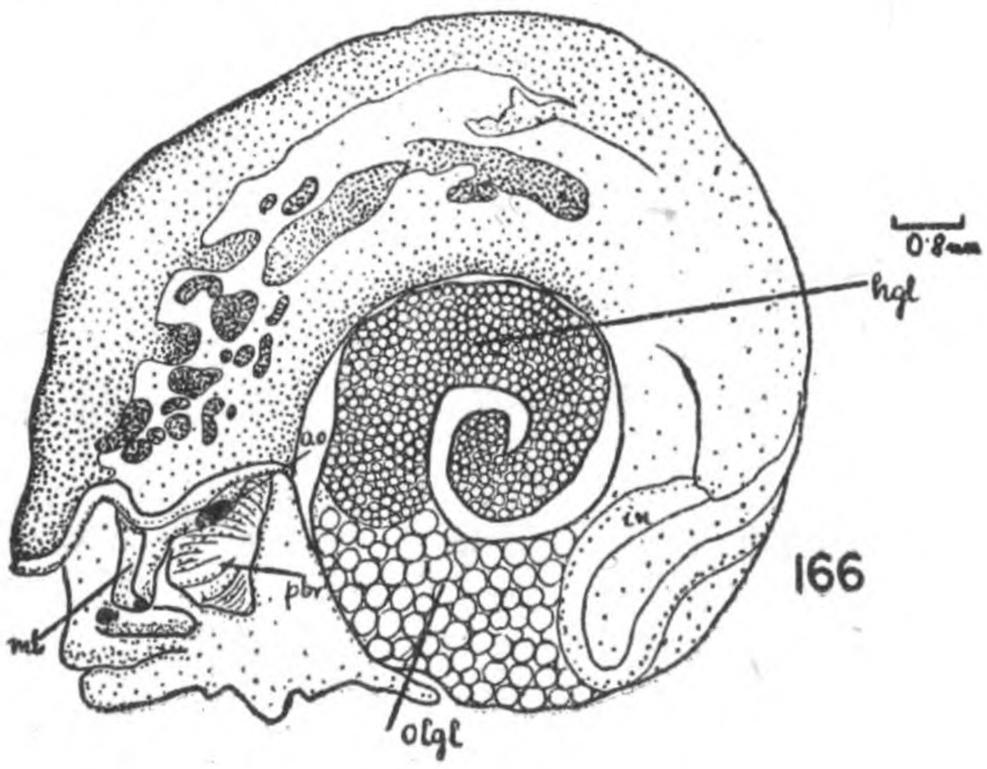
whorls the loop of the intestine, the digestive gland and the hermaphrodite gland shine through the thin skin (Fig. 166). The mantle lobe on the left side is well-developed and furrow-shaped. The pseudobranch is big and much folded (Fig. 166). When the snails move the pseudobranch is extended in the water and project forwards. The anal pore is loacted just anterior to the pseudobranch . Two parallel rectal ridges are present. One of the ridges ends on the pseudobranch into the other one on the caudal portion of the mantle lobe.

Jaw : Middle portion wide and low, striated on its outer face and slightly bent downwards at the end (Fig. 167).

Radula : Central tooth higher than wide rather narrow, the cutting edge is bicuspid ; the laterals are squarish and tricuspid, the outer cups the shortest and curved outside ; the intermediate teeth have 4 cusps till the 11th (to 13th), the mesocone well developed the entocone bicuspid the inner marginal-teeth (14-20) are narrow about three times long as broad, the entocone spliting to 3-4 denticles the mesocone larger and distinct, the ectocone split in to 2-3 denticles. The outer marginals (20-34) are still narrower and the cutting edge is denticulated with 7-9 delicate denticles (Fig. 168).

Nervous system : Very concentrated and forms a ring around the oesophagus and the ducts of the salivary glands. The cerebral ganglia are very close together. The commissure is short and gradually merge on to the ganglia on either side. From the cerebral ganglia arises the thick nerves to the tentacles, eyes and lips as well as the connective to the buccal ganglia. The pedal-, pleural-parietal ganglia and the abdominal ganglia are attached together and connected by very shor t and thick commissures (Fig. 169).

Reproductive system: Like in all planorbidae the genital organs are hermaphroditic. Descriptions and figures have been given by BAKER, 1933 (p. 197-199 and p. 278-279 ; pl. 21, fs. 1-10), LARAMBERGUE, 1939 and HUBENDICK, 1955 488-489 fs. 86-88).



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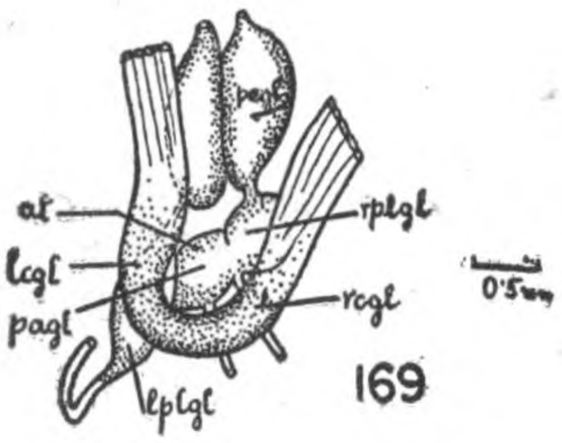

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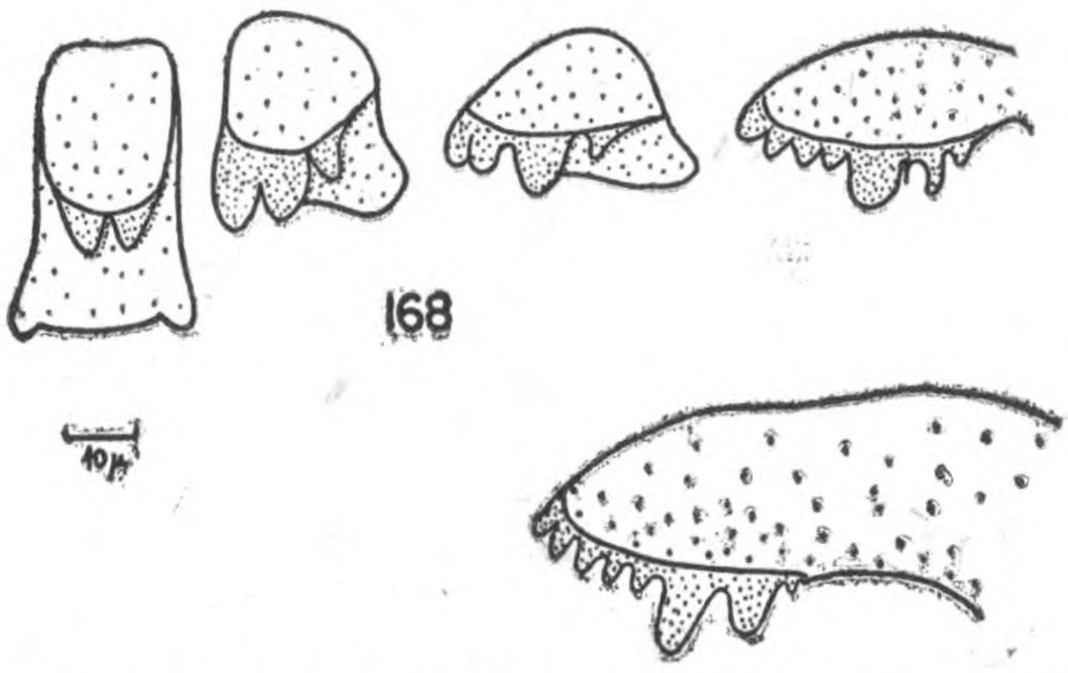

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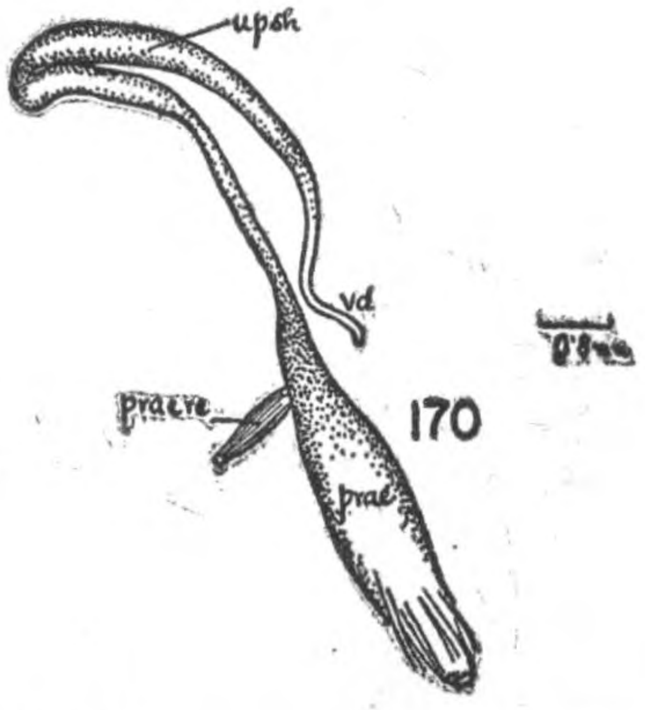

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Indoplanorbis exustus. Fig. 166 : soft body of the snail, seen from feft ; ao : anal opening, dgl : digestive gland, hgl : hermaphrodite gland, in : intestine, ml : mantle lobe, pbr : folded pseudobranch, Fig. 167 : middle portion of the jaw, Fig. 168 : radula teeth, Fig. 169 : nervous system; a+pa gl : abdominal and parietal ganglia attached, legl : left cerebral ganglion, lplgl : left pleural ganglion, pegl : pedal ganglia, rcgl : right cerebral ganglion, rlgl : right pleural ganglion, Fig. 170 : ultrapenis sheat and praeputium ; vd : vas deferens, upsh : ultrapenis sheat, prae : praeputium, praere : retractor muscle of the praeputium.

From the hermaphrodite gland, situated in the last whorl and surrounded by the digestive gland, arises the hermaphrodite duct with the seminal vesicle, composed of small tubercles surrounding the duct. The male duct, the vas deferens, is long and slender and opens in the middle part in the prostate gland and is composed of many long branched diverticula all of which radiate fan-wise from the common meeting place of the vas deferens. The lower part of the vas deferens is coiled and thickens gradually to the so called ultra penis sheath after HUBENDICK, 1955) which thickens gradually to the praeputium (Fig. 170). There is no free pendulous penis as in other Basommatophora (after HUBENDICK, 1955, p. 489 misunderstood by ANNANDALE et al., 1921 RAO, 1923 and BAKER, 1933, but with an accurate description by LARAMBERGUE, 1939) in general, but there is an ūltrapenis which is attached to the junction between the ūltrapenis sheath and the praeputium as well as to the proximal and of the ūltrapenis sheath where the vas deferens enters. The lumen of the ūltrapenis sheath which surrounds the ūltrapenis is only a slit in the musculature without any epithelial lining. This arrangement agrees with that in *Bulinus* and *Physopsis* (HUBENDICK, 1955 ; STARMÜHLNER, 1969 : p. 285, 300). On the transition from the ūltrapenis sheath to the comparatively short praeputium arises a strong retractor muscle and from the lower part of the praeputium arises many delicate muscle fibres as protractors. (Fig. 170).

The female part of the genital ducts possess a large albumin gland on the upper part of the thick coiled oviduct. On the lower part opens a long sac-like nidamental gland. The spermatheca is, in fact, almost sessile. The uterus is nearly 3-4 times as wide as the short vagina.

Ecological-biological remarks. The species occurs from the coast (also in slightly brackish water, like in lagoons (No. 89) and marshes (No. 97) over the low-to the upland (No. 69, a locality in 1200m altitude). These prefers stagnant waters, like irrigated paddy fields, marshes, pools, ponds and water reservoirs (tanks) with dense aquatic vegetation.

In No. 33 we found *I. exustus* in pools on the border of the We Ganga, filled with water by the flowing river. The snails were very abundant in cushion-like, filamentous algae on the sandy-muddy bottom which was overgrown with reeds.

Temperature : 25'6°C (10.12.1970 — 12^{h}.)

pH : 7'2 Conductivity : 89μ Siemens

Total hardness : 2'35°dH ; CaO : 15·6mg/1 ; MgO : 5·7mg/1

The conductibility, hardness and content of CaO and MgO is higher in No. 33 (We Ganga) than in the affluents of the crystalline zone, where *I. exustus* don't occur.

The snails feed on overgrowing algae, like diatoms and filamentous algae and on organic debris in the mud. Reproduction takes place by laying eggs in gelatinous strings. According to SEWELL, 1924 (Rec. Ind. Mus. Calcutta 26 : 535) *I. exustus* can reach an age of about two years. Very young shells are much higher than wide, with a slightly produced spire, much resembling the african genus *Bulinus* (ANNANDALE, 1918, Rec. Ind. Mus. Calcutta, 14 : 111–112 ; pl. 11, fs. 1, 1a and GERMAIN, 1912, ibid. 21 : 40–41 ; fs. 13–16).

Distribution. Lower Mesopotamia, Iran, India, Ceylon, Burma, Malay Peninsula and Archipelago, Indochina, Siam.

Planorbinae

Planorbeae

(31) *Gyraulus* (*Gyraulus*) *convexiusculus* (HUTTON, 1849)

Lit. : 1834 *Planorbis compressus* (HUTTON, J. asiat. Soc. Bengal, 3 : 91 (No. 13), 93)—1848 *P. tondanensis* (MOUSSON, Mitth. naturf. Ges. Zürich, 1 : 267)—1849 *P. convexiusculus* (HUTTON, J. asiat. Soc. Bengal, 18 (2) : 657)—1859 *P. propinqūūs* (ZOLLINGER, Natuurk. Tijdschr. Ned. Ind., 18: 424)—1867 *P. infralineatus* (MARTENS, Malak, Bl. 15 : 213)—1867 *P. compressus* (MARTENS, ibid. 213)—1867 *P. tondanensis* (MARTENS, ibid. 214)—1876 *P. compressus* (HANLEY & THEOBALD, Conch. Ind. : 40 ; pl. 99, fs. 1, 4)—1876 *P. convexiusculus* (HANLEY & THEOBALD, ibid. 40 ; pl. 99, fs. 8—10)—1878 *P. convexiusculus* (SOWERBY, in REEVE, Conch. Icon. 20 : pl. 11, f. 93)—1878 *P. compressus* (SOWERBY, ibid. : pl. 14, f. 118)—1886 *P. compressus* (CLESSIN, in MARTINI & CHEMNITZ, Syst. Conch. Cab., 1 (17) : 107 ; pl. 16, f. 10)—1886 *P. convexiusculus* (CLESSIN, ibid. : 127 ; pl. 17, f. 9)—1886 *P. saigonensis* (CLESSIN, ibid. : 141 ; pl. 29, f. 3)—1886 *P. infralineatus* (CLESSIN, ibid. : 157 ; pl. 23, f. 4)—1897 *P. proclivis* (pars) (MARTENS, in WEBER, Erg. Reise. Nied. Ost-Indien, 4 : 12 ; pl. 1, fs. 14–16)—1897 *P. compressus* (MARTENS, ibid. 13, pl. 1, fs. 17–22 ; pl. 12, fs. 7, 10)—1914 *P. compressus* (LESCHKE, Mitt. naturhist. Mus. Hamburg, 31 : 216)—1914 *P. infralineatus* (LESCHKE, ibid. : 250)—1915 *P.* (*Gyraulus*) *compressus* (PRESTON, F. Br. Ind. Freshw.

Gastr. & Pelec.) : 118, No. 233)—1915 *P.* (*Gyraulus*) *convexiusculus* (PRESTON, ibid. : 118 ; No. 234)—1919 *Gyraulus convexiusculus* (ANNANDALE & PRASHAD, Rec. Ind. Mus. Calcutta, 18 : 52, f. 7b)—1921 *Planorbis convexiusculus* (GERMAIN, ibid. 21 : 118)—1921 *P. saigonensis* (GERMAIN, ibid. 140)—1931 *P. convexiusculus*(BENTHEM-JUTTING, Treubia, 13 : 5–8 ; fs. 1–4)—1934a *Gyraulus convexiusculus* (RENSCH, Zool. Jb. (Syst.) 65 ; 394)—1934b *G. convexiusculus* (RENSCH, Trop. Binnengew., 5 : 209)—1945 *G. convexiusculus* (BAKER, Moll. Fam. Planorbidae : 68–71 ; pl. 19, fs. 1–3 ; pl. 47, f. 8)—1945 *G. compressus* (BAKER, ibid. : 71)—1945 *G. saigonensis* (BAKER, ibid. : 71)—1945 *G. tondanensis* (BAKER, ibid. : 71)—1945 *G. infralineatus* (BAKER, ibid. : 71)—1945 *G. proclivis* (pars) (BAKER, ibid. : 71)—1948 *G. convexiusculus* (ABBOTT, Bull. Mus. comp. Zool., 100 (3) : 304 ; f. 14)—1956 *G. convexiusculus* (BENTHEM-JUTTING, Treubia, 23 (2) : 463–466 ; fs. 129, 130 ; as synonyms are listed : *compressus* HUTTON, *tondanensis* MOUSSON, *propiqūūs* ZOLLINGER, *infralineatus* MARTENS, *saigonensis* CROSSE & FISCHER ; with exhaustive literature)—1962 *G. saigonensis* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., 12 : 57, f. 14).

Localities. Southern Province : No. 6 (4 ind.), No. 8 (4 ind.) ; Western Province : No. 14 (1 ind.) ; North Central Province : No. 76 (1 ind.), No. 79 (2 ind.), No. 80 (some ind.) ; North Western Province : No. 84 (1 ind.), No. 86 (2 ind.), No. 91 (2 ind.) ; Northern Province : No. 99 (1 ind.).

Shell. It is to be assumed that all the species of *Gyraulus*, found and described from Ceylon, are synonyms of the variable species *Gyraulus convexiusculus* (HATTON, 1849), widely distributed in the Oriental region. Like in most freshwater Gastropods, the shell vary in size, shape and form.

Other "species" found in Ceylon, not listed in the literature above :

Gyraulus elegantulus DOHRN, 1858 (Proc. zool. Soc. London, 1858 : 134)–1876 HANLEY & THEOBALD (Conch. Ind. : 60 ; pl. 151, fs. 1–3)–1915 PRESTON (F. Br. Ind. (Freshw. Gastr. & Pelec.) : 122, no. 244)–1945 BAKER (Moll. Fam. Planorbidae : 71)–1962 MENDIS & FERNANDO (Fish. Res. Stn. Bull., 12 : 57).

Gyraulus stelzneri DOHRN, 1858 (Proc. zool. Soc. London, 1858 : 134)–1876 HANLEY & THEOBALD (Conch. Ind. : 60 ; pl. 151, fs. 4, 7)–1878 SOWERBY (in REEVE, Conch. Icon., 20 : pl. 5, fs. 26a, b)–1884 CLESSIN (in MARTINI & CHEMNITZ, Syst. Conch. Cab., 1 (17) : 117 ; pl. 11, f. 11)–1915 PRESTON (F. Br. Ind. (Freshw. Gastr. & Pelec.) : 123, No. 247)–1945 BAKER (Moll. Fam. Planorbidae : 71)–1962 MENDIS & FERNANDO (Fish. Res, Bull., 12 : 57).

Gyraulus hyptiocyclos BENSON 1863 (1863 (A.M.N.H., ser 3 (9) : 89 and BENSON & PFEIFER, Mon. Helic. 5 : 117)–1876 HANLEY & THEOBALD (Conch. Ind. : 40 ; pl. 99, fs. 5–7)–1878 SOWERBY (in REEVE, Conch. Icon., 20 : pl. 14, f. 120)–1885 CLESSIN (in MARTINI & CHEMITZ, Syst. Conch. Cab., 1 (17) : 228)–1915 PRESTON (F. Br. Ind. (Freshw. Gastr. & Pelec.) : 123, No. 248)– 1962 MENDIS & FERNANDO (Fish. Res. Stn. Bull., 12 : 57).

Gyraulus liratus WESTERLUND (in VEGA Exped. Vetenskapliga Jakttagelser, 4 : 204 ; pl. 4, f. 18)–1915 PRESTON (F. Br. Ind. (Freshw. Gastr. & Pelec.) : 121, No. 241)–1945 BAKER (Moll. Fam. Planorbidae : 71)–1962 MENDIS & FERNANDO (Fish. Res. Stn. Bull., 12 : 57).

Gyraulus demissus WESTERLUND (in VEGA, Exped. Vetenskapliga Jakttagelser, 4 : 204 ; pl. 4 f. 16)–1915 PRESTON (F. Br. Ind. (Freshw. Gastr. & Pelec.) : 121, No. 242)–1945 BAKER (Moll. Fam. Planorbidae : 71)–1962 MENDIS & FERNANDO (Fish. Res. Stn. Bull., 12 : 57).

Gyraulus associatus WESTERLAND (in VEGA Exped. Vetenskaliga Jajttagelser, 4 : 205 ; pl. 4, f. 17)–1915 PRESTON (F. Br. Ind. (Freshw. Gastr. & Pelec.) : 122, No. 243, after PRESTON is this "species" certainly a variation of *demissus*)-945 BAKER (Moll. Fam. Planorbidae : 71)–1962 MENDIS & FERNANDO (Fish Res. Stn. Bull., 12 : 57).

The shell of the typical *convexiusculus* is depressed, discshaped, somewhat flat below than on the top side ; 4 to 5 whorls arranged in a flat spiral, increasing in diameter regularly each whorl embracing a great part of its preceeding one ; all whorls are visible on top and basal side. The apex is sunken, the whorls well rounded or angular (Fig. 171, Plate XVI) or carinate, sometimes with a membranous fringe along the carina (var. *compressus* HUTTON; Fig. 172, 173, Plate XVI). Finely close and obliquely striated by the growth lines; fine spiral striae can also occur (var. *liratus* WESTERLUND), but are often obsolete. Colour yellowish olive to pale horn-colour, fragile, polished and somewhat shi and transparent.

The aperture is oblique, broad-oval, pyramidal or ovate-lunate ; the upper margin projecting ; peristome sharp and mostly not continuous, sometimes the two ends connected by a callus against the penultimate whorl (Fig. 171–173, Plate XVI).

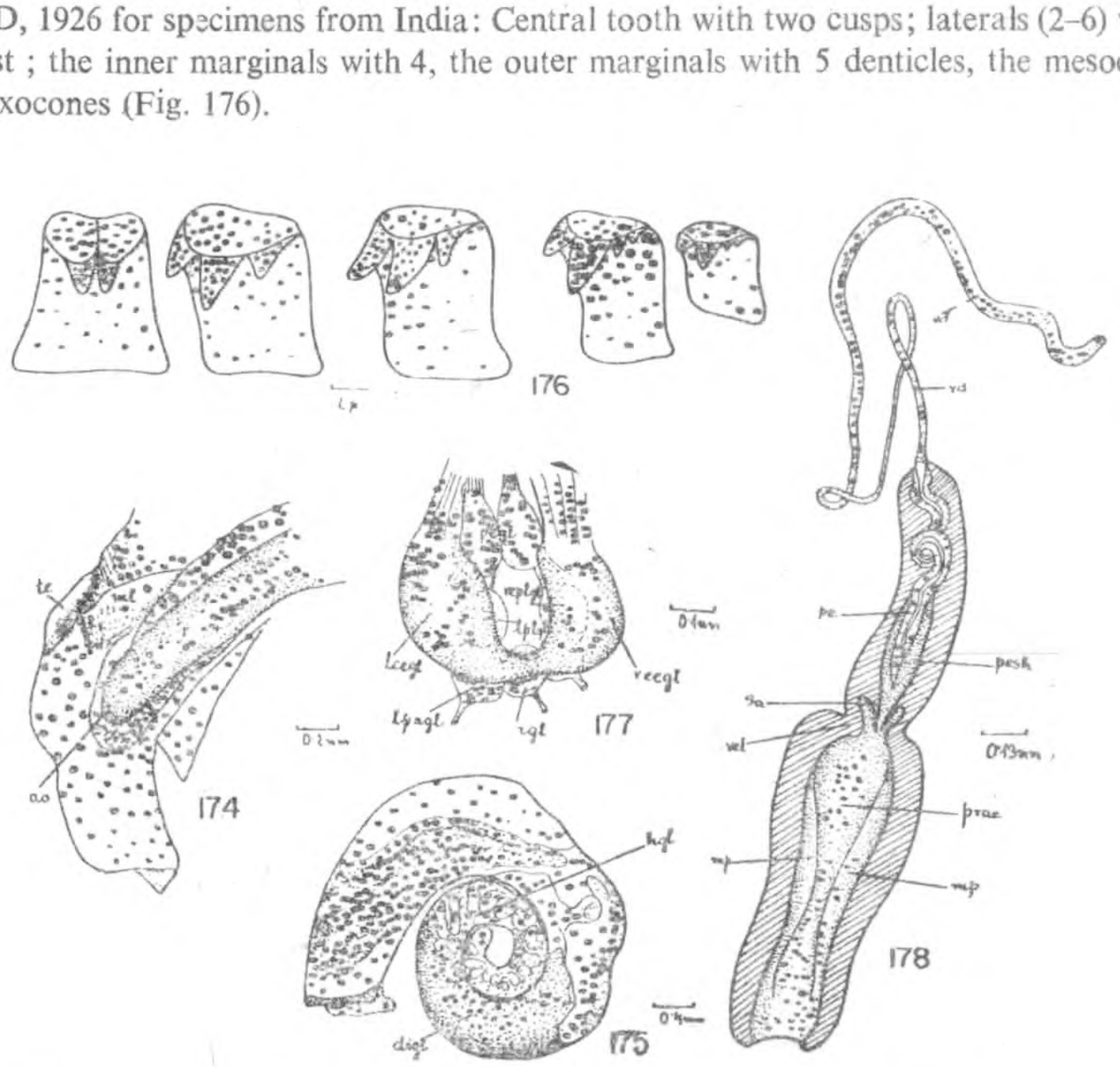
Sizes (in mm)	*Diam.*		*Ht.*
No. 8 (Yoda Wewa) var. *typica* (Fig. 171 Plate XVI)	6	..	1'6
	5'1	..	1'3
	4'8	..	1'25
No. 14 (Beruwala) var. *typica* ..	3'8	..	1'4
No. 76 (Wilpattu) var. *compressus* (Fig. 172 Plate XVI)	3'8	..	0'8
No. 79 (Wilpattu) var. *compressus* ..	3'3	..	0.6
No. 84 (Kurunegala) var. *typica* ..	3'5	..	1'2
No. 86 (Batalagoda) var. *typica* ..	4	..	1'4
No. 91 (Puttalam) var. *compressus* (Fig. 173 Plate XVI)	3'5	..	0'65
No. 99 (Nay Aru) var. *compressus* ..	3'3	..	0'5

The sizes are from the biggest specimens in the samples.

Anatomical remarks. Details on the anatomy of *Gyraulus convexiusculus* are given by ANNANDALE & PRASHAD 1926 (Rec. Ind. Mus. Calcütta, 18 : 55, f. 8 B (radula) and by BAKER, 1945 (Moll. Fam. Planorbidae : 68 (genitalia, respiratory and renals system) ; 69 (radula) ; figures on page 274 (pl. 19, fs. 1,2 (genitalia) f. 3 (pseudobranch, pneumostome ; p. 320 (pl. 47, f. 8 (gill).

External morphology ; Animal with long, cylindrical tentacles, the eyes at their inner bases ; the foot is narrow, the pseüdobranch a very small lobe with a free,undivided margin (Fig. 174). The outside of the mantle shows irregularly dark blue spots on yellow-whitish ground. All internal organs are elongate and situated behind each other (Fig. 175).

Radula : The dissected specimens from Ceylon correspond with the description and figure, given by ANNANDALE & PRASHAD, 1926 for specimens from India: Central tooth with two cusps; laterals (2–6) with three cusps, the mesoconus as biggest ; the inner marginals with 4, the outer marginals with 5 denticles, the mesocone almost stronger than the endo-and exocones (Fig. 176).



Gyraulus convexiusculus. Fig 174: mantle lobe 9nd accessory gill (pseudobranch) with anal opening from left; ao: anal opening, mi: mantle lobe, pbr: pseudobranch, r: rectum, te: tentacle, Fig. 175: soft body; di gl: digestive gland, h gl: hermaphrodite gland, Fig. 176: radula teeth, Fig. 177: nervous system; abbr. like in Fig. 169 and agl: abdominal panglion, lpalgl: left parietal ganglion, rpagl: right parietal ganglion, Fig. 178: vas deferens and longitudinal section of the penis sheat with penis and praeputium; mp : muscle pillars of the praeputium, pe: penis, pesh : penis sheat, prae : praeputium,sa: sarcobelum, vd: vas deferens, vel: velum.

Nervous system : Like in all Planorbidae very concentrated : cerebral ganglia long ovoid with a short, thick commissure ; on their outside arises the labial nerves, the n. tentacularis and opticus and the cerebro-buccal connective. On the right side arises also the penis nerve. Very short connectives between the pedal, pleural-and cerebral ganglia. The parietal-and abdominal ganglia form together a half ring below the oesophagus (Fig. 177).

Reproductive system : The hermaphrodite genitalia starts with a tubular hermaphroditic gland, behind the digestive gland, in the upper whorls (Fig. 175). The hermaphordite duct, running on the outside of the penultimate whorls, is slender and coiled. It divides into a thicker female and a slender male duct. The oval shaped albumen gland is connected with a narrow duct to the upper part of the oviduct. The free oviduct loops beneath the prostate and is widened to the uterus with the nidamental gland which is made up of many large diverticula. The vagina is very short and is in connection with a moderately long duct to the spermatheca.

The vas deferens is long and slender ; into the lower part of the duct opens the diverticulaof the prostate gland by very short ducts. The last part of the vas deferens enters, after forming some loops, in the penis immediately proximal to the stiletto-shaped free end. The praeputium is somewhat longer than the penis sheath and its cavity is narrowed by lateral muscle pillars on each side (Fig. 178).

Ecological-biological remarks. The species occurs in Ceylon from the coast to the lowland in pools, irrigated paddy fields, ponds, water reservoirs (tanks) and on the borders of slowly-running streams with sandy-muddy bottom and dense aquatic vegetation.In the locality No. 99 the species was found in a flooded river in salt meadows. *Gyraulus* feeds on algae, like diatoms, green-and blue algae. Reproduction takes place by eggs which are laid in small quantities, in gelatinous plates.

Distributions.—Lower Mesopotamia, Eastern Persia, Pakistan, India, Ceylon, Burma, Indo-China, Japan, Siam, Malay Peninsula and Archipelago, Philippines, New Guinea.

5 General Part

(A) Distribution of the Freshwater—Gasterpods in Ceylon

(a) Crystalline Central Highland (1500—2000 *m*) *; Central Province*

(a[1]) Brooks and torrents : The temperatures in these small streams is around 15°C. The chemistry of No. 47 (torrent in Hakgala) :

pH : 6'9 Conductivity : 26 μ-Siemens

Total hardness : 0'65°dH ; CaO : 2'6mg/1—MgO : 2'7mg/1

Species : *Paludomus* (*Philopotamis*) *nigricans*

(b) The precipice from the lower parts of the Crystalline Central Highland to the Upland (1200/800*m*) *to* 200*m : Sabaragamuwa, Central, Uva, South, and Western Province :*

(*b*1) Brooks, torrents, smaller streams (affluents) : The temperatue of these running waters with cascades, interrupted by pools, was from our measurements in the months November-December 1970 :

800m—1000m altitude : 18'8°C (average)

200m—500m altitude : 24°C (average)

Chemistry of these small streams :

pH : Between 5'8 and 6'7 Conductivity : 20 to 35 μ-Siemens

Total hardness : 0'25°dH to 2'35°dH (average : 0'8°dH)

CaO : 1'12mg/1 to 15'6mg/1 (average : 2mg/1)

MgO : 0'99mg/1 to 5'7 mg/1 (average : 2mg/1)

In the strong currents (50cm—1m/sec.) :

Species : *Paludomus* (*Tanalia*) *neritoides*
(var. *typica* and *dilatatus*)
Paludomus (*Tanalia*) *loricatus*
(var. *funiculatus* and *pictus*)
Paludomus (*Philopotamis*) *sulcatus*
rare : *Paludomus* (*Philopotamis*) *regalis*
Tricula montana (No. 53—2mls E of Madugoda, 800m)

On the borders and in pools, situated — between the cascades (0–30cm/sec) :

Thiara (*Plotia*) *scabra*
Melanoides (*Melanoides*) *tuberculata*
Bulimus stenothyroides
Indoplanorbis exustus

(b^2) Bigger streams with strong current (50cm–1m and more/sec) in the valleys :

Temperature : till 27°C in (average)

Chemistry: Conductivity : 46 µ Siemens Total hardness : 1'2°dH to 2'35°dH ;
CaO : 3 to 6mg/1

In the strong current (50cm–1m and more/sec) :

Paludomus (*Tanalia*) *loricatus*
(var. *typica* and *erinaceus*)
Paludomus (*Tanalia*) *neritoides*
(var. *tennanti* and *gardneri*)

On the borders (0–30cm/sec.) : The same species like above in the affluents.

(b^3) Brooks, torrents, smaller streams (affluents), chemically influenced by limestone formations in the upland of the Uva Province, 200m : Wetakei-Ela ; No. 61) :

Temperature : 23'9°C (9.12.1970/14^h)
pH : 8'3 Conductivity : 360 µ Siemens
Total hardness : 11'6°dH SiO_2 : 54'8mg/1
CaO : 59'4mg/1 MgO : 40'8mg/1

In the strong current (50cm–1m/sec) :

Paludomus (*Tanalia*) *solidus*

On the borders (0–30cm/sec) :

Paludomus (*Tanalia*) *solidus* (young specimens)
Paludomus (*Paludomus*) *tanschauricus* subsp. *nasutus*

(4) Stagnant waters, like marshes, irrigated paddy fields, pools, and ponds in the upland of the Sabaragamuwa-Central, Uva, South, and Western Province (1200/800m to 200m) :

Bellamya dissimilis var. *ceylanica*
Pila globosa (and all var.)
Bulimus inconspicua
Melanoides (*Melanoides*) *tuberculata*
Radix (*Cerasina*) *luteola* var. *pinguis*
Indoplanorbis exustus

(*c*) *Streams in the transition region between up- and lowland and in the lowland :*

Middle courses of the streams coming from the higher upland (200/100m to 50/20m altitude) of the Eastern, Uva, Southern, and Western Province : As an example No. 60 (Kuda Oya, a tributary of the Menik Ganga, near Buttala) :

Current : 30–50cm see (in average) Temperature : 25° to 26°C (December)
Conductivity : 295 μ Siemens pH : 7'5–8
Total hardness : 9'2°dH CaO : 52mg/1 MgO : 28'9mg/1

In the moderate current (30cm/sec) :

frequent : *Paludomus* (*Paludomus*) *chilinoides*
rare : *Paludomus* (*Paludomus*) *bicinctus*
Paludomus (*Paludomus*) *decussatus*
Paludomus (*Paludomus*) *inflatus*
Paludomus (*Paludomus*) *tanschauricus* subsp. *nasutus*

On the borders (0–30cm/sec.) :

Young specimens of the species of
Paludomus (*Paludomus*) listed above and
Bulimus inconspicua
Thiara (*Plotia*) *scabra*
Melanoides (*Melanoides*) *tuberculata*
Indoplanorbis exustus

(c^1) Stagnant waters in the same region :

Bellamya dissimilis var. *ceylanica*
Pila globosa (and all var.)
Bulimus inconspicua
Melanoides (*Melanoides*) *tuberculata*
Radix (*Cerasina*) *luteola* var. *pinguis*
Indoplanorbis exustus
Gyraulus (*Gyraulus*) *convexiusculus*

(*d*) Lower Parts of streams from the lowland to the coast (20m.–5m.) of the Southern and Western Province:

Current between 30 and 50 cm/sec. :

Neritina (*Neripteron*) *auriculata*
Septaria lineata
Melanoides (*Stenomelania*)) *torulosa*

On the borders of these streams (0–30 cm) are the same species as listed for the borders of (c).

(d^1) Stagnant waters in the lowland of the Southern and Western Province : The same species as listed in (c^1), but includes also

Mysorella costigera

(*e*) *Mouths of stream and rivers on the coast* (5m–0.m) ; during high tide sometimes with slightly brackish water (Southern and Western Province) :

Faunus ater

(*f*) *Slow running streams in the lowland* (100m. *to* 5m.) *in the North Central, North Western, and Northern Provinces :* As an example are the data of a small stream between Habarane and Dambulla (No. 74) and an artificial canal near Anuradhapura (No. 73) :

Locality	*Alt.*	*Curr.*	*Temp.*	*pH*	*Tot. H.*	*El.* $_{20}$	*CaO*	*MgO*
No. 73 ..	80m	30cm/sec	26°C	7	7°dH	no data	no data	no data
No. 74 ..	100m	30cm/sec	-25'5°C	7'25	12'9°dH	605 μS	50'9mg	56mg/1

The waters of these streams are moderately hard to very hard with a rather high content on CaO and MgO.

In the current of 30cm/sec. :

Paludomus (*Paludomus*) *chilinoides*
Paludomus (*Paludomus*) *tanschauricus*

The last species is often found in temporary streams !

On the border of the streams (0–30cm/sec) :

young specimens of the species of
Paludomus (*Paludomus*) listed above and
Pila globosa
Thiara (*Plotia*) *scabra*
Melanoides (*Melanoides*) *tuberculata*
Indoplanorbis exustus

(f) *Stagnant waters in the same region* : water reservoirs (tanks) with dense vegetation, pools (drying out in the dry season) and irrigated paddy fields :

Bellamya dissimilis var. ceylanica
Pila globosa (and var.)
Bulimus inconspicua
Mysorella costigera
Melanoides (*Melanoides*) *tuberculata*
Radix (*Cerasina*) *luteola* var. *pinguis*
Indoplanorbis exustus
Gyraulus convexiuculus var. *compressus*

(g) *Mouths of streams and rivers on the coast (5m-om) of the North Western Province* : During high tide they often become slightly brackish :

Faunus ater

(g) Brackish waterlagoon on the North West—Coast (Mundel Lake, No. 89)

Pila globosa var. *carinata*
Bulimus inconspicua
Melanoides (*Melanoides*) *tuberculata*
Indoplanorbis exustus

(h) *Stream running through a salt meadow in the Northern Province (No.99) :*

Gangetia burmanica
Syncera (*cf. hidalgoi*)
Syncera (cf. *woodmasoniana*)
Gyraulus convexiusculus var. *compressus*

These lists establish the following results for the distribution of the Freshwater Gastropods in running waters *Paludomus*(*Phiropotamis*) *nigricans* is restricted to the highest parts of the highland, living in small cool(15 ° C) streams with slightly acidic, very soft water and with a very low content of mineral salts, specially of Ca0 and Mg0.

The torrents, brooks and small streams, the affluents of the bigger streams from the uplands in the South West of Ceylon are characterized by *Paludomus* (*Tanalia*) *neritoides* and *P.* (*T.*) *loricatus* (in smaller varieties) rarely also *Palūdomūs* (*Philopotamis*) *sulcatus*. *P.* (*T.*) *P loricatus* dominates in the bigger streams but sometimes in association with the bigger and sculptured variations of *neritoides* (*var. gardneri*). These streams are also slightly acidic, very soft and with a low content of Ca0 and Mg0. The temperatures are between 18° and 25° C.

In the lower parts of the highland and in the lowland, where the temperatures of the running waters increase to 27° (on an average) the content of minerals is higher. In the such streams *Paludomus* (*Paludomus*) *chilinoides* dominates and rarely other species of the subgenus *Paludomus* like *bicinctus*, *decussatus*, *inflatus* and *tanschauricus* sūbspec. *nasūtūs* are found. In the streams influenced by limestone formations with hard water and high content of Ca0 and Mg0 is found the subgenus *Tanalia* represented by *P.* (*T.*) *solidus*. Sometimes also associated with *P.* (*P*) *tanschauricus* subspec. *nasutus*.

On the borders and in pools interrupting the cascades of the lower mountain streams are sometimes found *Thiara* (*Plotia*) *scabra*, *Būlimūs stenothyroides*, *Melanoides* (*Melanoides*) *tuberculata* and if there is present a very dense vegetation of filamentous algae in flooded pools near the border of streams *Indoplanorbis exustus*. will also be found.

The last listed species (without *Thiara* (*Pl.*) *scabra*) are also found in the stagnant waters of the up-and lowland, sometimes associated with *Bellamya dissimilis* var. *ceylanica*, *Pila globosa* (in different var.), *Bulimus inconspicua*, *Mysorella costigera*, *Radix* (*Cerasina*) *luteola* var. *pingūis*, *Gyraulus* (*G.*) *convexiusculus*. In the streams in the Northern Provinces

of Ceylon, with higher contents of mineral salts (specially on Ca0 and Mg0) and moderately hard water *Paludomus* (*P.*) *chilinoides* dominates again, some times associated with *Paludomus* (*P.*) *tanschauricus*. The last species occurs often in temporary streams, drying out in the dry season. The streams near the coast of South and West Ceylon are the habitat of *Neritina* (*Neripteron*) *auriculata* and *Septaria lineata* of different varieties. *Melanoides* (*Stenomelania*) *torulosa* sometime rarely occurs in the same habitat.

Near the mouths of streams on the coast often in slightly brackish waters is the habitat of *Faunus ater*.

In the stagnant waters of the Provinces in the North of Ceylon occur the same species of snails as in the lowland of the South and West.

A special fauna of brackish water Gastropods was found by the Swedish Lund Expedition 1962 in a stream crossing the salt meadow near the coast of the Northern Province ; *Gangetia burmanica* and two species of *Syncera* (= *Assiminea* But there were also some typical species for Freshwater like *Pila globosa* (and var.), *Bulimus inconspicua*, *Melanoides* (*M.*) *tuberculata*, *Indoplanorbis exustus* and *Gyraulus convexiusculus* var. *compressus* which tolerate slight brackish waters.

(B) *Geographical distribution of the Ceylonese Freshwater Gastropods.*

(Abbrev. : Malay Pen. Arch. : Malay Peninsula, Archipelago, ; Phil. : Philippines, N.G. : New Guinea ; P.I. : Pacific Islands).

Species	*East Africa*	*Madagascar Mascareignes*	*India (+ Burma)*	*Ceylon*	*Malay Pen. Arch.*	*Phil.*	*N. G.*	*P. I.*
Neritina auriculata	—	+	?	+	+	+	+	+
Septaria lineata	—	?	(South) +	+	+	+	+	+
Bellamya dissimilis	—	—	+	var. ceylanica)	—	—	—	—
Pila globosa	—	—	+	(varieties)....	—	—	—	—
Tricula montana	—	—	+	+	—	—	—	—
Gangetia burmanica	—	—	(Burma) +	+	—	—	—	—
Bulimus inconspicua	—	—	—	+	—	—	—	—
Bulimus stenothyroides	—	—	(South) +	+	—	—	—	—
Mysorella costigera	—	—	+	+	+	—	—	—
Syncera (c.f. *hidalgoi*)	—	+	?	+	+	+	+	+
Syncera (c.f. *woodmasoniana*)	—	—	+	+	+	—	—	(New Ireland) +
Faunus ater	—	+	?	+	+	+	+	—
Paludomus (*P.*) *chilinoides*	—	—	—	+	—	—	—	—
Paludomus (*P.*) *inflatus*	—	—	(South) +	+	—	—	—	—
Paludomus (*P.*) *palustris*	—	—	—	+	—	—	—	—
Paludomus (*P.*) *tanschauricus*	—	—	+	(North) +	—	—	—	—
Paludomus (*P.*) *tanschauricus nasutus*	—	—	—	(South) +	—	—	—	—

Species	*East Africa*	*Madagascar Mascareignes*	*India (+Burma)*	*Ceylon*	*Malay Pen. Arch.*	*Phil.*	*N.G.*	*P.I.*
Paludomus (P.) bicinctus	—	—	—	+	—	—	—	—
Paludomus (P.) decussatus	—	—	—	+	—	—	—	—
Paludomus (Ph.) nigricans	—	—	—	+	—	—	—	—
Paludomus (Ph.) regalis	—	—	—	+	—	—	—	—
Paludomus (Ph.) sulcatus	—	—	—	+	—	—	—	—
Paludomus (T.) loricatus	—	—	—	+	—	—	—	—
Paludomus (T.) neritoides	—	—	—	+	—	—	—	—
Paludomus (T.) solidus	—	—	—	+	—	—	—	—
Thiara (Plotia) scabra	+	+	+	+	+	+	+	+
Melanoides (M.) tuberculata	(North) +	+	+	+	+	+	+	+
Melanoides (?St.) torulosa	—	—	+	+	+	+	?	(Solomon I.) +
Radix (Cerasina) luteola	—	—	(South var. *pinguis*) +	(var. *pinguis*) +	—	—	—	—
Indoplanorbis exustus	(Mesopotamia : +)	+	+	+	+	—	—	—
Gyraulus (G.) convexiusculus	(Mesopotamia : +)	(Persia) +	+	+	+	+	+	(China, u. Japan) +

Species with an Indopacific distribution. From East Africa, resp. Madasgacar and Mascareignes Islands (Mauritius) in West to the Pacific Islands in the East) :

Neritina (Neripteron) auriculata, Septaria lineata RIECH, 1937 ; Arch. Nautrgesch. (N.F.), 6 : 69 gives a short report that the occurrence of these species in Madagascar, given by LIENARD was never confirmed! *Syncera* (c.f. *hidalgoi*), *Faunus ater, Thiara (Plotia)scabra, Melanoides (M.) tuberculata* (from North Africa, Asia Minor and Persia till the Pacific Islands) and *Gyraulus (G.) convexiusculus* (from Mesopotamia and Persia till China, Japan and New Guinea).

Species with an Indomalayan distribution. From India, Ceylon till the Malay Peninsula and Archipelago : *Synceram* (c.f. *wood masonianai*), *Indoplanorbis exustus* (in the West till Mesopotamia).

Species with an Indian-Ceylonese distribution. Bellamya dissimilis with the var. *ceylanica* in Ceylon, *Pila globosa* with different varieties in Ceylon, *Tricula monatana* (only in the highland), *Gangetia burmanica* (on the coasts in brackish water !), *Bulimus stenothyroides* (South-India), *Mysorella costigera, Paludomus (P.) inflatus* (South-India), *Paludomus (P.) tanschauricus* (North Ceylon), *Radix (Cerasina)luteola* with the var. *pinguis* in South India and Ceylon.

Species endemic to Ceylon. Bulimus inconspicua, Paludomus (p.) chilinoides, P.) Palustris, P. (P.) tanschauricus subspec. *nasutus* (South-Ceylon), *P. (P.) bicinctus, P. (P.) decussatus, P. (Pn.) nigricans, P. (Ph) regalis, P. (Ph.) sulcatus, P. (T.) loricatus, P. (T.) neritoides, P. (T.) solidus.*

Of the 31 species (including subspec. *nasutus*) of gastropods found by the three missions in the Freshwaters of Ceylon 37% are approximately endemic to Ceylon (33% are species and subspecies of the Genus *Paludomus*!) around 32% are with an Indian (resp. South-Indian)-Ceylonese distribution, 25% are widely distributed in the Indo Pacific area (mostly in the coast region) and around 6% of the species found in Ceylon have an Indo-Malayan distribution. The endemic species *Bulimus inconspicua* is very closely related to *B. stenothyroides* which occurs also in South India. The separation into two species (or subspecies ?) may have taken place after the immigration of *Bulimus* from South India to Ceylon.

The highest number of endemic species is shown the genus *Paludomus*. With the sùb genue *Pàludomus* this genus is distributed in the Indo-Malayan region till the Philippines. The subgenus *Philopotamis* is restricted to Ceylon and Sumatra. The subgenus *Tanalia* is endemic to the mountainous areas in South and South West Ceylon. The two species *loricatūs and neritoides* have evolved during the long time of separation and isolation in the mountain streams many variations in form, size and shape and are very closely related. The third species *solidus* which is in size of the shell like a young *loricatus*, is exclusively restricted to the calcareous streams in the South East of the mountains. This suggests that these three species of *Tanalia* have developed from the ancestors of the Paludomeae as a result of isolation in the "island-like "mountains of South Ceylon and have adapted to the conditions of the the fast running mountain streams.

The most related recent genus to *Paludomus* is the genus *Cleopatra*, distributed from Africa to Madagascar. Specially the species of *Cleopatra* from Madagascar are, in shells and anatomy very closely related to the Indian Ceylonese species of *Paludomūs* (STARMÜHLNER, 1969, Malacologia, 8 (1/2) : 186, 200, 205, 396). BROT, 1880 (in MARTINI and CHEMNITZ, Syst. Conch. Cab. 1 (25) : 45, 48) described the shells of *Cleopatra grandidieri* and *madagascariensis* as species of *Paludomus* ! The occurrence of the tribe Palūdomeae (Genus *Palūdomūs* and *Cleopatra* between East Africa, Seychelles, Comores, Madaga scar, Ceylon, India and Siam and Burma suggests that this old tribe (known since the Upper Cretaceous) is a relict of the "Gondwanian" stock. The fauna of the Freshwater gasteropods of Ceylon is closely related to the species ocurring in the freshwaters of India specially that of South India. Some species are only variations or forms of Indian species like *Bellamya dissimilis* var. *ceylanica*, *Pila globosa* (with different variations with transitional forms) and *Radix* (*Cerasina*) var. *pingūis*. The genus *Bellamya* is distributed between Africa and South and East Asia, the genus *Pila* is also represented in the Ethiopian region, in Madagascar, South Asia, Malay Archipelago and Philippines. The genus *Radix* is worldwide distributed, the subgenus *Cerasina* is only found in India (*luteola*-group).

Many species live only near the coast in the lower parts and mouths of streams and rivers, often in slightly brackish water. These species like *Faunus ater* or the genus *Syncera* (*Assiminea*) are widely distributed on the coasts of the Indo-Malayan or Indo Pacific area. In shell and anatomy *Faunus ater* is related to different species of the Melanopsinae and Melanatriinae.

Widely distributed on the coasts of the Indo-Pacifc are the fresh (and brackish) water species of the family Neritidae also occuring in Ceylon, like *Neritina* (*Neripteron*) *auriculata* and *Septaria lineata*. A wide distribution in also shown by the three species of Thiaridae ocurring in Ceylon, *Thiara* (*Plotia*) scabra, *Melonoides* (*Stenomelania*) *torulosa* and specially *Melanoides* (*M.*) *tuberculata*. Also *Gyraulus convexicusulcus* is widely distributed between Mesopoamia and Persia in the West and China, Japan and New Guinea in the East.

This wide distributions may be the result of spreading of these snails by water birds and secondarely by man constructing irrigation systems for paddy fields and transporting young rice plants.

The genus *Indoplanorbis*, respresented only by one species *exustus*, occurs from Mesopotamia in the West through the plains of India to Siam, the Malay Peninsula and Archipelago till Indo-China. *Indoplanorbis* is one of the three genera of the subfamily Bulininae and, apart from the difference in adult shells (young shells of *Indoplanorbis* are similar to *Bulinus* !) there are only a few small morphological differences between *Indoplanorbis* on one side and *Bulinus* and *Physopsis* on the other (HUBENDICK, 1955 ; Trans. zool. Soc. London, 28 (6) 522). *Bulinus* (including *Physastra*) occurs in Africa and Australia, *Physopsis* only in Africa.

The geographical range of *Radix* (*Cerasina*) *luteola* with all its varieties covers India, Burma, Siam, Ceylon and the Andaman Islands. The eastern limit of the range is not known for certain (HUBENDICK, 1951; Kungal. Sevnska Vetenskapsakad. Handl., Fj. ser., 3 (1) : 161).

Summarizing it could be stated that the Freshwater Gasteropods of Ceylon show very close affinities to the Indian, specially to the South Indian fauna. There are also affinities and transitions, specially in the genera *Paludomus*, *Pila* and *Bellamya* to the Ethiopian fauna, resp. to Madagascar and Seychelles. Most of the species, living on or near the coast in the lower parts and mouths of the running waters, like Neritidae, *Syncera* and *Faunus ater* are widely represented in the Indo-Pacific area. Widely distributed are also the species of the Thiaridae.

(5) SUMMARY

In the study are described 31 species of Fresh (and Brackish) water Gastropods from Ceylon of these 28 species are Streptoneura, 3 species are Euthyneura. The specimens were collected by : 1) Austrian-Ceylonese Hydobiological Mission 1970 of the Zoological Institute of the University of Vienna (Austria) and the Department of Zoology of Univer-

sity of Ceylon, Vidyalankara Campus, Kelaniya (Sri Lanka) ; 2) Prof. Dr. H. H. Costa and the members of staff Department of Zoology, University of Ceylon, Vidyalanakra Campus, Kelaniya (Sri Lanka) ;3). The Lund Unviersity Ceylon Expedition 1962 (P. Brinck, H. Andersson and L. Cederholm).

In the systematic part, the literature, synonyms and the localities are noted for each species the and shell (with sizes), and operculum (in the Streptoneura) are described. Anatomical, ecological and biological remarks with notes on their distribution, have also been made for each species. In the general part the distribution of the species found in Ceylon and their geographical range, have been described.

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