Annotated Guide to the Barnacles of the Northern Gulf of Mexico

Biological Oceanography

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Foreword

The 49 species of thoracican barnacles (the goose and acorn barnacles) that are known to occur in the northern Gulf of Mexico are differentiated by a taxonomic key based on external characters, with extensive illustrations and a glossary. The guide also includes an annotated list of those species and three systematically questionable ones, with areal range, bathymetry, substratum type and other data; a list of 16 species that have been found in the southern Gulf of Mexico but not in the northern Gulf; directions for collecting and examining specimens; and a list of references especially useful for further study of particular groups.

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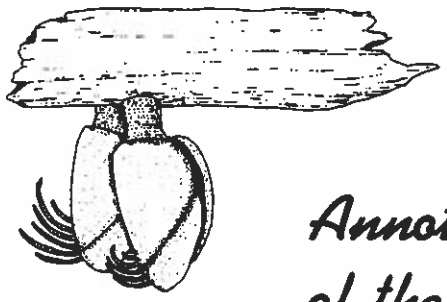


Annotated Guide to the Barnacles of the Northern Gulf of Mexico

Barnacles of the order Thoracica, the "shelled barnacles" (except for several species that have, through time, lost all shell plates), are found throughout the Gulf of Mexico. They occur in nearly fresh waters, in normal salinity seawater, at the uppermost intertidal zones and in the deepest waters of the Gulf. Barnacles can be found on jetties, piers, pilings, rocks, ship bottoms, buoys, oil rigs, tarballs, sticks, seaweed, reefs, fish, crabs, turtles, manatees, whales, dolphins, hard and soft corals, sponges, sea urchins, clams, and oysters and snails, among other substrata.

Several species of barnacles are considered fouling species because they occur in high numbers on man-made structures such as ship bottoms, pilings, buoys and oil rigs. These are generally shallow water species. In the case of ships, fouling greatly reduces fuel efficiency and increases maintenance costs. Furthermore, just as ships must undergo costly cleaning procedures and antifouling treatments, buoys must be replaced or cleaned periodically because of the ever-increasing weight of the fouling mat on the buoy.

Fouling is a much less serious problem in offshore or in deeper waters. This phenomenon was demonstrated by DePalma (1972), who developed a growth curve nomogram that enabled engineers and scientists to forecast fouling intensity in various marine environments.

Recently, barnacles have been used to trace patterns of movement and migration of host organisms on which the barnacles grow (e.g., Killingley and Lutcavage, 1983). This can be done inferentially by species identification and a knowledge of the barnacle's common range, or by utilizing uptake ratios of carbon and oxygen isotopes and a knowledge of the isotope ratios in various coastal and oceanic habitats.

Sample Collection

When collecting barnacles for examination, it is important to collect the entire specimen from a given substrate. The presence or absence of a calcareous base plate on the underside of some barnacles is important in distinguishing between several genera from the Gulf of Mexico. Careless collectors frequently leave this base plate on the substrate. It also is important to note the host of those barnacles attached to living things. Several species have very specific substrate preferences and often can be identified more quickly on that basis.

To simplify sample examination, it often is helpful to clean the surface of the specimens by soaking them in a dilute bleach (sodium hypochlorite) overnight and then lightly brushing off attached algae or hydroids with a toothbrush. This reveals colors and structures that otherwise might be overlooked. A toothbrush can be a valuable addition to field equipment if barnacles are to be identified outside the laboratory. Other useful tools for field collection and sample examination are scrapers, forceps, rulers (to document the sizes of specimens and hosts), pliers (to break shell walls in order to examine plate structure), plastic sample bags (usually double-packed to avoid leakage), buffered formalin for preservation, waterproofed labels, and a hand lens or portable microscope.

The key that follows is intended for either laboratory or field use. Very few shell characters require examination under high magnification. Virtually all shell characters of large adult specimens can be examined with the unaided eye or a 5X hand lens. Every attempt has been made to include taxonomic characters of the shell and opercular valves and to avoid characters of the soft parts (e.g., cirri, mouthparts, etc.), which typically require dissection.

Table 1 is a systematic list of species included in this key. Table 2 lists species found in the southern Gulf of Mexico (south of 26°N) but previously unreported from the range covered in this key. Table 3 lists some references that will be valuable to those requiring supplemental information on the cirripeds covered in the key. A glossary is included, and Plate 1 (figures A through H) shows the basic structure of the various thoracic barnacles. Following the key and the associated plates is an alphabetical, annotated listing of the species covered. Information on the worldwide distribution of each species is included in the annotations, as well as the species distribution in the Gulf of Mexico, hosts (where applicable) and other pertinent data.

The species composition of the thoracic barnacle fauna of the Gulf of Mexico was summarized by

Henry (1954) and, more recently, by Spivey (1981). The number of species known from the area, however, continues to increase. For example, Pequegnat (1983) reported 19 species in deep-sea collections, at least five of which had never been reported from the Gulf of Mexico. It is likely that even more species of barnacles, especially those in deep waters, will be found. The present key comprises only those species reported from north of 26°N latitude (north of a line from Brownsville, Texas, to Cape Romano, near Everglades City, Florida). This line was chosen for two reasons. First, one avoids including species taken only in and near the Straits of Florida, which may be of Caribbean origin and absent elsewhere in the Gulf of Mexico. Second, species from the very poorly sampled Mexican waters are not included. While the Mexican region certainly contains many of the species in this key, it may also contain a significant number of unreported species.

These measures necessitated the exclusion of, among others, several species of the Scalpellidae reported by Spivey (1981) in his analysis of the biogeographic status of the Gulf of Mexico, and by Pequegnat (1983). Because many of the Scalpellidae are known only from deep water and are relatively poorly sampled, some of these undoubtedly occur north of 26°N. This may also be the case for some of the other species of cirripeds occurring in deep water. For this reason, a supplemental list of species occurring in the Gulf south of 26°N, but not included in the key, is given in Table 2.

Parker (1960) noted that the northern Gulf of Mexico coastal waters should be considered more warm temperate than subtropical. They are significantly affected by cold winter weather (Temple et al., 1977) and freshwater runoff, which peaks during March to May (Gallaway, 1981). Due to the prevailing currents, the effects of the sediment-laden freshwater are most noteable in the northwestern Gulf. The faunal composition of the nearshore northwestern Gulf of Mexico has long been recognized as Carolinian in nature (i.e., similar to that of the temperate Atlantic coast [Deevey, 1950; Hedgpeth, 1953; and Defenbaugh, 1976, among others]). Spivey (1981) noted that, with respect to the cirriped fauna, many of the temperate species extend to the southern half of the Gulf (south of 25°N), while the more numerous, strictly tropical species range north of 29°N.

The offshore waters of the northern Gulf of Mexico are more subtropical in nature. Studies completed on the East and West Flower Garden coral reefs and other submerged banks in the northwestern Gulf have shown that the water temperature in the upper 30 meters over the continental shelf seaward of about 80 meters depth seldom drops below 18°C, the minimum seasonal temperature generally considered necessary for vigorous coral reef growth (Rezak, Bright and McGrail, 1985).

The northeastern Gulf of Mexico is characterized by coarse, carbonate, biogenic sediments, as opposed to the finer, terriginous sediments of the northwestern Gulf. Off west Florida, the DeSoto Canyon marks the northern limit of this carbonate shelf. This region is more likely than the western Gulf to be directly influenced by the tropical Loop Current, which enters the Gulf through the Yucatan Channel and exits through the Straits of Florida. A detailed study of the cirriped fauna of the northeastern Gulf versus the northwestern Gulf has not yet been attempted, although one might hypothesize, based on the current regimes of the two areas, the occurrence of a higher number of species with tropical affinities on the Florida shelf than on the shallow portions of the Texas or Louisiana shelf.

In most cases, the nomenclature used in this guide follows that of the most recent works and revisions. It should be noted, however, that Zevina (1978a,b, 1981, 1982) has recently extensively revised the genera and families of what we have called the Poecilasmatidae and Scalpellidae. The new classifications are not included here for various reasons. Primarily, we have not yet had Zevina's works translated from Russian and, therefore, have not evaluated her justification for the revisions. To avoid possible confusion by those interested in these groups, we have chosen to use older, and more familiar, names in this guide.

Table 1. Systematic List of Species Included in the Present Key

Superclass *Crustacea*
Class *Cirripedia*
Order *Thoracica*

Suborder *Lepadomorpha*
- Heteralepadidae
  - **Heteralepas** sp. aff. **cornuta** (Darwin, 1851)
- Lepadidae
  - **Conchoderma auritum** (Linnaeus, 1767)
  - **Conchoderma virgatum** (Spengler, 1790)
  - **Lepas anatifera** Linnaeus, 1758
  - **Lepas anserifera** Linnaeus, 1767
  - **Lepas pectinata** Spengler, 1793
- Poecilasmatidae
  - **Megalasma gracile gracilius** Pilsbry, 1907
  - **Octolasmis aymonini geryonphila** Pilsbry, 1907
  - **Octolasmis forresti** (Stebbing, 1895)
  - **Octolasmis hoeki** (Stebbing, 1895)
  - **Octolasmis lowei** (Darwin, 1851)
  - **Poecilasma inaequilaterale** Pilsbry, 1907
- Scalpellidae
  - **Arcoscalpellum antillarum** (Pilsbry, 1907)
  - **Arcoscalpellum arietinum** (Pilsbry, 1907)
  - **Arcoscalpellum diceratum** (Pilsbry, 1907)
  - **Arcoscalpellum idioplax** (Pilsbry, 1907)
  - **Arcoscalpellum intonsum** (Pilsbry, 1907)
  - **Arcoscalpellum portoricanum** (Pilsbry, 1907)
  - **Arcoscalpellum regina** (Pilsbry, 1907)
  - **Arcoscalpellum semisculptum** (Pilsbry, 1907)
  - **Lithotrya dorsalis** (Ellis and Solander, 1786)
  - **Scalpellum albatrossianum** Pilsbry, 1907
  - **Scalpellum gibbum** Pilsbry, 1907
  - **Scalpellum gracilius** Pilsbry, 1907
  - **Scalpellum svetlanae** Zevina, 1975

Suborder *Balanomorpha*
- Archaeobalanidae
  - **Acasta cyathus** Darwin, 1854
  - **Conopea galeata** (Linnaeus, 1771)
  - **Conopea merrilli** (Zullo, 1966)
  - **Membranobalanus declivis** (Darwin, 1854)
- Balanidae
  - **Balanus amphitrite amphitrite** Darwin, 1854
  - **Balanus calidus** Pilsbry, 1916
  - **Balanus eburneus** Gould, 1841
  - **Balanus improvisus** Darwin, 1854
  - **Balanus reticulatus** Utinomi, 1967
  - **Balanus spongicola** Brown, 1844 (not included in key, see annotated list)
  - **Balanus subalbidus** Henry, 1973
  - **Balanus trigonus** Darwin, 1854
  - **Balanus venustus** Darwin, 1854
  - **Megabalanus antillensis** (Pilsbry, 1916)
- Chthamalidae
  - **Chthamalus fragilis** Darwin, 1854
  - **Chthamalus proteus** Dando and Southward, 1980 (not included in key, see annotation for **C. fragilis**)
- Coronulidae
  - Coronulinae
    - **Xenobalanus globicipitis** Steenstrup, 1851
  - Chelonibiinae
    - **Chelonibia caretta** (Spengler, 1790)
    - **Chelonibia manati lobatibasis** Pilsbry, 1916
    - **Chelonibia patula** (Ranzani, 1818)
    - **Chelonibia testudinaria** (Linnaeus, 1757)
  - Platylepadinae
    - **Platylepas hexastylos** (Fabricius, 1798)
    - **Platylepas hexastylos icthyophila** Pilsbry, 1916 (not included in key, see annotation for **P. hexastylos**)
    - **Stomatolepas dermochelys** (Costa, 1838)
- Pyrgomatidae
  - **Ceratoconcha floridana** (Pilsbry, 1931)
- Tetraclitidae
  - **Tetraclita stalactifera stalactifera** (Lamarck, 1818)

Suborder *Verrucomorpha*
- Verrucidae
  - **Verruca floridana** Pilsbry, 1916

Table 2. Other Thoracica Reported from the Gulf of Mexico, South of 26°N Latitude

Lepadomorpha
- Poecilasmatidae
  - **Pagurolepas conchicola atlantica** Keeley and Newman, 1974
- Scalpellidae
  - **Arcoscalpellum gorgoniophilum** (Pilsbry, 1907)
  - **Arcoscalpellum hendersoni** (Pilsbry, 1911)
  - **Arcoscalpellum pentacrinarium** (Pilsbry, 1907)
  - **Arcoscalpellum vitreum** (Hoek, 1883)
  - **Scalpellum spicatum** Zevina, 1975

Balanomorpha
- Balanidae
  - **Balanus crenatus** Bruguiere, 1789 (questionable record)
  - **Megabalanus stultus** (Darwin, 1854)
- Chthamalidae
  - **Chthamalus angustitergum** Pilsbry, 1916
  - **Chthamalus bisinuatus**Pilsbry, 1916 (questionable record)
- Pyrgomatidae
  - **Ceratoconcha domingensis** (Des Moulins, 1866)
  - **Megatrema maderporarum** (Bosc, 1812)
- Tetraclitidae
  - **Newmanella radiata** (Bruguiere, 1789)

Verrucomorpha
- Verrucidae
  - **Verruca alba** Pilsbry, 1907
  - **Verruca nexa Darwin, 1854**
  - **Verruca rathbuniana** Pilsbry, 1916

Table 3. References Used for Description or of Value for Supplemental Information

Lepadomorpha
- Darwin, 1851
- Foster, 1978
- Gruvel, 1905
- Newman and Ross, 1971
- Nilsson-Cantell, 1978
- Pilsbry, 1907
- Pilsbry, 1911
- Pilsbry, 1953
- Spivey, 1979
- Zevina, 1975
- Zevina, 1978a, b
- Zullo, 1966
- Zullo, 1979

Verrucomorpha
- Pilsbry, 1916
- Pilsbry, 1953

Balanomorpha
- Dando and Southward, 1980
- Darwin, 1854
- Foster, 1978
- Gruvel, 1905
- Harding, 1962
- Henry and McLaughlin, 1975
- Monroe and Limpus, 1979
- Nilsson-Cantell, 1927
- Nilsson-Cantell, 1978
- Pilsbry, 1916
- Pilsbry, 1953
- Ross, 1969
- Ross and Newman, 1973
- Utinomi, 1967
- Zullo, 1966
- Zullo, 1979
- Zullo and Standing, 1983

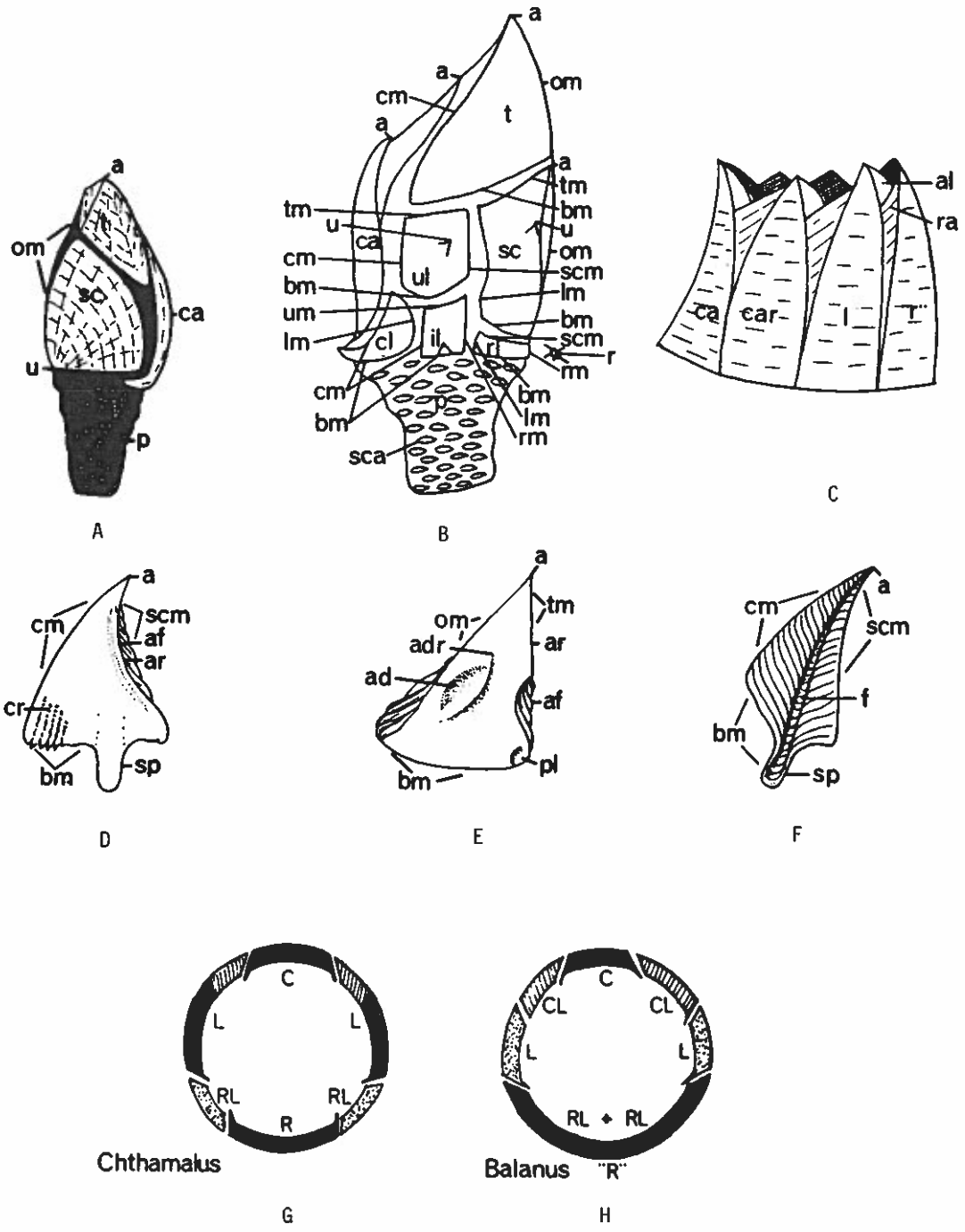
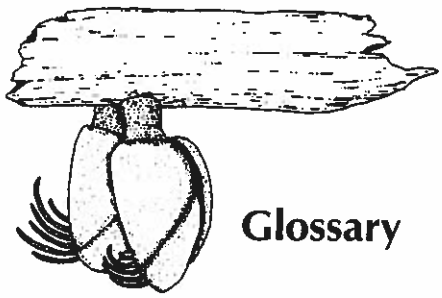


Plate 1. *Schematic drawings of: A. Lepadidae; B. Scalpellidae; C. Balanidae; D. tergum of C, internal view; E. scutum of C, internal view; F. tergum of C, external view; G, H. arrangement of wall plates in* ***Chthamalus*** *and* ***Balanus****. (From Nilsson-Cantell, 1978)*

a - apex
ad - depression of the adductor muscle
adr - adductor ridge
af - articular furrow
al - ala
ar - articular ridge
bm - basal margin
C,ca - carina
CL,car - carinolateral
cl - carinal latus
cm - carinal margin
cr - crests for depressor muscle
f - spur furrow
il - inframedian latus
L,l - lateral plate
lm - lateral margin
om - occludent margin
p - peduncle
pl - pit for lateral depressor muscle
R,r - real rostrum
"R," "r" - fused plate of the rostrolaterals
ra - radius
RL,rl - rostral latus
rm - rostral margin
sc - scutum
sca - peduncular scales
scm - scutal margin
sp - spur
t - tergum
tm - tergal margin
u - umbo
ul - upper latus
um - upper margin



Glossary

(Some terms after Henry and McLaughlin, 1975, Newman, Zullo and Withers, 1969, Nilsson-Cantell, 1978, and Zullo, 1979)

adductor pit—('ad" in Pl. 1, fig. E) pit or depression on interior of scutum for attachment of adductor muscle; between adductor pit and occludent margin.

adductor ridge—("adr" in Pl. 1, fig. E) ridge on interior of scutum between the tergal margin and adductor pit.

ala (pl. alae)—("al" in Pl. 1, fig. C) the portion of a compartmental plate (triangular in shape and delimited from the paries) which is overlapped by the radius of an adjacent plate.

angular—bent abruptly; not evenly curved.

aperture—the opening into the body chamber between the paired scuta.

apex—("a" in Pl. 1, figs. A, B, D-F) upper angle of a plate.

articular furrow—("af" in Pl. 1, fig. D) depression on tergal margin of the scutum, or the scutal margin of the tergum, adjacent to the articular ridge and together forming an articulation between the two plates.

articular ridge—("ar" in Pl. 1, fig. D) ridge on tergal margin of scutum, or scutal margin of tergum, adjacent to the articular furrow, and together forming an articulation between the two plates.

articulate—jointed (may or may not be moveable).

basal margin—("bm" in Pl. 1, figs. B, D-F) referring to the lower edge, or margin, of a plate.

basis—membranous tissue or calcareous plate attached to the substratum.

basiscutal angle—angle formed by the intersection of the basal and scutal margins of the tergum.

beak, or beaked—apex of tergum produced into a long, narrow, curved point which may be differentiated from the rest of the plate.

capitulum—the portion of a pedunculate cirriped above the peduncle.

carina—("C" or "ca" in Pl. 1, figs. A-C, G, H) single compartmental plate at the end of the shell adjacent to the terga.

carinal—toward or adjacent to the carina.

carinal margin—("cm" in Pl. 1, figs. D, F) edge of a plate adjacent to the carina.

carinolaterals—("CL" or "car" in Pl. 1, figs. C, H) compartmental plates on either side of the carina.

cirri—biramous thoracic appendages (six pairs exist in the Thoracica).

compartmental plates—rigid, articulated plates forming a wall or shell around the barnacle.

concave—bowing inward toward a point of reference.

convex—bowing outward from a center of reference.

crenulate—notched appearance on an edge.

crests for depressor muscle—("cr" in Pl. 1, fig. D) ridges on the basal margin of the interior of the tergum.

dentate—ribbed, or with regularly spaced notches.

depressor muscle pit—("pl" in Pl. 1, fig. E) small depression at the base of the tergal margin of the scutum.

fasciole—flat, or nearly so, to slightly depressed on the outer surface of valve.

furrow—("f" in Pl. 1, fig. F) moderate to deep depression on the exterior of the tergum running from the apex to the end of the spur.

inframedian latus—("il" in Pl. 1, fig. B) middle plate of the lower whorl of plates in Scalpellidae.

inner lamina or lamella—inner shell layer of a compartmental plate separated from the outer lamina by parietal tubes.

labrum—"upper lip" of trophi.

lateral margin—("lm" in Pl. 1, fig. B) that edge of a plate toward the inframedian latus or the upper latus in Scalpellidae.

laterals—("L" or "l" in Pl. 1, figs. C, G, H) compartmental plates on rostral side of the carinolaterals.

longitudinal or parietal septa—wall of parietal tubes, normal to and separating inner and outer laminae.

oblique—slanting; inclined.

occludent margin—("om" in Pl. 1, figs. A, B, E) margin on the rostral side of the scutum, and occluding (closing) with the same margin on the opposite scutum.

opercular plates—movable plates in the orifice of the shell.

orifice—opening containing the opercular plates.

paries (pl. parietes)—central, triangular part of a compartmental plate, the basal margin of which is attached to the basis of the shell.

parietal tubes—longitudinal tubes in the parietes between the inner and outer laminae.

peduncle—("p" in Pl. 1, figs. A, B) fleshy stalk between shell and substratum in lepadomorphs; may be nude or partially covered with calcified scales.

plicate—folded or pleated.

protuberant—bulging; swelling outward; prominent.

radius (pl. radii)—("ra" in Pl. 1, fig. C) the external part of a compartmental plate, delimited from the paries by a change in the direction of growth and a depressed surface, which overlaps the ala of an adjacent plate.

rostral latus—("rl" in Pl. 1, fig. B) plate adjacent to the rostral side of the inframedian latus in the lower whorl of plates in Scalpellidae.

rostral margin—("rm" in Pl. 1, fig. B) edge adjacent to the rostrum.

rostral plate—("R" or "r" in Pl. 1, figs. C, H) a compound compartmental plate at the rostral end of the shell.

rostrolaterals—("RL" in Pl. 1, figs. G, H) compartmental plates on either side of the rostrum.

rostrum—("R" or "r" in Pl. 1, figs. B, G) compartmental plate at the end of shell opposite the carina.

scales—("sca" in Pl. 1, fig. B) small, calcareous, scale-shaped plates

embedded in the peduncle in some lepadomorphs.

scutal margin—("scm" in Pl. 1, figs. B, D F) edge of a plate adjacent to the scutum.

scutum (pl. scuta)—("sc" in Pl. 1, figs. A, B, and fig. E) the pair of opercular plates at the rostral end of the orifice.

septum (pl. septa)—ribs between the inner and outer laminae.

shell—the entire suite of calcareous plates, minus the opercular plates.

spur—("sp" in Pl. 1, figs. D, F) projection on the basal margin of the tergum.

striate—striped or having an etched appearance in a particular direction.

summit—upper edge of a plate.

tergal margin—("tm" in Pl. 1, fig. E) edge of a plate adjacent to the tergum.

tergum (pl. terga)—("t" in Pl. 1, figs. A, B, and figs. D, F) the pair of opercular plates at the carinal end of the orifice.

transverse septa—septa normal to the longitudinal septa and parallel to the basis that divide parietal tubes into a series of cells.

truncate—blunt at the end; squared-off.

tubiferous—with longitudinal tubes in the parietes between the inner and outer laminae.

umbo—("u" in Pl. 1, figs. A, B) point of a plate from which growth begins.

umbo-apical ridge—prominence (ridge) from the umbo to the apex of the scutum of some lepadids.

upper latus—("ul" in Pl. 1, fig. B) capitular plate above the inframedian latus and between the tergum, scutum and carina in Scalpellidae.

upper margin—("um" in Pl. 1, fig. B) upper edge of a plate; opposite the basal margin and adjacent to the lateral margins.

whorl—ring of plates at a similar level on the capitulum of Scalpellidae.

Key to the Barnacles of the Order Thoracica (Crustacea: Cirripedia) in the Northern Gulf of Mexico

1a Attached by a fleshy peduncle (Suborder Lepadomorpha) or by greatly expanded opercular membrane which resembles a fleshy peduncle 2

1b Without peduncle, attached directly to substratum 27

2a Peduncle with calcified scales (may be difficult to see); capitulum with 8 to 15 plates ..... Family Scalpellidae 3

2b Peduncle nude; capitulum with up to 3 to 5 plates (may appear in some species as 7 plates) . 15

3a Total of eight plates; found embedded in calcareous material..... **Lithotrya dorsalis** (Pl. 3, fig. G)

3b Total of twelve to 15 plates, excluding those on the peduncle; found attached by base of peduncle..... 4

4a Inframedian latus beaked to triangular, or a reduced, thin linear plate nearly as small as or smaller than peduncular scales (see note in 4b) 5

4b Inframedian latus hourglass-, wineglass-shaped or pentagonal (plate may look superficially beaked due to calcified ridges projecting from the center of the upper margin to the two basal angles)..... 11

5a Inframedian latus a small and nearly linear plate; if triangular, very narrowly so 6

5b Inframedian latus beaked to triangular..... 7

6a Inframedian latus about 1/3 the length of the lateral margins of neighboring plates (rostral latus and carinal latus) ..... **Scalpellum svetlanae** (Pl. 3, figs. D-F)

6b Inframedian latus about as long as lateral margins of neighboring plates..... **Arcoscalpellum semisculptum** (Pl. 3, fig. I)

7a Inframedian latus with sides straight or nearly so 8

7b Inframedian latus a recurved triangular shape 9

8a Inframedian latus shorter than basal margin width, but as tall as adjacent margins of adjacent plates; rostrum triangular and small..... **Arcoscalpellum regina** (Pl. 5, figs. C, D)

8b Inframedian latus height about two times own basal width, but only about 1/2 height of adjacent plates; rostrum only a sunken linear vestige ..... **Arcoscalpellum antillarum** (Pl. 6, figs. A-C)

9a Carinal latus about as high as wide, without strongly pointed and projecting apex (may be projecting, but blunt)..... 10

9b Carinal latus wider than high, subtriangular, with apex strongly projecting beyond and downward below the carina and flaring out..... **Arcoscalpellum diceratum** (Pl. 4, figs. N, O)

10a Base of rostrum as long as lateral margins (nearly an equilateral triangle); apex of inframedian latus projecting only slightly above lateral margin of rostral latus; basal margin of inframedian latus nearly as long as or longer than the lateral margins ..... **Arcoscalpellum portoricanum** (Pl. 5, figs. E, F)

10b Base of rostrum shorter than lateral margins; apex of inframedian latus projecting well above lateral margin of rostral latus; basal margin of inframedian latus may be as little as half the length of the lateral margins ..... **Arcoscalpellum intonsum** (Pl. 5, figs. A, B)

11a Inframedian latus pentagonal, with or without ridges forming a triangle shape on the face of the plate 12

11b Inframedian latus hourglass- or wineglass-shaped (i.e. dilated toward the upper and lower ends) 13

12a Inframedian latus pentagonal, by far the largest plate of the lower whorl, without strong ridges; carina prominently angular near the middle; umbo of scutum slightly prominent on upper 1/3 of the occludent margin; tergum strongly recurved at apex; rostrum narrow with parallel sides (nearly rectangular); carinal latera not flaring strongly beyond and below carina..... **Scalpellum gibbum** (Pl. 5, figs. G, H)

12b Inframedian latus pentagonal, not the largest plate of the lower whorl, with two prominent ridges running from the center of the upper margin to the basal angles, giving a superficial triangular appearance to the plate; carina strongly arching throughout length but not angularly bent; occludent margin of capitulum only slightly convex; tergum receeding only slightly at apex; rostrum a small equilateral triangle; carinal latera strongly flaring beyond and below carina ..... **Arcoscalpellum arietinum** (Pl. 4, figs. L, M)

13a Inframedian latus narrow, upper portion smaller or only slightly larger than lower portion; rostrum present or absent 14

13b Inframedian latus very wide above center, upper portion about two times wider than lower portion; rostrum absent..... **Arcoscalpellum idioplax** (Pl. 6, figs. D-F)

14a Rostrum present, but reduced to a linear rudiment, located between the rostral latera along the upper half of their rostral margins; lateral margins of scuta only slightly sinuous, nearly parallel to occludent margins ..... **Scalpellum gracilius** (Pl. 5, figs. J-L)

14b Rostrum absent; lateral margins of scuta deeply sinuous, with apex of upper latus inserted in the deep groove ..... **Scalpellum albatrossianum** (Pl. 5, fig. I)

15a Plates fully calcified (covering entire body) 16

15b Plates incompletely calcified or separated by wide spaces (occasionally absent) 20

16a Carina extending to the base of the terga 17

16b Carina extending upward between the terga..... **Lepas** spp. 18

17a Carina narrow throughout, not expanding laterally at the base; surface of the valves smooth.. **Poecilasma inaequilaterale** (Pl. 4, figs. E, F)

17b Carina wide in its lower part, expanding laterally near the base; surface rough; umbo of carina produced below base of scutum, basal margin of carina as long as base of scutum..... **Megalasma gracile gracilius** (Pl. 4, figs. A-D)

18a Plates radially furrowed or strongly striate, without holes in valves 19

18b Plates smooth or minutely striate, often with an oblique series of square holes in valves..... **Lepas anatifera** (Pl. 2, figs. B-D)

19a Occludent margin of scutum strongly arched, protuberant; prominent umbo-apical ridge..... **Lepas anserifera** (Pl. 2, figs. E, F)

19b Occludent margin not strongly arched; no prominent umbo-apical ridge; plates sometimes with strong spines or barbs ..... **Lepas pectinata** (Pl. 2, figs. G, H)

20a Carina lacking or carina narrow throughout length, not forked at base; terga slender or lacking; capitulum with brownish stripes or blotches on each side; on whales, other cetaceans, turtles, fish, ships, buoys, etc..... 21

20b Carina forked at base; terga irregular; capitulum without stripes; in gill cavity or on carapace of some decapods (crabs, lobsters) or deep-sea isopods 24

21a Capitulum nude or apparently so (i.e. with compartmental plates embedded in host organism 22

21b Capitulum with 5 narrow capitular plates; several brownish stripes on each side of capitulum. **Conchoderma virgatum** (Pl. 2, fig. A)

22a Capitulum with compartmental plates embedded in cetacean host or with tubular, ear-like projections behind the positions of the terga 23

22b Capitulum completely nude (no compartmental or opercular plates) with no ear-like projections ..... **Heteralepas** sp. aff. **cornuta** (Pl. 3, fig. H)

23a Compartmental plates at base of grealty expanded opercular membrane forming more or less star-shaped configuration embedded in cetacean host; borders of mantle forming hood over the cirri; opercular plates lacking ..... **Xenobalanus globicipitis** (Pl. 3, figs. B, C)

23b Capitulum with greatly reduced compartmental plates on surface; no plates embedded in host or on substrate; two tubular, ear-like projections behind the positions of the terga; opercular valves reduced, if present ..... **Conchoderma auritum** (Pl. 3, fig. A)

24a Scutum composed of a narrow occludent and a wider lateral segment, the lateral segment shorter than the occludent segment; juveniles may have notch at apical end of tergum 25

24b Scutum composed of a narrow occludent and narrower lateral segment, the lateral segment usually as long as the occludent segment; no apical notch on tergum 26

25a Scutum composed of a narrow occludent and widely triangular lateral segment, separated by a rather narrow slit; lateral segment greater than half the length of the occludent segment ..... **Octolasmis hoeki** Pl. 4, fig. K)

25b Lateral and occludent branches of scutum separated by a rather wide gap; the lateral branch being somewhat triangular, and not more than half the length of the occludent branch ..... **Octolasmis aymonini geryonphila** (Pl. 4, figs. I, J)

26a Scutum composed of two slender branches ..... **Octolasmis lowei** (Pl. 4, fig. G)

26b Scutum composed of three slender branches ..... **Octolasmis forresti** (Pl. 4, fig. H)

27a Shell plates not arranged symmetrically on either side of the midline, a single valve hinged at one side of the opening ..... **Verruca floridana** (Pl. 16, figs. A-C)

27b Shell with the same arrangement of plates and valves on either side of the midline ..... Suborder Balanomorpha 28

28a Attached to sponges or in hard corals 29

28b Attached to other substrata 31

29a Attached to, or in a sponge 30

29b Within hard coral (not **Millepora**, or fire coral); walls with four plates ... **Ceratoconcha floridana** (Pl. 15, figs. A-E)

30a Spines protruding from outside of plates; carina often slightly longer than other plates ..... **Acasta cyathus** (Pl. 6, figs. G-K)

30b Shell plates smooth; rostral plate developed into a long curved shape, about twice as long as other plates ..... **Membranobalanus declivis** (Pl. 7, figs. F-J)

31a Basis membranous 32

31b Basis calcareous (Note: This base plate may be left on substratum when barnacle is removed) 38

32a Rostral plate overlapping adjacent lateral plates 33

32b Adjacent lateral plates overlap rostral plate (see **Chthamalus fragilis** species account concerning other species of **Chthamalus**) ..... **Chthamalus fragilis** (Pl. 13, figs. A-C)

33a Plates of wall solid when viewed from base, lacking tubes in parietes 34

33b Plates of wall when viewed from base with tubes in parietes between an inner and outer wall 35

34a Shell dome-shaped; each plate with a conspicuous downward projecting, internal midrib..... **Platylepas hexastylos** (Pl. 14, figs. E-G)

34b Shell bowl-shaped, orifice as wide or wider than base; no internal midribs..... **Stomatolepas dermochelys** (Pl. 13, fig. D)

35a Greatest thickness of shell wall at base at least 25 of carino-rostral diameter; radii may be transversely ribbed; orifice small, with greatest diameter less than one-half basal diameter..36

35b Thickness of shell wall at base less than 25 of carino-rostral diameter; radii broad, only slightly depressed, not transversely ribbed; orifice large, with greatest diameter usually greater than one-half basal diameter.....37

36a Radii absent or very narrow, not dentate (i.e. not ribbed) ..... **Chelonibia caretta**

36b Radii present, dentate..... **Chelonibia testudinaria** (Pl. 14, figs. C, D)

37a. Diameter of orifice about one-half carino-rostral diameter; basal margin of shell irregularly plicate (ribbed), partially embedded in outer skin of host; on manatees or turtles..... **Chelonibia manati lobatibasis** (Pl. 13, figs. F, G)

37b Diameter of orifice usually greater than one-half carino-rostral diameter; basal margin of shell smooth, not embedded in outer covering of host; usually on crabs and sometimes on gastropod shells..... **Chelonibia patula** (Pl. 14, figs. A, B)

38a Exterior of scuta with one or more longitudinal rows of pits; orifice triangular; shell wall usually with purple background with fine white ridges..... **Balanus trigonus** (Pl. 11, figs. F-J)

38b Exterior of scuta lacking rows of pits; orifice more or less diamond-shaped..... 39

39a Carinal side of basal margin of terga deeply excavated (more so in larger specimens); exterior of scuta often with distinct longitudinal striae..... **Balanus eburneus** (Pl. 9, figs. A-D)

39b Carinal side of basal margin of terga entire (exterior of scuta may or may not have longitudinal striae).....40

40a Exterior of scuta with distinct longitudinal striae; shell wall plicate..... **Balanus calidus** (Pl. 8, figs. G-J)

40b Exterior of scuta without longitudinal striae 41

41a Parietes solid; usually on gorgonians 42

41b Parietes tubiferous; rarely, if ever, directly on gorgonians 43

42a Boat-shaped basis; scutal margin of tergum deeply indentate; articular ridge limited to upper part of terga ..... **Conopea galeata** (Pl. 6, figs. L-O)

42b Non boat-shaped basis; scutal margin slightly concave; articular ridge well developed ..... **Conopea merrilli** (Pl. 7, figs. A-E)

43a Wall consisting of 4 calcareous plates, lacking purple coloration; tergum beaked..... **Tetraclita stalactifera stalactifera** (Pl. 15, figs. F-K)

43b Wall with 6 calcareous plates, with or without purple coloration; tergum may be recurved, but not beaked.....44

44a Parietes white or lacking striations.....45

44b Parietes purplish or with purple striations (not always apparent in very small specimens) ...46

45a Tergal spur narrow, its width less than one-fourth the width of basal margin; terga with slight spur furrow; radii narrow..... **Balanus improvisus**
(Pl. 9, figs. E-H)

45b Tergal spur broader, greater than one-fourth width of basal margin; terga with spur fasciole; radii may be wide..... **Balanus subalbidus**
(Pl. 11, figs. A-E)

46a Tergum with well-developed spur furrow; shell and especially parietes purplish; apex of tergum recurved, but not beaked ..... **Megabalanus antillensis**
(Pl. 12, figs. G-I)

46b Tergum with spur fasciole (i.e. no spur furrow); parietes white with purple striations; apex of tergum not recurved 47

47a Spur length greater than width; parietal tubes usually with transverse septa; labrum not multidenticulate (requires microscopic analysis)..... **Balanus reticulatus**
(Pl. 10, figs. A-F)

47b Spur length less than width; parietal tubes usually without transverse septa; labrum may be multidenticulate (in **B. a. amphitrite**) 48

48a Exterior of shell usually with narrow, regularly spaced, light to dark purple longitudinal stripes of equal width; distance from basiscutal angle to spur about 1/2 spur length and about 1/2 spur width; labrum simple with not more than three teeth on each side..... **Balanus venustus**
Pl. 12, figs. A-F)

48b Exterior of shell usually with broad, irregularly spaced, dark, red-purple stripes, except on central areas of larger plates, which may be free of striping, leaving a broad, white band; distance from basiscutal angle to spur greater than 1/2 spur length (often nearly equal) and greater than 1/2 spur width; labrum multidenticulate (8-23 teeth) . **Balanus amphitrite amphitrite**
(Pl. 8, figs. A-F)

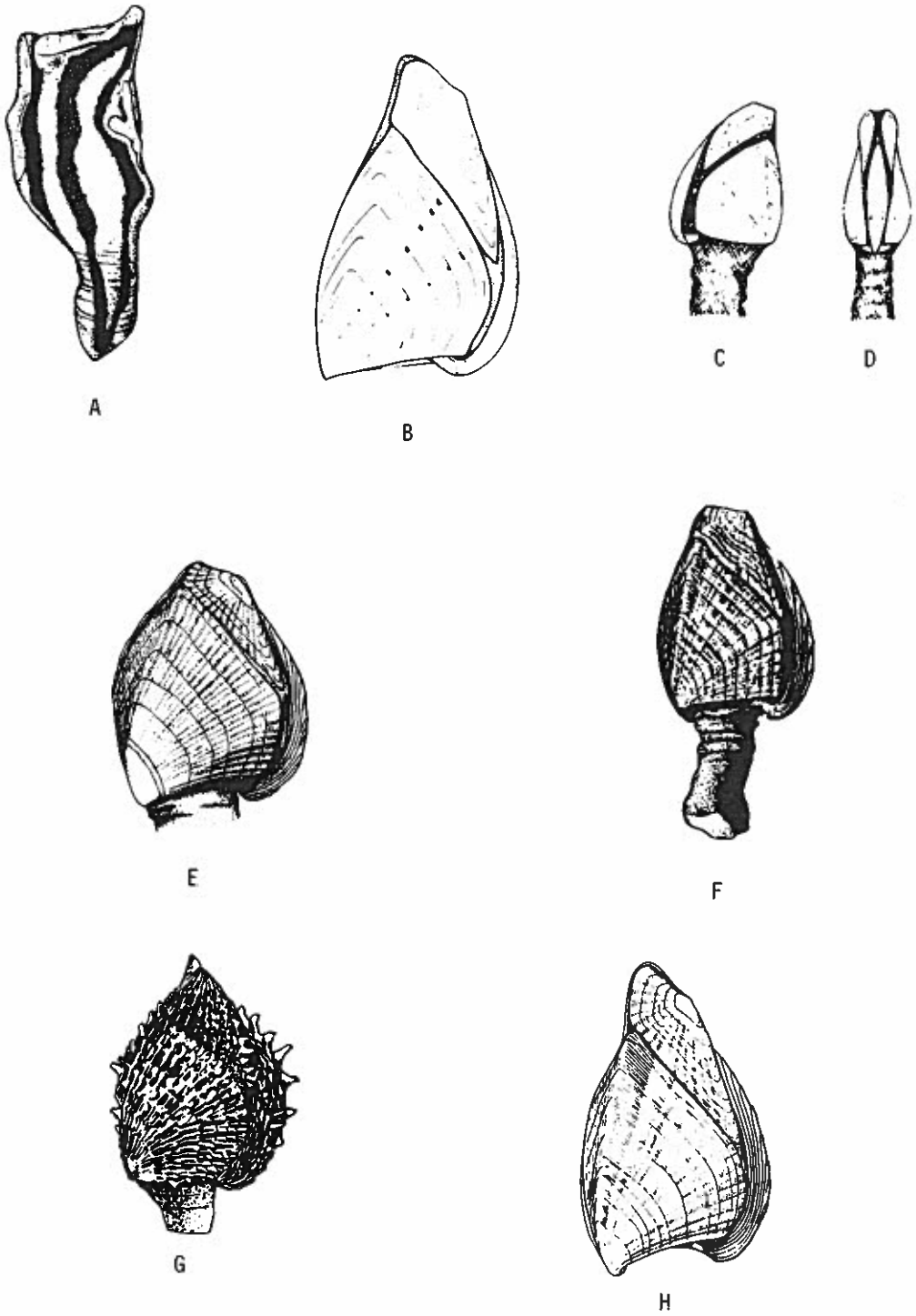


Plate 2. *A.* ***Conchoderma virgatum****, lateral view (from Pilsbry, 1907).*
B-D. ***Lepas anatifera****; B. lateral view, showing rows of holes occasionally seen on capitulum; C. lateral view; D. dorsal view (B from Zullo, 1979; C, D from Nilsson-Cantell, 1978).*
E,F. ***Lepas anserifera****, lateral views of different individuals (E from Zullo, 1979; F from Pilsbry, 1907).*
G,H. ***Lepas pectinata****, lateral views, showing extremes in shell textures (G from Zullo, 1979; H from Nilsson-Cantell, 1978).*

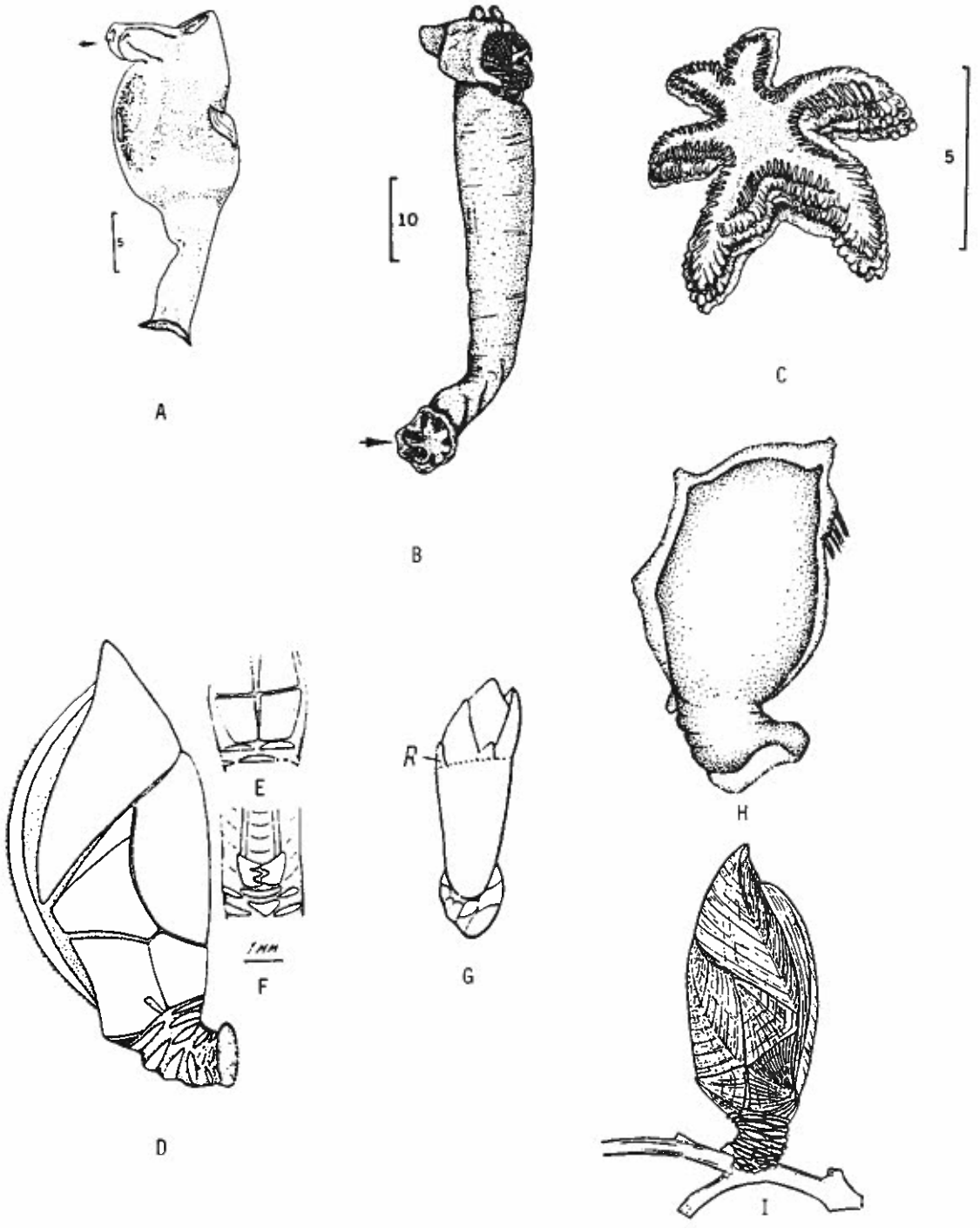


Plate 3. *A.* ***Conchoderma auritum****, lateral view showing "ears." Scale in millimeters (from Zullo, 1979).*

B,C. ***Xenobalanus globicipitis****; B. complete specimen with star-shaped shell at base; C. basal view of detached shell. Scale in millimeters (from Zullo, 1979).*

D-F. ***Scalpellum svetlanae****; D. lateral view; E. view of basal end of rostral margin; F. view of basal end of carinal margin (from Zevina, 1975).*

G. ***Lithotrya dorsalis****, lateral view. "R" marks rostrum (from Zevina, 1978b).*

H. ***Heteralepas*** *sp. aff.* ***cornuta****, lateral view (drawn by Bonnie Bower-Dennis from specimen from Gulf Coast Research Laboratory, Ocean Springs, Mississippi).*

I. ***Arcoscalpellum semisculptum****, lateral view (from Pilsbry, 1907).*

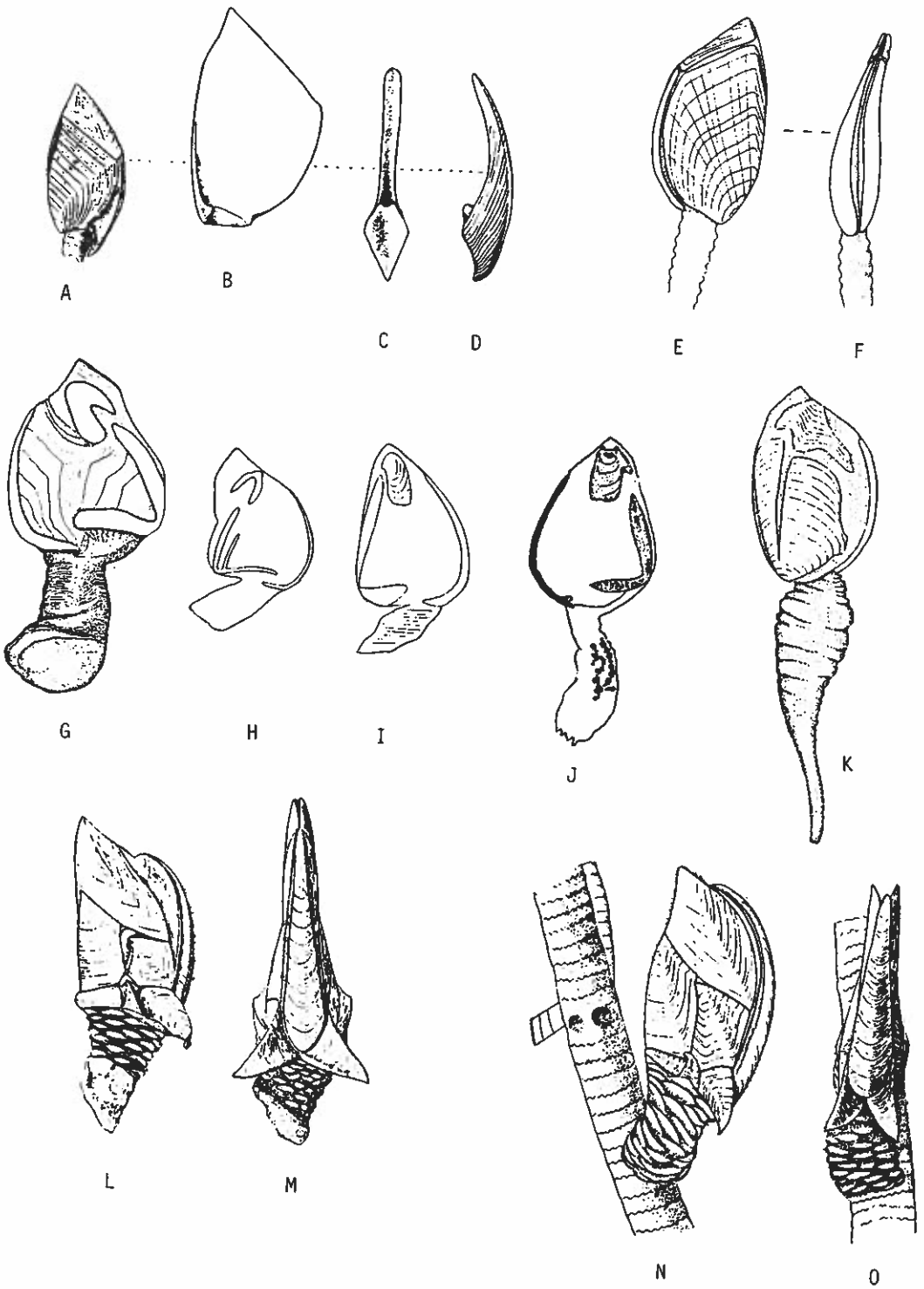


Plate 4.
A-D. ***Megalasma gracile gracilius***; *A. lateral view; B. interior of scutum; C. inside of carina; D. lateral view of carina (from Pilsbry, 1907).*
E,F. ***Poecilasma inaequilaterale***; *E. lateral view; F. apertural view (after Zullo, 1979).*
G. ***Octolasmis lowei***, *lateral view (drawn by Bryan L. Andryszak).*
H. ***Octolasmis forresti***, *lateral view (from Pilsbry, 1907).*
I,J. ***Octolasmis aymonini geryonphila***; *I. lateral view of adult; J. lateral view of juvenile showing notched apical margin of tergum (I from Pilsbry, 1907, J from Causey, 1960, formerly* ***O. dawsoni*** *before synonymy by Newman, 1961).*
K. ***Octolasmis hoeki***, *lateral view (drawn by Bonnie Bower-Dennis from specimen from Gulf Coast Research Laboratory, Ocean Springs, Mississippi).*
L,M. ***Arcoscalpellum arietinum***; *L. lateral view, showing pentagonal shape of inframedian latus; M. dorsal view (from Pilsbry, 1907).*
N,O. ***Arcoscalpellum diceratum***; *N. lateral view; O. dorsal view (from Pilsbry, 1907).*

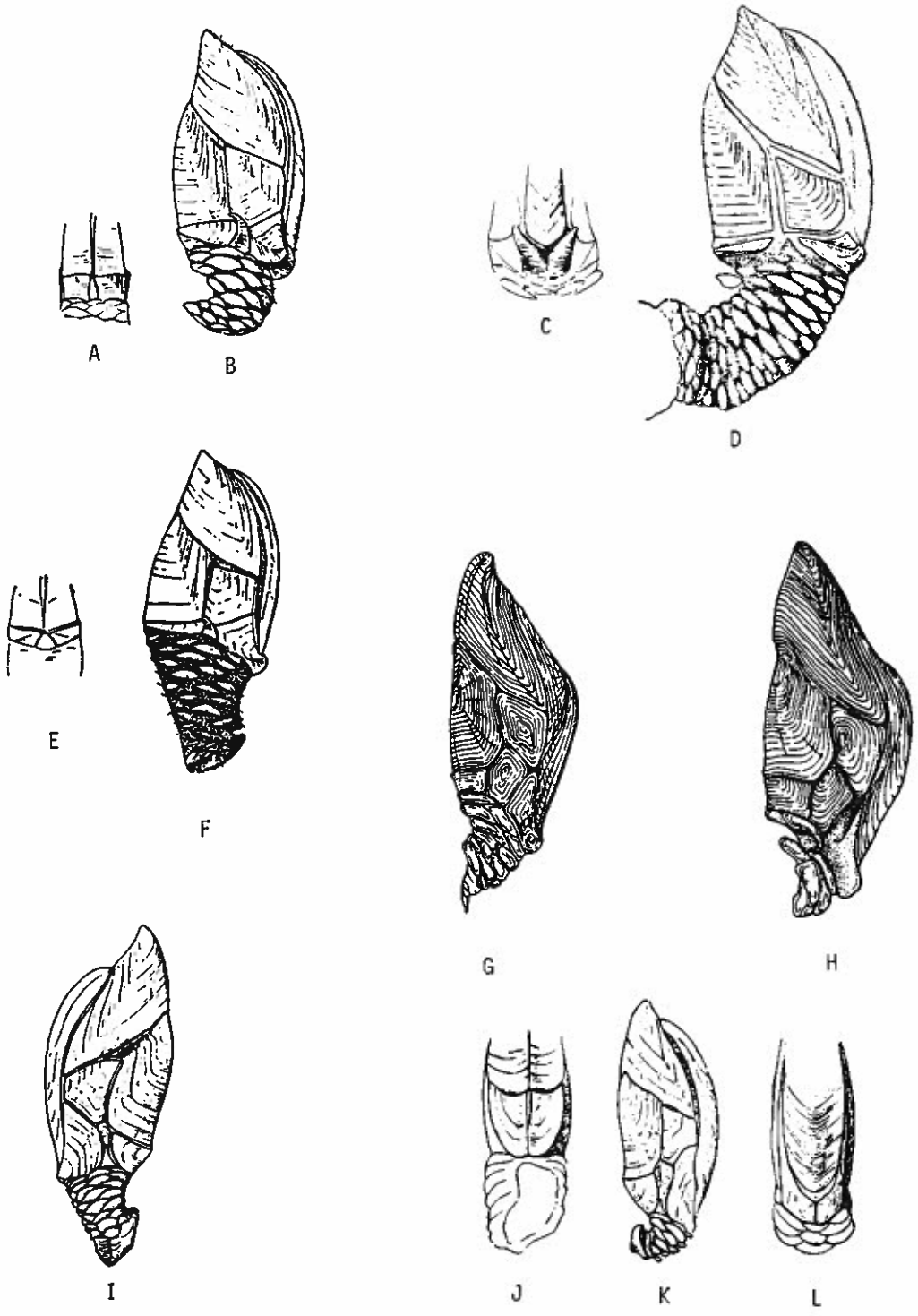


Plate 5. *A,B.* ***Arcoscalpellum intonsum****; A. detail of rostrum; B. lateral view (from Pilsbry, 1907).*
C,D. ***Arcoscalpellum regina****; C. detail of base of carina; D. lateral view (from Pilsbry, 1907).*
E,F. ***Arcoscalpellum portoricanum****; E. detail of rostrum; F. lateral view (from Pilsbry, 1907).*
G,H. ***Scalpellum gibbum****; G. adult; H. juvenile (from Zullo, 1966).*
I. ***Scalpellum albatrossianum****, lateral view (from Pilsbry, 1907).*
J-L. ***Scalpellum gracilius****; J. detail of rostrum; K. lateral view; L. detail of base of carina (from Pilsbry, 1907).*

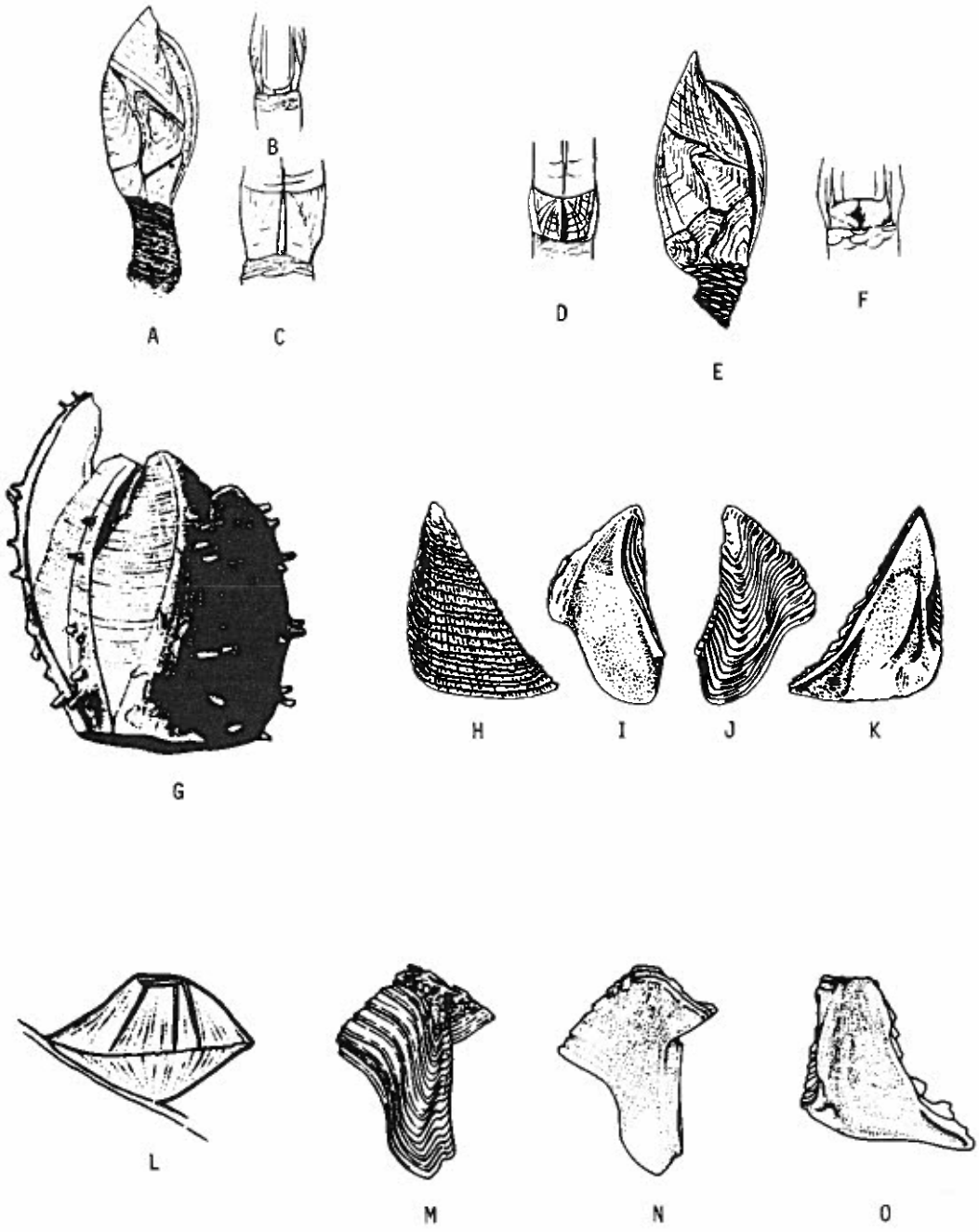


Plate 6. *A-C.* ***Arcoscalpellum antillarum***; *A. lateral view; B. detail of base of carina; C. detail of rostrum (from Pilsbry, 1907).*

D-F. ***Arcoscalpellum idioplax***; *D. detail of rostrum; E. lateral view; F. base of carina (from Pilsbry, 1907).*

G-K. ***Acasta cyathus***; *G. lateral view; H. exterior of scutum; I. interior of tergum; J. exterior of tergum; K. interior of scutum (G from Pilsbry, 1916; H-K from Zullo and Standing, 1983).*

L-0. ***Conopea galeata***; *L. lateral view, showing boat-shaped basis; M. exterior of tergum; N. interior of tergum; O. interior of scutum (L from Newman and Ross, 1976; M-O from Zullo, 1966).*

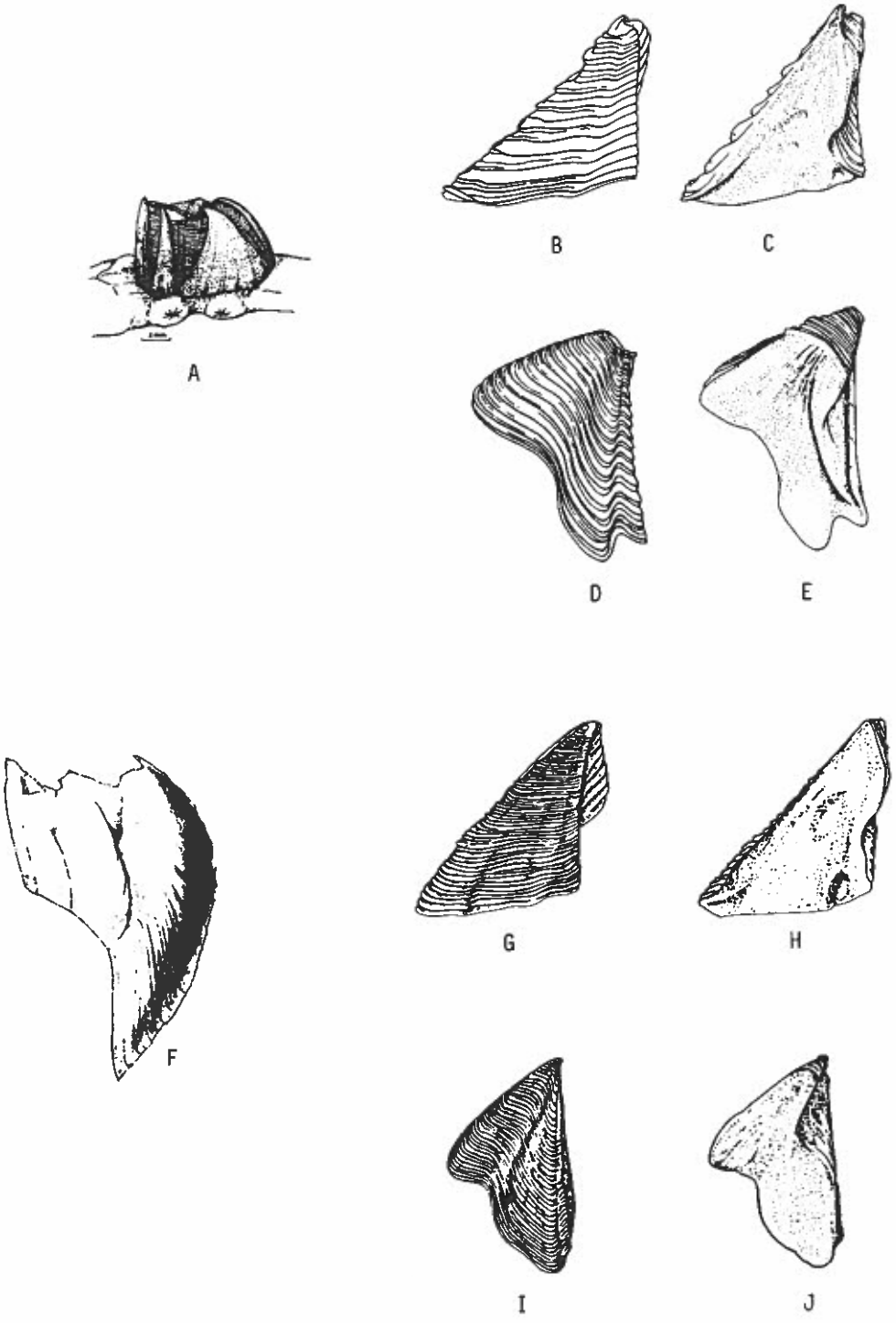


Plate 7. *A-E.* ***Conopea merrilli****; A. lateral view; B. exterior of scutum; C. interior of scutum; D. exterior of tergum; E. interior of tergum (from Zullo, 1966).*

F-J. ***Membranobalanus declivis****; F. lateral view; G. exterior of scutum; H. interior of scutum; I. exterior of tergum; J. interior of tergum (F from Pilsbry, 1916; G-J from Zullo and Standing, 1983).*

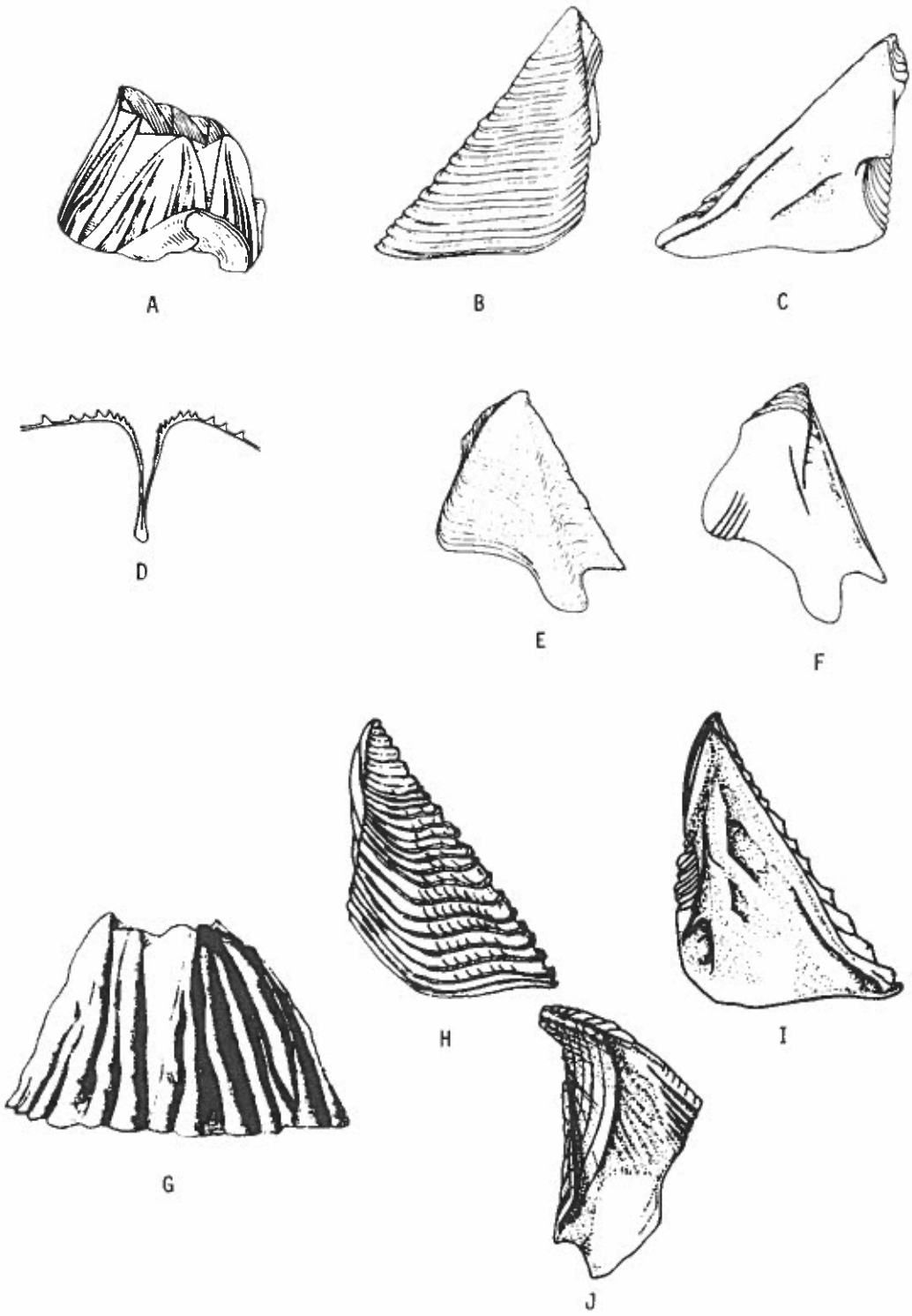


Plate 8. *A-F.* ***Balanus amphitrite amphitrite**; A. lateral view; B. exterior of scutum; C. interior of scutum; D. multidenticulate labrum; E. exterior of tergum; F. interior of tergum (D from Henry and McLaughlin, 1975; A-C, E and F from Zullo, 1979).*

G-J. ***Balanus calidus**; G. lateral view; H. exterior of scutum; I. interior of scutum; J. interior of tergum (G from Pilsbry, 1916; H-J from Zullo, 1979).*

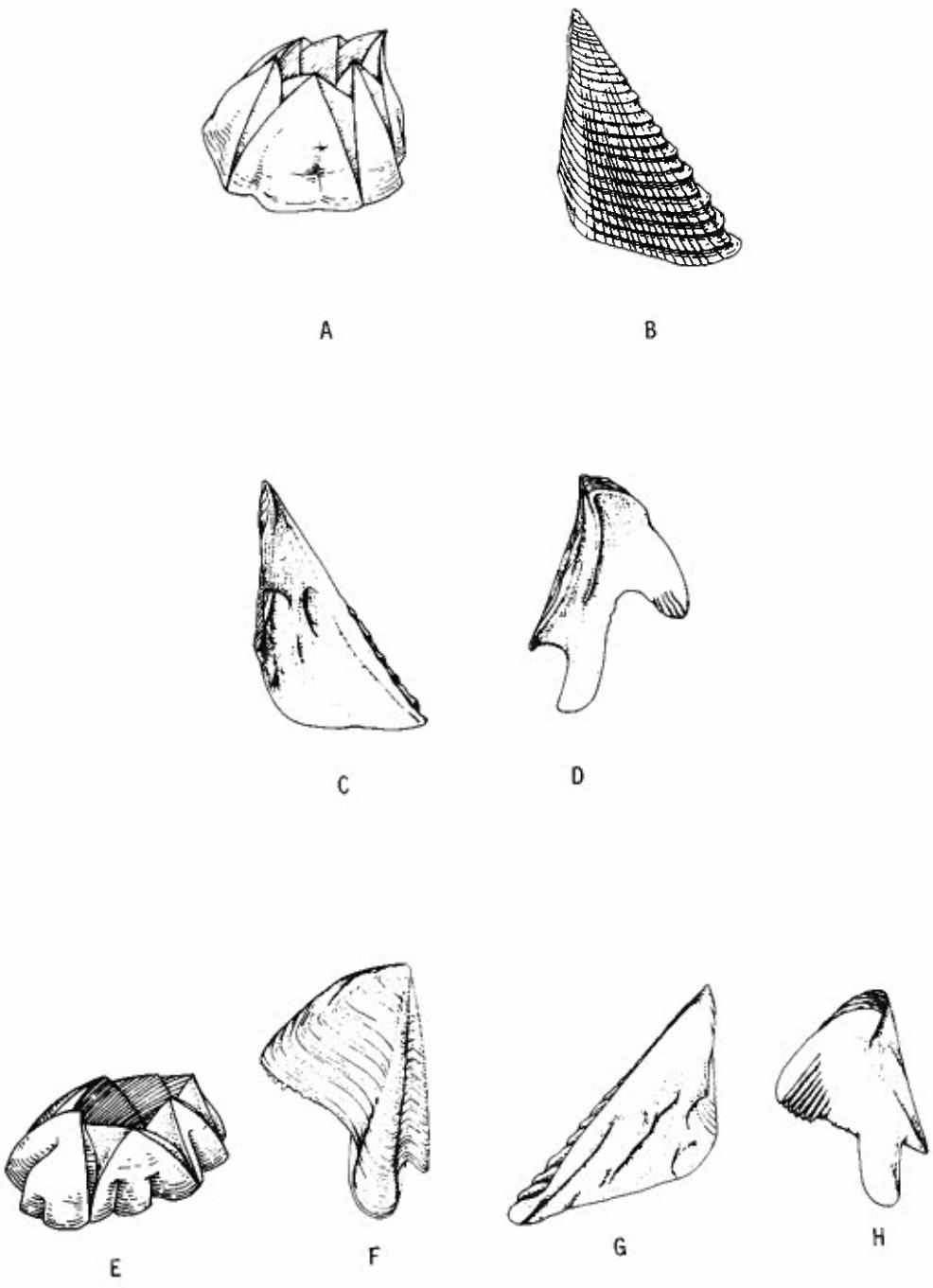


Plate 9. *A-D.* ***Balanus eburneus****; A. oblique view; B. exterior of scutum; C. interior of scutum; D. interior of tergum, showing deeply excavated basal margin (from Zullo, 1979).*
E-H. ***Balanus improvisus****; E. oblique view; F. exterior of tergum; G. interior of scutum; H. interior of tergum (from Zullo, 1979).*

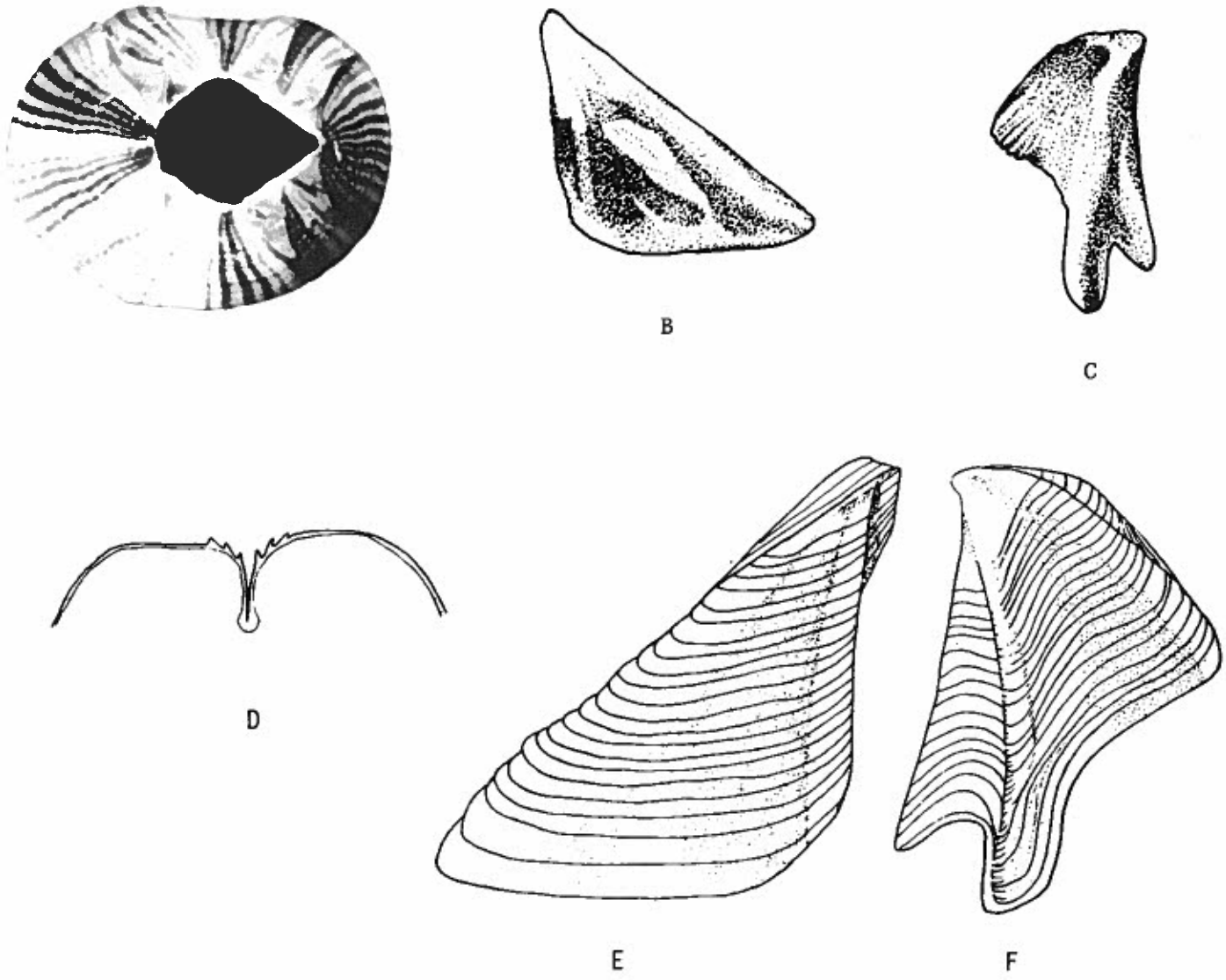


Plate 10. *A-F.* ***Balanus reticulatus;*** *A. top view; B. interior of scutum; C. interior of tergum; D. labrum; E. exterior of scutum; F. exterior of tergum (A from Thomas, 1975; B,C redrawn by Bonnie Bower-Dennis from Henry and McLaughlin, 1975; D-F from Utinomi, 1967).*

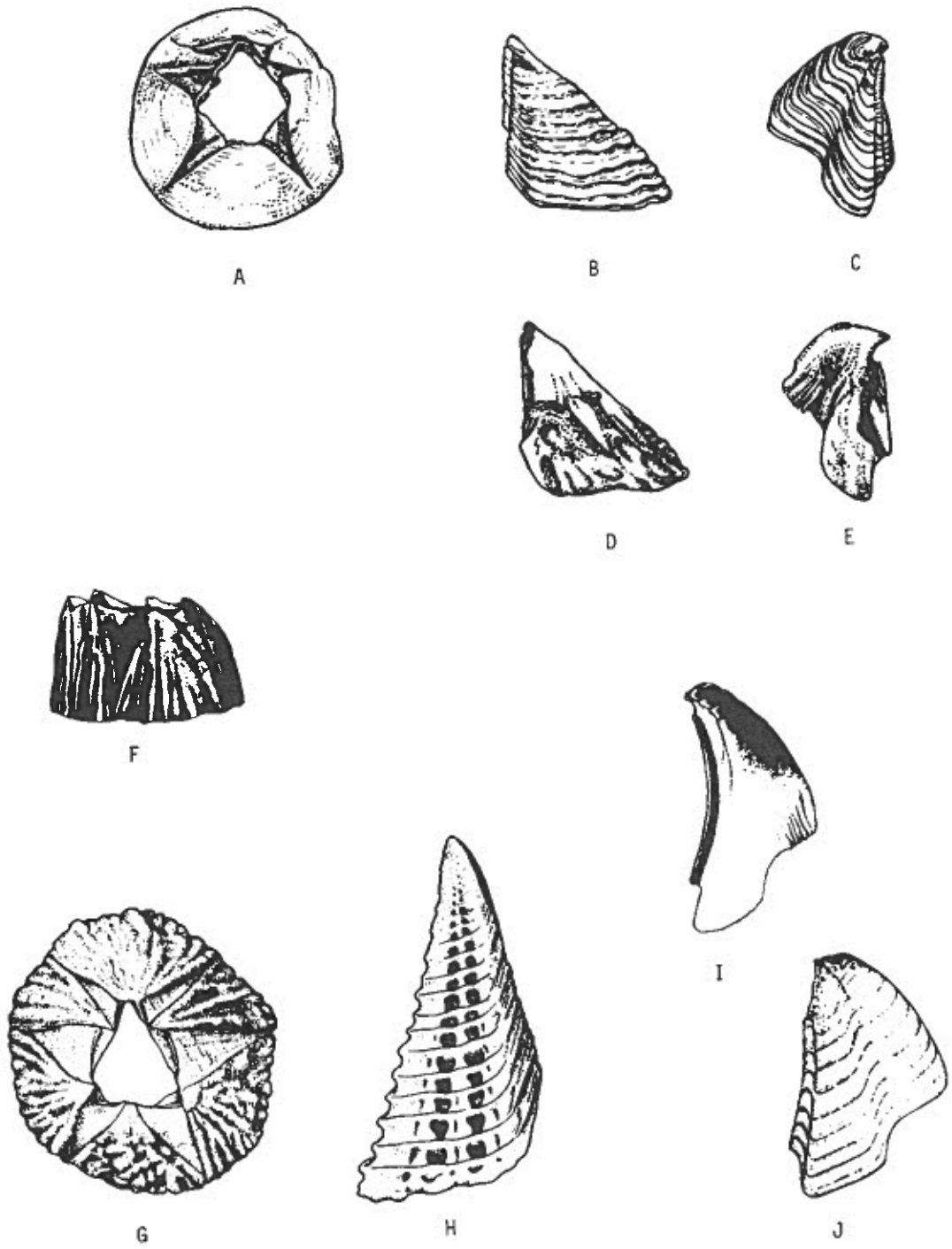


Plate 11. *A-E.* ***Balanus subalbidus****; A. top view; B. exterior of scutum; C. exterior of tergum; D. interior of scutum; E. interior of tergum (from Zullo, 1979).*

F-J. ***Balanus trigonus****; F. lateral view; G. top view of shell, showing triangular orifice; H. exterior of scutum, showing rows of pits; I. interior of tergum; J. exterior of tergum (F,I,J from Pilsbry, 1916; G,H from Zullo, 1979).*

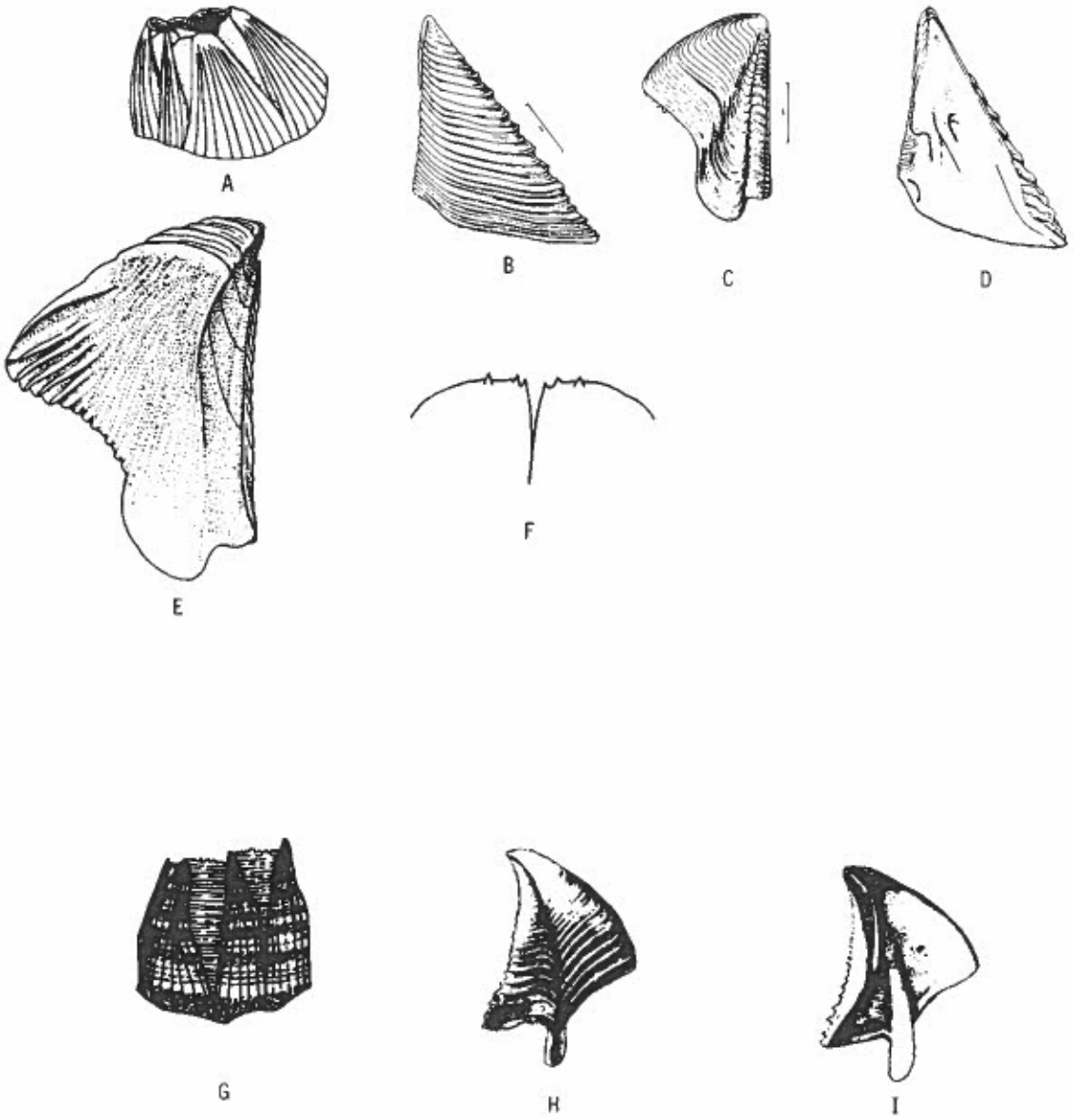


Plate 12. *A-F.* ***Balanus venustus****; A. lateral view; B. exterior of scutum; C. exterior of tergum; D. interior of scutum; E. interior of tergum; F. labrum (E from Zullo, 1966; A-D, F from Zullo, 1979).*

G-I. ***Megabalanus antillensis****; G. lateral view; H. exterior of tergum showing spur furrow; I. interior of tergum (G drawn by Bonnie Bower-Dennis; H,I from best available copy of Pilsbry, 1916).*

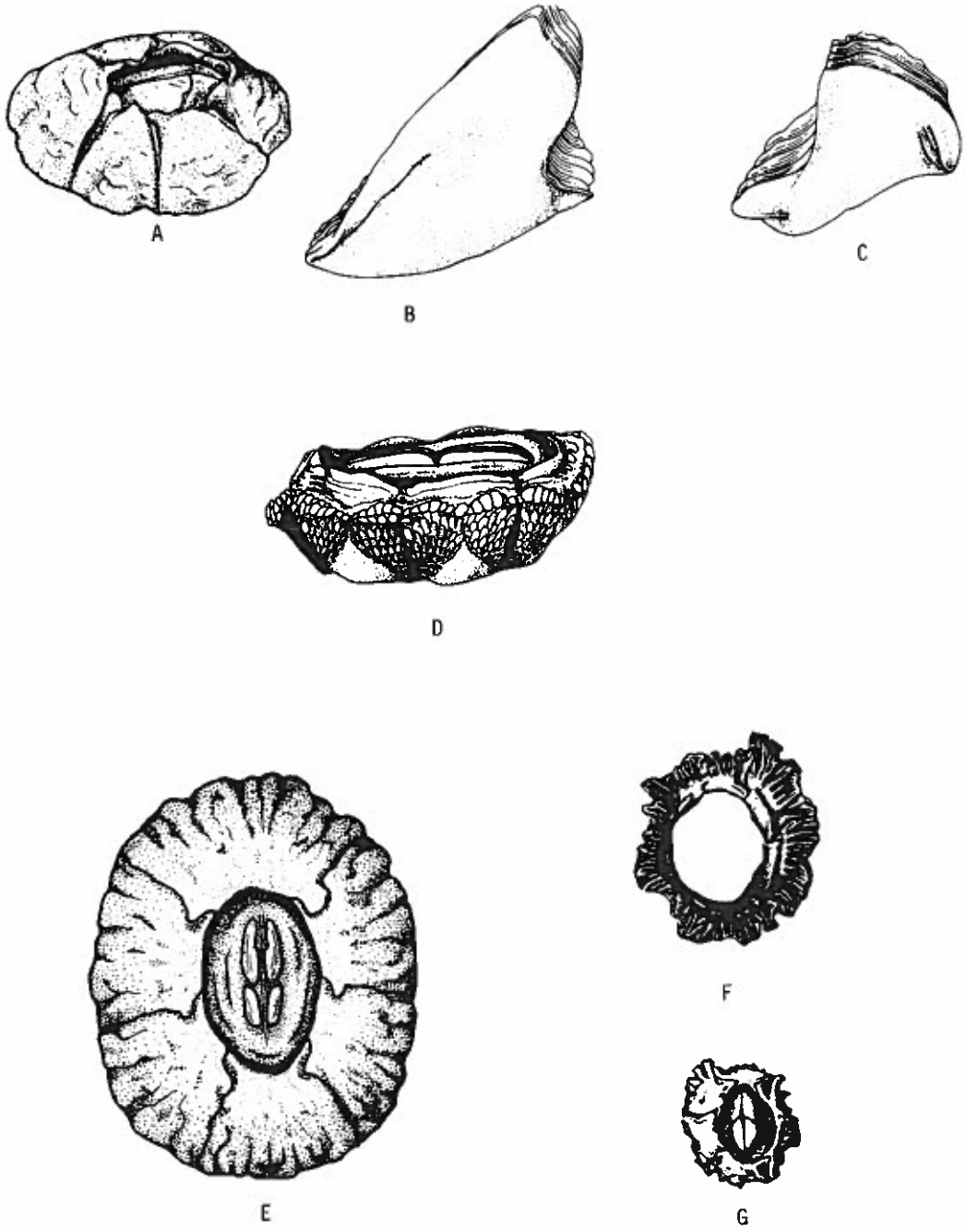


Plate 13. *A-C.* ***Chthamalus fragilis;*** *A. oblique view; B. interior of scutum; C. interior of tergum (from Zullo, 1979).*
D. ***Stomatolepas dermochelys,*** *lateral view (from Zullo, 1979).*
E. ***Chelonibia caretta,*** *top view of shell (from Zullo, 1979).*
F,G. ***Chelonibia manati lobatibasis;*** *H. view from below shell; I. top view of shell (from Pilsbry, 1916).*

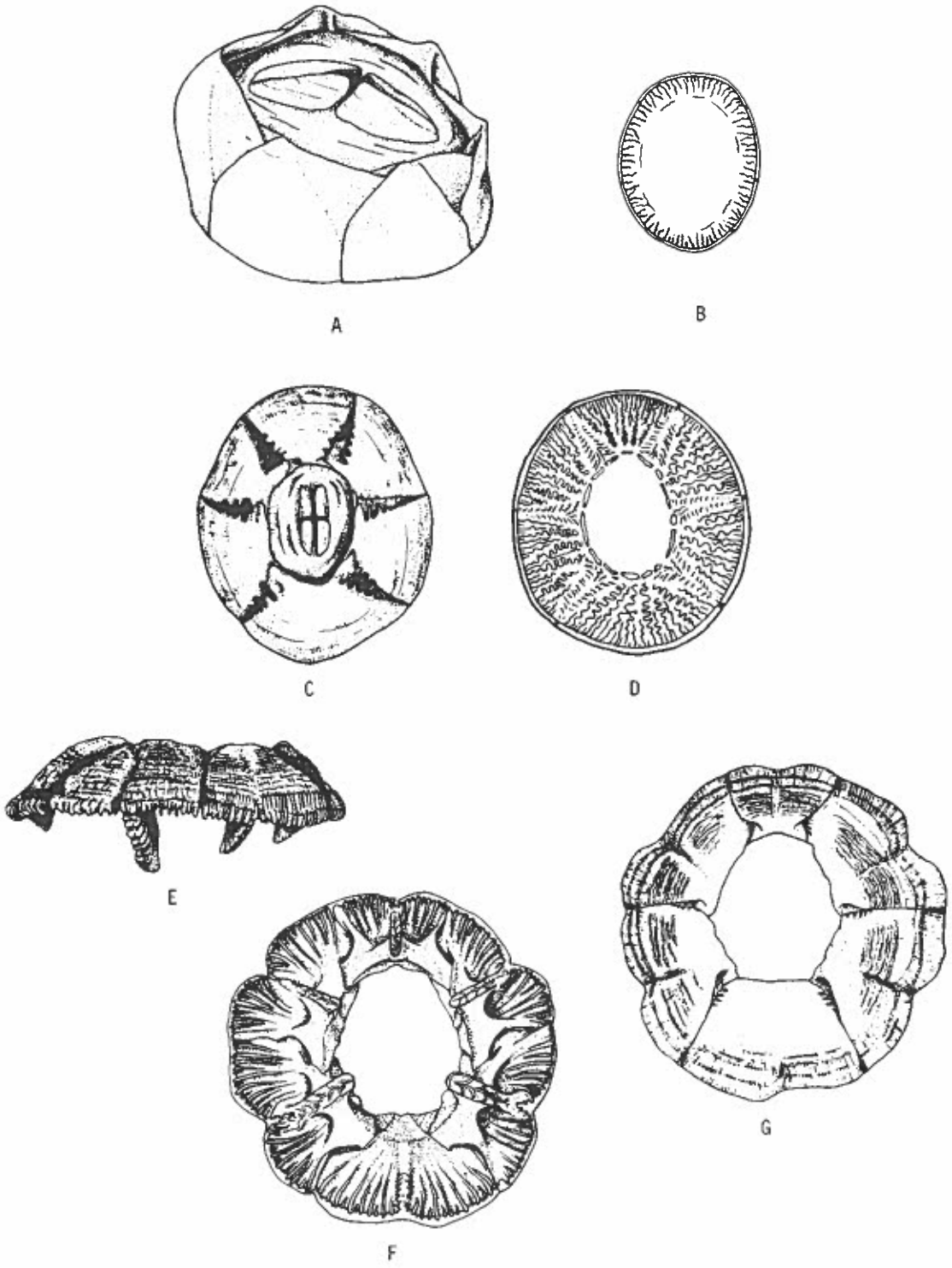


Plate 14. *A,B.* ***Chelonibia patula****; A. shell with opercular plates; B. view of base of shell (from Zullo, 1979).*

C,D. ***Chelonibia testudinaria****; C. shell with opercular plates; D. view of base of shell (from Zullo, 1979).*

E-G. ***Platylepas hexastylos****; E. lateral view, showing downward-projecting midribs; F. basal view of solid shell and midribs; G. top view of shell (from Zullo, 1979).*

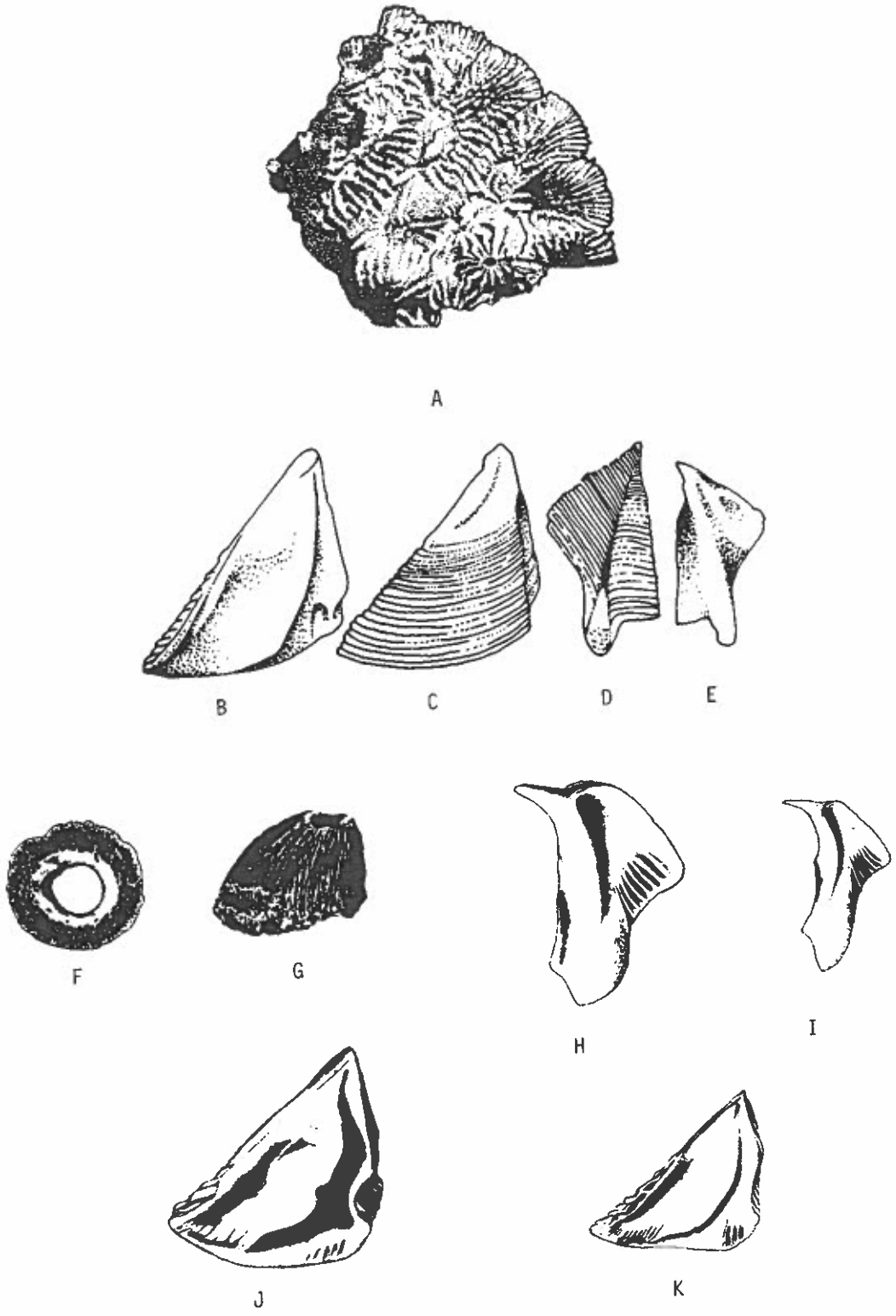


Plate 15. *A-E.* ***Ceratoconcha floridana****; A. barnacle living in* ***Meandrina*** *(?); B. interior of scutum; C. exterior of scutum; D. exterior of tegum; E. interior of tergum (redrawn from Pilsbry, 1931, by Bonnie Bower-Dennis).*

F-K. ***Tetraclita stalactifera****; F. view of base of shell; G. lateral view; H,I. interiors of terga of two growth forms (***T.s. stalactifera*** and* ***T. s. floridana****); J,K. interiors of scuta of the two growth forms (from Pilsbry, 1916).*

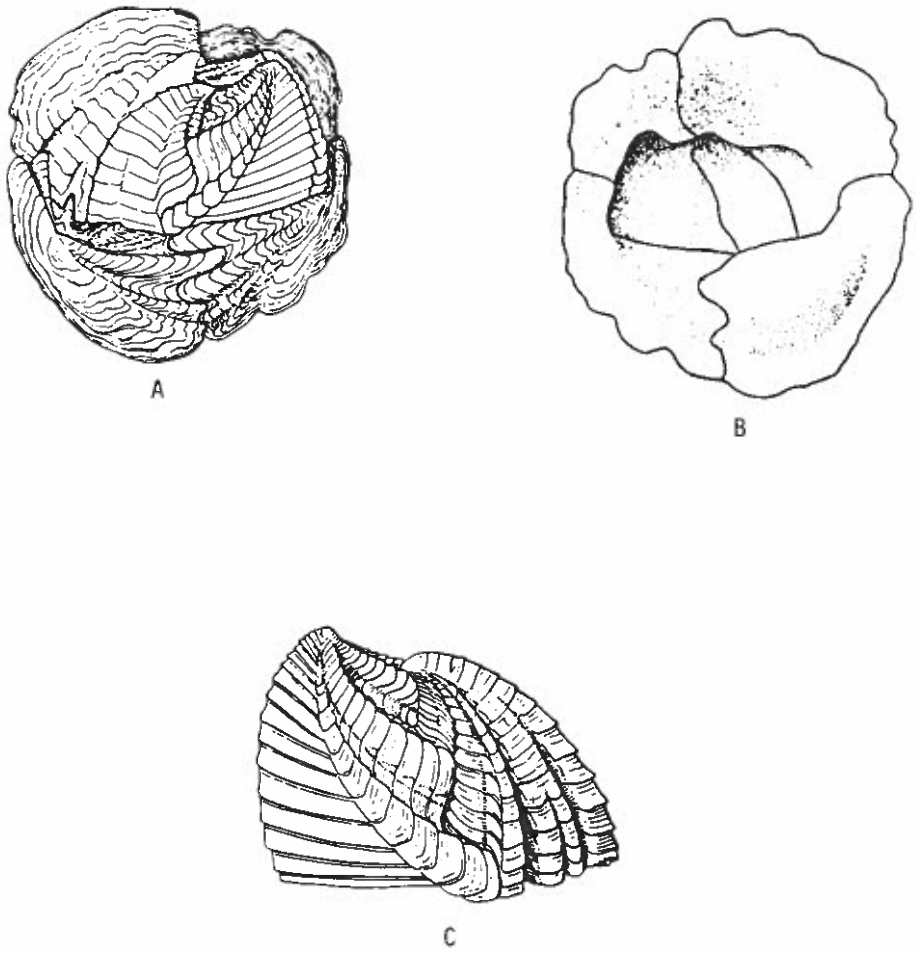
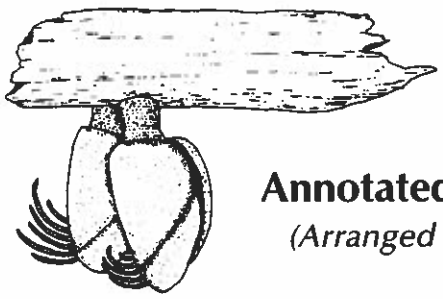


Plate 16. *A-C.* ***Verruca floridana****; A. top view; B. basal view; C. movable plates (from Pilsbry, 1916).*



Annotated Species List

(Arranged alphabetically)

Acasta cyathus Darwin, 1854
(Pl. 6, figs. G-K)

A common inhabitant of sponges in the northeastern Gulf of Mexico (e.g., tube sponges, **Callyspongia vaginalis**; stinker sponges, **Ircinia fasciculata**; and vase sponges, **Ircinia campana**; Wells, 1966), this species has stout spines on the fourth cirri which help the animal prevent overgrowth of the aperture by the host sponge. **Acasta cyathus** occurs also in the tropical western Atlantic, on the U.S. Atlantic coast north to Cape Lookout, North Carolina, in the eastern Atlantic, Red Sea, Indian Ocean and the Indo-West Pacific (Newman and Ross, 1976; Spivey, 1981; Zullo and Standing, 1983).

Arcoscalpellum antillarum (Pilsbry, 1907)
(Pl. 6, figs. A-C)

Specimens have been taken from only two locations, both in the Gulf of Mexico, near the DeSoto Canyon in the northeastern Gulf (800-1718 m; Pilsbry, 1907; Pequegnat, 1983).

Arcoscalpellum arietinum (Pilsbry, 1907)
(Pl. 4, figs. L, M)

In the Gulf of Mexico, this species has been taken from only four locations, all in water shallower than 55 m on the continental shelf between Alligator Point, Florida (in Apalachee Bay) and Destin, Florida (east of Pensacola). Elsewhere, it is known from the Straits of Florida (south of Key West, Florida, on the spine of a sea urchin at 68 m) and off Palm Beach, Florida. Pointed and widely flaring carinal latera distinguish this species from most other scalpellids.

Arcoscalpellum diceratum (Pilsbery, 1907)
(Pl. 4, figs. N, O)

This scalpellid was collected at two northern Gulf of Mexico locations, one south of Cape San Blas, Florida (55 m) and the other at the West Flower Garden Bank off Texas (101 m). Elsewhere, the species was found at three ALBATROSS stations in the Straits of Florida, off Palm Beach, Florida, off Sombrero Key, Florida, off Cape Florida, off North Carolina and northwest of Colombia, South America (Weisbord, 1977). Depths of collection range from 30 m to 340 m. **Arcoscalpellum diceratum** has been found on gorgonians, hydroids, echinoid spines, crinoids and on one coral, **Madracis myriaster.** It is often found to occur with **A. arietinum.**

Arcoscalpellum idioplax (Pilsbry, 1907)
(Pl. 6, figs. D-F)

One specimen has been found at one location in the northern Gulf of Mexico (28°51'N 87°36'W, 2102 m, in the DeSoto Canyon). It was attached to a tarball. Elsewhere, it has been taken from one location in the southern Gulf of Mexico (950 m), from several locations in the Caribbean Sea (824-1836 m) and off Melbourne, Florida (1045m) (Weisbord, 1977). Thus the depth range is 824-2102 m.

Arcoscalpellum intonsum (Pilsbry, 1907)
(Pl. 5, figs. A, B)

This species is covered rather densely with hairs (the hairs are omitted in the figures). It has been taken from six locations in the Gulf of Mexico. Two specimens were found near the DeSoto Canyon at 260 m and 366 m depth and four were collected off the Texas and western Louisiana coast (192 m, 204 m, 237 m and 512-640 m). The species is closely related to **Arcoscalpellum portoricanum**, but has a taller and narrower inframedian latus, a narrower rostrum, and a wider rostral latus. Pilsbry called the species **A. portoricanum intonsum.** Weisbord (1977) proposed to raise the rank of **intonsum** to species since the two are easily distinguishable.

Arcoscalpellum portoricanum (Pilsbry, 1907)
(Pl. 5, figs. E, F)

We know of only one record of the species in the Gulf of Mexico (one specimen, 26°12.5'N, 96°19.8'W, 274 m). It has also been found off Palm Beach, Florida (137 m), off Panama (307-366 m) and west northwest of Puerto Rico (329 m). The species is distinguishable from **A. intonsum** by its larger size, the nearly equilateral triangle shape of the rostrum, a narrower rostral latus and a shorter and wider inframedian latus.

Arcoscalpellum regina (Pilsbry, 1907)
(Pl. 5, figs. C, D)

This species is the most common scalpellid barnacle found in the Gulf of Mexico. It has been taken from at least 17 stations in the northern Gulf and several more in the southern Gulf. None, however, have been collected from the eastern Gulf of Mexico south of Cape San Blas, Florida. Although widely distributed in the Gulf of Mexico, the depth range of **A. regina** is quite restricted. All specimens have been taken from between 329 and 1097 m depth. Collections from other locations have come from between 91 and 548 m. Other collection locations include eight sites in a relatively small area (about 137 km by 300 km) off northwest Colombia, South America, and one locality off easternmost Brazil (7°37'S, 34°26.5'W) (Weisbord, 1977). The species can attain quite a large size. One specimen was reported to be 13 cm in overall length with a capitulum of 5.5 cm by 4.5 cm and a peduncle 3 cm in diameter.

Arcoscalpellum semisculptum (Pilsbry, 1907)
(Pl. 3, fig. I)

Collected from only one station in the northern Gulf of Mexico (south of Destin, Florida in 512 m), this species is also reported from the southern Gulf (550 m) and off Iceland (1484 m) (Weisbord, 1977). Bottom temperatures at these locations ranged from 3.5°C to 7.8°C.

Balanus amphitrite amphitrite Darwin, 1854
(Pl. 8, figs. A-F)

This species is considered cosmopolitan in tropical and warm temperate seas (Zullo, 1979). Although common in coastal waters throughout most of the Gulf of Mexico, no verified records exist in the northern Gulf between Redfish Bay, Texas, (near Port Aransas) and Panama City, Florida, (Gittings, 1985). While some individuals undoubtedly occur in this region, the dominant fouling species during the summer months is **Balanus reticulatus** Utinomi and during the winter, **B. improvisus** Darwin. **Balanus amphitrite amphitrite** is quite common in the bays of south Texas, along the west coast of Florida and in the Florida Keys.

Balanus calidus Pilsbry, 1916
(Pl. 8, figs. G-J)

Although not a common fouling barnacle in the Gulf of Mexico, **B. calidus** has been taken from approximately 23 locations in the region (19 in the northern Gulf). These collections are from various water types, including clear waters (off northern Yucatan and at the West Flower Garden Bank, 198 km south-southeast of Galveston, Texas), relatively turbid waters (off Cape San Blas and Apalachicola, Florida and off Freeport, Texas) and highly turbid waters (just west of the Mississippi Delta and off Cameron, Louisiana). Thus, the species probably occurs throughout the Gulf of Mexico.

Elsewhere, reproductive populations of **B. calidus** occur on the east coast of the United States, south of Cape Hatteras, North Carolina, to the West Indies (9-190 m) (Zullo, 1979).

Balanus eburneus Gould, 1841
(Pl. 9, figs. A-D)

This rather large **Balanus** species occurs throughout the Gulf of Mexico, being most abundant nearshore and in estuaries. Elsewhere, this euryhaline species occurs south of Massachusetts to northeastern South America and in the Pacific Ocean, and Mediterranean and Black Seas.

Balanus improvisus Darwin, 1854
(Pl. 9, figs. E-H)

Balanus improvisus has a worldwide distribution in tropical and temperate seas. It occurs throughout the Gulf of Mexico, especially in estuarine conditions, often occurring with **B. eburneus. Balanus improvisus** can withstand very low salinities for several weeks (lower than that which **B. eburneus** can withstand). It is extremely well adapted to stressful conditions and can pass through its first molt without food (Costlow and Bookhout, 1953). In the northwestern Gulf, **B. improvisus** dominates the nearshore fouling assemblage during the coldest portion of the year (January to March), while **B. reticulatus** Utinomi dominates during the summer and fall.

Balanus reticulatus Utinomi, 1967
(Pl. 10, figs. A-F)

This common fouling barnacle has a relatively continuous distribution along the U.S. coast of the Gulf of Mexico. Its abundance is clearly highest in the northwestern Gulf from off Timbalier Bay, Louisiana, to the Texas border. Although it is found in the clear offshore waters of the northwestern Gulf, abundances there are low. In the clearer, warmer water areas of the Gulf of Mexico off Mexico and Florida, **B. a. amphitrite** dominates the fouling community. Between Panama City, Florida, and Port Aransas, Texas, **B. reticulatus** may largely exclude **B. a. amphitrite.**

Balanus reticulatus is a western Pacific barnacle first found on the east coast of the United States by D.P. Henry in 1962 (unpublished), then later off Miami in 1969 (Moore et al., 1974) and in the Gulf of Mexico in the region off Timbalier Bay, Louisiana, (Thomas, 1975; George and Thomas, 1979). It is now also found in the Caribbean Sea (Southward, 1975).

The overall distribution of this species is the Indo-Pacific from Southeast Africa through the Malay Archipelago to Japan and Hawaii, the Mediterranean, tropical eastern Atlantic, southeastern United States, Gulf of Mexico and Caribbean Sea south to Trinidad. It has not been found in the eastern Pacific (Henry and McLaughlin, 1975).

Balanus spongicola Brown, 1844
(Not included in key)

One doubtful record of this species exists from the Gulf of Mexico off Panama City, Florida, (Pequegnat and Pequegnat, 1968). The specimens, however, were unavailable for verification. There is a chance that the species may have actually been **B. calidus**, with which **B. spongicola** is easily confused. Even Darwin (1854) "hesitated between describing [**B. calidus**] as a new species and placing it under **B. spongicola** as a variety" (Pilsbry, 1916).

Balanus subalbidus Henry, 1973
(Pl. 11, figs. A-E)

This species is found in low salinity estuarine conditions in upper bays and even up rivers throughout the Gulf of Mexico region (Henry, 1973). It thrives below 6 ppt and can survive salinity fluctuations between near 0 to 16 ppt (Porrier and Partridge, 1979). It is gradually replaced above 6 ppt by **B. improvisus** and **B. eburneus.** Overall distribution is the western Atlantic from Massachusetts to Trinidad.

Balanus trigonus Darwin, 1854
(pl. 11, figs. F-J)

A cosmopolitan species, **B. trigonus** is found primarily in tropical and subtropical seas (Werner, 1967; Newman and Ross, 1976). In the Gulf of Mexico, it may be extending its range (Wells, 1966; Gittings, 1985). It was first found in the United States (Atlantic coast) in 1961 and was probably absent before that time (Moore and McPherson, 1963). In the Gulf of Mexico, it is now widespread in both turbid and clear waters, although it is seldom the principal fouler of manmade structures in turbid waters. In clear waters off

the southwestern coast of Florida, it may also be the dominant biofouling species (Randall Howard, LGL Ecological Research Associates, Bryan, Texas, personal communication). In the Atlantic, reproductive populations exist only south of Cape Hatteras, North Carolina, although live specimens have been taken from turtles as far north as Cape Cod, Massachusetts, (Zullo, 1979.

Balanus venustus Darwin, 1854
(Pl. 12, figs. A-F)

A very common barnacle in the eastern Gulf of Mexico, it is often found on mollusc shells, crustaceans, gorgonians, etc., and rarely on artificial substrates. Recent collections have shown that this barnacle is probably present throughout the Gulf of Mexico (Gittings, 1985). The species has a worldwide distribution in warm seas, except for the eastern Pacific, where it has not been found (Henry and McLaughlin, 1975; Zullo, 1979). Latitudinal range in the western Atlantic is from Cape Cod, Massachusetts, to Brazil from the lower intertidal to about 62 m (Newman and Ross, 1976).

Ceratoconcha floridana (Pilsbry, 1931)
(Pl. 15, figs. A-E)

This barnacle has been collected from only three locations in the Gulf of Mexico. The first verified record of this coral-inhabiting barnacle in the Gulf was that of Pilsbry (1931) from about 50 miles north of Tarpon Springs, Florida, in the coral **Meandrina**. It was later reported by Wells (1966) in another coral, **Siderastrea radians**, off St. Teresa, Florida, and later at the West Flower Garden Bank off Texas in **Montastrea annularis** by Pequegnat and Ray (1974). Prior records in the Gulf had been questionable due to inadequate sample collection data. **Ceratoconcha floridana** is a tropical western Atlantic species (Spivey, 1981).

Chelonibia caretta (Spengler, 1790)
(Pl. 13, fig. E)

This is a tropical and subtropical species found partially embedded in the carapaces of loggerhead and green turtles (**Caretta caretta** (Linnaeus) and **Chelonia mydas** (Linnaeus), respectively). We are familiar with only three collections from the Gulf of Mexico (off St. Teresa, Florida, off the southwest pass of the Mississippi River delta and North Padre Island, Texas).

Chelonibia manati lobatibasis Pilsbry, 1916
(Pl. 13, figs. F, G)

Few records of this species exist, with all but one (which is questionable) from Florida. One record is from the Everglades on a female manatee, and the two others are from loggerhead turtles (**Caretta caretta**) at Osprey and at Bald Point, Florida. The questionable record is from Mustang Island, Texas. The host, unfortunately, was not recorded. This species is apparently endemic to the Gulf of Mexico.

Chelonibia patula (Ranzani, 1818)
(Pl. 14, figs. A, B)

This species usually occurs on crabs (especially **Callinectes sapidus** Rathbun, the blue crab) or **Limulus polyphemus** (Linnaeus), the horseshoe crab. Occasionally, it is found on gastropod shells (e.g. **Busycon**) and possibly on turtles. The species is common and is distributed throughout the Gulf of Mexico. It has a worldwide distribution in warm seas (Zullo, 1979).

Chelonibia testudinaria (Linnaeus, 1757)
(Pl. 14, figs. C,D,)

This species is found on the carapaces of sea turtles. It occurs primarily in tropical and warm temperate seas, though Pilsbry (1916) reported **C. testudinaria** on a loggerhead turtle (**Caretta caretta**) at Newport, Rhode Island. We have also seen records from **Chelonia mydas**, the green turtle and from **Lepidochelys kempi** (Garman), the Atlantic Ridley turtle.

Chthamalus fragilis Darwin, 1854
(Pl. 13, figs. A-C)

The distribution of this barnacle is the high intertidal zone throughout the Gulf of Mexico on jetties, pilings, rocks, buoys, etc. Its range extends south to at least the latitude of Tuxpan, Mexico, and it may be the species reported from the upper intertidal north of Veracruz, Mexico, (approximately 20°N latitude; Wiley et al., 1982). It is a warm temperate to subtropical species (Southward, 1975).

Dando and Southward (1980) distinguished **C. fragilis** from a second, previously undescribed species, which they named **C. proteus**, on the basis of enzyme electrophoresis and subsequent morphological considerations. Subsequent research has not yet supported the species designation of **C. proteus**. Since **C. fragilis** and **C. proteus** are morphologically very similar, **C. proteus** is not included in the present work.

Conchoderma auritum (Linnaeus, 1767)
(Pl. 3, fig. A)

This species has been found in only two locations in the Gulf of Mexico, one about 16 km south of Pensacola, Florida, on a plastic band around the head of a dusky shark (**Carcharinus obscurus** (Lesueur)) and the other (probably) near Port Arthur, Texas, where a "True's beaked whale" (**Mesoplodon mirus** True) beached. Two specimens were taken from a tooth of the whale. Zullo (1979) considered **C. auritum** to be a cosmopolitan species, often found attached to whale barnacles and occasionally to ships. This species has also been found attached to the baleen, palate and penis of whales (Henry R. Spivey, Florida State University, Tallahassee, Florida, personal communication). The nearest record to the Gulf of Mexico is from Cape Hatteras, North Carolina, on an iron buoy (Weisbord, 1979).

Conchoderma virgatum (Spengler, 1790)
(Pl. 2, fig. A)

This species has been found on at least eight occasions in the eastern Gulf of Mexico, and on two locations in the western Gulf (near the East Flower Garden Bank off Texas, and at Padre Island, Texas). It is cosmopolitan and has been found attached to ships, buoys, fish, parasitic copepods, crabs, turtles, sea snakes, whales and seaweed (Hastings, 1971).

Conopea galeata (Linnaeus, 1771)
(Pl. 6, figs. L-O)

Found only on gorgonians, this barnacle is often covered by tissue of the host. One usually sees only

a small opening, through which the animal can extend its cirri, on a lump on the gorgonian branch. Removal of the gorgonian tissue reveals the characteristic boat-shaped basis of the barnacle and its smooth, faintly striped, pinkish shell. Its distribution is from North Carolina through the West Indies to Curacao and Central America in the Atlantic, and southern California to Peru in the Pacific (Newman and Ross, 1976).

Conopea merrilli (Zullo, 1966)
(Pl. 7, figs. A-E)

Zullo (1966) described this species from specimens on gorgonians off South Carolina, off Apalachicola, Florida, and from La Parguera, Puerto Rico. The species also has been taken from gorgonians on the western side of Blanquilla Reef, Veracruz, Mexico (Zullo, 1966). Pequegnat and Pequegnat (1968) found the species at 4 to 44 m on fouling sample floats placed 2, 11 and 25 miles from Panama City, Florida. They were rare between 4 and 17 m and at the station nearest the shore. These are apparently the only published records of the species, but it may be more widespread in the Gulf of Mexico than these records indicate.

Heteralepas sp. aff. **cornuta** Darwin, 1851
(Pl. 3, fig. H)

For reasons beyond the scope of the present discussion, specimens of this species collected from the Gulf of Mexico have not been identified definitively as **Heteralepas cornuta** Darwin (see Gittings [1985] for a detailed discussion).

This species has been collected from only one location in the Gulf of Mexico (92 m depth at 29°15'N, 88°11.5'W). Worldwide, **Heteralepas cornuta** has been collected from depths of 90 to 4315 m. It has been taken from St. Vicent's, West Indies, off Fort Lauderdale, Florida, (90 m; Victor A. Zullo, University of North Carolina at Wilmington, personal communication), off Cape Lookout, North Carolina, (91 m), off Chile (4235 to 4315 m), from several localities in the eastern Atlantic (125 to 750 m) and from one location in the Indian Ocean. Ross (1975) suggested that the Indian Ocean record may actually be identified as **H. japonica** Aurivillius, a closely related species. **Heteralepas cornuta** has been found attached to crustaceans, bivalves and hydroid stems.

Lepas anatifera Linnaeus, 1758
(Pl. 2, figs. B-D)

This species can be found in all areas of the Gulf of Mexico, especially in the open ocean on seaweeds and other floating objects. It is also common on objects and seaweeds drifting onto beaches, especially during the summer. This is a cosmopolitan species with a latitudinal range from at least 76°N to 57°S.

Lepas anserifera Linnaeus, 1767
(Pl. 2, figs. E, F)

This is another cosmopolitan species that is found on floating objects such as seaweeds (**Sargassum**), driftwood, ships, buoys, etc. It is, however, apparently absent from the west coast of the Americas (Weisbord, 1979). Its latitudinal range is from 60°N to 35°S.

Lepas pectinata Spengler, 1793
(Pl. 2, figs. G, H)

Cosmopolitan in warm seas, individuals of this species are usually smaller than the other species of **Lepas** found in the Gulf of Mexico. This pelagic species is found, often in abundance, on **Sargassum**. These barnacles have also been found on floating feathers, ships and tarballs. They are rarely seen inshore, but may be found on **Sargassum** washing up on beaches, especially during the summer.

Lithotrya dorsalis (Ellis and Solander, 1786)
(Pl. 3, fig. G)

This is a tropical, shallow water species found embedded in coral or other calcareous rocks. In the Gulf of Mexico, it has been found only at the West Flower Garden Bank (in the northwestern Gulf, 27°52.3'N, 93°48.5'W), but can also probably be found in tropical hard bottom communities in the eastern and southern Gulf. It has been found in the Florida Keys, Biscayne Bay, Florida, Bahamas, Cuba, Jamaica, Puerto Rico, Barbados, Venezuela, Cayman Brac, Bonaire and Curacao (Weisbord, 1977). In the Indo-Pacific, **L. dorsalis** has been found in the Solomon Islands, Philippines, the Chagos Archipelago and Farquhar Atoll (Weisbord, 1977). Its occurrence in the northwestern Gulf reflects the strong tropical affinity of the Flower Garden banks and the tropical nature of the eastward-flowing currents over the Texas-Louisiana outer continental shelf.

Megabalanus antillensis (Pilsbry, 1916)
(Pl. 12, figs. G-I)

Regional reports through the 1970's referred to this species as **Balanus tintinnabulum** or **Balanus tintinnabulum antillensis**. Although a common fouling species in the northern Gulf of Mexico, it is not found, or is rare, on shoreline structures in the turbid nearshore waters north of Port Aransas, Texas, and west of Pensacola, Florida. The species is, however, found on offshore structures in these waters. South of Port Aransas, Texas, and between Pensacola and Panama City, Florida, **M. antillensis** can be found on jetties as well as offshore structures. Its range extends throughout the Caribbean and the species is typically restricted to fully marine conditions (around 35 ppt). Experiments with closely related species have shown that respiratory activity slows at a salinity of 20 parts per thousand (ppt) and stops at 15 ppt (Prasad Rao et al., 1982). These salinities can occur in nearshore waters in the northwestern Gulf of Mexico during periods of heavy freshwater runoff in the spring.

Megalasma gracile gracilius Pilsbry, 1907
(Pl. 4, figs. A-D)

First reported in the Gulf of Mexico in 1979, this barnacle has now been found in four locations in the Gulf (two locations off Pensacola, Florida, 420-636 m; off Key West, 192 m; and south of 26°N, 500 m). Its distribution is the Atlantic off the southeastern U.S., West Indies, Gulf of Mexico and off Nicaragua (94 to 192 m). It has been found on other deep-sea barnacles and on the spines of sea urchins.

Membranobalanus declivis (Darwin, 1854)
(Pl. 7, figs. F-J)

This balanomorph was previously found at several locations in the eastern Gulf of Mexico, and also in Bermuda, on the east coast of the United States north to Cape Lookout, North Carolina, and in the West Indies. Only one sponge, a shallow-water species, **Spheciospongia vesparium** (Lamarck), the loggerhead sponge, is known to host this barnacle.

Octolasmis aymonini geryonphila (Pilsbry, 1907)
(Pl. 4, figs. I, J)

Although not accepted by all systematists, this species includes those heretofore reported as **Octolasmis geryonphila** Pilsbry and **O. dawsoni** Causey in the Gulf of Mexico. Although reported from only a few locations in the Gulf (one location north of 26°N), the species is probably widespread. **Octolasmis aymonini geryonphila** is generally found on large deep-sea crabs such as **Geryon** and **Bathynectes** and the deep-sea isopod, **Bathynomus giganteus** A. Milne-Edwards. Its depth range is from 283 to 1861 m. Its biogeographic affinity is tropical to temperate, having been found in the western Atlantic off New England and Florida, and in the eastern Gulf of Mexico, off northeastern South America and in the Indian Ocean.

Octolasmis forresti (Stebbing, 1894)
(Pl. 4, fig. H)

This is a shallow-water lepadomorph that lives in the gill cavity of the Spanish lobster, **Scyllarus arctus** Rathbun (=**S. depressus** (Smith)), and the spiny lobster, **Palinurus argus** (Latreille). It has been found in the Gulf of Mexico from 1 to 27 m depth and is known from only the tropical and subtropical West Atlantic north to 30°N.

Octolasmis hoeki (Stebbing, 1894)
(Pl. 4, fig. K)

This species is found near, but not in, the branchial cavity, and on the legs and mouthparts of crabs (e.g. **Calappa sulcata** Rathbun and **C. flammea** (Herbst)) and lobsters (Spanish lobsters, **Scyllarides**). **Octolasmis lowei** (Darwin) often occurs on the same host, but is inside the gill chamber and on the gills. There is a clear spatial segregation between these two species. No niche expansion has been noted in the absence of one species. That is, these spatial preferences hold even if one of the two species is absent from a given host (Gittings, 1985).

Octolasmis hoeki is now known from throughout the shallow portions of the Gulf of Mexico, western Atlantic north to South Carolina, the Caribbean Sea, Cape Verde Islands and the eastern Atlantic off Africa (9-38 m).

Octolasmis lowei (Darwin, 1851)
(Pl. 4, fig. G)

This small lepadomorph is found inside the gill chamber and on the gills of several shallow-water crabs (e.g. **Calappa sulcata, Callinectes sapidus** (the blue crab), **Menippe mercenaria** (Say) (the stone crab), and several others). One may also find **O. hoeki**, a more highly calcified species, outside the gill chamber on the same crab. **Octolasmis mulleri** of Pilsbry (1907) is synonymous with this species, (not all systematists agree, however, that the two are the same species).

Octolasmis lowei and O. hoeki are apparently shallow-water species. In the Gulf of Mexico, samples of the two have not been taken below 38 m (30 m for **O. lowei**). On deep-water crabs, the common barnacle is **O. aymonini geryonphila** (Pilsbry). **Octolasmis lowei** occurs in tropical and temperate seas from 41°N to 43°S (usually shallow but possibly to 457 m, the depth range of the known hosts), but it has not been found in the eastern Pacific.

Platylepas hexastylos (Fabricius, 1798)
(Pl. 14, figs. E-G)

Platylepas hexastylos is found worldwide in tropical and warm temperate seas (north to Cape Cod, Massachusetts, in the Atlantic) on turtles, manatees, dugongs and the gar, **Lepisosteus** (Newman and Ross, 1976; Zullo, 1979). In the Gulf of Mexico, the species has been collected off Osprey, Florida, (50 miles south of Tampa), Bald Point, Florida, (in Apalachee Bay) and off Texas.

A subspecies, **P. h. icthyophila** Pilsbry, was described from a specimen found on a gar (**Lepisosteus**) about 40 miles north of Tampa, Florida. According to Pilsbry (1916), the internal midribs or props are much thinner than those of **P. hexastylos** and are less sculptured. In addition, the internal septa of the edge are much less numerous and project (tooth-like) at the edge. Its range is unknown, since no other specimens have been collected. The subspecies is not included in this key due to the lack of additional information.

Poecilasma inaequilaterale Pilsbry, 1907
(Pl. 4, figs. E, F)

This barnacle is very common on the northern Gulf of Mexico continental slope on crabs (e.g. **Rochinia crassa** (A. Milne-Edwards), **Nibilia antilocapra** (Stimpson), **Benthochascon schmitti** Rathbun, and **Geryon quinquedens** Smith). It is often very abundant on the appendages, mouthparts and carapace of the host, especially on the larger host speciments which, presumably, have undergone their terminal molt.

Poecilasma inaequilaterale is a tropical and temperate western Atlantic species which, although it has been taken from as shallow as 22 m, usually occurs at outer shelf and slope depths between 127 m and 1200 m.

Scalpellum albatrossianum Pilsbry, 1907
(Pl. 5, fig. I)

Pequegnat (1983) published the first and only northern Gulf of Mexico record of this species (27°29.5'N, 95°31'W, 878 m). It was also found at one station in the southern Gulf (Pequegnat, 1983). This apparently widespread scalpellid has also been taken off Virginia (3742 m), in the Bay of Bengal, off Iceland (1484 m) and northwest of Greenland (638 m) (Weisbord, 1977).

Scalpellum gibbum Pilsbry, 1907
(Pl. 5, figs. G, H)

This scalpellid is known from only one location in the Gulf of Mexico (south of Mobile Bay, 64

m), and also from off Palm Beach, Florida, and Cape Hatteras, North Carolina. Its depth range is 55 to 91 m.

Scalpellum gracilius Pilsbry, 1907
(Pl. 5, figs. J-L)

Scalpellum gracilius has been found at only one location in the Gulf of Mexico (28°46.5'N, 87°02'W, in the DeSoto Canyon, 788 m). Elsewhere this species is known from waters off South Carolina (1337 m) and southwest of Nevis, Lesser Antilles (1256 m).

Scalpellum svetlanae Zevina, 1975
(Pl. 3, figs. D-F)

One individual of this species has been taken from a station in the Gulf of Mexico (26°25'N, 94°47.5W, 1774 m; Pequegnat, 1983). The species was described from a specimen taken from the Caribbean Sea (Zevina, 1975).

Stomatolepas dermochelys (Costa, 1838)
(Pl. 13, fig. D)

Stomatolepas dermochelys (reported as **S. elegans** prior to renaming by Monroe and Limpus, 1979) is found worldwide in warm seas in the soft skin, mouth and throat of sea turtles (Newman and Ross, 1976). In the Gulf of Mexico, two collections have been made in the Dry Tortugas (west-northwest of Key West) and one has been made near Bald Point, Florida (in Apalachee Bay). All have been from the loggerhead turtle, **Caretta caretta**. Some have been taken from the soft dermis of the hind legs, some from the mouth cavity and tongue, and the rest from the upper gullet of the host.

Tetraclita stalactifera stalactifera (Lamarck, 1818)
(Pl. 15, figs. F-K)

This is one of the most common of the intertidal barnacle species of rocky shores along the exposed coasts of the Caribbean (Southward, 1975) and the Florida Keys (Stephenson and Stephenson, 1950). In the Gulf of Mexico, the species is found only on exposed coasts in relatively clear waters and on oil drilling platforms in oceanic waters. It is very common on the Gulf coast of Mexico north to at least Tampico. It has not been found on the Texas coast, but several individuals were found on an oil platform approximately 177 km southeast of Galveston (near the East Flower Garden Bank) in 1984 (Gittings, 1985). Aside from this record, **T. s. stalactifera** has not been found in the northern Gulf of Mexico.

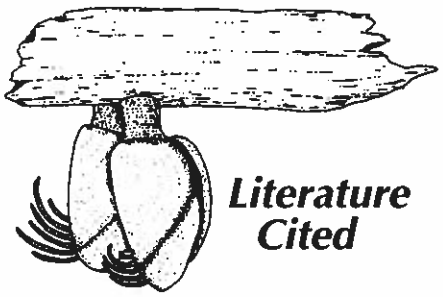
The species is also found in Bermuda, the West Indies to southern Brazil, the Gulf of California south to Acapulco, Mexico, the Arabian Sea and off South Africa (Newman and Ross, 1976).

Verruca floridana Pilsbry, 1916
(Pl. 16, figs. A-C)

This is the only **Verruca** known to be found in the Gulf of Mexico proper (i.e. not including the Straits of Florida, where this and three other **Verruca** exist, **V. alba** Pilsbry, **V. nexa** Darwin and **V. rathbuniana** Pilsbry). We have found no published records of the species in the Gulf of Mexico, but have seen one specimen in the Gulf Coast Research Laboratory Museum in Ocean Springs that was collected south of Galveston off the Texas coast in 238 m. The depth range of this species is 73 to 274 m. Other collection locations are off Palm Beach, Florida (137 to 274 m), Sombrero Key Light, Florida (73 to 137 m), and south of Key West, Florida (73 to 137 m). Most have been found on mollusc shells and urchin spines.

Xenobalanus globicipitis Steenstrup, 1851
(Pl. 3, figs. B, C)

This is a widely distributed species found exclusively on the fins and flukes of cetaceans and ranging from 71°N to 62°S (Spivey, 1980). It has been reported in the Gulf of Mexico on three occasions, from a dead bottlenosed dolphin (**Tursiops truncatus** (Montague)) washed ashore at Alligator Point, Florida; in Santa Rosa Sound (Pensacola, Florida); and from the Galveston Bay, Texas, area.



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