

A STUDY OF THE AMERICAN SPECIES OF VERTIGO CONTAINED
IN THE U. S. NATIONAL MUSEUM, WITH THE DESCRIPTION OF
A NEW SUBGENUS OF PUPIDÆ.

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(With Plate XLII.)

The North American forms of *Pupa* are far from being well known; this is especially the case with those belonging to the genus *Vertigo*. Though among the most interesting of all our mollusca, the shells of this section of the *Pupidæ* seem to be the most neglected. This may be due to two causes: First, their minute size and the supposed or real difficulty in collecting them; and, second, their apparent similarity and the critical skill required to separate and determine them. The multitude of features and the possibilities of their combination are greater than generally realized, but since many of their characteristics are rather constant, it is not so difficult to separate and define the different species as appears at first. Once become familiar with these little creatures and the observer will find them far more manageable than many a group with much larger shells, just as a botanist at first dreads the determining of *Cyperacæ*, and when versed in them likes them better than any others.

The *Vertigos* are particularly interesting because of their close relationship to European species. When the American species have been as thoroughly studied and are as well known as those of the Old World, it will probably be found that they form part of the great circumboreal land-shell fauna—like other groups of the mollusca that are distributed through the north temperate zone in the contiguous continents. They exhibit analogous features of resemblance and vary perhaps not in so extreme a degree as the *Limnæas*, but as much as other members of the fauna as a whole, aside from the *Protozoa*. For this reason it would be worth while for collectors to obtain as many specimens as they can, since not only new species will doubtless be detected, but with an abundance of material it will be possible to study their variations throughout the continent, and last, but not least, their geographical distribution, and enable us to make a comparison of the same with that of the Old World. For some time past I have been studying our *Vertigos* as far as I could obtain specimens from different States, and have compared them with European forms. The results obtained appear to me interesting enough to be published, at least in part. Considering the few species thus far described the results are not definite, and I have been careful to make no conclusions beyond such as follow directly from the examination of the material in hand. This has been for the most part only the shells; as

July 5, 1889.

to the soft parts my material has not been sufficient nor my study pursued far enough to warrant present consideration.

I shall not here present any systematic description of species—old or new—nor enter into critical discussions about synonymy, etc., except in a few cases necessary to my purpose, leaving such questions for later publication. The present will be only a general statement of a part of the characteristics of the *Vertigo* group as obtained by comparing North American and European species and forms, and the conclusions arising therefrom. These latter necessarily lead to the creation of a new subgenus of *Pupa* in order to properly segregate and place a few species, which in our sense are essentially different from the *Vertigos*. It is not necessary for our purpose to describe all parts and features of the *Vertigo* shell. Its size, shape, striation, coloration, whether umbilicated (widely or narrowly perforated) or not; the number and shape of the whorls, the relative size of the latter in respect to the ratio of their growth, the sutural character, etc., all of these we will put aside, and direct our attention to two principal points, closely connected, namely, the configuration of the last whorl near the aperture and of the latter itself, and its denticles. This last term is used for convenience, and has nothing to do with the odontophore of the animal, but refers only to the lamellæ of the aperture. The latter is of nearly similar shape in all the *Vertigos*; more or less half-oval or rounded, except at one point a little above the middle of the outer wall, or peristome, where there is, in some species, an indentation dividing the outer margin in two parts or curves, the upper of which is the smaller. (See Plate XLII, Figs. 1, 5, 6, 9, 11.) There are gradual differences in this feature, and many species show only a trace of that indentation, or slight flattening of the outer wall (Figs. 4, 9). Occasionally this point projects beyond the plane of the margin, as a rather prominent angle in some species, *e. g.*, *V. ovata* Say, or as a slightly rounded elevation in others; a few have scarcely a trace of it. It is seen when looking vertically at the plane of the aperture. This is a feature by no means peculiar to *Vertigo*; in many gastropod shells it is more or less perceptible, especially in most of our land and fresh water "snails," although in few so marked as in *V. antivertigo*, Drap., and some others, among which are *P. milium*, Gld., and *P. venetzi* Charp. At a little distance from the outer margin and parallel to it and to the lines of growth there is an elevation, in form of a prominent crest, separated from the margin by a more or less deep groove or constriction. (See Fig. 7 ×.) But there are again great differences in the aspect of this; in many species the crest is scarcely perceptible and the whorl continues with little change of form to the very margin, which then is generally not at all or but slightly expanded (Fig. 3), while it is considerably so in those species showing the above-named configuration in a marked degree. (Fig. 7.)

Inside, corresponding to the crest on the outside, many species show a callosity extending from the base to the suture, very variable in thick-

ness, and often of a lighter color than the shell, appearing as a crimson or otherwise colored "collar," as one of my correspondents terms it. Generally those species have it more conspicuously developed than those that have a prominent crest and strong lamellæ, but there are exceptions; thus a species undescribed, so far as I know, from Colorado (Table, No. 9), showing the last-mentioned feature, has not a trace of a callus, or at least my specimens have not. That there are differences in this respect in one and the same species, *V. curvidens*, Gld., furnishes proof; most of my specimens—I have them from various places in Ohio and several other States—have a well developed and often very strong callosity, while a few from Maine show no trace of it. This is constant in a number of species with simple last whorl and straight peristome, as *V. alpestris* Alder. That the callus is the homologue of the thickened lip in most of our *Helices*, etc., there can be no doubt.

Still another feature has to be considered in this connection. Behind the crest named above—behind, if we suppose the plane of the aperture to be in front—there is in some of the species a depression in the last whorl. It is not very deep, well defined below (towards the base), gradually disappearing above (towards the suture), occupying about the half of the middle of the whorl. Although this may appear trifling, I consider it a valuable feature in defining certain forms and species of *Vertigo* as well shown in *V. ovata* Say. (Fig. 7 at \times .)

The second of the main points is the dentition, a prominent feature in this group, so striking, indeed, that it has probably had too much importance given to it in many descriptions of species, while other characters of equal value have been more or less neglected. And yet, nevertheless, it has not been studied with sufficient care, especially its occurrence and aspect as a whole, both in its grouping and as to the shape of the separate *lamella*. This latter term I think to be better than "teeth" or "denticles," for it defines more correctly their real shape and typical value, as all of these, even the smallest, appear as lamellæ or folds, if examined with a magnifier of sufficient power, though in some instances they are only quite rudimentary. So far as known they vary in number and shape. Notwithstanding their variability in these respects, there is exceeding persistency in the matter of position, not only in the same species, but throughout the whole group of *Vertigo*; that is, if present at all. It appears, therefore, that the position of the lamellæ is of greater importance than their prominence. Whether one of these be strongly developed, small, or entirely wanting, it has its own particular or typically local place, and we know which are present and which wanting. This point, therefore, should be stated in descriptions. To appreciate this character requires a very critical examination, but once understood it facilitates diagnosis very materially. (Compare figs. 1-4, 6, 9.)

As already stated, the number and size of the lamellæ vary in different species. In general those with the crest near the aperture, with a

callosity and expanded margin, have also the most highly developed folds; such as *V. antivertigo* Drap. (Europe), and *ovata* Say (N. Am.), while in species with a simple configuration of these parts they are few and small. To return to these relations: the number of lamellæ may vary from three, or perhaps less, up to ten or even twelve or fourteen. (See figs. 1-5, 6, 9.) Five of them are the most characteristic and typical, because the most constant and at the same time, in most cases, the largest. For many years I regarded them as primaries; the others as accessories. This was in Europe, when I had no species from North America; but the latter so far as I know them, agree quite well with those of the European continent, in general appearance and structure.

The primary lamellæ are as follows, designated with letters (see fig. 5): one on the apertural wall or body whorl A; one on the columella B; one at or near the base C; two in the outer margin or peristome D and E. A is the most constant in shape, being a well developed, rather high lamella, steeply ascending at the ends, differing somewhat in size, and in its being inclined to the inner or outer side in some species (hence the name "curvidens"), as in the figure.

B, if not closely looked at, appears to be simply a projecting tooth in the columella while it is a true lamella, encircling the pillar in a direction nearly rectangular to the axis. It is a good plan in order to gain an idea of its configuration and also of that of the others, to examine and compare larger *Pupa* with well developed folds, e. g., *P. dolium* Drap., and *P. torquillas*, or our N. American *P. armifera* and *P. contracta*, in which of course the lamellæ are partly of another type and shape. In none of the *Vertigo* species I know is the columellar fold wanting.

C is the least constant of all the primary folds, in fact in most instances absent, and even in one and the same species it may be present, or not, as in *P. pygmaea* Drap. And yet there are reasons for considering it not merely an accessory. It appears like a simple *tooth*, rather variable in size, but really it is a *lamella*, although the shortest of the primaries. In most instances its position is not exactly at the base, but a little nearer the columella (see figs. 1-3, 5), so that many descriptions say that there are two "teeth" on the pillar, yet generally it is seen through the transparent shell quite near the lowest part of the latter, which is hardly a part of the columella.

The two lamellæ on the peristome are always easily recognizable as such, but of very different dimensions. Where there is a callus, as described above, they generally end in it, either beginning rather distant from it in the "throat" or quite near, then sometimes simply appearing to be a nodule upon it, especially when they are small. (Fig. 2.) Very generally they are absolutely and relatively smaller in species having no callosity and are isolated (Figs. 3, 4), while in others the callus connects them. The lower of the two, D, is remarkably constant, and in this regard, together with B, keeps the first rank, while the upper, E,

may be absent or represented by a mere trace, as in *V. alpestris* Ald., and *V. tridentata* Wolf. (Figs. 4, 9.)

Another peculiarity and really quite a prominent feature is that D in all species stands a trifle more remote from the margin, as can be seen also from the outside, at least in the majority of species. The position and direction of the upper fold E is so that its prolongation would reach the margin just at the projecting angle or point mentioned above (Figs. 1, 5), and sometimes there is a slight depression corresponding to the lamella. In more instances this is at the place of the lower lamella D, and in some species it coincides with the lower limit of the depressed part described above, corresponding to the space between the two folds.

The accessory lamellæ are in general less frequent and partly less constant, and smaller than the primaries, and thus less typical. A part of them are quite constant (1) towards the margin, in the direction of the coil of the shell, while others are very variable, present, or only a trace, or entirely wanting; but they always occupy certain definite places. These are (see corresponding numbers in Fig. 5):

(1) On the body whorl, between lamella A and the upper (outer) angle almost always nearer the margin. A lamella well developed in many species, especially in *V. pusilla* Müller, *V. substriata* Jeffr., both of Europe; smaller but distinctly lamellar in *V. antivertigo* Drp., in *V. ovata* Say, and in a species from Colorado (Table, No. 9); as a small nodule scarcely recognizable as a lamella in *V. moulinsiana* Drp. (Binney's Gould); sometimes absent and sometimes present in *V. pentodon* Say, and *V. curvidens* Gld., of the same shape. It certainly is the most significant of the accessories and for the first-named species quite characteristic.

(1a) In some specimens of *V. ovata* Say, *e. g.*, from Portage County, Ohio, there is a small but distinct nodule between the last named and the angle of the margin; also in occasional specimens of *V. antivertigo*.

On the body whorl, the margin is represented by an apparently more or less marked callosity between the upper ends of the columella and outer margin; it is really the limit of the deposit all over the body whorl within the aperture.

(2) On the body whorl, on the other side of A, between this and the columella, a small nodular lamella, rather constant in *V. antivertigo* and *V. ovata*, not infrequent in *V. pentodon* and *V. curvidens* Gld.

(2a) As to *P. venetzi* Charp., and *P. milium* Gld., see text below.

(3) Between C and D, a denticular lamella rather frequent, sometimes double, as in *V. ovata* and *V. pentodon*.

(4) Between D and E a small but quite distinct fold observed thus far only in several specimens of the two last-named species and their relatives.

(5) Above E one denticular lamella, constant in *V. antivertigo* and *V. ovata*, usually present in *V. pentodon* and *V. curvidens*, and frequently exhibited in *V. pygmaea* Drap.

(6) Above the last, near the suture, there is a small but distinct denticle in most examples of *V. antivertigo*, and it is sometimes seen in specimens of *V. pentodon* from Texas.

It has already been stated that in general the accessory lamellæ are smaller than the primaries, especially in *V. antivertigo* and *V. ovata*, as the former 1, 1a, 2, 3, 4, 5, 6 show in Figs. 1, 5, when compared with the latter A, B, C, D, E. But in certain species the differences in size are not so striking, *e. g.* in many specimens of *V. pentodon* Say and *V. curvidens* Gld., where the principals are not at all conspicuously large; here sometimes there is a row of fifteen to seven nearly equal lamellæ from the base to the suture (see Fig. 2), so that D and E are scarcely or not at all recognizable by their size, but only by their positions and the fact that they are constant, well developed in specimens where the others are wanting. Besides, D is always a trifle larger, inward, and there is on the outside a nearly corresponding impression or at least a rough line.

From the description and the table it is evident that there is a line, I venture to say of development, among the species of *Vertigo* from the simpler to the complicated—from the lower to the higher. The former are represented by those species with simple configuration of last whorl and aperture, as already pointed out, with few and small lamellæ, as in *V. alpestris* and *V. romnebyensis*; then in *V. tridentata*; from these we come to forms gradually differentiated and more complicated till we reach the end of the series in *V. antivertigo* and *V. ovata*, in which all the features above described are conspicuously developed; the crest and depression in the last whorl, the expanded margin, the projecting and at the same time impressed angle of the peristome, callosity, and the number and size of the lamellæ, (compare figs. 6, 9).

In the following table I give a few examples of parallel or nearly parallel species from both continents.

EUROPE.	NORTH AMERICA.
<i>V. antivertigo</i> Drap.	<i>V. ovata</i> Say.
<i>V. substriata</i> Jeffr.	<i>V. gouldii</i> Binn.
<i>V. pygmaea</i> Drap.	<i>V. indesc.</i> (Mass., Ohio).
<i>V. liljeborgii</i> West.	<i>V. tridentata</i> Wolf.
<i>V. alpestris</i> Alder.	None?

Better knowledge of our North American fauna will probably bring to light more such corresponding forms.

It is evident at once that those forms of *Vertigo* with cylindrical shape, slowly increasing whorls, relatively small and simple aperture, *e. g.* *V. alpestris*, stand nearest to some *Isthmias*, and that both of these groups originated and differentiated from a common root. In North America the types of *Vertigo* in general are about the same as in Europe, although the species differ, and although a smaller number has been described so far. It is a noticeable fact that there are on our continent no species of *Isthmia*, but it must also be added that no form like *V. alpestris* has as yet been found here.

Designating the primary lamellæ, when present, by their letters and the accessories by dots, we obtain a formula for the dentition of a certain species. The following table is the list of such formulæ for a number of North American and European species, and contains a few hitherto not generally included with the *Vertigos*:

	Name.	Origin.	Formula.	Remarks.
1	<i>V. pentodon</i> , Say	N. America	ABCDE.	
a	do	do	A.BC.D.E	
b	do	do	.A.BC.D.E.	
c	do	do	ABC.DE	Etc.
d	do	N. America—Tex.	A.BC.E.	
2	<i>V. floridana</i> , Dall. ^{1, 2}	N. America—Fla.	A.BC.D.E.	
3	<i>V. curvidens</i> , Gld. ^{1, 3}	do	A.BC.D.E.	
a	do	do	A.BC.D.E.	Etc.
b	do	do	ABCDE	Rare.
4	<i>V. antivertigo</i> , Drap. ^{4, 5}	Europe	A.BC.D.E.	Up to:
a	do	do	A.BC.D.E.	
5	<i>V. ovata</i> , Say ^{4, 6}	N. America	A.BC.D.E.	
a	do	do	A.BC.D.E.	
b	do	N. America—Ohio	.A.BC.D.E.	
c	<i>V. ovata</i> , var. ⁷	N. America, Roan Mountain.	ABCDE	
d	<i>V. ovata</i> , var. ^{7, 8}	N. America—Ill.	ABCDE	
6	<i>V. moulinsiana</i> , Drp.	Europe	ABCDE	
a	do	do	ABCDE	
7	<i>V. substriata</i> , Jeffr. ⁹	do	ABCDE	
8	<i>V. pusilla</i> , Müll. ¹	do	ABCDE	Sinistral.
9	<i>V. indescr</i> ¹⁰	N. America—Colo.	ABCDE	
10	<i>V. indescr</i> ¹¹	N. America—Mass., Ohio	ABC.D.E	
11	<i>V. pygmæa</i> , Drap.	Europe	ABCDE	
a	do	do	ABCDE.	
b	do	do	ABDE	
12	<i>V. gouldii</i> , Binn. ⁹	N. America—Mass., Conn.	ABCDE	
a	do	N. America—Me., Ohio	ABCDE	
13	<i>V. californica</i> , Rowell ¹	N. America—Pacific	ABDE	
14	<i>V. liljeborgii</i> , West	Europe, north	ABDE	
15	<i>V. tridentata</i> , Wolf ¹²	N. America	ABDE ⁸	
16	<i>V. ronneyensis</i> , West	Europe, north	ABDe	
17	<i>V. alpestris</i> , Alder	do	ABDe	
a	<i>V. alpestris</i> , Var.	do	ABD	
18	<i>V. heldii</i> , Cless.	do	BDE	
19	<i>P. venetzii</i> , Charp. ¹		: ABCDE +	Sinistral.
20	<i>P. milium</i> , Gld. ¹		.A.BCD + E.	

¹ For the systematic position of these species see text below.

² From descriptions and figure in Proc. U. S. Nat. Mus. VIII (1885), p. 261.

³ Quite distinct from *V. pentodon*, to judge from specimens from many localities in several States, though certain examples of either species seem to come very near to each other. They need further investigation.

⁴ *V. antivertigo* Drap. and *V. ovata* Say have almost exactly the same dentition as to number, size, and shape, and places of the single lamellæ. And also as to other features of the shells, they are very similar. *V. ovata*, in general is a little larger, of lighter coloration, the margin is somewhat more expanded: the aperture appears larger because the columellar margin is relatively a trifle shorter; the whorls increase in size somewhat more rapidly, and the suture is a trifle deeper: specimens from Massachusetts are not only of the same or even a darker shade, but also of the same and sometimes of a smaller size, and other distinguishing features are slightly marked. They resemble each other so much that it is difficult to separate them, and if collected at the same place no one would regard them as even distinct varieties. I hesitate, however, to declare them identical because I have not yet made a comparison of the soft parts. Doubtless they are parallel forms, and if found on the same continent, would be regarded as varieties of one species. Compare also the following notes:

⁵ *V. antivertigo* Drap., is remarkably constant throughout Europe so far as I know it, while

⁶ *V. ovata* Say is on the contrary quite variable, owing, possibly, to the greater differences in climate. Also a few decided varieties exist and may be more will be found; the future study of these forms is likely to be of great interest.

⁷ A trifle smaller than the average, perforated, the only form I know with this character.

⁸ Considerably smaller, conical, shell thin, appears to be a different species, but possibly connected with the types by intermediate forms.

⁹ *V. substriata* Jeffr., and *V. gouldii*, Binney (fig. 3) are nearly related. In the former the lamellæ are usually a little larger, especially the accessory No. 1, and the whorls larger and less in number; both are regularly striated. Accessory No. 1 (or body whorl) very small in *V. gouldii*, and quite near A, but absent in specimens from various localities.

¹⁰ In general appearance similar to *V. pygmæa* Drap.

¹¹ Rather large cylindrical, chestnut colored.

¹² Is as valid a species as any other of North America. Collected at different places in Ohio and Illinois; very nearly allied to *V. liljeborgii* Westerland, of Sweden, a relation well worthy of being studied more closely. In the formulæ of this and the two following species the "e" indicates that the upper primary lamellæ in the peristome are very small or entirely wanting. Also in *liljeborgii* the same is quite small, to judge from the few specimens in my hands.

There are apparently relations to other groups; thus to *Pupilla* (partly by species not named in the table), and to *Leucochila*, many of which show nearly the same dentition as the *Vertigos*.

As to deducing a final conclusion from the facts presented, in the matters of relationship on the one hand and geographical-geological distribution on the other, I do not at this time feel competent; an attempt to do so might result in at least a partial failure; especially because the soft parts require to be compared and the fossils of the various groups must yet be subjected to careful consideration.

One question more is suggested here: Whether *Vertigo* is to be considered a genus or only a subgenus of *Pupa*. The leading conchologists are of different opinions about it. It seems to me that our group is by intermediate forms connected with other subgenera of *Pupa*, therefore I still prefer to include it among the latter, though I shall study the question further.

Following the above considerations, I desire to direct the attention of conchologists to some species that require to be placed among the *Vertigos* which have hitherto been regarded as belonging to other groups, and a few others that require to be removed therefrom. Among the former is *V. pentodon* Say* (Fig. 2), and related forms; *V. curvidens* Gld. (probably identical with *V. pellucida* Pfr.), and *V. floridana* Dall. These have been recently placed in *Pupilla* and even in *Leucochila*, although Say had already written *Vertigo pentodon*. In shape and dentition their shells entirely agree with *Vertigo*, and do not agree with the other named groups. Also, the soft parts, as to jaw and odontophore, seem to exhibit no objection to this union. The only difference is the coloration of the shell, but in other genera and groups of *Pupa* albino forms occur as well as "colored." If *Vertigo pentodon* had a brown instead of a whitish shell it probably would have been placed elsewhere. These forms certainly represent a peculiar group of *Vertigo*, but, as before stated, their proper place is here.

Very probably *P. decora* Gld., *P. californica* Rowell, with *P. rowellii* Newc., and a few others of our continent are to be, and for certain good reasons have been, placed with *Vertigo*. Their general form, and more specially their dentition, are sufficient reasons for so doing. When Morse placed his *P. corpulenta* and *P. bollesiana* in *Isthmia*, it was equivalent to arranging them with the *Vertigos*, the connection and extent of *Isthmia* having been so restricted by European conchologists.

P. rupicola Say, and *P. corticaria* Say, at one time also included with *Vertigo*, are of a different type. Although bearing some features of that group, the former is quite variable, at least in many instances. It will suffice here to indicate these points; in order to settle them, more study and comparison is required.

* In *V. pentodon* the principal D begins also a trifle deeper in the throat than E, at least in the specimens I have seen from different parts of the United States. (Confr. Dall l. c., p. 262.)

P. simplex Gld. has also been arranged among *Vertigo* by a number of prominent conchologists. No further proof is wanting to show that its place is not here; it should be stated, however, that it is absolutely identical with *P. edentula* Drap., inhabiting the Old World as well as the New. By European conchologists it is regarded as the main recent representative of the group or subgenus *Edentulina*. Draparnaud's name will have to be substituted for Gould's.

We will now consider two species deserving of special attention, both European, viz, *P. pusilla* Müll., and *P. venetzi* Charp. (*P. angustior* Jeffr.), which have been placed in a group of *Vertigo* under the subgeneric name of *Vertilla*, both of them being sinistrorsal or reversed forms. After a critical examination and comparison I came to the conclusion that one of them, the latter, is nearly related to our North American *P. milium* Gld., while *P. pusilla* is quite different.

One thing which at first attracted my attention, the fact that each of these has a very long lamella in the outer wall (fig. 10), which is readily seen through the transparent shell (figs. 12,13), but while in *P. venetzi* the upper, E, is the largest, in *P. milium* it is the lower, D. Now, a careful examination will reveal the fact to any observer that in position each of these long folds is different from the other, but that the folds themselves are alike in both species; a morphological element quite unique. It is a long, thin, high lamella, beginning rather deep in the throat, and close to the base, in a direction with or near the lines of growth, then turning upward and toward the aperture, and meeting the lower primary lamella D in *P. milium*, and the upper E in *venetzi*. This may appear as a rather bold assertion, yet, nevertheless, I believe it to be in conformity with nature, and moreover it is not without analogy, as it is well known in many *Clausilias* two lamellæ on the body whorl may be entirely separate, or again, otherwise unite in apparently one, in which, however, a careful examination will detect the two elements, and nearly the same is to be seen in some Pupæ. May not the lamella in question be regarded as the homologue of the lunar, and partly gular fold of *Clausilia*, only more differentiated in the latter?

This feature alone is important enough to justify a separation of these two species from *Vertigo*, and to warrant the creation of a subgenus for them, but not alone on the point named; there are other characters also. Before considering these, I will say a few more words concerning the former. The gular lamella is generally larger in *P. venetzi* where its inner end can not be seen from the aperture (figs. 11, 12), than it is in *P. milium*; I found it shorter and a little curved in small specimens of the latter from Cedar Keys, Florida; yet it is doubtless the same thing as in others from Illinois, where it exhibits almost exactly the same size and curvature as in *P. venetzi*. As a proof of the distinct nature of the gular fold, it should be mentioned that in several examples of *P. milium* not fully mature, it has been found

well formed, high and thin and ending abruptly, when of the primary D to be connected with it there was not yet a trace to be seen.

The second distinguishing feature is the conformation of the last whorl; it is considerably narrowed toward the aperture, so that the whole shell diminishes at both extremities (hence the name of *angustior* Jeffr.). A deep impression near the base towards the aperture, corresponding to the upper primary, going through the crest to the very margin, adds to the peculiar character of the shell in both species.

Another highly important point is the shape and oblique direction of the columellar tooth (figs. 10, 11), again simulating *Clausilia* and not encircling the pillar as in most of the other groups of *Pupa*. I believe that if the size of our species was ten times what it is, their relation to *Clausilia* would have been remarked ere this.

To these characteristics may be added another; the lower primary lamella D in the peristome is much smaller than the upper, E, whether isolated or united with the gular. In *venetzi* it is very small, while in all *Vertigos* it is at least as large as E and very often a trifle larger, and is present in species having no upper E, or only a trace of it.

To briefly recapitulate the main distinguishing features of our group, they are, (1) the narrowed ultimate whorl, with deep constriction; (2) the long gular lamella, connected with one of the outer primary teeth; (3) the position of the columellar lamella along the pillar; (4) the small lamella D on the peristome. These characteristics separate our species widely from *Vertigo*, and require for them a distinct group; they must be considered as constituting a subgenus, as valid and well characterized as any other. I suggest for it the name of *Angustula*, referring to the narrower whorl, and at the same time recalling Jeffrey's name *angustior* for *P. venetzi* Charpentier. That one of the two is dextral, the other sinistral, is no reason against uniting them in one group. It is not without interest to note the fact that one inhabits the Old World and the other the New, in which there are found so few typically sinistral land-pulmonates. One is nearly like the mirror image of the other, yet there are a number of differences between them which may be presented as follows:

P. milium Gld.

- dextral.
- finely striated.
- gular lamella united with the lower primary D.
- basal fold C long, lamella-like.
- a small but distinct lamella on the peristome above E.
- without the nodule.

P. vertigo Charp.

- sinistral.
- strongly striated.
- gular lamella united with the upper primary E.
- the basal C short, nodule-like.
- without the lamella.
- a small nodule on body-whorl at the upper angle connected with the lamellar accessory.

P. pusilla Mueller does not differ essentially from the species of *Vertigo* except in being sinistral, and so it simply keeps its place among them.

The following figures from the work of Mr. W. G. Binney may be of use to collectors, though better ones, it is hoped, will in future be supplied in a more extended discussion of the *Pupidae*:



FIG. 1.



FIG. 2.



FIG. 3.

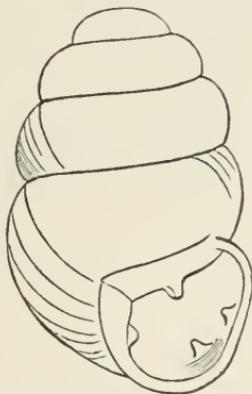


FIG. 4.



FIG. 5.



FIG. 5a.



FIG. 6.

- Fig. 1. *Vertigo gouldii*.
- Fig. 2. *Vertigo californica*.
- Fig. 3. *Vertigo rowellii*.
- Fig. 4. *Vertigo corpulenta*.

- Fig. 5. *Vertigo bollesiana*, last whorl enlarged.
- Fig. 5a. *Vertigo bollesiana*.
- Fig. 6. *Vertigo floridana*.

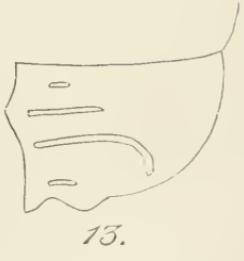
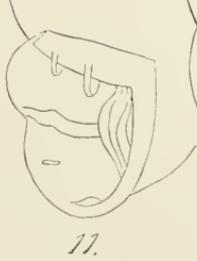
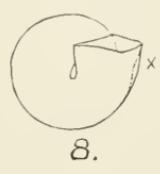
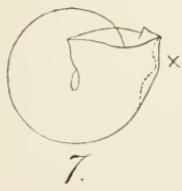
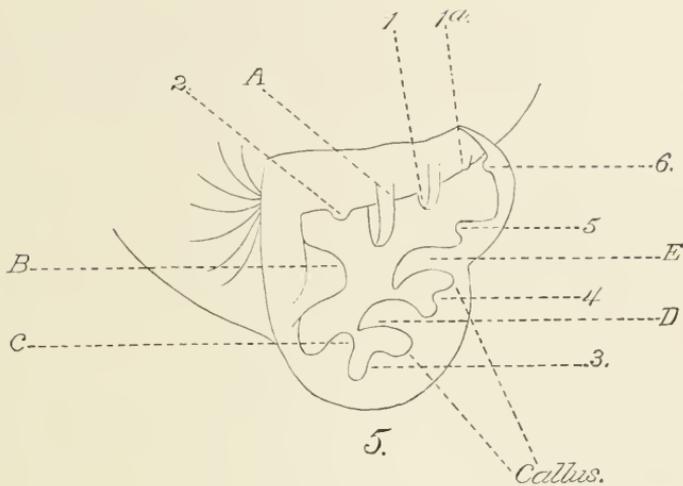
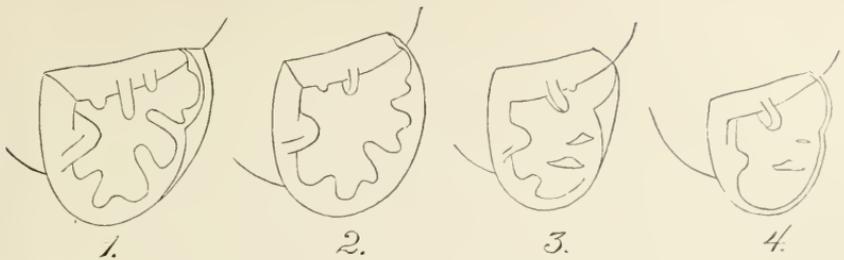
Lastly, I venture to add the request that specimens of *Pupa* may be forwarded to me. I shall be obliged for any and everything in this line, even if sent for examination and determination only; in the latter case, the specimens will be promptly returned. The locality and sender will in descriptions be conscientiously acknowledged in every instance.

EXPLANATION TO PLATE XLII.

Diagrams exhibiting the arrangement of the lamellæ of the aperture in *Vertigo*:

- Fig. 1. Outline of the aperture and teeth of *Vertigo antivertigo* Draparnaud; European.
- Fig. 2. Aperture of *Vertigo pentodon* Say; American.
- Fig. 3. Aperture of *Vertigo gouldii* Binney; American.

- Fig. 4. Aperture of *Vertigo tridentata* Wolf; showing a trace of the primary lamella E.
- Fig. 5. Diagram of the aperture of *Vertigo orata* Say; showing primary lamellæ, designated by letters, A on the body, B on the pillar, C at the base of the pillar, D and E on the outer lip. Also the secondary or accessory lamellæ designated by figures 1, 1a, and 2, on the body; 3, 4, 5, and 6 on the outer lip. There are sometimes two secondary denticles between C and D.
- Fig. 6. *Vertigo orata* Say, profile.
- Fig. 7. *Vertigo orata* Say; view of the base; the dotted lines opposite × represent the undulations shown by a section of the last whorl.
- Fig. 8. *Vertigo alpestris* Alder; European. Base as in Fig. 7.
- Fig. 9. *Vertigo alpestris* Alder, in profile.
- Fig. 10. *Angustula milium* Gould; outline of the aperture showing the lamellæ.
- Fig. 11. *Angustula venetzi* Charpentier; diagram of the aperture showing the lamellæ.
- Fig. 12. The same, showing the position of the lamellæ as seen through the shell on the left side.
- Fig. 13. *Angustula milium* Gould diagram showing the lamellæ, as seen through the shell from the right side, for comparison with figure 12.



DIAGRAMS EXHIBITING THE ARRANGEMENT AND RELATION OF THE TEETH IN VERTIGO.

FIG. 1. *Vertigo antivertigo* Drap.
 FIG. 2. *V. pentodon* Say.
 FIG. 3. *V. gouldii* Binney.
 FIG. 4. *V. tridentata* Wolf.

FIGS. 5-7. *V. ovata* Say.
 FIGS. 8, 9. *V. alpestris* Alder.
 FIGS. 10, 13. *Augustula millium* Gould.
 FIGS. 11, 12. *Augustula venetii* Charp.

(Explanation of plate on pages 379-380.)

