

SMITHSONIAN MISCELLANEOUS COLLECTIONS.

201

RESEARCHES

UPON THE

HYDROBINÆ

AND ALLIED FORMS;

CHIEFLY MADE UPON MATERIALS

IN THE

MUSEUM OF THE SMITHSONIAN INSTITUTION.

BY

DR. WILLIAM STIMPSON.



WASHINGTON:
SMITHSONIAN INSTITUTION.

AUGUST, 1865.

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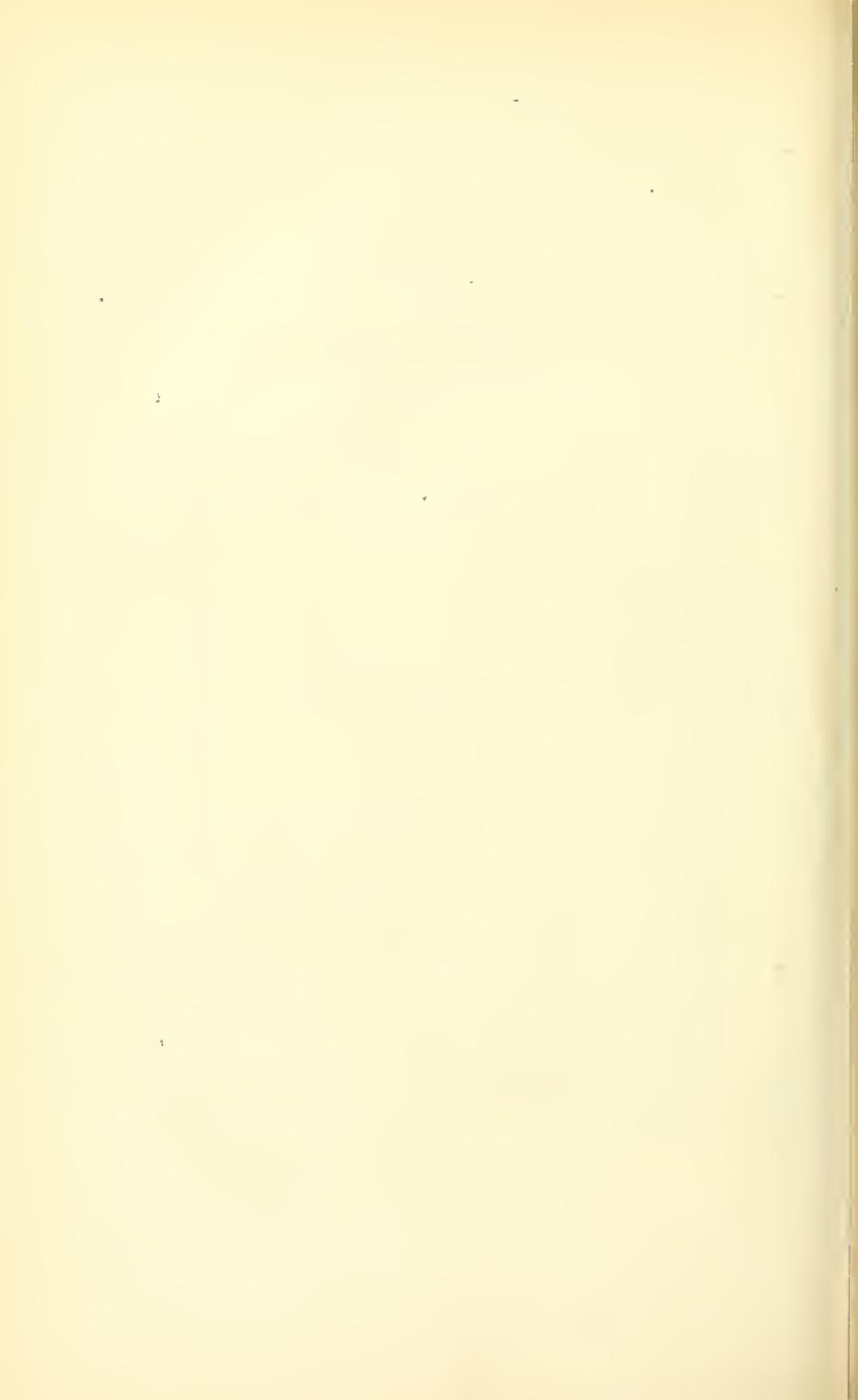
THIS memoir gives the results of an investigation relative to the structure of a group of small and little-known Gasteropods, which Dr. Stimpson has undertaken with a view to their classification, and arrangement in the museum of the Institution. It is thought that these results may also be useful in the arrangement of other collections of this group of Mollusks.

JOSEPH HENRY,
Secretary S. I.

SMITHSONIAN INSTITUTION,
WASHINGTON, August 30, 1864.

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RESEARCHES
UPON THE
HYDROBIINÆ
AND ALLIED FORMS.

INTRODUCTORY REMARKS.

ABOUNDING in the fresh waters of North America, and in some instances upon land contiguous to fresh water, there are to be found species of minute shells resembling the *Vivipari* in form, but differing from them in the spiral form of the operculum. Some of these shells have been erroneously referred to the genera *Paludina*, *Melania*, *Leptoxis*, and *Cyclostoma*. To others the generic names *Amnicola*, *Pomatiopsis*, *Somatogyrus*, and *Chilocyclus* have been applied. They must all, I believe, be referred to the extensive family RISSOIDÆ, a group of gasteropods remarkable for their small size, which are very generally distributed throughout the globe, and are very numerous in the sea, as well as in fresh waters.

The Rissoidæ were very properly separated as a family from the Littorinidæ by H. & A. Adams,¹ but the characters given by these naturalists are not entirely satisfactory. The character "rostrum more or less adnate, below, to the fore-part of the foot," is not a constant or general one, and some of the others given by them are only partially distinctive, and can scarcely be relied upon for the discrimination of families. The true distinction between this group and the Littorinidæ is found in the shape and position of the teeth on the lingual ribbon.

The Messrs. Adams include in their family Rissoidæ the genera *Rissoina*, *Rissoa*, *Alvania*, *Onoba*, *Barleeia*, *Ceratia*, *Setia*, *Cingula*, *Hydrobia*, *Skenea*, and *Amnicola*. These are all probably true Rissoids with the exception of *Barleeia*, which belongs to

a distinct family. But there are several genera to be added to this list, which will be named further on in this paper. It may now be mentioned, however, that *Lithoglyphus* and *Paludestrina*, placed by the Messrs. Adams in the Littorinidæ, must be included here, since they have the lingual dentition of the Rissoidæ, the characteristic of which, as shown by Troschel, consists in the presence of basal denticles on the rhachidian tooth. We also add *Bythinella* of Moquin-Tandon, usually considered as synonymous with *Hydrobia*, or with *Annicola*, but sufficiently distinct. And the genus *Pyrgula* of Christofori & Jan, found in the streams of Switzerland, probably also belongs here, although hitherto referred by most authors to the Melaniidæ.¹ The same may be said of *Tricula*, Benson, found in the rivers of India. A. Adams has also added *Fenella*. The probabilities of the genera *Cecina* and *Blanfordia*, A. Ad., and *Cremnobates*, Blandford, also belonging here, will be discussed further on.

Troschel² suggests the inclusion in the family of his groups "Bythinie, Lithoglyphi, and perhaps Truncatellæ," which would require the addition of the genera *Bythinia*, *Stenothyra*, *Assimineæ*, *Tomichia*, and *Truncatella*. The two first named are rightly, I think, here placed, in view of the structure of the male organ and the lingual teeth; but *Assimineæ* differs conspicuously in the position of the eyes, and *Tomichia* and *Truncatella* both in the position of the eyes and in the structure of the breathing organs.³ Gray⁴ includes in the family only three genera, *Rissoina*, *Rissoa*, and *Skenca*;—*Lithoglyphus*, *Hydrobia*, and *Annicola* being by him wrongly placed in the Littorinidæ.

The following is offered as an amended character of the family Rissoidæ, which will serve to distinguish it from the groups allied to it, or with which it has been confounded, as the Littorinidæ, Viviparidæ, Truncatellidæ, Melaniidæ, Valvatidæ, etc. :—

¹ Bourguignat has already recognized the affinity of *Pyrgula* to *Hydrobia*, although he incorrectly places both these genera in the Viviparidæ (Guerin's "Revue et Magasin de Zoologie [2], XIII (1861), p. 526).

² Gebiss der Schnecken, I, 106.

³ It may also be remarked that the dentition of the Truncatella group is characterized by the presence of a transverse, continuous, dentated plate beneath the cusp on the rhachidian tooth, which occurs in none of the Rissoidæ.⁴

Guide to the Systematic Distr. of Mollusca, etc., I, 96.

Tentacles elongated, with the eyes at their outer bases. Verge (male organ) exerted, situated on the back at a considerable distance behind the right tentacle. Gills both pallial; the right or principal one usually rather short and broad, and composed of few laminae, which are much broader than high. Foot oblong, truncate before, rounded or pointed behind. Operculigerous lobe well developed. Operculum horny or partly shelly, spiral or concentric. Lingual teeth 3. I. 3; the rows being more transverse and less arcuated than in the Littorinidæ. Rhachidian tooth broader than long, and armed with basal denticles (so called by Troschel) on each side, which may be either on the basal margin, or on the anterior surface of the tooth above the base; cusp recurved and denticulated. Intermediate tooth more or less hatchet-shaped, having a handle-like process (peduncle) projecting outwardly from the base of the broad body which is denticulated at the upper margin. Lateral teeth generally slender and armed with numerous minute denticles at their superior margins. Shell small, spiral, turreted or depressed, often more or less umbilicated; aperture more or less rounded, never truly channelled in front; peritreme continuous. Station in fresh, brackish, or sea water, rarely on land. Distribution mundane.

The family Rissoidæ, as now circumscribed, notwithstanding their agreement among themselves in all characters which are of importance for the discrimination of the family, yet present such considerable differences in minor details, that they are found to arrange themselves naturally into several distinct groups, or sub-families. We find genera in which the shell is turreted and elongated, and others in which it is globular or depressed; some in which the verge is bifid, and others in which it is simple; some which have long proboscidiform snouts, and others with extremely short ones; some with lateral sinuses in the foot, and others without them; some with the foot produced anteriorly, and others having it shorter than the snout; some with a cirriform appendage to the operculigerous lobe, and others without; some with a spiral, others with a concentric operculum; and these differences are in some cases coincident with the great diversity in station and habits which we observe among these little snails. As already noticed, they inhabit the greatest possible variety of station, some of the genera being marine, and living even at great depths in the

ocean, while others live in brackish water, many in fresh water, and one, at least, habitually on land.

Upon these grounds I would suggest the division of the family into the following subfamilies, using the characters of the soft parts, as well as those of the shell and operculum:—

BYTHINIINÆ, with an ovate shell, a concentric operculum which is calcareous within, and with cervical lobes. They are comparatively large. Fresh water. Genus *Bythinia*,¹ Gray.

RISSOININÆ, with an ovate or turreted shell, and a thick, corneous, subspiral operculum provided with an internal process (articulated). Size small. Marine. Genus *Rissoina*, D'Orb.

RISSOINÆ, with an ovate or elongated shell, and a subspiral operculum not provided with a process. Foot without lateral sinuses. Rhachidian tooth of the lingual ribbon with the basal teeth on the inferior margin. Size small. Marine. Genera *Rissoa*, Frem., *Cingula*, Flem., *Alvania*, Risso, *Onoba*, H. & A. Ad., *Setia*, H. & A. Ad., *Ceratia*, H. & A. Ad., *Fenella*, A. Ad.

SKENEINÆ, with a depressed, almost discoidal shell, and a corneous, paucispiral² operculum. Minute. Marine. Genus *Skenea*, Flem.

HYDROBIINÆ, with shell and operculum and foot like those of the Rissoinæ, but with the rhachidian tooth of the lingual ribbon having the basal teeth on the anterior surface, behind the lateral margin. Size variable; some are minute, some as large as Bythinia. Living in fresh or brackish water. Genera *Hydrobia*,³ Hartm., *Littorinella*, Braun, *Amnicola*, Gould & Hald., *Bythinella*,⁴ Moq.-Tand., *Stenothyra*,⁵ Benson, *Tricula*, Benson, *Pyr-gula*, Christ. & Jan., *Paludestrina*, D'Orb., *Tryonia*, Stm., *Potamopyrgus*, Stm., *Lithoglyphus*, Muhlfeldt, *Fluminicola*, Stm., *Gillia*, Stm., *Somatogyrgus*, Gill, *Cochliopa*, Stm.

POMATIOPSINÆ, with the shell and operculum as in the Rissoinæ. Foot with lateral sinuses. Size small. Amphibious. Genus *Pomatiopsis*,⁶ Tryon.

¹ Syn. *Elova*, Moq.-Tand.

² According to the terminology of Woodward, the operculum of *Skenea* would be multispiral, and that of the Rissoinæ, etc. paucispiral.

³ Syn. *Paludinella*, Lovèn (not Pfeiffer), and *Littorinida*, Eyd. & Soul.

⁴ Syn. *Leachia*, Risso (not Lesueur), *Microna*, Ziegler.

⁵ Syn. *Nematura*, Benson.

⁶ Syn. *Chilocyclus*, Gill.

The above mentioned characters may be tabulated as follows:—

- A. Operculum concentric BYTHINIÆ.
 B. Operculum spiral.
 a. Operculum pauci-spiral SKENIINIÆ.
 b. Operculum subspiral.
 1. Operculum with an internal process RISSOINIÆ.
 2. Operculum without an internal process.
 * Foot without lateral sinuses.
 † Rhachidian tooth of the lingual ribbon
 with the basal denticles on the infe-
 rior margin RISSOINIÆ.
 †† Rhachidian tooth of the lingual ribbon
 with the basal denticles on the ante-
 rior surface behind the lateral mar-
 gins HYDROBIINIÆ.
 ** Foot with lateral sinuses POMATIOPSINIÆ.

It is with the two subfamilies last mentioned that we have to do in the present paper: the HYDROBIINIÆ and POMATIOPSINIÆ.

I adopt, for several reasons, the name Hydrobiinæ for the first of these subfamilies in preference to that of Amnicolinæ, proposed by Mr. Gill¹ for a part of the group, to which some Pomatiopsinæ were added. First, because the group was first indicated by Troschel,² under the name Hydrobiæ; next, because the first genus of the subfamily ever described was called *Hydrobia*; and lastly, because the name Amnicolinæ is not universally applicable, since these animals are not all inhabitants of rivers, or even of fresh-water, some of them living in shallow inlets of the sea. The name Hydrobiinæ is in every respect appropriate.

J. D. W. Hartmann was the first to separate these little snails from the old heterogeneous group called *Paludina*. According to Herrmannsen³ he published the genus *Hydrobia* in 1821, in Sturm's "Fauna Deutschlands," Abth. VI, Heft 5, p. 46. I have been unable to find and consult this work for the purpose of ascertaining the type of the genus, but the author doubtless intended to include in it both fresh-water and marine forms, certainly fresh-water ones, as he again used the generic name (*vide* Herrmannsen) in a treatise on the land and fresh-water shells of Switzerland, in Steinmüller's "Nene Alpina," I, 258. Moquin-Tandon⁴

¹ Proc. Acad. Nat. Sci. Philad., 1863, p. 34.

² Gebiss der Schnecken, I, 106 (1857).

³ Ind. Generum Malacozoorum, I, 545.

⁴ Hist. Nat. des Moll. ter. et fluv. de France, II, 514.

says that Hartmann originally included but three species in his genus, one of which was marine; and rejects the name *Hydrobia*, "because it had already been applied by Leach to a genus of insects." But the name of the coleopteran genus is *Hydrobius*, and sufficiently distinct to avoid confusion. Gray¹ gives the *Turbo ulvæ* of Pennant, a marine species, as the type of the genus *Hydrobia*, in which he is followed by Woodward² and H. & A. Adams.³ I shall therefore retain the name for the marine species (included in *Rissoa* by Forbes & Hanley) until further bibliographical researches can be made. That the marine, or rather brackish-water forms truly belong to the same group with the fresh-water species—the *Amnicolæ*, etc.—is evident from the character of their lingual dentition, which I have recently examined in the *Littorinella minuta* (*Cingula minuta*, Gould) of the coast of Massachusetts. The other characters of this animal are also so similar to those of the fresh-water forms, both in shell and soft parts, that it would, if found in fresh water, be considered by many as an elongated *Amnicola*. The verge is simple as in some of the fresh-water genera to be described below.

In Sturm's "Fauna Deutschlands," Hartmann also published a second genus under the name of *Lithoglyphus* (the MSS. name of Muhlfeldt), which proves to belong to the Hydrobiinæ, the type being the *Paludina naticoides* of Ferussac, found in the Danube.

The small mollusks of the families Hydrobiinæ and Pomatopsinæ are not only numerous, but greatly diversified in form, in the fresh waters of North America. They may be distinguished from all the rest of our fluviatile gasteropods, with some groups of which they have often been confounded, by the presence of an external verge, coexistent with a corneous subspiral operculum.

Like the Vivipari and Melaniæ, they have recently received considerable attention from American naturalists, particularly in respect to their classification, which has been attempted upon various grounds, but, as it would seem, with indifferent success. In fact but little dependence can be placed upon the shell alone, in the systematic study of these groups; the entire animal must be examined for the discovery of the most important characters.

¹ Turton's Manual, 2d ed., 1840, pp. 87, 88.

² Manual of the Mollusca, p. 137.

³ Genera of Recent Mollusca, I, 335.

Having recently found some of these animals living in the District of Columbia, and received from my friends Messrs. Binney, Tryon, and others, numerous specimens preserved in spirits from other parts of the country, I have been able conveniently to study their structure and habits, with the view of determining their relations to each other and to neighboring groups. Before giving the results of this study, it will be proper to review what has been already published upon the subject in this country.¹

Mr. S. S. Haldeman and Dr. A. A. Gould were the first in this country to call attention to the generic distinctness of certain small shells previously referred to *Paludina*, to include which they proposed to establish a new genus, *Amnicola*. This genus was first published by the former gentleman in October, 1840, in a "Supplement to a Monograph of the Limniades," p. 3, as follows: "*Amnicola*, G. & H. Head proboscoidiform; shell like *Paludina*, opercule corneous and subspiral." No species was mentioned as the type, or even as an example. Dr. Gould, in his celebrated work, the "Invertebrata of Massachusetts," 1841, pages 228 and 229, gave a much more detailed description, pointing out other important characters in which the genus is distinguished from *Viviparus*, such as the production of the rostrum beyond the foot, certain peculiarities in the habits of the animal, etc. He states that "so far as observation has yet gone, the *Amnicola* is oviparous, while the true *Paludina* is ovo-viviparous;" and also remarks that the tentacles are "frequently, if not always, unequal in length; perhaps this is a sexual difference." The difference in the length of the tentacles is, however, purely accidental. Dr. Gould's description of the animal is excellent, though relating

¹ In some of the papers referred to below I find allusions to a work by Mr. Binney. As an excuse for not herein referring to such a work, I can only say that I am unaware that Mr. B. has published anything whatever upon the subject. I have, indeed, in common with some others interested in the subject, received certain *printer's proof-sheets* of a forthcoming work on the *Amnicolæ*, *Vivipari*, etc., to be published by the Smithsonian Institution. The distribution of these proofs, with the view of eliciting additional information, speaks well for Mr. Binney's carefulness and strong desire to perfect his work; but we should no more quote publicly his un-matured views, confidentially circulated in the form of proof, than we should a private letter.

only to those parts of the animal which are protruded from the shell in progression.

Haldeman, in his "Monograph of the genus *Amnicola*," which forms part of his beautiful work on the fresh-water gasteropods of North America, also gives a description of the animal, in which he adds nothing of importance to that of Dr. Gould, except short accounts of the gills and of the character of the ova, which do not accord with my own observations as detailed below.

Dr. Lewis, in the "Proceedings of the Boston Society of Natural History," Vol. VIII, 1861, p. 255, gives a description of the so-called *Amnicola lapidaria*, stating that the soft parts of this species are "identical in form with *Melania*," and subsequently, in the "Proceedings of the Academy of Natural Sciences of Philadelphia" for 1862, p. 590, gives a more detailed account of the animal, and points out certain resemblances to *Melania* and *Truncatella*. But, as has been elsewhere noticed,¹ its resemblance to the Melanians is only a superficial one, and it is far removed from that group in the structure of its generative organs. To the Truncatellæ the species indeed shows a strong likeness in form and habits, which Dr. Lewis was the first to detect, although Say had indeed placed it in *Cyclostoma*. But its respiratory organs are of a different type, "*Amnicola*" *lapidaria* being a true Ctenobranchiate, while the Truncatellæ, as far as known, are air-breathing mollusks.

In a paper published in the "Proceedings of the Academy of Natural Sciences of Philadelphia" for September, 1862, Mr. Tryon has elevated the group Amnicolæ to the rank of a family, under the name of Amnicolidæ, but as this author has given no diagnosis of the group thus proposed, we are ignorant of the grounds upon which he considered it distinct from the allied families already known and named. He mentions but a single genus, *Amnicola*, but proposes under it a subgenus, *Pomatiopsis*, for the elongated species, with *A. lapidaria* for an example. This species, however, is not congeneric with the other elongated forms; it being found upon examination to present structural peculiarities which separate it widely from all of the true Amnicolæ.

The subject has since been investigated by my friend Prof. Theodore Gill, of the Smithsonian Institution, whose views are

¹ Am. Journ. of Science and Arts, [2] xxxviii (1864) 50.

published in the same "Proceedings," for the month of February, 1863, in a paper entitled a "Systematic arrangement of the Mollusks of the family Viviparidæ and others, inhabiting the United States," which has great value as calling attention to the true generic characters of the shell in several groups hitherto little understood or not generally accepted. This naturalist first called attention to the general correlation of size with structure in the families he describes. He agrees with Mr. Tryon in the separation of the Amnicolæ as a distinct family, Amnicolidæ, to which he gives, however, a much greater extent, by including in it the European *Bythinia*, and the *Bythinella* of Moquin-Tandon, which genus he regards as identical with *Amnicola* proper. He thus follows Moquin-Tandon in approximating these two groups, which have been widely separated by others; but, apparently recognizing the value of the great difference in the form of their opercula, he proposes to place them in two distinct subfamilies, Bythininæ and Amnicolinæ.¹ In the latter group he includes three genera, *Amnicola*, G. & H., *Somatogyrus*, n. g., and *Chilocyclus*, n. g. The subgenus *Pomatiopsis* of Tryon he rejects as doubtful; this group, however, in view of the characters of its type *P. lapidaria*, must be accepted, and *Chilocyclus* of Gill is synonymous with it.

Mr. Gill gives a diagnosis of the proposed family "Amnicolidæ" as follows:—

"Family Amnicolidæ (Tryon), Gill. Animal oval or elongated, completely retractile within its shell. Foot oval or rounded, generally narrow, and not continued in front of the rostrum. Jaws obsolete. Tentacles cylindrical setaceous, pointed, with the eyes sessile at their postero-external bases. Branchiæ in a single row, in the form of transverse folds, somewhat dilated at the middle. Generative organs on the right side; verge external, behind the tentacle, bifid and with unequal branches; female orifice under the margin of the mantle, on the same side."²

The author states that his knowledge of the anatomical characters is chiefly due to Moquin-Tandon, and it will be noticed that this is an exact translation of Moquin-Tandon's description of the

¹ Proc. Acad. Nat. Sci. Philad., 1863, p. 34. The presence of cervical lobes in *Bythinia* is another important point in which it differs from the Amnicolæ, etc.

² Proc. Acad. Nat. Sci. Philad., 1863, p. 35.

soft parts of his genus *Bythinia*¹ (in which he includes not only the true *Bythinia* but the *Bythinellæ* also²), except in leaving out the expression "à tortillon spiral," in relation to the entire animal, and in the substitution of the more nearly exact term "Jaws obsolete" for "Mâchoires nulles." The characters are used for the group originally founded upon our American *Ammicola*, on the assumption that our American species agreed therein with the European forms studied by Moquin-Tandon. The diagnosis will not, however, apply to our American forms as a group. The foot is by no means "narrow" in the greater part of our species. The jaws are not "obsolete;"—I have found them present and sufficiently well-developed in *Ammicola porata* and all others which have come under my observation.³ The tentacles are not "setaceous, pointed," in *Ammicola* proper, but conspicuously of equal size throughout their length, and truncated at their extremity. Finally, the verge is not bifid in all of our species.

Having eliminated these false characters, we can more easily determine whether these *Ammicolæ*, and their allies, are entitled to rank as a family distinct from the *Rissoïdæ*, in which the typical forms were placed by H. & A. Adams. We find, however, no character left which will serve to distinguish them, with the exception of "foot not continued in front of the rostrum." But this character does not seem to be of sufficient importance to indicate the separation of the two groups as distinct families, when the agreement is so close in all other points. It is also a very uncertain character. In describing these animals, sufficient care has not been taken to mention their position or movement at the time the description is drawn up. Among the figures of *Rissoæ* in the great work of Forbes and Hanley on the British Mollusca, we find some species represented with the head in advance of the foot, and others with the anterior extremity of the foot in advance of the head. On the other hand, I have

¹ Mollusques terrest. et fluvi. de France, II, 514.

² Moquin-Tandon's rather unnatural approximation of these two groups seems to have been chiefly founded on the similarity of their generative organs, which are strikingly different from those of *Viviparus*, to which genus the *Bythinia* were formerly referred.

³ That they exist also in *Bythinia*, notwithstanding the statement to the contrary by Moquin-Tandon, has been discovered by Troschel (see "Gebiss der Schnecken," I, 162). Moquin-Tandon himself admits having found traces of them in *Bythinella viridis* (op. cit., II, 525).

often seen the auricles of the foot in *Amnicola porata*, in certain positions, protruded beyond the snout, although their normal position is most certainly in the rear of the snout. Other distinctive marks, not mentioned by Mr. Gill, might be cited for the discrimination of the Amnicolæ from the Rissœ, but none which, in my opinion, are of importance for *family* distinctions. The deep-water Rissoidæ have generally a caudal filament arising from the posterior extremity of the operculigerous lobe, but the shallow-water species are for the most part destitute of this appendage, although so closely allied to the others that Forbes and Hanley have not even generically separated them. The lingual dentition of the Amnicolæ is of the same type with that of the Rissœ, the only essential difference being in the position of the basal denticles of the rhachidian tooth. There may be, indeed, characters remaining to be discovered, which will serve to separate the two groups as distinct families, but certainly none have as yet been brought forward.¹

To conclude the history of the writings of American naturalists on mollusks belonging to the subfamily Hydrobiinæ, the paper of Dr. Lewis in the "Proceedings of the Boston Society of Natural History," IX, 161, February, 1863, may be noticed. He has given a short description of the soft parts of *Melania isogona*, Say, which he refers to *Amnicola*, as Dr. Lea had already done.²

My own investigations into the characters of the small North American Gasteropods usually referred to *Amnicola*, have led me to distinguish among them two distinct subfamilies, which have

¹ It may here be remarked that none of the authors quoted above have given us valid characters for the distinction of the *Amnicola* group from the Melaniidæ, in which family they are indeed included by Dr. Lea. Mr. Gill, in his Synopsis (loc. cit., p. 33), relies upon the obsolescence of the jaws (an error as shown above), the shape of the aperture, and the size of the shell; but neither of the last two characters will serve to distinguish our largest Amnicolinæ from certain Mudaliæ and Ancylosæ. The same may be said of the continuous peritreme of the aperture of the shell of the Amnicolinæ, the character usually relied upon by authors, although this latter has far more value than the others just mentioned. The real difference between the two groups is found in the generative organs, the male in the Melanians being destitute of an external verge. (See a paper "on the structural characters of the so-called Melanians of North America," in Silliman's "American Journal of Science and Arts," [2] XXXVIII, 41.)

² Tr. Am. Phil. Soc., IX, 16.

been already briefly alluded to, viz. (1) the Hydrobiinæ, characterized by their purely aquatic habits, gliding motion, and the smooth sides of the foot, of which we find the genera *Bythinella*, Moq.-Tand., *Amnicola*, G. & H., *Gillia*, n. g., *Somatogyrus*, Gill, and *Fluminicola*, n. g., in the fresh waters of the United States; and (2) the Pomatiopsinæ, characterized by their terrestrial, or more properly amphibious, habits, stepping method of progression, and sinuated sides of the foot, with but one genus, *Pomatiopsis*.

I will now proceed to describe in detail such species of these two groups as have come under my observation, reserving the systematic diagnoses of the genera for the conclusion of the paper.

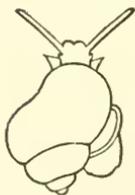
I. ON THE AMERICAN FRESH-WATER HYDROBIINÆ.

The considerations which have guided me in the selection of the family name, have been detailed on page 5.

Genus **AMNICOLA**, GOULD & HALD.

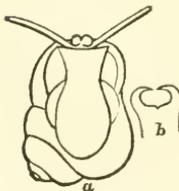
The following description of the characters of *Amnicola* proper is based upon the examination of a subglobular species (fig. 1) found in the Potomac River, which is probably the *Paludina porata* of Say, and undoubtedly congeneric with Gould's *Amnicola porata*, which Haldeman considers to be the *Paludina limosa* of Say, and which is the type of the genus, being the first species ever referred to it.

Fig. 1.



The foot (fig. 2, *a*, *b*) is simple, without any lateral sinuses, and is, when extended in progression, between two and three times as long as broad. It is dilated and auricled in front, somewhat narrowed before the middle, more or less expanded behind the middle, and rounded or subtruncate at the posterior extremity. The auricles are pointed, and generally project but little beyond the lateral margin; but under certain circumstances the animal can elongate them to such a degree that they become almost tentaculiform, and at least as long as the foot is wide. This is represented in the cut fig. 2, *b*. On one occasion I have seen the auricles thus remarkably protruded, and

Fig. 2.



vibrated laterally until their tips met in front, and they inclosed a heart-shaped open space between their margins. Under some circumstances they are doubtless used as tactile organs. The anterior extremity of the foot, between the tips of the auricles, is bi-marginate, or divided into two lips by a slit or furrow of slight depth. The subtruncate posterior extremity of the foot sometimes takes an obscurely trilobate form, the middle lobe being broad and arcuated, while the small lateral lobes are dentiform. The operculigerous lobe is oval or rounded, not continued anteriorly, but broader than the foot, so that it projects on either side beyond the margin of the latter. The operculum is thin, horny, and subspiral, with about two turns and a half. It is striated, both longitudinally and transversely to the whorl, except at the outer or larger extremity, where the transverse lines only are apparent, and are different in direction from the others. There are two parallel areas at the outer or dorsal margin, the inner one being longitudinally and the outer one obliquely striated. See Fig. 3. It is proper to state that this figure is taken from the Massachusetts species, *A. limosa* according to Haldeman.

Fig. 3.



The rostrum is very short, but normally placed in advance of the foot in consequence of the anterior position of the head; it is broader than long, and emarginated at the middle of its antero-inferior edge. The tentacles are slender, very long, two-thirds as long as the foot, exactly cylindrical, and blunt or truncated at their tips. The eyes are placed just at the outer bases of the tentacles, on the anterior side of somewhat prominent tubercles or bulgings of this part of the head. The mantle edge is simple. The gill, a portion of which is represented in Fig. 4, is situated in the usual position on the inner surface of the mantle, and is rather broad, far broader than in the Viviparidae and Melaniidae, and consists of transverse laminae of a somewhat triangular form with the prominent apices bent over to the left.¹

Fig. 4.



¹ Mr. Haldeman, in his "Monograph of Amnicola," page 6, attributes to the genus "about 8 rows of pectinated branchiae." I am unable to comprehend what is referred to here; perhaps the branchial laminae themselves

The generative organ of the male (Fig. 5) is of moderate size, and situated on the right side of the back, a short distance behind the right tentacle. It consists of a subglobular base from which arise two forks or processes,

Fig. 5.



one of which is short, straight and flattened, with parallel sides and truncated extremity; while the other is longer, pointed, and coiled loosely around the first, scarcely however completing a single turn. The generative orifice in the female is in the usual position at the juncture of the body with the mantle, a short

distance within the margin of the latter.

The apparatus for taking food is as follows: At the inferior end of the proboscis we find the mouth, with its jaws, which are strong, and of the usual imbricated structure, resembling much those of *Rissoa*, as figured by Troschel, except that the marginal denticles are less pointed. The teeth of the lingual ribbon (Fig. 6) are arranged in seven rows, 3. 1. 3. The rhachidian tooth is

Fig. 6.



very broad, at least three times as broad as long. It has a tongue-shaped process arising at the centre of its concave anterior surface, and projecting downward, reaching beyond the base. Its lateral lobes are acutely triangular and somewhat curved, and each of them presents, upon the anterior surface, a row of four denticles, extending from near the cusp to the lateral extremity, of which four denticles the two middle ones are minute, and the

are meant, but these are not pectinated. These branchiæ are undoubtedly in a single row.

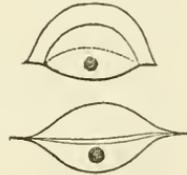
In speaking of the gill, the larger or principal one is always referred to in the present paper, the other being minute and inconspicuous, and rarely mentioned in descriptions.

two outer ones large. The upper margin of the rhachidian tooth is concave, and its broad cusp¹ is 7-denticulated—the central denticle being large (larger than is represented in the cut), though but little projecting, while the three lateral ones on each side are small and equal. The intermediate tooth ("zwischenplatte") is very considerably produced and narrowed below, so that its body is very small and its peduncle long, and the body has a strongly projecting knob at its infero-interior angle. Its cusp is armed with five strong, sub-equal denticles—the inner one being rounded and blunt, while all the rest are acutely triangular and strongly projecting. There seems to be also a minute denticle on the inner side of the large inner denticle. The two lateral teeth are long, slender, and curved; the terminal margin of the pointed inner one being armed with about eighteen minute denticles, and the rounded extremity of the outer one being so minutely serrated that the denticles, thirty or forty in number, can only be perceived under very high powers of the microscope.

Of the *Amnicola porata* the males and females occur in about equal numbers. The ova are deposited, in this latitude, during the months of April and May. The ova-capsule (Fig. 7) is thin, corneous, of a semi-lenticular shape, and attached by the cut face of the lens, which forms the base. The free limb is margined with a broad thin lamina of the same delicate horny texture as the envelope of the capsule itself. In size, these ova-capsules are a little larger than the head of the animal. They are deposited singly, and each contains but a single egg, which floats freely about in the fluid surrounding it. Those which occurred to me were found sticking to the shell of a female, although they were probably not deposited by the same individual, but by some other, while they were huddled together in groups according to their practice at this season.

It will be noticed that this description of the ova-capsule does

Fig. 7.



¹ It must be remarked that in the view of the teeth which is usually presented under the microscope, and which is represented in every diagram of a single row, the denticles of the cusps of the teeth appear foreshortened, and thus much shorter and blunter than they really are.

not agree with that given by Mr. Haldeman, in his Monograph,¹ except in regard to the isolation of the egg. This author states that the ova are deposited "in small oblong detached glairy masses, each of which contains apparently but one germ. The color of the germ is orange, of the mass yellowish transparent, with a dark central line upon the surface from end to end." If it were true that the eggs occur in "glairy masses" they would approximate in character to those of the fresh-water Pulmonates. In view, therefore, of the discrepancy between my own observations and those of Mr. Haldeman on this point, it will be proper to state that I have not actually witnessed the deposition of the egg by the mother. I have, nevertheless, no doubt whatever that the eggs which I have described above are really those of *Amnicola porata*. As far as has yet been observed, the eggs of all the allied Ctenobranchiates are contained in ova-capsules when deposited, and it would be very remarkable if those of the *Amnicola* formed the only exception. The "dark central line" mentioned by Haldeman probably corresponds to the lamina of the ova-capsule, described above.

The true *Amnicolæ* are exclusively aquatic, living in the deeper fresh-water lakes, and streams which do not dry up in summer. They creep with a regular gliding motion, the right and left sides of the sole of the foot being alternately put forward, as is usual in the creeping rostrifers.

Not having had an opportunity of examining all of the species which have been referred to *Amnicola*, I cannot, of course, say with certainty how many and what species truly belong to the restricted genus. There is a shining horn-colored shell found in Vermont and New York—which is probably the *A pallida* of Haldeman, although I have seen it labelled both *A. lustrica* and *A. grana*—the pupoid form of which, in connection with the shape of the aperture, has led me to suppose it generically distinct. I have, however, recently examined the lingual dentition of this species, and find it to be nearly like that of *Amnicola porata*, the rhabdian tooth being exactly similar. The species probably belonging here are, besides Say's *Paludina porata* and *P. limosa*, his *P. grana*: the *Amnicola orbiculata* and *A. parva* of Lea; the *A. decisa*, *A. galbana*, and *A. pallida* of Haldeman, and the

¹ Monograph of the genus *Amnicola*, p. 4.

Paludina cincinnatiensis of Anthony. The *Paludina lustrica* of Say, may perhaps belong to Gill's genus *Lyogyrus*, one of the Valvatidæ, on account of its large umbilicus and labrum simply touching the penult whorl—characters which recall the young of *Valvata pupoidea*, Gould.

It may here be remarked that none of the so-called "Amnicolæ," the dentition of which is figured by Troschel, in his "Gebiss der Schnecken," Vol. I, pl. viii, belong to the genus as here restricted to forms congeneric with the type, *A. limosa*, Hald.

Genus **BYTHINELLA**, Moq.-TAND.

Moquin-Tandon, in his work on the Terrestrial and Fluvial Mollusks of France, published in 1856, considered all the fresh-water Rissoids of that country as belonging to a single genus, *Bythinia*, which he divided into two subgenera: *Elonga*, synonymous with the true *Bythinia* of Gray, and *Bythinella*, Moq.-Tand., comprehending numerous small snails belonging to our subfamily Hydrobiinæ. The preoccupied name *Leachia* had already been applied to these latter forms by Risso. The group *Bythinella*, as proposed by Moquin-Tandon, contains at least two distinct genera, neither of which is synonymous with our *Amnicola*; but the name must be retained for the forms congeneric with *B. viridis*, the type of the genus as originally indicated by that author in the "Journal de Conchyliologie," II (1851), p. 239, note. I have not been able to procure specimens of these European true *Bythinellæ* for examination in regard to their lingual dentition; but Troschel, in his work already frequently quoted, has figured the teeth of a species called by him "*Amnicola (Subulina) thermalis*,"¹ which is probably congeneric with the true *Bythinellæ*, the *Turbo thermalis* of Linnæus being a fresh-water species.² In this species Troschel describes the rachidian tooth as having but one basal denticle on each side, and a 9-dentienlated cusp; the intermediate tooth with a peduncle longer than the body, and a 6-denticulated cusp; the inner lateral tooth armed at the summit with eighteen teeth, and the outer one with the margin of the summit smooth; the character of this latter

¹ Gebiss der Schnecken, I, 108, viii, 6.

² "Habitat prope thermas pisanas in aquis dulcibus." Linn., Syst. Nat., ed. 12, No. 1237.

May, 1865.

tooth being peculiar, as in all other genera of the Hydrobiinæ it is denticulated. This we will consider, for the present, as the dentition of the genus *Bythinella*.

The shells of the *Bythinellæ* differ from those of the *Ammicolæ* in being much more elongated; they correspond to those of the group *Pomatiopsis*, as proposed by Tryon, although that name must now have a far different signification on account of the character of its type. The apex of the shell is generally obtuse; the whorls are tightly coiled, and the umbilicus generally closed. The tentacles of the animal, according to Moquin-Tandon, are setaceous and pointed (not obtuse at the extremity, as in *Ammicola*); the verge is bifid, but the longer branch is not coiled about the shorter one; the foot is narrow, with its posterior extremity "concealed in great part by the operculum;"¹ and the eggs are "globular, hyaline, sometimes arranged symmetrically in two rows, and forming a band fixed to solid bodies."²

By comparison of these characters with those of *Ammicola* given above, it will be seen that *Bythinella* differs from that genus sufficiently both in its shell and its soft parts; in its dentition, and perhaps also in the form of the ova-capsules; and it therefore should not be united to *Ammicola*, as proposed by Troschel, Gill, and others.

The name *Hydrobia* is used for the *Bythinellæ* by Bourguignat³ and some other recent writers, but it would seem preferable to restrict that name to the marine forms, as has been done by Frauenfeld.⁴ The latter author has, however, wrongly used for the *Bythinellæ*⁵ the name *Paludinella*, Pfeiffer, which was founded⁶ on the *Truncatella littorina* of Philippi,⁷ an air-breathing snail having the eyes on the upper sides of the bases of the tentacles, and belonging therefore to a group of gasteropods far different from those here treated of.

¹ Moquin-Tandon, *l. c.*, p. 517.

² Moquin-Tandon, *l. c.*, p. 514. Possibly this description of the eggs refers to the true *Bythininæ* only.

³ Guerin's *Rev. et Mag. de Zool.*, XIV, 1862, 96.

⁴ *Verhandl. der K.-k. Zool.-bot. Gesellschaft in Wien*, XIII (1863), 1017.

⁵ *Loc. cit.*, XIII, 1863, 199.

⁶ *Archiv für Naturgeschichte*, I, 1841, 227.

⁷ *Arch. für Naturg.*, I, 1841, pl. v, fig. 7. See also, on this point, Forbes & Hanley, *Brit. Moll.*, III, 133.

Among Frauenfeld's synonyms we find the name of *Microna*, Ziegler, MSS., which is also equivalent to *Bythinella*.

We have among our North American Hydrobiinæ, species which should, with little doubt, be referred to the genus *Bythinella*. I have not, indeed, had opportunities of studying the entire soft parts of any of these species, nor of ascertaining the form of their eggs—having, except in one instance, to rely upon the shell alone for indications of the generic affinity. That instance is the *Amnicola Nickliniana* (Lea), Halde-
man, an elongated species (Fig. 8), of which I have found in the Smithsonian collection specimens containing the dried animal, and have thus been enabled to study the lingual dentition. This (Fig. 9¹) I find to be nearly of the same type with Troschel's *Amnicola* (*Subulina*) *thermalis*,

Fig. 8.



Fig. 9.



the rhachidian tooth having but one distinct basal tooth on each side, though an obtuse lateral lobe is developed below it, and a 7-denticulated cusp; the intermediate tooth has the inferior process or peduncle longer than the body (which has a central cavity and an infero-interior projection not seen in Troschel's figure of the dentition of *thermalis*), and a 6-denticulated cusp; the inner lateral has the outer margin of the shank reflexed or thickened, and has a 12-denticulated cusp; and the summit of the outer lateral is apparently smooth, although it has once appeared to me serrated, under a very high power; if so, the denticles must be exceedingly minute and numerous.

In view of the shape and obtuse apex of the shell, and the character of the dentition, I do not hesitate to place the *Palu-*

¹ It should be remarked that in this figure, as in most other figures of lingual dentition in this paper, the teeth are represented thrown a little out of their natural positions in respect to each other in order to show more distinctly the form of each.

dina Nickliniana of Lea in the genus *Bythinella*. The other American species, probably referable to the same genus, are *Amnicola attenuata*, Haldeman, *A. tenuipes*, Couper, *A. obtusa* (Lea), Haldeman, and *Pomatiopsis Binneyi*, Tryon.

The Bythinellæ cannot be distinguished by the shell alone from the brackish-water Littorinellæ, and from several of the marine Rissœæ. These two groups are as yet but little known, many of their most important characters remaining to be discovered. From our present knowledge we can only state that the fresh-water genus differs from the Rissœæ in the position of the basal denticles of the rhachidian tooth of the lingual ribbon, and from the Littorinellæ in the obsolescence of the armature of the outer lateral tooth, and in the bifid verge. The verge in *Littorinella minuta* (*Cingula minuta*, Gould), the only species I have examined, is simple and not forked. Practically, of course, the difference in the element they inhabit enables us to distinguish these groups, and may serve the purpose until their characters are better understood.

We now come to a group of American Hydrobiinæ in which the shell is globular in shape, and of large size, much larger, in fact, than in any other Rissoids, and approached only, in this respect, by the Bythinæ and Potamopyrgi. The *Amnicola isogona*, Lea, *A. integra*, Hald., *A. altibis* (Lea), and *A. Nuttalliana*, Cooper, may be mentioned as examples. They were originally described as Melaniæ or Paludinæ, but have, for the most part, been since placed in *Amnicola*, although some authors have been inclined to place them in the Melanian genus *Leptoris*, to which they have considerable resemblance, both in shell and operculum; or in *Bythinia*, from which they differ much in both these hard parts. The question of their true position is now solved by an examination of their soft parts; they are undoubtedly Hydrobiinæ. I have had opportunities of studying several species of the group, and find among them three distinct genera, founded on the character of the verge and shell, which will be described below. One of these, *Somatogyrus*, has already been indicated by Mr. Gill, upon the characters of the shell in the *Amnicola depressa* of Tryon. The genus *Lithoglyphus* of Mullfeldt, found in Europe and South America, belongs to the same group. The "*Amnicola*

isogona" and "*A. integra*" have in fact been placed in this genus by Frauenfeld.¹

Genus **SOMATOGYRUS**, GILL.²

I am indebted to the kindness of Mr. Tryon, and of Professor Sheldon, of Davenport, Iowa, for alcoholic specimens of *S. depressus* (Fig. 10), the species upon which this genus was founded. Very singularly, however, among these specimens, more than a hundred in number, I can find no males, and am therefore unable to describe the form of the verge in the type.

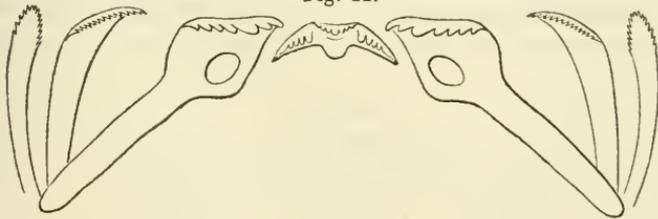
Fig. 10.



The genus presents the following characters: Shell short, thin, simply striate, distinctly umbilicated, and with four to six whorls; the body-whorl subglobose, more or less shouldered above; the spire small, and the suture impressed. Aperture oblique (upper part most advanced), rhombo-ovate, narrowly rounded in front and behind; peritreme thin and acute, appressed behind, below the upper angle, to the whorl, and with its entire margin in the same plane. Operculum subspiral, corneous, but comparatively thick and strong, and with its inner margin regularly convex. Foot short. Snout robust, and considerably longer than in *Amnicola*. Tentacles tapering, pointed.

The lingual dentition of the type is as follows (Fig. 11): Rha-

Fig. 11.



chidian tooth short and very broad, and trilobate below, with the outer angles much produced and narrow; cusp armed with seven denticles; basal denticles four on each side, the innermost largest, but not reaching the inferior margin of the tooth, and

¹ Verhandl. der K.-k. Zool.-bot. Gesellschaft in Wien, XIII, 1863, 194, 195.

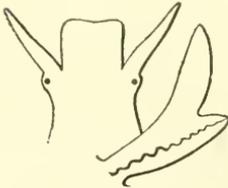
² Proc. Acad. Nat. Sci. Phila., 1863, p. 34.

the others gradually decreasing in size outwardly, the outermost being obtuse and rather a lobe than a denticle. Intermediate tooth with the body perforated,¹ and the peduncle more than twice as long as the body; cusp 7-denticulated, the third denticle (counting from within) being twice as broad as the others. Inner lateral tooth with fourteen denticles at the summit. Outer lateral also with fourteen denticles.

Mr. A. O. Currier, of Grand Rapids, Mich., has obligingly sent me, from that locality, alcoholic specimens of the *Melania isogona* of Say (Fig. 12), placed in *Amnicola* by Dr. Lea, which may prove to be congeneric with *Somatogyrus depressus*. Among these specimens there were fortunately some male individuals, so that the character of the verge could be determined. This organ (Fig.



Fig. 13.



13) is here much compressed, and bifid, the inner branch being much longer than the outer, but no longer than the basal part; while the outer is short, somewhat triangular and pointed, and contains the canal, which is conspicuous from its white color. The rostrum in the same species is rather broad, flat, and square-cut; the tentacles are rather short, in their contracted state scarcely longer than the rostrum, and flattened.

In the lingual dentition of *S. isogonus*, of which a figure is here given (Fig. 14), with a more enlarged view of the rha-

Fig. 14.



¹ It is very difficult to determine, with the instruments at my command, whether the hole seen in the figure is a true perforation, or only a deep pit. It certainly has the appearance of being the former, though, if so, it is hard to say what its office can be. Nothing like it has yet been described by Troschel or any other author.

chidian tooth, which is quite different in form from that of *S. depressus*, and noticeable for the great length of the central denticle of the seven-denticulate cusp,¹ the basal denticles are three in number, of which the innermost is by far the largest, and projects beyond the basal margin of the tooth; this basal margin is trilobate, as in *S. depressus*. The intermediate tooth has its peduncle twice as long as the body, and very slender; its body is perforated, and has a strong projection or shelf at the lower margin of the perforation, of nearly similar shape and size with the perforation itself, and appearing, in some points of view, very much like an open door or lid; the cusp is armed with about seven strongly prominent, sharply pointed denticles. The inner lateral tooth has twelve denticles at the summit. The outer lateral has about the same number, much smaller, as usual, than those of the inner.

It will be noticed that this dentition differs in some points from that of the type, *S. depressus*; and is remarkable in the length of the rhachidian cusp, as well as in the peculiar process guarding the perforation of the intermediate tooth. These differences would not, however, seem to be generic, as far as can be judged by our present knowledge of the value of such characters in the Hydrobiinæ.

The shell of *S. isogonus* is similar to that of *S. depressus*. The rostrum and tentacles are also similar to those of the type; they may be seen in Fig. 13. The tentacles, contracted by spirits, are of course much shorter than in life.

Mr. Currier informs me that *S. isogonus* has the habits of *Viviparus*, except that it burrows more deeply into mud. He finds it only on clay bottoms.

The *Melania integra* of Say, and *M. altilis* of Lea, and the *Paludina subglobosa* of Say, are placed in *Somatogyrus* by Tryon.² The first two species, however, belong to a different genus, as will be noticed below. The *Paludina subglobosa* I have not seen. It is perhaps the same as *S. isogonus*.

¹ The figure was drawn from a specimen in which the cusp was broken down by pressure; the lateral margins are in reality continuous.

² Proc. Acad. Nat. Sci. Phila., 1864, 104. Mr. T. spells the generic name *Somatogyra*.

Genus **FLUMINICOLA**, Srm.

In the "Transactions of the American Philosophical Society," Vol. VI, 1839, p. 101, pl. xxiii, fig. 89, Dr. Lea has described and figured a shell (Fig. 15, enlarged) from the Columbia River, Oregon, under the name of *Paludina Nuttalliana*.

Fig. 15.



Subsequently, in a "Report on the Survey of the Northern Pacific Railroad Route," Mr. William Cooper placed this species in *Amnicola*, having probably observed that its operculum is subspiral, and not concentric as in *Paludina*. Mr. Binney having kindly sent me specimens of this mollusk preserved in spirits, I have examined its characters,

which prove it to be distinct from *Amnicola* proper, although Mr. Cooper, in placing it in that genus, has made a much closer approximation to the truth than did its original describer.

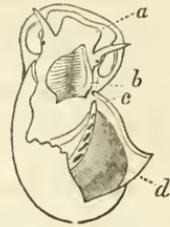
The shell is larger than in any of the other genera of Hydrobiinæ, and resembles in size and general appearance that of the *Leptoxis*-group of Melanians. It is also so like that of the *Paludina decisa* and its allies, that it is by no means surprising that it should have been referred to their vicinity by the distinguished naturalist who first described it, as the operculum was then unknown. In fact we find it to have the same shape, the same eroded apex and olive periostraca, and the same form of aperture with prominent outer lip and sinuated base, which are characteristic of the Eastern Melanthos (*Campelomæ*). These characters of the shell and its aperture will serve to distinguish the new genus *Fluminicola*, which has the species under consideration for its type, from all other Hydrobiinæ. The soft parts also furnish good distinctive marks.

The shell (Fig. 15) may be described as follows:—It is rather thick and strong, subglobular or subovate inclining to conic, imperforate, and simply striate. Periostraca thick, greenish-olive. Spire obtuse. Suture scarcely impressed. Aperture ovate, rounded in front, angular behind; columella concave, flattened, and callous, especially near the umbilical region; margin of the pretreme not in the same plane, but sinuated.

Having only alcoholic specimens of the animal for examina-

tion, its soft parts (Fig. 16) are described below in their contracted state. The foot, which is folded in the specimen figured, is short, somewhat contracted at the middle, broadly rounded behind, and auricled(?) and bimarginate in front. The operculigerous lobe is simple, little developed, and smaller than the operculum, which latter is thin, horny, subovate, and subspiral, with about three turns. The rostrum (Fig. 16, *a*) is quite large, broad and flattened, somewhat rectangular, bilobate in front, and wrinkled transversely—resembling in its general characters that of the *Melaniidæ* much more than that of *Amnicola*.

Fig. 16.



The tentacles in their contracted state about equal the rostrum in length; they are somewhat tapering, but flattened, and apparently bluntly pointed at their tips. The eyes are barely perceptible, and are situated on slight protuberances at the outer bases of the tentacles. The branchial cavity (laid open in the figure) is shallow. The mantle edge is simple. The gill (Fig. 16, *d*) is very broad in front, but becomes narrower behind; it consists of about twenty low subtriangular plates, much less projecting than in *Amnicola*, and sharply acuminate at the tip of the projection. The verge (Fig. 16, *b*) is large, flattened, broader than long, and placed obliquely on the right side of the neck, some little distance behind the right tentacle. It has on the left side and posteriorly a great wing-like expansion, the surface of which is striated transversely. This verge, though not bifid as in the preceding genus, is homologous in form, the wing corresponding to the left fork of the organ in *Somatogyrus isogonus*.

The oviduct of the female lies on the mantle, parallel to the rectum, filling the space between this latter sack and the line of juncture of the mantle with the body; its orifice is situated a little within the margin of the mantle, immediately below the anus. In the rectum (Fig. 16, *c*) the faecal matter is broken into fusiform pellets.

The lingual dentition is as follows:—The rhaechidian tooth is broad, but longer in proportion than in *Amnicola* and *Somatogyrus*, and trilobate below, the middle lobe being triangular, but not acute; the basal denticles, on the surface beneath the lateral margins, are three in number on each side, rather long and slender,

acute, and about equal in size; the cusp is armed with five denticles, and the broad central one has apparently an additional very minute one at its base on either side. The intermediate tooth has a moderately broad peduncle, and its cusp is armed with six denticles, of which the third from within is much larger than the others. The lateral teeth are shaped generally as in the allied genera already described; the cusp of the inner one has ten denticles, and that of the outer one six or seven. The outer lateral tooth when reversed or thrown outward, is seen to have a somewhat expanded truncated extremity upon which all the denticles are placed—none appearing on the sides.

It will be observed that this dentition is very distinct from that of *Lepioxis* or any other Melanian genus, the latter never having basal denticles on the rhabdian tooth.

Attached to the shell of some of the specimens before me, I find a thin brownish capsule (Fig. 17), about one-eighth of an

Fig. 17.



inch in diameter, containing eggs, which is in all probability the ova-capsule of the *Fluminicola*. It is disciform, very little convex, and attached by its broadest surface which forms the circular base. It contains about twenty-four ova, and is thus very distinct in character from the ova-capsules of the other genera of Hydrobiinæ, for in all other cases as yet observed, the eggs are deposited singly. The ova-capsules and their various modes of deposition, undoubtedly afford good generic characters.

The genus *Fluminicola* seems to be restricted to the freshwaters of the countries bordering on the Pacific coast of North America, all the species yet known being from California and Oregon. The genus will include, besides the type, *F. Nuttalliana*, the following species:—*Paludina virens*, Lea; *P. nuclea*, Lea; *P. seminalis*, Hinds; and *Ammicola Hindsii*, Baird.

Genus **GILLIA**, SEM.

Fig. 18.



In September, 1863, while on a visit at the residence of my friend Mr. Binney, at Burlington, N. J., I enjoyed opportunities of studying the soft parts of *Melania attilis*¹ of Lea (Fig. 18), which indicate a generic type different from any yet described.

¹ Placed in *Leptoxis* by Haldeman, Monog. Lept., 6, pl. v, fig. 152.

This genus I take pleasure in dedicating to my esteemed associate Prof. Theodore Gill, in recognition of his great ability as a malacologist, and of the assistance he has rendered me in the determination of the conchological characters of the animals now under consideration.

The shell in this genus is thin or only moderately thickened, simply striate, short, subconic, scarcely umbilicated, and with the body whorl subglobose, the spire rather small, and the suture not impressed. The aperture is ovate, regularly rounded in front, angular behind, with its peritreme thin and acute, appressed behind internally to the whorl, and with its entire margin in the same plane, which is very oblique, sloping downwards and backwards. The operculum is thin, and its margin concave within near the upper end.

The soft parts of *Gillia atilis* resemble those of the preceding two genera in the robust form of the body and snout, but differ considerably in other respects. The foot (Fig. 19, *b*) is oblong, broadly rounded behind, and strongly auricled in front. The tentacles (see in Fig. 19, *a*) are long, slender, and pointed. The eyes are placed on the outer sides of tubercles at the outer bases of the tentacles. The verge (see in Fig. 19, *a*) is very small, simple, compressed, and lunate or sickle-shaped; being thus strikingly different from that of the genera previously described in this paper. The colors of the animal recall those of the Melanians more than those of *Ammicola* proper, being very dark, and minutely mottled, as if peppered in.

The lingual dentition (Fig. 20) is of a character in some respects intermediate

Fig. 19.

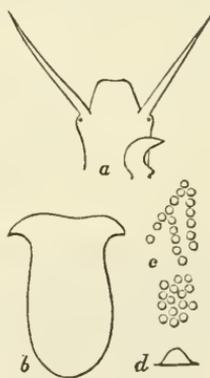
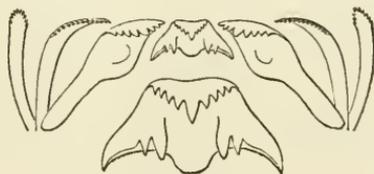


Fig. 20.



between that of *Somatogyrus* and that of *Bythinella*. The rhachidian tooth is of the usual shape, and has on each side but two distinct basal denticles, exterior to which there is a lobe. These denticles are, however, rather large, and acute, extending beyond the basal margin of the tooth. The cusp of the rhachidian tooth is armed with nine acute denticles. The intermediate tooth has its peduncle rather longer than the body, and the body has a depression upon its anterior surface but not a foramen; its cusp has eight denticles. The denticles of the summit in the inner lateral tooth are fourteen in number, and in the outer one ten.

The ova-capsules (Fig. 19, *c* and *d*) are small, nearly hemispherical, attached by the broad base, and are deposited singly, or in groups or linear series. Each contains but a single egg.

The only known species besides the type *G. altilis*, which may probably belong to the genus now under consideration is the *Melania integra* of Say, found in the tributaries of the Mississippi, the shell of which is very similar to that of *G. altilis*. A figure of lingual teeth, said to be of this species, given by Troschel,¹ is here copied (Fig. 21). The only essential difference between

Fig. 21.



this dentition and that of *G. altilis* figured above, is that the rhachidian tooth of the *integra* is represented as having but one basal tooth on each side, but this difference is an important one, and it is desirable that the teeth of both species should be re-examined on this point. The cavity in the body of the intermediate tooth, described above as occurring in *G. altilis*, is slight and may have been overlooked by Troschel in the other species.

It is not improbable that two or more species have been confounded under the name of *Amnicola altilis*; if so, it is only necessary to state that my observations were made upon the form found so abundantly in the Delaware River near Burlington, which must be considered as the type of the genus.

¹ *Op. supra cit.*, I, pl. viii, fig. 4.

II. ON THE SUBFAMILY POMATIOPSINÆ.

Genus unicum **POMATIOPSIS**, (TRYON) STM.

In the Proceedings of the Philadelphia Academy of Natural Sciences for September, 1862, page 452, Mr. Tryon proposed to separate from *Amnicola* a group of elongated species, as a subgenus under the name of *Pomatiopsis*, with the following diagnosis:—"Shell elongate, the spire (of about six whorls) much exceeding the length of the aperture. Example, *A. lapidaria*, Say." Following the diagnosis above this name could not be adopted for the terrestrial genus now to be described, for there are elongated species and ovate species in both the terrestrial and aquatic groups of the old genus *Amnicola*. But as Mr. Tryon, in accordance with a correct practice which authors would do well to follow universally, has distinctly mentioned "*A. lapidaria*" as the type of the genus, I do not hesitate to adopt his name.

Prof. Gill, in his paper already alluded to, doubts the validity of the subgenus as *defined* by Mr. Tryon, although he recognizes that the type "may however be quite different, and a representative of the *Aciculidæ*." But the *Pomatiopsis lapidaria*, as I shall presently show, is, notwithstanding its terrestrial habits, by no means allied to the terrestrial *Pneumonopoma* to which the *Aciculidæ* belong according to the observations of Moquin-Tandon. The mollusks of that group have a vascular respiratory cavity or lung, and their tentacles have the power of erection and motion during land-progression; while our *Pomatiopsis* breathes by means of a pectinated gill, and has no power of raising its tentacles in air, though in water they are of course mobile. The structure of its respiratory organ also separates this genus from the *Truncatellidæ*, which have nearly the same mode of progression. One genus, however, which has been referred to the latter family, approaches *Pomatiopsis* very nearly. I refer to the *Tomichia* of Benson, an East Indian form, the respiratory organs of which have not yet been observed.

Pomatiopsis is one of the very few true Ctenobranchiates which have yet been discovered to breathe air, habitually if not solely. Dr. Lewis, in his paper in the Proceedings of the Boston

Society of Natural History, above referred to,¹ observes that the *lapidaria* in habits is evidently air-breathing, but that in water they "seemed not to be embarrassed in their movements, though they soon made their way out, apparently preferring to be out of it." According to my own observations they exhibit considerable uneasiness when placed in the water, which caused me some surprise when on dissection I found them to possess a true gill and no trace of a vascular "lung." We have, however, analogous cases among the Crustacea, in such genera as *Cardisoma*, *Uca*, *Gecarcinus*, and *Cenobita*, which breathe air, although their breathing organs consist of gills, of similar structure with those of the aquatic Crustacea. There is no difficulty in understanding that a gill may perform the function of respiration in air, so long as its surfaces are kept damp. Even bivalve Mollusca may be kept out of water for great lengths of time, provided the surrounding atmosphere be sufficiently humid, and the temperature cool. In this case they can of course breathe only air unmixed with water.

That the *Pomatiopsis* is truly terrestrial in its habits, notwithstanding its preference to the vicinity of water, I can have no doubt. Its peculiar mode of progression is, indeed, adapted for land travel only. I have found it living in company with *Succinea ovalis*, *S. avara*, and *Helix electrina*, in places not liable to desiccation, that is, near the margins of streams or marshes which do not dry up in summer. Its occurrence in such places *only*, is in consequence of the necessity of having some moisture for its breathing organs, it being unable, like the Pulmonates, to prevent evaporation, and the consequent desiccation of those organs, by the formation of an epiphragm closing up the aperture of the shell.² The animal may be said to be *amphibious*, but only in the sense that *Succinea* and some other terrestrial Mollusca are so; that is, like them it is capable of living for a long time under

¹ Proc. Bost. Soc. Nat. Hist., VIII, 255.

² Since writing the above, I have received a letter from Mr. Tryon in which he informs me that "Mr. Conrad lately captured a number of specimens of *Pom. lapidaria*, and laid them away in a dry place. Upon examining them some time afterward he found the animal so much retracted that the operculum was out of sight, showing that, unlike *Amnicola*, it is provided against dry weather, and can exist out of water or even moisture for some time."

water. It moves under water with an awkward gliding motion, very different from its active "step" on land.

Without further preface I will proceed to the description of the soft parts of the type of the genus.

Pomatiopsis lapidaria.

The wood-cut, Fig. 22, represents the animal as it appears when placed in water.

The foot is a very large muscular organ, the texture of which resembles much more that of the Pulmonates than that of *Amnicola* and other aquatic forms. It is considerably broader than that of *Amnicola*, and capable of being protruded forward somewhat in advance of the rostrum, notwithstanding the considerable length of the latter organ. In progression on land, however, the end of the rostrum is constantly kept in advance. The lateral angles of the anterior extremity of the foot are not sufficiently produced to form auricles. Its posterior extremity is broadly rounded. The lateral surface of the body and foot presents a system of sinuses adapted for the peculiar mode of progression of the animal, which will be described below. These sinuses are most distinctly seen on the left side, to which the following description more particularly applies (see Figs. 25 and 26). First there is a distinct fold separating the foot into an anterior and a posterior part, the latter being about twice as large as the former; which fold, though very conspicuous on the upper surface of the foot, does not distinctly appear on its lower surface, nor form an emargination upon its edge, except when the animal is in motion. This fold terminates above at the point where the foot joins the rostrum. Next, above and nearly at right angles with the first fold, there is a horizontal sinus also arising from the juncture of the foot and rostrum, and separating the foot from the body;—the upper margin of this fold is continuous posteriorly with the operculigerous lobe. Above this there are two oblique folds arising from the inferior base of the rostrum and extending upward and backward, the upper one reaching to the base of the tentacle, and the lower one extending upward along the side of that constriction of the body which is sometimes called the "neck," or pedicle. The position of these

Fig. 22.



latter folds will be better understood by an inspection of the wood-cuts, Figs. 25 and 26. It was probably the observation of these sinuses which induced Dr. Lewis, in the papers already referred to, to consider the species as allied to the Melanians. The sinus in the side of the foot in our American Melanians is, however, of a different character and connected with the sexual system.

The rostrum or snout is longer than the tentacles, and capable of great protrusion. It is wrinkled transversely, and its extremity may be expanded so as to form an adherent disk, the upper margin of which is emarginated, while the lower side contains the mouth. The tentacles are short, subulate, pointed, and somewhat thickened near the base. They are not capable of erection in air, but droop, hanging down by the side of the head and resting against the base of the rostrum. The eye is situated on the *outer* side of a rather prominent swelling out or protuberance of the head at the base of the tentacle. On the upper and inner side of these protuberances there is a conspicuous longitudinal fusiform spot of flake-white or yellow, which is a prominent character, probably, however, of specific importance only.

The generative organ of the male (Fig 23) is situated nearly in the median line of the back, and comparatively very far behind the head, so that it is entirely concealed within the branchial cavity. It is of great size, and when extended would reach to the middle of the rostrum. It is thus twice as long as in *Amnicola*, and moreover is not bifid, but consists of a single broad flattened process, convoluted in a spiral of about one and a half turns, with a pointed extremity, rounded and smooth outer margin, and sharp, wrinkled inner margin.

Fig. 23.



The gill, situated in the position usual in Ctenobranchiata, is rather broader than in the Hydrobiinæ, and the plates, though nearly similar in shape to those of that genus, are much less projecting, and more broadly rounded at the summit. The rectum, lying to the right of the gill, contains fæces formed into little oval pellets; and it may here be mentioned that this character, though seemingly of trivial importance, will distinguish also all of our Hydrobiinæ from the Viviparidæ, in which the fæces appear in a continuous vermiform shape.

In the manducatory apparatus we find jaws resembling those

of *Amnicola*, though of smaller size. The dentition of the lingual ribbon (Fig. 24) resembles considerably that of *Pomatiopsis*

Fig. 24.



Sayana (*Amnicola Sayana*, Anthony), figured by Troschel in the "Gebiss der Schnecken," tab. viii, fig. 1. The differences are the following:—The central tooth is somewhat broader, and the lateral denticles of its tridenticulate cusp proportionally larger; while the denticles at the base are directed inward. The cusp of the intermediate tooth is 4-denticulate exactly as in *P. Sayana*. But the apices of the two lateral teeth differ considerably from those of that species, being each 5-denticulate, with the denticles subequal.

It will be noticed that, among the several prominent marks of distinction between this dentition and that of the Hydrobiinae, that the basal denticles of the rhachidian tooth are placed, in *Pomatiopsis*, at or near the base.

The operculum is very nearly like that of *Amnicola*.

To conclude this description I will give an account of the manner in which the stepping mode¹ progression of *Pomatiopsis* is effected. During this motion the foot is so contracted that its two parts are distinct. In what may be called the *first motion*, the anterior part being firmly fixed upon the ground, the posterior part is drawn up to it, by a sliding movement;—in the accompanying cut (Fig. 25)

Fig. 25.



¹ The progression of the *Pomatiopsis* has been called "looping," like that of *Truncatella*. But in *Truncatella* only two points of support are used, while in *Pomatiopsis* there are three. The motion of the latter animal may perhaps with more propriety be called "stepping."

it is by exaggeration represented a little raised from the ground, in order better to indicate its movement. At the same moment the snout is thrust forward, and its disk-like extremity affixed to the ground as far ahead as possible. Then comes the *second motion* (Fig. 26); in which, the snout and the posterior part of

Fig. 26.



the foot being firmly affixed and supporting the body, the anterior part of the foot becomes free, and is thrust forward to the disk of the rostrum where it is again planted. The operations of the first motion are then

repeated. Thus the animal moves by regular steps, upon three points of support, of which alternately two and one are used. During the movement the lateral folds of the body and foot are seen sliding upon each other, showing how their arrangement contributes to the facility with which this kind of progression is effected.

The surface of the animal is constantly lubricated with mucus apparently much greater in amount than is seen in the Helicidæ and other Pulmonates. The foot is capable of adhering with considerable tenacity. While these animals were under my observation, many of them escaped over the edge of the plate in which they were placed, and crept without much difficulty upon its under side.

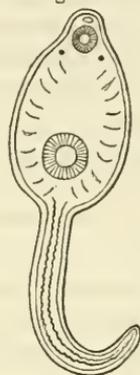
The females in *Pomatiopsis lapidaria* are considerably more numerous than the males, and are more elongated, having a more cylindrical shell. The outer whorl of the male is proportionally larger in order to afford space for the great verge. The ovary of the female lies further up in the spire, giving the shell its less conical form.

The eggs of *Pomatiopsis* have not yet been observed. Most probably they are deposited in the water.

It will not be out of place here to mention a cercarian parasite with which the *P. lapidaria* was thickly infested at the time of observation (May 6th). When the mollusk is extracted from its shell and placed in water, numbers of little white worms scarcely visible to the naked eye are washed out from the branchial cavity, which prove, on microscopic examination, to be the cercaria-nurses of a species of *Histrionella*. They were filled with young, which were found when extruded to be normally of a tad-pole

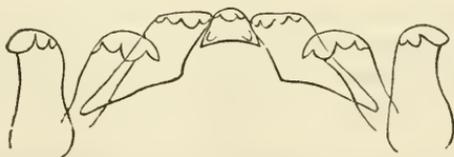
shape, although the body was capable of great elongation and contraction, assuming protean forms. The two black eyes were very conspicuous. There are apparently two acetabula, the anterior one of which is described by Diesing (*Systema Helminthum*, I, p. 300) as the mouth, and it performs the functions of a sucker. There is a small aperture anterior to it. In creeping, the motion is similar to that of the looping or geometric caterpillars, the suckers being alternately attached. But in water the animal swims by vibrations, and is so rapid in its elongations, contractions, and gyrations, that the eye cannot follow it. Often it takes the form of a round disk, from which the tail projects upward wriggling in the most comical manner. A figure of this little animal, which may be called *Histrionella pomatiopsidis*, is subjoined (Fig. 27). The species already known are European, and found upon aquatic snails, such as *Planorbis* and *Viviparus*.

Fig. 27.



Besides the *lapidaria*, there are undoubtedly one or more others of the so-called Amnicolæ of North America which belong to this genus as I have defined it; but with one exception I cannot state with any degree of probability what they are, having seen the animal of *lapidaria* only. The *Amnicola Sayana* of Anthony, however, upon which Mr. Gill founded his proposed genus *Chilocyclus*, belongs with little doubt to *Pomatiopsis*; for the shells are similar in all essential characters, such as the reflected lip,¹ which is developed only in the adult; the animal has similar terrestrial habits, and its lingual dentition is of the same general type, as may be understood by a comparison of the accompanying wood-

Fig. 28.



¹ This is the character ("circular lip reflected"), which was considered by Mr. Gill as the distinctive mark of *Chilocyclus*.

cut (Fig. 28) of that of *Sayana*, copied from Troschel's work, with that of the *lapidaria* as given above. The difference in the denticulation of the lateral teeth is indeed considerable, but can scarcely be considered generic, in the absence of other important distinctive characters.

Before concluding our remarks upon this subfamily, we must not fail to allude to the very close resemblance to *Pomatiopsis* shown in the genus *Tomichia* of Benson, which is placed by most writers among the air-breathing snails, of the order Operculata, suborder Opisophtalma, and family Truncatellidæ. In this animal the shell is extremely similar to that of *Pomatiopsis*, and the foot is also provided with lateral sinuses. It is said to live in fresh-water ditches. "The adult specimens, for the most part, crept about on the moist earth at the edge of the water; but the younger individuals were immersed."¹ Such habits would seem to indicate a branchiferous rather than a pulmoniferous mode of respiration, in the young at least. But the eyes are said to be placed on tubercles near the upper bases of the tentacles, whereas in *Pomatiopsis* they are at the outer bases. The superior position of the eyes may be of itself of little importance; but it is found, in other cases to be co-existent with respiratory organs formed for breathing air. The lingual dentition, as figured by Troschel,² is similar to that of *Pomatiopsis* in all respects except that the rhachidian tooth has its basal denticles connected by a transverse plate;—a character which approximates it to the Truncatellidæ. Troschel places *Tomichia* in the same group with *Lithoglyphus*, upon what grounds it is not easy to comprehend.

Whatever conclusions may be arrived at from these facts, we have undoubtedly here, between *Tomichia* and *Pomatiopsis*, the closest point of osculation between the branchiferous and pulmoniferous Gasteropods.

Three genera have been recently described in the "Annals and Magazine of Natural History," which have considerable resemblance in form or habits, or in both, to the Pomatiopsinæ. These are *Cecina*,³ A. Adams; *Blanfordia*,⁴ A. Adams, and *Cremno-*

¹ Benson, Ann. and Mag. Nat. Hist. [3], XII, (1863,) 424.

² Gebiss der Schnecken, I, pl. vii, fig. 15.

³ Ann. and Mag. Nat. Hist. [3], VIII, (1861,) 308.

⁴ Ann. cit. [3], XII, (1863,) 424, pl. vii, fig. 11, 12.

bates,¹ Blanford. Unfortunately the lingual dentition of these genera, which would afford us the best guide to their true position in the system, has not yet been examined. They are all more or less amphibious in habits, but their respiratory organs have not been studied with sufficient care to determine whether they are branchiferous or pulmoniferous. If they breathe by means of "lungs,"² two of them must be referred, with *Tomichia*, etc., to the neighborhood of the Truncatellidæ, while the other will form a new family. But if they are truly branchiferous, they must be closely related to the two subfamilies of Rissoids which have been treated of above.

Cecina and *Blanfordia* are both Manchurian or Japanese genera, found, like the Truncatellæ, in damp places near the sea. They have both, however, shells with olivaceous periostraca and opercula similar to those of *Pomatiopsis*. In the first-mentioned genus the eyes are also placed at the outer bases of the tentacles, which would seem to exclude it from the Truncatellidæ and approximate it still more to *Pomatiopsis*; but the tentacles are said to be lobiform and flattened, and no mention is made of sinuses in the sides of the foot. Further investigation of this genus is therefore necessary before its true place can be determined.

Blanfordia shows even greater resemblance to *Pomatiopsis* than *Cecina* does, for we find in it the same arrangement of lobes and sinuses in the sides of the foot, indicating the same stepping mode of progression; but this is accompanied by the Truncatelloid character of having the eyes on the *upper* bases of the tentacles; so that the genus will very probably be found to belong to the Truncatellidæ when its respiratory organs and dentition are examined.

Creminobates is an East Indian genus, found on rocks wet by fresh-water. It is referred by Blanford to the Littorinidæ. It has a trochiform shell very different from that of *Cecina* and *Blanfordia*, and approaching that of the marine genus *Fossarus*. There is said to be a "large vascular sac at the back of the neck." The eyes are on the outer bases of the tentacles, and the foot is not lobed. The operculum is subspiral and testaceous. The

¹ *Ann. cit.* [3], XII, (1863,) 184, pl. iv, fig. 1-12.

² The intermediate type of breathing-organ found in the operculated terrestrial Gasteropods, *Cyclostoma*, etc., is here meant.

position of this genus still remains in doubt, although, notwithstanding the "vaseular sac" and its amphibious habits, it seems to me most probable that it will prove to be branchiferous. For, as Mr. Blanford has pointed out, its characters exclude it from all known families of pulmoniferous gasteropods.

[Since the above remarks were written, I have received, through the kindness of Mr. W. H. Dall, a specimen of *Cremnobates synhydrænsis*, which, fortunately, contained the dried animal. I find that its dentition is entirely that of the Littorinidæ.]

III. SYSTEMATIC DIAGNOSES OF THE GENERA OF HYDROBIINÆ.

The subfamily Pomatiopsinæ, as far as is certainly known, contains but one genus, so that its further illustration is at present unnecessary. With the Hydrobiinæ it is far otherwise, no less than fourteen genera being indicated by the considerable differences to be observed among the species of this subfamily, which are very numerous in all parts of the world. In the recent monographs of von Fraucnfeld,¹ one hundred and twenty-five species are enumerated, a few of which, however, belong to the allied subfamilies Rissoinæ and Pomatiopsinæ. But the German naturalist has naturally overlooked some described species on account of their having been placed in wrong genera; and there are numerous undescribed species in the collections of American conchologists, particularly in that of Mr. Tryon, which would make the total number of species nearly two hundred.

The generic place of very many of these species, known as yet by the shell only, must remain undetermined until the soft parts and the lingual dentition are examined. Certain genera, as *Stenothyra*, *Tricula*, *Pyrgula*, and *Tryonia*, are indeed easily recognized by the shell alone; but no characters are found in it which will enable us to distinguish certain Littorinellæ and Hydrobiæ

¹ See Verhandl. der k.-k. zööl.-bot. Gesellschaft in Wien, XII, (1862,) pp. 1158-1160, and XIII, (1863,) pp. 193-210; 1017-1032. This author distributes the species of the subfamily among five genera,—*Nematura*, *Lithoglyphus*, *Paludinella*, *Hydrobia*, and *Amnicola*, but he gives no characters for the distinction of the last three genera, and confesses the difficulty of doing so until the soft parts are better known.

from *Bythinella* and *Paludestrina*, and the same difficulty will probably be found with *Gillia* and *Somatogyrus*, or with *Lithoglyphus* and *Fluminicola*. I shall therefore under each genus give as examples only a few species which certainly belong to it, without attempting to assign a place to every known species of the family. It would not, of course, be difficult to do this approximately, but rather than run the risk of adding to an already overburdened synonymy, I will leave the work to those who have proper opportunities for observing the entire animal in each case; and would beg my fellow-workers in this field to take the same course.

SUBFAMILY HYDROBIINÆ.

Shell very small, or of moderate size, never exceeding two-fifths of an inch in length, globose, ovate, or elongated, generally umbilicated or rimate, and covered with a periostraca for the most part of an olive color; whorls moderately numerous (4-8), smooth, or, rarely, ribbed or carinated, never cancellated; aperture more or less ovate or rounded, rarely subacute or effuse anteriorly; peritreme continuous; outer lip usually simple and acute. Operculum subspiral, corneous or testaceous. Tentacles, verge, and gills as in the diagnosis of the family, p. 3. Foot without lateral sinuses, truncate and auricled in front, and generally rounded behind; operculigerous lobe destitute of cirri. On the lingual ribbon the rhachidian tooth is much broader at the base than at the summit, with the basal margin trilobate, and the basal denticles situated on the anterior surface, between the base and the oblique lateral margins, being connected with these margins by a carina or lobe usually extending to the infero-exterior angle of the tooth; so that they are rather dependencies of the lateral margins than of the base. The peduncle of the intermediate tooth is slender and generally long. The lateral teeth are straight or regularly curved, with no approach to the sigmoid form seen in the *Rissoinæ* and *Skeneinæ*.

Station, in fresh or brackish water.

Like all of the *Rissoidæ* these little animals are strictly herbivorous. Moquin-Tandon remarks¹ that they have, connected with the stomach, a cartilaginous stylet like that occurring in certain

¹ Hist. Nat. des Moll. ter. et fluv. de France, II, 514.

bivalves. Something like this stylet I have observed also in our American Melanians.

In the following diagnoses of the genera, the characters given are always those of the type, except when they are expressly stated to have been made out from some other species. In the description of the lingual dentition of the typical or a congeneric species, the formula of the denticles is, strictly speaking, only specific, and is given only as an *indication* of the generic numerical character of these denticles. Their respective limits as to number in each genus must be determined by the examination of the other species.

STENOTHYRA, BENSON.

Nematura, BENSON, in the Calcutta Journal of Science. Name pre-occupied in Ornithology.

Stenothyra, BENSON, in H. & A. Adams' Genera of Recent Mollusca, II, (1858,) 626.

Shell ovate, smooth, imperforate; aperture rounded, contracted. Operculum testaceous.

Lingual ribbon, according to Troschel's figure,¹ with the rha-chidian tooth only one-third broader than long, and deeply emarginated on either side beneath the cusp, which is armed with nine denticles; basal denticles two in number on each lateral margin, pointing upward. Intermediate tooth with seven denticles; inner lateral with thirteen; outer lateral with eleven. These denticles may be conveniently formulated thus: $\frac{9}{2+2} - 7 - 13 - 11$.

Station, fresh-water.

Distribution, India and Southeastern Asia, and the neighboring islands.

TYPE *S. delta*, BENSON. Syn. *Nematura delta*, BENSON, Calcutta Jour. Sci.—H. & A. Ad. Gen. Rec. Moll. I, (1854,) 342, xxxvi, 5 (shell and operculum).—TROSCHER, Geb. der Schnecken, I, (1857,) 104, vii, 11 (lingual dentition). *Hab.* River Ganges.

The species are enumerated in H. & A. Adams' "Genera," II, 626, and by von Frauenfeld in the "Verhandl. der k.-k. zoöl.-bot. Gesellschaft in Wien," XII, (1862,) p. 1158.

This genus is placed in the Viviparidæ by H. & A. Adams, von Frauenfeld, and most other authors, and in the Littorinidæ

¹ Gebiss der Schnecken, I, pl. vii, fig. 11.

by Gray. Troschel arranges it with *Bythinia*; the two genera forming his group *Bythinia*. But it is removed from the *Bythinia* by its subspiral operculum.

TRICULA, BENSON.

Tricula, BENSON, Calcutta Jour. Sci., III, (1843.)

Shell elongated, smooth, subperforate; aperture ovate, rather narrow; inner lip thickened. Operculum corneous, with the nucleus very small and close to the base. Rostrum elongated. Tentacles filiform.

Lingual dentition unknown.

Station, fresh-water.

Distribution, India.

TYPE *T. montana*, BENSON, *loc. supra cit.*—H. & A. AD. Gen. Rec. Moll. I, (1854,) 306, xxxii, 5, 5a, 5b (shell and operculum). *Hab.* River Kaaman, India.

No other species is known. It is placed in the *Melaniidae* by Benson and H. & A. Adams. Benson says that the soft parts resemble those of *Melania*, but the characters he gives of these parts do not serve to distinguish them from those of the *Hydrobiinae*, to which group the genus has been referred by Brot.¹ My opinion of its affinities is based upon the characters of the shell, such as its small size, continuous peritreme, umbilicus, etc., which do not occur in the *Melaniidae*.

LITTORINELLA, BRAUN.

Littorinella, BRAUN, Ber. üb. d. Vers. d. Naturf. in Maynz, (1846,) p. 148;—also THOMÆ, Jahrb. des Ver. für Naturkunde in Herzogthum Nassau, II, (1845,) 159.

Shell ovate or elongated, thin, smooth, perforate; whorls ventricose; apex obtuse; aperture rather broadly oval; inner lip not thickened. Operculum corneous. In *L. minuta* the rostrum is rather long; the tentacles very slightly tapering, and blunt at the extremity; the verge is simple, slender, tapering, compressed, and pointed; and the foot is rounded behind.

Lingual dentition of *L. minuta*: Rhachidian tooth without a central basal process, and with a small lobe, almost amounting to

¹ Cat. Syst. Melan., (1862).

a denticle, at the outer side of the single basal denticle. Intermediate tooth with the body quadrate and strongly projecting at its infero-interior angle, which is blunt; peduncle very long. Formula of the denticles: $\frac{7}{1+1} - 5 - 12 - 12$.

Station, brackish or sea-water in sheltered positions.

Distribution, probably mundane.

TYPE *L. ventrosa*.—*Turbo ventrosus*, MONT.—*Cyclostoma acutum*, DRAP.—*Rissoa ventrosa*, FORBES & HANL., Brit. Moll., III, (1853,) 138, lxxxvii, 1, 5, 6, 7. Hab. Europe.

The following species belongs, with little doubt, to the same genus:—

L. minuta.—*Turbo minutus*, TOTTEN.—*Cingula minuta*, GOULD, INV. MASS. (1841,) 265, fig. 171. New England

The name *Littorinella* was originally proposed by Braun for "the Paludinas with a spiral operculum," which would make it include nearly the entire subfamily; and no species are mentioned by him, from which we can select a type. Thomæ, in the "Jahrbuch," quoted above, was the next author who used the name, and his first species must be taken as the type. This species is the *Cyclostoma acutum* of Draparnaud, a brackish-water or marine species, identical with the *Turbo ventrosus* of Montagu. The characters of the soft parts of this species, including its lingual dentition, are as yet unknown, but the shell so closely resembles that of the common "*Cingula minuta*" of the coast of New England, that we can have little doubt that they are congeneric. The characters of the animal, other than conchological ones, have therefore been drawn from the latter species. These characters seem to forbid its generic association with *Hydrobia* as typified by *H. ulvæ*. But, should the soft parts of Montagu's *Turbo ventrosus* be found, upon examination, to present characters differing generically from those of Totten's *Turbo minutus*, or if they do not so differ should Thomæ's shell be found to be generically distinct from the *Turbo ventrosus*, we would propose for the genus here indicated, the name *Ecrobia*, with *Turbo minutus* as the type. In our efforts to retain the names previously applied without knowledge of the true characters, to members of the group under consideration, and to avoid the introduction of new names which may prove to be synonyms, we experience great difficulty in ascertaining the typical species upon which such genera must be supposed to be founded; and when

that species is decided with some degree of certainty, materials are not always at hand for the determination of the important characters of its soft parts.

HYDROBIA, HARTMANN.

Hydrobia, HARTMANN, in Sturm's Fauna Deutschland's, Abth. VI, (1821,) Heft 5, p. 46 (in part).

Paludinella, LOVÈN, Öfv. af. k. vet.-Akad. Förh., III, (1846,) 157 (not of PFEIFFER).

Littorinida, EYD. & SOUL., Voy. Bonite., Zool., II, 536.

Shell ovate or elongated, smooth, subperforate; spire conic; whorls flat; apex acute; aperture ovate; inner lip not thickened. Operculum corneous. Rostrum rather long. Tentacles somewhat tapering, but blunt at the extremity. Foot somewhat pointed behind.

Lingual dentition of the type: Rhachidian tooth very broad, with a strong, central, obtuse, tongue-shaped process from the anterior concave surface, directed downward and reaching beyond the base. Intermediate tooth shaped as in *Littorinella minuta*, but with a deep concavity in the body. Lateral teeth with the dorsal or exterior margin of the peduncle or shank reflected or thickened. Formula of the denticles: $\frac{7}{1+1} - 6 - 13 - 25$.

Station, brackish water.

Distribution, mundane.

TYPE *H. ulvæ*, H. & A. AD., Gen. Rec. Moll., I, (1854) 335, xxxv, 10 (animal, shell, and operculum).—*Turbo ulvæ*, PENN.—*Rissoa ulvæ*, FORBES & HANL., Brit. Moll., III, (1853) 141, lxxxix, 4, 5, 8, 9, and lxxxvii, 2, 8 (shell), and jj, 8 (animal). *Hab.* Europe.

The difficulty of separating the Littorinellæ and Hydrobiæ from the Bythinellæ and Paludestrinæ by the shell alone, has been already alluded to. It might be convenient, as a temporary expedient, to arrange all the brackish-water species in the two former genera, and the fresh-water ones in the other two, the ultimate separation being founded upon the character of the apex of the shell and of its whorls.

My reasons for retaining the name *Hydrobia* for the genus typified by *H. ulvæ*, have been stated on page 6.

The *Paludinella* of Lovèn (not of Pfeif., on which see p. 18)

is synonymous with *Hydrobia*. H. & A. Adams' have rightly understood Pfeiffer's genus, as their description shows, but most of the species they refer to it, among them our *Littorinella minuta*, belong to groups entirely different.

BYTHINELLA, Moq.-TAND.

Leachia, RISSO, Hist. Nat. d'Europe Meridionale, IV, (1826) 100, 102 (not of LESUEUR, 1821).

Bythinella, Moq.-TAND., Jour. de Conch. II, (1851) p. 239, note; and Hist. Nat. des Moll. ter. et fluv. de France, II, (1855) 515.

Subulina, TROSCHEL, Geb. der Schnecke, I, (1857) 108 (not of BECK).

Paludinella, FRAUENFELD, Verhandl. der k.-k. zool.-bot. Gesellschaft in Wien, XIII, (1863) 199 (not of PFEIFFER).

Microna, ZIEGLER, in Frauenfeld's "Arten der Gattung *Lithoglyphus* Mhlf." etc., loc. cit. XIII, (1863) 200.

Shell elongated-ovate, usually somewhat pupiform, imperforate, or simply rimate; apex obtuse. Aperture oval or rounded; peritreme continuous, outer lip slightly thickened. Operculum corneous, with the nucleus moderately large, and not very close to the basal margin. Tentacles tapering, but blunt at tip. Foot rather narrow, rounded behind. Vergé (in *B. ferrusina*) bifid.

Lingual dentition of *B. thermalis*, according to Troscchel¹: Rhachidian tooth moderately long, with the infero-lateral angles much produced. Intermediate tooth with the body longer than broad. Formula of the denticles: $\frac{0}{1+1} - 6 - 18 - 0$.

Station, fresh water.

Distribution, Europe and North America

TYPE *B. viridis*, Moq.-TAND., Journ. de Conch., II, (1851) p. 239, note; and Hist. Nat. des Moll. ter. et fluv. de France, II, (1855) 524, pl. xxxix, fig. 11-17.—*Bulinus viridis*, POIR, Prodr., (1801) 45.—*Cyclostoma viride*, DRAP., Hist. Moll., (1805) p. 37. Hab. Western Europe.

The following species may also be mentioned:—

B. ferrusina, Moq.-TAND., Hist. Nat. des Moll. ter. et fluv. de France, II, (1855) 516, pl. xxxviii, fig. 20-28.—*Paludina ferrusina*, DES MOUL. Western Europe.

B. vitrea, Moq.-TAND., loc. cit., II, (1855) 518, pl. xxxviii, fig. 33-36.—*Cyclostoma vitreum*, DRAP. Western Europe.

¹ Genera of Recent Mollusca, II, 315.

² Gebiss der Schnecken, I, 108, pl. viii, fig. 6.

B. abbreviata, MOQ.-TAND., *loc. cit.* II, (1855), 519, pl. xxxviii, fig. 37, 38.—*Paludina abbreviata*, MICH. Western Europe.

B. conoidea, MOQ.-TAND., *loc. cit.*, II, (1855) 522, pl. xxxix, fig. 3-5.—*Paludina conoidea*, REYN. Western Europe.

B. brevis, MOQ.-TAND., *loc. cit.*, II, (1855) 523, pl. xxxix, fig. 6-10.—*Cyclostoma breve*, DRAP. Western Europe.

B. similis, MOQ.-TAND., *loc. cit.*, II, (1855) 526, pl. xxxix, fig. 18, 19.—*Cyclostoma simile*, DRAP. Western Europe.

B. Nickliniana, STM.—*Paludina Nickliniana*, LEA, Tr. Am. Phil. Soc., VI, (1839) 92, pl. xxiii, fig. 109. Pennsylvania.

B. Binneyi, STM.—*Ponatiopsis Binneyi*, TRYON, Proc. Acad. Nat. Sci. Philad., 1863, p. 148, pl. i, fig. 10. California.

See also on p. 20, *ante*, for others.

This genus differs from *Ammicola* in its lingual dentition, the rhachidian tooth having but one basal denticle. It differs from *Littorinella* in having a bifid verge; and from *Paludestrina* in the shape and obtuse apex of the shell, and in the want of perceptible denticulation on the cusp of the outer lateral tooth of the lingual ribbon.

Moquin-Tandon's varicose *Bythinellæ*, *B. marginata* and *B. gibba*, are not included in the above list of species, because they present characters in the shell which may indicate important differences in the soft parts. Whether they are true *Bythinellæ* remains to be determined by future examination.

If the type of Hartmann's genus *Hydrobia* should prove to be a fresh-water species, that name will have to be adopted in place of *Bythinella* for this genus.

The name *Leachia*, of Risso, must be rejected on account of its previous use by Lesueur for a genus of Cephalopoda. Lesueur's name is considered synonymous with *Loligopsis* by Gray,¹ but the group seems to be sufficiently distinct from the typical *Loligopside*s in the tuberculation of the body.

For further remarks upon the genus *Bythinella*, see *ante*, p. 17.

PALUDESTRINA, D'ORB.

Paludestrina, D'ORBIGNY, in Sagra's Cuba, Moll., II, (1841) 8.

Shell conic, more or less elongated, smooth, imperforate or nearly so; apex acute. Aperture ovate; peritreme continuous; outer lip acute; inner lip not thickened. Operculum corneous.

¹ Cat. Moll. Brit. Mus., Ceph. Antep., p. 39.

Lingual dentition of *P. culminea*, according to Troschel¹: Rhachidian tooth very short and broad; basal denticle with a lobe or ridge connecting it with the lateral margin. Body of the intermediate tooth longer than broad, and longer than its peduncle. Formula of the denticles: $\frac{9}{1+1} - 9 - 19 - 25$.

Station, fresh water.

Distribution, South America and the West Indies.

TYPE *P. Auberiana*, D'ORBIGNY, in Sagra's Cuba, Moll., II, (1841) 8, pl. x, fig. 6, 7. *Hab.* West Indies.

The following are congeneric:—

P. culminea, D'ORB., Voy. Am. Merid., Moll., p. 386, pl. xlvi, fig. 10-12. Bolivia.

P. Cumingiana, D'ORB., Voy. Am. Merid., Moll., p. 385, pl. xlvi, fig. 14-16. Chile.

P. Panchappii, D'ORB., Voy. Am. Merid., Moll., p. 383, pl. xlvi, fig. 4-6. Buenos Ayres.

D'Orbigny's description of his genus *Paludestrina* would make it include the entire subfamily Hydrobiinæ, with the exception of *Stenothyra*, and this was doubtless intended by him, as he seems to have been ignorant of the generic names previously proposed for the shells of the group. As in all such cases, we must select a type from among the species described by him, and of these we select the first, not only on account of the accordance of such a selection with a rule of nomenclature generally adopted, but because it will afford us a name for a group of American forms which should be generically separated from the other elongated fresh-water species which we have included in *Bythinella*.

The first species ever described by D'Orbigny, as far as we have been able to ascertain, is the *P. Auberiana* of the "Mollusques" of Sagra's Cuba. This species is said by the author to be "common on the maritime sands of Cuba," which at once suggests the idea that it may be a *Hydrobia* or *Rissoa*, and not congeneric with the South American fresh-water forms we have included in the genus, from one of which the lingual dentition of the genus has been made out. But we find that Poey, an excellent observer, has placed the *P. Auberiana* among the *fresh-water*

¹ Gebiss der Schnecken, I, 108, pl. viii, fig. 5.

shells of Cuba,¹ and D'Orbigny himself says that the species was found at Guadeloupe, "at the mouth of a rivulet." The conclusion would naturally follow that D'Orbigny was misinformed with regard to its habitat, and that it is not a marine, but a fresh-water species. I adopt this conclusion the more willingly on account of the close agreement of the shell of *P. Auberiana* with the South American fresh-water *P. culminea*; both having a form rarely found among the shells of the marine Hydrobiæ. If, however, I should prove to be mistaken in this conclusion, *Paludestrina Auberiana* will doubtless be found to be a *Hydrobia*, of which D'Orbigny's name will then become a synonym. In this case I would propose the name *Heleobia*, for *P. culminea* and its allies.

PYRGULA, CHRISTOFORI & JAN.

Pyrgula, CHRISTOFORI & JAN, Consp. Meth. Moll. (1832); and Mant. Catal. test., (1832) p. 4.

Shell elongated, turreted, imperforate; whorls carinated. Aperture oval, effuse anteriorly; outer lip not thickened. Operculum corneous, with projections on the outer margin, corresponding to the concavities of the carinæ of the shell. In the soft parts of *P. bicarinata*, according to Moquin-Tandon, the foot is "narrow, obtuse, and as if bilobate in front, somewhat pointed behind," and the tentacles are slender.

Lingual dentition unknown.

Station, fresh waters in mountainous regions.

Distribution, Europe and South America.

TYPE *P. helvetica*, H. & A. ADAMS, Gen. of Rec. Moll., I, (1854) 309, pl. xxxii, fig. 7.—*Melania helvetica*, MICHELIN, Mag. de Zool., 1831, p. 37, pl. xxxvii.—*Pyrgula annulata*, CHRIST. & JAN, Mant. Catal. Test. (1832) p. 4. Of a white color. *Hib.* Switzerland.

The following are all the other species as yet known:—

P. bicarinata, BOURGIGNAT, Rev. et Mag. de Zool., [2] XIII, (1861) 528.
—*Bythinia bicarinata*, DUPUY.—*Bythinella bicarinata*, MOQ.-TAND., Hist. Nat. des. Moll. ter. et fluv. de France, II, (1855) 520, pl. xxxviii, fig. 39-42. France.

P. pyrenaica, BOURGIGNAT, *loc. cit.*, [2] XIII, (1861) 530. Pyrenees.
P. andicola, STM.—*Paludestrina andicola*, D'ORB., Voy. Am. Merid., Moll., p. 385, pl. xlvii; fig. 13. Andes of Bolivia.

¹ Mem. sobre la Hist. Nat. de la Isla de Cuba, II, (1856) 10.

It is interesting to notice that all the species of the genus as yet described are severally reported to occur in mountainous districts; an instance of correlation of form to external conditions.

Herrnansen suggests that the name should be changed to *Pyrgiscus*, as the correct spelling. But *Pyrgula* is not a hybrid term, since *pyrgus* is a Latin as well as a Greek word.

TRYONIA, STM.

Tryonia, STIMPSON, Am. Journ. of Conch., I, (1865), 54.

Shell perforate, elongated, turreted, subulate, acute at summit and rather pointed at base; surface longitudinally ribbed or plicated, not spinous; whorls numerous, shouldered. Aperture small, oblique, rhombo-ovate; and somewhat pointed, sinuated, and effuse at base; outer lip thin and sharp, projecting below; inner lip appressed to the whorl above, peritreme however continuous.

Operculum and lingual dentition unknown.

Station, fresh water.

Distribution, Southern California.

TYPE *T. clathrata*, STM. (Fig. 29).—Whorls eight. Longitudinal ribs variable in number, usually about twelve to each whorl. Surface otherwise smooth, or marked with delicate incremental striæ. There is no trace of revolving striæ or lines. Length, 0.2 inch.

Fig. 29.



The specimens described are in a semi-fossilized condition, mostly white, though not chalky, but with an ivory-like hardness. Some of them are translucent, looking as if silicified. From the circumstances under which they were found, however, it is probable that the species existed within a very recent period, if not

indeed now living.

* Large numbers of specimens were found, in company with other dead fresh-water shells of the genera *Physa*, *Planorbis*, *Ammicola*, *Sphærium*, etc., in the basin of the Colorado Desert, Southern California, by Mr. Wm. P. Blake, on one of the Pacific Railroad Surveys. The basin is the bed of an ancient lake, now dry. The specimens collected by him are in the museum of the Smithsonian Institution.

The genus may be distinguished not only by the form and sculpture of the shell, but by the shape of the aperture and the

projection of the outer lip, which gives it a character somewhat like that seen in *Campeloma* and *Eburna*.

In company with the Tryoniæ Mr. Blake found a small cancellated shell which has been described as *Melania exigua* by Conrad and as *Ammicola protea* by Gould.¹ In view of the character of the surface, I think it scarcely possible that this species can belong to the Hydrobiinæ. It will, perhaps, be found to be allied to *Bittium*. The occurrence of this marine or brackish-water genus in the Desert would not be surprising, since *Gnathodon* was found in the same basin at a point somewhat nearer the Gulf.

It has, unfortunately, been only possible to describe this genus in a very imperfect manner, the characters of the shell alone being given. I have dedicated it to Mr. Geo. W. Tryon, a well-known conchologist of Philadelphia, to whom we have been indebted for the loan of many interesting specimens of *Ammicola*, etc.

POTAMOPYRGUS,² STM.

Potamopyrgus, STIMPSON, Am. Journ. of Conch., I, (1865) 53.

Shell ovate-conic, imperforate; apex acute; whorls coronated with spines; outer whorl nearly two-thirds the length of the shell; aperture ovate; outer lip acute. Operculum corneous. Rostrum of moderate length. Tentacles very long, slender, tapering, and pointed. Eyes on very prominent tubercles. Foot rather short, broadest in front and strongly auriculated.

Lingual dentition of type: Rhachidian tooth trapezoidal; inferior margin nearly straight, faintly trilobate; basal teeth minute and close to the lateral margins. Intermediate tooth with the peduncle very long, three times as long as the body and constricted at its juncture therewith; body subrhomboidal and excavated in the middle; cusp with numerous equal teeth. Lateral teeth constricted near the summit, and with the dorsal or outer margin of the shank reflexed or thickened; outer lateral with a broad summit shaped like a chopping-knife. Formula of the denticles: $\frac{9}{4+4} - 11 - 15 - 20$.

Station, fresh water.

Distribution, New Zealand.

¹ Pacific R. R. Reports, Vol. V, p. 332, pl. xi, fig. 6-9.

² Ποταμὸς, fluvius; πύργος, turris.

TYPE *P. corolla*, STM.—*Melania corolla*, GOULD, Proc. Bost. Soc. Nat. Hist., II, (1847) 223.—*Amnicola corolla*, GOULD, U. S. Expl. Exped., Moll., (1852) 129, pl. ix, fig. 149, a-c. New Zealand.

No other species is as yet certainly known to belong to this genus. There are other coronated species belonging to the family which must be placed in it, if they are found to agree with it in the lingual dentition, the peculiarities of which consist in the form of the rhachidian tooth, which is not strongly trilobate below as in the other genera of the group, in the approximation of the very small basal denticles of the same tooth to the lateral margins, and in the great number and equal size of the denticles of the intermediate tooth.

The dentition was made out from the type specimen of *Amnicola corolla*, Gould, in which the animal was found uninjured after more than twenty years' desiccation. This specimen is in the museum of the Smithsonian Institution

COCHLIOPA,¹ STM.

Cochliopa, STIMPSON, Am. Journ. of Conch., I, (1865) 52.

Shell depressed-conic; base concave, carinated; umbilicus large and deep; aperture oblique. Operculum thin, corneous, subspiral. Rostrum of moderate size; tentacles rather long, tapering. Verges rather elongated, compressed, geniculated, and bifid, the inner branch being very small, less than one-fourth the size of the outer one and arising at the inner angle of the geniculation.

Lingual dentition of the typical species: Rhachidian tooth short and broad; middle lobe of the basal margin very broad; basal denticles rather large. Intermediate tooth with a long peduncle, and square body having a cavity in the centre. Lateral teeth with an expansion of the inner side of the shank, separated from the summit by a deep rounded sinus; the outer lateral being more expanded than the inner. Formula of the denticles: $\frac{11}{2+2} - 8 - 18 - 24$.

Station, fresh water.

Distribution, California.

TYPE *C. Rowellii*, STM.—*Amnicola Rowellii*, TRYON, Proc. Acad. Nat. Sci. Phila., 1863, p. 147, pl. i, fig. 8, 9.—Head black; tentacles yellowish, with

¹ κόχλις, cochlea parva; ἄπρη, foramen.

black tips, and a black ring just beyond the middle. Found in Clear Lake, Cal., by the Rev. Mr. Rowell.

But one species is yet known of this very distinct genus, which differs from all other Hydrobiinae in its greatly depressed form and large umbilicus. The characters of the soft parts were made out from a specimen of the shell kindly furnished by Mr. Tryon, which fortunately contained a portion of the dried animal.

GILLIA, STM.

Gillia, STIMPSON, Am. Journ. of Conch., I, (1865) 53.

Shell rather large, subglobular, thin, subperforate, smooth; spire small; suture not impressed. Aperture large, broad, ovate, oblique; outer lip thin, acute, not projecting anteriorly. Operculum thin, corneous, regularly ovate. Rostrum rather broad. Tentacles tapering, pointed. Verge small, simple, lunate.

Lingual dentition of the type: Rhachidian tooth moderately long, deeply trilobate below; basal denticles close to the basal margin, and projecting beyond it. Intermediate tooth with the body subrhomboidal, slightly excavated in the middle. Outer lateral tooth with a smaller number of denticles than the inner. Formula of the denticles: $\frac{9}{2+2}$ -8-14-10.

Ova-capsules hemispherical, each containing a single egg, and deposited singly or in groups or linear series.

Station, fresh water.

Distribution, the eastern parts of the United States of North America.

TYPE *G. altilis*, STM.—*Melania altilis*, LEA, Trans. Am. Phil. Soc., VIII, (1843) 174, pl. v, fig. 23. Pennsylvania to South Carolina.

As mentioned on a previous page, the *Melania integra* of Say, described in the "New Harmony Disseminator," II, (1829) 276, may probably belong to this genus.

SOMATOGYRUS, GILL.

Somatogyrus, GILL, Proc. Acad. Nat. Sci. Phila., 1863, p. 34.

Shell rather large, globular, thin, smooth, perforate; spire small; suture impressed; body whorl globose, more or less shouldered above. Aperture large, oblique, rhombo-ovate, narrowly rounded in front and behind; peritreme thin and acute,

and with its entire margin uniformly in one plane, the outer lip not projecting anteriorly. Operculum rather thick, corneous, subovate; inner margin concave near the upper extremity. Foot rather short. Rostrum broad. Tentacles tapering, pointed.

Lingual dentition of type: Rhachidian tooth very short and broad. Intermediate tooth with the body perforated. Inner and outer lateral teeth with about the same number of denticles.

Formula of the denticles: $\frac{7}{4+4} - 7 - 14 - 14$.

Station, fresh water.

Distribution, the central parts of North America.

TYPE *S. depressus*, GILL, loc. cit., 1863, p. 34.—*Amnicola depressa*, TRYON, Proc. Acad. Nat. Sci. Phila., 1862, p. 452, wood-cut. Iowa.

As suggested on a previous page, the *Melania isogona* of Say, in the "New Harmony Disseminator," Vol. II, (1829) p. 277, will prove to belong to this genus, if the typical species, *S. depressus*, is found to have a broad, compressed, and bifid verge.

AMNICOLA, GOULD & HALD.

Amnicola, GOULD & HALD., in Gould's Invert. of Mass., (1841) p. 228.

Shell small, rather short, ovate or subglobular, thin, smooth, perforate; spire not acute. Aperture broadly ovate, not oblique; outer lip thin and sharp, not projecting anteriorly. Operculum corneous. Foot rather short and broad, expanded and broadly rounded behind. Rostrum short. Tentacles cylindrical, blunt at their tips. Verge short, bifid, with a globular base.

Lingual dentition of *A. porata*: Rhachidian tooth very short and broad, with a tongue-shaped process from the middle of the anterior surface, reaching beyond the base. Intermediate tooth with a short broad body having a strongly projecting infero-interior angle, and a very long peduncle. Formula of the denticles: $\frac{7}{4+4} - 5 - 18 - 30$.

Ova-capsules semi-lenticular in form, with a laminiform limb. Each contains but one egg.

Station, fresh water.

Distribution, North America.

TYPE *A. limosa*, HALDEMAN, Monog. Amn., p. 10, pl. i, fig. 5, 6.—*Paludina limosa*, SAY, Journ. Acad. Nat. Sci. Philad., I, 125.—*Amnicola porata*, GOULD, Inv. Mass., (1841) 229, fig. 157. New England States.

The following species may be added :—

- A. decisa*, HALD., loc. cit., p. 7, pl. i, fig. 2, 3. Pennsylvania.
A. pallida, HALD., loc. cit., p. 12, pl. i, fig. 7. Lake Champlain.
A. perata, HALD., loc. cit., p. 13, pl. i, fig. 8. Northern United States and Canada.

See also on p. 16, *ante*, for others.

LITHOGLYPHUS, MUEHFELDT.

Lithoglyphus, MUEHFELDT, in Hartmann's Moll. of Sturm's "Fauna Deutschlands," VI, (1821) p. 57.

Lithoglypter, FITZ., Syst. Verz., (1833) p. 116.

Lithoclypus, VILLA, Disp. Syst., (1841) p. 36 (fide Hermannsen).

Shell globular, thick, smooth, imperforate; spire short; suture not impressed. Aperture broadly subovate, or nearly circular, nearly as broad as long; inner lip callous; outer lip simple. Operculum corneous, rounded.

Soft parts of *L. lapidum*: Foot large, longer than the shell. Tentacles short, rather tapering and pointed. Verge bifid from the base, forks cylindrical, the posterior being two-thirds as long as the anterior one.

Lingual dentition of *L. fuscus*, according to Troschel:¹ Rha-chidian tooth less than twice as broad as long. Body of intermediate tooth longer than broad; peduncle rather short. Outer lateral tooth with fewer denticles than the inner. Formula of the denticles: $\frac{7}{3+3} - 7 - 8 - 6$.

The only notice we have of the eggs is the following by D'Orbigny with regard to *L. peristomatus*²:—"They live in numerous families; each shell carries oval eggs which are affixed to it." We cannot determine from this notice whether the eggs are deposited singly, or in groups covered by a common ova-capsule. Probably the latter arrangement is meant.

Station, fresh water.

Distribution, Southeastern Europe and South America.

TYPE *L. naticoides*, H. & A. ADAMS, Gen. Rec. Moll., I, (1854) 321. pl. xxxiv, fig. 1, a, b, c.—*Paludina naticoides*, FERRUSAC, KÜSTER, Monog. Paludin., p. 47, pl. ix, fig. 23-26. Hab. Moldavia, Dalmatia, etc.

The following species are apparently congeneric:—

L. fuscus, ZGL.—*Paludina fusca*, KÜST., Monog. Paludin., p. 46, pl. ix, fig. 19-22. Southern Russia.

¹ Gebiss der Schnecken, I, 105, pl. vii, fig. 12.

² Voy. Am. Merid., Moll., p. 382.

L. lapidum, H. & A. ADAMS, Gen. Rec. Moll., I, (1854) 321, pl. xxxiv, fig. 1.—*Paludestrina lapidum*, D'ORB., Voy. Am. Merid., Moll., p. 382, pl. xlvii, fig. 10-12. Buenos Ayres.

L. peristomatus, STM.—*Paludestrina peristomata*, D'ORB., loc. cit., p. 382, pl. xlvii, fig. 4-9. Buenos Ayres.

The lingual dentition of the South American species is unknown, and must be ascertained before these species can be said with certainty to belong to the genus *Lithoglyphus*. They resemble the type in the form of the shell

FLUMINICOLA, STM.

Fluminicola, STIMPSON, Am. Journ. of Conch., I, (1865) 52.

Shell comparatively large, obliquely ovate, thick, smooth, imperforate; spire moderate, obtuse. Aperture ovate; inner lip flattened, callous; outer lip effuse and projecting anteriorly, so that the peritreme is not continuously in the same plane. Operculum corneous. Tentacles tapering. Rostrum rather large. Foot broad. Verge large, compressed, with a broad semicircular laminiform expansion or wing on its left side.

Lingual dentition of the type: Rhachidian tooth more than twice as broad as long. Outer lateral tooth with a smaller number of denticles than the inner. Formula of the denticles: $\frac{5}{3+3} - 6 - 10 - 7$.

Ova-capsules large, circular, depressed, almost discoidal, each containing a large number of eggs.

Station, fresh water.

Distribution, Oregon and California.

TYPE *F. Nuttalliana*, STM.—*Paludina Nuttalliana*, LEA, Tr. Am. Phil. Soc. VI, (1839) 101, pl. xxiii, fig. 89. Oregon.

To which we add the following :-

F. virens, STM.—*Paludina virens*, LEA, loc. cit., VI, (1839) 91. Oregon.

F. nuclea, STM.—*Paludina nuclea*, LEA, loc. cit., VI, (1839) 91. Oregon.

F. seminalis, STM.—*Paludina seminalis*, HINDS, Voy. Sulphur, Moll., p. 54, pl. xvi, fig. 22. California.

F. Hindsii, STM.—*Amnicola Hindsii*, BAIRD.

SYNOPTIC TABLE OF THE GENERA OF HYDROBIINÆ.

A. Operculum testaceous	<i>Stenolytra</i> .
B. Operculum corneous.		
a.	only one distinct basal denticle on either side of rhachidian tooth.	
1.	Shell smooth.	
*	Inner lip thickened	<i>Tricula</i> .
**	Inner lip not thickened.	
†	Verge simple.	
	Apex of shell obtuse; whorls convex; rhachidian tooth without a central basal process	<i>Littorinella</i> .
	Apex of shell acute; whorls flattened; rhachidian tooth with a central basal process	<i>Hydrobia</i> .
††	Verge bifid.	<i>Dythinella</i> .
	Apex of shell obtuse; rhachidian tooth moderately long; outer lateral tooth not denticulated	<i>Paludestrina</i> .
	Apex of shell acute; rhachidian tooth very short; outer lateral tooth conspicuously denticulated	
2.	Shell sculptured.	
*	Shell carinated	<i>Pyrgula</i> .
**	Shell longitudinally plicated	<i>Trigonia</i> .
b.	Shell short; two to four basal denticles on either side of rhachidian tooth.	
1.	Shell ovate-conic; whorls coronated with spines; cusp of intermediate tooth with numerous (11) equal denticles	<i>Potamopyrgus</i> .
2.	Shell depressed, globular, or ovate; cusp of intermediate tooth with few (5-8) unequal denticles.	<i>Cochliopa</i> .
*	Shell depressed; base carinated; umbilicus large	
**	Shell not depressed; base not carinated; umbilicus small or closed.	<i>Gillia</i> .
†	Verge simple; two basal denticles on either side of rhachidian tooth	
††	Verge bifid or winged; three or four basal denticles on either side of rhachidian tooth.	
	Shell thin, perforate; outer lateral tooth with as numerous, or more numerous denticles than the inner.	
††	Shell comparatively large, globose; tentacles tapering; verge very large, compressed	<i>Somatopyrgus</i> .
†††	Shell small, ovate; tentacles cylindrical; verge small, not compressed	<i>Annicola</i> .
	Shell thick, imperforate; outer lateral tooth with fewer denticles than the inner.	
†	Verge bifid, with slender branches	<i>Lithochlophus</i> .
††	Verge winged on one side, not bifid	<i>F'unicicola</i> .

ADDENDA ET CORRIGENDA.

SINCE the completion of the printing of this memoir, Mr. Tryon, in his "American Journal of Conchology," Vol. I, p. 220, July, 1865, has proposed a new genus of Hydrobiinæ under the name of *Gabbia*, with the following diagnosis: "Shell like *Amnicola*, Gould and Hald. Operculum paucispiral, calcareous. Station, fresh water." The only species, *G. australis*, Tryon, is new, and figured on pl. xxii, of the volume quoted (fig. 7). It is from New South Wales. I have no opportunity to examine this shell, but must remark that the characters given in the description do not serve to distinguish it from the immature state of *Stenothyra* in which the contraction of the aperture has not yet commenced. The *figure* reminds us of *Bythinia* rather than any other genus, for in it the operculum is represented as decidedly concentric, although said to be "paucispiral" in the description.

On page 12, line 4, after "*Somatogyrus*, Gill," add "*Cochliopa*, Stm."

The figure of *Somatogyrus isogonus*, on page 22, is accidentally defective in representing the lower extremity of the aperture as notched.

August, 1865.

I N D E X.

In this Index, names of groups and species not belonging to the family RISSOIDÆ, and all synonyms, are in italics.

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