Arch. Moll. | 101 | (1/4) | 111—140 | Frankfurt a. M., 30. 7 1971

The molluscan fauna of the Mekong at the foci of Schistosomiasis in South Laos and Cambodia.

By

ROLF A. M. BRANDT & PRASONG TEMCHAROEN,
Bangkok *).

With 20 textfigures.

This account of the molluscan fauna of the Mekong at the foci of schistosomiasis in South Laos and North Cambodia is based on material collected by the authors in the years 1967-1970 around Bandan (Thailand), Pakse, Khong Island (Laos) and Kratie (Cambodia). This survey was suggested by the late DONALD B. MCMULLEN of the Walter Reed Army Institute of Research in Washington, D. C. and was partly sponsored by a Research & Development Grant of the U. S. Army Medical Research & Development Command (Grant No. DA-CRD-AFE-S92-544-69-G146). The authors are greatly indebted to the staff of the Thomas-Dooley-Foundation at Muang Khong for their kind hospitality and technical assistance. The authors would furthermore like to express their thanks to the authorities of the USAID at Pakse, to the WHO at Vientiane and to the representatives of the "Mekong Committee" for valuable technical help.

One of the primary objectives of this survey was to find the intermediate host or hosts of human schistosomiasis in the Mekong valley. Although we still need the last proof for a publication on the life cycle of the Mekong schistosomiasis that the suspected snails are really the intermediate hosts, we are convinced that the intermediate host was found. The species is a member of the Hydrobiid subfamily of Lithoglyphinae, *Pachydrobia bavayi* BRANDT, 1970.

An account of the malacological history of the Mekong can be given in few lines. The first visitor of the Mekong valley who collected molluscs, was HENRI MOUHOT, a Frenchman, who came to Cambodia in 1859 and died in the Mekong valley near Luang Prabang in Laos in 1879. In 1873 a French expedition to Cambodia had the objective to study the ancient Khmer monuments in that country. The expedition which was lead by DELAPORTE included several zoologists and other scientists as JULLIEN, HARMAND and RATTE. Their collections were published by JULLIEN & DESHAYES, CROSSE & FISCHER and POIRIER. The most important expeditions in the Mekong valley were those of the "Mission Pavie" which explored Indo-China in the years from 1879 until 1895. The malacological results of these expeditions were published by MORLET, BAVAY, DAUTZENBERG, CROSSE and P. FISCHER. No noteworthy malacological research

*) Addresses of the authors: School of Tropical Medicine, 420/6 Rajvithi Road, Bangkok, Thailand.

has been done since the First World War in Laos and Cambodia, and the newly awakened interest in the molluscan fauna of the Mekong is only due to the finding of schistosomiasis in various areas of the Mekong valley.

The Mekong is not only politically exceptional, as it passes through or touches six countries (China, Burma, Laos, Thailand, Cambodia and South Vietnam), it is also malacologically exceptional, as no other river is known to host so many different species of molluscs. As the attached zoo-geographic list shows, most of the species are not only endemic to the Mekong, but show also in the river only a limited area of distribution. While the paddy-field species (Viviparidae, Ampullariidae, Bithyniidae, Lymnaeidae and Planorbidae) are distributed over wide areas of Southeast Asia, all fluviatile species of the subfamily of Lithoglyphinae are restricted to the Mekong and its tributaries only, with the exception of one species of *Pachydrobia* (*P. siamensis* BRANDT is found in the Mae Klong in West Thailand). Reports of *Pachydrobia* from Indonesia and other Asian countries refer to other genera and subfamilies. Of the snail species found in the Mekong, only those which are not restricted to the river proper have a wider distribution (*Bithynia, Clea, Wattebledia* etc.). The Muricid genus *Clea* which seems to have its centre of distribution in the Mekong, is also reported from other parts of Thailand, Cambodia, Malaysia and Indonesia.

Description of new species.

Manningiella subulata BRANDT, n. sp.

fig. 1.

Diagnosis: A species of *Manningiella* BRANDT which differs from its closest relative, *M. microsculpta* BRANDT, by its very small size, subulate shape and lack of microsculpture.

Description: Shell very small, subulate, rather thin but solid, whitish, somewhat glossy, with delicate growth lines and partial rudiments of a delicate spiral microsculpture. The six whorls increase slowly in size; they are moderately convex and separated by a simple suture. The body whorl measures about half the length of the shell. — The aperture is ovate, pointed above and well rounded below. It measures about $^4/_7$ of the height of the body whorl. Peristome sharp, connected by a very thin parietal callus; columella short, curved. — Operculum very thin, paucispiral, translucent, with eccentric nucleus. — Soft parts and radula unknown.

Size (Holotype) A 3·5 mm; D 1·3 mm.
Type locality: Mekong about 20 km north of Bandan.
Distribution: Known from the type locality only.
Material: Holotype SMRL 5436/A; paratypes SMRL 5436/2.

Hydrorissoia waltoni BRANDT, n. sp.

fig. 2.

Diagnosis: A species of *Hydrorissoia* BAVAY which differs from all other species of this genus by its broad, stout and conic shape and from all species of this genus but *elegans* by having more than three spiral ridges on the body whorl.

Description: Shell small, ovate-conoidal, with very short, conic spire and large, ovate body whorl. Shell substance vitreous, diaphanous and somewhat glossy. The 4 1/2 moderately convex whorls increase rapidly in size and are separated by a shallow suture. The body whorl measures about 4/5 of the length of the shell. The first 1 1/2 whorls are smooth, the next whorls show two weak spiral ridges, the body whorl has 6-7 ridges, one on the periphery, two between suture and periphery and 2-3 on the base. The lower part of the face of the body whorl appears somewhat flattened. — Aperture large, about half the length of the shell, ovate; peristome thick, appressed, parietal margin with a blunt tubercle. — Operculum thin, corneous, paucispiral, with eccentric nucleus, ovate, but with a delicate dent at the columellar margin.

Size A 2·3-2·8 mm; D 1·7-2·0 mm.

No data on the pigmentation of the soft parts can be given as only animals preserved in alcohol were available for examination. Although the shell is similar to that of *Jullienia poirieri*, the radula proves its systematic position to be with *Hydrorissoia*. Radula with trapezoidal rhachis. This shows a simple, squarish cutting edge and 2 basal cusps on either side which are of different size. Laterals with a large, blunt mesocone and 2 small cusps on either side of it. Inner marginals with 6 cusps, outer marginals with 4-5.

Type locality: Mekong at Sambor in North Cambodia. Only known from the type locality.

Material: Holotype SMRL 16311/A and 4 paratypes.

Etiology: This species is dedicated to Colonel Bryce C. Walton, Commanding Officer, U. S. Army Research & Development Group (Far East).

Stenothyra cambodiensis Brandt, n. sp.

fig. 3.

Diagnosis: A species of *Stenothyra* Benson which differs from *S. mcmulleni* Brandt by its extremely small size and from all other species of this genus by the lack of the filiform dorsal process.

Description: Shell very small for the genus, pupaeform or cylindrical, somewhat tapering to the obtuse apex; glossy, transparent and corneous; with very delicate growth lines, but without any traces of a spiral sculpture. The 4 whorls are moderately rounded and separated by a marginate suture. The first two whorls increase rapidly in size, the body whorl is only a little broader than the penultimate whorl. The body whorl measures about 4/5 of the length of the shell. Its end part is somewhat descending. — Aperture rather large for the genus, but still smaller than that of *hybocystoides* Bavay and not exserted as in that species. It is oval and not so oblique as in most other species of the genus. It is somewhat angled above and well rounded below. Peristome rather thick, but not lipped, only with a low parietal swelling. Umbilicus chink-like, placed above the columellar part of the aperture. — The corneous and transparent operculum is of ovate shape; it is paucispiral with eccentric nucleus. The inner surface carries the typical two short, straight, high, diverging ridges and the long, low semicircular ridge parallel to the margin.

Size: A 1·4-2·0 mm; D 0·7-1·2 mm; size of the holotope: A 1·7 mm; D 1·0 mm.

Animal without the typical dorsal filiform process. This observation was made on live animals. No data are known on the colour of the pigmentation as all collected specimens are now completely desiccated. Rhachis with 5 cusps on the cutting edge and 4 basal cusps on either side. The laterals have the cusp formula 3-1-7, the inner marginals have 8 cusps, the outer 17.

Type locality: Mekong at Sambor, North Cambodia.

Distribution: Mekong between Bandan and Kratie.

Material: Holotype SMRL 16437/A; paratypes 16437/7. — SMRL 5154/4 - Mekong at Bandan, Thailand; 5078/5 - Mekong at Gaeng Soi, Thailand; 16443/11 - Mekong at Kratie, North Cambodia; 16431/6 - Mekong at Ban Na, Khong Island, Laos; 16242/14 - Mekong at Sompamit Falls, Khone, Laos; 16444/8 - Mekong at Muang Khong, Laos.

Relationship: This species looks so much like a dwarfish form or race of *S. mcmulleni* that it would have to be considered an extremely small form of this species were it not found together with *mcmulleni* without any intermediate forms. This species is the smallest *Stenothyra* known from the Mekong in Thailand. *S. mcmulleni* BRANDT is the largest species known from freshwater, exept for individually large specimens of *hybocystoides* BAVAY.

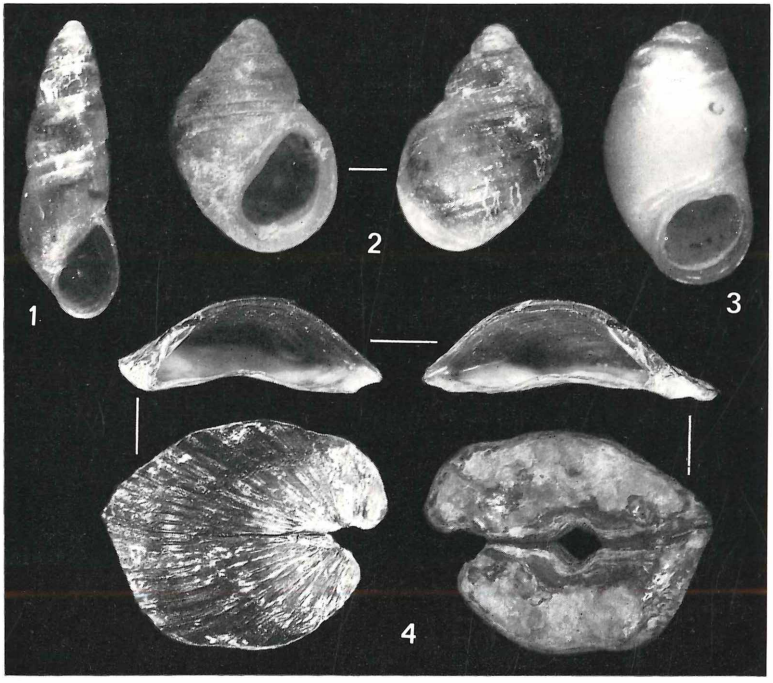

Fig. 1. *Manningiella subulata* BRANDT n. sp., $^{10}/_{1}$ (SMRL 5436/A).
Fig. 2. *Hydrorissoia waltoni* BRANDT n. sp., $^{10}/_{1}$ (SMRL 16311/A).
Fig. 3. *Stenothyra cambodiensis* BRANDT n. sp., $^{20}/_{1}$ (SMRL 16437/A).
Fig. 4. *Limnoperna depressa* BRANDT n. sp., $^{2}/_{1}$ (SMRL 17141/A).

Mytilidae RAFINESQUE, 1815.

Limnoperna ROCHEBRUNE, 1882.

Limnoperna depressa BRANDT, n. sp.

fig. 4.

Diagnosis: A species of *Limnoperna* ROCHEBRUNE which differs from *L. siamensis* (MORELET) by its extremely low, depressed shell and nacreous ventral outer side.

Description: Shell of medium size for the family but large for the genus, very depressed and broad; the sharp umbones are placed at the anterior end. There is a sharp lateral keel running from the umbones to the posterior end. The part of the shell above the keel is covered with a blackish-brown periderm, the ventral part below the keel is violet-nacreous. The shell is appressed to rocks with the nacreous ventral side. In the middle of the ventral side is a large byssus opening. The sculpture consists of strong, concentric growth lines. There is a very short septum at the anterior part of the shell, formed by shell substance underneath the umbones. This septum is different from that of *Dreissena*. The shell interior is blackish above the keel and cream-coloured below it. The dorsal line is slightly curved, the ventral side is somewhat concave. Hinge without teeth. Ligament short, placed directly behind the umbones.

Size: A 6-8 mm; L 20-23 mm; D 16-19 mm.

Mantle lobes of the animal only anteriorly connected. Anterior retractor rudimentary, posterior retractor thick, with large muscle scars in the shell. Foot finger-shaped, but very small as it is not functional anymore. The gonads are separated from the mantle.

Type locality: Mekong branch at Muang Sene, Khong Island, Laos.

Distribution: Known from the type locality only.

Biology: The shells are attached by a byssus to stones in the deep part of the river.

Material: Holotype SMRL 17141/A; paratypes 17141/9.

Localities (from north to south):

Laos:

1. Mekong near Pakse,
2. Mekong at Cham Passak (Bassak),
3. Mekong at Moulopanok,
4. Mekong at Done Houat, north of Khong,
5. Mekong at Houa Khong, northernmost tip of Khong Island,
6. Mekong at Muang Khong near Wat,
7. Mekong at Muang Khong near hospital,
8. Mekong at Ban Na on Khong Island,
9. Mekong at Ban Houay on Khong Island,
10. Mekong at Ban Hin Sion on Khong Island,
11. Mekong at Muang Sene on Khong Island,
12. Mekong at Done Tane, opposite Muang Sene,
13. Mekong at Ban Sala, south of Khong Island,
14. Mekong at Ban Done, opposite Khone,
15. Mekong at Khone,

16. Mekong 12 km north of Papaeng Falls,
17. Mekong at Sompamit Falls,
18. Mekong at Papaeng Falls.

Cambodia:

1. Mekong at Stung Treng,
2. Mekong at Kas Lognieu and Sambor,
3. Mekong at Sandan,
4. Mekong at Samboc,
5. Mekong at and opposite Kratie.

Streptoneura SPENGEL, 1881.
(Prosobranchia MILNE-EDWARDS, 1848).

Mesogastropoda THIELE, 1929.

Viviparacea, Viviparidae GRAY, 1847.

Mekongia CROSSE & FISCHER, 1876.

Mekongia jullieni (DESHAYES, 1876). textfig. 5.

There has been some doubt whether *Mekongia rattei* (FISCHER), *swainsoni* (LEA), *hainesiana* (LEA), *sphaericula* (DESHAYES), *kmeriana* (MORLET) and *massiei* (MORLET), most of them described as *Paludina,* were really congeneric with *jullieni,* the monotype of the genus *Mekongia.* All mentioned species have a radula with smooth, pointed outer marginals, the characteristic for the genus *Mekongia.* The radula of the type species, however, was not yet known. All other Viviparidae, as far as they are anatomically known, have serrate outer marginals. Examination of the radula (textfig. 5) of *jullieni* showed that this doubt was not justified. The radula shows a squarish rhachis with a very broad central cusp on the cutting edge and with 6 small, pointed cusps on either side. The laterals have the cusp formula 1-1-7, the inner and outer marginals are pointed and without cusps. The embryonic shell of this species, however, differs slightly from those of the above mentioned species. It is extremely large and shows a distinct keel. Those of all other species of the genus are round without any trace of a keel. This difference, however, does not justify a subgeneric division into one subgenus with keeled embryonic shell (*Mekongia* s. str.) and one with round embryonic shell.

Type locality: Sand-bank of the Mekong at the Kas Lognieu Island north of Sambor, Cambodia.

Distribution: This species seems to live everywhere in the Mekong between Cham Passak and Samboc. It has not yet been found in the Thai part of the Mekong. — Laos: 1, 2, 3, 4, 6, 13, 14. — Cambodia 1, 2, 3, 5.

Mekongia turbinata (DESHAYES, 1876).

Together with the monotype of *Mekongia,* DESHAYES & JULLIEN described a very similar large Viviparidae, *Paludina turbinata.* Some dead shells were found at Cham Passak, Moulapanok and Khong Island. Until the anatomy of this species is known it will be tentatively placed in the genus *Mekongia.*

Laos: 2, 3, 7.

Mekongia kmeriana (MORLET, 1890).

Type locality: Prec-Thenot at Kompong Toul, south-west of Phnom Penh. The Prec-Thenot, also spelled on maps "Prec-Thnott", is a tributary of the Tonle Bassac which it enters about 10 km south of Phnom Penh. It is also known from the Prachinburi river in East Thailand and from the Mekong in North Cambodia, but it has no continuous distribution in this area.

This species is, although relatively small for the genus, sold in the market in Kratie for food. Several thousand specimens have been examined for cercariae and metacercariae, but only two species of xiphidiocercariae have been found. As no Planorbidae live in the Mekong where they were collected, no metacercariae were to be expected in the animals.

Mekongia sphaericula (DESHAYES, 1876).
(*Paludina moreleti* DESHAYES, 1876).

The two most characteristic attributes of this species are the subglobose shape and deep-violet apex. Operculum chestnut-brown. Rhachis with 9 cusps on the cutting edge.

Type locality: Sand-bank of the Mekong north of Phnom Penh. The same locality is given for the synonymic *Paludina moreleti*. This species has not yet been found alive in the Mekong near Phnom Penh, only *M. rattei* (FISCHER).

Laos: 1, 2, 3, 5, 14, 17; Cambodia: 1, 2, 5, 6.

Mekongia lamarcki (DESHAYES, 1876).

This species differs from the preceding species by its ovate-conoidal shape. The periderm is of a brighter green, the apex is not so deep-dark and the operculum is straw coloured.

Type locality: Mekong at Kas Lognieu Island.

Distribution: Mekong between Nakon Panom and Kratie, but probably further south.

Laos: 1, 2, 3, 4, 5, 14, 17; Cambodia: 1, 2, 3, 4, 5.

Mekongia rattei (FISCHER) = *Paludina frauenfeldi* DESHAYES [non MORELET] has not yet been found near any of the foci of schistosomiasis. A subglobose-conoidal form is known from the Mekong between Nakon Panom and Tat Panom, *f. elongata* DAUTZENBERG & FISCHER is found near Phnom Penh and in the Tonle Bassac and several of its tributaries.

Anulotaia BRANDT, 1968.

This genus was established for *A. forcarti* BRANDT, a small, subglobose species from the Mun river in Thailand. Two other Thai species with strong, colourles spiral ridges (*S. mandahlbarthi* and *S. arturrolli* BRANDT) were considered congeneric with certain Chinese species, and therefore assigned to the genus *Sinotaia* HAAS.

Two other species may have to be assigned to this genus, although they differ conspicuously from the type species; these are *A. langrandierei* (BAVAY, 1898) and *mekongensis* BRANDT, 1970. Both species are subglobose with low, conic spire, but populations and individual specimens with higher spire are not rare. *A.*

lagrandierei is thinner and generally smaller than *mekongensis*. Its spiral ridges are generally sharper than those of *mekongensis*. There is a rather conic population known from the Sekong river, a tributary to the Mekong above Stung Treng.

Anulotaia lagrandierei (BAVAY, 1898). textfig. 6.

This species is much larger than the type species of the genus, *A. forcarti* BRANDT. Its texture is thin, at least in young specimens; older specimens may be thicker and not transparent. The figured holotype of this species (J. de Conch., **46**: 18, pl. 2 fig. 4) is not quite adult and therefore lower than the adults of the population from the type locality. Populations from other localities may be more conic than specimens from the type locality. The dimensions of our largest specimen are: A 30 mm; D 27 mm.

The radula shows a rounded-squarish rhachis with a low cutting edge; this carries 11 cusps. The laterals have the cusp formula 5-1-5, the inner marginals have 11, the outer marginals 6 to 8 cusps.

Type locality: Mekong branch at the Sompamit Falls near Khone, South Laos.

Distribution: Mekong and some of its tributaries between Pakse and Stung Treng. — Laos: 1, 17; Cambodia: 1.

Anulotaia mekongensis BRANDT, 1970.

Very similar to the preceding species, but larger, thicker, with weaker spiral ridges and obtuse periomphalic carina.

Cambodia: 1.

Filopaludina HABE, 1964.

This genus includes species of Viviparidae with coloured spiral bands which are sometimes raised to fine spiral ridges either at the postnuclear whorls *(Filopaludina* s. str.) or on the last two or three whorls *(Siamopaludina).*

Filopaludina (Filopaludina) s. str.

The brown bands are conspicuous; they are raised to fine spiral ridges on the postnuclear whorls, but not on the last two whorls. Operculum thin. Uterine brood-pouch with many small embryonic shells. Only one species is known from the Mekong valley.

Filopaludina sumatrensis speciosa (DESHAYES, 1876).

Not rare in quiet parts of the Mekong and its tributaries, but also in trenches, ponds and in lakes.

Laos: 1, 2, 8, 10; Cambodia: 1, 5.

Filopaludina (Siamopaludina) BRANDT, 1968.

The species of this subgenus have smooth colour bands on the postnuclear whorls and the bands are less conspicuous on the last two whorls. Here they are

sometimes raised to ridges or even keels. The shell is generally larger than that of *Filopaludina* s. str. and often of thicker texture.

F. (Siamopaludina) martensi (FRAUENFELD, 1865).
(*Paludina* [or *Sinopaludina*] *ingallsiana* REEVE [non LEA]).

This widely distributed species has a well defined geographic race, *martensi cambodjensis* MABILLE & LE MESLE, in Laos and Cambodia. This race lives in paddy-fields, klongs, trenches, ponds and lakes, but not in the Mekong river near the *Schistosoma* foci. It differs from the typical subspecies by its more rounded lower whorls and almost smooth surface. Young specimens are very similar to adult specimens of *javana*. Synonyms of this species are: *Paludina tiranti* (MORLET), *P. chalanguensis* (DESHAYES) and *P. vignesi* JULLIEN. *P. cochinchinensis* MORELET is very closely related to this race.

Laos: Known from ponds on Khong Island and from neighbouring islands, from Moulopanok, Pakse and Chom Passak. Cambodia: Common in paddy-fields, swamps and trenches in the Mekong valley.

F. (Siamopaludina) simonis (BAVAY, 1898).

This species differs from *martensi cambodjensis* by its coarse spiral microsculpture and shouldered whorls. It is thinner and generally smaller than the preceding species. It is probably only a race of *martensi* from the rapids of the Mekong.

Laos: 6, 17; Cambodia: 3.

F. (Siamopaludina) javanica (VON DEM BUSCH, 1844).

The continental race of this species which may well deserve an own name, differs from the Javanese typical race by its larger size, stronger colour bands (which are generally missing in the typical race), thicker texture and more glossy surface.

This species is much more common in the Mekong valley than *martensi*. It is found in the river proper as well as in paddy-fields, ponds and trenches.

Laos: 1, 2, 6, 15; Cambodia: 5.

Idiopoma PILSBRY, 1901.

This genus was established by PILSBRY for his *I. henzadensis*. The type, however, seems to be nothing but a local form of *I. dissimilis* (O. F. MULLER). The following two species, placed by recent authors into the genus *Bellamya*, may be assigned to this genus.

Idiopoma umbilicata (LEA, 1856).
(*Paludina ciliata* REEVE; *Paludina subciliata* KOBELT; *Paludina basicarinata* KOBELT).

Common in ponds on Khong Island. This species has not yet been found near Kratie, but has been reported from several localities in Cambodia. It does not live in the Mekong river proper nor in any other river, but is found in still water only. It is widely distributed in Thailand.

Idiopoma ingallsiana (LEA, 1856).

Very similar to the preceding species and formerly considered a form of it only. It is generally somewhat smaller, glossy, smooth, without conspicuous spiral lines; periomphalic keel and shoulder much weaker. Found together with the preceding species. The radula differs in having 15 cusps on the cutting edge of the rhachis instead of 11-13 as in *I. umbilicata*, and 13 cusps on the outer marginals (*umbilicata* has 5-7).

Laos: Known from ponds on Khong Island where it lives together with the preceding species. Not yet known from Cambodia, but found at several localities in Thailand.

Ampullariidae GRAY, 1847.

Pila RÖDING, 1798.

Pila ampullacea (LINNAEUS, 1758).
(*Ampullaria fasciata* ROISSY; *Pomacea ornata* PERRY; *A. celebensis* QUOY & GAIMARD; *A. sumatrensis* PHILIPPI; *A. linnaei* PHILIPPI; *A. turbinis* LEA; *A. dalyi* BLANFORD).

In ponds and paddy-fields on Khong Island and around Kratie. Not found in the Mekong proper.

Pila pesmei (MORLET, 1889).
(*Ampullaria begini* MORLET; *Pachylabra angelica* ANNANDALE).

This species differs from the well-known type species of the genus by its conspicuously orange-coloured peristome. It is not restricted to still water only, but also found in the Mekong at quiet places.

Laos: 1, 3, 7, 15; Cambodia: 1, 2.

Pila polita (DESHAYES, 1830).
(*Ampullaria callistoma* MORELET; *A. pagoda* MORELET; *A. brohardia* GRANGER).

In ponds on Khong Island, not in the river proper. Not yet known from the surroundings of Kratie.

Rissoacea H. & A. ADAMS, 1854.

Bithyniidae WALKER, 1927.

Bithynia LEA, 1818.

Bithynia (Digoniostoma) ANNANDALE, 1927.

Bithynia (Digoniostoma) siamensis (LEACH, 1856).
(*Bithynia laevis* MORELET).

In quiet parts of the Mekong and in trenches and ponds on Khong Island. The pond populations are identical with *siamensis siamensis*, those of the Mekong approach *s. goniomphalus* MORELET, the subspecies of East and Northeast Thailand and North Laos.

Hydrobioides NEVILL, 1884.

Hydrobioides vogeli TEMCHAROEN, 1971.

This species connects the genera *Hydrobioides* and *Parafossarulus*. Its spiral sculpture is stronger than that of any species of *Hydrobioides*, but weaker than that of the Chinese and Burmese *Parafossarulus* species. The genus *Parafossarulus* may therefore be placed into the synonymy of *Hydrobioides*.

Laos: Only known from a small pond north of the air-strip on Khong Island.

Wattebledia CROSSE, 1886.

Wattebledia crosseana (WATTEBLED, 1884).

Laos: 6, 7; not yet known from Kratie in Cambodia.

Hydrobiidae TROSCHEL, 1857.

Lithoglyphinae P. FISCHER, 1885.

(Delavayidae ANNANDALE, 1921).

Pachydrobia CROSSE & FISCHER, 1876.

Key to the *Pachydrobia* species:

1.	Shell with axial ribs or riblets	4
—	Shell smooth	2
2.	Shell larger than 10 mm	*fischeriana.*
—	Shell smaller than 8 mm	3
3.	Shell without dorsal tubercle	*bavayi.*
—	Shell with dorsal tubercle	*mcmulleni.*
4.	Body whorl with few, tubercle-like ribs	5
—	Body whorl with many axial ribs	8
5.	Shell stout, scalaroid, with short spire	6
—	Shell elongate, with long spire	7
6.	Shell longer than 10 mm	*variabilis.*
—	Shell shorter than 10 mm	*harmandi.*
7.	Shell length 10 mm and shorter	*dubiosa.*
—	Shell length 14 mm and longer	*scalaroides.*
8.	Shell turreted, size rarely above 7 mm	*poirieri.*
—	Shell ovate-conoidal, 8 mm or larger	9
9.	Back with distinct tubercle or spine	10
—	Back without distinct tubercle or spine	11
10.	Back with obtuse tubercle, 10-11 mm	*wykoffi.*
—	Back with sharp spine, 8-9 mm	*spinosa.*
11.	Ventral face of body whorl barely flattened ...	12
—	Ventral face of body whorl greatly flattened	*paradoxa.*
12.	Shell ovate, short, length about 8 mm	*bertini.*
—	Shell elongately ovoidal-conic, length 9·5-13 mm	*crooki.**)

*) Mekong at Bandan in Thailand and Sedone river in Laos. Not known from Khong and Kratie.

Pachydrobia paradoxa CROSSE & FISCHER, 1876.

The type species of this genus is only known from the Mekong in Cambodia: 2, 5, 6.

Pachydrobia spinosa POIRIER, 1881. Textfig. 7.

This is the prevailing species of the Mekong near Khong Island in Laos: 2, 4, 5, 7, 12, 17. This species is also known from Bandan in Thailand, but has not yet been found in Cambodia.

Pachydrobia scalaroides POIRIER, 1881.

Only known from Laos: 4, 12, 17.

Pachydrobia bertini POIRIER, 1881.

Only known from the Mekong near Khong Island. — Laos: 4, 12, 17.

Pachydrobia dubiosa POIRIER, 1881.

Laos: 6, 12.

Pachydrobia harmandi POIRIER, 1881.

Laos: 4, 12, 17.

Pachydrobia variabilis POIRIER, 1881. Textfig. 8.

Laos: 4, 5, 6, 7, 12.

Pachydrobia fischeriana POIRIER, 1881.

Laos: 4, 6, 12.

Pachydrobia wykoffi BRANDT, 1968.

This species which is common in the Mekong between Tat Panom and Bandan, has not yet been found south of Pakse. — Laos: 1.

Pachydrobia poirieri BRANDT, 1970.

Laos: 8, 17; Cambodia: 2, 3.

Pachydrobia mcmulleni BRANDT, 1970.

Cambodia: 1.

Pachydrobia bavayi BRANDT, 1970.

This species has been successfully infected with miracidia of *Schistosoma japonicum,* obtained from a Laotian patient from Khong Island and from dogs from Kratie. It is therefore a potential intermediate host of that trematode in the Mekong valley, though all infected snails died before cercariae could mature. This species is the only Lithoglyphinae, except for *Pachydrobia spinosa,* which was found at the "floating villages" near Kratie in Cambodia, where a considerable percentage of the population is infected with *Schistosoma. Pachydrobia spinosa* was not accepted by the miracidia of *S. japonicum,* nor were the *Stenothyra, Clea* and *Mekongia* species which live together with *P. bavayi.* Although the last proof — shedding of cercariae — is still wanting, this species must be considered the suspect of being the or an intermediate host of *Schistosoma japonicum* in the Mekong valley. As no laboratory animals were available at Kratie, no experimental infection could be made with *Schistosoma* cercariae of the *japonicum* type obtained from naturally infected snails.

Hubendickia BRANDT, 1968.

The type species of this genus, *H. siamensis* BRANDT, has only been found in the Mun river in Thailand. Its closest relative is *H. sulcata* BAVAY, described by its author as *Pachydrobia.*

Key to the *Hubendickia* species
from the Mekong between Khong and Kratie:

1. Shell with axial ribs or striae only 2
— Shell also with several weak spiral ridges ..... *rolfbrandti.*
2. Shell without or with very weak spiral microsculpture 3
— Shell with distinct spiral microsculpture *spiralis.*
3. Axial ribs continuous; shell with a silky lustre ..... *sulcata.*
— Axial ribs interrupted or replaced by two spiral rows of tubercles; glossy.... *schuetti.*

The distinguishing characteristics of the *Hubendickia* species extralimitarily known from other places of the Mekong:

H. crooki BRANDT, 1968. The shell is very glossy. A spiral microsculpture is either completely missing or there are only weak traces of it. A 6-8 mm.

H. gochenouri BRANDT, 1968. A cylindrical species with rudimentary ribs. Generally larger than 7 mm.

H. schlickumi (BRANDT, 1968). A very small, turreted species with two spiral rows of week tubercles. A 3·8 mm.

H. coronata BRANDT, 1968. With a strong subsutural ridge which connects the strengthened upper ends of the ribs.

H. tuberculata BRANDT, 1968. A small species with very convex whorls. A subsutural groove separates the upper end of the ribs from the rest. A 5·2-5·8 mm.

Hubendickia sulcata (BAVAY, 1895). Textfig. 9.

This was the only species of *Hubendickia* already known before the genus was established. The spiral sculpture of this species is less developed than that of the type species and the protoconch is always homoeostrophic. The radula is typical for the genus. The rhachis has a cutting edge with a large, pointed central cusp and 3 small cusps on each side. There are 3 basal cusps on either side; the wings are finger-shaped. The laterals have the cusp formula 3-1-5, the inner marginals have 10 cusps, the outer 8.

Laos: 4, 6, 7, 8, 9, 17, 18; Cambodia: 2.

Hubendickia schuetti (BRANDT, 1968).

This species seems to be more correctly placed into this genus than into *Paraprososthenia.* It has not yet been found near Khong Island or Kratie. It is known in its typical form only from Thailand. The Laotian population is more slender and the rips are often obsolete at the periphery.

Laos: 2.

Hubendickia rolfbrandti TEMCHAROEN, 1971.

Easily identified by its three weak spiral ridges which are superimposed on the obsolete axial rips. Not yet known from Cambodia. It is replaced in Thailand by a dwarfish geographical race. The specimens from Pakse are extremely large and may even deserve an own subspecific name.

Laos: 1, 6, 7, 8, 9, 17.

Hubendickia spiralis BRANDT, 1968.

This species which is common in the Mekong at and around Bandan, was only found near Pakse in Laos. It is not yet known from Khong and Kratie.

Laos: 1.

All other species of *Hubendickia (crooki, coronata, gochenouri* and *tuberculata* BRANDT) are known only from the Mekong between Kemmarat and Bandan. Another species from the same locality, *Paraprososthenia schlickumi* BRANDT, may better be placed into this genus. None of these species have yet been found in the Laotian or Cambodian part of the Mekong.

Manningiella BRANDT, 1970.

This genus was established for a group of ovate or cylindrical species which have only two characteristics in common: The shell is smooth [see under *M. incerta*] and the cutting edge of the rhachis is serrate. A further division of this genus into three subgenera may later prove to be necessary. *M. polita* BRANDT and *pellucida* (BAVAY) from the first group; the second group consists of *M. extensa* BRANDT and *cambodiensis* BRANDT; *M. microsculpta* (BRANDT) and *rolfbrandti* TEMCHAROEN form the third group. *Pachydrobia pallidula* BAVAY is placed tentatively into this genus.

Etiology: This genus was dedicated to Captain GEORGE S. MANNING, parasitologist in the SMRL.

Key to the Mekong species of *Manningiella*:

1. Peristome protruding at the base 2
— Peristome not protruding 3
2. Size 4: 2 mm and larger ..... *expansa.*
— Size 3·6: 1·7 and smaller ..... *cambodiensis.*
3. Shell corneous, translucent, ovate, ovoidal-conic or cylindrical 4
— Shell covered with grey periderm, not translucent 7
4. Shell very slender, with distinct spiral microsculpture ..... *microsculpta.*
— Shell comparatively stout, without microsculpture 5
5. Shell ovate or ovoidal-conic, solid 6
— Shell cylindrical, very thin ..... *pellucida.*
6. Shell ovate, body whorl $^3/_5$ of the length of the shell; aperture $^2/_5$ of the length of the shell ..... *polita.*
— Shell ovoidal; conic, body whorl $^4/_5$ of the length of the shell; aperture $^1/_2$ the length of the shell ..... *rolfbrandti.*
7. Shell ovate, with strong axial striae ..... *incerta.*
— Shell conic, smooth ..... *conica.*

Manningiella incerta (TEMCHAROEN, 1971).

This species was described by its author as a *Hubendickia* because of its weak axial sculpture. Shape and aperture, however, show closer relationship with *Manningiella.* The generic description has therefore to be extended to: ... Without or rarely with very weak axial costulation or spiral microsculpture.

Laos: 6, 8, 17.

Manningiella polita BRANDT, 1970.

The type species is common in the Mekong at and around Bandan. A lot of four dead specimens was found at the Sompamit Falls near Khone in Laos, but the authors have only found the following species at that locality alive.

Manningiella pellucida (BAVAY, 1895). Textfig. 10.

This species was described by its author as a *Pachydrobia*. It differs from the species of that genus by its thin texture, smooth surface and thin peristome. It has the shape of a *Hubendickia*, but differs from the species of that genus by its lack of axial sculpture and by the different shape of the aperture.

The animal is grey with dense black pigmentation and orange and sand-coloured on the tip of the rostrum, the tentacles and the side of the foot. — Radula with trapezoidal rhachis. Its cutting edge has a large central cusp and 5 small cusps on either side. The wings are finger-shaped. There are 5 basal cusps on either side, the innermost being the largest.

Parasitology: This species has been exposed to miracidia from *Schistosoma japonicum*, obtained from Laotian patients. The snail was not accepted by the miracidia.

Laos: 2, 5, 6, 7, 8, 9, 14, 17 — Not yet found in Thailand and Cambodia.

Manningiella microsculpta (BRANDT, 1968).

This species which was first assigned to the genus *Hubendickia* is not rare at and around Bandan in Thailand. Few specimens were found near Khone in Laos.

Manningiella expansa BRANDT, 1970.

This species forms together with the following a well defined group within this genus. It has already been collected by members of the "Mission Pavie", as unnamed specimens are stored in the collection of DAUTZENBERG in Brussels. The species is known from the Mekong between Bandan and Samboc.

Parasitology: Miracidia of *Schistosoma japonicum* obtained from a Laotian patient entered the species, but development into cercariae was not observed.

Laos: 1, 4, 6, 7, 8, 17; Cambodia: 2, 3, 4.

Manningiella cambodiensis BRANDT, 1970.

This species is not yet known from Thailand and found in the Mekong between Khong and Samboc only.

Laos: 7, 8, 9, 17; Cambodia: 2, 3, 4.

Manningiella rolfbrandti TEMCHAROEN, 1971.

A species with a very limited distribution as far as we know.

This species was accepted by miracidia of *Schistosoma japonicum*. Development into cercariae was not observed as all specimens died after two weeks. The species has not been found near the *Schistosoma* focus at Kratie.

Laos: 6, 7.

Manningiella conica TEMCHAROEN, 1971.

A species which was only tentatively assigned to this genus as the anatomy is still unknown. The shape of the shell is similar to that of a very slender *Lithoglyphopsis aperta* TEMCHAROEN.

Laos: 8.

Paraprososthenia ANNANDALE, 1919.

With some hesitation all the following species are assigned to this genus which was established by its author for a fossil species from Burma, *P. minuta* ANNANDALE. The only recent species previously known was *P. gredleri* (NEUMAYR), described as *Prososthenia. Hydrorissoia levayi* BAVAY proved to be a *Paraprososthenia* and not a *Hydrorissoia,* as its rhachis has a serrate cutting edge. *Hydrorissoia* has a simple, triangular cutting edge on the rhachis.

Key to the species of *Paraprososthenia*:

1. Shell conoidal 2
— Shell turreted 5
2. Shell without spiral microsculpture and generally with well developed macrosculpture, peristome normal, thin 3
— Shell with spiral microsculpture, spiral ridges rudimentary, peristome exceptionally thick for the genus ..... *fischerpiettei.*
3. Peristome not sinuously produced, shell with rows of tubercles 4
— Peristome sinuously produced, shell with spiral ridges ..... *bollingi.*
4. Length 4·1 mm and smaller, peristome expanded ..... *hydrorissoidea.*
— Length 5·5-7·0 mm, peristome barely expanded ..... *hanseni.*
5. Shell sculptured with solid spiral ridges 6
— Spiral ridges on the upper half of the body whorl dissolved into tubercles 9
6. Shell sculptured with 4 ridges 7
— Shell sculptured with 6 to 7 ridges 8
7. Shell extremely pointed, D 1·7-2·4 mm, peristome neither extended nor produced ..... *acicula.*
— Shell more than 3 mm broad, outer margin of peristome tongue-like produced ..... *vivonai.*
8. Shell size about 6: 2·2 mm; peristome simple ..... *davisi.*
— Shell size about 7·8: 2·9 mm; peristome expanded and flattened ..... *taylori.*
9. Shell with 1-4 rows of tubercles and 1-2 ridges, peristome tongue-like produced ..... *adami.*
— Shell with 2 rows of tubercles and 2-3 ridges, peristome not produced 10
10. Shell 5·0-5·5: 2-2·3 mm ..... *levayi.*
— Shell 3·5-4·5: 1·3-2 mm ..... *iijimai.*

Paraprososthenia bollingi BRANDT, 1970.

Cambodia: 2; Laos: 8.

Paraprososthenia acicula BRANDT, 1970.

Laos: 6, 7, 8; Cambodia: 2.

Paraprososthenia davisi BRANDT, 1968.

Thailand: Mekong at Bandan and Ban Khum; Laos: 6, 7, 8; Cambodia: 2.

Paraprososthenia fischerpiettei BRANDT, 1970.

Type locality is the Sedone river at Khong Sedone, Laos; Cambodia: 2.

Paraprososthenia iijimai BRANDT, 1870.

Type locality is the Mekong at Bandan in Thailand. The species has not yet been found in Laos; Cambodia: 2.

Paraprososthenia hanseni BRANDT, 1970.

Thailand: Bandan; Laos: 4, 8; Cambodia: 2.

Paraprososthenia levayi (BAVAY, 1895). Textfig. 11.

This species had been assigned by BAVAY to his genus *Hydrorissoia*. As the shape of the shell and the figure of the radula show, it belongs to this genus. This species is distributed over a rather large part of the Mekong, but has not yet been found in any of its tributaries, except for the mouth of the River Mun near Bandan. The northernmost locality is known from the Kemmarath rapids between Kemmarath and Ban Khum.

Laos: 4, 5, 6, 7, 8, 9, 17, 18; Cambodia: 2.

Parasitology: Large numbers of specimens of this species were exposed to miracidia of *Schistosoma* obtained from Laotian patients. The species was not accepted as intermediate host.

Paraprososthenia adami BRANDT, 1970.

Cambodia: 2.

Paraprososthenia vivonai BRANDT, 1968.

Type locality: Mekong at Bandan. Few atypical specimens were collected in Laos and Cambodia.

Laos: 2, 8; Cambodia: 2.

Paraprososthenia hydrorissoidea TEMCHAROEN, 1971.

Laos: 6, 7, 8, 9, 16, 18; Cambodia: 2.

Paraprososthenia brandti and *P. taylori* were not found near the foci of Schistosomiasis. *P. brandti* is only known from the Sedone River north of Pakse, *P. taylori* from Bandan in Thailand.

Hydrorissoia BAVAY, 1895.

Beside the type species, *H. elegans* BAVAY, the author of this genus assigned another species to his genus, *H. levayi* BAVAY. This latter species is now placed into the genus *Paraprososthenia* ANNANDALE. Another species, however, which BAVAY described as *Pachydrobia elongata*, belongs into this genus.

Key to the species of *Hydrorissoia*
from the Mekong between Pakse and Kratie:

1.	Shell with four or more spiral ridges	2
—	Shell with three or less spiral ridges	.. 3
2.	Aperture 1/2 the height of the shell; spiral ridges very weak	*waltoni.*
—	Aperture 2/5 of the height of the shell; ridges very strong	*elegans.*

3. Aperture half the height of the shell, more or less exserted *trispiralis.*
— Aperture $^2/_5$ of the height of the shell, not exserted 4
4. Shell very slender, aperture greatly exserted 5
— Shell moderately stout, aperture not exserted 6
5. Length of the shell less than 3·2 mm; spiral ridges distinct *gracilis.*
— Length of the shell more than 3·2 mm; spiral ridges obsolete *elongata.*
6. Whorls greatly convex, suture very deep, aperture rounded *paviei.*
— Whorls almost flat or moderately rounded, suture not very deep, aperture oval 7
7. The tubercles on the back of the body whorl form short, subsutural riblet; A 3·8-4·6 mm ..... *cambodiensis.*
— The tubercles do not form riblets; A 3·0-3·4 mm ..... *hospitalis.*

Hydrorissoia elegans BAVAY, 1895. Textfig. 12.

Type locality: Sompamit Falls near Khone, Laos.
Distribution: Mekong between Bandan and Samboc.
Laos: 2, 6, 7, 9, 17; Cambodia: 2, 4.

Hydrorissoia elongata (BAVAY, 1895). Textfig. 13.

Type locality: Sompamit Falls near Khone, Laos.
Distribution: Mekong between Cham Passak and Khone.
Laos: 6, 7, 17. Not yet found in Cambodia.

Hydrorissoia hospitalis BRANDT, 1968.

Probably only a stouter race with stronger spiral ridges of the preceding species.

Parasitology: This species has been successfully infected with miracidia from *Schistosoma japonicum,* obtained from a Laotian patient at Khong. Development into mother sporocysts was observed. Naturally infected specimens were found which harboured the same type of sporocysts.

The species is very rare at Bandan in Thailand, but common in South Laos. It is again rarer in Cambodia. — Laos: 6, 7, 8, 9, 17; Cambodia: 2, 4.

Hydrorissoia gracilis BRANDT, 1968.

First described from the type locality, Mekong river at Bandan in Thailand. This species looks similar in shape to *H. elongata,* but is much smaller.

Laos: 1, 6, 7, 17; Cambodia: 2, 3.

Hydrorissoia trispiralis BRANDT, 1968.

This species is found in abundance in the Mekong between Ban Khum and Bandan (type locality). It has not yet been found south of Pakse. — Laos: 1.

Hydrorissoia cambodiensis BRANDT, 1970.

This species has been wrongly identified by the present authors (in litt.) with *H. elongata* (BAVAY). It is a separate species whose distribution is limited to the Mekong in North Cambodia.

Cambodia: 2, 3, 4.

Note: No *Hydrorissoia* has been found near the foci of schistosomiasis in North Cambodia, whereas they are abundent around Khong Island. *H. cambo-*

diensis has also been found in the upper reaches of the Srepok river in North Cambodia. There is only one other species of *Hydrorissoia* known from a tributary of the Mekong, *munensis* BRANDT, from the Mun river at Pibun Mangsahan in Thailand.

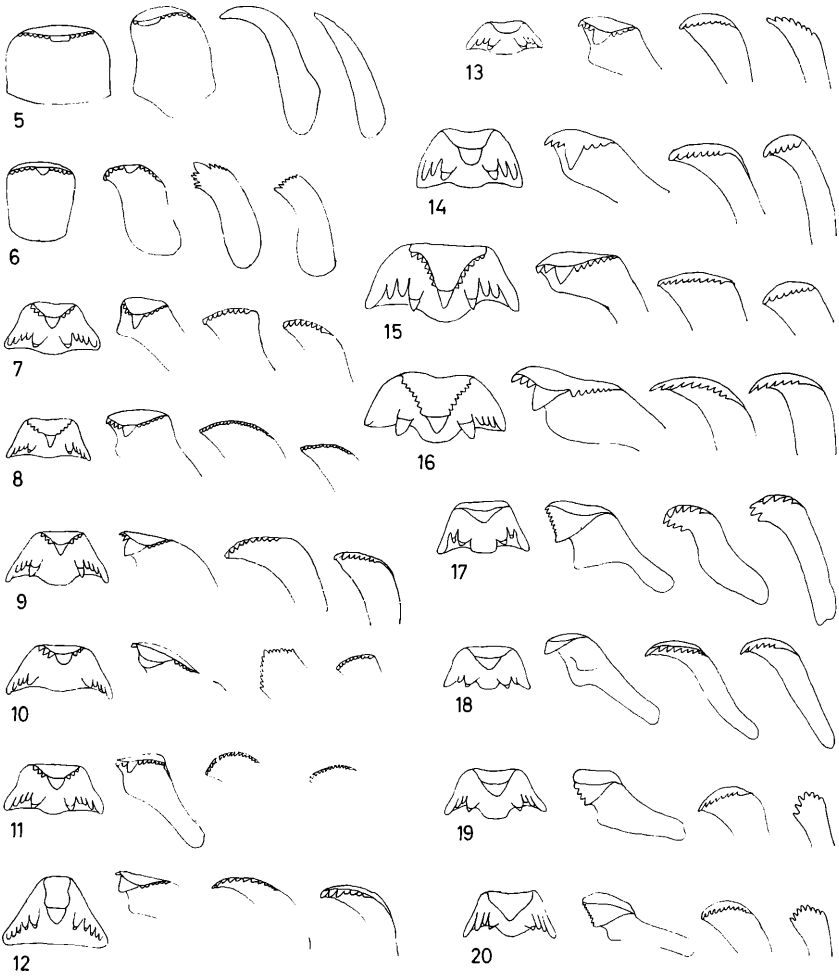

Fig. 5-20. Radula, half-row; × 100. — 5) *Mekongia jullieni* (DESHAYES); 6) *Anulotaia lagrandierei* (BAVAY); 7) *Pachydrobia spinosa* POIRIER; 8) *Pachydrobia variabilis* POIRIER; 9) *Hubendickia sulcata* (BAVAY); 10) *Manningiella pellucida* (BAVAY); 11) *Paraprososthenia levayi* (BAVAY); 12) *Hydrorissoia elegans* BAVAY; 13) *Hydrorissoia elongata* (BAVAY); 14) *Pachydrobiella brevis* (BAVAY); 15) *Jullienia flava* (DESHAYES); 16) *Jullienia nodulosa* POIRIER; 17) *Lacunopsis ventricosa* POIRIER; 18) *Lacunopsis jullieni* DESHAYES; 19) *Lacunopsis sphaerica* BAVAY; 20) *Lacunopsis monodonta* DESHAYES.

Pachydrobiella THIELE, 1928.

A monotypical genus for *Pachydrobia brevis* BAVAY. The shell is smooth, the rhachis has a simple, triangular cutting edge.

Pachydrobiella brevis (BAVAY, 1895). Textfig. 14.

This species has been exposed to miracidia of *Schistosoma japonicum* from Khong Island. The miracidia never tried to enter the animal. *P. brevis* has not yet been found in Thailand.

Laos: 7, 8, 9, 17 (type locality), 18; Cambodia: 2.

Lithoglyphopsis THIELE, 1928.

Lacunopsis dugasti MORLET, a species described from the Nam Fak river in Laos, seems to belong to this genus. The following species is the second species of this genus found in the Mekong drainage.

Lithoglyphopsis aperta TEMCHAROEN, 1971.

Laos: 2, 6, 7, 8, 17.

Note: The species of this genus look very similar to those of *Lithoglyphus*. The rhachis of this genus, however, is more squarish and has a simple cutting edge, that of *Lithoglyphus* is trapezoidal and has a serrate cutting edge. *Manningiella conica* TEMCHAROEN may well be a slender species of this genus. However, its anatomy is still unknown.

Jullienia CROSSE & FISCHER, 1876.

This genus was established by above named authors for *Melania flava* DESHAYES as a monotypical subgenus of *Lithoglyphus*. In 1881 POIRIER also placed *Lacunopsis tricostatus* DESHAYES into this genus and described several more species: *acuta, harmandi, nodulosa* and *costata*. *Lacunopsis tricostata* and *Jullienia costata* are placed for anatomical reasons in the genus *Wykoffia* BRANDT. All other species of *Jullienia*, including *Wykoffia crooki* BRANDT, have to remain in the genus *Jullienia* as they are closely related to the type species. The genus was based on a juvenile specimen from Cambodia which was described as *Melania*. The genus *Jullienia* includes several subglobose-conic or ovate-conoidal species with compressed columella, but without flat columellar septum. The cutting edges of the rhachisis are multiserrate in the larger species and show at least 3 to 4 lateral cusps in the small species. The rhachis of *Wykoffia* has a simple, triangular cutting edge.

Key to the species of *Jullienia*:

1. Shell ovate-conoidal, with high spire 2
— Shell globose-conic or ear-shaped, with low spire 4
2. Ventral face of body whorl distinctly flattened and with obtuse carina; about four granulous spiral lines ..... *nodulosa.*
— Ventral face of body whorl barely flattened and without carina. With many strong spiral ridges 3

3. Spiral ridges extremely thick; peristome very thick-lipped *acuta.*
— Spiral ridges and peristome only moderately thick *flava.*
4. Shell with distinctly flattened front 5
— Shell with rounded front 7
5. Body whorl with few, often dissolved spiral ridges below the suture *harmandi.*
— Body whorl with many spiral ridges 6
6. With very strong spiral ridges ..... *rolfbrandti.*
— With weak spiral rows of tubercles *crooki.*
7. Diameter larger than 4 mm 8
— Diameter smaller than 4 mm *poirieri.*
8. Shell rather thin, with spiral microsculpture ..... *microsculpta.*
— Shell thick, with spiral ridges, without microsculpture *nucula.*

Jullienia flava (DESHAYES, 1876). Textfig. 15.

This species has been recorded from Prec Omphil and Koko from Cambodia. It was found by the senior author at several places in North Cambodia and by the junior author in Laos. It is not only known from the Mekong but also from the Sedone river at Khong Sedone north of Pakse.

Laos: 1, 16, 17; Cambodia: 1, 2, 3.

Jullienia crooki (BRANDT, 1968).

This species was described by the author as a *Wykoffia* from the Mekong at Bandan in Thailand. It was only found at one locality in Laos, but is not yet known from Cambodia. — Laos: 2.

Jullienia nucula TEMCHAROEN, 1971.

Laos: 6, 7, 8, 17; Cambodia: 2.

Jullienia poirieri BRANDT, 1970.

Cambodia: 2.

Jullienia microsculpta BRANDT, 1970.

Cambodia: 2.

Jullienia nodulosa POIRIER, 1881.

Laos: 17 (type locality), 18.

Jullienia acuta POIRIER, 1881.

This species is found in abundance at Bandan, but this population is larger and stouter than the type form.

Laos: 6, 7, 17 (type locality); Cambodia: 2, 3.

Jullienia harmandi POIRIER, 1881.

Distribution: Known from the Mekong between Bandan and Sambor.

Laos: 1, 16, 17 (type locality), 18; Cambodia: 2.

Jullienia rolfbrandti TEMCHAROEN, 1971.

Type locality: Khong Island in Laos.

Distribution: Known from the Mekong between Ban Khum in Thailand and Khong Island. — Laos: 6, 7, 17.

Saduniella BRANDT, 1970.

Saduniella planispira BRANDT, 1970.

Laos: 8; Cambodia: 2 (type locality).

Wykoffia BRANDT, 1968.

At the present moment this genus is restricted to the three following species. *Wykoffia crooki* BRANDT is now assigned to *Jullienia.*

Wykoffia tricostata (DESHAYES, 1876).

This species has not yet been found outside of Cambodia, but the following species is so closely related to the type species that it may be considered a geographic race of this species.

Type locality: Mekong rapids of Omphil in North Cambodia. It was described as a *Lacunopsis.*

Cambodia: 2, 3, 4, 5.

Wykoffia costata (POIRIER, 1881).

This species was described as a *Jullienia.* POIRIER figured the radula which is quite different from that of *Jullienia.*

Laos: 6, 7, 17 (type locality), 18.

Wykoffia minima TEMCHAROEN, 1971.

Laos: 6, 7 (type locality), 8, 17. Found together with the proceding species.

Lacunopsis DESHAYES, 1876.

Key to the species of *Lacunopsis* from the Mekong River:

1.	Ventral face of the body whorl flattened and bordered by a sharp keel	2
—	Ventral face rounded, without keel	8
2.	D of facial plain less than 10 mm, surface of the shell not roughened	3
—	D of facial plain larger than 12 mm, surface roughened	*fischerpiettei.*
3.	Columella with tooth ...	4
—	Columella without tooth	6
4.	Shell smooth	5
—	Shell with spines or tubercles	7
5.	Apex pale, size about 10 mm	*monodonta.*
—	Apex pink, size about 7-8 mm	*deiecta.*
6.	Diameter of ventral face larger than diameter of shell and completely porcellaneous	*harmandi.*
—	Diameter of ventral face smaller than that of the shell; only columella porcellaneous	*jullieni.*
7.	Last whorl with a spiral row of tubercles	*rolfbrandti.*
—	Last whorl generally with several scaly spines	*massiei.*
8.	Shell with tubercles or spines	9
—	Shell without tubercles or spines	 10
9.	Shell with tubercles	*levayi.*
—	Shell with scaly spines	*coronata.*

10. Shell smaller than 8 mm — 11
— Shell larger than 9 mm — 12
11. Shell conoidal, apex generally pale — *conica.*
— Shell subglobose, apex always pink — .. *sphaerica.*
12. Shell surface smooth — *ventricosa.*
— Shell surface scaly — *globosa.*

Lacunopsis monodonta DESHAYES, 1876. Textfig. 20.

Only known from the island of Kas Lognieu and Sambor in North Cambodia.

Lacunopsis ventricosa POIRIER, 1881. Textfig. 17.

Probably identical with *L. globosa* POIRIER.
Laos: 17; Cambodia: 2.

Lacunopsis jullieni DESHAYES, 1876. Textfig. 18.

Cambodia: Known from the Mekong at the island of Kas Lognieu and Sambor. Laos: 6.

Lacunopsis harmandi POIRIER, 1881.

Very similar to the preceding species.
Distribution: Known from the Mekong between Ban Khum in Thailand and Kratie. — Laos: 1, 2, 6, 7, 17 (type locality), 18; Cambodia: 2, 5.

Lacunopsis globosa POIRIER, 1881.

Laos: 6, 7, 17 (type locality), 18; Cambodia: 2, 5.

Lacunopsis sphaerica BAVAY, 1895. Textfig. 19.

Laos: 6, 7, 8, 9, 17 (type locality); Cambodia 2, 3, 5.

Lacunopsis conica BRANDT, 1968.

Laos: 6, 7, 17 (type locality); Cambodia: 2, 3.

Lacunopsis massiei BAVAY, 1895.

Type locality: Mekong at Ban Khum in Thailand. Laos: 17, 18. Not yet known from Combodia.

Lacunopsis coronata BAVAY, 1895.

Distribution: From the Khemmarat rapids at Ban Khum to the rapids near Khone. Laos: 17 (type locality).

Lacunopsis levayi BAVAY, 1895.

Type locality: Khemmarat rapids at Ban Khum, Thailand.
Distribution: Mekong between Ban Khum and Khone. — Laos: 6, 17.

Lacunopsis rolfbrandti TEMCHAROEN, 1971.

Laos: 6 (type locality).

Lacunopsis concava TEMCHAROEN, 1971.

Laos: 1, 6, 7; Cambodia: 3.

Lacunopsis deiecta TEMCHAROEN, 1971.

Laos: 7, 17, 18.

Lacunopsis fischerpiettei BRANDT, 1968.

Type locality: Mekong at Bandan, Thailand.
Laos: 6, 7, 17; Cambodia: 2, 3.

Stenothyridae P. FISCHER, 1887.

Stenothyra BENSON, 1856.

Key to the species of *Stenothyra*:

1. Shell without spiral sculpture 2
— Shell with spiral sculpture 5
2. Aperture distinctly exserted and not constricted *hybocystoides.*
— Aperture not exserted, more or less constricted 3
3. Shell elongately oval, aperture about 1/2 the length of body whorl 4
— Shell broadly oval-conoidal, aperture about 1/3 of the length of the body whorl .... *laotiensis.*
4. Shell larger than 3 mm ..... *mcmulleni.*
— Shell length 2 mm and smaller *cambodiensis.*
5. Shell with continuous spiral grooves *roseni.*
— Shell with pitted spiral lines 6
6. Spiral sculpture on the upper whorls only 7
— Spiral sculpture not restricted to the upper whorls only 9
7. Shell oval, only embryonic whorls sculptured ..... *ovalis.*
— Shell ovate-conoidal, only postnuclear whorls sculptured 8
8. Shell broadly rhomboidal-conic ..... *crooki.*
— Shell ovate-conoidal ..... *koratensis.*
9. End-part of body whorl with delicate microsculpture, only spire and base with pitted spiral lines ..... *basisculpta.*
— End-part of the body whorl without microsculpture, the whole shell is sculptured with regular pitted lines *schuetti.*

Stenothyra hybocystoides BAVAY, 1895.

Laos: 6, 7, 8, 9, 17, 18; Cambodia: 2, 5.

Stenothyra schuetti BRANDT, 1968.

Type locality: Songkram river in Thailand.
Laos: Not yet found; Cambodia: 2.

Stenothyra koratensis BRANDT, 1968.

Some specimens from the Mekong at Khong Island have been assigned to this species. The identification is still doubtful.

Stenothyra crooki BRANDT, 1968.

This species has been found in the Mekong opposite Bandan, but it is not yet known from the vicinity of the *Schistosoma* foci.

Stenothyra roseni BRANDT, 1968.

Type locality: Maenam Songkram in Thailand.

Cambodia: 2. This species has not yet been found in Laos. Above locality is the first report from the Mekong proper.

Stenothyra ovalis BRANDT, 1970.

Type locality: Songkram river in Thailand.

Distribution: Known from the Mekong river between Tha Uthen and Khong Island and several of its tributaries. — Laos: 2, 6, 7. Not yet found in Cambodia.

Stenothyra basisculpta BRANDT, 1970.

Type locality: Mekong at Bandan, Thailand.

Distribution: Common between Bandan and Kratie. — Laos: 4, 6, 7, 17; Cambodia: 5.

Stenothyra mcmulleni BRANDT, 1970.

Distribution: Mekong between Bandan (type locality) and Kratie. — Laos: 6, 7, 8, 17; Cambodia: 5.

Stenothyra laotiensis TEMCHAROEN, 1971.

This species looks like a dwarfish form of *S. basisculpta* without basal spiral lines.

Laos: 6, 7, 8, 14, 17, 18. Not yet known from Cambodia.

Stenothyra cambodiensis TEMCHAROEN, 1971.

This rare species looks like a dwarfish race of *S. mcmulleni*. It lives together with that species without intermediate forms.

Distribution: Known between Bandan and Kratie. — Laos: 6, 7; Cambodia: 2, 5 (type locality).

Cerithiacea FLEMING, 1828.

Thiaridae GRAY, 1847.

Melanoides OLIVIER, 1804.

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

In small ponds on Khong Island. This species has been found together with *Tarebia granifera* (LAMARCK) and *Thiara scabra* (O. F. MÜLLER) at many places in the Mekong river, but not yet in the immediate vicinity of the *Schistosoma* foci of Khong and Kratie.

Brotia A. ADAMS, 1866.

(*Antimelania* FISCHER & CROSSE, 1892).

Brotia costula jullieni (DESHAYES, 1876).

(*Melania siamensis* BROT)

Distribution: Mekong between Bandan and Kratie. — Laos: 1, 2, 6, 14, 15; Cambodia: 5.

Note: *Brotia proteus* (BAVAY) has been found in tributaries of the Mekong in South Laos, but it is not yet known from the Mekong proper.

It is a surprise that of the numerous species of Thiaridae which are known from Southeast Asia only the two above named have been found near any *Schistosoma* focus.

Neogastropoda THIELE, 1929.

Buccinacea, Buccinidae FLEMING, 1821.

Clea A. ADAMS, 1855.

Clea (Anentome) COSSMANN, 1901.
(*Canidia* H. ADAMS, 1862 [non THOMSON, 1857]).

Clea (Anentome) helena (PHILIPPI, 1847).

(*Melania theminckiana* PETIT DE LA SAUSSAYE; *Hemisinus baudoniana* MABILLE & LE MESLE; *Canidia tenuicosta* BROT; *C. bocourti* BROT; *C. harmandiana* ROCHEBRUNE; *C. stomatodon* ROCHEBRUNE).

This widely distributed species — known from Java, Sumatra, Malaysia and Thailand — is not rare near the *Schistosoma* foci of Laos and Cambodia.

Laos: Pool at Ban Na, Khong Island; 6, 4, 11, 12, 17; Cambodia: 2, 3, 5.

This is the only species of *Clea* in Southeast Asia which is not only found in rivers, but also in still water. Because of the many different habitats this species is quite variable with regard to size, shape, colour and ornamentation. Strongly ribbed specimens with broad base may be found together with very slender, smooth specimens. All intermediate forms, however, may be found.

Clea (Anentome) paviei (MORLET, 1886).

A short, oval species which is easily identified by its subsutural ridge.

Laos: 8; Cambodia: 2.

Clea (Anentome) fusiformis (DESHAYES, 1876).

Very similar to *C. helena,* but stouter, thicker and almost without axial costulation.

Laos: 17; Cambodia: 2.

Clea (Anentome) jullieni (DESHAYES, 1876).

This species is described from Cambodia near the island of Kas Lognieu. It seems to be extremely rare as only two specimens, from each of the below localities, were found.

Laos: 1, 8; Cambodia: 2.

Clea (Anentome) broti (DESHAYES, 1876).
(*Canidia bizonata* DESHAYES, 1876).

This species is much smaller than the preceding species and almost smooth, apart from the fine spiral ridges. Specimens with and without fine axial ribs were found. This species is generally considered to be a mere synonym of *jullieni.* The differences in size, shape, colour and sculpture, as well as the common habitat

without intermediate forms, justifies a specific separation of *broti* from the preceding species.

Laos: 1, 4, 6, 8; Cambodia: 2, 3.

Clea (Anentome) scalarina (Deshayes, 1876).

Typical specimens are distinguished by their scalarid whorls with a subsutural shoulder, but there are also populations with well rounded whorls. These are generally much larger than typical specimens.

Laos: 6, 8; Cambodia: 2, 5. Also known from Bandan.

Clea (Anentome) fusca (A. Adams, 1861).

The description of this species being incomplete and no type material being known, the below populations are only, with hesitation, assigned to it.

Laos: 17; Cambodia: 2.

Clea (Anentome) spinosa Temcharoen, 1971.

Mekong at Khong Island (Laos: 6, 7) and from the Sompamit Falls (Laos: 17). It has not yet been found in Cambodia.

C. cambodiensis (Reeve), known from the Tonle Sap and supposed to have also been found in the Rayong River in Thailand, is not known from the Mekong valley proper.

Euthyneura Spengel, 1881.

Basommatophora Milne-Edwards, 1848.

Lymnaeacea, Lymnaeidae H. & A. Adams, 1855.

Lymnaea Lamarck, 1799.

Lymnaea (Radix) Montfort, 1810.

Lymnaea (Radix) auricularia rubiginosa (Michelin, 1831).

(*L. siamensis* Sowerby; *L. amygdala* Troschel; *L. spadicea* Morelet; *L. crosseana* Mabille & le Mesle).

Common in ponds and marshes bordering the Mekong, but quite rare in the river proper. Also in back-waters, irrigation trenches and canals with sluggish or still water. Widely distributed in Southeast Asia and Indonesia.

Planorbidae H. & A. Adams, 1855.

Bulininae Germain, 1931.

Indoplanorbis Annandale & Prashad, 1920.

Indoplanorbis exustus (Deshayes, 1834).

Distribution and habitat in Southeast Asia the same as of the preceding species. Also widely distributed in India.

Planorbinae H. & A. Adams, 1855.

Gyraulus Charpentier, 1837.

Gyraulus convexiusculus (Hutton, 1849).

In ponds and trenches with rich vegetation. This species is not rare in the Mekong valley, but has not yet been found in the vicinity of the *Schistosoma* foci. This species is not identical with *G. siamensis* (Martens) = *G. compressus* (Hutton [non Michaud]) = *G. confusus* (Rochebrune).

Hippeutis (Helicorbis) umbilicalis (Benson, 1836), *Segmentina (Polypylis) hemisphaerula* (Benson, 1842) and *Segmentina (Trochorbis) trochoideus* (Benson, 1836) are found in back-waters, trenches and ponds in the Mekong valley in Thailand and North Laos, but are not yet reported from the vicinities of Khong and Kratie.

Bivalvia Linnaeus, 1758.

As Bivalvia can be excluded from a list of potential intermediate hosts of *Schistosoma* only a list of the species found in the Mekong between Pakse in Laos and Kratie in Cambodia is given. The supergeneric taxa are restricted to families.

Mytilidae Rafinesque, 1816

Limnoperna siamensis (Morelet)
Limnoperna depressa n. sp.

Dreissenida Gray, 1840

Sinomytilus crosseanus (Morlet)
Sinomytilus massiei (Morlet)
Sinomytilus harmandi (Rochebrune)

Unionidae Fleming, 1828

Pilsbryoconcha exilis (Lea) = *Anodonta laminata* Rochebrune
Pseudodon ellipticus (Conrad) = *P. moreleti* Crosse & Fischer
Pseudodon cambodiensis (Petit)
Pseudodon mouhoti (Lea) = *P. thomsoni* Morlet
Pseudodon harmandi Rochebrune
Cristaria plicata (Leach)
Hyriopsis bialatus (Simpson) = *H. delphinus* (Gruner)
Hyriopsis delaportei (Crosse & Fischer)
Hyriopsis myersianus (Lea)
Unionetta fabagina (Deshayes) = *U. broti* Deshayes = *U. molleuri* Morlet
Physunio eximius (Lea)
Physunio semialatus (Deshayes) = *U. micropterus* Morelet
Scabies scobinata (Lea) = *U. pellislacerti* Morelet = *U. mandarinus* Morelet
Scabies phaselus (Lea) = *U. anceps* Deshayes
Scabies nucleus (Lea)
Scabies humilis (Lea)
Scabies ludoviciana (Rochebrune)
Trapezoideus misellus (Morelet) = *U. siamensis* Lea
Contradens micropterus (Morelet)

Contradens tumidulus (LEA) = *U. versus* LEA = *U. inaequalis* ROCHEBRUNE
Chamberlainia duclerci (ROCHEBRUNE)
Ensidens ingallsianus jaculus (ROCHEBRUNE)
Ensidens ingallsianus dugasti (MORLET)

Note: To which species the reports of *Unio radula* BENSON and *Unio contritus* HEUDE by ROCHEBRUNE refer has not yet been found out. ROCHEBRUNE also described a *Harmandia somboriensis* which is said to be based on a Southamerican species.

Corbiculidae GRAY, 1847

Corbicula baudoni PRIME
Corbicula blandiana PRIME
Corbicula bocourti MORELET
Corbicula gubernatoria PRIME
Corbicula linnaeana PRIME (?)
Corbicula laeviuscula PRIME (?)
Corbicula jullieniana CLESSIN
Corbicula aff. *striatella* DESHAYES
Corbicula tenuis CLESSIN

Two species of the genus *Pisidium (P. clarkeanum* NEVILL and *P. javanum* VAN BENTHEM JUTTING) have been found in several tributaries of the Mekong in Thailand and Laos, but not yet in the river proper.

Bibliography.

BAVAY, A. (1895, 1898): Coquilles nouvelles, provenant de récoltes de M. L. LEVAY, dans les rapides du Haut-Mékong, pendant la campagne du MASSIE, 1893-1894-1895. — J. de Conch., **43**: 82-94, pl. 5-6 (1895); **46**: 15-19, pl. 2 (1898).

BAVAY, A. & DAUTZENBERG, P. (1910): Contribution a la faune fluviatile de l'extrème-orient (Chine et Indo-Chine). — J. de Conch., **58**: 1-21, pl. 1-2.

— & — (1912): Description de coquilles nouvelles de l'Indo-Chine. — J. de Conch., **60**: 1-54, pl. 1-6.

BRANDT, R. A. M. (1968): Description of new non-marine molluscs from Asia. — Arch. Moll., **98**: 213-289, pl. 8-10.

— — — (1970): New freshwater gastropods from the Mekong. — Arch. Moll., **100**: 183-205, pl. 13.

CROSSE, H. & FISCHER, P. (1876): Mollusques fluviatiles, recueillis au Cambodge, par la Mission scientifique française de 1873. — J. de Conch., **24**: 313-342, pl. 10-11.

— & — (1882): Description d'une espèce nouvelle de *Melania,* provenant du Cambodge. — J. de Conch., **30**: 112-113, pl. 7 fig. 4.

DAUTZENBERG, P. & FISCHER, H. (1905): Liste des mollusques récoltés par M. H. MANSUY en Indo-Chine et au Yunnan. — J. de Conch., **53**: 343-471, pl. 8-10.

DESHAYES, P. G. & JULLIEN, J. (1876): Mémoire sur les mollusques nouveaux du Cambodge envoyés au Museum par M. le docteur JULLIEN. — Bull. nouv. Arch. Mus., **10**: (1874) 115-162, pl. 5-9.

FISCHER, H. & DAUTZENBERG, P. (1904): Mollusques, in: Mission Pavie Indo-Chine, Études diverses, **3**: 332-450, pl. 19-22.

FISCHER, P. (1891): Catalogue et distribution géographique des mollusques terrestres, fluviatiles & marins d'une partie de l'Indo-Chine (Siam, Laos, Cambodge, Cochinchine, Annam, Tonkin). — Bull. Soc. Hist. natur. d'Autun, **4**: 1-193.

FISCHER-PIETTE, E. (1950): Liste des types décrits dans le Journal de Comchyliologie et conservés dans la collection de ce Journal. — J. de Conch., **90**: 8-23, 65-82, 149-180, 310-333; pl. 2-5.

JOHNSON, R. I. (1959): The types of Corbiculidae and Sphaeriidae in the Museum of Comparative Zoology ... of TEMPLE PRIME. — Bull. Mus. comp. Zool., **120** (4): 431-479, pl. 1-7.

LO, C.-T. (1969): The Mekong Basin Bilharziasis Survey. — Internal Assignment Report of WHO, 1969.

MABILLE, J. (1872): Sur quelques mollusques rares ou peu connus. — Rev. Mag. Zool., (2) **23**: 48-51.

MABILLE, J. & LE MESLE, G. (1866): Observations sur la faune malacologique de la Cochinchine et du Cambodge, comprenant la description des espèces nouvelles. — J. de Conch., **14**: 117-138, pl. 7.

MORELET, A. (1869): Observations critiques sur quelques Paludines de l'Indo-Chine. — J. de Conch., **17**: 192-202.

MORLET, L. (1884): Description d'espèces nouvelles de coquilles, recueillies par M. PAVIE, au Cambodge. — J. de Conch., **32**: 386-403, pl. 11-13.

— — — (1889): Catalogue des coquilles recueillies, par M. PAVIE, dans le Cambodge et le Royaume de Siam, et description d'espèces nouvelles. — J. de Conch., **37**: 121-199, pl. 6-9.

— — — (1890): Contribution a la faune malacologique du Cambodge et du Siam. — J. de Conch., **38**: 119-122, pl. 3.

— — — (1892, 1893): Description d'espèces nouvelles, provenant de l'Indo-Chine. — J. de Conch., **40**: 314-329, pl. 6-8 (1892); **41**: 153-157, pl. 6 (1893).

POIRIER, J. (1881): Description de quelques espèces nouvelles du Cambodge aux genres *Lacunopsis, Jullienia* et *Pachydrobia*. — J. de Conch., **29**: 5-19, pl. 1-3.

ROCHEBRUNE, T. DE (1881): Documents sur la faune malacologique de la Cochinchine et du Cambodge. — Bull. Soc. philom. Paris, (7) **6**: 36-75, pl. 1.

TEMCHAROEN, P. (1971): New aquatic molluscs from Laos. — Arch. Moll., **101**: 91-109.

WATTEBLED, G. (1884): Description de mollusques inédites recueillis par M. le capitaine DORR, en Cochinchine. — J. de Conch., **32**: 125-131, pl. 6.