STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY
RALPH J. BERNHAGEN, Chief

BULLETIN 62

PART 2
(OF 4 PARTS)

PLEISTOCENE MOLLUSCA OF OHIO

by

Aurèle La Rocque

COLUMBUS
1967

STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY
RALPH J. BERNHAGEN, Chief

BULLETIN 62

PART 2

(OF 4 PARTS)

PLEISTOCENE MOLLUSCA OF OHIO

by

Aurèle La Rocque

COLUMBUS
1967

Price $2.50

Chapters 6 and 7 will appear as parts 3 and 4 of Bulletin 62 and will cover the detailed classification and description of the freshwater and terrestrial Gastropoda.

Columbus Blank Book Company
Columbus, Ohio 43207
1967

CONTENTS

CHAPTER 4 - NAIADES

CHAPTER 5 - SPHAERIIDAE

CONTENTS

ILLUSTRATIONS

FIGURES

CONTENTS

PLATES

Chapter 4

NAIADES

Class PELECYPODA
Order PRIONODESMACEA

This order is represented in Ohio by two families, the Margaritanidae and Unionidae, which are grouped together as the Naiades or freshwater mussels. Shells of this group seldom appear in lists of Pleistocene Mollusca, in Ohio or elsewhere. There are two reasons for this lack of records: first, the size of these clams is such that they are not included in the small samples usually taken; second, Naiades break down easily when attempts are made to remove them from the matrix in which they are embedded and good specimens are often discarded as too fragmentary for identification. In practice, it is not necessary to have an entire specimen or even a whole valve for identification; the species, or at least the genera, can be recognized from the hinge area alone or even from the sculpture of the beaks. Fragmentary specimens should therefore be collected, but care should be taken to include these diagnostic parts of the shells. The results that can be obtained from such material are rewarding enough from the paleogeographic and paleoecologic standpoint to justify the extra care and effort necessary to secure them.

The majority of Naiades are propagated by a larval form (the glochidium) which must spend its early larval life as a parasite on the gills of fish. In some cases, the naiad species is associated only with a particular kind of fish; in other cases, the range of fish hosts is greater. Fossil glochidia have been found in Pleistocene peat deposits by Wagner (1958) and it is possible that they are present but have been overlooked in other deposits.

The fossil record of the Naiades extends back to the Triassic but the group does not become abundant until the late Cretaceous and early Tertiary. At present, the two families recorded in this report have an extensive Nearctic range; in North America, the greatest variety of genera and species is developed in the Mississippi drainage. Other drainages have some cosmopolitan species and a few endemic genera and species, but generally yield a poorer variety of forms.

Family MARGARITANIDAE

The main differences between this family and the Unionidae reside in the soft parts of the animal; the Ohio genera and species can be distinguished by shell characteristics but in the fossil state no inkling of familial position is given by the shell structure.

Genus *Cumberlandia* Ortmann 1912

Cumberlandia Ortmann 1912, Nautilus, v. 26, p. 13 (*fide* Neave).

Cumberlandia Walker 1918, Synopsis and cat. fresh-water Moll., p. 41.

Type.—*Unio monodonta* Say.

Diagnosis.—Shell elongate, generally arcuate, rounded in front, almost lacking a posterior ridge; beaks rather low, sculpture consisting of a few coarse parallel ridges which follow the growth lines; epidermis concentrically striate, brownish or blackish; hinge teeth generally imperfect or not fully developed, two more or less perfect pseudocardinals in the left valve and one in the right, in many cases reduced to mere tubercles; laterals short, generally imperfect or wholly wanting; cavity of the beaks rather shallow.

Remarks.—The type species was once placed in the genus *Margaritana (Margaritifera auctt.)*, with which it is undoubtedly allied. The geologic implications of this relationship are rather interesting as *Margaritana* is holartic in distribution, probably carried from one freshwater drainage to another by its fish host, a salmonid; this accounts for its absence from the southern part of both North American coastal drainages and from the truly inland waters of the continent. Yet at some time or another the ancestral form of both *Margaritana* and *Cumberlandia* must have penetrated into the rivers of the southeastern United States, where *Cumberlandia* developed, to persist

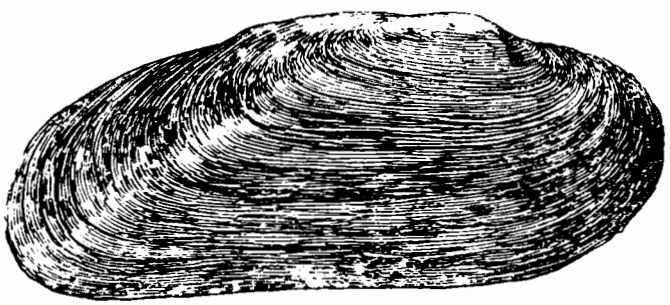


FIGURE 3.—*Cumberlandia monodonta,* exterior of the shell, X1; after Walker (1918, p. 41, fig. 142).

as an apparent endemic and to remain, with few exceptions, south of the glacial boundary.

Cumberlandia monodonta (Say) 1829
Fig. 3

Unio monodonta Say 1829, New Harmony Disseminator, v. 2, p. 293; 1830, Am. Conchology, no. 1, pl. 4.
Margaritana monodonta Call 1900, Moll. Ind., p. 526.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 393.
--- --- Ortmann 1912, Carnegie Mus. Annals, v. 8, p. 233.
Cumberlandia monodonta Ortmann 1912, Nautilus, v. 26, p. 13.
Margaritana monodonta Simpson 1914, Descr. cat. Naiades, p. 521.
--- --- F. C. Baker 1928, Fresh water Moll. Wis.,

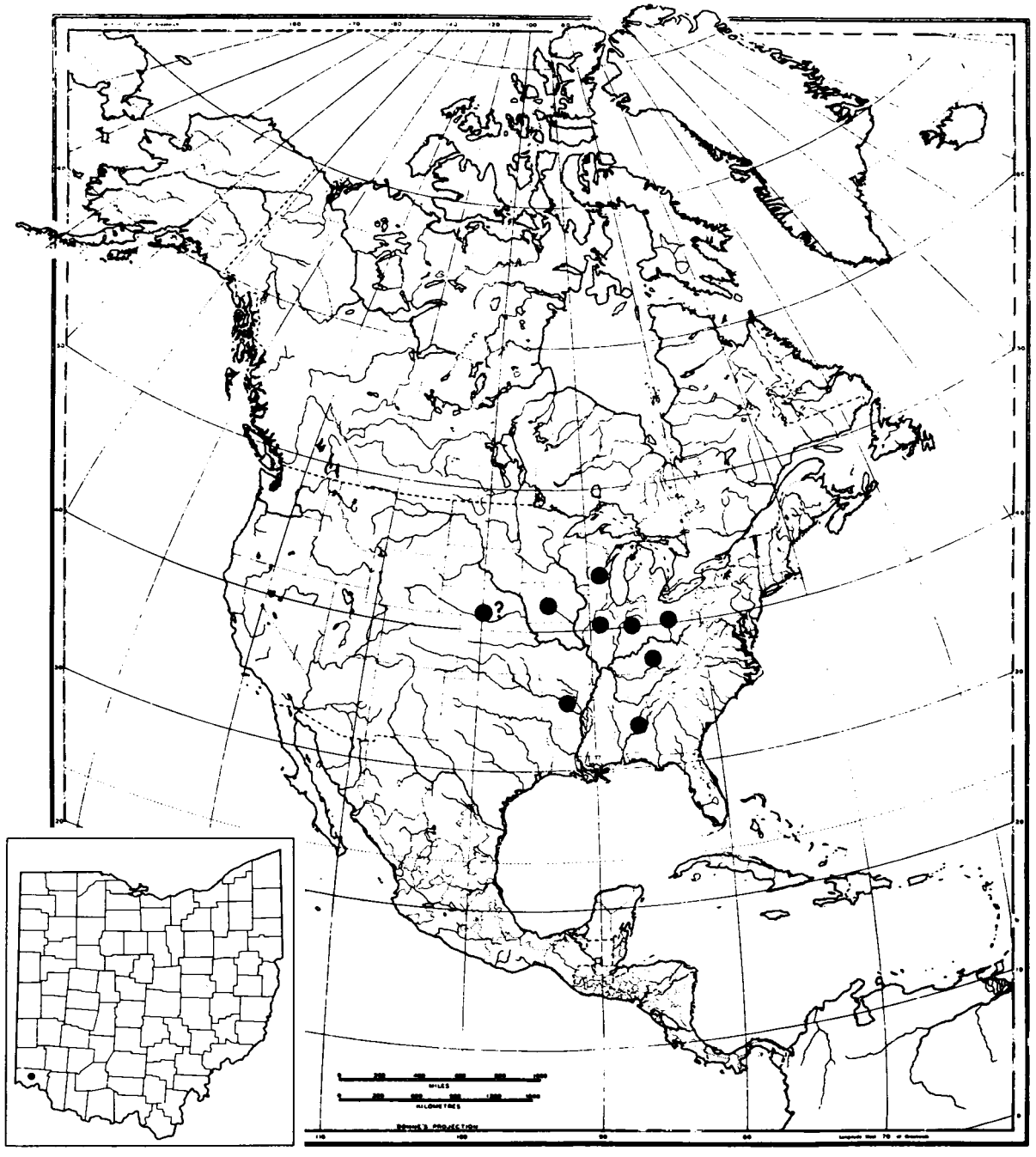


FIGURE 4.—Distribution of *Cumberlandia monodonta* in North America; *inset,* distribution in Ohio.[4]

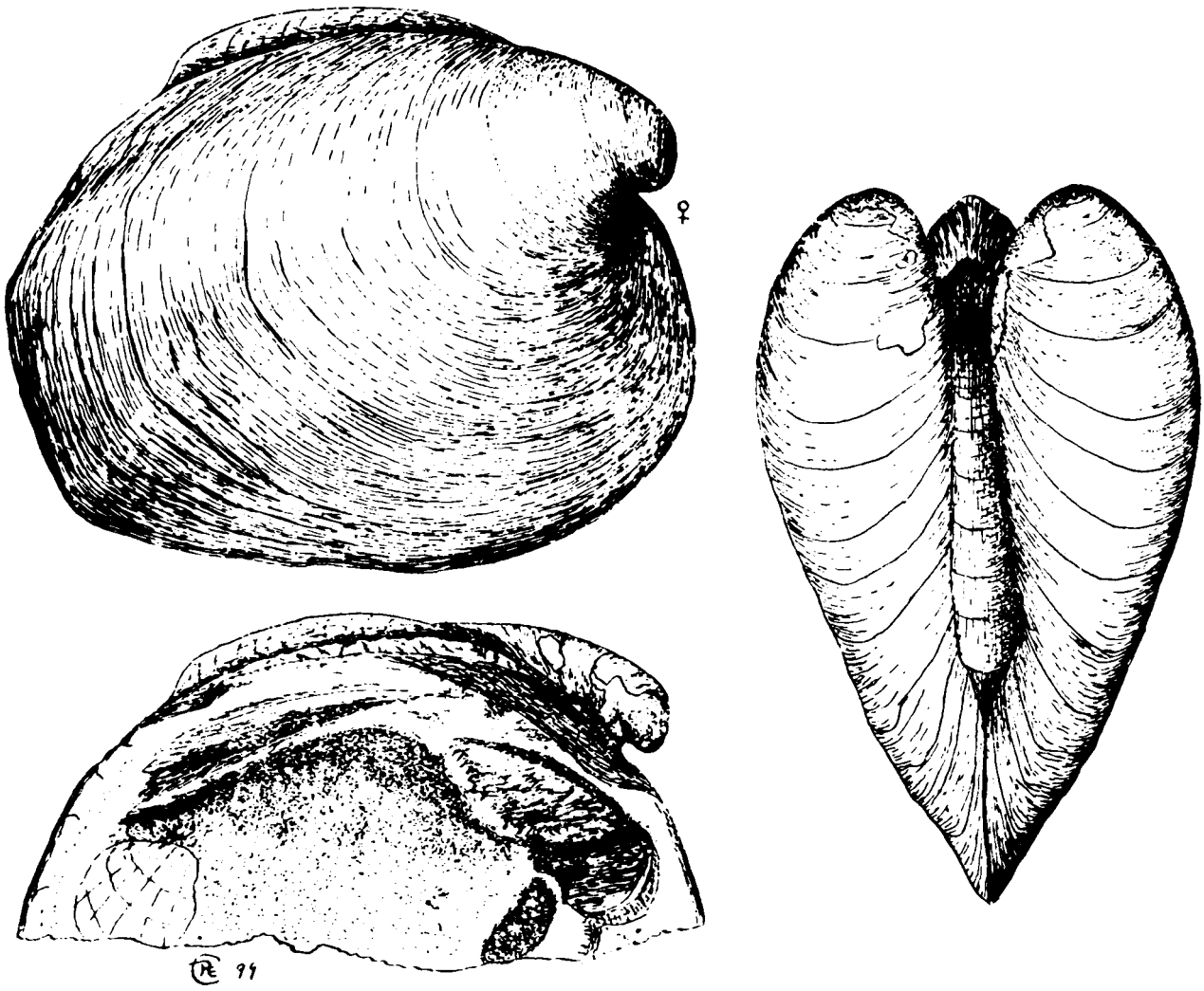


FIGURE 5.—*Fusconaia ebenus,* three views of the shell, X1; after Call, (1900, pl. 58).

pt. II, p. 48, pl. 31, figs. 1, 2 (glochidia).

Cumberlandia monodonta Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 305.

--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 456.

Type locality.—Falls of the Ohio and Wabash River (Say).

Diagnosis.—Shell elongate, arcuate, compressed; beaks anterior, low, with sculpture of heavy ridges parallel with the growth lines; anterior end broadly rounded, posterior end rounded; ventral margin broadly concave, dorsal margin broadly convex; posterior ridge curved, broadly rounded; surface with heavy growth lines, somewhat raised; pseudocardinals greatly reduced, a single tubercular tooth in the right valve fitting into a depression in the left valve in old specimens, in which the laterals also become indistinct and merge into the hinge line; nacre white, more or less granular and pitted, iridescent posteriorly (modified from F. C. Baker, 1928a, pt. II, p. 48).

Ecology.—Found on various kinds of stream bottom, including sand, gravel, and mud, usually deeply buried; it requires a fairly good current. Its habitat is the larger rivers and, unlike its relative, *Margaritana margaritifera,* of the eastern states and the Pacific Coast, it does not inhabit the small brooks and streams.

General distribution (fig. 4).[4]—Ohio; Cumberland and

4. See part 1, p. 9-10, for full discussion of map symbols.
● Living mollusk record. X Erroneous record.
○ Fossil mollusk record. ? Doubtful record.
∴ Stream drift record.

Tennessee River systems; Illinois; eastern Iowa; Nebraska? (Simpson, quoted by Baker, 1928a).

Distribution in Ohio (inset, fig. 4).—Sterki (1907a, p. 393) gives "Ohio River at Cincinnati (still!), but not common." I have no other records.

Geologic range.—Unknown.

Family UNIONIDAE
Subfamily UNIONINAE
Genus *Fusconaia* Simpson 1900

Fusconaia Simpson 1900, Synopsis Naiades, p. 784 (*fide* Neave).

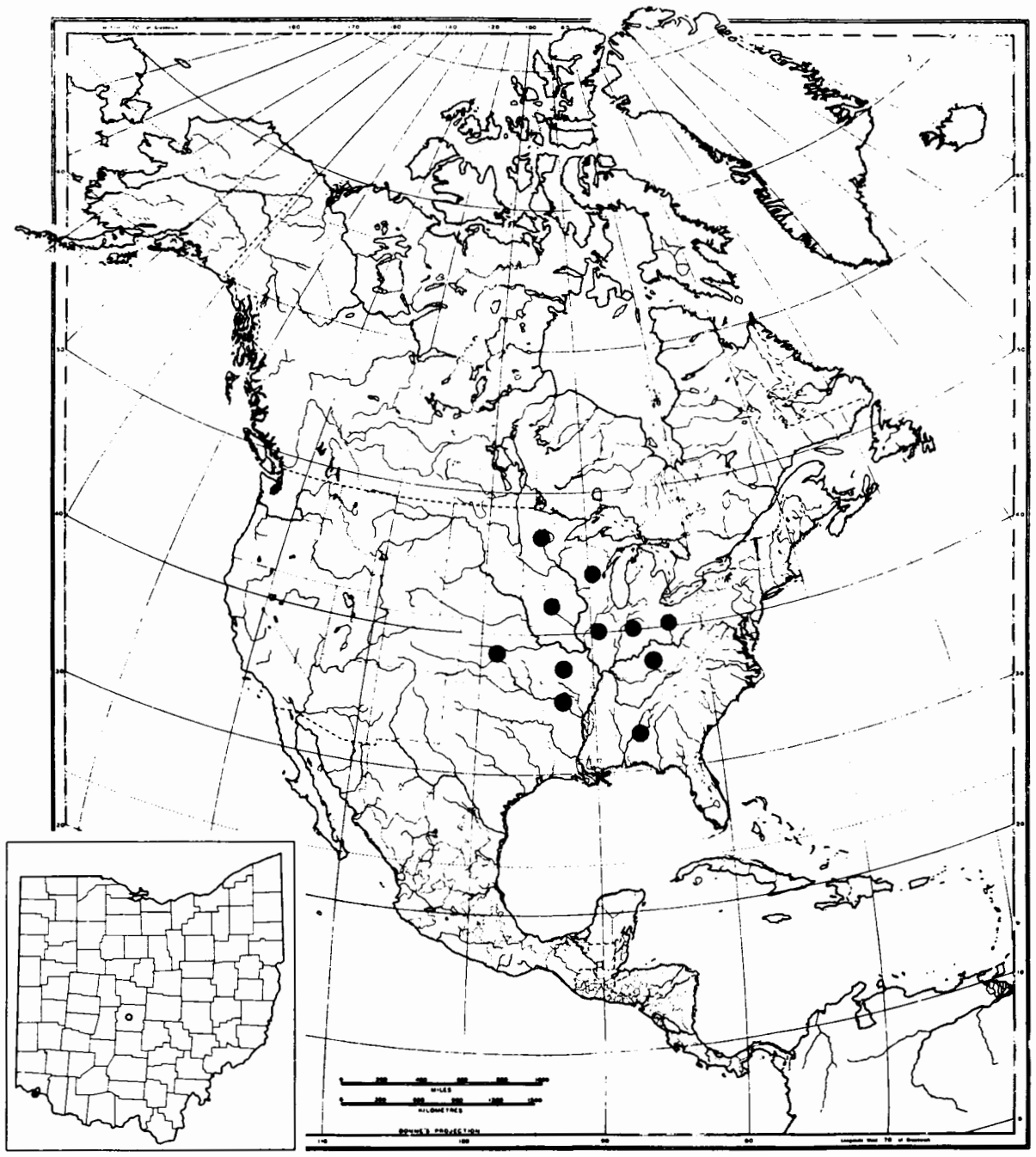


FIGURE 6.—Distribution of *Fusconaia ebenus* in North America; *inset,* distribution in Ohio.

Fusconaja (*err. pro -naia* Simpson 1900) Ortmann 1912, Carnegie Mus. Annals, v. 8, p. 240 (*fide* Neave).
Fusconaia Walker 1918, Synopsis and cat. fresh-water Moll., p. 48.
Fusconia (*err. pro -naia* Simpson 1900) Frierson 1927, Check list N. Am. Naiades, p. 10, 54 (*fide* Neave).
Fusconaia F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 53.
Fusconaia La Rocque 1953, Cat. Recent Moll. Canada, p. 91.

Type.—*Unio trigonus* Lea.

Diagnosis.—Shell round, rhomboid, triangular, or short elliptical, with a moderate posterior ridge; beaks high and full, curved inward and forward, sculptured with a few coarse parallel ridges which curve upward behind; epidermis dark; surface not sculptured; hinge plate of moderate width; pseudocardinals strong; nacre white, salmon, or purple.

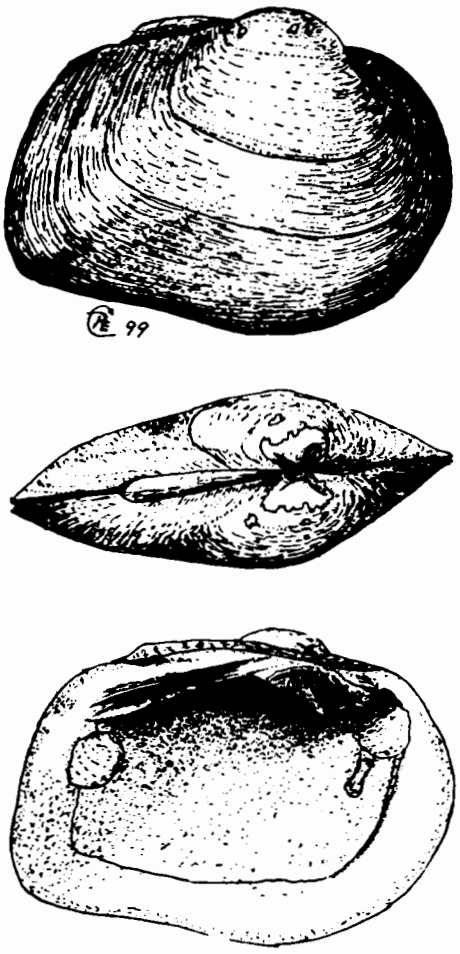


FIGURE 7.—*Fusconaia flava*, three views of the shell, X1; after Call (1900, pl. 61).

Fusconaia ebenus (Lea) 1831
Fig. 5

Unio ebenus Lea 1831, Am. Philos. Soc. Trans., v. 4, p. 84, pl. 9, fig. 14; 1834, Observer v. I, p. 94, pl. 9, fig. 14.
--- --- Call 1900, Moll. Ind., p. 503, pl. 58.
Quadrula ebena Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.
--- --- Simpson 1914, Descr. cat. Naiades, p. 897.
Fusconaia ebena F. C. Baker 1920, Life of Pleistocene, p. 382.
Fusconaia ebenus Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 4.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 66, pl. 41, figs. 1-3.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 307.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.

Type locality.—Ohio River (Lea).

Diagnosis.—Shell suborbicular to subelliptical, inflated, solid, decidedly inequipartite; anterior end truncated below the beaks; posterior end generally broadly rounded; dorsal and ventral margins curved; posterior ridge faint, rarely double; beaks high, full, turned forward and inward over a small lunule; sculpture of a few feeble corrugations; surface with many concentric ridges; epidermis reddish brown to black, rayless; pseudocardinals large, somewhat radial, the two in the left valve forming an inverted V, joined above, which receives the large triangular tooth of the right valve, which seems to rise out of a deep pit; laterals curved, massive, wide, the larger one in the right valve commonly double; interdentum very wide, smooth, flat; beak cavities deep, much roughened; nacre pearly white, iridescent posteriorly.

Ecology.—Common in large rivers with rather swift current, on mud, gravel, sand, in 1-3 m. or more of water; on sandy mud bottom in 6 feet of water.

General distribution (fig. 6).—Mississippi drainage generally; Alabama and Tombigbee Rivers.

Distribution in Ohio (inset, fig. 6).—Sterki (1907a, p. 392) gives only Ohio River.

Geologic range.—Recorded for Sangamon deposits by F. C. Baker (1920a, p. 382) but not noted for any other part of the Pleistocene.

Remarks.—The van der Schalies (1950, p. 454 ff.) show the distribution of this species in various parts of the Mississippi River, from Wisconsin to Illinois.

Fusconaia flava (Rafinesque) 1820
Fig. 7

Obliquaria flava Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 305, pl. 81, figs. 13, 14.
Unio rubiginosus Lea 1820, Am. Philos. Soc. Trans., v. 3, p. 427. pl. 8, fig. 10; 1834, Observer, v. I,

p. 41, pl. 8, fig. 10.
--- --- Call 1900, Moll. Ind., p. 505, pl. 61.
Quadrula rubiginosa Dall 1905, Harriman-Alaska Exped., v. 13, p. 154.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.
--- --- Simpson 1914, Descr. cat. Naiades, p. 872.
Fusconaia flava Ortmann 1919, Najades Pa., p. 14, pl. 2, fig. 3.
Fusconaja rubiginosa F. C. Baker, 1920, Life of Pleistocene, p. 382.
Fusconaia flava Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 5.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 53, pl. 39, figs. 6-9; pl. 40, fig. 7.
--- --- Goodrich 1932, Moll. Mich., p. 89.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.

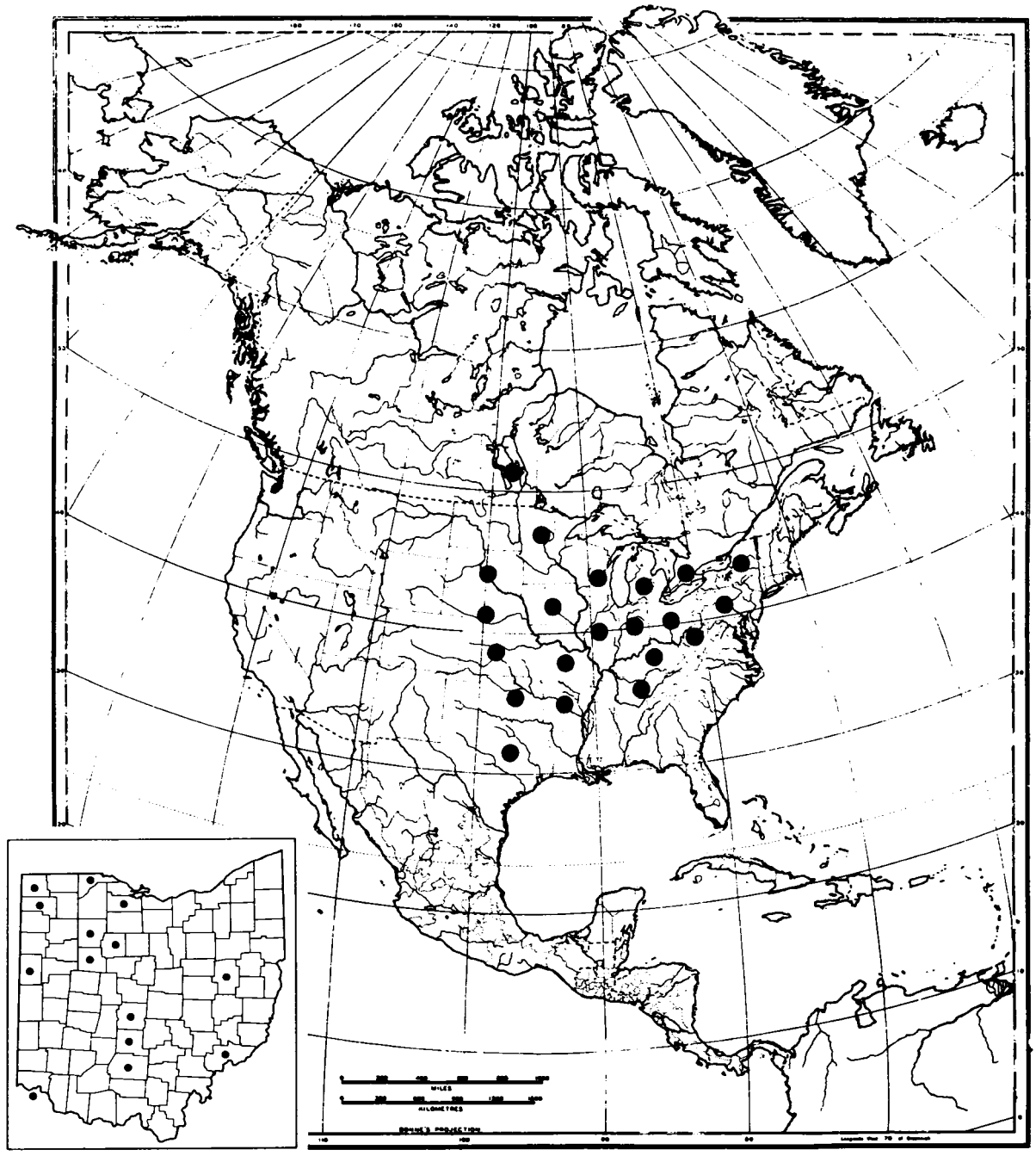


FIGURE 8.–Distribution of *Fusconaia flava* in North America; *inset,* distribution in Ohio.

--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 307.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 93, pl. 11, fig. 1.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 91.
--- --- Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 19, fig. 24.

Type locality.—Small tributaries of Kentucky, Salt, and Green Rivers.

Diagnosis.—Shell quadrate, smooth except for a few rough growth lines, yellow to brown; beaks a little raised above the curving hinge line, sculptured with a few curving furrows, prominent only in young shell; disk with a well marked ridge running diagonally from beaks to base, the shell sloping sharply posteriorly to the ridge, very

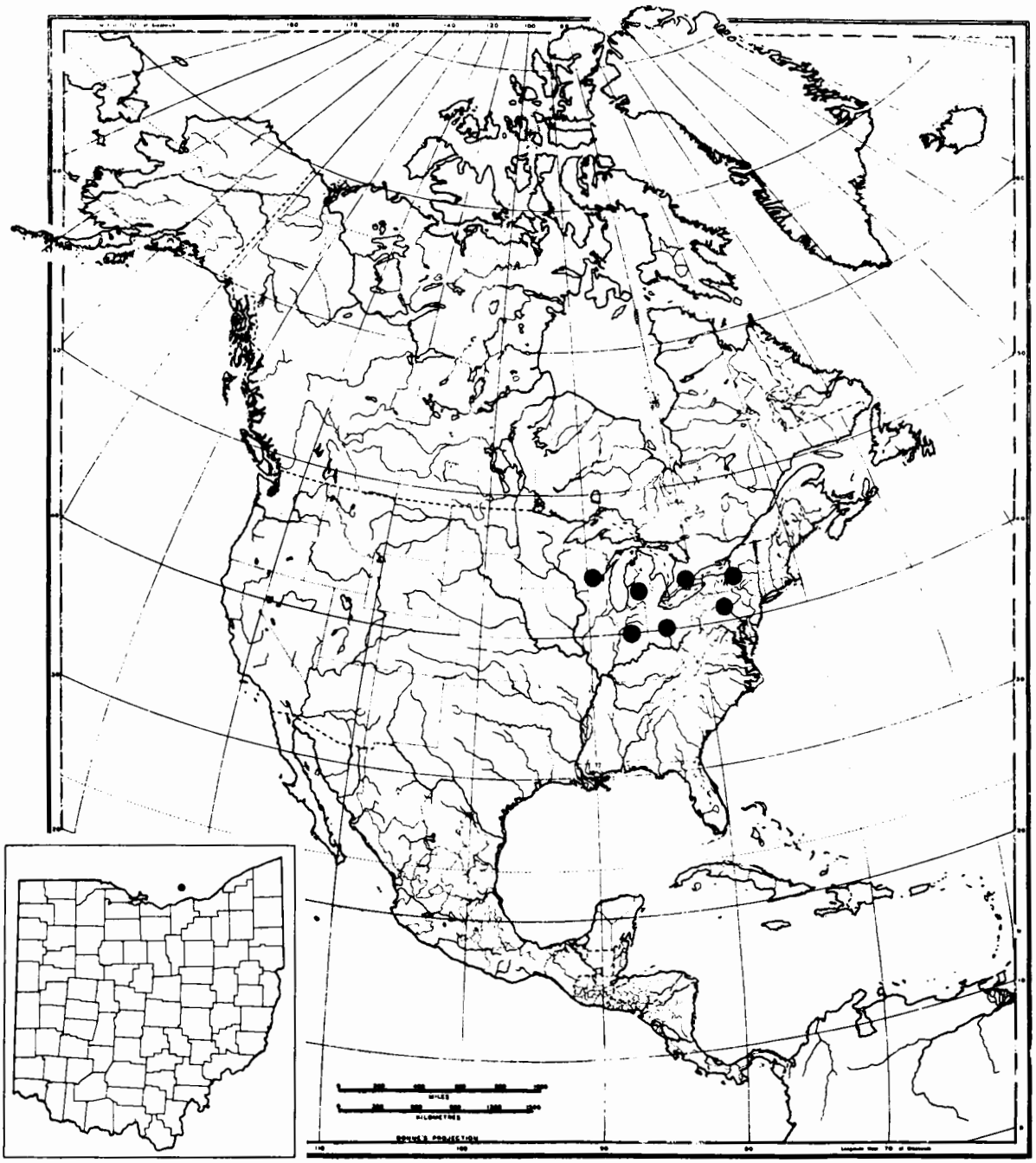


FIGURE 9.—Distribution of *Fusconaia flava parvula* in North America; *inset,* distribution in Ohio.

little anteriorly; pseudocardinals heavy, double in one valve and single in the other; lateral teeth curving, not very long; muscle scars well marked; pallial line not pronounced; beak cavity fairly deep; nacre pearly white; L. 60, H. 50, D. 30 mm. (Goodrich, 1932, p. 89).

Ecology.—Characteristically a species of the smaller rivers and creeks. It prefers a bottom of fine hard gravel, but occurs also in sand. Its normal habitat appears to be quiet places just below riffles. Shells from small tributaries are usually more compressed than those from larger streams; the latter are more inclined to be quadrate. Wisconsin ecological preferences are as follows: outlet of Green Lake, on sand bottom in water 0.3-0.6 m. deep; Moose Ear Creek, on sand and gravel bottom in riffles, water 0.3-0.6 m. deep; Red Cedar River, sand bottom, water 0.3 m. deep, buried from sight in sand; Bark River, near Dousman, gravel bottom, 0.3 m. deep, considerable current (condensed from F. C. Baker, 1928a, pt. II, p. 56).

Associations.—Living: MICHIGAN-52, 54, 55, 56, 57, 61, 63, 64, 65; OHIO-43; WISCONSIN-27, 58, 76, 82, 83, 87, 108, 115, 127, 130, 131.

General distribution (fig. 8).—Western New York west to Kansas and Nebraska, and from the Red River of the North south to Kentucky and West Virginia; the range includes southern Ontario and Ohio.

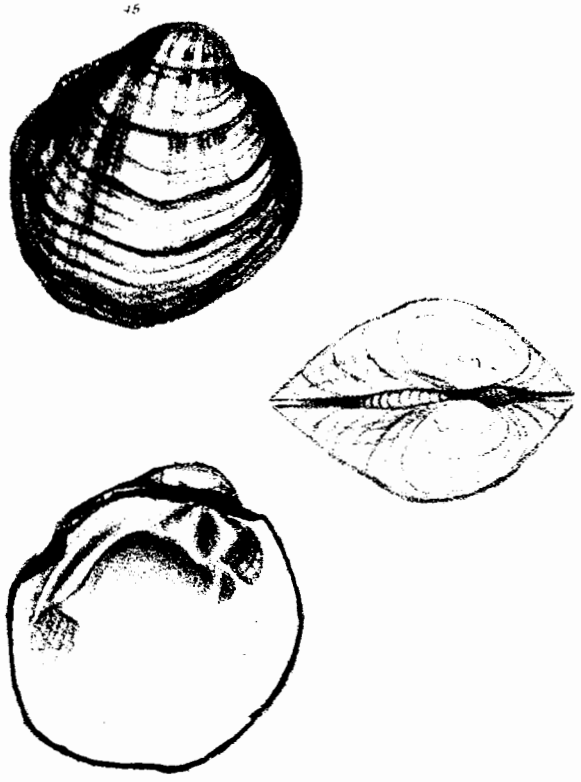


FIGURE 10.—*Fusconaia subrotunda,* three views of the shell, X1; after Lea (1831, Observations on the genus *Unio,* p. 127, pl. 18, fig. 45).

Distribution in Ohio (inset, fig. 8).—Sterki (1907a, p. 392) gives "over the state, generally common . . . some specimens from various rivers (Ohio, Tuscarawas, Tiffin)." Ortmann (1919) is more precise: Sandusky River, Sandusky and Wyandot Counties; Miami and Erie Canal, Swan Creek, Lucas County; Maumee River, Defiance County; St. Mary's River, Mercer County; Beaver Creek, Williams County; Tuscarawas River; Wolfe Creek, Washington County; Chillicothe, Ross County; Ohio Canal, Columbus, Franklin County; Scioto River, Hardin County.

Geologic range.—Recorded by Baker (1920a, p. 382) for beds of Yarmouth age.

Fusconaia flava parvula Grier 1918

Fusconaia flava var. *parvula* Grier 1918, Nautilus, v. 32, p. 11; 1919, Carnegie Mus. Annals, v. 12, p. 168.
Fusconaia flava parvula Ortmann 1919, Najades Pa., p. 21, pl. 2, fig. 2.
--- --- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 58, pl. 39, figs. 1-5.
--- --- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 150.
--- --- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 93.
--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 91.

Type locality.—Lake Erie, Presque Isle Bay, Erie County, Pennsylvania.

Diagnosis.—Shell smaller than in the type form, the hinge heavier, and the shell wider in proportion; epidermis dark brown.

Ecology.—Found on gravel and stone bottom in water 2-3 m. deep, in Lake Winnebago, Wisconsin (F. C. Baker, 1928a, pt. II, p. 58).

General distribution (fig. 9).—Western part of Lake Erie; Winona Lake, Indiana; Lake St. Clair; Lake Huron; Lake Winnebago and lower part of Fox River in Wisconsin.

Distribution in Ohio (inset, fig. 9).—The variety is confined to Lake Erie. Ortmann (1919) gives Lake Erie, Sandusky Bay, Erie County.

Geologic range.—Unknown.

Fusconaia subrotunda (Lea) 1831
Fig. 10

?*Unio brevialis* Crouch 1827, Illus. Introd. to Lamarck, p. 16, pl. 9, fig. 3.
Unio subrotundus Lea 1831, Am. Philos. Soc. Trans., v. 4, p. 117, pl. 18, fig. 45; 1834, Observer, v. I, p. 127, pl. 18, fig. 45.
Unio personatus Conrad 1834, New freshwater shells U.S., p. 71.
Unio politus Say 1834, Am. Conchology, v. 6, p. 25.
Quadrula subrotunda Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 391.

Fusconaja subrotunda Ortmann 1912, Carnegie Mus. Annals, v. 8, p. 244.
Quadrula subrotunda Simpson 1914, Descr. cat. Naiades, p. 892.
Fusconaia subrotunda Ortmann 1919, Najades Pa., p. 7, pl. 1, fig. 2.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 4.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D). p. 150.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 307.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 92.

Type locality.—Ohio.

Diagnosis.—Shell irregularly elliptical or subquadrate, subinflated to inflated, solid, inequilateral; beaks

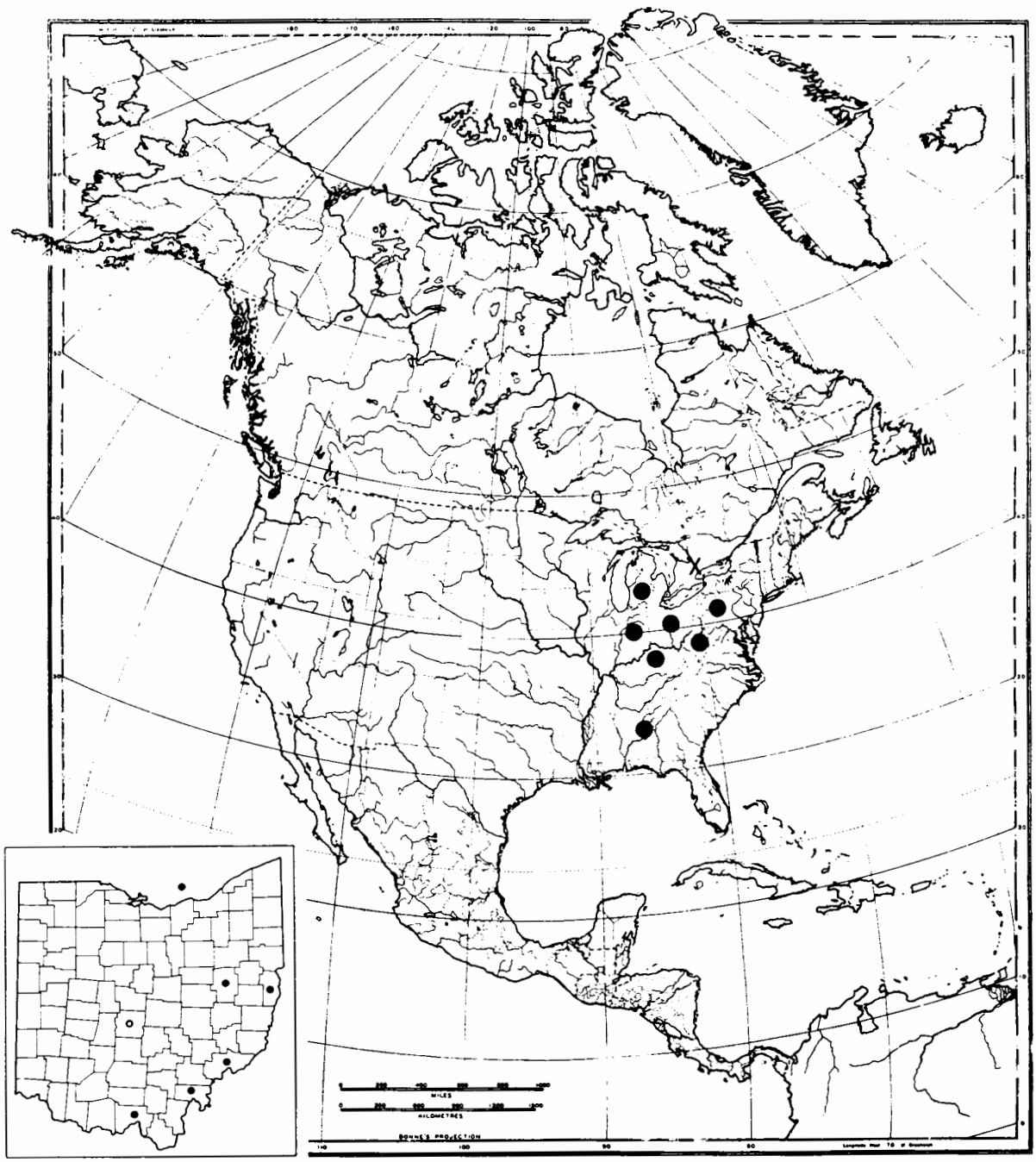


FIGURE 11.—Distribution of *Fusconaia subrotunda* in North America; *inset,* distribution in Ohio.

high, full, turned forward over a lunule, their sculpture a few subnodular ridges or wrinkles; anterior end obliquely truncate above, rounded below; hinge line and lower margins curved; surface with low, wide, concentric ridges; epidermis greenish brown, somewhat clothlike, commonly with wide and narrow green broken rays in the young, persisting on the umbonal region in the adults; pseudocardinals triangular, rough; lateral in the right valve disposed to be double; muscle scars impressed; beak cavities rather deep, compressed; nacre white, porcellaneous, thinner and slightly iridescent behind (modified from Simpson, 1914, p. 892).

Ecology.—No precise information available.

General distribution (fig. 11).—Ohio, Cumberland, and Tennessee River systems; reported doubtfully from Michigan and erroneously from Grand River, Ontario.

Distribution in Ohio (inset, fig. 11).—Sterki (1907a, p. 391) gives "Ohio River; Scioto River; Tuscarawas

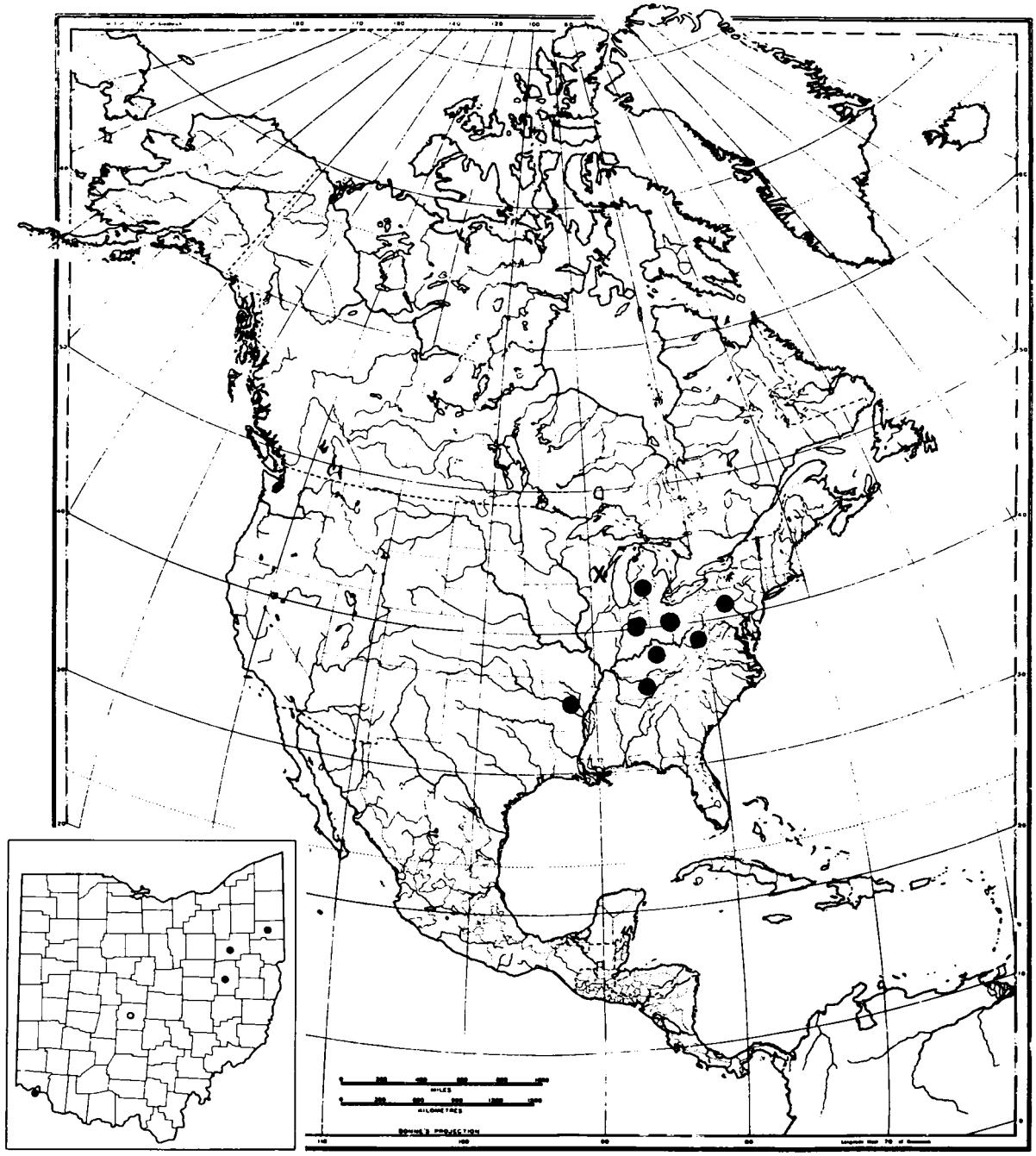


FIGURE 12.—Distribution of *Fusconaia subrotunda kirtlandiana* in North America; *inset,* distribution in Ohio.

River, a form with very heavy shell...a very small, slight form seems to be in Lake Erie." Ortmann (1919) gives the Ohio River, in Jefferson, Meigs, and Scioto Counties, and the Tuscarawas River.

Geologic range.—Unknown.

Remarks.—The relationship between *F. kirtlandiana* and this species is still confused. Simpson (1914, p. 893) had difficulty separating them and the criteria he gave for distinction are not convincing, as they are based on comparative size, compression, and lower beaks. Ortmann and Walker (1922, p. 4-5) imply that the two are distinct.

Fusconaia subrotunda kirtlandiana (Lea) 1834

Unio kirtlandianus Lea 1834, Am. Philos. Soc. Trans., v. 5, p. 98, pl. 14, fig. 41; 1834, Observer, v. I, p. 210, pl. 14, fig. 41.
Quadrula kirtlandiana Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 391.
--- --- Simpson 1914, Descr. cat. Naiades, p. 891.
Fusconaia subrotunda kirtlandiana Ortmann 1919, Najades Pa., p. 11, pl. 1, figs. 3-5.
Fusconaia kirtlandiana F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 136.
Fusconaia subrotunda kirtlandiana Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 307.

Type locality.—Mahoning River, Trumbull or Mahoning County, Ohio.

Diagnosis.—"Shell large, subrhomboid to subelliptical, subcompressed or convex, inequilateral, solid; beaks moderately full and high; posterior ridge varying from low to somewhat elevated, often widely double, ending near the base of the shell in a wide, feeble biangulation; anterior end rounded, often slightly truncate above; base line usually curved; outline of dorsal slope usually having the angle behind the ligament; surface irregularly, concentrically sculptured; epidermis yellowish-green with broken rays when young, becoming greenish-brown, brown or blackish and rarely rayed when adult; pseudocardinals radially striate; lateral of right valve partly double; beak cavities deep, compressed; muscle scars well marked; pallial line remote in front; nacre white, rarely lurid, porcellaneous, thinner behind. Length 120, height 88, diam. 45 mm.; L. 126, H. 88, D. 42 mm." (Simpson, 1914, p. 891).

Ecology.—No precise information available.

General distribution (fig. 12).—Ohio, Cumberland, and Tennessee River systems; southwest to Arkansas; north to Wisconsin?; east through southern Michigan.

Distribution in Ohio (inset, fig. 12).—Sterki (1907a, p. 391) gives "Ohio River and some tributaries: Mahoning River, from which Lea had his types; Tuscarawas River...." Ortmann (1919) gives only Mahoning and Tuscarawas Rivers.

Geologic range.—Unknown.

Remarks.—The distribution given above is that of Simpson (1914, p. 891). F. C. Baker (1928a, pt. II, p. 113, 136) has noted that the Wisconsin records are erroneous. It would appear that the Michigan records are likewise erroneous since neither Goodrich (1932) nor van der Schalie (1938, 1941, 1948) mention it for that State. Sterki (1907a) is somewhat doubtful as to the distinctness of *F. kirtlandiana* and *F. subrotunda.* Simpson (1914, p. 892) states that "Dr. Sterki believes that *Q. subrotunda* and *kirtlandiana* should be united," but to Simpson "they are as distinct as most of the closely related species of this and other allied groups," although he notes the existence of "intermediates which can scarcely be named." Simpson (1914, p. 892) recognizes

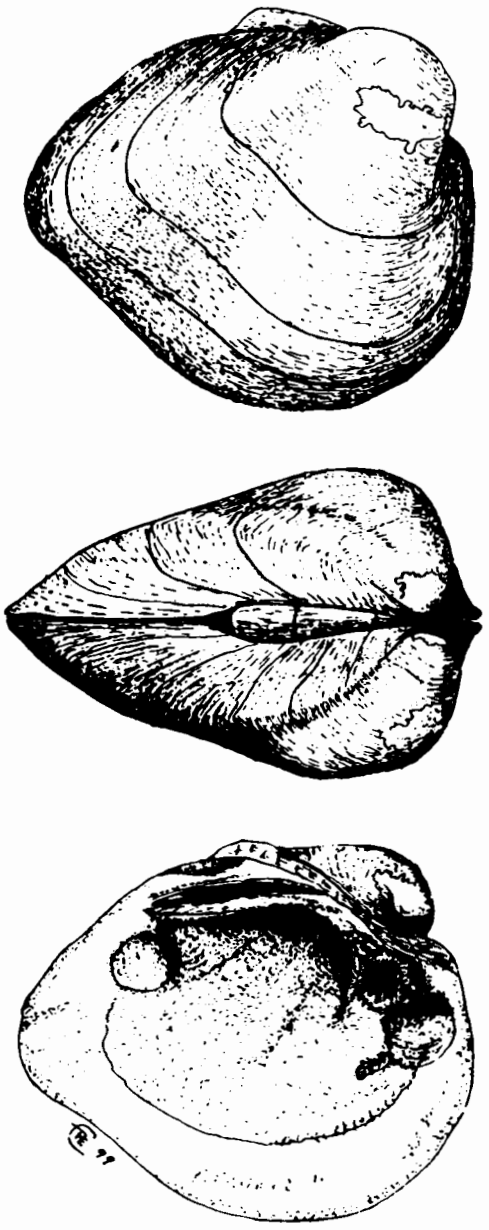


FIGURE 13.—*Fusconaia undata,* three views of the shell, X1; after Call (1900, pl. 60).

a variety, *F. kirtlandiana minor* (Simpson) 1900, from the Tennessee River drainage.

Fusconaia undata (Barnes) 1823
Fig. 13

Unio undatus Barnes 1823, Am. Jour. Sci., v. 6, p. 121, pl. 4, fig. 4.
Mya undata Eaton 1826, Zool. text book, p. 219.
Unio trigonus Call 1900, Moll. Ind., p. 504, pl. 60.
Quadrula undata Walker 1910, Nautilus, v. 24, p. 24, pl. 1, figs. 1-3; pl. 2, figs. 1-2.
--- --- Simpson 1914, Descr. cat. Naiades, p. 880.
Fusconaja undata F. C. Baker, 1920, Life of Pleistocene, p. 382.
Fusconaia undata Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 6.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 59, pl. 40, figs. 4-6.
--- --- Goodrich 1932, Moll. Mich., p. 89.

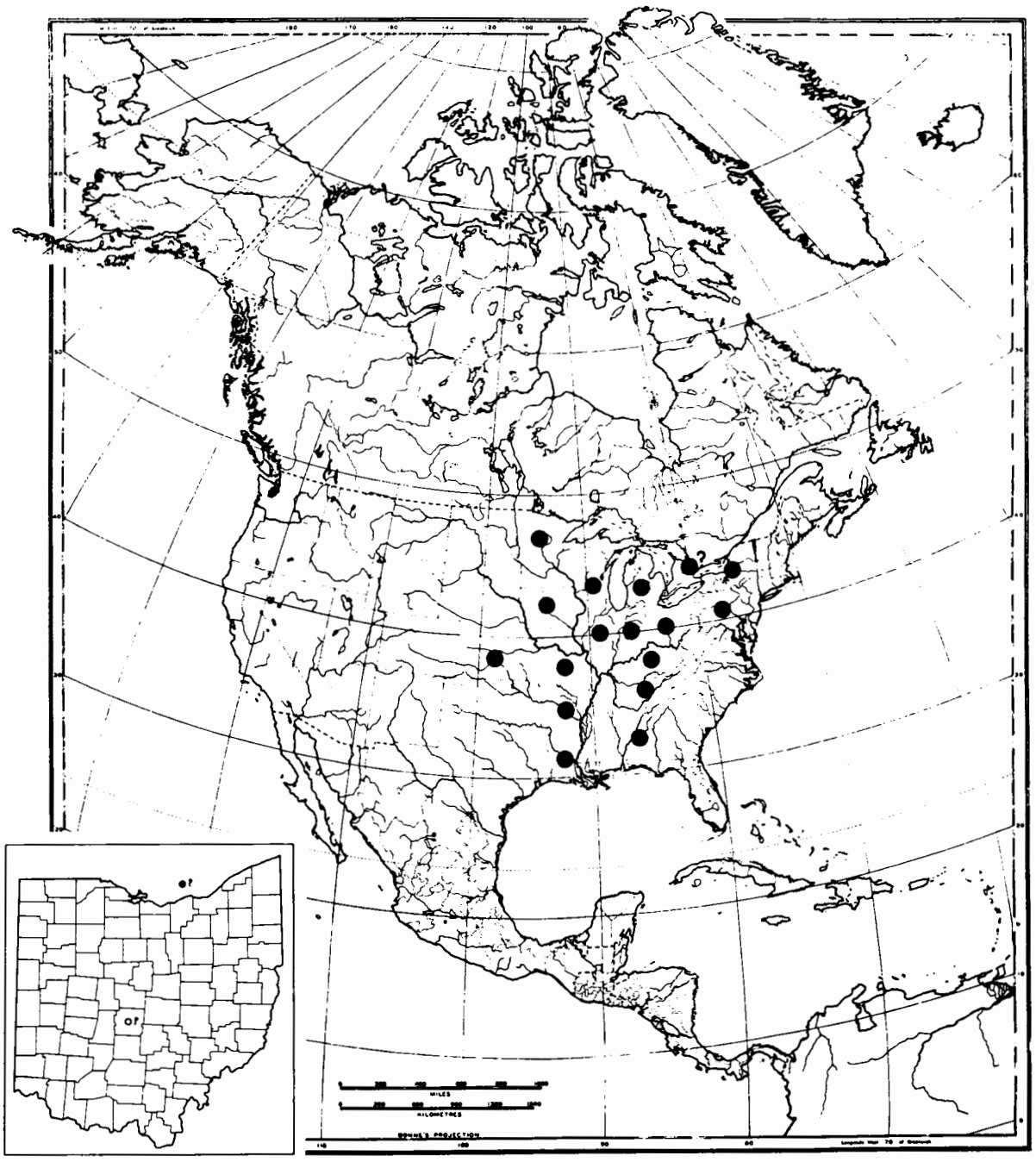


FIGURE 14.–Distribution of *Fusconaia undata* in North America; *inset,* distribution in Ohio.

--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 150.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 307.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 92.

Type locality.—Wisconsin and Fox Rivers (Barnes).

Diagnosis.—Similar to *F. flava,* but much more swollen and markedly less quadrate in shape.

Ecology.—Found in large rivers, on mud bottom in rather deep water; young and juvenile specimens on sand bars in gravel or coarse sand (F. C. Baker, 1928a, pt. II, p. 61).

General distribution (fig. 14).—Entire Mississippi drainage; Coosa River, Alabama; Michigan and the upper St. Lawrence drainage.

Distribution in Ohio (inset, fig. 14).—All the Ohio records since the turn of the century are for the variety *F. undata trigona.*

Geologic range.—Unknown.

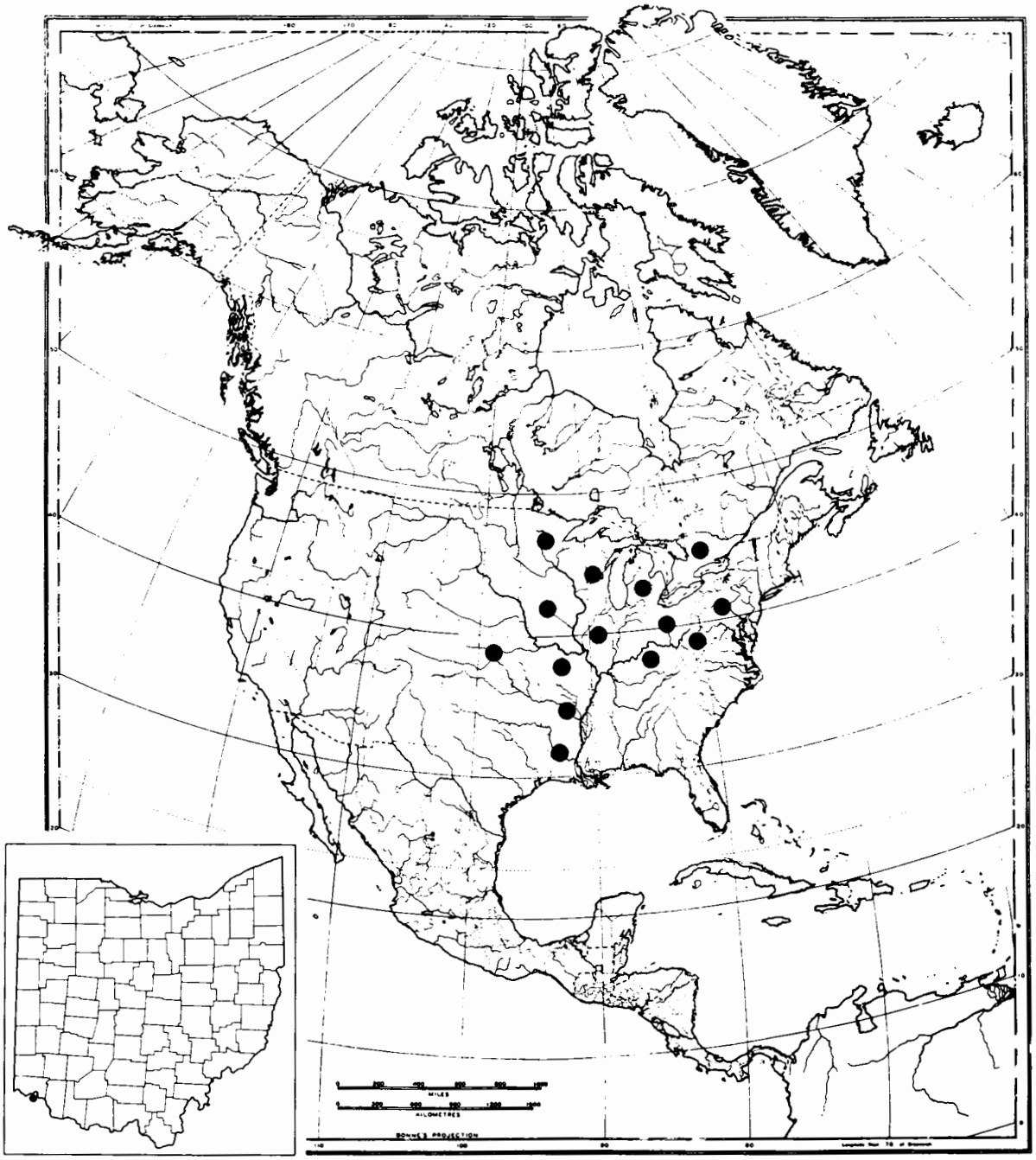


FIGURE 15.—Distribution of *Fusconaia undata trigona* in North America; *inset,* distribution in Ohio.

Fusconaia undata trigona (Lea) 1831

Unio trigonus Lea 1831, Am. Philos. Soc. Trans., v. 4, p. 110, pl. 16, fig. 40; 1834, Observer, v. I, p. 120, pl. 16, fig. 40.
Quadrula trigona Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.
Fusconaia flava trigona Ortmann 1919, Najades Pa., p. 19, pl. 2, fig. 1.
Fusconaia undata trigona F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 63, pl. 48, figs. 5, 6.

Type locality.—Ohio River, Cincinnati and Louisville.

Diagnosis.—"Differs from typical *undata* in being more trigonal, the diameter greater in comparison with the length, the posterior end shorter, not drawn out into a point, the umbones higher and the posterior ridge sharper" (F. C. Baker, 1928a, pt. II, p. 63).

Ecology.—According to Baker, this is the large river form of the *F. undata* group, living on gravel, sand, and mud bottom, in fairly deep water.

General distribution (fig. 15).—Mississippi River drainage, "probably includes Wisconsin, Minnesota, Illinois, and Ohio, as well as the states bordering the Mississippi and Ohio rivers" (Baker, 1928a, pt. II).

Distribution in Ohio (inset, fig. 15).—Sterki (1907a, p. 392) gives both drainages, not common. Ortmann (1919) gives Ohio River, Neville Island, Allegheny County, Pennsylvania, which indicates its probable presence in the upper Ohio, within the State of Ohio.

Geologic range.—Recorded for beds of Sangamon and late Wisconsin ("Wabash") age by Baker (1920a, p. 382).

Remarks.—Simpson (1914) and Goodrich and van der Schalie (1944, p. 307) unequivocally place this form in the synonymy of *F. undata* but Ortmann and Baker insisted on separating it as an ecological form of the large rivers. In Baker's system, *F. undata undata* is a form of

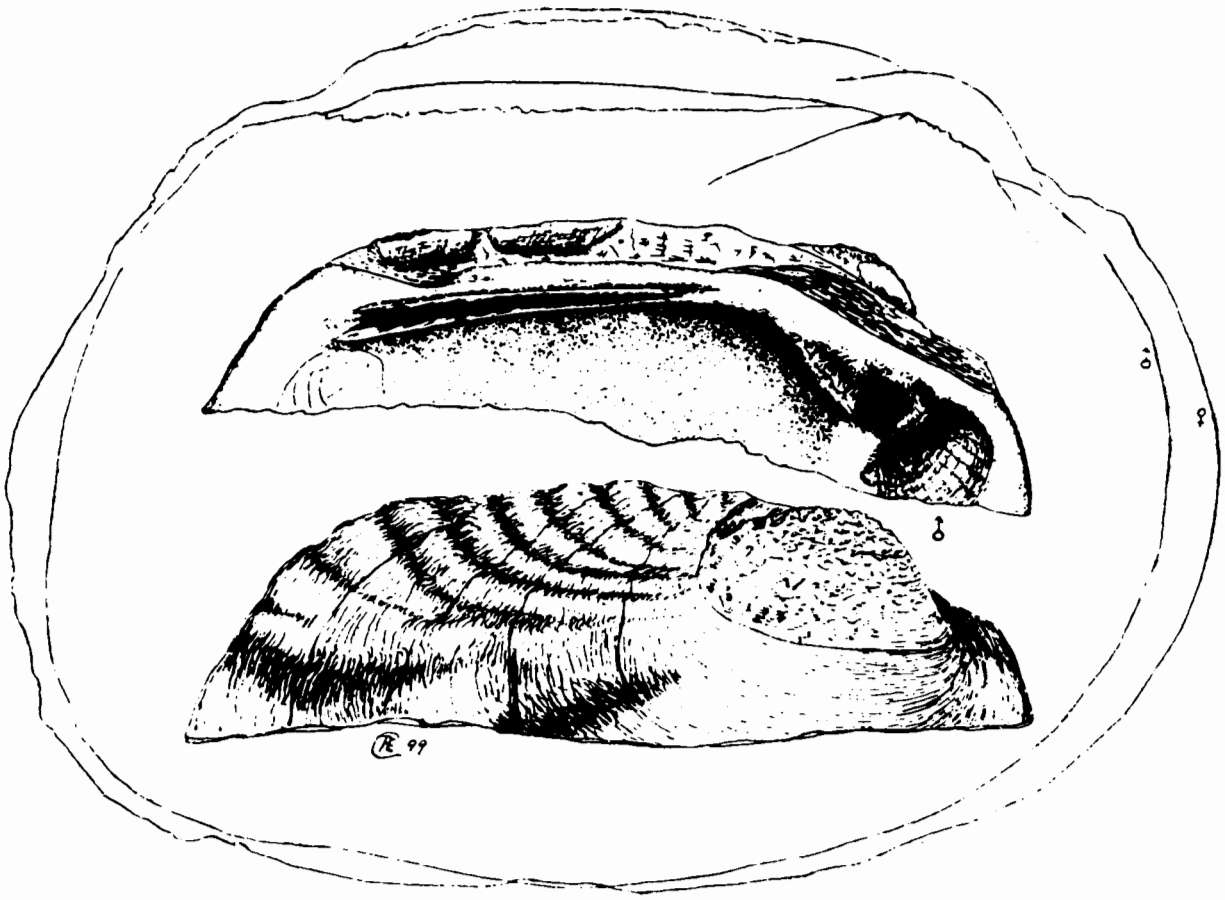


FIGURE 16.—*Megalonaias gigantea,* outline of female shell (larger) and outline of male shell (smaller); views of the hinge region: upper figure, internal, lower figure, external; not to scale; after Call (1900, pl. 15).

medium-sized rivers, *F. undata trigona* the large river form, and *F. undata wagneri* (Baker, 1928a, pt. II, p. 64) the large lake, or river-lake form of the species. There seems to be little inclination to accept the varietal names in Baker's concept; later workers on Naiades of either the Mississippi River or elsewhere do not mention either variety.

Genus *Megalonaias* Utterback 1915

Megalonaias Utterback 1915, Am. Midland Naturalist, v. 4, p. 123 (*fide* Neave).

Megalonaias Walker 1918, Synopsis and cat. fresh-water Moll., p. 46.

Megalonaias F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 68.

Megalonaias La Rocque 1953, Cat. Recent Moll. Canada, p. 95.

Type.—*Unio heros* Say (*gigantea* Barnes).

Diagnosis.—Shell large, heavy, obovate or rhomboid, alate postdorsally, disk obliquely folded; beaks sculp-

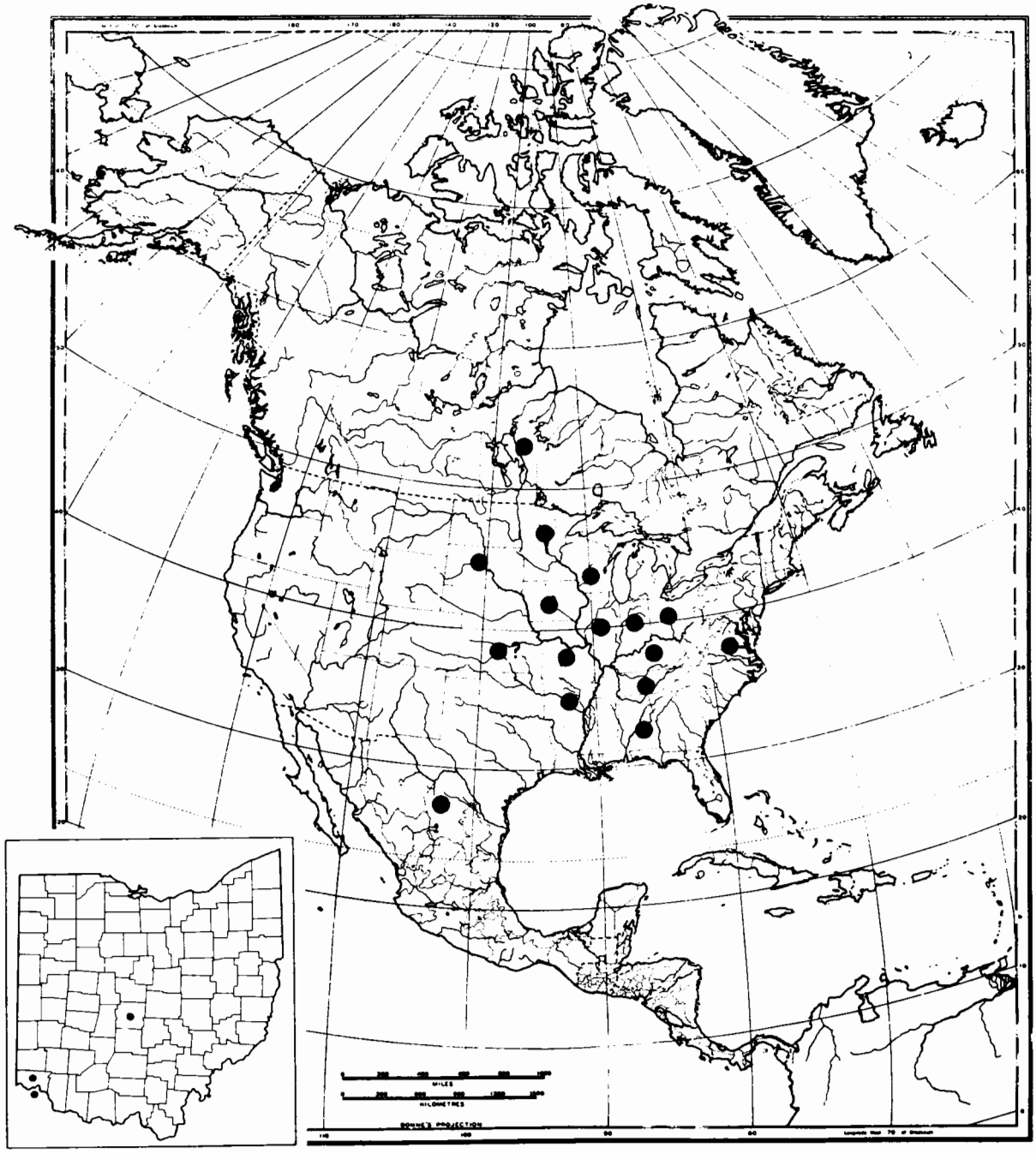


FIGURE 17.—Distribution of *Megalonaias gigantea* in North America; *inset,* distribution in Ohio.

tured with coarse double-looped corrugations which extend over the upper surface of the disk as nodulous plications; epidermis dark brown or blackish; beak cavities narrow and deep; anterior muscle scars deep and filled with a nacreous deposit, posterior scars large and indistinct.

Megalonaias gigantea (Barnes) 1823
Fig. 16

Unio giganteus Barnes 1823, Am. Jour. Sci., v. 6, p. 119.
Unio undulatus Barnes 1823, *ibid.*, p. 120, pl. 2, fig. 2.
Unio heros Say 1829, New Harmony Disseminator, v. 2, no. 19, p. 291.
Unio multiplicatus Lea 1831, Am. Philos. Soc. Trans., v. 4, p. 70, pl. 4, fig. 2.
--- --- Call 1900, Moll. Ind., p. 448, pl. 15.
Quadrula heros Dall 1905, Harriman-Alaska Exped., v. 13, p. 133.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.
Quadrula undulata Sterki 1907, *ibid.*
Quadrula heros Simpson 1914, Descr. cat. Naiades, p. 825.
Crenodonta undulata F. C. Baker 1920, Life of Pleistocene, p. 382.
Megalonaias gigantea Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 7.
Amblema (Megalonaias) gigantea Frierson 1927, Check list N. Am. Naiades, p. 62.
Megalonaias gigantea F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 69, pl. 47, figs. 3, 4.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 308.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 95.

Type locality.—Mississippi River, Prairie du Chien, Wisconsin.

Diagnosis.—Shell elongate-quadrate, very solid, inequipartite, moderately inflated; posterior ridge rounded; beaks full, depressed, with heavy double-looped ridges which become nodulous on the posterior ridge; surface with several broad folds on the posterior half of the shell; surface below the beaks heavily tuberculate; epidermis brownish or yellowish brown in young individuals, black in old ones; two pseudocardinals in left valve, heavy, broadly triangular, somewhat divergent, not united above, heavily radially sulcated; in right valve one heavy triangular sulcated tooth, with a smaller vestigial tooth

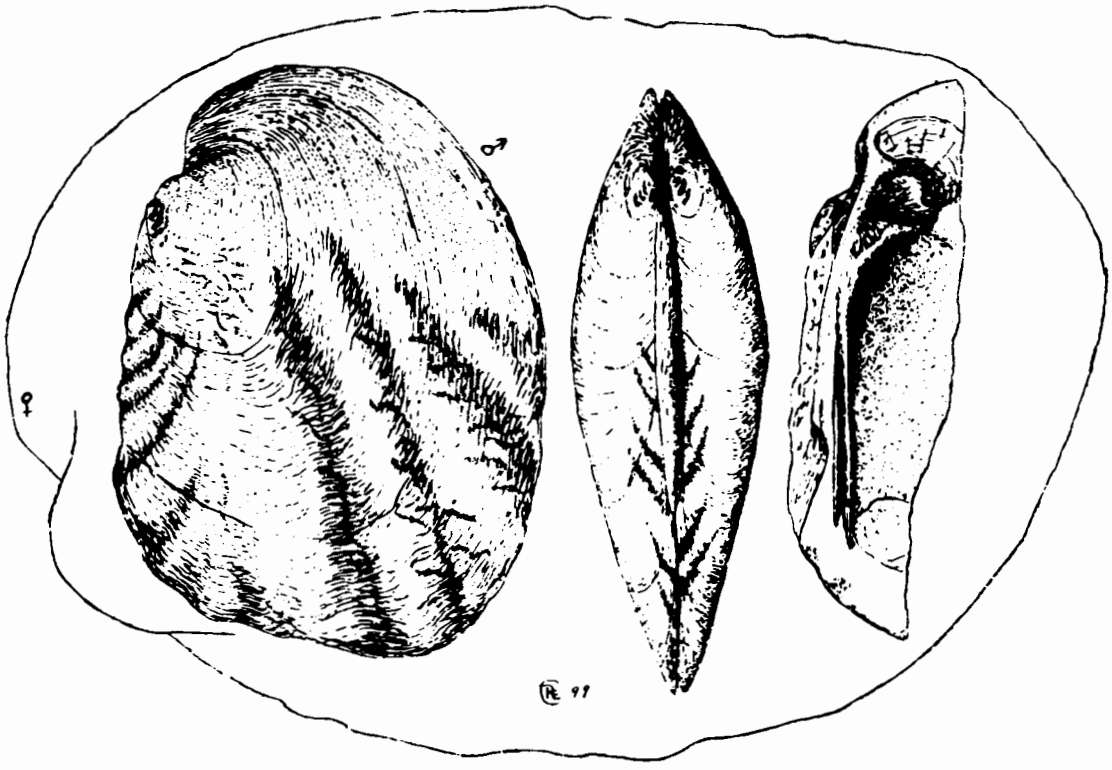


FIGURE 18.—*Amblema costata*, outline of female shell surrounding other figures, natural size; *inset*, three views of the shell, reduced; after Call (1900, pl. 13).

in front of and behind it, the latter absent in some specimens; interdentum narrow; laterals generally straight, slightly curved in old specimens, generally one in the right valve; anterior muscle scar large, very rough, deeply impressed in old shells with heavy addition of shelly matter; pallial line deeply impressed in front; nacre whitish, iridescent posteriorly, in some specimens salmon tinted; interior of shell commonly with dark brown spots (condensed from F. C. Baker, 1928a, pt. II, p. 69).

Ecology.—This species lives in large rivers in deep water commonly in quiet places on muddy bottom; it is sometimes found on gravelly bottom.

General distribution (fig. 17).—Mississippi River system generally; Red River of the North; Tombigbee River, Alabama; southwest to Nuevo Leon, Mexico.

Distribution in Ohio (inset, fig. 17).—Sterki (1907a, p. 390) gives "Ohio River, Little Miami River." Ortmann does not mention the species. The distribution of this

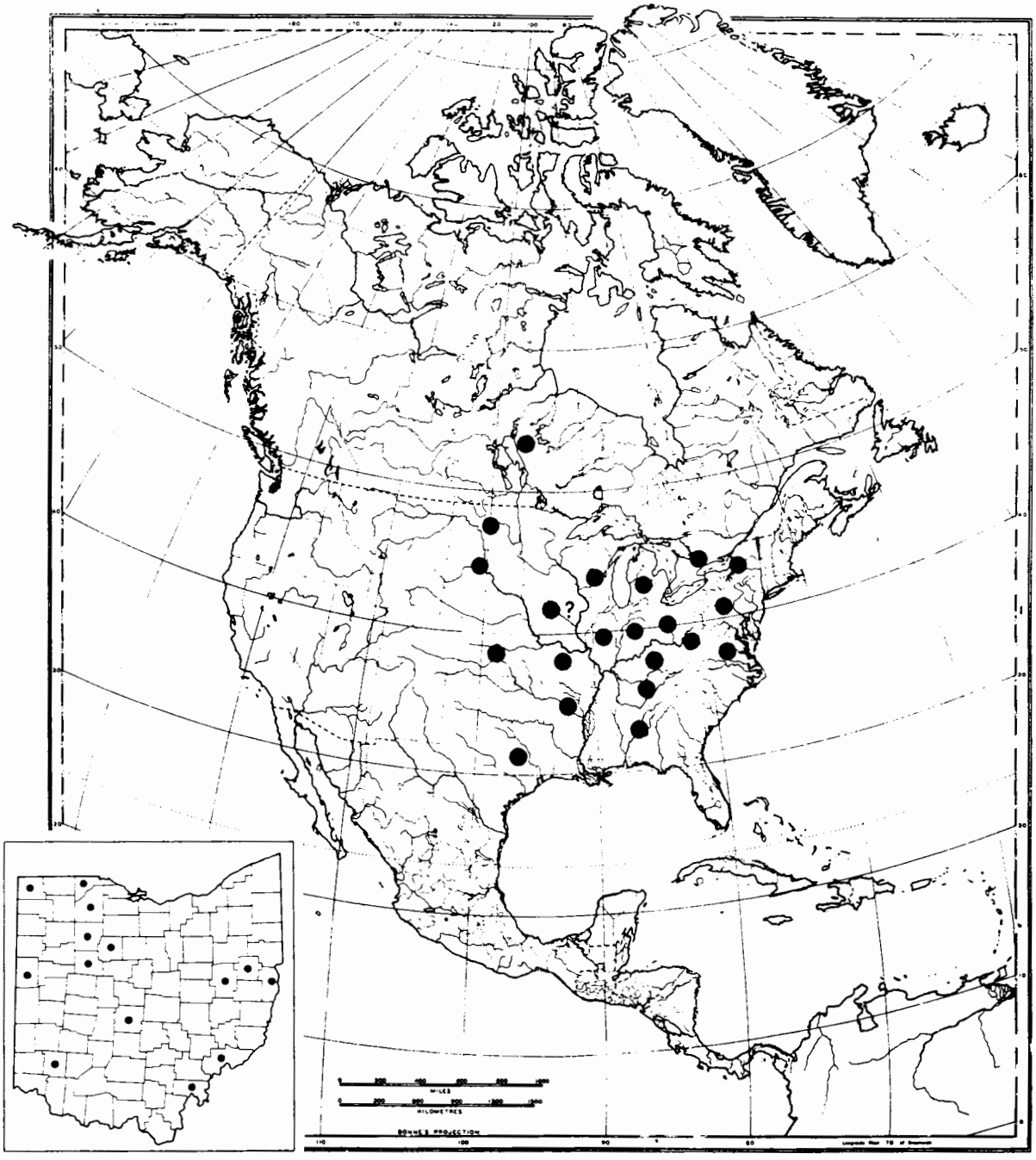


FIGURE 19.—Distribution of *Amblema costata* in North America; *inset,* distribution in Ohio.

species up the Ohio River deserves investigation. Certainly it is absent from the tributaries in the eastern part of the State or Sterki would have found it in the Tuscarawas or Mahoning Rivers and Ortmann in the Ohio itself above the Ohio-Pennsylvania line.

Geologic range.—According to Baker (1920a, p. 382) the species occurs in beds of Yarmouth, Sangamon, and late Wisconsin ("Wabash") age.

Genus *Amblema* Rafinesque 1819

Amblema Rafinesque 1819 (June), Jour. Physique, v. 88, p. 427 (*fide* Neave).
Amblema Walker 1918, Synopsis and cat. fresh-water Moll., p. 47.
Amblema Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 11.
Amblema F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 72.
Amblema La Rocque 1953, Cat. Recent Moll. Canada, p. 86.

Type.—*A. costata* Rafinesque.

Diagnosis.—Shell more or less alate; beaks prominent, sculptured with coarse concentric or somewhat double-looped ridges which do not extend over the surface of the shell; surface of the valves usually sculptured with oblique folds; posterior slope generally having small radial plications which curve upward behind; epidermis brownish or blackish; anterior muscle scars large, distinct, very shallow, the anterior edge smooth, the rest apparently filled with roughened shelly matter; posterior scars large, shallow, indistinct; escutcheon large and dark.

Remarks.—The genus is represented in the Ohio fauna by two species, *A. costata* and *A. plicata,* both rather variable, southern in origin, and represented in the Lake Erie drainage as well as the lake itself.

Amblema costata Rafinesque 1820
Fig. 18

Amblema costata Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 315, pl. 82, figs. 13, 14.
Unio undulatus Call 1900, Moll. Ind., p. 445, pl. 13.
Quadrula undulata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.
--- --- Simpson 1914, Descr. cat. Naiades, p. 819.
Amblema plicata costata Ortmann 1919, Najades Pa., p. 28, pl. 2, fig. 7; pl. 3, figs. 1-3.
Amblema costata Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 12.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 80, pl. 43, figs. 1-5.
--- --- Goodrich 1932, Moll. Mich., p. 87, pl. 1, fig. 1.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 306.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 86.
Crenodonta costata Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 20, fig. 25.

Type locality.—Ohio River (rare); small rivers of Kentucky, common (Rafinesque).

Diagnosis.—"Quadrate, heavy, rounded anteriorly, nearly oblong posteriorly. Hinge line almost straight,

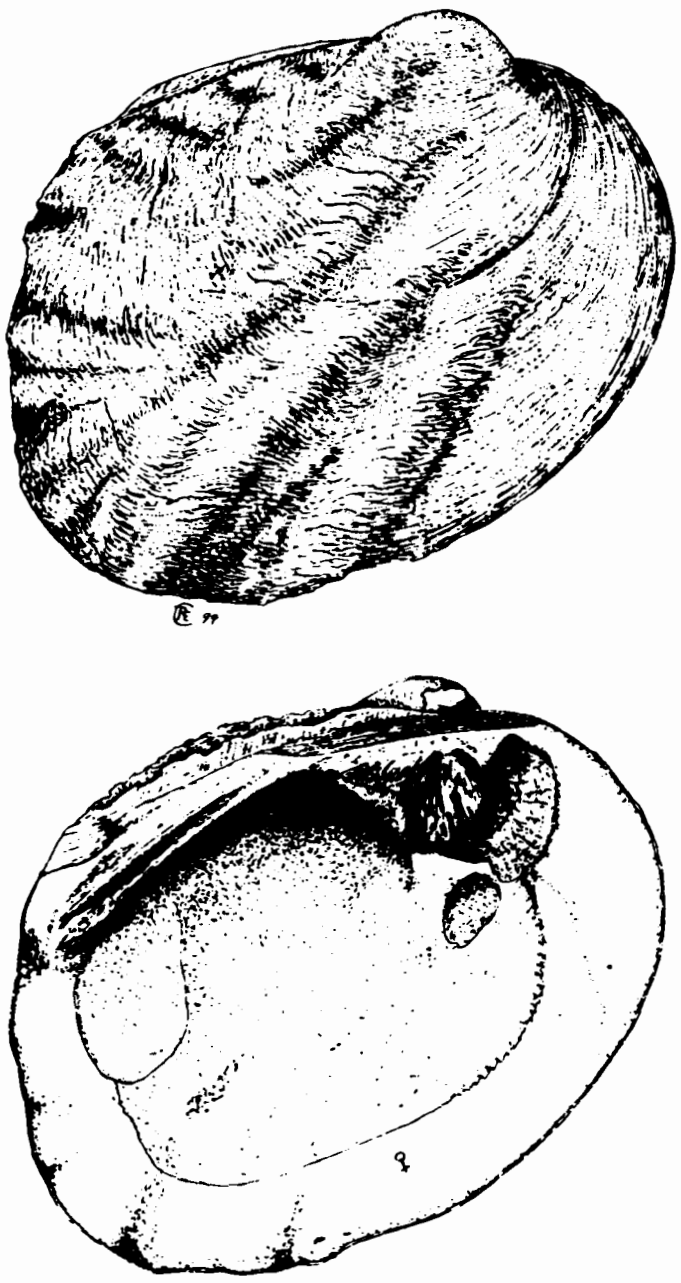


FIGURE 20.—*Amblema plicata,* two views of the shell; X1; after Call (1900, pl. 14).

base broadly rounded. Dark brown. Beaks triangular, with faint pustules on the posterior edge. Surface of shell undulate, having five more or less pronounced ridges. Beak cavity fairly deep, nacre pearly white. Pseudocardinals strong, heavy, striate; lateral teeth stout, long, curving. Anterior muscle scars deep and pitted, posterior ones broad and bluish. Pallial line impressed. Length 100, height 90, breadth 34 mm...." (Goodrich, 1932).

Ecology.—This is a species of small rivers and of tributaries of large rivers. Common on sand or gravel bottom in comparatively shallow water (0.3-1 m.); rare on mud bottom; not very deeply buried in the bottom (F. C. Baker, 1928a, pt. II, p. 82). In Manitoba it occurs in Red River, a permanent stream of the nonmountainous region; in Ohio in the small streams of Tuscarawas County; in Wisconsin, of six associations listed, five are rivers of various sizes, and one (115) is a lake.

Associations.—Living: MANITOBA-38; OHIO-43;

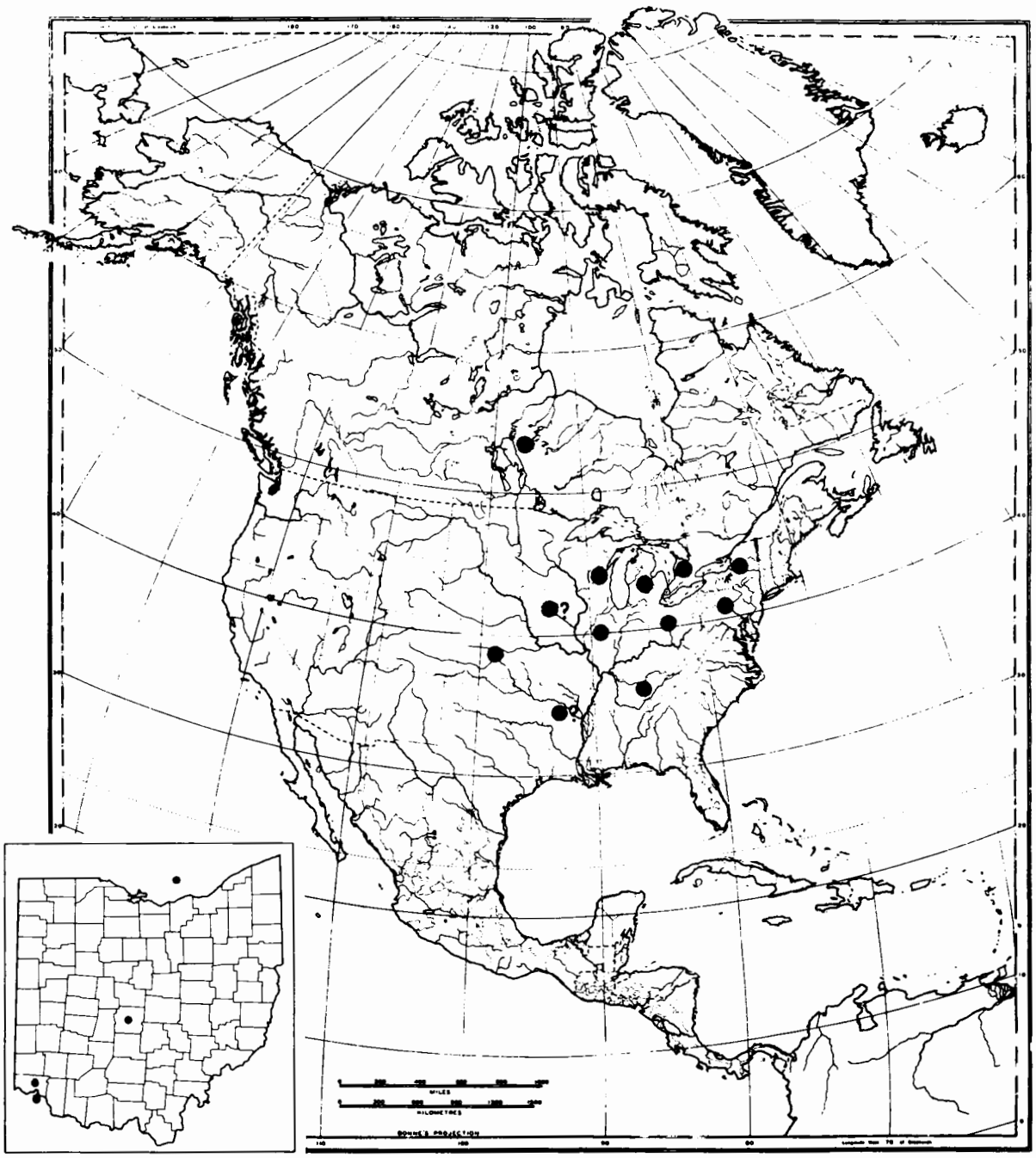


FIGURE 21.—Distribution of *Amblema plicata* in North America; *inset,* distribution in Ohio.

WISCONSIN - 58, 81, 83, 115, 131, 132.

General distribution (fig. 19).—Mississippi basin generally; St. Lawrence drainage; Red River of the North; Lake Winnipeg; Alabama River system. Great Lakes as follows: Lake Huron drainage, Lake St. Clair drainage, Detroit River, Lake Erie and drainage, Niagara River and tributaries.

Distribution in Ohio (inset, fig. 19).—Sterki (1907a, p. 390) is not specific; he gives "both drainages, generally common." Ortmann (1919) gives the following: Sandusky River, Wyandot County; Maumee River, Wood County; Swan Creek, Toledo, Ottawa River, and Maumee Bay, Lake Erie, Lucas County; Silver and Beaver Creeks, Williams County; St. Mary's River, Mercer County; the Ohio River in Jefferson and Meigs Counties; Conotton Creek, Carroll County; Tuscarawas River; Wolfe Creek, Washington County; Ohio Canal, Columbus, Franklin County; Scioto River, Hardin County; Big Beaver Creek, Mercer County.

Geologic range.—No fossil record to my knowledge.

Remarks.—Clarke and Berg (1959, p. 20) discuss the status of *Amblema* as a generic name for this species and point out that, in their opinion, it cannot be used. They have used the generic name *Crenodonta* Schluter but point out that there are two or three alternative solutions to the problem of what name to use. In the circumstances, it seemed preferable to await more or less final decision on this question before changing the name long used for this species. I have accordingly continued to use *Amblema,* fully aware of the uncertainty of this course, on the sole basis of its familiarity to workers on Naiades.

Amblema plicata (Say) 1817
Fig. 20

Unio plicata Say 1817, Nicholson's Encycl., v. 2, pl. 3, fig. 1.
Unio hippopoeus Lea 1845, Am. Philos. Soc. Proc., v. 4, p. 163.
Unio plicatus Dall 1905, Harriman-Alaska Exped., v. 13, p. 133.
Quadrula plicata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.
Quadrula plicata hippopoea Sterki 1907, *ibid.*
Quadrula undulata form *hippopoea* Sterki 1914, Ohio Naturalist, v. 14, p. 271.
Quadrula plicata hippopaea Simpson 1914, Descr. cat. Naiades, p. 816.
Amblema plicata Utterback 1916, Am. Midland Naturalist, v. 4, p. 33.
Quadrula plicata Walker 1918, Synopsis and cat. fresh-water Moll., p. 168.
Amblema plicata Ortmann 1919, Najades Pa., p. 25, pl. 2, figs. 4-6.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 13.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 87.
Amblema plicata hippopoea La Rocque 1953, *ibid.*

Type locality.—Lake Erie.

Diagnosis.—Shell subquadrate or subrhomboid, inflated, solid, inequilateral; beaks full and high, turned forward over a well-marked lunule, their sculpture a few coarse irregular somewhat corrugated ridges (condensed from Simpson, 1914, p. 814).

General distribution (fig. 21).—Lakes Huron and St. Clair, Detroit River, Lake Erie.

Distribution in Ohio (inset, fig. 21).—Sterki (1907a, p. 390) gives Ohio and Little Miami Rivers for the type form and Lake Erie for "Quadrula plicata hippopoea (Lea)," the name formerly assigned to the Great Lakes form. Ortmann (1919) gives Lake Erie, Cedar Point and Sandusky Bay, Erie County, but no Ohio River localities, probably because he considered the river form distinct but not ranging into Pennsylvania.

Remarks.—The range as given by me (La Rocque, 1953, p. 87) is in error. As pointed out by Ortmann and Walker (1922, p. 13) this species is the Lake Erie form and the name cannot be used for the "form with greatly swollen beaks found in the large rivers of the interior basin," a form which should be called *A. peruviana* (Lamarck). The latter species is known for the Mississippi River but not for the Ohio, at least in the State of Ohio. F. C. Baker (1928a, pt. II, p. 75) notes that shells from the Ohio River at Golconda, Illinois, are *A. rariplicata* and not *A. peruviana.*

Genus *Quadrula* Rafinesque 1820

Quadrula Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 305 (*fide* Neave).
Theliderma Swainson 1840, Treatise Malacology, p. 267, 378.
Quadrula Walker 1918, Synopsis and cat. fresh-water Moll., p. 43.
Quadrula Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 14.
Quadrula F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 83.

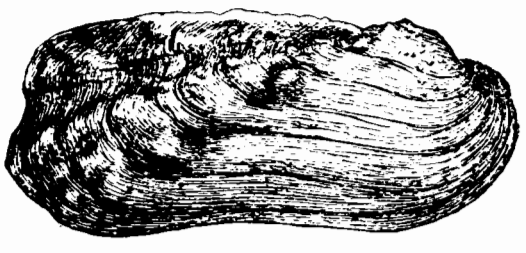


FIGURE 22.—*Quadrula cylindrica;* slightly reduced; after Walker (1918, p. 44, fig. 144).

Quadrula La Rocque 1953, Cat. Recent Moll. Canada, p. 98.

Type.—*Obliquaria (Quadrula) quadrula* Rafinesque.

Diagnosis.—Shell triangular, quadrate, or rhomboid; solid, inflated, with rather coarse prominent beaks which are generally sculptured with a few coarse irregular subparallel ridges that are inflated where they cross the posterior ridge; posterior ridge ordinarily well developed; disk sculptured or smooth; epidermis generally dull colored, dark, and rayless or weakly rayed; hinge plate heavy, wide, flattened; pseudocardinals solid, direct, ragged; laterals double in the left and single in the right valve; cavity of the beaks deep and compressed.

Quadrula cylindrica (Say) 1817
Fig. 22

Unio cylindricus Say 1817, Nicholson's Encycl., v. 2, pl. 4, fig. 3.

FIGURE 23.—Distribution of *Quadrula cylindrica* in North America; *inset,* distribution in Ohio.

Unio cylindricus Call 1900, Moll. Ind., p. 468, pl. 29.
Quadrula cylindrica Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.
--- --- Simpson 1914, Descr. cat. Naiades, p. 832.
--- --- Ortmann 1919, Najades Pa., p. 52, pl. 5, figs. 1-3.
--- --- Frierson 1927, Check list N. Am. Naiades, p. 51.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 309.

Type locality.—Wabash River, Indiana.

Diagnosis.—Shell elongate, inflated, almost cylindrical, solid; beaks rather full, turned forward over a deep, wide lunule, their sculpture a few irregular strong ridges that are nodulous on the posterior ridge; posterior ridge full, rounded; above it there is commonly a wide radial impression that may end in a slight sinus behind; anterior end rounded, subangular above; posterior end squarely or obliquely truncate; surface with irregular concentric sculpture, having a row of knobs extending along the posterior ridge and commonly more or less covered with tear-shaped nodules and plications; epidermis straw color, tawny, yellowish green or greenish yellow, generally overlaid with a pattern of triangular green blotches; pseudocardinals radially split up; laterals long and straight; anterior scars impressed; beak cavities deep, compressed; nacre silvery white, rarely purplish, iridescent and much thinner behind; L. 114, H. 50, D. 46 mm. (condensed from Simpson, 1914, p. 833).

Ecology.—Probably a small-river form or even a creek form, as it is not mentioned by the van der Schalies (1950) for the Mississippi River proper. Scammon (1906, p. 348) gives the following: "It is found in Kansas only in the clear-water streams of the southern drainage.... Although seeming to be nowhere abundant, it is not a rare species in the streams mentioned. Its favorite habitat is bars of gravel or shingle in a rather swift current. The thick and nodulous shell fits it admirably for these conditions."

Associations.—Living: OHIO-43.

General distribution (fig. 23).—"Entire Ohio, Cumberland, and Tennessee river systems; west to Nebraska (Aughey, doubtful); south to Arkansas and Indian Territory" (Simpson, 1914, p. 833). This is puzzling, for this range would include Wisconsin, yet F. C. Baker (1928a, pt. II) does not mention it for this State.

Distribution in Ohio (inset, fig. 23).—Sterki (1907a, p. 390) gives "Ohio River and most or all of its tributaries ... Tuscarawas River." Ortmann (1919) gives Ohio River in Jefferson and Scioto Counties and the Tuscarawas River, probably in Tuscarawas County.

Geologic range.—Unknown.

Quadrula fragosa (Conrad) 1836
Fig. 24

Unio fragosus Conrad 1836, Mon., pt. 2, p. 12, pl. 6, fig. 2.
Quadrula fragosa Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 391.
--- --- Simpson 1914, Descr. cat. Naiades, p. 843.
Quadrula quadrula-fragosa Frierson 1927, Check list N. Am. Naiades, p. 47.
Quadrula fragosa F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 88, pl. 46, figs. 5, 6; pl. 47, fig. 1; pl. 48, fig. 1.

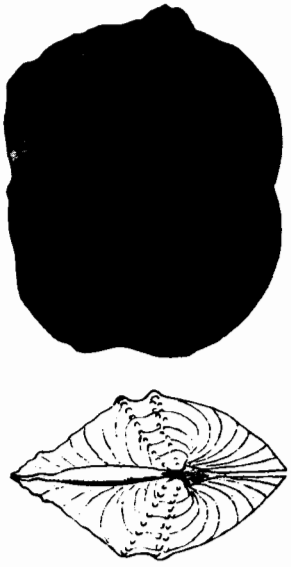


FIGURE 24.—*Quadrula fragosa,* X0.25; after Conrad's original figure (1836, pl. 6, fig. 2).

Type locality.—Scioto River, Ohio.

Diagnosis.—Shell differs from that of *Q. quadrula* in being more inflated, roundly quadrate in outline, the beaks more elevated and distinctly turned forward over the lunule, above which they are distinctly raised; this feature is not as apparent in *Q. quadrula;* the anterior swelling of the umbonal slope is also commonly more pustulose; the posterodorsal area is wider and more alate than in *Q. quadrula* (condensed from F. C. Baker, 1928a, pt. II, p. 88).

Ecology.—Found in the larger rivers on mud bottom in water 6 feet or more deep.

General distribution (fig. 25).—"Ohio, Cumberland, and Tennessee river systems; westward probably to Minnesota, Nebraska, and Kansas. It is quoted in state lists from Illinois ... Ohio ... Indiana ... Kansas ... and Missouri ..." (Baker, 1928a, pt. II, p. 89).

Distribution in Ohio (inset, fig. 25).—Sterki (1907a, p. 391) gives "Ohio River at Cincinnati, seems rare; Scioto River." Ortmann (1919) does not list the species.

Geologic range.—Unknown.

Remarks.—Goodrich and van der Schalie (1944) do not list this species for Indiana although Baker (1928a, pt. II, p. 89) specifically mentions it for the "Wabash." Possibly they considered it a synonym of some other species, perhaps *Q. quadrula,* as does Frierson (1927).

Quadrula metanevra Rafinesque 1820
Fig. 26

Obliquaris (Quadrula) metanevra Rafinesque 1820, Annales Gēn. Sci. Phys. (Bruxelles), v. 5, p. 305, pl. 81, figs. 15, 16.
Unio nodosus Barnes 1823, Am. Jour. Sci., v. 6, p. 124, pl. 6, figs. 7, 7a, 7b.
Unio metanevrus Call 1900, Moll. Ind., p. 467, pl. 28.
Quadrula metanevra Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.
--- --- Simpson 1914, Descr. cat. Naiades, p. 834.
--- --- Ortmann 1919, Najades Pa., p. 47, pl. 4, figs. 4-6.
--- --- F. C. Baker 1920, Life of Pleistocene, p. 382.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 17.

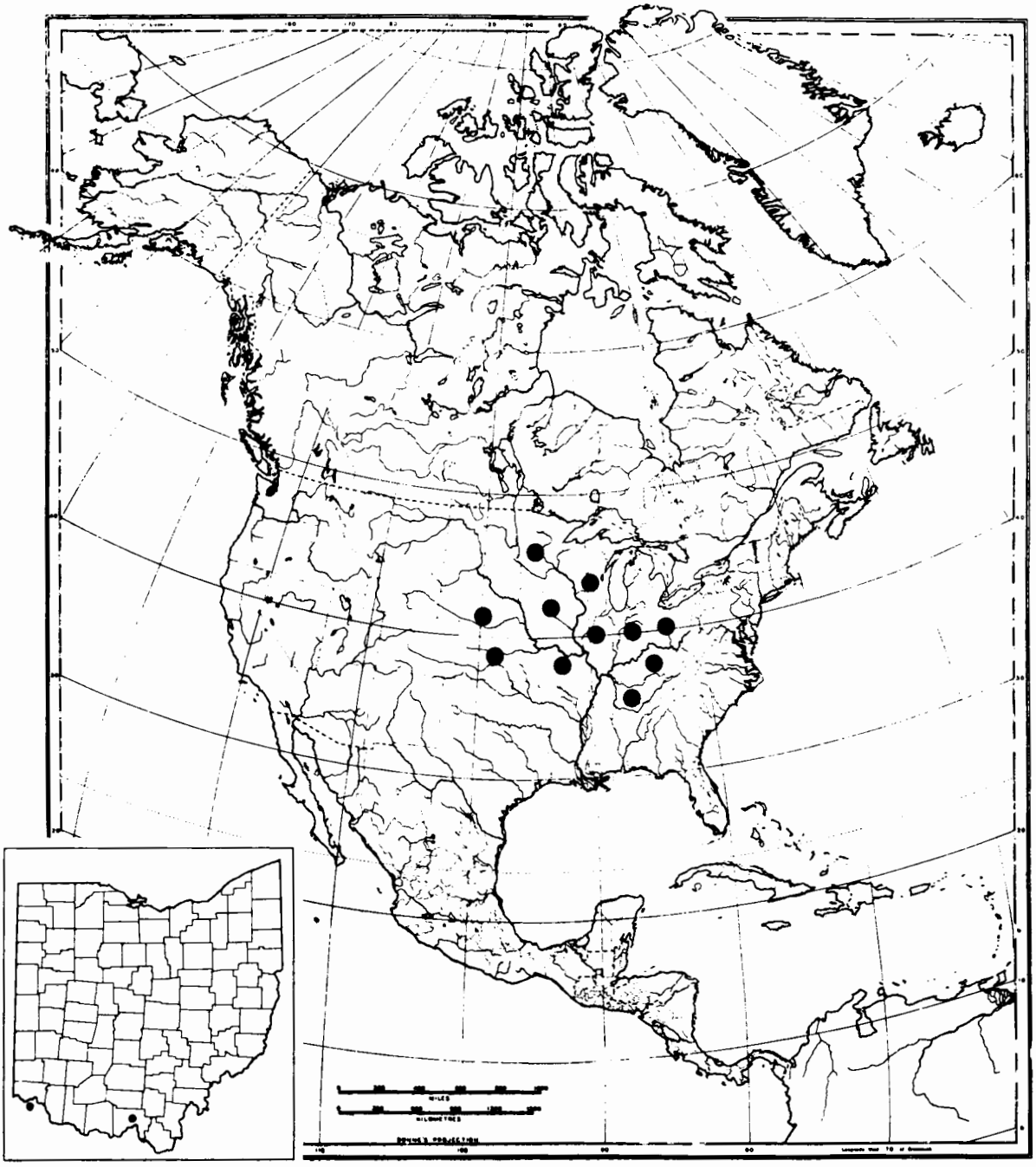


FIGURE 25.–Distribution of *Quadrula fragosa* in North America; *inset*, distribution in Ohio.

Quadrula metanevra Frierson 1927, Check list N. Am. Naiades, p. 51.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 97, pl. 48, fig. 2; pl. 49, figs. 1-3.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 309.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.

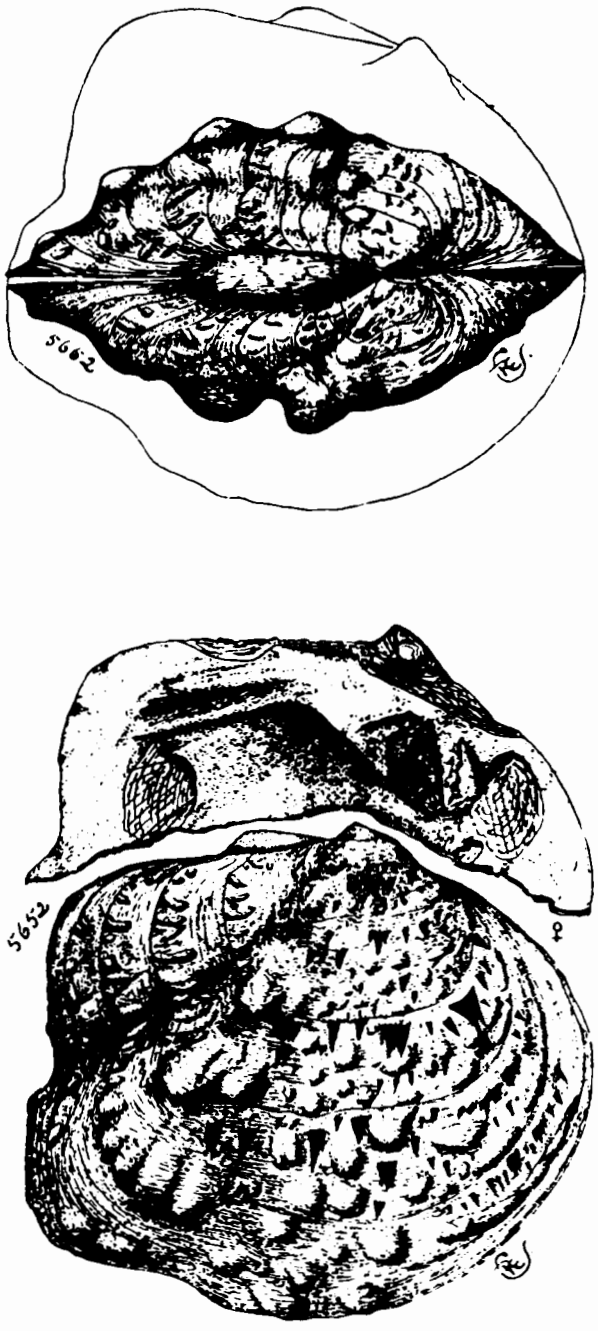


FIGURE 26.—*Quadrula metanevra*, outline and three views of the shell; X1; after Call (1900, pl. 28).

Type locality.—Kentucky River.

Diagnosis.—Shell solid, inequipartite, inflated, subrhomboid; beaks high, inflated, turned forward, with small irregular ridges which are nodulous on the posterior part; lunule narrow; anterior end rounded; posterior end sharply truncated with a striking sinus above the ridge; a strong wide elevated ridge extends obliquely from the umbones to the posterior angle of the shell; commonly, there is a depression or radial furrow behind this ridge; base slightly rounded or incurved behind the middle of the shell; surface of posterior two-thirds of shell more or less covered with rounded or tear-shaped tubercles, those on the posterior ridge larger and commonly forming elongated knobs; epidermis yellowish green or brownish, with many irregular triangular or chevron-shaped markings of dark green; surface slightly shining; pseudocardinals, two in left valve, divergent, heavy, triangular, sulcated; one in right valve, triangular, sulcated, with a small denticle in front, and one behind on the wide interdentum; laterals short, straight, heavy, sulcated, with, in a few cases, a small accessory tooth on the right lateral; anterior muscle scars deeply excavated; posterior scars distinct but not heavily impressed; beak cavities not very deep; nacre white, occasionally pinkish; shell greatly thickened anteriorly at the base, very thin posteriorly; no sexual differences in the shell (modified from F. C. Baker, 1928a, pt. II, p. 98).

Ecology.—This species lives in both large and small rivers, and is found on gravel bottom in the channels in deep water where there is a good current. The young are usually found on gravel bars in shallow water. Specimens have been collected on mud bottom, but only rarely.

General distribution (fig. 27).—Northern part of the Mississippi drainage area, as far south as the Tennessee and Arkansas Rivers.

Distribution in Ohio (inset, fig. 27).—Sterki (1907a, p. 390) gives "Ohio River, common." Ortmann (1919) gives Ohio River only, in the following Ohio counties: Jefferson, Monroe, Meigs, and Scioto.

Geologic range.—Baker (1920a, p. 382) cites this species from Aftonian and late Wisconsin ("Wabash") beds.

Quadrula metanevra wardii (Lea) 1861

Unio wardii Lea 1861, Acad. Nat. Sci. Philadelphia Proc., v. 5, p. 392.
Quadrula metanevra wardii Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.
--- --- --- Simpson 1914, Descr. cat. Naiades, p. 835.
Quadrula metanevra-wardii Frierson 1927, Check list N. Am. Naiades, p. 52.
Quadrula metanevra wardii F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 100.

Type locality.—"Walhonding River, Ohio: Wassepinicon River, Iowa; Coal River, Logan Co., Va." (Simpson,

1914, p. 835). The Walhonding is a tributary of the Muskingum River, flowing mainly in Coshocton County, Ohio. It joins the Muskingum near Coshocton.

Diagnosis.—"Shell more compressed, more delicate and less solid than the type, usually smoother, sometimes scarcely tuberculate" (Simpson, 1914, p. 835).

Associations.—Living: OHIO-43.

General distribution (fig. 28).—"Ohio; west to Iowa" (Simpson, 1914, p. 835).

Distribution in Ohio.—Sterki (1907a, p. 390) records this form from the Ohio River; Sugar Creek, tributary to the Tuscarawas River, "but not a trace of it was found in the River, nor of the typical *metanevra* in the river or creek." Ortmann (1919) does not mention the form.

Geologic range.—Unknown.

Remarks.—The form is not recognized by Goodrich and van der Schalie (1944) or the van der Schalies (1950); however, the latter are concerned mainly with mussels

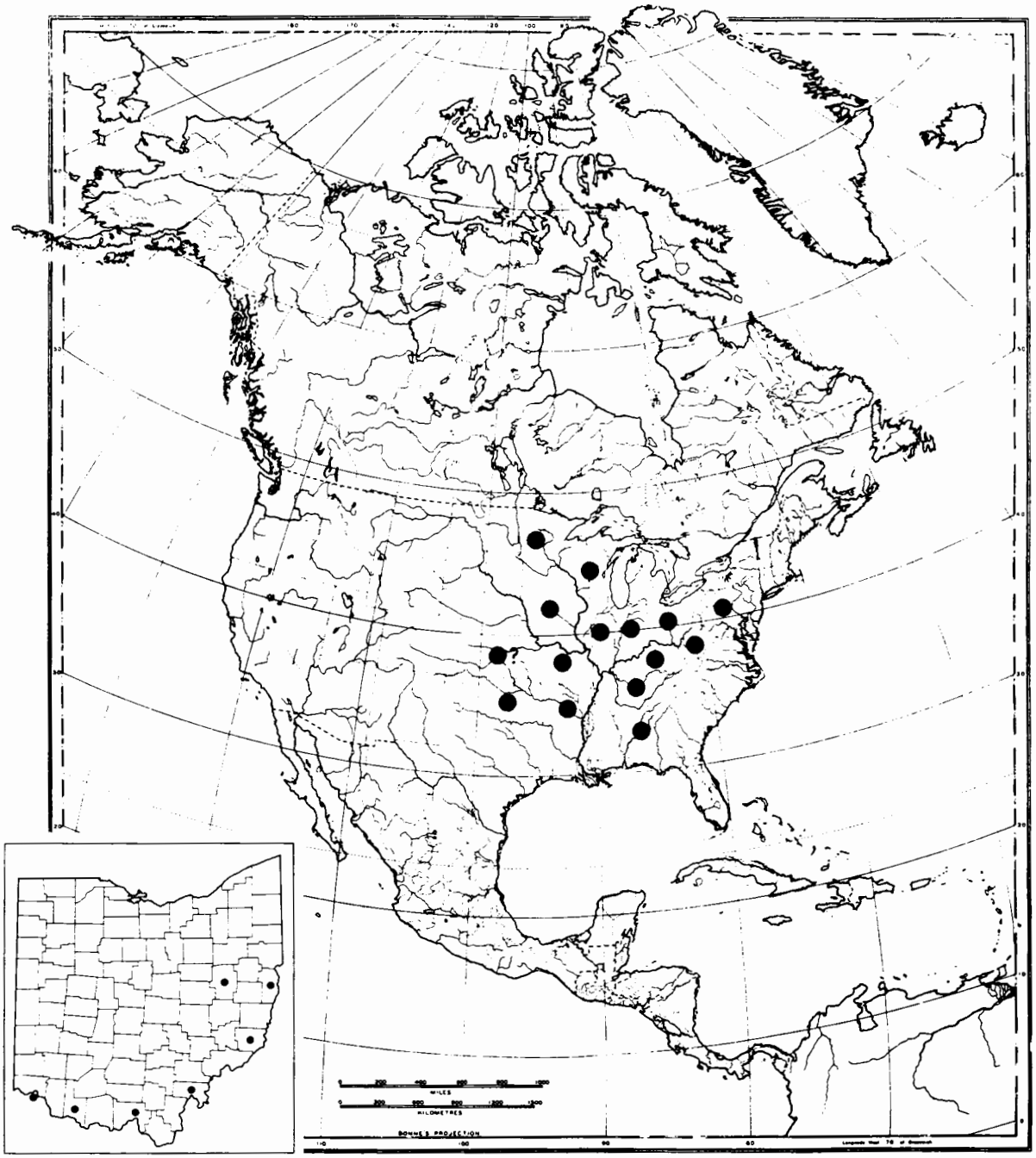


FIGURE 27.—Distribution of *Quadrula metanevra* in North America; *inset,* distribution in Ohio.

of the main Mississippi River and not with the small-river and creek forms.

Quadrula nodulata Rafinesque 1820
Fig. 29

Obovaria (Quadrula) nodulata Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 307, pl. 81, figs. 17, 18.
Unio pustulata Lea 1834, Am. Philos. Soc. Trans., v. 4, p. 79, pl. 7, figs. 19.
Unio pustulosus Call 1900, Moll. Ind., p. 484, pls. 45-47.
Quadrula pustulata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 391.
--- --- Simpson 1914, Descr. cat. Naiades, p. 856.
Quadrula nodulata Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 17.
--- --- Frierson 1927, Check list N. Am. Naiades, p. 49.
--- --- F. C. Baker 1928, Fresh water Moll. Wis.,

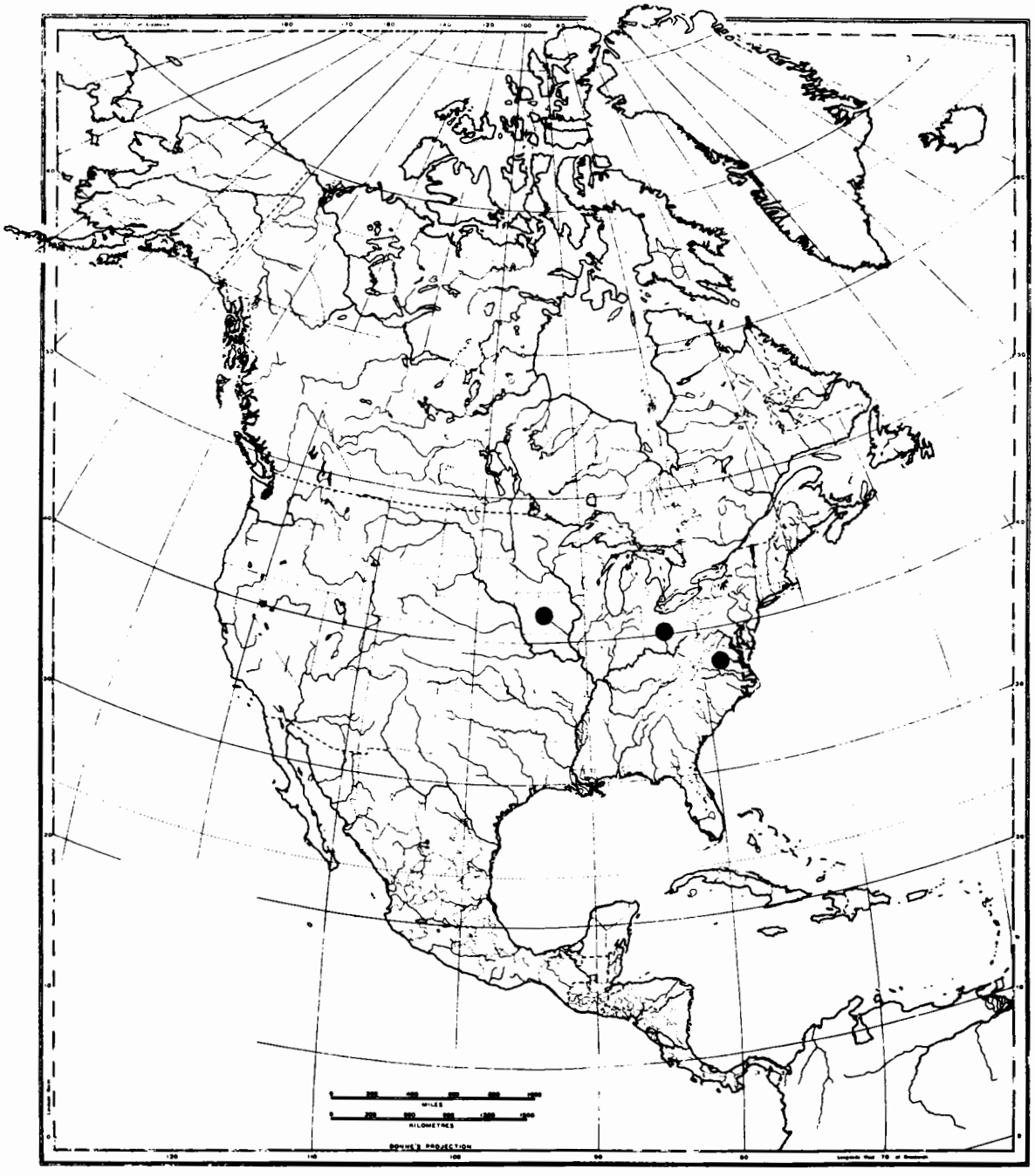


FIGURE 28.–Distribution of *Quadrula metanevra wardii* in North America.

pt. II, p. 95, pl. 45, figs. 1, 2, 4.
Quadrula nodulata Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 309.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.

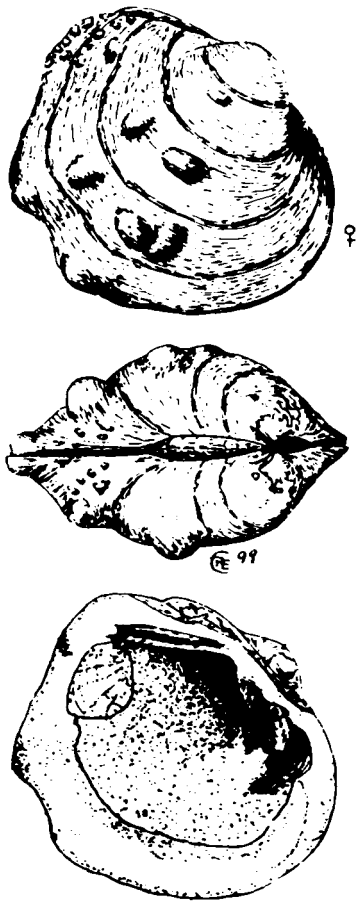


FIGURE 29.—*Quadrula nodulata,* three views of the shell; X1; after Call (1900, pl. 44).

Type locality.—Kentucky River.

Diagnosis.—Shell subquadrate, more or less inflated, solid, nearly equipartite; beaks high, swollen, turned forward over a wide lunule, with one or two coarse corrugations which continue down the disk of the shell in two diverging lines of widely separated tubercles; posterior ridge well developed, roundly angled; surface with two rows of widely spaced tubercles on the posterocentral part of the valve, and a group of small tubercles, varying in number from none to twelve, on the dorsoposterior part of the alate portion; epidermis yellowish green or brownish green, smooth and shining to rather rough, rarely feebly rayed; two pseudocardinals in left valve, divergent, pyramidal, roughened; one large pseudocardinal in right valve, sulcated, with a small denticle above anteriorly and posteriorly; laterals slightly curved, not heavy, with a few specimens having a second lamina in the right valve; interdentum narrow; beak cavities deep; anterior adductor muscle scars deeply excavated, posterior muscle scars faintly impressed; nacre white, iridescent posteriorly; L. 57, 51, 47, 35, 27; H. 50, 49, 41, 33, 23; D. 37, 38, 30, 25, 18 mm. (modified from F. C. Baker, 1928a, pt. II, p. 96).

Ecology.—A species of the large rivers where it is usually found on mud bottom; rare on gravel bottom. Young shells are abundant on sand bars, rare in mud or gravel.

General distribution (fig. 30).—"Ohio, Cumberland and Tennessee river systems, Mississippi River and tributaries from eastern Iowa to Louisiana" (Simpson, 1914, p. 856).

Distribution in Ohio (inset, fig. 30).—Sterki (1907a, p. 391) gives "Ohio River at Cincinnati; Mahoning River; cited from the Tuscarawas River, by Dean." Sterki was not able to find a trace of it and supposes that some form of *Q. pustulosa* was mistaken for it. Ortmann (1919) does not mention the species.

Geologic range.—Unknown.

Quadrula pilaris (Lea) 1840
Fig. 31

Unio pilaris Lea 1840, Am. Philos. Soc. Proc., v. 1, p. 285.
Unio lesueurianus Lea 1840, *ibid.*, p. 286.
Quadrula pilaris Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.
--- --- Simpson 1914, Descr. cat. Naiades, p. 893.
--- --- Frierson 1927, Check list N. Am. Naiades, p. 56.

Type locality.—French Broad and Holston Rivers, Tennessee.

Diagnosis.—Shell irregularly short oval, inflated, solid, inequilateral; beaks rather high and full, turned forward over a lunule; anterior end generally lightly truncated above, rounded below; base line rounded to almost straight; outline of dorsal slope curved, in a few cases elevated just behind the ligament; posterior ridge moderate, rounded; greatest diameter of the shell just below the beaks; surface covered with rough concentric growth lines; epidermis concentrically wrinkled, of various shades of dull brown or greenish brown with faint broken rays when young; pseudocardinals triangular, radially striate; lateral of the right valve inclined to be double; muscle scars small, impressed; beak cavities decidedly deep, compressed; nacre whitish, commonly blotched, thinner and brownish or bronzy, iridescent behind; L. 66, 50; H. 51, 45; D. 31, 27 mm. (modified from Simpson, 1914, p. 893).

Ecology.—Judging by the range, this is a species of small rivers and perhaps even creeks.

General distribution (fig. 32).—"Tennessee and Cumberland River systems; Green River, Kentucky; reported from the Ohio River" (Simpson, 1914, p. 894).

Distribution in Ohio (inset, fig. 32).—Sterki (1907a, p. 392) gives only Ohio River at Cincinnati. Ortmann (1919) does not list the species.

Geologic range.—Unknown.

Remarks.—Simpson's report from the Ohio River probably refers to Sterki's record (1907a, p. 392) which is itself probably indirect and therefore possibly inaccurate in that the material may have come from a tributary of the Ohio near Cincinnati and not from the Ohio River itself. No great importance need be attached to the record as it is probably erroneous; Goodrich and van der Schalie (1944) did not list the species for Indiana.

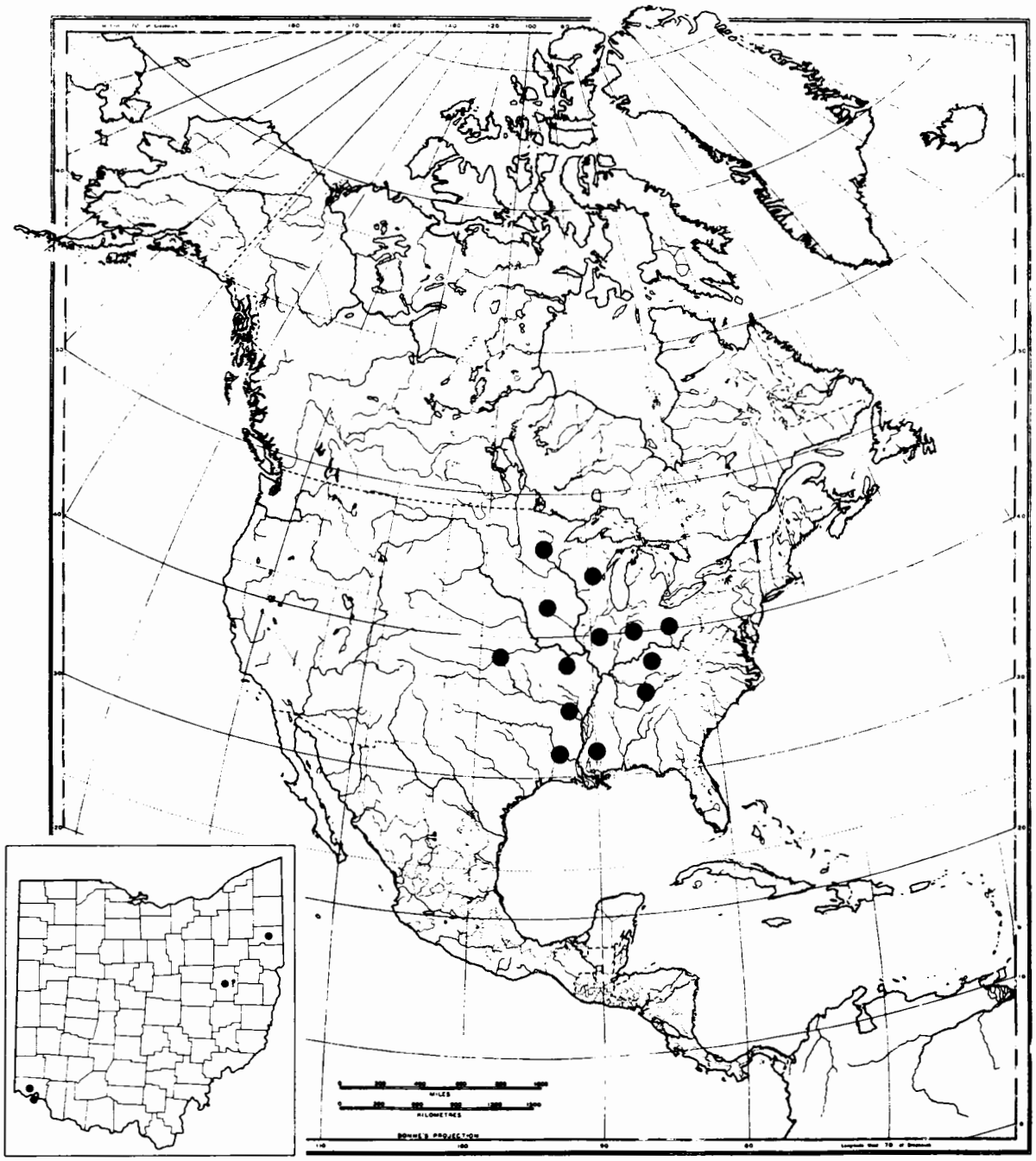


FIGURE 30.—Distribution of *Quadrula nodulata* in North America; *inset,* distribution in Ohio.

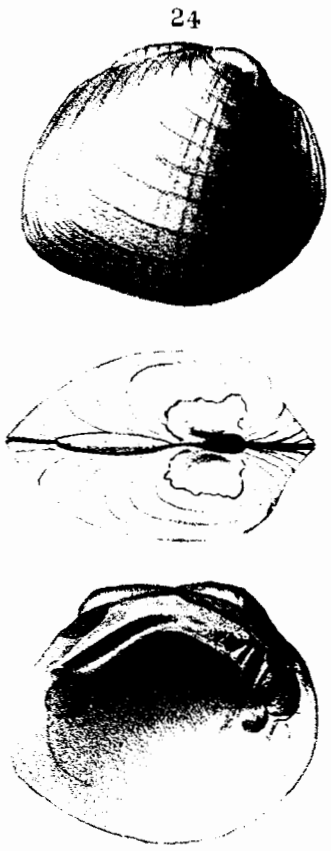


FIGURE 31.–*Quadrula pilaris*, three views of the shell; X1; after Lea (1840, pl. 14, fig. 24).

Quadrula pustulosa (Lea) 1831
Fig. 33

Unio pustulosus Lea 1831, Am. Philos. Soc. Trans., v. 4, p. 76, pl. 7, fig. 7.
Unio dorfeuillianus Lea 1838, *ibid.*, v. 6, p. 73, pl. 17, fig. 4.
Quadrula pustulosa Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 391.
--- --- Simpson 1914, Descr. cat. Naiades, p. 848.
--- --- Ortmann 1919, Najades Pa., p. 34, pl. 3, figs. 4, 5.
--- --- F. C. Baker 1920, Life of Pleistocene, p. 382.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 15.
--- --- Frierson 1927, Check list N. Am. Naiades, p. 48.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 90, pl. 44, figs. 1-6.
--- --- Goodrich 1932, Moll. Mich., p. 85.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 153.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 46.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 309.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 94, pl. 11, fig. 3.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 98.

Type locality.–The Ohio (and incorrectly Alabama) Rivers.

Diagnosis.–Shell subcircular, thick; epidermis yellow to dark brown, some specimens with dark rays of color radiating from the beaks; beaks raised a little above the hinge line, sculptured with three or four ridges that are a little higher in front than behind; surface with pustules, more or less rounded or oblong; beak cavity deep, anterior muscle scars deep, posterior scars broad and shallow; pseudocardinals heavy, projecting; nacre white; L. 60.5, H. 57.5, D. 37 mm. (modified from Goodrich, 1932, p. 85).

Ecology.–Found in rivers and large streams, in water 1-9 feet or more deep; on sand, gravel, and mud bottom. Young shells are usually found on gravel bars in shallow water. Van der Schalie (1938, p. 46) gives the following: "In this drainage [Huron River, Michigan] the species is decidedly a large-river form. It is rarely found alive in the lower reaches of the river, though I have taken it there from a gravel bottom. It is not restricted to gravel and may occur in sand or even mud."

Associations.–Living: MICHIGAN-54; OHIO-43.

General distribution (fig. 34).–Entire Mississippi drainage; Michigan; Lake Erie.

Distribution in Ohio (inset, fig. 34).–Sterki (1907a, p. 391) gives "Ohio River and most of its tributaries; Tiffin River, a variety, may be eq. *schoolcraftensis*." Ortmann (1919) gives Ohio River in Jefferson, Meigs, and Scioto Counties.

Geologic range.–Pleistocene, Don beds, Toronto, Ontario, Canada. F. C. Baker (1920a, p. 382) cites the species for beds of Yarmouth, Sangamon, and late Wisconsin ("Wabash") age.

Variation.–Two varieties, discussed below, have been recognized by previous workers in Ohio. One of these, *Q. pustulosa kieneriana* (Lea) is probably erroneously recorded for the State. The other, *Q. pustulosa prasina* (Conrad) is found in Lake Erie and its drainage.

[*Quadrula pustulosa kieneriana* (Lea) 1852]

Unio keinerianus (err. typ.) Lea 1852, Am. Philos. Soc. Proc., v. 5, p. 251.
Quadrula pustulosa kleineriana (err. typ.) Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 391.
--- --- --- Sterki 1914, Ohio Naturalist, v. 14, p. 271; not in Ohio.
Quadrula pustulosa kieneriana Simpson 1914, Descr. cat. Naiades, p. 851.
Quadrula pustulosa-kieneriana Frierson 1927, Check list N. Am. Naiades, p. 49.

Type locality.—Coosawattee River, Murray County, Georgia.

Diagnosis.—"Shell suborbicular, smooth or somewhat nodulous; epidermis ashy-brown or greenish-brown. Length 39, height 39, diam. 22 mm." (Simpson, 1914, p. 851).

Ecology.—Judging by the range, a small-river form of *Q. pustulosa* restricted to the Alabama River system.

General distribution (fig. 35).—Alabama River system (Simpson, 1914, p. 851).

Distribution in Ohio.—Recorded by Sterki (1907a, p. 391) as follows: entire Mississippi drainage; Lake Erie, "t. Simpson."

Geologic range.—Unknown.

Remarks.—Sterki's record of this form for Ohio is probably based on an unusual specimen of *Q. pustulosa.* Simpson may have considered its range to extend to Lake Erie previous to 1914, but in that year he gave only the

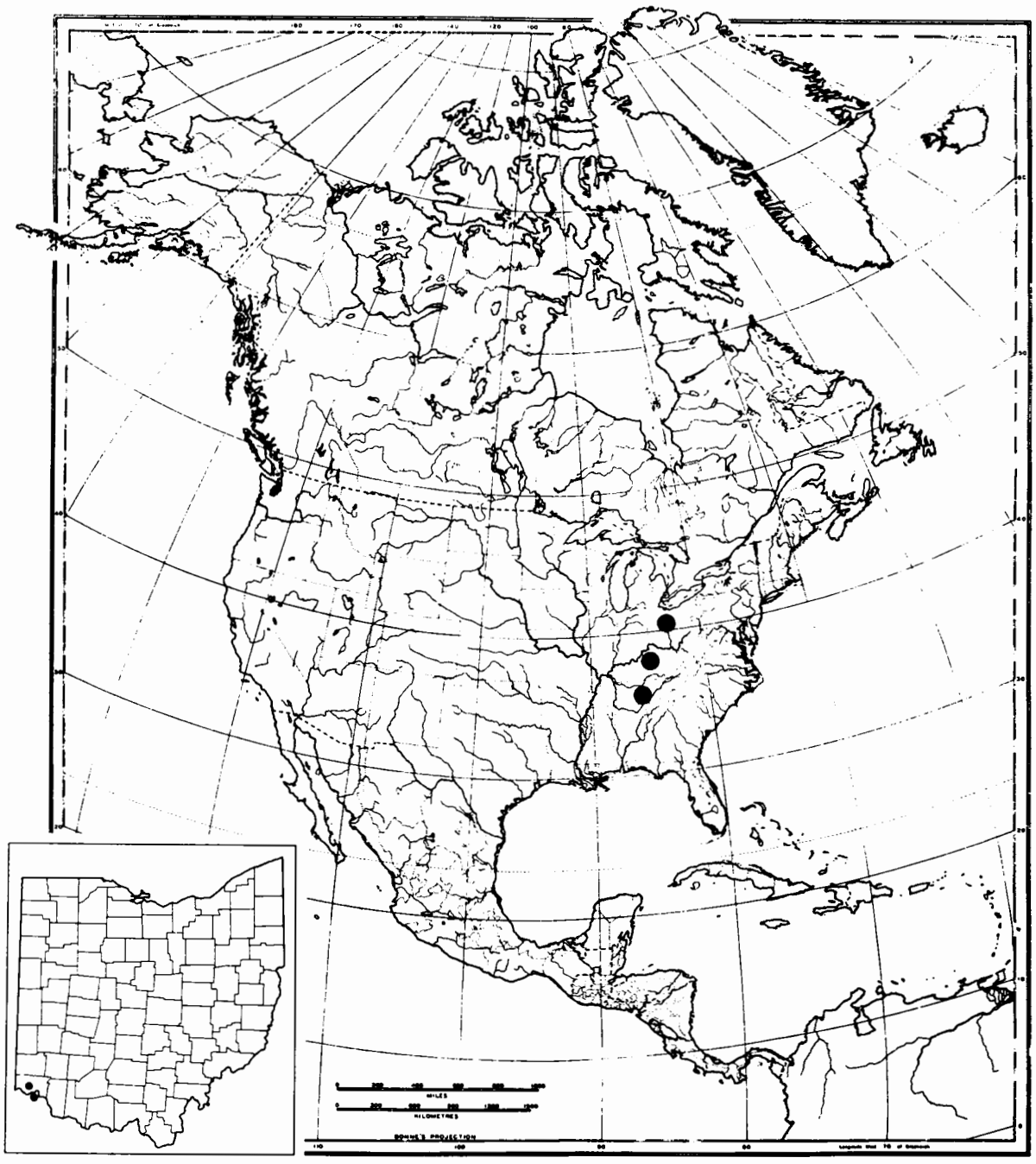


FIGURE 32.—Distribution of *Quadrula pilaris* in North America; *inset,* distribution in Ohio.

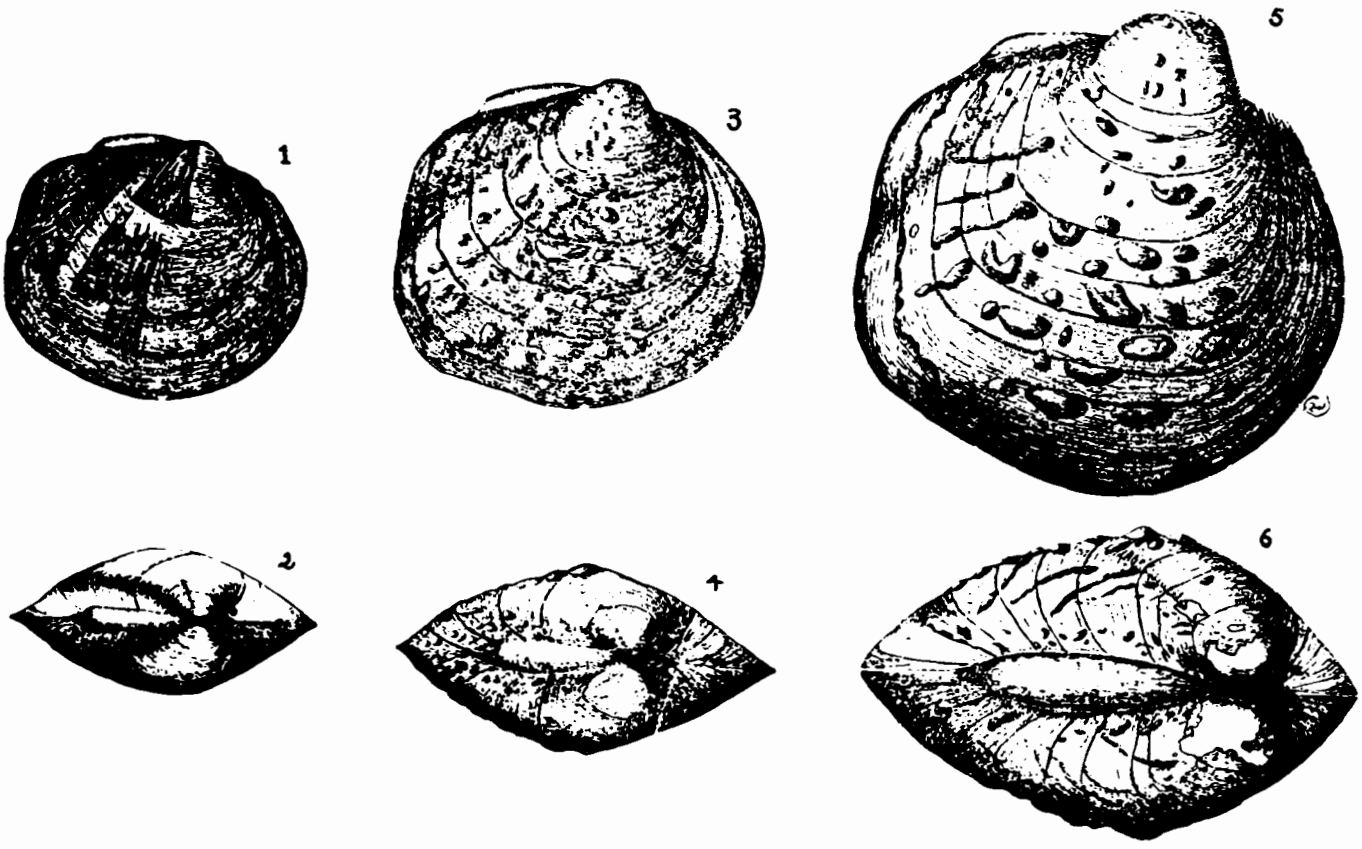


FIGURE 33.—*Quadrula pustulosa*, two views of each of three specimens, showing variation in the species, X1; after Call (1900, pl. 45).

Alabama River system. The varietal name has had an unfortunate history in that Lea misspelled Kiener's name in honoring him and Sterki compounded the error by adding an "l" which made it scarcely recognizable. Simpson (1914, p. 852) noted Lea's misspelling; he was undoubtedly aware of Sterki's record but did not mention it.

Quadrula pustulosa prasina (Conrad) 1834

Unio prasinus Conrad 1834 (May), New freshwater shells U.S., p. 44, pl. 3, fig. 1.
Unio schoolcraftensis Lea 1834 (Sept.), Am. Philos. Soc. Trans., v. 5, p. 37, pl. 3, fig. 9.
Quadrula schoolcraftensis Sterki 1914, Ohio Naturalist, v. 14, p. 271.
Quadrula pustulosa schoolcraftensis Simpson 1914, Descr. cat. Naiades, p. 850.
--- --- --- Ortmann 1919, Najades Pa., p. 38, pl. 3, figs. 6, 7.
--- --- --- F. C. Baker 1920, Life of Pleistocene, p. 382.
Quadrula pustulosa prasina Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 16.
Quadrula pustulosa-prasina Frierson 1927, Check list N. Am. Naiades, p. 48.
Quadrula pustulosa prasina F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 93, pl. 45, figs. 3, 5-8.
--- --- --- Goodrich 1932, Moll. Mich., p. 85.
Quadrula pustulosa schoolcraftensis La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 151.
--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 98.

Type locality.—Fox River at Green Bay, Wisconsin.

Diagnosis.—"Smaller than the typical species, is not so inflated, and it frequently has ridgelike growth lines" (Goodrich, 1932, p. 85).

Ecology.—"In quiet rivers on a mud, gravel or sand bottom, in shallow water. More abundant on a mud bottom" (F. C. Baker, 1928a, pt. II, p. 94). "A form that is fairly common in the shallow waters of Lake Erie" (Goodrich, 1932, p. 85).

General distribution (fig. 36).—Mississippi valley; Lake Erie.

Distribution in Ohio.—Lake Erie at Cedar Point, Erie County, and Maumee River, Defiance County (Ortmann, 1919). Sterki (1907a, p. 391) makes a rather vague mention of *Q. schoolcraftensis* for Ohio.

Geologic range.—Pleistocene, Don beds, Toronto,

Ontario, Canada. Baker (1920a, p. 382) cites it for Sangamon and late Wisconsin ("Wabash") beds.

Remarks.—The two statements under "Ecology" indicate a wide divergence in the concept of this form. Whether the term *prasina* should be restricted to the small-river form of *Q. pustulosa,* as would be natural considering the type form, or whether it should also include the Lake Erie form, living under very different conditions, I do not know. In any case, the form is entitled to recognition in an Ohio list, as it is found both in Lake Erie and in the smaller rivers of the State.

Quadrula quadrula Rafinesque 1820
Fig. 37; pl. 8, figs. 4, 7

Obliquaria (Quadrula) quadrula Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 307.
Unio lachrymosus Lea 1828, Am. Philos. Soc. Trans.,

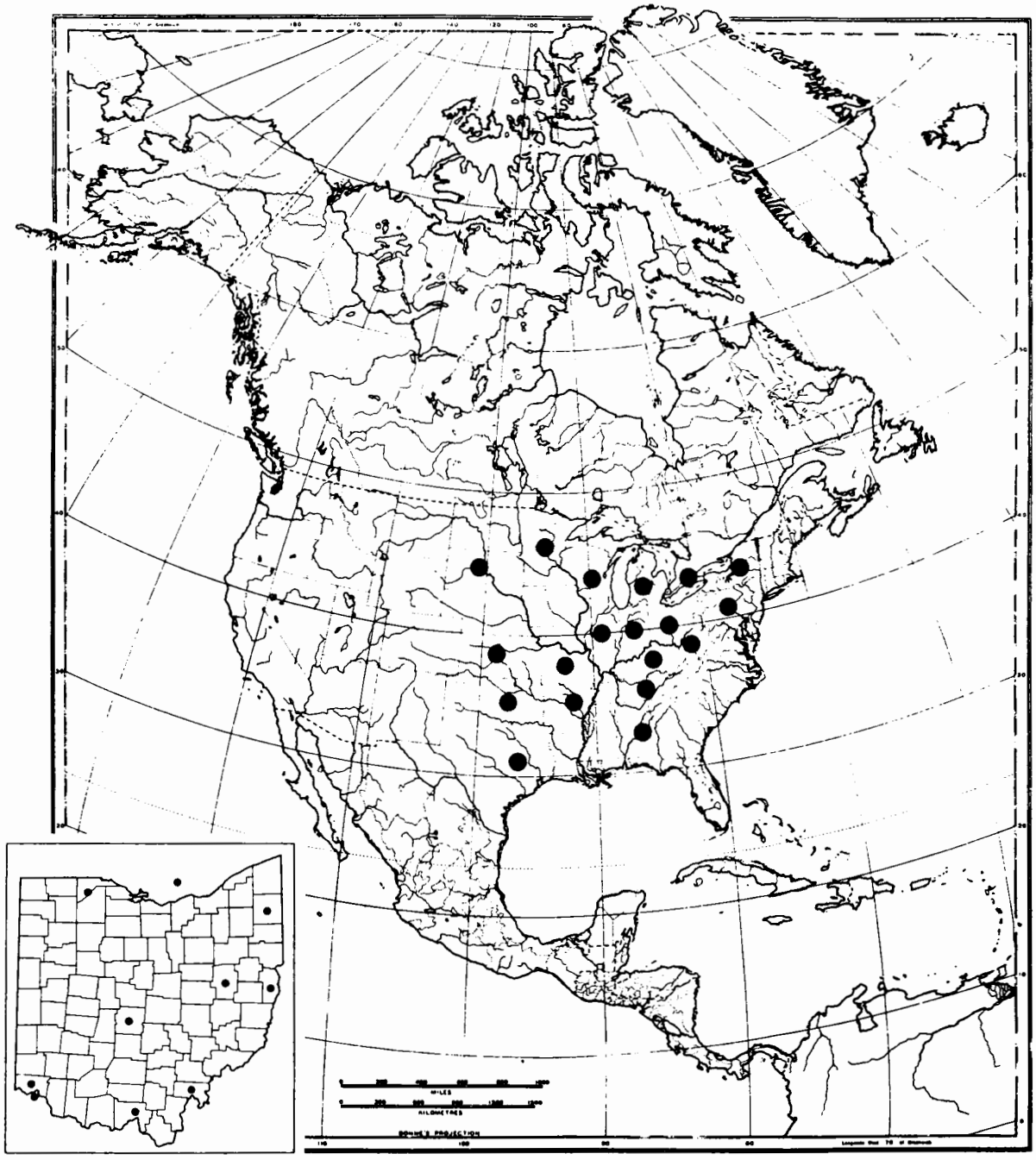


FIGURE 34.—Distribution of *Quadrula pustulosa* in North America; *inset,* distribution in Ohio.

v. 3, p. 272, pl. 6, fig. 8.
Unio asperrimus Lea 1831, Am. Philos. Soc. Trans., v. 4, p. 71, pl. 5, fig. 3.
Unio lachrymosus Call 1900, Moll. Ind., p. 489.
Quadrula lachrymosa Dall 1905, Harriman-Alaska Exped., v. 13, p. 134.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.
--- --- Simpson 1914, Descr. cat. Naiades, p. 841.
Quadrula quadrula Ortmann 1919, Najades Pa., p. 40, pl. 4, fig. 1.
Quadrula lachrymosa F. C. Baker 1920, Life of Pleistocene, p. 382.
Quadrula quadrula Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 16.
--- --- Frierson 1927, Check list N. Am. Naiades, p. 47.
--- --- F. C. Baker 1928, Fresh water Moll. Wis.,

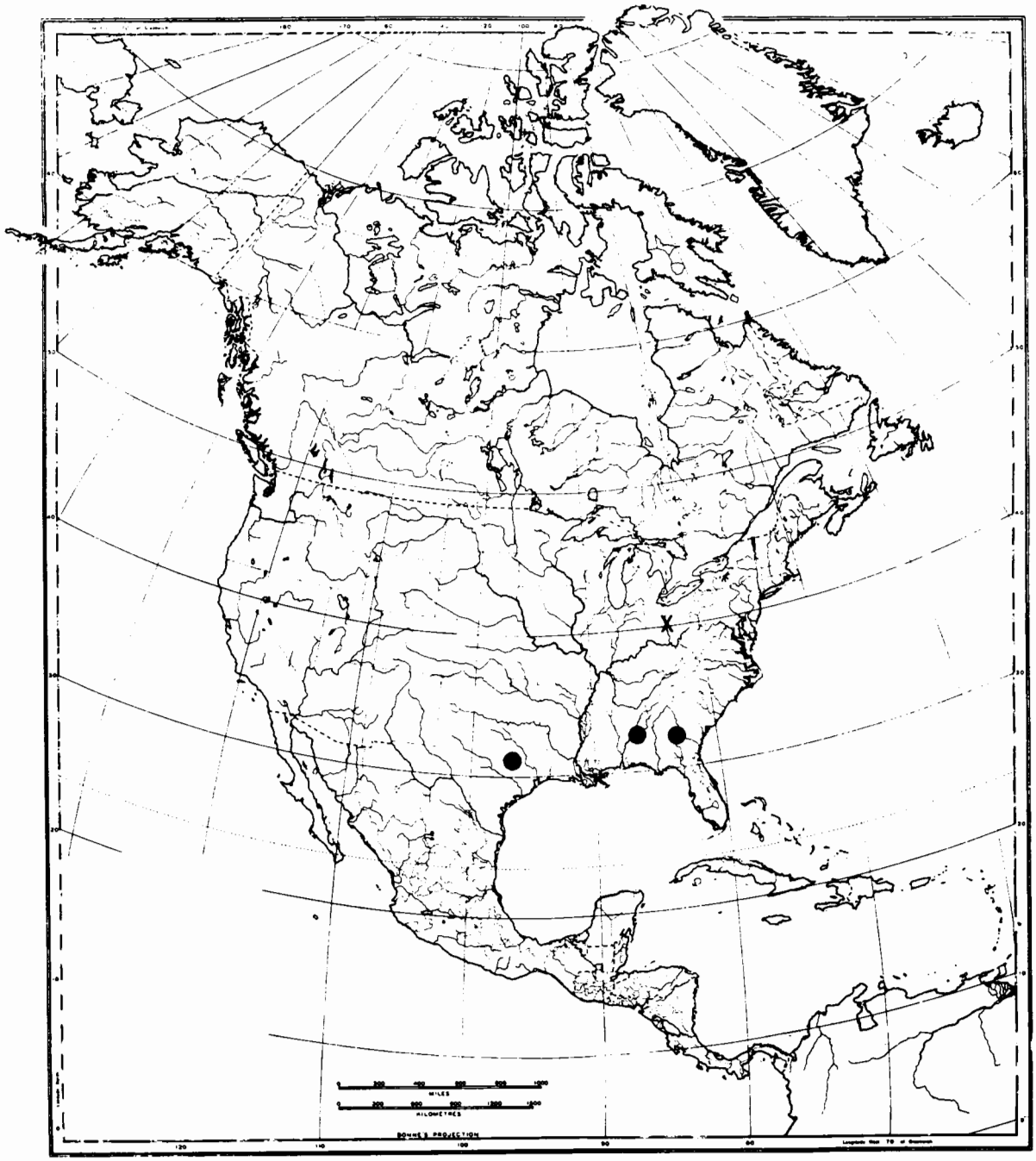


FIGURE 35.—Distribution of *Quadrula pustulose kieneriana* in North America.

pt. II, p. 84, pl. 46, fig. 4; pl. 48, figs. 2-4.
Quadrula quadrula Goodrich 1932, Moll. Mich., p. 85.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 153.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 310.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 94, pl. 11, fig. 7.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 98.
--- --- Hibbard and Taylor 1960, Mich. Univ. Mus. Paleontology Contr., v. 16, no. 1, p. 75.

Type locality.—Ohio River.

Diagnosis.—Shell quadrate, yellow to brownish green, rounded at the top and sinuous at the base; beaks not

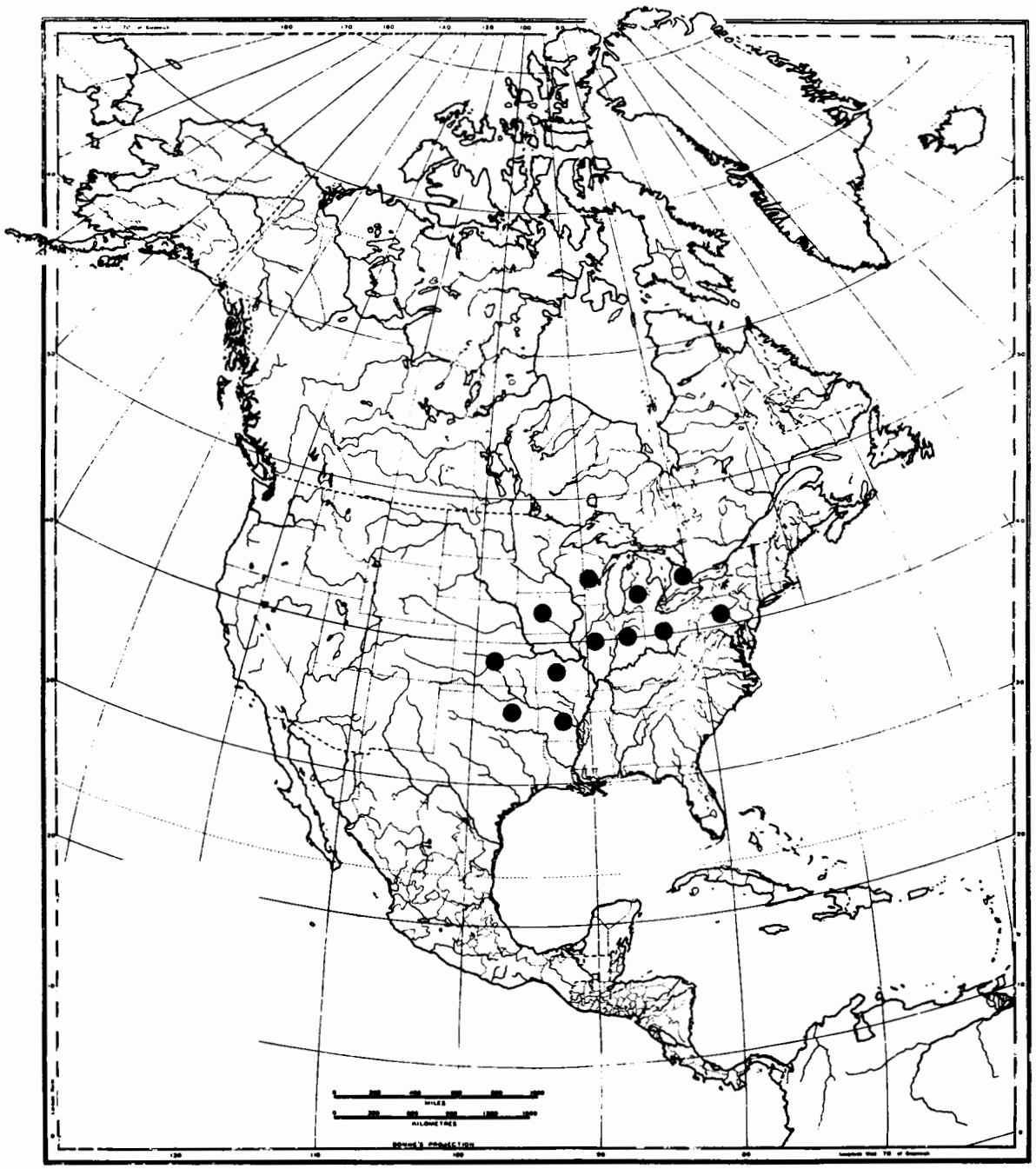


FIGURE 36.—Distribution of *Quadrula pustulosa prasina* in North America.

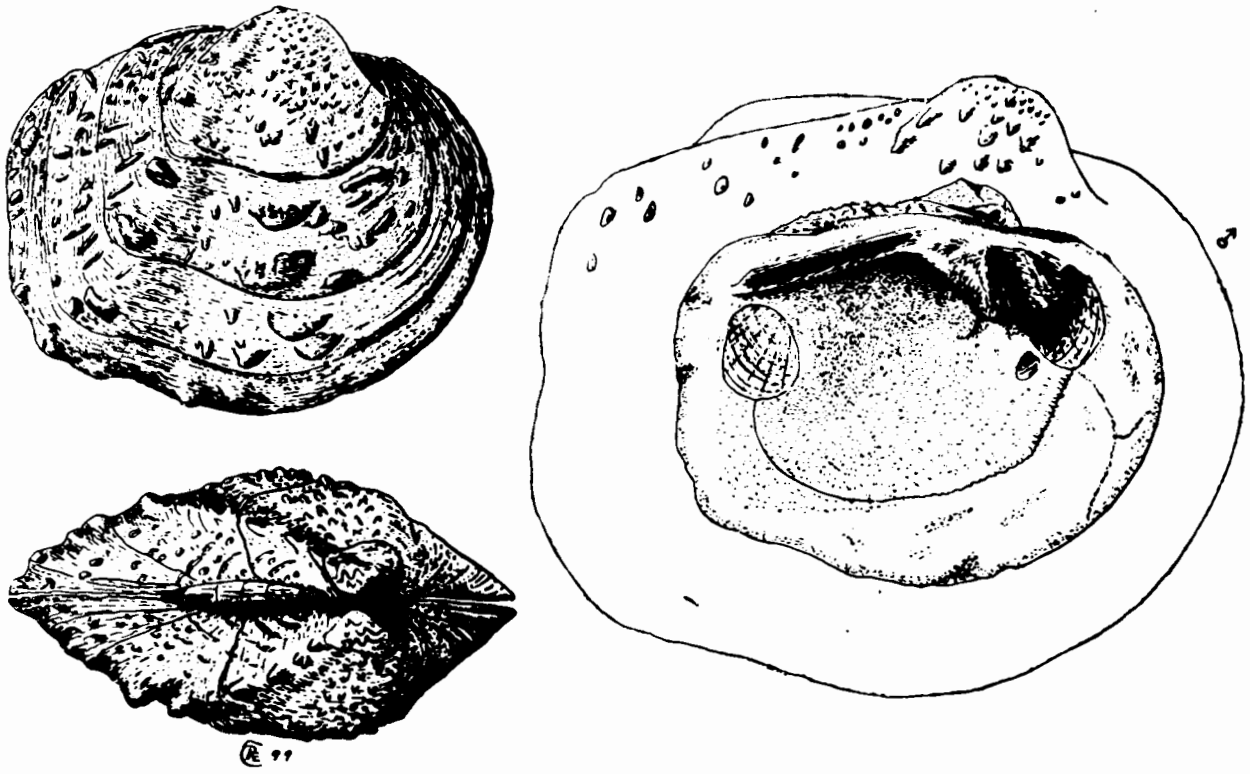


FIGURE 37.—*Quadrula quadrula,* several views showing variation, X1; after Call (1900, pl. 48).

much raised above the hinge; two well-defined ridges extend from beaks to base, the anterior ridge being covered with numerous irregular pustules, the other having a few at the top; smaller pustules, set in rows, upon the upper part of the posterior slope; a few faint rays can sometimes be made out on the disk; beak cavity deep; pseudocardinals stout, striate; lateral teeth sharp edged, not very long; muscle scars well defined, the smaller ones pitted; nacre pearly white, bluish near the thin posterior end; L. 75, H. 55, D. 33 mm. Modified from Goodrich (1932, p. 85).

Ecology.—Found on mud or sand bottom in fairly deep water (F. C. Baker, 1928a, pt. II, p. 86). "It often rivals *Obovaria ellipsis* as a habitant of sand-bars, and is also found in mud or shingle in water of variable depth. ... The shells of the animals living in muddy stations are large and massive; those from sand-bars thinner and smaller" (Scammon, 1906, p. 352).

Associations.—Fossil: S-6.

General distribution (fig. 38).—Mississippi drainage; St. Lawrence basin; Red River of the North; southwest into eastern Texas.

Distribution in Ohio (inset, fig. 38).—Sterki (1907a, p. 390) records this species from both drainages, decidedly variable. The Lake Erie form is a little inflated and has few tubercles; a similar form in the Ohio Canal near Cleveland (Allen); not in the Tuscarawas River. Ortmann (1919) gives Miami and Erie Canal, Lucas County; Ohio River, Scioto County; Wolfe Creek, Washington County.

Geologic range.—Cited by Baker (1920a, p. 382) only for late Wisconsin ("Wabash") beds. Pleistocene (Sangamon) of Kansas (Hibbard and Taylor, 1960, p. 75).

Genus *Tritogonia* Agassiz 1852

Tritogonia Agassiz 1852, Arch. Naturgesch., v. 18, no. 1, p. 48 (*fide* Neave).

Tritogonia Walker 1918, Synopsis and cat. fresh-water Moll., p. 45.

Tritogonia F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 100.

Type.—*Unio tuberculatus* Barnes (=*verrucosa* Rafinesque).

Diagnosis.—Shell solid, elongate, rhomboid, having a strong irregular posterior ridge, in the male obliquely truncated behind, in the female somewhat compressed and expanded into a broad wing; base curved; whole surface, except the rounded wing of the females, covered with pustules; beaks rather low, incurved and turned forward over the well-developed lunule; beak sculpture strong, consisting of irregular subparallel ridges which are curved upward behind and of fine radiating ridges in front of and behind them; epidermis dark olive; hinge plate rather narrow; pseudocardinals strong, ragged; laterals long and straight, near to the pseudocardinals;

cavity of beaks rather deep and compressed; female shell more compressed than that of the male.

Tritogonia verrucosa (Rafinesque) 1820
Fig. 39

Obliquaria verrucosa Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 304, pl. 86, figs. 10-12.

Unio tuberculatus Barnes 1823, Am. Jour. Sci., v. 6, p. 125, pl. 7, figs. 8a, 8b.

--- --- Call 1900, Moll. Ind., p. 465, pl. 26.

Tritogonia tuberculata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.

Quadrula tuberculata Simpson 1914, Descr. cat. Naiades, p. 318.

Quadrula verrucosa Ortmann 1919, Najades Pa., p. 43, pl. 4, figs. 2, 3.

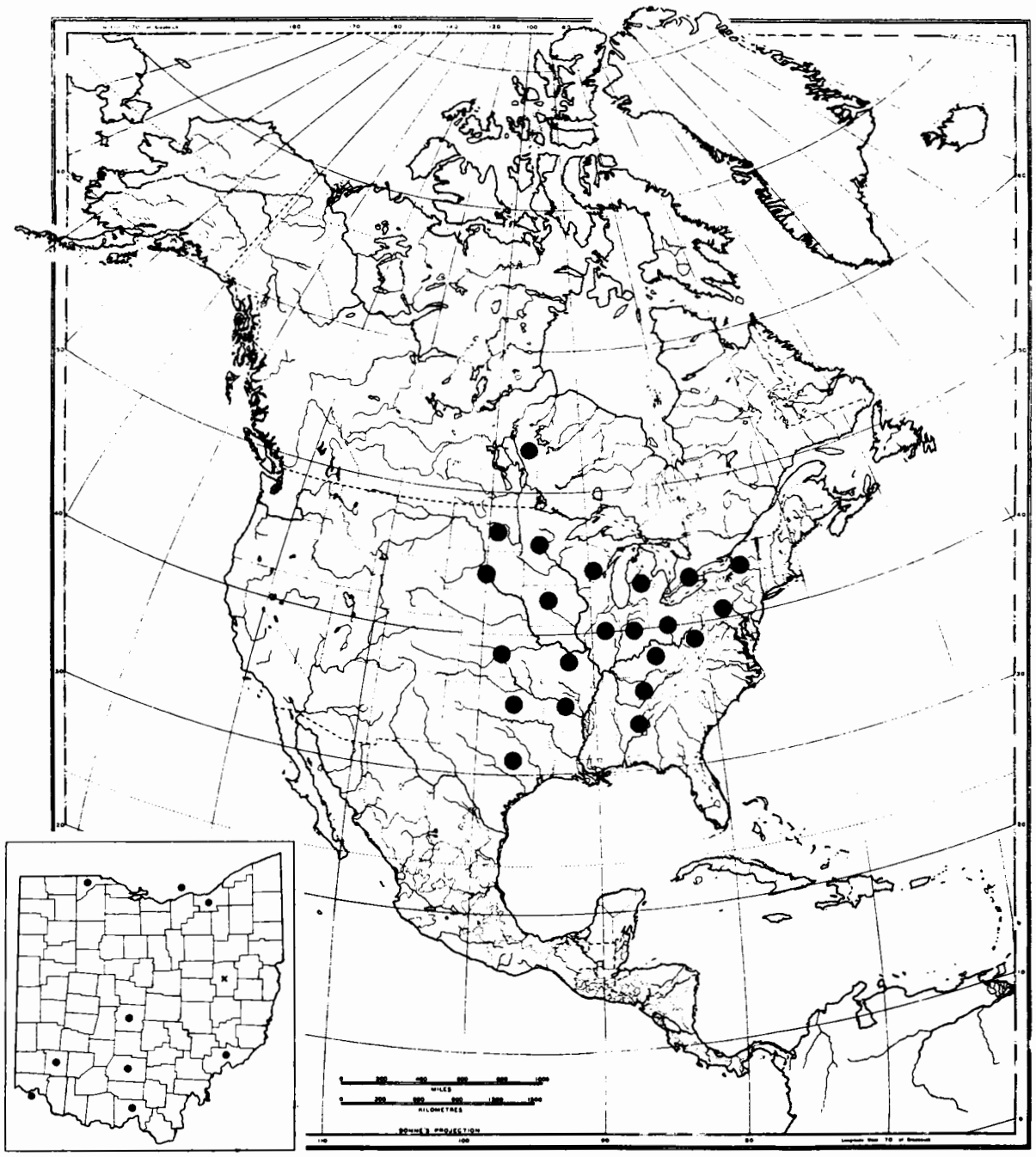


FIGURE 38.—Distribution of *Quadrula quadrula* in North America; *inset,* distribution in Ohio.

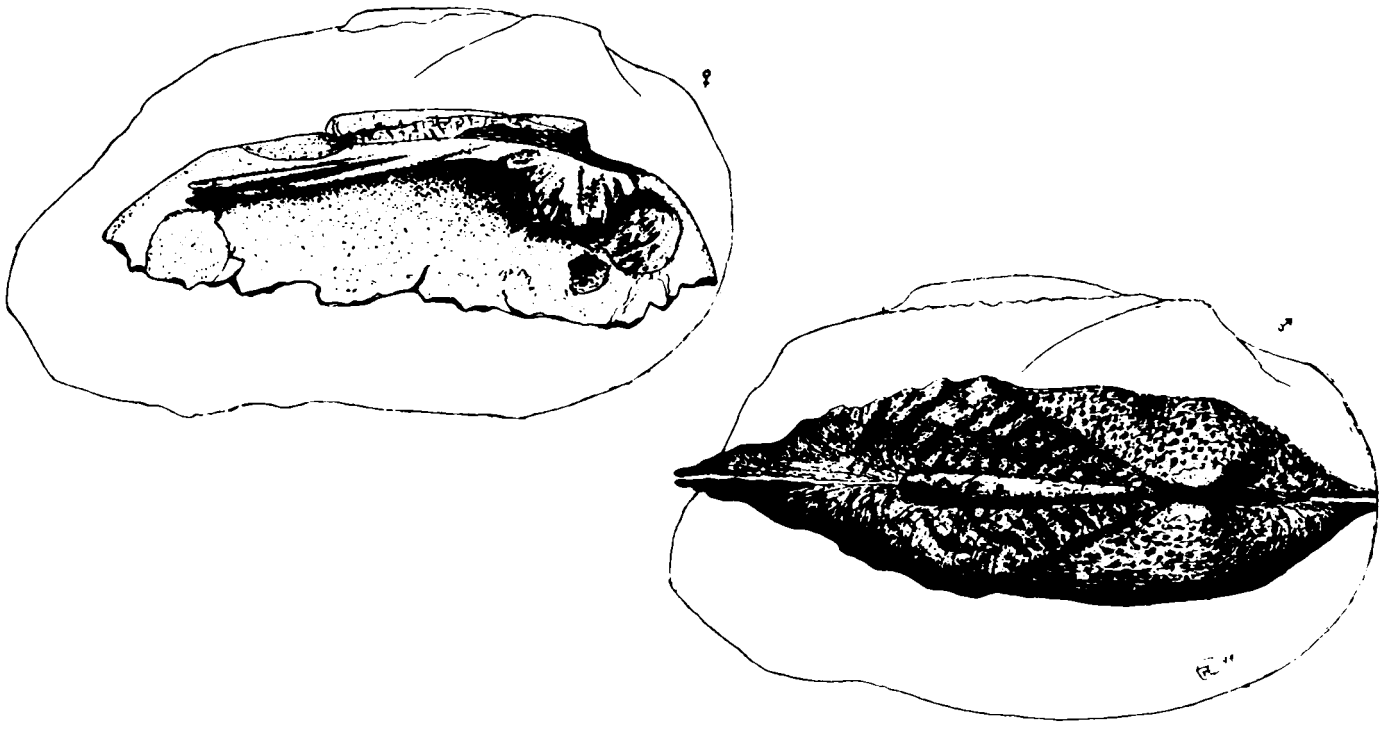


FIGURE 39.—*Tritogonia verrucosa,* several views of a male specimen (right figures) and a female specimen (left figures), X1; after Call (1900, pl. 26).

Quadrula verrucosa Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 48.
Quadrula (Tritogonia) verrucosa Frierson 1927, Check list N. Am. Naiades, p. 48
Tritogonia verrucosa F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 100, pl. 50, figs. 1-4.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 310.
Tritigonia verrucosa van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.

Type locality.—Ohio River.

Diagnosis.—Shell solid, elongate, rhomboid, with a strong irregular posterior ridge; whole surface, except the rounded wing of the female, covered with pustules; beaks rather low, incurved and turned forward over the well-developed lunule; beak sculpture strong, consisting of irregular subparallel ridges which are curved upward behind, and fine radiating ridges in front of and behind them; epidermis dark olive; hinge plate rather narrow; pseudocardinals strong, ragged; laterals long and straight, near to the pseudocardinals; cavity of beaks rather deep, compressed; female shell more compressed than that of the male (modified from F. C. Baker, 1928a, pt. II, p. 100).

Ecology.—Found in fairly deep water on sand or mud bottom, common on riffles, in shallow water in smaller streams; usually not deeply buried in riffles but deeper in mud; young shells are common on sand bars (condensed from Baker, 1928a, pt. II, p. 102).

Associations.—Living: OHIO-43.

General distribution (fig. 40).—Mississippi drainage generally; streams falling into the Gulf of Mexico from the Alabama system west to central Texas (Simpson, 1914).

Distribution in Ohio (inset, fig. 40).—Sterki (1907a, p. 390) records the species for the Ohio drainage generally. Ortmann (1919) gives Tuscarawas River; Wolfe Creek, Washington County.

Genus *Cyclonaias* Pilsbry 1922

Rotundaria Simpson 1900, Synopsis Naiades, p. 794; 1914, Descr. cat. Naiades, p. 80.
Rotundaria Walker 1918, Synopsis and cat. fresh-water Moll., p. 48.
Cyclonaias Pilsbry 1922, *in* Ortmann and Walker, Nomen. N. Am. Naiades, p. 18 (*fide* Neave).
Cyclonaias F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 103.
Cyclonaias La Rocque 1953, Cat. Recent Moll. Canada, p. 90.

Type.—Obliquaria tuberculata Rafinesque.

Diagnosis.—Shell rounded; slightly truncated above in front; posterior ridge low, beaks prominent, curved

inward and forward over a strongly marked lunule; beak sculpture consisting of numerous fine, irregular, broken, somewhat concentric corrugations; posterior three-fifths of the shell tuberculate; epidermis brown; nacre purple.

Cyclonaias tuberculata (Rafinesque) 1820
Fig. 41

Obliquaria (Rotundaria) tuberculata Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 308.

Unio verrucosus Barnes 1823, Am. Jour. Sci., v. 6, p. 123, pl. 5, fig. 6.

Unio tuberculatus Conrad 1836, Mon., pt. 3, p. 43, pl. 22.

Quadrula tuberculata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.

--- --- Simpson 1914, Descr. cat. Naiades, p. 903.

Rotundaria tuberculata Ortmann 1919, Najades Pa., p. 57, pl. 5, fig. 4.

--- --- F. C. Baker 1920, Life of Pleistocene, p. 382.

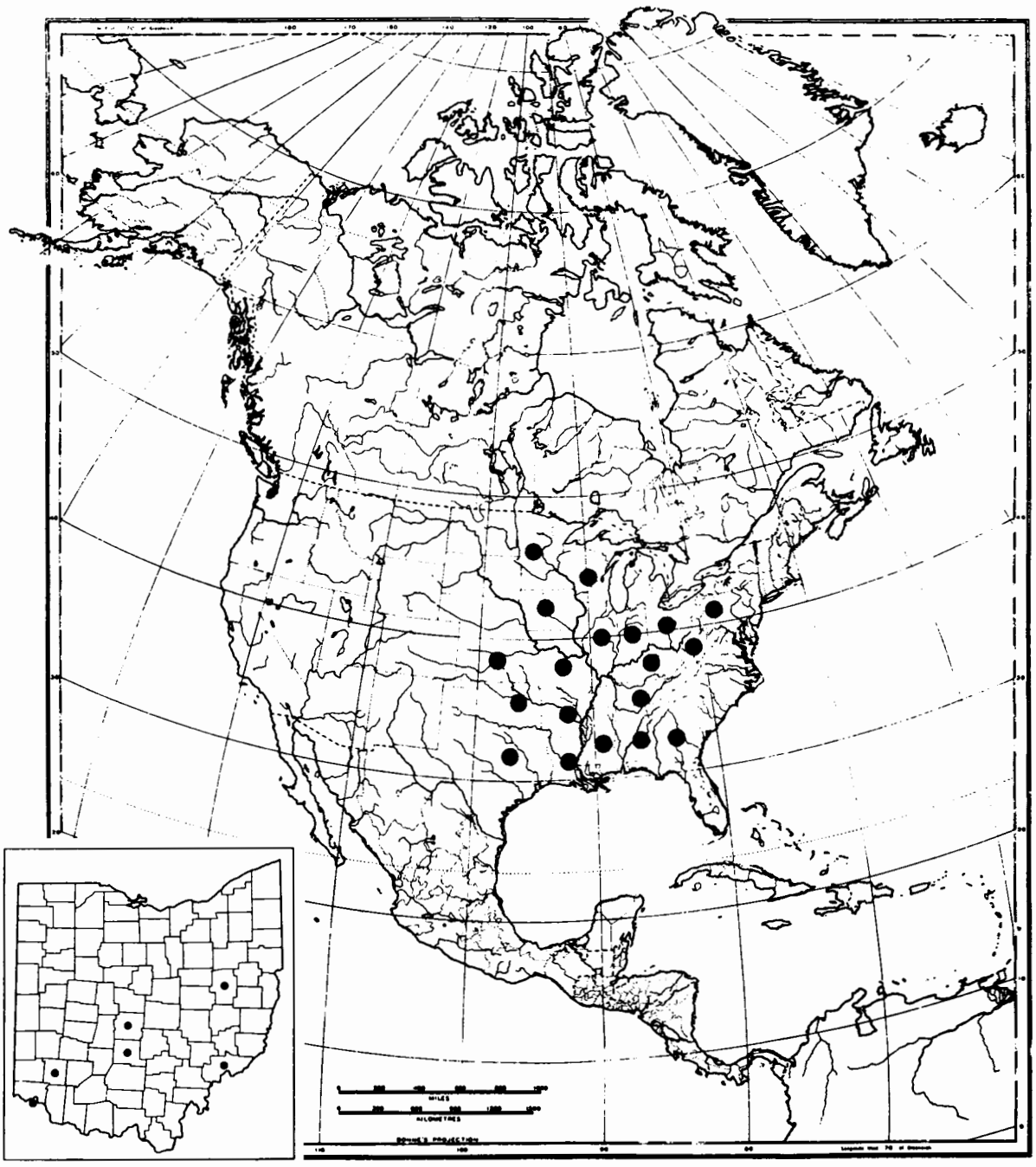


FIGURE 40.—Distribution of *Tritogonia verrucosa* in North America; *inset,* distribution in Ohio.

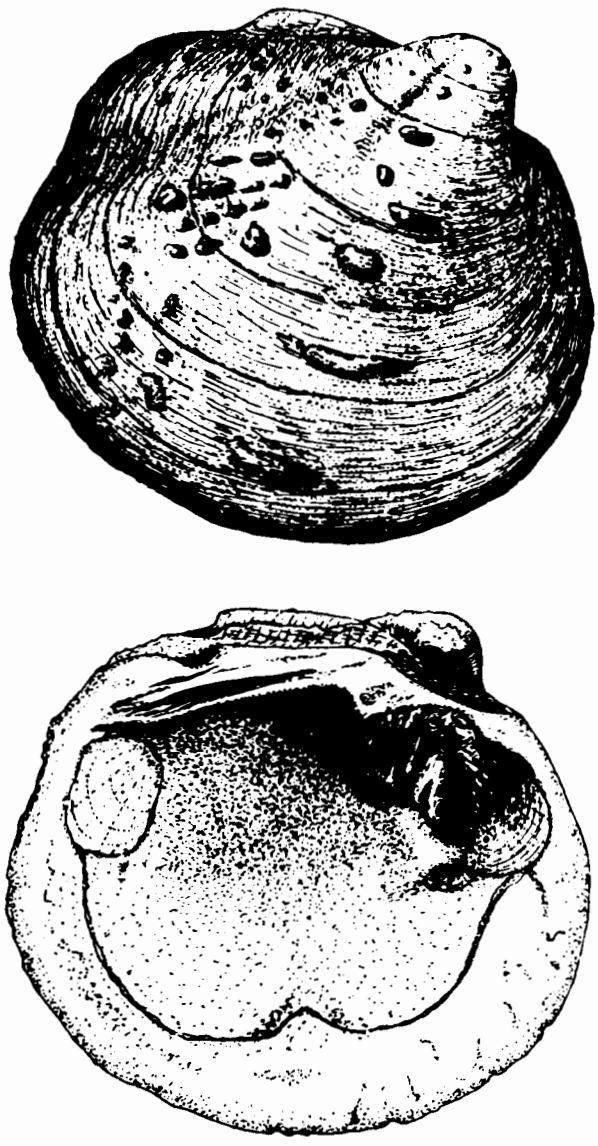


FIGURE 41.–*Cyclonaias tuberculata,* two views showing exterior (upper) and interior (lower), X1; after Call (1900, pl. 49).

Cyclonaias tuberculata Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 18.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 103, pl. 51, figs. 1, 2, 5.
--- --- Goodrich 1932, Moll. Mich., p. 86.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 152.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 306.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 90.

Type locality.–Ohio and its tributaries (Rafinesque, *O. tuberculata*); Wisconsin River (Barnes, *U. verrucosus*).

Diagnosis.–"Large, very nearly circular, dark brown. Growth lines crowded, raised. From beak to posterior end is an ill-defined ridge upon the face of which are irregular pustules that disappear anteriorly. Beaks raised, covered with numerous fine wrinkles. Pseudocardinals very heavy, broad, striate; lateral teeth high, curving, long. Muscle scars deep, well-marked. Beak cavity deep, marked with numerous little pits on the upper side. Nacre purple, tending to become white and chalky in old specimens. Length 90, height 80, breadth 37 mm. Shells of females are more swollen than males" (Goodrich, 1932, p. 86).

Ecology.–Found on mud bottom in fairly deep water, 10 cm. to 2 m. deep. Ortman records it from riffles in coarse gravel. This may include the flat form of small rivers, mentioned below (modified from F. C. Baker, 1928a, pt. II, p. 106).

Associations.–Living: MICHIGAN-51, 52, 54, 63, 65; OHIO-43.

General distribution (fig. 42).–Mississippi drainage generally; Lake St. Clair drainage; Detroit River and Lake Erie; Ohio River and its drainage.

Distribution in Ohio (inset, fig. 42).–Sterki (1907a, p. 390) gives "Ohio River; Little Miami River; Tuscarawas River (St.) ... Maumee and Tiffin rivers, near Defiance." Ortmann (1919) gives Ohio River in Meigs and Scioto Counties. Sterki (1907a) lists a synonym, *Quadrula granifera,* for a form from the Ohio River and, doubtfully, from its tributaries.

Geologic range.–Recorded for late Wisconsin ("Wabash") beds by Baker (1920a, p. 382).

Remarks.–Baker (1928a, pt. II, p. 107) separates the variety *granifera* (Lea) from the type form. Its type locality is the Ohio River, near Cincinnati, but the van der Schalies (1950, p. 456) include this form as a synonym of the typical form.

Genus *Plethobasus* Simpson 1900

Plethobasus Simpson 1900, Synopsis Naiades, p. 764 (*fide* Neave).
Plethobasus Walker 1918, Synopsis and cat. fresh-water Moll., p. 49.
Plethobasus F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 109.

Type.–Unio aesopus Green (=*Plethobasus cyphyus* Raf.).

Diagnosis.–Shell large, irregularly oval, inflated, solid, somewhat abruptly swollen at the posterior base; posterior ridge low and rounded; beaks rather high, near the anterior end having a few strong ridges which are curved upward behind; a row of low irregular tubercles extends from near the beaks to the postbasal part of the valves; epidermis tawny yellow to dark brown; hinge plate solid, not flattened; pseudocardinals triangular,

rough; cavity of the beaks not deep; front part of the shell very heavy, thinner behind.

Plethobasus cicatricosus (Say) 1829
Fig. 43

Unio cicatricosus Say 1829, New Harmony Disseminator, v. 2, no. 19, p. 292.

Unio varicosus Lea 1829, Am. Philos. Soc. Trans., v. 4, p. 90, pl. 11, fig. 20 (*non* Lamarck).

Unio cicatricoides Frierson 1911, Nautilus, v. 25, p. 53, pl. 2, upper fig.

Unio varicosus Call 1900, Moll. Ind., p. 499, pl. 55.

Quadrula cicatricosa Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.

Pleurobema cicatricosum Simpson 1914, Descr. cat.

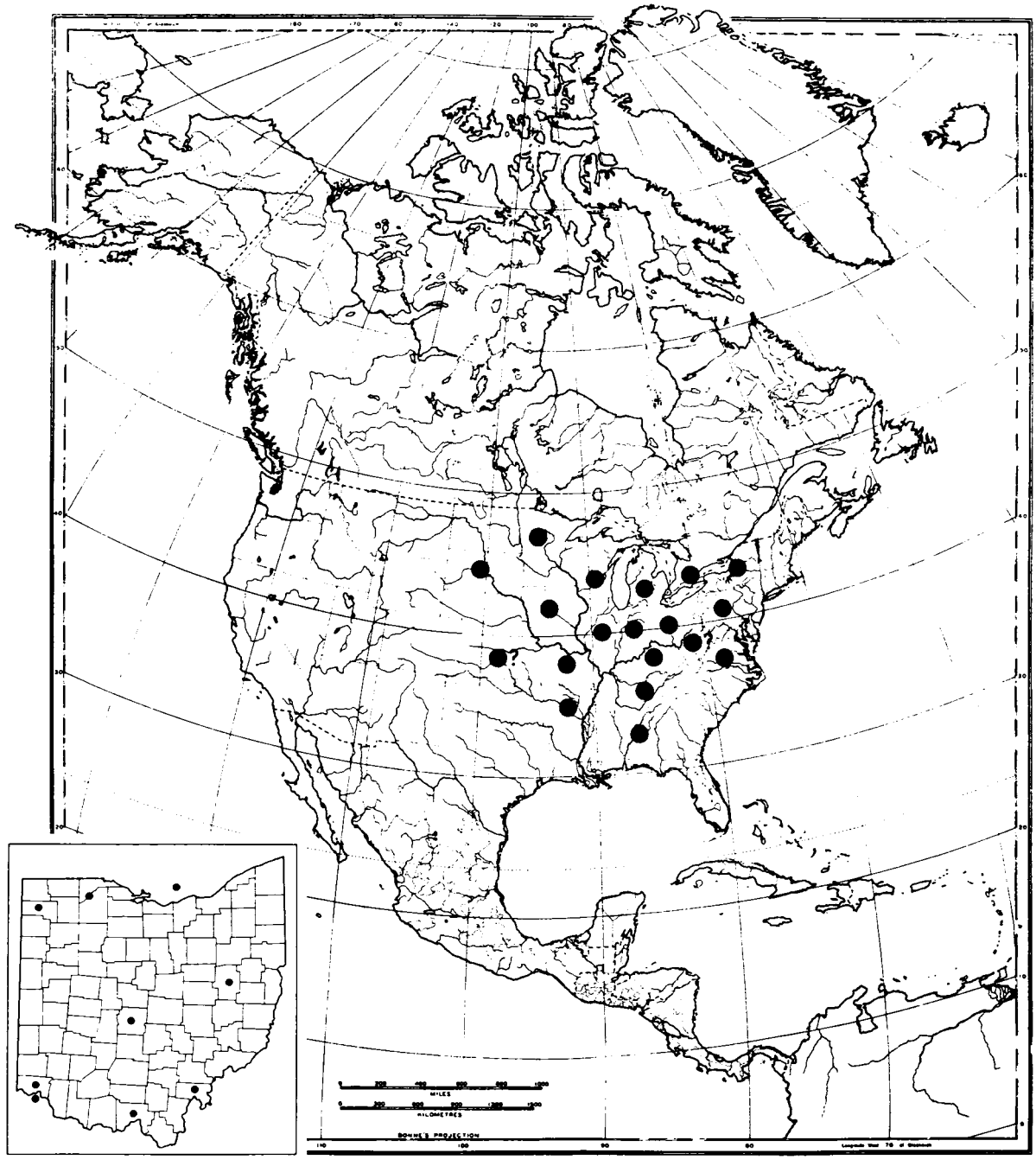


FIGURE 42.—Distribution of *Cyclonaias tuberculata* in North America; *inset,* distribution in Ohio.

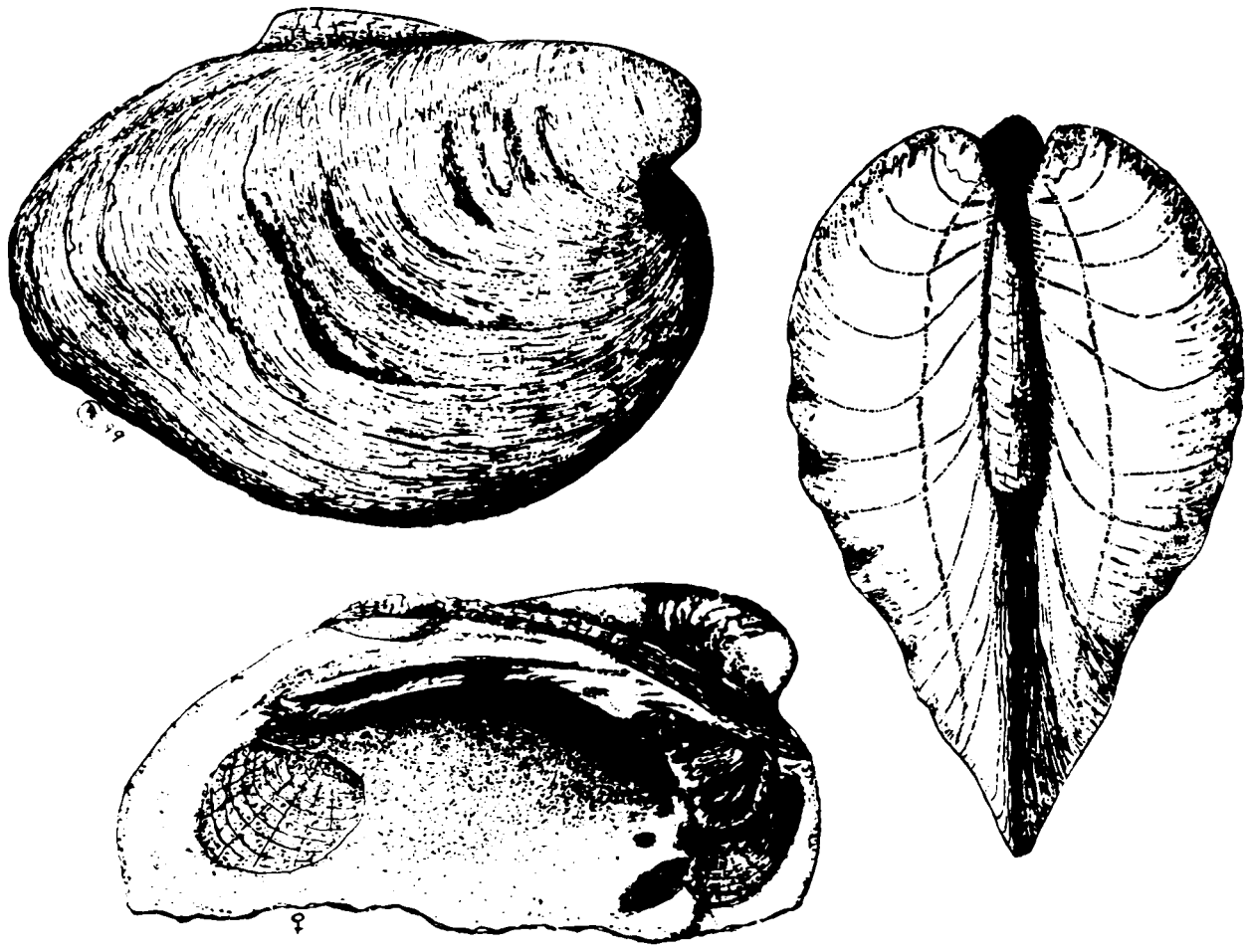


FIGURE 43.—*Plethobasus cicatricosus*, three views, X1; after Call (1900, pl. 55).

Naiades, p. 807.

Pleurobema cyphyum Frierson 1927 (part), Check list N. Am. Naiades, p. 45, 46.

Plethobasus cicatricosus Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 308.

Type locality.—Wabash River, Indiana.

Diagnosis.—"Shell subtriangular or subquadrate, somewhat inflated, solid, inequilateral; beaks very high and full, turned slightly forward over a well-developed lunule; in the middle of the disk there is a curved, radial row of low, irregular nodules, reaching to the base; posterior ridge low, narrowly rounded, ending in a blunt point at or below the median line; anterior end rounded or slightly truncated; base line rounded and quite full at the termination of the row of nodules, from this to the posterior point it is straight or slightly incurved; outline of dorsal slope curved; surface generally sculptured with low, uneven, concentric ridges; epidermis tawny to brown, lighter colored on the dorsal slope, silky; left valve with two rather small, triangular pseudocardinals and two laterals; right valve rather shallow; muscle scars small, impressed; nacre white, thicker in front" (Simpson, 1914, p. 808).

Ecology.—Judging by its distribution, this is a species of larger rivers, but so far I have seen no exact data for its situation.

General distribution (fig. 44).—"Ohio River; Tennessee; Claiborne, Alabama. The last locality I consider doubtful. Lea gives St. Paul, Minnesota, as a habitat, but I do not think it possibly can be" (Simpson, 1914, p. 808). F. C. Baker (1928a) did not find the species in Wisconsin or Illinois; therefore, Simpson was probably correct in doubting the St. Paul record.

Distribution in Ohio (inset, fig. 44).—Sterki (1907a, p. 392) gives only Ohio River. Ortmann (1919) does not mention the species so it is probable that it does not range all the way up the Ohio into Pennsylvania.

Geologic range.—Unknown.

Remarks.—Frierson (1927, p. 45) was of the opinion that this species was based on a specimen of *Plethobasus cyphyus*. His argument (1927, p. 46) sounds plausible but Goodrich and van der Schalie (1944, p. 308) recognize Say's species for the Wabash River. Lea's

name *(varicosus)* might have been available for the species but it is preoccupied by *Unio varicosa* Lamarck 1819, a species now placed in the genus *Alasmidonta.*

Plethobasus cooperianus (Lea) 1834
Fig. 45

Unio cooperianus Lea 1834, Am. Philos. Soc. Trans., v. 5, p. 61, pl. 8, fig. 21.

--- --- Call 1900, Moll. Ind., p. 485.

Quadrula cooperiana Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 391.

--- --- Simpson 1914, Descr. cat. Naiades, p. 852.

Plethobasus cooperianus Ortmann 1919, Najades Pa., p. 62, pl. 5, fig. 5.

Quadrula (Luteacarnea) striata Frierson 1927, Check list N. Am. Naiades, p. 50.

Plethobasus cooperianus Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 308.

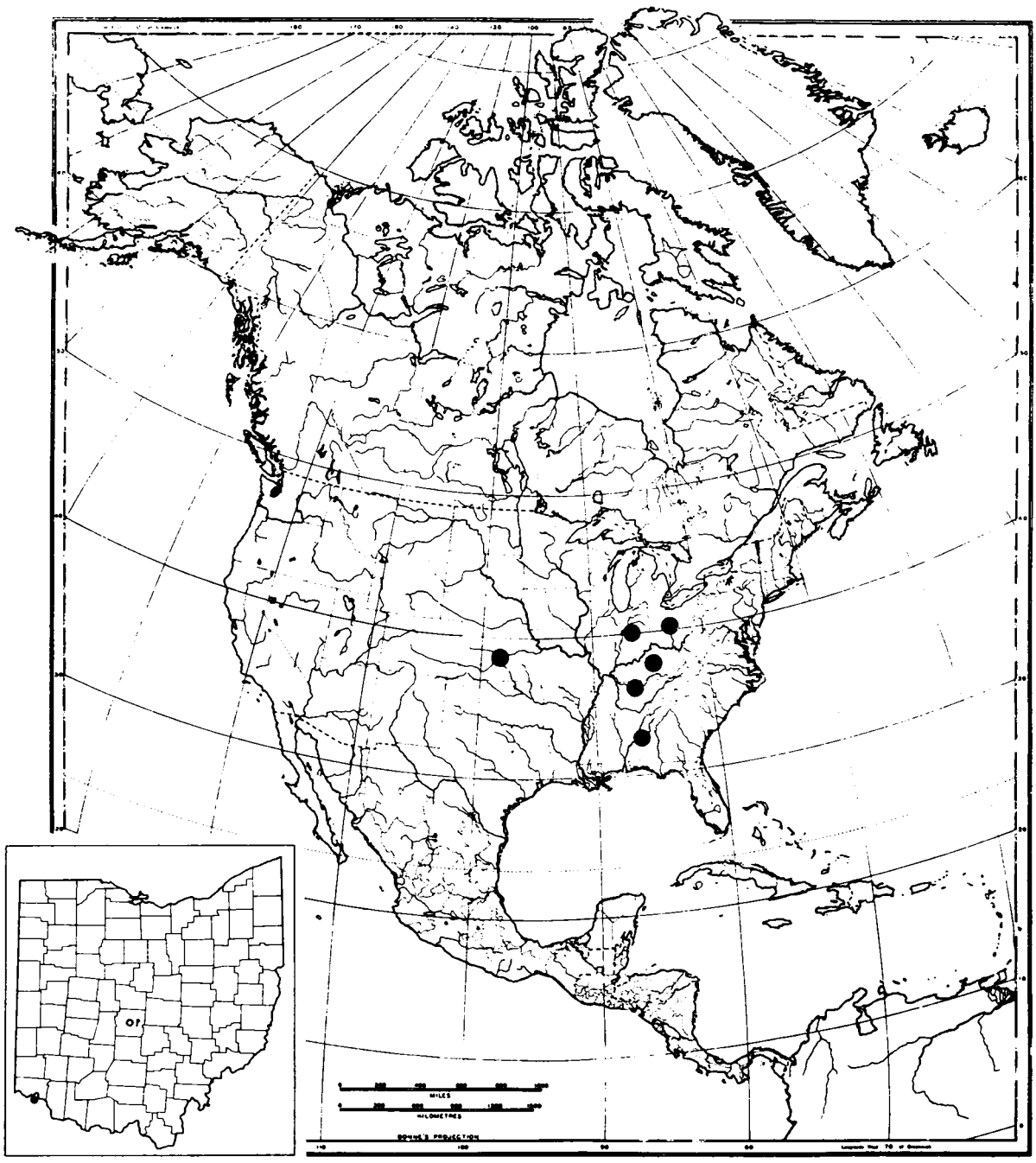


FIGURE 44.—Distribution of *Plethobasus cicatricosus* in North America; *inset,* distribution in Ohio.

FIGURE 45.—*Plethobasus cooperianus,* three views, X1; after Call (1900, pl. 42).

Type locality.—Ohio River.

Diagnosis.—"Shell subtriangular, rarely suborbicular, subinflated, solid, inequilateral; beaks very high, rather full, turned forward over a deep lunule; posterior ridge low, rounded; anterior end usually obliquely truncated above, rounded below; base line more or less rounded; outline of dorsal slope slightly curved, sometimes raised almost into an angle behind the ligament; surface with irregular growth lines; posterior two-thirds covered with strong, irregular pustules; epidermis reddish-brown; pseudocardinals triangular, not greatly roughened; laterals double in the right valve; beak cavities deep, compressed; muscle scars deep; nacre white or pink, thinner behind where it is often bronzy. Length 90, 80, height 80, 84, diam. 47, 43 mm." (Simpson, 1914, p. 852).

Ecology.—No precise data available.

General distribution (fig. 46).—"Ohio, Cumberland, and Tennessee River systems. Reported by Keyes at Muscatine, Iowa, but this is probably an error" (Simpson, 1914, p. 852).

Distribution in Ohio (inset, fig. 46).—Sterki (1907a, p. 391) gives Ohio River and, doubtfully, tributaries. Ortmann (1919) gives only the Ohio River in Monroe, Washington, and Meigs Counties.

Geologic range.—Unknown.

Remarks.—Frierson (1927, p. 51) argues for identification of Lea's species with *Quadrula striata* Rafinesque 1820. If his argument is accepted Rafinesque's name would have priority, but Frierson's opinion has not been followed by later workers on the Naiades. In addition, Frierson makes *Q. striata* Raf. the type of a new subgenus at first named *Striata,* then renamed *Luteacarnea,* as *Striata* is preoccupied. I follow Goodrich and van der Schalie (1944, p. 308) in using the name *Plethobasus cooperianus* (Lea) for this rather rare species.

Plethobasus cyphyus (Rafinesque) 1820
Fig. 47

Obliquaria cyphya Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 305.
Unio aesopus Green 1827, Maclurean Lyceum Nat. History Contr., v. 1, no. 2, p. 46, fig. 3.
Unio cyphyus Call 1900, Moll. Ind., p. 496, pl. 54.
Quadrula aesopus Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 391.
Pleurobema aesopus Simpson 1914, Descr. cat. Naiades, p. 806.
Plethobasus cyphyus Ortmann 1919, Najades Pa., p. 65, pl. 5, fig. 6; pl. 6, figs. 1-3.
Plethobasus aesopus F. C. Baker 1920, Life of Pleistocene, p. 382.
Plethobasus cyphyus Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 19.
Pleurobema (Plethobasus) cyphyum Frierson 1927, Check list N. Am. Naiades, p. 45.
Plethobasus cyphyus F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 110, pl. 49, figs. 4-6.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 308.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.

Type locality.—Falls of the Ohio, at Louisville, Kentucky.

Diagnosis.—Shell elongate ovate, inflated, solid, oblique; a thick rib extends toward the ventral margin in an oblique direction; this rib is swollen in the center, giving the outline of the shell a convex appearance; there is commonly a row of large tubercular swellings on the center of the valve extending down the rib from near the umbones to the ventral margin; beaks with a few concentric ridges confined to the apex of the umbones; there is a wide radial depression behind the row of tubercles; anterior adductor muscle scar deeply excavated; two large, more or less triangular, divergent sulcated pseudocardinals in the left valve; a large triangular sulcated pseudocardinal in the right valve, with a

small denticle on either side; interdentum narrow or absent; laterals heavy, sulcated, usually double in the right valve; beak cavities shallow; nacre pearly white, slightly iridescent posteriorly, thicker anteriorly (condensed from F. C. Baker, 1928a, pt. II, p. 110).

Ecology.—Found in large rivers, on mud bottom in water 3-6 feet deep, in a rapid current; also on gravel, and on sand bottom in deep water in a good current; in Pennsylvania it seems to prefer riffles with coarse gravel and strong current (condensed from Baker, 1928a, pt. II, p. 112).

Associations.—Living: OHIO-43.

General distribution (fig. 48).—Ohio, Cumberland, and Tennessee River systems; Mississippi drainage to Minnesota and Missouri.

Distribution in Ohio (inset, fig. 48).—Sterki (1907a, p. 391) gives Ohio River and tributaries, Scioto, Mahoning, and Tuscarawas Rivers. Ortmann (1919) gives Ohio

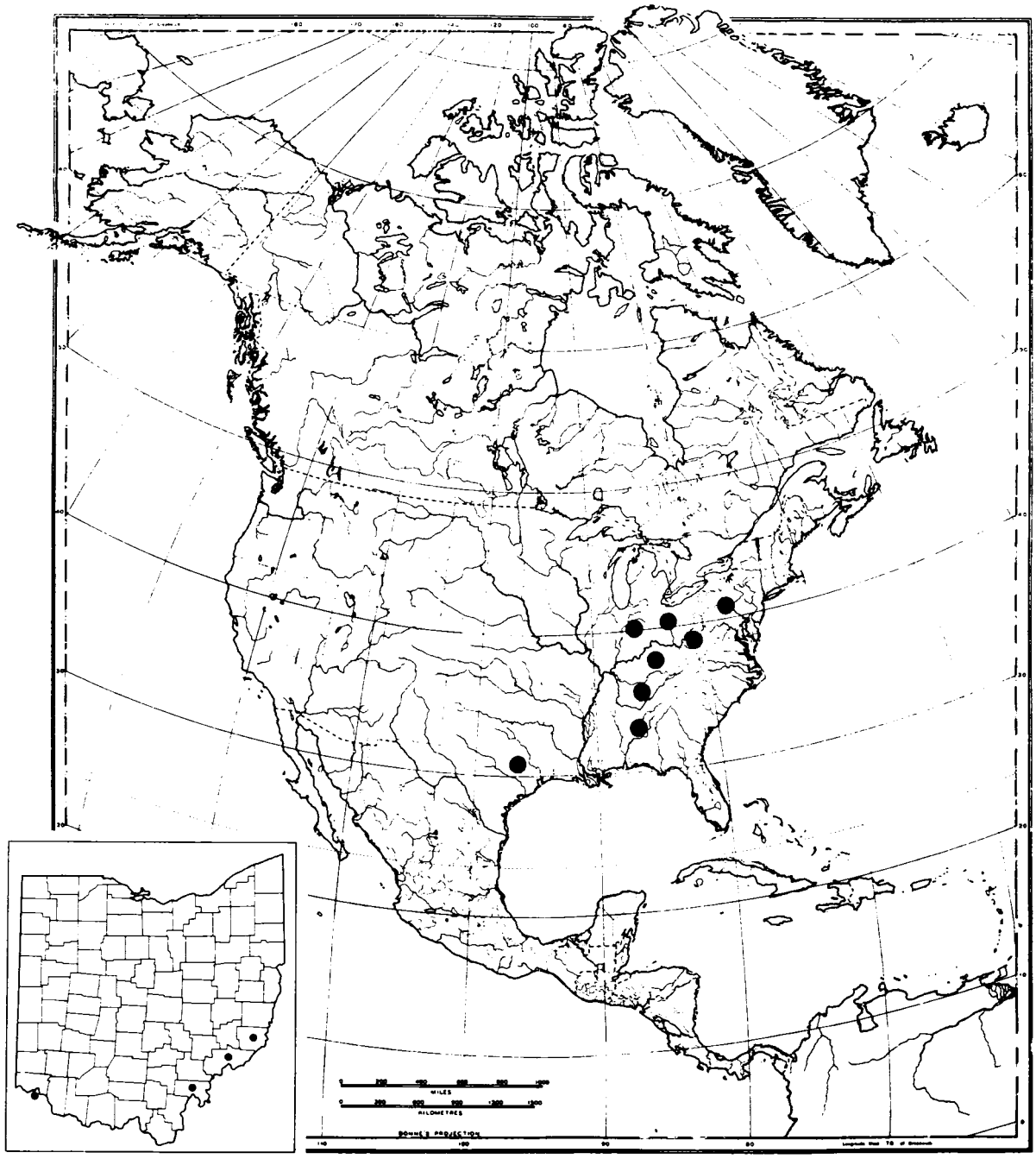


FIGURE 46.—Distribution of *Plethobasus cooperianus* in North America; *inset,* distribution in Ohio.

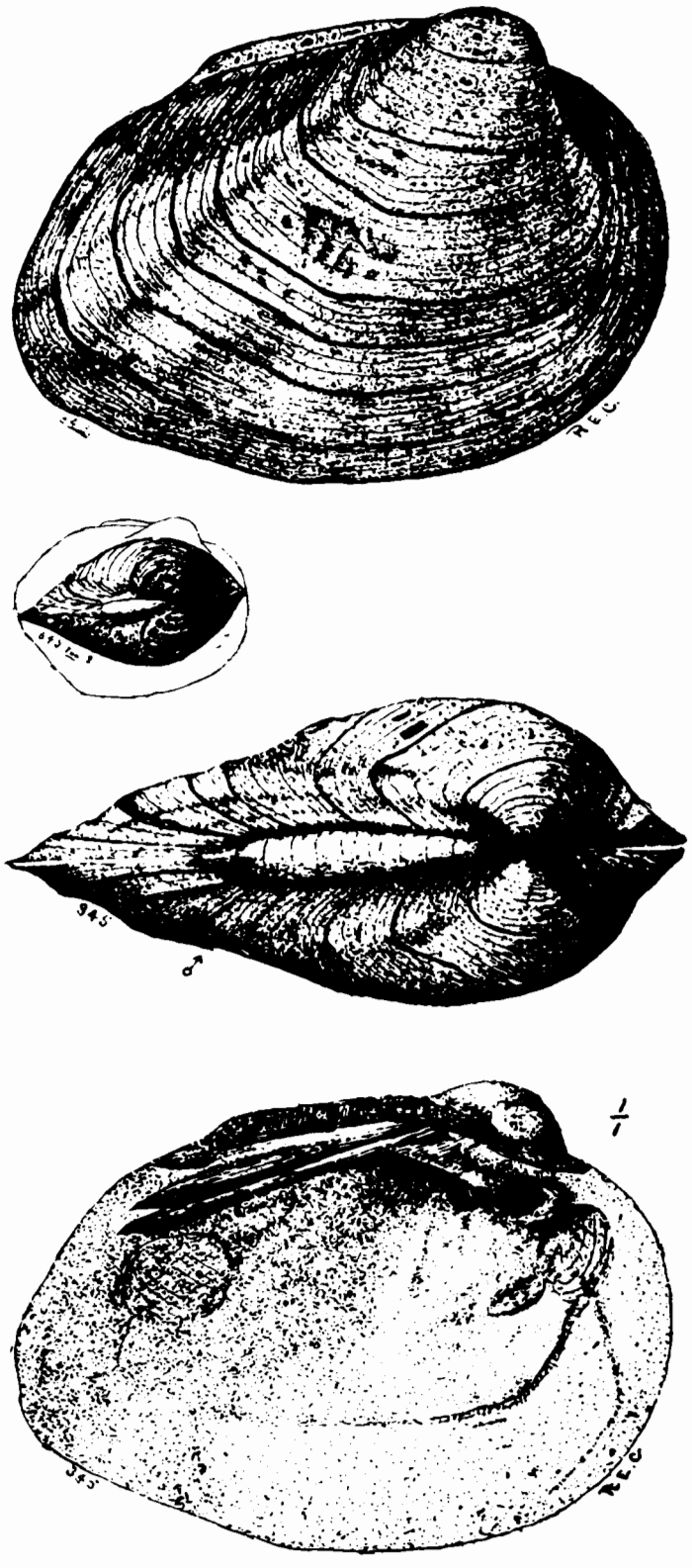


FIGURE 47.–*Plethobasus cyphyus*, four views, X1 except for small figure which is about 0.3 natural size; after Call (1900, pl. 54).

River in Jefferson, Meigs, and Scioto Counties; and the Tuscarawas River, probably in Tuscarawas County.

Geologic range.–Recorded by Baker (1920a, p. 382) only for late Wisconsin ("Wabash") beds.

Genus *Pleurobema* Rafinesque 1819

Pleurobema Rafinesque 1819, Jour. Physique, v. 88, p. 427 (*fide* Neave).
Pleurobema Walker 1918, Synopsis and cat. fresh-water Moll., p. 50 (gives author as "Raf. 1820, Agassiz").
Pleurobema Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 20.
Pleurobema F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 113.
Pleurobema La Rocque 1953, Cat. Recent Moll. Canada, p. 97.

Type.–*Pleurobema mytiloides* Rafinesque =*Unio clava* Lamarck.

Diagnosis.–Shell solid, triangular to rhomboid, generally with a prominent umbonal region; beaks at or near the anterior end of the shell, incurved and pointed forward over a small but well-developed lunule; beak sculpture coarse, consisting of a few commonly broken ridges which curve upward posteriorly; posterior ridge present, but low and rounded; epidermis showing the rest periods plainly, tawny to olive, commonly ornamented with rays which show a tendency to break into square spots; hinge rather strong, plate generally narrow; pseudocardinals double in both valves; cavity of the beaks shallow.

Pleurobema bournianum (Lea) 1840

Unio bournianus Lea 1840, Am. Philos. Soc. Proc., v. 1, p. 288.
Pleurobema bournianum Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.
--- --- Simpson 1914, Descr. cat. Naiades, p. 741.
Quadrula (Pleuronaia) cor Frierson 1927 (part), Check list N. Am. Naiades, p. 59.

Type locality.–Scioto River, near Chillicothe, Ohio.

Diagnosis.–"Shell triangular, short, subinflated or inflated, solid; beaks very high, rather sharp, full, turned forward over a lunule, placed nearest to the anterior end, their sculpture a few broken ridges; anterior end somewhat obliquely truncated, posterior outline curved from the beaks to the base; base line curved in front, nearly straight behind; posterior ridge low, narrowly rounded, placed almost at the posterior outline, ending below in a point at the base of the shell; in front of the middle of the shell there is a wide, high, radial swelling and here the diameter is much the greatest; between this and the posterior ridge there is a wide, radial depression; surface with irregular growth lines; epidermis greenish-yellow or pale tawny, with conspicuous, narrow and

wide, interrupted green rays, subshining; pseudocardinals low, irregular, rough, two in the left valve and three in the right; laterals curved, left valve with two, right valve with a double one; beak cavities shallow, muscle scars small, deep; nacre white. Length 30, 38, height 32, 40, diam. 19, 26 mm." (Simpson, 1914, p. 740).

Ecology.—No precise data available.

General distribution.—Known only from the type locality and possibly the Ohio River at Cincinnati.

Distribution in Ohio.—Same as the general distribution.

Geologic range.—Unknown.

Remarks.—There seems to be some doubt as to the validity of this species. Sterki (1907a) and Simpson (1914) recognized it, although the latter was somewhat doubtful. It has been recorded only for the type locality and for the Ohio River at Cincinnati, the latter an old record by Byrnes, cited by Sterki. Frierson (1927) refers

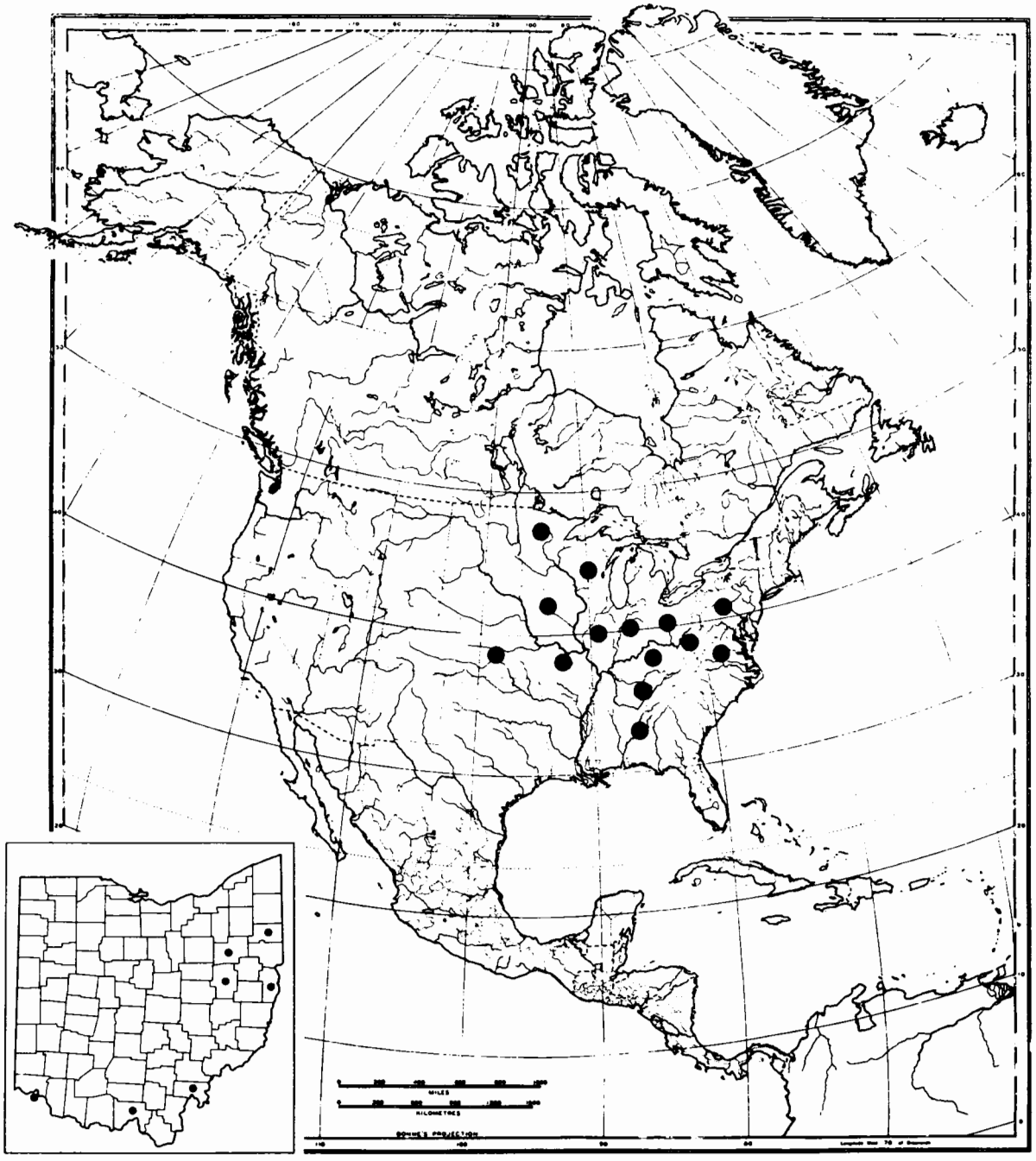


FIGURE 48.—Distribution of *Plethobasus cyphyus* in North America; *inset,* distribution in Ohio.

U. bournianus Lea to *Quadrula cor,* a species of the Alabama River system and Flint River, Georgia. Goodrich and van der Schalie (1944) did not list *P. bournianum* from Indiana and no one, to my knowledge, has identified it in the last 30 years or so. The Scioto River near Chillicothe has not been examined in recent years so that I am unable to say just what could have been mistaken for a new species of *Pleurobema* there. It is quite possible that the locality is erroneous and that the specimens seen by Lea were indeed *P. cor.* In that case, Sterki's acceptance of the Scioto River record is hard to explain. In any case, the name is noted here as doubtfully valid but it is not likely that the form represented will be found in the Pleistocene deposits of the State of Ohio.

Pleurobema clava (Lamarck) 1819
Fig. 49

Unio clava Lamarck 1819, Animaux sans vertèbres, v. 6, p. 74.
Unio clavus Call 1900, Moll. Ind., p. 506, pl. 62.
Pleurobema clava Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.
--- --- Simpson 1914, Descr. cat. Naiades, p. 735.
--- --- Ortmann 1919, Najades Pa., p. 86, pl. 7, figs. 7-9.
--- --- F. C. Baker 1920, Life of Pleistocene, p. 383.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 25.
Pleurobema mytiloides Frierson 1927, Check list N. Am. Naiades, p. 40.
Pleurobema clava Goodrich 1932, Moll. Mich., p. 91.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 151.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 308.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 97.

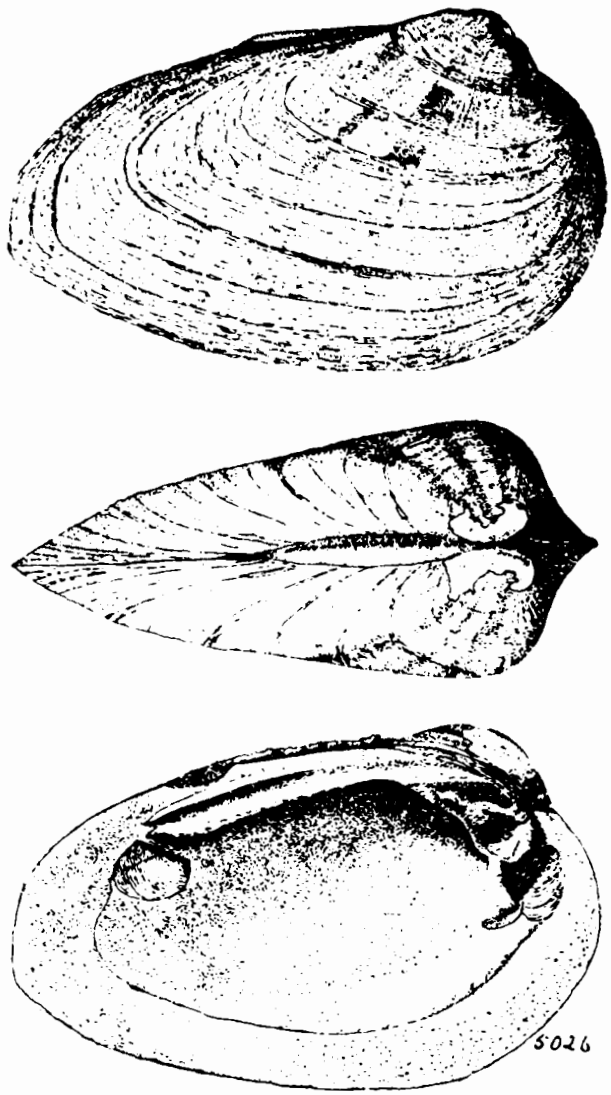


FIGURE 49.—*Pleurobema clava,* three views, X1; after Call (1900, pl. 62).

Type locality.—Incorrectly given as Lake Erie.

Diagnosis.—Shell elongate-oval, rather small, brown, with dark rays from the beaks to about midway to the base; beaks a little raised, triangular, sculptured with two or three loops or ridges; interior white, pseudocardinals strong, but not high; lateral teeth stout and curving; beak cavity not deep, muscle scars well defined; pallial line channelled; L. 50, H. 35, D. 22 mm. (modified from Goodrich, 1932, p. 91).

Ecology.—In the smaller rivers and creeks.

Associations.—Living: OHIO-43.

General distribution (fig. 50).—"Ohio, Cumberland, and Tennessee River systems, Maumee Basin, western New York, Ottawa, Canada (Call). Reported from Iowa City, Iowa; St. Peter's River, Minnesota, and from Nebraska" (Simpson, 1914, p. 736). I have pointed out (La Rocque, 1953, p. 97) that the Ottawa record is almost certainly erroneous. Robertson and Blakeslee (1948) do not list the species and it is likely that the New York record is also erroneous. It is also omitted from the Mississippi River list by the van der Schalies (1950), so that the records for Iowa, Minnesota, and Nebraska are likewise under suspicion. It may be found in the Mississippi below Iowa, but there are no recent records to substantiate this.

Distribution in Ohio (inset, fig. 50).—Sterki (1907a, p. 392) gives "both drainages; e.g. in the Maumee; not in the Cuyahoga River, t. Dean." Ortmann (1919) gives Maumee River, Defiance County; Tuscarawas River, probably in Tuscarawas County; and the Mahoning River in Pennsylvania which indicates its presence in the same river in Mahoning County, Ohio, perhaps also in Trumbull County.

Geologic range.—F. C. Baker (1920a, p. 383) gives only Sangamon for this species as a fossil.

Pleurobema cordatum (Rafinesque) 1820
Fig. 51

Unio obliqua Lamarck 1819, Animaux sans vertèbres, v. 6, p. 72.
Obliquaria lateralis Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 310.
Obovaria cordata Rafinesque 1820, *ibid.*, p. 312, pl. 82, figs. 6-7.
Unio obliquus Call 1900, Moll. Ind., p. 501, pl. 57.
Quadrula obliqua Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.
--- --- Simpson 1914, Descr. cat. Naiades, p. 881.
Pleurobema obliquum Ortmann 1919, Najades Pa., p. 69, pl. 6, figs. 4, 5, 8.

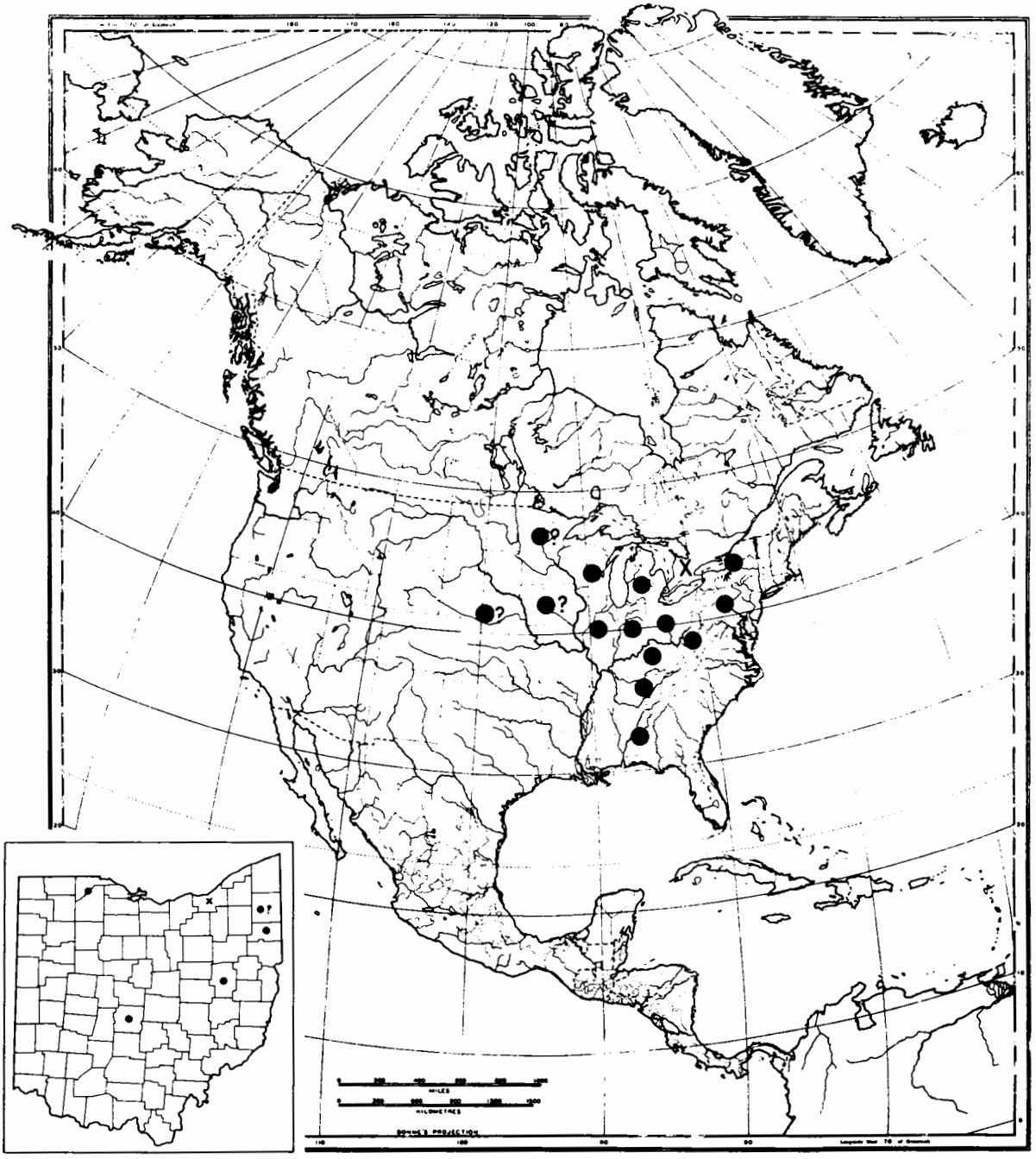


FIGURE 50.—Distribution of *Pleurobema clava* in North America; *inset*, distribution in Ohio.

Pleurobema obliquum cordatum Ortmann 1919, *ibid.*, p. 74, pl. 7, fig. 1.
Pleurobema obliquum F. C. Baker 1920, Life of Pleistocene, p. 383.
Pleurobema cordatum Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 21.
Quadrula (Obliquata) cordata Frierson 1927, Check list N. Am. Naiades, p. 53.
Pleurobema cordatum Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 309.

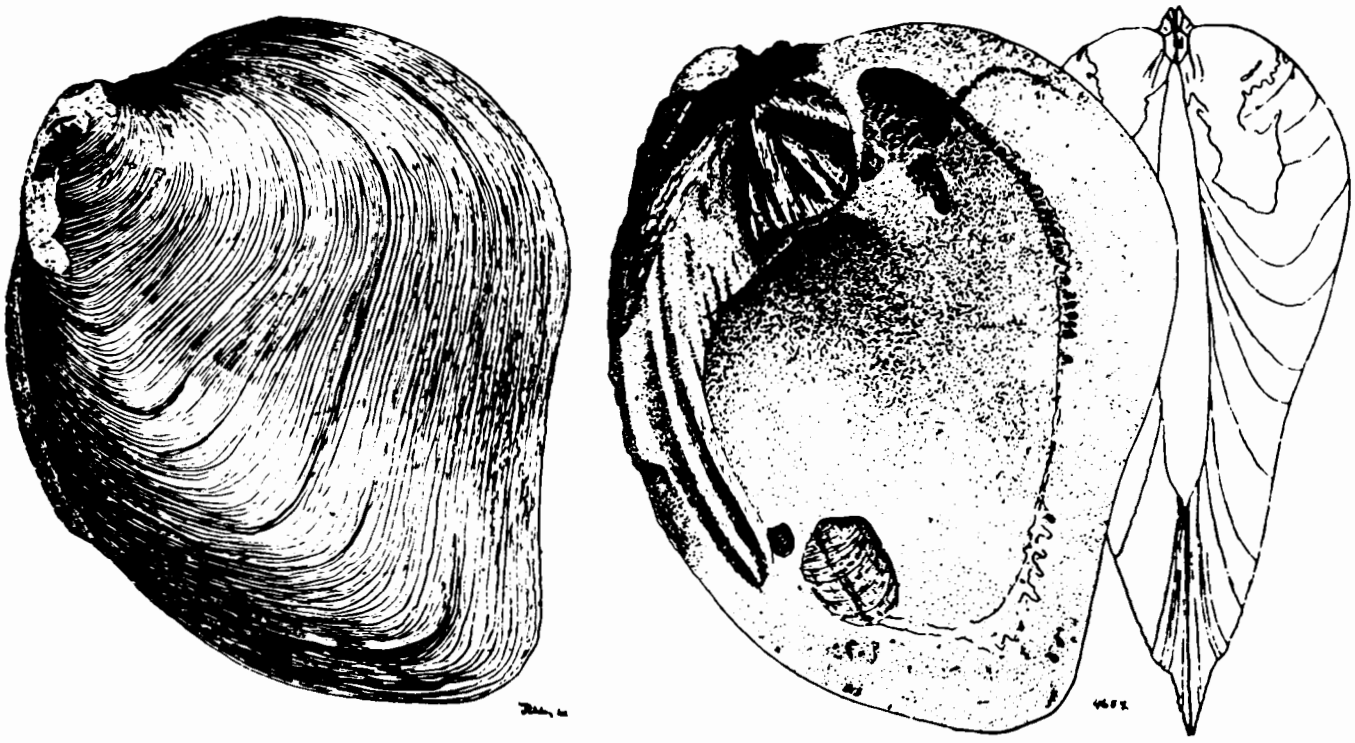


FIGURE 51.—*Pleurobema cordatum,* three views, X1; after Call (1900, pl. 57).

Type locality.—Ohio River.

Diagnosis.—Shell subtriangular, inflated, solid, somewhat inequilateral; beaks very high and full, turned inward and forward over a decided lunule, their sculpture a few coarse irregular ridges that are turned up behind and nodulous on the posterior ridge; posterior ridge rather low but well developed, narrowly rounded, placed near the edge of the shell and curved throughout; in front of the middle of the shell is a high, wide, curved radial swelling; between this and the much lower posterior ridge is a wide, curved radial depression; surface with irregular concentric striae; epidermis tawny brown and rayed in the young, dark reddish brown in the old shells, dull; pseudocardinals ragged; lateral of right valve partly double; muscle scars and beak cavities deep; nacre white, thinner and somewhat iridescent behind; L. 115, 95, 77; H. 95, 78, 69; D. 57, 50, 40 mm. (condensed from Simpson, 1914, p. 882).

Ecology.—According to Goodrich and van der Schalie (1944, p. 309), true *cordatum* and the high forms are largely restricted to the large rivers, such as the Ohio, White, and Wabash, in the southern portion of Indiana.

General distribution (fig. 52).—Ohio, Cumberland, and Tennessee River systems; west in Illinois to the Mississippi; Claiborne, Alabama.

Distribution in Ohio (inset, fig. 52).—Sterki (1907a, p. 392) gives "Ohio River, and some tributaries." Ortmann (1919) records two forms: *"P. obliquum"* from the Ohio River in Jefferson, Monroe, Meigs, and Scioto Counties, and the Tuscarawas River; *"Pleurobema obliquum cordatum"* from the Ohio River in Beaver County, Pennsylvania, which borders on Columbiana County, Ohio.

Geologic range.—F. C. Baker (1920a, p. 383) records this species only for Yarmouth deposits.

Remarks.—The species is exceedingly variable and this characteristic has inevitably given rise to several different names for it which have no greater value than forms. Goodrich and van der Schalie (1944, p. 309) summarize the situation as follows: "The late Dr. Ortmann has studied the group carefully and has shown that *cordatum* tends to vary in two directions. On the one hand, it becomes higher with an increasingly shortened posterior end. In this direction we get a series of forms that are named progressively as the specimens get higher in

this order: true *cordatum,* then *cordatum catillus* ... then *cordatum plenum,* and finally the highest forms are called *cordatum pyramidatum.* The series comprising the main species and its forms are associated with streams of comparatively large size. On the other hand, when *cordatum* (the typical form) loses its sinus, becomes rounded and tends to assume an elongated posterior end, then the name *cordatum coccineum* ... is applied. This form differs ecologically from the true *cordatum* and the higher forms in that it inhabits streams which are considerably smaller, getting well into the headwaters of the larger rivers."

All the forms mentioned above were recorded, under various names, by Sterki. They are treated as trinomials of *P. cordatum* here and data are given for the distribution of each one.

Lamarck's name, *Unio obliqua,* would seem to have priority over Rafinesque's but it is rejected by Ortmann

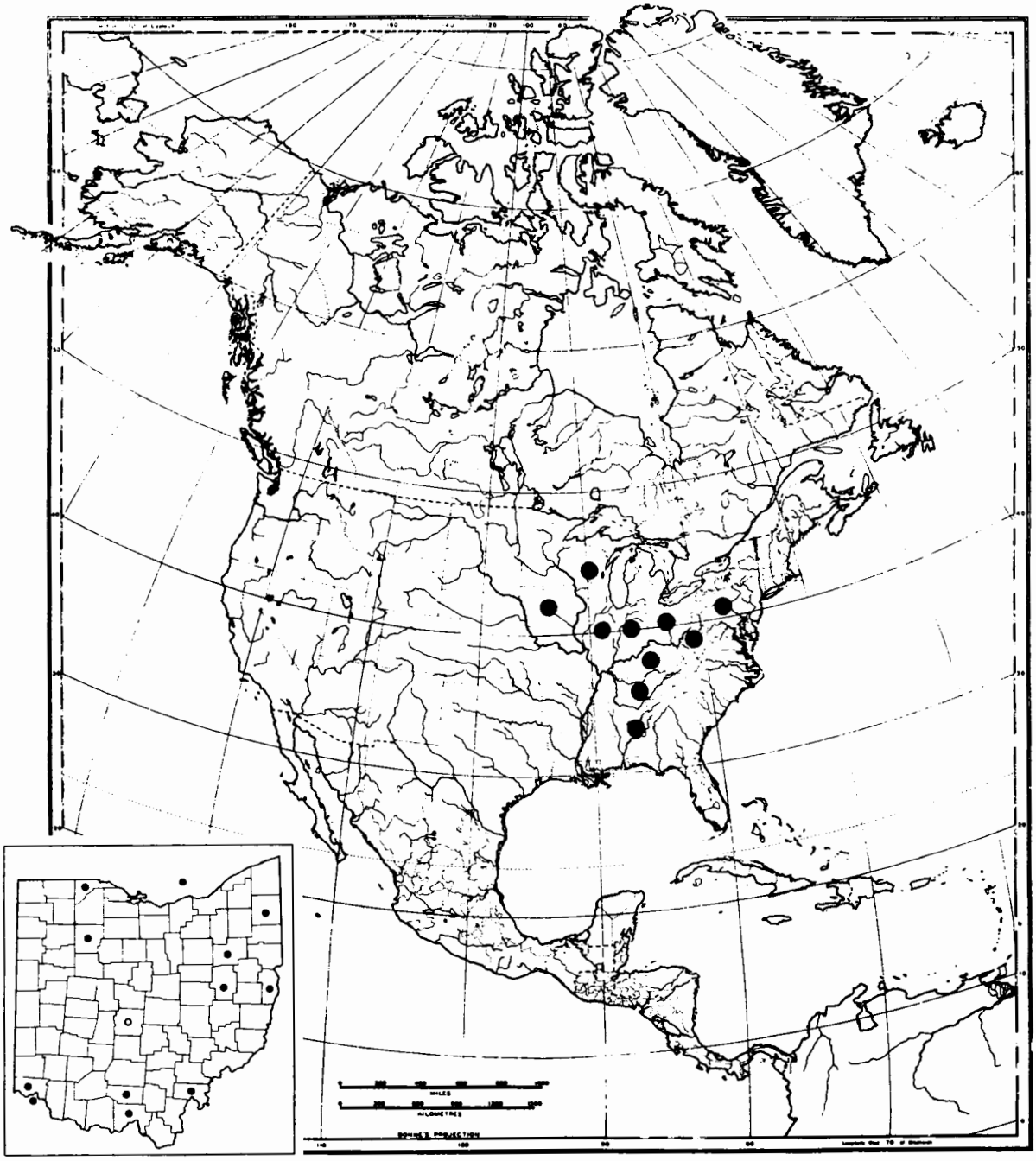


FIGURE 52.–Distribution of *Pleurobema cordatum* in North America; *inset,* distribution in Ohio.

and Walker (1922, p. 21); the gist of their argument is that Lamarck's description is imperfect and that the species cannot be identified by it, as pointed out by Lea as early as 1829. Later, Lea examined the type and found it to be identical with *U. undatus* Barnes, a synonym of *U. cordatus* Conrad. Before this, however, Rafinesque (1820) had described *Obovaria cordata* and *Obliquaria lateralis*, which can be identified from the description. In the absence of a prior selection, Ortmann and Walker (1922, p. 23) selected *O. cordata*, which is accompanied by both a description and a figure, over *O. lateralis* which is described but not figured. The synonymy given above will clear up the records of this species for Ohio.

Pleurobema cordatum catillus (Conrad) 1836
Fig. 53

Unio catillus Conrad 1836, Mon., pt. 3, p. 30, pl. 13, fig. 2.
Unio solidus Lea 1838, Am. Philos. Soc. Proc., v. 6, p. 13, pl. 5, fig. 13.
--- --- Call 1900, Moll. Ind., p. 504, pl. 59.
Quadrula solida Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.
--- --- Simpson 1914, Descr. cat. Naiades, p. 885.
Pleurobema obliquum catillus Ortmann 1919, Najades Pa., p. 75, pl. 6, fig. 6; pl. 7, fig. 2.
Fusconaja solida F. C. Baker 1920, Life of Pleistocene, p. 382.
Pleurobema catillus Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 23.
Quadrula catilla Frierson 1927, Check list N. Am. Naiades, p. 54.
Pleurobema coccineum catillus F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 117, pl. 55, figs. 1-3.
Pleurobema cordatum catillus Goodrich 1932, Moll. Mich., p. 90.
--- --- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 309.
Quadrula solida La Rocque 1953, Cat. Recent Moll. Canada, p. 98.

Type locality.—Scioto River, Ohio.

Diagnosis.—Shell thicker, more compact, and with higher beaks than that of *P. cordatum coccineum.*

Ecology.—A form of rivers of small to medium size, where it is found on sand, gravel, or mud bottom, in water 2-6 feet or more in depth, in more or less rapid current.

General distribution (fig. 54).—"Wisconsin, Illinois, Indiana, Ohio, Pennsylvania, Iowa; specimens from other states referred to this form seem more nearly related to *solida*" (F. C. Baker, 1928a, pt. II, p. 117).

Distribution in Ohio.—Sterki (1907a, p. 392) gave "Ohio River; Scioto River." Ortmann (1919) records it for the Ohio River in Jefferson, Meigs, Scioto, and Hamilton Counties; and the Tuscarawas River, probably in Tuscarawas County.

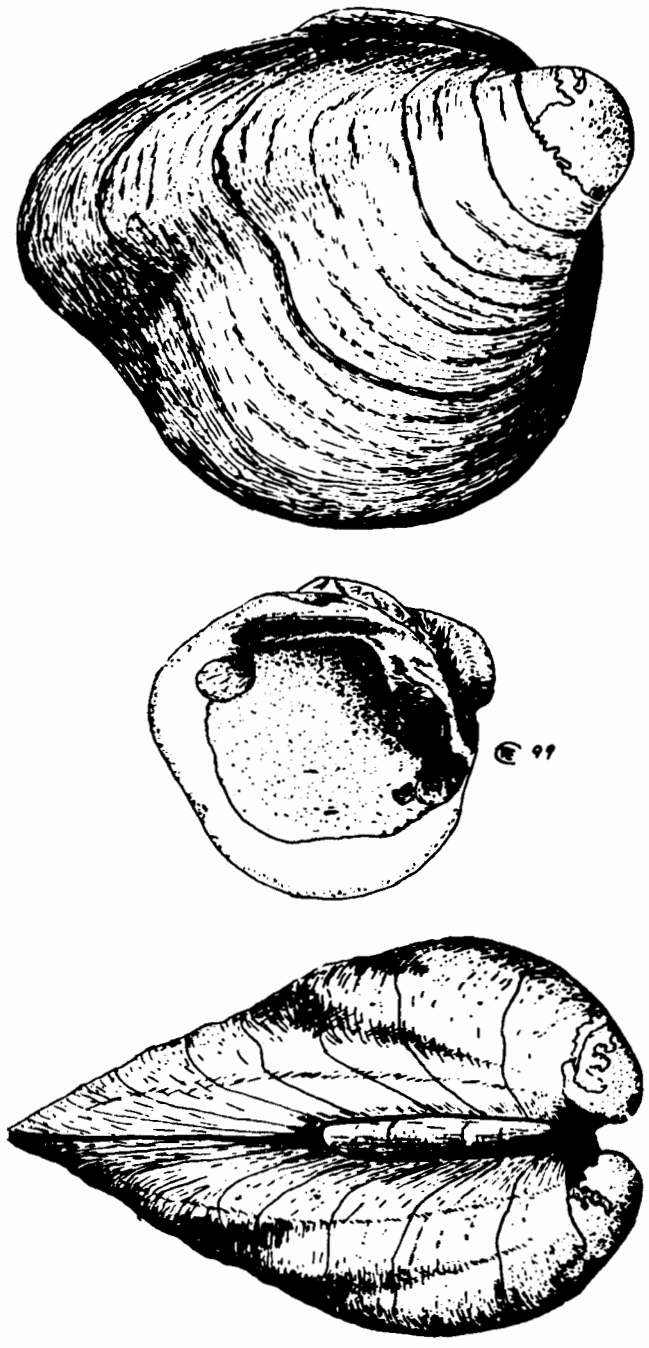


FIGURE 53.—*Pleurobema cordatum catillus*, three views, X1; after Call (1900, pl. 59).

Geologic range.—Sangamon and late Wisconsin ("Wabash") according to Baker (1920a, p. 382).

Remarks.—The distribution of this form is not satisfactorily known, but may, in suitable ecological conditions, coincide with that of the typical form.

Pleurobema cordatum coccineum (Conrad) 1836
Fig. 55

Unio coccineus Conrad 1836, Mon., pt. 3, p. 29, pl. 13, fig. 1.
--- --- Call 1900, Moll. Ind., p. 500, pl. 56.
Quadrula coccinea Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.
--- --- Simpson 1914, Descr. cat. Naiades, p. 883.
Pleurobema obliquum coccineum Ortmann 1919, Najades Pa., p. 78, pl. 7, figs. 3-5.
--- --- --- F. C. Baker 1920, Life of Pleistocene, p. 382.
--- --- --- Frierson 1927, Check list N. Am. Naiades, p. 53.
Pleurobema coccineum F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 113, pl. 54.
Pleurobema cordatum coccineum Goodrich 1932, Moll.

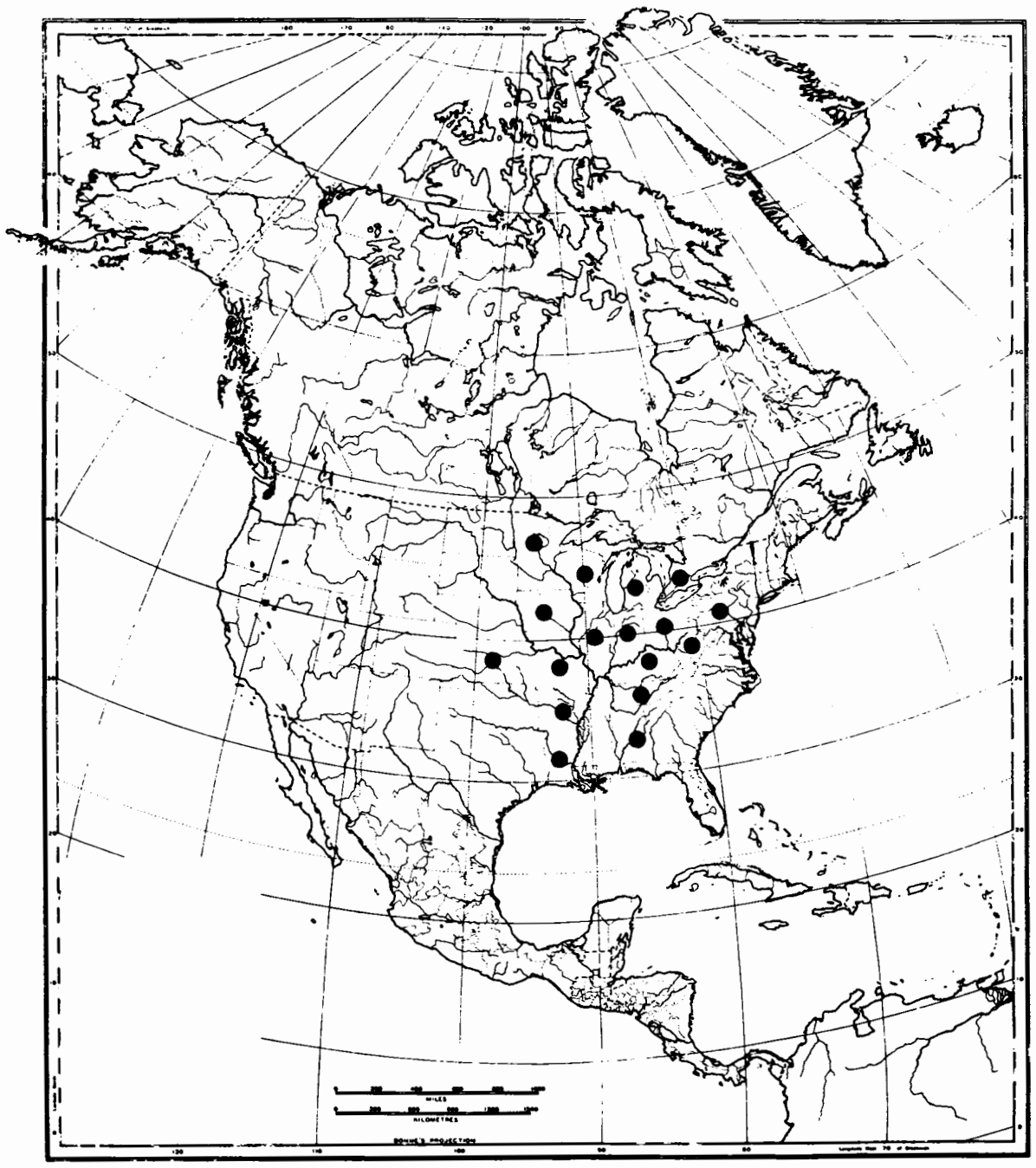


FIGURE 54.—Distribution of *Pleurobema cordatum catillus* in North America.

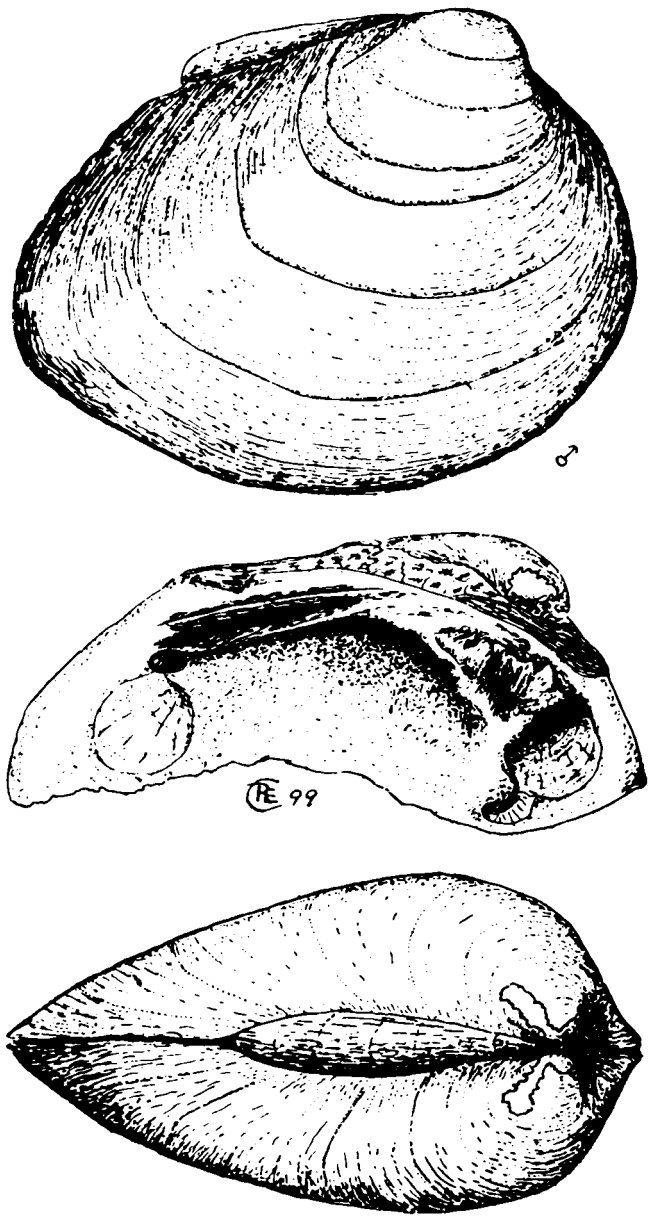


FIGURE 55.—*Pleurobema cordatum coccineum,* three views, X1; after Call (1900, pl. 56).

Mich., p. 90.

Pleurobema cordatum coccineum La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 150.

--- --- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 50.

--- --- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 309.

--- --- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 95.

--- --- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.

--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 97.

Type locality.—Mahoning River near Pittsburgh, Pennsylvania; more exactly at Mahoningtown, Lawrence County (*fide* Ortmann).

Diagnosis.—Shell solid, yellow to nearly black, without pustules or undulations, the shell nearly oval in outline, with a long slope to the posterior margin; hinge line nearly straight, base rounded; beaks low, triangular, with one or two irregular projections at the top and one below them; interior white or pink, pseudocardinals stout, striate; lateral teeth strong, curving; muscle scars well defined; beak cavity shallow; pallial line channelled only anteriorly; L. 80, H. 55, D. 32 mm. (condensed from Goodrich, 1932, p. 90).

Ecology.—Typically a species of small streams and creeks; it has been collected in shallow water in riffles, the shells deeply buried in sand bars; also in gravel and sand in riffles, shallow water, shells buried; on sand bottom in shallow water, near shore; generally in shallow streams, on gravel or sand bottom, rarely in mud, in riffles.

Associations.—Living: MICHIGAN-59, 65; OHIO-43; WISCONSIN-48, 83, 108, 131.

General distribution (fig. 56).—"Credited by Simpson to the Upper Mississippi drainage and St. Lawrence drainage. Its range is apparently bounded by western New York on the east, Iowa and Kansas on the west, Michigan and Wisconsin on the north, and Alabama and Arkansas on the south" (F. C. Baker, 1928a, pt. II, p. 115).

Distribution in Ohio.—Sterki (1907a, p. 392) gave "over the state, variable. In the Tuscarawas River is a form higher than the 'typical' one, resembling *kirtlandiana* in shape, but with the soft parts quite different, and usually with a few undulations in the middle of the disks; it may represent a variety." Ortmann (1919) gives St. Marys River, Mercer County; Swan Creek, Lucas County; Mahoning River, Trumbull County; Tuscarawas River, probably in Tuscarawas County; and Scioto River, without mention of county.

Geologic range.—Known for Sangamon and late Wisconsin ("Wabash") beds according to Baker (1920a, p. 382).

Remarks.—The limits of range of this form are still somewhat doubtful but the range undoubtedly includes Ohio.

Pleurobema cordatum pauperculum (Simpson) 1900

Quadrula paupercula Simpson 1900, Acad. Nat. Sci. Philadelphia Proc. 1900, p. 789.

Quadrula coccinea paupercula Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.

Quadrula coccinea var. *magnalacustris* Simpson 1914, Descr. cat. Naiades, p. 884.

Pleurobema obliquum pauperculum Ortmann 1919, Najades Pa., p. 83, pl. 7, fig. 6.

Pleurobema coccineum magnalacustris F. C. Baker 1920, Life of Pleistocene, p. 383.

Pleurobema coccineum pauperculum Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 24.

Quadrula coccinea-magnalacustris Frierson 1927, Check list N. Am. Naiades, p. 53.

Pleurobema cordatum pauperculum Goodrich 1932, Moll. Mich., p. 90.

--- --- --- Goodrich and van der Schalie 1932, Mich. Univ. Mus. Zoology Occas. Papers, no. 238, p. 12.

--- --- --- La Rocque and Oughton 1937, Cana-

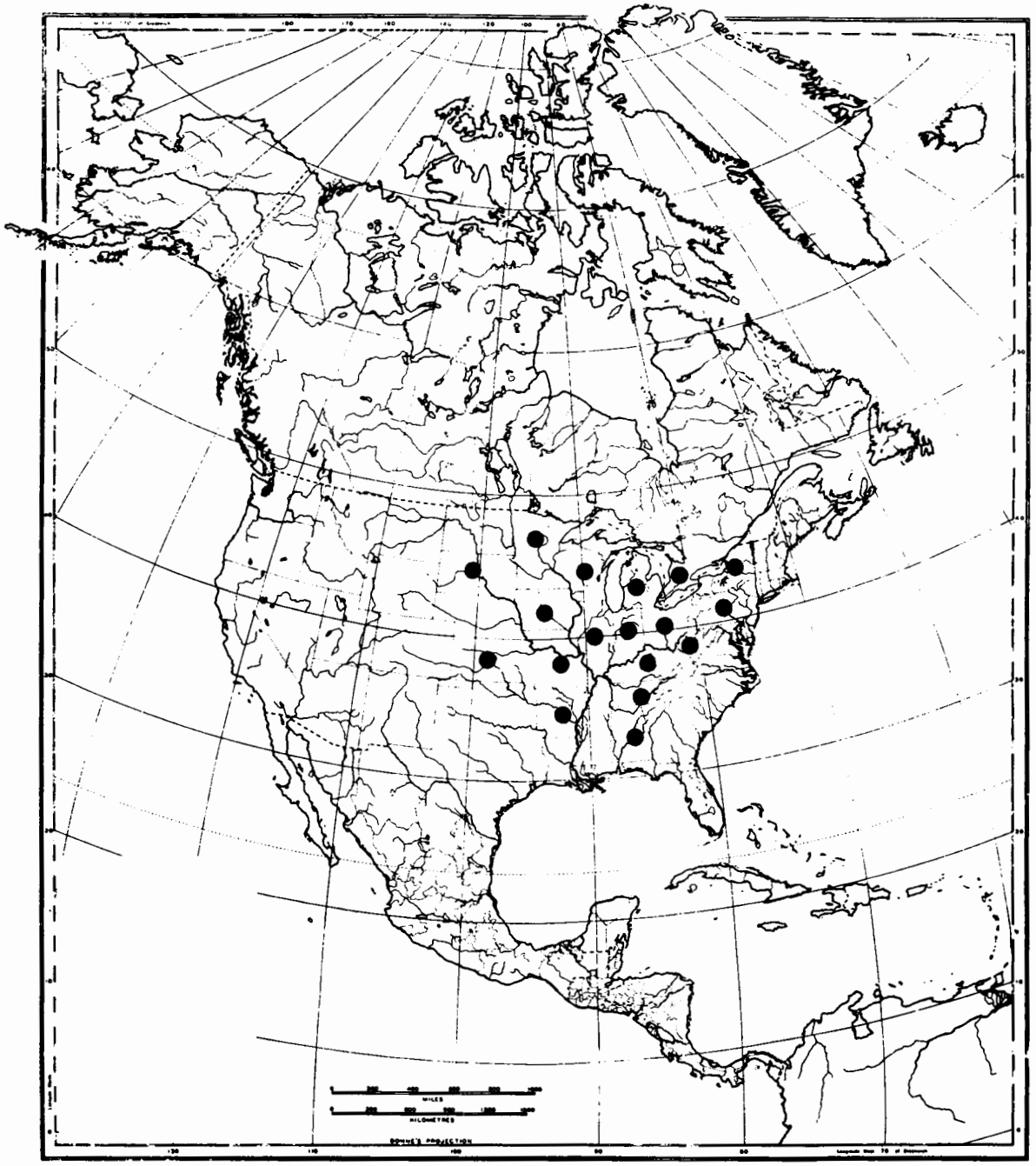


FIGURE 56.—Distribution of *Pleurobema cordatum coccineum* in North America.

dian Jour. Research, v. 15(D), p. 153.

Pleurobema cordatum pauperculum Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 95.

--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 97.

Type locality.—Niagara Falls.

Diagnosis.—Somewhat smaller than the stream form, rougher and more swollen.

Ecology.—No precise data located.

General distribution (fig. 57).—Lake St. Clair and Lake Erie.

Distribution in Ohio.—Sterki (1907a, p. 392) gave only "St. Lawrence drainage; probably in the state." Ortmann (1919) gave "Lake Erie, Ohio shores."

Geologic range.—Recorded only for late Wisconsin ("Wabash") beds by F. C. Baker (1920a, p. 383).

Remarks.—The name is applied easily when one is

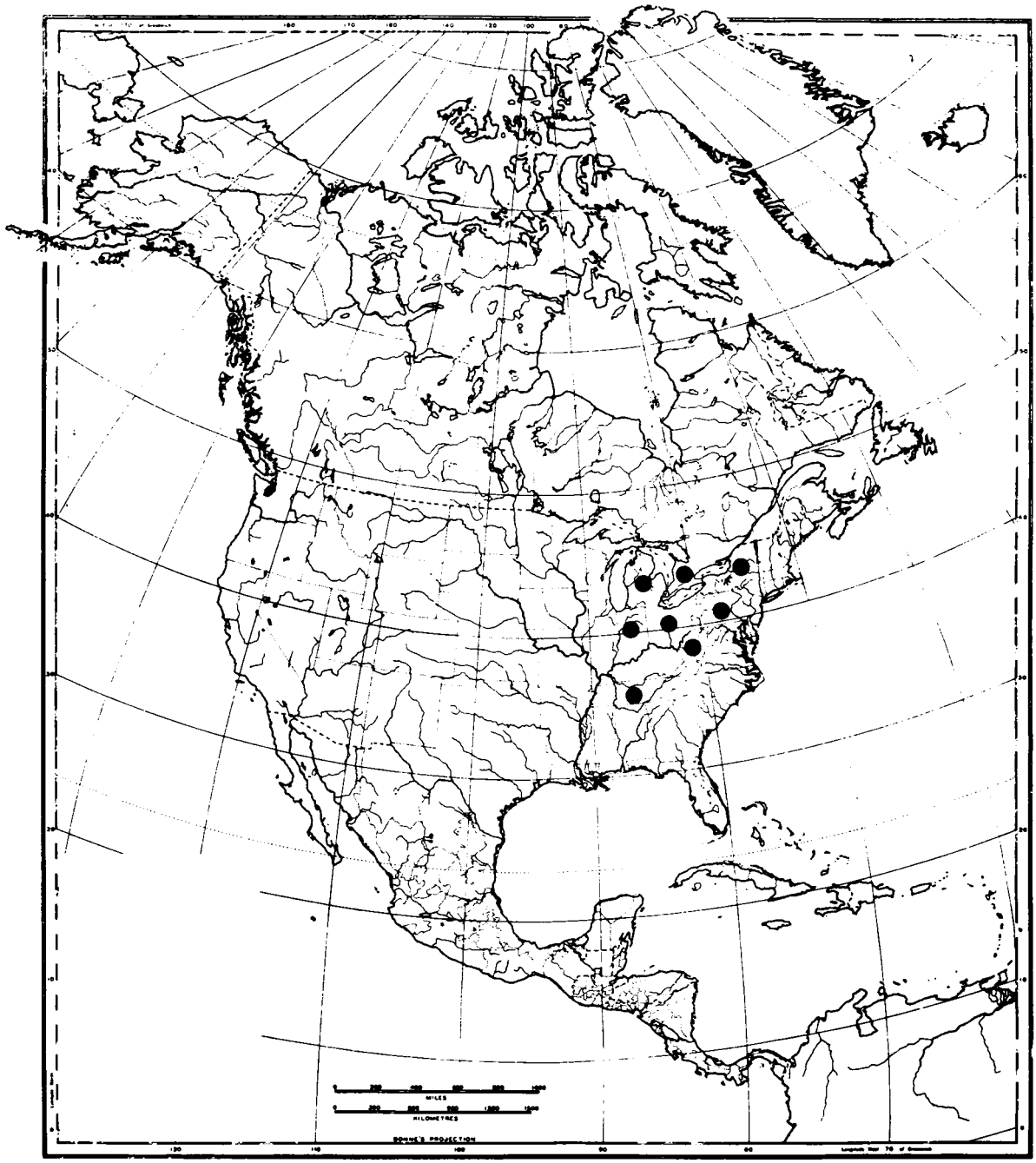


FIGURE 57.—Distribution of *Pleurobema cordatum pauperculum* in North America.

dealing with shells of Lake Erie, but it is a wise and acutely perceptive taxonomist who can be sure of the name for the intergrades between this and other forms of the species.

Pleurobema cordatum plenum (Lea) 1840

Unio plenus Lea 1840, Am. Philos. Soc. Proc., v. 1, p. 286.

Quadrula plena Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.

--- --- Simpson 1914, Descr. cat. Naiades, p. 886.

Pleurobema plenum Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 23.

Quadrula cordata-plena Frierson 1927, Check list N. Am. Naiades, p. 53.

Pleurobema cordatum plenum Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 309.

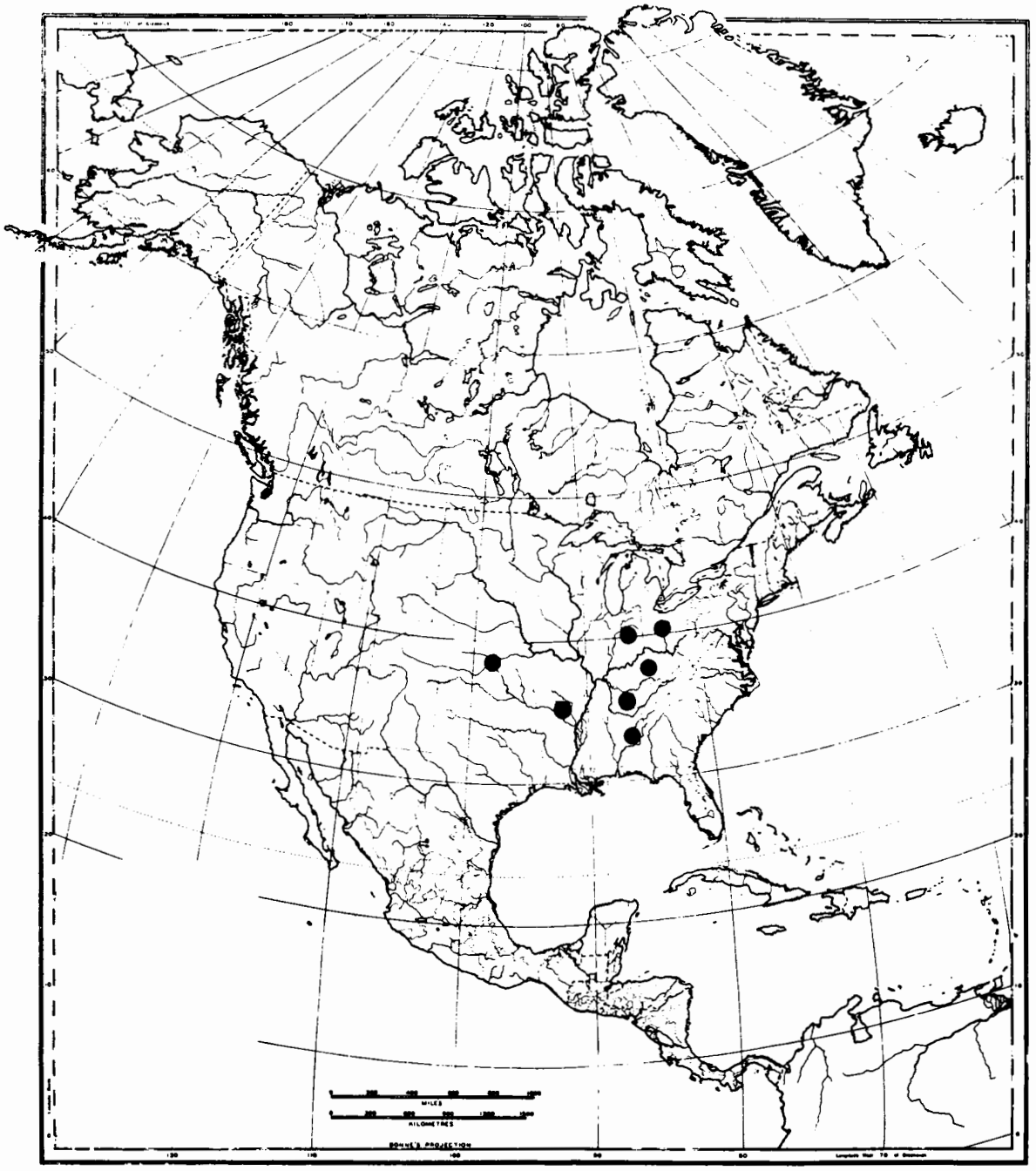


FIGURE 58.—Distribution of *Pleurobema cordatum plenum* in North America.

Type locality.—Ohio River, Cincinnati, Ohio.

Diagnosis.—A form intermediate between *P. cordatum catillus* and *P. cordatum pyramidatum.* It is higher than the former and lower than the latter.

Ecology.—The *cordatum-catillus-plenum-pyramidatum* complex is associated with streams of comparatively large size (Goodrich and van der Schalie, 1944, p. 309).

General distribution (fig. 58).—"Ohio, Cumberland, and Tennessee River systems; southwest to Kansas and Arkansas" (Simpson, 1914, p. 887).

Distribution in Ohio.—Sterki (1907a, p. 392) merely gives "Ohio River." Ortmann (1919) does not mention the form.

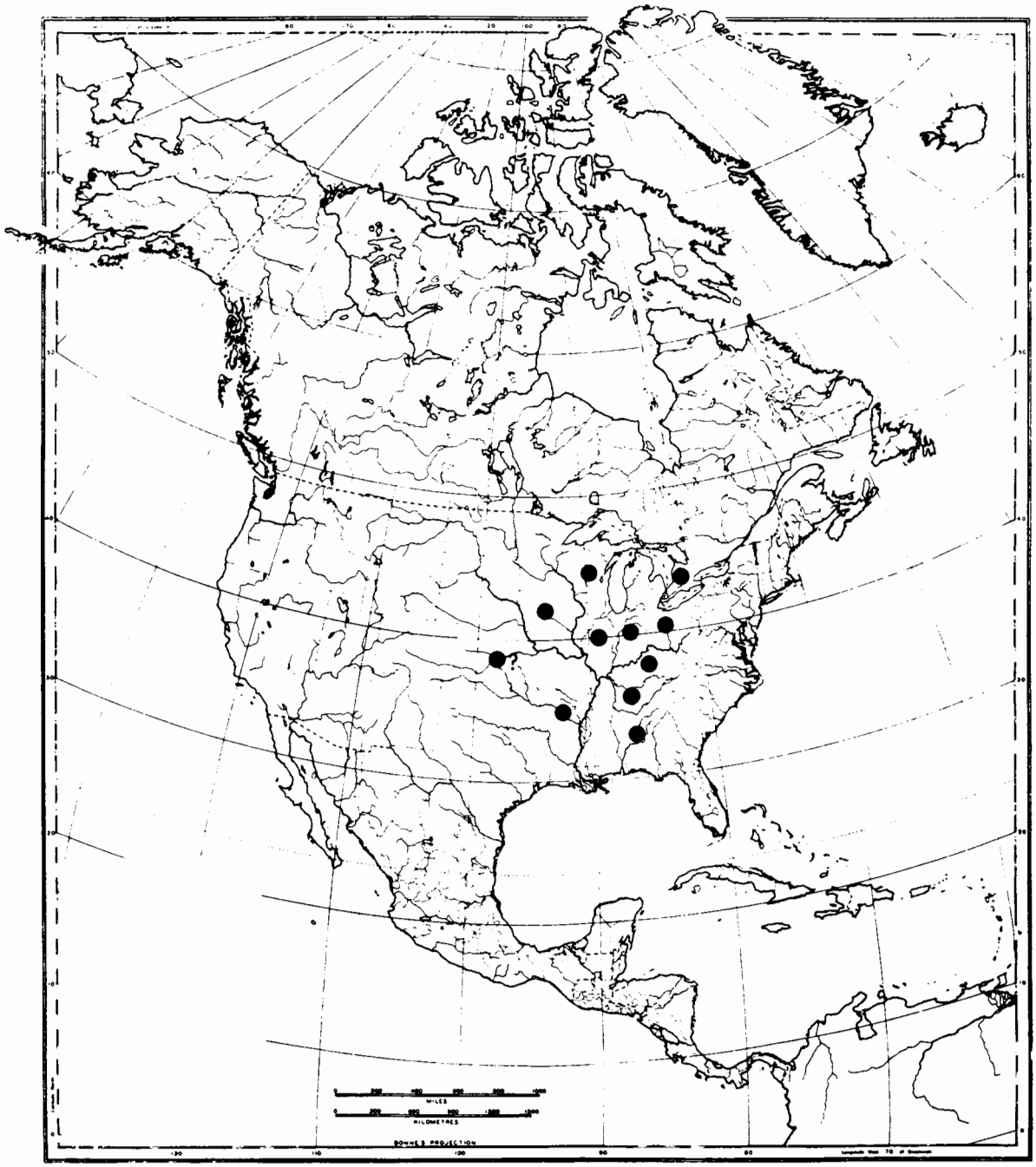


FIGURE 59.—Distribution of *Pleurobema cordatum pyramidatum* in North America.

Geologic range.—Unknown.

Pleurobema cordatum pyramidatum (Lea) 1834

Unio pyramidatus Lea 1834, Am. Philos. Soc. Trans., v. 4, p. 109, pl. 16, fig. 39.
Quadrula pyramidata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.
--- --- Simpson 1914, Descr. cat. Naiades, p. 888.
Pleurobema obliquum rubrum Ortmann 1919, Najades Pa., p. 84, pl. 6, fig. 7.
Pleurobema pyramidatum F. C. Baker 1920, Life of Pleistocene, p. 383.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 24.
Quadrula obliquata Frierson 1927 (part), Check list N. Am. Naiades, p. 52.
Pleurobema pyramidatum F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 137.
Pleurobema cordatum pyramidatum Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 309.
Pleurobema pyramidatum La Rocque 1953, Cat. Recent Moll. Canada, p. 97.

Type locality.—Ohio.

Diagnosis.—According to Goodrich and van der Schalie (1944, p. 309) this is the highest form of *P. cordatum* in the series *cordatum-catillus-plenum-pyramidatum.*

Ecology.—The complex mentioned above is associated with streams of comparatively large size according to the same authors.

Associations.—Living: OHIO-43.

General distribution (fig. 59).—"Ohio, Cumberland, and Tennessee River systems; southwest to Arkansas; west to Nebraska?; north in the Mississippi to Prairie du Chien, Wisconsin" (Simpson, 1914, p. 889).

Distribution in Ohio.—Sterki (1907a, p. 392) gives "Ohio River and tributaries; large and heavy specimens in the Tuscarawas River." Ortmann (1919) gives Ohio River, Scioto County; and the Tuscarawas River.

Geologic range.—Recorded only for Sangamon deposits by F. C. Baker (1920a, p. 383).

Remarks.—The distribution of this form is still not clear. Simpson (see above) questioned its presence in Nebraska. Baker (1928a, pt. II, p. 137) referred all Wisconsin records to "*Pleurobema solida*" and "*Pleurobema coccineum mississippiensis* F. C. Baker."

Genus *Elliptio* Rafinesque 1819

Elliptio Rafinesque 1819, Jour. Physique, v. 88, p. 426; 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 291 (*fide* Neave).
Elliptio Walker 1918, Synopsis and cat. fresh-water Moll., p. 51.
Elliptio Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 27.
Elliptio F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 123.
Elliptio La Rocque 1953, Cat. Recent Moll. Canada, p. 91.

Type.—*Unio crassidens* Lamarck.

Diagnosis.—Shell inequilateral, ovate to elongate, rounded in front and pointed or biangulate behind, with a more or less developed posterior ridge, in many cases becoming slightly arcuate when old; beaks only moderately full, generally sculptured with coarse ridges which run parallel with the growth lines or are somewhat doubly looped, in some cases broken and showing fine radiating lines behind; surface smooth, slightly concentrically ridged or pustulous; epidermis generally rather dull colored, rayless or fully rayed; hinge plate narrow, two pseudocardinals and two laterals in the left valve and one pseudocardinal and one lateral in the right, with rarely a vestige of a second lateral; cavity of the beaks not deep or compressed.

Elliptio complanatus (Solander) 1786
Fig. 60

Mya complanata Solander 1786, Portland cat., v. 11, lot 2190.
Unio complanatus Dall 1905, Harriman-Alaska Exped., v. 13, p. 133.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 393.
--- --- Simpson 1914, Descr. cat. Naiades, p. 651.
--- --- Johnson 1915, Fauna New England, p. 27.
Elliptio violaceus Ortmann 1919, Najades Pa., p. 103, pl. 8, figs. 4, 5.
Elliptio complanatus F. C. Baker 1920, Life of Pleistocene, p. 383.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 30.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 134, pl. 56, figs. 1, 2.
--- --- Goodrich 1932, Moll. Mich., p. 88.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.

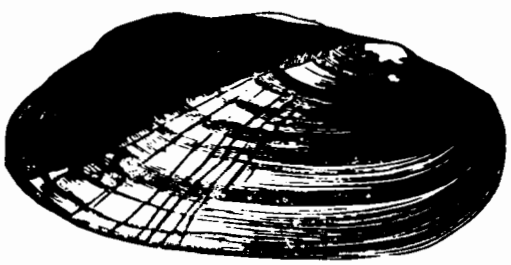


FIGURE 60.—*Elliptio complanatus,* X1; after Hartman and Michener (1874, p. 87, fig. 181).

Elliptio complanatus Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 98, pl. 11, fig. 10.
--- --- Matteson 1948, Nautilus, v. 61, p. 127-132; v. 62, p. 13-17.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 91.
--- --- Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 21, figs. 26-28.

Type locality.—Maryland.

Diagnosis.—Shell rhomboidal and compressed; beaks little, if at all, elevated; pseudocardinals small; nacre pinkish or purplish with coppery iridescence.

Ecology.—Found in creeks and small rivers on mud bottom in comparatively shallow water; in quiet or running water and on sand, gravel, and mud bottom; a species, apparently, that has no ecological prefer-

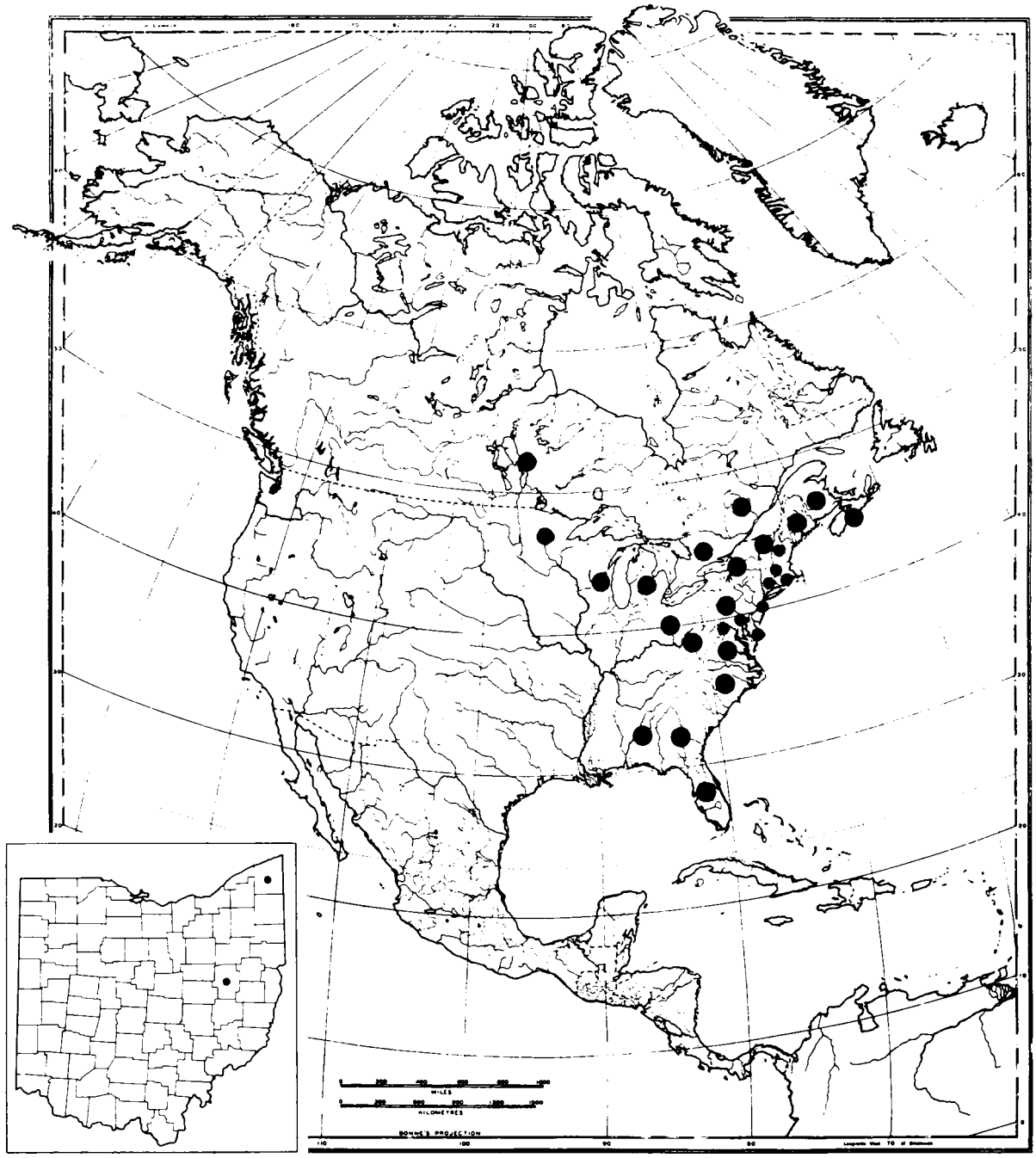


FIGURE 61.—Distribution of *Elliptio complanatus* in North America; *inset,* distribution in Ohio.

ences; it is not, however, a species of large rivers (condensed from F. C. Baker, 1928a, pt. II, p. 135). The last observation may be true in Wisconsin, but the species has been collected abundantly (Latchford, 1887, p. 66) in the Ottawa River, near Ottawa, Ontario, in the Rideau and other rivers of fair size, and even in the St. Lawrence at Montreal. In the northern part of its range, at least, it is also abundant in lakes, such as those of the region to the north of Ottawa where nearly every lake has this species in abundance.

Associations.—Living: NEW YORK-2a, 2b, 3a, 4c, 5b, 5c, 6, 7, 10, 13, 14, 15a, 15b, 16, 17, 18c, 19, 21, 22, 23, 24, 26, 27, 28, 29, 30, 32, 33, 34, 35, 40b, 41, 42, 45; OHIO-43; ONTARIO-1, 7, 10; QUEBEC-1, 2, 3, 4, 5, 7, 8.

General distribution (fig. 61).—Entire Atlantic drainage from Georgia to the St. Lawrence system. Saskatchewan River; Hudson Bay drainage; Lake Superior drainage in Minnesota, Wisconsin, and Michigan (Matteson, 1948, p. 13, fig. 1); Lake Huron drainage in Michigan and Ontario; Lake Erie drainage in New York; Lake Ontario drainage in New York and Ontario, thence throughout the St. Lawrence drainage.

Distribution in Ohio (inset, fig. 61).—Sterki (1907a, p. 393) did not find this species in Lake Erie. One specimen was found by him in a race on the Tuscarawas River, at New Philadelphia; he says of it: "... evidently the mussels have migrated from Lake Erie, over the divide, probably by way of the Ohio canal." Ortmann (1919) gives Tuscarawas County, Ohio, probably referring to the Sterki record above, and Grand River, Ashtabula County.

Geologic range.—Recorded for late Pleistocene ("Wabash") beds by F. C. Baker (1920a, p. 383).

Remarks.—Matteson (1948, p. 14) is at a loss to explain how the species reached Ohio. Two explanations are possible here: first, introduction through canal systems, prevalent in Ohio in the nineteenth century; second, a very complex and rather unlikely introduction through drainage changes in the river system of the State. Such changes would remain to be worked out, at least for the Tuscarawas River record. The Ashtabula County record may be due to unusual penetration of fish hosts of the species.

Elliptio crassidens (Lamarck) 1819
Fig. 62

Unio crassidens Lamarck 1819, Animaux sans vertèbres, v. 6, p. 71.
--- --- Call 1900, Moll. Ind., p. 509, pl. 63.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.
--- --- Ortmann 1912, Carnegie Mus. Annals, v. 8,

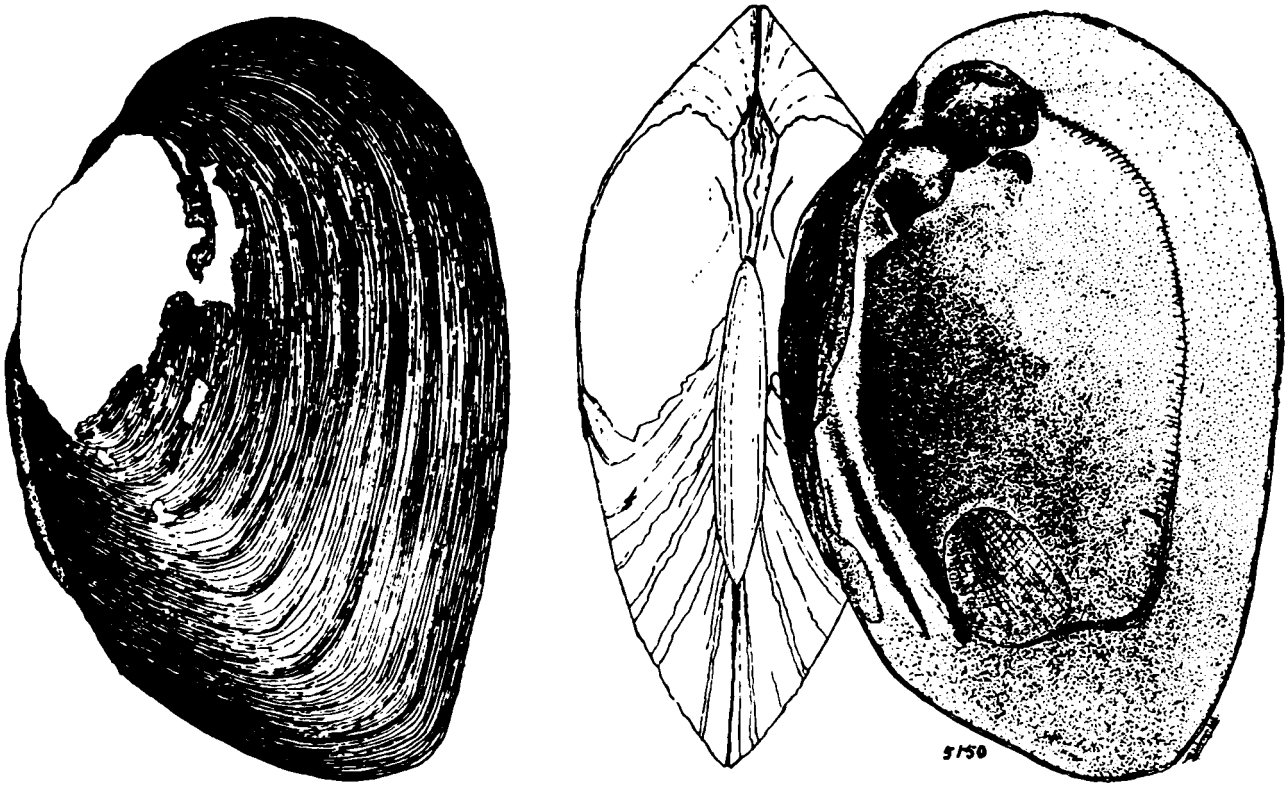


FIGURE 62.—*Elliptio crassidens*, three views, X1; after Call (1900, pl. 63).

p. 266, figs. 10, 10a.

Unio crassidens Simpson 1914, Descr. cat. Naiades, p. 607.

Elliptio niger Ortmann 1919, Najades Pa., p. 91, pl. 8, fig. 1.

Elliptio crassidens F. C. Baker 1920, Life of Pleistocene, p. 383.

--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 28.

--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 131, pl. 57, figs. 3-5.

--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 151.

--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 307.

--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 91.

Type locality.—Erroneously given as "Lake Erie" (F. C. Baker, 1928a); "Mississippi and other rivers

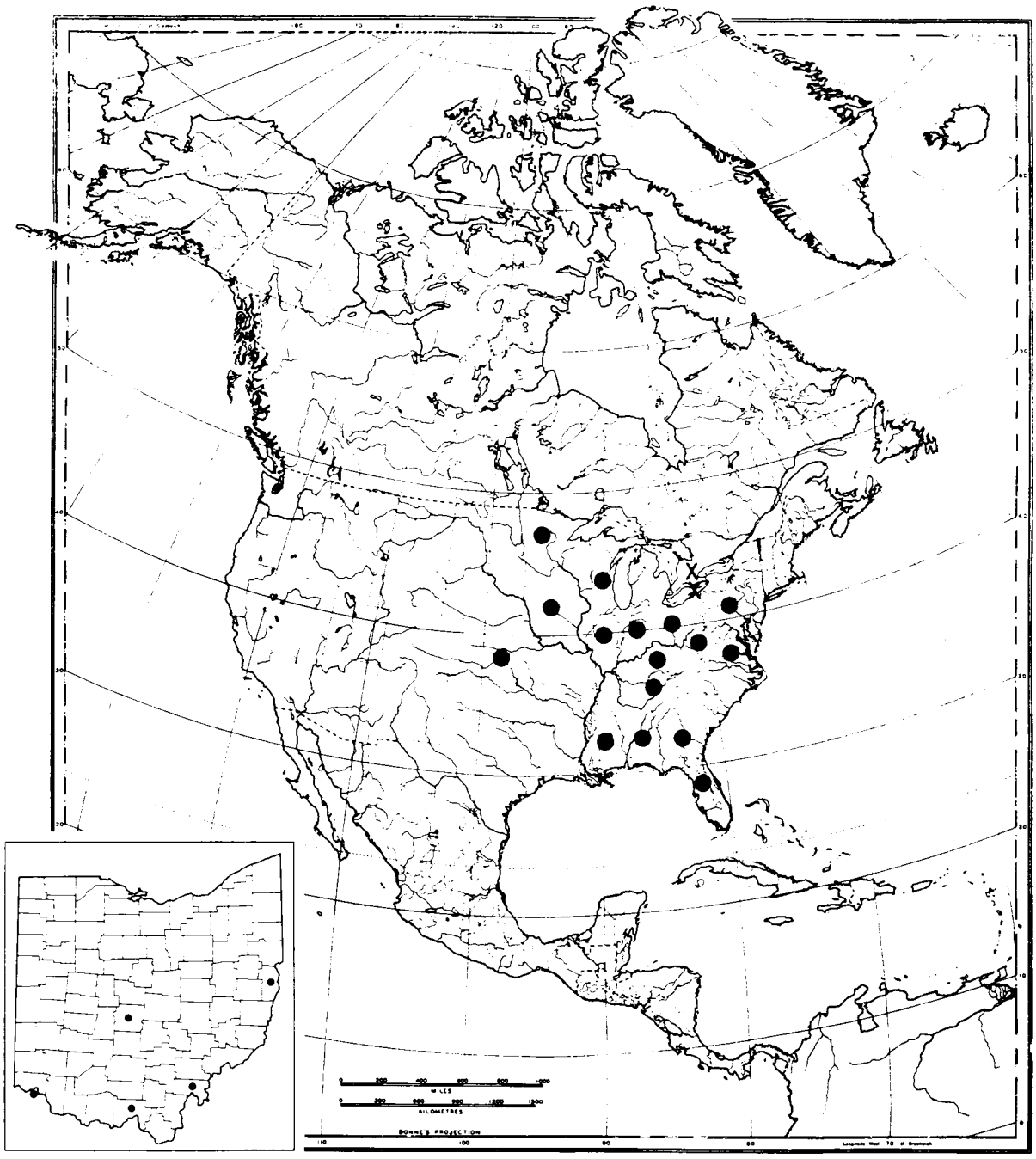


FIGURE 63.—Distribution of *Elliptio crassidens* in North America; *inset,* distribution in Ohio.

and lakes" (Simpson, 1914).

Diagnosis.—"Shell ponderous, convex or subinflated, subrhomboid, inequilateral; beaks full and elevated, their sculpture a few coarse ridges running nearly parallel with the growth lines; posterior ridge well developed and angled, sometimes faintly double below and ending behind at the base of the shell usually in a biangulation; base line straight or incurved in old specimens; outline of posterior slope subtruncate, slightly curved; surface with rude, irregular growth lines; posterior slope often having a few wrinkles; epidermis thick, reddish-brown or chestnut; left valve with two strong, rough pseudocardinals and two heavy laterals; right valve with one strong pseudocardinal with a small tooth in front of and behind it; with one very solid lateral; beak cavities very shallow with a few small scars; muscle scars small and deep; pallial line impressed, crenate; nacre purplish or salmon" (Simpson, 1914, p. 606).

Ecology.—"A species of large rivers where it is found on a gravel, stony, or shell bottom in rapid current, in rather deep water, 2 m. or more" (F. C. Baker, 1928a, pt. II, p. 133).

General distribution (fig. 63).—Mississippi drainage generally; Alabama and Tombigbee Rivers; southeast to Chattahoochee River (Simpson, 1914).

Distribution in Ohio (inset, fig. 63).—Sterki (1907a, p. 392) gives Ohio River, common; Scioto River. Ortmann records it from the Ohio River in Jefferson, Meigs, and Scioto Counties, Ohio.

Geologic range.—Recorded for late Wisconsin ("Wabash") beds by Baker (1920a, p. 383).

Elliptio dilatatus (Rafinesque) 1820
Fig. 64

Unio dilatata Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 7, p. 297.
Unio gibbosus Barnes 1823, Am. Jour. Sci., v. 6, p. 262, pl. 11, fig. 12.
Unio mucronatus Barnes 1823, *ibid.*, p. 266, pl. 13, fig. 13.
Unio gibbosus Call 1900, Moll. Ind., p. 450, pl. 16.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.
--- --- Simpson 1914, Descr. cat. Naiades, p. 97.
Elliptio dilatatus Ortmann 1919, Najades Pa., p. 95, pl. 8, fig. 2.
Elliptio gibbosus F. C. Baker 1920, Life of Pleistocene, p. 383.
Elliptio dilatatus Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 30.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 124, pl. 55, figs. 4-5.
--- --- Goodrich 1932, Moll. Mich., p. 88, pl. 2, fig. 3.

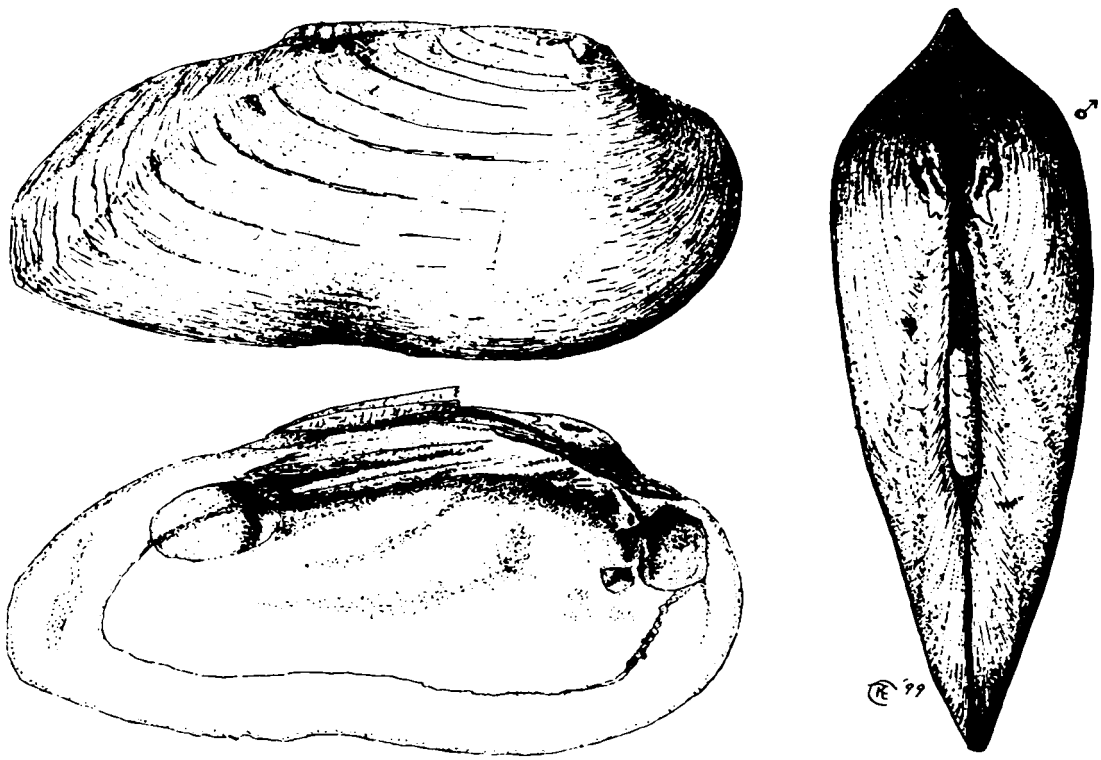


FIGURE 64.—*Elliptio dilatatus*, three views, X1; after Call (1900, pl. 16).

Elliptio dilatatus La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 306.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 95.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 91.
--- --- Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 23, fig. 44.

Type locality.—Ohio River.

Diagnosis.—Shell thick, elongate; hinge line curved, base and anterior end curved, posterior end bluntly pointed; epidermis very dark brown, nearly black; beak sculpture of a few heavy ridges, a little incurved in the center; beak cavity shallow, with three or four pits, or indentations; nacre purple; left valve with one stout curving striate pseudocardinal and one long lateral tooth; right valve with two rather low pseudocardinals and two lateral teeth; two deep muscle

FIGURE 65.—Distribution of *Elliptio dilatatus* in North America; *inset,* distribution in Ohio.

scars close to the pseudocardinals of each valve, a single broad and shallow scar posteriorly; L. 98, H. 51, D. 35 mm.

Ecology.—A species with a wide range of habitats, found on mud and sand bottom, and on gravel, sand, and mud bottom, in water 0.3-2 m. deep and even deeper water in lakes; in streams with sluggish to swift current, up to 7 or 8 miles per hour (condensed from F. C. Baker, 1928a, pt. II, p. 126).

Associations.—Living: MICHIGAN - 45, 48, 49, 50, 51, 52, 54, 55, 56, 57, 58, 59, 61, 62, 63, 64, 65, 66, 67; OHIO - 43; ONTARIO - 1; WISCONSIN - 58, 131.

General distribution (fig. 65).—Entire Mississippi drainage; St. Lawrence and its tributaries; Alabama River system; southeast into Florida; southwest to the Guadalupe River, Texas (Simpson, 1914).

Distribution in Ohio (inset, fig. 65).—Sterki (1907a, p. 392) gives "over the state, common and variable in

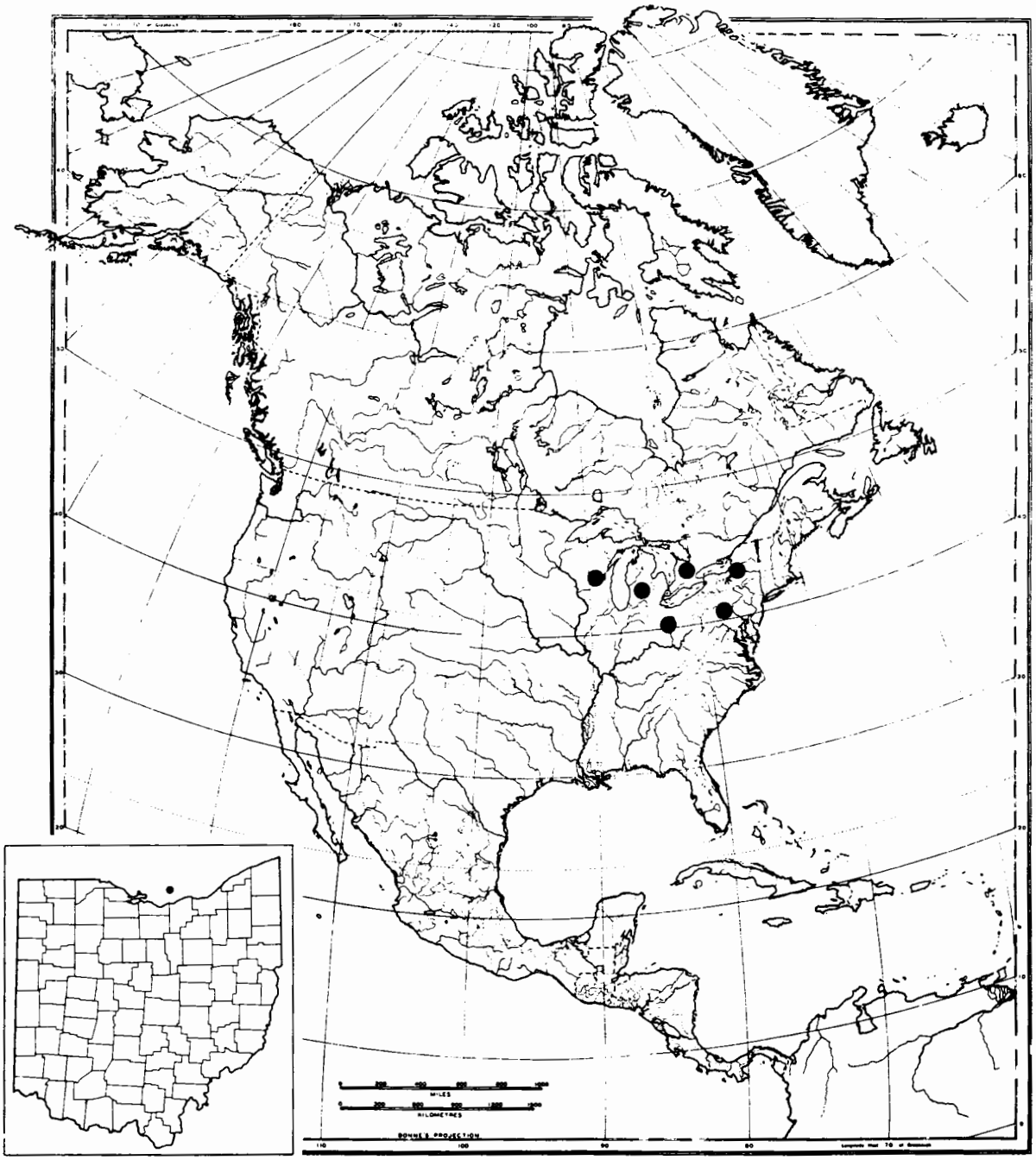


FIGURE 66.—Distribution of *Elliptio dilatatus sterkii* in North America; *inset,* distribution in Ohio.

regard to size, shape and color of the nacre; dark purple to salmon to white ... a very small form, with the beaks more anterior, is in Lake Erie." Ortmann (1919) records this for Swan Creek, Lucas County; Maumee River, Defiance County; the Tuscarawas River; and the Ohio River in Jefferson, Meigs, and Scioto Counties.

Geologic range.—Recorded for Sangamon and late Wisconsin ("Wabash") beds by Baker (1920a, p. 383).

Remarks.—Baker recognizes four forms, of which only two, the typical form and *E. dilatatus sterkii*, occur in Ohio. He characterizes them as follows:

Large-river form	*Elliptio dilatatus* (Raf.)
Medium-river form	*E. dilatatus gibbosus* (Barnes)
Creek form	*E. dilatatus delicatus* (Simpson)
Lake form	*E. dilatatus sterkii* Grier

All of these forms are to be expected in the State, since all sizes of streams and lakes are present, both now and in the various drainage patterns of the Pleistocene. Only one of these forms has gained wide recognition and it is the only one added here, *i.e.*, *E. dilatatus sterkii* Grier.

Elliptio dilatatus sterkii Grier 1918

Elliptio dilatatus var. *sterkii* Grier 1918, Nautilus, v. 32, p. 9.

Elliptio dilatatus sterkii Ortmann 1919, Najades Pa., p. 101, pl. 8, fig. 3.

--- --- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 130, pl. 56, figs. 3-6.

--- --- --- Goodrich 1932, Moll. Mich., p. 88.

--- --- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.

--- --- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 95, pl. 11, fig. 8.

--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 91.

Type locality.—Lake Erie, Presque Isle Bay, Erie County, Pennsylvania.

Diagnosis.—Shell smaller and more inflated than that of the type form; umbones nearer the anterior end; hinge delicate (condensed from Robertson and Blakeslee, 1948).

Ecology.—In lakes, especially Lake Erie, on gravel and cobble bottom, in water 2-3 m. deep; on gravel bottom, water 3 m. deep.

Associations.—Living: WISCONSIN - 82.

General distribution (fig. 66).—Lake Huron; Lake Erie; Lake St. Clair; Lake Ontario at Grand View Beach, New York; Lake Winnebago, Wisconsin; Chautauqua Lake, New York, "approaching *sterkii*" (F. C. Baker, 1928a, pt. II).

Distribution in Ohio (inset, fig. 66).—In this State, the variety is not known except for Lake Erie. It should be found in the Pleistocene fauna of the beach ridges of that lake but so far no records are available.

Geologic range.—Unknown.

Genus *Uniomerus* Conrad 1853

Uniomerus Conrad 1853, Acad. Nat. Sci. Philadelphia Proc., v. 6, p. 268 (*fide* Neave).

Uniomerus Walker 1918, Synopsis and cat. fresh-water Moll., p. 53.

Type.—*Unio tetralasmus* Say.

Diagnosis.—Shell trapezoidal, with a rounded posterior ridge and pointed or weakly biangulate behind; beaks not prominent, sculptured with rather strong curved concentric ridges; epidermis generally rayless; pseudocardinals commonly compressed; laterals delicate, slightly curved.

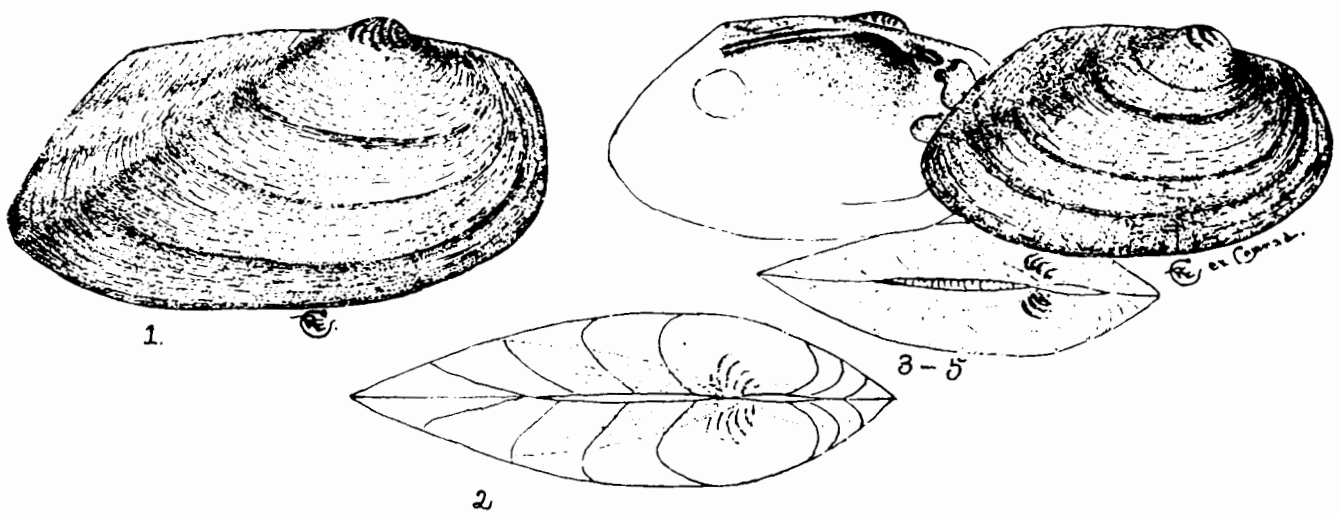


FIGURE 67.—*Uniomerus tetralasmus*, five views, X1; after Call (1900, pl. 67).

Uniomerus tetralasmus (Say) 1830
Fig. 67

Unio tetralasmus Say 1830, Am. Conchology, v. 3, pl. 23.
Unio excultus Conrad 1838, Mon., pt. 11, p. 99, pl. 54, fig. 1.
Unio parallelus Conrad 1841, Acad. Nat. Sci. Philadelphia Proc., v. 1, p. 20.
Unio symmetricus Lea 1845, Am. Philos. Soc. Proc., v. 4, p. 164.
Unio porrectus Conrad 1854, Acad. Nat. Sci. Philadelphia Jour., v. 7, p. 296, pl. 26, fig. 7.
Unio subcroceus Conrad 1854, *ibid.*, p. 297, pl. 27, fig. 1.
Unio jamesianus Lea 1857, Acad. Nat. Sci. Philadelphia Proc., v. 1, p. 84.
Unio (Uniomerus) tetralasmus Simpson 1914, Descr.

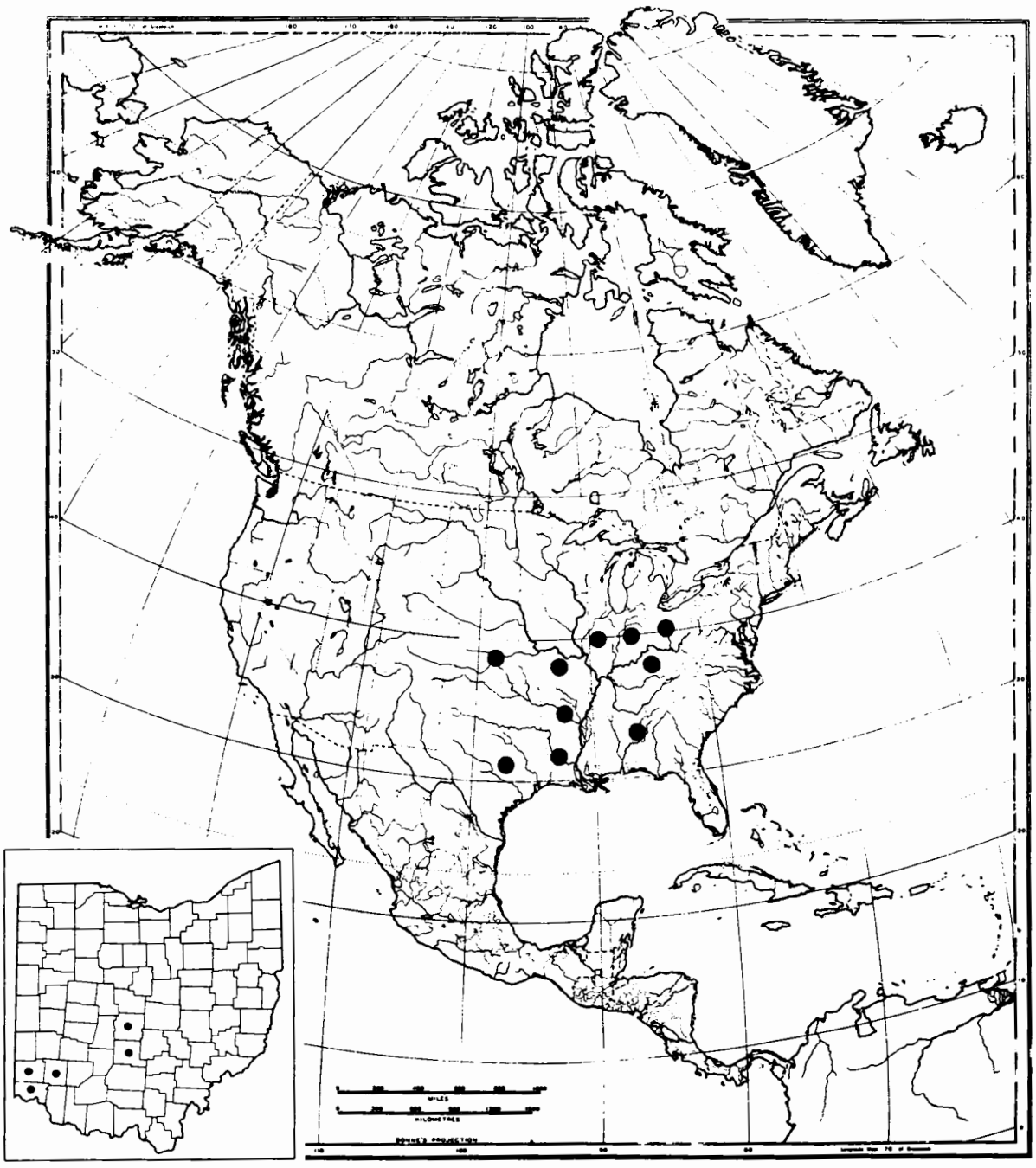


FIGURE 68.–Distribution of *Uniomerus tetralasmus* in North America; *inset*, distribution in Ohio.

cat. Naiades, p. 704.

Elliptio (Uniomerus) tetralasmus Frierson 1927, Check list N. Am. Naiades, p. 34.

Uniomerus tetralasmus van der Schalie 1940, Nautilus, v. 53, p. 137-138.

--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 310.

--- --- Hibbard and Taylor 1960, Mich. Univ. Mus. Paleontology Contr., v. 16, no. 1, p. 74.

Type locality.—Bayou St. John, New Orleans, Louisiana.

Diagnosis.—Shell elongate with dorsal and ventral lines nearly parallel, convex to subinflated, rather thin to subsolid, inequilateral, beaks somewhat full and elevated, sculptured with six or seven moderate concentric ridges which are evenly and abruptly rounded up behind; posterior ridge widely rounded, ending behind in a point just below the median line; on the

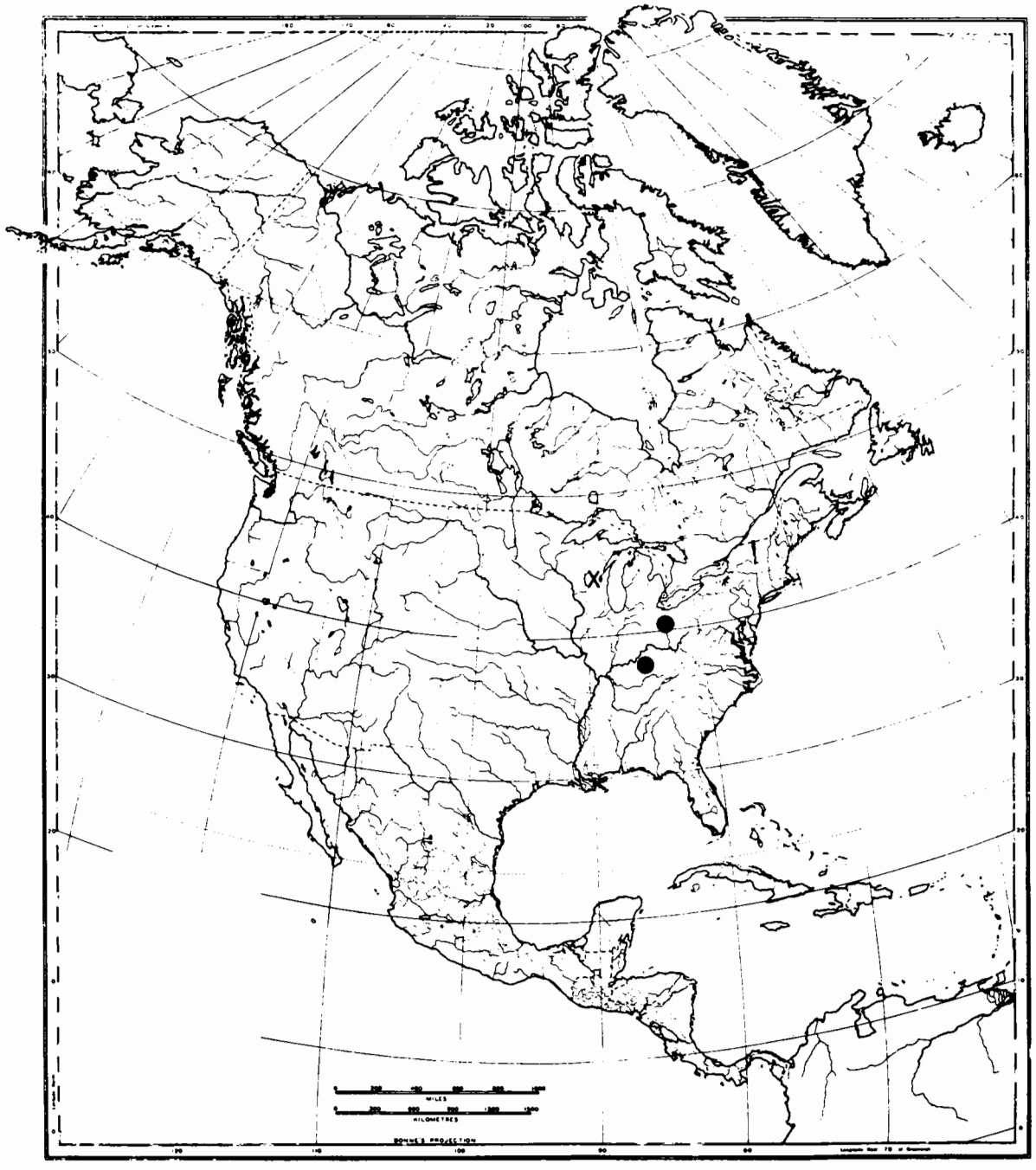


FIGURE 69.—Distribution of *Uniomerus tetralasmus sayi* in North America.

dorsal slope are two radiating furrows, the slope being slightly obliquely truncate behind; surface with weak concentric sulcations and traces of very fine radial sculpture; epidermis yellowish brown or ashy brown, banded with lighter color, rather smooth, commonly somewhat shining; pseudocardinals two in each valve, the upper in the right valve small, all subcompressed; laterals long, two in the left valve and one in the right; beak cavities impressed; dorsal scars immediately under the beaks; muscle scars smooth and shallow; nacre white; L. 96, H. 48, D. 30 mm. (modified from Simpson, 1914, p. 705).

Ecology.—Found in ponds, even those that dry up in summer; van der Schalie (1940, Naut. 53,[5] p. 137-138) has noted cases from the literature where specimens of this species lived without water for a period of 3-6 months.

General distribution (fig. 68).—Type form is found from "Alabama to Texas; north to Southern Missouri and Indian Territory" (Simpson, 1914, p. 705), but this author also gives, for "the species and all its varieties: Lower Mississippi drainage north to about latitude 40°; Ohio River system; Alabama River system and southwest through Texas into northern Mexico. Not reported, so far as I know, from the Tennessee and Cumberland rivers" (Simpson, 1914, p. 709).

Distribution in Ohio (inset, fig. 66).—Sterki (1907a, p. 392, 393) has recorded two varieties of this species in Ohio. The validity of the Ohio records is discussed under the varieties.

Geologic range.—None recorded. Hibbard and Taylor (1960, p. 74) give no fossil record for this species.

Remarks.—The extraordinary hardiness of this species, as indicated by its ability to withstand desiccation, should have given it wide distribution in North America, yet it does not range north of the 40th parallel in the Mississippi drainage. What caused it to stop? Is it a late arrival in the Mississippi drainage, a species which is still extending its range northward? Is it arrested in its spread by factors connected with its fish host or by factors of temperature? If the distribution of Naiades were haphazard, as some geologists have claimed, this species should have a much greater range to the north and east.

[*Uniomerus tetralasmus camptodon* (Say) 1832]

Unio camptodon Say 1832, Am. Conchology, v. 5, pl. 42.
Unio geometricus Lea 1832, Am. Philos. Soc. Trans., v. 5, p. 38, pl. 4, fig. 10.
Unio tetralasmus camptodon Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 392.
Unio (Uniomerus) tetralasmus camptodon Simpson 1914, Descr. cat. Naiades, p. 706.
Elliptio (Uniomerus) tetralasmus-camptodon Frierson 1927, Check list N. Am. Naiades, p. 34.

Type locality.—New Orleans, Louisiana.

Diagnosis.—"Shell subrhomboid, the base line usually incurved when adult; beaks sharper than in the type; surface dark, subshining or rougish [sic]; nacre bluish-white. Length of Say's figure 95, height 46, diam. 30 mm." (Simpson, 1914, p. 706).

Ecology.—"This is an exceedingly interesting species. It thrives in temporary ponds, 'tanks,' sloughs, and intermittent creeks. In small sluggish streams where no other mussels are likely to be found *U. tetralasmus* will probably appear. This species has unusual power to withstand drying .... I have found animals alive and in perfectly good condition buried deeply in old pond bottoms, so dry on the surface that the ground was being plowed" (Isely, 1925, p. 100). "In Kansas this species is found in all the drainage areas, but perhaps most frequently in the small, muddy tributaries and the large ponds and lakes of the southern drainage basin. There is hardly another species which has an equal range over the state ..." (Scammon, 1906, p. 337). "In Meade County [Kansas] this mussel lives in the deep pools of the upper part of Crooked Creek, along with *Anodonta grandis*" (Hibbard and Taylor, 1960, p. 74). See also van der Schalie (1940, Naut. 53) concerning the resistance to desiccation of this species.

General distribution.—States bordering the Gulf of Mexico (Simpson, 1914, p. 706).

Distribution in Ohio.—Sterki (1907a, p. 392) records

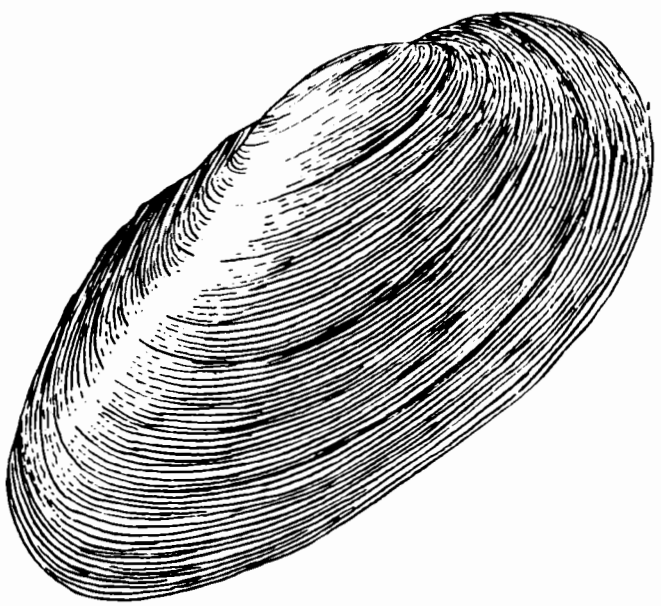


FIGURE 70.—*Anodonta grandis*, exterior of right valve, X1; after Goodrich (1932, pl. 2, fig. 1).

5. Nautilus, v. 53. In this and succeeding chapters, many references to papers in Nautilus will be noted in this manner rather than included in the Selected References list following Chapter 7.

this form from the Ohio River at Cincinnati and from the Great and Little Miami Rivers. Ortmann does not mention the form.

Geologic range.—Unknown.

Remarks.—Sterki's record of this variety may have been based on an extreme variant of the typical form. His record has not, apparently, been accepted by Simpson and the name should be dropped from the Ohio list of Naiades.

Uniomerus tetralasmus sayi (Ward) 1839

Unio sayi Ward (*in* Tappan) 1839, Am. Jour. Sci., v. 35, p. 268, pl. 3, fig. 1.
Unio sayanus B. H. Wright 1888, Check list.
Unio tetralasmus sayi Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 393.
Unio (Uniomerus) tetralasmus sayi Simpson 1914, Descr. cat. Naiades, p. 709.

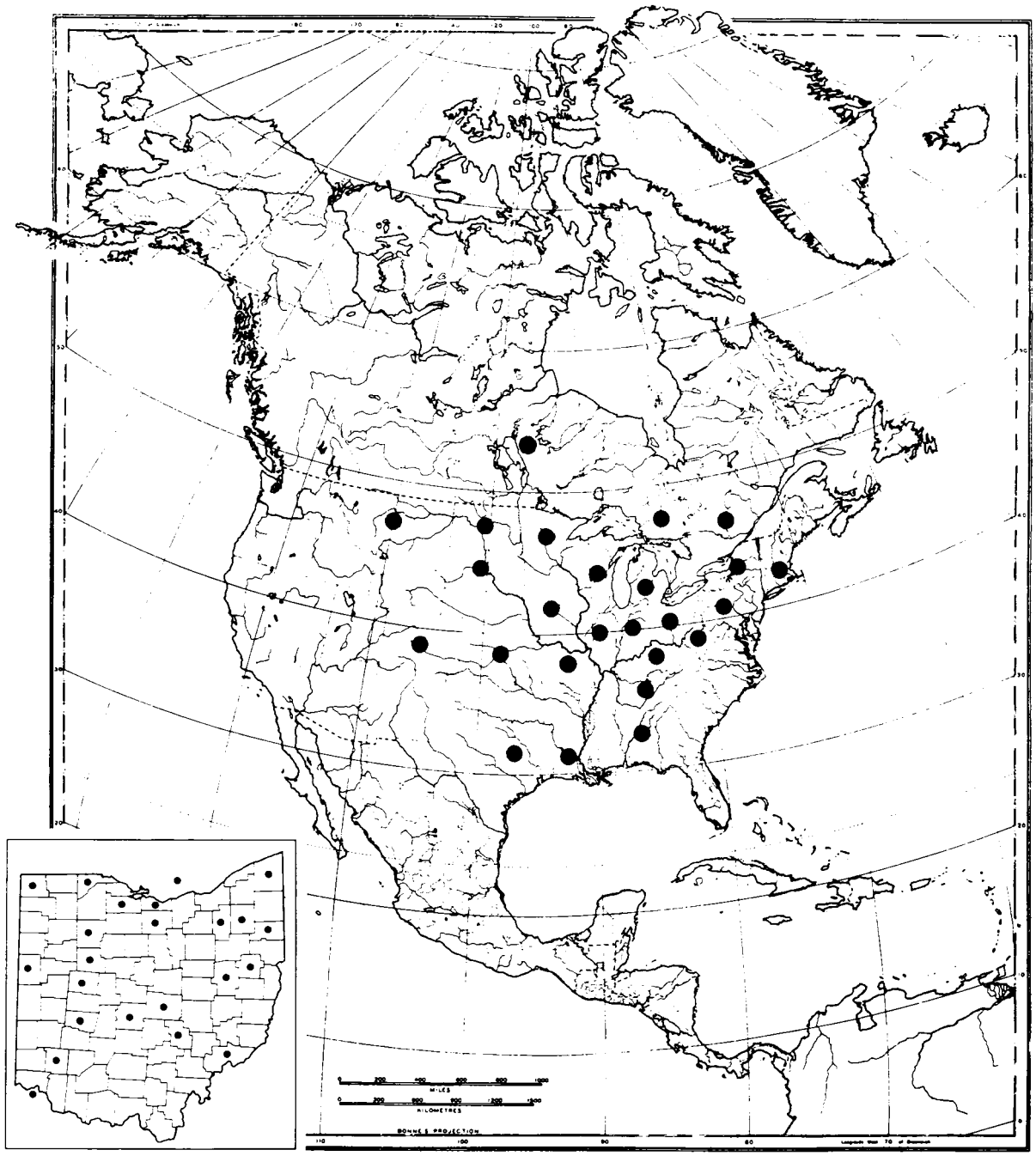


FIGURE 71.—Distribution of *Anodonta grandis* in North America; *inset,* distribution in Ohio.

Elliptio (Uniomerus) tetralasmus-sayi Frierson 1927, Check list N. Am. Naiades, p. 34.

Type locality.—Walnut Creek and Ohio Canal, Circleville, Pickaway County, Ohio.

Diagnosis.—"Shell rhomboid, with the dorsal and ventral lines very slightly curved; dorsal slope decidedly obliquely truncated; beaks rather full and high, their sculpture strong and distinct; posterior ridge well developed, rounded and ending near the base of the shell in a decided point; surface yellowish or greenish-ash, generally with darker, concentric bands; epidermis sometimes smooth, more commonly delicately, concentrically wrinkled; nacre bluish-white. Length 82, height 40, diam. 25 mm." (Simpson, 1914, p. 709).

Ecology.—See typical form of the species.

General distribution (fig. 69).—"Ohio River system" (Simpson, 1914, p. 709).

Distribution in Ohio.—Sterki (1907a, p. 393) records this variety for "Scioto River, e.g. at Circleville, (type locality)" only. Ortmann (1919) does not mention it.

Geologic range.—Unknown.

Remarks.—There is no doubt concerning the validity of Sterki's record for this variety, but Simpson is not quite convinced of the validity of the form, for he notes intermediates between it and typical *U. tetralasmus*. It may well be preferable to call Ohio specimens of this species by the species name only and to consider both forms (*sayi* and *camptodon*) as variations too minor to deserve formal treatment.

Subfamily ANODONTINAE
Genus *Anodonta* Lamarck 1799

Anodonta Lamarck 1799, Soc. Histoire Nat. Paris Mém., p. 87 (*fide* Neave).
Lastena Utterback 1916, Naiades Mo., p. 104 (*non* Rafinesque).
Anodonta Walker 1918, Synopsis and cat. fresh-water Moll., p. 56.
Utterbackia F. C. Baker 1927, Am. Midland Naturalist, v. 10, p. 221.
Anodonta F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 152.
Utterbackia F. C. Baker 1928, *ibid.*, p. 170.
Anodonta La Rocque 1953, Cat. Recent Moll. Canada, p. 87.

Type.—*Mytilus cygneus* Linnaeus.

Diagnosis.—Shell elliptical, thin, inflated, in many cases slightly winged posteriorly; beak sculpture consisting of rather numerous more or less parallel ridges, commonly somewhat doubly looped and becoming slightly nodulous on the loops; surface generally smooth, shining; hinge edentulous, reduced to a mere line, regularly curved; nacre dull.

Remarks.—This is an ancient genus, dating back at least to the Cretaceous. Henderson (1935, p. 64) lists six Cretaceous species and twelve from the Tertiary. Possibly because of its remote origin, it is a widespread genus, with species in Europe, Asia, and America. The North American species have undoubtedly been overdescribed and even after judicious elimination of synonyms by Dall, Simpson, and other workers on the Naiades, the remaining species are difficult to separate. A glance at the list of species recorded for Canada (La Rocque, 1953, p. 87-89) will demonstrate the large number of species and subspecies, and examination of such standard works as Simpson's Catalogue (1914), especially his synonymies, will show how very extensive is the list of species. Practical identification of this host of species is difficult and bewildering. In the circumstances, it was felt that all the species recorded for Ohio should be listed here with their synonymies, insofar as they could be ascertained, with the reservation that some species should be eliminated as invalid when careful work on the soft parts can be done.

In addition to the species and varieties described here, the following may be worthy of note: *A. subgibbosa* Anthony occurs in Michigan, in inland lakes near Lake Michigan; *A. corpulenta* Cooper, a western species, first found in the upper Missouri River, occurs in Indiana and Michigan but so far has not been recorded for Ohio.

Anodonta grandis Say 1829
Fig. 70

Anodonta grandis Say 1829, New Harmony Disseminator, v. 2, p. 341.
Anodonta palna (err. typ. pro plana) Lea 1834, Am. Philos. Soc. Trans., v. 5, p. 48; pl. 7, fig. 18; 1834, Observer, v. I, p. 160, pl. 7, fig. 18.
Symphynota benedictensis Lea 1837, Am. Philos. Soc. Trans., v. 5, p. 104, pl. 16, fig. 48.
Anodonta ovata Lea 1838, Am. Philos. Soc. Trans., v. 6, p. 2, pl. 2, fig. 2; 1838, Observer, v. II, p. 2, pl. 2, fig. 2.
Anodonta salmonea Lea 1838, Am. Philos. Soc. Trans., v. 6, p. 45, pl. 14, fig. 41; 1838, Observer,

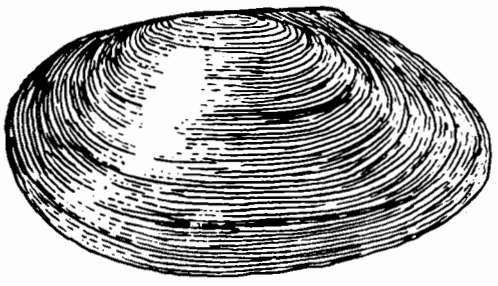


FIGURE 72.—*Anodonta imbecillis*, exterior of right valve, X1; after Goodrich (1932, pl. 2, fig. 2).

v. II, p. 45, pl. 14, fig. 41.

Anodonta pepiniana Lea 1838, Am. Philos. Soc. Trans., v. 6, p. 96.

Anodonta footiana Lea 1840, Am. Philos. Soc. Proc., v. I, p. 289; 1842, Am. Philos. Soc. Trans., v. 8, p. 225, pl. 20, fig. 44; 1842, Observer, v. III, p. 63, pl. 20, fig. 44.

Anodonta marryattana Lea 1842, Am. Philos. Soc. Trans., v. 8, p. 226, pl. 20, fig. 45; 1842, Observer, v. III, p. 64, pl. 20, fig. 45.

Anodonta grandis Call 1900, Moll. Ind., p. 531, pl. 77.

Anodonta footiana Call 1900, *ibid.*, p. 535.

Anodonta grandis Dall 1905, Harriman-Alaska Exped., v. 13, p. 129.

Anodonta grandis footiana Dall 1905, *ibid.*

Anodonta grandis Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 394.

Anodonta grandis footiana Sterki 1907, *ibid.*

FIGURE 73.–Distribution of *Anodonta imbecillis* in North America; *inset*, distribution in Ohio.

Anodonta grandis benedictensis Sterki 1907, *ibid.*
Anodonta grandis plana Sterki 1907, *ibid.*
Anodonta grandis salmonia Sterki 1907, *ibid.*
Anodonta kennicottii Sterki 1907, *ibid.*, p. 395.
Anodonta grandis decora Sterki 1907, *ibid*, p. 394.
Anodonta grandis Simpson 1914, Descr. cat. Naiades, p. 418.
Anodonta grandis footiana Simpson 1914, *ibid.*, p. 422.
Anodonta grandis benedictensis Simpson 1914, *ibid.*, p. 423.
Anodonta grandis Ortmann 1919, Najades Pa., p. 138, pl. 10, figs. 1, 2.
Anodonta grandis footiana Ortmann 1919, *ibid.*, p. 147, pl. 10, figs. 3, 4.
Anodonta grandis F. C. Baker 1920, Life of Pleistocene, p. 383.
Anodonta grandis footiana F. C. Baker 1920, *ibid.*
Anodonta marginata F. C. Baker 1920, *ibid.*

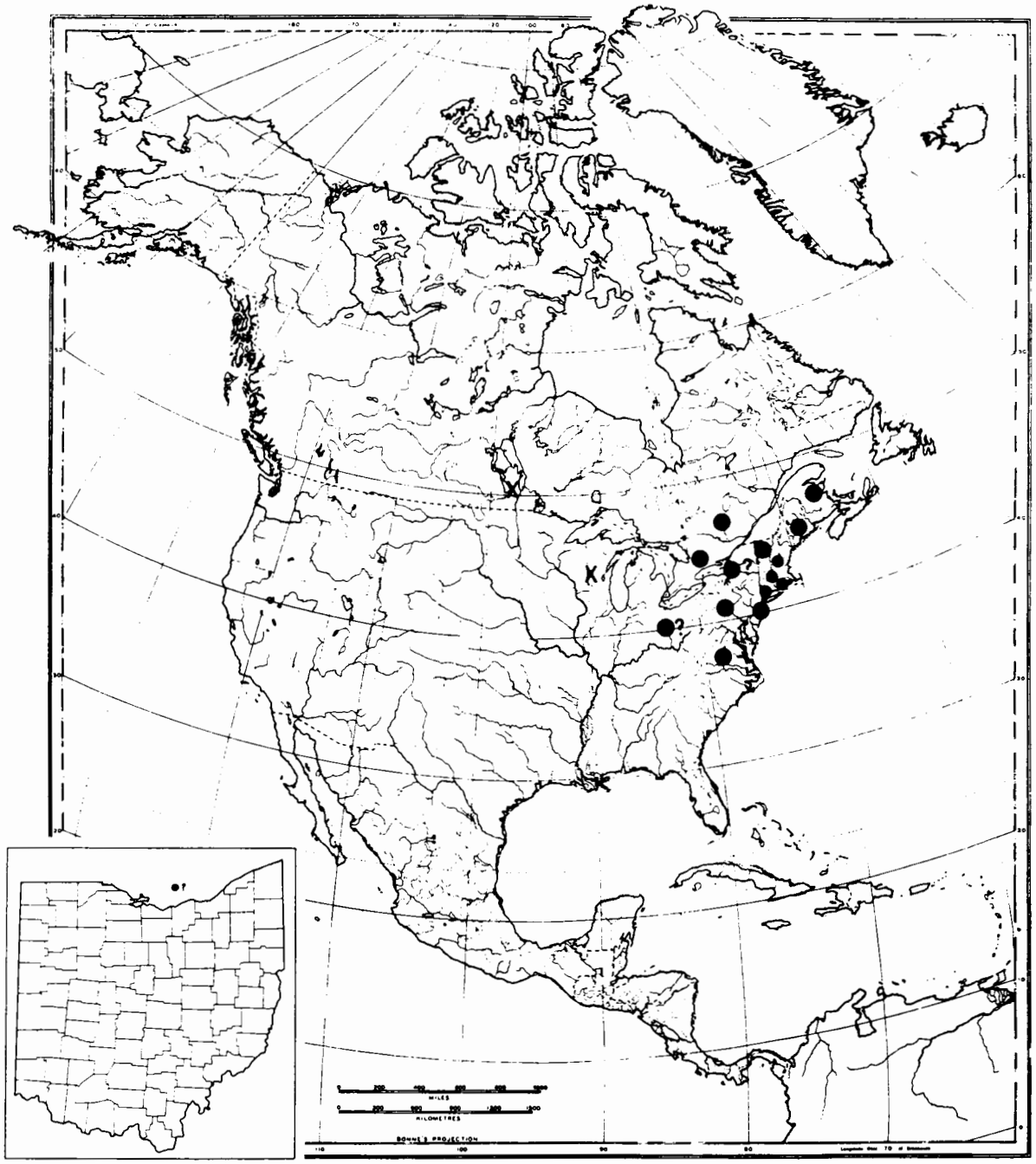


FIGURE 74.–Distribution of *Anodonta implicata* in North America; *inset*, distribution in Ohio.

Anodonta grandis plana F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 155, pl. 60, fig. 5; pl. 61, figs. 3-6.
Anodonta grandis La Rocque 1953, Cat. Recent Moll. Canada, p. 87.
Anodonta grandis footiana La Rocque 1953, *ibid.*, p. 88.
Anodonta grandis benedictensis La Rocque 1953, *ibid.*, p. 87.
? *Anodonta kennicotti* La Rocque 1953, *ibid.*, p. 88 (part?).
Anodonta (Anodonta) grandis Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 36, fig. 38.
Anodonta marginata Zimmerman 1960, Ohio Jour. Sci., v. 60, p. 20.
--- --- La Rocque 1960, Internat. Geol. Cong., pt. 4, p. 136.
? *Anodonta (Pyganodonta) grandis* D. W. Taylor 1960, U.S. Geol. Survey Prof. Paper 337, p. 45.
Anodonta (Pyganodonta) grandis Hibbard and Taylor 1960, Mich. Univ. Mus. Paleontology Contr., v. 16, no. 1, p. 73.

Type locality.—Fox River of the Wabash, Indiana.

Diagnosis.—"Thin, fragile, very much swollen and having a slight wing along the posterior hinge line; yellow to brown and nearly black. Beak sculpture consists of loops or folds that are raised into more or less conspicuous nodes or pustules. Young shells smooth and shining, old ones usually roughened and dark, frequently eroded. Length 165, height 92, breadth 60 mm." (Goodrich, 1932).

Ecology.—This species thrives especially well in quiet water, whether in slow streams or lakes. It prefers soft bottom, such as mud or sand or a mixture of both, in water a few centimeters to 2 m. deep. F. C. Baker (1928a, pt. II, p. 156) gave the following particulars for *A. grandis plana*, a minor form not recognized in this report: it is a variety of small streams where it occurs in quieter places on sand or mud bottom, seldom by choice occupying shallow water where there are riffles on gravel bottom or coarse sand bottom. It is not found in the large rivers. It may be found in water as deep as one meter. The same author (Baker, 1928a, pt. II, p. 158) noted that the form *footiana* occurs at the type locality on rock bottom, in 0.3 m. of water; elsewhere in Wisconsin in 0.2-2 m. of water, on sand, gravel, sandy clay, sand, sand and mud, and on hard sandy clay with *Chara*. He states that *A. grandis footiana* is a lake manifestation of *A. grandis*, modified to fit the environment of the rough waters of a lake. The form called *A. grandis decora* by Sterki (1907a, p. 394) was collected in small rivers and creeks but also occurred in the Miami canal in Ohio. Depauperate forms of *A. grandis* have been called *A. grandis benedictensis*. In lakes with low pH, elongate, thin-shelled forms of *A. grandis* have been called *A. marginata*. The form *A. pepiniana* was named from specimens collected in a small lake, Lake Pepin, in Portage County, Ohio; according to Clarke and Berg (1959, p. 38) it is probably an ecological form or a local race below the level of the subspecies.

Associations.—Living: MANITOBA-36, 38; MICHIGAN-41, 42, 43, 44, 45, 48, 49, 50, 51, 52, 53, 54, 55, 61, 68; MINNESOTA-15; NEW YORK-3a, 5c, 14, 17, 20, 23, 24, 29, 40b; OHIO-43; ONTARIO-1; QUEBEC-5; fossil: N-1?, S-6? *"footiana:"* WISCONSIN-1, 2, 7, 16, 22, 25, 42, 53, 56, 79, 82, 85, 89, 119, 123; *"plana:"* WISCONSIN-14, 17, 27, 49, 54, 58, 60, 77, 81, 83, 86, 93, 96, 100, 105, 106, 117, 120, 122, 127, 130, 131, 132.

As *Anodonta marginata:* Living: MINNESOTA-15, 18; NEW YORK-14, 24, 31, 35, 40b; QUEBEC-1, 3, 4, 7; WISCONSIN-1, 2, 7, 8, 9, 12, 14, 16, 19, 20, 22, 23, 27, 28, 33, 34, 41, 42, 44, 47, 49, 51, 53, 54, 55, 56, 58, 59, 60, 62, 68, 75, 78, 79, 80, 81, 82, 83, 87, 89, 93, 95, 96, 105, 106, 116, 117, 120, 121, 123, 124, 127, 128, 130. Fossil: W-45, 46, 47.

General distribution (fig. 71).—Mississippi drainage; St. Lawrence drainage, including the Great Lakes; Red River of the North; Lake Winnipeg; south to Texas. If *A. kennicottii* proves to be a synonym, the range should also include the Mackenzie drainage.

Distribution in Ohio (inset, fig. 71).—Sterki (1907a, p. 394) gave "over the state, very variable," for the typical form. Ortmann (1919) is more specific; creek in Huron County; Ten Mile Creek, Miami and Erie Canal, Maumee River, all in Lucas County; St. Marys

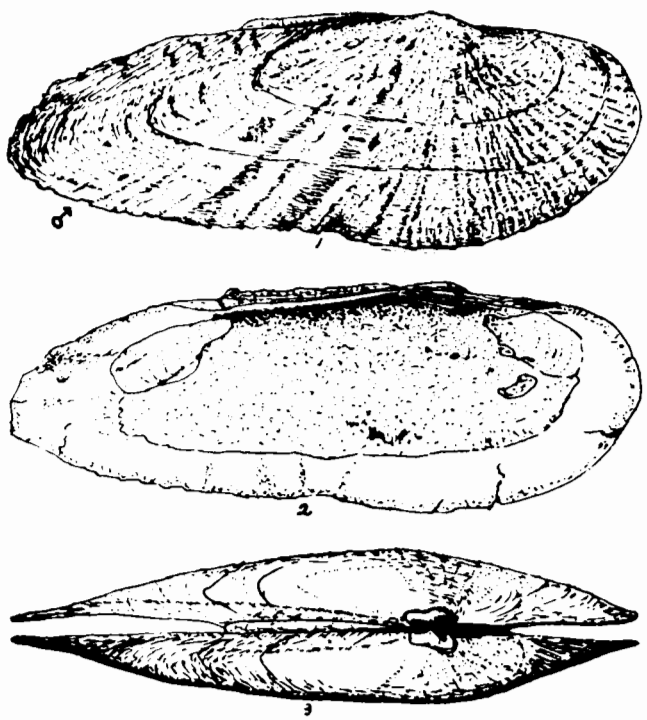


FIGURE 75.—*Lastena lata*, three views, X1; after Call (1900, pl. 68).

River, Mercer County; Beaver Creek, Williams County; Conotton Creek, Carroll County; Tuscarawas River; Wolfe Creek, Washington County; Redfield, Perry County; Scioto River, Hardin County; Lewistown Reservoir, Logan County; Wabash River, Mercer County. Sterki (1907a, p. 394) recorded the form *footiana* for Springfield Lake, Summit County; Ortmann (1919) cites it from Lake Erie; Cedar Creek, marsh north of Toledo, Miami and Erie Canal, and Maumee River, all in Lucas County; Grand Reservoir, Mercer County; Silver Lake, Clark County. Sterki (1907a, p. 394) cited form *benedictensis* from Rocky River and Lake Erie; form *plana* for the Scioto River, Columbus; Miami Canal; Ohio Canal at Canal Winchester; Sandusky River; also, under the name *salmonea* for Tuscarawas River and Ohio Canal; upper Cuyahoga River, at Hiram; Pymatuning River, Ashtabula County; Silver Lake, Clark County; Olentangy River; form *decora* from Mahoning River;

FIGURE 76.–Distribution of *Lastena lata* in North America; *inset*, distribution in Ohio.

Silas Creek, Portage County; Columbus, Franklin County; Little Miami River; Miami Canal; Little Stillwater Creek near Dennison.

Geologic range.—The typical form and form *footiana* are cited by Baker (1920a, p. 383) for Sangamon to present; *Anodonta marginata* is recorded for Sangamon and "Wabash" beds. There seems to be no older record save a doubtful one by D. W. Taylor (1960, p. 45) for the Sand Draw local fauna (Nebraskan) of Nebraska.

Remarks.—Species of the genus *Anodonta* are notoriously difficult to identify. As in many other genera with a multiplicity of species whose characteristics are not clear, it is permissible to suspect that undue splitting has obscured true relationships. In the case of the *Anodonta grandis* complex, the suspicion has become almost a certainty in recent years. That is why I have been led in this report to reduce to synonymy taxa which I considered, if not valid, at least worthy of listing some ten years ago (La Rocque, 1953, p. 87-89). A brief review of the history of the *A. grandis* complex may help explain the adoption of this view.

Broadly speaking, the tendency in the nineteenth century was to describe as a new species any group of specimens, or even a single specimen, which could be characterized by some peculiarity. During the first third of the twentieth century many of these so-called species were reduced to synonymy and others were considered as varieties or subspecies of a relatively small number of accepted species. Some difficulties still remained, for assignment of a given specimen of *A. grandis* to a variety was still not easily feasible and specimens of *A. marginata* were not always clearly separable from those of *A. grandis*. During the second third of this century, van der Schalie (1938, p. 52), after critically examining Michigan material, showed that specimens of *A. grandis*, *A. grandis footiana*, and *A. marginata* from that state were extreme variants of an intergrading series. He expressed grave doubts on the specific validity of *A. marginata* and on the advisability of using the subspecific names in *A. grandis*. Clarke and Berg (1959, p. 37-38) present data which strongly suggest that all named forms from Ohio, with the possible exception of *A. implicata*, whose occurrence in Ohio is doubtful at best, may be grouped under *A. grandis* and *A. imbecillis*.

There remains little doubt that *A. footiana*, *A. benedictensis*, *A. plana*, *A. decora*, and *A. pepiniana* should be listed as synonyms of *A. grandis*. In two other cases, *A. kennicottii* and *A. marginata*, it is possible that the species may prove recognizable elsewhere but it is almost certain that the forms listed under these names from Ohio are merely variants of *A. grandis* unworthy of recognition even as subspecies. If such lumping should seem unusually drastic the alternative seems no more inviting. Recognition of a multiplicity of forms or "subspecies" would not clarify the situation to any extent because of intergradation between the several groups.

Anodonta imbecillis Say 1829
Fig. 72

Anodonta imbecillis Say 1829, New Harmony Disseminator, v. 2, no. 23, p. 355.
--- --- Call 1900, Moll. Ind., p. 527, pl. 73.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 395.
--- --- Simpson 1914, Descr. cat. Naiades, p. 395.
Anodonta ohioensis Ortmann 1919, Najades Pa., p. 162, pl. 11, fig. 4.
Anodonta imbecillis F. C. Baker 1920, Life of Pleistocene, p. 383.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 37.
Utterbackia imbecillis F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 172, pl. 68, figs. 6-8.
Anodonta imbecillis Goodrich 1932, Moll. Mich., p. 93, pl. 2, fig. 2.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 150.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 311.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 88.
Anodonta (Utterbackia) imbecilis Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 41, fig. 40.

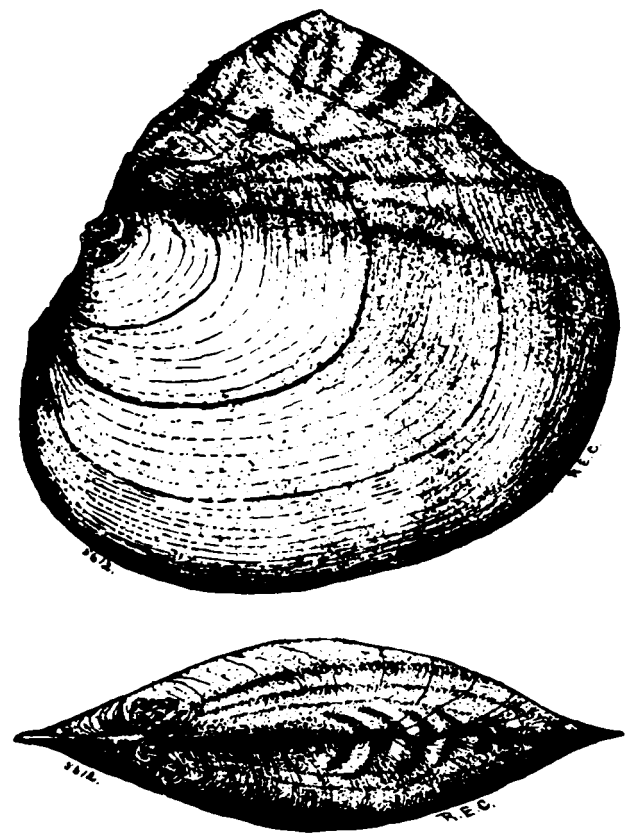


FIGURE 77.—*Lasmigona complanata*, two views, X1; after Call (1900, pl. 71).

Type locality.—Wabash River (probably in Indiana).

Diagnosis.—"Very thin, fragile, much longer than high, usually very smooth and of a shining yellow color. Beak sculpture is made up of a number of fine, irregular folds, the beaks being flattened to the rounded surface of the shell. Interior white, bluish, or purple, entirely without teeth .... Length 80, height 34, breadth 24 mm." (Goodrich, 1932, p. 93).

Ecology.—"Small rivers and ponds in shallow, quiet water along shore on a fine sand or mud bottom (Wisconsin, Fox River; Illinois, Vermilion River). Ecology of the Mississippi River form not specifically stated" (F. C. Baker, 1928a, pt. II, p. 174). In Michigan this species has been recorded for a variety of habitats in the Huron River drainage: small river (49), river of fairly large size (51), large river (52), impounded waters above artificial dams (53), and "lower river" or outlet area, near Lake Erie. In Wisconsin, it

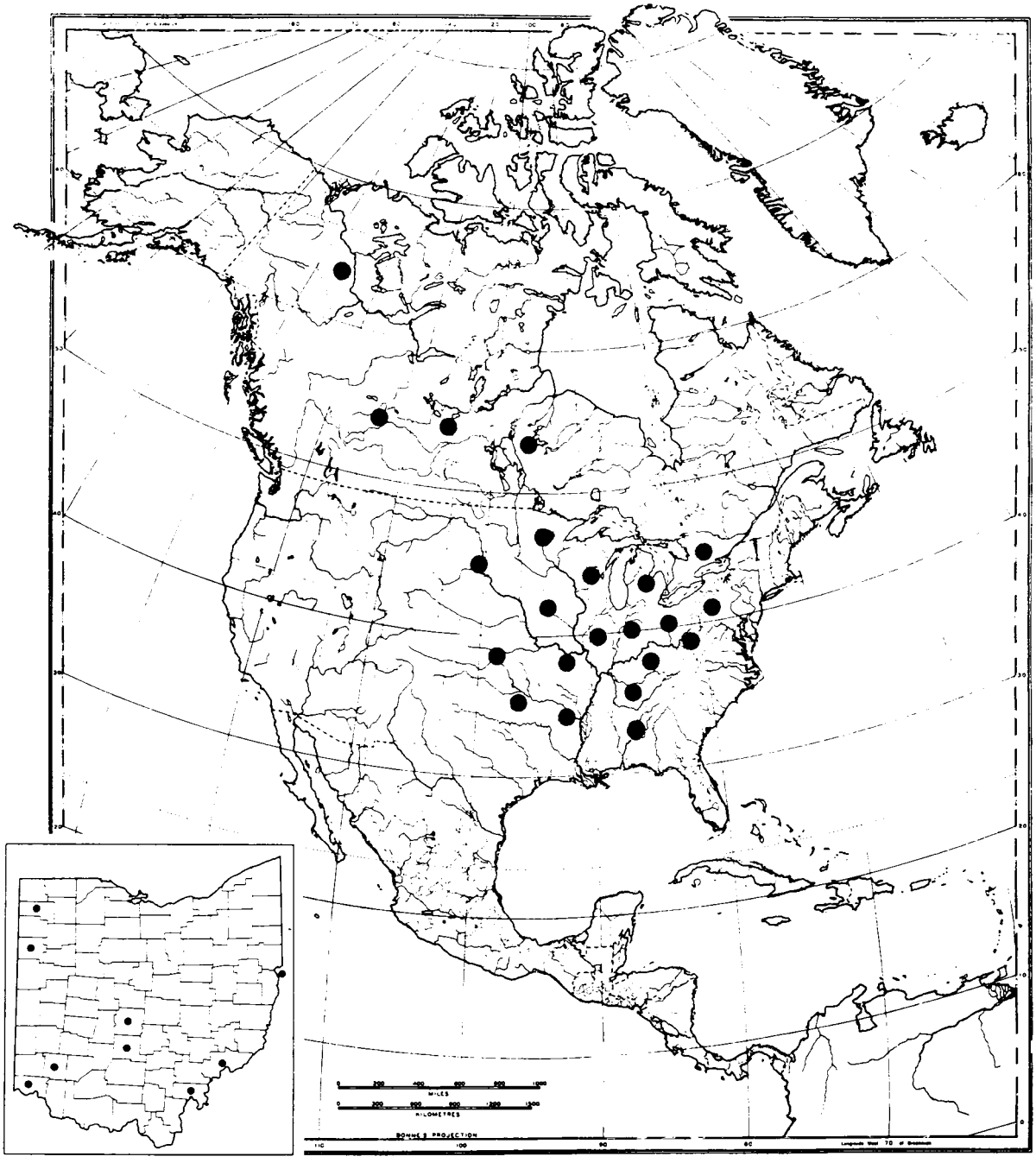


FIGURE 78.—Distribution of *Lasmigona complanata* in North America; *inset,* distribution in Ohio.

is recorded for streams (59, Manitowish River; 83, Turtle River) and a lake inlet (87, inlet of White Sand Lake).

Associations.—Living: MICHIGAN-49, 51, 52, 53, 54; OHIO-43; WISCONSIN-58, 83, 87.

General distribution (fig. 73).—Lake Erie; southern Michigan; North Carolina to Georgia, southwest to Mexico; Mississippi drainage.

Distribution in Ohio (inset, fig. 73).—Sterki (1907a, p. 395) gives "over the state, common, in all kinds of waters." Ortmann (1919) gives Miami and Erie Canal, Lucas County; Tuscarawas River; Scioto River, Franklin County.

Geologic range.—Recorded for beds of Aftonian age (Baker, 1920a, p. 383) but not so far recorded for younger Pleistocene deposits, so far as I know.

[*Anodonta implicata* Say 1829]

Anodonta implicata Say 1829, New Harmony Disseminator, v. 2, no. 22, p. 340.
--- --- Dall 1905, Harriman-Alaska Exped., v. 13, p. 129.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 395; not seen by Sterki from Ohio.
--- --- Simpson 1914, Descr. cat. Naiades, p. 391.
--- --- Johnson 1915, Fauna New England, p. 24.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 88.
Anodonta (Anodonta) implicata Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 40, fig. 42.

Type locality.—Danvers, Massachusetts.

Ecology.—The species is recorded for a number of stations in Oneida Lake in both protected and exposed situations, in water 6 inches to 4 feet in depth, and washed in from deeper water. It occurs on sandy or boulder bottom, with or without vegetation. It seems to tolerate sandy-silty bottom conditions (NEW YORK-24) but is not recorded on mud bottom.

Associations.—Living: NEW YORK-3a, 17, 22, 23, 24, 26, 30, 35, 40b; WISCONSIN-7.

General distribution (fig. 74).—Atlantic drainage, from Virginia northward; St. Lawrence drainage. Clarke and Berg (1959, p. 41) consider the Saskatchewan Basin record erroneous and all New York State records doubtful.

Distribution in Ohio (inset, fig. 74).—Sterki (1907a, p. 395) has seen no specimens of this St. Lawrence drainage species.

Geologic range.—None known to me.

Remarks.—The general distribution given above implies the possibility of the presence of this species in Ohio but so far there are no definite records. It is more likely that the Ohio record is based on a misidentification.

Genus *Lastena* Rafinesque 1820

Lastena Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 316 (*fide* Neave).
Lastena Walker 1918, Synopsis and cat. fresh-water Moll., p. 53.

Type.—*Anodonta (Lastena) lata* Rafinesque.

Diagnosis.—Shell elongate, subsolid, inequilateral, generally wider in front, rounded and truncate at the anterior base, pointed at the postbasal region, and having a low posterior ridge with one or more secondary ridges above it; beaks low, sculptured with a few coarse irregular longitudinal folds; epidermis shining, commonly rayed; a single imperfect tooth in each valve and in some cases vestiges of laterals; nacre purplish, shading to blue at the edge; pallial line radially ridged.

Lastena lata (Rafinesque) 1820
Fig. 75

Anodonta (Lastena) lata Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 317, pl. 82, figs. 17, 18.
Anodonta debiscens Call 1900, Moll. Ind., p. 533, pl. 68, figs. 1-3.
Lastena lata Simpson 1914, Descr. cat. Naiades, p. 453.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 32.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 308.

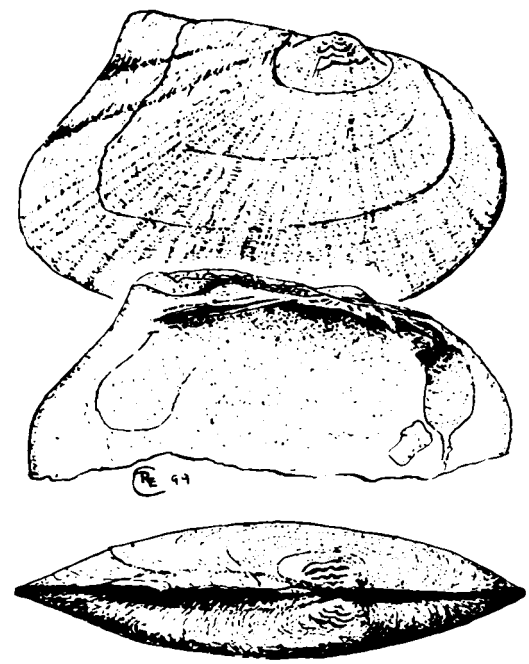


FIGURE 79.—*Lasmigona compressa,* three views, X1; after Call (1900, pl. 71).

Type locality.—Kentucky River.

Diagnosis.—"Shell elongated, subrhomboid, subsolid, compressed, inequilateral; beaks low and compressed but pointed, sculptured with a few strong ridges, which run nearly parallel with the dorsal margin; posterior ridge low, but often angled, usually ending behind in a point near the base of the shell, but sometimes the hinder part of the shell is much attenuated; above the posterior ridge there is generally a radial shallow furrow; surface with uneven growth lines, sometimes nearly smooth in front of the post-ridge; epidermis brownish-green, smoky, commonly having scattered, wide and narrow, broken rays; hinge often edentulous, sometimes with a feeble, smooth, compressed tooth or ridge; muscle scars confluent, the posterior ones elongated; nacre pale blue or purplish,

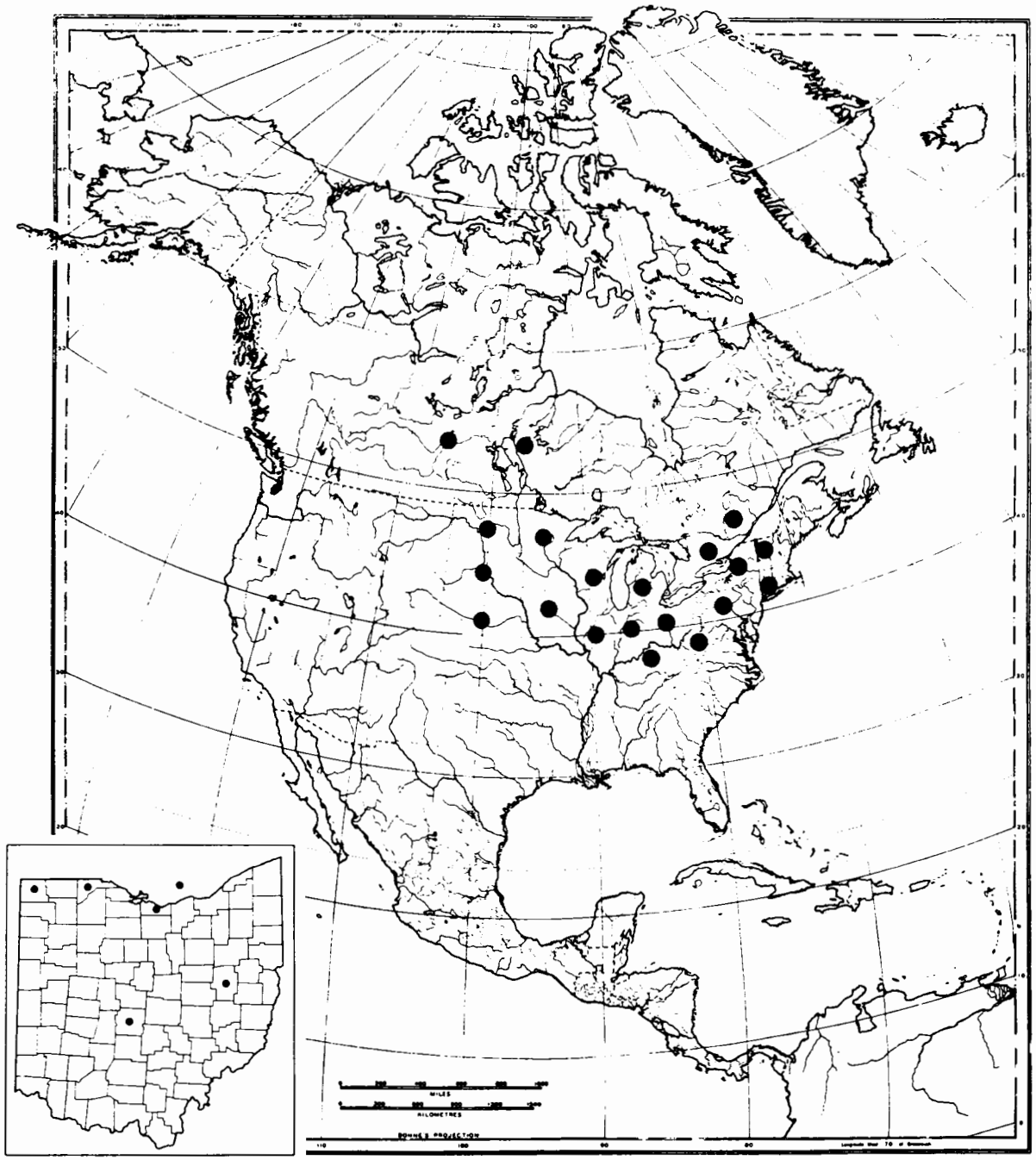


FIGURE 80.—Distribution of *Lasmigona compressa* in North America; *inset,* distribution in Ohio.

the cavities darker; pallial line showing a small, posterior sinus. Length 88, height 30, diam. 16 mm." (Simpson, 1914, p. 453).

Ecology.—A species of medium-sized rivers in the Ohio River drainage, but apparently not in the Ohio itself. Sterki (1907a, p. 393) records it for the small streams of Tuscarawas County, Ohio.

Associations.—Living: OHIO-43.

General distribution (fig. 76).—Ohio, Cumberland, and Tennessee River systems.

Distribution in Ohio (inset, fig. 76).—Sterki (1907a, p. 393) gives "Ohio drainage, not common." It does not appear to range up the Ohio River into Pennsylvania, as it is not mentioned by Ortmann (1919).

Geologic range.—Unknown.

Remarks.—Sterki's record (1907a) is unsatisfactory, as it is too general. It is probable that this species, which I have not seen from Ohio, is restricted to a few of the tributaries of the Ohio in the State. The Eggleston records make no mention of this species in Ohio.

Genus *Lasmigona* Rafinesque 1831

Lasmigona Rafinesque 1831, Continuation Mon. Shells Ohio, p. 4 (*fide* Neave).
Lasmigona Walker 1918, Synopsis and cat. fresh-water Moll., p. 59.
Lasmigona Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 33.
Lasmigona F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 138.
Lasmigona La Rocque 1953, Cat. Recent Moll. Canada, p. 94.

Type.—*Alasmidonta costata* Rafinesque.

Diagnosis.—Shell elliptic-rhomboid, compressed; beaks low, their sculpture consisting of strong bars; one pseudocardinal in the right valve and two in the left, the hinder somewhat inverted-V shaped, cutting off the hinge plate in the right valve; laterals generally imperfect.

Remarks.—The subgenera are given by Ortmann and Walker (1922) and the species occurring in Ohio have been assigned to subgenera according to these authors' system.

Lasmigona (Pterosyna) complanata (Barnes) 1823
Fig. 77

Alasmodonta complanata Barnes 1823, Am. Jour. Sci., v. 6, p. 278, pl. 13, fig. 21.
Margaritana complanata Call 1900, Moll. Ind., p. 522, pl. 71.
Symphynota complanata Dall 1905, Harriman-Alaska Exped., v. 13, p. 131.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 393.
--- --- Simpson 1914, Descr. cat. Naiades, p. 490.
Lasmigona (Pterosyna) complanata Ortmann 1919, Najades Pa., p. 133, pl. 9, fig. 7.
--- (---) --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 33.
Lasmigona complanata F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 147, pl. 40, figs. 1, 2.
--- --- Goodrich 1932, Moll. Mich., p. 96.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 54.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 312.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 94.

Type locality.—Fox River, Wisconsin.

Diagnosis.—Shell elliptical, compressed, mahogany brown; disk roughened only by growth lines; two poorly defined ridges extend from the beaks to the posterior edge and on the posterior slope near the beaks are three or four low folds; beaks not very high, sculptured by 2 or 3 small ridges that are more or less W-shaped; interior pearly white, with two slanting pseudocardinals in one valve and one in the other; lateral teeth broad, low, and not very long; beak cavities shallow; anterior muscle scars broad, deep; posterior scars scarcely showing against the pearly nacre; L. 130, H. 100, D. 32 mm. (modified from Goodrich, 1932, p. 96).

Ecology.—This species lives on mud bottom in quiet water, a few centimeters to a meter deep. It seems to have no preference as to size of stream, living in both large and small rivers and in creeks. It is rarely found in sand or in fine gravel. In Missouri, it is very common and grows to large size in oxbow lakes but is not found at all in the clear, swift-water streams of southern Missouri. Van der Schalie (1938) did not find it in lakes of the Huron River drainage in Michigan but collected it in the river itself, on fine sand

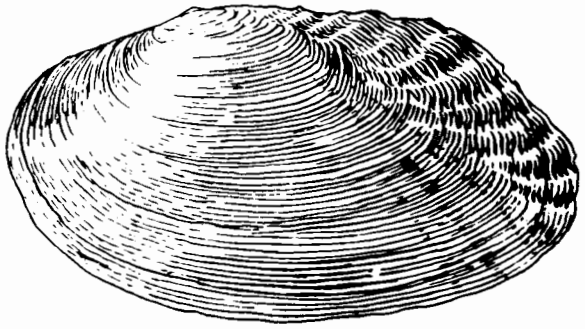


FIGURE 81.—*Lasmigona costata*, exterior of right valve, X1; after Goodrich (1932, pl. 4, fig. 2).

bottom in rather deep water with sluggish current.

Associations.—Living: MICHIGAN - 52, 53, 67; OHIO - 43; WISCONSIN - 121, 127, 130, 131, 132. Variety *katherinae:* Living: MANITOBA - 36, 38.

General distribution (fig. 78).—Pennsylvania and Ohio west to Iowa and Arkansas, south to Alabama, and north to Lake Winnipeg and the Nelson River in Manitoba. It is well established in parts of the Hudson Bay drainage, the Mississippi drainage, and the upper St. Lawrence and its tributaries, and ranges northward into the Mackenzie River. The Detroit River record is doubtful.

Distribution in Ohio (inset, fig. 78).—Sterki (1907a, p. 393) gives "over the state, in rivers, creeks, canals, lakes." Ortmann (1919) gives Ohio River in Meigs County; and Wolfe Creek, Washington County.

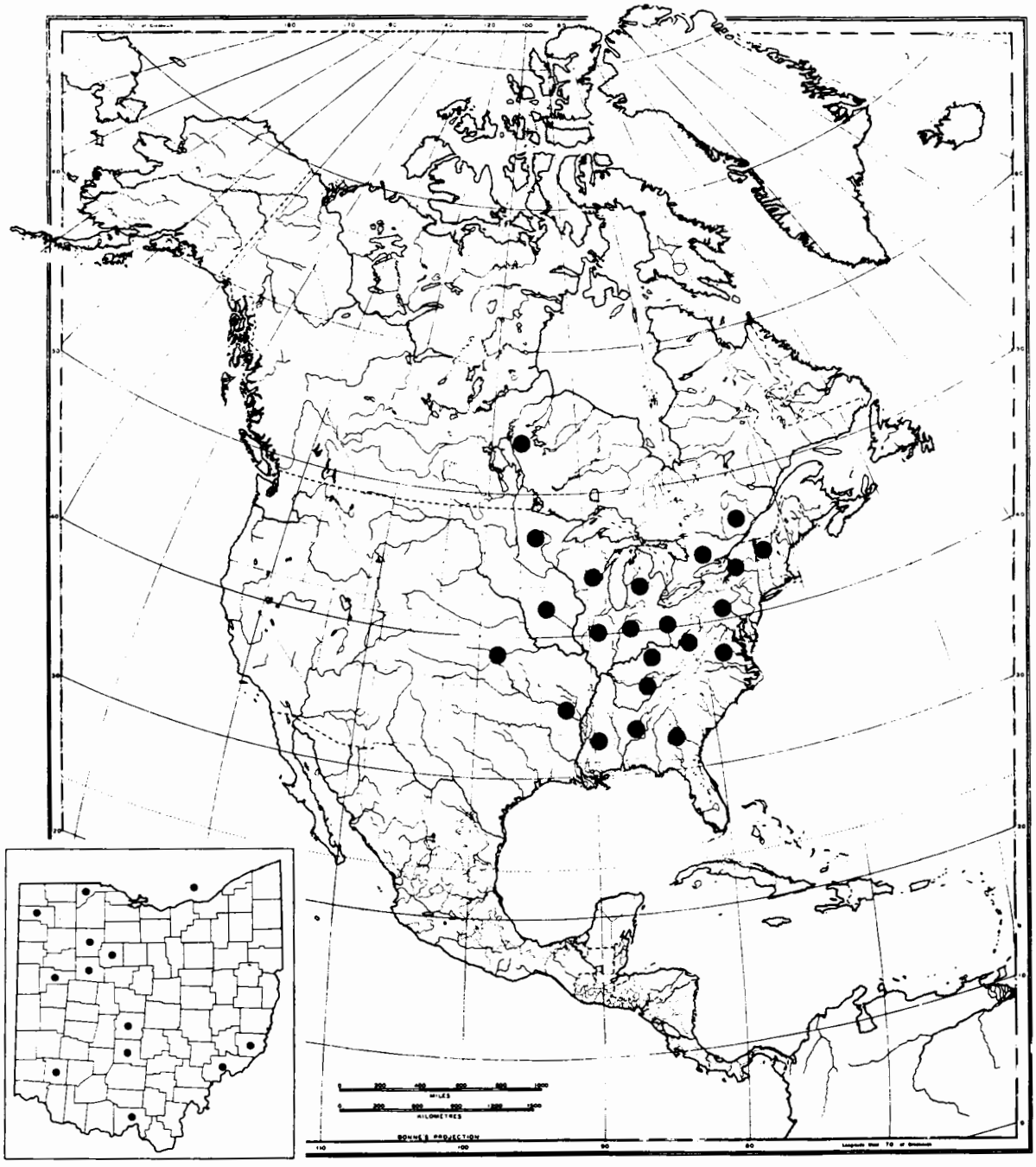


FIGURE 82.—Distribution of *Lasmigona costata* in North America; *inset,* distribution in Ohio.

Geologic range.—Unknown.

Remarks.—The variety *katherinae* (Lea) is recognized by F. C. Baker but it does not range into Ohio.

Lasmigona (Platynaias) compressa (Lea) 1829
Fig. 79

Symphynota compressa Lea 1829, Am. Philos. Soc. Trans., v. 3, p. 450, pl. 12, fig. 22; 1834, Observer, v. I, p. 64, pl. 12, fig. 22.
Unio pressus Lea 1843, Am. Philos. Soc. Proc., v. 2, p. 237.
--- --- Call 1900, Moll. Ind., p. 459, pl. 24.
Symphynota compressa Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 393.
--- --- Simpson 1914, Descr. cat. Naiades, p. 481.
--- --- Johnson 1915, Fauna New England, p. 25.
Lasmigona (Platynaias) viridis Ortmann 1919, Naj-

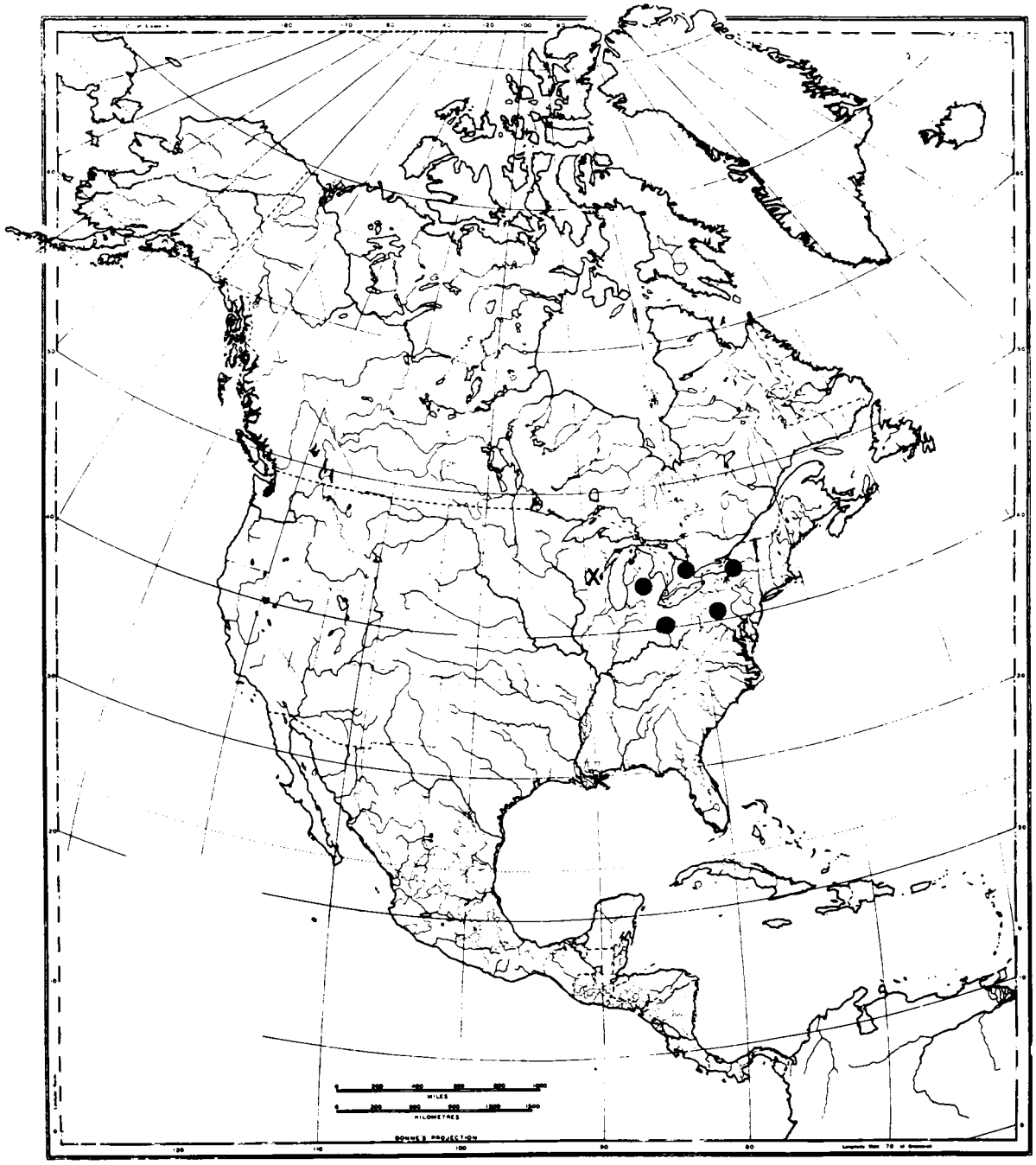


FIGURE 83.—Distribution of *Lasmigona costata eriganensis* in North America.

ades Pa., p. 116, pl. 9, figs. 1, 2.
Lasmigona compressa F. C. Baker 1920, Life of Pleistocene, p. 383.
Lasmigona (Platynaias) compressa Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 34.
Lasmigona compressa F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 139, pl. 58, figs. 1-4.
--- --- Goodrich 1932, Moll. Mich., p. 96.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 53.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 312.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 98, pl. 11, fig. 12.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 94.
--- --- Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 31, fig. 29.

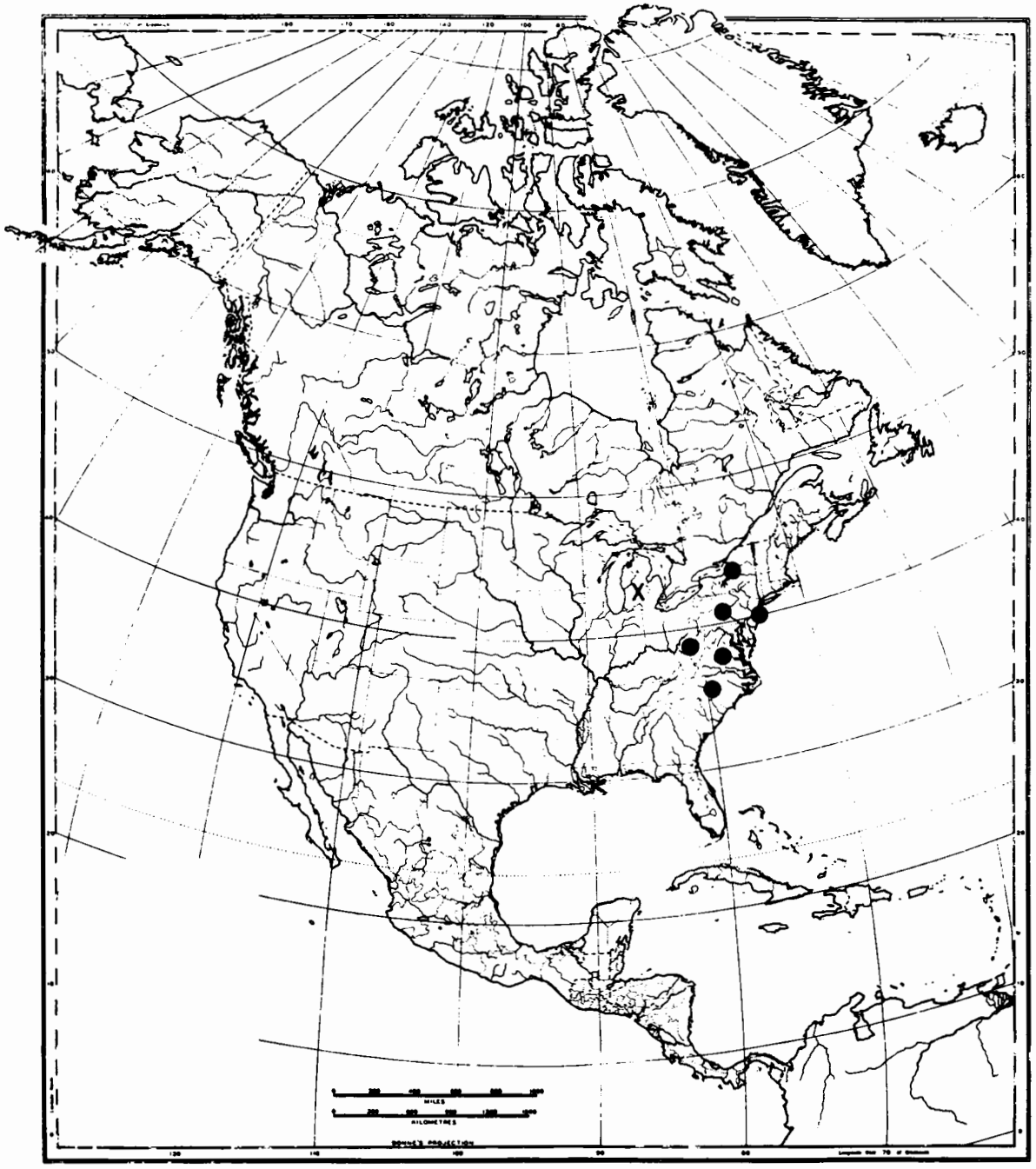


FIGURE 84.–Distribution of *Lasmigona subviridis* in North America.

Type locality.—Ohio, and Norman's Kill, Albany, New York (Lea).

Diagnosis.—Shell elongate-oval, commonly thin, dark green and marked with radiating waving lines or bands of yellow; hinge line straight, base rounded, anterior end rounded and posterior end subangulate; posterior slope with two incised lines extending from beaks to edge of shell; beaks low, sculptured with five wavy ridges; interior white, pseudocardinals high, slanting, nearly parallel with the hinge line; laterals inconspicuous; beak cavity shallow, pitted; anterior muscle scars well marked; pallial line bluish, not channelled; L. 80, H. 48, D. 24 mm. (modified from Goodrich, 1932, p. 96).

Ecology.—A species partial to creeks and small streams, spreading far up into the headwaters of rivers. It prefers quiet water in fine gravel, sand, or mud. It is not usually found in riffles, but below them in small pools, 1-3 feet deep, on fine sand or mud bottom. More rarely it lives on gravel bottom, in swift current, water 1-2 feet deep.

Associations.—Living: MICHIGAN - 46, 47, 48, 49, 50, 55, 66; OHIO - 43; ONTARIO - 4; WISCONSIN - 7, 14, 17, 27, 58, 76, 81, 82, 83, 87, 108, 120, 123, 130, 131.

General distribution (fig. 80).—Hudson Bay drainage; St. Lawrence drainage; Ohio River drainage; west to Saskatchewan, Nebraska, eastern Iowa, and Wisconsin; Hudson River, New York.

Distribution in Ohio (inset, fig. 80).—Sterki (1907a, p. 393) gives only "over the state." Ortmann (1919) adds Lake Erie at Cedar Point, Erie County; Tenmile Creek, Lucas County; Beaver Creek, Williams County; and Tuscarawas River, Tuscarawas County.

Geologic range.—F. C. Baker (1920a, p. 383) records this species only for late Wisconsin ("Wabash") beds.

Remarks.—The species is not easily confused with any other within the genus, except possibly *L. costata,* which has a far heavier hinge without distinct laterals. The laterals are always present in *L. compressa.*

Lasmigona (Lasmigona) costata (Rafinesque) 1820
Fig. 81

Alasmidonta costata Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 318, pl. 82, figs. 15, 16.
Margaritana rugosa Call 1900, Moll. Ind., p. 524, pl. 72.
Symphynota costata Dall 1905, Harriman-Alaska Exped., v. 13, p. 131.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 393.
--- --- Simpson 1914, Descr. cat. Naiades, p. 488.
--- --- Johnson 1915, Fauna New England, p. 26.
Lasmigona (Lasmigona) costata Ortmann 1919, Najades Pa., p. 125, pl. 9, fig. 5.
Lasmigona costata F. C. Baker 1920, Life of Pleistocene, p. 383.
Lasmigona (Lasmigona) costata Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 36.
Lasmigona costata F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 141, pl. 58, figs. 5, 6; pl. 59, fig. 7.
--- --- Goodrich 1932, Moll. Mich., p. 97, pl. 4, fig. 2.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 54.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 312.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 98.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 94.
--- --- Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 33, fig. 59.

Type locality.—Kentucky River.

Diagnosis.—Shell thick, not quite twice as long as it is high, rounded anteriorly, angled posteriorly; beaks low, ornamented with a few rough folds; epidermis green to dark brown, in many cases rayed in young specimens; posterior slope with a number of distinct folds or undulations; pseudocardinals, one in each

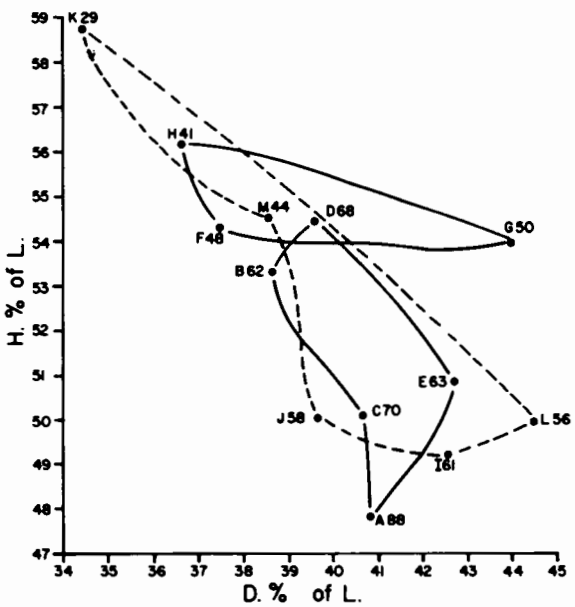


FIGURE 85.—Comparison of three forms of the genus *Anodontoides* based on Baker's (1928a, pt. II) measurements. A-E, *A. ferussacianus* (Lea), typical form; F-H, *A. ferussacianus subcylindraceus* (Lea); I-M, *A. birgei* F. C. Baker. Figures next to each letter indicate length of specimen in millimeters.

valve; lateral teeth reduced to a striate, ridgelike thickening of the top of each valve; nacre yellow, in some specimens orange; L. 142, H. 87, D. 37 mm. (modified from Goodrich, 1932, p. 97).

Ecology.—Found in large as well as in small rivers. It prefers gravel in riffles, but is also found in sand and fine gravel in quiet waters, rarely in mud. Van der Schalie (1938, p. 54) found it mainly on sand and gravel bottom, and in situations where there is a noticeable current.

Associations.—Living: MICHIGAN-50, 51, 52, 54, 55, 56, 57, 65; OHIO-43; ONTARIO-5, 10; WISCONSIN-7, 27, 58, 76, 80, 81, 83, 87, 108, 120, 121, 122, 127, 131, 132.

General distribution (fig. 82).—Mississippi and St. Lawrence basins; Manitoba; Vermont and New York westward to Iowa, southward to Alabama and Mississippi, and northward to Manitoba, and the Ottawa River and its tributaries in Ontario and Quebec.

Distribution in Ohio (inset, fig. 82).—Sterki (1907a, p. 393) gives "over the state; the Lake Erie form is quite small and of somewhat different shape." Ortmann (1919) treated the Lake Erie form as a separate variety and gave the following for the type form: Sandusky River, Wyandot County; Miami and Erie Canal, Lucas and Defiance Counties; St. Marys River, Monroe County; Ohio River, Scioto County; Wolfe Creek, Washington County; Scioto River, Hardin County.

Geologic range.—Recorded by F. C. Baker (1920a, p. 383) only for late Wisconsin ("Wabash") beds.

Variation.—Grier (1918) has described the variety *eriganensis,* discussed below, from Lake Erie. Baker (1928a, pt. II, p. 144, 145) has added two varieties, *L. costata pepinensis* and *L. costata nuda,* which have not been recorded for Ohio.

Lasmigona (Lasmigona) costata eriganensis Grier 1918

Lasmigona costata var. *ereganensis (err. typ.)* Grier 1918, Nautilus, v. 32, p. 10.
Lasmigona (Lasmigona) costata eriganensis Ortmann 1919, Najades Pa., p. 131, pl. 9, fig. 6.
Lasmigona costata eriganensis La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 99.
--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 94.

Type locality.—Lake Erie.

Diagnosis.—This form is "smaller, less elongated and proportionately lower than *costata.* Ventral line straight. Epidermis in *costata* light horn-color to dark chestnut in old specimens, surface usually with uneven growth lines. In *eriganensis* always smooth or polished, greenish olive to reddish brown to chocolate-brown, even growth lines. Nacre in *costata* cream-color to lavender or blue. In variety *eriganensis,* pinkish, buff or salmon-color" (Grier, 1918, p. 10).

Ecology.—This is the small Great Lakes form of the species.

General distribution (fig. 83).—Lakes St. Clair and Erie; Niagara River and its tributaries.

Distribution in Ohio.—Ortmann (1919) gives Lake Erie for this variety or form.

Geologic range.—Unknown.

Remarks.—This variety is noted here, as its name is primarily applied to the Lake Erie form. So far it has not turned up in Pleistocene deposits, but, if it does, measurements of fossil specimens should be carefully compared with those given by Grier.

[*Lasmigona (Platynaias) subviridis* (Conrad) 1835]

Unio viridis or *subviridis* Conrad 1835, New freshwater shells U.S., app., pl. 9, fig. 1.
Symphynota viridis Simpson 1914, Descr. cat. Naiades, p. 484.
Lasmigona (Platynaias) subviridis Ortmann 1919, Najades Pa., p. 121, pl. 9, figs. 3, 4.
--- (---) --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 35.
--- (---) --- Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 32, fig. 31.

Type locality.—Schuylkill River; Juniata River; creeks in Lancaster County, Pennsylvania (Clarke and Berg, 1959, p. 32).

Diagnosis.—See Simpson (1914, p. 484) for a complete description of this species.

General distribution (fig. 84).—Atlantic drainage only. According to Ortmann (1919, p. 121) the Monroe County, Michigan, record is "certainly incorrect." It is therefore unlikely that the species occurs in Ohio.

Remarks.—This species is noted here because it has sometimes been identified with *Unio viridis* Rafinesque 1820. Ortmann and Walker (1922, p. 35) agree that Conrad's name for the species should be retained and Rafinesque's discarded. The species, as understood by them, by Simpson (1914, p. 484), and by Ortmann (1919), is one found only in the Atlantic drainage and is not present in the Ohio River or its tributaries.

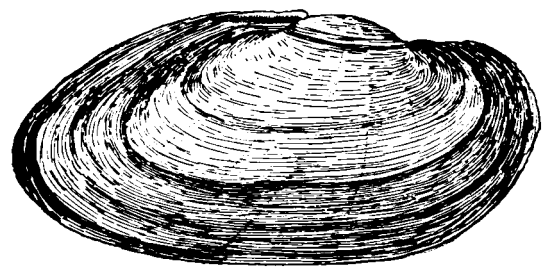


FIGURE 86.—*Anodontoides ferussacianus,* exterior of right valve, X1; after Walker (1918, p. 57, fig. 172).

Rafinesque stated that his specimens came from the Ohio and Kentucky Rivers and their small tributaries. What these specimens were it is difficult to say; the name was probably given to some species from the Ohio River drainage which cannot be identified from Rafinesque's summary description.

Genus *Anodontoides* Simpson 1898

Anodontopsis (Simpson ms.) F. C. Baker 1898, Acad. St. Louis Trans., v. 8, p. 76 (*fide* Neave).

Anodontoides (*n. n. pro Anodontopsis* F. C. Baker 1898) F. C. Baker 1898, Chicago Acad. Sci. Bull., v. 3, pt. 1, p. 72 (*fide* Neave).

Anodontoides Walker 1918, Synopsis and cat. fresh-water Moll., p. 57.

Anodontoides F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 175.

Anodontoides La Rocque 1953, Cat. Recent Moll. Canada, p. 89.

FIGURE 87.–Distribution of *Anodontoides ferussacianus* in North America; *inset*, distribution in Ohio.

Type.—*Anodonta ferussaciana* Lea.

Diagnosis.—Shell elliptical, inflated, thin, with a faint posterior ridge, sometimes constricted at the center of the base; beaks rather full, with a few not very coarse subparallel concentric ridges which are curved up rather abruptly; behind and back of these are fine radiating ridges; epidermis smooth and shining, often rayed; hinge line slightly incurved in front of the beaks, edentulous or bearing the merest rudiments of teeth; nacre bluish white.

Remarks.—F. C. Baker (1928a, p. 182) has summarized the criteria on which he distinguished members of this genus in Wisconsin:

A. ferussacianus: large shell with green rays and heavy umbonal markings;

A. f. subcylindraceus: smaller cylindrical shell, brown and rayless or but faintly rayed, also with coarse umbonal markings;

A. birgei: larger cylindrical shell, brown or horn-colored, with marked umbonal ridge and fine umbonal markings, the space between the bars being about half that in the two forms previously mentioned.

Baker's own measurements have been used in preparing fig. 85 which shows variation in his three forms. Admittedly, this graph is based on too few data, but it strongly suggests that the comparative characters used by Baker have no great significance. Two criteria for differentiation of his forms remain. The first, presence or absence of green rays and color of shell, may be useful in living or recently dead specimens but would be of no use with fossil material. The second, the relative size and spacing of the umbonal markings, appears to be more useful. Nothing is said of the other described forms of the genus, save that *A. birgei* is related to *A. modesta* in having the same type of beak sculpture, and Baker includes *A. f. buchanensis* in the synonymy of *A. ferussacianus*.

Four forms have been recorded from Ohio and it is evident that a review of this material is in order. Material should be examined especially for the character of the beak sculpture to determine if the specimens belong in the typical group or in the *modesta-birgei* group. In view of these uncertainties, all four forms are described in this report with the understanding that the distribution given is in doubt for all of them.

Clarke and Berg (1959, p. 35) place all central New York records of *Anodontoides* under the single species *A. ferussacianus* (Lea). It is possible that intensive study of Ohio specimens will show that the same thing should be done for Ohio records; certainly the discussion of the subspecies or forms given above strongly indicates that possibility. Nevertheless, it seemed best to list the forms cited for the State until positive data should indicate otherwise.

Anodontoides ferussacianus (Lea) 1834
Fig. 86

Anodonta ferussaciana Lea 1834, Am. Philos. Soc. Trans., v. 5, p. 45, pl. 6, fig. 15; 1834, Observer, v. I, p. 157, pl. 6, fig. 15.

Anodonta subcylindracea Call 1900, Moll. Ind., p. 530, pl. 76.

Anodontoides ferussacianus Dall 1905, Harriman-Alaska Exped., v. 13, p. 131.

--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 394.

--- --- Simpson 1914, Descr. cat. Naiades, p. 467.

--- --- Johnson 1915, Fauna New England, p. 25.

--- --- Ortmann 1919, Najades Pa., p. 165, pl. 11, fig. 5.

Anodontoides subcylindraceus F. C. Baker 1920, Life of Pleistocene, p. 383.

Anodontoides ferussacianus F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 175, pl. 67, figs. 3, 4, 7; pl. 75, figs. 3-5.

--- --- Goodrich 1932, Moll. Mich., p. 95.

--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D). p. 152.

--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 311.

--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 100, pl. 12, fig. 13.

--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 89.

--- --- Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 35, fig. 39.

Type locality.—Ohio River, near Cincinnati, Ohio.

Diagnosis.—"Elongate, rounded at the ends, usually thin and swollen. Beaks sculptured with a few more or less conspicuous folds. Epidermis yellow, green, brown, and sometimes nearly black; occasionally marked with rays of varying definiteness. Interior without teeth, nacre usually blue, but sometimes whitish. Length 82, height 43, breadth 32 mm." (Goodrich, 1932, p. 95).

Ecology.—Found in small quiet creeks on sandy bottom in shallow water, 0.2-0.7 m. deep (F. C. Baker, 1928a, pt. II, p. 177). It is recorded for slow flowing streams, in backwater areas, and in lakes, on mud, sand, and gravel, by Clarke and Berg (1959, p. 36). In Michigan, it occurs in small creeks and brooks (46, 47), large creeks (48), small rivers (49), impounded waters above artificial dams. In Ontario (1) it occurs in a large river, on sand bars.

Associations.—Living: MICHIGAN-46, 47, 48, 49,

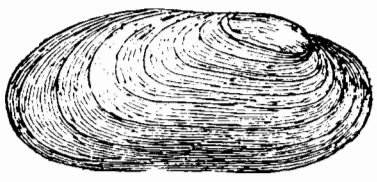


FIGURE 88.—*Simpsoniconcha ambigua*, exterior of right valve, X1; after Walker (1918, p. 64, fig. 186).

53, 57, 65, 67; OHIO - 43; ONTARIO - 1; WISCONSIN - 54.

General distribution (fig. 87).—Mississippi drainage; St. Lawrence, Red River and Saskatchewan basins; Lake Huron, Lake St. Clair, Lake Erie, Lake Ontario, and their drainages; St. Lawrence River, Ottawa River, and their tributaries; eastern New York west to Colorado, Red River of the North south to Kentucky and Tennessee.

Distribution in Ohio (inset, fig. 87).—Sterki (1907a, p. 394) gives merely "over the state." Ortmann (1919) gives a few specific localities: Swan Creek, Cedar Creek, Ten Mile Creek at Silica, all in Lucas County; Silver Creek, Williams County; Tuscarawas River. It is, therefore, surely present in the St. Joseph, Lake Erie, and upper Ohio drainages, but not in the lower part of the Ohio drainage in the State, unless Sterki's record

FIGURE 89.—Distribution of *Simpsoniconcha ambigua* in North America; *inset,* distribution in Ohio.

can be substantiated.

Geologic range.—Recorded for late Wisconsin ("Wabash") by Baker (1920a, p. 383).

Anodontoides ferussacianus buchanensis (Lea) 1838

Anodonta buchanensis Lea 1838, Am. Philos. Soc. Trans., v. 6, p. 47, pl. 14, fig. 43; 1838, Observer, v. II, p. 47, pl. 14, fig. 43.
Anodontoides ferussacianus buchanensis Simpson 1914, Descr. cat. Naiades, p. 469.
--- --- --- Ortmann 1919, Najades Pa., p. 170, pl. 11, fig. 6.
--- --- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 89.

Type locality.—Buck Creek, Ohio. The exact locality is unknown to me and there is no mention of county in the literature.

Diagnosis.—Smaller than the typical form and somewhat bluntly rounded posteriorly (Goodrich, 1932, p. 95).

General distribution.—Lakes Huron, St. Clair, and Erie. Note that this range completely overlaps that of the species.

Distribution in Ohio.—Ortmann (1919) records this variety for the Scioto River, Hardin County; Buck Creek (type locality), location unknown, possibly near Cincinnati.

Remarks.—The type locality is a small creek in Ohio, yet the species is recorded for the Great Lakes, where conditions are very different. It may be that this variety should be discarded, as has been done by F. C. Baker (1928a, pt. II, p. 175), since it appears to be based merely on size and a blunt rounding of the posterior outline of the shell. These do not seem to be characteristics of enough importance for even a variety.

Anodontoides ferussacianus modestus (Lea) 1857

Anodonta modesta Lea 1857, Acad. Nat. Sci. Philadelphia Proc. 1857, p. 84; 1860, Acad. Nat. Sci. Philadelphia Jour., v. 4, p. 364, pl. 63, fig. 189; 1860, Observer, v. VIII, p. 46, pl. 63, fig. 189.
Anodontoides ferussacianus var. *modestus* Simpson 1900, Synopsis Naiades, p. 660.
--- --- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 394.
--- --- --- Simpson 1914, Descr. cat. Naiades, p. 470.
Anodontoides ferussacianus var. *modesta* Goodrich 1932, Moll. Mich., p. 95.

Type locality.—Pond near Kalamazoo, Michigan.

Diagnosis.—This form is "still smaller than ***buchanensis*** and has well-defined beaks that are **sculptured** with 'parallel, doubly-looped ridges,' according to Simpson" (Goodrich, 1932, p. 95).

Ecology.—The type specimen came from a pond in Michigan, size and depth unknown. Goodrich (1932, p. 95) states that this variety, together with the others related to *A. ferussacianus,* is found plentifully in the southern part of the Lower Peninsula of Michigan, sparingly in the northern part, and apparently not at all in the Upper Peninsula, but he does not give details of its occurrence.

Associations.—Living: MINNESOTA - 13a, 18.

General distribution.—Michigan; Lake Erie (Sterki, 1907a).

Distribution in Ohio.—Sterki (1907a, p. 394) gives "St. Lawrence drainage, Lake Erie."

Remarks.—The characteristics given for this variety lead to the suspicion that the variety is not valid and should be discarded, as suggested by Goodrich (1932, p. 95). Simpson (1914, p. 470) gave it specific rank but his remark, "I am a little at a loss where to place the present form, which has all the characters of an *Anodontoides* except the beak sculpture," indicates that this was an expedient and that he did not confidently accept it as a species. Robertson and Blakeslee (1948) and Johnson (1915) have both ignored this form. The Ohio record is noted here for the sake of completeness but it is my personal opinion that the variety has no taxonomic value. On the other hand, F. C. Baker (1928a, pt. II, p. 182) states that this form has fine beak sculpture which he recognizes also in *A. birgei* Baker. If Baker is correct in his interpretation of the beak sculpture, it is possible that this form should be recognized, perhaps even as a species, in view of the allegedly different beak sculpture.

Anodontoides ferussacianus subcylindraceus (Lea) 1838

Anodonta subcylindracea Lea 1838, Am. Philos. Soc. Trans., v. 6, p. 106, pl. 24, fig. 117; 1838, Observer, v. II, p. 106, pl. 24, fig. 117.
Anodontoides ferussacianus subcylindraceus Sterki

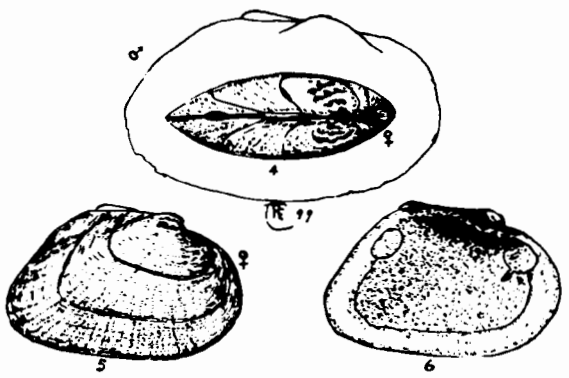


FIGURE 90.—*Alasmidonta calceolus,* four views, X1; after Call (1900, pl. 68).

1907, Ohio Acad. Sci. Proc., v. 4, p. 394.

Anodontoides subcylindraceus F. C. Baker 1920, Life of Pleistocene, p. 383.

Anodontoides ferussacianus subcylindraceus F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 178, pl. 67, figs. 5, 6; pl. 68, fig. 5.

--- --- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.

--- --- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 311.

--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 89.

Type locality.—Oak Orchard Creek, Orleans County, New York.

Diagnosis.—Smaller and more cylindrical and elongated than *ferussacianus*, more inflated postbasally, the dorsal margin more convex, the posterior end usual-

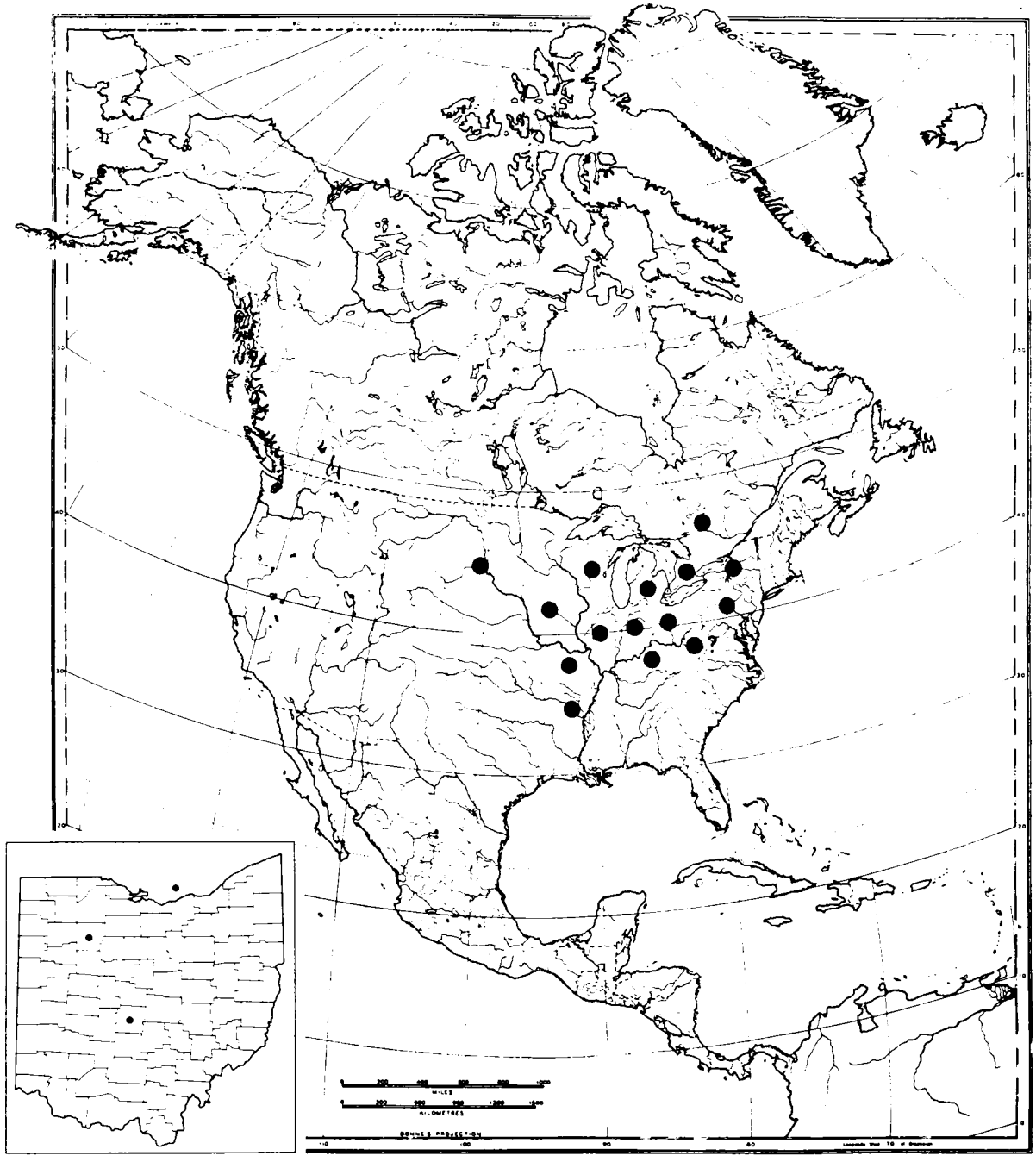


FIGURE 91.—Distribution of *Alasmidonta calceolus* in North America; *inset*, distribution in Ohio.

ly more sharply rounded, not distinctly biangulate, the anterior dorsal margin not straight but sharply descending, causing the shell to appear slightly oblique; color brownish, generally without rays (F. C. Baker, 1928a).

Ecology.—This is "a form of creeks and probably occupies the same relative habitats as the creek specimens of *ferussacianus*" (Baker, 1928a).

Associations.—Living: ONTARIO-10; WISCONSIN-14, 42, 47, 49, 58, 59, 75, 81, 83, 87, 89, 93, 108, 117, 123, 130, 131.

General distribution.—"Said to occur from New York to Wisconsin, south to Ohio. Specimens believed to be referable to this form have been seen from Wisconsin, Michigan, Ohio, Illinois, and Indiana" (Baker, 1928a); "Great Lakes drainage; Great Lakes, except Lake Superior; St. Lawrence drainage" (La Rocque, 1953).

Distribution in Ohio.—Sterki (1907a, p. 394) gives Pymatuning River in Ashtabula County; Grand River, Silver Creek in Portage County; Olentangy River at Delaware; Burton City, Wayne County. Ortmann (1919) does not list the variety.

Geologic range.—Unknown.

Remarks.—Simpson (1914, p. 469) includes this variety in typical *A. ferussacianus*. Baker resurrected the name in 1928 but Goodrich (1932) and Robertson and Blakeslee (1948) ignored it. La Rocque and Oughton (1937) included the form and La Rocque (1953, p. 89) also recognized it. Baker feels even more strongly than his treatment of the form might indicate. In his remarks (1928a, pt. II, p. 179) he says that it "appears to be separable from *ferussacianus* and might be considered a distinct species." In spite of this, it seems to me, at present, that all the described varieties of *A. ferussacianus* have little taxonomic value and represent only extremes in variation within a very plastic species. In this connection, it is to be noted that all the characters given by Baker are comparative ones and that not a single one of them is based on a constant characteristic present in the variety and not in the typical form.

Genus *Simpsoniconcha* Frierson 1914

Simpsonaias Frierson 1914, Nautilus, v. 28, p. 7 (*fide* Neave).

Hemilastena Simpson 1900 (*non* Agassiz), Synopsis Naiades, p. 673; 1914, Descr. cat. Naiades, p. 323.

Simpsoniconcha (*n. n. pro Simpsonaias* Frierson 1914) Frierson 1914, Nautilus, v. 28, p. 40 (*fide* Neave).

Simpsoniconcha Walker 1918, Synopsis and cat. freshwater Moll., p. 64.

Simpsoniconcha Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 38.

Simpsoniconcha F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 182.

Simpsoniconcha La Rocque 1953, Cat. Recent Moll. Canada, p. 99.

Type.—*Alasmodonta ambigua* Say.

Diagnosis.—Shell elongate elliptical, small, rounded in front and behind, in many cases slightly incurved at the central base; beak rather sharp but not full; sculpture of fine parallel ridges which are looped up in the middle and open behind; epidermis brownish, rayless; teeth imperfect, a single irregular compressed tooth in each valve; laterals nearly or quite wanting; anterior end of the shell much thickened; nacre dull whitish.

Simpsoniconcha ambigua (Say) 1825
Fig. 88

Alasmodonta ambigua Say 1825, Acad. Nat. Sci. Philadelphia Jour., v. 5, p. 131.

Unio hildrethianus Lea 1834, Am. Philos. Soc. Trans., v. 5, p. 36, pl. 3, fig. 8.

Margaritana hildrethiana Call 1900, Moll. Ind., p. 527.

Hemilastena ambigua Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 394.

--- --- Simpson 1914, Descr. cat. Naiades, p. 325.

Simpsoniconcha ambigua Ortmann 1919, Najades Pa., p. 136.

--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 38.

--- --- Frierson 1927, Check list N. Am. Naiades, p. 23.

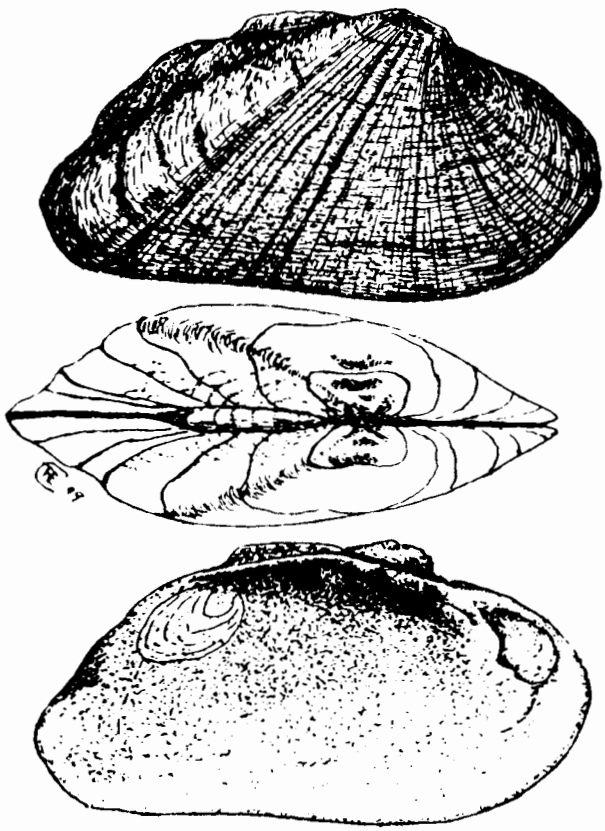


FIGURE 92.—*Alasmidonta marginata*, three views, X1; after Call (1900, pl. 70).

Simpsoniconcha ambigua Frierson 1927, Check list N. Am. Naiades, p. 23.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 183, pl. 70, figs. 1-3.
--- --- Goodrich 1932, Moll. Mich., p. 99.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 151.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 312.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 99.

Type locality.—"Northwest Territory" (Say).

Diagnosis.—Shell elongate, small, thin, with rounded ends; brown or ashy in color; beaks low, sculptured with rather delicate folds that are commonly wavy;

FIGURE 93.—Distribution of *Alasmidonta marginata* in North America; *inset,* distribution in Ohio.

nacre white to purplish; the teeth are confined to a low pseudocardinal in each valve and nearly obsolete laterals; L. 46, H. 23, D. 16 mm. (modified from Goodrich, 1932, p. 99).

Ecology.—In some cases found in mud and on gravel bars, but in greatest numbers hidden in the mud under flat stones, in company with the mud puppy *(Necturus)* which is its natural host (condensed from F. C. Baker, 1928a, pt. II, p. 184).

Associations.—Living: OHIO-43.

General distribution (fig. 89).—Ohio River system; north to Michigan; west to Iowa; south to Arkansas; east to Tennessee (Simpson, 1914, p. 325).

Distribution in Ohio (inset, fig. 89).—Sterki (1907a, p. 394) gives "Ohio drainage; Lake Erie." Ortmann (1919) says this species is not found in Pennsylvania but occurs in the Mahoning River, in Ohio.

Geologic range.—Unknown.

Genus *Alasmidonta* Say 1818

Alasmidonta Say 1818, Acad. Nat. Sci. Philadelphia Jour., v. 1, p. 459 (*fide* Neave).

Alasmidonta Walker 1918, Synopsis and cat. fresh-water Moll., p. 62.

Alasmidonta Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 38.

Alasmidonta F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 184.

Alasmidonta La Rocque 1953, Cat. Recent Moll. Canada, p. 86.

Type.—*Monodonta undulata* Say.

Diagnosis.—Shell generally rhomboid, inflated, with a well-developed posterior ridge which ends in a point when it is single or a biangulation when double; beaks full and high, with coarse concentric or slightly doubly looped bars; epidermis rayed, shining; hinge with two pseudocardinals in the left valve and one in the right; laterals usually wanting or imperfect, cavity of the beaks deep; nacre bluish.

Remarks.—The type species, *Alasmidonta undulata* (Say), appears to be absent from Ohio. It is found in the lower St. Lawrence drainage south to North Carolina, but does not seem to have penetrated farther up the St. Lawrence drainage than the Ottawa River. Another species, *A. heterodon* (Lea), is also confined to rivers east of the Appalachians according to C. W. Johnson (1915, p. 26).

Alasmidonta calceolus (Lea) 1830
Fig. 90

Unio calceolus Lea 1830, Am. Philos. Soc. Trans., v. 3, p. 265, pl. 4, fig. 1; 1834, Observer, v. I, p. 7, pl. 3, fig. 1.

Margaritana deltoidea Lea 1838, Am. Philos. Soc. Trans., v. 6, p. 43, pl. 13, fig. 38; 1838, Observer, v. II, p. 43, pl. 13, fig. 38.

--- --- Call 1900, Moll. Ind., p. 519, pl. 68, figs. 4-6.

Alasmidonta calceolus Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 393.

--- --- Simpson 1914, Descr. cat. Naiades, p. 496.

Alasmidonta calceola F. C. Baker 1920, Life of Pleistocene, p. 383.

Alasmidonta (Pressodonta) calceolus F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 185, pl. 69, fig. 1; pl. 72, figs. 1-7.

Alasmidonta calceolus Goodrich 1932, Moll. Mich., p. 98.

--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 310.

--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 86.

Alasmidonta (Pressodonta) calceolus Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 29, fig. 30.

Type locality.—*A. calceolus,* Ohio; *M. deltoidea,* Ohio River, near Cincinnati, Ohio; Scioto River.

Diagnosis.—Shell rhomboid, small, moderately inflated, more or less solid; anterior end rounded; posterior end roundly, obliquely truncated; ventral margin

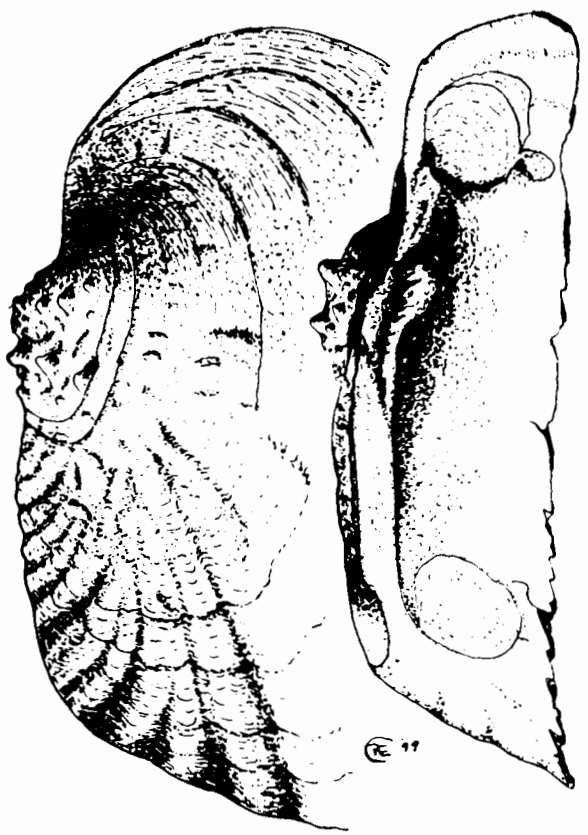


FIGURE 94.—*Arcidens confragosus,* two views, X1; after Call (1900, pl. 69).

straight or slightly incurved; dorsal margin slightly convex, rounding into the truncated posterior margin; posterior ridge high, rounded, commonly terminating in a rounded point at the base of the shell, which is often biangulate; beaks swollen, but not much elevated above the hinge line; sculpture consisting of 5 or 6 irregular heavy bars, the first one or two diagonal to the hinge line, the others more or less concentric; the bars form more or less of an angle behind and extend forward in a series of wavy bars, corrugations, or nodules, which sometimes assume a looped aspect; surface with uneven lines of growth, raised into dark lined ridges at rest periods; epidermis greenish or yellowish, sometimes pinkish, with many more or less wavy green rays of varying width; pseudocardinals more or less rudimentary; left valve with a small denticle beneath the beak and another, more indistinct, in front; right valve with one elevated triangular tooth beneath the beak and

FIGURE 95.–Distribution of *Arcidens confragosus* in North America; *inset,* distribution in Ohio.

with a slight swelling of the hinge behind; laterals represented by slight elevation of the hinge line; cavity of beaks not very deep; adductor muscle scars well marked, but not much impressed; nacre whitish, frequently tinged with pink or salmon, more or less iridescent; female shell swollen in the region of the posterior ridge, male more compressed.

Ecology.—Commonly burrowing in streams on sand bottom in shallow water; also on lake shores on sand bottom; in Sturgeon Bay, Wisconsin, on sandy clay bottom in 1-1.1 m. of water (F. C. Baker, 1928a, pt. II, p. 186). In Michigan, it has been recorded for the Huron River drainage in large creeks (47), small creeks (48), small (49), medium (50), and large river environments, and in the St. Joseph River (56, 57) but not its tributaries. See also Clarke and Berg (1959, p. 30).

Associations.—Living: MICHIGAN-47, 48, 49, 50, 53, 56, 57; OHIO-43.

General distribution (fig. 91).—Upper Mississippi drainage; Ohio, Cumberland, and Tennessee Rivers; lower and middle St. Lawrence systems. States of Illinois, Wisconsin, Indiana, Ohio, Michigan, New York, Missouri, Arkansas, and Kentucky. Provinces of Ontario and Quebec, Canada.

Distribution in Ohio (inset, fig. 91).—Sterki records it "over the state, common" but gives no details. Ortmann (1919) does not mention the species.

Geologic range.—Baker (1920a, p. 383) gives late Wisconsin ("Wabash"). The present distribution of this species suggests that it originated in the great southeastern naiad focus area and migrated northward into the Mississippi drainage, thence into the St. Lawrence drainage. Possibly its migration started early in post-Wisconsin time, to permit it to invade the Great Lakes region, but some factor prevented it from pushing northward into Lake Agassiz and thence into the Hudson Bay and Mackenzie drainages; in fact, it does not seem to have penetrated as far as Minnesota in the Mississippi drainage.

Alasmidonta marginata (Say) 1819
Fig. 92

Alasmodonta marginata Say 1819, Nicholson's Encycl., v. 2; 1819, Acad. Nat. Sci. Philadelphia Jour., v. 1, p. 459.
Alasmodon (Decurambis) scriptum Rafinesque 1831, Continuation Mon. Shells Ohio, p. 4.
Margaritana marginata Call 1900, Moll. Ind., p. 521, pl. 70.
Alasmidonta marginata Sterki 1907, Ohio Acad. Sci. Proc., v. 4. p. 393.
--- --- Simpson 1914, Descr. cat. Naiades, p. 504.
--- --- Johnson 1915, Fauna New England, p. 27.
Alasmidonta (Decurambis) marginata Ortmann 1919, Najades Pa., p. 181, pl. 12, fig. 3.
Alasmidonta marginata F. C. Baker 1920, Life of Pleistocene, p. 383.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 38.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 189, pl. 71, figs. 1-5.
--- --- Goodrich 1932, Moll. Mich., p. 97.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 310.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 86.
Alasmidonta (Decurambis) marginata Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 27, fig. 32.

Type locality.—Scioto River, Chillicothe, Ross County, Ohio.

Diagnosis.—Scarcely twice as long as it is high, thin to solid, swollen; smooth, greenish or brown with numbers of rays extending across the disk; beaks high, having stout rather rough ridges as sculpture; on the posterior slope is a well-defined ridge, and posterior to that a truncated surface covered commonly, but not in all cases, with short folds; interior yellow, blue, red, or purple; beak cavity deep; pseudocardinals small, one in each valve; lateral teeth absent or feebly indicated; L. 104, H. 64, D. 38 mm. (Goodrich, 1932, p. 97).

Ecology.—The typical form, according to F. C. Baker (1928a, pt. II, p. 192) inhabits small streams and creeks, usually on gravel or sand bottom, in water 0.2-1 m. deep. It prefers a location with good current, is rare on mud bottom. In Wisconsin (Bark River) it occurs on gravel-sand bottom in water 0.5 m. deep. The Michigan records are for various habitats in the Huron River drainage: large creeks (48), small river (49), medium-sized river (50), fairly large river (51), and large river (52); and for the St. Joseph River (56, 57, 59, 61, 65) and one tributary (63). In Ohio (43) it lives in the small rivers of Tuscarawas County; in Ontario, it occurs in the Rideau River, in a backwater above small rapids; in Wisconsin (108) it is recorded for the Tomahawk River. In Wisconsin also, the variety *variabilis* is recorded for various rivers (58, 76, 121, 132). See also Clarke and Berg (1959, p. 28).

Associations.—Living: MICHIGAN-48, 49, 50, 51, 52, 56, 57, 59, 61, 63, 65; OHIO-43; ONTARIO-5;

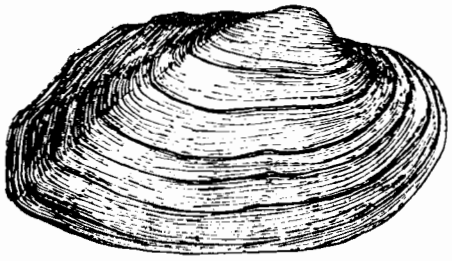


FIGURE 96.—*Strophitus undulatus*, exterior of right valve, X1; after Walker (1918, p. 56, fig. 168).

WISCONSIN - 108. Variety *variabilis:* WISCONSIN - 58, 76, 121, 132.

General distribution (fig. 93).—Upper Mississippi drainage; Ohio, Cumberland, and Tennessee River systems; upper St. Lawrence drainage as follows: Lake Huron and its drainage, Lake St. Clair and its drainage, Detroit River, Lake Erie and its drainage, Niagara River and its tributaries, Lake Ontario, Ottawa River and its tributaries, St. Lawrence River; Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

Distribution in Ohio (inset, fig. 93).—Sterki (1907a, p. 393) gives "over the state, both drainages; a small, slight form in Lake Erie." Ortmann (1919) adds Sandusky River, Wyandot County; Maumee River, Lucas County; Defiance, Defiance County; and Tuscarawas River.

Geologic range.—Baker (1920a, p. 383) gives late

FIGURE 97.—Distribution of *Strophitus undulatus* in North America; *inset,* distribution in Ohio.

Wisconsin ("Wabash").

Genus *Arcidens* Simpson 1900

Arcidens Simpson 1900, Synopsis Naiades, p. 661 (*fide* Neave).
Arcidens Ortmann 1912, Carnegie Mus. Annals, v. 8, p. 284.
Arcidens Simpson 1914, Descr. cat. Naiades, p. 475.
Arcidens Walker 1918, Synopsis and cat. fresh-water Moll., p. 57.
Arcidens F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 196.

Type.—*Alasmodonta confragosus* (Say).

Diagnosis.—Shell subrhomboidal, subsolid, inflated, with full high beaks; beak sculpture very strong, consisting of irregular corrugations which fall into two loops, at the base of which the ridges are swollen into knobs that continue out in two radiating rows on to the disk of the shell; in front of and behind the beaks are many fine radial wrinkles, the posterior ones being zigzagged; surface of the shell covered with oblique folds and wrinkles; epidermis dark olive, shining; left valve with two elongated compressed pseudocardinals, the posterior under the beak and curved upward, cutting off the hinge plate in the right valve, which has a single compressed pseudocardinal in front; laterals numerous, short, blurred; nacre white.

Arcidens confragosus (Say) 1829
Fig. 94

Alasmodonta confragosa Say 1829, New Harmony Disseminator, v. 2, p. 339; 1830, Am. Conchology, v. 1, pl. 21.
Margaritana confragosa Call 1900, Moll. Ind., p. 520, pl. 69.
Arcidens confragosus Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 393.
--- --- Simpson 1914, Descr. cat. Naiades, p. 475.
--- --- F. C. Baker 1920, Life of Pleistocene, p. 383.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 196, pl. 63, figs. 4-7.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 311.

Type locality.—New Orleans, Louisiana.

Diagnosis.—Same as for the genus, which is monotypic.

Ecology.—"On a sand or mud bottom in water a few feet deep. Current rapid" (F. C. Baker, 1928a, pt. II).

General distribution (fig. 95).—Mississippi River and states adjoining; Ohio River drainage; southwest to Colorado River, Texas; Bayou Teche, Louisiana (Simpson, 1914).

Distribution in Ohio (inset, fig. 95).—Sterki (1907a, p. 393) gives Ohio River at Cincinnati. It may be found farther up in the Ohio but it does not reach Pennsylvania as Ortmann (1919) does not list it.

Geologic range.—Recorded for beds of Sangamon age by Baker (1920a, p. 383). I have no other fossil record.

Genus *Strophitus* Rafinesque 1820

Strophitus Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 316 (*fide* Neave).
Strophitus Walker 1918, Synopsis and cat. fresh-water Moll., p. 56.
Strophitus F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 198.
Strophitus La Rocque 1953, Cat. Recent Moll. Canada, p. 99.

Type.—*Anodonta undulata* Say.

Diagnosis.—Shell elliptical to rhomboid, inflated, subsolid, pointed or biangulate behind, with a low posterior ridge which is in some cases double; beaks full, sculpture consisting of a few strong concentric ridges

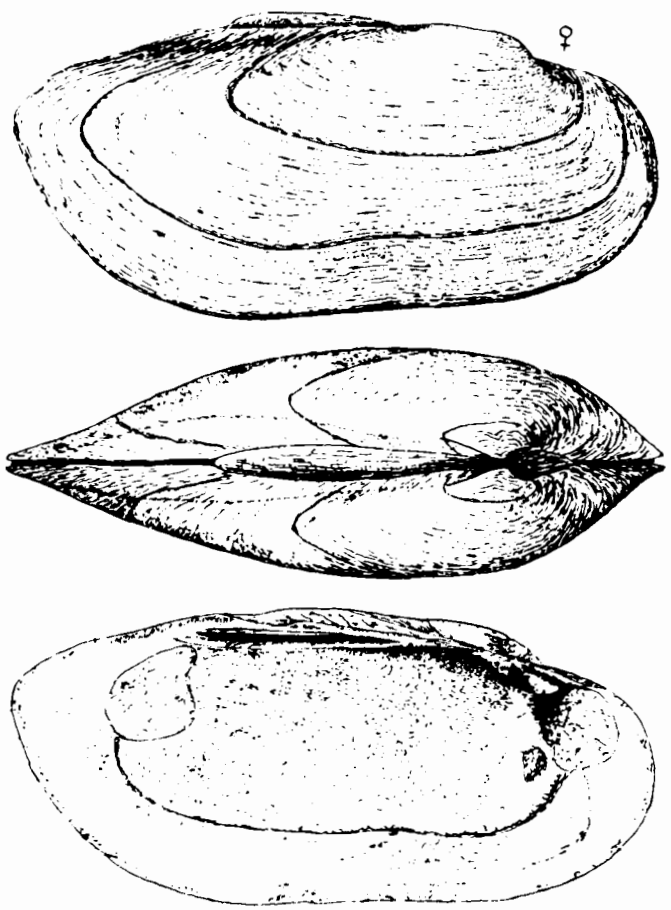


FIGURE 98.—*Lampsilis anodontoides*, three views, X1; after Call (1900, pl. 18).

which curve sharply upward behind; epidermis rayed or rayless, shining; hinge line incurved in front of the beaks; teeth rudimentary, a vestigial compressed tooth in each valve, and in some cases a secondary tooth; laterals rarely present.

Strophitus undulatus (Say) 1817
Fig. 96

Anodonta undulata Say 1817, Nicholson's Encycl., v. 2, p. 20-21, pl. 3, fig. 6.
Anodon rugosus Swainson 1822, Zoology Ill., ser. 1, v. II, pl. 96.
Alasmodonta edentula Say 1829, New Harmony Disseminator, v. 2, no. 22, p. 340.
Anodonta wardiana Lea 1838, Am. Philos. Soc. Trans., v. 6, p. 46, pl. 14, fig. 42.
--- --- Call 1900, Moll. Ind., p. 528, pl. 74.
Anodonta edentula Call 1900, *ibid.*, p. 529, pl. 75.
Strophitus rugosus Dall 1905, Harriman-Alaska Exped.,

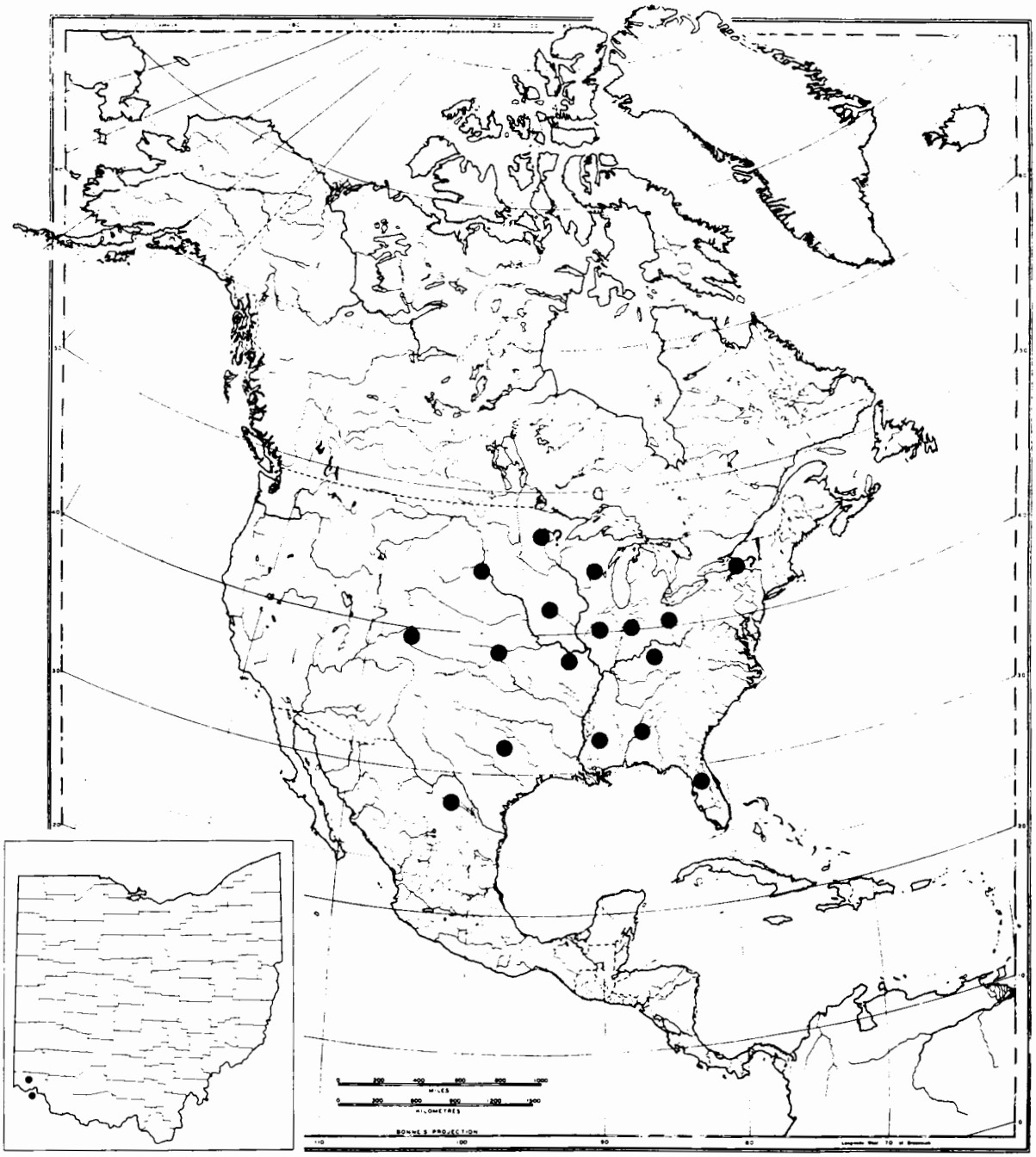


FIGURE 99.–Distribution of *Lampsilis anodontoides* in North America; *inset*, distribution in Ohio.

v. 13, p. 127.

Strophitus edentulus Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 394.

Strophitus edentulus pavonius Sterki 1907, *ibid.*

Strophitus edentulus Simpson 1914, Descr. cat. Naiades, p. 345.

--- --- Ortmann 1919, Najades Pa., p. 197, pl. 12, figs. 7, 8.

Strophitus rugosus Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 40.

Strophitus undulatus-rugosus Frierson 1927, Check list N. Am. Naiades, p. 22.

Strophitus rugosus F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 198, pl. 73, figs. 6, 7.

--- --- Goodrich 1932, Moll. Mich., p. 91.

--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 153.

--- --- van der Schalie 1938, Mich. Univ. Mus.

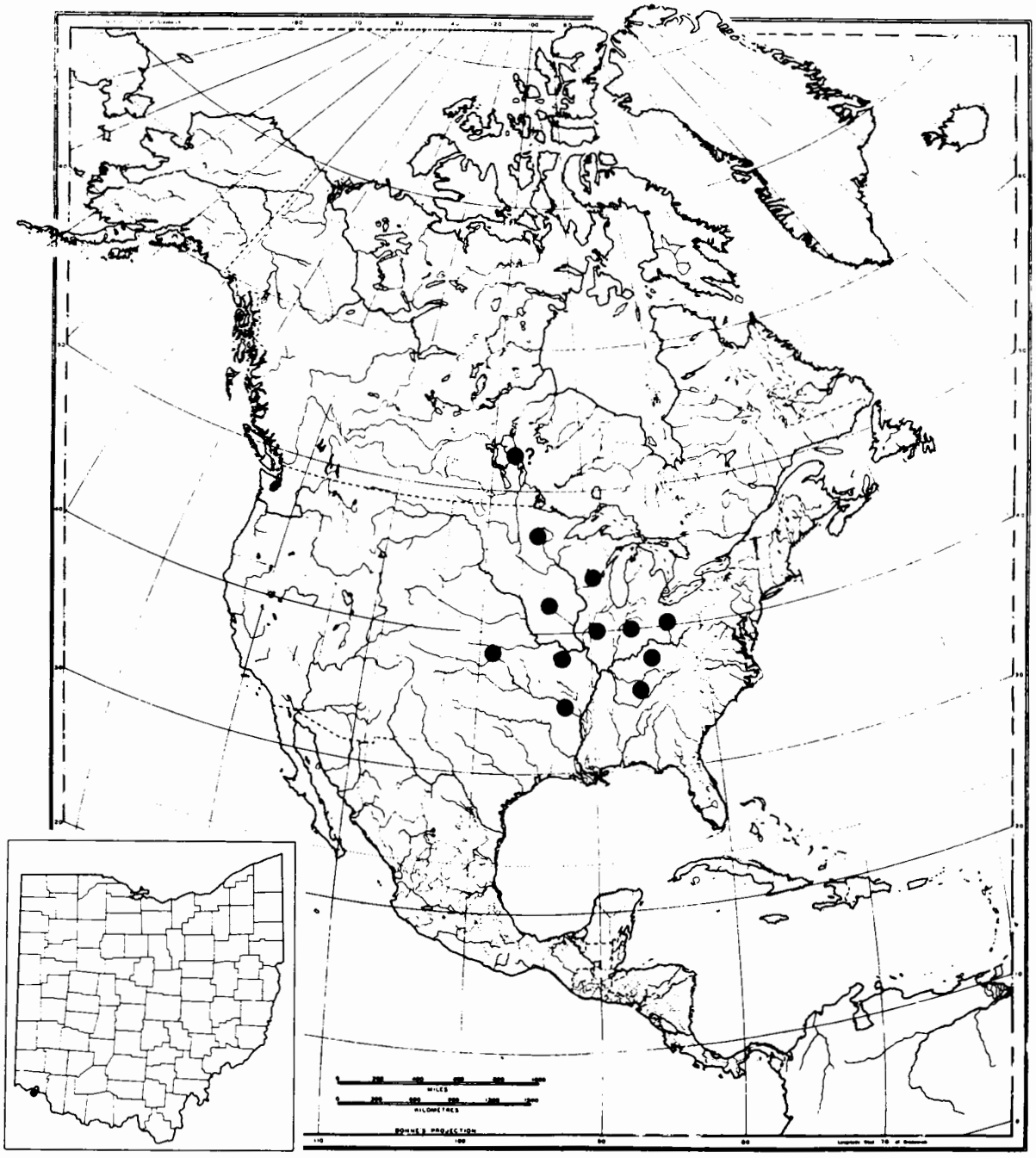


FIGURE 100.–Distribution of *Lampsilis anodontoides fallaciosa* in North America; *inset,* distribution in Ohio.

Zoology Misc. Pub. 40, p. 57.

Strophitus rugosus Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 312.

--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 101, pl. 12, fig. 9.

--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.

--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 99.

Strophitus undulatus Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 43, fig. 41.

Type locality.—This is "not specified, but presumably near Philadelphia" (Clarke and Berg, 1959, p. 43).

Diagnosis.—Shell of variable shape, but more commonly rhomboid than any other form; smooth, yellow, brown, or blackish, some specimens with rays extending from the beaks; beak sculpture of prominent loops or ridges, coarse for so thin a shell; interior pinkish or reddish, having only vestiges of teeth, the most noticeable one being in the left valve; beak cavity shallow, muscle scars well-marked; L. 87, H. 49, D. 28 mm. (modified from Goodrich, 1932, p. 92).

Ecology.—Occurs in a great variety of habitats; found most commonly in creeks and small streams on sand and gravel bottom, and occasionally on mud. It generally inhabits the pools and quiet-water areas and tends to avoid rapid-water zones. In the lakes it is found on several types of substrata, but only on nonshifting shoals, commonly of sand and fine gravel. Van der Schalie (1938, p. 57-58) has never found it on muck.

Associations.—Living: Found as *S. edentulus:* NEW YORK - 19, 22; OHIO - 43; WISCONSIN - 7. As *S. rugosus:* MANITOBA - 36, 38; MICHIGAN - 43, 44, 45, 47, 48, 49, 50, 51, 55, 56, 57, 59, 60, 61, 63, 65; ONTARIO - 5, 10; QUEBEC - 1. As *S. rugosus pavonius:* WISCONSIN - 27, 58, 76, 79, 80, 81, 83, 87, 108, 120, 121, 122, 127, 130. As *S. undulatus:* ONTARIO - 1.

General distribution (fig. 97).—Ohio west to Iowa, and from Wisconsin south to the states bordering the Ohio River in its lower part, and the Mississippi; also in the Wabash, Illinois, and Rock Rivers, ascending well up toward the headwaters (F. C. Baker, 1928a, pt. II, p. 201; typical form).

Distribution in Ohio (inset, fig. 97).—Sterki (1907a, p. 394) separated the typical form and the variety *pavonia.* For the typical form he gave "over the state, common and very variable. A very small, slight form, much inflated, in Lake Erie, seems to represent a variety." For *S. rugosus pavonius,* he gave "over the state; very small e.g. in a run in Portage Co.; very large in the Mahoning River, at Alliance; Tuscarawas River, with the common form of *edentulus,* and merging into it." Ortmann (1919) did not distinguish the variety but gives additional localities: Lake Erie, Erie County; creek in Huron County; Sandusky River, Wyandot County; creeks in Lucas County; St. Marys River, Mercer County; Beaver Creek, Williams County; West Branch Nimishillen Creek, Stark County; Tuscarawas River; Scioto River, Franklin County; Wabash River, Mercer County.

Remarks.—This species is so variable that a great many names have been applied to it, as shown by the lengthy synonymy given above. Ortmann and Walker (1922, p. 40) considered the Atlantic drainage form, *S. undulatus* (Say) 1817, distinguishable, at least as a form, from *S. rugosus* Swainson, but later workers have separated them specifically. An exception is Frierson (1927, p. 22), who lists *S. rugosus* as a trinomial of *S. undulatus,* of which he recognizes five other trinomials as well as seven other species of the genus which are outside the scope of this report. Baker (1928a, pt. II, p. 202 ff.) recognizes varieties, some of them described as new. In his system, the ecology of the varieties is as follows:

Large- and medium-sized—river form	*S. rugosus*
Creek form	*S. rugosus pavonius*
River—lake form	*S. rugosus pepinensis*

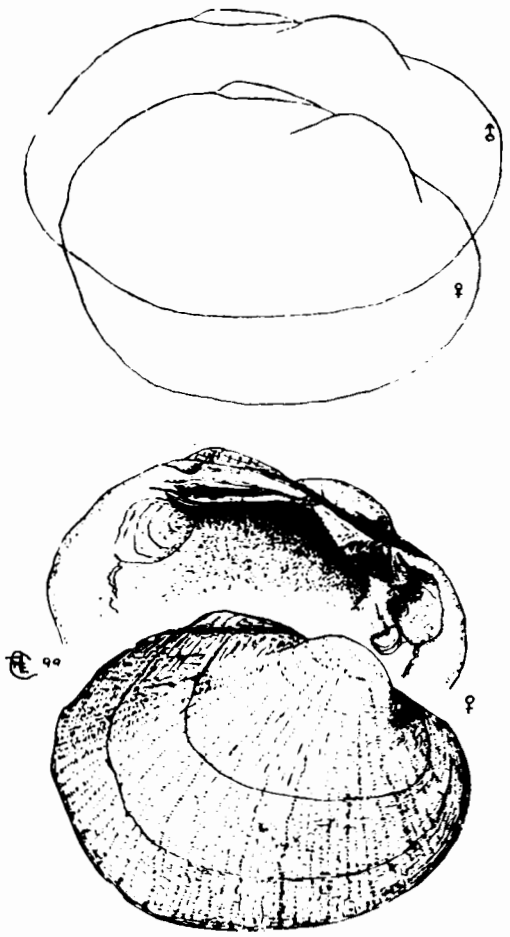


FIGURE 101.—*Lampsilis fasciola,* outlines of male and female shells (upper figure) and two views of female shell (lower figure), X1; after Call (1900, pl. 37).

Small-river–lake form *S. rugosus winnebagoensis*
Small-lake form *S. rugosus lacustris*

Van der Schalie (1938, p. 58) finds that the subspecific characters do not consistently hold and does not use them. His example has been followed here since the writer's experience has been that attempts to separate specimens of this species into "varieties" result in utter confusion. The treatment of Clarke and Berg (1959, p. 43), which recognizes only one species, appears much more satisfactory.

Subfamily LAMPSILINAE
Genus *Lampsilis* Rafinesque 1820

Lampsilis Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 298 (*fide* Neave).
Lampsilis Walker 1918, Synopsis and Cat. fresh-water Moll., p. 78.
Lampsilis F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 265.
Lampsilis La Rocque 1953, Cat. Recent Moll.

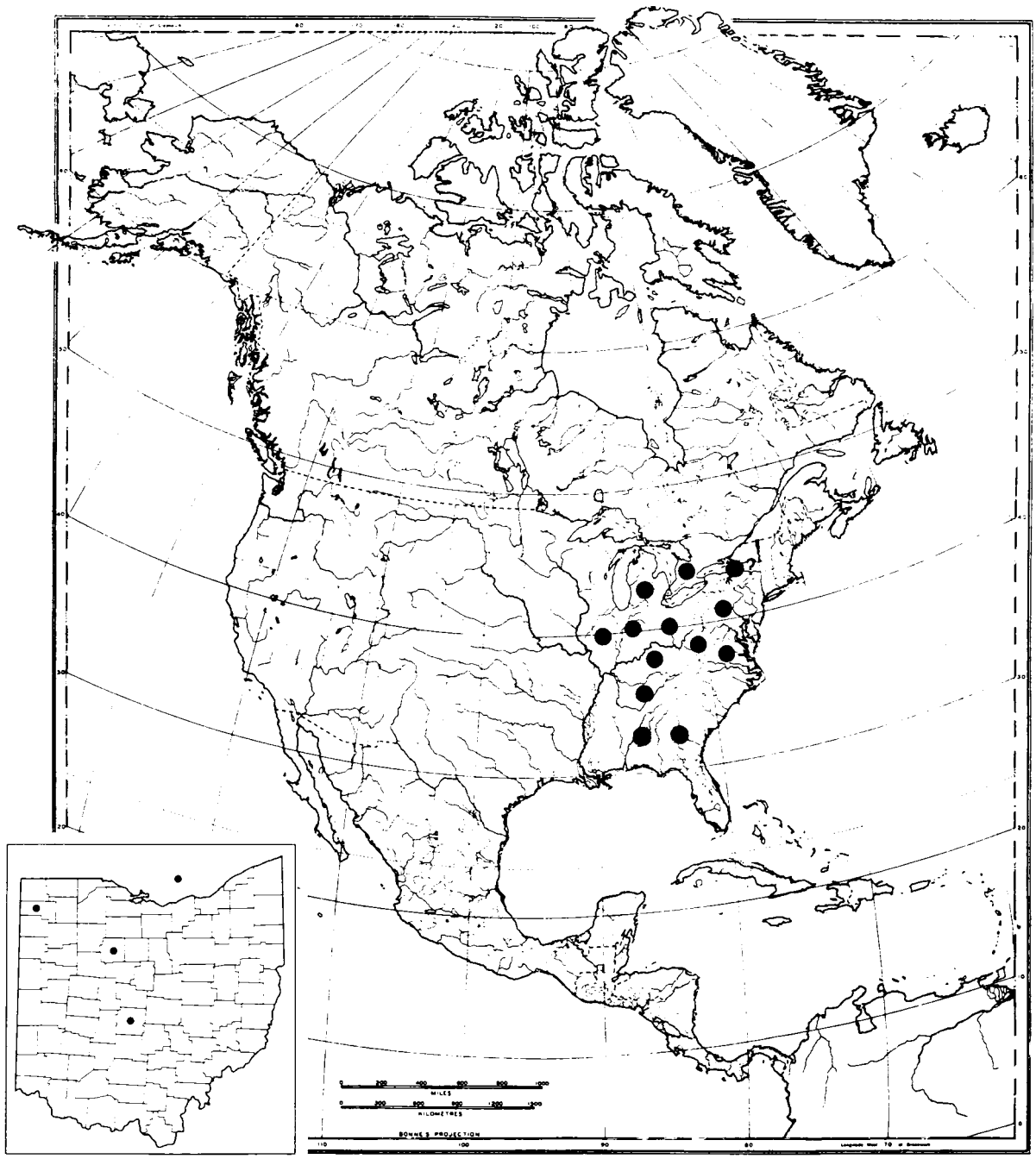


FIGURE 102.–Distribution of *Lampsilis fasciola* in North America; *inset,* distribution in Ohio.

Canada, p. 92.

Type.—*Unio ovatus* Say.

Diagnosis.—Shell oval to elliptical, smooth or slightly concentrically sculptured, generally without a posterior ridge; epidermis generally smooth and shining, in many cases rayed; beak sculpture consisting of double-looped parallel ridges, in some species the posterior loop is open behind or the sculpture is obsolete; hinge with one or two pseudocardinals and one lateral in the right valve, and two pseudocardinals and two laterals in the left; female shell with a strong inflation of the shell and dilatation in the postbasal region, producing a distinct posterior truncation of the shell.

Lampsilis anodontoides (Lea) 1831
Fig. 98

Unio anodontoides Lea 1834, Am. Philos. Soc. Trans., v. 4, p. 81, pl. 8, fig. 11; 1834, Observer, v. I, p. 91, pl. 8, fig. 11.
Unio teres Call 1900, Moll. Ind., p. 452, pl. 18.
Lampsilis anodontoides Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 389.
--- --- Simpson 1914, Descr. cat. Naiades, p. 90.
--- --- F. C. Baker 1920, Life of Pleistocene, p. 383.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 60.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 266, pl. 88, figs. 1-3.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 315.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 459.

Type locality.—Mississippi, Alabama, and Ohio Rivers.

Diagnosis.—Shell large, thick, solid, elongated, somewhat inflated; more or less gaping at both ends; anterior end rounded; posterior end pointed; dorsal and ventral margins straight, nearly parallel; posterior ridge rounded, low; beaks full, but low; beak sculpture of eight to ten ridges, looped in the middle, open posteriorly, in some specimens somewhat wavy; pseudocardinals two in each valve, laterals long, lamellar, nearly straight, roughened; shell thicker in anterior part; sexual differences well marked (condensed from F. C. Baker, 1928a, pt. II, p. 266).

Ecology.—Found in the larger rivers on sandy bottom, in a rather swift current, water a meter or more in depth; also lives on muddy bottom in quieter habitats (Baker, 1928a, pt. II, p. 267). "It lives preferably in muddy or sandy beds, and is found in rivers and streams of all sizes, often ascending into the smallest tributaries. It is quite active in its movements and is a rapid burrower. In spite of its adaptability to environment, as shown by its wide distribution, *L. anodontoides* is not a hardy species. It is one of the first to die when kept in an aquarium" (Scammon, 1906, p. 292).

General distribution (fig. 99).—Entire Mississippi drainage except (probably) the upper Missouri. All the Gulf drainage from Withlacoochee River, Florida, to the Rio Grande, and into Mexico (Simpson). This includes *L. fallaciosa,* according to Baker (1928a, pt. II, p. 267).

Distribution in Ohio (inset, fig. 99).—Sterki (1907a, p. 389) gives "Ohio River, Great Miami River (large)," but Ortmann (1919) does not mention the species. This indicates a possibility that in Ohio this species is found only in the western tributaries of the Ohio River.

Geologic range.—Recorded by Baker (1920a, p. 383)

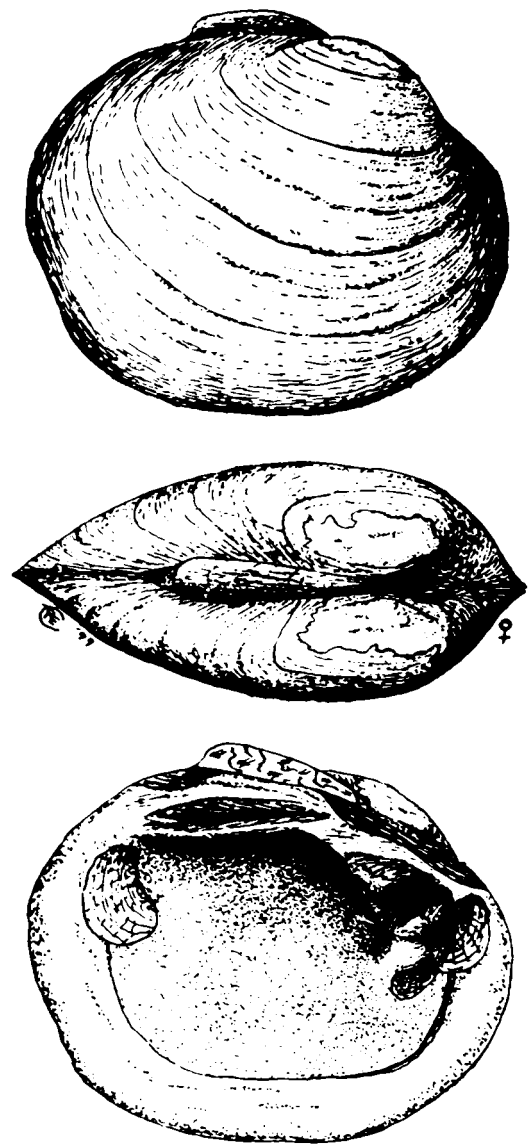


FIGURE 103.—*Lampsilis orbiculata,* three views, X1; after Call (1900, pl. 50).

for Aftonian and late Wisconsin ("Wabash") beds.

Remarks.—Simpson (1914, p. 90, 92) considered *L. anodontoides* and *L. fasciola* as distinct, but noted (p. 93) that there are intergrades. Ortmann and Walker (1922) considered the two species identical and included *L. fallaciosa* in the synonymy of *L. anodontoides*. Baker (1928a) insisted on the distinctness of the two and pointed out that there is a difference in the size of the glochidia. The van der Schalies (1950, p. 459) state that there are arguments in favor of both usages and that experiments are needed to settle the question. They treat *L. fallaciosa* as a form name for the smaller, green-rayed variety that occurs under sloughlike conditions and that usage is followed in this report.

Lampsilis anodontoides fallaciosa (Smith) 1899

Lampsilis fallaciosus Smith 1899, Fish. Comm. Bull., p. 291, pl. 79 (no description).

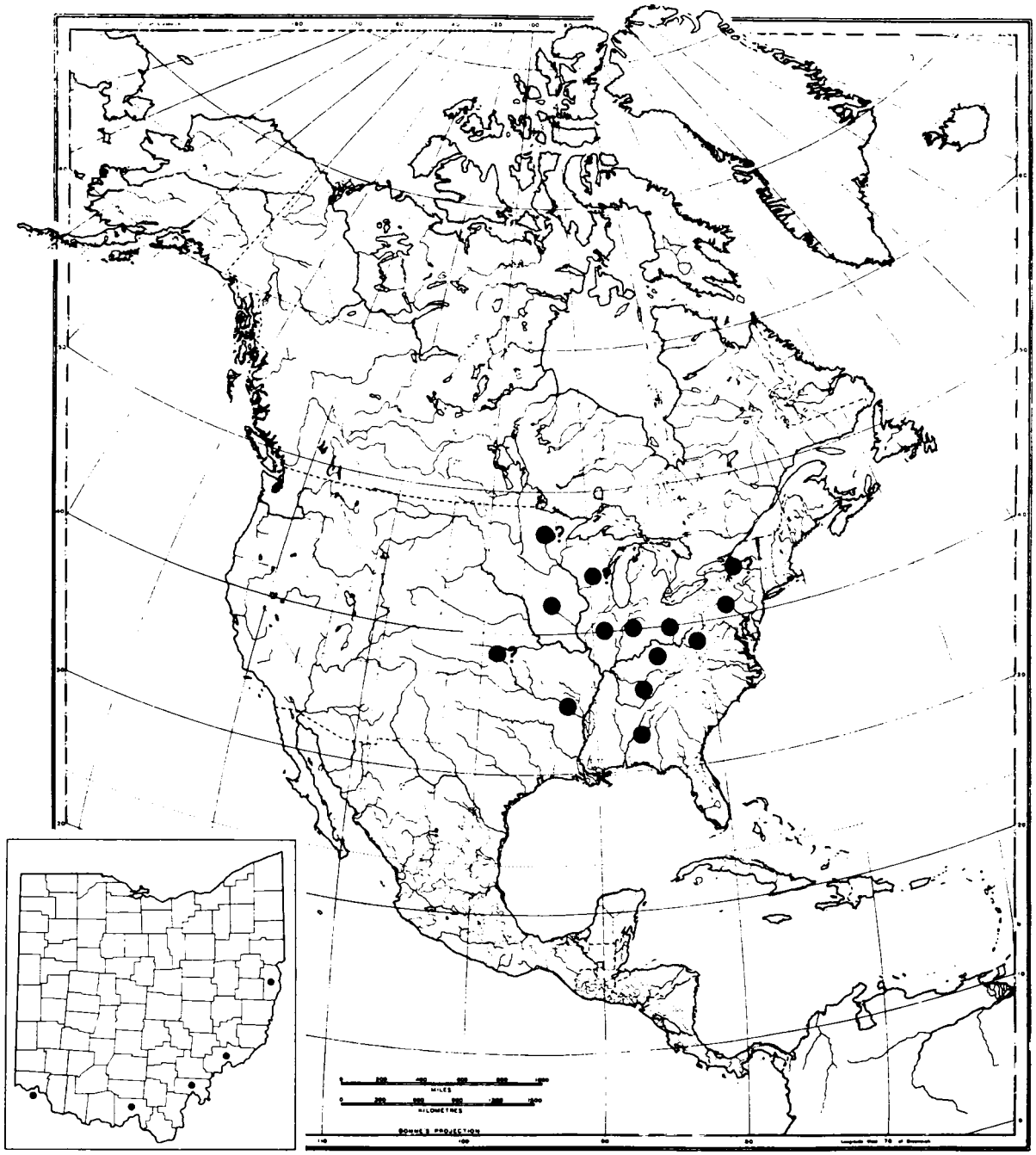


FIGURE 104.—Distribution of *Lampsilis orbiculata* in North America; *inset*, distribution in Ohio.

Lampsilis fallaciosus Simpson 1900, Acad. Nat. Sci. Philadelphia Proc., p. 74, pl. 2, fig. 5.
Lampsilis fallaciosa Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 389.
--- --- Simpson 1914, Descr. cat. Naiades, p. 92.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 268, pl. 89, figs. 1-4.
Lampsilis anodontoides fallaciosa Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 315.
--- --- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 459.

Type locality.—None given.

Diagnosis.—"Shell of medium size, not very thick, much elongated, somewhat inflated, cylindrical; anterior end rounded, posterior end pointed, dorsal and ventral margins almost parallel; posterior ridge rounded; beaks depressed and sculpture as in *anodontoides*; epidermis smooth and shining, greenish-yellow with many dark green rays covering the greater part of the surface; young shells are bright greenish-yellow with grass-green rays; hinge as in *anodontoides;* nacre the same" (F. C. Baker, 1928a, pt. II, p. 268).

Ecology.—Found in muddy sloughs or in pondlike "cut-offs" of the Mississippi River, where there is little current; in Illinois, small streams on mud bottom in shallow water (condensed from Baker, 1928a, pt. II, p. 269).

General distribution (fig. 100).—Upper Mississippi drainage; south to the Cumberland River, Tennessee, and to Arkansas; Red River of the North? (Simpson, 1914).

Distribution in Ohio (inset, fig. 100).—Sterki (1907a, p. 389) gives "Ohio River at Cincinnati (St.) and probably at other places." It does not seem to go all the way up the Ohio River, as Ortmann (1919) does not mention it.

Remarks.—The characters used by Baker to prove the specific rank of this form are all comparative; the shell is smaller and more elongate; it has a more cylindrical shape, the epidermis is smooth and densely rayed; the glochidia are considerably larger. Until the question of the relationship of this form with *L. anodontoides* has been cleared up, I follow the van der Schalies (1950) in treating it as a form of that species.

Lampsilis fasciola Rafinesque 1820
Fig. 101

Lampsilis fasciola Rafinesque 1820, Annales Gén.

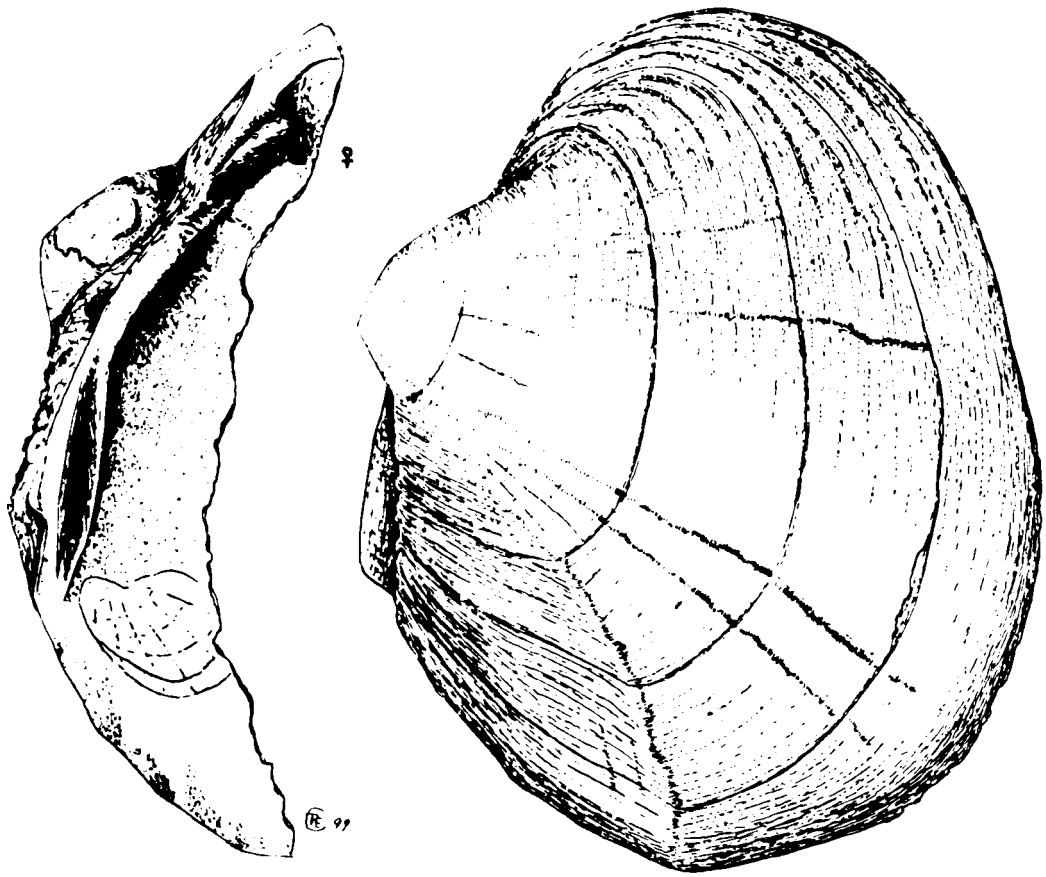


FIGURE 105.—*Lampsilis ovata,* two views, X1; after Call (1900, pl. 39).

Sci. Phys. (Bruxelles), v. 5, p. 299.
Lampsilis multiradiatus Lea 1829, Am. Philos. Soc. Trans., v. 3, p. 434, pl. 9, fig. 15.
Unio multiradiatus Call 1900, Moll. Ind., p. 479, pl. 37.
Lampsilis multiradiata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.
--- --- Simpson 1914, Descr. cat. Naiades, p. 55.
Lampsilis fasciola Ortmann 1919, Najades Pa., p. 309, pl. 20, figs. 1, 2.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 64.
Ligumia fasciola Goodrich 1932, Moll. Mich., p. 109.
Lampsilis fasciola La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 66.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 315.
Lampsilis multiradiatus Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 111.

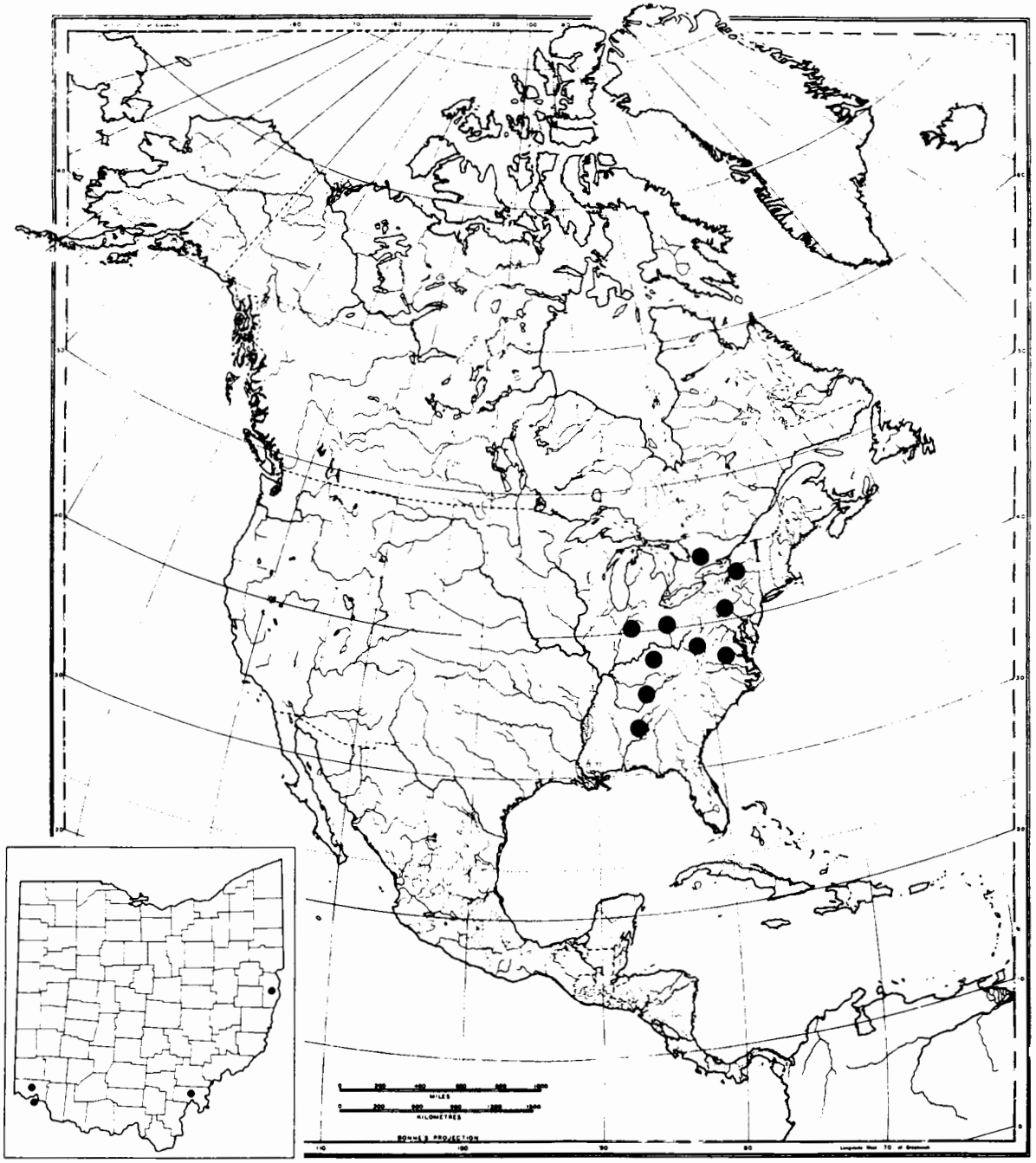


FIGURE 106.–Distribution of *Lampsilis ovata* in North America; *inset,* distribution in Ohio.

Lampsilis fasciola La Rocque 1953, Cat. Recent Moll. Canada, p. 92.
--- --- Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 62.

Type locality.—Kentucky River.

Diagnosis.—Shell ovate, thin to thick, swollen; yellow, green, or brown, and marked with closely set waving dark rays of color; beaks a little raised above the hinge line and with a few folds that are seldom conspicuous; pseudocardinals not very strong, high and single in one valve, double and serrate in the other; lateral teeth curved, not long; nacre white or bluish; female shell less pointed posteriorly than that of the male; L. 67, H. 41.5, D. 23 mm. (condensed from Goodrich, p. 109).

Ecology.—"This species is usually on a more or less solid sand and gravel bottom in riffles and rapid waters. It does not occur in streams as small as Fleming Creek and the upper part of Mill Creek. It is rare in the Huron River below Ann Arbor. Wherever found, it tends to bury itself deeply so that usually only the siphons are to be seen ..." (van der Schalie, 1938, p. 66).

Associations.—Living: MICHIGAN-49, 50, 51, 52, 54; OHIO-43.

General distribution (fig. 102).—Great Lakes and their drainage, but not in their entirety. La Rocque and Oughton (1937, p. 152) gave "Lake Huron, Lake St. Clair and drainage, Detroit River, Lake Erie and drainage, Niagara River and tributaries." The Niagara River record is erroneous, as pointed out by Robertson and Blakeslee (1948, p. 111); it was based on one specimen of *L. orbiculata* (Hildreth) erroneously labeled *L. multiradiatus*. Goodrich (1932, p. 109) points out that it has been collected in the Huron, Belle, Portage, Raisin, and Detroit Rivers but that it does not occur in Lake Erie or the inland lakes of Michigan, except in such lakes as are expansions of rivers.

Distribution in Ohio (inset, fig. 102).—Sterki (1907a, p. 388) gives "both drainages, over the state." Ortmann (1919) is more precise: Sandusky River, Wyandot County; Maumee River, Defiance County; and adds: "In the Ohio-drainage it is practically everywhere."

Geologic range.—Unknown.

Remarks.—This species should be looked for in Ohio in streams of the character of the Huron and Raisin Rivers in Michigan, *i.e.*, the Scioto and its tributaries, the Tuscarawas, and Licking Rivers. Its detailed distribution in the State may shed some light on drainage development. It may also occur in Pleistocene river deposits but so far there are no records.

Lampsilis orbiculata (Hildreth) 1828
Fig. 103

Unio orbiculatus Hildreth 1828, Am. Jour. Sci., v. 14, p. 284.
Unio abruptus Say 1831, Am. Conchology, no. 2, pl. 17.
Unio crassus Conrad 1834, Mon., pt. 4, p. 34, pl. 16.
Unio cyclips Férussac 1835, Guér. Mag., p. 28.
Unio orbiculatus Call 1900, Moll. Ind., p. 492, pl. 50.
Lampsilis orbiculata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 389.
--- --- Simpson 1914, Descr. cat. Naiades, p. 76.
--- --- Ortmann 1919, Najades Pa., p. 320, pl. 20, fig. 8; pl. 21, figs. 1, 2.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 315.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 456.

Type locality.—Muskingum River, Ohio.

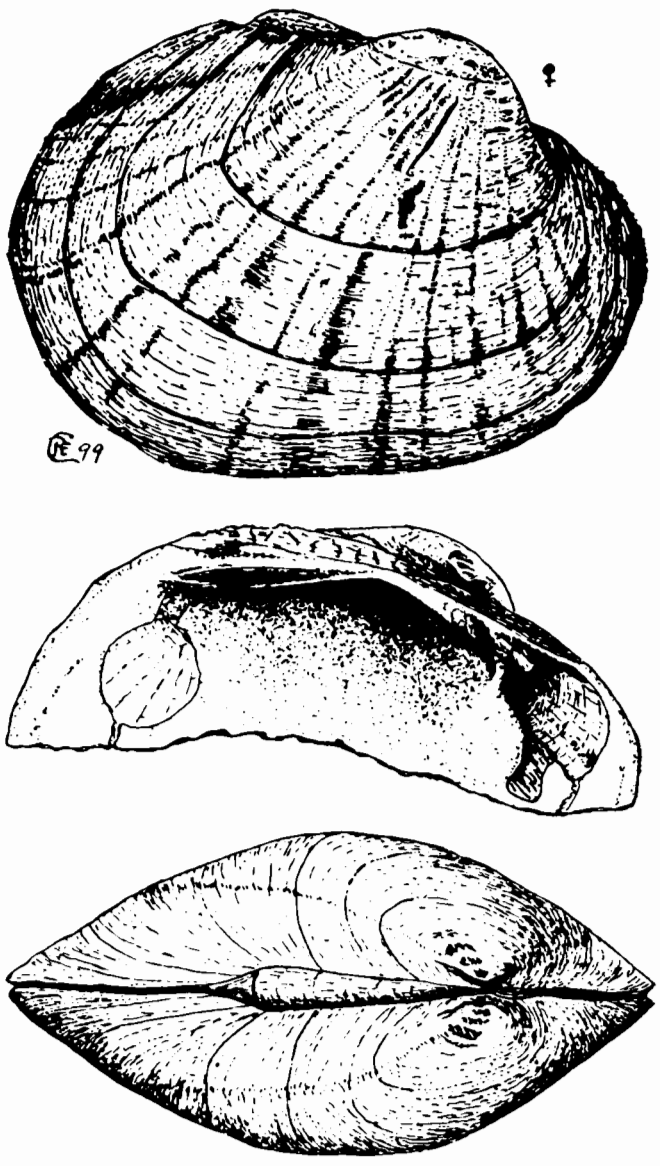


FIGURE 107.—*Lampsilis ovata ventricosa*, three views, X1; after Call (1900, pl. 38).

Diagnosis.—"Shell somewhat inflated with a well-marked posterior ridge, elliptical, solid, gaping at the anterior base; beaks moderately elevated, with very faint sculpture; lunule elongated, surface generally having wide, low, concentric ridges, the rest periods often marked by a sulcus, tawny to pale, dirty olive, sometimes feebly rayed; ligament large and full; left valve with two triangular pseudocardinals, the hinder triangular and large, the anterior small, there is sometimes a third small pseudocardinal behind the other two, there is one strong high lateral; posterior muscle scars large, rather deep; nacre white or salmon tinted. The male is pointed behind about midway up from the base; the female shell has a well-developed post-basal swelling" (Simpson, 1914, p. 76).

Ecology.—No exact data located.

General distribution (fig. 104).—Ohio and Cumberland Rivers; west to the Mississippi River.

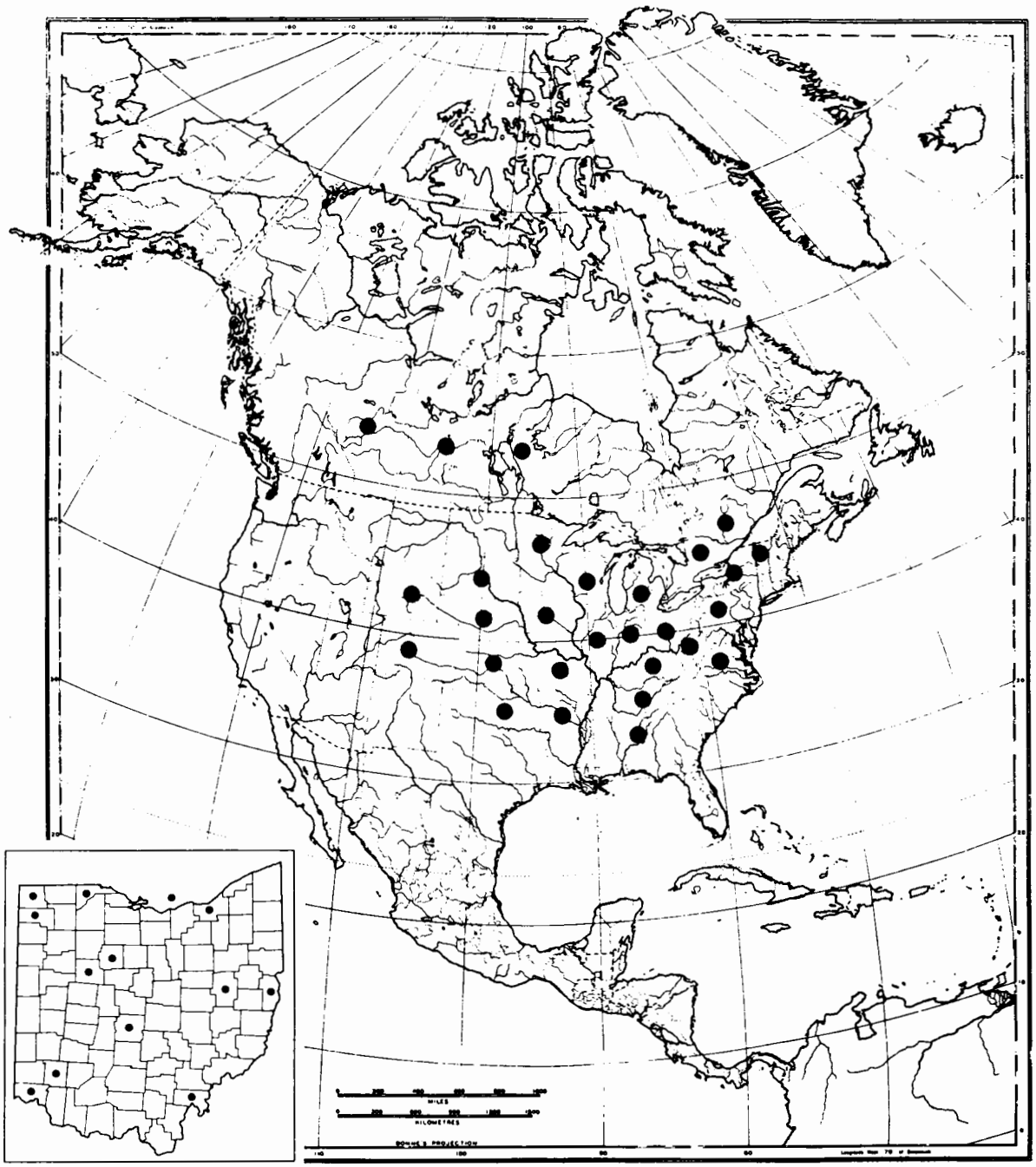


FIGURE 108.—Distribution of *Lampsilis ovata ventricosa* in North America; *inset,* distribution in Ohio.

Distribution in Ohio (inset, fig. 104).–Sterki (1907a, p. 389) gives "Ohio River and probably some of its tributaries." Ortmann (1919) gives Ohio River in Jefferson, Meigs, and Scioto Counties; Muskingum River, Marietta, Washington County (type locality).

Remarks.–Call (1900, p. 493) and the van der Schalies (1950, p. 456) consider *L. orbiculata* and *L. higginsii* (Lea) synonymous, but the latter use the name *L. higginsii* for the Mississippi River form, possibly because they considered it varietally distinct. If the two are synonymous, Lea's name has priority; if they are distinct, the Ohio form would certainly be *L. orbiculata;* hence that name has been used here. Simpson (1914, p. 78) describes the variety *grandis* which he records from Illinois, Iowa, Kansas, and doubtfully from Missouri and the Ohio River. Sterki (1907a, p. 389)

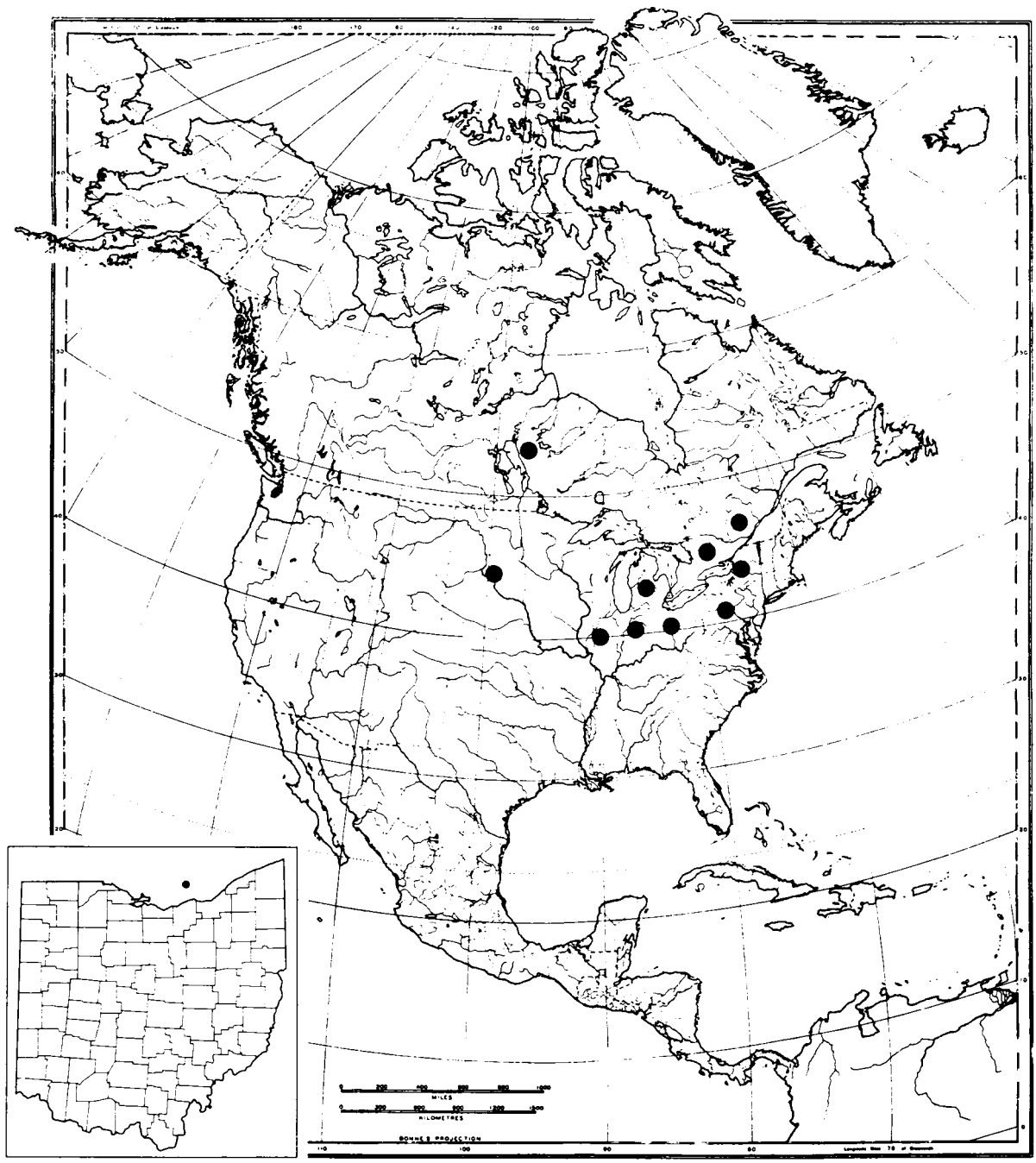


FIGURE 109.–Distribution of *Lampsilis ovata canadensis* in North America; *inset,* distribution in Ohio.

notes that *L. higginsii* (Lea) "is considered a variety of *orbiculata*, by some conchologists; I have not seen it from Ohio."

Lampsilis ovata (Say) 1817
Fig. 105

Unio ovatus Say 1817, Nicholson's Encycl., v. 2, pl. 2, fig. 7.
Lampsilis ovata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.
Lampsilis ventricosa form or var. *ovata* Sterki 1914, Ohio Naturalist, v. 14, p. 271.
Lampsilis ovata Simpson 1914, Descr. cat. Naiades, p. 48.
--- --- Ortmann 1919, Najades Pa., p. 297, pl. 17, figs. 8, 9; pl. 18, figs. 1-3.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 315.

Type locality.—Ohio River and its tributary streams.

Diagnosis.—Shell subrhomboid to elliptical, solid, somewhat inflated, with high, full beaks which have a few coarse ridges nearly parallel with the growth lines; posterior ridge high and sharp; surface with irregular rude growth lines; epidermis rather smooth and shining on the disk, somewhat roughened and wrinkled on the posterior slope, straw color, tawny, pale olive or brownish, rayless or feebly rayed; ligament large and prominent; left valve with two somewhat compressed pseudocardinals in front of the beak, the hinder the smaller, with two rather short, distant laterals, the middle of the hinge plate narrowed and rounded; right valve with two opposite pseudocardinals separated by a deep, parallel-sided socket, the upper smaller and much compressed, with one remote high sharply truncate lateral; beak cavities deep, not wide; muscle scars shallow, smooth, the hinder large, rounded or semilunar; nacre whitish; female shell but slightly inflated in the postbasal region; L. 140, H. 95, D. 55 mm. (condensed from Simpson, 1914, p. 48).

Ecology.—No specific data located.

General distribution (fig. 106).—"Ohio River drainage; Rome, Georgia?" (Simpson, 1914, p. 48).

Distribution in Ohio (inset, fig. 106).—Sterki (1907a, p. 388) gives "Ohio River; Great Miami River" citing Walker as authority. Ortmann (1919) gives Ohio River in Jefferson and Meigs Counties; he considers the Maumee River record as definitely erroneous.

Geologic range.—Unknown except for the subspecies, *q.v.*

Remarks.—The specific identity of this species with the form generally called *Lampsilis ventricosa* (Barnes) is not established. Say's name would have priority over *Unio ventricosus* Barnes, 1823. Both are recognized in this report pending clarification of their status.

Lampsilis ovata ventricosa (Barnes) 1823
Fig. 107

Unio ventricosus Barnes 1823, Am. Jour. Sci., v. 6, p. 267, pl. 13, fig. 14.
--- --- Call 1900, Moll. Ind., p. 480, pl. 38.
Lampsilis ventricosa Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.
--- --- Simpson 1914, Descr. cat. Naiades, p. 38.
--- --- Johnson 1915, Fauna New England, p. 21.
Lampsilis ovata ventricosa Ortmann 1919, Najades Pa., p. 301, pl. 18, fig. 4; pl. 19, figs. 1-3.
Lampsilis ventricosa F. C. Baker 1920, Life of Pleistocene, p. 383.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 63.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 281, pl. 48, fig. 7.
--- --- Goodrich 1932, Moll. Mich., p. 110.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 69.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 316.
Lampsilis ovata ventricosa Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 111, pl. 12, fig. 4.
Lampsilis ventricosa van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454 ff.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 93.
Lampsilis ovata ventricosa Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 55, figs. 47, 48.

Type locality.—Wisconsin and Mississippi Rivers, Prairie du Chien, Wisconsin.

Diagnosis.—Shell large, ovate, very much swollen; hinge line curved, base broadly rounded, posterior end bluntly pointed; epidermis with rough growth lines, yellow to brown; marked with diagonal dark rays,

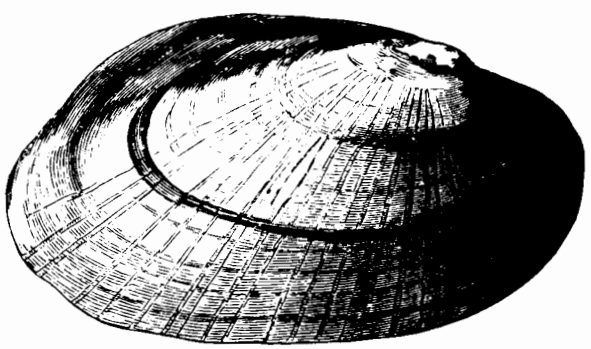


FIGURE 110.—*Lampsilis radiata*, X1; after Hartman and Michener (1874, p. 87, fig. 182).

though not in every case; beaks high, sculptured with a few curving folds; nacre pearly white, a little bluish posteriorly; beak cavity deep, pitted above; pseudocardinals strong, two in each valve; laterals curving, not long, striate; muscle scars deep and wide anteriorly, broad and shallow posteriorly; pallial line broad and iridescent; L. 156, H. 98, D. 50 mm. (modified from Goodrich, 1932, p. 110).

Ecology.—Found on sand and gravel bottom, more rarely in mud, in water 1-4 m. deep, in running water.

Associations.—Living: MANITOBA - 23, 38; MICHIGAN - 43, 44, 45, 49, 50, 51, 52, 53, 54, 56, 57, 59, 60, 62, 64, 65; OHIO - 43; ONTARIO - 1; WISCONSIN - 6, 7. Form *"lurida:"* Living: WISCONSIN - 25, 26, 42, 47, 79, 80. Form *"occidens:"* Living: MINNESOTA - 22a; WISCONSIN - 27, 58, 76, 81, 83, 108, 114, 120, 121, 127, 130, 131, 132, 133.

General distribution (fig. 108).—Entire Mississippi

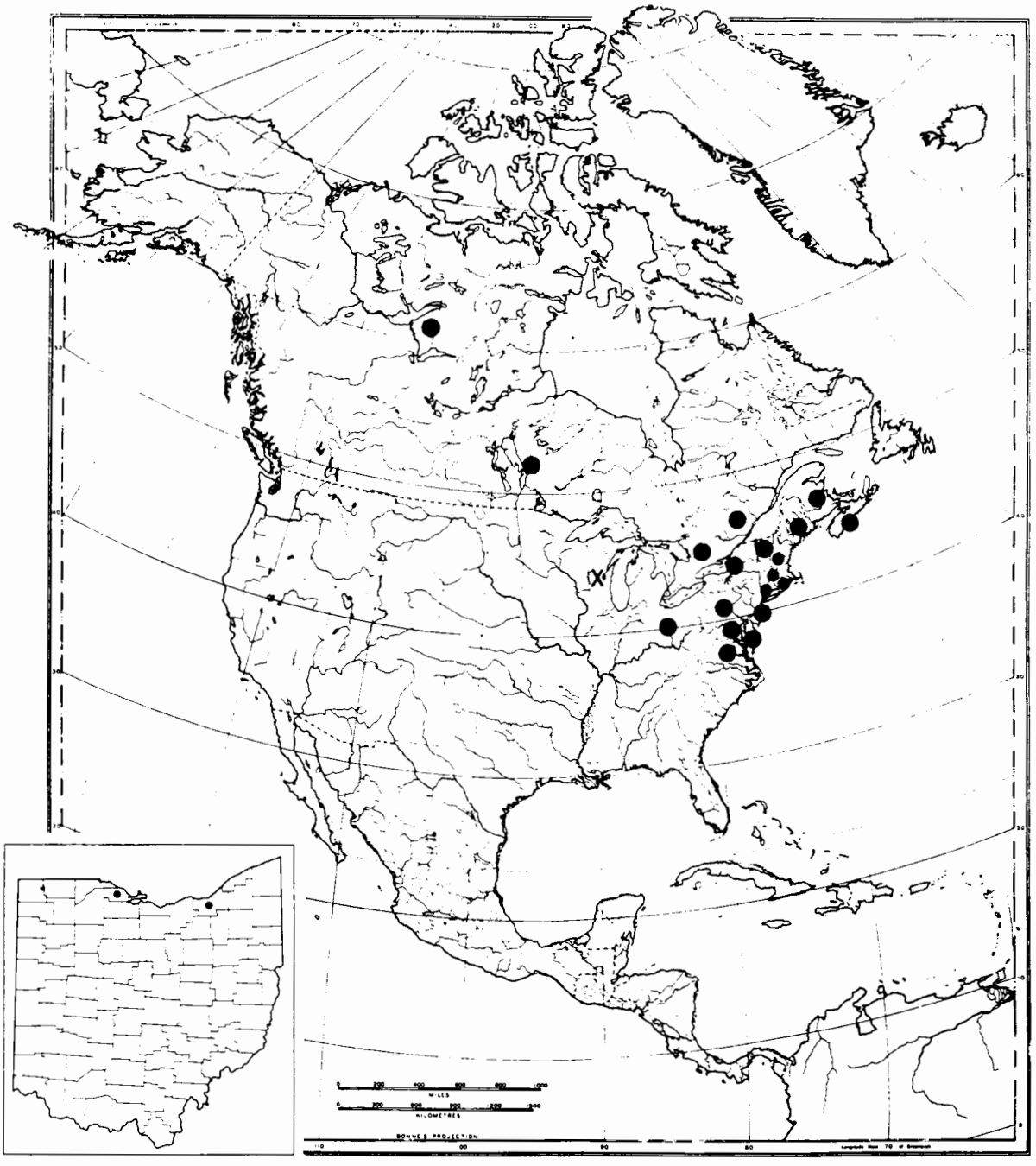


FIGURE 111.—Distribution of *Lampsilis radiata* in North America; *inset,* distribution in Ohio.

drainage; St. Lawrence system; southern drainage of Hudson Bay.

Distribution in Ohio (inset, fig. 108).—Sterki (1907a, p. 388) gives "over the state, decidedly variable, common in Lake Erie, very small to medium sized, of somewhat peculiar shape and appearance, representing a variety." Ortmann (1919) gives Chagrin River, Cuyahoga County; Sandusky River, Wyandot County; Maumee River, Lucas County; Defiance, Defiance County; Beaver Creek, Williams County; Tuscarawas River; Scioto River, Hardin County; Ohio River in Jefferson and Meigs Counties. He separates the Lake Erie form from the typical one. See below, under *L. ventricosa canadensis.*

Remarks.—There is some question as to the identity of *L. ventricosa* with *L. ovata* (Say), already mentioned under the latter species. Robertson and Blakeslee (1948) clearly considered the two identical but the van der Schalies (1950) retain the name *L. ventricosa* for the Mississippi River form. This usage, strengthened by the fact that Ortmann and Walker (1922) recognized *L. ventricosa* as valid, is retained here.

Geologic range.—Recorded by F. C. Baker (1920a, p. 383) for beds of Sangamon and late Wisconsin ("Wabash") age.

Lampsilis ovata canadensis (Lea) 1857

Unio canadensis Lea 1857, Acad. Nat. Sci. Philadelphia Proc., v. 1, p. 85.
Lampsilis ventricosa canadensis Ortmann 1919, Najades Pa., p. 307, pl. 19, figs. 4, 5.
--- --- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 316.
--- --- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 111, pl. 13, fig. 8.
--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 94.

Type locality.—Not given, but most probably St. Lawrence River or one of its tributaries in Canada.

Diagnosis.—Smaller than the typical form, some specimens with pink nacre; commonly marked with black rays against a light yellow background (modified from Goodrich, 1932).

General distribution (fig. 109).—Hudson Bay drainage; Lake Huron; Lake St. Clair; Lake Erie; doubtfully, Lake Ontario, St. Lawrence and its tributaries; Ottawa River and its tributaries.

Distribution in Ohio (inset, fig. 109).—Sterki (1907a, p. 388) noted that the Lake Erie specimens represented a variety but did not associate it with Lea's name. Ortmann (1919) records *L. ovata canadensis* from Lake Erie in Erie County, Ohio.

Geologic range.—Unknown.

Ecology.—In Goodrich's system, this is the Great Lakes form of the species. There is no doubt that the lake form is distinguishable from the river form to the south but specimens indistinguishable from the lake form also occur in the Ottawa and St. Lawrence Rivers and the rivers of the Hudson Bay drainage.

Remarks.—Simpson (1914, p. 39) includes this variety in the synonymy of *L. ventricosa,* but it is recognized by Robertson and Blakeslee (1948). Until its status is cleared up, it is recognized here as the Lake Erie form in Ohio.

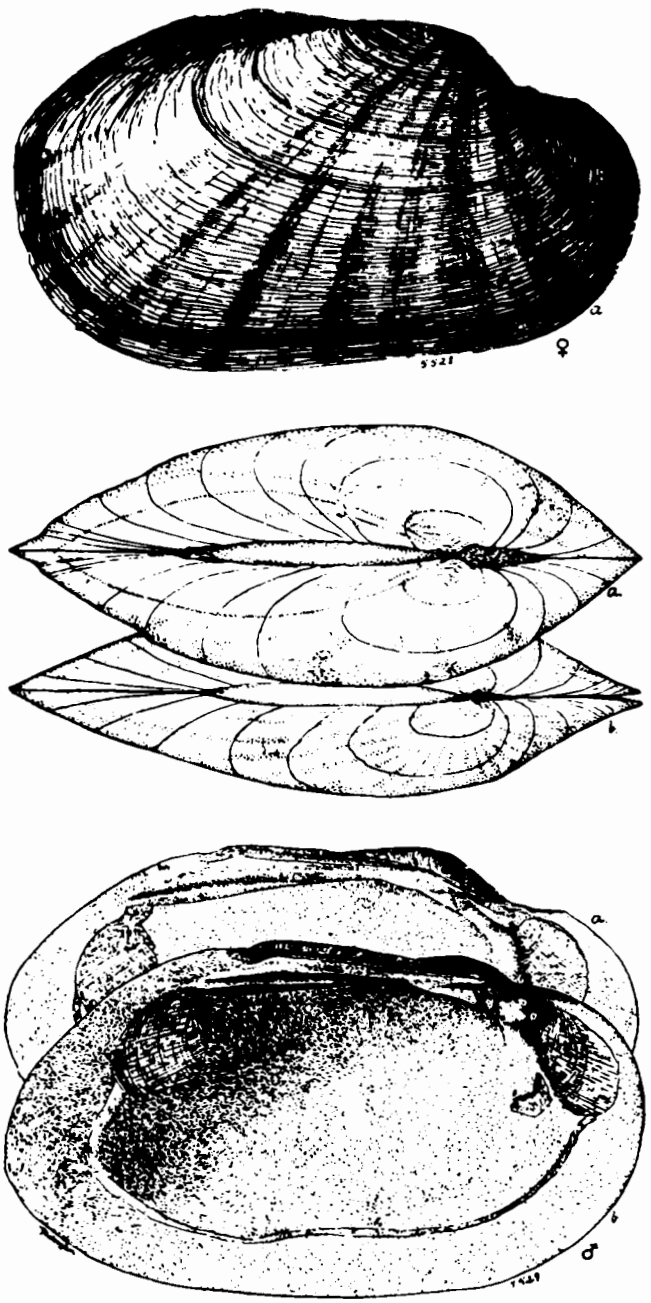


FIGURE 112.—*Lampsilis radiata siliquoidea,* five views, X1; after Call (1900, pl. 36).

Lampsilis radiata (Gmelin) 1792
Fig. 110

Mya radiata Gmelin 1792, Syst. Nat., 13th ed., p. 3220.
Unio virginiana Lamarck 1819, Animaux sans vertèbres, v. 6, p. 79.
Lampsilis radiata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.
--- --- Simpson 1914, Descr. cat. Naiades, p. 64.
--- --- Johnson 1915, Fauna New England, p. 22.
--- --- Ortmann 1919, Najades Pa., p. 292, pl. 17, figs. 6, 7; Ohio and Indiana records certainly wrong.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 301.
--- --- van der Schalie 1936, Nautilus, v. 49, p. 80.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 93.
Lampsilis radiata radiata Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 58, fig. 53.

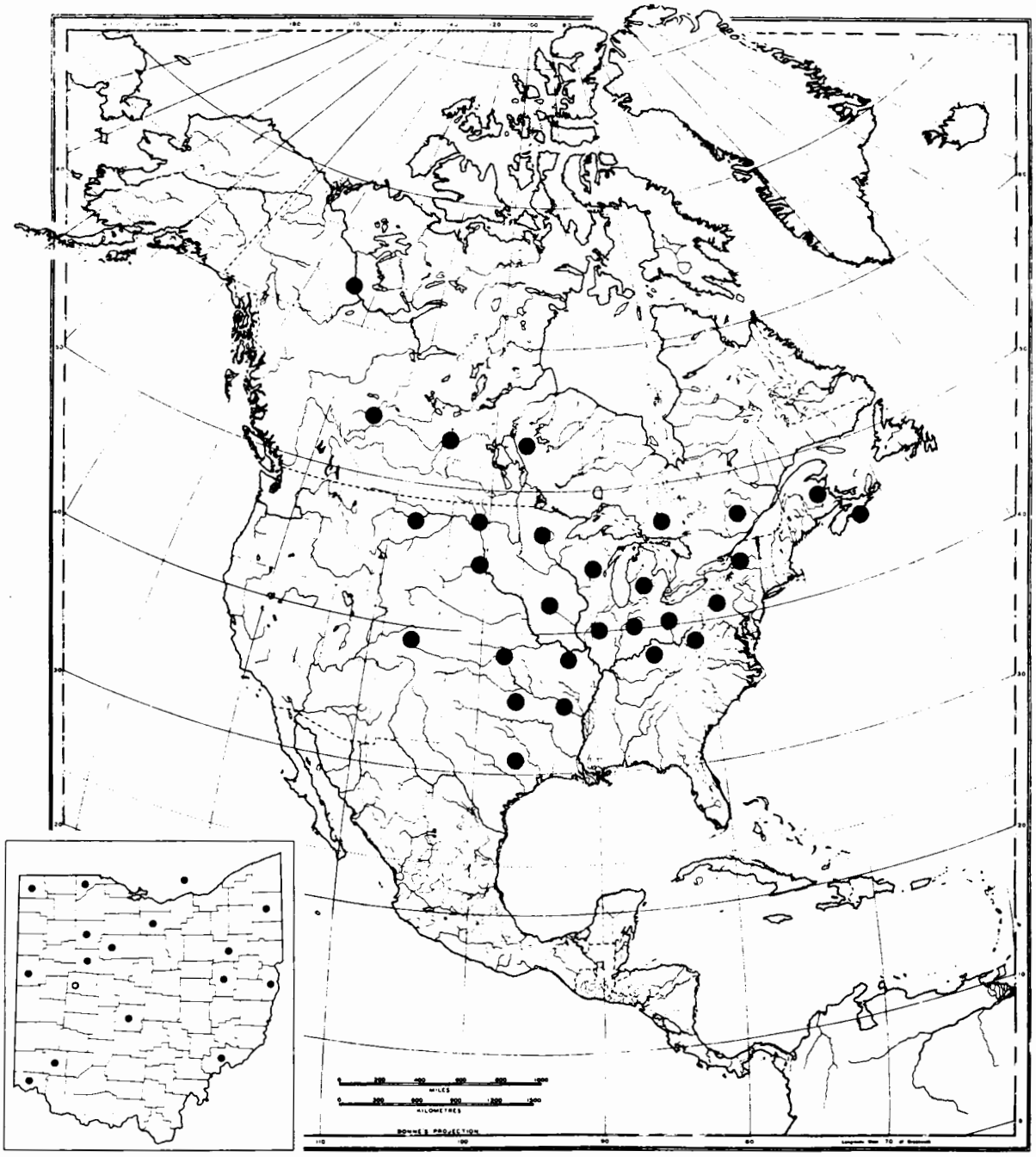


FIGURE 113.–Distribution of *Lampsilis radiata siliquoidea* in North America; *inset*, distribution in Ohio.

Type locality.—Virginia.

Diagnosis.—Shell long obovate, subsolid, subcompressed; posterior ridge feeble or wanting; beaks rather sharp but not full or high, with delicate doubly looped sculpture; epidermis concentrically wrinkled, in many cases looped, showing numerous more or less distinct rays on a yellowish or brownish-green ground; the left valve has two pseudocardinals, the hinder under the beak, and two straight laterals; the right valve has two pseudocardinals, the upper smaller and compressed, and a single subtruncated lateral; beak cavities not deep, compressed; muscle scars shallow; nacre bluish white, some specimens salmon reddish or purplish, dull, somewhat thickened in front; female shell shorter than that of the male, wider at the posterior end; male shell commonly drawn out and feebly biangulate; L. (male) 90, H. 50, D. 27 mm.; L. (female) 80, H. 52, D. 27 mm. (modified from Simpson, 1914, p. 64).

Ecology.—"It occurs in rivers and lakes of all sizes, usually on gravel or sand bottoms, and occasionally on mud. It is usually absent from the smaller creeks and ponds" (Clarke and Berg, 1959, p. 60).

Associations.—Living: NEW YORK - 2a, 3a, 5b, 5c, 6, 15a, 15b, 23, 29, 30, 32, 35, 38, 40b, 41, 45; ONTARIO - 1, 9, 10. Variety *"borealis:"* Living: NEW YORK - 15b, 32, 35, 40b, 42, 43b, 45.

General distribution (fig. 111).—St. Lawrence and Atlantic drainages; Manitoba; Hudson Bay drainage.

Distribution in Ohio (inset, fig. 111).—Sterki (1907a, p. 388) gives only one Ohio record, Portage River, which he has verified. Portage River flows into Lake Erie at Port Clinton, Ottawa County, Ortmann (1919) says that the Ohio and Indiana records are certainly wrong. I cannot feel as certain as Ortmann does on this point. The specimens seen by Sterki may have been extreme variants of *L. siliquoidea*, but they may equally have been true *L. radiata* brought into Portage River by a fish host infected in the rivers of the Lake Huron drainage where *L. radiata* does occur.

Geologic range.—Unknown.

Remarks.—In spite of the variability exhibited by this species, it is possible, in most of the range of the species, to distinguish typical *L. radiata radiata* from *L. radiata siliquoidea*. The texture of the epidermis is a useful character: in *L. radiata radiata* it is somewhat roughened, whereas in *L. radiata siliquoidea* it is generally smooth and bright. The shape of the pseudocardinals is also helpful: those of *L. radiata radiata* are triangular and almost perpendicular to the hinge line; those of *L. radiata siliquoidea* are lamellar rather than triangular and almost parallel to the hinge line. Nevertheless, the difficulty of separating the two is so great in some areas, notably in central New York, that Clarke and Berg (1959, p. 59) have suggested that "gene exchange has occurred" between the two. They have accordingly considered the two forms as constituting a single species.

Lampsilis radiata siliquoidea (Barnes) 1823
Fig. 112

Unio luteola Lamarck 1819, Animaux sans vertèbres, v. 6, p. 79.
Unio siliquoideus Barnes 1823, Am. Jour. Sci., v. 6, p. 269, pl. 13, fig. 15.
Unio inflatus Barnes 1823, *ibid.*, p. 266.
Unio rosaceus De Kay 1843, Zoology N. Y., v. 5, p. 192, pl. 39, figs. 355, 356; pl. 40, fig. 357.
Unio luteolus Call 1900, Moll. Ind., p. 478, pl. 36.
Lampsilis luteolus Dall 1905, Harriman-Alaska Exped., v. 13, p. 125.
Lampsilis luteola Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.
Lampsilis luteola rosacea Sterki 1907, *ibid.*
Lampsilis luteola Simpson 1914, Descr. cat. Naiades, p. 60.
Lampsilis luteola rosacea Simpson 1914, *ibid.*, p. 62.
--- --- --- Johnson 1915, Fauna New England, p. 22.
Lampsilis luteola Ortmann 1919, Najades Pa., p. 283,

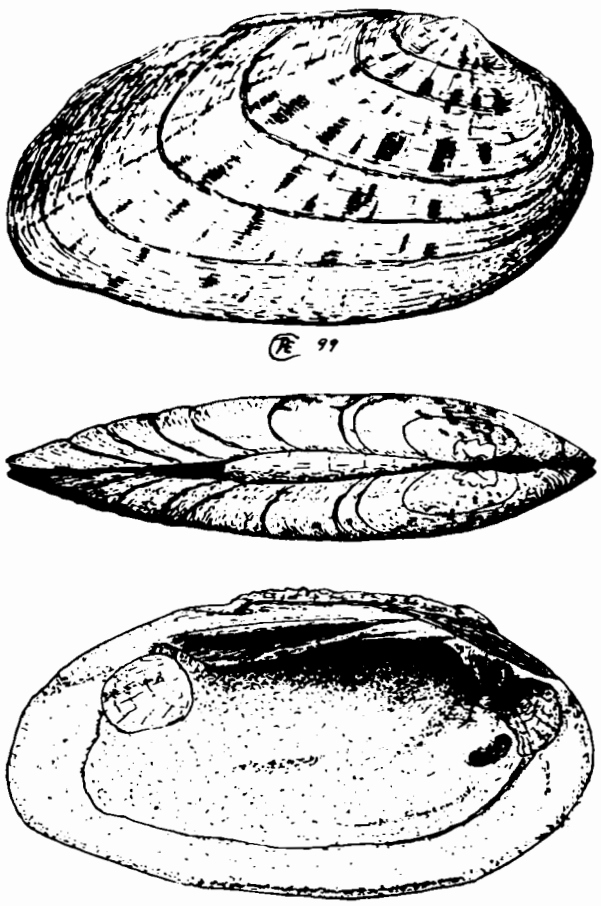


FIGURE 114.—*Ptychobranchus fasciolare*, three views, X1; after Call (1900, pl. 19).

pl. 17, figs. 1, 2.

Lampsilis luteola rosacea Ortmann 1919, *ibid.*, p. 289, pl. 17, figs. 3-5.

Lampsilis luteola F. C. Baker 1920, Life of Pleistocene, p. 383.

Lampsilis siliquoidea Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 61.

--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 270, pl. 89, figs. 5-8; pl. 90, fig. 1.

Lampsilis siliquoidea rosacea F. C. Baker 1928, *ibid.*, p. 277, pl. 91, figs. 1-4.

Lampsilis siliquoidea Goodrich 1932, Moll. Mich., p. 110.

Lampsilis siliquoidea rosacea Goodrich 1932, *ibid.*, p. 111.

Lampsilis siliquoidea La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.

Lampsilis siliquoidea rosacea La Rocque and Oughton 1937, *ibid.*

Lampsilis siliquoidea van der Schalie 1938, Mich.

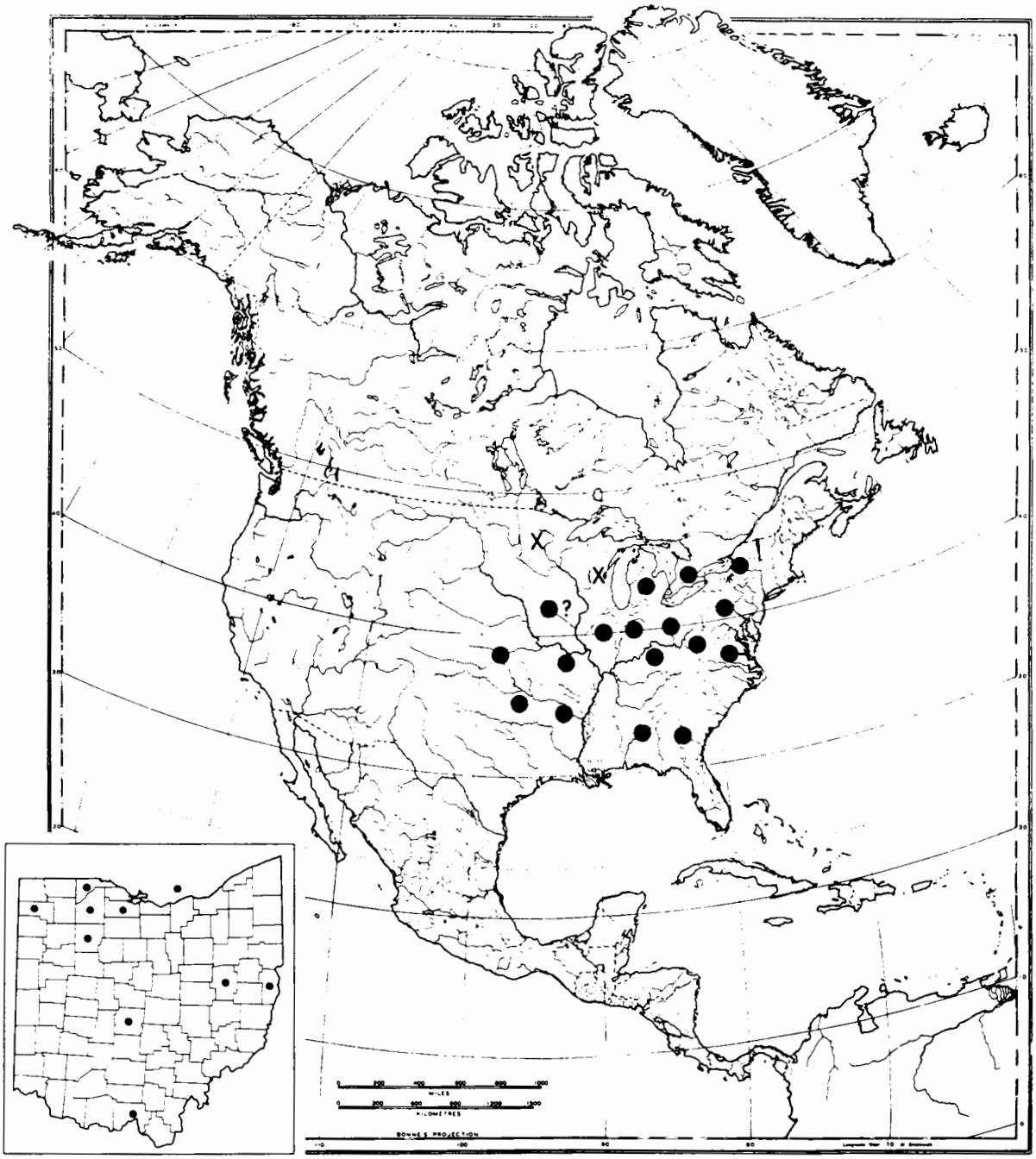


FIGURE 115.–Distribution of *Ptychobranchus fasciolare* in North America; *inset*, distribution in Ohio.

Univ. Mus. Zoology Misc. Pub. 40, p. 67.
Lampsilis siliquoidea rosacea van der Schalie 1938, *ibid.*, p. 68.
Lampsilis siliquoidea Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 315.
Lampsilis siliquoidea rosacea Goodrich and van der Schalie 1944, *ibid.*, p. 316.
Lampsilis siliquoidea Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 110, pl. 12, fig. 2.
Lampsilis siliquoidea rosacea Robertson and Blakeslee 1948, *ibid.*, p. 110, pl. 12, fig. 1.
Lampsilis siliquoidea La Rocque 1953, Cat. Recent Moll. Canada, p. 93.
Lampsilis siliquoidea rosacea La Rocque 1953, *ibid.*, p. 93.
Lampsilis radiata siliquoidea Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 60, figs. 51, 52.
Lampsilis siliquoidea Zimmerman 1960, Ohio Jour. Sci., v. 60, p. 20.
--- --- La Rocque 1960, Internat. Geol. Cong., pt. 4, p. 136.

Type locality.—Wisconsin River, Wisconsin.

Diagnosis.—Shell thick, elongate-ovate, swollen, smooth; yellow to reddish brown; growth lines coarse and rough toward the base; rest scars more or less crowded and varying in conspicuousness; nacre white, pallial line a little channelled anteriorly; one large elevated slightly curving pseudocardinal in one valve, together with a long curving lateral tooth; two triangular pseudocardinals and two sharp-edged curving laterals in the other valve; anterior muscle scars deep; posterior scars scarcely impressed; L. 100, H. 58, D. 37 mm.

Ecology.—This is "found under a number of conditions, but there is no doubt that it prefers rather quiet water and sandy-muddy bottoms. Strong currents and rough bottoms do not suit it, and although occasionally found in riffles, it probably has in such cases been washed out of the quieter pools. In the quiet water below riffles where there is more or less muddy bottom, or in slowly running water with fine gravel, sand, and mud, it is abundant" (Ortmann, 1919, p. 288, quoted by van der Schalie, 1938, p. 68).

The form *rosacea* is a naiad of lakes, where it is very abundant on rocky or sand bottom in water from a few centimeters to 2 meters or more in depth. Of this form in Lake Erie, Ortmann writes: "In Presque Isle Bay ... where it is a common shell, it is found everywhere on the sandy and gravelly shores, in shallow water, and down to a depth of about fifteen feet in sand and mud. It also is found in the beach pools of Presque Isle, upon sandy-muddy bottom, and is one of the few shells existing in the open lake, being frequently thrown out alive by the surf" (Ortmann, 1919, p. 292).

Associations.—Living: MICHIGAN-42, 43, 44, 45, 48, 49, 50, 51, 52, 66; NEW YORK-15a, 23, 29, 33, 35; OHIO-43; ONTARIO-5, 7, 9; QUEBEC-2, 5, 7, 8; WISCONSIN-1, 6, 7, 17, 27, 54, 58, 76, 78, 80, 81, 83, 105, 114, 117, 120, 121, 127, 130, 131, 132, 133. Fossil: W-45, 46, 47. Form *"rosacea:"* Living: MANITOBA-23, 36, 38; MINNESOTA-13a, 18; WISCONSIN-9, 12, 16, 23, 25, 29, 42, 47, 59, 79, 82, 85, 86, 89, 93, 106, 122, 123.

General distribution (fig. 113).—Mohawk River, New York, west to Iowa, Kansas, and Missouri, north to Ontario, Michigan, and Minnesota, south to Kentucky, Oklahoma, and West Virginia (F. C. Baker, 1928a, pt. II, p. 274). To this should be added "northward to Mackenzie River." La Rocque and Oughton (1937) note that the species is absent from the Lake Superior drainage and Lake Ontario, in Canada.

The general distribution of the form *rosacea* may be summarized as follows: New York west to North Dakota, north to Minnesota, Moose River, and north shore of Lake Superior, south to northern Illinois, northern Indiana, and northern Ohio. It also occurs in the St. Lawrence and Mackenzie drainages.

Distribution in Ohio (inset, fig. 113).—Sterki (1907a,

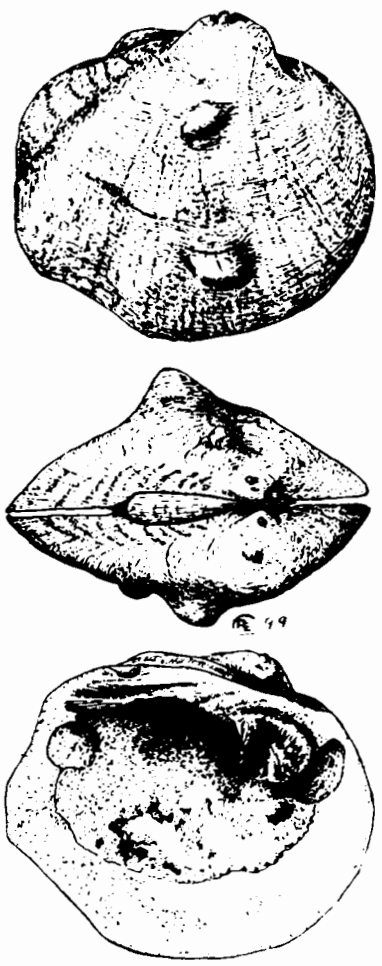


FIGURE 116.—*Obliquaria reflexa,* three views, X1; after Call (1900, pl. 27).

p. 388) gives "over the state, common and variable; common in Lake Erie and decidedly variable, some forms being very small." He noted the "variety" *rosacea* only for Lake Erie. Ortmann (1919) gives Sandusky River, Wyandot County; a creek in Huron County; Cedar and Swan Creeks and the Maumee River in Lucas County; St. Marys River, Mercer County; Blanchard River, Hancock County; Silver and Beaver Creeks, Williams County; Mahoning River, Trumbull County; West Branch Nimishillen Creek, Stark County; the Tuscarawas River; Wolfe Creek, Washington County; Scioto River, Hardin County; Ohio Canal, Franklin County; Ohio River in Jefferson County.

Geologic range.—Recorded by Baker (1920a, p. 383) for beds of Sangamon, Peorian, and late Wisconsin ("Wabash") age.

Remarks.—Van der Schalie (1938, p. 68-69) had reservations concerning the status of *rosacea*. Clarke

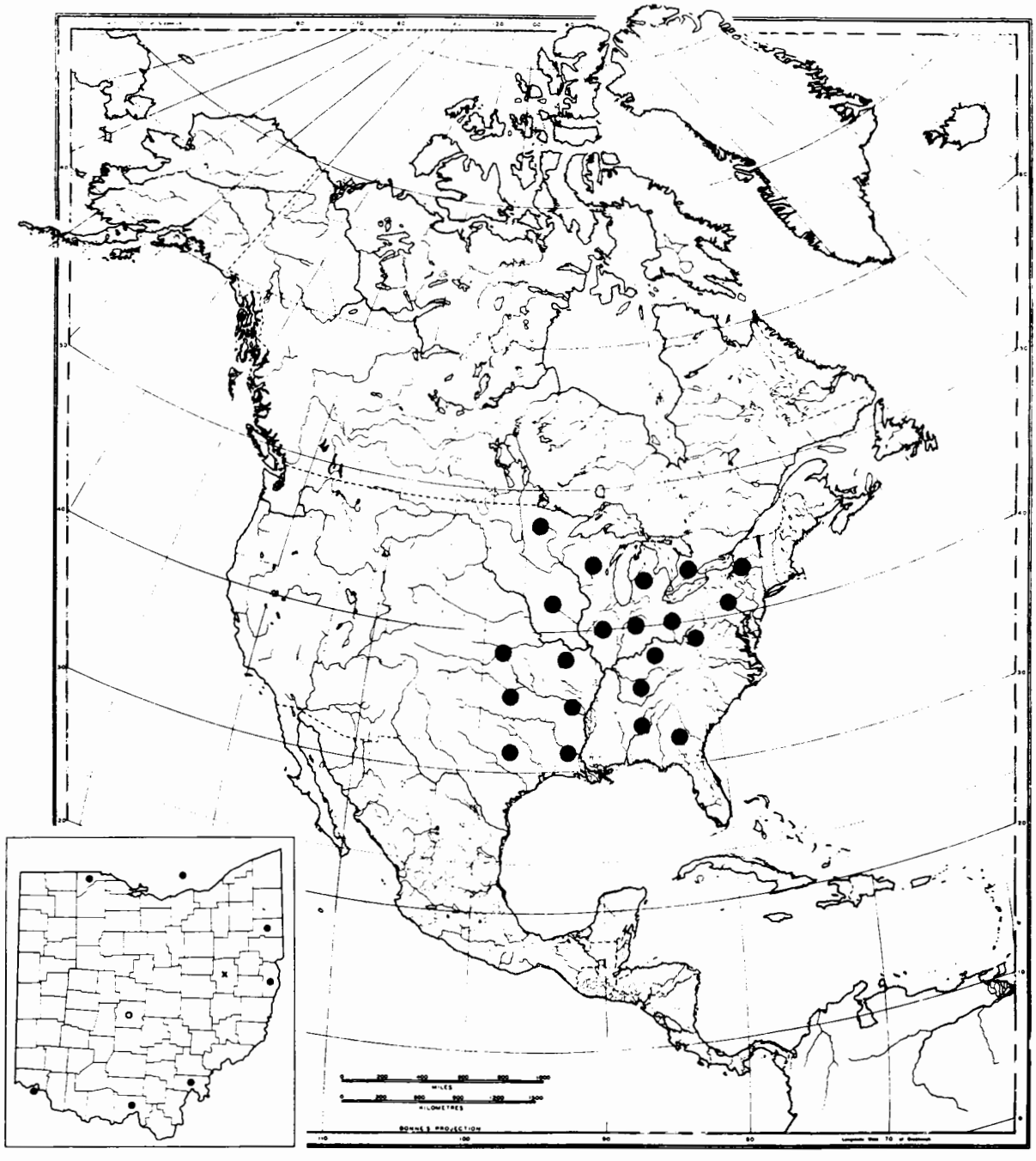


FIGURE 117.—Distribution of *Obliquaria reflexa* in North America; *inset*, distribution in Ohio.

and Berg (1959, p. 58) have reduced it to synonymy under *L. radiata radiata* (in part) and *L. radiata siliquoidea* (in part).

Genus *Ptychobranchus* Simpson 1900

Ptychobranchus Simpson 1900, Acad. Nat. Sci. Philadelphia Proc. 1900, p. 79 (*fide* Neave).
Ptychobranchus Walker 1918, Synopsis and cat. freshwater Moll., p. 66.
Ptychobranchus Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 41.
Ptychobranchus F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 300.
Ptychobranchus La Rocque 1953, Cat. Recent Moll. Canada, p. 98.

Type.—*Unio phaseolus* Hildreth.

Diagnosis.—Shell triangular, solid, old specimens becoming arcuate; umbonal region rather elevated; beak sculpture consisting of faint somewhat broken ridges which have a tendency to be doubly looped; posterior ridge rounded but well developed; epidermis commonly painted with wavy hairlike rays or broken radiating bars which show a tendency to form square spots; hinge plate rather wide and flat; pseudocardinals small, low, triangular and roughened; laterals club shaped, remote.

Ptychobranchus fasciolare Rafinesque 1820
Fig. 114

Obliquaria (Ellipsaria) fasciolaris Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 303.
Unio phaseolus Hildreth 1828, Am. Jour. Sci., v. 14, p. 283.
--- --- Call 1900, Moll. Ind., p. 454, pl. 19.
Ptychobranchus phaseolus Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.
--- --- Simpson 1914, Descr. cat. Naiades, p. 333.
Ellipsaria fasciolaris Ortmann 1919, Najades Pa., p. 208, pl. 13, figs. 1-3.
Ptychobranchus phaseolus F. C. Baker 1920, Life of Pleistocene, p. 383.
Ptychobranchus fasciolare Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 42.
--- --- Frierson 1927, Check list N. Am. Naiades, p. 64.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 300: Wisconsin records erroneous.
--- --- Goodrich 1932, Moll. Mich., p. 100.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 153.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 61.
Ptychobranchus fasciolaris Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 319.
Ptychobranchus fasciolare Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 104, pl. 13, fig. 7.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 98.

Type locality.—Ohio, Wabash, and Kentucky Rivers.

Diagnosis.—Shell nearly twice as long as high; thick, compressed, yellow to brown and marked in the young with lines of color radiating from the beaks; beaks low, sculptured with a few obscure folds; pseudocardinals solid, but low, not very large; laterals strong; beak cavity shallow, pitted; nacre white and furrowed; L. 93, H. 53, D. 30 mm. (modified from Goodrich, 1932, p. 100).

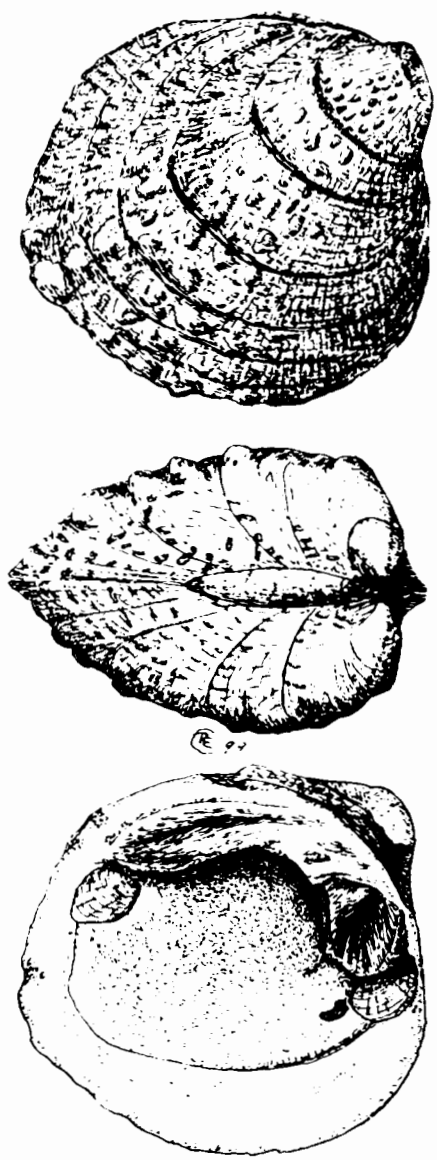


FIGURE 118.—*Cyprogenia irrorata*, three views, X1; after Call (1900, pl. 43).

Ecology.—This is "usually found buried deep in an unshifting sand and gravel bottom in rapids and seems to show a definite aversion towards ponded or backwater conditions. This is of interest because in Lake Erie a form occurs which does live under lake conditions. Its associates are *Micromya iris, Lampsilis fasciola,* and *Elliptio dilatatus*" (van der Schalie, 1938, p. 61).

Associations.—Living: MICHIGAN-49, 50, 51, 52, 54; OHIO-43.

General distribution (fig. 115).—Ohio, Tennessee, and Cumberland River systems; Lower Peninsula of Michigan; Kansas; Arkansas; Indian Territory; Louisiana. Lake St. Clair and its drainage; Niagara River and tributaries.

Distribution in Ohio (inset, fig. 115).—Sterki (1907a, p. 390) gives "both drainages, Lake Erie." Ortmann (1919) is more specific: Lake Erie, Erie County; Sandusky River, Sandusky County; Maumee River, Lucas County; Otsego Rapids, Wood County; Defiance, Defi-

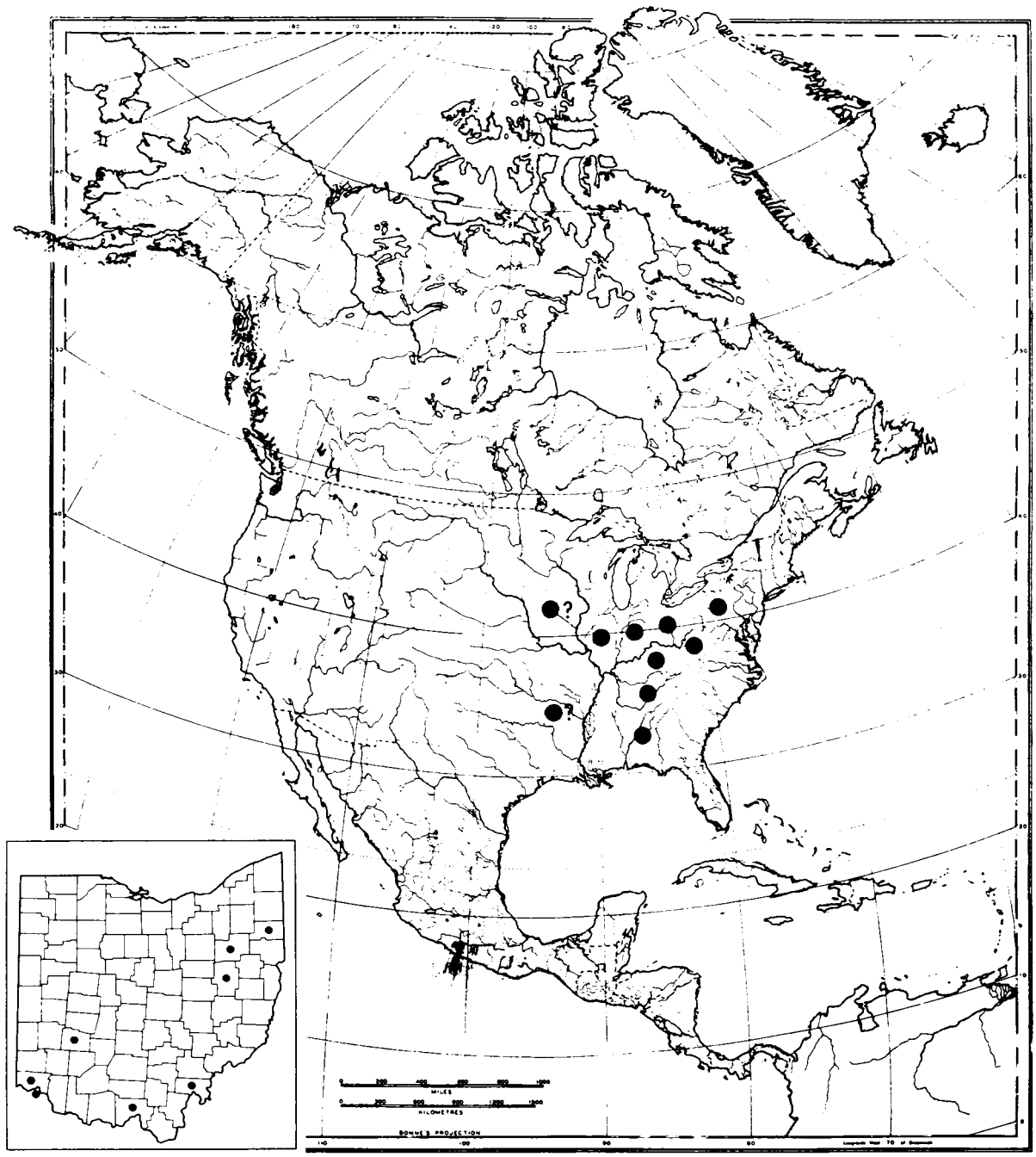


FIGURE 119.—Distribution of *Cyprogenia irrorata* in North America; *inset,* distribution in Ohio.

ance County; Tuscarawas River; Ohio River in Jefferson and Scioto Counties.

Geologic range.—Pleistocene, Don beds, Toronto, Ontario, Canada. Sangamon beds (F. C. Baker, 1920a, p. 383).

Remarks.—Baker (1928, Naut. 42, p. 52) has described the variety *lacustris,* type locality Chautauqua Lake, New York. The variety was not recognized by Goodrich and van der Schalie (1932) who refer the Lake Erie specimens to the typical form, but Robertson and Blakeslee (1948, p. 104) recognize Baker's form and refer to it not only the Chautauqua Lake material but also that from Lake Erie. The ecology of the two forms seems to be different (van der Schalie, 1938, p. 61) and the Lake Erie material may be properly referred to *P. fasciolare lacustre* (Baker).

Genus *Obliquaria* Rafinesque 1820

Obliquaria Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 301 (*fide* Neave).
Obliquaria Walker 1918, Synopsis and cat. fresh-water Moll., p. 67.
Obliquaria F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 210.
Obliquaria La Rocque 1953, Cat. Recent Moll. Canada, p. 96.

Type.—*Obliquaria reflexa* Rafinesque.

Diagnosis.—Shell inflated, solid, oval, ending in a rather sharp point behind, having a row of large compressed longitudinal knobs running from the beaks to the center of the base, those of one valve alternating with the knobs of the other, and a well developed posterior ridge, the space between the ridge and the knobs somewhat excavated; posterior slope and in some cases the entire shell more or less corrugately sculptured; beaks prominent, incurved, pointed slightly forward toward a rather well developed lunule; beak sculpture strong, consisting of four or five heavy parallel ridges which fall low in front but are curved upward behind; epidermis smooth, generally shining, painted with numerous delicate wavy darker broken rays; pseudocardinals strong, distinct, and ragged; laterals short, nearly straight; front part of the shell very solid, abruptly becoming rather thin just behind the knobs.

Obliquaria reflexa Rafinesque 1820
Fig. 116

Obliquaria (Quadrula) reflexa Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 306.
Unio cornutus Barnes 1823, Am. Jour. Sci., v. 6, p. 122, pl. 4, figs. 5a-c.
--- --- Call 1900, Moll. Ind., p. 466, pl. 27.
Obliquaria reflexa Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.
--- --- Simpson 1914, Descr. cat. Naiades, p. 330.
--- --- F. C. Baker 1920, Life of Pleistocene, p. 383.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 42.
--- --- Frierson 1927, Check list N. Am. Naiades, p. 65.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 210, pl. 76, figs. 1-3.
--- --- Goodrich 1932, Moll. Mich., p. 101.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 153.
--- --- Goodrich and van der Schalie 1944, Revis.

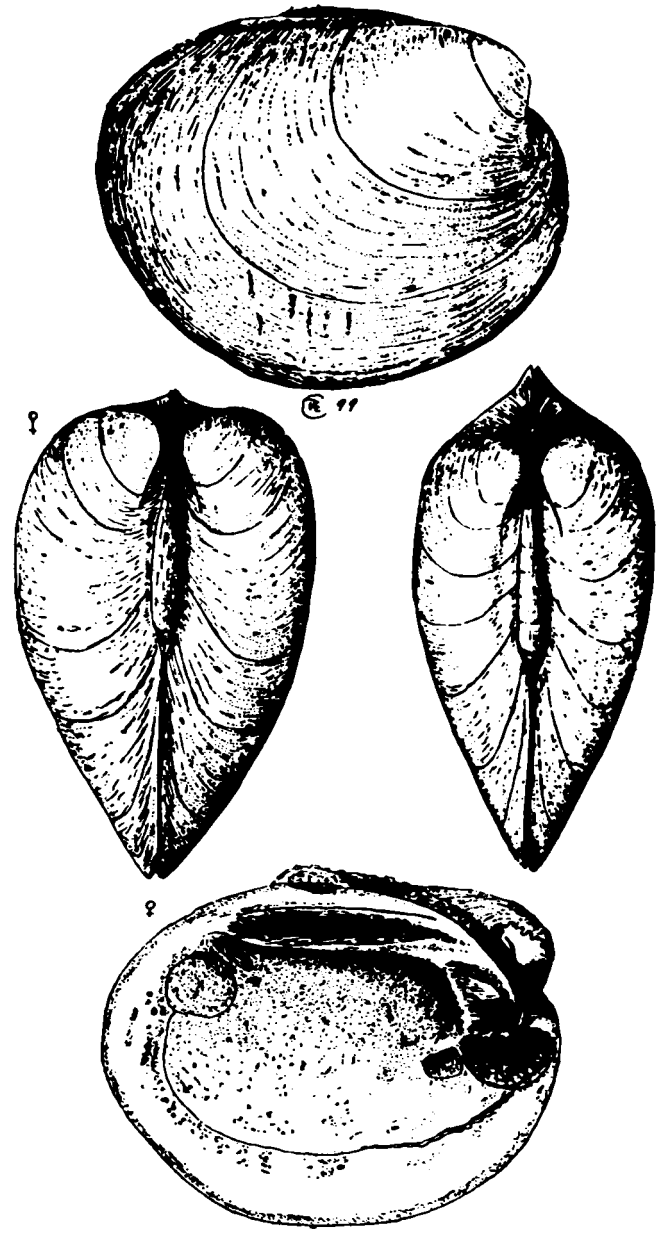


FIGURE 120.—*Obovaria olivaria,* four views, X1; after Call (1900, pl. 53).

Moll. Ind., p. 318.

Obliquaria reflexa Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 101, pl. 13, figs. 11, 12.

--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.

--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 96.

Type locality.—Kentucky River and Letart Falls, Meigs County, Ohio.

Diagnosis.—Shell thick, swollen, nearly as high as long; yellow and rayed to nearly black and dull; disk with large somewhat elongate pustules, those on one valve alternating with the pustules on the other; beak sculpture of prominent parallel ridges, four to five; pseudocardinals strong, striate; laterals a little curved; muscle scars distinct; L. 53.5, H. 47, D. 39 mm. (condensed from Goodrich, 1932, p. 101).

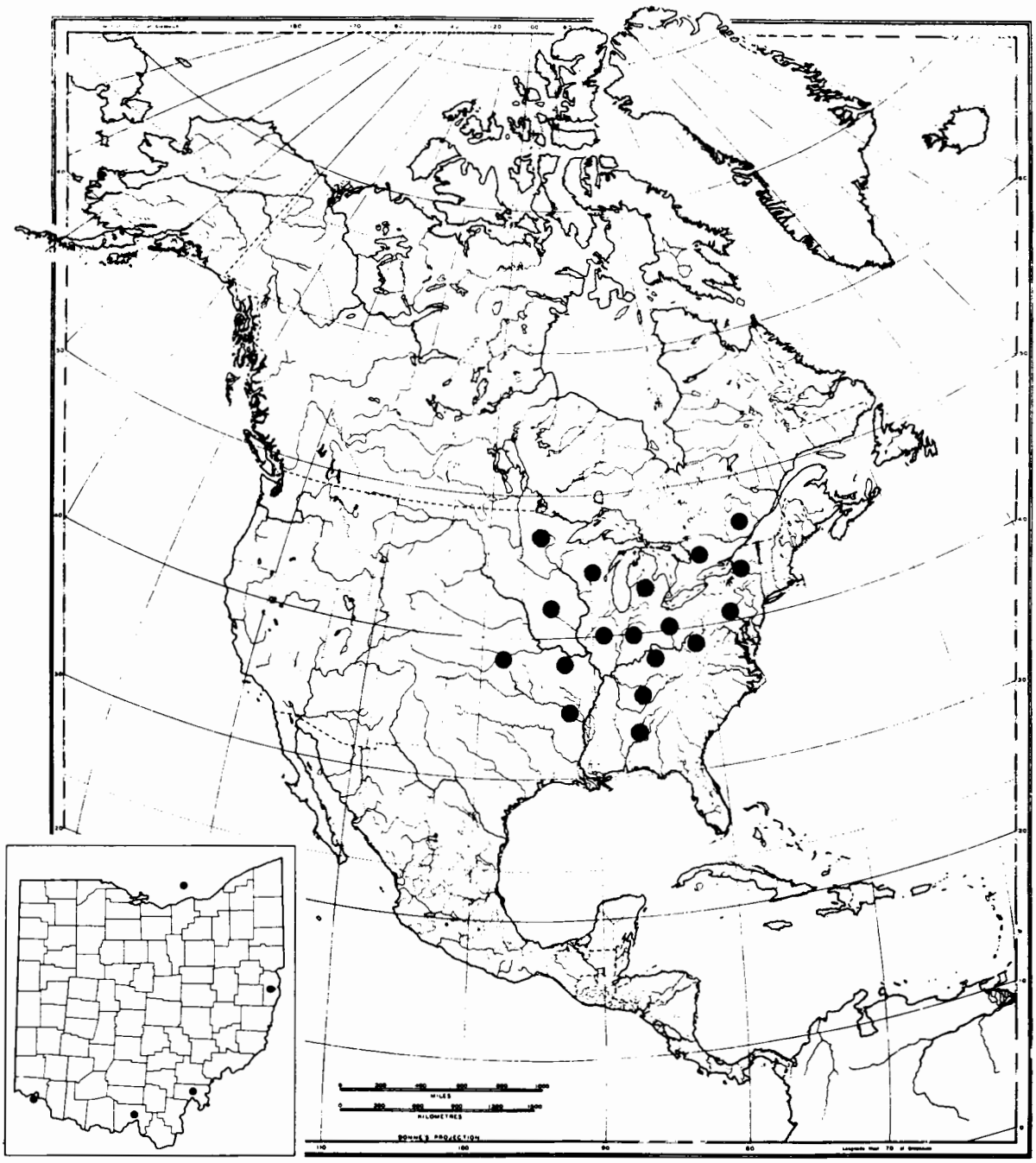


FIGURE 121.—Distribution of *Obovaria olivaria* in North America; *inset,* distribution in Ohio.

Ecology.—This species lives in large rivers, where it is found on sand, gravel, or mud bottom, in water 1 foot to 6 feet or more deep, in a more or less rapid current.

General distribution (fig. 117).—Western Pennsylvania west to Iowa, Kansas, and Oklahoma, south to Louisiana, Texas, and Georgia, north to Michigan, Ontario, and Minnesota.

Distribution in Ohio (inset, fig. 117).—Sterki (1907a, p. 390) gives "both drainages, but not everywhere; Ohio, Scioto, and Mahoning Rivers, not in the Tuscarawas; Lake Erie." Ortmann (1919) adds Lake Erie, Lucas County; Ohio River in Jefferson, Meigs, and Scioto Counties.

Geologic range.—F. C. Baker (1920a, p. 383) has recorded this species from late Wisconsin ("Wabash") beds.

Remarks.—The unique character of this species is the way the pustules of the two valves alternate; this arrangement is found in no other Ohio freshwater mussel and should permit immediate identification of the species.

Genus *Cyprogenia* Agassiz 1852

Cyprogenia Agassiz 1852, Arch. Naturgesch. v. 18, no. 1, p. 47 (*fide* Neave).
Cyprogenia Walker 1918, Synopsis and cat. fresh-water Moll., p. 68.

Type.—*Unio irroratus* Lea.

Diagnosis.—Shell solid, inflated, rounded, triangular, sometimes slightly retuse, generally a little biangular behind; posterior ridge generally well developed; umbonal region flattened parallel with the axis of the shell, in some cases compressed; beaks curved inward and forward, their sculpture very faint, consisting of slightly double-looped ridges; sculpture of the shell nodular, radiately wrinkled or lachrymose; ligament black and conspicuous; lunule distinct, well developed; epidermis shining, painted with a delicate mottling on a light ground; hinge plate wide and flat; pseudocardinals heavy, triangular, blunt and ragged; laterals short, obliquely striated, cavity of the beaks not deep; nacre bright and silvery.

Cyprogenia irrorata (Lea) 1828
Fig. 118

Unio irroratus Lea 1828, Am. Philos. Soc. Trans., v. 3, p. 269, pl. 5, fig. 5.
——— ——— Call 1900, Moll. Ind., p. 485, pl. 43.
Cyprogenia irrorata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.
——— ——— Simpson 1914, Descr. cat. Naiades, p. 326.
Cyprogenia stegaria Ortmann 1919, Najades Pa., p. 218, pl. 13, fig. 5.
Cyprogenia irrorata Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 43.
——— ——— Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 313.

Type locality.—Ohio.

Diagnosis.—Shell suborbicular or rounded triangular, very solid, inflated; beaks high and full but flat-

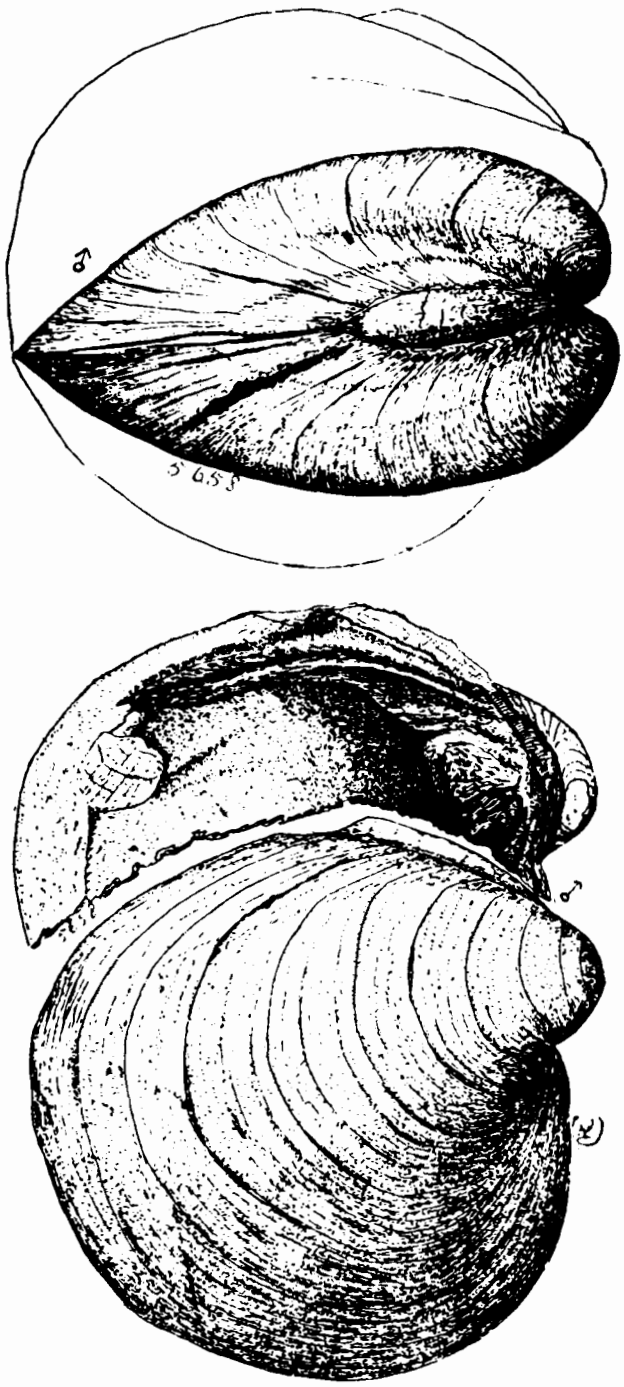


FIGURE 122.—*Obovaria retusa,* four views, X1; after Call (1900, pl. 52).

tened in the central area or a little nearer the anterior end, curved forward over the lunule and having very feeble sculpture; posterior ridge well developed, high and narrowly rounded at the umbonal region, with a shallow radial groove in front of and another behind it; surface having strong low concentric ridges, each ridge in some cases equaling a season's growth; in other cases they are more numerous; in addition the surface is more or less covered with irregular knobs or tubercles; epidermis pale greenish yellow covered with a pattern of rich green flecks or dots which show a tendency to form rays; left valve with two strong low ragged pseudocardinals and two laterals; right valve with one pseudocardinal and one double lateral; hinge plate wide and flat; beak cavities rather shallow, compressed; muscle scars small, deep; nacre silvery, white or flesh colored, thicker in front: L. 55, H. 50, D. 35 mm.; L. 42, H. 47, D. 30 mm. (Simpson, 1914, p. 326).

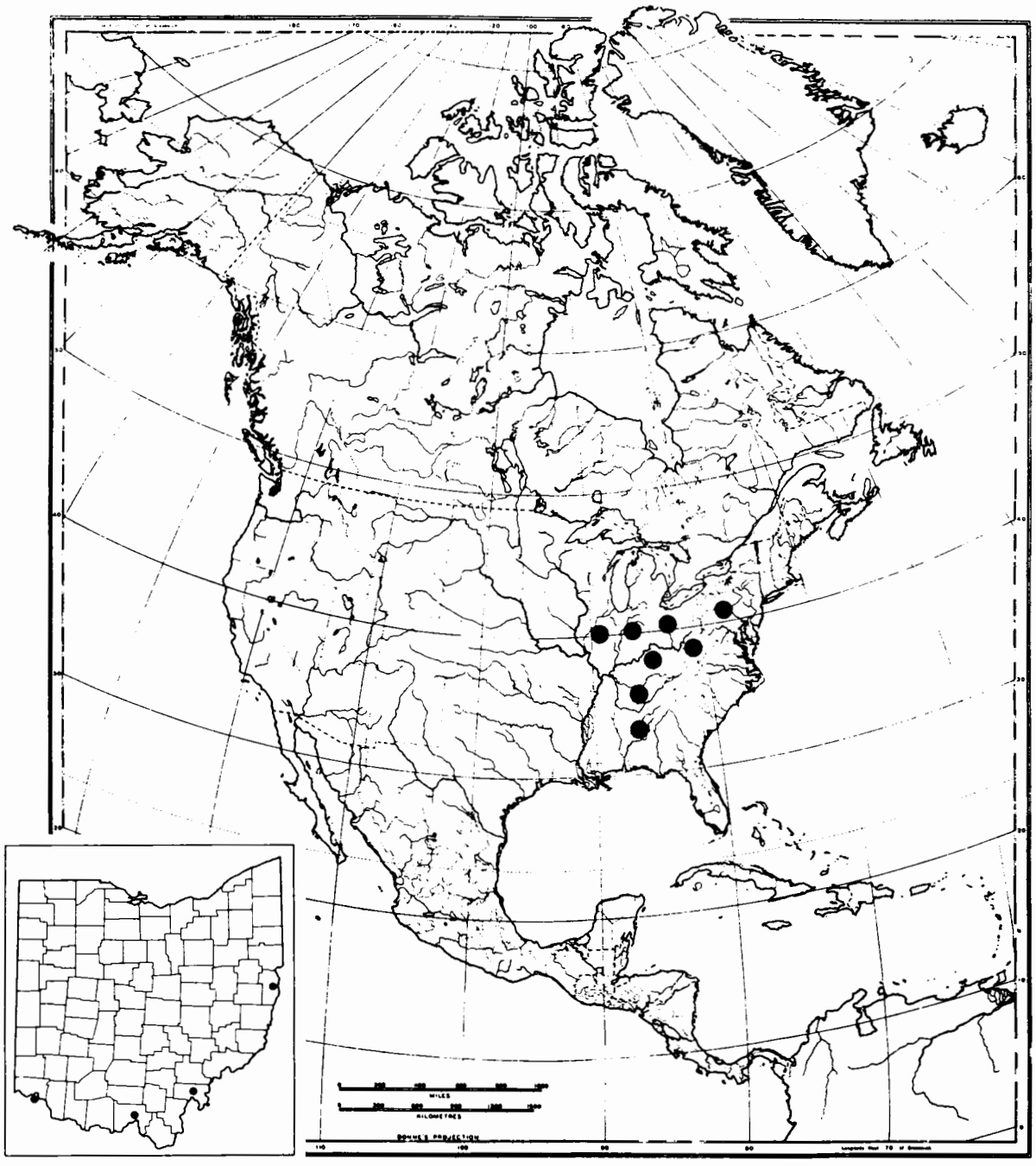


FIGURE 123.–Distribution of *Obovaria retusa* in North America; *inset,* distribution in Ohio.

Ecology.—Large (Ohio) and medium-sized (Cumberland, Tennessee) rivers; in Ohio, streams of Tuscarawas County.

Associations.—Living: OHIO-43.

General distribution (fig. 119).—Ohio, Cumberland, and Tennessee River systems; St. Francis and Saline Rivers, Arkansas? Eastern Iowa? The specimens reported from the western localities may be *C. aberti* (Simpson, 1914, p. 327).

Distribution in Ohio (inset, fig. 119).—The species is recorded by Sterki (1907a, p. 390) for "Ohio drainage: Ohio, Great Miami, Scioto, Tuscarawas, Mahoning Rivers." Ortmann (1919) adds the Little Miami River, Greene County; and the Ohio River in Meigs, Scioto, and Hamilton Counties.

Geologic range.—Unknown.

Genus *Obovaria* Rafinesque 1819

Obovaria Rafinesque 1819, Jour. Physique, v. 88, p. 426 (*fide* Neave).
Obovaria Walker 1918, Synopsis and cat. fresh-water Moll., p. 73.
Obovaria Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 44.
Obovaria F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 213.
Obovaria La Rocque 1953, Cat. Recent Moll. Canada, p. 96.

Type.—*Unio retusa* Lamarck.

Diagnosis.—Shell short, oval, rounded or retuse, solid, inflated, thick in front, thinner behind, with high beaks which are sculptured with very faint irregular commonly broken and slightly nodulous ridges which show a tendency to fall into two loops, the posterior often open behind; epidermis dull, brownish, silky or clothlike, rarely rayed, rays indistinct; female shell but slightly inflated in the postbasal region, commonly having a shallow furrow or a flattened area at the posterior end; pseudocardinals solid, stumpy; laterals short, club-shaped.

Obovaria olivaria Rafinesque 1820
Fig. 120

Amblema olivaria Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 314.
Unio ellipsis Lea 1828, Am. Philos. Soc. Trans., v. 3, p. 268, pl. 4, fig. 4.
——— ——— Call 1900, Moll. Ind., p. 495, pl. 53.
Obovaria ellipsis Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.
——— ——— Simpson 1914, Descr. cat. Naiades, p. 299.
Obovaria (Pseudoõn) olivaria Ortmann 1919, Najades Pa., p. 223, pl. 13, figs. 8, 9.
Obovaria ellipsis F. C. Baker 1920, Life of Pleistocene, p. 383.
Obovaria olivaria Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 46.
——— ——— Frierson 1927, Check list N. Am. Naiades, p. 91.
——— ——— F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 214, pl. 76, figs. 4-8; pl. 77, figs. 1-2.
——— ——— Goodrich 1932, Moll. Mich., p. 103.
——— ——— La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 153.
——— ——— Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 318.
——— ——— Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 104, pl. 13, fig. 9.
——— ——— La Rocque 1953, Cat. Recent Moll. Canada, p. 96.
Obovaria (Pseudoõn) olivaria Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 47, fig. 36.

Type locality.—Kentucky River.

Diagnosis.—Shell elliptical, rarely rather ovate, inflated, solid, with high subanterior beaks turned forward over a small lunule; beak sculpture of a few somewhat doubly-looped bars; posterior ridge scarcely developed; anterior end rounded or subtruncate; surface nearly smooth or with a few shallow irregular sulcations; epidermis greenish or yellowish brown with faint darker rays; left valve with two pseudocardinals, the posterior one nearly parallel with the stout curved laterals; right valve generally with three pseudocardinals, the two outer ones small, the middle and upper ones parallel with the strong double lateral; muscle scars small, impressed, the anterior ones rough; nacre

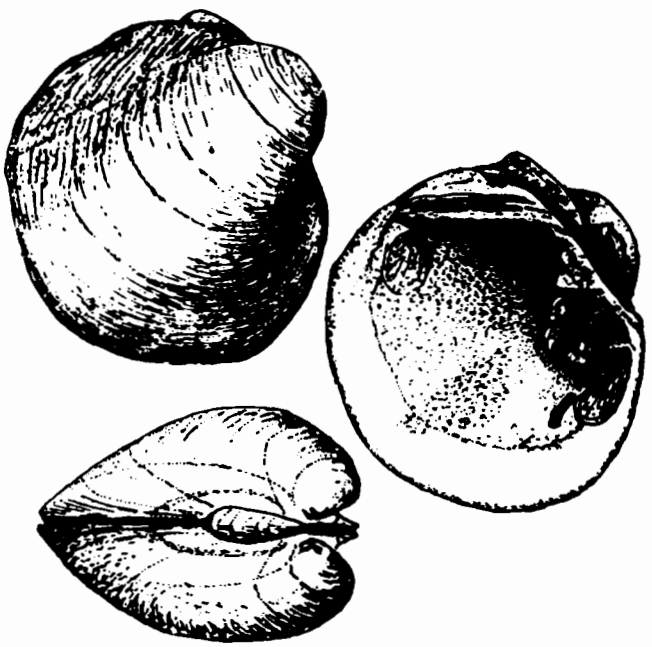


FIGURE 124.—*Obovaria subrotunda*, three views, X1; after Call (1900, pl. 51).

silvery white, much thickened in front; L. 75, 63; H. 56, 47; D. 45, 35 mm. (modified from Simpson, 1914, p. 299).

Ecology.—On sand or gravel bottom in rather deep water, 3-5 feet or more, where there is a good current; in smaller rivers it may be found at low water in shallow places (modified from F. C. Baker, 1928a, pt. II, p. 216).

Associations.—Living: ONTARIO - 1.

General distribution (fig. 121).—Western Pennsylvania and western New York west to Missouri, Iowa, and Kansas, south to Arkansas, Kentucky, and northern Alabama, north to Minnesota, Michigan, Ontario, and Quebec.

Distribution in Ohio (inset, fig. 121).—Sterki (1907a, p. 390) gives "Ohio River, common." Ortmann (1919) records it for the same river in Jefferson, Meigs, and

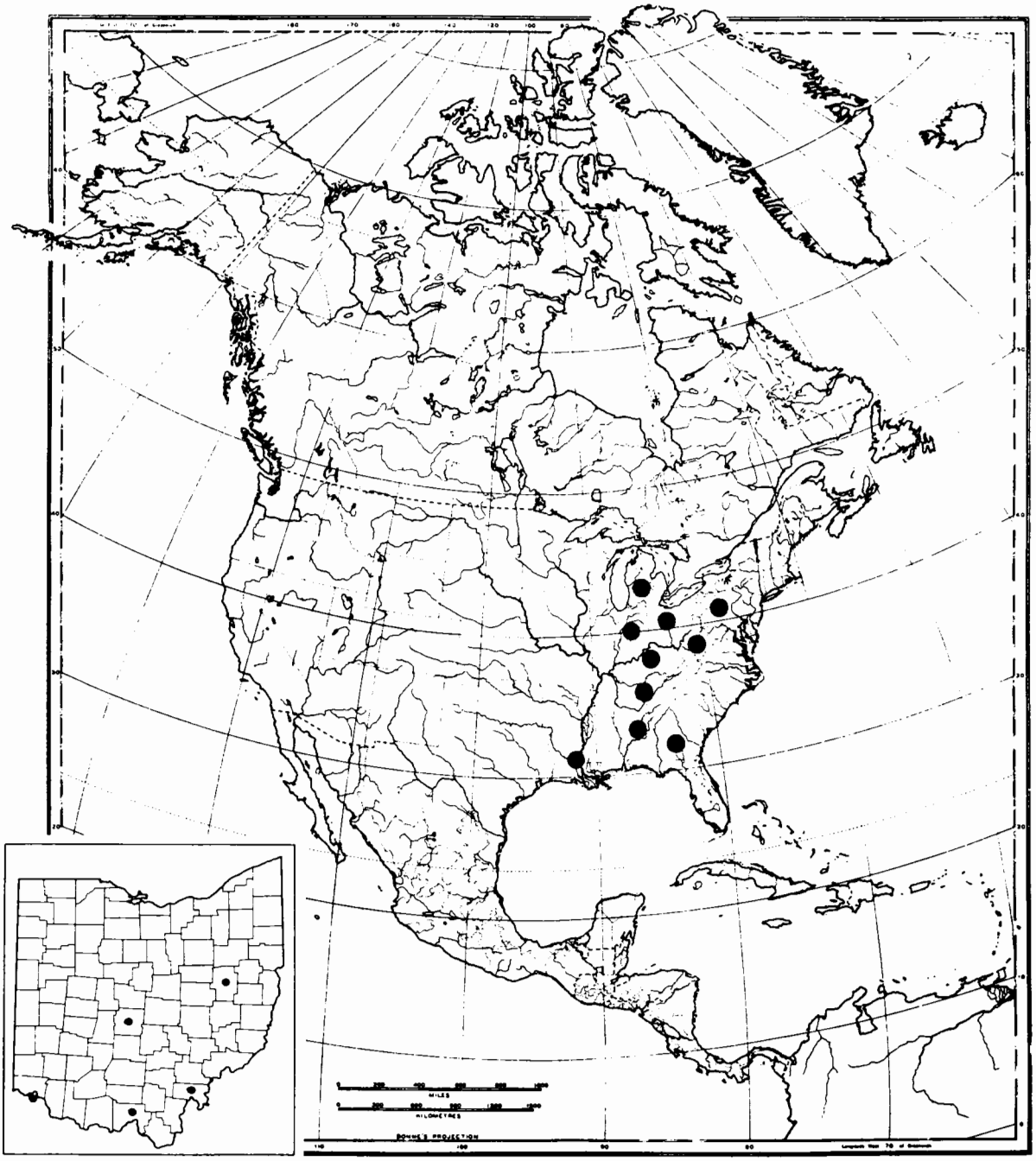


FIGURE 125.—Distribution of *Obovaria subrotunda* in North America; *inset,* distribution in Ohio.

Scioto Counties.

Geologic range.—Baker (1920a, p. 383) gives only late Wisconsin ("Wabash") for this species.

Obovaria retusa (Lamarck) 1819
Fig. 122

Unio retusa Lamarck 1819, Animaux sans vertèbres, v. 6, p. 72.

Unio retusus Call 1900, Moll. Ind., p. 494, pl. 52.

Obovaria retusa Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.

--- --- Simpson 1914, Descr. cat. Naiades, p. 290.

Obovaria (Obovaria) retusa Ortmann 1919, Najades Pa., p. 221, pl. 13, figs. 6, 7.

--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 45.

--- --- Frierson 1927, Check list N. Am. Naiades,

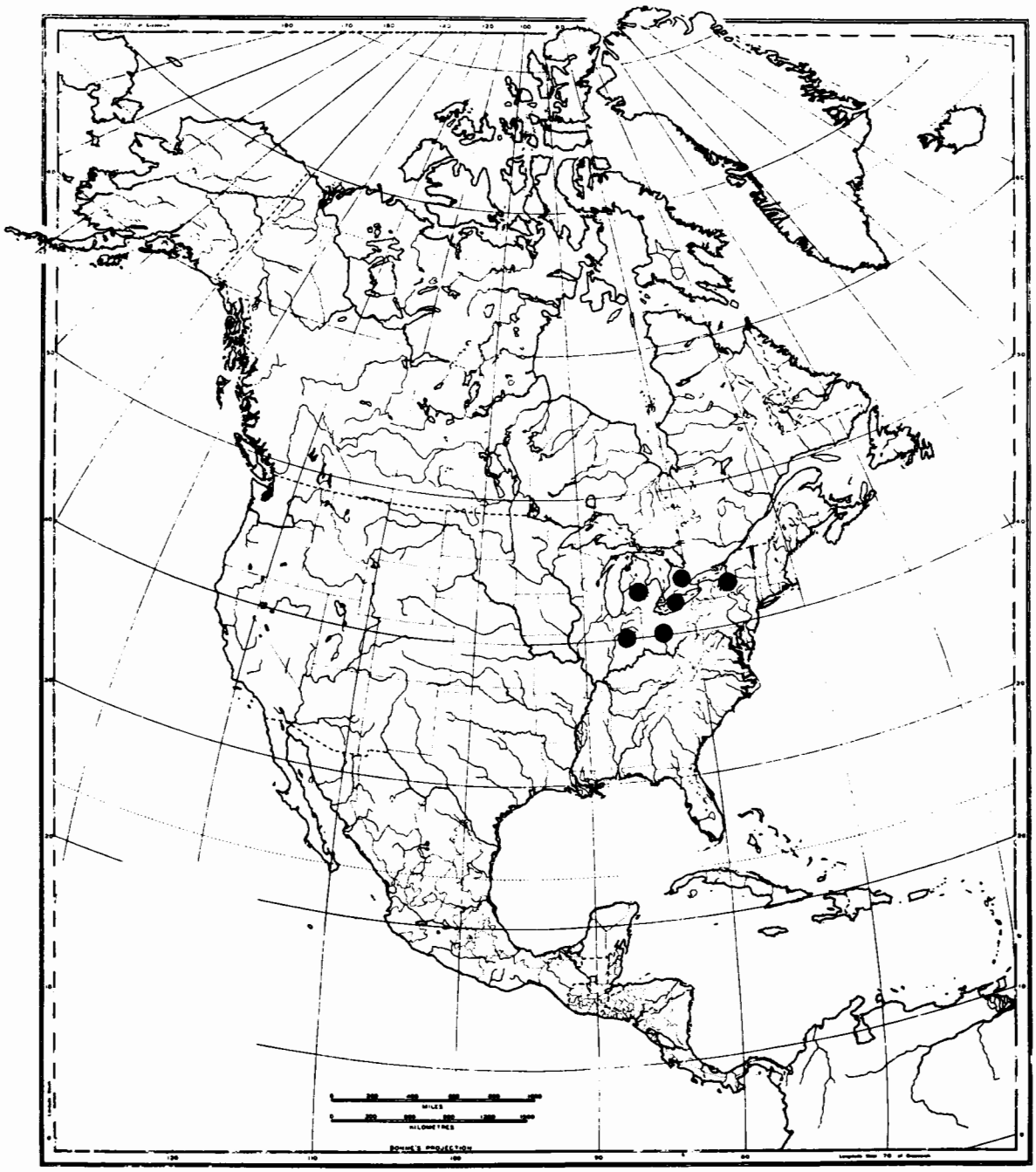


FIGURE 126.—Distribution of *Obovaria subrotunda leibii* in North America.

p. 89.

--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 318.

Type locality.—Erroneously given by Lamarck as Nova Scotia, where this species is certainly not found. Lamarck's description corresponds with that of shells from the Ohio River.

Diagnosis.—Shell irregularly quadrate, solid, inflated, with very high beaks, which are turned forward over a well-defined lunule; posterior ridge rather high and rounded; surface sculptured with low wide irregular concentric ridges; epidermis yellowish brown, somewhat clothlike in fresh specimens, rayless; left valve with two stout subradial pseudocardinals, with two short curved laterals, the lower double in some

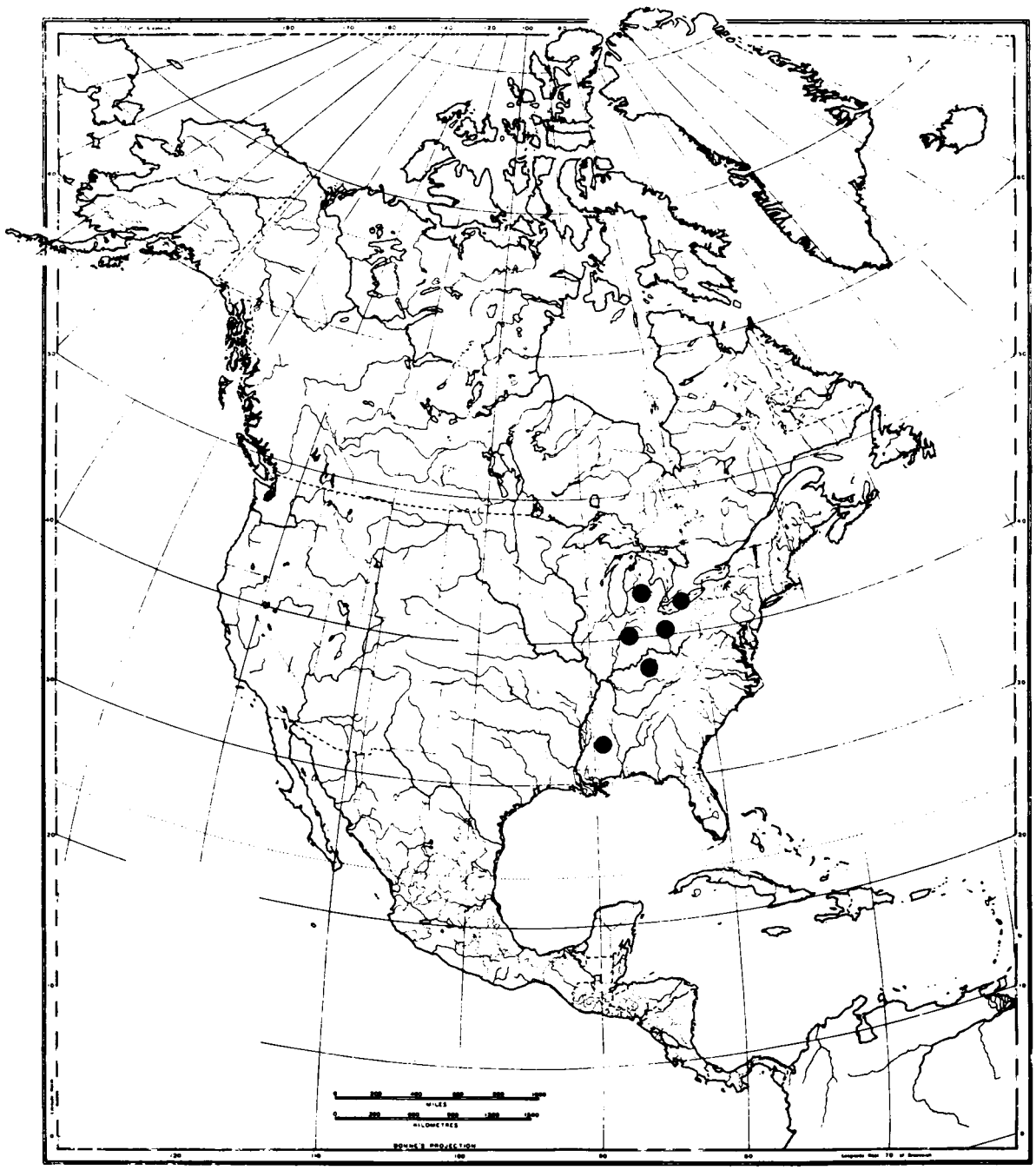


FIGURE 127.—Distribution of *Obovaria subrotunda lens* in North America.

specimens; right valve with three pseudocardinals, the middle largest, the hinder parallel with the somewhat double lateral; hinge plate flat, sharply curved in front of the laterals; beak cavities deep, compressed; muscle scars deep, small; nacre coppery purple, that of the female thickened in front; female shell with a decided groove behind the posterior ridge, the marsupial area slightly produced; L. (male) 50, H. 50, D. 32 mm.; L. (female) 47, H. 53, D. 35 mm." (condensed from Simpson, 1914, p. 290).

Ecology.—This is a species mainly of the larger rivers but it does penetrate into headwaters.

General distribution (fig. 123).—Ohio, Cumberland, and Tennessee River systems.

Distribution in Ohio (inset, fig. 123).—Sterki (1907a, p. 390) gives only "Ohio River" and Ortmann (1919)

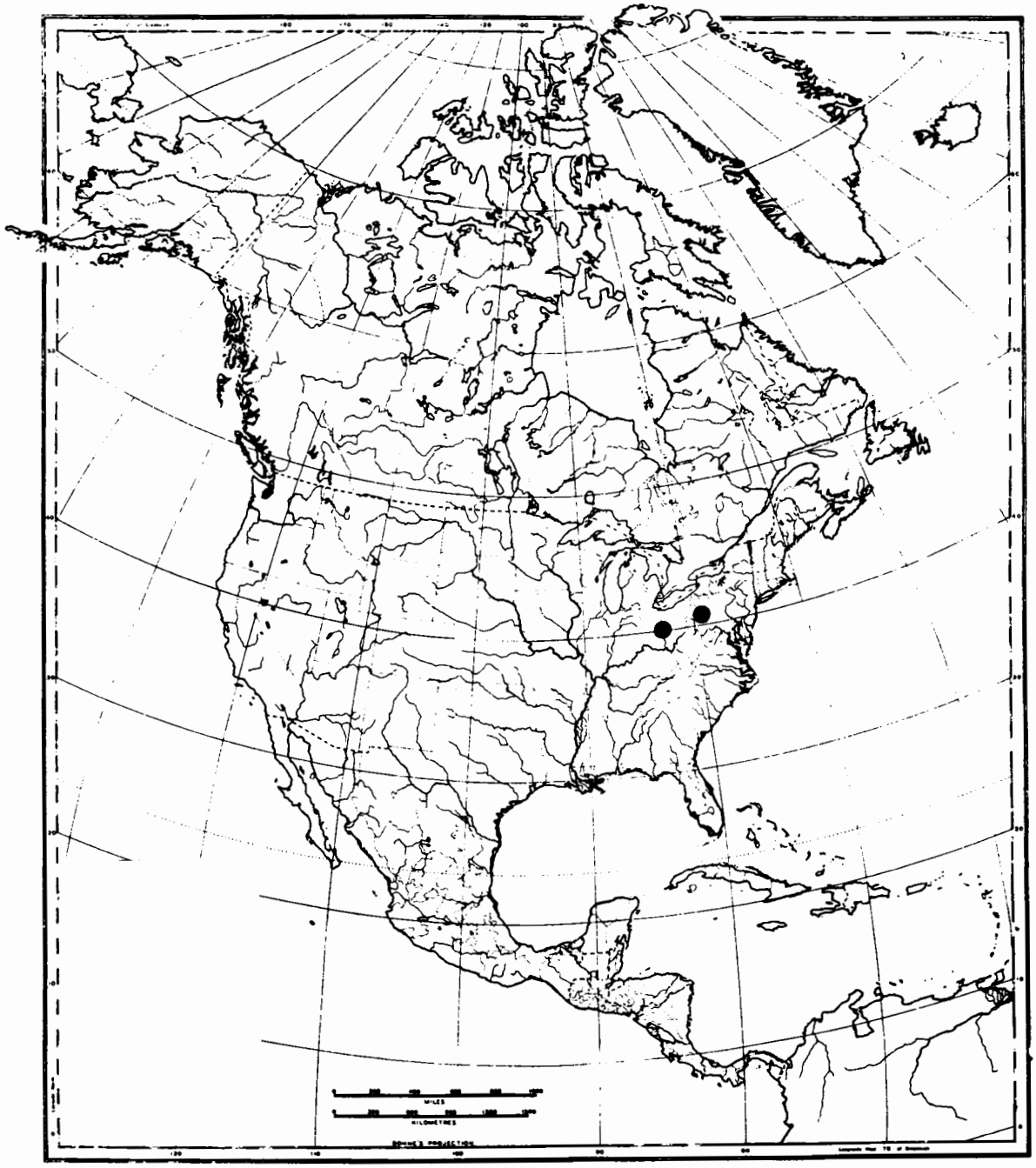


FIGURE 128.—Distribution of *Obovaria subrotunda levigata* in North America.

adds that in Ohio it is found in Jefferson, Meigs, and Scioto Counties.

Geologic range.—Unknown.

Obovaria subrotunda (Rafinesque) 1820
Fig. 124

Obliquaria subrotunda Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 308, pl. 81, figs. 21-23.
Obovaria striata Rafinesque 1820, *ibid.*, p. 45.
Unio circulus Lea 1829, Am. Philos. Soc. Trans., v. 3, p. 433, pl. 9, fig. 14.
--- --- Call 1900, Moll. Ind., p. 493, pl. 51.
Obovaria circulus Sterki 1907 (part), Ohio Acad. Sci. Proc., v. 4, p. 389.
--- --- Simpson 1914, Descr. cat. Naiades, p. 291.
Obovaria (Obovaria) subrotunda Ortmann 1919, Najades Pa., p. 223, pl. 14, figs. 1, 2.
Obovaria circula F. C. Baker 1920, Life of Pleistocene, p. 383.
Obovaria subrotunda Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 45.
--- --- Frierson 1927, Check list N. Am. Naiades, p. 90.
--- --- Goodrich 1932, Moll. Mich., p. 102.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 71.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 318.

Type locality.—Ohio River.

Diagnosis.—Shell nearly circular in outline, a little longer than high, of moderate thickness; brown, smooth, the rest areas showing as dark bands across the disk, the growth lines fine; beaks raised slightly above the hinge line, sculpture consisting of a few low folds that are slightly pustulous posteriorly; nacre white to yellowish; two irregular pseudocardinals in each valve, strong for a shell so small; laterals sharp edged, short, curved; muscle scars well marked; pallial line not channelled; L. 45.5, H. 39.5, D. 23 mm. (condensed from Goodrich, 1932, p. 102).

Ecology.—Small rivers (*e.g.*, Duck River, Tennessee) on sand and gravel bars (van der Schalie, 1938, p. 72).

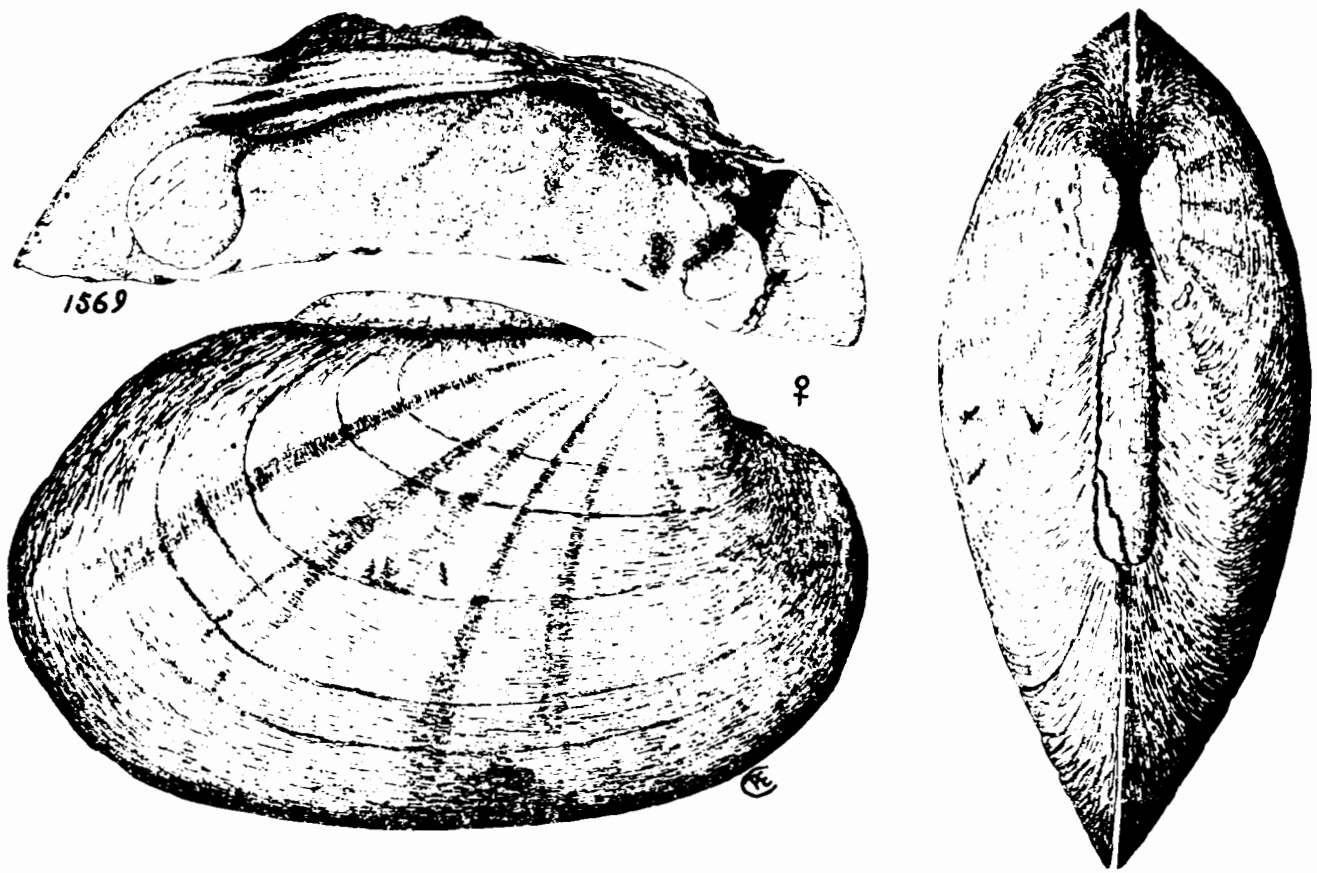


FIGURE 129.—*Actinonaias carinata*, three views, X1; after Call (1900, pl. 41).

Associations.—Living: MICHIGAN - 54; OHIO - 43.

General distribution (fig. 125).—Ohio, Tennessee, and Cumberland River systems; southeastern Louisiana and Tombigbee drainage, north to Michigan (Raisin, Huron, and Grand Rivers) and St. Lawrence drainage (varieties, not the typical form).

Distribution in Ohio (inset, fig. 125).—Sterki (1907a, p. 389) gives merely "over the state." Ortmann (1919) gives Ohio River, Meigs County. See remarks, below.

Geologic range.—F. C. Baker (1920a, p. 383) gives only late Wisconsin ("Wabash") for this species.

Remarks.—Sterki (1907a, p. 389-390) recorded four forms of the genus *Obovaria* from Ohio: *O. ellipsis* (Lea), *O. circulus, O. circulus leibei,* and *O. retusa.* After revision of the nomenclature by Ortmann and Walker (1922) three forms of *O. subrotunda* are recognized: the typical form, forms *leibii* and *lens.* The form *O. ellipsis* becomes *O. olivaria* Rafinesque and *O.*

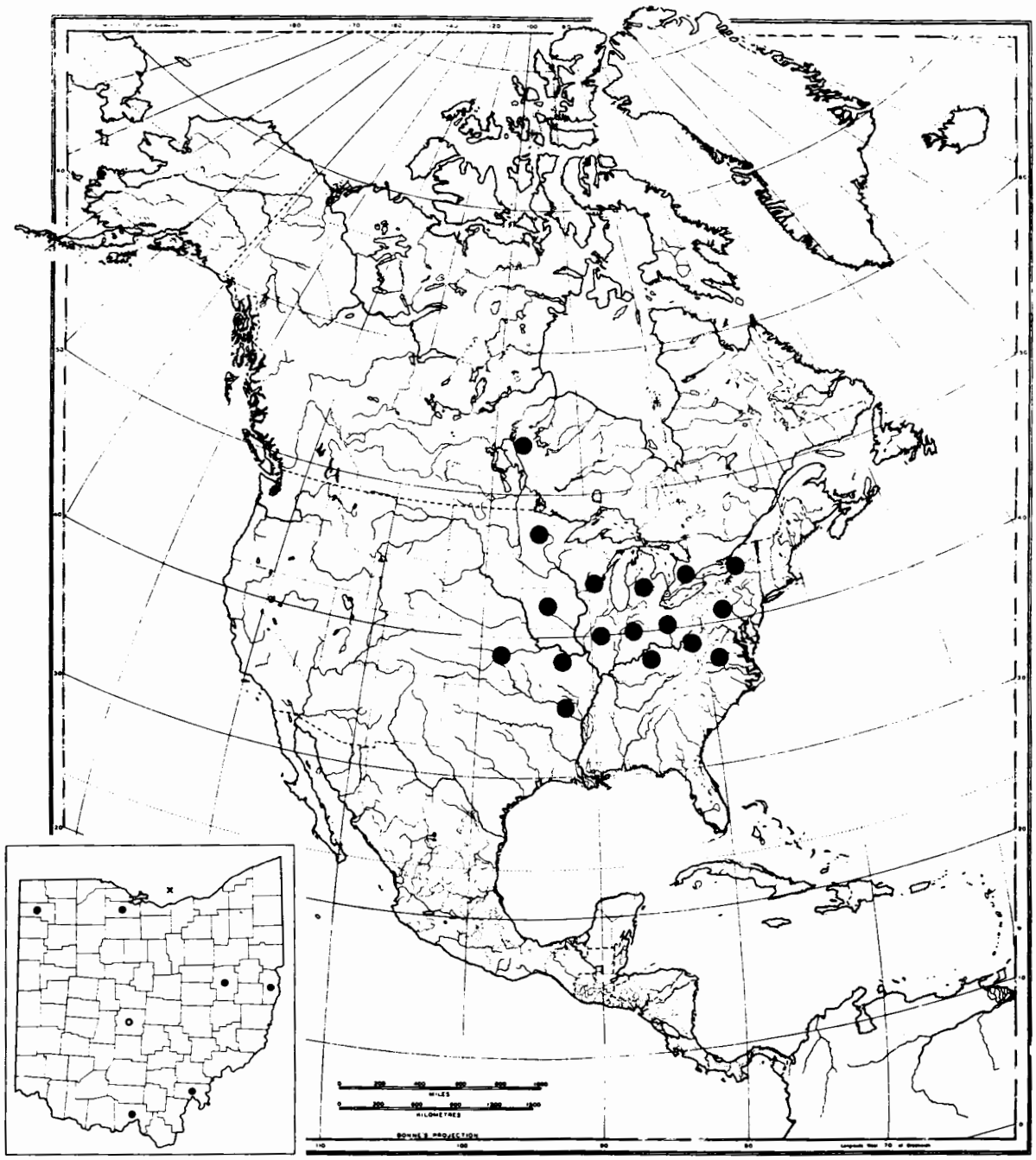


FIGURE 130.—Distribution of *Actinonaias carinata* in North America; *inset,* distribution in Ohio.

retusa (Lamarck) is recognized as a distinct species. Sterki's records are therefore rather confusing; specimens from Ohio should be re-examined wherever possible to determine just where they belong. In addition, Ortmann (1919, p. 226, pl. 14, figs. 3, 4) records *O. subrotunda levigata* from the Tuscarawas and Ohio Rivers.

Obovaria subrotunda leibii (Lea) 1862

Unio leibii Lea 1862, Acad. Nat. Sci. Philadelphia Proc., v. 6, p. 168.
Obovaria circulus leibei Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 390.
Obovaria leibii Simpson 1914, Descr. cat. Naiades, p. 296.
Obovaria subrotunda Frierson 1927 (part), Check list N. Am. Naiades, p. 90.
Obovaria subrotunda leibii Goodrich 1932, Moll. Mich., p. 103.
Obovaria leibii La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 153.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 96.

Type locality.—"Erie County, Michigan." Goodrich (1932, p. 103) points out that there is no such county in Michigan and that what was probably meant was Erie Township, Monroe County, since Dr. Leib, after whom Lea named the species, at one time lived in Monroe.

Diagnosis.—The Lake Erie form of the species is much more swollen than the typical form.

Ecology.—For the followers of the Grier and Baker system of naming ecological forms, this name may be applied to the Lake Erie form of *O. subrotunda.* The difficulty about recognizing it is that it is also recorded for streams flowing into Lake Erie.

General distribution (fig. 126).—"Lake Erie and streams falling into it" (Simpson, 1914, p. 296); southern Michigan, Lake Erie drainage in Ontario (La Rocque, 1953, p. 96).

Distribution in Ohio.—Sterki (1907a, p. 390) gives "Lake Erie" only.

Geologic range.—Unknown.

Remarks.—Frierson (1927) does not recognize the forms; Goodrich (1932, p. 103) gives it scant recognition and it has not been accepted by any subsequent writer on the Naiades except myself (La Rocque, 1953, p. 96). My present inclination would be to treat it, as I have done here, as a form of minor importance under the species *O. subrotunda* (Lea) and to apply the name, if it is used at all, only to Lake Erie specimens.

Obovaria subrotunda lens (Lea) 1831

Unio lens Lea 1831, Am. Philos. Soc. Trans., v. 4, p. 80, pl. 8, fig. 10.
Obovaria circulus Sterki 1907 (part), Ohio Acad. Sci. Proc., v. 4, p. 389.
Obovaria lens Simpson 1914, Descr. cat. Naiades, p. 293.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 46.
--- --- Goodrich 1932, Moll. Mich., p. 103.
Obovaria subrotunda lens Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 318.

Type locality.—Ohio and Tennessee.

Diagnosis.—Shell suborbicular, equilateral, subcompressed to subinflated, with rather high, but not inflated, beaks; beak sculpture fine doubly-looped ridges; posterior ridge rounded; posterior end subtruncate; surface generally with a few wide, low, concentric ridges; epidermis brownish, silky, lighter on the posterior slope; left valve with two subradial pseudocardinals, and two laterals; right valve with three pseudocardinals, the middle one largest, and one somewhat double lateral; beak cavities rather deep, compressed; muscle scars small, impressed; nacre white or silvery; female shell slightly fuller than the male just behind the center of the base; L. 50, H. 47, D. 26 mm. (modified from Simpson, 1914, p. 293).

Ecology.—Goodrich and van der Schalie (1944, p. 318) indicate that this is the small headwater form of the species.

General distribution (fig. 127).—Ohio River drainage; north to Lake Erie; southern Michigan; south to Columbus, Mississippi.

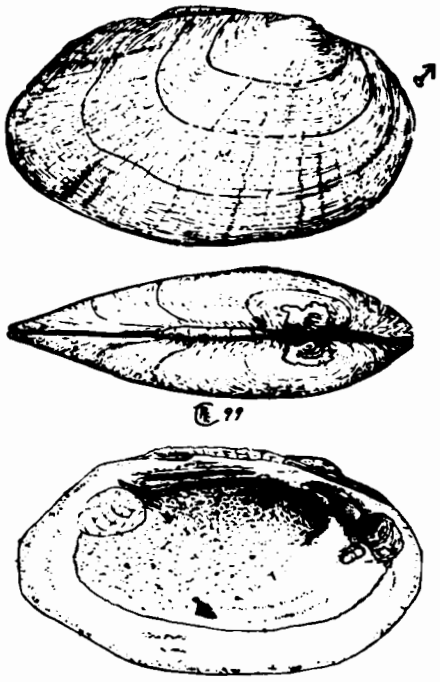


FIGURE 131.—*Actinonaias ellipsiformis,* three views, X1; after Call (1900, pl. 20).

Distribution in Ohio.–The specimens of headwaters of streams recorded by Sterki under *O. circulus* belong under this variety. I have no other records.

Geologic range.–Unknown.

Remarks.–Simpson (1914, p. 293) recognizes *O. lens* as a species and records three varieties, two of them new at the time. Later workers give less importance to the name and consider *O. lens* as a form of *O. subrotunda.*

[*Obovaria subrotunda levigata*]

Note.–Ortmann (1919, p. 223) records this form from the Tuscarawas River, Ohio, and the Ohio River in Pennsylvania (fig. 128). Just what its relationships are with typical *O. subrotunda* and its several varieties should be cleared up.

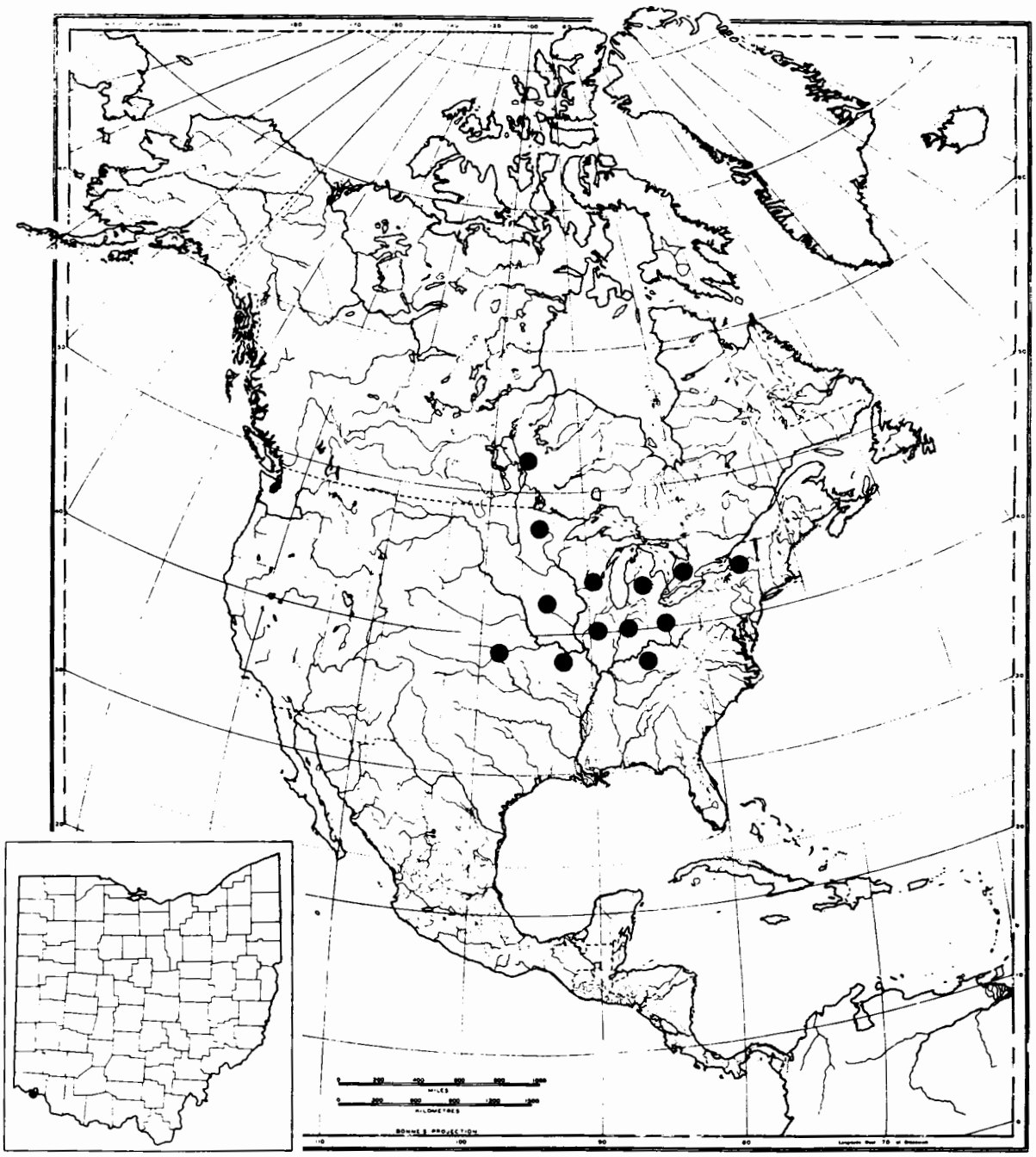


FIGURE 132.–Distribution of *Actinonaias ellipsiformis* in North America; *inset,* distribution in Ohio.

Genus *Actinonaias* Crosse and Fischer 1894

Actinonaias Crosse and Fischer 1894, Rech. zoöl. Hist. France, Amér. Centr. & Mexique, (7) 2, livr. 15, p. 556 (*fide* Neave).
Actinonaias Walker 1918, Synopsis and cat. fresh-water Moll., p. 75.
Actinonaias Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 47.
Actinonaias F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 217.

Type.—*Unio sapotalensis* Lea.

Diagnosis.—Shell ovate or subelliptical, distinctly longer than high, compressed or slightly inflated, without or with indistinct posterior ridge; disk not sculptured; beaks moderately anterior, never in the middle of the shell and never very near the anterior end; beak sculpture poorly developed, consisting of a few faint bars which have a tendency to become double looped, with the central part between the loops obliterated; epidermis yellowish to greenish, generally with distinct rays; male and female shells differing slightly in shape.

Remarks.—There is a conflict between Neave and Ortmann and Walker (1922) on the date and on the order in which the authors should appear.

Actinonaias carinata (Barnes) 1823
Fig. 129

Unio crassus Say 1817, Nicholson's Encycl., v. 2, pl. 1, fig. 8 (*non* Retzius 1778).
Unio ligamentina Lamarck 1819, Animaux sans vertèbres, v. 6, p. 72.
Unio carinatus Barnes 1823, Am. Jour. Sci., v. 6, p. 259, pl. 13, fig. 10.
Unio ellipticus Barnes 1823, *ibid.*, pl. 13, fig. 19.
Unio ligamentinus Call 1900, Moll. Ind., p. 483, pl. 41.
Lampsilis ligamentinus Dall 1905, Harriman-Alaska Exped., v. 13, p. 126.
Lampsilis ligamentina Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.
Actinonaias ligamentina Ortmann 1919, Najades Pa., p. 232, pl. 14, figs. 5, 6.
Nephronajas ligamentina F. C. Baker 1920, Life of Pleistocene, p. 383.
Actinonaias carinata Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 47.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 218, pl. 77, figs. 3-6.
--- --- Goodrich 1932, Moll. Mich., p. 104.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 313.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 85.
--- --- Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 48, fig. 43.

Type locality.—Fox River, Wisconsin.

Diagnosis.—Shell thick, heavy, large; beaks somewhat swollen; beak sculpture consisting of a few delicate more or less distinct bars which are more or less double looped; surface with growth lines only; epidermis yellowish to brown or blackish; pseudocardinals two in left valve, one in right valve, with one small somewhat cone-shaped anterior tooth and in some cases a third posterior tooth; laterals long, elevated, strong, heavy, somewhat roughened, two in left, one in right valve; dorsal muscle scars in beak cavity and on hinge plate; anterior adductor muscle scar deeply excavated, sulcated; posterior scar distinct; nacre silvery white to pink or cream colored, iridescent posteriorly.

Ecology.—Typically, this is a species of large rivers, but it is also found in smaller streams. It flourishes in water less than 30 feet wide, in riffles, on sand and gravel bottom. In some places it is found on hard stony bottom, wedged in between large boulders, almost buried from sight. Sand and gravel bars are its favorite places, in water 0.3-1.6 m. deep. Rarely it is found on mud bottom in deeper water. Its best habitat is a rather swift current, 2-7 miles per hour.

It is found naturally on numerous fish hosts, bluespotted sunfish, bluegill, smallmouthed black bass, largemouthed black bass, yellow perch, white crappie, and striped bass; successful artificial infection was secured on gills of the sauger and black crappie.

Associations.—Living: MICHIGAN-52, 54, 56, 57, 58, 59, 60, 63, 64, 65; NEW YORK-35; OHIO-43; WISCONSIN-6, 7, 27, 76, 79, 80, 83, 108, 114, 120, 121, 127, 130, 131, 132, 133.

General distribution (fig. 130).—St. Lawrence and Mississippi drainages; southern Ontario and Manitoba. Lake St. Clair and its drainage; Lake Erie drainage; Niagara River and its tributaries; Lake Ontario. The Lake Erie record is considered erroneous.

Distribution in Ohio (inset, fig. 130).—Sterki (1907a, p. 388) gives "both drainages, generally common,"

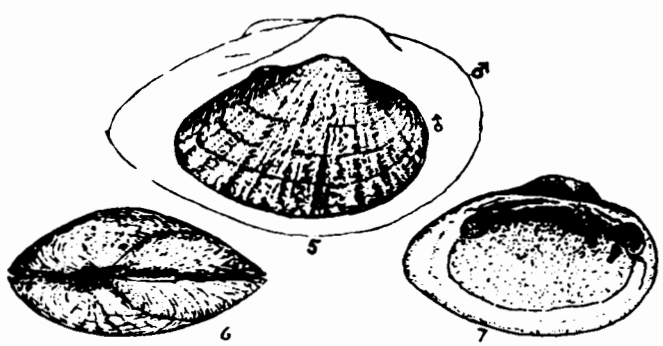


FIGURE 133.—*Truncilla donaciformis*, four views, X1; after Call (1900, pl. 23).

abundant in the Tuscarawas River but not in the Mahoning. Ortmann (1919) confirms the Tuscarawas River record and adds Sandusky River, Sandusky County; Maumee River, Defiance County; Ohio River in Jefferson, Meigs, and Scioto Counties.

Geologic range.–F. C. Baker (1920a, p. 383) recorded the species for Sangamon and late Wisconsin ("Wabash") deposits in Illinois but so far it has not been recorded for the Pleistocene of Ohio where it may well be expected.

This species was undoubtedly present in the Mississippi River as early as Wisconsin time, if not earlier. As the Wisconsin ice retreated northward this naiad was carried by its fish hosts into new territory, invading the waters of the Ohio, moving as far upstream as the Tuscarawas River in Ohio and into Pennsylvania. It was apparently unable to colonize the southward-flowing tributaries of the Ohio or its headwater tributaries such as the Mahoning. It penetrated into the Mississippi drainage as far north as Manitoba

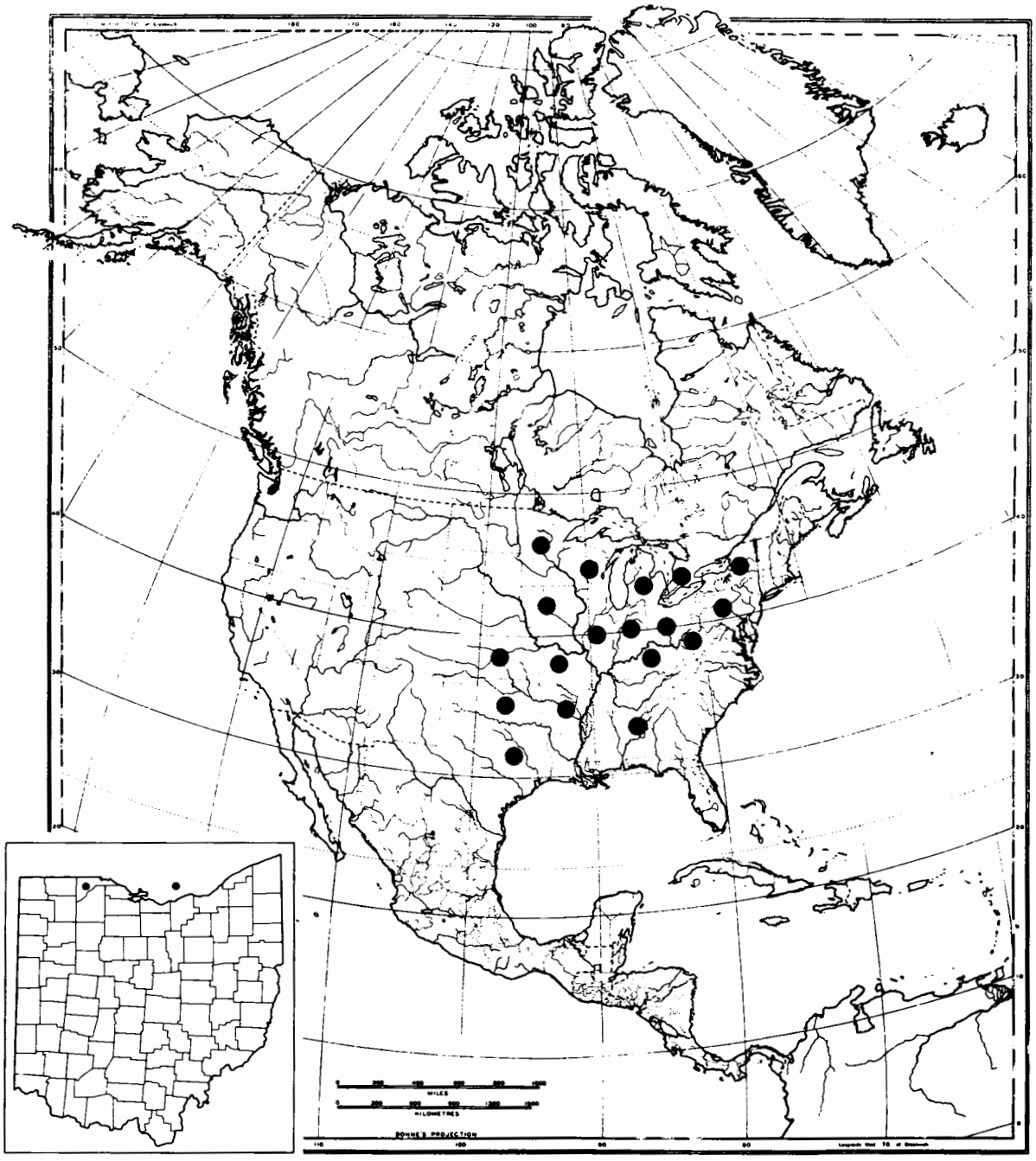


FIGURE 134.–Distribution of *Truncilla donaciformis* in North America; *inset,* distribution in Ohio.

but was apparently too late an arrival to take advantage of the Lake Agassiz connection to reach the Hudson Bay and Mackenzie drainages, although its absence there may be accounted for by temperature factors. With the post-Wisconsin changes in the Great Lakes drainage, it reached as far east as Lake Ontario and the Lake Erie drainage, but not into the Lake Ontario or lower St. Lawrence areas.

Remarks.—This species should be looked for in all fluviatile Pleistocene deposits in Ohio. Its absence from the recorded literature is somewhat surprising and may be due simply to lack of collecting.

The Ohio River form has been called *Actinonaias carinata gibba* (Simpson). Sterki (1907a, p. 389) noted the form for the Ohio River but it has not been considered worth differentiating from the typical form by most workers.

Actinonaias ellipsiformis (Conrad) 1836
Fig. 131

Unio ellipsiformis Conrad 1836, Mon., pt. 8, p. 60, pl. 34, fig. 1.
Unio spatulatus Lea 1845, Am. Philos. Soc. Proc., v. 4, p. 164.
--- --- Call 1900, Moll. Ind., p. 455, pl. 20.
Lampsilis ellipsiformis Dall 1905, Harriman-Alaska Exped., v. 13, p. 126.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 389.
--- --- Simpson 1914, Descr. cat. Naiades, p. 128.
Eurynia ellipsiformis F. C. Baker 1920, Life of Pleistocene, p. 383.
Lampsilis (Venustaconcha) ellipsiformis Frierson 1927, Check list N. Am. Naiades, p. 81.
Ligumia ellipsiformis F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 263, pl. 85, figs. 1-4.
Actinonaias ellipsiformis Goodrich 1932, Moll. Mich., p. 104.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 313.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 86.

Type locality.—Michigan.

Diagnosis.—"Small, elliptical, usually bluntly pointed posteriorly; greenish to very dark brown and ornamented with obscure waving rays. Surface smooth only in young and partly grown specimens. Pseudocardinals not high, laterals stout, short. Nacre white or pink, with one or two furrows breaking its smoothness. Muscle scars well marked. Length 66, height 36, breadth 24 mm." (Goodrich, 1932, p. 104).

Ecology.—Found on sand and gravel bottom, commonly on riffles in swift current, shallow water. Rare on mud bottom. A species of the smaller rivers and streams.

Associations.—Living: MICHIGAN-56, 57, 58, 59, 60, 61, 62, 63, 65.

General distribution (fig. 132).—Mississippi drainage north of latitude 38°; St. Lawrence drainage, in part; western New York, southern Michigan, southern Ontario; Red River of the North.

Distribution in Ohio (inset, fig. 132).—Sterki (1907a, p. 389) records it only for the Ohio River. It apparently does not range as far up the Ohio as Pennsylvania for Ortmann (1919) does not list it for that State.

Geologic range.—Late Wisconsin ("Wabash") according to F. C. Baker (1920a, p. 383). This species has had a geologic history similar to that of *A. carinata*, probably due to the same causes.

Remarks.—The range given above is from La Rocque (1953, p. 86). It should be qualified somewhat. The Toronto record is probably erroneous and the St. Lawrence drainage records are somewhat doubtful, as pointed out by La Rocque and Oughton (1937, p. 51) quoting van der Schalie, who suspects that specimens of *Micromya iris* were mistaken for this species. The species is not listed by Goodrich and van der Schalie (1932) for Lake Erie or its tributaries. The western New York occurrence, if it is valid, is therefore separated from the continuous distribution of the species

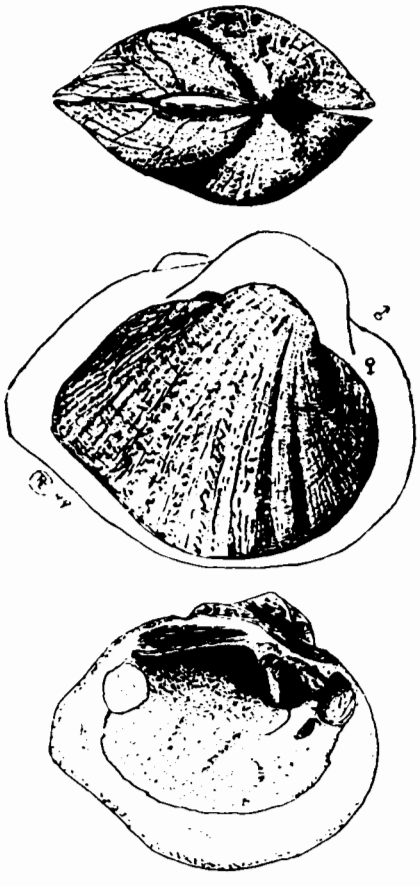


FIGURE 135.—*Truncilla truncata*, three views, X1; after Call (1900, pl. 31).

in the Mississippi and Ohio drainages by a considerable distance. It is nevertheless possible that this occurrence can be explained on the basis of the complex geologic history of the Great Lakes.

Genus *Truncilla* Rafinesque 1820

Truncilla Rafinesque 1819, Jour. Physique, v. 88, p. 427 (*fide* Neave).
Truncilla Walker 1918, Synopsis and cat. fresh-water Moll., p. 80.
Truncilla Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 49.
Truncilla F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 223.
Truncilla La Rocque 1953, Cat. Recent Moll. Canada, p. 99.

Type.—*Truncilla truncata* Rafinesque.
Diagnosis.—Shell rounded, oval or subtriangular,

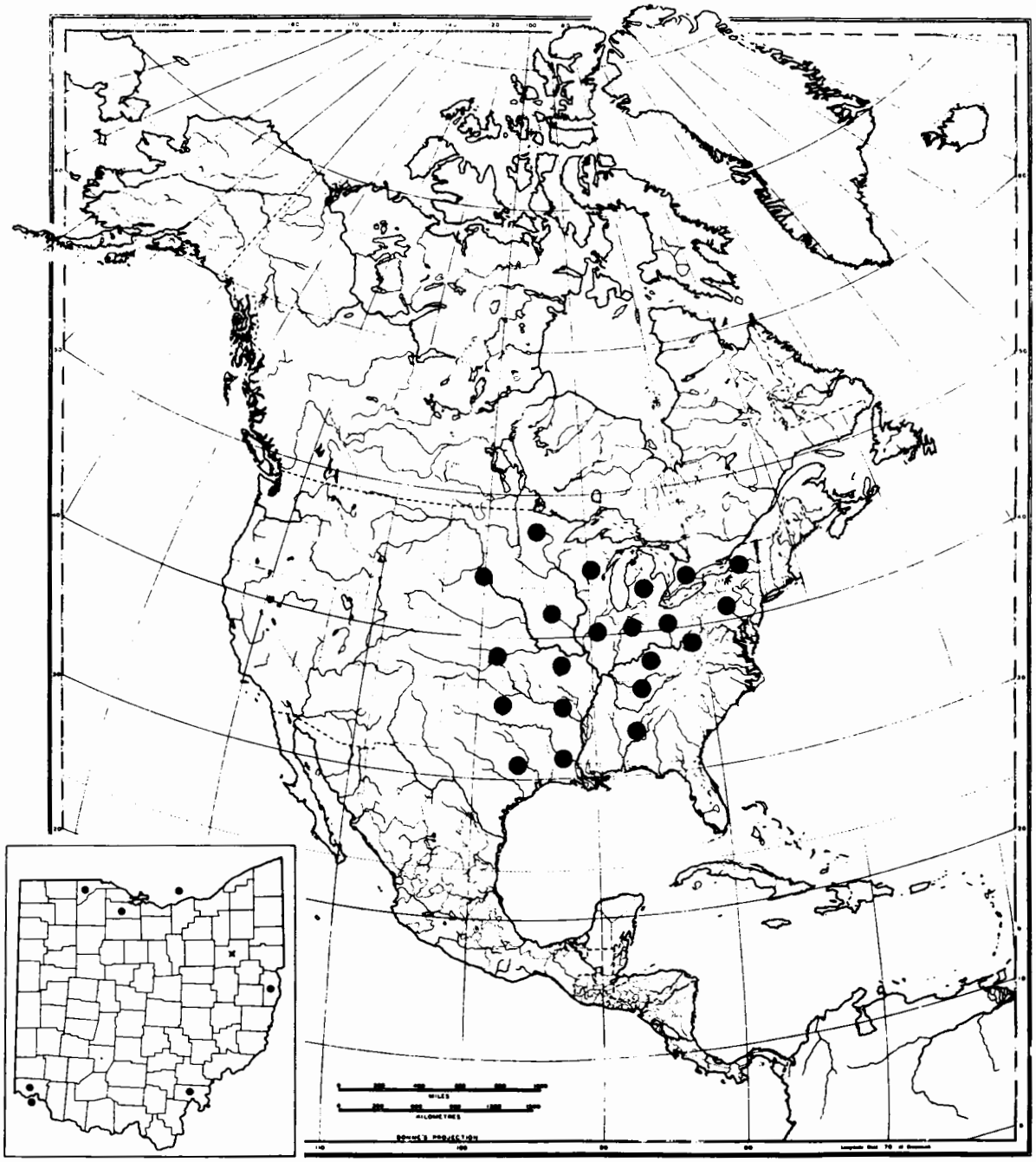


FIGURE 136.—Distribution of *Truncilla truncata* in North America; *inset,* distribution in Ohio.

solid, inflated, generally smooth and rayed; beak sculpture delicate, commonly obsolete, double looped; female shell very different from that of the male, having a decided inflation in the postbasal region, which is thinner than the rest of the shell, of different texture, commonly toothed, and generally radiately sculptured.

Truncilla donaciformis (Lea) 1828
Fig. 133

Unio donaciformis Lea 1828, Am. Philos. Soc. Trans., v. 3, p. 267, pl. 4, fig. 3.
Unio zigzag Lea 1829, *ibid.*, v. 3, p. 440, pl. 12, fig. 19.
Unio donaciformis Call 1900, Moll. Ind., p. 472, pl. 23, figs. 5-7.
Plagiola donaciformis Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 389.
--- --- Simpson 1914, Descr. cat. Naiades, p. 308.
Amygdalonaias donaciformis Ortmann 1919, Najades Pa., p. 241, pl. 14, figs. 8, 9.
Truncilla donaciformis Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 50.
--- --- Frierson 1927, Check list N. Am. Naiades, p. 89.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 228, pl. 79, figs. 1-3.
--- --- Goodrich 1932, Moll. Mich., p. 111.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 153.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 319.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 105, pl. 12, fig. 10; pl. 13, fig. 10.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 99.

Type locality.—Ohio.

Diagnosis.—Shell small, ovate or elliptical; the hinge line curved, the base broadly rounded, the posterior margin coming to a blunt point; epidermis greenish brown, marked with dark diagonal rays and dark rest marks; beaks high and sculptured with four or five loops or folds that are not conspicuous; nacre bluish white; pseudocardinals narrow, nearly parallel with the hinge line, two in one valve and one in the other; lateral teeth short, shallow, nearly straight; beak cavity moderately deep, a little pitted; L. 35.5, H. 23.5, D. 17 mm. (modified from Goodrich, 1932, p. 111).

Ecology.—"More usual in large rivers on a sand or mud bottom in water .3-1 m. or more in depth" (F. C. Baker, 1928a, pt. II, p. 230). Scammon (1906, p. 311) stated that it "does not frequent the smaller streams but seems to be confined to the sandy and muddy beds of rivers."

General distribution (fig. 134).—Western Pennsylvania west to Kansas, north to Minnesota, south to eastern Texas and Alabama.

Distribution in Ohio (inset, fig. 134).—Sterki (1907a, p. 389) gives both drainages, Lake Erie. Ortmann (1919) adds Miami and Erie Canal, Lucas County, but gives no records for the Ohio River drainage.

Geologic range.—Unknown.

Truncilla truncata Rafinesque 1820
Fig. 135

Truncilla truncata Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 301.
Unio elegans Lea 1831, Am. Philos. Soc. Trans., v. 4, p. 83, pl. 9, fig. 13.
--- --- Call 1900, Moll. Ind., p. 471, pl. 31.
Plagiola elegans Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 389.
--- --- Simpson 1914, Descr. cat. Naiades, p. 306.
Amygdalonaias truncata Ortmann 1919, Najades Pa., p. 238, pl. 14, fig. 7.
Amygdalonaias elegans F. C. Baker 1920, Life of Pleistocene, p. 383.
Truncilla truncata Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 50.
--- --- Frierson 1927, Check list N. Am. Naiades, p. 89.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 224, pl. 78, figs. 3-9.
--- --- Goodrich 1932, Moll. Mich., p. 112.

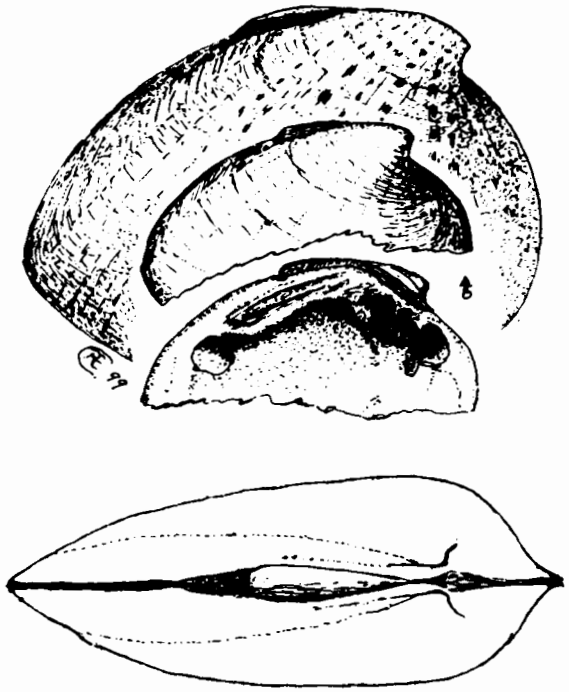


FIGURE 137.—*Plagiola lineolata*, four views, X1; after Call (1900, pl. 30).

--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 153.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 72.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 319.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 105, pl. 13, fig. 3.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 99.

Type locality.—Ohio River.

Diagnosis.—Shell triangular, seldom longer than 81 mm., very dark brown, and with a few obscure diagonal rays; posterior slope decidedly truncate; behind a low posterior ridge is a shallow, wide depression; base

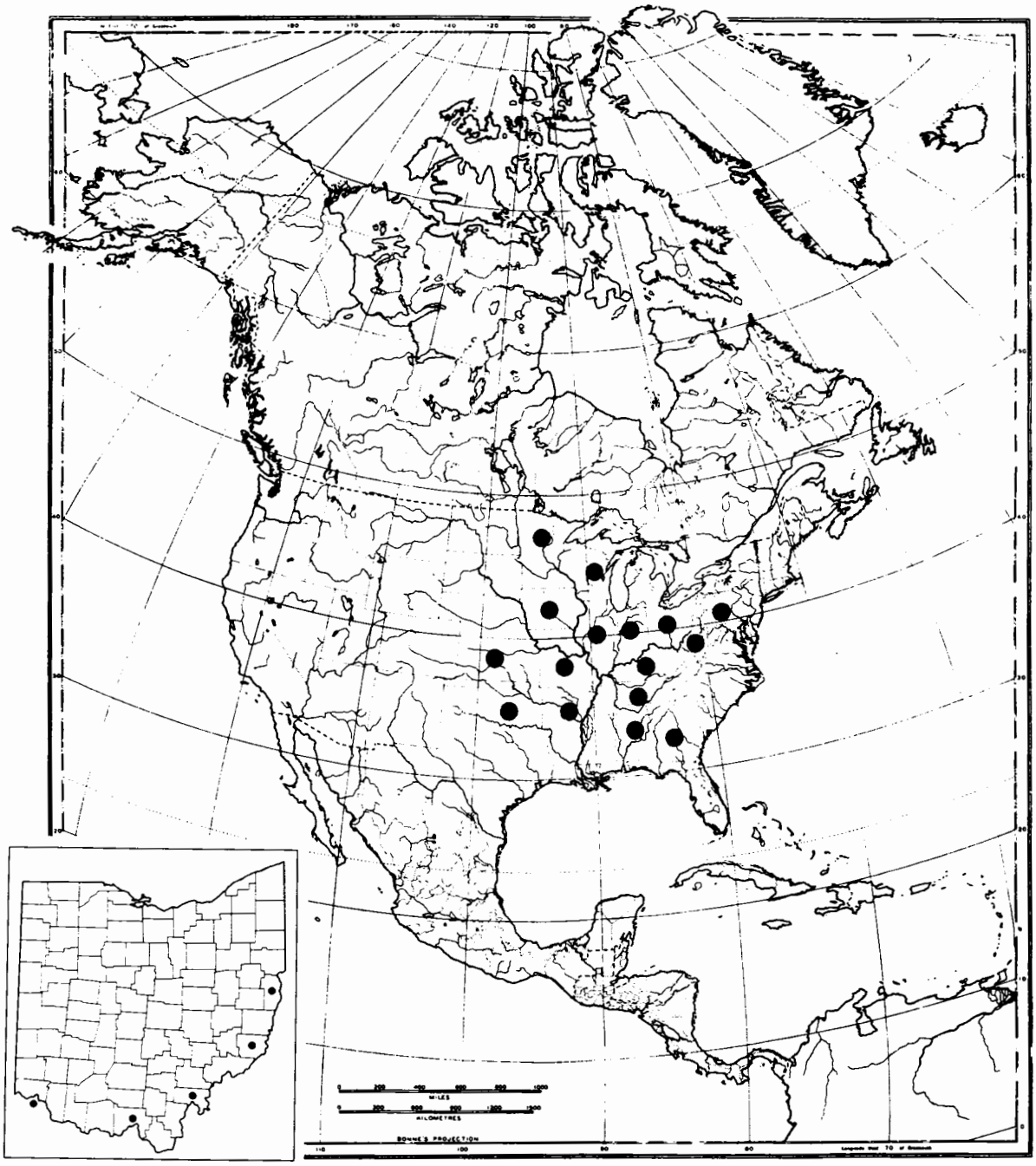


FIGURE 138.—Distribution of *Plagiola lineolata* in North America; *inset,* distribution in Ohio.

a little sinuous, hinge line slightly curved; beaks high and sculptured with a few weak folds; nacre pearly white, marked with one or two shallow furrows; beak cavity much pitted, muscle scars deep anteriorly; pseudocardinals high, ragged, stout; lateral teeth short, strong; L. 81, H. 53, D. 35.5 mm. (modified from Goodrich, 1932, p. 112).

Ecology.—"In Wisconsin River in water 1-2 m. deep, on a sand or mud bottom; in Fox River at Omro, on a sandy mud bottom in .3-.6 m. of water, usually along shore; in Lake Butte des Morts, on a mud bottom in water 11 feet deep" (F. C. Baker, 1928a, pt. II, p. 226). "In the Huron River . . . never occurs anywhere . . . except near its mouth . . . . It occurs in Lake Erie." In the Huron River it is abnormally large, and not at all like the stunted forms which occur in the large lake (condensed from van der Schalie, 1938, p. 72).

General distribution (fig. 136).—"Mississippi drainage generally. Western Pennsylvania west to Iowa and Kansas, north to Minnesota and Michigan, and south to northern Alabama, Tennessee, Louisiana, and Texas" (Baker, 1928a, pt. II, p. 226).

Distribution in Ohio (inset, fig. 136).—Sterki (1907a, p. 389) records this species for "both drainages; Ohio and Little Miami Rivers; Maumee and Tiffin Rivers; Lake Erie; not in the Tuscarawas River." Ortmann (1919) adds "Lake Erie, Erie Co.; Sandusky River, Sandusky Co.; Maumee and Erie Canal, Lucas Co.; and the Ohio River in Jefferson and Meigs counties."

Geologic range.—Baker (1920a, p. 383) gives only late Wisconsin ("Wabash") for this species.

Genus *Plagiola* Rafinesque 1819

Plagiola Rafinesque 1819, Jour. Physique, v. 88, p. 426 (*fide* Neave).
Plagiola Walker 1918, Synopsis and cat. fresh-water Moll., p. 69.
Plagiola Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 51.
Plagiola F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 231.

Type.—*Unio securis* Lea (=*Obliquaria lineolata* Raf.)

Diagnosis.—Shell solid, surface irregularly concentrically ridged; epidermis smoothish, but here and there wrinkled; painted with larger and smaller scattered rays which are generally broken into irregular lunate or squarish blotches; hinge heavy and strong; hinge plate wide and flat; female shell smaller than the male, more inflated and swollen in the postbasal region.

Plagiola lineolata Rafinesque 1820
Fig. 137

Obliquaria (Plagiola) lineolata Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 303.
Obliquaria (Plagiola) depressa Rafinesque 1820, *ibid.*, p. 302, pl. 81, figs. 5-7.
Unio securis Lea 1829, Am. Philos. Soc. Trans., v. 2, p. 437, pl. 11, fig. 17.
Unio lineolatus Call 1900, Moll. Ind., p. 469, pl. 30.
Plagiola securis Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 389.
--- --- Simpson 1914, Descr. cat. Naiades, p. 304.
Plagiola lineolata Ortmann 1919, Najades Pa., p. 243, pl. 14, fig. 10; pl. 15, figs. 1-3.
--- --- Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 51.
--- --- Frierson 1927, Check list N. Am. Naiades, p. 89.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 231, pl. 79, figs. 4-8.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 318.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.

Type locality.—Falls of the Ohio, at Louisville, Kentucky.

Diagnosis.—Characters of the genus (the genus is monotypic). The sharp posterior ridge, peculiarly painted epidermis, squarish or elongated spots, compressed shell, wide interdentum of hinge plate, and very low umbones are characteristics that will readily identify this beautiful species (F. C. Baker, 1928a, pt. II, p. 231).

Ecology.—A species of large rivers, found on sand, gravel, and mud bottom, especially bars. Call (1900, p. 471) says that it buries itself deeply in sand bars. In the Mississippi River it occurs on sand, gravel, and mud bottom in water 2 to 6 feet or more deep (Baker, 1928a, pt. II, p. 232).

General distribution (fig. 138).—Western Pennsylvania west to Iowa, north to Minnesota, south to Kan-

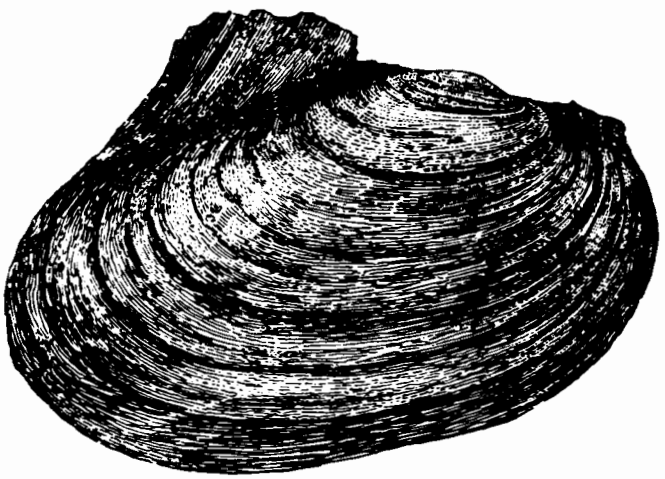


FIGURE 139.—*Leptodea fragilis*, exterior of right valve, X1; after Walker (1918, p. 73, fig. 202).

sas, Oklahoma, and Alabama (Baker, 1928a, pt. II, p. 233).

Distribution in Ohio (inset, fig. 138).—Sterki (1907a, p. 389) records it only for the Ohio River. Ortmann (1919) likewise did not have it for tributaries of the Ohio but for the main river in Jefferson, Monroe, Meigs, and Scioto Counties.

Geologic range.—Unknown.

Genus *Leptodea* Rafinesque 1820

Leptodea Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 295 (*fide* Neave and Ortmann and Walker).

Paraptera Ortmann 1911, Carnegie Mus. Mem., v. 4, p. 301 (*fide* Neave).

Paraptera Walker 1918, Synopsis and cat. fresh-water

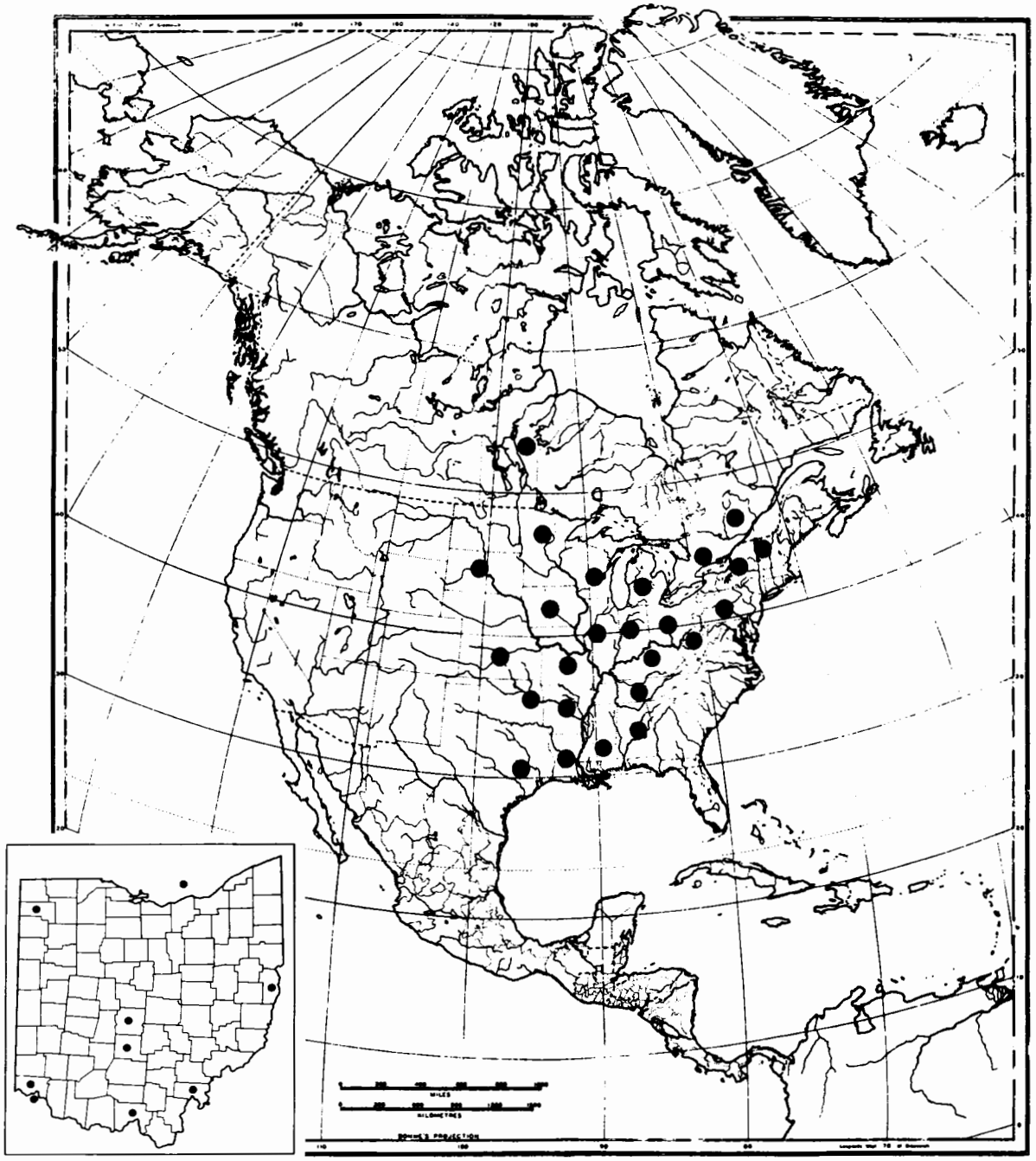


FIGURE 140.—Distribution of *Leptodea fragilis* in North America; *inset,* distribution in Ohio.

Moll., p. 72.

Leptodea Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 52.

Leptodea F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 233.

Leptodea La Rocque 1953, Cat. Recent Moll. Canada, p. 94.

Type.—*Unio (Leptodea) fragilis* Rafinesque.

Diagnosis.—Shell large, thin, elliptical or slightly obovate, more or less compressed, winged on the dorsal margin; beaks low; epidermis rather smooth, often feebly rayed, dull colored, but generally glossy; teeth compressed, pseudocardinals but feebly and in many cases imperfectly developed; nacre purplish; male and female shells nearly alike, the latter scarcely swollen at postbasal region.

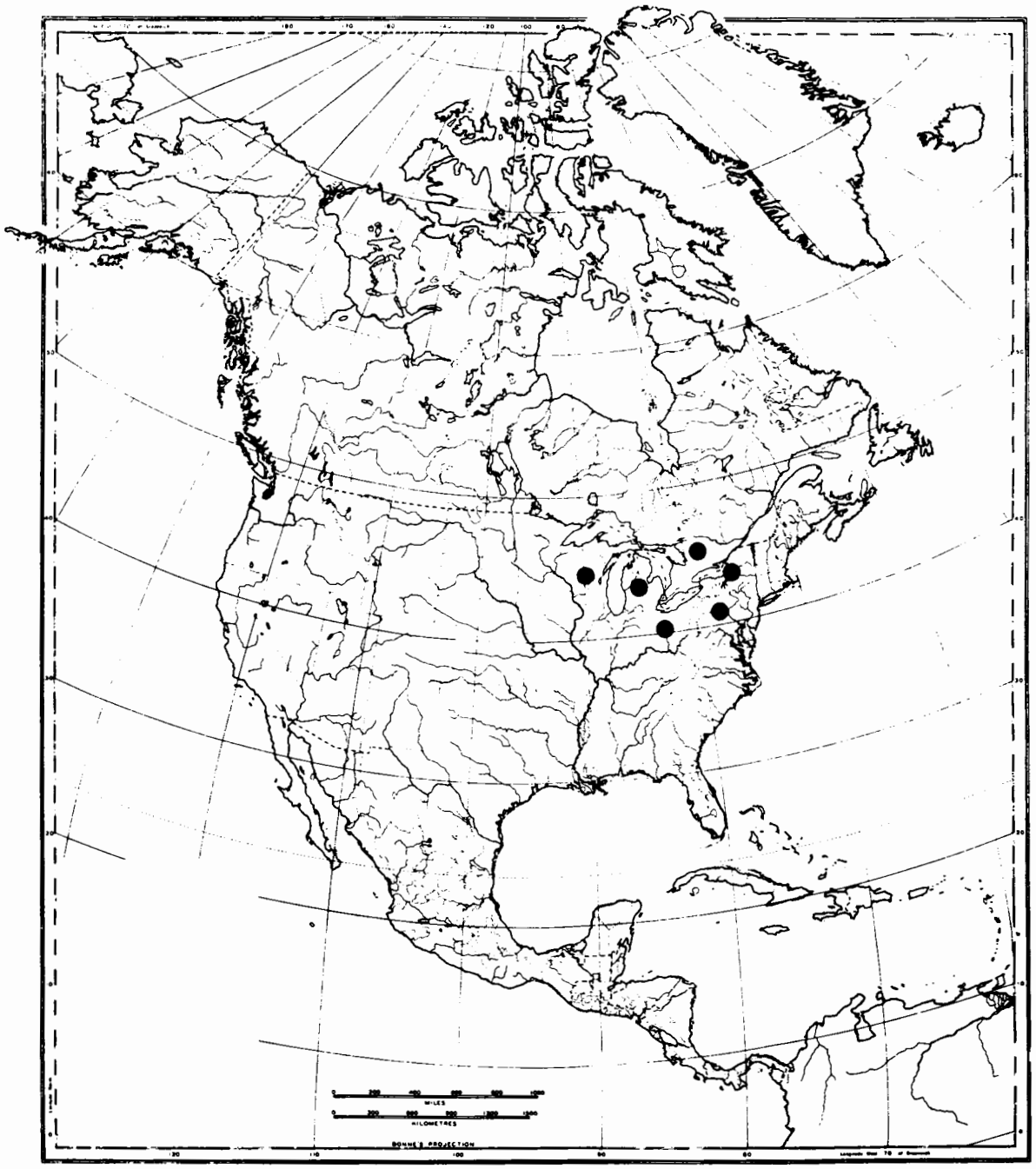


FIGURE 141.—Distribution of *Leptodea fragilis lacustris* in North America.

Leptodea fragilis (Rafinesque) 1820
Fig. 139

Unio (Leptodea) fragilis Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 295.
Unio gracilis Barnes 1823, Am. Jour. Sci., v. 6, p. 274.
--- --- Call 1900, Moll. Ind., p. 464.
Lampsilis gracilis Dall 1905, Harriman-Alaska Exped., v. 13, p. 127.
Proptera gracilis Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 393.
Lampsilis gracilis Simpson 1914, Descr. cat. Naiades, p. 181.
Lampsilis (Proptera) gracilis Johnson 1915, Fauna New England, p. 23.
Paraptera fragilis Ortmann 1919, Najades Pa., p. 247, pl. 15, figs. 4-6.
Leptodea fragilis Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 53.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 234, pl. 80, figs. 1-4.
--- --- Goodrich 1932, Moll. Mich., p. 102.
--- --- La Rocque and Oughton 1932, Canadian Jour. Research, v. 15(D), p. 152.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 316.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 105, pl. 13, fig. 2.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 94.
--- --- Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 46, fig. 22.

Type locality.—Ohio River.

Diagnosis.—Shell resembles *Proptera alata* in shape, but is rather more oblong; the wing is prominent in specimens from Lake Erie, absent or scarcely noticeable in river material; epidermis smooth, in many cases shining, showing the rest periods as dark lines or bands; yellow to brown; pseudocardinals not very stout, laterals strong only in adults; nacre white or bluish; L. 122, H. 81, D. 50 mm. (modified from Goodrich, 1932, p. 102).

Ecology.—Found in rivers, in 1-2 feet of water, on sandy mud bottom; in water 3-6 feet deep, on sand and mud bottom, in a rapid current. In Pennsylvania Ortmann found the species chiefly in riffles.

Associations.—Living: ONTARIO-1.

General distribution (fig. 140).—Eastern New York and the Ottawa River west to Iowa and Kansas, north to Red River of the North, and south to Texas, Mississippi, and Alabama. St. Lawrence and Mississippi drainages; Hudson River.

Distribution in Ohio (inset, fig. 140).—Sterki (1907a, p. 393) gives "both drainages; common in Lake Erie. Not found in the Tuscarawas River." Ortmann (1919) adds: Lake Erie, Erie County; Ohio River in Jefferson, Meigs, and Scioto Counties.

Geologic range.—Unknown.

Variation.—F. C. Baker (1922b; 1928a, pt. II, p. 237) describes a variety, *L. fragilis lacustris* (see below), from Wisconsin with which he identifies the Lake St. Clair specimens of the species and, more doubtfully, the Lake Erie forms. The identification is accepted here, though a little doubtfully.

Leptodea fragilis lacustris (F. C. Baker) 1922

Paraptera gracilis lacustris F. C. Baker 1922, Nautilus, v. 35, p. 131.
Leptodea fragilis lacustris F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 237, pl. 80, figs. 5-7; pl. 81, figs. 1, 2.
--- --- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 105, pl. 13, fig. 5.
--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 95.

Type locality.—Lake Butte des Morts, off Plummer's Point, Wisconsin.

Diagnosis.—"Differing from *fragilis* in being somewhat rounder, higher in proportion to length, the dorsal margin more strikingly alate in immature males, shell more compressed, color straw-yellow with few or no radiating lines, and rest periods distinctly marked and equally spaced. Other characters as in *fragilis*" (F. C. Baker, 1928a, pt. II, p. 237).

Ecology.—Found on "gravel bottom, water one foot deep ... gravel and stony bottom, water .3-1 m. deep ... sand with boulders; water .3-.6 m. deep ... sand

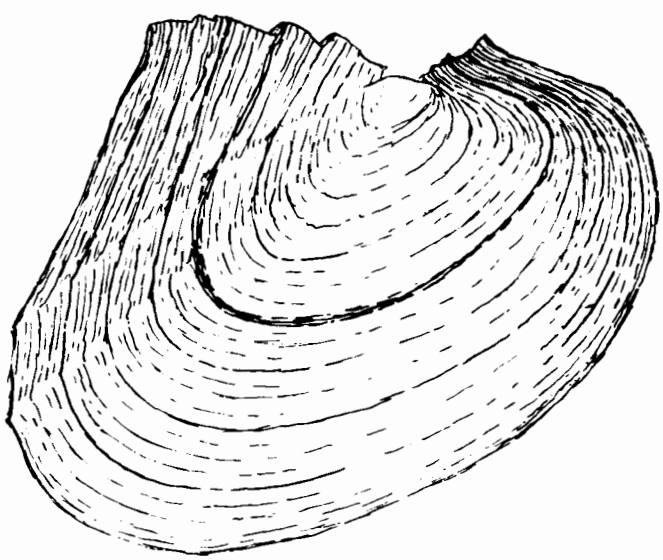


FIGURE 142.—*Leptodea laevissima,* X1; original figure by D. H. Stansbery.

bottom, water .3-.6 m. deep ... gravel and cobble bottom, water 2.5-3 m. deep" (Baker, 1928a, pt. II, p. 238).

General distribution (fig. 141).—Lakes Butte des Morts and Winnebago, Wisconsin; Lake St. Clair, Michigan; Lake Erie; Lake Ontario; doubtfully, Niagara River and its tributaries.

Distribution in Ohio.—Lake Erie only.

Geologic range.—Unknown.

Remarks.—The variety is not recognized by Goodrich (1932, p. 102) who tacitly includes it in the typical form by considering the specimens of the lower Great Lakes as belonging to the latter. The variety is recognized here, although with some misgivings, as the characteristics used to define it are rather unimportant.

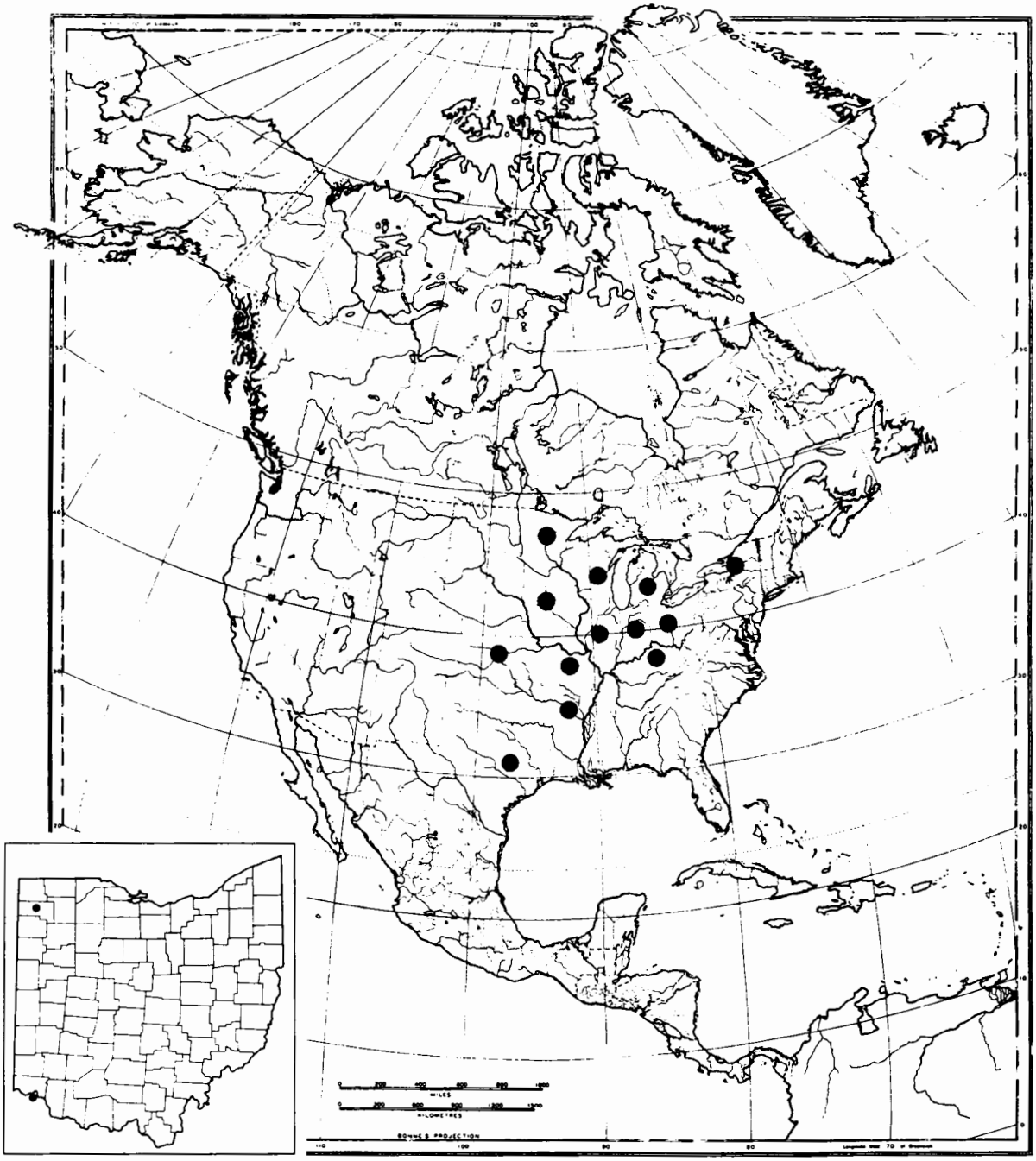


FIGURE 143.—Distribution of *Leptodea laevissima* in North America; *inset,* distribution in Ohio.

Leptodea laevissima (Lea) 1830
Fig. 142

Symphynota laevissima Lea 1830, Am. Philos. Soc. Trans., v. 3, p. 444, pl. 13, fig. 23.
Unio ohioensis Say 1834, Am. Conchology, no. 6.
Unio laevissimus Call 1900, Moll. Ind., p. 462.
Proptera laevissima Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 393.
Lampsilis laevissima Simpson 1914, Descr. cat. Naiades, p. 183.
Proptera laevissima Frierson 1927, Check list N. Am. Naiades, p. 86.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 247, pl. 88, figs. 1-3.
--- --- Goodrich 1932, Moll. Mich., p. 101.
Leptodea laevissima Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 316.
Proptera laevissima Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 106, pl. 13, fig. 4.
Leptodea laevissima van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.

Type locality.—Ohio.

Diagnosis.—Shell elliptical, wider posteriorly, thin, compressed ventrally, with a high triangular thin posterior wing, in many cases turned to one side, and a small anterior wing; valves gaping at both ends; beaks compressed, flattened, with several small nodulous slightly looped broken ridges; surface with irregular growth lines generally raised into ridges at rest periods, the whole surface commonly sculptured with delicate radiating impressed lines; epidermis olive green or yellowish green, yellowish near the beaks, polished, some specimens with fine rays; pseudocardinals weak, thin, somewhat lamellar, diagonal to the dorsal margin, slightly roughened, one or two in each valve; laterals well marked, long, thin, elevated, somewhat truncated at end; no interdentum; adductor muscle scars not deeply marked; nacre rich mauve, lighter in young shells; female shell a trifle fuller along the base than that of the male. L. 96, 120, 46; H. 62, 83, 30; D. 25, 36, 13 mm. (condensed from F. C. Baker, 1928a, pt. II, p. 247).

Ecology.—Found in large rivers, associated with *Proptera alata megaptera,* on sand and mud bottom in good current, water 3-6 feet or more deep; common on sand bars (Grier, quoted by Baker, 1928a, pt. II, p. 248).

General distribution (fig. 143).—Mississippi drainage generally; eastern Texas; southern Michigan; western New York; Ohio; Indiana; Illinois; Arkansas; Missouri.

Distribution in Ohio (inset, fig. 143).—Sterki (1907a, p. 393) gives "Ohio River, and tributaries --? Not found in Tuscarawas River."

Geologic range.—Unknown.

Leptodea leptodon (Rafinesque) 1820
Fig. 144

Unio (Leptodea) leptodon Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 295, pl. 80, figs. 5-7.
Unio tenuissimus Call 1900, Moll. Ind., p. 463.
Proptera leptodon Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 393.
Lampsilis leptodon Simpson 1914, Descr. cat. Naiades, p. 188.
Leptodea leptodon Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 52.
Lampsilis (Leptodea) leptodon Frierson 1927, Check list N. Am. Naiades, p. 82.
Leptodea leptodon F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 239, pl. 85, figs. 5-7.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 150.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 316.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 95.

Type locality.—Lower Ohio River.

Diagnosis.—Shell long-ovate, greatly inequipartite, compressed, thin; young shells slightly winged, older shells not winged; valves gaping at both ends; beaks compressed, with four or five very fine doubly-looped ridges; surface with heavy, almost sulcate, growth lines; epidermis dull, greenish or olive green with many wide faint-green rays; pseudocardinals reduced to a low inconspicuous tubercle under or a little in front of the beaks; two faintly marked laterals in the left valve, a single stronger lateral in the right valve; adductor muscle scars large, well marked; nacre purplish or salmon color; L. 90, 58, H. 44, 28, D. 26, 13 (condensed from F. C. Baker, 1928a, pt. II, p. 240).

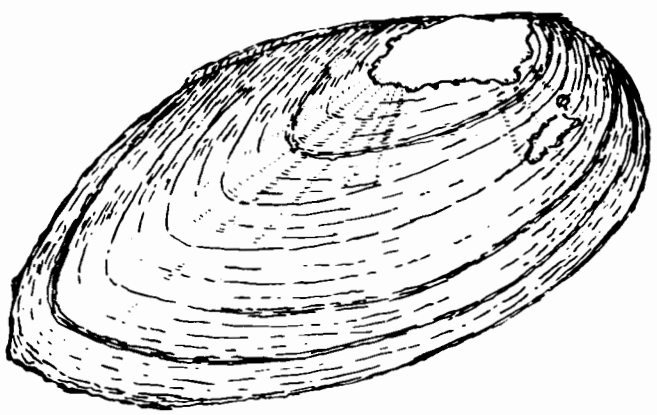


FIGURE 144.—*Leptodea leptodon,* X1; original figure by D. H. Stansbery.

Ecology.—The species lives on muddy bottom in the Ohio and Wabash Rivers (Call, 1900, p. 463).

General distribution (fig. 145).—Upper Mississippi River drainage; Souris River, Manitoba; Detroit River; Buffalo, New York; southern Michigan; southward to Tennessee River.

Distribution in Ohio (inset, fig. 145).—Sterki (1907a, p. 393) gives "both drainages, not common; a specimen from 'Cleveland' is in the Oberlin collection. Not found in the Tuscarawas River." Ortmann does not list this species.

Geologic range.—Unknown.

Genus *Proptera* Rafinesque 1819

Proptera Rafinesque 1819, Jour. Physique, v. 88, p. 426 (*fide* Neave).

Proptera Walker 1918, Synopsis and cat. fresh-water

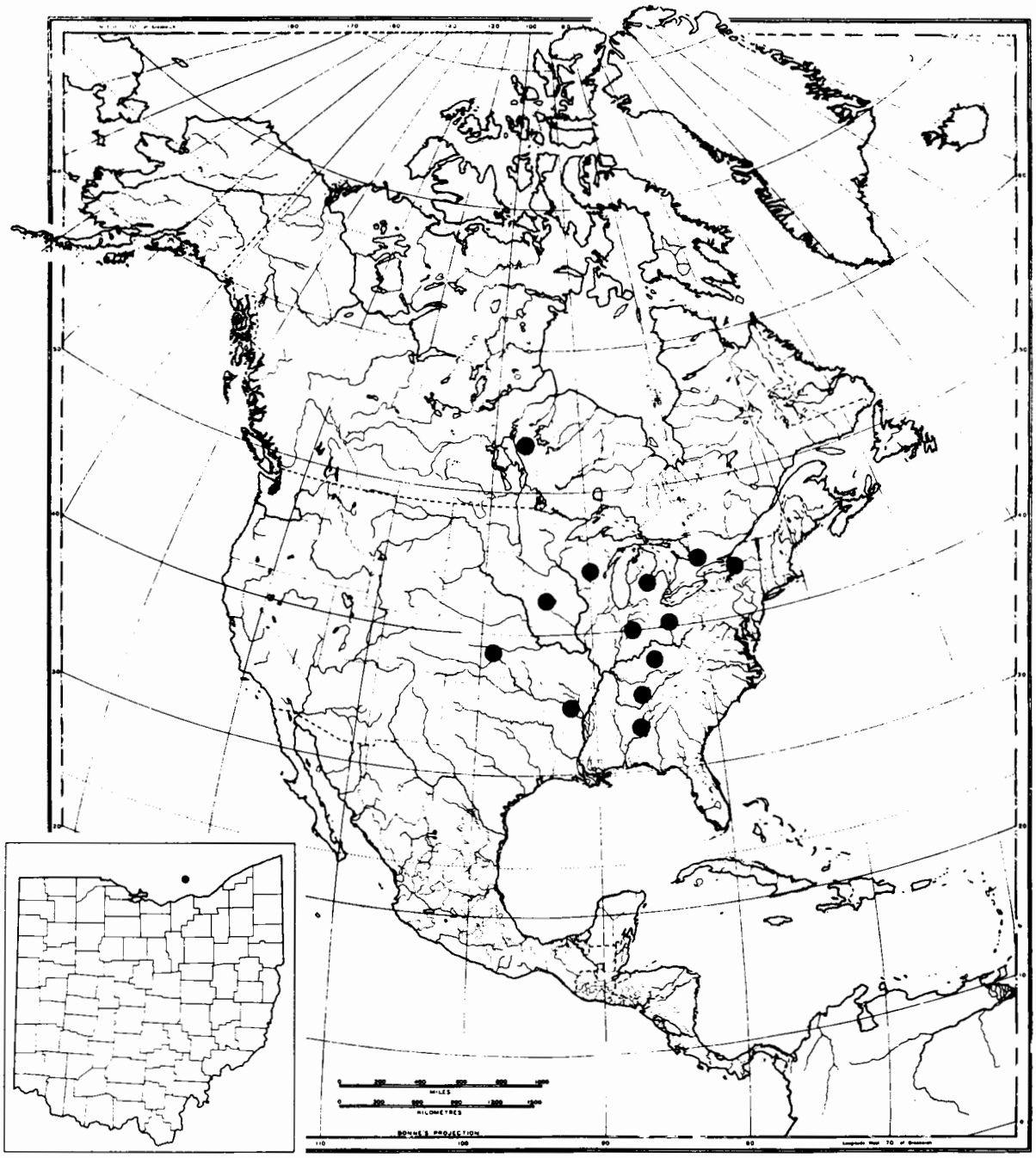


FIGURE 145.—Distribution of *Leptodea leptodon* in North America; *inset,* distribution in Ohio.

Moll., p. 71.
Proptera F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 241.
Proptera La Rocque 1953, Cat. Recent Moll. Canada, p. 97.

Type.—*Unio alatus* Say.

Diagnosis.—Shell generally large, gaping at anterior edge and edge of dorsal slope, winged along the dorsal region when young and commonly when adult; beak sculpture weak, consisting, when developed, of an anterior and posterior loop, the former commonly wanting; epidermis generally brown, commonly cloth-like when fresh, rayless or weakly rayed; teeth rather compressed, pseudocardinals in many cases imperfect or nearly wanting; laterals remote.

Proptera alata (Say) 1817
Fig. 146

Unio alatus Say 1817, Nicholson's Encycl., v. 2, pl. 4, fig. 2.
--- --- Call 1900, Moll. Ind., p. 461, pl. 25.
Lampsilis alatus Dall 1905, Harriman-Alaska Exped., v. 13, p. 126.
Proptera alata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 393.
Lampsilis alata Simpson 1914, Descr. cat. Naiades, p. 162.
Lampsilis (Proptera) alata Johnson 1915, Fauna New England, p. 23.
Proptera alata Ortmann 1919, Najades Pa., p. 252, pl. 15, fig. 7; pl. 16, figs. 1, 2.
--- --- F. C. Baker 1920, Life of Pleistocene, p. 383.
--- --- Frierson 1927, Check list N. Am. Naiades, p. 86.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 241, pl. 81, figs. 3-6.
--- --- Goodrich 1932, Moll. Mich., p. 100.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 153.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 319.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 105, pl. 13, fig. 13.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 97.

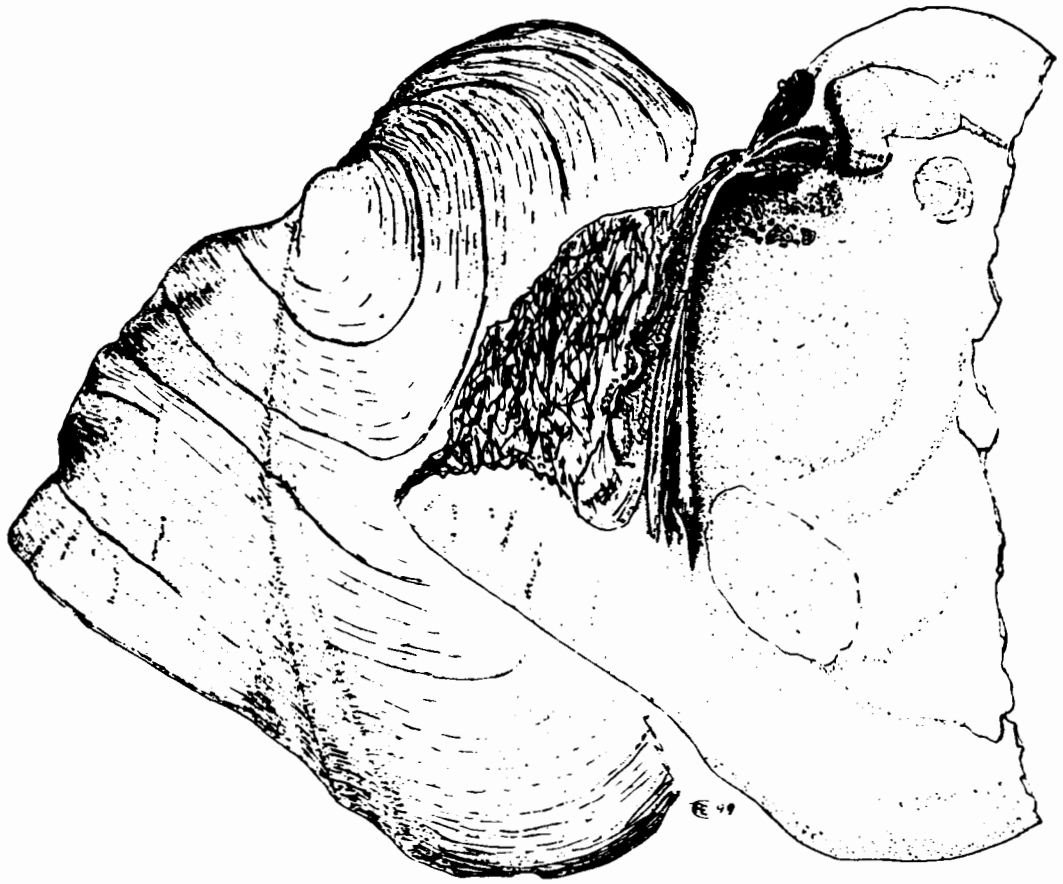


FIGURE 146.—*Proptera alata*, two views, X1; after Call (1900, pl. 25).

Proptera alata Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 45, fig. 23.

Type locality.–"None given" (Simpson, 1914); "Lake Erie" (F. C. Baker, 1928a).

Diagnosis.–Shell large, compressed, expanded posteriorly, and with a high posterior wing rising well above the hinge line and beaks; epidermis smooth and yellow brown in the young and commonly showing more or less distinct rays; dark and rough in adults; pseudocardinals stout, striate; laterals long and slightly curved; nacre deep purple as a rule, but in some cases of a copper hue; female shells more swollen than male shells; L. 110, H. 75, D. 39 mm. (modified from Goodrich, 1932, p. 100).

Ecology.–Found on open lake shores where it receives the full force of the waves, most abundant in water 1-2 feet deep on gravel or rocky bottom; in Lake

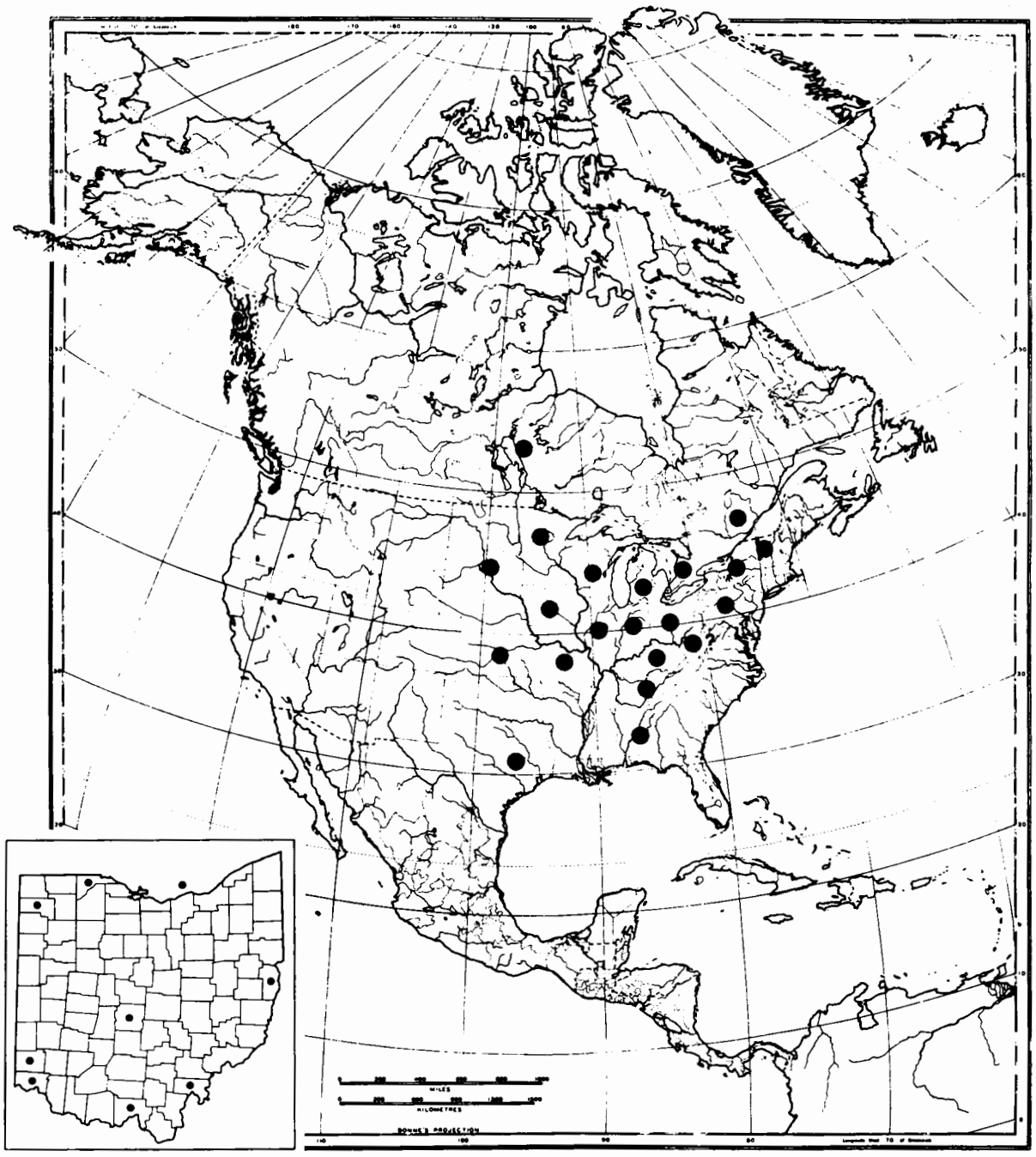


FIGURE 147.–Distribution of *Proptera alata* in North America; *inset,* distribution in Ohio.

Erie, in sand in water 2-3 feet deep, preferring open shores not covered and fringed with rushes (modified from Baker, 1928a, pt. II, p. 243).

General distribution (fig. 147).—Lakes Erie, St. Clair, and Winnebago in Wisconsin.

Distribution in Ohio (inset, fig. 147).—Sterki (1907a, p. 393) gave "both drainages; large e.g. in the Great Miami River; common in Lake Erie, rather small. Not found in Tuscarawas River." Ortmann (1919) gives Lake Erie, Erie County; Maumee River, Lucas County; Defiance, Defiance County; Ohio River in Jefferson, Meigs, and Scioto Counties; and adds that it is present only in the southern tributaries of the Ohio and is absent in the Tuscarawas River.

Geologic range.—Baker (1920a, p. 383) cites this species only for Sangamon deposits.

Remarks.—It is evident from Sterki's statement on the distribution of this species in Ohio that he did not

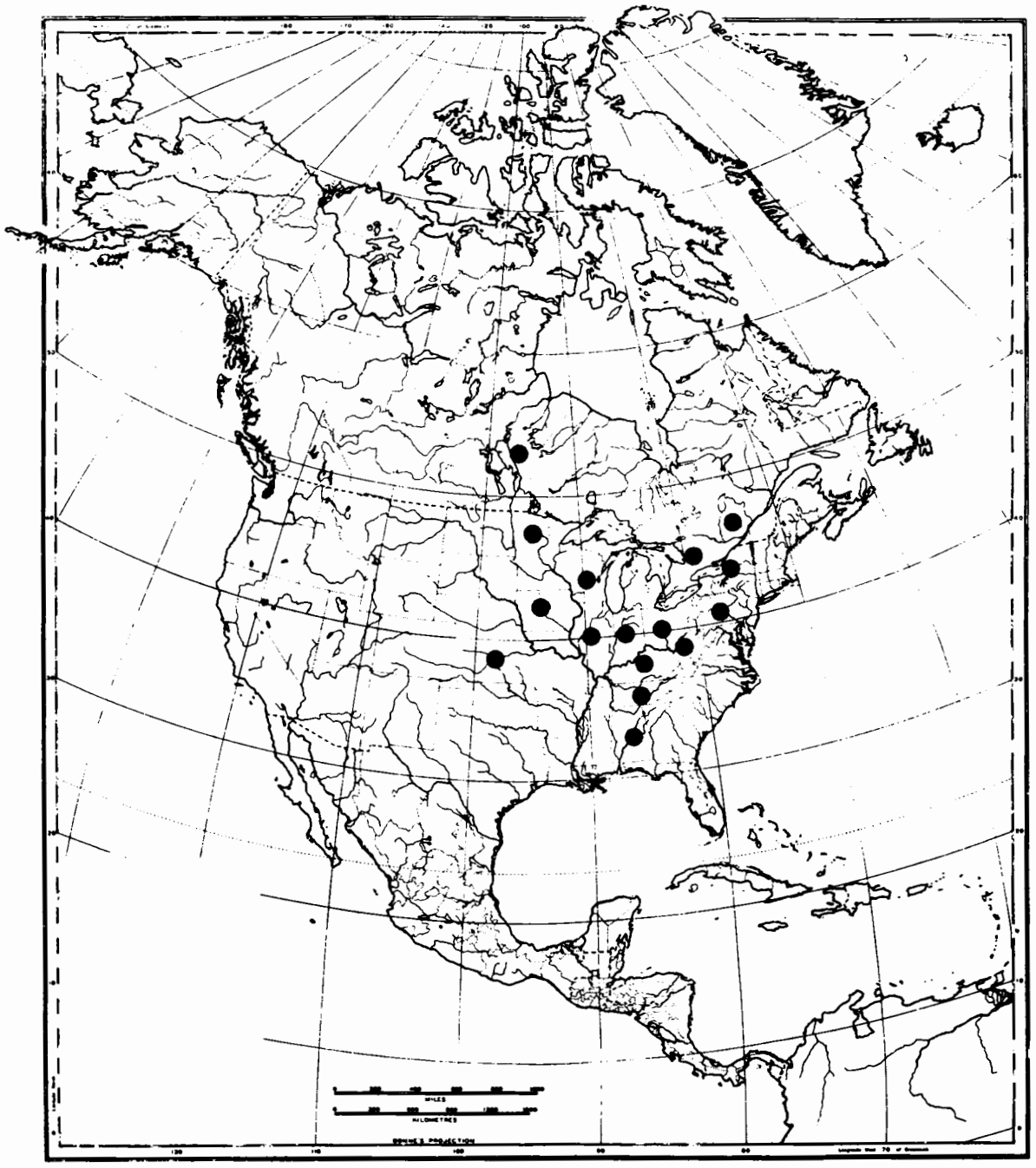


FIGURE 148.—Distribution of *Proptera alata megaptera* in North America.

differentiate the species from the variety *megaptera*. Certainly the two forms grade together; specimens from the open parts of Lake Erie are small, those from protected bays, such as Sandusky Bay, are larger and approach the river form, demonstrating the minor value of the distinction.

Proptera alata megaptera Rafinesque 1820

Metaptera megaptera Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 300, pl. 80, figs. 20-22.

Lampsilis alata Simpson 1914 (part), Descr. cat. Naiades, p. 162.

Proptera alata megaptera F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 244, pl. 82, figs. 1-4.

--- --- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 153.

--- --- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 106.

--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 97.

Type locality.—Ohio River.

Diagnosis.—"Differing from *alata* in being larger, a little less inflated on the average, with a lighter brown or black epidermis, a darker nacre, and a heavier hinge structure. The female shell is more elongated and not as much produced in the post-basal region" (F. C. Baker, 1928a, pt. II, p. 244).

Ecology.—An inhabitant of rivers of fair size, larger in large rivers, such as the Mississippi and Wisconsin, and smaller in smaller rivers, such as the Fox (Wisconsin); generally found in places where the current is strong; found on sand and mud bottom in water a few inches to 6 feet deep but has been dredged from as deep as 24 feet; reported on riffles on coarse gravel in several places (Ortmann, 1919, p. 256) (condensed from Baker, 1928a, pt. II, p. 245).

Associations.—Living: MANITOBA-38; ONTARIO-1.

General distribution (fig. 148).—Widely distributed in the Ohio and Mississippi valleys. Its range extends from eastern New York and Ottawa, Ontario, west to eastern Kansas, north to Red River of the North, and south to Tennessee and northern Alabama.

Distribution in Ohio.—As noted previously, Sterki (1907a, p. 393) and Ortmann (1919, p. 252) did not separate this subspecies from the type form. Interpretation of their records shows, nevertheless, that the river form of *P. alata* is widely distributed in Ohio, as follows: in the Lake Erie drainage, Maumee River; in the Ohio drainage, Great Miami River; in the Ohio River itself in Jefferson, Meigs, and Scioto Counties; but it

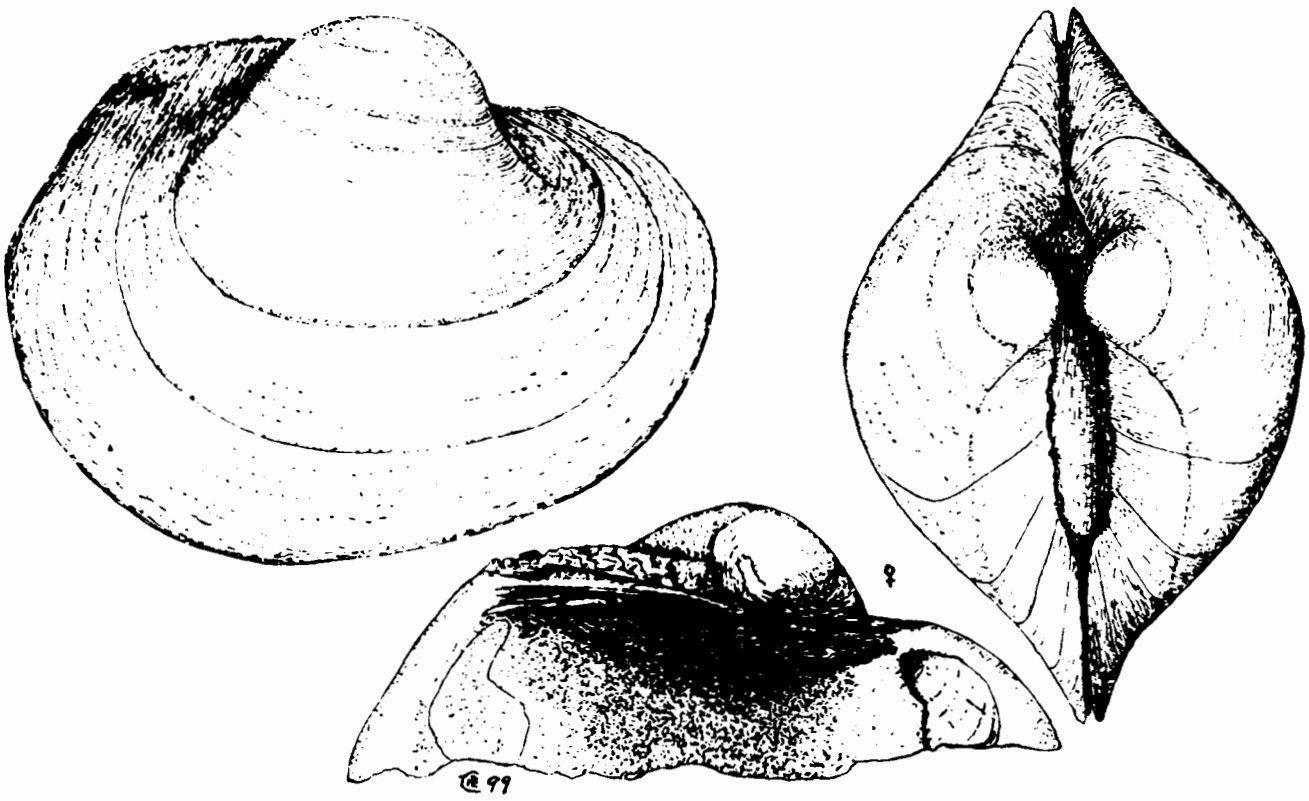


FIGURE 149.—*Proptera capax*, three views, X1; after Call (1900, pl. 40).

has not been recorded for the Tuscarawas River and other northern (*i.e.*, upstream) tributaries of the Ohio.

Geologic range.—Unknown.

Remarks.—The name can be applied with some propriety to river forms attaining large size but intergrades with the type form are numerous, as previously noted under the type form.

Proptera capax (Green) 1832
Fig. 149

Unio capax Green 1832, Cabinet Nat. History, v. 2, p. 290.
--- --- Call 1900, Moll. Ind., p. 482, pl. 40.
Lampsilis capax Sterki 1907, Ohio Acad. Sci. Proc.,

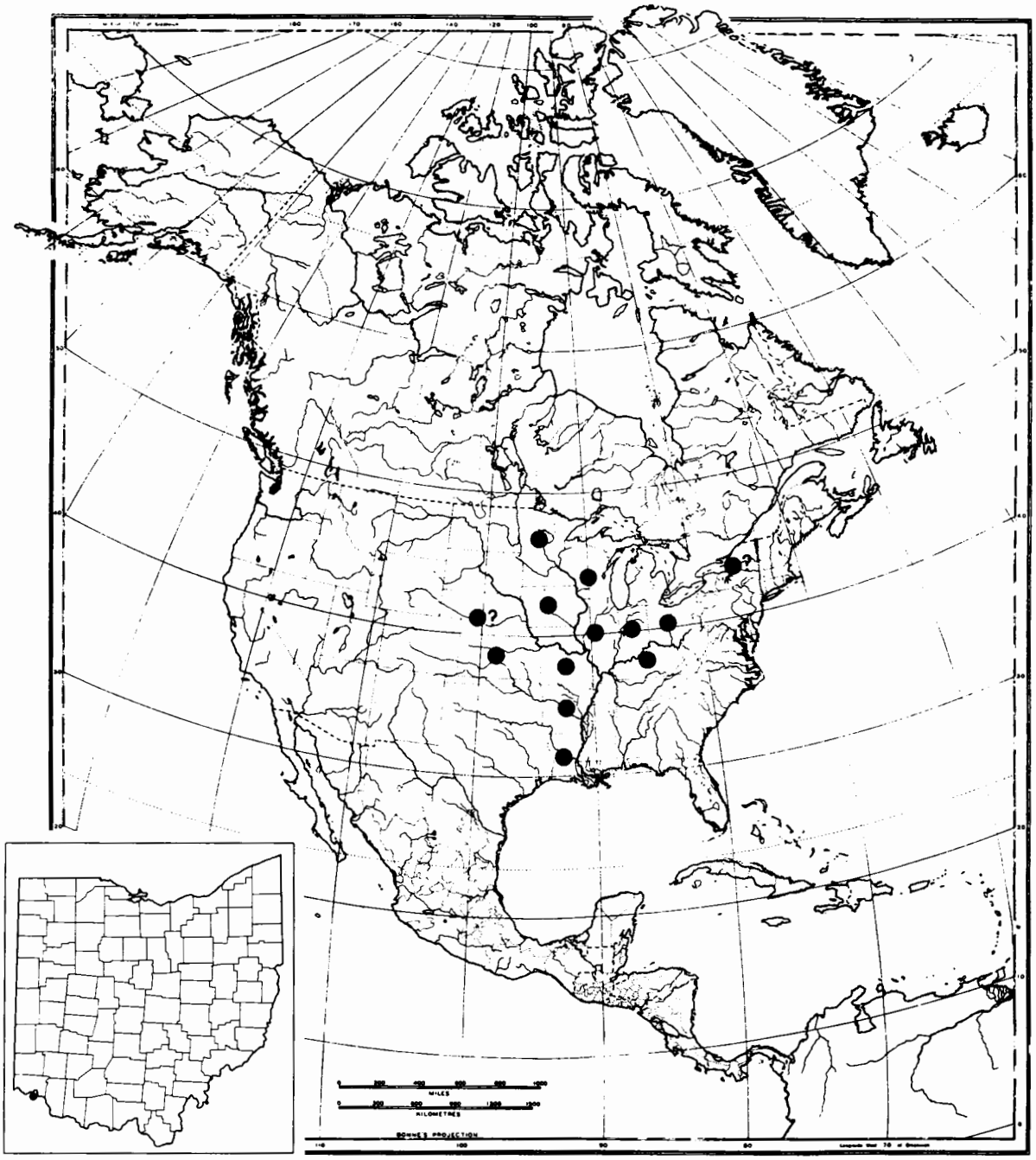


FIGURE 150.—Distribution of *Proptera capax* in North America; *inset,* distribution in Ohio.

v. 4, p. 388.
Lampsilis capax Simpson 1914, Descr. cat. Naiades, p. 47.
Proptera capax Frierson 1927, Check list N. Am. Naiades, p. 87.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 248, pl. 84, figs. 1-4.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 319.
--- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.

Type locality.—"Falls of St. Anthony; Bayou Teche" (Simpson, 1914, p. 47). It would be desirable to have a type locality a little less extensive than this but it seems that so far no one has attempted to designate either the Minnesota locality, which is the first mentioned, or the Louisiana locality as *the* type locality. The point is not of great importance since both places are in the Mississippi River drainage.

Diagnosis.—Shell greatly inflated, obovate, subsolid, gaping at both ends; umbones high, inflated, with sculpture of a few faint oblique ridges; posterior ridge full, rounded, with a flattened or excavated area posteriorly; anteriorly the shell is distinctly alate; surface smooth and more or less shining; epidermis yellowish or reddish brown, some specimens olive, more or less smoky, rayless; rest marks commonly very distinct; hinge line with a double curve; pseudocardinals of left valve more or less double, thin, compressed, elevated, sulcated, situated in front of the beaks; pseudocardinals of right valve double, erect, compressed; all pseudocardinals parallel to the hinge line; laterals short, erect, curved, double in left, single in right valve; beak cavities wide and deep; adductor muscle scars well marked anteriorly, very faint posteriorly; nacre bluish white, tinged with salmon; female shell a trifle more inflated in the postbasal region than the male shell (condensed from F. C. Baker, 1928a, pt. II, p. 249).

Ecology.—Not well recorded according to Baker (1928a, pt. II, p. 249), but in the Mississippi it appears to prefer mud bottom.

General distribution (fig. 150).—Lower Ohio River drainage; southwest to St. Francis River, Arkansas; north to eastern Iowa (Simpson, 1914). A species of more southern distribution (Baker, 1928a, pt. II, p. 250).

Distribution in Ohio (inset, fig. 150).—Sterki (1907a, p. 388) gives only "Ohio River." The species does not range into Pennsylvania and, judging by the paucity of records, it is probably not common in Ohio and not found in the Ohio River except possibly in the vicinity of Cincinnati.

Geologic range.—Unknown.

Genus *Carunculina* Simpson 1898

Carunculina Simpson 1898, in F. C. Baker, 1898, Chicago Acad. Sci. Bull. 3, p. 109 (*Corunculina* in text, emended to *Carunculina* in errata) (*fide* Neave).
?*Toxolasma* Ortmann 1919, Najades Pa., p. 257; Frierson, 1914, Nautilus, v. 28, p. 7; *non* Rafinesque.
Carunculina Walker 1918, Synopsis and cat. fresh-water Moll., p. 76.
Carunculina Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 54.
Carunculina F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 250.
Carunculina La Rocque 1953, Cat. Recent Moll. Canada, p. 90.

Type.—*Unio parvus* Barnes.

Diagnosis.—Shell small, inflated, obovate, rather solid, with a thick dark epidermis, which is rayless or only feebly rayed; beak sculpture consisting of rather strong concentric ridges which form, as a general thing, only a single rounded loop in front and are strongly curved upward behind; pseudocardinals compressed, smooth on the inside, generally reflected upward, somewhat torn on the edges; shell quite commonly pointed posteriorly, that of the female truncated obliquely on the postbase.

Carunculina glans (Lea) 1834
Fig. 151

Unio glans Lea 1834, Am. Philos. Soc. Trans., p. 82, pl. 18, fig. 12.
--- --- Call 1900, Moll. Ind., p. 514, pl. 65, figs. 5-7.
Lampsilis glans Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 389.
Eurynia (Carunculina) glans Ortmann 1912, Carnegie Mus. Annals, v. 8, p. 339.
Lampsilis glans Simpson 1914, Descr. cat. Naiades, p. 153.
Carunculina glans Goodrich 1932, Moll. Mich., p. 105.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 313.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 90.

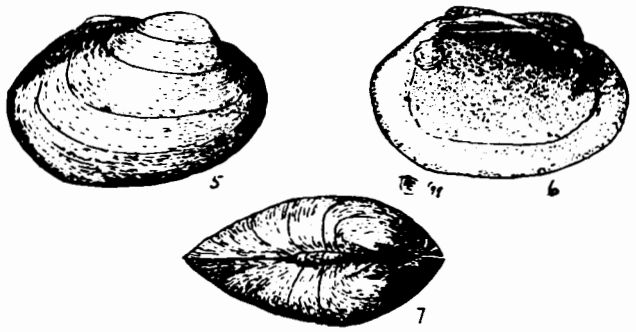


FIGURE 151.—*Carunculina glans*, three views, X1; after Call (1900, pl. 65).

Type locality.—Ohio River.

Diagnosis.—This is "larger, thicker, more swollen than *parva*, with purple nacre and high beaks whose sculpture consists of slightly nodulous folds" (Goodrich, 1932).

Ecology.—The single Michigan occurrence (Goodrich, 1932) is for a small creek, Otter Creek, in Monroe County. It may be expected in small unpolluted creeks in Ohio also.

General distribution (fig. 152).—Ohio River drainage; probably St. Lawrence River drainage; southern Michigan; Arkansas; Georgia.

Distribution in Ohio (inset, fig. 152).—This species is present in the Maumee drainage (Maumee and Auglaize Rivers, Sterki, 1907a, p. 389) and in the Ohio River drainage *(ibid.)* but not in all its tributaries as Sterki did not find it in the Tuscarawas River. Ortmann (1919) does not mention it for Pennsylvania, so it ap-

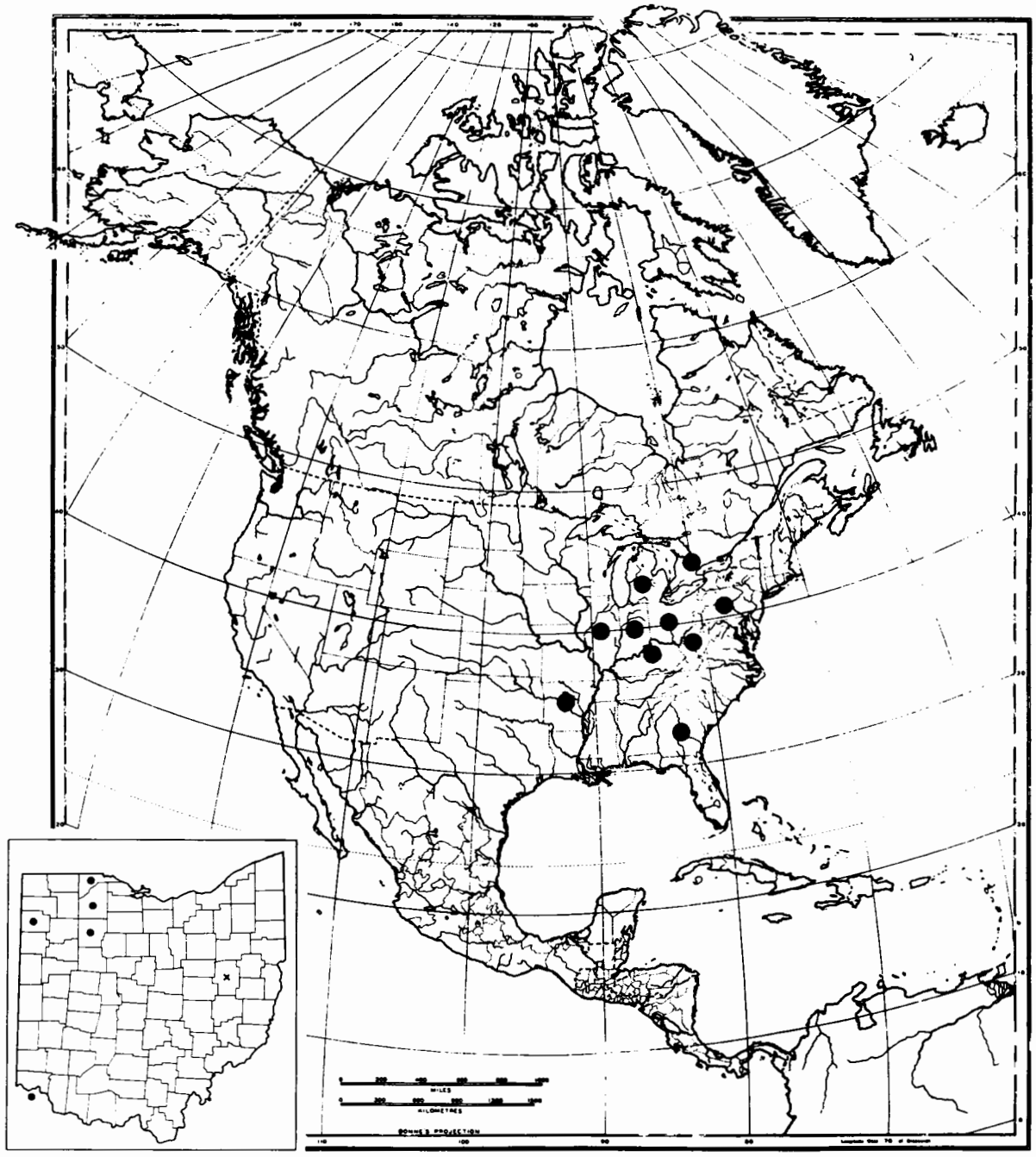


FIGURE 152.—Distribution of *Carunculina glans* in North America; *inset*, distribution in Ohio.

pears to be absent from the eastern part of the Ohio drainage in Ohio and of course from the Lake Erie drainage, except for the Maumee, as well. There are specimens in the University of Michigan collections from Hancock County, Ohio.

Geologic range.—Unknown.

Carunculina parva (Barnes) 1823
Fig. 153

Unio parvus Barnes 1823, Am. Jour. Sci., v. 6, p. 274, pl. 13, fig. 18.
--- --- Call 1900, Moll. Ind., p. 512, pl. 65, figs. 1-4.
Lampsilis parva Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 389.
--- --- Simpson 1914, Descr. cat. Naiades, p. 151.
Toxolasma parvum Ortmann 1919, Najades Pa., p. 258, pl. 16, fig. 3.
Carunculina parva F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 251, pl. 86, figs. 1-4.
--- --- Goodrich 1932, Moll. Mich., p. 105.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 313.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 90.
--- --- Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 49, fig. 37.

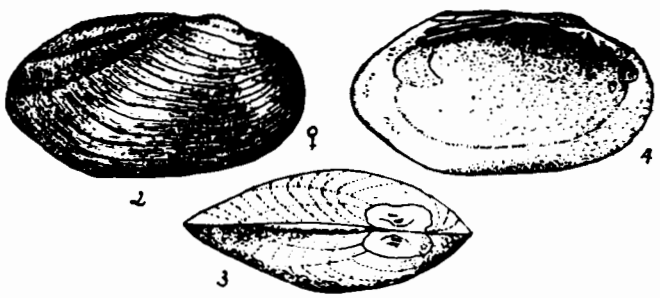


FIGURE 153.—*Carunculina parva*, three views, X1; after Call (1900, pl. 65).

Type locality.—Fox River, Wisconsin.

Diagnosis.—"Small, elliptical, swollen; very dark brown or blackish, often with a silky, smooth epidermis. Beaks low, sculptured with curving ridges, five to eight in number. Nacre white or bluish, iridescent in fresh specimens. Pseudocardinals rather low, striate; laterals small, short. Beak cavity shallow, muscle scars not very deep. Length 27.5, height 13, breadth 10 mm. Posterior end of shell swollen in females" (Goodrich, 1932).

Ecology.—Generally in small streams with sluggish current on mud bottom, in a few inches to 3 feet or more of water.

Associations.—Living: MICHIGAN-52, 53, 54; OHIO-43.

General distribution (fig. 154).—Western New York west to Iowa, Missouri, and Kansas, north to Minnesota, Michigan, and southern Canada, south to Oklahoma and Texas. Lake Erie and drainage. Mississippi drainage.

Distribution in Ohio (inset, fig. 154).—Sterki (1907a, p. 389) gives "over the state (both drainages, Lake Erie); rivers, creeks and canals." Ortmann (1919) adds specific localities: Lake Erie, Ottawa County; Crane and Ten Mile Creeks, Lucas County; Grand Reservoir, Mercer County; Tuscarawas River; Scioto River and Ohio Canal, Franklin County; Wabash River, Mercer County.

Geologic range.—Unknown.

Genus *Ligumia* Swainson 1840

Eurynia Rafinesque 1819, Jour. Physique, v. 88, p. 426 (*fide* Neave; others give 1820).
Ligumia Swainson 1840, Treatise Malacology, p. 267, 378 (in error as *Ligumea* on p. 263) (*fide* Neave).
Eurynia Walker 1918, Synopsis and cat. fresh-water Moll., p. 76.
Ligumia Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 59.
Ligumia F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 254.
Ligumia La Rocque 1953, Cat. Recent Moll. Canada, p. 95.

Type.—*Unio recta* Lamarck.

Diagnosis.—Shell oval to oblong; surface smooth; beak sculpture delicate, double looped; female shell more or less expanded or swollen in the postbasal region (condensed from Walker, 1918).

Ligumia nasuta (Say) 1817
Fig. 155

Unio nasutus Say 1817, Nicholson's Encycl., v. 2, pl. 4, fig. 1.
Lampsilis nasuta Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 389.
--- --- Simpson 1914, Descr. cat. Naiades, p. 97.
--- --- Johnson 1915, Fauna New England, p. 22.
Eurynia (Eurynia) nasuta Ortmann 1919, Najades Pa., p. 271, pl. 16, figs. 10, 11.
Lampsilis nasuta Frierson 1927, Check list N. Am. Naiades, p. 78.
Ligumia nasuta Goodrich 1932, Moll. Mich., p. 108.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 64.

Ligumia nasuta Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 317; a distinct New England and Lake Erie species.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 107, pl. 12, fig. 11.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 95.
--- --- Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 51, fig. 54.

Type locality.—Delaware and Schuylkill Rivers.

Diagnosis.—Shell long, thin, somewhat fragile; rounded in front, pointed behind; smooth, yellow brown, greenish, or dark brown; commonly with delicate rays extending across the disk; beaks low, sculptured, with a few folds, not prominent; nacre white, bluish, or pink, often spotted with liver-colored blotches; pseudocardinals stumpy, lateral teeth nearly straight; L. 75, H. 32, D. 15 mm. (modified from Goodrich, 1932, p. 108).

FIGURE 154.—Distribution of *Carunculina parva* in North America; *inset,* distribution in Ohio.

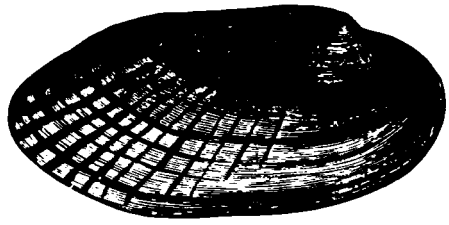


FIGURE 155.–*Ligumia nasuta,* X1; after Hartman and Michener (1874, p. 90, fig. 186).

Ecology.–In the Huron River, Michigan; "This species in the river is usually large and thick as compared with the small and thin specimens occurring in the lakes. In the river it occurs on a sandy bottom in more or less quiet pools, and even there must be counted as rare. In the lakes it is common in beach pools on a sand bottom" (van der Schalie, 1938, p. 64).

Associations.–Living: MICHIGAN - 54.

General distribution (fig. 156).–St. Lawrence drainage from lower half of Lake Huron and several inland lakes of Michigan to the lower St. Lawrence, but not in all its tributaries. Atlantic drainage south to North Carolina.

Distribution in Ohio (inset, fig. 156).–Sterki (1907a, p. 389) gives "St. Lawrence drainage, Lake Erie, probably also in the Ohio drainage, at least along the divide." He found large specimens in a pond near Rootstown, Portage County. Ortmann (1919) gives Ottawa River, Lucas County, and Lake Erie, Erie County.

Geologic range.–Unknown.

Ligumia recta (Lamarck) 1819
Fig. 157

Unio recta Lamarck 1819, Animaux sans vertèbres, v. 6, p. 74.
Lampsilis rectus Dall 1905, Harriman-Alaska Exped., v. 13, p. 126.
Lampsilis recta Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 389.
--- --- Simpson 1914, Descr. cat. Naiades, p. 95.
--- --- Johnson 1915, Fauna New England, p. 22.
Eurynia (Eurynia) recta Ortmann 1919, Najades Pa., p. 276, pl. 16, figs. 12, 13.
Eurynia recta F. C. Baker 1920, Life of Pleistocene, p. 383.
Lampsilis (Ligumia) recta Frierson 1927, Check list N. Am. Naiades, p. 70.
Ligumia recta F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 255, pl. 87, figs. 4, 5.
--- --- Goodrich 1932, Moll. Mich., p. 107, pl. 6, fig. 1.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 107, pl. 12, fig. 12.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 95.
--- --- Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 52, fig. 60.

Type locality.–Lake Erie.

Diagnosis.–Shell long, thick, smooth, light brown and marked with diagonal rays, to sooty black; anterior end rounded, posterior end bluntly pointed; base very broadly curved; hinge line nearly straight; beaks are low and sculptured with a few feeble curving folds; pseudocardinals somewhat high, serrate; lateral teeth long and nearly straight; nacre white in typical shells and in others discolored with brownish blotches; female shells more swollen than male and angled behind; males decidedly pointed; L. 132, H. 50, D. 39 mm. (modified from Goodrich, 1932, p. 107).

Ecology.–In Lake Winnebago, F. C. Baker (1928a, pt. II) found it on stony bottom in water a few inches to 1.5 feet or more deep, living where it receives the full pounding of the heavy surf in times of storm. The Lake Erie form lives on a sand or gravel shore in protected situations, and in beach pools in sandy-mud bottom, in quiet waters.

Associations.–Living: WISCONSIN - 6, 82.

General distribution (fig. 158).–Lake St. Clair, Detroit River, Lake Erie; Lake Winnebago, Wisconsin.

Distribution in Ohio (inset, fig. 158).–Sterki (1907a, p. 389) gives "both drainages; Lake Erie (small); not in the Mahoning River, t. Dean." Ortmann (1919) does not recognize the river form as distinct. He does record *L. recta* for Lake Erie, Erie County. See under *L. recta latissima* for his other Ohio records.

Geologic range.–Baker (1920a, p. 382) has noted the species for Sangamon and late Wisconsin ("Wabash") beds.

Remarks.–The restricted distribution given above is for the lake form. The river form has been given a varietal name, *L. recta latissima,* which is discussed below.

Ligumia recta latissima Rafinesque 1820
Fig. 159

Unio latissima Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 297, pl. 30, figs. 14, 15.
Unio rectus Call 1900, Moll. Ind., p. 451, pl. 17.
Eurynia (Eurynia) recta latissima Ortmann 1919, Najades Pa., p. 276, pl. 16, figs. 12, 13.
Ligumia recta latissima Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 59.
Lampsilis (Ligumia) recta-latissima Frierson 1927, Check list N. Am. Naiades, p. 70.
Ligumia recta latissima F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 257, pl. 87, figs. 1-3; pl. 86, figs. 13, 14.

Ligumia recta latissima Goodrich 1932, Moll. Mich., p. 108.
--- --- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 64.
--- --- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 317.
--- --- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 107.
--- --- --- van der Schalies 1950, Am. Midland Naturalist, v. 44, p. 454.
--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 95.

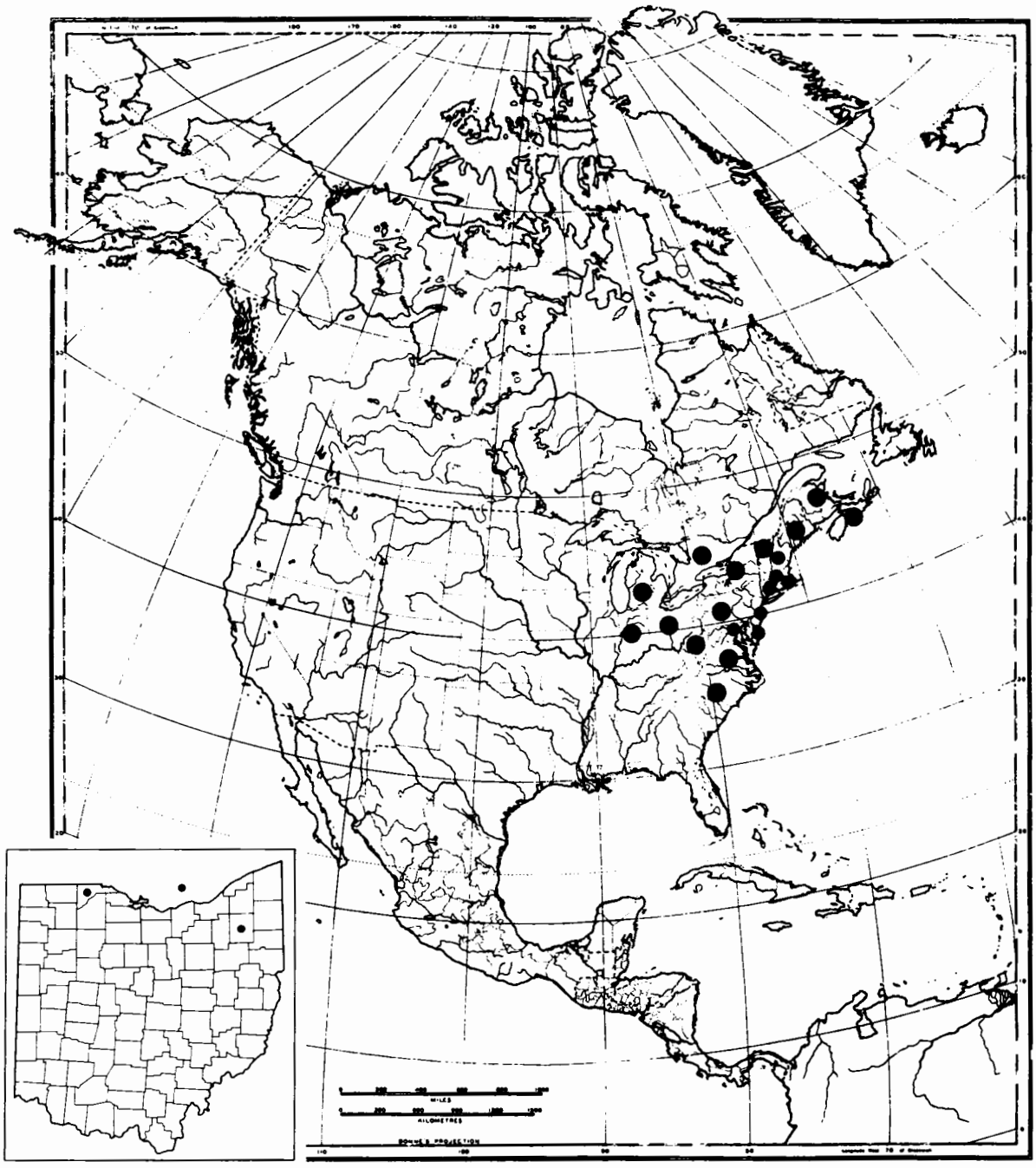


FIGURE 156.–Distribution of *Ligumia nasuta* in North America; *inset*, distribution in Ohio.

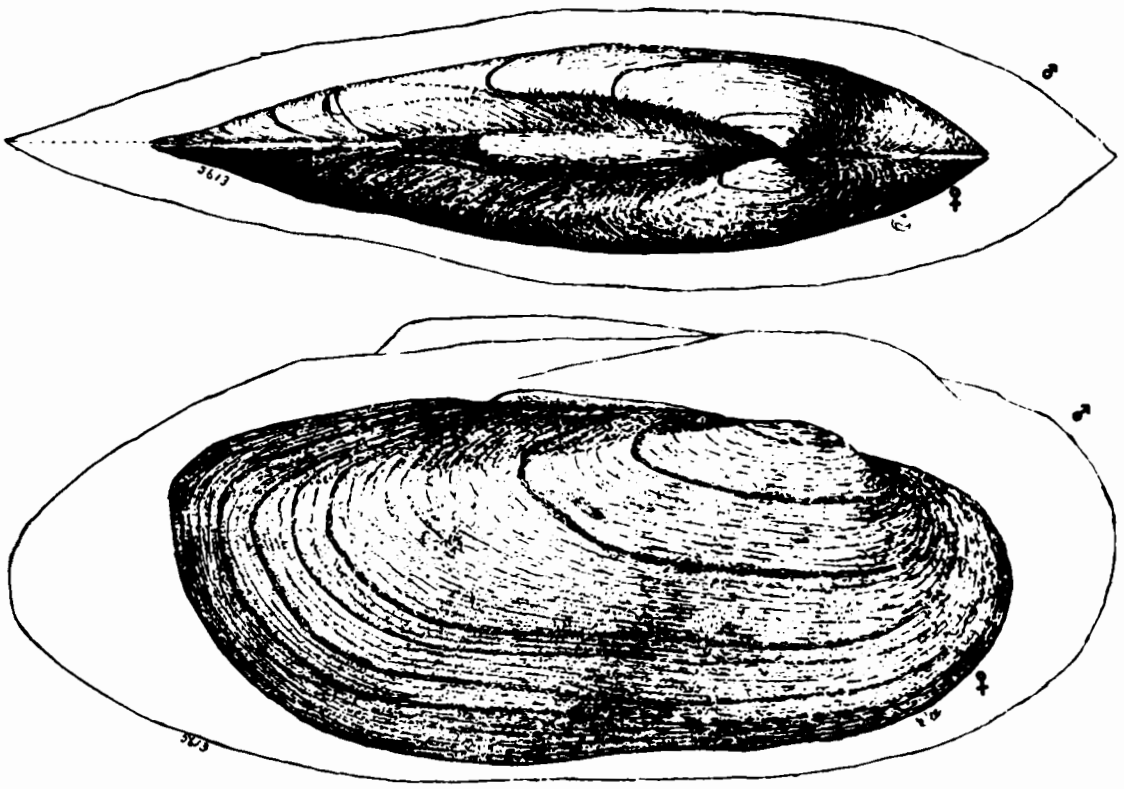


FIGURE 157.—*Ligumia recta*, four views, X1; after Call (1900, pl. 17).

Type locality.—Ohio River.

Diagnosis.—Larger and much more swollen than typical *L. recta*, with an exceedingly thick shell; nacre purple as commonly as it is white.

Ecology.—Most common in large and medium-sized rivers, on sand and gravel bottom in the current; young specimens have been taken on fine sand-mud bottom, in backwater areas (condensed from van der Schalie, 1938, p. 64).

Associations.—Living: MANITOBA-38; MICHIGAN-50, 51, 52, 53, 54; OHIO-43; ONTARIO-1, 5; WISCONSIN-58, 76, 83, 108, 121, 132.

General distribution (fig. 160).—Ontario, Quebec, western New York, and Pennsylvania west to Iowa and Kansas, north to Minnesota and Manitoba; south to Alabama, Georgia, and Arkansas.

Distribution in Ohio.—Sterki (1907a, p. 389) did not recognize the variety; his records for the rivers of Ohio, in both drainages, apply to this variety. Ortmann (1919) recorded the variety for Maumee River, Lucas County; Otsego Rapids, Wood County; Tuscarawas River; and Ohio River in Jefferson and Meigs Counties, under the typical form; his records are here referred to *L. recta latissima*, the river form.

Geologic range.—Unknown.

Remarks.—The range given above is for the river form only. Sterki did not record it for Ohio and included the river form of the State under the species. There is some doubt whether this form should be separated from the typical form which van der Schalie noted in his 1938 paper; however, since he has accepted the varietal name for the river form in subsequent papers, it is recognized here also.

Ligumia subrostrata (Say) 1831
Fig. 161

Unio subrostratus Say 1831, New Harmony Disseminator, Jan. 15, 1831.
--- --- Call 1900, Moll. Ind., p. 457, pl. 22.
Lampsilis subrostrata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 389.
--- --- Simpson 1914, Descr. cat. Naiades, p. 99.
Lampsilis (Ligumia) subrostrata Frierson 1927, Check list N. Am. Naiades, p. 77.
Ligumia subrostrata Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 317.
?*Ligumia subrostrata* D. W. Taylor 1960, U.S. Geol. Survey Prof. Paper 337, p. 45.

Type locality.—Wabash River, Indiana.

Diagnosis.—Shell elongate, irregularly elliptical, subsolid, somewhat inflated; beaks with numerous delicate ridges that are sharply drawn up in the middle; very slightly winged; growth lines irregular; posterior ridge moderately developed; surface dull, dirty greenish

yellow, generally with faint wide wavy rays on the hinder portion, some specimens with concentric bands of lighter and darker color; teeth compressed, two pseudocardinals in each valve, the upper in the right smaller, one lamellar lateral in the right and two in the left; muscle scars shallow; nacre bluish white; female shells noticeably swollen; L. (male) 70, H. 35, D. 23 mm.; L. (female) 62, H. 35, D. 23 mm. (condensed from Simpson, 1914, p. 99).

Ecology.—Inhabits both rivers and lakes; the pond and lake form has a high posterior ridge accentuated by a depressed or grooved posterior slope (condensed from Goodrich and van der Schalie, 1944, p. 317).

Associations.—Fossil: PLI-3?

FIGURE 158.—Distribution of *Ligumia recta* in North America; *inset,* distribution in Ohio.

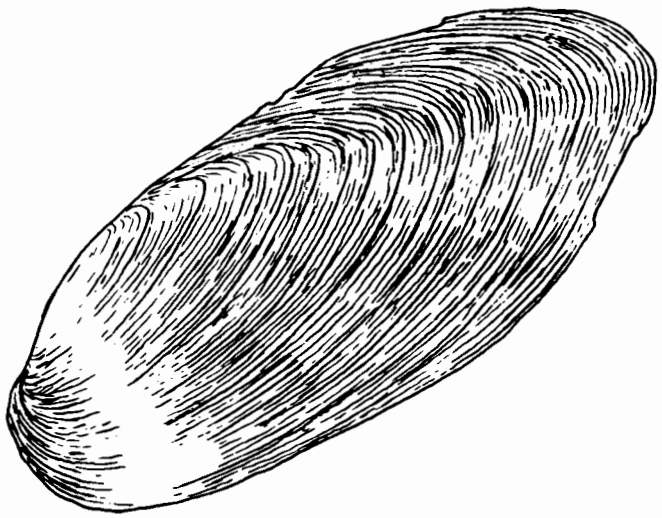


FIGURE 159.—*Ligumia recta latissima,* side view of a left valve, X1; after Goodrich (1932, pl. 6, fig. 1).

General distribution (fig. 162).—Entire Mississippi north to about latitude 41°; eastern half of Texas (Simpson, 1914, p. 99).

Distribution in Ohio.—Sterki (1907a, p. 389) has seen no Ohio specimens but suspects that it is at least in the northwestern part of the State. Ortmann does not mention the species. The species should be looked for particularly in the headwaters of the Wabash River in Ohio but so far I have no record of it.

Geologic range.—Reported doubtfully from the Pliocene (Rexroad local fauna) of Kansas by D. W. Taylor (1960, p. 27).

Genus *Villosa* Frierson 1927

Micromya Agassiz 1852, Arch. Naturgesch., v. 18, no. 1, p. 47 (*fide* Neave, but preoccupied by *Micromya* Rodani 1840, Dipt.).

Micromya Walker 1918, Synopsis and cat. fresh-water Moll., p. 78.

Villosa Frierson 1927, Check list N. Am. Naiades, p. 11, 80.

Micromya F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 260.

Villosa Clench and Turner 1956, Fla. State Mus. Bull., v. 1, no. 3, p. 205.

Villosa Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 53.

Type.—*Unio villosus* Wright.

Diagnosis.—Shell small or of medium size, suboval or subelliptical, not very long and not much pointed behind; beak sculpture distinctly double looped, but in many cases obsolete, the posterior loop in many cases showing a tendency to be open.

Villosa fabalis (Lea) 1831
Fig. 163

Unio fabalis Lea 1831, Am. Philos. Soc. Trans., v. 4, p. 86, pl. 10, fig. 16.

Unio capillus Say 1831, Transylvania Jour., v. 4, p. 528.

Unio lapillus Say 1832, Am. Conchology, v. 5, pl. 41.

Unio fabalis Call 1900, Moll. Ind., p. 458, pl. 23, figs. 1-4.

Micromya fabials Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.

Micromya fabalis Simpson 1914, Descr. cat. Naiades, p. 33.

Eurynia (Micromya) fabalis Ortmann 1919, Najades Pa., p. 262, pl. 16, figs. 4, 5.

Lemiox fabalis Frierson 1927, Check list N. Am. Naiades, p. 93.

Micromya fabalis Goodrich 1932, Moll. Mich., p. 107.

--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.

--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 63.

--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 317.

--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 96.

Type locality.—Ohio River.

Diagnosis.—Shell small, elliptical, smooth, dark green, and marked with nearly black waving rays; beaks a little raised above the hinge line, sculptured with a few irregular folds, a little nodulous at the posterior edges; pseudocardinals low, thick; laterals short and thick; nacre bluish; female shell slightly more swollen than the male; L. 34, H. 19, D. 11 mm. (modified from Goodrich, 1932, p. 107).

Ecology.—Imbedded in sand among the roots of aquatic vegetation in about four inches of water flowing about five miles an hour. Among patches of aquatic vegetation in small streams (Pennsylvania). Blue clay bottom near shore (Tippecanoe River, Indiana). Sand and gravel bottom, going down to a depth of four feet (Winona Lake, Indiana, Headlee, 1908, p. 306); also in fine black mud.

Associations.—Living: MICHIGAN-52, 54; OHIO-43.

General distribution (fig. 164).—Ohio River drainage; small streams tributary to the Lake Erie drainage in Michigan; New York. The New York record would seem to be erroneous; at least the species is not found in the Niagara region, according to Robertson and Blakeslee (1948),, who list only *Micromya iris.*

Distribution in Ohio (inset, fig. 164).—Sterki (1907a, p. 388) gives "both drainages, in nearly all rivers;" Ortmann (1919) gives Sandusky River, Wyandot County; Swan Creek, Lucas County; Tuscarawas River; Ohio

Canal, Franklin County.

Geologic range.—Unknown.

Remarks.—Goodrich (1932) has noted, firmly attached to a small stone, a specimen with a byssus, a feature that is comparatively rare in adults of American Naiades.

Villosa iris (Lea) 1830
Fig. 165

Unio iris Lea 1830, Am. Philos. Soc. Trans., v. 3, p. 439, pl. 11, fig. 18.
Unio creperus Lea 1838, *ibid.*, v. 6, p. 33, pl. 10, fig. 28.

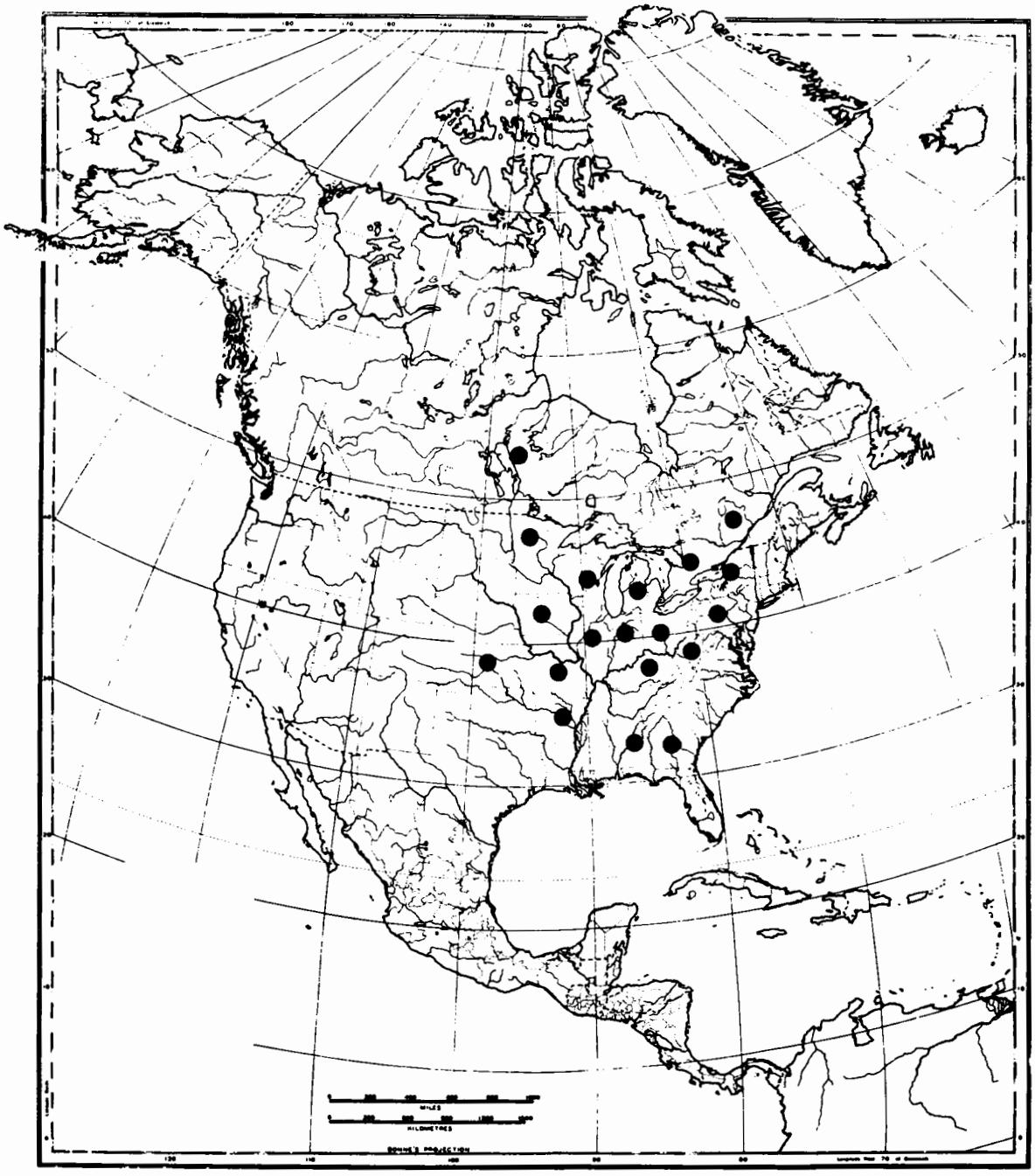


FIGURE 160.—Distribution of *Ligumia recta latissima* in North America.

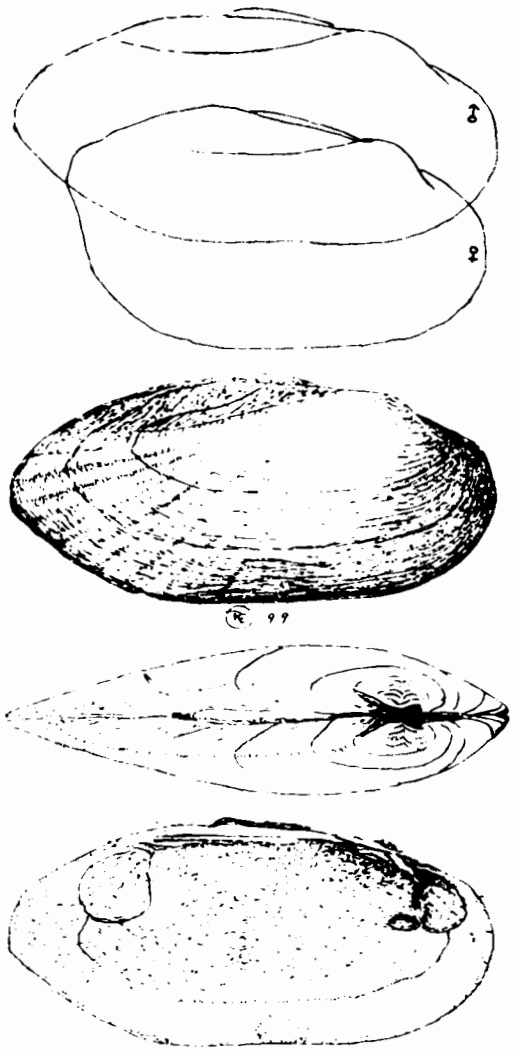


FIGURE 161.—*Ligumia subrostrata*, five views, X1; after Call (1900, pl. 22).

Unio radiatus De Kay 1843, Zoology N. Y., pt. 5, p. 189, pl. 17, fig. 236.
Unio iris Call 1900, Moll. Ind., p. 456, pl. 21.
Lampsilis iris Sterki 1907, Ohio Acad. Sci. Proc., v. 4, pt. 8, p. 389.
--- --- Simpson 1914, Descr. cat. Naiades, p. 113.
Eurynia (Micromya) iris Ortmann 1919, Najades Pa., p. 265, pl. 16, figs. 6, 7.
Eurynia iris F. C. Baker 1920, Life of Pleistocene, p. 383.
Lampsilis nervosa Frierson 1927, Check list N. Am. Naiades, p. 77.
Micromya iris Goodrich 1932, Moll. Mich., p. 106.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 153.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 62.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 317.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 107, pl. 13, fig. 6.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 96.
Villosa iris Clarke and Berg 1959, Cornell Expt. Sta. Mem. 367, p. 53, fig. 45.

Type locality.—Ohio River.

Diagnosis.—Shell small, elongate, thin to solid; yellow to brown, generally handsomely marked with dark rays extending from the beaks diagonally to the posterior margin and the base; beaks sculptured with waving folds, in some specimens a little pustulous; pseudocardinals stumpy, lateral teeth short and a little curved; nacre bluish; shell of the female generally with a rounded swelling of the posterior slope; L. 63.5, H. 33, D. 20 mm. (modified from Goodrich, 1932, p. 106).

Ecology.—The species is particularly at home on shoals of sand and gravel, in currents of small rivers.

Associations.—Living: MICHIGAN-45, 47, 48, 49, 50, 51, 52, 54, 56, 57, 58, 59, 62, 63, 64, 65, 66, 67; NEW YORK-15b, 22; OHIO-43.

General distribution (fig. 166).—St. Lawrence drainage; west to southern Michigan; Ohio River drainage; Illinois and Wisconsin.

Distribution in Ohio (inset, fig. 166).—Sterki (1907a, p. 389) gives "both drainages; Lake Erie." Ortmann (1919) states that "typical *E. iris* belongs to the Ohio-drainage in western Pennsylvania, West Virginia, Ohio, Indiana, and possibly Illinois." He separates the Lake Erie form as *M. iris novi-eboraci*, which is not recognized in this report. For those who do recognize it, Sterki's distribution should be restricted, for the typical form, to exclude Lake Erie. Ortmann gives the variety *M. iris novi-eboraci* for Lake Erie; Sandusky River, Sandusky County; and Swan Creek, Lucas County.

Geologic range.—F. C. Baker (1920a, p. 383) gives only late Wisconsin ("Wabash") for this species as a fossil.

[*Villosa iris novi-eboraci* (Lea) 1838]

Unio novi-eboraci Lea 1838, Am. Philos. Soc. Trans., v. 6, p. 104, pl. 24, fig. 114.
Lampsilis Novi Eboraci Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 389.
Eurynia (Micromya) iris novi-eboraci Ortmann 1919, Najades Pa., p. 268, pl. 16, figs. 8, 9.
Ligumia iris novi-eboraci F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 260, pl. 86, figs. 8-12.
Micromya iris novi-eboraci La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 153.
--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 96.

Type locality.—Oak Orchard Creek, Orleans County, New York.

General distribution.—Western New York and Pennsylvania west to Wisconsin, north to Ontario and North Dakota, south to Illinois and Ohio.

Remarks.—No diagnosis of this "variety" is given here as it has not been recognized by authorities on the Naiades. Simpson (1914, p. 116) placed it in the synonymy of the type form and he has been followed by van der Schalie (1938, p. 62) and Clarke and Berg (1959, p. 52). I erroneously recognized it (La Rocque, 1953, p. 96), following F. C. Baker (1928a, pt. II, p. 260), but am now satisfied that van der Schalie (1938, p. 62) was correct when he wrote: "In the past, a northern race, known as *Micromya iris novi-eboraci* (Lea) has been generally recognized. The only clear-cut distinction which has been used to separate this race from the typical *iris* is the color pattern. In true *iris* the

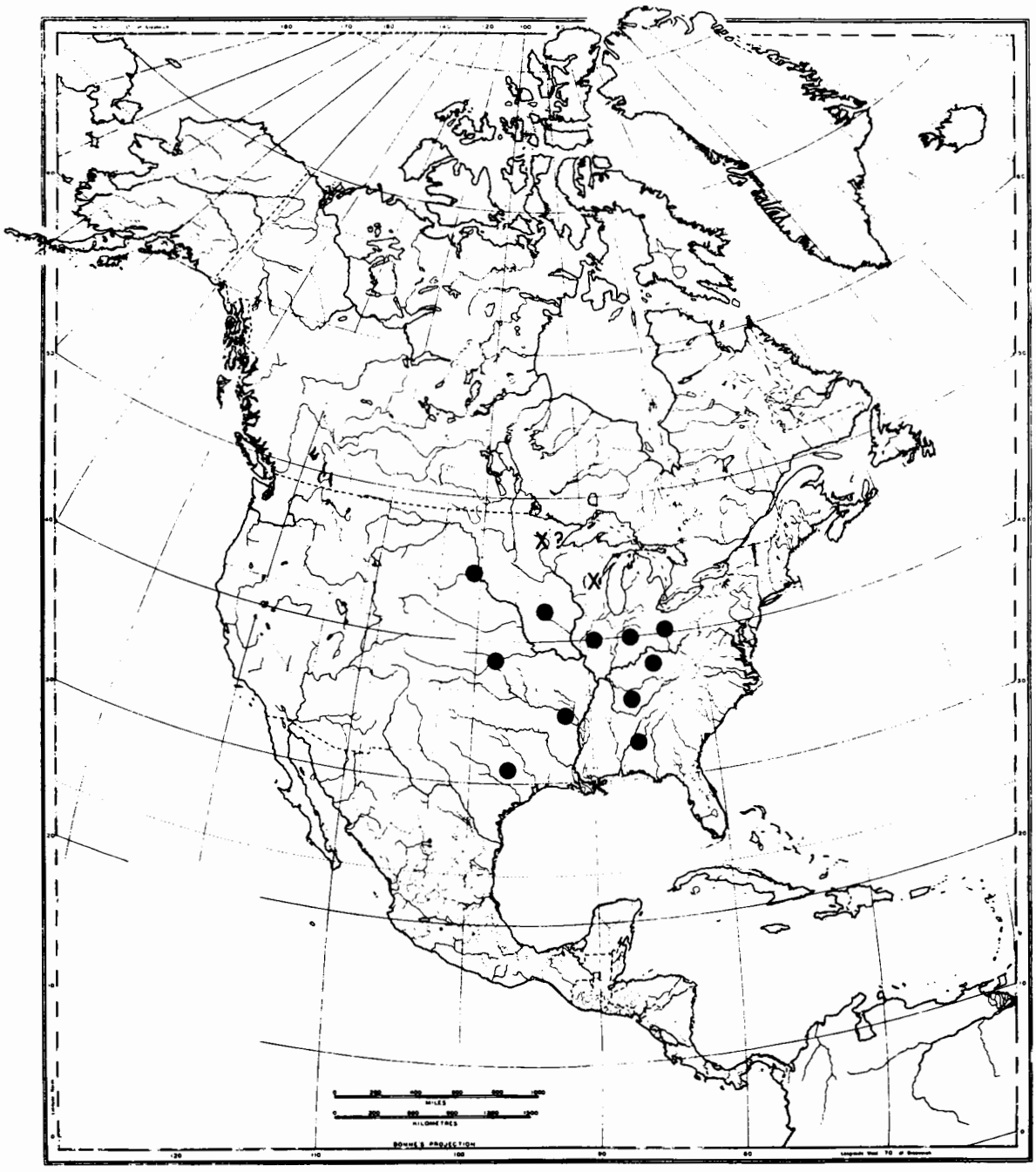


FIGURE 162.—Distribution of *Ligumia subrostrata* in North America.

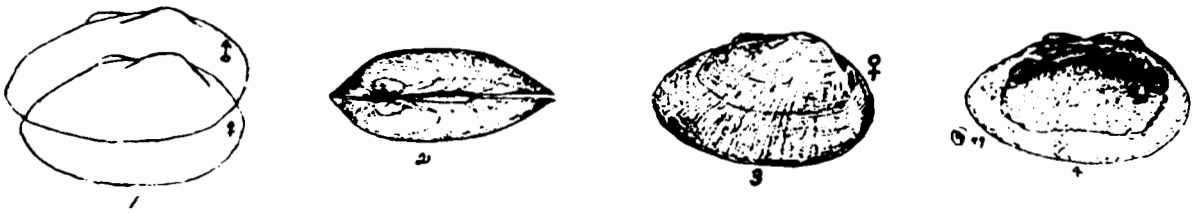


FIGURE 163.–*Villosa fabalis*, five views, X1; after Call (1900, pl. 23).

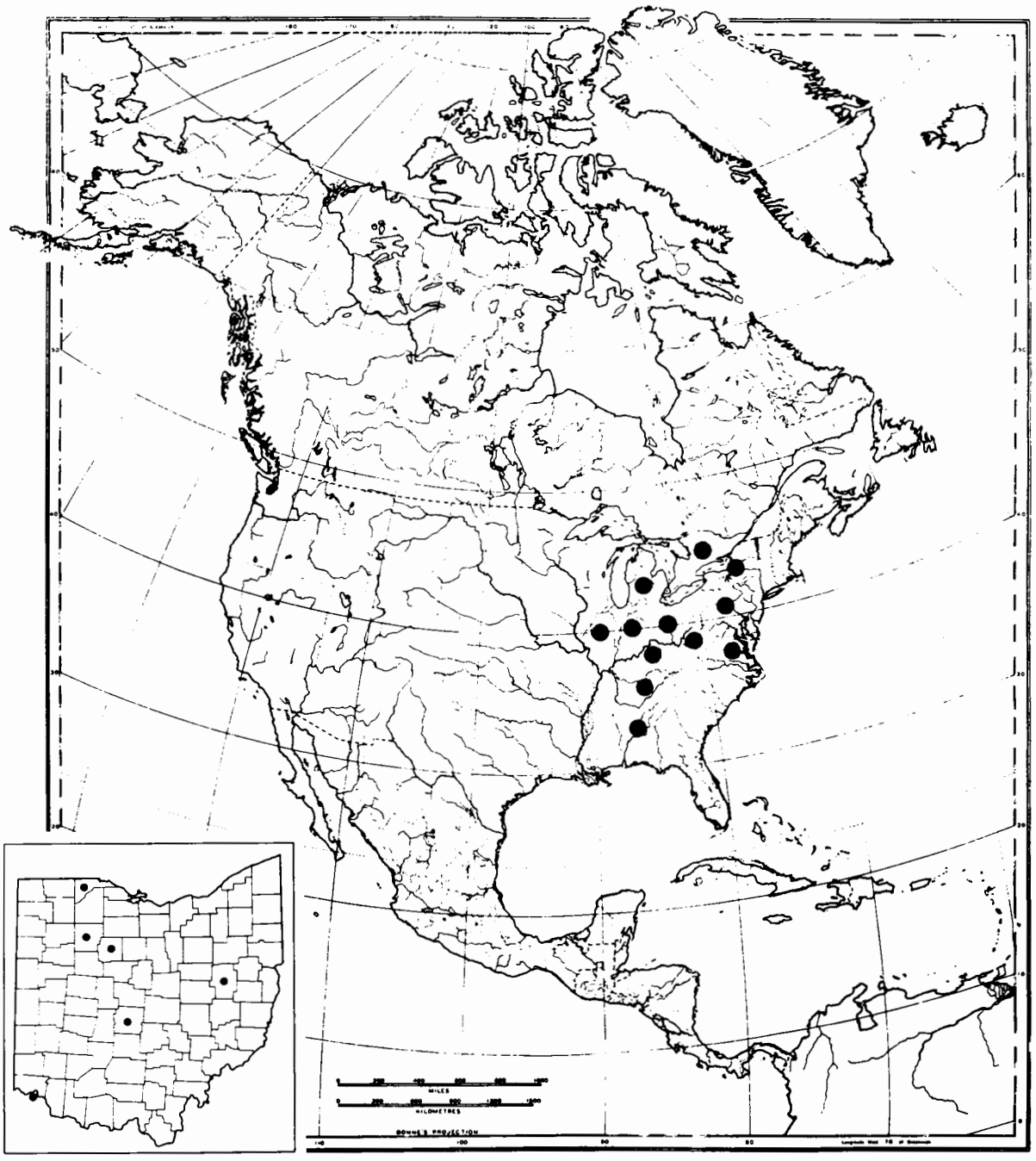


FIGURE 164.–Distribution of *Villosa fabalis* in North America; *inset*, distribution in Ohio.

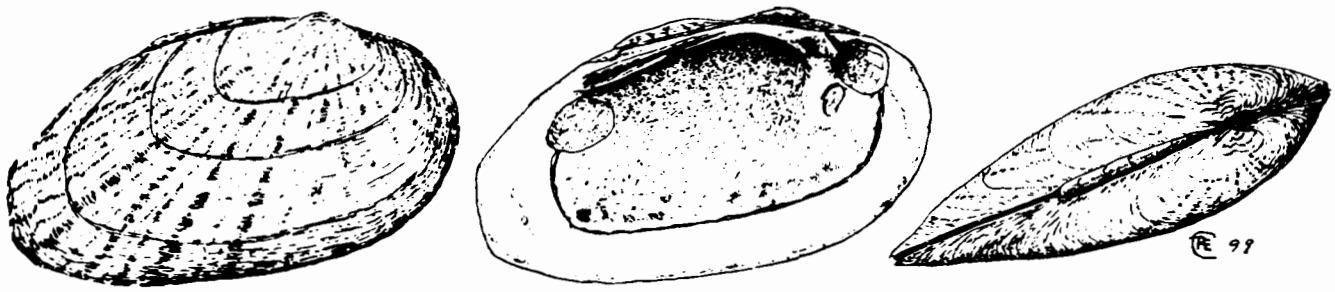


FIGURE 165.–*Villosa iris*, three views, X1; after Call (1900, pl. 21).

FIGURE 166.–Distribution of *Villosa iris* in North America; *inset*, distribution in Ohio.

rays are supposed to be broader and interrupted at the growth-rests, so as to appear as blotches usually arranged in concentric bands; whereas the variety has finer and more continuous rays. At the present time, I am not in a position to pass on the validity of this distinction in other regions. However, in this drainage [Huron River], I find too many intergrades to feel that such a distinction is valid. The color pattern is too variable a character in itself to be at all reliable for making such distinctions. My specimens not only intergrade, but a number of them are quite rayless."

Examination of specimens from a wide range of localities shows that the distinction based on rays is no more valid in the entire range of the species than it is in Michigan.

Genus *Dysnomia* Agassiz 1852

Dysnomia Agassiz 1852, Arch. Naturgesch., v. 18, no. 1, p. 43 (*fide* Neave).
Truncilla (part) Walker 1910, Nautilus, v. 24, p. 75-81.
Dysnomia Walker 1918, Synopsis and cat. fresh-water Moll., p. 82.
Dysnomia Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 65.
Dysnomia F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 295.
Dysnomia La Rocque 1953, Cat. Recent Moll. Canada, p. 90.

Type.—*Unio foliatus* Hildreth =*Obliquaria flexuosa* Rafinesque.

Diagnosis.—Shell rounded, solid, inflated, generally smooth and rayed; beak sculpture delicate, often obsolete, double looped; female shell very different from that of the male, having a very decided inflation in the postbasal region, which is thinner than the rest of the shell, of different texture, in many cases toothed and generally radiately sculptured; shell of the male with posterior and central radiating ridges with a wide flattened space between, that of the female with a greatly produced inflation, a continuation of the central ridge, a little behind the center of the base.

Remarks.—One of the most useful papers on this genus and its species is that of Bryant Walker (1910, Naut. 24) which lists the species in natural groups and gives a key for the identification of both males and females. The reader must naturally remember that Walker considered the species now assigned to *Dysnomia* as belonging to the genus *Truncilla* but separation of the groups belonging to each genus is not difficult.

[*Dysnomia brevidens* (Lea) 1834]

Unio brevidens Lea 1834, Am. Philos. Soc. Trans., v. 4, p. 75, pl. 6, fig. 6.
Truncilla brevidens Simpson 1914, Descr. cat. Naiades, p. 7.
Dysnomia brevidens Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 66.

Type locality.—"Ohio" (incorrectly given by Lea), corrected later by Lea to Cumberland River.

Remarks.—Ortmann and Walker categorically state that this species is not found in Ohio, nor have they seen it listed for Ohio in the literature except for Lea's original citation. Simpson (1914) repeats the erroneous type locality and this may lead to some confusion for workers in Ohio. The species and this note are therefore inserted here to call attention to the absence of this species from the State.

Dysnomia flexuosa (Rafinesque) 1820
Fig. 167

Obliquaria flexuosa Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 306.
Unio foliatus Hildreth 1828, Am. Jour. Sci., v. 14,

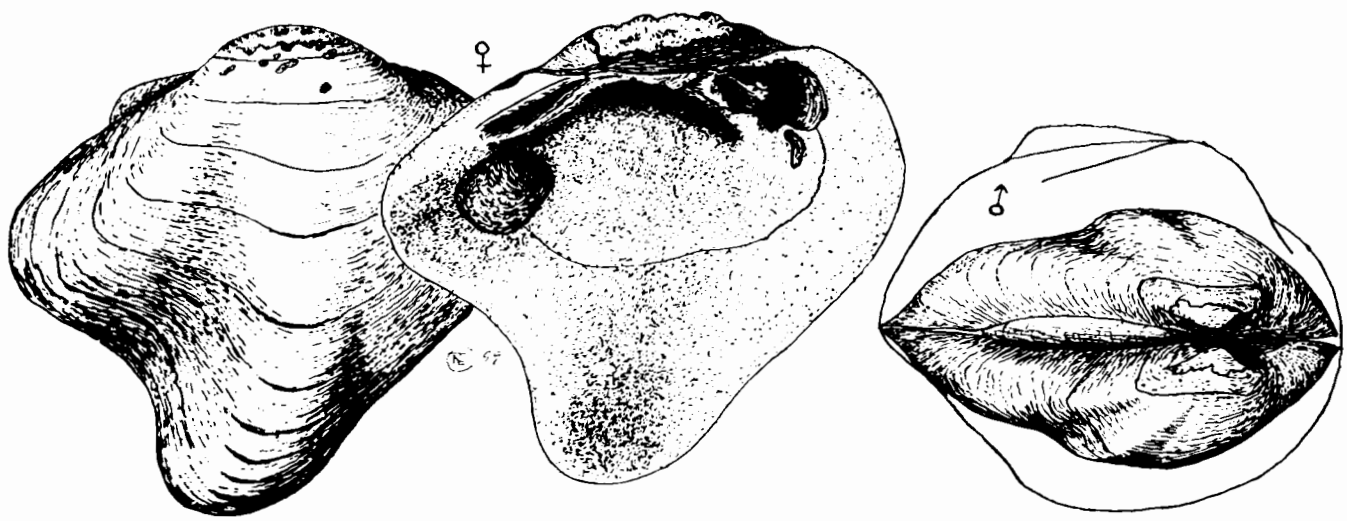


FIGURE 167.—*Dysnomia flexuosa,* four views, X1; after Call (1900, pl. 64).

p. 284, fig. 16.
--- --- Call 1900, Moll. Ind., p. 510, pl. 64.
Truncilla foliata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.
--- --- Simpson 1914, Descr. cat. Naiades, p. 18.
--- --- Walker 1918, Synopsis and cat. fresh-water Moll., p. 185.
Dysnomia (Dysnomia) flexuosa Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 70.
Dysnomia flexuosa Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 314.

Type locality.—Kentucky, Salt, and Green Rivers (Rafinesque, *flexuosa*); Ohio (Hildreth, *foliata*).

Diagnosis.—"Shell solid, but slightly inflated, subrhomboid or subquadrate, nearly equilateral; beaks somewhat elevated, subcompressed, elongated, with very faint, slightly corrugated sculpture; posterior

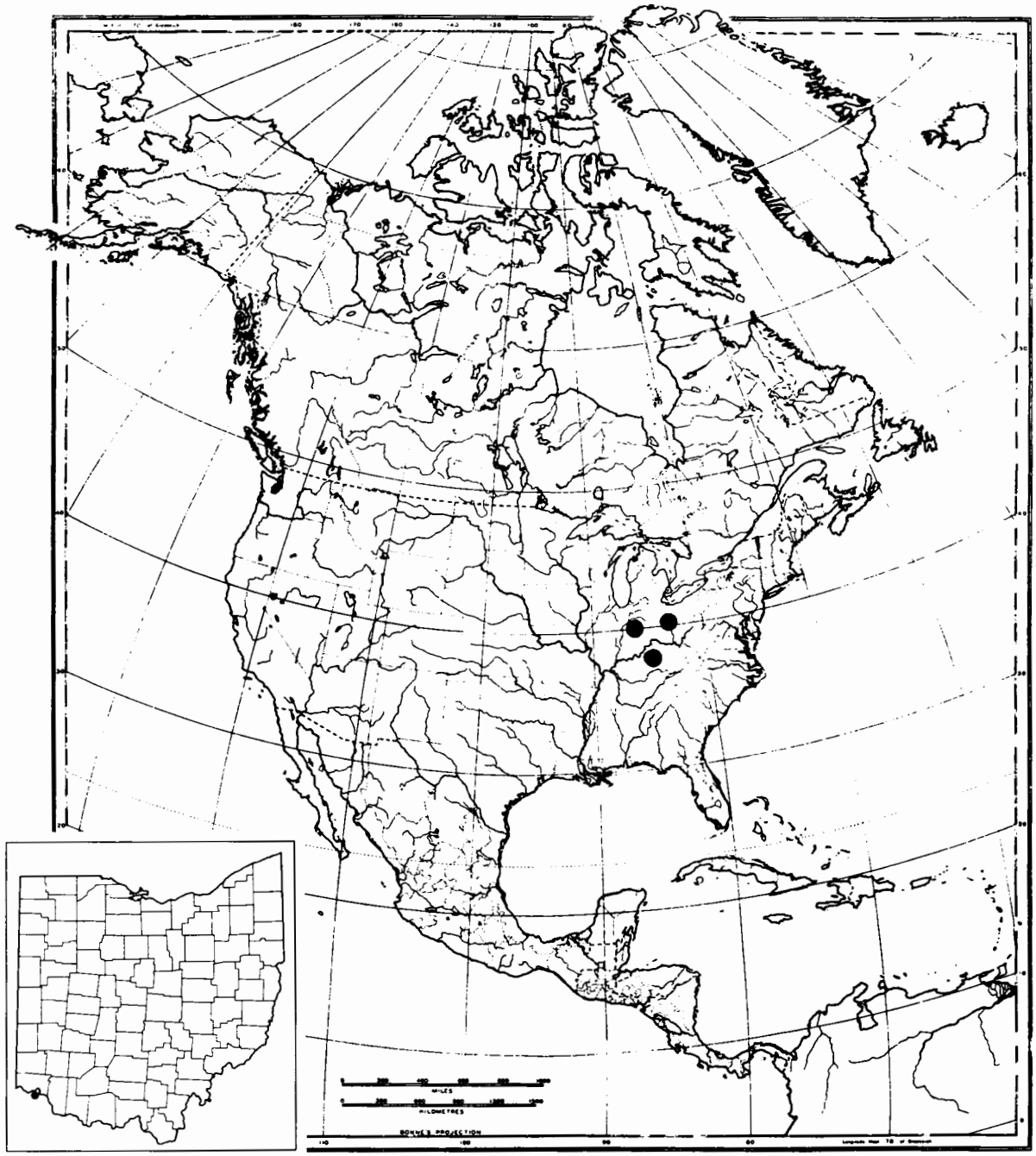


FIGURE 168.—Distribution of *Dysnomia flexuosa* in North America; *inset,* distribution in Ohio.

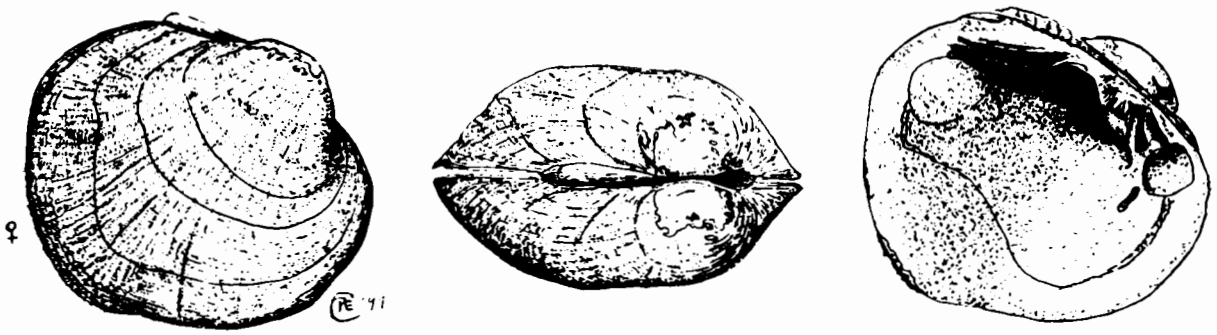


FIGURE 169.–*Dysnomia personata*, three views, X1; after Call (1900, pl. 33).

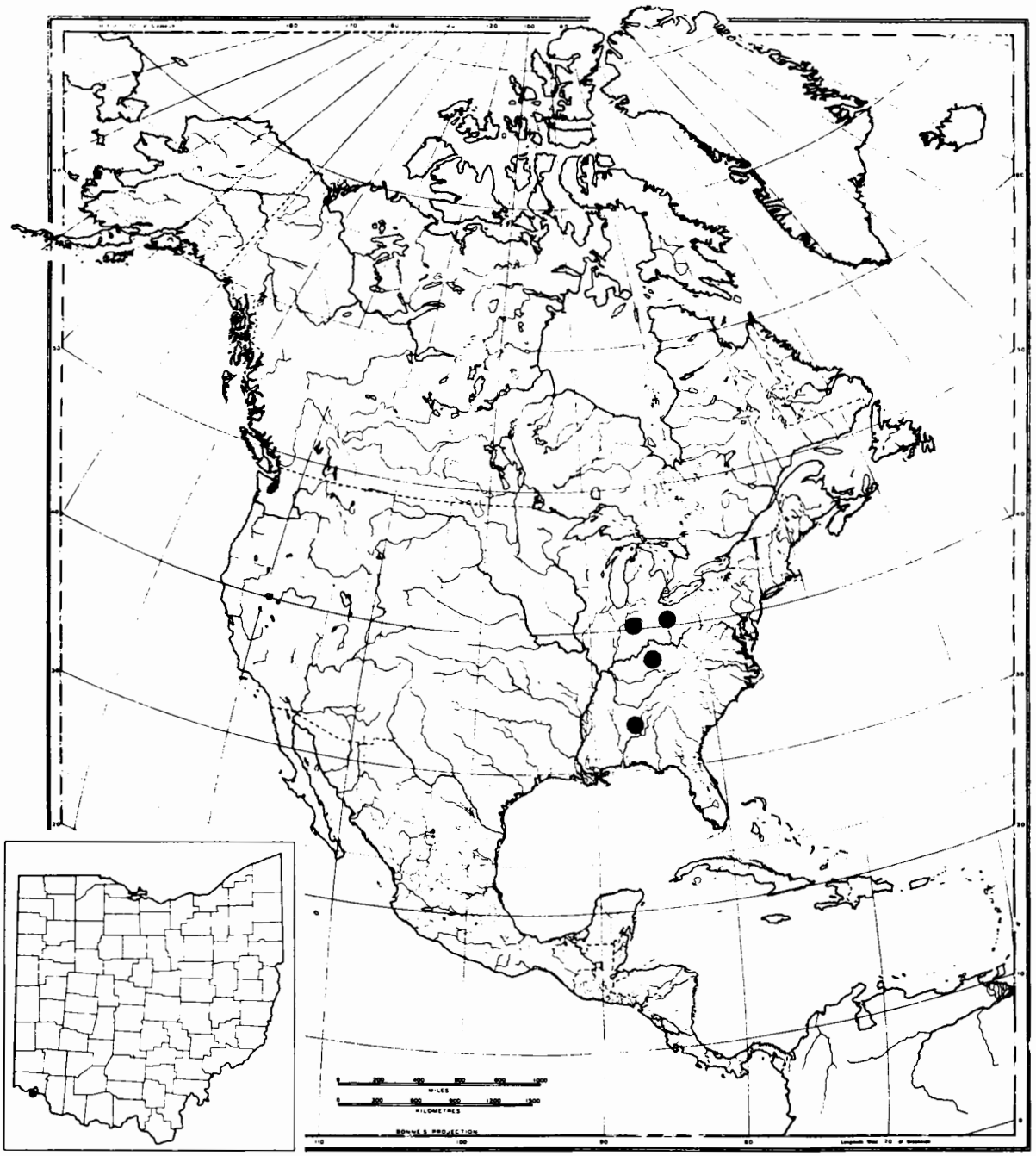


FIGURE 170.–Distribution of *Dysnomia personata* in North America; *inset*, distribution in Ohio.

ridge well developed, narrowly rounded, somewhat distinct from the rest of the shell; surface with uneven concentric sculpture; epidermis pale brownish-green or brownish, feebly rayed; pseudocardinals ragged, double in the left valve, single or treble in the right; laterals short, granular, more or less double in both valves; muscle scars impressed; nacre white; male shell subrhomboid, with a wide radial impression in front of the posterior ridge and a strong radial ridge in front of it; female shell with an enormously produced rounded wing-like marsupial swelling projecting downward and slightly backward at or a little behind the middle of the base. Length (male) 65, H. 54, D. 34; L. (female) 66, H. 48, D. 45; L. (female) 63, H. 65, D. 32 mm." (Simpson, 1914, p. 18).

Ecology.—No exact information located.

General distribution (fig. 168).—Ohio River drainage (Simpson, 1914).

Distribution in Ohio (inset, fig. 168).—Sterki (1907a, p. 388) lists this species for the Ohio River at Cincinnati. Ortmann does not list the species, so presumably it does not go up the Ohio into Pennsylvania. The species does not appear in the Eggleston records.

Geologic range.—Unknown.

Remarks.—Simpson (1914, p. 19) calls this "one of the most remarkable Naiades in the world." From one who had seen and described the entire group on a worldwide basis, these are strong words indeed. It must be extremely rare as I have no Ohio records except those mentioned above and no records for the rivers of Kentucky from which Rafinesque's types supposedly came. Bryant Walker, in describing an allied species, says that this species "is apparently confined to the Ohio and Wabash rivers . . .;" the species is not listed at all in the second index to the Nautilus which is for volumes 35 to 60.

Dysnomia personata (Say) 1829
Fig. 169

Unio personatus Say 1829, New Harmony Disseminator, v. 2, no. 20, p. 309.
Unio pileus Lea 1834, Am. Philos. Soc. Trans., v. 4, p. 119, pl. 18, fig. 47.
Unio personatus Call 1900, Moll. Ind., p. 474, pl. 33.
Truncilla personata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.
--- --- Walker 1910, Nautilus, v. 24, p. 77 ff.
--- --- Simpson 1914, Descr. cat. Naiades, p. 23.
Dysnomia personata Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 314.

Type locality.—Wabash River.

Diagnosis.—"Shell solid, subtriangular or subquadrate, inflated, inequilateral, beaks full and high; posterior ridge only moderately developed; surface irregularly concentrically sculptured; epidermis greenish-yellow, brownish or greenish-brown in old shells, with faint wavy rays, often silky or cloth-like; pseudocardinals triangular, ragged, two in the left valve, one to three in the right; laterals short, usually double in each valve; muscle scars somewhat impressed; nacre white or flesh-colored, thinner behind. Male shell subtriangular; posterior ridge usually feebly double; in front of it is a wide radial depression. Female shell usually subquadrate; marsupial swelling occupying the place of the radial depression, slightly swollen, radially sculptured and toothed, thin and excavated within" (Simpson, 1914, p. 23).

Ecology.—No exact data located.

General distribution (fig. 170).—Ohio River drainage.

Distribution in Ohio (inset, fig. 170).—Sterki (1907a, p. 388) lists this species for "Ohio River -- and tributaries?" Ortmann does not mention it at all and I have no further records.

Geologic range.—Unknown.

Dysnomia (Scalenilla) sulcata (Lea) 1829
Fig. 171

Unio sulcatus Lea 1829, Am. Philos. Soc. Trans., v. 3, p. 430, pl. 8, fig. 12.
--- --- Call 1900, Moll. Ind., p. 476, pl. 35.
Truncilla sulcata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.
--- --- Walker 1910, Nautilus, v. 24, p. 77 ff.
--- --- Simpson 1914, Descr. cat. Naiades, p. 14.
--- --- Walker 1918, Synopsis and cat. fresh-water

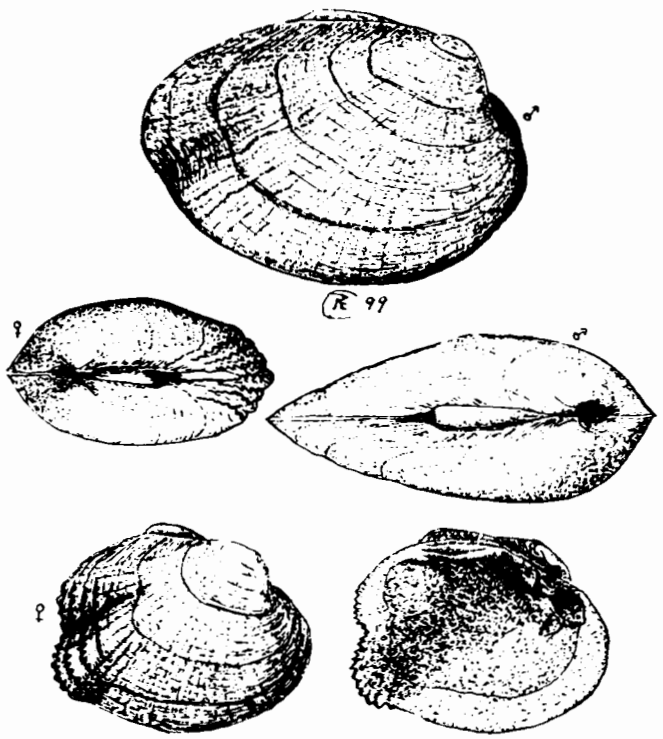


FIGURE 171.—*Dysnomia sulcata,* five views, X1; after Call (1900, pl. 35).

Moll., p. 186.
Dysnomia (Scalenilla) sulcata Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 68.
Dysnomia sulcata Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 314.

Type locality.—Ohio.

Diagnosis.—"Shell subquadrate or subtrapezoid, inflated, solid, very inequilateral; beaks somewhat elevated, prominent, their sculpture consisting of a few faint corrugations, which are sometimes broken or are occasionally double looped; lunule distinct, extending under the beaks; surface nearly smooth or irregularly concentrically sulcate; pseudocardinals subtriangular, elevated, ragged, two in the left valve, one to three in the right; laterals granulate, double in the left valve, partly double in the right; beak cavities rather shallow; muscle scars impressed; nacre purplish to deep purple, sometimes white. Male shell much larger than that of the female, usually somewhat trapezoid, the dorsal and

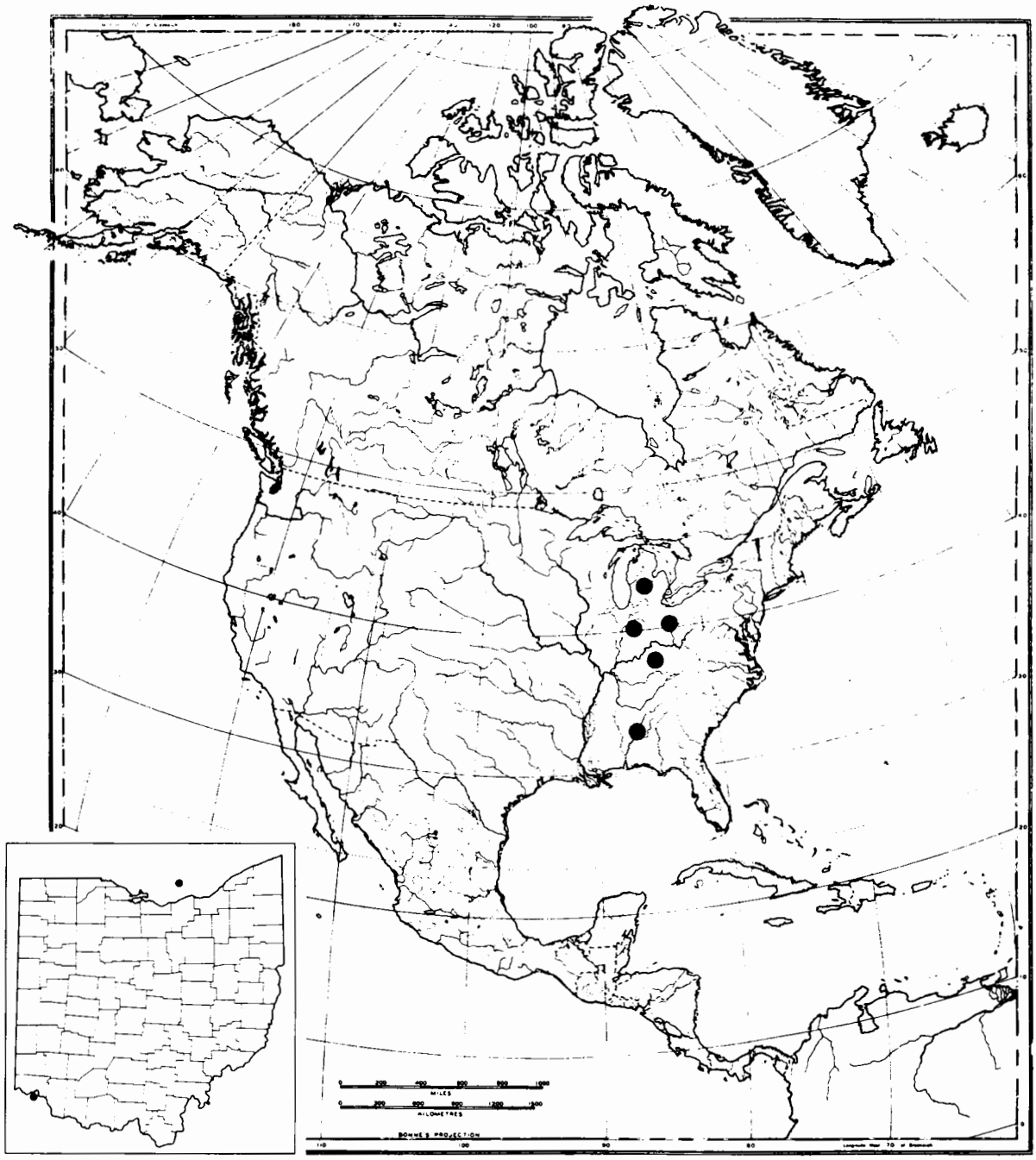


FIGURE 172.—Distribution of *Dysnomia sulcata* and *D. sulcata delicata* in North America; *inset,* distribution in Ohio.

basal lines lightly curved, the anterior end squarely subtruncate, the posterior end pointed bluntly above, slopingly truncate below, having a widely separated pair of posterior ridges, often with a radial sulcus between. Female shell subquadrate, the hinder end radially sculptured and toothed throughout; marsupial swelling inflated, rounded, separated from the shell behind by a deep sulcation, strongly toothed, thinner and excavated within. Its hinder muscle scars are large and circular" (Simpson, 1914).

Ecology.—No exact data located.

General distribution (fig. 172).—"Ohio River drainage" (Simpson, 1914).

Distribution in Ohio (inset, fig. 172).—Sterki (1907a, p. 388) records this species only for the Ohio River but gives no specific localities. It does not range into Pennsylvania as Ortmann does not mention it.

Geologic range.—Unknown.

Remarks.—The variety *delicata* was established by Simpson (1900) for the form of the Detroit River.

[*Dysnomia (Scalenilla) sulcata delicata* Simpson 1900]

Truncilla sulcata var. *delicata* Simpson 1900, Synopsis Naiades, p. 520.

Truncilla sulcata delicata Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.

Dysnomia sulcata delicata Goodrich 1932, Moll. Mich., p. 113.

--- --- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 150.

--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 90.

Type locality.—Detroit River, Michigan (Simpson, 1914).

Diagnosis.—"Shell more delicate than the type, smaller, paler colored, that of the male (the only one I have seen) being somewhat drawn out and pointed behind" (Simpson, 1914).

Ecology.—No exact data located.

General distribution.—Type locality only (Simpson, 1914; Goodrich, 1932).

Distribution in Ohio (inset, fig. 172).—"Lake Erie drainage ----?" (Sterki, 1907a, p. 388). Sterki's notation does not constitute a record for Ohio. He was merely indicating that this species might be expected in the Lake Erie drainage but not that he had seen specimens.

Geologic range.—Unknown.

Remarks.—Many years ago, during the preparation of a paper on the Naiades of Ontario (La Rocque and Oughton, 1937), the collections of the Museum of Zoology of the University of Michigan were examined for possible records of this variety, but without success. Simpson's record may have been based on a malformed specimen of some other species. At any rate, it has not as yet been found in Ohio.

Dysnomia (Pilea) torulosa (Rafinesque) 1820
Fig. 173

Amblema torulosa Rafinesque 1820, Annales Gén. Sci. Phys. (Bruxelles), v. 5, p. 314, pl. 82, figs. 11-12.

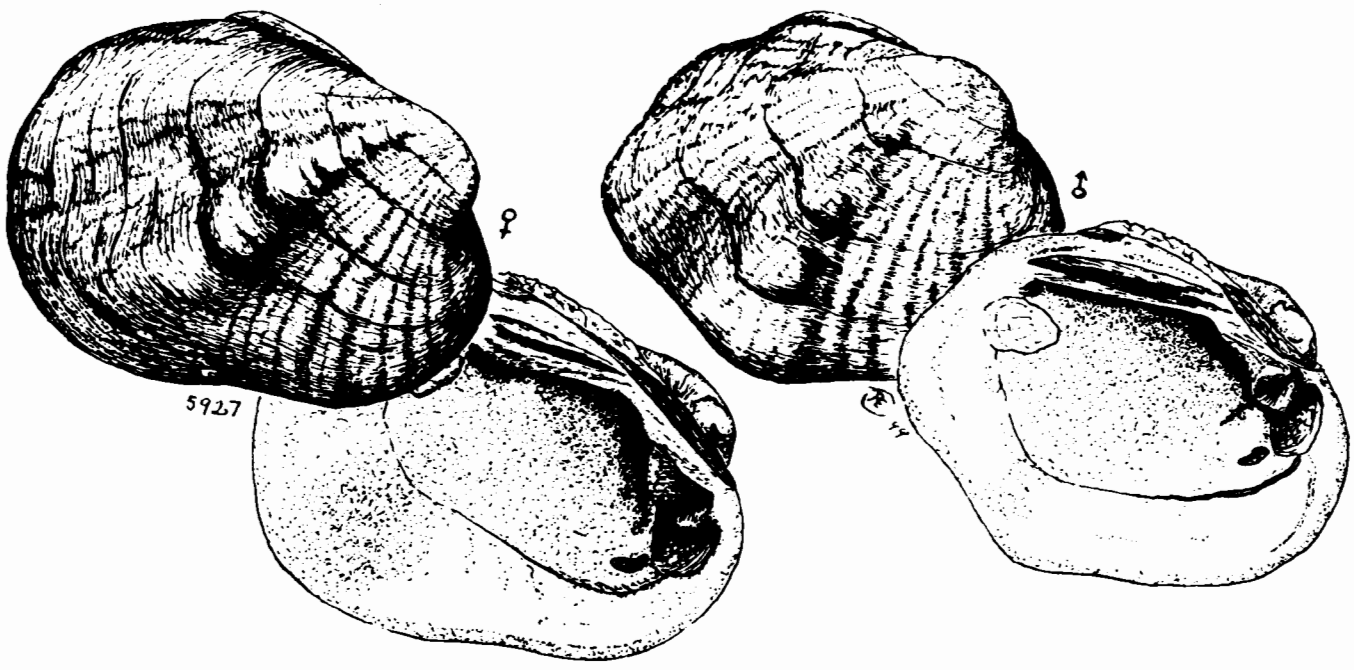


FIGURE 173.—*Dysnomia torulosa,* four views, X1; after Call (1900, pl. 34).

Amblema gibbosa Rafinesque 1820, *ibid.*, p. 315.
Unio perplexus Lea 1831, Am. Philos. Soc. Trans., v. 4, p. 112, pl. 27, fig. 42.
--- --- Call 1900, Moll. Ind., p. 475, pl. 34.
Truncilla perplexa Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.
--- --- Walker 1910, Nautilus, v. 24, p. 77 ff.
--- --- Simpson 1914, Descr. cat. Naiades, p. 24.
Dysnomia (Pilea) torulosa Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 69.
Dysnomia perplexa Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 314.

Type locality.—Ohio and Kentucky Rivers (Rafinesque).

Diagnosis.—"Shell solid, subinflated, inequilateral, irregularly ovate, elliptical or obovate; beaks full, somewhat turned forward over a small lunule; surface

FIGURE 174.—Distribution of *Dysnomia torulosa* in North America; *inset*, distribution in Ohio.

with irregular growth lines, with a radial row of knobs running down near the middle of the disk and sometimes with others on the low, narrowly rounded posterior ridge; epidermis tawny or yellowish-green, feebly rayed, smooth and shining; pseudocardinals triangular, double in the left valve, triple in the right; muscle scars well impressed; nacre white to salmon red. Male shell generally irregularly ovate with a deep, rather wide radial groove behind the row of nodules or knobs, ending in a sinus, the hinder end bluntly pointed. Female shell generally obovate, larger than that of the male, having an enormous, flattened, rounded marsupial swelling extending from the middle of the base to near the upper part of the posterior end, this being thin and usually dark green; posterior muscle scars large, impressed" (Simpson, 1914).

Ecology.—No exact data located.

General distribution (fig. 174).—Ohio River drain-

FIGURE 175.—Distribution of *Dysnomia torulosa rangiana* in North America; *inset,* distribution in Ohio.

age; southern Michigan? (Simpson, 1914, p. 24). Goodrich (1932, p. 113) lists only the variety *rangiana* (Lea).

Distribution in Ohio(inset, fig. 174).—Sterki (1907a, p. 388) records this species for the Ohio and Scioto Rivers. It does not seem to range much farther up the Ohio as Ortmann (1919) does not mention it. I have no further records.

Geologic range.—Unknown.

Dysnomia (Pilea) torulosa cincinnatiensis (Lea) 1840

Unio cincinnatiensis Lea 1840, Am. Philos. Soc. Proc., v. 1, p. 285; 1842, Am. Philos. Soc. Trans., v. 8, p. 194, pl. 8, fig. 4; 1842, Observer, v. 3, p. 32, pl. 8, fig. 4.
Margaron (Unio) cincinnatiensis Lea 1852, Synopsis Family Naiades, p. 22; 1870, *ibid.*, 3d ed., p. 33.
Truncilla perplexa var. *cincinnatiensis* Simpson 1900, Synopsis Naiades, p. 523.
Truncilla perplexa cincinnatiensis Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.
Truncilla perplexa var. *cincinnatiensis* Simpson 1914, Descr. cat. Naiades, p. 26.

Type locality.—Ohio River, Cincinnati, Ohio.

Diagnosis.—Shell having numerous small somewhat sharp knobs on the radial ridge with rarely a few on the posterior ridge and even an intermediate row in the furrow between the two; marsupial swelling of the female more inflated than in the type.

Ecology.—No exact data available.

General distribution.—Ohio River; it has not been recorded, to my knowledge, except for the vicinity of Cincinnati.

Distribution in Ohio.—Sterki (1907a, p. 388) has only one record, Ohio River at Cincinnati, and I have seen no others.

Geologic range.—Unknown.

Remarks.—The validity of this form is in doubt. Simpson (1914, p. 26) accepts it but notes that he has seen only the specimens in the Lea collection; Walker (1910, Naut. 24) does not mention it in his paper on *Truncilla.* The only other reference to the variety seems to be Sterki's record for Ohio, noted above.

Dysnomia (Pilea) torulosa rangiana (Lea) 1839

Unio rangianus Lea 1839, Am. Philos. Soc. Trans., v. 6, p. 95, pl. 18, fig. 56.
Truncilla perplexa var. *rangiana* Simpson 1900, Synopsis Naiades, p. 523.
Truncilla perplexa rangiana Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.
——— ——— ——— Walker 1910, Nautilus, v. 24, p. 77 ff.
Truncilla rangiana Ortmann 1912, Carnegie Mus. Annals, v. 8, p. 358, fig. 28.
Truncilla perplexa var. *rangiana* Simpson 1914, Descr. cat. Naiades, p. 26.
Truncilla rangiana Ortmann 1919, Najades Pa., p. 331, pl. 21, figs. 5-7.
Dysnomia perplexa rangiana Goodrich 1932, Moll. Mich., p. 113.
Dysnomia rangiana La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
Dysnomia perplexa rangiana Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 314.
Dysnomia rangiana La Rocque 1953, Cat. Recent Moll. Canada, p. 90.

Type locality.—Ohio River, Cincinnati, Ohio.

Diagnosis.—"Shell more compressed than the type; knobs on the median radial ridge low or even wanting. The marsupial swelling of the female shell is not quite so pronounced as it is in the type" (Simpson, 1914, p. 25).

Ecology.—Large and small rivers of the Ohio and upper Mississippi drainages.

Associations.—Living: OHIO-43.

General distribution (fig. 175).—Ohio River drainage and southern Michigan (Simpson, 1914).

Distribution in Ohio(inset, fig. 175).—Sterki (1907a, p. 388) lists this variety for the Ohio, Scioto, Tusca-

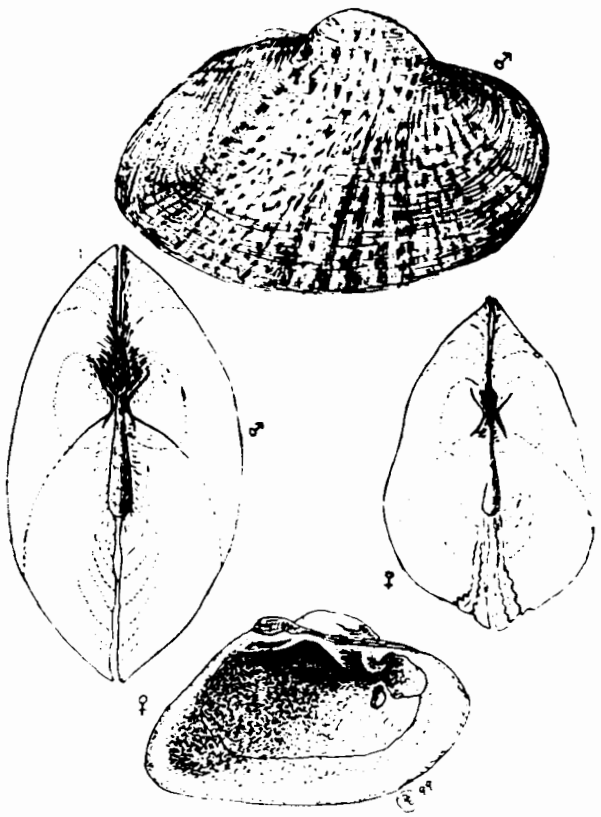


FIGURE 176.—*Dysnomia triquetra,* four views, X1; after Call (1900, pl. 32).

rawas, and Mahoning Rivers. Ortmann (1919) adds Columbus, Franklin County, which could be either for the Scioto, Olentangy, or the Ohio Canal, but at any rate in the Ohio drainage.

Geologic range.—Unknown.

Remarks.—Simpson (1914) is not convinced of the distinctness of this form and emphasizes that he has seen a great deal of connecting material between it and the type form. Walker (1910, Naut. 24) and Goodrich (1932) appear to agree with him, but in later work there is a tendency away from this opinion which may not be justified.

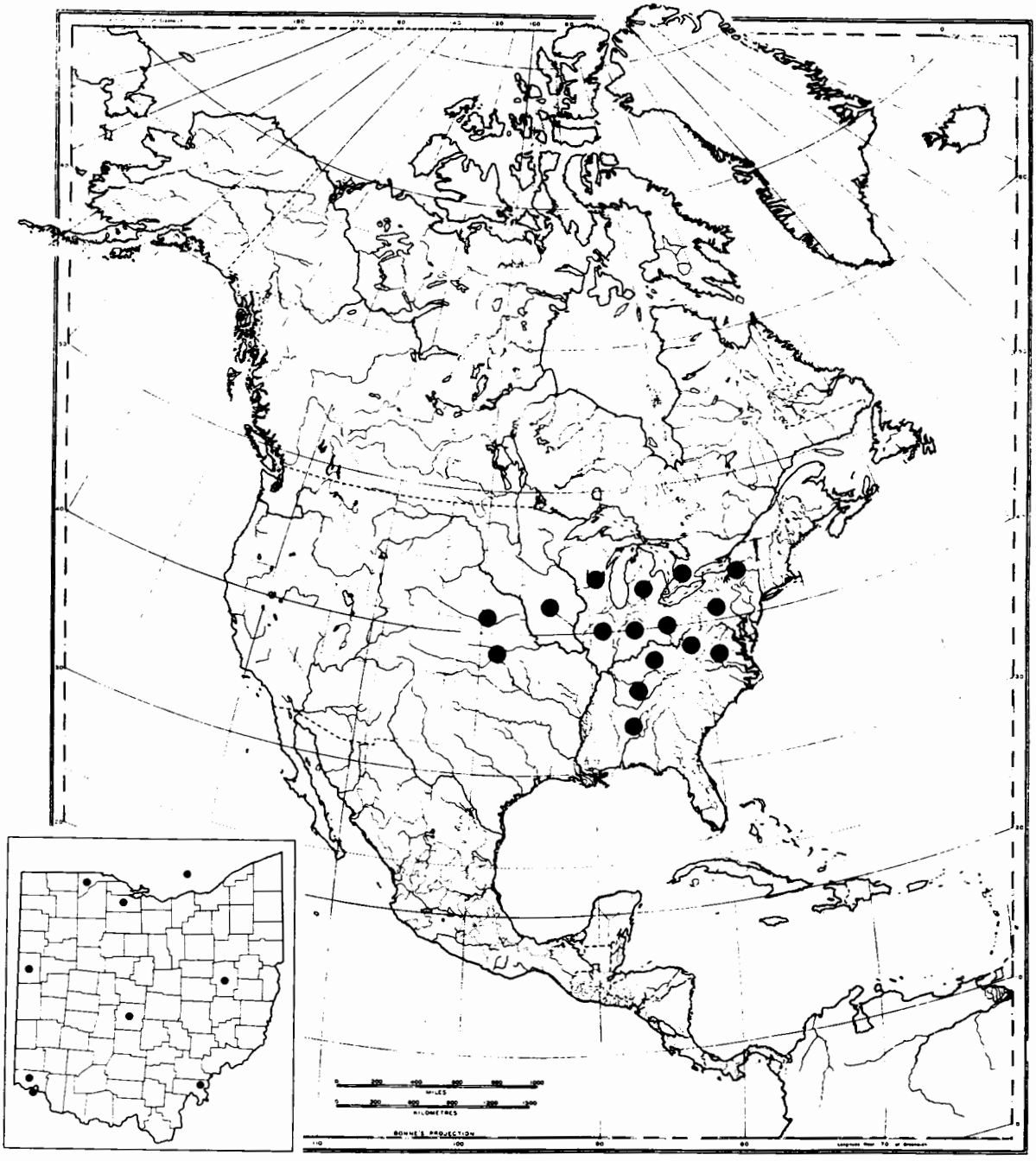


FIGURE 177.—Distribution of *Dysnomia triquetra* in North America; *inset*, distribution in Ohio.

Dysnomia (Truncillopsis) triquetra (Rafinesque) 1820
Fig. 176

Truncilla triqueter Rafinesque 1820, Annales Gen. Sci. Phys. (Bruxelles), v. 13, p. 300; pl. 81, figs. 1-4.
Unio triangularis Call 1900, Moll. Ind., p. 473, pl. 32.
Truncilla triquetra Simpson 1900, Synopsis Naiades, p. 517.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 388.
--- --- Walker 1910, Nautilus, v. 24, p. 77 ff.
--- --- Simpson 1914, Descr. cat. Naiades, p. 5.
--- --- Walker 1918, Synopsis and cat. fresh-water Moll., p. 186.
--- --- Ortmann 1919, Najades Pa., p. 325, pl. 21, figs. 3, 4.
Dysnomia (Truncillopsis) triquetra Ortmann and Walker 1922, Nomen. N. Am. Naiades, p. 65.
Dysnomia triquetra F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 296, pl. 86, figs. 5-7; pl. 70, figs. 4-7.
--- --- Goodrich 1932, Moll. Mich., p. 113.
--- --- La Rocque and Oughton 1937, Canadian Jour. Research, v. 15(D), p. 152.
--- --- van der Schalie 1938, Mich. Univ. Mus. Zoology Misc. Pub. 40, p. 12 ff.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 314.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 112, p. 11, fig. 9.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 90.

Type locality.—Falls of the Ohio.

Diagnosis.—"Triangular, swollen, thick, smooth, green or brown, and marked with diagonal rays. Female shell with stout posterior ridge and a few folds on the truncated posterior slope. Nacre white. Pseudocardinals short, two in each valve, more or less striated; lateral teeth short, two in one valve, one in the other. Muscle scars well marked. Length 50, height 31.5, breadth 30 mm." (Goodrich, 1932).

Associations.—Living: MICHIGAN-45, 49, 50, 51, 54, 59; OHIO-43.

Ecology.—Gravel bottom, water 2.5 m. deep; common in riffles with stony and sandy bottom and in swift currents; generally deeply buried in sand (condensed from F. C. Baker, 1928a; see also van der Schalie, 1938, p. 72).

General distribution (fig. 177).—Western New York and southern Ontario west to Nebraska and Kansas, south to West Virginia, Tennessee and northern Alabama, and north to Wisconsin and Michigan. Lake Huron; Lake St. Clair and its drainage; Detroit River; Lake Erie and its drainage.

Distribution in Ohio (inset, fig. 177).—Sterki (1907a, p. 388) records this species for the Ohio drainage, Lake Erie and its drainage. Ortmann (1919) gives Sandusky River, Sandusky County; Swan Creek, Lucas County; Ohio River in Meigs County; Tuscarawas River; Miami River; Big Beaver Creek, Mercer County; he adds that it is "chiefly . . . in the tributaries" of the Ohio River.

Geologic range.—Unknown.

Chapter 5

SPHAERIIDAE

Order TELEODESMACEA Dall
Family SPHAERIIDAE Dall 1895

Diagnosis.—Shell small and thin, ligament feeble, short; pallial line simple; no hinge plate; cardinal teeth generally two in each valve; laterals four in the right valve, two anterior and two posterior, and two in the left valve, one anterior and one posterior; foot long, narrow, grooved, byssiferous when young; monoecious; the young incubated in a marsupium formed by the inner gill (Walker, 1918).

Remarks.—Sphaeriids can be distinguished from naiads by their dentition, regardless of size; no North American naiad has the two sets of laterals that are always present in sphaeriids. Very young specimens of Naiades may be puzzling at first sight as the teeth are not as conspicuous as in later stages. The umbonal sculpture of the Naiades, always irregular and different from the later concentric growth striae, will distinguish these young specimens from the Sphaeriidae, in which the beak sculpture is not radically different from the growth striae except that the beaks may be conspicuously convex and rather smooth.

Two genera, *Sphaerium* and *Pisidium,* occur in Ohio. *Sphaerium* includes many species with convex (calyculate) beaks. These species were formerly separated as a genus, *Musculium,* no longer recognized as such and reduced to at most a subgenus of *Sphaerium.*

Two North American students have devoted much attention to the family and another has just completed a thorough revision of it. Temple Prime published a monograph in 1865. His classification is rather conservative and recognizes a relatively small number of species. Victor Sterki, a physician of New Philadelphia, Ohio, devoted many years of study to the group in the latter part of the nineteenth and the first quarter of the twentieth centuries. In 1916 he assembled his results, insofar as they concern classification, in a catalogue of the family and set down some of his guiding principles. He was struck by the "apparently endless" variation in the species of the group but considered that "injudicious and haphazard 'lumping' has done more to bring difficulties than has been caused by minute discrimination between forms." Sterki's system, based on careful and minute discrimination, led to insuperable difficulties in identification, not only for the nonspecialist but for Sterki himself. Herrington (1962) has pointed out that Sterki's use of specific or subspecific names meaning puzzling or tiring is a reflection of his state of frustration in describing extremely variable material.

Herrington, at first in collaboration with Brooks (Brooks and Herrington, 1944) and later on his own (Herrington, 1954, 1962), has proposed a new classification, based on a more conservative approach, namely that "a valid species ... must be sufficiently different from all other species to permit the distinguishing characters to be written down in such a way that other students in this field can recognize the species. The distinguishing characters must not be simply more or less, but the specimens must have some character, or characters, that do not intergrade with any marginal form of some other species." Application of this rule to the species described before Herrington's studies has resulted in the reduction of many of Sterki's species to synonymy and the introduction into the North American catalogue of many European species, formerly unrecognized under superfluous specific names. One curious result is that the zoögeography of the group appears more logical under the new arrangement. The Sphaeriidae are all small, some of them minute, and have great facility of dispersal as compared, for example, with the Naiades since the former need not pass part of their larval life on the gills of a fish. They might, therefore, be expected to occupy large segments of the world's land areas; to show similarities in Europe, Asia, and North America; and to show speciation within the larger physical subdivisions of continents. Quite the opposite was true under Sterki's treatment and it gave some justification for the statement that sphaeriids were distributed indiscriminately by wind and that any species might be expected almost anywhere on the continent.

In Herrington's (1962) latest revision no final disposal was made of a few taxa cited for Ohio. Some of these are not mentioned in this excellent work; others are listed as synonyms of other species but have been identified by Herrington as forms. Many of these taxa are probably useless encumbrances of the literature which are best laid aside, if not forgotten. They will always remain a problem for any worker who runs across them and therefore in this report they are discussed under each genus with such notations on them as might be useful. These doubtful taxa are not to be considered as valid merely because they are listed; quite the contrary is probably true. Their inclusion

here is solely for the purpose of saving others the tedious work of finding references to them.

Subfamilies.—F. C. Baker (1928a, pt. II, p. 311) separates the three genera occurring in Wisconsin into subfamilies on the basis of the arrangement of the siphons. The distinction appears superfluous to the writer and is not used in this report, since the subfamilies correspond to the arrangement into two genera used here.

Geologic occurrence.—Having regard to the ease with which they are dispersed, it might be expected that the sphaeriids, especially the smaller species of *Pisidium,* would be the first to appear at the base of a lacustrine deposit. Such is not the case, at least in Ohio, where study of several lacustrine deposits demonstrates that small freshwater gastropods are just as easily distributed—perhaps by the same agent, wind—as the sphaeriids.

Genus *Sphaerium* Scopoli 1777

Sphaerium Scopoli 1777, Introd. Hist. Nat., p. 397.
Cyclas Lamarck 1799, Prodrome, p. 84.
Musculium Link 1807, Beschr. Nat. Samml. Univ. Rostock, (3), 152.
Cornea Megerle von Mühlfeld 1811, Mag. Gesell. Naturf. Freunde, Berlin, v. 5, p. 56.
Corneocyclas (Férussac *in litt.*) Blainville 1818, Dict. Sci. Nat., v. 12, p. 278.
Phymesoda Rafinesque 1820, Annales gén. Sci. Phys. (Bruxelles), v. 5, p. 319.
Amesoda Rafinesque 1820, *ibid.*
Calyculina Clessin 1872, Malak. Blätt., v. 19, p. 159.
Musculium Walker 1918, Synopsis and cat. fresh-water Moll., p. 87.
Sphaerium Monk 1928, Jour. Morphology and Physiology, v. 45, p. 81-113.
Sphaerium F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 312.
Musculium F. C. Baker 1928, *ibid.*, p. 349.
Sphaerium Germain 1931, Faune de France, p. 686.
Sphaerium Adam 1947, Mém. Mus. roy. Hist. Nat. Belgique, no. 106, p. 206.
Sphaerium La Rocque 1953, Cat. Recent Moll. Canada, p. 112.
Musculium La Rocque 1953, *ibid.*, p. 100.
Sphaerium Herrington 1962, Revis. Sphaeriidae N. America, p. 17.

Type.—*Tellina cornea* Linnaeus 1758.

Diagnosis.—Shell thin, oval, more or less inflated; beaks subcentral; surface smooth or concentrically striate; teeth small, cardinals one in the right, two in the left valve; laterals double in the right, single in the left valve; nepionic shell calyculate in some species, passing into the adult shell without any distinct demarcation in others (modified from Baker, 1928a, pt. II, p. 312).

In practice, fossil shells with nearly central beaks or with calyculate beaks, are placed in *Sphaerium;* those with markedly posterior beaks are assigned to *Pisidium;* at first, the student will find a remainder of unassigned sphaeriids not sufficiently inflated, or with somewhat posterior beaks, and no sign of calyculation of the beaks which he will find it difficult to place. Experience with large numbers of specimens will eventually enable him to place these doubtful specimens in their correct genus.

General distribution.—North and Central America; some islands of the West Indies; Asia; Europe.

Geologic range.—The genus has had representatives in North America at least since the Cretaceous. Henderson (1935, p. 10-11) lists the fossil species of North America with a range from Upper Cretaceous to Pliocene. Herrington and Taylor (1958, p. 23-25) give a catalogue of late Tertiary Sphaeriidae, after reviewing Pliocene and Pleistocene species (p. 1-25).

Remarks.—The species of *Sphaerium* in this report are divided into two groups for convenience in identification. These groups have no formal taxonomic significance. Species with fine striae (12 or more striae per mm. in the middle of the shell) are dealt with first; this group includes *S. corneum,* the type species. Group 2 includes the species with coarse striae (8 or fewer striae per mm. in the middle of the shell). The division into groups and the diagnoses for the species are adapted from the key given by Herrington (1962, p. 15-17).

Group 1

Shell sculptured with fine striae (12 or more striae per mm. in the middle of the shell). This group includes eight species represented in our area and one, *S. patella,* of the Pacific Coast States and Idaho.

Sphaerium corneum (Linnaeus) 1758
Pl. 2, fig. 2

Tellina cornea Linnaeus 1758, Syst. Nat., 10th ed., p. 678.
Sphaerium corneum Sterki 1926, Nautilus, v. 40, p. 29, Lake Ontario, introduced.
--- --- Kennard and Woodward, 1926, Synonymy British Moll., p. 302-304.
--- --- Germain 1931, Faune de France, p. 689.
--- --- Brooks and Herrington, 1944, Nautilus, v. 57, p. 94.
--- --- Adam 1947, Mém. Mus. roy. Hist. Nat. Belgique, no. 106, p. 206.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 113.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 17, pl. 2, fig. 2.

Type locality.—Europe.

Diagnosis.—Large shells, more than 8 mm. long, may be distinguished by their rounded ends, which are not at all rectangular in outline, and by the low beaks, only very slightly raised above the dorsal margin. Shells less than 8 mm. are distinguished by the fact that the posterior end and dorsal margin are rounded or form an obtuse angle, and the striae fade out in the region of the beaks.

Dimensions.—Herrington (1962, p. 17) gave L. 8.6, H. 7.1, and D. 5.2 mm. for his largest North American specimen; he pointed out that Swiss specimens were much larger: L. 13.5, H. 11.0. Germain (1931, p. 689) had still larger specimens: L. 15.5, H. 11, and D. 8 mm., also from Europe.

Ecology.—In North America, the species is recorded for large rivers and lakes, including the Great Lakes; it has been taken in fine soft sand near shore. Germain (1931, p. 690) states that it lives in ponds, ditches, rivers, and swamps, preferring stagnant water; it also lives in large lakes to a depth of 20-30 m. (Swiss lakes: Geneva, lac de Joux, 1,008 m. altitude); it is common in all France, in many places in numerous colonies on muddy bottoms. Adamstone (1924) records it for Lake Ontario; Sterki (1926, p. 29) thought it had been introduced there. Adam (1947, p. 206) calls it one of the commonest species in Belgium and gives a number of localities without ecological data except for one, a canal, and notes that it is rare or lacking in the Ardennes region. Its habitat requirements were amply met in Pleistocene environments in North America but the fact that it has never been recorded as a fossil here lends support to the idea that it has been introduced on this continent, probably by man, and in relatively recent times.

General distribution (fig. 178).—Eurasia. Introduced in North America. St. Lawrence River, Lake Erie. Ontario: Rice Lake. New York: Lake Champlain. Ohio: Lake Erie.

Distribution in Ohio (inset, fig. 178).—The only record is that for Lake Erie, cited above.

Geologic range.—No fossil record of this species is known to me for North America.

Sphaerium occidentale (Prime) 1860
Pl. 1, fig. 4

Cyclas ovalis Prime 1852, Boston Soc. Nat. History Proc. 1852, p. 276 (preoccupied).
Sphaerium occidentale Prime 1860, Acad. Nat. Sci. Philadelphia Proc. 1860, p. 295.
--- --- Prime 1865, Mon. Am. Corbiculadae, p. 41, fig. 34.
--- --- Dall 1905, Harriman-Alaska Exped., v. 13, p. 137, fig. 104.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 395.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 438.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 347, pl. 99, figs. 1-3.
--- --- Brooks and Herrington 1944, Nautilus, v. 57, p. 94.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 321.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 115.
--- --- van der Schalie 1953, Nautilus, v. 66, p. 84.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 114.
--- --- Taylor and Hibbard 1955, Okla. Geol. Survey Circ. 37, p. 12.
--- --- Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 10.
--- --- La Rocque 1959, Sterkiana, no. 1, p. 32.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 21, pl. 1, fig. 4.

Type locality.—"Oswego and Greenwich, N. Y.; Columbus, Ohio" (F. C. Baker, 1928a, pt. II, p. 347).

Diagnosis.—Shell small, less than 8 mm. long; posterior end and dorsal margin rounded or forming an obtuse angle; striae fade out in the region of the beaks; beaks prominent, distinctly raised above the dorsal margin; anterior and posterior ends of the shell rounded, beaks not swollen.

Dimensions.—The largest specimen recorded by Herrington (1962, p. 21) has L. 7.0, H. 6.0, D. 4.1 mm.; Baker (1928a, pt. II, p. 348) recorded one almost as large (L. 6.6, H. 6.0, D. 4.0) from Wisconsin.

Ecology.—The species has quite a wide range of of habitat preferences. Herrington (1962, p. 22) gives "stillwaters of swamps, ditches, and ponds; among grass and leaves. This species has a preference for, or requires, a habitat that dries up for part of the year." Herrington and Taylor (1958, p. 10) have summarized the ecology as follows: "This species lives in swamps, lagoons, flood plains, and ponds, among leaves or grass. Most of its stations dry up for part of the year; at such times the clam stays under dry leaves or in the grass and keeps its shells tightly closed. At the end of the dry season when the rains begin, it once more opens up and resumes life as usual." As early as 1910, Baker (1910, p. 488, 491) had stated that it "is almost always ... an inhabitant of transient pools and ditches."

There is nevertheless a body of records which may indicate that it also lives in more permanent bodies of water. "Taken in canal near Dundas; also in streams running through open woods, among and under the dead leaves" (Hanham, 1890, p. 119); from a creek, Boligee, Alabama (Hinkley, 1906, Naut. 20, p. 43); Fort Erie trenches, Cazenovia Creek, Concord, West Seneca, Lewiston (Letson, 1909, p. 243); Thames River at Woodstock, Ontario; marsh near Lake Ontario at Leamington, Ontario (Whiteaves, 1912, p. 169); creek tributary to Coosa River (Goodrich, 1944, p. 49). Are these

records due to misidentification or to inexact recording of habitat? Both are possible, but the point is worth noting that the species may be more adaptable than the records would indicate at first sight.

Associations.—Living: MANITOBA-30; MINNESOTA-19; NEW YORK-1; OHIO-43; ONTARIO-7; WISCONSIN-4, 21, 43, 136. Fossil: S-1.

General distribution (fig. 179).—New Brunswick, Quebec, and Ontario (Thunder Bay district, north of Lake Superior), south to Alabama and Georgia, west to Washington, Oregon, Idaho, Utah, and Colorado.

Distribution in Ohio (inset, fig. 179).—"Over the state" (Sterki, 1907a, p. 395), specifically from Portage and Tuscarawas Counties (Sterki) to Auglaize, Erie, Hancock, and Mercer Counties (University of Michigan collections).

Geologic range.—Miocene? to present. Sterki (1916, p. 438) notes that this species, or one very close to

FIGURE 178.—Distribution of *Sphaerium corneum* in North America; *inset,* distribution in Ohio.

it, occurs in the Miocene of North Carolina. Baker (1920a, p. 383) records it for late Wisconsin ("Wabash") deposits. Herrington (1962, p. 22) has identified it from the Jinglebob fauna (Sangamon in age) of Meade County, Kansas.

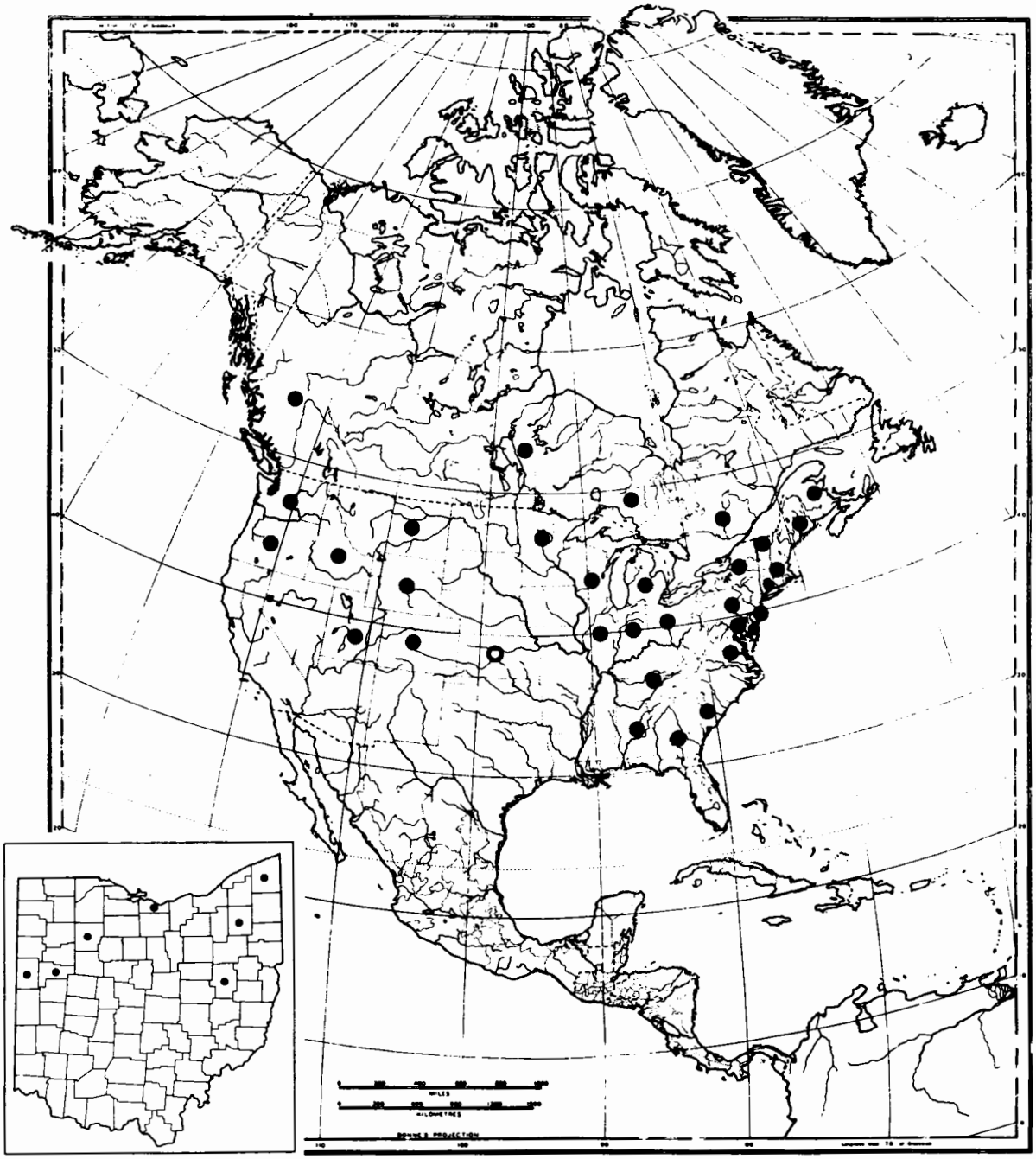
Variation.—The variety *amphibium* Sterki 1907 seems scarcely worth listing. It is not mentioned by Herrington (1962).

Sphaerium securis (Prime) 1851
Pl. 1, fig. 2

Cyclas securis Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 160.

Sphaerium securis Prime 1865, Mon. Am. Corbiculadae, p. 49.

Musculium securis Sterki 1907, Ohio Acad. Sci. Proc.,



v. 4, p. 396.
Musculium parvum Sterki 1909, Nautilus, v. 23, p. 67.
--- --- Latchford 1913, Ottawa Naturalist, v. 27, p. 20.
Musculium securis Johnson 1915, Fauna New England, p. 48.
Musculium parvum Johnson 1915, *ibid.*, p. 50.
Musculium securis Sterki 1916, Cat. N. American Sphaeriidae, p. 444.
Musculium parvum Sterki 1916, *ibid.*, p. 445.
Musculium securis Sterki 1920, Ohio Jour. Sci., v. 20, p. 176.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 360, pl. 99, figs. 10-13.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 322.
Musculium securis parvum Goodrich and van der Schalie 1944, *ibid.*
Musculium secure Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 118.
Musculium parvum La Rocque 1953, Cat. Recent Moll. Canada, p. 100.
Musculium secure La Rocque 1953, *ibid.*, p. 101.
Sphaerium (Musculium) parvum La Rocque 1959, Sterkiana, no. 1, p. 32.
Sphaerium (Musculium) securis La Rocque 1959, *ibid.*
Sphaerium securis Taylor 1960, U.S. Geol. Survey Prof. Paper 337, p. 46.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 26, pl. 1, fig. 2.

Type locality.—Fresh Pond and Cambridge Meadows, Cambridge, Massachusetts.

Diagnosis.—Shell small, less than 8 mm. long; posterior end nearly at right angles with dorsal margin; anterior ventral margin of shell slopes sharply upward; surface dull; striae coarser than in *S. partumeium.*

Dimensions.—F. C. Baker (1928a, pt. II, p. 361) gave L. 5.5, H. 4.4, and D. 3.2 mm. for the largest of three specimens from La Porte, Indiana. Herrington (1962, p. 26) had one somewhat larger specimen from Moira River, Hastings County, Ontario: L. 6.3, H. 5.2, D. 3.9 mm.

Ecology.—Baker (1928a, pt. II, p. 361) gives: "Swale near Oshkosh, water few inches deep, mud bottom; Lake Butte des Morts, mud bottom, water 2 m. deep; Oconomowoc Lake, in water plants, 3-5 m. deep." Whiteaves (1863, p. 110) found the species in old stone quarries in Montreal and at Lachine, Quebec. Letson (1909, p. 243) obtained it from the Fort Erie trenches and from a small lake and a creek in the Buffalo area. Latchford (1921, p. 68) repeated a former record for Dow's Lake and added one from a pond at Britannia Highlands, west of Ottawa, Ontario. D. W. Taylor (1960, p. 46) found it "in northern Nebraska ... in a small permanent or nearly permanent pond in sandy bottom among dense vegetation in shallow water." Herrington (1962, p. 26) summarizes the habitat as follows: "Ponds, lakes, and rivers. Frequently found in fine sand."

Associations.—Living: MANITOBA-21; MINNESOTA-15, 16, 17; NEW YORK-1, 35, 37; OHIO-43; ONTARIO-3; WISCONSIN-4, 10, 23, 43, 45, 53, 60, 61, 63, 102, 106, 107, 133. Fossil: W-27.

General distribution (fig. 180).—Newfoundland, Nova Scotia, New Brunswick, Quebec, Ontario (southern part only, north and east of Toronto), British Columbia. Maine, New York, Pennsylvania, Ohio, Michigan, Wisconsin, Minnesota, Iowa, Montana, and Washington, south to Florida, Alabama, Mississippi, Louisiana, and Texas.

Distribution in Ohio (inset, fig. 180).—Sterki (1907a, p. 396) gives "over the state," which is probably correct.

Geologic range.—Pleistocene: late Wisconsin. Walker (1907, p. 180) recorded the species from marl at Cobalt, Ontario (late Wisconsin). Sterki (1916, p. 444) notes it as a fossil in Maine and Michigan (very probably Wisconsin). Baker (1920a, p. 384) gives "Wabash" (late Wisconsin). The species occurs in the Tinkers Creek marl of Ohio (Sterki, 1920, p. 176) and at the base of a peat bed, Beauharnois County, Quebec (Whittaker, 1922a, p. 105). Sterki (1916, p. 445) gives "Fossil.-Michigan" for *S. parvum.* All of these records should probably be referred to the late Wisconsin. Herrington (1962, p. 26) gives no fossil record for this species.

[*Sphaerium securis* form *sphaericum* (Anthony) 1852]

Cyclas sphaerica Anthony 1852, Boston Soc. Nat. History Proc., v. 4, p. 275.
Sphaerium sphaericum Prime 1865, Mon. Am. Corbiculadae, p. 50.
Musculium sphaericum Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 396.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 444.
Musculium securis sphaericum F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 362, pl. 99, figs. 14-18.
Musculium sphaericum Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 322.
Sphaerium (Musculium) sphaericum La Rocque 1959, Sterkiana, no. 1, p. 32.
Sphaerium securis form *sphaericum* Herrington 1962, Revis. Sphaeriidae N. America, p. 26.

Type locality.—"Loraine [Lorain] Co., Ohio" (F. C. Baker, 1928a, pt. II).

Diagnosis.—"Differing from *securis* in being oval, the anterior and posterior margins rounded, not truncated, dorsal margin rounding into ends without notable angle. It is also usually larger than *securis.* The 'aestivale' forms have rounded beaks which are much lower than the calyculate beaks of the normal form, giving the shell a more regularly oval shape" (Baker,

1928a, pt. II, p. 362). "The form *sphaericum* Anthony is usually heavily coated with a rust-colored accretion, inflated, and the dorsal margin considerably curved" (Herrington, 1962, p. 26).

Dimensions.—Baker (1928a, pt. II) gives the following for specimens from Prairie Lake, Wisconsin: L. 6.0, 5.6, 5.4; H. 5.0, 4.6, 4.5; D. 3.5, 3.5, 3.2 mm.

Ecology.—Baker (1928a, pt. II, p. 362) gives: "Small pool near Prairie Lake, mud bottom, water .6 m. deep; pool near Shell Lake, mud bottom, shallow water (Baker). Bark River, gravel and coarse sand bottom, shallow water (Cahn)."

General distribution.—Recorded for Wisconsin, Iowa, Michigan, Indiana, Ohio, and New York.

Distribution in Ohio.—Sterki (1914, p. 272) lists it from Lorain (type locality), Geauga, and Wayne Counties. I have no other record.

Geologic range.—No fossil record known to me.

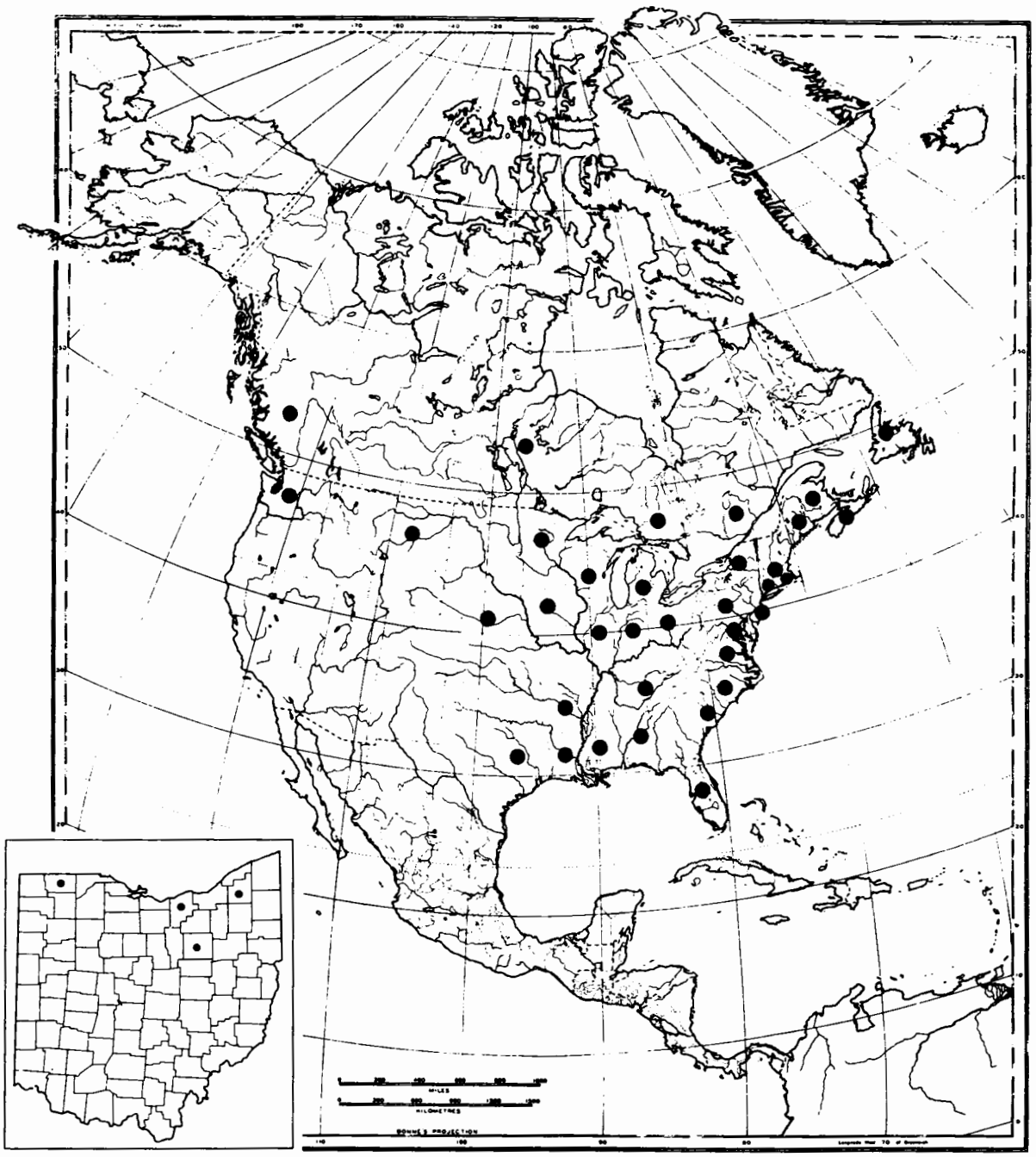


FIGURE 180.—Distribution of *Sphaerium securis* in North America; *inset,* distribution in Ohio.

[*Sphaerium securis* form *succineum* (Sterki) 1916]

Musculium sphaericum succineum Sterki 1916, Cat. N. Am. Sphaeriidae, p. 444.
Sphaerium (Musculium) sphaericum succineum La Rocque 1959, Sterkiana, no. 1, p. 32.

Type locality.—Agawam River at East Wareham, Massachusetts, is the only specific locality given; others refer to states only. Perhaps the Agawam River at East Wareham should be considered the type locality unless Sterki designated types from elsewhere after 1916.

Diagnosis.—"Mussel somewhat smaller, less inequipartite; beaks rather large and full, the shell is translucent to transparent, of clear amber-color, the surface glossy, with very fine slight striae, not scaly" (Sterki, 1916, p. 444).

Dimensions.—None given by Sterki (1916).

Ecology.—A small river form, judging by the type locality. I have found no other information.

General distribution.—Listed by Sterki (1916, p. 444) for Massachusetts, Rhode Island, New York, and Ohio.

Distribution in Ohio.—No specific locality known to me.

Geologic range.—No fossil record known to me.

Remarks.—This taxon is not mentioned by Herrington (1962) and is probably too minor for recognition. It is listed here merely for purposes of record.

Sphaerium nitidum Clessin 1876
Pl. 1, fig. 6

Cyclas tenuis Prime 1851, Boston Soc. Nat. History Proc. 1851, v. 4, p. 161; unidentifiable, *fide* Herrington, 1958.
Sphaerium tenue Prime 1865, Mon. Am. Corbiculadae, p. 47, fig. 44.
Sphaerium nitidum Clessin 1876, *in* Westerlund, Neue Binnenmoll. Sibir., p. 102.
Sphaerium walkeri Sterki 1901, Nautilus, v. 14, p. 141.
Sphaerium (Musculium) tenue Dall 1905, Harriman-Alaska Exped., v. 13, p. 139, fig. 109.
Sphaerium walkeri Dall 1905, *ibid.*, p. 135.
——— ——— Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 400.
Sphaerium tenue Sterki 1916, Cat. N. Am. Sphaeriidae, p. 438.
Sphaerium tenue walkeri Sterki 1916, *ibid.*, p. 439.
Sphaerium tenue Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 321.
Sphaerium walkeri Brooks and Herrington 1944, Nautilus, v. 57, p. 94, valid species.
Sphaerium tenue La Rocque 1953, Cat. Recent Moll. Canada, p. 116.
Sphaerium walkeri La Rocque 1953, *ibid.*, p. 117.
Sphaerium nitidum Herrington 1958, Nautilus, v. 72, p. 10.
?*Sphaerium (Musculium) nitidum* La Rocque 1959, Sterkiana, no. 1, p. 32.
Sphaerium walkeri La Rocque 1959, *ibid.*, p. 33.
Sphaerium nitidum Herrington 1962, Revis. Sphaeriidae N. America, p. 21, pl. 1, fig. 6.

Type locality.—Siberia.

Diagnosis.—Shell small, less than 8 mm. long; posterior end and dorsal margin rounded or forming an obtuse angle; striae maintain their spacing and height in the region of the beaks.

Ecology.—"Requires cold water, hence found only in deep water, at considerable altitudes, or quite far north" (Herrington, 1962, p. 21). This point, brought out clearly by Herrington, provides a revealing criterion in reconstructing the habitat of extinct lakes. Earlier records, listed below, confirm this point, as does the association listed in the next paragraph. Dall (1905, p. 139) notes the species for several large northern rivers; F. C. Baker (1920a, p. 69) for St. Anne Lake, Alaska, and Baker and Cahn (1931, p. 46) for Bamaji Lake, Ontario. Adamstone (1923b) gives Lake Nipigon, Ontario; Kindle (1925) Humber Bay, Lake Ontario; Whittaker (1924, Naut. 38, p. 10) three lakes and the Mackenzie River in the Northwest Territories of Canada; Mozley (1926, Naut. 40, p. 62) a small shallow inlet on the shore of Traverse Bay, Lake Winnipeg. Finally, Odhner (1939, Naut. 52, p. 79) collected it in a lake on Unimak Island, Alaska.

Association.—Living: MANITOBA-24.

General distribution (fig. 181).—Alaska, Northwest Territories, Ontario, Quebec, and Newfoundland, south to Washington, Utah, Michigan, New York, and Maine. Eurasia.

Distribution in Ohio.—Recorded for Michigan and Ontario, therefore possible, though not probable, for Ohio, because of its need of cold water.

Geologic range.—No fossil record from North America is known to me.

Sphaerium transversum (Say) 1829
Pl. 2, fig. 6; pl. 8, fig. 11

Cyclas transversa Say 1829, New Harmony Disseminator, v. 2, p. 356.
Sphaerium transversum Prime 1865, Mon. Am. Corbiculadae, p. 48, fig. 45.
Sphaerium martensi Pilsbry 1903, Acad. Nat. Sci. Philadelphia Proc. 1899, p. 401; *ibid.*, 1903, p. 786.
Sphaerium (Musculium) transversum Dall 1905, Harriman-Alaska Exped., v. 13, p. 139, fig. 110.
Musculium transversum Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 395.
——— ——— Johnson 1915, Fauna New England, p. 50.
——— ——— Sterki 1916, Cat. N. Am. Sphaeriidae, p. 440.
——— ——— F. C. Baker 1928, Fresh water Moll. Wis.,

pt. II, p. 351, pl. 98, figs. 22-28.

Musculium transversum Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 322.

--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 115.

--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 101.

Sphaerium transversum Taylor and Hibbard 1955, Okla. Geol. Survey Circ. 37, p. 12, Pleistocene, Kansas.

--- --- Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 8.

Sphaerium (Musculium) transversum La Rocque 1959, Sterkiana, no. 1, p. 33.

Sphaerium transversum Taylor 1960, U.S. Geol. Survey Prof. Paper 337, p. 47.

--- --- Hibbard and Taylor 1960, Mich. Univ. Mus. Paleontology Contr., v. 16, no. 1, p. 76, pl. 4,

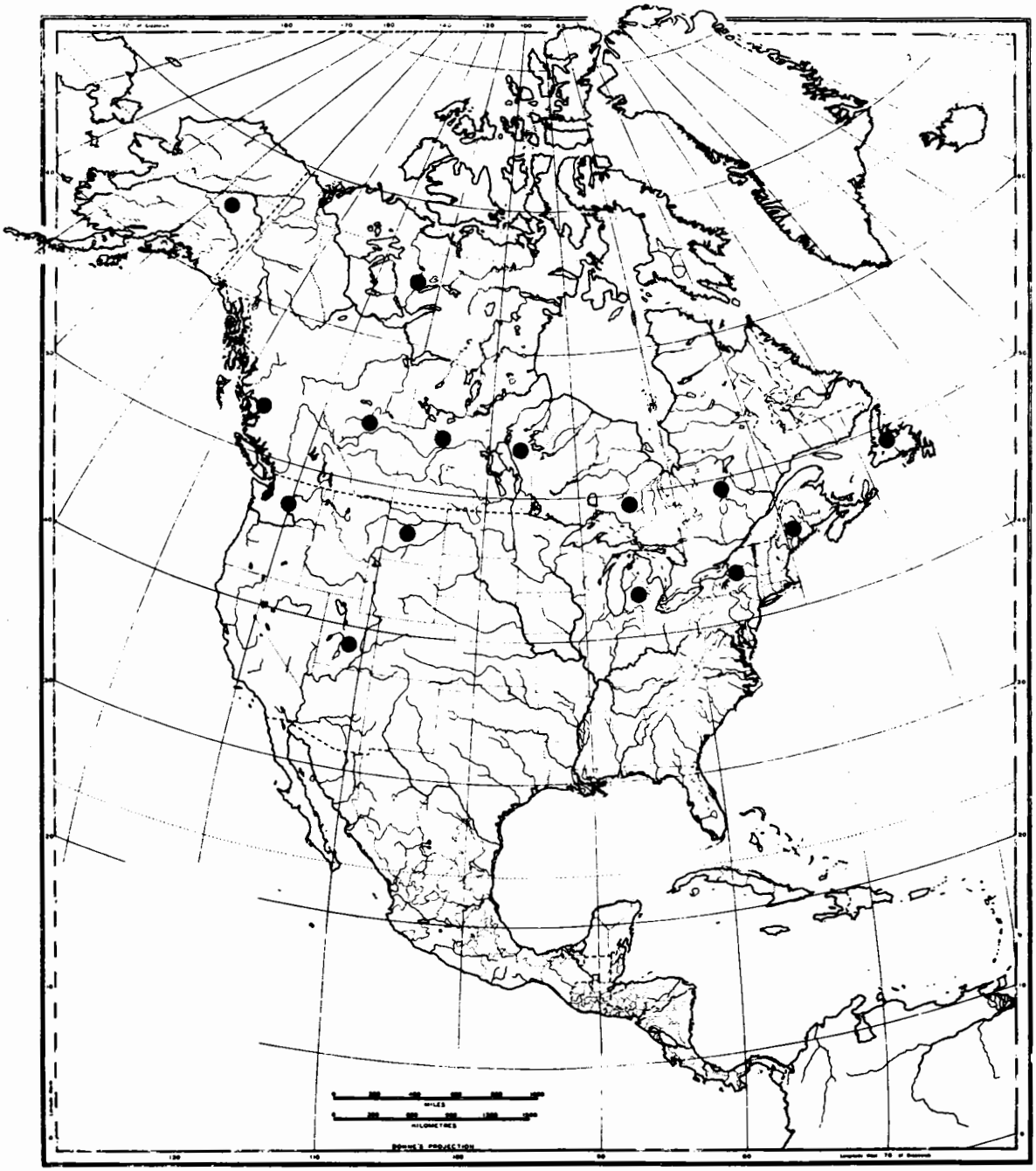


FIGURE 181.–Distribution of *Sphaerium nitidum* in North America.

figs. 8-9, 11.

Sphaerium transversum Herrington 1962, Revis. Sphaeriidae N. America, p. 29, pl. 2, fig. 6.

Type locality.—Kentucky.

Diagnosis.—Shell large, more than 8 mm. long; beaks prominent, distinctly raised above the dorsal margin; shell long in outline, height ¾ or less of length.

Dimensions.—Herrington (1962, p. 29) records his largest specimens from Lake Ontario (L. 14.3, H. 10.5, D. 6.9 mm.) but specimens from the Rideau Canal, Ottawa, are smaller (L. 12.5, 9.9, 8.0, 3.9; H. 8.9, 7.6, 5.9, 3.0; D. 6.0, 5.1, 3.8, 1.8 mm.); F. C. Baker (1928a, pt. II, p. 352) gave similar dimensions (L. 12.0, 10.0; H. 8.0, 6.8; D. 5.4, 4.6 mm.) for specimens from Omro, Wisconsin.

Ecology.—The various habitats of the species are summarized by Herrington (1962, p. 30) as large lakes, rivers, and sloughs. Sterki (1907a) also found it in rivers with strong current, with stony and rocky bottom. Herrington and Taylor (1958, p. 9) record it from both sand and mud, in slow current or quiet water. It had previously been known from similar locations, such as Stroudwater River, Maine (Lermond, 1909, p. 249); Cazenovia Creek, Buffalo area (Letson, 1909, p. 243); Chicago River, Illinois (Baker, 1910, p. 491); Red Rock Creek, Noble County, Oklahoma (Walker, 1915, p. 9); Rideau Canal, Ottawa, Ontario, in great numbers (Latchford, 1911, p. 20).

Associations.—Living: MANITOBA-23; OHIO-43; ONTARIO-1, 6. Fossil: N-1, 2; S-6.

General distribution (fig. 182).—Northwest Territories, Manitoba, Quebec, and Ontario, south to Texas, Louisiana, Mississippi, Alabama, Georgia, and Florida. Mexico. Europe.

Distribution in Ohio (inset, fig. 182).—The species is recorded only for Seneca County but is probably present throughout the State.

Geologic range.—Pleistocene: Nebraskan, Illinoian, Sangamon, Wisconsin. D. W. Taylor (1960, p. 47) records the species from the Nebraskan or earliest Aftonian of Nebraska. It is also known from the Illinoian (Berends local fauna) and the Sangamon (Jinglebob local fauna) of Kansas (Taylor and Hibbard, 1955, p. 12). Mozley (1928, p. 268) records it for a silt bed near Winnipeg, Manitoba, and Baker (1920a, p. 384) gives Yarmouth and "Wabash." I have found no fossil record for Ohio.

Sphaerium lacustre (Müller) 1774
Pl. 2, fig. 1

Tellina lacustris Müller 1774, Verm. Terr. et Fluv., p. 204.

Cyclas rosacea Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 155.

Sphaerium rosaceum Prime 1865, Mon. Am. Corbiculadae, p. 50, fig. 48.

Calyculina lacustris Clessin 1879, Mon. Cycladeen, p. 253, pl. 41, figs. 9, 12, 16, 17.

Sphaerium rosaceum Johnson 1915, Fauna New England, p. 50.

Musculium lacustre Sterki 1916, Cat. N. Am. Sphaeriidae, p. 442.

Musculium rosaceum Sterki 1916, *ibid.*

--- --- F. C. Baker 1920, Jour. Geology, v. 28, p. 446.

--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 358, pl. 99, figs. 19, 20.

Sphaerium (Musculium) lacustre Germain 1931, Faune de France, no. 22, p. 693.

Musculium lacustre Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 322.

Sphaerium lacustre Adam 1947, Mém. Mus. roy. Hist. Nat. Belgique, no. 106, p. 208.

Musculium lacustre La Rocque 1953, Cat. Recent Moll. Canada, p. 100.

Musculium rosaceum La Rocque 1953, *ibid.*, p. 101.

Sphaerium cf. *lacustre* (Müller) Taylor and Hibbard 1955, Okla. Geol. Survey Circ. 37, p. 12.

Sphaerium lacustre Herrington 1957, Canad. Field-Naturalist, v. 71, p. 8.

--- --- Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 8.

Sphaerium (Musculium) lacustre La Rocque 1959, Sterkiana, no. 1, p. 31.

Sphaerium (Musculium) rosaceum La Rocque 1959, *ibid.*, p. 32.

Sphaerium lacustre Herrington 1962, Revis. Sphaeriidae N. America, p. 19, pl. 2, fig. 1.

Type locality.—Europe, probably Denmark.

Diagnosis.—Shell large, more than 8 mm. long; beaks prominent, distinctly raised above the dorsal margin; shell high in outline, height 7/8 or more of length; dorsal margin rounded; posterior end at a greater angle to the dorsal margin and striae coarser than in *S. partumeium.* Smaller shells, less than 8 mm. long, may be distinguished by the fact that the striae fade out in the region of the beaks; the posterior end and dorsal margin are rounded or form an obtuse angle; and the posterior end of the shell is truncate, the beaks swollen.

Dimensions.—F. C. Baker (1928a, pt. II, p. 358) gave L. 5.7, H. 5.0, and D. 3.6 mm. for *S. rosaceum* from Wisconsin. Herrington (1962, p. 19) gave L. 9.0, 7.0, 5.5; H. 7.2, 5.7, 4.5; D. 5.4, 4.5, 3.0 for selected specimens of form *jayense* from Lake Ontario; and L. 14.0, H. 11.5, D. 8.2, for specimens from King County, Washington.

Ecology.—Herrington (1962, p. 20) summarizes the habitat of this species as follows: "Most plentiful in small lakes and ponds, but also found in large lakes, rivers, and creeks. It appears to have preference for a muddy bottom. I have collected the *S. lacustre* form *ryckholti* from ponds and bog-ponds, and *S. lacustre*

form *jayense* from the mud of Rice Lake, Peterborough Co., Ontario, and in Hay Bay, Lennox and Addington Co., Ontario. In the latter place most specimens were obtained from black ooze a quarter to a half mile from shore, at a depth of 6-8 meters." Germain (1931) recorded that it lives in ponds, ditches, marshes, puddles, muddy brooks, and even larger lakes; still lives at 1,300-1,400 m. altitude; lives in all France, but commoner in the north; Corsica; rather frequent as a fossil in the Quaternary. Mowery (1961, p. 7) summarized previous North American statements on this species: It occurs in swamps, ponds, lakes, or streams on a firm bottom of fine deep or hard packed mud, fine gravel, and hard clay, in water up to 0.6 m. deep; it has been collected in water with pH 6.4-7.64, fixed carbon dioxide ratio 9.3-18.87 p.p.m.

Associations.—Living: MANITOBA - 25; NEW YORK - 35; QUEBEC - 1; WISCONSIN - 5, 28, 51, 54, 68, 78, 79,

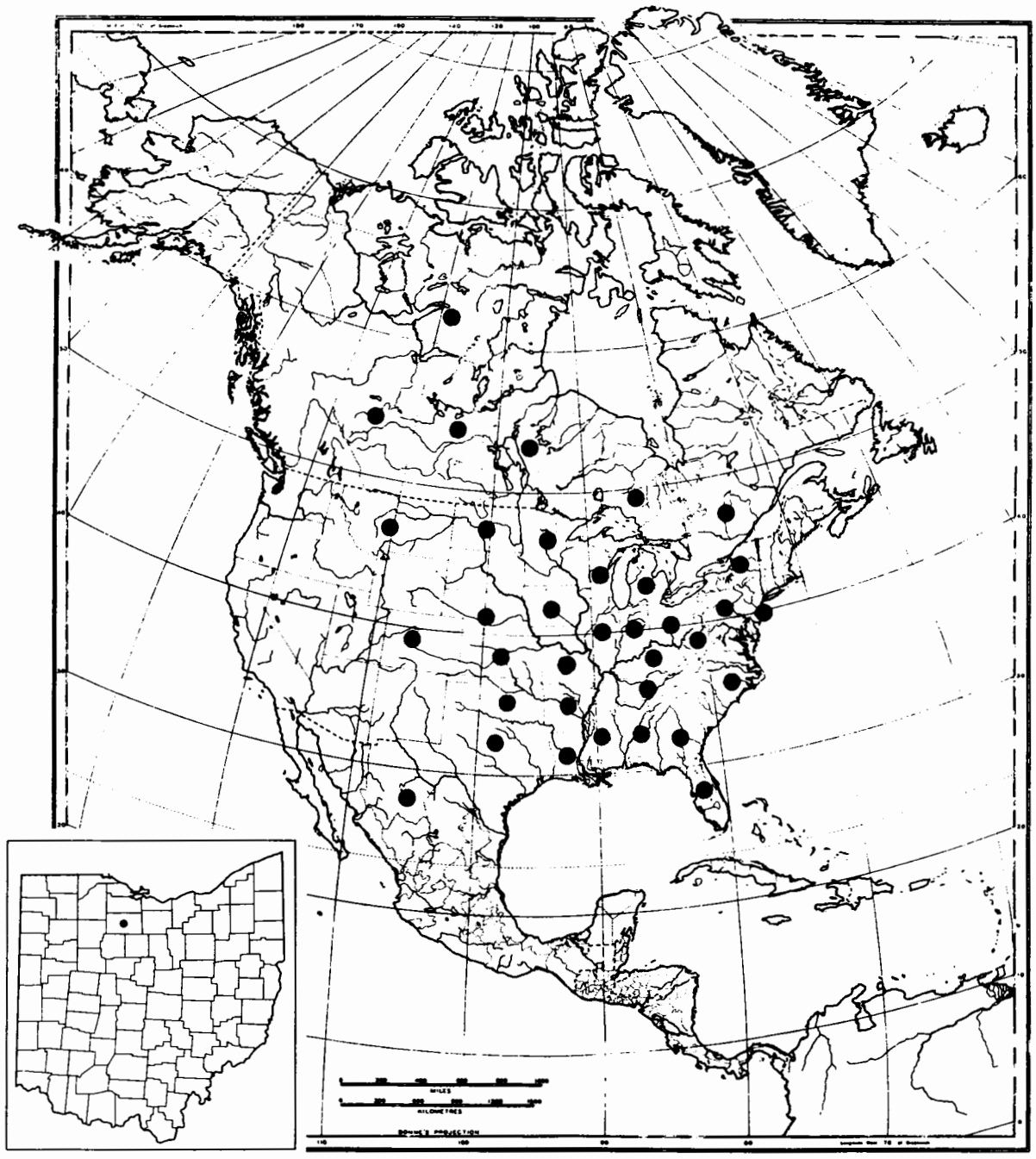


FIGURE 182.—Distribution of *Sphaerium transversum* in North America; *inset,* distribution in Ohio.

102, 107. Fossil: N-2; W-29, 33, 34, 36, 37, 38, 39, 41, 42, 45, 46, 47, 50, 51, 53, 54.

General distribution (fig. 183).—Northwest Territories east to Manitoba, Ontario, Quebec, and Nova Scotia, south to California, Colorado, Iowa, Nebraska, Louisiana, Alabama, Georgia, and Florida. Japan; Hawaii. Europe.

Distribution in Ohio (inset, fig. 183).—Recorded for the State (as *S. rosaceum*) only from Geauga and Portage Counties, living. See also fossil records.

Geologic range.—Pleistocene: Illinoian to present. D. W. Taylor and Hibbard (1955, p. 12) have identified this species from the Berends local fauna, probably Illinoian, of Oklahoma. According to Herrington (1962, p. 21), these specimens belong to form *ryckholti*. In Ohio, it is a late Pleistocene form recorded for the Newell Lake, Jewell Lake, Souder Lake, and the Aultman and Oakhurst deposits. As *S. rosaceum* it was

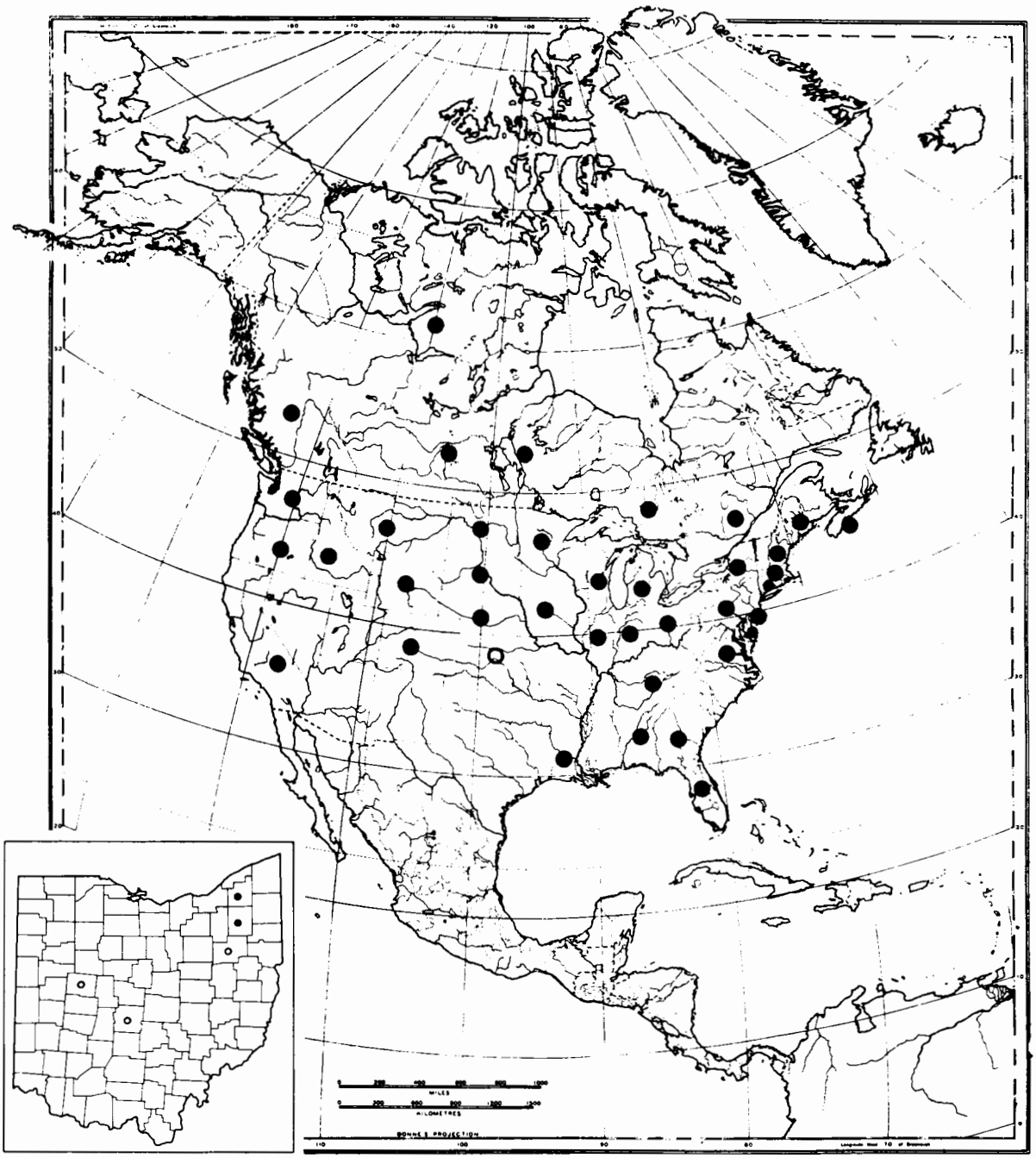


FIGURE 183.—Distribution of *Sphaerium lacustre* in North America; *inset*, distribution in Ohio.

listed by Baker (1920a, p. 384) for the "Wabash" (late Wisconsin) and (1920b, p. 446) for the Rush Lake deposit, Ohio (late Wisconsin).

[*Sphaerium lacustre* form *jayense* (Prime) 1851]

Cyclas jayensis Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 157.
Sphaerium jayanum Prime 1865, Mon. Am. Corbiculadae, p. 46, fig. 43.
Sphaerium (Musculium) jayanum Dall 1905, Harriman-Alaska Exped., v. 13, p. 139, fig. 108.
Musculium jayense Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 396.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 441.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 353, pl. 99, figs. 27, 28.
Musculium jayanum Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 322.
Musculium jayense La Rocque 1953, Cat. Recent Moll. Canada, p. 100.
Sphaerium (Musculium) jayense La Rocque 1959, Sterkiana, no. 1, p. 31.
Sphaerium lacustre form *jayense* Herrington 1962, Revis. Sphaeriidae N. America, p. 20.

Type locality.—Lake Superior.

Diagnosis.—"Rhombic, nearly equipartite, inflated, thin, fragile; dorsal margin short, but slightly curved; ventral margin convex; anterior and posterior ends squarely truncated, angled above, rounded below; umbones conspicuously elevated above dorsal margin, strongly calyculate; scutum and scutellum well marked; surface sculpture of very fine lines of growth; epidermis dull to shining; color corneous with sometimes a zone of yellowish bordering the valves.

"Hinge margin thin, narrow, slightly curved; cardinal in right valve rather large, curved acutely at the lower (posterior) end, which forms a club-shaped swelling, strongly emarginate on the base; upper cardinal of left valve short, slightly curved, narrow, erect; lower cardinal pyramidal, high, somewhat massive (Fig. 268); laterals long, curved, lamellar, not much raised above shell margin; cavity of beaks shallow; nacre bluish or bluish-white" (F. C. Baker, 1928a, pt. II, p. 353-354).

Dimensions.—Baker (1928a, pt. II) gives the following for specimens from De Pere, Wisconsin: L. 9.7, 6.5; H. 8.5, 6.0; D. 6.4, 4.0 mm.

Ecology.—Christie (1885, p. 339) records the species as abundant among roots of rushes on wetter parts of the shell-covered prairie south of Fort Ellice, Manitoba, but did not observe it elsewhere. G. W. Taylor (1895, p. 175) added two creeks and the Little Bow River in Alberta. Latchford (1921, p. 68) found it only sparingly in two or three feet of water on a muddy bottom in Lake Constance (near the Ottawa River and probably connected with it at high water) but nowhere else near Ottawa. Baker (1928a, pt. II, p. 354) took it on a sandy-mud bottom in 1 and 1.5 m. of water in Lake Butte des Morts, Wisconsin, and in "pure sand packed hard" in Silver Lake, Wisconsin.

These records indicate quite a range of environments and possibly a preference for sand bottom in shallow water.

Associations.—Living: WISCONSIN-51, 78.

General distribution.—Extreme points of the range are widely separated; Ottawa region, Ontario, Manitoba, Mackenzie River, Alberta, Colorado, Indiana, Ohio, but there are many gaps, probably the result of insufficient collecting, in the areas between those recorded.

Distribution in Ohio.—Records for Ohio are widely scattered, probably because of insufficient collecting.

Geologic range.—No fossil record known to me for North America.

[*Sphaerium lacustre* form *ryckholti* (Normand) 1844]

Cyclas ryckholti Normand 1844, Notes sur quelques nouvelles Cyclades, p. 7, figs. 5, 6.
Calyculina ryckholti Clessin 1879, Mon. Cycladeen, p. 257, pl. 40, figs. 20-27.
Musculium ryckholti Johnson 1915, Fauna New England, p. 50.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 443.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 359, pl. 99, figs. 6-9.
Sphaerium (Musculium) Ryckholti Germain 1931, Faune de France, no. 22, p. 695.
Musculium ryckholti La Rocque 1953, Cat. Recent Moll. Canada, p. 101.
Sphaerium lacustre form *ryckholti* Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 8.
Sphaerium (Musculium) lacustre ryckholti La Rocque 1959, Sterkiana, no. 1, p. 31.
Sphaerium lacustre form *ryckholti* Taylor 1960, U.S. Geol. Survey Prof. Paper 337, p. 46.
Sphaerium lacustre form *ryckholti* Herrington 1962, Revis. Sphaeriidae N. America, p. 21.

Type locality.—Europe (*fide* F. C. Baker, 1928a, pt. II).

Diagnosis.—"Small, trigonal, short, slightly inequipartite, calyculate, inflated; dorsal and ventral margins curved; anterior and posterior margins rounded, the latter rather roundly truncated; scutum and scutellum distinctly marked; the region in front of the umbones is much less in height than the region behind the umbones; beaks elevated, swollen; rather wide, not approximate; surface shining, sculpture of fine lines of growth; color smoky grayish or corneous.

"Hinge narrow, fragile; cardinal in right valve heavy, thick, anterior part straight, posterior end with

knob-like termination, directed toward lower part of hinge plate (fig. 271); upper cardinal in left valve short, straight, narrow; lower cardinal large, thick, pyramidal; laterals short, slightly curved; cavity of beaks deep; nacre smoky or grayish" (Baker, 1928a, pt. II, p. 359).

Dimensions.—Baker (1928a, pt. II, p. 360) gives the following for specimens from Green Lake, Wisconsin: L. 5.5, H. 5.0, D. 3.1 mm.; and from Bayfield, Wisconsin: L. 5.5, 5.0; H. 5.0, 4.0; D. 3.0, 2.9 mm.

Ecology.—According to Germain (1931, p. 695) the species may be considered as a variety of *S. lacustre* living more particularly in pools and stagnant waters without outlet, where it lives buried in the mud or crawling on muddy bottom. It lives in France, Belgium, northern Germany, Denmark, and the British Isles, which indicates a preference for cooler climates, or, rather, cool waters.

Herrington and Taylor (1958, p. 8) state that it seems to have a preference for ponds where there is considerable vegetation and even bog ponds that have a bottom of muck, rotting wood, grasses, and the like. Zimmerman (1960, p. 22) gives fine deep mud bottom, 0.6 m. deep; hard clay bottom, 0.3 to 0.6 m. deep; and mud bottom, 0.5 m. deep, as habitats. Mozley (1926, Naut. 40, p. 62) found it in a marsh and a slough in Manitoba.

Associations.—Living: MANITOBA - 25; WISCONSIN - 107.

General distribution.—Southern United States to Northwest Territories of Canada; Europe; Brazil (Herrington and Taylor, 1958, p. 8).

Distribution in Ohio.—The species probably lives in Ohio at present but neither Sterki nor any other authority has given any but Pleistocene fossil localities for the State.

Geologic range.—Pliocene to Pleistocene; Nebraskan to present. Recorded by D. W. Taylor (1960, p. 46) for the Dixon local fauna (Nebraskan or earliest Aftonian); in Ohio, it occurs in the Souder Lake deposit (late Wisconsin), cited by Cornejo (1961, fig. 11). Early and middle Pliocene of Kansas and Oklahoma (Herrington, 1962, p. 21).

Sphaerium partumeium (Say) 1822
Pl. 1, fig. 5

Cyclas partumeia Say 1822, Acad. Nat. Sci. Philadelphia Jour., v. 2, p. 380.
Cyclas truncata Linsley 1848, Am. Jour. Sci., v. 6, p. 234, fig. 3.
Cyclas pellucida Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 277.
Sphaerium pellucidum Prime 1865, Mon. Am. Corbiculadae, p. 45, fig. 42.
Sphaerium contractum Prime 1865, *ibid.*, p. 48.
Sphaerium truncatum Prime 1865, *ibid.*, p. 51, fig. 50.
Calyculina hodgsoni Sterki 1902, Nautilus, v. 16, p. 91.
Sphaerium (Musculium) partumeium Dall 1905, Harriman-Alaska Exped., v. 13, p. 139.
Sphaerium (Musculium) truncatum Dall 1905, *ibid.*, p. 140.
Musculium partumeium Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 396.
Musculium contractum? (Prime) Sterki 1907, *ibid.*, p. 395.
Musculium truncatum Sterki 1907, *ibid.*, p. 396.
Musculium partumeium Johnson 1915, Fauna New England, p. 48.
Musculium contractum Sterki 1916, Cat. N. Am. Sphaeriidae, p. 440.
Musculium hodgsoni Sterki 1916, *ibid.*
Musculium partumeium Sterki 1916, *ibid.*, p. 441.
Musculium partumeium globosum Sterki 1916, *ibid.*
Musculium truncatum Sterki 1916, *ibid.*
--- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 176.
Musculium partumeium F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 354, pl. 99, figs. 24-26.
Musculium truncatum F. C. Baker 1928, *ibid.*, p. 356, pl. 99, figs. 21-23.
Musculium contractum Goodrich 1944, Nautilus, v. 58, p. 49.
Musculium partumeium Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 322.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 118.
Musculium truncatum Robertson and Blakeslee 1948, *ibid.*
Musculium partumeium La Rocque 1953, Cat. Recent Moll. Canada, p. 100.
Musculium truncatum La Rocque 1953, *ibid.*, p. 102.
Sphaerium cf. *truncatum* Taylor and Hibbard 1955, Okla. Geol. Survey Circ. 37, p. 12.
Musculium contractum Walter 1956, J. Elisha Mitchell Soc., v. 72, p. 266.
Sphaerium partumeium Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 7.
Sphaerium (Musculium) contractum La Rocque 1959, Sterkiana, no. 1, p. 31.
Sphaerium (Musculium) hodgsoni La Rocque 1959, *ibid.*
Sphaerium (Musculium) partumeium La Rocque 1959, *ibid.*, p. 32.
Sphaerium (Musculium) partumeium globosum La Rocque 1959, *ibid.*
Sphaerium (Musculium) truncatum La Rocque 1959, *ibid.*, p. 33.
Sphaerium partumeium Taylor 1960, U.S. Geol. Survey Prof. Paper 337, p. 45.
--- --- Hibbard and Taylor 1960, Mich. Univ. Mus. Paleontology Contr., v. 16, p. 76.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 23, pl. 1, fig. 5.

Type locality.—Germantown, near Philadelphia, Pennsylvania (*S. partumeium*); Connecticut (*S. trun-*

catum).

Diagnosis.—Large shells, more than 8 mm. long, may be distinguished by their prominent beaks, distinctly raised above the dorsal margin; the higher outline of the shell as compared with *S. transversum,* the height in *S. partumeium* being 7/8 or more of the length; the rather straight dorsal margin, the posterior end more or less at right angles to the dorsal margin; and the very fine striae. Small shells, less than 8 mm. long, in contrast with *S. securis,* have the anterior ventral margin of the shell sloping upward, but only slightly, a glossy surface, and finer striae.

Dimensions.—The largest specimens measured by Herrington (1962, p. 23) are L. 13.5, 12.5; H. 11.5, 10.5; D. 9.0, 8.0. Measurements given by F. C. Baker (1928a, pt. II, p. 355) are intermediate: L. 8.0, 8.1; H. 6.9, 7.0; D. 4.2, 4.3. Other measurements given by Herrington are for smaller shells: L. 7.0, 5.5, 3.8, 2.6; H. 6.1, 4.6, 3.3, 2.2; D. 3.5, 3.0, 1.9, 1.4 mm.

Ecology.—Herrington (1962, p. 24) summarizes the habitats of this species as follows: "Ponds, swamps, small lakes, and slow-moving streams. It has a preference for a muddy bottom, and is fairly common." Earlier statements on ecology may give useful amplification. Herrington and Taylor (1958, p. 7) summarize as follows: "Ponds and eddies in rivers where there is considerable vegetation and a soft bottom." Bell (1861, p. 269) found the species in a creek and in a small river in the Lake Superior region of Ontario. Hanham (1890, p. 118) records it for both streams and ponds in the Hamilton area of Ontario. G. W. Taylor and Latchford (1890, p. 52) took it from the outlet of a lake in Quebec, near Ottawa, Ontario; Letson (1909, p. 243) from the Fort Erie trenches; Lermond (1909, p. 249) from a pond and a brook in Maine. Baker (1910, p. 491) says it "is quite characteristic of the summer-dry pools of northern Illinois." Latchford (1921, p. 68) records it for small ponds south of Ottawa, Ontario, and from Humber Bay, Toronto, Ontario. Baker (1928a, pt. II, p. 355) says: "Its natural habitat appears to be in ponds in black mud, shallow water." Alexander (1947, p. 2, 3) took it from Lily Lake, Cape May, New Jersey, and G. J. Thomas (1959, p. 131-140) took it southeast of Ann Arbor, Michigan, from temporary ponds studied earlier by Kenk (1949).

Associations.—Living: MANITOBA - 25; MICHIGAN - 10, 14; MINNESOTA - 15, 17; OHIO - 43; WISCONSIN - 4, 30, 42, 45, 51, 60, 63, 99, 136, 138; ONTARIO - 1, 3. Fossil: N - 1, 2; S - 2, 3; W - 27.

General distribution (fig. 184).—Saskatchewan, Ontario (southern part only), Quebec, and New Brunswick, south to California, Nevada, Texas, Louisiana, Mississippi, Alabama, and Florida.

Distribution in Ohio (inset, fig. 184).—"Over the state" (Sterki, 1907a, p. 396), specifically Lake, Portage, and Tuscarawas Counties.

Geologic range.—Pleistocene: Nebraskan to present. Recorded by D. W. Taylor (1960, p. 46) and Herrington (1962, p. 24) for the Sand Draw (Nebraskan) and Dixon (Nebraskan or earliest Aftonian) local faunas. There is a previous record (Goodrich, 1940, p. 78) for the Pleistocene of Meade County, Kansas. Baker (1920a, p. 384) gives "Wabash" (late Wisconsin).

Sphaerium rhomboideum (Say) 1822
Pl. 1, fig. 3

Cyclas rhomboidea Say 1822, Acad. Nat. Sci. Philadelphia Jour., v. 2, p. 380.
Cyclas elegans Adams 1840, Boston Jour. Nat. History, v. 3, p. 330, pl. 3, fig. 11.
Sphaerium rhomboideum Prime 1865, Mon. Am. Corbiculadae, p. 39, fig. 31.
--- --- Dall 1905, Harriman-Alaska Exped., v. 13, p. 136, fig. 101.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 395.
--- --- Johnson 1915, Fauna New England, p. 47.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 438.
--- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 176.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 345, pl. 98, figs. 13-17.
--- --- Brooks and Herrington 1944, Nautilus, v. 57, p. 94, valid species.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 321.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 115.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 115.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 25, pl. 1, fig. 3.

Type locality.—Lake Champlain.

Diagnosis.—Shell large, more than 8 mm. long; beaks not prominent, only very slightly raised above the dorsal margin; shell more or less rectangular in outline.

Dimensions.—F. C. Baker (1928a, pt. II, p. 346) gives the following for specimens from Brown County, Wisconsin: L. 10.5, 8.7; H. 8.1, 7.0; D. 5.9, 6.0 mm.; from Green Lake, Wisconsin: L. 10.0, 9.0; H. 8.0, 7.5; D. 6.0, 5.0 mm.; and from the Wisconsin River: L. 12.5, 12.0; H. 9.9, 9.0; D. 7.7, 8.1 mm. Herrington measured somewhat larger specimens from Ontario: L. 13.1, H. 10.5, D. 8.5 mm., and others in the same range as Baker's: L. 8.3, 6.5, 3.6; H. 6.7, 5.6, 3.1; D. 5.2, 3.1, 1.6 mm.

Ecology.—"Eddies in creeks and rivers; ponds; sheltered places in small lakes. Has a preference for muddy bottom with weeds and algae. The specimens used above for measurements were collected from such a habitat in a limestone region. They were distributed through the algae from top to bottom in water from 12 to 18 inches deep" (Herrington, 1962, p. 25). Earlier records are for similar habitats. Baker (1928a, pt. II,

p. 346) notes that in Wisconsin this species is as much at home in rivers as in lakes. He collected living forms on mud bottom in water 0.6 to 2 m. deep, and on gravel and coarse sand bottom in shallow water. The species was recorded for the Erie Canal in New York by Letson (1909, p. 243), and Hart (1929, p. 104) found it common in a small boggy lake on Long Point, Lake Abitibi.

Associations.—Living: OHIO - 43; ONTARIO - 1, 3, 9; QUEBEC - 1; WISCONSIN - 42, 68. Fossil: W - 27, 33, 34, 36, 38, 42, 53, 54, 55.

General distribution (fig. 185).—Herrington (1962, p. 25) lists the species for Ontario, as far north as James Bay; for Maine, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Ohio, Michigan, Minnesota, Iowa, Montana, Idaho. He considers that the "Alaskan record is probably based on a confusion by someone with *S. nitidum,* which is plen-

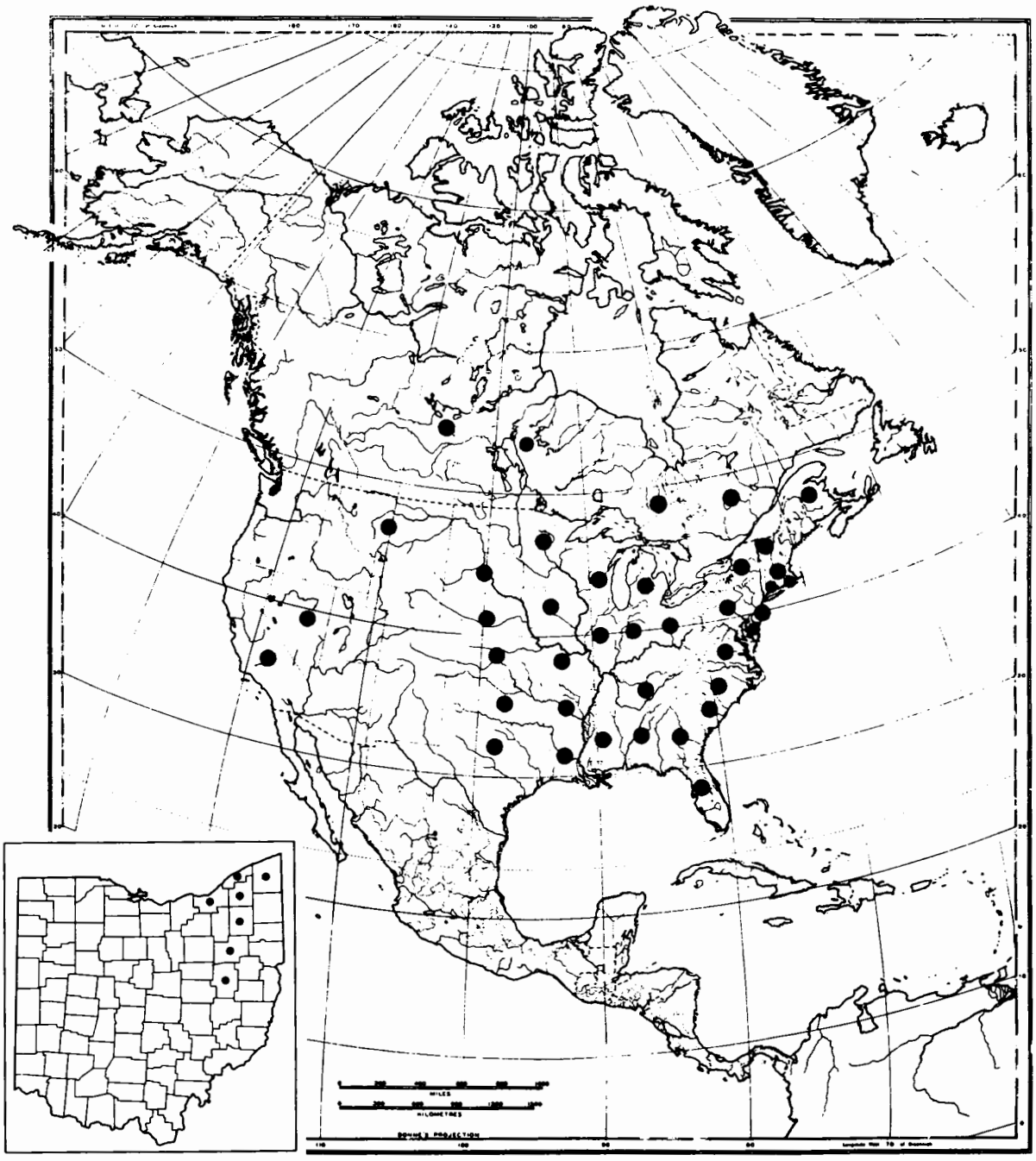


FIGURE 184.—Distribution of *Sphaerium partumeium* in North America; *inset,* distribution in Ohio.

tiful in Alaska and is a smaller member of the same group." He also quotes Sterki's (1916, p. 438) records for "Wisconsin ... Manitoba, Alaska, British Columbia(?), Nevada(?)."

Distribution in Ohio (inset, fig. 185).—Sterki (1907a, p. 395) gives Portage, Summit, Stark, Tuscarawas, Franklin, and Hamilton Counties, a distribution which, curiously, almost parallels the glacial boundary in the State. This is perhaps mere coincidence as the species occurs far to the north, in Michigan, Manitoba, Ontario, and Quebec.

Geologic range.—Pleistocene: Sangamon and late(?) Wisconsin. Sterki (1916, p. 438) records this species as "fossil" from Maine, Ohio, Michigan, and Illinois. Baker (1920a, p. 383) gives Sangamon and "Wabash." Heron (1880, p. 40) had noted it for marl beds near Ottawa, Ontario; Whittaker (1922a, p. 105) collected it from marl beds in Stormont County, Ontario, and Cole-

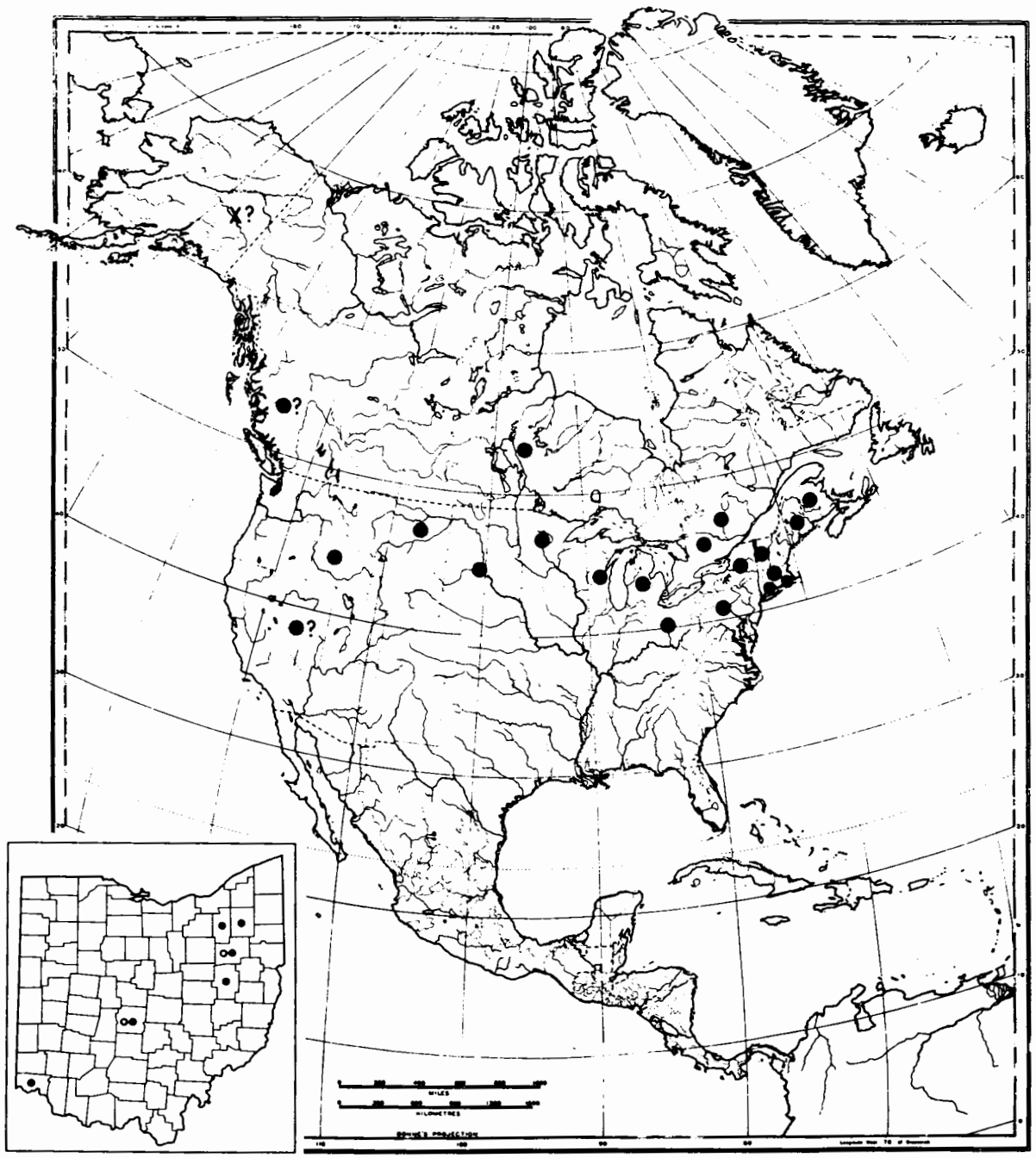


FIGURE 185.—Distribution of *Sphaerium rhomboideum* in North America; *inset,* distribution in Ohio.

man (1922, p. 75) from "Nipissing Great Lakes" deposits, Nottawasaga River, near Georgian Bay, Ontario. It was collected living from Hemlock (=Mackay) Lake, Ottawa, Ontario, by Latchford but does not appear in Whittaker's lists for the marl of that lake.

In Ohio, Sterki (1920, p. 176) records this species from the Tinkers Creek marl and more recently Cornejo (1961, fig. 11) has found it in the Souder Lake deposit; Aukeman (1960, p. 17) in the Oakhurst deposit; and Sheatsley (1960, p. 19) in the Aultman deposit.

Group 2

Shell sculptured with coarse striae (8 or fewer striae per mm. in the middle of the shell). Three valid species and two of doubtful validity constitute this group and all of them are represented in the State.

Sphaerium sulcatum (Lamarck) 1818
Pl. 1, fig. 1

Cyclas sulcata Lamarck 1818, Animaux sans vertebres, v. 5, p. 560.
Sphaerium sulcatum Prime 1865, Mon. Am. Corbiculadae, p. 33, fig. 25.
Sphaerium simile Dall 1905, Harriman-Alaska Exped., v. 13, p. 134 (part).
Sphaerium sulcatum Johnson 1915, Fauna New England, p. 45.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 431 (part).
--- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 175, Tinkers Creek deposit.
--- --- F. C. Baker 1920, Jour. Geology, v. 28, p. 446, Rush Lake deposit.
Sphaerium simile F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 313 (in part).
Sphaerium sulcatum Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 321.
--- --- Brooks and Herrington 1944, Nautilus, v. 57, p. 95, valid species.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 113.
--- --- Herrington 1950, Nautilus, v. 63, p. 119, distinct from *S. simile*.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 116.
--- --- Taylor and Hibbard 1955, Okla. Geol. Survey Circ. 37, p. 12, Kansas.
--- --- Herrington 1957, Canad. Field-Naturalist, v. 8, Lake Nipigon.
--- --- Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 9.
--- --- La Rocque 1959, Sterkiana, no. 1, p. 33.
--- --- Taylor 1960, U.S. Geol. Survey Prof. Paper 337, p. 46.
--- --- Zimmerman 1960, Ohio Jour. Sci., v. 60, p. 20, Newell Lake deposit.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 28, pl. 1, fig. 1.

Type locality.—Lake George, New York.

Diagnosis.—Shell large, transversely oval, inflated, almost equipartite, rather solid; striae unevenly spaced.

Dimensions.—Herrington (1962, p. 28) gives L. 20.0, 14.5, 10.0, 7.2; H. 14.5, 10.8, 7.6, 5.5; D. 11.0, 7.6, 5.5, 3.1 mm., for specimens from Scott Graham Creek, Carleton County, Ontario.

Ecology.—"Small lakes, also eddies in rivers and creeks. It has a preference for soft sand with vegetation; never found in swamps or ponds" (Herrington, 1962, p. 29). Much that has been written on the ecology of this species appears under *S. simile* (Say). The following statements deal with the true *S. sulcatum* (Lamarck) as understood by Herrington. It is "much more restricted in habitat than *striatinum*. Herrington has always found it in the soft bottom of a perennial small lake, river, or creek" (Herrington and Taylor, 1958, p. 9). It "has a preference for a soft bottom in fairly still waters, in eddies of a creek or river, along shore in lakes, and even in lakes filling up with marl. Herrington has found it associated with *Pisidium compressum* in all these habitats" (D. W. Taylor, 1960, p. 46).

Associations.—Living: MANITOBA-16; MINNESOTA-10, 11a, 13a, 15; OHIO-43; ONTARIO-5, 7; QUEBEC-2; WISCONSIN-25, 28, 42, 49, 54, 60, 68, 80, 83, 106, 117, 123, 125, 132, Fossil: N-1; S-1; W-27, 29, 31, 33, 34, 45, 46, 47, 53, 54, 55. As *S. fallax:* WISCONSIN-15, 16, 47, 50, 60, 62, 78, 83, 89, 130.

General distribution (fig. 186).—Washington(?), Alberta, Saskatchewan, Manitoba, Ontario, and Quebec (east to Gaspé Peninsula), south to Wyoming, Iowa, South Dakota, Minnesota, Illinois, Indiana, Ohio, Pennsylvania, and Virginia. Herrington (1962, p. 29) notes: "Apparently it does not now extend south of the area covered by the glaciers."

Distribution in Ohio (inset, fig. 186).—Over the State, in suitable habitats.

Geologic range.—Pliocene?; Pleistocene: Nebraskan, Illinoian(?), Sangamon, Wisconsin. F. C. Baker (1920a, p. 383) gave preglacial, Aftonian, Yarmouth, Sangamon, and "Wabash." Whether he meant Pliocene by "preglacial" is not certain. The oldest certain occurrence seems to be in the Sand Draw (Nebraskan) local fauna of Nebraska (D. W. Taylor, 1960, p. 46). It occurs also in the Berends (probably Illinoian) and Jinglebob (Sangamon) local faunas of Kansas (Taylor and Hibbard, 1955, p. 12). Sterki (1916, p. 431) lists it as a fossil from Maine, New Jersey, Ohio, Michigan, and Illinois. Heron (1880, p. 40) noted it in marl beds near Ottawa; Whiteaves (1895a, p. 22) in marl at Emerald Lake, district of Nipissing, Ontario; Coleman (1922, p. 71) from the banks of the Nottawasaga River (Nipissing Great Lakes in age); Baker identified specimens from the Pleistocene of Beachburg (unpublished

record). Nylander (1943, p. 45) collected it in marl, Bonaventure, Gaspé Peninsula, Quebec.

In Ohio, it has been recorded for the Tinkers Creek marl (Sterki, 1920, p. 175), Rush Lake marl (Baker, 1920b, p. 446), Humboldt deposit (Reynolds, 1959, p. 155), Newell Lake deposit (Zimmerman, 1960, p. 20), Oakhurst deposit (Aukeman, 1960, p. 19), and Aultman deposit (Sheatsley, 1960, p. 23).

Remarks.—Herrington (1950, p. 117-118) showed that what currently passed for *S. simile* (Say) should be called *S. sulcatum* (Lamarck) but that did not solve the problem of the identity of Say's species. In his latest paper (1962, p. 28) the identity of Say's species still remains in doubt. I have given an account of both names in this report for purposes of record.

[*Sphaerium sulcatum planatum* Sterki 1916]

Sphaerium sulcatum planatum Sterki 1916, Cat. N. Am. Sphaeriidae, p. 432.

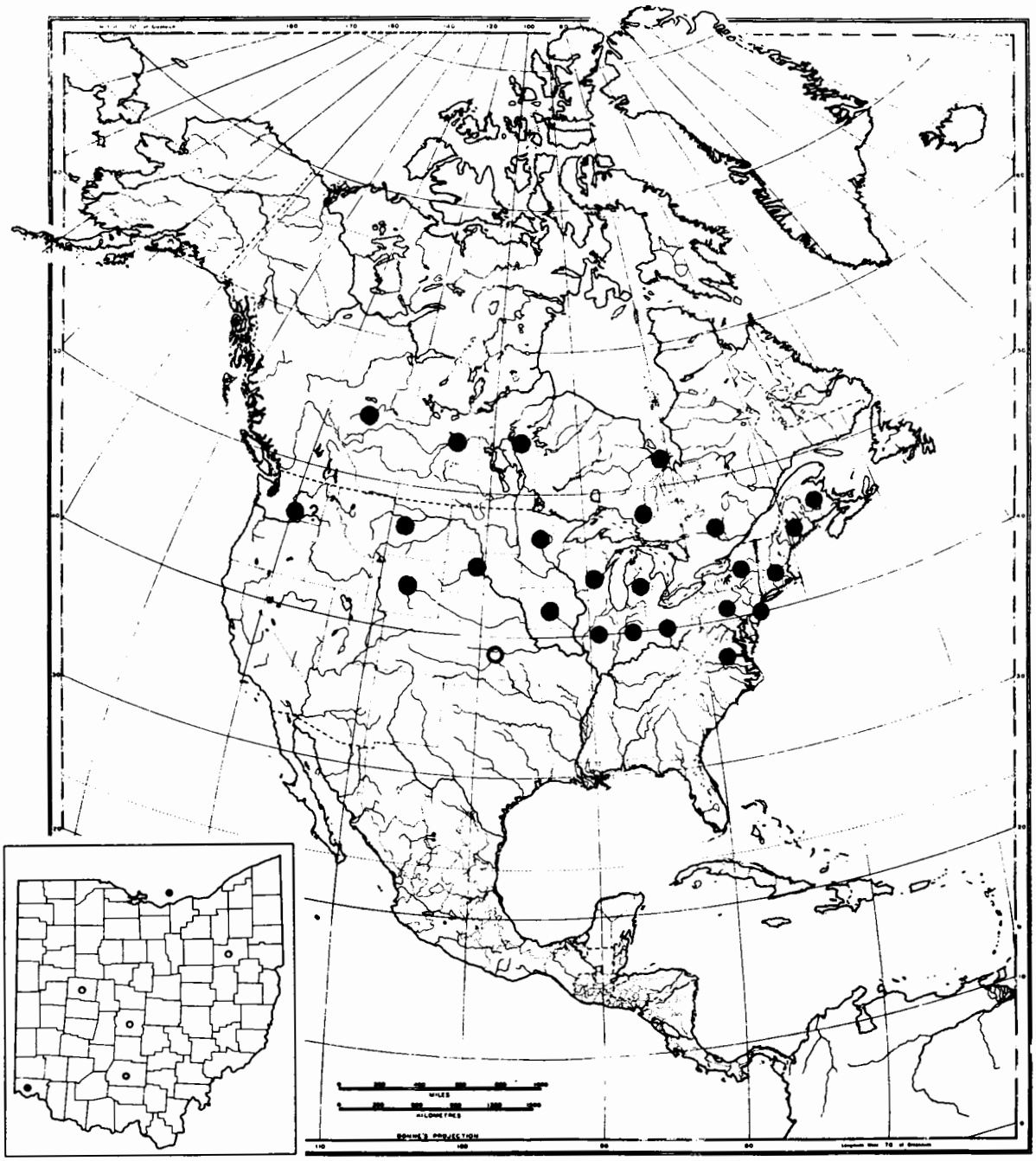


FIGURE 186.—Distribution of *Sphaerium sulcatum* in North America; *inset*, distribution in Ohio.

Sphaerium simile planatum F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 317, pl. 96, figs. 8-10; pl. 98, figs. 29-33.
Sphaerium sulcatum form *planatum* Brooks and Herrington 1944, Nautilus, v. 57, p. 95.
Sphaerium simile planatum MacMillan 1951, Pa. Acad. Sci. Proc., v. 25, p. 140.
Sphaerium sulcatum planatum La Rocque 1953, Cat. Recent Moll. Canada, p. 116.
--- --- --- La Rocque 1959, Sterkiana, no. 1, p. 33.

Type locality.—None given by Sterki.

Diagnosis.—"Smaller than common, or typical, *sulcatum*, more inequipartite, the beaks being markedly anterior; less inflated, especially flattened over the lower parts of the valves, more truncate anteriorly and posteriorly, inferior margin less curved; beaks narrower and little elevated; surface striae slighter; shell and hinge slighter. Extreme forms are so different as to appear distinct, but there are intermediates (Sterki)" (F. C. Baker, 1928a, pt. II, p. 317).

Dimensions.—Baker (1928a, pt. II) gives the following for specimens from Lake Winnebago, Wisconsin: L. 13.0, 11.9, 14.1, 15.5; H. 9.7, 9.0, 10.2, 11.1; D. 7.0, 6.6, 7.5, 8.0 mm.; from Dutchmans Lake, Wisconsin: L. 14.0; H. 10.0, D. 7.2 mm.

Ecology.—Baker (1928a, pt. II, p. 317) gave several Wisconsin habitats: "Lake Winnebago, .5 m. deep, boulder bottom; 2.2 m. to 3.1 m., sand and gravel bottom; 3.4 to 5.5 m.; Lake Butte des Morts, sand and mud bottom, 0.5 to 1.2 m. deep. Lake Chetek, sand and mud bottom, 1.3 to 1 m. deep (Baker). Oconomowoc Lake, water 3-5 m. deep, among vegetation; Golden Lake, bottom pure sand, water 1 m. deep (Cahn)." All of Baker's localities are for lakes, as is the only one cited by Latchford (1919, p. 84): Lake Gorman, in Ontario.

General distribution.—Wisconsin, Michigan, Ontario, and Quebec, south to Illinois, Indiana, Ohio, and Pennsylvania. Possibly extinct in Ohio.

Distribution in Ohio.—Recorded only as a fossil (see below) but should also be found living, at least in the northeastern part of the State. So far there are no records of the living form in Ohio.

Geologic range.—Pleistocene: late(?) Wisconsin. Sterki (1916, p. 432) notes it as fossil in Ohio, without specific locality. MacMillan (1951, p. 140) identified it from the Bridgeville mastodon site, southeast of Pittsburgh, Pennsylvania.

Remarks.—This form is recognized by Brooks and Herrington (1944, p. 95) but is not listed in Herrington's (1962, p. 28-29) latest paper. The above account is given here merely for purposes of record, as *planatum* may be a minor form of *S. sulcatum*.

[*Sphaerium simile* (Say) 1816]

Cyclas similis Say 1816, Nicholson's Encycl., v. 2, pl. 1, fig. 9.
Sphaerium simile Prime 1869, Cat. Recent Corbiculadae, p. 158.
--- --- Dall 1905, Harriman-Alaska Exped., v. 13, p. 134, fig. 97.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 395.
Sphaerium sulcatum Sterki 1916, Cat. N. Am. Sphaeriidae, p. 431 (part).
Sphaerium simile F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 313, pl. 96, figs. 4-7.
--- --- Herrington 1950, Nautilus, v. 63, p. 117, 119 (not synonymous with *S. sulcatum*).
--- --- MacMillan 1951, Pa. Acad. Sci. Proc., v. 25, p. 140.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 115.
--- --- La Rocque 1959, Sterkiana, no. 1, p. 32.

Type locality.—Delaware River.

Diagnosis.—"Shell suborbicular convex, base a little flattened; with nearly equidistant, raised, concentric lines, giving a sulcated appearance to the surface, and generally a more conspicuous elevated darker wave, marking the former year's growth of the shell. Epidermis brown or ferruginous; beak nearer central and obtuse; hinge with minute very oblique teeth, lateral ones very distinct, elongated, and considerably resembling those of the next species. Length, seven-twentieths of an inch; breadth, two-fifths." (The "next species" was *C. dubia.*) (Quoted from Say's original description, with additions, by Herrington, 1950, p. 117.)

Dimensions.—Herrington (1950, p. 118) translates Say's dimensions as follows: L. 9; breadth 10 mm., and notes that the two figures should probably be transposed because of differences in usage of terms between Say and later workers.

Ecology.—The confusion between *S. simile* and *S. sulcatum* makes it difficult, if not impossible, to say just what the habitat of Say's species may be. Say's types of *Cyclas similis* came from the Delaware River.

Associations.—Living: ONTARIO-9; WISCONSIN-1.

General distribution.—Alberta, Saskatchewan, Manitoba, Ontario, and Quebec, south to South Dakota, Iowa, Illinois, Indiana, Ohio, and Virginia. Some erroneous records for *S. sulcatum* may be included in this range as the two species have long been confused.

Distribution in Ohio.—Sterki (1907a, p. 395) gives "over the state" which is very probably correct as the species is recorded for all surrounding states except West Virginia and Kentucky.

Geologic range.—Pleistocene: late(?) Wisconsin. The confusion between this species and *S. sulcatum* must be kept in mind when dealing with the geologic record. As far as I know the fossil records are the following: Quebec: Eagle Nest Lake, shell marl, Rouge River Valley (D'Urban, 1860), probably very late Wisconsin since the lake is still extant. Ontario: deposit

of gravel and sand near Niagara Falls (Bell, 1861, p. 46); Owen Sound (Bell, 1861, p. 50); fine sand, Angus Station (Chapman, 1861a, p. 225); Cobalt marl (Walker, 1907, p. 180); lot 7, Eastview (Ottawa) (Whittaker, 1921, p. 63); lot 6, con. VI, on small creek which crosses road, Charlottenburg Township, Glengarry County (Whittaker, 1922a, p. 105); sand terrace, Osnabruck Township, Stormont County, near Wales Station (Whittaker, 1922a, p. 105). Pennsylvania: Bridgeville mastodon site, southeast of Pittsburgh (MacMillan, 1951, p. 140). Ohio: Hunters Run deposit, Fairfield County (La Rocque and Conley, 1956, p. 326). All these appear to be of Wisconsin age, probably late Wisconsin.

Remarks.–See under *S. sulcatum, ante.*

Sphaerium striatinum (Lamarck) 1818
Pl. 2, fig. 5; pl. 8, figs. 10, 12-16

Cyclas striatina Lamarck 1818, Animaux sans vertebres, v. 5, p. 560.
Cyclas flava Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 155.
Cyclas aurea Prime 1851, *ibid.*, p. 159.
Sphaerium striatinum Prime 1865, Mon. Am. Corbiculadae, p. 37, fig. 29.
Sphaerium aureum Prime 1865, *ibid.*, p. 35, fig. 26.
Sphaerium flavum Prime 1865, *ibid.*, p. 43, fig. 39.
Sphaerium striatinum Dall 1905, Harriman-Alaska Exped., v. 13, p. 135, fig. 98.
Sphaerium aureum Dall 1905, *ibid.*, fig. 99.
Sphaerium flavum Dall 1905, *ibid.*, p. 138.
Sphaerium striatinum Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 395.
Sphaerium flavum Sterki 1907, *ibid.*, p. 395, 399.
Sphaerium striatinum Johnson 1915, Fauna New England, p. 46.
Sphaerium aureum Walker 1915, Mich. Univ. Mus. Zoology Occas. Papers, no. 15, p. 8.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 432.
Sphaerium striatinum Sterki 1916, *ibid.*, p. 435.
Sphaerium flavum Sterki 1916, *ibid.*, p. 436.
Sphaerium striatinum Sterki 1920, Ohio Jour. Sci., v. 20, p. 176.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 334, pl. 98, figs. 1-5.
Sphaerium flavum F. C. Baker 1928, *ibid.*, p. 342, pl. 98, figs. 18-21.
Sphaerium striatinum Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 321.
Sphaerium flavum Goodrich and van der Schalie 1944, *ibid.*
Sphaerium striatinum Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 114.
Sphaerium flavum Robertson and Blakeslee 1948, *ibid.*
Sphaerium aureum La Rocque 1953, Cat. Recent Moll. Canada, p. 113.
Sphaerium flavum La Rocque 1953, *ibid.*, p. 114.
Sphaerium striatinum La Rocque 1953, *ibid.*, p. 116.
--- --- Taylor and Hibbard 1955, Okla. Geol. Survey Circ. 37, p. 12.
--- --- Herrington 1957, Canad. Field-Naturalist, v. 71, p. 8.
--- --- Taylor 1957, Jour. Paleontology, v. 31, p. 656.
--- --- Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 9.
Sphaerium flavum La Rocque 1959, Sterkiana, no. 1, p. 31.
Sphaerium aureum La Rocque 1959, *ibid.*
Sphaerium striatinum La Rocque 1959, *ibid.*, p. 32.
--- --- Taylor 1960, U.S. Geol. Survey Prof. Paper 337, p. 46.
--- --- Hibbard and Taylor 1960, Mich. Univ. Mus. Paleontology Contr., v. 16, p. 76, pl. 4, figs. 10, 12-16.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 27, pl. 2, fig. 5.

Type locality.–Lake George, New York.

Diagnosis.–Striae not evenly spaced; surface even except for rest marks and striae; shell inflated; striae not weaker in the region of the beak.

Dimensions.–Herrington (1962, p. 27) gives the following for Ontario specimens: L. 12.5, 10.1, 7.2, 3.9; H. 9.6, 8.0, 5.5, 3.1; D. 7.3, 6.0, 4.0, 2.5; L. 15.5, 10.0; H. 12.5, 8.5 mm. F. C. Baker (1928a, pt. II, p. 335) gives the following for Wisconsin specimens: L. 11.3, 10.9, 9.5, 9.0, 12.0; H. 8.8, 8.1, 7.6, 7.0, 9.0; D. 6.1, 6.0, 5.5, 5.0, 6.7 mm.

Ecology.–Herrington and Taylor (1958, p. 9) state that this species "can adapt itself to many kinds of habitats, from the Great Lakes and small lakes to rivers and creeks, in gravel, sand, or mud. We have never found it in ponds, lagoons, bog ponds, or swamps." In Ontario, these authors have found it in "a) sand and gravel in the cracks of bare rock forming the bed of Indian River; b) soft mud on the Ouse River, and c) soft to hard sand in Rice Lake, all near Keene, Ontario." D. W. Taylor (1960, p. 46) gives the following: "Perennial water bodies with some current action are suitable habitats. It lives in large lakes or small ones, in rivers or small streams, in a bottom of gravel, sand, or mud. Ponds, lagoons, and swamps are not favorable places, probably because there is insufficient current to oxygenate the water well."

A few records from older sources may be of interest. Whiteaves (1863, p. 108) found it in the Lachine Canal, near Montreal, and in the St. Lawrence and St. Charles Rivers near Quebec; Whiteaves (1880, p. 62C) records it, in numbers, from the stomach of a sturgeon caught in Great Playgreen Lake. Christie (1885, p. 339) found it in Pine Creek, Manitoba, and in ponds at York Factory. Smith (1894, p. 44) records it in rushes, quite generally on bottom, abundant, from Lake St. Clair.

Lermond (1909, p. 248) found it abundant on rocky bottom in Fish and St. John Rivers, Maine. Letson (1909, p. 243) collected it in the Niagara River and in creeks and the Fort Erie trenches in the Buffalo region. Latchford (1920, p. 30) obtained it from the canal at Cornwall, a bay east of the mouth of the Humber, near Toronto, Ontario, and from sandy shoals along the north shore of Duck Island, Ottawa River, where specimens were numerous. Finally, Whittaker (1924, Naut. 38, p. 10) collected it at the west end of Lake Kakisa, Northwest Territories, Canada. Herrington (1962, p. 28) adds the following: "Creeks, rivers, large and small lakes. I have never found it in ponds, swamps or anywhere in stagnant water, but in sand or sandy gravel in creeks and rivers (even in sandy gravel in cracks in flat rocks), in sandy mud, but not in fine, soft mud. I have collected it in fine sand in two or three inches of water in small lakes, and Kenneth G. Wood collected many specimens in Lake Erie down to a depth of 13.5 meters. This species is our most common *Sphaerium.*"

Associations.—Typical form, living: NEW YORK-14, 25; OHIO-43; ONTARIO-1, 4; WISCONSIN-6, 83, 134; fossil: P-1; N-1; S-6; W-27, 31. Form *bakeri,* living: WISCONSIN-122. Form *emarginatum,* living: ONTARIO-4; WISCONSIN-58, 76, 80, 83, 87. Form *modestum,* living: ONTARIO-6. Form *solidulum,* living: OHIO-43; WISCONSIN-122; fossil: ?W-27. Form *stamineum,* living: MINNESOTA-22a; OHIO-43; WISCONSIN-17, 27, 58, 60, 79, 80, 81, 108, 117, 131, 132, 133; fossil: ?W-27. Form *vermontanum,* living: NEW YORK-3a, 4b, 4c, 10, 11, 15b, 21, 23, 24, 26, 30, 32, 37.

General distribution (fig. 187).—Great Slave Lake south to Panama, east to New Brunswick, Maine, and New York, and south to Florida.

Distribution in Ohio (inset, fig. 187).—Sterki (1907a, p. 435) gives "over the state" which is probably correct as the species is recorded for all surrounding states except Kentucky and ranges far to the south. For *S. flavum,* Sterki (1907a, p. 395) gives "Lake Erie and probably some of its tributaries."

Geologic range.—Pliocene; Pleistocene: Nebraskan to present. Baker (1920a, p. 383) gives preglacial, Aftonian, Yarmouth, Sangamon, and "Wabash." The species is known from the Saw Rock local fauna of Kansas (Pliocene) and the Sand Draw local fauna of Nebraska (Nebraskan) according to D. W. Taylor (1960, p. 46). Taylor and Hibbard (1955, p. 12) record it from the Berends local fauna (probably Illinoian) and from the Jinglebob (Sangamon) local fauna of Kansas. There is a doubtful record, "one valve, more like *striatinum,* but?" from the loess(?) of Texas (Walker, 1915, p. 8). Sterki (1916, p. 435) gives it as fossil from Michigan, Illinois, and Ohio. In Ontario, it is known from the Cobalt marl (Walker, 1907, p. 180) and from Eastview (Ottawa) (Whittaker, 1921, p. 63). Mozley (1928, p. 268) has recorded it for a silt bed near Winnipeg.

In Ohio, Sterki (1920, p. 176) records it for the Tinkers Creek marl and Reynolds (1959, p. 155) for the Humboldt deposit, both late Wisconsin.

[*Sphaerium striatinum* form *acuminatum* (Prime) 1851]

Cyclas acuminata Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 155.

Sphaerium acuminatum Sterki 1916, Cat. N. Am. Sphaeriidae, p. 435.

--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 331, pl. 97, figs. 23-26.

--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 321.

Sphaerium striatinum form *acuminatum* Brooks and Herrington 1944, Nautilus, v. 57, p. 95.

Sphaerium acuminatum La Rocque 1953, Cat. Recent Moll. Canada, p. 112.

Type locality.—Lake Superior.

Diagnosis.—"Trigonal, somewhat rounded, but slightly inequipartite, not much inflated; beaks a trifle anterior, not much inflated, almost flush with the hinge line in some specimens; dorsal margin strongly arched; ventral margin broadly convex; anterior and posterior ends roundly truncated; scutum and scutellum well marked; surface glossy or silky, growth lines rather coarse with fine lines between; color corneous, sometimes with indistinct rays extending from umbones to ventral margin; there are usually several zones of dark color, mostly concentric, on the surface; shell rather thick.

"Hinge line rather strong, wide arched; cardinal of right valve large, heavy, strongly arched, often enlarged and bifid at the lower end; cardinals of left valve, upper long, thin, almost straight; lower high, thick, pyramidal, does not show much variation (fig. 257); laterals rather massive, short, wide, not much elevated above the edge of the valve; cavity of the beaks fairly deep; nacre bluish-white often tinged with pinkish" (F. C. Baker, 1928a, pt. II, p. 331-332).

Dimensions.—Baker (1928a, pt. II) gives the following for specimens from Lake Michigan: L. 11.0, 10.0, 9.0, 8.9; H. 9.0, 8.1, 7.5, 7.5; D. 6.0, 5.7, 5.7, 5.0 mm.

Ecology.—This seems to be mainly a lake form which can live even in the Great Lakes, along wave-beaten sandy beaches. Baker's (1928a, pt. II, p. 332) statement concerning its ecology seems ambiguous: "Golden Lake, pure sand, no vegetation, water about 1 m. deep; Oconomowoc Lake, sandy-clay bottom, 2.5 m. deep (Cahn). The Lake Michigan specimens must live on a more or less wave-beaten shore. Chadwick records sand bottom at Milwaukee ..." Under "Distribution in Wisconsin," he states: "Known in living condition only from Lake Michigan and Green Bay."

This form has been recorded from lakes of various sizes by the following: Lermond (1909, p. 248), Maine; Adamstone (1924), Ontario; Kindle (1925), Lake On-

tario; Mozley (1926, Naut. 40), Manitoba; Baker and Cahn (1931, p. 46), northern Ontario.

General distribution.—Manitoba, Ontario, Quebec(?), and Maine, south to South Dakota, Illinois, and Indiana. Great Lakes region (Sterki, 1916, p. 435).

Distribution in Ohio.—This form is listed for Ohio on the strength of Sterki's record (1914) for Lucas County and the Maumee River and on the indications of the general distribution, but I know of no other records.

Geologic range.—Pleistocene: late(?) Wisconsin. Sterki (1916, p. 435) records it as fossil from Illinois. Baker (1920a, p. 384) gives "Wabash." Mozley (1928, p. 268) cites it from a silt bed near Winnipeg, Manitoba.

Remarks.—The form is not recognized by Herrington (1962, p. 27-28) but Sterki's name is listed as a synonym. It had been recognized previously (Brooks and Herrington, 1944, p. 95). The account given here is merely for the purpose of record.

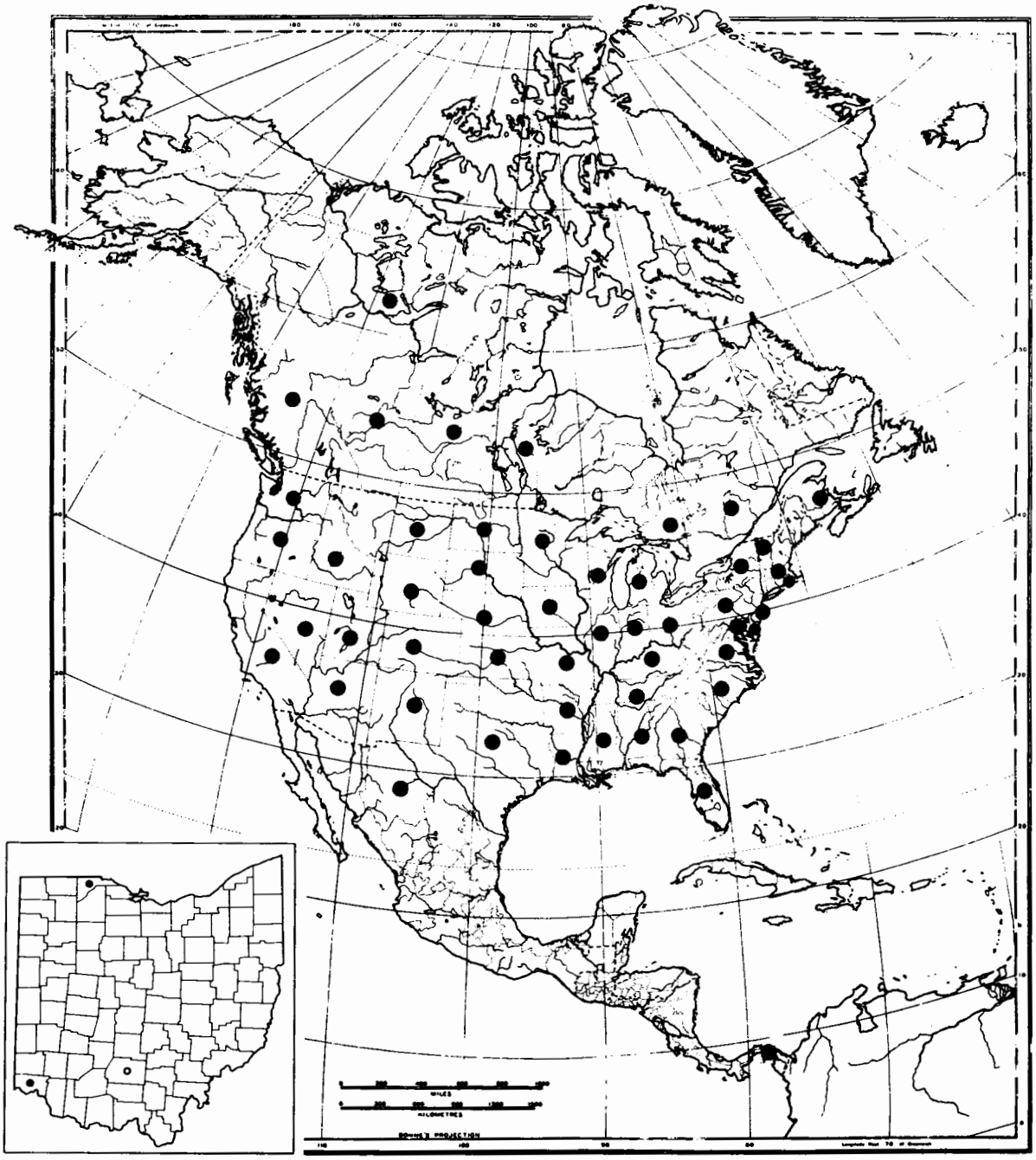


FIGURE 187.—Distribution of *Sphaerium striatinum* in North America; *inset,* distribution in Ohio.

[*Sphaerium striatinum* form *corpulentum* Sterki 1916]

Sphaerium striatinum corpulentum Sterki 1916, Cat. N. Am. Sphaeriidae, p. 435.
Sphaerium striatinum corpulentum Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 24.
--- --- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 336, pl. 98, figs. 6-9.
Sphaerium striatinum form *corpulentum* Brooks and Herrington 1944, Nautilus, v. 57, p. 95.
Sphaerium striatinum corpulentum La Rocque 1959, Sterkiana, no. 1, p. 32.

Type locality.—None given.

Diagnosis.—"Mussel large, high, well inflated, the surface often having rather coarse striae; shell and hinge rather strong.

"This appears to be the really typical form, rather than the small eastern mussel described by Prime in his *Monograph of the North American Corbiculadae.* Prime's figure does not agree with the description nor with any specimens" (Sterki, 1916, p. 435-436, original description).

Dimensions.—None given by Sterki.

Ecology.—A form mostly of creeks according to F. C. Baker (1928a, pt. II, p. 337). He records it in shallow water, 0.9-2.9 m., on mud (common) and gravel (less common).

General distribution.—Wisconsin, Michigan, Illinois, and Ohio.

Distribution in Ohio.—No specific locality is given by Sterki.

Geologic range.—No fossil record is known to me.

Remarks.—The form is not mentioned by Herrington (1962, p. 27) but it had been recognized earlier (Brooks and Herrington, 1944, p. 95). The above account is merely for purposes of record.

[*Sphaerium striatinum* form *emarginatum* (Prime) 1851]

Cyclas emarginata Prime 1851, Boston Soc. Nat. History, v. 4, p. 156.
Sphaerium emarginatum Prime 1865, Mon. Am. Corbiculadae, p. 43, fig. 38.
--- --- Dall 1905, Harriman-Alaska Exped., v. 13, p. 138, fig. 106.
--- --- Johnson 1915, Fauna New England, p. 47.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 434.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 328, pl. 97, figs. 19-22.
Sphaerium striatinum form *emarginatum* Brooks and Herrington 1944, Nautilus, v. 57, p. 95.
Sphaerium emarginatum Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 321.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 113.
Sphaerium striatinum form *emarginatum* La Rocque 1959, Sterkiana, no. 1, p. 32.

Type locality.—"In the region of Lake Superior" (F. C. Baker, 1928a, pt. II).

Diagnosis.—"Solid, thick, trigonal, nearly equipartite, inflated; anterior and posterior ends roundly truncated; dorsal margin much curved; ventral margin broadly convex; beaks almost centrally placed, distinctly elevated above the dorsal margin, rounded, sculpture of very fine lines; scutellum and scutum well marked; surface dull, sculpture of more or less regularly spaced sulcations, with fine growth lines between; color dark brown in adult, yellowish-brown in young and immature shells.

"Hinge rather weak, narrow; cardinal teeth elongated, narrow, slightly curved, the single cusp in the right valve with a swelling at the lower part, which is sometimes bifid; upper cardinal in left valve narrow, straight or but slightly curved; lower cardinal larger, short, pyramidal (fig. 255); laterals short, straight, extending well above the edge of the valve, pyramidal, compressed; nacre bluish-white; cavity of beaks deep (Baker, 1928a, pt. II, p. 328-329).

Dimensions.—Baker (1928a, pt. II) gives the following for specimens from Red Cedar River, Wisconsin: L. 11.4, 10.0, 9.0, 9.0, 7.0; H. 9.2, 8.1, 8.5, 7.5, 5.2; D. 7.0, 6.5, 6.5, 5.9, 4.4 mm.

Ecology.—The records include canals, rivers, and lakes (Great Lakes and smaller ones) but no data on bottom or on depth of water. Some of the more interesting records are: Attawapiskat River (Whiteaves, 1905d, p. 4); Lake Superior and Saskatchewan River at Grand Rapids, Manitoba (Dall, 1905, p. 138); outlet of Phillip's Lake, Pontiac County, Quebec, and Rideau Canal, near Ottawa, Ontario (Latchford, 1920, p. 33); Lake Nipigon (Adamstone, 1924); Pine Lake and Lake Michigan shore, Indiana and Illinois; Red Cedar River, Wisconsin (Baker, 1928a, pt. II, p. 329); Hamilton Lake, northern Ontario (Baker and Cahn, 1931, p. 46); Lake Simcoe (Rawson, 1930, p. 40).

Associations.—See under *S. striatinum.*

General distribution.—Manitoba, the Great Lakes, Ontario, Quebec, and Maine, south to Indiana and Illinois.

Distribution in Ohio.—Not recorded for the State, but probably occurs within the area, as indicated by the general distribution.

Geologic range.—Pleistocene: late(?) Wisconsin. The only fossil records known to me are Baker's (1920a, p. 384) for "Wabash" beds and Mozley's (1928, p. 268) for a silt bed near Winnipeg, Manitoba.

Remarks.—The form is not recognized by Herrington (1962, p. 27-28) but Prime's name is listed as a synonym under *S. striatinum.* It had been recognized previously (Brooks and Herrington, 1944, p. 95). The account given here is merely for purposes of record.

[*Sphaerium striatinum* form *forbesi* F. C. Baker 1906]

Sphaerium stamineum forbesi F. C. Baker 1906, Nautilus, v. 20, p. 21.

--- --- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 434.

--- --- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 24.

Sphaerium striatinum form *forbesi* Brooks and Herrington 1944, Nautilus, v. 57, p. 95.

Sphaerium striatinum forbesi La Rocque 1959, Sterkiana, no. 1, p. 32.

Type locality.—Thompson's Lake, Fulton County, Illinois.

Diagnosis.—"Shell of good size, inflated, solid, subequilateral, trigonal; umbones much elevated, rounded, somewhat inflated, placed a little anterior of the center of the shell, marked by very fine, concentric lines of growth (sometimes coarser), the beaks very closely approximating; dorsal and ventral margins well rounded; anterior end flatly rounded, posterior end plough-shaped; both ends have a somewhat truncated appearance; umbonal slopes convexly rounded; surface inclined to be shining, lines of growth rather crowded, fine in typical specimens, coarser in others; color light greenish or yellowish-horn, lighter on the umbones, indistinctly rayed in some specimens; ligament weak, short, brownish in color; cardinal teeth similar in form and position to those of *stamineum,* the hinge-line not quite so thick as in *stamineum;* lateral teeth not quite so solid as in *stamineum,* the posterior laterals also being shorter, not reaching so high up into the arch of the hinge-plait, the comparative distance between the anterior and posterior laterals being greater in *forbesi* than in *stamineum;* muscle scars and pallial line rather distinct; nacre faint bluish-white, with occasional darker zones" (F. C. Baker, 1906, Naut. 20, p. 21, original description).

Dimensions.—Baker (1906, Naut. 20) gives the following for type specimens: L. 14.50, 12.00; H. 11.50, 10.00; D. 8.00, 7.00 mm.; and for specimens from Havana: L. 12.00, 11.00, 11.50; H. 9.50, 8.50, 8.00; D. 6.75, 6.50, 6.50 mm.

Ecology.—No ecological data except that the types came from a small lake in Illinois.

General distribution.—Illinois, Michigan, Ohio, and Maryland, south to Kentucky and Virginia.

Distribution in Ohio.—Recorded by Sterki (1916, p. 434) but without specific locality. I have no other records.

Geologic range.—No fossil record known to me.

Remarks.—The form is not listed by Herrington (1962). The account given herewith is merely for purposes of record.

[*Sphaerium striatinum* form *modestum* (Prime) 1851]

Cyclas modesta Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 159.

Sphaerium modestum Sterki 1916, Cat. N. Am. Sphaeriidae, p. 436.

Sphaerium striatinum form *modestum* Brooks and Herrington 1944, Nautilus, v. 57, p. 95.

Sphaerium modestum La Rocque 1953, Cat. Recent Moll. Canada, p. 114.

Sphaerium striatinum modestum La Rocque 1959, Sterkiana, no. 1, p. 32.

Type locality.—Pennsylvania.

Diagnosis.—*C. testâ tenui, complanatâ, inequilaterali, postice dilatatâ, umbonibus magnis, elevatis.* L. 0.41; H. 0.36; D. 0.25 inches. Habitat Pennsylvania.

Shell rather fragile, somewhat elongated; beaks very prominent; color yellowish green; striations hardly visible (Prime, 1851, p. 159).

Ecology.—Latchford (1920, p. 69) records this form from the Rideau River above Billings' Bridge, along the right bank. This locality is well known to me and may be described as follows: water shallow, a few inches to two feet along the banks, bottom sandy mud with a few rounded pebbles and boulders of glacial origin. The water in the Rideau here is swift moving in the central channel but very quiet near the banks. It is well aerated after going over the dam at Hogsback and the rapids less than half a mile upstream. The lime content here is high both from glacial drift upstream and from limestone outcrops over which the river runs in several places from Hogsback to Billings' Bridge. In Latchford's day the river was relatively free from pollution as there were only a few houses and summer cottages in the vicinity of the village of Billings' Bridge. The area is now heavily built over and is a part of the city of Ottawa. Pollution from indiscriminate dumping of trash and garbage as well as sewage has increased markedly but is now being rigidly controlled. The writer collected there in the 1930's but has not ascertained the effect of pollution on the molluscan population which was then thriving in that part of the Rideau River.

Associations.—See *S. striatinum.*

General distribution.—Eastern Ontario, west to Pennsylvania, and south to Alabama and Virginia.

Distribution in Ohio.—Eastern Ohio (Sterki, 1916, p. 436).

Geologic range.—No fossil record known to me.

Remarks.—The diagnosis is hardly satisfactory but subsequent workers have been able to recognize the form. Since this is a rather unimportant form of *S. striatinum,* no one seems to have seen fit to elaborate on the distinguishing characters that separate it from others. It may be well to allow the situation to remain as it stands. Brooks and Herrington (1944, p. 95) listed this as a form of *S. striatinum* but Herrington (1962, p. 27-28) listed it as a mere synonym of that species.

[*Sphaerium striatinum* form *ohioënse* Sterki 1913]

Sphaerium ohioense Sterki 1913, Nautilus, v. 26, p. 139.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 436.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 341, pl. 97, figs. 15-17, 33-35.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 321.
Sphaerium striatinum form *ohioense* Brooks and Herrington 1944, Nautilus, v. 57, p. 95.
Sphaerium striatinum ohiöënse La Rocque 1959, Sterkiana, no. 1, p. 32.

Type locality.—Ohio River at Cannelton, Indiana.

Diagnosis.—"Transversely elongated, inequipartite, moderately inflated, the valves rather flat toward the margins; shell not solid, valves rather thin; dorsal and ventral margins slightly rounded; anterior end rounded; posterior end obliquely truncate to subtruncate, rounded below; umbones not much elevated, beaks small, placed just anterior of the center of the dorsal margin; scutum and scutellum rather long, narrow; surface dull, with irregularly placed ridges or sulci with fine lines of growth between; color straw to corneous, old specimens smoky-horn, sometimes with dark blotches.

"Hinge slight, plate narrow; cardinals small, right tooth curved, rather thick, lower part swollen or thickened, sometimes nearly cubical; left upper cardinal thick, slightly curved, lower tooth elevated, elongated, not pyramidal; cardinals very uniform (fig. 262); laterals short, slight, not much elevated above edge of valve; cavity of beaks broad, not very deep; ligament and resilium rather long, slight; nacre bluish-white" (F. C. Baker, 1928a, pt. II, p. 341).

Dimensions.—Baker (1928a, pt. II) gives the following for specimens from Portage, Wisconsin: L. 14.0, 13.5; H. 10.5, 9.5; D. 7.0, 7.0 mm.; and from Lake Winnebago, Wisconsin: L. 13.0, 10.0; H. 9.0, 8.0; D. 7.0, 5.5 mm.

Ecology.—This appears to be mainly a river form, recorded by Baker (1928a, pt. II, p. 341) from the Ohio River in Ohio and Indiana, the Elk River in West Virginia, and the Wisconsin and Fox Rivers in Wisconsin. The only exception is Lake Winnebago in Wisconsin. It is also recorded by Baker from Joliet, Illinois, from either the Des Plaines River or Lilycash Creek, both of which were collecting grounds of his. Baker does not indicate the exact locality at Joliet from which his specimens were obtained.

General distribution.—Wisconsin and Illinois east to Ohio and West Virginia.

Distribution in Ohio.—Sterki (1916, p. 436) gives no specific locality but Baker (1928a, pt. II, p. 341) states that it has been recorded for the Ohio River.

Geologic range.—No fossil record known to me.

Remarks.—Herrington (1962, p. 27) does not recognize this form. He lists Sterki's name as a synonym of *S. striatinum.*

[*Sphaerium striatinum* form *solidulum* (Prime) 1851]

Cyclas solidula Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 158.
Sphaerium solidulum Prime 1865, Mon. Am. Corbiculadae, p. 36, fig. 27.
--- --- Dall 1905, Harriman-Alaska Exped., v. 13, p. 136.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 395.
--- --- Johnson 1915, Fauna New England, p. 46.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 433.
--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 24.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 323, pl. 97, figs. 1-3, pl. 98, figs. 26-28.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 321.
Sphaerium striatinum form *solidulum* Brooks and Herrington 1944, Nautilus, v. 57, p. 95.
Sphaerium solidulum Pilsbry 1946, Nautilus, v. 59, p. 84-85.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 114.
Sphaerium closest to *S. solidulum* Leonard 1950, Kans. Univ. Paleont. Contr., Moll., art. 3, p. 40, pl. 1, fig. J.
Sphaerium solidulum Leonard 1952, Kans. Univ. Paleont. Contr., Moll., art. 4, p. 23, pl. 2, fig. E.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 115.
Sphaerium striatinum solidulum La Rocque 1959, Sterkiana, no. 1, p. 32.

Type locality.—Ohio.

Diagnosis.—"Elongate-ovate, slightly inequipartite, moderately inflated; beaks usually placed near the center of the dorsal margin, but often a trifle nearer the anterior end, of good size, rounded, projecting considerably above the hinge line; dorsal margin short, moderately curved; ventral margin broadly convex; anterior and posterior ends rounded, a trifle oblique in some specimens; scutum and scutellum well marked; surface dull in most specimens, with a silky gloss in more perfect specimens; sculpture of coarse concentric ridges, widely separated, with fine growth lines between; ridges especially coarse on the umbones, where they are erect and widely spaced; color light yellowish, smoky, horn; shell rather heavy, the valves thick.

"Hinge rather strong, slightly curved, plate rather wide; cardinals small, that in the right valve rather long, usually curved, placed near the ligament or below it, near the ventral margin of the plate; in left valve, upper tooth rather long, narrow, lower tooth more

or less pyramidal, thick; laterals short, thick, compressed-pyramidal; cavity of beaks deep; nacre bluish-white" (F. C. Baker, 1928a, pt. II, p. 323).

Dimensions.—Baker (1928a, pt. II) gives the following for specimens from near Joliet, Illinois: L. 13.0, H. 10.0, D. 7.0 mm.; and from the Mukwonago River, Wisconsin: L. 10.2, 9.1, 9.0; H. 8.6, 7.0, 8.0; D. 6.5, 5.0, 6.0 mm.

Ecology.—Sterki (1916, p. 433) gives "in rivers and creeks." Baker (1928a, pt. II, p. 323) summarized the ecology of this species as follows: "shallow water, bottom gravel, with sand, good current, water clear (Bark River, Rome); shallow water, clear and cold, gravel-sand bottom (Mukwonago River near Eagle Lake); shallow water, gravel bottom, swift current, some vegetation (Mukwonago). Cahn." It has also been collected in creeks, sloughs, and lakes, as the following records show: creek at L'Orignal, Ontario (Whiteaves, 1863, p. 50, 107); slough near Egg Lake, Alberta (G. W. Taylor, 1895, p. 173); Red River, Manitoba (Hanham, 1899, p. 4); Bucksehatchee Creek, Calera, Alabama (Hinkley, 1904, p. 57); Niagara River (Letson, 1909, p. 243); Clinch River, Virginia (Goodrich, 1913, p. 82); Lake Kakisa, Northwest Territories (Whittaker, 1924, Naut. 38, p. 10); Lake Ontario, 101 to 350 feet depth (Kindle, 1925), probably dead specimens; Whitemouth River, near its junction with Winnipeg River (Mozley, 1926, Naut. 40); St. Joseph's Island, Lake Huron (Richards, 1932, p. 33); creeks in Coosa basin, Alabama (Goodrich, 1944, p. 49).

General distribution.—Mackenzie River; Alberta and Manitoba east to eastern Ontario, south to New Mexico, Texas, Louisiana, Alabama, Kentucky, and North Carolina.

Distribution in Ohio.—Sterki (1907a, p. 395) gives "over the state" which is probably correct since the form is recorded for most adjoining states.

Geologic range.—Pleistocene: Kansan; Yarmouth?; Illinoian; Sangamon; Wisconsin; Baker (1920a, p. 383) gave Sangamon and "Wabash." This species may range back to the Yarmouth of Kansas and Texas (A. B. Leonard, 1950, p. 40) but there is some doubt about the identification of the material. Leonard (1952, p. 23) records it for the Sappa silts (Kansan) and the Crete-Loveland sediments (Illinoian and Sangamon) of Kansas. Mozley (1928, p. 268) identified it from a silt bed near Winnipeg. Earlier, Christie (1885, p. 339) had noted "bleached and semi-fossil specimens" at Winnipeg and Brandon, Manitoba. In Ontario, Coleman (1922, p. 75) notes the species at Niagara Falls as of "Nipissing Great Lakes" age. Whittaker (1921, p. 64) notes it doubtfully for Eastview, near Ottawa, and he (1922a, p. 105) also obtained it from a low terrace on Sheek Island, St. Lawrence River, near Cornwall, Ontario.

In Ohio, only one record (Sterki, 1916, p. 433) refers to this form and no exact locality is given for it.

Remarks.—Herrington (1962, p. 27) lists Prime's name as a mere synonym of *S. striatinum; solidulum* had previously been recognized as a form (Brooks and Herrington, 1944, p. 95) and may still be valid as such. It is treated separately here for purposes of record.

[*Sphaerium striatinum* form *stamineum* (Conrad) 1834]

Cyclas staminea Conrad 1834, Am. Jour. Sci., v. 25, p. 342, pl. 1, fig. 5.
Sphaerium stamineum Prime 1865, Mon. Am. Corbiculadae, p. 38, fig. 30.
--- --- Dall 1905, Harriman-Alaska Exped., v. 13, p. 136, fig. 100.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 395.
--- --- Johnson 1915, Fauna New England, p. 46.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 433.
--- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 176, Tinkers Creek deposit.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 325, pl. 97, figs. 6-9.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 321.
Sphaerium striatinum form *stamineum* Brooks and Herrington 1944, Nautilus, v. 57, p. 95.
Sphaerium stamineum Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 114.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 116.
Sphaerium striatinum form *solidulum* La Rocque 1959, Sterkiana, no. 1, p. 32.

Type locality.—Southern Alabama.

Diagnosis.—"Trigonal or roundly ovate, inequipartite, much inflated; beaks slightly anterior, of good size, swollen, greatly elevated above the hinge line; dorsal margin short, slightly convex; ventral margin more broadly rounded; anterior margin rounded or slightly truncated; posterior margin similar; scutum and scutellum well marked, surface dull, with silky gloss, sculpture of coarse concentric ridges with fine lines between, coarse on the umbones; color brownish or chestnut, rarely yellow; shell rather heavy, thick.

"Hinge strongly curved, plate wide, thick; cardinals small, a single massive, thick, straight or slightly curved cusp in the right valve, and two cusps in the left valve, the upper thick, straight, the lower short, erect, pyramidal (fig. 253); laterals short, broadly pyramidal, laterally compressed, not much elevated above the hinge line; cavity of beaks deep; nacre bluish, more or less purplish" (F. C. Baker, 1928a, pt. II, p. 326).

Dimensions.—Baker (1928a, pt. II) gives the following for specimens from the Red Cedar River, Wisconsin: L. 10.4, 9.5; H. 8.9, 8.5; D. 6.5, 6.4 mm.; and from the outlet of Lake Chetek, Wisconsin: L. 11.5, H. 9.1, D. 7.0 mm. Clench and Turner (1956, p. 215) give the following for a creek in Alabama: L. 14.4,

H. 10.7, D. 8 mm.; for a creek in Georgia: L. 11.2, H. 8.5, D. 6 mm.; and for a spring in Georgia: L. 11.0, H. 9.0, D. 6 mm.

Ecology.—This form appears to inhabit a variety of environments from small creeks to large lakes but not sloughs or ponds; it is found in shallow water (up to 1 m.) on sand, mud, and marly-clay bottom. This statement is based on the following records. Rideau River at rifle range (=Strathcona Park, Ottawa) (G. W. Taylor and Latchford 1890, p. 52; Latchford, 1920, p. 30). Taylor and Latchford give no details but this locality is well known to me. Here the Rideau River is very shallow—it can be crossed in places without wetting oneself above the knee—and flows in miniature rapids over exposures of Ordovician shales. The bottom is strewn with glacial boulders and some low spots have gathered mud in which waterweed grows. The specimens of *Sphaerium striatinum stamineum* probably came from these mud pockets. Hanham (1890, p. 119) lists the form from Ancaster Creek, near marsh, very plentiful; Baker (1902, p. 395) took it in Lilycash Creek, near Joliet, Illinois; Letson (1909, p. 243) from creeks in the Buffalo area; Whiteaves (1905d, p. 4) records it from the Kawinogans River and (1905c, p. 169) from Lakes Erie and Abitibi in Ontario. Baker (1910, p. 473) found it abundant in the east branch of the Chicago River in shallow water along shore, in soft blue clay, retreating to small pools at low water during summer. Over (1915, p. 94) found it in Lake Kampeska, Codington County, South Dakota. Latchford (1920, p. 30) lists it for several small rivers flowing into Lakes Ontario and Erie in Ontario. Baker (1928a, pt. II, p. 325) lists the following: Omro, Fox River, mud bottom, 0.7-0.9 m.; outlet of Lake Chetek, sand bottom, 0.3-1 m.; Red Cedar River, sand bottom, 0.3-1 m.; Green Lake, marly-clay bottom, 3 m., all in Wisconsin. Rawson (1930) found it in Lake Simcoe, Ontario; Goodrich (1944, p. 49) in the Coosa River, Floyd County, Georgia; Clench and Turner (1956, p. 215) in creeks in Alabama and a spring in Georgia.

Associations.—See *S. striatinum.*

General distribution.—Manitoba, Ontario (James Bay), New York, and Connecticut, south to Arkansas, Alabama, and Georgia. Its western limits in the United States appear to be South Dakota (doubtfully North Dakota), Iowa, Illinois, and Arkansas.

Distribution in Ohio.—Sterki (1907a, p. 395) gives "over the state" which is most probably correct in view of the general distribution.

Geologic range.—Pleistocene: late(?) Wisconsin. Sterki (1916, p. 433) records the form as a fossil for New York, Ohio, Michigan, and Illinois. The Ohio record refers to the Tinkers Creek marl, Summit and Portage Counties. Baker (1920a, p. 383) gave Sangamon and "Wabash." Mozley (1928, p. 268) found it in a silt bed near Winnipeg, Manitoba.

Remarks.—This taxon was previously recognized as a form by Brooks and Herrington (1944, p. 95) but is listed merely as a synonym of *S. striatinum* by Herrington (1962, p. 27). The account given here is for purposes of record.

[*Sphaerium striatinum* form *vermontanum* (Prime) 1861]

Sphaerium vermontanum Prime 1861, Acad. Nat. Sci. Philadelphia Proc. 1861, p. 128.
--- --- Prime 1865, Mon. Am. Corbiculadae, p. 42.
--- --- Johnson 1915, Fauna New England, p. 46.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 435.
Sphaerium striatinum form *vermontanum* Brooks and Herrington 1944, Nautilus, v. 57, p. 95.
Sphaerium vermontanum Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 321.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 117.
Sphaerium striatinum vermontanum La Rocque 1959, Sterkiana, no. 1, p. 32.

Type locality.—Vermont.

Diagnosis.—"Shell very oblique, tumid, inequilateral, full; anterior margin abrupt, posterior drawn out to an angle, basal slightly curved; beaks large, full, prominent, placed very much towards the anterior, in which direction they are slightly inclined; sulcations coarse, moderately regular; epidermis light green; ligament conspicuous; valves solid, interior light blue; hinge margin much curved, broad; cardinal teeth strong, representing the letter V reversed; lateral teeth elongated, strong" (Prime, 1862, p. 9).

Dimensions.—Prime (1862, p. 9) gives the following: L. 9/16; H. 6/16; D. 4/16 inches.

Ecology.—This appears to be a lake form of the species, recorded for Lakes Michigan (F. C. Baker, 1902, p. 394), Champlain and Memphremagog (Sterki, 1916, p. 435), and Nipigon (Adamstone, 1923b, somewhat doubtful identification), for Botsford Lake, Ontario (Baker and Cahn, 1931, p. 46), and for the Mackenzie River(?) "near Fort Wrigley" (Whittaker, 1924, Naut. 38, p. 10).

Associations.—See *S. striatinum.*

General distribution.—Eastern Ontario, Quebec, Vermont, and Maine, south to Illinois, Indiana, Ohio, New York, and Massachusetts.

Distribution in Ohio.—No specific records. The species is included here on the basis of its general range and its presence in some of the Great Lakes. It should eventually be found in Lake Erie but so far I have no records.

Geologic range.—Pleistocene: Wisconsin. The only mention I have found of this form as a fossil is Baker's (1902, p. 394). The reference is rather vague but seems to refer to Illinois.

Remarks.—Along with most of the forms of *S. striatinum* listed here as doubtful, this one was recognized by Brooks and Herrington (1944, p. 95) but is

listed merely as a synonym by Herrington (1962, p. 27). The account given here is for purposes of record.

Sphaerium fabale (Prime) 1851
Pl. 2, fig. 3

Cyclas fabalis Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 159.
Sphaerium fabalis Prime 1865, Mon. Am. Corbiculadae, p. 40, fig. 33.
Sphaerium fabale Dall 1905, Harriman-Alaska Exped., v. 13, p. 137, fig. 103.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 395.
--- --- Johnson 1915, Fauna New England, p. 47.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 436.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 321.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 115.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 113.
Sphaerium (Musculium) fabale La Rocque 1959, Sterkiana, no. 1, p. 31.
Sphaerium fabale Herrington 1962, Revis. Sphaeriidae N. America, p. 18, pl. 2, fig. 3.

Type locality.—Lake Superior.

Diagnosis.—Surface uneven; shell compressed; striae not evenly spaced and weaker in the region of the beaks.

Dimensions.—Herrington (1962, p. 18) gives the following measurements for shells from Salmon River, Richmond Township, Lennox and Addington Counties, Ontario: L. 11.25, 10.0, 6.2, 4.6; H. 9.0, 8.0, 5.0, 3.8; D. 5.9, 4.9, 2.9, 1.6 mm.

Ecology.—Herrington (1962, p. 19) summarizes the habitat as follows: "Creeks and small rivers. I have found it only in coarse gravel or in gravelly sand in cracks on a flat limestone bottom." This may be amplified by the following observations previously published. Goodrich (1944, p. 49) records it for creeks but not for the Coosa River in Alabama and Georgia. In Virginia it lives in the Clinch River (Goodrich, 1913, p. 82). Letson (1909, p. 243) found it in the Niagara River near Buffalo and G. W. Taylor (1895, p. 174) in Battle River, Alberta. One of the most specific bits of information on the ecology of this species is for a sandspit on Berens Island, Lake Winnipeg (O'Donoghue, 1921, p. 125). These records show quite a contrast: from protected situations in slow moving waters to a very exposed situation in Lake Winnipeg, unless, as noted below, the Alberta and Manitoba records are erroneous.

Associations.—Living: OHIO-43.

General distribution (fig. 188).—Most of the records are concentrated east of the Mississippi River (Vermont to Alabama and Georgia). The species has been recorded for Manitoba and Alberta but these records are not mentioned by Herrington (1962, p. 19), presumably because they are erroneous.

Distribution in Ohio (inset, fig. 188).—Records for the State are concentrated in the northeast (Summit, Portage, Tuscarawas, and Stark Counties), which seems odd in view of the general distribution and may be due simply to lack of collecting in other parts of Ohio.

Geologic range.—Pleistocene: Sangamon (F. C. Baker, 1920a, p. 383).

[*Sphaerium steenii* A. Schmidt 1850]

Cyclas Steenii A. Schmidt 1850, Zeitschr. Malac., 1850, p. 118.
Sphaerium steinii Kennard and Woodward 1926, Synonymy British Moll., p. 306 (as synonym of *lacustre*).
Musculium steinii Sterki 1928, Nautilus, v. 42, p. 27.
--- --- Henderson 1929, Colo. Univ. Studies, v. 17, p. 66 (Wash.).
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 101.
Sphaerium (Musculium) steinii La Rocque 1959, Sterkiana, no. 1, p. 32.

Type locality.—Germany.

Diagnosis.—No diagnosis is given here as this species is almost certainly a synonym of *S. lacustre, q. v.*

Associations.—Living: WISCONSIN-87.

General distribution.—Europe. In North America, British Columbia, Washington; Great Lakes (Sterki, 1928). If distinct, probably listed as *S. lacustre* or one of its many synonyms.

Distribution in Ohio.—Listed here only because Sterki (1928, p. 27) considered the species distinct and listed it for the Great Lakes. If this statement implied Lake Erie, then the species has a place on the Ohio list.

Geologic range.—No North American fossil records are known to me.

Remarks.—Although *S. steinii* is listed here separately, following Sterki, Kennard and Woodward (1926) consider it a synonym of *S. lacustre*, which it may well be. The name is not mentioned by Herrington (1962) either in the synonymy of *S. lacustre* or in the Synonymy (Herrington, 1962, p. 52-54).

Genus *Pisidium* C. Pfeiffer 1821

Pisidium C. Pfeiffer 1821, Naturg. deutsch. Land-Moll. (1), 17, p. 123.
Corneocyclas Dall 1903 (*non* Férussac) Wagner Free Inst. Sci., v. 3, no. 6, p. 1459.
Corneocyclas Hannibal 1912 (*non* Férussac) Malac. Soc. London Proc., v. 10, p. 134.
Pisidium Walker 1918, Synopsis and cat. fresh-water

Moll., p. 88.
Pisidium F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 363.
Pisidium Germain 1931, Faune de France, p. 696.
Pisidium Kuiper 1942, Basteria, v. 7, p. 23 ff. (ecology).
Pisidium Adam 1947, Mém. Mus. roy. Hist. Nat. Belgique, no. 106, p. 198.
Pisidium Herrington 1962, Revis. Sphaeriidae N. America, p. 30.

Type.—*Tellina amnica* Müller.

Diagnosis.—Shell small, rounded, oval or obliquely cuneiform; inequilateral, anterior side longer; beaks terminal; cardinal teeth double in left, single in right valve, at times united, situated immediately under the beaks; laterals elongated, lamelliform, double in the right, single in the left valve; ligament on the shorter side, internal.

Remarks.—As for *Sphaerium*, the species of genus *Pisidium* are divided into two groups without formal

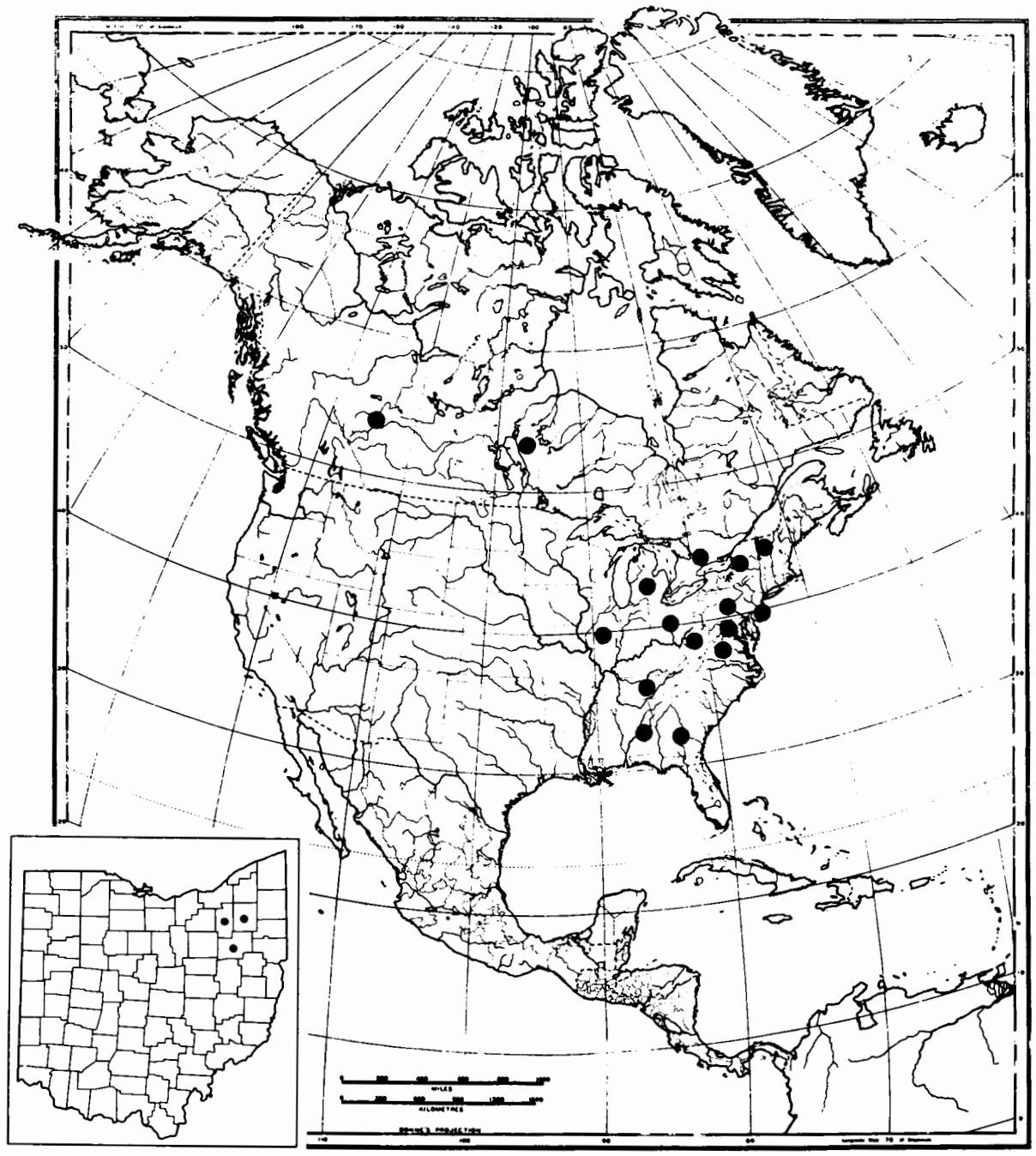


FIGURE 188.—Distribution of *Sphaerium fabale* in North America; *inset*, distribution in Ohio.

taxonomic significance. Four species in which the adult shell is 6 mm. or more long are placed in group 1. Nineteen species, in which the adult shell is less than 6 mm. long, are placed in group 2.

Group 1

Shell large, adults 6 mm. or more long. There are four species in this group, two *(P. adamsi* and *P. idahoense)* with fine striae and two *(P. amnicum* and *P. dubium)* with coarser striae.

Pisidium adamsi Prime 1851
Pl. 3, fig. 5; pl. 7, fig. 5

Pisidium adamsi (Prime) Stimpson 1851, Moll. New England, p. 16.
--- --- Prime 1865, Mon. Am. Corbiculadae, p. 63, fig. 63.
Pisidium sargenti Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 397.
--- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 175, Tinkers Creek deposit.
Pisidium adamsi Johnson 1915, Fauna New England, p. 52.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 454.
Pisidium sargenti Sterki 1916, *ibid.*
Pisidium adamsi F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 385, pl. 101, figs. 7-9, 19.
Pisidium sargenti F. C. Baker 1928, *ibid.*, p. 387, pl. 101, figs. 5, 6, 18.
Pisidium adamsi Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 323.
Pisidium sargenti Goodrich and van der Schalie 1944, *ibid.*
Pisidium adamsi La Rocque 1953, Cat. Recent Moll. Canada, p. 102.
--- --- Herrington 1954, Nautilus, v. 67, p. 136.
--- --- La Rocque 1959, Sterkiana, no. 1, p. 29.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 30, pl. 3, fig. 5; pl. 7, fig. 5.

Type locality.—Norway, Maine; Holly, Oakland County, Michigan.

Diagnosis.—Shell long in outline, height less than 90 percent of length; surface dull; striae fine (15 or more per mm.); cusps of P I distal; cusp of P II on distal side of center.

Dimensions.—Herrington (1962, p. 30) gives the following for cotype specimens from Maine: L. 7.2, H. 6.3, D. 4.7 mm.; and for specimens from a dried up lake near Keene, Ontario: L. 7.3, 5.6, 3.7, 1.6; H. 6.3, 4.5, 3.2, 1.2; D. 4.5, 3.1, 2.0, 0.7 mm. F. C. Baker (1928a, pt. II, p. 385) gave the following for "Type. Average:" L. 6.0, H. 5.0, D. 4.0 mm.; for specimens from Taber Lake, Wisconsin: L. 5.5, H. 4.5, D. 3.9 mm., and from Yellow River, Wisconsin: L. 5.2, H. 4.8, D. 3.9 mm.

Ecology.—Herrington (1962, p. 31) summarizes its habitat as follows: "Small lakes, ponds, rivers, and (rarely) creeks. It has a preference for muck and decaying vegetable matter." The following additional observations may be helpful. The species has a wide range of environmental adaptability, apparently preferring quiet water. Specific data from the literature indicate that this preference may be found in a variety of bodies of water: rivers, lakes, ponds. Ottawa River, a little below Gatineau village (Heron, 1880, p. 36); Kawinogans River, Ontario (Whiteaves, 1905d, p. 3); pond near Deschenes Rapids (Latchford, 1922, p. 4); extreme end of Gore Bay, Manitoulin Island (Latchford, 1922, p. 4); Lake Winnebago, mud bottom, 3.4 m. deep; Lake Butte des Morts, mud bottom, 1.2-2.2 m. deep; Green Lake, mud and marly-clay bottom, 1-13.5 m.; Lake Chetek, mud bottom, 0.6 m.; Taber Lake, mud bottom, 0.3 m. "It seems to prefer quiet water, small lakes and slow-running streams" (Sterki, 1916). Its presence in Lake Winnebago indicates that it also lives in the larger lakes (Baker); Oconomowoc Lake, pebble bottom, shallow water; 3-5 m. deep with vegetation; Mud Lake, soft mud bottom, with decomposing vegetation, shallow water (Cahn) (Baker, 1928a, pt. II, p. 386); Lake Winnebago, mud bottom, 0.3 mm.; mud with gravel, 1.5-5.4 m.; mud and gravel, 2.8 m.; Lake Butte des Morts, mud bottom, 1.2 m. (Baker, 1928a, pt. II, p. 388, *P. sargenti*). Cat and Fitchie Lakes, Ontario (Baker and Cahn, 1931, p. 47); Lake Simcoe, form? (Rawson, 1930). Appears to prefer quiet water, about 3 m. deep, in small and some large lakes or slow moving streams. The bottom generally consists of mud which has scattered vegetation; depth of water ranges from 0.3 to 13.5 m., water with pH 6.05-7.7; fixed carbon dioxide 2.75-18.36 p.p.m. (Mowery, 1961, p. 7).

Associations.—Living: MANITOBA - 20; OHIO - 43; WISCONSIN - 42, 49, 63, 123; fossil: W - 27, 36, 37, 38, 39, 42. As *P. sargenti,* living: WISCONSIN - 15, 27, 55, 58, 63, 79, 81, 85, 95, 116, 121, 123, 128, 130, 133.

General distribution (fig. 189).—New Brunswick, Quebec, Ontario, and Saskatchewan; Maine, New Hampshire, Massachusetts, New York, New Jersey, Pennsylvania, Delaware, Virginia (Sterki), Tennessee, Alabama, Georgia, Florida, Ohio, Michigan, Indiana, Wisconsin, Illinois, Iowa, Missouri, and Montana (Herrington, 1962, p. 31).

Distribution in Ohio (inset, fig. 189).—I have no record of *P. adamsi* as such living in the State but Sterki (1907a, p. 397) records it as *P. sargenti,* a synonym, living and fossil.

Geologic range.—Pleistocene: late Wisconsin. Sterki (1916, p. 454) recorded the species as fossil in Maine under one synonym *(P. sphaericum)* and in Michigan and Illinois (loess) under another *(P. sargenti).* Later (1920, p. 175), he noted it as *P. sargenti* from the Tinkers Creek marl in Ohio. Baker (1920a, p. 384) gave Sangamon and "Wabash" for the species and "Wabash" for *P. sargenti.* In recent years, three other Ohio

marl occurrences have been noted, the Jewell Hill deposit (Mowery, 1961, p. 7), the Souder Lake deposit (Cornejo, 1961, fig. 11), and the Oakhurst deposit (Aukeman, 1960, p. 24). See also other records for *P. adamsi* form *affine*.

[*Pisidium adamsi* form *affine* Sterki 1901]

Pisidium affine Sterki 1901, Nautilus, v. 15, p. 66.

--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 397.

--- --- Johnson 1915, Fauna New England, p. 57.

Pisidium adamsi affine Sterki 1916, Cat. N. Am. Sphaeriidae, p. 454.

--- --- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 175, Tinkers Creek deposit.

--- --- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 323.

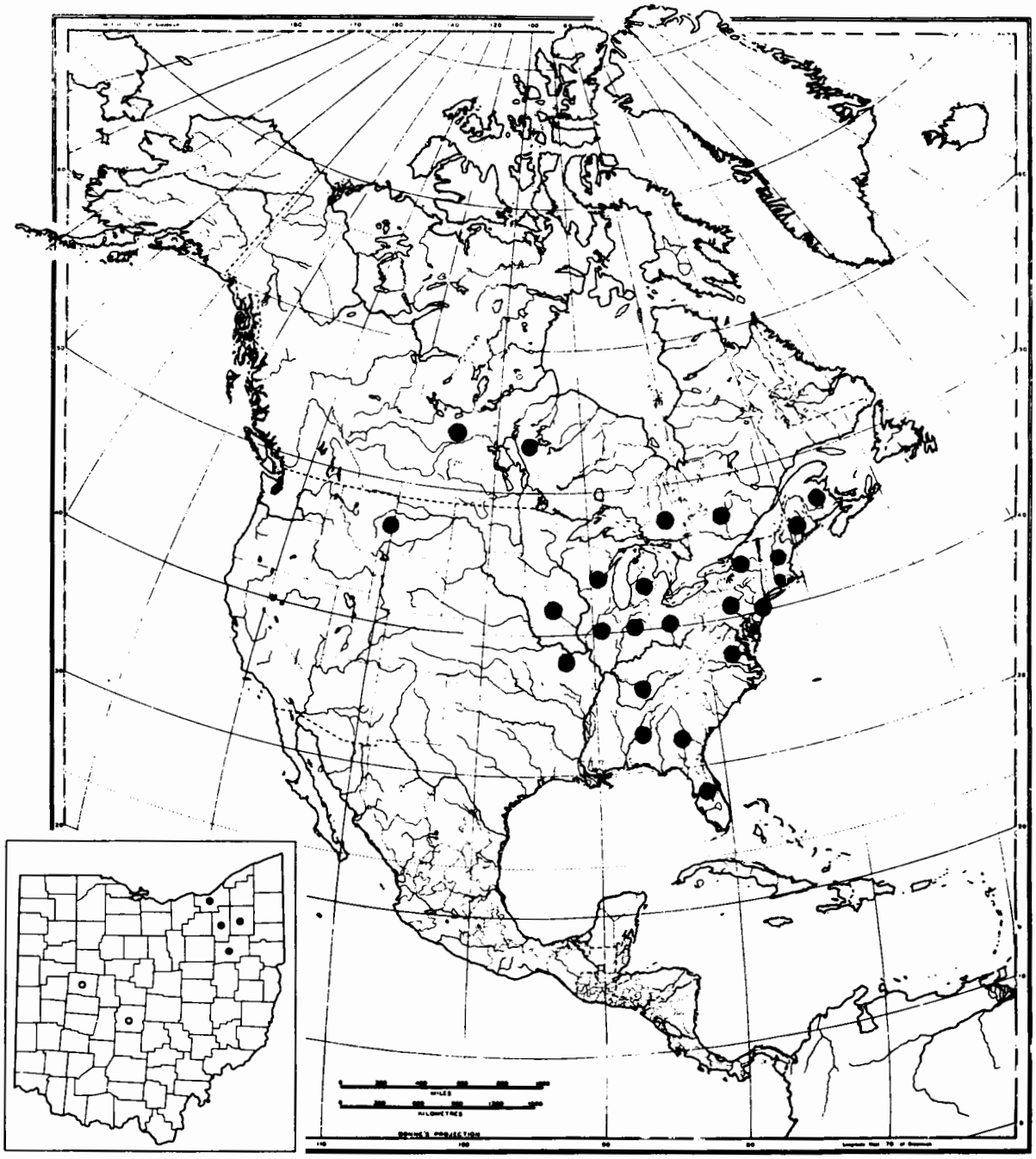


FIGURE 189.–Distribution of *Pisidium adamsi* in North America; *inset*, distribution in Ohio.

Pisidium adamsi affine La Rocque 1953, Cat. Recent Moll. Canada, p. 103.
--- --- --- Herrington 1954, Nautilus, v. 67, p. 136.
--- --- --- La Rocque 1959, Sterkiana, no. 1, p. 29.

Type locality.—Great Lakes region, Michigan to New York.

Diagnosis.—"Rather large, well-inflated, slightly oblique, beaks somewhat posterior, large and prominent in full-grown, broad and quite low in young specimens, rounded or slightly flattened on top; superior and inferior margins moderately curved, posterior subtruncate, with slightly marked angles above and below, supero-anterior forming one regular curve from the beaks to the anterior end, which is low-situated and well-rounded; surface distinctly and somewhat irregularly striated, with some coarser lines of growth, dull or somewhat shining; color lighter or darker grayish horn to plumbeous or brownish with a few irregular darker zones corresponding with the lines of growth, and often with fine darker mottlings, usually with a broad lighter zone along the margins; the young are pale horn or straw-colored; shell moderately thick, nacre whitish, muscle insertions little; hinge rather stout, plate rather broad; cardinal teeth long, not very strong, the right one curved, its free edge often indented in the middle, its posterior end somewhat thicker, with a fine groove, the left anterior tooth curved, the posterior slightly so, oblique, rather behind the anterior, each covering the other for half their lengths; lateral teeth stout, rather long, their cusps short and somewhat pointed, the outer ones in the right valve of good size; ligament rather long and stout" (Sterki, 1901, Naut. 15, p. 66, original description).

Dimensions.—Sterki gives: L. 6, H. 5, D. 4 mm. (average).

Ecology.—Probably the same as that of the typical form. It has been recorded for lakes (F. C. Baker, 1918b, p. 164) and for rivers (Whiteaves, 1905d, p. 5).

General distribution.—The form is recorded for Minnesota, Michigan, Ontario, Ohio, New York, Maine, and Virginia, all within the range of the type form.

Distribution in Ohio.—Sterki (1907a, p. 397) records the form as living in Ohio but without specific locality. He also records it as a fossil in the State.

Geologic range.—Pleistocene: late Wisconsin. "Fossil, Ohio, Michigan, Illinois" (Sterki, 1916, p. 454); Tinkers Creek marl (Sterki, 1920, p. 175). Baker 1920a, p. 384) gave only "Wabash."

Remarks.—This form appears to be of very minor value. Herrington (1926, p. 30) lists *affine* as a synonym of *P. adamsi* but nowhere mentions it as a valid form.

Pisidium idaboense Roper 1890
Pl. 3, fig. 3; pl. 7, fig. 3

Pisidium idaboense Roper 1890, Nautilus, v. 4, p. 85.
Pisidium idaboense Herrington 1962, Revis. Sphaeriidae N. America, p. 42, pl. 3, fig. 3; pl. 7, fig. 3.

Diagnosis.—Shell high in outline, height 90 percent of length; surface glossy; striae fine (15 or more per mm.); cusps of P I distal; cusp of P II central or on proximal side of center.

Associations.—Living: WISCONSIN - 110.

General distribution (fig. 190).—Alaska to California, eastward to Northwest Territories and Saskatchewan in Canada; Montana and Idaho. Great Lakes area: Wisconsin, Michigan, Indiana, Ohio, and Ontario. Prince Edward Island, Canada.

Pisidium amnicum (Müller) 1774
Pl. 3, fig. 2; pl. 7, fig. 2

Tellina amnica Müller 1774, Verm. Terr. et Fluv. Hist., p. 205.
Pisidium amnicum B. B. Woodward 1913, Cat. Brit. *Pisidia*, p. 16, figs.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 446.
--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 26.
--- --- Adam 1947, Mém. Mus. roy. Hist. Nat. Belgique, no. 106, p. 199.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 103.
--- --- Herrington 1954, Nautilus, v. 67, p. 135.
--- --- La Rocque 1959, Sterkiana, no. 1, p. 30.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 32, pl. 3, fig. 2; pl. 7, fig. 2.

Type locality.—Not ascertained. Certainly Europe, probably Denmark.

Diagnosis.—Striae coarse (10 or fewer per mm.), not fading out in region of beaks; cardinals near anterior cusps; cusp of P I distal of center; cusp of A II proximal or on proximal side of center.

Dimensions.—Herrington (1962, p. 32) gives the following for a specimen from Fiskebok, Sjolland Oht, Denmark: L. 11.9, H. 9.2, D. 7.5 mm.; and for specimens from the mouth of a small creek into the St. Lawrence River, Ontario: L. 9.7, 6.2, 4.7, 2.9; H. 7.2, 4.6, 3.5, 2.1; D. 5.3, 3.1, 2.4, 1.2 mm.

Ecology.—"On this continent it appears to have a preference for sandy bottoms of big waters. *P. amnicum* is not very plentiful in Europe, and very scarce in North America. It appears to be an introduced species here" (Herrington, 1962, p. 33). Germain (1931, p. 699)

states that it lives in rather clean waters, large and small rivers, brooks, ditches, and lakes, among aquatic plants, but frequently also in mud where it forms populous colonies. In lakes it lives as far down as 25-30 m. (Lake Geneva); is found fossil in many Quaternary formations; common or very common in all France, but more abundant in the north. In Belgium, Adam (1947, p. 199) has found it in rivers, brooks, and canals, where it seems to be fairly resistant to pollution. In North America it has been recorded for Lake Ontario (Sterki, 1916, p. 446; Adamstone, 1924), an environment which differs considerably from its European habitats.

General distribution (fig. 191).—St. Lawrence River, Ottawa River, Lake Ontario, Lake Erie, Lake Huron. Pennsylvania, New Jersey (Delaware River), Lake Champlain. Africa: Egypt. Eurasia.

Distribution in Ohio.—The species is included here

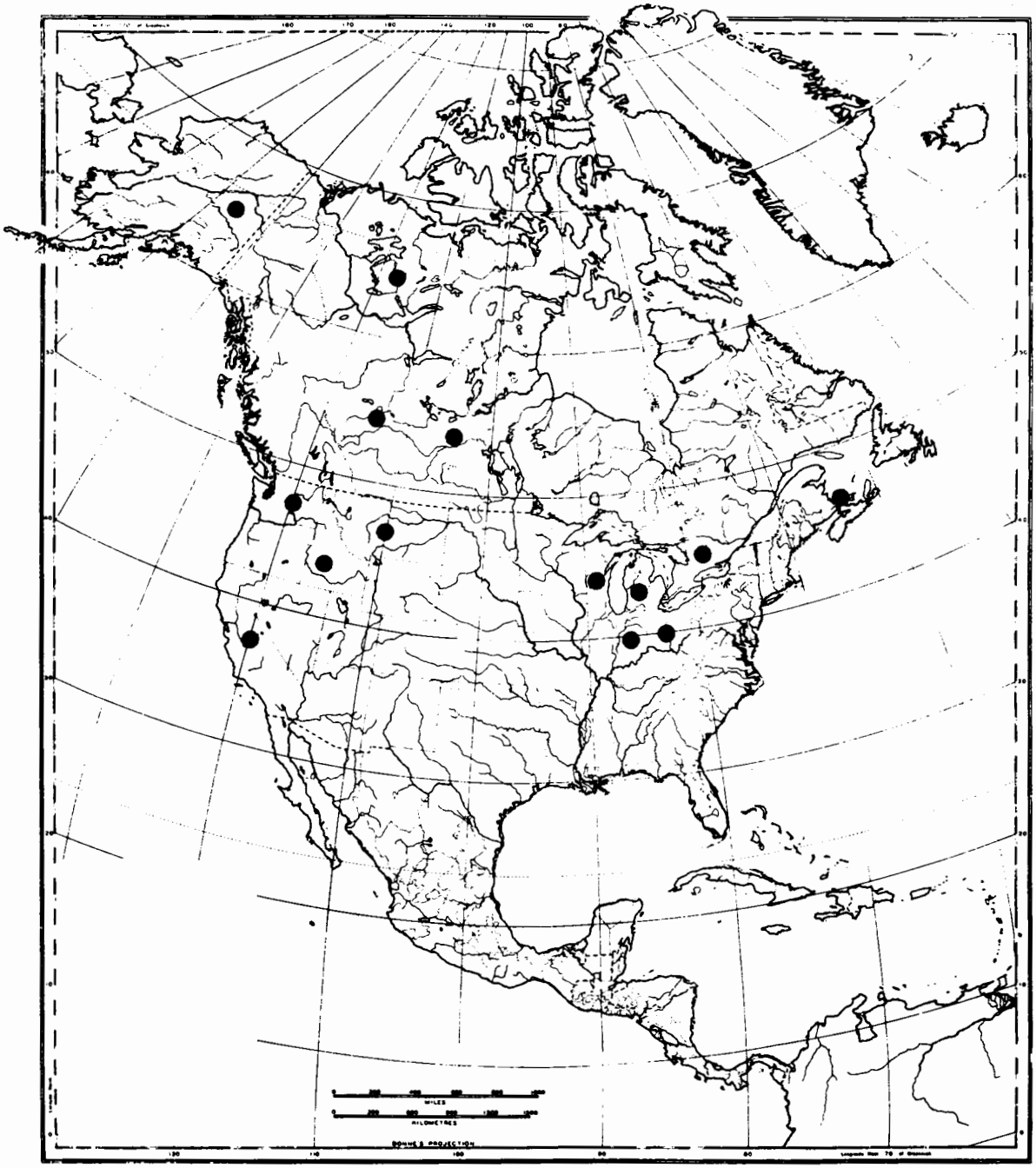


FIGURE 190.—Distribution of *Pisidium idahoense* in North America.

because of the Lake Erie record, above.

Geologic range.—Unknown as a fossil in North America, so far as I know. It occurs in the Pleistocene of Europe.

Pisidium dubium (Say) 1816
Pl. 3, fig. 1; pl. 7, fig. 1

?*Tellina virginica* Gmelin 1792, Syst. Nat., v. 6, p. 3236.

Cyclas dubia Say 1816, Nicholson's Encycl., v. 2, pl. 1, fig. 10.

Phymesoda dubia (Say) Rafinesque 1820, Annales gén. Sci. Phys. (Bruxelles), v. 5, p. 319.

Pisidium virginicum Bourguignat 1853, Amén. Mal., v. 1, p. 53.

--- --- Prime 1865, Mon. Am. Corbiculadae, p. 61, figs. 61, 62.

Corneocyclas (Phymesoda) virginica Dall 1905, Harriman-Alaska Exped., v. 13, p. 141, fig. 112.

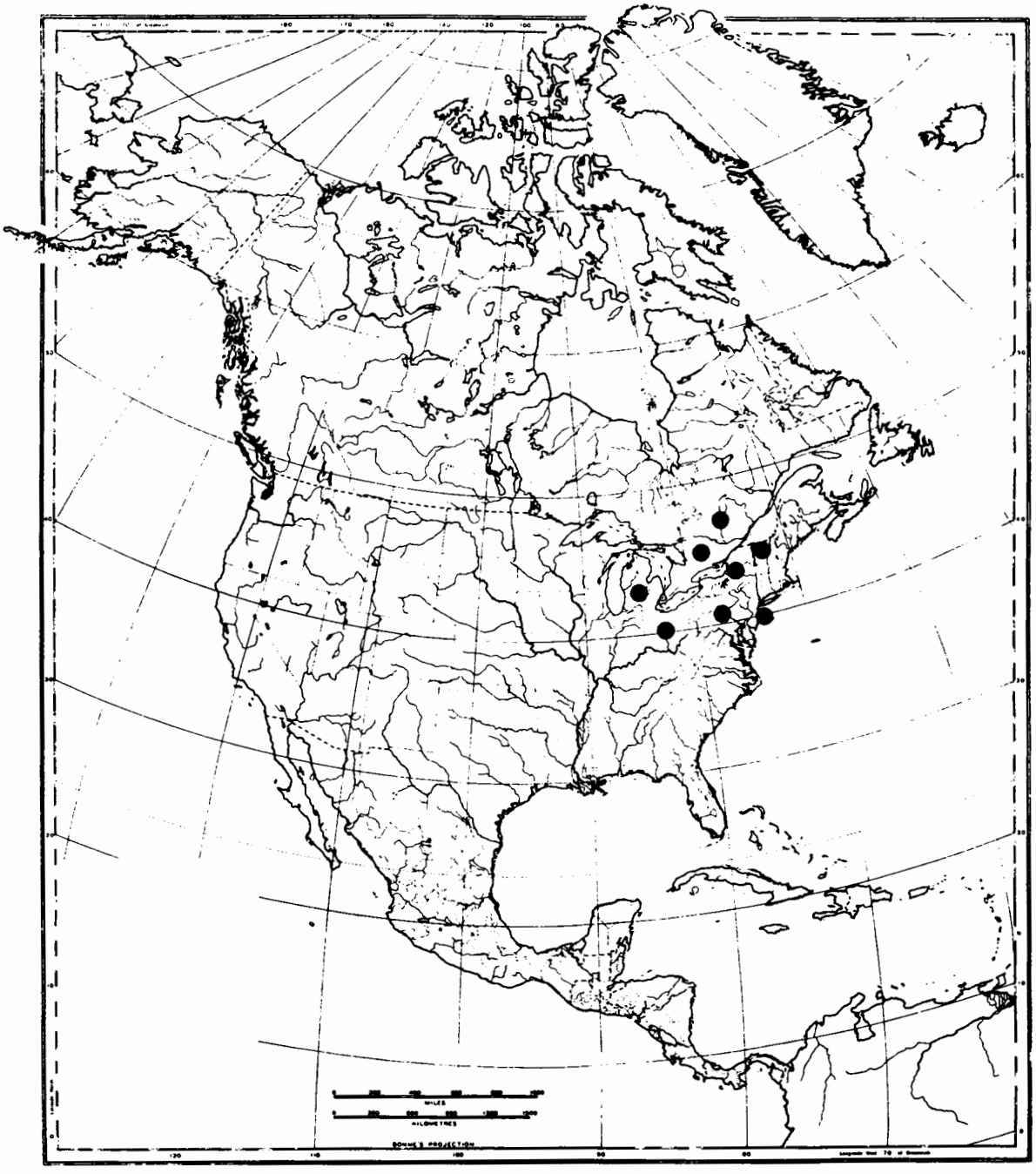


FIGURE 191.—Distribution of *Pisidium amnicum* in North America.

Pisidium virginicum Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 396.
--- --- Johnson 1915, Fauna New England, p. 52.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 446.
--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 28.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 367, pl. 100, figs. 4-6.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 323.
Pisidium dubium (Say) Pilsbry 1946, Nautilus, v. 59, p. 86.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 118.
Pisidium virginicum La Rocque 1953, Cat. Recent Moll. Canada, p. 112.
Pisidium dubium Herrington 1954, Nautilus, v. 67, p. 136.
--- --- La Rocque 1959, Sterkiana, no. 1, p. 30.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 37, pl. 3, fig. 1; pl. 7, fig. 1.

Type locality.—Delaware River *(dubium);* "Virginia" *(virginicum).*

Diagnosis.—Striae coarse (10 or fewer per mm.), fading out in the region of the beak; cardinals nearer posterior cusps; cusp of P I distal of center; cusp of A II distal or on distal side of center.

Dimensions.—F. C. Baker (1928a, pt. II, p. 367) gives the following for specimens from Fox River, Wisconsin: L. 7.0, 6.0, 6.8; H. 5.5, 4.6, 5.1; D. 4.2, 3.5, 4.1 mm. Clench and Turner (1956, p. 217) give the following for specimens from Florida: L. 7.2, H. 6.6, D. 4.6, and from Georgia: L. 6.5, H. 6.5, D. 4.6 mm. Herrington (1962, p. 37) gives the following for specimens from Ontario: L. 9.0, 7.0, 5.0, 3.0; H. 8.0, 5.75, 4.0, 2.25; D. 5.5, 4.0, 2.25, 1.25 mm.

Ecology.—Herrington (1962, p. 38) summarizes the habitat as follows: "*P. dubium* has a preference for large, muddy creeks. But I have found live individuals in fine sand near shore in Rice Lake, Peterborough Co., Ontario, and in 34 feet of water in the St. Lawrence River near Grenadier Island."

Associations.—Living: ONTARIO-1; WISCONSIN-6, 123, 133.

General distribution (fig. 192).—There is still some doubt as to the exact distribution of this species in North America. Herrington's (1962, p. 38) statement reflects the present state of our knowledge: "Sterki (1916b, p. 446) states; 'East of the Rocky Mountains, north to Yukon and Alaska.' But all the records I have are: CANADA: Ontario (Lake Ontario and St. Lawrence River drainage, and Ottawa River near Ottawa); UNITED STATES: Vermont, Massachusetts, New York, New Jersey, Pennsylvania, District of Columbia, Virginia, South Carolina, Tennessee, Alabama, Georgia, Florida and Michigan."

Distribution in Ohio (inset, fig. 192).—Sterki (1907a, p. 396) records only *P. virginicum* for Ohio but in widely separated areas of the State: Portage, Stark, and Hamilton Counties, plus the Auglaize River in northwestern Ohio.

Geologic range.—Pleistocene: late(?) Wisconsin. There are two old and doubtful records of *P. dubium* from shell marl in Canada: Quebec, Rouge River Valley (D'Urban, 1860, p. 99), and Ontario, Niagara Falls, deposit of gravel and sand (Bell, 1861, p. 46). *P. virginicum* is recorded by Baker (1920a, p. 385) for the Sangamon and "Wabash."

Group 2

Shell medium or small, adults less than 6 mm. long. Nineteen species are included in this group, of which twelve occur in Ohio.

Pisidium fallax Sterki 1896
Pl. 4, fig. 5; pl. 7, fig. 11

Pisidium fallax Sterki 1896, Nautilus, v. 10, p. 20.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 396.
--- --- Sterki 1907, *ibid.*, p. 402, Defiance deposit.
--- --- Johnson 1915, Fauna New England, p. 55.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 449.
--- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 175, Tinkers Creek deposit.
--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 26.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 374, pl. 102, figs. 1-4.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 104.
--- --- Herrington 1954, Nautilus, v. 67, p. 136.
--- --- Herrington 1957, Canad. Field-Naturalist, v. 71, p. 8, Lake Nipigon.
--- --- La Rocque 1959, Sterkiana, no. 1, p. 30.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 38, pl. 4, fig. 5; pl. 7, fig. 11.

Type locality.—Tuscarawas River and Sugar Creek, Tuscarawas County, Ohio.

Diagnosis.—Anterior cusp of left valve twisted toward the interior, and the corresponding sulcus in the right valve twisted correspondingly. This characteristic distinguishes *P. fallax* from all others in Group 2.

Dimensions.—F. C. Baker (1928a, pt. II, p. 375) gives the following for Sterki's type specimen: L. 3.2, H. 2.9, D. 2.1 mm.; and for specimens from Lake Winnebago, Wisconsin: L. 2.9, 2.0; H. 2.5, 1.6; D. 1.6, 1.4 mm. Herrington (1962, p. 38) adds the following for specimens from the Indian River, Peterborough County, Ontario: L. 3.5, 2.8, 2.3, 1.7; H. 3.1, 2.5, 1.9, 1.5; D. 2.0, 1.4, 1.1, 0.8 mm.

Ecology.—"*P. fallax* has a preference for coarse sand and gravel, even sandy gravel in cracks on a flat rock bottom (specimens from sand are more apt to have the peculiar *P. fallax* beaks than are those from gravel). It appears to like water in motion, i.e., large creeks, rivers, or lakes and bays where there is considerable wave action. This species is rather scarce, has a spotty distribution, and usually only a few specimens are found in a place" (Herrington, 1962, p. 39). The following data are summarized from previous work. A species of lakes, especially large ones (Erie, Nipigon, Winnebago), rivers, both large and small (Ohio, Tuscarawas), and creeks. Specific records are numerous: Tuscarawas River and Sugar Creek, Ohio (Sterki, 1896, Naut. 10, p. 20); Lilycash Creek, Illinois (Baker, 1902, p. 401). Rivers, creeks, and races in Portage, Summit, Stark, and Tuscarawas Counties; Miami Canal at Hamilton; Sandusky and Maumee Rivers, in Ohio (Sterki,

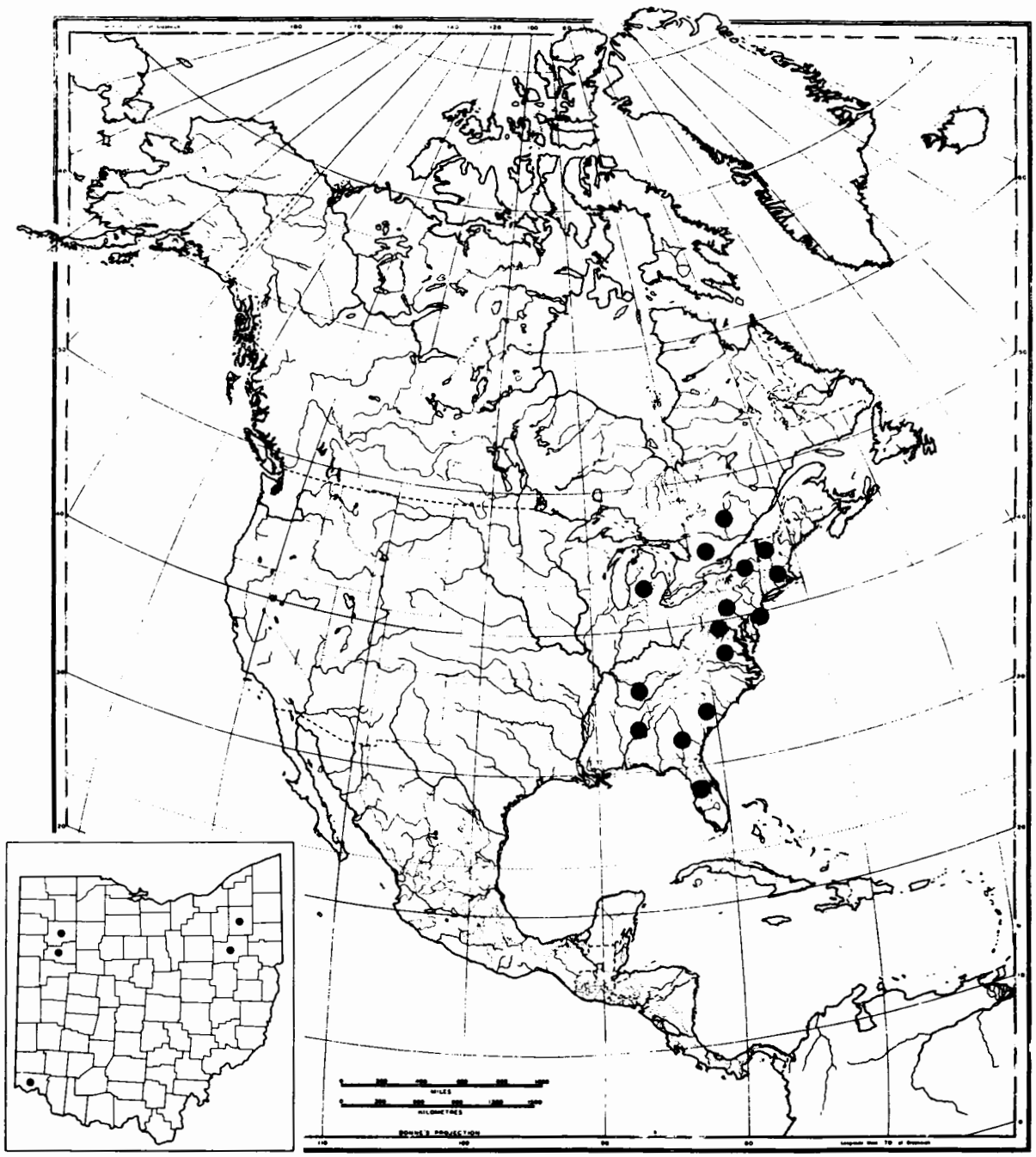


FIGURE 192.—Distribution of *Pisidium dubium* in North America; *inset,* distribution in Ohio.

1907a, p. 396). Aroostook River, rare (Lermond, 1909, p. 250); Lake Nipigon, Ontario (Adamstone, 1923b); Whitesand River, Saskatchewan (Mozley, 1926, Naut. 40). Ohio River, Lake Erie; Lake Winnebago, Wisconsin, boulder bottom, 0.6 m. deep (Baker, 1928a, pt. II, p. 375).

Associations.—Living: OHIO-43; WISCONSIN-80, 87. Fossil: W-26, 27.

General distribution (fig. 193).—Northwest Territories (Great Slave Lake), Saskatchewan, and Ontario, south to Maine (Sterki), New York, New Jersey, Alabama, Ohio, Michigan, Illinois (Sterki), Minnesota (Sterki), Iowa, and Washington (Herrington, 1962, p. 39).

Distribution in Ohio (inset, fig. 193).—Sterki's (1907a, p. 396) records indicate that this species probably lives all over the glaciated areas of Ohio, from Butler County in the south to Seneca County in the

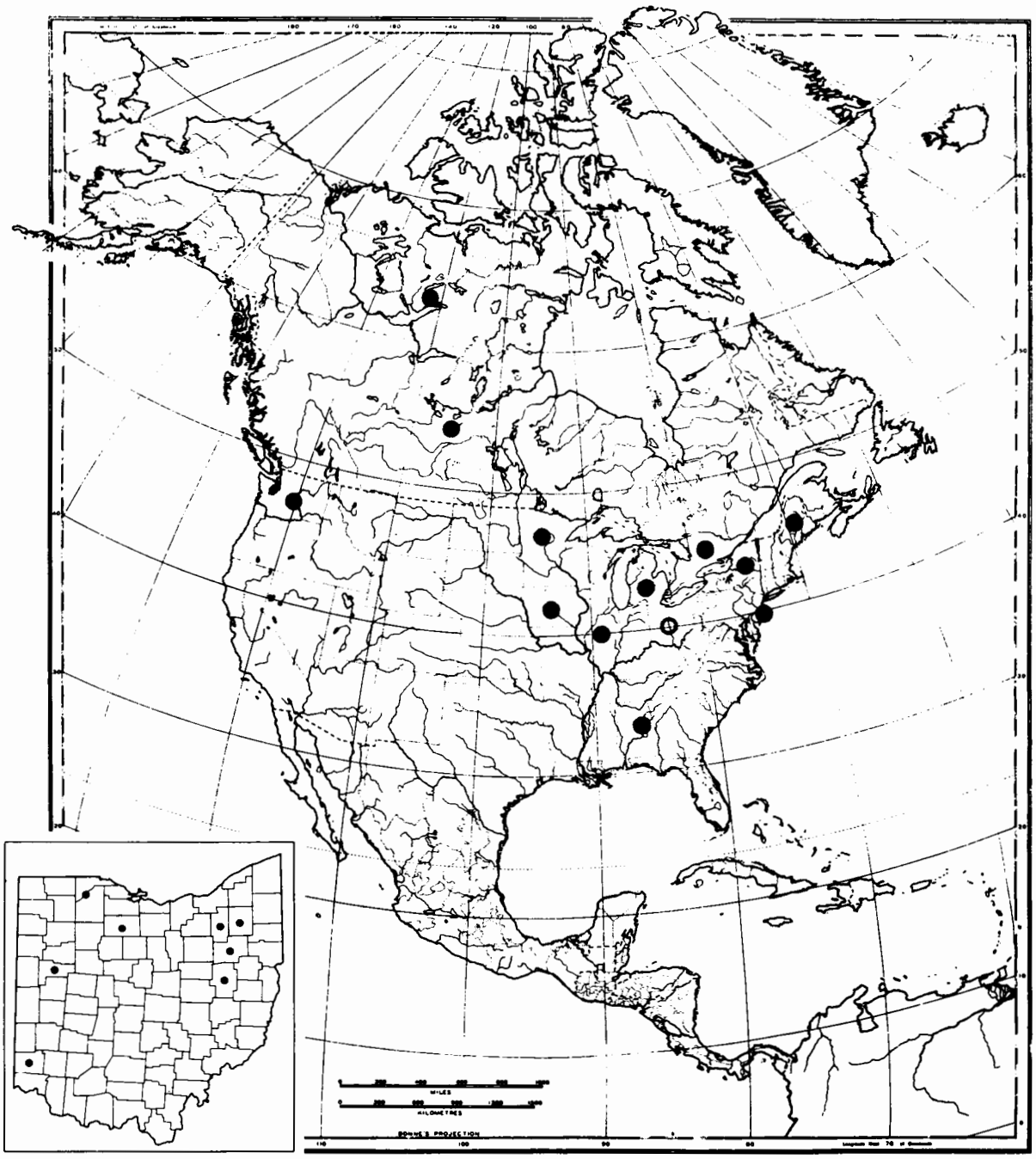


FIGURE 193.—Distribution of *Pisidium fallax* in North America; *inset,* distribution in Ohio.

north and Tuscarawas County in the east. His records also include Portage, Summit, and Stark Counties, and the Sandusky and Maumee Rivers.

Geologic range.—Pleistocene: Wisconsin. Sterki (1907a, p. 402) recorded this species for the Defiance deposit (loess?) of Ohio. Later (1916, p. 449) he listed it as a fossil in Michigan, New York (Goat Island), Ohio, and Illinois. Baker (1920a, p. 384) gave Sangamon and "Wabash." Sterki (1920, p. 175) cited it for the Tinkers Creek marl, Ohio. Mozley (1928, p. 268) listed it for a silt bed near Winnipeg, Manitoba. Aukeman (1960, p. 29) cited it for the Oakhurst deposit.

[*Pisidium fallax kirklandi* Sterki 1899]

Pisidium kirklandi Sterki 1899, Nautilus, v. 13, p. 11.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 396.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 449.
--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 27.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 323.
Pisidium fallax form *kirklandi* Herrington 1954, Nautilus, v. 67, p. 136.
Pisidium fallax kirklandi La Rocque 1959, Sterkiana, no. 1, p. 30.

Type locality.—None given. (The original description gives localities in Michigan, Illinois, and Ohio.)

Diagnosis.—"Mussel of medium size, somewhat oblique, well inflated when mature, very little so in the young, high, rather oval in outline; superior margin strongly, inferior moderately curved, posterior slightly truncated, passing into the superior by an obtuse, rounded angle, antero-superior slightly curved or almost straight, sloping toward the rounded anterior end; scutum well, scutellum slightly marked; beaks somewhat posterior, high and prominent in the mature, low in the young mussel, with stout ridges, highest at the posterior and slanting towards the anterior ends, slightly sinuous on the outer sides; surface with very coarse, rather regular striation, dull, rugulose, straw colored in the young, light grayish in the adult with a light zone along the margin; shell rather thick, nacre almost glossy, appearing bluish in old specimens, muscle insertions distinct; hinge stout, hinge plate broad; cardinal teeth of moderate size, rather high up on the plate, the right one angular, its posterior part thickened, with or without a groove; below it is a deep excavation; left cardinal teeth: the anterior rather stout but its edge acute, the posterior oblique, slightly curved; lateral teeth stout, the outer ones of the right valve quite small; ligament strong" (Sterki, 1899, Naut. 13, p. 11-12, original description).

Dimensions.—Sterki gives only "Long. 4, alt. 3.8, diam. 2.7 mill."

Ecology.—This form inhabits a variety of environments, as the following records show. Berry Lake, Illinois (F. C. Baker, 1902, p. 408); Auglaize River, Ohio (Sterki, 1907a, p. 396); Hidewood Creek, Deuel County, South Dakota (Over, 1915, p. 94).

General distribution.—South Dakota, Michigan, and Ontario, south to Alabama, but not yet recorded for many states in between.

Distribution in Ohio.—Auglaize River at Wapakoneta, Auglaize County.

Geologic range.—Pleistocene: late Wisconsin. Walker (1907, p. 180) has recorded this form from the Cobalt, Ontario, marl; Baker (1920a, p. 384) gave only "Wabash."

Remarks.—The form is probably of very little taxonomic value as Herrington (1962, p. 38-39) lists it merely as a synonym of *P. fallax.*

[*Pisidium fallax mite* Sterki 1905]

Pisidium fallax mite Sterki 1905, Nautilus, v. 19, p. 84.
--- --- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 397.
--- --- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 449.
--- --- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 26.
--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 104.
--- --- --- La Rocque 1959, Sterkiana, no. 1, p. 30.

Type locality.—Grand River, Michigan (first locality given).

Diagnosis.—"Rather smaller than the typical form, beaks without appendages, or slightly flattened on top; shell and hinge slighter" (Sterki, 1905, Naut. 19, p. 84, original description).

Dimensions.—None given by Sterki in the original description.

Ecology.—Sterki's original material came from Grand River, Michigan, and Nimishillen Creek, Canton, Ohio; it would seem that the form is one of small streams with rather sluggish flow.

General distribution.—Michigan, Ontario, and Ohio.

Distribution in Ohio.—Nimishillen Creek at Canton, Stark County (Sterki, 1907a, p. 397).

Geologic range.—No fossil record known to me.

Remarks.—The above account is given merely as a matter of record. Herrington (1962, p. 38) does not even list the name as a synonym of *P. fallax.*

[*Pisidium milium* Held 1836]
Pl. 4, fig. 3; pl. 7, fig. 9

Pisidium milium Held 1836, Isis, v. 29, p. ?
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 44.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin. Ventral aspect of shell very truncate in end view. In all the following species the shell, in end view, is not truncate but is evenly tapered ventrally.

Dimensions.—Herrington (1962, p. 44) gives the following for specimens from Denbigh Lake, Ontario: L. 2.9, 2.5, 2.2, 1.7; H. 2.3, 1.9, 1.7, 1.4; D. 2.0, 1.6, 1.4, 1.0 mm.

General distribution (fig. 194).—Ontario (north to James Bay), Manitoba (Sterki), Saskatchewan, and British Columbia, south to Maine (Sterki), New York, Michigan, Minnesota (Sterki), Montana, Oregon, Utah, Colorado; Aleutian Islands; Europe (Herrington, 1962, p. 45).

[*Pisidium insigne* Gabb 1868]
Pl. 6, fig. 5; pl. 7, fig. 21

Pisidium insigne Gabb 1868, Am. Jour. Conchology,

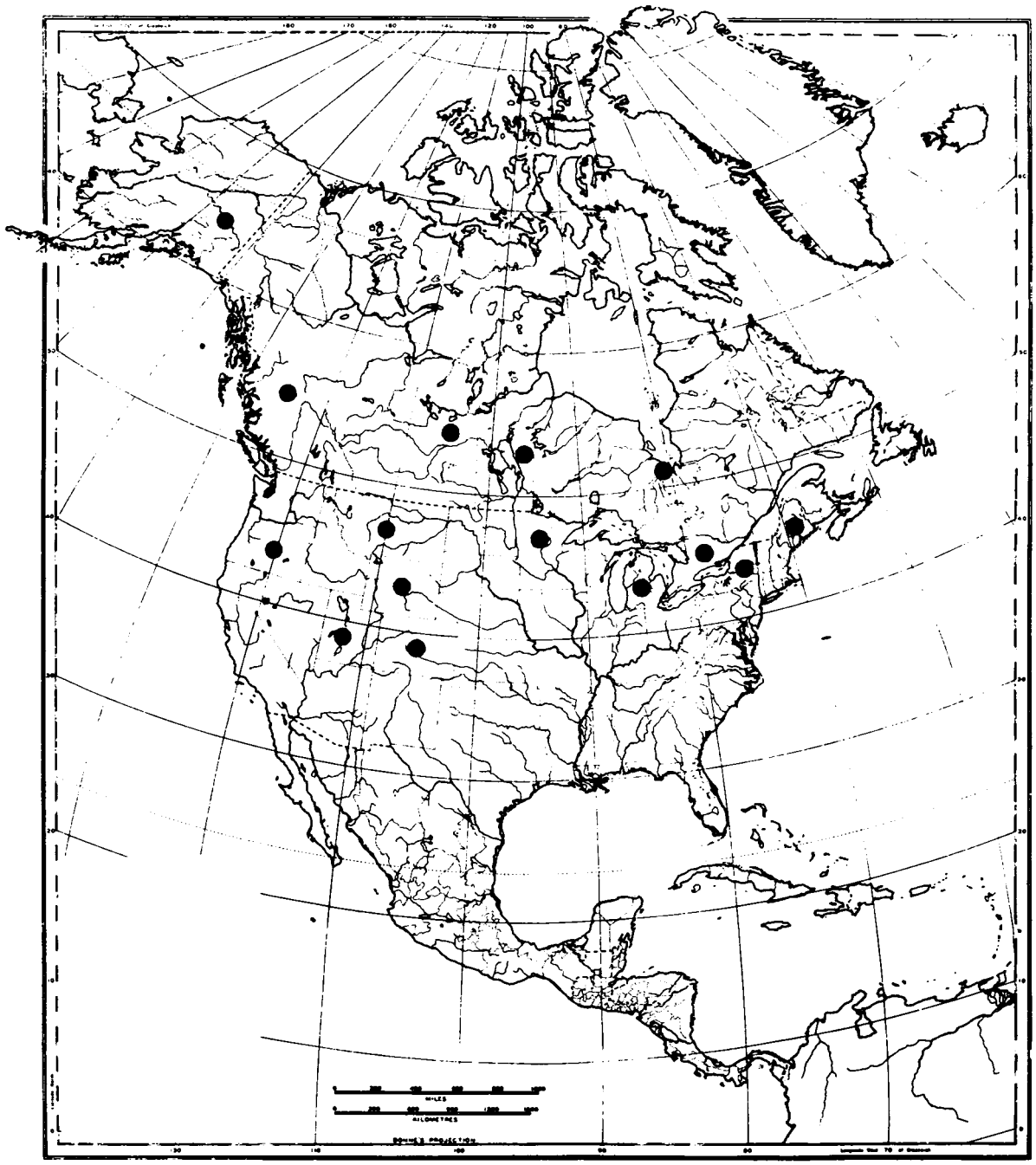


FIGURE 194.—Distribution of *Pisidium milium* in North America.

v. 4 (2), p. 69.

Pisidium insigne Herrington 1962, Revis. Sphaeriidae N. America, p. 42, pl. 6, fig. 5; pl. 7, fig. 21.

Diagnosis.—Anterior cusp of left valve not twisted but parallel to the dorsal margin; shell evenly tapered ventrally, in end view; hinge long (more than ¾ shell length); anterior end terminating in a blunt point.

Dimensions.—Herrington (1962, p. 42) gives the following for specimens from Spring Creek, Newburgh cheese factory, Lennox and Addington Counties, Ontario: L. 2.2, 1.9, 1.7, 1.5; H. 1.8, 1.6, 1.4, 1.1; D. 1.3, 1.1, 0.8, 0.7 mm.

General distribution.—Southern Ontario; British Columbia; Maine, New York, Michigan, Montana (Sterki), Wyoming, Washington, Oregon, Idaho, California, Nevada, Colorado, Arizona, and New Mexico.

Remarks.—The species has not so far been recorded, either living or fossil, for Ohio, but the general distribution indicates that it is likely to occur in the State, hence the description is given here for convenience.

Pisidium conventus Clessin 1877
Pl. 6, fig. 6; pl. 7, fig. 22

Pisidium abyssomus (Stm.) Hoy 1872, Wis. Acad. Sci. Trans., v. 1, p. 100 *(err. typ. pro abyssorum; nom. nud.).*

Pisidium abditum var. *abyssorum* Stimpson, S. I. Smith 1874, U.S. Fish Comm. Rept., 1872-73, p. 704 *(nom. nud.).*

Pisidium conventus Clessin 1877, Malakoz. Blätt., 1877, p, 181.

Pisidium abyssorum Stimpson 1898 *in* Sterki, Nautilus, v. 11, p. 124.

Corneocyclas abyssorum Dall 1905, Harriman-Alaska Exped., v. 13, p. 143.

Pisidium abyssorum (Stimpson) Sterki 1916, Cat. N. Am. Sphaeriidae, p. 463.

--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 25.

--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 415, pl. 104, figs. 16-20.

Pisidium conventus Odhner 1939, Nautilus, v. 52, p. 83, Alaska.

Pisidium abyssorum La Rocque 1953, Cat. Recent Moll. Canada, p. 102.

Pisidium conventus Herrington 1954, Nautilus, v. 67, p. 97, 134.

--- --- Herrington 1957, Canad. Field-Naturalist, v. 71, p. 8, Lake Nipigon, Ontario.

--- --- La Rocque 1959, Sterkiana no. 1, p. 30.

--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 36, pl. 6, fig. 6, pl. 7, fig. 22.

Type locality.—Not ascertained.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally in end view; hinge long (more than ¾ shell length); anterior end rounded; shell without heavy ridges or ridges, if present, only on the beaks; cardinals central or subcentral; shell commonly shaped like a parallelogram, *i.e.*, anterior and posterior ends sloped at the same angle; found only in cold waters.

Dimensions.—Herrington (1962, p. 36) gives the following measurements for specimens from Amethyst Lake, Jasper Park, Alberta: L. 3.2, 2.5, 1.8, 1.3; H. 2.8, 2.2, 1.6, 1.0; D. 2.0, 1.3, 1.0, 0.5 mm.

Ecology.—According to Herrington (1962, p. 36), "*P. conventus* apparently cannot stand warm water. It is found only in the Far North where it will be found even along the shore, or, when collected farther south, at high altitudes or in deep water (Herrington, 1950, p. 31). On July 2, 1947, D. S. Rawson's party brought up a live adult from a depth of 219 meters in Hearne Channel, Great Slave Lake, Northwest Territories (Herrington, 1950, p. 26)." The peculiar habitat of this species is well known in Europe. Germain (1931, p. 710) has described it as "essentially a form of the depths of Alpine lakes. In the lakes of Geneva and Joux, it is localized in the sublittoral and deep parts, where it lives from 5-8 m. to 70 m. and more in depth (exceptionally down to 300 m. in Lake Geneva). In fact, as has been shown by Odhner (1923, p. 36 ff.), this *Pisidium* has been cited, under various names, in numerous Alpine or subalpine lakes of central Europe and in the lakes of southern Sweden, always at notable depths. It has been found, but in the littoral zone, in the high lakes of the northern part of the Scandinavian peninsula and in Novaya-Zemlya (Odhner, 1923).

General distribution (fig. 195).—Herrington (1962, p. 36) gives the following: "CANADA: Quebec, Ontario, Saskatchewan, Alberta, and Northwest Territories (north to Great Bear Lake). UNITED STATES: Alaska, Washington, Colorado, New York (Cayuga Lake), Lake Superior, and Lake Michigan. EURASIA: as far north as Novaya Zemlya." Previous records for Lake Ontario (Sterki, 1916, p. 463; Kindle, 1925, p. 62, 450 feet) may be erroneous as they are not mentioned by Herrington.

Distribution in Ohio.—The species is included here on the possibility that it may occur in Lake Erie. I have no positive record for the State.

Geologic range.—No fossil record of this species is known to me. It would seem rather logical to expect it in proglacial deposits, which would meet its requirement for cold water, but so far there is no record of it as a fossil that I know of.

Pisidium punctiferum (Guppy) 1867
Pl. 6, fig. 2; pl. 7, fig. 19

Cyclas punctifera Guppy 1867, Annals and Mag. Nat. History, v. 3, no. 19, p. 160-161.

Pisidium punctatum Sterki 1895, Nautilus, v. 8, p. 99,

pl. 2, figs. 7-12, 14.

Pisidium limatulum Sterki 1905, Nautilus, v. 18, p. 108.

?*Pisidium punctatum simplex* Sterki 1905, Nautilus, v. 19, p. 84.

?*Pisidium variabile brevius* Sterki 1906, Nautilus, v. 19, p. 118.

Pisidium punctatum Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 397.

--- --- Johnson 1915, Fauna New England, p. 57.

Pisidium limatulum Sterki 1916, Cat. N. Am. Sphaeriidae, p. 451.

Pisidium punctatum Sterki 1916, *ibid.*

--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 27.

--- --- Goodrich and van der Schalie, 1944, Revis. Moll. Ind., p. 323.

Pisidium punctatum punctatum La Rocque 1953, Cat.

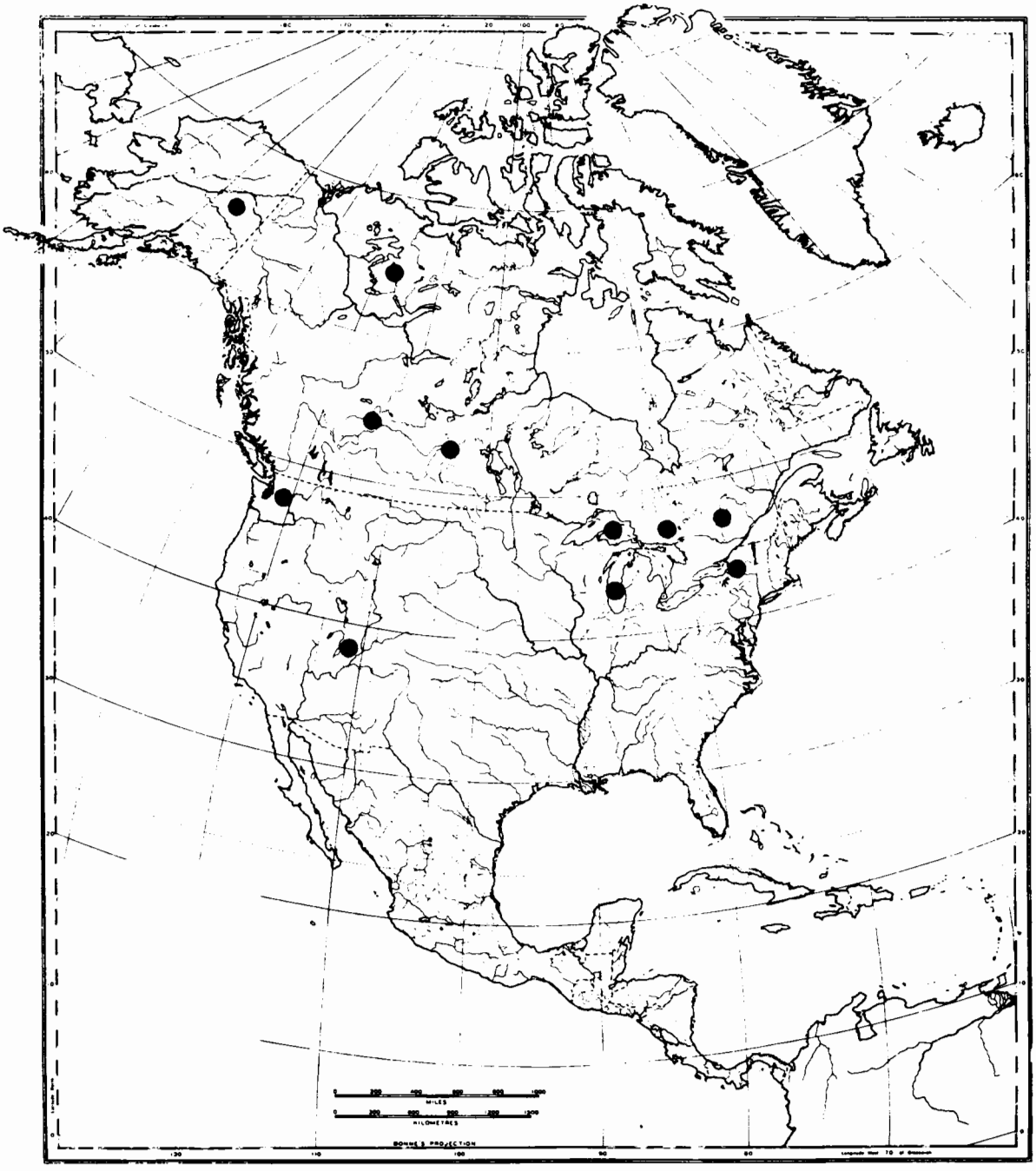


FIGURE 195.—Distribution of *Pisidium conventus* in North America.

Recent Moll. Canada, p. 109.

?*Pisidium variabile brevius* La Rocque 1953, *ibid.*, p. 112.

Pisidium limatulum Herrington 1954, Nautilus, v. 67, p. 137, *species dubia.*

--- --- La Rocque 1959, Sterkiana, no. 1, p. 30.

Pisidium punctatum La Rocque 1959, Sterkiana, no. 1, p. 31.

Pisidium punctiferum Herrington 1962, Revis. Sphaeriidae N. America, p. 47.

Type locality.—Trinidad.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally in end view; hinge long (more than ¾ shell length); anterior end rounded; shell without heavy ridges, or with ridges only on the beaks; cardinals central or subcentral; anterior and posterior ends sloped at different angles, *i.e.*, not parallel; shell dull; without ridges on the beaks.

Dimensions.—Herrington (1962, p. 47) gives the following for specimens from Bon Echo Creek, Frontenac County, Ontario: L. 2.2, 2.0, 1.8, 1.7; H. 1.8, 1.7, 1.6, 1.3; D. 1.2, 1.2, 1.0, 1.0 mm.; and for specimens in drift from Rio Culiacán, Sinaloa, Mexico: L. 2.4, 2.0, 1.7, 1.3; H. 2.1, 1.7, 1.3, 1.1; D. 1.7, 1.1, 0.8, 0.6 mm.

Ecology.—The following summary is by Herrington (1962, p. 48): "Creeks (the more angular form), lakes, and rivers. It has been collected from the St. Lawrence River at a depth of 34 feet." Goodrich (1944, p. 51) records the species for tributaries of the Coosa River, Alabama. F. C. Baker (1902, p. 404) recorded it for lakes and rivers, both large and small; Lake Erie and St. Lawrence drainage in Ohio; Mississippi drainage in Ohio; Mississippi drainage in Illinois. Sterki (1907a, p. 397) cited it from the Ohio River at Cincinnati; Miami Canal at Hamilton; doubtless all over the State, in running water. Lermond (1909, p. 250) found it rare in Portage Lake and Little Madawaska River, Maine; and Baker and Cahn (1931, p. 47) recorded it for Hamilton Lake, Ontario.

Associations.—Living: OHIO-43; WISCONSIN-133.

General distribution (fig. 196).—The latest summary is Herrington's (1962, p. 48): "CANADA: Ontario. UNITED STATES: Massachusetts, Pennsylvania, Virginia, Mississippi, Alabama, Florida, Ohio, Michigan, Indiana (Sterki), Illinois (Sterki), Wisconsin, Texas, and Arizona. MEXICO. CENTRAL and SOUTH AMERICA: Guatemala, Uruguay, and West Indies (including Trinidad). EUROPE."

Distribution in Ohio (inset, fig. 196).—Sterki (1907a, p. 397) gives Portage, Summit, Stark, and Tuscarawas Counties; Ohio River at Cincinnati; Miami Canal at Hamilton, and adds: "doubtless all over the state, in running water." Sterki (1916, p. 451) also gave "northeastern Ohio" for *P. limatulum*, a synonym.

Geologic range.—Pliocene? "What appears to be an early form of this species was recovered by the U.S. Geological Survey from the Late Pliocene of Utah and Idaho" (Herrington, 1962, p. 48). Pleistocene: Sangamon, Wisconsin. Sterki (1916, p. 451) gives "Fossil. - Illinois (loess)," and Baker (1920a, p. 384) gives Sangamon and "Wabash."

Pisidium cruciatum Sterki 1895
Pl. 5, fig. 5; pl. 7, fig. 16

Pisidium cruciatum Sterki 1895, Nautilus, v. 8, p. 97, pl. 2, figs. 1-6, 13.

--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 396.

--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 449.

--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 26.

--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 376, pl. 105, figs. 4-6.

--- --- Herrington 1954, Nautilus, v. 67, p. 137.

--- --- La Rocque 1959, Sterkiana, no. 1, p. 30.

--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 37, pl. 5, fig. 5; pl. 7, fig. 16.

Type locality.—Tuscarawas River, New Philadelphia, Tuscarawas County, Ohio.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally in end view; hinge long (more than ¾ shell length); anterior end rounded; shell without heavy ridges or with ridges only on the beaks; cardinals central or subcentral; anterior and posterior ends sloped at different angles, not parallel; shell dull, with ridges on the beaks; ridges U-shaped.

Dimensions.—F. C. Baker (1928a, pt. II, p. 376) gave the following for the type specimen: L. 1.9, H. 1.9, D. 1.4 mm.; and for a specimen from the Bark River, Wisconsin: L. 1.0, H. 1.0, D. 0.8 mm. Herrington (1962, p. 37) gave the following for a juvenile specimen from Joliet, Illinois: L. 1.3, H. 1.1, D. 0.7 mm.

Ecology.—Sterki's types came from the Tuscarawas River, Tuscarawas County, Ohio, a small river flowing over Lower Pennsylvanian rocks. Sterki (1895, Naut. 8, p. 98-99) stated "They live in mud among aquatic plants and dead leaves, and, as a rule, are covered with a black or brown coat, sometimes so thick that they appear to be globules of dirt . . ." Sterki (1907a, p. 396) also recorded it for the Miami Canal at Hamilton, Ohio; Baker (1902, p. 399) for Lilycash Creek, near Joliet, Illinois. It may therefore, be described as a species of small sluggish streams and canals, and may be expected in slow-moving waters, perhaps even in ponds and small lakes.

Associations.—Living: OHIO-43.

General distribution (fig. 197).—Ontario, Wisconsin, Michigan, Ohio, Maryland, south to Arkansas, Alabama, and Virginia.

Distribution in Ohio (inset, fig. 197).—Sterki (1907a, p. 396) gives "Tuscarawas River, Miami Canal at Hamilton." I have no other record.

Geologic range.—Pleistocene: Sangamon. The only fossil records appear to be those of Sterki (1916, p. 449) for "Illinois (lower loess)" and of Baker (1920a, p. 384) for Sangamon.

Pisidium compressum Prime 1851
Pl. 5, fig. 2; pl. 7, fig. 14

Pisidium compressum Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 164.
--- --- Prime 1865, Mon. Am. Corbiculadae, p. 64, figs. 67-68.

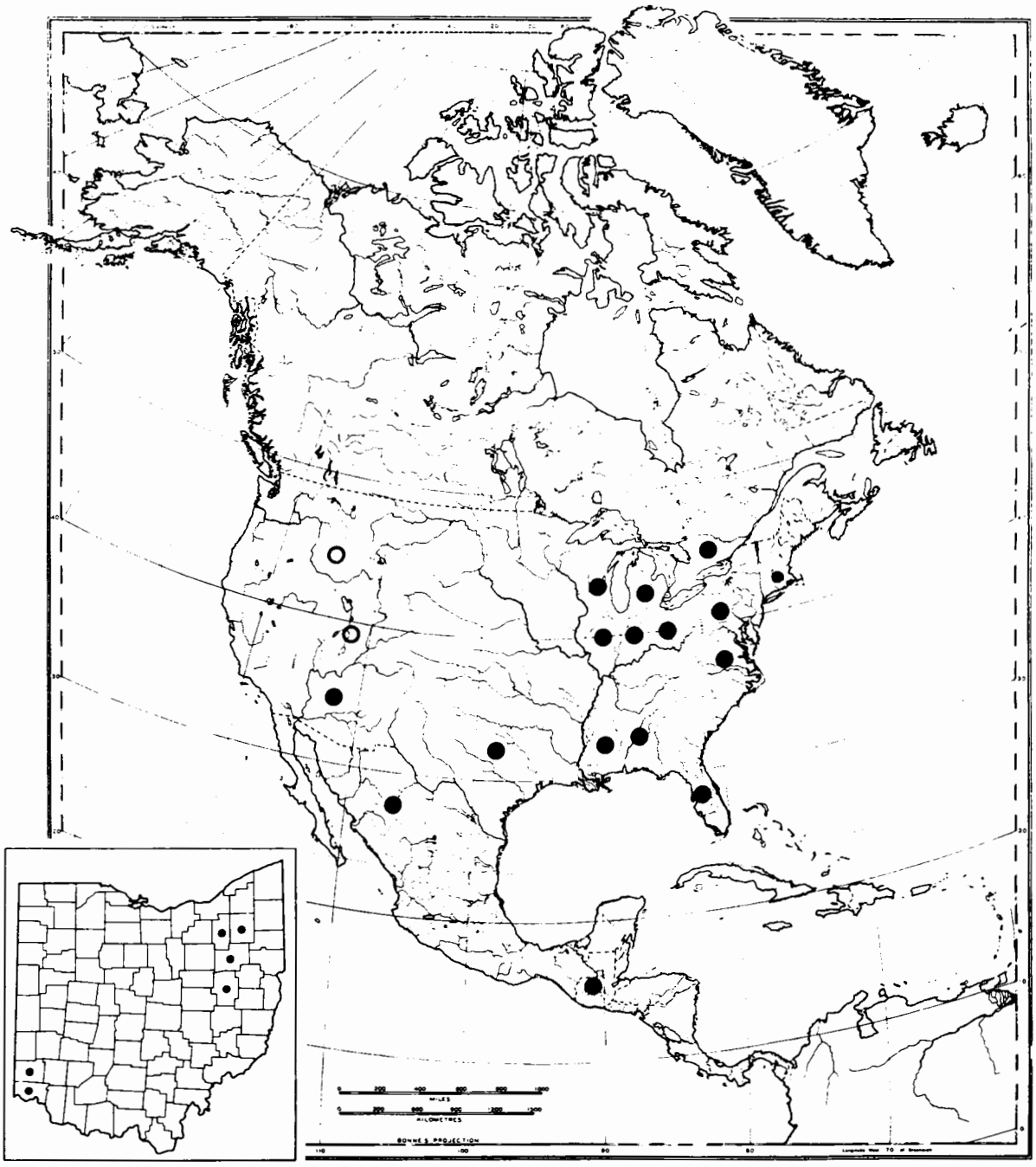


FIGURE 196.—Distribution of *Pisidium punctiferum* in North America; *inset,* distribution in Ohio.

Corneocyclas (Cymatocyclas) compressa Dall 1905, Harriman-Alaska Exped., v. 13, p. 142.
Pisidium compressum Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 396, 402.
--- --- Johnson 1915, Fauna New England, p. 54.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 447.
--- --- F. C. Baker 1920, Jour. Geology, v. 28, p. 446, Rush Lake deposit.
--- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 175, Tinkers Creek deposit; v. 20, p. 183.
--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 26.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 370, pl. 100, figs. 9-13.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 322.
--- --- Robertson and Blakeslee 1948, Moll. Niag-

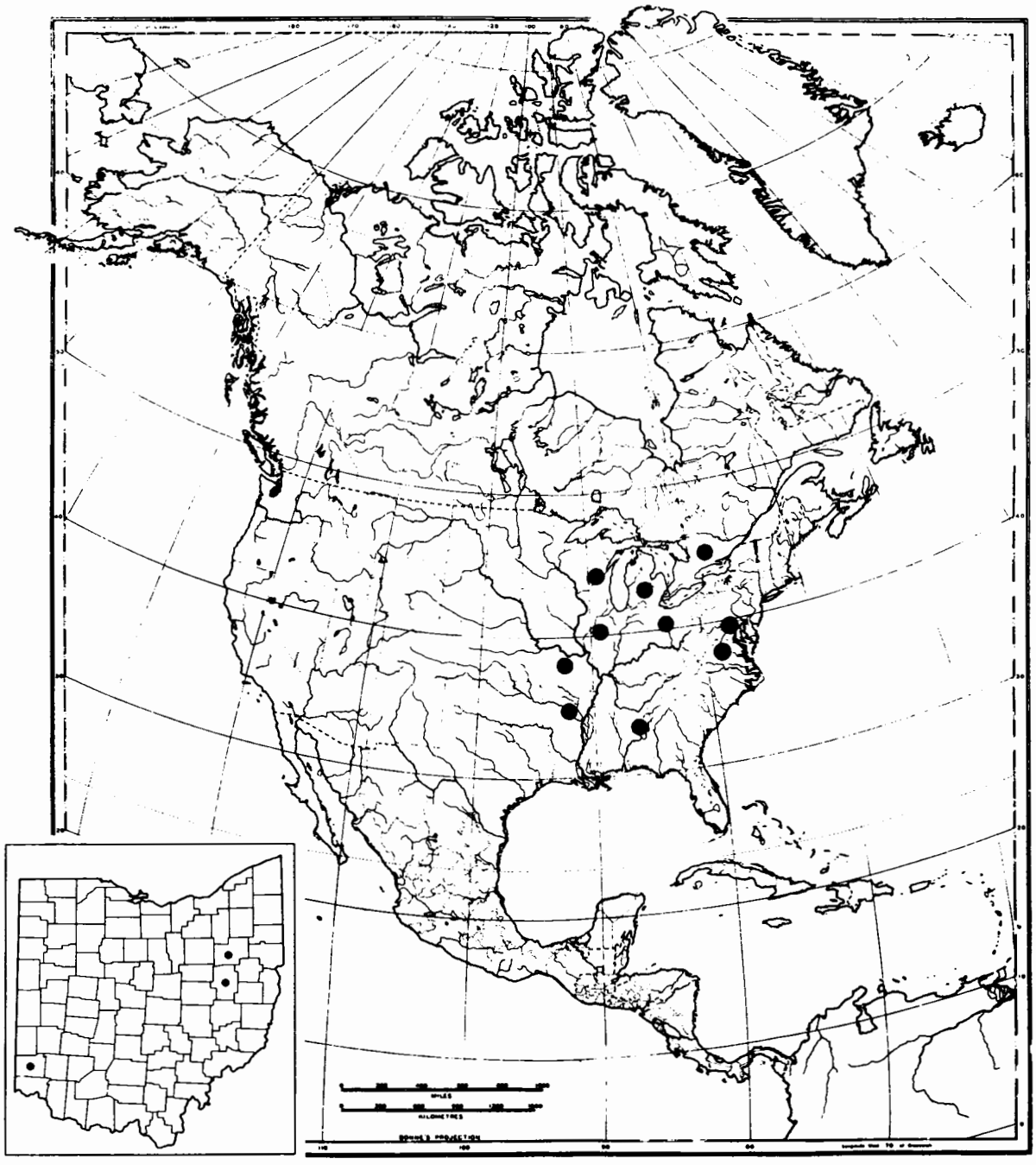


FIGURE 197.—Distribution of *Pisidium cruciatum* in North America; *inset,* distribution in Ohio.

ara Frontier, p. 119.

Pisidium compressum Leonard 1950, Kans. Univ. Paleont. Contr., Moll., art. 3, p. 40, pl. 1, fig. H, Yarmouth to Recent: Yarmouth?

--- --- van der Schalie 1953, Nautilus, v. 66, p. 84, Pleistocene, Kans.

--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 103.

--- --- Taylor and Hibbard 1955, Okla. Geol. Survey Circ. 37, p. 12.

--- --- Herrington 1957, Canad. Field-Naturalist, v. 71, p. 8.

--- --- Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 15.

--- --- La Rocque 1959, Sterkiana, no. 1, p. 30.

--- --- Taylor 1960, U.S. Geol. Survey Prof. Paper 337, p. 47.

--- --- Hibbard and Taylor 1960, Mich. Univ. Mus. Paleontology Contr., v. 16, no. 1, p. 78.

--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 35, pl. 5, fig. 2; pl. 7, fig. 14.

Type locality.—Fresh Pond, near Cambridge, Massachusetts.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally in end view; hinge long (more than ¾ shell length); anterior end rounded; shell without heavy ridges or with ridges only on the beaks; cardinals central or subcentral; anterior and posterior ends sloped at different angles, *i.e.*, not parallel; shell dull; shell with ridges on the beaks; ridges straight or slightly curved, but not U-shaped.

Dimensions.—F. C. Baker (1928a, pt. II, p. 370) gave the following for specimens from Medford, Wisconsin: L. 3.5, 3.1; H. 3.5, 3.0; D. 2.5, 2.3 mm.; and Herrington (1962, p. 35) gave the following for specimens from Rice Lake, Birdsall Beach, Peterborough County, Ontario: L. 3.8, 3.1, 2.4, 1.8; H. 3.8, 2.8, 2.1, 1.6; D. 2.7, 2.0, 1.3, 1.0 mm.

Ecology.—The following summary is by Herrington (1962, p. 35): "Creeks, rivers, and lakes. It has a preference for sandy bottoms with vegetation, and shallow water, but Kenneth G. Wood collected it at 16 meters in the western end of Lake Erie, and I brought it up from a depth of 20 meters in Mazinaw Lake, Lennox and Addington Co., Ontario. Sterki (1916b, p. 447) states: 'the river and creek form is regarded as typical.' Next to *P. casertanum* it is the most common *Pisidium* in North America."

The following recent summaries describe the environmental preferences of this species. It is "an inhabitant of streams, rather than ponds, but is occasionally found in the latter. It has been taken in lakes at depths up to 20 feet or more, on mud or clay bottoms. This species flourishes in a brook fed by artesian springs in Meade County, Kansas; here it lives in fine to coarse sand in swiftly flowing water, though it may also be found creeping about on aquatic vegetation" (A. B. Leonard, 1950, p. 40-41). "In lakes, rivers, and creeks; never in ponds, swamps, lagoons, or bog ponds" (Herrington and Taylor, 1958, p. 15). "This species inhabits only perennial water bodies with some current action, such as lakes, rivers and creeks; it is never found in ponds, swamps, lagoons, or bogs" (D. W. Taylor, 1960, p. 47). Reynolds (1959, p. 160) adds that it is a burrowing form that feeds on detritus and plankton, and is found in a variety of habitats, all of which have relatively firm bottoms. It has been collected in water with pH 7.0-8.37, fixed carbon dioxide 9.3-30.56 p.p.m. Quotations from previous literature would add many curious details but would not modify these statements in any essential way.

The Ohio records (Reynolds, 1959; Zimmerman, 1960; Mowery, 1961; Cornejo, 1961) show without a doubt that *P. compressum* is found in lacustrine deposits but it should be noted that the detailed ecological methods used explain its presence there in a satisfactory way without invalidating the general statements of Leonard, Herrington, and Taylor. The Humboldt deposit was laid down in a dammed river valley (Reynolds, 1959). In the other three, which are definitely lacustrine, *P. compressum* is a minor constituent of the fauna and must be interpreted as an allochthone, washed in from streams emptying into the lake. Its presence in lakes, noted by Leonard, may be due to the same circumstances.

Associations.—Living: NEW YORK-4b, 4c, 11, 21 (form *laevigatum*); OHIO-43; ONTARIO-9; QUEBEC-3; WISCONSIN-15, 16, 17, 27, 28, 29, 49, 54, 55, 56, 60, 79, 80, 84, 85, 86, 89, 93, 97, 121, 123, 128, 130, 133. Fossil: N-1, 2; K-1, 2; Y-1, 2, 4, 7, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20; W-26, 27, 28, 29, 30, 31, 32, 33, 34, 36, 37, 38, 39, 40, 41, 42, 45, 46, 47, 53, 54, 55.

General distribution (fig. 198).—North America from Northwest Territories (Great Slave Lake), Canada (British Columbia to Quebec and Prince Edward Island), southward to California, Nevada, Texas, Georgia, and Mexico.

Distribution in Ohio (inset, fig. 198).—Over the State.

Geologic range.—Middle Pliocene; Pleistocene: Nebraskan to present. Baker (1920a, p. 384) gave Aftonian, Yarmouth, Sangamon, and "Wabash." D. W. Taylor (1960, p. 47) recorded it for the Nebraskan of Nebraska and the Nebraskan or earliest Aftonian of Kansas. Leonard (1950, p. 12) gives Yarmouth(?) to Recent. Taylor and Hibbard (1955, p. 12) noted it for the Berends local fauna (probably Illinoian) of Kansas; van der Schalie (1953, p. 84) and Taylor and Hibbard (1955, p. 12) recorded it for the Sangamon of Kansas. Herrington (1962, p. 35) added middle Pliocene (pre-Buies Ranch fauna), the oldest record known to him. It is widespread in the Wisconsin of Kansas (Taylor and Hibbard, 1955, p. 12), Manitoba (Mozley, 1928,

p. 268), Ontario (Whittaker, 1921, p. 64), and Quebec (Whittaker, 1922a, p. 105).

The Ohio records, all of Wisconsin age, are the following: Defiance deposit (Sterki, 1907a, p. 402); Rush Lake marl (Baker, 1920b, p. 446); Castalia and Tinkers Creek marls (Sterki, 1920, p. 175, 183); Humboldt deposit (Reynolds, 1959, p. 155); Newell Lake deposit (Zimmerman, 1960, p. 20); Jewell Hill deposit (Mowery, 1961, p. 7); Souder Lake deposit (Cornejo, 1961, fig. 11); Oakhurst deposit (Aukeman, 1960, p. 27); and Aultman deposit (Sheatsley, 1960, p. 29).

[*Pisidium compressum laevigatum* Sterki 1905]

Pisidium compressum laevigatum Sterki 1905, Nautilus, v. 19, p. 81.

--- --- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 396.

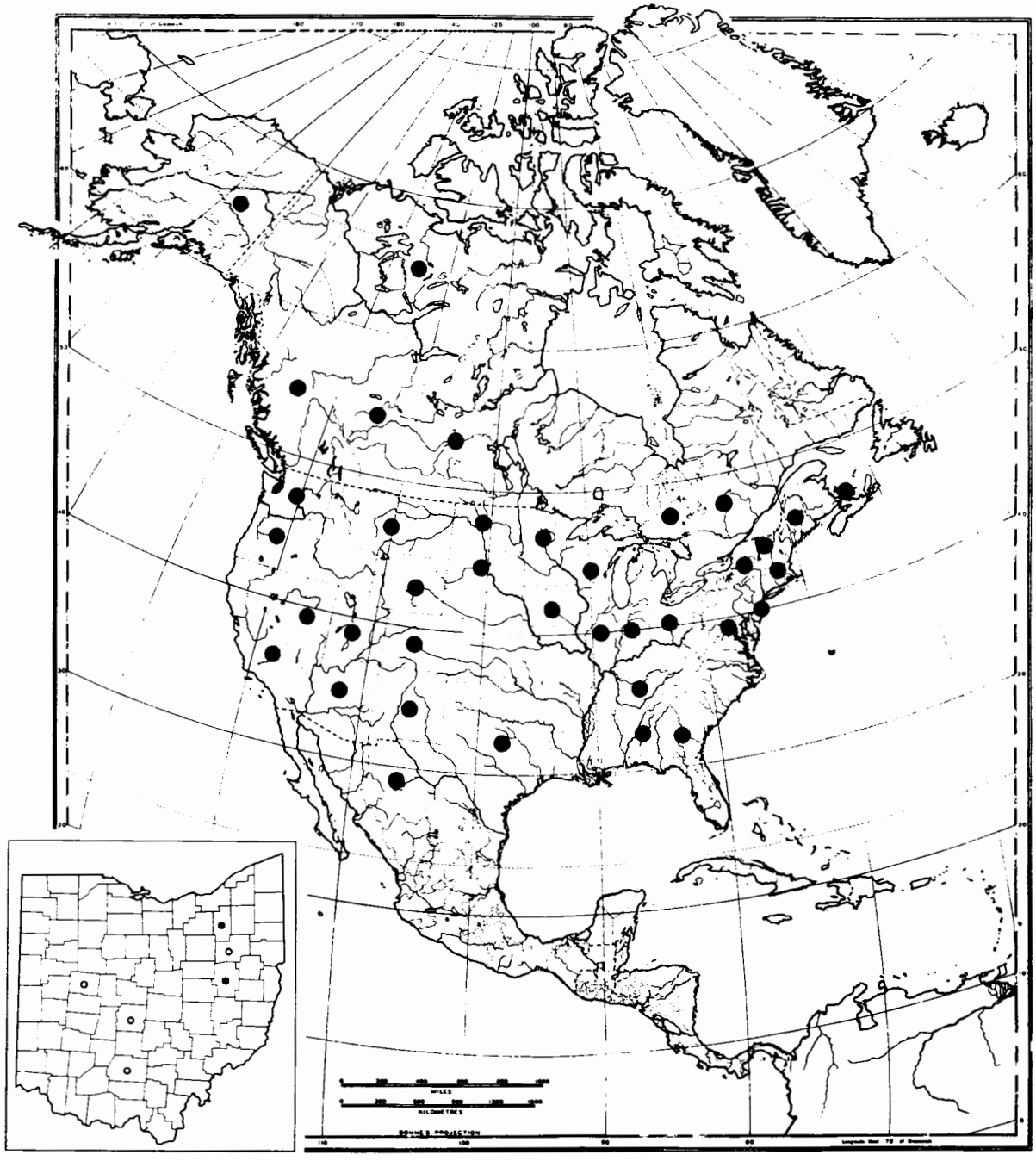


FIGURE 198.—Distribution of *Pisidium compressum* in North America; *inset*, distribution in Ohio.

Pisidium compressum laevigatum Sterki 1916, Cat. N. Am. Sphaeriidae, p. 447.
--- --- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p, 26.
--- --- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 323.
--- --- --- La Rocque 1959, Sterkiana, no. 1, p. 30.

Type locality.—None given.

Diagnosis.—"Moderately oblique, of medium to rather large size, generally well inflated; beaks less elevated, rounded or more or less flattened on top with slight or obsolete ridges; surface with fine irregular striae to nearly smooth, more or less shining; color light to dark horn; shell slight, translucent, nacre, more glassy; hinge slight, generally less angular than in the type" (Sterki, 1905, Naut. 19, p. 81, original description).

Dimensions.—None given by Sterki in original description.

Ecology.—"Widely distributed, in quiet waters. These mussels often have considerable resemblance, in shape, with *Pis. variabile* Pr. . . ." (Sterki, 1905, Naut. 19, p. 81). F. C. Baker (1916b, p. 261) collected it at four stations in Oneida Lake, New York: common at three, abundant at one. These four stations are classified under two environmental types, described by Baker as the "Bulrush-Water Willow Type" (1916b, p. 94) and the "Arrowhead-Cattail-Pickerelweed Type" (1916b, p. 95).

General distribution.—Montana, South Dakota, Michigan, New York, Illinois, Indiana, and Ohio.

Distribution in Ohio.—"Over the state" (Sterki, 1907a, p. 396).

Geologic range.—Pleistocene: late Wisconsin. Baker (1920a, p. 384) gave only "Wabash" for this form.

Remarks.—The form is of very minor taxonomic value, if any, as Herrington (1962, p. 35) does not mention it.

[*Pisidium compressum opacum* Sterki 1905]

Pisidium compressum opacum Sterki 1905, Nautilus, v. 19, p. 81.
--- --- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 396.
--- --- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 447.
--- --- --- La Rocque 1959, Sterkiana, no. 1, p. 30.

Type locality.—None given.

Diagnosis.—"In shape and size near the typical form, well inflated, but the surface is finely and irregularly striate, dull to shining, color often plumbeous above; beaks with the appendages slighter, or merely flattened on top; shell and hinge stout, the former opaque" (Sterki, 1905, Naut. 19, p. 81, original description).

Dimensions.—None given by Sterki in the original description.

Ecology.—"This is a form of sloughs, ditches, pools, etc., along rivers and creeks, quiet places in such, with muddy bottom, also of lakes and ponds near inlets; it seems to be a retrograde one, with respect to the surface sculpture, and it is notable that also the young in such places have the fine, obsolete striae" (Sterki, 1905, Naut. 19, p. 81, following original description).

General distribution.—Illinois, Ohio, and New Jersey (Sterki, 1916, p. 447).

Distribution in Ohio.—Recorded by Sterki (1907a, p. 396) only for Tuscarawas County.

Geologic range.—No fossil record is known to me.

Remarks.—This form is of very little taxonomic value, if any, as Herrington (1962, p. 35) does not mention it.

Pisidium nitidum Jenyns 1832
Pl. 5, fig. 6; pl. 7, fig. 17

Pisidium nitidum Jenyns 1832, Cambridge Philos. Soc. Trans., v. 4, p. 304, pl. 20, figs. 7-8.
Pisidium splendidulum Sterki 1898, Nautilus, v. 11, p. 113.
Pisidium tenuissimum Sterki 1901, Nautilus, v. 14, p. 99.
Pisidium minusculum Sterki 1906, Nautilus, v. 20, p. 17.
Pisidium splendidulum Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 398.
Pisidium nitidum Woodward 1913, Cat. British *Pisidia*, p. 44.
Pisidium glabellum Sterki 1913, Nautilus, v. 26, p. 137.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 454.
Pisidium minusculum Sterki 1916, *ibid.*, p. 453.
Pisidium splendidulum Sterki 1916, *ibid.*, p. 461.
Pisidium splendidulum corneolum Sterki 1916, *ibid.*, p. 462.
Pisidium tenuissimum Sterki 1916, *ibid.*, p. 463.
Pisidium splendidulum Sterki 1920, Ohio Jour. Sci., v. 20, p. 175, Tinkers Creek deposit.
Pisidium tenuissimum F. C. Baker 1920, Jour. Geology, v. 28, p. 447, Rush Lake deposit.
Pisidium splendidulum Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 28.
Pisidium minusculum F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 383, pl. 102, figs. 5-8.
Pisidium splendidulum F. C. Baker 1928, *ibid.*, p. 410, pl. 102, figs. 28-30.
Pisidium tenuissimum F. C. Baker 1928, *ibid.*, p. 418, pl. 104, figs. 29-33.
Pisidium nitidum Germain 1931, Faune de France, v.

22, p. 706.

Pisidium glabellum Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 323.

Pisidium splendidulum Goodrich and van der Schalie 1944, *ibid.*

Pisidium nitidum Adam 1947, Mém. Mus. roy. Hist. Nat. Belgique, no. 106, p. 202.

Pisidium glabellum La Rocque 1953, Cat. Recent Moll. Canada, p. 105.

Pisidium splendidulum La Rocque 1953, *ibid.*, p. 110.

Pisidium nitidum Herrington 1954, Nautilus, v. 67, p. 132.

--- --- Taylor and Hibbard 1955, Okla. Geol. Survey Circ. 37, p. 12.

--- --- Herrington 1957, Canad. Field-Naturalist, v. 71, p. 8, Lake Nipigon.

--- --- Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 14.

--- --- La Rocque 1959, Sterkiana, no. 1, p. 31.

--- --- Hibbard and Taylor 1960, Mich. Univ. Mus. Paleontology Contr., v. 16, no. 1, p. 78.

--- --- Taylor 1960, U.S. Geol. Survey Prof. Paper 337, p. 48.

--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 45, pl. 5, fig. 6; pl. 7, fig. 17.

Type locality.—Great Britain.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally in end view; hinge long (more than ¾ shell length); anterior end rounded; shell without heavy ridges or with ridges only on the beaks; cardinals central or subcentral; anterior and posterior ends of shell sloped at different angles, *i.e.*, not parallel; shell glossy; beaks not prominent; finely striate (more than 30 striae per mm.) and frequently with several coarse striae at outer edge of embryonic shell.

Dimensions.—Germain (1931, p. 706) gave measurements for European specimens up to 5 mm. long and 2.75 mm. high. Herrington (1962, p. 45) gave the following measurements for specimens from Napanee River, ¼ mile above Colebrook, Lennox and Addington Counties, Ontario: L. 3.0, 2.6, 2.2, 1.6; H. 2.7, 2.2, 1.8, 1.4; D. 2.0, 1.4, 1.3, 0.9 mm.

Ecology.—Herrington (1962, p. 46) summarized the habitat of this species as follows: "Large ponds, bog ponds, lakes, creeks, and rivers. Seems to prefer shallow water; fairly common." Germain (1931, p. 706) stated that it lives in lakes (down to 20-25 m. in large lakes such as Lake Geneva), ponds, brooks, and ditches, preferably in clear or fairly clear waters but with aquatic plants (rare or absent in marshes); it still lives in the Pyrenees, at 2,150 m. altitude; it is frequent, fossil, in many Quaternary formations; common, all France; lives also in Corsica, in a brook with clear water, at 1,500 m. alt. Adam (1947, p. 202) said that it seems to prefer stagnant or slow moving water. Previous statements on its ecology in North America may be helpful. Herrington and Taylor (1958, p. 14) stated: "The typical form of this species occurs in lakes and ponds. The form *pauperculum* Sterki lives in lakes, rivers, and large creeks, where it thrives in soft sand." Found "on a clay bottom in 5 ft water, on a mud bottom in approximately 17 ft water, and on a soft sand bottom in shallow water" (Reynolds, 1959, p. 162). "Found only in perennial water bodies, such as lakes, ponds, rivers, and large creeks" (D. W. Taylor, 1960, p. 48). The following records, for very small bodies of water, illustrate the adaptability of the species: muddy duck pond in field, Warren, Maine (Lermond, 1909, p. 251); Scott Graham Creek, Graham Bay Creek, Hare's Spring, on Hare Farm, Nepean, near Watson line, Carleton County, Ontario (Latchford, 1916, p. 93).

Associations.—Living: WISCONSIN-55, 79 *(minusculum);* 129 *(splendidulum).* Fossil: N-1, 2; S-6; W-27, 28, 29, 31, 32, 33, 34, 36, 37, 38, 39, 41, 42, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55. Form *contortum:* Fossil: S-1; W-53, 54, 55. See also under *P. nitidum* form *pauperculum.*

General distribution (fig. 199).—"Eurasia and North Africa; in North America, from Mexico to Hudson Bay, except for southeastern United States" (Herrington and Taylor, 1958, p. 14).

Distribution in Ohio (inset, fig. 199).—Probably to be found living throughout the State.

Geologic range.—Early Pliocene; Pleistocene: Nebraskan, Aftonian, Illinoian(?), Sangamon, Wisconsin. This species has been recorded by Taylor (1960, p. 48) for the Nebraskan of Nebraska and the Nebraskan or earliest Aftonian of Kansas; by Taylor and Hibbard (1955, p. 12) for the Berends local fauna (probably Illinoian), the Jinglebob local fauna (Sangamon), and the Jones local fauna (Wisconsin) of Kansas. Herrington (1962, p. 46) records it for the Laverne formation (early Pliocene). In Ohio, it has been identified from the Humboldt deposit (Reynolds, 1959, p. 155), the Newell Lake deposit (Zimmerman, 1960, p. 20), the Jewell Hill deposit (Mowery, 1961, p. 7), the Souder Lake deposit (Cornejo, 1961, fig. 11), the Oakhurst deposit (Aukeman, 1960, p. 34), and the Aultman deposit (Sheatsley, 1960, p. 35). As *P. handwerki* it is noted doubtfully for the Pleistocene, presumably of Illinois, by F.C. Baker (1902, p. 406). Under *P. splendidulum,* a synonym, Sterki (1916, p. 461) gives "Fossil.-Maine, Ohio, Michigan, Illinois." Baker (1920a, p. 384) gives "Wabash." Sterki (1920, p. 175) records it for the Tinkers Creek marl under the same name. As *P. tenuissimum* Sterki (1916, p. 463) notes it as fossil from Maine, Ohio, Michigan, and Illinois; and Baker (1920a, p. 384) for "Wabash." Walker (1907, p. 180) cites it from the Cobalt, Ontario, marl; and Baker (1920b, p. 447) from the Rush Lake, Ohio, marl. As *P. triangulare,* Baker (1920a, p. 384) gives it as a fossil of "Wabash" age.

[*Pisidium nitidum* form *pauperculum* Sterki 1896]

Pisidium pauperculum Sterki 1896, Nautilus, v. 10, p. 64.

Pisidium pauperculum Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 398.

Pisidium pauperculum crystalense Sterki 1907, *ibid.*, p. 398 *(nom. nud.)*.

--- --- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 463 (described).

Pisidium pauperculum Sterki 1916, *ibid.*, p. 463.

--- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 183, Castalia marl.

--- --- "different forms, *crystalense* and *nylanderi*" Sterki 1920, Ohio Jour. Sci., v. 20, p. 175, Tinkers Creek deposit.

Pisidium pauperculum Winslow 1928, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 27.

Pisidium pauperculum crystalense Winslow 1926, *ibid.*

Pisidium pauperculum F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 420, pl. 100, figs. 22-25.

--- --- La Rocque 1953, Cat. Recent Moll. Canada,

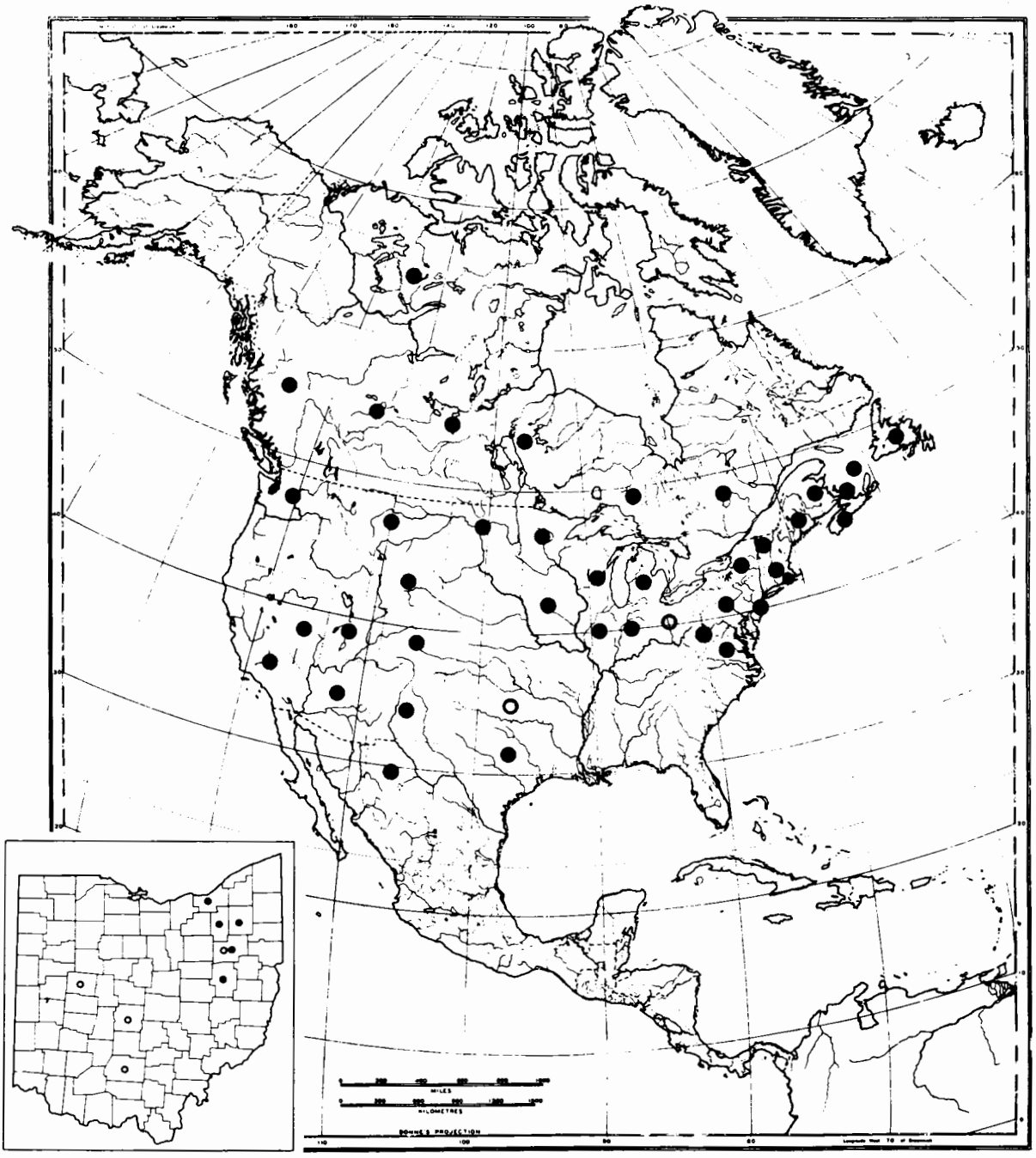


FIGURE 199.–Distribution of *Pisidium nitidum* in North America; *inset*, distribution in Ohio.

p. 108.

Pisidium nitidum pauperculum La Rocque 1959, Sterkiana, no. 1, p. 31.

--- --- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 45.

Type locality.—None given.

Diagnosis.—"Of moderate size, rather oblique, moderately to rather strongly inflated; beaks slightly posterior, moderately large and prominent, rounded; scutum and scutellum slightly marked, edges acute or acutish, not pinched; superior and inferior margins moderately curved, posterior well rounded or slightly truncated, joining the inferior without any marked angle; antero-superior margin sloping, oblique, slightly curved, meeting the inferior at an angle situated rather inferior, more distant in the adult than in younger examples; surface very finely striated, polished; color pale or yellowish to greenish-horn, sometimes whitish or straw in old specimens; shell thin, translucent. (Sterki).

"Hinge moderately strong; cardinal of right valve more or less curved, enlarged at the posterior end, placed about the center of the hinge plate; upper cardinal of left valve rather long, curved more or less, rather thin; lower cardinal thicker, long; (fig. 295); laterals strong, the posterior ones curved, the anterior almost straight" (F. C. Baker, 1928a, pt. II, p. 420-421).

Dimensions.—Baker (1928a, pt. II) gives the following measurements for the average of type specimens: L. 3.2, H. 2.7, D. 1.9 mm.; and for specimens from Lake Winnebago, Wisconsin: L. 3.1, 2.5, 3.0; H. 3.0, 2.1, 2.6; D. 2.2, 1.5, 1.9 mm. Herrington (1962, p. 45) gives the following for specimens from the Indian River, Peterborough County, Ontario: L. 2.8, 2.4, 2.0, 1.7; H. 2.6, 2.2, 1.8, 1.6; D. 1.8, 1.6, 1.3, 1.0 mm.

Ecology.—Several workers on Pleistocene Mollusca in Ohio have written on the ecology of this form (Reynolds, 1959, p. 160; Zimmerman, 1960, p. 23; Mowery, 1961, p. 7; Cornejo, 1961, p. 41); their statements may be summarized as follows: The form seems to prefer quiet shallow water and mud or sand bottom, much as does *P. nitidum nitidum.* It has been collected in depths of 1-39.5 m. but is commoner in 1-5 m. It will live on sand and gravel or gravel bottom and on marly clay. It is known in large, medium-sized, and small lakes but has also been recorded in brooks (Lermond, 1909, p. 252; Sterki, 1907a, p. 398) and small rivers, such as the Cuyahoga in Ohio (Sterki, 1907a, p. 398). It burrows into the bottom sediments and feeds on detritus and plankton. Its recorded pH range is 7.0-8.0, fixed carbon dioxide ratio 9.3-24.73 p.p.m.

Associations.—Living: WISCONSIN - 15, 16, 28, 29, 51, 54, 79, 93, 116, 123, 128, 133. Fossil: W - 30, 31, 32, 33, 34, 36, 37, 38, 39, 40, 41, 42, 45, 46, 47, 53, 54, 55.

General distribution.—Manitoba (doubtfully) and Ontario, to Maine, south to South Dakota, Minnesota, Wisconsin, Indiana, Ohio, and New Jersey.

Distribution in Ohio.—Sterki (1907a, p. 398) records it living in Summit County (typical form) and in Cuyahoga and Stark Counties (form *crystalense*).

Geologic range.—Pleistocene: late Wisconsin. *Pisidium pauperculum* is cited as a fossil by Walker (1907, p. 180) for the Cobalt, Ontario, marl; by Sterki (1916, p. 463) for Maine, New Jersey, Ohio, Michigan, Ontario, but "partly including varieties"; by Baker (1920a, p. 384) as "Wabash"; by Sterki (1920, p. 183) for the Castalia, Ohio, marl. As a form of *P. nitidum* it is recorded for Ohio marl deposits for the Humboldt (Reynolds, 1959, p. 155), Newell Lake (Zimmerman, 1960, p. 20), Jewell Hill (Mowery, 1961, p. 7), Souder Lake (Cornejo, 1961, fig. 11), Oakhurst (Aukeman, 1960, p. 38), and Aultman (Sheatsley, 1960, p. 39) deposits.

Sterki (1920, p. 175) records forms *crystalense* and *nylanderi* from the Tinkers Creek marl. The form *nylanderi* is also recorded by Sterki (1916, p. 463) as a fossil in Maine.

Pisidium aequilaterale Prime 1852
Pl. 5, fig. 1; pl. 7, fig. 13

Pisidium aequilaterale Prime 1852, Boston Nat. History Jour., v. 6, p. 366, pl. 12, figs. 23-25.

--- --- Prime 1865, Mon. Am. Corbiculadae, p. 63, figs. 65-66.

Corneocyclas aequilateralis Dall 1905, Harriman-Alaska Exped., v. 13, p. 141, fig. 113.

Pisidium aequilaterale Johnson 1915, Fauna New England, p. 51.

--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 451.

--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 103.

--- --- Herrington 1954, Nautilus, v. 67, p. 135.

--- --- La Rocque 1959, Sterkiana, no. 1, p. 29.

--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 31, pl. 5, fig. 1; pl. 7, fig. 13.

Type locality.—Augusta, Maine.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally; hinge long (more than ¾ shell length); anterior end rounded; shell without heavy ridges or with ridges only on the beaks; cardinals central or subcentral; anterior and posterior ends sloped at different angles, *i.e.*, not parallel; shell glossy; beaks prominent, moderately striate (fewer than 30 striae per mm.); beaks subcentral.

Dimensions.—Herrington (1962, p. 31) gives the following measurements for specimens from Mazinaw Lake, Campbell's Bay, at mouth of small creek, Lennox and Addington Counties, Ontario: L. 3.5, 3.0, 2.2, 1.6; H. 3.4, 2.9, 1.9, 1.2; D. 2.8, 2.2, 1.5, 1.0 mm.

Ecology.—The following excellent summary is given by Herrington (1962, p. 32). "Creeks, rivers, and lakes. Prefers small weeds on a fine sandy bottom. Almost

all my specimens are from igneous rock formations. In the Mississippi River (Ontario) drainage system it is fairly abundant. Over 500 specimens were collected from a spot a rod square in the mouth of a creek in Mazinaw Lake." Prime's original specimens came from a clay pit in Maine; F. C. Baker (1916b, p. 261) obtained it from Oneida Lake in a sandy exposed bay and in a protected bay with vegetation, rare in both places.

Associations.—Living: NEW YORK - 21.

General distribution (fig. 200).—The range as given by Herrington (1962, p. 32) is considerably more restricted than previous records and is quoted here in full: "CANADA: Quebec and Ontario (east of Toronto). UNITED STATES: Maine, Vermont, Massachusetts, Rhode Island, New York, New Jersey, Pennsylvania, Virginia (Sterki), Michigan (Sterki), and Illinois." Dall (1905, p. 141) had given its range as "Alaska to Michigan and Maine" but much of this was apparently based

FIGURE 200.—Distribution of *Pisidium aequilaterale* in North America.

on misidentifications.

Distribution in Ohio.—The presence of the species in Ohio is to be expected since it is recorded to the north, east, and south of the State, but so far it has not been recorded here.

Geologic range.—Pleistocene: late Wisconsin, perhaps incorrectly, in marl associated with mammoth bones, at Elephant Point, Kotzebue Sound, Alaska. Another record (Sterki, 1916, p. 451) is for New Jersey and is probably correct. It has not been recorded as a fossil for Ohio.

Pisidium variabile Prime 1851
Pl. 3, fig. 4; pl. 7, fig. 4

Pisidium variabile Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 163.
--- --- Prime 1865, Mon. Am. Corbiculadae, p. 66, figs. 69, 70.
Pisidium mirabile (Whittemore) Clessin 1879, Cycladeen, p. 49, pl. 6, figs. 1-3, 19-21.
Corneocyclas variabilis Dall 1905, Harriman-Alaska Exped., v. 13, p. 142, fig. 114.
Pisidium variabile Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 397.
--- --- Johnson 1915, Fauna New England, p. 53.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 453.
--- --- F. C. Baker 1920, Jour. Geology, v. 28, p. 446, Rush Lake deposit.
--- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 175, Tinkers Creek deposit.
--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 28.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 381, pl. 101, figs. 1-4.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 323.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 119.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 111.
--- --- Herrington 1954, Nautilus, v. 67, p. 135.
--- --- Herrington 1957, Canad. Field-Naturalist, v. 71, p. 8, Lake Nipigon.
--- --- La Rocque 1959, Sterkiana, no. 1, p. 31.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 50, pl. 3, fig. 4; pl. 7, fig. 4.

Type locality.—Fresh Pond, near Cambridge, Massachusetts.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally in end view; hinge long (more than ¾ shell length); anterior end rounded; shell without heavy ridges or with ridges only on the beaks; cardinals central or subcentral; anterior and posterior ends sloped at different angles, *i.e.*, not parallel; shell glossy; beaks prominent; moderately striate (fewer than 30 striae per mm.); beaks posteriorly placed.

Dimensions.—Baker (1928a, pt. II, p. 381) gave the following for specimens from Brown County, Wisconsin: L. 3.8, 3.9, 3.5; H. 3.2, 3.2, 3.0; D. 2.5, 2.5, 2.5 mm. Herrington (1962, p. 50) gave the following for specimens from a creek, Lennox and Addington Counties, Ontario: L. 4.6, 3.8, 3.0, 1.8; H. 3.9, 3.2, 2.4, 1.4; D. 2.8, 2.3, 1.7, 0.9 mm.

Ecology.—"Creeks, rivers, and lakes; usually in still water where soft sediments accumulate" (Herrington, 1962, p. 50). The following summaries are from previously published accounts. Reynolds (1959, p. 162) summarized its habitats as follows: It is found both in rivers and lakes, frequently in water 1-13 ft. deep, burrowing in gravel, sand, clay, and mud, but is more abundant in mud where the water is 4-11 feet deep. It has been collected in waters with pH 5.72-8.37, fixed carbon dioxide 1.72-30.56 p.p.m. Baker (1928a, pt. II, p. 382) gave numerous data for lakes and rivers in Wisconsin: Lake Winnebago, mud bottom, 3.7-6.1 m.; sand and gravel bottom, 0.3-3.1 m.; Lake Butte des Morts, mud bottom, 1.2-3.4 m.; Lake Chetek, mud bottom, 2.5 m.; Green Lake, marly clay bottom, 0.5-10 m.; Bayfield, mud bottom, small pool behind beach, 0.3 m.; Devils Lake, mud bottom, 8.5-13.5 m. (Baker); Bark River, sand bottom, with gravel and some silt, matted vegetation, shallow water, considerable current; Ashippun River, gravel and silt bottom, shallow to 1 m. deep; Oconomowoc Lake, water 3-5 m. deep, in vegetation; Mud Lake, soft mud bottom, shallow water; Oconomowoc Lake, 12 m. deep, sand bottom (Cahn). The following data from the literature confirm the impression that the species may live in almost any kind of lake or river. Stewart River, Yukon (Whiteaves, 1905a, p. 64); Kawinogans River, Ontario (Whiteaves, 1905a, p. 64); Lake St. Joseph and Albany River (Whiteaves, 1906, p. 30); small lake in the sand hills west of Pine Creek, and northeast of Carberry, Manitoba (Whiteaves, 1907, p. 240); Chippawa Creek, near Buffalo (Letson, 1909, p. 244); Oneida Lake, New York, at three stations, on sandy bottom in protected bays (Baker, 1916b, p. 261); Lake Nipigon (Adamstone, 1923b); Lake Ontario, 101-150 feet (Kindle, 1925); Lake Simcoe (Rawson, 1930); Rogue River at Grants Pass, Josephine County, Oregon (Haas, 1954, p. 96).

Associations.—Living: NEW YORK - 4b, 21; OHIO - 43; WISCONSIN - 15, 16, 28, 29, 32, 37, 42, 54, 59, 60, 68, 71, 78, 79, 84, 85, 86, 89, 93, 97, 109, 116, 123, 124, 128, 133. Fossil: W - 27, 29, 31, 33, 34, 36, 37, 38, 39, 41, 42, 52, 53, 54, 55.

General distribution (fig. 201).—British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, Maine, and Prince Edward Island, south to California, Utah, Colorado, Illinois, Indiana, Ohio, and Virginia (Herrington, 1962, p. 50). Previous records for the Yukon, Alberta, Texas, and Missouri are not mentioned by Herrington, probably because the identifications were erroneous.

Distribution in Ohio (inset, fig. 201).—Records for living individuals of the species are for Summit, Stark, and Tuscarawas Counties and Sterki added "probably all over the State."

Geologic range.—Pleistocene: Yarmouth, Sangamon, Wisconsin. Over (1915, p. 95) records it for the Pleistocene of the Grandview well, Douglas County, South Dakota. Sterki (1916, p. 453) noted it as a fossil for Maine, New Jersey, Ohio, Michigan, Ontario, Illinois, and South Dakota. Baker (1920a, p. 384) gave Yarmouth, Sangamon, and "Wabash." In Ohio, it occurs in the following deposits: Tinkers Creek marl (Sterki, 1920, p. 175); Rush Lake marl (Baker, 1920b, p. 446); Humboldt (Reynolds, 1959, p. 155); Souder Lake (Cornejo, 1961, fig. 11); Oakhurst (Aukeman, 1960, p. 43); and Aultman (Sheatsley, 1960, p. 51).

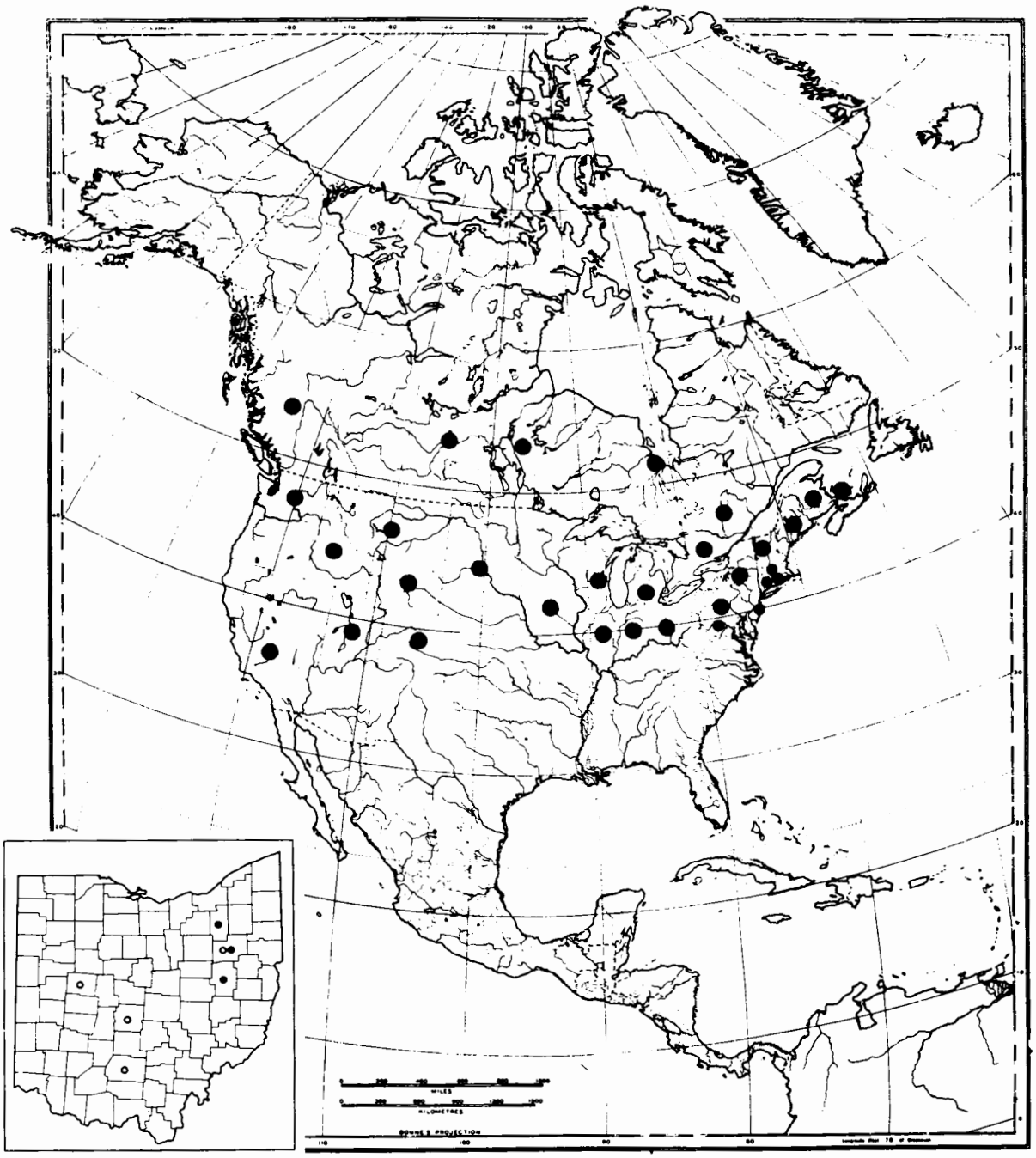


FIGURE 201.—Distribution of *Pisidium variabile* in North America; *inset,* distribution in Ohio.

Pisidium ferrugineum Prime 1851
Pl. 4, fig. 6; pl. 7, fig. 12

Pisidium ferrugineum Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 162.
--- --- Prime 1865, Mon. Am. Corbiculadae, p. 71.
--- --- Johnson 1915, Fauna New England, p. 51.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 467.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 426, pl. 104, figs. 3-5.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 105.
--- --- Herrington 1954, Nautilus, v. 67, p. 133.
--- --- Taylor and Hibbard 1955, Okla. Geol. Survey Circ. 37, p. 12.
--- --- Herrington 1957, Canad. Field-Naturalist, v. 71, p. 8, Lake Nipigon.
--- --- Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 17.
--- --- La Rocque 1959, Sterkiana, no. 1, p. 30.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 39, pl. 4, fig. 6; pl. 7, fig. 12.

Type locality.—Cambridge, Massachusetts.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally in end view; hinge long (more than ¾ shell length); anterior end rounded; shell without heavy ridges or with ridges only on the beaks; cardinals near anterior cusps; cusps of AII shaped like a toothpick, *i.e.*, with nearly vertical and parallel sides.

Dimensions.—F. C. Baker (1928a, pt. II, p. 427) gives the following for specimens from Chetek Lake, Wisconsin: L. 2.3, 2.0; H. 2.0, 1.8; D. 1.5, 1.3 mm. Herrington (1962, p. 39) gives the following for specimens from Camden Lake, Lennox and Addington Counties, Ontario: L. 2.8, 2.4, 2.0, 1.3; H. 2.5, 2.1, 1.6, 1.1; D. 2.2, 1.9, 1.6, 0.9 mm.

Ecology.—"*P. ferrugineum* has a preference for cool climates. When found on a sandy bottom the striae are prominent and the beaks more or less tubercular. Those specimens obtained from lakes that are filling up with marl or developing a mucky bottom are smoother, have a greater diameter, and the beaks do not have the tubercular appearance. The varieties are much more common than the typical form with its strange tubercular beaks. Found in lakes, creeks, and rivers" (Herrington, 1962, p. 40). The following additional data may be helpful. Herrington and Taylor (1958, p. 17) give a succinct statement: "in lakes, creeks, and rivers." Zimmerman (1960, p. 23) and Mowery (1961, p. 7) add more detail; the following is quoted from Mowery's paper: "... inhabits the mud, sand, or marly clay bottoms of ponds, lakes, and some rivers in water 1 to 3 m. deep.... is usually found among vegetation and algae" in water with "pH 7.23 to 8.14, fixed carbon dioxide 10.8 to 22.5 p.p.m."

Previous records are mainly for lakes, large and small: Shakespeare Island Lake (Cronk, 1932); Lake Nipigon (Adamstone, 1924); Hamilton Lake (Baker and Cahn, 1931, p. 47), all in Ontario.

Associations.—Living: WISCONSIN - 51, 79, 98, 116, 121, 128. Fossil: W - 27, 28, 29, 33, 34, 37, 38, 39, 42, 45, 46, 47, 52, 53, 54, 55.

General distribution (fig. 202).—Northern North America: Northwest Territories and British Columbia to Newfoundland and New Brunswick, south to California, Utah, Illinois, Indiana, Ohio, New York, and New Jersey. Europe.

Distribution in Ohio (inset, fig. 202).—Not recorded as such from Ohio, but the forms and synonyms indicate that it is widely distributed in the State.

Geologic range.—Pleistocene: Wisconsin. D. W. Taylor and Hibbard (1955, p. 12) record this species from the Jones local fauna, of Wisconsin age, from southwestern Kansas. In Ohio it occurs in the following late Wisconsin deposits: Newell Lake (Zimmerman, 1960, p. 20); Jewell Hill (Mowery, 1961, p. 7); Souder Lake (Cornejo, 1961, fig. 11); Oakhurst (Aukeman, 1960, p. 31); and Aultman (Sheatsley, 1960, p. 32).

[*Pisidium ferrugineum* form *medianum* Sterki 1899]

Pisidium medianum Sterki 1899, Nautilus, v. 13, p. 10.
--- --- Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 398.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 466.
--- --- F. C. Baker 1920, Jour. Geology, v. 28, p. 447, Rush Lake deposit.
--- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 183, Castalia marl.
--- --- Sterki 1920, *ibid.*, p. 175, Tinkers Creek deposit.
--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 27.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 425, pl. 103, figs. 6-8.
--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 323.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 106.
Pisidium ferrugineum form *medianum* Herrington 1954, Nautilus, v. 67, p. 133.
Pisidium ferrugineum form *medianum* La Rocque 1959, Sterkiana, no. 1, p. 30.
Pisidium ferrugineum form *medianum* Herrington 1962, Revis. Sphaeriidae N. America, p. 40.

Type locality.—None given. The original description gives localities in Michigan and Wisconsin.

Diagnosis.—"Of rather small size, elliptical in outline, much inflated, often of somewhat irregular growth; superior and inferior margins moderately curved, posterior well rounded, or with a slight angle above, an-

terior rounded or slightly truncated obliquely; beaks rather in the middle, slightly directed toward the posterior, rather high, prominent over the hinge margin; scutum and scutellum very slightly marked; surface with very fine, crowded striae, somewhat shining, light horn to yellowish or straw colored; shell thin; nacre colorless, muscle insertions barely perceptible (Sterki).

"Hinge rather fine, plate narrow; cardinal of right valve almost straight or greatly curved, sometimes sharply angular, enlarged at the posterior end and frequently grooved or cleft, the tooth placed near the middle of the hinge plate; upper cardinal of left valve short, thin, straight or slightly curved; lower cardinal large, rounded or pyramidal; space between cardinals deep (fig. 298); laterals pointed, outer ones of right valve comparatively large" (F. C. Baker, 1928a, pt. II, p. 425).

Dimensions.—Baker gives the following for type

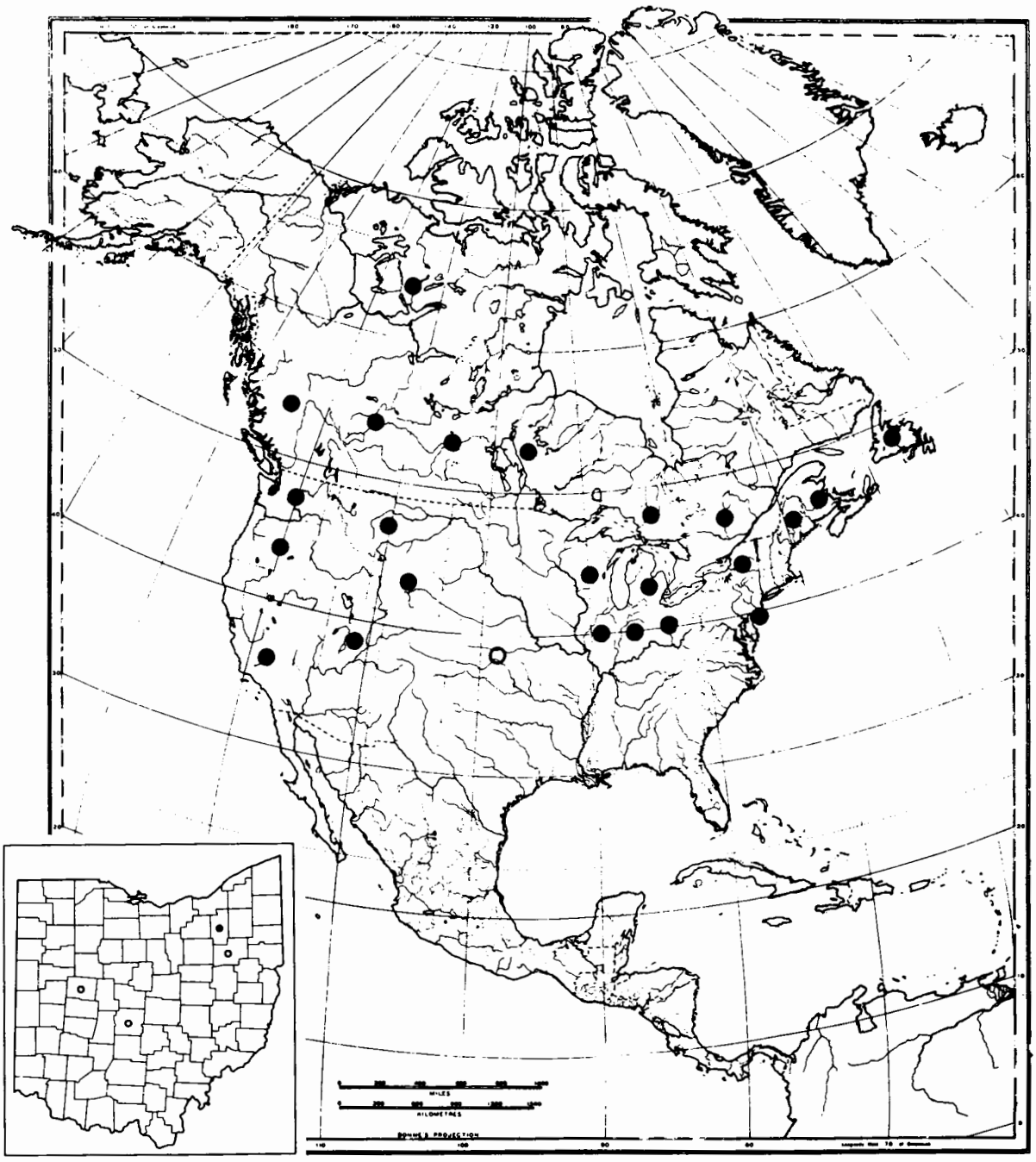


FIGURE 202.—Distribution of *Pisidium ferrugineum* in North America; *inset,* distribution in Ohio.

specimens: L. 2.5, 3.5; H. 2.0, 2.8; D. 1.7, 2.3 mm.; and specimens from Lake Winnebago, Wisconsin: L. 3.5, 3.0; H. 2.5, 2.6; D. 2.0, 2.0 mm.

Ecology.—This form has a surprising range of habitats: large and small lakes, brooks, mud, sand, and gravel bottom, 0.4-24 m. deep, as the following records show. Lake St. Joseph, Ontario (Whiteaves, 1906, p. 30); small lake in Manitoba (Whiteaves, 1907, p. 240); Springfield Lake, northeastern Ohio (Sterki, 1907a, p. 398); Barren Brook, Maine (Lermond, 1909, p. 251). Lake Michigan and large and small lakes in Wisconsin (Baker, 1928a, pt. II, p. 426) in the following situations: Lake Winnebago, mud bottom, 4.9-6.1 m.; sand bottom 0.8-2.8 m.; gravel and boulder bottom, 0.4-1.5 m.; Silver Creek, Green Lake, marly-clay bottom, 1.5 m.; Devils Lake, mud bottom, 8 to 13 m. (Baker); dredged from 24 m. off New York Point, Lake Michigan (Walker); Oconomowoc Lake, Wisconsin, 3-5 m., in vegetation; Ashippun Lake, sand bottom, shallow; Golden Lake, pure sand, 1 m. deep (Cahn), and taken from the stomach of a whitefish.

General distribution.—Manitoba, Wisconsin, Michigan, Ontario, New York, and Maine, south to Utah, South Dakota, Illinois, Indiana, and Ohio.

Distribution in Ohio.—"Springfield Lake (St.); probably at least over the northern part of Ohio" (Sterki, 1907a, p. 398).

Geologic range.—Pleistocene: Yarmouth, Wisconsin. Walker (1907, p. 180) recorded this form from the Cobalt, Ontario, marl; Over (1915, p. 95) from the Grandview well, Douglas County, South Dakota. Sterki (1916, p. 466) noted it as a fossil in Ontario, Michigan, Ohio, and Illinois. Baker (1920a, p. 384) gave Yarmouth and "Wabash." In Ohio it has been found in the following deposits: Rush Lake marl (Baker, 1920b, p. 447); Tinkers Creek marl (Sterki, 1920, p. 175); and Castalia marl (Sterki, 1920, p. 183).

Pisidium casertanum (Poli) 1791
Pl. 4, fig. 1; pl. 7, fig. 7

Cardium casertanum Poli 1791, Test. utr. Sicil., p. 65, pl. 16, fig. 1.
Pisidium abditum Haldeman 1841, Acad. Nat. Sci. Philadelphia Proc., v. 1, p. 53.
Pisidium regulare Prime 1852, Boston Jour. Nat. History, v. 6, p. 363.
Pisidium noveboracense Prime 1853, Annals N. Y. Lyceum Nat. History, v. 6, p. 66, pl. 1, fig. 3.
Pisidium politum Sterki 1895, Nautilus, v. 9, p. 75.
Pisidium trapezoideum Sterki 1896, Nautilus, v. 9, p. 124.
Pisidium roperi Sterki 1898, Nautilus, v. 12, p. 77.
Pisidium streatori Sterki 1901, Nautilus, v. 14, p. 100.
Pisidium strengii Sterki 1902, Nautilus, v. 15, p. 126.
Pisidium elevatum Sterki 1906, Nautilus, v. 19, p. 119.
Pisidium proximum Sterki 1906, Nautilus, v. 20, p. 5.
Pisidium subrotundum Sterki 1906, Nautilus, v. 20, p. 19.
Pisidium neglectum Sterki 1906, Nautilus, v. 20, p. 87.
Pisidium succineum Sterki 1907, Nautilus, v. 20, p. 99.
Pisidium casertanum Woodward 1913, Cat. Brit. *Pisidia*, p. 31.
Pisidium neglectum corpulentum Sterki 1916, Cat. N. Am. Sphaeriidae, p. 456.
Pisidium casertanum Adam 1947, Mém. Mus. roy. Hist. Nat. Belgique, no. 106, p. 200.
--- --- van der Schalie 1953, Nautilus, v. 66, p. 84.
--- --- Herrington 1954, Nautilus, v. 67, p. 97, 131.
--- --- Taylor and Hibbard 1955, Okla. Geol. Survey Circ. 37, p. 12.
--- --- Herrington 1957, Canad. Field-Naturalist, v. 71, p. 8.
--- --- Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 14.
--- --- La Rocque 1959, Sterkiana, no. 1, p. 30.
--- --- Hibbard and Taylor 1960, Mich. Univ. Mus. Paleontology Contr., v. 16, no. 1, p. 77.
--- --- Taylor 1960, U.S. Geol. Survey Prof. Paper 337, p. 47.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 33, pl. 4, fig. 1; pl. 7, fig. 7.

Type locality.—Sicily.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally in end view; hinge long (more than ¾ shell length); anterior end rounded; shell without heavy ridges or with ridges only on the beaks; cardinals near anterior cusps; cusps of AII with steeply inclined sides, but not toothpicklike. Some specimens in which the hinge is short (less than ¾ shell length) may be distinguished by the following features: cusp of PII distal or on distal side of center; anterior end curves gently into the dorsal margin; cusp of PII central or on distal side of center; beaks never ridged; dorsal margin almost straight or only slightly curved.

Dimensions.—The following measurements are given by Herrington (1962, p. 33) for specimens from a small roadside creek near Keene, Ontario: L. 4.1, 3.3, 2.7, 1.7; H. 3.4, 2.8, 2.1, 1.3; D. 2.8, 2.0, 1.6, 0.7 mm.; and for others from Kitchen Creek, Lolo National Forest, Granite County, Montana: L. 8.2, H. 6.5, D. 4.5 mm.

Ecology.—"*P. casertanum* has succeeded in adapting itself to a wide variety of habitats. One finds it in bog ponds, ponds, swamps that dry up for several months of the year, swamp-creeks, creeks with considerable current, rivers, and lakes, including the Great Lakes. This is by far the most common *Pisidium*" (Herrington, 1962, p. 34). "Lives in all aquatic environments and common everywhere. In lakes, it lives down to 35-40 m., up to 1300-2500 m. alt. in the Alps and even to 2,200 m. in the Pyrenees. Rather common in Corsica, up to 1,800 m." (Germain, 1931, p. 701).

According to Adam (1947, p, 201), this species lives everywhere in Belgium, preferably in running

water. In North America several ecological notes are available. All of these are reproduced here because of the relative lack of information on this species in this hemisphere until recently. Herrington and Taylor (1958, p. 14) give the following: "... even more adaptable than *Sphaerium striatinum,* lives in a wide range of habitats and shows a corresponding variation in shell. It can maintain itself wherever any other *Pisidium* does, except in deep water. The form *roperi* Sterki, as well as somewhat similar shells with thin walls and smooth outlines, comes from ponds, swamps, lagoons, bog ponds, and small lakes that are filling up with marl. The heavier-shelled, typical *casertanum* lives in rivers or fairly large creeks." D. W. Taylor (1960, p. 47) states: "The wide distribution of *Pisidium casertanum* reflects a corresponding adaptability, greater than any other American sphaeriid. It lives where any other species of *Pisidium* can live, except for deep water. The typical form of the species, with relatively heavy shells, lives in rivers or fairly large creeks. Thinner shells with smoother outline are found in ponds, swamps, lagoons, bog ponds, and similar quiet water bodies. *P. casertanum* is one of the few species of *Pisidium* which can tolerate seasonal desiccation, and sometimes it may be the only aquatic mollusk in a small, temporary stream or seepage." Zimmerman (1960, p. 22) adds details on bottom and depth of water: "... inhabits a sand or mud bottom, in shallow water, from 0.5 m. to 3 m. in depth .... occurs under swampy conditions or protected bays and has been collected by Baker (1916, 1918a, as *P. abditum*) from shallow water, with a sand, clay, or mud bottom, among vegetation. In Tomahawk Lake, Baker (1911a, *P. abditum, P. roperi,* and *P. subrotundatum*) ... from a swampy environment, among *Iris* and *Typha. P. abditum* was collected from soft sticky mud filled with algae .... pH 5.8 *(P. roperi)* to 7.95 *(P. strengi)* fixed carbon dioxide 5.5 *(P. roperi)* to 30.56 p.p.m. *(P. strengi).*" Clark (1961, p. 22) repeats the same data, as does Mowery (1961, p. 7).

Associations.—Living: MANITOBA-25; NEW YORK-1; OHIO-43; ONTARIO-3, 7, 9; WISCONSIN-4, 5, 21, 43, 68, 89, 102, 106, 107, 109, 118, 133. Fossil: P-1, 2, 3; N-1, 2; S-1, 2, 3, 4, 5, 6; W-27, 28, 29, 36, 37, 38, 47, 48, 49, 50, 51, 52, 53, 54, 56, 57, 58,59.

General distribution (fig. 203).—"Almost cosmopolitan; Eurasia; New Zealand, and Australia; in the Western Hemisphere from Patagonia to Alaska" (Herrington and Taylor, 1958, p. 14).

Distribution in Ohio (inset, fig. 203).—Its presence throughout the State is attested by numerous records.

Geologic range.—Pliocene; Pleistocene: Nebraskan; Illinoian(?); Sangamon; Wisconsin. Pliocene of Texas, Oklahoma, and Kansas (Taylor, 1960, p. 47); Pleistocene: Nebraskan or earliest Aftonian of Kansas and Nebraskan of Nebraska (Taylor, 1960, p. 47); probably Illinoian (Berends local fauna) of Kansas (Taylor and Hibbard, 1955, p. 12); Sangamon (Jinglebob local fauna) of Kansas (van der Schalie, 1953, p. 84; Taylor and Hibbard, 1955, p. 12); Wisconsin of Ohio: Newell Lake deposit (Zimmerman, 1960, p. 20); Castalia deposit (Clark, 1961, p. 22); Jewell Hill deposit (Mowery, 1961, p. 7); Souder Lake deposit (Cornejo, 1961, fig. 11); Aultman deposit (Sheatsley, 1960, p. 26); and Oakhurst deposit (Aukeman, 1960, p. 25). The following records, published under various synonyms, may be added here. As *P. abditum:* McKay Lake, Ottawa, Ontario (Whittaker, 1918, p. 15); Baker (1920a, p. 384): preglacial, Aftonian, Yarmouth, Sangamon, "Wabash." McKay, Colton, and Mink Lakes, Ontario (Whittaker, 1921, p. 64); base of peat bed, Beauharnois County, Quebec (Whittaker, 1922a, p. 105); Castalia marl and Tinkers Creek marl (Sterki, 1920, p. 183). *Pisidium* sp., near *huachucanum*: Coconino County, Arizona (Colton, 1929, p. 94). *P. neglectum:* Ohio, no specific locality (Sterki, 1916, p. 456). *P. noveboracense:* Ontario, Cobalt marl (Walker, 1907, p. 180); fossil, New Jersey, Michigan (Sterki, 1916, p. 454); Ohio, Rush Lake marl (Baker, 1920b, p. 447); Sangamon, "Wabash" (Baker, 1920a, p. 384). *P. politum:* fossil, Michigan (Sterki, 1916, p. 458); "Wabash" (Baker, 1920a, p. 385). *P. regulare:* fossil, Michigan (Sterki, 1916, p. 455). *P. roperi:* fossil, Michigan (Sterki, 1916, p. 458); "Wabash" (Baker, 1920a, p. 384). *P. subrotundum:* fossil, Maine, Michigan (Sterki, 1916, p. 459). *P. superius:* "Wabash" (Baker, 1920a, p. 384); *P. trapezoideum:* "Wabash" (Baker, 1920a, p. 384).

Pisidium walkeri Sterki 1895
Pl. 3, fig. 6; pl. 6, fig. 4; pl. 7, fig. 6

Pisidium walkeri Sterki 1895, Nautilus, v. 9, p. 75.
Pisidium walkeri var. *mainense* Sterki 1898, Nautilus, v. 12, p. 79.
Pisidium walkeri Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 397.
Pisidium mainense Sterki 1907, *ibid.*
--- --- Johnson 1915, Fauna New England, p. 54.
Pisidium walkeri Sterki 1916, Cat. N. Am. Sphaeriidae, p. 457.
Pisidium mainense Sterki 1916, *ibid.*
Pisidium walkeri Sterki 1920, Ohio Jour. Sci., v. 20, p. 175.
Pisidium mainense Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 27.
Pisidium walkeri Winslow 1926, *ibid.*, p. 28.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 394, pl. 102, figs. 12-14.
Pisidium mainense F. C. Baker 1928, *ibid.*, p. 396, pl. 105, figs. 12, 13.
Pisidium walkeri Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 323.
Pisidium mainense Goodrich and van der Schalie 1944, *ibid.*
Pisidium walkeri Robertson and Blakeslee 1948, Moll.

Niagara Frontier, p. 119.

Pisidium mainense La Rocque 1953, Cat. Recent Moll. Canada, p. 106.

Pisidium walkeri La Rocque 1953, *ibid.*, p. 112.

--- --- Herrington 1954, Nautilus, v. 67, p. 136.

Pisidium mainense Herrington 1954, *ibid.*

Pisidium walkeri Taylor and Hibbard 1955, Okla. Geol. Survey Circ. 37, p. 12.

--- --- Herrington 1957, Canad. Field-Naturalist, v. 71, p. 8.

--- --- Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 17.

Pisidium mainense La Rocque 1959, Sterkiana, no. 1, p. 31.

Pisidium walkeri La Rocque 1959, *ibid.*

--- --- Hibbard and Taylor 1960, Mich. Univ. Mus. Paleontology Contr., v. 16, no. 1, p. 78.

--- --- Herrington 1962, Revis. Sphaeriidae N.

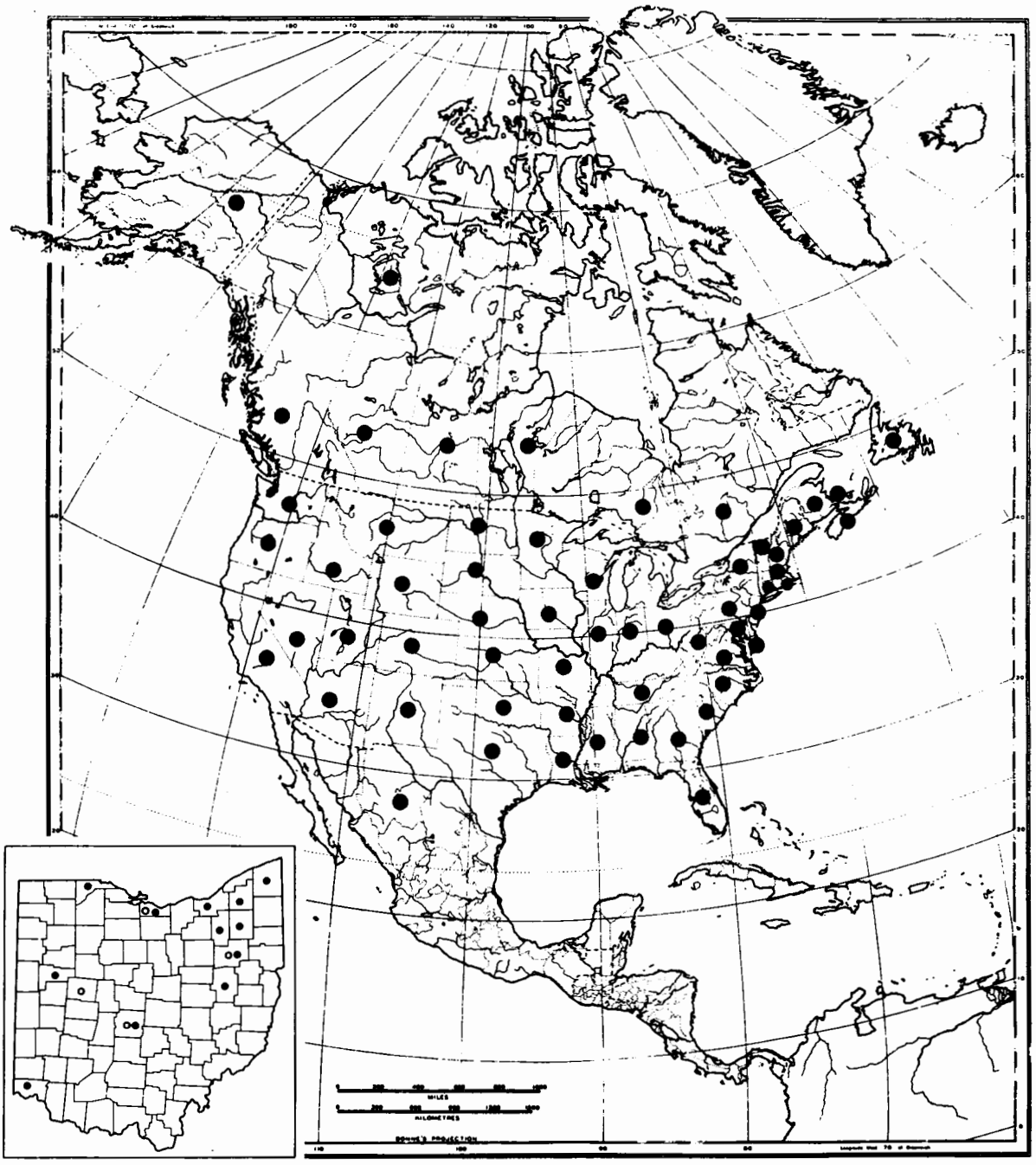


FIGURE 203.—Distribution of *Pisidium casertanum* in North America; *inset*, distribution in Ohio.

America, p. 51, pl. 3, fig. 6; pl. 6, fig. 4; pl. 7, fig. 6.

Type locality.—Kent County, Michigan.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally, in end view; hinge short (less than ¾ shell length); cusp of P II central or on proximal side of center; surface dull; moderately striate (fewer than 30 striae per mm.).

Dimensions.—F. C. Baker (1928a, pt. II, p. 394) gives the following for the type: L. 4.5, H. 3.7, D. 2.8 mm.; and for specimens from Lake Winnebago, Wisconsin: L. 3.5, 3.5, 3.4; H. 3.0, 2.9, 2.9; D. 1.9, 1.9, 1.9 mm. Herrington (1962, p. 51) gives measurements for specimens from Stoco Lake, Hastings County, Ontario: L. 5.9, 3.7, 3.0, 2.1; H. 4.9, 3.0, 2.4, 1.7; D. 3.6, 2.0, 1.4, 1.0 mm.; and the following for form *mainense* from Dry Lake, Marlbank, Hastings County, Ontario: L. 3.1, 2.6, 2.1, 1.7; H. 2.5, 2.2, 1.7, 1.4; D. 1.7, 1.5, 1.2, 0.8 mm.

Ecology.—Herrington (1962, p. 51) summarizes habitats as follows: "Creeks, rivers, and small lakes. Scarce and usually not abundant in any one place. *P. walkeri* form *mainense* is found in bodies of water hava soft bottom. From the 19 stations that had yielded the specimens of the form *mainense* in my collection, 17 were small lakes or ponds; there was one creek and one small river. It is found in relatively few places, but is abundant in some small lakes that are filling up with shells and marl." Herrington and Taylor (1958, p. 17) give: "In rivers, creeks, and small lakes." The following records from the literature may be useful. Clearwater and Mississippi Rivers, Minnesota; DuPage River, Illinois; Lilycash Creek, near Joliet, and Francis Creek, Illinois (Baker, 1902, p. 402). Chippawa Creek, near Buffalo (Letson, 1909, p. 244). Hidewood Creek, Deuel County, South Dakota (Over, 1915, p. 95). Lake Nipigon (Adamstone, 1923b). Lake Ontario (Adamstone, 1924). Lake Winnebago, mud bottom, 4.9-6.1 m.; sand and boulder bottom, 0.6 and 0.8 m.; Green Lake, marly-clay bottom, 0.6-1.3 m. (Baker, 1928a, pt. II, p. 395). Lake Simcoe (Rawson, 1930).

Ecology.—Sterki (1907a, p. 397) records form *mainense* only for Navarre, Stark County, Ohio, on the Tuscarawas River, from which his specimens probably came. In any event they were certainly from a small lake, pond, or small stream in that vicinity as no large bodies of water exist within miles of the town. Whiteaves (1906, p. 30) cites it for Root River, Ontario, and (1905c, p. 170) for Jupiter River, Anticosti Island, Quebec. Baker (1928a, pt. II, p. 396) gives only one locality, Golden Lake, Wisconsin, bottom pure sand, no vegetation, water about 1 m. deep (Cahn), not common.

Associations.—Living: OHIO-43; fossil: W-27, 36, 38, 39, 42, 53, 54. Form *mainense*, fossil: W-38, 54, 55.

General distribution (fig. 204).—Northwest Territories to Ontario, southward to New York, eastward to Maine and southward to Arizona, Montana, South Dakota, Iowa, Missouri, Michigan, Pennsylvania, and Virginia. The form *mainense*, according to Herrington (1962, p. 51) has been found in Alberta, Saskatchewan, and the southern parts of Ontario; Maine, Massachusetts, Rhode Island, New York, Ohio, Michigan, and Illinois.

Distribution in Ohio (inset, fig. 204).—Sterki (1907a, p. 397) gives records for Portage, Stark, Tuscarawas, and Hamilton Counties. The form *mainense* is cited for Navarre, Stark County.

Geologic range.—Pleistocene: Illinoian, Sangamon, Wisconsin. Baker (1920a, p. 385) gave Sangamon and "Wabash." Hibbard and Taylor (1960, p. 78-79) recorded the species from the Sangamon of Kansas and with some doubt from the Illinoian of the same State. Herrington (1962, p. 51) added Sangamon records (Jinglebob and Jones local faunas) of Kansas. Sterki (1916, p. 457) gave it as fossil, Illinois (marl and loess). In Ohio, Sterki (1920, p. 175) cited it for the Tinkers Creek marl. It occurs in the following Ohio deposits, all late Wisconsin: Souder Lake (Cornejo, 1961, fig. 11); Oakhurst (Aukeman, 1960, p. 47, form *mainense*); Aultman (Sheatsley, 1960, p. 54, typical and form *mainense*). The form is recorded by Walker (1907, p. 180) for the Cobalt, Ontario, marl; by Sterki (1916, p. 457) for Maine, Ontario, Ohio, Michigan, and Illinois. Baker (1920a, p. 384) gives "Wabash."

Pisidium obtusale Pfeiffer 1821
Pl. 4, fig. 4; pl. 7, fig. 10

Pisidium obtusale Pfeiffer 1821, Naturg. deutsch. Moll., p. 125.
Pisidium vesiculare Sterki 1896, Nautilus, v. 10, p. 21.
Pisidium obtusale "(Lam.?) Jenyns 1832," Woodward 1913, Cat. Brit. *Pisidia*, p. 119.
Pisidium vesiculare Sterki 1916, Cat. N. Am. Sphaeriidae, p. 466.
Pisidium obtusale Walker 1918, Synopsis and cat. fresh-water Moll., p. 189.
Pisidium vesiculare Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 28.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 423.
Pisidium obtusale Germain 1931, Faune de France, v. 22, p. 704.
Pisidium vesiculare Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 323.
Pisidium obtusale Goodrich and van der Schalie 1944, *ibid.*
--- --- Adam 1947, Mém. Mus. roy. Hist. Nat. Belgique, no. 106, p. 203.
Pisidium vesiculare La Rocque 1953, Cat. Recent Moll. Canada, p. 112.
Pisidium obtusale van der Schalie 1953, Nautilus, v. 66, p. 84.

Pisidium obtusale Herrington 1954, Nautilus, v. 67, p. 134.
--- --- Taylor and Hibbard 1955, Okla. Geol. Survey Circ. 37, p. 12.
--- --- Reynolds 1959, Ohio Jour. Sci., v. 59, p. 155.
--- --- La Rocque 1959, Sterkiana, no. 1, p. 31.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 46, pl. 4, fig. 4; pl. 7, fig. 10.

Type locality.—Europe, probably Germany; not ascertained.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally in end view; hinge short (less than ¾ shell length). Cusp of P II central, distal, or proximal. In specimens with cusp of P II distal or on distal side of center: anterior end curves gently into the dorsal margin; beaks never ridged; dorsal margin well rounded.

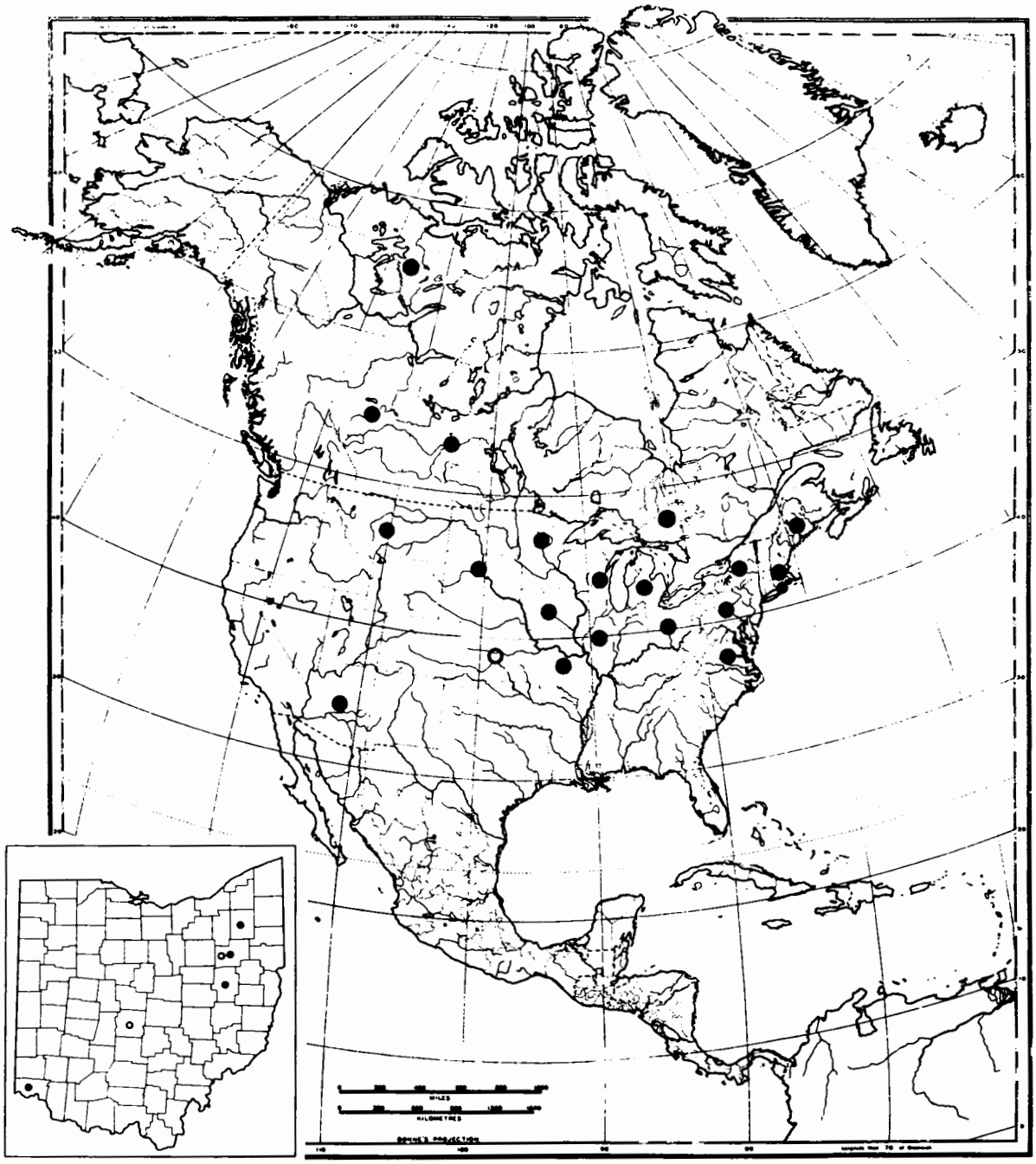


FIGURE 204.—Distribution of *Pisidium walkeri* in North America; *inset*, distribution in Ohio.

In specimens with cusp of P II central or on proximal side of center: surface glossy; finely striate (more than 30 striae per mm.); anterior (proximal) end of posterior sulcus in right valve closed.

Dimensions.—Germain (1931, p. 704) gives the following measurements for European specimens: L. 3, 3.75, 4 mm.; H. 2.5, 3.5, 3.75, 4 mm. See also dimensions given by Herrington for two forms discussed below.

Ecology.—"Lives in stagnant and muddy waters, ponds, marshes and ditches choked with aquatic plants; lacking in lakes and rivers; lives up to 1.300 m. alt. at least; rather common, fossil, in recent Quaternary formations. Almost everywhere, but mainly in the North and East [of France] ... Corsica ...." (Germain, 1931, p. 704, translated).

North American ecological data for this species, under *P. vesiculare*, considered a synonym, are at considerable variance with Germain's statement above, especially the statement that the species is lacking in lakes and rivers, as the following records show. Head of Lake St. Joseph, Ontario (Whiteaves, 1906, p. 30); Lake Ontario (Adamstone, 1924); Lake Nipigon (Adamstone, 1924). Lake Winnebago, mud bottom, 4.9-5.6 m.; gravel bottom, 1.6 m.; Devils Lake, mud bottom, 9.5 m. (Baker); Oconomowoc Lake, 12 m., sand bottom, 2.5 m., sand and clay bottom (Cahn) (F. C. Baker, 1928a, pt. II, p. 424). Lake Simcoe (Rawson, 1930); Shakespeare Island Lake (Cronk, 1932); on mud in 8 and 11 feet of water in Oneida Lake, New York (Reynolds, 1959, p. 162).

Associations.—Living: WISCONSIN - 79 *(vesiculare)*. Fossil: S - 1; W - 27, 28, 31. See also under forms *rotundatum* and *ventricosum*.

General distribution (fig. 205).—Northwest Territories and Alberta eastward to Quebec and Maine, south to California, Utah, Colorado, South Dakota, Minnesota, Illinois, Ohio, and New Jersey. Also Mexico; Eurasia, from Ireland to Japan.

Distribution in Ohio (inset, fig. 205).—Recorded from the Pleistocene of the State but apparently represented here only by the form *rotundatum* (see below).

Geologic range.—Pleistocene: Illinoian, Sangamon, Wisconsin. In Kansas, van der Schalie (1953, p. 84) and D. W. Taylor and Hibbard (1955, p. 12) recorded it for the Jinglebob local fauna (Sangamon). Taylor and Hibbard (1955, p. 12) also recorded it for the Illinoian. In Ohio, it is known from the Humboldt deposit (Reynolds, 1959, p. 155). Walker (1907, p. 180) has cited it for the Cobalt, Ontario, marl; Sterki (1916, p. 466) noted it as fossil in Michigan without specific locality. As *P. vesiculare* Sterki? Baker (1920a, p. 384) recorded it for the "Wabash."

[*Pisidium obtusale* form *rotundatum* Prime 1851]

Pisidium rotundatum Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 164.

--- --- Prime 1865, Mon. Am. Corbiculadae, p. 72.

Corneocyclas rotundata Dall 1905, Harriman-Alaska Exped., v. 13, p. 143.

Pisidium rotundatum Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 398.

--- --- Johnson 1915, Fauna New England, p. 54.

--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 465.

--- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 175, Tinkers Creek deposit.

--- --- Sterki 1920, *ibid.*, p. 183, Castalia marl.

--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 27.

--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 422.

--- --- Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 323.

--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 120.

--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 109.

Pisidium obtusale form *rotundatum* Herrington 1954, Nautilus, v. 67, p. 134.

Pisidium obtusale form *rotundatum* Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 16.

Pisidium obtusale form *rotundatum* La Rocque 1959, Sterkiana, no. 1, p. 31.

Pisidium obtusale form *rotundatum* Herrington 1962, Revis. Sphaeriidae N. America, p. 46.

Type locality.—Lake Superior.

Diagnosis.—"Shell very small, walls thin, more or less oval in outline, well inflated; striae moderate to very fine, evenly spaced; periostracum glossy; beaks rather prominent and well posterior; dorsal margin short and well rounded; ventral margin long and more openly rounded; posterior end well rounded and vertical; anterior end descending rather low, round, shell without an angle; hinge very short, far back but almost parallel with ventral margin; hinge-plate narrow; laterals short; cusps short and high with near-vertical ends; cusps of A II proximal, of P II and A I central or on distal side of center; cardinals close to anterior cusps; C 3 curved, but not much enlarged at posterior end (in *P. o.* form *ventricosum* it is much enlarged); C 2 and C 4 short; C 2 almost parallel with hinge-plate, straight, sometimes slightly curved, or just a peg; C 4 straight or slightly curved, sometimes parallel with hinge-plate, but more often directed slightly downward, then not parallel with C 2; proximal end of posterior sulcus of right valve closed by a pseudocallus on inner side of proximal end of P III and, therefore, does not run out on top of hinge-plate" (Herrington, 1962, p. 46-47).

Dimensions.—Herrington (1962, p. 46) gives the following for specimens from a pond in creek, Lennox and Addington Counties, Ontario: L. 2.7, 2.4, 1.7, 1.4; H. 2.4, 2.1, 1.4, 1.1; D. 2.0, 1.6, 1.0, 0.7 mm.

Ecology.—"The form *rotundatum* is found in sheltered spots in lakes, creeks, and rivers, but is most commonly found in ponds and lagoons; it usually takes shelter among dead leaves of trees" (Herrington, 1962, p. 47). "The form *rotundatum* prefers shallow water and it is principally in ponds, bog ponds, lagoons, and floodplains" (Herrington and Taylor, 1958, p. 16). Mowery (1961, p. 8) has amplified this as follows: It is an inhabitant of ponds, large and small lakes, and lagoons with various bottoms consisting of mud, marly clay, sand, and sometimes gravel; it occurs in water consistently deeper than do the other Sphaeriidae, ranges from shallow, 1.6 m., to more than moderately deep, 12 m.; the pH is 5.8-6.2; fixed carbon dioxide 1.97-9.0 p.p.m. Other records of ecological interest are the following: outlet of Leamy's Lake, Hull, Quebec (G. W. Taylor and Latchford, 1890, p. 52); St. Paul Island, Bering Sea (Dall, 1905, p. 143, *inter alia*);

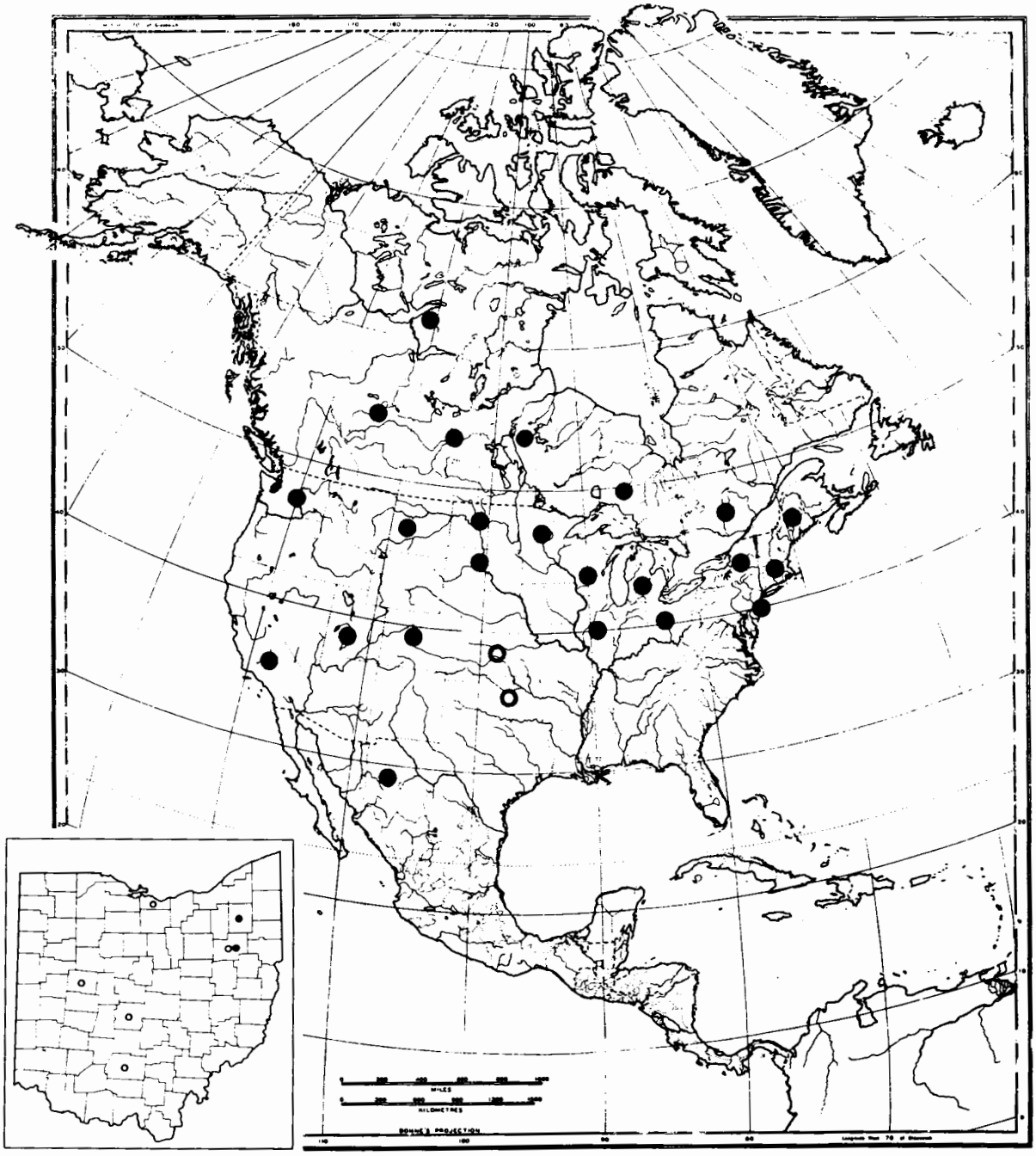


FIGURE 205.—Distribution of *Pisidium obtusale* in North America; *inset*, distribution in Ohio.

Garrettsville and Justus, Stark County, from small bodies of water since no large ones are near either place (Sterki, 1907a, p. 398); Lime Lake, Buffalo region (Letson, 1909, p. 244); Lake near Bernard Harbour, stomach of *Cristivomer namaycush* and *Salvelinus* sp. (Dall, 1919, p. 18A); Lake Nipigon (Adamstone, 1923b); small lakes in Jasper Park, Alberta (Mozley, 1926, Naut. 40, p. 56); small lake and lagoon, Yukon and British Columbia (Craig, 1927, p. 69); Hamilton and Kimmewin lakes, Ontario (Baker and Cahn, 1931, p. 47).

Associations.—Living: WISCONSIN-13, 43. Fossil: W-47, 48, 49, 50, 51, 52, 53, 54, 55.

General distribution.—Alaska, Yukon, Northwest Territories, east to Manitoba, Ontario, Quebec, and Maine, south to Colorado, Minnesota, Wisconsin, Indiana, Ohio, and New Jersey. A single record for Mexico (Herrington and Taylor, 1958, p. 16).

Distribution in Ohio.—Sterki (1907a, p. 398) records the form only for Stark County (living); his other records refer to fossils.

Geologic range.—Pleistocene: late Wisconsin. Cobalt, Ontario, marl (Walker, 1907, p. 180). "Fossil.-Michigan" (Sterki, 1916, p. 465); "Wabash" (Baker, 1920a, p. 384). Tinkers Creek marl (Sterki, 1920, p. 175) and Castalia marl (Sterki, 1920, p. 183), Ohio. Newell Lake (Zimmerman, 1960, p. 20), Jewell Hill (Mowery, 1961, p. 8), Oakhurst (Aukeman, 1960, p. 41), and Aultman (Sheatsley, 1960, p. 42) deposits, all in Ohio.

[*Pisidium obtusale* form *ventricosum* Prime 1851]

Pisidium ventricosum Prime 1851, Boston Soc. Nat. History Proc., v. 4, p. 68 (p. 87, *fide* St. 16).
--- --- Prime 1865, Mon. Am. Corbiculadae, p. 72, figs. 79, 80.
--- --- Dall 1905, Harriman-Alaska Exped., v. 13, p. 143, fig. 116.
--- --- Johnson 1915, Fauna New England, p. 54.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 466.
--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 28.
--- --- LaRocque 1953, Cat. Recent Moll. Canada, p. 112.
Pisidium obtusale form *ventricosum* Herrington 1954, Nautilus, v. 67, p. 134.
Pisidium obtusale form *ventricosum* Herrington 1957, Canad. Field-Naturalist, v. 71, p. 8, Lake Nipigon.
Pisidium obtusale form *ventricosum* La Rocque 1959, Sterkiana, no. 1, p. 31.
Pisidium obtusale form *ventricosum* Cornejo 1961, Sterkiana, no. 4, fig. 11, opp. p. 42, Souder Lake deposit.
Pisidium obtusale form *ventricosum* Herrington 1962, Revis. Sphaeriidae N. America, p. 46.

Type locality.—Fresh Pond, Cambridge, Massachusetts.

Diagnosis.—"*P. obtusale* form *ventricosum* looks like a *P. obtusale* form *rotundatum* with a heavier hinge-plate, and with the ventral margin pushed forward, making the posterior end not vertical but undercut. What Sterki called *P. vesiculare* is found in specimens in which the process is not carried as far. *P. obtusale* form *ventricosum* sometimes has a slight angle at the anterior end, and some specimens are greatly inflated" (Herrington, 1962, p. 47).

Dimensions.—Herrington (1962, p. 46) gives measurements for specimens from Hughes Lake, Lennox and Addington Counties, Ontario: L. 1.7, 1.7, 1.5, 1.2; H. 1.7, 1.6, 1.2, 1.1; D. 2.1, 1.7, 1.2, 0.7 mm.

Ecology.—"The form *ventricosum* is found principally in lakes and large rivers" (Herrington, 1962, p. 47). Some of the more specific previous records are listed below. Lake in Dow's Swamp (Latchford and Poirier, 1885, p. 264). Small lake in the sand hills west of Pine Creek, and northeast of Carberry, Manitoba (Whiteaves, 1907, p. 240). Lake Nipigon (Adamstone, 1924). South shore, Second Lake, Horn River (Whittaker, 1924, Naut. 38, p. 10). Shakespeare Island Lake, Ontario (Cronk, 1932).

Associations.—Living: ONTARIO-3. Fossil: W-33, 34, 36, 37, 38, 39, 41, 42, 52, 53, 54, 55.

General distribution.—Scattered records indicate a wide distribution for this form. It is known from the Northwest Territories, Manitoba, Colorado, Michigan, Ohio (fossil only?), New York, Maine, New Hampshire, and Massachusetts.

Distribution in Ohio.—The only record is for a Pleistocene deposit (see below).

Geologic range.—Pleistocene: late Wisconsin. Marl beds near Ottawa (Heron, 1880, p. 40). "Fossil.-Maine, Michigan" (Sterki, 1916, p. 466). "Wabash" (F. C. Baker, 1920a, p. 385). Souder Lake (Cornejo, 1961, fig. 11), Oakhurst (Aukeman, 1960, p. 42), and Aultman (Sheatsley, 1960, p. 45) deposits, Ohio.

Pisidium subtruncatum Malm 1855
Pl. 6, fig. 1; pl. 7, fig. 18

Pisidium subtruncatum Malm 1855, Götheborgs k. Vet. & Vitt. Samh. Handl., v. 3, p. 92.
--- --- Woodward 1913, Cat. Brit. *Pisidia*, p. 84.
Pisidium subrotundum subtruncatum Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 28.
Pisidium subtruncatum F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 428, pl. 104, figs. 21, 22.
--- --- Germain 1931, Faune de France, v. 22, p. 702.
--- --- Adam 1947, Mém. Mus. roy. Hist. Nat. Belgique, no. 106, p. 204.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 111.
--- --- Herrington 1954, Nautilus, v. 67, p. 134.

Pisidium subtruncatum Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 18.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 48, pl. 6, fig. 1; pl. 7, fig. 18.

Type locality.—Europe, probably Sweden.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally, in end view; hinge short (less than ¾ shell length); cusp of P II central or on proximal side of center; surface glossy; finely striate (more than 30 striae per mm.); anterior (proximal) end of posterior sulcus in right valve not closed.

Dimensions.—Herrington (1962, p. 48) gives the following measurements for specimens from Stoco Lake, Hastings County, Ontario: L. 3.4, 2.9, 2.4, 1.8; H. 2.8, 2.4, 2.0, 1.5; D. 1.8, 1.7, 1.3, 0.9 mm. Baker's (1928a, pt. II, p. 428) measurements for Lake Winnebago specimens are within the same range: L. 2.6, 3.0; H. 2.2, 2.4; D. 1.5, 2.0 mm.

Ecology.—"Streams, bays, and lakes, including the Great Lakes. In Europe they are abundant, but on this continent there are only a few at a station. The 'western form' is very abundant where found" (Herrington, 1962, p. 49).

Germain (1931, p. 702) states that it lives in running water, in rivers and ponds with clear water (among *Chara* and *Potamogeton*), but not in pools proper. It is very common in lakes, mainly in the littoral zone, but lives down to 25-30 m. below the surface (exceptionally, 35 m. in Lake Geneva) and is found up to 1,300 m. altitude.

In North America, Herrington and Taylor (1958, p. 18) give: "In rivers and lakes, including the Great Lakes." Earlier, Baker (1928a, pt. II, p. 428) had noted it for Lake Winnebago, mud bottom, 5.5 and 5.6 m.; sand bottom, 0.8 m.; gravel bottom, 1.6-3.1 m. Sterki (1926, p. 27) added Lake Nipigon, collected by Adamstone.

General distribution (fig. 206).—Herrington and Taylor (1958, p. 18) state that it is very scarce in North America, but more plentiful in Eurasia. They give its range as Northwest Territories south to states bordering Canada and the Great Lakes, as well as Colorado. Specific records are for Wyoming, Utah, and Colorado in the west and for Wisconsin, Michigan, and Ontario in the east. Herrington (1962, p. 49) adds California, South Dakota, and Montana.

Distribution in Ohio (inset, fig. 206).—The species is included here on the basis of the range given above. Herrington (1962, p. 49) mentions Ohio specifically in the list of states where it occurs.

Geologic range.—Pleistocene: Wisconsin. Herrington and Taylor (1958, p. 18) record this species for the Jones Sink, lower level (Wisconsin) of Kansas. The only Ohio record is for the Aultman deposit (Sheatsley, 1960, p. 48).

Pisidium lilljeborgii Clessin 1886
Pl. 4, fig. 2; pl. 7, fig. 8

Pisidium lilljeborgi Clessin 1886, *in* Esmark and Hoyer, Malak. Blätt., n. s., v. 8, p. 119.
Pisidium scutellatum Sterki 1896, Nautilus, v. 10, p. 66.
Corneocyclas scutellata Dall 1905, Harriman-Alaska Exped., v. 13, p. 141.
Pisidium lilljeborgii Woodward 1913, Cat. Brit. *Pisidia*, p. 111.
Pisidium scutellatum Johnson 1915, Fauna New England, p. 60.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 457.
--- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 175, Tinkers Creek deposit.
--- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 27.
--- --- F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 392, pl. 101, figs. 14-17.
Pisidium lilljeborgi Sterki 1928, Nautilus, v. 42, p. 25.
--- --- Odhner 1939, Nautilus, v. 52, p. 82, Alaska.
Pisidium scutellatum Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 323.
--- --- Robertson and Blakeslee 1948, Moll. Niagara Frontier, p. 119.
Pisidium lilljeborgii La Rocque 1953, Cat. Recent Moll. Canada, p. 106.
--- --- Herrington 1954, Nautilus, v. 67, p. 134.
--- --- Taylor and Hibbard 1955, Oklahoma Geol. Survey Circ. 37, p. 12.
--- --- Herrington 1957, Canad. Field-Naturalist, v. 71, p. 8, Lake Nipigon.
--- --- Herrington and Taylor 1958, Mich. Univ. Mus. Zoology Occas. Papers, no. 596, p. 17.
--- --- La Rocque 1959, Sterkiana, no. 1, p. 30.
--- --- Herrington 1962, Revis. Sphaeriidae N. America, p. 43, pl. 4, fig. 2; pl. 7, fig. 8.

Type locality.—Europe.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally in end view; hinge short (less than ¾ shell length); cusp of P II distal or on distal side of center; anterior end joining dorsal margin at an angle.

Dimension.—Herrington (1962, p. 43) gives the following measurements for specimens from Rice Lake, Birdsall Beach, Peterborough County, Ontario: L. 3.8, 3.1, 2.4, 1.7; H. 3.2, 2.6, 2.0, 1.4; D. 2.5, 2.0, 1.3, 0.9 mm.

Ecology.—The following summary is by Herrington (1962, p. 44): "Lakes and rivers, with a preference for lakes; found in fine sand containing scattered small weeds. Fairly common in some localities; quite common in Europe." Data by other writers are given below. Lives in central and northern Europe (up to 2,300 m. altitude in the Alps) and the British Isles. In Switzer-

land, common in lakes, not in shallow water but in water from 2 to 15 m. deep. It is known as a fossil from numerous Quaternary deposits, notably in England and in Switzerland. This species, which has not yet been recorded for France, will be found in numerous localities, notably in the east (Germain, 1931, p. 707, translated).

Herrington and Taylor (1958, p. 17) give the following summary: "In rivers and lakes, even the Great Lakes, but never in small creeks or ponds." Odhner (1939, Naut. 52, p. 82) has recorded it for Unimak Island, False Pass, Alaska. The following data have been given under various synonyms: Pine Lake, 5-11 m.; Lake Michigan off New York Point, 24 m.; Lake Michigan, stomachs of whitefish; various parts of Michigan and Minnesota; Lake Michigan near Chicago; Huntley, Illinois (F. C. Baker, 1902, p. 403). Ozhiski Lake; Kawinogans River, both in Ontario, and Frances Lake,

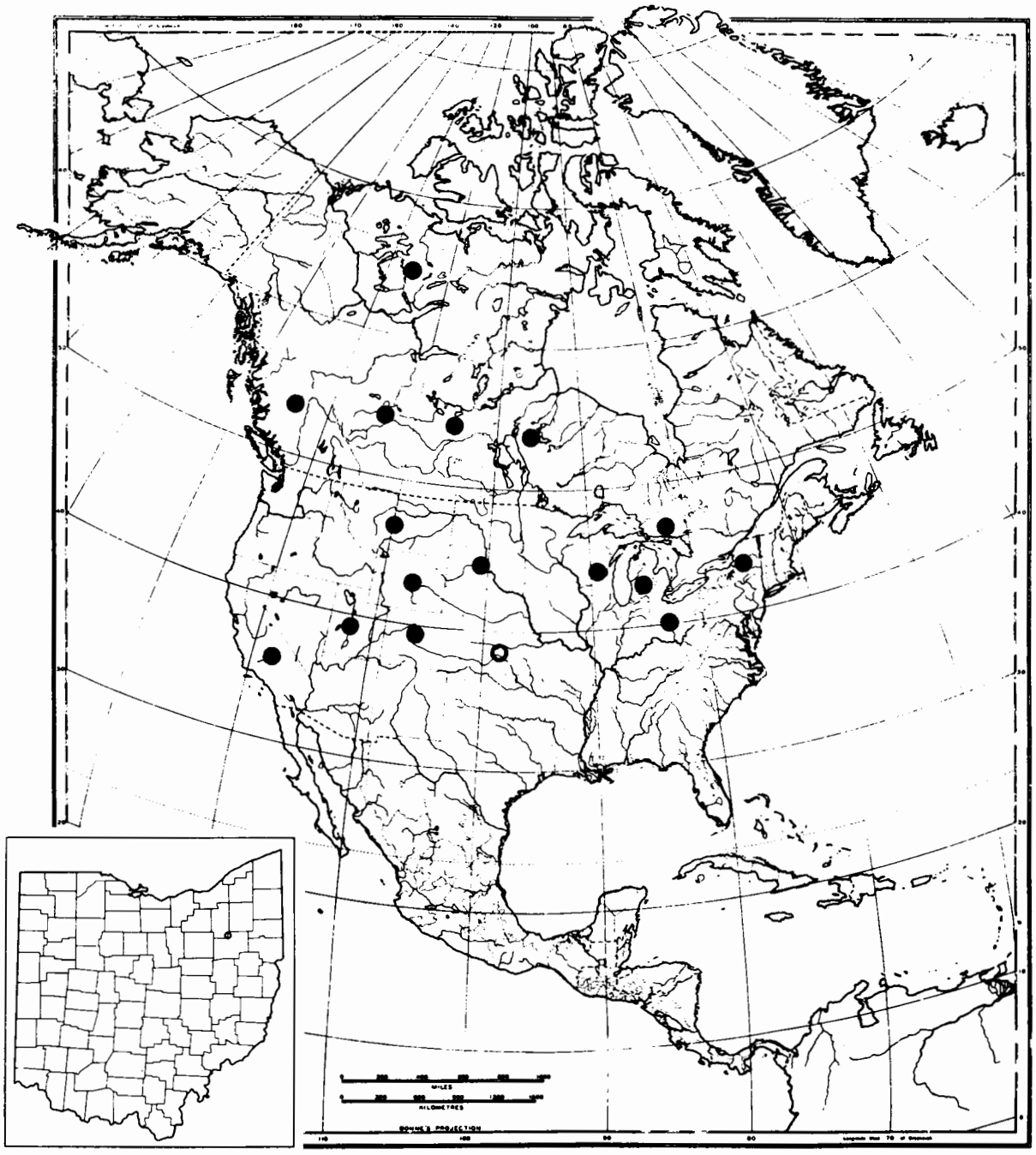


FIGURE 206.—Distribution of *Pisidium subtruncatum* in North America; *inset*, distribution in Ohio.

Yukon (Whiteaves, 1905b, p. 64); Lake Nipigon (Adamstone, 1923b); lakes in the Mackenzie basin and the Mackenzie River, Northwest Territories (Whittaker, 1924, Naut. 38, p. 10); Lake Ontario, 15-150 ft. (Kindle, 1925); Lake Patricia, Jasper Park, Alberta (Mozley, 1926, Naut. 40, p. 56). Lake Winnebago, mud bottom, 3.4 m.; sand bottom, 0.8 m.-1.7 m.; sand-gravel bottom, 1.5-2.8 m.; gravel bottom, 1.6-3.1 m.; boulder bottom, 0.4-0.6 m.; Lake Butte des Morts, sand bottom, 0.8 m.-1.2 m.; Green Lake, sand bottom, 1.5 m.; marly clay bottom, 13.5 m.; Devils Lake, mud bottom, 9 m.-13.5 m.; Oconomowoc Lake, water 12 m. deep, bottom sand; water 17.5 m., black mud bottom; 2.5 m., sand and clay bottom (Cahn); Lake Winnebago, sand and gravel bottom, 1.5 to 2.6 m.; Lake Chetek, sand and mud bottom 1 m. (Baker, 1928a, pt. II, p. 393, 394). Bamaji, Hamilton, Pashkokogan, and Kimmewin Lakes, Ontario (Baker and Cahn, 1931, p. 48). Lake Simcoe, Ontario (Rawson, 1930); Shakespeare Island Lake, Ontario (Cronk, 1932).

Associations.—Living: WISCONSIN - 13, 15, 27, 29, 55, 79, 85, 98, 116, 123, 128. Fossil: W - 27.

General distribution (fig. 207).—Alaska and Northwest Territories (north to Great Bear Lake), Saskatchewan and Alberta, east to Quebec, south to New York, Michigan, Indiana, Wisconsin, Colorado, Utah, and California. Europe: north to Outer Hebrides. Iceland.

Previous records for the species, under various synonyms, extended the range southward to Ohio and Illinois but these two states are not mentioned by Herrington (1962, p. 44), possibly because the records were erroneous.

Distribution in Ohio (inset, fig. 207).—Probably throughout the State.

Geologic range.—Pleistocene: Wisconsin. Baker (1920a, p. 384) gave "Wabash." D. W. Taylor and Hibbard (1955, p. 12) record it for the Jones local fauna, of Wisconsin age, from southwestern Kansas. As *P. scutellatum,* it was mentioned as "Pleistocene" by Baker (1902, p. 403), presumably from Illinois; by Walker (1907, p. 180) from the Cobalt, Ontario, marl; and by Sterki (1920, p. 175) from the Tinkers Creek marl of Ohio.

Pisidium henslowanum (Sheppard) 1825
Pl. 5, fig. 4; pl. 6, fig. 3; pl. 7, fig. 20

Tellina henslowana Leach MS., Sheppard 1825, Trans. Linnaean Soc., v. 14, p. 148.
Pisidium supinum Schmidt 1850, Zeitschr. f. Malak., v. 7, p. 118-119.
Pisidium henslowanum Herrington 1962, Revis. Sphaeriidae N. America, p. 41, pl. 5, fig. 4; pl. 6, fig. 3; pl. 7, fig. 20.

Type locality.—Not stated, probably England.

Diagnosis.—Anterior cusp of left valve not twisted, but parallel to the dorsal margin; shell tapering ventrally in end view; cusp of P II distal or on distal side of center; anterior end curves gently into the dorsal margin; cusp of P II distal; beaks usually ridged.

Dimensions.—Herrington (1962, p. 41) gives the following measurements for specimens from Bay of Quinte, Carrying Place, Prince Edward County, Ontario: L. 4.0, 3.0, 2.3, 1.6; H. 3.6, 2.5, 1.8, 1.3; D. 2.4, 1.5, 1.0, 0.8 mm. and from Lake Ontario, Prince Edward County, Ontario, shore debris, form *supinum:* L. 3.2, 2.7, 2.2, 1.7; H. 3.0, 2.4, 2.0, 1.6; D. 2.0, 1.6, 1.3, 1.0 mm.

Ecology.—"In North America at least, *P. henslowanum* is not found in creeks, small rivers, ponds, or small lakes. In Europe it appears to be fairly common, in North America, rare. I have found it from only seven localities, mostly in shore debris" (Herrington, 1962, p. 41).

Associations.—Living: NEW YORK - 21.

General distribution (fig. 208).—Ontario (Lake Ontario, Bay of Quinte, Rideau River, and St. Lawrence River - all connected); Michigan (Lake Michigan off Grand Haven). Sterki (1916b, p. 449) gives Lake Champlain and cites Dall, "Lake Superior to Lake Winnipeg." This species appears to be introduced. However, Upper Pliocene and lower Pleistocene specimens are known and specimens from Eurasia and Iceland (Herrington, 1962, p. 41).

Distribution in Ohio.—So far, there is no record of this species for the State. It will probably be found in Lake Erie if it spreads from the other Great Lakes (Michigan, Ontario) in which it is known to occur.

Geologic range.—Upper Pliocene to lower Pleistocene. Herrington (1962, p. 41) gives upper Pliocene and lower Pleistocene of Idaho.

[*Pisidium fraudulentum* Sterki 1912]

Pisidium fraudulentum Sterki 1912, Nautilus, v. 26, p. 95.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 451.
--- --- Herrington 1954, Nautilus, v. 67, p. 137, *species dubia.*
--- --- La Rocque 1959, Sterkiana, no. 1, p. 30, *species dubia.*

Type locality.—None given, but after the original description Sterki states: "... ditch on the Cameron Run, west of Alexandria, Va., No. 602, types ...." This may be taken as the type locality since Sterki makes no mention of types in connection with any other locality.

Diagnosis.—"Mussel of medium size, barely longer than high, somewhat oblique, rather well inflated; superior margin curved, passing with angles into the adjoining; supero-anterior slope well marked, steeply oblique, straight or nearly so, anterior end a rounded angle situated near the ventral side, inferior margin

rounded, posterior truncate at right angles to the longitudinal axis; beaks rather large, rounded or somewhat flattened on top, moderately projecting over the upper margin; surface dullish or with a silky gloss, rather smooth, with fine, crowded, somewhat irregular striae; color corneous to yellowish; shell opaque or subtranslucent, rather strong, hinge strongly angular, curved, very stout, its whole surface rugulose; right cardinal tooth angular, enclosing a deep excavation for the left anterior, often emarginate in the middle, its anterior part thin, the posterior very thick and usually grooved; left anterior rather short and massive, strongly curved upward, with apex pointed, the posterior short, steep oblique, slightly curved; ligament and resilium rather short, the latter strong" (Sterki, 1912, Naut. 26, p. 95, original description).

Dimensions.—Sterki gives only "long. 4.5, alt. 4.3, diam. 3 mm. (100:95:66)."

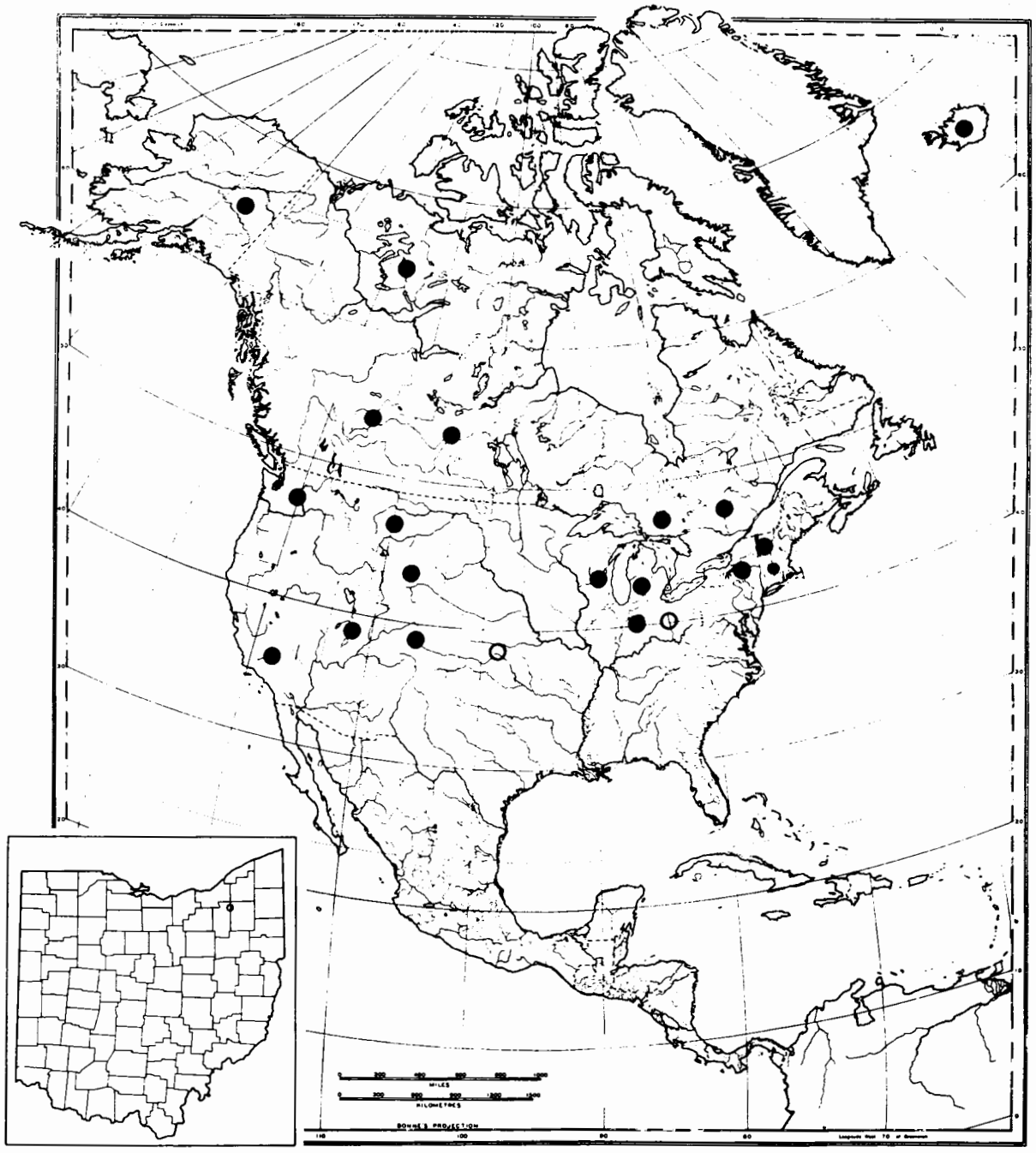


FIGURE 207.—Distribution of *Pisidium lilljeborgii* in North America; *inset,* distribution in Ohio.

Ecology.—The only ecological information I have been able to locate is that from the type locality.

General distribution.—Recorded for Iowa, Illinois, Ohio, and Maryland, south to Mississippi, Kentucky, and Virginia.

Distribution in Ohio.—The general range, if it is correct, would indicate the presence of this species in Ohio.

Geologic range.—No fossil record known to me.

[*Pisidium fraudulentum peraltum* Sterki 1900]

Pisidium peraltum Sterki 1900, Nautilus, v. 14, p. 5.
Pisidium fraudulentum peraltum Sterki 1916, Cat. N. Am. Sphaeriidae, p. 451.
--- --- --- Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 26.
Pisidium peraltum F. C. Baker 1928, Fresh water Moll. Wis., pt. II, p. 379, pl. 100, figs. 7, 8.

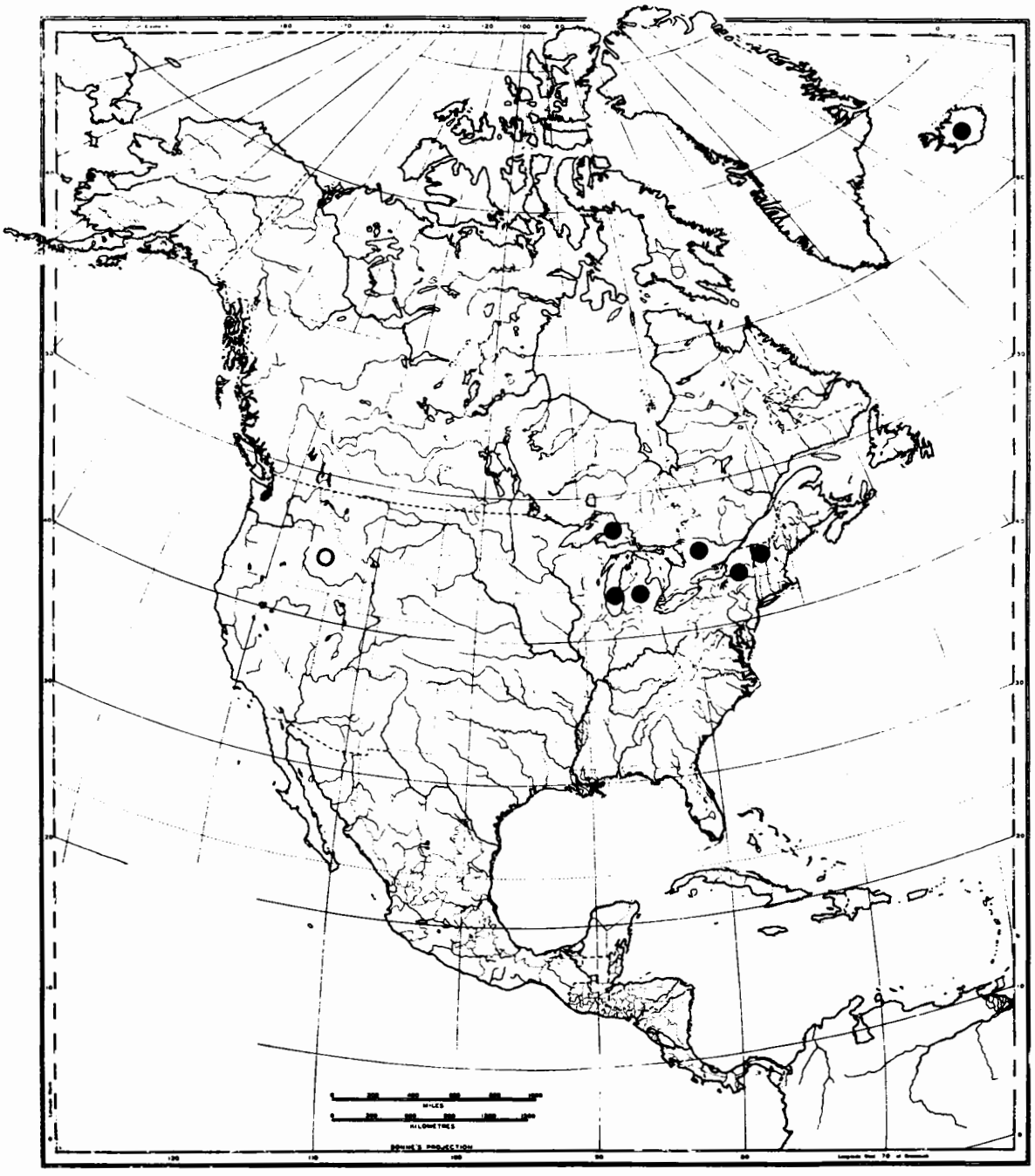


FIGURE 208.—Distribution of *Pisidium henslowanum* in North America.

Pisidium peraltum Goodrich and van der Schalie 1944, Revis. Moll. Ind., p. 323.
--- --- Herrington 1954, Nautilus, v. 67, p. 137, "too few or mixed for decision."
--- --- Walter 1956, Jour. Elisha Mitchell Soc., v. 72, p. 266, N.C.
--- --- La Rocque 1959, Sterkiana, no. 1, p. 30, doubtfully valid.

Type locality.—Crystal Lake, Benzie County, Michigan.

Diagnosis.—"Mussel of moderate size, somewhat oblique, very high, much inflated, beaks large, full and prominent; hinge margin strongly curved; posterior part, behind the beaks, very short, the margin high, slightly to distinctly truncated, passing into the well rounded inferior, with a wide, regular curve; antero-superior margin slightly curved in a steep slope to the slightly angular, rounded anterior end; color light yellowish horn in the young and a zone along the margins in older species, in which the upper parts usually are grayish; surface slightly shining, finely and irregularly striated, with some deeper lines of growth usually of a darker color; shell rather strong, nacre whitish to grayish, muscle insertions distinct; hinge stout, strongly curved, plate moderately broad; cardinal teeth short, the one in the right valve curved, its posterior part thick, and usually grooved; the anterior of the left valve short, stout, triangular, abrupt, with a deep groove, posterior short, oblique, curved; lateral teeth short, stout, high, pointed, the outer ones in the right valve quite small; ligament short, moderately strong" (Sterki, 1900, Naut. 14, p. 5-6, original description).

Dimensions.—Sterki gives only "long. 3.8 alt. 3.8 diam. 2.8 mill."

Ecology.—The doubtful status of this form makes it pointless to attempt an ecological summary.

General distribution.—Given as Wisconsin, Michigan, Indiana, Ohio (doubtful), Kentucky, and North Carolina.

Distribution in Ohio.—The single record, a doubtful one, is that of Sterki (1916, p. 451).

Geologic range.—Pleistocene: late Wisconsin. Sterki (1916, p. 451) notes it as a fossil in Michigan and Ohio(?).

[*Pisidium ohioënse* Sterki 1903]

Pisidium ohioënse Sterki 1903, Nautilus, v. 17, p. 20.
Pisidium ohioense Sterki 1907, Ohio Acad. Sci. Proc., v. 4, p. 398.
--- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 461.
--- --- Sterki 1920, Ohio Jour. Sci., v. 20, p. 175, Tinkers Creek deposit.
--- --- Sterki 1920, *ibid.*, p. 183, Castalia marl.
Pisidium ohioënse Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 27.
--- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 107.
--- --- Herrington 1954, Nautilus, v. 67, p. 137, *species dubia.*
--- --- La Rocque 1959, Sterkiana, no. 1, p. 31, doubtfully valid.

Type locality.—None given. The original description gives localities in Ohio and Michigan.

Diagnosis.—"Mussel minute, equipartite, well inflated, elliptical in outline; beaks in the middle, rather broad, rounded, prominent over the hinge line; superior margin little curved or almost straight, with slightly marked, rounded angles at the scutum and scutellum; the other margins rounded or the posterior subtruncate; surface somewhat shining, horn colored, very finely and irregularly striate, usually with a few coarser lines of growth; shell thin, translucent; nacre glassy-transparent, muscle insertions slightly marked; hinge fine, plate narrow, cardinal teeth fine, lamellar, the right slightly curved, abruptly thickened and bifid at the posterior end, the left anterior longitudinal, almost straight, the posterior slightly oblique or longitudinal and parallel with the anterior and extending to over about its middle; lateral teeth comparatively stout, their cusps pointed, the outer ones of the right valve small but well formed; ligament rather stout" (Sterki, 1903, Naut. 17, p. 20, original description).

Dimensions.—Sterki gives the following: L. 2.5, 2, 1.8; H. 2-2.1, 1.6-1.7, 1.5; D. 1.5, 1.2-1.4, 1.3 mm., and for a young specimen: L. 1, H. 0.8, D. 0.3 mm.

Ecology.—If the species turns out to be valid, the ecological data given by Sterki in the original description, meager as they may be, are the only ones we have. He records it from a pond near Garrettsville, Portage County, Ohio; a brook near Indian mounds, and a very small stream in Kent County, Michigan.

Associations.—Fossil: W-27, 28.

General distribution.—This doubtful species has been recorded for Michigan, Ohio, Ontario, Maine, and Massachusetts.

Distribution in Ohio.—Sterki (1907a, p. 398) gives only Garrettsville (Portage County) and Justus (Stark County) but he also gives fossil records.

Geologic range.—Pleistocene: late Wisconsin. Ohio: Tinkers Creek marl (Sterki, 1920, p. 175) and Castalia marl (Sterki, 1920, p. 183). "Wabash" (F. C. Baker, 1920a, p. 384).

Remarks.—The status of this species is doubtful, as pointed out by Herrington (1954, p. 137). It is included here merely for purposes of record.

[*Pisidium variabile*(?) *brevius* Sterki 1906]

Pisidium variabile brevius Sterki 1906, Nautilus, v. 19, p. 118.
--- --- --- Sterki 1916, Cat. N. Am. Sphaeriidae, p. 453.

Pisidium variabile brevius Winslow 1926, Mich. Univ. Mus. Zoology Occas. Papers, no. 181, p. 28.
--- --- --- La Rocque 1953, Cat. Recent Moll. Canada, p. 112.

Type locality.—None given.

Diagnosis.—"Much shorter than the usual form, oblique, moderately to well inflated, beaks comparatively large, generally slightly flattened on top; color darker; so far as known, the mussels are usually smaller. This *Pisidium* is considerably different from the 'typical' form, and an analogue of *P. compressum* var. *confertum*" (Sterki 1906, Naut. 19, p. 118, original description).

Dimensions.—None given by Sterki in the original description.

Ecology.—This seems to be a form of northern lakes and rivers: Houghton Lake, Gogebic Lake, Slate River, Carp River and Lake, in Michigan; Crystal Lake and Clear Water Lake, in Minnesota. It ranges even farther north into Ontario: Attawapiskat River. Mozley (1926, Naut. 40, p. 56) records it for two small lakes in Jasper Park, Alberta.

General distribution.—Alberta, Manitoba (doubtfully), and Ontario, south to South Dakota, Michigan, and Ohio.

Distribution in Ohio.—Recorded for the State, without specific locality, by Sterki (1916, p. 453).

Geologic range.—Pleistocene: Wisconsin. Recorded as fossil for Michigan and Ontario by Sterki (1916, p. 453).

Remarks.—This is a name of extremely doubtful value. Since it appears in the literature, it is listed here for purposes of record.

PLATES
1 THROUGH 8

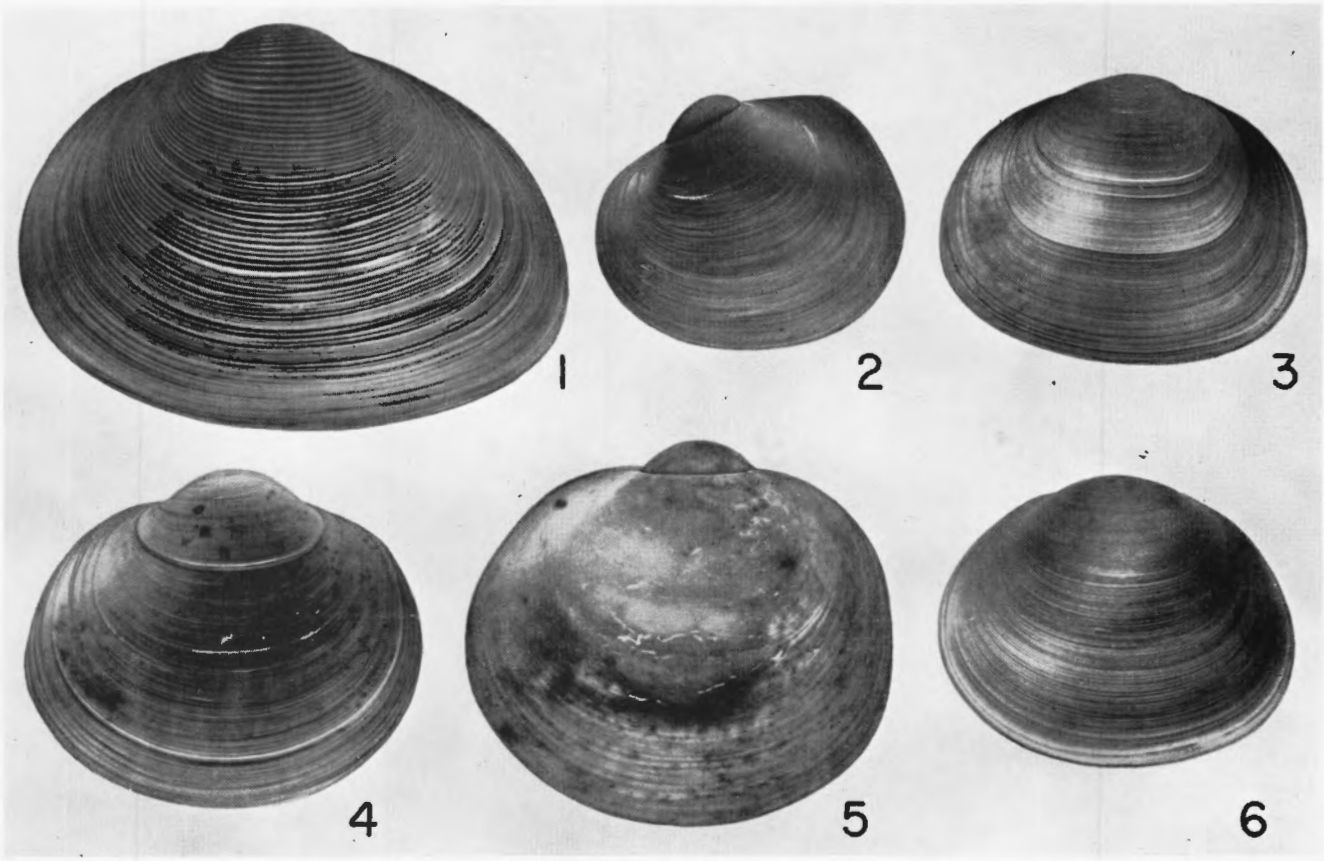


PLATE 1

Shells of *Sphaerium* (after Herrington, 1962, pl. 1)

1. *Sphaerium sulcatum*, X4
2. *Sphaerium securis*, X8
3. *Sphaerium rhomboideum*, X4
4. *Sphaerium occidentale*, X8
5. *Sphaerium partumeium*, X8
6. *Sphaerium nitidum*, X8

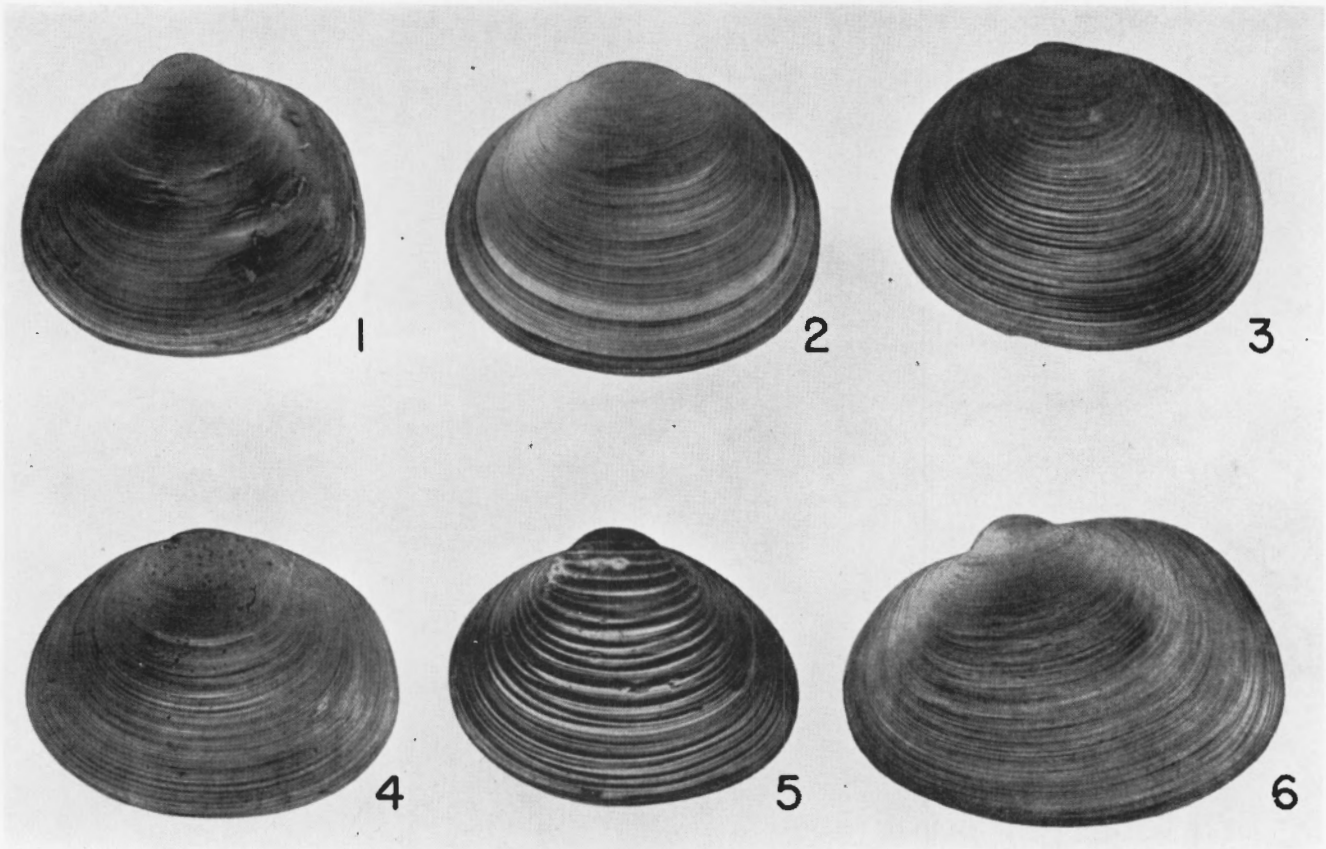


PLATE 2

Shells of *Sphaerium* (after Herrington, 1962, pl. 2)

1. *Sphaerium lacustre*, X4.5
2. *Sphaerium corneum*, X4.5
3. *Sphaerium fabale*, X4.5
4. *Sphaerium patella*, X4.5
5. *Sphaerium striatinum*, X4.5
6. *Sphaerium transversum*, X4.5

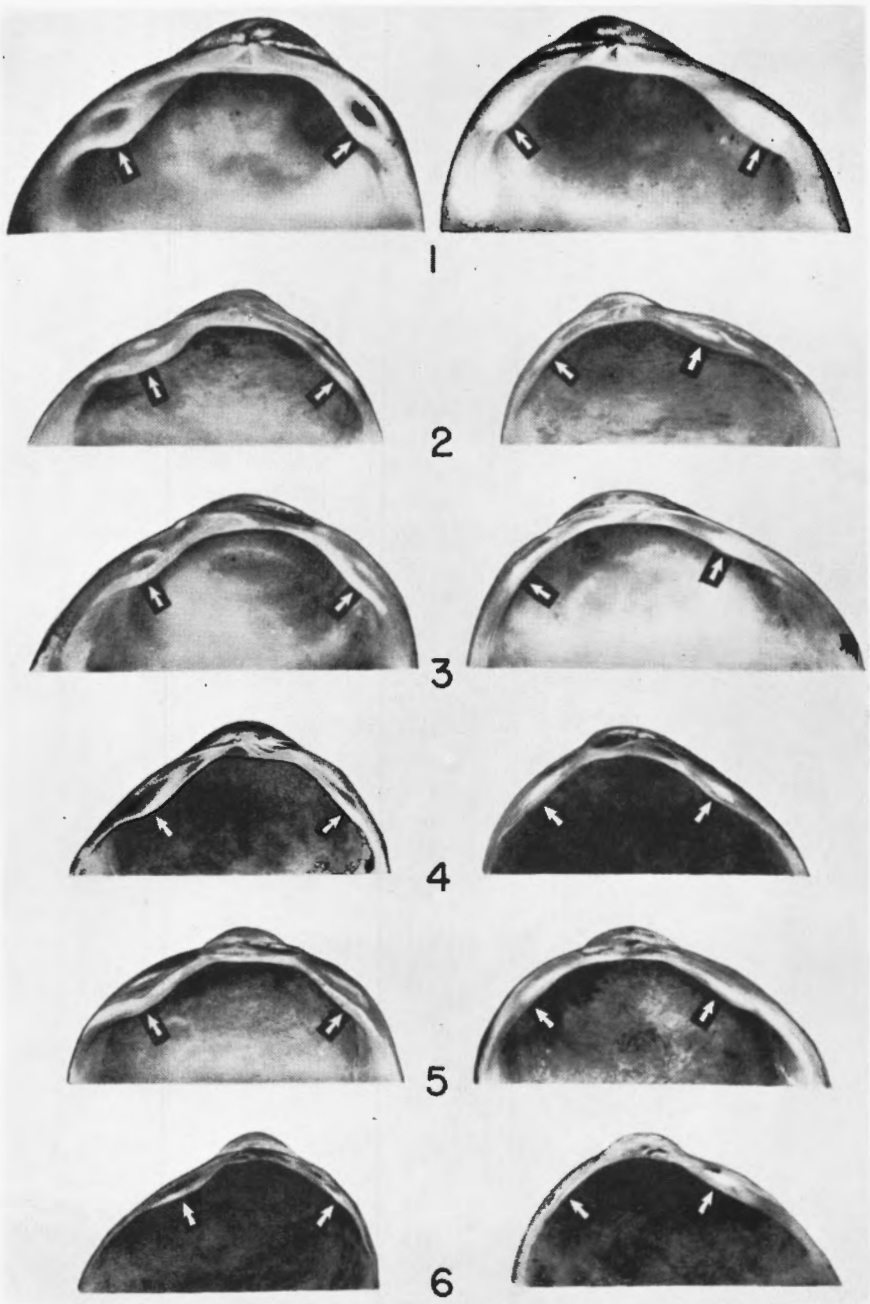


PLATE 3

Hinges of *Pisidium* (after Herrington, 1962, pl. 3)

1. *Pisidium dubium,* X6.5
2. *Pisidium amnicum,* X6.5
3. *Pisidium idahoense,* X6.5
4. *Pisidium variabile,* X10
5. *Pisidium adamsi,* X10
6. *Pisidium walkeri,* X10

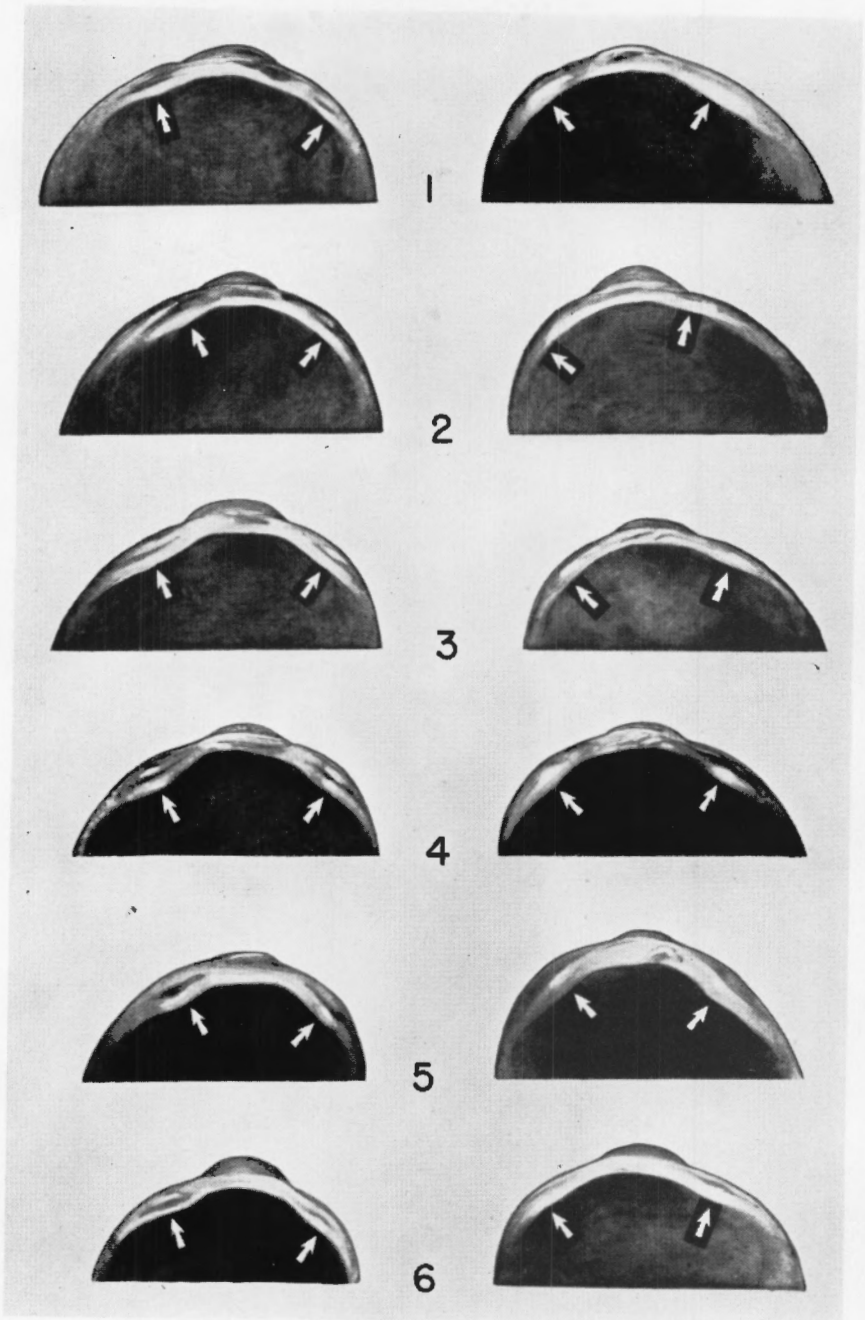


PLATE 4

Hinges of *Pisidium* (after Herrington, 1962, pl. 4)

1. *Pisidium casertanum,* X15
2. *Pisidium lilljeborgii,* X12.5
3. *Pisidium milium,* X15
4. *Pisidium obtusale,* X15
5. *Pisidium fallax,* X15
6. *Pisidium ferrugineum,* X15

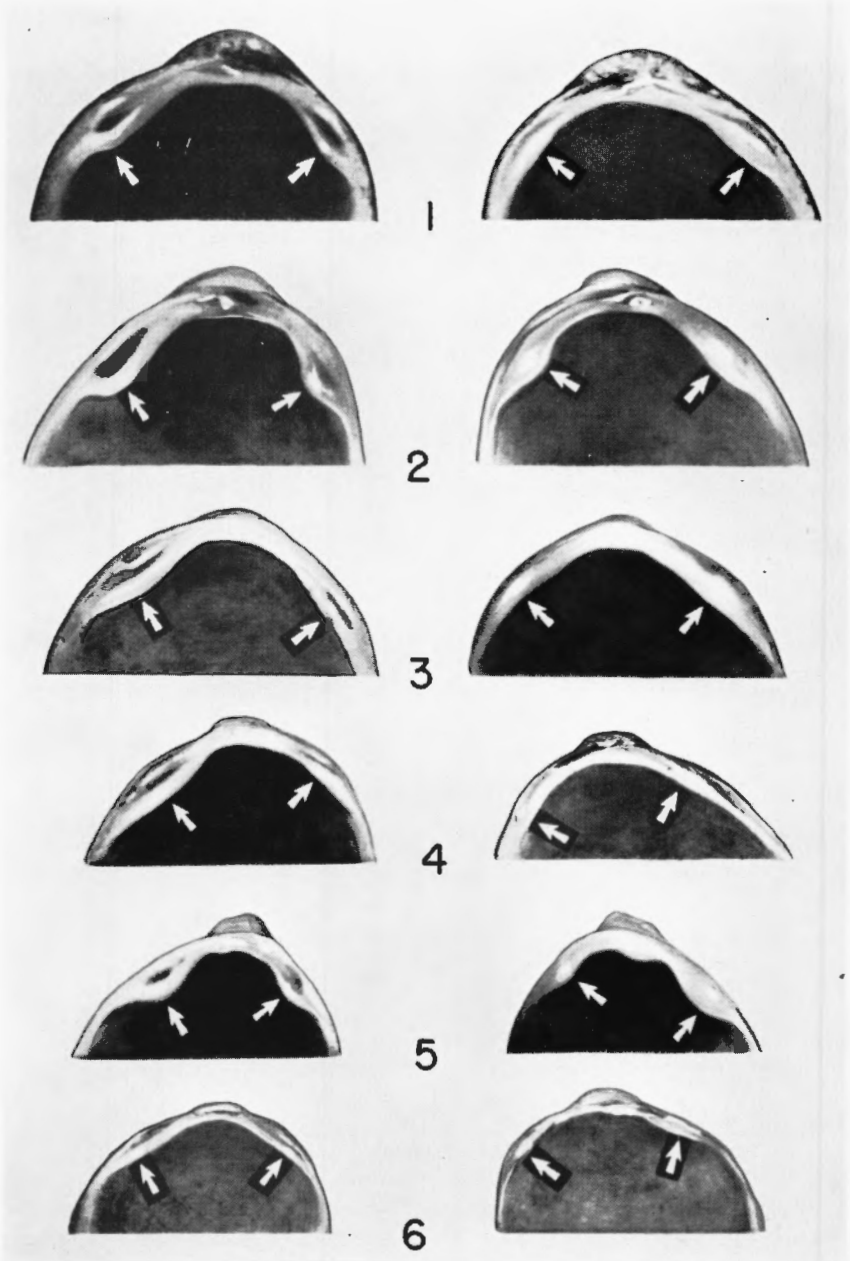


PLATE 5

Hinges of *Pisidium* (after Herrington, 1962, pl. 5)

1. *Pisidium aequilaterale,* X17
2. *Pisidium compressum,* X13
3. *Pisidium ultramontanum,* X13
4. *Pisidium henslowanum* form *supinum,* X13
5. *Pisidium cruciatum,* X17
6. *Pisidium nitidum,* X13

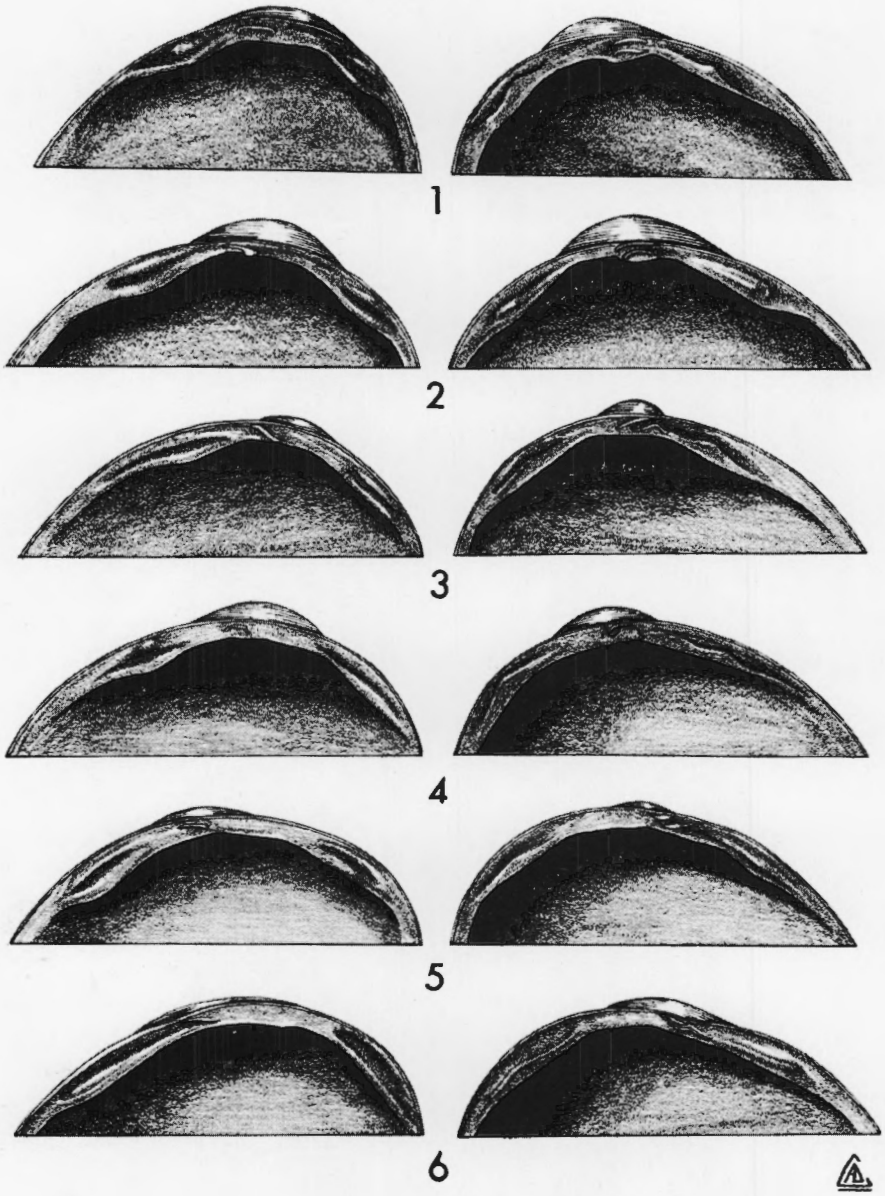


PLATE 6

Hinges of *Pisidium* (not to scale, after Herrington, 1962, pl. 6)

1. *Pisidium subtruncatum*
2. *Pisidium punctiferum*
3. *Pisidium benslowanum*
4. *Pisidium walkeri*
5. *Pisidium insigne*
6. *Pisidium conventus*

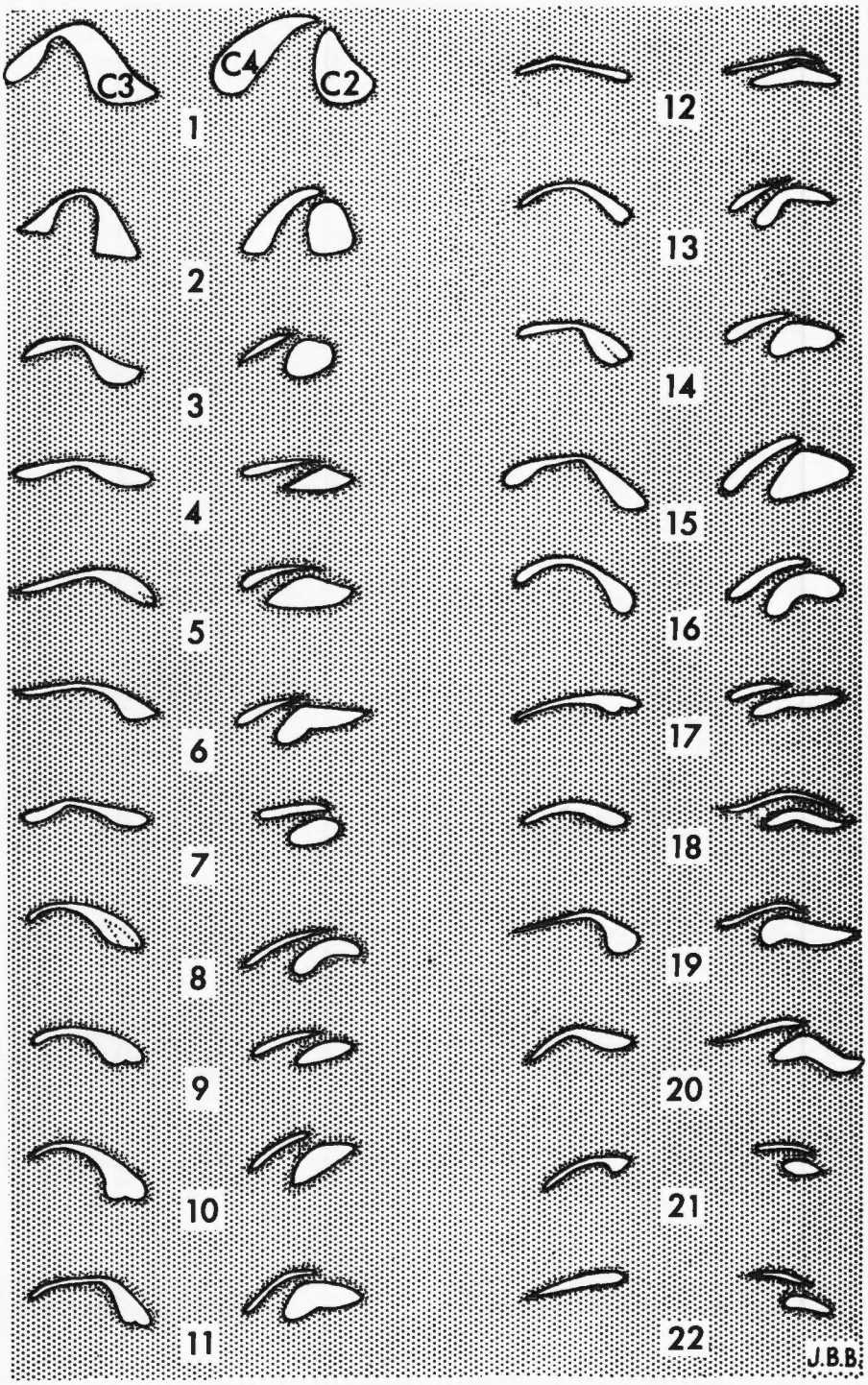


PLATE 7

Cardinal teeth of *Pisidium* (not to scale, after Herrington, 1962, pl. 7)

1. *Pisidium dubium*
2. *Pisidium amnicum*
3. *Pisidium idaboense*
4. *Pisidium variabile*
5. *Pisidium adamsi*
6. *Pisidium walkeri*
7. *Pisidium casertanum*
8. *Pisidium lilljeborgii*
9. *Pisidium milium*
10. *Pisidium obtusale*
11. *Pisidium fallax*
12. *Pisidium ferrugineum*
13. *Pisidium aequilaterale*
14. *Pisidium compressum*
15. *Pisidium ultramontanum*
16. *Pisidium cruciatum*
17. *Pisidium nitidum*
18. *Pisidium subtruncatum*
19. *Pisidium punctiferum*
20. *Pisidium henslowanum*
21. *Pisidium insigne*
22. *Pisidium conventus*

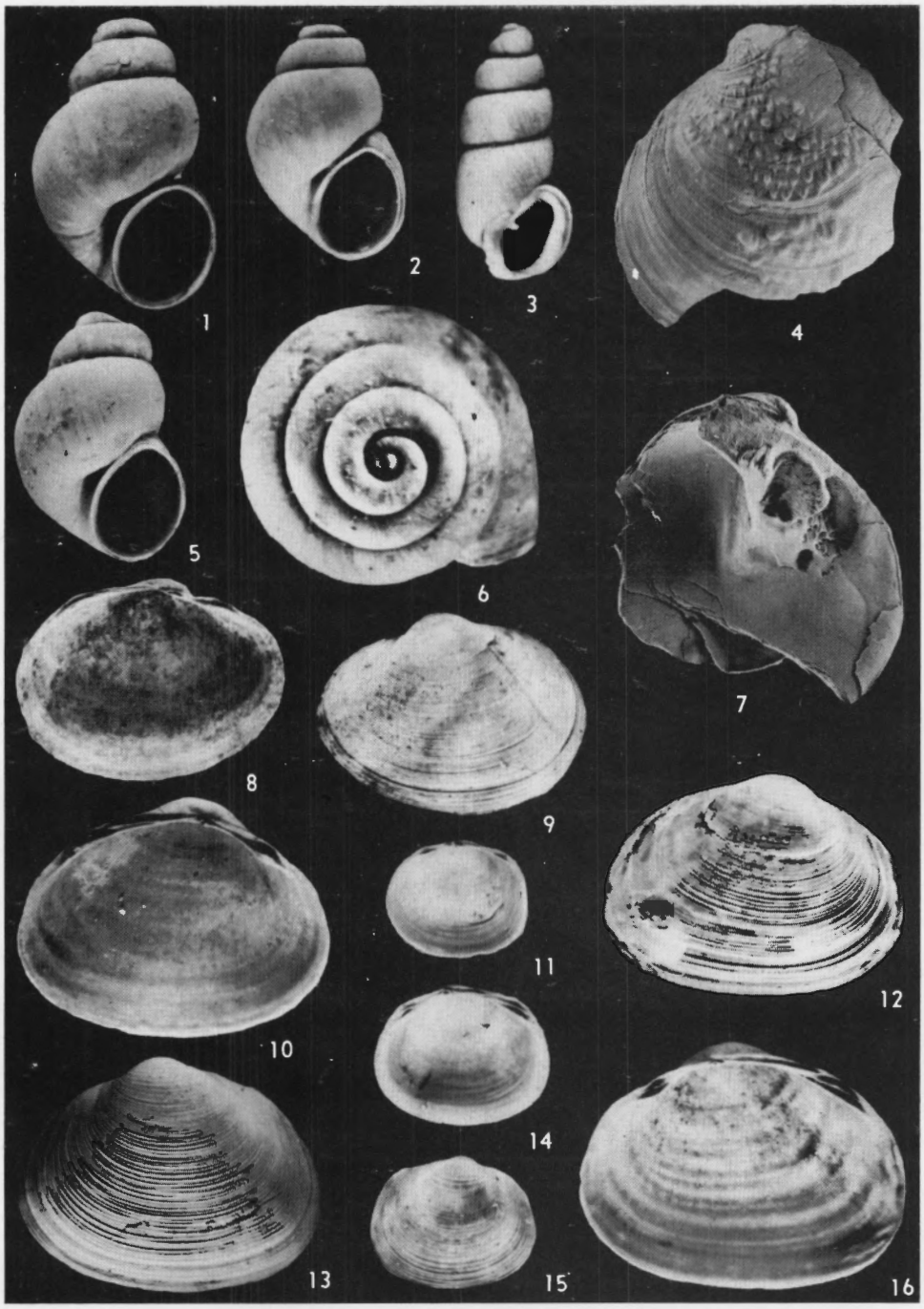


PLATE 8

Shells of *Amnicola, Carychium, Quadrula,* and *Sphaerium* (after Hibbard and Taylor, 1960, pl. IV; Pleistocene, Kansas)

1. *Amnicola lacustris,* X10
2. *Amnicola lacustris,* X10
3. *Carychium exiguum,* X20
4. *Quadrula quadrula,* X1
5. *Amnicola lacustris,* X10
6. *Amnicola lacustris,* X20
7. *Quadrula quadrula,* X1
8. *Sphaerium transversum,* X3
9. *Sphaerium transversum,* X3
10. *Sphaerium striatinum,* X3
11. *Sphaerium transversum,* X5
12. *Sphaerium striatinum,* X3
13. *Sphaerium striatinum,* X3
14. *Sphaerium striatinum,* X3
15. *Sphaerium striatinum,* X3
16. *Sphaerium striatinum,* X3