

SCAMIT Meeting

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Workshop topic: Ascidiacea

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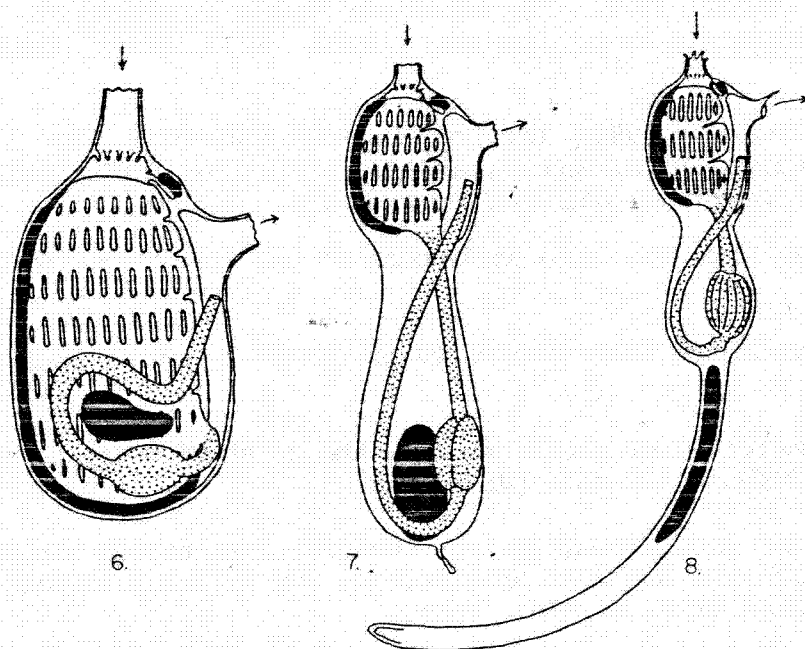


PLATE 149. Ascidiacea (3). Diagrams showing common variations in body form and arrangement of gut and gonads: gut stippled; brain, endostyle, and gonads solid black. 6, intestinal loop lying beside and at left of the pharynx, body not divided into regions (holosomatous), gonads on one or both sides, attached to gut or to mantle. This condition is common in simple ascidiaceans and is found in numerous colonial species. 7, 8, zooids of colonial ascidiaceans showing the subdivision into more or less distinct regions (merosomatous): 7, a generalized polycitorid zooid (e.g., *Clavelina*, *Archidistoma*) showing division of body into two regions, thorax and abdomen; 8, a generalized synoicid zooid (e.g., *Aplidium*, *Synoicum*) showing division of body into three regions, thorax, abdomen, and postabdomen.

From: Abbott, D.P. 1975

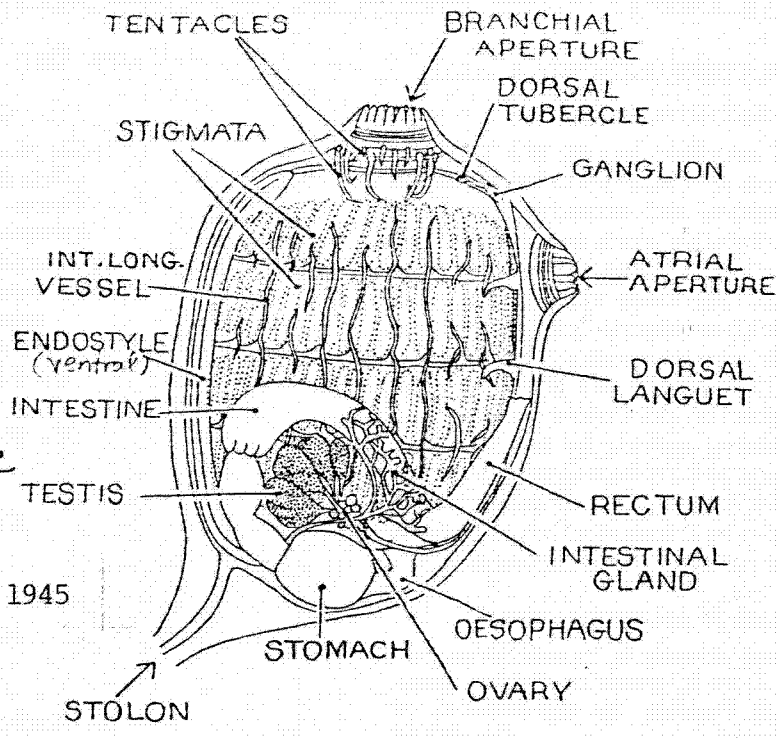
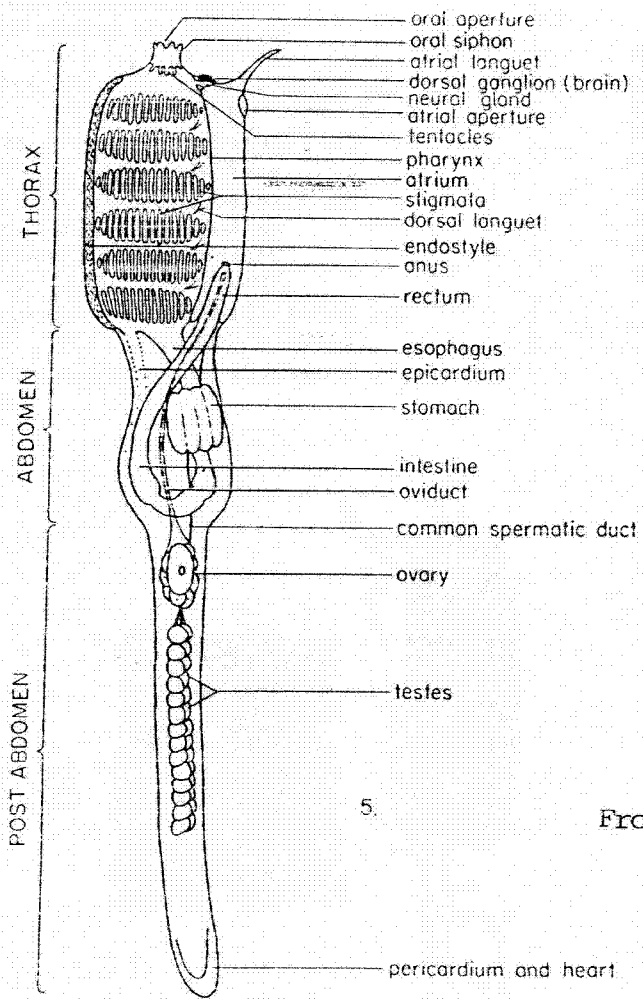


FIG. 1. An ascidian (*Pero-phora*) showing many of the principal internal structures used in the classification and descriptions.

View of left side

From: Van Name, W.G. 1945



5.

From: Abbott, D.P. 1975

PLATE 148. Ascidiacea (2). 5, diagram of generalized compound ascidian zoid with a postabdomen.

ORDER APLOUSOBRANCHIA LAMILLE

(=Krikobranchia Seeliger)

Compound ascidians having the body divided into two or three parts or segments (thorax, abdomen, and sometimes post-abdomen), the digestive tract, reproductive organs, and heart being situated in the posterior part or parts. Tentacles simple, branchial sac without folds or internal longitudinal vessels. Dorsal lamina represented by languets arising usually a little to the left of the median dorsal vessel on the transverse vessels.

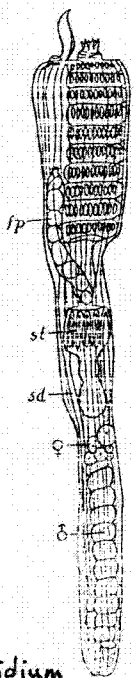
Though judging entirely by the adult zooids, this seems to be a homogeneous group; important differences in the budding in the families composing it indicate that the resemblances are in part due to convergence.

FAMILIES OF APLOUSOBRANCHIA

- A. Body of zooid elongate, in three divisions, gonads and heart in posterior division (post-abdomen). Budding by segmentation of post-abdomen Synoicidae
- B. Body of zooids in two divisions, alimentary loop, gonads, and heart, all in posterior division.
 - C₁. Colony incrusting, minute stellate spicules usually present in test, zooids very small; never more than three or four rows of stigmata; budding of pyloric type (see p. 79). Didemnidae
 - C₂. Colony lobed or massive, zooids when large often more or less independent. No stellate spicules (disk-like spicules in one genus). Budding by segmentation of body or from stolons Polycitoridae

GENERA OF SYNOICIDAE

- A₁. Adult zooids elongate, post-abdomen in more or less direct continuation of thorax and abdomen. Zooids probably always arranged in systems.
- B₁. Stomach wall usually with well-marked longitudinal plications sometimes irregular or obsolete in part of the stomach.
 - C₁. Post-abdomen rather short, the testes in irregular group. *Aplidium*
 - C₂. Post-abdomen (in adults) elongate, usually with serially arranged testes.
 - D₁. ~~Atrial aperture not produced, usually well forward with a small, sometimes three-cleft languet *Amaroucium*~~
 - D₂. Both apertures six-lobed on forwardly directed tubes *Sigillinaria*
- B₂. Stomach wall with rounded areolations (not in longitudinal rows) which are often obsolete so that the wall is smooth. Atrial aperture usually slightly produced, its anterior lip often three-parted *Synoicum*
- A₂. Post-abdomen sac-like, connected with abdomen by a slender neck.
 - B₁. Post-abdomen elongate; transverse vessels of sac smooth *Aplidiopsis*
 - B₂. Post-abdomen ovate, sac-like; branchial sac large with minute papillae on its transverse vessels (unique in this order). Atrial languet large. *Polyclinium*
- A₃. Zooids cylindrical, independent, connected by basal stolons *Euherdmania*
- A₄. Imperfectly known abyssal genus (see p. 75) *Pharyngodictyon*



Aplidium
FIG. 12. *Amaroucium californicum* n. Ritter and

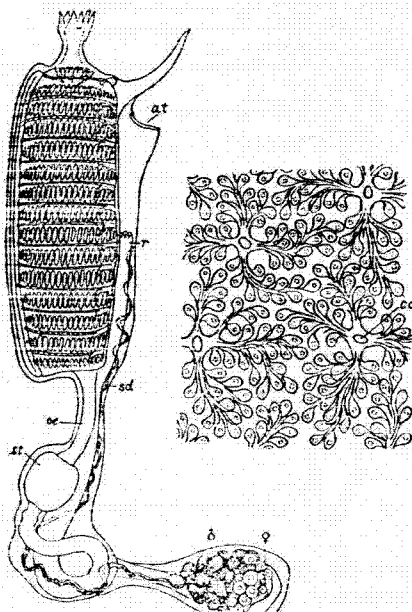


FIG. 28. *Polyclinium constellatum* Savigny. Zooid, X30, and part of surface of colony showing branchial and common cloacal apertures, X46.

GENERA OF POLYCITORIDAE

GENERA OF DIDEMNIDAE

- A₁. Proximal part of sperm duct spirally coiled. Thoracic muscles usually strong.
 - B₁. Four rows of stigmata. Stellate spicules usually abundant, rarely absent.
 - C₁. Atrial aperture not produced, sometimes with a small languet; testis single or in two (rarely three) divisions *Didemnum*
 - C₂. Atrial aperture with languet. Testis usually in five or more divisions . . . Subgenus *Polysyncrator*
 - C₃. Atrial aperture produced into a short funnel-like tube often directed somewhat posteriorly. Testis divided *Lepidoclinides*
 - C₄. Imperfectly known abyssal genus *Coelocormus*
 - B₂. Three rows of stigmata. No atrial languet. Testis single. Stellate spicules present or absent *Trididemnum*
- A₂. Proximal part of sperm duct not coiled. Thoracic muscles usually weak. Always four rows of stigmata.
 - B₁. No spicules. Common cloacal cavities usually very extensive. Testis of two rounded divisions. No atrial languet *Diplosoma*
 - B₂. Spicules present. Testis more or less cleft or divided.
 - C₁. Spicules tetrahedral (four-pointed). Testis partially cleft. *Echinoclinum*
 - C₂. Spicules stellate. Testis of two or more glands. Small atrial languet present *Lissoclinum*

- A₁. Colony massive or lobed, zooids usually completely embedded or nearly so. No incubatory pouch (larvae develop in the atrial cavity).
 - B₁. Disk-shaped spicules in test (sometimes poorly developed or replaced by calcareous deposits). Four rows of stigmata *Cystodites*
 - B₂. No spicules.
 - C₁. Three rows of stigmata.
 - D₁. Zooids embedded . . . *Eudistoma*
 - D₂. Posterior part only embedded *Archidistoma*
 - C₂. Four or more rows of stigmata *Polycitor*
- A₂. Zooids large, numerous rows of stigmata, thorax and abdomen connected by a long neck. Zooids embedded or partially or wholly independent and connected only by stolons from which the buds form. No incubatory pouch *Clavelina*
- A₃. Colony variously shaped; four rows of stigmata. Embryos develop into larvae in an incubatory pouch joined to the parent by a slender neck.
 - B₁. A slender parastigmatic vessel crosses each row of stigmata at their middle. Several larvae in brood pouch *Distaplia*
 - B₂. Colony very long, band shaped, later breaks away and becomes pelagic. Said to have but one embryo in brood pouch *Holozoa*
 - B₃. No parastigmatic vessels, brood pouch with numerous larvae. Colony capitate, sometimes branched. Sexes in separate colonies *Sycozoa*

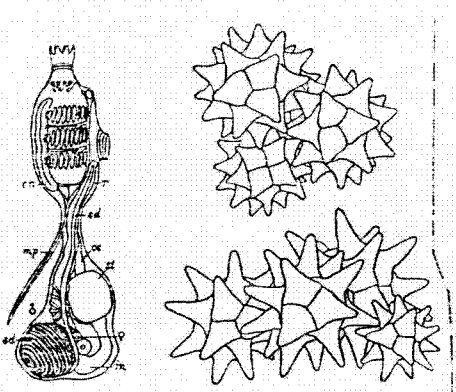


FIG. 40. *Trididemnum solidum* (Van Name). Zooid, X60. Upper, spicules of type colony from Bermuda, X460. Lower, spicules of a colony from Puerto Rico, X460.

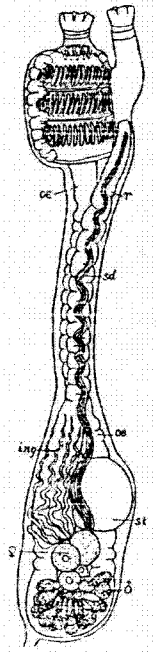


FIG. 56. *Eudistoma alutaceum* (Van Name). Zooid, X32. **Archidistoma**

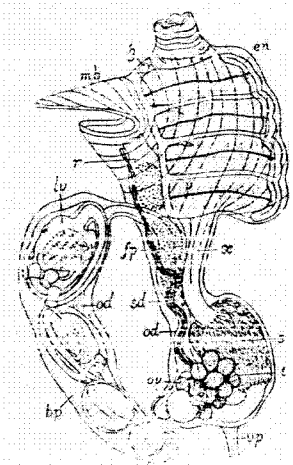


FIG. 69. *Distaplia clivata* (Sars). Zooid, 3 with incubatory pouch.

ORDER PHLEBOBRANCHIA LAHILLE

(= Diktyobranchia Seeliger)

A large group containing both compound and simple ascidians, distinguished chiefly by the character of the branchial sac, which is flat, without large pleats or folds, though minute undulations may occur. A system of slender, tubular, internal longitudinal vessels (usually numerous and equally spaced) raised on supporting papillae is normally present on the inner surface of the sac, though in a few genera it has become rudimentary or lost. Branchial tentacles always simple; stigmata either straight or spiral in arrangement; gonads present on one side of the body only, usually situated in, or in close relation to, the intestinal loop. Test usually more or less gelatinous and translucent, though often tough.

FAMILIES OF PHLEBOBRANCHIA

- A₁. Body in two divisions (thorax and abdomen) as in most compound ascidians; well-developed internal longitudinal vessels in branchial sac. Compound ascidians with large, partly embedded, or independent zooids Diazonidae
- A₂. Body sac-like, undivided.
 - B₁. Simple ascidians often of considerable size.
 - C₁. Body somewhat elongate; alimentary and reproductive organs extending more or less behind the branchial sac. Mantle muscles in a few broad, conspicuous, longitudinal bands Clonidae
 - C₂. Alimentary and reproductive organs wholly on left side of body; intestine bending dorsally beyond the stomach, forming an S-shaped curve anterior or dorsal to the stomach. Mantle muscles chiefly of narrow bands or fibers often forming a network.
 - D₁. Stigmata straight in parallel rows, internal longitudinal vessels of branchial sac well developed and usually bearing papillae Ascidiidae
 - D₂. Stigmata in spirals. Internal longitudinal vessels wanting or rudimentary Agnesiidae
 - B₂. Alimentary and reproductive organs on the ventral and more or less on right side of body due to intestine bending ventrally beyond the stomach, passing back ventral to the latter. (For the characters of its genera, see p. 203) Rhodosomatidae
 - C₄. Imperfectly known abyssal family Hypobythiidae
- B₂. Compound ascidians with zooids resembling small Ascidiidae in most of their characters; zooids usually independent, budding from a vine-like stolon (in one species sometimes confluent) Perophoridae

GENERA OF RHODOSOMATIDAE

- A. Body elongate, both apertures in an oblique cleft near the anterior end capable of being closed by a movable cover. Branchial sac with straight stigmata and internal-longitudinal vessels *Rhodosoma*
- B. Apertures both near together on an ovate, disk-like, distinctly bounded area which in all but one species (*inaequale*) is protected by definitely arranged thin horny plates. Stigmata curved or in small spirals. *Chelyosoma*
- C. Body sac-like, without protective structures, sometimes with a short pedicel for attachment; test transparent, stigmata in small, often very perfect spirals regularly arranged.
 - D₁. Internal longitudinal vessels numerous and well developed. *Corella*
 - D₂. Imperfectly known abyssal genera related to *Corella* (see pp. 215, 217).
. *Corynascidia* and *Benthascidia*
 - D₃. Arctic genera related to *Corella*, internal longitudinal vessels incomplete (see p. 214)
. *Corelloides* and *Corellopsis*

GENERA OF PEROPHORIDAE

- A₁. Zooids small, ovate, not over three to five rows of stigmata *Perophora*
- A₂. Zooids oblong or clavate, up to 200 mm. or more long and with 15 to 30 rows of stigmata when adult *Ecteinascidia*

ORDER STOLIDOBRANCHIA LAHILLE

(= Ptychobranchia Seeliger)

The most highly specialized order of ascidians. It contains both compound and simple forms. The body is never divided into a thorax and abdomen; the digestive tract and reproductive organs always lie beside, or project only slightly behind, the branchial sac, which has internal longitudinal vessels and a few large longitudinal folds or plications (rudimentary or lost in a few forms). The tentacles are sometimes branched, a character not found in other orders, and the neural gland is dorsal to the ganglion instead of ventral to the latter as usual in most ascidians.

The internal longitudinal vessels are more numerous and closely placed on the folds or plications of the branchial sac than on the flat parts. These vessels, which are often of flattened cross section, may be raised on low papillae, but never bear papillae themselves. The gonads are commonly attached to the inner surface of the mantle, not to the digestive tract.

When budding occurs it is of the so-called "palleal type," the buds or stolons producing them being outgrowths of the lateral part of the body.

FAMILIES OF STOLIDOBRANCHIA

A₁. Simple ascidians, often large; body sac-like, larger tentacles branched; branchial sac with internal longitudinal vessels and a small number of large, curved, pleat-like folds (reduced or obsolete in some cases). Alimentary tract on left side of body.

B₁. Body sessile or sometimes borne on a stalk or pedicel. Test tough, wrinkled, opaque and often minutely (sometimes coarsely) spinous; both apertures commonly conspicuously square or four-lobed. Color often red or reddish during

life, especially about the apertures. Branchial sac usually with more than four large folds on each side, stigmata usually straight (spiral in a few cases); stomach elongate, tapering into the intestine, and bearing a hepatic organ of small tubes. Gonads few (usually but one on each side), elongate, hermaphroditic, the left commonly in, or partly in, the intestinal loop. No renal sac

Pyuridae

B₂. Body usually sessile; often unattached and living buried in sand or mud. Test often covered with hair-like processes, and with much adherent sand or mud. Branchial aperture commonly with about six lobes, atrial with four lobes or square. Branchial sac with five to seven folds on each side; in some genera these are obsolete and indicated only by a small group of internal longitudinal vessels or a single large one. Stigmata mostly in large spirals, sometimes very perfectly formed and raised into inwardly projecting conical infundibula. Dorsal lamina continuous, often with a dentate margin. Stomach elongate, a part of its wall modified into a glandular organ. Usually one large hermaphroditic gonad on each side. A large closed renal sac on the right side of the body

Molgulidae

A₂. Simple or compound ascidians; tentacles always simple; dorsal lamina always a continuous membrane; branchial folds usually but four (rarely a rudimentary fifth one) on each side; there may be less than four, some or all being obsolete. The simple species often resemble Pyuridae in their thick, tough, wrinkled test, often reddish about the apertures, which are commonly both four-lobed. Stigmata always straight; stomach rather short, rounded or ovate, often with a longitudinally plicated wall and a small caecum, but no hepatic gland. Gonads vary in number from one to many; usually hermaphroditic (sometimes of one sex in the small compound species), attached to the inner surface of the body wall. No renal sac

Styelidae

A₃. Compound ascidians closely related to the Styelidae; test gelatinous, zooids small and arranged in the common test in systems discharging by common cloacal cavities and apertures. Branchial sac with no folds and only three internal longitudinal vessels on each side. Male and female gonads separate

Botryllidae

GENERA OF MOLGULIDAE

- Branchial sac with folds (usually six or seven on each side), each bearing several or many internal longitudinal vessels.
- B₁. Stigmata more or less curved or spiral in their arrangement, especially on the summits of the folds, which are formed by or bear a row of conical infundibula.
 - C₁. Gonads one on each side, the left gonad dorsal or anterior to the primary intestinal loop (in the secondary loop) typical species of *Molgula*
 - C₂. Gonads one on each side, the left gonad in the primary intestinal loop . . . Subgenus *Molguloides*
 - C₃. Gonads one on each side but the male and female parts of each gonad separated Subgenus *Meristocarpus*
 - C₄. Similar to *Molgula*, stigmata said not to form spirals even on the folds *Ascopera*
- B₂. Stigmata in connected double spirals on infundibula on the folds and also on the flat parts of the sac. A pair of adhesive secreting glands near the endostyle. No right gonad *Rhizomolgula*
- Branchial sac without folds but with one wide internal longitudinal vessel of flat cross section in the place of each fold.
- B₁. Body axis much curved (very convex ventrally), stigmata short, mostly curved, forming small, irregularly distributed infundibula. A gonad on each side; left gonad in the secondary intestinal loop *Paramulgula*
- B₂. Stigmata spiral, on large infundibula bridged over by the internal longitudinal vessels, additional (accessory) infundibula present in some species.
 - C₁. Spirals formed by the stigmata interrupted at intervals, accessory infundibula present; gonads present on both sides. *Pareugyrioides*
 - C₂. Stigmata in connected chains of very perfect double spirals usually interrupted only at the summits of the infundibula or centers of the spirals *Eugyra*
 - C₃. Arrangement of stigmata similar to *Eugyra* in young individuals, but the infundibula become greatly multiplied and irregularly distributed in old individuals *Bostrichobranchus*
- Imperfectly known abyssal genera (see pp. 428, 442) . . . *Anomopera* and *Hexacrobylus*

GENERA OF BOTRYLLIDAE

- varies one or several on each side; anterior or dorsal to the testes; no incubatory pouch, the embryos developing in the peribranchial cavity. *Botryllus*
- varies one on each side, situated posterior to the testes. The egg develops in a sac-like incubatory pouch; formed as an outgrowth of the body wall *Botrylloides*

GENERA OF STYELIDAE

- A₁. Simple ascidians.
 - B₁. Gonads on both sides of the body.
 - C₁. Gonads few, sometimes only one on each side; the ovary is somewhat elongate flask-shaped or tubular, sometimes branched, attached to the inner side of the body wall; the numerous small testes attached to the body wall near to (alongside or around the end of) the ovary but separately from it.
 - D₁. Branchial folds well developed. *Styela*
 - D₂. No branchial folds. Each gonad elongate U-shaped. . . *Pelonaia*
 - C₂. The ovary and testes of each gonad form a compact body often enclosed in a membranous capsule or tube.
 - D₁. Gonads thus formed few in number, elongate, sometimes branched . . . *Cnemidocarpa*
 - D₂. Gonads numerous on each side of the body (especially on the right side) of shorter, ovate, or rounded form. . . . *Polycarpa*
 - B₂. One gonad (of the *Cnemidocarpa* type) present on the right side, none on the left.
 - C₁. Gonad branched typical species of *Dendrodoa*
 - C₂. Gonad unbranched Subgenus *Stylopsis*
- A₂. Compound ascidians; zooids small, sometimes embedded in a common test, in other cases more or less independent.
 - B₁. Branchial sac without folds, and with only a few (three to 16) internal longitudinal vessels on each side.
 - C₁. One gonad on each side composed of an ovary and two testes. Test gelatinous, similar to that of *Botryllus* *Symplegma*
 - C₂. A gonad on the left side only, composed of an ovary and two groups of testes, in a sac-like outgrowth of the body wall. An incubatory pouch also developed . . . *Kükenthalia*
 - C₃. A row of gonads each side of the endostyle, each gonad with an ovary and one testis *Polyzoa*
 - C₄. A row of gonads each side of the endostyle, each of one sex, female on the right, male on the left side *Allococarpa*
 - C₅. Gonads mostly of one sex, those in the anterior part of the body female, in the posterior part male *Metandrocarpa*
 - B₂. Branchial sac with folds.
 - C₁. Gonads hermaphroditic, present on both sides of the body.
 - D₁. Each gonad with several or many testes *Polyandrocarpa*
 - D₂. Each gonad with only two testes. Subgenus *Eusynstyela*
 - C₂. A gonad on the right side only, peculiar in having the oviduct opening into the cavity of the branchial sac. *Gynandrocarpa*

GENERA OF PYURIDAE

- A₁. Branchial folds well developed (usually six or more on each side) and bearing internal longitudinal vessels.
 - B₁. Dorsal lamina cleft into a series of narrow teeth or languets.
 - C₁. Stigmata longitudinal, arranged in transverse rows. Intestine forming a large open loop.
 - D₁. Gonads one (rarely two) on each side, usually consisting of small separated sacs containing an ovary and testes arranged along the oviduct and common sperm duct, but sometimes of more compact structure. . . . *Pyura*
 - D₂. Gonads one on each side, consisting of a long sinuous ovary bordered by the small testes. Needle-like spicules covered with small appressed spines in mantle and internal organs *Herdmania*
 - D₃. Gonads several on each side; flask shaped or tubular, their distal ends directed anteriorly and lying across the intestine *Halocynthia*
 - C₂. Stigmata transverse (unique among ascidians) crossed by the internal longitudinal vessels . . . *Bollenia*
 - C₃. Abyssal species, body borne on slender flexible stalk arising from the anterior end or on a shorter pedicel. Branchial sac consisting mainly of transverse and internal longitudinal vessels only *Culeolus, Fungulus*
 - B₂. Dorsal lamina a continuous membrane. Left gonad partly in intestinal loop.
 - C₁. Stigmata straight . . . *Microcosmus*
 - C₂. Stigmata curved or in spirals on the folds *Hartmeyeria*
 - B₃. Abyssal and Antarctic forms having body surface with converging rows of minute papillae bearing spicules. Stigmata small, irregular *Bathypera*
- A₂. Branchial folds obsolete, stigmata in large flattened infundibula *Heterostigma*