DELAWARE BAY REPORT SERIES

Volume 5

Guide to the Macroscopic Estuarine and Marine Invertebrates of the Delaware Bay Region

LES WATLING and DON MAURER

photograph by byron shurtleff

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GUIDE TO THE MACROSCOPIC ESTUARINE AND MARINE INVERTEBRATES OF THE DELAWARE BAY REGION

by

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Illustrations

Introduction to the Use of This Guide

This guide is intended to facilitate the study of macroscopic estuarine and marine invertebrates of the Delaware Bay region, especially those living on or near the benthos. As we all know, lightning-like changes in our environment caused by human activities have made ecology a household word. Many of these changes are occurring in coastal waters. To understand these phenomena it is imperative that we return to the environment and study the organisms under field conditions. Consequently, a knowledge of the flora and fauna is necessary before one can begin to deal with the components of the community.

Confronted with the wide diversity of species in the marine environment it is extremely difficult for the beginner and non-specialist to identify the organisms in the community he or she wants to study. This is one of the most basic steps in describing the ecology of an area. Unfortunately taxonomic training of biologists has not kept pace with the renewed interest in ecology, a discipline which requires taxonomy as a vital tool. Taxonomic training is available only at museums and a small number of academic institutions. At the present time there are too few taxonomists to handle all the materials collected by ecologists.

Once a species has been defined by the specialist, it must then be presented to the non-specialist and the field ecologist. We believe this to be an important secondary responsibility of the

taxonomist or taxonomically-oriented biologist. Thus taxonomic characters must be found which, though they are admittedly phylogenetically artificial, will allow the non-specialist to distinguish a particular species from all other species in his biogeographic region. Identification guides such as this one are the product of this philosophy.

So far as possible the information in this guide has been arranged into a standard format. Within each part (with the exception of Part IX) there is first a classificatory outline to the phylum or phyla of that part. The species listed (and thus also the suprageneric categories) are only those species that have been collected, or reported in the literature, from the Delaware Bay region. Next, for those categories where more than one species is represented, there is a key to those species. Otherwise, the characters given for the higher categories should be used to distinguish the species. In order to facilitate the use of the keys, illustrations of key characters are provided. These illustrations are intended not to represent actual species but rather to show the shape of a morphologic feature and its relationship with surrounding features. In addition, species which may be expected to occur are also included. At the end of each part there is a bibliography of papers or books dealing with the taxonomy or biology of many of the local species.

Many invertebrate groups have been excluded from this guide for one or both of the following reasons. First, we have concerned

ourselves primarily with those species living on or near the substrate. The many species that are exclusively planktonic could easily fill another guide. Secondly, we have not dealt with the many species of protozoans, flatworms, nematodes, rotifers, copepods, etc. that are microscopic in size or endoparasitic. This is primarily because these species have not been determined for this region by specialists.

Part IX provides a summary of the collecting sites from which most of the species in this guide were obtained. At the present time we have not prepared a list of occurrences for each species.

This guide is the result of many research projects, past and present. In the mid-nineteen-fifties Mr. William Amos, a research biologist of this laboratory started a faunal survey of the marine invertebrates of the Delaware Bay region. This work was continued ten years later by Dr. Harry Wells, a University of Delaware faculty member. He compiled a list of marine invertebrates which one might expect to find in Delaware waters. Throughout the late nineteen-sixties to the present this work has progressed with our own studies on the oyster fauna community, the intertidal sand flat community at Cape Henlopen, and the soft level-bottom communities of Indian River and Rehoboth Bays. At the same time, researchers at Rutgers University, New Jersey have been engaged in similar efforts in the lower bay and Cape May, New Jersey areas. Thus this guide is based on considerable

research, of which little has yet been published.

At this time it is appropriate to acknowledge the people and organizations who have helped make this guide possible. Our efforts have been greatly aided by colleagues within the College of Marine Studies, especially Dr. Dennis Polis and Dr. Kent Price. From other institutions Dr. E. L. Bousfield of the National Museum of Natural History, Ottawa, Canada, kindly verified species of gammarid amphipods. The caprellid amphipods were verified by Dr. J. C. McCain while he was at the Smithsonian Institution. Dr. Dale Calder of the Virginia Institute of Marine Science (VIMS) has helped greatly with our hydroid identifications. Both Dr. Bousfield and Dr. Calder generously granted us permission to examine and cite their unpublished manuscripts. Dr. David Franz of the University of Connecticut supplied us with reprints of his extensive research on local nudibranchs and kindly offered a tentative list of species to be expected here.

We would especially like to thank Dr. Marvin Wass and his students at VIMS who have given generously of their time to verify our polychaete and mollusc identifications. Over the years Dr. Wass has made a major effort to document the invertebrate fauna of the Chesapeake Bay area. Toward this end he has produced extensive species lists with annotated remarks on their ecology. In addition he and his students have generated many taxonomic keys for the Chesapeake system. These keys were particularly useful, and in some instances were extensively adapted for preparation

of our local keys. Dr. Wass has encouraged our effort for the past several years and we are grateful to him.

Our research has been supported in part by the National Marine Fisheries Service, the National Science Foundation Sea Grant Program, the Delaware River Basin Commission, the Delaware River and Bay Authority, Delmarva Power and Light Company, University of Delaware Research Foundation, and the Delaware Department of Natural Resources and Environmental Control. A special grant from the National Geographic Society has made publication of this guide possible.

Mrs. Gloria Cresswell has patiently typed several versions of the guide and Mr. Frank Danberg has completed and refined the figures. Mrs. Bernice Williams typed the final manuscript.

Key to the Major Groups in the Guide

1. Body without discrete internal organs or tissues; two cell layers may be present but there is no organization into visible (including use of microscrope) internal organs. Body irregular in shape; with skeletal elements termed spicules (are visible microscopically); without tentacles; water enters the body through many pores of various sizes . . . . . Phylum Porifera

   Body with internal organs 2

2. Body flattened dorsoventrally or long slender and worm-like, but not segmented; may possess two tentacles on dorsal side, but no circlet of tentacles anteriorly; without a hard skeleton; free-living, never attached to the substrate. 3

   Body otherwise. 5

3. Body flattened dorsoventrally, never more than 10 times as long as wide; glide along surface of substrate; some ectoparasitic . . . . . .Phylum Platyhelminthes

   Body worm-like or ribbon-like (more than 10 times as long as wide). 4

4. Body worm-like; divisible into 3 distinct regions . . . . . Phylum Hemichordata

   Body worm-like or ribbon-like, not divisible into more than 2 distinct regions; several species fragment when touched . . . . . Phylum Rhynchocoela

5. Body segmented, with bilateral symmetry, not colonial 6

   Body not segmented, may be colonial 7

6. Body with jointed appendages and chitinous exoskeleton. . . . . Phylum Arthropoda

   Body without jointed appendages, or chitinous exoskeleton . . . . . Phylum Annelida

7. Body globose; without calcareous exoskeleton though outside may be tough and horny; two openings, one for entrance, one for exit of water . . . . . .Phylum Chordata, Subphylum Urochordata

   Body otherwise. 8

8. Body with external features occurring in series of five (with pentameral symmetry). . . . Phylum Echinodermata

Body without pentameral symmetry. 9

9. Occurring as a colony, i.e., with many specialized individuals joined together. 10

Occurring as an obviously solitary individual 13

10. Without an exoskeleton; individuals minute, joined together by stolons (check these features microscopically); tentacles not retractile into body; forms a velvety mat . . . . . Phylum Entoprocta

With either a calcareous or chitinous exoskeleton 11

11. Colony may consist of a series of rectangular compartments that are either encrusting or erect, or may possess a variety of other forms; in the latter cases two distinct tentacle retractor muscles are visible microscopically through the body wall . . . . . Phylum Ectoprocta

Colony never a series of rectangular compartments; paired tentacle retractor muscles not present. 12

12. Individuals embedded in a calcareous exoskeleton which may be encrusting and massive or erect with whip-like branches; individuals with radially arranged internal septa; includes coral and sea-whip members of . . . . . Phylum Cnidaria, Class Anthozoa

Colony with chitinous exoskeleton, form varying from erect and many-branching to minute individuals arising from a stolonal network; radial septa never present . . . . . Phylum Cnidaria, Class Hydrozoa (part)

13. With calareous exoskeleton. 14

Without calcareous exoskeleton. 16

14. Calcareous exoskeleton consists of two parts with body between . . . . . Phylum Mollusca, Class Pelecypoda

Calcareous exoskeleton consists of eight parts along dorsal side of body . . Phylum Mollusca, Class Amphineura

Calcareous exoskeleton a single unit. 15

15. Exoskeleton tooth-shaped. . Phylum Mollusca, Class Scaphopoda

    Exoskeleton not tooth-shaped, usually spiral or cap shaped. . . . Phylum Mollusca, Class Gastropoda (part)

16. Free-swimming, unattached 17

    Living attached to, on, or in the substrate 19

17. Body bell-shaped or disc-shaped, swims by pulsations. 18

    Body elongate, bears arms with suckers, rapid swimmers, squid . . . . Phylum Mollusca, Class Cephalopoda

18. Delicate, with shelf along inner margin of bell or disc . . . . . Phylum Cnidaria, Class Hydrozoa (part)

    Robust, no shelf along inner margin of bell or disc, true jellyfish. . Phylum Cnidaria, Class Scyphozoa (part)

19. Body worm-like, anterior portion bears circlet of tentacles and is retractable. . Phylum Sipunculida

    Not as above. 20

20. With obvious plate-like foot, animal free-living, able to crawl about, nudibranchs . . . . . Phylum Mollusca, Class Gastropoda (part)

    Without foot, attached by disc. . . . . Phylum Cnidaria, Class Scyphozoa (part)

Part I. PORIFERA

Phylum Porifera: Asymmetrical or radially symmetrical; without mouth or nervous tissue; with a body permeated with pores, canals, for water currents; with internal cavities lined by choanocytes.

Class Demospongiae: skeleton of siliceous spicules with spongin; spicules never triaxons.

Subclass Monaxonida: megascleres monaxonial.

Order Haplosclerina: spicules primarily oxeas; some styles or strongyles.

Family Haliclonidae
Haliclona loosanoffi (Hartman, 1958)

Order Poecilosclerina: megasceleres of two or more kinds; spongin present; microspicules often present.

Family Mycalidae
Mycale fibrexilis (Wilson, 1891)

Family Microcionidae
Microciona prolifera (Ellis and Solander, 1786)

Order Halichondrina: spicules usually oxeas, styles, or strongyles; usually lacking microscleres, if present are raphids; with little spongin.

Family Halichondridae
Halichondria bowerbanki Burton, 1930

Order Hadromerina: spicules usually tylostyles; microscleres present some kind of aster.

Family Suberitidae
Prosuberites epiphytum (Lamarck, 1816)

Family Clionidae
Cliona celata Grant, 1826

Subclass Tetractinellida: with tetraxon spicules; without spongin.

Order Choristida: megascleres are four-rayed triaenes; microscleres are various types of asters.

Family Craniellidae

Craniella laminaris (George and Wilson, 1919)

Key to the Porifera of the Delaware Bay Region
(Modified from Hartman, 1964b)
For terminology, see Plate 1.

1. Sponges obviously boring into or overgrowing shells or other calareous material; color yellow; spicules tylostyles. . . . . Cliona celata

   Sponges not boring into shells; form and color various. . . . 2

2. Megascleres oxeas only. 3

   Megascleres other than oxeas. 4

3. Megascleres smaller (< 200μ in length); and conspicuously joined together by spongin to form a network, intertidal or subtidal; form various, often with large terminal oscules. . . . . .Haliclona loosanoffi

   Megascleres larger (> 200μ in length); arranged in loose tracts with little spongin; color orange-brown to yellow-beige; form various. . . Halichondria bowerbanki

4. Color bright red in life; form encrusting to complexly branched; spicules include styles to subtylostyles; toxas and isochelas . . . . . .Microciona prolifera

   Color never bright red; spicules otherwise. 5

5. Megasceleres tylostyles 6

   Megascleres long oxeas and triaenes; sponge biscuit shaped with terminal osculum and flattened base . . . . . Craniella laminaris

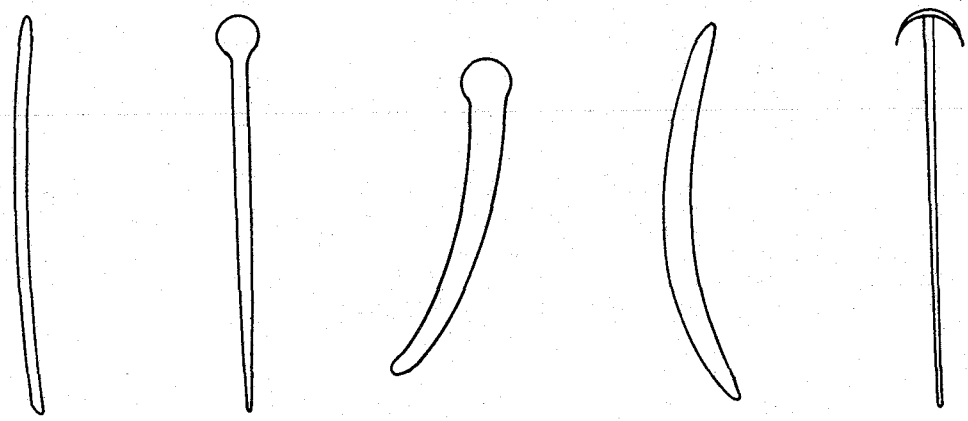
6. Microscleres absent; form a thin encrustation . . . . . .Prosuberites epiphytum

   Microscleres present; form encrusting to massive; sigmas, toxas and anisochelas . . . . . Mycale fibrexilis

Additional species which may be found in Delaware waters:

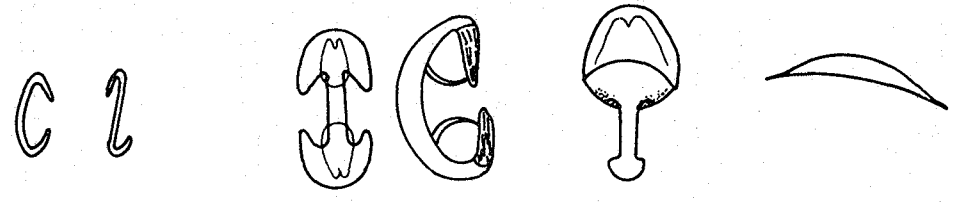
Cliona vastifica Hancock, 1849
C. lobata Hancock, 1849
C. truitti Old, 1941
Suberites ficus (Johnston, 1842)
Lissodendoryx isodictyalis (Carter, 1882)
Haliclona oculata (Pallas, 1766)
H. canaliculata Hartman, 1958

MEGASCLERES



A B C D E

MICROSCLERES



F G H I

A. STYLE
B. TYLOSTYLE
C. SUBTYLOSTYLE
D. OXEA
E. TRIAENE
F. SIGMA
G. ISOCHELA
H. ANISOCHELA
I. TOXA

Porifera

PLATE I

Bibliography for the Porifera

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Part II. PHYLUM CNIDARIA

Phylum Cnidaria: Metazoa with tentacles; primary radial, biradial, or radio-bilateral symmetry; essentially have two body layers with a matrix between them; possess nematocysts; have only one body cavity opening only at the mouth.

Class Hydrozoa: with tetramerous or polymerous radial symmetry; with both polypoid and medusoid forms; gastrovascular system not divided by projecting partitions; medusae characteristically with a velum.

Order Hydroida: polypoid generation well developed; bud off free medusae, or medusae remain attached and are vestigial (sporosacs); medusae have as sense organs ocelli and ectodermal statocysts.

Suborder Gymnoblastea or Anthomedusae or Athecata: hydranths without hydrothecae; gonophores naked (lack a gonotheca); free medusae are tall and bell-like, possessing ocelli but lacking statocysts, gonads borne on the manubrium.

Family Tubulariidae
Ectopleura dumortieri (Van Beneden, 1844)
Tubularia crocea (L. Agassiz, 1862)

Family Corynidae
Sarsia tubulosa (M. Sars, 1835)

Family Clavidae
Cordylophora caspia (Pallas, 1771)

Family Hydractiniidae
Hydractinia echinata (Fleming, 1828)
Podocoryne carnea Sars, 1846

Family Bougainvilliidae
Garveia franciscana (Torrey, 1902)

Suborder Calyptoblastea or Leptomedusae or Thecata: hydranths with a hydrotheca; gonophores with hydrothecae; free medusae flat, dish-like, usually with statocysts, gonads borne on the radial canals.

Family Haleciidae
Halecium gracile Verrill, 1874

Family Campanulariidae
Clytia edwardsi (Nutting, 1901)
Obelia bicuspidata Clark, 1876
O. commissuralis McCrady, 1857
O. longicyatha Allman, 1877
O. longissima (Pallas, 1766)
Gonothyraea loveni (Allman, 1859)
Hartlaubella gelatinosa (Pallas, 1766)
Eulaomedea angulata (Hincks, 1861)

Family Lovenellidae
Lovenella gracilis Clarke, 1882

Family Sertulariidae
Sertularia argentea Linné, 1758

Family Plumulariidae
Schizotricha tenella (Verrill, 1874)

Incertae Sedis
Campanulina spp.

Class Scyphozoa: medusae without velum; usually free-swimming but may be attached by an aboral stalk; gastrovascular system may be divided into four interradial pouches by four radial septa; cellular mesoglea; gonads are entodermal; marginal sense organs usually tentaculocysts; polypoid stage absent or in the form of polyp-like scyphistoma which develops directly into adult or gives rise to medusae by transverse fission.

Order Stauromedusae: attached by aboral stalk; develops directly from scyphistoma; has septa.

Family Cleistocarpidae
Craterolophus convolvulus (Johnston, 1835)

Order Semaeostomae: manubrium extended into four oral arms; no furrow; without septa; margin scalloped; 8 to 16 rhopalia.

Family Pelagidae
Chrysaora quinquecirrha (Desor, 1848)

Family Cyanidae
Cyanea capillata (Linné, 1758)

Family Ulmaridae
Aurelia aurita (Linné, 1758)

Order Rhizostomeae: oral arms fused producing many mouths and canals; without septa; margin scalloped; 8 or more rhopalia.

Family Rhizostomatidae
Rhopilema verrilli (Fewkes, 1887)

Class Anthozoa: polypoid form only; oral end developed into an oral disc; gastrovascular cavity divided into many compartments by septa; septa bear nematocysts on the edge; mesoglea mesenchymal or fibrous; gonads entodermal in the septa.

Subclass Alcyonaria or Octocorallia: with eight complete septa, and one ventral siphonoglyph; colonial; endoskeleton present.

Order Gorgonacea: colony highly branched; skeleton axial, of calcareous spicules, of gorgonin, or of both; polyps small, borne on the sides of the skeletal axis.

Family Gorgoniidae
Leptogorgia virgulata (Lamarck, 1815)

Subclass Zooantharia or Hexacorallia: tentacles simple; septa other than eight in number (as in Alcyonaria); skeleton, when present, does not consist of separate spicules.

Order Actinaria: septa paired, complete and incomplete, may be in multiples of six; usually one or more siphonoglyphs; solitary, without skeleton.

Family Aiptasiomorphidae
Aiptasiomorpha luciae (Verrill, 1898)

Family Diadumenidae
Diadumene leucolena (Verrill, 1866)

Family Metridiidae
Metridium senile (Linné, 1758)

Family Sagartidae
Sagartia modesta Verrill, 1866

Order Madreporaria: Compact, calcareous exoskeleton; no siphonoglyph; otherwise as in Actinaria.

Family Astraeidae
Astrangia danae Agassiz, 1847

Order Ceriantharia: long, solitary, anemone-like without pedal disk; tentacles in two whorls, oral and marginal.

Family Cerianthidae
Cerianthus americanus (Verrill, 1866)

Key to the Hydrozoa of the Delaware Bay Region
(Modified, in part, from Calder, 1971)
For terminology, see Plate 2

1. Hydrotheca absent 2

   Hydrotheca present. 7

2. Hydranth with capitate tentacles. . . . . Sarsia tubulosa

   Hydranth with filiform tentacles only 3

3. Filiform tentacles scattered. . . . . Cordylophora caspia

   Filiform tentacles in one or more distinct whorls 4

4. Tentacles in two clearly distinct whorls. 5

   Tentacles in a single whorl 6

5. Free medusae formed . . . . . Ectopleura dumortieri

   Fixed gonophores formed, apical processes of gonophores laterally compressed. . . . . .Tubularia crocea

6. Hydranths arise singly from a stolonal mat, perisarc forms rough spines, gonophores producing sporosacs . . . . . .Hydractinia echinata

   Hydranths arise singly from a stolonal mat, perisarc forms smooth spines, gonophores producing free medusae . . . . . Podocoryne carnea

   Colony erect, branched; zooids protected by thick perisarc, no spines . . . . . Garveia franciscana

7. Hydrothecae free from stem, supported on a pedicel. 8

   Hydrothecae adnate on stem. 16

8. Hydrothecae saucer-shaped, not capable of covering hydranth. . . . . .Halecium gracile

   Hydrothecae capable of coving hydranth. 9

9. Hydrothecae campanulate, operculum absent 10

   Hydrothecae turbinate or cylindrical, operculum present . . .15

10. Hydrothecal margin wavy; colony generally 15 - 20 cm long; many branches, branches alternate; stem dark brown to black; hydrothecae 585 - 660 u long..*Obelia longissima*

Hydrothecal margin smooth, entire 11

Hydrothecal margin with distinct, simple teeth. 12

Hydrothecal margin with distinct, bicuspidate teeth 13

11. Colony small, 15 mm., unbranched or with a few small branches. . . . . *Eulaomedea angulata*

Colony large, 15 cm., branches numerous; hydrothecae 285 - 420 u long. . . . . .*Obelia commissuralis*

12. Creeping stolon giving rise to pedicels up to 2 cm high; pedicels typically branched; hydrothecae 750 - 1050 u long . . . . . *Clytia edwardsi*

Colony erect, pedicels shorter than hydrothecae; hydrothecae 395 - 660 u long. . . . . .*Gonothyraea loveni*

13. Colony large, stem fascicled; lower branches also fascicled; colony with hydrothecae in nodes of branches . . . . . *Hartlaubella gelatinosa*

Colony smaller, never with hydrothecae in nodes of branches. 14

14. Colony only a few cm, hydrothecae 360 - 385 u long. . . . . .*Obelia bicuspidata*

Colony generally 5 cm long; hydrothecae 480 - 560 u long. . . . . .*Obelia longicyatha*

15. Stem divided into short, cylindrical internodes by irregularly spaced indentations; opercular facets with a definite base. . . . . .*Lovenella gracilis*

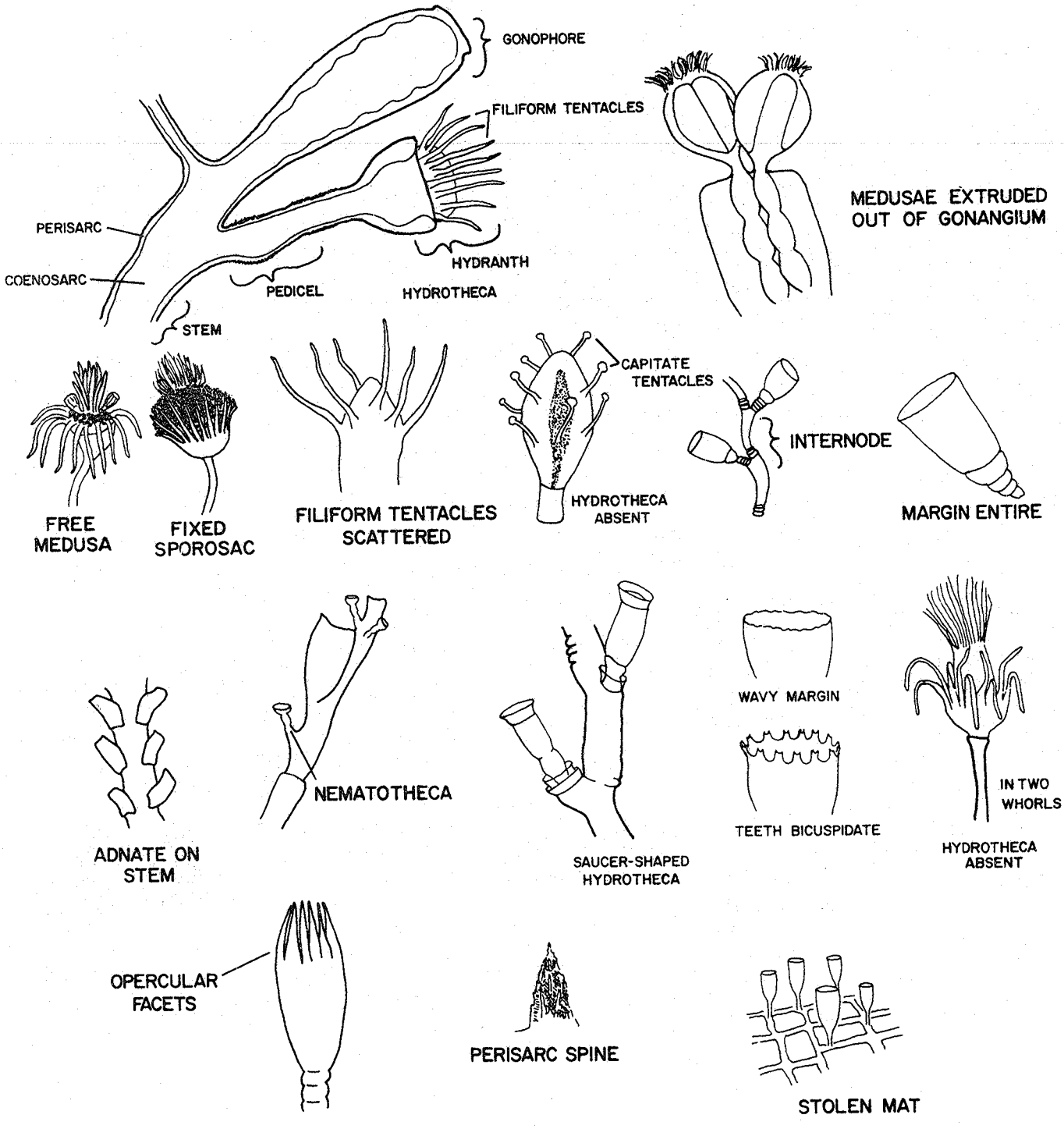
Opercular facets without distinct base; pedicels annulated throughout. . . . . .*Campanulina* spp.

16. Nematothecae present, hydrothecae arise from only one side of stem and branches . . . . .*Schizotricha tenella*

Nematothecae absent, hydrothecae alternate on opposite side of stem and branches . . . . . *Sertularia argentea*

Additional species which may be found in Delaware waters:

Moerisia lyonsi Boulenger, 1908
Halocordyle disticha (Goldfuss, 1820)
Linvillea agassizi (McCrady, 1857)
Zanclea costata Gegenbaur, 1856
Turritopsis nutricula McCrady, 1856
Garveia cerulea (Clarke, 1882)
Proboscidactyla ornata (McCrady, 1856)
Eudendrium album Nutting, 1898
E. ramosum (Linné, 1758)
Obelia geniculata (Linnaeus, 1758)
Dynamena cornicina McCrady, 1857



Hydrozoa

PLATE 2

Key to the Scyphozoa of the Delaware Bay Region
For terminology, see Plate 3.

1. Small, broadly bell-shaped, with 8 marginal clusters of tentacles, lives attached to algae . . . . . *Craterolophus convolvulus*

   Large, unattached, pelagic. 2

2. Oral arms fused, no marginal tentacles. *Rhopilema verrilli*

   Oral arms not fused, marginal tentacles present 3

3. Bell flat, many short marginal tentacles. . *Aurelia aurita*

   Bell deep, marginal tentacles long. 4

4. Marginal tentacles single . . . . *Chrysaora quinquecirrha*

   Marginal tentacles arranged in 8 subumbrellar clusters. . . . . *Cyanea capillata*

Key to the Anthozoa of the Delaware Bay Region
For terminology, see Plate 3

1. Colonial, with hard exoskeleton or endoskeleton 2

   Solitary, no skeleton present 3

2. Colony highly branched, usually orange or purple, polyps borne on the sides of endoskeletal axis . . . . . . Leptogorgia virgulata

   Colony compact, calcareous, truly "coral-like" . . . . . Astrangia danae

3. Without flattened base; tube-dwelling; body pink in life; tentacles in two whorls . . . . . Cerianthus americanus

   With flattened base; no tube, but may be buried in sediment; color various 4

4. Flattened base attached to pebbles or shell, body buried in sand or mud with only tentacles exposed, body white . . . . . .Sagartia modesta

   Attached to hard surface, not buried, body well exposed, body colored 5

5. Body usually with distinct, vertical orange lines, usually a trace of these lines after preservation, column dark green when live . . . Aiptasimorpha luciae

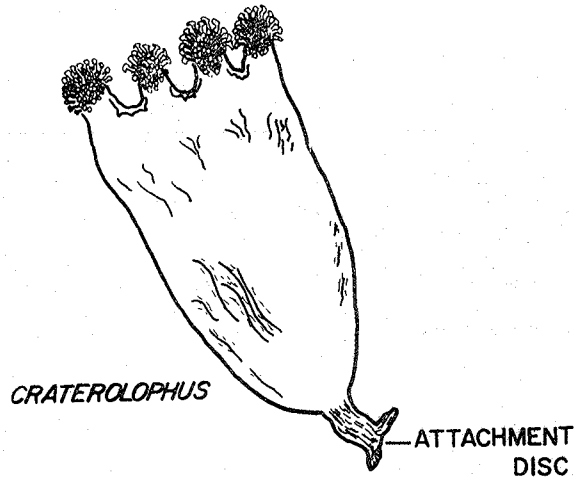
   Body pale translucent pinkish, to orange or brown 6

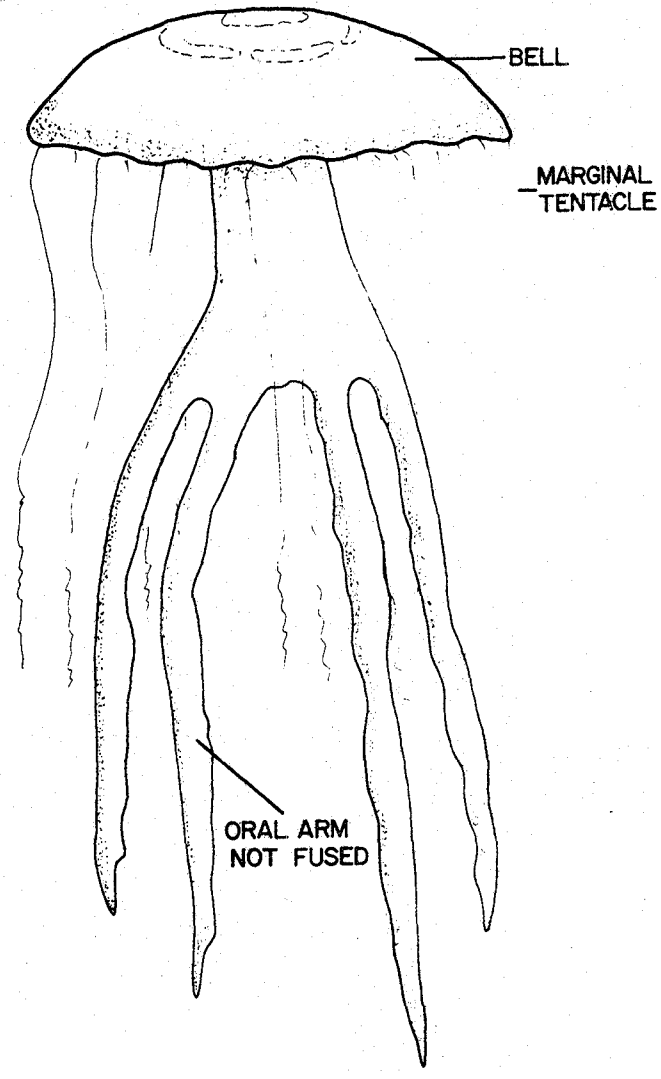
6. Column 3 or more times taller than wide, about 40-60 tentacles, body translucent pink when live, opaque when preserved. . . . . Diadumene leucolena

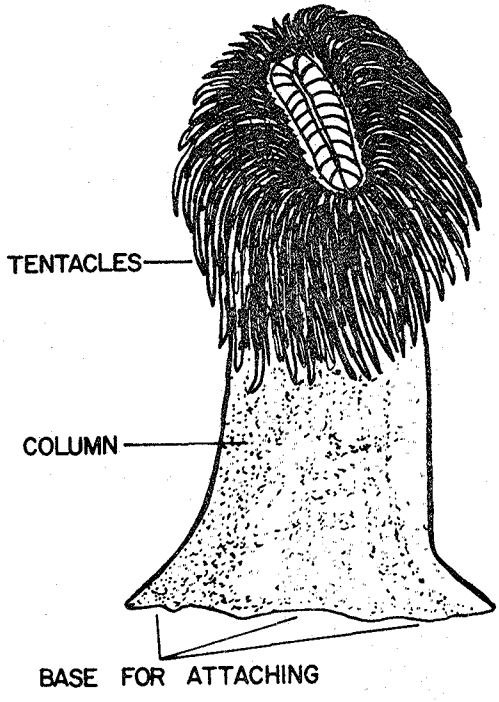
   Column less than 2 times higher than wide, about 1000 tentacles, body usually a dark brown. .Metridium senile

Additional species which may be found in Delaware waters:

Edwardsia leidyi Verrill, 1898
Nematostella vectensis Stephenson, 1935
Peachia parasitica (L. Agassiz, 1859)







Scyphozoa and Anthozoa

PLATE 3

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Part III. PLATYHELMINTHES AND RHYNCHOCOELA

Phylum Platyhelminthes: Body dorsoventrally flattened; digestive cavity, if present, with single opening, no anus; ganglia anterior.

Class Turbellaria; mostly free-living; epidermis ciliated, at least on ventral surface; digestive system incomplete, mouth located mid-ventrally.

Order Tricladida: intestinal tract divided into three main branches, one anterior and two posterior; plicate pharynx; protonephridia arranged in lateral networks; marine, fresh-water, and terrestrial.

Family Bdellouridae
Bdelloura candida (Girard, 1850)

Order Polycladida: intestinal tract centrally located with many highly branched diverticulae; pharynx plicate; eyes numerous; exclusively marine.

Family Stylochidae
Stylochus ellipticus (Girard, 1850)

Family Leptoplanidae
Euplana gracilis (Girard, 1850)
Notoplana atomata (Müller, 1776)

Phylum Rhynchocoela: elongate, unsegmented, worm-like; ectoderm ciliated; with an eversible proboscis situated dorsal to the alimentary tract; perivisceral body cavity not present, the spaces being occupied by parenchyma cells; anus present; blood system present; gonads simple, repeated, sexes separate.

Class Anopla: proboscis unarmed; mouth posterior to brain; central nervous system beneath the epidermis.

Order Paleonemertini: body wall generally with two muscle layers; if three layers are present, the innermost and outer most layers are circular.

Family Tubulanidae
Tubulanus pellucidus (Coe, 1895)

Order Heteronemertini: body wall of three muscle layers (note: outer longitudinal, middle circular, inner longitudinal); cerebral and cephalic organs present.

Family Lineidae
Zygeupolia rubens (Coe, 1895)
Micrura rubra Verrill, 1892
Cerebratulus lacteus (Leidy, 1851)

Class Enopla: proboscis armed or unarmed; mouth anterior to brain; central nervous system internal to body wall muscles.

Order Hoplonemertini: proboscis armed with one or more stylets; intestine with lateral diverticula.

Family Carcinonemertidae
Carcinonemertes carcinophila (Kolliker, 1845)

Family Tetrastemmatidae
Tetrastemma elegans (Girard, 1852)

Order Bdellonemertini: proboscis unarmed; intestine does not have diverticula; parasitic with posterior adhesive disc.

Family Malacobdellidae
Malacobdella grossa (Müller, 1776)

Key to the Platyhelminthes of the Delaware Bay Region
(Modified from Bush, 1964)
For terminology, see Plate 4.

1. Intestine with three main branches, one anterior and two posterior; single local species commensal on Limulus. . Tricladida. . . . . Bdelloura candida

   Intestine with many large branches. . . . . POLYCLADIDA . . 2

2. With tentacles, body broadly elliptical, of various shades of cream yellow, gray, or brown. . . . . .Stylochus ellipticus

   Tentacles absent. 3

3. Body yellowish to gray-brown, 8-12 mm. long, cerebral eyes usually 4 or 5 on each side in a row running lengthwise, and 2 eyes close together a little posterior to each row . . . . . .Euplana gracilis

   Cerebral eyes in 4 conspicuous clusters.Notoplana atomata

Additional species which may be found in Delaware waters:

various members of the Orders Acoela, Allococoela, and Rhabdocoela
Bdelloura propinqua Wheeler, 1894; on Limulus
Syncoelidium pellucidum Wheeler, 1894; on Limulus
Coronadena mutabilis (Verrill, 1873); free-living
Hoploplana inquilina (Wheeler, 1894); in Busycon canaliculatum, possibly Urosalpinx cinera
Stylochus zebra (Verrill, 1882); with hermit crabs, in empty Mercenaria shells
Probursa veneris Hyman, 1944

Key to the Rhynchocoela of the Delaware Bay Region
(Modified from McCaul, 1963)
For terminology, see Plate 4.

1. Living commensally in *Mercenaria mercenaria* (the hard clam) . . . . . *Malacobdella grossa*

   Living on the gills or egg masses of the blue crab, *Callinectes sapidus*. . . . . *Carcinonemertes carcinophila*

   Free living 2

2. Ocelli present; cephalic grooves lacking; 15-20 mm long . . . . . *Tetrastemma elegans*

   Ocelli absent 3

3. Cephalic grooves lacking. 4

   Cephalic grooves present. 5

4. Body rounded in cross-section, thicker anteriorly . . . . . *Tubulanus pellucidus*

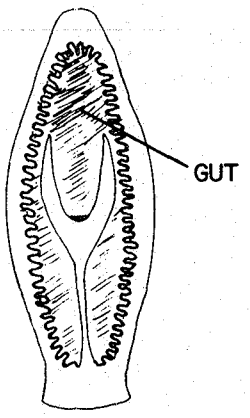
   Body flattened; head long, cylindrical. . . . . *Zygeupolia rubens*

5. Color reddish; head rounded anteriorly. . . *Micrura rubra*

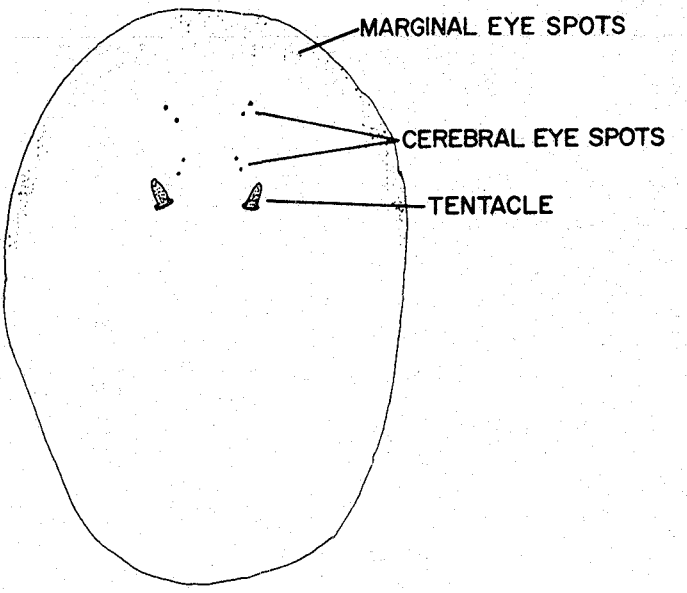
   Color cream white to salmon-pink; head slightly spatulate; body long, generally about 300 mm, may exceed 4 meters. . . . . *Cerebratulus lacteus*

Additional species which may be found in Delaware waters:

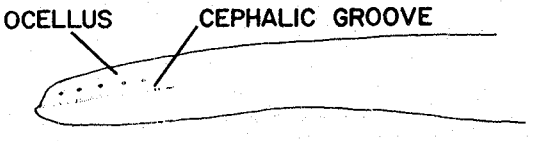
Lineus bicolor Verrill, 1892
Micrura leidyi (Verrill, 1892)
Amphiporus ocraceus (Verrill, 1873)



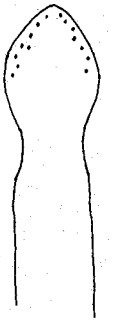
TRICLADIDA
Bdelloura Candida



POLYCLADIDA



Side View of Head



Dorsal View of Spatulate Head

NEMERTEA

Platyhelminthes and Rhynchocoela

PLATE 4

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Part IV. ANNELIDA AND SIPUNCULIDA

Phylum Annelida: Well developed metamerism; spacious, compartmentalized coelom; surface sometimes annulated as well as segmented; well-developed system of circular and longitudinal muscles; some groups show high development of locomotory appendages.

Class Polychaeta: Generally possess many setae; have a distinct head part; parapodia or modified parapodia on nearly all segments; possess a diversity of gill and tentacular structures. There are two orders usually recognized in the Polychaeta: the Errantia and the Sedentaria. Since these orders represent a spectrum of free living species to relatively immobile ones, they are arbitrary and probably do not reflect any true phylogenetic relationships.

Family Ampharetidae
Asabellides oculata Webster, 1879
Hypaniola grayi Pettibone, 1953
Melinna maculata Webster, 1879

Family Arabellidae
Arabella iricolor (Montagu, 1804)

Family Arenicolidae
Arenicola cristata Stimpson, 1856

Family Capitellidae
Capitella capitata (Fabricius, 1780)
Heteromastus filiformis (Claparède, 1864)
Notomastus latericeus Sars, 1851

Family Chaetopteridae
Chaetopterus variopedatus (Reiner, 1804)
Spiochaetopterus oculatus Webster, 1879

Family Cirratulidae
Cirriformia filigera (Delle Chiaje, 1828)

Family Eunicidae
Marphysa sanguinea (Montagu, 1815)
M. belli: (Audouin and Milne - Edwards, 1833)

Family Glyceridae
Glycera americana Leidy, 1855
G. capitata Oersted, 1843
G. dibranchiata Ehlers, 1868
G. robusta Ehlers, 1868

Family Goniadidae
Glycinde solitaria Webster, 1879

Family Hesionidae
Gyptis vittata Webster and Benedict, 1887
Podarke obscura Verrill, 1873

Family Lumbrineridae
Lumbrinereis fragilis Müller, 1776
L. tenuis Verrill, 1873

Family Maldanidae
Clymenella torquata (Leidy, 1855)
Maldane sarsi Malmgren, 1865
Maldanopsis elongata (Verrill, 1873)

Family Nephtyidae
Nephtys bucera Ehlers, 1868
N. picta Ehlers, 1868

Family Nereidae
Laonereis culveri (Webster, 1879)
Nereis (Neanthes) succinea (Frey and Leuckart, 1847)

Family Onuphidae
Diopatra cuprea (Bosc, 1802)

Family Opheliidae
Ophelia bicornis Savigny, 1818

Family Orbiniidae
Scoloplos (Scoloplos) armiger (O. F. Miller, 1776)
S. (S.) fragilis (Verrill, 1873)

Family Oweniidae
Owenia fusiformis Delle Chiaje, 1844

Family Pectinariidae
Pectinaria (Cystenides) gouldii (Verrill, 1873)

Family Phyllodocidae
Eteone heteropoda Hartman, 1951
E. lactea Claparède, 1868
Eumida sanguinea (Oersted, 1843)
Paranaitis speciosa (Webster, 1880)
Phyllodoce (Anaitides) arenae Webster, 1879

Family Polynoidae
Harmothoe (Lagisca) extenuata (Grube, 1840)
H. imbricata (Linné, 1767)
Lepidametria commensalis Webster, 1879
Lepidonotus sublevis (Verrill, 1873)

Family Sabellariidae
Sabellaria vulgaris Verrill, 1873

Family Sabellidae
Potamilla neglecta (Sars, 1851)
Sabella microphthalma Verrill, 1873

Family Serpulidae
Hydroides (Eupomatus) dianthus (Verrill, 1873)

Family Sigalionidae
Sthenelais limicola (Ehlers, 1864)
Sigalion arenicola Verrill, 1879

Family Spionidae
Polydora ligni Webster, 1879
P. websteri Hartman, 1943
Prionospio heterobranchia Moore, 1907
Scolecolepides viridis (Verrill, 1873)
Spiophanes bombyx (Claparède, 1870)
Streblospio benedicti Webster, 1879
Paraprionospio pinnata Ehlers, 1901
Scolelepis squamata (Müller, 1789)

Family Syllidae
Autolytus cornutus Agassiz, 1863
Brania clavata (Claparède, 1863)
Parapionosyllis longicirrata (Webster and Benedict, 1884)
Exogone dispar (Webster, 1879)

Family Terebellidae
Loimia medusa (Savigny, 1818)
Pista palmata (Verrill, 1873)

Class Oligochaeta: Parapodia absent; setae few; primarily terrestrial or freshwater, some marine species.

Class Hirudinea: The leeches; no setae or parapodia; body provided with terminal suckers; terrestrial, freshwater, or marine.

Phylum Sipunculida: vermiform, unsegmented, coelomate; body divided into anterior introvert region, and posterior trunk region; mouth terminal and generally surrounded by tentacles; annelid type nervous system.

There are no suprageneric categories.

Golfingia gouldi (Pourtales, 1851); free-living; 300 mm long

Additional species which may be found in Delaware waters:

Phascolion strombi (Montagu, 1804); lives in mollusc shells and polychaete tubes; 25 mm long.

Key to the Families of Polychaeta
(Modified from Hartman, 1961;
Selected keys from Pettibone, 1963; Smith, 1964)
For terminology, see Plates 5 - 8.

1. Dorsal surface more or less covered with scales (elytra) or hairs, or overlain by a thick felty layer. 2

   Dorsal surface not covered with scales, hair, or felt 4

2. Dorsal surface more or less covered by felty layer that covers elytra; sea mice . . . . . .APHRODITIDAE

   Dorsal surface more or less covered by elytra only. 3

3. Elytra and dorsal cirri alternate on anterior segments, but on the posterior segments elytra are present on all segments and entirely replace cirri. . . . . .SIGALIONIDAE

   Elytra and dorsal cirri alternate regularly from the 4th to about the 23rd segment; thereafter each 2 elytra are followed by a dorsal cirrus . . . . . .POLYNOIDAE

4. Anterior end with long, strong spinous setae, not forming operculum, but projecting forward and concealing prostomium. . . . . FLABELLIGERIDAE

   Anterior end completely concealed by chitinous spines forming operculum 6

   Anterior end completely concealed by branching tentacles. . . 5

   Anterior end more or less completely covered by many long filamentous outgrowths. 7

   Anterior end otherwise; prostomium generally not concealed. . 9

5. Thoracic membrane well developed to absent; operculum usually present; in calcareous tubes. . . . . .SERPULIDAE

   Thoracic membrane little developed or absent; no operculum; in sandy or silty mucus tubes . . . . . .SABELLIDAE

6. Thorax with 2 pairs of pectinate branchiae; caudal appendage annulated and with setae; operculum formed of single series of a few large spines; construct solitary, conical tubes open at both ends . . . . . PECTINARIIDAE

Thorax without pectinate branchiae; caudal appendage smooth; operculum formed of 3 whorls of numerous closely spaced spines; constructs masses of sandy tubes cemented together. . . . . SABELLARIIDAE

7. Filamentous outgrowths present anteriorly and continued along sides of body; body not divided into 2 distinct regions . . . . . CIRRATULIDAE

Filamentous outgrowths concentrated on anterior region; body usually with 2 distinct regions. 8

8. Tentacles retractile into mouth, leaving branchiae exposed and extending over anterior end; prostomium often clearly visible . . . . . .AMPHARETIDAE

Tentacles not retractile into mouth; prostomium and branchiae usually not visible except by lifting tentacles away; branchiae, when present, dorsal . . . . . .TEREBELLIDAE

9. Prostomial palpi long, prehensile, and tentacular, sometimes accompanied by pair of minute anterior antennae 10

Prostomial palpi short, usually fleshy, or absent; anterior tentacles various 11

10. Body divisible into 2 or more regions, each markedly different from the others . . . . . .CHAETOPTERIDAE

Body not divisible into regions, although sometimes single anterior segment is specially modified. . . . SPIONIDAE

11. Prostomium not ciliated, without tentacles, although occasionally with lobed, flaring membrane; body with many more than 15 segments. 12

Prostomium with tentacles, which may be minute. 19

12. Anterior end, or both ends, flat; at least anterior segments elongate. 13

Anterior and posterior ends pointed or rounded; segments usually not elongate. 14

13. Anterior end forms a flat plaque; posterior end terminates in plaque with or without cirri; segments very long, segmental grooves nodelike; bamboo worms. . .MALDANIDAE

Anterior end with flat lobed membrane . . . . . OWENIIDAE

14. Proboscis provided with dark, chitinous jaw pieces; body smooth, elongate, cylindrical, resembling an earthworm; parapodia weakly developed, or at most, simple lobes; dorsal and ventral cirri often tiny 15

    Proboscis without chitinous jaws; form variable; body more or less divisible into regions. 16

15. Parapodia provided with hooded hooks and pointed setae; prostomium without eyespots . . . . . .LUMBRINEREIDAE

    Parapodia with only pointed setae; prostomium with or without eyespots. . . . . ARABELLIDAE

16. Thorax with palisaded ranks of neurosetae; dorsum sometimes more or less completely concealed by overlapping, cirriform branchiae . . . . . .ORBINIIDAE

    Thoracic neuropodia without palisaded ranks of setae. 17

17. Body consisting of 3 regions, an anterior and a posterior without branchiae, and a median region with conspicuous branchiae . . . . . .ARENICOLIDAE

    Body consisting of 2 regions which are not easily distinguishable from each other 18

18. No uncini; all setae slender, pointed; body eel-like, broad, or short and grub-like; some with lateral eyespots; segments usually closely multiannulate. . . .OPHELIIDAE

    Some parapodia with uncini, body slender, sometimes very long and fragile; without lateral eyespots.CAPITELLIDAE

19. Prostomium with minute tentacles, which are usually inconspicuous unless rendered conspicuous because of reduced size of head; prostomium usually reduced in size, or if large, partly concealed by first few segments of body . . .20

    Prostomium with tentacles more or less conspicuous. 22

20. Prostomium quadrate or subcircular; anterior part with two pairs of small antennae; with branchia-like structures in the form of a recurved cirrus between two rami of parapodium. . . . . .NEPHTYIDAE

    Prostomium pointed, provided with 4 tiny tentacles in a cross at the tip; proboscis large, stout, cylindrical, terminating distally in dark, chitinous jaw pieces. 21

21. Parapodia similar throughout, either all uniramous or all biramous; distal end of proboscis with four jaws. . . . . .GLYCERIDAE

    Parapodia uniramous in anterior part, biramous and larger in posterior part of body; distal end of proboscis with many small black jaw pieces . . . . . .GONIADIDAE

22. Palpi present, sometimes globular and obscure 23

    Palpi absent; parapodia uniramous, dorsal cirri often large, foliaceous, glandular, sometimes resembling the elytra of a polynoid; proboscis cylindrical, with soft papillae in specific patterns. . . . . PHYLLODOCIDAE

23. Palpi slender, pointed, biarticulate; prostomium with 3 tentacles . . . . . .HESIONIDAE

    Palpi fleshy and forwardly directed; usually biarticulated and prominent 24

    Palpi short and globular, not especially prominent. 25

24. With an unpaired median prostomial antenna, with or without paired peristomial tentacles; parapodia uniramous; dorsal cirri often beaded; barrelet of proboscis usually visible through body wall . . . . . .SYLLIDAE

    With paired prostomial tentacles and peristomial cirri; parapodia biramous; almost never with beaded cirri; proboscis with paragnaths and jaws. . . . . .NEREIDAE

25. Palpi globular, obscure, giving prostomium a bilobed appearance; either 1, 3, or 5 prostomial tentacles; pharynx with chitinized, paired mandibles and maxillae . . . . . EUNICIDAE

    With 7 prostomial tentacles, of which anterior pair are small and simple, and the other 5 large with thickened annulated bases; in addition usually a pair of small dorsolateral peristomial cirri; pharyngeal maxillae not completely paired . . . . . ONUPHIDAE

AMPHARETIDAE

1. Dorsal hooked setae behind branchiae; ventral collarette present; abdominal region long about 50 segments. . . . . .Melinna maculata

   Dorsal hooked setae wanting; ventral collarette absent; abdominal region shorter, 13-25 segments. 2

2. Paleae few, delicate; thoracic setigers 17; setae long; abdominal segments 22-25. . . . . Hypaniola grayi

   Paleae wanting; thoracic setigers 14; setae shorter; abdominal segments 13 . . . . . Asabellides oculata

ARABELLIDAE

Parapodia lacking heavy projecting acicular setae; prostomium with 4 eyes in posterior row, mandibles well developed . . . . . Arabella iricolor

ARENICOLIDAE

Midregion with 11 pairs of dorsal red branchiae, body thick, dark green to brown, rare. . .Arenicola cristata

CAPITELLIDAE

1. Capillary setae restricted to first 5 setigers. . . . . Heteromastus filiformis

   Capillary setae not restricted to first 5 setigers. 2

2. Capillary setae on first 7 setigers . .Capitella capitata

   Capillary setae on first 11 setigers. Notomastus latericeus

CHAETOPTERIDAE

Tube long, chitinous, annulated, buried vertically in the sand, body thin, with 2 very long ciliated, grooved palps . . . . . Spiochaetopterus oculatus

Tube U-shaped, opaque, openings narrow, body large, with 2 short filiform palps. . . . Chaetopterus variopedatus

CIRRATULIDAE

Paired palps lacking; branchial filaments 1/3 or more of body length, large species occurs in silt-clay. . . . . .Cirriformia filigera

EUNICIDAE

1. Branchiaebegin on about setiger 20 (10-40), extending over a long region of body, with 1-8 filaments per branchia. . . . . .Marphysa sanguinea

   Branchiae begin on setigers 12-15, relatively few in number (12-21 pairs) with 7-19 filaments per branchia. . . . . Marphysa bellii

GLYCERIDAE

1. Parapodia with a single postsetal lobe and 2 unequal presetal lobes, globular dorsal cirri on dorsolateral body wall, well above the parapodia, without branchiae . . . . . .Glycera capitata

   Parapodia with 2 presetal and 2 postsetal lobes, globular dorsal cirri at dorsal base of parapodia, with branchiae. . 2

2. Branchiae digitate or fingerlike lobes, retractile into grooves posterior to bases of notopodia (often retracted - look for groove). . . . . Glycera americana

   Branchiae not retractile or multilobed. 3

3. Branchiae conspicuous as elongate dorsal and ventral lobes of parapodia. . . . . .Glycera dibranchiata

Branchiae blister-like. . . . . Glycera robusta

GONIADIDAE

Proboscis without chevrons, provided throughout with sharp, pale teeth as in a molluscan radula, neurosetae compound spinigers only. . . . . .Glycinde solitaria

HESIONIDAE

Tentacular cirri 6 pairs; color dark, epifaunal . . . . . Podarke obscura

Tentacular cirri 8 pairs; color light, apparently infaunal. . . . . .Gyptis vittata

LUMBRINERIDAE

Acicula black, setae with dark bases.Lumbrineris fragilis

Acicula yellow, setae pale to yellow, posterior parapodia with postsetal lobe elongate, often erect . . . . . .Lumbrineris tenuis

MALDANIDAE

1. Anus within a funnel shaped structure, with deep membranous collarette on fourth setigerous segment; 18 setigerous segments; two color phases; pale with red nodes or green in mud. . . . . Clymenella torquata

Anus associated with (dorsal to) an oblique structure 2

2. Anus dorsal to anal disc; anal segment forms a spatulate lobe dorsally and funnel-like concavity ventrally; anterior end speckled with black or dark purple; mud tube. . . . . .Maldanopsis elongata

Tail formed by an obliquely truncated flat oval plate with short lateral marginal incisions . . Maldane sarsi

NEPHTYIDAE

Dorsal (branchial) cirrus with enlarged lobe at base, ventral tentacular cirri lateral and continuous with widest part of enlarged tentacular (first) segment. . . . . .Nephtys bucera

Dorsal cirrus lacking enlarged lobe at base, ventral tentacular cirri anterolateral, anterior to widest part of enlarged tentacular segment. . . . . Nephtys picta

NEREIDAE

Proboscis only with soft papillae, found in oligohaline, shallow areas . . . . . .Laeonereis culveri

Proboscis with well developed paragnaths, notopodia with 3 conical ligules, widespread . . . . . Nereis succinea

ONUPHIDAE

Branchiae strongly spiraled, beginning on setigers 4 or 5 . . . . . Diopatra cuprea

OPHELIIDAE

Body rounded anteriorly; ventral groove posteriorly; branchiae begin setiger 11 or 12. . . .Ophelia bicornis

ORBINIIDAE

With interramal cirri on anterior abdominal segments, a notched or incised subpodal lobe. . .Scoloplos fragilis

Without interramal cirri, thoracic neuropodia usually with crotchets ending in blunt tips in addition to numerous neurosetae ending in capillary tips . Scoloplos armiger

OWENIIDAE

Prostomium with a slashed branchial membrane; tube distinctive, with a dense coating of flattened sand grains and bits of shell set in overlapping fashion like shingles; . . . . . Owenia fusiformis

PECTINARIIDAE

Uncini with major teeth in single series; shorter notopodial setae strongly incised; tubes constructed of very fine, light-colored sand grains. Pectinaria gouldii

PHYLLODOCIDAE

1. Tentacular cirri 2 pairs. 2

   Tentacular cirri 4 pairs. 3

2. Segment 2 with ventral cirri only, lacking setigerous lobe, tentacular cirri unequal, ventral pair 2-3 times longer than dorsal pair. . . . . Eteone lactea

   Segment 2 with setigerous lobe and setae well developed tentacular cirri subequal . . . . . Eteone heteropoda

3. Prostomium lacking median antenna 4

   Prostomium with median antenna, neuropodia bilobed distally with lobes subequal, rounded, color variable in life. . . . . .Eumida sanguinea

4. Color solid green in life, brown in alcohol; proboscis seldom everted, associated with oyster beds or mud bottom, prostomium suboval, body stout and short, dorsal cirri broadly ovate, asymmetrical . Paranaitis speciosa

   Color in distinct pattern, dorsum with wide spindle-shape dark transverse bars, proboscis with papillae covering base, except middorsally, in close-set cross hatched pattern, proboscis often everted, associated with sandy bottom. . . . . Phyllodoce arenae

POLYNOIDAE

1. Lateral antennae terminal on anterior extensions of the prostomium, lacking distinct ceratophores, elytra 12 or 23+ pairs 2

   Lateral antennae ventral to median antenna, ceratophores variably distinct, elytra 15-16 pairs 3

2. Segments numerous (50+); elytra 23+ pairs; commensal with terebellids, elytra smooth lacking tubercles and fringes of papillae. . . . . *Lepidametria commensalis*

   Segments few (26); elytra 12 pairs; not commensal with terebellids, all notosetae with capillary tips, elytral tubercles tiny, widely spaced. . . *Lepidonotus sublevis*

3. Anterior pair of eyes anteroventral, not visible dorsally . . . . . *Harmothoe imbricata*

   Anterior pair of eyes anterolateral, visible dorsally, elytra with microtubercles and nodular to spiny macrotubercles. . . . . *Harmothoe extenuata*

SABELLARIIDAE

Middle row of opercular paleae not concealing inner row; inner paleae elongate, outer paleae with many serrations distally, common, forms reef-like masses. . . . . *Sabellaria vulgaris*

SABELLIDAE

Two irregular rows of eye-spots on branchial filaments; collarette bilobed, widely separated mid-dorsally, deeply notched mid-ventrally; body short and thick. . . . . *Sabella microphthalma*

No eye-spots on branchial filaments; collarette bilobed, deeply notched mid-dorsally slit mid-ventrally. . . . . *Potamilla neglecta*

SERPULIDAE

Calcareous tube, coiled sinistrally; operculum a two-tiered structure on a smooth penduncle; common, tube attached for most of length . . . . .*Hydroides dianthus*

SIGALIONIDAE

1. Prostomium with median antenna; elytra thin, translucent, delicate, smooth, without microtubercles . . . . . *Sthenelais limicola*

   Prostomium without median antenna; elytra with fringe of pinnately-branched papillae on external border. . . . . .*Sigalion arenicola*

SPIONIDAE

1. Fifth setiger with heavy, retractable setae . .(*Polydora*) . . 2

   Fifth setiger unmodified. 3

2. Median occipital antenna present; caruncle well developed; branchia present on about 14 segments; tubes mud-mucoid, on solid substrates . . . . . .*Polydora ligni*

   Median antenna lacking; caruncle abruptly terminated; branchia on about 100 segments; boring in bivalve shells, especially those of live oysters. . . *Polydora websteri*

3. Prostomium acutely pointed, neuropodial lamellae bilobed posteriorly, with neurosetae and hooks between the lobes, occurs in shallow sandy area.*Scolelepis squamata*

   Prostomium conical, rounded or truncate 4

4. Prostomium T-shaped (with lateral horns). 5

   Prostomium truncate or rounded but lacking lateral horns. . . 6

5. Branchiae absent; tube firm, of sand; in shallow, sandy areas meso-to polyhaline, small, whitish species. . . . . *Spiophanes bombyx*

Branchiae on first setiger to 1/2 to 2/3 of body; tube fragile; seldom noticed; in sandy-mud and detritus, most common in oligohaline areas, dark green body with red branchiae . . . . . .Scolecolepides viridis

6. Branchiae 1 pair; setiger 2 with dorsal collar. Streblospio benedicti

Branchiae 4 pairs; prostomium snout-like, bordered by flap-like lobes of peristomium; medium sized estuarine species with green, pinnate branchiae . . . . . .Paraprionospio pinnata

Branchiae 5 pairs; posterior pair of eyes crescentic; in sand near shore . . . . . Prionospio heterobranchia

SYLLIDAE

1. Body minute, thread-like, antennae tentacular and dorsal cirri short, fusiform or subulate, tentacular cirri 1 pair. 2

Body larger, antennae tentacular and dorsal cirri longer, filiform or clavate; tentacular cirri 2 pairs, ventral cirri lacking, sexual stolons produced singly, with head usually forming between setigers 13 and 14 (1) body colorless or with dusty longitudinal stripes. . . . . .Autolytus cornutus

2. Tentacular cirri 2 pairs, similar to antennae and dorsal cirri; prostomium with pair of minute eye spots in addition to 2 larger pairs. . . . . .Brania clavata

Tentacular cirri 1 pair; similar to dorsal cirri; palps fused on basal third; body smooth lacking papillae; median and lateral antennae slightly longer or subequal to palps, prostomium suboval, length 5 mm . . . . . .Parapionosyllis longicirrata

Tentacular cirri 1 pair, rudimentary, smaller than dorsal cirri; palps fused dorsally . . . . . .Exogone dispar

TEREBELLIDAE

1. First pair of branchiae larger; lateral buccal lobes large . . . . . Loimia medusa

Branchiae arborsecent, with large main trunk, green, sub-equal . . . . . Pista palmata

Additional species which may be found in Delaware waters:

PILARGIIDAE
- Ancistrosyllis hartmannae Pettibone, 1966
- A. jonesi Pettibone, 1966
- Cabira incerta Webster, 1879
- Sigambra tentaculata (Treadwell, 1941)
- S. wassi Pettibone, 1966

NEREIDAE
- Ceratonereis irritabilis (Webster, 1879)
- Nereis arenaceodonta (Moore, 1903)
- N. grayi Pettibone, 1956
- N. pelagica Linné, 1758
- N. virens Sars, 1835
- Lycastopsis pontica (Bobretsky, 1872)
- Platynereis dumerilii Audouin and Milne-Edwards, 1833

ORBINIIDAE
- Orbinia ornata Verrill, 1873
- Scoloplos riseri Pettibone, 1957
- S. robustus (Verrill, 1873)

DORVILLEIDAE
- Stauronereis rudolphi (Della Chiaje, 1828)
- S. sociabilis (Webster, 1879)
- Protodorvillea egena (Ehlers, 1913)

SPIONIDAE
- Dispio uncinata Hartman, 1951
- Polydora commensalis Andrews, 1891
- P. hamata (Webster, 1879)
- Prionospio cirrifera (Wiren, 1883)
- P. malmgreni Claparède, 1868
- Scolelepis bousfieldi Pettibone, 1963
- Spio filicornis (O. F. Muller, 1776)
- S. setosa (Verrill, 1873)

PHYLLODOCIDAE
- Eulalia viridis (Linné, 1767)
- Phyllodoce mucosa Oersted, 1843
- Nereiphylla fragilis (Webster, 1879)

POLYNOIDAE
Gattyana cirrosa (Pallas, 1766)
Harmothoe acanellae (Verrill, 1881)
H. nodosa (Sars, 1860)
Lepidonotus squamatus (Linné, 1758)
L. variabilis Webster, 1879

SIGALIONIDAE
Sthenelais boa (Johnston, 1873)

GONIADIDAE
Goniada falklandica Pratt, 1901
Goniadella gracilis (Verrill, 1873)

NEPHTYIDAE
Aglaophamus verrilli (McIntosh, 1885)
Nephtys incisa Malmgren, 1865
N. magellanica (Augener, 1912)

TEREBELLIDAE
Amphitrite ornata (Leidy, 1855)
Lysilla alba Webster, 1879
Pista cristata (O. F. Muller, 1776)
P. maculata Marenzeller, 1884
Polycirrus eximius (Leidy, 1855)
Enoplobranchus sanguineus

APHRODITIDAE
Aphrodita hastata Moore, 1905

PARAONIDAE
Aricidea fragilis (Webster, 1879)
A. wassi Pettibone, 1965

MAGELONIDAE
Magelona rosea Moore, 1907

SYLLIDAE
Autolytus alexandri (Malmgren, 1867)
A. fasciatus (Bosc, 1802)
A. prolifer (O. F. Muller, 1788)
Brania wellfleetensis Pettibone, 1956
Eusyllis lamelligera Marion and Bobretsky, 1875
Odontosyllis fulgurans Claparede, 1864
Paraprionosyllis manca (Treadwell, 1931)
Sphaerosyllis erinaceus Claparede, 1868
Syllis cornuta Rathke, 1843
S. gracilis Grube, 1840

MALDANIDAE
Clymenella mucosa (Andrews, 1891)
C. zonalis (Verrill, 1874)

ARABELLIDAE
Drilonereis filum (Claparède, 1869)
D. longa Webster, 1879
D. magna Webster, 1887

SABELLIDAE
Fabricia sabella (Ehrenberg, 1837)
Potamilla reinformis (Linné, 1788)

ONUPHIDAE
Onuphis conchylega Sars, 1835
O. eremita Audouin and M. Edwards, 1833

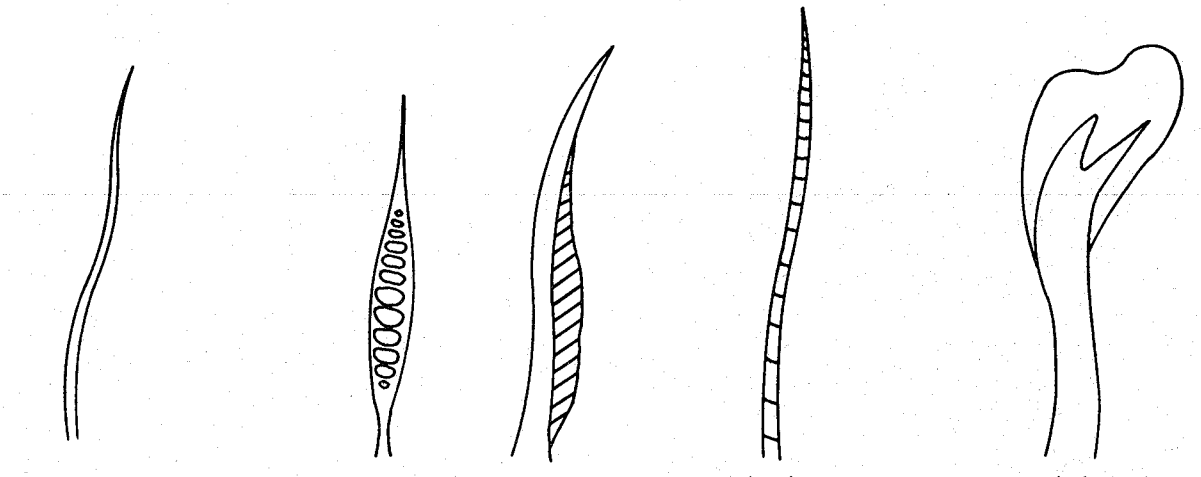
LUMBRINEREIDAE
Lumbrinereis acuta Verrill, 1875
L. coccinea (Renier, 1804)
L. impatiens (Claparède, 1868)

SCALIBREGMIDAE
Scalibregma inflatum Rathke, 1843

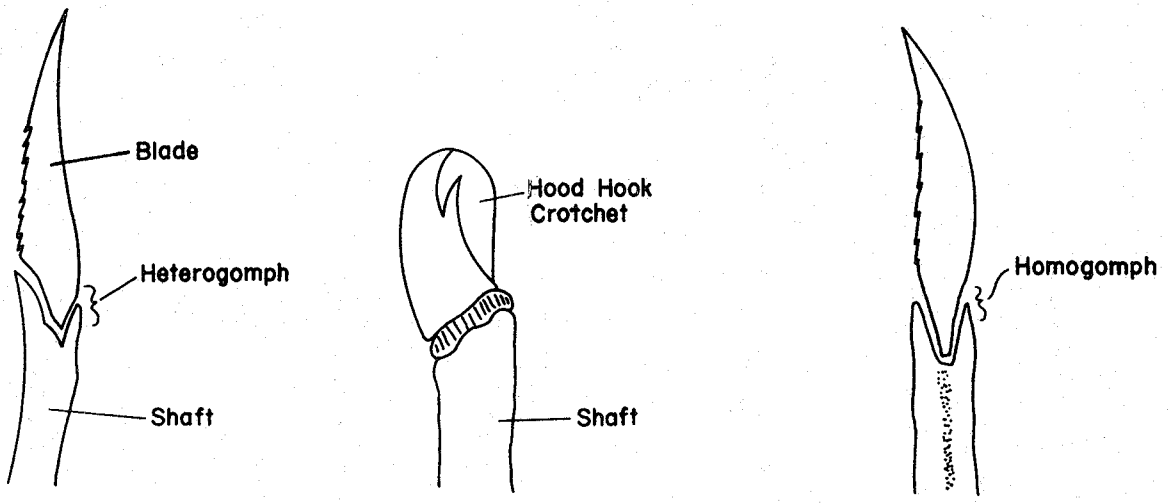
CIRRATULIDAE
Tharyx setigera Hartman, 1945

OPHELIIDAE
Travisia carnea Verrill, 1873

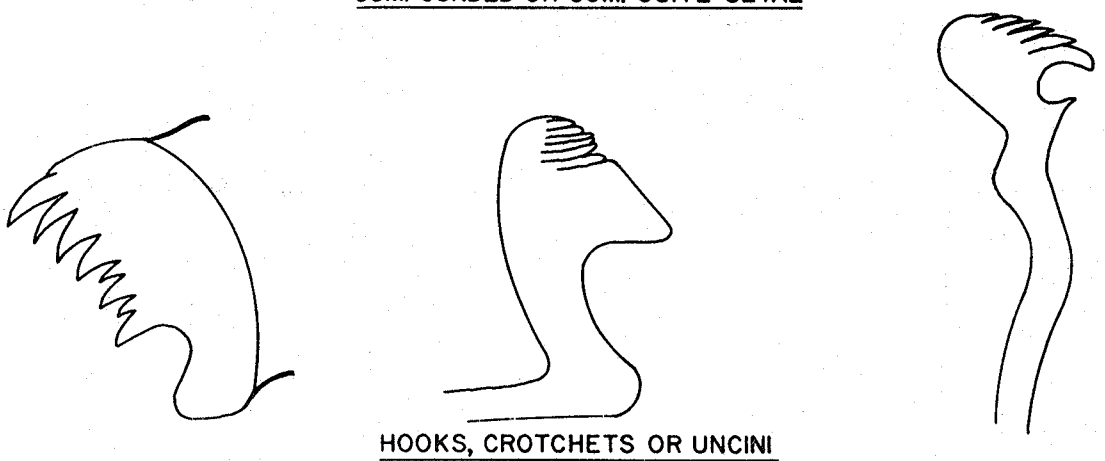
CAPITELLIDAE
Notomastus luridus



SIMPLE SETAE



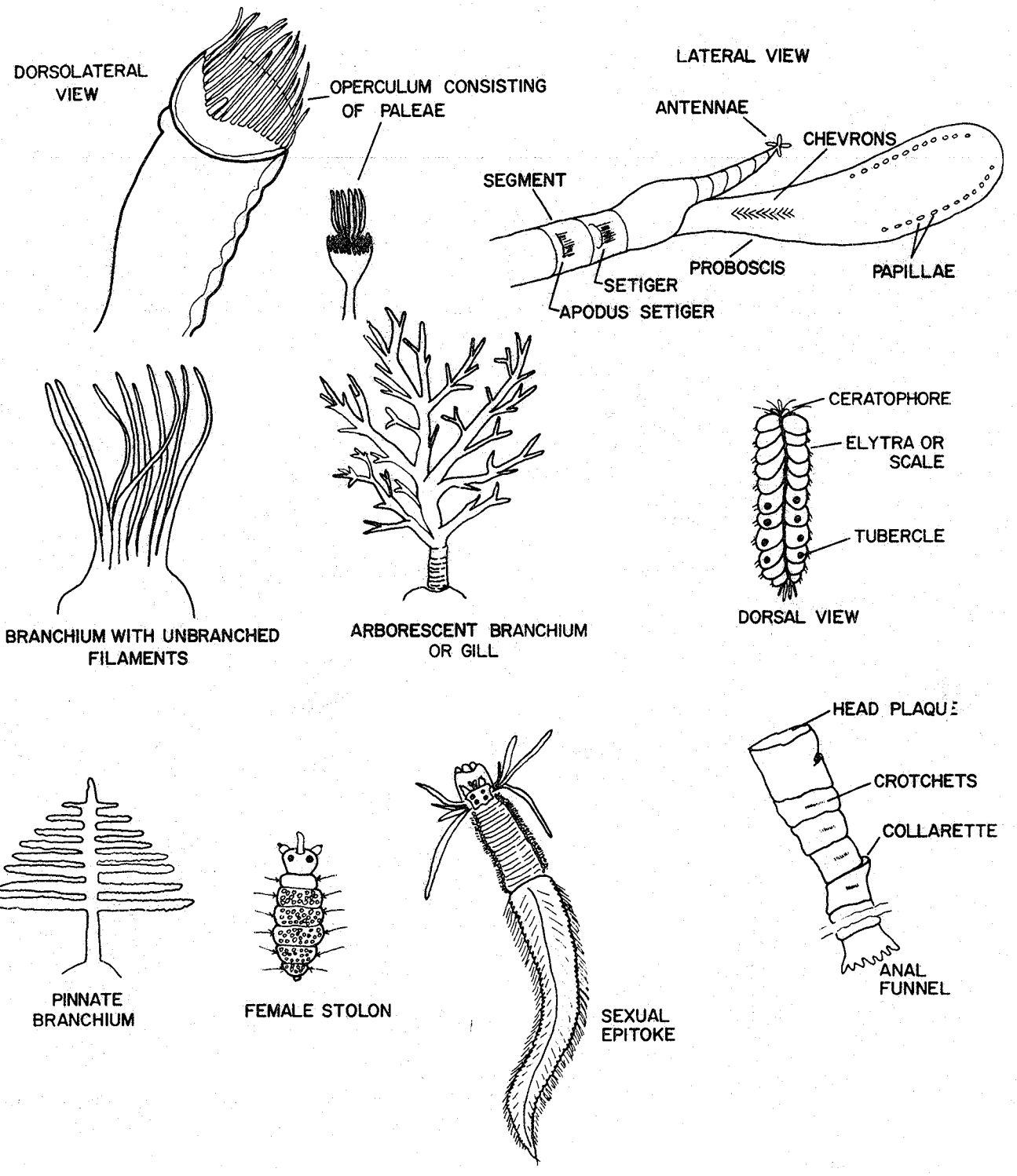
COMPOUNDED OR COMPOSITE SETAE



HOOKS, CROTCHETS OR UNCINI

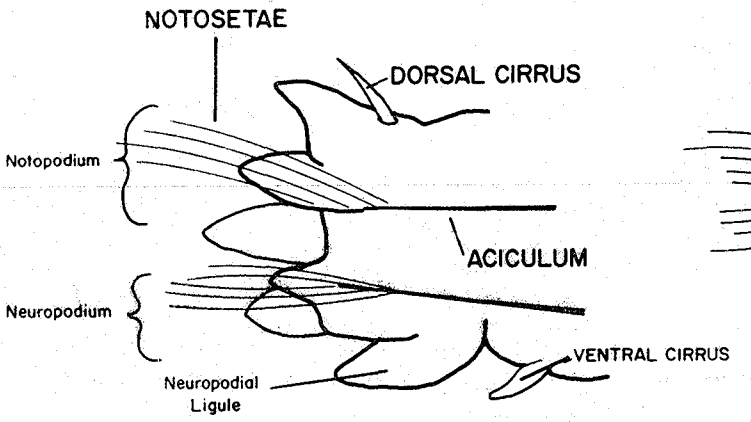
Polychaeta

PLATE 5

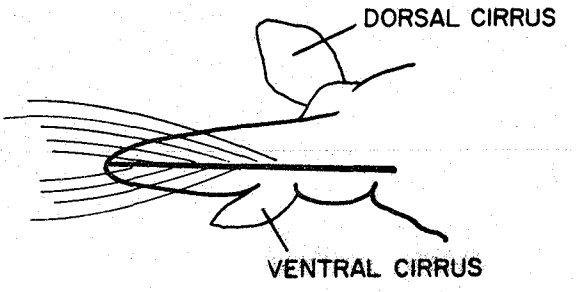


POLYCHAETA

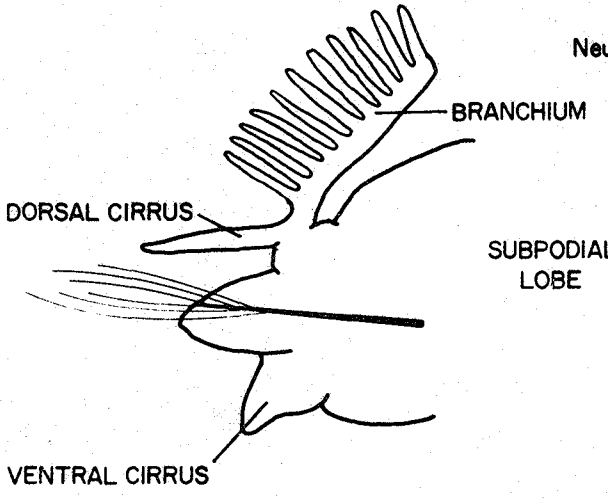
PLATE 6

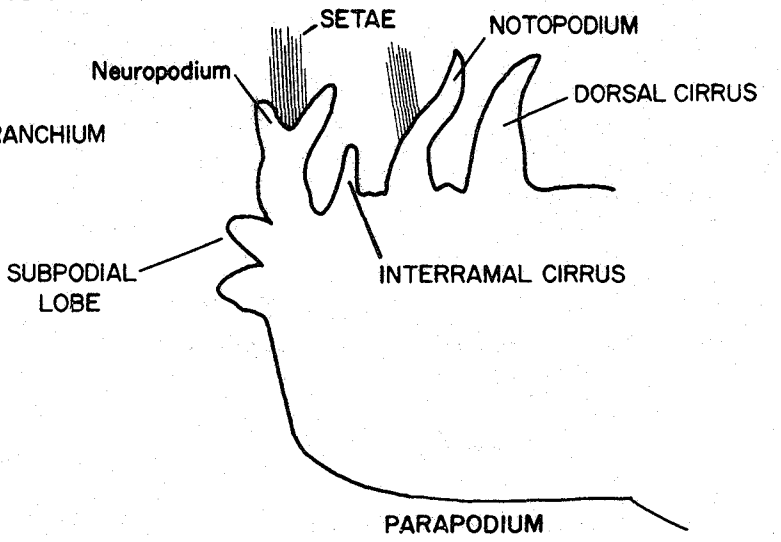


BIRAMOUS PARAPODIUM

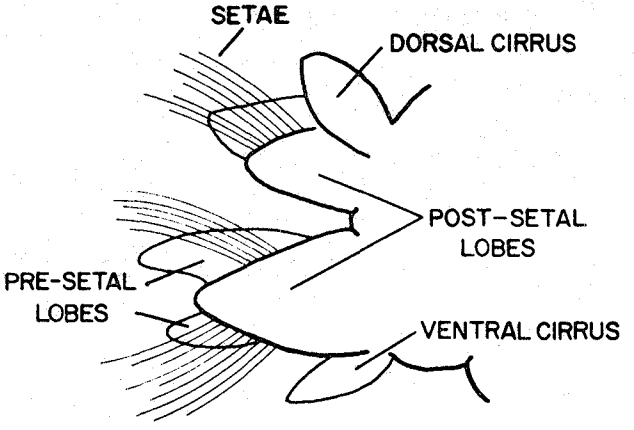


UNIRAMOUS PARAPODIUM

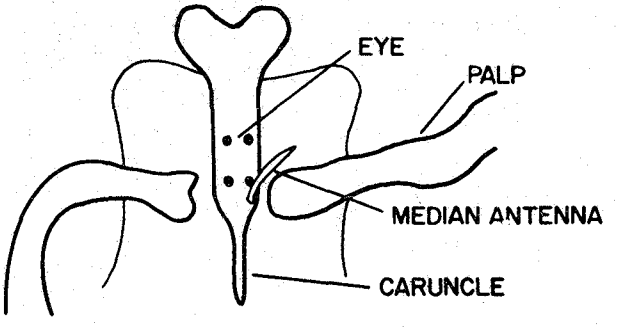




PARAPODIUM
seen from POSTERIOR end



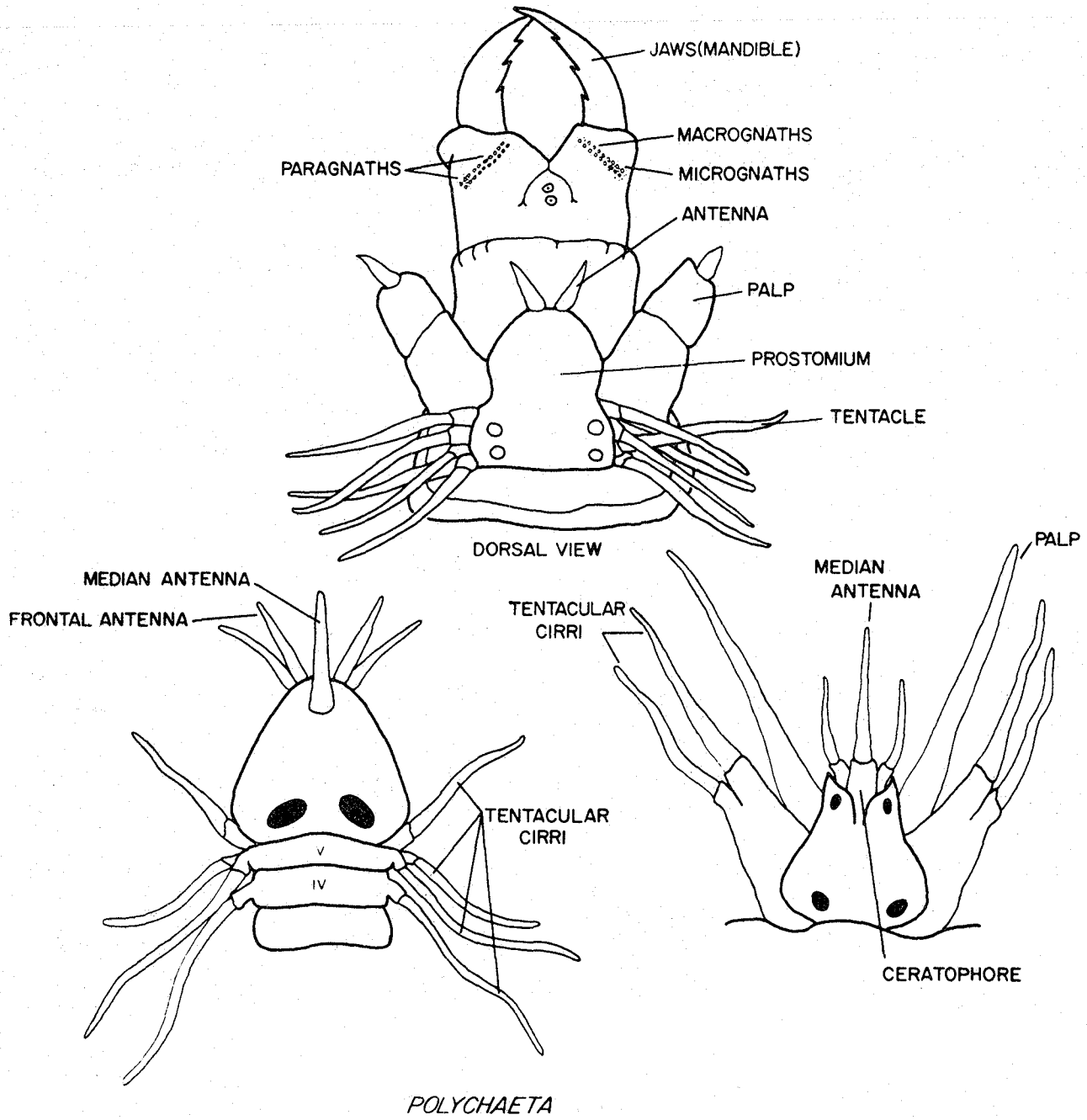
PARAPODIUM
From Posterior



HEAD
Dorsal View

POLYCHAETA

PLATE 7



POLYCHAETA

PLATE 8

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Part V. PHYLUM MOLLUSCA

Phylum Mollusca: Body generally bilaterally symmetrical; chiefly unsegmented; body soft and covered by a mantle which often secretes a calcareous shell of one to several parts; usually provided with a head and ventral muscular foot; mantle cavity encloses gills or lung-like structures; digestive system complete, coiled or U-shaped, sometimes with a radula; fertilization internal or external; development with larval stages or direct; terrestrial, fresh water or marine.

Class Pelecypoda: Shell a pair of laterally symmetrical valves, usually with a dorsal hinge and ligament; paired mantle lobes enclosing laterally compressed body; usually two pairs of gills (ctenidia) in mantle cavity; posterior part of mantle modified into siphons or apertures; feet for burrowing, creeping or absent; larva a veliger or glochidium, fresh water or marine.

Order Palaeoconcha: Shells fragile, weak toothless hinge, gaping at both ends; covered by a polished, horny, brown periostracum, primitive group, no near relatives.

Family Solemyacidae
Solemya velum Say, 1822

Order Protobranchia: Filaments of each gill arranged in two divergent rows (protobranch) on opposite sides of axis; hinge simple or with similar teeth along hinge (taxodont); modified labial palps; feet with flat ventral surface; marine.

Family Nuculidae
Nucula proxima Say, 1820

Family Nuculanidae
Yoldia limatula (Say, 1831)

Order Filibranchia: Gills usually W-shaped in cross section, muscles unequal with reduced (or absent) anterior adductor and enlarged posterior adductors; often attached by byssus or cementing agent.

Family Arcidae
Anadara ovalis Bruguiere, 1792
A. transversa (Say, 1822)
Noetia ponderosa (Say, 1822)

Family Mytilidae
Modiolus demissus (Dillwyn, 1817)
Amygdalum papyria (Conrad, 1846)
Mytilus edulis Linné, 1758

Family Pectinidae
Aequipecten irradians (Lamarck, 1819)

Family Anomiidae
Anomia simplex Orbigny, 1845

Family Ostreidae
Crassostrea virginica (Gmelin, 1792)

Order Eulamellibranchia: Gill W-shaped, reflexed lamellae of each half (demibranch) joined at regular intervals by vascular tissue connections forming enclosed spaces; two adductor muscles of same size.

Family Astartidae
Astarte undata Gould, 1841

Family Leptonidae
Mysella planulata Stimpson, 1857

Family Carditidae
Venericardia borealis (Conrad, 1831)

Family Cardiidae
Trachycardium muricatum (Linné, 1758)

Family Veneridae
Mercenaria mercenaria (Linné, 1758)
Pitar morrhuana (Linsley, 1845)
Gemma gemma (Totten, 1834)

Family Petricolidae
Petricola pholadiformis Lamarck, 1818

Family Tellinidae
Tellina agilis Stimpson, 1858
T. versicolor (DeKay 1844)
Macoma balthica (Linné, 1758)
M. tenta (Say, 1834)

Family Semelidae
Abra aequalis (Say, 1822)

Family Donacidae
Donax fossor Say, 1822

Family Teredinidae
Bankia gouldi Bartsch, 1890
Teredo navalis Linné, 1758

Family Sanguinolariidae
Tagelus divisus (Splenger, 1794)
T. plebeius (Solander, 1786)

Family Solenidae
Solen viridis Say, 1822
Ensis directus Conrad, 1843
Siliqua costata (Say, 1822)

Family Mactridae
Spisula solidissima (Dillwyn, 1817)
Mulinia lateralis (Say, 1822)
Rangia cuneata (Gray, 1831)

Family Myacidae
Mya arenaria (Linné, 1758)

Family Corbulidae
Corbula contracta Say, 1822

Family Pholadidae
Cyrtopleura costata (Linné, 1758)
Barnea truncata (Say, 1822)

Family Lyonsiidae
Lyonsia hyalina (Conrad, 1831)

Family Pandoridae
Pandora gouldiana Dall, 1866

Class Amphineura: elongated, bilaterally symmetrical molluscs with mouth and anus terminal. Mantle very extensive covering the dorsal surface and sides. Heart dorsal and posterior with ventricle and lateral auricles. Nervous system with longitudinal (ganglionic) pallial and pedal cords with cross anastomoses. Amphineura are exclusively marine, most of whose members are the familiar "chiton."

Order Polyplacophora: Chitons have a flattened oval-shaped body covered dorsally by a shell consisting of eight transverse valves surrounded by a leathery or fleshy girdle. The valves are of three types - the head or anterior, six central or median, and the tail or posterior valve numbering one to eight. The median valves are divided into two lateral and two central areas connected by a dorsal area which may project posteriorly into a beak. The posterior valve is divided into two areas -- the ante-mucronal and post-mucronal -- separated by the central projection or mucro. Classification of the chitons is in a "fluid" state and probably will continue for some time. Most present-day systems stem largely from Pilsbry's Manual of Conchology Vol. 14-16 (1892-94).

Flattened littoral or sublittoral Amphineura with a broad ventral foot; the mantle bearing eight transverse shell plates, bordered by a spiculose or scaly girdle. Ctenidia multiplied into numerous pairs, adjacent ones functionally associated so dividing each pallial groove into anterior and outer inhalant, and posterior and inner exhalant cavities. Characteristically intertidal.

Family Chaetopleuridae
Chaetopleura apiculata (Say, 1830)

Class Gastropoda: Asymmetrical molluscs with a well-developed head and, at least primitively, a broad flattened foot. The shell is in one piece, coiled in a helical spiral at least in the young stages. The viscero-pallium has undergone torsion of 180 degrees; because of its asymmetrical coiling (distinct torsion) the palliopericardial complex is usually reduced and one-sided.

Subclass Prosobranchia: Generally aquatic gastropods with the visceral mass retaining pronounced torsion and the visceral loop crossed into a figure eight. The head carries a single pair of tentacles with eyes at the base. The spiral shell is closed by an operculum. The

mantle cavity contains primitively two ctenidia but usually there is reduction to one (posttorsional left). The solitary gonad opens on the right, either through the right kidney (where the left one is suppressed) or through the renal duct (where the left kidney is retained and functional). In the latter case the genital ducts become elaborate. Usually a free-swimming veliger larva.

Order Mesogastropoda: Organs of right side of palliopericardial complex lost. Ctenidium monopectinate (pectinibranch), osphradium well-developed, sometimes pectinate. Nervous system more concentrated. Left kidney duct with pallial glandular extensions producing egg capsules or jelly mass. Cephalic penis and internal fertilization. Usually a free-swimming veliger. Shell sometimes siphonate, carnivorous habit with eversible proboscis in some.

Family Littorinidae
Littorina irrorata (Say, 1822)
L. obtusata (Linné, 1758)
L. saxatilis (Olivi, 1792)
L. littorea (Linné, 1758)

Family Cerithiidae
Cerithiopsis greenii C. B. Adams, 1839

Family Epitonidae
Epitonium rupicolum (Kurtz, 1860)

Family Calyptraeidae
Crepidula convexa Say, 1822
C. fornicata (Linné, 1758)
C. plana Say, 1822

Family Naticidae
Polinices duplicatus (Say, 1822)
Lunatia heros Say, 1822
L. triseriata Say, 1826

Family Skeneidae
Skenea planorbis Fabricus, 1780

Order Neogastropoda: Most advanced Prosobranchia, with highly concentrated nervous system, a siphonate shell, and eversible proboscis. Carnivorous habits, feeding on living or dead animals. Free-swimming veliger usually suppressed, with embryos as a rule intracapsular, sometimes practicing embryonic cannibalism. Osphradium large, bipectinate.

Family Muricidae
Eupleura caudata (Say, 1822)
Urosalpinx cinera (Say, 1822)

Family Columbellidae
Anachis avara (Say, 1822)
A. translirata Ravenel, 1861
Mitrella lunata (Say, 1826)

Family Buccinidae
Colus pygmaea Gould, 1841

Family Melongenidae
Busycon canaliculatum (Linne, 1758)
B. carica (Gmelin, 1790)
B. perversum (Linné,)

Family Nassariidae
Nassarius obsoletus (Say, 1822)
N. trivittatus (Say, 1822)
N. vibex (Say, 1822)

Family Turridae
Mangelia cerina (Kurtz and Stimpson, 1851)

Subclass Opisthobranchis: Marine hermaphrodite Gastropoda; shell reduced, becoming internal and finally disappearing with an accompanying tendency to detorsion. the mantle cavity moving back along the right side and widely opening before final loss; also uncrossing and shortening of the visceral loop. Gill probably never a ctenidium. Calcareous spicules often developed in notum of naked forms. With loss of torsion and of asymmetrical shell, eventual return to bilateral external symmetry, with great adaptive range of form and color, feeding, and locomotion. Usually with a (reduced) free-swimming veliger.

Order Tectibranchia: Shell present or absent; a series of gills present within a mantle cavity on right side or dorsally; a pair of enrolled or tubular rhinophores usually present anteriorly, many species ectoparasitic.

Family Acteonidae
Acteon punctostriatus C. B. Adams, 1840

Family Atyidae
Haminoea solitaria (Say, 1822)

Family Retusidae
Retusa canaliculata (Say, 1822)
R. obtusa Montagu, 1808

Family Pyramidellidae
Odostomia (*Odostomia*) *gibbosa* Bush
O. (*Menestho*) *impressa* Say, 1822
O. (*Chrysallida*) *seminuda* C. B. Adams, 1840
Pyramidella (*Syrnola*) *fusca* C. B. Adams, 1840
Turbonilla (*Pyrgiscus*) *interrupta* Totten, 1835

Order Nudibranchia: Shell absent; true ctenidium absent but body usually provided with dorsal processes and/or secondary gills (branchiae); anterior part of dorsum usually bears a pair of rhinophores; exceedingly diverse in color, form and sizes.

Family Coramidae
Doridella obscura (Verrill, 1870)

Family Lamellidorididae
Acanthodoris pilosa (Abildgaard, 1789)
Onchidorus aspera (Alder and Hancock, 1842)

Family Eubranchidae
Eubranchus pallidus (Alder and Hancock, 1842)

Family Cuthonidae
Tergipes despectus (Johnston, 1835)
Tenellia fuscata (Gould, 1870)

Family Cratenidae
Cratena pilata (Gould, 1870)

Subclass Pulmonata: Hermaphrodite Gastropoda, with no ctenidium, with mantle cavity vascularized

as a lung. A small contractile pallial aperture. Detorsion seldom complete, but nervous system concentrated to lose all trace of chiastoneury. Shell and visceral mass primitively spiral but may assume slug-like form.

Order Basommatophora: Amphibious molluscs, air breathers, dependent on moisture, shell spiral with horny epidermis, aperture long, with strong folds on inner lip, outer lip often toothed or grooved inside.

Family Ellobiidae
Melampus bidentatus Say, 1822

Class Cephalopoda: Bilaterally symmetrical Mollusca with circle of tentacles round the head. Circulation in the mantle cavity reversed with epipodium modified to form a pallial funnel through which passes the concentrated exhalant current and serves for jet populsion. Nervous system greatly concentrated and highly organized sense organs. With higher metabolism than other Mollusca.

Order Decapoda: Tentacular retractile arms in addition to eight normal arms which are shorter than the body. Suckers pedunculate with horny rings. Internal shell relatively well-developed. Squids and cuttlefish.

Loligo pealei Lesueur, 1821
Lolliguncula brevis Blainville, 1823

Order Octopoda: Eight uniform arms longer than the body, with nonpedunculate suckers. The mantle encloses the viscera in a rounded muscular sac, and the internal shell is lacking, although the female Argonauta has an external "shell" secreted by the dorsal arms.

Octopus vulgaris Lamarck, 1798

Key to the Pelecypoda of the Delaware Bay Region
(Modified from Keen 1965, Turgeen 1968)
For terminology, see Plate 9.

1. Shell with an apophysis or myophore in both valves. 2

   No apophysis or myophore present. 6

2. Anterior end indented by an angular notch; wood burrowers . . 3

   Anterior end arcuate or evenly curved 4

3. Siphons ending in paddle-shaped pallets . .Teredo navalis

   Siphonal pallets cone-in-cone shaped. . . . Bankia gouldi

4. Valve sculpture divided into two clear cut areas; left valve with three cardinal teeth, two cardinals in right; anterior 10-12 radial ribs prominent, common burrower in clay and moss, maximum size 5.0 cm. . . . . Veneracea . . . . . Petricola pholadiformis

   Valves not divided into clear cut areas 5

5. Shell rectangulate, anterior pointed, posterior truncate; protoplax calcareous; mesoplax lacking, gaping at both ends, radial ribs, maximum size 6.5 cm. Barnea truncata

   Shell oval, rounded at both ends; protoplax chitinous; mesoplax lying anterior to protoplax, with about thirty well-developed beaded radial ribs, heavier and scale like at anterior end, maximum size 20 cm. . . . . Cyrtopleura costata

6. Hinge with taxodont dentition 7

   Hinge other than taxodont 11

7. Ligament confined to a central pit. . Nuculacea 8

   Ligament not confined to a central pit. . Arcacea 9

8. Shell symmetrical, obliquely ovate, closing tightly, pallial sinus lacking, maximum size 1.5 cm. . . . . .Nucula proxima

   Shell asymmetrical, elongate, gaping widely pallial sinus deep; maximum size 6.5 cm . . . . . Yoldia limatula

9. Left valve extending slightly beyond right; beaks closely or moderately separated and directed toward anterior or center of shell; adductors impressed 10

   Left valve not extending beyond right; beaks widely separated and directed posteriorly; adductors elevated; 25-38 square ribs with medial line, scars elevated; maximum size 6.5 cm . . . . . .Noetia ponderosa

10. Beaks directed centrally, moderately separated; external ribs beaded; shell rhomboidal-ovate; maximum size 4.0 cm. . . . . .Anadara transversa

    Beaks directed anteriorly, nearly touching; external ribs square; shell roundly ovate; black-brown, hairy periostracum maximum size 6.0 cm . . . . . .Anadara ovalis

11. Dorsal margin produced anteriorly and posteriorly into triangular ears, well developed corrugated ribs, may swim via "jet propulsion," maximum size 7.5 cm . . . . . Pectinacea, Aequipecten irradians

    Dorsal margin not eared 12

12. Adductor muscle scars coalesced, appearing as one large scar near center of shell 13

    Adductor muscle scars separated, opposite ends of shell . . .14

13. Right (lower) valve with a prominent hole for calcified byssal attachment to substrate; upper valve thin, translucent, smooth; single adductor divided into one large scar and two accessory scars, maximum size 5.0 cm. . . . . Anomiacea, Anomia simplex

    Neither valve perforated; animal attached to substrate by left valve; valves thick, opaque, rough, commonly occupied by other epifauna; adductor scar undivided, maximum size 15.0 cm. . . . . .Ostreacea, Crassostrea virginica

14. Hinge plate without true teeth or other interlocking projections; irregular denticles may be present 15

    Hinge plate with projecting teeth or a chondrophore 20

15. Adductor muscle scars very unequal in size; anterior smaller, near beaks . . . Mytilacea 16

    Adductor muscle scars approximately equal in size (not necessarily in shape) 18

16. Beaks terminal, shell firm, opaque; hinge with 3-12 crenulations, umbones at anterior tip; color blue-black, occurs in reeflike clusters, maximum size 7.5 cm. . . . . .Mytilus edulis

Beaks near anterior end but not terminal. 17

17. External of valves with bifurcate ribs; hinge lacking crenulations, common in salt marshes; maximum size 10.0 cm . . . . . .Modiolus demissus

Shell fragile, transparent; hinge lacking crenulations, umbones a few mm from anterior tip; color light gray, yellow-brown to red-brown; maximum size 3.0 cm, normally smaller. . . . . Amygdalum papyria

18. Periostracum prolonged as a fringe beyond margins of shell; fragile shell, elongate, gaping at both ends; delicate, shiny, brown periostracum, light radial bands of yellowish-brown may be present, maximum size 2.5 cm . . . . . Solemyacidae, Solemya velum

Periostracum, if present not prolonged beyond margins . . . . . Anomalodesmacea 19

19. Sinus slight; shell elongate-oval; posterior drawn out and pointed; moderately obese anteriorly; hinge lacking protuberances; periostracum thin with numerous radial lines; contains agglutinated sand grains; shell thin and fragile, semi-translucent, whitish to tan, maximum size 2.5 cm . . . . . Lyonsia hyalina

Sinus represented by series of separate, small muscle scars; shell crescent-shaped, flat; posterior drawn out into short, stubby, turned up rostrum; shell is opaque and chalky, hinge with protuberances functioning as teeth; periostracum inconspicuous, lacking agglutinations, maximum size 3.5 cm . . . . . Pandora gouldiana

20. Valves elongate, razor shaped 21

Valves otherwise. 24

21. Beaks at or near anterior end . . . Solenacea 22

Beaks sub-central . . . . . Tellinacea. 23

22. Two cardinals and one lateral in left valve, one cardinal and one lateral in right valve; dorsal and ventral margin curving dorsally; maximum size 25 cm. . .Ensis directus

One cardinal in each valve, laterals lacking; dorsal and ventral margins straight, maximum size 5.0 cm . . . . . Solen viridis

Beaks in anterior fourth of shell; right valve with bifid lateral tooth; shell ovate-elongate; internal raised rib for support; periostracum smooth glossy; shell thin, fragile; maximum size 6.3 cm. . . . . Siliqua costata

23. Pallial sinus equal in size extending to midline; shell oblongate with anterior truncate, with large bulbous callus behind cardinal teeth, umbones somewhat posterior to center, moderately thick shell, maximum size 10.0 cm . . . . . Tagelus plebius

Pallial sinus equal in size; shell elongate, fragile smooth, umbones nearly central, obscure weak radial rib running across the center of the valve just anterior to the two small cardinal teeth, maximum size 4.0 cm . . . . . Tagelus divisus

24. Valves with well developed radial ribs. 25

If radial ribs present, weak or faint 26

25. Lateral teeth present, valves each with two cardinals and two laterals; ligament external; byssus lacking, 30-40 radiating ribs sculptured with small spines; maximum 5.0 cm. . . .Cardiacea, Trachycardium muricatum

Lateral teeth absent; hinge with two cardinal teeth in the left and three in the right valve; shell thick, 18-20 well developed, rounded, radiating ribs, periostracum brown or black; margin crenulated; maximum size 2.5 cm . . . . . Carditacea, Venericardia borealis

26. Hinge with a chondrophore or a large mostly horizontally projecting tooth in one valve, a socket or gap in the other 27

Hinge with similar tooth structures in either valve 28

27. Equivalve, evenly ovate; large, spoon-shaped, projecting chondrophore in left valve; anterior adductor elongate-suboval, pallial sinus somewhat V-shaped, shell elliptical; periostracum thin and light-gray to straw; maximum size 15.0 cm. . . . . .Myacea, Mya arenaria

Inequivalve, single slender cardinal tooth; valves unequal; anterior end rounded, somewhat pointed posteriorly; basal margin contracted in middle; has many concentric raised lines or ribs; maximum size 12.0 cm . . . . . Corbulacea, Corbula contracta

28. With a conspicuously developed pallial sinus. 29

Pallial line entire or obscure. 39

29. Chondrophore present. . . . . Mactracea 30

Chondrophore lacking. 32

30. Ligament external and internal; chondrophore large, broad, spoon-shaped; lateral teeth bear serrated or saw-teeth ridges, thick and brittle shell, maximum size 17.5 cm . . . . . Spisula solidissima

Ligament internal; chondrophore small, triangular; laterals lacking serrations 31

31. Shell triangulate with distinct external radial ridge; periostracum thin, yellow-brown left valve with two laterals, right with four; moderately obese; beaks quite prominent, near center of shell, maximum size 2.5 cm. . . . . Mulinia lateralis

Shell obliquely ovate, strong ridge lacking; periostracum strong, gray-brown; left valve with two laterals, right with three; beaks near anterior end, high, inrolled, pointing downward and anteriorly, maximum size 6.5 cm . . . . . .Rangia cuneata

32. Cardinal teeth stout, well developed, form conspicuous wedge-shaped bifid tooth. . . Veneracea 33

Cardinal teeth distinct but not stout, form distinct Λ shaped bifid tooth. . . . . Tellinacea. 35

33. Hinge with laterals lacking or with obsolescent knob in anterior of left valve; periostracum distinct; species moderately large. 34

Hinge with two distinct laterals; periostracum inconspicuous; exterior polished, color whitish to tan with purplish over beak, pallial sinus about length of posterior muscle scar; it points upward; maximum size 1.0 cm . . . . . Gemma gemma

34. Lateral teeth lacking; margins crenulate; pallial sinus shallow, left middle (cardinal) tooth split, numerous concentric lines of growth or small riblets; shell heavy and quite thick, moderately inflated, numerous, heavy growth lines; maximum size 4.0 cm . . . . . Mercenaria mercenaria

Anteriorlateral tooth in left valve knoblike; margins smooth; pallial sinus deep, posterior right cardinal tooth split, moderately inflated, numerous, heavy growth lines; maximum size 4.0 cm . . . Pitar morrhuana

35. Shells light or fragile; each valve with two cardinals, one lateral or none; margins smooth 36

Shells moderately heavy, firm; left valve with two cardinals and two laterals, right valve with one cardinal and two laterals; margin crenulate; maximum size 2.0 cm . . . . . .Donax fossor

36. Right valve with distinct anterior lateral teeth, fragile, glossy-white externally with an opalescent sheen, ligament external and prominent, curved ventral margin, maximum size 2.0 cm . . . . . .Tellina agilis

Right valve with anterior laterals obsolescent or lacking 37

37. Shell smooth, fragile, glossy, orbicular and rather inflated, two cardinals in both valves; sometimes poorly developed, definite pallial sinus, sub-central beaks; maximum size 1.0 cm . . . . . Abra aequalis

Color white, red, pink or rayed, nearly straight ventral margin; shell is more elongate, slightly stouter, and pallial sinus is closer to anterior muscle scar than T. agilis; maximum size 2.0 cm. . . .Tellina versicolor

Pallial sinus extending further in one valve than the other, reaching nearly to anterior adductor; shell generally ovate 38

38. Shell broadly ovate, not gaping; sinus extending further toward anterior adductor in right valve; periostracum pale gray, thin; moderately compressed; maximum size 4.0 cm. . . . . Macoma balthica

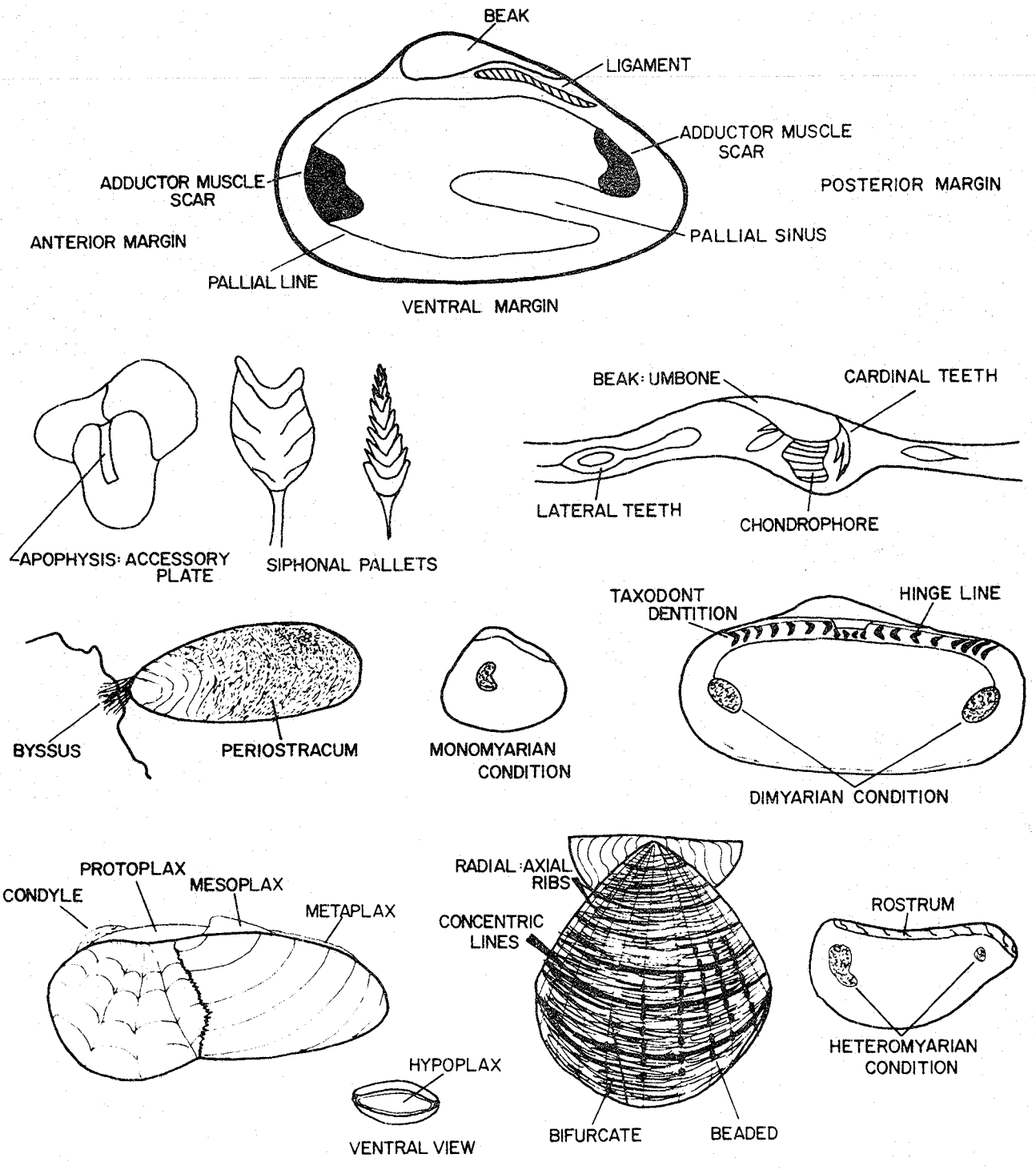
Shell oval-elongate, posterior truncate, and twisted slightly to the left, gaping moderately, maximum size 2.0 cm . . . . . .Macoma tenta

39. Hinge with two or three cardinal teeth and lateral teeth; external surface relatively smooth; shell dark brown; margin smooth, 10-25 concentric ripples; maximum size 3.5 cm. . . . Astartacea. . . . . .*Astarte undata*

Two cardinal teeth in the right valve, none in the left; well compressed, beaks small, 3/4 the distance back from the anterior end; color white with thin, nut brown smoothish periostracum; maximum size 1.0 cm . . . . . *Mysella planulata*

Additional species which may be found in Delaware waters:

Abra lioica (Dall, 1881)
Aligena elevata (Stimpson, 1851)
Arctica islandica (Linné, 1758)
Astarte castanea Say, 1822
Brachidontes recurvus (Rafinesque, 1820)
Cardiomya gemma (Verrill and Bush, 1898)
Cerastoderma pinnulatum (Conrad, 1831)
Congeria leucopheata (Conrad, 1831)
Corbula swiftiana (C. B. Adams, 1839)
Cumingia tellinoides (Conrad, 1831)
Cyclinella tenuis (Recluz, 1852)
Diplothyra smithii (Tryon, 1862)
Divaricella quadrisulcata (d'Orbigny, 1842)
Dosinia discus (Reeve, 1850)
Hiatella arctica (Linné, 1767)
Labiosa (*Labiosa*) *plicatella* Lamarck, 1818
Laevicardium mortoni (Conrad, 1830)
Lucina multilineata (Tuomey and Holmes)
Macoma phenax Dall, 1881
Modiolus modiolus (Linné, 1758)
Musculus niger (Gray, 1824)
Nucula annulata Hampson, 1971
Nuculana acuta (Conrad, 1831)
Parastarte triquetra Conrad, 1831
Phacoides filosus (Stimpson, 1851)
Placopecten magellanicus (Gmelin, 1791)
Thyasira gouldi (Philippi, 1845)
T. trisinuata (d'Orbigny, 1842)
Yoldia sapotilla (Gould, 1841)



Bivalvia

PLATE 9

Key to the Gastropoda of the Delaware Bay Region
(Portions from Keen 1965, Kraeuter 1966)
For terminology, see Plates 10 & 11.

1. Shell not present . . . . . Order Nudibranchia. 2

   Shell present 8

2. With branchial plumes arranged in circle about the anus; anus located medially on the posterior dorsal half of the body; with single pair of tentacles 3

   Without circlet of branchial plumes as above; other dorsal processes (pallial outgrowth) present or absent; with one or two pairs of tentacles 4

3. Branchial plumes singly pinnate; mantle distinct from foot, body white or occasionally slightly yellowish; branchial plumes about 11, arranged in circle close to anus; dorsal surface covered with numerous knobbed tubercles of variable size. . . . . Onchidoris aspera

   Branchial plumes doubly pinnate (or imperfectly tripinnate); mantle distinct from foot; dorsal surface thickly covered with numerous soft, slender, conical papillae of almost uniform size. . . . . Acanthodoris pilosa

4. Cerata (dorsal processes which contain as a central core a branch of the digestive gland) absent, with a pair of small ctenidia between mantle and foot at posterior end of body in the midline; mantle covers entire body, including head. . . . . Doridella obscura

   Cerata present. 5

5. Single pair of tentacles (oral tentacles lacking), tentacles arising directly from head (without basal sheaths); cerata simple and without tubercles . .Tenellia fuscata

   Two pair of tentacles (both oral and dorsal tentacles present). 6

6. Anterior lateral corners of foot extended and sharply acutely angled, dorsal tentacles smooth or slightly wrinkled, not annulated; body pale gray with white margins, and with 3 longitudinal reddish to russet interrupted stripes on head and anterior part of body . . . . . .Cratena pilata

   Anterior angles of foot rounded 7

7. Cerata fairly numerous (at least 30 to 50 on a side), oral tentacles about half as long as dorsal tentacles; cerata ovoid or ovate, much inflated, some compressed . . . . . Eubranchus pallidus

Cerata few (4 or 5 on a side); set in a single longitudinal row on each side; cerata smoothly (not abruptly) tapering; body transparent white, not spotted, sometimes striped anteriorly with two lateral reddish streaks; tentacles not banded. . . . . .Tergipes despectus

8. Shell cap-shaped or patellate; no key-hole like aperture at the apex . . . . . see key for CALYPTRAEIDAE

Shell bulloid; spire concealed; aperture as long as shell; sides of whorls globose; amber to whitish, 1.5 cm size. . . . . .Haminoea solitaria

Shell otherwise 9

9. Shell obconic; two upturned denticulations shorter than the upturned columellar fold; 4-5 whorls, common in salt marsh; 1.5 cm size. . . . . Melampus bidentatus

Shell otherwise 10

10. Spire apparent, slightly or moderately elevated; aperture not full length of shell; glossy smooth, suture slightly channeled; 1.0 cm size. . . . . Retusa canaliculata

Siphonal canal or notch not present; margin entire. 11

Siphonal canal or notch present; margin not entire. 15

11. Shell turriform 12

Shell otherwise 13

12. Whorls well rounded; definite subcontinuous axial ribs; heavier more elevated ribs at intervals; no fine lines between ribs; 11 globose whorls, 12 to 18 ribs; 2.5 cm size. . . . . Epitonium rupicolum

Whorls not well rounded; or axial ribs absent, shells minute. . . . . .see key for PYRAMIDELLIDAE

13. Shell minute, white, body whorl marked on lower half with numerous revolving lines composed of punctate dots; size 1 cm or less . . . . . Acteon punctostriatus

Shell without punctate lines; larger than 1 cm. 14

14. Umbilicus not present; heavy shell; may have spiral rows of brown dots when wet. . . . .see key for LITTORINIDAE

Umbilicus present, no spiral rows of brown dots . . . . . see key for NATICIDAE

15. Shell minute, turriform; inconspicuous short anterior canal or notch; whorls ornamented by spiral sculpture of spiral tubercles, shell with two to three rows of large beads per whorl; 14 whorls, 2 cm size . . . . . Cerithiopsis greeni

Size variable, but if minute not turriform; or the spiral sculpture has been replaced by varices or ribs so only final spiral lines are present. 16

16. Anterior canal reduced to a notch or nearly so; columella not denticulate; aperture oval. see key for NASSARIIDAE

Anterior canal not reduced to a notch 17

17. Shell large, fusiform; anterior canal long; body whorl at least two-thirds total length .See key for MELONGENIDAE

Shell size variable; anterior canal short to moderately long; body whorl less than two-thirds total length. 18

18. Shell small, outer lip thickened and inner surface of lip denticulate; exterior polished. . . . . see key for COLUMBELLIDAE

Shell size variable, surface unpolished; outer lip lacking denticulations. 19

Shell with a narrow deep umbilicus and a nearly smooth exterior, flattened spiral almost in one plane; 5 mm in diameter . . . . . .Skenea planorbis

19. Small shell, outer lip having a slit or notch at the upper angle near but not on the suture; siphonal canal reduced, 10 axial ribs tapering off toward the sutures; spiral sculpture fine; 7 whorls well shouldered; 1.5 cm size . . . . . Mangelia cerina

Size variable; outer lip lacking a slit or notch at the upper angle, but may be on the suture, forming a distinct anal canal in some species; in others this is lacking; all have a conspicuous siphonal canal . . . . . see key for MURICIDAE

Size small, spire smooth or with spiral sculpture only, light olive gray, thin, velvety periostracum; 6 to 7 whorls, fairly fragile, 1.5 cm size . . . Colus pygmaea

CALYPTRAEIDAE

1. Shell convex or flat; interior and exterior white, apex rarely turned to one side; 3 cm size. . Crepidula plana

Shell convex, high backed; interior polished, mottled purple brown mixed with white 2

2. Horizontal partition concave, white to buff, extends over posterior half on inside of shell, edge sinuate or waved in two places; shape variable, 5 cm size. . . . . Crepidula fornicata

Horizontal partition convex, chestnut to bluish brown, edge is almost straight, small muscle scar just under outer corner of deck, shell usually highly arched; 2 cm size . . . . . Crepidula convexa

COLUMBELLIDAE

1. Shell with axial ribs or plications 2

Shell without axial ribs or plications, glossy, smooth; marked with fine, axial, zig-zag stripes; 1 cm size . . . . . Mitrella lunata

2. Shell with about 12 axial ribs on upper 1/2 of whorl; spiral lines weak or lacking; 1.5 cm size . . . . . Anachis avara

Shell with about 24 axial ribs on entire whorl; spiral lines strong; 1.5 cm size . . . . . Anachis translirata

LITTORINIDAE

1. Shell flattened with a low spire. 2

Shell with moderate to high spire 3

2. Shell surface smooth, shiny; suture faint, outer lip acute; operculum bright yellow to orange brown, variable body color, columella whitish; 2 cm size .*Littorina obtusata*

   Shell solid and thick, 4-5 whorls; sculptured with raised revolving lines of growth, yielding a rough shouldered appearance, drab gray and banded with hues varying from yellow to brown and black; 1.5 - 2 cm size. . . . . *Littorina saxatilis*

3. Shell solid, slightly glossy, acute apex, 6-7 whorls, color red-black or brown; fine irregularly spaced spiral threads, common on rocky coast or jetties; size 2.5 cm . . . . . .*Littorina littorea*

   Shell heavy build, 5 whorls, moderate spire, chalk-like surface, outer lip slightly flared; numerous regularly formed spiral grooves, yellowish-white, streaks of reddish brown; common in salt marsh; size 2.5 cm . . . . . .*Littorina irrorata*

MELONGENIDAE

1. Shell heavy; shoulder with low strong tubercles, felt-like periostracum, lacking channelled suture; about 22 cm maximum size; shell spirals to the right. . . . . .*Busycon carica*

   Shell thinner; tubercles on shoulder very small or absent; felt-like periostracum; suture with wide channel; 17 cm size . . . . . *Busycon canaliculatum*

   Shell thick; tubercles on shoulder strong; shell spirals to the left . . . . . *Busycon perversum*

MURICIDAE

1. Siphonal canal nearly closed; aperture small, rounded; outer lip heavy, whorls with spiral cords and strong axial ribs; 2.5 cm size . . . . . .*Eupleura caudata*

   Siphonal canal more or less open for its full length; outer lip relatively thin, without varices; 9-12 axial ribs per whorl; 2.5 cm size . . . . .*Urosalpinx cinerea*

NASSARIIDAE

1. Outer lip thin and sharp; whorls in spire with 4 to 5 rows of strong distinct beads, suture slightly channeled or impressed; 2.0 cm size . . . . Nassarius trivitattus

   Outer lip not thin and sharp. 2

2. Shell heavily eroded, forming axial ridges in older specimens, often covered with a light coat of green alga; shell brown-black; aperture deep purple in young; common on mud flats and tidal creeks; 2.5 cm size. . . . . .Nassarius obsoletus

   Shell light colored, gray to gray brown; beaded; no axial ridges from erosion and no algal mat; outer lip heavy; 1.5 cm size . . . . . Nassarius vibex

NATICIDAE

1. Shell considerably wider than high with flat spire; clean bluish-gray, with obvious purple (or more rarely brown or pink) callus almost completely occluding umbilicus, forming a button; up to 7.5 cm diameter; often abundant intertidally and in shallow water .Polinices duplicatus

   Shell without callus occluding umbilicus. 2

2. Shell with 3 spiral rows of bluish or reddish-brown, squarish spots on each whorl. . . . .Lunatia triseriata

   Shell dirty-white to brown in color; no spots on the shell . . . . . Lunatia heros

PYRAMIDELLIDAE

1. Shell sculpture predominantly axial ribs; with some spiral lines; pale wax yellow color; 5 mm size . . . . . Turbonilla (Pyrgiscus) interrupta

   Shell sculpture not predominantly axial ribs. 2

2. Shell with tubercles formed from cross ridges and revolving lines; cross ridges terminate abruptly about middle

of body whorl, while revolving lines continue to the aperture, 6-7 whorls; 5 cm size . . . . . .Odostomia (Chrysallida) seminuda

Shell without tubercles 3

3. Shell smooth, elongate to sub-globular; aperture large and ear-shaped. 4

With 7-8 whorls, shell with three deeply cut spiral grooves: base well rounded marked by seven spiral grooves, columella stout with strong oblique fold at insertions: 5 mm size . . . . . Odostomia (Menestho) impressa

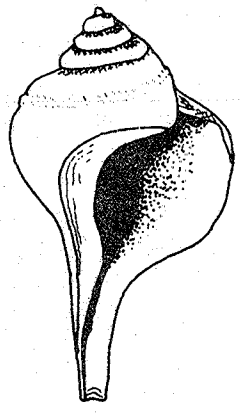
4. Body with 6-7 whorls; shell light brown; last whorl little larger than preceding whorl; shell elongate. . . . . Pyramidella (Syrnola) fusca

Body with 5-6 whorls; shell shiny, yellowish: last whorl much larger than preceding whorl; shell sub-globular. . . . . Odostomia (Odostomia) gibbosa

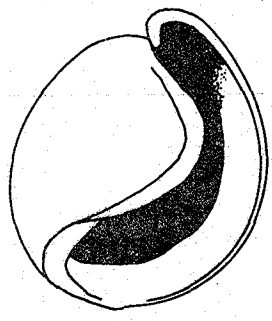
Additional species which may be found in Delaware waters:

Acteon exilis Jeffreys, 1870
Aeolidia papillosa (Linné, 1761)
Alderia modesta (Loven, 1844)
Alvania aculeus (Gould, 1841)
Aplysia willcoxi Heilprin, 1886
Bittium alternatum (Say, 1822)
B. varium Pfeiffer, 1840
Catriona aurantia (Alder and Hancock, 1842)
Caecum cooperi Smith, 1860
C. puchellum Stimpson, 1851
Cerithiopsis subulata (Montagu, 1803)
Colus stimpsoni (Mörch, 1867)
Crucibulum striatum (Say, 1826)
Cylichna alba Brown, 1827
Cylichna vortex Dall, 1881
Dendronotus frondosus (Ascanius, 1774)
Diodora cayenensis (Lamarck, 1822)
Doris verrucosa Linné, 1758
Doto coronata (Gmelin, 1870)
Elysia catula Gould, 1870
E. chlorotica Gould, 1870
Epitonium multistriatum (Say, 1826)
Hermaea cruciata (Gould, 1870)
Hydrobia totteni Morrison, 1954
Lacuna vincta (Montagu, 1803)

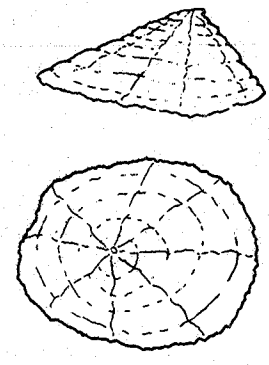
Natica clausa (Broderip and Sowerby, 1829)
N. pusilla (Say, 1822)
Mangelia plicosa C. B. Adams, 1840
Melanella intermedia (Cantraine, 1835)
Odostomia bisuturalis (Say, 1821)
Philine quadrata Wood, 1839
Philine sinuata Stimpson, 1850
Placida dentritica (Alder and Hancock, 1855)
Polycerella conyma Marcus, 1957
Polycerella emertoni Verrill, 1870
Retusa ovata Jeffreys, 1870
Scaphander nobilis Verrill, 1884
Scaphander punctostriatus Migheis, 1841
Seila adamsi (H. C. Lea, 1845)
Sinum perspectivum Say, 1831
Stiliger fuscatus (Gould, 1870)
Terebra dislocata Say, 1822
Tergipes tergipes
Triphora nigrocincta C. B. Adams, 1839
Turbonilla stricta (Verrill, 1874)



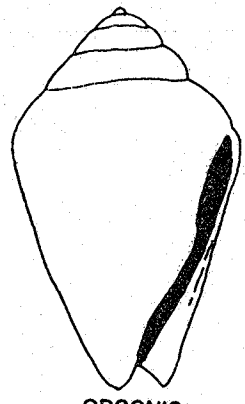
FUSIFORM



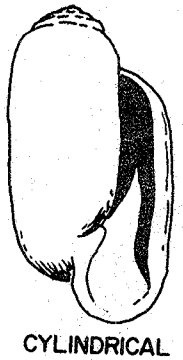
BULLOID



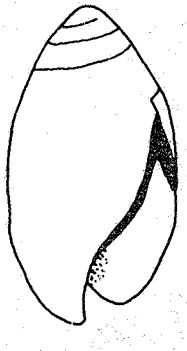
PATELLATE TENT-LIKE



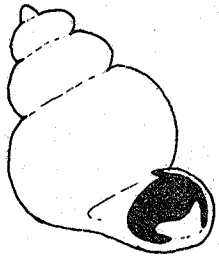
OBCONIC



CYLINDRICAL

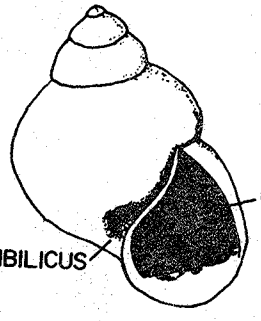


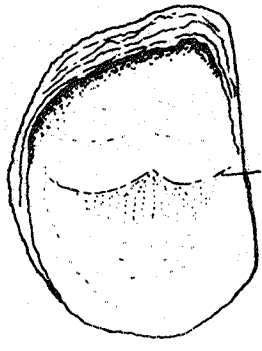
OBOVATE



TURBINATE

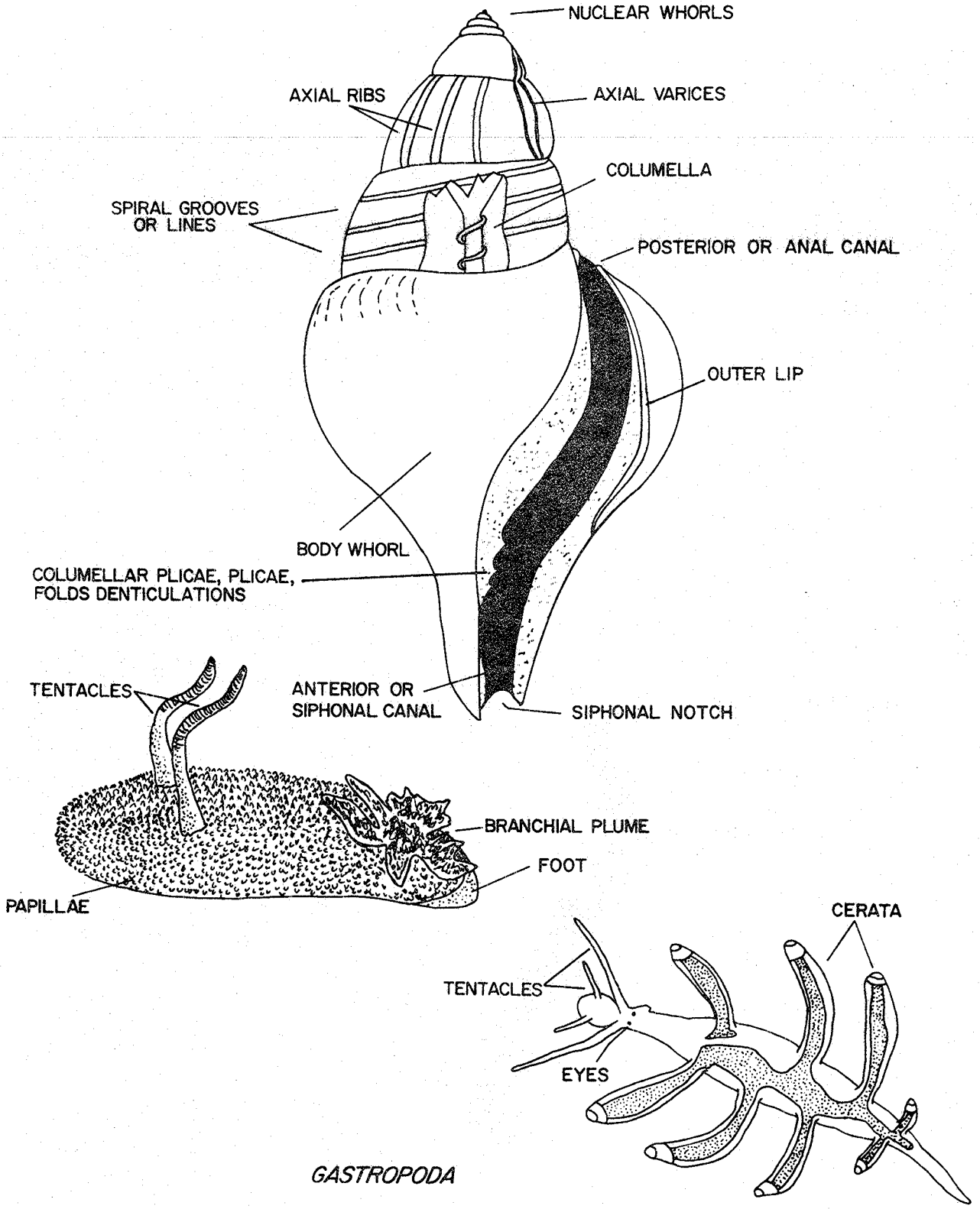
TURRIFORM
AUGER-LIKE





Gastropoda

PLATE 10



GASTROPODA

PLATE II

Key to Cephalopoda of the Delaware Bay Region

1. Body globose, usually without fins; eight arms with one to three rows of sessile suckers. . . . . .Order Octopoda, Octopus vulgaris

   Body more or less elongate, with fins; eight short arms and a pair of longer, tentacular, retractile arms, suckers pedunculate with horny rings. 2

2. Body elongate torpedo shaped, fin pattern rhomboid in adults . . . . . Loligo pealei

   Body shortened, stub-like; mantle length three to four times smaller than L. pealei; fin pattern ellipsoidal . . . . . Lolliguncula brevis

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Part VI. ARTHROPODA

Phylum Arthropoda: bilaterally symmetrical; segmented; primitively have a pair of appendages on each segment, but these are often reduced; body covered by chitinous exoskeleton; cuticle lines stomodaeum and proctodaeum; coelomic cavity greatly reduced; contractile heart is situated in dorsal pericardial sinus; cilia are completely missing throughout almost the entire phylum.

Subphylum Chelicerata: body divided into cephalothorax (prosoma) and abdomen (opisthosoma); there are no antennae; first pair of appendages are chelicerae; second pair of appendages are the pedipalpi; the following four somites bear walking legs and constitute the remainder of the prosoma; there may be a maximum of 13 segments in the opisthosoma; the gonopores are borne on the second abdominal segment.

Class Merostomata: prosoma covered by continuous dorsal carapace; flattened, respiratory appendages borne on 5 or 6 opisthosomal somites; a long, pointed telson at posterior end; a pair of simple and a pair of compound eyes.

Subclass Xiphosura: horseshoe crabs; prosoma semicircular in outline; walking legs 4-to 6-segmented; opisthosoma bears 6 pairs of book gills.

Limulus polyphemus (Linné, 1758)

Class Pycnogonida: sea spiders; large prosoma; greatly reduced opisthosoma; mouth near end of proboscis; four simple eyes; 4 pairs of legs on prosoma.

Family Pallenidae
Callipallene brevirostris (Johnston, 1837)

Subphylum Mandibulata: body of two or three sections; one or two pairs of antennae, one pair of mandibles, one or more pairs of maxillae, three or more pairs of walking legs; gills or tracheae for respiration.

Class Crustacea: predominantly aquatic; five pairs of head appendages, which are, from anterior to posterior, first antennae (antennules), second antennae (antennae), mandibles, first maxillae (maxillules), second maxillae (maxillae); body divided into sections, telson contains anus but bears no appendages; a single medial eye and a pair of compound lateral eyes are present.

Subclass Ostracoda: body without segmentation; body completely enclosed by carapace; carapace often impregnated by calcium salts; both pair of antennae used for locomotion.

Order Myodocopa: carapace with convex ventral margin; second antenna possesses exopodite with more than one segment.

Family Sarsiellidae
Sarsiella zostericola Cushman, 1906

Subclass Cirripedia: barnacles; sessile; body enclosed in a large carapace which bears calcified plates; first antennae reduced; no second antennae; mandibles without palps; six well developed thoracic appendages; mandible reduced.

Order Thoracica: six pairs of well-developed cirri; mantle usually covered with calcareous plates.

Suborder Lepadomorpha: possess stalk derived from preoral part of body.

Family Lepadidae
Lepas antifera Linné, 1758
L. fascicularis Ellis and Solander, 1786

Suborder Balanomorpha: no peduncle; sessile; tergal and scutal plates movable.

Family Chthamalidae
Chthamalus fragilis Darwin, 1854

Family Balanidae
Balanus (*Balanus*) *eburneus* Gould, 1841
B. (*B.*) *improvisus* Darwin, 1854
B. (*Semibalanus*) *balanoides* (Linne
Chelonibia patula (Ranzani, 1818)
C. testudinaria (Linné

Subclass Malacostraca: body divided into head, thorax and abdomen; head usually with stalked compound eyes; carapace usually extends over thorax; eight thoracic segments; female gonopores on sixth thoracic segment; male gonopore on eighth thoracic segment.

Superorder Hoplocarida

Order Stomatopoda: Head ends anteriorly in two movable pieces; carapace covers remainder of head; first five thoracic appendages subchelate; last three thoracic appendages simple and elongate; five pairs abdominal appendages bear gills; last appendages are uropods.

Family Squillidae
Squilla empusa Say, 1818

Superorder Peracarida: without a carapace, or with a carapace not fused to at least four thoracic somites; first thoracic somite fused with head; oostegites in female.

Order Mysidacea: transparent carapace over most of thorax; eyes stalked or absent; first thoracic and often second thoracic appendages as maxillipeds; remainder of thoracic appendages modified for swimming.

Family Mysidae
Neomysis americana (S. I. Smith, 1873)
Mysis mixta Lilljeborg, 1852
Gastrosaccus dissimilis Coifman, 1937
Mysidopsis bigelowi Tattersall, 1926
Metamysidopsis munda (Zimmer, 1918)

Order Cumacea: inflated carapace contains a gill cavity and covers first three to four thoracic somites; abdomen lacks pleopods in females and has two to five in males; mandibles without palps; body tiny.

Family Bodotriidae
Cyclaspis varians Calman, 1912

Family Leuconidae
Leucon americanus Zimmer, 1943

Family Diastylidae
Oxyurostylis smithi Calman, 1912

Order Tanaidacea: body flattened dorso-ventrally; carapace covers first two thoracic somites and enclosed lateral gill chambers; five pairs of pleopods on abdomen; body tiny.

Family Paratanaidae
Leptochelia savignyi (Kröyer, 1842)

Order Isopoda: body macroscopic, dorso-ventrally flattened; first thoracic segment fused to head; no carapace; abdominal somites often partially joined; eight pairs of uniramous thoracic legs; six pairs of biramous pleopods bear gills.

Suborder Anthuridea: body elongate, cylindrical; first pair of legs subchelate; first pair of pleopods form an operculum covering other pairs.

Family Anthuridae
Cyathura polita (Stimpson, 1855)
Ptilanthura sp.

Suborder Flabellifera: body flattened; last abdominal segment fused with telson; uropods and telson form a tail fan.

Family Sphaeromidae
Sphaeroma quadridentatum Say, 1818
Ancinus depressus (Say, 1818)

Family Cymothoidae
Irona nana Schioedte and Meinert, 1883-84
Lironeca ovalis (Say, 1818)
Aegothoa medialis Richardson, 1900
Olencira praegustator (Latrobe)

Family Cirolanidae
Cirolana concharum (Stimpson, 1853)

Suborder Valvifera: exopodite of uropods vestigial or absent; uropods ventral, form cover of a chamber containing pleopods.

Family Idoteidae
Chiridotea almyra Bowman, 1955
C. coeca (Say, 1818)
C. tuftsi (Stimpson, 1883)
C. nigrescens Wigley, 1961
Edotea triloba (Say, 1818)
Erichsonella filiformis (Say, 1818)
Idotea balthica (Pallas, 1772)

Suborder Bopyroidea: parasitic on Crustacea; body may be modified; suctorial mouthparts with piercing mandibles.

Family Bopyridae
Probopyrus pandalicola (Packard, 1879)

Order Amphipoda: body bilaterally flattened; first thoracic segment fused to head; no carapace; abdominal somites not fused; second and third thoracic legs modified as gnathopods; six pairs of pleopods.

Suborder Gammaridea: abdomen well-developed; maxilliped with palp; pleopods biramous, rarely reduced.

Family Ampeliscidae
Ampelisca abdita Mills, 1964
A. vadorum Mills, 1963
A. verrilli Mills, 1967

Family Ampithoidae
Ampithoe valida Smith, 1873
Cymadusa compta (Smith, 1873)

Family Aoridae
Lembos smithi (Holmes, 1905)
Microdeutopus gryllotalpa Costa, 1853
Leptocheirus pinguis (Stimpson, 1853)
L. plumulosa Shoemaker, 1932

Family Bateidae
Batea catharinensis Fr. Müller, 1865

Family Corophiidae
Cerapus tubularis Say, 1818
Corophium acherusicum Costa, 1857
C. acutum Chevreux, 1908
C. insidiosum Crawford, 1937
C. lacustre Vanhoffen, 1911
C. tuberculatum Shoemaker, 1934
Erichthonius brasiliensis Dana, 1853
Unciola irrorata Say, 1818
U. serrata Shoemaker, 1945
U. dissimilis Shoemaker, 1945

Family Gammaridae
Gammarus daiberi Bousfield, 1969

G. mucronatus Say, 1818
G. palustris Bousfield, 1969
G. tigrinus Sexton, 1909
Elasmopus laevis (Smith, 1871)
Melita appendiculata (Say, 1818)
M. nitida Smith, 1873

Family Haustoriidae
Haustorius canadensis Bousfield, 1962
Parahaustorius attenuatus Bousfield, 1965
P. holmesi Bousfield, 1965
P. longimerus Bousfield, 1965
Protohaustorius wigleyi Bousfield, 1965
Protohaustorius deichmannae Bousfield, 1965
Pseudohaustorius caroliniensis Bousfield, 1965
Acanthohaustorius millsi Bousfield, 1965
A. intermedius Bousfield, 1965

Family Isaeidae
Microprotopus raneyi Wigley, 1966
Photis macrocoxa Shoemaker

Family Ischyroceridae
Jassa falcata (Montagu, 1808)

Family Liljeborgiidae
Listriella barnardi Wigley, 1966

Family Lyssianassidae
Lysianopsis alba Holmes, 1905
Orchomene pinguis (Boeck, 1860)

Family Oedicerotidae
Monoculodes edwardsi Holmes, 1905

Family Phoxocephalidae
Paraphoxus spinosus Holmes, 1903
P. epistomus (Shoemaker, 1938)

Family Pleustidae
Parapleustes n. sp.

Family Stenothoidae
Parametopella cypris (Holmes, 1905)
Stenothoe minuta Holmes, 1905

Family Talitridae
Hyale plumulosa (Stimpson, 1853)
Orchestia grillus Bosc, 1802
Talorchestia megalophthalma (Bate, 1862)

Suborder Caprellidea: abdomen normally vestigial, usually lacking large pleopods or uropods; gills two or three pairs and brood lamellae two pairs each.

Family Caprellidae
Caprella andreae Mayer, 1890
C. penantis Leach, 1814
C. equilibra Say, 1818
Paracaprella tenuis Mayer, 1903
Aeginina longicornis (Kroyer, 1842-43)

Superorder Eucarida: all thoracic terga constitute the carapace; stalked eyes; thoracic legs bend between fourth and fifth segments; no oostegites.

Order Decapoda: first pereopods usually are chelipeds; three pairs of maxillipeds; last five pairs of thoracic legs are uniramous pereopods.

Suborder Natantia: body almost always laterally compressed; rostrum usually compressed and serrated; antennal scale generally large and lamellar; pleopods present in full number, used for swimming.

Family Penaeidae
Penaeus aztecus Ives, 1891

Family Palaemonidae
Palaemonetes pugio Holthuis, 1949
P. vulgaris (Say, 1818)

Family Crangonidae
Crangon septemspinosa (Say, 1818)

Suborder Reptantia: lobster-like or crab-like; abdomen and carapace depressed; pleopods reduced or absent, not used for swimming.

Section Macrura

Family Homaridae
Homarus americanus H. Milne-Edwards, 1837

Family Callianassidae
Upogebia affinis (Say, 1818)
Callianassa sp.

Section Anomura

Family Paguridae
Pagurus longicarpus Say, 1817
P. pollicaris Say, 1817

Family Hippidae
Emerita talpoida (Say, 1818)

Section Brachyura

Family Portunidae
Callinectes sapidus Rathbun, 1896
Ovalipes ocellatus (Herbst, 1799)
Carcinus maenas (Linné, 1767)

Family Cancridae
Cancer irroratus Say, 1817
C. borealis Stimpson, 1859

Family Xanthidae
Eurypanopeus depressus (Smith, 1869)
Neopanope texana sayi (Smith, 1869)
Panopeus herbsti H. Milne-Edwards, 1834
Rhithropanopeus harrisi (Gould, 1841)
Hexapanopeus angustifrons (Benedict and Rathbun, 1891)

Family Pinnotheridae
Pinnotheres ostreum Say, 1817
Pinnixa retinens Rathbun, 1818
P. sayana Stimpson, 1860

Family Grapsidae
Sesarma cinereum (Bosc, 1801)
S. reticulatum (Say, 1817)

Family Ocypodidae
Ocypode quadrata (Fabricius, 1787)
Uca minax (Le Conte, 1855)
U. pugnax (Smith, 1870)
U. pugilator (Bosc, 1801)

Family Majidae
Libinia dubia H. Milne-Edwards, 1834
L. emarginata Leach, 1815

Key to the Major Groups of Crustacea
(Modified from Light et al, 1961)
For terminology, see Plates 12 - 17.

1. Firmly attached, to solid substrate, or rarely as a parasite that is partly internal . . . . . .Subclass Cirripedia

   Free-living, or, if parasitic, generally external 2

2. With a bivalved carapace enveloping the entire body, small (not more than 2-3 mm length), with few appendages. . . . . .Subclass Ostracoda

   Carapace absent or present, but covering at most the thoracic region . . . . . Subclass Malacostraca . . 3

3. First five pairs of thoracic appendages subchelate, second pair developed as raptorial claws . . . . . Superorder Hoplocarida

   Carapace, if present, not fused with more than four thoracic segments, oostegites present. . .Superorder Peracarida . . 4

   Carapace fused with all the thoracic segments; no oostegites. . . . . Superorder Eucarida, Order Decapoda

4. Body possessing the caridoid (shrimp-like) form, with a distinct carapace over the thorax and an elongated abdomen 5

   Body having thorax and abdomen not sharply distinguishable; carapace lacking or very small. 6

5. Eyes stalked when present; carapace covering all or most of the thorax . . . . . Mysidacea

   Eyes sessile when present; carapace covering only 3 or 4 thoracic segments and inflated into a branchial chamber on each side. . . . . Cumacea

6. A small carapace present, covering 2 thoracic segments; resemble small isopods but have 1st pair of legs chelate . . . . . .Tanaidacea

   Carapace lacking. 7

7. Body usually dorsoventrally flattened; thoracic legs (except for maxilliped) essentially alike; abdominal limbs modified for respiration or swimming. . . . . Isopoda

Body usually laterally compressed; thoracic limbs of more than one form, with the second and third usually prehensile. . . . . Amphipoda

Key to the Cirripedia of the Delaware Bay Region
(Modified from Zullo, 1963)
For terminology, see Plate 12.

1. Shell attached directly to substrate. 2

   Shell attached to substrate by fleshy stalk of peduncle . . . 7

2. Eight compartmental plates visible in shell wall 3

   Six compartmental plates visible in shell wall. 4

3. Parieties thick, greater than 1/5 basal carino-rostral diameter; orifice small, with greatest diameter less than 1/2 the basal diameter of the shell. . . . . . Chelonibia testudinaria

   Parieties thin, less than 1/5 basal carino-rostral diameter; orifice large; with greatest diameter at least 1/2 basal diameter. . . . . Chelonibia patula

4. Rostrum with alae, overlapped by adjacent compartmental plates; basis membranous; intertidal. . . . . Chthamalus fragilis

   Rostral plate with radii, overlapping adjacent plates 5

5. Basis membranous. . . . .Balanus (Semibalanus) balanoides

   Basis calareous 6

6. Exterior of scutum distinctly striate longitudinally; carinal side of basal margin of tergum deeply excavated; radius covers most of ala . . . . . .Balanus (Balanus) eburneus

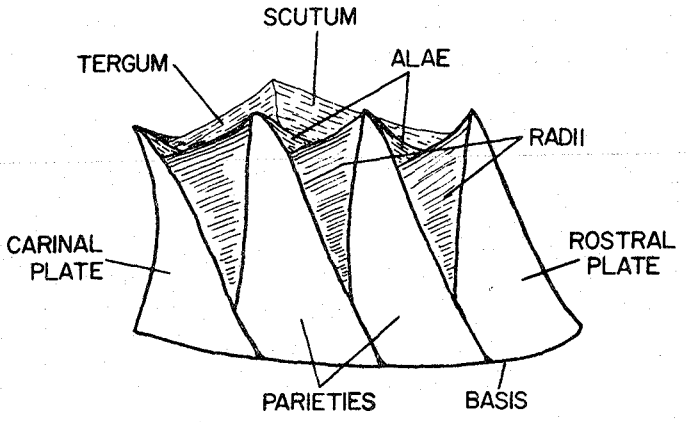
   Exterior of scutum lacking distinct longitudinal striae; turgal spur narrow, less than 1/4 width of basal margin; radius covers only a small portion of ala . . . . . .Balanus (Balanus) improvisus

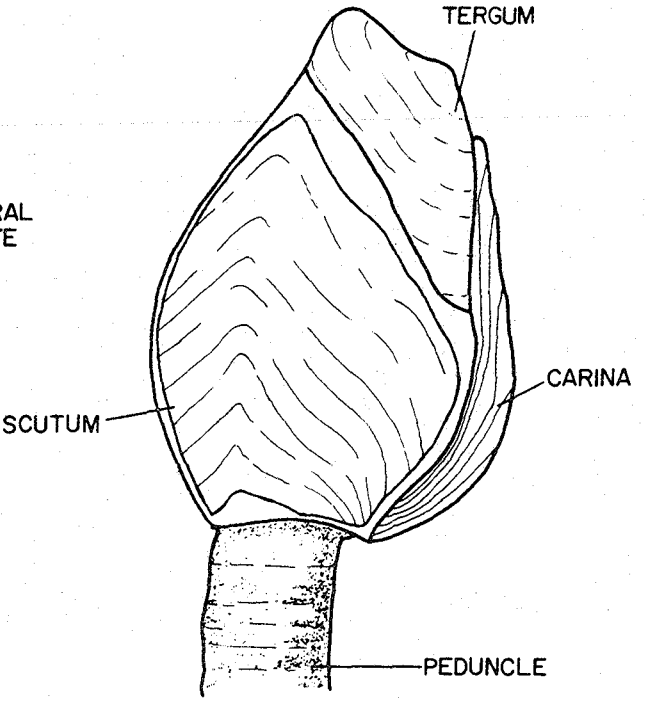
7. Carina terminating below in a flat oblong external disk, umbo projecting angularly; valves thin, papery. . . . . .Lepas fascicularis

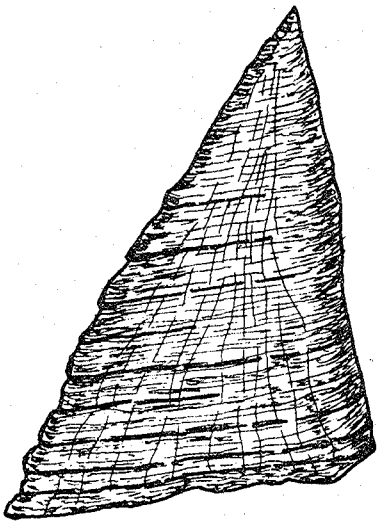
   Carina terminating below in a fork; valves well calcified; valves smooth or minutely striate. . . . . Lepas anatifera

Additional species which may be found in Delaware waters:

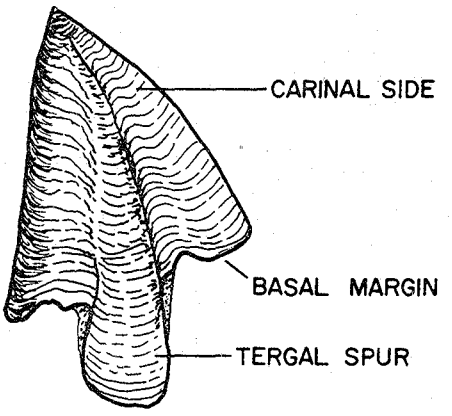
Lepas anserifera Linné, 1767
L. hilli Leach, 1818
L. pectinata Spengler, 1793
Balanus (Balanus) venustus niveus Darwin, 1854
Chelonibia caretta (Spengler, 1790)
Platylepas hexastylos (Fabricius, 1798)
Loxothylacus panopaei (Gissler, 1884)







SCUTUM EXTERIOR



TERGUM EXTERIOR

CIRRIPEDIA

PLATE 12

Key to the Mysidacea of the Delaware Bay Region
For terminology, see Plate 13.

1. Telson cleft. 2

   Telson entire 3

2. Lateral margin of telson with less than 15 spines . . . . . *Gastrosaccus dissimilis*

   Lateral margin of telson with more than 30 spines . . . . . *Mysis mixta*

3. Lateral margin of telson with spines along the whole length . 4

   Lateral margin of telson with proximal two-thirds smooth and without spines. . . . . *Metamysidopsis munda*

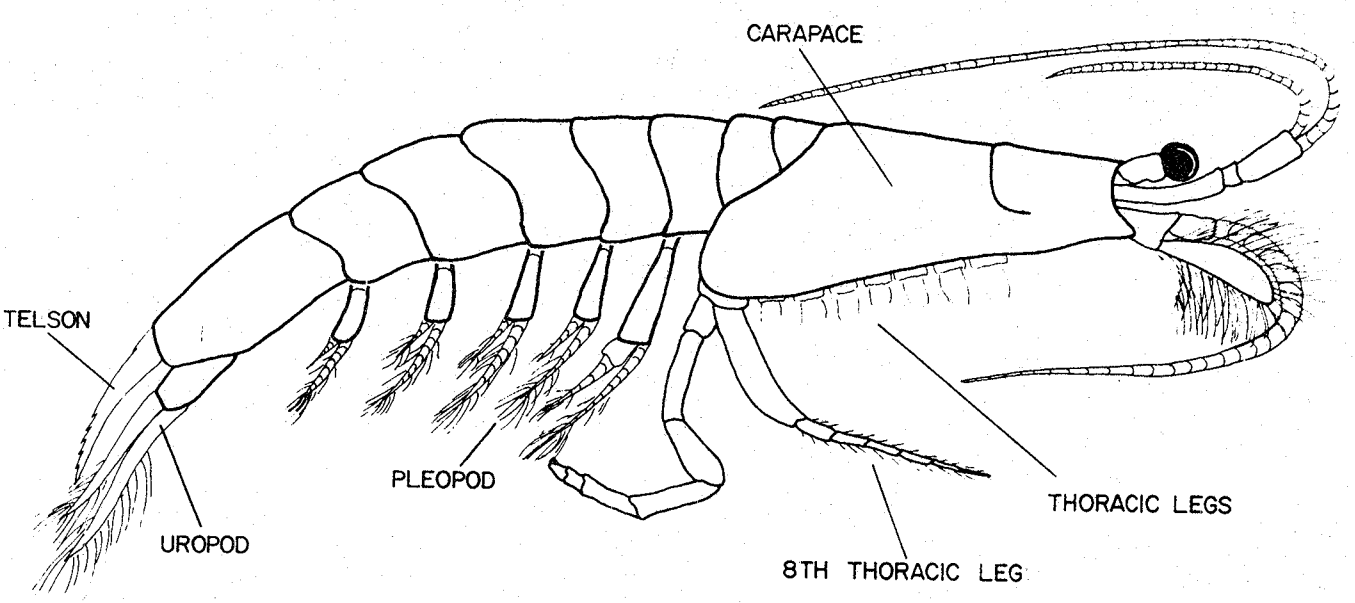
4. Lateral margin of telson with about 12 short spines along the whole length; apex with 3 pairs of long, strong spines. . . . . *Mysidopsis bigelowi*

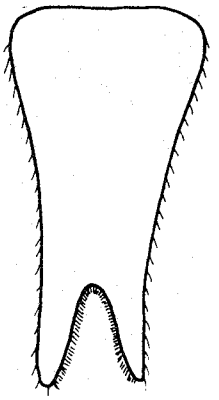
   Lateral margin of telson with about 40 spines, distally these are grouped with 1-3 shorter spines between longer ones . . . . . *Neomysis americana*

Additional species which may be found in Delaware waters:

Heteromysis formosa S. I. Smith, 1873
Bowmaniella johnsoni (Tattersall, 1937) (=Gastrosaccus?)
Erythrops erythrophthalma (Göes, 1864)

MYSIDACEA





CLEFT TELSON

PLATE 13

Key to the Cumacea of the Delaware Bay Region
(Modified from Wigley, 1964)
For terminology, see Plate 14.

1. Independent telson present; telson apex upturned, without apical spines . . . . . Oxyurostylis smithi

   Without independent telson. 2

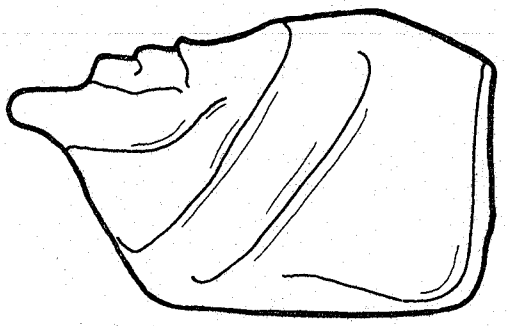
2. Pseudorostrum well developed; basal segment of uropod shorter than rami; male with 2 pairs of pleopods. . . . . Leucon americanus

   Basal segment of uropod longer than rami; male with 5 pairs of pleopods; second antenna well developed. . . . . Cyclaspis varians

Additional species which may be found in Delaware waters:

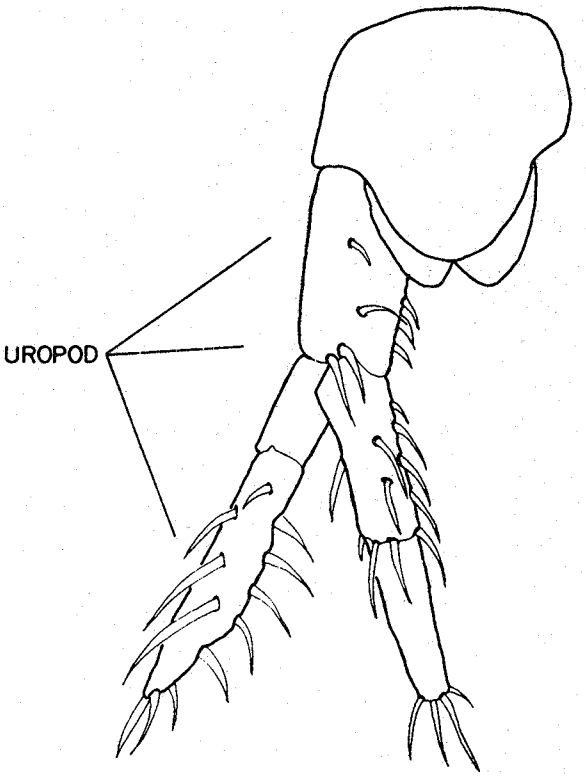
Diastylus politus Smith, 1879
D. quadrispinosa G. O. Sars, 1871

CUMACEA

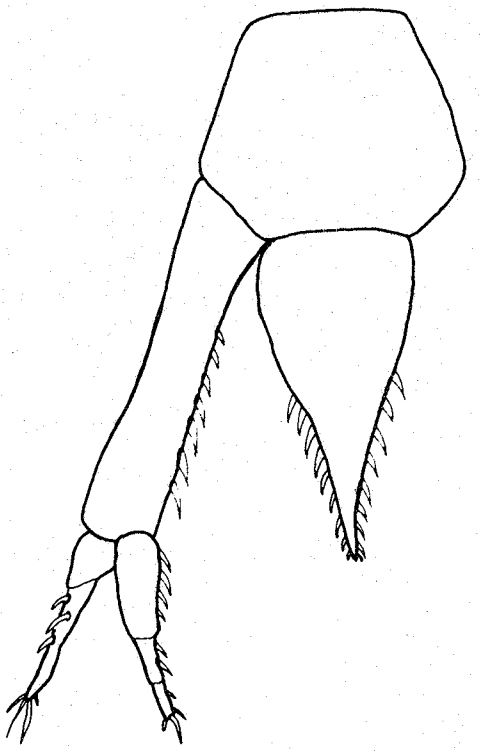


CARAPACE

(Side View)



without INDEPENDENT TELSON



with INDEPENDENT TELSON

PLATE 14

Key to the Isopoda and Tanaidacea of the Delaware Bay Region
(In part modified from Schultz, 1969)
For terminology, see Plate 15.

1. First pair of legs chelate; 6 free thoracic segments. . . . . Tanaidacea. . . .*Leptochelia savignyi*

   First pair of legs not chelate. 2

2. Parasitic on Crustacea; females asymmetric; males tiny; body highly modified. . . . . .Bopyroidea (Epicaridea) *Probopyrus pandalicola*

   Not parasitic on Crustacea, body symmetrical or at least with traces of bilateral symmetry 3

3. Uropods folded under pleotelson, form the cover of a chamber encasing the pleopods (branchial cavity). . . . . Valvifera 12

   Uropods lateral, flattened, forming with the telson, a caudal fan. 4

4. Body elongate, length about 7 or more times the width; pleotelson (or telson) elongate; uropods partially folded over or extending above pleotelson . Anthuridea. . . 5

   Body never elongate, length much less than 7 times width; pleotelson moderately large to large; uropods with endopods and exopods flattened or pointed, never folded over or above pleotelson . . . . . Flabellifera. . . 6

5. Maxillipedal palp of two articles, sixth pleonal segment fused to telson . . . . . *Cyathura polita*

   Maxillipedal palp of one article; mandibular palp of only one article . . . . . *Ptilanthura* sp.

6. Pleon composed of one visible free segment plus pleotelson; uropod with one ramus fused to basis. . . .Sphaeromidae . . 7

   Pleon composed of four or five free segments plus pleotelson; uropods present 8

7. Uropods uniramous, only a long endopod present . . . . . *Ancinus depressus*

   Uropods biramous (remember endopod and basis are fused) . . . . . .*Sphaeroma quadridentatum*

8. All pereopods prehensile, modified for clinging . . . . . Cymothoidae . . 9

   First three pereopods prehensile; other pereopods ambulatory or with long natatory setae. . . . . .*Cirolana concharum*

9. Posterior margin of uropodal rami with fringing setae; eyes very large . . . . . *Aegathoa medialis*

   Posterior margin of uropodal rami never with fringing setae; eyes if present, only moderately large 10

10. Body elongate; uropods not extending beyond posterior margin of pleotelson; pereopod VII significantly longer than other six pereopods . *Olencira praegustator*

    Body more compact; uropods sometimes extend beyond posterior margin of pleotelson; pereopod VII not significantly longer than other six pereopods 11

11. Pleon enveloped by peraeonal segment VII; uropodal rami much longer than basis. . . . . .*Irona* (=*Mothocya*) *nana*

    Pleon not enveloped by peraeonal segment VII; uropod rami short, scarcely longer than basis. *Lironeca ovalis*

12. Eyes dorsally located; cephalon with notched anterolateral lobes; first three paraeopods subchelate. 13

    Eyes laterally or dorsolaterally located, cephalon without antero-lateral lobes; first three pereopods not subchelate. 16

13. Antenna two with flagellum longer than all of antenna one . .14

    Antenna two with flagellum short, whole of antenna two only slightly longer than antenna one 15

14. Eyes prominent; antenna one extends only to end of peduncle of antenna two. . . . . *Chiridotea tuftsi*

    Eyes small; antenna one extends just beyond peduncle of antenna two. . . . . *Chiridotea almyra*

15. Clavate flagellum of antenna one about 3 times as long as wide . . . . . *Chiridotea nigrescens*

    Clavate flagellum of antenna one much more than 3 times as long as wide . . . . . .*Chiridotea coeca*

16. Flagellum of second pair of antennae well developed and multi-articulate. . . . . Idotea balthica

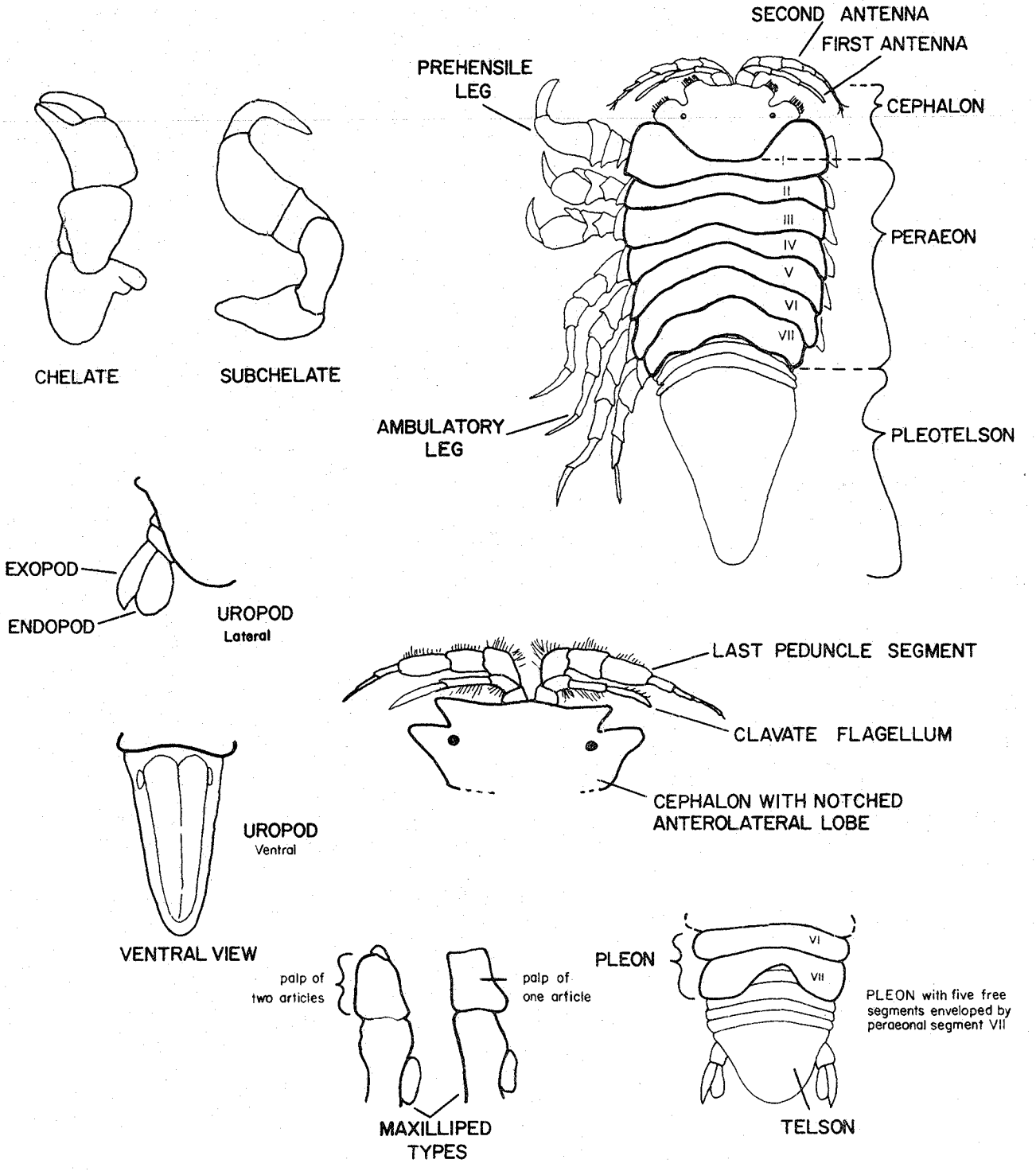
    Flagellum of second pair of antennae with less than four articles 17

17. Second pair of antennae shorter than first pair . . . . . .Edotea triloba

    Second pair of antennae much longer than first pair. . . . . Erichsonella filiformis

Additional species which may be found in Delaware waters:

Cyathura burbancki Frankenburg, 1965
Pitilanthura tricarina Menzies and Frankenburg, 1966
Paracerceis caudata (Say, 1818)
Idotea metallica Bosc, 1802
I. phosphorea Harger, 1873
Ligia exotica Roux, 1828
L. oceanica (Linné, 1767)



Isopoda and Tanaidacea

PLATE 15

Key to the Amphipoda of the Delaware Bay Region
For terminology, see Plate 16.

1. Six free thoracic segments, abdomen greatly reduced; skeleton shrimps. . . . . CAPRELLIDAE

   Seven free thoracic segments, abdomen not reduced 2

2. Four eyes (2 pairs), all simple . . . . . .AMPELISCIDAE

   Two compound eyes or eyes absent. 3

3. Abdomen flattened dorso-ventrally; body generally depressed, coxae 1 - 4 small, reduced . . . . COROPHIIDAE

   Abdomen not flattened dorso-ventrally; body laterally flattened, cylindrical or circular in cross-sectional outline 4

4. Terminal uropods uniramous. 5

   Terminal uropods biramous, inner ramus may be minute. 7

5. Antenna 1 with acessory flagellum . . . .part of ISAEIDAE

   Antenna 1 without acessory flagellum 6

6. Coxal plate 4 greatly expanded, overlapping adjacent plates. . . . . .STENOTHOIDAE

   Coxal plate 4 about same size as plates 1 - 3, overlapping only a small part of plate 3. . . . .TALITRIDAE

7. Terminal uropods with short rami, not equal to peduncle, outer ramus uncinate or appearing so. 8

   Terminal uropods not uncinate, at least one ramus equal to or larger than peduncle 9

8. Antennae 1 and 2 with less than 6 segments in flagellum; males distinguished by greatly enlarged gnathopod 2 . . . . . .ISCHYROCERIDAE

   Antennae 1 and 2 with many more than 6 segments in flagellum; male gnathopod 2 not greatly enlarged. . . . . AMPITHOIDAE

9. Accessory flagellum absent. 10

Accessory flagellum present, may be of one minute segment or scale (check very carefully!) 12

10. First gnathopod rudimentary; epimeral side plate 3 with several prominent upturned teeth . . . . .BATEIDAE

First gnathopod normally developed. 11

11. Third uropod, inner and outer rami of nearly equal length; eyes large, united dorsally . . . OEDOCEROTIDAE

Third uropod, outer ramus shorter than inner ramus; eyes circular, not united dorsally. . . . . .PLEUSTIDAE

Third uropod, inner ramus minute, much shorter than outer ramus. . . . . .part of ISAEIDAE

12. Gnathopods poorly developed 13

Either pair of gnathopods well-developed. 14

13. Gnathopod 2, segment 3 elongate; segments of pereopods 3 - 5 not greatly expanded. . . . . LYSIANASSIDAE

Gnathopod 2, segment 3 not elongate; segments of pereopods 3 - 5 greatly expanded. . . . . .HAUSTORIIDAE

14. Gnathopods of equal size or second larger than first. 15

First gnathopod larger than second. . . . . AORIDAE

15. Rostrum well-developed, extending beyond peduncle segment 1 . . . . . PHOXOCEPHALIDAE

Rostrum short, not extending to end of peduncle segment 1 . .16

16. First antenna with 6 segments or less in flagellum. . . . . .LILJEBORGIIDAE

First antenna with more than 6 segments in flagellum . . . . . .GAMMARIDAE

AMPELISCIDAE
(Adapted from Mills, 1967)

1. Article 3 of pereopod 5 shorter than article 4; antenna 1 much shorter than peduncle of antenna 2 . . . . . .Ampelisca verrilli

   Article 3 of pereopod 5 longer than article 4; antenna 1 longer than peduncle of antenna 2 2

2. Posterolateral corners of third segment of urosome sharply upturned, uropod 2 outer ramus outer margin with three to five spines . . . . . Ampelisca vadorum

   Posterolateral corners of third segment of urosome rounded, uropod 2 outer ramus outer margin with one to two spines. . . . . .Ampelisca abdita

AMPITHOIDAE

1. Without accessory flagellum; male gnathopod 2 larger than gnathopod 1. . . . . Ampithoe valida

   Without accessory flagellum of 2 articles; male gnathopod 2 not significantly larger than gnathopod 1 . . . . . Cymadusa compta

AORIDAE

1. Accessory flagellum consists of one article; article 5 larger than article 6 on first gnathopod. . . . . Microdeutopus gryllotalpa

   Accessory flagellum of more than one article. 2

2. Pereopods 3 - 5, article 2 several times longer than wide. . . . . Lembos smithi

   Pereopods 3 - 5, article 2 slightly longer than wide. 3

3. Antenna 1 longer than antenna 2 . . .Leptocheirus pinguis

   Antenna 1 shorter than antenna 2. Leptocheirus plumulosus

BATEIDAE

Only one local species. . . . . Batea catharinensis

CAPRELLIDAE

1. Pereopods 3 and 4 minute, present at base of gills . . . . . Paracaprella tenuis

   Pereopods 3 and 4 absent. 2

2. Anterior of head without anteriorly-directed, triangular spine. 3

   Anterior of head with anteriorly-directed triangular spine 4

3. Ventral spine between bases of second gnathopods . . . . . .Caprella equilibra

   No ventral spine between bases of second gnathopods . . . . . .Aeginina longicornis

4. Palm of propodus of pereopods 5 - 7 convex; found among hydroids on back of loggerhead turtle . .Caprella andreae

   Palm of propodus of pereopods 5 - 7 concave; found on many substrates in marine waters. . . Caprella penantis

COROPHIIDAE

1. Accessory flagellum present; terminal uropods appear biramous. 2

   Accessory flagellum absent; terminal uropod definitely uniramous 4

2. Epimeral side plate 3 with postero-ventral corner upturned . . . . . .Unciola irrorata

   Epimeral side plate 3 with postero-ventral corner not upturned. 3

3. Antenna 1, peduncle article 2 longer and more slender than article 1; moveable ramus of uropod 3 with

more than a dozen long setae; ventral margin of antenna 2, article 4 smooth in male .*Unciola dissimilis*

Antenna 1, penduncle article 2 slightly shorter and nearly as wide as article 1; movable ramus of uropod 3 smaller and with about six setae; ventral margin of antenna 2 article 4 in male with 5 or 6 strong serrations. . . . . *Unciola serrata*

4. Antenna 2 conspicuously more robust than antenna 1; urosome segments fused. 6

Antenna 2 of approximately the same size as antenna 1; urosome segments separate 5

5. Antenna 1 flagellum of 3 or 4 articles; pleopods short with proximal segments many times wider than distal segments; usually found in a chitinous tube which the animal carries about. . . . . *Cerapus tubularis*

Antenna 1 flagellum of more than 4 articles; pleopods of normal slender shape; gnathopod 2 complexly chelate with antero-ventral lobe of article 5 developed into strong tooth . . . . . *Erichthonius brasiliensis*

6. Urosome with a raised lateral margin forming a ridge; oligohaline . . . . . .*Corophium lacustre*

Urosome lateral margin not raised; marine to mesohaline . . . 7

7. Antenna 2, article 4 with large curved tooth on distal ventral corner. . . . . males . . 8

Antenna 2, article 4 without this tooth . . . . . females . .11

8. Antenna 2, article 4 with many long setae on both ventral and dorsal sides. . . . . .*Corophium tuberculatum*

Antenna 2, article 4 with only a few short setae on both sides. 9

9. Antenna 1, peduncle article 1 with proximal end at least twice as large as distal end. . . *Corophium acherusicum*

Antenna 1, peduncle article 1 with proximal end same size as distal end. 10

10. Antenna 2, article 5 with large mid-ventral curved tooth . . . . . .*Corophium acutum*

    Antenna 2, article 5 without mid-ventral tooth. . . . . .*Corophium insidiosum*

11. Antenna 2, articles 4 & 5 sparsely setose (about 6 setae on article 4, do not count spines). . . . . .*Corophium acutum*

    Antenna 2, articles 4 & 5 moderately to densely setose (at least 15 setae on article 4). 12

12. Antenna 2, article 5 densely setose but without spines. . . . . .*Corophium tuberculatum*

    Antenna 2, article 5 moderately setose and with 1 or 2 spines. 13

13. Rostrum extended, narrow; antenna 2, article 5 with a single spine, setose on lateral and dorsal sides. . . . . .*Corophium insidiosum*

    Rostrum a small, flat triangle; antenna 2, article 5 with 2 spines, setose on ventral aspect only . . . . . *Corophium acherusicum*

GAMMARIDAE
(In part modified from Bousfield, 1969)

1. Pleonal segments with posteriorly-directed dorsal processes 2

   Pleonal segments without posteriorly-directed dorsal processes 3

2. Pleonal segments with a single, mid-dorsal process; third uropods lanceolate. . . . . *Gammarus mucronatus*

   Pleonal segments with 5 - 7 dorsal, posteriorly-directed processes; third uropods elongate, spinose, not lanceolate, inner ramus minute; in male one of the second gnathopods greatly enlarged.*Melita appendiculata*

3. Third uropod, inner ramus much shorter (less than 1/3 length) than outer ramus. . . . . *Melita nitida*

   Third uropod, inner ramus equal to or at least half as long as outer 4

4. Third uropods, rami with spines on outer margins only; rami rectangular, outer ramus uni-articulate. . . . . .Elasmopus laevis

Third uropods, rami densely setose on outer and inner margins, outer ramus 2-articulate; rami lanceolate. 5

5. Pereopods 1 & 2, anterior margins of article 6 without setae . . . . . .Gammarus palustris

Pereopods 1 & 2, anterior margins of article 6 with setae. 6

6. Antenna 1, basal flagellar segments with alternate posterior setae longer than twice the width of respective segments; antenna 2, peduncular segments 4 & 5 each with 4 - 7 clusters of long stiff setae. . .Gammarus daiberi

Antenna 1, basal flagellar segments with alternate posterior setae short, scarcely exceeding width of segment; antenna 2, peduncular segments 4 & 5 each with 3 (occasionally 4) clusters of long setae . . . . . Gammarus tigrinus

HAUSTORIIDAE
(Adapted from Bousfield, 1965)

1. Posterodorsal border of pleon segment 3 free or slightly decurved, not reflexed; pleon side plate 3 rounded 2

Posterodorsal border of pleon segment 3 strongly reflexed forming a lobe overhanging urosome; pleon side plate 3 (except in Haustorius) with posterior spinous process 6

2. Body relatively slender, lateral lobes of pereon weak; head not broadened, rostrum weak. 3

Body broadly arched, pereon lobes pronounced; abdomen abruptly narrowing beyond pereon 7; head very broad rostrum distinct. 4

3. Coxal plate of pereopod 2 much broader than deep, elongate behind; pereopod 5, posterior border of segment 4 narrower than anterior border, with 2 spine groups; uropod 1, posterior margin of peduncle distally spinose . . . . . Protohaustorius deichmannae

Coxal plate of pereopod 2 little broader than deep; pereopod 5, posterior margin of segment 4 wider than anterior, with 3 - 4 spines; uropod 1 posterior margin of peduncle spinose throughout . . . . . *Protohaustorius wigleyi*

4. Pereopod 5, coxal plate broadly acute or rounded behind, article 6 about equal to article 5; uropod 1, posterior margin of peduncle spinose throughout 5

Pereopod 5, posterior lobe of coxal plate sharply elongated, article 6 markedly longer than article 5; uropod 1 posterior margin of peduncle centrally unarmed. . . . . *Parahaustorius attenuatus*

5. Pereopod 5, article 4 subrectangular, posterior margin subtruncate, with two (or three) prominent spines; pereopod 4, article 6 not longer than article 5 . . . . . *Parahaustorius longimerus*

Pereopod 5, article 4 narrowing behind, posterior margin oblique, with one spine; pereopod 4, article 6 longer than article 5 . . . . . *Parahaustorius holmesi*

6. Rostrum short; head broadest posteriorly; uropod 3, terminal segment of outer ramus small or vestigial . . . . . *Pseudohaustorius caroliniensis*

Rostrum strong; head broadest medially; uropod 3, terminal segment of outer ramus normal, distinct 7

7. Pleon side plate 3 rounded behind; uropod 1, rami subequal; pereopod 5, posterior margin of segment 4 with one group of spines only. . . . . *Haustorius canadensis*

Pleon side plate 3 with posterior spinous process; uropod 1 inner ramus shorter, usually more slender than outer. . . . 8

8. Pleosome 3, posterodorsal margin produced as a large subconical process; pereopod 5, posterior lobe of segment 4 short, posterior and proximal margins continuous, with 1 spine. . . . . *Acanthohaustorius intermedius*

Pleosome 3, posterodorsal margin normally rounded behind; pereopod 5, hindlobe of segment 4 elongate, posterior margin distinct, with 2 spines. *Acanthohaustorius millsi*

ISAEIDAE

1. Antenna 1 with acessory flagellum . .*Microprotopus raneyi*

   Antenna 1 without acessory flagellum. . .*Photis macrocoxa*

ISCHYROCERIDAE

Only one local species. . . . . *Jassa falcata*

LILJEBORGIIDAE

Only one local species. . . . . *Listriella barnardi*

LYSIANASSIDAE

1. Telson entire, eye circular . . . . . *Lysianassa alba*

   Telson cleft, eye elongate. . . . . *Orchomene pinguis*

OEDOCEROTIDAE

Only one local species. . . . . .*Monoculodes edwardsi*

PHOXOCEPHALIDAE

1. Pereopod 4 elongate, with few spines, article 6 about twice as long as article 5. . . . . *Paraphoxus spinosus*

   Pereopod 4 short, spinose, article 6 about same length as article 5. . . . . .*Trichophoxus epistomus*

PLEUSTIDAE

Only one local species. . . . . .*Parapleustes* sp.

STENOTHOIDAE

1. Coxal plate 4 greatly expanded, covers nearly all of the other coxal plates which are reduced. . . . . .Parametopella cypris

   Coxal plate 4 expanded but overlaps only coxal plates 3 and 5; body very small. . . . . .Stenothoe minuta

TALITRIDAE

1. First antenna shorter than peduncle of second antenna 2

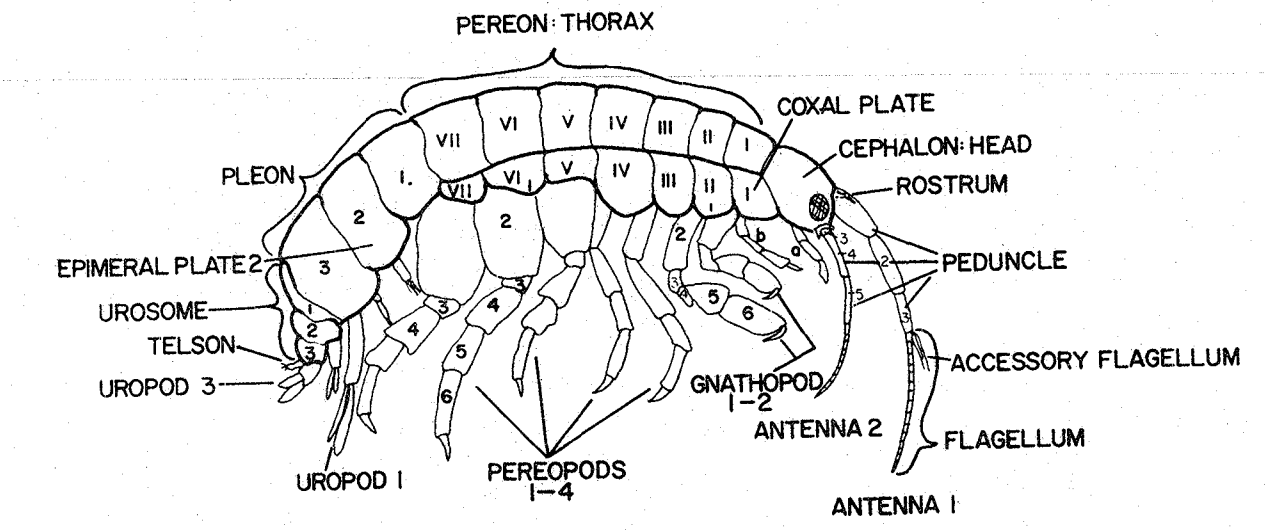
   First antenna longer than peduncle of second antenna; ventral side of antenna 2 with large tufts of setae . . . . . Hyale plumulosa

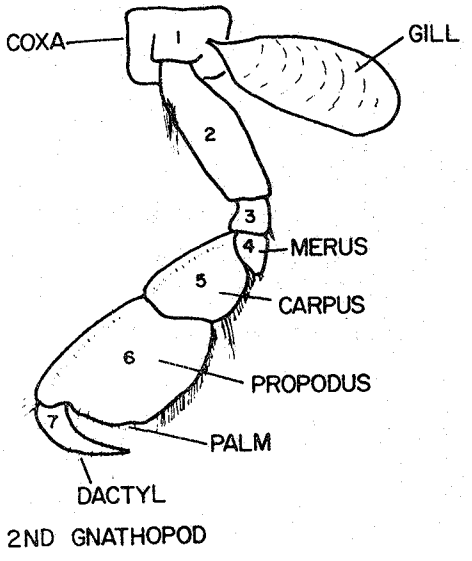
2. Eyes cover less than 1/4 of side of head; propodus of gnathopod 1 no more than twice as long as wide; gnathopod 1 in female subchelate. . . Orchestia grillus

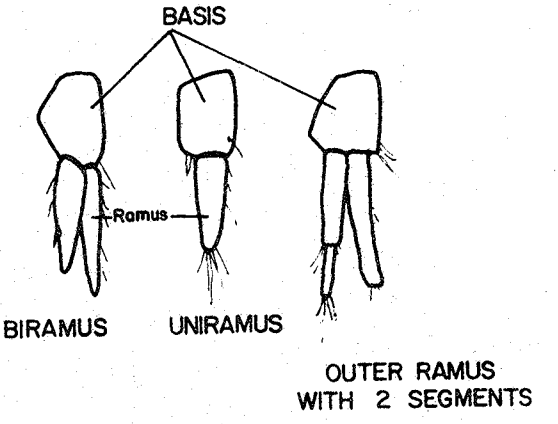
   Eyes cover more than half of side of head; propodus of gnathopod 1 at least three times as long as wide; gnathopod 1 in female simple. . . . . Talorchestia megalophthalma

Additional species which may be found in Delaware waters:

Ampithoe rubricata (Montagu, 1808)
Cymadusa compta (Smith, 1873)
Chelura terebrans Philippi, 1839
Erichthonius rubricornis (Stimpson, 1853)
Orchestia uhleri Shoemaker, 1930
Orchestia platensis Kroyer, 1845
Talorchestia longicornis (Say, 1818)
Corophium simile Shoemaker, 1934
Listriella clymenellae Mills, 1962
Atylus minikoi (Walker)
Elasmopus pocillimanus (Bate, 1862)
Neohaustorius schmitzi Bousfield, 1965







Amphipoda

PLATE 16

Key to the Decapoda of the Delaware Bay Region
(Modified from Williams, 1965)
For terminology, see Plate 17.

1. Body laterally compressed; rostrum usually compressed and serrated; antennal scale large and lamellar; pleopods used for swimming. . . . . Suborder Natantia . . 2

   Lobster-like or crab-like; abdomen depressed; pleopods reduced or absent, not used for swimming. . . . . .Suborder Reptantia . . 5

2. Pleura of second abdominal segment not overlapping those of first segment, first three pairs of legs chelate . . . . . Penaeus aztecus

   Pleura of second abdominal segment overlapping those of first segment. 3

3. First pair of legs subchelate . . . Crangon septemspinosa

   First pair of legs chelate. 4

4. Carpus of second leg in adult female shorter than palm, in male about same length as palm; dactyl of second leg with two, immovable finger with one, tooth on cutting edge. . . . . Palaemonetes vulgaris

   Carpus of second leg in adult female much longer than palm; in male almost as long as whole chela; fingers of second leg without teeth on cutting edge . . . . . .Palaemonetes pugio

5. Abdomen extended, symmetrical, with well-developed tail fan . . . . . Section Macrura . . 6

   Abdomen bent upon itself or flexed beneath thorax; tail fan variable in development; pleura small or absent 7

6. Abdomen more or less membranous; much longer and/or wider than cephalothorax; rostrum present; chelipeds alike and subequal. . . . . .Upogebia affinis

   Abdomen about same size as cephalothorax; body firm, well armored and well pigmented. . . . . .Homarus americanus

7. Uropods usually present, often reduced, abdomen asymmetrical, twisted, or reduced; fifth pair of thoracic legs reduced and folded up above bases of 4th pair. . . . . Section Anomura . . 8

   Fifth pair of thoracic legs not reduced; abdomen reduced, lacking uropods, and folded under body. . . . . Section Brachyura . .10

8. Abdomen much reduced, flexed under thorax, symmetrical, lives in unprotected sandy beaches, body egg-shaped; carapace grey . . . . . .*Emerita talpoida*

   Abdomen well developed, asymmetrical; animal inhabits gastropod shells. 9

9. Width of major chela less than one-half the length. . . . . *Pagurus longicarpus*

   Width of major chela more than one-half the length, dactyl with sharply produced angle on medial margin . . . . . .*Pagurus pollicaris*

10. Body narrowed in front, rostrum usually distinct; orbit indistinct. 11

    Body of medium width or broad in front; rostrum reduced or absent 12

11. Median line of carapace with about nine spines. . . . . .*Libinia emarginata*

    Median line of carapace with about six spines . . . . . *Libinia dubia*

12. Small, usually commensal crabs; eyes reduced; carapace subcircular or markedly widened from side to side 13

    Free-living crabs with well-developed eyes; carapace hard . .15

13. Third walking leg not longer than other legs; usually found in the oyster, but also in *Anomia simplex* and *Mytilus edulis*. . . . . *Pinnotheres ostreum*

    Third walking leg longer and stronger than the others 14

14. Chela with immovable finger bent downward; carapace more than twice as wide as long. . . . . .*Pinnixa sayana*

Chela with immovable finger nearly straight; carapace less than twice as wide as long . . . .*Pinnixa retinens*

15. Carapace front margin curved, bears a series of teeth between the eye and the anterolateral corner. 16

Carapace outline squarish with more or less straight front margin; most are semi-terrestrial 24

16. First antennae folded longitudinally; edges of anterolateral teeth with tubercles; body with hairs . . . . . *Cancer borealis*

First antennae folded longitudinal or nearly so; edges of anterolateral teeth entire; body without hairs . . . . . .*Cancer irroratus*

First antennae folded transversely or obliquely 17

17. Last pair of walking legs flattened and paddle-like; tips rounded, adapted for swimming. 18

Last pair of walking legs not adapted for swimming; tips sharp, used for walking. 19

18. Anterolateral teeth on carapace 3 to 5 in number; carapace not very broad; body mottled or speckled . . . . . .*Ovalipes ocellatus*

Anterolateral teeth 9 in number; carapace very broad; outermost lateral tooth especially long and sharp . . . . . *Callinectes sapidus*

19. Front region between eyes produced into 3 low teeth; 5 prominent sharp anterolateral teeth; hind pair of legs slightly flattened; legs long; color green-black . . . . . *Carcinus maenas*

Front region not produced into teeth; legs shorter; tips of chelae may be dark. 20

20. Extreme edge of frontal margin with shallow transverse groove, each half appearing double (under magnification); fingers of chelae white . . . . . *Rhithropanopeus harrisi*

Extreme edge of frontal margin not transversely grooved; fingers of chelae darkly pigmented 21

21. Major cheliped with a conspicuous tooth at base of dactyl, tooth larger than adjacent teeth and of slightly differing color 22

    Major cheliped with no tooth at base of dactyl, or tooth no different from adjacent teeth. 23

22. Third and fourth teeth of anterolateral border definitely pointing forward with outer borders curved; third maxilliped with red spot on inner surface . . . . . .Panopeus herbsti

    Third and fourth teeth of anterolateral border pointing outward, outer borders not curved; red spot lacking . . . . . Hexapanopeus angustifrons

23. Third maxilliped with red spot; fingers of minor cheliped "spooned" . . . . . .Eurypanopeus depressus

    Third maxilliped without red spot; fingers of minor cheliped not "spooned". . . . . Neopanope texana sayi

24. Front with moderate width; eyestalks long; outer maxillipeds nearly, or quite, closing buccal area 25

    Front broad; eyestalks of moderate length or short; a gap of varying size between outer maxillipeds 28

25. Eyestalks stout; chelipeds of male nearly equal . . . . . Ocypode quadratus

    Eyestalks slender; chelipeds of male unequal. 26

26. Large cheliped of male with oblique tuberculate ridge on inner surface of palm extending upward from lower margin. .27

    No oblique tuberculate ridge on inner surface of palm. . . . . Uca pugilator

27. A prominent transverse depression behind orbit; leg joints red on large cheliped . . . . . Uca minax

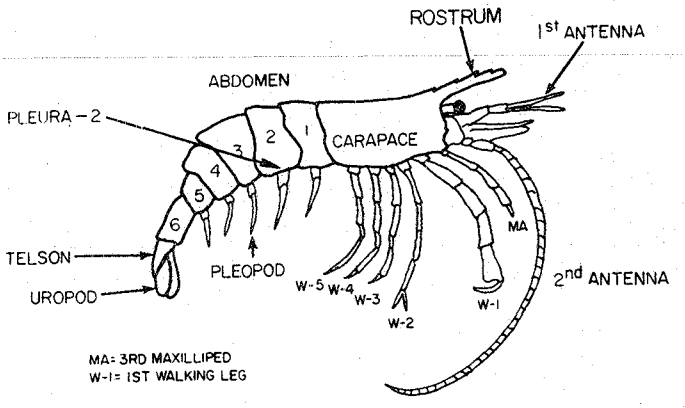
    Without prominent transverse depression behind orbit; leg joints not red; color dark often with blue on front . . . . . .Uca pugnax

28. Lateral margin of carapace with a tooth behind the outer orbital tooth; body strongly convex above; last three articles of first three walking legs with dense mat of hairs. . . . . Sesarma reticulatum

Lateral margin of carapace straight; body nearly flat above; last three articles of first three legs without dense mat of hairs. . . . . .*Sesarma cinereum*

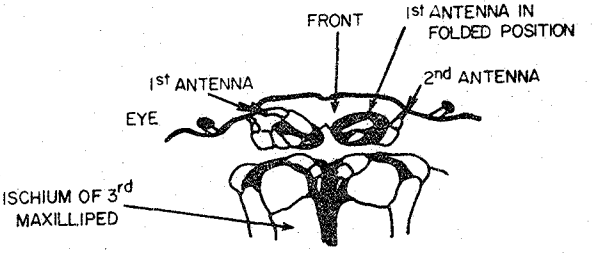
Additional species which may be found in Delaware waters:

Parapenaeus longirostris (Lucas, 1849)
Lucifer faxoni Borradaile, 1915
Callianassa atlantica Rathbun, 1926
Polyonyx gibbesi Haig, 1956
Pagurus annulipes (Stimpson, 1860)
Persephona punctata aquilonaris Rathbun, 1937
Portunus gibbesii (Stimpson, 1859)
Arenaeus cribrarius (Lamarck, 1818)
Cancer borealis Stimpson, 1859
Pinnotheres maculatus Say, 1818
Dissodactylus mellitae Rathbun, 1918
Pinnixa chaetopterana Stimpson, 1860
P. cylindrica (Say, 1818)
Pelia mutica (Gibbes, 1850)

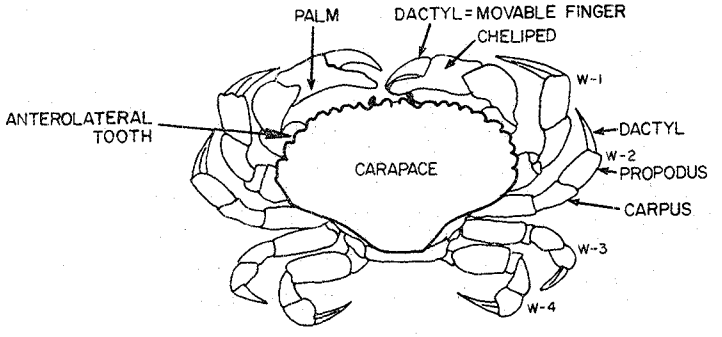


GENERALIZED "SHRIMP-LIKE"
DECAPOD

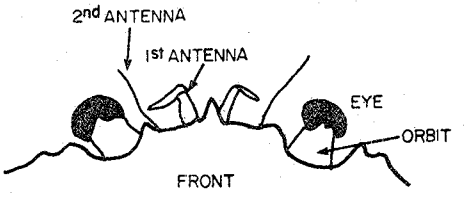
SUBCHELATE WALKING LEG



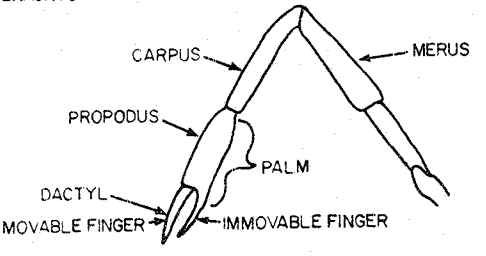
FRONTAL REGION OF CRAB VENTRAL VIEW



CANCER IRRORATUS
A BRACHYURAN



FRONTAL REGION OF CRAB
DORSAL VIEW



CHELATE WALKING LEG

Decapoda

PLATE 17

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Part VII. ENTOPROCTA AND ECTOPROCTA

Phylum Entoprocta: Stalked, sessile, pseudocoelomate; with distinct circlet of tentacles surrounding the mouth and anus; flame-cell protonephridia; looped gut tract.

Family Pedicellinidae
Pedicellina cernua (Pallas, 1771)

Phylum Ectoprocta: Microscopic; colonial; secrete exoskeletal chambers in which they live; lophophore circular or crescentic; digestive tract recurved; lack circulatory system and excretory system.

Class Gymnolaemata: Lophophore circular; without epistome, body-wall muscles, or coelomic communication between zooids, marine.

Order Ctenostomata: Chitinous zoaria encrusting, erect or stolonate; no avicularia or true external ovicells present; zooids cylindrical to flat; orifice terminal or nearly so.

Family Alcyonidiidae
Alcyonidium polyoum (Hassall, 1841)
A. verrilli Osborn, 1912
A. mammillatum Alder, 1857

Family Nolellidae
Anguinella palmata Van Beneden, 1844

Family Flustrellidae
Flustrellidra hispida (Fabricius, 1780)

Family Vesiculariidae
Amathia vidovici (Heller, 1867)
Bowerbankia gracilis Leidy, 1855

Family Triticellidae
Triticella elongata (Osburn, 1912)

Family Valkeriidae
Aeverillia armata (Verrill, 1874)
A. setigera (Hincks, 1887)

Order Cheilostomata: Zooecial walls calcified; orifice on frontal wall, with operculum;

specialized zooecia (e.g. avicularia) commonly present.

Suborder Anasca: frontal wall membranous.

Family Membraniporidae
Membranipora tenuis Desor, 1848
M. tuberculata (Bosc, 1802)
Conopeum tenuissimum (Canu, 1908)
C. truitti Osburn, 1944

Family Electridae
Electra hastingsae Marcus, 1938

Family Bicellariellidae
Bugula turrita Desor, 1848
B. stolonifera Ryland, 1960
B. californica Robertson, 1905

Suborder Ascophora: frontal wall calcareous.

Family Cheiloporinidae
Cryptosula pallasiana (Moll, 1803)

Family Schizoporellidae
Schizoporella errata (Watess, 1878)
S. biaperta (Michelin, 1841-42)

Family Microporellidae
Microporella ciliata (Pallas, 1766)

Key to the Ectoprocts of the Delaware Bay Region
For terminology, see Plate 18.

1. Zooecia not calcareous, may be leathery, membranous or corneous . . . . . Order Ctenostomata. 2

   Zooecia calcareous. . . Order Cheilostomata 8

2. Zoarium (colony) encrusting or rise as erect, fleshy stalks 3

   Zoarium (colony) stolonate, sometimes with erect branches, not fleshy. 6

3. Zoarium encrusting, with erect, fleshy masses arising from encrusting part. 4

   Zoarium encrusting, never with erect, fleshy, masses. 5

4. Zoarium with chitinous spines between zooecia, giving colony somewhat of a fuzzy or rough appearance. . . . . Flustrellidra hispida

   Zoarium without chitinous spines, colony smooth . . . . . .Alcyonidium verrilli

5. Aperture located on a short, cylindrical projection . . . . . Alcyonidium mammillatum

   Aperture located on zooecial wall, not on raised projection. . . . . Alcyonidium polyoum

6. Zooecia arise as expansions of the stolon and are directly continous with it . . . . . .Anguinella palmata

   Zooecia separated from the stolon by a constriction at the point of attachment 7

7. Zooecia often clustered on the stolons or erect branches, no pedicel. 8

   Zooecia with long, slender pedicels . Triticella elongata

8. Erect or sprawling branches and the zooecia in a spiral cluster . . . . . .Amathia vidovici

   Zooecia never in a spiral cluster 9

9. Zooecia arising from the stolon in an irregular manner, not paired. . . . . .*Bowerbankia gracilis*

   Zooecia arising from short internodes at the side of the stem, usually in pairs; base of zooecia without spines. . . . . .*Aeverrillia armata*

   Zooecia arising from short internodes at side of stem, usually in pairs; base of zooecia with distinct spines. . . . . .*Aeverrillia setigera*

10. Zoarium erect and bushy 11

    Zoarium encrusting. 13

11. Outer distal angle of zooid with one spine or finger-like projection. . . . . .*Bugula turrita*

    Outer distal angle of zooid with two spines, the frontal-most one may be reduced to denticle or knob 12

12. Have three size classes of avicularia, the smallest being 0.07-0.11 mm long and occur on the zooid at the bifurcation . . . . . .*Bugula stolonifera*

    Only two size classes of avicularia, lacking minute size class, those present are at least 0.16 mm long. . . . . .*Bugula californica*

13. Frontal wall membranous 14

    Frontal wall completely calcified; pores present. 17

    Frontal wall calcified in proximal part; no pores penetrating the calcified part; many spines extend over membranous opesium. . . . . .*Electra hastingsae*

14. Zooecia with rounded corners. 15

    Zooecia with square corners 16

15. Zooecia without tubercles on the proximal corners . . . . . .*Conopeum tenuissimum*

    Zooecia with chitinous tubercles on the proximal. . . . . corners . . . . . .*Conopeum truitti*

16. Zooecia without tubercles on the proximal corners . . . . . *Membranipora tenuis*

Zooecia with calcareous tubercles on the proximal corners . . . . . .*Membranipora tuberculata*

17. Orifice with straight proximal border, special ascopore present. . . . . .*Microporella ciliata*

Orifice curved but with special denticles at the proximal corners, special ascopore absent. 16

18. Avicularia and ovicells absent. . . *Cryptosula pallasiana*

Avicularia and ovicells present 19

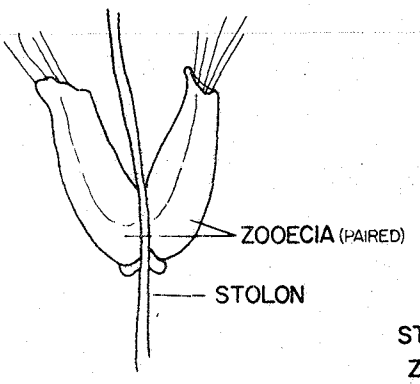
19. Avicularia oval or ellispsoidal; ovicells only with pores on lateral margins; colony forming bilaminate, foliaceous mass . . . . . .*Schizoporella biaperta*

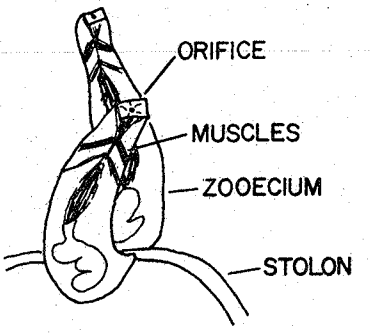
Avicularia sharply pointed; ovicells with pores throughout; colony unilaminate, encrusting . . . . . .*Schizoporella errata*

Additional species which may be found in Delaware waters:

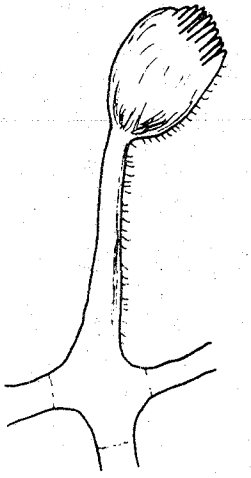
Phylum Entoprocta
Barentsia laxa (Kirkpatrick, 1890)

Phylum Ectoprocta
Crisia eburnea (Linné, 1758)
Victorella pavida Kent, 1870
Hyppothoa hyalina (Linné, 1767)

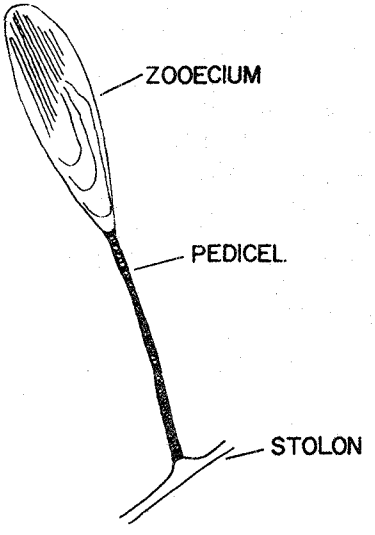


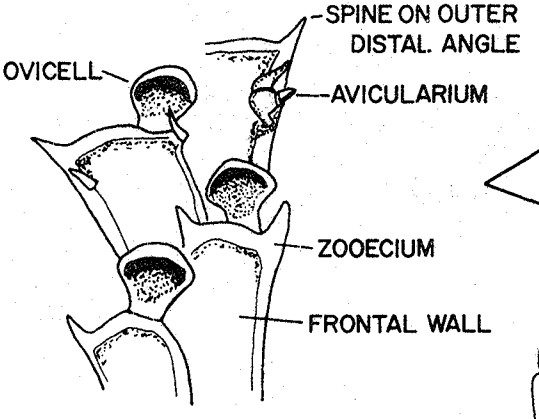


STOLONATE ZOARIUM

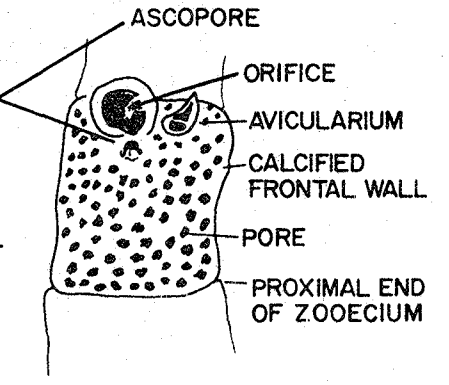


ENTOPROCT
PEDICELLINA CERNUA





BUGULA SP.



CALCAREOUS ENCRUSTING ZOOECIUM

Ectoprocta and Entoprocta

PLATE 18

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Part VIII. ECHINODERMATA AND PRIMITIVE CHORDATES

Phylum Echinodermata: body of pentamerous radial symmetry, enterocoelous coelomate; bilateral symmetry as larvae; body usually of five ambulacra that bear tube feet (podia), alternating with interambulacra around an oral-aboral axis; calcareous endoskeleton of separate plates; jawed pedicellariae (in some); coelomic canals forming a water-vascular system with projections to the exterior (tube feet); definite head and brain absent; dioecious; external fertilization; entirely marine.

Subphylum Eleutherozoa: free-living, moving with the oral surface downward or lying on one side; usually pentamerous; ambulacral system typically used for locomotion; main nervous system oral.

Class Asterozoa: body star-shaped or pentagonal; rays, five or more, not sharply set off from central disk; open ambulacral grooves on oral surface; tube feet with suckers; pedicellariae present.

Order Forcipulata: no conspicuous marginal plates; spines not in groups; papulae on both surfaces; pedicellariae all of the pedunculate type with a basal piece; podia mostly in four rows, with suckers.

Family Asteriidae
Asterias forbesii (Desor, 1848)
A. vulgaris Verrill, 1866

Class Ophiuroidea: body flat and pentamerous; arms long and slender, sharply set off from central disk; ambulacral grooves absent or covered; intestine and anus absent; ceca of stomach usually do not extend into arms; tube feet without suckers; usually with ten genitorespiratory bursae projecting into interior between stomach outpouchings; no pedicellariae.

Order Ophiurae: arms simple, not branched; scalation of arms and disk mostly well developed.

Family Amphiuridae
Amphioplus abditus (Verrill)

Class Echinoidea: body spheroidal, globular, or cordiform; endoskeleton in form of test of closely fitted plates arranged in ambulacral and interambulacral regions; ambulacral grooves covered; mouth usually centrally located with membranous peristome; anus with membranous periproct at or near the aboral pole; tube feet or podia with suckers extending through pores in ambulacral plates; body covered with movable spines; pedicellariae present.

Subclass Regularia: globose; pentamerously symmetrical with two rows of inter-ambulacral plates; peristome and periproct central, at the oral and aboral poles, respectively.

Order Diadematoida (Centrechinoida): gills and small bodies on the ambulacra thought to be balance organs; all types of pedicellaria or without pedicellariae.

Family Arbaciidae
Arbacia punctulata (Lamarck, 1816)

Subclass Irregularia: test flattened, oval to circular; periproct displaced posteriorly on aboral surface; mouth central or displaced anteriorly.

Order Clypeasteroida: aboral ambulacral areas petaloid; lantern present; gills absent.

Family Echinarachnidae
Echinarachnius parma (Lamarck, 1816)

Class Holothuroidea: body elongated in the oral-aboral axis with secondary bilateral symmetry; ambulacral and interambulacral regions arranged meridionally around axis; side of body lying on substratum; endoskeleton reduced to microscopic ossicles embedded in body wall; ambulacral grooves covered; tube feet around mouth in form of tentacles; tube feet usually provided with suckers; spines and pedicellariae lacking.

Order Apoda: vermiform; without tube-feet; oral tentacles present; water-vascular system greatly reduced; respiratory tree absent.

Family Synaptidae
Leptosynapta tenuis (Ayres, 1851)

Order Dendrochirota: numerous podia; oral tentacles dendroid; oral retractors and respiratory tree present.

Family Cucumariidae

Thyone briareus (Le Sueur, 1824)

Phylum Hemichordata: vermiform; without appendages; body composed of three parts, an anterior proboscis, a collar, and the posterior trunk; mouth at base of proboscis within the collar.

Class Enteroptneusta: acorn worms; gut straight; gill slits present; solitary, live buried in sediments.

Family Harrimaniidae

Saccoglossus kowalevskii (A. Agassiz, 1873)

Phylum Chordata: characterized by the possession of three major features during some stage in the life cycle. These are: a supportive structure, the notochord; a dorsal, hollow nerve cord, formed by invagination of neurectoderm; and gill slits which open into the pharynx.

Subphylum Urochordata: possess the first two chordate characteristics only in larval stage.

Class Ascidiacea: sessile, solitary or colonial; tunic thick; adults with degenerate nervous system; gill slits open into an atrial cavity, water is discharged through an atrial pore.

Order Pleurogona: body not always divided into thorax and abdomen; the digestive tract and the gonads are always along the edge of atrium.

Family Styelidae

Dendrodoa (Styelopsis) carnea (Agassiz, 1850)

Styela partita (Stimpson, 1852)

Family Molgulidae

Molgula manhattensis (DeKay, 1843)

Key to the Echinodermata of the Delaware Bay Region

1. Body soft, without obvious calcareous skeleton, elongate or globular (when contracted) 2

   Body hard, with obvious calcareous skeleton 3

2. Body white, translucent, without tube-feet. . . . . *Leptosynapta tenuis*

   Body brown, opaque, with numerous tube-feet . . . . . *Thyone briareus*

3. Body globular, with numerous long, pointed spines . . . . *Arbacia punctulata*

   Body flattened, disc-shaped, with numerous short spines . *Echinarachnius parma*

   Body otherwise. 4

4. Arms long and thin, sharply set off from central disc . . *Amphioplus abditus*

   Arms thick, grade into central disc 5

5. Arms somewhat flattened, with distinct median row of aboral plates; skeleton weak, flexible . . . *Asterias vulgaris*

   Arms inflated, without median row of aboral plates; skeleton strongly interlocking, thus body quite firm . . . . . *Asterias forbesii*

Additional species which may be found in Delaware waters:

Holothuria
- *Pantamera pulcherrima*
- *Thyonella gemmata*
- *T. pervicax*
- *Leptosynapta roseola*
- *Toxodora ferruginea*
- *Molpadia musculus*

Asteroidea
- *Odontaster setosus*
- *Asterias tanneri* Verrill, 1880
- *A. vulgaris* Verrill, 1866

Astropecten americanus Verrill, 1880
A. articulatus (Say, 1825)
Henricia sanguinolenta (Sars, 1844)
Leptasterias tenera (Stimpson, 1862)

Ophiuroidea
Ophioderma brevispinum
Amphipholis squamata

Key to the Ascidians of the Delaware Bay Region
(Modified from Smith, 1964)

1. Branchial and atrial apertures square or 4-lobed; no kidney present. 2

   Branchial aperture 6-lobed, atrial aperture 4-lobed; kidney present; body globose; individuals usually growing in clusters to which the name "sea grape" has been applied. . . . . .Molgula manhattensis

2. Test leathery, tough, irregular, yellowish or brownish in color; when collected often feels like a rough lump of gristly consistency. . . . . .Styela partita

   Test thin, tough, membranous, pinkish to bright red in life, attached by a relatively large area basally; body depressed with long axis parallel to substrate . . . . . .Dendrodoa carnea

Additional species which may be found in Delaware waters:

Amaroucium stellatum Verrill, 1871
A. constellatum Verrill, 1871
A. pellucidum (Leidy, 1855)
Perophora viridis Verrill, 1871
Botryllus schlosseri (Pallas, 1766)
Molgula arenata Stimpson, 1852

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Part IX

DESCRIPTION OF SELECTED COLLECTING ENVIRONMENTS IN THE DELAWARE BAY REGION

The following localities may be found on the accompanying map by keying the locality number with the number on the map:

A. Intertidal Sand Beaches:

1. Ocean Beach: extending from Cape Henlopen south; marine, highly oxygenated water; clean sand; dynamic environment, sample by hand or with various hand tools; dominant species include Emerita talpoida, Talorchestia megalophthalma, Nephtys picta and Haustorius canadensis.

2. Cape Henlopen Sand Flat: marine, highly oxygenated water over the surface, interstitial oxygen levels low; silty-sand; sand bars move but not dynamic as ocean beach; dominant species include: Mercenaria mercenaria, Nassarius obsoletus, Saccoglossus kowalevski, Scoloplos fragilis, Lumbrinereis tenuis, and Ensis directus.

3. Broadkill Beach: marine to polyhaline, highly oxygenated water, clean sand; sample by hand or with various hand tools; dominant species include: Talorchestia megalophthalma, Thyone briareus.

4. Kitts Hummock: polyhaline to mesohaline water; overlying water highly oxygenated, interstitial water probably low in oxygen; sand, gravel and shell make up higher intertidal portion of the beach, marsh mud flat in lower intertidal region; sample by hand or with hand tools; dominant species include Orchestia sp.

5. Indian River Bay and Rehoboth Bay: most beaches of sand, but in many places the marsh fronts directly on the bay; except for the creeks flowing into the bays both contain primarily marine to polyhaline water; sample by hand or with hand tools; dominant species include Orchestia sp.

B. Salt Marsh:

6. Depending on the location of the marsh the maximum salinity ranges from marine (near the bay mouth) to mesohaline (in the Leipsic River area); these

are intertidal environments subject to the normal rigors of a twice daily exposure; silts and clays predominate; sample by hand or with hand tools; dominant species include Modiolus demissus, Nassarius obsoletus, Sesarma spp., Uca spp., Melampus bidentatus, and Littorina irroratus.

C. Jetties and Breakwaters:

7. Outer Breakwater: marine, highly oxygenated water; subject to heavy wave action, particularly on the ocean side; rock substrate; sample by hand or with such hand tools as scraping devices; boat necessary; Homarus americanus, Obelia spp., Mytilus edulis, Balanus spp., Corophium spp., Littorina spp., other hydroids, ectoprocts, amphipods, barnacles and other epifaunal species.

8. Inner Breakwater: marine, highly oxygenated water; subject to heavy wave action, but landward side quite well protected; rock; sample by hand or with hand tools; boat necessary; same species dominate here as on outer breakwater.

9. Ferry Jetty: primarily marine, but possibly some polyhaline waters; high oxygen content; outer side subject to storm waves, landward side quite well protected; rock; sample by hand or with hand tools; can be reached from land; hydroids, ectoprocts, caprellids, barnacles predominate.

10. Mispillion River Jetty: primarily influenced by polyhaline waters; high turbidity in area; outer side subject to storm waves; rock, wood, and sand coral; sample by hand or with hand tools; boat necessary to reach outer side; dominant species include Garveia franciscana, Melita nitida.

11. Woodland Beach Jetty: mesohaline to oligohaline waters; high turbidity; rock and wood substrates; sample by hand or with hand tools; can be reached by wading; dominant species include Garveia franciscana, Gammarus spp., Modiolus demissus.

12. Indian River Inlet Jetty: marine, highly oxygenated waters; portion extending into ocean subject to heavy wave activity; wave action less, but currents strong along part extending into Indian

River Bay; rock; sample by hand or with hand tools; can be reached by land; Metridium senile, Cancer irroratus, Callinectes sapidus, Balanus spp., Mytilus edulis, other barnacles, mussels, ectoprocts, sponges, anemones, crabs, amphipods, and most other epifaunal groups are represented here.

D. Oyster Beds: most oyster beds are dominated by the following species: Crassostrea virginica, Aiptasiomorpha luciae, Sabellaria vulgaris, Hydroides dianthus, Sertularia argentea, Panopeus herbsti, Eurypanopeus depressus, Membranipora spp., Balanus improvisus.

13. Broadkill River: salinity range, 3.5-31.0 o/oo; temperature range, -1.8 to 28.9 °C, dissolved oxygen range 0.7-9.5 mg/1.; deposited surf clam shells and mud; mud often high in H_2S; sample with dredge or bottom grab from boat; epifaunal organisms predominate, especially ectoprocts, hydroids, anemones, crabs, amphipods.

14. Mispillion River: salinity range, 2.5 to 29.0 o/oo; temperature range, -1.0 to 29.0 °C; dissolved oxygen range, 2.0 - 11.0 mg/1.; good shell first 1500 yds., then scattered shell with mud and marsh grass debris; sample with dredge in shell or with bottom grab in mud; epifaunal species predominate but some infaunal organisms in mud clumps.

15. Murderkill River: salinity range, 2.0 - 27.0 o/oo; temperature range, -1.5 to 28.5 °C; dissolved oxygen range, 1.8 - 11.1 mg/1; good shell first 2000 yds., then scattered shell and mud; intertidal oyster bar near mouth; sample with dredge in shell, with bottom grab in mud, or by hand on intertidal bars; boat necessary, except for intertidal bar; epifaunal species predominate, large portions of the bottom covered with tubes of the polychaete Sabellaria vulgaris.

16. St. Jones River: salinity range, 2.0 - 26.0 o/oo; temperature range, -1.5 to 28.5 °C; dissolved oxygen range, 0.8 - 12.5 mg/1.; scattered shell and mud; intertidal bars near mouth; sample with dredge or bottom grab from boat except on intertidal bar; epifaunal organisms predominate.

17. Leipsic River: salinity range, 2.0 - 18.0 o/oo; temperature range, -1.0 to 29.0 °C; dissolved

oxygen range, 2.0 - 11.0 mg/1.; good shell first 2000 yds., then scattered shell, mud and marsh grass debris; sample with dredge or bottom grab from boat; epifaunal species predominate, large regions of mud and marsh debris provide space for Nereis succinea.

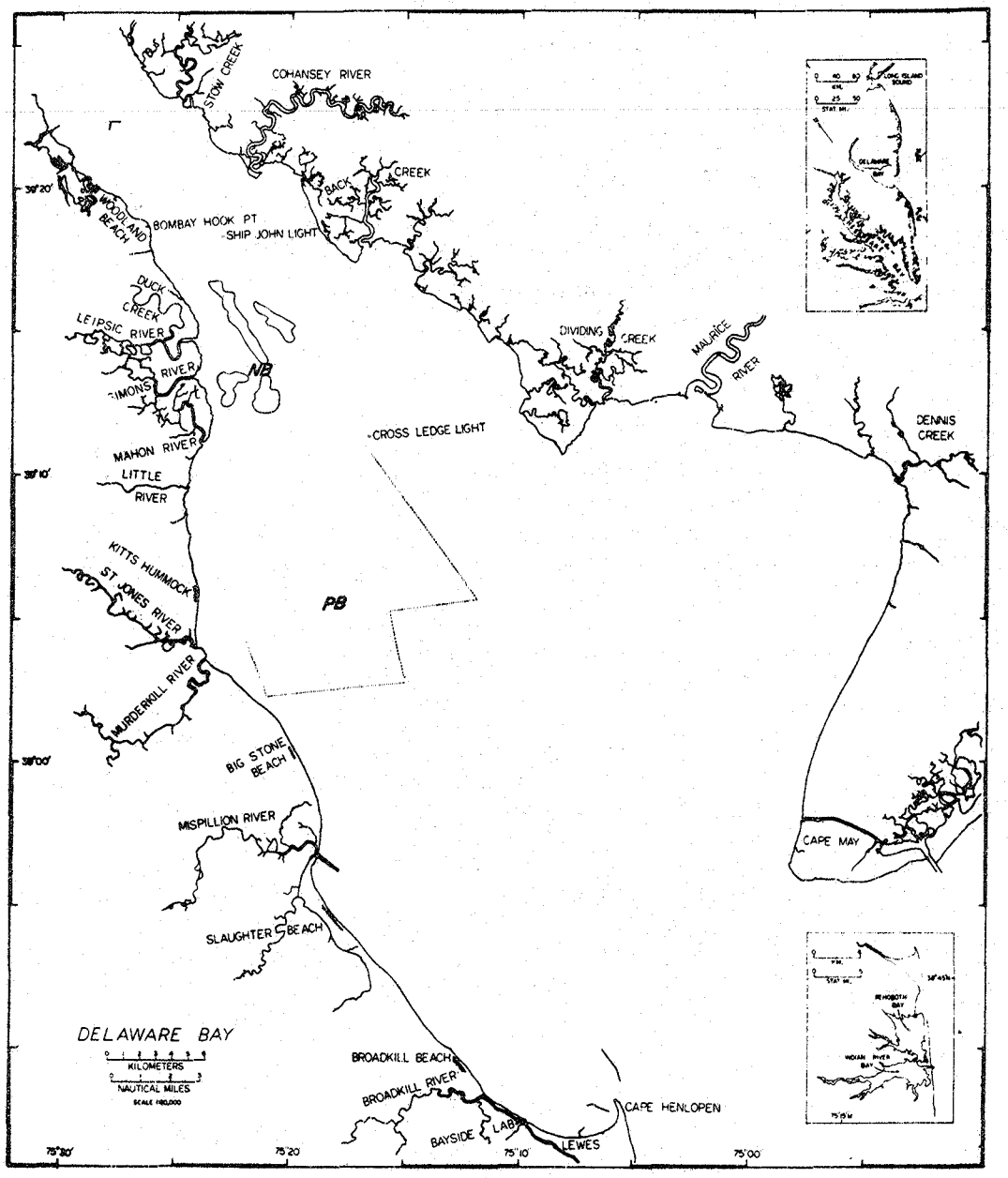
18. Natural Oyster Beds: salinity range 18.0 - 25.0 o/oo; temperature range, 1.0 to 26.0 °C; dissolved oxygen range, 6.0 - 8.0 mg/1.; good shells in central portion of each bed, however most of area is muddy shell; sample with dredge or bottom grab from boat; epifaunal organisms predominate.

E. Subtidal Bay Bottom:

19. Delaware Bay: marine to mesohaline, well-oxygenated water; turbidity usually high; sediments vary from highly reducing muds to clean sand, gravel and shell deposits; sample with dredge or bottom grab from boat; most phyla and classes represented, both infaunal and epifaunal, little or no algae.

20. Rehoboth Bay: marine to upper polyhaline, salinity reducing as one proceeds up the creeks flowing into the bay; water reasonably clear, particularly in winter; sediment primarily sands, silts and clays; algae present, quite abundant in some localities; fauna primarily infaunal.

21. Indian River Bay: salinity ranges from marine at the ocean inlet to mesohaline in the upper reaches of the bay; sediment varies from sands near the inlet to silts and clays in the upper half; algae present; fauna primarily infaunal.



Map of collecting localities in the Delaware Bay region.

NB = Natural oyster beds
PB = Planted oyster beds