

## THE FLORIDA SPECIES OF THE FAMILY CHAMIDAE

By F. M. BAYER<sup>1</sup>

The chamas<sup>2</sup> have been in a state of confusion for quite some time. Pilsbry and McGinty's review of the group (*Nautilus* 51: 3, pp. 73) threw much light on the matter, but even at that time information concerning certain species and varieties was fragmentary or lacking. Until then, illustrations were, for the most part, poor, and positive identification was difficult or impossible.

Many kindnesses were extended the author in this work, and especial thanks are due Dr. F. G. Walton Smith, Department of Zoology, the University of Miami; Director T. Van Hyning, of The Florida State Museum, in whose Section of Comparative Florida Mollusca the species discussed herein are contained; Alfred H. Patterson, of Miami; and Mr. and Mrs. James Donovan, of Norfolk, Virginia.

A large series of examples of all the species from both coasts of the state, as well as the Keys and Tortugas, was examined. The greater part of the material used as a basis for this study was collected from Carysfort Reef by A. H. Patterson, and from Biscayne Bay by Noble Mason and the author. Photographs are by Bob Vollmer, Miami; Trent Rogers, Gainesville; and C. C. Sherley, Miami.

While working over the large series of shells collected for this work, and many from private collections as well, some observations of unusual interest were made. From the observed material of the genus *Pseudochama*, *P. radians variegata* is certainly not the only one of its genus to be found in the Florida area, as has been supposed. One species turned up by Mr. Patterson forms a striking addition to the Florida mollusk fauna, and although there are some West Indian species described that might easily be found in this area, the new shell is not likely to be confused with any of the possible indigenes not now confirmed as Floridian. This species entirely lacks the marginal crenulation typical of the other

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<sup>2</sup> The word *Chama* comes from the Greek, meaning a gaper, and is pronounced *kā'-ma*.

*Pseudochama* species of Florida, and has an entirely different type of sculpture. In addition, another species of *Pseudochama* was collected at Palm Beach Inlet which does not satisfactorily fit in with any of the known forms. Unfortunately, due to lack of adequate material, this species cannot be placed properly at the present time. Despite this fact, I have, however, included it in the key, since it is my desire to have this key as complete as possible, and yet avoid revising it entirely at a later date. Information concerning it will be published as soon as time allows. A figure is given herewith (fig. 5).

Key to the Florida Species of the Family Chamidae:

1. Shell usually free when adult; nearly equivalve, lunule well developed; long, erect tubular spines on radiating costae:  
*ECHINOCHEMA arcinella* Linne.  
 Shell usually attached when adult, very inequivalve, no lunule; flattened foliations, not tubular spines: . . . . . (2)
2. Apex of free right valve turning in a counterclockwise spiral:  
 Genus *CHAMA* (3)  
 Apex of free left valve turning in a clockwise spiral:  
 Genus *PSEUDOCHEMA* (10)
3. Interior margins of valves crenulate: . . . . . (4)  
 Interior margins of valves not crenulate: . . . . . (8)
4. Pallial line passing around anterior end of anterior adductor scar, and joining it anteriorly; red markings, if present, are spots: . . . . . (5)  
 Pallial line not passing around anterior end of anterior adductor scar, but joining it posteriorly; red markings are blotches which more or less cover the surface, sometimes entirely: . . . . . *Chama sarda* Reeve.
5. Shell usually about 50 mm. in diameter when adult; profusely sculptured with broad foliations; color, yellow, purple, or white: . . . . . *Chama macerophylla* Gmelin.  
 Shell usually 35 mm. or less in diameter when adult: . . . . (6)
6. Foliations profuse, concentric, no radial corrugation: . . . . (7)  
 Foliations scant, scattered; radial corrugation more or less prominent: . . . . . *Chama congregata* Conrad.
7. Sculpture of upper and lower valves similar; fluted foliations rather widely spaced; several radial series of red or pink spots:  
*Chama florida* Lamarek.  
 Sculpture of upper and lower valves dissimilar; foliations of upper valve relatively short, closely spaced; lower valve having concentric ruffles not divided into foliations; white, with livid brown radial streaks: . . . . . *Chama lactuca* Dall.

8. Broad, cupped, striate foliations; one, sometimes two radial furrows from umbo to posterior basal area of the free valve; shell not excessively heavy: . . . . . *Chama sinuosa* Broderip. Few, if any, foliations; sculpture effaced; radial furrow weak or obliterated; shell heavy: . . . . . (9)
9. Shell with attached valve not excessively deepened, but very thick and heavy:  
*Chama sinuosa firma* Pilsbry and McGinty.  
 Shell with lower valve very deep, and spirally coiled; very heavy, sometimes unattached:  
*Chama sinuosa bermudensis* Heilprin.
10. Interior margins crenulate; radially corrugate exterior; shell colored, especially on the fronds: . . . . . (11)  
 Interior margins not crenulate, but finely shagreened; broad, raised concentric ruffles not cut into fronds; color pure white:  
*Pseudochama inezae*, n.sp.
11. Flattened, sometimes striate foliations, no spinelike processes; radially corrugate; color, white more or less marked with lavender: *Pseudochama*, species indet.  
 Short, spinelike, or somewhat flattened foliations usually but not always present; strongly radially corrugate; color whitish, marked with maroon or red-brown:  
*Pseudochama radians variegata* Reeve.

ECHINOCHEMA ARCINELLA Linnaeus. Plate 13, figs. 13, 14.

Shell usually free when adult; equivalve, with about fifteen radial costae bearing erect tubular spines, which are very long in young specimens, but often worn down in adults. The interstices between the ribs are pitted; remnants of a thin, light brown periostracum may occasionally be seen in the lines left by growth pauses. The possibility that the Florida race of *E. arcinella* may prove to be subspecifically different from the typical West Indian form, as suggested by Pilsbry and McGinty, seems to rest on the larger size and greater number of ribs of the latter. Some Florida specimens examined seem to indicate that the general run of Florida specimens have not reached the maximum size, and that the number of ribs on the under-sized individuals is increased by intercalation as growth proceeds, until maximum size, and the typical number of ribs, is arrived at. The young specimen shown in our photograph possesses only seven ribs, while an ordinary, normal, Florida specimen (35 mm.) has nine, with two or three introduced, and a larger specimen (45 mm.) has thirteen, several

of which were introduced by intercalation. When the maximum size is reached, the ribs number fifteen or sixteen, more or less.

Julia Gardner<sup>3</sup> considers *Echinochama* as a subgenus of *Pseudochama*; indeed, *Echinochama* follows the characters of *Pseudochama* in attaching by the right valve, and in hinge construction. However, most of the recent authorities give *Echinochama* full generic rank, and I follow that decision.

*Range*: North Carolina to the West Indies. *Records*: St. Marks, northwest Florida, 20 fath. (J. M. Hall); Lake Worth (Bayer); Marco (Royce); Naples (Van Hyning).

CHAMA SARDA Reeve. Plate 14, figs. 15, 16.

The shell is rather small, snow-white, with stains of brilliant red more or less covering the upper valve, sometimes completely, leaving only the flattened spines white. The attached valve is usually deep pink or red internally, pinkish and white externally. There is sometimes a slight radial corrugation on the upper valve; the internal margins are sharply crenulate, and the pallial line joins the anterior adductor scar at the nearest point. It is distinguished from *Chama florida* by its irregular foliation, its radial corrugation, and more or less widespread red staining. It is apparently an uncommon shell in Florida, although numerous lower valves were once to be seen on the rocks at Jupiter Inlet, east Florida, and a few at Palm Beach. The rocks at Palm Beach were dredged from the channel, and the top valves were all lost before any collecting could be done. Mr. Patterson collected the specimen illustrated on our plate, and the one in the author's collection, from Carysfort Reef. *Range*: East Florida, Florida Keys, and West Indies. *Records*: Palm Beach Inlet (Bayer); Carysfort Reef (Patterson); Lantana, Florida, 40 fathoms, and Ocean Ridge, Florida, 40 fathoms (Lyman).

CHAMA MACEROPHYLLA Gmelin. Plate 13, fig. 12.

Shell profusely foliate with flattened, striate fronds, which vary in development in accordance with the habitat of the individual. The exterior color may be yellow with a few red spots under the fronds, various shades of purple, or pure white. Occasionally specimens are seen which are white and yellow, white and purple,

<sup>3</sup> Gardner, Julia: U. S. Geol. Sur. Professional Paper 142 B, p. 95. 1926.

or yellow and purple, and these combinations are unusually beautiful. The interior margins are crenulate, and the pallial impression passes around the end of the anterior adductor scar before joining it anteriorly. It is the most abundant, and most easily recognized of the Florida Chamas. *Range*: Florida to the West Indies. *Records*: Lake Worth; Biscayne Bay (Mason and Bayer); Old Rhodes Key (Lyman); Tortugas, Garden Key (Russel); Marquesas (Van Hynning); Sarasota, 5 fath. (Royce).

CHAMA CONGREGATA Conrad. Plate 12, fig. 3.

This is one of the smaller species, whitish with tawny or maroon corrugations and prickles; the interior is white, usually stained with brown. The inner margins are markedly crenulate, and the pallial line proceeds around the anterior adductor scar, and joins it at the outer margin. It is easily recognized by its nondescript color, radial corrugation, and scanty foliation. The specimen figured is a rather large individual from Palm Beach Inlet, collected by Mr. and Mrs. Donovan. *Range*: North Carolina to the West Indies. *Records*: Palm Beach Inlet (Donovan); Biscayne Bay (Mason and Bayer); Fort Walton (Lyman); Big Pass, Sarasota (Royce).

CHAMA FLORIDA Lamarek. Plate 12, fig. 6.

The shell is rather small, subcircular, with concentric rows of fine, rather elongate, fluted foliations. The ground color is white, with several radial rows of deep pink or carmine spots, which give the shell a striking appearance. The interior of both valves white, the upper pink stained. The interior margins are crenulate, and the pallial line passes around the end of the anterior adductor scar, and joins it at the anterior end. The species is often so covered with the common encrusting agencies that it is quite unrecognizable. The specimen shown comes from Carysfort Reef. *Range*: South Florida to the West Indies. *Records*: Biscayne Bay (Donovan); Soldier Key; Carysfort Reef (Patterson); Garden Key, Tortugas, (Russel).

CHAMA LACTUCA Dall. Plate 12, figs. 1, 2.

In this species, the sculpture of the upper and lower valves is entirely different. The upper valve has rather short, concen-

trically arranged foliations closely set upon its surface, each frond grooved beneath. The color is dirty white, streaked with brown. The lower valve has sharp, raised concentric ruffles, which are fluted here and there, but not divided. The color is dirty white. The inner margins of the valves are finely crenulate, and the pallial impression passes around the anterior adductor scar, joining it at the anterior end. It is a shell of deeper water, found from ten to one hundred fathoms. The figured shell is from the collection of Mr. and Mrs. Donovan, and was taken at Palm Beach in 10 fathoms. *Range*: North Carolina to the West Indies.

CHAMA SINUOSA Broderip. Plate 13, figs. 9, 10.

Shell large, not very heavy, sculptured with radially striate, cupped fronds arranged in concentric series; a deep furrow runs from the umbo to the posterior basal margin of the free valve, and a weaker furrow may run to the anterior basal margin. (In older specimens, the young shells have the sulci rather close together, when two are present, and these diverge as maturity is reached, causing large specimens to appear three-parted.) The interior margins are smooth, and devoid of any crenulation. Color dirty white, cream, or pale fawn, with a reddish brown spot at the base of, and another beneath, the majority of the fronds; each frond lightly sprinkled with tiny spots of brown arranged on the radial striae; the furrow (or furrows) on the upper valve may be dark brown, and the adjacent fronds are also touched with brown. The interior is white and china-like.

*Chama sinuosa* is probably the finest east American *Chama*, beautiful alike in coloration and sculpture. The specimen on our plate, in the Van Hyning collection, is a very fine shell, dredged from 40 fathoms off Yamato, east Florida, by Frank Lyman. Specimens from shallow water do not have such deep color, and the spines are apt to be more flat and spreading than cupped. *C. sinuosa* and its varieties may always be distinguished by the smooth inner margins.

CHAMA SINUOSA FIRMA Pilsbry and McGinty. Plate 13, fig. 11.

The outstanding difference between this and the typical *sinuosa* is the effaced sculpture and increased thickness and weight. I am inclined to agree with its authors in their suggestion that *firma* is an ecologic form. All the same, a name for such well defined forms is convenient. The shell shown on the accompanying plate

was collected from a somewhat sheltered situation on Garden Key, Dry Tortugas, and consequently, a few marginal folia are developed. *Range*: Boynton (Palm Beach County) Florida, to the Tortugas.

CHAMA SINUOSA BERMUDENSIS Heilprin. Plate 14, fig. 26.

Shells referable to this subspecies have been taken from the moat surrounding Fort Jefferson, Garden Key, Dry Tortugas. The shells are similar to the heavy *C. s. firma*, but differ in having extremely spirally coiled and cupped lower valves, and deeper upper valves as well. Most specimens are heavily incrustated by thick, limy deposits, which form excellent boring-grounds for boring worms and mollusks, such as *Gastrochaena*. The illustrated shell is from the Van Hyning collection, and was collected on Garden Key. *Range*: Bermuda and the Tortugas.

PSEUDOCHAMA RADIANIS VARIEGATA Reeve. Plate 12, fig. 4.

As a general rule, this is one of the smaller species, although large individuals are not uncommon. The sculpture is usually rough and unlovely, consisting of stubby processes and points, radial corrugations, and concentric growth marks. The color is usually dirty white, marked with reddish brown or maroon, the interior white, more or less stained by the color of the outside, especially at the margins. There is a noticeable crenulation of the inner borders. The shell on the plate was collected from Biscayne Bay by Noble Mason.

PSEUDOCHAMA INEZAE, sp. nov. Plate 15.

Shell rather large, subcircular, very thin and light; attached by the right valve; hinge teeth weakly developed; sculpture of about eleven flared, concentric ruffles, which are very thin and irregularly margined, but not cut into fronds. The marginal frills are radially striate, and somewhat fluted, recurved a little downward on the upper valve. The interior margins lack any crenulation, but are finely shagreened at the edge, especially on the lower valve. The shell is pure, alabaster white, with no trace of coloring whatsoever. Greatest diameter, 42, least, 38 mm.

The illustrated type was collected by Mr. Patterson from the wreck of an old steamship, which rested in about ten fathoms, off Carysfort Reef. It is named for Mrs. Patterson.

The chamas are, at best, an inherently difficult and somewhat confusing group. Their great variation is a result of widely varying local conditions, such as water purity, food supply, protection from weathering effects, and dozens of other factors for each specific locality. The same species from two localities, perhaps only a few yards distant, may differ from each other to a greater degree than do two totally different but related species from the same place. In utilizing the accompanying key, these factors must be kept in mind in order to arrive at accurate identifications. Undoubtedly new information will continue to be forthcoming, as new material is collected, and relationships will become increasingly clearer.

## EXPLANATION OF PLATES 12 TO 15

Plate 12. Fig. 1, *Chama lactuca* Dall; diam. maj. 11, min. 10 mm.; upper valve, off Lantana, Fla.; photograph by Bob Vollmer. Fig. 2, same, lower valve; diam. maj. 12.5, min. 11 mm.; photo by Vollmer. Fig. 3, *Chama congregata* Conrad, dorsal view; diam. maj. 28, min. 26 mm.; Palm Beach Inlet; photo by Vollmer. Fig. 4, *Pseudochama radians variegata* Reeve, upper valve; diam. maj. 41, min. 32 mm.; Biscayne Bay; photo by Vollmer. Fig. 5, *Pseudochama* sp.; Palm Beach Inlet; photo by Vollmer. Fig. 6, *Chama florida* Lamarek, dorsal view; 22 mm.; Carysfort Reef; photo by Hi-Tone. Fig. 7, *Pecten mildredae* Bayer, exterior and interior of upper valve; alt. 35, lat. 30 mm.; photo by Rogers. Fig. 8, *Marginella oblonga* Swainson; 23 mm.; original illustration, copied by Hortense Christensen.

Plate 13. Fig. 9, *Chama sinuosa* Broderip, exterior of upper valve; diam. maj. 68, min. 63 mm.; photo by Hi-Tone. Fig. 10, same, interior of lower valve; diam. maj. 66, min. 65 mm. Fig. 11, *Chama sinuosa firma* Pilsbry and McGinty, upper valve; diam. maj. 54, min. 38 mm.; Garden Key, Tortugas; photo by Vollmer. Fig. 12, *Chama macerophylla* Gmelin, upper valve; diam. maj. 44, min. 33 mm.; Biscayne Bay; photo by Vollmer. Fig. 13, *Echinochama arcinella* Linnaeus, left valve; diam., excl. spines, maj. 15, min. 13 mm.; young shell from Lake Worth; photo by Vollmer. Fig. 14, same; right valve.

Plate 14. Figs. 15-16, *Chama sarda* Reeve; 25 mm.; Carysfort Reef; photo by Hi-Tone. Figs. 17-18, *Marginella carnea* D. H. Storer; long. 18 mm.; photo by Rogers. Fig. 19, *M. nobiliana*, n. sp., Type; long. 22, lat. 13 mm.; photo by Rogers. Fig. 20, same; long. 20, lat. 12 mm.; paratype. Fig. 21, *M. guttata* Dillwyn, var.; long. 25 mm.; photo by Rogers. Fig. 22, same; long. 18 mm.; photo by Rogers. Fig. 23, *M. amabilis* Redfield; long. 24 mm. Fig. 24, *M. evelynae*, paratype; long. 17.5 mm.; photo by Rogers. Fig. 25, *M. evelynae*, n. sp., Type; long. 16, lat. 10.5 mm.; photo by Rogers. Fig. 26, *Chama sinuosa bermudensis* Heilprin; oblique view; photo by Rogers. Fig. 27, *Cyphoma intermedia* Sowerby, drawing from life. Fig. 28, *Pecten eulyratus*, sp. nov., type, upper view; alt. 20.5, lat. 20.0 mm.; photo by E. H.



Bone. Fig. 29, *P. antillarum* Recluz; photo by Bone. Fig. 30, *Pecten kallinubilosus*, sp. nov., type, upper valve; alt. 36, lat. 38.5 mm.; photo by Rogers. Fig. 31, same, lower valve. Fig. 32, same, interior of upper valve.

Plate 15. Fig. 33, *Pseudochama inezae*, n. sp., Type; diam. maj. 42, min. 38 mm.; all figs. by Mr. Charles C. Sherley. a, Exterior of right valve. b, Exterior of left valve. c, Interior of left valve. d, Interior of right valve. The fine shagreen surface, or granulation, is easily seen at margins of shell in fig. d; present but not noticeable in c.

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## A PRELIMINARY REVISION OF THE RECENT SPECIES OF CHINESE VIVIPARIDAE <sup>1</sup>

BY TENG-CHIEN YEN

One of the most comprehensive monographs of Viviparidae is Kobelt's work, in continuation of Kuester's, on "*Paludina* Lam.—*Vivipara* Montf.," which was issued at different intervals during 1906–1909 in the new edition of *Conchylien-Cabinet* by Martini and Chemnitz. This work has practically included all the forms of the family known to the author at that time. Since then, this group of freshwater mollusks was subsequently studied by a number of authors, notably Annandale (1920, 1921, 1924) and Rao (1925, 1928), whose attention was particularly directed to the Asiatic forms; Prashad (1928) presenting a synthetic study in distribution and evolution of both recent and fossil Viviparidae; and Kuroda (1929) on the classification of the Japanese forms.

But, nevertheless, a revised synopsis of the family in generic and minor divisions was not available till the publication of the first part of Thiele's "Handbuch" in 1929. Later on in 1936, Taki also attempted to present a "Revision of System of Viviparidae," but his "revision" does not seem to make any important change other than reducing a few of Thiele's subgenera to sections (*Bellamyia* Jousseaume, *Dactylochlamys* Rao = *Angulyagra* Rao, *Heterogen* Annandale, etc.) and his genera into subgenera (*Rivularia* Heude, *Margarya* Nevill, *Neothauma* Smith and *Tulotoma* Haldeman). Such changes do not seem to offer a better background for further study of the family and sometimes may cause confusion.

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