Thesaurus of Sponge Morphology

NICOLE BOURY-ESNAULT
and
KLAUS RÜTZLER
EDITORS

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY · NUMBER 596

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ABSTRACT

Boury-Esnault, Nicole, and Klaus Rützler, editors. Thesaurus of Sponge Morphology. *Smithsonian Contributions to Zoology,* number 596, 55 pages, 305 figures, 1997.—This is a vade mecum of terms for describing all aspects of sponge morphology, such as habit, surface structure, consistency, and anatomy. Definitions of microscopic features include aquiferous system, cytology, reproductive structures, skeletal architecture, and calcareous and siliceous spicules. Terms were selected and reviewed by an international group of 10 experts in sponge systematics, during several workshops. Each entry is accompanied by a precise diagnosis and an illustration. Terms listed as "rejected" are those judged unsuitable, redundant, or preoccupied. The thesaurus will aid descriptions in future systematic papers, computerized data banks, and identification keys. The literature cited presents a historical perspective on similar attempts to create a precise terminology of sponge morphology and helps to further clarify the selected terms.

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Contributors

Radovan Borojevic, Universidade Federal de Rio de Janeiro, Departamento de Histologia e Embriologia, CP 68021, 21944-970 Ilha do Fundaõ, Rio de Janeiro, Brazil.

Nicole Boury-Esnault, Centre d'Océanologie de Marseille, Station marine d'Endoume, rue de la Batterie des Lions, 13007 Marseille, France.

Ruth Desqueyroux-Faundez, Musée d'Histoire Naturelle, case postale 6434,1211 Genève 6, Switzerland.

Claude Lévi, Muséum National d'Histoire Naturelle, Laboratoire de Biologie des Invertébrés marins et Malacologie, 57 rue Cuvier, 75231 Paris cedex 5, France.

Maurizio Pansini, Istituto di Zoologia della Università, Via Balbi 5, 16126 Genova, Italy.

Klaus Rützler, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560, USA.

Rob W.M. van Soest, Institute of Systematics and Population Biology (Zoological Museum), University of Amsterdam, P.O. Box 94766, 1090 GT Amsterdam, The Netherlands.

Shirley Stone, British Museum Natural History, Department of Zoology, Sponge Department, Cromwell Road, London SW 7, Great Britain.

Maria-Jesus Uriz, Centro d'Estudis Avançats de Blanes, CSIC, camí de Santa Bàrbara, 17300 Blanes Girona, Spain.

Jean Vacelet, Centre d'Océanologie de Marseille, Station marine d'Endoume, rue de la Batterie des Lions, 13007 Marseille, France.

Thesaurus of Sponge Morphology

Nicole Boury-Esnault
and Klaus Rützler

Editors

Introduction

Since the end of the nineteenth century, sponge systematists have periodically pursued the important task of compiling a list of accepted terms that would allow species to be described in an objective manner. In 1888, W.J. Sollas, S.O. Ridley, A. Dendy, and R. von Lendenfeld met in London to establish a terminology of spicule types, which is generally used to this date (Schulze and Lendenfeld, 1889). In the late 1960s R. Borojevic, W.G. Fry, W.C. Jones, C. Lévi, R. Rasmont, M. Sarà, and J. Vacelet met in Roscoff, France, to update and standardize a terminology for sponges (Borojevic et al., 1968). Since then, many important events have taken place—such as the increase in the availability of the electron microscope, appearance of automated data processing and its use in building data banks, and application of cladistic theory to sponge phylogeny—all of which necessitate another updating. Furthermore, natural product chemists are showing more and more interest in marine invertebrates in general and sponges in particular and thus require precise identifications for an ever increasing volume of specimens.

Nevertheless, sponge systematics is still in its infancy. That is to say, sponges are one of the rare phyla over which agreement has not been reached, even at the level of order. This situation is partly due to a lack of specialists. Sponges are reportedly the phylum with the smallest ratio of number of specialists to number of species (Winston, 1988). In view of these problems, a group of European and American systematists met repeatedly over several years to establish a standard terminology and precise definitions for descriptive morphological purposes. This monograph is the outcome of those meetings. The principal aim here is to be as thorough as possible in disposing of all ambiguities connected with language in common use. For instance, a single term is often used for morphologically or functionally similar yet not homologous characteristics. Just as the word "wing" is used for the flight organ of birds, insects, and bats (although no one would suggest it as a synapomorphy linking the three groups to a common ancestor), there are terms, such as "triactine" or "amphiblastula," that serve to designate analogous and more or less comparable but not homologous elements in different classes of sponges. To help researchers, particularly evolutionary biologists and paleontologists, avoid misinterpreting characters based on such unsuitable terminology, we have redefined existing designations more precisely and have introduced new terms where necessary.

To facilitate the use of this thesaurus, illustrations appear on the page facing their definitions. Literature references used for preparing figures and text are cited at the beginning of each section. Terms defined elsewhere in the text are set in small capitals.

Nicole Boury-Esnault, Centre d'Océanologie de Marseille, Station marine d'Endoume, rue de la Batterie des Lions, 13007 Marseille, France.
Klaus Rützler, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560.

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RECOMMENDED PROCEDURES

Below is an outline of the most basic procedures used in preparing sponges for study. More details and additional techniques can be found in Rützler (1978), Reiswig and Browman (1987), De Vos et al. (1991), and Hooper (1991). References to the general sponge literature are found in Bergquist (1978) and De Vos et al. (1991).

DESCRIPTION.—In describing or redescribing a species, one must mention the following diagnostic elements: (1) general shape, color, surface structure, and distribution of openings of the aquiferous system; (2) skeleton organization and elements (spicules and fibers), accompanied by camera lucida drawings or photographs and by measurements of sizes (ranges, means) calculated from at least 10 measurements; (3) if possible, cell and choanocyte-chamber types and sizes and reproductive characteristics; and (4) information on ecological and biological activity, including exact locality, habitat, depth, substrate, water clarity, light, temperature, associated species, and reproductive mode.

FIXATION AND PRESERVATION.—Numerous standard histological fixatives work well for sponges, but the simplest and most reliable is 10% formalin in seawater. Buffer additions are generally not necessary; hexamine buffer should definitely not be used because it promotes maceration of the sample. After fixation of a few hours to a few days (depending on the size and type of material), the samples must be transferred to and stored in at least 70% alcohol.

SPICULE PREPARATION.—For siliceous sponges, boil a fragment (~0.5 cm^3) in a test tube with about 10 times the volume of fuming nitric acid (HNO_3) until the cellular material is dissolved and the liquid is clear; fill the sample tube with distilled water and let the spicules settle to the bottom for at least 2 hr. (the process may be speeded up by gentle centrifugation). Remove water by pipette and change (three times). After the third water change, rinse with 95% alcohol in the same way, again three times. After the last change, suspend spicules in 1–2 ml alcohol and pour onto a microscope slide; let the alcohol evaporate and then dry the slide at ~60°C (burning off the alcohol may cause unwanted clustering of spicules). Some workers prefer to acid-boil small fragments or sections of sponge directly on a microscope slide (boil until just dry). Cover with a thin layer of mounting media (Caedax, Permount, Araldite), and cover slip. If the spicule size range is very large, mount up to three size fractions separately to allow study of the smaller spicules by high magnification objectives, which have a very short working distance. If the sponge specimen under study is large, it may be important to make a preparation from the interior as well as from the surface area.

For calcareous sponges, dissolve sponge fragment in an aqueous solution of sodium hypochlorite (Clorox, Eau de Javelle) and continue processing according to the methods given above.

In the case of very small specimens, one may prefer to make the preparation directly on the microscope slide. Put a small piece of the sponge on the slide, and add two to three drops of fuming nitric acid (for siliceous sponges); boil carefully by repeatedly pulling the slide across the flame of a Bunsen or alcohol burner. Replace evaporated acid by adding a few more drops. As soon as the remaining ash is clean, rinse with 90% alcohol, dry, and mount in resin.

PREPARATION OF SKELETON STRUCTURE.—Make thin hand sections from a piece of the sponge, cutting perpendicular and parallel to the surface with a fresh, thin, razor blade; make sure to identify the direction of the sections, particularly the one that includes the surface layer. Dehydrate (for instance, 0.5 hr. in butyl alcohol; saturated solution of phenol in xylene) and mount in the same kind of media as the spicules. If a stain is desired for contrast, add basic fuchsin to one step of the dehydration alcohol. Very soft specimens may be embedded in paraffin for sectioning. Keratose sponge skeletons may be better studied after separating the spongin fibers or network by teasing away cellular material using fine forceps and dissecting needles. The separated fibers can then be dehydrated and mounted using the aforementioned procedures.

Thesaurus

Macroscopical Features: Habit, Surface Characteristics, and Consistency

LITERATURE CONSULTED: Brown, 1956.

agglutinating. Creating substrate or support by cementing together a mixture of foreign material, such as sand, shell, or rock.

amorphous. Without definite shape. To be rejected, vague term. See MASSIVE.

arborescent. Erect, branching habit, tree-like in appearance (*Axinella polypoides*) (Figure 1).

areolated. Surface covered by numerous circular ectosomal areas (*Hamigera*) (Figure 2).

boring. See EXCAVATING.

branching. Spreading out in branches (see also ARBORESCENT and REPENT).

burrowing. See EXCAVATING.

caliculate. Cup shaped (*Poterion neptuni*) (Figure 3).

clathrate. Resembling open latticework (*Clathrina coriacea*) (Figure 4).

clavate. Club shaped (*Rhizaxinella pyrifera*) (Figure 5).

columnar. Shape of solid, erect cylinder (*Petrosia capsa*) (Figure 6).

compressible. Easily squeezed.

conulose. Surface with numerous cone-shaped projections raised up by underlying skeleton (*Dysidea* sp.) (Figure 7).

corrugated. Surface with alternating parallel ridges and grooves (*Callyspongia plicifera*) (Figure 8).

crateriform. Massive shape, with a broad base and large central depression (*Xestospongia muta*).

cup shaped. See CALICULATE.

dendritic. To be rejected for habit (term used as a descriptor of skeleton, see "Architecture of the Skeleton of Demospongiae").

digitate. Deeply divided, finger-like outgrowths from basal mass (*Halichondria bowerbanki*) (Figure 9).

elastic. Resilient.

encrusting. Thin, sheet-like coating of the substrate (*Hymedesmia* spp.) (Figure 10).

endolithic. Occupying cavities in hard substrata (see also EXCAVATING).

endopsammic. Main part of body buried in sand (*Oceanapia peltata*) (Figure 11).

erect. General term for having a vertical (away from substrate) growth strategy.

excavating. Living in galleries or cavities bored into limestone or other calcareous materials (species of *Cliona, Thoosa, Aka*) (Figure 12).

ficiform. Fig shaped (*Petrosia ficiformis*) (Figure 13).

firm. Solid, requires considerable pressure to deform sponge (species of *Chondrosia*).

fistulose. Bearing fistules (*Coelosphaera hechteli*) (Figure 14). See also FISTULE in "Anatomy and Aquiferous System."

flabellate. Fan shaped (*Phakellia ventilabrum*) (Figure 15).

flagelliform. Shaped as a single, very long, erect branch (*Raspailia viminalis*) (Figure 16).

foliaceous. In the form of a leaf (*Carteriospongia foliacens*) (Figure 17).

foliose. See FOLIACEOUS.

fragile. Easily broken.

friable. Easily broken, delicate, brittle.

glabrous. See SMOOTH.

globular. Ball shaped, spherical (*Tethya aurantium*) (Figure 18).

glutinous. Sticky (*Reniera mucosa*).

gyriform. See SULCATE.

hard. Firm consistency, unyielding to pressure (most lithistids, species of *Petrosia*).

hispid. Surface with long and scattered spicular projections (*Stelletta* spp.) (Figure 19).

honeycombed. Surface with polygonal pattern of ridges (*Verongula gigantea*) (Figure 20).

incompressible. Not easily squeezed.

infundibuliform. Funnel shaped (*Callyspongia plicifera*) (Figure 21).

lamellate. Plate-like erect (*Phyllospongia lamellosa*).

limp. Soft to the point of collapsing out of water.

lipostomous. Condition of a surface in which oscula and ostia are inconspicuous (in old descriptions).

lobate. Having rounded projections.

lobodigitate. To be rejected (tautology).

massive. Large, compact structure without definable shape (*Spongia officinalis*).

muricate. See SPINY.

ovate. Egg shaped, ellipsoid (*Cinachyrella*) (Figure 22).

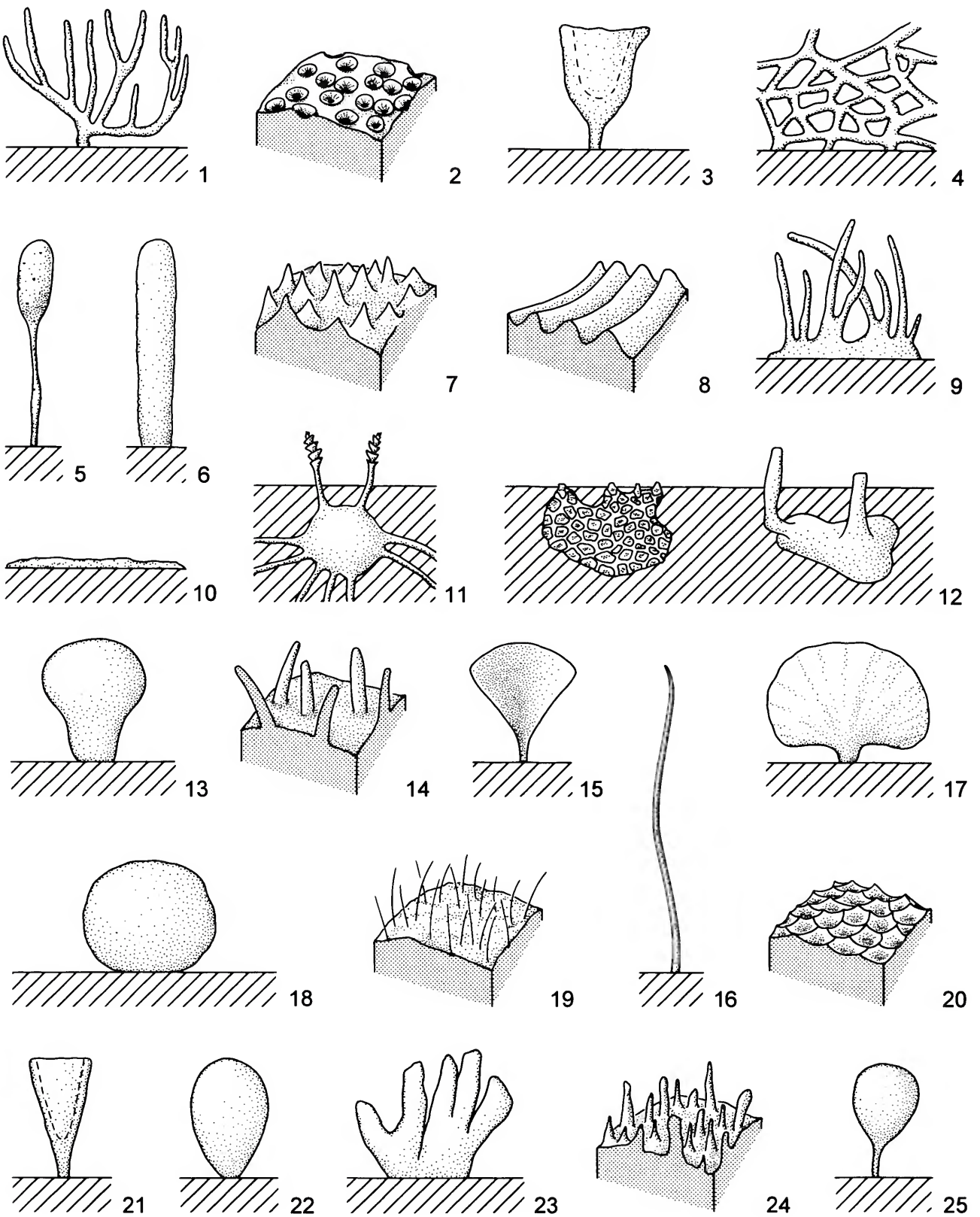
palmate. Hand shaped (*Isodictya palmata*) (Figure 23).

palmodigitate. To be rejected (tautology).

papillate. Surface bearing papillae (*Polymastia* spp.) (Figure 24). See also PAPILLA in "Anatomy and Aquiferous System."

pedunculate. Supported by a short stalk containing choanosome (*Aplysina pedunculata*) (Figure 25).

perforating. See EXCAVATING.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pinnate. Feather shaped (*Asbestopluma pennatula*) (Figure 26).

platy. Thickly lamellate, usually in horizontal orientation.

polymorphic. Occurring in different shapes.

punctate. Surface appearing dotted because of microscopic pores.

pyriform. See FICIFORM (Figure 13).

repent. Growing along or just above the substrate, simple or branching, attaching to the substrate at intervals (*Haliclona simulans*) (Figure 27).

resilient. Resumes original shape after deformation.

ribbed. Surface with series of ridges (*Xestospongia muta*) (Figure 28); ridges not necessarily parallel, as in CORRUGATED.

rooted. Anchored to or into substrate with root-like processes (*Pheronema grayi*).

rubbery. Resilient and tough.

rugose. Having a rough and ridged surface (*Topsentia* spp.) (Figure 29).

sessile. Permanently attached to substrate.

smooth. Surface without any projections (*Chondrosia reniformis*).

soft. Yielding to pressure, easily torn.

spiny. Surface with scattered, stiff, and sharp spicular or fiber projections (*Pleraplysilla spinifera*) (Figure 30).

stipitate. Supported by a long stalk (*Stylocordyla stipitata*) (Figure 31).

stoloniferous. Condition in which distinct, massive parts of a sponge are interconnected by repent, rope-like structures (*Haliclona tubifera*).

sulcate. Furrowed with longitudinal, or meandering (gyriform), parallel channels (*Myrmekioderma styx*) (Figure 32).

tough. Resistant to tearing (*Ircinia*).

tuberculate. See VERRUCOSE.

tubular. Shape of hollow, erect cylinder (*Aplysina fistularis*) (Figure 33).

turbinate. Resembling an inverted cone (*Cribochalina vasculum*) (Figure 34).

vallate. To be rejected (old-fashioned, heraldic term used to describe massive forms).

velvety. Surface with dense, short spicular projections, feeling soft and smooth to the touch.

verrucose. Warty (genus *Tethya*) (Figure 35).

vesicular. Hollow, bladder-like (*Inflatella belli*).

villose. Surface shaggy, with dense, long spicular bundles (*Rosella villosa*) (Figure 36).

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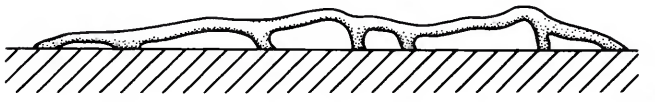

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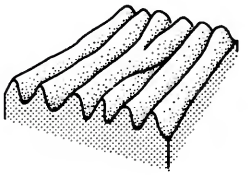

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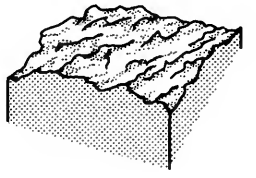

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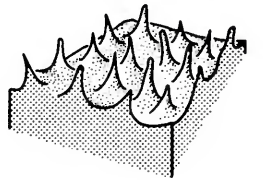

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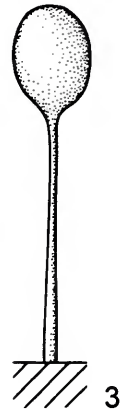

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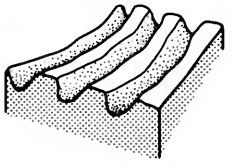

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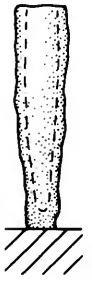

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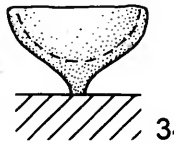

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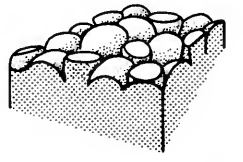

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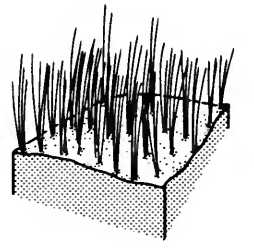

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Aanatomy and Aquiferous System

LITERATURE CONSULTED: Borojevic et al., 1968; Boury-Esnault, 1972, 1974; Boury-Esnault et al., 1990; Rützler, 1987; Sollas, 1888.

aphodal. Type of choanocyte chamber that connects directly with the inhalant canals through prosopyles and with the exhalant canal through an apopyle extended by an aphodus. Only one chamber opens into one aphodus (Figure 37).

aphodus. Small exhalant canal leading from the apopyle to an exhalant canal (*ap* in Figure 37).

apopyle. Opening of a choanocyte chamber into an exhalant canal (*apo* in Figure 37).

aquiferous papilla. See PAPILLA.

aquiferous system. The entire water-conducting system between the ostia and the oscula, which comprises the inhalant system, choanocyte chambers, and the exhalant system (Figure 38).

asconoid. Aquiferous system in which the internal cavity of the sponge is entirely lined by choanocytes (Figure 39).

atrium ("spongocoel," "cloaca," or "gastral cavity"). Preoscular cavity. This term is used specifically to designate the central exhalant cavity (Figure 40).

choanochamber. New term for Hexactinellida (replacing "flagellated chamber") to designate the equivalent of the choanocyte chambers of Demospongiae and Calcarea.

choanocyte chamber (flagellated chamber). Any cavity lined by choanocytes and located between inhalant and exhalant systems (Figures 37, 42).

choanosome. The internal region of a sponge, including the choanocyte chambers.

chone (uniporal chone, cribriporal chone). See PORE SIEVE.

cortex. A bark-like superficial region of a sponge distinct from the choanosome (see "Architecture of the Skeleton of Demospongiae," Figure 171).

diplodal. Type of choanocyte chamber that connects with the inhalant canals through a canaliculum called the prosodus and with the excurrent canal through an apopyle extended by an aphodus (Figure 41).

ectosome. The superficial region of a sponge that has no choanocyte chambers.

eurypylous. Type of choanocyte chamber that connects directly with the inhalant canals through prosopyles and with the excurrent canal through an apopyle. There is no special canal after the apopyle, and several chambers open into the same exhalant canal (Figure 42).

exhalant canal. Any canal forming part of the exhalant system, lined by the apopinacoderm.

exhalant system. Part of the aquiferous system between the apopyle and oscule (Figure 37).

fistule. A tube-like protuberance projecting from the sponge surface. See also PAPILLA (Figure 43).

flagellated chamber. To be rejected. See CHOANOCYTE CHAMBER and CHOANOCHAMBER.

inhalant canal. Any canal forming part of the inhalant system and lined by the prosopinacoderm.

inhalant system. Part of the aquiferous system between ostia and prosopyle.

intracellular pore. Term to be rejected. See PORE.

leuconoid. Aquiferous system in which the choanocytes are restricted to discrete choanocyte chambers, which are dispersed in the mesohyl (Figures 37, 42).

osculum (pl. oscula). Opening through which the water leaves a sponge (Figure 38).

ostium (pl. ostia) (= pore). Any opening in the exopinacoderm through which water enters the sponge (Figures 38, 45).

papilla. Nipple-like protuberance projecting from the sponge surface and bearing either ostia, oscula, or both (Figure 43).

pore. See OSTIUM.

pore groove. A furrow in the ectosome where the ostia are located (Figure 44).

pore sieve (fr. crible). A specialized area of the ectosome with a cluster of ostia and an underlying inhalant cavity called the vestibule (Figure 45).

porocalyx. Cup-shaped depressions with pore-sieves, typical of some genera of Tetillidae (Figure 46).

prosodus. A small inhalant canal leading to a prosopyle (Figures 37, 41).

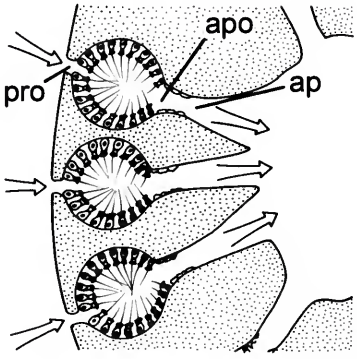
prosopyle. Opening of an inhalant canal into a choanocyte chamber (*pro* in Figure 37).

sieve plate. Perforated plate that extends over the broad terminal opening of some tubular-shaped Hexactinellida (*Euplectella*). See "Architecture and Spicules of Hexactinellida" (Figure 128).

syconoid. Aquiferous system with elongated choanocyte chamber containing free distal cones or extending from cortex to atrium (Figure 47).

sylleibid. Aquiferous system with elongate choanocyte chambers arranged radially around invagination of the atrial cavity (*Leucilla uter*) (Figure 48).

vestibule (= subdermal cavity). Subectosomal cavity. An inhalant aquiferous cavity close to the surface (see also PORE SIEVE) (Figures 39, 45).



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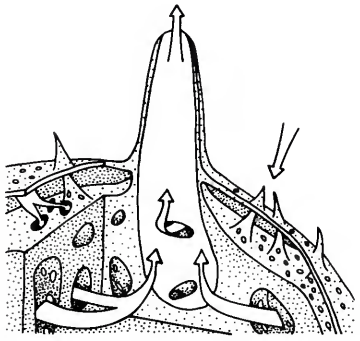
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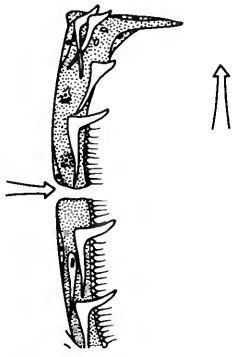
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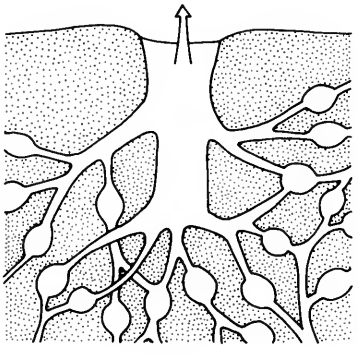
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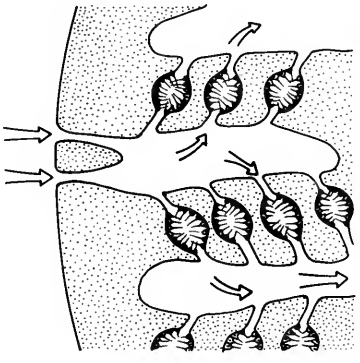
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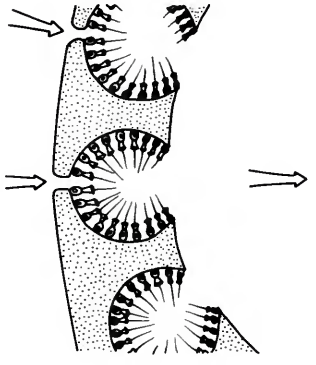
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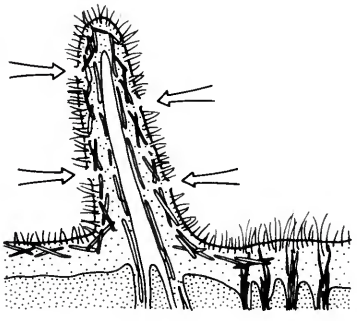
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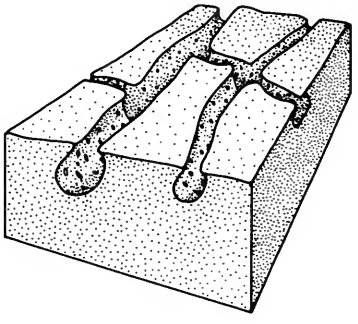
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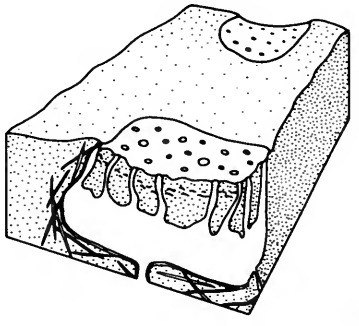
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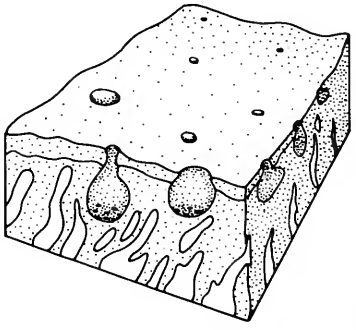
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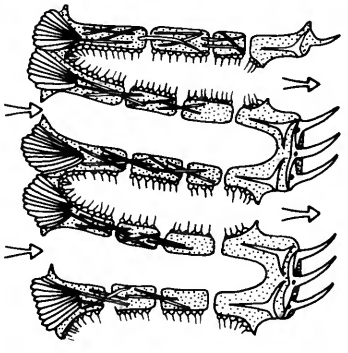
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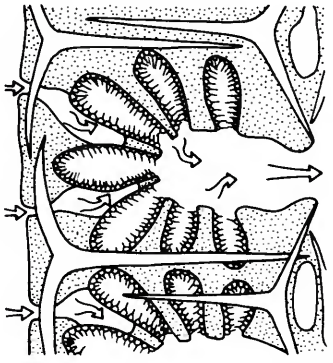

48

Cytology

LITERATURE CONSULTED: Borojevic et al., 1968; Boury-Esnault, 1972, 1973, 1974, 1977; Boury-Esnault et al., 1990; De Vos et al., 1990; Garrone, 1975, 1978; Mackie and Singla, 1983; Rützler, 1987; Simpson, 1984; Sollas, 1888; Vacelet, 1975.

actinocyte. Elongated contractile cell often grouped in sphincter-like structure around the osculum, below the sieve-plates, and around the large exhalant canals. Characterized by numerous filaments of actin within their cytoplasm. New term for the contractile cell (*ac* in Figure 49; see also Figure 50). "Myocyte" to be rejected.

apopinacocyte. Endopinacocyte lining the exhalant canal (*ai* in Figure 51).

apopinacoderm. Surface lined by apopinacocytes.

apopylar cell. Cell surrounding the apopyle and located between the choanocytes and the apopinacocytes (*ay* in Figure 51).

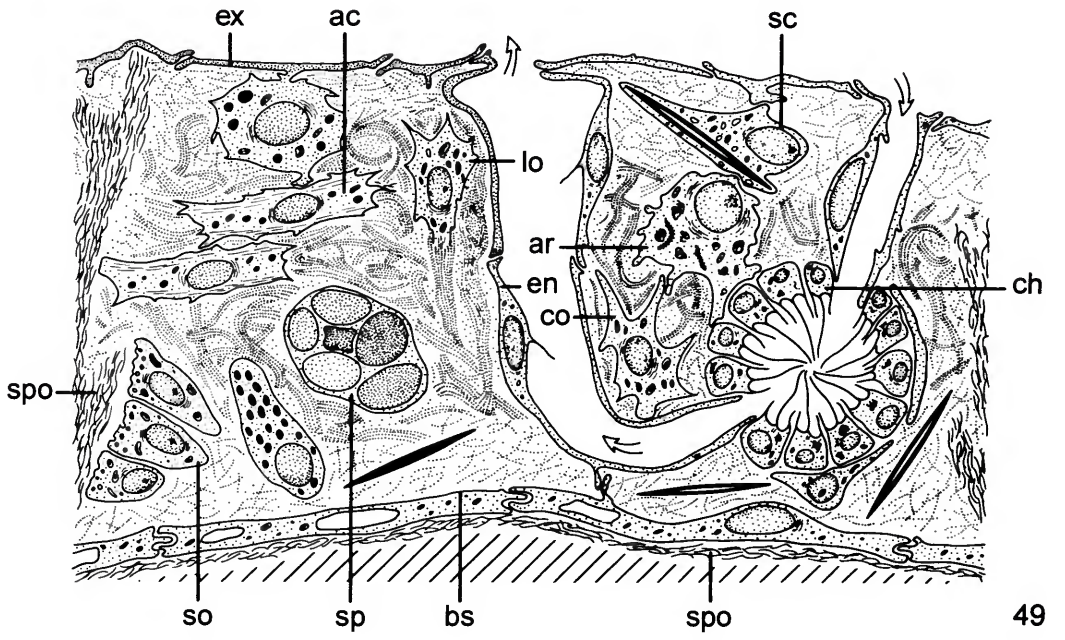
archaeocyte. Amoeboid cell with large nucleolus and capable of phagocytosis. May differentiate into other types of cells (*ar* in Figure 49; see also Figure 52).

bacteriocyte. Cell containing prokaryotic microsymbionts (Figure 53).

basopinacocyte. Pinacocyte affixing the sponge to the substratum by external secretion of a collagenous matrix (*bs* in Figure 49).

central cell. Single cell located at the apopyle of choanocyte chambers (Figure 54).

choanoblast. Cell that buds anucleate outgrowth called COLLAR BODY; in Hexactinellida (Figure 55).



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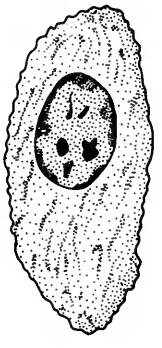

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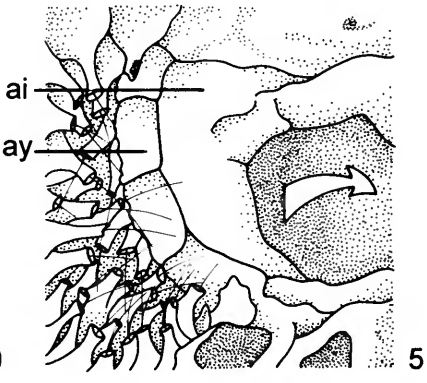

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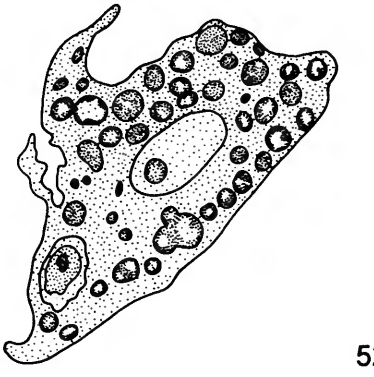

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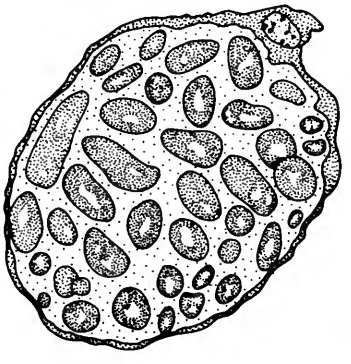

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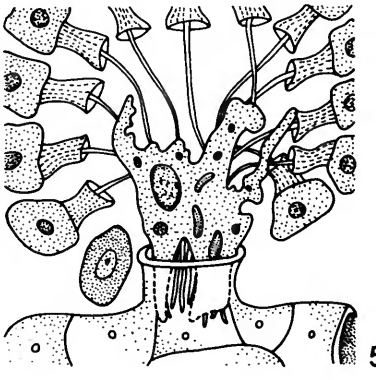

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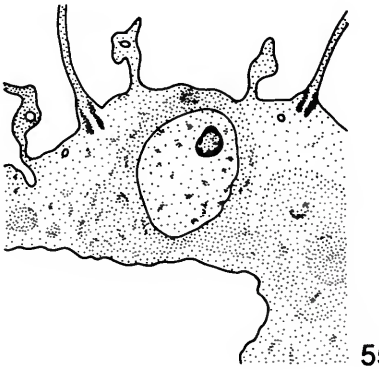

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choanocyte. Cell having a flagellum that is surrounded by a collar of cytoplasmic microvilli linked by bridges of glycocalyx. Several are typically arranged in spherical, ovoid, or elongated chambers. Fundamental cell of sponges (*ch* in Figure 49; see also Figure 56).

choanoderm. Surface lined by choanocytes.

collar body. Anucleate choanocyte in hexactinellids (Figure 57).

collencyte. Cell with branching pseudopods, involved in the secretion of collagen (*co* in Figure 49).

cystencyte. Cell with a single large vesicle containing amorphous material identified as polysaccharide and occupying most of the cell volume (Figure 58).

endopinacocyte. Pinacocyte lining the inhalant and exhalant canals. In some Demospongiae orders, it has a flagellum (*en* in Figure 49; see also Figure 59).

endopinacoderm. Surface lined by endopinacocytes.

eosinophilic cell. Cell with inclusions that react positively with eosine.

exopinacocyte. Fusiform or T-shaped pinacocyte covering the free surface of a sponge. In exceptional cases, it has a flagellum (Homoscleromorpha) (*ex* in Figure 49; see also Figure 60).

fuchsinophilic cell. Cell with inclusions that react positively with acid fuchsin.

globoferous cell. Cell with a single large globule, a reduced cytoplasm, and a small conical nucleus (Clathriidae) (Figure 61).

glycocyte. Cell with conspicuous dictyosomes, characterized by the presence of glycogen rosettes and osmiophilic inclusions. Also known as gray cell (Figure 62).

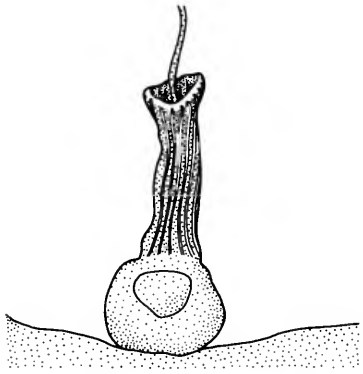
gray cell. See GLYCOCYTE.

lophocyte. Collencyte with a characteristic tuft of collagen fibrils attached to the posterior pole (*lo* in Figure 49; see also Figure 63).

mesohyl. Part of sponge enclosed by pinacoderm and choanoderm (= "mesenchyme," term to be rejected for sponges) (Figure 49).

mesolamella. Sheet of collagen separating the choanochambers of hexactinellids.

microgranular cell. A cell with cytoplasm filled with small dense granules (Figure 64).



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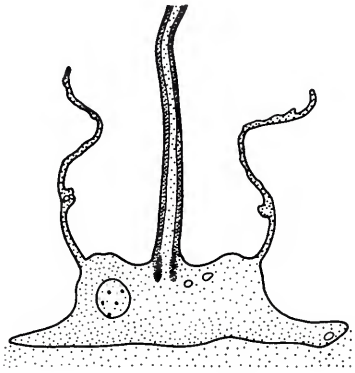

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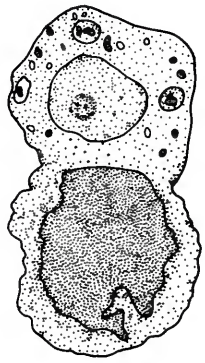

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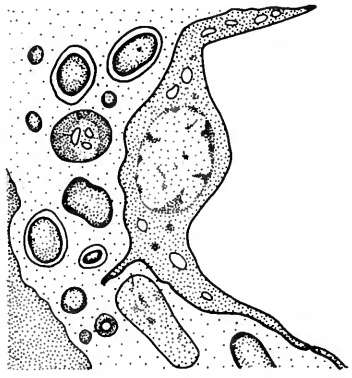

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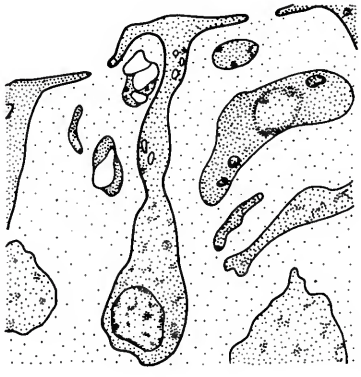

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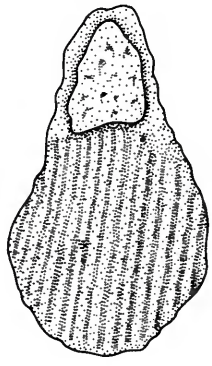

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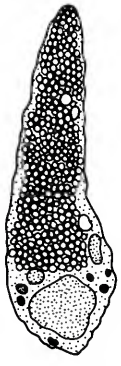

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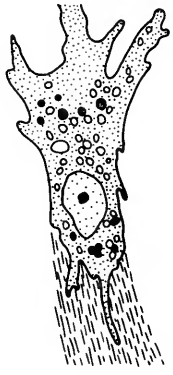

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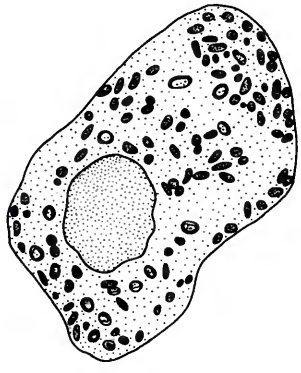

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microsymbiont. Prokaryotic or more rarely eukaryotic microorganism living inside a sponge. May be unicellular or multicellular filamentous, with or without pigments, and may occur intra- or intercellularly (Figure 65).

myocyte. See ACTINOCYTE.

pinacocyte. Cell delimiting the sponge from the external milieu and always only in a layer one-cell deep (Figures 49, 51, 59).

pinacoderm. Surface lined by pinacocytes (*ex* and *en* in Figure 49).

pocket cell. Special kind of bacteriocyte that surrounds an area of the intercellular matrix, including microsymbionts (Figure 66).

porocyte. Cell surrounding a pore (ostium) (Figure 67).

prosopinacocyte. Endopinacocyte lining the inhalant canals.

prosopinacoderm. Surface lined by prosopinacocytes.

rhabdiferous cell. Large cell with numerous rod-like inclusions parallel to the long axis of the cell containing acid mucopolysaccharides (Figure 68).

sclerocyte. Cell involved in spicule secretion. In Demosponges, with intracellular secretion, sclerocytes are characterized by numerous mitochondria and the presence of spicule-axial filaments. In Calcarea, where secretion is extracellular, sclerocytes have septate junctions between them (*sc* in Figure 49; see also Figure 69).

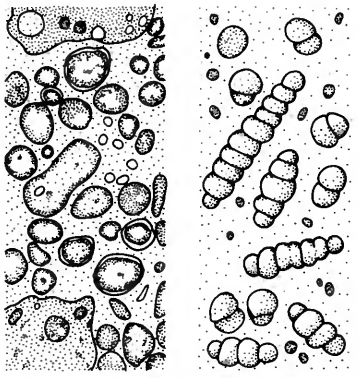
spherulous cell. Cell filled with large round spherules that occupy almost the entire cell body, compressing the cytoplasm into thin sheets (*sp* in Figure 49; see also Figure 70).

spongocyte. Cell secreting spongin fibers (*so* (*spo* = spongin) in Figure 49; see also Figure 71).

thesocyte. Dormant archaeocyte in gemmules or gemmule-like structures in which the cytoplasm is full of reserves partly arranged in vitelline platelets (Figure 72).

trabecular tissue. Syncytia in hexactinellids occurring around the choanochambers.

trophocyte. Cell providing reserves to archaeocytes during gemmulogenesis and to the oocyte during ovogenesis (Figure 73).



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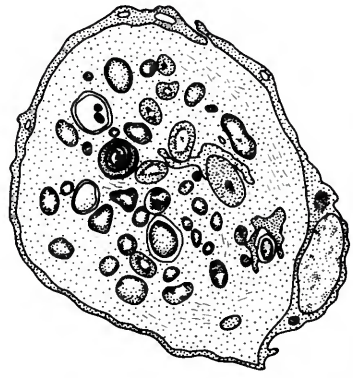

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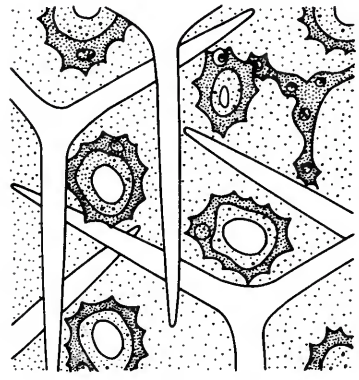

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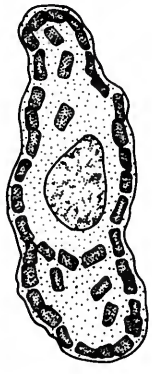

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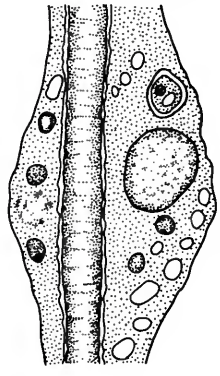

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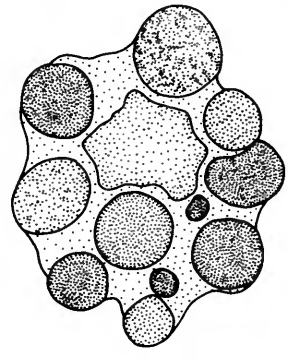

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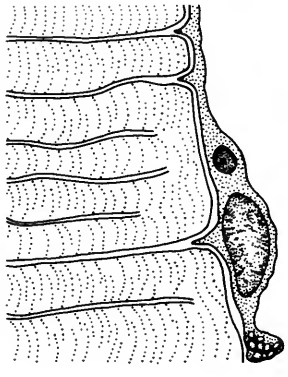

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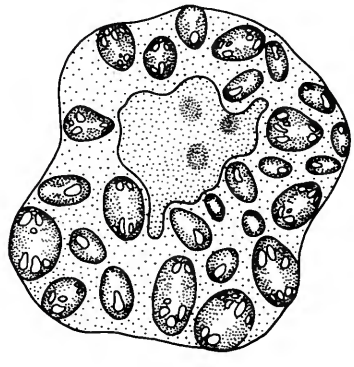

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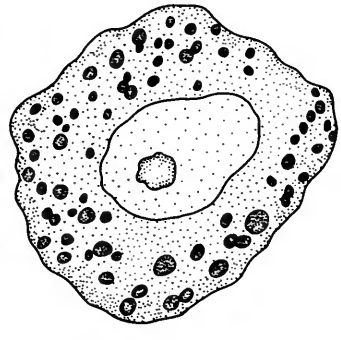

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Reproduction

LITERATURE CONSULTED: Bergquist, 1978; Borojevic et al., 1968; Boury-Esnault and Vacelet, 1994; De Vos et al., 1991; Tuzet et al., 1970.

amphiblastula. Hollow, ovoid larva, with anterior flagellated and posterior nonflagellated groups of cells; typical of Calcaronea (Figure 74).

anterior pole. Pole directed forward when larva is swimming (Figures 74, 79, 84).

blastula. Term to be rejected. See COELOBLASTULA.

bud. An asexual reproductive body composed of various types of cells (e.g., *Tethya* spp., *Axinella damicornis*) (Figure 75).

carrier cell. Modified choanocyte that transports a captured spermatozoid to an oocyte (Figure 76).

cellules en croix. Nonflagellated cells arranged in tetraradial fashion in the amphiblastula of Calcaronea (Figure 77).

cinctoblastula. Hollow larva, entirely flagellated, with a central ring of pigmented cells; typical of Homoscleromorpha (Figure 78).

coeloblastula. Hollow larva composed of an envelope of morphologically similar equipotent cells, to which a few larger nonflagellated cells may be added at the posterior pole (Figure 79). "Blastula" to be rejected.

follicle cell. Cell in a group surrounding an oocyte (Figure 80).

fragmentation. Breakup of a sponge without concomitant formation of special reproductive bodies.

gemmule. A resistant asexual reproductive body, composed of a mass of archaeocytes charged with reserves and enclosed in a noncellular protective envelope or coat (Figure 81).

micropyle. Opening in the gemmule coat through which cells leave a hatching gemmule (*mp* in Figure 81).

nurse cells. Cells that are incorporated in developing oocytes to provide nutrient material for further growth (Figure 82).

olynthus. Earliest developmental stage with a functional aquiferous system, with a single choanocyte chamber opening directly into the osculum; typical of some calcareous sponges (Figure 83).

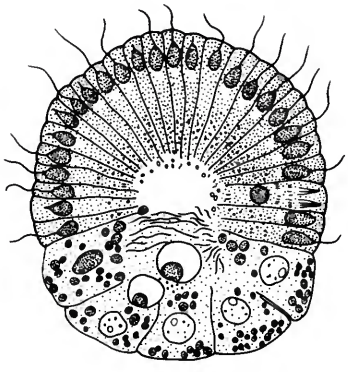
oviparity. Mode of reproduction in which embryo develops outside the parent sponge.

parenchymella. Larva composed of an envelope of flagellated cells surrounding an internal mass of cells (Figure 84).

posterior pole. Pole opposite to anterior pole when larva is swimming, often without flagella (Figures 74, 79, 84).

pseudogemmule. Accumulation of gemmular archaeocytes (crypt cells, tract cells) in basal cavities of a solid calcareous skeleton (Figure 85).

reduction body. A multicellular mass resulting from the disorganization of a sponge and presumably capable of reorganizing into a new functional sponge.



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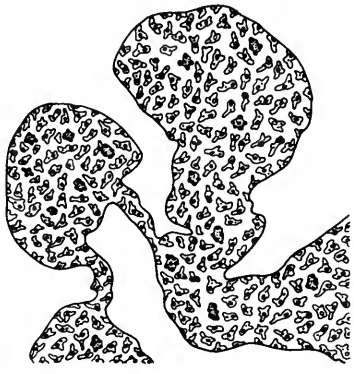

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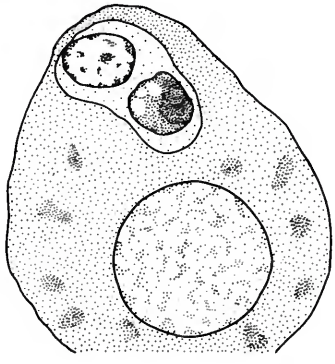

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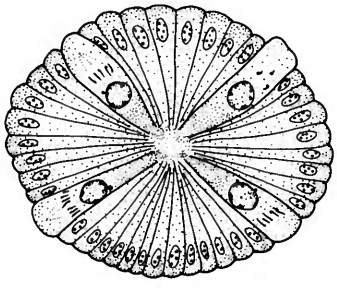

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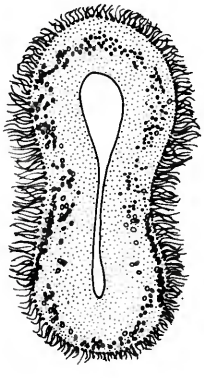

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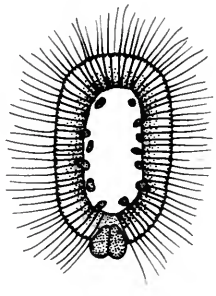

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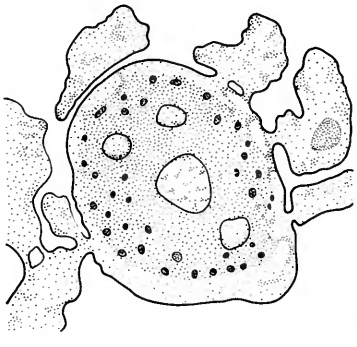

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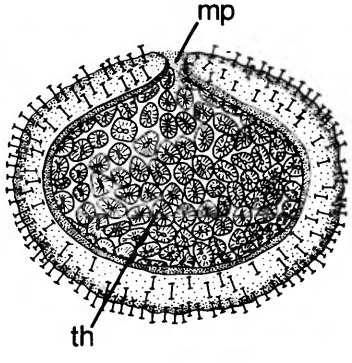

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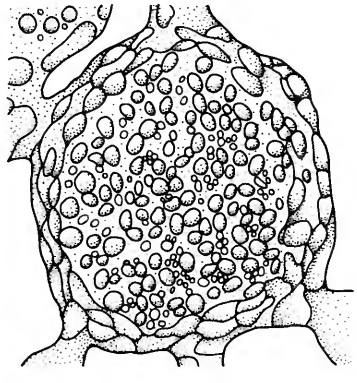

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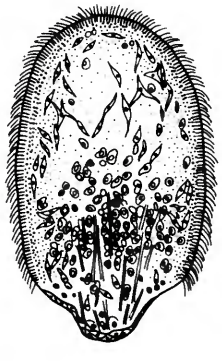

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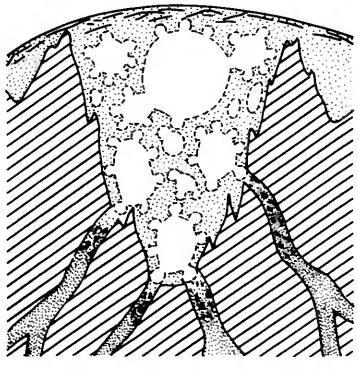

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rhagon. Earliest functional stage with multiple choanocyte chambers and aquiferous canals, typical for Demospongiae (Figure 86).

"smoking". Massive release of gametes.

spermiocyst. Modified, encysted spermatozoid transported by a carrier cell to the oocyte (Figure 76).

statoblast. Particular gemmule that lacks a complex spongin coat and is covered externally by megascleres; typical of the freshwater Potamolepidae.

stomoblastula. Developmental stage of amphiblastulas that precedes the reversion stage and is characterized by internal flagella and a large opening through which the eversion occurs (Figure 87).

thesocyte. Vitelline-rich archaeocyte in a sponge gemmule (*th* in Figure 81; see also Figure 72).

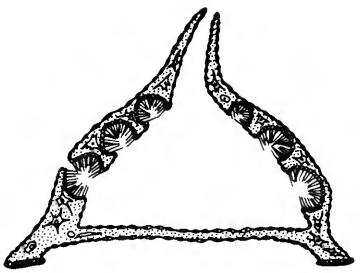
trichimella. Hexactinellid larva, distinguished by median zone with multiflagellated mononucleate cells between anterior and posterior poles; with special larval stauractin skeleton (Figure 88).

trophocyte. Nurse cell involved in the initial stages of gemmule and oocyte formation (see Figure 73).

viviparity. Mode of reproduction in which internal fertilization and incubation of the embryo occur inside the parent sponge.

Architecture of the Skeleton and Spicules of Hexactinellida

LITERATURE CONSULTED: Ijima, 1901, 1903, 1926; Schulze, 1887, 1895, 1900, 1904; Schulze and Lendenfeld, 1889; Topsent, 1904, 1917, 1927, 1928. Spicule arrangement is illustrated in Figure 89.



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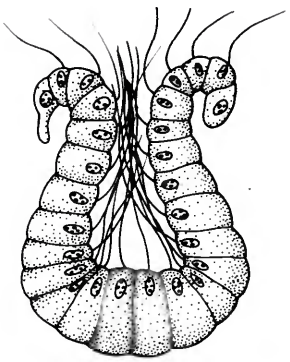

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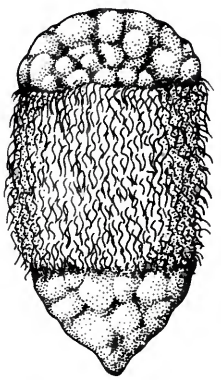

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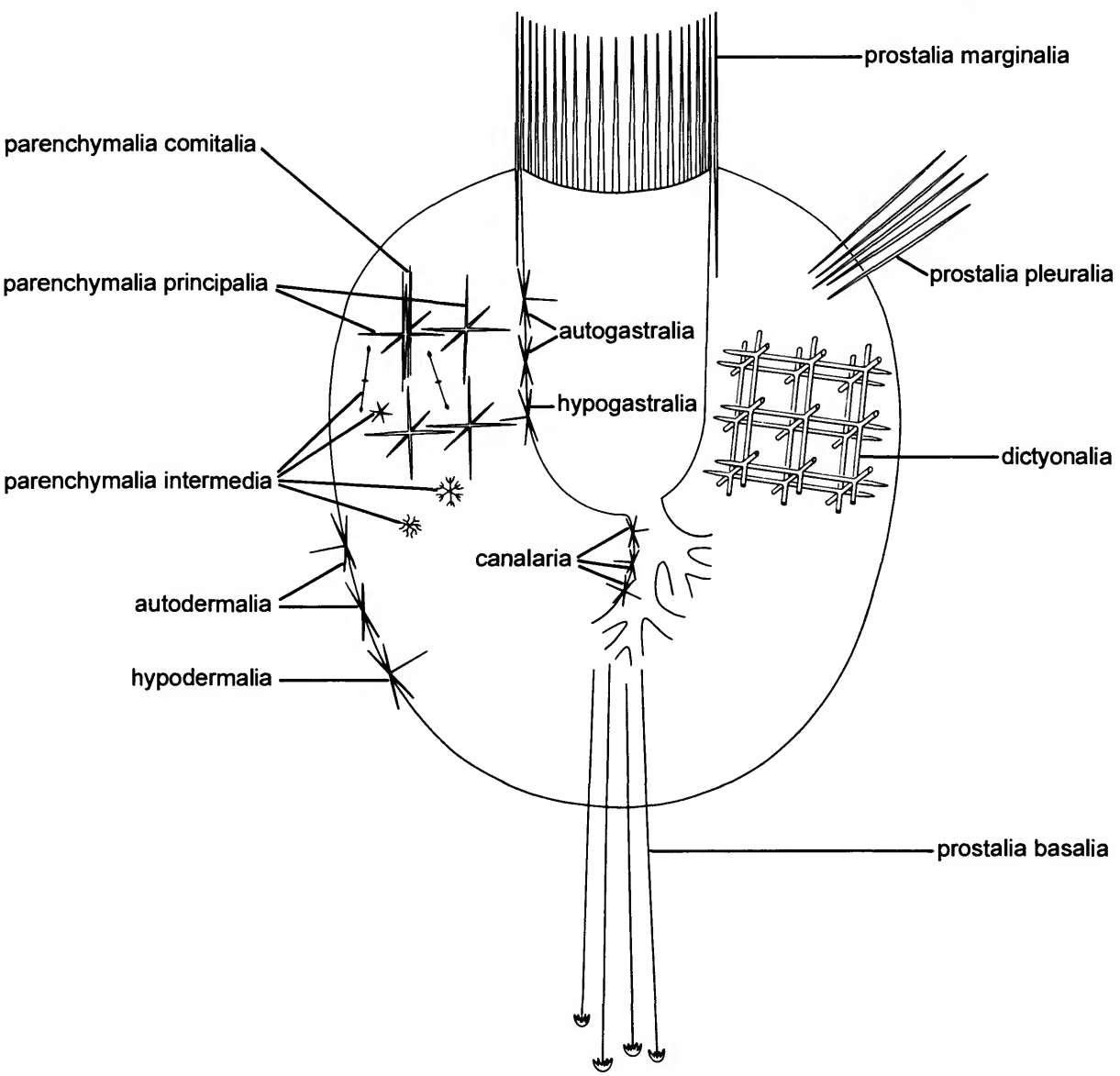
prostalia marginalia
parenchymalia comitalia
parenchymalia principalia
prostalia pleuralia
autogastralia
hypogastralia
dictyonalia
parenchymalia intermedia
canalaria
autodermalia
hypodermalia
prostalia basalia

89

acanthophore. Spicule having two to six stout spined rays, typically surrounding the point of insertion of the root tuft in *Hyalonema* species (Figures 90, 136, 139).

amararhysis. Paleontological term for longitudinal, tunnel-like canal opening to the exhalant surface by slit-like apertures.

ambucinate. Diactin with spines recurved toward the center (Figure 91).

amphidisc. Dumbbell-shaped microsclere with ends developed into umbel-like expansions. Three size classes, termed macramphidisc, mesamphidisc, micramphidisc (Figure 92).

anchor. Basalia megasclere, one end with hooks (Figures 89, 93).

apochete. Exhalant canal in fossil sponges.

apopore. To be rejected; in fossil sponges, an opening forming an exit from an apochete (= osculum).

aporhysis. In fossil sponges, canal closed at the outer end (cf. epirhysis).

aspidoplumicome. Hexaster with numerous S-shaped terminal rays whose external curved ends form several successive tiers (Figure 94).

autodermalia. Dermalia belonging wholly or at least primarily to the outer bounding skin, without actin protruding inside the sponge body (Figure 89).

autogastralia. Gastralia with one actin protruding into the atrium (Figure 89).

barbule. See UNCINATE.

basalia. Spicules protruding from lower sponge surface; sometimes called root spicules, anchors, barbed basalia; in some species, forming a root tuft (Figure 89).

basidictyonal plate. Rigid basal skeletal framework (Figure 95).

calycocome. Hexaster with stout main rays and with terminal rays directed outward (Figure 96).

canalaria. Spicules lining canals (Figure 89).

clavule. Sceptrule with one terminal umbel (Figure 97) or with terminal anchor teeth (Figure 98).

codonhexactin. Discohexactin with long, dendate, umbel-like structures (Figure 99).

comitalia. Parenchymalia located close and parallel to principalia (Figure 89).

dermalia. Spicules of the external sponge surface. See AUTODERMALIA, HYPODERMALIA (Figure 89).

diactin. Megascleres with two rays and frequently with central swellings indicating the hexactin origin (Figures 90, 91, 100, 117, 138, 140).

diarhysis. In fossil sponges, radial canal in the honeycomb-like skeleton of Aphrocallistidae.

dictyonal skeleton (= dictyonine). Three-dimensional network of fused, regular hexactins (Figure 89).

dictyonalia. Spicules fused into a rigid framework (Figures 89, 101, 113).

discohexactin. Hexactin with rays terminating in dentate, umbel-like structures (Figure 102).

discohexaster. Hexaster with dentate, umbel-like terminal rays (Figures 103, 112, 132).

discoctaster. Octaster with terminal rays ending in umbel-like disks (Figure 104).

drepanocome. Hexaster with sickle-like terminations (genus *Dictyaulus*) (Figure 105).


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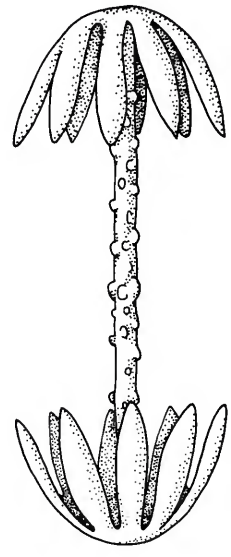
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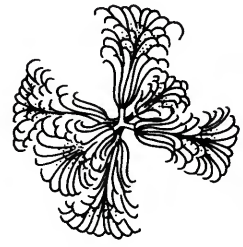
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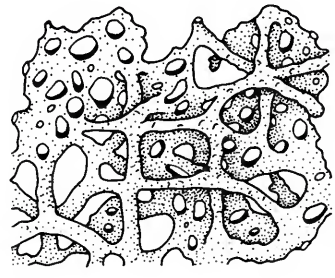
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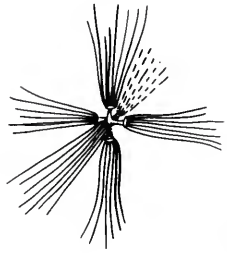
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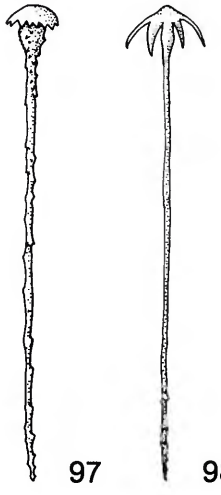
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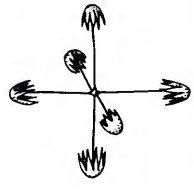
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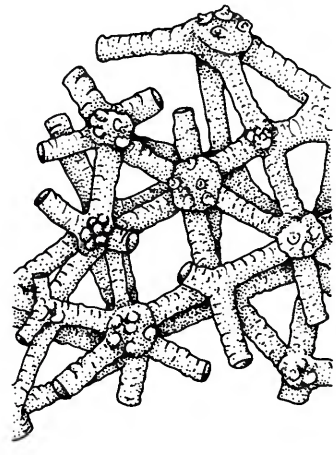
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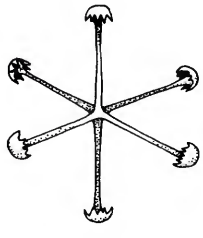
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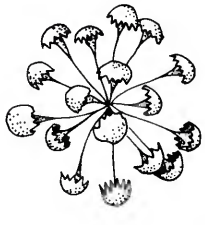
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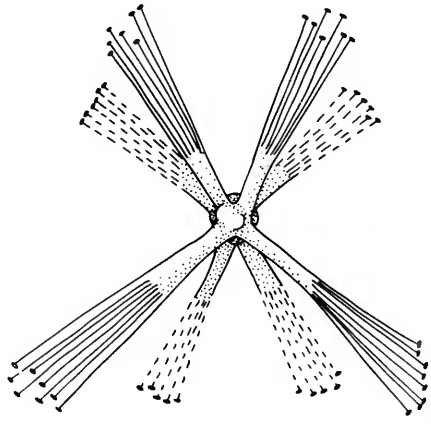
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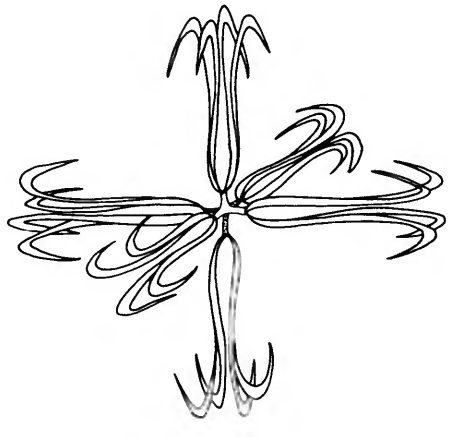
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epirhysis. In fossil sponges, canal closed at inner end (cf. aporhysis).

fibule. Microsclere consisting of two bent rays derived from greatly reduced oxyhexaster (in *Holascus fibulatus*) (Figure 106).

floricome. Discohexaster with S-shaped terminal rays that end in a plate provided with teeth or claws (Figure 107).

gastralia. All spicules that line the main exhalant cavity. See AUTOGASTRALIA, HYPOGASTRALIA (Figure 89).

graphicome (= graphihexaster). Hexaster with long, thin, parallel branches forming terminal brushes (Figure 108).

hemioxyhexaster. Hexaster in which two opposite rays are longer than the other four; the branched rays are reduced or absent (genus *Aphrocallistes*) (Figure 109).

hexactin (hexact). Siliceous spicule with six unbranched rays perpendicular to one another (Figures 99, 102, 115, 118, 123, 130).

hexadisc. Microhexactin with six actins ending in amphidisc-like umbels (Figure 111).

hexaster. Microsclere with six branched rays (Figures 94, 96, 103, 105, 107–110, 112, 116, 120, 121, 129, 131, 132, 134).

holactin. See MICROHOLACTIN.

holoxyhexaster. See OXYHEXASTER.

hypodermalia. Dermalia with one actin protruding inside the body and the other ones tangential to the external surface (Figure 89).

hypogastralia. Gastralia with one actin protruding inward, the other ones oriented tangentially to the atrium (Figure 89).

intermedia. Parenchymalia situated among the principalia or dictyonalia (Figure 89).

lophocome (= lophodiscohexaster). Discohexaster with short, stout main rays and numerous slender secondary rays (Figure 112).

lychnisc. Hexactin with a center resembling a perforated octohedron; building block of fused (dictyonal) framework called LYCHNISCA (Figure 113; lower two lychnics shown in optical section).

lychnisca. Dictyonal hexactin framework formed by lychniscs (Figure 113).

lyssacine. Spicular framework formed by the juxtaposition and interlacing of elongate rays of hexactins (Figure 114).

macruncinate. See UNCINATE.

marginalia. Prostalia that project in a wreath-like arrangement from the oscular margin (Figure 89).

microhexactin. Hexactin microsclere.

microholactin. Large category of microscleres lacking spines and appendages (*Monorhaphis*) (Figure 115).

micruncinate. See UNCINATE.

octactin. Spicule with eight rays, generally six in one plane, the other two perpendicular to them.

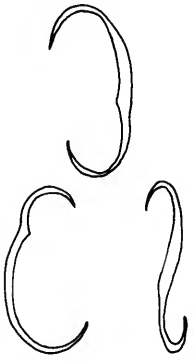
octaster. Octactin microsclere with branched rays (Figure 104).

onychaster (= onychohexaster, onychohexactin). Hexaster with terminal rays ending in four actins that are perpendicular to the rays (Figure 116).

orthodiactin. Diactin in which the two rays belong to different axes of a triaxon and form an angle of 90° (Figure 117).

oxy-. Prefix indicating that rays are tapering to a point. See examples for DIACTIN (Figures 100, 140), HEXACTIN (HEXACT) (Figure 118), HEXASTER (Figures 109, 110, 116), PENTACTIN (Figure 119), and STAURASTER (Figure 120).

pappocome. Graphicome-like spicule with diverging terminal rays (Figure 121).



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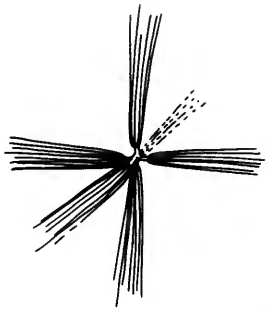

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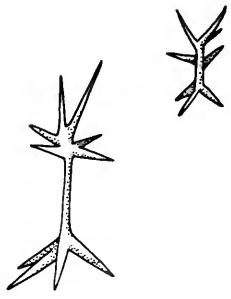

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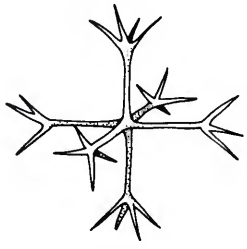

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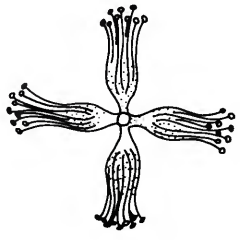

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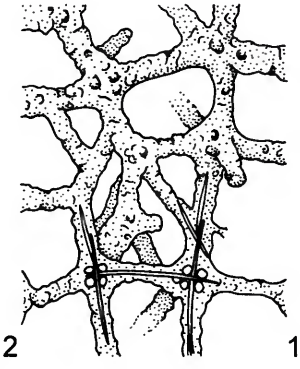

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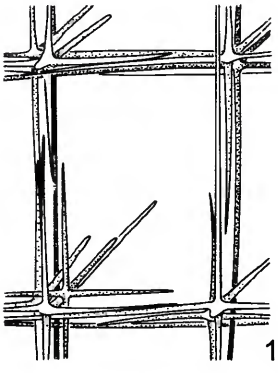

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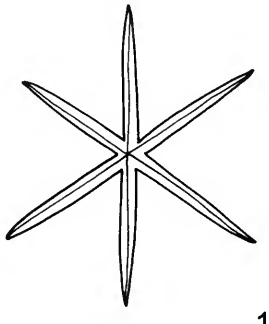

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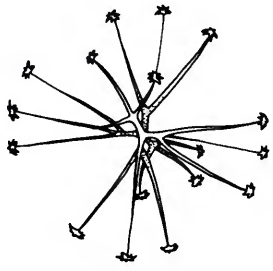

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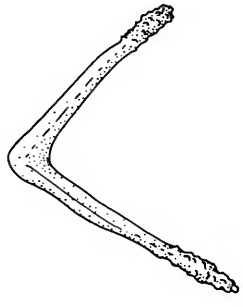

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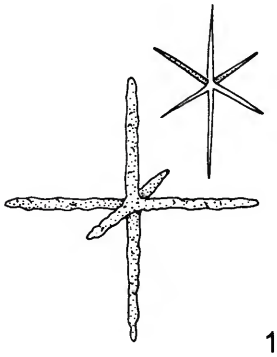

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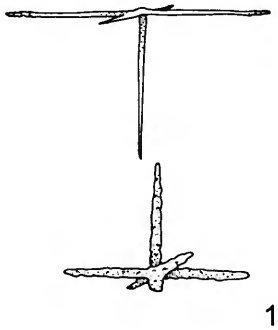

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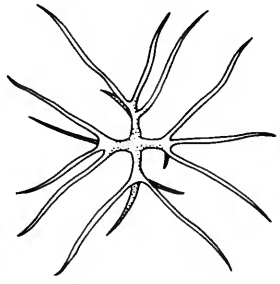

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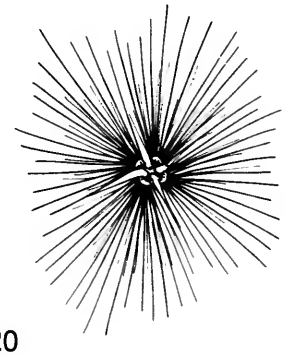

121

parenchymalia. All spicules in the choanosome (Figure 89).
pentactin (pentact). Five-rayed spicule (Figures 119, 122).
pinule. Pentact or hexact spicule with four basal rays and one perpendicular ray ornamented by obliquely set spines directed distally (Figures 122, 123).
pleuralia. Spicules protruding from lateral surface (Figure 89).
plumicome. See ASPIDOPLUMICOME, STROBILOPLUMICOME.
posticum. Cf. apopore (= osculum); in fossil sponges.
principalia. Spicules making up main skeletal framework (Figure 89).
prosochete. In fossil sponges, inhalant canal leading to prosopore.
prostalia. Spicules protruding from a surface (Figure 89).
rhabdodiactin. Diactin in which the two rays are aligned in a single axis (Figures 90, 91, 100, 138, 140).
sarule. Sceptrule with one end swollen and ornamented with distally directed spines (Figure 124).
scepter. Uncinate marginalia, with spiny shaft acerated at one end; terminating in four very short actins at the other (Pheronematidae, genus *Semperella*) (Figure 125).
sceptrule. A small, prostal monactin spicule exhibiting peculiar secondary developments at one end (order Hexactinosa) (Figures 97, 98, 125–127).
schizorhysis. In fossil sponges, continuous system of interconected canal spaces (Tretodictyidae).
scopule. Fork-like sceptrule with one end branched (leptoscopule, pachyscopule) (Figures 126, 127).
sieve-plate. Perforated plate that covers the broad terminal opening of some tubular Hexactinellida (*Euplectella* spp.) (Figure 128).
sigmatocome. Hexaster with long, S-shaped terminal rays (*Dictyaulus*) (Figure 129).
sphaerohexactin (sphaerohexact). Hexactin with rays ending in spherical knobs (Figure 130).
sphaerohexaster. Hexaster with terminal rays ending in spherical knobs (Figure 131).
spirodiscohexaster. Discohexaster with a bunch of terminal, spirally twisted rays (genus *Rhabdodictyum*) (Figure 132).
stauractin. Reduced hexactin with four rays all arranged in one plane (Figure 133).
stauraster. Reduced hexaster with four rays all arranged in one plane (Figure 120).
strobiloplumicome. Plumicome with numerous slender terminal rays arranged in two concentric circles (Figure 134).
synapticule. Bridges composed of siliceous cement joining spicules (Figure 135).
tauactin. Large, smooth triactin (genus *Monorhaphis*).
tetractin. Spicule with four rays in one plane (Figure 136).
tetradisc. Microsclere with four actins ending in amphidisc-like umbels (Figure 137).
tignule. Gigantic, isolated diactin (*Hyalonema toxeres*) (Figure 138).
triactin. Spicule with three rays in one plane (Figure 139).
triaxone. Spicule with three axes (Figures 99, 102, 118, 119, 122, 123, 130).
trichaster. Graphicome (genus *Trichasterina*).
uncinate. Diactin covered with short spines directed distally (barbule); size classes are designated by macrouncinate, microuncinate (Figure 140).


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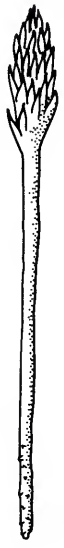
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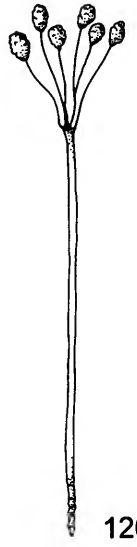
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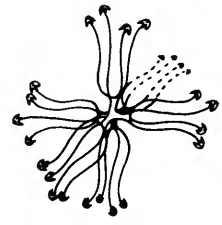
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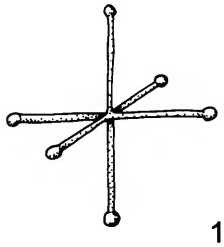
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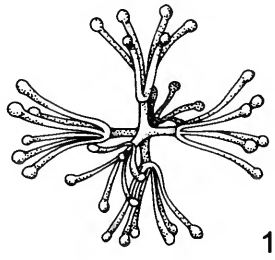
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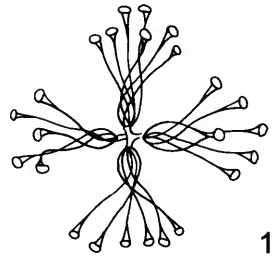
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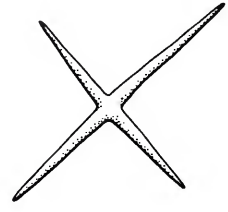
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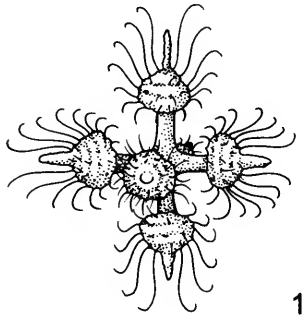
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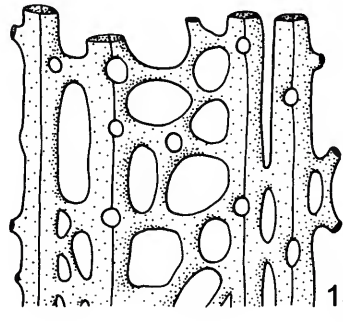
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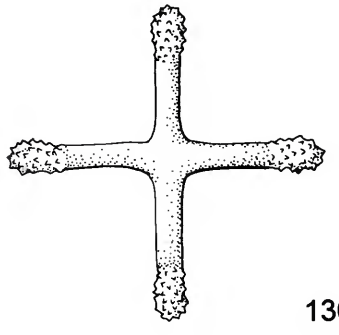
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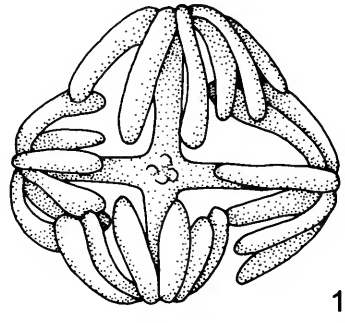
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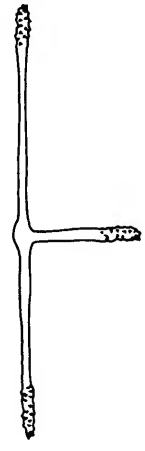
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140

Calcareous Spicules and Calcareous Spicule Skeleton

LITERATURE CONSULTED: Borojevic, 1965, 1966a, 1966b; Borojevic et al., 1968, 1990; Hartman, 1980. Structural arrangements are illustrated in Figures 141 and 142.

actine. Ray of a spicule.

anchor. Anchor-like spicule, protruding free from the basal part of the sponge; derived from diactine, triactine, or tetractine spicules, with terminal rays or spines, curved in the proximal direction along the main ray (Figure 143).

apical actine (ray). The fourth actine of a tetractine that is joined to the basal triradiate system (Figure 144).

articulate skeleton. Choanoskeleton composed of several rows of similar spicules (Figure 141).

atrial spicule/skeleton. Spicules surrounding the atrium (Figures 141, 142). Terms "gastral spicule/skeleton" are to be rejected.

basal actine (ray). See UNPAIRED ACTINE.

basal triradiate system. The three rays of a tetractine that correspond to those of a triactine (Figure 144).

calcareous spicule. A spicule composed largely of calcite having a radiate form, the number of rays being either two (diactine), three (triactine), or four (tetractine).

calcareous tripod. Regular triactine whose center is not in the same plane as the extremities of the recurved rays (Figure 145).

center. Point of union of the three rays of a triactine or of a basal triradiate system.

chiactine. Tetractine with the unpaired ray of the basal system and the apical ray in the same alignment (Figure 146).

choanoskeleton. Skeleton of the part of the sponge that contains choanocytes (Figure 141).

cortical spicule/skeleton. Spicule or skeleton of the external layer or cortex of the sponge ("dermal" spicule/skeleton, incorrect) (Figure 141).

diactine. A spicule composed of two actines (Figure 147).

diapason (tuning-fork spicule). Sagittal triactine with parallel paired rays (Figure 148).

facial plane. The plane passing through tips of the three rays of a triactine or of a basal triradiate system of a tetractine.

free actine. A ray that projects through the external or the atrial surface (Figures 141, 142).

gastral. See ATRIAL.

inarticulate skeleton. Choanoskeleton composed only of the unpaired rays of the subatrial spicules and of one of the rays of the cortical or subcortical spicules. Without specific spicules of the choanoskeleton (Figure 142).

microanchor. A small tetractine anchor (described only from the atrial skeleton).

microdiactin. A small diactine spicule (Figure 149).

needle-like biradiate. A diactine with a hole at one end (Figure 149).

optic axis. The crystallographic trigonal axis of the calcite spicule.

oral/oscular ray. See PAIRED ACTINE.

paired actine(s). One or both equivalent rays of a sagittal spicule. "Oscular" or "oral" rays to be rejected.

parasagittal spicule. Bilaterally symmetrical triactine or tetractine with unequal actines, having equal angles (120°) between the basal rays when projected into a plane perpendicular to the optic axis (Figure 150). "Secondary sagittal spicule" to be rejected.

primary sagittal spicule. See SAGITTAL SPICULE.

pseudosagittal spicule. A subcortical triactine essentially sagittal, but having unequally long and differently curved rays on each side of the unpaired angle (Figure 151).

regular spicule. Triactine or tetractine spicule with basal rays of equal length, and with equal angles (120°) between them, when projected into a plane perpendicular to the optic axis (Figure 152).

sagittal spicule. Triactine or tetractine with two equal angles (paired angles) and one dissimilar angle (unpaired angle) at the center, when projected into a plane perpendicular to the optic axis (Figure 153). "Primary sagittal spicule" to be rejected.

scale. Triangular or circular spicule derived from a triactine (Figure 154).

secondary sagittal spicule. See PARASAGITTAL SPICULE.

spicule tract. See "Architecture of Demosponges."

subatrial spicule. Sagittal spicule with paired rays adjacent to the atrial skeleton (Figures 141, 142). "Subgastral spicule" to be rejected.

subcortical spicule. A pseudosagittal triactine, with unpaired actine and a shorter paired actine adjacent to the cortex, or a tetractine with basal triradiate system adjacent to the cortex (Figures 141, 142).

subdermal spicule. Term to be rejected. See SUBCORTICAL SPICULE.

subgastral spicule. Term to be rejected. See SUBATRIAL SPICULE.

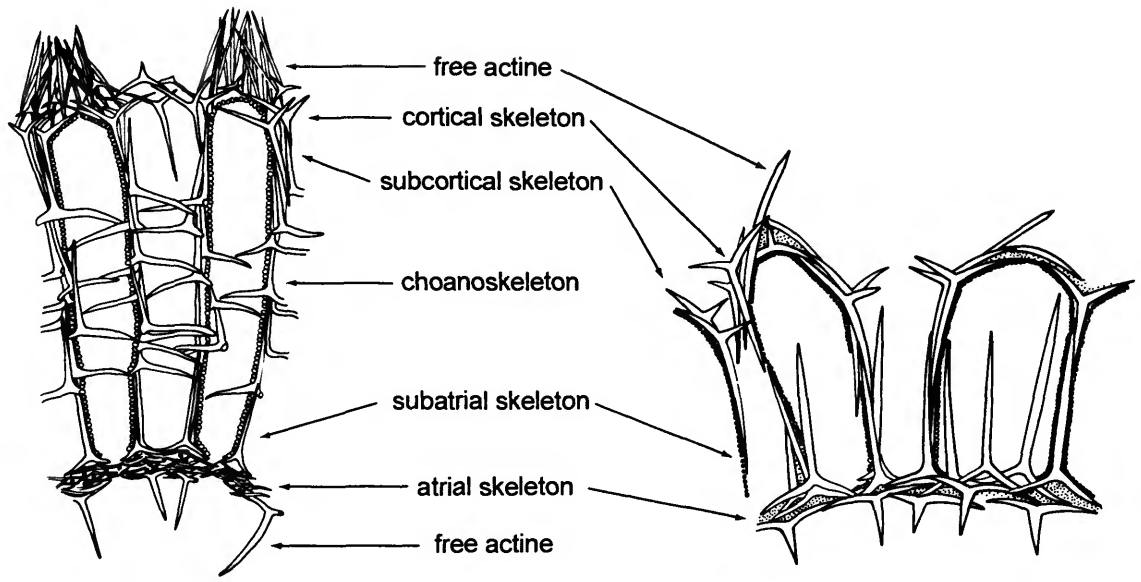
tangential spicule. Spicule arranged parallel to the surface.

tetractine. A spicule with four rays (in Figure 144, sagittal tetractine at the top and regular tetractine at the bottom).

triactine. A spicule with three rays (Figures 148, 150–153).

trichox. Thin, hair-like straight monaxon spicules present in general around the osculum or protruding from the cortex.

unpaired actine. In sagittal spicules, the ray of a triactine or of a triradiate basal system of a tetractine lying in the plane of bilateral symmetry. "Basal ray" to be rejected.



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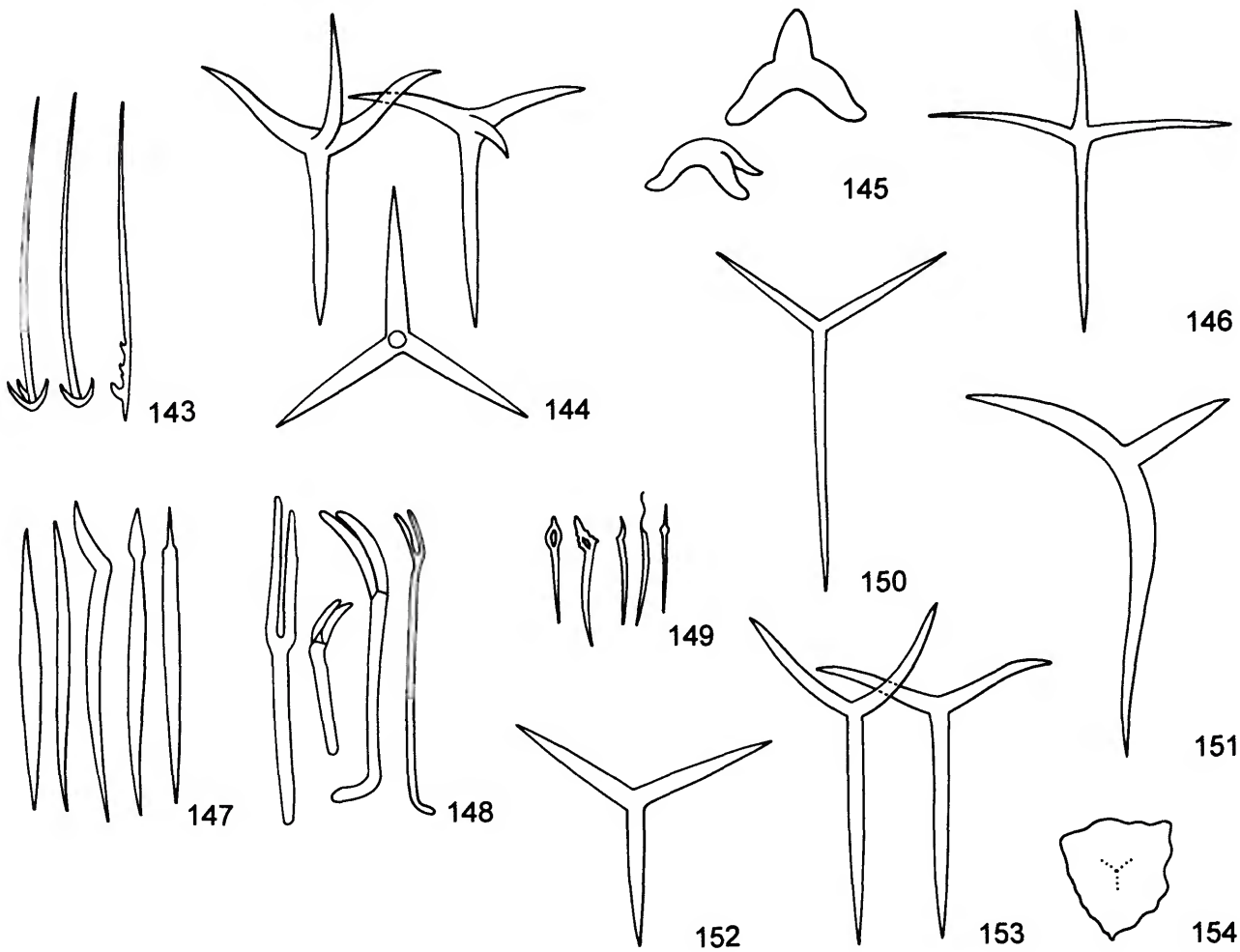


143 144 145 146 147 148 149 150 151 152 153 154

Architecture of the Skeleton of Demospongiae

LITERATURE CONSULTED: Bergquist, 1978, 1980; Lévi, 1973; Topsent, 1928; Wiedenmayer, 1977.

accessory spicule. A category of megasclere echinating the primary skeleton. See ECHINATING SPICULE.

accretive. Regularly anisotropic reticulation with ascending (primary and radial) fibers or tracts and interconnecting fibers or tracts about equal in thickness (Figure 155).

alveolate. Skeleton arranged around choanosomal cavities (Figure 156).

anastomosing (= reticulate). Tracts, lines, or fibers are interconnected (Figure 157).

anisotropic skeleton. Reticulate skeleton with primary and secondary tracts, lines, or fibers (Figure 158).

ascending fiber/tract/line. See PRIMARY fiber, tract, or line (Figures 155, 158).

auxiliary spicule. See INTERSTITIAL SPICULE.

axial skeleton. A type of skeletal organization in which some components are condensed to form a central region or axis (Figure 159).

axinellid skeleton. Structure with a dense core of parallel fibers or strands fanning out toward the periphery of a sponge (Figure 159). See also PLUMOSE or PLUMORETICULATE.

bark. The dense area of compacted spongin surrounding the central zone in pithed fibers (Figure 160).

basal lamina. See BASAL SPONGIN PLATE.

basal spongin plate. A spongin layer covering the substratum (Figure 161).

bouquet. Ectosomal brush of spicules perpendicular to the surface of the sponge, with pointed ends outward (Figure 162).

calcareous rigid skeleton. See "Calcareous Rigid Skeleton."

chalinid skeleton. See ANISOTROPIC skeleton (Figure 163).

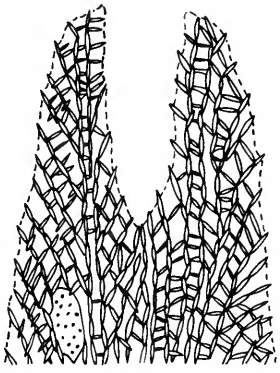
choanosomal skeleton. Skeleton of the main body, supporting the canal system and responsible for the form of the sponge.

choristid (= astrophorid). Predominantly radiate, occasionally confused arrangement of megascleres including triaenes with cladome outward, lacking spongin, and commonly with a cortex (Figures 164, 174).

clathrate skeleton. Polyhedral arrangement of fibroreticulate sheets (Figure 165).

clathriid skeleton. Isodictyal or subisodictyal arrangement of fibers cored and/or echinated by styles in the family Microcionidae (Figure 166).

collagen. See SPONGIN.



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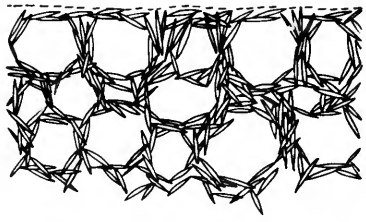

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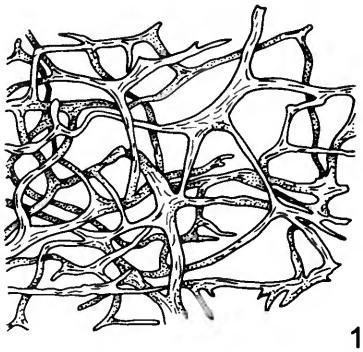

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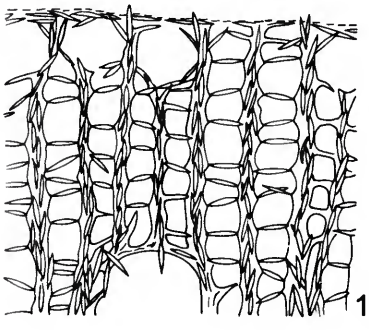

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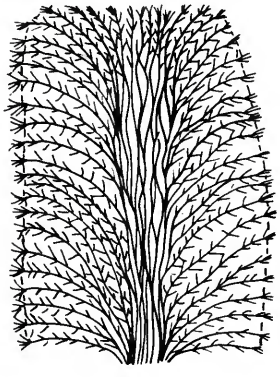

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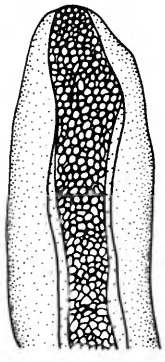

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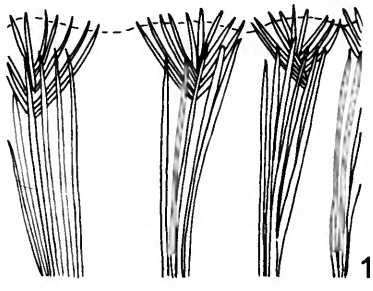

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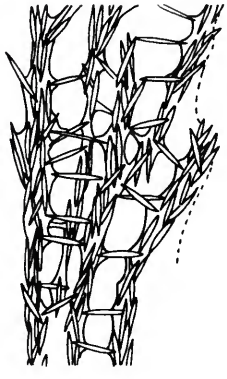

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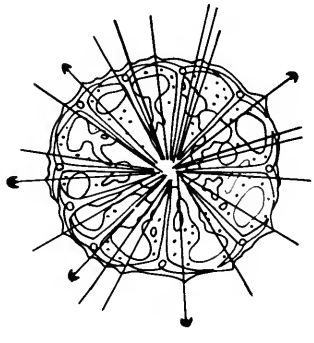

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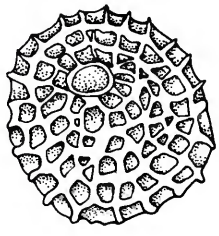

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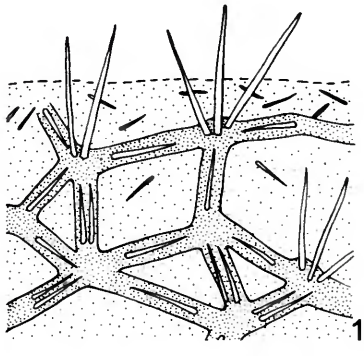

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collagen fascicle. A dense band of intercellular collagen fibrils, which has a skeletal role in some sponges (e.g., genus *Chondrosia*) (Figure 167).

compound (= fasciculate, trellised) fiber. Several fibers merged or intricately interconnected (Figure 169).

confused skeleton. Irregularly positioned megascleres (Figure 168).

connective tracts, lines, fibers. See SECONDARY tracts, lines, or fibers.

cored fiber. A fiber that incorporates indigenous spicules or foreign material (spicules and sediment); coring may be light and limited to a central axis or may fill in the whole fiber (Figure 170).

cortex. A superficial region of a sponge reinforced by a special organic or inorganic skeleton (Figure 171).

cortical skeleton. Ectosomal skeleton reinforced by a layer of special skeleton elements.

crust. See CORTEX.

cuticle. A spongin layer covering the surface or a part of the surface of a sponge.

dendritic skeleton. A skeleton consisting of single or ramifying fibers or tracts that branch but rarely anastomose (tree-like branching) (Figure 172).

dendroreticulate fiber skeleton. Ambiguous, to be rejected.

dermal skeleton. See ECTOSOMAL SKELETON.

echinating spicule. Megasclere that protrudes from the spongin plate, a fiber, or a spicule tract (Figure 173).

ectochrote. Outer layer of the cortex (Figure 174).

ectosomal crust. See ECTOSOMAL SKELETON.

ectosomal skeleton. Skeleton found in the superficial region of a sponge, distinct from that of the choanosome (Figure 175).

endosomal skeleton. See CHOANOSOMAL SKELETON.

extra-axial skeleton. Structurally distinct skeleton arising from or surrounding an axial region (Figure 159).

fasciculate fiber. See COMPOUND FIBER.

fiber (or fibre). A column (strand, thread) of spongin forming a reticulate or dendritic skeleton, with or without indigenous spicules or foreign material (e.g., Figures 160, 170).

fibrofascicle. See COMPOUND FIBER.

fibroreticulate. Forming a net composed of fibers.

halichondrioid skeleton. Confused skeleton except at the surface; choanosomal skeleton may be in vague tracts (Figure 168).

hispidation. Spicules projecting through the pinacoderm (Figures 166, 174).

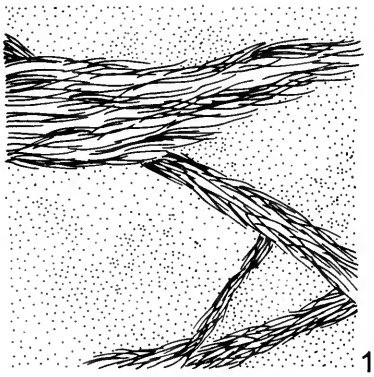
homogeneous fiber. A fiber without central pith and without conspicuous layers (Figure 176).

hymedesmioid (= leptoclathriid) skeleton. Skeleton of encrusting sponge where monactine megascleres are arranged singly with heads fixed to a basal plate of spongin and points directed outward (Figure 177).

intercellular collagen fibrils. Fibrillar collagen, formerly called "spongin A," dispersed in the intercellular matrix in all sponges. The fibrils are 20–30 nm in diameter, with a transverse banding of 64 nm intervals, and may be smooth or rugose.

interstitial (= auxiliary) spicule. Free choanosomal spicule not included in tracts or fibers, common in subectosomal skeleton (Figure 166).

irciniid filament. Long, slender (0.5–15 μm thick) spongin element, terminally knobbed; intertwined or free in the sponge body (Figure 178).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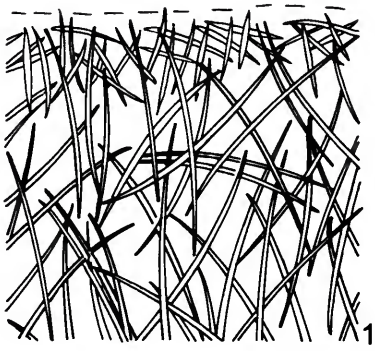
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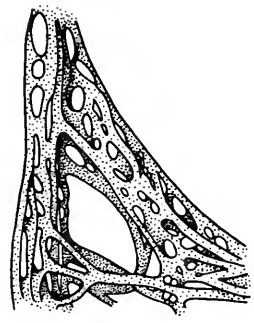
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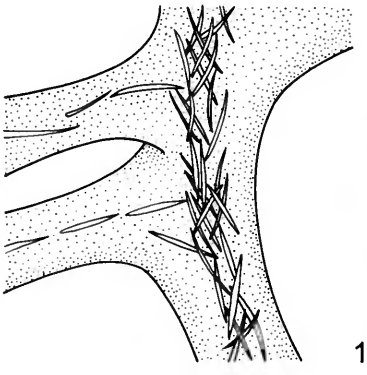
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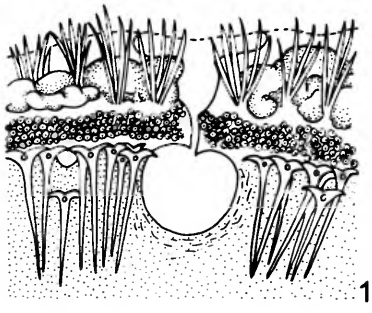
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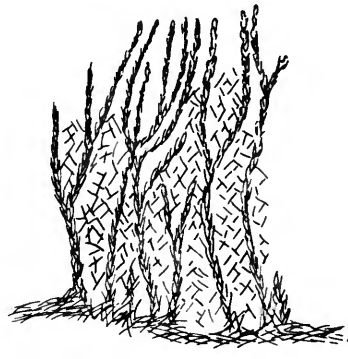
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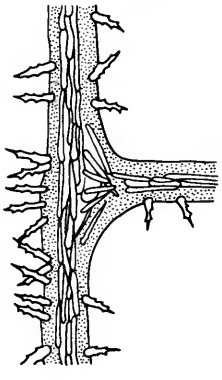
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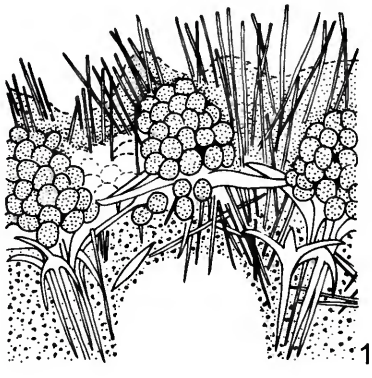
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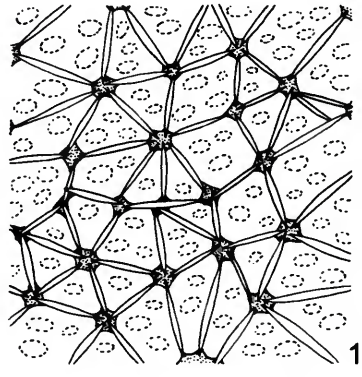
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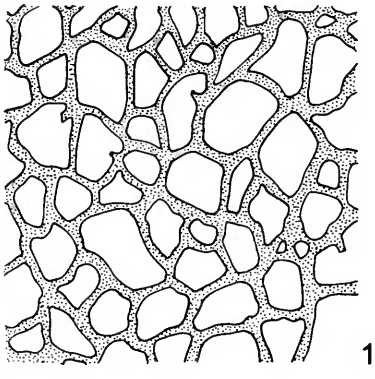
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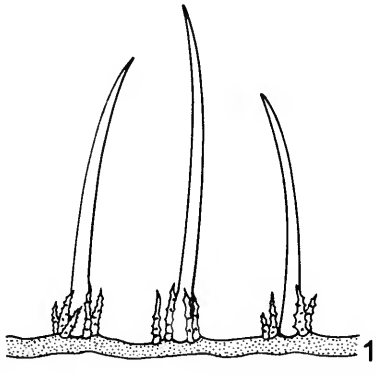
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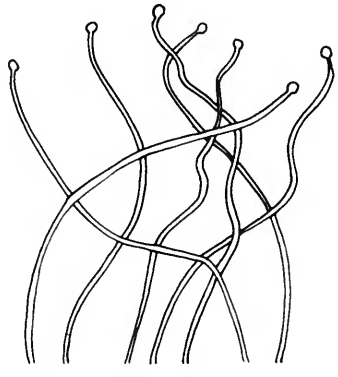
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isodictyal reticulation. Isotropic reticulation in which the meshes are triangular and have sides one spicule long (Figure 179).

isotropic reticulation. Reticulation without differentiation into primary or secondary fibers, tracts, or lines (Figures 156, 180).

laminated (= stratified) fiber. A fiber in which concentric layers are visible (Figure 181).

leptoclathriid. See HYMEDESMIOID.

lax (= loose, vague) skeleton. Skeleton lacking clear tracts or fibers (Figure 182).

line of spicules. Unispicular tract (Figure 183).

lipo-. Prefix meaning without.

lithistid skeleton. Main skeleton consisting of an interlocked assemblage of desmas (Figure 184).

longitudinal fiber/tract. See PRIMARY FIBER.

main skeleton. See CHOANOSOMAL SKELETON.

microcionid. Structure of microcionid sponges in which spicules project from an elevation of the basal plate of spongin (Figure 185).

multispicular fiber (tract). Fiber or tract composed of six or more spicules adjacent to one another.

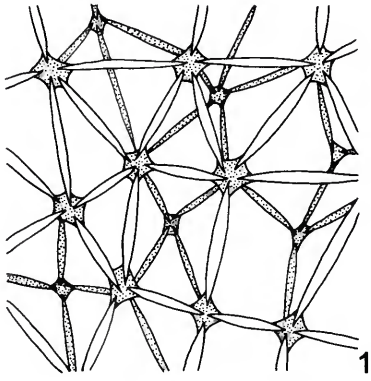
node. Junction of spicule tips cemented by spongin (Figure 186).

palisade. Perpendicular arrangement of ectosomal spicules, with points directed outward (Figure 187).

paratangential skeleton. Arrangement of ectosomal spicules intermediate between the palisade and tangential type (Figure 188).

parchment. Tangential ectosomal skeleton in which the megascleres are arranged in a tight feltwork (Figure 189).

paucispicular fiber (tract). Fiber or tract with two to five megascleres adjacent to one another (Figure 190).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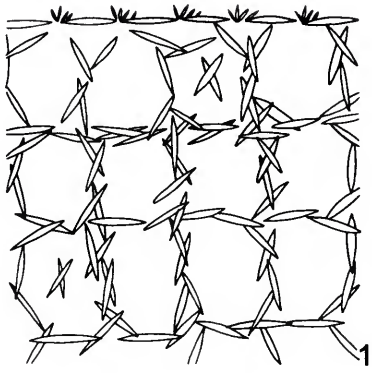
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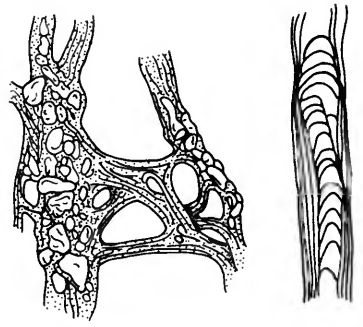
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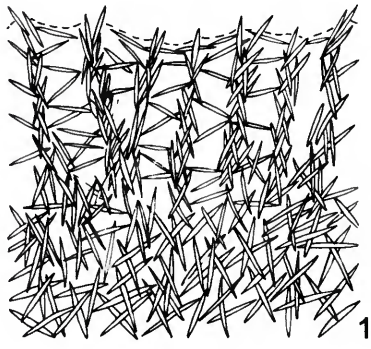
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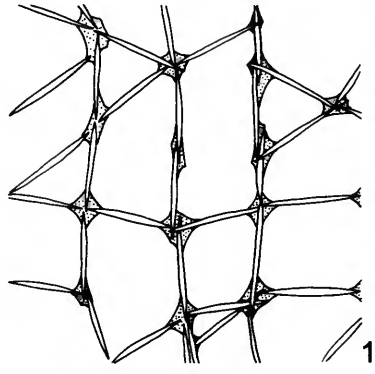
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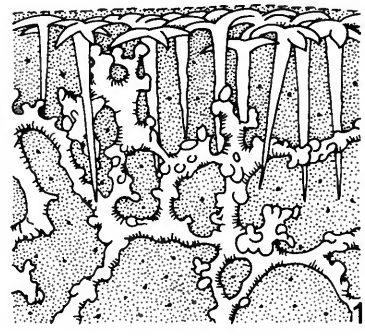
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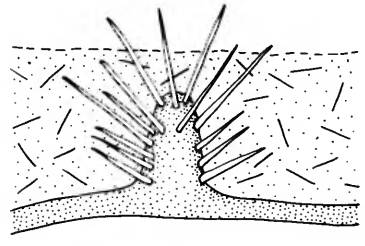
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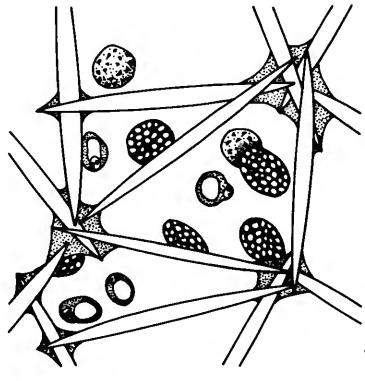
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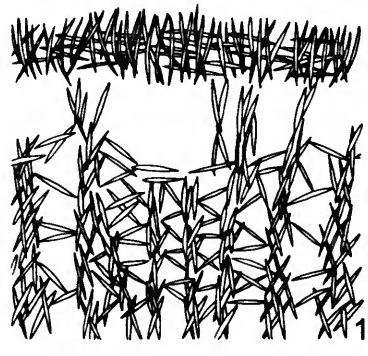
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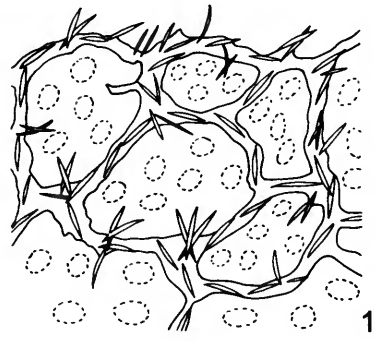
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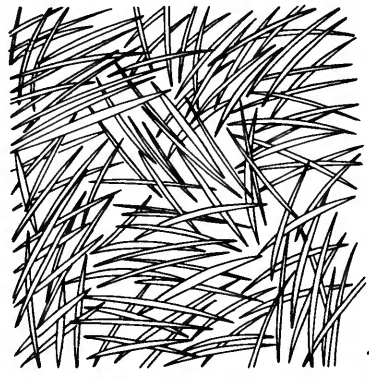
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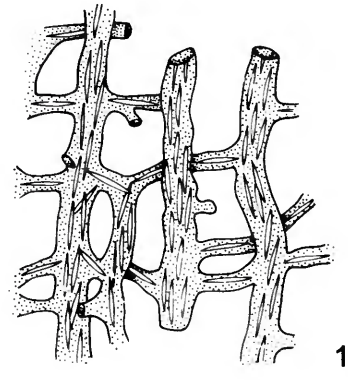

190

pith. Central area of a fiber made up of more or less diffuse wisps of collagen or of a coarsely granular collagen material. See PITHED FIBER.

pithed fiber. A fiber in which pith is easily distinguished from the surrounding bark (see, e.g., Figures 160; 181, right; and 200).

plumoreticulate skeleton. A type of plumose skeletal construction in which cross-connections occur (Figure 191).

plumose skeleton. A type of skeletal construction made of primary fibers or spicule tracts from which skeletal elements radiate obliquely (Figure 192).

plurispicular. See MULTISPICULAR.

polyserial. See MULTISPICULAR.

polyspicular. See MULTISPICULAR.

primary (= main, ascending) fiber. An ascending fiber ending at a right angle to the surface (Figure 193).

primary skeleton. See CHOANOSOMAL SKELETON.

primary spicule. The major structural megasclere in any particular sponge.

principal skeleton. See CHOANOSOMAL SKELETON.

radiate skeleton. A type of skeleton in which the structural components diverge from a central region toward the sponge surface (Figure 194).

renieroid skeleton. See RETICULATE SKELETON.

reticulate skeleton. Three-dimensional network of fibers, tracts, lines, or single spicules (see, e.g., Figures 155–158, 163, 175, 176, 180, 183, 195).

secondary (= connecting) fiber. In a reticulate skeleton, a fiber that links the primary fibers.

skeleton. All structures supporting and protecting the sponge body.

spiculation. General term for spicule complement.

spicule. A component of the mineral skeleton, typically composed of silica or calcium carbonate (Figure 196).

spiculoid (= spongin spicule). A spongin component of the skeleton that has the form of a diactinal, triactinal, or polyactinal spicule (Figure 197).

spongin. Skeletal substance in Demospongiae made up of collagen microfibrils of ~10 μm diameter (see, e.g., Figures 160, 170, 176, 185, 200).

sublithistid skeleton. Skeleton consisting of a loose assemblage of desmas (Figure 198).

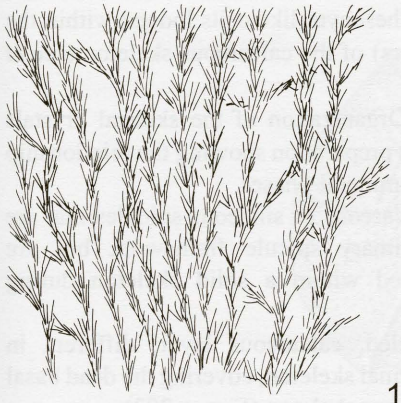
tangential skeleton. Ectosomal skeleton arranged parallel to the surface (Figure 199 shows upper right, view from the top).

tertiary fiber. In a reticulate skeleton, a fiber interconnecting the secondary fibers (Figure 200).

tract. A column of aligned megascleres (Figure 201 shows two types of tract).

trellised fiber. See COMPOUND FIBER.

unispicular fiber, tract. A single aligned row of megascleres (Figure 202).



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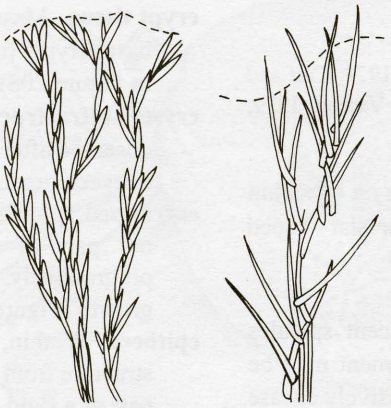

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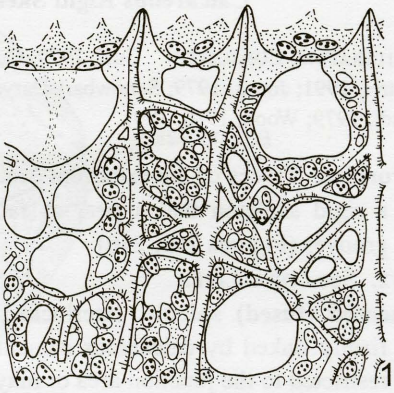

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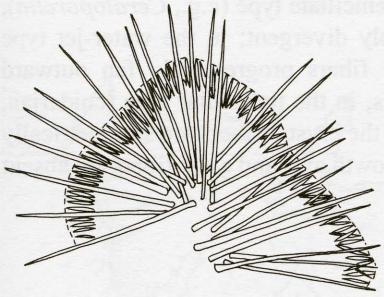

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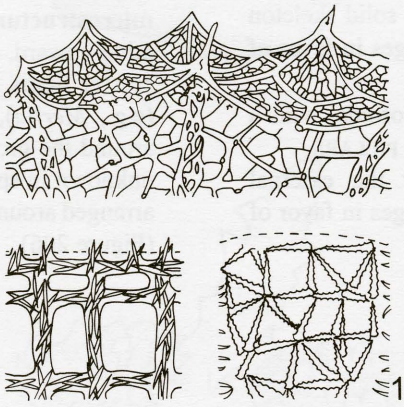

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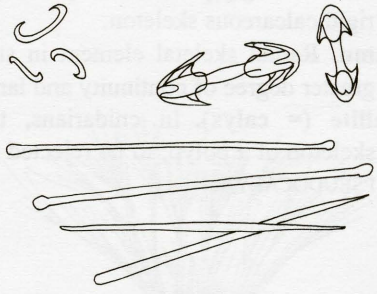

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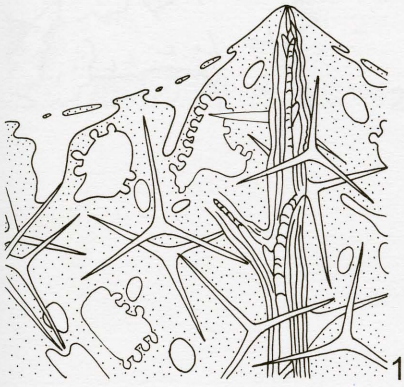

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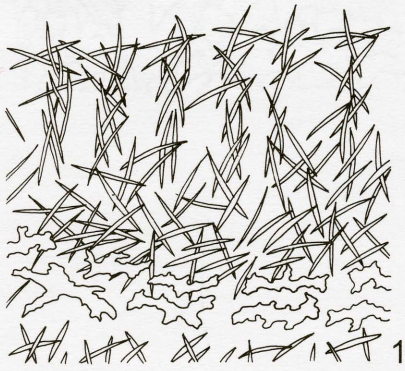

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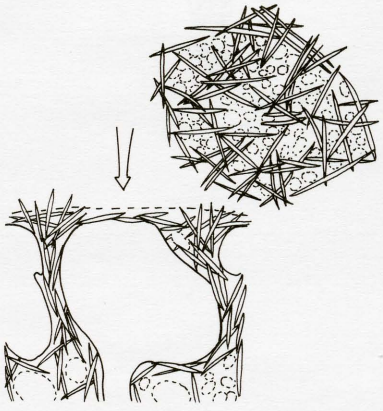

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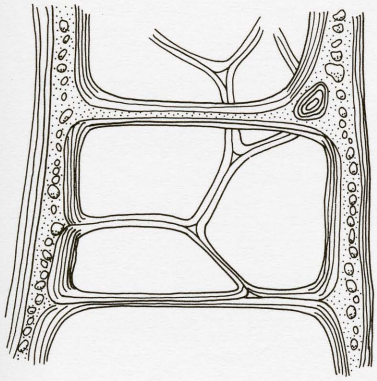

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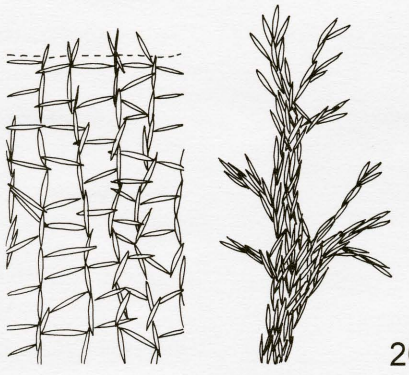

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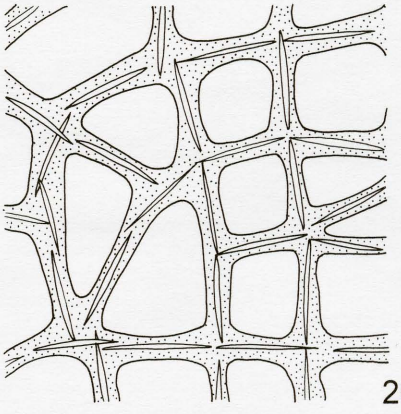


202

Calcareous Rigid Skeleton

LITERATURE CONSULTED: Cuif, 1979; Cuif et al., 1979; Cuif and Gautret, 1991; Jones, 1979; Senowbari-Daryan, 1991; Vacelet, 1979; Wendt, 1979; Wood, 1986, 1991.

astrorhiza. Traces of the excurrent canal system on or within a rigid skeleton that appear as radiating or star-shaped grooves (Figures 203, 210).

calyx. See CORALLITE.

cemented (fused) spicule. Interlocked or adjacent spicules firmly linked by calcareous cement; the cement may be restricted to the junction area or may progressively encase the entire spicule (Figure 204).

coenosteum. Term for cnidarians, used for the solid skeleton in stromatoporoids; to be rejected for sponges in favor of rigid calcareous skeleton.

column. Radial skeletal element in stromatoporoids, with a greater degree of continuity and larger than PILLARS.

corallite (= calyx). In cnidarians, term for the external skeleton of a polyp; to be rejected for sponges in favor of PSEUDOCALYX.

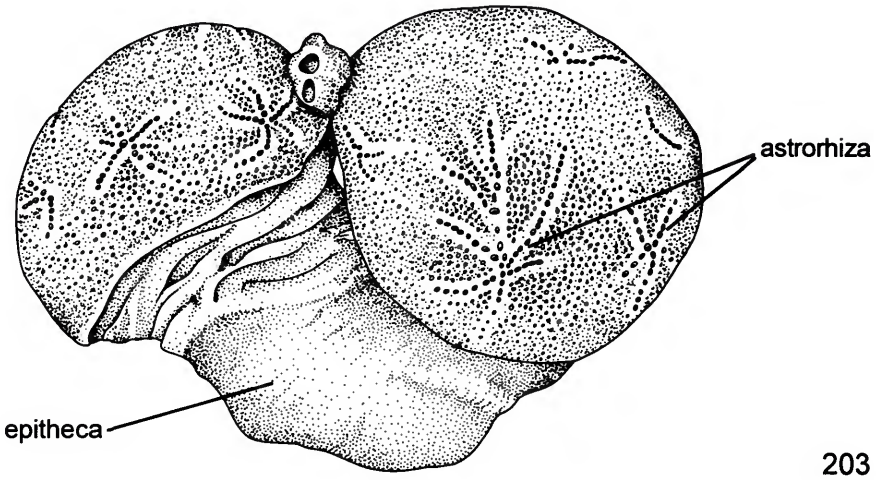
crypt tissue. Masses of thesocyte-like cells lodged within the basal crypts (chambers) of the calcareous skeleton (see *ct* in Figure 208).

crystal ultrastructure. Organization of the skeletal crystals observed after special preparation showing the relationship between organic and mineral phases.

entrapped spicules. Calcareous or siliceous spicules that are not part of the primary spicule framework but are progressively enclosed within a solid skeleton during growth (Figure 205).

epitheca. A thin, wrinkled, calcareous layer, different in structure from the normal skeleton, covering the dead basal part of a rigid calcareous skeleton (Figure 203).

fascicular fibrous (= water-jet, penicillate, trabecular) microstructure. Crystal fibers fanning outward and radiating upward. In the penicillate type (e.g., *Ceratoporella*), crystal fibers are feebly divergent; in the water-jet type (e.g., *Merlia*), crystal fibers progressively fan outward around the growth axis; in the trabecular type (cnidarian, unknown in sponges), the crystal fibers are symmetrically arranged around the growth axis and axial fibers are absent (Figure 206).



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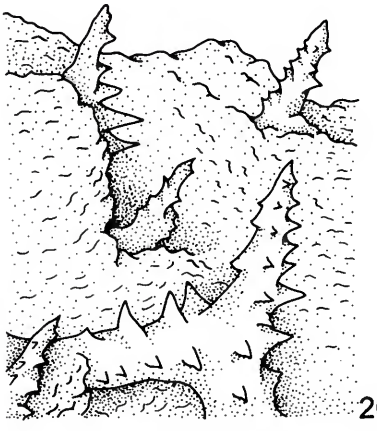

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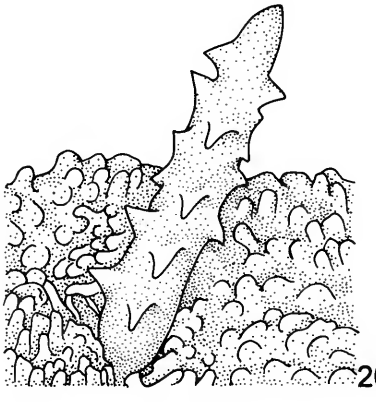

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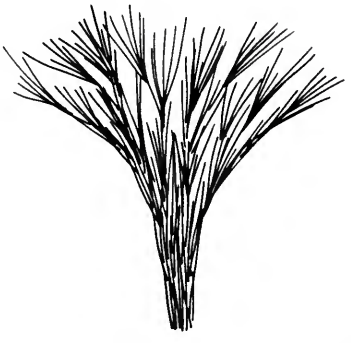

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filling (tissue) structure. Secondary calcareous skeleton that partitions or fills abandoned parts of the skeleton (Figure 207).

foramen. Circular pore in laminae connecting adjoining interlamellar spaces (*fo* in Figure 208, which also shows *cc* = choanocyte chamber; *ct* = crypt tissue; *sk* = rigid aspicular skeleton; *spi* = spicule; and *ta* = tabula).

fused. See CEMENTED.

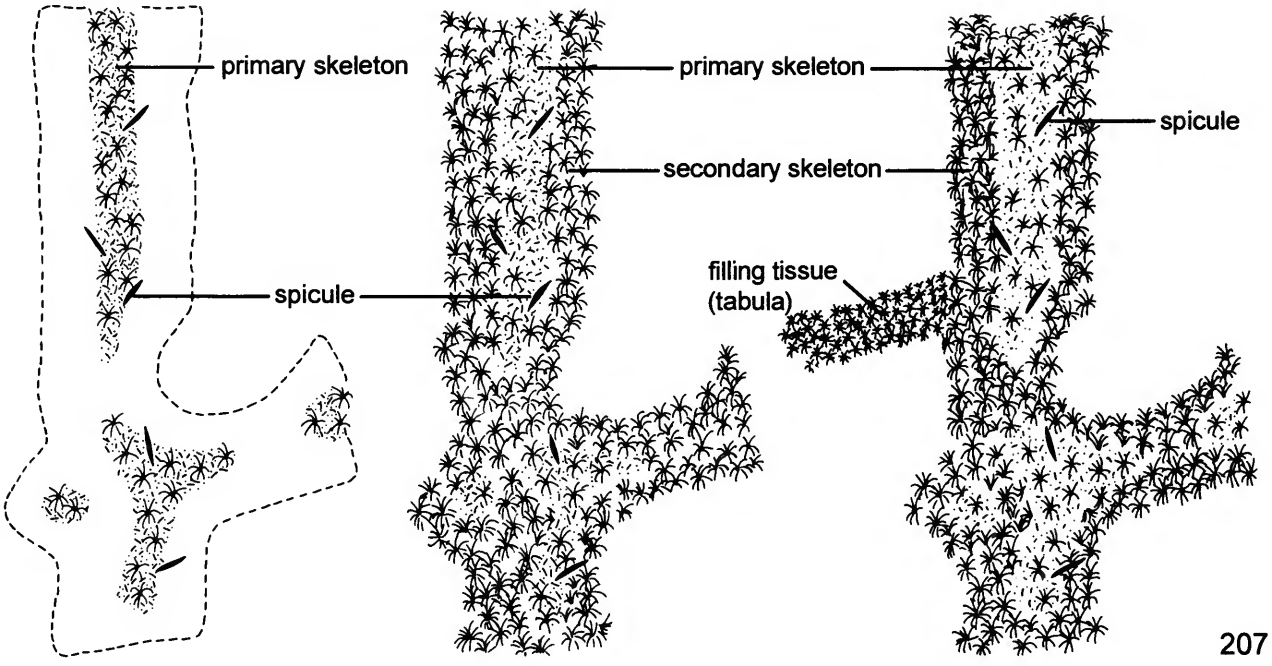
irregular (felt) microstructure. Structure in which tangled crystal fibers have no preferred orientation (e.g., genus *Vaceletia*). Shape and nature of the crystal fiber may be diverse (Figure 209).

lamina. Calcareous plate in stromatoporoids, perpendicular to radial skeletal components (Figure 210).

latilamina. A macroscopic, banded calcareous skeletal plate in stromatoporoids (Figure 210).

linked spicules. Spicules that are interlocked by ZYGOSIS.

mamelon. Rounded regular or irregular elevation of the skeleton surface; may or may not show correlation with astrorhizae (Figure 210).



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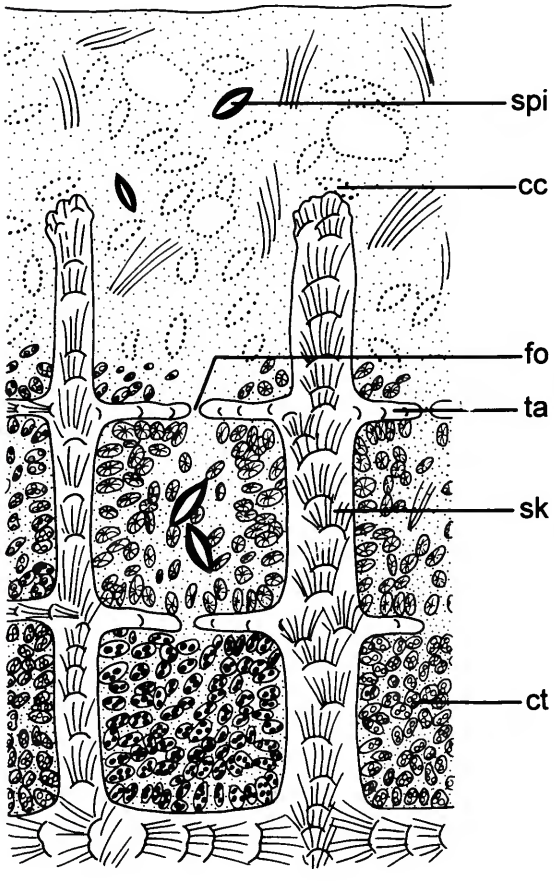

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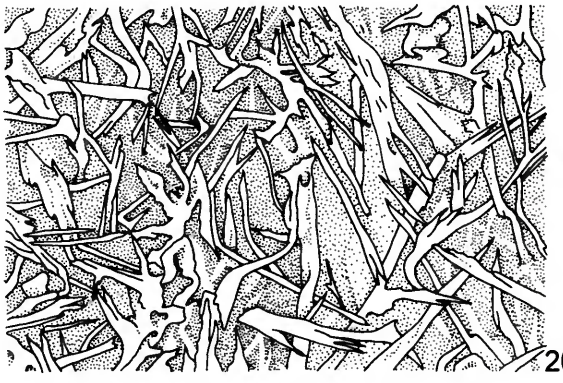

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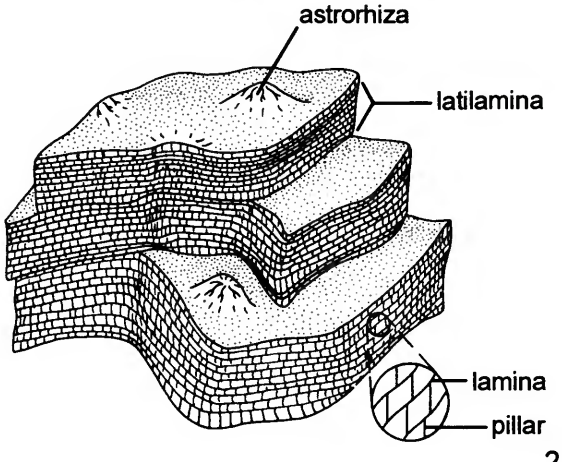

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microgranular microstructure. Diverse structure in which small, round elements are scattered (Figure 211).

microlamellar microstructure. Structure in which the crystal fibers are disposed in criss-cross layers, mostly parallel to the surface of the skeleton (e.g., genus *Acanthochaetetes*) (Figure 212).

microstructure. The arrangement of crystals that form the skeletal components, as seen without special preparations.

orthogonal microstructure. Microstructure in which the crystal fibers are in perpendicular and radial orientation relative to a central axis (Figure 213).

penicillate. See FASCICULAR.

pillar. Radial skeletal component, relatively short compared with COLUMN (Figure 210).

primary calcareous skeleton. Initially formed skeletal components (Figure 207).

primary spicule framework. Framework of spicules around which a cement is deposited (Figure 207).

pseudocalyx (pl. pseudocalices). One of a group of skeletal tubes—closely packed together, mostly hexagonal in shape and containing the live material—that resemble the calices or corallites of cnidarians (Figure 214).

rigid aspicular skeleton. Skeleton that originates from the direct secretion of aspicular elements made up of calcium carbonate; siliceous or calcareous spicules may be secondarily entrapped in the skeleton during the growth process (*sk* in Figure 208).

rigid spicular skeleton. A skeleton in which the main framework is first made up of fused or linked spicules that may later be invested by an aspicular cement (Figure 204).

sclerodermite. Aggregate of crystals forming a microstructural unit of the calcareous skeleton (Figure 215).

secondary calcareous skeleton. Skeletal components formed after the deposition of the primary calcareous skeleton (Figure 207).

spherulitic (= spheroidal) microstructure. Globular (centric or excentric) arrangement of crystal fibers radiating from a common center (e.g., genus *Astrosclera*) (Figure 215).

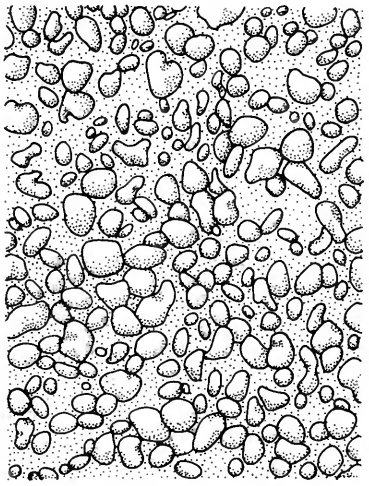
tabula. Plate or floor that partitions the basal part of a skeletal cavity (Figure 207; and *ta* in Figure 208).

tabulate osculum. Osculum in stromatoporoids that has been repeatedly partitioned by secondarily deposited tabulae.

trabecular. See FASCICULAR.

water jet. See FASCICULAR.

zygosis. Mode of interspicular junction without cement (see SPICULE TYPES OF "LITHISTIDS"; Figure 301).



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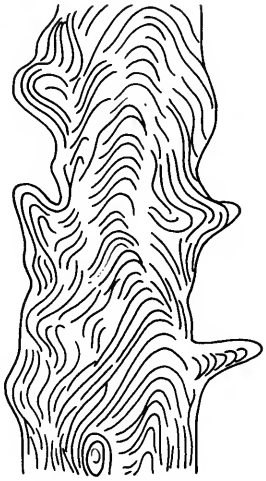

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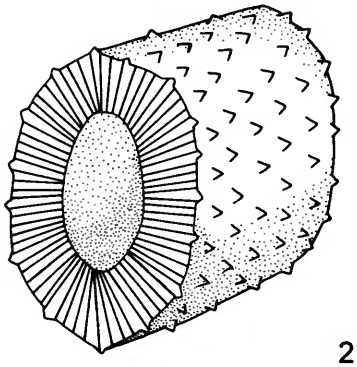

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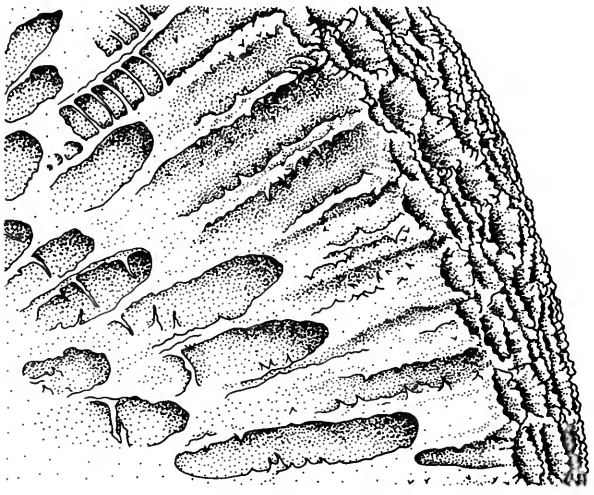

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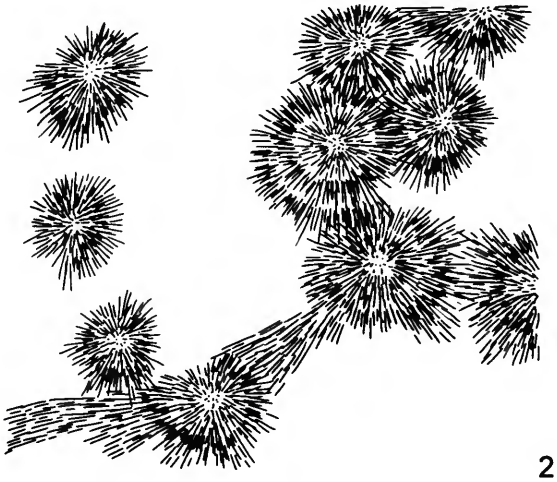


215

Spicules of Demospongiae

LITERATURE CONSULTED: Bergquist, 1978; Lundbeck, 1902, 1905, 1910; Ridley and Dendy, 1887; Sarà, 1959; Schulze and Lendenfeld, 1889; Sollas, 1888; Wiedenmayer, 1977, 1994.

acantho-. Prefix meaning spined, as in acanthostyle (Figure 216) or acanthomicrorhabd (Figure 268).

acerate. Pointed like a needle; adjective referring to the extremities of megascleres. See OXEA.

actine. A centered ray containing an axis or axial canal. See also CLAD.

ala. One of the thin, wing-like or spatulate structures in each recurved portion of a chela. The anterior ala is the one facing the shaft; others are lateral alae. See CHELA.

amphidisc. See BIROTULA.

amphiaster. A microsclere with microspined rays radiating from both ends of a shaft; the rays are shorter than the shaft (Figure 217).

amphitriaene. A double triaene with a short rhabd bearing two opposed cladomes (Figure 218).

anatriaene. A triaene in which the clads are sharply curved backward (Figure 219).

anchorate chela. An isochela with three or more free alae (at each end) in the form of recurved processes shaped like anchor claws (unguiferous, Figure 220) or anchor blades (spatuliferous, Figure 221); with two incipient lateral alae fused with the shaft over their entire length and a gently curved, not abruptly arched shaft. An anchorate chela with three teeth is called a tridendate chela.

angulate. Sharply bent; referring to overall spicule shape, as in oxea or sigmas. See OXEA.

aniso-. Prefix meaning unequal; generally referring to the ends of a spicule; see ANISOCHELA.

anisochela. A chela with unequal ends (Figure 222).

antho-. Prefix meaning thorny.

anthosigma. A special form of spiraster (genus *Anthosigmella*; = *Cliona*); to be rejected.

anthaster. An euaster with tuberculate, denticulate, or spined, sometimes digitate, expansions at the ray tips (*Chondrilla grandis*) (Figure 223).

arcuate chela. An isochela with three free alae and the shaft characteristically curved outward, often bow-shaped (Figure 224).

aspidaster. An elongate-compressed microsclere in which the numerous rays are fused and end in minute spinose projections (*Erylus* spp.) (Figure 225).

asymmetric. Adjective referring to the extremities of a megasclere. See OXEA.

axial filament. The organic core around which a siliceous spicule is organized.

bipocillum. A modified anisochela with fused alae connected by a short curved shaft (genus *Iophon*) (Figure 226).

birotula. A type of microsclere with a straight shaft and umbrella-shaped ends (Figure 227).

blunt. Adjective referring to the extremities of megascleres. See OXEA.

calthrop. Equiangular tetraxon with equal rays (Figure 228).

candelabrum. A special form of lophocalthrop characterized by branching, multispined rays (Figure 229).

canonochela. Modified, ellipsoid isochela with wing-like extensions on one (the "bottom") side (genus *Cercidochela*) (Figure 230).

centrotriaene. A triaene with three clads and two small rhabds (genus *Triptolemus*) (Figure 231).

centrotylote. Spicule with a median tyle (globular swelling). See OXEA.

chela. A microsclere with a curved shaft and recurved ala at each end (Figures 220–222, 224, 226, 235, 246, 261, 274, 284).

chiaster. See STRONGYLASTER.

chiastosigma. Microsclere composed of two crossed sigmas (genus *Chiastosia*) (Figure 232).

clad. Any ray or axial branch containing an axis or axial canal confluent with that of the protoclad or protorhabd in any type of spicule; term chiefly used in triaene spicules (Figures 219, 240, 242, 252, 254, 256, 262, 265).

cladome. The clads of a triaene or triaene-derivative spicule (Figures 219, 231, 240, 242, 252, 256, 262).

cladotylote. Monaxon megasclere, one end with knobs, the other with hooks (Figure 233).

clavidisc. A ring-shaped microsclere (genus *Merlia*) (Figure 234).

cleistochela. A chela with the ends (anterior alae) very close to each other (e.g., *Clathria echinata*) (Figure 235).

coelodischela. See DISCHELA.

comma. A curved microstyle (Figure 236).

conical (= abruptly pointed). Adjective referring to the extremities of megascleres. See OXEA.

cri-. Prefix indicating spiral or annulate ornamentation, as in cricalthrop (genus *Sphinctrella*) (Figure 237).

croca. A J-shaped microsclere (Figure 238).

curved. Referring to spicule shape (may be symmetrical or asymmetrical). See OXEA.

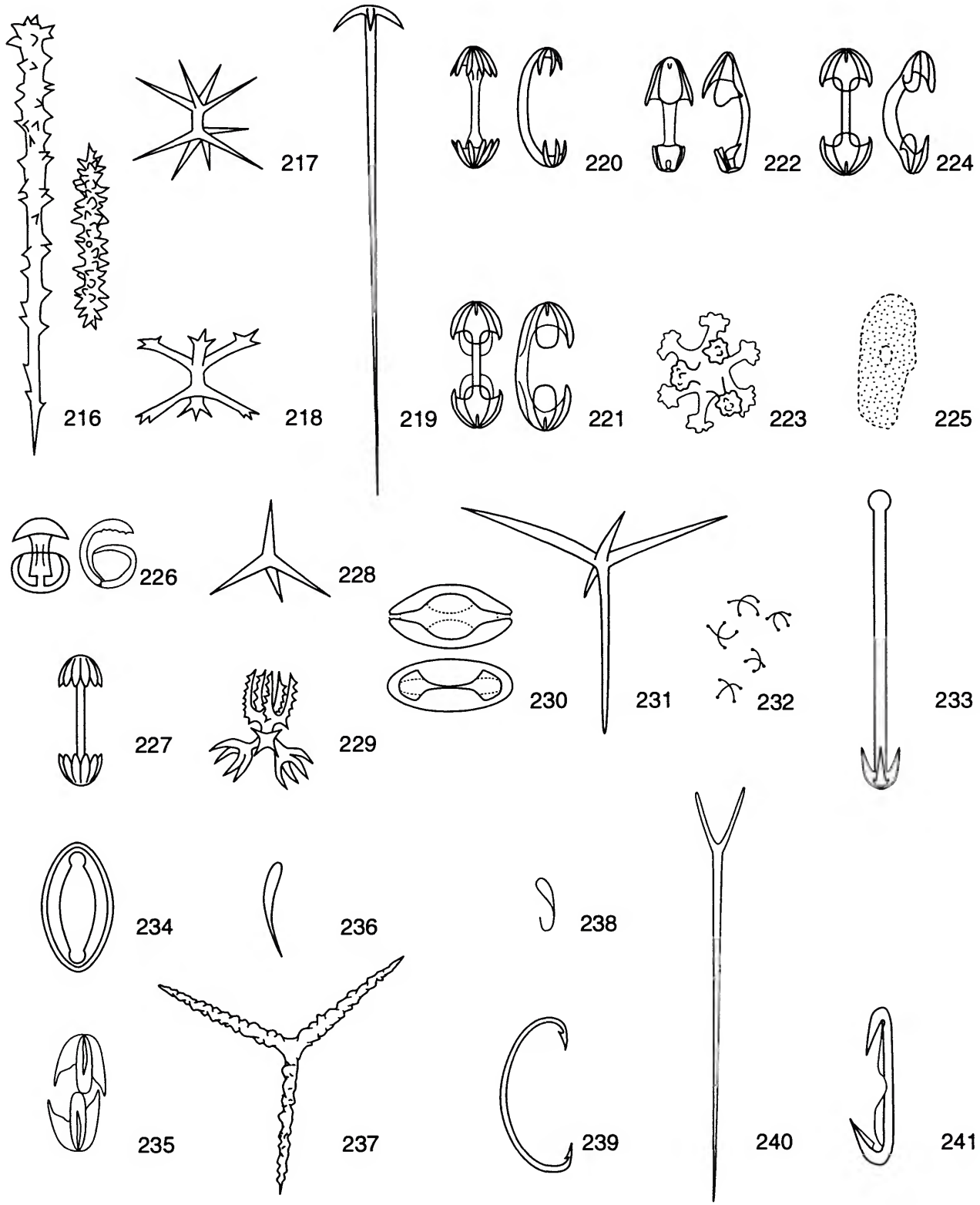
cyrtancistra. A sigma with semilanceolated extremities (genus *Pozziella*) (Figure 239).

desma. A typical interlocked megasclere of lithistids with hypertrophic terminal secretion of silica (see "Spicule Types of 'Lithistids'").

deuteroclad. An actinal branch or a distal, branched portion of a ray. See DICHOTRIAENE.

diaene. Reduced triaene with two clads (Figure 240).

diancistra. A microsclere with hooked, knife-shaped ends, notched where they join the shaft and in the middle of the shaft (genus *Hamacantha*) (Figure 241).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dichotriaene. An ortho or plagiotriaene in which the clads are bifurcate (Figure 242).

didiscorhabd. Microxea or microstrongyle ornamented by two discs along the shaft (genus *Didiscus*) (Figure 243).

diod. Any diactine spicule with a central double-bent kink (Figure 244).

diplaster. An astrose microsclere in which the rays or spines radiate from two, slightly distant, points (Figure 245).

disc. A monocrepid spicule resembling a DISCOTRIAENE (genus *Neopelta*); see "Spicule Types of 'Lithistids.'"

discaster. A collective term for DISCORHABD and SCEPTRUM; to be rejected.

dischela. A modified isochela whose disc-shaped alae are very close to each other and connected on their margins by two extremely reduced shafts (genus *Coelodischela*) (Figure 246).

discorhabd (= sceptrum). A rod-shaped microsclere with several smooth or serrated discs along the shaft (genera *Latrunculia, Podospongia, Sceptrinus*) (Figure 247).

discotriaene. A triaene with a disc-shaped cladome. The single clads may be distinguished by the presence of short axial canals (genus *Discodermia*) (Figure 248).

dragma. See TRICHODRAGMA.

equal. Adjective referring to the extremities of megascleres. See OXEA.

euaster. A collective term for astrose microscleres in which the rays radiate from a central point (Figures 223, 258, 275, 276, 279, 291).

exotyle. Styles or tylostyles with enlarged or ornated distal end, projecting from the sponge surface (Figure 249).

fimbria. Narrow structure, similar to an ala, flanking the shaft of an anchorate chela (Figure 221).

flexuous (= sinuous, wavy). Referring to the spicule shape. See OXEA.

forceps (= labis). A U-shaped microsclere (Figure 250).

fusiform. Shape of a monactin spicule, tapering regularly toward a point. See OXEA.

hastate. Spicule remaining isodiametric for most of its length, with the point or points tapering abruptly. See OXEA.

hilum. A more or less distinct, funnel-shaped depression in the surface of a STERRASTER, situated on one side in ellipsoidal forms; also occurs in ASPIDASTERS in reduced form, resembling an umbilicus (see Figures 225, 278 in "Spicules of Demospongiae").

iso-. Prefix meaning equal (generally referring to the ends of a spicule).

isochela. A chela with equal ends (Figures 220, 221, 224, 259, 261).

labis. See FORCEPS.

lopho-. Prefix for categories of spicules having one or more rays affected by multiple, sometimes complex, branching (lophate spicules); see LOPHOCALTHROP.

lophocalthrop. Modified calthrop with one (monoloph), three (triloph), or four (tetraloph) rays (Figure 251).

mesotriaene. A triaene in which the rhabd is extended beyond the cladome (Figure 252).

metaster. A microsclere with a twisted shaft no longer than the spines; intermediate between plesiaster and spiraster (Figure 253).

micro-. Prefix used for naming microscleres that are similar in shape to megascleres (e.g., microxea, microstyle).

microrhabd. A general term for a straight, monaxonic microsclere.

microsclere. Small spicule, often ornate in shape.

monaene. Reduced triaene with only one clad (Figure 254).

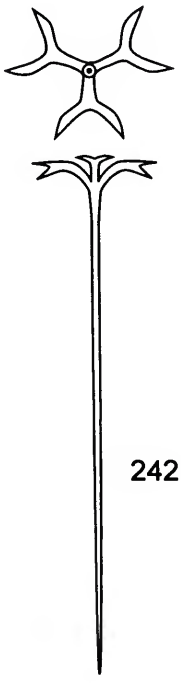
monaxon. Linear, nonradiate spicule, or a spicule type not having more than two rays along one axis.

mucronate. Adjective referring to the nipple-like point of a megasclere. See OXEA.

onychaete. A long, thin, finely spined, asymmetric microsclere (Figure 255).

orthotriaene. A triaene in which the clads are directed at right angles to the rhabd (Figure 256).

oxea. Monaxon (diactinal) spicule pointed at both ends (Figure 257*a–m*). Different types are distinguished by shape and tip morphology. Shape may be fusiform (a), angulate (b), centrotylote (c), curved (d), or flexuous (e). Tips may be acerate (f), asymmetrical (g), blunt (h), conical (i), hastate (j), mucronate (k), stepped (l), or symmetrical (m).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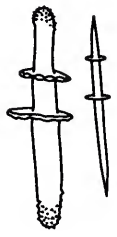
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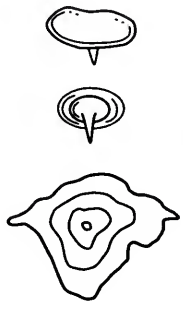
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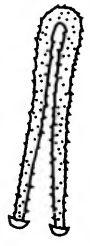
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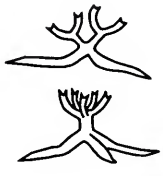
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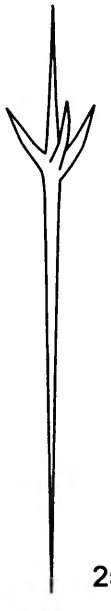
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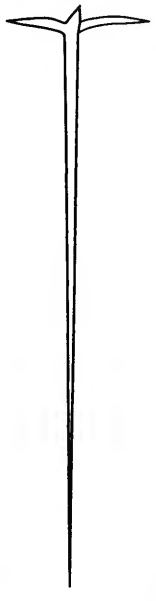
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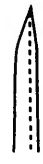
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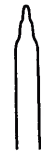
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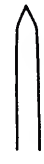
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oxy-. Prefix referring to radiate spicule types with rays gradually tapering to a point.

oxyaster. An euaster with acerate free rays and a small centrum less than one-third the diameter of the whole spicule) (Figure 258).

oxyspheraster. See SPHEROXYASTER.

palmate chela. An iso- or anisochela in which the lateral alae coalesce with the shaft over their entire length, and the single, median, anterior ala (one at each end) stands free and widens distally (Figure 259).

phyllotriaene. A triaene with a leaf-shaped cladome (Figure 260).

placochela. A special type of isochela with plate-like alae. The alae and the shaft are internally ornamented by radial ridges (genus *Guitarra*) (Figure 261).

plagiotriaene. A triaene in which the clads are directed forward and form with the rhabd an angle of about 45°, and may be recurved distally (Figure 262).

plesiaster. A streptaster with a very short shaft (always shorter than the spines) (Figure 263).

polytylote. Megasclere with several annular swelling along its shaft (Figure 264).

protoclad. The proximal, unbranched portion of a branched ray. See DICHOTRIAENE).

protorhabd. The original simple shaft of ornamented monaxons and of triaenes.

protriaene. A triaene in which the clads are directed or sharply curved forward, away from the rhabd (Figure 265).

pycnaster. A small euaster in which the rays are merely low conules; to be rejected.

raphide. A very thin, hair-like microsclere, often in bundles called trichodragmas (Figure 266).

ray. See ACTINE.

rhabd. A collective term for a monaxonic megasclere, later applied to the one ray of a triaene that is distinct from the other three, mostly in length (= rhabdome).

rhabdome. The rhabd of a triaene and of a triaene-derived spicule.

rhabdostyle. A style with a pronounced basal bend (Figure 267).

sanidaster. A rhabd-derived, straight microsclere having spines at intervals along the entire length. Spines along the shaft are perpendicular to the axis and may or may not be spirally arranged; those at the ends diverge obliquely (e.g., genera *Tribrachium, Disyringa*) (Figure 268).

scale. Disc-shaped microsclere forming ectosomal ("dermal") armor (genus *Lepidosphera*) (Figure 269).

sceptrum. See DISCORHABD.

selenaster. A special type of spiraster approaching the shape of a sterraster (genus *Placospongia*) (Figure 270).

sigma. A microsclere of C or S shape (Figure 271).

sigmancistra. A slightly modified sigma found in *Cladorhiza* (Figure 272).

sigmaspire. A contorted-sigmoid microspined microsclere (family Tetillidae) (Figure 273).

sinuous. See FLEXUOUS.

spatuliferous-anchorate chela (= ancora spatulifera). An anchorate chela (usually isochela) having alae that are completely free from the shaft and that are spatulate or shaped like anchor teeth (Figure 221).

sphaerancora. Modified isochela, consisting of two ellipsoid ridged plates intersecting at right angles (genus *Melonanchora*) (Figure 274).

spheraster. An euaster with short rays and a thick centrum; the diameter of the centrum (more than one-half the total diameter) exceeds the length of the rays (Figure 275).

spheroxyaster. Euaster with a discrete centrum that is more than one-third the total diameter (Figure 276).

spinispira. See SPIRASTER.

spiraster (= spinispira). Spiral, rod-shaped microsclere with spines peripherally arranged (Figures 277).

stepped (= "telescoped"). Adjective referring to the extremities of a megasclere. See OXEA.

sterraster. A spherical or ellipsoidal microsclere in which the numerous rays are fused and end in stellate terminations (e.g., genus *Geodia*; Figure 278).

sterrospheraster. Ball-shaped euaster with numerous conical or flattened, often denticulate or tuberculate protuberances; to be rejected. See STERRASTER.

streptaster. Aster in which the rays proceed from an axis that is usually spiral (Figure 263).

strongylaster (= chiaster). Aster with free, isodiametric, blunt rays (Figure 279).

strongyle. An isodiametric, diactinal megasclere with rounded ends (Figure 280).

strongyloxea. A fusiform oxea with one end blunt (Figure 281).

style. Monaxon spicule with one end pointed, the other (head or base) blunt (Figure 282).

subtylostyle. Tylostyle with one end pointed, the other with a slight swelling or knob; the swelling, more or less distinct, may be displaced along the shaft (Figure 283).

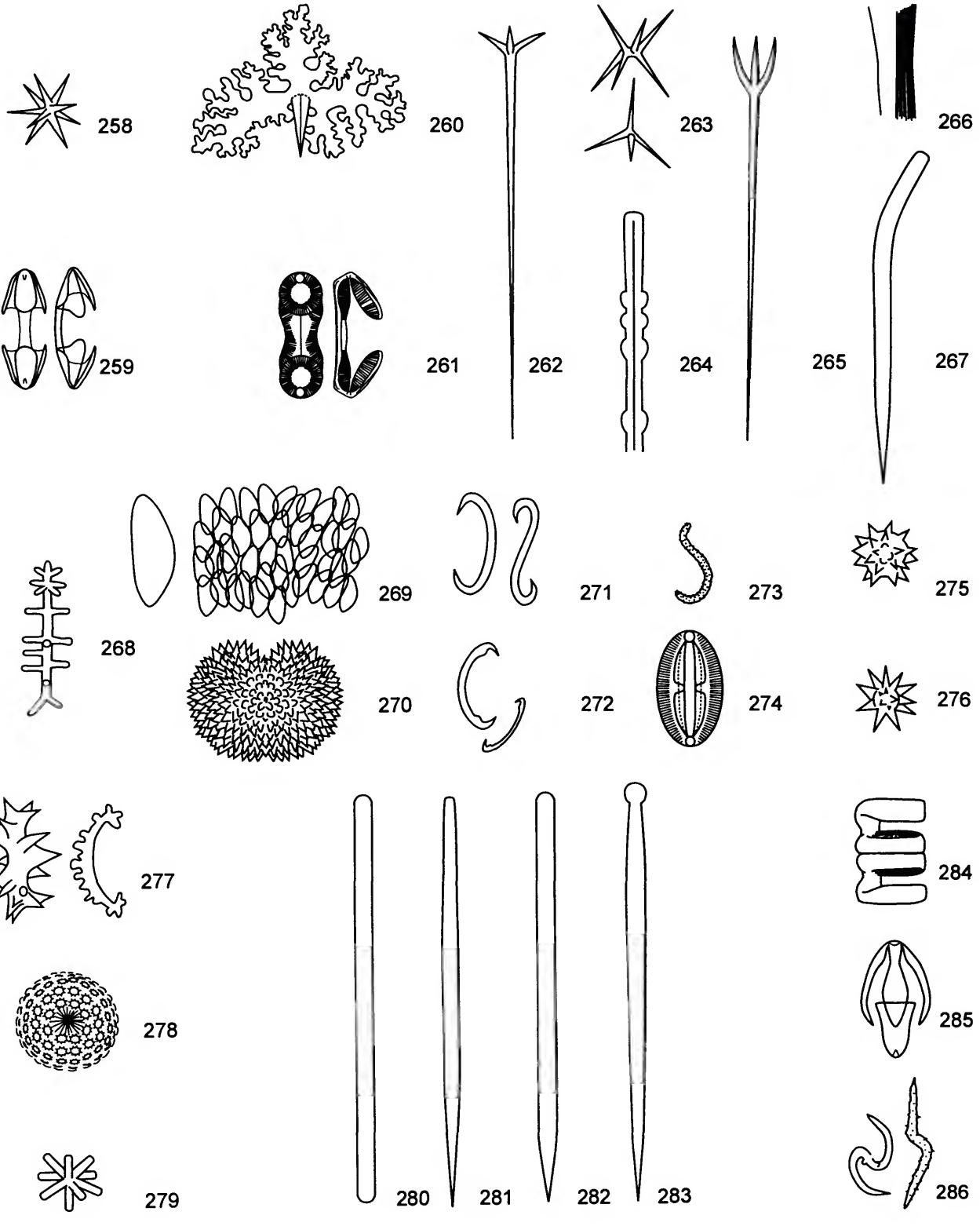
symmetrica. Adjective referring to the extremities of megascleres. See OXEA.

telescoped. See STEPPED.

tetrapocillum. A rare, modified isochela having two small disks both at the extremities and in the middle of a straight shaft; the two in the middle are fused (genus *Tetrapocillon*) (Figure 284).

thaumatochela. A rare, minute anisochela with the smaller extremity jar- or slipper-shaped and partly enveloped by four alae issuing from the opposite end and forming an umbrella-like structure (*Mycale thaumatochela*) (Figure 285).

thraustoxa. Toxa-like, smooth to spinose microsclere, double-bent in the middle and often with central swelling (genus *Rhabderemia*) (Figure 286).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tornote. A straight, isodiametric, diactinal megasclere with conical or mucronate extremities (Figure 287).

toxa. Bow-shaped microsclere (Figure 288).

triaene. General term for a tetractinal megasclere having one unequal ray (termed rhabd) that is commonly much longer than the other three (termed clads, forming the cladome) (Figures 218, 219, 240, 242, 248, 252, 254, 256, 260, 262, 265).

trichodragma (pl. trichodragmas or trichodragmata). A bundle of raphids (Figure 266).

trichotriaene. A triaene in which the clads are trifurcate.

tridentate chela. A chela with three free alae. See also ANCHORATE CHELA.

triod. Triact in which the rays are equal, straight, in one plane, and diverging at an angle of 120° (Figure 289).

tripod. A modified triod with rays forming a regular pyramid (Figure 290).

truncaster. Aster with crowded, blunt rays (genus *Rhabdastrella*) (Figure 291).

tuberculate. Spicule ornamented with blunt knobs.

tylaster. Aster with free, microtylote rays (Figure 292).

tyle. Any rounded swelling or knob in a spicule (*c* in Figure 257; see also Figures 292–294).

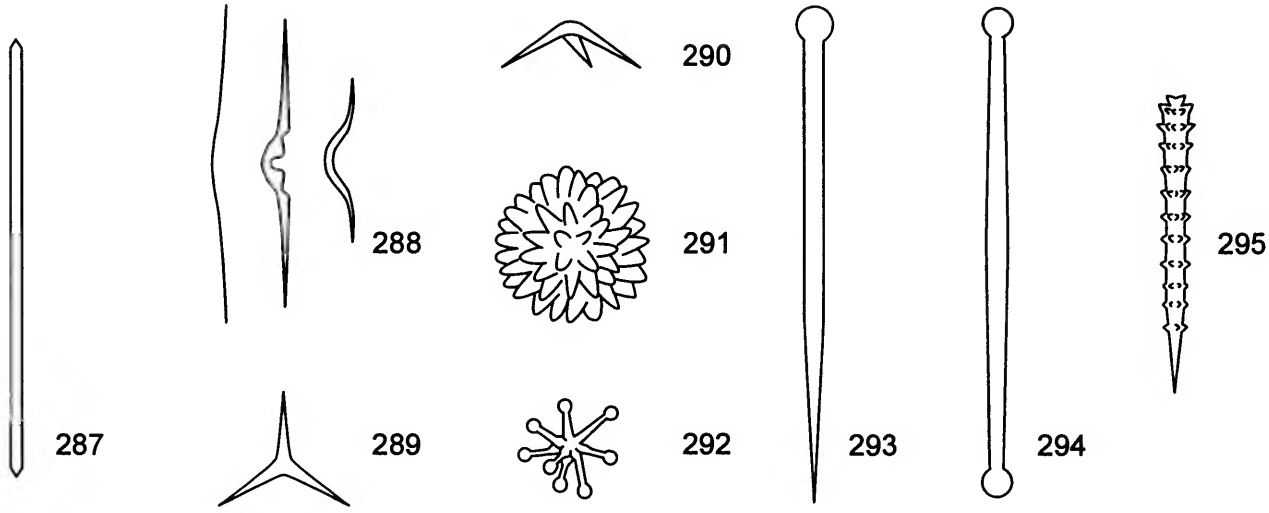
tylostyle. A style with a tyle (globular swelling) at the base (Figure 293).

tylote. Diactinal megasclere with a swelling on each end (Figure 294).

unequal. Adjective referring to the extremities of megascleres. See also ANISO-.

unguiferous-anchorate chela (= ancora unguifera). An anchorate chela in which the recurved processes are in the form of claws or sickles and are normally connected to the shaft by expansions called falces (Figure 220).

verticillate. Spicule ornamented by whirls (e.g., genus *Agelas*) (Figure 295).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Spicule Types of "Lithistids"

LITERATURE CONSULTED: Lévi, 1991; Reid, 1970; Rigby and Stearn,1983; Sollas, 1888.

acrepis. See CREPIS.

amphitrider. Tetraclone resembling an amphitriaene.

anaxial desma. Desma without central axis.

anomoclone. To be rejected. See ASTROCLONE, SPHAEROCLONE.

astroclone. Desma made up of radiating arms (Figure 296).

brachyome. Shortened arm of a trider.

chiastoclone. Dendroclone with a very short central shaft.

clone. Ray-like arm that is entirely anaxial.

crepis. The fundamental, inceptional body of a desma before it is modified by deposition of multiple layers of silica. A monocrepid desma develops from a monaxon spicule that is recognized by a straight, undivided axial thread (canal) (see top of Figure 297); a tetracrepid desma is based on a tetraxon spicule with a four-rayed axial thread (a small calthrops; see bottom of Figure 297, also "Spicule Types of Demospongiae"); an acrepid desma is based on a polyaxon fundamental structure lacking axial threads.

dendroclone. Desma with branched ends or tetracladine, amphitrider-like; always positioned perpendicular to skeletal fibers (Figure 298).

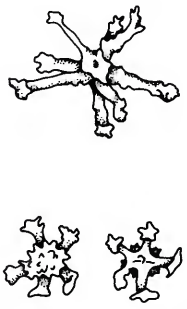
desma (= desmome). A typical interlocked megasclere with hypertrophic terminal secretion of silica.

desmome. See DESMA.

dicranoclone. Tuberculate monaxial desma, arch shaped, tripodal, tetrapodal, or rarely polygonal; zygomes are terminal, like those of the tetraclone (Figure 299).

epirhabd. Part of the developed desma formed by the deposition of concentric layers immediately around the crepis.

heloclone. Desma with elongate and usually sinuous shaft, without branches, possibly with small digitations at the ends; the zygomes are lateral notches. An axial canal is usually found along most of the length of the spicule (Figure 300).



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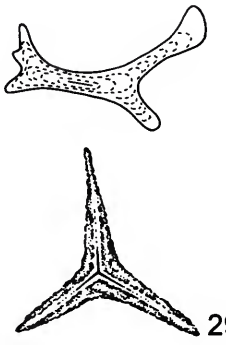

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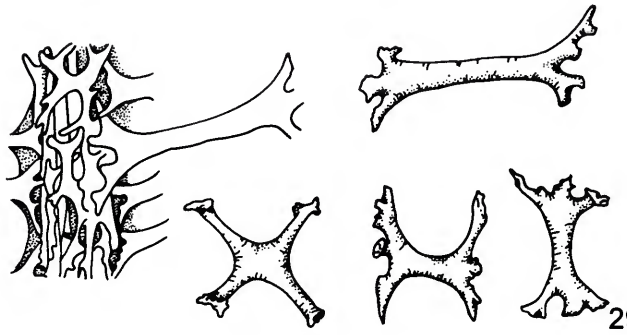

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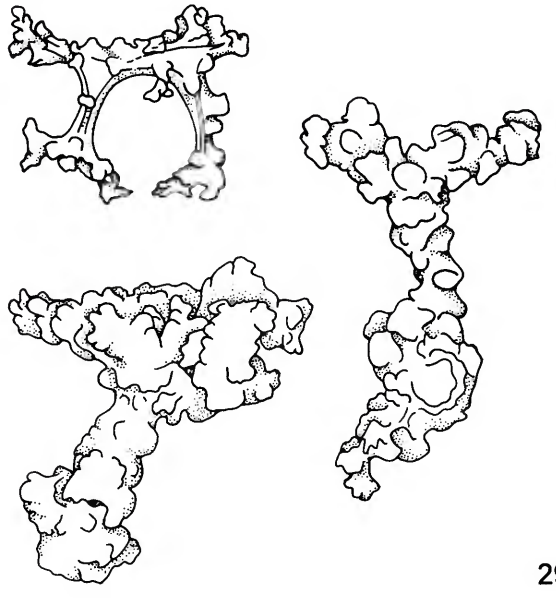

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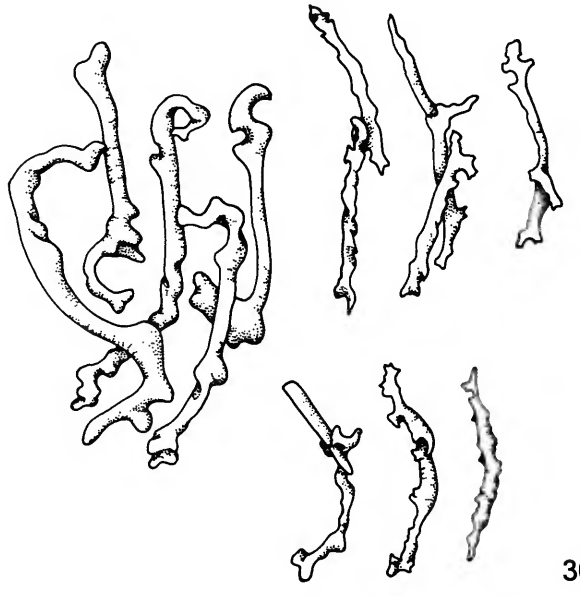

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linked spicules. Spicules that are interlocked by zygosis, without cement (Figure 301).

megaclone. Arch-shaped desma with a short crepis. The zygomes vary from oblique lateral facets to tongue- or hand-like terminal expansions (Figure 302).

megarhizoclone. Nontuberculate dicranoclone desma (Figure 303).

mesotrider. Tetraclone with a mesotriaene (see "Spicules of Demospongiae") crepis.

monocrepid. See CREPIS.

rhizoclone. Nontuberculate irregular monaxial desma, with spiny to root-like zygomes that are usually mainly lateral (Figure 304).

sphaeroclone. Anaxial desma in which several ray-like arms extend from one side of a globular centrum that is spiny on the other side (Figure 305).

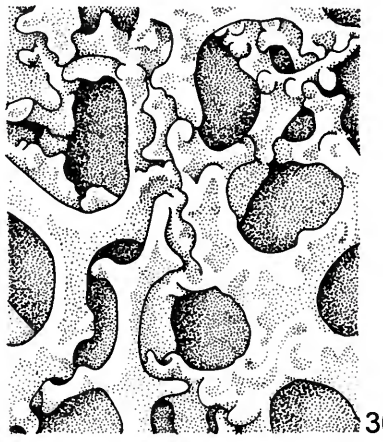
tetraclone. Tetraxial desma that does not show a triaenose symmetry; the zygomes are typically terminal (Figure 306).

tetracrepid. See CREPIS.

trider. Variant of tetraclone, with triaenose symmetry and three similar arms.

zygome. Part of a desma that interlocks with another spicule.

zygosis. Mode of junction between siliceous and calcareous tetraradiates characterized by the interlocking of their terminal or lateral expansions; cement, if present, is secondary (Figure 301).



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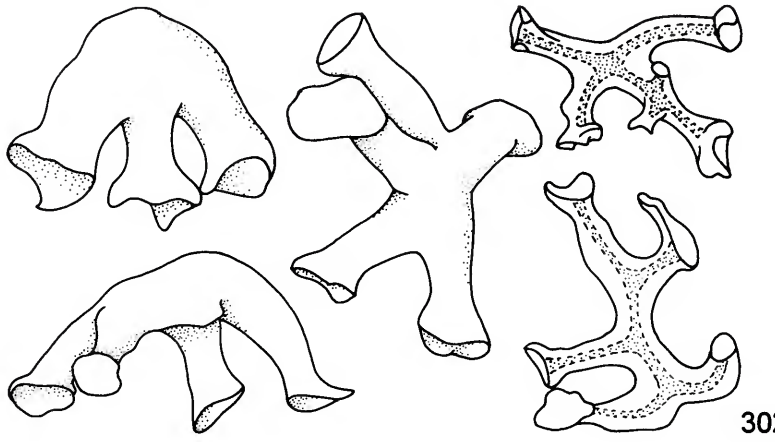

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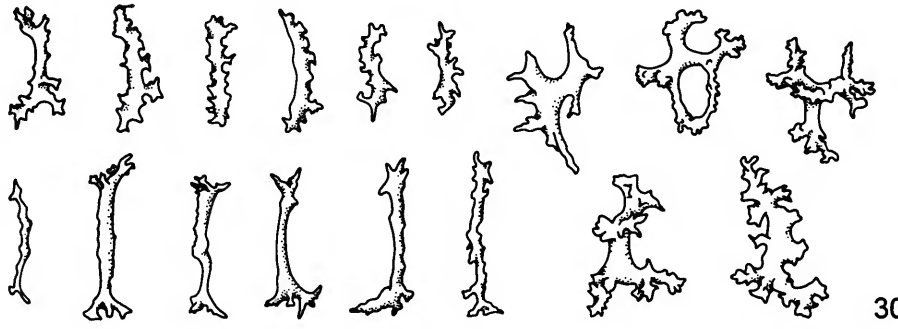

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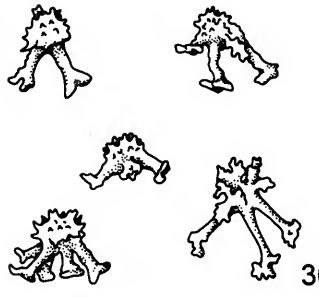

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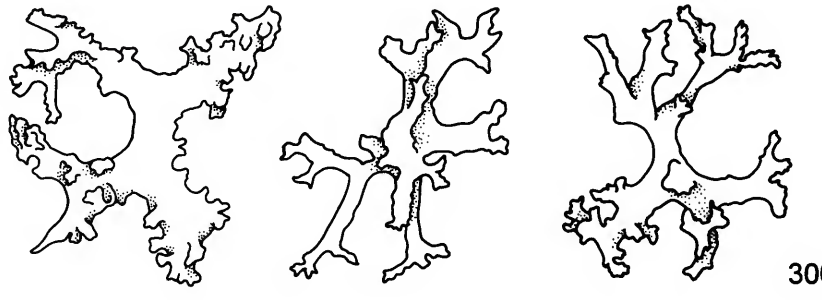

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