Ann. Naturhist. Mus. Wien	86	B	145–204	Wien, November 1984

Results of the Austrian-Indian Hydrobiological Mission 1976 to the Andaman-Islands:

Part IV: The Freshwater Gastropods of the Andaman-Islands

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Abstract

The study deals with 20 species of Fresh- and Brackishwater Gastropods, collected by the Austrian-Indian Hydrobiological Mission 1976 on the Andaman-Islands (North- and South-Andaman) in the Gulf of Bengal. From every species, collected at 26 stations (20 at South-, and 6 at North-Andaman), mostly in running waters, are given conchological, anatomical, ecological-biological and zoogeographical remarks. In the General Part the distribution of the found species in the running waters between headwaters and mouth-region is shown. The zoogeographical position of the Freshwater Gastropods is characterized by the dominance of malayo-pacific elements.

1. Introduction

In contrast to the high increased literature concerning the Freshwater Gastropods of the Western Indian Ocean Islands (Madagascar and adjacent islands, Sri Lanka) for example: SGANZIN (1843); DESHAYES (1863); MORELET (1877, 1879, 1881 a & b, 1882 and 1883); CROSSE (1879, 1880, 1881); DOHRN (1857, 1858); BOETTGER (1889, 1890, 1892); MARTENS (1880 [in MOEBIUS]); MARTENS & WIEGMANN (1898); SYKES (1905), GERMAIN (1921); CONOLLY (1925); DAUTZENBERG (1929); HUBENDICK (1951); GRÉBINE & MENACHÉ (1953); RANSON (1956); BARNACLE (1962); MENDIS & FERNANDO (1962); STARMÜHLNER (1969, 1974, 1983); FERNANDO (1969 and some others) particulars, concerning the Freshwater Gastropods of the Andaman- & Nicobar Islands are very rare:

The stations, mostly from the Nicobars, are based on shell-collections such as from ROEPSTORFF, WARNEFORD and the Austrian NOVARA-Expedition 1857 to the Nicobars. They are noted by REEVE (1859–61); FRAUENFELD (1869); BROT (1874; after notices of MOERCH [Mus. v. d. BUSCH] and ZELEBOR [Novara-Expedition]); MARTENS (1878/79); NEVILL (1884/85) and PRESTON (1908, 1915). HUBENDICK (1951) noted for *Lymnaea luteola* from India also the occurence on the Andamans.

The Andamans, a chain of islands stretching from Cap Negrais in Burma to the Nicobars in South, occupies a total of 212 islands (Fig. 1). Great-Andaman consists of North-, Middle- and South-Andaman. Our mission has collected only in

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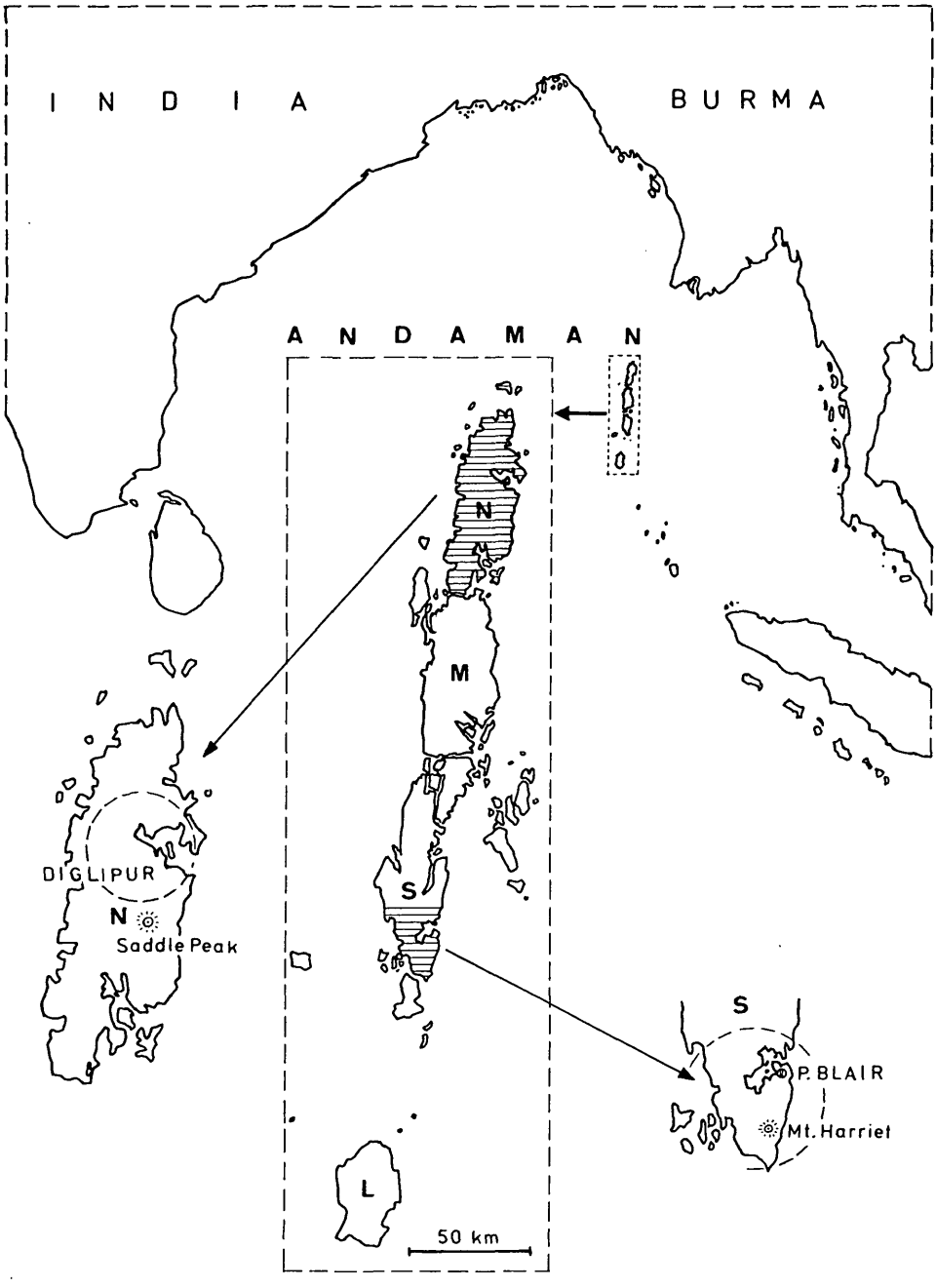


Fig. 1. Map of the geographical situation of the Andaman-Islands with refernece to the areas of the collections (encircled lines) in South-Andaman (vicinity of Port Blair) and North-Andaman (vicinity of Diglipur). (drawing: M. MIZZARO)

North-Andaman (vicinity of Diglipur) and South-Andaman (vicinity of Port Blair). These islands are situated between the 6° and 14° N-latitude and the 92° to 94° O-longitude. The highest points are the Saddle Peak with 750 m at North-, and the Mount Harriet Range at South-Andaman with 433 m above sea level.

The rocks of the Andamans are divided in Eocene Sedimentaries and older Serpentine Series (BANDYOPADHYAYA, SUBRAMANYAN & SHARMA, 1973; STARMÜHLNER, 1978). The islands are the unsubmerged portions of a continous ridge connecting the moutain range of the Arakan (Manipur-Burma belt) with the festoon of Sumatra. During Pleistocene the deposited sediments and volcanic flows in the geosyncline have been uplifted.

The running waters, flowing through the serpentine highlands, preserve a continous flow of clear water throughout the year. If the rivers are arising the areas where the more porous sandstones and conglomerats prevail, are either quite dry during the early months of the year, or occurs as a number of separate pools linked together by a gradula seepage of water beneath the surface in the sandy beds of watercourses.

The climat is tropical and fairly uniform throughout the year with a mean air-temperature of 29° to 30° C, the average rainfall during a year is about 3500 mm (most rainfall during SW-Monsoon between May and November.

Following PRAIN (J. Asiat. Soc. Bengal. **60** (II): 238–406) the vegetation of the Andamans contains a number of species, the presence of which can only explained by the supposition of a past land connection with the Arakan-region in Burma. The mainly parts of the hill-areas inside of the islands are covered by dense jungle and primary rain-forests. Near the East-coast of North- (region Diglipur), Middle- (region Mayarbunder) and South-Andaman (region Port Blair) the jungles were cleared by Indian settlers. These farmers cultivate on fertile soils rice, rubber, betelnut, bananas, coconut and other tropical fruits and legumes.

In consequence of the relatively low altitude of the mountains in North- and South-Andaman the short running waters (5–10 km; Riv. Kalimpong: 20 km) have only a flat gradient between 20‰ in the upper and 5(and lower)‰ in the middle and lower courses. In the dry season between December and March many of the smaller rivers dry out partly and they occur as a number of separate pools.

The velocity of the water-current reaches only in the head-waters and some parts of the upper courses in the hilly areas in short cascade-zones more than 1 m/sec. In these regions the bottom is composed by serpentinic and volcanic rocks or boulders of 20 to 50 cm in diameter. In the middle and lower courses the medium velocity of the current lies between 30 cm and 50 cm/sec (sometimes up to 75 cm/sec). The cascade-zones are interrupted by large, deep pools with a very low current-velocity of about 5 cm to 20 cm/sec. These low currents were found also on the lentic parts of the banks. In the medium current the bottom is composed by smaller boulders (10–20 cm in diameter) and gravel (5 to 10 cm in diameter), often covered by a dense growth of filamentous algae. The bottom of the pools and the creeks near the banks is composed by sand and mud, often covered with a thick layer of vegetable debris and paddings of algae, such as *Spirogyra* sp.

The mean water-temperature of the rivulets and rivers increased, from the shady headwaters in the forests (200–300 m altitude) from 23° C to 25°/26° C in the upper and middle courses. In free, sunny sectors the temperatures can reach more than 28° C. The mean temperatures in the lower courses lies between 27° C and 28.5° C and reaches in the mouth-zones 30° C and more. After the measurements of the Austria-Indian Mission 1976 the differences of the water temperature in the headwaters and the mouth-zones was only 7° C–8° C (STARMÜHLNER, 1978).

Following the measurements of the chemistry in running waters of South- and North-Andaman by the Austrian-Indian Mission 1976 (STARMÜHLNER, 1978) the running waters in the vicinity of Port Blair contain little dissolved mineral salts in the headwaters of the primary forests, flowing over vulkanite, quartzitic-limonitic breccie and porphyrit, but also in the upper courses with sandstone-bottom: The values of the electrolytic conductivity rise up from the headwaters and upper courses from a minimum from 59 ° Siemens to a maximum of 401 µ Siemens (mean: 145–170 µ Siemens) in the middle and lower courses, influenced by sedimentary ground and the cultivated areas nearby. These values are correlated with the increasing of the total hardness from a minimum from only 0,8° dH to a maximum of 10° dH (mean 4.9° dH). In the mouth-regions, influenced by brackish-water, the conductivity goes up to 8500 ° Siemens and more, the total hardness to more than 59° dH! Content on Ca was measured from 2 mg/l in the headwaters to 31 mg/l in the lower courses and to 87 mg/l in the mouth-zones. The content on Mg counted with a minimum from 3 mg/l in the headwaters up to 30 mg/l in the lower courses and up to 245 mg/l in the brackish zones of the mouth. The content on Cl was counted in the headwaters by a minimum of 7 mg/l, in the lower courses with 44 mg/l and in the mouth-zone with brackish-water with 3360 mg/l. The content on SiO_2 was in mean about 14.5 mg/l–16,5 mg/l, the content on K was counted with a mean of 1.07–1.15 mg/l; Na goes up from a minimum of 5.9 mg/l to a maximum of 45 mg/l and reaches in the mouth-zones more than 1750 mg/l.

In North-Andaman the largest river of the Andamans, the River Kalimpong, with headwaters, coming from the serpentinitic Saddle Peak, shows a relatively high content on Mg with a mean of 40 mg/l, whereas the mean content on Ca is only 7.5 mg/l. The conductivity was with a mean of 280 µ Siemens in the upper courses higher than in the middle courses with a mean of 208 µ Siemens, but increases in the lower courses up to 235 µ Siemens. Total hardness was in the upper courses with 9.5° dH also higher than in the middle courses with a mean of 4.5° dH. and in the lower courses with nearly 6° dH. In contrast to the serpentinic areas with a low content of Ca the values of Ca of the middle and lower courses rises up to a mean of 15 mg/l, by a maximum of 24 mg/l, whereas the content on Mg in theses areas was in mean only 13 mg/l! From the headwaters to the lower courses the content on Na was increasing from 3.9 mg/l to 10.9 mg/l, on K from 0.45 mg/l to 1.6 mg/l and on Cl from 8.5 mg/l to more than 12 mg/l

(maximum: 21 mg/l). SiO_2-content was measured in the serpentinitc upper courses with 24.5 mg/l in the sedimentary areas only by a mean of 12.75 mg/l.

2. Material and Methods

The specimens of Freshwater- and Brackishwater-Gastropods from the Austrian-Indian Hydrobiological Mission 1976 were collected by the author and Mr. K. K. APPUKUTAN qualitatively and quantitatively. The quantitative samples were taken mostly from $1/16$ m², sometimes from $1/4$ m² to 1 m². 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 M 5 and a drawing tube. The photographs of the shells were made by Mrs. Prof. Maria MIZZARO with near-lenses and flash.

The Fresh- and Brackishwater-Gastropods of this study were collected from 26 localities of North- and South-Andaman. mostly from running waters, but some were also found in stagnant waters nearby, like flooded pools and swamps. Listed from these localities are 20 species: 18 species are Streptoneura (= Prosobranchia) and 2 species are Euthyneura-Pulmonata-Basommatophora.

List of recorded species:

Phylum: MOLLUSCA
Classis: GASTROPODA
Subclassis: PROSOBRANCHIA (= STREPTONEURA)
Ordo: Archaegastropda
Superfam.: Neritacea
Familia: Neritidae
Subfamilia: Neritinae
Genus: *Nerita* LINNE, 1758
Subgenus: *Nerita* s. str.
1. *Nerita (Nerita) chamaeleon, LINNÉ, 1758*
Genus: *Clithon* MONTFORT, 1810
Subgenus: *Clithon* s. str.
2. *Clithon (Clithon) corona* (LINNÉ, 1758)
3. *Clithon (Clithon) peguensis* (BLANFORD, 1867)
4. *Clithon (Clithon) sowerbyana* (RÉCLUZ, 1842)
Genus: *Neritina* LAMARCK, 1816
Subgenus: *Neripteron* LESSON, 1830
5. Neritina (Neripteron) auriculata LAMARCK, 1816
Subgenus: *Vittoida* BAKER, 1923 (= *Vittina* BAKER, 1923 ?)
6. *Neritina (Vittoida) variegata* LESSON, 1831
Subgenus: *Neritina* s. str.
7. *Neritina (Neritina) pulligera* (LINNÉ, 1767)
8. *Neritina (Neritina)* cf. *squamipicta* RÉCLUZ, 1843
Genus: *Septaria* FÉRRUSAC, 1807
9. *Septaria porcellana* (LINNÉ, 1758)
Subfamilia: Neritiliinae
Genus: *Neritilia* MARTENS, 1879

10. *Neritilia rubida* (PEASE, 1865)
Ordo: Mesogastropoda
Superfam.: Cerithiacea
Familia: Thiaridae
Subfamilia: Thiarinae
Genus: *Thiara* RÖDING, 1798
11. *Thiara scabra* (O. F. MÜLLER, 1774)
12. *Thiara setigera* (BROT, 1870)
Genus: *Melanoides* OLIVIER, 1804
Subgenus: *Melanoides* s. str.
13. *Melanoides (Melanoides) tuberculata* (O. F. MÜLLER, 1774)
Subgenus: *Stenomelania* P. FISCHER, 1885
14. *Melanoides (Stenomelania) plicaria* (BORN, 1780)
15. *Melanoides (Stenomelania) torulosa* (BRUGUIERE, 1789)
Genus: *Tarebia* H. & A. ADAMS, 1854
16. *Tarebia granifera* (LAMARCK, 1822)
Familia: Planaxidae
Genus: *Planaxis* LAMARCK, 1822
Subgenus: *Planaxis* s. str.
17. *Planaxis (Planaxis) sulcatus* (BORN, 1778)
Familia: Potamididae
Subfamilia: Potamidinae
Genus: *Cerithidea* SWAINSON, 1840
Subgenus: *Cerithideopsilla* THIELE, 1929
18. *Cerithidea (Cerithideopsilla) cingulata* (GMELIN, 1790)
Subclassis: EUTHYNEURA
Ordo: Pulmonata
Superfamilia: Lymnaeacea
Familia: Lymnaeidae
Genus: *Lymnaea* LAMARCK, 1799
Subgenus: *Radix* MONTFORT, 1810
19. *Lymnaea (Radix) luteola* LAMARCK, 1822
Superfamilia: Ancylacea
Familia: Bulinidae
Subfamilia: Bulininae
Genus: *Indoplanorbis* ANNANDALE & PRASHAD, 1920
20. *Indoplanorbis exustus* (DESHAYES, 1834)

3. List and Description of the Stations

3.1. South-Andaman

No. 1. S.-And./19/21. 12. 1976: Rivulet near Allahmajid; affluent of the Dhanikari-reservoir; dense, primary forest. Alt: 200 m; Br.: 3–10 m; C: 20–30 cm/sec (c: 50–70 cm/sec; b, p: 0–10 cm/sec); Gr: serpentinic rocks, boulders, gravel (b, p: sand, mud, vegetable debris); Alg: *Bostrychia radicans, Compsopogon caeruleus, Nostochopsis lobatus, Hydrosera whampoensis, Nostoc* sp.; Te: 24.6° C–25.1° C; Che: Cond: 136–148 µ S; pH: 7; Tot. H: 2.6° dH; Ca: 10–13 mg/l; Mg: 10 mg/l. Found species: *Neritina pulligera, Melanoides tuberculata, Thiara scabra.*

No. 2. S.-And./3/4. 1. 2. 1976: River Nayachal; effluent of the Dhanikhari-reservoir; primary and secondary forest. Alt: 120 m; Br: 3–8 m; D: 5–10 cm; C: 50 cm – 1 m/sec (b, p: 10–20 cm/sec); Gr: sand-stone boulders, sand, vegetable debris; Alg: *Compsopogon caeruleus, Stigeoclonium* sp., *Oedogonium* sp.; Te: 29.2°–28.8° C; Che: Cond: 59–63° S; pH: 6–6.1; Tot. H: 1° dH; Ca:

2.5–4 mg/l; Mg: 3 mg/l. Found species: *Neritina pulligera, Thiara scabra, Melanoides tuberculata, Indoplanorbis exustus.*

No. 3. S.-And./12/8. 12. 1976: Rivulet near Asmadabad, bordered by dense forest, meadows and plantations. Alt: 80 m; Br: 1–5 m; D: 1–3 cm (p: to 50 cm); C: 30 cm/sec (b, p: 0–10 cm/sec); Gr: boulders, gravel, sand, mud and vegetable debris; Alg: *Compsopogon caeruleus, Spirogyra setiformis, Oedogonium* sp., *Cladophora* sp.; Te: 23.2°–23.6° C; Che: Cond: 121–138 µ S; pH: 6.8–7; Tot. H: 1.8° dH; Ca: 6 mg/l; Mg: 6 mg/l. Found species: *Melanoides tuberculata, Indoplanorbis exustus.*

No. 4. S.-And./15/19. 12. 1976: Torrentical rivulet with cascades in the forested hills near Bambooflat (North-Bay); dense forest. Alt: 50 m; Br: 2–5 m; D: 3–10 cm; C: 30–50 cm/sec (c: 1 m/sec; b, p: 0–10 cm/sec); Te: 25° C; Gr: rock, boulders; sand, mud und vegetable debris; Che: Cond: 84–91 µ S; pH: 6.5–6.9; Tot. H: 0.8° dH; Ca: 2–6 mg/l; Mg: 4 mg/l. Found species: *Neritina pulligera, Neritina (V.) variegata, Septaria porcellana.*

No. 5. S.-And./11/8. 12. 1976: Rivulet near Doligung; dense secondary forest. Alt: 30 m; Br: 20 cm – 1 m; D: 2–10 cm (p: 50 cm); C: 10–20/30 cm/sec (b, p: 0–10 cm/sec); Gr: boulders, gravel between mud and organic debris; Te: 25.2° C; Che: pH: about 6; Tot. H: 2° dH. Found species: *Melanoides tuberculata, Indoplanorbis exustus.*

No. 6. S.-And./10/8. 12. 1976: Rivulet near the village Bimblton: bordered by paddy-fields, partly polluted as watering-place for water-buffalos. Alt: 30 m; Br: 2–10 m; D: c: 3–5 cm; b, p: 50 cm – 1 m; C: 30–50 cm/sec (b, p: 0–10 cm/sec); Gr. muddy gravel, mud, vegetable debris; Alg: *Rhizoclonium* sp., *Oedogonium* sp., *Cladophora*? sp., *Hydrosera whampoensis*; Te: 25.7°–28.5° C; Che: Cond: 222–242 µ S; pH: 7–7.8; Tot. H: 5.9° dH; Ca: 14–23 mg/l; Mg: 14 mg/l. Found species: *Thiara scabra, Melanoides tuberculata, Indoplanorbis exustus.*

No. 7. S.-And./6/6. 12. 1976: Rivulet near the village Mongelutonge, downstream the River Nayachel (Nr. 2), secondary forest, plantations. Alt: 25 m; Br: 5–10 m; D: 5 cm (p: 50 cm); C: 30 cm/sec (b, p: 0–10 cm/sec); Gr: muddy gravel; mud, sand, vegetable debris; Te: 25.8°–26.8° C; Che: Cond: 107–141 µ S; pH: 7.2–7.9; Tot. H: 1.6° dH; Ca: 4–8 mg/l; Mg: 6 mg/l. Found species: *Neritina (V.) variegata, Neritina pulligera, Thiara scabra, Melanoides tuberculata, Melanoides (St.) torulosa, Tarebia granifera, Indoplanorbis exustus.*

No. 8. S.-And./13/18. 12. 1976: Repulsion of a very slow flowing creek, with large, deep pools near Mithakhrai; dens secondary forest. Alt: 20 m; Br: 2–5 m; D: 30 cm – 1 m; C: 0–10 cm/sec; Gr: muddy sand, some stones, vegetable debris; Te: 25.4° C; Che: Cond: 152–160 µ S; pH: 6.9–7; Tot. H: 2.8° dH; Ca: 8–15 mg/l; Mg: 7 mg/l. Found species: *Thiara scabra, Melanoides tuberculata.*

No. 9. S.-And./9A/7. 12. 1976: Rivulet near Tayaledrabad; bordered by paddy-fields and swamps, polluted by watering-places for water buffalos. Alt: 20 m; Br: 2–3 m; D: 2–5 cm (p: 50 cm); C: 30–50 cm/sec (b, p: 0–20 cm/sec); Gr: gravel; mud, sand, vegetable debris; Te: 25.5°–26.6° C; Che: pH: 7, Tot. H: 11° dH. Found species: *Thiara scabra, Melanoides tuberculata.*

No. 9A. S.-And./16/19. 12. 1976: Rivulet near Matra, bordered by paddy-fields; overflooded after heavy rain, sample only from the borders. Alt: 20 m; Br: 2–3 m; D: overflooded: 1–2 m, otherwise 5–10 cm; C: 30–50 cm/sec; Gr: muddy sand; Te: 25.1° C. Found species: *Lymnaea (Radix) luteola* juv.

No. 10. S.-And./8/7. 12. 1976: Rivulet near Guptapara, bordered by plantations. Alt: 10 m; Br: 3–10 m; D: 5–10 cm (p: 50 cm), C: 30–50 cm/sec (c: 75 cm – 1 m/sec; b, p: 0–10 cm/sec); Gr: boulders, gravel; sand, Alg: *Spirogyra* sp.; Te: 24.2°–25° C; Che: Cond: 74–80 µ S; pH: 6.8–7.2; Tot. H: 1° dH; Ca: 2–4 mg/l; Mg: 5 mg/l. Found species: *Clithon corona, Neritina (V.) variegata, Neritilia rubida, Melanoides (St.) plicaria, Melanoides (St.) torulosa.*

No. 11. S.-And./5/5. 12. 1976: Rivulet near Bhatrapur, bordered by secondary forest and plantations. Alt: 10 m; Br: 2–3 m (p: to 10 m); D: 10–20 cm (b, p: to 1 m); C: 20–30 cm/sec (c: 50 cm/sec; b, p: 0–10 cm/sec); Gr: boulders, gravel; mund, vegetable debris; Te: 26.4° C; Che: Cond: 129–158 µ S; pH: 7.1; Tot. H: 3° dH; Ca: 6–11 mg/l; Mg: 8 mg/l. Found species: *Neritina (V.) variegata, Neritina pulligera, Septaria porcellana, Melanoides tuberculata, Melanoides (St.) plicaria.*

No. 12. S.-And./17B/20. 12. 1976: Torrentical rivulet from the hills near the Tourist-Home of Port Blair to the Fisheries Jetty (upstream of No. 16), bordered by shrub and meadows. Alt: from 10 m to 2 m; Br: 1–2 cm; D: 5–10 cm (b, p: 20–50 cm); C: 50 cm – 1 m/sec (b, p: 0–20 cm/sec); Gr: rock,

boulders, gravel; sand, Alg: freshwater: *Cladophora* sp.; Te: 27.3° C; Che: Cond: 233 ° S; pH: 7.4; Tot. H: 3.6° dH; Ca: 19 mg/l. Found species: *Clithon corona, Clithon sowerbyana* (lower parts!), *Neritina pulligera, Neritina* cf. *squamipicta, Septaria porcellana, Melanoides tuberculata, Melanoides (St.) torulosa* juv.

No. 13. S.-And./2A/4. 12. 1976: School-lane Creek, S of the Airstrip of Port Blair, bordered by scrub and meadows, partly paddy-fields; pools polluted by watering-place of water buffalos. Alt: 10 m; Br: 1–4 m; D: 5–10 cm (p: 50 cm); C: 30–50 cm/sec (b, p: 0–10 cm/sec); Gr: gravel; mud, Alg: *Compsopogon caeruleus, Spirogyra* sp., *Oedogonium* sp., *Phormidium* sp.; Te: 25.6°–26.7° C; Che: Cond: 113–126 µ S; ph: 6.7–6.8; Tot. H: 2° dH; Ca: 9–10 mg/l; Mg: 4 mg/l. Found species: *Clithon corona; Neritina pulligera, Neritina* cf. *squamipicta, Neritina (Neripteron) auriculata, Septaria porcellana, Neritilia rubida, Thiara scabra* (f. *acanthica*), *Melanoides tuberculata.*

No. 14. S.-And./4/5. 12. 1976: Rivulet in the Chidiatop-area, about 300 m upstream of the mouth and about 100 m upstream of the influence of brackish water during the high-tide, bordered by plantations and scrub. Alt: 5 m; Br: 1–3 m; D: 5 cm (p: 15–30 cm); C: 30–50 cm/sec (b, p: 0–10 cm/sec); Gr: boulders, gravel, Alg: *Thorea ramosissima, Spirogyra decimina;* Te: 25.1°–27.6° C; Che: Cond: 275–324 µ S; pH: 7.4–7.5; Tot. H: 10° dH; Ca: 19–21 mg/l; Mg: 30 mg/l. Found species: *Clithon corona, Neritina (V.) variegata, Neritina* cf. *squamipicta, Septaria porcellana, Neritilia rubida, Thiara scabra* (f. *acanthica*), *Melanoides (St.) plicaria, Melanoides (St.) torulosa.*

No. 15. S.-And./1/3. 12. 1976: June Creek near Corbyn's Bay Cove; downstream of No. 13; bordered by swampy meadows, influence of brackish water of the recurrent flow during high tide. Alt: 1–2 m; Br: 5 m; D: 2–3 cm (p: 50 cm) C: 30–50 cm/sec (b, p: 0–10 cm/sec); Gr: sand, mud, Alg: *Microcoleus* cf. *chthonoplastes, Lyngbya* sp.; Te: more than 30° C; Che: Cond: 385–401 µ S; pH: 7.3–7.6; Tot. H: 4° dH; Ca: 22–31 mg/l; Mg: 12 mg/l; Na: 45 mg/l; Cl: 39–44 mg/l. Found species: *Clithon corona, Clithon sowerbyana, Neritina pulligera, Neritina (Neripteron) auriculata, Neritilia rubida, Melanoides tuberculata, Thiara scabra, Melanoides (St.) plicaria.*

No. 16. S.-And./17A/20. 12. 1976: Downstream of No. 12, mouthregion of a torrent coming from the hills near the Tourist-Home of Port Blair and flowing in the harbour near the Fisheries-Jetty; during high-tide covered with sea water, during low-tide influence of brackish water. Alt: 1 m–0 m (mean sea level); Br: 1–2 m (low-tide); D: 5–10 cm (low-tide); C: 30–50 cm (low-tide); Gr: gravel, sand, dead coralls, shells; Te: 28.1° C; Che: Cond: 7521–9500 µ S; pH: 6.9–7.2; Tot. H: up to 50° dH; Ca: 82–87 mg/l; Mg: 245 mg/l; Na: 1750 mg/l; Cl: 3360 mg/l. Found species: *Clithon corona, Clithon sowerbyana, Neritina (Neripteron) auriculata, Nerita chamaeleon, Cerithidea cingulata, Planaxis sulcatus.*

No. 17. S.-And./2B/4. 12. 1976: Small pools on the slope of a hill, right hand of the School-Line Creek (No. 13). Diameter: 1–3 m; D: 10–30 cm; Gr: muddy clay; Te: more than 30° C. Found species: *Indoplanorbis exustus.*

No. 18. S.-And./7/7. 12. 1976: Pools in the swamps SW of Port Blair; bordered with reed-grasses and sedges; Diameter: 1–5 m and more; D: 10–50 cm; Gr: mud, vegetable debris, dense paddings of *Spirogyra* sp. Te: 28.5° C. Found species: *Indoplanorbis exustus.*

No. 19. S.-And./9B/7. 12. 1976: Pools in the swamps near Tayaledrabad (near No. 8), S of Port Blair; bordered by reed-grasses and sedges; Diameter: 1–5 m and more; D: 20–50 cm; Te: 26.6° C; Che: pH: 7; Tot. H: 13° dH; Gr: mud, vegetable debris. Found species: *Melanoides tuberculata, Indoplanorbis exustus.*

No. 20. S.-And./14/18. 12. 1976: Pool in the swamps near the road from Port Blair to the Mithakrai-Creek; Diameter: some meters; D: 10–30 cm; dense growth of algae and higher water-plants. Found species: *Melanoides tuberculata, Indoplanorbis exustus.*

3.2. North-Andaman

No. 1. N.-And./2/13. 12. 1976: River Kalimpong on the W-slope of the Saddle Peak, approx. 4 km S of Diglipur; bordered by primary forest and meadows with scrub. Alt: 50 m; Br.: 30–40 m (divided in some branches of 5–10 m); D: 5–20 cm (b, p: 50 cm – >1 m); C: 50 cm/sec (b, p: 0–10 cm/sec), Gr: serpentinic boulders, gravel and sand, vegetable debris, Alg: *Spirogyra* sp.; Te:

24.9°–26.2° C; Che: Cond: 272–306 µ S; pH: 7.4–8; Tot. H: 10° dH; Ca: 6–8 mg/l, Mg: 41 mg/l (!). Found species: *Neritina pulligera, Melanoides tuberculata.*

No. 2. N.-And./7/15. 12. 1976: River Kalimpong, 2 km downstream of No. 1; bordered by paddy-fields, meadows with scrub. Alt: 30 m; Br. 5–10 cm; D: 10–30 cm; C: 30–50 cm/sec (b, p. 0–10 cm/sec); Gr: gravel, some boulders; mud, Alg: *Spirogyra* sp.; Te: 28° C; Che: Cond: 242 ° S; pH: 7–7.5; Ca: 9 mg/l; Mg: 41 mg/l (!). Found species: *Melanoides (St.) torulosa* (sporadic).

No. 3. N.-And./3/13. 12. 1976: River Kalimpong, 2 km downstream of No. 2; near the road-bridge of Diglipur, polluted by domestical sewage and washing-places. Alt: 20 m; Br: 10 m; D: 10–30 cm (b, p: 1 m); C: 30–50 cm/sec (b, p: 0–20 cm/sec); Gr: gravel, sand, mud; Te: 26.7° C; Che: Cond: 265–293 µ S; pH: 6.9–7; Tot. H: 9° dH; Ca: 6–10 mg/l; Mg: 39 mg/l (!). Found species: *Neritina pulligera, Thiara setigera, Melanoides (St.) torulosa, Tarebia granifera, Indoplanorbis exustus.*

No. 4. N.-And./4/14. 12. 1976: Rivulet near Lakshmipur, approx. 5 km SW of Diglipur; bordered by secondary forest, meadows and scrub. Alt: 20–10 m; Br: 2–5 m; D: 3–5 cm (p: 50 cm); C: 30–50 cm/sec (b, p: 0–10 cm/sec); Gr: gravel; muddy sand; Te: 25.6°–27.1° C; Che: Cond: 168–185 ° S; pH: 7.4–7.8; Tot. H: 4.4° dH; Ca: 6–15 mg/l; Mg: 10 mg/l. Found species: *Melanoides (St.) torulosa.*

No. 5. N.-And./6/15. 12. 1976: River Durgapur, 10 km O of Diglipur, 1.5 km upstream of the mouth; borderd scrub and plantations. Alt: 5 m; Br: 50 cm – 1 m (p: 2–3 m); D: 1–5 cm (b, p: up to 1 m); C: 20–30 cm/sec (b. p: 0–5 cm/sec); Gr: gravel, sand, mud, vegetable debris, Alg: *Compsopogon caeruleus, Spirogyra* sp.; Te: 26.4°–27.3° C; Che: Cond: 223–253° S; pH: 7.2–7.8; Tot. H: 5° dH; Ca: 16–24 mg/l; Mg: 13 mg/l. Found species: *Neritina (Neripteron) auriculata, Neritina* cf. *squamipicta, Melanoides (St.) plicaria, Melanoides (St.) torulosa, Indoplanorbis exustus.*

No. 6. N.-And./1/15. 12. 1976: Rivulet 7 km E of Diglipur, on the road from Diglipur to the harbour, affluent of the lower course of the River Kalimpong; hills of Maghar-Nalah, bordered by scrub and plantations, papyrus-weed. Alt: 3–5 m; Br: 2–3 m; D: 10 cm (b, p: up to 1 m); C: 30 cm/sec (b, p: 0–5 cm/sec); Gr: muddy gravel, mud; Te: 26.1°–27.5° C; Che: Cond: 215–247 µ S; pH: 7.2; Tot. H: 5.9° dH; Ca: 12–18 mg/l; Mg: 18 mg/l. Found species: *Clithon corona, Clithon peguensis, Neritina* cf. *squamipicta, Thiara scabra, Melanoides (St.) torulosa* (mussel: *Polymesoda ceylanica*).

Abbrevations in the lists: Alt: Altitude; Br: Breadth; D: Depth; b: near the banks, p: in pools between cascades; C: velocity of the surface-Current; c: cascade-zone; Gr: conditions of the Ground; Te: Temperature of the water; Che: Chemistry: Cond: Conductivity;Tot. H: Total Hardness; Ca: content on Calcium-ions; Mg: content on Magnesium-ions; Na: content on Natrium-ions and Cl: content on Chlorid-ions; Alg: *Algae.*

4. Systematic-Anatomical Part

Subclassis: PROSOBRANCHIA (= STREPTONEURA)
Ordo: Archaegastropoda
Superfamilia: Neritacea
Familia: Neritidae
Subfamilia: Neritinae

1. *Nerita (Nerita) chamaeleon* (LINNÉ, 1758)

Lit.: 1758 *Nerita chamaeleon* (LINNÉ, Syst. Nat., Ed. **10:** 779, Ed. XII: 1255) – 1850 *Nerita stella* (CHEMNITZ, Conch. Cab., **11:** 197; Pl. 197, figs. 1907, 1908) – 1855 *Nerita stella* (REEVE, Conch. Icon., **9:** Pl. 13, fig. 60) – 1866 *Nerita chamaeleon* (WATSON, in „Challenger", Zoology, **15,** Gastropoda: 132) – 1908 *Nerita (Theliostyla) chamaeleon* (SCHEPMAN, Siboga-Exp., Prosobranchia, Monogr. **49:** 4) – 1942 *Nerita chamaeleon* (GRAVELY, Bull. Mad. Govt. Mus. (Nat. Hist.), **5** (2): 18) – 1952 *Nerita chamaeleon* (SATYAMURTI, Bull. Mad. Govt. Mus. (Nat. Hist.) N. S., **1** (2/6): 58; Pl. 3, figs. 7 a, 7 b) – 1974 *Nerita chamaeleon* (STARMÜHLNER, J. mar. biol. Ass. India, **16** (1): 54).

Localities: S.-And.: No. 16 (26 ind.).

Shell: Spire distinctly, though slightly a raised, above the level of the body whorl; spirally ribbed; columellar surface with transversed ridges on the inner and outer borders, while the tubercles are confined to the central portion of the surface, the ridges away from the aperture are stronger than the ones adjoining the aperture; outer lip toothed; yellowish-white to white, variegated with dark green, sometimes broad, dark green spiral bands (Pl. 1, Fig. 1 a, b).

Sizes (in mm)	Shell		Aperture		
Locality	Height	Diameter	Height	Diameter	Col. area
S.-And.: No. 16	18.5	18.1	15.7	9.5	6

The sizes are from the largest shell in the sample.

Operculum: Outside yellowish-white to greyish, granulated, inner surface greyish-brownish; peg triangular, passing away to the base of the flat, curved ridge with a cutted free end (10.5 × 6.3 mm).

Anatomical remarks:

Radula: central-tooth elongated, the concav curved cutting edge near the base, superior margin on the sides extended; first lateral tooth with a concav

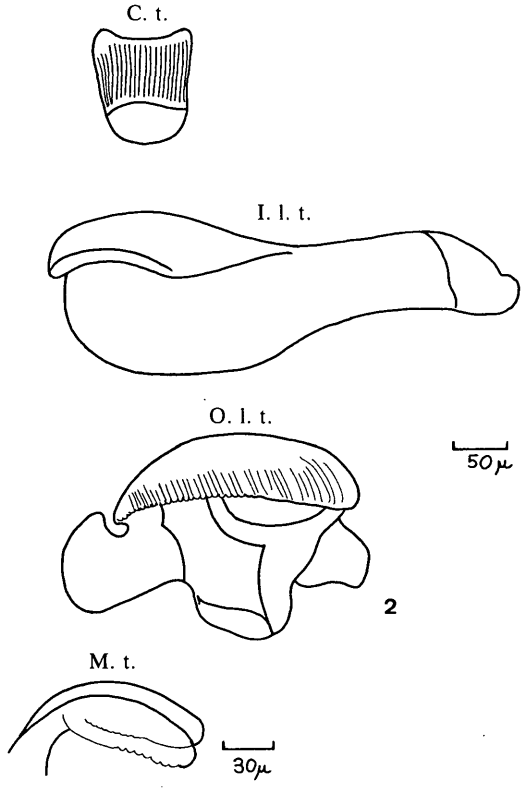


Fig. 2. *Nerita chamaeleon:* Radula

curved cutting edge and the second lateral finely serrated on the cutting edge, also the marginals (Fig. 2).

Biological-ecological remarks: *Nerita chamaeleon* is a marine species, typically for the litorale zone of the sea-shore. It was found in our samples only in the mouth-region of a rivulet (No. 16). These habitat is covered with sea-water during the high-tide and with brackish water during the low-tide. The species was associated with *Clithon corona, Planaxis sulcatus* and *Cerithidea cingulata.*

Geographical range: Indian Ocean.

2. *Clithon (Clithon) corona* (LINNÉ, 1758)

Lit.: 1758 *Nerita corona* (LINNÉ, Syst. Nat., Ed. **10:** 777) – 1822 *Neritina corona* and *N. brevispina* (LAMARCK, Anim. s. vert., **6** (2): 185) – 1848 *Neritina corona australis* (MOUSSON, Mitth. naturf. Ges. Zürich, **1:** 269) – 1878 *Neritina brevispina* (TAPPARONE-CANEFRI, Bull. Soc. Zool., **3:** 267) – 1883 *Neritina subgranosa* (TAPPARONE-CANEFRI, Ann. Mus. Genova, **1883:** 74) – 1883 *Neritina rhytidophora* (TAPPARONE-CANEFRI, ibid.: 76; Pl. 1, figs. 5–7) – 1879 *Neritina brevispina* (MARTENS, in M. & CH., Conch. Cab., **2** (10): 156; Pl. 17, figs. 1–4, 9) – 1885 *Neritina subocellata* (SCHEPMAN, Not. Leyden Mus., **7:** 49) – 1888 *Neritina brevispina* (TRYON, Man. Conch., **10:** 65; Pl. 32, figs. 16–18, Pl. 14, figs. 19–28 and 31–34) – 1888 *Neritina rhytidophora* (TRYON, ibid.: 66; Pl. 24, figs. 29–30) – 1923 *Theodoxus (Clithon) corona* (BAKER, Proc. Acad. Nat. Sc. Philadelphia, **75:** 155; Pl. 13, fig. 21) – 1937 *Clithon brevispina* (RIECH, Arch. Naturgesch. (N. F.), **6:** 82) – 1956 *Clithon corona* (BENTHEM-JUTTING, Treubia, **23** (2): 275; figs. 1, 6) – 1958 *Theodoxus corona* (CLENCH, Sc. Res. Danish Rennel-Exp. 1951 & Brit. Mus. Exp. 1953, **2** (27): 155–202) – 1963 *Clithon corona* (BENTHEM-JUTTING, Nova Guinea, Zool., **20:** 414) – 1970 *Clithon corona* (STARMÜHLNER, Cah. ORSTOM, sér. Hydrobiol. **4** (3/4): 29) – 1976 *Clithon corona* (STARMÜHLNER, Ann. Naturhist. Mus. Wien, **80:** 494; Figs. 2–5, Pl. 7, Figs. 30, 31).

Localities: S.-And.: No. 10 (9 ind.), No. 12 (26 ind. + ca. 150 iuv.), No. 13 (3 ind.), No. 14 (84 ind., many iuv.), No. 15 (1 ind.), No. 16 (326, mostly iuv.); N.-And.: No. 6 (85 ind.).

Shell: Spire small and inflated last whorl; rapidly increasing in size, apex mostly eroded; suture crenulated by the coarse growth striae, which are wrinkled and somewhat undulating; most specimens are conspicuously „shouldered" below the suture (f. *angulosa* MARTENS, 1897), it can be more accentuated by distinctly placed spines along it, the spines are often eroded and broken; spiny specimens were found at the stations mostly on the transition zone of fresh- and brackish water in the mouth region, influenced by the recurrent flow during high tide (No. 12); coloration is very varying from dull yellowish to greenish with a red-violet tinge, sometimes with 2–3 dark or yellowish spiral bands on the lower part of the last whorl, sometimes with dark radial flames from the suture to the upper third of the whorls, interrupted by yellowish bands, on the coarse growth striae with small yellowish to whitish triangular spots, which are sometimes black margined; the pattern of bands and spots shows a great variation by mostly spineless and smaller specimens; surface of the shell often covered by a black layer, hiding the coloration in the brackish mouth region of streams, which are covered with pure saltwater during high tide (Pl. 1, fig. 2 a–v).

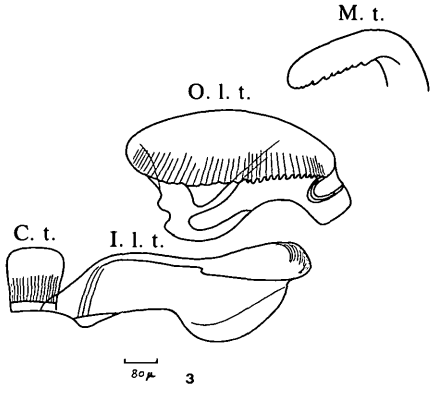
Sizes (in mm) Localities:		Shell Height	Shell Diameter	Aperture Height	Aperture Diameter	Col. area
S.-And.:	No. 10 (eroded)	20.3	21.8	15	8.5	5
	No. 12 (eroded)	18.2	17.3	13.2	7.5	4.4
	(eroded)	18	17.4	12.5	8	4
	No. 13 (eroded)	13.4	12	9.6	6	3
	No. 14 (eroded)	17	16.5	14.3	8	3.8
	No. 15	10.3	10	8	4.5	2.3
	No. 16	14	13.5	11.5	7	3.5
N.-And.:	No. 6 (eroded)	21.6	21	15.5	9	4.5
		18.7	17.5	13.5	8.4	4

The sizes are from the largest shells in the samples.

Operculum: Semilunar; external surface withish with yellow-reddish nucleus, exterior margin dark brown, covered with numerous, distantly placed granules, oblique shallow groove coresponds with a ridge on the interior surface, which is light brown coloured; peg yellow-reddish and connected by a shallow callus with the withish, flattened and curved ridge (11 mm × 7.5 mm).

Anatomical remarks: Corresponding with the particulars given by BAKER (1923: 155) and by STARMÜHLNER (1976: 495) from specimens of Pacific islands.

Radula: central-tooth elongated, cutting edge appreached the base, inner lateral tooth with straight edge, outer lateral tooth with distinct saw-shaped denticles near the outer margin, marginal teeths with denticles on the inner edge (Fig. 3). The female reproductive organs correspond also with the details given by STARMÜHLNER (1976: 495): Big spermatheca with more than 15 spermatophors of 25 mm lenght, which are stretched and with a long threadlike end (Fig. 4 b); the vaginal connecting duct slender with loops and enters in the superior part of the vagina at the base of an ampoule-shaped enlargement of the vagina; the end of the vagina is again narrow and arched; receptaculum seminis heart-shaped



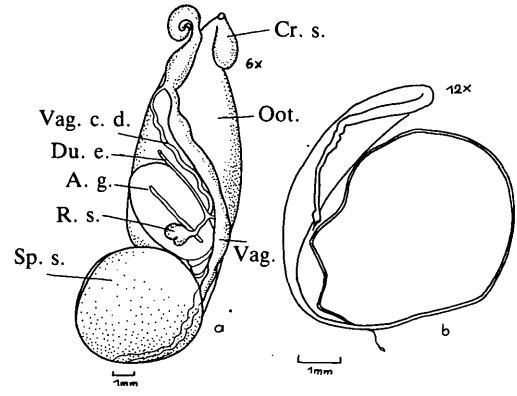


Fig. 3. *Clithon (Clithon) corona:* Radula

Fig. 4. *Clithon (Clithon) corona:* **a:** Female reproductive organs; **b:** spermathophor

and with a short duct; ductus enigmaticus and crystal-sac are developped (Fig. 4 a).

Biological-ecological remarks: *Clithon corona* is to be found on stones exlusively in the lower parts of the coastal streams, it occurs in the zone of the recurrent of brackish water during high-tide and still in pure sea water in the mouth region. Juvenile specimens living in the change of fresh- and brackishwater in the transition zone of the stream with pure freshwater and the upper frontier of the recurrent flow have always long spines developped, which are mostly corroded or broken by adult specimens. In areas with pure brackish water (during low-tide) or seawater (during high-tide), like in station No. 16, the specimens are mostly spineless (only very few young specimens have 1–2 spines), but extremly varying in the pattern of the coloration (P. 1, Fig. 2 a–j).

Current	Temperatur	pH	Range of: Conductivity (μ Siemens)	Total Hardness	(Na-ions) brackish area: (mg/l)	Cl-ions)
30–50 cm/sec	24.2° – °30° C	6.7–7.6	74–401 (average: 260; brackish: up to 9500!)	1°–10° dH (brackish: up to 50° dH!)	up to 1750!	up to 3360!

The species was associated in freshwater or in the transition zone of fresh- and brackish water with *Clithon sowerbyana* (in North-Andaman with *Clithon peguensis*), *Neritina (V.) variegata, Neritina* cf. *squamipicta, Neritina pulligera, Neritina (Neripteron) auriculata, Septaria porcellana, Neritilia rubida, Thiara scabra* f. *acanthica, Melanoides tuberculata, Melanoides (Stenomelania) plicaria, Melanoides (Stenomelania) torulosa.* In the brackish habitats of the mouth *Clithon corona* was associated with *Clithon sowerbyana, Neritina (Neripteron) auriculata,* and the brackish and marine species of *Nerita chamaeleon, Cerithidea cingulata* and *Planaxis sulcatus.* The density was in freshwater habitats 1–3 ind./1/16 m^2, in the transition-zone between fresh- and brackish water about 10, mostly juvenile, individues/ 1/16 m^2 (all specimens with spines). In the mouth-zone with brackish water, mostly spineless, but very varying in colour pattern, up to 150 ind./1/16 m^2!

Geographical range: Andaman & Nicobars, Malay Archipelago, Philippines, Moluccas, Aru, New Guinea, Bismarck Archipelago, Solomons, New Caledonia and Fiji.

3. *Clithon (Clithon) peguensis* (BLANFORD, 1867)

Lit.: 1858 *Neritina fuliginosa* (THEOBALD, J. asiat. Soc. Bengal, **27:** 315 (non von dem BUSCH, 1843) – 1867 *Neritina peguensis* (BLANFORD, J. asiat. Soc. Bengal, **36:** 58; Pl. 1, figs. 1–16) – 1876 *Neritina fuliginosa* (HANLEY & THEOBALD, Conch. Ind.: 63; Pl. 157; figs. 8–9 (non von dem BUSCH) – 1878 *Neritina peguensis* (MARTENS, in M. & C., Conch. Cab., **2** (10): 188; Pl. 19, figs. 10–11) – 1888 *Neritina peguensis* (TRYON, Man. Conch., **10:** 71; Pl. 26, fig. 87) – 1950 *Neritina peguensis* (SUVATTI,

Fauna Thailand: 41) – 1974 *Clithon (Clithon) peguensis* (BRANDT, Arch. Moll. **105** (1/4): 11; probably identical with *Neritina retifera* SOWERBY from Bengal, this species probably synonym with *N. retifera* BENSON 1836 = *N. michaudi* RÉCLUZ, *N. reticularis* SOWERBY = *N. capillata* GOULD of SOWERBY, *N. mörchiana* FRAUENFELD = *N. humeralis* THEOBALD and ? *N. fulgetrum* REEVE [Pl. 12, fig. 30]).

Localities: N.-And.: No. 6 (14 ind.).

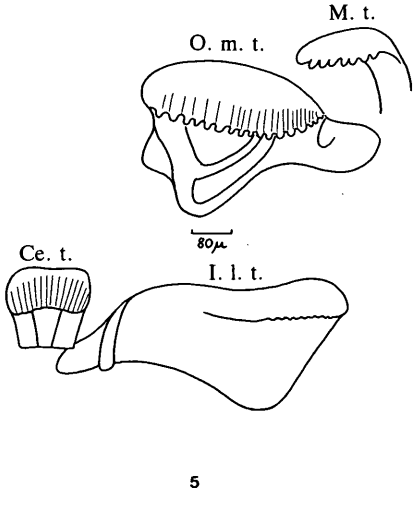
Shell: Subglobose, spire rounded, apex exserted, dull; small spire generally eroded and often covered or almost so by the upper part of the body whorl; generally greenish or yellowish-olivaceous with minute white patches or dots, shaded in front with brown or black, sometimes indistinctly darker banded; aperture bluish-white, columellar area or septum bluish grey, delicately verrucose, edge slightly incised, with several small denticles and one larger tooth in between (Pl. 2, Fig. 3 a, b).

Sizes (in mm)	Shell		Aperture		
Locality	Height	Diameter	Height	Diameter	Col. area
N.-And.: No. 6	14	14.3	12	6.5	3.5

The sizes are from the largest shell in the sample.

Operculum: Typically for the genus *Clithon:* peg short and knobshaped, ridge curved, connecting callus high and strong.

Anatomical remarks: Radula: typically for the genus: central-tooth higher than broad, cutting edge slightly curved and denticulated, first lateral tooth with straight edge, very slightly and fine denticulated, outer marginal with distinct 15–18 denticles on the whole edge, marginals with 8–10 denticles on the outer edgs (Fig. 5).



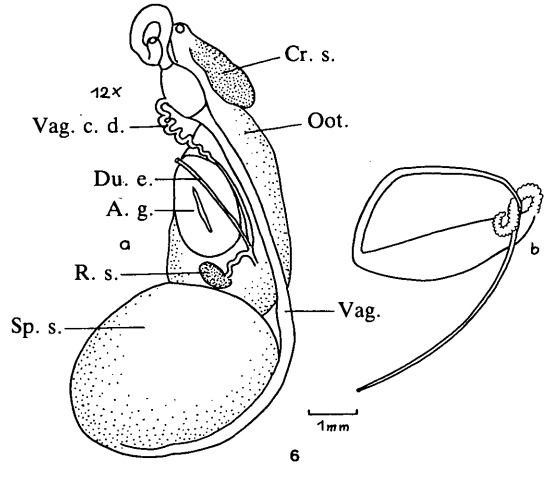


Fig. 5. *Clithon (Clithon) peguensis:* Radula

Fig. 6. *Clithon (Clithon) peguensis:* **a:** Female reproductive organs; **b:** spermathophor

The female reproductive system consists of a big, globose spermatheca with about 10–12 spermatophores, which are 12–13 mm long, cigar-shaped, the one end short and cork-screw-shaped, the other long and filiform extended (Fig. 6 b); the vaginal connecting duct slender and in the distal part looped, he enters in the upper third of the vagina, which is-typically for the genus *Clithon*-ampoul-shaped, the free end of the vagina is more narrow and curved; receptaculum seminis with short duct, ductus enigmaticus and crystal sac are typically (Fig. 6 a).

Biological and ecological remarks: Like all species of the genus, *Clithon peguensis* was found only in the lower part of running waters, in a rivulet, at No. 6 of North-Andaman: 2–3 ind/1/16 m^2 were counted, on muddy stones, in a current of 30–50 cm/sec, associated with *Clithon corona, Neritina* cf. *squamipicta* and, near the banks, with *Thiara scabra, Melanoides (Stenomelania) torulosa* and the mussel *Polymesoda ceylanica.* Many specimens of the species were found in copulation (December).

	Range of:		
Temperature	Conductivity	pH	Total Hardness
26.1°–27.5° C	215–247 µ S	7.2.–7.8	5° dH

Geographical range: Reported from the coastal areas of Burma and the Malayan peninsula and recorded by SUVATTI, 1950 from Thailand and if-identical with *Neritina retifera* SOWERBY – occuring also on the coast of Bengal.

4. *Clithon (Clithon) sowerbyana* (RÉCLUZ, 1842)

Lit.: 1842 *Nerita sowerbyana* (RÉCLUZ, Proc. zool. Soc. London, **10:** 174) – 1855/56 *Nerita soverbii* (REEVE, Conch. Ic.: Pl. 20, figs. 89 a–d) – 1842 *Nerita pulchella* (RÉCLUZ, Proc. zool. Soc. London, **10:** 175) – 1855/56 *Neritina pulchella* (REEVE, Conch. Icon.: Pl. 21, fig. 91) – 1879 *Neritina sowerbiana* (MARTENS, in M. & CH., Conch. Cab., **2** (10): 171; Pl. 18, figs. 1–4, 10, 13 (= var. *pulchella*)) – 1888 *Neritina sowerbyana* (TRYON, Man. Conch. **10:** Pl. 24, fig. 45; Pl. 25, figs. 46–51; as synonyms: *N, pulchella* RÉCLUZ, *N. sowerbii* REEVE) – 1950 *Neritina sowerbyana* (SUVATTI, Fauna Thailand: 41) – 1974 *Clithon (Clithon) sowerbyana* (BRANDT, Arch. Moll. **105** (1/4): 13; Pl. 1, fig. 9).

Localities: S.-And.: No. 12 (19 iuv.), No. 15 (55, mostly iuv.), No. 16 (92, mostly iuv.).

Shell: Ovate-globose, thick with dense growth-lines, almost dull; closely faintly striate and shining; spire small and depressed, often eroded and partly covered by the penultimate whorl: variable pattern of colours: predominantly yellowish, reddish or blackish on a yellowish-green or olive ground colour, frequently with minute white and red spots, sometimes more or less interruptedly banded or longitudinally strigate with black; MARTENS (1879) has distinguished four colour-varieties: *polysticta:* white and red spots (redwhite arrow-arrow-headed spots) and red, sometimes changing to black – *lactiflua:* yellow-white radial striae, sometimes reddish on green-geryish ground, striae mostly interrupted by a zone of

spots – *maculafasciata:* black longitudinal bands, yellow-withish spots – *interruptis:* black bands, interrupted by white-yellowish striae and yellowish or reddish fields, spotted or striaed; apterure and septum are ash coloured sometimes to bluish-white, the edge with 1+5+1 teeth (Pl. 2, Fig. 4 a–e).

Sizes (in mm) Localities		Shell Height	Shell Diameter	Aperture Height	Aperture Diameter	Col. area
S.-And.:	No. 12 (iuv.)	6.6	–	–	–	–
	No. 15	14	13	10.2	5.4	3.6
	No. 16	11	10.5	8	4	2.4

The sizes are from the largest specimens in the samples.

Operculum: External surface greyish, border reddish; peg yellowish, short connected with the long curved ridge (4.8 mm × 2.3 mm).

Anatomical remarks: Radula: typically for the genus: central-tooth a little higher than broad, cutting edge slightly concav, first lateral tooth with straight cutting edge, very fine cutted, outer lateral tooth with about 20 prominent denticles, marginals with 6–8 prominent denticles on the inner edge (Fig. 7).

Female reproductive system: big, globular spermatheca consisting of about 10 spermatophors of 10 mm lenght, one end of the cigar-shaped spermatophor long and filiform extended (Fig. 8 b); receptaculum seminis darkblue coloured with very short duct, vaginal connecting duct slender, enters on the upper part of the ampoul-shaped distal part of the vagina, free end of the vagina S-shaped curved; ductus enigmaticus and crystal-sac typically (Fig. 8 a).

Biological-ecological remarks: *Clithon sowerbyana* was found – like all species of these genus – exclusively in the lower parts of running waters, at South-Andaman on the transition of fresh- and brackish water from the recurrent flow during high-tide. Sporadic the species was associated with *Clithon corona* and some brackish and marine species, such as *Nerita chamaeleon, Cerithidea cingulata* and *Planaxis sulcatus* in pure brackish habitats (S.-And.: No. 16). In the zones with

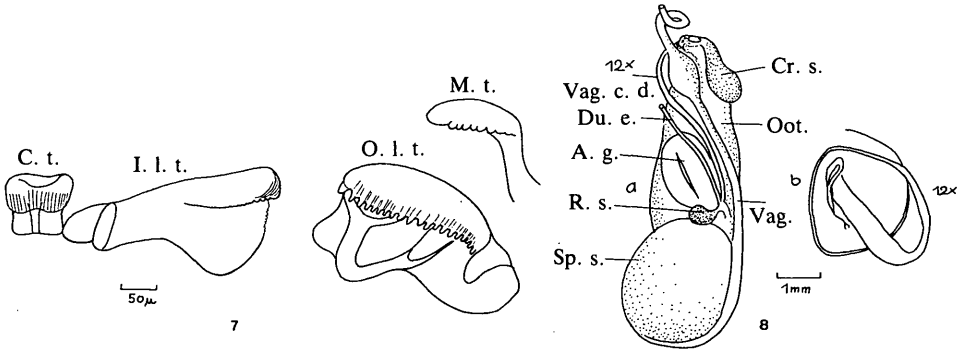


Fig. 7. *Clithon (Clithon) sowerbyana:* Radula
Fig. 8. *Clithon (Clithon) sowerbyana:* **a:** Female reproductive organs; **b:** spermathophor

pure freshwater or changing of fresh- and brackish water *Clithon sowerbyana* was associated also with *Neritina pulligera, Neritina* cf. *squamicta, Septaria porcellana, Neritilia rubida, Neritina (Neripteron) auriculata, Thiara scabra* f. *acanthica, Melanoides tuberculata, Melanoides (Stenomelania) plicaria* and *Melanoides (St.) torulosa.* The frequency was upstream of the recurrent flow 1–5 ind./1/16 m^2 and in the recurrent flow 2 ind./1/16 m^2, in a current of 30–50 cm/sec.

	Range of:				
				Brackish-area	
Temperature	Conductivity	pH	Total Hardness	(Na-ions)	(Cl-ions)
27.3°–30° C	233–401 µ Siemens (brackish: up to 9500 µ Siemens	7.4–7.6	3.6°–4° dH (brackish: up to 50° dH)	(1750 mg/l	3360 mg/l)

Geographical range: Andaman & Nicobars, Malay Peninsula and Archipelago, Thailand, Philippines, Taiwan, Japan, China.

5. *Neritina (Neripteron) auriculata* (LAMARCK, 1816)

Lit.: 1816 *Neritina auriculata* (LAMARCK, Enc. Méth. (Vers.) Explic.: Pl. 455, fig. 6) – 1822 *Neritina auriculata* (LAMARCK, An. s. vert., **6** (2): 186) – 1829 *Neritina alata* (BBRODERIP & SOWERBY, Zool. Jb. **4:** 371) – 1879 *Neritina auriculata* (MARTENS, in M. & CH., Conch. Cab. **2** (10): 30; Pl. 6, fig. 13–15, 24–27; *N. alata:* 254; *N. dilatata:* 29; Pl. 6, fig. 16–19; *N. tahitensis:* 33; Pl. 6, fig. 10–12) – 1888 *Neritina auriculata* (TRYON, Man. Conch. **10:** 73; Pl. 21, fig. 58–63) – 1937 *Neripteron auriculata auriculata* (RIECH, Arch. Naturgesch. (N. F.), **6:** 69; fig. 14; *N. auriculata alata:* 70) – 1956 *Neritina auriculata* (BENTHEM-JUTTING, Treubia, **23** (2): 297; fig. 22) – 1969 *Neritina auriculata* (STARMÜHLNER, Malacologia, **8** (1/2): 56; fig. 58–62) – 1970 *Neritina auriculata* s. str. and f. *lecontei* (STARMÜHLNER, Cah. ORSTOM, sér. Hydrobiol., **4** (3/4): 35; figs. 12–17) – 1974 *Neritina (Neripteron) auriculata* (STARMÜHLNER, Bull. Fish. Res. Stn., Sri Lanka, **25** (1/2): 108; figs. 5–8; Pl. 2, figs. 2–4) – 1976 *Neritina (Neripteron) auriculata* (STARMÜHLNER, Ann. Naturhist. Mus. Wien, **80:** 511; Pl. 9, figs. 64–65; Pl. 10, figs. 76–79, 82–85; text-figs. 17–19).

Localities: S.-And.: No. 13 (1 iuv.), No. 15 (14 iuv.), No. 16 (1 iuv.); N.-And-: No. 5 (some iuv. specimens).

Shell: Very varying in size and shape in adaption of the ground and many races and local-forms were described [RIECH (1937); BENTHEM-JUTTING (1956); STARMÜHLNER (1969); 1970; 1974; 1976)]. The specimens found by our mission at South- and North-Andaman in December 1976 were all not full grown: semi-globar with a flat base; 1–1½ whorls with growth-striae in semi-circles and -specially on iuvenile shells-with distinct spiral lines, which are developped as fine, elevated ridges of the brownish periostracum; aperture large, half-moon shaped, the broad peristome ends in two „wings" or „auricles" at the upper and lower columellar sides; margin of the columellar area a little arcuate in the middle an minutely toothed (Pl. 3, Fig. 6 a, b).

Sizes (in mm) Localities		Shell Height	Shell Diameter	Aperture Height	Aperture Diameter	Col. area
S.-And.:	No. 13 (iuv.)	5	–	–	–	–
	No. 15 (iuv.)	8.5	10.9	8.5	8.3	4.8
	No. 16 (iuv.)	4	–	–	–	–

The sizes are from the largest species in the samples.

Operculum: Semilunar with a sinous columellar side, nucleus right hand, exterior margin horny; peg conical with rounded top, ridge sickle-shaped, sharp and a acute free end.

Anatomical remarks: Descriptions of the anatomy of these species are to be found by BAKER (1923); STARMÜHLNER (1969; 1970; 1974 and 1976). From the not full grown specimens of the collections at the Andaman-islands no section of the soft body was made.

Biological-ecological remarks: Following STARMÜHLNER (1969; 1970; 1974 and 1976) these species is to be found only in the lower parts of running waters, mostly near or in the habitats covered with a mixture of fresh and brackish water of the recurrent flow during high-tide. At our stations in South- and North-Andaman the species was rarely found in juvenile, not full grown individues, attached below boulders and gravel in a current of 20–30 cm/sec. One young specimen was found in the brackish mouth-zone, together with *Clithon corona, Clithon sowerbyana* and the brackish and marine species *Nerita chamaeleon, Cerithidea cingulata* and *Planaxis sulcatus,* a habitat with a conductivity up to 9500μ Siemens (Na: 1750 mg/l, Cl: 3360 mg/l). The other specimens were collected upstream of the influence of brackish water from the recurrent flow:

Temperature	Conductivity	pH	Total Hardness
25.6°–30° C	113–401 μ S	6.7–7.6	2μ–4o dH

In these habitats *Neritina (Neripteron) auriculata* was associated with *Clithon corona, Clithon sowerbyana, Neritina pulligera, Neritina* cf. *squamipicta, Septaria pulligera, Neritilia rubida, Thiara scabra* f. *acanthica, Melanoides tuberculata, Melanoides (Stenomelania) plicaria.*

Geographical range: Indopacific coasts: Madagascar, Ceylon, Malay Archipelago, Philippines, Moluccas, Aru, New Guinea, Bismarck-Archipelago, Solomons, New Hebrides, New Caledonia, Fiji, Tahiti and other polynesian islands as far as Hawaii in the North-East.

6. *Neritina (Vittoida) variegata* (LESSON, 1831)

Lit.: 1831 *Neritina variegata* (LESSON, Voy. Coquille, Zool. **2:** 378) – 1879 *Neritina variegata* (MARTENS, in M. & CH., Conch. Cab. **2** (10): 98; Pl. 10, figs. 11–17) – 1888 *Neritina variegata* (TRYON, Man. Conch., **10:** 35; Pl. 10, figs. 82–86; Pl. 12, figs. 23, 24) – 1923 *Neritina (Vittoida) variegata* (BAKER,

Proc. Acad. Nat. Sc. Philadelphia, **75:** 146; Pl. 11, fig. 14) – 1937 *Vittina variegata* (RIECH, Arch. Naturgesch. (N. F.), **6:** 77) – 1956 *Neritina variegata* (BENTHEM-JUTTING, Treubia, **23** (2): 305; fig. 29) – 1970 *Neritina variegata* (STARMÜHLNER, Cah. ORSTOM, sér. Hydrobiol., **4** (3/4): 39; figs. 18–21) – 1974 *Neritina (Vittoida) variegata* (BRANDT, Arch. Moll. **105** (1/4): 15) – 1976 *Neritina (Vittoida) variegata* (STARMÜHLNER, Ann. Naturhist. Mus. Wien, **80:** 520; Pl. 9; figs. 74, 75; Pl. 21, fig. 6; text-figs. 24, 25).

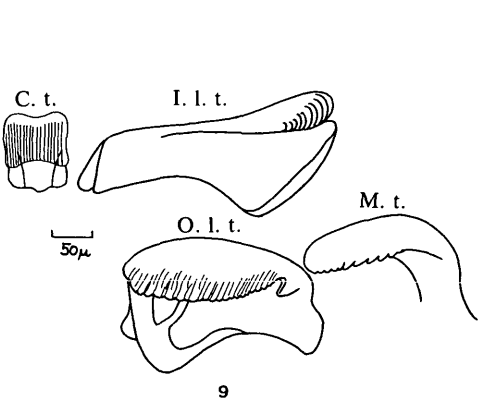
Localities: S.-And.: No. 4 (1 ind.), No. 7 (1 iuv.), No. 10 (4 ind.), No. 11 (1 ind.), No. 12 (5 iuv.), No. 14 (29, mostly iuv.).

Shell: Ovoidal-conic with small spire and large ultimate whorl; surface smooth (delicate spiral microsculpture); withish or brownish ground with black variegation on yellowish, brownish to oliv ground; columellar-area narrow and smooth, white and mostly with an typically orange patch on the base; margin serrate with 7–13 fine denticles (first and last somewhat larger) (Pl. 2, Fig. 5 a–f).

Sizes (in mm) Localities	Shell Height	Shell Diameter	Aperture Height	Aperture Diameter	Col. area
S.-And.: No. 4 (eroded)	16	14.5	12.5	8	4–5
No. 7 (iuv.)	7	–	–	–	–
No. 10 (eroded)	19.3	18.2	14.5	10	5–6
No. 11 (eroded)	23	22	15.5	11	6
No. 12 (iuv.)	6	–	–	–	–
No. 14 (eroded)	17.6	12.1	13.7	9.5	6

The sizes are from the largest specimens in the samples.

Operculum: External surface black with a whitish spot near the nucleus, sometimes with a lighter zone near the margin; short cutted peg not connected with the sickle-shaped ridge, which is spoon-shaped enlarged on the free end (12 mm × 7 mm).



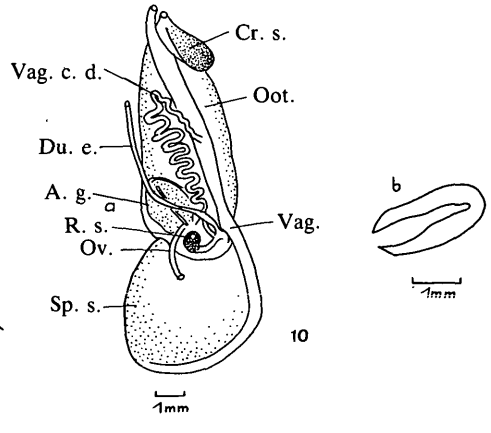


Fig. 9. *Neritina (Vittoidea) variegata:* Radula
Fig. 10. *Neritina (Vittoidea) variegata:* **a:** Female reproductive organs; **b:** spermathophor

Anatomical remarks: Corresponding with the anatomical findings of BAKER (1923: radula: 146; Pl. 11, fig. 14) and STARMÜHLNER (1976).

Radula: central-tooth slightly higher than broad, cutting edge concav incisived and on the lower third of the tooth; first lateral with straight cutting edge, slightly projected on the outer margin, outer lateral-tooth serrated, also the inner edge of the marginals (Fig. 9).

Female reproductive organs: Big globular spermatheca consisting of 4–5 spermatophors of 5 mm lenght, short-cigar-shaped and V-like buckled (Fig. 10 b); vaginal connecting duct very long, slender and looped, he extends to the upper part but enters petrograde in the middle part of the vagina; receptaculum seminis small and darkblue pigmented, crystal-sac typically (Fig. 10 a).

Biological-ecological remarks: *Neritina (V.) variegata* occurs in the lower parts of running waters, but always upstream of the influence of brackish water from the recurrent flow. The snails are attached on stones in an average current of 30–50 cm/sec and a density of about 1–2 ind./1/16 m²; mostly associated with *Neritina pulligera, Clithon corona, Clithon sowerbyana, Neritina* cf. *squamipicta, Septaria porcellana, Neritilia rubida, Thiara scabra, Melanoides tuberculata, Melanoides (St.) plicaria, Melanoides (St.) torulosa* and *Indoplanorbis exustus*. Small, juvenile specimens were found in paddings of algae.

	Range of:		
Temperatures	Conductivity	pH	Total Hardness
24.2°–27.6° C	74–324 µ Siemens	6.5–7.9	0.8°–10° dH

Geographical range: From the Andamans and Nicobars to the Malay Archipelago, Philippines, Moluccas, New Guinea, Bismarck Archipelago, Solomons, New Hebrides, New Caledonia, Fiji, Tahiti, Santa Cruz.

7. *Neritina (Neritina) pulligera* (LINNÉ, 1767)

Lit.: 1767 *Neritina pulligera* (LINNÉ, Syst. Nat., Ed. **12:** 1235) – 1879 *Neritina pulligera* (MARTENS, in M. & CH., Conch. Cab. **2** (10): 49; Pl. 1, figs. 4, 5; *N. iris:* 52; Pl. 9, figs. 5, 6; *N. knorri:* 55; Pl. 8, figs. 4, 6; *N. bruguieri:* 59; Pl. 9, figs. 11–13; *N. sanguinea:* 61) – 1888 *Neritina pulligera* (TRYON, Man. Conch., **10:** 56; Pl. 18, figs. 6–13; Pl. 19, figs. 14–19, 22, 24) – 1923 *Neritina (Neritina) pulligera* (BAKER, Proc. Acad. Sc. Philadelphia, **75:** 149; Pl. 12, fig. 17) – 1937 *Neritina pulligera* (ANDREWS, J. Morph., **61:** 525; Pl. 5, fig. 36) – 1937 *Neritina pulligera* (RIECH, Arch. Naturgesch. (N. F.), **6:** 73; fig. 18) – 1956 *Neritina pulligera* (BENTHEM-JUTTING, Treubia, **23** (2): 307; fig. 24) – 1956 *Neritina pulligera* (FRANC, Mém. Mus. Nat. Hist. Nat., sér. A. Zool., **13:** 25; Pl. 2, fig. 23) – 1969 *Neritina pulligera* (STARMÜHLNER, Malacologia, **8** (1/2): 69; figs. 73–84) – 1970 *Neritina pulligera* (STARMÜHLNER, Cah. ORSTOM, sér. Hydrobiol., **4** (3/4): 45; fig. 30) – 1974 *Neritina pulligera* (BRANDT, Arch. Moll., **105** (1/4): 14; Pl. 1, fig. 10) – 1976 *Neritina (Neritina) pulligera* (STARMÜHLNER, Ann. Naturhist. Mus. Wien, **80:** 531; Pl. 12, figs. 123–128; text-figs. 34, 35).

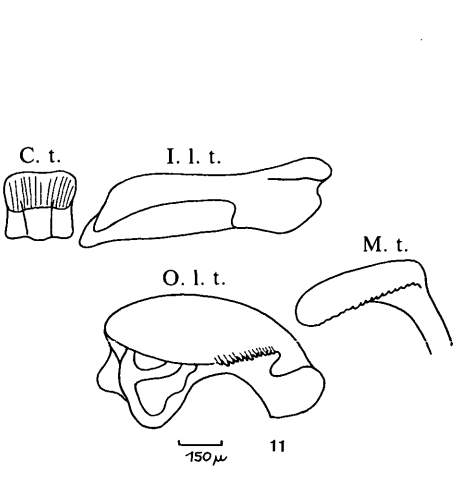
Localities: S.-And.: No. 1 (34 ind.), No. 2 (13 ind.), No. 4 (6 ind.), No. 7 (11 iuv.), No. 11 (4 ind.), No. 12 (2 ind.), No. 13 (4 iuv.), No. 15 (2 iuv.); N.-And.: No. 1 (5 ind.), No. 3 (25, mostly iuv.).

Shell: Subglobose, backside regularly rounded, apex depressed, completly or partly covered by the upper part of the last whorl; brownish with an irregular pattern of black ornamentation (mostly only to see on immature shells) adult shells regularly covered with a black layer of mineral deposit and sometimes with eggs of other femals of the same species or other Neritinae; very delicate spiral lines; aperture large with brown-red or orange columellar-area, parietal part of the aperture greyish to bluish; columellar margin with 12–19 small teeth; peristome somewhat thickened within, the upper insertion forming a pointed angle (Pl. 3, Fig. 7 a, b).

Sizes (in mm)		Shell		Aperture		
Localities		Height	Diameter	Height	Diameter	Col. area
S.-And.:	No. 1	21.4	28	21.4	14.5	9.5–10
	No. 2	11.7	14.7	10.2	8.5	5.5
	No. 4	17.5	22	16.5	12	8.7
	No. 7 (iuv.)	9	12	12	6	4
	No. 11	15.4	18.4	13.6	9	6.4
	No. 12	17.5	21.3	16	11.5	8
	No. 13 (iuv.)	–	3.5	–	–	–
	No. 15 (iuv.)	–	5	–	–	–
N.-And.:	No. 1	19.3	23.4	19.3	13.5	7
	No. 3	19	23	19	12.7	6.5

The sizes are from the largest specimens in the samples.

Operculum: Greyish and yellowish radiating rays, crossed by the growth lines, nucleus basal; peg orange-yellow, stumpy not connected with the sickle-shaped orange ridge.



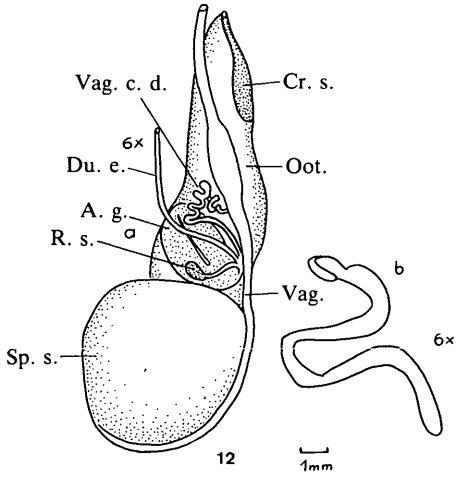


Fig. 11. *Neritina (Neritina) pulligera:* Radula
Fig. 12. *Neritina (Neritina) pulligera:* **a:** Female reproductive organs; **b:** spermathophor

Anatomical remarks: Radula figured and described by BAKER (1923: Pl. 12, fig. 17); RIECH (1937: fig. 18) and BRANDT (1974). With other anatomical detailes also described by STARMÜHLNER (1969 and 1976). The findings in the specimens of the Andamans correspond with these facts.

Radula: central-tooth nearly square-shaped, cutting-edge slightly concav in the middle of the tooth, first lateral small elongated with sort, straight cutting edge, outer lateral on the outside of the cutting-edge very fine denticulated, also the marginals (Fig. 11). Female reproductive organs: spermatheca big, globular, consisting of more than 30 spermatophors of about 10 mm lenght, spindle-shaped and looped; the vaginal connecting duct enters after some loops in the lower third of the vagina, which is slightly enlarged in the middle part; receptaculum seminis small and with short duct, ductus enigmaticus and crystal-sac typically (Fig. 12 a, b).

Biological and ecological remarks: From the Neritinae these species goes very high in the upper parts of the running waters: it was found from the head waters downstream till the zones upstream of the influence of brackishwater in the lower courses. The main occurence is in the upper and middle courses, mostly associated with *Septaria porcellana,* in the lower courses also with the other species of Neritinae. The frequency was changing from 1–2 individues/1/16 m^2 to 1 Ind./m^2 in the upper and middle courses, sporadic in the lower courses. The snails are attached on stones in a mean current of 30–50 cm/sec, sporadic-mostly juvenile-also near the banks.

	Range of:		
Temperature	Conductivity	pH	Total Hardness
24.6° – >30° C	59–401 µ Siemens	6–7.9	0.8°–10° dH

Most of the found shells were covered with eggs of Neritinae.

Geographical range: Coasts of the Indopacific: From SE-Africa, Madagascar and E-African Islands to the Andamans and Nicobars in the Indian Ocean, from the Malay Archipelago, Philippines, Moluccas, Aru and New Guinea eastwards to the Pacific Islands, such as Bismarck Archipelago, Solomons, New Hebrides, New Caledonia, Fiji, Carolines and E-Australia. Many local forms and races!

8. *Neritina (Neritina)* cf. *squamipicta* (RÉCLUZ, 1843)

Lit: 1843 *Neritina squamipicta* (RÉCLUZ, Proc. zool. Soc. London, **1843:** 169) – 1879 *Neritina squamipicta* (MARTENS, in M. & CH., Conch. Conch. Cab., **2** (10): 62; Pl. 5, figs. 9–11) – 1888 *Neritina squamipicta* (TRYON, Man. Conch., **10:** 58; Pl. 19, figs. 20, 21, 25–27) – 1956 *Neritina squamipicta* (FRANC, Bull. Mus. Nat. Hist. Nat. Paris, **13,** sér. A. Zool.: 25; Pl. 2, fig. 24) – 1976 *Neritina (Neritina) squamipicta* (STARMÜHLNER, Ann. Naturhist. Mus. Wien, **80:** 534; Pl. 11, figs. 111, 112; text-fig. 36).

Localities: S.-And.: No. 12 (64 iuv.), No. 13 (1 iuv.), No. 14 (11 iuv.); N.-And.: No. 5 (1 iuv.); No. 6 (2 iuv.).

Shell: Only one shell was nearly mature, all other found shells juvenile; the recorded shells are nearly identically with the description and figures of *N. squamipicta* (RÉCLUZ, 1843), but the determination of not full grown specimens is only tentitatively. Semiglobar, spire and apex entirely concleaded by the last whorl, forming a false apex, the aperture-margin can even form a small elevated fold; surface only sculptured by fine growth lines; olive-brown, with fine reticulations and smoky spiral bands, specially to recognize on immature shells; aperture broad semilunar, white or greyish to yellowish, columellar area slightly sinous on the middle part of the edge, with 12–18 minute serrations (Pl. 3, Fig. 8 a, b).

Sizes (in mm) Localities	Shell Height	Shell Diameter	Aperture Height	Aperture Diameter	Aperture Col. area
S.-And.: No. 12 (iuv.)	5	–	–	–	–
No. 13 (iuv.)	12.2	13	10.5	6.5–7	3–4
No. 14 (iuv.)	9.1	10.4	9	5	2.5
N.-And.: No. 5 (iuv.)	8.5	8.9	7.6	4.5	2.5–2.8
No. 6 (iuv.)	4.6	5.2 –	–	–	

The sizes are from the largest specimens in the samples.

Operculum: Semilunar, nucleus left hand base; light flesh-colour, with a dark margin; peg conical with rounded top, sharp sickle-shaped ridge, which is longitudinally grooved.

Anatomical remarks: All found specimens were not full grown and the genital system immature.

Radula: corresponds with description and figure of STARMÜHLNER (1976: 535: f. 36): central-tooth more broad as high, upper margin concave, on the edges extended, cutting edge in the middle, slightly concave, first lateral elongated with slightly serrated, straight cutting edge, outer lateral with prominent 8–10 denticles, also the marginals (Fig. 13).

Biological-ecological remarks: Like indicated above, only immature specimens were collected in December 1976. They were found only in the lower parts of the running waters, mostly upstream of the influence of brackish water of

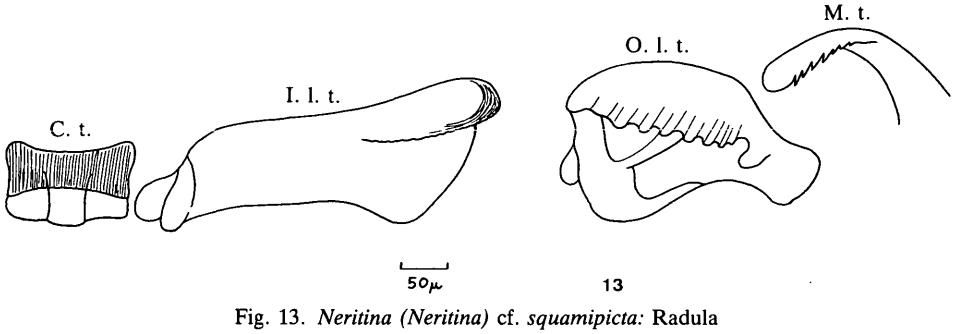


Fig. 13. *Neritina (Neritina)* cf. *squamipicta:* Radula

the recurrent flow and associated with other species of Neritinae. The snails are attached – sporadic – on stones in a current between 30 and 50 cm/sec.

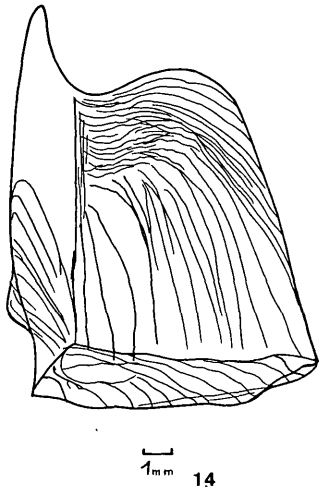
	Range of:		
Temperature	Conductivity	pH	Total Hardness
25.1°–27.6° C	113–324 µ Siemens	6.7–7.8	2°–10° dH

Geographical range: Java, Madura (BENTHEM-JUTTING, 1956), Philippines, Guam? (MARTENS, 1879), New Caledonia (FRANC, 1956), New Britain, New Hebrides (cf. *squamipicta:* STARMÜHLNER 1976).

9. *Septaria porcellana* (LINNÉ, 1758)

Lit.: 1758 Patella porcellana (LINNÉ, Syst. Nat., Ed. **10:** 781) – 1825 *Navicella suborbicularis* (SOWERBY, Cat. TANKERVILLE, Coll. App.: 10) – 1831 *Navicella suborbicularis* (MARTENS, in M. & CH., Conch. Cab., **2** (10 a): 31; Pl. 6, figs. 5–14, including var. *furcato-radiata*) – 1888 *Navicella suborbicularis* (TRYON, Man. Conch., **10:** 81; Pl. 19, fig. 44) – 1923 *Septaria porcellana* (BAKER, Proc. Acad. Nat. Sc. Philadelphia, **75:** 152) – 1937 *Septaria (borbonica) depressa* and *suborbicularis* (RIECH, Arch. Naturgesch. (N. F.), **6:** 65, 66) – 1956 *Septaria porcellana* (BENTHEM-JUTTING, Treubia, **23** (2): 315; fig. 31) – 1970 *Septaria borbonica depressa* (STARMÜHLNER, Cah. ORSTOM, sér. Hydrobiol., **4** (3/4): 45; figs. 26 a–g, 27–29) – 1976 *Septaria porcellana* f. *depressa* (STARMÜHLNER, Ann. Naturhist. Mus. Wien, **80:** 537; Pl. 13, figs. 131–137; Pl. 14, figs. 150–154; text-figs. 38–41).

Localities: S.-And.: No. 4 (3 ind.), No. 11 (1 iuv.), No. 12 (30 + many iuv.), No. 13 (13 iuv.), No. 14 (5, mostly iuv.).



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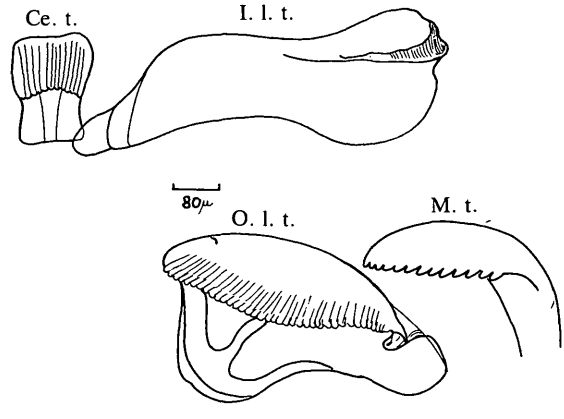

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Fig. 14. *Septaria porcellana:* Operculum
Fig. 15. *Septaria porcellana:* Radula

Shell: Symmetrical, cap-shaped, apex posterior, slightly curved to right, apex lies just above the posterior margin and is often eroded, but not by wear against the supporting surface; yellowish brown to yellowish-green, apical region sometimes reddish-violet, ornamented with a network of dark threads, making a pattern of small triangular, oval or drop-shaped spots, sometimes with radiating dark striae; aperture very large, septum of the columellar side flat, narrow and mostly yellow-reddish, margin straight or slightly concave (Pl. 3, Fig. 9 a, b).

Sizes (in mm) Localities		Shell Lenght	Width	Height	Col. area	Index L: B	L: H
S.-And.:	No. 4	23.5	20	18.3	3.2	–	–
	No. 11 (iuv.)	13	11	4.3	–	–	–
	No. 12	28	21.5	10.7	3.7	77%	38%
		23.6	18	8.3	4	76%	35%
		24.6	19.3	9	4.3	78%	36%
		23.3	18.2	9	4	78%	38%

Cont. Localities		Lenght	Width	Height	Col. aera
S.-And.:	No. 13 (iuv.)	10	8	3	1.5
	No. 14 (iuv)	17	13.9	5.5	2.9

The sizes are from the largest specimens in the samples.

Operculum: Irregularly squarrish with the nucleus on the side, surface shining, interior dull, back part straight with horny margin, slender lateral, prominent rib and very short flat and rounded diagonal-projecting (Fig. 14).

Anatomical remarks: Detailled studies on the anatomy of the genus were made by BOUVIER (1886, 1887, 1892); BOURNE (1908); ANDREWS (1937); STARMÜHLNER (1969, 1970 and 1976).

Radula: TROSCHEL (1856/63); STARMÜHLNER (1970, 1976); the specimens from the Andamans nearly identically: central-tooth higher than broad, superior margin slightly convex curved, cutting edge in the middle part, concav incisived and slightly serrated; inner lateral-tooth elongated, cutting edge relatively short projected to the outside, outer lateral-tooth on the cutting edge with numerous fine denticles (serrated), the marginals with prominent 12–13 denticles (Fig. 15). The female genital-organs shows a relatively big kidney-shaped red darkblue pigmented receptaculum seminis, the spermatheca was not so clearly putted down from the vaginal duct like it is was found by specimens from Fiji and Tahiti by STARMÜHLNER, 1976 (figs. 39, 41). No spermatophors were found.

Biological-ecological remarks: The majority of the found specimens in December were immature. The frequency of young specimens was counted between 1 and 5 individues/1/16 m^2, adult specimens occurs in a density of about 1 ind./m^2, always in the strong current of 1 m/sec and more, attached on the surface of rocks, boulders and gravel. The species occurs from the middle courses to the

lower parts of running waters, but always in freshwater, upstream of the influnence of brackish water of the recurrent flow. They are associated mainly with other species of Neritinae, such as *Neritina pulligera* in the upper parts and also with *Neritina (V.) variegata* and *Clithon*-species in the lower courses.

Temperature	Range of: Conductivity	pH	Total Hardness
25°–27.6° C	74–324 µ Siemens	6.5–7.5	0.8°–10° dH

Geographical range: Widely distributed in the coastal areas of the Eastern Indian Ocean and the Pacific: Ceylon, Malay Archipelago, Philippines, Moluccas, New Guinea, Bismarck Archipelago, New Hebrides, New Caledonia, Fiji, Samoa, Tahiti, Carolines and Marianes.

Subfamilia: Neritiliinae

10. *Neritilia rubida* (PEASE, 1865)

Lit.: 1865 *Neritina rubida* (PEASE, Proc. zool. Soc. London, **1865:** 514) – 1867 *Neritina rubida* (PEASE, Amer. J. Conch., **3:** 285; Pl. 24, fig. 5) – 1869 *Neritina rubida* (MOUSSON, J. de Conch., **17:** 380) – 1879 *Neritina (Neritilia) rubida* (MARTENS, in M. & CH., Conch. Cab., **2** (10): 244; Pl. 23, fig. 19, 20) – 1888 *Neritilia rubida* (TRYON, Man. Conch., **10:** 54; Pl. 17, fig. 84; Pl. 18, fig. 85) – 1923 *Neritilia rubida* (BAKER, Proc. Acad. Nat. Sc. Philadelphia, **75:** 169; Pl. 16, fig. 42) – 1974 *Neritilia rubida* (BRANDT, Arch. Moll., **105** (1/4): 17; Pl. 1, fig. 13) – 1976 *Neritilia rubida* (STARMÜHLNER, Ann. Naturhist. Mus. Wien, **80:** 548; Pl. 14, figs. 158, 159; textfigs. 47, 48).

Localities: S.-And.: No. 10 (1 ind.), No. 13 (1 iuv.), No. 14 (1 ind.), No. 15 (1 iuv.).

Shell: Small, obliquely subglobose, 3 almost flat whorls increasing rapidly in size; aperture semicircular and large, columellar area narrow, glossy and greyish with smooth edge (Pl. 3, Fig. 10 a, b).

Sizes (in mm) Localities		Diameter	Height
S.-And.:	No. 10	4	3
	No 13 (iuv.)	2.6	1.9
	No. 14	4	3
	No. 15 (iuv.)	1.9	1

The sizes are from the largest specimens in the samples.

Operculum: Thin, reddish, from the inner surface a rather long curved process, not divided into peg and ridge and with the free end projecting from the margin of the operculum (Fig. 16).

Anatomical remarks: The descriptions and figures of the radula given by BAKER (1923) and STARMÜHLNER (1976) correspond with the facts, found by specimens from the Andamans: without central-tooth, inner lateral tooth without

cutting edge but U-shaped incision, outer lateral tooth with 13–15 acute denticles on the cutting edge, marginals with 5–6 long, acute denticles (Fig. 17). The femal genital organs were described by ANDREWS (1937) (a reproduction of the figure was given by HYMAN, 1967: fig. 133 A) and correspond with the figure given by STARMÜHLNER (1976: fig. 48). The animals of our samples show no differences.

Biological-anatomical remarks: A typical form of the lower courses, near the influence of brackish water from the recurrent flow. The small snails are attached in small gapes of boulders, sometimes near the water surface. In our samples *Neritilia rubida* was sporadic.

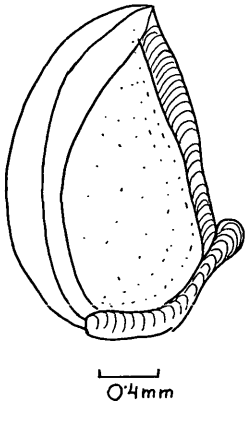
	Range of:		
Temperature	Conductivity	pH	Total Hardness
24.2° – >30° C	74–401 µ Siemens	6.7–7.6	1°–10° dH

Geographical range: Andamans (first record), Java, Celebes, Thailand, New Guinea, New Hebrides, Fiji, Samoa, Tahiti.

Ordo: Mesogastropoda
Superfamilia: Cerithiacea
Familia: Thiaridae
Subfamilia: Thiarinae

11. *Thiara scabra* (O. F. MÜLLER, 1774)

Lit.: 1774 *Buccinum scabrum* (O. F. MÜLLER, Hist. Verm. **2:** 136) – 1791 *Helix aspera* (GMELIN, Syst. Nat., **13:** 3656) – 1822 *Melania spinulosa* (LAMARCK, Hist. nat. Anim. s. Vert., **6** (2): 166) – 1831 *Melania doreyana* (LESSON, Voy Coquille, **2** (1): 358) – 1831 *Melania spinescens* (LESSON: ibid. 363) – 1842 *Melanium granum* (v. d. BUSCH, in PHILIPPI, Abb. & Beschr., **1:** 4; Pl. 1, fig. 7) – 1844 *Melania pugilis* (HINDS, Ann. Mag. Nat. Hist., **14:** 10 and Sulphur, **1844:** 58) – 1847 *Melania scabrella* (PHILIPPI,



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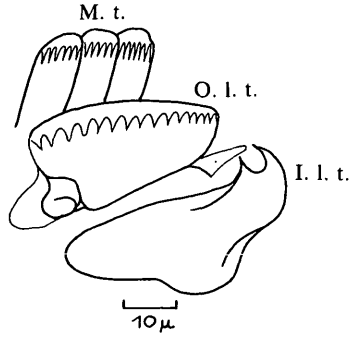

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Fig. 16. *Neritilia rubida:* Operculum
Fig. 17. *Neritilia rubida:* Radula

Abb. & Beschr., **1:** 4; Pl. 4, 13) – 1850 *Melania acanthica* (LEA, Proc. zool. Soc. London, **1850:** 194) – 1850 *Melania cochlea* (LEA, ibid.: 196) – 1850 *Melania denticulata* (LEA, ibid.: 194) – 1850 *Melania pagoda* (LEA, ibid.: 197) – 1858 *Melania datura* (DOHRN, Proc. zool. Soc. London, **1858:** 135) – 1859 *Melania elegans* (REEVE, Coch. Icon. **12:** Pl. 26, fig. 178; *M. pugilis:* Pl. 26, fig. 180; *M. scabra:* Pl. 26, fig. 183; *M. pagoda:* Pl. 26, fig. 182; *M. granum:* Pl. 33, fig. 219) – 1860 *Melania rugosa* (BROT, Rev. Mag. Zool. **1860: 257;** *M. myurus:* 257; Pl. 16, fig. 3) – 1874 *Melania scabra* (BROT, in M. & CH. Conch. Cab. **1** (24): 266; Pl. 27, fig. 14, 15; *M. granum:* 270; Pl. 27, fig. 12, *M. myurus:* 271; Pl. 28, fig. 1; *M. acanthica:* 278; Pl. 28, fig. 10) – 1880 *Melania snellemanni* (SCHEPMAN, Midd. Sumatra Exp.: 15; Pl. 1, fig. 5; Pl. 3, fig. 9) – 1881 *Melania bockii* (BROT, J. de Conch., **29:** 157; Pl. 6, fig. 3) – 1884 *Melania savinieri* (MORELELT, ibid., **32:** 330; Pl. 7, fig. 2) – 1890 *Melania subcancellata* (BOETTGER, Ber. senckenberg, naturf. Ges., **1890:** 151; Pl. 6, fig. 4) – **1897** *Melania pinguicola* (MARTENS, in WEBER, Erg. zool. Reise Niederl. Ostind., **4:** 74; Pl. 4, figs. 17–20; *M. scabra* with var. *spinulosa, nodosocostata, angulifera, mutica:* 62; Pl. 4, figs. 6–12; Pl. 9, figs. 8, 9; *M. granum:* 65; *M. savinieri:* 315) – 1904 *Melania varia* (BULLEN, Proc. malac. Soc. London, **6:** 110) – 1914 *Melania intrepida* (FULTON, Proc. malac. Soc. London, **11:** 163) – 1928 *Melania sykesi* (DEGNER, Treubia, **10:** 377) – 1931 *Melania (Plotia) scabra* (THIELE, Handb. d. Weichtierkde.: 200) – 1934 *Melania zollingeri* (RENSCH, Trop. Binnengew., **5;** 233 – non *zollingeri* BROT, 1868; *M. scabra:* 234) – 1937 *Melania scabra* (RIECH, Arch. Naturgesch. (N. F.), **6:** 42; figs. 1–5) – 1938 *Thiara (Plotia) scabra* (WENZ, Handb. Paläozool., Gastr., **1:** 713; fig. 2058) – 1938 *Thiara (Plotiopsis) scabra* (Bull. Mus. comp. Zoöl., Havard Coll., **100** (3): 291; Pl. 3, fig. 12) – 1956 *Thiara scabra* (BENTHEM-JUTTING, Treubia, **23** (2): 393; figs. 72, 88) – 1963 *Thiara scabra scabra* (BENTHEM-JUTTING, Nova Guinea, Zool., **20:** 466) *Th. scabra acanthica:* 467) – 1974 *Thiara scabra* (BRANDT, Arch. Moll., **105** (1/4): 163; Pl. 12, fig. 8) – 1974 *Thiara (Plotia) scabra* (STARMÜHLNER, Bull. Fish. Res. Stn. Sri Lanka, **25** (1/2): 156; Pl. 15, fig. 146; textfigs. 147–149) – 1976 *Thiara scabra* (STARMÜHLNER, Ann. Naturhist. Mus. Wien, **80:** 565; Pl. 15, figs. 170–172; textfigs. 70, 71).

Localities: S.-And.: No. 1 (4, partly iuv.), No. 2 (102, mostly iuv.), No. 6 (5, partly iuv.), No. 7 (34, mostly iuv.), No. 8 (1 ind.), No. 9 (4, partly iuv.), No. 13 (40, mostly iuv.), No. 14 (5, partly iuv.), No. 15 (2 ind.); N.-And.: No. 6 (2 ind.).

Shell: Extremly varying in size and form: elevated conical with a high spire of 8–12 whorls, regularly increasing in size, descending step-like, distinct suture; surface roughly striated in spiral direction below the suture, especially in the region of the umbilicus, sometimes the spiral striae form stronger ridges; spiral striation crossed by ribs in vertical direction; at about one third of the distance between the suture and the periphery of the whorls the axial ribs form, more or less, knobs or spines (f. *acanthica*), pointing obliquely outward; blunt knobs are developped mostly in populations of running waters in the upper courses, sharp prickly needles (f. *acanthica*) are to find by young specimens and typically for specimens from regions with influence of brackish water or in stagnant waters; apex often eroded; yellowish-brown to olive-brown with irregular reddish-brown spots and flames, often 2–3 spiral bands, coloration by older specimens often coated by a black layer; aperture almost vertical, oval, exterior margin sinuous, projecting forward, basal margin somewhat channeled (Pl. 4, Fig. 11 a–d).

Sizes (in mm) Localities	Shell Height	Shell Diameter	Aperture Height	Aperture Diameter	Spines
S.-And.: No. 1 (eroded)	9	4.4	4.6	2.5	knobs
No. 2 (eroded)	10.8	5.2	4.5	3	knobs
No. 6	12	5.7	5.8	3.5	knobs
No. 7 (eroded)	11.4	5.3	5	3	0.1–0.2
No. 8	12	6	5.9	3.7	0.05–0.1
No. 9	15.6	7.3	7.4	4.4	knobs
No. 13 (eroded)	15.3	7.7	7	4.2	1.4
No. 14	16.1	8	6.9	5	1.2
No. 15	14	7	6.5	4	0.5
N.-And.: No. 6 (eroded)	9	5	4	3.1	0.05–0.1

The sizes are from the largest specimens in the samples.

Operculum: Figured by STARMÜHLNER, 1974 (fig. 147) and 1976 (fig. 70): horny; oval, dark-brown; nucleus excentrical, at the left lower corner, growth lines are fanning out to to the tip and the side.

Anatomical remarks: Descriptions are to find by RIECH (1937); ABBOT (1948); BRANDT (1974); STARMÜHLNER (1974 and 1976). No differences in the specimens from the stations from the Andamans, were found.

Biological-ecological remarks: These variable species was recorded in stagnant and slowly flowing waters. In rivers always near the banks and in pools between with cascades, where the surface-current was between 0 to 30 cm/sec. Young specimens are mostly between paddings of filamentous algae or – like in S.-And.: No. 2) – in freshwater sponges. *Thiara scabra* was mostly associated with *Melanoides tuberculata* and *Indoplanorbis exustus.* In lower courses with *Melanoides (Stenomelania) plicaria* and *torulosa,* but also with Neritidae. It was to observe, like indicated by RIECH (1937); STARMÜHLNER (1974; 1976), that specimens from populations in stagnant waters or in slowly flowing waters with influence of brackish water from the recurrent flow have long spines (f. *acanthica*). Specimens from rivers in the upper and middle courses with pure freshwater and a current of 10–30 cm/sec posses mostly only knobs.

Temperature	Range of: Conductivity	pH	Total Hardness
24.6° – >30° C	59–401 µ Siemens	6–7.8	1°–11° dH

Geographical range: On the coasts of the Indopacific: East-Africa, Madagascar, East-African Islands, coasts of India, Ceylon, South- and Southheast-Asia, Malay Archipelago, Philippines, Moluccas, South-China, New Guinea, Bismarck Archipelago, Solomons, New Hebrides, New Caledonia, East-Australia, Fiji, Samoa.

12. *Thiara setigera* (BROT, 1870)

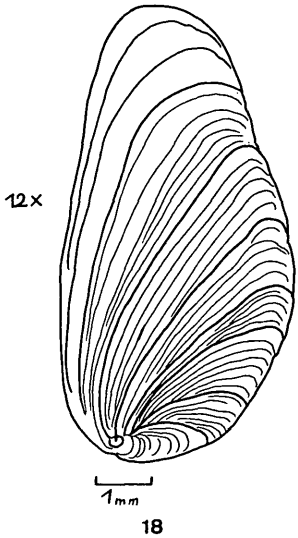
Lit.: 1859 *Melania setosa* pars (REEVE, Conch. Icon., **12:** Pl. 27, fig. 185) – 1870 *Melania setigera* (BROT, Amer. J. Conch., **6:** 300) – 1874 *Melania setigera* (BROT, in M. & CH., Conch. Cab., **1** (24): 298; Pl. 30, fig. 7) – 1897 *Melania setifera* sic! (MARTENS, in WEBER, Erg. Reise Nied. Ost Indien, **4:** 67) – 1899 *Melania setigera* (HORST & SCHEPMAN, Cat. Syst. Moll. Mus. Hist. Nat. Pays-Bas, **13** (2): 262) – 1905 *Melania setigera* (MARTIN, Samml. Geol. Reichsmus. Leiden (N. F.) **1:** 234 and 240; Pl. 36, fig. 574) – 1907 *Melania setigera* (MARTIN, N. Jahrb. Mineral. **100** (II): 161) – 1914 *Melania setifera* sic! (LESCHKE, Mitt. naturhist. Mus. Hamburg, **31:** 256) – 1919 *Melania setigera* (MARTIN, Samml. Geol. Reichmus. Leiden, Beilage Band: 96) – 1929 *Melania setigera* (BENTHEM-JUTTING, Treubia, **11:** 85) – 1931 *Melania setigera* (VAN DER VLERK, Leidsche Geol. Meded. **5:** 255) – 1956 *Thiara setigera* (BENTHEM-JUTTING, Treubia, **23** (2): 398; fig. 85).

Localities: N.-And.: No. 3 (2 ind.).

Shell: Low-conical, almost globular; 3 evenly descendig whorls, apex mostly eroded; the last one large and spacious, sculptured by a crown of spines at a short distances from the suture, the spiral ridges about equally strong above and below the spines, in the subsutral areal cut into nodules, along the suture each whorl is standing up like a collar, shelly part of spines short, but the bristles long; oliv-green to oliv-brown, but full grown specimens almost covered with a black mineral layer; aperture a little oblique and broad-oval, the exterior margin finely crenulated by the ribs of the sculpture (Pl. 4, Fig. 12).

Sizes (in mm) Locality	Shell Height	Aperture Diameter	Height	Diameter	Spines
N.-And.: No. 3 (eroded)	21.3	15	15	10	4
	15	10	10	6	3.5

The sizes are from the two recolted specimens in the sample.



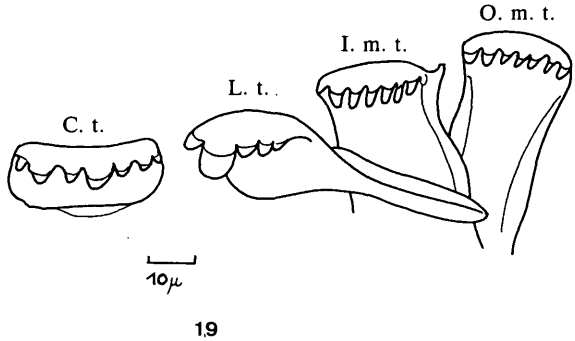


Fig. 18. *Thiara setigera:* Operculum
Fig. 19. *Thiara setigera:* Radula

Operculum: Horny, oval with darkbrown colour; nucleus basal-excentrical, the growth lines are fanning to the tip and the side, sometimes step-like liftet off (10 mm × 6 mm: Fig. 18).

Anatomical remarks: From the two found specimens only one were dissected: it was a male and the reproductive organs show no differences to the descriptions and figures of the male reproductive system of *Thiara amarula* and *Thiara bellicosa* described by STARMÜHLNER (1976: figs. 65 and 69).

Radula: Central-tooth broad-trapezoid with 3+1+3 strong denticles, lateral-tooth with 1+1+3 dentlices, spoon-shaped, inner marginals with 7–8, outer marginals with 7 acute denticles (Fig. 19).

Biological-ecological remarks: *Thiara setigera* was found sporadic only at one station in North-Andaman (No. 3 – middle course of the River Kalimpong) near the border on sandy-muddy bottom with layers of vegetable debris, in a surface-current of 10–30 cm/sec.

The ecological dates from these habitat:

Temperature	Conductivity	pH	Total Hardness
26.7° C	265–293 µ Siemens	6.9–7	9° dH

At station No. 3 the species was associated with *Neritina pulligera, Melanoides (St.) torulosa, Tarebia granifera* and *Indoplanorbis exustus.*

Geographical range: Andamans (first record!), Sumatra, Java, Bali, Philippines.

13. *Melanoides (Melanoides) tuberculata* (O. F. MÜLLER, 1774)

Lit.: 1774 *Nerita tuberculata* (O. F. MÜLLER, Hist. Verm., **2:** 191) – 1779 *Strombus costatus* (SCHROETER, Flußconch.: 373; Pl. 8, fig. 14) – 1804 *Melanoides fasciolata* (OLIVIER, Voy. Emp. Ottom., **6:** Pl. 31, fig. 7) – 1822 *Melania truncatula* (LAMARCK, Hist. Anim. s. Vert., **6** (2): 167) – 1831 *Melania terebra* (LESSON, VOY. Coquille, **2:** 354) – 1834 *Melania virgula* (QUOY & GAIMARD, Voy Astrolabe, Zool. **3:** 141; Pl. 56, fig. 1–4) – 1836 *Melania pyramis* (BENSON, J. asiat. Soc. Bengal, **5:** 354) – 1837 *Melania adspersa* (TROSCHEL, Arch. Naturgesch., **1837:** 157) – 1838 *Melania punctata* (POTIEZ & MICHAUD, Gal. Moll. Mus. DOUET, **1:** 262; Pl. 27, fig. 15, 16) – 1841 *Melania rothiana* (MOUSSON, Coqu. terr. fluv. Palestine: 61) – 1847 *Melania suturalis* (PHILIPPI, Abb. Beschr., **2:** 173; Pl. 4, fig. 6; – *M. rivularis:* 174; Pl. 4, fig. 17) – 1848 *Melania unifasciata* (MOUSSON, Mitth. naturf. Ges. Zürich, **1:** 269) – 1849 *Melania coarctata* (MOUSSON, Land- u. Süßw. Moll. Java: 67; *M. unifasciata:* 70; Pl. 11, fig. 8; *M. inhonesta:* 71; *M. cylindracea:* 72; Pl. 11, fig. 9; *M. tuberculata,* incl. f. *virgulata,* f. *plicifera:* 73; Pl. 11, figs. 6, 7) – 1850 *Melania juncea* (LEA, Proc. zool. Soc. London, **1850:** 189; *M. turriculus:* 190) – 1850 *Melania tigrina* (HUTTON, J. asiat. Soc. Bengal, **19:** 658) – 1852 *Melania fasciolata* (RAYMOND, J. de Conch., **3:** 325) – 1853 *Melania fasciolata* (RAYMOND, ibid., **4:** 33) – 1855 *Melania judaica* (MOUSSON, Malak. Bl., **2:** 53; Pl. 2, fig. 1–3) – 1858 *Melania layardi* (DOHRN, Proc. zool. Soc. London, **1858:** 135) – 1859 *Melania coarctata* (REEVE, Conch. Icon., **12:** Pl. 5, fig. 22; *M. exusta:* Pl. 12, fig. 74; *M. tuberculata:* Pl. 13, fig. 87; Pl. 16, fig. 110; *M. punctulata:* Pl. 15, fig. 100; *M. crepidinata:* Pl. 17, fig. 120; *M. ornata:* Pl. 21, fig. 146; *M. inhonesta:* Pl. 33, fig. 226; *M. commersoni:* Pl. 35, fig. 237) – 1860 *Melania obscura* (BROT, Rev. Mag. Zool. *1860:* 8; Pl. 17, fig. 9; *M. beryllina:* 8; Pl. 17, fig. 8) – 1864 *Melania matheroni* (GASSIES, Faune Conch. Nouv. Caléd., **1:** 96; Pl. 4, fig. 5; *M. lancea:* 97; *M. mageni:* 95; Pl. 6, fig. 10; *M. canalis:* 98; Pl. 6, fig. 2; *M. montrouzieri:* Pl. 5, fig. 10) – 1864

Melania psorica (MORELET, J. de Conch., **12:** 287) – 1865 *Melania rubropunctata* (TRISTRAM, Proc. zool. Soc. London, **33:** 541) – 1870 *Melania javanica* (BROT, Amer. J. Conch., **6:** No. 200) – 1871 *Melania mariei* (GASSIES, Faune Conch. Nouv. Caléd., **2:** 159; Pl. 6, fig. 15) – 1874 *Melania ornata* (BROT, in M. & CH., Conch. Cab., **1** (24): Pl. 21, fig. 23; *M. distinguenda:* 190; Pl. 21, fig. 8; *M. inhonesta:* 206; Pl. 23, fig. 8; *M. matheroni:* 211; Pl. 23, figs. 6, 6 a; *M. denisoniensis:* 234; Pl. 25, figs. 6 a, 6 b,; *M. crepidinata:* 238; Pl. 25, fig. 13; *M. commersoni:* 244; Pl. 26, figs. 1, 1 a, 6; *M. javanica:* 246; Pl. 26, fig. 7; *M. tuberculata:* 247; Pl. 26, fig. 11: *M. cylindracea:* 252; Pl. 27, fig. 7; *M. malayana:* 253; Pl. 26, fig, 5; *M. pareyssi:* 254; Pl. 27, fig. 5; *M. unifasciata:* 262; Pl. 27, fig. 7; *M. psorica:* 316; Pl. 33, figs. 4, 4 a) – 1877 *Melania singularis* (TAPPARONE CANEFRI, Ann. Mus. Civ. Stor. Nat. Genova, **9:** 30; Pl. 1, fig. 18) – 1880 *Melania wilkinsoni* and *M. scalariformis* (TENISON WOODS, Proc. Linn. Soc. N. S. Wales, **4:** 25; Pl. 4, fig. 4) – 1883 *Melania pellicens* (TAPPARONE CANEFRI, Ann. Mus. Civ. Stor. Nat. Genova, **19:** 30; Pl. 1, fig. 18; *M. dominula:* 31; Pl. 1, fig. 16; *M. petiti:* 37 (-non PHILIPPI); *M. nicobarica:* 38) – 1915 *Tiara (Striatella) tuberculata* (PRESTON, Fauna Brit. India., Moll. (Freshw. Gastr. & Pelec.): 15, with var. *subcrebra, layardi, tigrina, orissaensis, luteomarginata, myadoungensis,* subvar. *subplicifera; T. nevilli,* var. *andamanica,* subvar. *semilaevigata, appressa; T. nicobarica,* var. *fusiformis,* var. *perstriatula,* subvar. *canaliculata, gigantea:* 18–19; *T. rivularis,* var. *subunifascialis:* 20; *T. pyramis:* 20) – 1919 *Melania woodwardi* (MARTIN, Samml. Geol. Reichsmus. Leiden, Beilage-Band: 96) – 1934 a *Melania tuberculata truncatula* (RENSCH, Zool. Jb. (Syst.) **65:** 400; figs. 2 a–e) – 1934 b *Melania tuberculata truncatula* (RENSCH, Trop. Binnengew., **5:** 228) – 1931 *Melania (Melanoides) tuberculata* (THIELE, Handb. syst. Weichtierkde.: 200) – 1937 *Melania tuberculata truncatula* (RIECH, Arch. Naturgesch. (N. F.), **6:** 55) – 1938 *Melanoides (Melanoides) tuberculata* (WENZ, Handb. Paläoz., Gastr., **1:** 715; fig. 2065) – 1948 *Thiara (Melanoides) tuberculata* (ABBOTT, Bull. Mus. comp. Zoöl., Havard Coll. **100** (3): 289; Pl. 3, fig. 13) – 1950 *Melanoides ningpoensis* (SUVATTI, Fauna Thailand: 61) – 1956 *Melanoides tuberculata* (BENTHEM-JUTTING, Treubia, **23** (2): 412; figs. 69, 73, 91) – 1956 *Melania tuberculata truncatula* (FRANC, Mém. Mus. Nat. Hist. Nat., sér. A. Zool., **13:** 56; Pl. 6, fig. 7) – 1957 *Melanoides tuberculata* (STARMÜHLNER & EDLAUER, S. B. Öst. Akad. Wiss. (Math.-Kat. Kl.) **166:** 452; Pl. 2, fig. K; Pl. 3, fig. 13) – 1963 *Melanoides tuberculatus* (BENTHEM-JUTTING, Nova Guinea, Zool., **20:** 473) – 1969 *Melanoides (Melanoides) tuberculatus* (STARMÜHLNER, Malacologia, **8** (1/2): 224; fig. 296–320) – 1970 *Melanoides tuberculatus* (STARMÜHLNER, Cah. ORSTOM, sér. Hydrobiol., **4** (3/4): 89; figs. 129–132) – 1974 *Melanoides tuberculata* (BRANDT, Arch. Moll., **105** (1/4): 164; Pl. 12, figs. 9–12) – 1974 *Melanoides (Melanoides) tuberculata* (STARMÜHLNER, Bull. Fish. Res. Stn. Ceylon, **25** (1/2): 159; Pl. 15, figs. 150–153) – 1976 *Melanoides (Melanoides) tuberculata* (STARMÜHLNER, Ann. Naturhist. Mus. Wien, **80:** 591; Pl. 17, fig. 206).

Localities: S.-And.: No. 1 (72, partly iuv.), No. 2 (157, partly iuv.), No. 3 (3, partly iuv.), No. 5 (43 ind.), No. 6 (13, partly iuv.), No. 7 (75, partly iuv.), No. 8 (15 ind.), No. 9 (33, partly iuv.), No. 11 (14, partly iuv.), No. 12 (8 ind.), No. 13 (7, partly iuv.), No. 15 (3, partly iuv.), No. 19 (7 ind.), No. 20 (2 ind.); N.-And.: No. 1 (2 ind.).

Shell: Extremly variable in form and size, many local forms have led conchologists to discriminate a profusion of species, subspecies, varieties, subvarietis, races and forms! Turreted with high spire and moderately last whorl, 10–15 whorls, regularly increasing in diameter, the first more conve, the later ones more flattened; apex often eroded, sometimes somewhat „shouldered"; 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; often coated by mud, algae and ferruginous encrustations; straw-yellow to olive with darker red-brown dots and flames, either irregularly distributed or arranged in vertical rows; some specimens can possess a spiral band of the same

colour in the umbilical region; aperture vertical-oval, exterior margin sinuous protruding in the middle (Pl. 4, Fig. 13 a).

Sizes (in mm) Localities		Shell Height	Shell Diameter	Aperture Height	Aperture Diameter
S.-And.:	No. 1	20.5	8	8	5
	No. 2	17	5.7	5.5	3.5
	No. 3	12.7	5.4	5	3
	No. 5	20.5	7.3	7.1	4.4
		19.7	7	7	4.2
		19	7.2	7	4.1
	No. 6	22.2	7.7	7.6	4.2
	No. 7	28.6	9.3	8.9	5.5
	No. 8	33.2	9.8	9.9	5.8
	(eroded)	32	11	9.9	6
	No. 9	20.5	7.6	7	4
	No. 11	20.6	7.4	7	4.2
	No. 12	19	7	6.5	4
	No. 13	18.4	6.3	6.1	3.8
	No. 15	20	7	7	4
	No. 19	13.1	4.6	3.4	2.8
	No. 20	22.7	8.6	8.9	5.3
N.-And.:	No. 1	15.9	5.6	5	3.5

The sizes are from the largest specimens in the samples.

Operculum: Horny, blackish-brown; nucleus excentric-basal; growth striae fanning to the tip and the side.

Anatomical remarks: Anatomical details of these species are given by RAYMOND (1852; 1853: discovery of the broud-pouch and the viviparie, typically for the Thiaridae); a detailled study was given by STARMÜHLNER (1969); STARMÜHLNER & EDLAUER (1957); older studies (nervous-system) are from BOUVIER (1887: Ann. Sci. Nat., Zool, **7** (3): 1) and new contributions from RAMAMOORTHI (1949 and 1950), further from STARMÜHLNER (1970; 1974 and 1976). The specimens of the Andamans show no differences.

Biological-ecological remarks: *Melanoides tuberculata* has a wide range of occurrence in subtropical and tropical habitats: it is to find in stagnant water as well as in slowly running waters. At the stations of the Andamans the frequency was about 5–10 ind./1/16 m² on the borders of rivers with 0–30 cm/sec and muddy-sandy bottom, rich vegetable debris and filamentous algae. Juvenile specimens were counted on algae up to 50 ind./1/16 m².

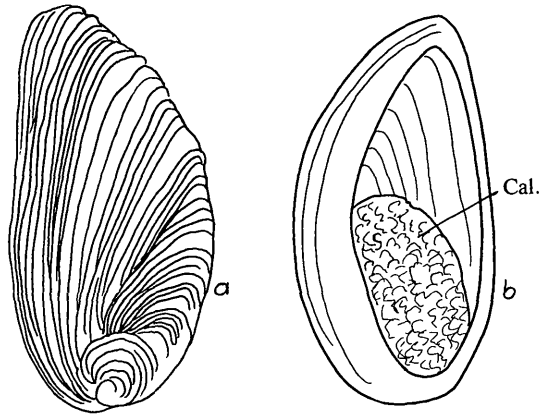
Range of: Temperature	Conductivity	ph	Total Hardness
23.3° – >30° C	59–401 µ Siemens	6–8	1°–13° dH

Melanoides tuberculata was mostly associated with *Thiara scabra* and *Indoplanorbis exustus,* in the lower courses also with *Melanoides (Stenomelania) plicaria* and *torulosa,* further with species of Neritidae.

Geographical range: South-Europe (in Central-Europe settled on by man in thermal waters), Lower Asia and Northern Africa, Central, East- and South-Africa, East African Islands, Madagascar, India, Ceylon, Southeast and South-Asia, Malay Peninsula and Archipelago, Philippines, Moluccas, New Guinea, Bismarck-Archipelago, Solomons, New Hebrides, New Caledonia, East-Australia, Fiji, Samoa, Tahiti, Western Carolines.

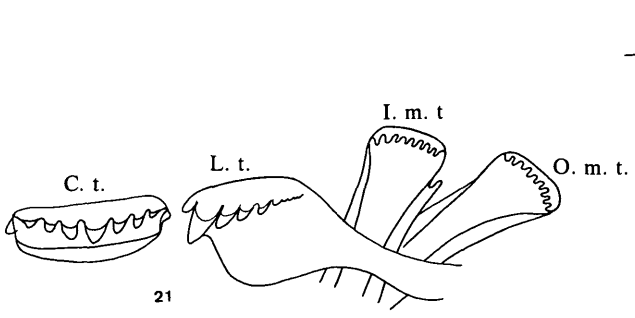
14. *Melanoides (Stenomelania) plicaria* (BORN, 1780)

Lit.: 1780 *Helix plicaria* (BORN, Test. Mus. Caes. Vindob.: 389; Pl. 16, fig. 14) – 1822 *Melania corrugata* (LAMARCK, Hist. Nat. Anima. s. Vert., **6** (2): 165) – 1828 *Melania subulata* (LAMARCK, ibid., after RIECH, **1937:** 58) – 1830 *Melania blossevilliana* (LESSON, Voy. Coquille, **2** (1): 358; *M. graciosa:* 359) – 1834 *Melania funiculus* (QUOY & GAIMARD, Voy. Astrolabe, Zool., **3:** Pl. 56, fig. 43, 44) – 1844 *Melania anthracina* (V. D. BUSCH, in PHILIPPI, Abb. & Beschr., **1:** 160; Pl. 3, fig. 3; *M. flammulata:* Pl. 1, fig. 3,4) – 1844 *Melania fumosa* (HINDS, Ann. Mag. Nat. Hist., **14:** 8) – 1850 *Melania hastula* (LEA, Proc. zool. Soc. London, **1850:** 189) – 1858 *Melania acutissima* (V. D. BUSCH, Malak. Bl., **5:** 33) – 1859 *Melania arroensis* (REEVE, Conch. Icon., *Melania:* in the index: Pl. 9, fig. 48, but these figure: *M. acuta!; M. figurata:* Pl. 9, fig. 49; *M. costata:* Pl. 6, fig. 28, 29; *M. acutissima:* Pl. 10, fig. 57, 58; *M. anthracina:* Pl. 4, fig. 17; *M. picta:* Pl. 9, fig. 43) – 1874 *Melania corrugata* (BROT, in M. & CH., Conch. Cab., **1** (24): 127; Pl. 15, fig. 9; *M. anthracina:* 127; P. 15, fig. 10, 10 a; *M. acutissima:* 129; Pl. 16, fig. 2, 2 a; *M. perplicata:* 134; Pl. 16, fig. 6, 6 a; *M. hastula:* 129; Pl. 16, fig. 3, 3 a–d; *M. blossevilliana:* 133; Pl. 17, fig. 6 (?); *M. landaueri:* 199, Pl. 22, fig. 12, 12 a; *M. salomonis:* 132; Pl. 16, fig. 4) – 1874 *Melania scutulata* (TAPPARONI CANEFRI, Ann. Mus. Civ. Stor. Nat. Genova, **6:** 559; *M. landaueri:* 1959, sic!) – 1889 *Melania auroriana* (HARTMANN, Proc. Acad. Philadelphia, **1889:** 91) – 1908 *Melania charon* (PRESTON, Rec. Ind. Mus. Calcutta, **2:** 196; Pl. 15, fig. 22) – 1911 *Melania acuminata* (LESCHKE, Jb. wiss. Anst. Hamburg, **1911:** 123) – 1915 *Tiara (Radina) hastula* (PRESTON, Fauna Brit. India., Moll, (Freshw. Gastr. & Pelec.): 11; v. *subacutissima,* subv. *subcrenulata*) – 1918 *Melania alkmaarensis*



20

Fig. 20. *Melanoides (Stenomelania) plicaria:* **a:** Operculum, outer surface; **b:** Operculum, inner surface



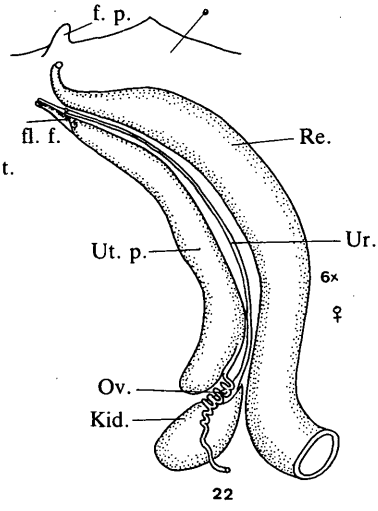


Fig. 21. *Melanoides (Stenomelania) plicaria:* Radula
Fig. 22. *Melanoides (Stenomelania) plicaria:* Female Reproductive system

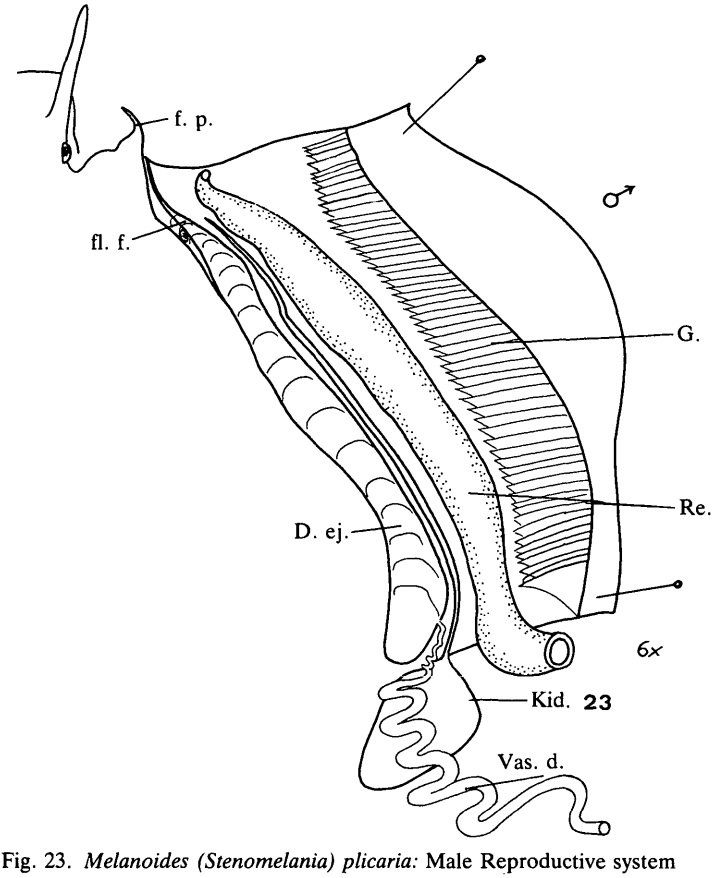


Fig. 23. *Melanoides (Stenomelania) plicaria:* Male Reproductive system

(SCHEPMAN, Nova Guinea, **13:** 174) – 1934 *Melania plicaria* (RENSCH, Zool. Jb. (Syst.), **65:** 413) – 1937 *Melania plicaria* (RIECH, Arch. Naturgesch. (N. F.), **6:** 58) – 1956 *Melanoides plicaria* (BENTHEM-JUTTING, Treubia, **23** (2): 420; fig. 94) – 1963 *Melanoides plicarius* (BENTHEM-JUTTING, Nova Guinea, Zool., **20:** 480; *M. funiculus:* 481) – 1976 *Melanoides (Stenomelania) plicaria* (STARMÜHLNER, Ann. Naturhist. Mus. Wien, **80:** 580; Pl. 16, fig. 183–194; textfig. 87–96).

Localities: S.-And.: No. 10 (18 ind.), No. 11 (46 ind.), No. 12 (2 ind.), No. 14 (32 & 232 iuv.), No. 15 (3 ind.); N.-And.: No. 5 (31 ind.).

Shell: Long and slender, numerous (up to 16–18) whorls, the last one high, but not inflated; inital whorls spirally striated with 9–12 elevated lirae, the following whorls with more or less strong vertical ribs and fine spiral threads, the last whorl often smooth or with a few spiral striae, more elevated below the periphery than above it; apex often eroded; older shells with more convexity of the whorls augments as an effect of loose-coiling, causing the profile of each whorl to be a little conave below the suture, then convex again; olive to brownish but mostly coated by a black layer; young specimens often transparent and with brown spots along the suture or coloured with vertical brown streaks and flames; aperture bluish, broad-pyriform, exterior margin slightly sinuous, columellar side twisted (Pl. 4, Fig. 14 a–e).

Sizes (in mm) Localities		Shell		Aperture	
		Height	Diameter	Height	Diameter
S.-And.:	No. 10 (eroded)	52.8	18.3	20.2	12
	No. 11 (eroded)	56.3	16.8	19.7	11
	No. 12 (eroded)	43.3	14.3	17	9.2
	(eroded)	41.8	14	15.5	9
	No. 14 (eroded)	47.6	15.5	17.6	10
	(eroded)	43	11.4	13.4	7.8
	No. 15 (iuv., erod.)	34.2	11	13	7

The sizes are from the largest specimens of the samples.

Operculum: Horny, pear-shaped, nucleus excentrical; growth striae fanning up to the tip and side, sometimes irregularly lifted off step-like (fig. 20 a); inner surface with a callus (fig. 20 b).

Anatomical remarks: Descriptions with figures from specimens from Pacific islands has given STARMÜHLNER (1976). The specimens of the Andamans correspond with these facts: Radula: central-tooth broad-trapezoid, prominent cusps in the formula: 3+1+3, on both sides small protrusions; lateral-tooth with 1+1+3–4 denticles and the marginals with 8, resp. 9 serrated cusps (fig. 21). The femal Reproductive system with a slender, looped oviduct, entering in the last third of the extended sack-shaped uterus; in the the brood-pouch of the mantle-ground like in all species of the subgenus *Stenomelania* numerous small embryos, mostly in the stage of veliger (fig. 22). The male Reproductive system with a thick, looped vas deferens entering in the last portion of the ductus ejaculatorius, he is tapering in the proximal part and is opening to a ciliated small groove, which goes to the neck of the male (fig. 23).

Biological-ecological remarks: Like all species of the subgenus *Stenomelania,* with free-living veliger-larvae, occurs *M. (St.) plicaria* exclusively in the lower courses of running waters till the influence of brackish water from the recurrent flow during high tide. During day often digged-in in mud and sand and during night on the surface of the soft bottom near the banks and in pools between cascades by a surface-current of 10–30 cm/sec. The density goes up from 1–2 ind., to 3–5 and sometimes up to 5–10 ind./1/16 m^2, specially if many immature specimens are in the population.

	The range of:		
Temperature	Conductivity	pH	Total Hardness
24.2° – >30° C	74–401 µ Siemens	6.8–7.8	1°–10° dH

Geographical range: Andaman & Nicobars, Malay Archipelago, Philippines, Palau-Islands, Moluccas, Aru, New Guinea, Bismarck Archipelago, Solomons, New Hebrides, New Caledonia, Fiji.

15. *Melanoides (Stenomelania) torulosa* (BRUGUIÈRE, 1789)

Lit.: 1789 *Bulimus torulosus* (BRUGUIÈRE, Encycl. Méth. Vers, **1:** 322) – 1790 *Helix crenata* (non *crenata* GMELIN) (Ibid.: 3623 = *Amphibola crenata*) – 1834 *Melania aculeus* (LEA, Trans. Phil. Soc. Philadelphia (N. S.), 81; Pl. 19, fig. 72) – 1834 *Melania tirouri* (QUOY & GAIMARD, Voy. Astrolabe, Zool., **3:** 159; Pl. 56, figs. 38, 39) – 1838 *Melania crenulata* (DESHAYES, Hist. Nat. Anim. s. Vert., Ed. **2** (8): 434; *M. tirouri:* 435) – 1844 *Melania semicancellata* (VON DEM BUSCH, in PHILIPPI, Abb. & Beschr., **1;** *Melania:* 159; Pl. 3, fig. 2) – 1844 *Melania porcata* (JONAS, Z. f. Malak., **1:** 50) – 1848 *Melania semicancellata* and *porcata* (MOUSSON, Mitth. naturf. Ges. Zürich, **1:** 268) – 1849 *Melania semicancellata* (MOUSSON, Land & Süßw. Moll. Java: 68; *M. porcata:* 69) – 1859 *Melania crenulata* (REEVE, Conch. Icon., **12:** Pl. 5, fig. 26; *M. semicancellata:* Pl. 8, fig. 37) – 1859 *Melania porcata* (ZOLLINGER, Natuurk. Tijdschr. Ned. Ind. **18:** 424) – 1860 *Melania porcata* (ZOLLINGER, ibid., **21:** 318) – 1874 *Melania crenulata* (BROT, in M. & CH., Conch. Cab., **1** (24): 114; Pl. 14, figs. 9 a–f; *M. semicancellata:* 118; Pl. 15, figs. 1, 1 a–b; *M. obesula:* 121; Pl. 15, fig. 8; *M. aculeus:* 122; Pl. 15, fig. 6) – 1884 *Melania semicancellata* (NEVILL, Hand List Moll. Ind. Mus., **2:** 226) – 1888 *Melania crenulata* (TENISON WOODS, Proc. Linn. Soc. N. S. W. **3:** (2): 1080; var. *porcata, M. semicancellata, M. obesula, M. aculeus:* 1080) – 1897 *Melania crenulata* (incl. var. *porcata*) (MARTENS, in WEBER, Erg. Reise Nied. Ost Indien, **4:** 45) – 1899 *Melania crenulata* (HORST & SCHEPMAN, Cat. Syst. Moll. Mus. Hist. Pays-Bas, **13** (2): 252; *M. semicancellata:* 252) – 1908 ?*Melania expatriata* (PRESTON, Rec. Ind. Mus. Calcutta, **2:** 196, Pl. 15, fig. 23; ?*M. multistriata:* 196; Pl. 15, fig. 24) – 1914 *Melania crenulata* (LESCHKE, Mitt. naturhist. Mus. Hamburg, **31:** 253; *M. porcata, M. obesula:* 253; *M. semicancellata:* 254) – 1915 *Tiara (Radina) crenulata* (PRESTON, Fauna Brit. India., Moll. (Gastr. & Pelec.): 11; var. *tirouri:* 12; var. *confusa:* 12; ?*M. (R.) expatriata;* 14; ?*M. (R.) multistriata:* 15) – 1929 *Melania crenulata* (BENTHEM-JUTTING, Treubia, **11:** 84; *M. obesula, M. semicancellata:* 84) – 1934 *Melania crenulata* (RENSCH, Zool. Jb. (Syst.), **65:** 414) – 1940 Melanoides (Stenomelania) torulosa (SESHAIYA, Curr. Sc., **9** (7): 331) – 1941 *Thiara crenulata* (BENTHEM-JUTTING, Arch. néerl. Zool., **5:** 281) – 1956 *Melanoides torulosa* (BENTHEM-JUTTING, Treubia, **23** (2): 410; fig. 92).

Localities: S.-And.: No. 7 (12 ind.), No. 10 (12 ind.), No. 12 (13 iuv.), No. 14 (18 ind.); N.-And.: No. 2 (5 ind.), No. 3 (76, mostly iuv.), No. 4 (1 ind.), No. 5 (5 ind.), No. 6 (125 ind, partly iuv.).

Shell: Turreted with many flat whorls (up to 12–14) and a large ultimate whorl; fine decurrent spiral lines, mostly separating flat ridges (only the first whorls of young specimens are occasionally axially plicate), in the lower whorls the spiral ridges are broader and less numerous; in some specimens the spiral ridges are crossed by transverse lines in 1–4 rows of nodules, which may even appear as vertical nodulous ribs; the nodules immediately below the suture are generally the strongest; below the periphery remain the spiral ridges; apex often eroded; olive to brown, in young specimens the top whorls generally lighter and often spotted with small brown spots and lines; adult specimens mostly coated by a thick black layer; aperture pyriform, with twisted columellar side and slightly channelled basal margin (Pl. 5, Fig. 15 a–e).

Sizes (in mm) Localities		Shell		Aperture	
		Height	Diameter	Height	Diameter
S.-And.:	No. 7 (eroded)	28.1	9	8.9	5.1
	No. 10 (eroded)	38	14	13	8.5
	No. 12 (iuv.)	17	4.2	4.5	2.9
	(eroded)	36.5	11	10.5	6
	No. 14 (eroded)	36	14	15.5	8.6
	(eroded)	33.5	11.8	13	6.7
N.-And.:	No. 2 (eroded)	53.5	17.6	20	12.3
	(eroded)	54.8	17.1	21	13.2
	(eroded)	41	16.2	19	12.2
	No. 3 (eroded)	56	11	13	12
	No. 5 (eroded)	52.8	15.6	19	10.3
	No. 6 (eroded)	45	15	15.4	10

The sizes are from the largest specimens of the samples.

Operculum: Pear-shaped with excentrical nucleus at the left basal corner, growth lines are fanning to the tip and side, sometimes irregularly lifted off step-like (fig. 24 a); inner surface with a callus (fig. 24 b).

Anatomical remarks: Radula: Central-tooth broad-trapezoid, with prominent rounded cusps (2+1+2); lateral-tooth with 1+1+2–3 cusps and marginals with 7–8, resp. 9 acute denticles (fig. 25). Female Reproductive system identically with the other species of the subgenus *Stenomelania:* numerous small embryos, resp. veliger-larvae in the pallial brood-pouch, such as described by SESHAIYA (1940), also by ABBOTT (1952) from specimens from India. The small, slender oviduct stretches in loops to the posterior end of the broad uterus part, which contains in these part a compact substance (secret? spermatophor?), in the lower part the uterus stretches in a ciliated groove to the opening of the brood-pouch (fig. 26). The mantle border is, like in all species of *Melanoides,* fringed.

Biological-ecological remarks: Also *M. (St.) torulosa* occurs exklusively, like all other species of these subgenus, in the lower courses of running waters. On mud, sand, vegetable debris near the borders and banks, in pools between cascades with a surface current from 0–30 cm/sec. The frequency at the stations

was about 1–5 ind./1/16 m². During day many specimens are dugging in the sand and mud, during night they are crawling on the surface. In one specimens was found a water-mite (Unionicolidae?) in the pallial cave.

	The range of:		
Temperature	Conductivity	pH	Total Hardness
24.2°–27.6° C	74–324 µ Siemens	6.8–7.8	1°–10° dH

The species was associated with *M. (St.) plicaria, Thiara scabra, Indoplanorbis exustus* and in North-Andaman at one station also with the mussel *Polymesoda ceylanica.*

Geographical range: India, Burma, Andaman & Nicobars, many Malay islands, Philippines, Solomons.

16. *Tarebia granifera* (LAMARCK, 1822)

Lit.: 1822 *Melania granifera* (LAMARCK, Hist. Anim. s. Vert., **6** (2): 167) – 1828 *Helix lineata* (GRAY in WOOD, Index, test., Suppl.: 24; Fig. 68) – 1834 *Melania celebensis* (QUOY & GAIMARD, Voy. Astrolabe, Zool., **3:** 152; Pl. 56, figs. 26–29) – 1842 *Melania semigranosa* (V. D. BUSCH, in PHILIPPI,

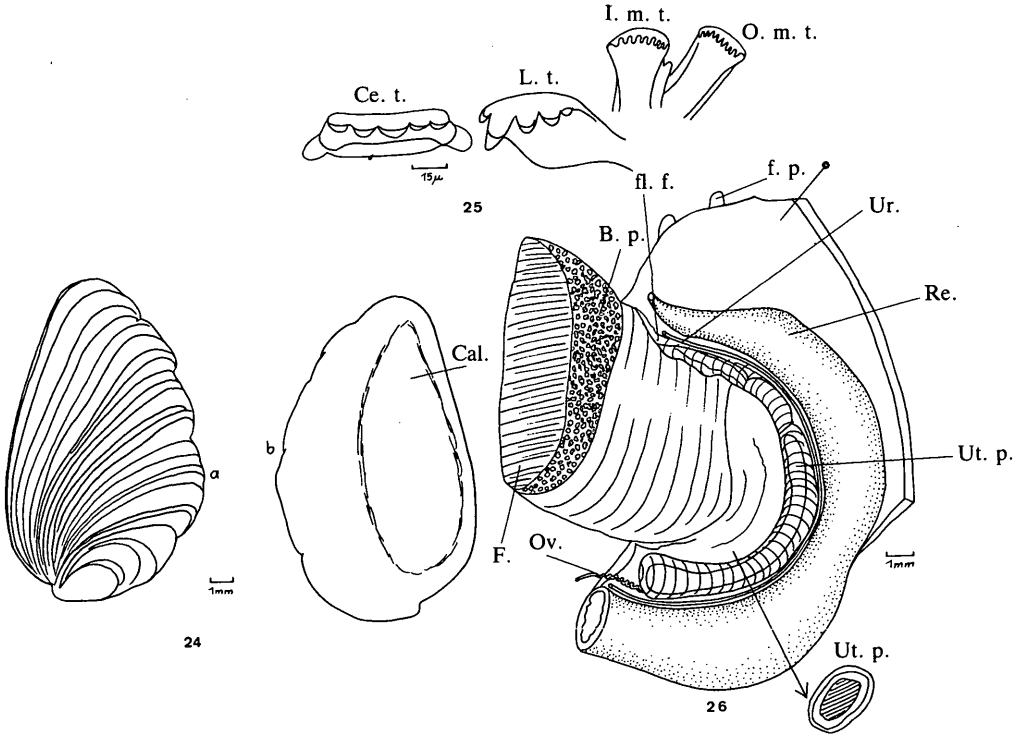
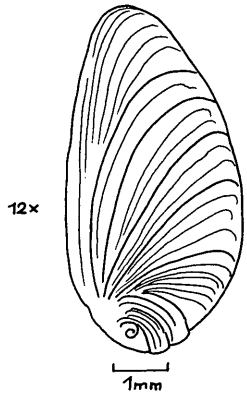


Fig. 24. *Melanoides (Stenomelania) torulosa:* **a:** Operculum, outer surface; **b:** Operculum, inner surface
Fig. 25. *Melanoides (Stenomelania) torulosa:* Radula
Fig. 26. *Melanoides (Stenomelania) torulosa:* Female reproductive system

Abb. Beschr., **1:** 2; Pl. 1, fig. 13) – 1843 *Melania coffea* (PHILIPPI, Abb. Beschr. **1:** 60; Pl. 2, fig. 4) – 1843 *Melania batana* (GOULD, Proc. Boston Soc. nat. Hist., **1:** 144) – 1844 *Melania flavida* (DUNKER, in PHILIPPI, Abb. Beschr. **1:** 164; Pl. 3. fig. 15) – 1844 *Melania verrucosa* (HINDS, Ann. Mag. nat. Hist., **14:** 9) – 1850 *Melania lateritia* (LEA, Proc. zool. Soc. London, **1850:** 184; *M. rudis:* 185; *Melania microstoma:* 185; *M. luzoniensis:* 188; *M. crenifera:* 192) – 1857 *Melania granospira* (MOUSSON, J. de Conch., **6:** 61) – 1858 *Melania monilifera* (V. D. BUSCH, Malak. Bl., **1858:** 34) – 1859 *Melania broti* (REEVE, Conch. Icon., **12:** Pl. 22, fig. 160; *M. lyrata:* Pl. 24, fig. 170; *M. semigranosa:* Pl. 24, fig. 167; *M. verrucosa:* Pl. 24, fig. 168; *M. crenifera:* Pl. 24, fig. 169) – 1860 *Melania chocolatum:* Pl. 16, fig. 2) – 1860 *Melania granospiralis* (ZOLLINGER, Natururk. Tijdschr. Nederl. Ind., **18:** 424) – 1868 *Melania damonis* (BROT, Matér. Melan., **2:** Pl. 1, fig. 3; *M. asperula:* 30; Pl. 1, fig. 11; *M. granospira:* 27; Pl. 1, fig. 10; BROT, ibid., **3:** *M. granifera:* 20; Pl. 1, figs. 3) – 1874 *Melania celebensis* (BROT, in M. & CH., Conch. Cab., **1** (24): 317; Pl. 32, fig. 15; *M. verrucosa:* 318; Pl. 33, fig. 3; *M. granifera:* 321; Pl. 33, fig. 13; *M. crenifera:* 323; Pl. 33, fig. 9; *M. granospira:* 324; Pl. 33, fig. 14; *Melania coffea:* 326; Pl. 33, fig. 10; *M. asperula:* 327; Pl. 33, fig. 11; *M. lirata:* 328; Pl. 33, fig. 6) – 1879 *Melania junghuhni* (MARTIN, Tertiärsch. Java: 89; Pl. 14, fig. 20) – 1904 *Melania lateritia* (FISCHER & DAUTZENBERG, Miss. Pavie, **3:** 418) – 1905 *Melania tjariangensis* (MARTIN, Samml. geol. Reichsmus. Leiden (N. F.) **1:** 235; *M. kritjianensis:* 235) – 1907 *Melania browni* (PRESTON, Proc. Malac. Soc. London, 7: 266) – 1911 *Melania langemaki* (LESCHKE, Jb. wiss. Anst. Hamburg, Beih. **2:** 129) – *Melania cingulifera* (SYKES, Proc. Malac. Soc. London, **1911:** 14) – 1911 *Melania granifera* var. *papuana* (SOOS, Ann. Hist. Nat. Mus. Hung., **9:** 350) – 1914 *Melania tjibodasensis* (LESCHKE, Mitt. naturh. Mus. Hamburg, **31:** 219; *M. margaritana:* 258; fig. 12) – 1915 *Tiara (Tarebia) batana* (PRESTON, Fauna Brit. India, Moll. (Freshw. Gastr. & Pelec.): 33; *T. broti:* 33; var. *subviridis:* 33; *T. rudis:* 34; *T. lineata:* 34; var. *semigranosa, pergranosa, flavida:* 35) – 1918 *Melania kampeni* (SCHEPMAN, Zool. Meded., **4:** 13; Pl. 1, fig. 8) – 1931 *Melania (Tarebia) granifera* (THIELE, Handb. syst. Weichtierkde.: 200) – 1935 *Melania martini* (OOSTINGH, Wet. Meded. Dienst Mijn. Nederl. Ind., **26:** 25; non SCHEPMAN, 1898) – 1937 *Melania granifera granifera* (RIECH, Arch. Naturgesch. (N. F.), **6:** 51; fig. 9) – 1938 *Melanoides (Tarebia) granifera* (WENZ, Handb. Palöozool., **1:** 714; fig. 2061) – 1948 *Thiara (Tarebia) granifera* (ABBOTT, Bull. Mus. comp. Zoöl., Havard Coll., **100** (3): 290; Pl. 3, fig. 4) – 1952 *Thiara granifera* (ABBOTT, Proc. US. Nat. Mus. Smithsonian, **102:** 71; fig. 32–40, Pl. 1, 2) – 1956 *Melanoides granifera* (BENTHEM-JUTTING, Treubia, **23** (2): 404; fig. 90) – 1958 *Tarebia granifera* (CLENCH, in TORBEN, Sci. Res. Danish Rennel-Exp. 1952 & Brit. Mus. Exp. 1953, **2** (27): 155) – 1963 *Melanoides graniferus graniferus* (BENTHEM-JUTTING, Nova Guinea, Zool., **20:** 468; *M. graniferus laevis, M. graniferus kampeni:* 469) – 1974 *Tarebia granifera* (BRANDT, Arch. Moll. **105** (1/4): 167; Pl. 12, figs. 14–18) – 1976 *Tarebia granifera* (STARMÜHLNER, Ann. Naturhist. Mus. Wien, **80:** 569; Pl. 16, figs. 175–179; textfigs. 72–74).



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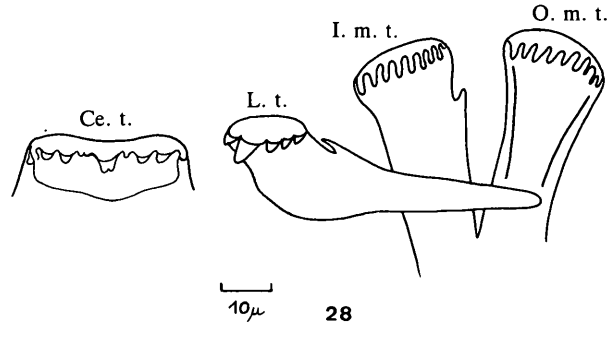

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Fig. 27. *Tarebia granifera:* Operculum, outer surface
Fig. 28. *Tarebia granifera:* Radula

Localities: S.-And.: No. 7 (23 ind.); N.-And.: No. 3 (166, mostly iuv.).

Shell: Extremly variable in size, shape and sculpture: obtusely to elongately conical, elevated spire up to 12–15 whorls, the ultimate whorl large; coarsely sculptured by elevated ridges in vertical and spiral direction, causing a pattern of more ore less strong, blunt nodules, the f. *lineata* (GRAY, 1828) possesses fine dark lines coinciding with the spiral ridges; on the last whorl 4 to 8 spiral ridges, sometimes predominate the spiral, sometimes the axial ribs; apex often eroded; yellow-brownish to olive, immature shells often with 1–3 reddish-brown spiral bands: below the suture, periphery and in the umbilical region; top whorls mostly much darker than later ones; sometimes occur reddish-brown spotes and flames on the later whorls; aperture oval with sonuous outer margin and somewhat channeled (Pl. 5, Fig. 16 a–d).

Sizes (in mm)	Shell		Aperture	
Localities	Height	Diameter	Height	Diameter
S.-And.: No. 7 (eroded)	16.3	8.5	8.8	5
N.-And.: No. 3	19.2	8	8.8	4.8
	18.5	8.9	9	5

The sizes are from the largest specimens in the samples.

Operculum: Oval, dark brown; nucleus at left border; growth striae fanning to the tip and side (fig. 27).

Anatomical remarks: Detailled descriptions of the anatomy given by ABBOTT (1948; 1952); STARMÜHLNER (1976) noted details on the radula (first described by TROSCHEL, 1857) and the female reproductive system. The radulae of the specimens from the Andamans shows no differences: central-tooth broad-trapezoid with 3–4+1+3–4 denticles on the cutting edge, on each sides a very small protrusion; lateral-tooth with 1+1+3 denticles, the marginals with 8–9, resp. 9 acute cusps (fig. 28).

Biological-ecological remarks: On muddy-sand bottom of middle courses with layers of vegetable debris near the banks and in pools between cascades with a frequency of 2–5 ind./1/16 m^2 (surface-current: 0–30 cm/sec).

	Range of:		
Temperature	Conductivity	pH	Total Hardness
25.8°–26.7° C	107–293 µ Siemens	6.9–7.9	1.6°–9° dH

Tarebia granifera was associated with other Thiaridae such as *Thiara scabra, Thiara setifera, Melanoides tuberculata, Melanoides (St.) torulosa* and the pulmonate *Indoplanorbis exustus.*

Geographical range: India, Malay Peninsula and Archipelago, Ceylon, Southeast-Asia, South-China, Philippines, Formosa, Moluccas, Aru, New Guinea, Bismarck Archipelago, Solomons, New Hebrides, Tahiti, Marianes, Guam.

Familia: Planaxidae

17. *Planaxis (Planaxis) sulcatus* (BORN, 1778)

Lit.: 1778 *Buccinum sulcatum* (BORN, Ind. Mus. Caes. Vindob.: 251; Pl. 10; figs. 5, 6) – 1878 *Planaxis sulcatus* (REEVE, Conch. Icon., **20:** Pl. 1, fig. 4) – 1886 *Planaxis sulcata* (WATSON, Challenger, Zool., **15:** 573) – 1894 *Planaxis sulcatus* (TRYON, Man. Conch., **9:** 276; Pl. 2, figs. 22, 23) – 1908 *Planaxis sulcatus* (SCHEPMAN, Siboga-Exp., Pros., Monogr. **49:** 171) – 1941 *Planaxis sulcatus* (CRICHTON, J. Bombay Nat. Hist. Soc., **42:** 337) – 1942 *Planaxis sulcatus* (GRAVELY, Bull. Mad. Govt. Mus. (Nat. Hist.), **5** (2): 24) – 1952 *Planaxis sulcatus* (SATYAMURTI, Bull. Mad. Govt. Mus. (N. S., Nat. Hist.), **1** (2; 6): 79; Pl. 5, figs. 6 a, b) – 1974 *Planaxis (Planaxis) sulcatus* (STARMÜHLNER, J. mar. biol. Ass. India, **16** (1): 57; Pl. II, fig. B).

Localities: S.-And.: No. 16 (1 iuv.).

Shell: Thick and strong with the spire slightly less strongly raised, and the apex less sharply pointed, the ultimate whorl slightly angular below; surface regularly and uniformly spirally grooved; aperture ovate, outer lip spirally ridged, the callus on the columella thick above, but thin and lamina-like below, where it borders the short, but deeply V-shaped anterior canal.

Sizes (in mm)

Locality	Height
S.-And.: No. 16 (iuv.)	4.5

Only one immature specimen was recorded.

Operculum: Thick-horny, nucleus terminal.

Anatomical remarks: The unique, immature specimen was not dissected.

Biological-ecological remarks: *Planaxis sulcatus* is a marine species, typically for the supralitoral and the higher parts of the eulitoral on rocky coasts of the Indian Ocean. The found specimen was occuring in the mouth-zone of a small river (S.-And.: No. 16), associated with *Clithon corona* and *Cerithidea cingulata*. These habitat is brackish during low-tide and covered by sea water during high tide.

	Range of:		
Temperature	Conductivity	pH	Total Hardness
28.1° C	7521–9500 µ Siemens	6.9–7.2	up to 50° dH

Geographical range: Indian Ocean

Familia: Potamididae
Subfamilia: Potamidinae

18. *Cerithidea (Cerithideopsilla) cingulata* (GMELIN, 1790)

Lit.: 1790 *Murex cingulatus* (GMELIN, Syst. Nat., Ed. **13:** 3561) – 1838 *Cerithium fluviatile* (POTIEZ & MICHAUD, Gal. Moll. DOUAI, **1:** 363; Pl. 31, fig. 19, 20) – 1866 *Tympanotus fluviatilis* (REEVE,

Conch. Icon., **15:** Pl. 2, fig. 9) – 1889 *Tympanotus fluviatilis* (MORELET, J. de Conch., **37:** 144) – 1897 *Potamides cingulatus* (MARTENS, in WEBER, Erg. Reise Nied. Ost. Indien, **4:** 183) – 1909 *Potamides cingulatus* (SCHEPMAN, Siboga Exp. Monogr., **49** (1–b): 168) – 1914 *Potamides cingulatus* (LESCHKE, Mitt. naturhist. Mus. Hamburg, **31:** 259) – 1923 *Potamides cingulatus* (OOSTINGH, Meded. Landb. Hoogesch., **26** (3): 73) – 1929 *Potamides cingulatus* (BENTHEM-JUTTING, Treubia, **11:** 86) – 1938 *Cerithidea cingulata* (ADAM & LELOUP, Mém. Mus. Roy. Hist. Nat. Belg. (Hors sér.) **2** (19): 98) – 1940 *Cerithidea cingulata* (REGTEREN-ALTENA, Zool. Meded. Mus. Leiden, **22:** 212; Pl. 20, fig. 1–11) – 1941 *Cerithidea cingulata* (REGTEREN-ALTENA, Leidsche Geol. Meded., **12:** 7) – 1945 *Cerithidea cingulata* (REGTEREN-ALTENA, Zool. Meded. Mus. Leiden, **25:** 144) – 1949 *Cerithidea cingulata* (SCHUSTER, Publ. No. 2, Onderafd. Binnenviss.: 197) – 1952 *Cerithidea fluviatilis* (SATYAMURTI, Bull. Madr. Govt. Mus., N. H., **1** (2; 6): 80; Pl. 5, figs. 7 a, 7 b) – 1974 *Cerithidea fluviatilis* (STARMÜHLNER, J. mar. biol. Ass. India, **16** (1): 57) – 1974 *Cerithidea (Cerithideopsilla) cingulata* (BRANDT, Arch. Moll. **105** (1/4): 190; Pl. 14, fig. 48).

Localities: S.-And.: No. 16 (2 ind.).

Shell: Elongately conoidal or turreted with 12–15 whorls, which are almost flat and increasing regularly, the last whorl delicately angled at the periphery; 3 strong spiral ridges crossed by axial grooves thus cutting the ridges in 3 spiral rows of tubercles, they are obsolete on the last whorl; the second spiral groove is much shallower than the first below the suture, the grooves mostly darker than the tubercles; dark to violet-brown, with brighter zones or whitish bands, mostly placed on third row of tubercles; aperture oval, angled above and below; short siphonal canal, peristom connected with a callus and outer margin thickened and expanded (Pl. 5, Fig. 17 a).

Sizes (in mm)	Shell		Aperture	
Locality	Height	Diameter	Height	Diameter
S.-And.: No. 16	27.8	10.4	8.8	7
	27.4	10.2	8.8	7

The sizes are from the 2 recorded specimens of the sample.

Operculum: Circular, horny and with many concentrical growing striae round the central nucleus.

Anatomical remarks: Following BRANDT (1974: p. 191) the animal is without a reddish pigmentation; the central-tooth of the radula is broad and without cusps on the cutting-edge; the females of the genus *Cerithidea* have no brood pouch and are oviparous. The specimens from our sample were not dissected.

Biological-ecological remarks: Following BENTHEM-JUTTING (1956), STARMÜHLNER (1974) and BRANDT (1974) these species is a very common inhabitant of brackish and seawater lagoons and estuaries, living as „mud-creepers" on mud-flats. They occur on muddy coasts (STARMÜHLNER, 1974) as well as in brackish habitats (BENTHEM-JUTTING, 1956; BRANDT, 1974). Our specimens were found in the mouth-region of a small river, about 10–50 meters from the sea. The habitat is brackish during low-tide and covered with seawater during high-tide. The species was associated with *Clithon corona* and the marine species *Planaxis sulcatus,* crawling on sand and dead shells, coralls in a surface current of about 30 cm/sec.

Temperature	The range of: Conductivity	pH (during low – tide)	Total Hardness
28.1° C	7521–9500 µ Siemens	6.9–7.2	up to 50° dH

Geographical range: India, Ceylon, Malay Peninsula and Archipelago, Southern China, Japan, Thailand, Philippines, Formosa, New Guinea.

Subclassis: EUTHYNEURA
Ordo: Pulmonata
Superfamilia: Lymnaeacea
Familia: Lymnaeidae

19. *Lymnaea (Radix) luteola* (LAMARCK, 1822)

Lit.: 1822 *Lymnaea luteola* (LAMARCK, Hist. nat. Anim. s. Vert., **6** (2): 16) – 1822 *Lymnaea ovalis* (SOWERBY, Gen. Rec. Foss. Shells, **1** (7)/Pl. 178) – 1834 *Lymnaea succinea* (DESHAYES, Voy. Belanger, Zool.: 418) – 1836 *Lymnaea butta* (error type for *bulla* (!), BENSON, J. asiat. Soc. Bengal, **5:** 744 – following HUBENDICK, 1951 a nomen nudum!) – 1837 *Lymnaea cerasum* (TROSCHEL, in WIEGMANN's Arch. Naturgesch., **3:** 170; *L. impurus:* 172; *L. nucleus; L. impurus:* 172) – 1841 *Lymnaea luteola* (DELESSEERT, Rec. Coqu. décr. LAMARCK: Pl. 30, figs. 5 A, B) – 1858 *Limnaea pinguis* (DOHRN, Proc. zool. Soc. London, **26:** 134; *L. tigrina:* 134) – 1862 *Limnaeus oliva* (KÜSTER in M. & CH., Conch. Cab., **1** (17 b): 31; Pl. 5; figs. 25, 26; *L. succineus:* 29; Pl. 5, figs. 18, 19) – 1872 *Limnaea pinguis* var. *strigata* (SOWERBY, in REEVE, Conch. Icon., **18:** Pl. 9, fig. 18 b; *L. ovalis:* Pl. 9, fig. 59; *L. siamensis:* Pl. 10, f. 63; *L. nucleus:* Pl. 10, fig. 67) – 1867 *Limnaea ovalis* (HANLEY & THEOBALD, Conch. Ind.: 30; Pl. 70, figs. 2, 3; *L. ovalis* var. *strigata:* 30; Pl. 70, fig. 4; *L. luteola:* 30; Pl. 70, figs. 5, 6; *L. pinguis:* 30; Pl. 70, figs. 7, 10 and var.: fig. 8; *L. tigrina:* XVI, foot-note: 8) – 1877 *Limnaea andersoniana* (NEVILL, J. asiat. Soc. Bengal, **46:** 26) – 1878 *Limnaeus luteolus* (NEVILL, Handl. Mus. Calcutta, **1:** 233) – 1881 *Limnaea nucleus* (MARTENS, Conch. Mittheil., **1:** 82; Pl. 15, figs. 8, 9; *L. tigrina:* 85; Pl. 15, f. 5; *L. succinea* var. *impura:* 86; Pl. 15, fig. 6) – 1886 *Limnaeus ovalis (CLESSIN, KÜSTER & DUNKER) in M. & CH., Conch. Cab.,* **1** (17): 375; Pl. 52, f. 1; *L. nucleus:* 378; Pl. 50, fig. 6; *L. siamensis:* 380; Pl. 50, fig. 9) – 1915 *Limnaea (L.) ovalis* (PRESTON, Fauna Brit. Ind., Moll. (Freshw. Gastr. & Pelec.): 109; var. *nucleus:* 109; *L. (L.) tigrina:* 110; var. *minor:* 110; *L. (Gulnaria) succinea:* 112; var. *impura:* 112; *L. (G.) pinguis:* 113; *L. (Gulnaria) siamensis:* 113) – 1919 *Lymnaea pinguis* (ANNANDALE, Rec. Ind. Mus. Calcutta, **16:** 144; text-fig. 5; Pl. 5, fig. 4) – 1925 *Lymnaea luteola* (ANNANDALE, ibid., **27:** 106; r. *siamensis:* 107) – 1925 *Lymnaea luteola* (ANNANDALE & RAO, ibid., **27:** 162; text-fig. VI: 4, 5, 14, 15; text-fig. IX: A, B, C; text-fig. XV: K. L, M. N; f. *typica:* 184; f. 184; f. *australis (= pinguis):* 184; f. *ovalis:* 184; f. *impura:* 185; f. *succinea:* 185; f. *siamensis:* 185) – 1951 *Lymnaea luteola* (HUBENDICK, Kungl. Svenska Vetenskapakad. Handl., Fj. Ser. **1:** 43; text-fig. 33–35 (with *pinguis*): 47; text-fig. 39, 40, 49f; 76, 79; text-fig. 137; 180, text-fig. 178; 161, text-fig. 349 a–i; as synonyms are listed: *L. andersoniana:* 180; *L. cerasum:* 183; *L. impura:* 190; *L. nucleus:* 197; *L. oliva:* 197; *L. ovalis:* 198; *L. pinguis:* 199; *L. siamensis:* 202; *L. strigata:* 204;1 *L. succinea:* 205; *L. tigrina:* 206) – 1958/60 *Radix (Cerasina) luteola* (WENZ & ZILCH, Handb. Paläozool., **6** (2), Gastr.-Euthyn,: 94; fig. 304) – 1962 *Lymnaea pinguis* (MENDIS & FERNANDO, Fish. Res. Stn. Bull., Ceylon, **12:** 55, fig. 15; as foot-note: *pinguis = luteola,* following HUBENDICK, 1951) – 1962 *Lymnaea ovalis* (MENDIS & FERNANDO, ibid.: 57; *L. tigrina:* 58; var. *minor:* 58) – 1974 *Radix (Cerasina) luteola* var. *pinguis* (STARMÜHLNER, Bull. Fish. Res. Stn. Sri Lanka, **25** (1/2)/162; Pl. 15, fig. 154; text-figs. 155–163).

Locality: S.-And.: No. 9 A (1 iuv.).

Shell: Varying in size, shape and form has led into naming a profusion of

species, subspecies, varieties and forms. In the monograph of „Recent Lymnaeidae" HUBENDICK (1951) has united the most of Indian species to *L. luteola* LAMARCK, 1822: 5 to 6 flat whorls, separated by a shallow suture, columella twisted and the columellar fold likewise pronounced, the inner lip is closely appressed to the body whorl and there is consequently no umbilical chink, surface smooth and often very glossy, in this form which occur in Indian, Burma and Andaman Islands the shell size may vary fairly large to large size (ANNANDALE & RAO, 1925: 184).

Sizes (in mm)	Shell		Aperture	
Locality	Height	Diameter	Height	Diameter
S.-And.: No. 9 A (iuv.)	4.5	3	3	2

Only one, not full grown shell was found.

Anatomical remarks: Details of the anatomy of the Indian *Lymnaea (Radix) luteola* were given by ANNANDALE & RAO (1925): jaw, radula, genitalia), HUBENDICK (1951: shell variation, genitalia, radula) and SRARMÜHLNR (1974: radula, jaw, pigmentation of soft body, nervous-system, genitalia). The immature specimen of No. 9 A was on the outside of the mantle blackish pigmented. No dissection was made.

Biological and ecological remarks: Following STARMÜHLNER (1974) ocurring in stagnant waters, but also on the borders of slowly running rivers with muddy bottom and dense vegetation. In station No. 9 A the immature specimen was found in a flooded rivulet (after a heavy rain) on the border on floating plants.

Geographical range: India, Ceylon (var. *pinguis*), Burma, Andaman-Islands, Thailand.

Superfamilia: Ancylacea
Familia: Bulinidae
Subfamilia: Bulininae

20. *Indoplanorbis exustus* (DESHAYES, 1834)

Lit.: 1834 *Planorbis exustus* (DESHAYES, in BELANGER, Voy. Indes-Orient., Zool.: 417; Pl. 1, figs. 11–13) – 1836 *Planorbis indicus* (BENSON, J. asiat. Soc. Bengla, **5:** 743) – 1838 *Planorbis orientalis* (DESHAYES, Hist. An. s. Vert. **8:** (2), 385) – 1855 *Planorbis modicus* (ADAMS, Gen. Rec. Moll., **2:** 261; *Pl. brunneus:* 261) – 1856 *Planorbis coromandelicus* (DUNKER, in M. & CH., Conch. Cab., **1** (17): 43; Pl. 6, figs. 14–16; *Pl. zebrinus:* 57; Pl. 6, figs. 11–13) – 1860 *Planorbis coromandelicus* f. *minor* (MARTENS, Proc. zool. Soc. London, **1860:** 12) – 1862 *Planorbis circumspissus* (MORELET, Rec. Mag. Zool., **14:** 477) – 1876 *Planorbis merguensis* (HANLEY & THEOBALD, Conch. Ind., **8:** 60; Pl. 151, figs. 5–6) – 1886 *Planorbis zonatus* (CLESSIN, in M. & CH., Conch. Cab. **1** (17), (2): 117; Pl. 17, fig. 1; *Pl. hindu:* 224; Pl. 35, fig. 9) – 1921 *Planorbis exustus* (GERMAIN, Rec. Ind. Mus. Calcutta, **21:** 26; Pl. 1, figs. 4–9; Pl. 4, figs. 11, 17, 18;1 text-figs- 1–11, 13–16) – 1931 *Planorbis (Indoplanorbis) exustus* (THIELE, Handb. Syst. Weichtierkde.: 479) – 1945 *Indoplanorbis exustus* (BAKER, Moll. Fam. Planorbidae: 196; Pl. 21; 66, fig. 1; Pl. 22, figs. 5–9; Pl. 79, figs. 33–35) – 1955 *Indoplanorbis exustus* (HUBENDICK, Trans. zool. Soc. London, **28** (6): 488; figs. 86–88, 177 b and 183) – 1956 *Indoplanorbis exustus* (BENTHEM-JUTTING, Treubia, **23** (2): 471; figs. 126, 135) – 1959/60 *Indoplanorbis exustus* (WENZ–ZILCH, Handb. Paläozool., Gastr. 2, Euthyneura: 105; fig. 338) – 1974 *Indoplanorbis exustus*

(BRANDT, Arch. Moll., **105** (1/4): 234; Pl. 16, fig. 99) – 1974 *Indoplanorbis exustus* (STARMÜHLNER, Bull. Fish. Res. Stn., Sri Lanka, **25** (1/2): 165; Pl. 16, figs. 164, 165; text-figs. 166–170) – 1976 *Indoplanorbis exustus* (STARMÜHLNER, Ann. Naturhist. Mus. Wien, **80:** 605).

Localities: S.-And.: No. 2 (3 iuv.), No. 3 (3 ind.), No. 5 (1 ind.), No. 6 (3 ind.), No. 7 (1 ind.), No. 17 (16 iuv.), No. 18 (4 ind.), No. 19 (24, partly iuv.), No. 20 (8 ind.); N.-And.: No. 5 (16, partly iuv.).

Shell: Discoidal with a slight tendency to be pseudodextral, moderately, large, base much less concave or almost flat; periphery rounded, narrowly and irregularly striated by the growth striae; last whorl occasionally of irregular shape and mostly with inflations and constrictions; 4 to 5 whorls, rapidly increasing in diameter, last whorl very large and dilated towards the aperture, often bell-shaped and slightly ascending; aperture, broad, sickle-shaped and little oblique; shell often coated by mud and reddish to blackish encrustations (Pl. 5, Fig. 18 a, b).

Sizes (in mm) Localities		Shell Diameter	Aperture Height	Aperture Diameter
S.-And.:	No. 2 (iuv.)	6	4.3	3.4
	No. 3	15.3	8	6.5
	No. 5	9.4	5.4	4.3
	No. 6	11.6	5.6	5.2
	No. 7	10	5	3.7
	No. 17	10.5	5.3	4
	No. 18	12.4	6.5	4.5
	No. 19	11.8	6	5.3
	No. 20	18.7	9.7	8.1
N.-And.:	No. 5	17	9	7.5

(The height of the shell correspond with the height of the aperture).
The sizes are from the largest specimens in the samples.

Anatomical remarks: Detailled descriptions and figures are given by RAO (1923); BAKER (1945); HUBENDICK (1955); BENTHEM-JUTTING (1956); BRANDT (1974) and STARMÜHLNER (1974).

Biological-ecological remarks: *Indoplanorbis exustus* is typically for stagnant waters with rich vegetation and organic debris, but also to find near the banks of slowly running waters, up to a surface current of 20 cm/sec. Mostly associated with *Melanoides tuberculata, Tarebia granifera* and *Thiara scabra,* the shells often correded and with growth of filamentous algae. Density from sporadic to 10–20 ind./1/16 m².

	Range of:		
Temperature	Conductivity	pH	Total Hardness
23.2° – >30° C	59–242 µ Siemens	6–7.9	1°–13° dH

Geographical range: Mesopotamia, India, Ceylon, Malay Peninsula and Archipelago, Following BRANDT (1974) the species is introduced in Java, Celebes,

Japan and Hawaii and following STARMÜHLNER (1976) also in New Guinea (Port Moresby) and Tahiti.

5. General Part

5.1 Distribution of the Freshwater (and Brackishwater) Gastropods in South-Andaman

5.1.1 Running Waters (Fig. 29).

A. Headwaters and Upper courses (200 m – 100 m altitude):

Ecological dates:

Temp.: 24.6° C (–29.2° C: outflow of the Dhanikari-reservoir, sunny!);

Chem.: Cond.: (59 µ Siemens: outflow of the Dhanikari-reservoir!) – 148 µ Siemens; *Tot. H.:* (1° dH: outflow of the Dhanikari-reservoir!) – 2.6° dH; *pH:* 6–7; *Ca:* (2,5 mg/l: outflow of the Dhanikari-reservoir!) – 13 mg/l; *Mg:* (3 mg/l: outflow of the Dhanikari-reservoir!) – 10 mg/l.

A.1 Banks and pools (0–30 cm/sec):

Melanoides tuberculata, Thiara scabra, Indoplanorbis exustus.

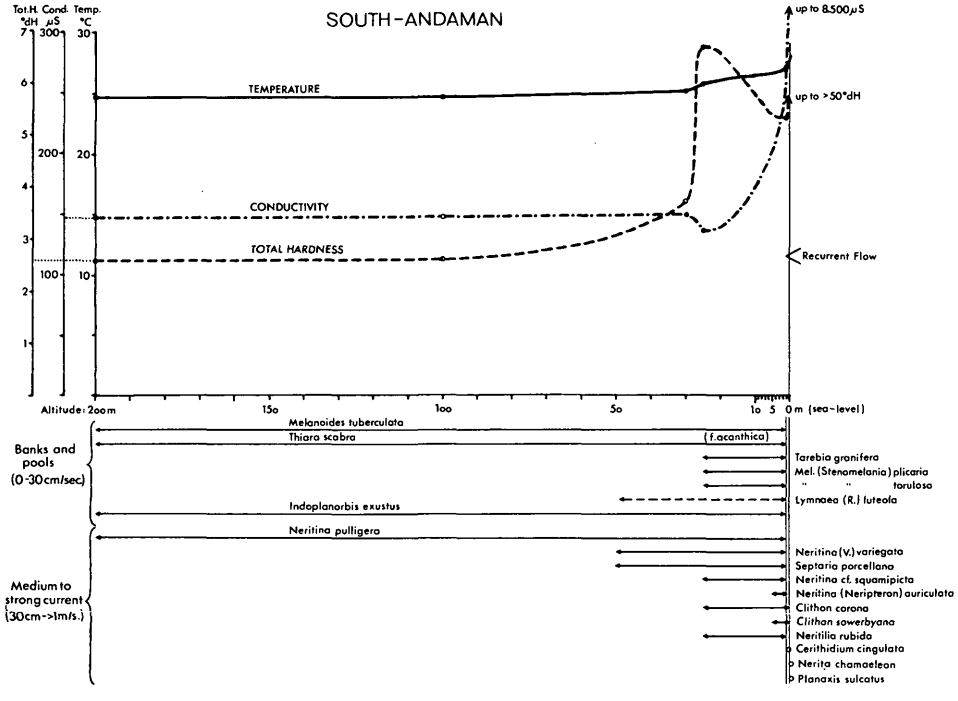

Fig. 29. Distribution of the Fresh and Brackishwater Gastropds in South Andaman in Running Waters between the Headwaters and the Mouth Region in connection with Water-Temperature, Conductivity and Total Hardness (Water-Temp.: in ° C; Cond.: in µ Siemens; Tot. H.: in ° dH). (graph: F. DORNER)

A.2 Medium to strong current (30 cm – >1 m/sec):

Neritina pulligera

B. Middle courses (100 m – 25 m altitude):

Ecological dates:

Temp.: 23.2° C – 28.5° C (average: 25.2° C); *Chem.: Cond.:* 84–242 µ Siemens (average: 150 µ Siemens); *pH:* 6.5–7.8; *Tot. H.:* 0.8° dH – 5.9° dH (average: 3.7° dH); *Ca:* 2–23 mg/l (average: 13.6 mg/l); *Mg:* 6–14 mg/l (average: 7 mg/l).

B.1 Banks and pools (0–30 cm/sec):

Melanoides tuberculata, Thiara scabra, Indoplanorbis exustus.

B.2 Medium to strong current (30 cm – >1 m/sec):

Neritina (V.) variegata, Neritina pulligera, Septaria porcellana.

C. Lower courses (25 m – about 1 m altitude):

Upper parts, upstream of the influence of the recurrent flow of the high tide and brackish water:

Ecological dates:

Temp.: 24.2° C – 26.8° C (average: 25.6° C); *Chem.: Cond.:* 74–233 µ Siemens (average: 137 µ Siemens); *pH:* 6.8–7.9; *Tot. H.:* 1° dH – 11° dH (average: 6.7° dH); *Ca:* 2–19 mg/l (average: 8.6 mg/l); *Mg:* 5–8 mg/l (average: 6.5 mg/l).

C.1 Banks and pools (0–30 cm/sec):

Melanoides tuberculata, Melanoides (Stenomelania) plicaria, Melanoides (Stenomelania) torulosa, Thiara scabra, Tarebia granifera, Indoplanorbis exustus, Lymnaea (Radix) luteola.

C.2 Medium to strong current (30 cm – °1 m/sec):

Clithon corona, Clithon sowerbyana (lower parts only!), *Neritina (V.) variegata, Neritina pulligera, Neritina* cf. *squamipicta, Septaria porcellana, Neritilia rubida.*

D. Lower courses to the mouth-zones (from about 1 m altitude to sea level):

Lower parts with influence of the recurrent flow during high tide: brackish, during low-tide freshwater.

Ecological dates:

Temp.: 25.1° C – >30° C; *Chem.: Cond.:* 113–401 µ Siemens (average: 270 µ Siemens); *pH:* 6.8–7.9; *Tot. H.:* 2° dH – 10° dH (average: 5.3° dH); *Ca:*

0–31 mg/l (average: 18.6 mg/l); *Mg:* 4–30 mg/l (average: 15.3 mg/l); *Na:* 45 mg/l; *Cl:* 39–44 mg/l (average: 41.5 mg/l).

D.1 Banks and pools (0–30 cm/sec):

Melanoides tuberculata, Melanoides (Stenomelania) plicaria, Melanoides (Stenomelania) torulosa, Thiara scabra f. *acanthica.*

D.2 Medium to strong current (30 cm – >1 m/sec):

Clithon corona (spiny form), *Clithon sowerbyana, Neritina (V.) variegata, Neritina (Neripteron) auriculata, Neritina pulligera, Neritina* cf. *squamipicta, Septaria porcellana, Neritilia rubida.*

E. Mouth-region (sea-level):

During low-tide brackish water, during high-tide covered with sea-water.

Ecological dates:

Temp.: 28.1° C; *Chem.* (low-tide, brackish): *Cond.:* 7521–9500 µ Siemens (average: 8510 µ Siemens); *pH:* 6.9–7.2; *Tot. H.:* up to 50° dH; *Ca:* 82–87 mg/l (average: 84.5 mg/l); *Mg:* 245 mg/l; *Na:* 1750 mg/l; *Cl:* 3360 mg/l.

E.1 Medium current (during low-tide only: 30–50 cm/sec):

Clithon corona, Clithon sowerbyana, Neritina (Neripteron) auriculata (only sporadic in the upper parts!); brackish species: *Cerithidea cingulata;* marine, litoral species: *Nerita chamaeleon, Planaxis sulcata.*

According to the relatively low altitudes of the hills with the origin of the headwaters and the short distances between the headwaters and the mouth regions the water temperature increase from an average of about 24° C in the upper courses only to an average of 25.2° C in the middle courses and up to an average of 27° C (maximum up to 30° C in sunny localities) in the lower courses and mouth-regions. These indicates only an average increase of about 3° C (between absolute found minimum and maximum: 7° C; depending on the situation of the running water, free and sunny or bordered by forest and shady).

The water chemistry shows also only slightly differences in the found values of the electric conductivity of the waters, it ranges between 137 and 150 µ Siemens in average. Only in the lower courses increase the conductivity, influenced partly by villages and cultivations (pollution by washing-places, fertilizers) and partly in the lower parts by influence of brackish water in the transition-zone to the recurrent flow during high-tide: up to an average of 270 µ Siemens (maximum up to 401 µ Siemens!). In the brackish mouth-region, influenced by sea water also by low-tide the conductivity increase up to 8500 µ Siemens and more. These values correspond with the the values of the total hardness: upper and middle courses with soft water and and an average hardness of 2.6° dH to 3.7° dH, in the lower courses increase the hardness to 5.3° dH – 6.7° dH with medium hard water. In the

mouth-zones (the hardness goes up to about 50° dH), extremly hard brackish water with an high content on mineral-salts (Ca: 84.5 mg/l, Mg: 245 mg/l, Na: 1750 mg/l, Cl: 3360 mg/l).

From the upper courses downstream to the lower courses and the transition zone with influence of brackish water from the recurrent flow of the high tide occur near the borders and in pools between cascade-zones: *Melanoides tuberculata, Thiara scabra* and the pulmonate snail *Indoplanorbis exustus.* These species, ocurring also in stagnant waters, are to be found in running waters only to a current-velocity up to 30 cm/sec. In such habitats the bottom is composed by mud, sand, sporadic gravel, covered with mud and algae, besides of thick layers of organic debris. Sometimes paddings of filamentous algae, such as *Spirogyra* sp. are developped. In the transition-zone between fresh- and brackish water occur sometimes *Melanoides tuberculata* and *Thiara scabra* f. *acanthica,* both species tolerate slightly brackish water (STARMÜHLNER, 1976).

In the cascade-zones of the upper courses with a surface current from 30 cm/sec up to more than 1 m/sec the bottom is covered by gravel, boulders and in strong current by rocks. Between a current of 50 cm/sec – 1 m/sec is to be found on the sides of stones *Neritina pulligera.* In the middle courses occurs also *Septaria porcellana* – mostly in the strong current – on the surface of stones and rocks. Both species are to be found also downstream in the lower courses, but always upstream of the brackish water of the recurrent flow.

In the lower courses, near the banks and in pools between cascade-zones two species of *Melanoides (Stenomelania)* are typically: *M. (Stenomelania) plicaria* and *M. (Stenomelania) torulosa.* Like all species of the subgenus *Stenomelania* they have still free living veliger larvae, like their marine ancestors (SESHAIYA, 1940; ABBOTT, 1952; STARMÜHLNER, 1976). The shells of *Thiara scabra* in habitats near the recurrent flow with change of fresh- and brackish water bear long spines (f. *acanthica*) whereas the shells of specimens living upstream always in freshwater have almostly bluntly knobs (only specimens living in stagnant freshwater have also spines (RIECH, 1937; STARMÜHLNER, 1976). At one station of the lower courses was also recorded *Tarebia granifera* and at one station also one single young specimen of *Lymnaea (Radix) luteola,* reported by HUBENDICK (1951) from the Andamans.

In the cascade zones of the lower courses increase the number of species and number of individues of the family Neritidae: in addition to *Neritina pulligera* and *Septaria borbonica* occur in the lower courses also *Neritina (V.) variegata, Neritina* cf. *squamipicta* and downstream, near to the transition to the influence of the recurrent flow (during high-tide) *Clithon corona, Clithon sowerbyana, Neritina (Neripteron) auriculata* and the small *Neritilia rubida.* Both species of *Clithon* (and very sporadic in the transition zone also *Neritina (N.) auriculata*) are typically for the mouth-zone and tolerate brackish water, resp. also see water during the high-tide, Specially *Clithon corona* – with a high variation in colour pattern – was recorded in a high frequency with an average of 150 ind./1/16 m^2! The snails are active during low tide covered with brackish water, but entrenched in the sandy-gravely bottom during the high-tide with sea water. In the mouth-zone were found,

associated with *Clithon corona,* sporadic the estuarine species *Cerithidea cingulata* and, immigrated from the litoral of the coast the marine species *Nerita chamaeleon* and, also sporadic, *Planaxis sulcatus.*

5.1.2 Stagnant Waters (Pools)

Ecological dates:
Temp.: 26.6° C 5– °30° C; *pH:* 7; *Tot. H.:* 13° dH.
Melanoides tuberculata, Indoplanorbis exustus.

5.2 Distribution of the Freshwater Gastropods in North-Andaman

5.2.1 Running waters (Fig. 30)

A. Middle courses (50 m – 30 m altitude):

Ecological dates:
Temp.: 24.9° C – 26.2° C (average: 25.5° C); *Che: Cond.:* 272–306 ° Siemens (average: 290 ° Siemens); *pH:* 7.8–8; *Tot. H.:* 10° dH; *Ca:* 6–8 mg/l (average: 7 mg/l); *Mg:* 41 mg/l.

A.1 Banks and pools (0–30 cm/sec):

Melanoides tuberculata.

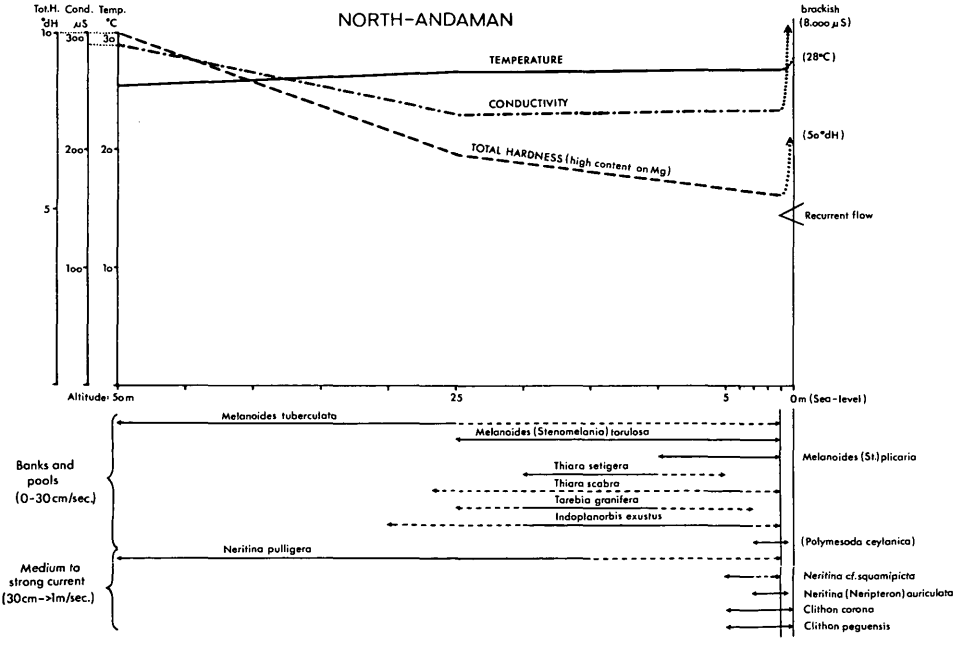

Fig. 30. Distribution of the Fresh and Brackishwater Gastropods in North-Andaman in Running Waters between the Middle courses and the Lower courses in connection with Water-Temperature, Conductivity and Total Hardness (Water-Temp.: in ° C; Cond.: in µ Siemens; Tot. H.: in ° dH). (graph: F. DORNER)

A.2 Medium to strong current (30 cm – >1 m/sec):

Neritina pulligera.

B. Lower courses (30 m – about 5 m altitude):

Upper parts of the lower courses, upstream of the influence of brackishwater of the recurrent flow during high-tide.

Ecological dates:

Temp.: 25.6° C – 28° C (average: 26.8° C); *Chem.: Cond.:* 168–293 µ Siemens (average: 230 µ Siemens); *pH:* 6.9–7.8; *Tot. H.:* 4.4°–9° dH (average: 6.75° dH); *Ca:* 6–15 mg/l (average: 9 mg/l); *Mg:* 10–41 mg/l (average: River Kalimpong in the serpintinic area: 40 mg/l; rivers in the sedimentary area: 10 mg/l).

B.1 Banks and pools (0–30 cm/sec):

Melanoides (Stenomelania) torulosa, Thiara setigera, Tarebia granifera, Indoplanorbis exustus.

B.2 Medium to strong current (30 cm – >1 m/sec):

Neritina pulligera.

C. Lower courses, lower parts (5 m – about 3 m to 1 m altitude):

Transition zone between freshwater and slightly brackish water from the recurrent flow during high-tide.

Ecological dates:

Temp.: 26.1° C – 27.5° C (average: 26.8° C); *Chem.: Cond.:* 215–253 µ Siemens (average: 234 µ Siemens); *pH:* 7.2–7.8; *Tot. H.:* 5° dH – 5.9° dH (average: 5.45° dH); *Ca:* 12–24 (average: 17.5 mg/l); *Mg:* 13–18 mg/l (average: 15.5 mg/l).

C.1 Borders and pools (0–30 cm/sec):

Melanoides (Stenomelania) plicaria, Melanoides (Stenomelania) torulosa, Thiara scabra, Indoplanorbis exustus; (mussel: *Polymesoda ceylanica).*

C.2 Medium to strong current (30 cm – >1 m/sec):

Clithon corona, Clithon peguensis, Neritina (Neripteron) auriculata, Neritina cf. *squamipicta.*

At North-Andaman only few stations were observed by our mission. No dates were available from the headwaters, upper courses at one hand and from the mouth-zone at other hand.

In the short distances between the middle and lower courses (mostly represented by station at the River Kalimpong) the average temperature of the water increases from 25.6° C to 26.8° C with an average amplitude of only 1.2° C.

The chemistry of the water shows a difference to the situation at South-Andaman. The River Kalimpong, flowing from the slopes of the Saddle-Peak, streams over serpentinic rocks. The conductivity reaches values between 272 and 306 μ Siemens and the hardness 9°–10° dH. These water is rich on Mg-ions, with an content of about 40 mg/l (Ca: about 7 mg/l). In the transition from the middle to the lower courses, flowing through a sedimentary area, the conductivity goes down to an average of 230 μ Siemens and the total hardness to an average of 6°–7° dH (Mg: 10 mg/l; Ca: 9 mg/l).

From the middle to the lower courses (upstream of the influence of brackish water from the recurrent flow) occurs only *Neritina pulligera.* In the middle courses was found in the regions with slow current *Melanoides tuberculata,* in the lower courses *Melanoides (Stenomelania) torulosa* was frequent near the banks and in pools between cascade-zones. Other species found in these habitat were *Tarebia granifera,* and – sporadic – *Thiara setigera* and *Indoplanorbis exustus.*

In the lower parts of the lower courses, the transition-zone to the brackish habitats, influenced by the recurrent flow during high-tide increase the density of *Melanoides (Stenomelania) torulosa* and it occurs also the second species *Melanoides (St.) plicaria.* These species were associated with *Thiara scabra* and – sporadic – *Indoplanorbis exustus* were represented. In the muddy bottom was also typically the mussel *Polymesoda ceylanica.* In the cascade-zones of these region are dominating, like in South-Andaman, the species of the genus *Clithon,* represented by *Clithon corona* and *Clithon peguensis.* On the backside of stones was to find *Neritina (Neripteron) auriculata* and – sporadic – *Neritina* cf. *squamipicta.*

5.3 Geographical range of the Fresh- (and Brackish)water Gastropods of North- and South-Andaman

Following list gives a survey on the geographical range of the found gastropods:

Species	E. Afr.	Mad. + Masc.	Ceyl.	Ind.	B.	Mal. P	And. + Nic.	Mal. Arch.	Phil.	N. G.	Pac. Is.
(Nerita chamaeleon)	(+)	(+)	+	+	+	+	+	+	?	–	–
Clithon corona	–	–	–	–	?	(+)	+	+	+	+	+
Clithon peguensis	–	–	–	? Bengal	+	(+)	+ N.-And.	–	–	–	–
Clithon sowerbyana	–	–	–	–	–	+	+	+	+	–	–
Neritina (Neript.) auriculata	?	+	+	?	?	?	+	+	+	+	+
Neritina (V.) variegata	–	–	–	–	–	?	+	+	+	+	+
Neritina pulligera	+	+	–	–	–	?	+	+	+	+	+

Species	E. Afr.	Mad. + Masc.	Ceyl.	Ind.	B.	Mal. P	And. + Nic.	Mal. Arch.	Phil.	N. G.	Pac. Is.
Neritina cf. *squamipicta*	–	–	–	–	–	?	+	+	+	?	+
Septaria porcellana	–	–	+	–	?	?	+	+	+	+	+
Neritilia rubida	–	–	–	–	–	–	+	+	?	+	+
Thiara scabra	+	+	+	+	+	+	+	+	+	+	+
Thiara setigera	–	–	–	–	–	–	+	+	+	–	–
Melanoides (M.) tuberculata	+	+	+	+	+	+	+	+	+	+	+
Melanoides (Stenomelania) plicaria	–	–	–	–	–	–	+	+	+	+	+
Melanoides (Stenomelania) torulosa	–	–	–	+	+	+	+	+	+	?	(Solomons) +
Tarebia granifera	–	–	–	+	+	+	+	+	+	+	+
(Planaxis sulcatus)	?	?	+	+	+	+	+	+	+	+	+
Cerithidea cingulata	–	–	+	+	+	+	+	+	+	+	?
Lymnaea (Radix) luteola	–	–	+	+	+	+	+	–	–	–	–
Indoplanorbis exustus	–	+ –	+	+	+	+	+	+	–	+ intr.	+ Tahiti intr.

Abbrevations in the list: E. Afr. = East-Africa (coast); Mad. + Masc. = Madagascar and Mascareignes Islands (Réunion, Mauritius); Ceyl.: Ceylon; Ind.: India (coast); B.: Burma (coast of Further India); Mal. P.: Malay Peninsula; And. + Nic.: Andaman and Nicobars; Mal. Arch.: Malay Archipelago; Phil.: Philippines; N. G.: New Guinea; Pac. Is.: Pacific Islands; ( ) = marine species; + = present; (+) = probably present; ? = doubtfull; – = not recorded; intr. = introduced by man.

5.3.1 Indopacific Distribution

a) (North-) to Est-Africa, Madagascar, East African Islands, Ceylon, India (northwest to Middle East and Lower Asia), Burma, Malay Peninsula, Andaman & Nicobars, Malay Archipelago, SE-Asia, S-China, New Guinea, Philippines, N-, E-Australia, Pacific Islands:

Melanoides tuberculata, Thiara scabra (excl. N-Africa, Lower Asia, Middle East)

b) E-Africa, Madagascar and East-African Islands, Andaman & Nicobars, Malay Archipelago, Philippines, S-E-Asia, New Guinea, Pacific Islands:

Neritina pulligera (with many local forms)

c) Madagascar and East-African Islands, Ceylon, Andaman & Nicobars, Philippines, S-E-Asia, New Guinea, Pacific Islands:
Neritina (Neripteron) auriculata

5.3.2 Indomalayan-Pacific Distribution

Ceylon, India (coast), Burma, Malay Peninsula, Andaman & Nicobars, Malay Archipelago, Philippines, New Guinea, Pacific Islands:
Cerithidea cingulata (also SE-Asia), *Septaria porcellana, Melanoides (Stenomelania) torulosa, Tarebia granifera* (also SE-Asia).

5.3.3 Malayan-Pacific Distribution

Andaman & Nicobars, Malay Archipelago, Philippines, New Guinea, Pacific Islands:
Clithon corona, Neritina (V.) variegata, Neritina cf. *squamipicta, Neritilia rubida, Melanoides (Stenomelania) plicaria.*

5.3.4 Malayan Distribution

Andaman & Nicobars, Malay Archipelago, Philippines:
Thiara setigera, Clithon sowerbyana (Bengal?)

5.3.5 Indomalayan Distribution

India, Ceylon, Andaman & Nicobars, Burma, Malay Peninsula, Malay Archipelago (Sumatra):
(Nerita chamaeleon-marine!), *Indoplanorbis exustus* (north west of India until Mesopotamia, north-east until Thailand, introduced accidentally by man: Java, Celebes, New Guinea, Tahiti, Hawaii).

5.3.6 Indian-Further Indian Distribution

India, Ceylon, Burma, Malay Peninsula, Andaman & Nicobars:
Lymnaea (Radix) luteola

5.3.7 Further India Distribution

(Bengal?), Burma, Andaman (& Nicobars?), (Malay Peninsula?), Thailand:
Clithon peguensis

5.4 Comparison of the geographical range of the recorded fresh- and brackish-water gastropods of the Andaman-Island

5.4.1 North-Andaman

From 12 species of fresh- (and brackish-)water gastropods, found in the running waters of North-Andaman (vicinity of Diglipur) are:

Indopacific:	33%
Indomalayan-Pacific:	17%
Malayan-Pacific:	25%
Malayan:	8%
Indomalayan	8%
Further Indian:	8%
approx.	100%

One third of the found species have a wide distribution in the Indopacific area, together with species, distributed from the Eastern Indian Ocean coasts to the (Southern) Pacific Islands they include about 75% of all recorded species. Nearly 17% are to be found from India, resp. the Andaman & Nicobars to the Malay Archipelago and one species – *Clithon peguensis* is only represented in Further India (south – coast of Burma, resp. North-Andaman and Thailand). These species is one of the many zoological and botanical examples of the near relations to the fauna (and flora) of the birmese Arakan-region to North-Andaman, explained as relicts from a former land-connection.

5.4.2 South-Andaman

From 16 species of fresh- (and brackish-)water gastropods, found in the running and stagnant inland-waters of South-Andaman (vicinity of Port Blair) are:

Indopacific:	25%
Indomalayan-Pacific:	25%
Malayan-Pacific:	31%
Malayan:	6%
Indomalayan	6%
Indo-(Further Indian):	6%
approx.	100%

More than the half of the recorded fresh- (and brackish-)water gastropods (56%) have a distribution from the eastern Indian to the (southern) Pacific. Including the found species distributed from the western Indian Ocean to the Pacific Islands these group includes more than four fifth (81%) of the water gastropods, recorded at South-Andaman!

Only three species (18%), about one fifth *Clithon sowerbyana, Lymneae (Radix) luteola* and *Indoplanorbis exustus* are restricted to the Indomalayan, resp. the Indian region. Only *Indoplanorbis exustus* extends its range eastwards till Mesopotamia and was introduced accidentally by man to Java, Celebes and different Pacific islands.

In conclusion it is to state that the fauna of freshwater (and brackish) gastropods of the inland waters of North- and South-Andaman show distinct relations to the fauna of the Malay Archipelago and the (southern) Pacific islands, but only few relations to the fauna of India and Ceylon. Except species widely distributed with many local forms on the coasts of the Indopacific, such as *Neritina (Neritina) pulligera, Neritina (Neripteron) auriculata, Melanoides tuberculata* and

Thiara scabra, no species, typically for the western Indian Ocean coasts (coast of E- and SE-Africa, Madagascar, Seychelles, Comores, La Réunion, Mauritius and Rodriguez (STARMÜHLNER, 1969; 1974) are to be found in the inland and coastal waters of the Andaman-islands.

6. Acknowledgments

The author thanks the Austrian FONDS ZUR FÖRDERUNG DER WISSENSCHAFT (Project: No. 2942), the KULTURAMT DER STADT WIEN and the ERSTE OESTERREICHISCHE SPAR-CASSE for the grants making possible the execution of the mission to the Andaman-Islands.

For cooperation and aid in Andaman-Islands gratefull acknowledgement to the Government of India and the Andaman & Nicobar Administration, the Central Marine Fisheries Research Institute of India (Director: Dr. S. SILAS) with Mr. K. K. APPUTTAN (Vizinham Research Station) and the Officer-in-Charge of the Substation of CMFRI in Port Blair Mr. D. B. JAMES.

The author has also to thank to Mrs. Prof. M. MIZZARO and Mr. F. DORNER for the drawings of the map and the graphs and Mr. A. BELLINGRATH for the execution of the text-figures after the pattern of the author. Prof. M. MIZZARO has also made the photographs of the shells.

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Abbrevations of the text-figures

A: A. g.: Albumen gland. **B:** B. p.: Brood pouch (with embryos). **C:** Cal.: Callus; Ce. t.: Central tooth (= Rachis tooth); Cr. s.: Crystal sac. **D:** D. ej.: Ductus ejaculatorius; Du. e.: Ductus enigmaticus. **F:** F.: Foot; F. p.: Finger-shaped process (mantle edge fringed); Fl. f.: Flap-shaped fold. **G:** G.: Gill. **I:** I. l. t.: Inner lateral tooth; I. m. t.: Inner marginal tooth. **K:** Kid.: Kidney. **L:** L. t.: Lateral tooth. **M:** M. t.: Marginal tooth. **O:** O. l. t.: Outer lateral tooth; O. m. t.: Outer marginal tooth; Oot.: Ootyp (with

capsule gland); Ov.: Oviduct. **R:** Re.: Rectum; R. s.: Receptaculum seminis. **S:** Sp. s.: Spermatophor sac (= Spermatheca). **U:** Ur.: Urether (= Renal duct); Ut. p.: Uteral part (of the oviduct). **V:** Vag.: Vagina; Vag. c. d.: Vaginal connecting duct; Vas. d.: Vas deferens.

Explanation of Plates

Plate 1

Fig. 1. *Nerita chamaeleon:* **a:** aperture with operculum; **b:** dorsal side.

Fig. 2. *Clithon corona:* **a:** aperture with operculum; **b:** dorsal side of a juvenile specimen; **c:** dorsal side of a specimen with two short spines; **d–j:** dorsal side different colour-patterns from specimens in brackish habitat; **k–n:** dorsal side, spiny specimens from the transition zone between fresh and brackish water (recurrent flow); **o:** aperture with operculum; **p:** dorsal side with one prominent spine; **q:** dorsal side, accentuated "shouldered" and with spines; **r:** dorsal side with eroded spines and spire; **s:** dorsal side with eroded spines and spire; **t:** aperture with operculum; **u:** dorsal side with accentuated "shoulder" and spines; **v:** aperture with operculum.

Plate 2

Fig. 3. *Clithon peguensis:* **a:** aperture with operculum; **b:** dorsal side.

Fig. 4. *Clithon sowerbyana:* **a:** aperture with operculum; **b:** dorsal side; **c–e:** dorsal side, variation of the colour pattern from specimens in brackish water.

Fig. 5. *Clithon variegata:* **a:** aperture with operculum; **b–f:** dorsal sides; variations of the colour patterns.

Plate 3

Fig. 6. *Neritina (Neripteron) auriculata:* **a:** aperture with operculum; **b:** dorsal side.

Fig. 7. *Neritina (Neritina) pulligera:* **a:** aperture with operculum: **b:** dorsal side (apex eroded).

Fig. 8. *Neritina (Neritina)* cf. *squamipicta:* **a:** aperture with operculum; **b:** dorsal side.

Fig. 9. *Septaria porcellana:* **a:** ventral side with foot; **b:** dorsal side.

Fig. 10: *Neritilia rubida:* **a:** aperture; **b:** dorsal side.

Plate 4

Fig. 11. *Thiara scabra:* **a:** aperture, apex eroded, short spines; **b:** aperture, apex eroded; knobs; **c:** f. *acanthica:* aperture, with spines and knobs, apex eroded; **d:** f. *acanthica:* aperture, prominent spines, apex eroded, the specimens c and d are from the transition zone between fresh- and brackish water.

Fig. 12. *Thiara setigera:* **a:** aperture.

Fig. 13. *Melanoides tuberculata:* **a:** aperture, apex eroded.

Fig. 14. *Melanoides (Stenomelania) plicaria:* **a:** adult specimen with eroded upper whorls; **b:** young specimens, only the apex eroded; **c:** adult specimen with eroded upper whorls and erosion-perforations; **d–e:** young and juvenil specimens with upper whorls, the first whorls ventrically plicated.

Plate 5

Fig. 15. *Melanoides (Stenomelania) torulosa:* **a:** with spiral ridges, crossed, in the upper parts of the whorls, by transvers lines in rows of nodules: **b:** with spiral lines separating flat ridges; **c:** with fine decurrent spiral lines; **d:** old, decollated specimen, flat ridges flattened, eroded; **e:** young specimen with axially plicated upper whorls, lower whorls with typically spiral ridges.

Fig. 16. *Tarebia granifera:* **a–b:** f. *lineata* with fine dark lines coinciding with the spiral ridges, apex eroded; **c–d:** coarsely sculpturd by elevated rides in vertical and spiral direction, causing blunt nodules in the upper third of the whorls; apex eroded.

Fig. 17. *Cerithidea (Cerithideopsilla) cingulata:* **a:** with three strong spiral ridges crossed by axial grooves, upper whorls eroded.

Fig. 18. *Indoplanorbis exustus:* **a:** upper side; **b:** on the below side.

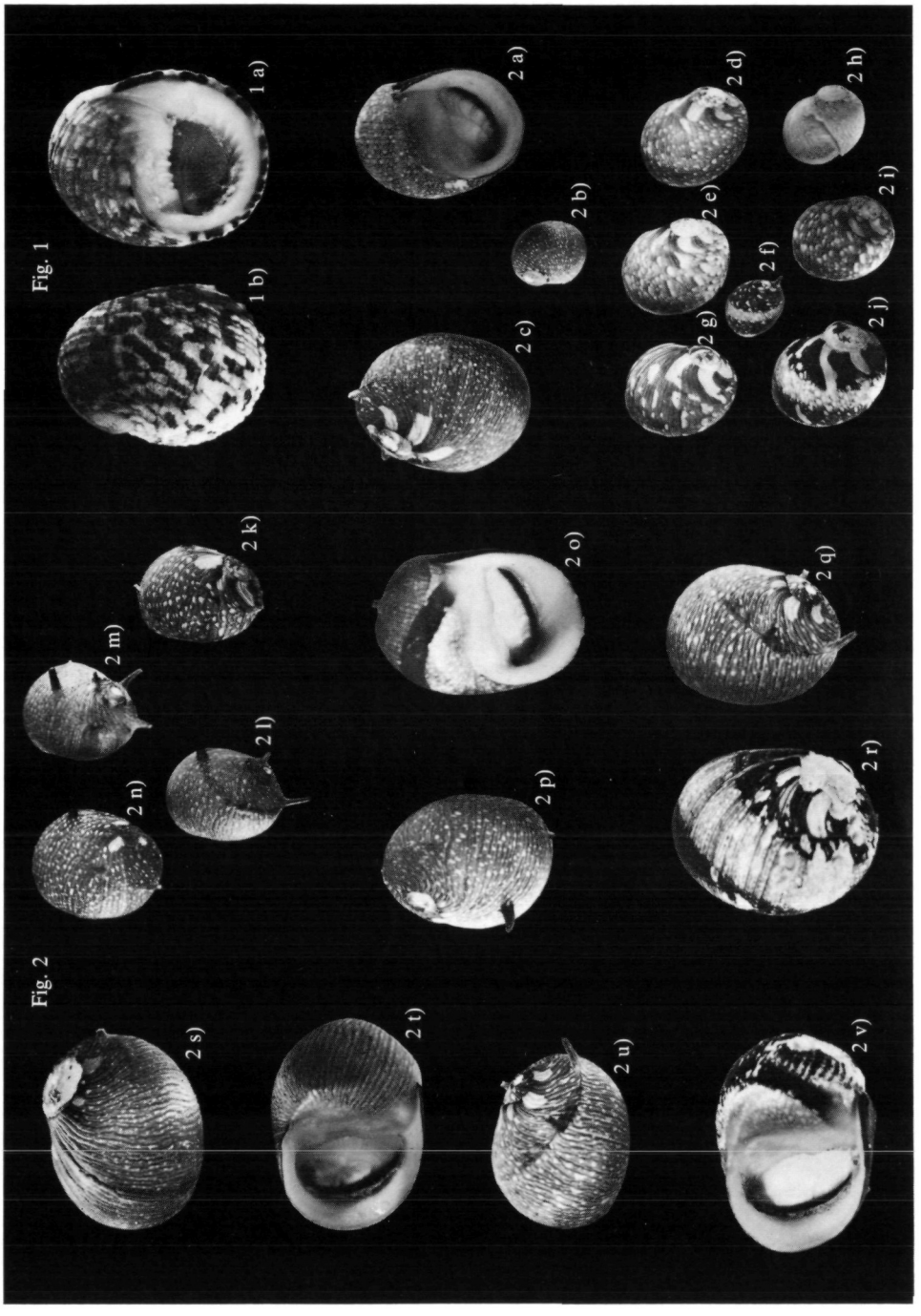
Fig. 1
1 a)
1 b)
2 a)
2 b)
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Fig. 2
2 k)
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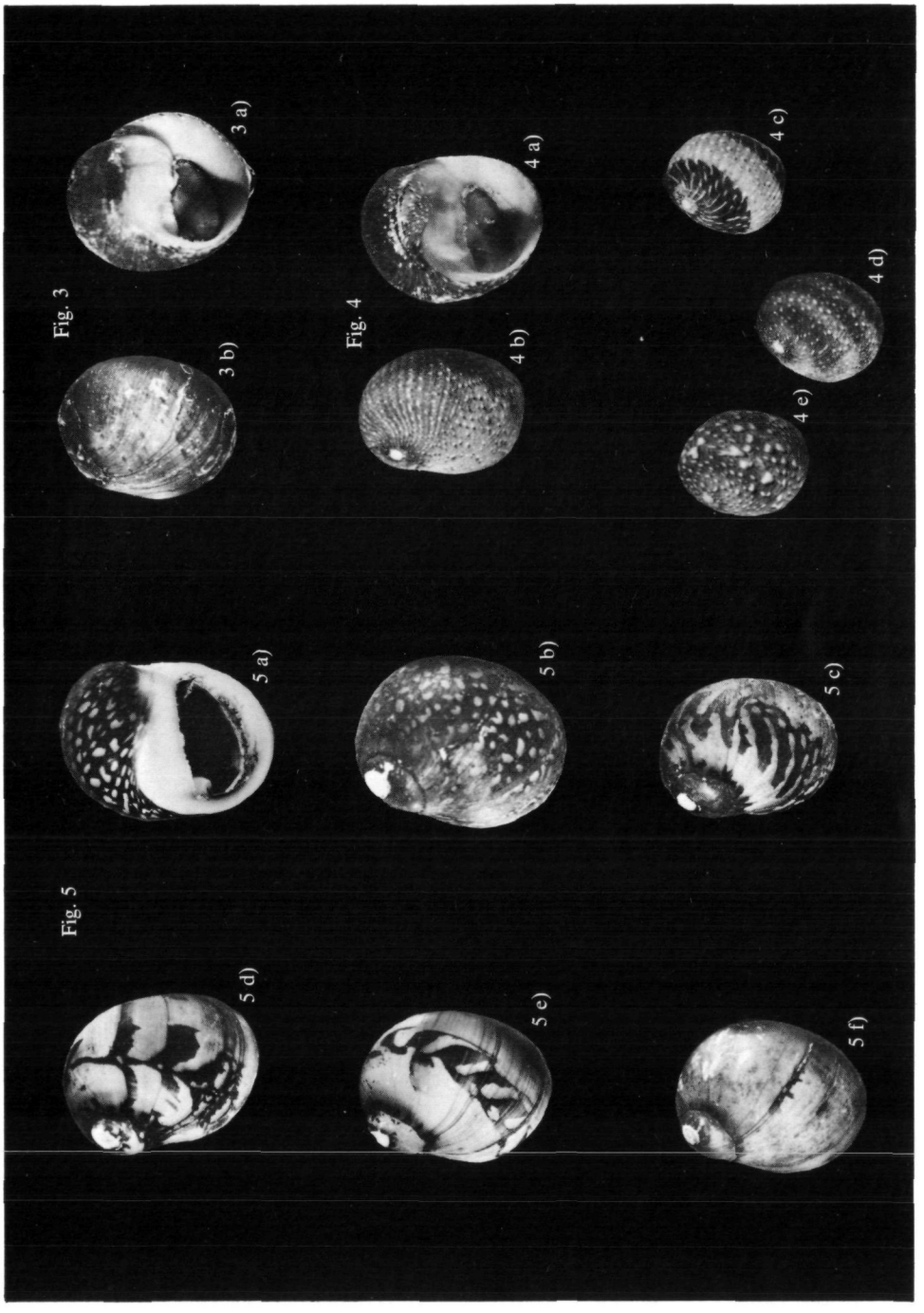
Fig. 3
3 a)
3 b)
Fig. 4
4 a)
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Fig. 5
5 a)
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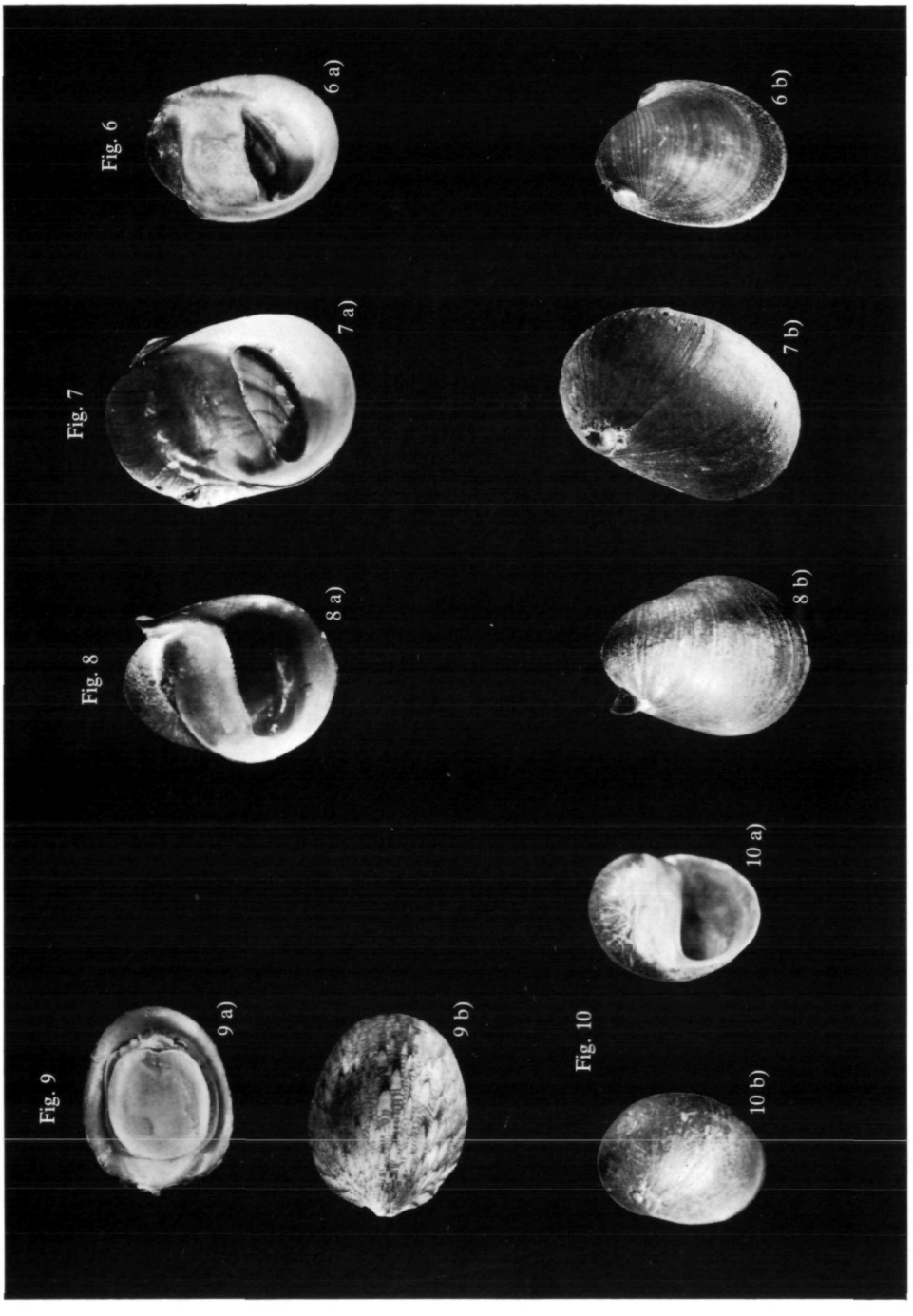
Fig. 6
6 a)
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Fig. 8
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Fig. 10
10 a)
10 b)

Fig. 11

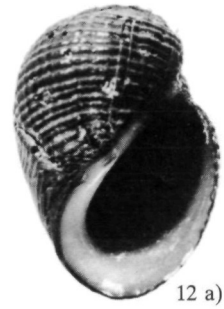
11 a)

11 b)

11 c)

11 d)

Fig. 12



12 a)

Fig. 13

13 a)

14 a)

14 b)

Fig. 14

14 c)

14 d)

14 e)

Fig. 15

15 a)

15 b)

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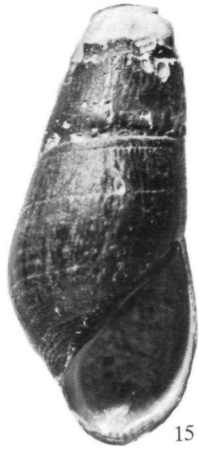


15 d)

15 e)

Fig. 16

16 a)

16 b)

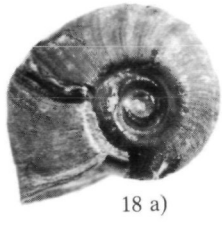
16 c)

16 d)

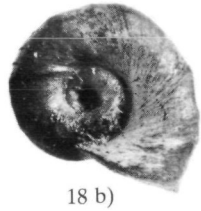
Fig. 17

17 a)

Fig. 18



18 a)



18 b)