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Descriptions of eight new minute freshwater snails and a new and rare species of land snail from China

(Prosobranchia: Pomatiopsidae, Hydrobiidae; Hydrocenidae).

By

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With 14 figures and 1 plate.

Introduction.

During June, 1979 to October, 1983 a series of field surveys on Mollusca in Hubei, Hunan, Guangxi and Guangdong Provinces were made. And lots of different kinds of freshwater and land snails were collected by Comrades PEI-XI ZHANG, SHI-DE ZHANG, QIAO-YU ZHONG, BAO-FU YAO, DE-HUA PENG and the author himself. After examination we came across eight new species of minute freshwater snails belonging to three genera of the families *Hydrobiidae* and Pomatiopsidae and a new and rare species of land snail belonging to the *Hydrocenidae*. The descriptions of the new species and new genus are as follows. All holotypes and most paratypes are deposited in the Research Laboratory of Medical Malacology, Department of Parasitology, Hubei Medical College, Wuhan City, China and part of the paratypes is stored in the Senckenberg Museum in Frankfurt am Main.

I. On eight new minute freshwater snails.

Gastropoda.

Mesogastropoda.

Pomatiopsidae.

Triculinae.

Tricula BENSON, 1843·

Tricula heudei n. sp.

Fig. 1, Pl. 1 Fig. 1.

Diagnosis: A species of *Tricula* BENSON, which differs from its closest relative, *Tricula martini* RAO, by its larger size, more conical spire, by having more whorls which are only little convex, by lacking of a peripheral keel on the last whorl, and by having a shadow at each subsuture.

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Description: Shell minute, elongate conical, thin, translucent. Part of viscera can be seen through the shell. The surface of shell is always covered with mud or dirt, so that the colour of the majority of the snails is of blackish-brown but the minority is of yellowish-brown. The cleaned shell is smooth except for the weak growth lines which can be seen under strong magnification only. There are 7 whorls, rarely 6 whorls, which are only little convex or almost flat, increase regularly in size and are separated by a less deep suture. There is a shadow at each subsuture which is one of the most conspicuous characteristic of the new species. The penultimate and antepenultimate whorls are band-shaped in dorsal view. The apex is small and acute. The spire of the shell is long and conical. The body whorl is large, its height is equal to or a little less than half of total length. The ratio of breadth to length is 1 : 2·56. The ratio of height of aperture to height of body whorl is 1 : 1·86. The aperture is ovate, narrowed above and well rounded below; peristome continuous, not thickened; lower portion of outer lips slightly reflected outward. There is a very small rift between inner lip and body whorl which can be seen under strong magnification. The umbilicus is narrow, chink-like.

The operculum is oval, corneous; its inner face is generally flat, sticking to the back of the foot; its outer face always covered with some mud, of yellowish-brown, but when cleaned the colour is of light yellow, and transparent. The operculum is slightly thickened from the edge to the nucleus. The nucleus is excentrically situated on the broader end near the inner margin, with 34-38 extremely fine growth lines. The operculum measures 1·23-1·36 mm (average 1·3 mm) in length and 0·75-0·78 mm (average 0·77 mm) in width, and is capable of retraction within the mouth of the shell.

The animal is greyish with blackish pigment dusted over head, foot, neck, rostrum, tentacles and gills. The back of visceral sac has reticular black dots. The mantle and mantle edge are milky white. After removing the operculum the back of foot is greyish-white except for the margin which is blue black. The intestine is long and black, containing many spindle fecal pellets which are 0·38 mm long and 0·13 mm broad. The rostrum is broad and short, and there is a deep mouth slit in the middle of it. The tentacles are black but their tips and margins are milky white and transparent. In the alcohol specimens the tentacles are somewhat flattened and short, and are equal to or shorter than the rostrum; but in living specimens they are long, tapering and blunt pointed at the ends, measuring about three times as long as the rostrum. The small, black eyes are placed in minute swellings at the outer side of the bases of the tentacles. The distance between the eyes measures 0·78 mm. The animal is dioecious and oviparous. Out of 100 specimens examined 48 snails are females and 52 snails are males. The ratio of female to male is 1 : 1·083. The verge of male is flat and long, measuring 2·08 mm in length and 0·10 mm in width situated at the right side of the neck, turning from right to left and then to behind, with a single duct and without appendages.

The radula is band-shaped. The cutting edge of the central tooth has 7 cusps, a large middle and three smaller lateral cusps on either side of it. There are 3 basal cusps on each side of the plate. The lateral has a large mesocone, 3 small endo-and 4 small ectocones. The inner marginal has 10-12 cusps, the outer marginal 7-9 cusps.

Holotype: Length 5·13 mm, breadth 1·86 mm; length of aperture 1·43 mm, breadth of aperture 1·17 mm; collected on October 10, 1983.

Paratypes: Length 4·56-5·19 mm (4·82 mm in average of 20 specimens), breadth 1·69-1·92 mm (average 1·86 mm); length of aperture 1·19-1·56 mm (average 1·28 mm), breadth of aperture 1·09-1·32 mm (average 1·22 mm); collected on October 10, 1983. Paratypes SMF 305649-305651.

Type locality: Bankou Village (24°39'N, 108°62'E, 650 m), Tun-meng Brigade, Shibie Commune, Yishan County, Guangxi Province, China.

Distribution: Yishan, Luocheng and Rongshui Counties, Guangxi Province, China.

Etymology: This species is dedicated to the memory of P.M. HEUDE, the French missionary and amateur scientist, who contributed so much to our malacological knowledge of China.

Habitat: The type locality is a flat ground between hills belonging to the thick layer distribution area of calcareous sandstone. The climate is temperate, the rainfall abundant, and the soil rich. The hills are rocky, soilless, and isolated from each other. Between the hills there are some wide level lands where rice, maizes, sweet potatoes, soybeans, sesames, sugarcanes etc. can be cultivated. Near the village there is an irrigation canal that is 85-120 cm wide and about 20-30 cm deep. The water in it was cool and clear, and was flowing slowly. The bottom was of soft greyish-yellow mud. The canal banks were overgrown with reeds and weeds. The snails of the new species were found living on the banks near the water, distributed in some points at the canal.

Tricula gredleri n. sp.

Figs. 2, 8, Pl. 1 Fig. 2.

Diagnosis: A species of *Tricula*, which differs from its closest relative, *T. minutoides fuchsi* (GREDLER 1887) by the following features: (1) The shell of adult is larger; (2) The aperture is very peculiar, which is provided with a prominent tooth in the inner lip and with a sharp mouth like the spout of a teapot in the upper portion; (3) There is a shadow on each suture.

Description: Shell minute, oval-conical, thin, translucent and light yellow. The spindle fecal pellets in the intestine can be seen through the shell. To the naked eye the shell presents a smooth appearance, without ribs or varix; but when examined under a binocular microscope the surface shows very weak growth lines. The whorls are three to five in number (according to the statistics of 100 specimens 3 whorls, 4 whorls and 5 whorls occupying 21·43%, 64·28%, 14·29% respectively). Each of which is somewhat convex. The whorls increase rapidly in breadth but slowly in height. The penultimate and antepenultimate are band-shaped in both dorsal and ventral views. The apex is always eroded, so that the spire is very low, only occupying ca. 30% of the shell length. The body whorl is very inflated; its height is about 70% of the length of the shell. The ratio of breadth to length is 1:2·32, the ratio of height of aperture to length is 1:2·5, the ratio of height of aperture to height of body whorl is 1:1·76. The umbilicus is narrow but distinct. The sutures are moderately impressed, each of which with a shadow. This is one of the characteristics of the new species. The aperture is peculiar, ovate in shape, continuous, with black margin. The upper portion is pointed and slender like the spout of a teapot; the lower portion is blunt rounded; the outer lip thin, rounded curved and not reflected outwards. The inner lip is very slightly apart from the parietal wall. There is a prominent tooth in the inner lip, which is one of the outstanding characteristics of this species.

The operculum is thin, corneous, elongate elliptical, light yellow, consisting of two layers which come off easily. The inner margin is more or less straight, the outer margin is curved. The nucleus is convex, situated near the lower part of the columellar margin, with radial growth lines. The operculum is 1·15 mm long and 0·60 mm wide, and is capable of retraction within the mouth.

The animal is greyish, dusted with fine black pigment dots which are particularly dense on head, foot, rostrum, tentacles and gills. The mantle edge and the front part of rostrum are milky white, the mantle is light yellow. The liver of female is light reddish yellow. The intestine is thick and long, containing about 12-17 spindle fecal pellets which are, in average, 0·24 mm long and 0·12 mm wide, tidily arranged in transverse, their shape can be seen through the shell. The tentacles are greyish black in general but sometimes the tip is greyish white. In the living specimens the tentacles are long and thin, about 2½ times the length of the proboscis but in alcohol specimens they are thick and short, measuring 0·26-0·3 mm long and 0·13 mm wide at their base, equal to or a little longer than the proboscis which is broad and short, and slightly emarginate in front. The eyes are black and small, and are placed in the base of the back of tentacles. The distance between the eyes is small, about 0·34 mm. The animals are dioecious. Out of 100 snails dissected 44 are males and 56 are females, the ratio of male to female is 1 : 1·27 The females are oviparous. The male reproductive organs show a single, curved, somewhat flattened verge which is placed at the right side of the neck, measuring, in average of 10 specimens, 1·78 mm long and 0·026 mm wide, and with a single duct.

The radula is band-shaped. The cutting edge of the central tooth has 7 cusps, a large middle and three smaller lateral cusps on either side of it. There are 3 basal cusps on each side of the plate. The lateral has a large mesocone, 3 small endo-and 4 small ectocones. Inner marginal with 13-14 cusps, the outer marginal with 9-12 equal cusps on the cutting edge.

Holotype: Length 3·13 mm, breadth 1·35 mm; length of aperture 1·22 mm, breadth of aperture 1·0 mm; collected on October 18, 1983.

Paratypes: Measurements of the Paratypes based on 20 specimens as follows: Length 2·69-3·23 mm, mean 2·93 mm; breadth 1·23-1·56 mm, mean 1·26 mm; length of aperture 0·97-1·43 mm, mean 1·17 mm; breadth of aperture 0·87-1·23 mm, mean 1·09 mm; collected on October 18, 1983. Paratypes SMF 305652-305654.

Type locality: Maluxi (28°56'N, 109°92E, ca. 600 m), Orientalis Commune, Guzhang County, Hunan Province, China.

Distribution: Maluxi and Xiaguanping (10 km from Maluxi), Orientalis Commune, Guzhang County, Hunan Province, China.

Etymology: This species is dedicated to V. GREDLER, the famous German malacologist, who first reported the Chinese *Tricula* snails from Hunan Provine in 1885.

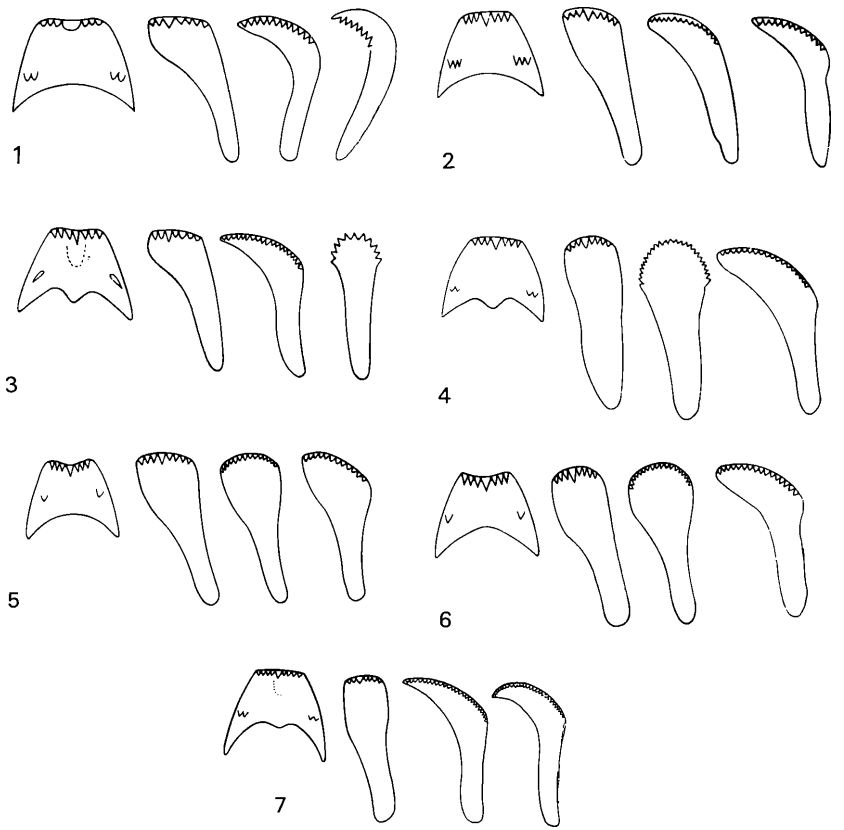
Habitat: The new species lives in the mountain stream in the remote mountain areas where the altitude is approximately 600 meters above sea level. The stream was 50-60 cm wide and about 7-10 cm deep at the type locality. The bottom was sandy and stony. The stream banks were overgrown with reeds, weeds and rare bushes without large trees. Thus the bottom is well shaded. The water in the stream was shallow, cool and clear, with a pH of 6·8-7·0. The snails always sticked on the underside and flank of the stones, distributed in some points at the stream. The density was high at the middle section of the stream. Four to five hundreds snails were caught in an hour.

Tricula gushuiensis n. sp.

Pl. 1 Fig. 3.

Diagnosis: A species of *Tricula* which differs from all species formerly assigned to this genus by its five weak spiral streaks on the lower half of the body whorl.

Description: Shell minute, elongate conical, 2·82 mm in length and 1·1 mm in breadth; shell thin, opaque, black in colour, and always stained with black dirt. There are five very weak spiral streaks on the lower half of body whorl, which is the most outstanding character of this new species. The five to six whorls are somewhat convex, and increase regularly in size, and are separated by a well marked suture. Umbilicus chink-like. Apex obtuse. Body whorl large, its height is about 57% of the length of the shell. Aperture ovate, continuous, narrowed above and more rounded below; outer lip simple, thin; inner lip attached to the body whorl.



Figs. 1-7. Radulae. — 1) *Tricula heudei* n. sp., 2) *Tricula gredleri* n. sp., 3) *Bythinella robusta* n. sp., 4) *Bythinella lii* n. sp., 5) *Akiyoshia (S.) orientalis* n. sp., 6) *Akiyoshia (S.) microstoma* n. sp. 7) *Akiyoshia (S.) chebaensis* n. sp. — Not to scale.

Operculum ovate, 0·85 mm in length and 0·48 mm in width, corneous, thin, light yellow, paucispiral with an excentric nucleus. Soft parts and radula unknown.

Holotype: Length 2·82 mm, breadth 1·1 mm; length of aperture 1·026 mm, breadth of aperture 0·7 mm; collected on November 25, 1980.

Paratypes: Measurements of Paratypes based on 20 specimens as follows: Length 2·43-3·19 mm (average 2·79 mm), breadth 0·96-1·26 mm (average 1·19 mm); length of aperture 0·82-1·2 mm (average 1 mm), breadth of aperture 0·6-0·76 mm) average 0·68 mm); collected on November 25, 1980. Paratypes SMF 305655-305656.

Type locality: Qilingkeng (23°50'N, 112°30'E, 500 m), Shidong Brigade, Gushui Commune, Guangning County, Guangdong Province, China.

Distribution: Known from the type locality only.

Parasitology: 2100 snails were examined by De-hua Peng, and one of them (0·0476%) was found infected with microcercous cercariae of *Paragonimus skrjabini* Chen 1959.

Etymology: The new species is named for Gushui Commune in which it was found.

Habitat: The type locality is located in the Sansu Mountain Area of the northwest of Guangdong Province, China. The highest peak in the Sansu Mountain has an elevation of 1015 meters, but the type locality only has an altitude of 500 meters. The new species lives in a rivulet between two hills. The rivulet is very narrow. Along the banks there were many bamboos, bushes and weeds, thus making a good sunshade. The rivulet was covered with bamboo leaves and other leaves of the trees. The bottom was of sand, small stones and dirty mud. The water in it was very shallow (about 5-15 cm deep), cool and clear, and slowly-flowing, with a pH of 5·8-6·8. The temperature of water near where the snails lived was recorded in November, 1980 from 15 to 20C. The snails were abundant, living on withered bamboos, dead leaves and attached to the underside of small stones, distributed mainly in the upper and middle portions of the rivulet. In general, the slower the current velocity is and the more fallen leaves there are, the higher is the density of snails.

Hydrobiidae.

Bythinella Moquin-Tandon 1855.

Bythinella robusta n. sp.

Figs. 3, 9, Pl. 1 Fig. 4.

Diagnosis: A species of *Bythinella* which differs from *B. (Moria) nipponica minatoi* Habe 1965 by its larger size and more convex whorls. From *Pseudobythinella shimenensis* Liu & al. 1982 it is distinguished by its smaller size, by its inner lip without tooth, by the shape and structure of the operculum and verge, and also by differences in the outer marginal teeth of the radula.

Description: Shell minute, robust, short cylindrical, 2·25 mm in length and 1·12 mm in breadth, milky white or light yellow, thin and transparent. The black eyes and yellowish-brown fecal pellets can be seen through the transparent shell. The surface of shell is rather smooth with very weak growth lines. The whorls are three and a half in number, each of which is well inflated and scalariform. The suture between each two whorls is well impressed. The apex is low and rounded. The body whorl is rather large, its height about 71% of the shell length, and its width always more than that of the penultimate whorl. The ratio of breadth to

length is 1 : 2; the ratio of height of aperture to length of shell is 1 : 2·59; and the ratio of height of aperture to height of body whorl is 1 : 1·84. In both dorsal and ventral views the penultimate whorl is not band-shaped, its right side always wider than the left one, so that the spire is inclined to the left. The aperture is rather large, continuous, subcircular, blunt rounded in both ends. The outer lip is simple, rounded, and not reflected. The inner lip is more or less straight, reflected outwards, and attached to body whorl, without a prominent tooth in the middle of it. The umbilicus is slit-like, small chink.

The operculum is subcircular, horny, thin, whitish, transparent, and paucispiral with an excentrical nucleus. It is smaller than the aperture, being 0·73 mm long and 0·44 mm wide.

The animal is milky white. The eyes are black, suborbicular, measuring 0·04 mm by 0·04 mm, and are placed in the base of the tentacles. The distance between eyes is wider and measures 0·43-0·59 mm. In living specimens the tentacles are long and slender, about three times as long as the snout; but in alcohol specimens they are equal to or shorter than the snout, being 0·35 mm long and 0·05 mm wide at their bases. The snout is wide and short, and measures, in average of 10 specimens, 0·43 mm in length and 0·52 mm in width. The intestine is long and thin, containing many spindle fecal pellets of yellowish-brown colour. The new species is dioecious. The females predominate the males in nature. The verge of the male reproductive organs is long, bent and pointed at end. It has a single duct and no appendages.

The radula has a trapezoidal rhachis; its cutting edge has 7 cusps, the middle one is slightly larger. There is one basal cusp on either side. The laterals have a cusp formula 2-1-4, the inner marginals have 20-22 small cusps, the outer marginals have 9-12 small cusps.

Holotype: Length 2·28 mm, breadth 1·13 mm; length of aperture 0·98 mm, breadth of aperture 0·85 mm; taken in August, 1979.

Paratypes: Length 1·92-2·35 mm (2·25 mm in average of 20 specimens, the same below); breadth 0·96-1·3 mm (average 1·12 mm); length of aperture 0·9-1·05 mm (average 0·96 mm); breadth of aperture 0·8-0·92 mm (average 0·87 mm); collected with the holotype. Paratypes SMF 305657-305659.

Type locality: Qing-guan-du (29°67′N, 110°52′E, ca. 850 m), Nanzhen Commune, Shimen County, Hunan Province, China.

Distribution: Known from the type locality only.

Habitat: The new species lives in a small mountain stream where the altitude is approximately 850 meters above sea level. The banks of the stream were overgrown with weeds and bushes. The bottom was formed of sand and stones. The water is cool, clear and was flowing slowly. The snails were attached to the underside of the stones with high density, but sometimes attached on withered leaves and dead branches.

Bythinella lii n. sp.

Figs. 4, 10, Pl. 1 Fig. 5.

Diagnosis: A species of *Bythinella*, which differs from *B. nipponica* Mori and *B. kubotai* Kuroda & Habe by its ovateconical shape, short and conical spire, much larger size, straight inner lip, the base of body whorl strongly rounded and descending to the aperture, and by the shape of its operculum and the radula formula.

Description: Shell ovate-conical, minute, thin, translucent, dull white; smooth except for the very weak incremental lines. Whorls 4 in number, each of which well convex with a deeply constricted suture. Apex small but obtuse. Spire short and conical. Body whorl very large and inflated, the base of which is strongly rounded and descending to the aperture, it measures about two-thirds the length of the shell. Aperture large, roundly ovate; peristome continous, simple, with a brownish margin; outer lip thin, roundly curved, inner lip more or less straight, slightly reflected outwards, and its middle portion attached to the body whorl. Umbilicus narrow but distinct. Operculum elliptical, rounded at both ends, 0·79 mm in length and 0·5 mm in breadth, corneous, thin, semitransparent, light yellow, paucispiral with excentric nucleus.

The animal is usually light yellow. The single tentacle on each side of the head in life is long and slender, slightly swollen at the base and pointed at the end. In alcohol specimens the tentacles are thick and flat, and its length is always longer than the snout. The small black eye-spots are situated at the dorsal side of the base of the tentacles. The proboscis is wide and short, and slightly bilobed in front where the mouth is located. The mantle is dull white, translucent, and its edge is smooth, without processes of any kind. The verge of the male is simple, slender and light yellow, and is coiled up at the back of neck near the right, and its tip is pointed and blunt.

The radula is band-formed, 0·68 mm in length and 0·62 mm in breadth. The central tooth has 7 denticles on the free edge, of which the median is larger. It also has two pairs of basals; its formula, there-$\frac{3\text{-}1\text{-}3}{2\text{-}2}$-fore, is. The lateral tooth has a large denticle and 3 smaller ones on the inside, and 4 on the outside. The inner marginal bears 25 denticles and the outer 18.

Holotype: Length 2·4 mm, breadth 1·43 mm; length of aperture 1·01 mm, breadth of aperture 0·84 mm; length of body whorl 1·63 mm; length of spire 0·77 mm; taken on July 15, 1979 by the author and his friends.

Paratypes: Measurements of the Paratypes based on 20 specimens as follows: Length 2-2·43 mm (average 2·26 mm), breadth 1·28-1·44 mm (average 1·35 mm); length of aperture 0·85-1·02 mm (average 0·98 mm), breadth of aperture 0·71-0·86 mm (average 0·78 mm); length of body whorl 1·14-1·64 mm (average 1·55 mm); length of spire 0·59-0·78 mm (average 0·71 mm); taken on July 15, 1979, January 14, 1983 and September 30, 1984 by Comrades Xuan-sen Xiang, Zai-yuan Chen, Ji-han Tian, Pei-xi Zhang and the author himself. Paratypes SMF 305660-305662.

Type locality: Longqiao Village (30°9'N, 110°50'E, ca. 1100 m), Wantan District, Wufeng County, Hubei Province, China.

Distribution: Known from the type locality only.

Etymology: This new species is named in honor of Prof. F. C. Li, the famous Chinese anatomist, one of the early workers on *Oncomelania* in China.

Habitat: The type locality is a mountain region where the altitude is approximately 1100 meters above sea level, but the topography is smooth and wide. There is a high mountain located in the east, which is called "Yuquanshan" A mountain cave known as "Yuquandong" is situated in the foot of the mountain, many fishes are in this cave, and the spring water in it flows murmurously little by little without a letup, it never dries out throughout the year. The South and the West also have high mountains. There is a road from Wufeng County to Hefong County along the

foot of the mountain in the West. A river named Wantan River runs along the side of the road. A bridge known as "dragon bridge" is laid across the river. A stretch of flat ground is situated in the east of the bridge, where maizes (Indian corn), tobaccos and so on are planted. The new species lives in the small mountain ditch on that flat ground. There is a triangular pond in the beginning of the mountain ditch. The water in which oozes out of the underground and takes its source from the "Yuquan Cave", and then the water of the pond oozes out into the ditch and flows to Wantan River. The ditch is 200 m long, 35-50 cm wide and 6-10 cm deep. The water is little, cool and slowly-flowing, with a pH of 6·8-7·0. Parts of the ditch were choked with water and grass and the sides of it were overgrown with weeds. The bottom was mixed with sand and small stones. The snails were completely submerged and attached to the underside and flank of the small stones, with the majority to the underside.

Comparison: The present species is closely allied to *Bythinella nipponica* MORI 1937 and *Bythinella kubotai* KURODA & HABE 1959, but can be readily differentiated by the characters listed in the following table.

species / characters	*Bythinella lii*	*Bythinella nipponica*	*Bythinella kubotai*
size of shell	2.4X1.43 mm	1.5X0.95mm	1.6X1.2 mm
shape of shell	ovate-conoidal	short cylindrical	stoutly ovate
no. of whorls	4	4	$3\frac{3}{4}$
shape of spire	short and conical	cylindrical	cap-like
$\frac{\text{length of body whorl}}{\text{length of shell}}$	68%	67.6%	81.3%
breadth / length	1 : 1.68	1 : 1.57	1 : 1.33
$\frac{\text{width of body whorl}}{\text{width of penultimate}}$	1.73	1.64	1.91
size of aperture	1.01X0.84 mm	0.7X0.5 mm	0.7X0.7 mm
shape of aperture	roundly ovate	suborbicular	widely lunate
operculum	elliptical, with many minute and radial lines	elongated elliptical, with concentric and radial striae	similar to *B. nipponica*
central tooth	$\frac{3\text{-}1\text{-}3}{2\text{-}2}$	$\frac{4\text{-}1\text{-}4}{2\text{-}2}$	$\frac{5\text{-}1\text{-}5}{2\text{-}2}$
lateral teeth	3-1-4	2-1-4	3-1-5

Akiyoshia KURODA & HABE 1954.

Akiyoshia (Saganoa) KURODA, HABE & TAMU 1957.

Akiyoshia (Saganoa) orientalis n. sp.

Fig. 5, Pl. 1 Fig. 6.

Diagnosis: A species of *Akiyoshia (Saganoa)* which differs from its closest relative, *A. (S.) kishiiana* KURODA, HABE & TAMU by its elongate cylindrical shape, less dilated body whorl, having more whorls, animal with eyes, and by its radula formula. From *A. (S.) imamurai* HABE it differs by its larger average size, subcircular aperture, body whorl less than or equal to half length of the shell, and by its aperture shape.

Description: Shell minute, elongate cylindrical, very thin, transparent, milky white or light yellow. The shell surface is rather smooth, but with very weak incremental lines, which sometimes are also indistinct under heigh magnification. The 5-5½ whorls are less convex, increase rapidly in height, but slowly in breadth. The suture between each two whorls is shallow but distinct. The mammillate apex is obtuse and rounded. The spire of shell is long and slender. The body whorl is not inflated, its length is less than or equal to half length of the shell (average 49%), and its breadth is a little wider than that of the penultimate. The ratio of breadth to length is 1 : 2·86. The aperture is large, about 57·5% of the height of the body whorl, subcircular. Peristome continuous, slightly reflected outward. Under strong magnification a minute rift can be seen between body whorl and inner lip. The umbilicus is a chink-like narrow opening besides the peristome.

The operculum is corneous, thin, transparent, nearly white, ovate in shape, measuring, in average of 10 specimens, 0·44 mm by 0·29 mm, paucispiral with lateral and basal nucleus.

The animal is of greyish white colour. The intestine is long, slender, and is full of spindle fecal pellets of yellowish-brown colour. The small and black eyes are placed at the back of the base of the tentacles. The distance between the eyes is wider. The single tentacle on each side of the head is greyish-white, long and thin, and pointed at the tip; but in alcohol specimens the tentacles are relatively short, about 1½ times the length of the proboscis, measuring 0·26 mm in length and 0·078 mm in width at their base. The snout is wide and short, slightly emarginate in front. The animal is dioecious. The verge of male is placed in the neck near to the middle line. It is coiled, simple, without appendages, and has a single duct.

Radula with trapezoidal rhachis; its cutting edge has 7 cusps, of which the median one is the largest; there is one basal cusp on either side. Laterals with the cusp formula 3-1-4, inner marginals with 14-16 cusps, outer marginals with 9-12.

Holotype: Length 1·83 mm, breadth 0·61 mm; length of aperture 0·52 mm, breadth of aperture 0·48 mm; collected in July, 1979.

Paratypes: Measurements of 30 adult specimens: Length 1·72-1·95 mm (mean 1·82 mm), breadth 0·55-0·63 mm (mean 0·6 mm); length of aperture 0·49-0·55 mm (mean 0·53 mm), breadth of aperture 0·45-0·52 mm (mean 0·5 mm); collected in July, 1979 and on October 18, 1983. Paratypes SMF 305663-305665.

Type locality: Xiaguanping (28°65'N, 110°E, ca. 600 m), Orientalis Commune, Guzhang County, Hunan Province, China.

Distribution: Xiaguanping, Orientalis Commune and Shangbuchi, Qietong Commune, Guzhang County, Hunan Province, China.

Parasitology: 721 snails of the new species were examined by crush method, and three of them (0·41%) were found infected with cercariae of *Paragonimus skrjabini* CHEN 1959.

Habitat: The new species lives in the mountain stream where the altitude is approximately 600 meters above sea level. The small stream under a sheer cliff was 40-60 cm wide and 6-10 cm deep at the type locality; its bottom being sandy and stony; its water being shallow, cool and clear, and flowing slowly with a pH of 6·8-7·0. The banks were overgrown with weeds and bushes, thus making a good sunshade. The snails are attached to the underside of stones and decayed twigs with high density. The new species always lives together with *Tricula gredleri* n. sp. in the same stream at Xiaguanping, Orientalis Commune, Guzhang County, Hunan Province.

Akiyoshia (Saganoa) microstoma n. sp.

Fig. 6, Pl. 1 Fig. 7.

Diagnosis: A species of *Akiyoshia (Saganoa)* which differs from its closest relative, *A. (S.) orientalis* n. sp. by its smaller average size, lack of umbilicus and by its small aperture which is elliptical rather than subcircular. From *A. (S.) imamurai* HABE, it differs by its larger size, having more whorls which are less convex, the base of body whorl not rounded and by its small aperture which shape is also different from the latter.

Description: Shell cylindrical, thin, fragile, translucent, and dull white. The shell surface is very smooth, even under high magnification the growth lines are still indistinct. The 5-5½ whorls are only slightly convex and separated by a shallow but distinct suture; they increase gradually and evenly in size. The penultimate and antepenultimate whorls are band-shaped in both dorsal and ventral views. The mammillated apex is almost smooth. The body whorl is large and cylindrical, it measures about 52·8% of the length of the shell. The shell length is 2·68 times as much as the breadth. The width of body whorl is equal to or a little more than that of the penultimate whorl. The length of aperture is about 51·86% of the height of the body whorl. Aperture very small, elliptical, continuous; outer lip simple, thin and not reflected outwards; inner lip closely adherent to the surface of the body whorl. No umbilicus. Operculum small, thin, ovate, horny, nearly white, transparent, measuring 0·4 × 0·3 mm, paucispiral with excentric nucleus.

The animal is milky white. The mantle edge is thin and smooth without any kind of papillae. The eyes are small, black, and placed in minute swellings in the base of the tentacles. The distance between eyes is very narrow, and measures about 0·02 mm. In living specimens the tentacles are long and slender, and pointed at the tip, but in alcohol specimens the tentacles are short and thick, only slightly longer than the proboscis, measuring, in average of 10 specimens, 0·22 mm in length and 0·07 mm in width at their base. The proboscis is short and thick, with a deep emargination in front. The intestine is long and slender, containing many spindle fecal pellets of yellowish-brown colour, they can be seen through the translucent shell. The species is dioecious. The verge is small, simple, and coiled on the back of neck. It shows no appendages and has a single duct. The radula is band-formed, the cutting edge of the central tooth has 7 cusps, a large middle and three smaller lateral cusps on either side of it. There is one basal cusp on each side of the plate. The laterals have the formula 3-1-4, inner marginals with 18-20 cusps and the outer marginals with 14-16.

Holotype: Length 1·61 mm, breadth 0·56 mm; length of aperture 0·52 mm, breadth of aperture 0·32 mm; collected in July, 1979.

Paratypes: Measurements are based on 20 specimens: Length 1·56-1·69 mm (average 1·61 mm), breadth 0·56-0·65 mm (average 0·6 mm); length of aperture 0·42-0·56 mm (average 0·52 mm), breadth of aperture 0·30-0·36 mm (average 0·34 mm); collected in July, 1979 and on October 18, 1983. Paratypes SMF 305666-305668.

Type locality: Shangbuche (28°78′N, 109°86′E, 720 m), Qietong Commune, Guzhang County, Hunan Province, China.

Distribution: Shangbuche, Qietong Commune and Xiaguanping, Orientalis Commune, Guzhang County, Hunan Province, China.

Habitat: The new species lives in the rivulet on the mountain where the altitude is approximately 720 meters above sea level. The rivulet-head is the spring

water at the top of the mountain that runs down from the rocky cliff into its body. The bottom was formed of sand and small stones. It flowed gently and had clear, cool clean water with a pH of 6·8-7·0. The banks were overgrown with weeds and bushes along the rivulet that provided a good sunshade. The snails were found attached to the underside and flank of the stones, with the majority to the underside, sometimes they were also found on the dead branches and decayed leaves.

Akiyoshia (Saganoa) chebaensis n. sp.

Figs. 7, 11, Pl. 1 Fig. 8.

Diagnosis: A species of *A. (S.)* which differs from *A. (S.) nanatsugamaensis* HABE by its larger size, peculiar aperture, the base of body whorl not strongly rounded, and the animal with eyes.

Description: Shell minute, cylindrically ovate, thin, translucent, dull white; shell surface rather smooth, even under a strong lens or a binocular microscope the growth lines are still indistinct. The four whorls increase regularly in size; they are moderately convex and separated by a simple suture. The apex is small and blunt. The body whorl is large and cylindrical, the base of which is not strongly rounded, its height is always more than half the length of the shell. The ratio of breadth to length is 1 : 2·33, the ratio of body whorl to shell is 1 : 1·76. The aperture is somewhat peculiar, oval in shape, rounded anteriorly and narrowed posteriorly. It measures about 5/9 of the height of the body whorl. Peristome continuous, with a brownish margin. Outer and inner lips are simple and thin, outer lip not expanded, inner lip slightly reflected, and attached to the body whorl. Columella with 2 small teeth. The corneous, light yellow and transparent operculum is of ovate shape, measuring 0·49 mm in length and 0·3 mm in width; its nucleus is placed near the lower end of the columellar margin.

The animal is greyish white except the intestine, which is yellow-brown, full of spindle fecal pellets. The tentacle is situated at each side of the head; in life it is long and thin, but in alcohol-fixed specimens the tentacles are thick and short, measuring

Figs. 8-11. Opercula. — 8) *Tricula gredleri* n. sp., × 37, 9) *Bythinella robusta* n. sp., × 37, 10) *Bythinella lii* n. sp., × 47, 11) *Akiyoshia (S.) chebaensis* n. sp., ×74.

0·31 mm in length and 0·13 mm in width at the base. It is much longer than the snout. The eyes are small and black, measuring 0·05 mm × 0·03 mm and are situated at the base of the dorsal side of the tentacles. The distance between the eyes is about 0·26 mm. The snout is wide and short, and slightly emarginate in front where the mouth is located. The verge of male is situated on the neck near the right, measuring 0·42 mm in length and 0·07 mm in width at the base in alcohol specimens. It is a bent, short, somewhat compressed organ with pointed tip. There is only a single duct and no appendages. The radula is band-shaped, measuring 0·43 mm in length and 0·06 mm in breadth. Rhachis with 9 cusps on the cutting edge and 2 basal cusps on either side. Laterals with the cusp formula 2-1-4, inner marginals with 27-30 cusps, outer marginals with 25-27.

Holotype: Length 1·7 mm, breadth 0·69 mm; length of aperture 0·56 mm, breadth of aperture 0·48 mm; collected on August 5, 1982.

Paratypes: Measurements of the paratypes based on 30 specimens as follows: Length 1·58-1·91 mm (mean 1·74 mm), breadth 0·69-0·8 mm (mean 0·75 mm); length of aperture 0·61-0·69 mm (mean 0·63 mm), breadth of aperture 0·43-0·52 mm (mean 0·46 mm); collected on 5 August 1982, 18 August 1984 and 9 October 1984. Paratypes SMF 305669-305671.

Type locality: Chai-ling-gou (30°34′N, 109°34′E, ca. 750 m) near Cheba hydropower station of Tunbao District, Enshi County, Hubei Province, China.

Distribution: Known from the type locality only.

Etymology: The species name *chebaensis* was given because of the type locality near Cheba hydropower station of Tunbao District, Enshi County, Hbei Province, China.

Habitat: This new species lives in the small brook on the mountain where the altitude is approximately 750 meters above sea level. The brook was about 50-70 cm wide and 8-12 cm deep at the type locality. The banks were covered with many weeds and scattered bushes. The bottom was formed of sand and stones. The water was very little, cool, and slowly-flowing. The temperature of water near where the snails lived was recorded at noon on August 5, 1982 at 22°C, while the pH was 7·2; but the atmospheric temperature on that hot summer day was as high as 30°C. The snails were found attached to the underside of stones. The distribution of *A. (S.) chebaensis* was limited to the upper portion of the brook. It was very difficult to find them in middle and lower portion of the brook. This new species was found in company with *Tricula tunbaoensis* KANG at the same brook.

II. A new and rare species of land snail.

Archaeogastropoda.

Hydrocenidae.

Lapidaria n. gen.

Diagnosis: The new genus is similar to genus *Georissa* BLANFORD 1864 but differs in the following characters: (1) Shell minute, thin, translucent, reddish-brown, ovate-conoidal, with low and short spire and large, inflated body whorl; (2) Whorls 3½-4, well convex, scalariform, all with a wider platformlike area; (3) Under strong magnification the protoconch appears very smooth, the other

whorls are sculptured with regular spiral lines; (4) Aperture continuous, semicircular; outer lip thin, roundly curved, its back with about 20 spiral lines; inner lip straight, there is a chitinous, transparent, and very small plane between inner lip and body whorl, under which there is a conical tube; a conical soft tissue stretches from the base of the soft parts, with a black and thin membrane, inserting in this tube; (5) Operculum thick, fragile, whitish, translucent, elliptical in shape, blunt rounded at both ends, paucispiral with excentric nucleus; characteristic is on its inner surface a chitinous, transparent and long spicule; (6) The intestine is very very long, but the feces not become fecal pellets; (7) No tentacles; (8) The radula is very long, without central tooth, consisting of two bands which are grappling with each other; each band consists of 7-9 transverse rows, each of which bearing 6-7 cusps on the upper margin.

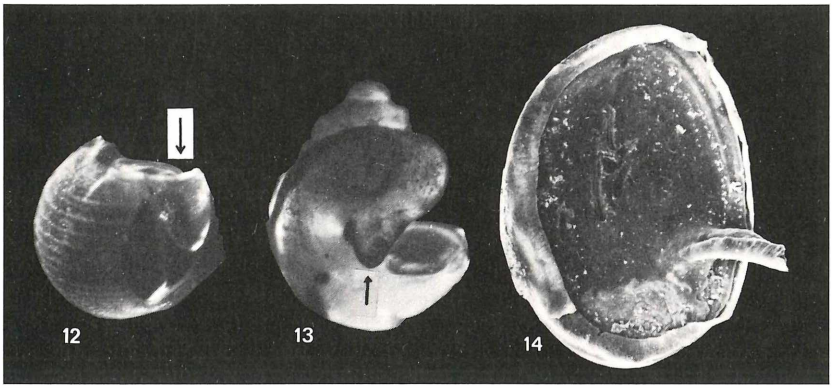
Discussion: The new genus is similar to genus *Georissa* BLANFORD 1864. The type species of which is the little *G. pyxis* BENSON 1856, from the neighbourhood of Thayet Myo in Pegu, where it is abundant, adhering to limestone rocks. All species of *Georissa* are with a projection on the inner side of the operculum, and without teeth in the central portion of the lingual membrane. These characters are closely related to the new genus. The genus *Georissa* in China has been recorded by YEN (1939) and he enumerated only four species, namely *sinensis* (HEUDE 1882), *bachmanni* (GREDLER 1881), *hungerfordiana* MOELLENDORFF 1885 and *sulcata* MOELLENDORFF 1885. But the new genus differs from *Georissa* by the following features: (1) Gill is not well developed; (2) No tentacles; (3) A conical soft tissue with a black and thin membrane stretches out from the base of the soft parts; (4) There is a conical tube under the inner lip; (5) Outer surface of operculum with 8-15 curved growth lines.

Etymology: The genus name *Lapidaria* was given because of its habitat.
Type species: *Lapidaria chinensis* n. sp.

Lapidaria chinensis n. gen. n. sp.

Figs. 12-14, Pl. 1 Fig. 9.

Description: Shell very small, 1·96 mm long and 1·43 mm wide, conoidal-ovate in shape, reddish-brown in color, thin and translucent. The intestine and eyes may be seen through the shell. Whorls 3½-4, well convex, scalariform, all with a broad platformlike area and separated by a deep suture. The whorls increase slowly in height but rapidly in breadth. The mammillate apex is small, round and smooth. The body whorl is very large and inflated, occupying 69·66% of the length of the shell, its width is 1·65 times as much as that of the penultimate whorl. The ratio of breadth to length is 1 : 1·367. Under strong magnification the mammillate apex is smooth, the remaining whorls are sculptured with regular spiral lines, about 20-22 on the body whorl, 12-15 on the penultimate whorl, 10 on the antepenultimate whorl. The umbilicus is indistinct. The aperture is semicircular, about 55% of the length of the body whorl; peristome continuous; outer lip thin, roundly curved, its back with about 20 spiral lines; inner lip straight, there is a chitinous, transparent and small plane between inner lip and body whorl, under which there is a conical tube; a conical soft tissue stretches from the base of the soft parts, with a black and



Figs. 12-14. *Lapidaria chinensis* n. gen. n. sp.; 12) part of body whorl showing inner conioal tube, × 13) soft parts showing black conical tissue, × 20, 14) operculum, × 60.

thin membrane, inserting in this tube; it is a very particular structure, in other snails it has never been seen. Operculum thick, fragile, easily peeling off, whitish, translucent, elliptical in shape, blunt rounded at both the anterior and posterior ends. Nucleus lateral, near the broad end to the inner lip, with 8-15 growth lines. On the inner surface there is a chitinous, transparent and long spicule (average 0·2 mm long and 0·09 mm broad) which extends from the nucleus and inserts in the muscle of the foot. It is one of the characteristics of the new species. The operculum measures 0·65-0·78 mm long (average 0·72 mm) and 0·43-0·56 mm wide (average 0·5 mm), and is capable of retraction within the mouth of the shell.

Animal: The head, foot and mantle are milky white, the gill is greyish-black, the posterior portion of visceral sac has a black marked membrane. When the operculum is removed the back of the foot is black with the exception of the margin which is milky white. The intestine is very long, slender, with many windings, measuring 3·83 mm in length and 0·09 mm in breadth, yellowish-brown in colour, and opening in the right of the mantle cavity, in which the feces are pulpy, not becoming fecal pellets. The eyes are black and large (0·09 mm × 0·08 mm), and are placed in each side of the head. The distance between the eyes is 0·35 mm. Tentacles are lacking. The proboscis is short and wide, and deeply emarginate in front. The radula is very different from other species of the family Hydrocenidae. It is very long, without central tooth, consisting of two bands which were grappling with each other; and each of which bearing 6-7 cusps on the upper margin. The reproductive system is not yet cut clear, and awaits further investigation.

Holotype: Length 2 mm, breadth 1·46 mm; length of aperture 0·74 mm, breadth of aperture 0·83 mm; taken on October 15, 1983.

Paratypes: Measurements of the Paratypes based on 20 specimens as follows: Length 1·65-2·26 mm (average 1·96 mm), breadth 1·22-1·57 mm (average 1·43 mm); length of aperture 0·64-0·87 mm (average 0·75 mm), breadth of aperture 0·78-0·90 mm (average 0·82 mm); taken on October 15, 1983. Paratypes SMF 305672-305674.

Type locality: Longjiaodong (27°83'N, 109°66'E, ca. 900 m), Heku Commune, Fenghuang County, Hunan Province, China.

Distribution: Known from the type locality only.

Habitat: The type locality was a narrow mountain valley where the altitude is approximately 900 meters above sea level. On the right of the valley there were sheer precipitating and overhanging rocks. There were many trees and bushes around there. The illumination was very short. The atmospheric temperature was relatively low. A rivulet is at the base of the rocky cliff; the water was little, cool and clear. The rocky cliff was covered with moss. The snails of the new species live in the moss. The distribution area of the snails was about some square meters with only low density.

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Explanations to plate 1.

Phot. Senckenberg-Mus. (R. ALBERT).

Fig. 1. *Tricula heudei* n. sp., × 10.
China (Guangxi prov.): Shibie comm.: Bankou [paratype SMF 305651].

Fig. 2. *Tricula gredleri* n. sp., × 15.
China (Hunan prov.): Orientalis comm.: Maluxi [paratype SMF 305654].

Fig. 3. *Tricula gushuiensis* n. sp., × 15.
China (Guangdong prov.): Gushui comm.: Qilingkeng [paratype SMF 305656].

Fig. 4. *Bythinella robusta* n. sp., × 20.
China (Hunan prov.): Nanzhen comm.: Qing-guan-du [paratype SMF 305659].

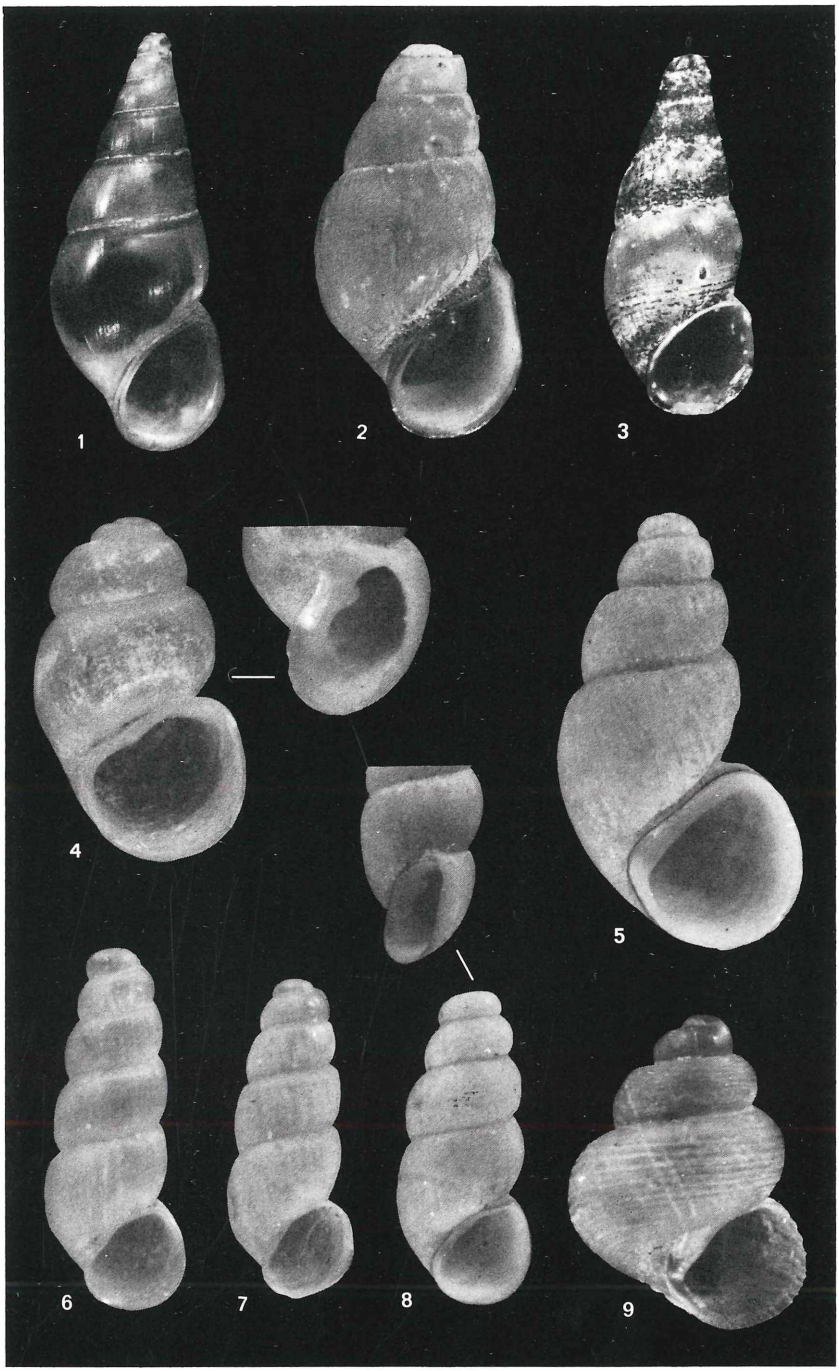
Fig. 5. *Bythinella lii* n. sp., × 20.
China (Hubei prov.): Wantan distr.: Longqiao [paratype SMF 305662].

Fig. 6. *Akiyoshia (Saganoa) orientalis* n. sp., × 25.
China (Hunan prov.): Orientalis comm.: Xiaguanping [paratype SMF 305665].

Fig. 7. *Akiyoshia (Saganoa) microstoma* n. sp., × 25.
China (Hunan prov.): Qietong comm.: Shangbuche [paratype SMF 305668].

Fig. 8. *Akiyoshia (Saganoa) chebaensis* n. sp., × 25.
China (Hubei prov.): Tunbao distr.: Chai-ling-gou [paratype SMF 305671].

Fig. 9. *Lapidaria chinensis* n. gen. n. sp., × 20.
China (Hunan prov.): Heku comm.: Longjiaodong [paratype SMF 305674].



Z.-B. KANG: Descriptions of eight new minute freshwater snails and a new and rare species of land snail from China.