

REPORT ON THE FRESHWATER  
GASTROPOD MOLLUSCS OF LOWER  
MESOPOTAMIA.

PART I. THE GENUS *LIMNAEA*.

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(With Plates XIII, XIV.)

In the report of which the first part is now published we propose to discuss the freshwater Gastropod molluscs of the delta of the Tigris and Euphrates and of the lower reaches of the two rivers. Stress of other work and official duties have already greatly delayed its preparation, and as the medical authorities are anxious for any information about the freshwater molluscs as soon as possible, we have decided to issue it in parts dealing with separate genera or larger groups. It will be convenient to include this report in the same volume as that on the molluscs of Seistan, as the two faunas are related.

The material from Mesopotamia that we now have in our hands consists of three collections, all presented by the generosity of their collectors to the Zoological Survey of India. Two of these have already been discussed.<sup>1</sup> They were made by Lt. Col. W. H. Lane and Bombadier R. Hodgart and consist of empty shells, most of which were probably subfossil. The third collection, made by Capt. C. L. Boulenger, adds greatly to our knowledge as it includes specimens preserved in spirit. It has been possible with its aid to correct and expand the results based on shells previously examined.

We have, so far as possible, consulted the literature on the Persian, Central and Western Asiatic molluscs, as well as that on those of India and Europe, but it is possible that some Russian works, or memoirs published in Europe during the war, may have escaped our notice. The only paper dealing specifically with Lower Mesopotamia that we have found is Mousson's, "Coquilles ters. et fluv. rec. Dr. A. Schlæfli en Orient" in the *Journ. de Conchyl.* XXII (1874). The descriptions in this paper are fairly full and it has not been difficult with specimens before us to discriminate the species. The paper, however, is not illustrated, and without figures or specimens verbal descriptions of freshwater molluscs have little value. We are strongly of the opinion that

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<sup>1</sup> Annandale, *Rec. Ind. Mus.* XV, pp. 159-170, pl. xx (1918).

among the Pulmonata at any rate no description unaccompanied by a recognizable figure should be considered valid.

### Genus *Limnaea*, Lamarck.

The species that occur in Lower Mesopotamia are of considerable interest. They fall into two of the main groups of the genus, namely those that may be called, in quite a general sense, those of *L. auricularia* and *L. truncatula*. Most of them we assign to the former group. These species are all variable and at first sight it might seem that most of those of southern Persia and the lower valley of the Tigris and Euphrates were conspecific, merely separable into numerous races and varieties. A careful study of a large amount of material has, however, convinced us that this is not the case, and that a number of species actually exist which can be separated by anatomical as well as merely conchological characters. The examination of young shells is most important for this reason, and we find that adults which resemble one another rather closely can often be traced back to young forms that differ considerably. In conditions such as those found in Lower Mesopotamia, and also in most parts of Persia, convergence seems to have taken place between different species of the genus on a fairly extensive scale, and forms which are perhaps not closely related genetically have come to resemble one another owing to the plastic influence of environment.

In Seistan we know of two species of the *L. auricularia* group (*L. gedrosiana* and *L. bactriana*) which at first sight appear almost identical, but on a detailed investigation have proved quite distinct. We are of the opinion that these species each had a different line of ancestry, but have thought it best in the present state of our knowledge not to discuss these lines of ancestry in detail.

Similarly in collections from Lower Mesopotamia we have found five forms that seemed to us on a superficial examination to grade the one into the other. Two of these (*L. gedrosiana* and *L. bactriana*) are the same as the two Seistan species. The others are *L. peregra canalifera*, *L. tenera euphratica* and *L. cor*.

It is important, therefore, to consider what common features are to be found in the forms of each country, and to what extent these features can be correlated with peculiarities of environment. Both Lower Mesopotamia and Seistan are countries that have a prolonged dry season, when the temperature is high, and are nevertheless liable to floods. In Seistan the water always contains a high percentage of mineral salts, while the delta of the Tigris and Euphrates is an estuarine tract in which even water that is practically fresh is probably liable to be contaminated with water of comparatively high salinity. Moreover, this tract has been gradually extending southwards and receding from the north for a considerable period, and many of our specimens are from old deposits that must have been laid down in conditions far more estuarine than

those that now prevail in the districts where the specimens were collected.

Both the species of *Limnaea* from Seistan and those from Mesopotamia have in most instances small and very thin and fragile shells, which are sculptured with more or less prominent longitudinal ribs, but the ribs on those from Mesopotamia are much more pronounced than on Seistan shells. This is so even in identical species. The shape of the shell in most forms exhibits slightly different modifications in the two countries. The two Seistan species are both rather narrow but have relatively large and patent mouths and short, pointed spires. The three distinct Mesopotamian forms exhibit a tendency, on the other hand, to grow broad in proportion to their height, while their spires are still shorter. Their mouths, in the broader forms, are relatively narrow but on the whole resemble those of *L. gedrosiana* and *L. bactriana*. An entirely new character appears in Mesopotamia in the canalization of the suture above the body-whorl found in all the endemic species and well-defined races.

How far can these differences and resemblances be correlated with similar peculiarities of the shell from different or identical types of environment in other countries? Baker,<sup>1</sup> in his fine monograph of the North American Limnaeidae, states that shells from saline districts in that country are prominently ribbed, but whether this ribbing is associated with the presence of any particular salt we are not informed. We know in a general way what salts are present in the waters of Seistan,<sup>2</sup> but no information is available about the composition of those of the Euphratic delta.

Thinness, fragility and paleness of shell in *Limnaea* are usually associated with unfavourable conditions of life, but more precise information is needed on the point. The reduction of the spire and enlargement of the body-whorl and mouth provide additional space for the branchial chamber and allow a larger portion of the animal to be extended from the shell. This character, moreover, seems to be definitely correlated with difficulty in obtaining the necessary oxygen, and we find different forms of the same species<sup>3</sup> (living in different types of environment in the same localities) in which it is more developed in those that live in still water than in those that inhabit streams. Both in Seistan and in Mesopotamia the *Limnaeae* live mainly in flooded country, perishing in large numbers when the floods subside. The few individuals that survive to perpetuate the species from year to year retire to shallow pools, backwaters or lakes. In the course of such an existence conditions must be encountered in which life is difficult and water lacking in free oxygen.

The *Limnaeae* of Mesopotamia are, except *L. peregra canalifera*, clearly depauperated forms, and the considerably larger size attained

<sup>1</sup> Baker, *Spec. Pub. Chicago Ac. Sci.* III (1911).

<sup>2</sup> Annandale, *Rec. Ind. Mus.* XVIII, pp. 10, 15 (1919).

<sup>3</sup> Annandale, *Rec. Ind. Mus.* XIV, p. 149, fig. 4 (1918).

by this race is in itself evidence of a different origin from that of the others associated with it—evidence which is greatly strengthened by an examination of the young shell.

In this discussion we have left *L. hordeum* out of account. It is so different from the other species of the fauna that there can be no doubt of its different origin; there can be little doubt of its relationship to *L. truncatula*. It has, however, a larger mouth to the shell than that species and more tumid whorls, especially of the spire. It has, therefore, followed a line of evolution in some respects parallel to, in others divergent from, that which has resulted in such forms as *L. cor*.

*Key to shells of Limnaea from S. Persia and Lower Mesopotamia.*

- A. Height of mouth less than  $\frac{2}{3}$  that of shell.<sup>1</sup>
1. Whorls of spire tumid; suture oblique ... .. *L. hordeum*.
  2. Whorls of spire not tumid; suture much less oblique ... *L. truncatula*.
- B. Length of mouth more than  $\frac{2}{3}$  that of shell.
1. Upper surface of body-whorl not flattened; suture above it not canalized. (Height less than 20 mm.)
    - a. Mouth of shell projecting strongly in ventral view; arc of lip practically a semicircle ... .. *L. persica*.
    - b. Mouth less expanded, projecting less; arc of lip less than a semicircle.
      - i. Whorls of spire somewhat tumid<sup>2</sup>; suture impressed; main axis of mouth forming an acute angle with that of shell. ... .. *L. bactriana*.
      - ii. Whorls of spire not at all tumid; suture little or not at all impressed; main axis of mouth parallel to that of shell.
        - α Arc of lip quite regular; apex sharply pointed ... .. *L. iranica*.
        - β Arc of lip irregular; apex bluntly pointed.
          - † Arc of lip never more than slightly flattened ... .. *L. gedrosiana*.
          - \* Arc of lip so flattened as to form a slanting straight line ... .. *L. gedrosiana* var. *rectilabrum*.
  2. Upper surface of body-whorl distinctly flattened and deeply depressed round suture.
    - a. Shell over 15 mm. high, not very fragile, with the spire usually about  $\frac{1}{5}$  as long as the body-whorl and the latter much narrower than high ... .. *L. peregra canali-* [fera.
    - b. Shell not higher than 15 mm., fragile, with the spire always less than  $\frac{1}{5}$  the height of the body-whorl, which is as broad or nearly as broad as high.
      - i. Spire very small; upper surface of body-whorl transverse, almost at right angles to the main axis; deeply depressed round suture ... .. *L. cor*.
      - ii. Spire small; upper margin of body-whorl cutting main axis obliquely, less depressed round suture. *L. tenera euphratica*.

The key applies only to adult shells; for young shells our figures in the plates issued with this paper and our former one

<sup>1</sup> Cf. p. 41, *Rec. Ind. Mus.* XVIII. The specimens now before us show that the mouth may be, and probably always is in the adult, more than  $\frac{1}{2}$  as long as the shell.

<sup>2</sup> On p. 45, line 19 of this volume, the word "greatly" has slipped out between "not" and "swollen."

on the molluscs of Seistan may be consulted (see plates vi, vii, xiii, xiv of this volume).

***Limnaea gedrosiana*, Annand. and Prashad.**

1918. *Limnaea subpersica*, Annandale, *Rec. Ind. Mus.* XV, p. 146, pl. xx, fig. 5.  
 1919. *Limnaea gedrosiana*, Annandale and Prashad, *Rec. Ind. Mus.* XVIII, p. 48, pl. vii, figs. 2-4.

There is in Captain Boulenger's collection a fairly good series of specimens in spirit which we cannot separate from our recently described species. The shells, however, though not thicker or less fragile, possess much stronger longitudinal ridges on the body-whorl than specimens from Seistan or Baluchistan. There is no spiral sculpture. The mouth of the shell is also as a rule a little narrower, but this difference is hardly beyond the limits of normal variation and is not so great as that observed between shells from Baluchistan and those from Seistan. The largest shell is 10 mm. high and its maximum diameter is 7 mm. The specimen recently figured by one of us provisionally as *L. subpersica*, Locard, is a very young shell of this species.

*The radula* is so variable in *L. gedrosiana* that it cannot be regarded in this species as possessing sound diagnostic characters. In a specimen from Mesopotamia it is very like that of some individuals from Baluchistan.

*The genitalia* resemble those of the Seistan form figured and described by us in the original description of the species. Some differences exist, but these are due to the fact that the Seistan specimen we figured was abnormal in certain respects, as is borne out by dissection of another specimen from the same country. This specimen was found to have the genitalia quite similar to those of specimens in the present collection. The abnormality in the individual figured consisted in the large development of the accessory gland and in the poorer development of the hermaphrodite gland, its duct and the uterine duct; all these latter structures are much better developed in normal specimens, while the accessory gland is usually a small structure. The proximal part of the vas deferens also is rather thicker in normal specimens.

It is clear, therefore, that individual differences must be looked for in the genitalia as well as in the shell and radula of species belonging to this group of *Limnaea*.

The precise locality of Capt. Boulenger's specimens is given by him as "higher reaches of Khandag Creek, Basra, Mesopotamia." The species is not uncommon in swamp-deposits in the delta of the Euphrates.

***Limnaea bactriana*, Hutton.**

(Pl. XIV, fig. 3.)

1919. *Limnaea bactriana*, Annandale and Prashad, *Rec. Ind. Mus.* XVIII, p. 45, pl. v, figs. 1, 2; pl. vii, fig. 6.

Three specimens in spirit collected by Capt. Boulenger in ponds connected with the Khandag Creek in a palm-grove near Basra seem to belong to this species. The shells are, however, thicker and are sculptured with curious flattened opaque ribs on the body-whorl. The form is also narrower, perhaps because the specimens had not reached their full growth, and the basal whorl of the spire is smaller and not so distinctly separated from the body-whorl. Otherwise the spire has the characteristic features of Hutton's species. A shell is 10.5 mm. long, and its maximum diameter is 6 mm.

The three shells are all more or less broken. With more abundant material racial differences might perhaps be found between shells from the eastern parts of the range of the species and those from Mesopotamia.

*The radula* of a specimen has the approximate formula 18.8.1. 8.18. The asymmetry of the cusps of the central tooth is very distinctly marked, as also is its tridentate character. The inner cusp of the lateral tooth though situated at a higher level than the outer is not much larger; all the cusps of the laterals, however, are pointed, differing in this respect from those of the Seistan specimens. The marginals have four to seven blunt cusps, all situated in the same straight line, and one or two small pointed cusps situated on the outer margins of the teeth near the base.

*The genitalia.* Owing to paucity of material and to the specimens being very much contracted we are not able to add much to our previous account. The genitalia of a Mesopotamian specimen resemble those of specimens from Seistan except that the uterine duct is much thicker at its commencement, the prostate is better developed and lies a little higher up on the male duct, which also is much thicker in its proximal part. These differences may be due at any rate in part to the state of sexual activity in which the molluscs were killed.

### ***Limnaea peregra* race *canalifera*, Mousson.**

(Pl. XIV, figs. 1, 2.)

1874. *Limnaea canalifera*, Mousson, *Fourn. de Conchyl.* XXI, p. 41.

1918. *Limnaea peregriformis*, Annandale, *Rec. Ind. Mus.* XV, p. 165, pl. xx, fig. 4.

This is much the largest form of *Limnaea* known to us from Mesopotamia, and the only one in which the shell grows more than 20 mm. long. The shell is also stouter and more coarsely sculptured than that of other species from the lower Euphrates. It has as a rule—though the fact is not mentioned in the original description—one more whorl, *i.e.* five whorls instead of four.

In dorsal view the shell is very asymmetrical bilaterally. The spire is acuminate, conical, vertical, exerted but short, but not so short as that of other shells of the same group from Mesopotamia, being at least (in adult shells)  $\frac{1}{3}$  as long as the body-whorl. Its whorls increase rapidly and evenly in size and the spiral between them is oblique, linear and somewhat impressed.

Each whorl is nearer the inner than the outer margin of the one that succeeds it. They are slightly swollen and slightly flattened above. The apex is small and rounded. The body-whorl is long but rather narrow and not very convex. Its upper surface is flattened and oblique but not angulate. The inner margin is Z-shaped, the upper half of the outline consisting of a somewhat flat curve. It then slopes in fairly abruptly and finally forms a broad projecting lobe, which corresponds with the inner anterior angle of the mouth. This lobe does not project so far sideways as the outline of the upper part of the whorl. The outer margin of the whorl forms an arc of wide diameter and less than a semi-circle. The surface is not highly polished. It is ornamented with rather coarse and irregular longitudinal ridges, some of which may be called low costae, and striae. Minute spiral striae are also present. The first three whorls are, however, almost smooth.

In ventral view the shell is ovoid. The body-whorl is swollen above and transverse at its upper margin. It disappears behind the mouth some little distance above the anterior extremity of the latter. The shell is very narrowly rimate. The mouth is long and somewhat expanded, ovate, nearly vertical, sometimes narrowly rounded or truncate both above and below, sometimes pointed above and rounded below. The lip is thin and sharp and its curvature is often uneven but never highly convex. The callus is well developed above, joining the columellar border to the lip. The columella is long and twisted but not curved. The margin of the mouth is long, straight and vertical below the umbilicus. The columellar border is expanded and flattened over the umbilicus. The inner anterolateral border of the mouth is very slightly expanded and produced. The sculpture of the surface is not so well developed in this view as in the dorsal.

As seen from above, the spire increases gradually but often irregularly and the suture becomes gradually more impressed until it is practically canaliculate as it approaches the outer lip.

*The radula* has the dental formula 13.8.1.8.13. The central tooth though minute is distinctly bicuspid, having a small, sharp subsidiary cusp at the base of the main one, which is narrow and sharp. The laterals are tricuspid and their cusps are long, slender and sharply pointed. The lateral cusps are equal and a little smaller than the central one, but the inner cusp arises at a considerably lower level than the outer one. The marginals are very uniform in structure. Each has three (or occasionally four) subequal cusps arranged in a slanting line. The only difference between those of the inner and the outer rows is that in the later the cusps are blunter and a little less regular in shape.

*The jaw* is broad, dark and stout. The free margin of the upper part is broadly truncate and the internal surface is concave in the middle region.

The animal, as seen in a highly contracted state and preserved in spirit, offers no particular external diagnostic features. The mantle is pale with large dark spots.

*The genitalia.* On comparing the genitalia of this form with those of *L. gedrosiana*<sup>1</sup> we find that the hermaphrodite gland is much larger and more lobose. The hermaphrodite duct is much longer, more convoluted and more swollen in its distal portion. The situation of the prostate is similar but the gland itself is larger and the upper part of the male duct above the prostate much more swollen; the penis-sac is also more elongate. The uterus is swollen in the middle but pointed at the two ends. The spermatheca has a shorter duct than in *L. gedrosiana*, but nearly equal in length to the spermatheca itself.

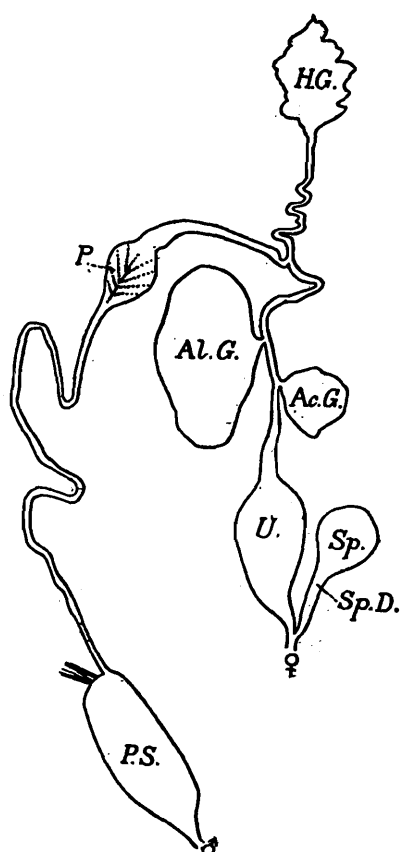


FIG. 1.—Genitalia of *Limnaea peregra canalifera*, Mousson.

*Measurements (in millimetres) and Proportions of Shells.*

Height ... ..	21	21	21	17	17
Maximum diameter ... ..	15	13	13	13	11
Height of mouth ... ..	16	17.5	15	14	12
Maximum diameter of mouth ... ..	8	8	7	7	5
Maximum diameter to height of shell ... ..	1:1.4	1:1.61	1:1.61	1:1.55	
Maximum diameter to height of mouth ... ..	1:2	1:2.17	1:2.14	1:2.4	
Height of mouth to that of shell ... ..	1:1.31	1:1.2	1:1.4	1:1.42	
Maximum diameter of mouth to that of shell ... ..	1:1.87	1:1.62	1:1.71	1:2.2	

<sup>1</sup> *Rec. Ind. Mus.* XVIII, p. 40, fig. 5B (1919).



The height of the shell is from  $1\frac{2}{5}$  to  $1\frac{3}{5}$  the maximum diameter; the height of the mouth at least twice its maximum diameter. The height of the shell is from  $1\frac{1}{5}$  to  $1\frac{2}{5}$  that of the mouth and the maximum diameter from  $1\frac{3}{5}$  to  $2\frac{1}{5}$  that of the mouth.

Capt. Boulenger obtained a number of living specimens in the Khandag Creek at Basra.

The specimen recently figured by one of us and assigned provisionally to *L. peregriformis*, Locard, is a young shell of this species. It differs considerably from older ones. Adult shells only differ from a series from the Rhineland in the Indian Museum, labelled *L. ovata* var. *inflata*, in having the upper surface of the body-whorl flatter and more depressed round the suture.

### *Limnaea cor*, sp. nov.

(Pl. XIII, figs. 1, 2.)

The shell is moderately small (less than 15 mm. high), thin and fragile, diaphanous, tinged with rose-pink when fresh, conspicuously striate longitudinally, and remarkable for its short, erect acuminate spire, the base of which is deeply depressed, and its large, irregularly heart-shaped, transverse body-whorl, the maximum diameter of which is practically the same as the height.

In dorsal view the following particulars are apparent: The spire consists of three whorls and is not more than  $\frac{1}{6}$  as high at the body-whorl. The apical whorl is minute and rounded, the second at least three times as deep and broad as the first, which is set upon it nearer the inner than the outer margin of the shell. It is somewhat convexly flattened above and its outer margin slopes gradually outwards and downwards, while its inner margin is vertical. The third whorl, which is at least five times as large as the second, possesses the same characters in a more developed manner. The suture of the spire is oblique, linear and depressed, but not very deeply. The body-whorl is bilaterally very asymmetrical and irregularly heart-shaped. Its upper surface is broadly flattened and decidedly angulate at its outer margin. The suture just above it is deep and broad. The inner margin is conspicuously Z-shaped. In its upper half it is very convex, representing an arc of nearly a semicircle. It then slopes gradually inwards for some distance, and finally projects outwards to form a semicircular lobe corresponding to the outer anterior extremity of the lip. Just above this lobe there is a broad, slanting longitudinal depression on the surface of the shell. The outer margin of the whorl possesses a fairly even convexity in an arc greater than a semicircle, but its middle region is often more or less flattened and straight. The upper and outer part of the whorl is tumid, but the surface slopes somewhat abruptly towards both the lip and the anterior extremity of the shell. The sculpture on this surface is conspicuous even to a good naked eye, but has a very delicate appearance. It consists, as seen under a powerful lens,

of numerous curved, flattened ridges or fine ribs separated by sharp-cut furrows and themselves composed of numerous sharp lesser ridges divided by striae. Transverse striae are ill-developed or obsolete. The polish of the surface is exceptionally bright.

In ventral view the spire appears nearly of the same size as in dorsal view and, except that the spiral is of course reversed, has much the same appearance. The body-whorl in this view is broad and transverse above, with its surface highly convex, but it disappears rapidly behind the mouth, which is of great relative length and nearly in the same axis as that of the shell. The mouth is more or less quadrate, narrowly truncate or subtruncate above and by no means broadly rounded at its anterior end, where the lip is hardly at all expanded or everted. Its upper extremity is situated a very short distance below that of the body-whorl. The lip is sharp and convex in an arc greater than a semicircle. Its arc is, however, often a little flattened in the middle region and the extreme margin is occasionally introverted in this flattened part. The callus is well developed but not coarse above, connecting the columellar border with the lip. The columella is strongly arcuate. Its expanded border completely or almost completely closes the narrowly rimate umbilicus. Below the body-whorl the inner edge of the mouth is straight and vertical. The sculpture on this surface is not so delicate or regular as on the dorsal surface and the polish is less marked.

As seen from above the shell presents several characteristic features. Rapid and regular increase of the whorls is apparent and also the flattened upper surface of all the whorls but the apical one. It is also evident that the upper surface of the body-whorl is not only flattened towards its margin, but deeply hollowed outside the suture, especially in the region near the lip. The lip projects from the shell with an almost semicircular concavity in its margin and then slopes outwards gradually.

*Measurements (in millimetres) and Proportions of Shells.*

Height	...	...	12.0	11.0	10.5	8.25
Maximum diameter	...	...	9.5	8.5	9.5	5.5
Height of mouth	...	...	10.0	9.0	8.5	5.5
Maximum diameter of mouth	...	...	6.5	5.5	5.0	3.0
Maximum diameter to height of shell	...	...	1 : 1.26	1 : 1.29	1 : 1.1	1 : 1.5
Maximum diameter to height of mouth	...	...	1 : 1.45	1 : 1.54	1 : 1.7	1 : 1.83

The total height of the shell varies from almost equal to  $1\frac{1}{4}$  times the maximum diameter. In young shells it may be as much as  $1\frac{1}{2}$  times as great. The height of the mouth is about  $1\frac{1}{6}$  times its maximum diameter and nearly  $\frac{1}{5}$  the total height. Its maximum diameter is from about  $\frac{1}{2}$  to about  $\frac{2}{3}$  that of the shell. The proportions of the height of the spire and the body-whorl vary owing to the fact that the former is occasionally almost flat. *Type-series.* No.  $\frac{11666}{2}$  M. Z.S.I (Ind. Mus.).

The type-series consists of recent shells and was collected by Capt. C. L. Boulenger in a marsh five miles north of Samara on the lower Euphrates. Col. W. H. Lane also obtained many broken subfossil shells in a lake-deposit at Nasariyeh.

*Limnaea cor* bears a resemblance, perhaps quite superficial, to certain forms of *L. auricularia* and allied species or races, but the direction of the spiral, the form of the spire and body-whorl and especially the comparatively narrow, quadrate or subquadrate outline of the mouth are very different on actual comparison. It is probably an extreme form derived from *L. lagotis*. The young shell departs much less conspicuously from this type than the adult. It is unfortunate that we have no anatomical material.

***Limnaea tenera* race *euphratica*, Mousson.**

(Pl. XIII, figs. 3-5.)

1874. *Limnaea euphratica*, Mousson, *Fourn. de Conchyl.* XXI, p. 40.

1918. *Limnaea tenera*, Annandale, *Rec. Ind. Mus.* XVI, p. 165, pl. xx, fig. 3.

At first sight the shell looks like a connecting link between *L. peregra canalifera* and *L. cor*, but many differences from both appear on a close inspection. Both the adult and the young shell are more like those of *L. cor*.

The differences from *L. cor* to be noted in the dorsal aspect of the mature shell are the following. The spire is longer and more prominent and has its basal whorl less depressed and more swollen and its suture less transverse. The upper surface of the body-whorl is less broadly flattened and the suture above it less transverse. The outline of the shell is more graceful and still more asymmetrical. The upper part of the inner margin is less convex and the slope inwards more abrupt and the terminal lobe more prominent and narrower. The outer margin is practically semi-circular. The sculpture of the surface is less regular and the composite longitudinal ribs less distinct and less curved.

In ventral view the part of the body-whorl visible is longer, narrower and less tumid. Its upper margin is more oblique and less flattened. The spire is considerably shorter than in the dorsal view. The upper extremity of the mouth is removed from that of the body-whorl by a distance nearly equal to the length of the spire as seen in this view. The outline of the mouth is regularly oval. The lip at its inner anterior extremity is distinctly expanded and flattened. The callus is poorly developed above the columella, which is straighter.

As seen from above, the most noteworthy differences between the shells are, apart from those already noted in the dorsal and ventral views, (1) that the surface of the body-whorl is much less concave and that its concavity near the lip has a less confined character; (2) that the lip on leaving the shell has at first a comparatively narrow concavity and then proceeds outwards and backwards abruptly with a slight arc.

The specimens we have examined are also colourless and opaque and seem to be thicker than those of *L. cor*, but they are perhaps not so fresh.

*Measurements (in millimetres) and Proportions of Shells.*

Height ... ..	13	10.5	11	10.5	7.5
Maximum diameter ...	8	9.5	7	7.0	5.25
Height of mouth ...	11	8.0	7.5	7.5	6.0
Maximum diameter of mouth ...	5.25	4.5	4.5	3.25	3.0
Maximum diameter to height of shell ...	1:1.5	1:1.1	1:1.57	1:1.5	1:1.33
Maximum diameter to height of mouth ...	1:2.09	1:1.77	1:1.37	1:2.3	1:2

These measurements, few as they are, illustrate the variable character of the race. We do not, however, find it possible to draw any line between the *forma typica* and Mousson's var. *angustior*, as narrowness of the shell and flattening of the arc of the lip are by no means always correlated and shells with the arc of the lip flattened are mixed indiscriminately with those in which it is convex. The mouth, however, is as a rule narrower and more elongate than in the typical *L. tenera*, Küster, and the shell seems to be more variable, some individuals departing from the *forma typica* more than others. (Küster, however, only figures one shell). For these reasons we think it best to recognize the Mesopotamian race as distinct, though not specifically. Fully adult shells are perhaps more different than young ones. The differences between the extreme types of the typical form of the race and its phase *angustior* and those between phases A and B of *L. bactriana* are very much the same, but intermediate individuals are much more numerous.

*L. tenera euphratica* is common along the banks of the lower Euphrates in both recent and subfossil deposits. Capt. Boulenger obtained a series of rather small shells in a marsh 5 miles north of Samara.

***Limnaea hordeum*, Mousson.**

(Pl. XIV, figs. 4, 5.)

1874. *Limnaea hordeum*, Mousson; *Journ. de Conchyl.* XXII, p. 42.

1919. *Limnaea hordeum*, Annandale & Prashad, *Rec. Ind. Mus.* XVIII, p. 57, pl. vii, fig. 5.

We have found in the collection of the Indian Museum a shell (identified by Mr. H. B. Preston as *Succinea bensoni*, var.) which we believe to represent the adult of this species. It was associated with a young shell of *L. gedrosiana* under the same name and came from the banks of the Gaud-i-Zirreh in the Afghan desert, where it was collected by Sir Henry McMahon some years ago. This shell agrees better in dimensions with Mousson's type than those we have hitherto examined but is slightly larger. It differs from young shells in having the body-whorl proportionately smaller and the mouth larger and broader and the lip thinner—differences that

might be expected in an adult shell. The measurements are as follows:—Height 7 mm., maximum diameter 3·5 mm., height of mouth 4·7 mm., maximum diameter of mouth 2·2 mm.

The species is only known in what may be a subfossil state. It has been found on the banks of the lower Euphrates at two places, in Seistan, and in the Afghan desert to the south-east of that district. The Gaud-i-Zirreh is a great basin of strongly saline marshland into which the Helmand river at one time drained. See p. 4 and plate 1 of this volume.

The adult shell is still more like that of *L. truncatula* than the young, but the same differences persist in a sufficiently strong degree for specific separation. The Mesopotamian specimens we have examined are all young.

