

CORALLINALES AND RHODOGORGONALES

CORALLINALES

- walls of most vegetative cells impregnated with calcite
- meristems often intercalary and covered by a layer of cells
- plugs of primary pit-connections have two-layered, dome-shaped caps
- reproductive structures produced in roofed conceptacles in all genera but one
- tetrasporangial initials usually undergo simultaneous zonate division
- postfertilization events involve a cluster of procarpal filamentous systems

CORALLINACEAE

Subfamilies and Main Features	Genera
Lithophylloideae Direct secondary pit-connections present between cells; tetrasporangial pore plugs absent, i.e., conceptacles uniporate	<i>Dermatolithon</i> <i>Ezo</i> <i>Goniolithon</i> <i>Lithophyllum</i> <i>Metamastophora</i> <i>Tenarea</i>
Mastophoroideae Cell joined laterally by fusions, no direct secondary pit-connections; tetrasporangial pore plugs absent, i.e., conceptacles uniporate	<i>Choreonema</i> <i>Lithoporella</i> <i>Fostiella</i> <i>Mastophora</i> <i>Heteroderma</i> <i>Hydrolithon</i> <i>Neogoniolithon</i> <i>Litholepis</i> <i>Porolithon</i>
Melobesioideae Cells joined laterally by fusions, no direct secondary pit-connections; tetrasporangial pore plugs present and hence a pore forming above each sporangium	<i>Antarcticophyllum</i> <i>Chaetolithon</i> <i>Mastophoropsis</i> <i>Clathromorphum</i> <i>Melobesia</i> <i>Kvaley</i> <i>Mesophyllum</i> <i>Leptophyllum</i> <i>Phymatolithon</i> <i>Lithothamnium</i> <i>Sporolithon</i> <i>Synarthrophyton</i>
Schmitzielloideae Specialized endophyte in algal cell walls (<i>Cladophora</i>); uncalcified filaments lacking epithallial cells; no conceptacles, reproductive nematocysts erupting through cell walls of host	<i>Schmitziella</i>
Amphiroideae Genicula one tier or, more often, several tiers of cells; direct secondary pit-connections present between cells; conceptacles on lateral surfaces of intergenicula	<i>Amphiroa</i> <i>Lithothrix</i>
Corallinoideae Genicula single tier of long cells; cells joined laterally by fusions, no direct secondary pit-connections present	<i>Alatocladia</i> <i>Arthrocardia</i> <i>Bossiella</i> <i>Calliarthron</i> <i>Cheilosporum</i> <i>Chiharaea</i> <i>Corallina</i> <i>Haliptilon</i> <i>Jania</i> <i>Marginisporum</i> <i>Serraticardia</i> <i>Yamadaea</i>
Metagoniolithoideae Genicula of many layers of cells, and producing branches; cells joined laterally by fusions, no direct secondary pit-connections present; conceptacles on lateral surfaces of intergenicula	<i>Metagoniolithon</i>

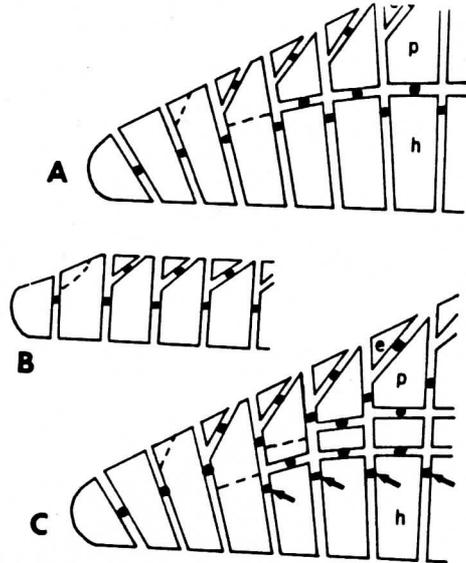


FIGURE 2. Diagrams of crust margins showing initiation of tissue types. A. Formation of hypothallus from which is derived small epithallial cells (e) and subsequently perithallial cells (p). Secondary pit-connections are not present. B. Perithallus lacking. C. The formation of epithallial and perithallial cells from the hypothallus. Here secondary pit-connections (arrows) are produced between the older hypothallial cells.

LITHOPHYLLOIDEAE

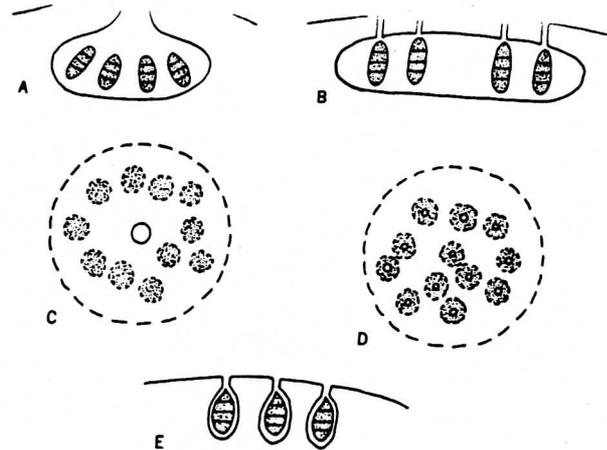


FIGURE 6. Diagrams of conceptacles. A. Section of single-pored conceptacle containing tetrasporangia. B. Section of multipored conceptacle with a pore above each sporangium. C. View from above of single-pored conceptacle with tetrasporangia beneath the roof. Outline of the chamber shown by large dashed circle. D. View from above of multipored conceptacle with one tetrasporangium beneath each pore. E. Section of unisporengial conceptacles in which a pore forms above each tetrasporangium. These are related to the conceptacle in (B), except that the filaments among the sporangia have not broken down to form a chamber.

Order Corallinales (174, 175, 800, 1631, 1912)

- 1 The thalli are macroscopic and calcareous, taking the form of prostrate crusts (Fig. 5.27a) or erect bushy plants (Fig. 5.27c, d). The thallus structure is multi-axial. The cell walls are impregnated with calcium carbonate, in the form of calcite crystals (Fig. 5.3).
- 2 The pit plugs lack cap membranes and have two-layered plug caps. The outer layers of the pit plugs are conspicuously domed (type 3 pit plug; p. 55).
- 3 The tetrasporangia are zonate and are formed in conceptacles (cavities in the thallus; Fig. 5.30).
- 4 The cells bearing the carpogonial branches (the 'supporting cells') function as auxiliary cells.

After receiving the diploid nucleus from the fertilized carpogonium, the auxiliary cell fuses with numerous other auxiliary cells to form a large fusion cell, which then produces gonimocarps at its margins (Figs. 5.28, 5.29).

- 5 Each carpogonium is the end cell of a two-celled carpogonial branch (Figs. 5.28a, 5.29) borne by the auxiliary cell. After fertilization, the carpogonium transfers the diploid zygotic nucleus to the auxiliary cell, this being facilitated by the fusion of the carpogonium, the single vegetative cell of the carpogonial branch, and the auxiliary cell (Fig. 5.29). The carpogonia, fusion cells, gonimoblasts and carpospores are all formed inside conceptacles (Fig. 5.28); the spermatangia too are formed in special conceptacles.
- 6 The life cycle is diplohaplontic and isomorphic.

Crustose and erect members of the Corallinales are very common along marine coasts, especially in the tropics, and they are important rock builders. Crustose corallines play a primary role in the construction and consolidation of coral reefs, cementing together loose rubble, for example. Erect coralline red algae are among the most important producers of calcium carbonate sand, which, after lithification in the cavities of reefs, becomes an important matrix component of marine limestones (^{10, 1751}; see also p. 52).

Lithophyllum expansum (Figs. 5.27a, b, 5.28 – 5.30; ^{174, 601})

Lithophyllum expansum is a crustose coralline alga, forming fragile pink crusts, 1–2 mm thick, which can often be quite large, attaining diameters of 15–30 cm. It grows in the Mediterranean sea, at depths of 15–60 m, sometimes deeper (up to 160 m!). On deep sediments *Lithophyllum expansum* is an important constituent of the large organic concretions formed by assemblages of various benthic organisms, which themselves also produce calcium carbonate tubes, or other structures (^{110, 1056}).

The crust consists of a basal layer (hypothallus), from which there arise upright lines or filaments of cells forming the perithallus (Fig. 5.27b). In a recent paper, the filaments of the hypothallus have been termed 'primigenous filaments' and those of the perithallus, 'postigenous filaments' (¹⁹¹²). In *Lithophyllum expansum*, the hypothallus is one layer of

cells thick but in other *Lithophyllum* species it often contains several layers. The crust expands through division of the apical (i.e. peripheral) cells of the hypothallus (Fig. 5.27b, horizontal arrow). It grows in thickness by division of the uppermost perithallus cells (Fig. 5.27b, vertical arrow), but these meristematic cells are covered by one to several non-dividing epithallus cells, so that vertical growth (increase in thickness) is in fact brought about by intercalary, not apical cell division. Also noteworthy are the distinct secondary pit connections between cells in different lines of cells in the perithallus (Fig. 5.27, SP).

The reproductive structures have been described briefly in the list of characteristics for the order Corallinales (see above, characters 3–6; Figs. 5.28 – 5.30).

Jania adhaerens (Fig. 5.27c, d)

The bushy plants of *Jania adhaerens* are approxi-

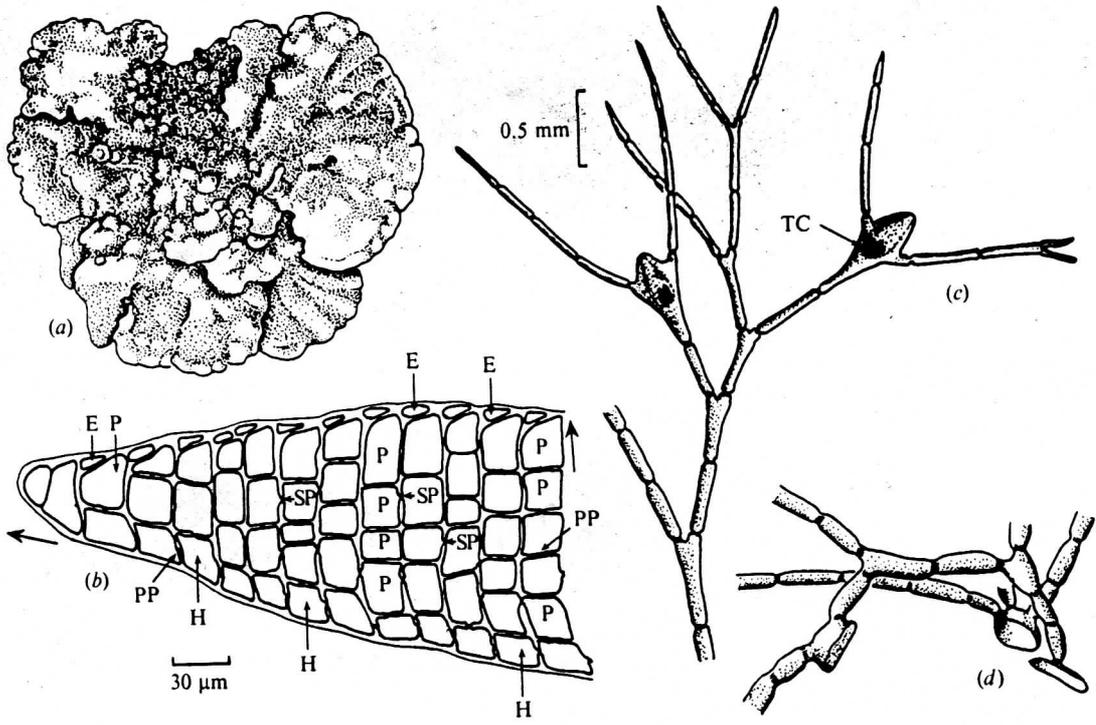


Figure 5.27. (a, b) *Lithophyllum expansum*, an example of a crustose coralline red alga. (a) Top view of the calcareous thallus. (b) Cross section through the growing margin of the thallus. (c, d) *Jania adhaerens*, an example of a geniculate coralline red alga. (c) Erect portion of the thallus, with tetrasporic conceptacles.

(d) Creeping basal parts of thalli, with rounded attachment discs. E = epithallus cells; H = hypothallus cells; P = perithallus cells; PP = primary pit connections; SP = secondary pit connections; TC = tetrasporangial conceptacle. (a based on ¹³⁴¹; b on ¹⁷³³; c, d on ¹⁰⁵.)

mately 1–3.5 cm high and exhibit repeated dichotomous branching. Each branch consists of a number of calcified segments, which are linked by flexible, non-calcified joints (genicula).

The internal structure is multiaxial. The multiaxial core is like a hypothallus and grows by division of its apical cells. Around this, in the calcified segments, is a perithallus consisting of lines of cells perpendicular to the core, which arise from the hypothallial cells.

Jania adhaerens is very common throughout the tropics, where it is one of the most important producers of calcium carbonate sand.

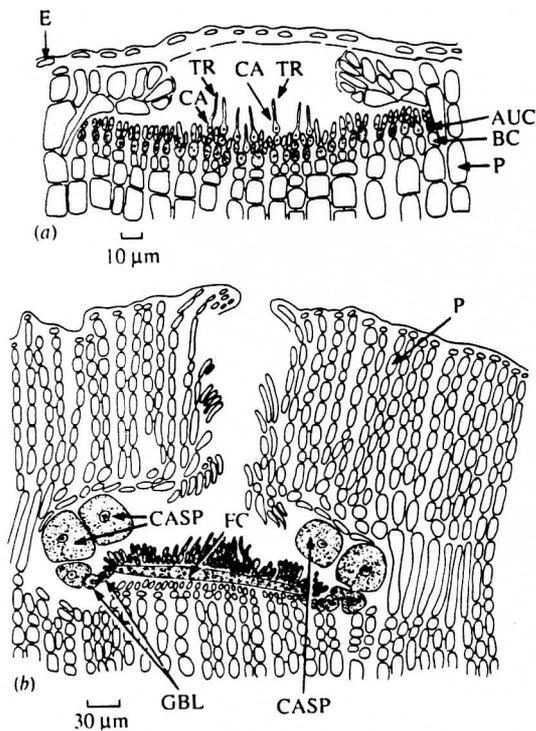


Figure 5.28. Development of carposporic (female) conceptacles in *Lithophyllum expansum*. (a) Just before fertilization. (b) After fertilization, with mature carpospores. AUC = auxiliary cell; BC = basal cell of fertile filament; CA = carpogonium; CASP = carpospore; E = epithallus cell; FC = fusion cell; GBL = gonimoblast filament; P = perithallus cell; TR = trichogyne. (Based on ¹⁷³³.)

ORDER 7. CORALLINALES

Formerly placed within the Cryptonemiales, this assemblage of calcareous red algae is now thought to be sufficiently distinct to justify ordinal rank. Distinguishing characteristics include the following: meristems apical and intercalary; production of reproductive organs in conceptacles; cell walls containing calcium carbonate in the form of calcite; tetrasporangia undergoing simultaneous zonate division; two-celled carpogonial branch on a supporting cell that serves as the auxiliary cell; many supporting cells fusing after fertilization to produce a large fusion cell from which the gonimoblast filaments arise; and plugs of primary pit connections with two-layered dome-shaped caps (Silva and Johansen, 1984). Like the members of the Cryptonemiales, coralline algae have an auxiliary cell which is borne on an accessory, or specialized, filament; the combination of other characteristics, however, distinguishes the order. The order contains two families, the Corallinaceae, containing about 35 extant genera, and the Solenoporaceae, a family of extinct forms, some dating back to the late Paleozoic (Wray, 1977). Only the former family is treated here.