

FEATHERY/FLAT/FISHBONE -BRANCHED RED ALGAE. 3rd EDITION

(red algae with small side branches arising from both edges of a flat axis)

Red Algae. With some 800 species, many of which are endemic (found nowhere else), southern Australia is a major centre of diversity for red algae. Classification is based on detailed reproductive features. Many species unrelated reproductively have similar vegetative form or shape, making identification very difficult if the technical systematic literature is used.

This key Fortunately, we can use this apparent problem to advantage - common shapes or morphologies will allow you to sort *some* algae directly into the level of Genus or Family and so shortcut a systematic search through intricate and often unavailable reproductive features. The pictured key below uses this *artificial* way of starting the search for a name. It's designed to get you to a possible major group in a hurry. Then you can proceed to the appropriate fact sheets

Scale: the coin used as a scale is 24 mm or almost 1" wide. Microscope images of algae are usually blue stained.

This key is *restricted* to algae with

- compressed or flat, ribbon-shaped main branches (axes) consisting of many cells that are often equal-sided ("parenchymatous")
- shorter side branches arising from both *edges* of the axes (pinnate branching)
- side branches undivided or divided again from both edges

Excluded are algae where

- flat side branches arise from a *central* mid-rib not from the blade edges for example *Phytimophora* and *Hypoglossum*, Figs 1, 2, which may at first glance appear as if they have pinnate branches
- the plant body is obviously made of strings of cells (filaments). These red algae are already covered in "filamentous Red algae". However, several plants with a basic but obscure filamentous construction are included below because their gross external features are pinnate
- all branches are ribbon-like, that is, equal-sized. These algae are covered in "strap-like and narrow-leaved Red algae"

PICTURED KEY

- 1a. plants *filmy*, branches almost transparent. Figs 3-5.
.....*Hemineura frondosa*
See also "Delesseriaceae"
- 1b. plants *not* filmy but slimy, gristly (cartilaginous) or firm in texture, some paper thin but *not* transparent
..... 2.
- 2a. side branches un-divided (simple), and in a "fishbone" pattern, flat, compressed or cylindrical. (Some have ultimate branches and tips ending in threads (see Fig. 6), but this is usually obscure, or lost in denuded plants)
..... 3.
- 2b. side branches divided several times, arising from branch edges (pinnately) or forming regularly toothed ultimate branches (ramuli)
..... 6.



Fig. 1: *Phytimophora hypoglossum* in the Delesseriaceae with flat, filmy side branches arising from *mid-ribs*: **excluded from this key**



Fig. 2: *Hypoglossum harveyanum* in the Delesseriaceae with flat, filmy side branches arising from the axis *mid-rib*: **excluded from this key**



Fig. 3: *Hemineura frondosa*

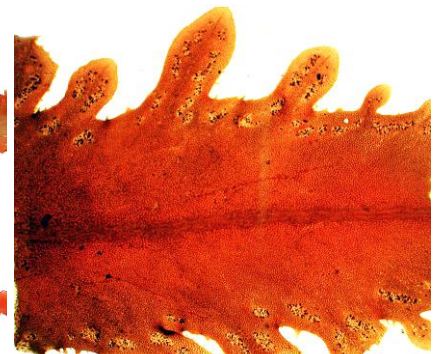


Fig. 4: *Hemineura frondosa*, short flat side branches from axis edges

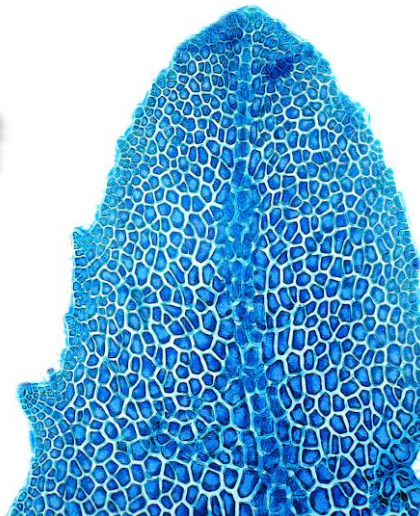


Fig. 5: *Hemineura frondosa*, plant tip, transparent, a few cells thick, more in midline veins

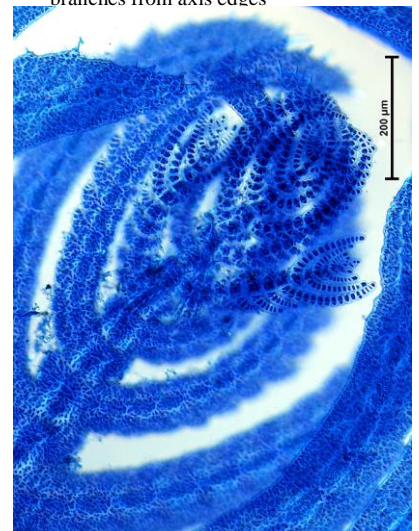


Fig. 6: *Rhodocallis elegans*; tip showing the basic filamentous construction of the plant



can be difficult to locate

3a. ultimate branches edged with microscopic spines; tips show a basic filamentous construction (unless denuded), cross sections of mid-ribs show a prominent central thread.
Figs 7-10 *Rhodocallis elegans*

Family: Ceramiaceae

See also "Filamentous red algae: Part VIII"

3b. ultimate branches generally smooth, or toothed, tips with a single apical cell
..... 4.

4a. side branches often irregularly arranged; axis with only a slight mid-rib; in cross section a central filament surrounded by a mass of threadlike rhizoids **and a ring** of several large cells can be seen; reproductive structures occur in minute clusters of threads, on axis edges. Figs 11-14.
..... *Diapse ptilota*

Family: Ceramiaceae

See also: "Filamentous red algae: Part VIII"

4b. side branches regularly arranged; mid-ribs often with prominent central filaments in cross section also surrounded by threads but rings of large cells **absent**; reproductive structures ball-shaped or in ball-shaped masses, between or on the edges of horn-like side branches
..... 5.
(next page)



Fig. 7: *Rhodocallis elegans*

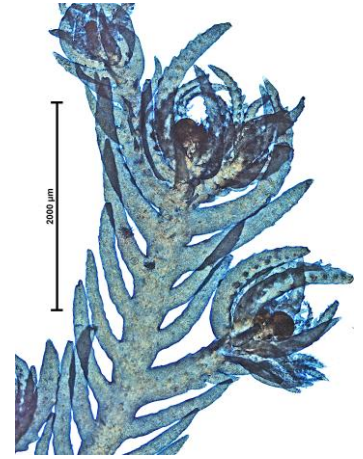


Fig. 8: *Rhodocallis elegans*, side branches with stubby spines and reproductive structures at tips

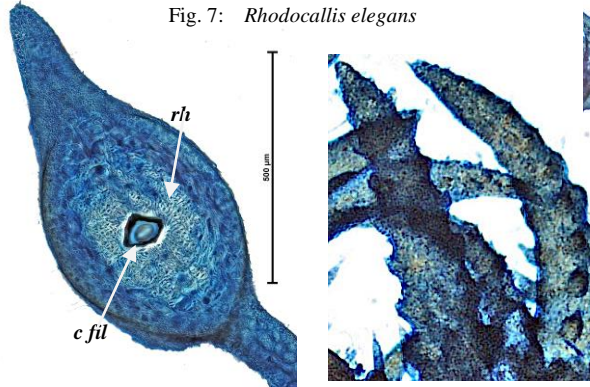


Fig. 9 (left): *Rhodocallis elegans*, magnified view of spines

Fig. 10 (above): *Rhodocallis elegans*, cross section, central thread (c fil), surrounded by a mass of rhizoids (rh)



Fig. 11: *Diapse ptilota*, irregular side branches

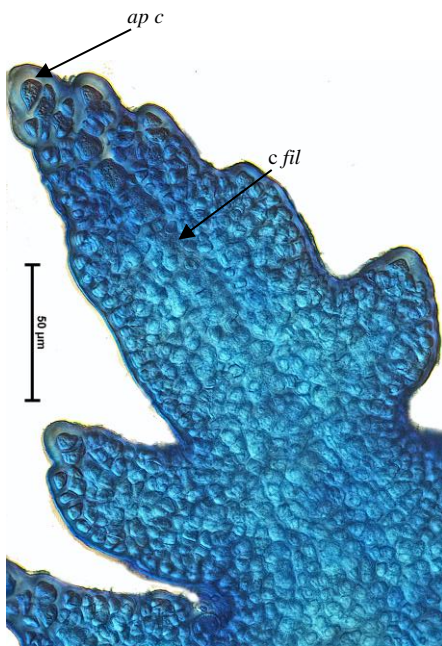


Fig. 12: *Diapse ptilota*, branch tip with prominent tip cell (ap c) and central filament (c fil)

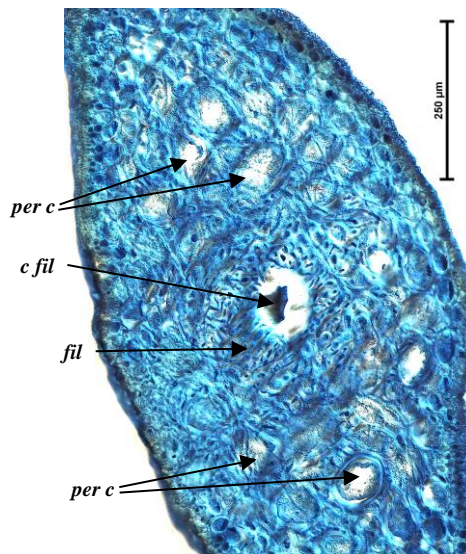


Fig. 13: *Diapse ptilota*, cross section, central filament (c fil); mass of filaments (fil); ring of large cells (periaxial cells, per c)

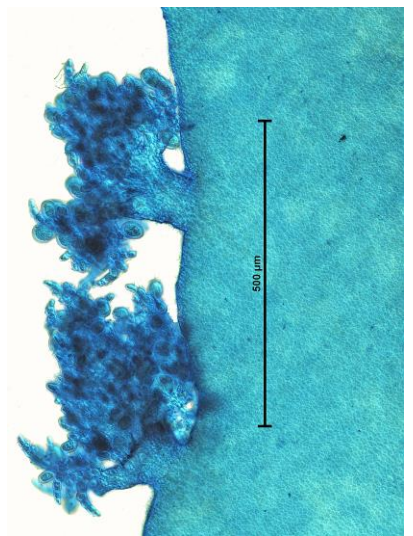


Fig. 14: *Diapse ptilota*, edge of an axis, stalked clusters of branched threads bearing tetrasporangia

5a. ball-shaped reproductive structures at edges of, or in the angles (axils) between axes and short ultimate branches (ramuli), often on short stalks. Figs 15-19.

..... *Phacelocarpus*
 Family: Phacelocarpaceae
 See also "*Phacelocarpus*"

5b. reproductive structures embedded in axes near plant tips, Figs 20-24.

..... *Delisea* spp
 Family: Bonnemaisoniaceae
 See also "*Bonnemaisoniaceae*"

⚠ Separation of these genera is almost impossible without reproductive structures

6a. plant slimy, axes thick, gelatinous

..... 7.

6b. plant *not* slimy or gelatinous, but thin or leathery or gristly or flexible

..... 9.



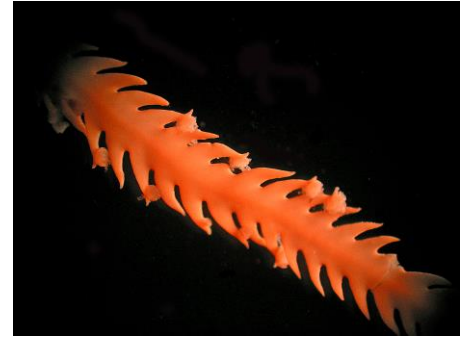
Figs 15: *Phacelocarpus peperocarpos*



Figs 16: *Phacelocarpus peperocarpos*, reproductive structures on stalks in the angle between the axis and a side branch



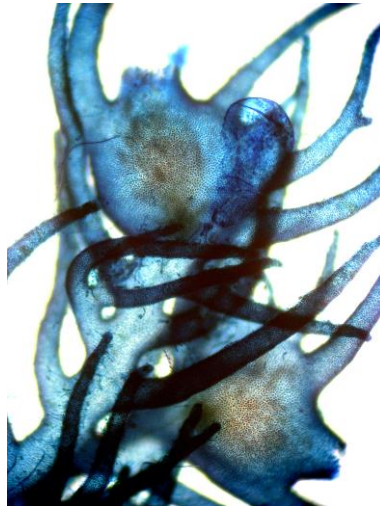
Figs 18: *Phacelocarpus complanatus*, broad midrib



Figs 19: *Phacelocarpus complanatus*, broad midrib, reproductive structures on inside edges of side branches



Figs 17: *Phacelocarpus alatus*, very broad midrib



Figs 20: *Delisea hypneoides*, embedded reproductive structures at tips



Fig. 21: *Delisea pulchra*, embedded reproductive structures near plant tips



Fig. 22: *Delisea elegans*, alternating pattern of branches at plant tips, characteristic of the genus



Fig. 23: *Delisea plumosa*



Fig. 24: *Delisea elegans*, reproductive structures embedded near tips of branches

- 7a. plant slimy, axes thick, gelatinous
 Found also in
 See also "slimy/mucilaginous red algae"
 8.
- 7b. plant *not* slimy or gelatinous, but thin
 or leathery or gristly or flexible
 11.

- 8a. cross sections show a middle layer of
 large, irregular cells, Figs 25, 26.
 *Gloiocladia* spp
 Family: Rhodymeniaceae
- 8b. cross section or a tissue squash under
 the microscope shows a wide core of
 thread-like cells and, in some genera,
 spidery (ganglionic) cells.
 9.

- 9a. axes compressed; thin, spidery
 (ganglionic) cells **absent**, plant
 gelatinous but becoming gristly with
 age; female structures embedded in
 cups in the branches, Figs 27, 28.
 *Grateloupia subpectinata*
 (as *G. filicina* var. *luxurians*
 in the Marine Benthic Flora)
 Family: Halymeniaceae

- 9b. axes flat, broad; tissue squashes
 show presence of spidery
 (ganglionic) cells 10.

- 10a. short side branches firm, pointed,
 arise from the edges of axes. Figs
 29, 30.
 *Gelinarina ulvoidea*
 Family: Halymeniaceae

- 10b. short side branches filmy, irregularly
 branched, some unbranched ones
 arise from the axis face as well as
 blade edges. Figs 31-33.
 *Halymenia floresia*
 Family: Halymeniaceae



Fig. 25: *Gloiocladia halymenioides*

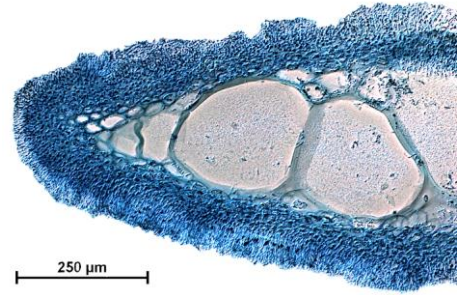


Fig. 26: *Gloiocladia halymenioides*, cross section with core of large, irregular cells

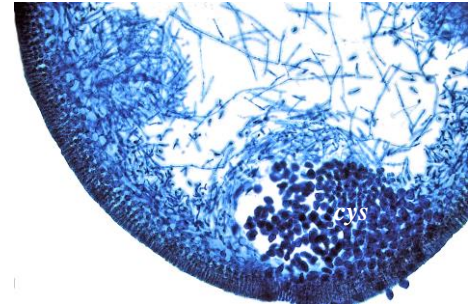


Fig. 27: *Grateloupia subpectinata*, cross section, central core of loosely packed threads; sunken female structure (cystocarp, cys)

Fig. 28 (left): *Grateloupia subpectinata*



Fig. 30 (left): *Gelinarina ulvoidea*

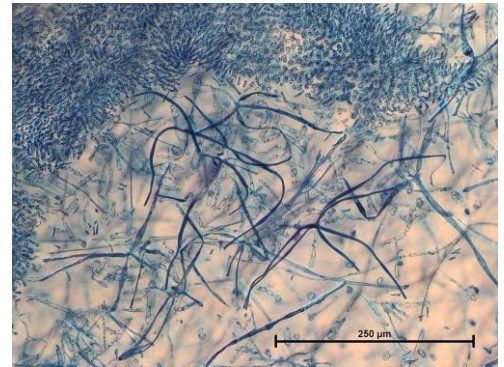


Fig. 29: *Gelinarina ulvoidea*, tissue squash, spidery ganglionic cells



Fig. 31: *Halymenia floresia*

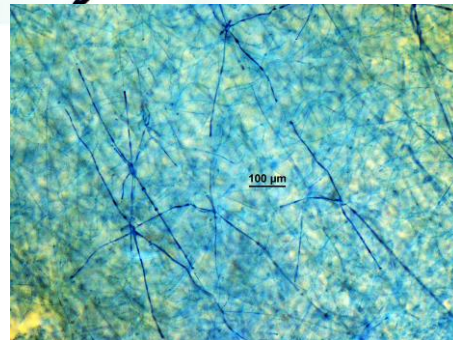


Fig. 32: *Halymenia floresia*, tissue squash showing spidery (ganglionic) cells

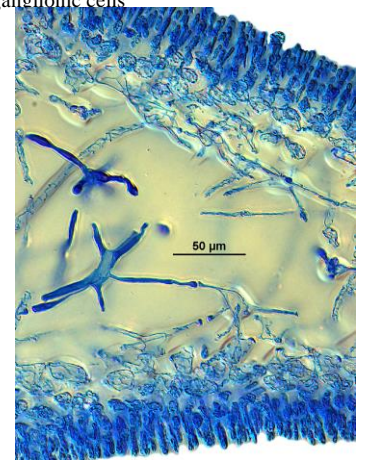


Fig. 33: *Halymenia floresia*, cross section, wide core (medulla) of fine, well-separated threads, two deeply stained ganglionic cells

11a. plants delicate; tips of ultimate branches have exposed filaments, the apical cells of which cut off sloping (oblique) walls; cross sections of axes show a prominent central filament and 2 large flanking (periaxial) cells. Figs 34-36.

..... *Euptilota articulata*
 Family: Ceramiaceae

See also "Filamentous red algae: Part VIII"

11b. tips without filaments, cross sections show a core of equal-sided cells **or** many fine threads

..... 12.

12a plant robust, gristly or leathery; cross sections show a wide core of threads with several-arms (stellate cells) (but bright ganglionic cells **absent**). Figs 30-32.

..... *Gigartina densa*, *G. disticha*, *G. pinnata*
 See also "Gigartinaceae"

12b. plants drying gristly **or** paper thin; cross section with threads **or** thick-walled cells, stellate cells **absent**

..... 13.



Fig. 34: *Euptilota articulata*: detail of pinnate branching pattern

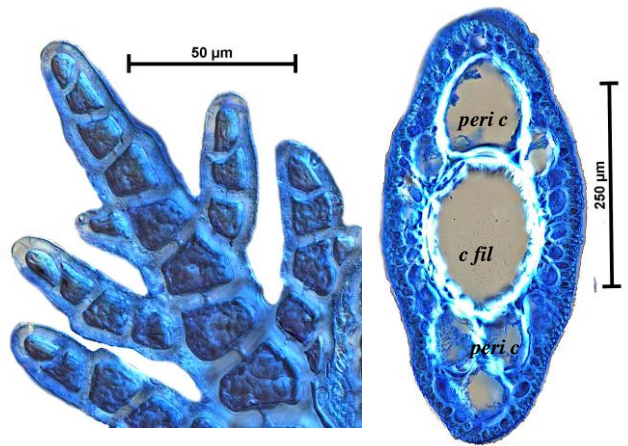


Fig. 35: *Euptilota articulata*, apical cells with oblique cell walls

Fig. 36: *Euptilota articulata*: cross section, central filament (*c fil*), flanking (periaxial) cells (*peri c*), one divided further

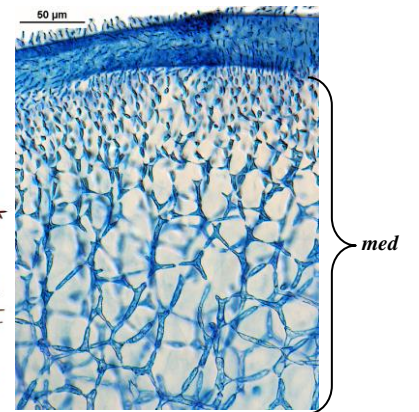


Fig 33: *Gigartina densa*, extracted from a turf of many close-cropped plants

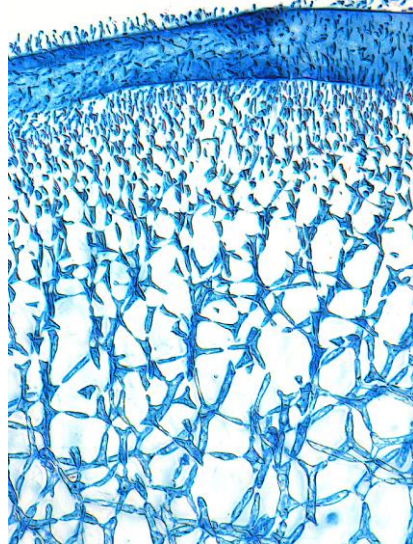


Fig 33: *Gigartina disticha*, cross section, wide core of many-sided (stellate) cells



Fig 32: *Gigartina disticha*



Fig 34: *Gigartina densa*

13a. ultimate branches flat, occasionally cylindrical, *paper thin*, pointed, *arranged in sets* of 2's, or 3's, 4's and 5's that alternate along opposite sides of axes and sometimes also on short side branches. Figs 35-38.

..... *Plocamium* 8 spp

Family: Plocamiaceae

See also "Plocamiaceae"

13b. ultimate branches flat, *not* arranged in alternating sets of 2's, 3's, 4's or 5's, but branched simply in 2 rows (pinnate)

..... 14.
(next page)



Fig. 35: *Plocamium angustum*, with series of minute, paired, alternating ultimate branches (ramuli)



Fig. 36: *Plocamium preissianum*, magnified about 4x, showing ultimate branches (ramuli) in alternating sets of 3's (A₁, A₂, A₃, etc.). Two sets are labelled. The lower two in a set are unbranched with the edge of the lowest ramulus serrated; the uppermost ramulus is divided. There are clusters of finger-like reproductive structures in the angles between ramuli

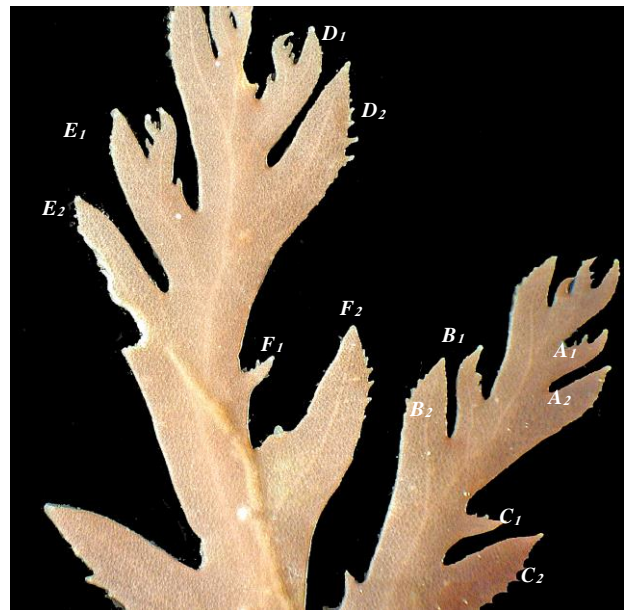


Fig. 37: *Plocamium dilatatum*, magnified view of ultimate branches (ramuli) in alternating pairs (A₁, A₂, etc.), the lower ramulus of a pair is undivided, although the lower edge is serrated. Some upper ramuli have divided, repeating the same pattern of alternating pairs

Fig. 38: *Plocamium*, a common red algae amongst brown algae on a reef at Victor harbor, SA



14a. sections through axes show a core (medulla) of *loosely packed* fine threads under the microscope; pustule-like fertile structures are imbedded in the branches, Figs 39-42.

..... *Callophycus*, 5 spp
 Family: *Areschougiaceae*
 See also "*Callophycus*"

14b. sections show thick-walled oval cells *or* a central filament ringed by equal-sided cells 15.

15a. axes compressed; cross sections show a core (medulla) of thick-walled, *compact* threads; fertile structures occur in stubby, lance shaped or pinnate side branches (for example, tetrasporangia in pinnate side branches resembling a double cross). Figs 44-47.



..... *Gelidium australe*.
 Family: *Gelidiaceae*
 See also "*Gelidiaceae*" for *Gelidium* spp without pinnate branching

15b. axes compressed, cross sections show a core with a central filament ringed by equal-sided cells 16.



Fig. 39 *Callophycus oppositifolius*



Fig. 40: *Callophycus costatus*

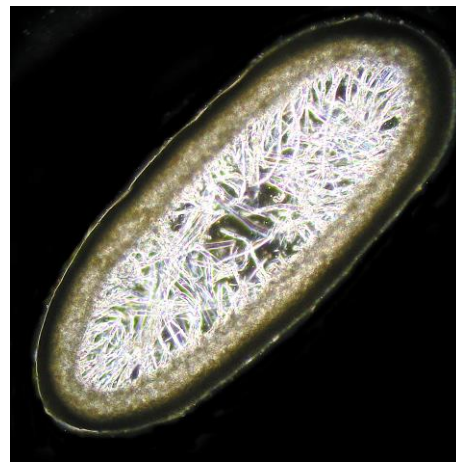


Fig.41: *Callophycus laxus*, cross section showing core of fine, closely-packed threads



Fig. 42 *Callophycus costatus*. Side branches branched oppositely twice



Fig. 44: *Gelidium australe*, a common mat plant of the lower intertidal



Fig. 45: *Gelidium australe*, detail of beaked sporangial structures (stichidia, *stich*)

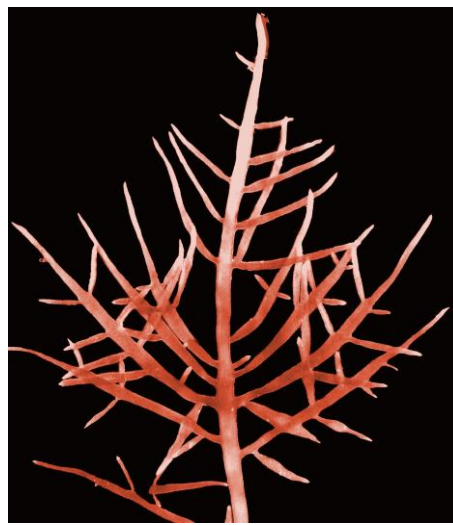


Fig. 46: *Gelidium australe*, detail of branching pattern

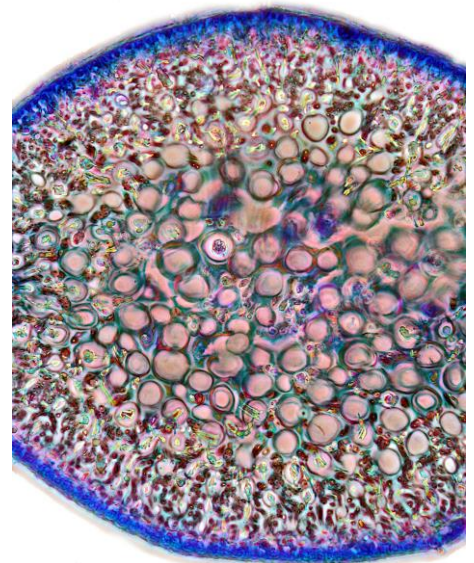


Fig. 47: *Gelidium australe*, cross section with core (medulla, *med*) of compact, thick-walled threads

16a. fine, branched, hair-like filaments occur in rings around ultimate branches, but may be lost with age; internally a central filament surrounded by a ring of cells (pericentrals) is present. Figs 48-54. *Psilothallia* 2 spp

Family: Ceramiaceae

See also "Filamentous red algae: Part VIII"

17b. branched, coloured hairs (trichoblasts) occur at branch tips, but are soon lost; internally, a central filament is ringed by 2 opposite, large cells and 4 smaller ones. Figs 55-58. (next page).

Dictyomenia spp

Family: Rhodomelaceae

See also "Dictyomenia 2nd edition"



Fig. 48: *Psilothallia striata*



Fig. 50. *Psilothallia striata*, flat-branched ultimate branches with dense rings of hair-like filaments

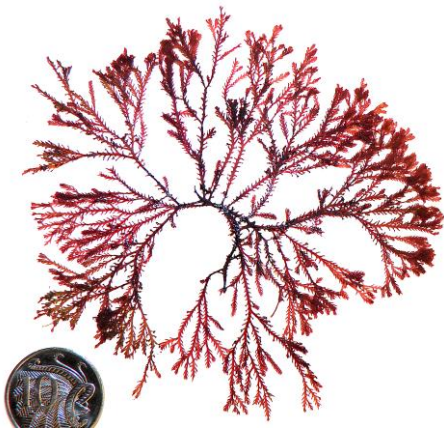


Fig. 51: *Psilothallia siliculosa*

Fig. 49. *Psilothallia striata*, cross section, central filament ringed by oval cells (periaxials) with filamentous branches extending beyond the outer layers

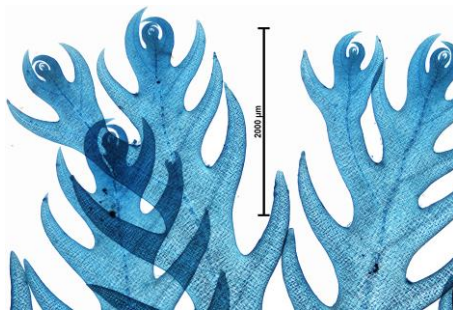
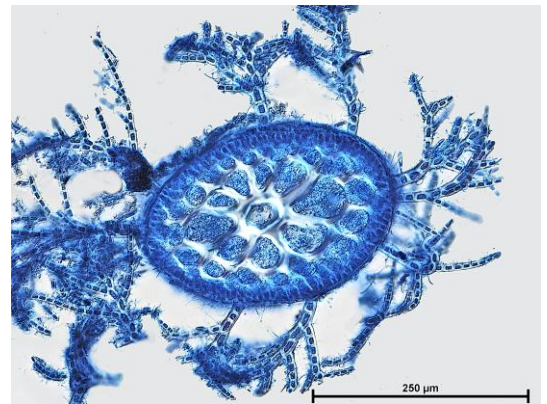



Fig. 52: *Psilothallia siliculosa*, branching pattern

 probably rare

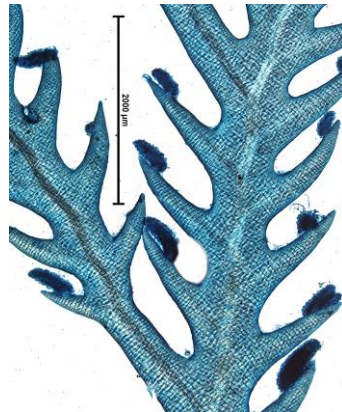


Fig. 53: *Psilothallia siliculosa*, pod-like structures bearing tetrasporangia

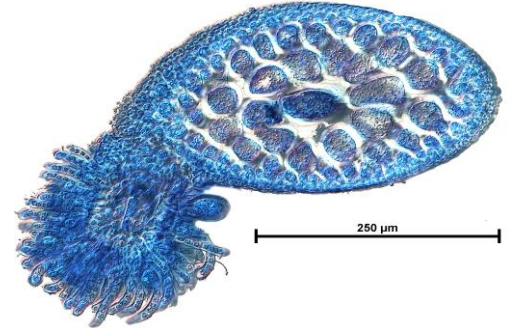


Fig. 54: *Psilothallia siliculosa*, cross section, bunch of filaments forming around a pod-like tetrasporangial structure



Fig. 55: *Dictyomenia harveyana*



Fig. 56: *Dictyomenia harveyana* on an abalone shell

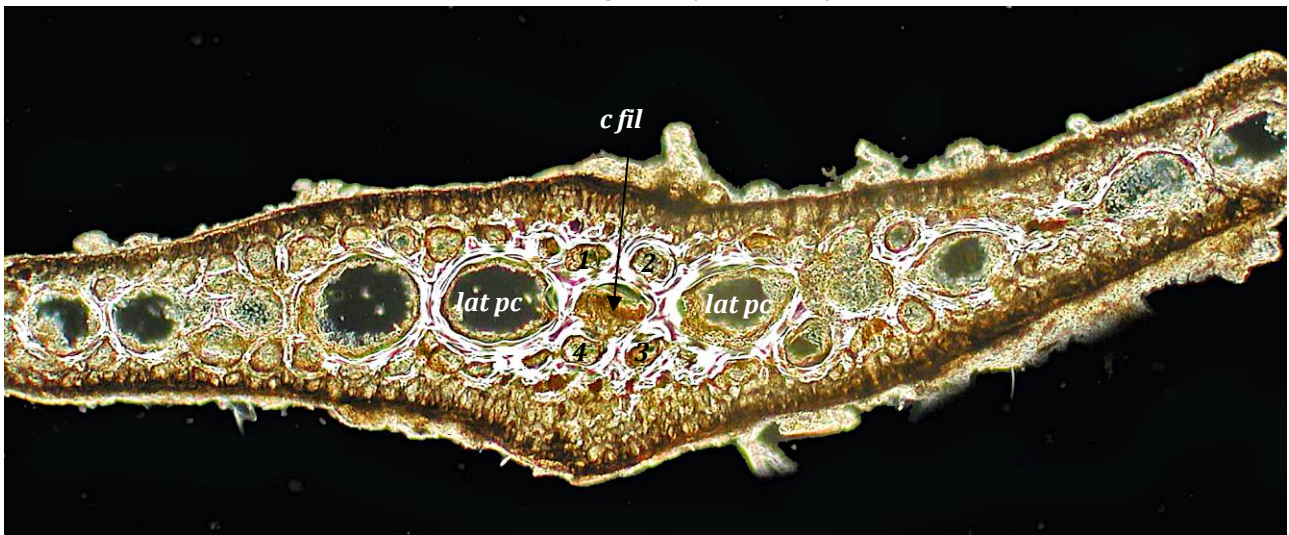


Fig. 57: *Dictyomenia tridens*, cross section through the axis, central filament (*c fil*), large side pericentral cells (*lat pc*) and smaller pericentrals (1-4)



Fig. 58: *Dictyomenia tridens* pointed short laterals

SPECIES ILLUSTRATED IN THE KEY

species	author(s)	page(s)	current name in <i>Algaebase</i>	author(s)
<i>Callophycus costatus</i>	(Harvey) P c Silva	7		
<i>Callophycus laxus</i>	(Sonder) P C Silva	7		
<i>Callophycus oppositifolius</i>	(C Agardh) P C Silva	7		
<i>Delisea elegans</i>	Lamouroux	3		
<i>Delisea hypneoides</i>	Harvey	3		
<i>Delisea plumosa</i>	Levring	3		
<i>Delisea pulchra</i>	(Greville) Montagne	3		
<i>Diapsea ptilota</i>	(Hooker f. & Harvey) Kyllin	2		
<i>Dictyomenia harveyana</i>	Sonder	9		
<i>Dictyomenia tridens</i>	(Meretens ex Turner) Greville	9		
<i>Euptilota articulata</i>	(J. Agardh) Schmitz	5		
<i>Gelidium australe</i>	J Agardh	7		
<i>Gelinaria ulvoidea</i>	Sonder	4		
<i>Gigartina densa</i>	Edyvane & Womersley	5		
<i>Gigartina disticha</i>	Sonder	5		
<i>Gigartina pinnata</i>	J. Agardh	5		
<i>Gloiocladia halymenioides</i>	(Harvey) Re E Norris	4	<i>Gloioderma halymenioides</i>	(Harvey) J. Agardh
<i>Grateloupia subpectinata</i>	Holmes	4		
<i>Halymenia floresia</i>	(Clemente) C. Agardh	4	<i>Halymenia floresii</i>	(Clemente) C. Agardh
<i>Hemineura frondosa</i>	(Hooker f. Harvey) Harvey	1		
<i>Phacelocarpus alatus</i>	Harvey	3		
<i>Phacelocarpus complanatus</i>	Harvey	3		
<i>Phacelocarpus peperocarpos</i>	(Poiret) Wynne, Ardré & Silva	3		
<i>Plocamium dilatatum</i>	J. Agardh	6		
<i>Plocamium preissianum</i>	Sonder	6		
<i>Psilothallia siliculosa,</i>	(Harvey) DeToni	8		
<i>Psilothallia striata</i>	(Harvey) Schmitz	8		
<i>Rhodocallis elegans</i>	Kützing	1, 2		