MARINE FAUNA AND FLORA OF BERMUDA

A Systematic Guide to the Identification of Marine Organisms

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stomulida (p. 211), Gastrotricha (p. 213), Nematoda (p. 216), Rotifera (p. 219), Kinorhyncha (p. 220), Priapulida (p. 222), Acanthocephala (p. 223), Sipuncula (p. 224), Echiura (p. 228), Pogonophora (p. 230), Annelida (p. 232), Tardigrada (p. 265), Arthropoda (p. 268), Mollusca (p. 392), Bryozoa (p. 500), Phoronida (p. 516), Brachiopoda (p. 518), Chaetognatha (p. 519), Echinodermata (p. 522), Hemichordata (p. 541), and Chordata (p. 545). The 5 phyla not represented are the microscopic, primitive, marine Placozoa, Nematomorpha (nematode-like worms with few marine representatives), the recently described marine interstitial Loricifera, the terrestrial Onychophora and the parasitic Pentastomida. Recent phylogenetic analyses support the subdivision of Metazoa into Placozoa, Parazoa (= Porifera) and Eumetazoa (all other phyla), and the latter into Coelenterata (= Radiata, i.e., Cnidaria and Ctenophora) and Bilateria. Only the latter term is used for classification purposes here (p. 197).

Phylum Porifera (Sponges)

CHARACTERISTICS: *Sedentary, aquatic, filter-feeding METAZOA bounded by a 1-cell layer of flat pinacocytes (pinacoderm) and containing flagellated choanocytes (choanoderm) that create a unidirectional water current through the body. Water enters numerous small ostia (pores) and leaves through larger oscula. Mesohyle (between pinacoderm and choanoderm) contains various mobile cells, collagen and, usually, a skeleton of spongin, mineral (silica or calcium carbonate) or both.* The size ranges from millimeters to more than 1 m diameter, commonly 0.1-10 l in volume. Consistency varies with nature and density of the skeleton from soft crumbly to stiff elastic and stony hard. Colors are often vivid (yellow, red, blue), particularly in dark locations; shades of green and brown are commonly caused by symbiotic algae. Sponges are crustose or massive, cushion-, fan-, tube-, tree- or cup-shaped. Attached to the substrate, they show little movement except contraction of the entire body or of the openings upon disturbance. They are most commonly confused with compound ascidians.

Of the 4 recent sponge classes, the reef-dwelling Sclerospongea have hitherto not been found in Bermuda, and Hexactinellida occur in the deep sea. Owing to many new data on embryology, histology and chemistry, the positions of higher taxa remain in a state of flux. Of about 5,000 species known, 70 (approximately, because of many uncertain identifications) are found in Bermuda; 49 are reported here.

OCCURRENCE: Predominantly marine (3 Demospongea families in fresh water, but none reported from Bermuda), on stable substrates. Calcarea are most common in very shallow water; Demospongea (95% of all recent species) occur in all depths and climatic zones but, except for small, crustose and endolithic forms, avoid high-energy environments. Substrates include rock (particularly in caves), dead coral, subtidal mangrove roots, sea grass rhizomes, algae, other sponges, shells of mollusks and crabs, and artificial structures (buoys, pilings). Soft bottoms in calm water are colonized by initial settlement on rubble fragments.

Collect by wading, snorkeling or SCUBA diving (turn over rocks, look inside caves); on deep level bottoms also by dredging. Cut with knife or chisel; include substrate where possible (with encrusting or excavating forms in particular). Wear gloves for some forms are irritating to the skin (by spicules, toxins or epizoic cnidarians). Commercially usable species have been reported from Bermuda but are now very rare or absent. Other forms are under

investigation for their antimicrobial properties.

IDENTIFICATION: Some species can be identified from color, shape, consistency and surface structures. These characters should be noted from fresh specimens, together with possible presence of pigment exudate or color changes shortly after collecting. Color photographs for documentation are useful if immediate identification is not possible. Presence and type of skeleton should be determined from microscope preparations. Make 0.2-0.5 mm sections (razor blade) of dehydrated (alcohol or air dried) material; cut perpendicular and, subsequently, parallel to the surface and note whether a surface layer (ectosome) is detachable from the internal layer (choanosome); clear in xylene and mount in balsam under cover glass. Alcohol-hardened material can also be stained to make soft tissue components (e.g., spongin, choanocyte chambers) better visible. A convenient stain for this purpose is a saturated solution of basic fuchsin in 95% ethanol; rinse well with alcohol. Spicules are isolated by digesting small but representative tissue fragments in cold sodium hypochlorite (Clorox) or (siliceous spicules only) boiling nitric acid; examine under high-power optics. Permanent mounts of dry spicules in balsam require thorough rinsing with water and absolute alcohol. Let spicules settle in test tube after each change (minimum 1 hr in water, 0.5 hr in alcohol) to prevent loss of microscleres. Use standard histological techniques to determine shape, size and arrangement of choanocytes and choanocyte chambers for classification of some Keratosa and Calcarea.

Common sponge shapes are crustose, chambered (excavating), irregularly massive, spherical, tubular or cylindrical. Most colors are represented, but fade or change quickly after collecting (especially when exposed to air), even before preservation. Consistency can be mucous soft, compressible, elastic, stiff, cartilaginous or hard and brittle. Conspicuous surface structures include exhalant openings (oscula), protrusions (conuli, papillae), embedded sand grains and special spiculous reinforcements (cortex). The surface layer (ectosome) covers an internal layer (choanosome) that contains skeletal material and is traversed by canal systems. Three types of canal systems are recognized in sponges; all occur in Calcarea. Ascon is a simple tube (spongocoel) lined with choanocytes (choanoderm), e.g., in *Clathrina*. Sycon, named after the sponge where it occurs, has a folded choanoderm; the choanocytes line short tubes that radiate from a common atrium. Leucon occurs in many Calcarea (e.g., *Leucandra*) and in all Demospongea; the choanocytes are restricted to small chambers that are dispersed through the thick mesohyl; the choanocyte chambers are connected to each other and to the outside by a system of canals without flagellated cells.

Note reticulation and structure of spongin fibers, and mineral composition, size classes, position and type (shape) of spicules. Collagenous spongin can occur as patches connecting spicules or it can build up a substantial elastic framework. Skeleton structure can be reticulate (net-like), with ascending primary and connecting secondary fibers, dendritic (tree-like branching) or intermediate such as dendroreticulate or plumoreticulate (feather-like). Spongin fibers can be clear or cored by a pith, by sediments, or by spicules. Spongin fibrils (*Ircinia*) and spongin spicules (*Darwinella*) are structures not connected to the framework. Most sponge spicules are siliceous, except in Calcarea where they are of calcium carbonate (test with acid!). One distinguishes megascleres (commonly >50 μm) that are structurally important, and microscleres that occur unoriented in certain parts of the tissue. Megascleres can be arranged in radiate, reticulate or felted fashion, in strands, coring (fully embedded), or echinating (partly embedded in) spongin fibers. Megascleres can have 1 (monaxon), 3 (triaxon) or 4 (tetraxon) axes. Monaxon forms can be pointed at both ends (oxea); pointed at one end, rounded at the the other (style); rounded at both (strongyle); pointed at one, knobbed at the other (tylostyle); or knobbed at both ends (tylote). Cladotylotes are tylote at one end, anchor-like with recurved clads (rays) at the other. Spined spicules have the prefix acantho- (e.g., acanthostyle).

Monactines, diactines, triactines and tetractines are radiate spicules with 1-4 rays, respectively. Triaenes are tetractines with 1 ray (rhabd) commonly much larger than the other 3, which can point forward of (protriaen) or toward (anatriaen) the rhabd. Desmas are irregular complex branching and interlocking megascleres. Microscleres can be various forms of asters where rays originate from 1 point (euaster) or from an axis (streptaster). Euasters include those with long free tapered rays (oxyaster),

with short ray and thick centrum (spheraster) and with coalescent rays and special surface ornamentation (sterraster). The most common kind of streptaster has a spiraled axis and is termed spiraster. A related type, the amphiaster, has spines radiating from both ends of the shaft. Microscleres can also be hair-like (raphid), C- or S-shaped (sigma; sigmaspire, if contorted) or bow-shaped (toxa). Another common group of microscleres are anchors (chelae) with either equal-sized (isochela) or unequal-sized (anisochela) recurved ends. Arcuate chelae have a bow-shaped shaft. Hexactinal spicules (e.g., hexaster) characteristic of the class Hexactinellida have 6 rays arranged in 3 perpendicular axes (triaxon).

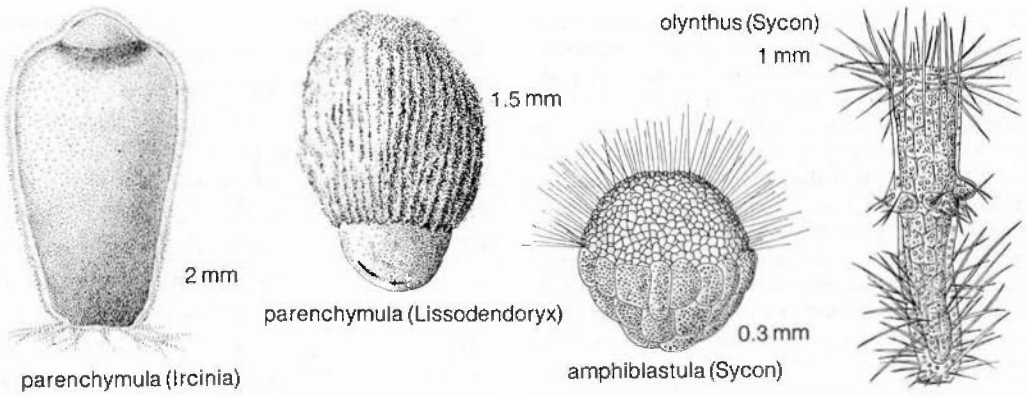
Sizes given in plates refer to the largest dimension (height or width) of the specimen shown.

Fix in 10% formalin-seawater, neutralized and buffered by methenamine (20 g/l final solution), store in 70-80% ethyl alcohol (change twice). Dry large specimens for more convenient storage but fix representative portions in liquid. Use formalin or Bouin's fixation and Mallory's triple stain for routine histological examination. If necessary decalcify in 5% nitric acid (rinse well, neutralize in 5% aqueous sodium sulfate solution). For sectioning embed in polyester wax or epoxy resin, or in 12% gelatin for freezing and cryostat microtomy.

BIOLOGY: Most sponges are successive hermaphrodites, producing male and female gametes anywhere in the endosome. Male specimens emit sperm through their oscula into the water column. In viviparous species, which constitute the majority, females receive sperm through the inhalant water current and incubate fertilized eggs until they are expelled as free-swimming larvae. The few known oviparous species release numerous eggs enveloped in mucous sheets for outside fertilization. Several methods of asexual reproduction are common. Most species are able to regenerate from fragments. External budding is commonly observed (e.g., *Tethya* spp.), and gemmules, cell aggregates comparable to but less complex than those of freshwater sponges, are formed by some species (e.g., *Ulosa ruetzleri*, *Cliona lampa*). Life-span ranges from a few months to about 10 yr; some very large (0.8-2.5 m diameter) specimens of Demospongea observed in deep reef zones, outside the range of wave action, are estimated to be 50-100 years old. Sponges can be classified as unselective suspension feeders. They create a unidirectional water current by uncoordinated beating of choanocyte flagella, and filter bacterial and other cells and detrital organic particles under 50 μm in diameter, the maximum size of incurrent openings (ostia). Thirty to over 100 l water can be micro-filtered in 1 hr by a sponge of 1 l volume. Digestion takes place intracellularly (phagocytosis). Many tropical and subtropical shallow-water species harbor symbiotic bacteria (e.g., *Aplysina* spp., *Pseudoceratina crassa*) and unicellular algae (zoocyanellae, e.g., *Ircinia felix*, *Chondrilla nucula*; zooxanthellae, e.g., *Cliona caribbaea*) that are partly phagocytized, partly used as a source of dissolved nutrients. Sponges provide substrate or hiding places for many epibionts such as algae (*Jania*), Hydrozoa (*Sphaerocoryne*), Zoanthidea (*Parazoanthus*), Entoprocta (*Loxosomella*), Amphipoda (*Caprella*) and endobionts (many polychaetes and crustaceans). Some of these are parasites or predators because they regularly feed on the tissue of the host (e.g., Alpheidae). Predators not living in or on sponges are many fishes and some sea turtles. Some crabs (Dromiidae, Majidae) hold sponges on their backs for camouflage without harming them except for an occasional trimming. Several species are remarkable for their capacity of exacavating limestone (Clionidae, in particular).

Plate 29

DEVELOPMENT: Two principal types of larvae occur in Porifera; both have a ciliated anterior portion. The parenchy-



29 PORIFERA: Development

mula proper to most Demospongea is oval or pear-shaped, solid, 0.5-2 mm long; it is comparable to the cnidarian planula. The amphiblastula of Calcarea is spherical, smaller (50-300 μm), and has a central cavity. Hexactinellid larvae, as far as they are known, are of the parenchymula type but may not be able to swim actively. Parenchymula larvae, in contrast to amphiblastulae, can have a high degree of differentiation when released from the parent. Most sponge larvae swim in characteristic rotating or spiraling fashion close to the bottom. Settlement is preceded by a short creeping phase. Attachment by the anterior pole occurs usually after a few hours or a day. Then the larva flattens and develops a canal system and 1 osculum within 2 days. Higher Calcarea (e.g., Sycettida) go through a tubular asconoid development stage (olynthus) shortly after settlement.

Sponge larvae are best caught by stationary plankton nets installed near the bottom and facing a unidirectional current. Nearly mature larvae are often released by the parent sponge in the lab under adverse conditions (e.g., heating, oxygen depletion).

REFERENCES: Recent comprehensive presentations of the phylum are found in BRIEN et al. (1973) and BERGQUIST (1978). Techniques for systematic and ecological study are outlined in RÜTZLER (1978).

Bermuda sponges have been treated by DE LAUBENFELS (1950) and RÜTZLER (1974). A recent monograph on a related fauna from the Bahamas, including chapters on systematic procedures and an illustrated glossary, is presented by WIEDENMAYER (1977). Modern revisions of 3 orders of Caribbean demosponges are by SOEST (1978, 1980, in press).

CL. DEMOSPONGEA: Porifera with siliceous spicules or spongin fibers, commonly both, rarely neither present. Megascleres monaxon or tetraxon. Great variety of color, shape and size.

Plate 30

O. KERATOSA: Demospongea lacking proper mineral spicules. Commonly elastic in life owing to spongin skeleton. Generally in shallow water. (About 20 spp. from Bda.)

F. SPONGIIDAE: Keratosa with reticulum of primary (ascending) and secondary (interconnecting, thinner) spongin fibers. Fibers without pith, some cored by moderate quantities of foreign inclusions (sediment grains). Small, spherical choanocyte chambers (<50 μm diameter).

Ircinia felix (Duch. & Mich.) (=*I. fasciculata* sensu de Laub.): Genus with filamentous spongin threads filling the choanosome, which make the sponges extremely tough and difficult to tear; reticulated sand pattern on surface.—Typical form (f. *felix*) of species crustose, with raised oscula, or massive, with 1-2 mm conules on surface. Forma *fistularis* (Verrill) with simple erect hollow branches and terminal oscula; f. *acuta* (Duch. & Mich.) (non *I. strobilina*) conical or massive, with elevated oscula, with large (2-4 mm) conuli. All forms grayish to chestnut-brown, up to 25 cm. With a very distinctive odor when exposed to the air. On protected sediment and rock bottoms (f. *felix*, f. *fistularis*) and on the reefs (f. *felix*, f. *acuta*), 0.5-5 m; very common. (Color Plate 3.3.)

F. **APLYSINIDAE:** Keratosa with laminated fibers cored by a granular pith, without foreign inclusions. Small (<50 μm) ovoid choanocyte chambers.

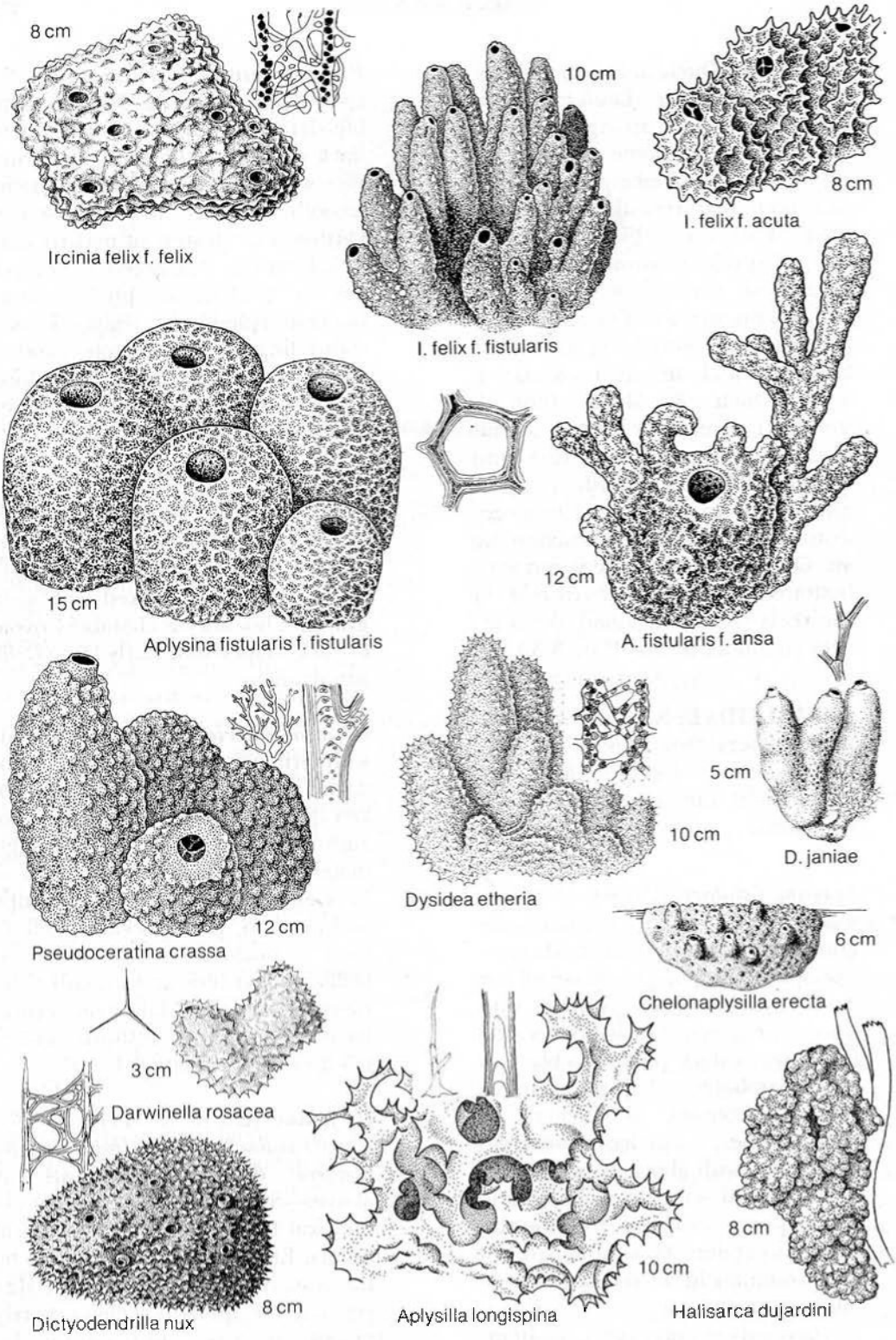
Aplysina fistularis (Pallas)(=*Verongia fistularis*): Genus with regular hexagonal reticulum of amber fibers.—Species fleshy spongy, with small low conuli. Color deep yellow with brown or greenish (shallow water) tinge; turns dark purple to black in air (aerophobic). Typical form (f. *fistularis*) consists of clusters of smooth tubes; f. *ansa* has more irregular tubes with short or fairly long (15 cm) and sometimes branching digital processes rising from the rim of the cylinder. Maximum size 30 cm. Common in all reef and open-lagoon environments, 1-6 m; f. *fistularis* only in outer reefs, 30-40 m.

Pseudoceratina crassa (Hyatt) (=*Ianthella ardis* de Laub.) (Blue bleeder): Dendritic knotty fibers, dark amber, to 0.5 mm thick. Surface with rounded conuli, otherwise smooth. Rubbery, firm consistency. Cushions or clusters of massive conical chimneys. Dull green, brown yellow or golden, aerophobic (turns bluish-purple-black when killed); stains fingers with purple exudate when handled. Size to 25 cm. Very common in shallow caves, on open rocks and reefs, 0.5-5 m. (Color Plate 3.1.)

F. **DYSIDEIDAE:** Keratosa with laminated primary (ascending) and secondary (interconnecting) spongin fibers, commonly packed with sand grains. Choanocyte chambers ovoid or sack-shaped and fairly large (>50 μm diameter).

Dysidea etheria de Laub.: Genus with primary fibers packed, secondaries cored by sand grains and broken (foreign) spicule fragments; choanosome also charged with foreign material. Unelastic, easily torn.—Species occurs as crusts or lumpy cushions, to 12 cm, with small (1 mm) conules. Two color varieties: brilliant clear blue and grayish blue; rarely transitions. Mainly on vertical hard substrates in inshore waters, 0.5-2 m. (Color Plate 3.4, 5.)

D. janiae (Duch. & Mich.) (=*Desmacella janiae* Verr.; *D. fragilis* forma *algafera* de Laub.): Genus as above.—Species as aggregates of cylindrical lobes, to 6 cm, with apical oscula. Entire sponge permeated by the branching alga *Jania* sp. The alga replaces the spongin skeleton partly or entirely; it is dead (white) in the



30 KERATOSA (Sponges 1)

deeper portions of the sponge, mostly live (pinkish to greenish purple) near the surface. Sponge color accordingly whitish, pinkish, light greenish purple. Common but inconspicuous among *Jania* turfs on patch reefs of inshore waters, 0.5-2 m. (Color Plate 3.6.)

F. DICTYODENDRILLIDAE: Keratosa with reticulate, distinctly pithed, laminated, and dark puplish colored fibers and delicate, cavernous tissue. Choanocyte chambers ovoid and large (>50 μm diameter).

Dictyodendrilla nux (de Laub.) (=*Dendrilla nux*): Primary and secondary fibers with only a few isolated foreign inclusions. Massive, to 15 cm, with finely conulose surface, cavernous choanosome; very soft and compressible. Dark grayish blue, appearing black in the field; bleeds clear blue pigment when handled. Moderately common on inshore hard bottoms, 1-2 m.

F. APLYSILLIDAE: Keratosa with simple or branched (dendritic), pithed and laminated ascending fibers and large (>50 μm) choanocyte chambers.

Aplysilla longispina George & Wilson (=*A. sulfurea* sensu de Laub.): Thickly incrusting, covering large areas, to 20 cm × 15 cm. Surface with numerous large (1-5 mm), slender, frequently compound conules. Soft cavernous tissue, stiff elastic fibers. Bright sulfur yellow color turns dark purple upon preservation. Abundant in shallow inshore caves, 1 m. (Color Plate 3.10.)

Chelonaplysilla erecta (Row): Genus with neat surface reticulation of sand grains.—Species encrusting, covering up to 20 cm × 20 cm, with small oscular chimneys. Consistency soft, easy to tear. Deep purplish black color. Common in inshore waters, fouling on buoys, pilings and similar structures, 1-5 m.

Darwinella rosacea Hechtel: Genus with spongin spicules in addition to the fiber skeleton. Thin rose-red conulose crusts, to 5 cm. In inshore waters, 1 m; uncommon. (Color Plate 7.11.)

F. HALISARCIDAE: Keratosa in which the spongin skeleton is absent. Large (>50 μm) sack-shaped choanocyte chambers.

Halisarca dujardini Johnston: Soft yellowish brown lumpy incrustations, 5 cm × 10 cm, on shells and seagrass blades. In protected bays, 1-2 m.

Plate 31

O. HAPLOSCLERIDA: Demospongea with reticulate skeleton of simple spicules (oxeas, strongyles). Spicules single (unispicular) or in bundles (multispicular), connected by more or less spongin, or coring solid spongin fibers. Usually no microscleres, occasionally sigmas. (About 12 spp. from Bda.)

F. HALICLONIDAE: Haplosclerida with small (generally <150 μm long) oxeas of uniform length, lacking microscleres and specialized tangential ectosomal skeleton.

Reniera hogarthi (Hechtel) (=*Haliclona permollis* sensu de Laub.): Ge-

nus with isodictyal (equal-sided mesh) reticulation, some multispicular tracts (spongin restricted to spicule nodes).—Species encrusting or forming clusters of volcano-shaped or tubular elevations to 15 cm. Very soft, limp consistency. Color violet. Common on rubble pieces among sea grass in protected inshore bays, 1-3 m.

Amphimedon viridis Duch. & Mich. (=*Haliclona viridis*): Genus with ascending multispicular tracts cemented by spongin, with unoriented spicules in between.—Species appears as massive cushions with raised oscula, as groups of conical tubes, occasionally as solid branches. Maximum size 18 cm. Consistency fleshy, doughy, mucous when rubbed. Color dull green, occasional specimens purplish brown. Very common in shallow caves, on open rocks and on mud bottoms in inshore waters, 0.5-5 m. (Color Plate 3.9.)

Haliclona molitba de Laub.: Genus characterized by reticulation of spongin fibers cored by spicules.—Species amorphous, encrusting or digitate-ramose, to 10 cm, very soft, compressible and limp. Clear vivid violet color. Typically attached to seaweeds in inshore bays, 1-3 m. (Color Plate 3.8.)

H. monticulosa (Verr.) (=*Liosina monticulosa*): Genus as above.—Species encrusting or digitate, to 12 cm. Soft spongy, bright scarlet. On rocks or, characteristically, encrusting other sponges (e.g., *Ircinia felix*), in shallow inshore caves, 0.5-1 m. (Color Plate 3.2.)

F. NIPHATIDAE: Haplosclerida with irregular reticulation of stiff spongin fibers cored by robust oxeas. Dendritic or frazzled fiber ends protruding above the surface.

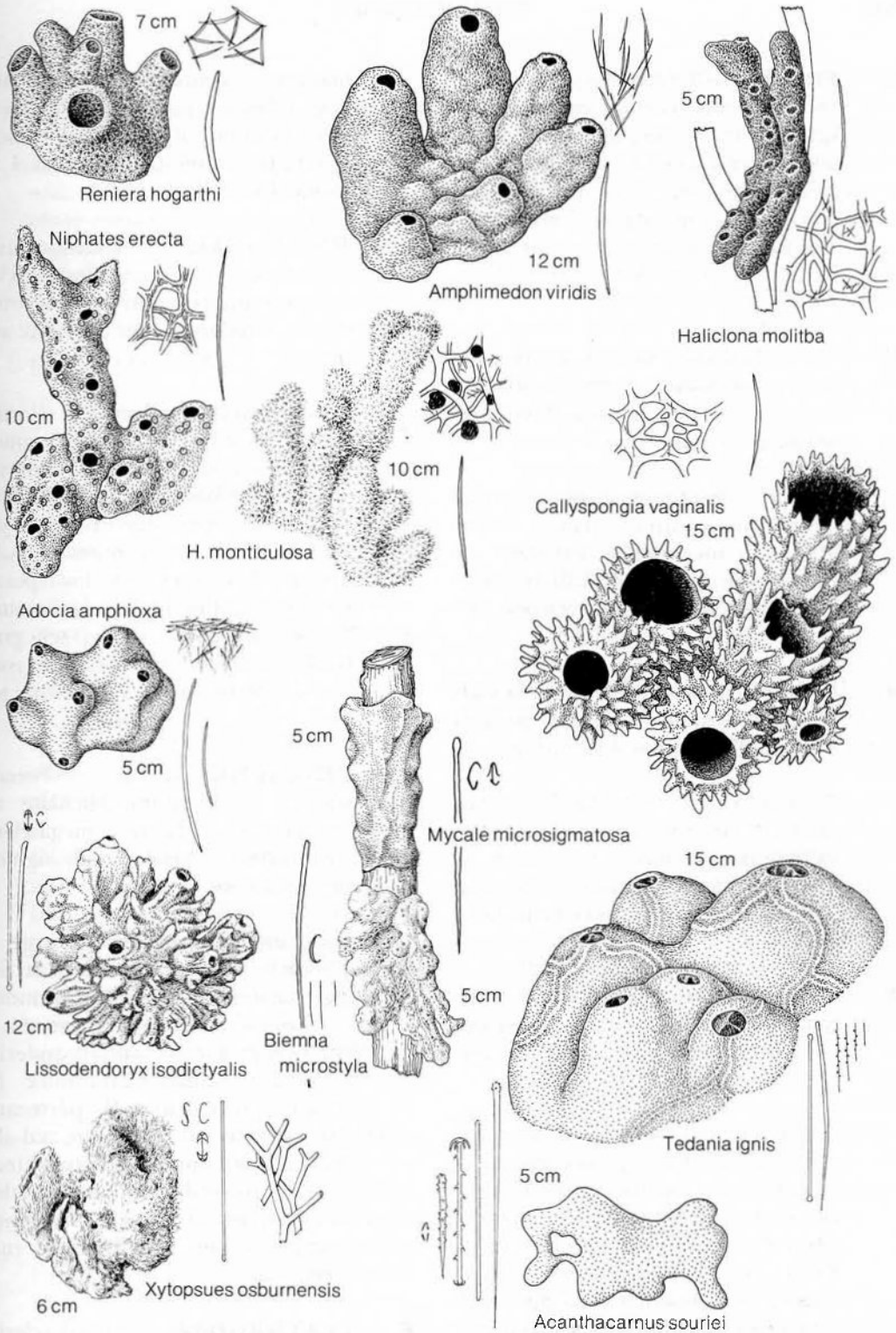
Niphates erecta Duch. & Mich. (=*Haliclona variabilis* sensu de Laub.): Cushions or single creeping or erect branches to 20 cm. Flush oscular rims ragged owing to protruding fiber ends. Stiff spongy, resilient consistency. Color bluish to pinkish lavender. Some specimens have sigmas for microscleres. Common on shallow (0.5-3 m) patch reefs. Most frequently found with *Parazoanthus parasiticus* covering surface. (Color Plates 3.12, 7.9.)

F. CALLYSPONGIIDAE: Haplosclerida with spongin fibers cored by spicules, and with special tangential surface reticulation of primary and secondary meshes.

Callyspongia vaginalis (Lam.): Clusters of large, thin-walled tubes, to 25 cm. Surface of most specimens covered by pronounced cone-shaped projections ("spines," conules). Spongy elastic, grayish green to lavender. Surface commonly colonized by *Parazoanthus parasiticus*. Most abundant on outer reefs and inshore patch reefs, 1-5 m.

F. ADOCIIDAE: Haplosclerida with spicules in isodictyal reticulation and ascending multispicular tracts. Spicules in a range of sizes. Tangential ectosomal spicule skeleton present.

Adocia amphioxa (de Laub.) (=*Strongylophora amphioxa*): Genus with oxeas, no microscleres.—Species as dull gray brittle cushions, to 10 cm, with elevated oscula. Moderately common on rocks in inshore waters, 1 m.



31 HAPLOSCLERIDA, POECILOSCLERIDA (Sponges 2)

O. **POECILOSCLERIDA:** Demospongea with skeleton composed of spicules and spongin fibers. Megascleres (monactine and diactine, frequently spiny) and microscleres (varied; chelae, sigmas, microxeas and toxa; no asters). Great variety in shape, structure and color. (About 14 spp. from Bda.)

F. **MYCALIDAE:** Poecilosclerida with dendroreticulate spicule strands (styles or subtylostyles), interstitial anisocheles and sigmas.

Mycale microsigmatosa Arndt: Thin crusts of up to 8 cm × 15 cm area with meandering exhalant canals. Brick red over drab interior. Coating subtidal mangrove roots; inshore waters.

F. **BIEMNIDAE:** Poecilosclerida with dendroreticulate spicule strands (styles), with sigmas and raphids.

Biemna microstyla de Laub.: Thin crusts (8 cm × 15 cm) with uneven, tuberculate surface. Dull yellow to yellow-orange. Common, coating subtidal mangrove roots in inshore waters.

F. **TEDANIIDAE:** Poecilosclerida with dendroreticulate monactines (styles), ectosomal diactines (tylotes) and roughened oxeote microscleres.

Tedania ignis (Duch. & Mich.) (Fire sponge): Encrusting to massive, to 20 cm, with vents located on conical elevations; at some locations erect digitate. Cavernous, soft, easily torn. Bright red ectosome, brownish red inside. Occasionally specimens appear blackish at the surface owing to dense populations of epizoic *Loxosomella tedaniae*. Very common on mangrove roots, other organisms (e.g., other sponges, crabs), rock and mud bottoms of protected inshore water, from low tide level to 4 m. (Color Plates 3.11, 11.6.)

F. **MYXILLIDAE:** Poecilosclerida with endosomal monactines (styles) in isodictyal reticulation, ectosomal diactines (tylotes), and isochelae and sigmas.

Lissodendoryx isodictyalis (Carter) (Garlic sponge): Massive amorphous to lobate, with meandering surface convolutions. Size to 20 cm. Spongy compressible. Golden yellow, frequently with tinges of bluish green. Tendency to incorporate large quantities of foreign matter, e.g. sand, rubble, algae, sea grass blades. Common on mangrove roots and sediment bottoms of inshore waters, 1-3 m. (Color Plate 3.7.)

F. **DESMACIDONIDAE:** Poecilosclerida with plumoreticulate arrangement of diactine megascleres (strongyles), chelate and sigmoid microscleres.

Xytopsues osburnensis (George & Wilson): Genus packed with foreign materials.—Species rounded-massive, some oscular tubes, to 14 cm. Lumpy surface with meandering subsurface canals. Endosome between spicule strands permeated densely with strands of the red alga *Jania*. Soft, mucous, easily torn. Color brownish purple, mottled, with tinges of pink and green. Inshore waters, moderately common, 1 m.

F. **CLATHRIIDAE:** Poecilosclerida with ascending tracts of monactines (styles, acanthostyles) that are

echinated by accessory megascleres. Microscleres are isochelae and toxa.

Acanthacarnus souriei Levi: Genus with echinating acanthostyles and characteristic cladotylotes (rose-stem spicules).—Species a thin, bright red-orange film, to 20 cm, coating and permeating substrate, possibly boring. Common on coral rock, patch reefs, 1-3 m.

Plate 32

O. **HALICHONDRIIDA:** Demospongea with monaxonid megascleres (oxeas, styles, strongyles) and spongin, without microscleres. Endosomal spicules in confusion (crisscross) with ectosomal organization, or arranged in ascending tracts. (About 5 spp. from Bda.)

F. **HYMENIACIDONIDAE:** Halichondriida with ascending spicule strands.

Ulosa ruetzleri Wiedenmayer (=*Dysidea crawshayi* sensu de Laub.): Genus with flat, ribbon-like dendroreticulate spongin fibers cored by spicules; skin-like conulose ectosome resembling keratose sponges; quantities of foreign materials throughout the choanosomes, including the fibers.—Species with spicules as long styles. Encrusting to massive, to 20 cm, very soft, compressible, limp; bright orange, with darker conspicuous gemmules. On rocks, other sponges (e.g., *Ircinia felix*, *Amphimedon viridis*), mangrove roots, in inshore waters and on patch reefs, 1-3 m. (Color Plate 4.12.)

U. bermuda (de Laub.) (=*Fibulia bermuda*): Genus as above.—Species with spicules as strongyles. Massive, with oscula on rounded lobes or low tubes, to 12 cm. Very spongy, limp, conulose surface, chestnut to blackish brown. Fairly common, inshore waters, 1-3 m.

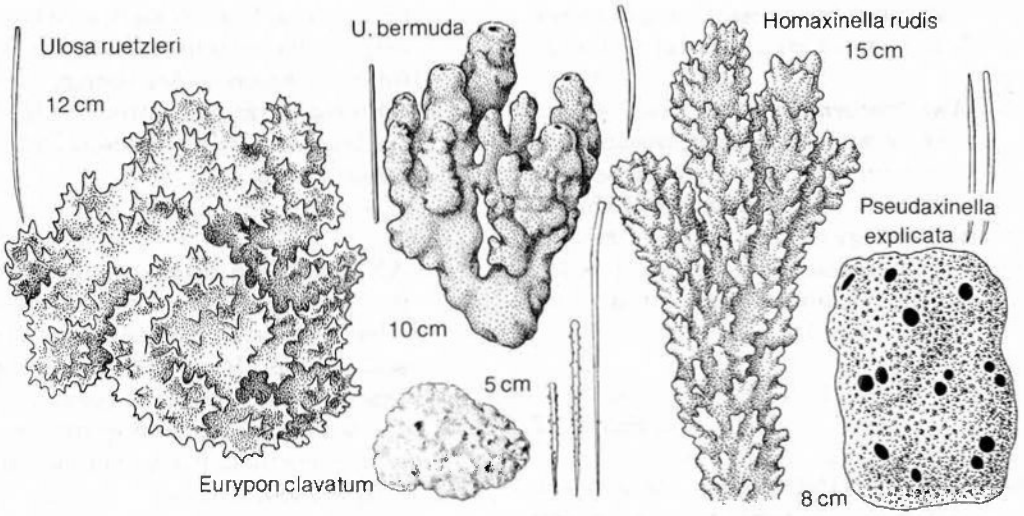
O. **AXINELLIDA:** Demospongea with great variety of monaxon megascleres, including acanthose forms and spongin. Microscleres absent, except in a few families. Typically with condensed axial, and plumose or plumoreticulate extra-axial skeleton. (3 spp. from Bda.)

F. **AXINELLIDAE:** Axinellida with styles, with or without oxeas, without microscleres.

Homaxinella rudis (Verr.) (Red tree sponge): Genus ramose, with simple spiculation of styles. Erect, tree-like branching, to 12 cm, with lumpy, hispid surface. Spongy, but firm elastic, slightly mucous. Clear red. Common on rock in shaded locations, shallow caves, inshore waters, 0.5-2 m. (Color Plate 4.2.)

Pseudaxinella explicata (Wiedenmayer) (=*P. rosacea* sensu de Laub.): Genus massive, axial condensation replaced by ascending plumoreticulate spicule columns.—Species red orange crusts or cushions, to 10 cm, stiffly spongy; strong mucus production when handled. Common on rock in shallow caves, inshore waters, 0.5-2 m. (Color Plate 4.1.)

F. **EURYPONIDAE:** Encrusting Axinellida with principal megascleres perpendicular to the substrate, echinated by secondaries.



32 HALICHONDRIIDA, AXINELLIDA (Sponges 3)

Eurypon clavatum (Bowerbank): Genus with erect tylostyles echinated by acanthostyles of 2 size classes.—Species as very thin, hispid, orange red encrustation of up to 18 cm. Moderately common, coating rocks; inshore waters, 1 m.

Plate 33

O. HADROMERIDA: Demospongea with monactinal megascleres (tylostyles or subtylostyles, rarely styles) organized on a radial pattern. Spongin present, but never as fibers. Microscleres, if present, astrose (asters, spirasters) or oxeote (micro-oxeas). (About 12 spp. from Bda.)

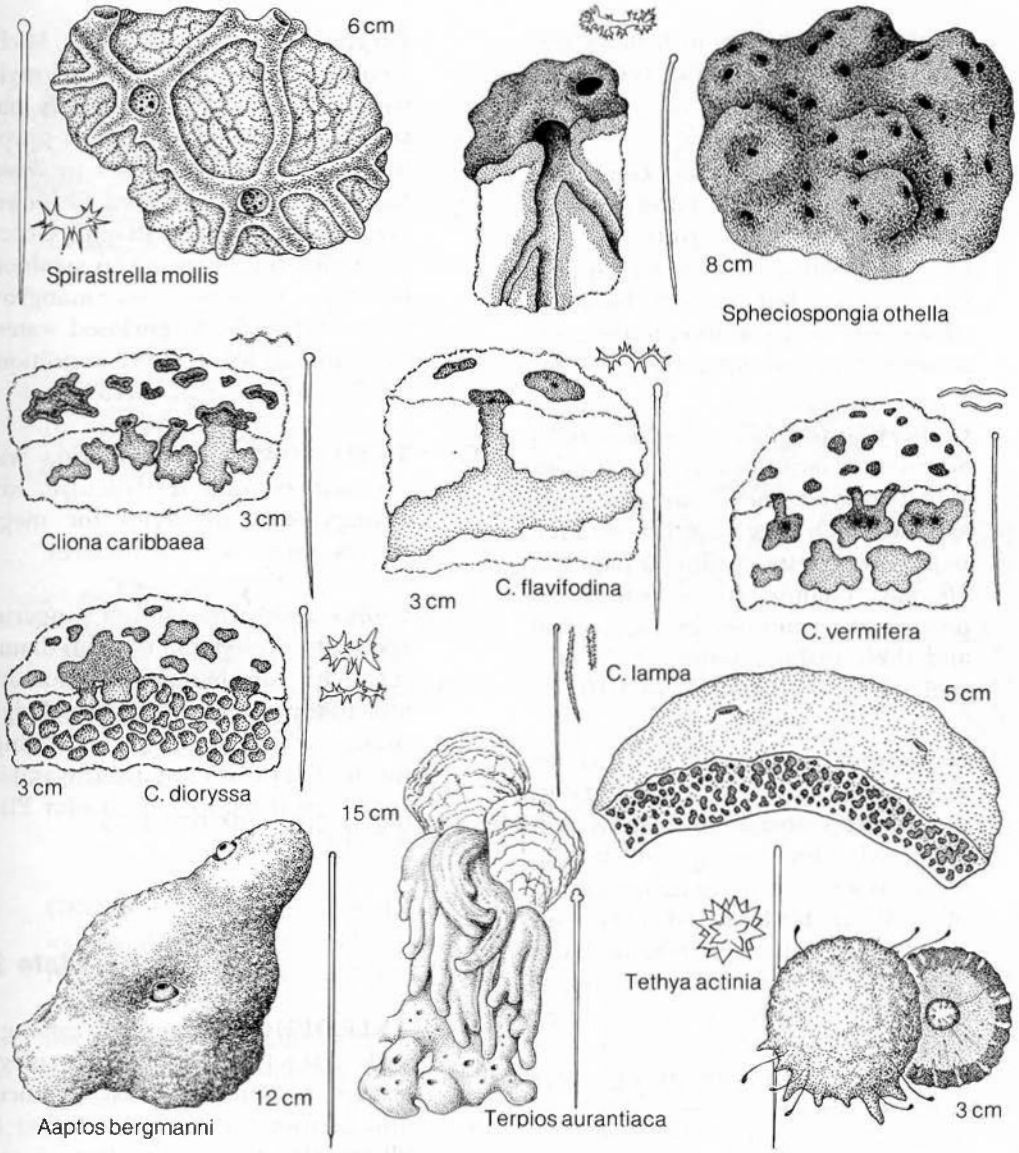
F. SPIRASTRELLIDAE: Encrusting or massive Hadromerida with tylostyles and spirasters. The spirasters are mostly stout and form a substantial part of the skeleton.

Spirastrella mollis Verr. (=*S. coccinea* sensu de Laub.): Encrusting, to 14 cm with meandering subsurface canals; yellow-orange, reddish orange to brownish red. Small specimens very common under rocks of reef environments, intertidal to 5 m. (Color Plate 4.14.)

F. CLIONIDAE: Papillate, encrusting or massive Hadromerida, with tylostyles and spirasters or amphiasters, some species with oxeas or raphids. Microscleres constitute only a small portion of the skeleton. All species excavate limestone, at least in the early stages of their life cycles.

Spheciospongia othella de Laub.: Large, massive, to 25 cm, boring when young; with robust tylostyles and minute spirasters and amphiasters with compound spines. Grayish brown to black. Common in and on rocks of inshore waters, intertidal to 2 m. Sometimes associated with snapping shrimps (*Alpheus cylindricus*) and barnacles (*Membranobalanus declivis*).

Cliona caribbaea Carter (non *C. caribboea* sensu de Laub.): Genus



33 HADROMERIDA (Sponges 4)

mostly endolithic, with surface papillae; some stages encrust substrate. Boring throughout life cycle.—Species with tylostyles and 1 size class of thin wavy spirasters. Bores small chambers, with tendency of merging inhalant and exhalant papillae to form small (3-20 mm) crusts. Greenish, olive or brown, depending on density of symbiotic zooxanthellae. Very common in shells and rock, inner and outer reefs, 0.5-3 m. (Color Plate 4.11.)

C. flavifodina Rützler: Genus as above.—Species with tylostyles and robust coarsely spined spirasters of 1 size class. Small (5 mm) discrete yellow-brown papillae, large (25 mm) ragged excavations filled with yellow

tissue. Very common in inshore waters, open bays and outer reefs, 0.5-10 m.

C. vermifera Hancock: Genus as above.—Species with tylostyles and smooth, undulated rods as microscleres. Vivid orange-red papillae (2 mm), large but discrete chambers (to 8 mm). Very common in rock, inshore waters and outer reefs, 1-5 m.

C. dioryssa (de Laub.) (=*Spirastrella dioryssa*): Genus as above.—Species with tylostyles and 2 size classes of spirasters. Orange to yellow-orange papillae or crusts (confluent papillae, 16 mm), chambered excavations (8 mm). Very common in rock, coral and shell, inshore waters and outer reefs, 0.5-5 m. (Color Plate 4.10.)

C. lampa de Laub.: Genus as above.—Species with tylostyles, spined micro-oxeas and spiny microrhabds. Encrusting and boring large (to several square meters) areas of substrate, brilliant red. Less common yellow variety with same habit and distribution. Bears gemmules. Kills coral and clam substrates (e.g., *Siderastrea*, *Chama*). Very common at shallow locations with strong water currents, inshore waters, 0.5-1 m. (Color Plate 4.8, 9.)

F. SUBERITIDAE: Hadromerida without microscleres.

Aaptos bergmanni de Laub.: Genus with styles for spicules. Massive or subspherical, to 20 cm; firm consistency. Dark brown appearance, with rich yellow interior. Moderately common in shaded inshore habitats, 0.5-2 m.

Terpios aurantiaca Duch. & Mich.: Genus characterized by tylostyles with 3-lobed heads. Irregularly massive, lobate, some specimens grape- or finger-shaped with processes fused sideways. To 20 cm. Color yellow, orange or greenish blue. Greenish-bluish tinges owing to symbiotic bacteria. Common on mangrove roots and rocks in enclosed waters, even under low salinity conditions, 0.5-2 m. (Color Plate 4.13.)

F. TETHYIDAE: Hadromerida with pronounced radiate structure, with strongyloxeas or styles for megascleres, asters for microscleres.

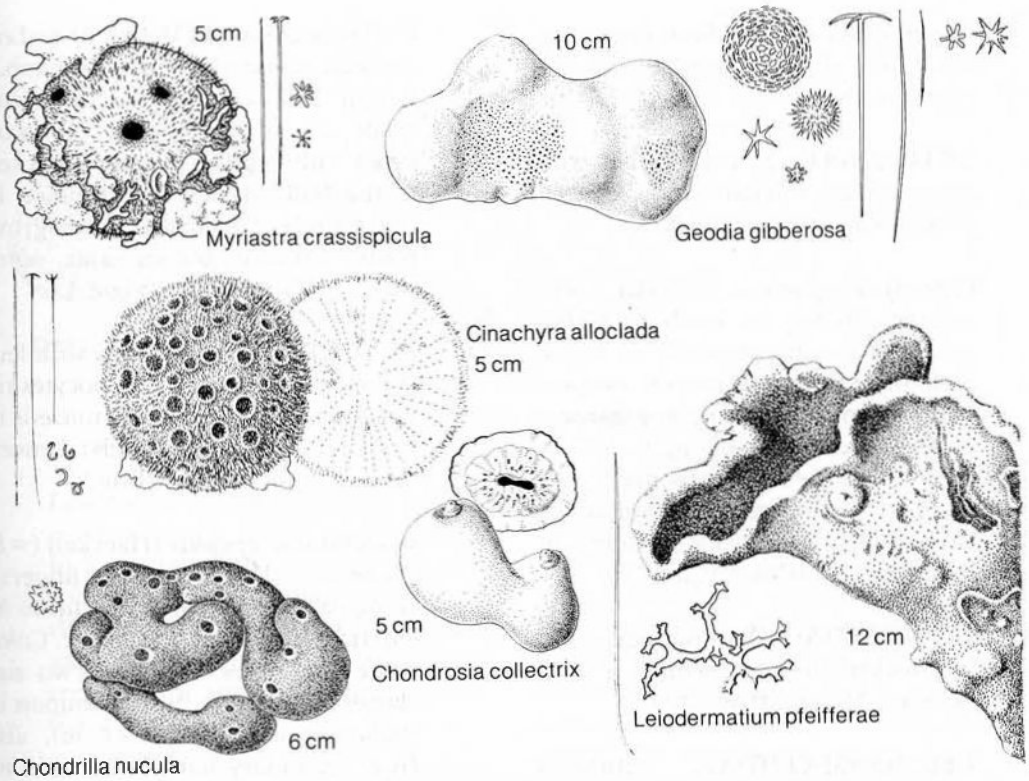
Tethya actinia de Laub. (Tangerine sponge): Spherical, to 5 cm diameter. With lumpy surface, buds and attachment fibers protruding. Bright orange or green outside, dull orange inside. Very common inshore and on reefs, intertidal to 1 m. (Color Plate 4.3, 4.)

Plate 34

O. ASTROPHORIDA: Demospongea with tetractine and oxeote megascleres in some radial arrangement, and astrose microscleres. Either or all spicule types can be lost. (5 spp. from Bda.)

F. STELLETTIDAE: Astrophorida with long-shafted triaenes, and with euasters.

Myriastra crassispicula (Sollas): With one category of oxyasters. Drab, spherical, to 5 cm; attached to pieces of rubble. Common on offshore secondary hard bottoms, 80 m.



34 ASTROPHORIDA, SPIROPHORIDA, LITHISTIDA (Sponges 5)

F. **GEODIIDAE:** Astrophorida with long-shafted triaenes, and with sterrasters forming surface armor.

Geodia gibberosa Lam.: Encrusting to amorphous massive, 12 cm. Smooth, partly pitted surface, leathery tough consistency. Color white to dark gray, dependent on light exposure. Moderately common but inconspicuous under rocks or among seaweeds, frequently overgrown by other sponges; inshore waters and outer reefs, intertidal to 10 m.

F. **CHONDROSIIDAE:** Astrophorida with reduced spicule complement.

Chondrilla nucula Schmidt (Chicken liver sponge): Spherasters of 1 size class only. Thickly encrusting, to 15 cm, with slippery smooth surface, firm cartilaginous consistency. Brown, greenish brown (from cyanelles) to cream color, depending on light exposure. Very common on rocks, mangrove roots and fouling artificial structures, in caves as well as illuminated habitats, inshore waters and reefs, 0.5-5 m.

Chondrosia collectrix (Schmidt): Genus without spicules.—Species reniform or lobate, cartilaginous cushions, 5 cm, off-white, gray to black. Moderately common in caves and under rocks, inshore waters, 0.5-2 m.

O. **SPIROPHORIDA:** Spherical Demospongea with radial skeleton of

triaenes and oxeas. Microscleres are contorted sigmas (sigmaspirae). (1 sp. from Bda.)

F. TETILLIDAE: Spirophoridae with characteristic inhalant and exhalant depressions (porocalyces).

Cinachyra alloclada Uliczka (=*C. cavernosa* sensu de Laub.): Hemispherical or subspherical, to 8 cm, with hispid surface caused by protruding spicules. Firm consistency, ability to contract strongly. Yellow color frequently obscured by trapped sediments. Common in caves and under rocks; inshore waters, 0.5-2 m. (Color Plate 4.5.)

O. LITHISTIDA: Demospongea with interlocked desmas forming a hard skeleton. (2 spp. from Bda.)

F. LEIODERMATIIDAE: Lithistida with oxeas.

Leiodermatium pfeifferae (Carter) (=*Azorica pfeifferae*): Thin erect folded plate, 13 cm, stony hard, ochreous white. Dredged twice, from 800 and 1,900 m.

Plate 35

CL. CALCAREA: Porifera with mineral skeleton composed of calcium carbonate. No distinction between megascleres and microscleres.

O. CLATHRINIDA: Calcarea with simple tubular spongocoel lined by choanocytes (asconoid type); choanocyte nucleus in basal position (Only 1 family: Clathrinidae, with about 3 spp. from Bda.)

Clathrina coriacea (Montagu) (=*Leucosolenia canariensis* sensu de Laub.): Bright yellow cushions, to 8 cm, made up of trelliswork of ascon tubes with regular triactines packed in the wall. Moderately common in caves, under rocks and on mangrove roots, inshore waters and outer reefs, 0.5-3 m. (Color Plate 4.6.)

O. LEUCETTIDA: Calcarea with leuconoid construction; choanocytes restricted to chambers, with nucleus in basal position (Only family: Leucettidae, with 1 sp. from Bda.)

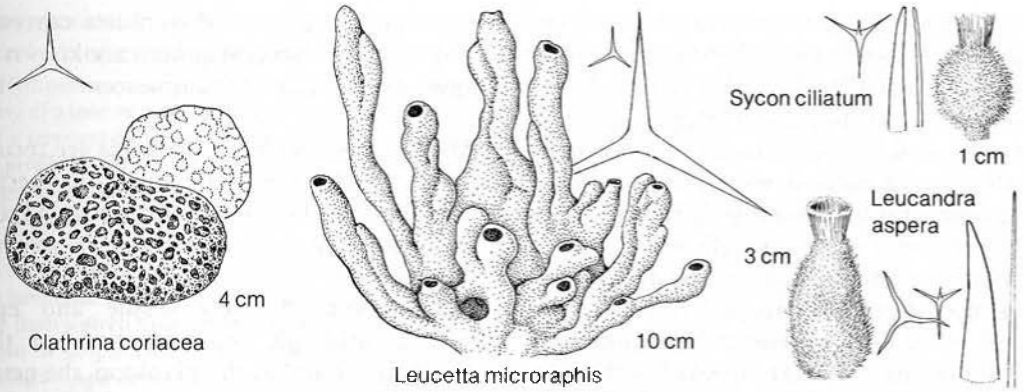
Leucetta microraphis (Haeckel) (=*L. floridana*) (Dead man's fingers): Irregular lobate to digitate, up to 50 cm, fragile with rough surface. Color white to shades of pink. Two size classes of triaxons. Very common in shallow caves inshore (1 m), also from secondary hard bottoms in 80 m. (Color Plate 4.15.)

O. SYCETTIDA: Calcarea with syconoid or leuconoid canal system (choanocytes lining tubes or chambers); choanocyte nucleus apical, connected to flagellum. (About 5 spp. from Bda.)

F. SYCETTIDAE: Sycettida with tubular choanocyte chambers radiating from the atrium.

Sycon ciliatum (Fabricius) (=*Scypha ciliata*): Vase-shaped, 12 mm, with spicule crown around osculum. Fragile, white. Varieties of monaxon, triaxon and tetraxonspicules present. Common in caves and under rocks, inshore and near shore, 0.5-1 m. (Color Plate 4.7.)

F. GRANTIIDAE: Sycettida with choanocyte chambers and cortical wall.



35 CALCAREA (Sponges 6)

Leucandra aspera (Schmidt) (=*Leuconia aspera*): White, sack-shaped, to 5 cm, tapering toward an oscular spicule crown. Brittle, with hispid surface. Thin and thick oxeas, triaxons and tetraxons. Moderately common in shallow inshore water, 0.5-2 m.

K. RÜTZLER

Phylum Cnidaria

CHARACTERISTICS: *Polyp- or medusa-shaped METAZOA of generally radial symmetry and with nematocysts (stinging capsules); body wall of 2 cellular layers enclosing a (mostly) non-cellular membrane (mesoglea); the sole body cavity (gastrovascular cavity, or coelenteron) may be subdivided by radially arranged partitions (mesenteries). The larva is typically a planula.*

Distinguish between individuals and colonies, the usually sedentary polypoid stage and the usually free-swimming medusoid stage, and various skeletal materials and types. The mesoglea can be thin-membranous, or massive-gelatinous. Nematocysts, each produced by and contained in an epidermal cell (cnidocyte), are small egg- to spindle-shaped capsules that explode when stimulated, discharging thread-like tubes variously adapted to coil around, stick to or penetrate and poison a prey organism or aggressor. There are 3 basic and a number of subtypes of nematocysts whose occurrence has significance for cnidarian classification (but is of only limited use for the purposes of identification within the framework of this book and therefore not considered in any detail).

The presentation of the 3 classes Hydrozoa (p. 127), Scyphozoa (p. 155) and Anthozoa (p. 159) follows the conservative order; more recent arguments variously propose either Scyphozoa or Anthozoa as the most primitive Cnidaria. In some systems the Cubomedusae, here treated as an order of Scyphozoa, are given the rank of a class, Cubozoa.

Class Hydrozoa

CHARACTERISTICS: *CNIDARIA occurring as either polypoid or medusoid stages or both, with tetramerous or polymerous radial symmetry (infrequently bilateral), non-cellular mesoglea, and gonads that are usually epidermal. A stomodeum and nematocyst-bearing structures in the gastrovascular cavity, such as septa and gastric cirri, are lacking. Medusae are typically craspedote (i.e., with a velum or shelf of tissue about the opening of the subumbrellar cavity).*

Hydrozoan systematics has been complicated by separate classification systems for polyps (hydroids) and hydromedusae; moreover, hydroid and medusa stages of a given species have often been known by different scientific names. Progress is being made toward uniting different stages of a species under a single name and in eliminating the dual classification. The system used here recognizes 7 orders in the class, all of which occur in Bermuda. The presentation as "Hydroida", "Hydromedusae" and Siphonophora is for convenience only. A group of genera (*Velella, Porpita*) often united as Chondrophora (either as a separate order or within Siphonophora) are here considered as Athecata within the hydroid polyps.

Nearly 3,000 species of hydrozoans are known worldwide, 160 of which have been recorded from Bermuda. Of these, 70 are included here.

HYDROIDA (Hydroid polyps)

CHARACTERISTICS: *(Polypoid HYDROZOA; usually colonial, benthic and sessile; with or without a medusa stage in the life cycle).* From about 1 mm to 2 m or more in height; most reach a maximum size of a few centimeters. Although the living parts are typically soft and rather delicate, hydroids are commonly protected to some degree by a chitinous envelope (perisarc). Hydrocorals secrete a hard calcareous skeleton whose form superficially resembles that of the true corals. Hydranths may be variously colored owing to pigment in the gastrodermis, and the perisarc may be clear, golden or even black. Several species are brown owing to the presence of algal symbionts. Movements consist basically of hydranth and tentacle bending and contraction, and mouth opening. *Velella* and *Porpita,* regarded as colonies by some authors and as solitary polyps by others, float at the surface and are propelled by water currents and the wind. Several genera are known to have species that are luminescent.

About 2,000 species of hydroids are recognized worldwide. Of the 70 species identified to date from Bermuda, 32 are included here.

OCCURRENCE: Largely sessile and epifaunal, although representatives of the group are found in the plankton, the neuston, and even the meiofauna. Bathymetrically, they occur from the intertidal zone to the deep sea. In shallow waters around Bermuda, they are most diverse and abundant in areas swept by tidal currents or subjected to wave action. Some species display a marked substrate preference, whereas others occur on a large number of substrate types. Around Bermuda, hydroids commonly occur on rocks and rock rubble, algae, turtle grass, invertebrates including other hydroids, pilings, floats, buoys and wrecks. Little is known about seasonal cycles and reproductive periodicities of Bermuda hydroids.

Hydroids in shallow waters are best collected by snorkeling or SCUBA diving. Collections from deeper waters may be made using a dredge. Discovery of small species usually requires careful examination of a variety of substrates in the laboratory using a dissecting microscope or magnifying glass. *Velella, Porpita,* and species growing on pelagic *Sargassum* may be collected in neuston nets, by dipnetting or by beachcombing.

Some hydroids, most notably *Millepora alcicornis* and *Macrorhynchia philippina,* are capable of stinging humans.

IDENTIFICATION: Based principally upon external characters, species determination requires the use of a stereoscope or microscope. Gonophores must be present or medusae obtained for the identification of

COLOR PLATE 3: PORIFERA 1 (Sponges). 1 *Pseudoceratina crassa*; 2 *Haliclona monticulosa*; 3 *Ircinia felix*; 4 & 5 *Dysidea etherea*; 6 *Dysidea janiae*; 7 *Lissodendoryx isodictyalis*; 8 *Haliclona molitba* (with the red algae *Laurencia papillosa* and *Amphiroa fragilissima*); 9 *Amphimedon viridis*; 10 *Aplysilla longispina*; 11 *Tedania ignis*; 12 *Niphates erecta*. (Sponsored by *The Trustees of the Bermuda Biological Station*.)

COLOR PLATE 4: PORIFERA 2 (Sponges). 1 *Pseudaxinella explicata*; 2 *Homaxinella rudis*; 3 & 4 *Tethya actinia*; 5 *Cinachyra alloclada*; 6 *Clathrina coriacea*; 7 *Sycon ciliatum*; 8 & 9 *Cliona lampa*; 10 *Cliona dioryssa*; 11 *Cliona caribbaea*; 12 *Ulosa ruetzleri*; 13 *Terpios aurantiaca* (on *Isognomon alatus*); 14 *Spirastrella mollis*; 15 *Leucetta microraphis*. (Sponsored by *Shell Company of Bermuda Ltd.*)