

CANADA  
DEPARTMENT OF MINES  
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NATIONAL MUSEUM OF CANADA  
W. H. COLLINS, ACTING DIRECTOR

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BULLETIN No. 79

BIOLOGICAL SERIES No. 21

**The Freshwater Mollusc *Helisoma*  
*Corpulentum* and Its Relatives  
in Canada**

BY  
F. C. Baker



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OTTAWA  
J. O. PATENAUDE, I.S.O.  
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY  
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# THE FRESHWATER MOLLUSC *HELISOMA CORPULENTUM* AND ITS RELATIVES IN CANADA

By F. C. Baker<sup>1</sup>

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## INTRODUCTION

In 1824 the great American naturalist, Thomas Say, described a member of the old genus *Planorbis* as *Planorbis corpulentus*, giving as localities Winnipeg (Winnipeck) river, Winnipeg (Winnipeck) lake, Lake of the Woods, and Rainy lake, all in Manitoba or western Ontario. Owing probably to the rarity of this species in collections, although it has been found by later exploration to be an abundant species in Canada, it has been generally misunderstood by most subsequent students of the Mollusca down to the present time. A few isolated instances occur of quotations relating to the true *corpulentum*. In 1900 (Nautilus, XIII, page 133) Dr. Bryant Walker, a critical and careful student of freshwater molluscs, rescued the species from oblivion, correctly calling attention to Say's very exact description of the species (and to his figure) which, when read with a specimen of the true *corpulentum* in hand, is excellent.

The researches of Dr. Alvin R. Cahn in the waters of central and western Ontario (See Ann. Rept., Nat. Mus. of Canada, 1929, page 41) resulted in securing the largest series of specimens of this species that has ever been obtained, far in excess of material in all previously known collections combined. A study of this material has shown that the species is a composite one, embracing several varieties and at least one additional species, which have been previously referred to *corpulentum*. With this wealth of material it has been possible to clear up all doubts concerning the status of Say's species, to ascertain its probable geographic distribution, and to distinguish its variations and related species. More than five hundred specimens of *corpulentum* and related species and varieties have been examined in the course of this investigation.

<sup>1</sup> Contribution from the Museum of Natural History, University of Illinois, No. 75.



It was also believed that the positive identification of all previous records of *corpulentum* would be of value and, accordingly, this was attempted. To carry out this plan successfully necessitated the examination of all the available original specimens upon which the old records were based. This has been made possible by the hearty co-operation of the large museums in which this material is now deposited, principally the National Museum of Canada, the United States National Museum, the American Museum of Natural History, the Academy of Natural Sciences of Philadelphia, and the Zoology Museum of the University of Michigan. The author has also drawn upon Dr. Walker's article in the *Nautilus*.

The examination of this material, so generously placed at the disposal of the author, plainly shows that this fine northern species has been totally misunderstood by nearly all previous students. Upward of eleven different species and races have been confused with this species, *trivolvus*, *binneyi*, *macrostomum*, *tenuis*, *intercalare*, *pilsbryi*, *ammon*, *occidentale*, *vermillionense*, *multicostatum*, and *infracarinatum*, the last three new forms recently diagnosed. *Binneyi* and *trivolvus* have been the species most usually mistaken for *corpulentum*, and the former bears considerable resemblance to the figures of Say. The reference of *corpulentum* to this western form in Binney's work (1865), based on Gould's previous disposition of the species (1852), perpetuated this error, in spite of Tryon's later correction (1867) in which he bestows the name *binneyi* on the western form, but states that *corpulentum* is a synonym of *trivolvus*. With the single exception of Grant (1887), the species was totally misunderstood previous to the publication of Walker's paper in 1900. The previous references to this species and their present relationship will be found in the literature identifications in this paper.

In the discussion of the species included in the *corpulentum-trivolvus* complex an effort has been made to state the salient diagnostic features of each form, the type localities and present location of the type material, and a detailed list of the material contained in the museums of the institutions from which specimens were loaned, with their collection numbers, this for the convenience of later students who might wish to check up any of the citations. The material in the Natural History Museum of the University of Illinois has also been used in the investigation. The specimens figured on the plates are mostly in this museum.

In a previous paper (Ecology, XI, page 469) the writer called attention to the significant geographic distribution of certain species of freshwater molluscs in relation to the moraines of the last glacial invasion, the Wisconsin. In a summary (page 479) the following statement is made:

"Previous to the Glacial Period the country had been reduced to base-level and probably few lakes existed, the physiography being one of rivers with dendritic form of drainage, like the driftless area in Wisconsin today. After the last invasion, the Wisconsin, the country was greatly changed; in place of rivers there were lakes, swamps, and sluggish rivers. The fauna reacted to this change to such an extent that where previously there had been but one or two varieties in a species, as many as ten developed which were peculiar to the newly glaciated country. Many entirely new species were evolved which have not occurred in any glacial deposits yet examined. The change affected some species more than others, but all have been affected to a noteworthy degree."



The study of the *Helisomas* of the *corpulentum-trivolvis* groups bears out this assumption in a marked manner. None of the *corpulentum* group—*corpulentum*, *vermilionense*, *multicostatum*, *whiteavesi*—is known south of northern Minnesota, and they are mostly confined to western and central Ontario. *Macrostomum*, *pilsbryi*, and *infracarinatum* of the *trivolvis* group are distributed far to the north of the Wisconsin ice border and none has been found in geological deposits south of this area. We must conclude, therefore, that following the last glacial advance there was an acceleration of evolutionary factors resulting in the appearance of the large species and races of *Helisomas* so abundantly distributed throughout Ontario and other parts of Canada. The parent stock of these forms would appear to have been the widely distributed *trivolvis* of the central and eastern part of the United States. That the drastic change in the environment played a large part in directing this evolution is the belief of the author.

#### ACKNOWLEDGMENTS

The success of the present paper is largely due to the co-operation of the following persons who generously loaned much valuable material in their institutions for study and comparison, in addition to supplying considerable material from their own collections:

Dr. Paul Bartsch, U.S. National Museum, Washington, D.C.

Mr. Calvin Goodrich, Museum of Zoology, University of Michigan, Ann Arbor, Mich.

Dr. Wm. J. Clench, Museum of Comparative Zoology, Cambridge, Mass.

Prof. J. R. Dymond, Director, Royal Ontario Museum of Zoology, Toronto, Canada.

Dr. F. Kermode, Director, Provincial Museum, Victoria, B.C.

Mr. J. Henderson, University of Colorado, Boulder, Colo.

Mr. A. LaRocque, Geological Survey, Canada, Ottawa, Canada.

Mr. Wm. B. Marshall, U.S. National Museum, Washington, D.C.

Dr. Roy W. Miner, American Museum of Natural History, New York, N.Y.

Dr. H. A. Pilsbry, Academy of Natural Sciences, Philadelphia, Pa.

Prof. D. S. Rawson, University of Saskatchewan, Saskatoon, Sask.

To Dr. A. R. Cahn, of the Department of Zoology, University of Illinois, special acknowledgment is due for the splendid collections of *Helisoma* gathered during the years 1928, 1929, and 1931 in parts of central and western Ontario. Without this material this revision of the northern species of *Helisoma* could not have been undertaken.

# REVISION OF THE GROUPS *HELISOMA CORPULENTUM* AND *HELISOMA TRIVOLVIS* IN CANADA

The large snails of the genus *Helisoma* divide into two well-defined groups, *corpulentum* and *trivolvus*, around which several species and races arrange themselves. In the *corpulentum* group the upper and lower margins of the body whorl have the carina bordering the outer edge, presenting a flattened body whorl separated from the dorsal and ventral surface by a sharp ridge. In the *trivolvus* group the carina is placed in the centre of the basal and spire whorls and the body whorl is usually quite rounded. The various species and races differ not only in shell characteristics but also in the size and numerical formula of the teeth on the radula. The genitalia are fairly uniform for both groups (See Proc. Zool. Soc., London, 1931, page 575, where the genitalia are figured). It is to be noted that the generic name *Helisoma* is a Greek neuter noun and that all specific names as adjectives must also be neuter, thus *Helisoma corpulenta* as previously understood becomes *Helisoma corpulentum* (See H. B. Baker, Nautilus, XLIII, page 319, 1930).

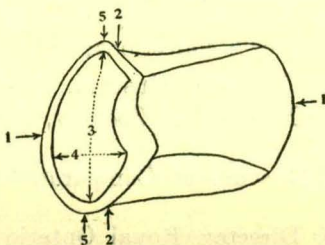


Figure 1. Shell of *Helisoma* showing methods of measurement. 1-1, greater diameter (from behind expanded lip); 2-2, height; 3, height of aperture; 4, diameter of aperture; 5-5, height of aperture with expanded lip.

A word concerning the method of making measurements of the shells considered in this paper may not be out of place, since it may differ from the method used by some conchologists. The annexed figure in the text sufficiently explains the method used without further description (Figure 1). The figures on the accompanying plates are from typical specimens of each species or race, the types being used in many cases for this purpose. The plate of immature shells is of importance in showing that certain differences are shown in the young shell which may more or less disappear in some adult specimens from certain localities. The catalogue numbers and locations of all specimens used for illustrative purposes are given to facilitate future consultation. It is to be noted that the shells of *Helisoma* are sinistral and not dextral and in this respect Say was correct in his early descriptions.



## Group of *Helisoma Corpulentum*

### *Helisoma corpulentum* (Say)

Plate I, figures 1-7; Plate IV, figures 1-4

*Planorbis corpulentus* Say, Long's Exped., II, p. 262; Pl. xv, Fig. 9 (1824); Binney, Complete Writings of Thomas Say on Conch. of U.S., p. 128, Pl. 74, Fig. 9 (1858); Binney, L. and F.-W. Shells N.A., II, p. 114, Fig. 190 (1865); Walker, Nautilus, XIII, p. 123, Pl. iii, Figs. 1-3 (1900); Dall, Alaska Moll., p. 87, Fig. 65 (1905).

*Helisoma corpulenta* (Say), Baker, Fresh Water Moll. Wis., I, p. 337, Pl. xix, Figs. 40-42 (1928).

*Helisoma corpulentum* Baker, Nautilus, XLVI, p. 6 (1932).

Shell light to dark horn coloured, whorls about  $4\frac{1}{2}$ , flatly rounded at the periphery, sharply carinated above and below; spire flat, usually sunken below the enveloping body whorl; umbilical region deep, less than three whorls visible; aperture reversed ear-shaped, higher than wide, sharply angled above, rounded below; lip reflexed and aperture entire, joined by a wide, heavy, white callus; the last half of the body whorl projects abruptly upward, throwing the aperture out of line with the rest of the shell; sculpture of coarse, rib-like wrinkles or costæ normally spaced a millimetre apart, each rib heavy and raised above the level of the body whorl; there are fine horizontal lines parallel with and between the ribs, and fine transverse lines over the whole shell.

H.11·2; Gr. diam. 25·1; Ap.H. 11·0; D.7·5 mm., Rainy lake, Ont. Baker coll. 1101.

H.12·5; Gr. diam. 21·5; Ap.H. 11·2; D.7·8 mm., Rainy lake, Ont. Baker coll. 1101.

H.13·6; Gr. diam. 24·5; Ap.H. 12·5; D.8·5 mm., lac la Croix, Ont. U.I. coll. Z32296.

H.14·0; Gr. diam. 25·1; Ap.H. 12·6; D.7·4 mm., lac la Croix, Ont. U.I. coll. Z32296.

H.11·5; Gr. diam. 19·0; Ap.H. 11·2; D.7·1 mm., lac la Croix, Ont. U.I. coll. Z32296.

The last measurement is about the size of Say's original specimen.

In his original description Say mentions the shell as "rather rugged with coarse wrinkles" and it is this form that must be taken as representing typical *corpulentum*. Specimens from Rainy lake (from the collection of Hon. Mr. Justice F. R. Latchford), which is one of original localities, are of this nature, with coarse, widely spaced rib-sculpture (Plate I, figure 6). Specimens from lac la Croix, southeast of Rainy lake, are exactly like Say's diagnosis. One specimen (Plate I, figure 4), is like Say's figure and about the size of his specimen. Although the majority of specimens of typical *corpulentum* will conform closely to the above diagnosis there are occasional specimens that have a greater axial height, in this respect approaching the race *vermilionense* (Plate I, figure 5). Also, individual specimens may have finer sculpture, approaching the race *multicostatum*. These variations are rare, however, and the majority of colonies are quite uniform and easily distinguishable as typical *corpulentum*.



Compared with *Helisoma trivolvis*, the distribution of *corpulentum* is quite restricted, judging by the authentic records. It is a common species in the waters of the International Boundary and in the lakes of western Ontario. Say found it in Winnipeg (Winnipeck) river, Rainy lake, and Lake of the Woods. It is in the National Museum of Canada from the following localities and sources:

- 2227. Lac Seul. Wm. McInnes, June 20, 1904.
- 2260. English river below Manitou fall. Wm. McInnes, June 22, 1905.
- 2222. Minnitaki lake. Wm. McInnes, June 18, 1904.
- 2321. Lake of the Woods. J. Fletcher, 1882.
- 2229. Sioux Lookout, English river. Wm. McInnes, Sept. 29, 1904.
- 2228. Lac Seul. Wm. McInnes, June 24, 1904.
- 2107. Kenora (Rat Portage) above falls. A. C. Lawson, 1884.

In the museum of the University of Michigan the following records occur:

- 35678. Kenora (Rat Portage). Fred Stearns, coll.
- 28228. Kettle falls, Rainy lake. Hon. F. R. Latchford, coll.

In the collection of the United States National Museum the specimens listed below are typical *corpulentum*:

- 347755. Lake of the Woods, northwest angle, Minn. U.S. Biol. Surv., W. F. Kubichek, Sept. 16, 1921.
- 347783. Lake of the Woods, Warroad, Minn. U.S. Biol. Surv., F. P. Metcalf, Sept. 17, 1921.
- 251143. Kettle falls, Rainy lake. Hon. F. R. Latchford, coll.
- 346628. Kettle falls, Rainy lake. Hon. F. R. Latchford, coll., June 28, 1910.
- 361737. Kettle falls, Rainy lake. Hon. F. R. Latchford, coll.

The museum of the Academy of Natural Sciences of Philadelphia contains the following material referable to typical *corpulentum*:

- 127768. West end lac Seul. A. W. Fahrenbruck, 1920.

It is in the Natural History Museum of the University of Illinois, collected by Dr. A. R. Cahn, from the following localities:

- Z32296. Lac la Croix, Rainy River district. 1931. Adult.
- Z32297. Lac la Croix, Rainy River district. 1931. Immature.
- Z32298. Lac la Croix, Rainy River district. 1931. Young.
- Z32349. Basswood River rapids, Rainy River district. 1931.
- Z32319. Northern Light lake, Thunder Bay district. 1931.
- Z29845. Trout lake, Patricia portion of Kenora district. 1928.
- Z32300. Iron lake, St. Louis county, Minn. 1931.

The typical species is recorded from Manitoba and Ontario by Mozley as noted below, but the material may include related species or races. None of the specimens has been available for study.

Indian lake, Falcon bay, Manitoba; Minaki, Sand lake, White Dog, Sword lake near Minaki, all on or near Winnipeg river; Fox lake, near Wade, all in Ontario.

The presence of typical *corpulentum* in the Mississippi drainage has been questioned by the writer, but undoubted specimens of the species in several authentic collections remove all doubt of its presence in the headwaters of Mississippi river. The records are noted below.

- Mus. Univ. Mich. 47010. Outlet lake Itasca, Itasca State park, Minn.
- Phil. Acad. 121324. Upper Mississippi. C. M. Wheatley.

It is very doubtful if this species occurs in either Michigan or Wisconsin. Walker's record (Nautilus, XIII, page 133) cites the species as simply from Michigan with the comment that it must have come from



the western part of the upper peninsula of Michigan as none has been collected from the lower part of the upper peninsula by recent collecting parties. The writer has collected extensively in northern Wisconsin and did not find *corpulentum*. It is quite possible that the Michigan specimens really came from Minnesota and were collected by an early survey party that failed to specify the exact locality. Until additional specimens are found in Michigan this record must be looked upon with suspicion. Its presence in northern Minnesota in abundance is without question.

The range of typical *corpulentum*, as judged by the available records, is from the southeastern corner of Manitoba eastward to Minnitaki lake, Thunder Bay district, Ontario, and from Trout lake, Patricia portion of Kenora district, Ontario, southward to Itasca State park in Clearwater county, Minn. Dall's and Walker's record from lake Vermilion, Alberta, in latitude 56° 30', leaves a wide stretch of territory (about 750 miles) without records. Dall evidently included this record from Walker's paper (1900), in which the specimens are said to have been in the James Lewis collection, the collector being unknown. The specimen figured, which is in the Walker collection, is so like an immature specimen of the race *vermilionense* that one is led to wonder whether or not Vermilion lake, Minnesota, was not the locality rather than the lake in Alberta so many miles from the other records of *corpulentum*. This record of the species must be open to question until authentic material from the intervening area has been obtained.

*Helisoma corpulentum vermilionense* F. C. Baker

Plate I, figures 8-13; Plate IV, figures 5-8

*Helisoma corpulenta vermilionensis* F. C. Baker, Nautilus, XLII, page 131 (1929).

*Planorbis corpulentus* Grant, Ann. Rept., Geol. and Nat. Hist. Surv. Minn., 16, page 484 (1887); Walker, Nautilus, XIII, page 136 (part), Pl. iii, figs. 4-6 (1900).

*Helisoma corpulenta* F. C. Baker, Trans. Am. Micr. Soc. XLVIII, pages 44-46 (part), Pl. viii (1929); Fresh Water Moll. Wis., I, Pl. xix, figures 38-39 (1928).

Shell differing from typical *corpulentum* in having the whorls at the shoulder and base encircled by a sharp, cord-like carina which persists to the aperture both above and below, the spire much flatter, the umbilicus relatively deeper, and the base of the shell much flatter; the axial height is greater and the aperture is higher and narrower, and peculiarly effuse and expanded below; the body whorl is more flat-sided in the race, in many specimens being concave, hence modifying the aperture to a considerable degree. In most specimens the new whorl is so tightly appressed to the preceding whorl as to form a marked plait on the columella, which is notably conspicuous on immature shells (See Plate IV, figures 5, 6). The sculpture of the surface is usually coarse like that of the typical form, but specimens occur with the fine sculpture of *multicostatum* (See Plate I, figure 13).



H.15·0; Gr. diam. 21·5; Ap.H. 16·0; D.12·0 mm.	Holotype.	Baker coll.	3019.
H.14·0; Gr. diam. 22·0; Ap.H. 15·5; D.12·0 mm.	Paratype.	Baker coll.	3020.
H.13·5; Gr. diam. 17·5; Ap.H. 13·0; D. 9·5 mm.	Paratype.	Baker coll.	3020.
H.12·0; Gr. diam. 13·5; Ap.H. 11·0; D. 9·0 mm.	Paratype.	Baker coll.	3020.
H. 8·0; Gr. diam. 10·0; Ap.H. 7·9; D. 5·5 mm.	Paratype.	Baker coll.	3020.

*Type Locality.* Vermilion lake, St. Louis county, Minn. Birch point.

*Types.* F. C. Baker coll., as above. Paratypes: Nat. Hist. Mus., U. of I., Z32518; Acad. Nat. Sci. Phil., 147370.

The same characteristics that separate *vermilionense* from *corpulentum* will distinguish it from the race *multicostatum*, from which it differs also in its coarser sculpture. Although the base of *multicostatum* is more flattened than in the typical *corpulentum*, it is never concavely flattened and with the sharply angled peripheral edge of *vermilionense*. Immature shells differ widely and are compared on Plate IV, figures 1 to 4 and 5 to 8. The geographic range of this race is unknown at present. It is very abundant in Vermilion lake, Minn., and is, apparently, the only large *Helisoma* found in the lake. The specimen figured by Walker (Nautilus, XIII, Pl. iii, figure 7) and stated to be from Vermilion lake, Alberta, looks very much like *vermilionense*, and the record may be an error for Vermilion lake, Minn. It was in the James Lewis collection, acquired by Dr. Walker, and the collector is unknown. Until the record is substantiated by fresh specimens it must remain in question. It appears, then, that as far as authentic material is concerned the race *vermilionense* is confined to the Vermilion Lake region. It was not found by the Cahn parties in western Ontario.

*Helisoma corpulentum multicostatum* F. C. Baker

Plate I, figures 14-20; Plate IV, figures 9-12, 21

*Helisoma corpulentum multicostatum* F. C. Baker, Nautilus, XLVI, page 7 (1932).

Shell differing from typical *corpulentum* in having the rib-striae finer and more numerous, there being three or four riblets in the space of a millimetre; the base is flatter with a well-developed carina on the edge of the basal whorls; the base exhibits three full whorls, whereas in *corpulentum* only two and a fraction are visible; the shell is normally larger with about half a whorl more than in the typical form.

H. 13·8; Gr. diam. 24·0; Ap.H. 11·8; D. 8·0 mm.	Holotype.	U.I. coll.	Z32306.
H. 15·5; Gr. diam. 29·5; Ap.H. 13·0; D. 8·5 mm.	Paratype.	U.I. coll.	Z32307.
H. 14·0; Gr. diam. 26·8; Ap.H. 11·5; D. 7·7 mm.	Paratype.	U.I. coll.	Z32307.
H. 13·5; Gr. diam. 20·0; Ap.H. 11·1; D. 6·6 mm.	Paratype.	U.I. coll.	Z32307.
H. 11·0; Gr. diam. 15·5; Ap.H. 10·1; D. 5·5 mm.	Paratype.	U.I. coll.	Z32307.

*Type Locality.* Kahnipiminanikok lake, Rainy River district, Ontario.

*Types.* Holotype, paratypes, U. of I. coll. as above. Paratypes: Nat. Mus., Canada, No. 3216; Acad. Nat. Sci. Phil., 158592.

The *corpulentum* of the Canadian lakes divides into two well-marked groups, one with coarse sculpture and one with fine sculpture, the riblets crowded and evenly spaced. It is probable that Say did not see the form with fine, crowded riblets or he would not have described the shell as rugged with coarse wrinkles, features so characteristic of the true *corpulentum*, but would have distinguished between the two forms. So far as known the *multicostatum* form has not been found in the waters visited by Say. The crowded striæ of the surface and the flatter base will readily separate *multicostatum* from *corpulentum*. Occasional specimens occur that are true *corpulentum* with widely spaced riblets for three whorls where an injury has distorted the shell, the remaining growth being true *multicostatum* with fine, close-set riblets. Text Figures 2 and 3 illustrate differences in rib-sculpture.

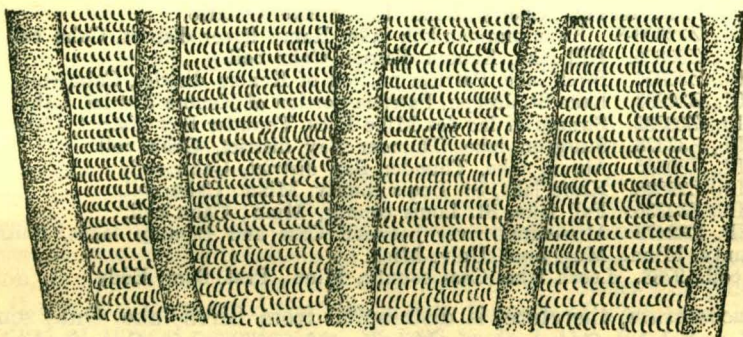


Figure 2. Sculpture of *Helisoma corpulentum* showing wide spacing of riblets. Line indicates one millimetre. Camera lucida drawing.

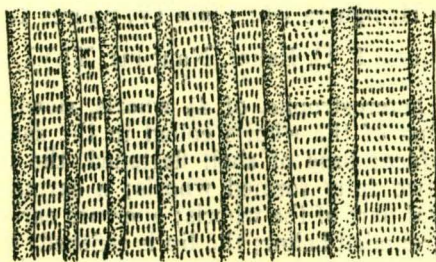


Figure 3. Sculpture of *Helisoma corpulentum multicostatum* showing close spacing of riblets. Line indicates one millimetre. Camera lucida drawing.

*Multicostatum* is at once distinguished from *Helisoma pilsbryi*, which it somewhat resembles in its fine sculpture, by the flattened base and carinated whorls. From the race *vermillionense* it is separated by its finer sculpture and lesser axial height which is about like that of *corpulentum*.



in the *multicostatum* race. The radula formulæ of the related species and races also differ somewhat, as noted below: *corpulentum* 32-1-32 to 41-1-41; *vermilionense* 25-1-25 to 29-1-29; *multicostatum* 35-1-35 to 43-1-43; *pilsbryi* 27-1-27 to 29-1-29.

*Multicostatum* has been confused with typical *corpulentum* and its geographic range cannot be ascertained from the literature without an examination of the specimens upon which the older records of *corpulentum* were based. Such examinations have been made wherever the material was available. The material examined, together with that collected by Dr. Cahn, provides the following records for this race:

- National Museum, Canada, 2221. Root river, coll. by Wm. McInnes, June, 1904.  
 Acad. Nat. Sci. Phil., 141906. Cherry island, Rainy lake, Ontario.  
 Mus. Zool., Univ. Mich., 49737. Lake Plantagenet, near Bemidji, Hubbard county, Minn.  
 U.S. Nat. Mus., 251142. Cherry island, Rainy lake, Ontario.  
 Univ. Ill., Z32306-8. Kahnipiminanikok lake, Rainy River district, Cahn coll.  
 Univ. Ill., Z30865. Hill lake, Kenora district, Cahn coll.  
 Univ. Ill., Z30864. Birch lake, Patricia portion of Kenora district, Cahn coll.  
 Univ. Ill., Z30863. Lake St. Joseph, Patricia portion of Kenora district, Cahn coll.  
 Univ. Ill., Z32332. Swamp of lac des Mille Lacs, Thunder Bay district, Cahn coll.  
 Univ. Ill., Z32326. Sturgeon lake, Thunder Bay district, Cahn coll.  
 Univ. Ill., Z30866. Abram lake, Thunder Bay district, Cahn coll.  
 Univ. Ill., Z29828. Knife lake, St. Louis county, Minn., Cahn coll.  
 Univ. Ill., Z32336. Fall lake, St. Louis county, Minn., Cahn coll.  
 Univ. Ill., Z32473. Mississippi river between Cass and Bemidji lakes, Beltrami county, Minn., Mus. Zool. Univ. Mich.  
 Baker coll., 2783. Leech lake, Cass county, Minn., Prof. Sam. Eddy.

*Multicostatum*, therefore, is distributed from Birch lake, Ont., southward to Leech lake, Cass county, Minn., and eastward in Ontario to lake St. Joseph. Its geographic range is thus about the same as that of typical *corpulentum* in both Ontario and Minnesota.

#### *Helisoma whiteavesi* F. C. Baker

Plate II, figures 1-5; Plate IV, figures 13, 14

*Helisoma whiteavesi* F. C. Baker, Nautilus, XLVI, p. 7 (1932).

Shell strikingly heterostrophe, of  $4\frac{1}{2}$  whorls, slowly increasing in diameter; spire consisting of the whorls coiled in the same plane forming a truncated upper surface; base of shell flattened, the umbilicus deep, the base showing only two fully formed whorls; a carina encircles both the shoulder and the basal part of the whorls; aperture ear-shaped, higher than wide, angled above, rounded below; the lip is reflexed; the aperture may be chocolate coloured within or the outer lip may be margined by a dark band; the sculpture is of distinct, rather evenly spaced riblets, the spaces being twice as wide as the riblets.

- H.19-0; Gr. diam. 24-0; Ap.H. 15-5; D.9-0 mm. Holotype. U.I. coll. Z32311.  
 H.18-2; Gr. diam. 23-2; Ap.H. 15-0; D.9-0 mm. Paratype. U.I. coll. Z32312.  
 H.16-8; Gr. diam. 21-5; Ap.H. 14-2; D.8-1 mm. Paratype. U.I. coll. Z32312.  
 H.12-0; Gr. diam. 10-4; Ap.H. 11-5; D.5-0 mm. Paratype. U.I. coll. Z32312.

*Type Locality.* Lac des Mille Lacs, Thunder Bay district, Ontario.



*Types.* Holotype and paratypes, U.I. coll., Z32311, 32312. *Paratypes:* Nat. Mus., Canada, No. 3223; Acad. Nat. Sci. Phil., 158591. Collected by A. R. Cahn.

*Whiteavesi* is distinguished from all other members of the *corpulentum* group by its flat spire, great axial height, and deep umbilicus in which only two full whorls may be seen. The sculpture is coarser than in the race *multicostatum*, but finer than in the typical *corpulentum*. It is with some hesitancy that this striking form is made a distinct species, for it is obviously a member of the *corpulentum* group. However, no individual in the rather large number of specimens of *corpulentum* and its races examined has shown a tendency to vary toward this form and the lot of *whiteavesi* material is so constant in its characteristics that it is deemed to be of specific rank. This fine species is dedicated to the deceased Canadian naturalist, Dr. J. F. Whiteaves, who did so much to advance the knowledge of the molluscan fauna of Canada.

The geographic distribution of *whiteavesi* is unknown. The type locality, lac des Mille Lacs, is in Thunder Bay district, Ontario, where it is apparently common. Three specimens in the National Museum, Canada, from Greenwater lake, about 15 miles south of lac des Mille Lacs, appear to be referable to *whiteavesi*. Although this species is at present unknown beyond its typical locality region in Thunder Bay district, there is every reason to believe that its distribution will be widely extended, unless the species be one of the products of post-glacial evolution of limited distribution, as appears to be the case with some of the freshwater pulmonates.

It is a curious parallel that the radula formula of *whiteavesi* is exactly like that of typical *corpulentum*, 36-1-36 to 41-1-41. Immature shells of *whiteavesi* are different from those of *corpulentum*, *vermilionense*, or *multicostatum* (See Plate iv, figures 13-14). In axial height they most nearly resemble the immature form of *vermilionense* (Plate iv, figures 5-6).

### Group of *Helisoma trivolvis*

*Helisoma trivolvis* (Say)

Plate III, figures 1-8; Plate IV, figures 17-19

*Planorbis trivolvis* Say, Nicholson's Ency., 1st. Ed., II (no pagination), Pl. ii, fig. 2 (1817); Am. Conch., VI, Pl. 54, fig. 2 (1834); Binney, Writings of Thomas Say, p. 44, Pl. 54, fig. 2 (1858); Land and F.-W. Shells N.A., II, p. 115, fig. 194 (1865).

*Helisoma trivolvis* (Say), Baker, Fresh Water Moll. Wis., I, p. 330, Pl. xx, figs. 1-6 (1928).

*Planorbis trivolvis* has been made a "dumping ground" for nearly every *Planorbis*-like shell of the United States and Canada from the Atlantic to the Pacific, and the various forms referred to this protean species probably include nearly all of the larger species. Say's original locality was French creek, a tributary of Allegheny river, this being the only locality given in the original description. As this creek rises in Chautauqua county, N.Y., and passes into Erie county, Pa., the original



locality may have been in either of these states and counties. Say gives the locality as French creek near lake Erie, but some later authors (Dall, Alaska Moll., p. 88) give French creek, lake Erie. The creek does not flow into lake Erie. Since so many diverse forms have been called *trivolvis* it becomes necessary to fix the form to which this name should be given. Say's figure in the American Conchology is excellent and is of the size and form of the figures on Plate III of this paper. The size of the French Creek specimen is said to be three-fourths of an inch in diameter (breadth) and specimens from western New York occur abundantly in almost every river and creek, and in the small bays that line the shore of lake Ontario, which correspond to this size and to Say's description. Four specimens from Braddock bay, near Rochester, N.Y., have the following measurements (Plate III, figures 1-4).

H. 9·0; Gr. diam. 20·5; Ap. H. 8·5; D. 6·5 mm. Univ. Ill., Z29789.  
 H. 9·5; Gr. diam. 19·5; Ap. H. 9·0; D. 6·0 mm. Univ. Ill., Z29789.  
 H. 7·5; Gr. diam. 18·5; Ap. H. 6·8; D. 6·0 mm. Univ. Ill., Z29789.  
 H. 9·0; Gr. diam. 19·2; Ap. H. 8·1; D. 6·1 mm. Univ. Ill., Z29789.

These measurements conform closely to Say's original specimens. Some specimens from New York and elsewhere measure 25 mm. or more in diameter. *Helisoma trivolvis* has a rather depressed shell axially, is of  $4\frac{1}{2}$  to 5 whorls, subcarinated above, the first three whorls flattened or even concave, laid tightly against the enveloping whorl without distinct suture, the outer edge of the inner whorls forming a sharp carina at the shoulder; the last whorl has a more or less sharp angle in the centre; the base shows three full whorls in adult specimens, the inner  $1\frac{1}{2}$  whorls usually subangulated, the last  $1\frac{1}{2}$  whorls rounded; in young specimens and on some adult individuals there are several spiral ridges; umbilicus small; sculpture of distinct, low, crowded riblets (3 to 4 in 1 mm. on body whorl), the spaces several times as wide as the riblets; aperture a trifle higher than wide, either flat or slightly rounded below and rather sharply angled above where it is much narrowed; the aperture is more or less pyriform in outline; outer lip and border of aperture usually but little reflected or expanded, thickened within and bordered inside by a brownish band. Say's types of *trivolvis* are in the Academy of Natural Sciences of Philadelphia.

This type of shell is abundantly distributed in the northeastern part of the United States from Maine westward to Nebraska. The southward extension of the typical form appears to be northern Illinois and Indiana, Ohio, Pennsylvania, and New Jersey. Distinct races carry the distribution southward to Florida, Mississippi, Louisiana, and Texas, including the races *lentum*, *pseudotrivolvis*, and *intertextum*. In the Rocky Mountain region *trivolvis* is replaced by other species, several of which extend their distribution into Canada.

The distribution of *trivolvis* in Canada is not well known, owing to its confusion with other species. It is apparently common in Quebec, and specimens have been examined from Ottawa river, near Ottawa. Mr. A. LaRocque of the National Museum of Canada has examined all the material in the National Museum of Canada and also in his own personal collection, and states positively that typical *trivolvis* occurs in the Ottawa



region in Ottawa river, but that the form in Rideau river is *infracarinatum* (See Pl. III, figures 7, 8, Ottawa *trivolis*). These small, flat specimens are possibly the form called *lentus* by Whiteaves. The *trivolis* listed by Whiteaves (1863, page 104) are larger and heavier than this shell and are the form now called *infracarinatum*. The large collection of *Helisoma trivolis* in the Royal Ontario Museum of Zoology shows the distribution of this species to cover all of lower Ontario from bay of Quinte west to lake Huron and Georgian bay (about twenty lots). It is also in the United States National Museum from lake Simcoe (No. 47555). The material in the Royal Ontario Museum is of special interest in showing great variation in the sculpture of the umbilical region, in several cases a lot from one locality exhibited all gradations from the typical rounded inner whorls to a condition in which the inner whorls had a sharp carina with several spiral striae, varying toward the forms of the Mississippi valley called *pseudotrivolis* (F. C. Baker) and *lentum* (Say). A few of these lots are listed below:

Georgian bay, Ontario, A. D. Robertson, collector. No. 1653. No. 1660.

Turkey point, lake Erie, J. P. Oughton, collector. No. 6174.

Hanlan point, Toronto, J. P. Oughton, collector. No. 1654.

Hamilton, Ontario, J. P. Oughton, collector. No. 6478.

Some of the Georgian Bay specimens have a diameter of 23 mm.

*Trivolis* appears to be rare in western Ontario, none having occurred in any of the Cahn collections obtained in that region. It evidently lives abundantly farther north as typical examples occurred in collections from Wainwright park, Alberta (Animal Diseases Research Institute). This is the farthest north and west yet reported of the typical form.

References to *trivolis* from the interior of Canada and west of the Rocky mountains in the United States are based on other species. As these related species may (or have) been found in Canada it seems desirable to indicate the principal characters by which they may be known.

### *Helisoma plexatum* (Ingersoll)

#### Plate III, figures 9-14

*Planorbis plexata* Ingersoll, U.S. Geol. and Geog. Surv. Terr., 1874, p. 402, text figures; *Planorbis trivolis* of western writers generally.

*Type Locality.* St. Mary lake, Mineral county, Colorado. Types: lectotype, U.S. Nat. Mus., No. 420210. Paratypes: U.S.N.M., No. 125130.

This *Helisoma* is usually higher axially than *trivolis*, there are five spire whorls, the inner  $2\frac{1}{2}$  whorls more or less angled in the middle, the outer whorls rounded; the base shows rather more than three full turns, the inner whorls rounded, not angulated or spirally ridged; umbilicus small; sculpture of crowded riblets (3 to 4 in mm. on body whorl); the spire whorls are not sunken and flattened as in *trivolis*, but are loosely coiled leaving a distinct suture between the rounded whorls, which are never marked by a sharp carina at the shoulder as in *trivolis*; aperture much higher than wide, somewhat lunate, roundly angled above and below, extending well above and below the penultimate whorl, often widely expanded; outer lip thickened and bordered by a dark purple band in the mature shell.



H.11·0; Gr. diam. 22·0; Ap.H. 10·0; D.7·0 mm. Lectotype, St. Mary lake.  
 H.13·0; Gr. diam. 28·5; Ap.H. 12·0; D.8·0 mm. Grand Mesa, Colo.  
 H.10·0; Gr. diam. 22·0; Ap.H. 8·5; D.6·5 mm. Grand Mesa, Colo.  
 H.11·2; Gr. diam. 22·7; Ap.H. 10·2; D.6·4 mm. Grand Mesa, Colo.

The shell diagnosed above is common in Colorado and has been observed in Idaho, Montana, and Washington. It differs uniformly from *trivolvis*, both in shell and radula. It extends northward into Canada. Whiteaves' record of *trivolvis* (Nautilus, XIX, page 4) from 2 miles above the mouth of Harricanaw river, Hannah bay, collected by W. Spreadborough in July 1904, is *plexatum* (Plate III, figures 11, 12). The following records in the National Museum of Canada are also referable to *plexatum*: Black Bear island, lake Winnipeg, collected by Dowling and Lambe (Plate III, figures 13, 14); Cormorant lake, Manitoba, collected by W. McInnes in 1906. Specimens have been seen from Athlestone lake, Ontario, collected by Dr. A. R. Cahn, of the University of Illinois. Material in the Haines collection of the American Museum of Natural History (A3868), however, is typical *trivolvis*, said to have come from the "Winnipeck" river. Material from this region is needed to satisfactorily interpret the distribution of *trivolvis* and *plexatum*. The extent of the distribution of *plexatum* in Canada is at present unknown, but probably covers a wide area. In many specimens the whorls are distorted, as noted by Ingersoll in his original description. This, however, is not a specific character, for it has been observed in a number of species.

#### *Helisoma hornii* (Tryon)

*Planorbis hornii* Tryon, Am. Jour. Conch., I, p. 231, Pl. 22, fig. 16 (1865).

This large planorbid snail has been somewhat of a puzzle to American conchologists since its publication. There has been doubt about the type locality as to whether the Simpson mentioned by Tryon was on Mackenzie river in Canada or on Portland sound in the western part of British Columbia (Dall, Alaska Moll., p. 89). Cooper (Proc. Cal. Acad., 2, III, p. 88, 1890) says, however, "*hornii* was described from the coast at the southern boundary of Alaska, latitude 54° 40'" and this seems to have been the location accepted by the Californian conchologists of this period. Dr. Pilsbry also believes that this was the locality, as the Philadelphia Academy has many specimens received from Dr. Horn from this region but none from Mackenzie River region. As Dr. Horn was a United States army surgeon it is extremely unlikely that he should have been stationed on Mackenzie river in Canadian territory. There appears to be no reasonable doubt about Tryon's specimens coming from Port Simpson, on Portland sound, British Columbia, and this type locality should be used by all workers on Canadian Mollusca.

Just what the species is that Tryon called *hornii* has also been in considerable doubt. Dall and Cooper relate it to *subcrenatum* (Cpr.), but the mature shell of the latter species is quite unlike Tryon's figure and description. Henderson and Daniels (Proc. Phil. Acad., 1917, p. 65) list



the species as *Helisoma trivolvis hornii*, identified by Dr. Pilsbry, from Newton Town reservoir, near Clarkston, Utah. Specimens of this lot recently examined are related to *subcrenatum*, having the sculpture and aperture of that species. Tryon emphasized the rotundity of the aperture and the roundness of the whorls "equally convex above and below".

Tryon's types have apparently been lost. No specimens of the large *Helisoma* group are available from the region of Port Simpson, British Columbia, and material from the southern part of Vancouver island is quite unlike Tryon's figure of *hornii*, having the body whorl disproportionately enlarged and the aperture expanded and slightly oblique. The sculpture is also coarser. This form is related to *plexatum*.

Recently, several specimens of a large "Planorbis" were received from the U.S. National Museum, collected by Robert Kennicott at Simpson (No. 28375). These are listed as *trivolvis* by Binney on page 121 of the "Fresh Water Shells," Nos. 8952 and 9069. A study of Kennicott's journals proves beyond doubt that this locality is on Mackenzie river, where he remained one winter. There is no record of a visit to Simpson, British Columbia. These specimens fulfil the original diagnosis exactly and correspond with the figure. They have the rounded aperture and the whorls equally rounded above and below. Measurements of three specimens are similar to the dimensions given by Tryon.

H.8.9; Gr. diam. 22.5; Ap.H. 7.4; D.7.0 mm. Simpson (Kennicott).

H.9.0; Gr. diam. 19.5; Ap.H. 8.0; D.5.6 mm. Simpson (Kennicott).

H.8.0; Gr. diam. 19.5; Ap.H. 7.1; D.5.6 mm. Simpson (Kennicott).

H.7.0; Diam. 21.0 mm. Tryon's measurements, page 231.

H.9.3; Diam. 21.0 mm. Dimensions of Tryon's figure.

It will be noted that the dimension given does not correspond in height with that of the shell figured. The dimensions of the figure correspond with those of the Kennicott specimens. Tryon's figures in the "Continuation of Haldeman's Monograph" are different from those given in the American Journal of Conchology, being much smaller, but his description is the same in both.

Quite recently, some specimens of a large *Helisoma* were received from Professor D. S. Rawson, of the University of Saskatchewan, collected in Paul lake, in Kamloops region, south-central British Columbia. These are like Tryon's description and figure and are nearer the type locality than the Mackenzie River specimens. Two specimens measure as follows:

H.8.5; Gr. diam. 18.0; Ap.H. 8.0; D.5.1 mm.

H.8.0; Gr. diam. 16.0; Ap.H. 6.6; D.4.5 mm.

Tryon's *hornii* appears to be a distinct species characterized by fine sculpture, the riblets, though widely spaced (2 to 3 in 1 mm., some 1 mm. apart) are low and inconspicuous, upper and lower whorls equally rounded, the inner whorls of the spire with a distinct suture, the aperture rounded, regularly orbicular, without sharp angles above or below. In these features it differs from any known species of *Helisoma*. The shell is also thin. The

three authentic localities at present known show its distribution to be from Port Simpson, British Columbia, northeast to Simpson on Mackenzie river, and southward to south-central British Columbia.

*Helisoma subcrenatum* (Carpenter)

Plate III, figures 15-16

*Planorbis subcrenatus* Carpenter, Proc. Zool. Soc., 1856, p. 220; Binney, L. and F.-W. Shells N.A., II, p. 103, Fig. 176 (1865).

This large, western species is practically unknown to present-day conchologists. Carpenter described the species from a single specimen collected by Nuttall in "Oregon." As the Oregon of the early thirties included all of the territory west of the Rocky mountains and north of California it is impossible to know where Nuttall collected his specimen. The figure in Binney and the original description, however, appear to give a definite clue to the identity of the species when compared with a large series of western *Helisoma*. Its size, 0.95 inch in diameter, 0.36 inch in height (a typographical error in Binney makes the shell 0.05 inch in diameter) indicates a large shell nearly an inch in diameter, and of low axial height. The manuscript note by Cummings, in Binney, also reveals a diagnostic feature, "differs from *Planorbis trivolvis* Say, in the acuteness of the ribs, and in their being more distant." In *trivolvis* there are 3 to 5 riblets in 1 mm., whereas in the western species believed to be *subcrenatum* there are 1 to 3 riblets in the same space. This species, as understood by the writer, may be diagnosed as follows:

Shell depressed, whorls 5 to 5½, spire whorls rounded or only slightly angulated, the nuclear whorls rounded, and all whorls separated by a deep suture; base showing three full turns of regularly and slowly increasing whorls, well rounded, a fourth whorl disappearing in the very deep umbilicus; sculpture of widely spaced, rather acute riblets, 1 to 3 in the space of 1 mm., often more than 1 mm. apart; aperture rounded, flattened below and rounded or bluntly angled above, usually a trifle wider than high, and frequently expanded; the aperture may be entire in some specimens, the parietal wall being covered by a white callus; interior of aperture brownish, often with a purplish border within the lip; colour of shell greenish or light horn.

H. 9.0; Diam. 24.5 mm.

H.10.0; Gr. diam. 21.0; Ap.H. 9.0; D.6.3 mm.

H. 9.2; Gr. diam. 19.4; Ap.H. 8.6; D.6.1 mm.

H. 9.0; Gr. diam. 21.5; Ap.H. 8.0; D.7.0 mm.

H.10.5; Gr. diam. 23.0; Ap.H. 9.0; D.7.5 mm.

Carpenter's measurements.

Newton Town, Utah.

Newton Town, Utah.

Logan, Utah.

Wainwright park, Alta.

*Helisoma subcrenatum* differs from *H. plexatum*, with which it has been confused, in its generally flatter shell, more orbicular aperture, rounder spire whorls, and particularly by its more widely spaced sculpture, *plexatum* having 3 to 6 riblets in the space of 1 mm. *Subcrenatum* is also a much thicker shell, although Carpenter described it as "very thin." Some specimens are thin, but the majority are rather thick as compared



with either *hornii* or *plexatum*. This species appears to be specifically different from *plexatum* or *hornii*, the three species varying around three easily recognized types of *Helisoma*.

The species here referred to *subcrenatum* is widely distributed in the United States and Canada. In the former territory it is known from Washington, Idaho, and Utah. In Canada it has been identified from the following places:

New Osgoode, Saskatchewan (Royal Ontario Museum of Zoology, No. 6830).

Mackenzie district: Fawn lake, mouth of Hay river; Mackenzie river, 30 miles above Providence (Whittaker, *Nautilus*, vol. 38, p. 11); Little lake, west end Great Slave lake (Nat. Mus., Canada, 3148, Plate III, figures 15-16).

Alberta: Wainwright park, several lakes; British Columbia: Cranbrook and Fernie (U.S.N.M., coll. by O. Bryant).

Of the *trivolvis* group there are thus seen to be three distinct species, two of which have been referred to *trivolvis* as synonyms, and the third totally misunderstood. The distribution of these species will be found to cover much of western, central, and northern Canada when more material has been studied. The molluscan fauna of the great stretch of territory in northwestern Canada is very little known.

In studying large quantities of *Helisoma trivolvis* from various parts of the United States a size variation coincident with geographic range may be noted. The *trivolvis* of Mississippi valley, now referred to the race *pseudotrivolvis*, are all relatively small, rarely exceeding 20 mm. in diameter. Typical *trivolvis* is smaller in the southern part of its range, also. As the range passes northward into Wisconsin, Michigan, and Minnesota, the size increases and the aperture becomes more expanded. Specimens of this nature, from a pool near Presqu'île, lake Huron, Michigan, are figured on Plate III, figures 17, 20. These so-called transition specimens lead to the race named *macrostomus* by Whiteaves.

*Helisoma trivolvis macrostomum* (Whiteaves)

Plate III, figures 18, 19, 21, 22

*Planorbis macrostomus* Whiteaves, Can. Nat. and Geol., VIII, p. 113, Fig. 12 (1863); Binney, L. and F.-W. Shells N.A., II, p. 119, fig. 199 (1865); Dall, Alaska Moll., p. 89, fig. 69 (1905); Tryon, Con. Hald. Mon., p. 202, Pl. 6, fig. 16 (1872).

*Helisoma trivolvis* Baker (part), Fresh Water Moll. Wis., I, p. 330, Pl. xx, fig. 13 (1928).

Shell much larger than typical *trivolvis*, the whorls swollen, rounded below and subcarinate above; spire sunken below the level of the last two whorls, the last whorl in many cases overlapping the previous whorl; base excavated and umbilicus deep, exhibiting 3 to 3½ whorls; whorls 4½ to 5, rapidly increasing in diameter; sculpture of distinct, widely spaced riblets with growth lines between and crossed by spiral striæ; aperture V-shaped above, widely expanded and rounded below; outer lip strongly reflected



and thickened, white, a wide white callus covering the parietal wall; the aperture is purplish within.

- H. 12.0; Gr. diam. 26.5; Ap. H. 11.5; D. 7.5 mm. Lake Nipigon (re Whiteaves, N.M.C. 2093).  
 H. 11.0; Gr. diam. 23.6; Ap. H. 10.0; D. 8.0 mm. Lake Nipigon (re Whiteaves, N.M.C. 2093).  
 H. 12.1; Gr. diam. 26.1; Ap. H. 11.0; D. 8.0 mm. Bayfield, Wis. (U.I. Z13677).  
 H. 12.2; Gr. diam. 28.0; Ap. H. 11.0; D. 8.0 mm. Bayfield, Wis. (U.I. Z13677).  
 H. 13.5; Gr. diam. 29.0; Ap. H. 12.5; D. 9.0 mm. Outlet Bamaji lake (U.I. Z30857).  
 H. 14.9; Gr. diam. 28.0; Ap. H. 13.8; D. 10.0 mm. Outlet Bamaji lake (U.I. Z30857).

*Type Locality.* Ponds near Mile-end Toll Gate, Montreal, Canada.

*Types.* National Museum of Canada (Mollusca), lectotype 3869, paratypes 3870.

*Macrostomum* has been considered a synonym of *trivolvis* by nearly all students of freshwater molluscs, including the writer (Moll. Wis., p. 331). Dall (Alaska Moll., p. 89) considered it a recognizable variety and it is sufficiently distinct to constitute a rather characteristic geographic race of *trivolvis*. The shell is much larger, the whorls swollen, and the axial height much greater, the aperture is larger, higher than wide, and the lip is notably expanded and reflected. Anatomically, the radula formula is 30-1-30 to 35-1-35, whereas in *trivolvis* it is never more than 26-1-26 and the average is 24-1-24. There are many forms that appear to connect *macrostomum* with *trivolvis*, which if absent would lead the most careful student to give the large form specific rank. In Michigan and Wisconsin, and even in the northern part of Ohio, there are large, *trivolvis*-like shells that appear to be intermediate between the two forms. Specimens from a pond near Presqu'île harbour, Huron county, Mich., are of this nature and some of the larger individuals would certainly be identified as *macrostomum* if found without the transition specimens. Two specimens are figured on Plate III, figures 17, 20.

*Macrostomum* is widespread geographically. It has been personally identified from the following places:

Lake Nipigon, Ontario (Nat. Mus., Canada, 2093), Ojiski lake, Attawapiskat (2220), Wapikapa lake, Winisk river (2218, 2219), Machawaian lake, Attawapiskat (2216), Winisk river. The last five lots were collected by McInnes. Also collected from a lake northwest of Cormorant lake, Manitoba (2309), McInnes collector. It is in the University of Illinois Museum from: beach pond north of Bayfield, Bayfield county, Wis., and Pike creek, near Salmo, Bayfield county (Z13677, Z13395), collected by F. C. Baker; Yellow river, near Spooner, Washburn county, Wis. (Z18524), collected by F. C. Baker; Aroostook county, Maine, several localities (Z32480, Z32481), collected by O. O. Nylander; Pashkokogan lake (Z30860, 30861), outlet Bamaji lake (Z30856, 30857), Bamaji lake (Z30858), Cat lake (Z30859), all western Ontario, collected by Dr. A. R. Cahn. The U.S. National Museum contains three lots: Lake of the Woods, northwest angle of Minnesota, collected by W. F. Kubichek of the U.S. Biological Survey (347753); Lake of the Woods, Warroad, Minn., collected by Metcalf of the Biological Survey (347783); and Cross Lake thoroughfare, Aroostook county, Maine, collected by W. C. Kendall (187682). In the Royal Ontario Museum of Zoology this race is represented from the following localities: lake Abitibi, Ontario, collected by J. L. Hart (1663, 1671); Georgian bay, Ontario, collected by A. D.



Robertson (1674); Avon river, Stratford, Ontario, collected by J. P. Oughton. The Baker collection contains a specimen from Brown lake, near Saskatoon, Saskatchewan.

The geographic range is, therefore, from Maine and Montreal westward to Saskatchewan and southward to northern Wisconsin and Minnesota. It apparently replaces *trivolis* in Canada with the exception of the lower part of Ontario where typical *trivolis* is common.

The type specimens of *macrostomum* have been thought lost, inquiry having failed to locate them in any Canadian or United States repository. Recently, however, Mr. A. LaRocque, while examining molluscan material in the Perth Municipal Museum, discovered three specimens of a large *Helisoma* labelled in Whiteaves' handwriting as from the Toll Gate, Montreal, presented by R. J. Fowler, Esq. The collection was originally in the Montreal Natural History Society collection which was presented to McGill University, and later given to the Perth Municipal Museum by McGill University. The three specimens, figured on Plate V, measure as follows:

H.11.6; Gr. diam. 25.0; Ap.H. 10.3; D.7.5 mm. (Lower specimen on plate).

H.11.6; Gr. diam. 25.0; Ap.H. 9.5; D.7.5 mm. (Specimen at left).

H.11.5; Gr. diam. 23.5; Ap.H. 10.0; D.7.5 mm. (Specimen at right).

Height at expanded lip 14.0 mm.; diameter including lip 25.0 mm. (Lower).

Height at expanded lip 13.1 mm.; diameter including lip 25.0 mm. (Left).

Height at expanded lip 13.0 mm.; diameter including lip 25.8 mm. (Right).

The specimens are very light horn colour, the growth lines very distinct; lip greatly reflected, with a dark brown line within the aperture; 5 whorls, 4 whorls showing in the umbilicus; all shells have a varix on the last half of the body whorl and all have a white callus on the parietal wall.

In all probability these specimens are the original types upon which Whiteaves' founded his species. On the plate the lower figure may be taken as a lectotype since no holotype was designated by Whiteaves. The other specimens may be designated as paratypes. The specimens have been placed in the National Museum of Canada and bear the numbers 3869 (lectotype) and 3870 (paratypes).

### *Helisoma pilsbryi* (F. C. Baker)

#### Plate II, figures 16-18

*Planorbis binneyi* F. C. Baker (not Tryon), Nautilus, XXIII, p. 41 (1909); Trans. Wis. Acad. Arts. Sci., XVII, p. 237 (1911); Tech. Pub. 4, N.Y. State Coll. For., p. 277, figs. 46, 17-18 (1916).

*Planorbis trivolis pilsbryi* F. C. Baker, Nautilus, XXXIX, p. 117 (1926); Fresh Water Moll. Wis., I p. 334, Pl. xx, figs. 14-21 (1928).

Shell axially high; whorls  $4\frac{1}{2}$ , rather tightly coiled, the body whorl well rounded; spire depressed below the level of the body whorl, which is obtusely carinated; umbilical region deep, three full turns of the whorls visible; the basal whorls are all rounded, without a trace of carination; sculpture of rather distinct riblets, usually rather crowded on the body whorl; aperture much higher than wide, rounded below, forming a sharp,

V-shaped angle above; outer lip not reflected, or only very slightly reflected in some individuals; parietal wall with only a slight wash of callus; aperture brownish within.

H.15.0; Gr. diam. 27.5; Ap.H. 14.5; D.9.0 mm. Holotype, Baker coll., 846.

H.15.0; Gr. diam. 26.0; Ap.H. 15.5; D.9.5 mm. Paratype, Baker coll., 843.

H.14.0; Gr. diam. 26.0; Ap.H. 13.0; D.8.0 mm. Paratype, Baker coll., 843.

*Type Locality.* Tomahawk lake, Oneida county, Wis.

*Types.* Baker collection, as above; Acad. Nat. Sci. Phil., 140269.

*Helisoma pilsbryi* proves to be another composite species including in its references large specimens of *trivolvis* and especially the recently recognized species *infracarinatum*. The rounded, uncarinated whorls of the base are its principal distinguishing feature, differing widely in this respect from the new form called *infracarinatum* in which at least the inner basal whorls are always carinated. • The rounded whorls of *pilsbryi* will at once distinguish it from any member of the *corpulentum* complex. In previous references the author has considered this form to be a variety of the common *trivolvis*. But the form of the shell is sufficiently characteristic, it would seem, to consider *pilsbryi* another form allied to *trivolvis* and *infracarinatum*. The radula formula ranges from 27-1-27 to 29-1-29, whereas that of *trivolvis* ranges from 22-1-22 to 26-1-26. The previous record (Fresh Water Moll. Wis., p. 334) of 23-1-23 for *pilsbryi* was an error, four different membranes examined with high powers gave not less than 27 nor more than 29 teeth on each side. The specimens were from Chetek region in Wisconsin.

Geographically, *pilsbryi* is distributed from New Brunswick westward to Wisconsin and northward to the vicinity of the Canadian boundary. The records upon which this distribution is based are as follows:

In Nat. Hist. Museum, U.I., Tomahawk lake, Oneida county, Wis. (Z29138, 29139); Chetek lake, Prairie lake, Taber lake, Barron county, Wis. (Z13482, 13485, 13496, 13527, 13538), collected by F. C. Baker; Plum lake (25129), Star lake (29916), Nixon lake (23130), outlet Big Johnson lake (23128), Vilas county, Wis., collected by A. R. Cahn; Little Arbor Vitae lake, Vilas county, from Wis. Geol. Nat. Hist. Surv. (Z18630); first lake on Green river, Restigouche district, New Brunswick (Z32479), collected by O. O. Nylander; Baker collection as follows:

Oneida lake, New York (863), Cazenovia lake, Madison county, N.Y. (850).

Meach lake, Quebec, Canada (LaRocque).

The states from which authentic specimens are represented are New York, Michigan, Wisconsin, and Minnesota. It is apparently rare in Canada, the only specimens seen being from New Brunswick and Meach lake. All material from Canada previously referred to *pilsbryi* is now referable to *infracarinatum*. *Pilsbryi* appears to occupy a strip of territory in the United States somewhat south of the International Boundary. It will probably be found in some of the lakes immediately north of the boundary.



*Helisoma infracarinatum* F. C. Baker

Plate II, figures 6-15; Plate IV, figures 15, 16, 20

*Helisoma infracarinatum* F. C. Baker, Nautilus, XLVI, p. 8 (1932).*Planorbis binneyi* Baker, Nautilus, XXIII, p. 41 (1909) (part).*Planorbis trivolvis* Whiteaves, Can. Nat. and Geol., VIII, p. 104 (1863); and of most Canadian authors.

Shell resembling *Helisoma pilsbryi* in general form, but distinguished by a more or less heavy carina on the centre of the basal whorls; the umbilical region is more sunken and usually exhibits three full whorls, whereas in *pilsbryi* the whorls shown are a trifle less than three; the spire whorls are carinated, the body whorl sharply carinated, whereas they are rounded or bluntly angled in *pilsbryi*; the aperture is greatly expanded below and forms a strongly angled V-shape above with the dorsal carina extending to the aperture, and the lip is heavily reflexed, features absent in *pilsbryi*; *infracarinatum* also has a thicker shell; the sculpture is rib-striate, coarser than in *pilsbryi*; radula formula 32-1-32 to 37-1-37, whereas in *pilsbryi* it is 27-1-27 to 29-1-29.

H. 14.0; Gr. diam. 25.5; Ap. H. 12.6; D. 8.5 mm. Holotype, U.I. coll. Z32361.

H. 12.3; Gr. diam. 24.0; Ap. H. 11.0; D. 7.3 mm. Paratype, U.I. coll. Z32362.

H. 12.3; Gr. diam. 23.0; Ap. H. 11.1; D. 7.2 mm. Paratype, U.I. coll. Z32362.

H. 10.0; Gr. diam. 18.0; Ap. H. 9.5; D. 6.0 mm. Paratype, U.I. coll. Z32362.

*Type Locality.* Basswood River rapids, Rainy River dist., Ontario, Canada.

*Types.* Mus. Nat. Hist., U.I., holotype and paratypes, Z32361, Z32362; paratypes, Nat. Mus., Canada, No. 3222; Acad. Nat. Sci. Phil., 158594.

This species appears to be one of the most abundant *Helisomas* in certain parts of Canada. It has been confused with both *corpulentum* and *pilsbryi*, from both of which it is quite distinct. The differentiating characteristics separating it from *pilsbryi* have been noted above. From *corpulentum* it differs in having the carina in the centre instead of at the edge of the whorl and the sculpture is much finer; from the race *multicostatum* it differs in having a rounded instead of a flattened base, a rounded instead of a flattened body whorl, and generally more rounded whorls above and below. *Infracarinatum* is liable to be confused with large forms of *trivolvis* which have a decided carina on the whorls of the upper surface. In the absence of the radula these shells may be distinguished by being of much shorter axial height, and by having an aperture wider than high, whereas it is the reverse in the present species. Such perplexing shells of *trivolvis* occur in the lakes of central Wisconsin. These shells differ from *macrostomum* in the possession of a sharp keel on the lower whorls, those of *macrostomum* being rounded.

There is the most perplexing variation in the series of shells here referred to *infracarinatum*. Specimens from Basswood River rapids and from Georgian bay are typical, with a well-developed carina in the centre



of the basal whorls. In the Georgian Bay lot, however, there are some specimens with the body whorl rounded on the base, although the inner whorls are subangulated or even angled. These connect perfectly with the Rideau River shells which have a rounded body whorl with subangulated inner whorls. These shells show considerable variation in this respect, but the inner whorls appear to be invariably carinated as in the Basswood River and Georgian Bay shells. In some of the Canadian lakes both *infracarinatum* and *corpulentum multicostatum* occur and the two forms are difficult to distinguish in the case of some adult shells. Thus the two forms occur in Bamaji lake and in lac des Mille Lacs swamp. An examination of the young or very immature specimens will invariably separate the two species, that of *multicostatum* having a sharp carina encircling the basal whorl, whereas this part of the shell is rounded or but slightly angulated in *infracarinatum*. This feature is well shown on Plate IV, figures 20 and 21. The radula formula of the several lots referred to *infracarinatum* is shown below: Basswood river, 33-1-33 to 38-1-38; Rideau river, 34-1-34 to 37-1-37; Bamaji lake, 31-1-31 to 38-1-38; lac des Mille Lacs swamp, 30-1-30 to 37-1-37.

The geographic distribution of this species appears to be extensive. The material examined is as follows:

Nat. Mus., Canada, many localities in Rideau river; U.S. Nat. Mus., Rideau river, collected by F. R. Latchford (120987, 251144, 346625, 361736); Mus. Nat. Hist. U.I., Basswood River rapids (types); marshy area on Toad island, Georgian bay, collected by Dr. R. C. Rush (Z25258); Marchington river, Kenora district (Z30850); Bamaji lake (Z32342, 32343), Blackstone lake (30868), Trout lake (Z32363), Patricia portion of Kenora district; lac des Mille Lacs swamp, Thunder Bay district (Z32335); all collected by Dr. A. R. Cahn. The Baker collection contains a lot of *infracarinatum* from Thousand Island park, St. Lawrence river, N.Y. (852). These were previously referred to *binneyi*.

The collection of the U.S. National Museum contains two lots apparently referable to *infracarinatum*. One from isle La Crosse, English river, collected by Robert Kennicott (29231), and one from Knee lake, western Ontario, collected by E. A. Preble (180279). These shells were previously referred to *corpulentum* by Dall (Alaska Moll., p. 87) but are not that species. Both are characterized by great axial height and expanded aperture. A specimen from Knee lake measures H. 14.0; Gr. diam. 23.6; Ap. H. 14.5; D. 8.1 mm. The height of the expanded aperture is 16 mm. It is desirable that more specimens of this form be examined, especially the radula, as it might constitute a variety of *infracarinatum*. The lower whorls are not as distinctly carinated as in that species but more so than in *pilsbryi*.

In the American Museum of Natural History, two specimens occur in the Jay collection, one marked Winnipeck river, and labelled *corpulentus* (6222); another specimen, half grown (11133) is without locality, but labelled *corpulentus*. A specimen in the Cooke collection, 15576, from 'lake Superior,' labelled *corpulentus*, is *infracarinatum*. Three specimens in the Stewart collection from Winnipeg river are *infracarinatum*.

A specimen in the collection of the Zool. Mus., Univ. Mich. (49737) from Wabamun lake, Alberta, has a wide, flaring aperture and heavily re-



flexed lip. There are five whorls, three basal whorls with the body whorl rounded, the inner ones subcarinate. The part of the body whorl near the lip suddenly enlarges, forming a very great axial height at this point. The specimen measures as follows: H. 15.5; Gr. diam. 25.5; Ap. H. 18.0; D. 9.0 mm. The height at the aperture is 18.5 mm., whereas that part of the shell, body whorl, on the opposite side of the aperture, measures only 12.5 mm. It would be very interesting to see more of the shells from this lake.

Mr. A. LaRocque says of this species:

"I have some twenty lots of this species in my collection from various localities on Rideau river all the way from Rideau falls, where it empties into Ottawa river, up to Burritt rapids, about 40 miles from Ottawa. Also a lot from Rouge river at St. Andrews, Quebec, near its junction with rivière du Nord. I have found no *infracarinatum* in Ottawa river and no typical *trivolvis* in Rideau river."

The geographic distribution of *infracarinatum* appears to be from Quebec west to Alberta and south to southern Ontario and northern New York.

#### IDENTIFICATION OF CORPULENTUM REFERENCES IN THE LITERATURE

1824. Say, T.: Original Description in Long's Expedition, II, p. 262, Pl. xv, fig. 9. Lake of the Woods, Winnipeg River, etc. Type localities.
1837. Beck, H.: Index Molluscorum, p. 118. *Corpulentum*.
1840. Whittimore, T. J.: Note on *Planorbis corpulentus*; Am. Jour. Sci. and Arts, 38, p. 193. Otter Creek, Middlebury, Vt. *Trivolvis*, approaching *macrostomum*.
1841. Gould, A. A.: Report on the Invertebrata of Mass, p. 201. "*Planorbis corpulentus* seems little else than an exuberant growth of the shell." *Trivolvis*.
1841. Adams, C. B.: Catalogue of Mollusca of Middlebury, Vt.; Am. Jour. Sci. and Arts, 40, p. 269. Referred to *lentus* authors (non Say) and referable to the large form of *trivolvis* approaching the race *macrostomum*.
1842. Adams, C. B.: In Thompson's History of Vermont, p. 155 (reprint, p. 5). *Trivolvis*.
1843. De Kay, J. E.: Zoology of New York, Mollusca, p. 64, Pl. viii, fig. 185, a, b. From lake Champlain. Is the large form of *trivolvis* approaching *macrostomum*. Also called *lentus* by many of the early writers.
1844. Haldeman, S. S.: Mon. Fresh Water Univ. Shells of N.A., p. 19, Pl. iii, figs. 7-9. From Lewis river, Washington (formerly Oregon). *Binneyi*.
1845. Wheatley, Chas. M.: Cat. of the Shells of U.S., p. 21. *Trivolvis*.
1848. Anthony, J. G.: List of Land and Freshwater Shells Found in the Vicinity of Cincinnati, Ohio. *Trivolvis*.
1852. Jay, J. C.: Cat. of Recent Shells, etc., 4th Ed., p. 267. Two specimens in Jay collection, one from Winnipeg river, are *infracarinatum*.
1852. Gould, A. A.: Wilkes U.S. Expl. Exped., Mollusca, p. 114, fig. 130, a, b, Columbia river, Oregon. *Binneyi*.
1852. Lapham, I. A.: Systematic Catalogue of the Animals of Wisconsin; Trans. Wis. State, Agric. Soc., II, p. 368. N.W. Territory (Say) refers to the true *corpulentum*, which is not found in Wisconsin.

1856. Lewis, James: List of Living Mollusca in Little Lakes, Otsego County, N.Y.; Proc. Bost. Soc. N.H., VIII, p. 260. *Trivolvis*.
1856. Carpenter, P. P.: Rept. Moll. West Coast N.A., pp. 210, 316. *Binneyi*.
1857. Dawson, J. W. (?): Description of Some of the Fresh Water Gastropods Inhabiting the Lakes and Rivers of Canada; Can. Nat., II, p. 202. "Seems little more than exuberant growth of this shell." Large form of *trivolvis*.
1858. Complete Writings of Thomas Say, etc., Binney's Ed., p. 128, Pl. 74, fig. 9. *Corpulentum*.
1859. Chenu, L. C.: Man. de Conch., I, p. 482, f. 3560. *Binneyi*.
1859. Cooper, J. G.: Pacific R.R. Report, Mollusca, p. 378. *Binneyi*.
1860. Lapham, I. A.: A List of the Shells of the State of Wisconsin; Proc. Acad. Nat. Sci. Phil., p. 155. "N.W. Territory, Say." *Corpulentum*.
1861. Tristram, H. B.: Cat. Coll. Terr. and Fluv. Moll. in Guatemala; Proc. Zool. Soc., p. 231. This reference might have been based on specimens of *tenuis* or *caribaeum*. None of the large *Pierosoma* is found in Central America.
1863. Whiteaves, J. F.: On the Land and Freshwater Mollusca of Lower Canada; Can. Nat. and Geol., VIII, p. 104. Under *trivolvis*, *corpulentus* is said to be but a variety of the former species.
1864. Carpenter, P. P.: Supplement to Rept. on Moll. West Coast of N.A., pp. 532, 558, 599, 607, 675. *Binneyi*.
1865. Binney, W. G.: Land and Fresh-water Shells of North America, pp. 114, 115; Smith. Misc. Coll., 143. The true *corpulentus* is figured and described on p. 114, after Say. Figs. 191 and 192 of p. 115 are *binneyi*. Fig. 193 is *occidentale* Cooper.
1867. Tryon, Geo. W.: Am. Jour. Conch., III, p. 197. The *corpulentus* of Gould, Haldeman, and Binney is here described as *binneyi*. Tryon considers *corpulentus* Say a synonym of *trivolvis*.
1870. Tyron, Geo. W.: Con. Hald. Mon. Freshwater Shells U.S., pp. 199, 204. Refers the figures of Haldeman and Binney to *binneyi*. Considers *corpulentus* a synonym of *trivolvis*.
1872. Carpenter, P. P.: Mollusca of Western North America, pp. 18, 44, 85, 93, 161. *Binneyi*.
1873. Strebel, H.: Beitr. Mex. Land-und Sussw.-Conch., I, p. 39, Pl. 5, fig. 19. *Planorbis trivolvis* or *corpulentus*. Later described as *Planorbis tenuis* var. *strebelianus* by von Martens, in Biol. Cent.-Amer., p. 385 (1899).
1875. Dawson, George M.: Land and Fresh-water Mollusca collected during Summers of 1873-74, etc.; British N.A. Boundary Com., Report on Geology and Resources, etc., Appendix E, p. 349. Flag island, Lake of the Woods. Dawson remarks that if *corpulentus* is a variety of *trivolvis* it is a well-marked one. Although no specimens have been examined from this expedition there is every reason to believe that these specimens were the true *corpulentus*.
- 1876 (?). Sowerby, G. B.: Reeves' Conch. Icon., XX, fig. 4. *Binneyi*.
1876. Ingersoll, Ernest: Report on the Natural History of the United States Geological and Geographical Survey of the Territories, 1874; Ann. Rept. U.S. G. and G. Surv. Terr., 1874, p. 404. Oregon and Washington references are *binneyi*; lake Osoyoos and Okanagan river are *binneyi*.
1881. Stearns, R. E. C.: Observations on Planorbis; Proc. Acad. Nat. Sci. Phil., pp. 94, figs. 4, 4a; p. 103, figs. 18, 19 are *binneyi*. In the list of species on p. 101 the forms represented are: Indian river, Texas (error for Indian



- river, Florida), *H. duryi intercalare* (Pilsbry) 47562; Bexar county, Texas, *H. tenuis* (Phil.) 47554; Miami, Florida, 153412, 47558, are *H. duryi intercalare* (Pilsbry); near Portland, Oregon, 47611, *H. occidentale* (Cooper); lake Simcoe, Canada, 57555, is *H. trivolvis* (Say). (Numbers from the Stearns' collection, U.S. Nat. Mus.)
1881. Melville, J. C.: List of Mollusca obtained in South Carolina and Florida (principally at the island of Key West, in 1871-72); Jour. Conch., III, p. 167. As the reference does not state whether the specimens came from South Carolina or Florida it is impossible to infer what the species may have been. It was not *corpulentum*. If from Florida the species was probably *H. duryi intercalare* (Pilsbry).
1883. Cope, E. D.: On the Fishes of the Recent and Pliocene Lakes of the Western Part of the Great Basin, and of the Idaho Pliocene Lake; Proc. Phil. Acad. Sci., p. 140. The *Planorbis corpulentus* recorded from Upper Klamath lake is referable to a form of *Helisoma occidentale* (Cooper).
1885. Christy, Robert M.: Notes on the Land and Fresh-water Mollusca of Manitoba; Jour. Conch. (Leeds) IV, p. 348. Lake of the Woods (after Dawson). *Corpulentum*.
1886. Clessin, S.: Conch. Cab., Planorbis, p. 144, Pl. 17, fig. 4; Pl. 22, fig. 1. *Binneyi*.
1887. Grant, U.S.: Notes on the Molluscan Fauna of Minnesota; Ann. Rept. Geol. Nat. Hist. Surv. Minn., XVI, p. 484. *Corpulentum vermillionense*.
1893. Walker, Bryant: The Shell-bearing Mollusca of Michigan; Nautilus, VI, p. 136. *Trivolvis* (part); *corpulentum* (part).
1894. Walker, Bryant: A Review of Our Present Knowledge of the Molluscan Fauna of Michigan. Detroit. P. 18. *Trivolvis*.
1894. Stearns, R. E. C.: The Shells of the Tres Marias and Other Localities along the Shores of Lower California and the Gulf of California; Proc. U.S. Nat. Mus., 17, p. 166. The Cape St. Lucas shells referred to are either *tumens* or *tenuis*. The Columbia River references are to *binneyi*. The Lake Winnipeg references probably to the true *corpulentum*.
1899. Hanham, A. W.: A List of the Land and Fresh-water Shells of Manitoba; Nautilus, XIII, p. 6. Lake of the Woods (Dawson). *Corpulentum*.
1900. Walker, Bryant: The Genuine *Planorbis corpulentus*, Say; Nautilus, XIII, pp. 133-138. On Plate iii, figs. 1 to 3, are *corpulentum*; figs. 4 to 6 are *corpulentum vermillionense* from Vermilion lake, Minn. Fig. 7 is apparently *corpulentum*, but the locality Vermilion lake, Hudson Bay territory, is open to question. See further under *corpulentum* in body of paper. Footnote p. 134; the specimen in the Jay collection is *infracarinatum*, not *corpulentum*. Specimen from Cooke collection is also *infracarinatum*. The specimens from the Haines collection are small *trivolvis*.
1905. Dall, William H.: Alaska Land and Fresh Water Mollusks; Harriman Alaska Series, XIII, p. 87. Fig. is *corpulentum*, original figure of Say. All references are to true *corpulentum* excepting following: Isle La Crosse lake is *infracarinatum*; Knee lake, Keewatin, is *infracarinatum*; lake Simcoe, Ontario, is *trivolvis*.
1905. Whiteaves, J. F.: List of some Fresh-Water Shells from North-Western Ontario and Keewatin; Ottawa Nat., XIX, p. 29. English river below Manitou falls. *Corpulentum*. Same, p. 32. Knee lake, on Hayes river. *Infracarinatum*. (Specimens collected by E. A. Preble from Knee lake, now in Smith. Coll., are this species.)
1906. Whiteaves, J. F.: List of Land and Fresh Water Shells from the District of Keewatin; Geol. Surv., Canada, Ann. Rept., vol. XVI, p. 164. Minnitaki lake; lac Seul; Sioux Outlook, English river. *Corpulentum*. Root River specimens are *corpulentum multicostatum*.

1906. Chadwick, Geo. H.: Notes on Wisconsin Mollusca; Bull. Wis. Nat. Hist. Soc., 4, p. 83. *Planorbis trivolvis* Say, large form. This is the large form of *trivolvis* approaching *macrostomum*.
1910. Latchford, F. R.: Conchological Notes; Ottawa Nat., XXV, p. 19. Kettle falls, east end Rainy lake. *Corpulentum*. The shells referred to *binneyi*, from Rideau canal and river, are referable to the new species, *infracarinatum*.
1911. Walker, Bryant.: A Check-list of Michigan Mollusca; Mich. Acad. Sci., 13th Rept., 1911, p. 125. Is the true *corpulentum*, but its inclusion in the Michigan fauna is doubtful.
1918. Walker, Bryant.: A Synopsis of the Classification of the Fresh-water Mollusca of North America, etc.; Misc. Pub., Mus. Zool., Univ. Mich., 6, p. 98. *Corpulentum*.
1926. Winslow, Mina L.: A Revised Check List of Michigan Mollusca; Oc. Papers, Mus. Zool., Univ. Mich., 181, p. 14. *Corpulentum*. See Walker's paper, 1900.
1926. Mozley, Alan: Molluscs from the Manitoba-Ontario Boundary; Nautilus, 39, p. 126. Various localities on Winnipeg river. All apparently typical *corpulentum*, but specimens not examined.
1928. Mozley, Alan: New Records of Western Canadian Mollusca; Nautilus, 42, p. 17. Indian Bay Station, Falcon bay, Manitoba. Probably *corpulentum*.
1928. Baker, Frank C.: The Fresh Water Mollusca of Wisconsin; Bull. 70, Wis. Geol. and Nat. Hist. Surv., I, p. 337, Pl. xix, figs. 38-42. Figs. 40-42, Rainy lake, Ontario, typical *corpulentum*. Figs. 38-39, from Minnesota (locality unknown) are referable to *corpulentum vermillionense*.
1928. Baker, Frank C.: Mollusca from Vermilion and Pelican Lakes, Minnesota, with the Description of a New Variety of *Helisoma corpulenta*; Nautilus, 42, p. 131. From Vermilion lake, Minn. *Corpulentum vermillionense*. Typical *corpulentum* is mentioned on p. 131 as from Trout lake, Ont. The specimens quoted from Fall lake, Minn., and Kahnipiminanikok lake, Ont., are referable to *corpulentum multicostatum*.
1929. Baker, Frank C.: Certain Anatomical Features of the Fresh Water Mollusk, *Helisoma corpulenta* Say; Trans. Am. Micr. Soc., 48, p. 44. *Corpulentum vermillionense*.
1931. Baker, F. C., and Cahn, A. R.: Freshwater Mollusca from Central Ontario; Ann. Rept. for 1929, Nat. Mus., Canada, p. 56. The list of references to the literature have already been commented upon above. The localities listed on p. 56 are now distributed among the following races or the typical form: Trout lake, Ontario, is *corpulentum*; St. Joseph, Hill, Birch, and Abram lakes, Ontario, and Knife lake, Minn., are *corpulentum multicostatum*; Marchington river and Blackstone lake are *infracarinatum*.
1932. Baker, Frank C.: New Species and Varieties of *Helisoma* and *Gyraulus* from Canada; Nautilus, 46, pages 6-9. *Multicostatum*, *whiteavesi*, and *infracarinatum*.
1934. Henderson, Junius: Some Western Fresh Water Mollusks; Nautilus, 47, p. 87, Pl. 9, fig. 2. Describes and figures the true *binneyi* previously confused with *corpulentum*.

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- 1931b. Description of a New Variety of *Valvata Lewisi* Currier; Nautilus, XLIV, pp. 119-121.



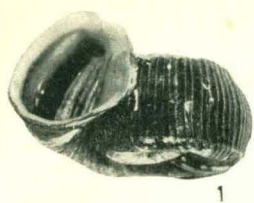
1932. New Species and Varieties of *Helisoma* and *Gyraulus* from Canada; *Nautilus*, XLVI, pp. 6-9.
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- Henderson, J., and Daniels, L. E.: 1917. Hunting Mollusca in Utah and Idaho in 1916; *Proc. Acad. Nat. Sci. Phil.*, pp. 48-81.
- Simpson, Chas. T.: 1914. A Descriptive Catalogue of the Naiades, or Pearly Fresh-Water Mussels, Part 1. Bryant Walker, Detroit, Mich.
- Tryon, Geo. W.: 1865. Descriptions of New Species of North American Limnaeidae; *Am. Jour. Conch.*, I, pp. 223-231.
- Whittaker, E. J.: 1924. Freshwater Mollusca from Mackenzie River Basin, Canada; *Nautilus*, XXXVIII, pp. 8-12.

## PLATE I

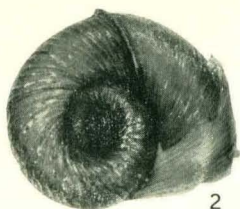
- Figures 1-7. *Helisoma corpulentum* (Say). Figures 1-5, 7, lac la Croix, Ont., University Illinois, Z32624; figure 4, shell about size of Say's type, University Illinois, Z32625; figure 6, Rainy lake, Ont., Baker coll., 1101.
- Figures 8-13. *Helisoma corpulentum vermillionense* F. C. Baker. Vermilion lake, Minn. Figure 8, holotype, Baker coll., 3021; others paratypes, Baker coll., 3014. Figures 7 and 10 back views of *corpulentum* (7) and *vermillionense* (10).
- Figures 14-20. *Helisoma corpulentum multicostatum* F. C. Baker. Kahnipiminanikok lake, Ont. Figure 14, holotype Z32306; figures 15-17, paratypes, University Illinois, Z32307. Figures 18-20, Birch lake, Ont., Z30864.

Figures enlarged  $1\frac{1}{2}$  diameters.

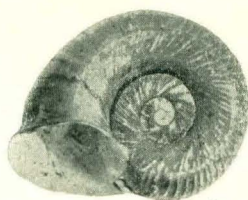




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## PLATE II

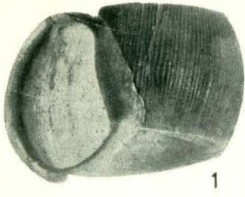
Figures 1-5. *Helisoma whiteavesi* F. C. Baker. Lac des Mille Lacs, Ont. Figure 1, holotype, Z32311; figure 2, paratype, Z32312; figures 3-5, type locality, Z32313.

Figures 6-15. *Helisoma infracarinatum* F. C. Baker. Figure 6, holotype, Z32361; figures 7-9, paratypes, Z32362, Basswood River rapids; figures 10-11, Georgian bay, Z25258; figures 12-14, Bamaji lake, showing rounded basal whorls, Z32342; figure 15, Rideau river, near Billings bridge, base subcarinate, Z32521.

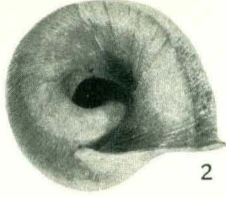
Figures 16-18. *Helisoma pilsbryi* (F. C. Baker). Tomahawk lake, Wis. Type locality, University Illinois, Z29138a.

Figures enlarged  $1\frac{1}{2}$  diameters.

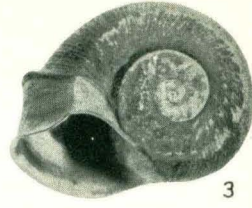




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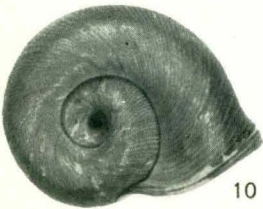
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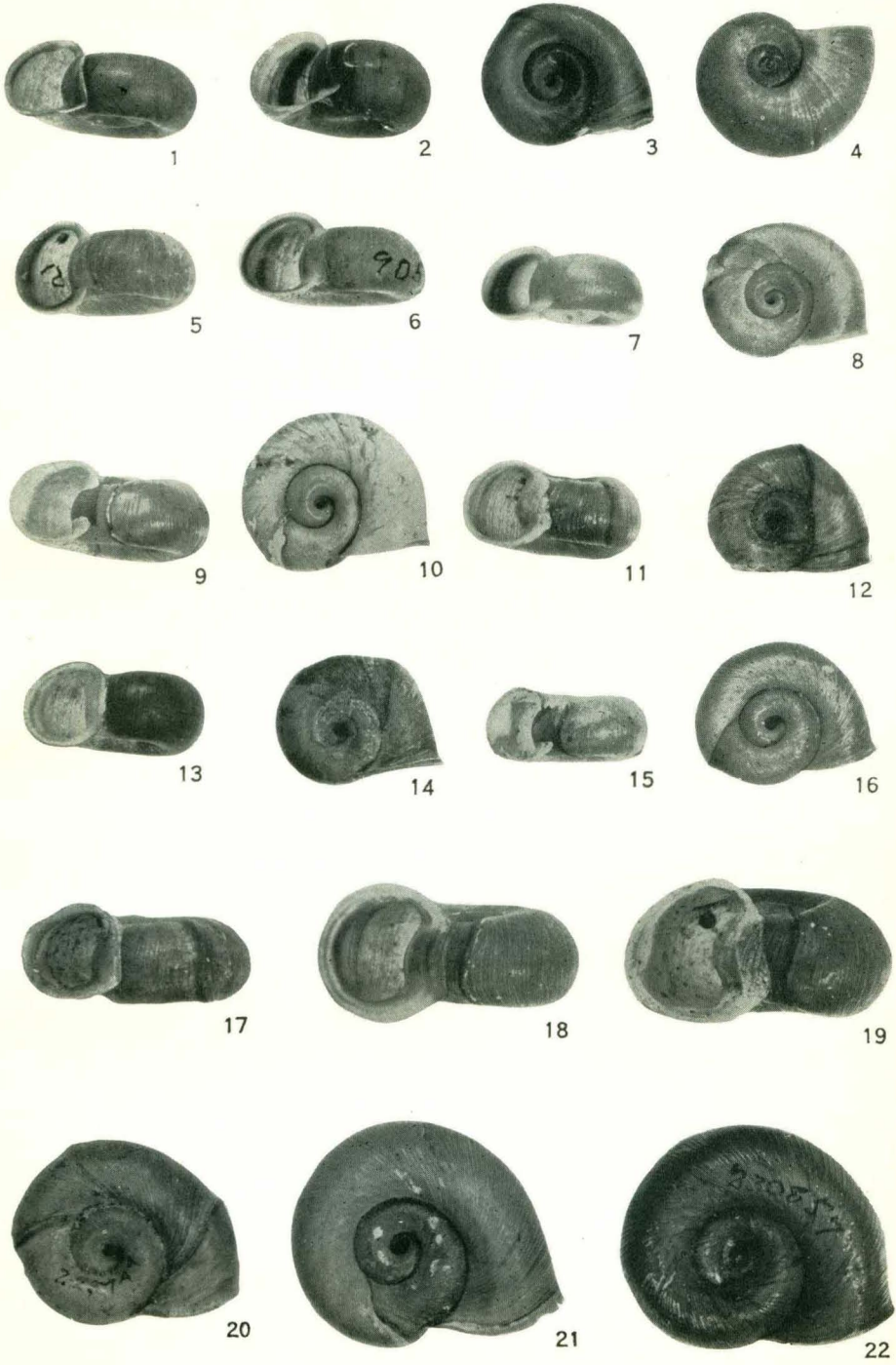
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## PLATE III

- Figures 1-8. *Helisoma trivolvis* (Say). Figures 1-4, Braddocks bay, near Rochester, N.Y., University Illinois, Z29789; figure 5, Oneida lake, N.Y., showing flaring aperture figured by Binney; figure 6, same locality but aperture not flaring, Baker coll., 905; figures 7-8, Ottawa river, Ontario, Baker coll., 3005.
- Figures 9-14. *Helisoma plexatum* (Ingersoll). Figures 9-10, Boulder, Col., University Illinois, Z32500; figures 11-12, 2 miles above Harricanaw river, Hannah bay, Ont., collected by Spreadborough, Nat. Mus., Canada, 3149; figures 13-14, Black Bear island, lake Winnipeg, Man., Dowling and Lambe coll., Nat. Mus., Canada, 2156.
- Figures 15-16. *Helisoma subcrenatum* (Cpr.). Little lake, near west end Great Slave lake, Mackenzie river. Nat. Mus., Canada, 3148.
- Figures 17, 20. *Helisoma trivolvis* (Say). Transition form. Pond near Presqu'île, lake Huron. University Illinois, Z23749.
- Figures 18, 21. *Helisoma trivolvis macrostomum* (Whiteaves). Pond near Bayfield, Bayfield county, Wis. University Illinois, Z13677a.
- Figures 19, 22. *Helisoma trivolvis macrostomum* (Whiteaves). Bamaji lake, Ont. University Illinois, Z30857a.

Figures enlarged  $1\frac{1}{2}$  diameters.





## PLATE IV

Figures 1-4. *Helisoma corpulentum* (Say). Lac la Croix. U.I., Z32626.

Figures 5-8. *Helisoma corpulentum vermillionense* F. C. Baker. Vermilion lake, Minn. U.I., Z32627.

Figures 9-12. *Helisoma corpulentum multicostatum* F. C. Baker. Kahnipiminanikok lake, Ont. U.I., Z32628.

Figures 13-14. *Helisoma whiteavesi* F. C. Baker. Lac des Mille Lacs, Ont. U.I., Z32312.

Figures 15-16. *Helisoma infracarinatum* F. C. Baker. Lac des Mille Lacs swamp. U.I., Z32629.

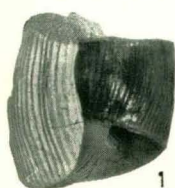
Figures 17-19. *Helisoma trivolvis* (Say). Genesee river, N.Y. U.I., Z29130a.

Figure 20. *Helisoma infracarinatum* F. C. Baker. Lac des Mille Lacs swamp. U.I., Z32629.

Figure 21. *Helisoma corpulentum multicostatum* F. C. Baker. Lac des Mille Lacs swamp. U.I., Z32312.

Figures enlarged 2 diameters. Immature.





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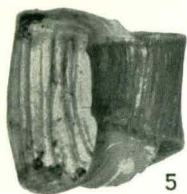
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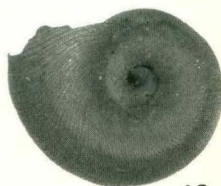
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## PLATE V

Figures 1-3. *Helisoma trivolvis macrostomum* (Whiteaves). Lectotype from Mile-end Toll Gate, Montreal, Canada. Specimens from Perth Municipal Museum, now in National Museum of Canada, No. 3869 (lectotype, lower figure); 3870 (paratypes, upper figures).

Figures enlarged 2 diameters.



PLATE V

