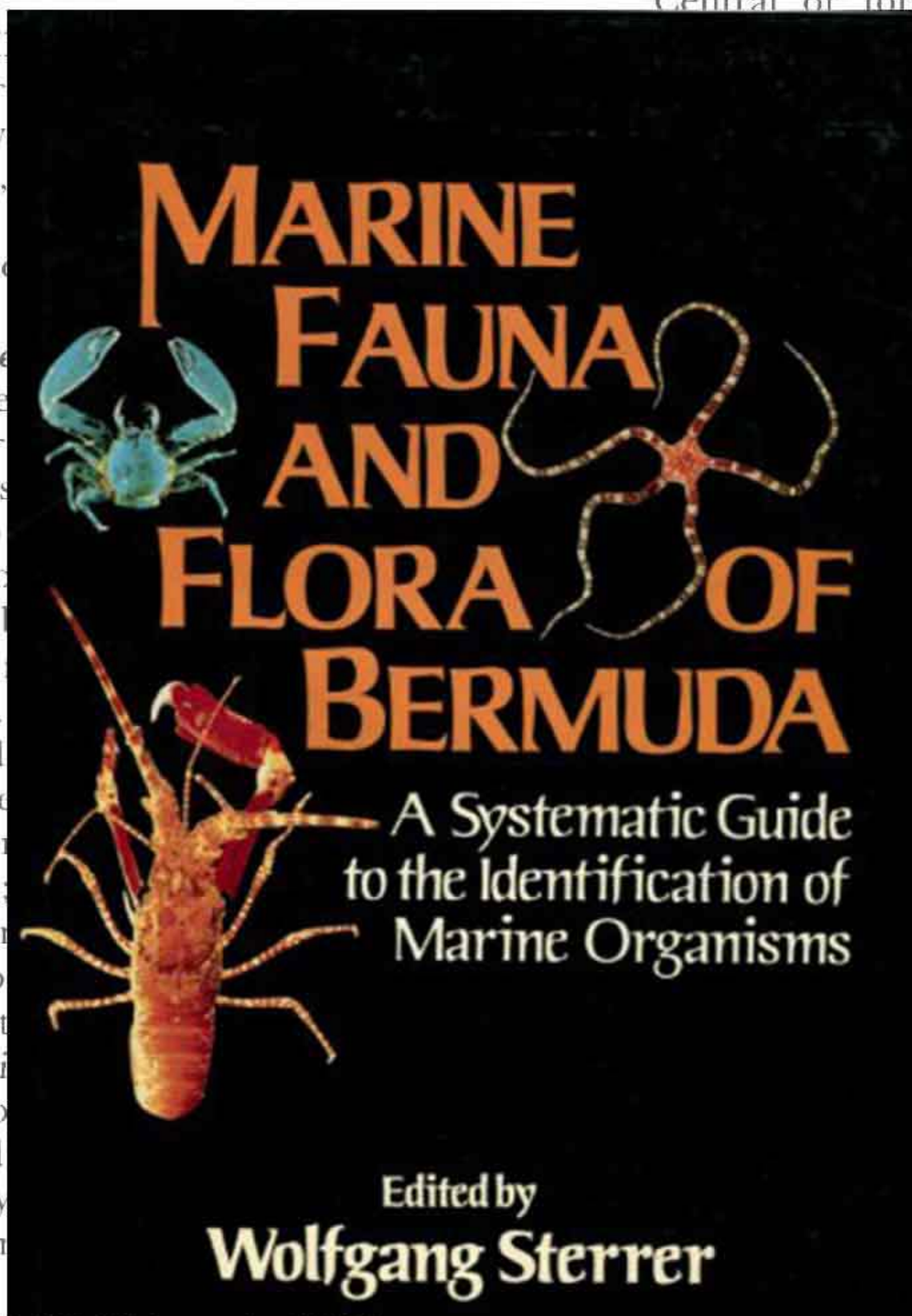


rated by small flexible chitinous joints; ovicell a large swollen sac-like gonozooid inserted among the autozoocia.

F. CRISIIDAE: Rigid branches of several zooecia, zooecia from Bda.

Crisia Very deep aperture margins (ing 10) sive joint short, ward; colored inflated or upper transverse surface of branch some locally out and barrier ally inshore rock and recorded by *eburnea* on



Lichenopora radiata (Audouin): Fairly thick (averaging about 1 mm high) disc, often light purple or lavender-colored when living. Central or top area of colony by tiny alveoli (ovicell below). Zooecia closely regular, uniserial, on lateral surface apertures partly by hood-like at many low reef (outer, lateral reefs), but also on coral, rock,

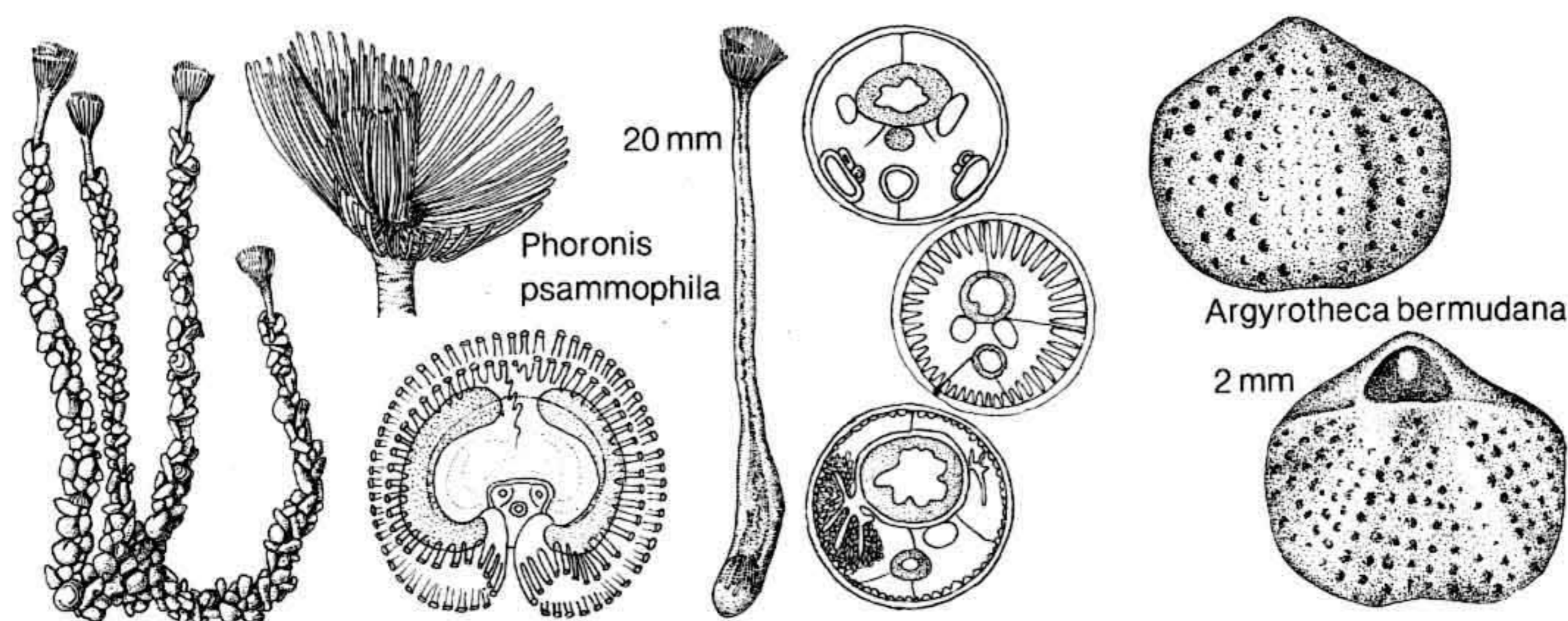
ski (Harmer): averaging under usually white when top area of colony all; ovicell there irregular ridges well-defined alveoli rows of widely uniserial, but less margin of zooecia extended into apertures. Sparse at occasionally in outer and lateral, rock, shells

.O. RECTANGULINA: Cyclostomida with encrusting disc- or wart-like colony; zooecia tubular, radiating outward and upward from colony center, arranged in distinct radial series (fascicles), separated from laterally adjacent series by tiny coelomic chambers (kenozoocia or "alveoli"). Ovicell formed from zoecium covered over by alveoli, often in upper center of colony. (Only family: Lichenoporidae, with 2 spp. from Bda.)

R. J. CUFFEY & S. S. FONDA

Phylum Phoronida (Horseshoe worms)

CHARACTERISTICS: *Worm-shaped, solitary, tube-dwelling LOPHOPHORATA with a horseshoe-shaped lophophore embracing the terminal mouth opening.* To 20 cm (rarely more) in length (but only a few millimeters in diameter); colorless-transparent, or with white, yellow or red pigment. Movement is



171 PHORONIDA (Horseshoe worms), BRACHIOPODA (Lamp shells)

limited to emergence of the anterior end from the tube.

Of only 10 species in 2 genera, 1 is known from Bermuda.

OCCURRENCE: Exclusively marine and benthic, from the intertidal to 390 m. Tubes may occur singly, vertically embedded in soft sediment, or form tangled masses; some species burrow in, or encrust, calcareous shells and rock, and 1 is associated with the tubes of *Ceriantharia*. Distribution is worldwide.

IDENTIFICATION: A low-power microscope is needed for live observation; species identification may require histological sectioning. To remove animals from their chitinous, rigid, sand-encrusted tube, the latter has to be broken, or split open with fine-point tweezers.

Note the shape of the lophophore and the position of mouth (inside the tentacular crown) and anus (outside between the recurving parts). The nephridia (which also act as gonoducts) open next to the anus. The posterior part of the body is swollen to form a bulb.

Fix, after anesthetization (to prevent shedding of the lophophore!), in ethanol or formaldehyde; for histology in Bouin's.

BIOLOGY: Most are dioecious, some hermaphroditic. Fertilization is internal. The

life-span is probably 1 yr. All species can reproduce asexually by transverse fission or budding; autotomy of the lophophore, with subsequent regeneration, is common. Phoronids are suspension feeders, gathering small particles by way of tentacular ciliary currents. Known predators are fishes, gastropods and nematodes; gregarines and trematodes are known to live as parasites in the coelom.

Plate 165

DEVELOPMENT: The embryo is either expelled at an early stage, or brooded in the concavity of the lophophore. The larva, called actinotrocha, is ciliated, and has a pelagic life of 10-20 days before it settles and rapidly (within 10-30 min) metamorphoses.

Actinotrochae are not uncommonly found in plankton tows.

REFERENCES: For a general introduction see HYMAN (1959) and the little book (with an extensive bibliography) by EMIG (1979); the latter author has also given monographic accounts of systematics (1974), ecology (1973) and biology (1982).

There are no published records of species from Bermuda.

Plate 171

Phoronis psammophila Cori: Genus without epidermal collar fold below the lophophore. —Species with a horseshoe-shaped lophophore of up to 130 tentacles. Nephridia with 1 coelomic funnel; 1 (left) giant nerve fiber. To 190 mm when extended (15-40 mm contracted), flesh-colored with white spots on tentacles and base of lophophore. Dioecious; ♀ broods embryos in a single lophophoral mass. Larva is "Actinotrocha sabatieri" (with up to 12 tentacles and 3 blood masses). On sandy-muddy subtidal bottoms of inshore waters (e.g., *Thalassia* beds); locally abundant.

C. C. EMIG

Phylum Brachiopoda (Lamp shells)

CHARACTERISTICS: *Solitary, mostly sedentary LOPHOPHORATA with body enclosed in a shell consisting of a dorsal and a ventral valve. With or without a stalk.* Shells range from 0.5 to 80 mm in size and are mostly yellowish gray; some are glassy-transparent or show bright colors.

Of 260 recent species (there are some 30,000 extinct species!) in 2 classes, the Inarticulata (Ecardines) are not known from Bermuda, and the Articulata (Testicardines) with only 1 species.

OCCURRENCE: Exclusively marine and benthic, from the shallow subtidal to the abyss. They are usually attached to hard substrates, often in clusters; few live in sediment burrows, or lie on the bottom unattached.

Collect *Argyrotheca* by examining the underside of reef corals.

IDENTIFICATION: Use a low-power microscope for observation of live animals and internal anatomy.

The bilaterally symmetrical shell is calcareous in Articulata and consists of a smaller dorsal and a larger ventral valve, the latter with an opening for the stalk (pedicle). The valves can be variously sculptured and, in *Argyrotheca*, are incompletely pierced by tubules which appear as dots on the inner surface (punctate type). In Articulata, valves are hinged together posteriorly by a tooth-and-socket arrangement. Other internal features used in classification are mostly associated with the shape of the tentacular apparatus (lophophore) and its supporting skeleton; the latter can appear as simple prongs (crura), or as a complex 3-dimensional structure.

Preserve in 75% alcohol.

BIOLOGY: Sexes are separate in most species; *Argyrotheca*, however, is probably hermaphroditic. Sex cells are shed into the coelom and discharged into the open water by way of the nephridia; in some species (probably also in *A. bermudana*) brooding up to the larval stage takes place. Brachiopods are suspension feeders, producing a ciliary current through the shell and trapping small plankton (especially diatoms) in their lophophore. They can be parasitized by gregarines and copepods, and preyed upon by fishes.

Plate 165

DEVELOPMENT: Although the hatching larva of Inarticulata resembles an adult, that of *Argyrotheca* appears mushroom-shaped, with long larval setae. Larval development of most species is still poorly known.

REFERENCES: For an introduction to the voluminous literature see MOORE (1965).

Recent species of *Argyrotheca* are dealt with by DALL (1911a, b; 1921), and LOGAN (1975) gives observations on the ecology of Bermuda's species.

Plate 171

- CL. ARTICULATA:** Brachiopoda with calcareous valves hinged posteriorly by a tooth-and-socket arrangement. Pedicle opening through the ventral valve. Lophophore with internal skeleton; anus absent.
- O. TEREBRATULIDA:** Articulata with punctate shell and simple lophophoral skeleton. Shell commonly smooth, teardrop-shaped.

Argyrotheca bermudana Dall (= *Cistella cistellula* of VERRILL 1900d): Rarely exceeds 2 mm in width. Shell cream in color, with irregular, non-divaricate, pink-red bands particularly prominent near the anterior margin; growth lines progressively crowded around the anterior margin. Valves with fairly short, subtruncate, and small deltidial plates (elements bordering the pedicle base); crura widely separate. Lophophoral support (or loop) relatively long, formed by 2 descending branches joined anteriorly on the median septum. Lophophore large, schizolophous (indented anteromedially). Pedicle well developed. On offshore and nearshore reefs and in caves, on the underside of reef-building corals (particularly *Montastrea* and *Agaricia*), often in clusters. Common but easily overlooked.

C. C. EMIG

Phylum Chaetognatha
(Arrow worms)

CHARACTERISTICS: *Small arrow-shaped BILATERIA with tripartite body consisting of*

a head with paired chitinous (!) hooks, a trunk and a tail, the 2 latter carrying rigid horizontal fins. Length 3-30 (rarely 100) mm; colorless and often extremely transparent (especially trunk and tail).

Morphologically very uniform, Chaetognatha are one of the most isolated taxa within the animal kingdom, with possible relationships to groups as diverse as Nematoda, Annelida, Echinodermata and Chordata. Of about 65 described species, 20 have been recorded from the Bermuda region; 9 are included here.

OCCURRENCE: Exclusively marine and—with the exception of 1 benthic genus not recorded from Bermuda as yet—pelagic; in all oceans, sometimes in enormous numbers. Several species are cosmopolitan. Many species are confined to specific depth zones; some are indicators for coastal waters, whereas the majority are found in the open ocean. Diurnal vertical migrations are common.

Collect with large plankton nets.

IDENTIFICATION: Live specimens can be observed under a dissecting microscope; for species identification, preserved, unstained (!) specimens should be transferred to a flat dish or depression slide and examined under a microscope.

Note the head provided with 1 pair of eyes, and bearing curved grasping hooks and 1 or 2 rows of teeth under a retractable fold of skin. The epithelium (with a cuticle) can be thickened into a spongy "collarlette". A ciliated chemoreceptive organ (corona) is situated in the neck region. The trunk (containing the ovaries and the ventral ganglion) is separated from the tail (containing the testes) by a transverse septum. Respiratory, circulatory and secretory organs are lacking. For species identification, the number and shape of lateral fins, of hooks and teeth, and the shape of testes, seminal vesicles and ovaries are important.

Fix in 5% buffered formaldehyde-seawater.