

SMITHSONIAN MISCELLANEOUS COLLECTIONS

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WITH DESCRIPTIONS OF TWO NEW SPECIES AND
A NOTE ON THEIR PHILIPPINE RELATIVE

(WITH ONE PLATE)

BY

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Curator of Mollusks and Cenozoic Invertebrates
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CITY OF WASHINGTON
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(WITH ONE PLATE)

Some time ago I received for determination specimens of fresh-water mollusks from Dr. R. Cecil Robertson, M. C., M. D., D. Ph., collected at Tali-Fu, Yunnan, China, which he stated were serving as intermediate hosts of *Schistosoma japonicum* in that region. Dr. Robertson has published upon the medical phase of this subject in the China Medical Journal, 1940, pp. 358-363, where he figures the shell of this species as figure 1-2 E. From this paper I may quote at length:

During 1939, whilst on survey work chiefly connected with the malaria situation on the Burma highway my attention was drawn to a series of patients in the Hsiakwan Hospital under the direction of Dr. S. H. Liu of the South Western Transportation Bureau. These cases presented the classical symptoms of Schistosomiasis and the condition was verified by the discovery of *Schistosoma* ova in the stools of the patients. On further inquiry we found that most of the patients were local inhabitants coming from the country villages on the plain which lies near the lake in the Tali-Fu region and Fengih district. This is one of the plains to be found on the Yunnan plateau where the altitude is approximately 6,900 feet above sea level.

PHYSIOGRAPHY OF THE DISTRICT

These plains are scattered throughout this southwestern table land, small in area and surrounded by mountains. A number represent undissected portions of an old plateau surface, once more extensive. Only fragments of these plateaux remain, for the rest have been carved into a sea of mountains or broken by faulting. A more important type of plain is formed by old lake basins, now partially or entirely drained. Large lakes still remain in the vicinity of Tali and Kunming and the plains surrounding them form the most important agricultural areas of the table land. Other alluvial tracts border some of the rivers and are narrow and subject to flood. Other than these plains, rugged mountains and deep gorges dominate the landscape. At Tali the mountains tower over the lake and the town lies at the foot of these on the lake shore. Hsiakwan is the most important trade centre lying at the southern end of the Erh Hai at an elevation

of 6,900 feet. This city is 15 kilometres from Tali and is situated on the new Yunnan to Burma highway. We have here important transport depots due to the opening up of the district by a motor road; also the city is a busy centre for marketing and agricultural produce.

SEARCH FOR THE MOLLUSCAN HOST

In miniature, the Hsiakwan district resembles a portion of the rich agricultural regions of the Yangtze delta. The cases of Schistosomiasis came from villages situated on this plain or from the outskirt of Hsiakwan. Certain cases came from villages on the lake side between Hsiakwan and Tali. With this information available I considered it advisable to institute a search for molluscs which might be implicated in the transmission of Schistosomiasis in the rice growing districts in the area. From previous experience of the habitat of these snails we made a search in the vegetation along the edges of creeks and small streams flowing into the Erh Hai.

We took the villages from which actual cases had come as a starting point. We also were guided by the fact that a new comer to the district, one of the staff of the transport company who had been bathing in the lake during the summer season had contracted Schistosomiasis. We questioned this patient as to where he had been bathing and made a search for snails of the *Oncomelania* type in the vicinity and along the banks of the lake near where he had been in the habit of swimming.

The time of the year in which we conducted this investigation was late autumn, October, and we at first thought that as we failed to find snails along the actual bank of the lake we were rather late in the season to get successful results.

However on sloping banks of the irrigation ditches which led to the rice paddies we found a mollusc which resembled closely the type of snail we were familiar with in Foochow districts.

These snails were found on soft mud, stones and grass singly or in small groups. As we had become familiar with elsewhere, we found the ideal site to be along the banks of the smaller ditches between the rice fields. As winter was approaching the snails seemed to tend to hibernate; many were found close to the roots of dead plants or under stones.

Apparently the habits of the snails were similar to that described by Wu ("Schistosomiasis in the Shanghai Hills region": China J., 28: 133, 1938) on his survey of the Shanghai Hills region; where he found that the winter was the best season to make collections as there is less vegetation to hide the snails.

A collection of several hundreds of these molluscs was made with the assistance of Mr. W. M. Chow, the technician from the South Western hospital at Hsiakwan who was kindly placed at our disposal by Dr. S. H. Liu. On examining these, we found one or two infected with cercariae belonging to the furcocercous or fork tailed group. Although we did not have opportunity to infect the animals with these cercariae to prove their identity, judging from their structures they were found to belong to *Schistosoma japonicum*.

Our collections were too limited in total numbers to determine the relative percentages of cercarial infection. It is evident, however, that sufficient evidence has been collected to verify the whole life cycle of Schistosomiasis in this region.

Further study might be made as to reservoir hosts other than man in this region as there is a possibility of the disease having been imported by animal

hosts such as cattle, goats or sheep (Wu, "Cattle as reservoir hosts of *Schistosomiasis japonica* in China": *Am. J. Hyg.*, 27: 290, 1938). The snails look very similar to those found in Fukien and undoubtedly belong to the *Katayama* group. A selection has been sent to Dr. Paul Bartsch of the Smithsonian Institution, Washington, U. S. A., for final classification and identification.

There is every reason to believe that the vicious circle of the disease is established by fertilization of the fields with excrement containing *Schistosoma* ova (Robertson, "*Schistosomiasis* in the Shanghai region": *China J.*, 19: 28, 1933). The miracidial stage of the parasite then attacks the molluscan host where further developmental changes take place. In due time the snails become infected and are liable to deposit cercariae into the surrounding water or after rainfall. By this means the smaller creeks become infected and undoubtedly the borders of the lake and the water for some distance from the shore become potentially dangerous for swimmers.

From the public health standpoint the public should be warned about this matter and the employees of the transport companies who use ponds along the highway in this vicinity for washing, domestic purposes or cleaning down cars should realise that the waters of these ponds may be highly infected at certain seasons of the year. The water supplies coming from the surrounding hills are safe as far as we know. We made an attempt to get statistics as to the prevalence of Schistosomiasis in the Tali region by calling upon the various local hospitals. The information gained was very meagre. Some doctors said the disease had been noted, but had up till now not been definitely recognized as Schistosomiasis. Where splenic enlargement was a prominent symptom it was thought to be due to chronic malaria or some other cause.

One of the physicians at Tali said he was under the impression that a disease such as we described was very common in villages across the lake from Tali but we were unable to visit this part of the plain. We found traces of Schistosomiasis as far as the foot hills about 20 kilometres to the east of Hsiakwan.

Dr. Robertson's sending proved a puzzler, for the radula as well as the shell bespoke a *Schistosomophora*, a genus then known only from the Philippines and the island of Honshu, Japan. Dr. Robertson's mollusks proved to belong to an undescribed species which I deferred describing, hoping that the intensive medical exploration in progress would yield additional information that would prove helpful in understanding what then appeared as an isolated distribution problem. Recently we have received a sending of mollusks from the Surgeon General's Office of the Army with the following information:

This office has received another report from Lt. Colonel Paul R. Slater transmitting specimens of snails from areas where schistosomiasis presumably occurs in China. This report deals with medical conditions in Ch'engtu, Szechwan, and contains the following paragraph:

"*Disease Carriers.* . . . Known snail vectors of schistosomiasis are not known to exist in the immediate Ch'engtu area. However, about 25 miles north of Ch'engtu at P'eng Hsien, species of *Katayama* snails have been found infected with schistosomiasis. Some 50-odd snails (shells with animals inside) from the P'eng Hsien area preserved in 70% alcohol are enclosed as Appendix 'A' of this

report. They were obtained from Dr. Y. T. Yao, Assistant Director of the Chinese National Institute of Health and head of the Department of Parasitology. To 4 October 1945 Dr. Yao and his assistants had examined 3,940 of these snails and had found two infected ones giving an infection rate of 0.05 per cent. Dr. Paul Bartsch of the Smithsonian Institution is especially desirous of obtaining some of these specimens for identification and examination. Return report is requested."

When I wrote my paper on the "Molluscan Intermediate Hosts of the Asiatic Blood Fluke, *Schistosoma japonicum*, and Species Confused with Them" (Smithsonian Misc. Coll., vol. 95, No. 5, pp. 1-60, pls. 1-8, 1936) it seemed that as far as *Schistosomophora* was concerned we were dealing with an autochthonous group developed somewhere in the Philippine Islands which had been spread through them by migrating waterfowl and waders. The fact that the genus appeared to be confined to low elevations and seemed to be absent in the elevated areas suggested a comparatively recent arrival, geologically speaking. Their confinement to what might be termed coastal-plain fresh-water areas not long ago submerged beneath the sea would indicate this.

The Chinese species before me come from higher elevations, Tali-Fu, Yunnan, 6,900 feet, and P'eng Hsien, Szechwan, about 3,300 feet. It is possible that nearer the coast will be found other species which may have furnished the ancestral stock for the island forms. Future explorations in this field should yield interesting information.

From the medical standpoint both of these sendings are decidedly important, since the elimination of the intermediate hosts appears to furnish the best control of the dire malady in which they play an important part. They are here described as new species.

I am indebted to Dr. J. P. E. Morrison for the preparation of the radulae and the drawings thereof.

SCHISTOSOMOPHORA ROBERTSONI, new species

Plate 1, figs. 1, 7, 8, 9, 10

1940. *Katayama* spec. ? ROBERTSON, China Med. Journ., 1940, pp. 358-363, figs. 1-2 E.

Shell very elongate-ovate, horn-colored with the peristome a little paler. The nucleus consists of a little more than 2 well-rounded whorls which under high magnification show minute granulations. The nuclear whorls form a blunt apex. The postnuclear whorls are moderately well rounded, marked by incremental lines, and show exceedingly feeble indications of axial ribs. Under certain light, there is also an indication of very fine microscopic spiral markings. Suture

well impressed. Periphery of the last whorl well rounded. Base moderately long, narrowly openly umbilicated, marked like the spire. Aperture ovate. Outer lip reenforced within by a moderately thick callus. The inner lip is concave and slightly reflected. Parietal wall covered by a moderately thick callus. The rachidian tooth of the radula has the formula: $\frac{2-1-2}{2-2}$. It is possible that there may be a third minute

basal tooth. The lateral tooth has 7 denticles of which the third is larger than the rest. The inner marginal has 8 denticles and the outer 5, of which the first is heavier than the rest.

The type, U.S.N.M. No. 573637, was collected by Dr. Robertson at Tali-Fu, Erh Hai, Yunnan, China. It has 8 whorls and measures: Height, 6.5 mm.; diameter, 3 mm.

U.S.N.M. No. 573638 contains 9 topotypes from the same source, which yield the following measurements:

No. of whorls	Length in mm.	Diameter in mm.
8.0	6.8	3.0
8.0	6.8	3.1
8.4	7.5	3.1
8.0	6.7	3.1
8.1	7.0	3.1
7. +	6.3	3.1
7. +	7.1	3.1
3.8 +	0	3.0
6.3 +	6.3	2.9

I take pleasure in bestowing Dr. Robertson's name on this species.

SCHISTOSOMOPHORA SLATERI, new species

Plate 1, figs. 2, 3, 4, 5, 6

Shell elongate-ovate, horn-colored with a reddish flush at the thickened callus of the outer lip. The nucleus consists of about 2.1 thin whorls which are well rounded, smooth, and under high magnification minutely granulose. They form a blunt apex. The postnuclear whorls are moderately well rounded and marked by incremental lines and on the middle turns by very feeble indications of slightly retractively slanting axial riblets. These are the merest indications. Suture well constricted. Periphery of the last whorl slightly inflated, well rounded. Base moderately long, rounded, and narrowly openly umbilicated. Aperture ovate. The outer lip is reinforced within by a heavy callus. The inner lip concave and slightly reflected. The parietal

wall is covered by a moderately thick callus. The operculum is very thin, corneous, and consists of about 1.6 turns, with decidedly eccentric nucleus. The rachidian tooth of the radula has the formula: $\frac{2-1-2}{3-3}$. The lateral has the formula: 2-1-3 or 2-1-4, while the first marginal has 11 denticles and the second marginal 6 or 7.

The type, U.S.N.M. No. 573639, was collected by Dr. Y. T. Yao at P'eng Hsien, Szechwan, China. It has 7.1 whorls and measures: Height, 6 mm.; diameter, 2.9 mm.

U.S.N.M. No. 573640 contains 71 topotypes, 10 of which yield the following measurements:

No. of whorls	Height in mm.	Diameter in mm.
6.4	5.8	3.0
6.4	6.0	3.0
7.2	6.3	3.1
7.0	6.0	3.0
6.5	5.8	3.0
6.6	6.0	2.9
7.1	6.3	3.0
7.1	6.0	3.0
7.0	5.8	3.0
6.7	5.8	3.0

The small ovate form will readily distinguish this species from *Schistosomophora robertsoni*.

I take pleasure in naming the species for Colonel Slater.

SCHISTOSOMOPHORA QUADRASI (Möllendorff)

1895. *Prososthenia quadrasi* MÖLLENDORFF, Nachrichtsbl. Deutsch. Malakozool. Ges., vol. 27, p. 138.
1932. *Prososthenia quadrasi* TUBANGUI, Philippine Journ. Sci., vol. 49, pp. 298-301.
1932. *Oncomelania hydrobiopsis* RENSCH, Philippine Journ. Sci., vol. 49, pp. 551-552, figs. 1a-c.
1932. *Blanfordia quadrasi* TUBANGUI, Philippine Journ. Sci., vol. 49, pp. 298-301, pl. 2, fig. 3, pl. 5, fig. 1.
1934. *Blanfordia quadrasi* BEQUAERT, Journ. Parasit., vol. 20, pp. 280-281.
1934. *Prososthenia quadrasi* BEQUAERT, Journ. Parasit., vol. 20, pp. 280-282.
1934. *Oncomelania hydrobiopsis* BEQUAERT, Journ. Parasit., vol. 20, p. 281.
1936. *Schistosomophora quadrasi* BARTSCH, Smithsonian Misc. Coll., vol. 95, No. 5, pp. 31-32, pl. 1, fig. 8; pl. 2, fig. 5; pl. 3, fig. 1.
1936. *Schistosomophora hydrobiopsis* BARTSCH, Smithsonian Misc. Coll., vol. 95, No. 5, pp. 32-33, pl. 1, fig. 7; pl. 2, fig. 6; pl. 3, fig. 2.

Extensive collections that have come to hand since I prepared my paper on the "Molluscan Intermediate Hosts of the Asiatic Blood Fluke, *Schistosoma japonicum*, and Species Confused with Them," indicate that the characters of the paratype of *Schistosomophora quadrasi* (Möllendorff), U.S.N.M. No. 420943, collected by Quadras at Surigao, Mindanao, which was the only specimen available to me at the time I prepared the paper, fall within the limit of variation of *Schistosomophora hydrobiopsis* Rensch. *S. hydrobiopsis* being of later date will therefore have to be merged with *S. quadrasi* (Möllendorff).

It is well to state here also that an extensive series of radula mounts now prepared reveal that in this species a third basal minute outer denticle is indicated on the rachidian tooth.

The species is now known from the islands of Mindanao, Leyte, Samar, and Mindoro.

EXPLANATION OF PLATE

PLATE I

- Fig. 1. *Schistosomophora robertsoni*.
- Fig. 2. *Schistosomophora slateri*.
- Fig. 3. Rachidian tooth of *S. slateri*.
- Fig. 4. Lateral tooth of *S. slateri*.
- Fig. 5. First marginal tooth of *S. slateri*.
- Fig. 6. Second marginal tooth of *S. slateri*.
- Fig. 7. Rachidian tooth of *S. robertsoni*.
- Fig. 8. Lateral tooth of *S. robertsoni*.
- Fig. 9. First marginal tooth of *S. robertsoni*.
- Fig. 10. Second marginal tooth of *S. robertsoni*.



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6



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10

SCHISTOSOMOPHORA
(For explanation, see p. 7.)