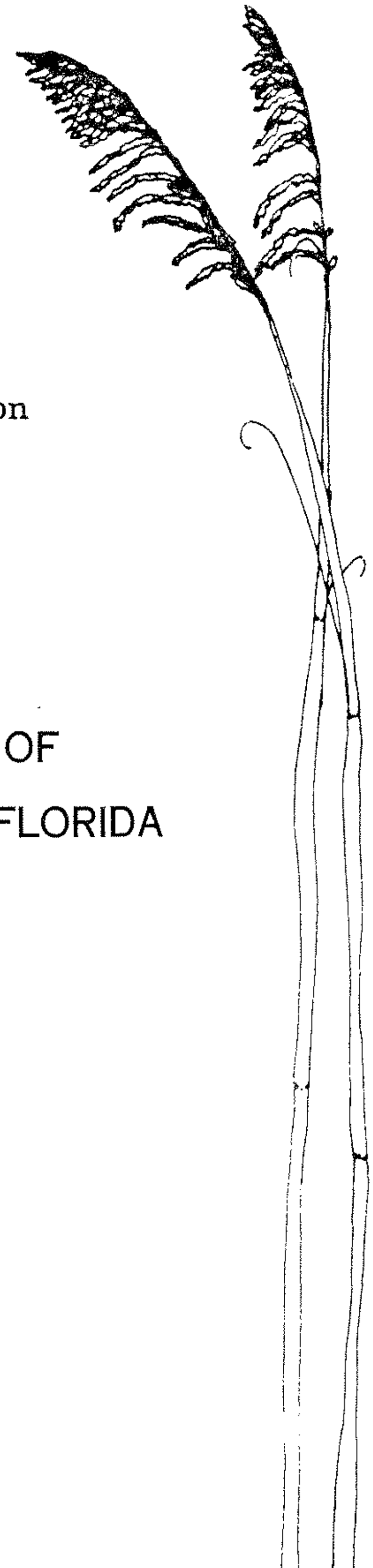
Heard 1979

Technical Series
Vol. 4 No. 2
October 1979



State of Florida
Department of
Environmental Regulation

IDENTIFICATION MANUAL OF THE FRESHWATER CLAMS OF FLORIDA

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IDENTIFICATION MANUAL OF
THE FRESHWATER CLAMS OF FLORIDA

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FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
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INTRODUCTION

Numerous species of freshwater clams were described and named during the past century, and over a period of time some received several names from the same or another author(s). As a consequence, considerable confusion occurred in attempts to identify specimens. In order to alleviate this situation, every so often a taxonomist would publish a monograph or revision of at least part of this assemblage of bivalved Mollusca, treating either a particular group of species or those species of a defined geographical or political area. However, many of these works were comprehensible only to other taxonomists, were poorly illustrated (if at all), and were of little practical value to non-specialists.

The purpose of this present account is to address the needs of those latter workers in the State of Florida (e.g., environmental specialists). It is well known that in particular the North American freshwater mussel fauna (superfamily Unionacea) is declining (e.g., see Heard, 1970; Athearn, 1970; Jorgensen and Sharp, 1971) and that all species, including those in Florida, are threatened by aquatic pollution and by such other alterations of habitats as are made by stream channelization and impoundments (caused by hydroelectric and other dams) (Fuller, 1974; Burch, 1975a). Hopefully, new studies will be initiated to identify particular water quality indicator species and also to generate conservation measures. The Inventory of Rare and Endangered Biota of

Florida lists only 3 species of freshwater clams (*Lampsilis haddletoni*, *Ptychobranchus jonesi* and *Villosa choctawensis*, the first 2 of which actually do not occur in the State), although even the most widespread and commonly encountered species face various environmental changes that are potentially deleterious to them. However, endemic species (occurring in only a single drainage) are in the greatest danger because they will more rapidly become extinct if irreparable changes of their habitats are made.

DIAGNOSTIC SHELL FEATURES

Different reproductive biologies and certain anatomical adaptations for reproduction form major bases for classification of freshwater clams above the level of species (see section on Classification), whereas species, and especially those in the same genus, are recognized by shell characters. Several prior authors first relied on anatomical and/or other reproductive features to deductively characterize such higher categories as families, subfamilies and genera and then provided shell descriptions and/or shell identification keys to species within those groups. That practice made it necessary to have in hand either live or preserved animals, and sometimes gravid females were needed to make an identification of the proper higher category before being able to continue the quest for the name of the species. However, many collections consist of only empty shells, or the available animals might be males.

The recent identification keys provided by Johnson (1972) and Burch (1975a, 1975b) are admirable for their efforts to utilize shell features to identify species, although they share a shortcoming of all keys (likely including the one presented herein), viz., ranges of variation within species are often very difficult to portray. In addition, certain shell characters listed in a text description or in a key might not be present in the specimens under examination, not because they were never present but because they are no longer present or at least are not preceptible.

An excellent example is that of characteristic beak sculpturing, customarily employed to define genera of freshwater mussels (Unionacea); it might be present in very young, very small specimens, but in most species it is likely to vanish as the beaks undergo erosion with growth (often at quite an early age). In addition, deposition of mineral deposits on the outside of the shell often obscures colors and makes difficult the determination of whether or not radiating color lines are also present. Moreover, such color lines are more commonly encountered in younger, smaller individuals and often become obscure with age, even in the absence of mineral deposits.

Other problems with species identifications based on shell characters are: environmental modification of shell shape and size (recognized, but poorly understood); intraspecific variation in the color of the inner surface of the shell (sometimes in the same population); sexual dimorphism in shell shape of certain species; and the great similarity of juveniles of different species of the same genus (and sometimes of several genera).

The features emphasized in the present identification key are: the kinds of hinge teeth; spacing of growth striae; shell size; shell shape; background color and presence or absence of radiating color lines; distribution of sculpturing (except on the beak); presence or absence of external gloss on the shell; nature of the posterior ridge, if present; and geographic occurrence (specific drainages). Technical terminology has been avoided whenever possible, and most characters are self-explanatory or can be readily identified by examining the shell illustrations or are defined in parentheses. Aspects of the hinge teeth and shell shape requiring more detailed explanation are shown in Figs. 1-10.

REPRODUCTION

The species of clams occupying the fresh waters of Florida belong to 2 groups (superfamilies Sphaeracea and Unionacea) that contain representatives on all continents of the world. All species of both groups are mucus-ciliary feeders, subsisting on phytoplankton and detritus. The vast majority of species, including those in Florida, undergo a form of internal feterilization within either the inner 2 "gills" (i.e., demibranchs) (Sphaeriacea) or the outer 2 demibranchs Unionacea: family Unionidae) or in all 4 demibranchs (Unionacea: Amblemidae and Margaritiferidae), where the developing young are brooded, and release nonplanktonic offspring.

The superfamily Sphaeriacea is represented in Florida by members of 2 families, viz., Corbiculidae and Sphaeriidae. Only 1 corbiculid, (*Corbicula manilensis*) is present, whereas 12 sphaeriids occur here (see section on Classification). All 13 species are hermaphroditic, although the paucity of testicular tissue in *Byssanodonta cubensis* suggests the occurrence of parthenogenetic reproduction in that sphaeriid (pers. observ.). Unlike some other, Asian species of *Corbicula*, *C. manilensis* releases a nonplanktonic advanced veliger larval stage (see Sinclair and Isom, 1963). In contrast, all sphaeriids expel crawl-away newborn that, except for an underveloped or inoperative structural reproductive system, are miniature adults (Heard, 1965a, 1977; Meier-Brook, 1970; Mackie, 1976).

The superfamily Unionacea contains 1-9 families, depending on which reference that one consults; members of 2 occur in Florida. Crawl-away newborn are produced by very few species, none of which are found in the State. The vast majority of species discharge bivalved larvae (glochidia) that are obligatory parasites on the gills or fins of various species of freshwater fishes for about 3 weeks, after which period the metamorphosed juvenile clams leave the host to adopt a free-living existence (Lefevre and Cutris, 1912; Coker, et al., 1922; Fuller, 1974). Very few life cycle studies of these animals (commonly called freshwater mussels), including the identification of the host fishes, have been completed, and none have ever been undertaken in Florida.

Other information concerning reproduction is provided in the section on Classification and also in that on Ecology.

CLASSIFICATION

Species are grouped (classified) into different higher categories, e.g., genera and families, on the bases of natural affinities. Species with some features in common are placed together in the same category, which differs from others of the same rank by differences between the groups of species. The same kinds of characters (e.g., attributes of shells) may be used to define species and also higher categories of them, but it is also possible to employ different kinds of characters for species and higher categories.

All species of freshwater clams were described from shell characteristics, and the vast majority of groups were also originally established according to shells. However, many groupings of species of these mollusks have been redefined on the bases of anatomical and (other) reproductive grounds.

Different subgenera, genera and subfamilies of the Sphaeriidae are recognized by differences in: the incurrent and excurrent siphons; comparative size of the outer demibranchs ("gills"); structural details of those demibranchs; duration of incubation of developing young; general brood size; and size of newborn (see Heard, 1965a, 1965b, 1966, 1977).

Different subfamilies, families and several genera of the Unionacea are characterized by differences in: the number of marsupial demibranchs ("gills" in which the developing young are brooded); the location of the marsupia in those demibranchs; structural adaptations of the marsupial demibranchs; duration of brooding; and form of the larva (see Heard and Guckert, 1971; Heard, 1974, 1975).

Those "animal features" might assist in the recognition of a higher grouping and thus facilitate reduction of the number of choices in attempting to identify a species, but they will be of little use if the specimens are males or nongravid females. This account is therefore based on shell characters for the purpose of identifying species. One can then simply append the name of the appropriate genus (and other names, if needed).

It must be realized, however, that classification is not a static exercise. Reclassification occurs as new discoveries about organisms are made. In this regard, some name changes for several of the freshwater clams in Florida might eventually be needed. For example, initial analysis of findings from current electrophoretic and immunological studies suggest that the distinction between Unionacea: Amblemidae and Unionidae (with 4 or 2 marsupial demibranchs, respectively) is artificial and thus is in error, that species of *Fusconaia* and *Pleurobema* constitute a single genus, and that *Elliptio icterina* from the Gulf drainages appears to be "different" from what is called the same species in the Atlantic drainages (G.M. Davis, pers. commun.). Because those and related provisional findings are still undergoing analyses and are not yet published, a comparatively conservative classification is used here.

There follows a listing of the species treated herein, arranged alphabetically within the various higher categories. Also included are references to remarks correspondingly numbered in the section entitled Notes.

CLASSIFICATION	*NOTE*	*FIGURE*
Superfamily Sphaeriacea		
Family Corbiculidae		
Corbicula manilensis (Philippi)	1	12
Family Sphaeriidae (= Pisidiidae)		
Subfamily Euperinae		
Byssanodonta cubensis (Prime)	2	13
Subfamily Sphaeriinae *sensu stricto*		
Musculium lacustre (O.F. Muller)	3	14
Musculium partumeium (Say)	3	15
Musculium securis (Prime)	3	16
Musculium transversum (Say)	3	17
Sphaerium occidentale (Prime)	4	18
Sphaerium striatinum (Lamarck)		19
Subfamily Pisidiinae		
Pisidium (*Cyclocalyx*) *adamsi* Prime		20
Pisidium (*Cyclocalyx*) *casteranum* (Poli)		21
Pisidium (*Cyclocalyx*) *compressum* Prime		22
Pisidium (*Pisidium*) *dubium* (Say)		23
Pisidium (*Cyclocalyx*) *punctiferum* (Guppy)		24

CLASSIFICATION (continued)	*NOTE*	*FIGURE*
Superfamily Unionacea		
Family Amblemidae *sensu* Heard and Guckert (1971)		
Subfamily Ambleminae *sensu stricto*		
Amblema neisleri (Lea)		33
Amblema perplicata (Conrad)	5	34
Elliptoideus sloatianus (Lea)	5	35
Fusconaia escambia Clench and Turner		36
Fusconaia rotulata (Wright)		37
Fusconaia succissa (Lea)		38
Plectomerus dombeyanus (Valenciennes)	5	39
Quincuncina burkei (Walker)		40
Quincuncina infucata (Conrad)	6	41-42
Subfamily Megalonaiadinae		
Megalonaias boykiniana (Lea)	7	43-45
Family Margaritiferidae		
Margaritifera hembeli (Conrad)		
Family Unionidae *sensu* Heard and Guckert (1971)		
Subfamily Anondontinae		
Alasmidonta triangulata (Lea)		25
Alasmidonta wrightiana (Walker)	8	
Anodonta cataracta Say		26
Anodonta couperiana Lea		27
Anodonta imbecilis Say		28
Anodonta peggyae Johnson		29

CLASSIFICATION (continued)	*NOTE*	*FIGURE*
Anodonta suborbiculata Say		30
Anodontoides radiatus (Conrad)		31
Strophitus subvexus (Conrad)		32
Subfamily Lampsilinae		
Carunculina parva (Barnes)	9	62-65
Glebula rotundata (Lamarck)	9	66-67
Lampsilis binominatus Simpson		
Lampsilis claibornensis (Lea)		68
Lampsilis excavatus (Lea)	9	69-70
Lampsilis haddletoni Athearn		
Lampsilis teres (Rafinesque)	9	71-73
Medionidus penicillatus (Lea)		74
Medionidus simpsonianus Walker		75
Medionidus walkeri (Wright)		76
Ptychobranchus jonesi (van der Schalie)		
Villosa amygdala (Lea)	10	78-79
Villosa australis (Simpson)	11	77
Villosa choctawensis Athearn		80
Villosa lienosa (Conrad)	9	81-82
Villosa subangulata (Lea)	11	83
Villosa vibex (Conrad)		84
Villosa villosa (Wright)	9	85-88
Subfamily Pleurobeminae (= Popenaiadinae)		
Elliptio arctata (Conrad)		46

CLASSIFICATION (continued)	*NOTE*	*FIGURE*
Elliptio buckleyi (Lea)	10	47
Elliptio chipolaensis (Walker)		48
Elliptio complanata (Lightfoot)		49
Elliptio crassidens (Lamarck)		50-51
Elliptio dariensis (Lea)		52
Elliptio icterina (Lea)		54-55
Elliptio jayensis (Lea)		53
Elliptio lanceolata (Lea)		56
Elliptio mcmichaeli Clench and Turner		57
Elliptio nigella (Lea)		
Pleurobema pyriforme (Lea)		58
Pleurobema strodeanum (Wright)		59
Uniomerus carolinianus (Bosc)	12	60
Uniomerus declivis (Say)	12	61

KEY TO SPECIES

1a Hinge with anterior lateral, cardinal and posterior lateral teeth (Figs. 1-2) 2

1b Hinge either with both pseudocardinal and lateral teeth present (Fig. 3), or with only vestigial pseudocardinal teeth (Fig. 4), or altogether lacking hinge teeth 14

2a Lateral teeth with fine, transverse serrations (Fig. 12) . . . . *Corbicula manilensis*

2b Lateral teeth lacking serrations 3

3a Beaks slightly anterior of center of the shell (see Figs. 13-19) 4

3b Beaks posterior of center of the shell (Figs. 1-2, 20-24) 10

4a 1 cardinal tooth in each valve; shell usually with variable pattern of dark blotches (Fig. 13) . . . . *Byssanodonta cubensis*

4b 2 cardinal teeth in the left valve, only 1 in the right valve; shell not bearing dark blotches 5

5a Exterior of shell with prominent, often coarse, concentric growth striae (less than 8 per mm in the middle of the shell) of irregular height and spacing (Fig. 19) . . . . *Sphaerium striatinum*

5b Shell with fine, more regularly and narrowly spaced striae (more than 12 per mm in the middle of the shell) 6

6a Length of shell greater than 8 mm 7

6b Length of shell less than 8 mm 9

7a Beaks conspicuously elevated over the dorsal margin of the shell, only rarely calyculate (i.e., beaks seldom distinguished from the rest of the shell by a prominent sulcus) (Fig. 17) . . . . *Musculium transversum*

7b Beaks sometimes protruding only slightly above the dorsal margin of the shell, or calyculate when conspicuously elevated 8

8a Dorsal margin of the shell angularly merging with the anterior and posterior margins (Fig. 14) . . . . *Musculium lacustre*

8b Shell rounded in lateral outline (Fig. 15) . . . . *Musculium partumeium*

9a Anteroventral margin of the shell sloping upward (Fig. 16) . . . . *Musculium securis*

9b Anteroventral margin of the shell rounded (Fig. 18) . . . . *Sphaerium occidentale*

10a Shell comparatively large, up to 10 mm long (Fig. 23) . . . . *Pisidium dubium*

10b Shell comparatively small, rarely longer than 5 mm and usually shorter 11

11a Shell with 1 short, comparatively straight ridge atop each beak (Fig. 22) . . . . *Pisidium compressum*

11b Shell lacking a ridge atop each beak 12

12a External surface of the shell with fine concentric growth striae (about 15 per mm in the middle of the shell) (Fig. 20) . . . . *Pisidium adamsi*

12b External surface of the shell with very fine concentric growth striae (at least 30 per mm in the middle of the shell) 13

13a Cusp (most elevated part) of the anterior lateral tooth of the left valve in anterior position on the tooth (Fig. 21) . . . . *Pisidium casertanum*

13b Cusp of the anterior lateral tooth of the left valve in central to posterior position on the tooth (Fig. 24) . . . . *Pisidium punctiferum*

14a Hinge entirely without teeth (edentulous condition) 15

14b Hinge bearing well developed (Fig. 3) or vestigial (Fig. 4) pseudocardinal teeth, and with or without lateral teeth, respectively 19

15a Beaks well elevated above the dorsal margin in the shell (Fig. 26) . . . . *Anodonta cataracta*

15b Beaks rarely, and then only slightly, extending above the dorsal margin of the shell 16

16a Ventral margin of the shell strongly curved 17

16b Ventral margin of the shell only moderately curved or rather straight 18

17a Shell laterally compressed (narrow width); external surface of younger, smaller specimens sometimes with numerous radiating color lines from anterior to posterior, but with no or only a few such lines on older, larger shells; Escambia drainage (Fig. 11: 1) (Fig. 30) . . . . *Anodonta suborbiculata*

17b Shell laterally inflated (wide); external surface of the shell of a straw yellow color and typically with numerous radiating green color lines (sometimes absent), usually over the posterior half of the shell (Fig. 27) . . . . *Anodonta couperiana*

18a Shell length about twice the height; dorsal and ventral margins rather straight and parallel to each other; posterior end pointed; usually of uniform bright green color, but sometimes also with a few widely spaced radiating dark lines (Fig. 28) . . . . *Anodonta imbecilis*

18b Shell length about 1 1/2 times the height; ventral margin moderately curved, not parallel to the dorsal margin from which it diverges posteriorly; posterior end rounded; of bright green color that is interrupted by numerous pale yellow radiating lines from anterior to posterior (Fig. 29) . . . . *Anodonta peggyae*

19a Hinge bearing only vestigial pseudocardinal teeth, lacking lateral teeth 20

19b Hinge with well developed pseudocardinal and lateral teeth 21

20a Vestigial pseudocardinal teeth lamellate (long, low, thin, blade-like) (Fig. 31) . . . . *Anodontoides radiatus*

20b Vestigial pseudocardinal teeth low, blunt knobs (Fig. 32) . . . . *Strophitus subvexus*

21a External surface of the shell sculptured with ridges, either below the beaks and on the posterior slope (region behind the posterior ridge, which runs diagonally from the rear of the beaks toward the posteroventral margin of the shell) or only on the posterior slope 22

21b External surface of the shell below and behind the beaks smooth, not sculptured 34

22a Sculpturing present below the beaks and on the posterior slope 23

22b Sculpturing confined to the posterior slope 30

23a Inner surface of valves with purple color 24

23b Inner surface of valves white 25

24a Purple color occurring as a wide peripheral band that borders a central white area (Fig. 35) . . . . *Elliptoideus sloatianus*

24b Entire interior surface of valves purple; Escambia drainage (Fig. 11: 1) (Fig. 39) . . . . *Plectomerus dombeyanus*

25a Sculpturing not present anterior to the beaks 26

25b Sculpturing also present in front of the beaks 28

26a Shell small, less than 6 cm long; Choctawhatchee drainage (Fig. 11: 3); also see choices 29b and 31a . . . . *Quincuncina burkei*

26b Shell large, up to 11 cm long 27

27a Shell extremely inflated (width = height in large, old individuals); ventral margin moderately curved (Fig. 33) or sometimes rather straight . . . . . . *Amblema neisleri*

27b Shell laterally compressed (narrow); ventral margin distinctly rounded; Escambia drainage (Fig. 11: 1) (Fig. 34) . . . . *Amblema perplicata*

28a Shell large, up to 20 cm long; sculpturing consisting of heavy coarse corrugations (Figs. 43-45) . . . . *Megalonaias boykiniana*

28b Shell small, less than 6 cm long; sculpturing consisting of fine ridges 29

29a Posterior end of shell vertically truncated (Figs. 41-42) . . . . *Quincuncina infucata*

29b Posterior end of shell not truncated, that margin gradually curving posteroventrally; Choctawhatchee drainage (Fig. 11: 3); also see choices 26a and 31a . . . . *Quincuncina burkei*

30a Shell small, less than 6 cm long 31

30b Shell large, more than 8 (up to 13) cm long 32

31a Endemic to the Choctawhatchee drainage (Fig. 11: 3); also see choices 26a and 29b (Fig. 40). . . . . . . *Quincuncina burkei*

31b Occuring only in the Apalachicola and Yellow drainages (Fig. 11: 4-7 and 2) (Fig. 74) . . . . *Medionidus penicillatus*

31c Endemic to the Ochlockonee drainage (Fig. 11: 8) (Fig. 75) . . . . *Medionidus simpsonianus*

31d Endemic to the Suwannee drainage (Fig. 11: 12) (Fig. 76) . . . . *Medionidus walkeri*

32a Occurring in the Apalachicola and Yellow drainages (Fig. 11: 4-7, and 2); also see choices 43b and 60a (Fig. 51) . . . . *Elliptio crassidens*

32b Found in the St. Johns drainage (Fig. 11: 20); also see choice 43a . . . . *Elliptio dariensis*

32c Endemic to the Choctawhatchee drainage (Fig. 11: 3) (Fig. 57) . . . . *Elliptio mcmichaeli*

33a Lateral teeth vestigial, barely visible; Apalachicola drainage (Fig. 11: 4) (Fig. 25) . . . . *Alasmidonta triangulata*

33b Lateral teeth distinctly present 34

34a Shell round in lateral outline; Escambia drainage (Fig. 11: 1) (Fig. 37) . . . . *Fusconaia rotulata*

34b Lateral outline of shell not round 35

35a Shell with a posterior ridge running diagonally from the posterior end of the beaks toward the posteroventral margin of the shell 36

35b Shell lacking a distinct posterior ridge 44

36a External surface of the shell glossy (shiny). 37

36b External surface of the shell dull, not glossy 40

37a Posterior ridge distinct and straight, forming an acute angle with the ventral margin 38

37b Posterior ridge faint and curved 39

38a Shell comparatively high, length/height ratio less than 1.4; external surface yellow, with a few radiating green lines; Escambia drainage (Fig. 11: 1) (Figs. 69-70). . . . . *Lampsilis excavatus*

38b Shell longer in relation to height, and of variable shape (subtrapezoidal to ovate); external surface usually glossy, with yellow, green or copper background color and numerous radiating green lines from anterior to posterior (Fig. 47) . . . . *Elliptio buckleyi*

39a Posterior ridge convex, curving toward the dorsal margin and posteriorly terminating above the vertical midpoint of the shell; external surface of glossy yellow color, usually lacking but sometimes with several radiating green lines (Figs. 71-73) . . . . *Lampsilis teres*

39b Posterior ridge concave, curving toward the ventral margin and terminating at the vertical midpoint of the shell or below; external surface glossy pale yellow, with numerous radiating wide green lines from anterior to posterior (Fig. 83) . . . . *Villosa subangulata*

40a Lateral outline of the shell subtriangular; Escambia and Yellow drainages (Fig. 11: 1-2) (Fig. 36) . . . . *Fusconaia escambia*

40b Lateral outline of shell rhomboidal, trapezoidal, elliptical or ovate, not subtriangular 41

41a Shell small, adult length up to 4.5 cm 42

41b Shell of medium to large size, 6-13 cm long 43

42a Shell subelliptical in lateral outline, externally glossy (Fig. 58) . . . . *Pleurobema pyriforme*

42b Shell subovate in lateral outline, externally dull (Fig. 59) . . . . *Pleurobema strodeanum*

43a Shell laterally compressed (narrow width); valves thin for the large size (10-13 cm long); St. Johns drainage (Fig. 11: 20); also see choice 32b (Fig. 52) . . . . *Elliptio dariensis*

43b Shell wide, in part owing to the great thickness of the valves; length up to 8 cm in the Chipola River (Fig. 11: 5) but more than 10 cm elsewhere; also see choices 32a and 60a (Fig. 50). . . . . . . *Elliptio crassidens*

44a Shell length/height ratio greater than 2.0 45

44b Shell length/height ratio less than 2.0 47

45a Ventral margin of the shell arcuate (slightly curved dorsally) (Fig. 46) . . . . *Elliptio arcata*

45b Ventral margin of the shell nearly straight, slightly curved downward 46

46a Shell of medium size, 7-9 cm long; dorsal and ventral margins diverging posteriorly, not parallel (Fig. 53) . . . . *Elliptio jayensis*

46b Shell large, 10-13 cm long; dorsal and ventral margins parallel to each other (Fig. 56) . . . . *Elliptio lanceolata*

47a Shell small, usually up to only 3.5 cm long 48

47b Shell of medium or large size, 5-12 cm long 49

48a External surface the shell very dark brown to black, moderately glossy; Choctawhatchee drainage (Fig. 11: 3) (Fig. 79). . . . . *Villosa choctawensis*

48b External surface the shell dark gray to black, dull, without gloss and often of satiny appearance (Figs. 62-65) . . . . *Carunculina parva*

49a Lateral outline of shell subquadrate (Fig. 38) . . . . *Fusconaia succissa*

49b Lateral outline of shell subelliptical, subovate, subrhomboidal, subtrapezoidal or subcircular, but not subquadrate 50

50a Shell subcircular in lateral outline, especially in females; in Apalachicola and Escambia drainages (Fig. 11: 4, 1) near the Gulf of Mexico (Figs. 66-67) . . . . *Glebula rotundata*

50b Shell not subcircular, of another shape in lateral outline 51

51a External surface of shell glossy 52

51b External surface of shell dull, not glossy 53

52a Shell subovate in lateral outline; external surface usually of uniform orange-tan color, sometimes also with a few narrow radiating dark lines on the posterior half (Fig. 68) . . . . *Lampsilis claibornensis*

52b Shell elliptical in lateral outline; external surface of young, small individuals of yellow-green background color and with numerous darker green radiating lines from anterior to posterior; external surface of larger individuals uniformly black, without perceptible rays, but still very glossy (Fig. 77) . . . . *Villosa australis*

53a External surface of shell with a satiny appearance 54

53b External surface of shell dull but not satiny 56

54a Shell subelliptical in lateral outline; males (Fig. 85) are pointed posteriorly, whereas females (Fig. 86) are rounded-truncate posteriorly; with (when younger) or without (older) radiating color lines from anterior to posterior . . . . *Villosa villosa*

54b Shell rhomboidal in lateral outline, lacking radiating color lines 55

55a Shell comparatively compressed, the length/width ratio barely exceeding 3.0; posterodorsal margin long, forming an acute angle with the ventral margin (Fig. 61) . . . . *Uniomerus declivis*

55b Shell comparatively inflated, the length/width ratio being less than 2.5; posterodorsal margin shorter, forming a greater angle with the ventral margin (Fig. 60) . . . . *Uniomerus carolinianus*

56a Shell ovate to subovate in lateral outline 57

56b Shell subrhomboidal or elliptical in lateral outline, or with a rather straight dorsal margin and an angular ventral margin 58

57a External surface of shell tan to dark brown, lacking radiating color lines; Chipola River (Fig. 11: 5) (Fig. 48). . . . . *Elliptio chipolaensis*

57b External surface of shell yellowish-green, with numerous radiating color lines from anterior to posterior (often obscured by mineral deposits) (Fig. 84) . . . . *Villosa vibex*

58a Shell with a rather straight dorsal margin and an angular ventral margin; also see choice 62a (Fig. 82) . . . . .female *Villosa lienosa*

58b Shell elliptical or subrhomboidal in lateral outline 59

59a Shell subrhomboidal in lateral outline 60

59b Shell elliptical in lateral outline 61

60a Shell comparatively wide, owing to the heavy thickness of the valves; also see choices 32a and 43b . . . . *Elliptio crassidens*

60b Shell compressed, valves thin; Apalachicola drainage (Fig. 11: 4) (Fig. 49) . . . . *Elliptio complanata*

61a Inner surface of valves white; males (Fig. 78) are pointed posteriorly, whereas females (Fig. 79) are rounded-truncate posteriorly . . . .*Villosa amygdala*

61b Inner surface of valves usually with various tones of purple (or other color than white) 62

62a External surface of shell only rarely with radiating color lines, and then just in small, young individuals, also see choice 58a (Fig. 81) . . . . male *Villosa lienosa*

62b External surface of shell often covered with numerous radiating color lines (at least in small, young individuals that in some populations are obscured by mineral deposits (Figs. 54-55). . . . . *Elliptio icterina*

GEOGRAPHIC DISTRIBUTION

Below is an alphabetical listing of the different drainages in which each sphaeriid and unionacean species is known to occur in Florida; the numbers correspond to those employed in Fig. 11. Drainage names used here are those employed by Johnson (1970, 1972), except that here the Fisheating Creek and Kissimmee River tributaries of Lake Okeechobee (19) are collectively referred to as the Lake Okeechobee drainage.

The introduced *Corbicula manilensis* (Sphaeriacea: Corbiculidae) was first encountered in Florida in the early 1960s (see Heard, 1964) and now occurs throughout the State. Sphaeriids are more commonly found in the Peninsula, whereas there is a much greater diversity of unionaceans in the Panhandle.

Also provided is a list of Unionacea that have never been collected in Florida but which occur in Alabama and Georgia in drainages that flow through the Panhandle into the Gulf of Mexico.

Species that are endemic (confined) to a single drainage are indicated by an asterisk (*).

SPHAERIACEA: SPHAERIIDAE (after Heard, 1963, 1965a, 1965b)

Byssanodonta cubensis: Apalachicola (4), Caloosahatchee (18), Hillsborough (15), Lake Okeechobee (19), Ochlockonee (8), St. Johns (20) and Waccassassa (13) drainages, and canals in Broward, Dade and Palm Beach counties.

Musculium lacustre: Apalachicola (4), Escambia (1), St. Johns (20), St. Mark's (9) and Suwannee (12) drainages.

Musculium partumeium: Aucilla (10), Hillsborough (15), Ochlockonee (8), Peace (17), St. Johns (20), Suwannee (12) and Withlacoochee (14) drainages, and canals in Dade County.

Musculium securis: Choctawhatchee (3), Lake Okeechobee (19), Ochlocknee (8), Peace (17), St. Johns (20) and Suwannee (12) drainages, and canals in Broward, Dade and Palm Beach counties.

Musculium transversum: Apalachicola (4), Caloosahatchee (18), Escambia (1), Lake Okeechobee (19), Peace (17), St. Johns (20) and Suwannee (12) drainages, and canals in Palm Beach County.

Pisidium adamsi: St. Johns (20), Suwanee (12) and Withlacoochee (14) drainages.

Pisidium casertanum: Apalachicola (4), Aucilla (10), Escambia (1), Hillsborough (15), Lake Okeechobee (19), Myakka (16), Ochlockonee (8), Peace (17), St. Johns (20), Suwannee (12), Waccasassa (13) and Withlacoochee (14) drainages.

Pisidium compressum: Apalachicola (4), Choctawhatchee (3), Ochlockonee (8), St. Johns (20), St. Mark's (9), Suwannee (12) and Withlacoochee (14) drainages.

Pisidium dubium: Apalachicola (4), Aucilla (10), Choctawhatchee (3), Escambia (1), Ochlockonee (8), St. Johns (20), St. Mark's (9) and Suwannee (12) drainages.

Pisidium punctiferum: Peace (17), St. Johns (20) and Withlacoochee (14) drainages.

Sphaerium occidentale: Apalachicola drainage (4).

Sphaerium striatinum: Aucilla (10), St. Mark's (9) and Suwannee (12) drainages.

UNIONACEA (after Johnson, 1967, 1969, 1979, 1972; and personal observations)

Alasmidonta triangulata: Apalachicola drainage (4).

**Alasmidonta wrightiana*: Ocklockonee drainage (8).

Amblema neisleri: Apalachicola (4) and Escambia (1) drainages.

Amblema perplicata: Escambia drainage (1).

Anodonta cataracta: Apalachicola (4) and Choctawhatchee (3) drainages.

Anodonta couperiana: Apalachicola (4), Lake Okeechobee (19), Myakka (16), Ochlockonee (8) and St. Johns (20) drainages.

Anodonta imbecilis: Apalachicola (4), Escambia (1) and Ochlockonee (8) drainages.

Anodonta peggyae: Apalachicola (4), Choctawhatchee (3), Hillsborough (15), Ochlockonee (8), Suwannee (12), Withlacoochee (14) and Yellow (2) drainages.

Anodonta suborbiculata: Escambia drainage (1).

Anodontoides radiatus: Apalachicola (4) and Escambia (1) drainages.

Carunculina parva: Apalachicola (4), Choctawhatchee (3), Escambia (1), Hillsborough (15), Lake Okeechobee (19), Ochlockonee (8), Peace (17), St. Johns (20), Suwannee (12), Withlacoochee (14) and Yellow (2) drainages.

Elliptio arctata: Apalachicola (4), Escambia (1) and Yellow (2) drainages.

Elliptio buckleyi: Chipola River tributary (5) of the Apalachicola, Lake Okeechobee (19), Myakka (16), Peace (17), St. Johns (20) and Withlacoochee (14) drainages.

**Elliptio chipolaensis*: Chipola River tributary (5) of the Apalachicola drainage.

Elliptio complanata: Apalachicola drainage (4).

Elliptio crassidens: Apalachicola (4) and Escambia (1) drainages.

Elliptio dariensis: St. Johns drainage (20).

Elliptio icterina: Apalachicola (4), Choctawhatchee (3), Escambia (1), Hillsborough (15), Lake Okeechobee (19), Ochlockonee (8), Peace (17), St. Johns (20), St. Mark's (9), St. Marys (21), Steinhatchee (11), Suwannee (12), Waccasassa (13), Withlacoochee (14) and Yellow (2) drainages, and canals in Dade County.

Elliptio jayensis: Hillsborough (15), Lake Okeechobee (19), Ochlockonee (8), St. Johns (20), St. Mark's (9) and Suwannee (12) drainages.

Elliptio lanceolata: Apalachicola (4) and Escambia (1) drainages.

**Elliptio mcmichaeli*: Choctawhatchee drainage (3).

Elliptioideus sloatianus: Apalachicola (4), Escambia (1) and Ochlockonee (8) drainages.

Fusconaia escambia: Escambia (1) and Yellow (2) drainages.

**Fusconaia rotulata*: Escambia drainage (1).

Fusconaia succissa: Choctawhatchee (3), Escambia (1) and Yellow (2) drainages.

Glebula rotundata: Apalachicola (4) and Escambia (1) drainages.

Lampsilis claibornensis: Apalachicola (4), Choctawhatchee (3), Escambia (1), Ochlockonee (8), Suwannee (12) and Yellow (2) drainages.

Lampsilis excavatus: Escambia drainage (1).

Lampsilis teres: Apalachicola (4), Choctawhatchee (3), Escambia (1), Ochlockonee (8), Suwannee (12) and Withlacoochee (14) drainages.

Medionidus penicillatus: Apalachicola (4) and Yellow (2) drainages.

**Medionidus simpsonianus*: Ochlockonee drainage (8).

**Medionidus walkeri*: Suwannee drainage (12).

Megalonaias boykiniana: Apalachicola (4), Escambia (1) and Ochlockonee (8) drainages.

Plectomerus dombeyanus: Escambia drainage (1).

Pleurobema pyriforme: Apalachicola (4), Ochlockonee (8) and Suwannee (12) drainages.

Pleurobema strodeanum: Apalachicola (4), Escambia (1) and Yellow (2) drainages.

**Quincuncina burkei*: Choctawhatchee drainage (3).

Quincuncina infucata: Apalachicola (4), Ochlockonee (8) and Suwannee (12) drainages.

Strophitus subvexus: Apalachicola drainage (4).

Uniomerus carolinianus: Apalachicola (4), Choctawhatchee (3), Escambia (1), Hillsborough (15), Lake Okeechobee (19), Myakka (16), Ochlockonee (8), Peace (17), St. Johns (20), Steinhatchee (11), Suwannee (12), Yellow (2) and Withlacoochee (14) drainages.

Uniomerus declivis: Apalachicola drainage (4).

Villosa amygdala: Caloosahatchee (18), Hillsborough (15), Lake Okeechobee (19), Peace (17), St. Johns (20) and Withlacoochee (14) drainages.

Villosa australis: Choctawhatchee (3) and Escambia (1) drainages.

**Villosa choctawensis*: Choctawhatchee drainage (3).

Villosa lienosa: Apalachicola (4), Choctawhatchee (3), Escambia (1), Ochlockonee (8), Suwannee (12) and Yellow (2) drainages.

Villosa subangulata: Apalachicola (4) and Ochlockonee (8) drainages.

Villosa vibex: Apalachicola (4), Choctawhatchee (3), Escambia (1), Hillsborough (15), Lake Okeechobee (19), Ochlockonee (8), Peace (17), St. Johns (20), St. Mark's (9), Suwannee (12), Waccasassa (13), Withlacoochee (14) and Yellow (2) drainages.

Villosa villosa: Apalachicola (4), Hillsborough (15), Myakka (16), Ochlockonee (8), Peace (17), St. Johns (20), St. Marys (21), Suwannee (12) and Withlacoochee (14) drainages.

Very rare unionaceans not known from Florida but occurring upstream in drainages that discharge through the State are:

**Elliptio nigella*: confined to the Chattahoochee (6) and Flint (7) tributaries of the Apalachicola drainage (see Johnson, 1968; Burch, 1975a).

**Lampsilis binominatus*: occurring only in the Chattahoochee (6) and Flint (7) tributaries of the Apalachicola drainage (see Johnson, 1967; Burch, 1975a).

**Lampsilis haddletoni*: known from just 2 specimens collected from the Choctawhatchee drainage (3) in Alabama (see Athearn, 1964; Burch, 1975a).

Margaritifera hembeli: restricted to a few tributaries of the Escambia (1) drainage in Alabama (see Clench & Turner, 1956; Burch, 1975a); occurs elsewhere only in Bayou Teche, Louisiana.

**Ptychobranchus jonesi*: confined to the Choctawhatchee drainage (3) in Alabama (see *Lampsilis jonesi* in Johnson, 1967).

Species lists for different drainages (alphabetical)

Apalachicola drainage (Fig. 11: 4-7)

Alasmidonta triangulata
Amblema neisleri
Anodonta cataracta
Anodonta couperiana
Anodonta imbecilis
Anodonta peggyae
Anodontoides radiatus
Byssanodonta cubensis
Carunculina parva
Elliptio arctata
Elliptio buckleyi
**Elliptio chipolaensis*
Elliptio complanata

(Apalachicola, cont.)

Elliptio crassidens
Elliptio icterina
Elliptio lanceolata
**Elliptio nigella*
Elliptoideus sloatianus
Glebula rotundata
**Lampsilis binominatus*
Lampsilis claibornensis
Lampsilis teres
Medionidus penicillatus
Megalonaias boykiniana
Musculium lacustre
Musculium transversum

(Apalachicola, cont.)

Pisidium casertanum

Pisidium compressum

Pisidium dubium

Pleurobema pyriforme

Pleurobema strodeanum

Quincuncina infucata

Sphaerium occidentale

Strophitus subvexus

Uniomerus carolinianus

Uniomerus declivis

Villosa lienosa

Villosa subangulata

Villosa vibex

Villosa villosa

Aucilla drainage (10)

Musculium partumeium

Pisidium casertanum

Pisidium dubium

Sphaerium striatinum

Caloosahatchee drainage (18)

Byssanodonta cubensis

Musculium transversum

Villosa amygdala

Choctawhatchee drainage (3)

Anodonta cataracta

(Choctawhatchee, cont.)

Anodonta peggyae

Carunculina parva

Elliptio icterina

**Elliptio mcmichaeli*

Fusconaia succissa

Lampsilis claibornensis

**Lampsilis haddletoni*

Lampsilis teres

Musculium securis

Pisidium compressum

Pisidium dubium

**Ptychobranchus jonesi*

**Quincuncina burkei*

Uniomerus carolinianus

Villosa australis

**Villosa choctawensis*

Villosa lienosa

Villosa vibex

Escambia drainage (1)

Amblema neisleri

Amblema perplicata

Anodonta imbecilis

Anodonta suborbiculata

Anodontoides radiatus

Carunculina parva

(Escambia, cont.)

Elliptio arctata

Elliptio crassidens

Elliptio icterina

Elliptio lanceolata

Elliptoideus sloatianus

Fusconaia escambia

**Fusconaia rotulata*

Fusconaia succissa

Glebula rotundata

Lampsilis claibornensis

Lampsilis excavatus

Lampsilis teres

Margaritifera hembeli

Megalonaias boykiniana

Musculium lacustre

Musculium transversum

Pisidium casertanum

Pisidium dubium

Plectomerus dombeyanus

Pleurobema strodeanum

Uniomerus carolinianus

Villosa australis

Villosa lienosa

Villosa vibex

Hillsborough drainage (15)

Anodonta peggyae

Byssanodonta cubensis

Carunculina parva

Elliptio icterina

Elliptio jayensis

Musculium partumeium

Pisidium casertanum

Uniomerus carolinianus

Villosa amygdala

Villosa vibex

Villosa villosa

Myakka drainage (16)

Anodonta couperiana

Pisidium casertanum

Uniomerus carolinianus

Villosa villosa

Ochlockonee drainage (8)

**Alasmidonta wrightiana*

Anodonta couperiana

Anodonta imbecilis

Anodonta peggyae

Byssanodonta cubensis

Carunculina parva

Elliptio icterina

Elliptio jayensis

(Ochlockonee, cont.)

Elliptoideus sloatianus

Lampsilis claibornensis

Lampsilis teres

**Medionidus simpsonianus*

Megalonaias boykiniana

Musculium partumeium

Musculium securis

Pisidium casertanum

Pisidium compressum

Pisidium dubium

Pleurobema pyriforme

Quincuncina infucata

Uniomerus carolinianus

Villosa lienosa

Villosa subangulata

Villosa vibex

Villosa villosa

Peace drainage (17)

Carunculina parva

Elliptio buckleyi

Elliptio icterina

Musculium partumeium

Musculium securis

Musculium transversum

Pisidium casertanum

(Peace, cont.)

Pisidium punctiferum

Uniomerus carolinianus

Villosa amygdala

Villosa vibex

Villosa villosa

St. Johns drainage (20)

Anodonta couperiana

Byssanodonta cubensis

Carunculina parva

Elliptio buckleyi

Elliptio icterina

Elliptio jayensis

Musculium lacustre

Musculium partumeium

Musculium securis

Musculium transversum

Pisidium adamsi

Pisidium casertanum

Pisidium compressum

Pisidium dubium

Pisidium punctiferum

Uniomerus carolinianus

Villosa amygdala

Villosa vibex

Villosa villosa

Yellow drainage (2)

Anodonta peggyae

Carunculina parva

Elliptio arctata

Elliptio icterina

Fusconaia escambia

Fusconaia succissa

Lampsilis claibornensis

Pleurobema strodeanum

Uniomerus carolinianus

Villosa lienosa

Villosa vibex

ECOLOGY

Very little is known about the effects of different environmental conditions on freshwater clams, and less yet of the role of these animals in aquatic ecosystems. This section first lists general habitat descriptions (from Athearn, 1964; Burch, 1975b; Clench and Turner, 1956; Johnson, 1970, 1972, 1977; and personal observations) and then provides a brief summary of largely previously unpublished personal observations on other ecological aspects.

Alasmidonta triangulata: in muddy sand in moderate current.

Alasmidonta wrightiana: unknown (extinct?).

Amblema neisleri: in muddy sand in moderate current.

Amblema perplicata: in muddy sand in moderate to swift current (but see Note 5).

Anodonta cataracta: in muddy sand in slight to moderate current.

Anodonta couperiana: in sandy and muddy substrates of ponds, lakes and slow-moving streams.

Anodonta imbecilis: in muddy sand in moderate current and in the same and muddy substrates of reservoirs.

Anodonta peggyae: in sandy or muddy substrates of reservoirs, ponds, lakes, and slow-moving streams.

Anodonta suborbiculata: in muddy substrate of reservoirs and sandy substrate of springs.

Anodontoides radiatus: in muddy sand slight to moderate current.

Byssanodonta cubensis: unanchored or byssally attached to hard objects in muddy sand or sand substrates in reservoirs and streams with slight to moderate current.

Carunculina parva: in mud and sand of small streams with slight current and of lakes.

Corbicula manilensis: in sandy substrates of reservoirs and lakes but principally of streams with slight to moderate current.

Elliptio arctata: in fine gravel and sand in moderate current.

Elliptio buckleyi: in various substrates of ponds, lakes and small and large streams with slight to moderate current.

Elliptio chipolaensis: in muddy sand in moderate current.

Elliptio complanata: in sandy substrate in moderately swift current.

Elliptio crassidens: in muddy sand, sand and rocky substrates in moderate currents.

Elliptio dariensis: in sandy substrate in lakes and in streams with slight current.

Elliptio icterina: in various substrates of lakes, ponds, reservoirs and streams with slight to moderate current.

Elliptio jayensis: in mud or usually sand in small to medium-sized streams with slight current and in lakes.

Elliptio lanceolata: in mud and sand in slight current.

Elliptio mcmichaeli: in muddy sand and sandy clay in moderate current.

Elliptoideus sloatianus: in sand in moderate current.

Fusconaia escambia: in muddy sand in slight current.

Fusconaia rotulata: in muddy sand and sand in moderate current.

Fusconaia succissa: in muddy sand, sand and sandy clay in slight to moderate current.

Glebula rotundata: in muddy sand in moderate current.

Lampsilis claibornensis: in sand in moderate current and in a reservoir.

Lampsilis excavatus: in sand and fine gravel in moderate current.

Lampsilis teres: in muddy sand and sand in slight to moderate current and in a few lakes and reservoirs.

Medionidus penicillatus: in sand and fine gravel in slight to moderate current.

Medionidus simpsonianus: in muddy sand and sand in moderate current.

Medionidus walkeri: in mud and sand in slight to moderate current.

Megalonaias boykiniana: in muddy sand, sand and rocky substrates in moderate current.

Musculium lacustre: in large streams (also see Note 3).

Musculium partumeium: in small streams, canals and lakes (also see Note 3).

Musculium securis: in streams of various sizes, lakes and canals (also see Note 3).

Musculium transversum: in streams of various sizes, canals and lakes (also see Note 3).

Pisidium adamsi: in small to medium-sized streams.

Pisidium casertanum: in springs and small and medium-sized streams.

Pisidium compressum: in springs and small and medium-sized streams.

Pisidium dubium: in small and medium-sized (and rarely large) streams.

Pisidium punctiferum: in springs and mainly medium-sized streams.

Plectomerus dombeyanus: in sand and fine gravel in moderate current (but see Note 5).

Pleurobema pyriforme: in muddy sand and sand in slight to moderate current.

Pleurobema strodeanum: in muddy sand and sandy clay in slight to moderate current.

Quincuncina burkei: in muddy sand and sandy clay in slight to moderate current.

Quincuncina infucata: in muddy sand and sand in moderate current.

Sphaerium occidentale: see Note 4.

Sphaerium striatinum: in small and medium-sized streams.

Strophitus subvexus: in muddy sand in slight to moderate current.

Uniomerus carolinianus: in muddy sand and sand in slight current, and in lakes.

Uniomerus declivis: in fine gravel in moderate current.

Villosa amygdala: in mud or soft sand of streams of various sizes and current velocities, and in lakes.

Villosa australis: in muddy sand in slight to moderate current.

Villosa choctawensis: in muddy sand and sandy clay in moderate current.

Villosa lienosa: in sandy substrates in slight to moderate current.

Villosa subangulata: in muddy sand and sand in slight to moderate current.

Villosa vibex: in mud or soft sand in slight to moderate current, and in lakes.

Villosa villosa: in mud and muddy sand of reservoirs, and in muddy sand in moderate current.

Recent examination of several populations of Floridian freshwater clams has revealed different kinds of environmental variations. *Pisidium dubium* (Sphaeriidae) broods a single litter of developing young from September to May in Michigan (see Heard, 1965a), whereas the incubation period of this species in northern Florida is from late October to March. In addition, *Pisidium casertanum* in Michigan produces only 2 broods a year, but in northern Florida generates at least 5 broods a year. The brood sizes in the Michigan and Florida populations do not differ significantly, and the differences in the incubation periods and reproductive performances are likely due to more moderate winter water temperatures in the south. Other peculiarities in incubation periods occur in some Floridian freshwater mussels. Although species of Unionidae: Anodontinae are characterized by incubation of a single brood for nearly a year, 1 population of *Anodonta couperiana* contained gravid females only in mid-winter, and 1 population of *Anodonta peggyae* produced 2 consecutive broods in a year (see Heard, 1975).

Other variations in freshwater mussels include the stunting of Apalachicola River *Elliptio crassidens* (Unionidae) in a rocky substrate only a half-mile downstream from significantly larger individuals in sand. Moreover, *Elliptoideus sloatianus* and *Megalonaias boykiniana* (Amblemidae) are significantly smaller in the Ochlockonee River than in the Apalachicola River, even when all populations are from sandy substrates. It is unknown whether that difference in size is due to direct environmental stunting or to differential life spans. That latter circumstance occurs in *Villosa villosa* in which the largest individuals in the Mosquito Creek reservoir are older than the largest individuals in the Lake Talquin reservoir. A similar (?) variation occurs between Black Creek (Figs. 62-63) and Mosquito Creek reservoir *Carunculina parva* (Figs. 64-65). Interestingly, the sexual dimorphism in the shells of *Carunculina parva* and *Villosa villosa* is much striking in larger individuals. It is significant that smaller females have smaller marsupial demibranchs and therefore can support fewer developing young, i.e., can produce fewer offspring.

NOTES

1: Juvenile *Corbicula manilensis* might be confused with *Sphaerium striatinum*. Both have coarse, concentric growth striae, but *S. striatinum* has a short-rhomboid shape in lateral outline while the dorsal margin of *C. manilensis* slopes notably far downward to join the anterior and posterior ends. In addition, the young shell of *C. manilensis* typically possesses a broad, radiating, pale violet color mark that is lacking in older *C. manilensis* and in all *S. striatinum*.

2: Species of *Byssanodonta* (= *Eupera*) are often found attached to a hard object by byssal threads (see Heard, 1956b).

3: Except for *M. transversum*, which has a predilection for large streams, species of *Musculium* usually inhabit standing waters. Moreover, *M. lacustre*, *M. partumeium* and *M. securis* are frequently found in ephemeral habitats in which water vanishes seasonally, and their reproductive habits vary according to the nature of their habitat (see Mackie, 1976).

4: *Sphaerium occidentale* occupies seasonally drying habitats (see Heard, 1977). Its single known occurrence in Florida, viz., Chipola River in Jackson County (Heard, 1963), is therefore misleading; it was probably washed into this stream by flooding.

5: *Amblema perplicata, Elliptoideus sloatianus* and *Plectomerus dombeyanus* are known from Florida (Escambia River drainage near Century) from only from 1 empty shell each. Those specimens were likely washed down from upstream in Alabama.

6: Surface sculpturing on *Quincuncina infucata* is most prominent in the Suwannee drainage, is less distinct in the Ochlockonee drainage (Fig. 42), and is inconspicuous in the Apalachicola drainage (Fig. 41).

7: Burch (1975a) questioned whether *Megalonaia boykiniana* is really *M. gigantea* in the Alabama River system and more northern drainages.

8: *Alasmidonta wrightiana* is known from only 2 shells and might be extinct.

9: When older and larger, striking sexual dimorphism of shells is displayed by *Carunculina parva* (Figs. 64-65), *Glebula rotundata* (Figs. 66-67), *Lampsilis excavatus* (Figs. 69-70), *Lampsilis teres* (Figs. 72-73), *Villosa lienosa* (Figs. 81-82) and *Villosa villosa* (Figs. 85-88).

10: *Elliptio buckleyi* (= *Popenaias buckleyi sensu* Heard and Guckert (1971) and Burch (1975a)) and *Villosa amygdala* are the only species treated in this work that occur entirely within Florida.

11: *Villosa australis* and *Villosa subangulata* have hitherto been treated as species of the genus *Lampsilis*. They are herein placed in the genus *Villosa* for anatomical reasons (pers. observ).

12: Clench and Turner (1956) listed only *Uniomerus obesus* from Florida, whereas Johnson (1970, 1972) synonymized that name and *Uniomerus declivis* under *Uniomerus tetralasmus* (Say). In contrast, Morrison (1977) considered this genus to contain 3 species, viz., *U. carolinianus* (= *U. obesus*), *U. declivis* and *U. tetralasmus*. The first 2 of these names are applied here because the 2 distinct shell forms found in Mosquito Creek of the Apalachicola drainage coincide with Morrison's concepts. However, if *Uniomerus declivis* is a valid, different species, it is a new occurrence for Florida and indeed for any drainage east of the Alabama River system.

ACKNOWLEDGEMENTS

This work was sponsored by STAR grant 78-102 from the Board of Regents of the State University System of Florida to meet specific needs of Florida's Department of Environmental Regulation. I am indebted to Drs. J. Scott Dailey and Landon T. Ross of those agencies, respectively, for their continued encouragement throughout the project.

I also express my gratitude to Drs. John B. Burch and Fred G. Thompson for generously loaning me specimens and appropriate literature for study. Finally, but with no less appreciation, I thank G.W. Hanning, L. Parker and P. Moore for preparing the illustration used herein.

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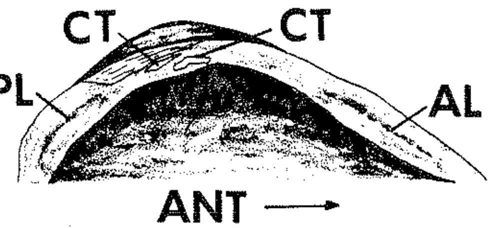
FIGURES

FIGS. 1-2. Hinge teeth of Sphaeriacea: Corbiculidae and Sphaeriidae (after Herrington, 1962; Burch, 1975b).

Fig. 1: left valve of *Pisidium*. Fig. 2: right valve of *Pisidium*. AL, anterior lateral tooth; ANT, anterior; BK, beak; CT, cardinal tooth; IAL, inner anterior lateral tooth; IPL, inner posterior lateral tooth; OAL, outer anterior lateral tooth; OPL, outer posterior lateral tooth; PL, posterior lateral tooth.

FIGS. 3-4. Hinge teeth of Unionacea (freshwater mussels). Fig. 3: Complete dentition, with pseudocardinal teeth (PT) and lateral teeth (LT). Fig. 4: Incomplete dentition, with vestigial pseudocardinal teeth (PT) but lacking lateral teeth (*Strophitus*). ANT, anterior.

FIGS. 5-10. Lateral outlines of Unionacea (freshwater mussels) showing various shapes (after Burch, 1975a). Fig. 5: rhomboidal. Fig. 6: elliptical. Fig. 7: ovate. Fig. 8: circular. Fig. 9: quadrate. Fig. 10: subtriangular. Shells of some species do not coincide exactly with these outlines but are closer to 1 shape than any other. For those cases the prefix "sub-" is applied (e.g., subelliptical).



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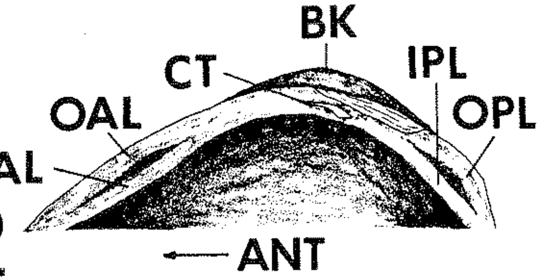

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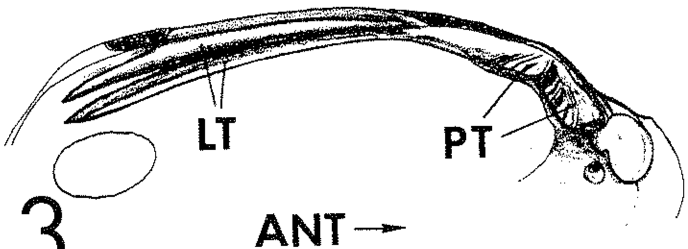

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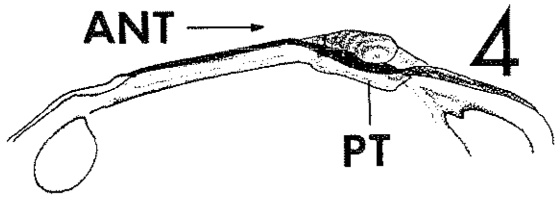

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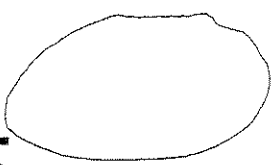

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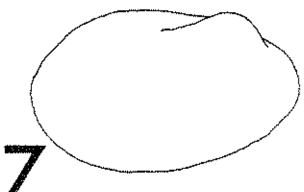

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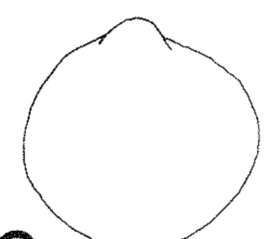

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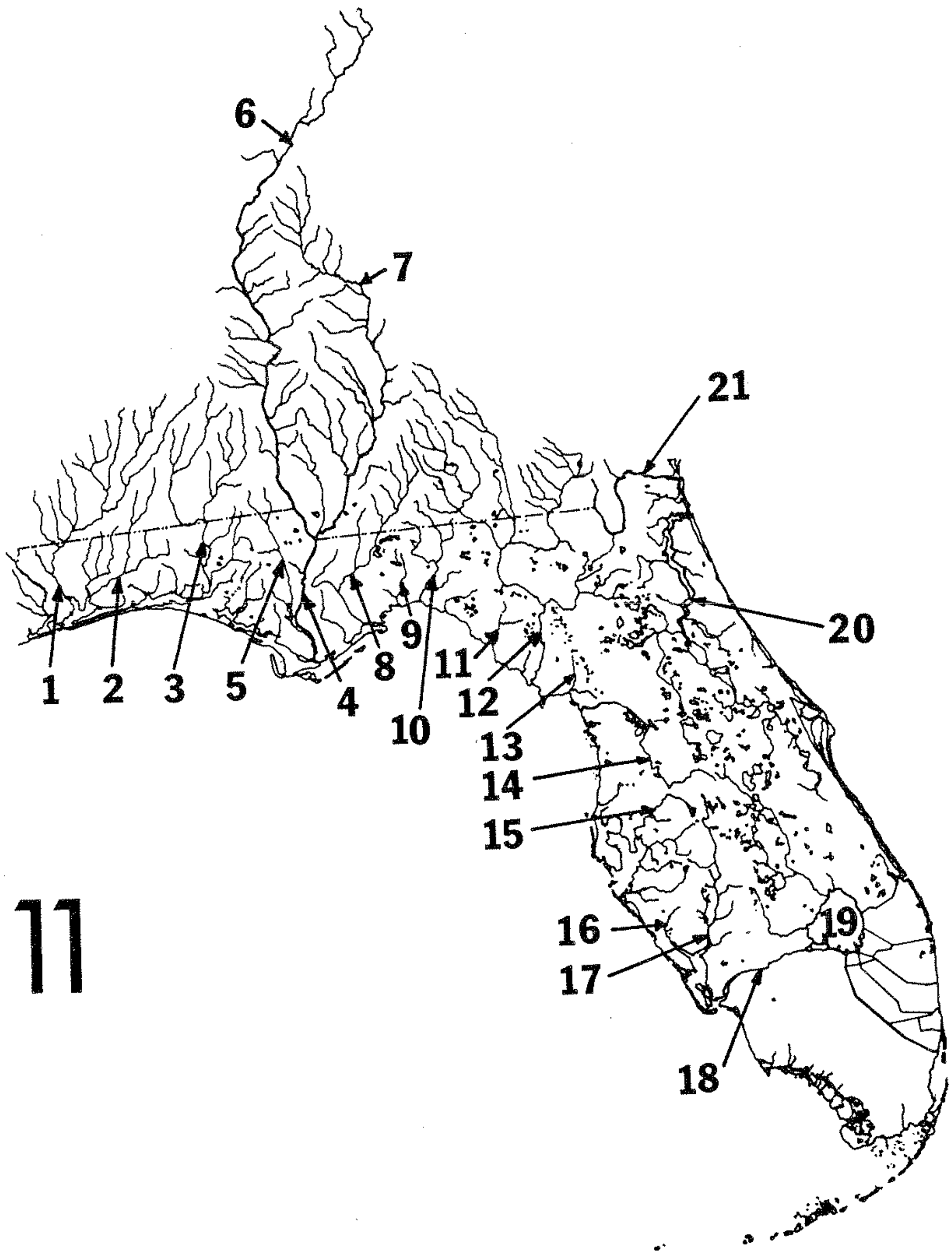
FIG. 11. Major drainages of Florida

1. Escambia (called Conecuh in Alabama)
2. Yellow
3. Choctawhatchee
4. Apalachicola
5. (Chipola River tributary)
6. (Chattahoochee River tributary)
7. (Flint River tributary)
8. Ochlockonee
9. St. Mark's
10. Aucilla
11. Steinhatchee
12. Suwannee
13. Waccasassa
14. Withlacoochee
15. Hillsborough
16. Myakka
17. Peace
18. Caloosahatchee
19. Lake Okeechobee
20. St. Johns
21. St. Marys



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FIGS. 12-17. External view of the right valve of sphaeriacean clams (Corbiculidae and Sphaeriidae). Size scale of *Corbicula*: 1 cm; of *Byssanodonta* and *Musculium*: 2 mm.

Fig. 12. *Corbicula manilensis*

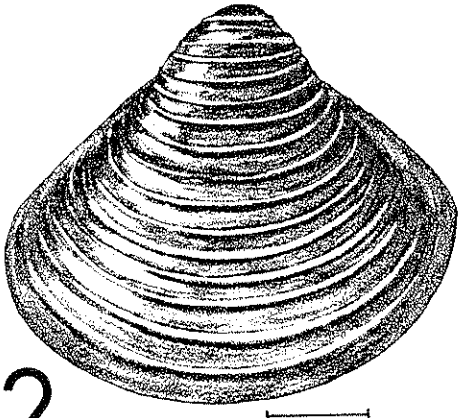
Fig. 13. *Byssanodonta cubensis*

Fig. 14. *Musculium lacustre*

Fig. 15. *Musculium partumeium*

Fig. 16. *Musculium securis*

Fig. 17. *Musculium transversum*



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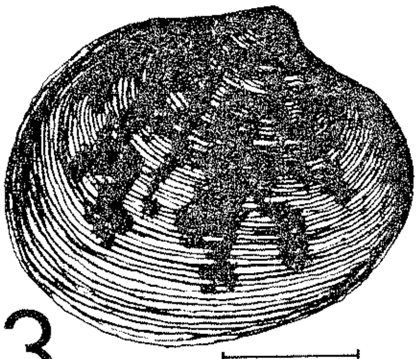

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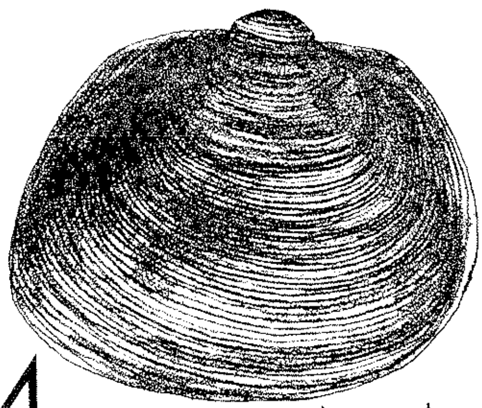

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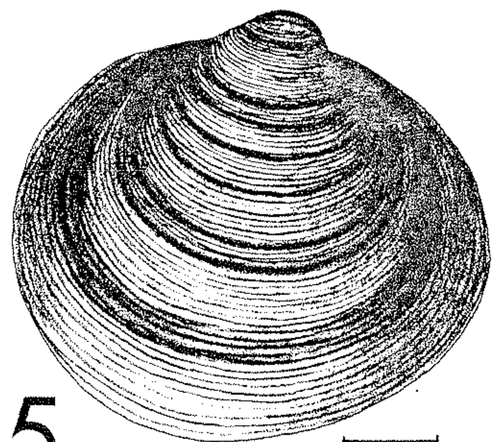

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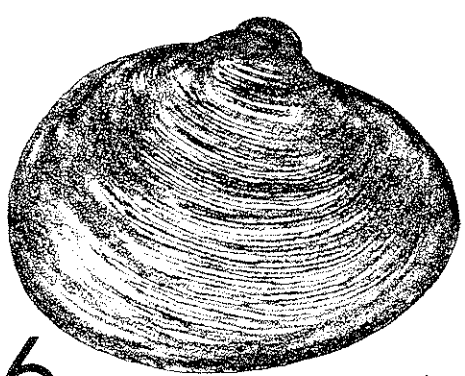

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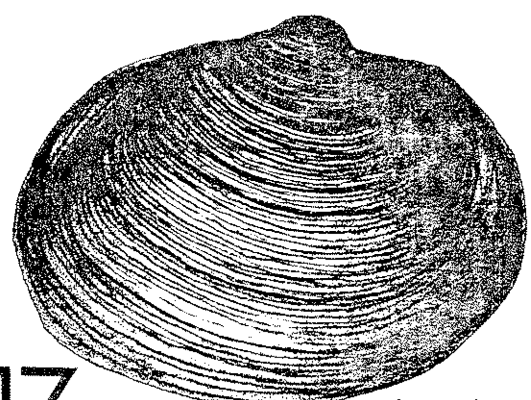

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FIGS. 18-24. External view of the right valve of Sphaeriidae. All Size scales: 2 mm.

Fig. 18. *Sphaerium occidentale*

Fig. 19. *Sphaerium striatinum*

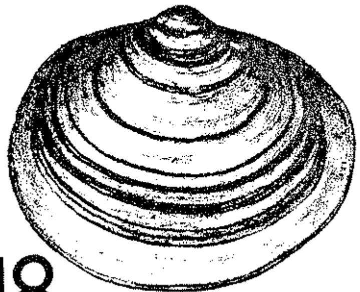
Fig. 20. *Pisidium adamsi*

Fig. 21. *Pisidium casertanum*

Fig. 22. *Pisidium compressum*

Fig. 23. *Pisidium dubium*

Fig. 24. *Pisidium punctiferum*



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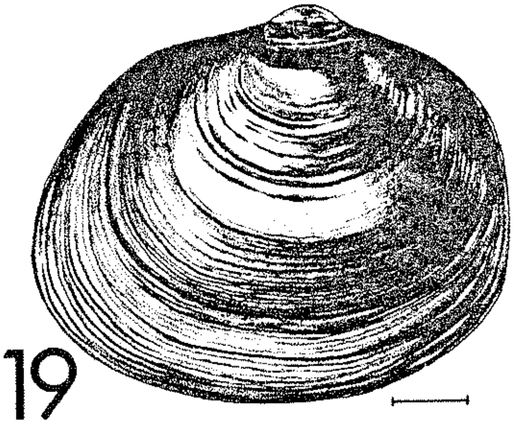

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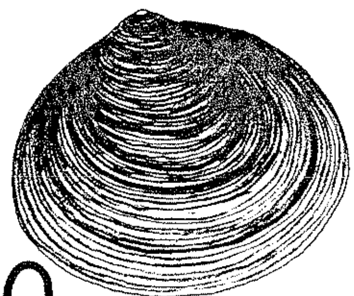

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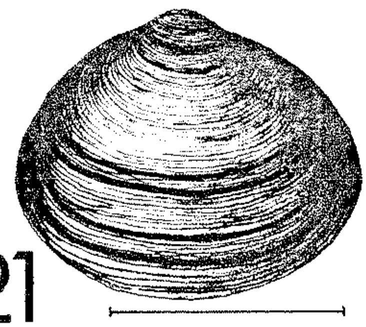

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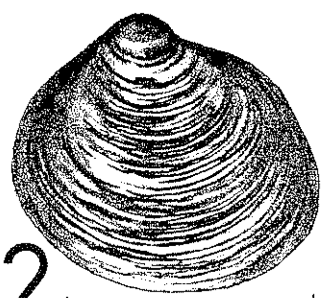

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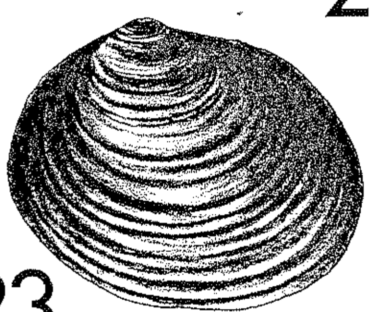

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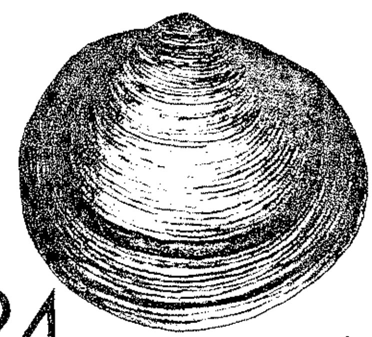

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FIGS. 25-30. External view of the right valve of Unionidae: Anodontinae. All size scales: 1 cm.

Fig. 25. *Alasmidonta triangulata*

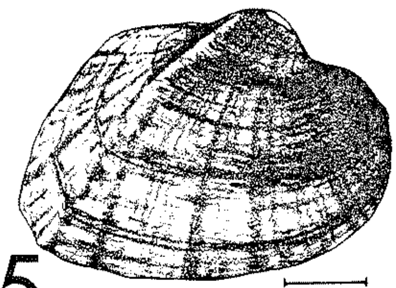
Fig. 26. *Anodonta cataracta*

Fig. 27. *Anodonta couperiana*

Fig. 28. *Anodonta imbecilis*

Fig. 29. *Anodonta peggyae*

Fig. 30. *Anodonta suborbiculata*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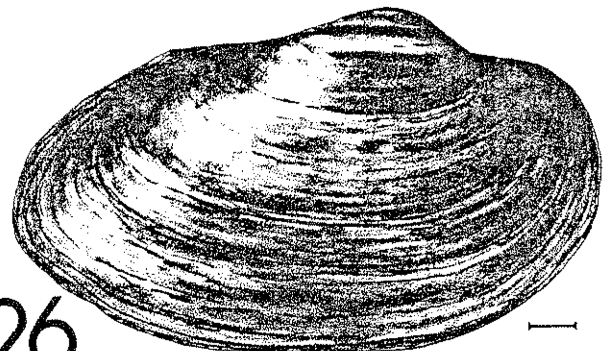
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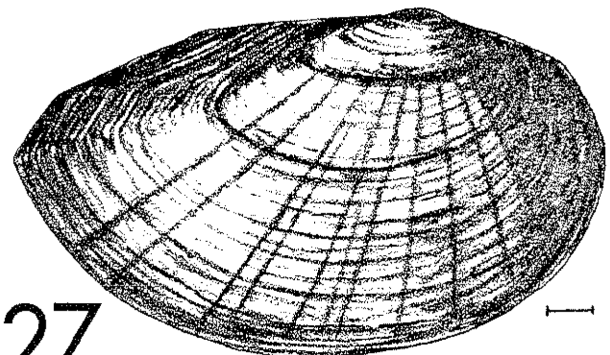
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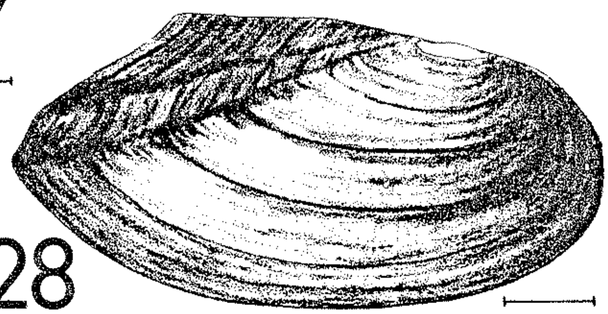
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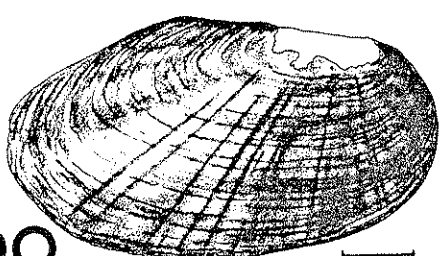
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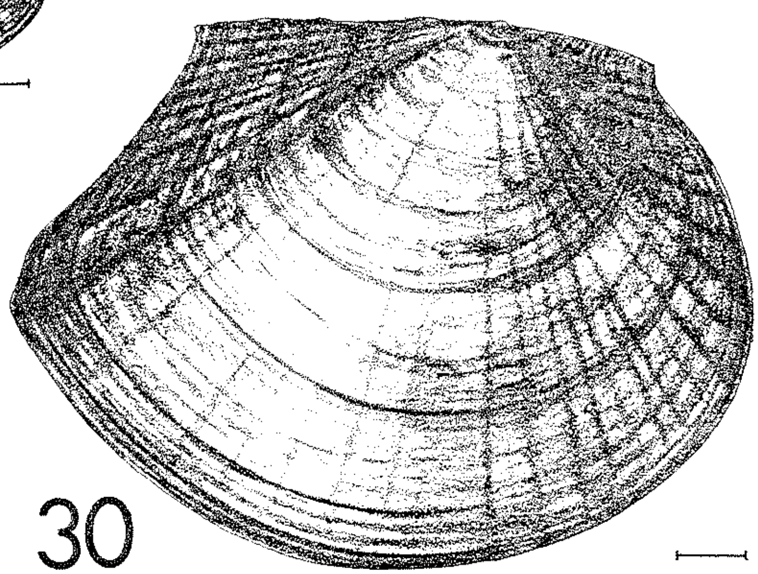
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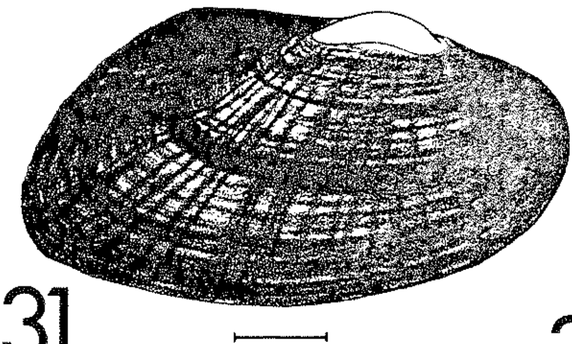
FIGS. 31-34. External view of the right valve of Unionidae: Anodontinae (*Anodontoides* and *Strophitus*) and Amblemidae: Ambleminae (*Amblema*). All size scales: 1 cm.

Fig. 31. *Anodontoides radiatus*

Fig. 32. *Strophitus subvexus*

Fig. 33. *Amblema neisleri*

Fig. 34. *Amblema perplicata*



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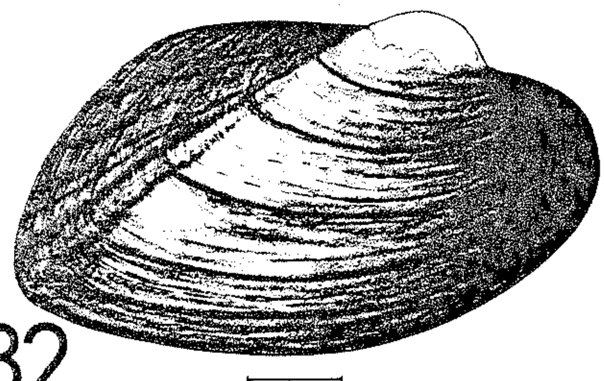

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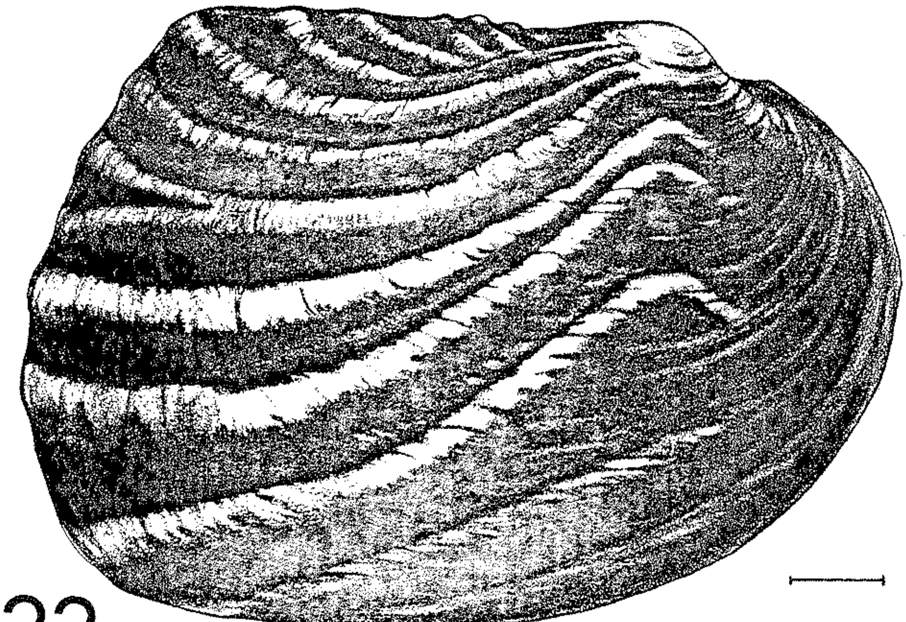

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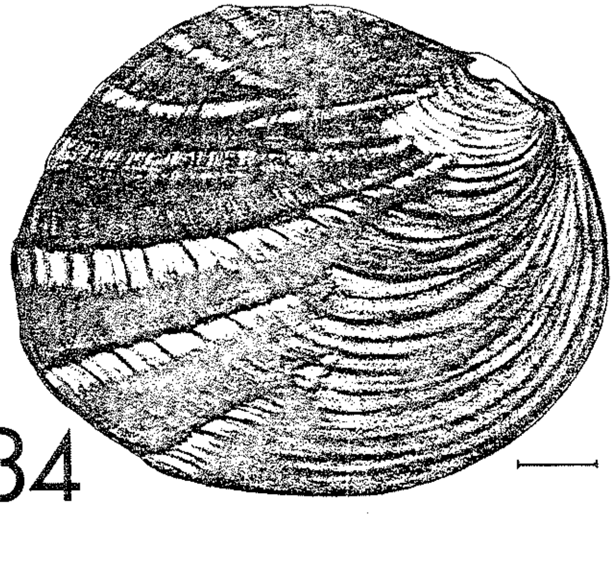

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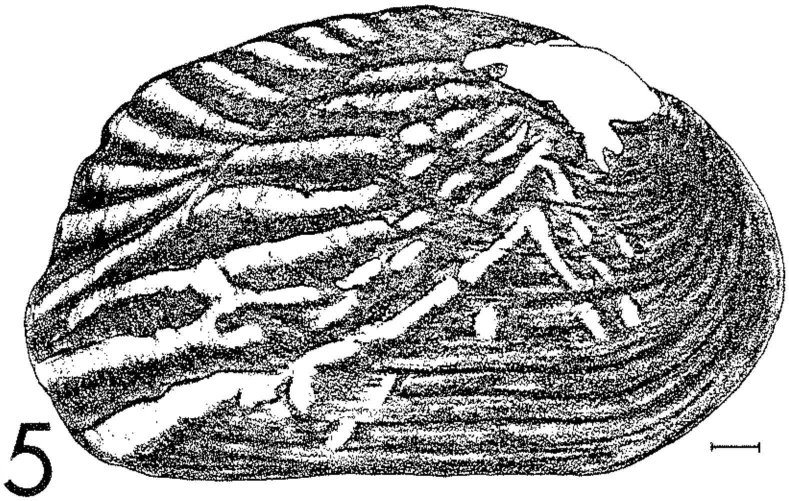
FIGS. 35-38. External view of the right valve of Amblemidae: Ambleminae. All size scales: 1 cm.

Fig. 35. *Elliptoideus sloatianus*

Fig. 36. *Fusconaia escambia*

Fig. 37. *Fusconaia rotulata*

Fig. 38. *Fusconaia succissa*



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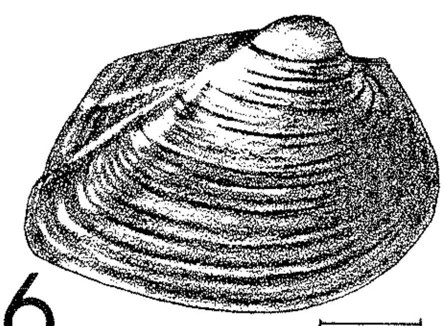

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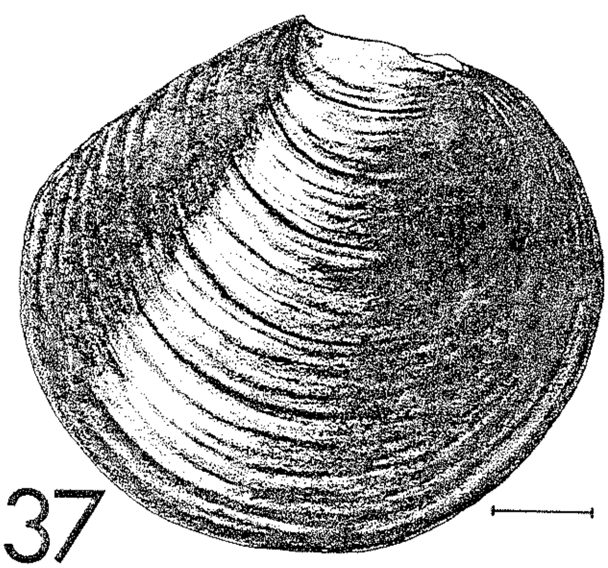

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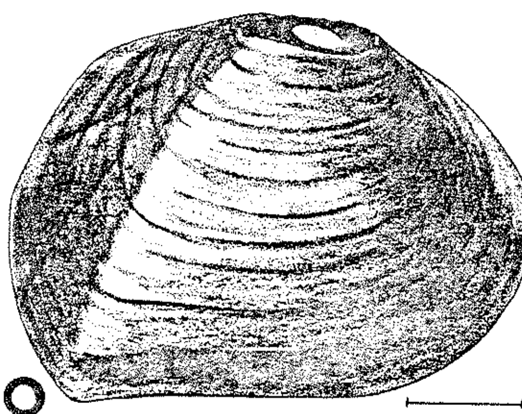

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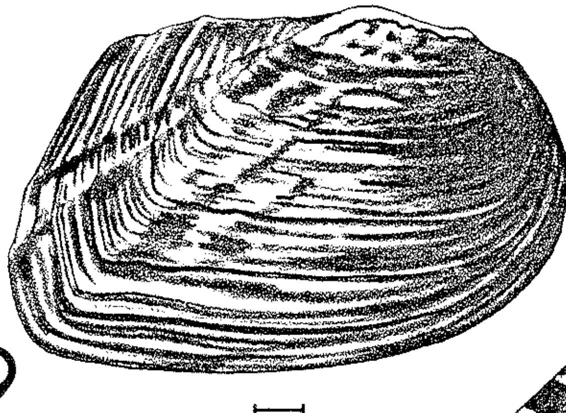
FIGS. 39-42. External views of the right valve of Amblemidae: Ambleminae. All size scales: 1 cm.

Fig. 39. *Plectomerus dombeyanus*

Fig. 40. *Quincuncina burkei*

Fig. 41. *Quincuncina infucata* (Apalachicola River)

Fig. 42. *Quincuncina infucata* (Ochlockonee River)



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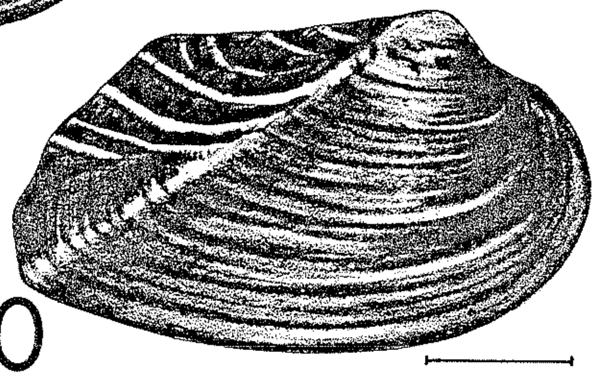

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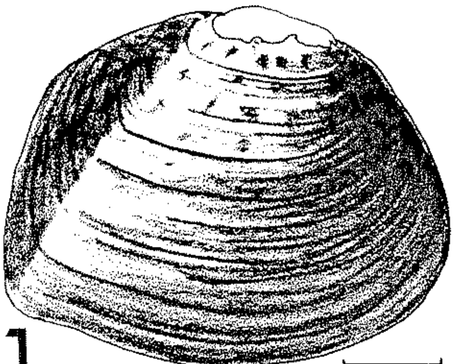

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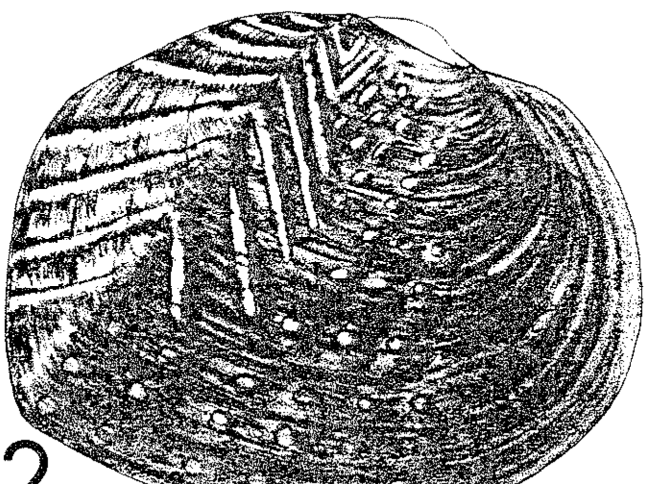

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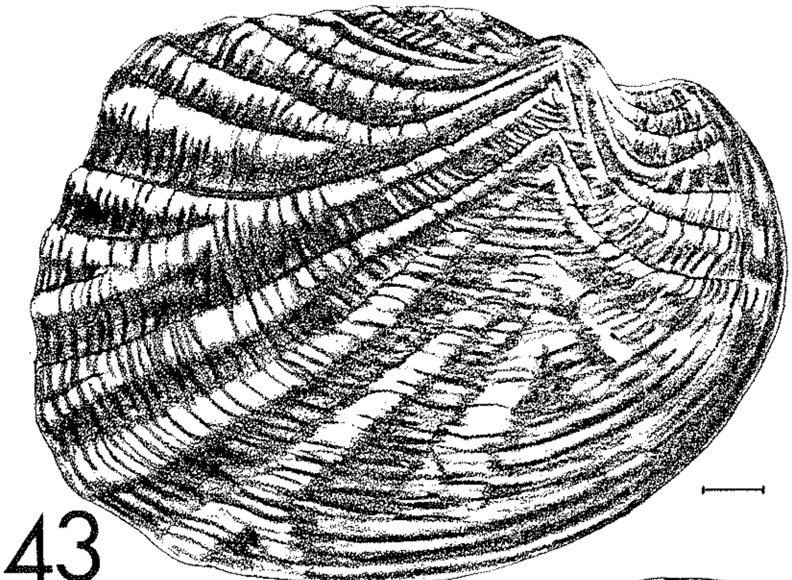
FIGS. 43-45. External view of the right valve of Amblemidae: Megalonaiadinae: *Megalonaias boykiniana*. All size scales: 1 cm.

Fig. 43. Ochlockonee River specimen from sandy substrate.

Fig. 44. Apalachicola River specimen from sandy substrate.

Fig. 45. Apalachicola River specimen from rocky substrate (note extensive erosion shown in white).



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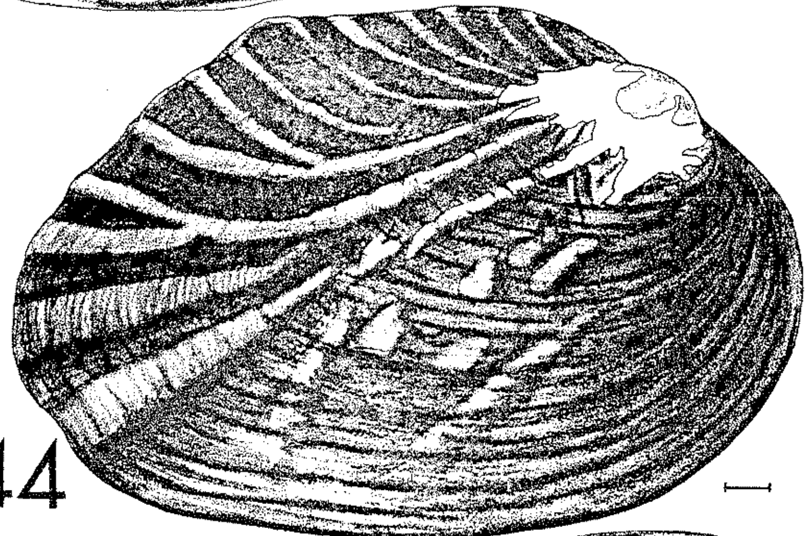

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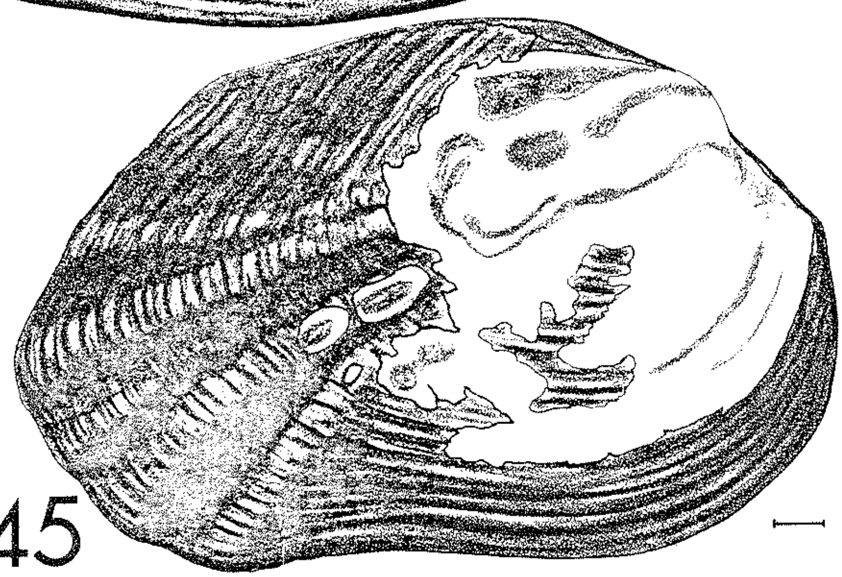

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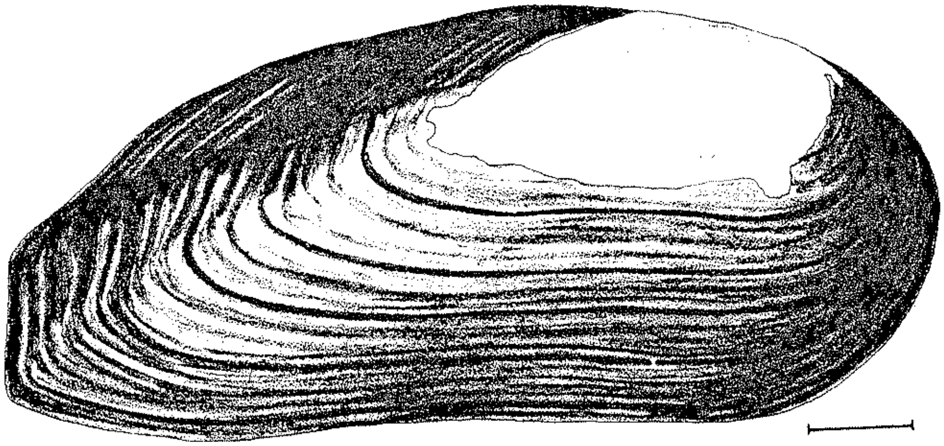
FIGS. 46-49. External view of the right valve of Unionidae: Pleurobemidae. All size scales: 1 cm.

Fig. 46. *Elliptio arctata*

Fig. 47. *Elliptio buckleyi*

Fig. 48. *Elliptio chipolaensis*

Fig. 49. *Elliptio complanata*



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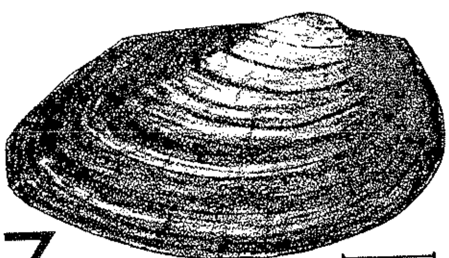

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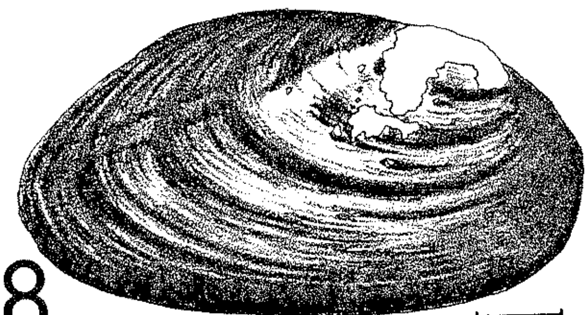

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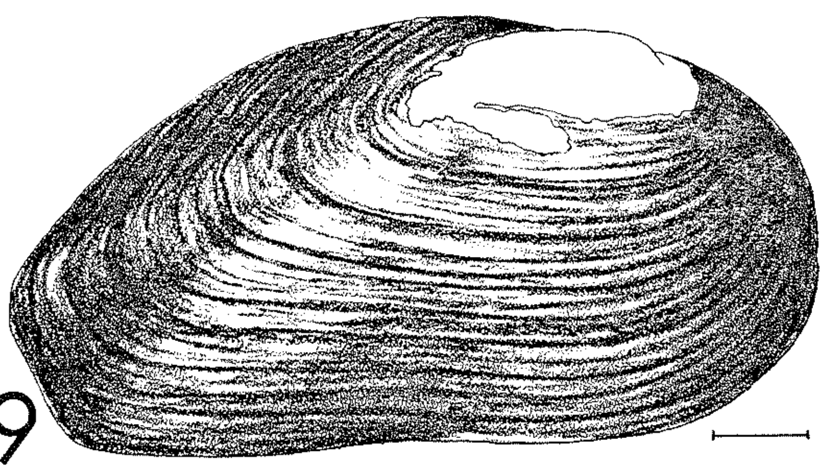

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FIGS. 50-55. External view of the right valve of Unionidae: Pleurobeminae. All size scales: 1 cm.

Fig. 50. *Elliptio crassidens* (Apalachicola River)

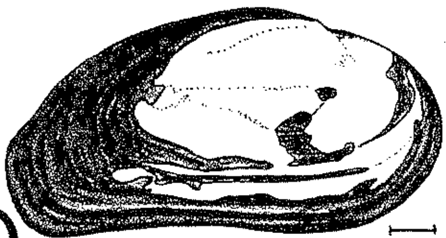
Fig. 51. *Elliptio crassidens* (Chipola River)

Fig. 52. *Elliptio dariensis*

Fig. 53. *Elliptio jayensis*

Fig. 54. *Elliptio icterina* (Mosquito Creek)

Fig. 55. *Elliptio icterina* (Ochlockonee River)



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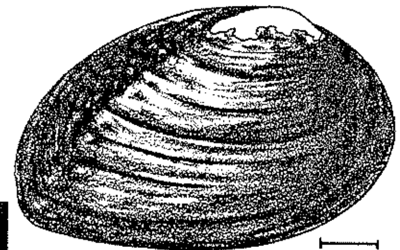

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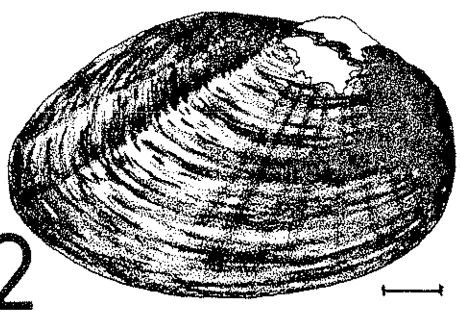

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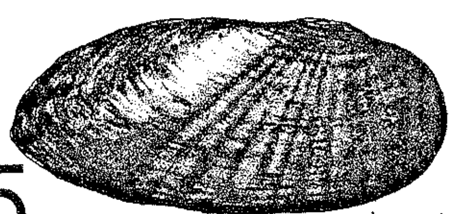

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FIGS. 56-61. External view of the right valve of Unionidae: Pleurobeminae. All size scales: 1 cm.

Fig. 56. *Elliptio lanceolata*

Fig. 57. *Elliptio mcmichaeli*

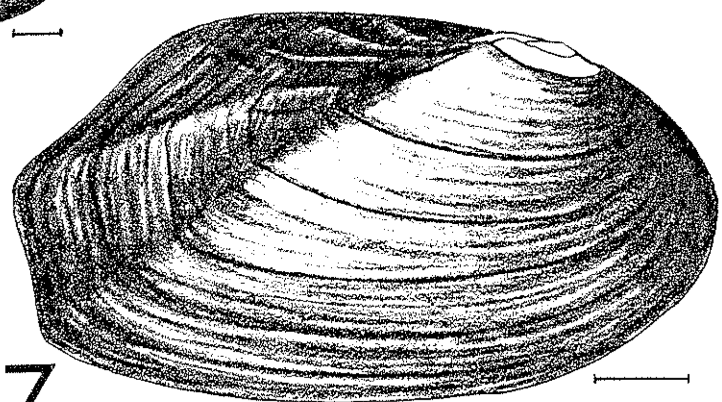
Fig. 58. *Pleurobema pyriforme*

Fig. 59. *Pleurobema strodeanum*

Fig. 60. *Uniomerus carolinianus*

Fig. 61. *Uniomerus declivis*

56



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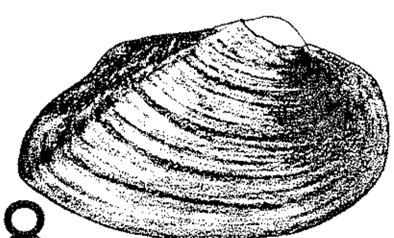

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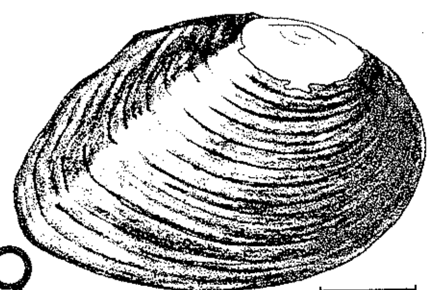

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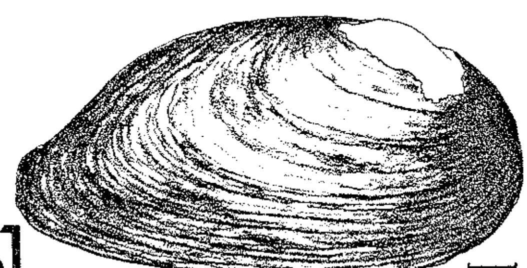

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FIGS. 62-68. External view of the right valve of Unionidae: Lampsilinae. All size scales: 1 cm.

Fig. 62. *Carunculina parva* (male from Black Creek)

Fig. 63. *Carunculina parva* (female from Black Creek)

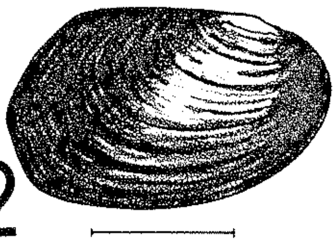
Fig. 64. *Carunculina parva* (male from Mosquito Creek reservoir)

Fig. 65. *Carunculina parva* (female from Mosquito Creek reservoir)

Fig. 66. *Glebula rotundata* (male)

Fig. 67. *Glebula rotundata* (female)

Fig. 68. *Lampsilis claibornensis*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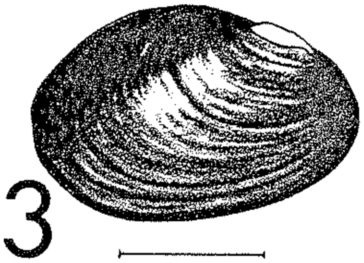
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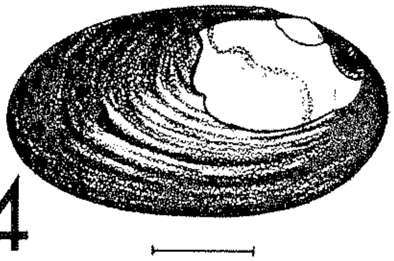
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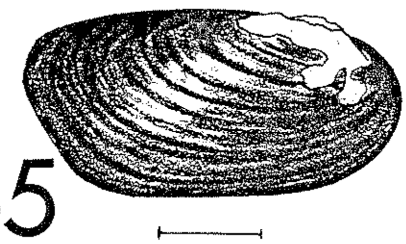
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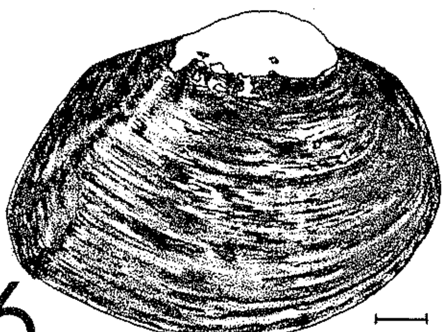
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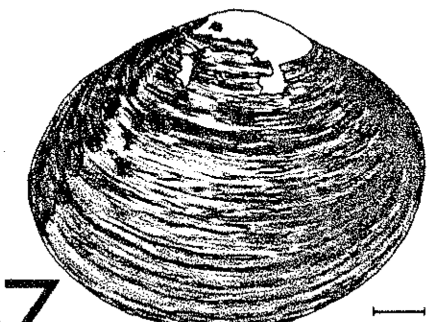
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FIGS. 69-73. External view of the right valve of Unionidae: Lampsilinae. All size scales: 1 cm.

Fig. 69. *Lampsilis excavatus* (male)

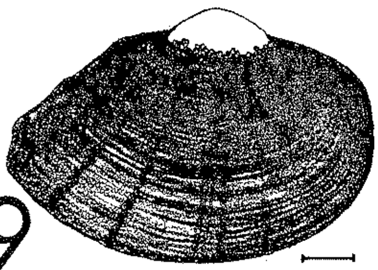
Fig. 70. *Lampsilis excavatus* (female)

Fig. 71. *Lampsilis teres* (male)

Fig. 72. *Lampsilis teres* (lateral outline of male)

Fig. 73. *Lampsilis teres* (lateral outline of female)

Except in the Apalachicola River (Fig. 11: 4), shells of *Lampsilis teres* in Florida rarely exceed 8 cm in length. Moreover, those smaller individuls do not display the pronounced sexual dimorphism shown in Figs. 72-73, and members of both sexes have the shape of males.



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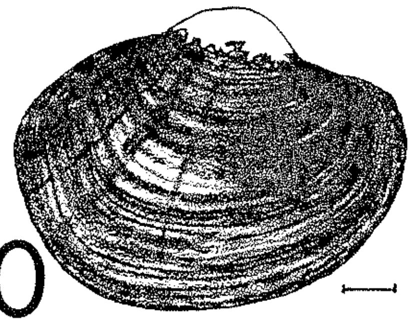

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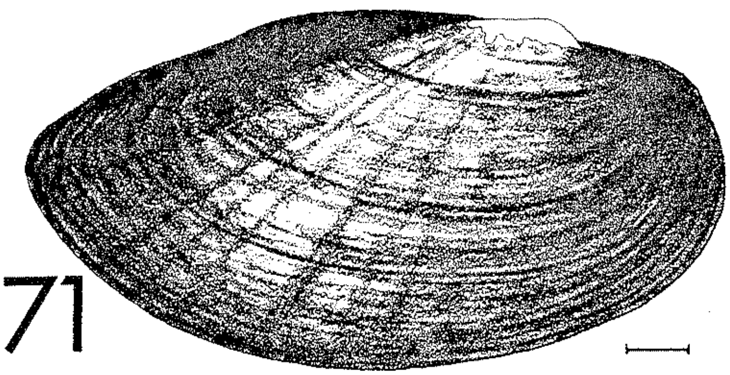

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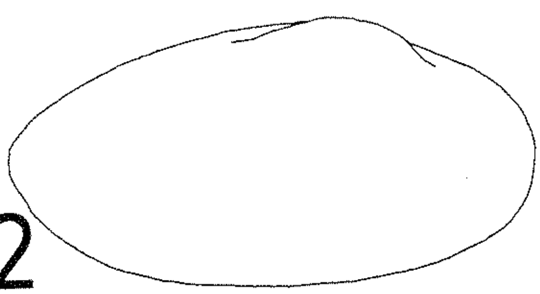

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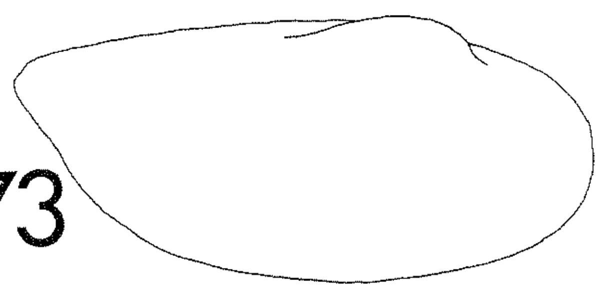

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FIGS. 74-80. External view of the right valve of Unionidae: Lampsilinae. All size scales: 1 cm.

Fig. 74. *Medionidus penicillatus*

Fig. 75. *Medionidus simpsonianus*

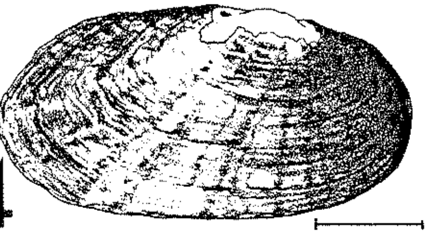
Fig. 76. *Medionidus walkeri*

Fig. 77. *Villosa australis*

Fig. 78. *Villosa amygdala* (male)

Fig. 79. *Villosa amygdala* (female)

Fig. 80. *Villosa choctawensis*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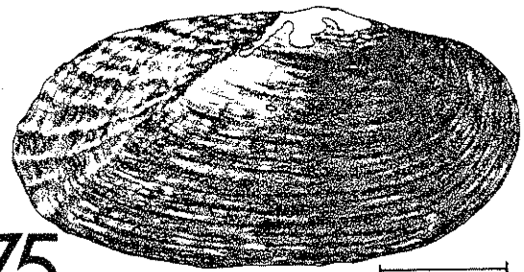
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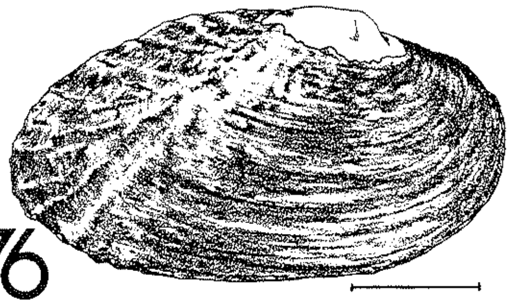
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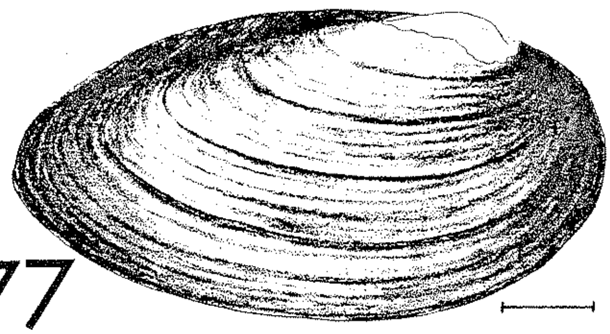
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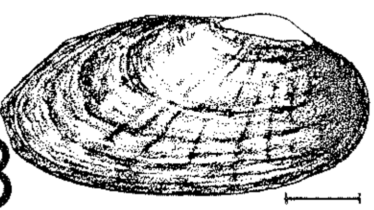
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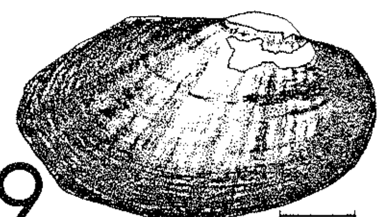
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FIGS. 81-86. External view of the right valve of Unionidae: Lampsilinae. All size scales: 1 cm.

Fig. 81. *Villosa lienosa* (male)

Fig. 82. *Villosa lienosa* (female)

Fig. 83. *Villosa subangulata*

Fig. 84. *Villosa vibex*

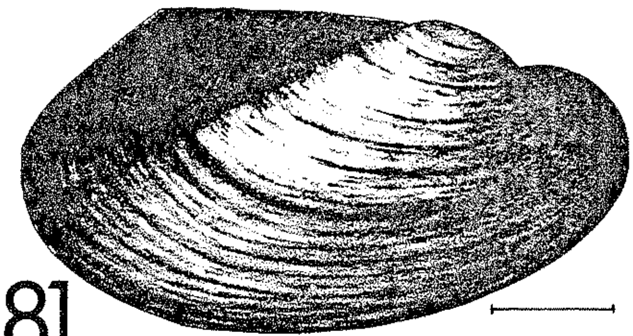
Fig. 85. *Villosa villosa* (male)

Fig. 86. *Villosa villosa* (female)

FIGS. 87-88. Transverse outline of the shell of *Villosa villosa*. All size scales: 1 cm.

Fig. 87. Male

Fig. 88. Female



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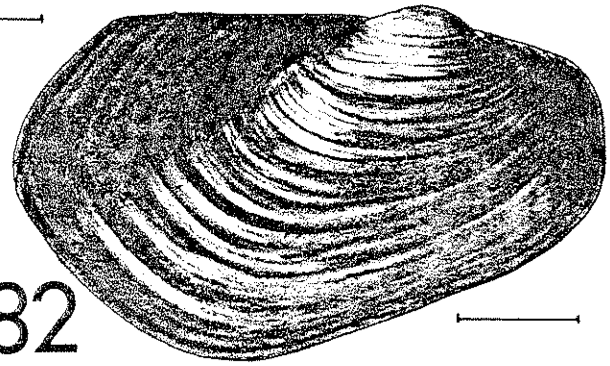

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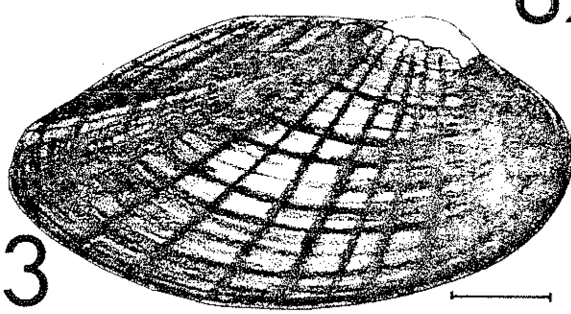

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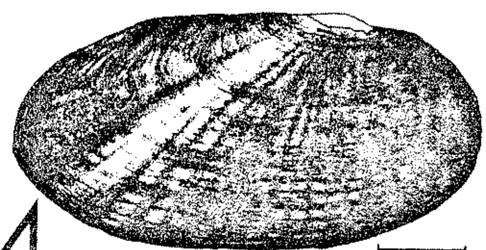

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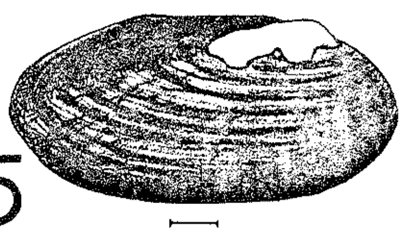

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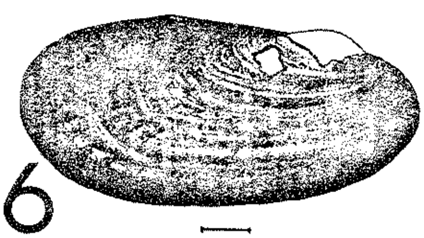

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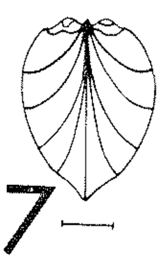

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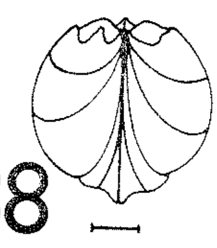

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