

XXVIII CONTRIBUTIONS TO THE FAUNA
OF YUNNAN BASED ON COLLECTIONS
MADE BY J COGGIN BROWN, B Sc ,
1909-1910 ¹

PART IX. TWO REMARKABLE GENERA OF FRESHWATER
GASTROPOD MOLLUSCS FROM THE LAKE ERH-HAI.

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Numerous fossil shells from the Miocene beds of Eastern Europe have been assigned (somewhat doubtfully we agree with Fischer²) to the family Pleuroceratidae or Pleuroceridae, but this family is usually believed to be confined in a living condition to North America. In the collection of molluscs made by Mr. J. Coggin Brown of the Geological Survey of India in Yunnan some years ago, we find numerous specimens of two species which we think may find a place at least provisionally among the Pleuroceratidae more conveniently than elsewhere. One of these species has already been described more than once, and has been placed by three different authors in three different genera of Hydrobiidae. Its proper name is *Fenouilia kreitneri* (Neumayr). The other species has not, so far as we can discover, been as yet described. It is impossible to separate it generically from the living and fossil Burmese and Chinese genus recently described by one of us under the name *Paraprososthenia*. It has, however, such marked conchological differences that we propose for its reception a new subgenus. We have named it *Paraprososthenia (Parapyrgula) coggini* in allusion to the name of its discoverer and to the *Pyrgula*-like appearance of the shell.

The precise locality at which both species were found is Shangkuan at the north end of Erh-Hai. They were living on stones at the edge of the lake at a spot liable to strong wave-action.

The shells of *Paraprososthenia coggini* and *Fenouilia kreitneri* are very different in shape, that of the former being elongate and strictly conical, while that of the latter is trochiform. They resemble one another, however, in the structure of the mouth, which is pyriform with a continuous peristome and a thin, slightly everted outer lip, and is slightly produced posteriorly but broadly rounded anteriorly. Neumayr in 1880 placed *F. kreitneri*, on

¹ Former papers in this series were published in Vols. V-VII of the *Records of the Indian Museum* (1910-1912).

² *Man. Conchyl.*, p. 705 (1887).

shell-characters, in the genus *Lithoglyphus*. He was acquainted with the peculiarities of the radula to which we will refer later, but did not consider them of generic importance. In 1889 Heude erected a new genus (*Fenouilia*) for what we believe to be the same species. He was apparently ignorant of Neumayr's description and called the form *F. bicingulata*. This species was described for the third time in 1904 by Fulton under the name *Jullienia carinata*. The shell is very like that of *Lithoglyphus* but differs in the shape of the mouth (which is not shown quite correctly in Neumayr's figures); from *Jullienia* it differs in its thin outer lip.

The genus *Paraprososthenia*, or rather the only known recent species, was identified by Neumayr with the fossil genus *Prososthenia*. The latter is only known from the Miocene beds of Eastern Europe, while the living species inhabits Lake Tali Fu, in which *P. coggini* was also found. The fossil shells differ, however, in their thick outer lip and the resemblance is probably convergent. The subgenus *Parapyrgula* resembles the recent and fossil genus *Pyrgula* of Central Europe and the eastern Mediterranean basin in shell-characters, but has not quite the same type of sculpture and again differs in the distinctly pyriform shape of the mouth. Except in its very small size and delicacy of structure it closely resembles the shell of the N. American *Goniobasis*, the most prolific in species of the Pleuroceratid genera and the only one of which the geographical range extends to the Pacific coast of North America.

This resemblance in the outward form of the shell between *Parapyrgula* and *Goniobasis* would not be sufficient in itself to establish family identity, and in *Fenouilia* evidence of the kind is weak, depending as it does on a much less marked resemblance between the shell and that of *Anculosa*. The operculum of the two Chinese genera might equally well belong to the Hydrobiidae, to the Melaniidae or to the Pleuroceratidae. It is only when we examine the radulae that definite affinities begin to manifest themselves. According to Troschel's¹ figures the radulae of the Pleuroceratidae resemble those of the Melaniidae rather than those of the Hydrobiidae. The central tooth is small and transverse and its disc is without latero-basal denticulations or other projections. The tooth on either side of the central tooth differs greatly from the two outermost teeth and the dental formula would seem to be 2. 1. 1. 1. 2. The lateral tooth is characterized by the large size of the central denticulation. According to Stimpson² this feature is characteristic of the family as a whole, but Walker³ in his recent synopsis of the N. American freshwater molluscs lays stress on the absence of basal denticulations on the central tooth.

¹ *Das Gebiss der Schnecken* I, p. 109, pl. viii, figs. 7-9 (Berlin: 1856-63).

² For an account of certain features of the anatomy of the Pleuroceratidae see Stimpson, *Amer. Journ. Sci.* (1) XXXIII, pp. 41-63 (1864).

³ In Ward and Whipple's *Fresh-water Biology*, p. 991 (New York: 1918).

The radulae of *Fenouilia* and *Parapyrgula* are very similar in general structure. They differ from those of all Melaniidae, Pleuroceratidae, Rissoidae or Hydrobiidae we have examined or seen figured (except the (?) Hydrobiid *Delavaya*, Heude¹) in that the cusp of the central tooth is a simple elongate plate. This tooth is otherwise like that of the Hydrobiidae and Rissoidae, with latero-basal denticulations as in many genera of these families. The lateral and marginal teeth, however, resemble those of the American Pleuroceratidae, especially in the great enlargement of one of the denticulations of the laterals. As a whole the radula of these two Chinese genera is, therefore, intermediate in structure between that of the Hydrobiidae or Rissoidae and that of the American Pleuroceratidae, but it is no more different from the latter than the radulae of some genera of Hydrobiidae are from one another. Fischer² regards the presence or absence of latero-basal denticulations on the central tooth as a subfamily character, but this distinction is not accepted by all malacologists.

When the soft parts of *Fenouilia* are examined its real divergence from the Hydrobiid type becomes apparent. From this type it differs in the shape of its head, in the position of its eyes and above all in the complete absence of a copulatory organ in the male. The distal part of the genital system, especially in the male, is also simpler, the intestine is more capacious and the gill-filaments are longer, extending almost completely across the dorsal wall of the branchial chamber. Unfortunately the anatomy of the Pleuroceratidae is imperfectly known, but the absence of a copulatory organ is well established in all the genera that have been examined. We have satisfied ourselves that this organ is also absent in males of *Fenouilia* diagnosed by a microscopic examination of the gonad. Stimpson's figure of the living *Anculosa dissimilis* shows clearly that the eyes are situated just behind the cleft between the tentacles and the head, and this is precisely their position in *Fenouilia*. The latter also differs from all the Hydrobiidae of which we have particulars in that the head is spindle-shaped, with a distinct neck. Whether this is the case in the Pleuroceratidae we have no information. Stimpson states that the only visible difference between the sexes in *Anculosa* (= *Mudalia*) is the presence of a groove on the right side of the body of the female between the tentacle and the base of the operculiferous lobe of the foot. We think that we have detected a similar groove in female specimens of *Fenouilia*, but they are too much contracted to permit a dogmatic statement.

Of *Paraprososthenia* we have examined only dried specimens of *P. (Parapyrgula) coggini*. So far as we can say, they resemble those of *Fenouilia* preserved in spirit, but we rely in placing the

¹ Heude, *Mém. Hist. Nat. Emp. Chinois*, I, p. 172, pl. xxxiii, figs. 8, 9, 10, 10a. See also Bavay and Dautzenberg (*Journ. de Conchyl.*, I.X, p. 37: 1912), who regard *Delavaya* as a subgenus of *Pachydrobia* and ascribe to it several species from the Mekong.

² *Man. Conchyl.*, p. 724 (1887).

two genera together rather on the resemblance between the radulae than on other anatomical grounds.

The conclusion we derive from the above observations is that the genera *Fenouilia* and *Paraprososthenia* are not Hydrobiidae but resemble the Pleuroceratidae, within the limits of which they may be included provisionally, rather than any other family.

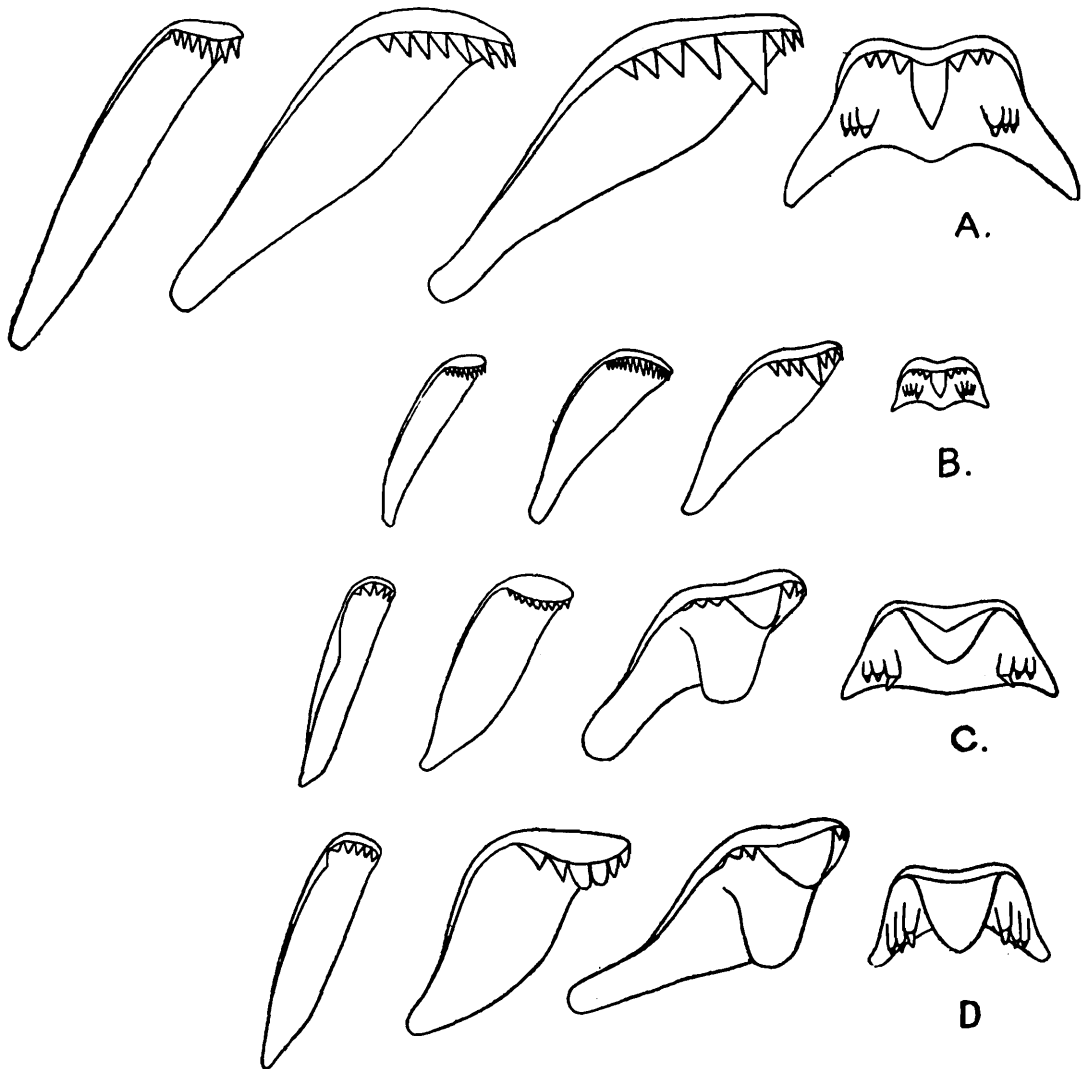


FIG. 1.—Radulae of Hydrobiidae and (?) Pleuroceratidae from China and Europe.

A. *Lithoglyphus fuscus*, Zieg. from E. Europe.

B. *Lithoglyphus liliputanus*, Gredler, from the Tong-Ting Lake, China.

C. *Fenouilia kreitneri* (Neumayr) from Erh-Hai Lake, China.

D. *Paraprososthenia coggini*, sp. nov. from the same lake.

Their possible relationship to the Rissoidae cannot be discussed in a satisfactory manner owing to lack of anatomical information about that family. Some relationship to forms like those included in the genus *Iravadia*, Blanford, is not impossible, but the position of that genus is also doubtful. It is found in brackish water, chiefly in the estuaries of the Ganges and Irrawaddi and also in the backwaters of the West Coast of India.

Neumayr¹ in describing *F. kreitneri* alluded, as we have already stated, to the peculiar form of the central tooth, but did not regard this character as of generic importance and placed the species in the genus *Lithoglyphus*. This genus is made the type of a subfamily by Fischer,² who describes the Lithoglyphinae thus: "Pied simple; plusieurs denticulations basales; verge simple ou fourchue; opercule corné, spiral ou subspiral." The only other species from China ascribed to *Lithoglyphus* is *L. liliputanus*, Gredler, of which there are specimens (apparently cotypes or paratypes) in the Museum collection. We have extracted the radula from one of these and find it differs little from that of the European *L. fuscus*. The radular teeth of *L. fuscus* have been figured by Troschel.³ Our preparation differs from his figure only in having the chief denticulation of the lateral tooth relatively larger. We figure the teeth of *L. liliputanus* and *L. fuscus* for comparison with those of *F. kreitneri*.

Genus *Fenouilia*, Heude.

1880. *Lithoglyphus*, Neumayr, *Wiss. Ergebn. Reise B. Szechenyi* II, p. 655.

1889. *Fenouilia*, Heude, *Journ. de Conchyl.* XXXVIII, p. 46.

1890. *Fenouilia*, id., *Mém. Hist. Nat. Emp. Chinois* I, p. 172.

The only known species has experienced some vicissitude of nomenclature at the hands of three authors who have described it under as many generic and specific names. Heude described it as *Fenouilia bicingulata*, gen. et sp. nov., while Fulton called it *Jullienia carinata*. We have been able to compare specimens named by Fulton with topotypes of Neumayr's species.

Heude's original description of the genus (1889) ran as follows:—*Testâ trochoideâ, imperforatâ; operculo corneo, paucispirali, nucleo basali. Animali probabiliter rissoino*. Later (1890) he added, *radulâ 3. 1. 3., laminâ mediâ integrâ, laterali paucidentatâ*. So far as it goes, this is a correct description of the shell, operculum and radula, except that we read the dental formula 2. 1. 1. 1. 2. Heude, moreover, published in 1890 some good figures of the soft parts drawn by Rathouis, and most of these we have been able to substantiate by dissecting specimens from Mr. Coggin Brown's collection. Our examination of specimens diagnosed as male by a microscopic examination of the gonad shows that the vas deferens ends in a simple pore the margin of which is not even invaginated. The peculiarities of the head and branchial chamber to which we have alluded are also clear.

Fenouilia kreitneri (Neumayr).

1880. *Lithoglyphus kreitneri* (with varr.), Neumayr, *op. cit.*, p. 655, pl. iv, figs. 7-8.

1889. *Fenouillia bicingulata*, Heude, *op. cit.*, p. 46.

¹ *Wiss. Ergebn. Reise B. Szechenyi* II, p. 655.

² *Op. cit.*, p. 724.

³ *Op. cit.*, I, p. 105, pl. vii, figs. 12, 12a.

1890. *Fenouillia bicingulata*, *id.*, *op. cit.*, p. 172, pl. xxxiii, fig. 11.

1904. *Jullienia carinata*, Fulton, *Fourn. Malac.* XI, p. 52, pl. iv.

The species has been described from three different lakes in Yunnan, as *Lithoglyphus kreitneri* from Erh-Hai (Tali Fu Lake), as *Fenouillia bicingulata* from Lake Hai Si in the same district and as *Jullienia carinata* from Yunnan Fu Lake (K'un-Yang Hai) some distance further east. The specimens we have examined are from the first and the last of these lakes. The shells from Erh-Hai are smaller and apparently thinner than the types of the species from the same lake and also than those named by Fulton *Jullienia carinata* and there is less variation among them than was the case in Neumayr's specimens. Several of them, however, possess a varix across the body-whorl as in Heude's type-specimens of *F. bicingulata*. We see no reason to think that specimens from the three lakes represent more than one species. It is unnecessary for us to redescribe the shell, but for convenience's sake we give a translation of Neumayr's description.

"Shell small, blunt, conico-ovoid, stout, dextral, non-umbilicate, consisting of four whorls sharply separated by an impressed suture; upper whorls convex, but the last flattened. Shell sculptured with stout growth-lines and with 1-2 spiral keels; base flattened. Mouth shortly ovoid, pointed and strongly contracted above, strongly recurved below; peristome continuous; inner lip swollen, outer lip quite sharp. Shell covered with an olive-green epidermis."

Neumayr also describes in the same place two varieties, *carinata* and *bicarinata*, the names of which practically explain themselves. Our specimens belong to the form *carinata*.

We have examined a number of specimens in spirit. They are fairly well preserved, but brittle and contracted. The operculum is relatively large, very thin, horny, of a pale yellow colour, regularly ovoid, broadly rounded anteriorly and bluntly pointed posteriorly. It has an extremely delicate narrow colourless inner border. Its sculpture is obscure, but it is possible to detect the nucleus situated near the inner anterior border and surrounded by a spiral of two or three whorls, above which curved lines radiate onwards to the base of the membranous inner margin. The external surface of the operculum is thickly covered with diatoms in all the specimens examined.

The foot appears to have been broad in proportion to its length, bluntly pointed behind and truncate in front, with a broad lobular antero-lateral process on either side. The operculiferous lobe was relatively large. There is a sharply-defined narrow transverse groove running across the sole a short distance behind the anterior margin. In a contracted specimen diagnosed by microscopic examination of the gonad as female, a distinct longitudinal groove runs along the right side of the body from just behind the tentacle to the base of the operculiferous lobe. When the animal was expanded this groove may have had a vertical or nearly vertical direction.

The head is distinctly spindle-shaped, bluntly pointed in front and tapering to a short contracted neck behind. The snout is of moderate length. The mouth is a longitudinal slit, entirely ventral in position except when the head is much contracted, with tumid, corrugated lips. The tentacles are rather stout but taper to their apex. They are situated rather far back on the head. The eyes are very large and prominent, though sessile. They seem to have a peculiar construction, being covered with integument except for a minute pinhole in the centre. The retinal cup is relatively large, deeply pigmented and of an oval shape. The situation of the eyes is peculiar, for they are situated one at the base of each tentacle just behind the point at which it diverges from the head.

The edge of the mantle is smooth and pale, the remainder being deeply stained with black pigment. The mantle is ample and its margin is free all along the outer end of the branchial chamber, which is relatively large. The gill consists of numerous narrow but rather deep ridges, which run almost completely across the roof of the chamber and are not differentiated at either extremity. The osphradium is well developed and ridge-like.

The mouth opens into a short conical muscular pharynx, which is rather shorter than the buccal mass. The muscles of this mass are large and powerful, forming a well developed bulb. The horny lateral jaws are situated inside these muscles, forming in contraction a thin longitudinal plate at either side of the radula. They are merely cornified and pigmented patches on the sides of the alimentary canal, with ill-defined outlines and with an obscurely squamous structure. The radula is narrow and of moderate length. The central tooth is relatively large and of transverse form. Its lower margin is sinuous and its lower lateral angles are pointed. The cusp is broadly rounded at the tip, considerably narrower and shorter than the disk. There are three latero-basal denticulations on each side, each pedunculate. The lateral tooth is hardly at all bent but consists of a relatively narrow slanting basal part and a broad upper part bearing a broad, downwardly directed lobe on its disk. The main denticulation is triangular, but rather bluntly pointed. It occupies rather less than a third of the free margin and has two or three small denticulations on either side. The inner marginal tooth is not much broader than the outer and has its denticulation, of which there are a considerable number, smaller and sharper. Neither marginal is much narrower below than above, both begin to taper a short distance above the base. The outer marginal has an elongate triangular membrane on its outer margin. The oesophagus is rather long, narrow, cylindrical and sinuate. The salivary glands, situated at the posterior end of the buccal mass, are small and their ducts short. We have not been able to trace the alimentary canal further inwards. The intestine is a relatively capacious tube which opens by a simple pore on the edge of the mantle on the right side, running along the outer edge of the branchial cavity. The faecal pellets it

contains are of large size, very compact and somewhat spindle-shaped.

The most remarkable feature of the anatomy lies in the fact that there is no intromittent organ in the male. The lower part of the oviduct and of the vas deferens is alike a simple tube opening near the anus on the right side of the body. We have satisfied ourselves of this fact by dissecting a considerable number of specimens, of which we have also examined the gonads microscopically. Unfortunately the condition of our material renders it impossible to investigate the genitalia further.

Heude (*op cit.*, 1890, pl. xxxiii, fig. 11e) reproduces a figure of the central nervous system drawn by Rathouis. It shows the whole structure as being compact with rather short commissures. The optic nerves are, however, long. The otocysts are situated just in front of the supracæsophageal ganglia. Each otocyst, as we have satisfied ourselves, contains a single circular otocyst.

Imperfect as is this description of the anatomy of *Fenouilia*, it is sufficient to prove its wide divergence from the Hydrobiid type.

Genus *Paraprososthenia*, Annandale.

1919. *Paraprososthenia*, Annandale, *Rec. Geol. Surv. Ind.* 1. (3), pp. 209-240.

This genus, although it closely resembles *Prososthenia*, Neumayr, from the Miocene beds of Eastern Europe in form of shell differs in sculpture and in the structure of the lip, which is thin and somewhat expanded instead of thickened and contracted. Nothing is known of the soft parts, radula or operculum, but the shape of the shell and the structure of its mouth are so close to those of the new species here described that we think they must be united, notwithstanding certain obvious differences, as subgenera of a single genus. For the new subgenus we propose the name *Parapyrgula* in allusion to the resemblance, probably quite superficial, between the shell and that of *Pyrgula* from central Europe and the eastern parts of the Mediterranean basin.

Parapyrgula, subgen. nov.

The shell is elongate, narrow, strictly conical, with the base rounded and somewhat produced. Its substance is delicate and fragile but not very thin. There is a very delicate periostracum. The suture, which is sometimes almost obsolete externally, has a peculiar involute structure owing to each whorl growing over and pressing closely round the base of the one preceding it. The shell is imperforate. Its mouth, which is not very oblique, is of moderate size and of distinctly pyriform outline, slightly produced posteriorly. The peristome is continuous and there is a rather thick columellar callus, but the outer lip is thin. The only prominent sculpture is a single smooth spiral ridge on the body-whorl.

The operculum resembles that of *Fenouilia*.

The radula is also similar to that of that genus, but the denticulations of the teeth are for the most part longer and more

pointed. The cusp of the median tooth is simple and it bears several large latero-basal denticulations at each side. This tooth is not so high as in *Fenouilia* and has the base emarginate. The inner lateral tooth is relatively broad.

Type-species. *Paraprososthenia coggini*, sp. nov.

Distribution. Only known from the lake Erh-Hai, Yunnan.

In outline and general structure the shell of this subgenus resembles, as we have already noted, the North American Pleuroceratid genus *Goniobasis*. The size is, however, much reduced and the structure of the shell more delicate. The structure of the suture resembles that of *Pleurocera elevatum*, Say, shells of which we have examined.

***Paraprososthenia (Parapyrgula) coggini*, sp. nov.**

The shell is narrow and elongate, sharply pointed at the apex and not at all expanded at the base. It is about twice as long as

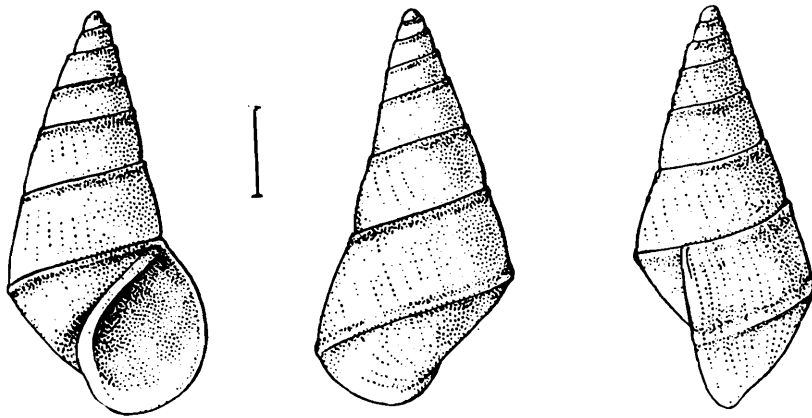


FIG. 2.—Shell of *Paraprososthenia (Parapyrgula) coggini*, sp. nov.

broad. The shell-substance is translucent bluish white like opal-glass, the periostracum pale yellow; but all the specimens examined are covered with a dense growth of diatoms which gives them an almost furry appearance. There are $7\frac{1}{2}$ or 8 whorls, but the terminal whorl or half-whorl is minute and slightly depressed. The other whorls increase gradually and evenly. The suture is oblique and linear when not obliterated externally. It is sometimes accompanied by a low flattened spiral ridge, which runs above it. The spiral ridge on the body-whorl is narrow but slightly flattened and not very prominent. The minute sculpture of the shell consists of numerous longitudinal and transverse striae. On the body-whorl fine longitudinal grooves are also sometimes disposed at fairly regular intervals, but they are often obsolete. The mouth of the shell is large, $1\frac{2}{3}$ – $1\frac{3}{5}$ times as long as broad and a little more than $\frac{1}{3}$ as long as the whole shell. Anteriorly it is rounded and a little produced, while posteriorly it has a subcanaliculate structure. The callus is moderately developed, the outer lip strongly arched

and the columella curved. The main axis of the aperture forms an acute angle with that of the shell.

Measurements of shells (in millimetres).

	A (type)	B	C	D
Length of shell	10.3	9.5	8.5	8.8
Maximum diameter of shell	5	4.5	3.7	3.6
Length of spire (dorsal view)	6	5.3	4.5	4.8
Length of aperture	3.4	3.5	2.4	2.4
Breadth of aperture	2.2	2.2	1.7	1.7

We have extracted the dried animal from a shell. It seems to resemble that of *Fenouilia* but is much shrivelled. The operculum is ovoid, thin, horny, of a dark brown colour and resembles that of *F. kreitneri* in sculpture.

We have already pointed out certain characters in which the radula differs from that of *Fenouilia*. The following is a more precise account of the differences. The central tooth is low in proportion to its breadth, its base is produced at either side and sharply pointed but broadly and rather deeply concave. The cusp is very large, extending downwards far beyond the base of the tooth. The lateral tooth is bent in such a way that the narrow basal part makes an obtuse angle with the broad upper part. The main denticulation of this tooth is very large, occupying nearly half the free margin. The inner marginal tooth is much broader than the outer marginal and its denticulations are blunt. The triangular membrane on the outer margin of the outer marginal tooth is short and confined to the upper third.

Type specimen: M 11598/2 in the collection of the Zoological Survey of India.

Locality. Erh-Hai (Tali Fu Lake), Yunnan, W China, alt. 6,700 ft.

The shape and structure of the shell are so like those of *Paraprososthenia gredleri* (Neumayr) from the same lake that we do not consider a complete generic separation possible in the present state of our knowledge. It must be remembered, however, that we know as yet nothing but the shell of *P. gredleri*. The resemblance in the shell to that of *Pyrgula*, Cristofora & Jan (of which the anatomy seems to be equally unknown) is probably quite superficial. If we are right in thinking that the anatomy resembles that of *Fenouilia*, as the radula undoubtedly does, there can be no relationship to *Oncomelania*, Gredler (= *Hypsobia*, Heude), the soft parts of which, according to Heude,¹ are of the Hydrobiid type. In considering the value of the radula as a guide to affinities, however, it must be remembered that the same author (*op. cit.*, pl. xxxiii, fig. 8) figures the teeth of *Delavaya* (which also appears to be of the Hydrobiid type and is regarded by Bavay and Dautzenberg on shell-characters as no more than a subgenus

¹ Heude, *Mem. Hist. Nat. Emp. Chinois* I, pl. xxxiii, figs. 1-7 (1890).

of the undoubted Hydrobiid genus *Pachydrobia*, Crosse & Fischer) as being not unlike those of *Fenouilia* in certain respects.

ADDENDUM.

Just as this paper was going to the press to be printed off, I received through the courtesy of the Rev. Father Courtois, S.J., a small but valuable collection of Chinese shells from the Zi-Ka-Wei College. It includes specimens of *Delavaya rupicola*, Heude, apparently cotypes. These shells could not be separated generically from *Paraprososthenia coggini* on conchological grounds, but they seem to be specifically distinct. If Heude's figures are correct, there are considerable differences in the radula and possibly the anatomy, and should our species prove to be so closely related to *D. rupicola* as it appears to be on shell-characters, the subgeneric name *Parapyrgula* will have to give place to *Delavaya*, of which *Paraprososthenia* will become a subgenus. The relationship between *Fenouilia* and these forms may therefore be less close than we thought, for no great reliance can be placed on apparent resemblances in the soft parts of dried specimens. I doubt in any case that *Delavaya* is really congeneric with *Pachydrobia*.

20th September, 1919.

N. Annandale.

